Flood Hazard Area Delineation

Sanderson Gulch

Updated October 2018







Sponsored by:

Urban Drainage and Flood Control District
City and County of Denver
City of Lakewood

Prepared by:

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October 30, 2018

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RE: Sanderson Gulch Flood Hazard Delineation Report Update (FHAD)
Agreement No. 16-10.15

Dear Mrs. Thomas:

Matrix Design Group, Inc. is pleased to submit the *Digital Flood Hazard Area Delineation Report Update* for Sanderson Gulch, a watershed originating in Lakewood and flowing downstream into Denver. This report provides a description of the watershed, updated hydrologic modeling, new detailed hydraulic modeling, and an updated assessment of damage that would occur under existing conditions in major flood events.

The 7.6 square mile Sanderson Gulch watershed extends from Green Mountain to the South Platte River and is fully developed. Analysis of the watershed was made possible using detailed topographic base mapping on the NAVD '88 vertical datum. The eastern half of the watershed was mapped in 2008 using regional LIDAR-derived contour data. The western half was mapped in May 2012 specifically for this project.

Flood event hydrology is based upon our new study using current rainfall parameters of the Sanderson Gulch watershed, the tributary of North Sanderson Gulch, and the adjacent 0.94 square mile watershed of Mississippi Gulch.

An 8.23-mile-long detailed HEC-RAS hydraulic model was developed for the main stem of Sanderson Gulch and the tributary of North Sanderson Gulch. The complex HEC-RAS model utilizes a total of 398 cross sections, spaced at 109 feet on average to detail the floodplain. There are 299 cross sections along the main stem of Sanderson Gulch, and 99 cross sections along the tributary of North Sanderson Gulch.

This hydraulic study updates the previous 2013 Flood Hazard Area Delineation report for Sanderson Gulch & North Sanderson Gulch by Matrix Design Group, Inc., and also incorporates four recent Letters of Map Revision (LOMRs) for Sanderson Gulch and North Sanderson Gulch. The 2013 FHAD report was based upon hydrology developed using Colorado Unit Hydrograph Procedure (CUHP 2005), Version 1.3.3. The latest version of CUHP (Version 2.0.0) uses precipitation from NOAA Atlas 14 and applies depth-area reduction factors (DARF's) to point rainfall depths used within CUHP based on watershed size. The new hydrologic protocols have reduced the flood hydrology. Therefore, the 2018 study removed 26 structures from the 100-year floodplain than shown in the 2013 study.

The report format and submittal is intended to follow the requirements of the Urban Drainage & Flood Control District DFHAD Guidelines. This report provides the following information:

- A summary of the hydrologic and hydraulic analyses,
- HEC-RAS water surface profile for the 10-, 50-, 100-, and 500-year storm events, and
- Determination of the 100- and 500-year floodplains, and a 0.5-foot rise floodway.

This floodplain and floodway information provides the City and County of Denver, City of Lakewood, and the Urban Drainage & Flood Control District with updated analyses and mapping for better floodplain management.

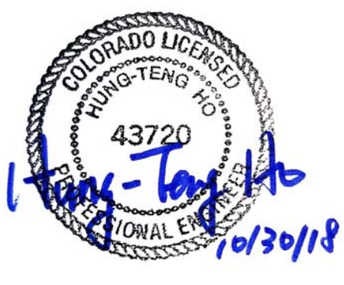
We appreciate the opportunity to provide this FHAD Update report.

Sincerely,
Matrix Design Group, Inc.

Robert Krehbiel, PE
Project Manager

Hung-Teng Ho, PE
Project Engineer





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1.0 INTRODUCTION

1.1 Authorization

Matrix Design Group, Inc. (Matrix) was retained by Urban Drainage and Flood Control District (UDFCD) to update the August 2013 Flood Hazard Area Delineation (FHAD) study for the Sanderson Gulch watershed including the tributaries of North Sanderson Gulch and Mississippi Gulch. The project is co-sponsored by the City of Lakewood (Lakewood) and the City and County of Denver (Denver). The Agreement regarding the Major Drainageway Plan (MDP) and Flood Hazard Area Delineation (FHAD) study for Sanderson Gulch (Agreement No. 16-10.15) was executed on October 27, 2016.

1.2 Purpose and Scope

The purpose and scope of this project is to update the August 2013 Flood Hazard Area Delineation (FHAD) for the Sanderson Gulch watershed (Study Area) by updating the rainfall and hydrologic modeling to use the most current models and techniques. The Urban Drainage & Flood Control District was formed in 1969 and Sanderson Gulch was one of the first watersheds to be master planned in 1972. The former FHAD for the Study Area is *Flood Hazard Area Delineation, Sanderson Gulch and North Sanderson Gulch* (Gingery Associates, Inc., August 1979).

Major elements of the scope of work for the current project are as follows:

- Gather and assemble available information on existing drainage facilities, planning studies, land use plans, zoning, land ownership and other relevant information.
- Coordinate with project sponsors including preparing for and participating in project meetings and public outreach meetings.
- Develop updated hydrologic modeling for the entire watershed in accordance with current UDFCD modeling criteria.
- Develop updated hydraulic modeling for all of Sanderson Gulch and North Sanderson Gulch.
- Assess deficiencies in existing road crossings.
- Assess deficiencies in existing grade controls and determine if and where new grade control structures are needed.
- Assess deficiencies and failures in channel banks.
- Evaluate alternative solutions to identified problems.
- Evaluate options to import Mississippi Gulch major storm flows into Sanderson Gulch. (The minor storm is currently piped from Mississippi Gulch to Sanderson Gulch).
- Develop an updated master plan for improvements including costs that address identified deficiencies and needs.
- Develop an updated MDP report that documents all work completed and the selected improvements plan.

1.3 Planning Process

Project sponsors consist of the following:

- Urban Drainage and Flood Control District
- City and County of Denver
- City of Lakewood

Participants from the project sponsors are listed in Section 1.6 Acknowledgements. The original project had a project advisory committee consisting of representatives from the project sponsors held a kickoff meeting on July 17, 2012 at the offices of UDFCD. Progress meetings with the advisory committee were subsequently held August 21, October 15, 2012, and March 5, 2013. Meeting minutes are provided in Appendix A: Project Correspondence. A public meeting was held for this project April 9, 2013 to gather input from residents, stakeholders and interested parties. Meeting minutes and list of attendees are provided in the Appendix A. No special meetings were held for this technical project update.

1.4 Mapping and Surveys

Mapping information for this project was obtained from several sources. Given the multi-jurisdictional makeup of the watershed, every attempt was made to use the best available data. The following describes the various mapping components and their sources.

Topographic Contours
Two-foot topographic LIDAR-derived contour data collected by the USGS in the spring of 2008 was used for the eastern half of the watershed. The area along the drainageway for the west portion of the watershed was flown by TransVision in May 2012 which produced 2-foot contour data. USGS 10 meter DEM data were used to supplement the remaining area outside the Gulch corridor in the western half of the basin.

Aerial Photography
A 2009 color aerial photo, with a one foot pixel resolution, was provided by UDFCD.

Base Mapping
Base mapping information including street centerlines, parcels, zoning, jurisdictional boundaries, and park boundaries were provided by the City and County of Denver and the City of Lakewood.

Crossing Structure Survey
Field survey of all existing road crossings was completed in Accurate EngiSurv, LLC and provided by UDFCD. Denver provided sufficiency ratings for the bridges within their jurisdiction.

Coordinate System and Datum
All GIS mapping and data for this study were developed using the Colorado State Plane, Central Zone coordinate system in U.S. feet. The horizontal datum is NAD83 and the vertical datum is NAVD88.

1.5 Data Collection

In addition to mapping and survey data described in the previous section, the following sources of data and information on the watershed were utilized in the study:

- *Major Drainageway Planning, Sanderson Gulch/Weir Gulch* (Frasier & Gingery, August 1972).
- *Flood Hazard Area Delineation, Sanderson Gulch and North Sanderson Gulch* (Gingery Associates, Inc., August 1979).
- *Letter of Map Revision (LOMR) for Green Gables Redevelopment, Case No. 17-08-0933P, Effective April 20, 2018 (City of Lakewood and unincorporated Jefferson County, April 2018).*
- *Sanderson Gulch Drop Structure Inventory and Bank Stabilization, South Platte River to Sheridan Boulevard, Engineering Assessment and Maintenance Master Plan* (Icon Engineering, Inc., January 2002).
- *Gulch Master Plan, Denver Parks and Recreation* (Matrix Design Group Inc., October 2009).
- *Final DRAFT Mississippi Gulch Outfall Alternatives Analysis and Scoping Study (*Matrix Design Group Inc., December 2010).
- *The River South Greenway Master Plan* (Greenway Foundation, 2010).
- Soils information for the hydrologic analysis was obtained from the Natural Resources Conservation Service (NRCS). Note that GIS data for soils was only available for the portion of the study area located within Jefferson County.
- Future landuse information for the redevelopment of the Green Gables Country Club was taken from the *Green Gables Official Development Plan* (DTJ Design, Inc., Revised April 11, 2012).
- As-Built Drawings of various channel improvement projects from the UDFCD website (http://udfcd.gisworkshop.com/).

Additional data obtained from the project sponsors included GIS data, drainage reports and design drawings and structure survey data. A complete list of references is provided in Section 5.0 References.

Van tours of the drainageway were conducted with the project participants to better understand field conditions. The Denver portion was conducted by Denver Parks and Recreation on August 20, 2012. The tour for the Lakewood portion was conducted by City of Lakewood staff on September 24, 2012.

1.6 Acknowledgements

This report was prepared with the cooperation of UDFCD, City & County of Denver and the City of Lakewood. Representatives who were involved in and contributed to the study are listed in the following Table 1-1.

Table 1-1 Project Update Participants

Name	Representing	Project Role
Shea Thomas	UDFCD	Project Manager
Terri Fead	UDFCD	Floodplain Manager
Jeremy Hamer	Denver Public Works – Floodplain Manager	Sponsor
Terry Rogers	Lakewood	Sponsor
Robert Krehbiel	Matrix Design Group, Inc.	Project Manager
Hung-Teng Ho	Matrix Design Group, Inc.	Project Engineer

2.0 STUDY AREA DESCRIPTION

2.1 Project Area

The project study area consists of the Sanderson Gulch watershed including the tributary North Sanderson Gulch. A map of the watershed is provided in the interactive Hydrology Map, Figure B-1 of Appendix B. Sanderson Gulch is a west bank tributary to the South Platte River in Denver. The confluence with the South Platte River is immediately downstream of Florida Avenue. The confluence and lower portion of the Sanderson Gulch watershed are located within the City and County of Denver. The watershed extends west from the South Platte River approximately 7 miles to S. Union Boulevard in the City of Lakewood and Jefferson Count. The watershed ranges from approximately 0.5 to 1.8 miles wide. The northern boundary of the watershed varies from Exposition Avenue on the east to Florida Avenue on the west; the southern boundary of the watershed varies from approximately Harvard Avenue on the east to Morrison Road on the west. The jurisdictions within the Sanderson Gulch watershed are shown on Figure 2-1.

The Sanderson Gulch watershed has a drainage area of 7.6 square miles. NRCS hydrologic soil types within the basin are predominantly Type C. A soils map is provided in the interactive Hydrology Map, Figure B-1 of Appendix B. The watershed is essentially fully developed. The 152-acre Green Gables Country Club located near the southeast corner of the intersection of Wadsworth and Jewell in Jefferson County is the only significant undeveloped parcel and it is currently under redevelopment as mixed-use commercial and residential. Since development is approved and construction is imminent, this study assumes development of this site under the future conditions model. Watershed elevations range from 5,230 feet at the confluence with the South Platte River to 5,805 feet at the western limit of the watershed near S. Union Boulevard. The average slope of Sanderson Gulch downstream of the confluence with North Sanderson Gulch is 0.95% and 1.31% upstream of the confluence. North Sanderson Gulch has an average slope of 1.28%.

Figure 2-2 identifies the parcels within the Sanderson Gulch that are city-owned. Within the City and County of Denver, Sanderson Gulch was one of the first drainageways to preserve the floodplain as open space and the gulch is almost entirely an open channel system contained within linear park and open space areas. Sanderson Gulch is not designated a wildlife corridor by Denver Parks and Recreation, but there are portions of the gulch that are designated as “Park” which means there are some use restrictions for those designated areas. The middle and upper reaches of Sanderson Gulch and the entirety of its tributary, North Sanderson Gulch, are located within Jefferson County and the City of Lakewood. Upper Sanderson Gulch and North Sanderson Gulch are also generally open channel systems, but the number of adjacent parks or open space areas is much more limited. Significant portions of the upper gulches are contained in narrow constructed drainageways. Figure 2-3 depicts the parks and open spaces within the Sanderson Gulch watershed.

There are several irrigation ditches and water storage reservoirs within the Sanderson Gulch watershed. Figure 2-4 shows the ditch locations for the Agricultural Ditch, Welch Ditch, and the Salisbury Lateral Ditch. Smith Reservoir, Ward Reservoir No. 1, Ward Reservoir No. 2 and Ward Reservoir No. 5 within the Sanderson Gulch watershed are privately owned and used for irrigation water storage. The operation of these ditches is described in Section 2-4.

2.2 Land Use

Land use and zoning data was provided by the City and County of Denver and the City of Lakewood. A summary of how impervious area values were determined for hydrologic modeling is included in Section 3.3.2 Watershed Imperviousness. Land use in the watershed is illustrated on the interactive Hydrology Map, Figure B-1 of Appendix B. Residential land uses make up a majority of the watershed. Limited commercial and industrial development exists along major arterial streets primarily Federal Boulevard, Sheridan Boulevard, Wadsworth Boulevard and the western part of Jewell Avenue. Land use within the watershed is summarized in Table 2-1.

Table 2-1 Watershed Land Use Summary

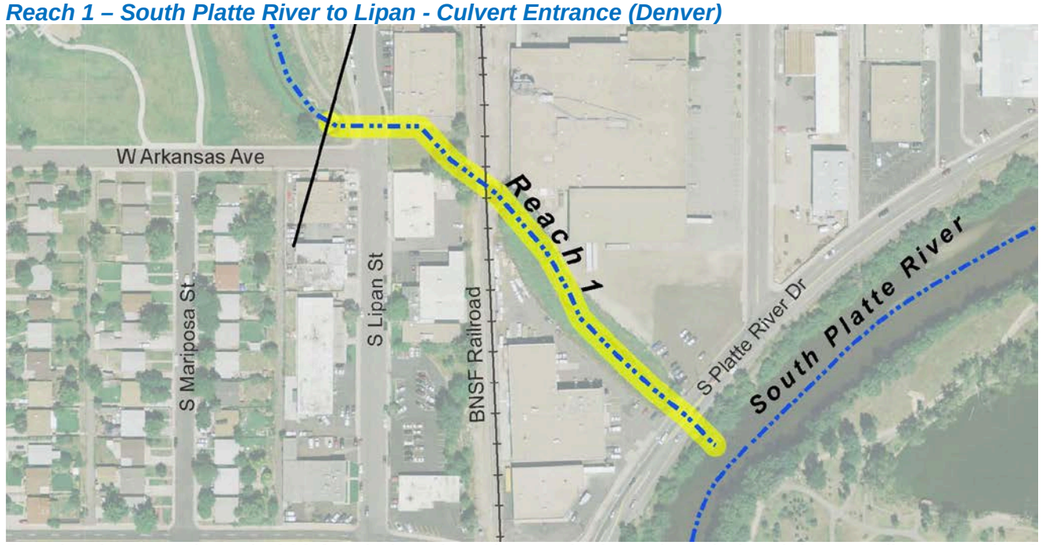
Land Use	Percentage of Watershed
Residential	75.7%
Commercial/Industrial	11.4%
Parks/Open Space/Ponds	12.9%
Total	**100.0%**
Watershed Area-Weighted Imperviousness	**49.6%**

2.3 Reach Descriptions

For the purposes of the evaluation of MDP alternative improvements, Sanderson Gulch has been divided into 12 reaches and North Sanderson Gulch into 4 reaches. Descriptions of the reaches are provided in the sections below and reach limits are illustrated in Figure 2-5. Major crossings are shown on Figure 2-6 and listed in Table 2-2. An inventory of existing drop structures is shown in Table 2-3. There are currently 35 drop structures on Sanderson Gulch and 17 on North Sanderson Gulch as shown on Figure 2-7.

Sanderson Gulch

Reach 1 – South Platte River to Lipan - Culvert Entrance (Denver)



Reach 1 is approximately 900 feet in length and extends through an industrial area adjacent to the South Platte River. The reach is distinguished from upstream areas by its adjacent industrial land uses, very limited access and floodplain encumbrance. Reach 1 has a lack of maintenance and public access, and unlike other

park reaches, has no parallel trail system to the gulch. Beginning downstream and progressing upstream, the South Platte River Drive culvert has less than 10-year capacity. Upstream of this roadway culvert, Sanderson Gulch is a simple grass lined open channel. The Burlington Northern Santa Fe (BNSF) Country Line Railroad Bridge is poorly aligned with the open channel discharge from the upstream culvert and has 10-year capacity, although the railroad does not have a history of overtopping. From Lipan to the BNSF railroad, Sanderson Gulch is contained within a twin 14-foot wide x 6.75-foot high (14' x 6'9") reinforced concrete box culvert (RCBC). The box culvert is 214 feet long, curvilinear double box culvert at 2.35% slope and has approximately 40-year capacity. The box culvert, railroad bridge, open channel and culvert under South Platte River Drive have limited flood conveyance capacity for the 100-year flood and many adjacent and downstream structures are in the regulatory floodplain due to insufficient capacity of this reach.

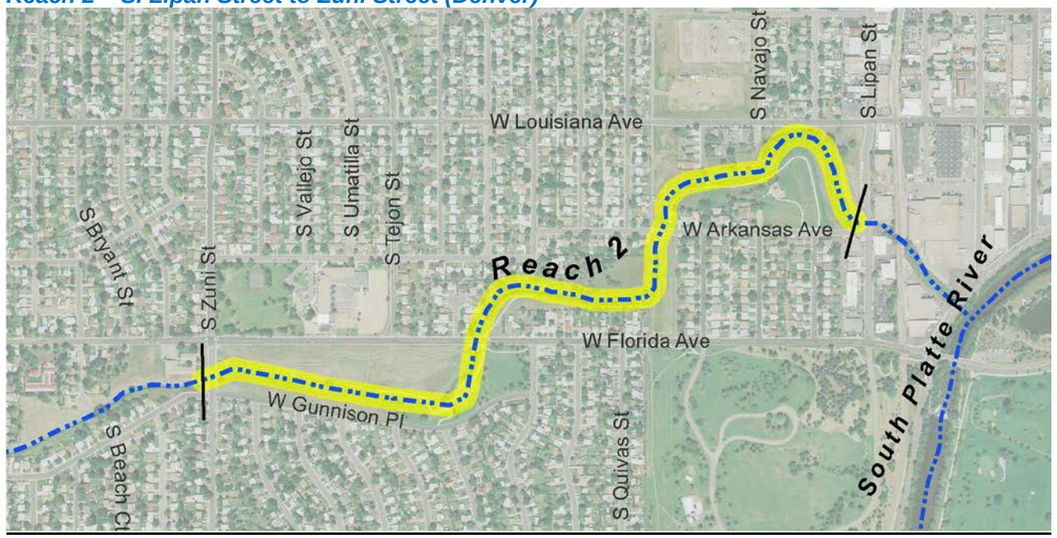


Lower Sanderson Gulch at the BNSF Railroad Bridge.



Lower Sanderson Gulch open channel at the South Platte River Drive crossing.

Reach 2 – S. Lipan Street to Zuni Street (Denver)



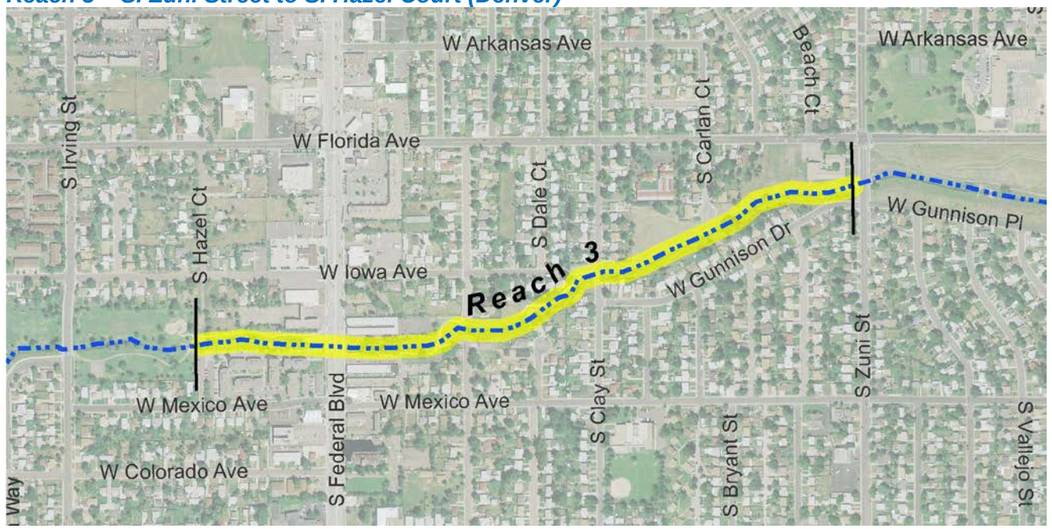
Reach 2 begins upstream of the S. Lipan Street culvert and extends approximately 5,300 feet upstream through S. Zuni Street. The linear park and continuous pedestrian trail that characterize the Denver reach of Sanderson Gulch begins at S. Lipan Street. Adjacent park areas and the floodplain in Reach 2 are generally broader than areas upstream and include the Sanderson Gulch Park between W. Florida Avenue and S. Zuni Street which is up to 500 feet in width. The wide park areas in this reach have provided opportunities for channel restoration not possible in narrow upstream reaches. Two restoration projects have been completed in recent years in Sanderson Gulch Park. One project realigned the channel and restored a native riparian edge downstream and upstream of W. Florida Avenue. A second project replaced a single large drop structure with several smaller structures raising the incised channel invert over a 600-foot reach and allowing the use of softer drop structures of vegetation and ungrouted boulders. Aside from this recently restored section, the remainder of Reach 2 is moderately incised with 2-foot high vertical banks typical along the low flow channel. Channel banks have generally been stabilized with soil riprap. There is also a substantial amount of riprap in the channel invert forming intermittent riffles helping the channel to maintain a typical slope of 0.4% in this reach.



Recently improved channel downstream of Zuni Street.

Reach 2 includes three road crossings and nine existing drop structures. The W. Arkansas Avenue crossing also has only 10-year capacity. The W. Florida Avenue crossing has less than 10-year capacity and adjacent residential structures are in the regulatory floodplain. The Zuni Street crossing has greater than 10-year capacity which results in the adjacent structure being in the 100-year floodplain. Existing drop structures are in fair to good condition with one very small grouted boulder structure and two vertical drop structures with heights of 5 and 6 vertical feet. The drop heights for the two vertical structures are greater than current UDFCD standards.

Reach 3 – S. Zuni Street to S. Hazel Court (Denver)



Reach 3 is approximately 3,700 feet in length. There is a continuous pedestrian trail but open space adjacent to the gulch is generally fairly narrow and there are no formal park areas. The floodplain is similarly narrow, being confined to a 100-200 foot width except at road crossings. The reach from S. Zuni Street to S. Clay Street is particularly incised within a roughly 100-foot wide floodplain.

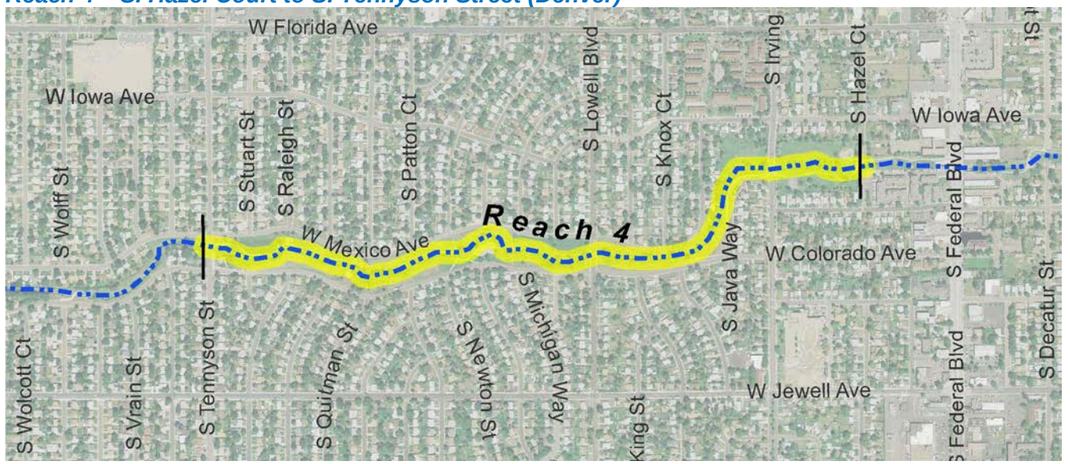
There are two road crossings and four existing drop structures in the reach. The crossing at Clay Street has less than 10-year capacity and does not meet current City of Denver crossing criteria for overtopping depth, but a previous property acquisition eliminated adjacent structures in the floodplain. The crossing at Federal Boulevard has greater than 10-year capacity but no structures are in the floodplain.



Clay Street crossing during a heavy rainfall event July 9, 2012.

The low flow channel is moderately incised with typically vertical 2-foot height channel banks. Banks are generally composed of soil riprap but deteriorated gabion mattresses also exist in some portions of the reach. The channel invert slope varies from approximately 0.4% to 0.6%. The steeper slopes are maintained by substantial riprap in the channel invert and intermittent informal riprap riffles that have formed. The drop upstream of Zuni Street is in reasonably good condition but the previous 2002 *Sanderson Gulch Drop Structure Inventory and Bank Stabilization* report by Icon Engineering (2002 Drop Inventory) recommended replacing it with a larger structure. Two sloping grouted boulder structures between S. Clay Street and Federal Boulevard are new with relatively low drop heights and are in good condition. The drop structure upstream of Federal Boulevard is a near vertical structure of grouted riprap that the 2002 Drop Inventory recommended increasing in height and breaking into two separate structures.

Reach 4 – S. Hazel Court to S. Tennyson Street (Denver)

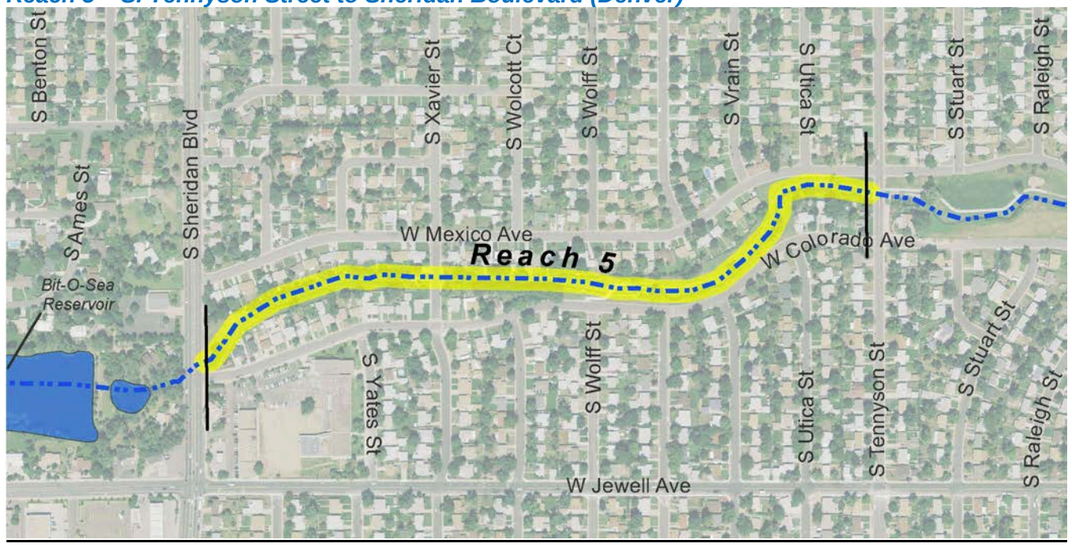


Reach 4 is approximately 5,400 feet in length and is contained within a linear park that is typically approximately 240 feet in width. There is a continuous pedestrian trail through the reach. Three road crossings (Irving, Lowell and Tennyson) exist, all of which have less than 10-year capacity. These crossings do not meet current Denver criteria for allowable floodwater overtopping. There are no adjacent structures in the floodplain in Reach 4. Four pedestrian low-flow bridge crossings exist in the reach and four existing drop structures varying in height from 4 to 5 feet. The four existing drops are all vertical structures constructed of gabion baskets with crest sections coated in gunite. These drops are all in poor condition and do not meet current UDFCD criteria for vertical drop height. The existing drops have been designed around a 0.4% overall channel slope which is maintained by numerous informal riprap riffles that exist between the formal drop structures. Additional drops are proposed for the upper portion of this reach above S. Lowell Boulevard where existing channel slopes are as steep as 1.5%. Channel banks throughout the reach are largely soil riprap and moderately incised typically with 2-foot height vertical low-flow banks. Sections of the banks are protected by deteriorated gabion mattresses.



Sanderson Gulch west of Irving Street within the linear park corridor.

Reach 5 – S. Tennyson Street to Sheridan Boulevard (Denver)



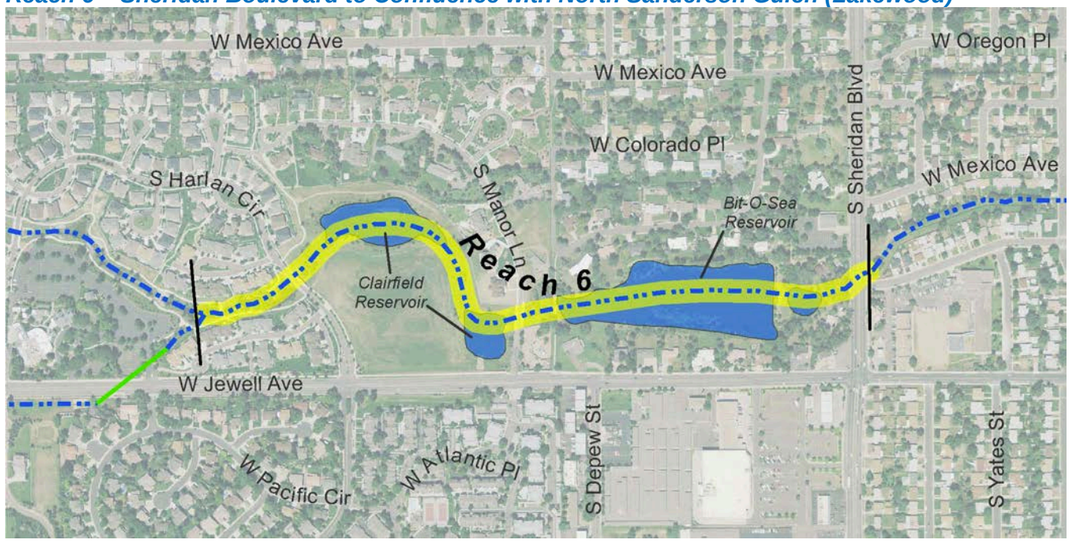
Reach 5 is approximately 2,800 feet in length and extends from S. Tennyson Street to the dividing line between the City and County of Denver and the City of Lakewood (Jefferson County) at Sheridan Boulevard. The formal wide linear park corridor of Sanderson Gulch ends at S. Tennyson Street, and the remainder of the reach within Denver up to Sheridan Boulevard is contained within a narrower corridor. At Tennyson Street the gulch corridor is initially 100 feet in width and then reduced further to 60 feet for the upper half of the reach starting near S. Wolff Street. The pedestrian path extends only east of S. Wolff Street. West of Wolff Street to Sheridan, the channel has a concrete lined invert.



East of Xavier the Sanderson Gulch channel is confined to a narrow corridor without good maintenance access.

Reach 5 includes a road crossing at S. Xavier Street which has less than 10-year capacity. There are two existing drop structures in the reach, both in reasonably good condition. One of these, a near vertical gabion and gunite structure above S. Xavier Street, has a 5 foot drop height and does not meet current UDFCD criteria for vertical drops. The upper half of the reach above S. Wolff Street has a concrete-lined invert. Below this point, channel slopes alternate between fairly flat sections and informal riprap riffles, resulting in an overall slope approaching 0.8%. Additional grade control is planned for the steeper reach.

Reach 6 – Sheridan Boulevard to Confluence with North Sanderson Gulch (Lakewood)



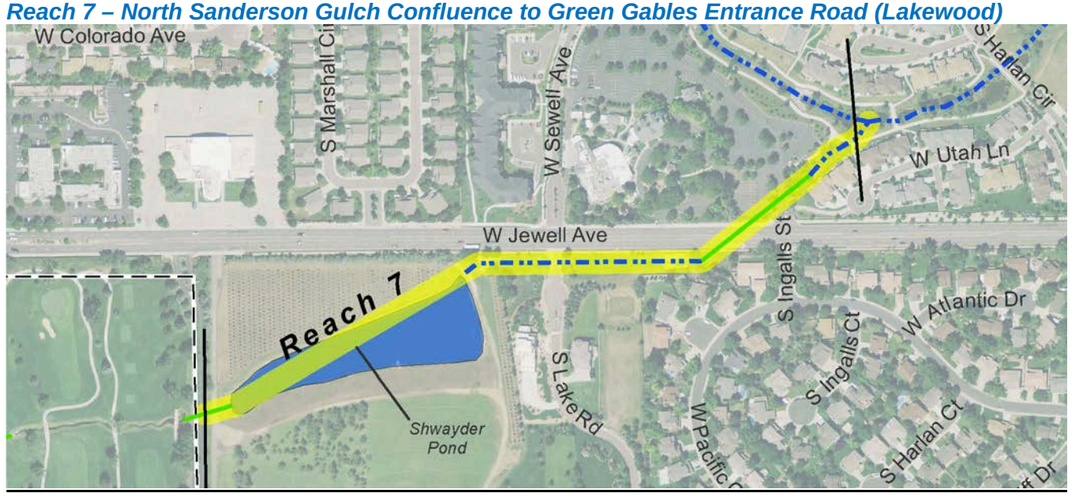
Reach 6 extends approximately 3,500 feet upstream of Sheridan Boulevard through open space and a series of three ponds to S. Harlan Drive where it re-enters a narrow, constructed drainageway. The Bit-O-Sea Reservoir is privately owned and has no public or maintenance access. Upstream of Bit-O-Sea Reservoir is Clairfield Reservoir and the Wilson Family Park, which is within the City of Lakewood open space. This public area has a broad floodplain and more natural channel conditions without hardened banks or structures and little incision. There is a gravel trail adjacent to the gulch through the open space which serves the Wilson Family Park and Clairfield Reservoir. The broad floodplain and ponds offer unique opportunities in this reach.



Wilson Family Park at S. Harlan Circle. This area has been improved and includes a recent LOMR.

There are three road crossings within this reach. The Sheridan Boulevard crossing has approximately 10-year capacity. The Manor Lane and S. Harlan Circle bridges generally have 100-year capacity, although the Manor Lane has some minor flow spill in the left overbank in a 100-year flood. Drop structures exist only at the outlets of Clairfield and Bit-O-Sea Reservoir. The Clairfield outlet drop structure is in good condition. The Bit-O-Sea outlet drop structure is privately owned and its current condition is unknown.

Reach 7 – North Sanderson Gulch Confluence to Green Gables Entrance Road (Lakewood)



Reach 7 is approximately 2,000 feet in length and extends from the confluence with North Sanderson to the privately owned Shwayder Pond at the Green Gables entrance road. Except for Shwayder Pond, the reach is contained in a narrow constructed drainageway. A public trail along the gulch with a pedestrian bridge crossing exists downstream of W. Jewell Avenue, and there is little opportunity to continue it upstream because of private property ownership. The entire reach has been stabilized and the existing channel and facilities are generally in good condition. Road crossings consist of W. Jewell Avenue, the privately owned S. Lake Road gated community entrance, and the Green Gables entrance road. The S. Lake Road crossing and the Green Gables entrance road have full 100-year capacity. The Jewell crossing has 50-year capacity. An estimated 252 cfs of the 100-year flood flow will exceed the crossing culvert capacity and spill over Jewell Avenue in a 100-year flood event. The shallow overland flood flow generally follows the alignment of the crossing culvert to the downstream channel and spreads out into the neighboring depressed areas. The Shwayder Pond outlet culvert has less than 10-year capacity and a spillway is provided to accommodate any overtopping. Three grouted rock drop structures exist in the reach, all of which are relatively new and in good condition.

Reach 8 – Green Gables Country Club (Jefferson County)



This section traverses through the existing Green Gables Golf Course. Reach 8 and the entire 152-acre Green Gables Country Club are currently within the jurisdiction of Jefferson County. In 2011, the Country Club closed its operations and was sold for redevelopment. Rezoning and redevelopment of the site is currently underway to change the land use into a planned development of mixed commercial and residential uses. Current plans show Sanderson Gulch through the site as an open channel within an open space corridor. There are two proposed 100-year capacity road crossings and five grouted boulder drop structures within the site development. As-built plans for redevelopment have been incorporated into this study through LOMR Case No. 17-08-0933P.

Reach 9 –S. Wadsworth Blvd. to S. Allison Street (Lakewood)

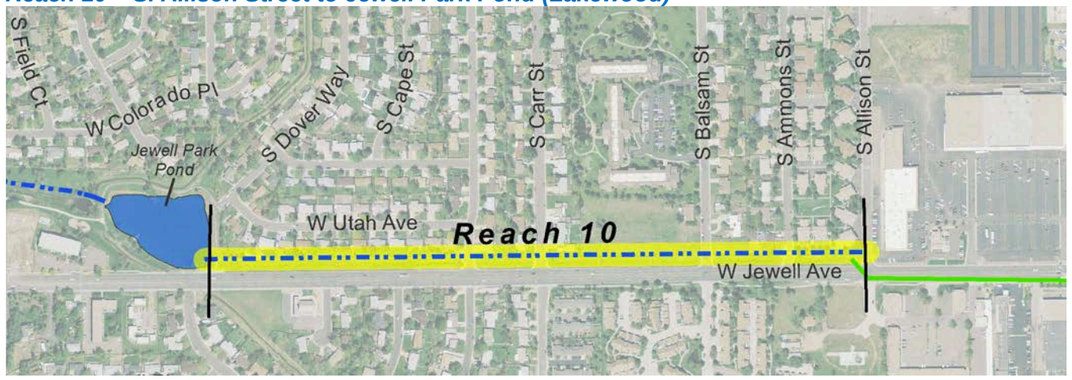


Reach 9 consists of a 1,600-foot length of twin 66-inch diameter culverts that convey flows across W. Jewell Avenue and Wadsworth through two commercial developments. The culverts have approximately 20-year capacity and extensive flooding of commercial buildings is possible during a large flood event.



Entrance into the twin 66" culverts. The trash racks are in poor condition and do not meet current criteria for sizing.

Reach 10 – S. Allison Street to Jewell Park Pond (Lakewood)



Reach 10 is 2,600 feet in length and consists of a narrow constructed drainageway paralleling W. Jewell Avenue. The drainageway is approximately 45 feet in top width with a narrow (3' +/-) low flow channel and steep grassed side-slopes. The low flow channel has generally incised 1 to 2 feet, and bank failures exist throughout the reach. There are numerous low height drop structures constructed of gabions that are mostly in varying states of failure. Four road crossings exist in the reach each of which consists of parallel 60- to 66-inch culverts. Capacity of these crossings is limited to approximately the 10-year event but overtopping during larger storms up to the 100-year event does not flood adjacent structures. Repairs to the channel and drop structures in the reach are recommended. Storm outfall pipes have caused local erosion areas. On the east, the path ends at S. Allison Street at the entrance to the long, Reach 9 culverts. To the west, the path has connectivity to Jewell Park and open space areas upstream.



Storm outfall into the Reach 10 open channel section with local erosion at the outlet.



Open channel section with eroded banks and gabion basket drop structures at Ammons Street. Culverts are undersized relative to the capacity of the channel section.

Reach 11 - Jewell Park Pond to Kendrick Reservoir (Lakewood)



Reach 11 extends 4,500 feet from the outlet of Jewell Park Pond upstream to the outlet of Kendrick Reservoir. Jewell Park Pond is located on the downstream side of the Agricultural Ditch crossing. Kendrick Reservoir was historically used as an irrigation storage facility, but its use as such was discontinued over 40 years ago. Both water bodies are currently owned by the City of Lakewood and are operated as park and recreation facilities. Jewell Park Pond is small and has a surface area of 1.89 acres.

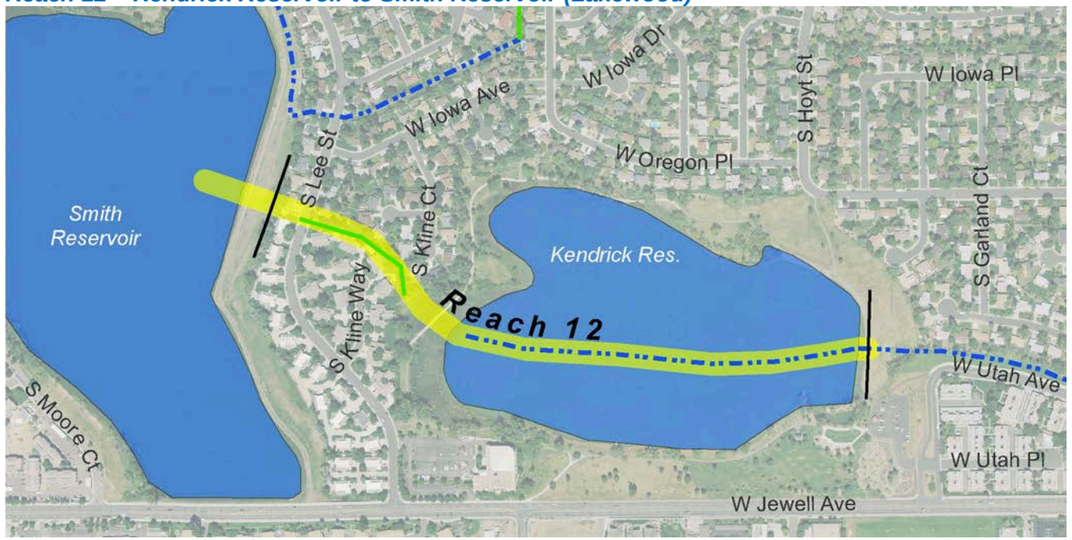
Open channel areas in Reach 11 are limited to a 2,000-foot reach between Jewell Park Pond and Kendrick Reservoir. Open channel road crossings consist only of S. Garrison Street which has greater than 10-year capacity. The open channel reach below S. Garrison has broad grassy overbank areas and a wide floodplain. Above S. Garrison, there is only intermittent flow and the channel has been confined to a 50-foot wide grass swale.



Greenway corridor upstream of Jewell Park Pond. The park owned by the City of Lakewood is well maintained.

The channel connection between Jewell Park and Kendrick Reservoir Park occurs on City of Lakewood property adjacent to W. Utah Avenue, with an 8-foot attached walk serving as the public access trail. The S. Garrison Street pedestrian crossing is at grade.

Reach 12 – Kendrick Reservoir to Smith Reservoir (Lakewood)



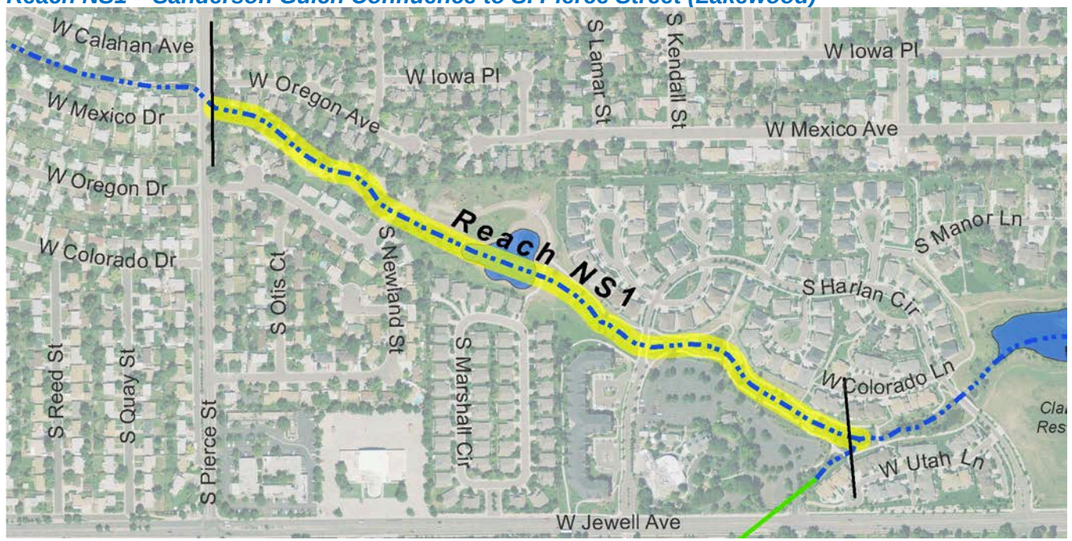
Reach 12 is the upstream-most reach of Sanderson Gulch and extends from the Kendrick Reservoir outlet 1,100 feet upstream to Smith Reservoir. There is no formal connection between Smith and Kendrick Reservoirs. A small diameter pipe with a reported capacity of 19 cfs collects local drainage and outfalls into Kendrick Reservoir. Kendrick Reservoir is owned by the City of Lakewood and has a water surface area of 31 acres. Smith Reservoir is an irrigation storage facility owned by the Agricultural Ditch and Reservoir Company and has a surface area of approximately 52.5 acres. Both Smith and Kendrick Reservoirs have a small tributary drainage area and adequate capacity to contain the 100-year storm event with no outflows.



Kendrick Reservoir is owned by the City of Lakewood and can contain the 100-year runoff event.

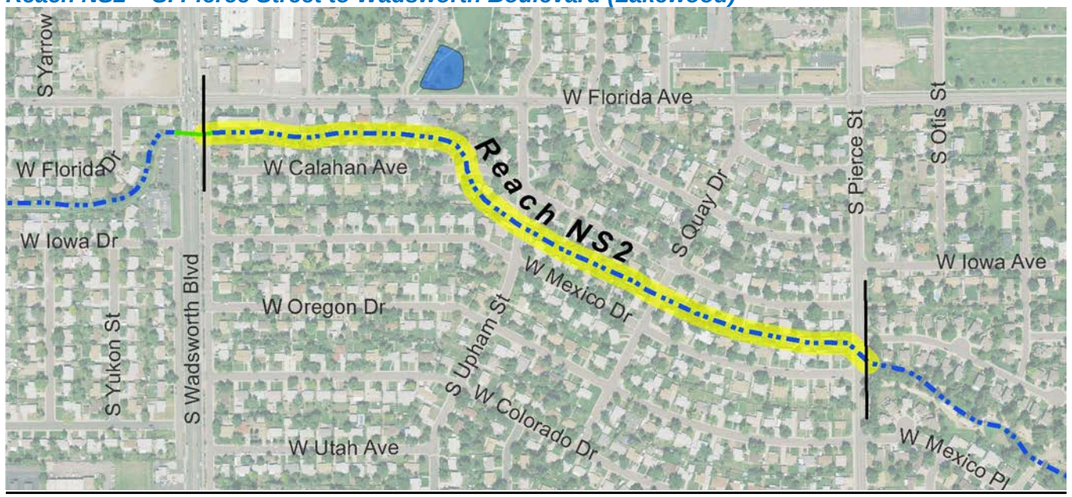
North Sanderson Gulch

Reach NS1 – Sanderson Gulch Confluence to S. Pierce Street (Lakewood)



Reach NS1 is approximately 2,800 feet long and extends upstream from the confluence with Sanderson Gulch to S. Pierce Street. The 2009 *North Sanderson Gulch Greenbelt Improvements* project stabilized the western half of this reach of the channel and included a large wetland pond area. The channel in this reach is contained in a narrow open-space corridor mostly less than 100-feet in width. It is recently stabilized with ten new grouted boulder drop structures but has an unlined invert and typically vegetated soil riprap banks. There is a small intermittent base flow in the lower portion of the reach and standing water in the small ponds and drop stilling basins. All of the existing drop structures and most channel banks are in good condition. A continuous concrete pedestrian path exists in the reach and the lower third has a path on both sides of the channel. The road crossing on S. Harlan Circle has 100-year capacity.

Reach NS2 – S. Pierce Street to Wadsworth Boulevard (Lakewood)



The character of North Sanderson Gulch changes significantly in several ways at S. Pierce Street. The more open, aesthetic, drainageway with continuous public access and relatively new, 100-year drainage facilities downstream changes at S. Pierce Street to a 22-foot to 36-foot width constructed channel with a concrete invert, steep gabion mattress banks and no public access through Reach NS2. The small base flows which exist downstream disappear above S. Pierce Street. The concrete channel invert has deteriorated in many areas and the four bridge crossings at Pierce, Quay, Upham and Calahan have only approximately 10-year capacity with numerous adjacent residential structures in the floodplain.

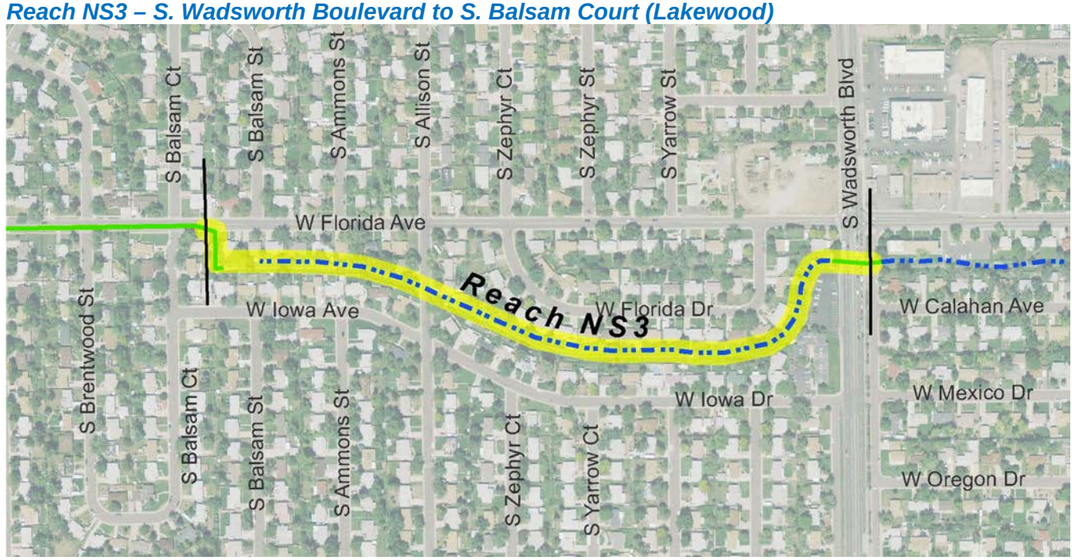


Channel downstream of Wadsworth. Concrete pan and drop structure.



The concrete channel bottom is severely eroded in some areas.

Reach NS3 – S. Wadsworth Boulevard to S. Balsam Court (Lakewood)



Reach NS4 S. Balsam Court to S. Garrison Street (Lakewood)



Reach NS3 is similar in character to the downstream Reach NS2. The channel is contained within a 36-foot wide drainage easement with no public access. The channel has 2H:1V grassed side slopes and a 4-foot wide concrete invert. The concrete invert is significantly deteriorated in areas. The Wadsworth crossing has been upgraded to nearly 100-year capacity. The S. Allison Street crossing of an 8'x5' RCBC provides approximately 10-year capacity. The open channel portion of North Sanderson Gulch ends at W. Florida Avenue where twin 7'x4' RCBC's discharge from Florida Avenue to the head of the channel.



North Sanderson Gulch upstream of Allison Street. The channel is trapezoidal with a concrete pan.

This upstream-most reach of North Sanderson Gulch is approximately 3,400 feet in length and consists of a 24- to 36-inch diameter pipe in W. Florida Avenue. The pipe system begins at S. Garrison Street at the outfall of the lake in Sanctuary Park and extends down W. Florida Avenue to discharge into the open channel at W. Florida Avenue just east of S. Balsam Court.

2.4 Irrigation Ditches

Irrigation ditches are an important consideration for Major Drainageway Planning studies. Municipalities are working to disconnect urban storm drainage from the irrigation ditches for liability and water quality concerns. Under existing conditions these open channel irrigation ditches can import or export flow. In accordance with UDFCD criteria for planning and hydrologic modeling, an evaluation for future conditions is conducted to ensure that storm flows do not discharge to irrigation ditches (source: UDFCD Volume 1, Section 1.5, 4.5.4, 5.5, 5.5.1, 5.5.3). Piped reaches of the irrigation ditches are less of a concern because they minimize the ability for stormwater runoff interaction.

The Sanderson Gulch headwaters receive irrigation water from two major ditches as shown on **Figure 2-4**:

- Agricultural Ditch which diverts water from Clear Creek
- Ward Canal which diverts water from Bear Creek

2.4.1 Agricultural Ditch

The Agricultural Ditch is operated by the Agricultural Ditch & Reservoir Company and also operates Smith Reservoir within the Sanderson Gulch drainage basin, and Main and East Reservoirs within the Weir Gulch drainage basin. The Agricultural Ditch is generally an open channel ditch which could have an interaction with surface stormwater runoff. It has emergency overflow spill points at Mississippi Avenue to discharge into Weir Gulch if necessary, and at Jewell Park Pond to discharge into Sanderson Gulch if necessary.

Smith Reservoir has a 250 acre tributary basin, including the reservoir itself. Smith Reservoir is able to contain a 100-year storm event. However, during normal operations and in an emergency situation, Smith Reservoir can send water north into East Reservoir. If East Reservoir were to spill, water would be intercepted by the Agricultural Ditch and conveyed into Sanderson Gulch via the emergency spill point at Jewell Park Pond.
For the purposes of this study, the Agricultural Ditch is not expected to have an impact on major storm hydrology. If Smith Reservoir were to spill (potential export), this water would be returned back to the Sanderson Gulch watershed at Jewell Park Pond. During a major storm, the open channel could fill with stormwater and be a potential import to Sanderson Gulch. However, with an emergency overflow located at Mississippi Avenue, the Weir Gulch watershed tributary basin to the Agricultural Ditch downstream of the spill is relatively minor and considered insignificant.

2.4.2 Ward Canal

The Ward Canal, operated by the Ward Canal Company, supplies water to Kendrick Lake No. 1, Kendrick Lake, Smith Reservoir, Ward Reservoir No. 1 and Ward Reservoir No. 2 within the Sanderson Gulch watershed. The canal is open channel in some areas, but mostly piped underground through a majority of the reach in Sanderson Gulch. Because the canal is located along the ridgeline of the basin divide between Bear Creek and Sanderson Gulch, there is little area tributary to the canal. The amount of stormwater that could be imported or exported by the Ward Canal during a significant storm event is insignificant to the Sanderson Gulch major storm hydrology.

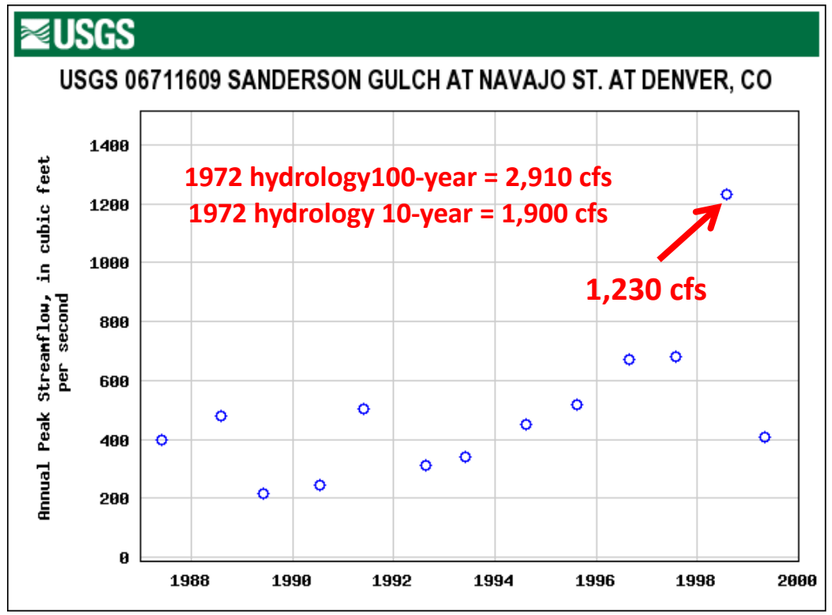
2.5 Flood History

In 1958, the City & County of Denver initiated a floodplain zoning ordinance along Sanderson Gulch. This ordinance preserved the floodplain areas immediately adjacent to the Sanderson Gulch channel and has likely since played a major role in limiting flood damages along the Gulch.

Past flooding along Sanderson and North Sanderson Gulch is not well documented and historical stream gaging data is limited. No reports of flooding property have been reported. The 1979 report *Flood Hazard Area Delineation, Sanderson Gulch & North Sanderson Gulch* (Gingery Associates, Inc., 1979) stated that major flood events had not occurred in the past 20 years. Other flood events have undoubtedly occurred but the fact that little information on historical flooding can be found may be indicative of both a lack of major flood events and early floodplain management efforts.

USGS Gage No. 06711609 (Sanderson Gulch at Navajo St. at Denver, CO) near the outfall to the South Platte River was in operation between 1987 and 1999. The gage was located upstream of the Mississippi Gulch storm drain outlet to Sanderson Gulch with drainage area 7.98 square miles, and is no longer active. During this 13 year period, the maximum peak discharge recorded was 1,230 cfs on July 25, 1998. This flow is only slightly greater than the hydrology computed in 1972 for a 5-year event, and therefore significant flood events did not occur during this period.

USGS Gage No. 06711600 (Sanderson Gulch Tributary at Lakewood, CO) is located near the near intersection of Wadsworth and Florida in the North Sanderson Gulch with drainage area 0.57 square miles. The peak flood event for the 33 year period of record occurred on June 6, 1977.



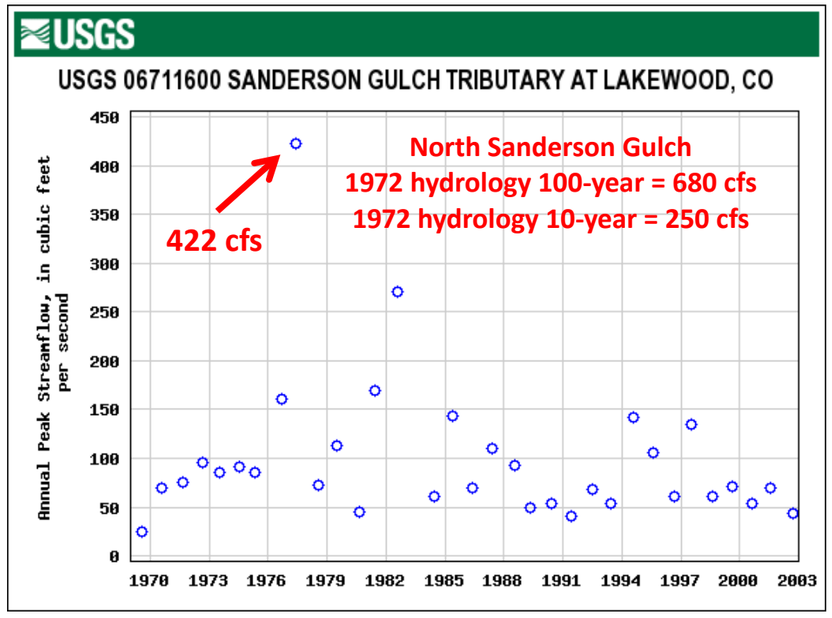


Table 2-2 Major Crossing Structure Inventory

River Station	Location	Reach	Crossing Type	Size	Condition	General Capacity
Sanderson Gulch						
0+00	S. Platte River Dr.	S-1	Culvert	15’-4” x 9’-3” CMP	Good	< 10 yr
6+50	BNSF Railroad	S-1	Bridge	2 – 19’ x 5.5’ Open		10 yr
9+00	S. Lipan St.	S-1	Culvert	2 - 14’ x 6’ 9”’ RCB	Good*	50 yr
27+00	W. Arkansas Ave.	S-2	Culvert	96” RCP + 120” x 78” HERCP		10 yr
43+50	W. Florida Ave.	S-2	Culvert	15’-4” x 9’-3” CMP		10 yr
62+50	S. Zuni St.	S-2	Culvert	2 – 12’ x 6’ RCB	Good*	> 10 yr
77+00	S. Clay St.	S-3	Culvert	2 – 66” RCP		< 10 yr
91+00	S. Federal Blvd.	S-3	Culvert	2 – 10’ x 6’ RCB + 14’ x 8’ RCB		> 10 yr
104+50	S. Irving St.	S-4	Culvert	2 – 10’ x 6’ RCB	Good*	> 10 yr
121+00	S. Lowell Blvd.	S-4	Culvert	66” RCP		< 10 yr
153+00	S. Tennyson St.	S-4	Culvert	72” RCP		< 10 yr
171+00	S. Xavier St.	S-5	Culvert	2 – 78” RCP		> 10 yr
181+00	Sheridan Blvd.	S-6	Culvert	2 – 9.5’ x 5’ RCB		> 10 yr
197+00	S. Manor Ln.	S-6	Bridge	2 – 22.5’ x 5’ Openings		100 yr w/ minor LOB flow spill
210+50	S. Harlan Cir.	S-6	Bridge	2 – 16’ x 6’-8” Openings		100 yr
220+00	W Jewell Ave.	S-7	Culvert	3 - RCB drop entrance and 3 - 68" x 43" HERCP outlet		50 yr
225+50	S. Lake Road	S-7	Bridge	2 – 3’-9” x 14’ Openings		> 50 yr (Nearly 100 yr)
228+00	Shwayder Pond Outlet (Private)	S-7	Culvert	3 – 24”		< 10 yr
236+50	Green Gables Entrance Rd.	S-7	Culvert	8’ x 4’ + 24” RCP + 15” RCP		10 yr
247+20	S Reed St.	S-8	Culvert	2 – 20’ x 8’ RCB	Good	100 yr
257+30	S Pierce Way	S-8	Culvert	2 – 20’ x 8’ RCB	Good	100 yr
286+00	W. Jewell Ave. S. Wadsworth Ave.	S-9	Culvert	2 – 66" to 2 – 10’-5” x 4’ @ exit		> 10 yr
289+00	S. Ammons St.	S-10	Culvert	60” + 66”		> 10 yr
292+50	S. Balsam St.	S-10	Culvert	60” + 66”		> 10 yr
299+00	S. Carr St.	S-10	Culvert	2 – 63" CMP		> 10 yr
302+00	S. Cody St.	S-10	Culvert	2 – 66” CMP		> 10 yr
312+00	Jewell Park Pond Outlet	S-10	Bridge Over Spillway	24’ x 4’-9” Open		100 yr
318+00	Agricultural Ditch	S-11	Low Flow Pipe + Overflow	24” RCP		< 10 yr
326+50	S. Garrison St.	S-11	Culvert	45” x 29” HERCP		< 10 yr
339+50	Kendrick Res. Outlet	S-11	Bridge Over Spillway	72’ x 6.8’ Open		100 yr
North Sanderson Gulch						
9+00	S. Harlan Cir.	NS-1	Bridge	2 – 16’ x 5’		100 yr
28+00	S. Pierce St.	NS-2	Culvert	2 – 12’ x 3’ RCB		10 yr
37+00	S. Quay Dr.	NS-2	Culvert	2 – 8’ x 4’ RCB		> 10 yr
43+00	S. Upham St.	NS-2	Culvert	2 – 8’ x 4’ RCB		> 10 yr
46+50	S. Calahan St.	NS-2	Culvert	2 – 8’ x 5’ RCB		> 50 yr
59+00	S. Wadsworth Blvd.	NS-3	Culvert	2 – 8’ x 4’ RCB		100 yr
74+00	S. Allison St.	NS-3	Culvert	8’ x 5’ RCB entrance and 79" x 56" Arch CMP exit		> 10 yr

Culvert/Bridge Condition Ratings:

Good – No significant structural damage or degradation that would bring into question the structural integrity of the facility. Significant future service life is expected.

Fair – Some damage or degradation to structural elements of the facility is evident. Structure is not in eminent danger of failure but repairs are required to ensure an extended future service life.

Poor – Significant damage or degradation of structural elements of the facility is evident. Significant remedial work is required in the near future.

Critical – Significant damage or degradation of structural elements of the facility is evident and at least partial failure appears possible during a large flood event. Major rehabilitation or complete replacement is required.

Erosion Threat - In some cases channel invert and bank erosion can pose a threat to structures that are otherwise structurally sound. When this is the case, it is noted in parentheses.

* Condition Rating from Kevin Rens, City & County of Denver, email dated 7/25/2012.

Table 2-3 Existing Drop Structure Inventory

River Station	Drop #	Drop Type	Drop Height (ft)	Condition Rating	Safety Hazard	Location Notes
18+40	1	Vertical Concrete	5	Good	X	S Navajo St.
32+00	2	Steep Grouted	4.1	Fair	X	
34+70	3	Grouted Rock	1.5'+/-	Good		
37+90	4	Grouted Rock	2'+/-	Fair		
42+50	5	Grouted Sloping Boulders	3.8	Good		W. Florida Ave. D/S
44+00	6	Stepped Blocks	5.4	Good	X	W. Florida Ave. U/S
50+50	7	Ungrouted Boulders and Vegetated Face	2.3	Good (new 2012)		
54+00	8	Ungrouted Boulders and Vegetated Face	2.3	Good (new 2012)		
55+20	9	Ungrouted Boulders and Vegetated Face	2.3	Good (new 2012)		
64+50	10	Steep Grouted	4.2	Good	X	S Zuni St.
80+50	11	Sloping Grouted	3	Good (New 2001)		Approxi. 400 feet U/S Clay St.
84+50	12	Sloping Grouted	2	Good (new 2001)		S. Decatur St.
95+20	13	Vertical Grouted	2.4	Fair		Approxi. 450 feet U/S Federal Blvd.
107+50	14	Vertical Gunite Gabions	3.4	Poor	X	S Java Way
126+00	15	Vertical Gunite Gabions	4.5	Poor	X	S Michigan St.
133+00	16	Vertical Gunite Gabions	3.5	Poor	X	S Newton St.
141+00	17	Rock Drop	1'+/-	Fair	X	
163+50	18	Vertical Gunite Gabions	4	Fair	X	S Winona St.
172+00	19	Vertical Gunite Gabions	4.6	Fair	X	S Xavier St.
185+00	20	Loose Riprap	8.5			Bit-O-Sea Outlet
197+00	21	Grouted Boulders	2.4	Good		Manor Lane
210+00	22	Grouted Boulders	4	Good		S. Harlan Circle
222+00	23	Grouted Boulders	4	Good		Approxi. 300 feet D/S S Lake Rd.
228+00	24	Grouted Boulders	5	Good		Shwayder Pond Outlet
249+07	25	Grouted Boulders	4.5'	Good		Green Gable
253+32	26	Grouted Boulders	4.5'	Good		Green Gable
258+56	27	Grouted Boulders	3'	Good		Green Gable
260+56	28	Grouted Boulders	4.2'	Good		Green Gable
270+50	29	Grouted Boulders	6.7'	Good		Green Gable
287+80	30	Concrete/Gabions	1'+/-	Poor		
289+50	31	Concrete/Gabions	1'+/-	Poor		
294+50	32	Concrete/Gabions	1'+/-	Poor		
296+70	33	Concrete/Gabions	1'+/-	Poor		
299+50	34	Concrete/Gabions	1'+/-	Poor		
302+50	35	Concrete/Gabions	1'+/-	Poor		
304+80	36	Concrete/Gabions	1'+/-	Poor		
306+20	37	Concrete/Gabions	1'+/-	Poor		
309+30	38	Concrete/Gabions	1'+/-	Poor		
311+00	39	Concrete/Gabions	1'+/-	Poor		
312+00	40	Concrete Baffle Block	5.3	Good		Jewell Park Pond Outlet
North Sanderson Gulch						
1+80	1	Grouted Sloping Boulders	5.6	Good		White Fence Farm Filing No. 1
5+50	2	Grouted Sloping Boulders	4.3	Good		White Fence Farm Filing No. 1
7+20	3	Grouted Sloping Boulders	4.4	Good		White Fence Farm Filing No. 1
8+70	4	Grouted Sloping Boulders	3.6	Good		White Fence Farm Filing No. 1
12+00	5	Grouted Sloping Boulders	1'+/-	Good		White Fence Farm Filing No. 1
14+00	6	Grouted Sloping Boulders	2.7	Good		Greenbelt Improvement
16+70	7	Grouted Sloping Boulders	3	Good		Greenbelt Improvement
20+00	8	Grouted Sloping Boulders	4	Good		Greenbelt Improvement
24+70	9	Grouted Sloping Boulders	2.7	Good		Greenbelt Improvement
27+20	10	Grouted Sloping Boulders	1.75	Good		Greenbelt Improvement
37+44	11	Concrete Drop Inlet	2	Fair		Quay Dr.
47+50	12	Vertical Concrete	3	Poor	X	North of Calahan
54+00	13	Stepped Concrete	2.5	Poor		East of Wadsworth
56+00	14	Stepped Concrete	2.3	Poor		East of Wadsworth
65+00	15	Vertical Concrete	2	Fair		West of Wadsworth
73+00	16	Sloped Concrete	2	Fair		Allison St.
77+00	17	Vertical Concrete/Gabions	2.5	Fair		Balsam St.

2.6 Environmental Assessment

Wetlands and Riparian Areas

Wetland and riparian areas along the Sanderson Gulch and North Sanderson Gulch corridors are currently very limited. Figure E-1 in Appendix E delineates significant potential wetland and riparian areas based on the National Wetlands Inventory, 2009 aerial photography and field observations. Two recent projects within Sanderson Gulch Park between W. Florida Avenue and S. Zuni Street in Reach S-2 have re-established a natural riparian channel edge for approximately 1,600 feet of the channel. In those reaches of Sanderson Gulch contained within linear parks and open space, significant additional potential exists to reestablish wetlands and riparian areas. The 2009 Denver Parks and Recreation *Gulch Master Plan* (Matrix, 2009) recognized this potential and proposes establishing a sizeable riparian buffer along the channel edge throughout the Denver reach.

Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) currently lists the following threatened and endangered species for Denver and Jefferson Counties (http://www.fws.gov/endangered/):

Denver County	Status
Piping plover	Threatened
Least tern	Endangered
Ute ladies'-tresses orchid	Threatened
Preble's jumping mouse	Threatened

Jefferson County	Status
Mexican spotted owl	Threatened
Piping plover	Threatened
Least tern	Endangered
Colorado Butterfly plant	Threatened
Pawnee montane skipper	Threatened
Canada Lynx	Threatened
Preble's jumping mouse	Threatened

The entirety of the Sanderson Gulch watershed is within the Denver metropolitan Block Clearance Zone for Ute ladies'-tresses orchid, Preble's meadow jumping mouse and the Colorado butterfly plant. These species should not be a concern for projects within the watershed.

USFWS on-line maps currently indicate that the Canada lynx, Mexican spotted owl and the Pawnee montane skipper are not known or believed to occur within the Denver portion of the watershed east of Sheridan Avenue. Bird habitat resources for Piping plover, Least tern and the Mexican spotted owl within the Sanderson Gulch watershed and along the Sanderson and North Sanderson Gulch waterways are currently limited because the watershed is fully urbanized and there is little riparian corridor adjacent to the channels. Future design projects will require more detailed assessments of any potential threatened and endangered species habitat resources within the project limits.

Landfills and Contamination

There are many landfills in the lower Sanderson Gulch area. Figure E-2 in Appendix E presents known historical landfill areas within the Sanderson Gulch watershed. The source of this information is the City and County of Denver GIS. A review of environmental records and consultation with Denver Environmental Health staff indicates that likelihood of encountering severe environmental hazards is relatively low.

As part of the Final DRAFT *Mississippi Gulch Outfall Alternatives Analysis and Scoping Study,* December 2010, an initial file review was conducted of the regulatory-listed environmental issues potentially affecting Sanderson Gulch between Lipan Street and the South Platte River in Denver. A letter report dated October 15, 2009 by Matrix Environmental Services, LLC., (MES) to the City and County of Denver presented a summary of the sites identified during a regulatory search that are adjacent to or up-gradient of the outfall and may have impacted the drainageway. A First Search regulatory review of sites within a 1-mile radius of the outfall was conducted. The only sites identified that may have a current impact on the outfall area are the potential landfills located along lower Sanderson Gulch. Based on the potential presence of this landfill and because of the highly industrialized areas surrounding the Study Area, a materials management plan should be implemented for Sanderson Gulch during any intrusive development activities.

Denver Radium Site

UDFCD has been made aware of the potential for radium near the Sanderson Gulch outfall. However, the threat has been cleared according to research as summarized in the October 15, 2009 report from Matrix Environmental Services:

"The Denver Radium Site consists of more than 65 properties along the South Platte River Valley in Denver, Colorado. In the early 1900s, radium was used for commercial purposes including cancer therapy and research. Several ore processing facilities located along the South Platte River provided a domestic source to meet the radium market demands. In the early 1920s, radium, vanadium, and uranium ores were discovered in Africa, and the Denver radium industry dried up. Radioactive soils and debris were abandoned at the processing facilities and the locations of the sites and contaminated debris piles were forgotten. In 1979, the EPA re-discovered the Denver Radium Site during a review of old documents and the State spearheaded several studies to locate the Denver Radium Site properties. The Denver Radium Site was added to the National Priority List (NPL) of Superfund Sites in September 2003 and was divided into 11 Operable Units (OUs)."

"Contaminants at the site included radium, thorium, arsenic, lead, and radon gas, and contaminated media included air, soils, and groundwater. Clean-up was conducted at all 11 OUs and included the removal of contaminated soil to a permanent offsite disposal site, installation of radon gas ventilation systems, and contaminant stabilization. In September 2006, the Final Closeout Report for the Denver Radium Site was completed and the properties were deemed suitable for redevelopment."

"The Sanderson Gulch outfall is down-gradient of the Denver Radium Site Operable Unit 3 (OU3), bordering OU3 on the south. Remedial actions at OU3 began in August 1989 and were originally completed in September 1991. A phased approach to the cleanup allowed onsite businesses to maintain operations during the excavation and shipment of 63,672 tons of contaminated materials from OU3. Some areas of OU3 were not excavated and approximately 5,868 cubic yards of contaminated soils were originally left onsite beneath the groundwater table, near water lines, under South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive."

"In 2001, groundwater was collected from a monitoring well located within the OU3 boundary. The well had elevated levels of gross alpha and gross beta contamination. In 2003, an additional five monitoring wells were installed around OU3 and sampled for radionuclide contamination. Of the five new wells, only two wells exhibited radionuclide contamination. These wells were located within or immediately down-gradient of the contaminated soils that were left onsite. A final round of groundwater monitoring was completed in February 2004 and a final report was submitted in May 2004. In the 2008 five-year review of the Denver Radium Site,

the CDPHE recommended allowing natural attenuation of contaminants in groundwater at OU3, with a milestone date set for September 2013.'

"Because contaminated soil was left onsite, Institutional Controls (ICs) were implemented at OU3 where wastes were left in the ground. An informational IC for OU3 was placed by the State Engineer's Office (SEO) which notified any well permit applicant of the presence of groundwater contamination. As part of the informational IC, the SEO also would send a copy of the well permit application to the EPA and CDPHE.'

"In 2007, the City and County of Denver (CCOD) removed the remaining contaminated soil from OU3 at the Jason Street location. No groundwater sampling has been conducted since the removal of the contaminated soil from this area; however natural attenuation of the groundwater contamination is expected.'

"Operation and Maintenance of OU3 includes monitoring compliance with the informational IC and is the responsibility of the State of Colorado. The IC includes areas around the Packaging Corporation of America Building at 1377 South Jason Street, the Central and Sierra Railroad right of way between West Louisiana and West Florida Streets, and the Kwan Sang Noodle Company, formerly Titan Labels at 1140 West Louisiana Street. The remaining properties within OU3 have been cleared for unrestricted use.'

"On October 7, 2009, MES interviewed Mark Rudolph of the CDPHE, the Project Manager for the Denver Radium Site. Mr. Randolph indicated that no sampling has been completed within Sanderson Gulch and that all OUs from the Denver Radium Site (excluding OU8) have been recommended for de-listing from the NPL. Furthermore, Mr. Rudolph did not believe that there were any environmental concerns for Sanderson Gulch."

"Opinion: Because of the extensive investigation and remediation of OU3, and because of Institutional Controls for the remaining contamination within OU3, the Denver Radium Site, Operable Unit 3 is not considered a current area of concern for Sanderson Gulch."

Legend

- Storm Pipe
- Open Channel
- City & County of Denver
- City of Lakewood
- Unincorporated Jefferson County

Union Blvd
Kipling Pkwy
Wadsworth Blvd
Sheridan Blvd
Morrison Rd
Federal Blvd
Jewell Ave
South Platte River
Mississippi Gulch Remnant
N. Sanderson Gulch
Sanderson Gulch
East Reservoir
Smith Reservoir
Kendrick Res.
Kenderick Lake No. 1
Clairfield Reservoir
Green Gables Country Club
Ward Reservoir No. 1
Ward Reservoir No. 2
Ward Reservoir No. 5
Garfield Lake
Huston Lake
S Lee St
S Holland Ct
S Garrison St
S Dover Way
S Allison St
S Wadsworth Blvd
S Balsam Ct
S Pierce St
S Harlan Cir
S Hazel Ct
S Zuni St
S Lipan St
S Tennyson St
S Sheridan Blvd
W Florida Ave
W Kentucky Ave
W Arkansas Ave
W Mississippi Ave
W Evans Ave
City of Lakewood
Denver

0 0.25 0.5 1
Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by:
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/27/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH
FLOOD HAZARD AREA DELINEATION

JURISDICTION MAP

FIGURE 2-1

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\active\apps\Hydrology_Report\Fig_2-1_UDFCD_Sanderson_Gulch_Jurisdiction_Map_11x17.mxd, 11/1/2012, wilson_wheeler

Legend

- Storm Pipe
- Open Channel
- City-Owned Parcel

Mississippi Gulch Remnant

0 0.25 0.5 1
Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

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drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/27/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH
FLOOD HAZARD AREA DELINEATION

CITY-OWNED PARCELS

FIGURE
2-2

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\active\apps\Hydrology_Report\Fig_2-2_UDFCD_Sanderson_Gulch_City_Owned_Parcels_11x17.mxd, 11/1/2012, wilson_wheeler

Legend

- Park
- Storm Pipe
- Open Channel

Union Blvd
Kipling Pkwy
Wadsworth Blvd
Sheridan Blvd
Morrison Rd
Federal Blvd
Jewell Ave
South Platte River
City of Lakewood
Denver

Green Gables Park
Sanctuary Park
East Reservoir
Lakewood Link Recreation Center
Lasley Cottages
Founders Park
Lasley Park
N. Sanderson Gulch
Patterson Cottages
Wilson Family Park
Smith Reservoir
Smith Reservoir
Kendrick Lake Park
Kendrick Res.
Sanderson Gulch Greenbelt
Kenderick Lake No. 1
Jewell Park
Cottonwood Park
Green Gables Country Club
Ward Reservoir No. 1
Ward Reservoir No. 2
Carmody Park
Garfield Lake
Garfield Reservoir
Denison Park
Lakewood Estates Park
Ward Reservoir No. 5
Harvey Park
Kunsmiller Park
Johnson Park
Unnamed Kentucky & Knox Park
Tennessee Utility Easement
Huston Lake Park
Huston Lake
Goldrick Park
Mississippi Gulch Remnant
W Mississippi Ave
W Ford Pl
Garfield Lake Park
Schenck Park
Force Park
Sanderson Gulch - Irving & Java
Sanderson Gulch
Sanderson Gulch
Godsman Park
Sanderson Gulch - Florida & Raritan
Athmar Park
Ruby Hill Park

0 0.25 0.5 1
Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by:
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/27/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH MAJOR FLOOD HAZARD AREA DELINEATION

PARKS AND OPEN SPACE

FIGURE 2-3

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\activeapps\Hydrology_Report\Fig_2-3_UDFCD_Sanderson_Gulch_Parks_11x17.mxd, 11/1/2012, wilson_wheeler

Agricultural Ditch (from Clear Creek)

Agricultural Reservoir Ditch (Extended Welch Ditch) (from Clear Creek)

N. Weir Gulch

Weir Gulch

Emergency Overflow

Salisbury Lateral Ditch

Salisbury Lateral Ditch

Greene Ditch Inflow to Garfield Lake

Outflow from Garfield Lake

Emergency Overflow

Ward Canal

Agricultural Ditch

Union Blvd

Kipling

Wadsworth Blvd

Sheridan Blvd

Morrison Rd

Federal Blvd

Jewell Ave

Kipling Pkwy

Wadsworth Blvd

Sheridan Blvd

Federal Blvd

Jewell Ave

Morrison Rd

W Florida Ave

W Arkansas Ave

W Mississippi Ave

W Kentucky Ave

W Evans Ave

N. Sanderson Gulch

Sanderson Gulch

South Platte River

S Lipan St

S Zuni St

S Hazel Ct

S Balsam Ct

S Lee St

S Holland Ct

S Garrison St

S Allison St

S Wadsworth Blvd

S Pierce St

S Harlan Cir

City of Lakewood

Denver

S Tennyson St

S Sheridan Blvd

Main Reservoir

East Reservoir

Smith Reservoir

Kendrick Res.

Kendrick Lake No. 1

Clairfield Reservoir

Green Gables Country Club

Ward Reservoir No. 1

Ward Reservoir No. 2

Ward Reservoir No. 5

Huston Lake

Garfield Lake

0 0.25 0.5 1

Miles

Legend

Irrigation Ditches

- Agricultural Ditch
- Salisbury Lateral Ditch
- Ward Canal
- Welch Ditch

- Storm Pipe
- Open Channel
- Pond
- Irrigation Reservoir

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

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drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/27/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH FLOOD HAZARD AREA DELINEATION

IRRIGATION DITCHES

FIGURE 2-4

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\activeapps\Hydrology_Report\Fig_2-4_UDFCD_Sanderson_Gulch_Irrigation_Ditches_11x17.mxd, 11/1/2012, wilson_wheeler

Legend

- Reach Limit
- Storm Pipe
- Open Channel

Union Blvd
Kipling Pkwy
Wadsworth Blvd
Sheridan Blvd
Morrison Rd
Federal Blvd
Jewell Ave
W Evans Ave
W Florida Ave
W Arkansas Ave
W Mississippi Ave
W Kentucky Ave
South Platte River
City of Lakewood
Denver
S Lee St
S Holland Ct
S Garrison St
S Dover Way
S Allison St
S Wadsworth Blvd
S Balsam Ct
S Pierce St
S Harlan Cir
S Hazel Ct
S Zuni St
S Lipan St
S Tennyson St
S Sheridan Blvd

East Reservoir
Smith Reservoir
Kendrick Res.
Kenderick Lake No. 1
Green Gables Country Club
Ward Reservoir No. 1
Ward Reservoir No. 2
Ward Reservoir No. 5
Garfield Lake
Huston Lake
Clairfield Reservoir

N. Sanderson Gulch
Sanderson Gulch

NS4 NS3 NS2 NS1
S12 S11 S10 S9 S8 S7 S6 S5 S4 S3 S2 S1

Mississippi Gulch Remnant

0 0.25 0.5 1
Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by:
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/27/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH
FLOOD HAZARD AREA DELINEATION

REACH DEFINITION MAP

FIGURE 2-5

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\active\apps\Hydrology_Report\Fig_2-5_UDFCD_Sanderson_Gulch_Reaches_11x17.mxd, 11/1/2012, wilson_wheeler

Legend

- Ped Bridge (15)
- Bridge (7)
- Culvert (30)
- Storm Pipe
- Open Channel

Mississippi Gulch Remnant

Union Blvd
Kipling Pkwy
Wadsworth Blvd
Sheridan Blvd
Morrison Rd
Federal Blvd
Jewell Ave
W Evans Ave
W Florida Ave
W Kentucky Ave
W Mississippi Ave
W Arkansas Ave
South Platte River
City of Lakewood
Denver
S Lee St
S Holland Ct
S Garrison St
S Dover Way
S Balsam Ct
S Allison St
S Pierce St
S Harlan Cir
S Hazel Ct
S Zuni St
S Lipan St
S Tennyson St
S Sheridan Blvd
N. Sanderson Gulch
Sanderson Gulch
East Reservoir
Smith Reservoir
Kendrick Res.
Kenderick Lake No. 1
Clairfield Reservoir
Green Gables Development
Ward Reservoir No. 1
Ward Reservoir No. 2
Ward Reservoir No. 5
Huston Lake
Garfield Lake

0 0.25 0.5 1
Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by:
drawn by: CM
checked by: RK
project no.: 16.155.029
date: 6/08/2018

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH
FLOOD HAZARD AREA DELINEATION

EXISTING CROSSINGS

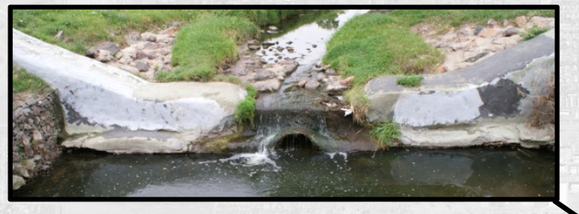
FIGURE
2-6

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\active\apps\Hydrology_Report\Fig_2-6_UDFCD_Sanderson_Gulch_Crossings_11x17.mxd, 6/8/2018, chris_martin

Legend

- Good Condition (31)
- Fair Condition (8)
- Poor Condition (17)
- Unknown Condition (2)
- Storm Pipe
- Open Channel

U/S of Ped. Bridge at Newton St.



D/S of Ped. Bridge at Michigan Way



U/S of Cody St. at Jewell Ave.



U/S of Irving St. at Iowa Ave.



Mississippi Gulch Remnant

South Platte River

Union Blvd

Kipling Pkwy

Wadsworth Blvd

Sheridan Blvd

Federal Blvd

Jewell Ave

Morrison Rd

W Evans Ave

W Florida Ave

W Kentucky Ave

W Arkansas Ave

W Mississippi Ave

N. Sanderson Gulch

Sanderson Gulch

East Reservoir

Smith Reservoir

Kendrick Res.

Kenderick Lake No. 1

Clairfield Reservoir

Green Gables Development

Ward Reservoir No. 1

Ward Reservoir No. 2

Ward Reservoir No. 5

Huston Lake

Garfield Lake

S Lee St

S Holland Ct

S Garrison St

S Dover Way

S Balsam Ct

S Allison St

S Wadsworth Blvd

S Pierce St

S Harlan Cir

City of Lakewood

Denver

S Sheridan Blvd

S Tennyson St

S Hazel Ct

S Zuni St

S Lipan St

0 0.25 0.5 1

Miles

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by: _____
drawn by: CM
checked by: RK
project no.: 16.155.029
date: 10/24/2018

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH FLOOD HAZARD AREA DELINEATION

EXISTING DROP STRUCTURES

FIGURE 2-7

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\activeapps\Hydrology_Report\Fig_2-7_UDFCD_Sanderson_Gulch_Drop_Structures_11x17.mxd, 10/24/2018, chris_martin

3.0 HYDROLOGIC ANALYSES

3.1 Overview and Methodology

This study updates the major drainageway design flood flows based upon current criteria for the entirety of the Sanderson Gulch watershed including the tributary North Sanderson Gulch. The updated peak discharge rates along the major drainageway will be used by project sponsors and communities as a base for regulating future development, re-development, floodplain management and infrastructure design. The following sections depict the detailed study and findings.

The objective of the existing condition hydrologic analysis is to study the entirety of the Sanderson Gulch watershed using the Colorado Unit Hydrograph Procedure (CUHP), Version 2.0.0 to generate hydrographs for each subwatershed. Hydrographs for the subwatersheds were routed through the drainage network using the Environmental Protection Agency Stormwater Management Model (EPA SWMM), Version 5.1.012, to determine peak discharge rates along the major drainageway at key design points.

3.1.1 Previous Hydrologic Model

The hydrologic model from the 1972 MDP was used as the framework for the updated hydrologic model. However, some of the model inputs and modeling methodology do not meet the current criteria. Subwatershed delineations, basin parameters, and detention pond routing were updated to be consistent with current criteria.

Subwatershed Delineations

The 1972 MDP divided the Sanderson Gulch watershed into 20 subbasins. These original 20 subbasins were subdivided into a total of 89 new subbasins to comply with current UDFCD modeling criteria.

Basin Parameters

All basin parameters were updated from the 1972 MDP including soil infiltration loss which was changed to Horton's Equation because an unknown method was used in the 1972 MDP. The infiltration coefficients used in the 1972 MDP were 0.75 inch/hour and an extra loss of 5 percent. These are not applicable to Horton's Equation and cannot be used in the current model. Soils in the portion of the watershed within the City of Lakewood consist primarily of Hydrologic Soil Group (HSG) C, as defined by the NRCS. There is no Hydrologic Soil Group information available for the City and County of Denver. The *City and County of Denver Storm Drainage Master Plan* (Matrix, June 2009) assumed Type C soils and this assumption was adopted for the 2013 Sanderson Gulch MDP. Figure B-1 in Appendix B shows the distribution of soil types within the watershed. Initial and final infiltration rates and Horton's decay rate were determined using Table 6-7 in Volume 1 of the UDFCD-USDCM. For HSG C soils, the initial infiltration rate was 3.0 inches per hour, the final infiltration rate was 0.5 inches per hour. The decay coefficient was 0.0018.

Detention Pond Routing

Stage-storage-discharge curves for detention ponds within the watershed from the 1972 MDP were found to not match the results reported in the 1972 MDP. For calibration purposes, the curves were adjusted so that they produced the same pond discharges as the 1972 MDP for given inflows. Calibrated detention pond inflow and outflow hydrographs are presented in Appendix B, Figure B-3.

3.2 Design Rainfall

Rainfall depth and distribution has been updated to current UDFCD criteria for use in the baseline hydrologic model. Precipitation from NOAA Atlas 14 was used in this study per the Urban Storm Drainage Criteria Manual (USDCM) revised March 2017. Depth-area reduction factors (DARF's) applied to point rainfall depths used within CUHP vary with the size of the watershed being analyzed. The total contributing drainage area at the outfall of Sanderson Gulch to the South Platte River is 7.6 square miles. For watersheds less than 15 square miles, the UDFCD-USDCM stipulates that the 1-hour point precipitation depth be used for the 25-, 50-, 100-, and 500-year events without applying a DARF. Based on the UDFCD-USDCM criteria, DARFs were applied for the 2-, 5-, and 10-year events only.

The one-hour point rainfall depths for the 2-, 5-, 10-, 25-, 50-, 100- and 500-year events were obtained from NOAA Atlas 14 at Lakewood, Colorado, USA (Latitude: 39.6832°, Longitude: -105.0541°). Selected one-hour point rainfall depths for these design events are given in Table 3-1 below. Table B-1 in Appendix B shows the detailed rainfall temporal distributions for each event.

Table 3-1 One-Hour Point Rainfall Depths (Inches)

2018/ 2013 Sanderson Gulch MDP Update (Matrix)						
2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**500-Year**
0.79	1.06	1.30	1.64	1.93	2.23	3.00
1972 Sanderson Gulch MDP (Frasier & Gingery, Inc.) Rainfall varies by sub-basin within the watershed						
2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**500-Year**
0.67-0.79	-	1.35 - 1.74	-	-	2.00 - 2.26	-

The Sanderson Gulch watershed is 7.6 square miles and the UDFCD-USDCM requires the use of a 2-hour storm for watersheds less than 15 square miles.

3.3 Subwatershed Characteristics

3.3.1 Subwatershed Delineation

The 1972 MDP divided the Sanderson Gulch watershed into 20 subbasins. These original 20 subbasins were subdivided into a total of 89 new subbasins to comply with current UDFCD modeling criteria. Subdividing of the original basins was based on topographic mapping, road profiles, curb and gutter, cross pans, previous drainage studies and site observations. Mapping used for the delineation consisted of 2-foot contour interval topography based on a 2008 LIDAR survey provided by Denver, one-foot contour interval mapping flown by TransVision in May 2012, and 10-foot contour interval USGS mapping.

In accordance with UDFCD guidelines, subbasins within the study area were delineated so that no single subbasin exceeded 130-acres in area, and individual subbasins averaged no more than 100 acres. Subbasin delineation parameters are summarized in the Table 3-2. The maximum subbasin area is 150 acres because Ward Reservoir Number 5 could not be further sub-divided. The second largest subbasin area is 122 acres.

In addition to the Sanderson Gulch watershed, two-off site basins contribute runoff through storm drainage systems. The off-site basins are the Mississippi Gulch basin and Federal Boulevard / Lowell Avenue basin and are shown in Table 3-2.

Table 3-2 Subbasin Delineation Summary

	Total Area (sq. mi.)	Average Sub-basin Area (acres)	Minimum Sub-basin Area (acres)	Maximum Sub-basin Area (acres)	Total No. of Sub-Basins
Study Area (Sanderson Gulch Watershed)*	**7.6**	**54.6**	**1.16**	**150**	**89**
Offsite Area (Federal Blvd and Lowell Ave)	0.48	61.4	38.1	93.1	5
Offsite Area (Mississippi Gulch)	0.92	84	37.4	122.7	7

Subbasin flow paths and slopes were determined using the project topography previously described. For the subbasins with drainageway slopes greater than 0.04 ft/ft, Figure 6-4, Slope Correction for Streams and Vegetated Channels in Volume 1 of the UDFCD *Urban Storm Drainage Criteria Manual* (USDCM) was used for the adjustment. Figure B-1 in Appendix B shows the delineation of subbasins. The recommended watershed shape factor, which is the drainage basin length-to-width ratio, should not exceed 4 to 1 per UDFCD guidance. All subbasins were delineated for compliance with the shape factor criteria which unavoidably produced some small subbasins.

3.3.2 Watershed Imperviousness

A GIS-based approach was used to calculate the percent impervious area within the watershed. Zoning data provided by the City and County of Denver and the City of Lakewood was used in conjunction with Table RO-3 and Figures RO-3 through RO-5, from the 2008 UDFCD-USDCM, to generate percent impervious values for each zoning type. The 2008 tables were used to be consistent with previous efforts. Table 3-3 lists each zoning type, the corresponding UDFCD land use description, and the associated percent impervious values used in the hydrologic model. GIS data representing the zoning-based imperviousness was intersected with the subbasin polygons to calculate area-weighted, or composite, percent impervious values for each subbasin. As previously described, the Sanderson Gulch watershed is essentially fully developed and the project sponsors elected to create only a future conditions model. The only significant future development anticipated is the redevelopment of the 152-acre Green Gables Country Club. No existing conditions modeling was completed because of the insignificant change to the drainage basin.

Table 3-3 Zoning-Based Impervious Summary

Land Use Description	% Imp.	% of Watershed Area
Business - Commercial Area	95%	2.9%
Business - Neighborhood Area	85%	2.7%
Industrial - Light Areas	80%	7.9%
Open Space - Conservation	2%	0.0%
Open Space - Park	5%	8.4%
Residential - Apartments	80%	1.0%
Residential - Multi-Unit (Attached)	75%	1.4%
Residential - Multi-Unit (High Density)	66%	0.1%
Residential - Multi-Unit (Low Density)	48%	0.5%
Residential - Multi-Unit (Medium Density)	61%	0.2%
Residential - Single-Family (Low Density)	28%	0.0%
Residential - Single-Family ~3.6 DU/AC	42%	3.9%
Residential - Single-Family ~4.2 DU/AC	43%	28.8%
Residential - Single-Family ~4.8 DU/AC	45%	0.2%
Residential - Single-Family ~5.1 DU/AC	45%	0.3%
Residential - Single-Family ~7.3 DU/AC	48%	37.7%
Residential - Single-Family ~9.7 DU/AC	55%	0.2%
Water Bodies	100%	3.7%

** Percent imperviousness and land use values are based on the 2008 UDFCD-USDCM to be consistent with previous efforts.*

Basin input parameters including percent impervious are provided in Appendix B Table B-2. Future conditions percent impervious values are illustrated for the watershed within the interactive Hydrology Map of Figure B-1 in Appendix B.

3.3.3 Depression Losses

Impervious depression losses used are the same as the 1972 MDP, however, the previous depression loss values were updated based on Table 6-6 in Volume 1 of the UDFCD-USDCM. A pervious area value of 0.35 inches (0.5 inches in 1972 MDP) and an impervious depression loss of 0.1 inches were used for the entire watershed.

3.3.4 Infiltration

Modeling of infiltration utilized Horton's Infiltration Equation. Initial and final infiltration rates and Horton's decay rate were determined using Table 6-7 in Volume 1 of the UDFCD-USDCM. For HSG C soils, the initial infiltration rate was 3.0 inches per hour, the final infiltration rate was 0.5 inches per hour. The decay coefficient was calibrated to 0.0018.

3.4 Detention

Typically, UDFCD's policy is to model only regional, publicly-owned facilities. However, the decision was made to include privately owned and maintained ponds since they were included in the previous study. Inadvertent detention areas were not modeled since their use and function cannot be predicted in the future.
The following seven detention ponds were included in the 1972 and current updated baseline hydrology:

1. Smith Reservoir (private)
2. Kendrick Reservoir
3. Jewell Park Reservoir
4. Green Gables Entrance Road (private and has been enlarged to detain the excess runoff from the Green Gables Redevelopment)
5. Clairfield Reservoir
6. Bit-O-Sea Reservoir (private)
7. Green Gable Park Pond

In addition to these, four additional reservoirs have been included in the updated modeling:

1. Kendrick Reservoir Number 1 (commonly referred to as Cottonwood Park pond)
2. Ward Reservoir Number 1
3. Ward Reservoir Number 5
4. Harvey Park Lake

These reservoirs and their tributary basins were excluded from the 1972 MDP because there is no outflow from these ponds for events up to at least the 100-year. Therefore, the results are the same whether they are in the model or excluded because they fully contain a 100-year event runoff without a discharge downstream. These four reservoirs have been included in the Baseline Hydrology Model to connect all subbasins and obtain an accurate 500-year result. These four reservoirs are filled by irrigation ditches and receive very little runoff from relatively small tributary areas and, consequently, have 100-year capacity. Agreements should be developed with the reservoir owners to ensure their long-term use for 100-year capacity storage of runoff is maintained.

Garfield and Huston Lakes within the Mississippi Gulch hydrologic model were not included in the Baseline Hydrology Model because there is no formal storage volume or agreement for detention. However, these lakes will be considered for some detention in the MDP alternatives analysis which evaluates conveying the 100-year storm from the Mississippi Gulch watershed to Reach 1 of Sanderson Gulch.

Stage-storage-discharge curves were established using topographic mapping, design information and previous studies. No design information for Smith Reservoir could be found and stage-storage-discharge data was developed using 2012 aerial mapping and discharges from 1972 MDP. Kendrick Reservoir's stage-storage-discharge information from the 1972 MDP was found to be consistent with existing conditions and was adopted into the Baseline Hydrology Model without change.

Reservoir routing information for Jewell Park Reservoir, Green Gables Entrance Road and Bit-O-Sea Reservoir from the 1972 MDP were determined to be obsolete. The stage-storage-discharge curves were developed using the structure survey data provided by UDFCD, topographic mapping and as-built drawings of the outlet structures. Clairfield Reservoir information was derived from LOMR Case Number 03-08-0090P and modified to extend the stage-storage-discharge curve above the top of the control weir.

The Green Gables Park Pond is an irrigation pond that has no outlet. This pond can contain 100-year runoff from the tributary basin because of the small tributary area. The reservoir routing information for this pond was derived from topographic mapping and field measurement.

UDFCD's Detention Volume Estimating Workbook Version 2.03a was used to develop stage-storage-discharge information for input into the SWMM model. Overflow elements were added within SWMM where they were needed to convey the full 100-year storm event and ensure no inadvertent detention was being modeled at any of the detention ponds. A summary of the detention pond stage-storage-discharge information can be found in Table B-3 in Appendix B.

3.5 Hydrograph Routing

Parameters for the SWMM model conveyance elements were determined using the mapping described in Section 1.4. Manning's roughness values were determined based on the 2009 aerial image supplemented by field observation. Table 3-4 provides the Manning's *n* values selected for use in the Baseline Hydrology Model and also provides the 1972 MDP study values for comparison. The Manning's *n* values were increased by 25 percent in accordance with the UDFCD-USDCM.

The underground storm sewer system was not modeled, except at locations where trans-basin inflows occur. This is the result of storm sewers contravening topography where flows in the pipes are routed down streets and do not follow surface flows based upon topography. There are two trans-basin inflows in the updated hydrologic model and occur from Mississippi Gulch and Federal Boulevard/Jewell Avenue. These storm pipes have less than 100-year capacity. Therefore, in the 100-year model, only the capacity of the pipe is used to determine the trans-basin inflow.

Additionally, split flow design points were setup to analyze trans-basin outflows as shown in Appendix B, Figure B-5. These occur where streets or pipe are conveying stormwater runoff into or away from the Sanderson Gulch watershed. Rather than following surface topography, stormwater runoff can be contained in the curb, gutter and cross pans of the roadway in a major event which divert water from the natural watershed.

Table 3-4 Manning's Roughness Coefficients & Comparison

2018/ 2013 Sanderson Gulch MDP and FHAD		
Routing Element Description	**Original 'n'**	**Increase 'n' by 25%***
Reinforced Concrete Pipe (old)	0.015	0.019
Asphalt Pavement	0.016	0.020
Engineered Channel, Ditch	0.035	0.044
Natural Drainageway with No Brush	0.035	0.044
Natural Drainageway with Brush	0.044 - 0.052	0.055 - 0.065
Natural Drainageway with Trees	0.060	0.075
1972 MDP		
Initial Run with **0.035**, final Run with "n" values determined from formula in SWMM manual using invert slope to approximate friction slope.		

**UDFCD-USDCM Chapter 4 EPA SWMM and Hydrograph Routing Section 4.2.2.*

The SWMM input parameters and 100-year future conditions output are included in Appendix B as Table B-4 and B-5. SWMM model elements, including subbasins, design points and conveyance elements are illustrated within the interactive Hydrology Map of Figure B-1 in Appendix B. Figure B-2 of the Appendix B provides a SWMM routing schematic.

3.6 Mississippi Gulch Major Storm Hydrology

The Mississippi Gulch drainage basin is adjacent to the Sanderson Gulch basin but does not have a good outfall connection to the South Platte River. The watershed includes the existing Garfield and Huston Lakes owned by Denver Parks and Recreation. Although these lakes provide some physical attenuation and inadvertent detention, there is no formal agreement to maintain any stormwater controls within these water bodies. Therefore, their impact to stormwater has not been included in the baseline hydrologic model.

In the minor storm event on Mississippi Gulch, a 72-inch pipe transitioning to a 7-foot high by 4-foot wide box culvert constructed in 1981 will convey stormwater from Mississippi Gulch into Sanderson Gulch. In a major storm event, up to 307 cfs water will flow easterly in Mississippi Avenue, some will flow down Mississippi Gulch and some will be imported into Sanderson Gulch.

UDFCD's UD-Inlet Workbook for Streets was used to determine the capacity of Mississippi Avenue during a major storm event where the flow in the gutter is 12-inches deep and the street slope is 2%. The amount of surface flow leaving the Mississippi Gulch watershed and flowing to the Sanderson Gulch watershed currently is limited by the capacity of the storm drain. Figure B-7 depicts major event storm flows from Mississippi where an estimated 90 cfs will be in Mississippi Avenue, 987 cfs in Mississippi Gulch, and 307 cfs will be imported by pipe into Sanderson Gulch.

3.7 Result of Analysis

Baseline Hydrology Model peak discharges and volumes for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year storm events for selected key SWMM design points are presented in Table 3-5. Peak discharges and runoff volumes for all SWMM design points are provided in Table B-6 in Appendix B.

Figure B-3 in Appendix B shows hydrographs generated by EPA SWMM 5.1 for various storm events at key design points within the study area. Figure B-4 in Appendix B shows peak discharge versus location (station) for Sanderson Gulch and North Sanderson Gulch for all storm events.

Table 3-5 Peak Discharge and Runoff Volume Summary (Selected Locations)

Locations	SWMM Design Points /Conveyance Elements	Total Drainage Area		River Station	Future Conditions Peak Flow (cfs)							Future Conditions Runoff Volume (acre-feet)						
		(acres)	(mi^2)	(ft)	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}
Sanderson Gulch																		
Confluence at S Platte River	Sanderson_Out	4861	7.60	0+00	562	902	1255	2593	3246	4113	6330	120	177	238	434	541	664	954
W Florida Avenue	1106	4643	7.25	43+87	497	809	1115	2248	2846	3682	5877	103	151	203	378	477	591	864
Federal Blvd	1114	4334	6.77	91+34	476	775	1065	2134	2696	3481	5638	96	141	189	351	440	548	800
S Lowell Blvd	1124	4046	6.32	121+81	420	680	938	1934	2449	3185	5295	81	120	163	311	394	492	723
Sheridan Blvd	1145	2933	4.58	181+76	318	500	676	1377	1726	2223	3987	56	83	113	217	275	345	504
Bit-O-Sea Reservoir - Out	Bit-O-Sea_Out	2758	4.31	195+46	297	466	630	1297	1618	2115	3774	-	-	-	-	-	-	-
Bit-O-Sea Reservoir - In	Bit-O-Sea	2758	4.31	195+46	314	474	639	1330	1636	2134	3779	50	75	102	199	253	317	468
Clairefield Reservoir - Out	Clairefield_Out	2618	4.09	210+25	297	449	603	1244	1526	2003	3566	-	-	-	-	-	-	-
Clairefield Reservoir - In	Clairefield	2618	4.09	210+25	333	493	657	1435	1781	2215	3746	48	71	97	187	238	297	437
Confluence with N.S. G. - Downstream	1157	2192	3.42	214+44	286	423	560	1189	1464	1819	3278	41	61	84	162	205	257	378
Confluence with N.S.G. - Upstream	1162T	1431	2.24	216+17	159	229	300	545	645	1021	1839	25	37	50	95	120	150	221
Green Gable Entrance Road - Out	GG_Entrance_Out	1335	2.09	237+22	149	215	282	509	604	961	1697	-	-	-	-	-	-	-
Green Gable Entrance Road - In	GG_Entrance	1335	2.09	237+22	154	231	310	726	931	1212	1822	23	34	47	88	111	138	202
Wadsworth Blvd.	1167	1169	1.83	271+76	116	174	242	589	761	1003	1492	19	28	38	72	91	113	166
W. Jewell Avenue	1169	976	1.53	286+43	71	116	166	430	560	739	1091	12	18	25	51	65	82	122
Jewell Park - Out	JewellPark_Out	746	1.17	312+35	39	66	95	256	337	442	653	-	-	-	-	-	-	-
Jewell Park - In	JewellPark	746	1.17	312+35	51	79	112	303	392	503	756	7	10	15	30	39	50	74
Kendrick Reservoir - Out	Kendrick_Out	416	0.65	339+30	2	3	4	8	10	12	16	-	-	-	-	-	-	-
Kendrick Reservoir - In	Kendrick	416	0.65	339+30	40	59	77	171	214	263	376	6	9	12	20	23	27	35
Smith Reservoir - Out	Smith_Out	251	0.39	368+25	8	11	15	19	19	19	19	-	-	-	-	-	-	-
Smith Reservoir - In	Smith	251	0.39	368+25	108	154	198	406	506	618	883	8	11	15	25	32	39	56
North Sanderson Gulch																		
Confluence with Sanderson Gulch	1201	748	1.17	0+00	126	195	272	699	902	1155	1722	16	24	33	66	84	105	155
S Pierce Street	1202	699	1.09	29+17	122	187	260	667	855	1089	1625	15	23	31	62	78	98	146
Wadsworth Blvd.	1205	384	0.60	58+97	65	100	140	369	475	606	898	8	12	16	33	42	53	79
Florida Avenue	1206	277	0.43	80+33	45	69	97	257	329	419	619	6	8	12	23	30	38	56
Green Gables Park	1208T	113	0.18	107+48	18	27	37	100	128	162	239	2	3	4	9	11	15	22

Note: All 2-, 5-, 10-, 25-, 50-, 100- and 500-year discharges include off-site flows of the storm drain capacity from Mississippi Gulch and Federal Blvd./Lowell Avenue basins. The table excludes proposed major storm imports from Mississippi Gulch evaluated later in the Alternatives section.

3.8 Comparison to Previous Studies

Comparison of peak discharges from the 1972 MDP with values computed in this study is provided in Table 3-6. Peak discharges determined in this study are significantly higher than the 1972 MDP throughout the basin with a 23 percent increase in 100-year peak discharge occurring at the outfall to the South Platte River.

Table 3-6 Comparison to Previous Studies

Locations	SWWM Design Points /Conveyance Elements	1972 MDP		2018 FHAD			Notes
		New Mapping Updated Tributary Area (acre)	100-Year Peak Flow (cfs) (A)	Tributary Area (acre) Excluding Split Flow and Retention [1]	100-Year Peak Flow (cfs) (B)	% Difference (B) to (A)	
Sanderson Gulch							
Confluence at S Platte River	Sanderson_Out	4749	3350	4621	4113	23%	Peak flow excludes trans-basin flow from Mississippi Gulch and Federal Blvd which were not included in 1972 MDP.
W Florida Avenue	1106	4549	3250	4403	3682	13%	Peak flow rate excludes offsite basin flow from Federal Blvd which were not included in 1972 MDP.
Federal Blvd	1114	4215	2880	4094	3481	21%	Peak flow rate excludes offsite basin flow from Federal Blvd which were not included in 1972 MDP.
Sheridan Blvd	1145	2837	1450	2783	2223	53%	
Bit-O-Sea reservoir - Out	Bit-O-Sea_Out	2555	1300	2608	2115	63%	
Bit-O-Sea reservoir - In	Bit-O-Sea	2555	1500	2608	2134	42%	
Clairefield Reservoir - Out	Clairefield_Out	2555	1470	2468	2003	36%	
Clairefield Reservoir - In	Clairefield	2555	1800	2468	2215	23%	
Confluence with N.S. G.[2] - Downstream	1157	2270	1330	2179	1819	37%	
Confluence with N.S.G.[2] - Upstream	1162T	1414	620	1431	1021	65%	
Green Gable Entrance Road - Out	GG_Entrance_Out	-	580	1335	961	66%	
Green Gable Entrance Road - In	GG_Entrance	-	950	1335	1212	28%	
Wadsworth Blvd.	1167	1162	670	1169	1003	50%	
W. Jewell Avenue	1169	994	520	976	739	42%	
Jewell Park - Out	JewellPark_Out	820	375	746	442	18%	
Jewell Park - In	JewellPark	820	505	746	503	0%	
Kendrick Reservoir - Out	Kendrick_Out	363	10	416	12	20%	
Kendrick Reservoir - In	Kendrick	363	225	416	263	17%	
Smith Reservoir - Out	Smith_Out	245	19	251	19	0%	
Smith Reservoir - In	Smith	245	375	251	618	65%	
North Sanderson Gulch							
Confluence with Sanderson Gulch	1201	857	1250	748	1155	-8%	
S Pierce Street	1202	718	1100	699	1089	-1%	
Wadsworth Blvd.	1205	406	680	384	606	-11%	
Florida Avenue	1206	296	480	277	419	-13%	
Green Gables Park	1208T	125	220	113	162	-26%	

[1]Tributary area excludes 119, 120, 121, 122, 123 (Federal and Jewell), 137(Harvey Park), 138, 139(Ward Reservoir #5), and 156(Ward Reservoir #1).

[2] North Sanderson Gulch (N.S.G.)

4.0 HYDRAULIC ANALYSES

An 8.23 mile long HEC-RAS hydraulic model was developed for the entire main stem of Sanderson Gulch, and also included the tributary of North Sanderson Gulch. Sanderson Gulch and North Sanderson Gulch were analyzed within one HEC-RAS model using the junction function to connect the waterways. The total length of the Sanderson Gulch main stem model is 35,434 feet (6.71 miles). The average slope downstream of the confluence with North Sanderson Gulch is 0.95% and 1.31% upstream of the confluence. North Sanderson Gulch is 8,033 feet (1.52 miles) with an average slope of 1.28%. Data regarding the model input are summarized in the table below:

Table 4-1 HEC-RAS Model Input

Drainageway	Length (ft)	Manning's N		Number of Cross Sections	Average Spacing (ft)	Culverts	Bridges	Modeled Drop Structures	Average Slope
		Overbank	Channel						
Sanderson Gulch Mainstem									
Downstream of Confluence	21,460	0.02-0.06	0.015 - 0.055	166	129	16	10	18	0.0095
Upstream of Confluence	13,987	0.025-0.04	0.015 - 0.075	133	105	12	3	3	0.0131
North Sanderson Gulch	8,033	0.025-0.05	0.02 - 0.05	99	81	9	1	16	0.0128
Total	43,480	-	-	398	109	37	14	37	-

The U.S. Army Corps of Engineer's standard step backwater program HEC-RAS, Version 4.1.0, was used for the floodplain analysis of the drainageways. Cross sections used by the HEC-RAS model were developed electronically by cutting the triangulated irregular network (TIN) developed from the USGS topographic 2-foot contour mapping and 1-foot contour aerial mapping flown in May 2012 by TransVision provided by UDFCD. Bridges and culverts were individually surveyed or measured in the field by Accurate EngiSurv, LLC. The average spacing of cross sections is 113 feet, which is significantly more detailed study than a typical FEMA floodplain mapping study with a typical cross section spacing of 500 feet. The model was run in the sub-critical mode in accordance with floodplain mapping criteria.

Flow data in the HEC-RAS model was derived from the results of the EPA SWMM 5.1 hydrograph routing for the future land-use condition/existing topographic features model. A steady flow analysis was utilized to determine the flood profiles for the 10-, 50-, 100-, and 500-year storm events. Data from Table 3-5 was used to develop the discharge data. Flow change locations were established where the design points associated with the EPA SWMM model were located. A unit area runoff analysis was used to establish additional flow changes inside basin boundaries where no SWMM design points were available. The split flow calculation in North Sanderson Gulch between S Wadsworth Boulevard and S Pierce Street was determined in HEC-RAS by balancing the energy grade line elevation at the neighboring cross sections of North Sanderson Gulch and the split flow reach down W. Calahan Avenue. Split flows at roadway crossings in North Sanderson Gulch were determined by estimating the overland flow as that portion of the total flow that is beyond the culvert capacities. Between flow change locations, steady flow is maintained for defined channel segments along the reach.

The steady flow data used in the HEC-RAS model is shown in the table to the right. The discharges in Table 3-5 do not exactly match the discharges in Table 4-2 due to the desire to simplify and limit the flow change locations within the HEC-RAS model. Design points in the EPA SWMM model associated with the HEC-RAS cross sections with slight discharge increases were combined and assigned the higher discharges from the neighboring design point. In Table 4-2, the downstream discharges from design points 1104, 1106 and 1112 were used instead of the discharges at design points 1106T, 1108 and 1114, respectively.

Table 4-2 Steady Flow Data Input to the HEC-RAS Model

Location	Design Point/ Conveyance Element	No.	River	Reach	River Station	10-Year	50-Year	100-Year	500-Year
W Calahan Avenue	Split Flow Analysis	1	NS_Split	NS-2	1606	0.01	0	19	158
u/s of S Upham Street	Split Flow Analysis	3	NS_Split	NS-2	1528	0.01	62	143	330
W Calahan Avenue/ S Upham Street	Split Flow Analysis	2	NS_Split	NS-2	1425	0.01	202	310	567
W Calahan Avenue	Split Flow Analysis	4	NS_Split	NS-2	1108	0.01	235	345	611
W Calahan Avenue/ S Quay Street	Split Flow Analysis	5	NS_Split	NS-2	847	0.01	240	375	640
W Calahan Avenue/ S Quay Street	Split Flow Analysis	6	NS_Split	NS-2	744	0.01	146	250	480
W Calahan Avenue	Split Flow Analysis	7	NS_Split	NS-2	436	0.01	33	100	290
W Calahan Avenue/ S Pierce Street	Split Flow Analysis	8	NS_Split	NS-2	173	0.01	30	30	30
S Garrison Street	NA[1]	9	N_Sanderson	NS-4	11451	28	97	123	182
S Field Court	1208T	10	N_Sanderson	NS-4	10880	37	128	162	239
S Dover Court	NA[2]	11	N_Sanderson	NS-4	9604	59	199	252	369
Approxi. 100' u/s of S Balsam Street	1206	12	N_Sanderson	NS-4	8523	97	329	419	619
S Wadsworth Boulevard	1205	13	N_Sanderson	NS-3	5929	140	475	606	898
Approxi. 100' u/s of W Calahan Avenue	1204T	14	N_Sanderson	NS-2	4777	176	592	755	1122
W Calahan Avenue	Split Flow Analysis	15	N_Sanderson	NS-2	4630	176	592	736	964
Approxi. 70' u/s of S Upham Street	Split Flow Analysis	16	N_Sanderson	NS-2	4394	176	530	612	792
Downstream face of S Upham Street	Split Flow Analysis	17	N_Sanderson	NS-2	4295	176	390	445	555
Approxi. 290' u/s of S Quay Street	Split Flow Analysis	18	N_Sanderson	NS-2	3995	176	357	410	511
Upstream face of S Quay Street	Split Flow Analysis	19	N_Sanderson	NS-2	3744	176	352	380	482
Upstream face of S Quay Street	Split Flow Analysis	20	N_Sanderson	NS-2	3680	176	342	337	305
Approxi. 70' d/s of S Quay Street	Split Flow Analysis	21	N_Sanderson	NS-2	3633	176	446	505	642
Approxi. 420' u/s of S Pierce Street	Split Flow Analysis	22	N_Sanderson	NS-2	3291	176	549	665	832
S Pierce Street	Split Flow Analysis	23	N_Sanderson	NS-2	2973	176	562	725	1092
Upstream face of S Pierce Street	1202	24	N_Sanderson	NS-1	2913	260	855	1089	1625
Approxi. 300' u/s of S Harlan Circle	1201	25	N_Sanderson	NS-1	1214	272	902	1155	1722
Kendrick Reservoir	Kendrick	26	Sanderson	S-12	35747	77	214	263	376
Kendrick Reservoir outlet structure	Kendrick_Out	27	Sanderson	S-11	33973	4	10	12	16
S Garrison Street	1171	28	Sanderson	S-11	32802	94	337	432	643
Jewell Park	JewellPark	29	Sanderson	S-11	31852	112	392	503	756
Jewell Park	JewellPark_Out	30	Sanderson	S-11	31253	95	337	442	653
Jewell Park Spillway downstream	1169T	31	Sanderson	S-11	31183	143	487	640	944
S Allison Street & W Jewell Avenue	1169	32	Sanderson	S-9	28677	166	560	739	1091
S Allison Street & W Jewell Avenue	Split Flow Analysis	33	Sanderson	S-9	28656	0.01	96	297	648
S Wadsworth Boulevard	1167	34	Sanderson	S-8	27058	242	761	1003	1492
Green Gables	1164	35	Sanderson	S-8	24873	295	895	1168	1752
Green Gables Entrance Road	GG_Entrance	36	Sanderson	S-8	24222	310	931	1212	1822
Green Gables Entrance Road	GG_Entrance_Out	37	Sanderson	S-7	23715	282	604	961	1697
W Jewell Avenue	1162	38	Sanderson	S-7	22600	287	626	990	1774
S Ingalls Street/ White Fence Farm	1162T	39	Sanderson	S-7	21768	300	645	1021	1839
Confluence with North Sanderson Gulch	1157	40	Sanderson	S-6	21460	560	1464	1819	3278
Wilson's Family Park Inflow	Clairefield	41	Sanderson	S-5	20953	657	1781	2215	3746
Wilson's Family Park Outflow	Clairefield_Out	42	Sanderson	S-6	19791	603	1526	2003	3566
S Manor Lane downstream	Bit-O-Sea	43	Sanderson	S-6	19693	639	1636	2134	3779
Bit-O-Sea Reservoir Spillway	Bit-O-Sea_Out	44	Sanderson	S-6	18531	630	1618	2115	3774
S Sheridan Boulevard upstream	1145	45	Sanderson	S-6	18192	676	1726	2223	3987
S Wolff Street	1143T	46	Sanderson	S-5	16515	693	1771	2275	4073
S Lowell Boulevard upstream	1124	47	Sanderson	S-4	12227	938	2449	3185	5295
S Federal Boulevard upstream	1114	48	Sanderson	S-3	9175	1065	2696	3481	5638
S Zuni Street upstream	1108	49	Sanderson	S-2	6442	1107	2819	3637	5829
W Florida Avenue downstream	1106T	50	Sanderson	S-2	4269	1120	2864	3705	5905
S Quivas Street projection	1103T	51	Sanderson	S-2	3188	1131	2907	3764	5972
S Mariposa Street	1102	52	Sanderson	S-2	1435	1252	3240	4102	6319
Railroad downstream	Sanderson_Out	53	Sanderson	S-1	608	1255	3246	4113	6330

[1] Peak Discharges are combined runoff from sub-basins 210 and 211.

[2] Peak Discharges are calculated using unit area runoff from sub-basins 206 and 207 plus peak discharges from design point 1208T.

The downstream hydraulic control for the model was set at the 10-year flood elevation of the South Platte River as recommended by UDFCD, although a 100-year flood elevation of the South Platte River yields the same results. The South Platte River floodplain is at a much lower elevation than the Sanderson Gulch outfall since the gulch must cross over the existing Metro Wastewater sanitary sewer pipe just west of the river. If the 100-year floods are coincidental on the South Platte River and Sanderson Gulch, the results of the Sanderson Gulch floodplain analysis will not change. Since the model was run in the "sub-critical" mode, no upstream boundary was specified within the model.

Estimates of channel and overbank roughness for existing conditions were made from aerial photographs, field observation, and through experience for future fully developed conditions. Manning's *n* values in the hydraulic model ranged from 0.015 to 0.075 in the channel section, and from 0.02 to 0.06 in the overbank areas.

Ineffective flow was utilized to account for flow areas with little or no flow conveyance. Blocked obstructions were used to account for large structures, or to block out the non-realistic flow distribution areas in sump conditions of the overbank area.

The hydraulic analysis for this study was based on unobstructed flow at all structures. It was assumed that all bridges and channels were free of silt and debris at the elevation shown on the cross section. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

The floodway has been defined along each of the drainageways to establish the portion of the channel that must remain free from obstruction to allow for conveyance of the 100-year flood. The floodway was defined using a 0.5-foot allowable rise in Energy Grade Line (EGL) or the Hydraulic Grade Line (HGL) in conjunction with the new Colorado Water Conservation Board Rules and Regulations by request of UDFCD and project stakeholders. This floodway model was complicated by the number of crossing structures where rapidly varied flow and roadway overtopping occurs. Since most of the structures have less than 100-year capacity, computation of the 100-year floodway included significant flow over roadways, railroads and trails. The floodway was delineated utilizing an approach to evenly distribute the encroachment to the fullest extent possible.

Two split flow reaches were modeled in the HEC-RAS model; one on Sanderson Gulch at S. Allison Street and W. Jewell Avenue, and the other on North Sanderson Gulch between S. Wadsworth Boulevard and S. Pierce Street.

The twin 66-inch CMP in Sanderson Gulch from S. Allison Street to S. Wadsworth Boulevard have 10-year capacity. For events greater than 10-year, storm runoff will overtop S. Allison Street and flow easterly in W. Jewell Avenue to a low point at the northwest corner of the King Soopers plaza. Runoff will cross the plaza parking area toward S. Wadsworth Boulevard, where a portion of the flow will enter an inlet at the west side of S. Wadsworth Boulevard and the rest will overtop S. Wadsworth Boulevard and fall back into Sanderson Gulch at Green Gables. Since the overland flow path is significant, the HEC-RAS model was set up to follow the overland flow path per direction from UDFCD. The discharges applied for the overland flow were derived by subtracting the capacity of the twin 66-inch CMP.

The split flow reach on North Sanderson Gulch between Wadsworth and Pierce is the result of the roadway crossings at S Upham Street and S Quay Street having only 10-year capacities. For larger events, stormwater runoff will overtop the W. Calahan Avenue road crossing and flow on grade down Calahan Avenue where the roadway is lower than the adjacent North Sanderson Gulch channel invert. Per direction from UDFCD, a split flow reach was set up in the HEC-RAS model and a split floodway calculation was performed through this reach with two primary flow paths. This establishes two floodways, one along the channel and one along the roadway.

Shallow flooding areas were identified on the floodplain mapping where overbank floodplain flows in a different direction with the main channel flow. The shallow flooding area analyses were performed at the flow split location using normal depth calculations to determine the shallow overland flow depth. The depth of flooding was applied to the 2-foot contours to delineate the shallow flow area boundary. For Sanderson Gulch, the shallow flow areas identified are as follows:

- Between Lipan Street and the South Platte River
- W. Florida Avenue from S. Raritan Street to S. Quivas Street
- W. Colorado Avenue from S. Xavier Street to S. Wolff Street
- W. Jewell Avenue from S. Lake Road to White Fence Farm

For North Sanderson Gulch, a shallow flow area was identified at W. Mexico Place from S. Pierce Street to S. Newland Street.

Two downstream limits of study were identified at the outfall of Sanderson Gulch into the South Platte River. The first is at the western bank of the South Platte River. The second limit of study was determined as a cross section approximately 600 feet northeast and parallel to Sanderson Gulch. This area was previously defined by FEMA as a Zone AO with a flooding depth of 1 foot. During a 100-year event, flow from Sanderson Gulch overtops S. Lipan Street and spills over the left bank of Sanderson Gulch. Topographic data show the adjacent area is very flat, resulting in overland flow to the north for approximately 6,300 feet until the flow joins the South Platte River near S. Huron Street. Approximately 115 acres of this area is inundated by the shallow overland flow. The updated topographic data does not provide any justification to remove properties from the previously defined floodplain. This results in extensive shallow flooding of properties and flow primarily in roadways with a maximum depth of approximately 1.6 feet deep on the roadways, which is higher than previous studies due to higher 100-year flow rates. In order to define a reasonable study limit, the limits of the cross-sections were defined where the flow transitions from rapidly changing overtopping flow to normal depth pooled water in the flooded area. This revised shallow flooding hazard area still falls in the FEMA FIRM floodplain category of Zone AO which typically has a flooding depth of 1 to 3 feet and low velocity.

Floodplain maps showing the *100-year*, *500-year* and *Floodway* delineation have been generated to identify areas, structures, and properties which have the potential of being inundated by the 100-year flood event.

Flood profiles for the 10-year, 50-year, 100-year and 500-year events are also provided. The floodplain mapping and channel profiles show the location of cross-sections for the channel and all hydraulic structures. The pertinent floodplain and floodway data are shown in Table D-1. This table identifies the channel cross-sections; thalweg elevations; 10-, 50-, 100-, and 500-year discharges and water surface elevations; 100-year floodplain channel top widths and energy grade line (EGL) elevations; floodway water surface elevation, top width, cross-sectional area and velocity.

4.1 Evaluation of Existing Facilities

An existing infrastructure inventory along the drainageways was compiled based on the detailed survey information and field measurements conducted by staff.

Table 2-2 identifies 37 existing major crossing culvert, bridge and pond outlet structures, of which 30 are on the main stem and 7 are on North Sanderson Gulch. Major crossings were defined as road or railroad crossings and major hydraulic structures, such as a pond outlets and spillways. Pedestrian bridges are generally less hydraulically significant and were categorized as minor crossings. In total, there are 52 existing crossing structures, minor and major, comprising 30 culvert crossings and 22 bridges (many small pedestrian bridges and 5 large roadway or railroad bridges). Five roadway crossing structures have full 100-year capacity (S. Harlan Circle, S Reed St., S Pierce St over the main stem of Sanderson Gulch and S. Harlan Circle, S Wadsworth Blvd over the North Sanderson Gulch) and the remainder of the roadway crossings has less than full 100-year capacity before overtopping. Flood flow split conditions have been identified at Florida Avenue near S. Shoshone Street.

Table 2-3 identifies 57 existing drop structures, 40 of which are on the main stem and 17 on North Sanderson. Not every drop structure was specifically included in the HEC-RAS model. The hydraulic model included 42 grade control structures. Only drop structures with heights greater than 1-foot were coded into the model by placing tightly spaced cross sections around the drop where one cross section is placed immediately upstream and one downstream of the structure. Drops 3, 4, and 17 were not modeled as they were not identified using the 2-foot contour data. Where it was critical to carefully define rapidly varied flow over the drop structure, a total of four cross sections were used in the model to define water surface elevations around the drop structures; two upstream and two downstream.

No levees were coded into the HEC-RAS model for Sanderson Gulch.

4.2 Flood Hazards

The Sanderson Gulch drainage basin includes residential, industrial, and commercial land uses. Although Sanderson Gulch was developed as a greenbelt corridor with parks and open space along the drainageway, some structures are at risk of flooding. Even though there is not a history of flooding on Sanderson Gulch, if a 100-year flood occurred without any future-improvements, a total of 64 structures would experience some level of flood inundation.

Most of the flooding is the result of undersized crossing structures (culverts and bridges) since most have been sized for a 10-year flood event. Habitable structure flooding occurs primarily in three locations: the flat terrace at the outfall near the South Platte River, the retail center in the southwest corner of the Wadsworth & Jewell intersection, and along North Sanderson Gulch from Wadsworth to Pierce. The analysis shows the majority of the structures are inundated only in a 100-year event. In a 50-year event, the number of inundated structures decreases to 34 structures. The following table summarizes the number and type of structures in the floodplain:

Table 4-3 Habitable Structures in the 100-Year Floodplain

Land Use	Outfall Along South Platte	Wadsworth & Jewell	Wadsworth to Pierce	Miscellaneous Locations	Total
Commercial	7		1	2	10
Industrial	4				4
Residential			19	27	46
Retail		4			4
Total	11	4	20	29	64

There are 83 habitable structures estimated to be in the current FEMA or UDFCD floodplains. The FEMA floodplain on North Sanderson Gulch ends at Pierce Street (end of Reach NS-1), however a UDFCD defined floodplain continues to the end of Reach NS-4 (S. Garrison St.). This study decreases the number of structures in the floodplain to 64 which is mainly due to the drainageway improvement in the past and higher resolution base mapping. This study actually removes 60 structures and adds 41 to the floodplain; the structure counts are presented by reach in Table 4-4.

Table 4-4 Inundated Structures Comparison

Reach	Structures in 2018 FHAD Update	Structures in Existing Regulatory Floodplain and UDFCD Floodplain	Structures Added to Floodplain	Structures Removed from Floodplain
S1	11	8	3	0
S2	2	2	2	2
S3	4	3	3	2
S4	0	2	0	2
S5	7	0	7	0
S6	3	7	1	5
S7	0	0	0	0
S8	0	0	0	0
S9	4	1	3	0
S10	1	0	1	0
S11	2	0	2	0
S12	0	0	0	0
NS1	0	2	0	2
NS2	20	29	13	22
NS3	4	1	3	0
NS4	6	28	3	25
Total	64	83	41	60

4.3 Previous Analyses

FEMA has mapped a Zone AE designated 100-year floodplain for Sanderson Gulch through the City & County of Denver and Jefferson County. Flood insurance rate maps (FIRMs) are based on the 1979 FHAD and include four LOMRs, 17-08-0933P, 03-08-0090P, 05-08-0282P and 11-08-0033P for Sanderson Gulch and North Sanderson Gulch. The FIRM Panels, 0800460184G, 0800460191G, 0800460192G of City and County of Denver, Colorado, dated November 17, 2005 and 08059C0305E, 08059C0315E and 08059C0320E of City of Lakewood, Colorado, dated June 17, 2003 show the floodplain designation.

A comparison was made between the information presented here and the effective Flood Insurance Study (FIS) for Denver and Jefferson Counties. Both this study and the effective FIS for Denver used the NAVD-88 vertical datum while the effective FIS for City of Lakewood, Jefferson County is on the NGVD-29 vertical datum. A datum adjustment of 3.3 feet was used to be added to the NGVD-29 datum to bring it up to the NAVD-88 datum for the effective FIS in the City of Lakewood.

In general, the 100-year Base Flood Elevations (BFEs) along Sanderson Gulch are higher compared to the effective FIS BFEs because of the increased flow rates. The two locations having the largest disparity between the effective FIS BFEs and the updated BFEs are at S. Umatilla Street in Sanderson Gulch-Florida and Raritan Park in Reach 2 and S. Vrain Street in Sanderson Gulch Park in Reach 5, where the flood elevations increase approximately three feet. The maximum increase in BFEs occurs at S. Umatilla Street due to the combined results of the increased flow rates and recently constructed drop structures. The BFE increases at S. Vrain Street are solely due to the increased flow rates. Both locations are within Sanderson Gulch Parks and therefore the increases do not affect habitable structures. Additional cross sections throughout the model also contribute to the higher BFEs when compared to previous studies.

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APPENDIX A

PROJECT CORRESPONDENCE

MEETING MINUTES

Matrix Design Group, Inc.
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MEETING MINUTES
Sanderson Gulch
Major Drainageway Plan and Flood Hazard Area Delineation
Tuesday July 17, 2012, 8:00am – 10:00am at UDFCD

Attendees:

Shea Thomas	UDFCD	303-455-6277	sthomas@udfcd.org
Bill DeGroot	UDFCD	303-455-6277	bdegroot@udfcd.org
Terry Rogers	Lakewood Engineering	303-987-7934	terrog@lakewood.org
John Paliga	Lakewood Community Resources	303-987-7815	johpal@lakewood.org
Mike Anderson	Denver Capital Projects	720-865-3023	mike.anderson@denvergov.org
David Marquardt	Denver Parks	720.913.0629	david.marquardt@denvergov.org
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Jane Kopperl	Matrix Design Group – LA	303-572-0200	jane_ kopperl@matrixdesigngroup.com

1. Project Coordination

a. Meet Monthly – Next meeting in approximately 4 weeks for Hydrology
b. Web Site to be set up by Matrix

2. Data Gathering

a. Aerial base mapping Lakewood – received from UDFCD (The mapping is for the drainageway floodplain mapping and does not cover the entire upper watershed for the hydrologic model, especially, the area around the intersection of Kipling & Jewell and Kendrick Lake No.1.)
b. Structure survey information – received from UDFCD
c. 1972 hydrology Technical Appendix – received from UDFCD (The two binders of hardcopy named Sanderson Gulch FHAD provide data for HEC-2 input. The hydrology information of the 1972 Study is not included except six rating curves. Four of the six rating curves are for the Clairefield Reservoir, Green Gable Entrance Road, Green Gable GC and Kendrick Reservoir in the Sanderson Gulch. The other two rating curves are for the KLIR Reservoir and Wadsworth & Florida in North Sanderson Gulch.)
d. Survey information of detention areas – this may be requested later if needed
e. Survey of thalweg at drop structures – this may be requested later if needed
f. Historic aerial of outfall 1933 – Matrix is in the process of obtaining from Denver
g. Parks data – available in GIS. David Marquardt to set up tour of the corridor.
h. Mike Anderson to provide structural assessment from bridges group.

3. Contacts:

a. Irrigation Ditch Co. – Matrix to provide name of ditches to Lakewood for contact info.
    i. Salisbury lateral owned by Denver Water and Denver Parks
    ii. Agricultural Ditch Company contact is Gary Theander
    iii. Ward Canal

b. Green Gables Development
    i. Official development plan available
    ii. CLOMR application submitted last week
        1. CLOMR based upon ~900 cfs
        2. Systems build for ~1800 cfs per their current modeling
    iii. Inertia and Wright Water Engineers working for the developer
c. Burlington Northern Railroad – UDFCD working with them for a trail under RR at West Harvard

4. Project Schedule

a. 46 Weeks by contract (showing 42 weeks by cutting 4 weeks from Hydrology)
b. Concurrent FHAD

SANDERSON GULCH MDP & FHAD SCHEDULE

	Draft / First	Comments	Final/Second	Public Meeting	Selected Plan
Baseline Hydrology Report	8/27/2012	9/17/2012	10/8/2012		
Alternatives Analysis	11/19/2012	12/10/2012	1/4/2013	January 2013	1/28/2013
Concept Design	3/25/2013	4/15/2013	5/6/2013	April 2013	
FHAD	11/5/2012	11/26/2012	12/17/2012		

5. Project Approach

a. Hydrology: Existing Conditions = Future Conditions if add Green Gables Development
    i. Develop "Duplicate Effective" model using values from 1972 model
        1. Set up model is in 1972, but with smaller basins
        2. Recreate previous detention ratings curves
        3. With all parameters the same, calibrate the new model to the old results
        4. Correct the model with updated rainfall, impervious, soils data, etc.
        5. Correct detention rating curves as needed
        6. Use future imperviousness for Green Gables
    ii. Detention (6 in previous study in Lakewood)
        1. Only dedicated detention facilities can be considered in FHAD
        2. Only ponds with adequate assurances agreement
        3. Inadvertent detention not allowed for FHAD studies unless an agreement with UDFCD is executed.
        4. Baseline report based upon existing detention
        5. Alternatives analysis can consider the value of other detention facilities
        6. Green Gables – detention has been formalized
b. Hydraulics
    i. New Channel centerline
        1. Stationing zero at South Platte River
        2. Stationing zero for North Sanderson at confluence
    ii. Model Limits – extend same limits as UDFCD floodplains into Smith Reservoir
    iii. Tie into 10-year WSE of South Platte River
    iv. Junction for North Sanderson and Mississippi Gulch Alternative
    v. UDFCD has recently updated DFHAD guidelines
c. Define Reaches as needed

d. Deficiencies
    i. Criteria for road culverts – per Denver and Lakewood manuals
        1. In general, Lakewood does not allow overtopping
        2. Denver criteria to be verified by Mike Anderson with Denver PW staff.
        3. Plan for 100-year capacity.
    ii. Criteria for drop structures
        1. The 2002 inventory for DCM was more detailed than needed for a master plan
        2. Up to 3' vertical drop allowed
        3. Master plan drop height – preliminary design may break into multiple smaller
    iii. Bed and bank stabilization
    iv. Private property
        1. Bit O Sea
        2. Tree Farm – Use water for irrigation (no detention in pond)
        3. North Sanderson Pierce to Wadsworth (City cleans sediment)
    v. Trail connectivity
    vi. Parks - vegetation establishment, etc.
e. Alternatives
    i. Bank stabilization approaches
    ii. Grade control
    iii. Water quality
    iv. Outfall alternatives
    v. Mississippi Gulch alternatives
    vi. North Sanderson alternatives
    vii. Jewell reach alternatives
    viii. Maintenance responsibilities

6. Action Items:

a. Matrix to set first meeting on Hydrology in 4 weeks
b. Matrix to set up website
c. Matrix to review new updated DFHAD Guidelines
d. Matrix to check the map labeling of Clairefield Reservoir
e. Matrix to distribute the basin map electronically
f. Matrix/Denver to check if all CCD Parks data is available in GIS
g. Matrix/Denver to set a van tour – extend the tour into Lakewood
h. Lakewood/Denver to get contact info for ditch companies
i. Lakewood to check on easements along private sections of the gulch
j. Denver to ask their bridge group if any bridges have structural issues
k. Denver to confirm desired capacity for street crossings.

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MEETING MINUTES
Sanderson Gulch
Major Drainageway Plan and Flood Hazard Area Delineation
Tuesday August 21, 2012, 10:00am – 11:30am at UDFCD

Attendees:

Shea Thomas	UDFCD	303-455-6277	sthomas@udfcd.org
Bill DeGroot	UDFCD	303-455-6277	bdegroot@udfcd.org
Terry Rogers	Lakewood Engineering	303-987-7934	terrog@lakewood.org
Mike Anderson	Denver Capital Projects	720-865-3023	mike.anderson@denvergov.org
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HungTeng Ho	Matrix Design Group – Eng	303-572-0200	hungteng_ho@matrixdesigngroup.com

1. Previous Action Items:

a. Matrix to set first meeting on Hydrology in 4 weeks – done
b. Matrix to set up website – done
c. Matrix to review new updated DFHAD Guidelines – done
d. Matrix to check the map labeling of Clairefield Reservoir – done
e. Matrix to distribute the basin map electronically – done
f. Matrix/Denver to check if all CCD Parks data is available in GIS – done
g. Matrix/Denver to set a van tour – extend the tour into Lakewood – done
h. Lakewood/Denver to get contact info for ditch companies – *open. Information has been provided, but the ditch companies have not been contacted to-date.*
i. Lakewood to check on easements along private sections of the gulch – done
j. Denver to ask their bridge group if any bridges have structural issues – done
k. Denver to confirm desired capacity for street crossings – done

2. Baseline Hydrology

a. Basin boundary delineation
    i. New model has 101 sub basins – 94 in Sanderson Gulch and 7 in Mississippi Gulch
    ii. 1972 model had 20 sub-basin. These sub-basins are larger than the recommended average size of 100 acres.
    iii. Shape factor and design point inflow are reasons for further subdividing basins
b. Basin parameters
    i. Impervious & pervious retention loss
        1. 1972 hydrology used an infiltration of 0.75 inches/hour. This does not equate to parameters used in the current model following Horton's infiltration parameters
        2. 1972 pervious reported as 0.3 in the text, but example sub-basins used 0.1
    ii. Infiltration loss (Type C soil used throughout) – based upon Lakewood data. Type C soils will be assumed throughout the entire watershed.
    iii. Imperviousness City of Denver Land Use Data, City of Lakewood Land Use data and Future Green Gables Plan
        1. Average in 1972 was 40%
        2. Average for the updated study is 51%
c. Rainfall
    i. 1972 rainfall varied by sub-basin
    ii. 1972 MDP rainfall distribution curve compared with current USDCM
    iii. 1972 modeled a 2-hour storm with a lower peak value for 100-year

    iv. Rainfall distribution criteria shown for Denver, Lakewood and USDCM
    v. Recommend using one rainfall for the entire watershed following USDCM
d. Hydrograph Routing
    i. Channel cross section measured from topographic mapping
    ii. Crossing structures at basin boundary modeled with overflow elements
    iii. Trans-basin flow – water imported into basin by pipes and roadway
        1. Federal Blvd
        2. Mississippi Gulch Basin
    iv. Detention modeled in the following reservoirs:
        1. Smith Reservoir
        2. Kendrick Reservoir #1 (not in 1972 MDP because of 100-year capacity)
        3. Kendrick Reservoir
        4. Jewell Park Reservoir
        5. Green Gable Entrance Road
        6. Ward Reservoir #1 (not in 1972 MDP because of 100-year capacity)
        7. Clairefield Reservoir
        8. Bit-O-Sea Reservoir
        9. Ward Reservoir #5 (not in 1972 MDP because of 100-year capacity)
        10. Harvey Park Lake (not in 1972 MDP because of 100-year capacity)
        11. Green Gable Park Reservoir
    v. Findings regarding detention reservoirs
        1. Smith and Kendrick have low level outlets - not only spillway
        2. No rating curve chart was available for Smith Reservoir from 1972 study
        3. New rating curve needed for modified Green Gables Entrance Road
e. Calibration
    i. Steps 1 – Input 1972 basin parameters and rainfalls, except infiltration coefficients into CUHP 2005. Using stage-storage-discharge curves from 1972 MDP.
    ii. Step 2 – Adjusted infiltration decay coefficient to 0.00111and adjusted Cp to reproduce peak flows at comparable design points. Adjusted the stage-storage-discharge curve for each reservoir to match the release peak flow in 1972 Study.
    iii. Step 3 – Adjust rating curves for detention ponds to match outfall with inflow. The 1972 study reported detention volume, but the actual stored volume was larger. There are 3 with rating curves that do not match 1972 results.
f. Duplicate Effective Results
    i. Results of duplicate effective model are a good comparison with 1972
    ii. Hydrographs prepared showing matching the peaks
    iii. Time of concentration good, except North Sanderson peak time calculated to be longer and outfall is calculated to be shorter.
g. Corrected Effective Model and Preliminary Results
    i. Change imperviousness
    ii. Replace rainfall in the CUHP 2005 using up-to-date information
    iii. Correct detention pond rating curves using available topo to determine storage volume
    iv. Need to get corrected model from Green Gables
h. Preliminary Model Results
    i. 4142 cfs vs 3350 cfs at outfall, but using incorrect rating curves from 1972
    ii. Concerned about Smith Reservoir in is 85% higher
    iii. How does Horton infiltration affect the numbers?
    iv. Need to check time of concentration. Look at a comparison from Sheridan Blvd to the South Platte River. Why is the time of concentration now shorter?

3. Define Reaches

a. A map was distributed with proposed reaches – 11 reaches on Sanderson, and 5 on North Sanderson
b. Street names should be shown at reach divides on the map
c. Add reach 12 outlet of Smith
d. Move 11 to Kendrick

Action Items

1. Matrix to change the rating curves of detention ponds for Corrected Effective model to actual conditions
2. Matrix to check time of concentration to understand the model results
3. Matrix to gather corrected effective model for Green Gables
4. Matrix to contact the ditch companies in this study area
5. Matrix to compare the 10-year gage analysis with the modeled 10-year hydrology
6. Edit reach map to add reach 12, add street names, and move reach divide at the confluence and in Kendrick Lake
7. Terry Rogers to arrange a van tour of Sanderson Gulch in Lakewood

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MEETING MINUTES
Sanderson Gulch
Major Drainageway Plan and Flood Hazard Area Delineation
Monday October 15, 2012, 10:00am – 11:30am at UDFCD

Attendees:

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Mike Anderson	Denver Capital Projects	720-865-3023	mike.anderson@denvergov.org
David Marquardt	Denver Parks	720.913.0629	david.marquardt@denvergov.org
Kevin Lewis	Denver Public Works	303-446-3658	donald.lewis@denvergov.org
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Bob Eck	Matrix Design Group	303-572-0200	bob_eck@matrixdesigngroup.com

1. Previous Action Items:

a. Matrix to change the rating curves of detention ponds for Corrected Effective model to actual conditions. *Done.*
b. Matrix to check time of concentration to understand the model results. *Done.*
c. Matrix to gather corrected effective model for Green Gables. *Open.*
d. Matrix to contact the ditch companies in this study area. *Open.*
e. Matrix to compare the 10-year gage analysis with the modeled 10-year hydrology. *Done – See summary at the end of these minutes.*
f. Edit reach map to add reach 12, add street names, and move reach divide at the confluence and in Kendrick Lake. *Done.*
g. Terry Rogers to arrange a van tour of Sanderson Gulch in Lakewood. *Done.*

2. Schedule

UPDATED SANDERSON GULCH MDP & FHAD SCHEDULE

(dates revised from the kickoff meeting minutes are shown in red)

	Draft / First	Comments	Final/Second	Public Meeting	Selected Plan
Baseline Hydrology Report	8/27/2012	10/04/2012	10/25/2012		
Alternatives Analysis	11/19/2012	12/10/2012	1/4/2013	January 2013	1/28/2013
Concept Design	3/25/2013	4/15/2013	5/6/2013	April 2013	
FHAD	11/5/2012 First technical review only to UDFCD.	11/26/2012	12/17/2012 Distribution to Sponsors		

3. Review Baseline Hydrology Report Comments

a. Statistical Gage Analysis – the computed 10 year discharge based upon the gage data is lower than model discharges. This validates the calibration approach to adjust the raw model factor Cp to lower the model flows to the 1972 values with all other model input the same. FEMA accepted the hydrology in 1972 and the gage data is not giving us any reason to increase the hydrology because of the newer models. It is important to note that actual hydrology will generally always be less than model hydrology due to small on-site detention ponds not considered in the regional model, along with undersized inlets and other minor losses not considered.
b. Irrigation Ditches Impacting Transbasin Flow - Transbasin flows could occur between Sanderson Gulch and Weir Gulch. The Agricultural Ditch diverts flows between Smith Reservoir (within Sanderson) and East Reservoir (within Weir). It appears that it might depend on the WSELs in each of the reservoirs to know which way the flows would go. This is discussed in the 1972 study. Runoff from the upper Sanderson Gulch is intercepted by Smith Reservoir, an irrigation storage reservoir owned by the Agricultural Ditch and Reservoir Co. The Smith Reservoir spillway directs overflow into an irrigation ditch flowing into East Reservoir which is located in the Weir Gulch Basin. This is effectively a transbasin diversion which would convey stormwater to the Weir Gulch basin during overflows of Smith Reservoir. If this discharge is allowed to continue during a major storm event, the effect would be to continually increase the inflow to East Reservoir into Weir Gulch. It will be important to understand where emergency overflows for the ditches are planned.
c. Green Gables Road Detention – The Green Gables redevelopment project is moving ahead. A CLOMR has been submitted to UDFCD. The Baseline Hydrology model should match their design release rates.
d. Mississippi Gulch – The baseline model imports only the capacity of the existing pipe into Sanderson Gulch. A FLO-2D model to assess flows either following or crossing Mississippi Avenue from Clay Street to Pecos is not necessary at this time. The Alternatives Analysis will explore options to leave the allowable capacity in Mississippi Avenue in a major event and convey the remainder to Sanderson Gulch.
e. Water Quality – Water quality to be discussed as a subsection in Chapter 2 Reach Descriptions and also in the Alternatives Analysis section
f. Maintenance - Lakewood has easements for North Sanderson Gulch from Pierce to Florida

4. Alternatives Analysis Approach

a. Hydrology – Look for opportunities to reduce the hydrology (Detention)
   i. Jewell Park Pond – Good opportunity to reduce flows into the King Soopers pipe at Jewell and Wadsworth
   ii. Carmody Park Pond – May provide a little benefit
   iii. Green Gables Entrance Road – Match the design flows in the CLOMR. No opportunity for additional detention beyond what is planned.
   iv. North Sanderson Greenbelt Improvement Wetland Pond (near Lamar Street). This area is not an opportunity for future detention.
   v. Clairefield Reservoir – The surrounding area is planned for future ballfields. This area is known as “Wilson Family Park.” The proposed ballfields could be set at the 25-year level or some other event to shave the peak off the 100-year flood. The fields cannot be flooded frequently. Lakewood to address the allowable frequency of flooding.
   vi. Irving Street – Could provide some marginal storage for peak shaving. Doubtful that this area could be regraded.
   vii. Garfield Lake – Currently not providing any benefit in the model. To account for some attenuation would require a formal agreement for a commitment to provide a detention volume. Detention options could include formalizing existing conditions to provide attenuation, or rebuilding the outlet to provide formal detention.
   viii. Huston Lake - Currently not providing any benefit in the model. To account for some attenuation would require a formal agreement for a commitment to provide a detention volume. Detention options could include formalizing existing conditions to provide attenuation, or rebuilding the outlet to provide formal detention.
b. Flood Control – Examine options to remove structures from the floodplain. Use FEMA’s model as the preferred method to evaluate Benefits to Costs.

c. Crossing Structures – The Sponsors decided to show an upsize of all culverts/bridges to 100-year capacity. Denver has a "sufficiency rating" condition assessment for some of its structures and will investigate providing it for all structures on Sanderson Gulch within its jurisdiction.
d. Channel Stabilization - Sanderson Gulch is quite stable today. Minor bank erosion areas will be addressed in the Concept Design Report (this is not a concern for the Alternatives Evaluation unless the solution would require additional drop structures.) The Alternatives Analysis will focus on ways to reduce the hydrology or where drop structures are needed.
e. King Soopers Parking Lot – Can the hydrology be regulated so that a major flood can be contained in the existing pipes?
f. South Platte Outfall – Evaluate alternatives for the connection to the South Platte, but do not spend the entire alternatives analysis budget on this one alternative.
g. Mississippi Gulch – Evaluate options to import this flow into Sanderson Gulch
h. Water Quality – Address ways to improve water quality, particularly from neighborhood streets.

5. Statistical Gage Summary

The limited data from the two historic USGS gages on Sanderson Gulch was analyzed and compared using the US Army Corps of Engineers HEC-SSP Statistical Software Package, Version 2.0, October 2010. The Flow Frequency Analysis (Bulletin 17B) procedure was used for the analysis.

Gage 06711600 is near the intersection of Wadsworth and Florida in the North Sanderson Gulch with a drainage area of 0.57 square miles according to the USGS gage data. A total of 33 years of record are available from 1969 through 2002. The following table summarizes the statistical analysis.

HEC-SSP 2.0 - Sanderson Gulch

Frequency Curve for: Sanderson Gulch-LAKEWOOD, CO-FLOW-ANNUAL PEAK

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.05	0.95
0.2	689.8	905.6	1229.1	466.8
0.5	516.2	627.6	857.1	365.5
1.0	411.0	475.3	645.9	301.2
2.0	324.0	359.5	481.5	245.8
5.0	231.7	245.9	319.5	184.0
10.0	175.8	182.1	229.0	144.2
20.0	129.2	131.4	159.4	108.9
50.0	77.4	77.4	91.1	65.4
80.0	51.1	50.6	60.8	41.1
90.0	42.6	41.8	51.4	33.2
95.0	37.2	36.3	45.6	28.3
99.0	30.2	28.9	37.9	22.0

System Statistics — Log Transform: Flow

Statistic	Value
Mean	1.918
Standard Dev	0.245
Station Skew	0.722
Regional Skew	
Weighted Skew	
Adopted Skew	0.722

Number of Events

Event	Number
Historic Events	0
High Outliers	1
Low Outliers	0
Zero Or Missing	0
Systematic Events	33
Historic Period	34

For 33 years of record, the highest recorded peak discharge was 422 cfs.

The following table is a summary of the gage analysis compared with the 1972 hydrology and also compared to this study:

	Gage Analysis	1972 MDP	Current MDP
10-year	175 cfs	250 cfs	304 cfs
100-year	411 cfs	680 cfs	835 cfs

Gage 06711609 is located at Navajo Street, upstream of the Mississippi Gulch storm drain outlet to Sanderson Gulch with a drainage area 7.98 square miles according to USGS data. A total of 13 years of record are available from 1986 through 1999. The following table summarizes the statistical analysis.

HEC-SSP 2.0 - Sanderson Gulch

Frequency Curve for: Sanderson Gulch-NAVAJO ST. AT DENVER, CO-FLOW-ANNUAL PEAK

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.05	0.95
0.2	2221.5	3996.7	5198.4	1426.9
0.5	1809.1	2730.2	3836.6	1217.0
1.0	1536.3	2081.3	3015.9	1071.1
2.0	1292.9	1601.3	2343.1	934.6
5.0	1010.2	1141.5	1639.4	765.8
10.0	820.9	882.1	1221.5	643.9
20.0	647.9	670.5	883.7	522.0
50.0	430.1	430.1	534.9	342.4
80.0	301.4	294.3	374.8	219.3
90.0	255.5	244.6	323.5	175.1
95.0	225.2	210.7	290.5	146.7
99.0	182.0	160.6	243.8	108.2

System Statistics — Log Transform: Flow

Statistic	Value
Mean	2.650
Standard Dev	0.200
Station Skew	0.501
Regional Skew	
Weighted Skew	
Adopted Skew	0.501

Number of Events

Event	Number
Historic Events	0
High Outliers	1
Low Outliers	0
Zero Or Missing	0
Systematic Events	13
Historic Period	13

For 13 years of record, the highest recorded peak discharge was 1,230 cfs.

The following table is a summary of the gage analysis compared with the 1972 hydrology and also compared to this study:

	Gage Analysis	1972 MDP	Current MDP
10-year	821 cfs	1900 cfs	1662 cfs
100-year	1536 cfs	3210 cfs	4205 cfs

Note: The design point locations are not the same for the 1972 study to this current study. This study has a design point at the gage location. However, the nearest design point to the gage from the 1972 MDP was at Florida Avenue. The tributary basin to the gage has a tributary area of approximate 150 acres more than the 1972 Florida Avenue design point.

6. Action Items

a. Matrix to take a look at the 1972 study regarding transbasin flows between Sanderson and Weir and let me know if/how it affects your model.
b. Matrix to look at Green Gables CLOMR submittal and match their design in the Baseline Hydrology study.
c. Matrix to incorporate comments on the Baseline Hydrology Report and resubmit.
d. Denver has a list of 20 structures in Sanderson Gulch. 17 are minor structures and 3 are major structures. Denver to provide a more detailed listing of the condition assessment data.
e. Lakewood to investigate their floodplain ordinances regarding the ability to put the Wilson Family Park in the floodplain.

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MEETING MINUTES
Sanderson Gulch
Major Drainageway Plan and Flood Hazard Area Delineation
Tuesday March 5, 2013, 10:00am – 11:30am at UDFCD

Attendees:

Shea Thomas	UDFCD	303-455-6277	sthomas@udfcd.org
Bill DeGroot	UDFCD	303-455-6277	bdegroot@udfcd.org
Terry Rogers	Lakewood Engineering	303-987-7934	terrog@lakewood.org
John Paliga	Lakewood Community Resources	303-987-7815	johpal@lakewood.org
Mike Anderson	Denver Capital Projects	720-865-3023	mike.anderson@denvergov.org
Kevin Lewis	Denver Public Works	303-446-3658	donald.lewis@denvergov.org
Robert Krehbiel	Matrix Design Group - Eng	303-572-0200	robertk@matrixdesigngroup.com
Wilson Wheeler	Matrix Design Group – GIS	303-572-0200	Wilson_wheeler@matrixdesigngroup.com

Handouts:

- Summary of references regarding Sanderson Gulch in the River South Greenway Master Plan (RISO), January 2010, with a copy of the Master Plan for the Evans to Florida reach.
- Profile of an improved channel at the outfall from Lipan to the South Platte River

1. Major Comments for Discussion on the Alternatives Report:

Project Sponsors provided comments on the draft report on February 19, 2013. The following are the most significant comments requiring discussion:

Denver Parks

- Integrate pedestrian crossings into drop structures where possible. *Response: Yes, Matrix will look for opportunities.*
- Trail connections and pedestrian crossings needed at new culverts. *Response: Yes, 100-year capacity culverts may provide new opportunities for grade separated crossings.*
- It would be great to get trail connection in Reach 1 to the Platte River Drive. The report recommends a connection through Lipan to Ruby Hill Park, which is great, but it would be nice to have that connection to the Platte River Drive as well for a future pedestrian bridge. *Response: This master plan will consider Florida Avenue and/or Sanderson Gulch to route pedestrians to Sanderson Gulch from the South Platte River. If Sanderson Gulch is used as a pedestrian corridor, they must cross under the BNSF railroad. An at-grade RR crossing is doubtful given the proximity to the crossing at Florida. PUC approval would be required. A pedestrian crossing of the BNSF track which is used daily, usually about 4 trips per day, 6 days per week without adequate pedestrian warning devices creates a safety hazard. BNSF would likely object due to the increased risk of an additional at-grade crossing on their system, especially when a controlled crossing exists nearby at W. Florida Avenue.*

Denver Public Works

- Trail under S. Platte River Drive would require reconstruction for bridge 3' higher than existing grade. Does this necessitate raising S. Platte River drive? If so discuss how far in each direction, impacts if any, and include in costs. Discuss with Denver Traffic Engineering Services to verify it would be allowed and is feasible. Reconstruction and realignment of South Platte River Drive is shown in the RISO plan. *Response: Assumed 10' vertical trail clearance, plus trail 2' above the channel invert. If the height clearance is given a waiver to 8', costs would be reduced. Additional analysis will be prepared by Matrix, including costs of South Platte River Drive reconstruction.*

- Please elaborate on the use of Garfield and Huston Lakes for stormwater management. The benefit of counting inadvertent detention (with agreements) needs to be analyzed and quantified beyond the little reduction in flow rate; how does that translate to reduced pipe size, if any, and cost reduction? For WQ, what are the costs/impacts to the lake, and benefits? If we are to consider Garfield and/or Huston Lake for formal inadvertent detention (with an agreement between UDFCD & Denver) I understand the maximum flow reduction is 161 cfs (12.5%) by Huston and 80 cfs (6.2%) individually. What is the effect to the 100-year drain from S. Quivas to Sanderson if one or both are used? What do these reductions mean in pipe size from S. Quivas to Sanderson and its cost? What does it mean for Reach 1? *Response: Additional analysis will be performed by Matrix to evaluate the use of these two lakes for stormwater. A table will be prepared which summarizes answers to these questions.*
- Table 3-5 Hydrology Summary includes minor storm off-site flows from Mississippi Gulch and Federal Blvd./Lowell Avenue basins; excludes major storm import from Mississippi Gulch evaluated in Alternatives for all frequencies. *Response: This table uses this approach for all frequencies. The hydrology shown in the table under "Hydraulics" is not consistent with Table 3-5 and will be removed from the Alternatives Report. The FHAD report will detail the hydraulic model inputs.*

Lakewood

- Reach S-6 and Reach NS-1 contains USCOE regulated plantings that may be impacted by proposed alternative. *Response: No work will be proposed which disturbs these regulatory wetlands.*
- The improved drainageway for the White Fence Farm Filing 1 through the Wilson Family Park and Clairfield Reservoir area is maintained by UDFCD. This is not shown on the UDFCD maintenance maps. *Response: The UDFCD map shows maintenance along this reach, except in the Wetland Pond within the 2009 Greenbelt Improvements area. The reach of North Sanderson Gulch upstream of the White Fence Farm Filing 1is still in the monitoring period for the Corps of Engineers 404 Permit. Weed control and planting mitigation will continue in this reach until the monitoring period is complete. After this period is complete, there is no intention of continuing routine maintenance in this reach. Routine maintenance of the reach through the White Fence Farm Filing 1 is the responsibility of the adjacent homeowners associations, except for periodic mowing one width on each side of the pedestrian path by the City. Major repairs to the drop structures and crossings are eligible for UDFCD maintenance assistance.*
- Expanding the retention area at Founders Park may not be well received. Residents in that area have been asking for more "active" improvement areas in the park. Making more of it storm related may not go over well. We would like to take a look at an option of reducing the impact to Founders Park and Jewell Park for the proposed increased detention and see what effects that may have downstream. *Response: Matrix will design an open channel section through the 22-foot wide easement reach from Upham Street to Pierce Street showing concrete walls and soil riprap channel bottom. The baseline hydrology (not master planned hydrology) will be run through this improved reach to see if homes remain in the floodplain. There may be capacity above the wall for flood conveyance before inundation of structures. The results will be presented to sponsors to help in the evaluation.*
- We would also like to work closely with Matrix in developing more detailed grading and site improvement plans to implement the proposed additional detention in the Wilson Family Park, Founders Park, Jewell Park and Carmody Park. Our goal is to try and strike a balance of providing the additional detention and enhance the function and aesthetics of each of the park sites. *Response: A concept design was previously prepared for each site. These hand sketch designs will be submitted to UDFCD and Lakewood for consideration. We understand that Lakewood is concerned from a parks use perspective of increasing the detention area in Wilson Family Park, Founders Park, and Jewell Park, and from a water rights perspective in Carmody Park. Once sponsors have a selected plan, Matrix will prepare formal concept designs.*

- Prior to commenting further on the proposed detention enlargements in Lakewood Parks the Community Resources needs more detail on the proposed facilities in order to understand physical impacts, costs and permanent encumbrances. *Response: Matrix will provide additional analyses and exhibits to help sponsors determine the selected plan. The value/benefits of the detention will be described in the report narrative.*
- Is it possible to install a different size culvert under Pierce St. to avoid removing drop structure N10? Also, Lakewood would like to eliminate drop structure N15 due to maintenance problems. *Response: Yes, drop structures will be consolidated to lessen impacts as recommended. A wider culvert will be considered under Pierce St. to avoid removing the recently constructed drop structure immediately downstream. However, the 22-foot wide easement under Pierce on the upstream end may limit the ability to expand the width, and therefore, the depth would need to be increased which would impact drop N10.*

UDFCD

- Discuss the number of structures in the current FEMA floodplain. *Response: There are 100 structures in the FEMA floodplain, and there are 175 structures in this FHAD study floodplain. This study covers a larger reach so the additional structures are partly due to new floodplains defined in areas such as North Sanderson Gulch from Wadsworth to Pierce Street.*
- Since Garfield and Huston Lakes are owned by the City, an agreement is not necessary. We need to get everyone on board with adding the use of flood control. *Response: Additional evaluation will be completed by Matrix to understand the value of using these lakes for stormwater management.*
- Replace culverts with 100-year capacity. Is this true for all road types? Or just larger collectors and arterials? *Response: Both Denver and Lakewood prefers to have 100-year capacity shown for all new roadway crossings.*
- Retaining walls on both sides for North Sanderson? We try to stay away from this for safety reasons. *Response: The walls shown are for the 22-foot wide easement reach. Freeboard will be eliminated from the design to reduce the wall height to less than 5 feet. This is an area where trespassing is not allowed. Since there is no trail in the area, the wall height is less of a concern.*
- Are there any existing agreements for irrigation reservoirs (Smith, Kendrick, Ward)? *Response: To our knowledge, there are no formal agreements for flood control.*
- Do not include information on the HEC-RAS model input/output in the Alternatives report. This will be presented in the FHAD report. *Response: Matrix will move this information to the FHAD report.*

2. **Public Meeting:**
   - Matrix to incorporate sponsor comments provided
   - Select a date and location for one public meeting. The location should be near the centroid of the study area.
3. **FHAD Schedule:**
   - UDFCD will complete their technical review within a week. Matrix to address comments, and resubmit with a Draft FHAD report.
4. **Action Items:**
   - Matrix to send out conceptual designs for proposed regional detention ponds
   - Matrix to provide GIS shape files extending over all floodplain areas and within 300 feet of the channel centerline for the notices of the public meeting
   - Matrix to address sponsor comments, make edits to the Alternatives report and reissue in draft form.
   - Project Sponsors to select a location and date for the public meeting

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MEETING MINUTES
Sanderson Gulch Public Meeting
Major Drainageway Plan and Flood Hazard Area Delineation
Tuesday April 9, 2013, 6:30pm – 8:00pm at
Athmar Recreation Center, 2680 W. Mexico Avenue

Attendees:

Shea Thomas	UDFCD	303-455-6277	sthomas@udfcd.org
Ken MacKenzie	UDFCD	303-455-6277	kmackenzie@udfcd.org
Terry Rogers	Lakewood Engineering	303-987-7934	terrog@lakewood.org
Mike Anderson	Denver Capital Projects	720-865-3023	mike.anderson@denvergov.org
Robert Krehbiel	Matrix Design Group - Eng	303-572-0200	robertk@matrixdesigngroup.com

Eight members of the community participated in the meeting (see attached sign-in sheet).

Presentation Materials:

- 19 slide PowerPoint presentation of the work on the study completed to-date. Two copies of the presentation were distributed.
- Roll Plot Map of the Draft Floodplain
- Roll Plot Map of the Recommended Improvements

The Urban Drainage & Flood Control District (UDFCD) is sponsoring this master plan study, along with the City & County of Denver and the City of Lakewood.

1. **Ken MacKenzie**, UDFCD Manager of the Master Planning Program, provided an introduction to this Major Drainageway Master Planning project and introduced the project team. Ken explained that this is a master plan that will recommend improvements in the watershed over the next 30 years. This master plan is a guidance document for future improvements and is not directly for the purposes of construction; i.e., construction is not imminent. Ken explained how UDFCD is funded through a property tax mill levy to improve and maintain the waterways within the Metro area. Ken noted that the storm on July 31, 1998 overtopped South Platte River drive and took out half the road. Some residents noted that Lowell and Tennyson are also periodically overtopped.

2. **Robert Krehbiel**, consultant to UDFCD from Matrix Design Group, is the lead engineer on this master plan project and presented the PowerPoint slide show. The presentation showed that the previous study was completed in 1972 and is now over 40 years old. It was the first master plan study completed by UDFCD. Robert described the watershed, and the components of Engineering, Urban Ecology and Parks that go into this study. The purpose of this public meeting is to gain community input on the recommendations for flood control, channel stabilization and water quality. It was noted that the primary components of the plan are: grade control, culvert improvements to pass the 100-year flood, and flood storage needs such as enlarging the Jewell Park pond in Lakewood. Other recommended areas for flood storage include Carmody Pond and excavating the future ballfield area in the Wilson Family Park above the 10-year flood elevation (no work is recommended in the channel along Wilson Family Park).

3. **Group Question and Answer Session.**

a. Where does the water come from? The watershed is fairly large at 7.6 square miles, which contributes surface water and groundwater, resulting in base flow in Sanderson Gulch. In addition, water is imported to the basin by irrigation ditches.

b. Can this project raise the Bit-O-Sea spillway or dredge the lake? One attendee noted that he believed that Bit-O-Sea was constructed by the Corps of Engineers circa 1970 and has filled in with silt over the years. In some areas, the silt is piled one foot above the normal standing water. Poor water quality resulting from runoff after a hail storm killed many fish in the lake. UDFCD cannot dredge private lakes with their public funding. The study recommends widening the Bit-O-Sea spillway to fully contain the 100-year flood.

c. Who is funding these improvements? UDFCD is funded by a mill levy on property tax. In addition, the local municipalities collect a stormwater fee. This fee is approximately $2/month in Lakewood, and it was $68/year in Denver (but this rate has gone up). The total cost of every recommended improvement contained in this master plan is approximately $28.4 million. The split between jurisdictions is $16.9 million in Denver, and $11.5 million in Lakewood.

d. Will there be bonding for these improvements? Most of the projects shown in the master plan can be completed jointly by UDFCD and the local municipality without bonding.

4. **Individual Question and Answer Session** was conducted using the maps on the wall. Project stakeholders met with individuals to discuss their comments on the plan.

a. There was interest in UDFCD's water quality project on the north side of Sanderson Gulch, along W. Mexico between Mabry and Stuart. They also noted the need for water quality treatment at the storm outfall near the basketball court on the south side of the Gulch.

b. There was interest in upsizing the Tennyson Street culvert since floods have overtopped the street in this area, which could impact the adjacent residence.

Sanderson Gulch
Major Drainageway Plan
Public Meeting Comment Card
Tuesday, April 9, 2013

Name	Address	Phone	Email
BILL JACKSON	1840 S. MANOR LN	3) 429 4643	
The Sniders	11636 So. Michigan hwy	720-984-7429	
Kevin Getz	1750 S. Tennyson St.	303 810-9803	apsgetz@yahoo.com
Marilyn Barela	1420 S. Osage St.	303-733-0027	marilynbarela@yahoo.com
Tom TRELOAR	1555 S Shoshone St	303 935 1155	TomTreloar@msn.com
MICHAEL ANDERSON	201 W. Colfax Dept 509	720-865-3023	

Name	Address	Phone	Email
Tim Gilmore, DITO Serv	5482 W. Colo Lakewood Ave	303 722.3994	gilmoretp@yahoo.com
TERRY ROGERS	CITY OF LAKEWOOD	3-987-7934	
ROBERT KRETHAIEL	MATRIX		
SHEA THOMAS	UDFCD		
KEN MACKENZIE	UDFCD		

DRAFT FHAD REPORT REVIEW COMMENTS AND RESPONSES

Responses to Full Review Comments Received on 09/17/2018
Flood Hazard Area Delineation Update - Sanderson Gulch

Comment No.	PDF Page No.	Reviewer	Comments	Responses
1	Review Commnet Document	UDFCD	Plans, Flows, and Profiles 1. Verify HEC-RAS peak flow discharges match the hydrology Peak Discharge table in the report	1. Peak flow discharges have been reviewed and revised.
2			Reach Lengths/Cross Section Widths 2. Downstream reach lengths for cross sections directly upstream of Junction 1 should be zero.	2. Downstream reach lengths for cross sections directly upstream of Junction 1 have been revised to be zero.
3			Cross Sections 3. "XS HTab Starting Elevations" error when opening model in HEC-RAS version 5.0.5. Starting WSEL are lower than the minimum channel elevation for cross sections 27050 – 23863. 4. Flows are uncontained in the following cross sections: 27058, 22757, 12227	3. The hydraulic model HEC-RAS Version 4.1.0 was used for this study. The "XS HTab Starting Elevations" error will show up when opening this model in newer HEC-RAS version 5.0.5. However, the error check is for unsteady flow analysis that has no impact on the 1-D steady flow analysis. 4. Cross-sections 27058, 22757 and 12227 have been expanded to confine all flow discharges.
4			Flow Splits 5. Blocked obstructions not updated to IEFA in Culverts at Allison_Jewell HEC-RAS model.	5. The Culverts at Allison_Jewell HEC-RAS model is for the behind the scenes calculation only, so the blocked obstructions were not updated for IEFA everywhere. This model intends to only calculate water surface elevations at the entrance of the culvert at S Allison St. The water surface elevations were then used as known W.S.Es. in the overland flow HEC-RAS model. The results are not impacted by the change, so no edits need to be made.
5			Floodplain Work Maps (GIS) 1. Verify channel distances match HEC-RAS for North Sanderson Gulch.	1. This comment stemmed from comment #2 under "Reach Lengths/Cross Section Widths" that has been addressed.
6			*Flood Profile* *1. Legend does not include symbols for crossings.* *2. Labels for crossings are cutoff on upstream end of North Sanderson Gulch reach.* *3. Verify channel distances match HEC-RAS for North Sanderson Gulch reach. (Junction length)*	1. Legend for bridge and culvert have been added. 2. Labels for crossings on upstream end of North Sanderson Gulch reach have been fixed. 3. Channel distances have been revised to match HEC-RAS for the North Sanderson Gulch reach.
7	30	UDFCD	Didn't we update %I? And aren't other parameters different due to discretization?	All basin parameters were updated from the 1972 MDP.
8	32	UDFCD	"A pervious area value of 0.35 inches (0.5 inches in 1972 MDP) … " This is different from the 2013 report. Was this updated in the new model, or was it not documented correctly in that report?	The depression loss for pervious areas was updated in the new model.
8	39	UDFCD	Table 4-3, inundated structure count at outfall along South Platte River	The 2018 FHAD Update report shows that the inundated structure count in Table 4-3 was reduced from the 2013 FHAD at the outfall along S Platte River. The reduction of inundated structures is because this 2018 FHAD Update does not propose to revise the Zone AO floodplain along S Platte River. Therefore, only the structures located within the area subjected to the map revision were included in the count.
9	39	UDFCD	The 2013 report says 161 in the text and 171 in Table 4-4. Should this be 171?	171 structures were impacted by the effective floodplain and UDFCD floodplain, which includes 88 structures located in the Zone AO (Depth 1 ft) floodplain along S Platte River. However, this 2018 FHAD Update does not revise the Zone AO floodplain, therefore, the 88 structures have been be excluded from the structure count since there is no change. As a result, the inundated structure count for the effective mapping is reduced to 83 structures that relate to the area of this map revision.
9	40	UDFCD	Why would this be different than what was shown in Table 4-4 in your 2013 report?	The Draft 2018 FHAD update report incorrectly showed 110 inundated structures on Table 4-4. The number of inundated structures were re-counted using the effective floodplain and the floodplain determined in the 2013 FHAD. The inundated structures in the Zone AO (Depth 1 ft) floodplain along S Platte River were not included in the re-count. However, the re-count of inundated structure was misleading because the 2013 FHAD floodplain is not a regulatory floodplain. The re-counted inundated structure number should be discarded. **The 2018 study removed 26 structures from the 100-year floodplain.**

Responses to Full Review Comments Received on 12/28/2018
Flood Hazard Area Delineation Update - Sanderson Gulch

Comment No.	PDF Page No.	Reviewer	Comments	Responses
1	6	UDFCD	Add sponsor names to table.	Sponsors' name were added.
2	11	Lakewood UDFCD	Not true if culvert is undersized. From Shea: Remove this sentence from the FHAD. We'll amend the master plan to account for improvements needed.	We concured and removed the sentence.
3	11	Lakewood UDFCD	Not true if there is overtopping. From Shea: Change this (I believe it's 50-year capacity) and explain that there is overtopping of Jewell.	We concured and added explanation in the text.
4	34	Lakewood UDFCD	why did these numbers change from the previous study? From Shea: This can be addressed in a comment response form, no additional text needed.	The change in numbers was a result due to incorporation of the LOMR for new development at Green Gable.
5	35	Lakewood UDFCD	Why are some of the shallow flow areas in the previous study not included? From Shea: This can be addressed in a comment response form, no additional text needed.	Some shallow flow areas did not exist anymore because of lower 100-year flood flow per the revised hydrology.
6	36	Lakewood UDFCD	Section 4.1 Evaluation of Existing Facilities *Why did the highlighted numbers change from the previous report?* *From Shea: This can be addressed in a comment response form, no additional text needed.*	The change in numbers was a result due to incorporation of the LOMR for new development at Green Gable.
7	36	Lakewood UDFCD	This number was 161 in the previous study, why did it change? From Shea: Verify. If correct, this can be addressed in a comment response form, no additional text needed.	Explanation has been provided in the *Response to Full Review Comments Received on 09/17/2018* in Appendix A.
8	37	Lakewood	Figures 4-1 through 4-4 from the previous study are missing.	We intended to remove Figure 4-1 through 4-4 because all the inundated structures have been included on the floodplain work map.
8	232	CCD	Why wasn't a floodway defined for Sanderson Gulch Reach 1? The effective map has a floodway defined. Recommend adding text in Section 4.0 to justify why floodway wasn't defined in Sanderson Gulch Reach 1. From Shea: We're working with Denver and FEMA to resolve this comment - no action needed at this time.	No action taken per direction from UDFCD.
9	232	CCD	At the confluence of SPR, the effective AO Zone is currently 1' average depth. The FHAD map shows shallow flooding average less than 1' u/s of Lipan and shallow flooding average less than 2' d/s of Lipan. Based on what was done for Harvard Gulch, these shallow flooding areas relate to FEMA AO (1' depth) and AO (2' depth) Zones, respectively. The abrupt study limit doesn't chase the ponding, so the intent north of the study limits is not clear. Is the effective AO (1' depth) Zone intended to be fully revised to AO (2' depth) or is the intent to have a zone break at the study limits to go from AO (2') to AO (1')? Either way, consider adding discussion in the text in Section 4.0 to justify and notes on the FHAD map to clarify. Consider revising the labels in the legend as well. From Shea: We are working with Denver and FEMA to resolve this comment - no action needed at this time.	No action taken per direction from UDFCD.

APPENDIX B

HYDROLOGIC ANALYSIS

Legend

- County Boundary
- Unincorporated Jefferson County
- Stream/River
- Irrigation Ditch
- Sanderson Gulch Watershed
- Subbasin
- USGS Gage
- Basin ID
  Area, %Imp

SWMM Routing Elements

- Detention
- Outfall
- Design Point
- Conveyance

Hydrologic Soil Group

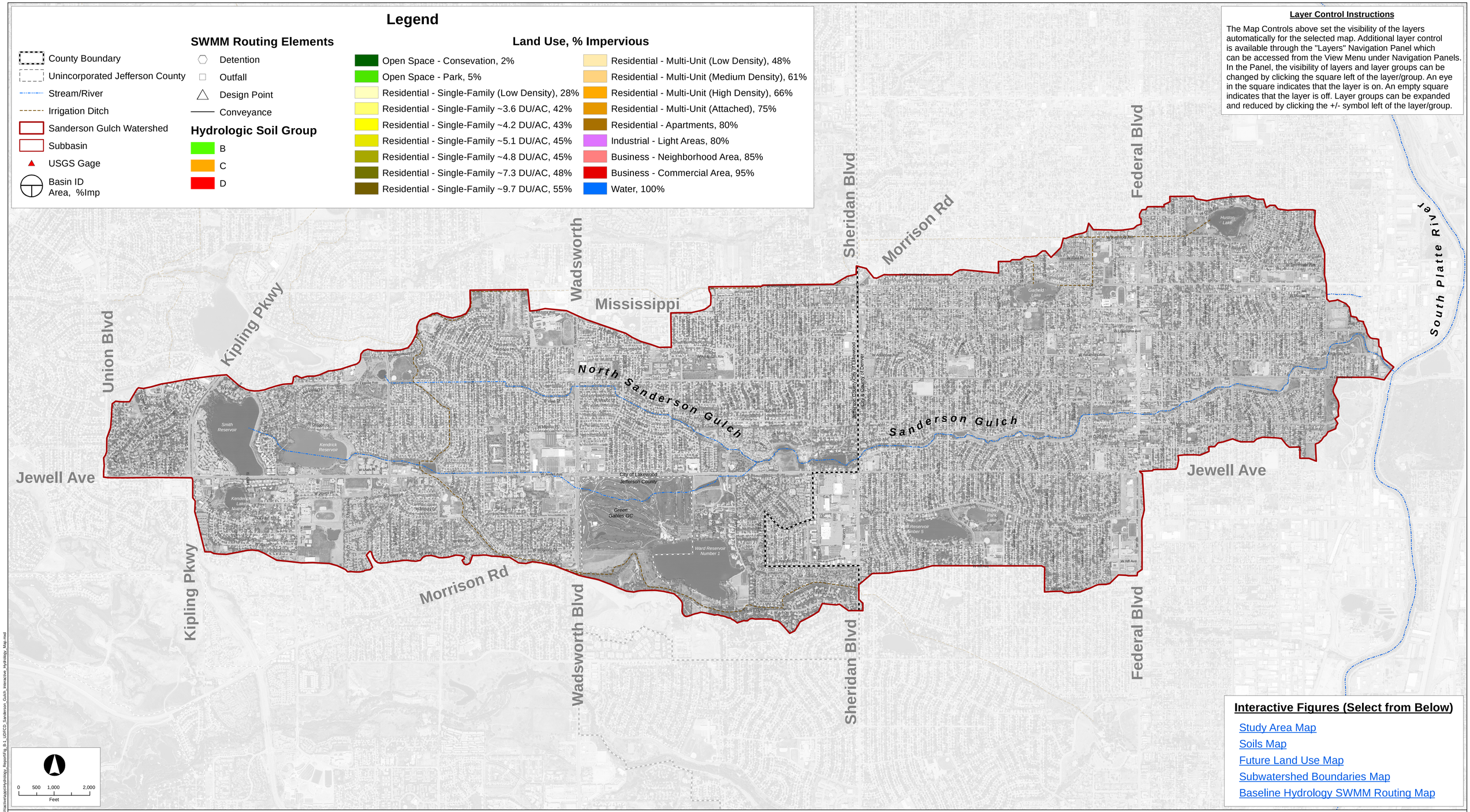
- B
- C
- D

Land Use, % Impervious

- Open Space - Consevation, 2%
- Open Space - Park, 5%
- Residential - Single-Family (Low Density), 28%
- Residential - Single-Family ~3.6 DU/AC, 42%
- Residential - Single-Family ~4.2 DU/AC, 43%
- Residential - Single-Family ~5.1 DU/AC, 45%
- Residential - Single-Family ~4.8 DU/AC, 45%
- Residential - Single-Family ~7.3 DU/AC, 48%
- Residential - Single-Family ~9.7 DU/AC, 55%
- Residential - Multi-Unit (Low Density), 48%
- Residential - Multi-Unit (Medium Density), 61%
- Residential - Multi-Unit (High Density), 66%
- Residential - Multi-Unit (Attached), 75%
- Residential - Apartments, 80%
- Industrial - Light Areas, 80%
- Business - Neighborhood Area, 85%
- Business - Commercial Area, 95%
- Water, 100%

Layer Control Instructions

The Map Controls above set the visibility of the layers automatically for the selected map. Additional layer control is available through the "Layers" Navigation Panel which can be accessed from the View Menu under Navigation Panels. In the Panel, the visibility of layers and layer groups can be changed by clicking the square left of the layer/group. An eye in the square indicates that the layer is on. An empty square indicates that the layer is off. Layer groups can be expanded and reduced by clicking the +/- symbol left of the layer/group.



Interactive Figures (Select from Below)

- Study Area Map
- Soils Map
- Future Land Use Map
- Subwatershed Boundaries Map
- Baseline Hydrology SWMM Routing Map

Lakewood

DENVER
THE MILE HIGH CITY

Matrix DESIGN GROUP

Figure B-1
Hydrology Map
Flood Hazard Area Delineation - Sanderson Gulch

Path: G:\gis_projects\UDFCD_Sanderson_Gulch\active\support\Hydrology_Report\Fig_B-1_UDFCD_Sanderson_Gulch_interactive_Hydrology_Map.mxd

Legend

- Basin ID
- Design Point
- Conveyance Element
- Detention Element
- Outfall Element

MATCHLINE SEE SHEET 2

S FEDERAL BLVD

W JEWELL AVE

S LIPAN ST

Mississippi_St_Out

Mississippi_Out

Sanderson_Out

Jewell_Out

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by:
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/23/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH MAJOR FLOOD HAZARD AREA DELINEATION

EPA SWMM 5.0 ROUTING SCHEMATIC SHEET 1 OF 4

FIGURE B-2

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\active\apps\Hydrology_Report\UDFCD_Sanderson_Gulch_SWMM_Routing_Schematic_11x17.mxd, 8/27/2012, chris_martin

Legend

- Basin ID
- Design Point
- Conveyance Element
- Detention Element
- Outfall Element

W MISSISSIPPI AVE

S FEDERAL BLVD

MATCHLINE SEE SHEET 3

MATCHLINE SEE SHEET 1

W JEWELL AVE

S SHERIDAN BLVD

S FEDERAL BLVD

Ward_5

Harvey

Harvey_Out

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\active\apps\Hydrology_Report\UDFCD_Sanderson_Gulch_SWMM_Routing_Schematic_11x17.mxd, 8/27/2012, chris_martin

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

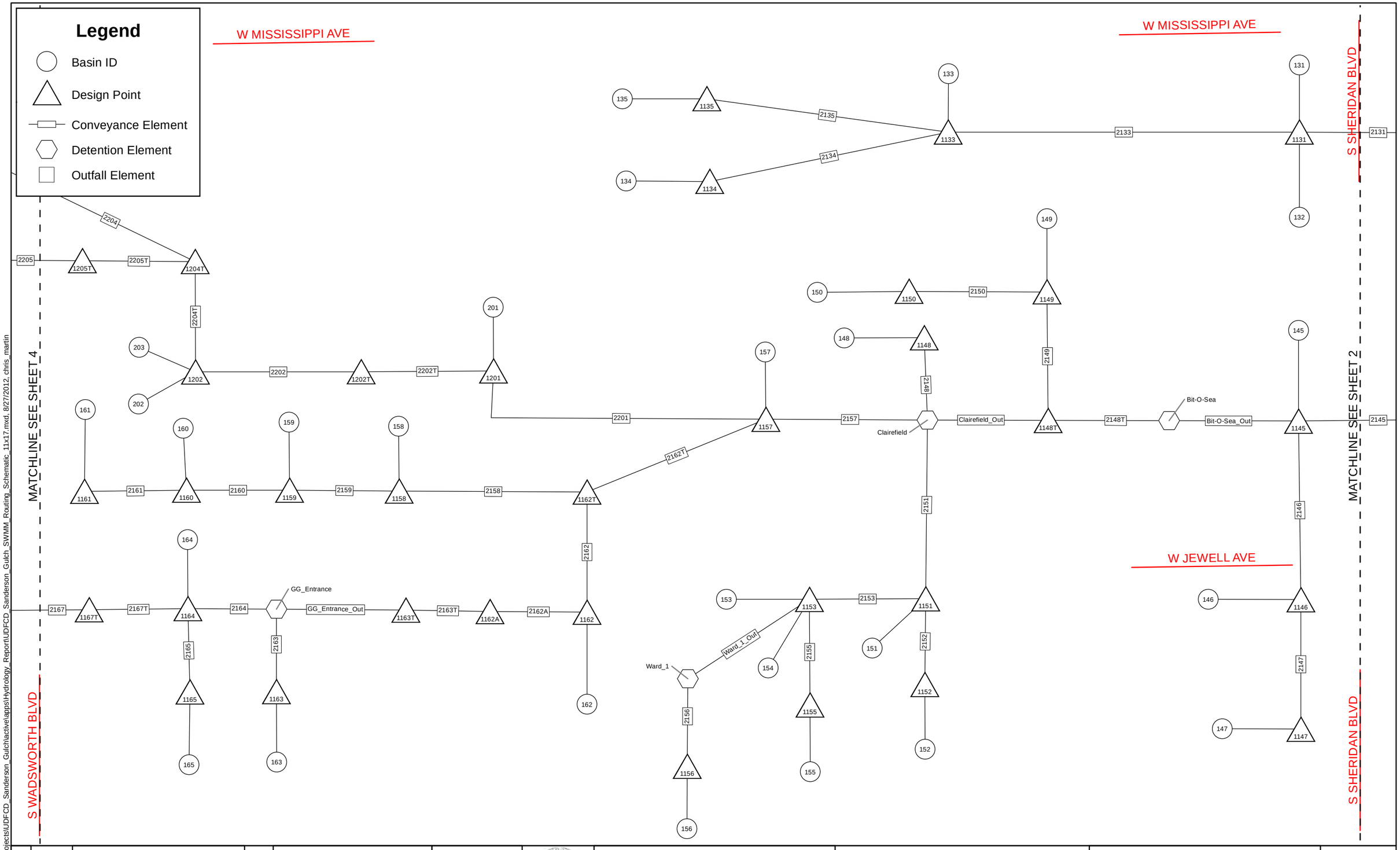
designed by:
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/23/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH MAJOR FLOOD HAZARD AREA DELINEATION

EPA SWMM 5.0 ROUTING SCHEMATIC SHEET 2 OF 4

FIGURE B-2



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No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

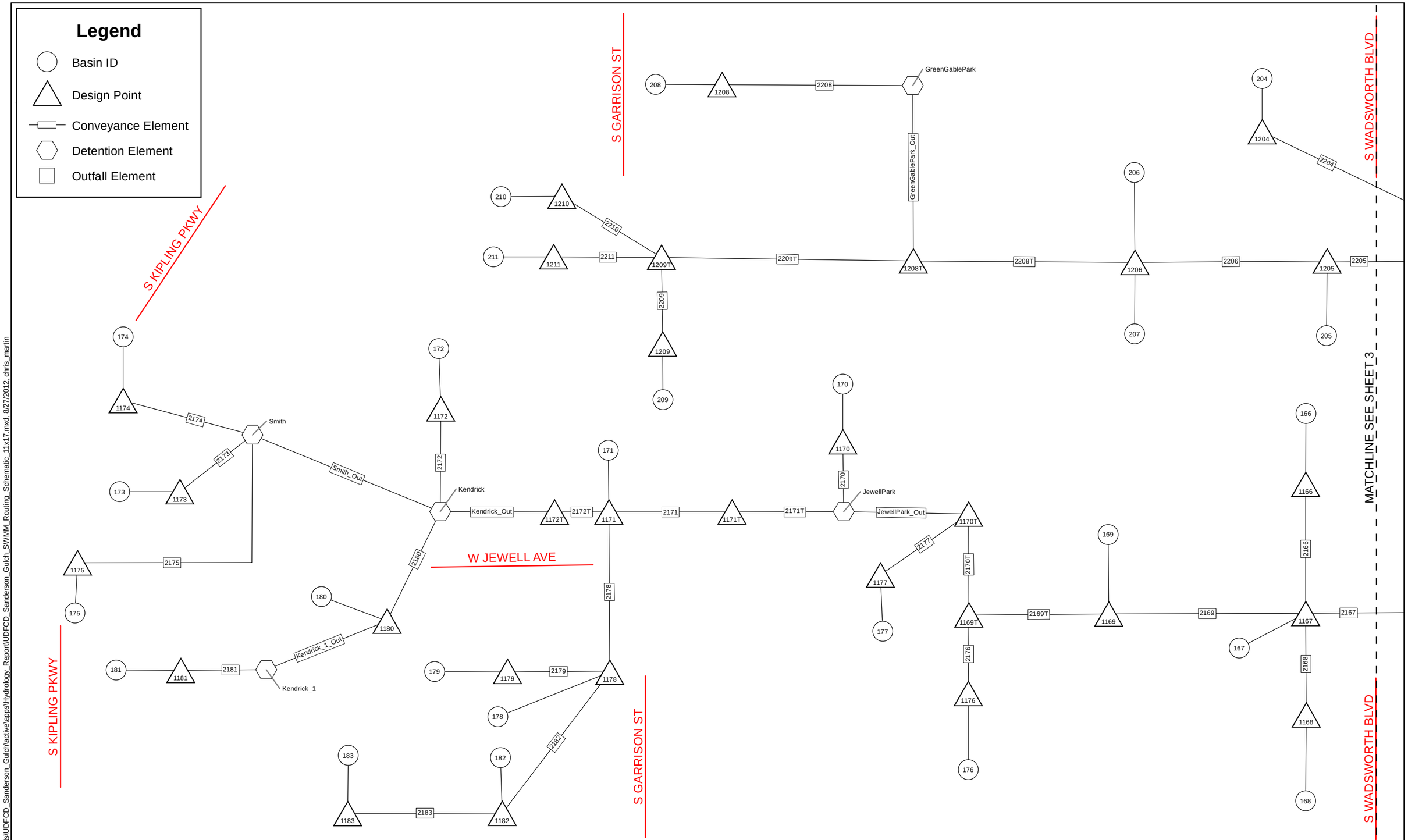
designed by: _____
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/23/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH MAJOR FLOOD HAZARD AREA DELINEATION

EPA SWMM 5.0 ROUTING SCHEMATIC SHEET 3 OF 4

FIGURE B-2



FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\active\apps\Hydrology_Report\UDFCD_Sanderson_Gulch_SWMM_Routing_Schematic_11x17.mxd, 8/27/2012, chris_martin

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by: _____
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/23/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH MAJOR FLOOD HAZARD AREA DELINEATION

EPA SWMM 5.0 ROUTING SCHEMATIC SHEET 4 OF 4

FIGURE B-2

Table B-1 - Rainfall Distributions

(Source of Point Rainfall: Precipitation Frequency Data Server, NOAA Atlas 14, Volume 8, Version 2)

Return Period	2-Year
1Hr Depth (in)	0.798
6Hr Depth (in)	1.23
Area Adjust (sq. mi.)	7.6
Time	Depth
0:05	0.02
0:10	0.03
0:15	0.06
0:20	0.10
0:25	0.16
0:30	0.09
0:35	0.05
0:40	0.04
0:45	0.02
0:50	0.02
0:55	0.02
1:00	0.02
1:05	0.02
1:10	0.02
1:15	0.02
1:20	0.02
1:25	0.02
1:30	0.02
1:35	0.02
1:40	0.02
1:45	0.02
1:50	0.02
1:55	0.01
2:00	0.01
Total Depth	0.83 inch

Return Period	5-Year
1Hr Depth (in)	1.06
6Hr Depth (in)	1.61
Area Adjust (sq. mi.)	7.6
Time	Depth
0:05	0.02
0:10	0.04
0:15	0.09
0:20	0.13
0:25	0.21
0:30	0.11
0:35	0.06
0:40	0.04
0:45	0.04
0:50	0.04
0:55	0.03
1:00	0.03
1:05	0.03
1:10	0.03
1:15	0.03
1:20	0.02
1:25	0.02
1:30	0.02
1:35	0.02
1:40	0.02
1:45	0.02
1:50	0.02
1:55	0.02
2:00	0.01
Total Depth	1.11 inch

Return Period	10-Year
1Hr Depth (in)	1.30
6Hr Depth (in)	1.95
Area Adjust (sq. mi.)	7.6
Time	Depth
0:05	0.03
0:10	0.05
0:15	0.10
0:20	0.16
0:25	0.26
0:30	0.13
0:35	0.07
0:40	0.05
0:45	0.05
0:50	0.04
0:55	0.04
1:00	0.04
1:05	0.04
1:10	0.04
1:15	0.04
1:20	0.03
1:25	0.02
1:30	0.02
1:35	0.02
1:40	0.02
1:45	0.02
1:50	0.02
1:55	0.02
2:00	0.02
Total Depth	1.36 inch

Return Period	25-Year
1Hr Depth (in)	1.64
6Hr Depth (in)	2.46
Area Adjust (sq. mi.)	-
Time	Depth
0:05	0.021
0:10	0.057
0:15	0.082
0:20	0.131
0:25	0.246
0:30	0.410
0:35	0.197
0:40	0.131
0:45	0.082
0:50	0.082
0:55	0.052
1:00	0.052
1:05	0.052
1:10	0.039
1:15	0.039
1:20	0.030
1:25	0.030
1:30	0.023
1:35	0.023
1:40	0.023
1:45	0.023
1:50	0.023
1:55	0.023
2:00	0.023
Total Depth	1.9 inch

Return Period	50-Year
1Hr Depth (in)	1.93
6Hr Depth (in)	2.89
Area Adjust (sq. mi.)	-
Time	Depth
0:05	0.03
0:10	0.07
0:15	0.10
0:20	0.15
0:25	0.29
0:30	0.48
0:35	0.23
0:40	0.15
0:45	0.10
0:50	0.10
0:55	0.06
1:00	0.06
1:05	0.06
1:10	0.05
1:15	0.05
1:20	0.03
1:25	0.03
1:30	0.03
1:35	0.03
1:40	0.03
1:45	0.03
1:50	0.03
1:55	0.03
2:00	0.03
Total Depth	2.23 inch

Return Period	100-Year
1Hr Depth (in)	2.23
6Hr Depth (in)	3.34
Area Adjust (sq. mi.)	-
Time	Depth
0:05	0.02
0:10	0.07
0:15	0.10
0:20	0.18
0:25	0.31
0:30	0.56
0:35	0.31
0:40	0.18
0:45	0.14
0:50	0.11
0:55	0.09
1:00	0.09
1:05	0.09
1:10	0.04
1:15	0.04
1:20	0.03
1:25	0.03
1:30	0.03
1:35	0.03
1:40	0.03
1:45	0.03
1:50	0.03
1:55	0.03
2:00	0.03
Total Depth	2.58 inch

Return Period	500-Year
1Hr Depth (in)	3.00
6Hr Depth (in)	4.52
Area Adjust (sq. mi.)	-
Time	Depth
0:05	0.03
0:10	0.09
0:15	0.14
0:20	0.24
0:25	0.42
0:30	0.75
0:35	0.42
0:40	0.24
0:45	0.19
0:50	0.15
0:55	0.12
1:00	0.12
1:05	0.12
1:10	0.06
1:15	0.06
1:20	0.04
1:25	0.04
1:30	0.04
1:35	0.04
1:40	0.04
1:45	0.04
1:50	0.04
1:55	0.04
2:00	0.04
Total Depth	3.47 inch

Table B-2 - Basin Input Parameters (CUHP 2.0.0)

Basin	Area	Area	Distance to Centroid	Length	Slope	Future Percent Imperviousness	Average Maximum Depression Storage on Pervious	Average Maximum Depression Storage on Impervious	Initial Infiltration Rate	Horton's Decay Coefficient	Final Infiltration Rate
	acres	mi^2	mi	mi	ft/ft	%	in	in	in/hr	1/seconds	in/hr
101	23	0.0352	0.1579	0.3845	0.0364	60	0.35	0.1	3.00	0.00180	0.50
102	72	0.1118	0.2558	0.5524	0.0295	37	0.35	0.1	3.00	0.00180	0.50
103	64	0.0998	0.3015	0.5969	0.0355	40	0.35	0.1	3.00	0.00180	0.50
104	25	0.0391	0.1243	0.3255	0.0326	44	0.35	0.1	3.00	0.00180	0.50
105	5	0.0072	0.0703	0.1963	0.0232	48	0.35	0.1	3.00	0.00180	0.50
106	58	0.0911	0.3035	0.6674	0.0272	35	0.35	0.1	3.00	0.00180	0.50
107	31	0.0480	0.1763	0.4228	0.0215	44	0.35	0.1	3.00	0.00180	0.50
108	59	0.0927	0.1949	0.4927	0.0208	44	0.35	0.1	3.00	0.00180	0.50
109	44	0.0688	0.2038	0.4419	0.0197	44	0.35	0.1	3.00	0.00180	0.50
110	27	0.0419	0.2154	0.4369	0.0069	60	0.35	0.1	3.00	0.00180	0.50
111	40	0.0623	0.2043	0.4749	0.0120	57	0.35	0.1	3.00	0.00180	0.50
112	23	0.0361	0.1183	0.3091	0.0257	62	0.35	0.1	3.00	0.00180	0.50
113	57	0.0894	0.0797	0.4304	0.0158	53	0.35	0.1	3.00	0.00180	0.50
114	77	0.1201	0.3143	0.6878	0.0171	47	0.35	0.1	3.00	0.00180	0.50
115	65	0.1021	0.2437	0.5682	0.0087	65	0.35	0.1	3.00	0.00180	0.50
116	16	0.0244	0.0746	0.2562	0.0177	48	0.35	0.1	3.00	0.00180	0.50
117	46	0.0721	0.2934	0.5455	0.0083	38	0.35	0.1	3.00	0.00180	0.50
118	84	0.1320	0.4056	0.7760	0.0190	50	0.35	0.1	3.00	0.00180	0.50
119	93	0.1454	0.3854	0.7890	0.0091	55	0.35	0.1	3.00	0.00180	0.50
120	51	0.0798	0.2787	0.5274	0.0108	56	0.35	0.1	3.00	0.00180	0.50
121	56	0.0880	0.2071	0.5197	0.0109	48	0.35	0.1	3.00	0.00180	0.50
122	68	0.1069	0.2388	0.6764	0.0095	48	0.35	0.1	3.00	0.00180	0.50
123	38	0.0596	0.2245	0.4372	0.0208	47	0.35	0.1	3.00	0.00180	0.50
124	103	0.1611	0.3869	0.7122	0.0176	44	0.35	0.1	3.00	0.00180	0.50
125	30	0.0470	0.2736	0.5753	0.0105	48	0.35	0.1	3.00	0.00180	0.50
126	17	0.0262	0.1570	0.3971	0.0124	63	0.35	0.1	3.00	0.00180	0.50
127	56	0.0880	0.2711	0.4851	0.0102	51	0.35	0.1	3.00	0.00180	0.50
128	44	0.0685	0.1790	0.6333	0.0150	48	0.35	0.1	3.00	0.00180	0.50
129	43	0.0677	0.1665	0.5053	0.0172	48	0.35	0.1	3.00	0.00180	0.50
130	84	0.1308	0.1268	0.6447	0.0112	58	0.35	0.1	3.00	0.00180	0.50
131	110	0.1715	0.4525	1.0269	0.0129	54	0.35	0.1	3.00	0.00180	0.50
132	36	0.0568	0.2067	0.4451	0.0068	53	0.35	0.1	3.00	0.00180	0.50
133	76	0.1188	0.2113	0.5778	0.0151	43	0.35	0.1	3.00	0.00180	0.50
134	11	0.0173	0.1335	0.3701	0.0113	43	0.35	0.1	3.00	0.00180	0.50
135	40	0.0620	0.2232	0.5319	0.0093	43	0.35	0.1	3.00	0.00180	0.50
136	64	0.0994	0.2912	0.6553	0.0225	43	0.35	0.1	3.00	0.00180	0.50
137	46	0.0718	0.1772	0.4061	0.0215	35	0.35	0.1	3.00	0.00180	0.50
138	30	0.0469	0.1472	0.2632	0.0058	75	0.35	0.1	3.00	0.00180	0.50
139	14	0.0215	0.0765	0.2140	0.0266	48	0.35	0.1	3.00	0.00180	0.50
140	78	0.1223	0.4184	0.8016	0.0156	47	0.35	0.1	3.00	0.00180	0.50

Table B-2 - Basin Input Parameters (CUHP 2.0.0)

Basin	Area	Area	Distance to Centroid	Length	Slope	Future Percent Imperviousness	Average Maximum Depression Storage on Pervious	Average Maximum Depression Storage on Impervious	Initial Infiltration Rate	Horton's Decay Coefficient	Final Infiltration Rate
	acres	mi^2	mi	mi	ft/ft	%	in	in	in/hr	1/seconds	in/hr
141	36	0.0559	0.1072	0.4336	0.0114	49	0.35	0.1	3.00	0.00180	0.50
142	111	0.1740	0.4051	0.8517	0.0191	48	0.35	0.1	3.00	0.00180	0.50
143	69	0.1079	0.2040	0.5089	0.0238	48	0.35	0.1	3.00	0.00180	0.50
144	14	0.0225	0.1114	0.2569	0.0206	45	0.35	0.1	3.00	0.00180	0.50
145	79	0.1240	0.2809	0.6422	0.0106	48	0.35	0.1	3.00	0.00180	0.50
146	29	0.0459	0.1449	0.3269	0.0174	80	0.35	0.1	3.00	0.00180	0.50
147	66	0.1038	0.2437	0.6380	0.0220	73	0.35	0.1	3.00	0.00180	0.50
148	69	0.1084	0.2791	0.6250	0.0121	38	0.35	0.1	3.00	0.00180	0.50
149	105	0.1633	0.3531	0.9491	0.0108	43	0.35	0.1	3.00	0.00180	0.50
150	35	0.0551	0.1964	0.4929	0.0146	32	0.35	0.1	3.00	0.00180	0.50
151	72	0.1122	0.2305	0.4978	0.0228	50	0.35	0.1	3.00	0.00180	0.50
152	19	0.0300	0.1842	0.3552	0.0192	66	0.35	0.1	3.00	0.00180	0.50
153	28	0.0439	0.2620	0.4020	0.0170	48	0.35	0.1	3.00	0.00180	0.50
154	22	0.0347	0.1743	0.3457	0.0164	47	0.35	0.1	3.00	0.00180	0.50
155	66	0.1035	0.1679	0.5046	0.0180	46	0.35	0.1	3.00	0.00180	0.50
156	150	0.2344	0.2810	0.6918	0.0088	64	0.35	0.1	3.00	0.00180	0.50
157	12	0.0190	0.1399	0.2228	0.0289	91	0.35	0.1	3.00	0.00180	0.50
158	1	0.0018	0.0522	0.0989	0.0230	42	0.35	0.1	3.00	0.00180	0.50
159	6	0.0099	0.1019	0.1903	0.0100	59	0.35	0.1	3.00	0.00180	0.50
160	13	0.0203	0.1890	0.3874	0.0176	43	0.35	0.1	3.00	0.00180	0.50
161	17	0.0258	0.0847	0.3289	0.0138	82	0.35	0.1	3.00	0.00180	0.50
162	59	0.0924	0.2662	0.5910	0.0199	13	0.35	0.1	3.00	0.00180	0.50
163	37	0.0572	0.1337	0.3367	0.0349	52	0.35	0.1	3.00	0.00180	0.50
164	76	0.1182	0.1952	0.5456	0.0139	64	0.35	0.1	3.00	0.00180	0.50
165	54	0.0843	0.1460	0.3448	0.0220	48	0.35	0.1	3.00	0.00180	0.50
166	38	0.0599	0.2005	0.4044	0.0169	88	0.35	0.1	3.00	0.00180	0.50
167	74	0.1153	0.2504	0.5778	0.0193	69	0.35	0.1	3.00	0.00180	0.50
168	80	0.1254	0.3930	0.6312	0.0180	48	0.35	0.1	3.00	0.00180	0.50
169	74	0.1155	0.3506	0.6581	0.0178	50	0.35	0.1	3.00	0.00180	0.50
170	46	0.0718	0.1819	0.4444	0.0136	46	0.35	0.1	3.00	0.00180	0.50
171	60	0.0932	0.1454	0.4772	0.0167	45	0.35	0.1	3.00	0.00180	0.50
172	112	0.1756	0.3023	0.7611	0.0105	54	0.35	0.1	3.00	0.00180	0.50
173	106	0.1662	0.1707	0.5466	0.0125	78	0.35	0.1	3.00	0.00180	0.50
174	111	0.1729	0.3859	0.7941	0.0324	45	0.35	0.1	3.00	0.00180	0.50
175	34	0.0524	0.1641	0.4529	0.0510	44	0.35	0.1	3.00	0.00180	0.50
176	66	0.1028	0.3309	0.8397	0.0131	43	0.35	0.1	3.00	0.00180	0.50
177	90	0.1410	0.3820	0.8103	0.0101	47	0.35	0.1	3.00	0.00180	0.50
178	59	0.0920	0.3070	0.6641	0.0063	38	0.35	0.1	3.00	0.00180	0.50
179	18	0.0287	0.1731	0.3240	0.0129	72	0.35	0.1	3.00	0.00180	0.50
180	8	0.0125	0.1393	0.3074	0.0074	77	0.35	0.1	3.00	0.00180	0.50

Table B-2 - Basin Input Parameters (CUHP 2.0.0)

Basin	Area	Area	Distance to Centroid	Length	Slope	Future Percent Imperviousness	Average Maximum Depression Storage on Pervious	Average Maximum Depression Storage on Impervious	Initial Infiltration Rate	Horton's Decay Coefficient	Final Infiltration Rate
	acres	mi^2	mi	mi	ft/ft	%	in	in	in/hr	1/seconds	in/hr
181	45	0.0699	0.1455	0.3793	0.0120	58	0.35	0.1	3.00	0.00180	0.50
182	60	0.0940	0.1375	0.3647	0.0078	25	0.35	0.1	3.00	0.00180	0.50
183	88	0.1370	0.2713	0.6775	0.0109	37	0.35	0.1	3.00	0.00180	0.50
201	49	0.0766	0.1832	0.4301	0.0159	37	0.35	0.1	3.00	0.00180	0.50
202	113	0.1762	0.4277	0.8838	0.0124	52	0.35	0.1	3.00	0.00180	0.50
203	99	0.1550	0.3106	0.6331	0.0168	43	0.35	0.1	3.00	0.00180	0.50
204	103	0.1608	0.3855	0.8730	0.0115	42	0.35	0.1	3.00	0.00180	0.50
205	107	0.1674	0.2371	0.6388	0.0142	44	0.35	0.1	3.00	0.00180	0.50
206	92	0.1437	0.3596	0.7951	0.0133	44	0.35	0.1	3.00	0.00180	0.50
207	72	0.1131	0.2412	0.6034	0.0163	43	0.35	0.1	3.00	0.00180	0.50
208	7	0.0113	0.0766	0.1741	0.0152	16	0.35	0.1	3.00	0.00180	0.50
209	23	0.0365	0.1636	0.3465	0.0131	42	0.35	0.1	3.00	0.00180	0.50
210	30	0.0474	0.1741	0.5143	0.0147	40	0.35	0.1	3.00	0.00180	0.50
211	52	0.0811	0.2545	0.6503	0.0181	37	0.35	0.1	3.00	0.00180	0.50
301	37	0.0584	0.1636	0.3892	0.0253	66	0.35	0.1	3.00	0.00180	0.50
302	84	0.1310	0.2676	0.7107	0.0144	55	0.35	0.1	3.00	0.00180	0.50
303	123	0.1918	0.3219	0.6564	0.0081	51	0.35	0.1	3.00	0.00180	0.50
304	83	0.1294	0.1985	0.6277	0.0084	45	0.35	0.1	3.00	0.00180	0.50
305	114	0.1783	0.2671	0.8137	0.0088	62	0.35	0.1	3.00	0.00180	0.50
306	85	0.1333	0.3408	0.7853	0.0154	50	0.35	0.1	3.00	0.00180	0.50
307	62	0.0963	0.2790	0.5751	0.0191	47	0.35	0.1	3.00	0.00180	0.50

Table B-3 - Detention Pond Stage-Storage-Discharge Information

Smith Reservoir			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	2286900	0
0.3	-	-	19
1	52.8	2308680	-
2	106.3	2352240	19
3	160.8	2395800	1000

100-year capacity reservoir, Stage-Storage information was developed using 2012 Survey. Stage-Discharge curve was information from 1972 MDP. This is a 100-year capacity reservoir.

Kendrick #1 Reservoir			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	317988	0
3	22.8	344124	0
3.1	27.2	3449952	1000

Stage-Storage & Stage-Discharge information was developed using 2012 Survey.

Kendrick Reservoir			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	1511532	0
0.2	7.0	1528085	2
0.4	14.0	1544638	6
0.6	21.2	1561190	11
0.8	28.4	1577743	16
1	35.7	1594296	23
1.2	43.0	1610849	30
1.3	46.7	1619125	34
1.4	50.4	1627402	38
1.5	54.2	1635242	42

Stage-Storage and Stage-Discharge information were adopted from 1972 MDP.

Jewell Park Reservoir			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	93654	0
0.8	1.7	96703	47
1.8	4.0	101059	158
2.8	6.4	108029	305
3.8	9.0	116741	482
4.8	12.4	179032	686
4.9	12.8	181962	710
5	13.2	185218	760
5.1	13.7	188474	827
5.3	14.5	194986	995
5.8	16.9	211266	1574

Stage-Storage information was developed using 2012 aerial survey topography mapping. Stage-Discharge curve was calculated using UDFCD's survey data, as-built plans and UD-Detention Workbook.

Green Gable Entrance Road				
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)	Note
0.4	0.0	650	1	a
1.4	0.1	8500	40	a
2.4	0.5	25865	105	a
3.4	1.4	50235	175	a
4.4	2.9	78625	244	a
5.4	5.0	105660	309	a
6.4	7.6	127930	367	a
7.4	10.8	149965	418	a
8.4	16.1	174950	464	a
9.4	20.3	191450	506	a
10.4	24.8	200075	545	a
11.4	29.6	211725	581	a
11.9	-	-	628	a
12.4	34.5	223400	724	a
12.9	-	-	878	a
13.4	39.8	235725	1104	a
13.9	-	-	1401	a
14.4	45.4	250550	1788	a

a. Stage-Storage information was incorporated from the Wright Water Engineers, Inc. Green Gables Redevelopment CLOMR, May 2012.

Clairefield Reservoir			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	35277	0
0.3	0.3	39316	12
1.3	2.2	133873	108
2.3	5.5	153706	253
4.3	13.3	182573	647
5.3	17.9	219868	885
6.3	23.5	268772	1147
7.3	30.1	302896	1430
7.5	31.5	310072	1490
8.5	39.0	345953	1812
9.55	47.6	366340	2344
10	51.6	409028	2684
11	61.5	453024	3766

Source: LOMR Case No. 03-08-0090P, September 24, 2002, City of Lakewood Drainage Conformation Statement and expanded using 2012 survey and As-built Plans.

Table B-3 - Detention Pond Stage-Storage-Discharge Information

Bit-O-Sea Reservoir			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	195584	0
1.2	5.8	227383	269
3.2	17.1	264845	1371
4.5	25.8	315810	2503
5.2	31.1	343253	3294
6.2	39.1	355014	5495

Stage-Storage information was developed using Denver's 2008 topography. Stage-Discharge curve was calculated using as-built plans and UD-Detention Workbook.

Ward Reservoir #1			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	2744280	0
2	132.3	3018708	5
4	277.3	3297492	1000

Stage-Storage-Discharge curves were developed using Denver's 2008 topography, storm drainage information. This is a 100-year capacity reservoir.

Harvey Park Lake			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	248292	0
2	12.4	291852	5
2.2	13.8	296208	1000

Stage-Storage information was developed using Denver's 2008 topography. 100-year capacity, outlet controlled by 18-inch pipe.

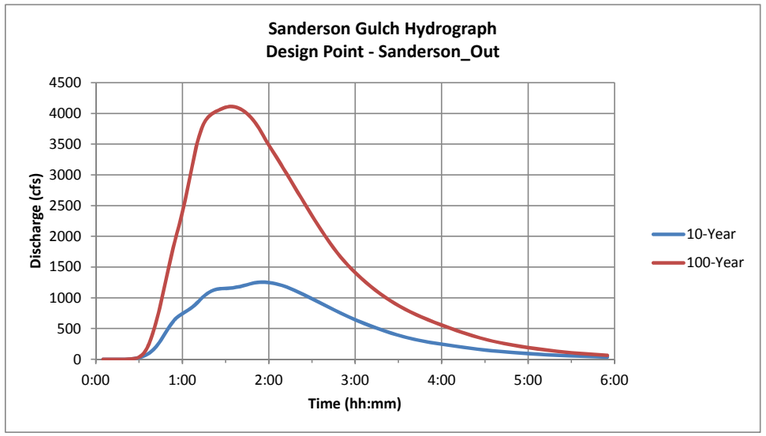
Ward Reservoir #5			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	781902	0
2	36.4	801504	3
2.2	40.0	801504	1000

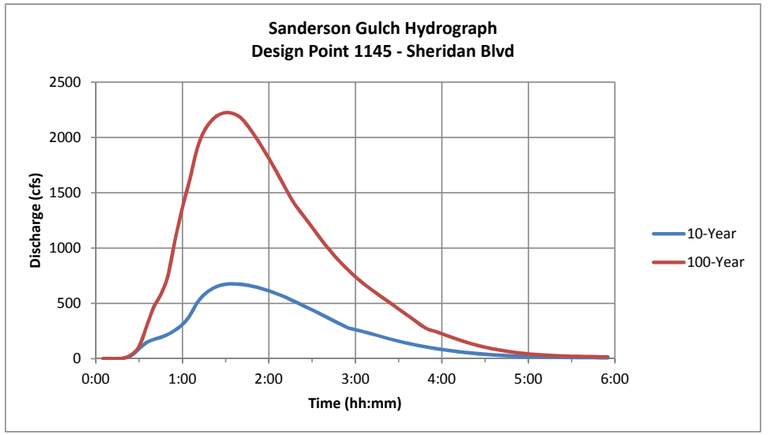
Stage-Storage information was developed using Denver's 2008 topography. 100-year capacity, outlet controlled by 12-inch pipe.

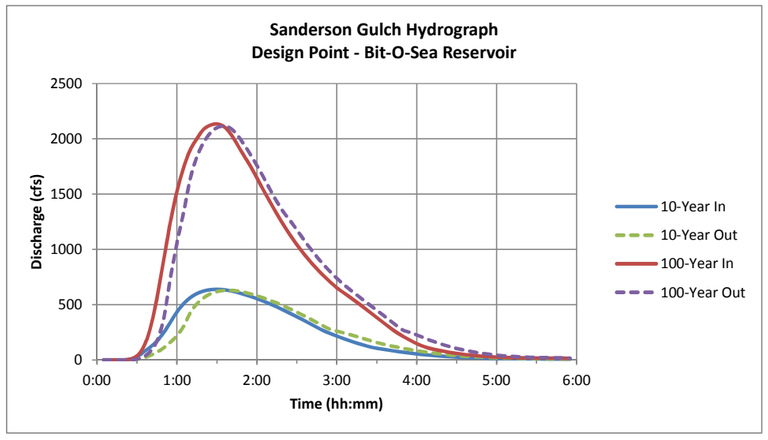
Green Gable Park Reservoir			
Depth (ft)	Storage (AF)	Area (SF)	Total Discharge (cfs)
0	0.0	37026	0
1	0.9	39640	0
2	1.8	44431	0
2.5	2.4	50965	53
3	3.0	55321	150

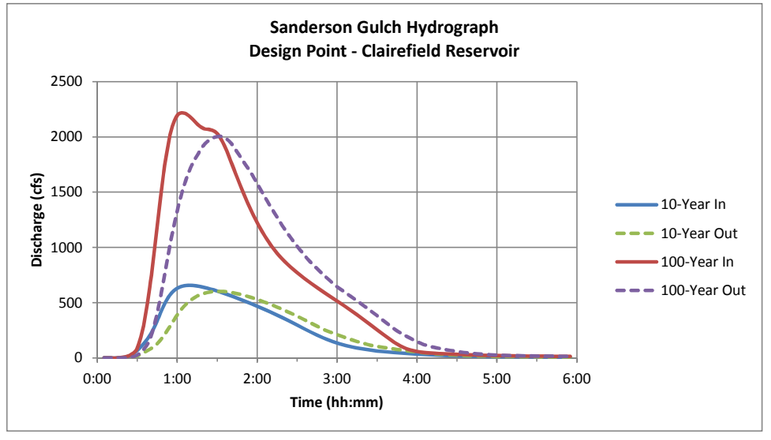
Stage-Storage & Stage-Discharge information was developed using 2012 Survey.

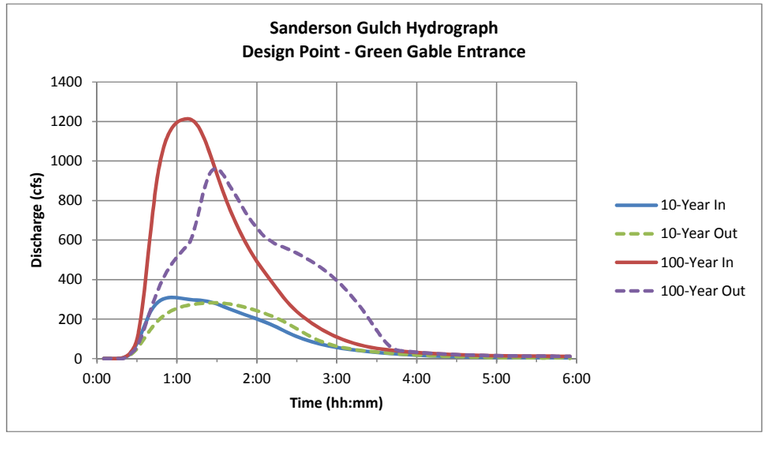
Figure B-3 - Storm Hydrographs at Key Design Points











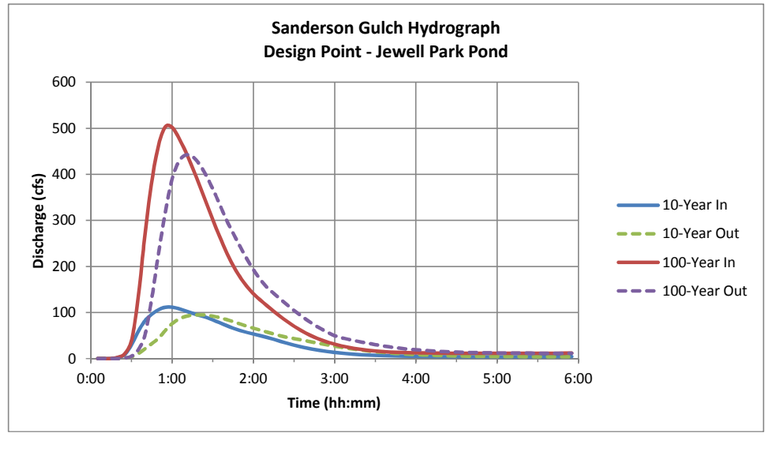
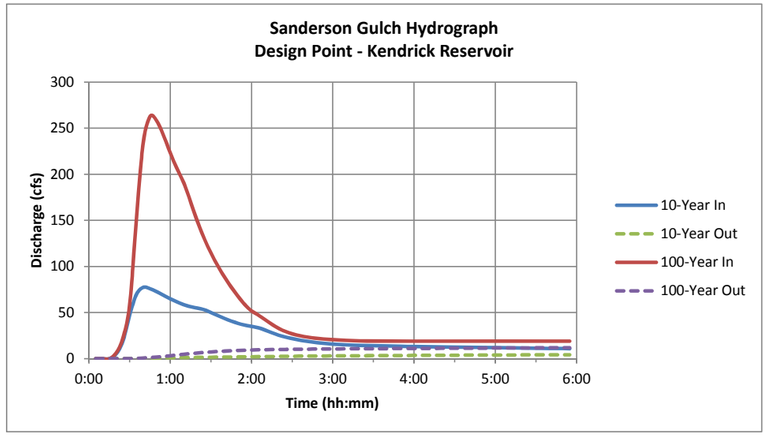
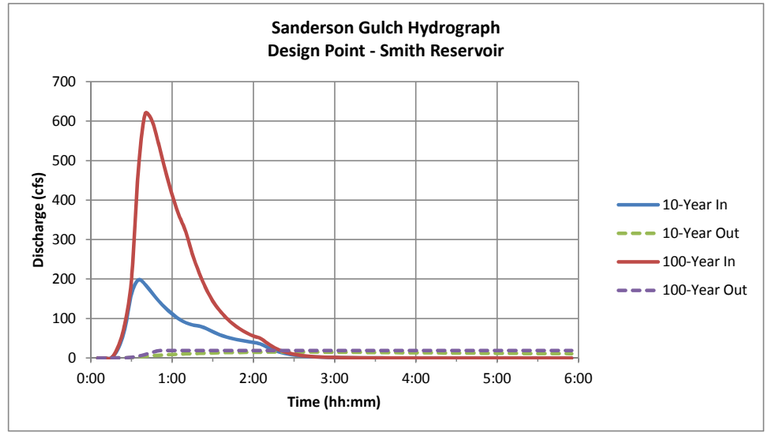
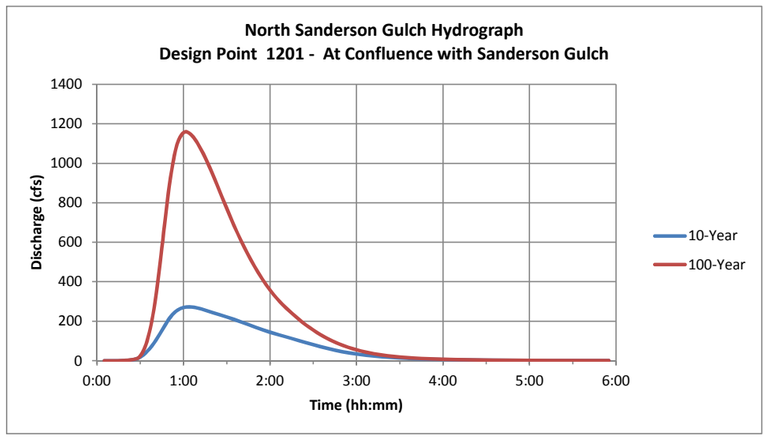


Figure B-3 - Storm Hydrographs at Key Design Points







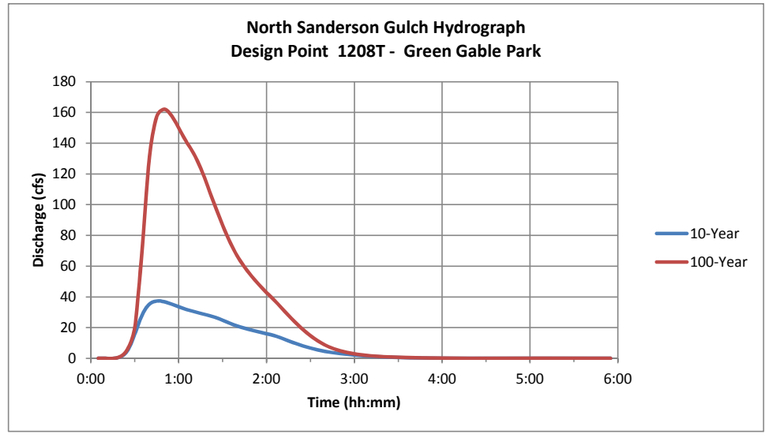


Figure B-4a - Sanderson Gulch
Baseline Peak Discharge vs. Channel Station - Future Conditions

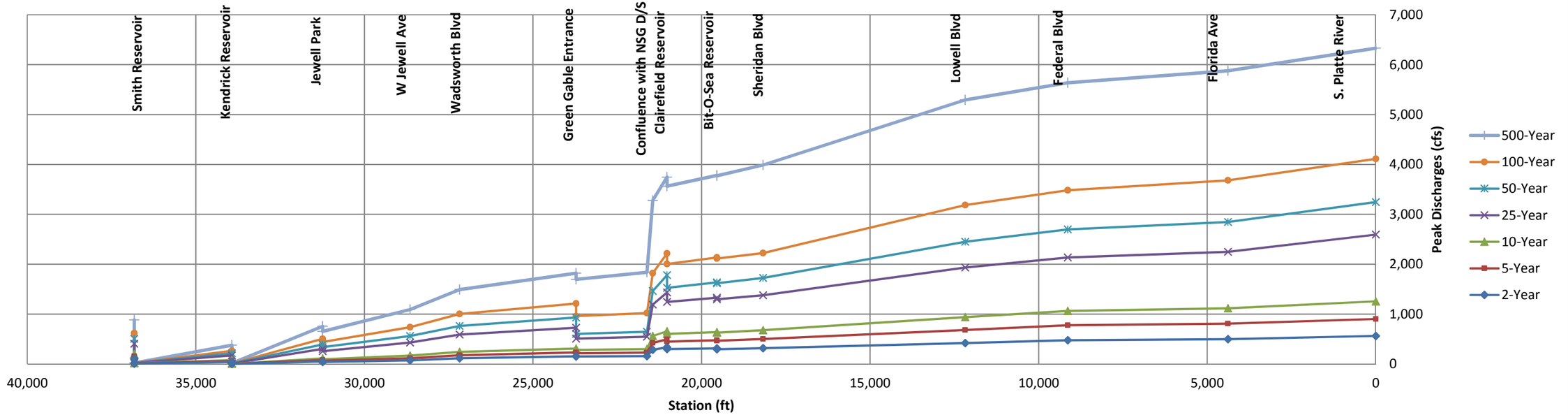
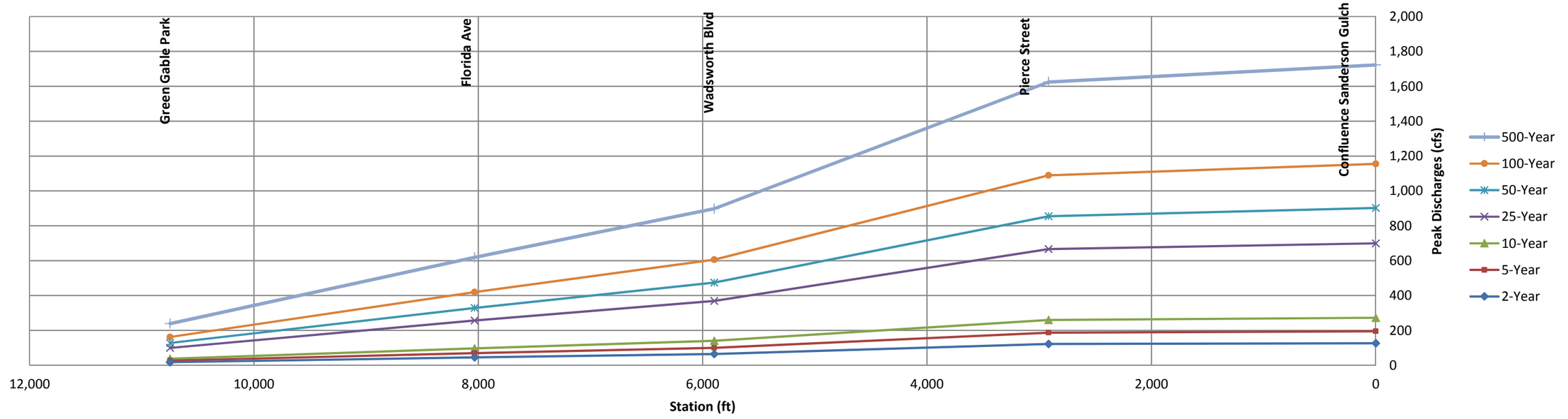


Figure B-4b - North Sanderson Gulch
Baseline Peak Discharge vs. Channel Station - Future Conditions



Low Flows to Weir Gulch 30" Storm Drain (Not Modeled)

Irrigation Flows to East Reservoir

Sanctuary Park Wetland

Low Flows to Bear Creek 30" Storm Drain (Not Modeled)

Mississippi Gulch Remnant

Q_{100}= 90 cfs

Q_{100}= 709 cfs

Q_{100}= 314 cfs

Q_{100}= 71 cfs

Q_{100}= 464 cfs

Smith Reservoir
- Irrigation Storage
- Effective Routing
- Private
- 100-Year Capacity

Kenderick Lake No. 1
- City-Owned
- Irrigation Storage
- Effective Routing Reservoir
- 44 AC Tributary
- 100-Year Capacity

Kenderick Reservoir
- City-Owned
- Effective Routing Reservoir
- 100-Year Capacity

Jewell Park Pond
- City-Owned
- Effective Routing Reservoir
- Approximate10-Year Capacity

Green Gables Park
- City-Owned
- Detention
- Effective Routing Reservoir
- 100-Year Capacity

Ward Reservoir Number 1
- Private
- Effective Routing Reservoir
- 100-Year capacity

Green Gables Entrance Road
- City-Owned
- Detention
- Effective Routing Reservoir
- Less than 25-Year Capacity

Clairfield Reservoir
- City-Owned
- Effective Routing Detention
- Approximate 25-Year Capacity

Bit-O-Sea
- Private
- Effective Routing Detention
- Less than 100-Year Capacity

Ward Reservoir Number 5
- Private
- Effective Routing Reservoir
- 100-Year capacity

Harvey Park Lake
- City-Owned
- Effective Routing Reservoir
- 100-Year capacity

0 0.25 0.5 1 Miles

FILE: G:\gis_projects\UDFCD_Sanderson_Gulch\activelappsHydrology_Report\Fig_B-7_UDFCD_Sanderson_Gulch_Detention_11x17.mxd, 11/2/2012, wilson_wheeler

No.	DATE	DESCRIPTION	APPR.

Matrix DESIGN GROUP

designed by: _____
drawn by: WW
checked by: RK
project no.: 12.155.020
date: 8/27/2012

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, CITY & COUNTY OF DENVER, CITY OF LAKEWOOD

SANDERSON GULCH FLOOD HAZARD AREA DELINEATION

MODELED DETENTION AND SPLIT FLOWS

FIGURE B-5

EPA SWMM 5.0 INPUT PARAMETERS

Table B-4 EPA SWMM 5.1 INPUT PARAMETERS

```
[TITLE]
;;Project Title/Notes

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         HORTON
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           01/01/2005
START_TIME           00:00:00
REPORT_START_DATE    01/01/2005
REPORT_START_TIME    00:00:00
END_DATE             01/01/2005
END_TIME             06:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:05:00
WET_STEP             00:05:00
DRY_STEP             01:00:00
ROUTING_STEP         0:05:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[FILES]
;;Interfacing Files
USE INFLOWS "R:\16.155.029 (Sanderson Gulch FHAD Revision)\Hydrology\Sanderson Gulch_Hydrology_NOAA
14\CUHP\6_Fut_100yr_0mi^2_Sanderson FHAD 2018_CUHP_200.txt"

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
CONSTANT         0.0
DRY_ONLY         NO

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ----------
1101             5241.96    0          0          0          0
1102T            5256       0          0          0          0
1103             5284       0          0          0          0
1103T            5273       0          0          0          0
1104             5274       0          0          0          0
1105             5330       0          0          0          0
1106T            5278.19    0          0          0          0
1107             5308       0          0          0          0
1108T            5296.54    0          0          0          0
1109             5310       0          0          0          0
1110             5354       0          0          0          0
1111             5338       0          0          0          0
1112             5318       0          0          0          0
1113             5340       0          0          0          0
1114T            5322.91    0          0          0          0
1115             5362       0          0          0          0
1116             5384       0          0          0          0
1117             5384       0          0          0          0
1120             5394       0          0          0          0
1121             5410       0          0          0          0
1122             5404       0          0          0          0
1123             5420       0          0          0          0
1124T            5344.06    0          0          0          0
1125             5380       0          0          0          0
1126             5398       0          0          0          0
1127             5400       0          0          0          0
1128             5418       0          0          0          0
1129             5422       0          0          0          0
1130             5428       0          0          0          0
1131             5438       0          0          0          0
1133             5450       0          0          0          0
1134             5498       0          0          0          0
1135             5494       0          0          0          0
1136T            5366       0          0          0          0
1137             5436       0          0          0          0
1137T            5432       0          0          0          0
1138             5452       0          0          0          0
1139             5454       0          0          0          0
1140T            5377       0          0          0          0
1141             5420       0          0          0          0
1143             5456       0          0          0          0
1143T            5386       0          0          0          0
1144T            5393.72    0          0          0          0
1145T            5405.56    0          0          0          0
1146             5440       0          0          0          0
1147             5466       0          0          0          0
1148             5428       0          0          0          0
1148T            5426       0          0          0          0
1149             5444       0          0          0          0
1150             5482       0          0          0          0
1151             5440       0          0          0          0
1152             5480       0          0          0          0
1153             5480       0          0          0          0
1155             5506       0          0          0          0
1156             5510       0          0          0          0
1157             5434       0          0          0          0
1158             5464       0          0          0          0
1159             5476       0          0          0          0
1160             5492       0          0          0          0
1161             5514       0          0          0          0
1162A            5458.46    0          0          0          0
1162T            5435       0          0          0          0
1163             5462       0          0          0          0
1163T            5460       0          0          0          0
1164             5480       0          0          0          0
1165             5500       0          0          0          0
1166             5518       0          0          0          0
1167T            5499.42    0          0          0          0
1168             5520       0          0          0          0
1169T            5548       0          0          0          0
1170             5578       0          0          0          0
1170T            5574.19    0          0          0          0
1171T            5583.12    0          0          0          0
1172             5620       0          0          0          0
```

```
1172T           5600       0         0         0         0
1173            5660       0         0         0         0
1174            5666       0         0         0         0
1175            5680       0         0         0         0
1176            5552       0         0         0         0
1177            5580       0         0         0         0
1178            5608       0         0         0         0
1179            5626       0         0         0         0
1180            5644       0         0         0         0
1181            5652       0         0         0         0
1182            5625       0         0         0         0
1183            5635       0         0         0         0
1201            5451.23    0         0         0         0
1202T           5472.5     0         0         0         0
1204            5522       0         0         0         0
1204T           5496       0         0         0         0
1205T           5508       0         0         0         0
1206            5544       0         0         0         0
1208            5588       0         0         0         0
1208T           5582       0         0         0         0
1209            5584       0         0         0         0
1209T           5583       0         0         0         0
1210            5590       0         0         0         0
1211            5590       0         0         0         0
1303            5330       0         0         0         0
1304            5346       0         0         0         0
1305            5350       0         0         0         0
1306            5366       0         0         0         0
1307            5398       0         0         0         0
1102            5246.14    0         0         0         0
1106            5278.63    0         0         0         0
1108            5297.85    0         0         0         0
1114            5323.02    0         0         0         0
1124            5347.31    0         0         0         0
1140            5378.64    0         0         0         0
1144            5394.07    0         0         0         0
1145            5406.98    0         0         0         0
1162            5442.24    0         0         0         0
1167            5500.1     0         0         0         0
1169            5521.3     0         0         0         0
1205            5510.53    0         0         0         0
1171            5586.49    0         0         0         0
1202            5473.15    0         0         0         0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
Jewell_Out       5384       FREE                        NO
Mississippi_Out  5270       FREE                        NO
;Sanderson Gulch at South Platte River
Sanderson_Out    5230       FREE                        NO
Mississippi_St_Out 5298       FREE                        NO

[DIVIDERS]
;;Name           Elevation  Diverted Link    Type       Parameters
;;-------------- ---------- ---------------- ---------- ----------
1119             5386       2119DIV          OVERFLOW   0          0          0          0
1301             5275.56    2301DIV          OVERFLOW   0          0          0          0
1302             5300       2302             CUTOFF     89         0          0          0         0

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap
Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------
         -------- --------
Bit-O-Sea        5422.8   6.2        0          TABULAR    Bit-O-Sea_Storage            0        0
Clairefield      5427     11         0          TABULAR    Clairefield_Storage          0        0
GG_Entrance      5460.8   14.4       0          TABULAR    GG_Entrance_Storage          0        0
GreenGablePark   5587     3          0          TABULAR    GreenGablePark               0        0
Harvey           5434     2          0          TABULAR    Harvey_Storage               0        0
JewellPark       5576     5.8        0          TABULAR    Jewell_Storage               0        0
Kendrick         5618     2          0          TABULAR    Kendrick_Storage             0        0
Kendrick_1       5651     3          0          TABULAR    Kendrick_1_Storage           0        0
Smith            5658     4          0          TABULAR    Smith_Storage                0        0
Ward_1           5508     4          0          TABULAR    Ward_1_Storage               0        0
Ward_5           5450     3          0          TABULAR    Ward_5_Storage               0        0

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow
MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- --
--------
2101             1101             Sanderson_Out    644        0.044      0          0          0          0

2102             1102             1101             210        0.01875    0          0          0          0

2102T            1102T            1102             810        0.044      0          0          0          0

2103             1103             1103T            232        0.02       0          0          0          0

2103T            1103T            1102T            1743       0.044      0          0          0          0

2104             1104             1103T            310        0.044      0          0          0          0

2105             1105             1104             1635       0.02       0          0          0          0

2106             1106             1106T            104        0.03       0          0          0          0

2106T            1106T            1104             490        0.044      0          0          0          0

2107             1107             1106T            545        0.02       0          0          0          0

2108             1108             1108T            115        0.019      0          0          0          0

2108T            1108T            1106             1785       0.044      0          0          0          0

2109             1109             1108             305        0.02       0          0          0          0

2110             1110             1109             1906       0.02       0          0          0          0

2111             1111             1109             1297       0.02       0          0          0          0

2112             1112             1108             584        0.044      0          0          0          0

2113             1113             1112             420        0.02       0          0          0          0

2114             1114             1114T            106        0.019      0          0          0          0

2114T            1114T            1112             724        0.05       0          0          0          0

2115             1115             1114             1092       0.02       0          0          0          0

2116             1116             1115             2486       0.02       0          0          0          0

2117             1117             1115             2456       0.02       0          0          0          0

2119             1119             1114             1809       0.023      0          1.89       0          0

2119DIV          1119             Jewell_Out       400        0.02       0          0          0          0

2120             1120             1119             1348       0.02       0          0          0          0
```

2121	1121	1119	2820	0.02	0	0	0	0	2149	1149	1148T	1124	0.02	0	0	0	0
2122	1122	1119	2593	0.02	0	0	0	0	2150	1150	1149	3411	0.02	0	0	0	0
2123	1123	1119	3872	0.02	0	0	0	0	2151	1151	Clairefield	400	0.01	0	0	0	0
2124	1124	1124T	133	0.019	0	0	0	0	2152	1152	1151	1865	0.02	0	0	0	0
2124T	1124T	1114	2910	0.05	0	0	0	0	2153	1153	1151	1715	0.02	0	0	0	0
2125	1125	1124	1657	0.02	0	0	0	0	2155	1155	1153	1736	0.02	0	0	0	0
2126	1126	1125	1010	0.02	0	0	0	0	2156	1156	Ward_1	400	0.01	0	0	0	0
2127	1127	1125	1636	0.02	0	0	0	0	2157	1157	Clairefield	540	0.044	0	0	0	0
2128	1128	1127	1877	0.02	0	0	0	0	2158	1158	1162T	1004	0.02	0	0	0	0
2129	1129	1127	1816	0.02	0	0	0	0	2159	1159	1158	524	0.02	0	0	0	0
2130	1130	1129	1179	0.02	0	0	0	0	2160	1160	1159	937	0.02	0	0	0	0
2131	1131	1130	1378	0.02	0	0	0	0	2161	1161	1160	1751	0.02	0	0	0	0
2133	1133	1131	1616	0.02	0	0	0	0	2162	1162	1162T	343	0.019	0	0	0	0
2134	1134	1133	2177	0.02	0	0	0	0	2162A	1162A	1162	668	0.044	0	0	0	0
2135	1135	1133	2581	0.02	0	0	0	0	2162T	1162T	1157	200	0.05	0	0	0	0
2136T	1136T	1124	1693	0.044	0	0	0	0	2163	1163	GG_Entrance	400	0.01	0	0	0	0
2137	1137	Harvey	400	0.01	0	0	0	0	2163T	1163T	1162A	759	0.044	0	0	0	0
2137T	1137T	1136T	1910	0.019	0	0	0	0	2164	1164	GG_Entrance	800	0.03	0	0	0	0
2138	1138	Ward_5	400	0.01	0	0	0	0	2165	1165	1164	1285	0.03	0	0	0	0
2139	1139	Ward_5	400	0.01	0	0	0	0	2166	1166	1167	406	0.02	0	5.9	0	0
2140	1140	1140T	83	0.019	0	0	0	0	2167	1167	1167T	130	0.019	0	0	0	0
2140T	1140T	1136T	1321	0.044	0	0	0	0	2167T	1167T	1164	2142	0.03	0	0	0	0
2141	1141	1140	1895	0.02	0	9.36	0	0	2168	1168	1167	862	0.02	0	5.9	0	0
2143	1143	1143T	1997	0.02	0	0	0	0	2169	1169	1167	1606	0.03	0	0	0	0
2143T	1143T	1140	1232	0.05	0	0	0	0	2169T	1169T	1169	1320	0.044	0	0	0	0
2144	1144	1144T	65	0.019	0	0	0	0	2170	1170	JewellPark	400	0.01	0	0	0	0
2144T	1144T	1143T	513	0.05	0	0	0	0	2170T	1170T	1169T	1320	0.044	0	0	0	0
2145	1145	1145T	140	0.019	0	0	0	0	2171	1171	1171T	160	0.03	0	0	0	0
2145T	1145T	1144	914	0.044	0	0	0	0	2171T	1171T	JewellPark	826	0.044	0	0	0	0
2146	1146	1145	406	0.02	0	11.02	0	0	2172	1172	Kendrick	400	0.01	0	0	0	0
2147	1147	1146	1140	0.02	0	0	0	0	2172T	1172T	1171	1063	0.044	0	0	0	0
2148	1148	Clairefield	400	0.01	0	0	0	0	2173	1173	Smith	400	0.01	0	0	0	0
2148T	1148T	Bit-O-Sea	400	0.01	0	0	0	0	2174	1174	Smith	200	0.02	0	0	0	0

2175	1175	Smith	1402	0.019	0	0	0	0
2176	1176	1169T	100	0.02	0	0	0	0
2177	1177	1170T	200	0.02	0	0	0	0
2178	1178	1171	475	0.02	0	0	0	0
2179	1179	1178	1268	0.02	0	0	0	0
2180	1180	Kendrick	465	0.044	0	0	0	0
2181	1181	Kendrick_1	400	0.01	0	0	0	0
2182	1182	1178	2500	0.02	0	0	0	0
2183	1183	1182	1351	0.02	0	0	0	0
2201	1201	1157	944	0.044	0	0	0	0
2202	1202	1202T	110	0.019	0	0	0	0
2202T	1202T	1201	1860	0.044	0	0	0	0
2204	1204	1204T	1885	0.02	0	0	0	0
2204T	1204T	1202	1855	0.044	0	0	0	0
2205	1205	1205T	130	0.019	0	0	0	0
2205T	1205T	1204T	956	0.044	0	0	0	0
2206	1206	1205	2277	0.044	0	0	0	0
2208	1208	GreenGablePark	400	0.01	0	0	0	0
2208T	1208T	1206	3278	0.02	0	0	0	0
2209	1209	1209T	400	0.01	0	0	0	0
2209T	1209T	1208T	400	0.01	0	0	0	0
2210	1210	1209T	550	0.02	0	0	0	0
2211	1211	1209T	756	0.02	0	0	0	0
2301	1301	1102T	1735	0.015	0	.88	0	0
2301DIV	1301	Mississippi_Out	400	0.02	0	0	0	0
2302	1302	1301	349	0.02	0	16.44	0	0
2303	1303	1301	1655	0.02	0	16.44	0	0
2304	1304	1303	2445	0.02	0	0	0	0
2305	1305	1303	2117	0.02	0	0	0	0
2306	1306	1305	2260	0.02	0	0	0	0
2307	1307	1306	1598	0.02	0	0	0	0
Mississippi_St 0	1302	Mississippi_St_Out	100	0.019	0	0	0	

[OUTLETS]

;;Name	From Node	To Node	Offset	Type	QTable/Qcoeff	Qexpon	Gated
;;--------------	---------------	---------------	----------	--------------	----------------	----------	--
Bit-O-Sea_Out	Bit-O-Sea	1145	0	TABULAR/DEPTH	Bit-O-Sea_Out		NO
Clairefield_Out	Clairefield	1148T	0	TABULAR/HEAD	Clairefield_Out		NO
GG_Entrance_Out	GG_Entrance	1163T	0	TABULAR/HEAD	GG_Entrance_Out		NO
GreenGablePark_Out	GreenGablePark	1208T	0	TABULAR/DEPTH	GreenGablePark_Out		NO
Harvey_Out	Harvey	1137T	0	TABULAR/HEAD	Kendrick_1_Out		NO
JewellPark_Out	JewellPark	1170T	0	TABULAR/HEAD	Jewell_Out		NO
Kendrick_1_Out	Kendrick_1	1180	0	TABULAR/HEAD	Kendrick_1_Out		NO
Kendrick_Out	Kendrick	1172T	0	TABULAR/HEAD	Kendrick_Out		NO
Smith_Out	Smith	Kendrick	0	TABULAR/HEAD	Smith_Out		NO
Ward_1_Out	Ward_1	1153	0	TABULAR/HEAD	Ward_1_Out		NO
Ward_5_Out	Ward_5	Harvey	0	TABULAR/HEAD	Ward_5_Out		NO

[XSECTIONS]

;;Link	Shape	Geom1	Geom2	Geom3	Geom4	Barrels	Culvert
;;--------------	------------	----------	----------	----------	----------	----------	----------
2101	TRAPEZOIDAL	12	10	3.5	3.5	1	
2102	TRAPEZOIDAL	10	10	5	5	1	
2102T	TRAPEZOIDAL	10	10	14	5.7	1	
2103	TRAPEZOIDAL	5	1	20	20	1	
2103T	TRAPEZOIDAL	12	10	5	5	1	
2104	TRAPEZOIDAL	12	10	5	10	1	
2105	TRAPEZOIDAL	5	1	20	20	1	
2106	TRAPEZOIDAL	10	10	5	5	1	
2106T	TRAPEZOIDAL	12	10	4	6	1	
2107	TRAPEZOIDAL	5	1	20	20	1	
2108	TRAPEZOIDAL	10	10	5	5	2	
2108T	TRAPEZOIDAL	16	10	6	6	1	
2109	TRAPEZOIDAL	5	1	20	20	1	
2110	TRAPEZOIDAL	5	1	20	20	1	
2111	TRAPEZOIDAL	5	1	20	20	1	
2112	TRAPEZOIDAL	8	10	8	3	1	
2113	TRAPEZOIDAL	5	1	20	20	1	
2114	TRAPEZOIDAL	10	10	5	5	3	
2114T	TRAPEZOIDAL	14	10	8	3	1	
2115	TRAPEZOIDAL	5	1	20	20	1	
2116	TRAPEZOIDAL	5	1	20	20	1	
2117	TRAPEZOIDAL	5	1	20	20	1	
2119	CIRCULAR	3	0	0	0	1	
2119DIV	TRAPEZOIDAL	5	1	20	20	1	
2120	TRAPEZOIDAL	5	1	20	20	1	
2121	TRAPEZOIDAL	5	1	20	20	1	
2122	TRAPEZOIDAL	5	1	20	20	1	
2123	TRAPEZOIDAL	5	1	20	20	1	
2124	TRAPEZOIDAL	10	10	5	5	1	
2124T	TRAPEZOIDAL	14	10	4	5	1	
2125	TRAPEZOIDAL	5	1	20	20	1	
2126	TRAPEZOIDAL	5	1	20	20	1	
2127	TRAPEZOIDAL	5	1	20	20	1	
2128	TRAPEZOIDAL	5	1	20	20	1	
2129	TRAPEZOIDAL	5	1	20	20	1	
2130	TRAPEZOIDAL	5	1	20	20	1	
2131	TRAPEZOIDAL	5	1	20	20	1	

```
2133            TRAPEZOIDAL  5              1         20        20        1
2134            TRAPEZOIDAL  5              1         20        20        1
2135            TRAPEZOIDAL  5              1         20        20        1
2136T           TRAPEZOIDAL  9              10        10        10        1
2137            DUMMY        0              0         0         0         1
2137T           CIRCULAR     1.5            0         0         0         1
2138            DUMMY        0              0         0         0         1
2139            DUMMY        0              0         0         0         1
2140            TRAPEZOIDAL  10             10        5         5         1
2140T           TRAPEZOIDAL  10             10        10        10        1
2141            TRAPEZOIDAL  5              1         20        20        1
2143            TRAPEZOIDAL  5              1         20        20        1
2143T           TRAPEZOIDAL  12             10        6         3.5       1
2144            TRAPEZOIDAL  10             10        5         5         1
2144T           TRAPEZOIDAL  12             10        2         2         1
2145            TRAPEZOIDAL  10             10        5         5         1
2145T           TRAPEZOIDAL  12             10        3         3         1
2146            TRAPEZOIDAL  5              1         20        20        1
2147            TRAPEZOIDAL  5              1         20        20        1
2148            DUMMY        0              0         0         0         1
2148T           DUMMY        0              0         0         0         1
2149            TRAPEZOIDAL  5              1         20        20        1
2150            TRAPEZOIDAL  5              1         20        20        1
2151            DUMMY        0              0         0         0         1
2152            TRAPEZOIDAL  5              1         20        20        1
2153            TRAPEZOIDAL  5              1         20        20        1
2155            TRAPEZOIDAL  5              1         20        20        1
2156            DUMMY        0              0         0         0         1
2157            TRAPEZOIDAL  8              50        5         5         1
2158            TRAPEZOIDAL  5              1         20        20        1
2159            TRAPEZOIDAL  5              1         20        20        1
2160            TRAPEZOIDAL  5              1         20        20        1
2161            TRAPEZOIDAL  5              1         20        20        1
2162            TRAPEZOIDAL  10             10        5         5         1
2162A           TRAPEZOIDAL  6              40        3         3         1
2162T           TRAPEZOIDAL  12             10        4         4         1
2163            DUMMY        0              0         0         0         1
2163T           TRAPEZOIDAL  6              120       7         3         1
2164            TRAPEZOIDAL  5              1         20        20        1
2165            TRAPEZOIDAL  5              1         20        20        1
2166            TRAPEZOIDAL  5              1         20        20        1
2167            TRAPEZOIDAL  10             10        5         5         1
2167T           TRAPEZOIDAL  5              10        20        20        1
2168            TRAPEZOIDAL  5              1         20        20        1
2169            TRAPEZOIDAL  5              1         2         20        1
2169T           TRAPEZOIDAL  7              4         3         3         1
2170            DUMMY        0              0         0         0         1
2170T           TRAPEZOIDAL  7              4         3         3         1
2171            TRAPEZOIDAL  5              1         20        20        1
2171T           TRAPEZOIDAL  10             4         9         7         1
2172            DUMMY        0              0         0         0         1
2172T           TRAPEZOIDAL  4              10        10        10        1
2173            DUMMY        0              0         0         0         1
2174            TRAPEZOIDAL  5              1         20        20        1
2175            HORIZ_ELLIPSE 3.58          5.67      0         0         1
2176            TRAPEZOIDAL  5              1         20        20        1
2177            TRAPEZOIDAL  5              1         20        20        1
2178            TRAPEZOIDAL  5              1         20        20        1
2179            TRAPEZOIDAL  5              1         20        20        1
2180            TRAPEZOIDAL  5              1         20        20        1
2181            DUMMY        0              0         0         0         1
2182            TRAPEZOIDAL  5              1         20        20        1
2183            TRAPEZOIDAL  5              1         20        20        1
2201            TRAPEZOIDAL  10             10        5         5         1
2202            TRAPEZOIDAL  5              1         20        20        2
2202T           TRAPEZOIDAL  8              10        10        10        1
2204            TRAPEZOIDAL  5              1         20        20        1
2204T           TRAPEZOIDAL  6              10        3         3         1
2205            TRAPEZOIDAL  5              1         20        20        1
2205T           TRAPEZOIDAL  6              10        3         3         1
2206            TRAPEZOIDAL  6              4         2         2         1
2208            DUMMY        0              0         0         0         1
2208T           TRAPEZOIDAL  5              1         20        20        1
2209            DUMMY        0              0         0         0         1
2209T           DUMMY        0              0         0         0         1
2210            TRAPEZOIDAL  5              1         20        20        1
2211            TRAPEZOIDAL  5              1         20        20        1
2301            CIRCULAR     5.5            0         0         0         1
2301DIV         TRAPEZOIDAL  5              1         20        20        1
2302            TRAPEZOIDAL  5              1         20        20        1
2303            TRAPEZOIDAL  5              1         20        20        1
2304            TRAPEZOIDAL  5              1         20        20        1
2305            TRAPEZOIDAL  5              1         20        20        1
2306            TRAPEZOIDAL  5              1         20        20        1
2307            TRAPEZOIDAL  5              1         20        20        1
Mississippi_St  TRAPEZOIDAL  5              1         20        20        1

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
Clairefield_Out  Rating     0          0
Clairefield_Out             0.3        11.9
Clairefield_Out             1.3        107.5
Clairefield_Out             2.3        253
Clairefield_Out             4.3        646.7
Clairefield_Out             5.3        884.9
Clairefield_Out             6.3        1146.8
Clairefield_Out             7.3        1430.4
Clairefield_Out             7.5        1489.6
Clairefield_Out             8.5        1812
Clairefield_Out             9.55       2344
Clairefield_Out             10         2684
Clairefield_Out             11         3766
;
Bit-O-Sea_Out    Rating     0          0
Bit-O-Sea_Out               1.2        269
Bit-O-Sea_Out               3.2        1371
Bit-O-Sea_Out               4.5        2503
Bit-O-Sea_Out               5.2        3294
Bit-O-Sea_Out               6.2        5495
;
GG_Entrance_Out  Rating     0.4        0.9
GG_Entrance_Out             1.4        40.3
GG_Entrance_Out             2.4        105.0
GG_Entrance_Out             3.4        174.7
GG_Entrance_Out             4.4        243.8
GG_Entrance_Out             5.4        308.6
GG_Entrance_Out             6.4        366.5
GG_Entrance_Out             7.4        418.0
GG_Entrance_Out             8.4        464.1
GG_Entrance_Out             9.4        506.1
GG_Entrance_Out             10.4       544.8
GG_Entrance_Out             11.4       580.9
GG_Entrance_Out             11.9       627.8
GG_Entrance_Out             12.4       723.7
GG_Entrance_Out             12.9       877.5
GG_Entrance_Out             13.4       1103.9
GG_Entrance_Out             13.9       1401.1
GG_Entrance_Out             14.4       1788.2
;
Kendrick_Out     Rating     0          0
Kendrick_Out                0.2        2
Kendrick_Out                0.4        6
Kendrick_Out                0.6        11
```

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Kendrick_Out                0.8         16
Kendrick_Out                1.0         23
Kendrick_Out                1.2         30
Kendrick_Out                1.3         34
Kendrick_Out                1.4         38
Kendrick_Out                1.5         42
;
Ward_1_Out        Rating    0           0
Ward_1_Out                  2.0         5
Ward_1_Out                  4.0         1000
;
Ward_5_Out        Rating    0           0
Ward_5_Out                  2.0         3
Ward_5_Out                  2.2         1000
;
Harvey_Out        Rating    0           0
Harvey_Out                  2.0         5
Harvey_Out                  2.2         1000
;
Kendrick_1_Out    Rating    0           0
Kendrick_1_Out              3.0         0
Kendrick_1_Out              3.1         1000
;
Smith_Out         Rating    0           0
Smith_Out                   0.3         19
Smith_Out                   2.0         19
Smith_Out                   3.0         1000
;
Jewell_Out        Rating    0           0
Jewell_Out                  0.8         47
Jewell_Out                  1.8         158
Jewell_Out                  2.8         305
Jewell_Out                  3.8         482
Jewell_Out                  4.8         686
Jewell_Out                  4.9         710
Jewell_Out                  5.0         760
Jewell_Out                  5.1         827
Jewell_Out                  5.3         995
Jewell_Out                  5.8         1574
;
GreenGablePark_Out Rating     0           0
GreenGablePark_Out            1           0
GreenGablePark_Out            2           0
GreenGablePark_Out            2.5         53
GreenGablePark_Out            3           150
;
Clairefield_Storage Storage    0           35277
Clairefield_Storage            0.3         39316
Clairefield_Storage            1.3         133873
Clairefield_Storage            2.3         153706
Clairefield_Storage            4.3         182573
Clairefield_Storage            5.3         219868
Clairefield_Storage            6.3         268772
Clairefield_Storage            7.3         302896
Clairefield_Storage            7.5         310072
Clairefield_Storage            8.5         345953
Clairefield_Storage            9.55        366340
Clairefield_Storage            10          409028
Clairefield_Storage            11          453024
;
Bit-O-Sea_Storage Storage    0           195584
Bit-O-Sea_Storage            1.2         227383
Bit-O-Sea_Storage            3.2         264845
Bit-O-Sea_Storage            4.5         315810
Bit-O-Sea_Storage            5.2         343253
Bit-O-Sea_Storage            6.2         355014
;
GG_Entrance_Storage Storage    0.4         650
GG_Entrance_Storage            1.4         8500
GG_Entrance_Storage            2.4         25865
GG_Entrance_Storage            3.4         50235
GG_Entrance_Storage            4.4         78625
GG_Entrance_Storage            5.4         105660
GG_Entrance_Storage            6.4         127930
GG_Entrance_Storage            7.4         149965
GG_Entrance_Storage            8.4         174950
GG_Entrance_Storage            9.4         191450
GG_Entrance_Storage            10.4        200075
GG_Entrance_Storage            11.4        211725
GG_Entrance_Storage            12.4        223400
GG_Entrance_Storage            13.4        235725
GG_Entrance_Storage            14.4        250550
;
Kendrick_Storage Storage    0           1511532
Kendrick_Storage            0.2         1528085
Kendrick_Storage            0.4         1544638
Kendrick_Storage            0.6         1561190
Kendrick_Storage            0.8         1577743
Kendrick_Storage            1.0         1594296
Kendrick_Storage            1.2         1610849
Kendrick_Storage            1.3         1619125
Kendrick_Storage            1.4         1627402
Kendrick_Storage            1.5         1635242
;
Ward_1_Storage   Storage    0           2744280
Ward_1_Storage              2.0         3018708
Ward_1_Storage              4.0         3297492
;
Ward_5_Storage   Storage    0           781902
Ward_5_Storage              2.0         801504
Ward_5_Storage              2.2         801504
;
Harvey_Storage   Storage    0           248292
Harvey_Storage              2.0         291852
Harvey_Storage              2.2         296208
;
Kendrick_1_Storage Storage    0           317988
Kendrick_1_Storage            3.0         344124
Kendrick_1_Storage            3.1         3449952
;
Smith_Storage    Storage    0           2286900
Smith_Storage               1.0         2308680
Smith_Storage               2.0         2352240
Smith_Storage               3.0         2395800
;
Jewell_Storage   Storage    0           93654
Jewell_Storage              0.8         96703
Jewell_Storage              1.8         101059
Jewell_Storage              2.8         108029
Jewell_Storage              3.8         116741
Jewell_Storage              4.8         179032
Jewell_Storage              4.9         181962
Jewell_Storage              5.0         185218
Jewell_Storage              5.1         188474
Jewell_Storage              5.3         194986
Jewell_Storage              5.8         211266
;
GreenGablePark   Storage    0           37026
GreenGablePark              1           39640
GreenGablePark              2           44431
GreenGablePark              2.5         50965
GreenGablePark              3           55321

[REPORT]
```

```
;;Reporting Options
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 3102616.142 1663774.660 3142690.333 1686881.022
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
1101             3140170.407        1677111.384
1102T            3139680.315        1677450.678
1103             3138613.962        1676238.913
1103T            3138608.576        1676605.135
1104             3138249.830        1676674.271
1105             3137619.654        1677754.672
1106T            3137915.509        1676447.982
1107             3137393.654        1676447.982
1108T            3136428.019        1676189.110
1109             3136259.546        1676521.946
1110             3135304.023        1677787.520
1111             3134862.456        1676521.946
1112             3134352.929        1675400.165
1113             3134363.837        1674949.897
1114T            3133773.548        1675338.529
1115             3133577.365        1676476.661
1116             3131656.234        1676754.100
1117             3132268.693        1677691.109
1120             3133655.982        1672194.926
1121             3132327.032        1671829.718
1122             3130967.648        1673615.178
1123             3130896.635        1672225.360
1124T            3131180.686        1674700.657
1125             3130945.818        1676417.905
1126             3129971.630        1676408.715
1127             3129962.440        1677033.665
1128             3128593.063        1677759.711
1129             3128142.731        1677116.379
1130             3127012.306        1677438.045
1131             3125615.358        1677575.902
1133             3124319.504        1677015.284
1134             3122260.844        1677088.808
1135             3122288.415        1677925.139
1136T            3129450.942        1674564.573
1137             3129393.509        1672168.513
1137T            3129133.678        1672750.039
1138             3127884.015        1671846.817
1139             3128570.711        1671630.292
1140T            3128441.628        1674741.235
1141             3126859.061        1675136.877
1143             3126950.363        1672438.398
1143T            3127004.767        1674426.990
1144T            3126736.373        1674433.872
1145T            3125834.846        1674151.715
1146             3125645.054        1673550.958
1147             3125675.488        1672384.323
1148             3123798.116        1674423.959
1148T            3124535.946        1673993.109
1149             3124383.838        1675241.528
1150             3122270.035        1676371.953
1151             3124153.789        1673561.103
1152             3124559.576        1672150.996
1153             3123068.311        1672688.663
1155             3122966.864        1670882.913
1156             3121199.288        1671096.115
1157             3122966.864        1673936.456
1158             3121729.216        1673692.984
1159             3121201.694        1673692.984
1160             3120258.240        1673692.984
1161             3118519.368        1673690.460
1162A            3121921.964        1673540.814
1162T            3122753.826        1673804.575
1163             3120582.870        1672617.650
1163T            3121150.970        1673206.040
1164             3119811.875        1672962.568
1165             3119122.039        1671988.681
1166             3117722.076        1673784.286
1167T            3117995.982        1673175.606
1168             3117722.076        1672293.021
1169T            3115150.307        1673680.832
1170             3113557.481        1674262.432
1170T            3113899.045        1673675.908
1171T            3112615.177        1674004.944
1172             3110261.616        1674704.925
1172T            3111570.277        1674217.982
1173             3107745.740        1674613.623
1174             3107167.495        1675861.416
1175             3106771.853        1673639.736
1176             3115080.710        1673445.271
1177             3113681.686        1673506.851
1178             3112436.184        1673489.600
1179             3111184.780        1673487.566
1180             3109784.817        1673507.856
1181             3107959.659        1672823.712
1182             3111225.358        1672026.736
1183             3109784.817        1672381.799
1201             3122063.990        1674362.531
1202T            3120538.750        1675227.251
1204             3117708.717        1677002.614
1204T            3118851.277        1676065.129
1205T            3117954.807        1676141.299
1206             3115678.148        1676265.727
1208             3112784.407        1676429.189
1208T            3113321.468        1676265.727
1209             3113148.039        1676025.498
1209T            3113150.319        1676198.790
1210             3112381.008        1676326.581
1211             3112392.072        1676099.764
1303             3137006.784        1678761.589
1304             3136271.310        1680433.577
1305             3135113.939        1678991.826
1306             3132844.969        1678981.297
1307             3131307.755        1678923.388
1102              3140089.622        1677267.567
1106              3137913.831        1676244.299
1108              3136255.437        1676131.583
1114              3133559.875        1675338.529
1124              3130945.818        1674699.291
1140              3128188.012        1674741.235
1144              3126560.885        1674437.313
1145              3125662.799        1674062.250
1162              3122388.619        1673561.103
1167              3117711.931        1673165.461
1169              3116443.849        1673692.984
1205              3117667.702        1676129.581
1171              3112402.139        1674025.233
1202              3120316.098        1675303.422
Jewell_Out        3134505.011        1673650.570
```

```
Mississippi_Out  3140259.876        1678713.257
Sanderson_Out    3140869.943        1676526.055
Mississippi_St_Out 3140684.348        1679116.862
1119             3133617.403        1673641.475
1301             3138910.308        1678705.821
1302             3138891.719        1679088.757
Bit-O-Sea        3125046.519        1674027.757
Clairefield      3123927.371        1673976.952
GG_Entrance      3120795.907        1673145.172
GreenGablePark   3112996.940        1676399.574
Harvey           3129176.983        1672514.954
JewellPark       3113591.982        1673838.065
Kendrick         3110403.641        1674197.692
Kendrick_1       3108245.009        1673218.812
Smith            3108486.301        1674968.687
Ward_1           3121759.429        1670906.477
Ward_5           3128168.592        1672100.462

[VERTICES]
;;Link            X-Coord            Y-Coord
;;--------------- ------------------ ------------------
2102T            3139971.139        1677563.776
2103T            3138985.570        1676637.449
2103T            3139082.511        1677299.881
2105             3137656.636        1676879.437
2105             3138194.927        1676875.327
2106T            3138010.772        1676664.377
2108T            3137763.034        1675996.560
2112             3134982.661        1675670.168
2112             3135865.246        1676086.099
2119             3133588.639        1674490.002
2121             3132327.032        1672692.014
2123             3131708.208        1672347.096
2123             3131708.208        1673128.235
2124T            3131840.089        1674710.801
2124T            3132093.705        1675319.481
2128             3128804.443        1677281.807
2133             3125367.216        1677061.237
2134             3124356.266        1677015.284
2136T            3130300.151        1674794.780
2137T            3129164.462        1673914.877
2141             3126930.074        1674822.393
2145T            3126169.224        1674365.883
2150             3122435.463        1675480.479
2155             3122763.971        1671278.555
2169             3117417.736        1673561.103
2175             3108374.709        1673629.592
2182             3111945.629        1672168.761
2201             3122388.619        1674321.953
2201             3122713.248        1674058.191
2204             3118845.418        1676744.806
2206             3117138.627        1675828.690
2301             3139672.460        1678519.931
2304             3136311.834        1679055.757


[BACKDROP]
FILE       "R:\12.155.020 (Sanderson Gulch MDP)\Hydrology\CUHP_SWMM\Working\2013 MDP _ NOAA
14\SWMM\UDFCD_Sanderson_Gulch_SWMM.jpg"
DIMENSIONS 3101879.795 1663152.848 3144379.795 1686542.503
```

EPA SWMM 5.0 100-YEAR, FUTURE CONDITIONS OUTPUT

Table B-5 EPA SWMM 5.1 Output
100-Year, Future Conditions

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

Scenario ID = 6_Fut_100yr_0mi^2_Sanderson Gulch FHAD_2018

Element Count

Number of rain gages	0
Number of subcatchments	0
Number of nodes	135
Number of links	134
Number of pollutants	0
Number of land uses	0

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
1101	JUNCTION	5241.96	12.00	0.0	
1102T	JUNCTION	5256.00	12.00	0.0	
1103	JUNCTION	5284.00	5.00	0.0	
1103T	JUNCTION	5273.00	12.00	0.0	
1104	JUNCTION	5274.00	12.00	0.0	
1105	JUNCTION	5330.00	5.00	0.0	
1106T	JUNCTION	5278.19	12.00	0.0	
1107	JUNCTION	5308.00	5.00	0.0	
1108T	JUNCTION	5296.54	16.00	0.0	
1109	JUNCTION	5310.00	5.00	0.0	
1110	JUNCTION	5354.00	5.00	0.0	
1111	JUNCTION	5338.00	5.00	0.0	
1112	JUNCTION	5318.00	14.00	0.0	
1113	JUNCTION	5340.00	5.00	0.0	
1114T	JUNCTION	5322.91	14.00	0.0	
1115	JUNCTION	5362.00	5.00	0.0	
1116	JUNCTION	5384.00	5.00	0.0	
1117	JUNCTION	5384.00	5.00	0.0	
1120	JUNCTION	5394.00	5.00	0.0	
1121	JUNCTION	5410.00	5.00	0.0	
1122	JUNCTION	5404.00	5.00	0.0	
1123	JUNCTION	5420.00	5.00	0.0	
1124T	JUNCTION	5344.06	14.00	0.0	
1125	JUNCTION	5380.00	5.00	0.0	
1126	JUNCTION	5398.00	5.00	0.0	
1127	JUNCTION	5400.00	5.00	0.0	
1128	JUNCTION	5418.00	5.00	0.0	
1129	JUNCTION	5422.00	5.00	0.0	
1130	JUNCTION	5428.00	5.00	0.0	
1131	JUNCTION	5438.00	5.00	0.0	
1133	JUNCTION	5450.00	5.00	0.0	
1134	JUNCTION	5498.00	5.00	0.0	
1135	JUNCTION	5494.00	5.00	0.0	
1136T	JUNCTION	5366.00	10.00	0.0	
1137	JUNCTION	5436.00	0.00	0.0	
1137T	JUNCTION	5432.00	1.50	0.0	
1138	JUNCTION	5452.00	0.00	0.0	
1139	JUNCTION	5454.00	0.00	0.0	
1140T	JUNCTION	5377.00	10.00	0.0	
1141	JUNCTION	5420.00	5.00	0.0	
1143	JUNCTION	5456.00	5.00	0.0	
1143T	JUNCTION	5386.00	12.00	0.0	
1144T	JUNCTION	5393.72	12.00	0.0	
1145T	JUNCTION	5405.56	12.00	0.0	
1146	JUNCTION	5440.00	5.00	0.0	
1147	JUNCTION	5466.00	5.00	0.0	
1148	JUNCTION	5428.00	0.00	0.0	
1148T	JUNCTION	5426.00	5.00	0.0	
1149	JUNCTION	5444.00	5.00	0.0	
1150	JUNCTION	5482.00	5.00	0.0	
1151	JUNCTION	5440.00	5.00	0.0	
1152	JUNCTION	5480.00	5.00	0.0	
1153	JUNCTION	5480.00	5.00	0.0	
1155	JUNCTION	5506.00	5.00	0.0	
1156	JUNCTION	5510.00	0.00	0.0	
1157	JUNCTION	5434.00	12.00	0.0	
1158	JUNCTION	5464.00	5.00	0.0	
1159	JUNCTION	5476.00	5.00	0.0	
1160	JUNCTION	5492.00	5.00	0.0	
1161	JUNCTION	5514.00	5.00	0.0	
1162A	JUNCTION	5458.46	6.00	0.0	
1162T	JUNCTION	5435.00	12.00	0.0	
1163	JUNCTION	5462.00	0.00	0.0	
1163T	JUNCTION	5460.00	6.00	0.0	
1164	JUNCTION	5480.00	5.00	0.0	
1165	JUNCTION	5500.00	5.00	0.0	
1166	JUNCTION	5518.00	5.00	0.0	
1167T	JUNCTION	5499.42	10.00	0.0	
1168	JUNCTION	5520.00	5.00	0.0	
1169T	JUNCTION	5548.00	7.00	0.0	
1170	JUNCTION	5578.00	0.00	0.0	
1170T	JUNCTION	5574.19	7.00	0.0	
1171T	JUNCTION	5583.12	10.00	0.0	
1172	JUNCTION	5620.00	0.00	0.0	
1172T	JUNCTION	5600.00	4.00	0.0	
1173	JUNCTION	5660.00	0.00	0.0	
1174	JUNCTION	5666.00	5.00	0.0	
1175	JUNCTION	5680.00	3.58	0.0	
1176	JUNCTION	5552.00	5.00	0.0	
1177	JUNCTION	5580.00	5.00	0.0	
1178	JUNCTION	5608.00	5.00	0.0	
1179	JUNCTION	5626.00	5.00	0.0	
1180	JUNCTION	5644.00	5.00	0.0	
1181	JUNCTION	5652.00	0.00	0.0	
1182	JUNCTION	5625.00	5.00	0.0	
1183	JUNCTION	5635.00	5.00	0.0	
1201	JUNCTION	5451.23	10.00	0.0	
1202T	JUNCTION	5472.50	8.00	0.0	
1204	JUNCTION	5522.00	5.00	0.0	
1204T	JUNCTION	5496.00	6.00	0.0	
1205T	JUNCTION	5508.00	6.00	0.0	
1206	JUNCTION	5544.00	6.00	0.0	
1208	JUNCTION	5588.00	0.00	0.0	
1208T	JUNCTION	5582.00	5.00	0.0	
1209	JUNCTION	5584.00	0.00	0.0	
1209T	JUNCTION	5583.00	5.00	0.0	
1210	JUNCTION	5590.00	5.00	0.0	
1211	JUNCTION	5590.00	5.00	0.0	
1303	JUNCTION	5330.00	5.00	0.0	
1304	JUNCTION	5346.00	5.00	0.0	
1305	JUNCTION	5350.00	5.00	0.0	
1306	JUNCTION	5366.00	5.00	0.0	
1307	JUNCTION	5398.00	5.00	0.0	

1102	JUNCTION	5246.14	10.00	0.0
1106	JUNCTION	5278.63	16.00	0.0
1108	JUNCTION	5297.85	10.00	0.0
1114	JUNCTION	5323.02	14.00	0.0
1124	JUNCTION	5347.31	10.00	0.0
1140	JUNCTION	5378.64	14.36	0.0
1144	JUNCTION	5394.07	12.00	0.0
1145	JUNCTION	5406.98	16.02	0.0
1162	JUNCTION	5442.24	10.00	0.0
1167	JUNCTION	5500.10	10.90	0.0
1169	JUNCTION	5521.30	7.00	0.0
1205	JUNCTION	5510.53	6.00	0.0
1171	JUNCTION	5586.49	5.00	0.0
1202	JUNCTION	5473.15	6.00	0.0
Jewell_Out	OUTFALL	5384.00	5.00	0.0
Mississippi_Out	OUTFALL	5270.00	5.00	0.0
Sanderson_Out	OUTFALL	5230.00	12.00	0.0
Mississippi_St_Out	OUTFALL	5298.00	5.00	0.0
1119	DIVIDER	5386.00	5.00	0.0
1301	DIVIDER	5275.56	21.44	0.0
1302	DIVIDER	5300.00	5.00	0.0
Bit-O-Sea	STORAGE	5422.80	6.20	0.0
Clairefield	STORAGE	5427.00	11.00	0.0
GG_Entrance	STORAGE	5460.80	14.40	0.0
GreenGablePark	STORAGE	5587.00	3.00	0.0
Harvey	STORAGE	5434.00	2.00	0.0
JewellPark	STORAGE	5576.00	5.80	0.0
Kendrick	STORAGE	5618.00	2.00	0.0
Kendrick_1	STORAGE	5651.00	3.00	0.0
Smith	STORAGE	5658.00	4.00	0.0
Ward_1	STORAGE	5508.00	4.00	0.0
Ward_5	STORAGE	5450.00	3.00	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
2101	1101	Sanderson_Out	CONDUIT	644.0	1.8575	0.0440
2102	1102	1101	CONDUIT	210.0	1.9909	0.0187
2102T	1102T	1102	CONDUIT	810.0	1.2174	0.0440
2103	1103	1103T	CONDUIT	232.0	4.7467	0.0200
2103T	1103T	1102T	CONDUIT	1743.0	0.9754	0.0440
2104	1104	1103T	CONDUIT	310.0	0.3226	0.0440
2105	1105	1104	CONDUIT	1635.0	3.4271	0.0200
2106	1106	1106T	CONDUIT	104.0	0.4231	0.0300
2106T	1106T	1104	CONDUIT	490.0	0.8551	0.0440
2107	1107	1106T	CONDUIT	545.0	5.4779	0.0200
2108	1108	1108T	CONDUIT	115.0	1.1392	0.0190
2108T	1108T	1106	CONDUIT	1785.0	1.0034	0.0440
2109	1109	1108	CONDUIT	305.0	3.9868	0.0200
2110	1110	1109	CONDUIT	1906.0	2.3091	0.0200
2111	1111	1109	CONDUIT	1297.0	2.1593	0.0200
2112	1112	1108	CONDUIT	584.0	3.4524	0.0440
2113	1113	1112	CONDUIT	420.0	5.2453	0.0200
2114	1114	1114T	CONDUIT	106.0	0.1038	0.0190
2114T	1114T	1112	CONDUIT	724.0	0.6782	0.0500
2115	1115	1114	CONDUIT	1092.0	3.5719	0.0200
2116	1116	1115	CONDUIT	2486.0	0.8850	0.0200
2117	1117	1115	CONDUIT	2456.0	0.8958	0.0200
2119	1119	1114	CONDUIT	1809.0	3.3789	0.0230
2119DIV	1119	Jewell_Out	CONDUIT	400.0	0.5000	0.0200
2120	1120	1119	CONDUIT	1348.0	0.5935	0.0200
2121	1121	1119	CONDUIT	2820.0	0.8511	0.0200
2122	1122	1119	CONDUIT	2593.0	0.6942	0.0200
2123	1123	1119	CONDUIT	3872.0	0.8781	0.0200
2124	1124	1124T	CONDUIT	133.0	2.4443	0.0190
2124T	1124T	1114	CONDUIT	2910.0	0.7230	0.0500
2125	1125	1124	CONDUIT	1657.0	1.9732	0.0200
2126	1126	1125	CONDUIT	1010.0	1.7825	0.0200
2127	1127	1125	CONDUIT	1636.0	1.2226	0.0200
2128	1128	1127	CONDUIT	1877.0	0.9590	0.0200
2129	1129	1127	CONDUIT	1816.0	1.2115	0.0200
2130	1130	1129	CONDUIT	1179.0	0.5089	0.0200
2131	1131	1130	CONDUIT	1378.0	0.7257	0.0200
2133	1133	1131	CONDUIT	1616.0	0.7426	0.0200
2134	1134	1133	CONDUIT	2177.0	2.2054	0.0200
2135	1135	1133	CONDUIT	2581.0	1.7050	0.0200
2136T	1136T	1124	CONDUIT	1693.0	1.1040	0.0440
2137	1137	Harvey	CONDUIT	400.0	0.5000	0.0100
2137T	1137T	1136T	CONDUIT	1910.0	3.4576	0.0190
2138	1138	Ward_5	CONDUIT	400.0	0.5000	0.0100
2139	1139	Ward_5	CONDUIT	400.0	1.0001	0.0100
2140	1140	1140T	CONDUIT	83.0	1.9763	0.0190
2140T	1140T	1136T	CONDUIT	1321.0	0.8327	0.0440
2141	1141	1140	CONDUIT	1895.0	1.6889	0.0200
2143	1143	1143T	CONDUIT	1997.0	3.5074	0.0200
2143T	1143T	1140	CONDUIT	1232.0	0.5974	0.0500
2144	1144	1144T	CONDUIT	65.0	0.5385	0.0190
2144T	1144T	1143T	CONDUIT	513.0	1.5050	0.0500
2145	1145	1145T	CONDUIT	140.0	1.0143	0.0190
2145T	1145T	1144	CONDUIT	914.0	1.2572	0.0440
2146	1146	1145	CONDUIT	406.0	5.4267	0.0200
2147	1147	1146	CONDUIT	1140.0	2.2813	0.0200
2148	1148	Clairefield	CONDUIT	400.0	0.2500	0.0100
2148T	1148T	Bit-O-Sea	CONDUIT	400.0	0.8000	0.0100
2149	1149	1148T	CONDUIT	1124.0	1.6016	0.0200
2150	1150	1149	CONDUIT	3411.0	1.1141	0.0200
2151	1151	Clairefield	CONDUIT	400.0	3.2517	0.0100
2152	1152	1151	CONDUIT	1865.0	2.1453	0.0200
2153	1153	1151	CONDUIT	1715.0	2.3330	0.0200
2155	1155	1153	CONDUIT	1736.0	1.4979	0.0200
2156	1156	Ward_1	CONDUIT	400.0	0.5000	0.0100
2157	1157	Clairefield	CONDUIT	540.0	1.2964	0.0440
2158	1158	1162T	CONDUIT	1004.0	2.8897	0.0200
2159	1159	1158	CONDUIT	524.0	2.2907	0.0200
2160	1160	1159	CONDUIT	937.0	1.7078	0.0200
2161	1161	1160	CONDUIT	1751.0	1.2565	0.0200
2162	1162	1162T	CONDUIT	343.0	2.1113	0.0190
2162A	1162A	1162	CONDUIT	668.0	2.4289	0.0440
2162T	1162T	1157	CONDUIT	200.0	0.5000	0.0500
2163	1163	GG_Entrance	CONDUIT	400.0	0.3000	0.0100
2163T	1163T	1162A	CONDUIT	759.0	0.2029	0.0440
2164	1164	GG_Entrance	CONDUIT	800.0	2.4007	0.0300
2165	1165	1164	CONDUIT	1285.0	1.5566	0.0300
2166	1166	1167	CONDUIT	406.0	2.9570	0.0200
2167	1167	1167T	CONDUIT	130.0	0.5231	0.0190
2167T	1167T	1164	CONDUIT	2142.0	0.9067	0.0300
2168	1168	1167	CONDUIT	862.0	1.6243	0.0200
2169	1169	1167	CONDUIT	1606.0	1.3202	0.0300
2169T	1169T	1169	CONDUIT	1320.0	2.0231	0.0440
2170	1170	JewellPark	CONDUIT	400.0	0.5000	0.0100
2170T	1170T	1169T	CONDUIT	1320.0	1.9845	0.0440
2171	1171	1171T	CONDUIT	160.0	2.1067	0.0300
2171T	1171T	JewellPark	CONDUIT	826.0	0.8620	0.0440
2172	1172	Kendrick	CONDUIT	400.0	0.5000	0.0100
2172T	1172T	1171	CONDUIT	1063.0	1.2710	0.0440
2173	1173	Smith	CONDUIT	400.0	0.5000	0.0100
2174	1174	Smith	CONDUIT	200.0	4.0032	0.0200
2175	1175	Smith	CONDUIT	1402.0	1.5694	0.0190
2176	1176	1169T	CONDUIT	100.0	4.0032	0.0200
2177	1177	1170T	CONDUIT	200.0	2.9062	0.0200
2178	1178	1171	CONDUIT	475.0	4.5331	0.0200
2179	1179	1178	CONDUIT	1268.0	1.4197	0.0200
2180	1180	Kendrick	CONDUIT	465.0	5.6002	0.0440
2181	1181	Kendrick_1	CONDUIT	400.0	0.2500	0.0100
2182	1182	1178	CONDUIT	2500.0	0.6800	0.0200

2183	1183	1182	CONDUIT	1351.0	0.7402	0.0200	2122	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5772.86
2201	1201	1157	CONDUIT	944.0	1.8255	0.0440	2123	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6492.78
2202	1202	1202T	CONDUIT	110.0	0.5909	0.0190	2124	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	22464.84
2202T	1202T	1201	CONDUIT	1860.0	1.1436	0.0440	2124T	TRAPEZOIDAL	14.00	1022.00	7.35	136.00	1	9760.62
2204	1204	1204T	CONDUIT	1885.0	1.3794	0.0200	2125	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	9732.83
2204T	1204T	1202	CONDUIT	1855.0	1.2319	0.0440	2126	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	9250.41
2205	1205	1205T	CONDUIT	130.0	1.9465	0.0190	2127	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7661.09
2205T	1205T	1204T	CONDUIT	956.0	1.2553	0.0440	2128	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6785.23
2206	1206	1205	CONDUIT	2277.0	1.4701	0.0440	2129	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7626.41
2208	1208	GreenGablePark	CONDUIT	400.0	0.2500	0.0100	2130	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	4942.79
2208T	1208T	1206	CONDUIT	3278.0	1.1593	0.0200	2131	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5902.44
2209	1209	1209T	CONDUIT	400.0	0.2500	0.0100	2133	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5970.72
2209T	1209T	1208T	CONDUIT	400.0	0.2500	0.0100	2134	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10289.52
2210	1210	1209T	CONDUIT	550.0	1.2728	0.0200	2135	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	9047.21
2211	1211	1209T	CONDUIT	756.0	0.9260	0.0200	2136T	TRAPEZOIDAL	9.00	900.00	4.71	190.00	1	8979.64
2301	1301	1102T	CONDUIT	1735.0	1.0767	0.0150	2137	DUMMY	0.00	0.00	0.00	0.00	1	0.00
2301DIV	1301	Mississippi_Out	CONDUIT	400.0	1.3901	0.0200	2137T	CIRCULAR	1.50	1.77	0.38	1.50	1	13.36
2302	1302	1301	CONDUIT	349.0	2.2929	0.0200	2138	DUMMY	0.00	0.00	0.00	0.00	1	0.00
2303	1303	1301	CONDUIT	1655.0	2.2967	0.0200	2139	DUMMY	0.00	0.00	0.00	0.00	1	0.00
2304	1304	1303	CONDUIT	2445.0	0.6544	0.0200	2140	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	20199.84
2305	1305	1303	CONDUIT	2117.0	0.9448	0.0200	2140T	TRAPEZOIDAL	10.00	1100.00	5.21	210.00	1	10192.68
2306	1306	1305	CONDUIT	2260.0	0.7080	0.0200	2141	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	9004.34
2307	1307	1306	CONDUIT	1598.0	2.0029	0.0200	2143	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	12976.10
Mississippi_St	1302	Mississippi_St_Out	CONDUIT	100.0	2.0004	0.0190	2143T	TRAPEZOIDAL	12.00	804.00	6.35	124.00	1	6331.23
	Bit-O-Sea_Out	Bit-O-Sea	1145	OUTLET			2144	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	10543.95
	Clairefield_Out	Clairefield	1148T	OUTLET			2144T	TRAPEZOIDAL	12.00	408.00	6.41	58.00	1	5132.40
	GG_Entrance_Out	GG_Entrance	1163T	OUTLET			2145	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	14471.51
	GreenGablePark_Out	GreenGablePark	1208T	OUTLET			2145T	TRAPEZOIDAL	12.00	552.00	6.43	82.00	1	7225.33
	Harvey_Out	Harvey	1137T	OUTLET			2146	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	16140.55
	JewellPark_Out	JewellPark	1170T	OUTLET			2147	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10465.05
	Kendrick_1_Out	Kendrick_1	1180	OUTLET			2148	DUMMY	0.00	0.00	0.00	0.00	1	0.00
	Kendrick_Out	Kendrick	1172T	OUTLET			2148T	DUMMY	0.00	0.00	0.00	0.00	1	0.00
	Smith_Out	Smith	Kendrick	OUTLET			2149	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	8768.63
	Ward_1_Out	Ward_1	1153	OUTLET			2150	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7313.33
	Ward_5_Out	Ward_5	Harvey	OUTLET			2151	DUMMY	0.00	0.00	0.00	0.00	1	0.00
							2152	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10148.25
							2153	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10582.97
							2155	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	8479.83
							2156	DUMMY	0.00	0.00	0.00	0.00	1	0.00
							2157	TRAPEZOIDAL	8.00	720.00	5.47	130.00	1	8597.15
							2158	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	11778.05
							2159	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10486.55
							2160	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	9054.67
							2161	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7766.69
							2162	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	20878.21
							2162A	TRAPEZOIDAL	6.00	348.00	4.46	76.00	1	4966.29
							2162T	TRAPEZOIDAL	12.00	696.00	6.39	106.00	1	5035.64
							2163	DUMMY	0.00	0.00	0.00	0.00	1	0.00
							2163T	TRAPEZOIDAL	6.00	900.00	4.96	180.00	1	3982.77
							2164	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7156.94
							2165	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5763.01
							2166	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	11914.43
							2167	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	10392.22
							2167T	TRAPEZOIDAL	5.00	550.00	2.62	210.00	1	4924.95
							2168	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	8830.59
							2169	TRAPEZOIDAL	5.00	280.00	2.49	111.00	1	2930.05
							2169T	TRAPEZOIDAL	7.00	175.00	3.63	46.00	1	1983.87
							2170	DUMMY	0.00	0.00	0.00	0.00	1	0.00
							2170T	TRAPEZOIDAL	7.00	175.00	3.63	46.00	1	1964.82
							2171	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6704.44
							2171T	TRAPEZOIDAL	10.00	840.00	5.08	164.00	1	7786.40
							2172	DUMMY	0.00	0.00	0.00	0.00	1	0.00
							2172T	TRAPEZOIDAL	4.00	200.00	2.21	90.00	1	1292.96
							2173	DUMMY	0.00	0.00	0.00	0.00	1	0.00
							2174	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	13862.92
							2175	HORIZ_ELLIPSE	3.58	16.27	1.10	5.67	1	169.40
							2176	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	13862.92
							2177	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	11811.78
							2178	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	14751.87

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Cross Section Summary
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Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
2101	TRAPEZOIDAL	12.00	624.00	6.41	94.00	1	9910.06
2102	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	20544.54
2102T	TRAPEZOIDAL	10.00	1085.00	5.21	207.00	1	12151.67
2103	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	15095.50
2103T	TRAPEZOIDAL	12.00	840.00	6.35	130.00	1	9603.08
2104	TRAPEZOIDAL	12.00	1200.00	6.26	190.00	1	7815.85
2105	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	12826.65
2106	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	5919.25
2106T	TRAPEZOIDAL	12.00	840.00	6.34	130.00	1	8987.44
2107	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	16216.56
2108	TRAPEZOIDAL	10.00	600.00	5.36	110.00	2	15336.40
2108T	TRAPEZOIDAL	16.00	1696.00	8.29	202.00	1	23496.87
2109	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	13834.43
2110	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10528.67
2111	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10181.47
2112	TRAPEZOIDAL	8.00	432.00	4.33	98.00	1	7200.40
2113	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	15868.50
2114	TRAPEZOIDAL	10.00	600.00	5.36	110.00	3	4628.78
2114T	TRAPEZOIDAL	14.00	1218.00	7.29	164.00	1	11204.98
2115	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	13094.80
2116	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6518.09
2117	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6557.78
2119	CIRCULAR	3.00	7.07	0.75	3.00	1	69.30
2119DIV	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	4899.35
2120	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5337.71
2121	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6392.04

2179	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	8255.61
2180	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7452.95
2181	DUMMY	0.00	0.00	0.00	0.00	1	0.00
2182	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5713.61
2183	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5961.14
2201	TRAPEZOIDAL	10.00	600.00	5.36	110.00	1	8383.33
2202	TRAPEZOIDAL	5.00	505.00	2.51	201.00	2	5606.49
2202T	TRAPEZOIDAL	8.00	720.00	4.22	170.00	1	6785.89
2204	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	8137.71
2204T	TRAPEZOIDAL	6.00	168.00	3.50	46.00	1	1452.76
2205	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10175.53
2205T	TRAPEZOIDAL	6.00	168.00	3.50	46.00	1	1466.51
2206	TRAPEZOIDAL	6.00	96.00	3.11	28.00	1	838.20
2208	DUMMY	0.00	0.00	0.00	0.00	1	0.00
2208T	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7460.24
2209	DUMMY	0.00	0.00	0.00	0.00	1	0.00
2209T	DUMMY	0.00	0.00	0.00	0.00	1	0.00
2210	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	7816.93
2211	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6667.27
2301	CIRCULAR	5.50	23.76	1.38	5.50	1	301.99
2301DIV	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	8169.19
2302	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10491.56
2303	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10500.28
2304	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5605.00
2305	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	6734.65
2306	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	5829.91
2307	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	9805.75
Mississippi_St	TRAPEZOIDAL	5.00	505.00	2.51	201.00	1	10315.39

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NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
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Analysis Options
****
Flow Units ..... CFS
Process Models:
Rainfall/Runoff ..... NO
RDII ..... NO
Snowmelt ..... NO
Groundwater ..... NO
Flow Routing ..... YES
Ponding Allowed ..... NO
Water Quality ..... NO
Flow Routing Method ..... KINWAVE
Starting Date 01/01/2005 00:00:00
Ending Date 01/01/2005 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:05:00
Routing Time Step ..... 300.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	844.478	275.186
External Outflow	740.654	241.353
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	105.374	34.338
Continuity Error (%)	-0.184	

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Highest Flow Instability Indexes
****
Link Mississippi_St (15)
Link 2133 (6)
Link 2134 (6)
Link 2157 (6)
Link 2158 (6)

****
Routing Time Step Summary
****
Minimum Time Step : 300.00 sec
Average Time Step : 300.00 sec
Maximum Time Step : 300.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.39
Percent Not Converging : 0.00

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Node Depth Summary
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Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1101	JUNCTION	4.15	8.29	5250.25	0 01:35	8.29
1102T	JUNCTION	4.40	8.18	5264.18	0 01:35	8.18
1103	JUNCTION	0.20	0.78	5284.78	0 00:45	0.78
1103T	JUNCTION	4.63	8.93	5281.93	0 01:30	8.93
1104	JUNCTION	4.63	8.93	5282.93	0 01:30	8.93
1105	JUNCTION	0.07	0.30	5330.30	0 00:45	0.30
1106T	JUNCTION	4.23	8.36	5286.55	0 01:30	8.36
1107	JUNCTION	0.15	0.58	5308.58	0 00:45	0.58
1108T	JUNCTION	3.85	7.57	5304.11	0 01:30	7.57
1109	JUNCTION	0.28	1.02	5311.02	0 00:45	1.02
1110	JUNCTION	0.19	0.63	5354.63	0 00:45	0.63
1111	JUNCTION	0.20	0.80	5338.80	0 00:45	0.80
1112	JUNCTION	4.39	8.74	5326.74	0 01:30	8.74
1113	JUNCTION	0.17	0.90	5340.90	0 00:40	0.90
1114T	JUNCTION	4.39	8.74	5331.65	0 01:30	8.74
1115	JUNCTION	0.37	1.06	5363.06	0 00:50	1.06
1116	JUNCTION	0.15	0.70	5384.70	0 00:40	0.70
1117	JUNCTION	0.29	0.83	5384.83	0 00:50	0.83
1120	JUNCTION	0.30	1.10	5395.10	0 00:45	1.10
1121	JUNCTION	0.27	1.07	5411.07	0 00:45	1.07
1122	JUNCTION	0.32	1.16	5405.16	0 00:45	1.16
1123	JUNCTION	0.23	0.91	5420.91	0 00:45	0.91
1124T	JUNCTION	4.32	8.86	5352.92	0 01:25	8.86
1125	JUNCTION	0.72	2.20	5382.20	0 01:00	2.20
1126	JUNCTION	0.16	0.58	5398.58	0 00:45	0.58
1127	JUNCTION	0.71	2.20	5402.20	0 00:55	2.20
1128	JUNCTION	0.25	0.93	5418.93	0 00:45	0.93
1129	JUNCTION	0.74	2.29	5424.29	0 00:55	2.29
1130	JUNCTION	0.72	2.29	5430.29	0 00:50	2.29
1131	JUNCTION	0.60	1.90	5439.90	0 00:50	1.90
1133	JUNCTION	0.43	1.42	5451.42	0 00:50	1.42
1134	JUNCTION	0.13	0.41	5498.41	0 00:50	0.41
1135	JUNCTION	0.23	0.74	5494.74	0 00:50	0.74
1136T	JUNCTION	2.85	5.67	5371.67	0 01:30	5.67

1137	JUNCTION	0.00	0.00	5436.00	0	00:00	0.00
1137T	JUNCTION	0.00	0.00	5432.00	0	00:00	0.00
1138	JUNCTION	0.00	0.00	5452.00	0	00:00	0.00
1139	JUNCTION	0.00	0.00	5454.00	0	00:00	0.00
1140T	JUNCTION	2.86	5.67	5382.67	0	01:30	5.67
1141	JUNCTION	0.19	0.83	5420.83	0	00:40	0.83
1143	JUNCTION	0.21	0.95	5456.95	0	00:40	0.95
1143T	JUNCTION	3.92	8.26	5394.26	0	01:35	8.26
1144T	JUNCTION	3.80	8.26	5401.98	0	01:30	8.26
1145T	JUNCTION	3.39	7.22	5412.78	0	01:30	7.22
1146	JUNCTION	0.25	1.07	5441.07	0	00:45	1.07
1147	JUNCTION	0.24	1.07	5467.07	0	00:40	1.07
1148	JUNCTION	0.00	0.00	5428.00	0	00:00	0.00
1148T	JUNCTION	0.41	1.18	5427.18	0	00:55	1.18
1149	JUNCTION	0.40	1.18	5445.18	0	00:55	1.18
1150	JUNCTION	0.23	0.73	5482.73	0	00:50	0.73
1151	JUNCTION	0.36	1.18	5441.18	0	00:50	1.18
1152	JUNCTION	0.15	0.62	5480.62	0	00:40	0.62
1153	JUNCTION	0.36	1.19	5481.19	0	00:45	1.19
1155	JUNCTION	0.24	1.09	5507.09	0	00:40	1.09
1156	JUNCTION	0.00	0.00	5510.00	0	00:00	0.00
1157	JUNCTION	2.76	6.13	5440.13	0	01:35	6.13
1158	JUNCTION	0.22	0.77	5464.77	0	00:50	0.77
1159	JUNCTION	0.22	0.77	5476.77	0	00:50	0.77
1160	JUNCTION	0.21	0.76	5492.76	0	00:45	0.76
1161	JUNCTION	0.16	0.73	5514.73	0	00:40	0.73
1162A	JUNCTION	1.04	2.63	5461.09	0	01:30	2.63
1162T	JUNCTION	2.76	6.12	5441.12	0	01:35	6.12
1163	JUNCTION	0.00	0.00	5462.00	0	00:00	0.00
1163T	JUNCTION	1.04	2.65	5462.65	0	01:30	2.65
1164	JUNCTION	1.12	2.64	5482.64	0	01:15	2.64
1165	JUNCTION	0.25	1.24	5501.24	0	00:40	1.24
1166	JUNCTION	0.19	0.86	5518.86	0	00:40	0.86
1167T	JUNCTION	1.36	3.69	5503.11	0	01:10	3.69
1168	JUNCTION	0.29	1.05	5521.05	0	00:45	1.05
1169T	JUNCTION	1.73	4.38	5552.38	0	01:10	4.38
1170	JUNCTION	0.00	0.00	5578.00	0	00:00	0.00
1170T	JUNCTION	1.64	4.15	5578.34	0	01:10	4.15
1171T	JUNCTION	1.29	3.22	5586.34	0	00:55	3.22
1172	JUNCTION	0.00	0.00	5620.00	0	00:00	0.00
1172T	JUNCTION	0.35	0.45	5600.45	0	06:00	0.45
1173	JUNCTION	0.00	0.00	5660.00	0	00:00	0.00
1174	JUNCTION	0.26	1.03	5667.03	0	00:45	1.03
1175	JUNCTION	0.33	1.68	5681.68	0	00:40	1.68
1176	JUNCTION	0.24	0.75	5552.75	0	00:50	0.75
1177	JUNCTION	0.29	0.93	5580.93	0	00:50	0.93
1178	JUNCTION	0.47	1.45	5609.45	0	01:00	1.45
1179	JUNCTION	0.17	0.67	5626.67	0	00:40	0.67
1180	JUNCTION	0.14	0.47	5644.47	0	00:45	0.47
1181	JUNCTION	0.00	0.00	5652.00	0	00:00	0.00
1182	JUNCTION	0.44	1.46	5626.46	0	00:50	1.46
1183	JUNCTION	0.35	1.20	5636.20	0	00:50	1.20
1201	JUNCTION	1.28	4.32	5455.55	0	01:00	4.32
1202T	JUNCTION	1.15	3.81	5476.31	0	01:00	3.81
1204	JUNCTION	0.35	1.11	5523.11	0	00:50	1.11
1204T	JUNCTION	1.21	4.44	5500.44	0	00:55	4.44
1205T	JUNCTION	1.07	3.98	5511.98	0	00:55	3.98
1206	JUNCTION	1.24	4.44	5548.44	0	00:55	4.44
1208	JUNCTION	0.00	0.00	5588.00	0	00:00	0.00
1208T	JUNCTION	0.35	1.17	5583.17	0	00:50	1.17
1209	JUNCTION	0.00	0.00	5584.00	0	00:00	0.00
1209T	JUNCTION	0.28	0.92	5583.92	0	00:50	0.92
1210	JUNCTION	0.21	0.71	5590.71	0	00:45	0.71
1211	JUNCTION	0.28	0.92	5590.92	0	00:50	0.92
1303	JUNCTION	0.59	1.95	5331.95	0	00:55	1.95
1304	JUNCTION	0.33	1.30	5347.30	0	00:45	1.30
1305	JUNCTION	0.55	1.87	5351.87	0	00:50	1.87
1306	JUNCTION	0.43	1.56	5367.56	0	00:50	1.56
1307	JUNCTION	0.24	0.93	5398.93	0	00:45	0.93
1102	JUNCTION	3.34	6.47	5252.61	0	01:35	6.47
1106	JUNCTION	4.16	8.23	5286.86	0	01:30	8.23
1108	JUNCTION	2.95	5.92	5303.77	0	01:30	5.92
1114	JUNCTION	4.71	8.84	5331.86	0	01:30	8.84
1124	JUNCTION	2.72	5.35	5352.66	0	01:35	5.35
1140	JUNCTION	9.56	10.18	5388.82	0	00:50	10.18
1144	JUNCTION	3.38	7.22	5401.29	0	01:30	7.22
1145	JUNCTION	11.26	12.07	5419.05	0	00:45	12.07
1162	JUNCTION	1.15	2.66	5444.90	0	01:35	2.66
1167	JUNCTION	6.20	6.95	5507.05	0	00:50	6.95
1169	JUNCTION	1.74	4.37	5525.67	0	01:10	4.37
1205	JUNCTION	1.27	4.42	5514.95	0	01:00	4.42
1171	JUNCTION	0.76	1.77	5588.26	0	00:55	1.77
1202	JUNCTION	1.26	4.43	5477.58	0	01:00	4.43
Jewell_Out	OUTFALL	0.43	2.05	5386.05	0	00:55	2.05
Mississippi_Out	OUTFALL	0.29	1.98	5271.98	0	00:55	1.98
Sanderson_Out	OUTFALL	4.14	8.29	5238.29	0	01:35	8.29
Mississippi_St_Out	OUTFALL	0.25	0.83	5298.83	0	00:40	0.83
1119	DIVIDER	1.20	3.00	5389.00	0	00:35	3.00
1301	DIVIDER	17.03	18.38	5293.94	0	00:55	18.38
1302	DIVIDER	0.25	0.82	5300.82	0	00:45	0.82
Bit-O-Sea	STORAGE	1.54	4.05	5426.85	0	01:35	4.05
Clairefield	STORAGE	3.36	8.88	5435.88	0	01:30	8.88
GG_Entrance	STORAGE	5.05	13.08	5473.88	0	01:30	13.08
GreenGablePark	STORAGE	0.75	0.95	5587.95	0	06:00	0.95
Harvey	STORAGE	0.87	1.07	5435.07	0	06:00	1.07
JewellPark	STORAGE	1.03	3.57	5579.57	0	01:10	3.57
Kendrick	STORAGE	0.49	0.64	5618.64	0	06:00	0.64
Kendrick_1	STORAGE	0.79	0.94	5651.94	0	05:55	0.94
Smith	STORAGE	0.54	0.67	5658.67	0	02:25	0.67
Ward_1	STORAGE	0.31	0.38	5508.38	0	03:00	0.38
Ward_5	STORAGE	0.32	0.39	5450.39	0	02:50	0.39

Node Inflow Summary

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1101	JUNCTION	56.38	4111.58	0	01:35	1.14	216	-0.000
1102T	JUNCTION	0.00	4057.91	0	01:35	0	212	0.000
1103	JUNCTION	115.68	115.68	0	00:45	2.86	2.86	0.000
1103T	JUNCTION	0.00	3764.06	0	01:30	0	198	0.000
1104	JUNCTION	57.95	3719.79	0	01:30	1.14	195	0.000
1105	JUNCTION	8.85	8.85	0	00:45	0.215	0.215	0.000
1106T	JUNCTION	0.00	3704.63	0	01:30	0	194	0.000
1107	JUNCTION	58.05	58.05	0	00:45	1.42	1.42	0.000
1108T	JUNCTION	0.00	3637.68	0	01:30	0	190	0.000
1109	JUNCTION	86.28	210.27	0	00:45	2.03	5.4	0.000
1110	JUNCTION	46.77	46.77	0	00:45	1.36	1.36	0.000
1111	JUNCTION	83.01	83.01	0	00:45	2	2	0.000
1112	JUNCTION	64.28	3507.38	0	01:30	1.17	182	0.000
1113	JUNCTION	173.40	173.40	0	00:40	2.73	2.73	0.000
1114T	JUNCTION	0.00	3481.55	0	01:30	0	178	0.000
1115	JUNCTION	147.01	218.37	0	00:50	3.44	6.22	0.000
1116	JUNCTION	37.93	37.93	0	00:40	0.725	0.725	0.000
1117	JUNCTION	59.02	59.02	0	00:50	2.05	2.05	0.000
1120	JUNCTION	98.53	98.53	0	00:45	2.55	2.55	0.000
1121	JUNCTION	110.20	110.20	0	00:45	2.67	2.67	0.000
1122	JUNCTION	121.18	121.18	0	00:45	3.24	3.24	0.000
1123	JUNCTION	74.11	74.11	0	00:45	1.8	1.8	0.000
1124T	JUNCTION	0.00	3184.52	0	01:25	0	160	0.000
1125	JUNCTION	42.14	940.31	0	01:00	1.43	26.4	0.000
1126	JUNCTION	33.08	33.08	0	00:45	0.871	0.871	0.000

1127	JUNCTION	107.00	876.08	0	00:55	2.72	24.1	0.000	1209	JUNCTION	39.63	39.63	0	00:45	1.06	1.06	0.000
1128	JUNCTION	82.00	82.00	0	00:45	2.08	2.08	0.000	1209T	JUNCTION	0.00	162.14	0	00:50	0	4.72	0.000
1129	JUNCTION	89.36	706.94	0	00:55	2.05	19.3	0.000	1210	JUNCTION	46.61	46.61	0	00:45	1.36	1.36	0.000
1130	JUNCTION	232.45	628.83	0	00:50	4.24	17.3	0.000	1211	JUNCTION	76.86	76.86	0	00:50	2.29	2.29	0.000
1131	JUNCTION	249.44	454.98	0	00:50	7.19	13	0.000	1303	JUNCTION	243.67	865.61	0	00:55	5.93	22.7	0.000
1133	JUNCTION	151.97	213.53	0	00:50	3.48	5.82	0.000	1304	JUNCTION	161.08	161.08	0	00:45	3.86	3.86	0.000
1134	JUNCTION	15.27	15.27	0	00:50	0.506	0.506	0.000	1305	JUNCTION	260.98	496.71	0	00:50	5.93	12.9	0.000
1135	JUNCTION	60.42	60.42	0	00:50	1.82	1.82	0.000	1306	JUNCTION	152.86	267.68	0	00:50	4.09	6.99	0.000
1136T	JUNCTION	0.00	2447.45	0	01:30	0	126	0.000	1307	JUNCTION	117.83	117.83	0	00:45	2.9	2.9	0.000
1137	JUNCTION	84.93	84.93	0	00:45	2	2	0.000	1102	JUNCTION	134.77	4101.80	0	01:35	3.16	215	-0.000
1137T	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal	1106	JUNCTION	85.49	3682.13	0	01:30	2.54	192	0.000
1138	JUNCTION	81.91	81.91	0	00:40	1.66	1.66	0.000	1108	JUNCTION	125.01	3637.39	0	01:30	2.73	190	0.000
1139	JUNCTION	35.03	35.03	0	00:40	0.628	0.628	0.000	1114	JUNCTION	288.94	3480.96	0	01:30	7.68	178	0.000
1140T	JUNCTION	0.00	2449.27	0	01:30	0	126	0.000	1124	JUNCTION	292.52	3184.79	0	01:25	7.68	160	0.000
1141	JUNCTION	80.47	80.47	0	00:40	1.7	1.7	0.000	1140	JUNCTION	323.47	2449.29	0	01:30	8.98	126	0.000
1143	JUNCTION	162.70	162.70	0	00:40	3.26	3.26	0.000	1144	JUNCTION	29.16	2229.66	0	01:30	0.661	112	-0.000
1143T	JUNCTION	0.00	2274.70	0	01:30	0	116	0.000	1145	JUNCTION	145.00	2223.40	0	01:30	3.75	112	0.000
1144T	JUNCTION	0.00	2229.53	0	01:30	0	112	0.000	1162	JUNCTION	61.26	990.06	0	01:35	2.17	46.9	0.000
1145T	JUNCTION	0.00	2223.04	0	01:30	0	112	0.000	1167	JUNCTION	200.62	1002.89	0	01:10	3.97	36.8	0.000
1146	JUNCTION	89.65	260.22	0	00:45	1.66	5.3	0.000	1169	JUNCTION	136.92	738.60	0	01:10	3.54	26.7	0.000
1147	JUNCTION	180.20	180.20	0	00:40	3.65	3.65	0.000	1205	JUNCTION	223.56	606.10	0	00:55	4.93	17.2	0.000
1148	JUNCTION	105.40	105.40	0	00:50	3.08	3.08	0.000	1171	JUNCTION	138.63	431.60	0	00:55	2.77	14	0.000
1148T	JUNCTION	0.00	2133.79	0	01:30	0	103	0.000	1202	JUNCTION	386.68	1089.18	0	01:00	10.1	32	0.000
1149	JUNCTION	157.62	194.41	0	00:55	4.79	6.31	0.000	Jewell_Out	OUTFALL	0.00	464.12	0	00:55	0	10.8	0.000
1150	JUNCTION	47.40	47.40	0	00:50	1.5	1.5	0.000	Mississippi_Out	OUTFALL	0.00	708.52	0	00:55	0	11.8	0.000
1151	JUNCTION	169.30	431.20	0	00:50	3.44	10	0.000	Sanderson_Out	OUTFALL	0.00	4112.60	0	01:35	0	216	0.000
1152	JUNCTION	42.63	42.63	0	00:40	1.01	1.01	0.000	Mississippi_St_Out	OUTFALL	0.00	90.22	0	00:40	0	3.08	0.000
1153	JUNCTION	88.47	238.32	0	00:45	2.37	5.58	0.000	1119	DIVIDER	163.74	532.88	0	00:55	4.62	14.9	0.000
1155	JUNCTION	151.49	151.49	0	00:40	3.08	3.08	0.000	1301	DIVIDER	107.19	1009.41	0	00:55	1.96	25.8	0.000
1156	JUNCTION	369.71	369.71	0	00:45	7.84	7.84	0.000	1302	DIVIDER	180.01	180.01	0	00:45	4.17	4.17	0.000
1157	JUNCTION	37.20	1818.68	0	01:25	0.714	83.7	0.000	Bit-O-Sea	STORAGE	0.00	2133.79	0	01:30	0	103	0.053
1158	JUNCTION	1.80	77.71	0	00:50	0.0514	1.9	0.000	Clairefield	STORAGE	0.00	2215.47	0	01:05	0	96.7	0.020
1159	JUNCTION	12.15	75.40	0	00:50	0.316	1.85	0.000	GG_Entrance	STORAGE	0.00	1211.59	0	01:10	0	44.9	0.021
1160	JUNCTION	17.95	64.00	0	00:45	0.596	1.53	0.000	GreenGablePark	STORAGE	0.00	8.62	0	00:50	0	0.272	0.000
1161	JUNCTION	48.90	48.90	0	00:40	0.932	0.932	0.000	Harvey	STORAGE	0.00	85.12	0	00:45	0	2.08	0.000
1162A	JUNCTION	0.00	950.45	0	01:30	0	44.8	0.000	JewellPark	STORAGE	0.00	503.23	0	00:55	0	16.1	0.079
1162T	JUNCTION	0.00	1020.85	0	01:35	0	48.8	0.000	Kendrick	STORAGE	0.00	262.71	0	00:45	0	8.74	-0.046
1163	JUNCTION	101.44	101.44	0	00:40	1.74	1.74	0.000	Kendrick_1	STORAGE	0.00	117.28	0	00:40	0	2.26	0.000
1163T	JUNCTION	0.00	960.81	0	01:30	0	44.9	0.000	Smith	STORAGE	0.00	618.20	0	00:40	0	12.6	-0.012
1164	JUNCTION	205.28	1168.29	0	01:10	3.95	43.2	0.000	Ward_1	STORAGE	0.00	369.71	0	00:45	0	7.84	-0.003
1165	JUNCTION	145.58	145.58	0	00:40	2.52	2.52	0.000	Ward_5	STORAGE	0.00	116.94	0	00:40	0	2.29	-0.006
1166	JUNCTION	116.34	116.34	0	00:40	2.29	2.29	0.000									
1167T	JUNCTION	0.00	1002.82	0	01:10	0	36.8	0.000									
1168	JUNCTION	144.49	144.49	0	00:45	3.8	3.8	0.000									
1169T	JUNCTION	0.00	639.50	0	01:10	0	23.2	0.000									
1170	JUNCTION	92.08	92.08	0	00:45	2.14	2.14	0.000									
1170T	JUNCTION	0.00	560.12	0	01:10	0	20.3	0.000									
1171T	JUNCTION	0.00	430.95	0	00:55	0	14	0.000									
1172	JUNCTION	234.06	234.06	0	00:45	5.56	5.56	0.000									
1172T	JUNCTION	0.00	11.95	0	06:00	0	1.39	0.000									
1173	JUNCTION	351.35	351.35	0	00:40	5.88	5.88	0.000									
1174	JUNCTION	216.82	216.82	0	00:45	5.14	5.14	0.000									
1175	JUNCTION	75.52	75.52	0	00:40	1.55	1.55	0.000									
1176	JUNCTION	94.00	94.00	0	00:50	3.02	3.02	0.000									
1177	JUNCTION	142.72	142.72	0	00:50	4.27	4.27	0.000									
1178	JUNCTION	71.68	321.94	0	01:00	2.61	9.93	0.000									
1179	JUNCTION	42.09	42.09	0	00:40	1	1	0.000									
1180	JUNCTION	14.99	14.99	0	00:45	0.451	0.451	0.000									
1181	JUNCTION	117.28	117.28	0	00:40	2.26	2.26	0.000									
1182	JUNCTION	89.23	222.68	0	00:50	2.42	6.3	0.000									
1183	JUNCTION	136.77	136.77	0	00:50	3.87	3.87	0.000									
1201	JUNCTION	88.08	1155.24	0	01:00	2.15	34.2	0.000									
1202T	JUNCTION	0.00	1090.41	0	01:00	0	32	-0.000									
1204	JUNCTION	153.38	153.38	0	00:50	4.69	4.69	0.000									
1204T	JUNCTION	0.00	754.65	0	00:55	0	21.9	0.000									
1205T	JUNCTION	0.00	606.06	0	00:55	0	17.2	0.000									
1206	JUNCTION	281.76	419.46	0	00:55	7.57	12.3	0.000									
1208	JUNCTION	8.62	8.62	0	00:50	0.272	0.272	0.000									
1208T	JUNCTION	0.00	162.14	0	00:50	0	4.72	0.000									

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
Bit-O-Sea	353.514	21	0	0	987.310	58	0 01:35	2114.99
Clairefield	542.705	20	0	0	1831.206	68	0 01:30	2002.73
GG_Entrance	436.557	23	0	0	1593.329	83	0 01:30	960.81
GreenGablePark	28.648	22	0	0	36.298	28	0 04:30	0.00
Harvey	224.837	42	0	0	277.494	51	0 06:00	0.00
JewellPark	101.181	14	0	0	365.892	50	0 01:10	441.89
Kendrick	750.427	24	0	0	982.854	31	0 06:00	11.95
Kendrick_1	254.331	26	0	0	301.815	30	0 03:05	0.00
Smith	1240.759	13	0	0	1549.506	16	0 02:20	19.00
Ward_1	867.665	7	0	0	1041.928	9	0 02:55	0.94

Ward_5	253.563	11	0	0	302.544	13	0	02:45	0.58

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Jewell_Out	38.89	171.77	464.12	10.793
Mississippi_Out	23.61	309.70	708.52	11.814
Sanderson_Out	95.83	1393.21	4112.60	215.651
Mississippi_St_Out	52.78	36.08	90.22	3.077
System	52.78	1910.76	4743.84	241.335

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
2101	CONDUIT	4112.60	0 01:35	12.72	0.41	0.69
2102	CONDUIT	4102.00	0 01:35	22.80	0.20	0.51
2102T	CONDUIT	4059.92	0 01:35	8.51	0.33	0.65
2103	CONDUIT	115.12	0 00:45	8.82	0.01	0.16
2103T	CONDUIT	3755.91	0 01:35	9.04	0.39	0.68
2104	CONDUIT	3717.44	0 01:30	5.41	0.48	0.74
2105	CONDUIT	8.70	0 00:50	4.16	0.00	0.06
2106	CONDUIT	3681.85	0 01:30	8.75	0.62	0.82
2106T	CONDUIT	3702.88	0 01:30	8.56	0.41	0.70
2107	CONDUIT	57.84	0 00:45	7.83	0.00	0.12
2108	CONDUIT	3637.68	0 01:30	14.90	0.12	0.40
2108T	CONDUIT	3636.27	0 01:30	8.69	0.15	0.47
2109	CONDUIT	210.49	0 00:50	9.63	0.02	0.20
2110	CONDUIT	46.02	0 00:50	5.41	0.00	0.13
2111	CONDUIT	82.29	0 00:45	6.09	0.01	0.16
2112	CONDUIT	3506.92	0 01:30	13.90	0.49	0.74
2113	CONDUIT	178.35	0 00:40	10.34	0.01	0.18
2114	CONDUIT	3481.55	0 01:30	5.44	0.25	0.56
2114T	CONDUIT	3481.23	0 01:30	6.86	0.31	0.62
2115	CONDUIT	216.69	0 00:55	9.33	0.02	0.21
2116	CONDUIT	33.05	0 00:55	3.68	0.01	0.13
2117	CONDUIT	57.40	0 01:00	4.04	0.01	0.16
2119	CONDUIT	71.06	0 02:20	11.84	1.03	1.00
2119DIV	CONDUIT	464.12	0 00:55	6.75	0.09	0.41
2120	CONDUIT	96.74	0 00:50	3.92	0.02	0.22
2121	CONDUIT	103.29	0 00:55	4.66	0.02	0.21
2122	CONDUIT	114.84	0 00:55	4.41	0.02	0.23
2123	CONDUIT	65.67	0 01:00	4.35	0.01	0.17
2124	CONDUIT	3184.52	0 01:25	22.84	0.14	0.44
2124T	CONDUIT	3168.60	0 01:30	7.24	0.32	0.63
2125	CONDUIT	940.95	0 01:00	10.76	0.10	0.41
2126	CONDUIT	32.65	0 00:45	4.50	0.00	0.12
2127	CONDUIT	871.31	0 01:00	8.85	0.11	0.44
2128	CONDUIT	79.25	0 00:50	4.50	0.01	0.18
2129	CONDUIT	699.60	0 00:55	8.38	0.09	0.41
2130	CONDUIT	629.11	0 00:55	5.87	0.13	0.46
2131	CONDUIT	454.94	0 00:55	6.18	0.08	0.38
2133	CONDUIT	211.31	0 00:55	5.17	0.04	0.28
2134	CONDUIT	14.85	0 01:00	4.02	0.00	0.08
2135	CONDUIT	58.81	0 00:55	5.17	0.01	0.15
2136T	CONDUIT	2445.79	0 01:35	7.21	0.27	0.59
2137	DUMMY	84.93	0 00:45			
2137T	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
2138	DUMMY	81.91	0 00:40			
2139	DUMMY	35.03	0 00:40			
2140	CONDUIT	2449.27	0 01:30	19.73	0.12	0.41
2140T	CONDUIT	2447.45	0 01:30	6.49	0.24	0.57
2141	CONDUIT	77.56	0 00:50	5.55	0.01	0.16
2143	CONDUIT	162.56	0 00:45	8.66	0.01	0.19
2143T	CONDUIT	2271.66	0 01:35	6.09	0.36	0.66
2144	CONDUIT	2229.53	0 01:30	11.87	0.21	0.52
2144T	CONDUIT	2229.04	0 01:35	10.18	0.43	0.69
2145	CONDUIT	2223.04	0 01:30	15.02	0.15	0.45
2145T	CONDUIT	2220.21	0 01:30	9.72	0.31	0.60
2146	CONDUIT	262.06	0 00:45	11.44	0.02	0.21
2147	CONDUIT	178.73	0 00:45	7.58	0.02	0.21
2148	DUMMY	105.40	0 00:50			
2148T	DUMMY	2133.79	0 01:30			
2149	CONDUIT	193.82	0 00:55	6.71	0.02	0.24
2150	CONDUIT	44.40	0 01:05	4.18	0.01	0.14
2151	DUMMY	431.20	0 00:50			
2152	CONDUIT	41.64	0 00:50	5.17	0.00	0.12
2153	CONDUIT	237.24	0 00:50	8.17	0.02	0.24
2155	CONDUIT	149.59	0 00:45	6.21	0.02	0.22
2156	DUMMY	369.71	0 00:45			
2157	CONDUIT	1818.70	0 01:30	7.61	0.21	0.44
2158	CONDUIT	76.53	0 00:50	6.67	0.01	0.15
2159	CONDUIT	75.94	0 00:50	6.07	0.01	0.15
2160	CONDUIT	63.69	0 00:50	5.23	0.01	0.15
2161	CONDUIT	46.43	0 00:45	4.40	0.01	0.14
2162	CONDUIT	991.01	0 01:35	16.00	0.05	0.27
2162A	CONDUIT	952.59	0 01:35	8.48	0.19	0.40
2162T	CONDUIT	1022.81	0 01:35	4.84	0.20	0.51
2163	DUMMY	101.44	0 00:40			
2163T	CONDUIT	950.45	0 01:30	2.73	0.24	0.44
2164	CONDUIT	1168.07	0 01:10	9.01	0.16	0.50
2165	CONDUIT	141.57	0 00:45	4.60	0.02	0.24
2166	CONDUIT	117.24	0 00:40	7.45	0.01	0.17
2167	CONDUIT	1002.82	0 01:10	9.57	0.10	0.37
2167T	CONDUIT	995.32	0 01:15	6.07	0.20	0.53
2168	CONDUIT	143.78	0 00:50	6.28	0.02	0.21
2169	CONDUIT	734.10	0 01:15	7.43	0.25	0.59
2169T	CONDUIT	636.95	0 01:10	8.54	0.32	0.62
2170	DUMMY	92.08	0 00:45			
2170T	CONDUIT	558.59	0 01:10	8.20	0.28	0.59
2171	CONDUIT	430.95	0 00:55	6.68	0.06	0.35
2171T	CONDUIT	428.29	0 01:00	4.51	0.06	0.32
2172	DUMMY	234.06	0 00:45			
2172T	CONDUIT	11.90	0 06:00	1.85	0.01	0.11
2173	DUMMY	351.35	0 00:40			
2174	CONDUIT	216.26	0 00:45	9.69	0.02	0.21
2175	CONDUIT	75.18	0 00:45	10.15	0.44	0.46
2176	CONDUIT	94.00	0 00:50	7.88	0.01	0.15
2177	CONDUIT	142.68	0 00:50	7.75	0.01	0.19
2178	CONDUIT	322.57	0 01:00	11.24	0.02	0.23
2179	CONDUIT	41.63	0 00:45	4.41	0.01	0.13
2180	CONDUIT	14.88	0 00:45	3.13	0.00	0.09
2181	DUMMY	117.28	0 00:40			
2182	CONDUIT	217.15	0 01:00	5.08	0.04	0.29
2183	CONDUIT	135.23	0 00:55	4.62	0.02	0.24
2201	CONDUIT	1153.09	0 01:05	8.48	0.14	0.43
2202	CONDUIT	1090.41	0 01:00	6.20	0.10	0.41
2202T	CONDUIT	1081.84	0 01:00	6.00	0.16	0.48
2204	CONDUIT	151.88	0 00:55	6.00	0.02	0.22
2204T	CONDUIT	752.44	0 01:00	7.33	0.52	0.74
2205	CONDUIT	606.06	0 00:55	9.95	0.06	0.34
2205T	CONDUIT	602.77	0 00:55	6.95	0.41	0.66
2206	CONDUIT	415.14	0 01:00	7.38	0.50	0.74
2208	DUMMY	8.62	0 00:50			

2208T		CONDUIT	156.19	0	01:00	5.73	0.02	0.23
	2209		DUMMY		39.63	0	00:45	
	2209T		DUMMY		162.14	0	00:50	
2210		CONDUIT	46.79	0	00:50	4.31	0.01	0.14
2211		CONDUIT	76.61	0	00:50	4.34	0.01	0.18
2301		CONDUIT	314.15	0	01:45	15.13	1.04	1.00
2301DIV		CONDUIT	708.52	0	00:55	8.78	0.09	0.40
2302		CONDUIT	92.53	0	00:45	9.37	0.01	0.17
2303		CONDUIT	863.40	0	00:55	11.16	0.08	0.39
2304		CONDUIT	152.61	0	00:55	4.63	0.03	0.25
2305		CONDUIT	491.84	0	00:55	7.01	0.07	0.37
2306		CONDUIT	262.59	0	00:55	5.41	0.05	0.31
2307		CONDUIT	116.53	0	00:50	6.47	0.01	0.18
Mississippi_St		CONDUIT	90.22	0	00:40	6.28	0.01	0.16
	Bit-O-Sea_Out		DUMMY		2114.99	0	01:35	
	Clairefield_Out		DUMMY		2002.73	0	01:30	
	GG_Entrance_Out		DUMMY		960.81	0	01:30	
	GreenGablePark_Out		DUMMY		0.00	0	00:00	
	Harvey_Out		DUMMY		0.00	0	00:00	
	JewellPark_Out		DUMMY		441.89	0	01:10	
	Kendrick_1_Out		DUMMY		0.00	0	00:00	
	Kendrick_Out		DUMMY		11.95	0	06:00	
	Smith_Out		DUMMY		19.00	0	00:55	
	Ward_1_Out		DUMMY		0.94	0	03:00	
	Ward_5_Out		DUMMY		0.58	0	02:50	

Conduit Surcharge Summary

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full: Normal Flow	Hours Capacity Limited
2119	1.75	1.75	1.75	0.08	1.75
2301	1.17	1.17	1.17	1.17	1.17

Analysis begun on: Mon Jun 04 16:19:04 2018
Analysis ended on: Mon Jun 04 16:19:04 2018
Total elapsed time: < 1 sec

Table B-6 - Peak Discharges and Runoff Volumes (All Design Points)

Design Point	Drainage Area		Future Conditions Peak Flow (cfs)							Future Conditions Runoff Volume (acre-feet)						
	(acres)	Note	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}
1101	4861	a	562	903	1256	2599	3248	4112	6330	120	177	238	434	541	664	957
1102T	4767	a	554	896	1243	2576	3210	4058	6266	118	174	234	425	529	652	935
1103	64		13	19	27	72	92	116	170	1	2	3	5	7	9	13
1103T	4767	b	503	819	1131	2289	2907	3764	5972	105	154	208	388	489	609	889
1104	4703	b	500	813	1123	2267	2874	3720	5918	104	153	205	385	483	600	877
1105	5		1	2	2	6	7	9	13	0	0	0	0	1	1	1
1106T	4673	b	499	812	1120	2260	2864	3705	5905	103	152	204	381	480	597	871
1107	31		7	11	15	37	47	58	85	1	1	1	3	3	4	6
1108T	4584	b	495	803	1106	2224	2819	3638	5829	102	150	201	375	471	584	852
1109	111		30	44	59	135	170	210	305	3	4	6	11	13	17	24
1110	27		8	11	14	31	38	47	67	1	1	2	3	3	4	6
1111	40		13	19	25	54	68	83	118	1	2	2	4	5	6	9
1112	4414	b	481	782	1074	2152	2716	3507	5671	98	144	193	357	449	560	815
1113	57		25	37	48	110	138	173	247	1	2	3	5	7	8	12
1114T	4334	b	476	775	1064	2133	2696	3482	5639	96	140	189	351	440	548	800
1115	127		32	46	61	139	175	218	318	3	5	7	12	16	19	28
1116	16		5	8	10	24	30	38	55	0	1	1	1	2	2	3
1117	46		6	10	13	36	46	59	87	1	1	2	4	5	6	9
1120	51		15	22	29	64	80	99	141	1	2	3	5	6	8	11
1121	56		15	22	29	70	89	110	160	1	2	3	5	7	8	12
1122	68		16	24	32	77	98	121	176	2	2	3	6	8	10	15
1123	38		10	14	19	47	60	74	107	1	1	2	4	4	6	8
1124T	4046		420	680	938	1935	2449	3185	5294	81	120	163	311	394	492	723
1125	547		123	184	248	589	746	940	1377	14	21	28	52	66	81	118
1126	17		6	8	11	22	27	33	47	1	1	1	2	2	3	4
1127	500		113	170	231	546	695	876	1285	13	19	26	47	60	74	108
1128	44		11	16	22	52	66	82	119	1	2	2	4	5	6	9
1129	400		92	137	186	443	561	707	1027	10	15	21	38	48	59	87
1130	357		84	124	168	393	501	629	923	9	14	18	34	43	53	78
1131	273		59	87	119	285	363	455	667	7	10	13	25	32	40	59
1133	127		24	37	51	132	168	214	314	3	4	6	11	14	18	26
1134	11		2	3	4	9	12	15	22	0	0	0	1	1	2	2
1135	40		7	11	15	38	48	60	88	1	1	2	4	4	6	8
1136T	3332		345	548	746	1515	1914	2447	4332	63	94	127	245	311	388	572
1137	46		8	13	18	52	67	85	125	1	1	2	4	5	6	9
1137T	90		0	0	0	0	0	0	0	0	0	0	0	0	0	0
1138	30		17	24	30	56	68	82	114	1	2	2	4	4	5	7
1139	14		5	7	9	22	28	35	51	0	0	1	1	2	2	3
1140T	3242		345	549	746	1517	1919	2449	4328	63	94	128	245	311	388	572
1141	36		11	16	22	51	65	80	117	1	1	2	3	4	5	8

Table B-6 - Peak Discharges and Runoff Volumes (All Design Points)

Design Point	Drainage Area		Future Conditions Peak Flow (cfs)							Future Conditions Runoff Volume (acre-feet)						
	(acres)	Note	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}
1143	69		21	32	43	103	131	163	236	2	2	3	6	8	10	15
1143T	3017		325	512	693	1410	1771	2275	4073	58	86	117	225	285	357	523
1144T	2948		319	502	678	1382	1732	2230	3999	56	83	114	218	277	345	508
1145T	2933		318	500	676	1377	1726	2223	3988	56	83	113	217	275	345	504
1146	96		54	75	94	177	217	260	365	4	6	7	11	14	16	23
1147	66		36	51	64	122	149	180	252	3	4	5	8	9	11	16
1148	69		11	17	24	64	83	105	155	1	2	3	6	7	9	14
1148T	2758		314	474	639	1330	1636	2134	3779	50	75	102	199	253	317	468
1149	140		21	32	45	118	152	194	288	3	4	6	12	15	19	29
1150	35		4	7	10	28	37	47	71	1	1	1	3	4	5	7
1151	358		57	85	114	273	344	431	631	5	8	10	20	25	31	45
1152	19		8	11	14	28	35	43	60	1	1	1	2	3	3	4
1153	267		30	45	60	150	191	238	348	3	4	6	11	14	17	25
1155	66		19	29	38	95	121	151	221	1	2	3	6	8	9	14
1156	150		66	94	120	245	302	370	521	5	7	10	16	20	24	34
1157	2192		286	423	560	1189	1464	1819	3278	41	61	84	162	205	257	378
1158	37		14	20	25	52	64	78	110	1	2	2	4	5	6	8
1159	36		14	19	25	50	62	75	106	1	2	2	4	5	6	8
1160	30		12	17	21	43	53	64	91	1	1	2	3	4	5	7
1161	17		11	15	19	34	40	49	67	1	1	1	2	2	3	4
1162A	1335		148	214	282	509	603	950	1699	23	34	46	88	111	138	202
1162T	1431		159	229	300	545	645	1021	1839	25	37	50	95	120	150	221
1163	37		15	22	28	65	81	101	145	1	1	2	3	4	5	8
1163T	1335		149	215	282	509	604	961	1697	23	34	46	88	111	138	202
1164	1298		147	219	295	694	895	1168	1752	22	33	45	85	107	133	194
1165	54		19	29	38	92	116	146	210	1	2	3	5	6	8	11
1166	38		28	38	47	81	97	116	160	2	3	3	5	6	7	10
1167T	1169		116	174	242	589	761	1003	1492	19	28	38	72	90	113	166
1168	80		19	29	38	92	117	144	210	2	3	4	7	9	12	17
1169T	902		60	99	143	373	487	640	944	10	15	22	44	57	71	106
1170	46		12	18	24	59	74	92	134	1	2	2	4	5	7	10
1170T	837		52	86	124	327	427	560	825	9	13	19	38	49	62	93
1171T	700		42	66	94	259	336	431	643	6	9	12	26	34	43	64
1172	112		35	51	68	152	190	234	336	3	5	6	11	14	17	25
1172T	416		2	3	4	8	10	12	16	1	1	1	3	3	4	6
1173	106		76	105	131	239	289	351	486	4	6	8	13	15	18	25
1174	111		27	40	55	137	174	217	316	2	4	5	10	13	16	23
1175	34		9	14	19	47	60	76	110	1	1	2	3	4	5	7
1176	66		11	17	23	59	75	94	138	1	2	3	6	7	9	14
1177	90		19	28	38	90	114	143	207	2	3	4	8	11	13	19
1178	225		31	49	70	195	251	322	482	4	6	9	19	24	31	46

Table B-6 - Peak Discharges and Runoff Volumes (All Design Points)

Design Point	Drainage Area		Future Conditions Peak Flow (cfs)							Future Conditions Runoff Volume (acre-feet)						
	(acres)	Note	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}
1179	18		8	12	15	28	35	42	59	1	1	1	2	3	3	4
1180	53		3	4	5	10	13	15	21	0	0	1	1	1	1	2
1181	45		19	28	36	76	95	117	167	1	2	3	5	6	7	10
1182	148		20	31	45	133	174	223	333	2	3	5	11	15	19	29
1183	88		14	22	31	84	107	137	201	2	2	3	7	9	12	18
1201	748		126	195	272	699	902	1155	1722	16	24	33	66	84	105	155
1202T	699		122	187	260	667	854	1090	1623	15	23	31	62	78	98	146
1204	103		18	27	37	95	122	153	225	2	3	4	9	11	14	21
1204T	487		82	125	176	459	592	755	1122	10	15	21	42	54	67	100
1205T	384		65	100	140	369	474	606	898	8	12	16	33	42	53	79
1206	277		45	69	97	257	329	419	619	6	8	12	23	30	38	56
1208	7		0	1	1	5	7	9	13	0	0	0	0	1	1	1
1208T	113		18	27	37	100	128	162	239	2	3	4	9	11	15	22
1209	23		5	7	10	25	32	40	58	0	1	1	2	3	3	5
1209T	106		18	27	37	100	128	162	239	2	3	4	9	11	15	22
1210	30		5	8	11	29	37	47	69	1	1	1	3	3	4	6
1211	52		8	12	17	47	60	77	113	1	1	2	4	6	7	11
1303	467		116	172	231	546	689	866	1254	12	18	25	45	57	70	102
1304	83		20	30	41	102	129	161	234	2	3	4	7	9	12	18
1305	261		71	104	138	315	398	497	722	7	11	14	26	32	40	58
1306	147		36	53	71	170	214	268	388	4	5	7	14	17	22	31
1307	62		15	23	31	75	95	118	171	1	2	3	6	7	9	13
1102	4839	a	559	900	1252	2593	3240	4102	6319	119	176	237	431	538	661	951
1106	4643	b	497	809	1115	2248	2846	3682	5877	103	151	203	378	477	591	864
1108	4584	b	494	804	1107	2224	2819	3637	5829	102	150	201	375	471	584	852
1114	4334	b	476	775	1065	2134	2696	3481	5638	96	141	189	351	440	548	800
1124	4046		420	680	938	1934	2449	3185	5295	81	120	163	311	394	492	723
1140	3242		345	549	746	1518	1919	2449	4327	63	94	128	245	311	388	572
1144	2948		319	502	679	1382	1731	2230	4000	56	83	114	218	277	345	508
1145	2933		318	500	676	1377	1726	2223	3987	56	83	113	217	275	345	504
1162	1394		149	217	287	527	626	990	1774	23	35	47	91	115	144	212
1167	1169		116	174	242	589	761	1003	1492	19	28	38	72	91	113	166
1169	976		71	116	166	430	560	739	1091	12	18	25	51	65	82	122
1205	384		65	100	140	369	475	606	898	8	12	16	33	42	53	79
1171	700		42	66	94	259	337	432	643	6	9	12	26	34	43	64
1202	699		122	187	260	667	855	1089	1625	15	23	31	62	78	98	146
Jewell_Out	307		2	36	73	267	356	464	707	0	2	4	17	25	33	53
Mississippi_Out	588		0	0	0	296	482	709	1209	0	0	0	12	22	36	70
Sanderson_Out	4861	a	562	902	1255	2593	3246	4113	6330	120	177	238	434	541	664	954
Mississippi_St_Out	-	c	28	40	53	90	91	90	90	2	4	5	8	9	9	11

Table B-6 - Peak Discharges and Runoff Volumes (All Design Points)

Design Point	Drainage Area		Future Conditions Peak Flow (cfs)							Future Conditions Runoff Volume (acre-feet)						
	(acres)	Note	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}
1119	307		71	105	142	336	424	533	774	8	12	16	30	37	46	67
1301	588		125	188	253	604	786	1009	1504	14	20	27	50	63	79	118
1302	84		28	40	53	117	146	180	257	2	4	5	8	10	13	19
Bit-O-Sea	2758		314	474	639	1330	1636	2134	3779	50	75	102	199	253	317	468
Clairefield	2618		333	493	657	1435	1781	2215	3746	48	71	97	187	238	297	437
GG_Entrance	1335		154	231	310	726	931	1212	1822	23	34	47	88	111	138	202
GreenGablePark	7		0	1	1	5	7	9	13	0	0	0	0	1	1	1
Harvey	90		8	13	18	52	67	85	126	1	1	2	4	5	6	10
JewellPark	746		51	79	112	303	392	503	756	7	10	15	30	39	50	74
Kendrick	416		40	59	77	171	214	263	376	6	9	12	20	23	27	35
Kendrick_1	45		19	28	36	76	95	117	167	1	2	3	5	6	7	10
Smith	251		108	154	198	406	506	618	883	8	11	15	25	32	39	56
Ward_1	150		66	94	120	245	302	370	521	5	7	10	16	20	24	34
Ward_5	44		21	31	39	78	96	117	165	2	2	3	5	6	7	10

Note:
a. Area excludes Mississippi Gulch Basin area of 587.8 acres and Federal Basin area of 307 acres.
b. Area excludes Federal Basin area of 307 acres.
c. Area is not counted for split flow.

SUPPORTING DOCUMENTATION

NOAA Atlas 14, Volume 8, Version 2
Location name: Lakewood, Colorado, USA*
Latitude: 39.6832°, Longitude: -105.0541°
Elevation: 5415.56 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.208 (0.163-0.264)	0.259 (0.203-0.330)	0.348 (0.272-0.444)	0.426 (0.331-0.546)	0.541 (0.408-0.718)	0.634 (0.466-0.848)	0.732 (0.520-0.997)	0.837 (0.569-1.16)	0.982 (0.641-1.39)	1.10 (0.696-1.56)
10-min	0.304 (0.239-0.387)	0.379 (0.298-0.483)	0.510 (0.399-0.651)	0.624 (0.485-0.799)	0.792 (0.598-1.05)	0.929 (0.683-1.24)	1.07 (0.761-1.46)	1.23 (0.833-1.70)	1.44 (0.939-2.04)	1.61 (1.02-2.29)
15-min	0.371 (0.291-0.472)	0.463 (0.363-0.590)	0.621 (0.486-0.793)	0.761 (0.592-0.975)	0.966 (0.729-1.28)	1.13 (0.833-1.51)	1.31 (0.928-1.78)	1.49 (1.02-2.07)	1.75 (1.15-2.48)	1.96 (1.24-2.79)
30-min	0.518 (0.407-0.660)	0.644 (0.506-0.821)	0.862 (0.674-1.10)	1.05 (0.820-1.35)	1.33 (1.01-1.77)	1.56 (1.15-2.09)	1.81 (1.28-2.46)	2.06 (1.40-2.86)	2.42 (1.58-3.42)	2.70 (1.71-3.85)
60-min	0.647 (0.508-0.823)	0.798 (0.626-1.02)	1.06 (0.830-1.35)	1.30 (1.01-1.66)	1.64 (1.24-2.18)	1.93 (1.42-2.58)	2.23 (1.58-3.04)	2.55 (1.74-3.54)	3.00 (1.96-4.25)	3.36 (2.13-4.79)
2-hr	0.775 (0.616-0.975)	0.951 (0.755-1.20)	1.26 (0.997-1.59)	1.54 (1.21-1.95)	1.95 (1.49-2.56)	2.29 (1.71-3.03)	2.65 (1.91-3.57)	3.04 (2.09-4.18)	3.58 (2.37-5.02)	4.02 (2.58-5.67)
3-hr	0.849 (0.679-1.06)	1.03 (0.827-1.29)	1.36 (1.09-1.71)	1.66 (1.31-2.09)	2.10 (1.62-2.75)	2.47 (1.86-3.26)	2.87 (2.08-3.84)	3.29 (2.28-4.50)	3.89 (2.59-5.42)	4.37 (2.82-6.12)
6-hr	1.02 (0.822-1.25)	1.23 (0.994-1.52)	1.61 (1.30-1.99)	1.95 (1.56-2.42)	2.46 (1.92-3.18)	2.89 (2.19-3.76)	3.34 (2.45-4.43)	3.83 (2.69-5.17)	4.52 (3.05-6.23)	5.07 (3.32-7.03)
12-hr	1.25 (1.03-1.53)	1.51 (1.24-1.85)	1.97 (1.60-2.41)	2.37 (1.92-2.91)	2.97 (2.34-3.79)	3.47 (2.66-4.45)	3.99 (2.96-5.22)	4.55 (3.23-6.07)	5.33 (3.64-7.26)	5.96 (3.95-8.17)
24-hr	1.54 (1.27-1.85)	1.85 (1.53-2.23)	2.38 (1.96-2.88)	2.85 (2.34-3.45)	3.53 (2.81-4.43)	4.09 (3.17-5.17)	4.67 (3.50-6.02)	5.29 (3.80-6.96)	6.14 (4.24-8.26)	6.82 (4.58-9.25)
2-day	1.80 (1.51-2.14)	2.16 (1.81-2.58)	2.78 (2.32-3.32)	3.31 (2.75-3.96)	4.06 (3.27-5.02)	4.67 (3.66-5.82)	5.29 (4.01-6.72)	5.94 (4.31-7.71)	6.83 (4.77-9.06)	7.52 (5.11-10.1)
3-day	1.91 (1.61-2.25)	2.32 (1.96-2.74)	3.01 (2.53-3.56)	3.59 (3.00-4.27)	4.41 (3.56-5.39)	5.05 (3.98-6.24)	5.70 (4.34-7.18)	6.37 (4.66-8.20)	7.27 (5.11-9.58)	7.97 (5.46-10.6)
4-day	2.00 (1.70-2.35)	2.44 (2.07-2.87)	3.17 (2.67-3.73)	3.78 (3.17-4.46)	4.63 (3.75-5.62)	5.29 (4.19-6.49)	5.96 (4.56-7.46)	6.64 (4.88-8.51)	7.56 (5.34-9.91)	8.27 (5.69-11.0)
7-day	2.33 (2.00-2.71)	2.76 (2.36-3.21)	3.47 (2.96-4.05)	4.08 (3.46-4.77)	4.93 (4.05-5.94)	5.61 (4.50-6.82)	6.30 (4.88-7.82)	7.01 (5.21-8.90)	7.98 (5.70-10.4)	8.73 (6.08-11.5)
10-day	2.64 (2.28-3.05)	3.05 (2.63-3.52)	3.73 (3.21-4.33)	4.33 (3.69-5.03)	5.17 (4.28-6.20)	5.85 (4.73-7.08)	6.55 (5.11-8.09)	7.28 (5.45-9.19)	8.28 (5.96-10.7)	9.06 (6.35-11.8)
20-day	3.45 (3.02-3.94)	3.90 (3.40-4.45)	4.64 (4.03-5.30)	5.28 (4.56-6.05)	6.17 (5.17-7.29)	6.89 (5.63-8.22)	7.62 (6.02-9.28)	8.38 (6.35-10.4)	9.40 (6.86-12.0)	10.2 (7.25-13.2)
30-day	4.10 (3.61-4.64)	4.64 (4.08-5.25)	5.53 (4.84-6.27)	6.26 (5.45-7.13)	7.28 (6.13-8.49)	8.06 (6.63-9.52)	8.85 (7.04-10.7)	9.65 (7.36-11.9)	10.7 (7.87-13.5)	11.5 (8.24-14.8)
45-day	4.92 (4.37-5.53)	5.63 (4.99-6.33)	6.76 (5.96-7.61)	7.67 (6.73-8.67)	8.90 (7.53-10.3)	9.82 (8.12-11.5)	10.7 (8.57-12.8)	11.6 (8.90-14.2)	12.7 (9.40-15.9)	13.6 (9.78-17.3)
60-day	5.63 (5.01-6.28)	6.50 (5.79-7.27)	7.89 (7.00-8.83)	8.99 (7.93-10.1)	10.4 (8.85-11.9)	11.5 (9.55-13.3)	12.5 (10.0-14.8)	13.5 (10.4-16.3)	14.7 (10.9-18.3)	15.5 (11.3-19.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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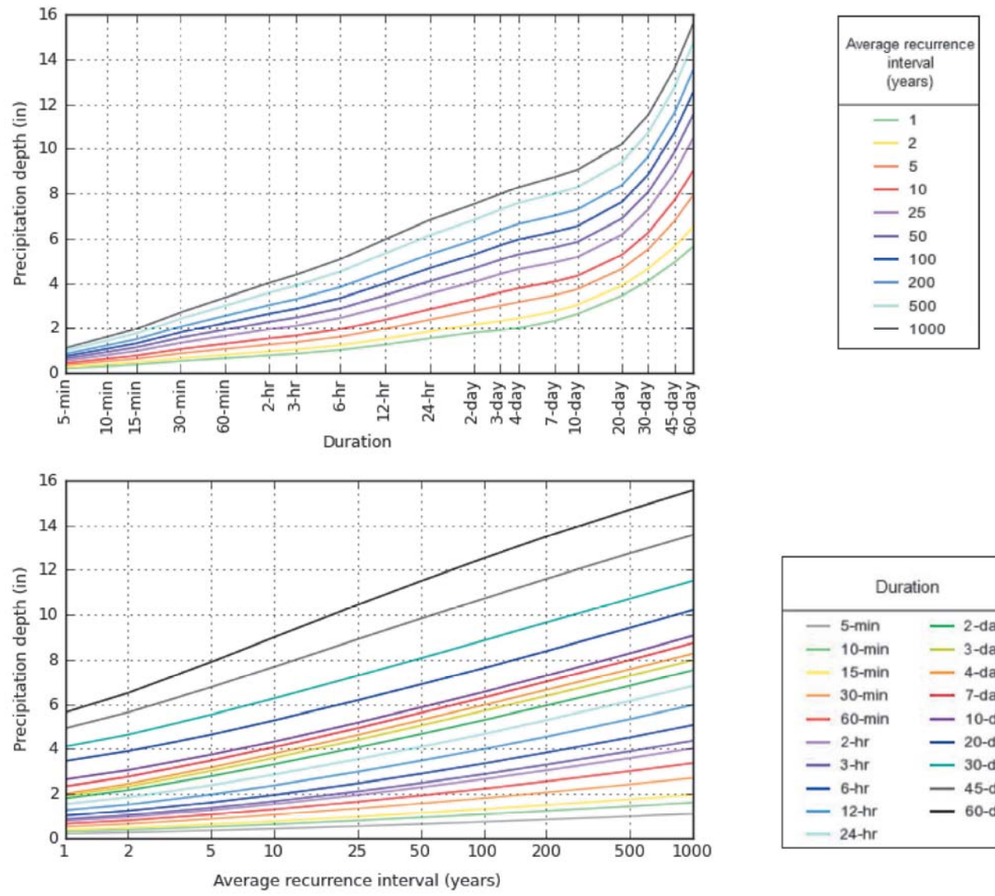
PF graphical



NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Tue Dec 13 23:59:46 2016

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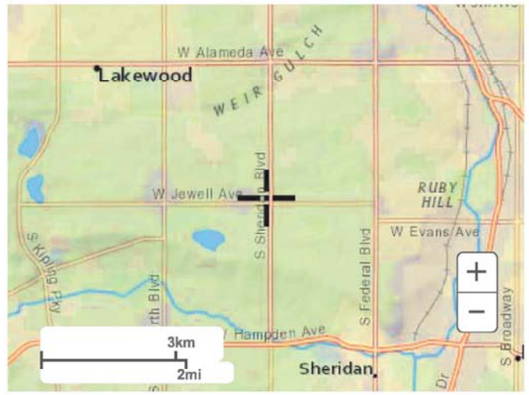
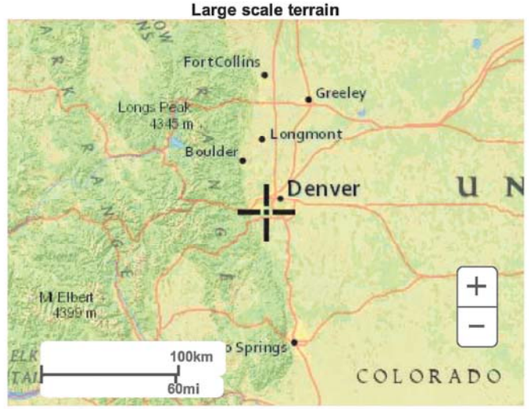
Maps & aerials

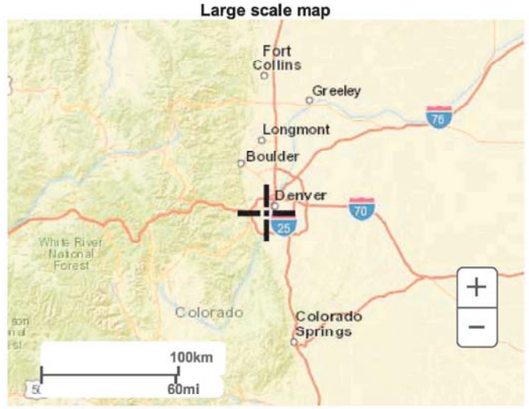
Small scale terrain



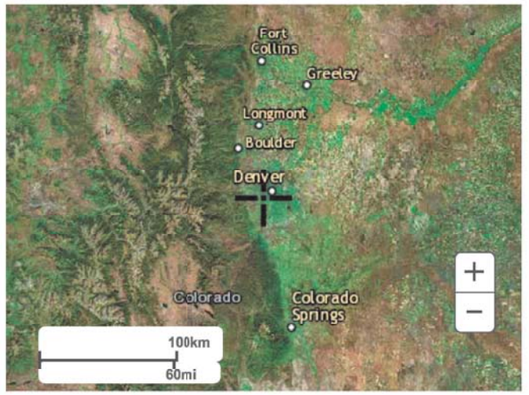
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table RO-3—Recommended Percentage Imperviousness Values

Land Use or Surface Characteristics	Percentage Imperviousness
Business:	
Commercial areas	95
Neighborhood areas	85
Residential:	
Single-family	*
Multi-unit (detached)	60
Multi-unit (attached)	75
Half-acre lot or larger	*
Apartments	80
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	5
Playgrounds	10
Schools	50
Railroad yard areas	15
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	0
Lawns, clayey soil	0

* See Figures RO-3 through RO-5 for percentage imperviousness.

$$C_A = K_A + \left(1.31i^3 - 1.44i^2 + 1.135i - 0.12\right) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \quad \text{(RO-6)}$$

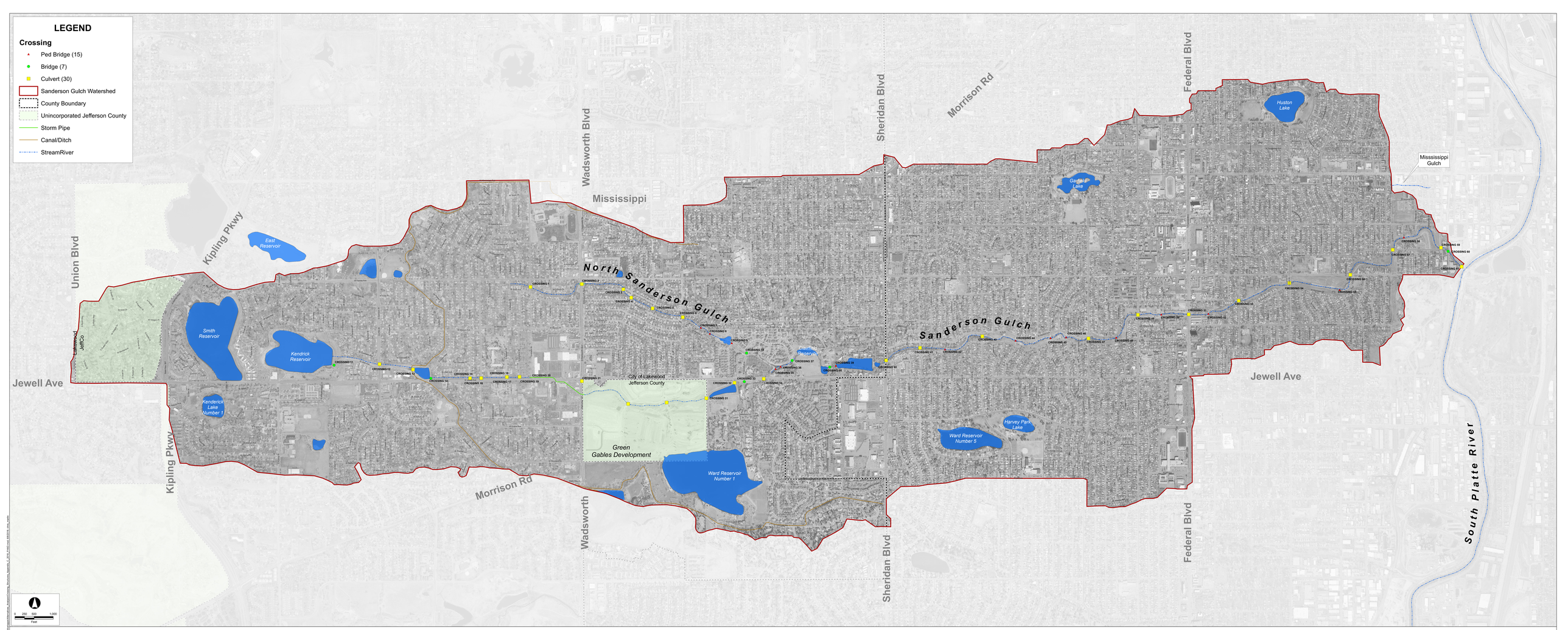
$$C_{CD} = K_{CD} + \left(0.858i^3 - 0.786i^2 + 0.774i + 0.04\right) \quad \text{(RO-7)}$$

$$C_B = \left(\mathrm{C_A} + C_{CD}\right)/2$$

APPENDIX C

HYDRAULIC ANALYSIS

EXISTING HYDRAULIC STRUCTURES



Existing Hydraulic Structures
Flood Hazard Area Delineation - Sanderson Gulch


SANDERSON GULCH CROSSING 1


SANDERSON GULCH CROSSING 2


SANDERSON GULCH CROSSING 3


SANDERSON GULCH CROSSING 4


SANDERSON GULCH CROSSING 5


SANDERSON GULCH CROSSING 6


SANDERSON GULCH CROSSING 7


SANDERSON GULCH CROSSING 8


SANDERSON GULCH CROSSING 9


SANDERSON GULCH CROSSING 10


SANDERSON GULCH CROSSING 11


SANDERSON GULCH CROSSING 12


SANDERSON GULCH CROSSING 12
13


14
SANDERSON GULCH CROSSING 14


SANDERSON GULCH CROSSING 15


SANDERSON GULCH CROSSING 16


SANDERSON GULCH CROSSING 17
17


SANDERSON GULCH CROSSING 18
18


SANDERSON GULCH CROSSING 19
Balsam


SANDERSON GULCH CROSSING 20


SANDERSON GULCH CROSSING 21


SANDERSON GULCH CROSSING 22
22


SANDERSON GULCH CROSSING 23


SANDERSON GULCH CROSSING 24
24


SANDERSON GULCH CROSSING 25


SANDERSON GULCH CROSSING 26


SANDERSON GULCH CROSSING 27

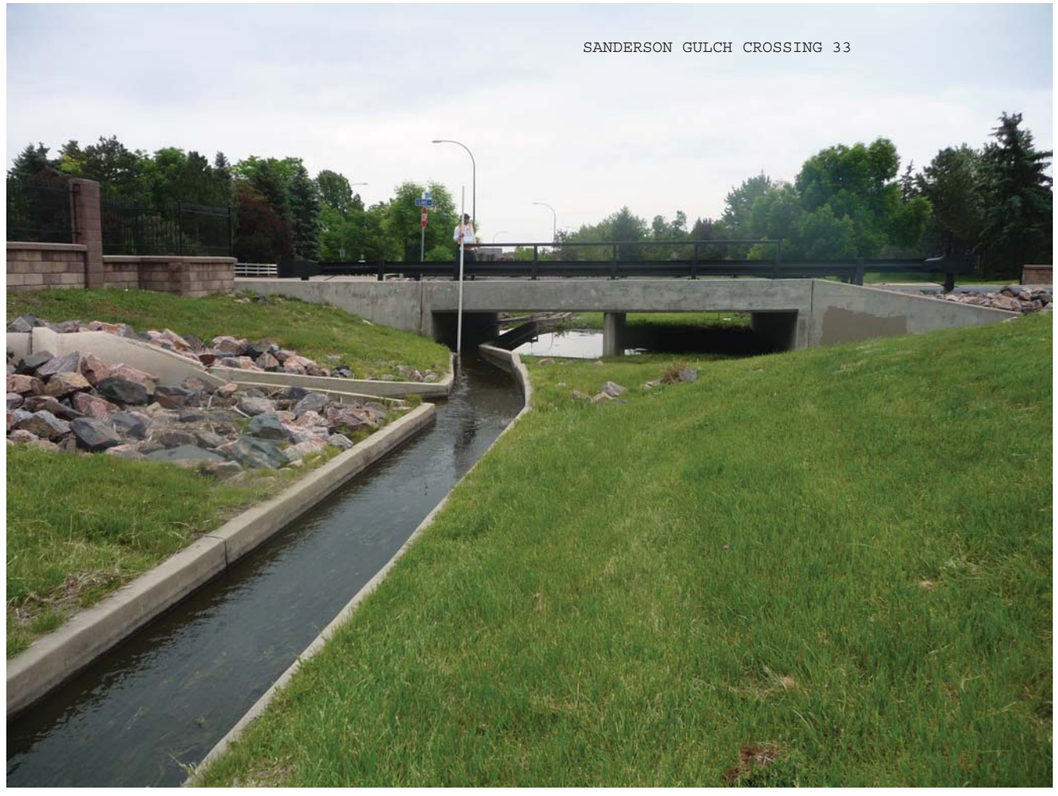

SANDERSON GULCH CROSSING 28


SANDERSON GULCH CROSSING 29
29


SANDERSON GULCH CROSSING 30
30

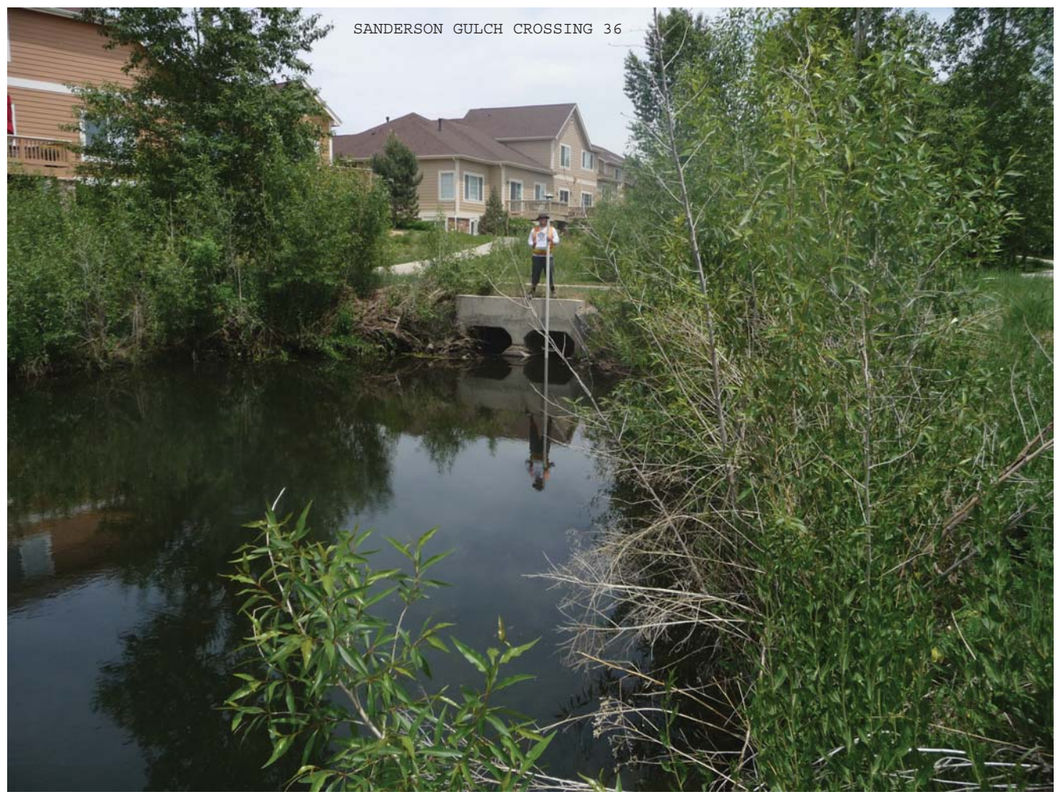

SANDERSON GULCH CROSSING 31
31


SANDERSON GULCH CROSSING 32
32


SANDERSON GULCH CROSSING 33


SANDERSON GULCH CROSSING 34


35
SANDERSON GULCH CROSSING 35


SANDERSON GULCH CROSSING 36


SANDERSON GULCH CROSSING 37


38
SANDERSON GULCH CROSSING 38


SANDERSON GULCH CROSSING 39
39


40
SANDERSON GULCH CROSSING 40


SANDERSON GULCH CROSSING 41


42
SANDERSON GULCH CROSSING 42


SANDERSON GULCH CROSSING 43


SANDERSON GULCH CROSSING 44
44


SANDERSON GULCH CROSSING 45


SANDERSON GULCH CROSSING 46


SANDERSON GULCH CROSSING 47


SANDERSON GULCH CROSSING 48


SANDERSON GULCH CROSSING 49


SANDERSON GULCH CROSSING 50


SANDERSON GULCH CROSSING 51


SANDERSON GULCH CROSSING 52


SANDERSON GULCH CROSSING 53


SANDERSON GULCH CROSSING 54


55
SANDERSON GULCH CROSSING 55


SANDERSON GULCH CROSSING 56


SANDERSON GULCH CROSSING 57


SANDERSON GULCH CROSSING 58


SANDERSON GULCH CROSSING 59


SANDERSON GULCH CROSSING 60


SANDERSON GULCH CROSSING 61

HEC-RAS FLOW CHANGE
UNIT AREA DISCHARGE ANALYSIS

North Sanderson Gulch Peak Discharges/Locations in Florida Ave. from S Garrison Street to S Balsam Ct.

Location	Design Point/ Conveyance Element	No.	River	Reach	River Station	10-Year	50-Year	100-Year	500-Year
S Garrison Street[1]	NA	1	N_Sanderson	NS-4	11451	28	97	123	182
S Endicott Street	1208T	2	N_Sanderson	NS-4	10880	37	128	162	239
S Dover Street[2]	NA	4	N_Sanderson	NS-4	9604	59	199	252	369
S Balsam Ct.	1206	5	N_Sanderson	NS-4	8523	97	329	419	619

[1] Peak Discharges are combined runoff from sub-basins 210 and 211.
[2] Peak Discharges are calculated using unit area runoff from sub-basins 206 and 207 plus peak discharges from design point 1208T.

Runoffs for Sub-basins

	Basin	Aera (acre)	Peak Discharge (cfs)			
			10-Year	50-Year	100-Year	500-Year
Sub-basin Peak Runoff at Concentration Point	**206**	92	37	118	149	216
	207	72	34	110	137	200
	210	30	11	37	47	69
	211	52	17	60	77	113

Calculation of Runoff per Unit Area of Sub-basin

	Basin	Aera (acre)	Unit Area Runoff (cfs)			
			10-Year	50-Year	100-Year	500-Year
Sub-basin Unit Area Runoff	**206**	92	0.40	1.28	1.61	2.35
	207	72	0.47	1.52	1.90	2.78

Calculation of Runoff at Internal Point

	Basin	Aera (acre)	Peak Discharge (cfs)			
			10-Year	50-Year	100-Year	500-Year
Internal Runoff at S Dove Street	**206**	13	5	17	21	31
	207	36	17	55	68	100

FLOW SPLIT CALCULATION

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

1. Railroad to South Platte River Drive

Cross Section Output

File Type Options Help

River: Sanderson Profile: 100-Year

Reach 01 RS: 146 Plan: SG_FHAD_FP

Plan: SG_FHAD_FP Sanderson 01 RS: 146 Profile: 100-Year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	5248.31				
Vel Head (ft)	0.30	Wt. n-Val.	0.020	0.035	0.020
W.S. Elev (ft)	5248.01	Reach Len. (ft)	93.26	94.18	95.10
Crit W.S. (ft)	5247.06	Flow Area (sq ft)	504.32	388.75	219.97
E.G. Slope (ft/ft)	0.001076	Area (sq ft)	504.32	388.75	219.97
Q Total (cfs)	4112.00	Flow (cfs)	1362.41	2146.88	602.70
Top Width (ft)	657.19	Top Width (ft)	428.11	44.96	184.12
Vel Total (ft/s)	3.69	Avg. Vel. (ft/s)	2.70	5.52	2.74
Max Chl Dpth (ft)	12.06	Hydr. Depth (ft)	1.18	8.65	1.19
Conv. Total (cfs)	125382.9	Conv. (cfs)	41542.6	65462.6	18377.7
Length Wtd. (ft)	94.18	Wetted Per. (ft)	432.08	49.21	184.47
Min Ch El (ft)	5235.95	Shear (lb/sq ft)	0.08	0.53	0.08
Alpha	1.42	Stream Power (lb/ft s)	1394.64	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	24.39	105.28	25.80
C & E Loss (ft)		Cum SA (acres)	0.51	0.12	0.31

Errors, Warnings and Notes

Flow in left overbank.

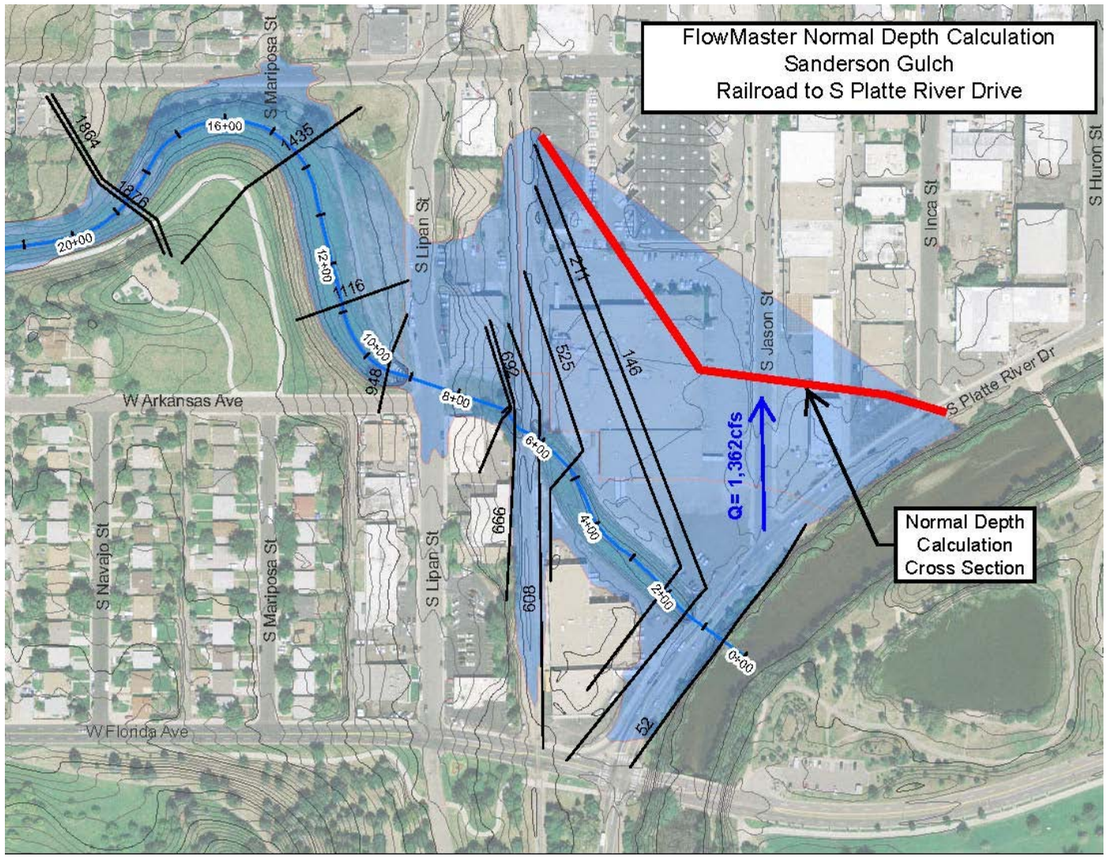


Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

Worksheet for Railroad to SPR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	1362.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5250.00
1+02	5248.00
1+36	5246.00
2+71	5246.00
4+58	5248.00
5+62	5248.00
6+55	5246.00
6+65	5244.00
6+69	5242.00
7+63	5242.00
8+92	5244.00
10+62	5246.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5250.00)	(10+62, 5246.00)	0.017

Options

Current Roughness Weighted	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.46	ft

Worksheet for Railroad to SPR

Results

Elevation Range	5242.00 to 5250.00 ft	
Flow Area	208.31	ft²
Wetted Perimeter	191.51	ft
Hydraulic Radius	1.09	ft
Top Width	191.16	ft
Normal Depth	1.46	ft
Critical Depth	1.55	ft
Critical Slope	0.00404	ft/ft
Velocity	6.54	ft/s
Velocity Head	0.66	ft
Specific Energy	2.13	ft
Froude Number	1.10	
Flow Type	Supercritical	

GVF Input Data

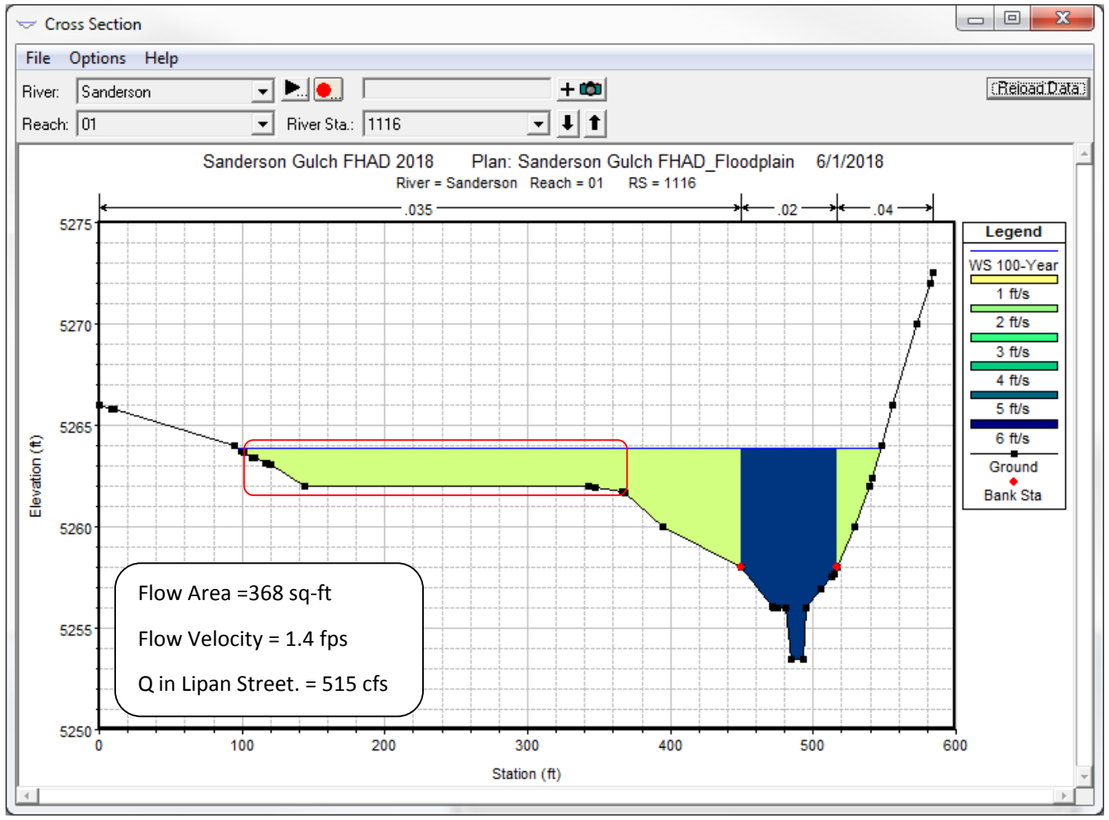
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.46	ft
Critical Depth	1.55	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00404	ft/ft

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

2. Lipan Street (Sta. 11+16)



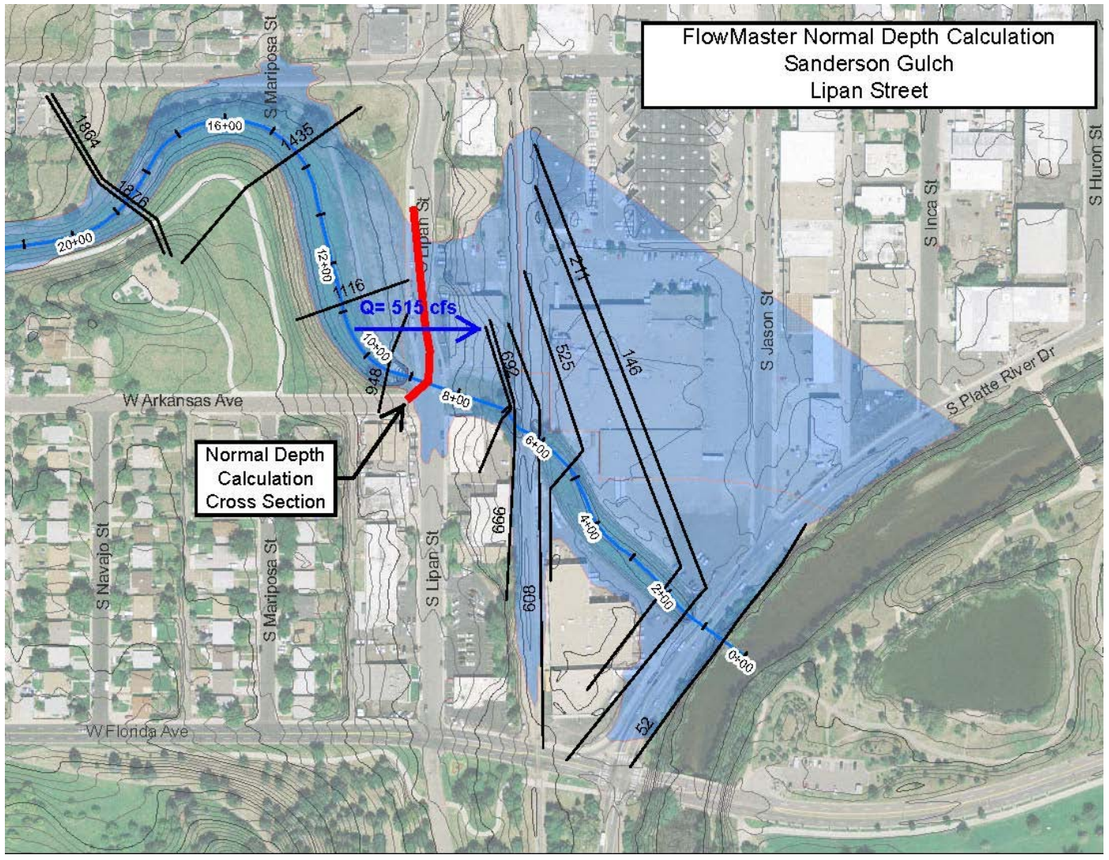


Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

Worksheet for Lipan St.

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01300	ft/ft
Discharge	515.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5262.00
2+38	5261.68
2+86	5261.36
3+43	5261.23
4+03	5262.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5262.00)	(4+03, 5262.00)	0.017

Options

Current Roughness Weighted	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.75	ft
Elevation Range	5261.23 to 5262.00 ft	
Flow Area	115.25	ft²
Wetted Perimeter	383.89	ft
Hydraulic Radius	0.30	ft
Top Width	383.88	ft
Normal Depth	0.75	ft
Critical Depth	0.83	ft

Worksheet for Lipan St.

Results

Critical Slope	0.00587	ft/ft
Velocity	4.47	ft/s
Velocity Head	0.31	ft
Specific Energy	1.06	ft
Froude Number	1.44	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.83	ft
Channel Slope	0.01300	ft/ft
Critical Slope	0.00587	ft/ft

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

3. Florida Avenue (Sta. 43+30)

Split Flow Calculation - Lipan Street

Broad Weir Coefficient 3

Station/ Cross Section	W.S.E.	Ground El.	Water Depth Overtop (ft)	Average Water Depth Overtop (ft)	Reach Length to d/s (ft)	Weir Length (ft)	Q Leaving (cfs)	Note
4433	5292.5	5293.71	-1.21	-0.60	90			
	5292.47	**5292.47**	**0.01**	**0.08**	10	**10**	**1**	Seek where W.S.E. equals to ground surface El.
4387	5292.47	5292.31	0.16	**0.41**	34	**34**	**27**	
4330 u/s	5292.47	5291.8	0.67	**0.33**	41	**23**	**13**	
	5291.69	**5291.693**	**0.00**	-0.27	18			Seek where W.S.E. equals to ground surface El.
4330 d/s	5291.08	5291.61	-0.53					
				Total Flow Leaves (cfs)			**41**	

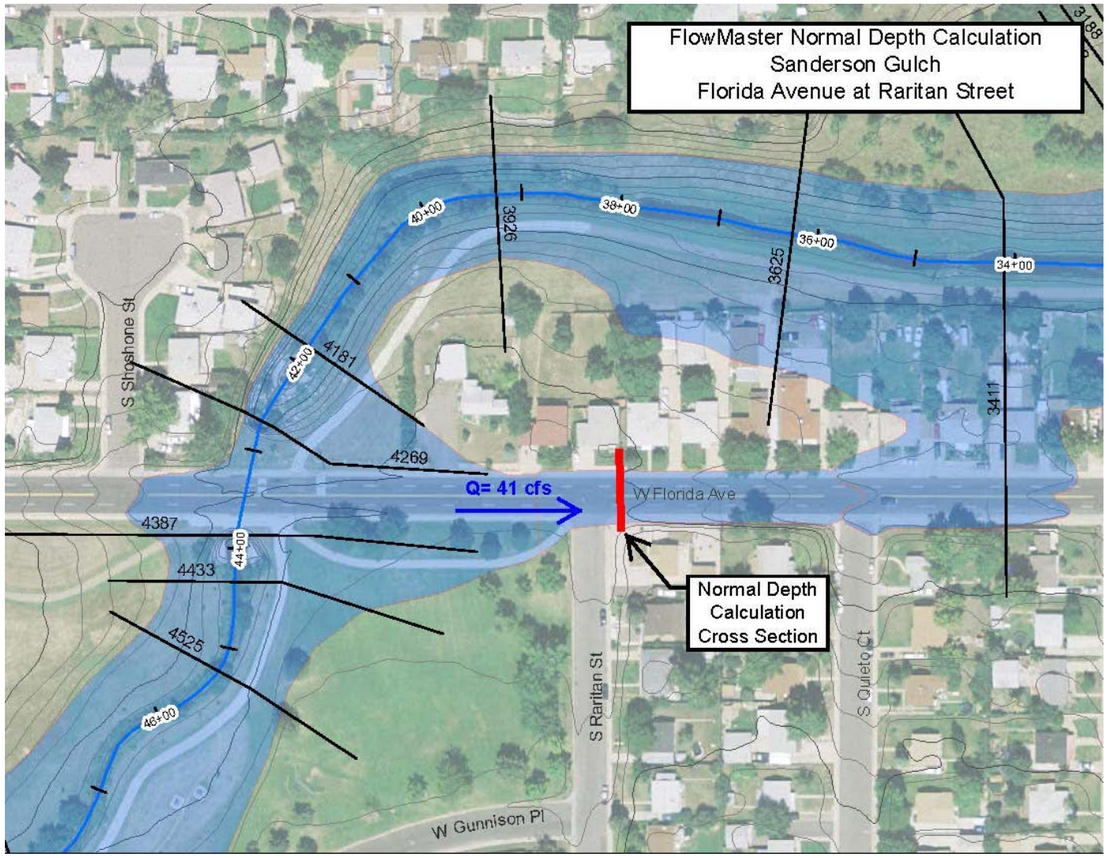


Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

Worksheet for Florida Ave at Raritan St.

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02340	ft/ft
Discharge	41.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5292.00
0+25	5290.00
0+46	5290.50
0+63	5290.00
0+78	5292.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5292.00)	(0+78, 5292.00)	0.017

Options

Current Roughness Weighted	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.42	ft
Elevation Range	5290.00 to 5292.00 ft	
Flow Area	8.63	ft²
Wetted Perimeter	40.76	ft
Hydraulic Radius	0.21	ft
Top Width	40.70	ft
Normal Depth	0.42	ft
Critical Depth	0.53	ft

Worksheet for Florida Ave at Raritan St.

Results

Critical Slope	0.00645	ft/ft
Velocity	4.75	ft/s
Velocity Head	0.35	ft
Specific Energy	0.77	ft
Froude Number	1.82	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.53	ft
Channel Slope	0.02340	ft/ft
Critical Slope	0.00645	ft/ft

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

4. W Colorado Ave at Xavier (Sta. 170+66)

Cross Section Output

File Type Options Help

River: Sanderson Profile: 100-Year

Reach 01 RS: 17066 Plan: SG_FHAD_FP

Plan: SG_FHAD_FP Sanderson 01 RS: 17066 Profile: 100-Year

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	5404.63	Wt. n-Val.	0.040	0.035	0.040
Vel Head (ft)	0.82	Reach Len. (ft)	47.84	47.19	46.53
W.S. Elev (ft)	5403.81	Flow Area (sq ft)	15.39	293.41	12.80
Crit W.S. (ft)	5400.31	Area (sq ft)	15.39	293.41	12.80
E.G. Slope (ft/ft)	0.002161	Flow (cfs)	37.14	2155.31	30.55
Q Total (cfs)	2223.08	Top Width (ft)	8.49	34.04	6.89
Top Width (ft)	49.41	Avg. Vel. (ft/s)	2.41	7.35	2.39
Vel Total (ft/s)	6.91	Hydr. Depth (ft)	1.81	8.62	1.86
Max Chl Dpth (ft)	10.09	Conv. (cfs)	798.8	46363.8	657.3
Conv. Total (cfs)	47820.0	Wetted Per. (ft)	9.31	40.86	7.87
Length Wtd. (ft)	47.19	Shear (lb/sq ft)	0.22	0.97	0.22
Min Ch El (ft)	5393.72	Stream Power (lb/ft s)	456.88	0.00	0.00
Alpha	1.10	Cum Volume (acre-ft)	59.65	241.44	52.57
Frctn Loss (ft)	0.15	Cum SA (acres)	21.00	18.20	13.72
C & E Loss (ft)	0.17				

Errors, Warnings and Notes

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Select River Station

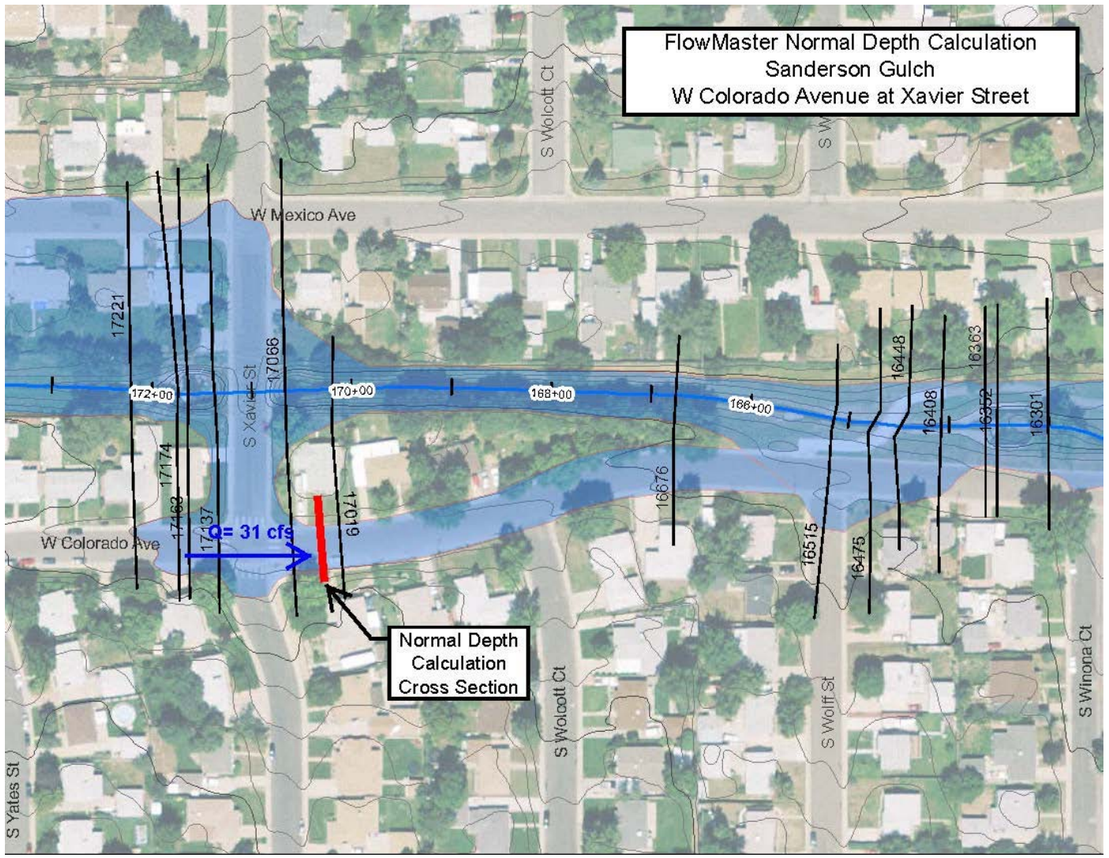


Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

Worksheet for W Colorado Ave at Xavier

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	31.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5406.00
0+19	5404.00
0+74	5404.00
0+84	5406.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5406.00)	(0+84, 5406.00)	0.017

Options

Current Roughness Weighted	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.19	ft
Elevation Range	5404.00 to 5406.00 ft	
Flow Area	10.82	ft²
Wetted Perimeter	57.81	ft
Hydraulic Radius	0.19	ft
Top Width	57.78	ft
Normal Depth	0.19	ft
Critical Depth	0.21	ft
Critical Slope	0.00713	ft/ft

Worksheet for W Colorado Ave at Xavier

Results

Velocity	2.86	ft/s
Velocity Head	0.13	ft
Specific Energy	0.32	ft
Froude Number	1.17	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.19	ft
Critical Depth	0.21	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00713	ft/ft

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

5. Jewell Avenue at White Fence Farm (Sta. 221+27)

Cross Section for Jewell Ave at White Fence Farm_Street Capacity

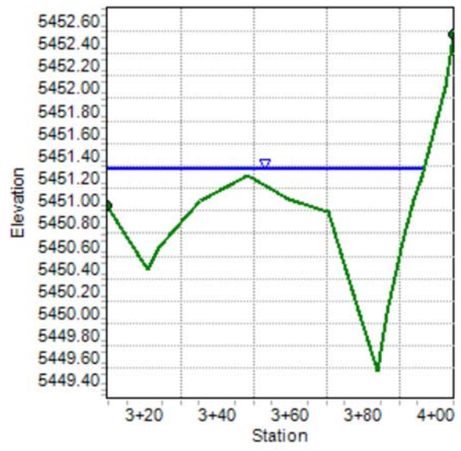
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

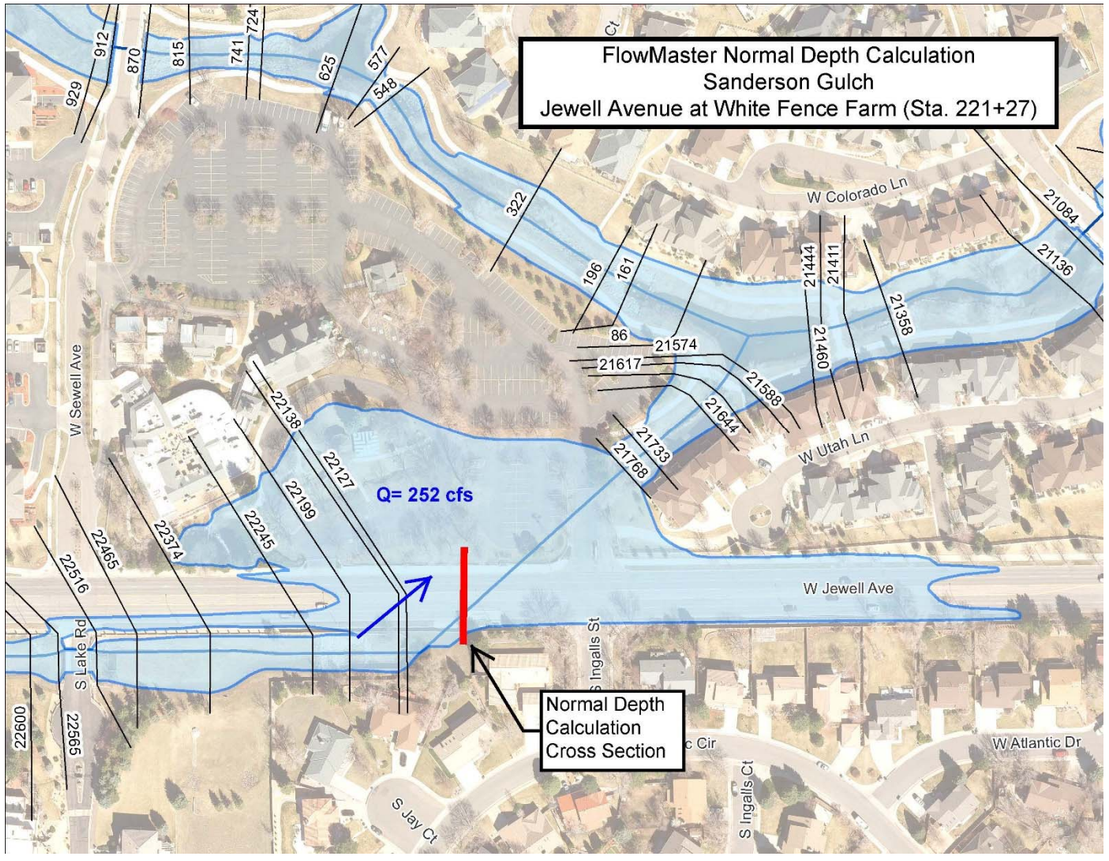
Input Data

Channel Slope	0.01180	ft/ft
Normal Depth	1.79	ft
Discharge	252.00	ft³/s

Cross Section Image



Bentley Systems, Inc. Haestad Methods Solution Center
Bentley FlowMaster V8i (SELECTseries 1) [08.11.01.03]
6/7/2018 10:05:34 AM 27 Siemons Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 1



100-year floodplain depth is less than 2-foot deep within W. Jewell Avenue.

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

FlowMaster Normal Depth Calculation - Jewell Avenue at White Fence Farm (Sta. 221+27)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01180	ft/ft
Discharge	252.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
3+09	5450.94
3+21	5450.38
3+24	5450.58
3+35	5450.99
3+48	5451.21
3+59	5451.01
3+60	5451.00
3+70	5450.89
3+79	5450.01
3+84	5449.48
3+86	5450.00
3+91	5450.64
3+94	5451.00
3+96	5451.20
4+03	5452.00
4+05	5452.47

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(3+09, 5450.94)	(4+05, 5452.47)	0.020

Options

Current Roughness Weighted	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for Jewell Ave at White Fence Farm_Street Capacity

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.79	ft
Elevation Range	5449.48 to 5452.47 ft	
Flow Area	47.25	ft²
Wetted Perimeter	87.88	ft
Hydraulic Radius	0.54	ft
Top Width	87.31	ft
Normal Depth	1.79	ft
Critical Depth	1.89	ft
Critical Slope	0.00686	ft/ft
Velocity	5.33	ft/s
Velocity Head	0.44	ft
Specific Energy	2.24	ft
Froude Number	1.28	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.79	ft
Critical Depth	1.89	ft
Channel Slope	0.01180	ft/ft
Critical Slope	0.00686	ft/ft

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

6. Jewell Ave at S Lake Road Sta. 225+30

Bridge Output

File Type Options Help

River: Sanderson Profile: 100-Year

Reach 02 RS: 22530 Plan: SG_FHAD_FP

Plan: SG_FHAD_FP Sanderson 02 RS: 22530 Profile: 100-Year

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	5457.41	E.G. Elev (ft)	5457.42	5456.79
W.S. US. (ft)	5457.04	W.S. Elev (ft)	5457.04	5456.36
Q Total (cfs)	990.00	Crit W.S. (ft)	5454.74	5454.75
Q Bridge (cfs)	961.75	Max Chl Dpth (ft)	5.79	5.11
Q Weir (cfs)	28.25	Vel Total (ft/s)	0.00	0.00
Weir Sta Lft (ft)	114.47	Flow Area (sq ft)		
Weir Sta Rgt (ft)	204.72	Froude # Chl	0.68	0.69
Weir Submerg	0.00	Specif Force (cu ft)	686.77	604.18
Weir Max Depth (ft)	0.78	Hydr Depth (ft)		
Min El Weir Flow (ft)	5457.01	W.P. Total (ft)	91.39	96.58
Min El Prs (ft)	5455.05	Conv. Total (cfs)		
Delta EG (ft)	0.62	Top Width (ft)	25.24	39.07
Delta WS (ft)	1.69	Frctn Loss (ft)		
BR Open Area (sq ft)	104.27	C & E Loss (ft)		
BR Open Vel (ft/s)	9.22	Shear Total (lb/sq ft)		
Coef of Q		Power Total (lb/ft s)	0.00	0.00
Br Sel Method	Press/Weir			

Errors, Warnings and Notes

Note: Yarnell answer is not valid if the water surface is above the low chord or if there is weir flow. The Yarnell answer has been disregarded.

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.

Note: The downstream water surface is above the minimum elevation required for orifice flow. The orifice flow equation was used for pressure flow.

Flow over the weir.

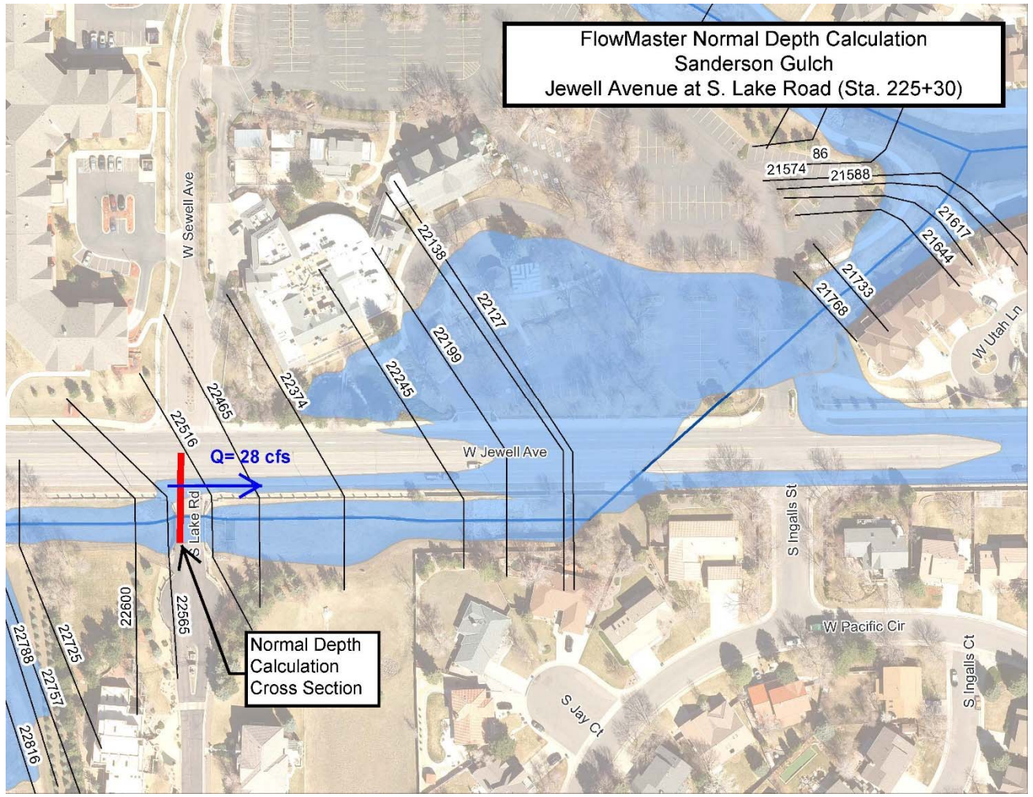


Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

Worksheet for Jewell Ave at S Lake Road Sta. 225+30

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	28.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	5455.90
0+14	5455.34
0+20	5455.00
0+26	5454.70
0+26	5454.69
0+26	5454.70
0+30	5455.00
0+31	5455.14
0+35	5455.54
0+38	5455.61
0+40	5455.66
0+40	5455.69

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5455.90)	(0+40, 5455.69)	0.020

Options

Current Roughness Weighted	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.67	ft

Worksheet for Jewell Ave at S Lake Road Sta. 225+30

Results

Elevation Range	5454.69 to 5455.90 ft		
Flow Area		6.62	ft²
Wetted Perimeter		19.80	ft
Hydraulic Radius		0.33	ft
Top Width		19.75	ft
Normal Depth		0.67	ft
Critical Depth		0.74	ft
Critical Slope		0.00817	ft/ft
Velocity		4.23	ft/s
Velocity Head		0.28	ft
Specific Energy		0.95	ft
Froude Number		1.29	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.74	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.00817	ft/ft

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

7. Reach S-9 S. Allison St. to S. Wadsworth Blvd.
(2 – 66-Inch CMP Capacity by HEC-RAS)

Culvert Output

File Type Options Help

River: Sanderson Profile: 10-Year Culv Group: Culvert #1
Reach 02 RS: 28000 Plan: SG FHAD

Plan: SG FHAD Sanderson 02 RS: 28000 Culv Group: Culvert #1 Profile: 10-Year

Q Culv Group (cfs)	166.00	Culv Full Len (ft)	
# Barrels	2	Culv Vel US (ft/s)	7.87
Q Barrel (cfs)	83.00	Culv Vel DS (ft/s)	8.42
E.G. US. (ft)	5525.23	Culv Inv El Up (ft)	5521.28
W.S. US. (ft)	5525.17	Culv Inv El Dn (ft)	5499.42
E.G. DS (ft)	5502.19	Culv Frctn Ls (ft)	21.85
W.S. DS (ft)	5501.32	Culv Exit Loss (ft)	0.71
Delta EG (ft)	23.04	Culv Entr Loss (ft)	0.48
Delta WS (ft)	23.85	Q Weir (cfs)	
E.G. IC (ft)	5525.00	Weir Sta Lft (ft)	
E.G. OC (ft)	5525.23	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	5523.79	Weir Max Depth (ft)	
Culv WS Outlet (ft)	5501.80	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	2.38	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.51	Min El Weir Flow (ft)	5529.82

Errors, Warnings and Notes

Note: During supercritical analysis, the culvert direct step method went to normal depth. The program then assumed normal depth at the outlet.
Note: The flow in the culvert is entirely supercritical.

Number of barrels in a culvert.

Culvert Output

File Type Options Help

River: Sanderson Profile: 50-Year Culv Group: Culvert #1
Reach 02 RS: 28000 Plan: SG FHAD

Plan: SG FHAD Sanderson 02 RS: 28000 Culv Group: Culvert #1 Profile: 50-Year

Q Culv Group (cfs)	464.19	Culv Full Len (ft)	532.51
# Barrels	2	Culv Vel US (ft/s)	9.77
Q Barrel (cfs)	232.10	Culv Vel DS (ft/s)	11.76
E.G. US. (ft)	5530.32	Culv Inv El Up (ft)	5521.28
W.S. US. (ft)	5530.26	Culv Inv El Dn (ft)	5499.42
E.G. DS (ft)	5505.36	Culv Frctn Ls (ft)	23.75
W.S. DS (ft)	5503.41	Culv Exit Loss (ft)	0.46
Delta EG (ft)	24.95	Culv Entr Loss (ft)	0.74
Delta WS (ft)	26.86	Q Weir (cfs)	95.50
E.G. IC (ft)	5530.30	Weir Sta Lft (ft)	48.47
E.G. OC (ft)	5530.32	Weir Sta Rgt (ft)	182.51
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	5526.78	Weir Max Depth (ft)	1.31
Culv WS Outlet (ft)	5503.68	Weir Avg Depth (ft)	0.39
Culv Nml Depth (ft)	5.50	Weir Flow Area (sq ft)	52.37
Culv Crt Depth (ft)	4.26	Min El Weir Flow (ft)	5529.82

Errors, Warnings and Notes

Warning: During the culvert inlet control computations, the program could not balance the culvert/weir flow. The reported inlet energy grade answer may not be valid.
Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

Select Profile

Culvert Output

File Type Options Help

River: Sanderson Profile: 100-Year Culv Group: Culvert #1
Reach 02 RS: 28000 Plan: SG FHAD

Plan: SG FHAD Sanderson 02 RS: 28000 Culv Group: Culvert #1 Profile: 100-Year

Q Culv Group (cfs)	441.84	Culv Full Len (ft)	1582.00
# Barrels	2	Culv Vel US (ft/s)	9.30
Q Barrel (cfs)	220.92	Culv Vel DS (ft/s)	9.30
E.G. US. (ft)	5530.81	Culv Inv El Up (ft)	5521.28
W.S. US. (ft)	5530.74	Culv Inv El Dn (ft)	5499.42
E.G. DS (ft)	5506.03	Culv Frctn Ls (ft)	23.34
W.S. DS (ft)	5505.45	Culv Exit Loss (ft)	0.77
Delta EG (ft)	24.78	Culv Entr Loss (ft)	0.67
Delta WS (ft)	25.29	Q Weir (cfs)	298.30
E.G. IC (ft)	5530.66	Weir Sta Lft (ft)	45.56
E.G. OC (ft)	5530.81	Weir Sta Rgt (ft)	189.21
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	5526.78	Weir Max Depth (ft)	1.80
Culv WS Outlet (ft)	5504.92	Weir Avg Depth (ft)	0.84
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	120.49
Culv Crt Depth (ft)	4.16	Min El Weir Flow (ft)	5529.82

Errors, Warnings and Notes

Select Profile

Culvert Output

File Type Options Help

River: Sanderson Profile: 500-Year Culv Group: Culvert #1
Reach 02 RS: 28000 Plan: SG FHAD

Plan: SG FHAD Sanderson 02 RS: 28000 Culv Group: Culvert #1 Profile: 500-Year

Q Culv Group (cfs)	442.79	Culv Full Len (ft)	1582.00
# Barrels	2	Culv Vel US (ft/s)	9.32
Q Barrel (cfs)	221.40	Culv Vel DS (ft/s)	9.32
E.G. US. (ft)	5531.40	Culv Inv El Up (ft)	5521.28
W.S. US. (ft)	5531.30	Culv Inv El Dn (ft)	5499.42
E.G. DS (ft)	5506.45	Culv Frctn Ls (ft)	23.44
W.S. DS (ft)	5505.93	Culv Exit Loss (ft)	0.84
Delta EG (ft)	24.95	Culv Entr Loss (ft)	0.67
Delta WS (ft)	25.36	Q Weir (cfs)	647.76
E.G. IC (ft)	5531.25	Weir Sta Lft (ft)	42.36
E.G. OC (ft)	5531.40	Weir Sta Rgt (ft)	191.12
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	5526.78	Weir Max Depth (ft)	2.38
Culv WS Outlet (ft)	5504.92	Weir Avg Depth (ft)	1.39
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	206.59
Culv Crt Depth (ft)	4.16	Min El Weir Flow (ft)	5529.82

Errors, Warnings and Notes

Select Profile

Table C-1 Flow Split and 100-year Shallow Flooding Depth (Normal Depth) Calculation

8. Jewell Avenue at Cody St., Carr St., Balsam St., and Ammons St.

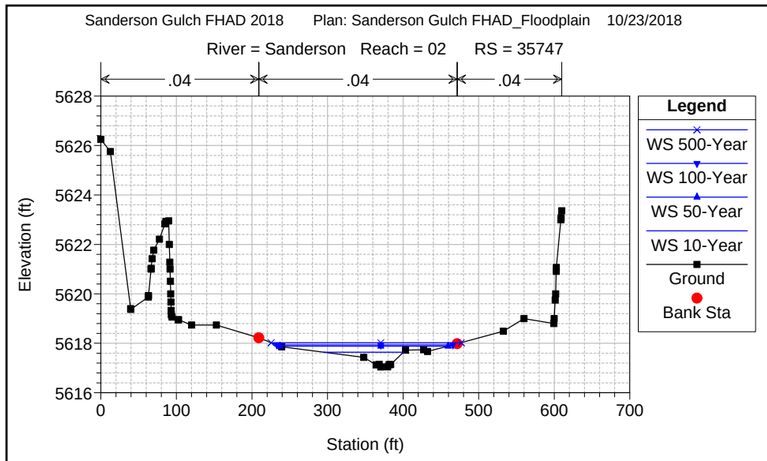
Split Flow Calculation - Cody Street, Carr Street, Balsam Street and Ammo Street

Broad Weir Coefficient 3

Station/ Cross Section	W.S.E.	Ground El.	Water Depth Overtop (ft)	Average Water Depth Overtop (ft)	Weir Length (ft)	Q Leaving (cfs)	Accumulative Q (cfs)	
30210 d/s	5557.78	5557.77	0.01	0.01	65	0.2	0.2	Cody Street overtopping
29920 d/s	5552.63	5552.62	0.01	0.01	80	0.2	0.4	Carr Street overtopping
29250 d/s	5541.27	5541.3	0	0	62	0.0	0.4	Balsam Street overtopping
28910 d/s	5535.97	5535.96	0.01	0.01	66	0.2	0.6	Ammons Street overtopping
				Total Flow Leaves (cfs)		**0.6**		

Note: The total amount of split flow that overtops roadway crown of the W Jewell Avenue is negligible and did not be mapped as 100-year shallow overland floodplain. The minor split flow will be contained and conveyed in curb and gutter at south side of W Jewell Avenue.

HEC-RAS OUTPUTS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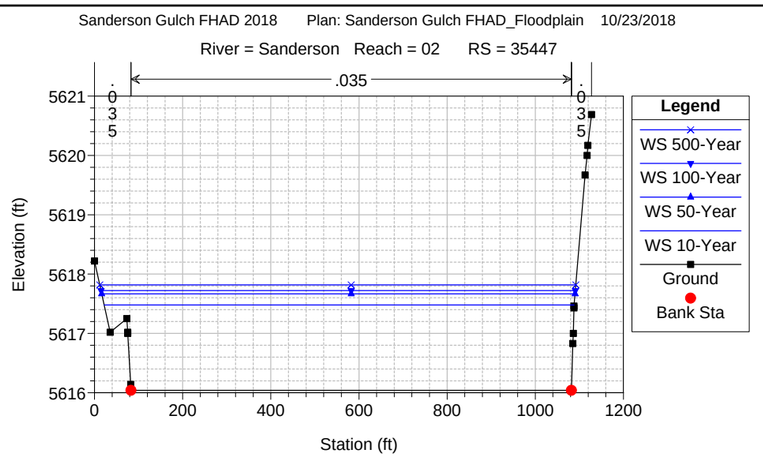
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 02 RS = 35447
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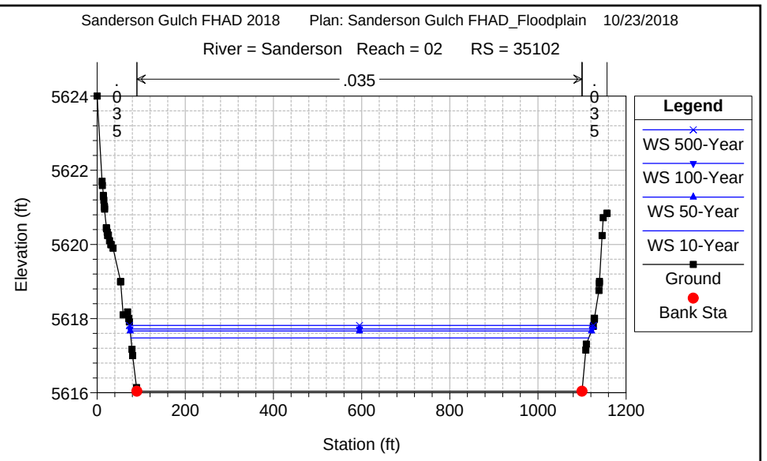
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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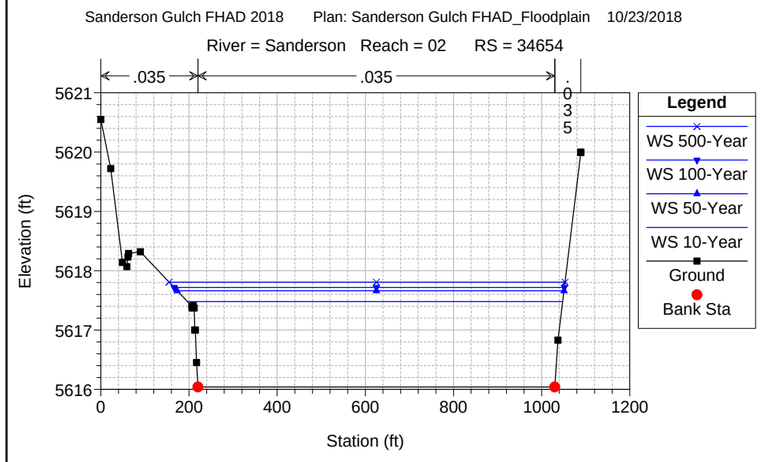
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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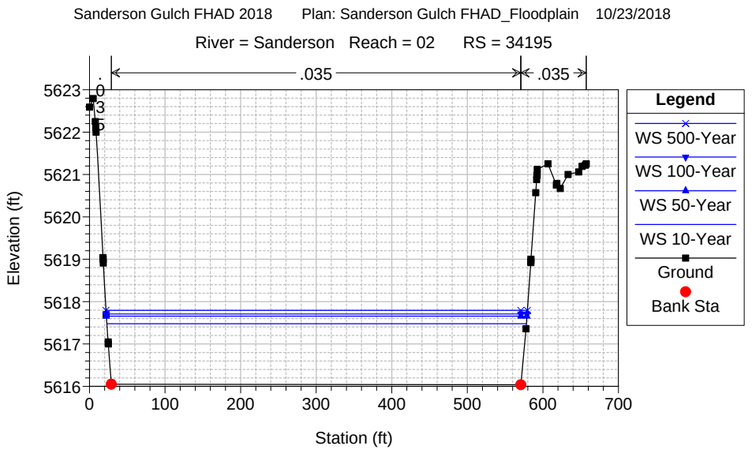
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 02 RS = 34195
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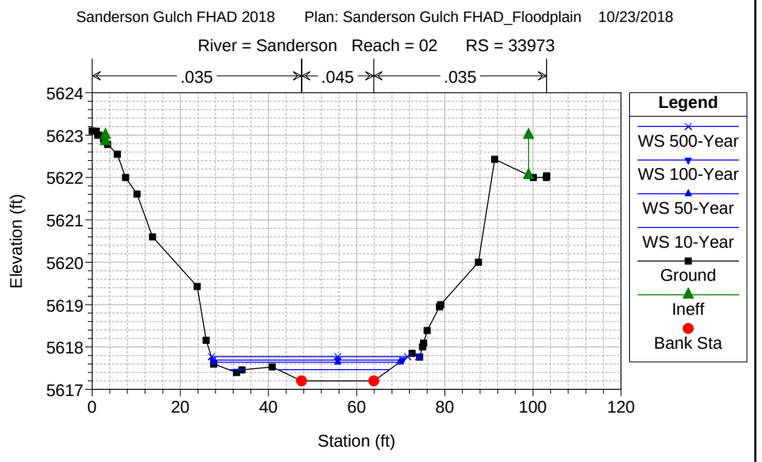
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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.045
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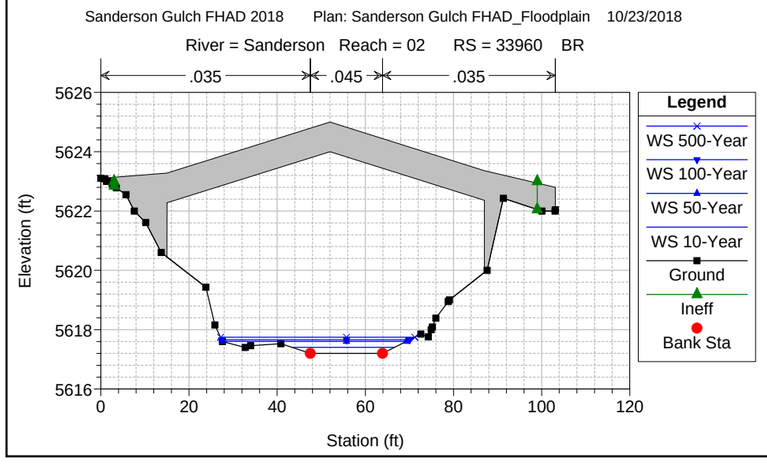
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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.045
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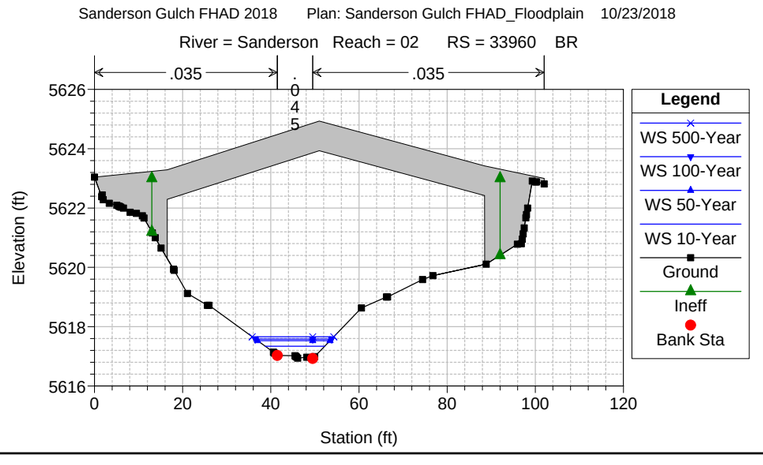
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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.035
.035
Elevation (ft)
Station (ft)
Legend
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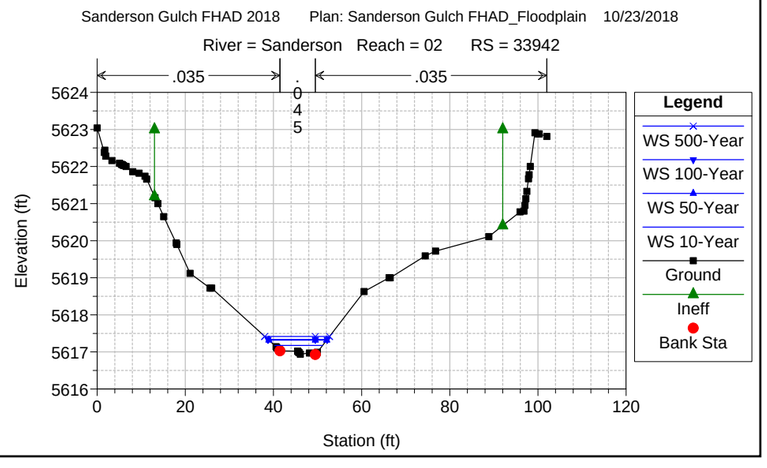
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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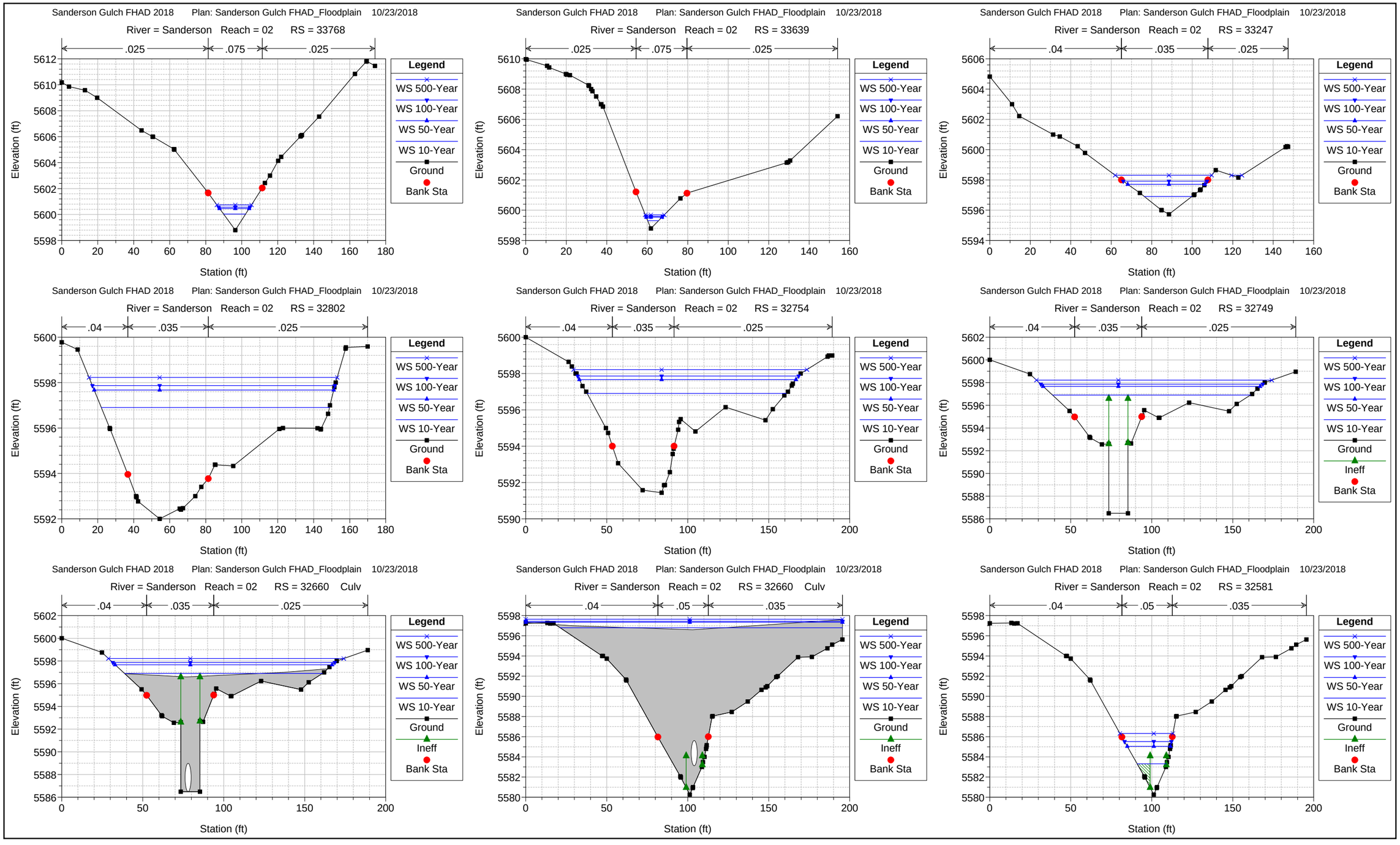
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = Sanderson Reach = 02 RS = 33768
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 33639
.025 .075 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 33247
.04 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 32802
.04 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 32754
.04 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 32749
.04 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 32660 Culv
.04 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 32660 Culv
.04 .05 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 32581
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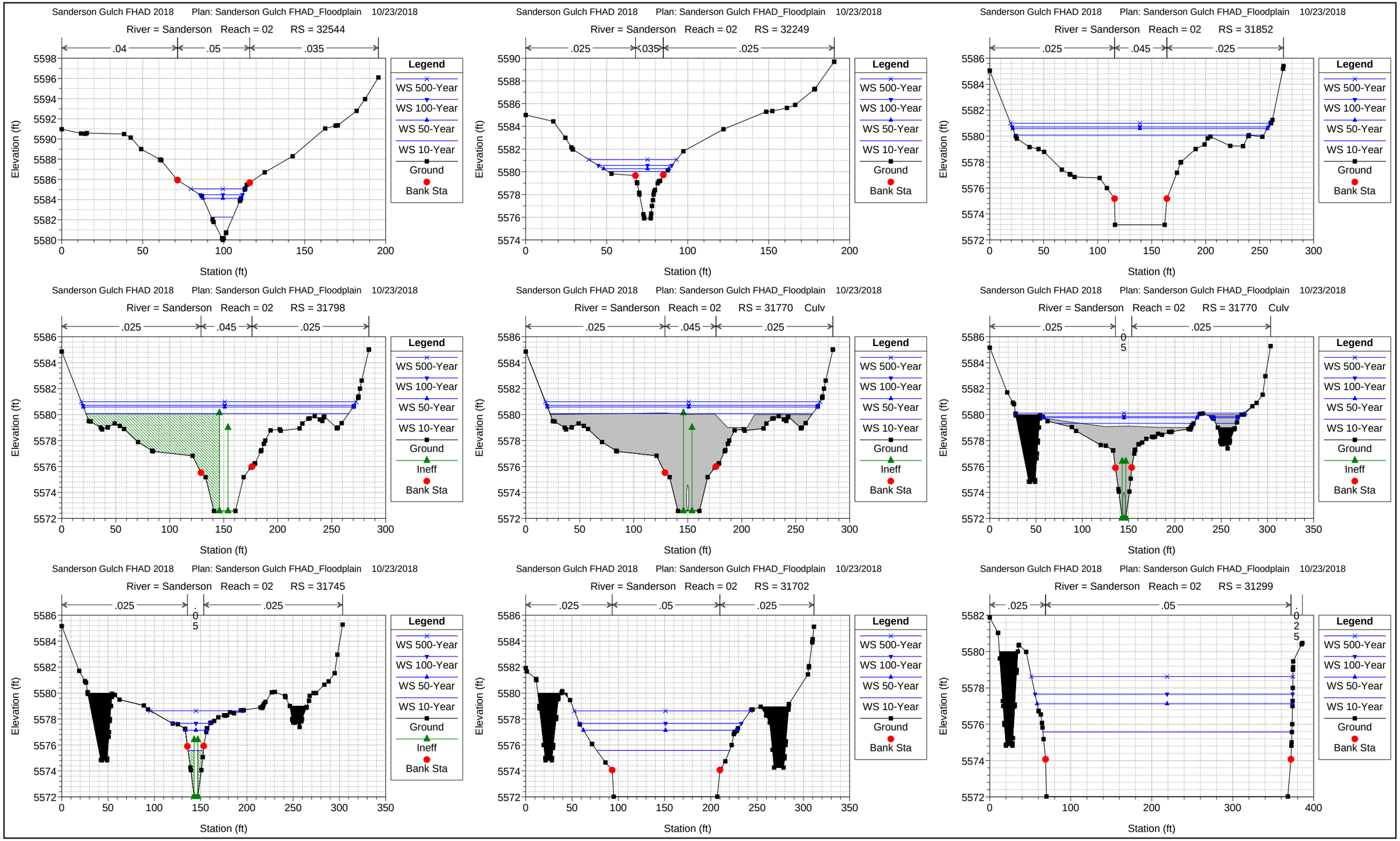
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
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River = Sanderson Reach = 02 RS = 32249
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.035
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 31852
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 31798
.025
.045
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 31770 Culv
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.045
.025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 31770 Culv
.025
.05
.025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 31745
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.05
.025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 31702
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.05
.025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 31299
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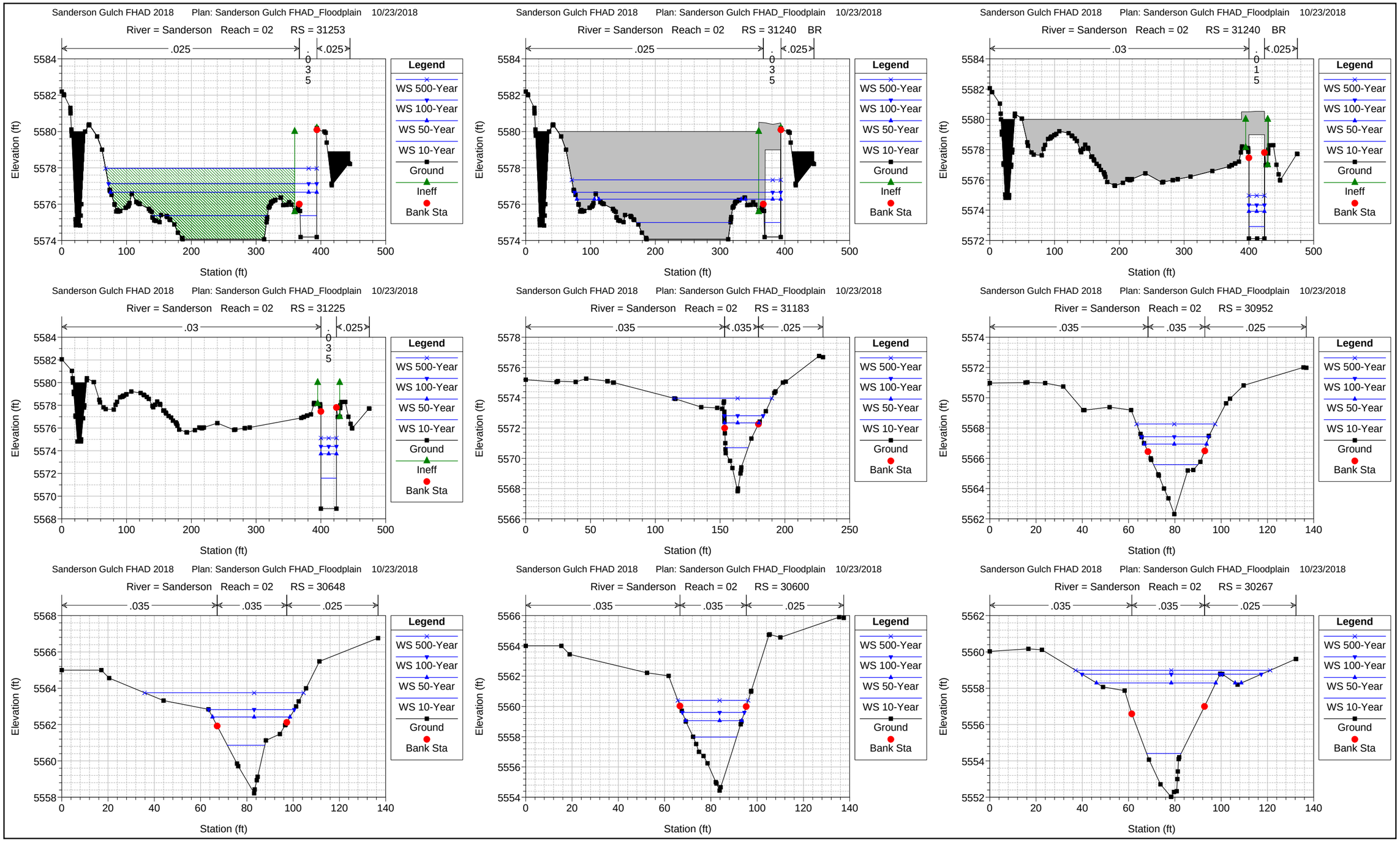
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 02 RS = 30267
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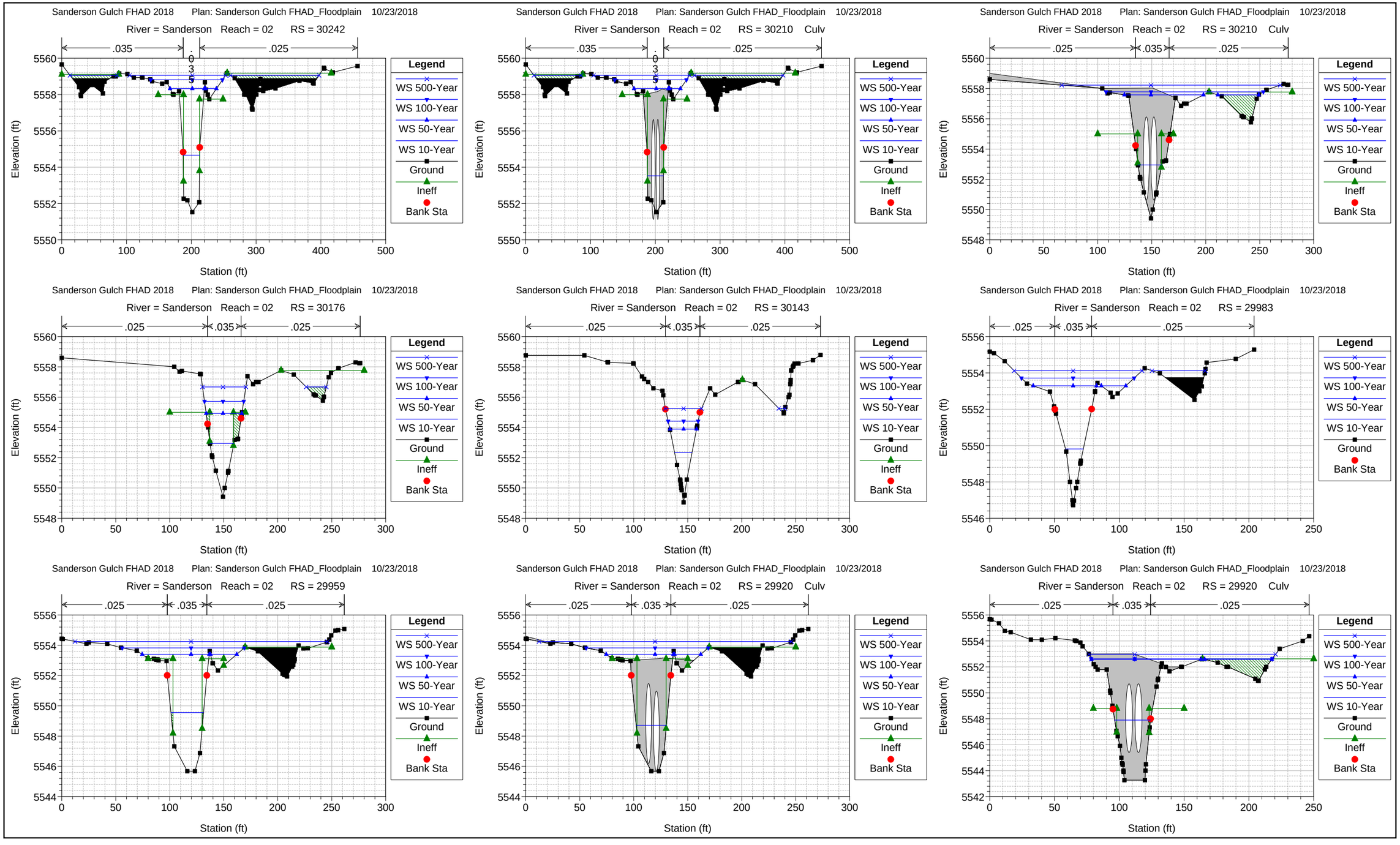
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = Sanderson Reach = 02 RS = 30242
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 30210 Culv
.035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 30210 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 30176
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
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Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
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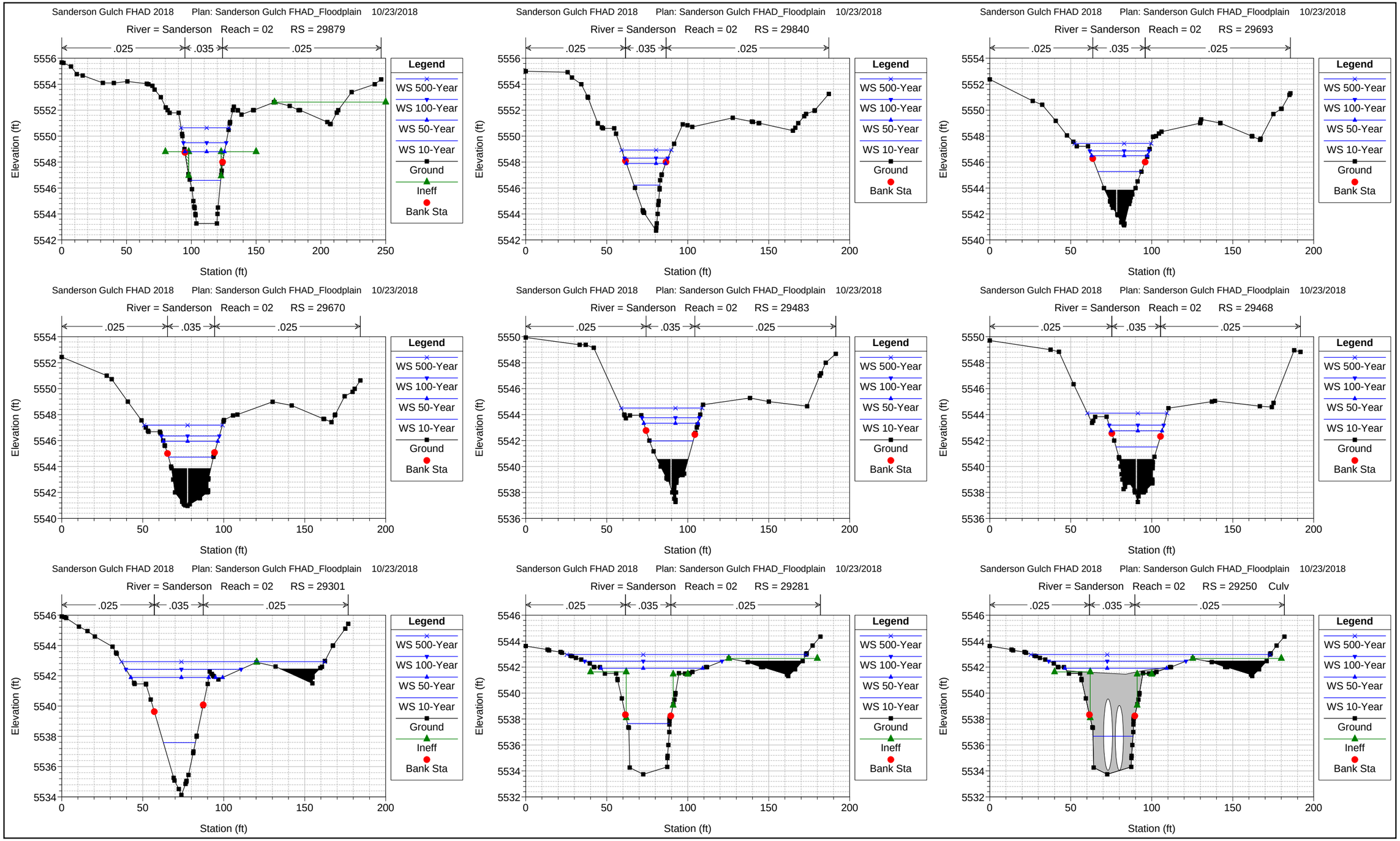
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29920 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29920 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29840
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29693
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29670
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29483
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29468
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29301
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29281
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29250 Culv
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Station (ft)
Legend
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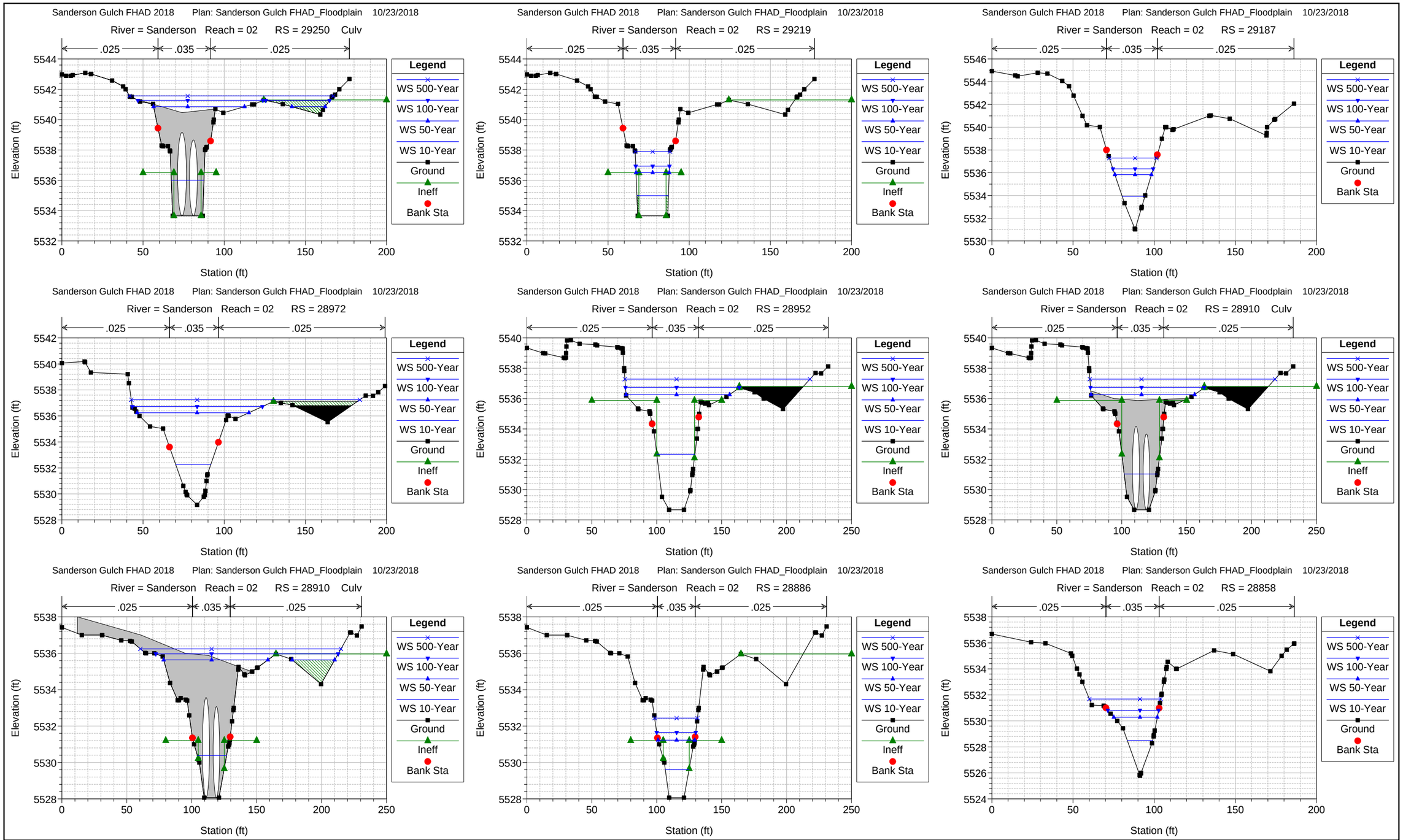
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = Sanderson Reach = 02 RS = 29250 Culv
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29219
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 29187
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28972
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28952
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28910 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28886
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28858
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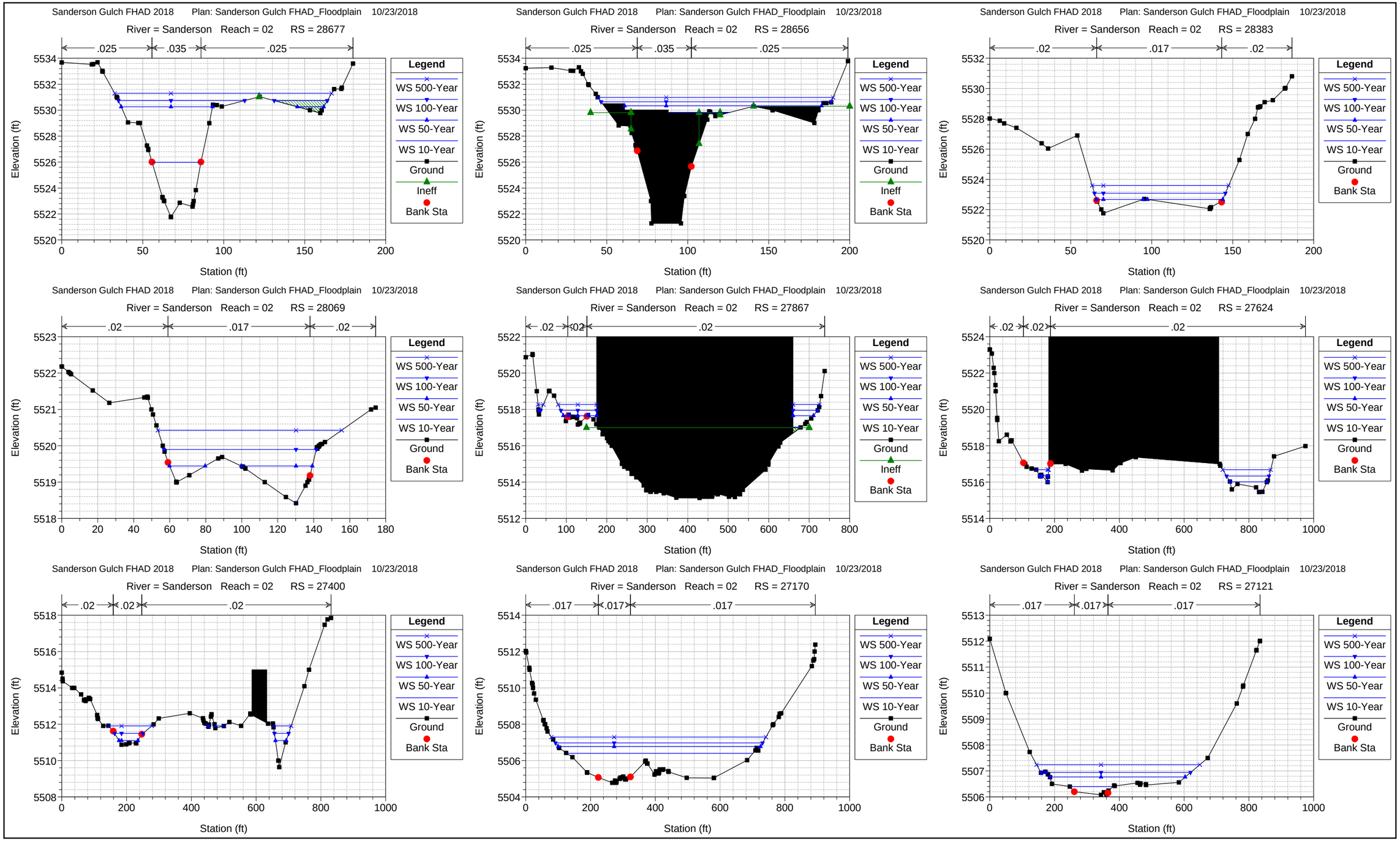
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 02 RS = 28677
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28656
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28383
.02 .017 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 28069
.02 .017 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 27867
.02 .02 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 27624
.02 .02 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 27400
.02 .02 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 27170
.017 .017 .017
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 27121
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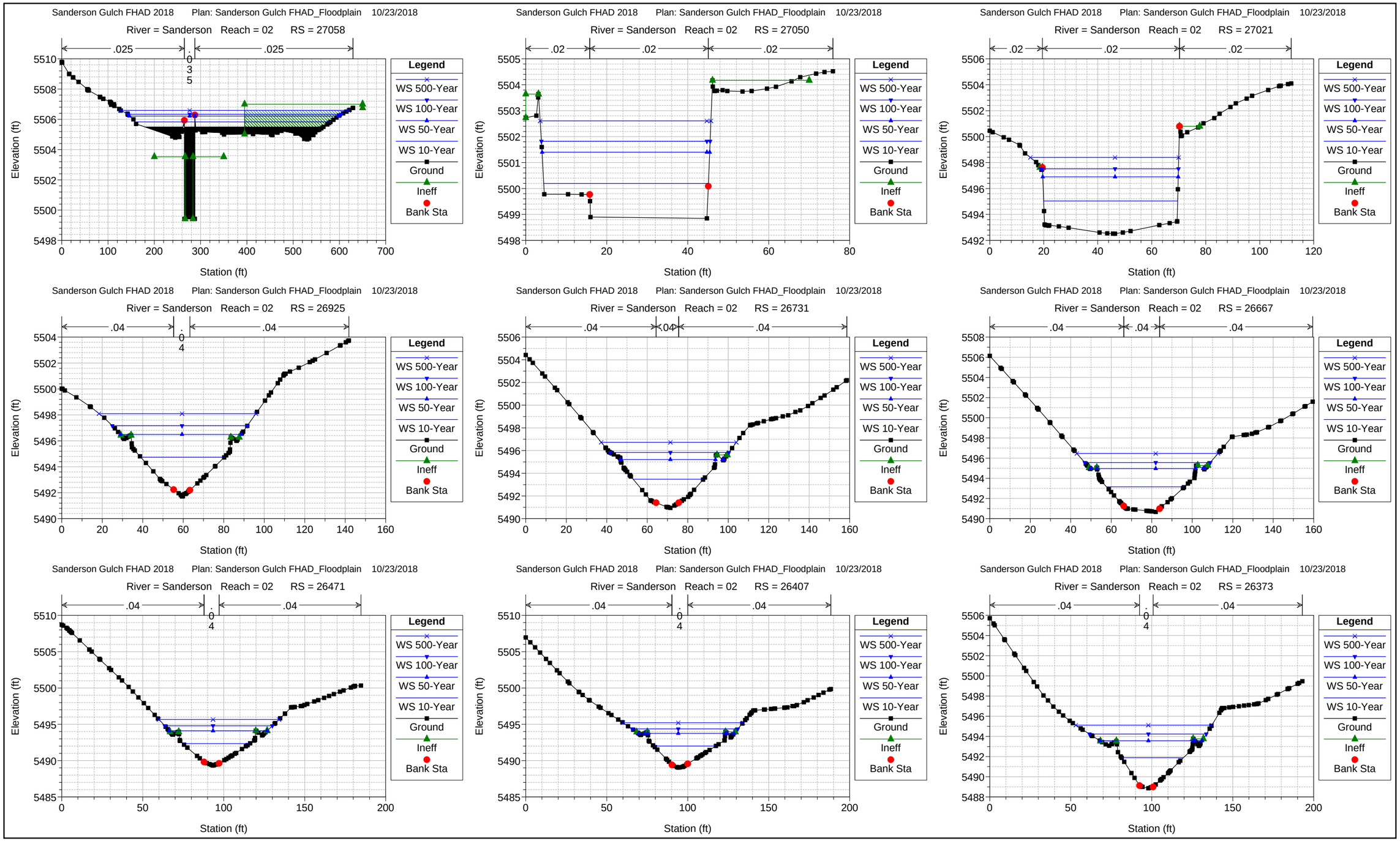
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 02 RS = 27058
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 27050
.02
.02
.02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 27021
.02
.02
.02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26925
.04
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26731
.04
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26667
.04
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26471
.04
.04
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26407
.04
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26373
.04
.04
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
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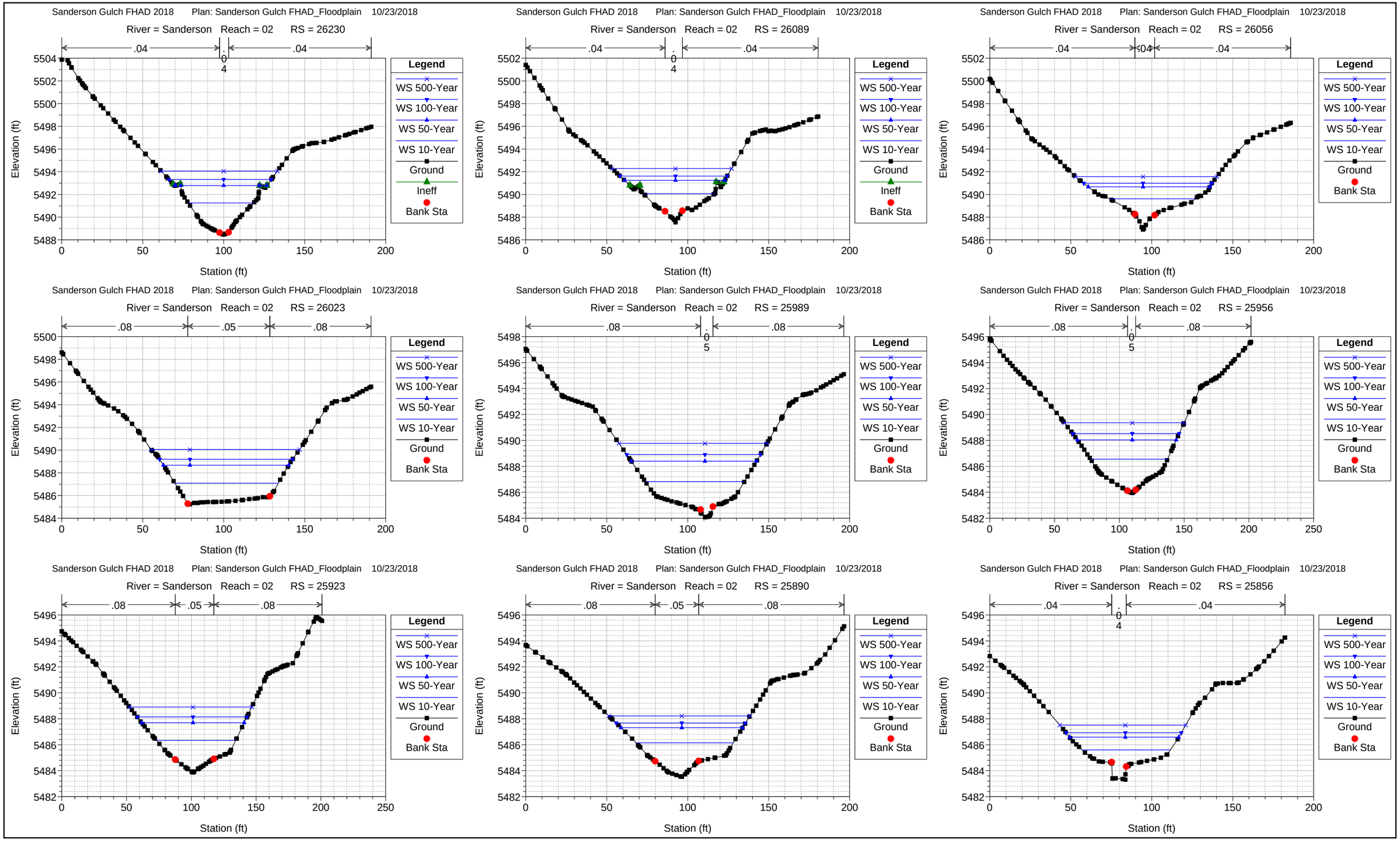
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26230
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Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26089
.04
.04
.04
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26056
.04
.04
.04
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 26023
.08
.05
.08
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25989
.08
.08
.08
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25956
.08
.08
.08
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25923
.08
.05
.08
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25890
.08
.05
.08
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25856
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WS 500-Year
WS 100-Year
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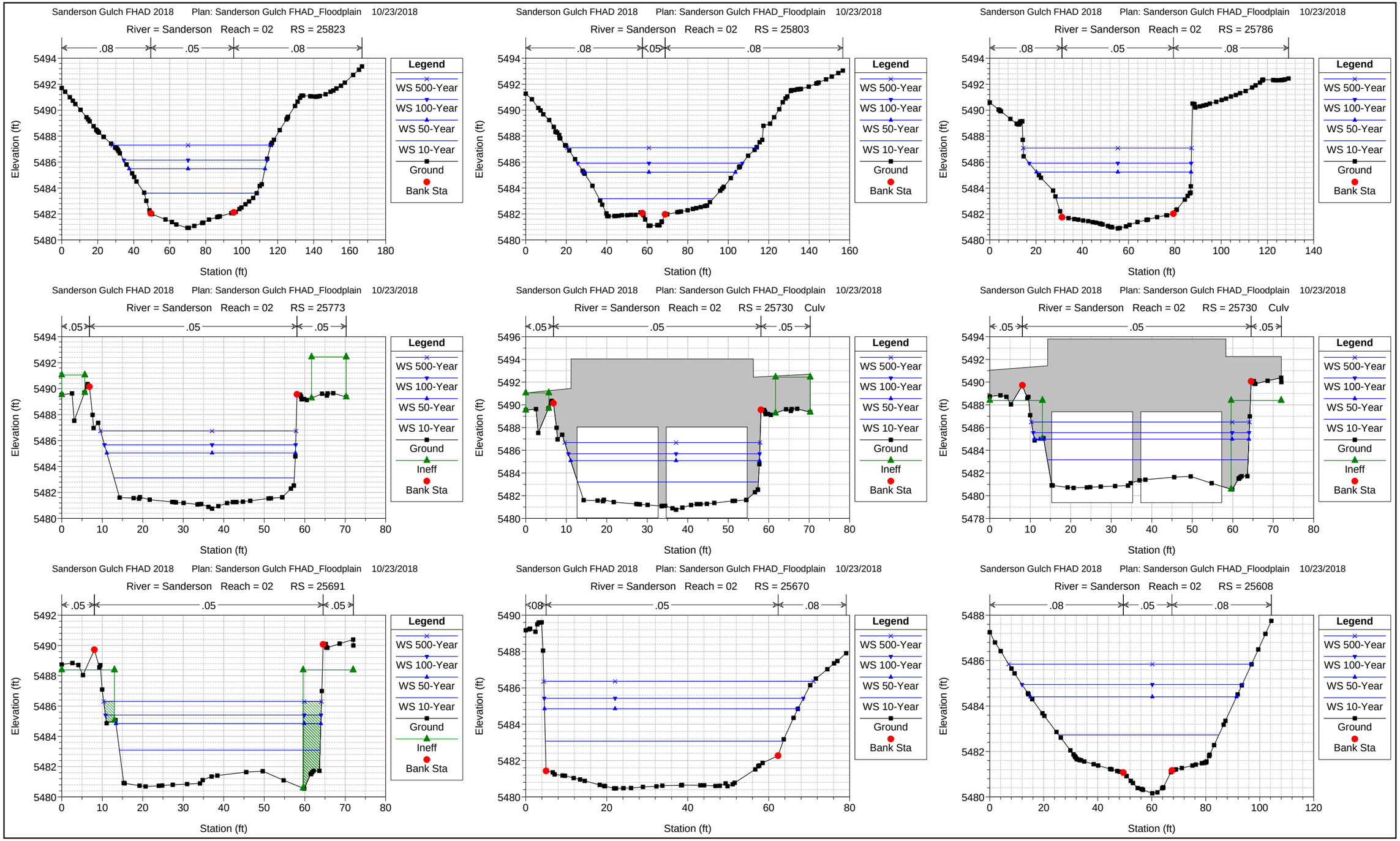
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 02 RS = 25823
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25803
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25786
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25773
.05 .05 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25730 Culv
.05 .05 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25730 Culv
.05 .05 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25691
.05 .05 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25670
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 25608
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
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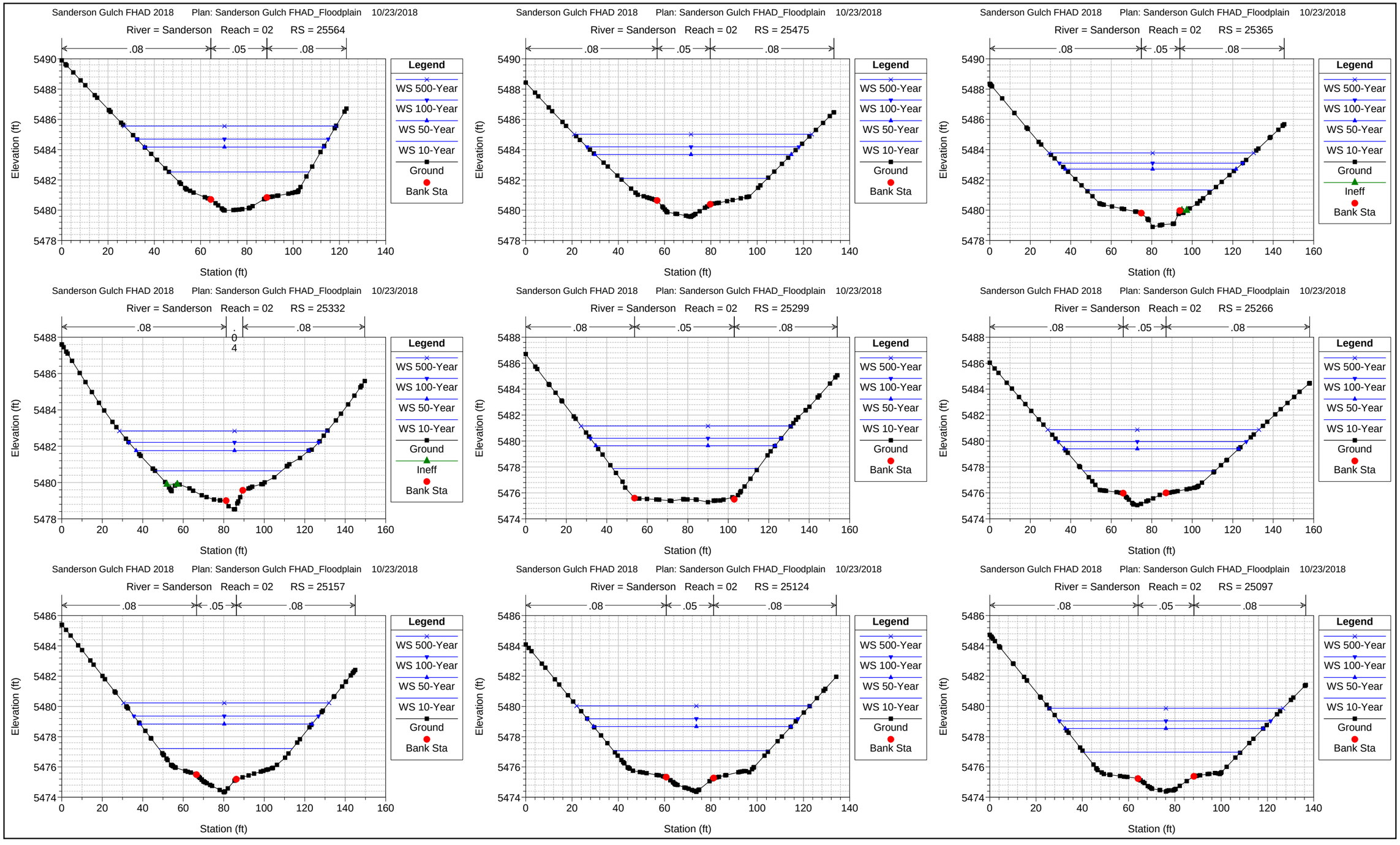
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 02 RS = 25332
River = Sanderson Reach = 02 RS = 25299
River = Sanderson Reach = 02 RS = 25266
River = Sanderson Reach = 02 RS = 25157
River = Sanderson Reach = 02 RS = 25124
River = Sanderson Reach = 02 RS = 25097
.08
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Legend
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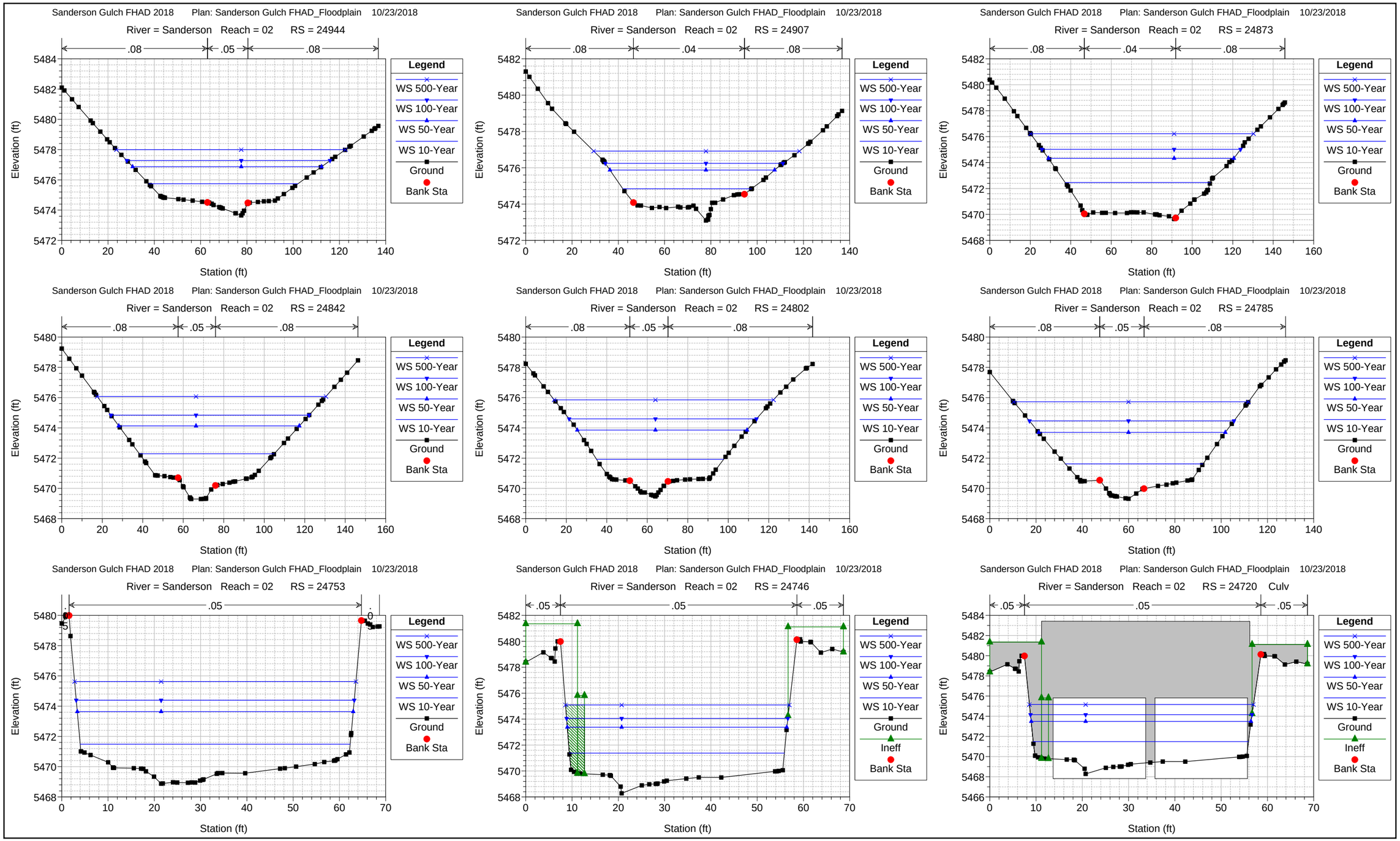
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 02 RS = 24873
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Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24842
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River = Sanderson Reach = 02 RS = 24802
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River = Sanderson Reach = 02 RS = 24785
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.05
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River = Sanderson Reach = 02 RS = 24746
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River = Sanderson Reach = 02 RS = 24720 Culv
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Station (ft)
Legend
WS 500-Year
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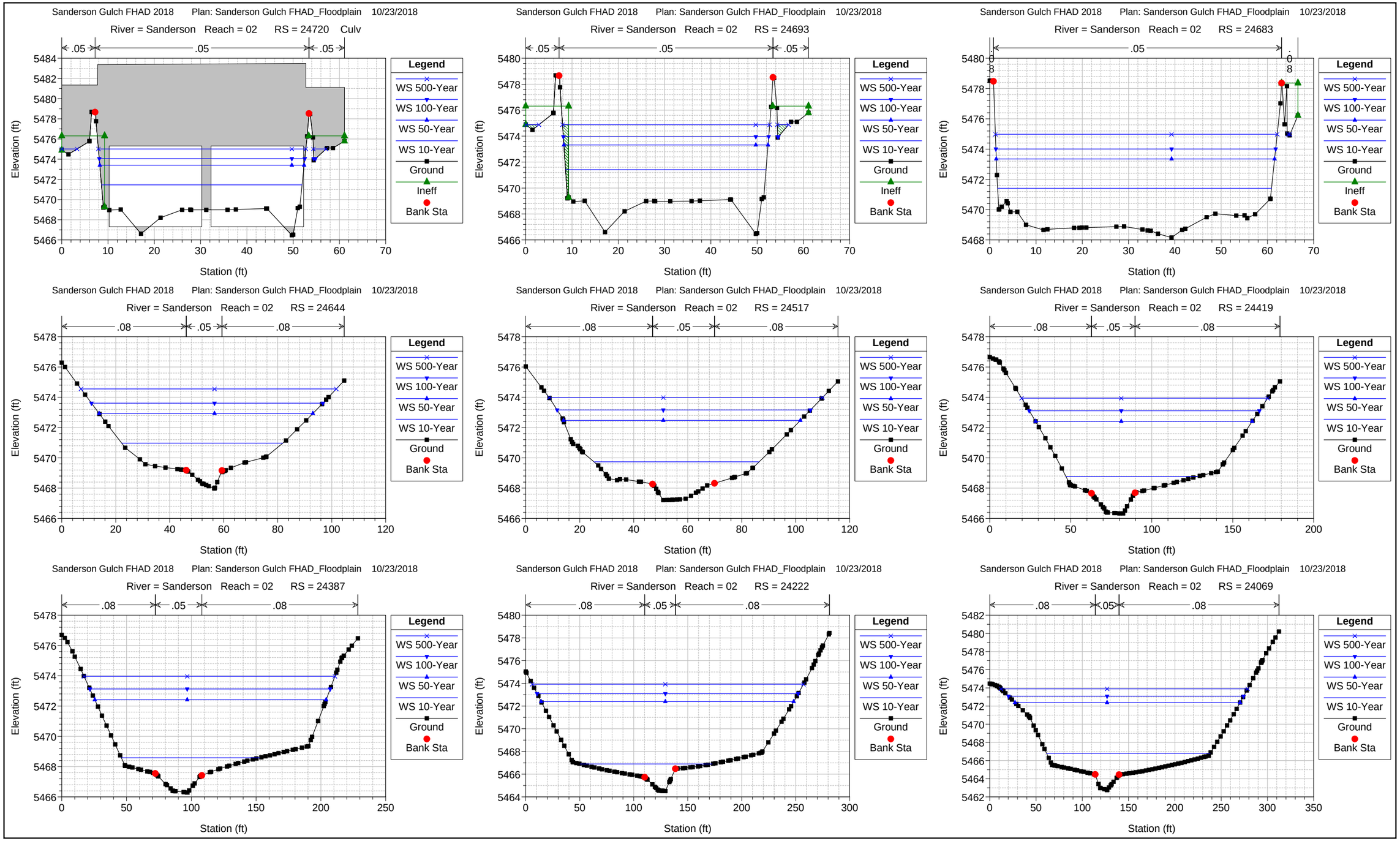
WS 10-Year
Ground
Ineff
Bank Sta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River = Sanderson Reach = 02 RS = 24720 Culv
.05 .05 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24693
.05 .05 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24683
.05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24644
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24517
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24419
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24387
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24222
.08 .05 .08
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 24069
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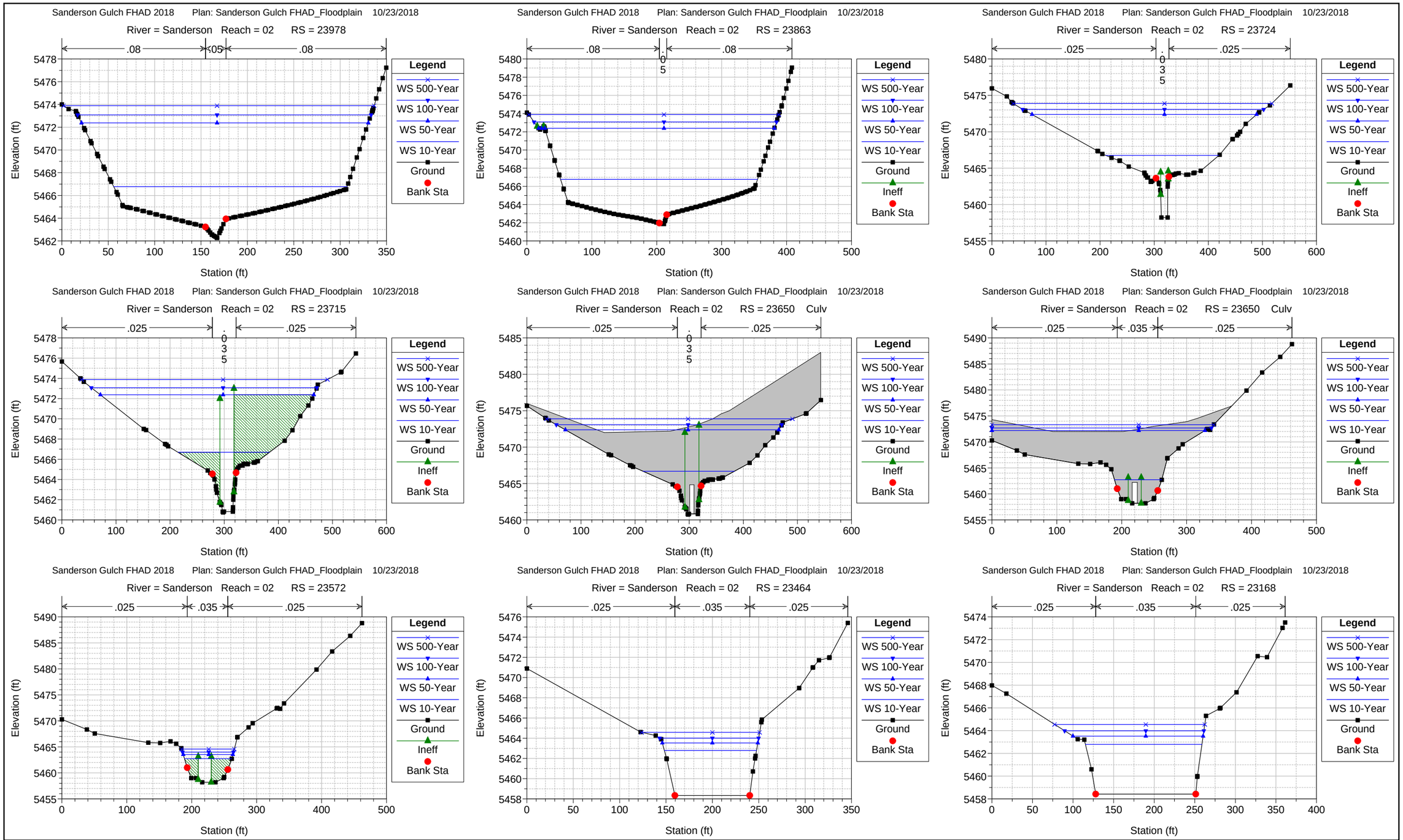
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 02 RS = 23724
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River = Sanderson Reach = 02 RS = 23715
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River = Sanderson Reach = 02 RS = 23650 Culv
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River = Sanderson Reach = 02 RS = 23650 Culv
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River = Sanderson Reach = 02 RS = 23572
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River = Sanderson Reach = 02 RS = 23464
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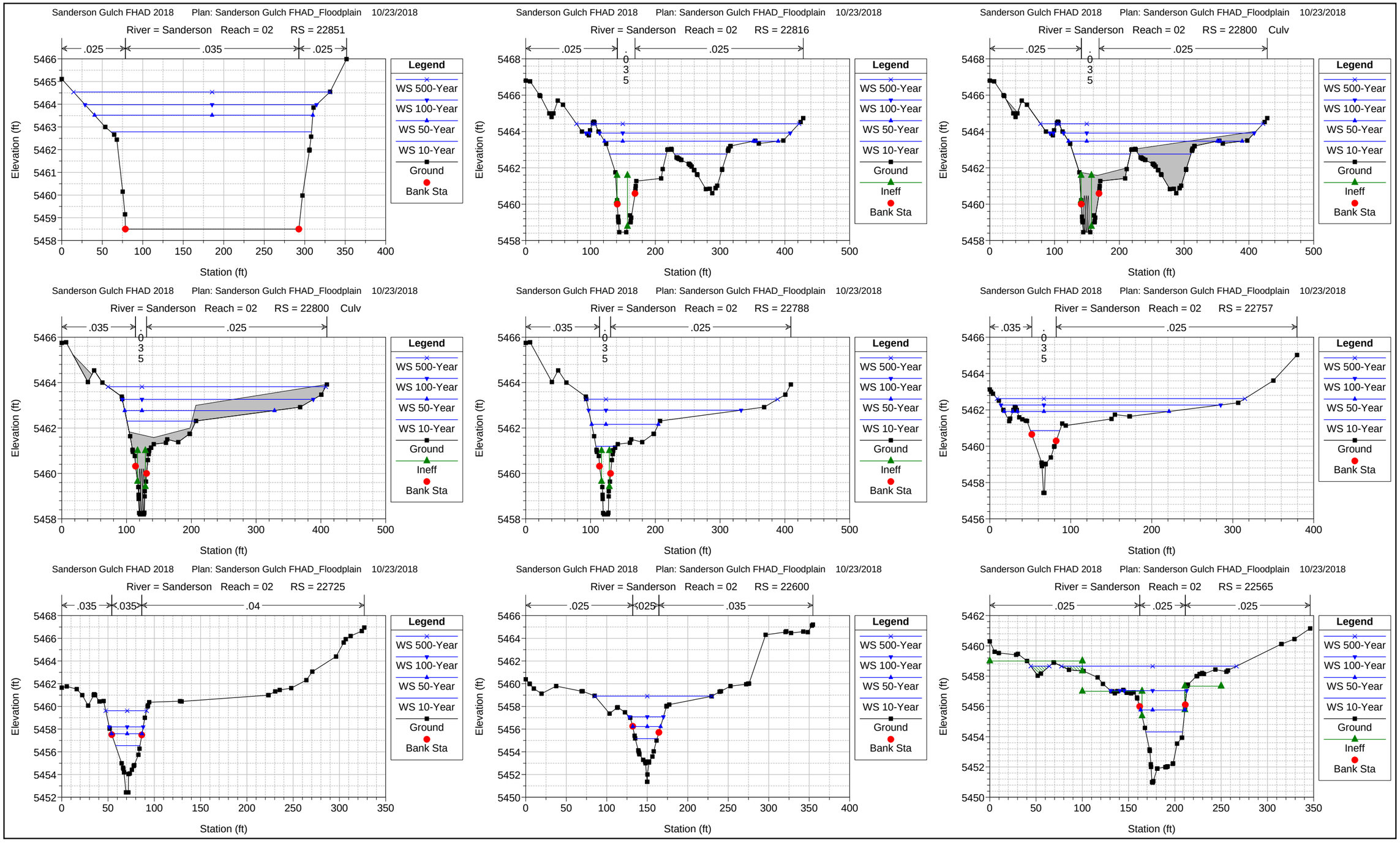
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 23168
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22816
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22800 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22800 Culv
.035 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22788
.035 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22757
.035 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22725
.035 .035 .04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22600
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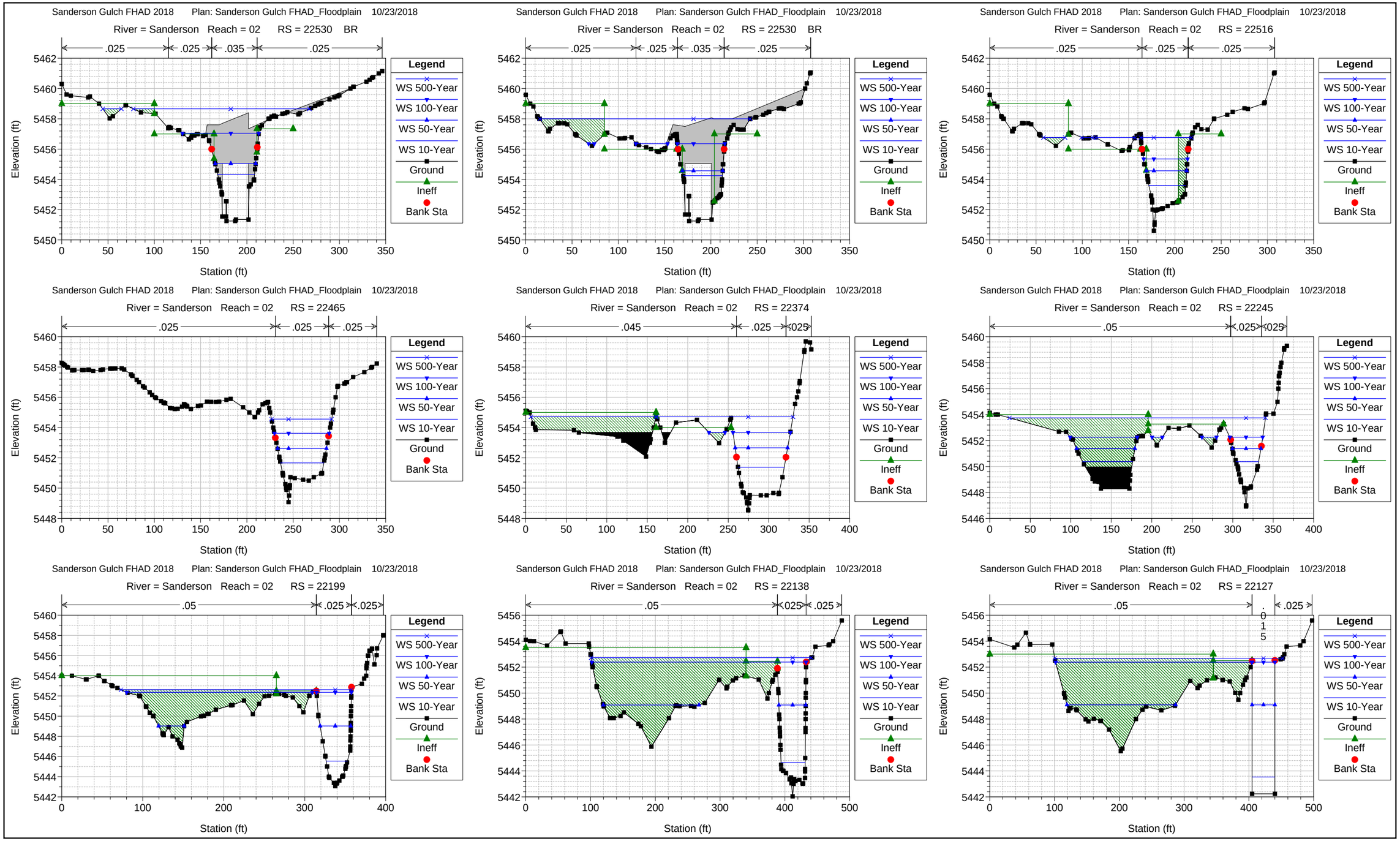
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22565
.025 .025 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22530 BR
.025 .025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22516
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22465
.025 .025 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22374
.045 .025 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22245
.05 .025 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22199
.05 .025 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22138
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Elevation (ft)
Station (ft)
Legend
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WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 22127
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WS 10-Year
Ground
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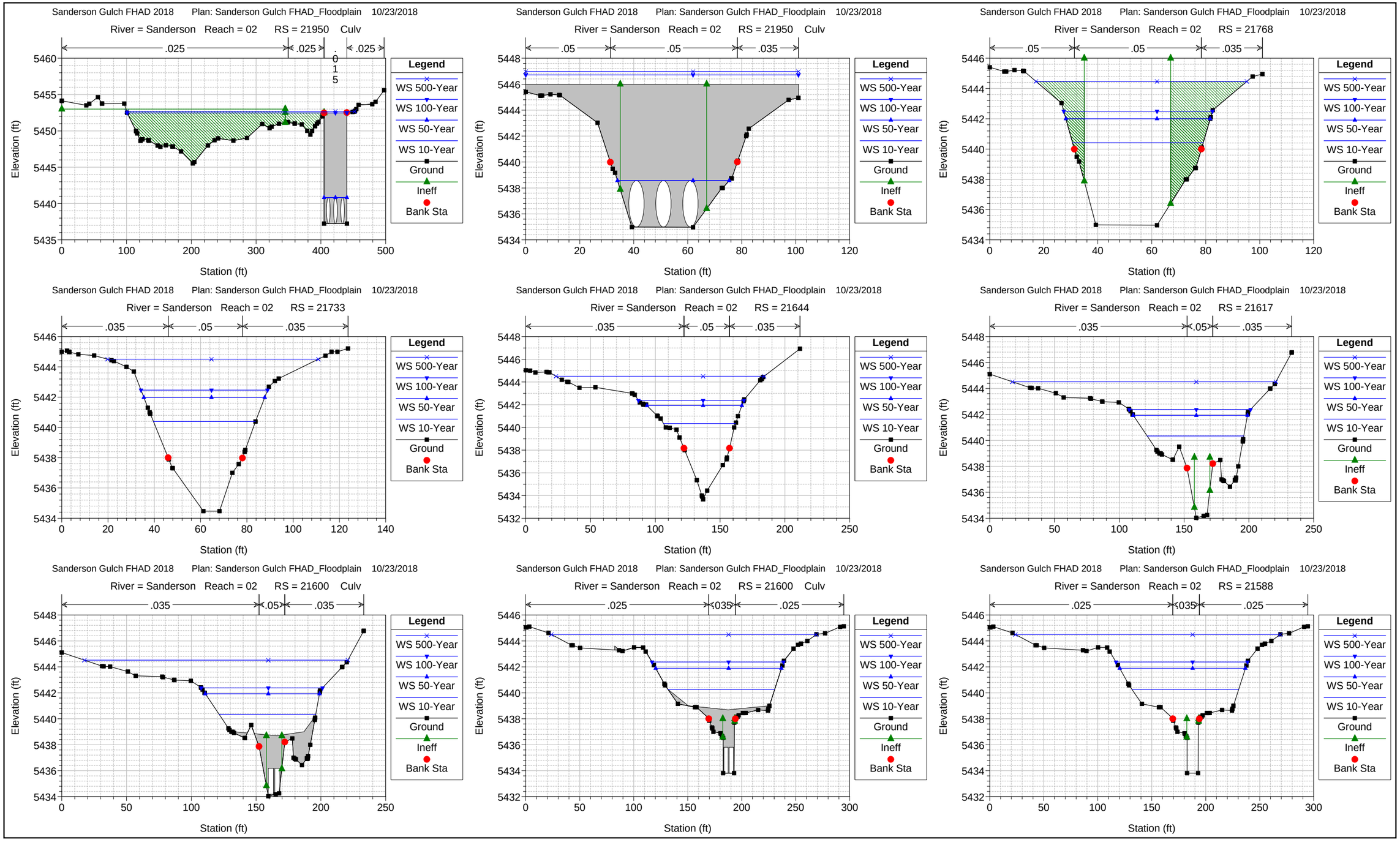
Bank Sta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.025 .025 .015 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21950 Culv
.05 .05 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21768
.05 .05 .035
Elevation (ft)
Station (ft)
Legend
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WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21733
.035 .05 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21644
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21617
.035 .05 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21600 Culv
.035 .05 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21600 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 02 RS = 21588
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Station (ft)
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WS 100-Year
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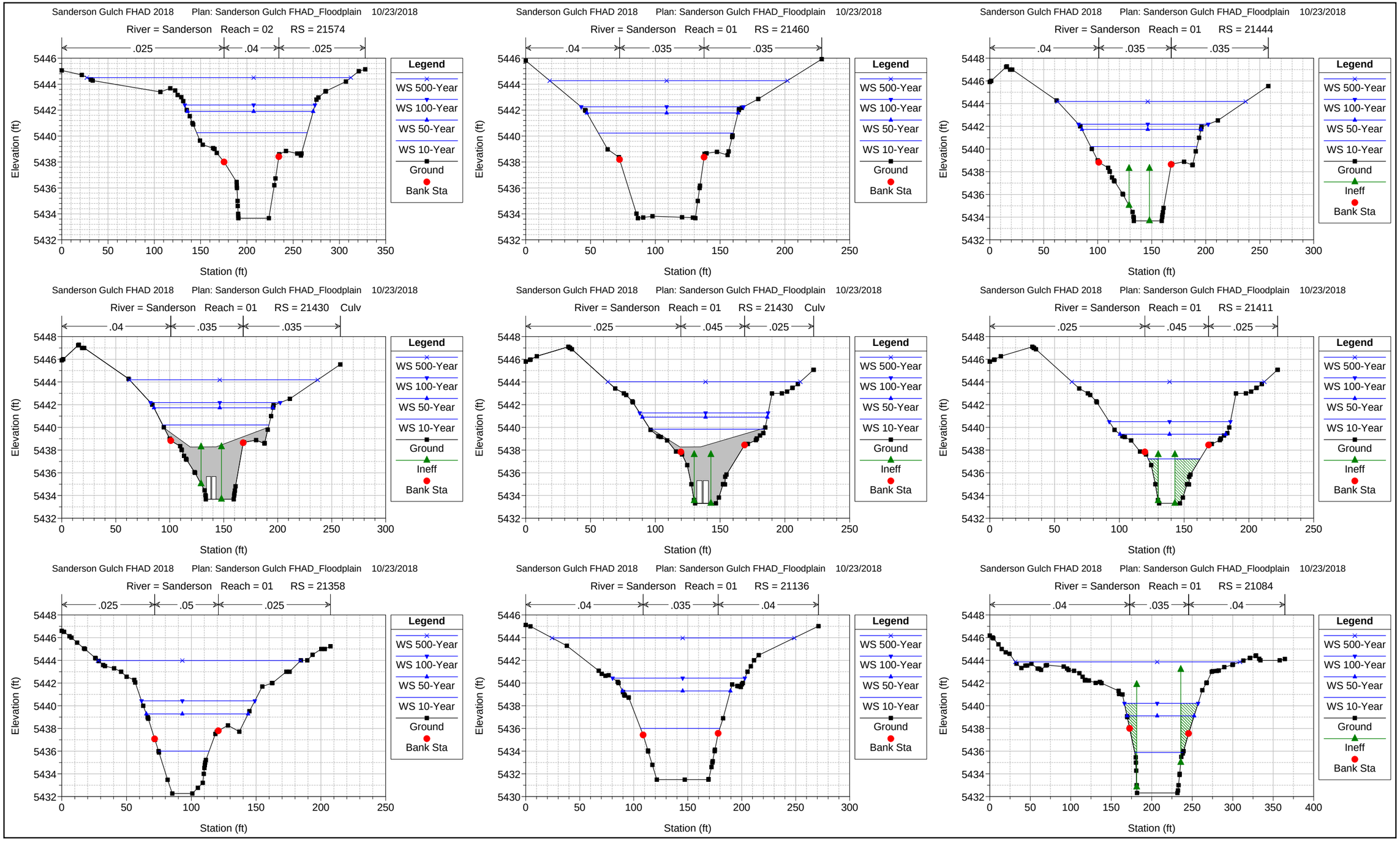
WS 10-Year
Ground
Ineff
Bank Sta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River = Sanderson Reach = 01 RS = 21084
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WS 50-Year
WS 10-Year
Ground
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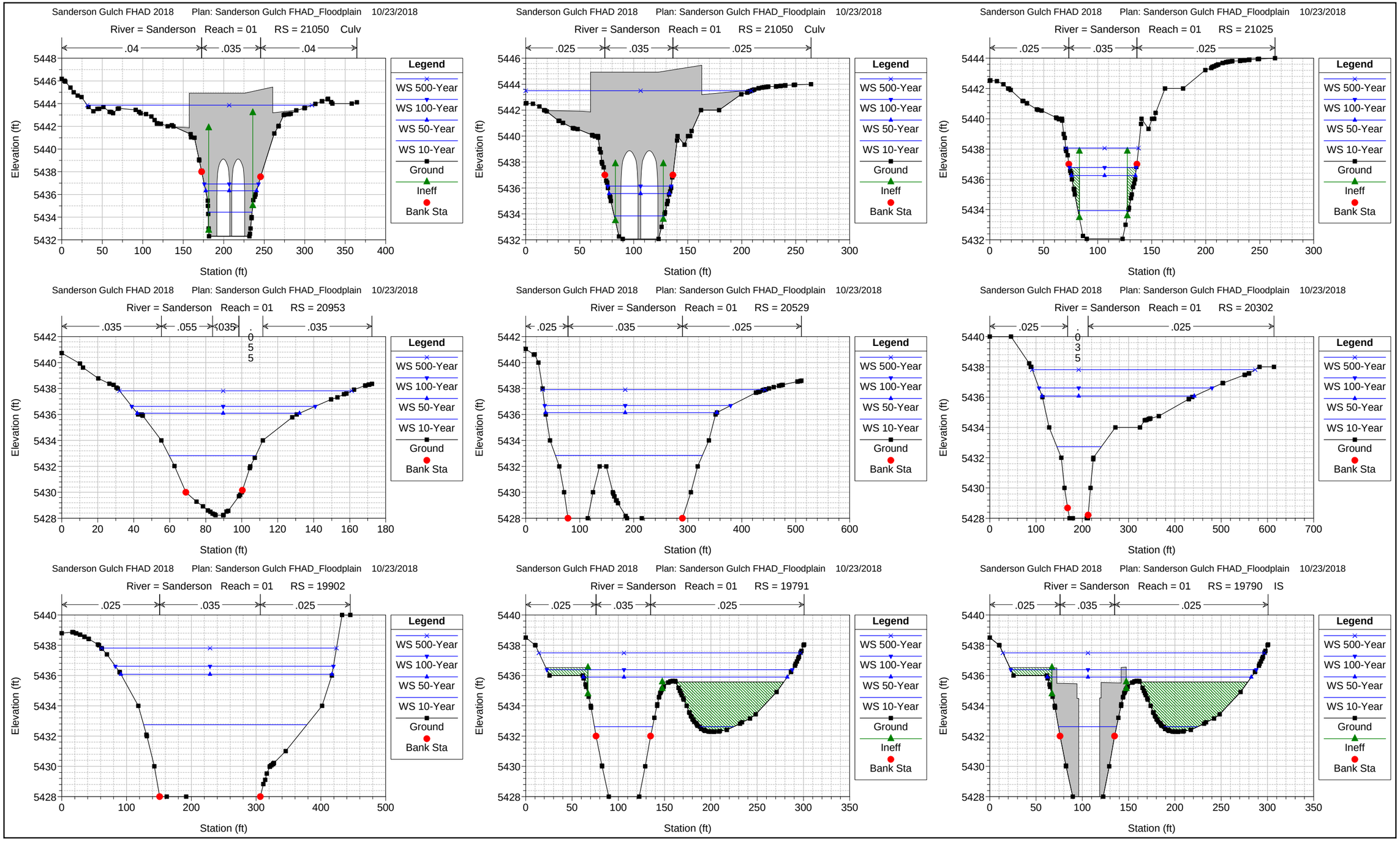
Bank Sta
Elevation (ft)
Station (ft)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Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
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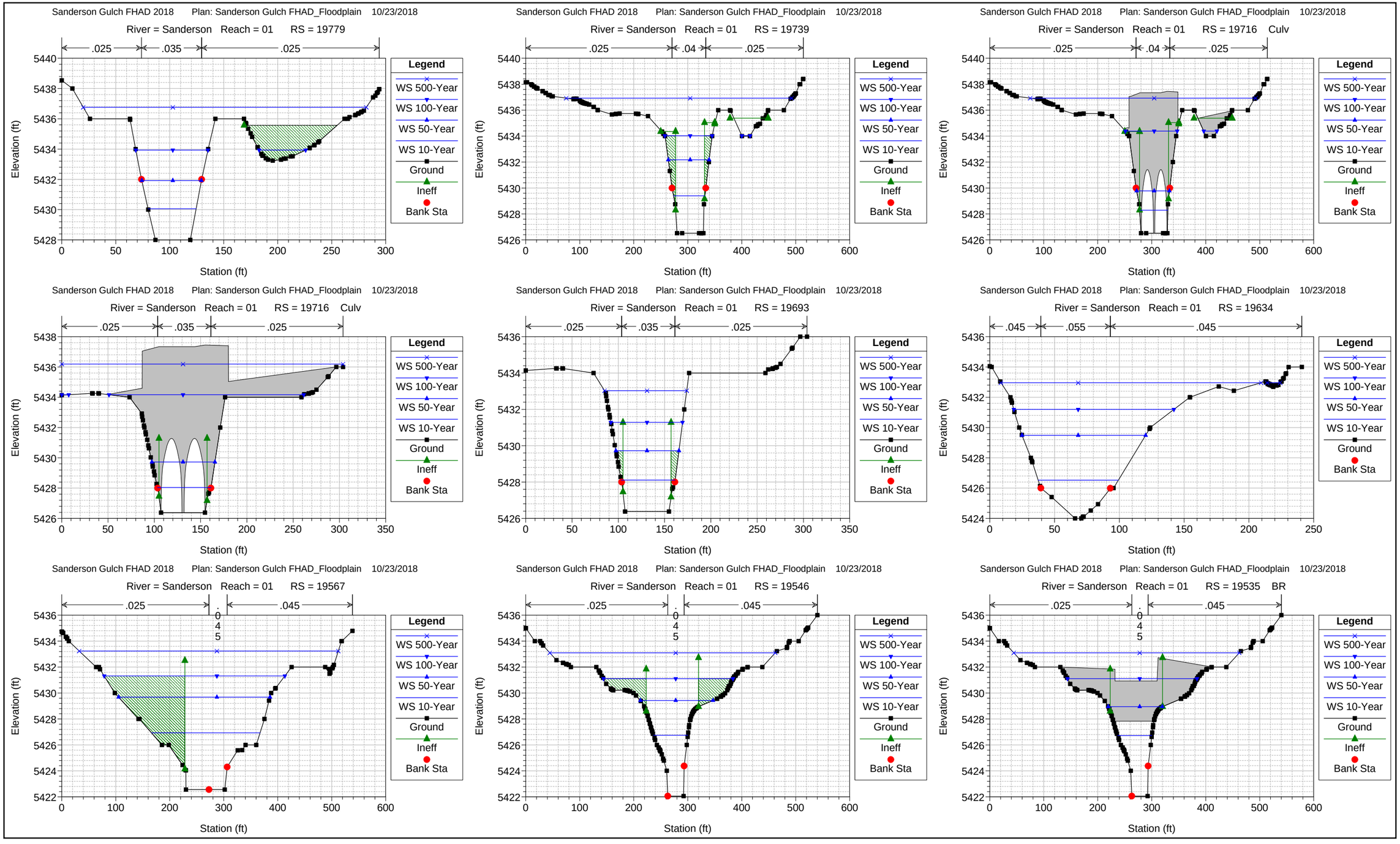
Bank Sta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River = Sanderson Reach = 01 RS = 19535 BR
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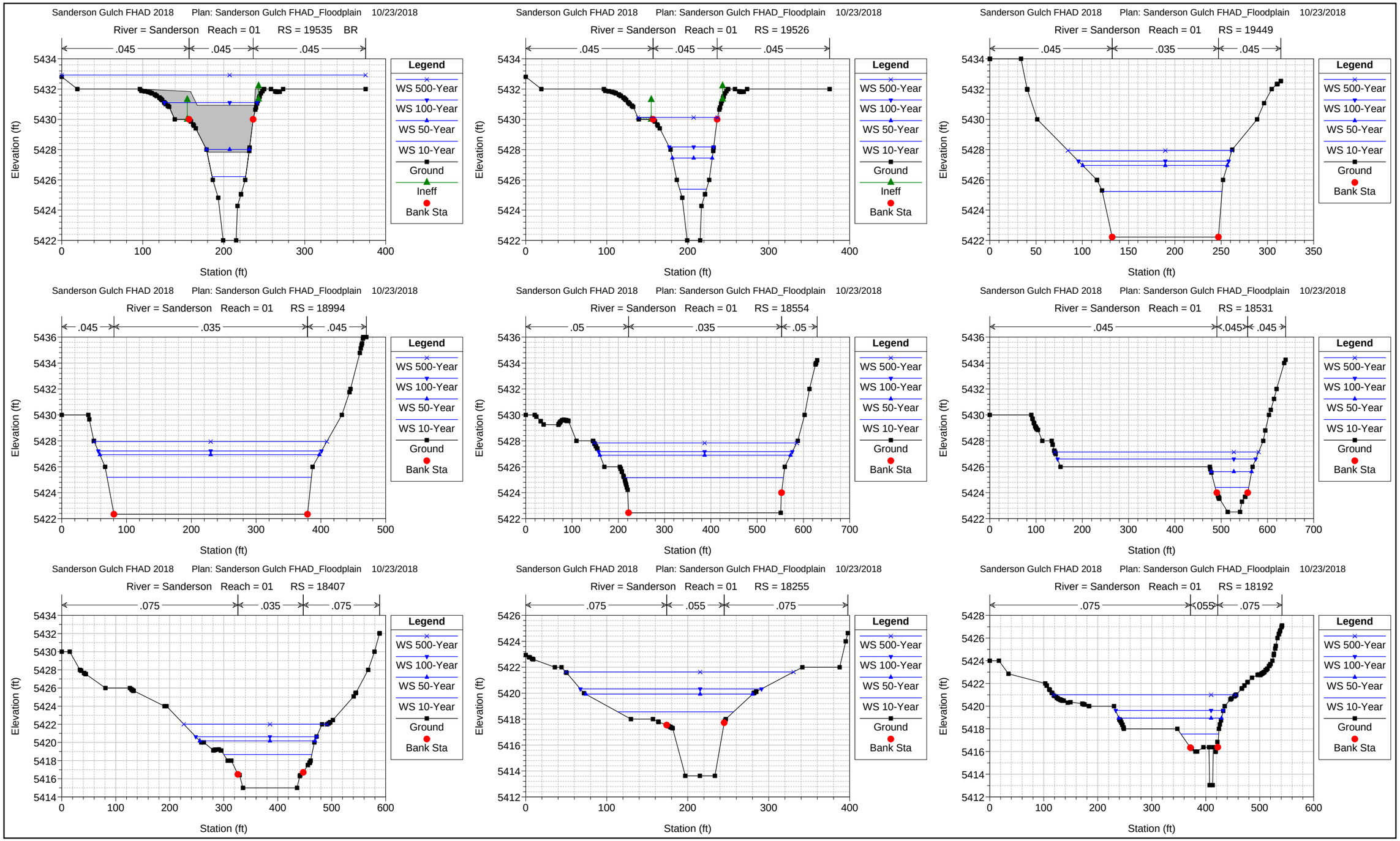
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 19526
.045 .045 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 19449
.045 .035 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18994
.045 .035 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18554
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18531
.045 .045 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18407
.075 .035 .075
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18255
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18192
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
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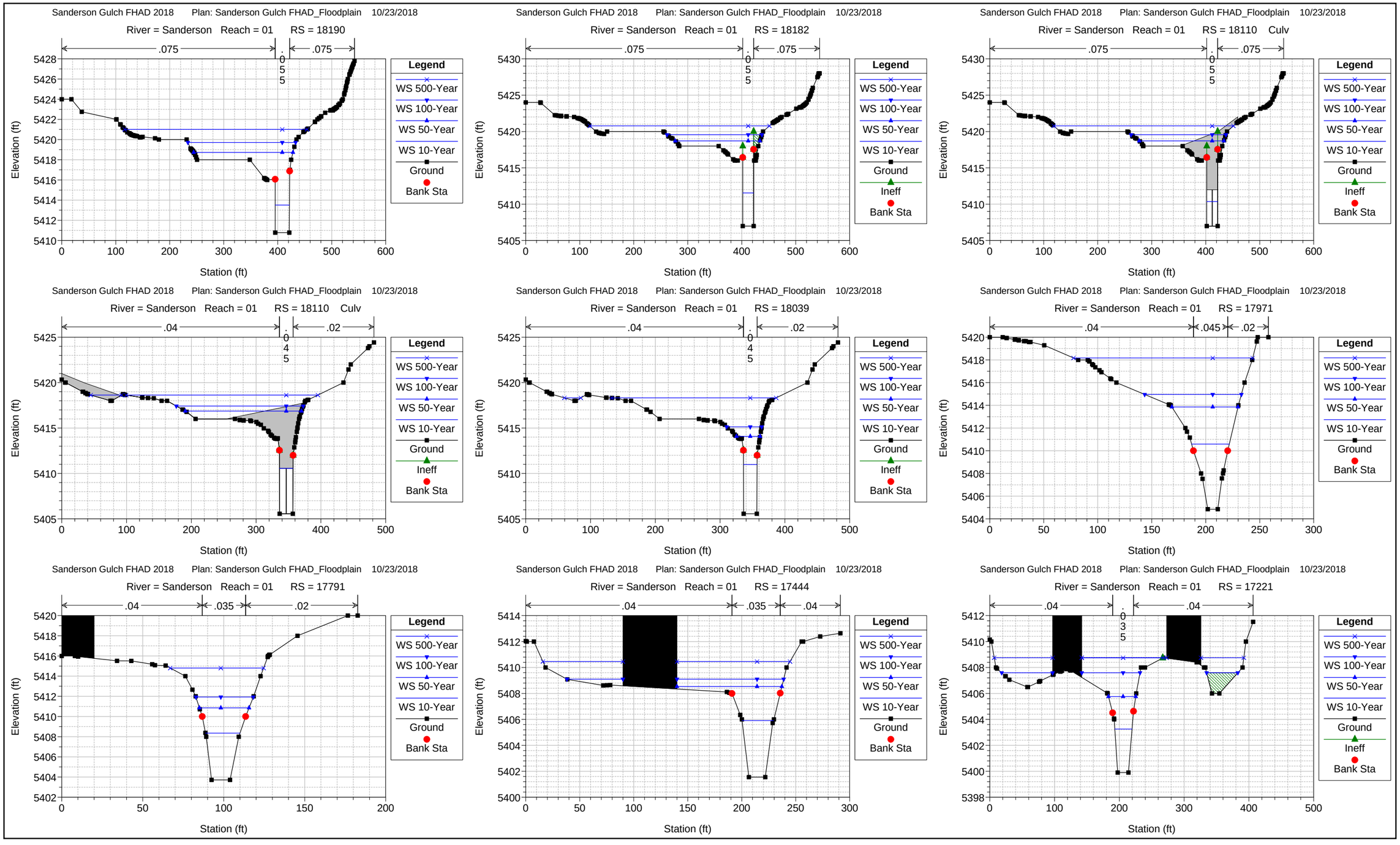
WS 10-Year
Ground
Bank Sta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.055
.075
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18182
.075
.055
.075
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18110 Culv
.075
.055
.075
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18110 Culv
.04
.045
.02
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 18039
.04
.045
.02
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 17971
.04
.045
.02
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 17791
.04
.035
.02
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
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River = Sanderson Reach = 01 RS = 17444
.04
.035
.04
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 17221
.04
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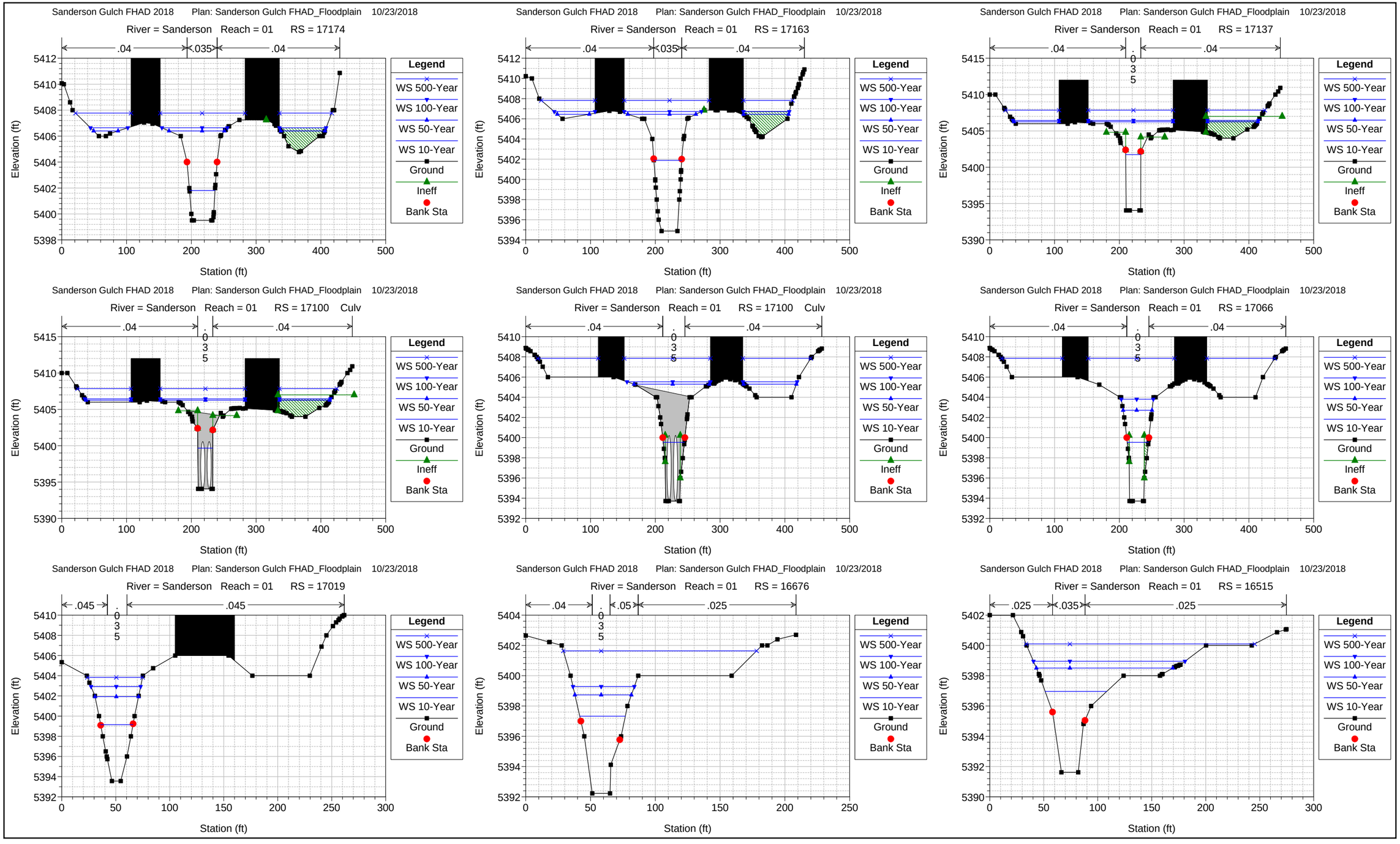
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 17019
River = Sanderson Reach = 01 RS = 16676
River = Sanderson Reach = 01 RS = 16515
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Station (ft)
Legend
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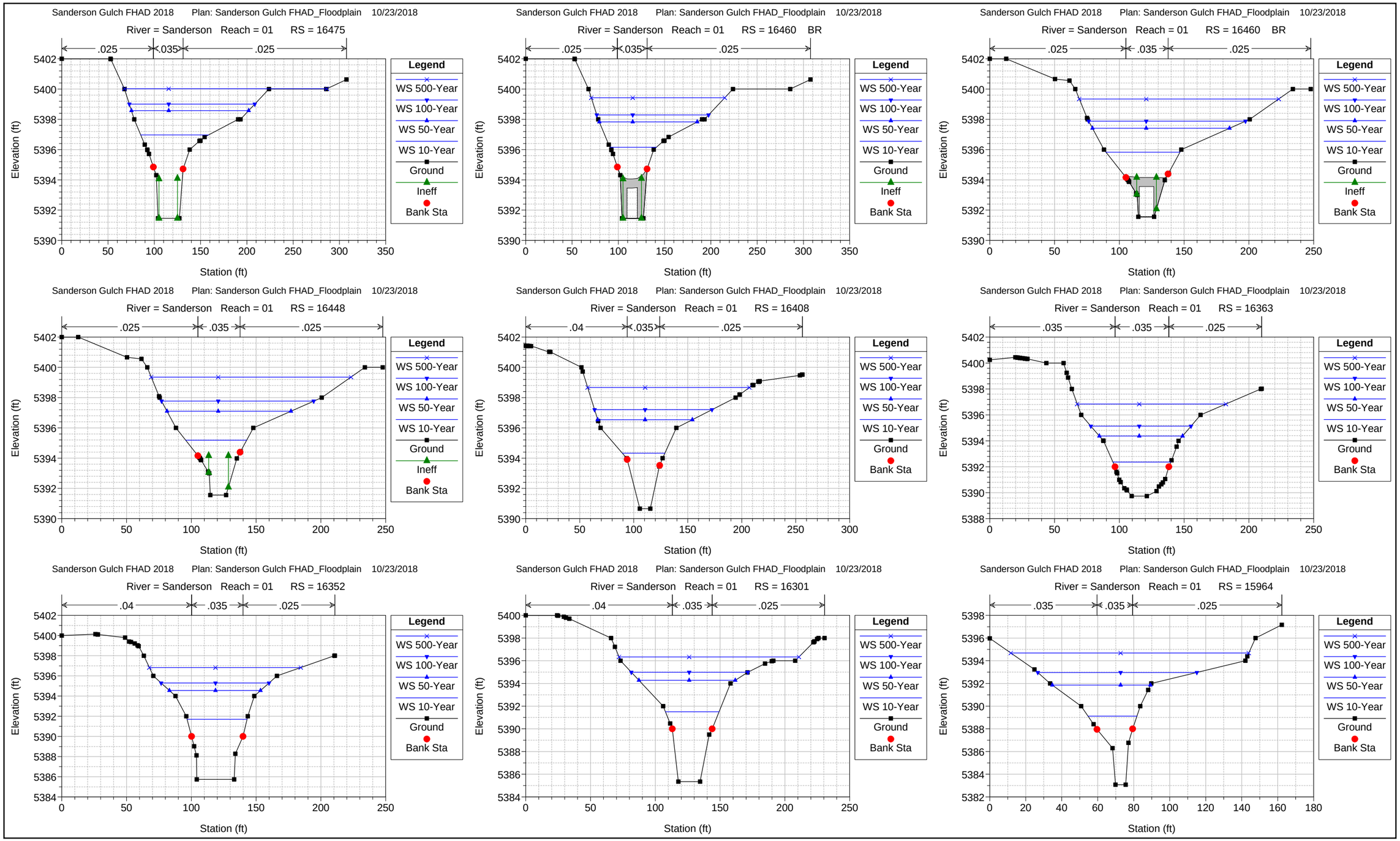
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
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Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 16460 BR
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
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Bank Sta
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River = Sanderson Reach = 01 RS = 16460 BR
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Elevation (ft)
Station (ft)
Legend
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WS 50-Year
WS 10-Year
Ground
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River = Sanderson Reach = 01 RS = 16448
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Elevation (ft)
Station (ft)
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WS 10-Year
Ground
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River = Sanderson Reach = 01 RS = 16408
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Elevation (ft)
Station (ft)
Legend
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WS 10-Year
Ground
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River = Sanderson Reach = 01 RS = 16363
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WS 50-Year
WS 10-Year
Ground
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River = Sanderson Reach = 01 RS = 16352
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Station (ft)
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WS 10-Year
Ground
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River = Sanderson Reach = 01 RS = 16301
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WS 10-Year
Ground
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River = Sanderson Reach = 01 RS = 15964
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Legend
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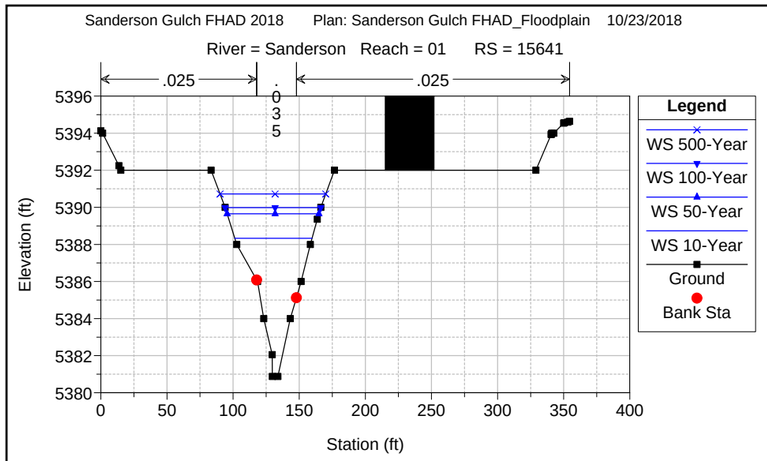
WS 50-Year
WS 10-Year
Ground
Bank Sta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Legend
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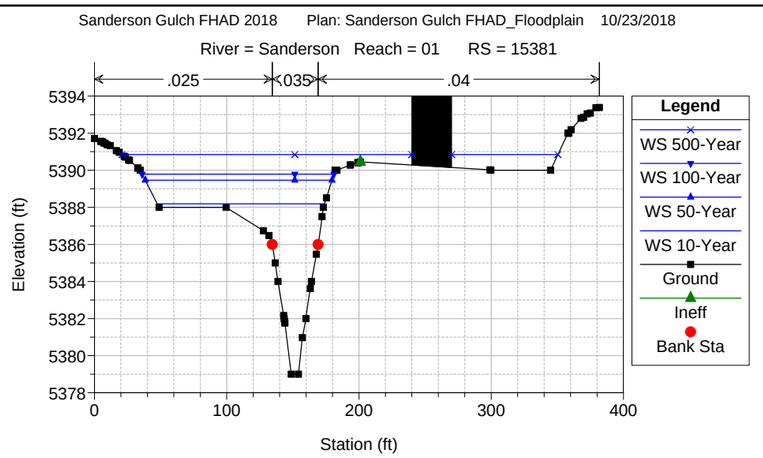
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)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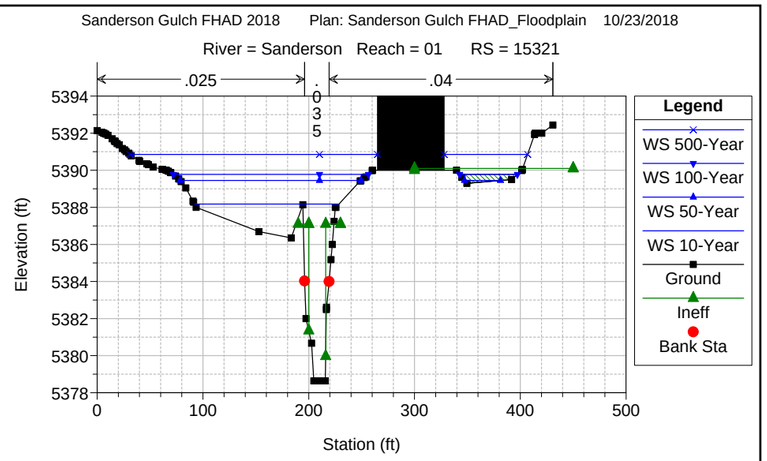
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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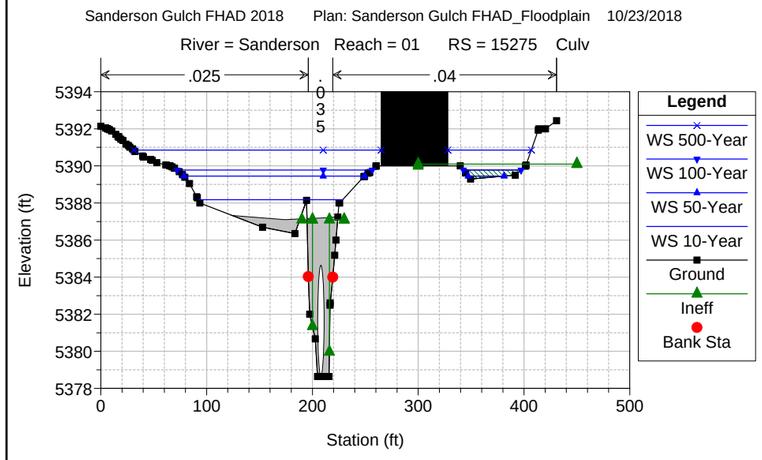
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 15275 Culv
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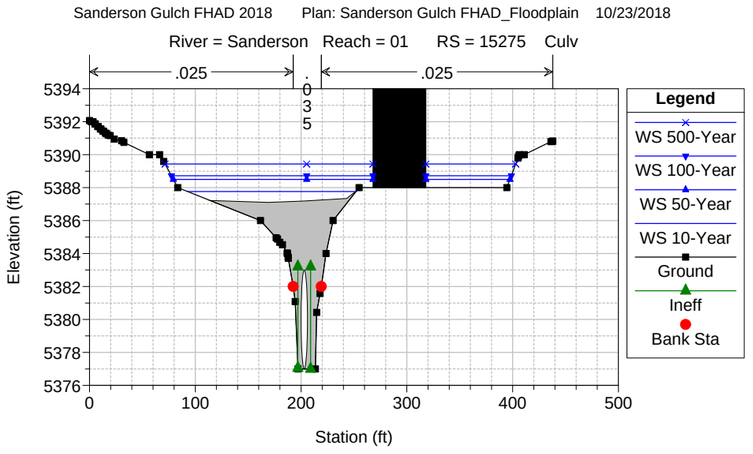
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 15275 Culv
.025
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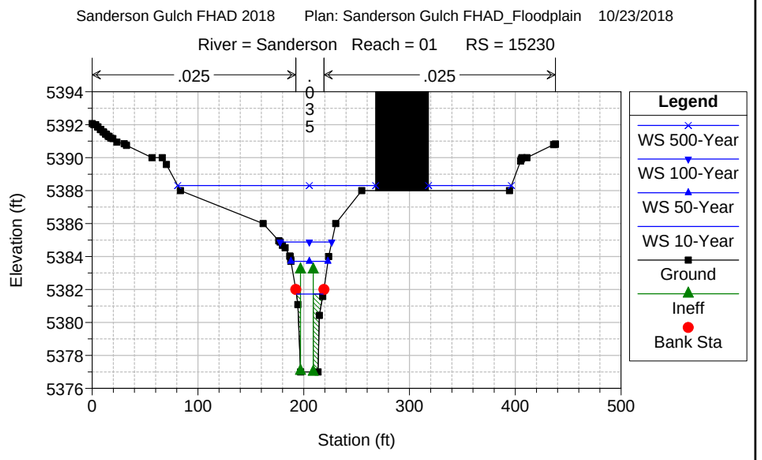
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 15230
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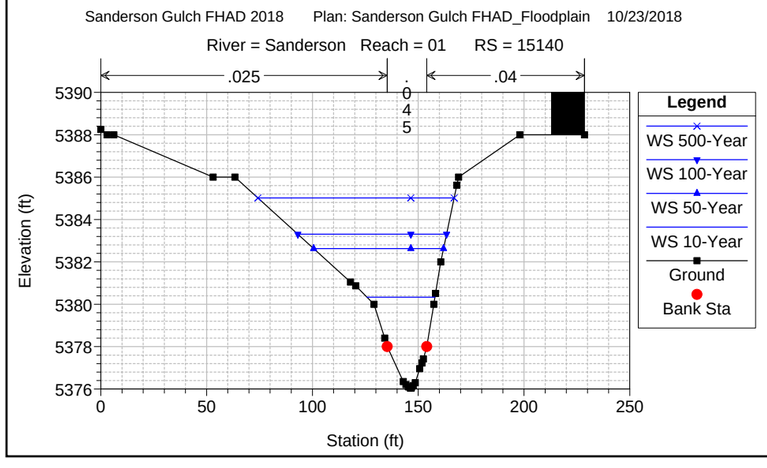
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 15140
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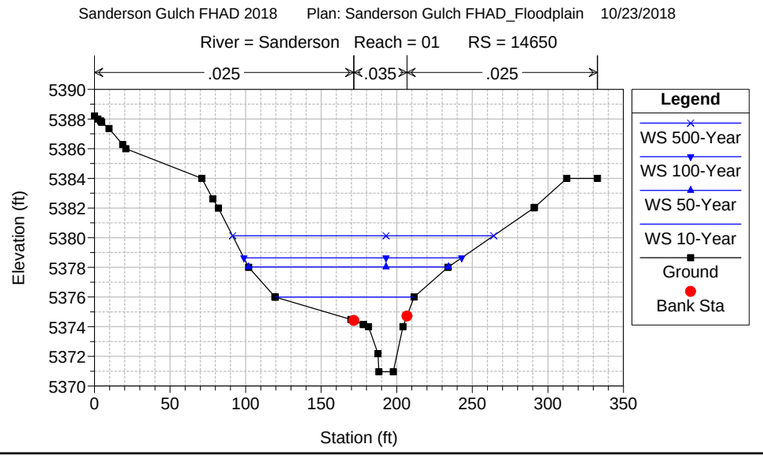
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 14650
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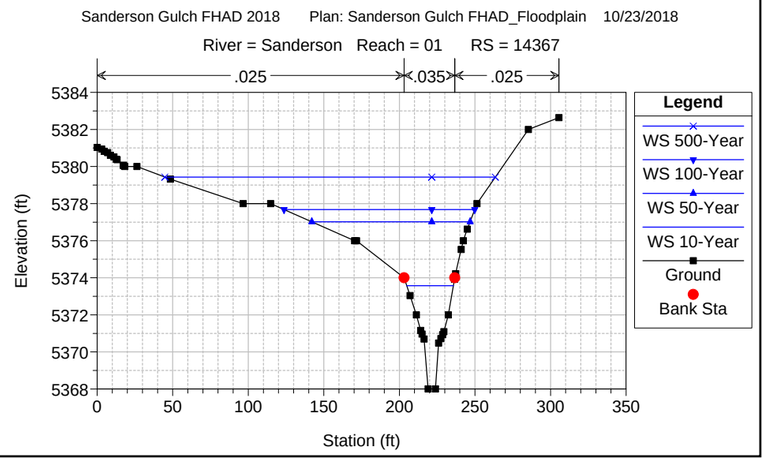
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 14367
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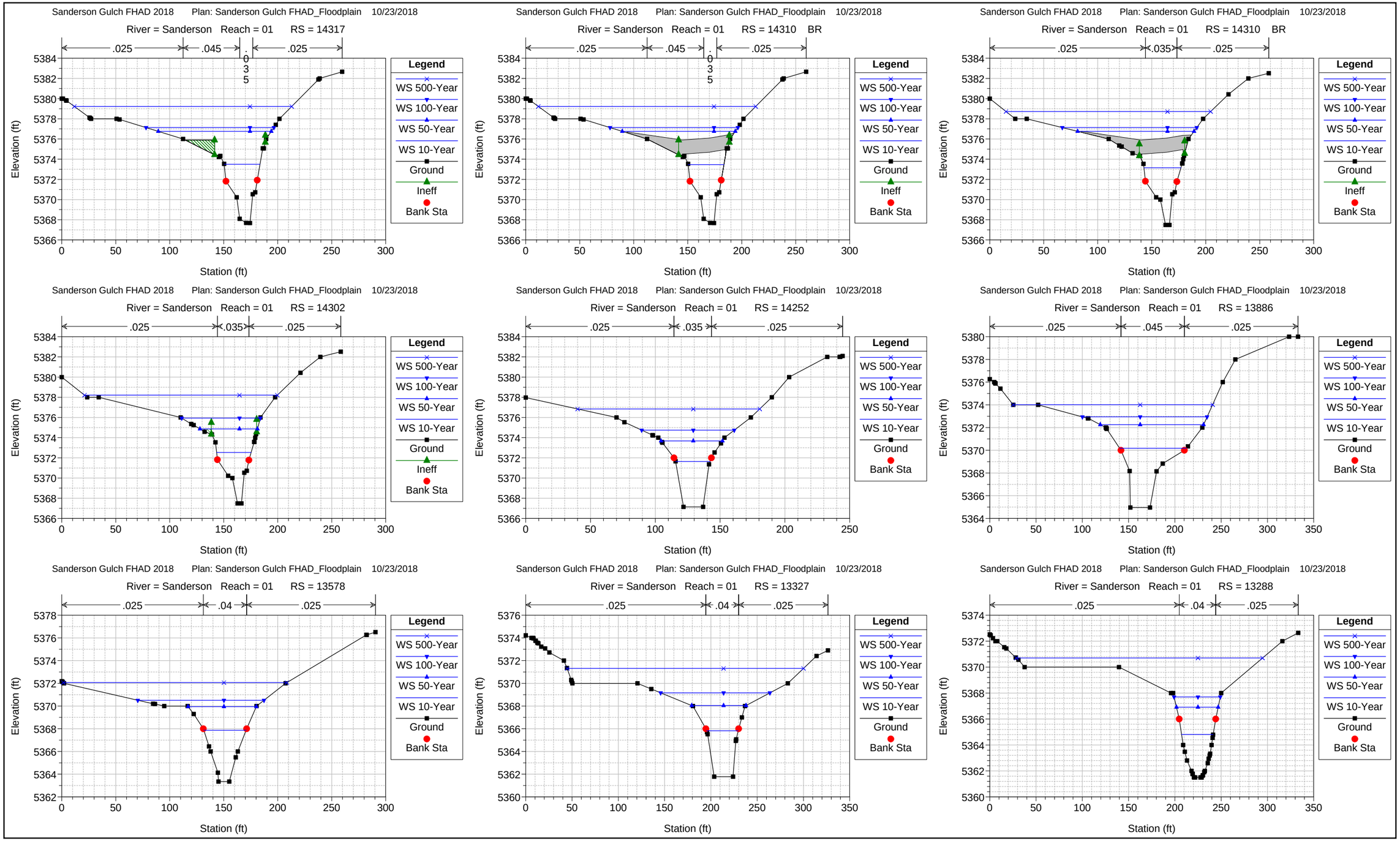
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 14317
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River = Sanderson Reach = 01 RS = 13886
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River = Sanderson Reach = 01 RS = 13327
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River = Sanderson Reach = 01 RS = 13288
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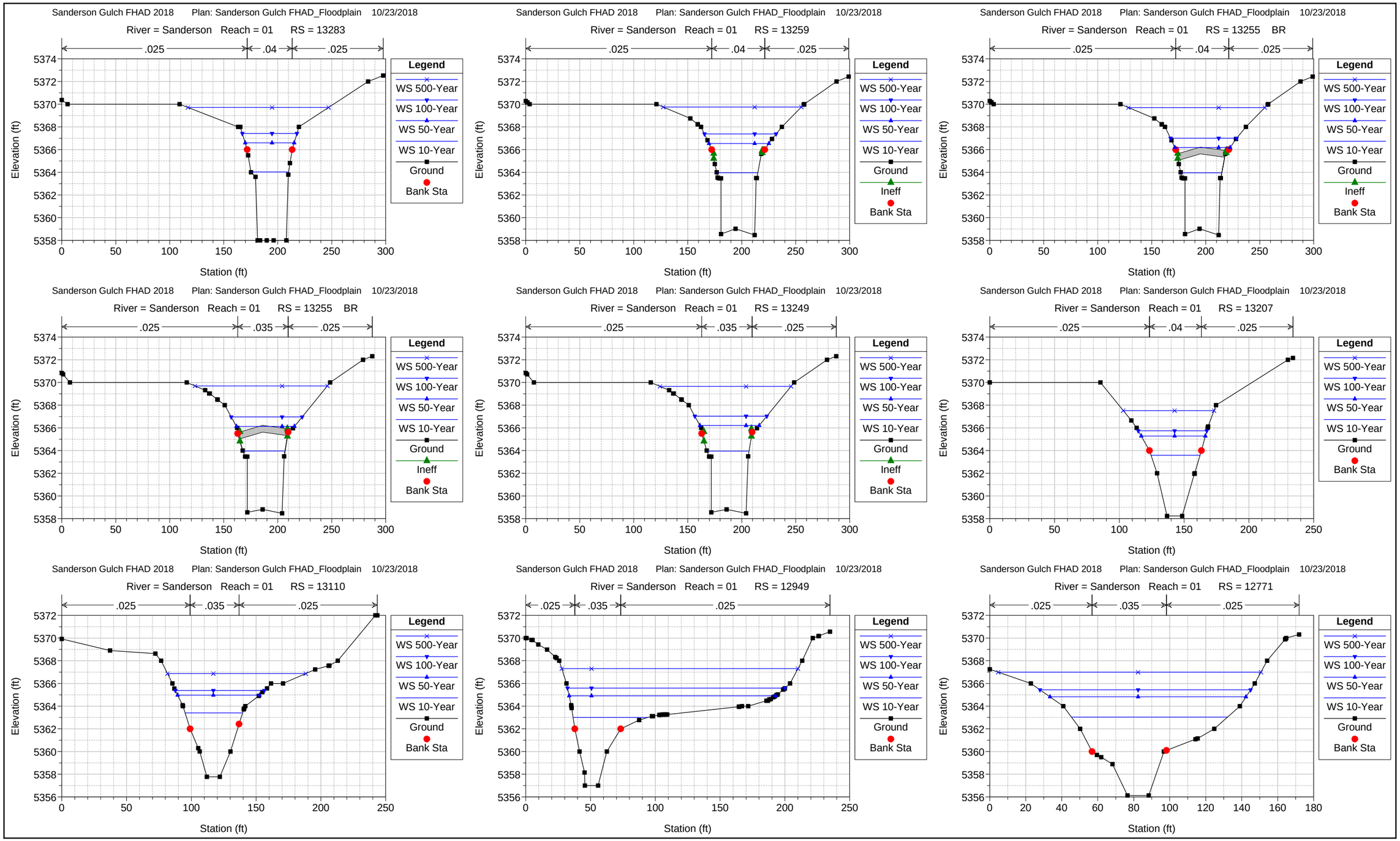
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
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River = Sanderson Reach = 01 RS = 13259
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 13255 BR
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 13255 BR
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 13249
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 13207
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 13110
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 12949
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
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River = Sanderson Reach = 01 RS = 12771
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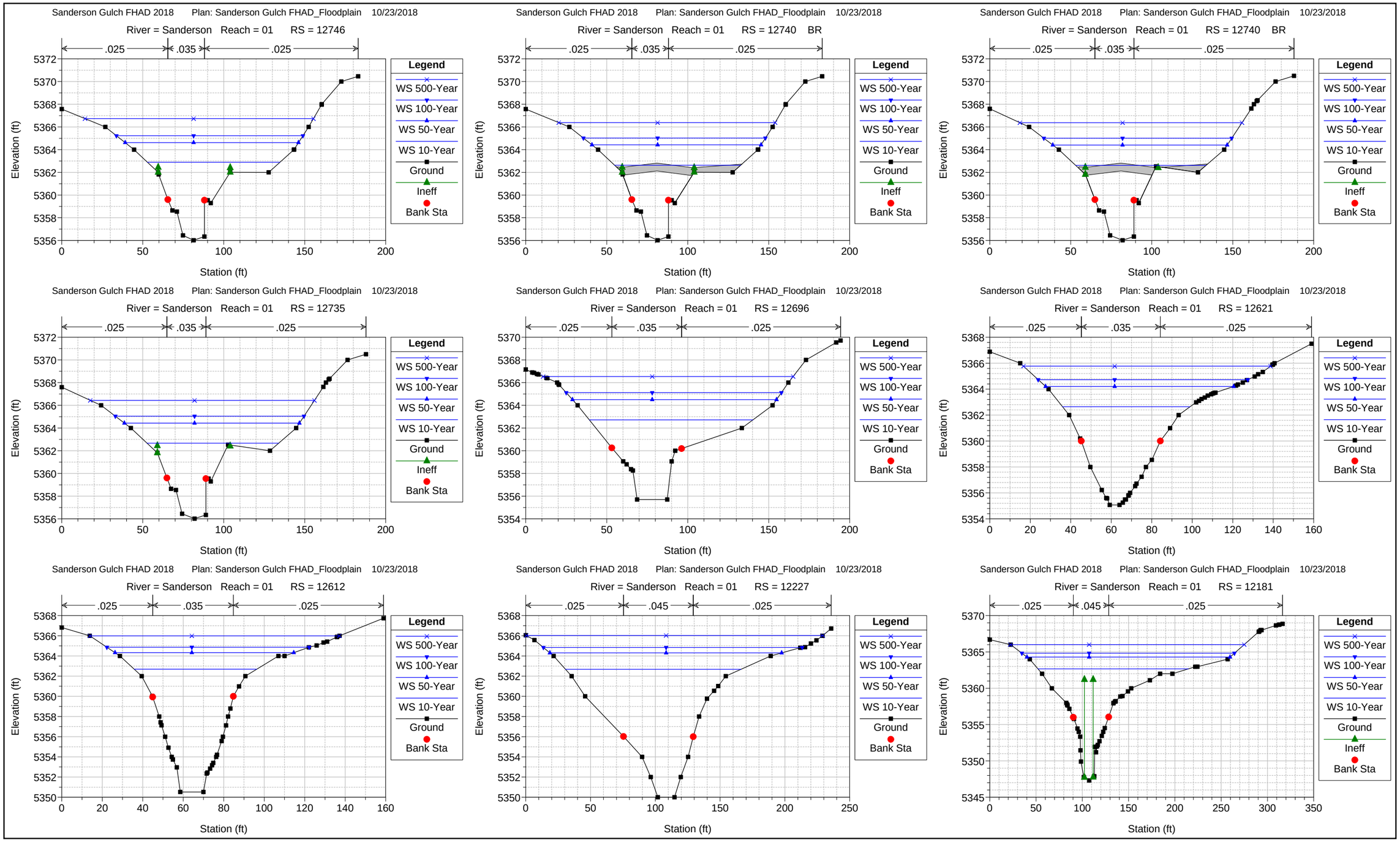
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 01 RS = 12696
River = Sanderson Reach = 01 RS = 12621
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River = Sanderson Reach = 01 RS = 12181
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WS 100-Year
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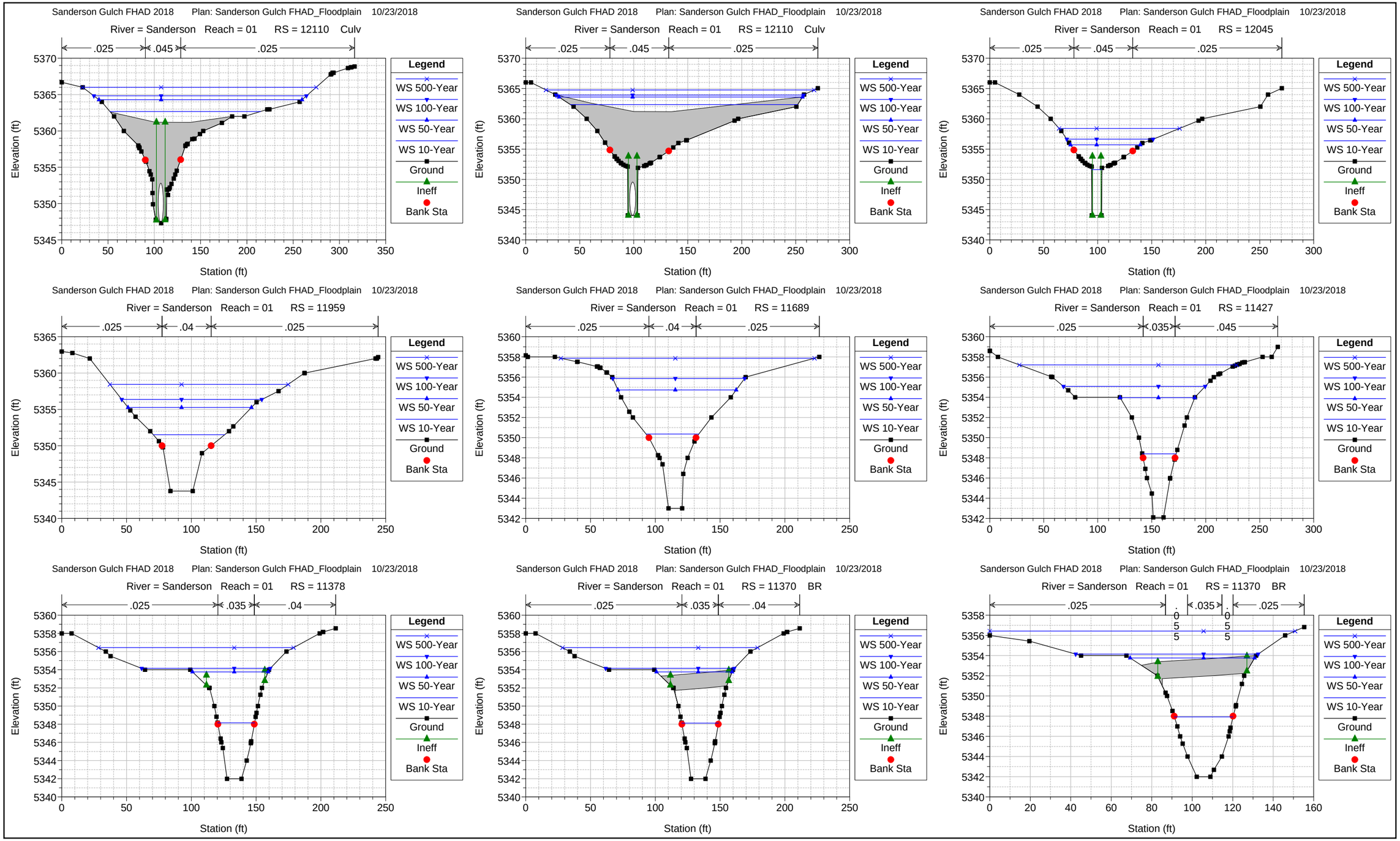
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 12110 Culv
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 12110 Culv
.025 .045 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 12045
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 11959
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
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River = Sanderson Reach = 01 RS = 11689
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 11427
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 11378
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 11370 BR
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 11370 BR
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
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WS 10-Year
Ground
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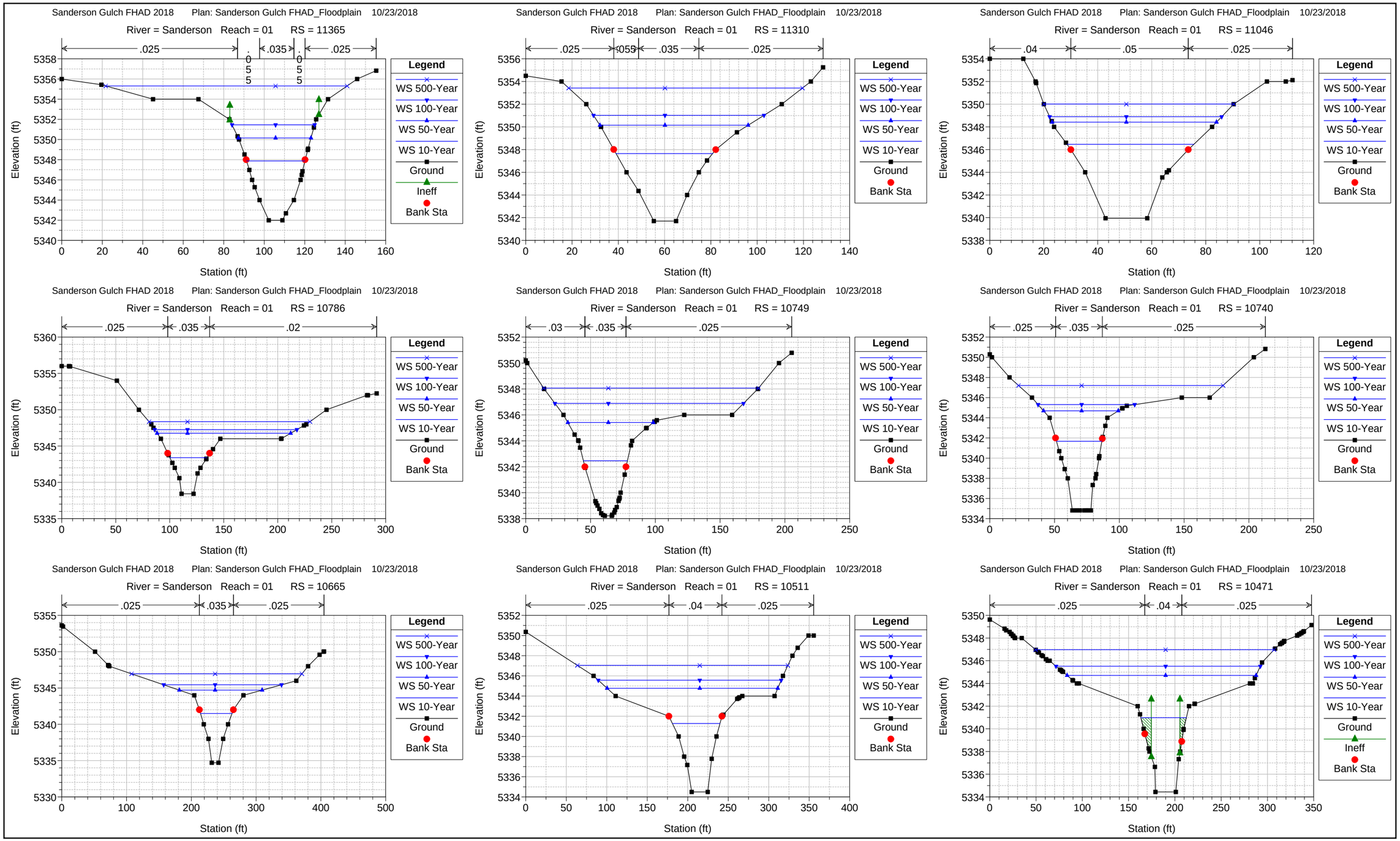
Bank Sta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River = Sanderson Reach = 01 RS = 10665
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River = Sanderson Reach = 01 RS = 10471
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WS 100-Year
WS 50-Year
WS 10-Year
Ground
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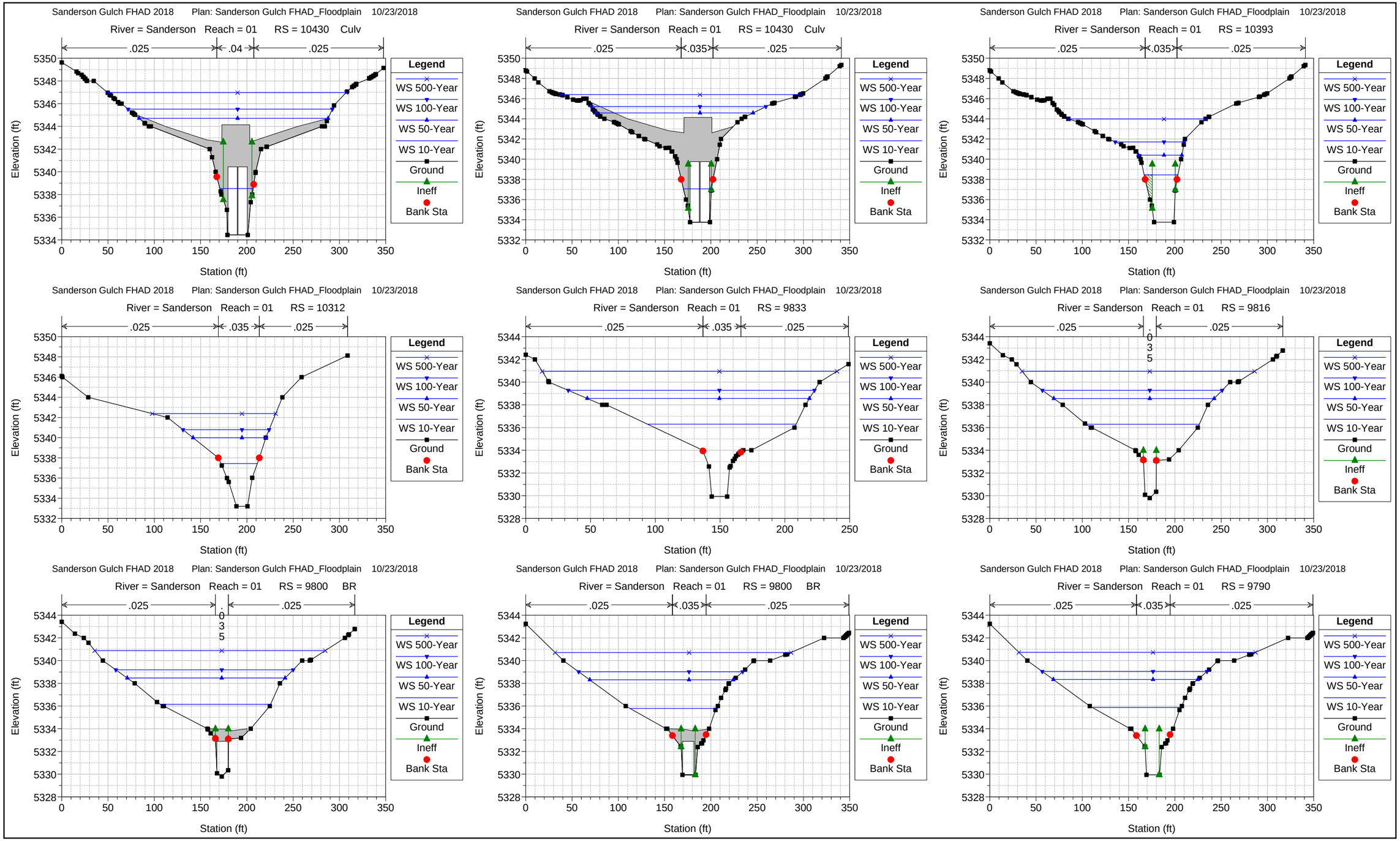
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 10430 Culv
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 10430 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 10393
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 10312
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9833
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
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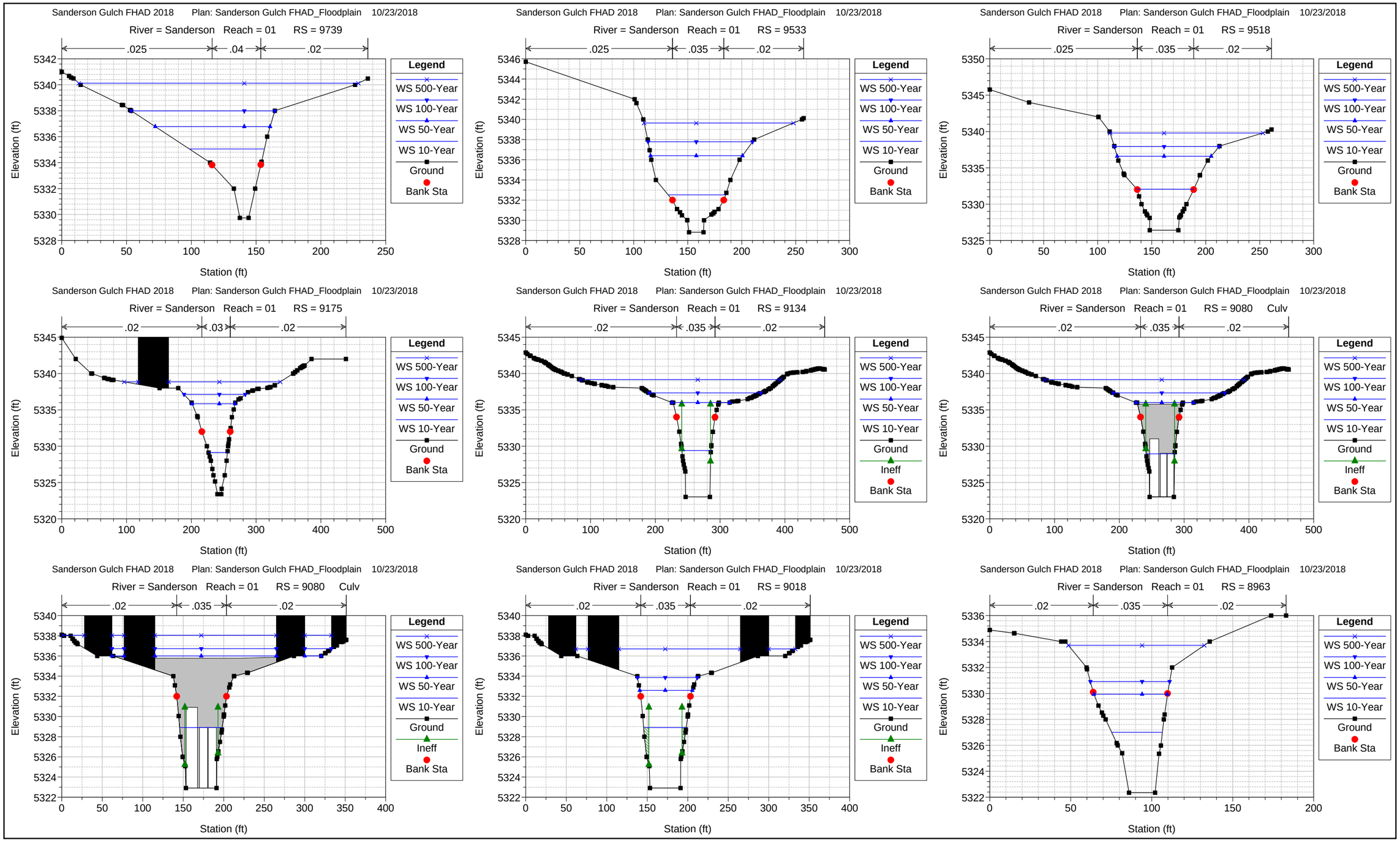
River = Sanderson Reach = 01 RS = 9816
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9800 BR
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9800 BR
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9790
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = Sanderson Reach = 01 RS = 9739
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9533
.025 .035 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9518
.025 .035 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9175
.02 .03 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9134
.02 .035 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9080 Culv
.02 .035 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9080 Culv
.02 .035 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 9018
.02 .035 .02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8963
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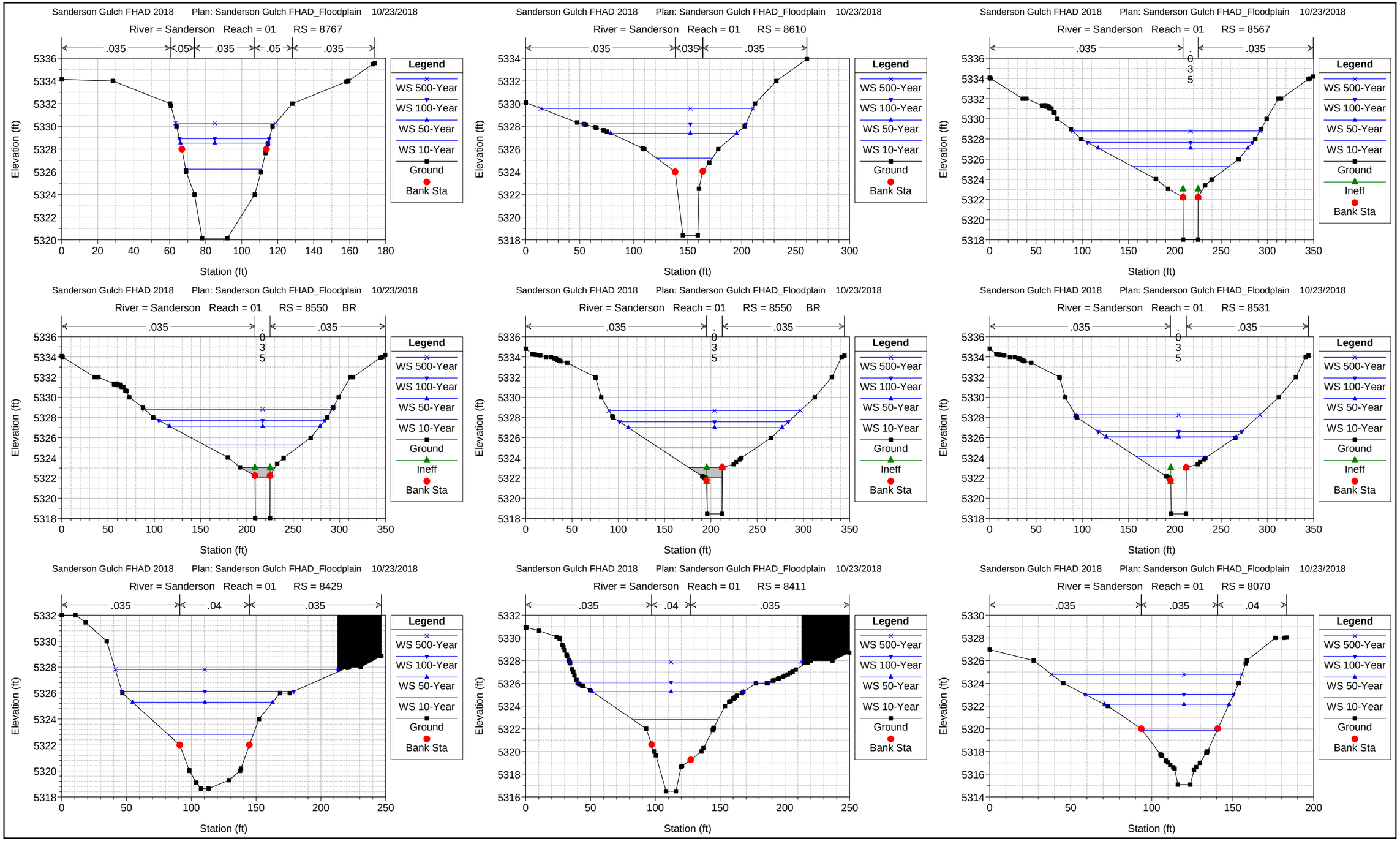
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 01 RS = 8767
.035 .05 .035 .05 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8610
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8567
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8550 BR
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8550 BR
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8531
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8429
.035 .04 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8411
.035 .04 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 8070
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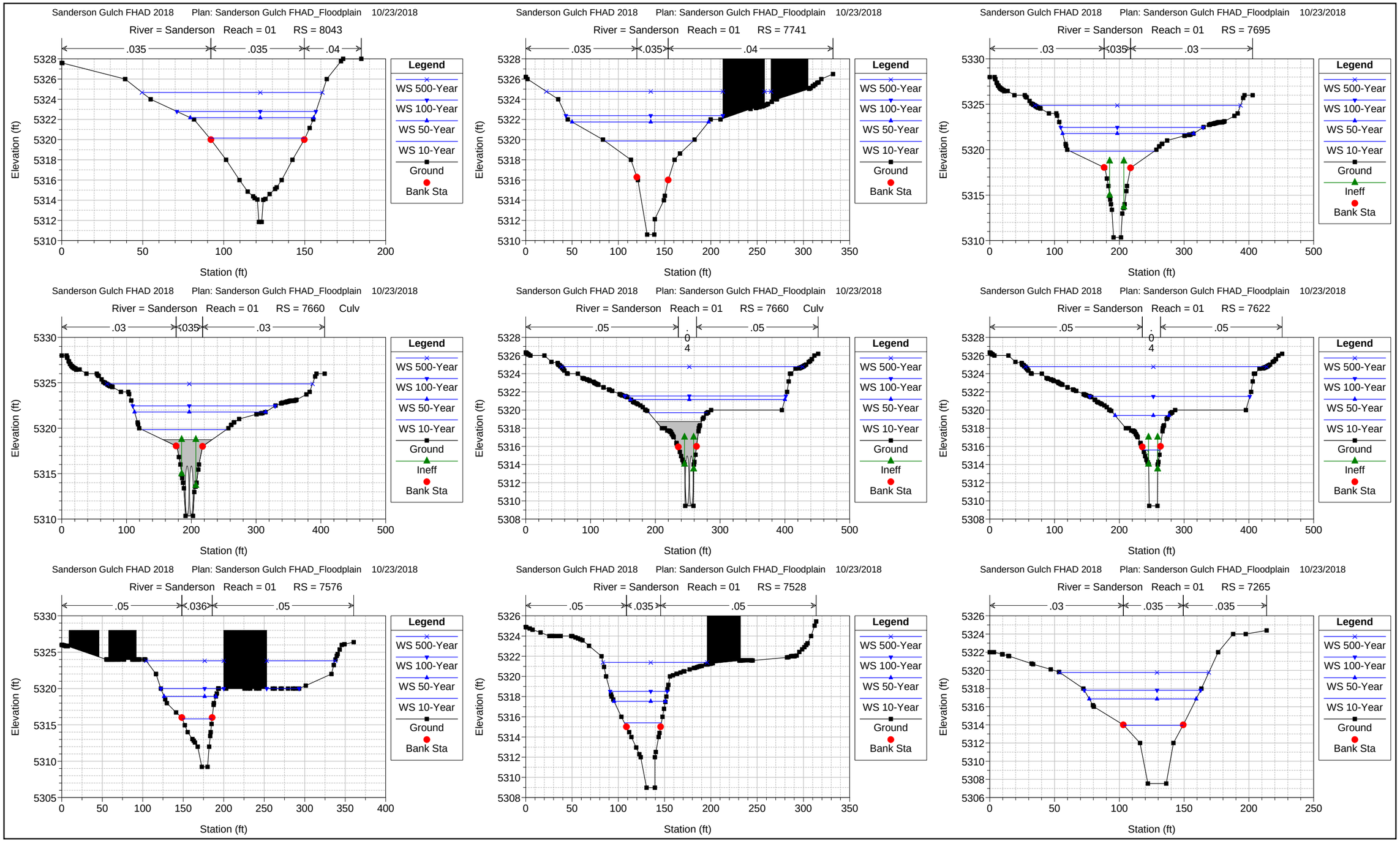
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 01 RS = 8043
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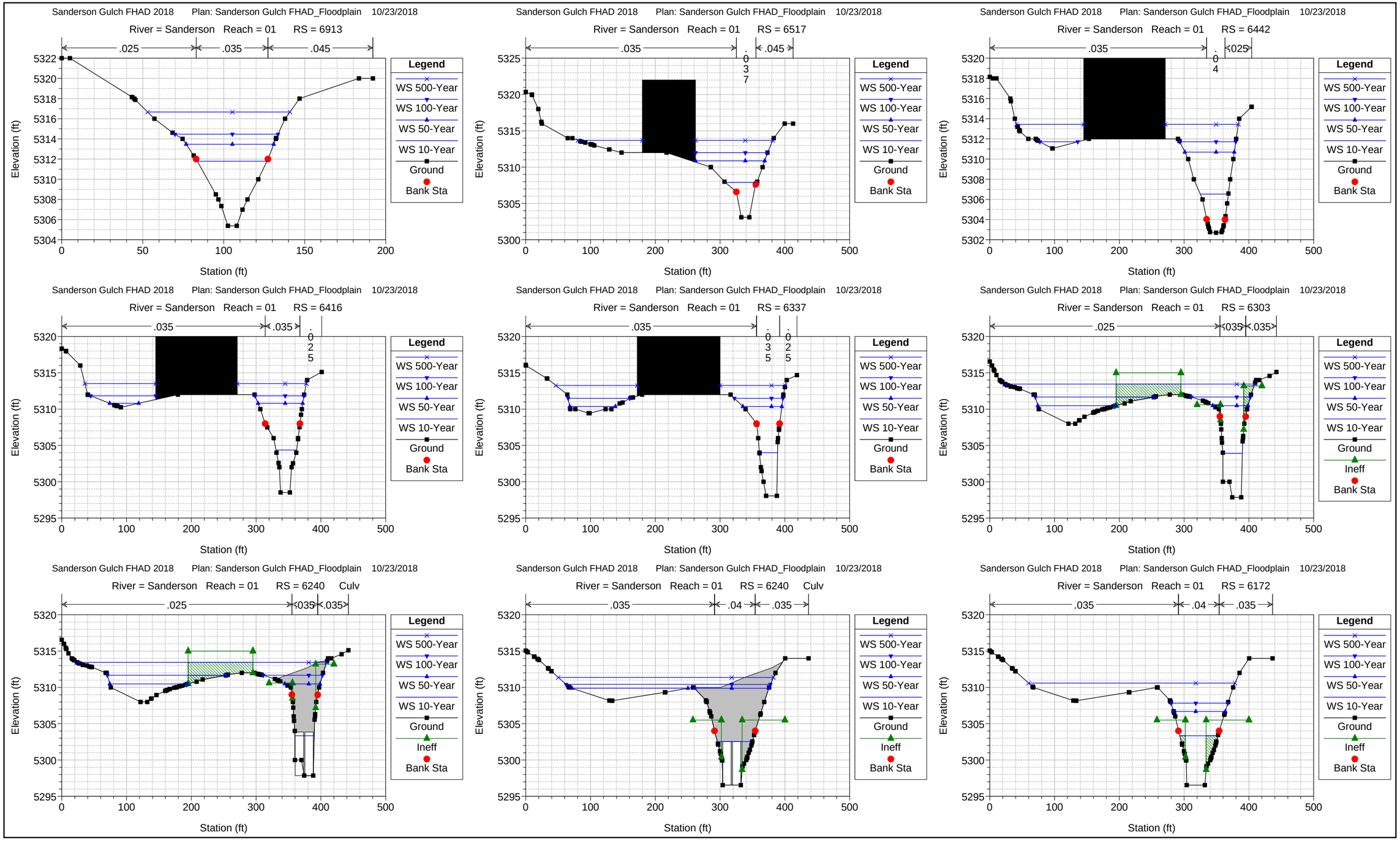
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7741
.035 .035 .04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7695
.03 .035 .03
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7660 Culv
.03 .035 .03
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7660 Culv
.05 .04 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7622
.05 .04 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7576
.05 .036 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7528
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 7265
.03 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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.035 .037 .045
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River = Sanderson Reach = 01 RS = 6442
.035 .04 .025
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
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River = Sanderson Reach = 01 RS = 6240 Culv
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River = Sanderson Reach = 01 RS = 6240 Culv
.035 .04 .035
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 6172
.035 .04 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
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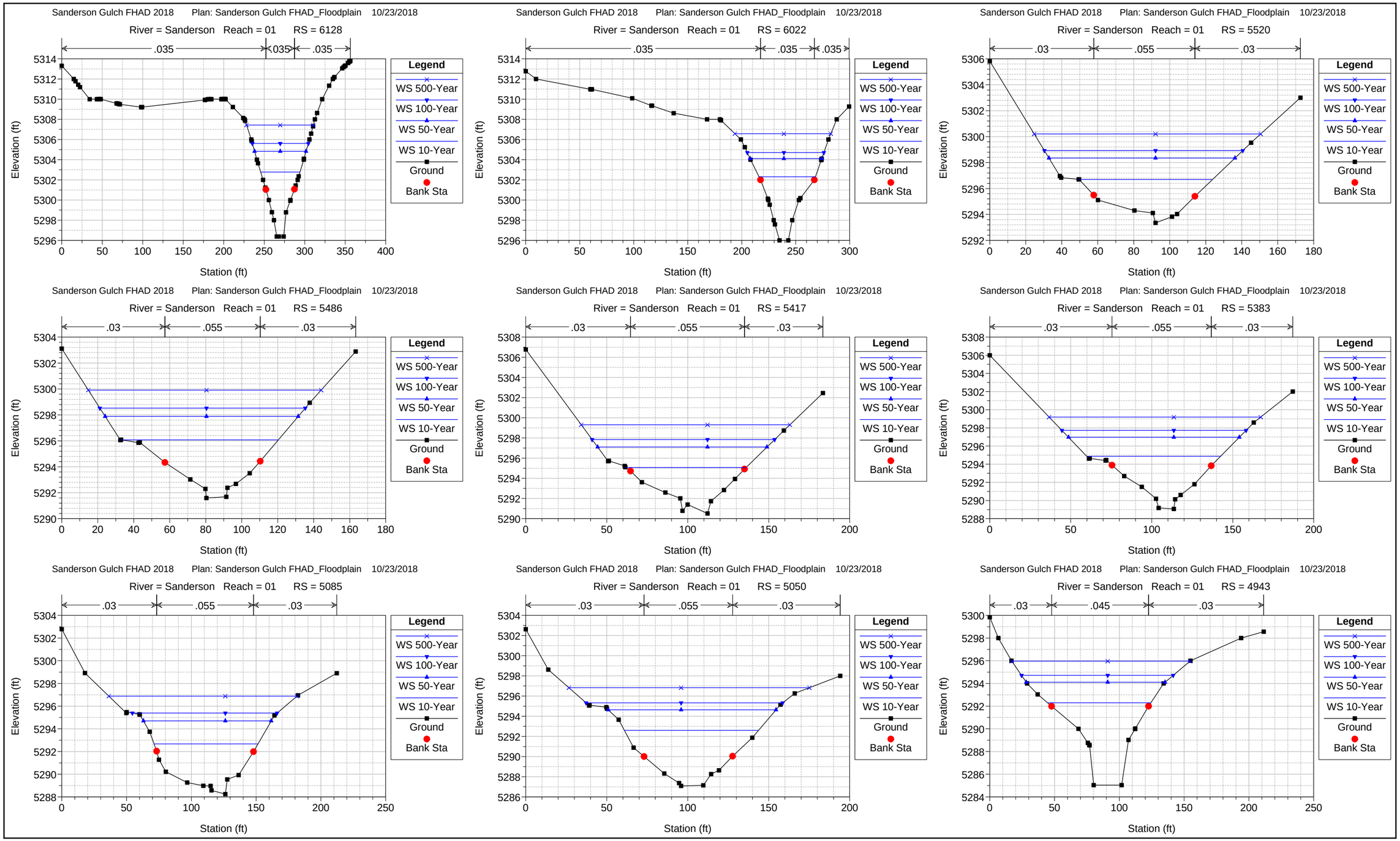
Bank Sta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River = Sanderson Reach = 01 RS = 6128
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Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 6022
.035 .035 .035
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 5520
.03 .055 .03
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 5486
.03 .055 .03
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 5417
.03 .055 .03
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 5383
.03 .055 .03
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 5085
.03 .055 .03
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 5050
.03 .055 .03
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 4943
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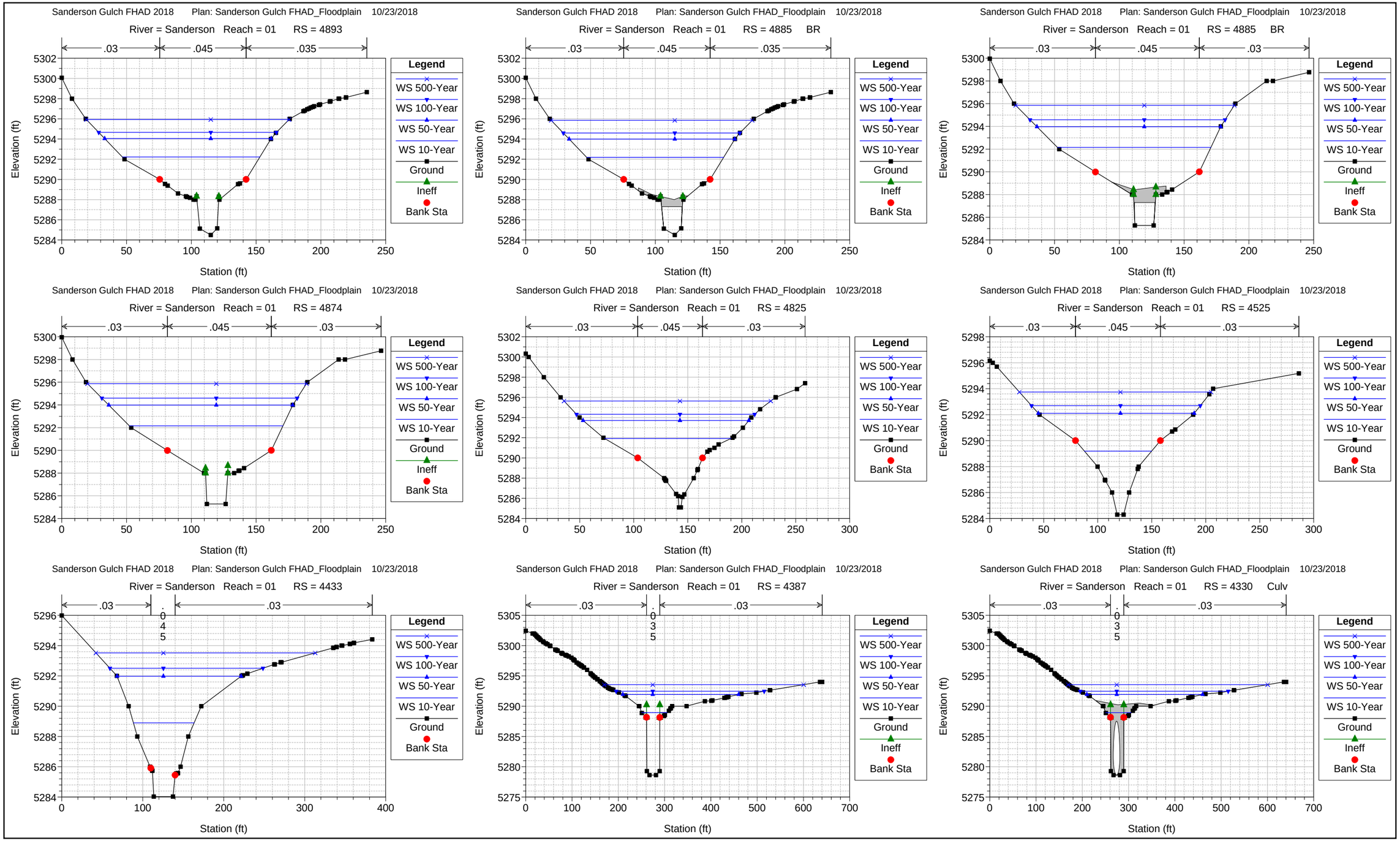
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 4874
River = Sanderson Reach = 01 RS = 4825
River = Sanderson Reach = 01 RS = 4525
River = Sanderson Reach = 01 RS = 4433
River = Sanderson Reach = 01 RS = 4387
River = Sanderson Reach = 01 RS = 4330 Culv
.03
.045
.035
.04
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
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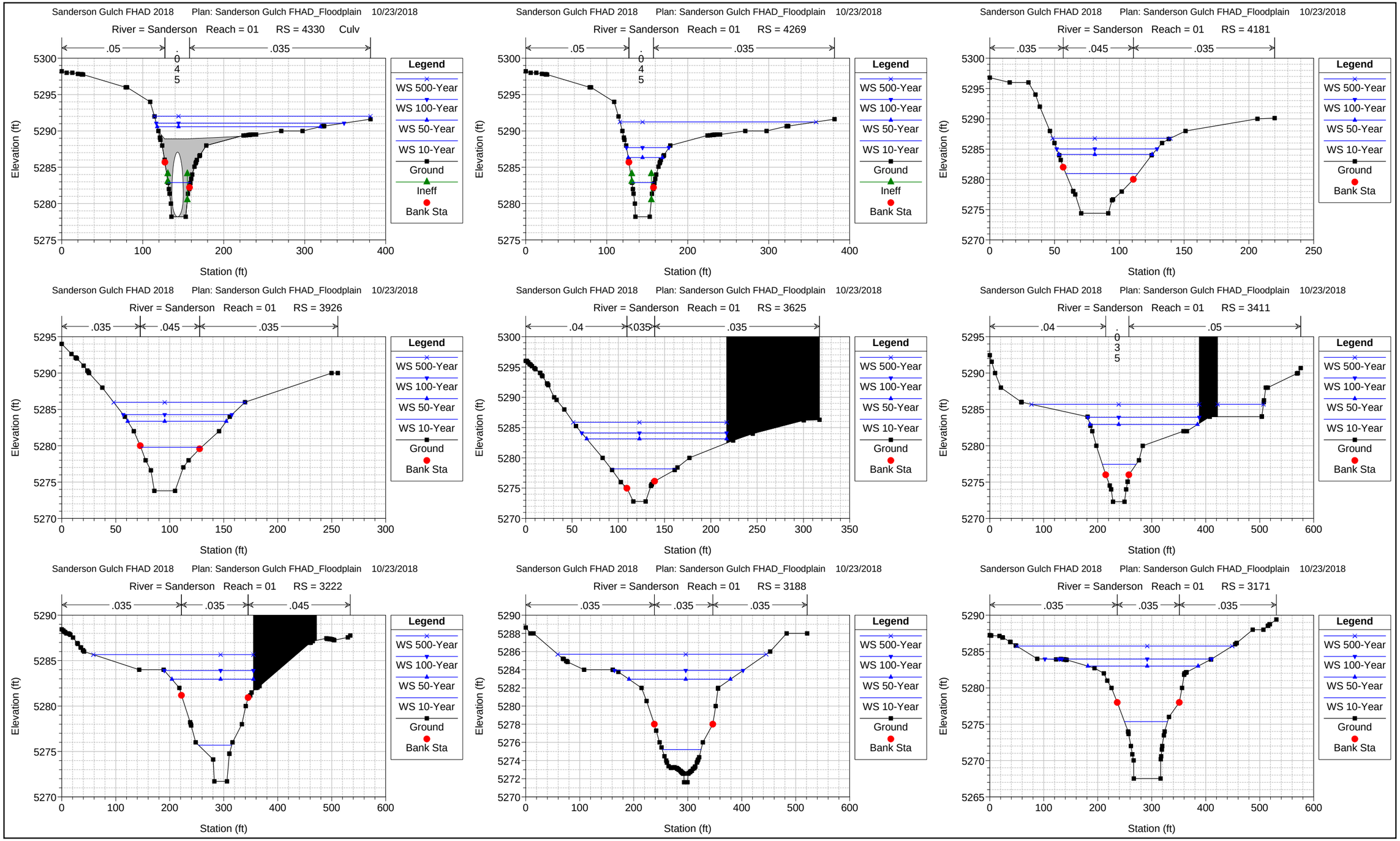
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River = Sanderson Reach = 01 RS = 4330 Culv
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Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 4269
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Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 4181
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Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 3926
.035
.045
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Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 3625
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.035
.035
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 3411
.04
.035
.05
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 3222
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Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 3188
.035
.035
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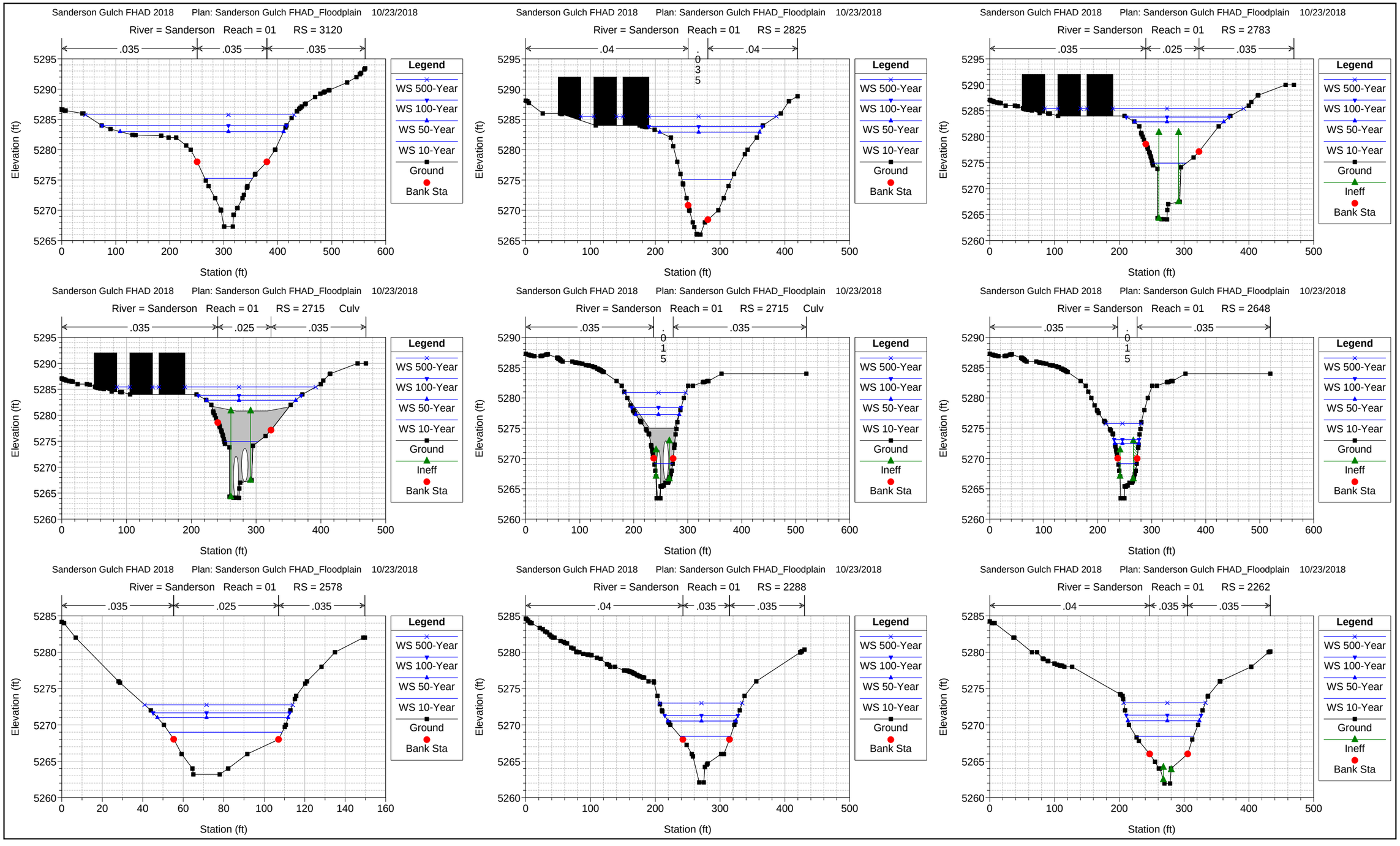
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 3171
.035
.035
.035
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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River = Sanderson Reach = 01 RS = 3120
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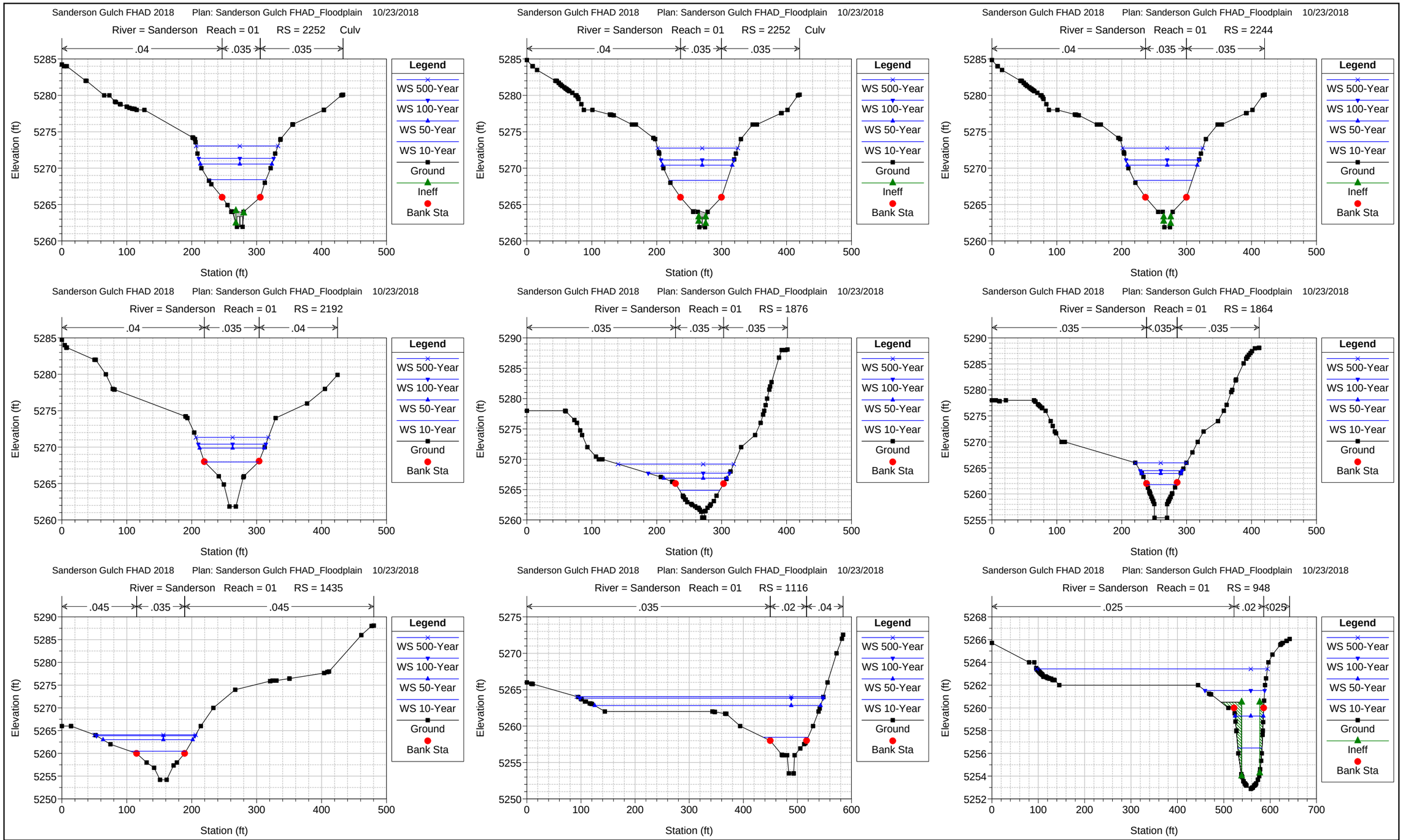
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2825
.04 .035 .04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2783
.035 .025 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2715 Culv
.035 .025 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2715 Culv
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2648
.035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2578
.035 .025 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2288
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2262
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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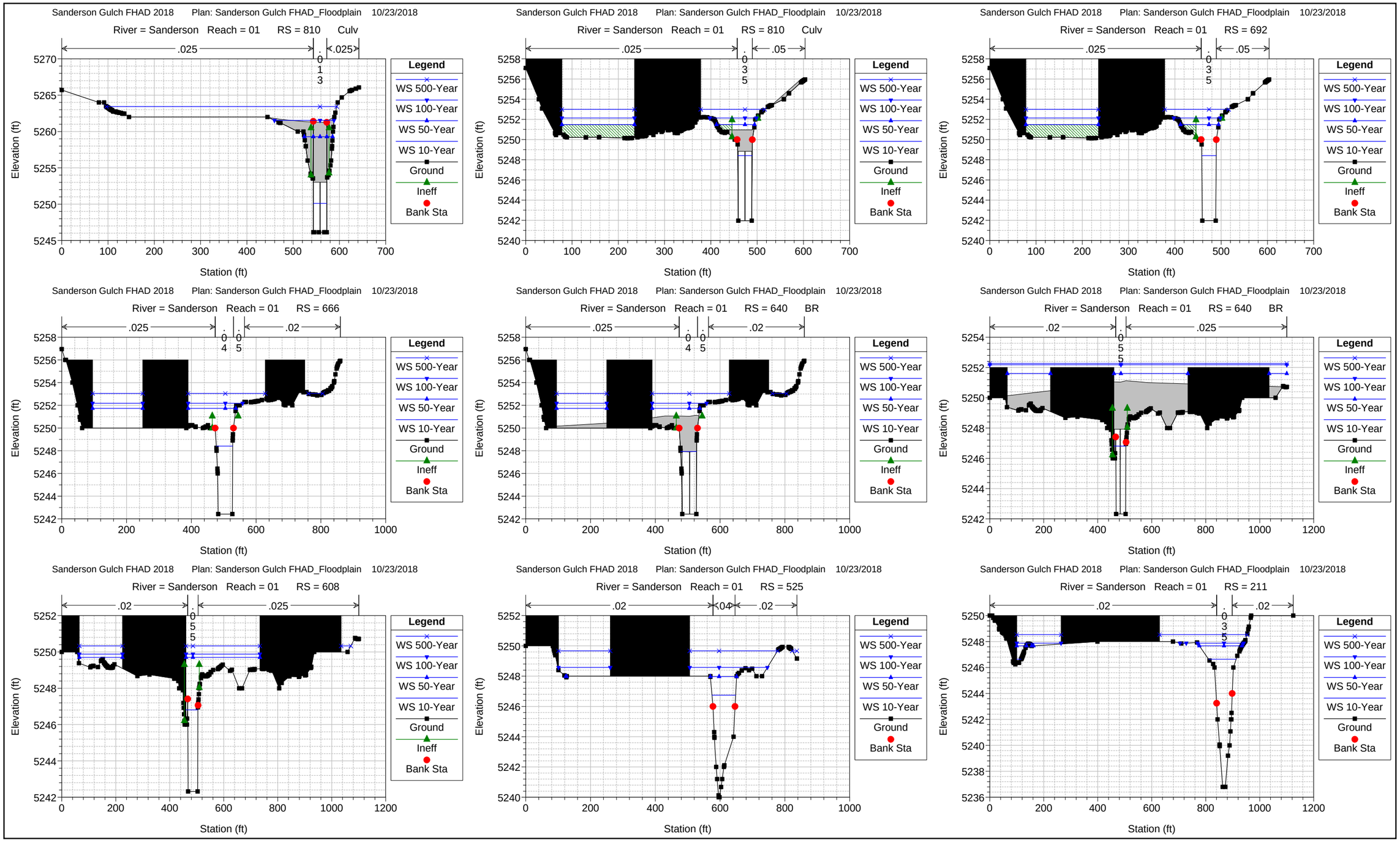
River = Sanderson Reach = 01 RS = 2252 Culv
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2252 Culv
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2244
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 2192
.04 .035 .04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 1876
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 1864
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 1435
.045 .035 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 1116
.035 .02 .04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 948
.025 .02 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = Sanderson Reach = 01 RS = 810 Culv
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.025
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 810 Culv
.025
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 692
.025
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 666
.025
.02
.045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 640 BR
.025
.02
.045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 640 BR
.02
.025
.055
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 608
.02
.025
.055
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 525
.02
.04
.02
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 211
.02
.02
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Station (ft)
Legend
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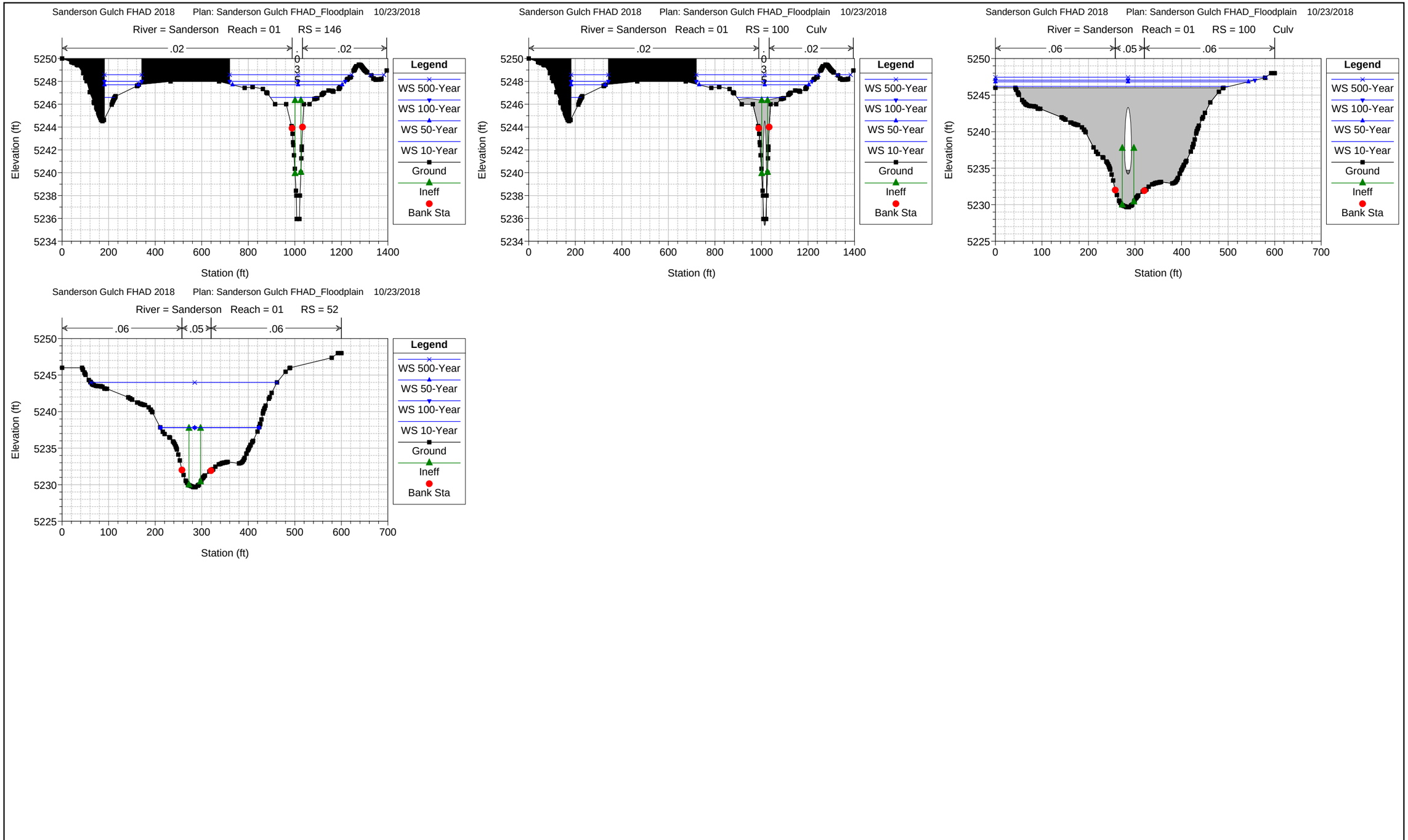
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = Sanderson Reach = 01 RS = 146
.02
.02
0.035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 100 Culv
.02
.02
0.035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 100 Culv
.06
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = Sanderson Reach = 01 RS = 52
.06
.05
.06
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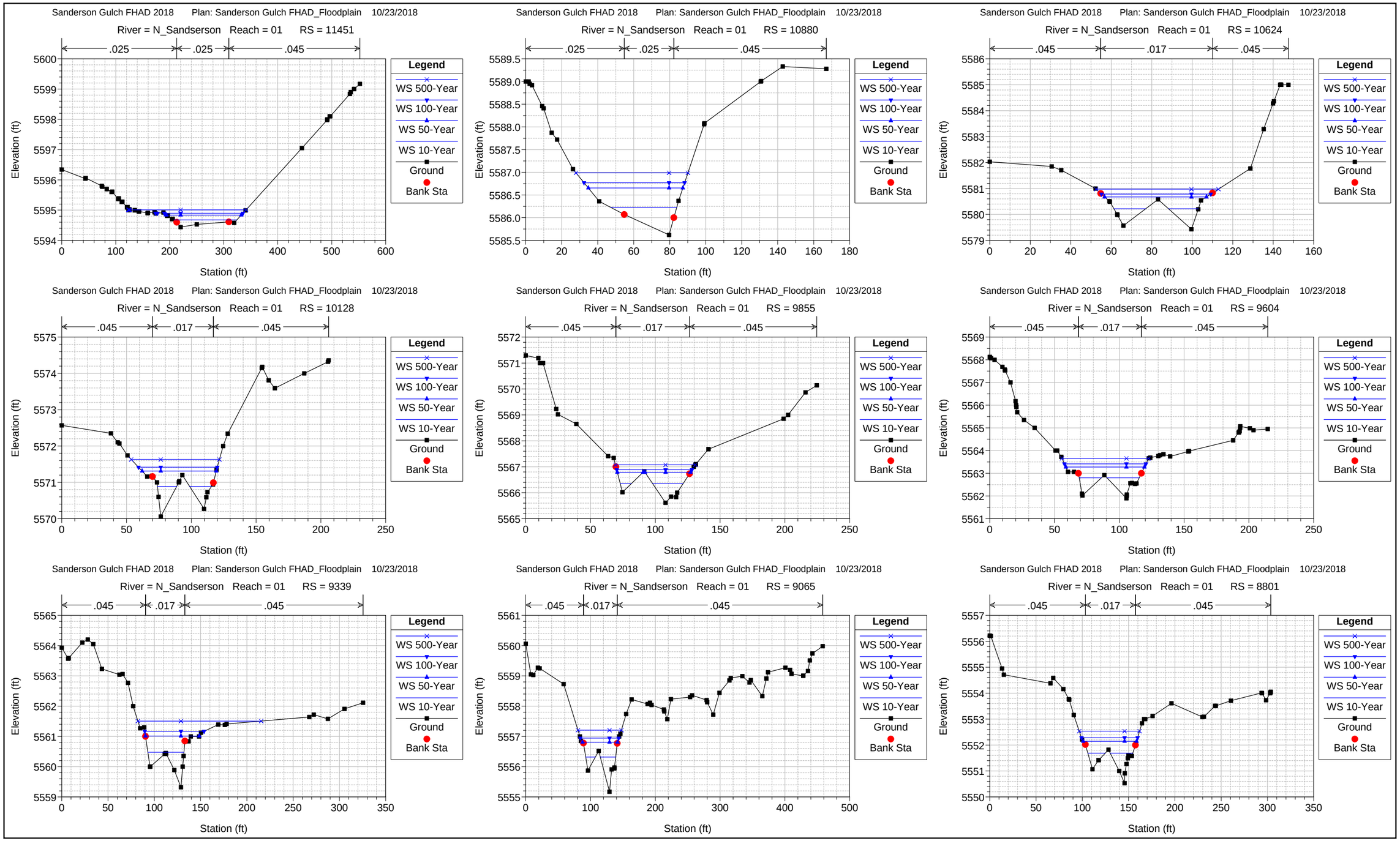
Station (ft)
Legend
WS 500-Year
WS 50-Year
WS 100-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = N_Sandserson Reach = 01 RS = 11451
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Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 10880
.025 .025 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 10624
.045 .017 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 10128
.045 .017 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 9855
.045 .017 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 9604
.045 .017 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 9339
.045 .017 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 9065
.045 .017 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 8801
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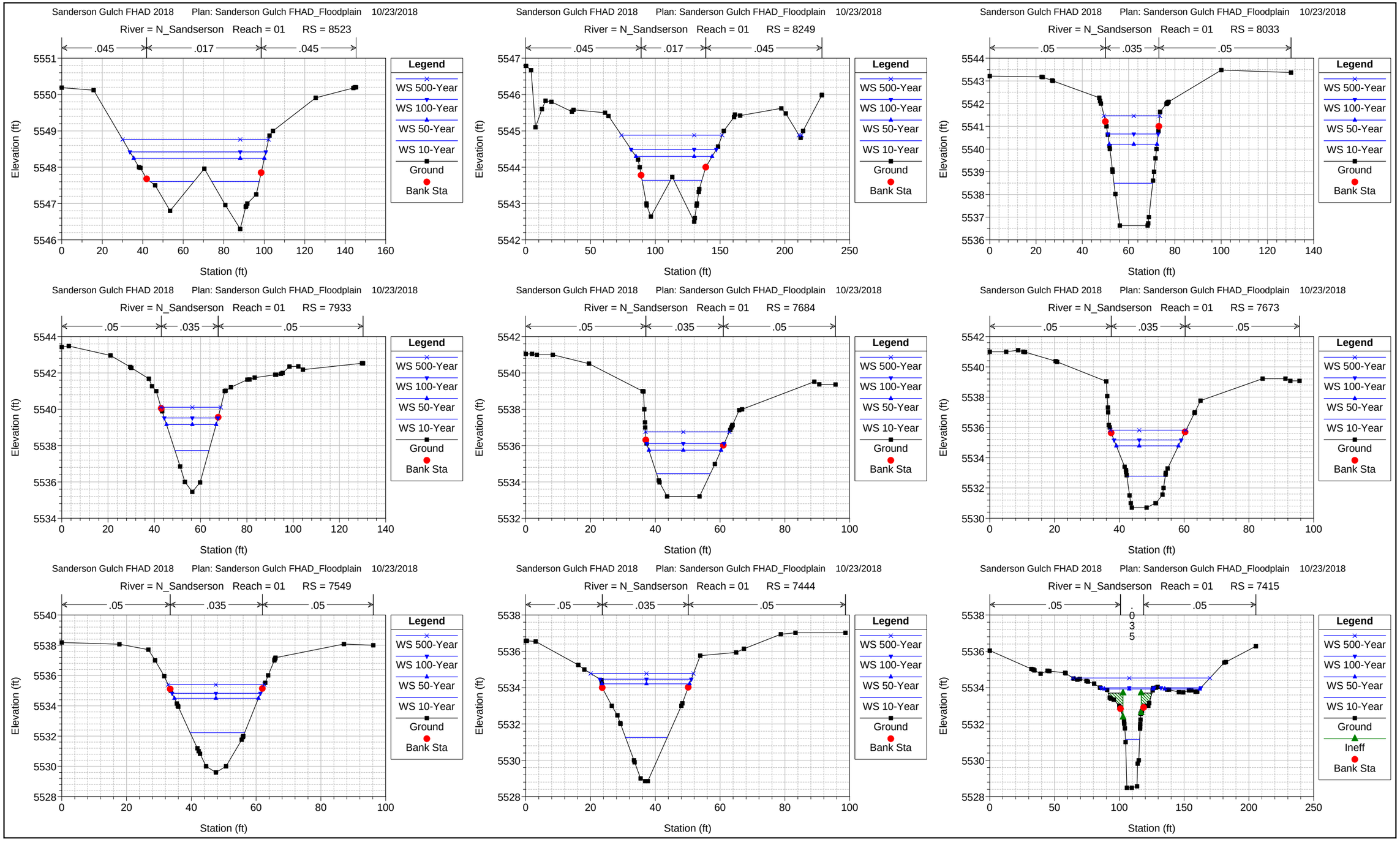
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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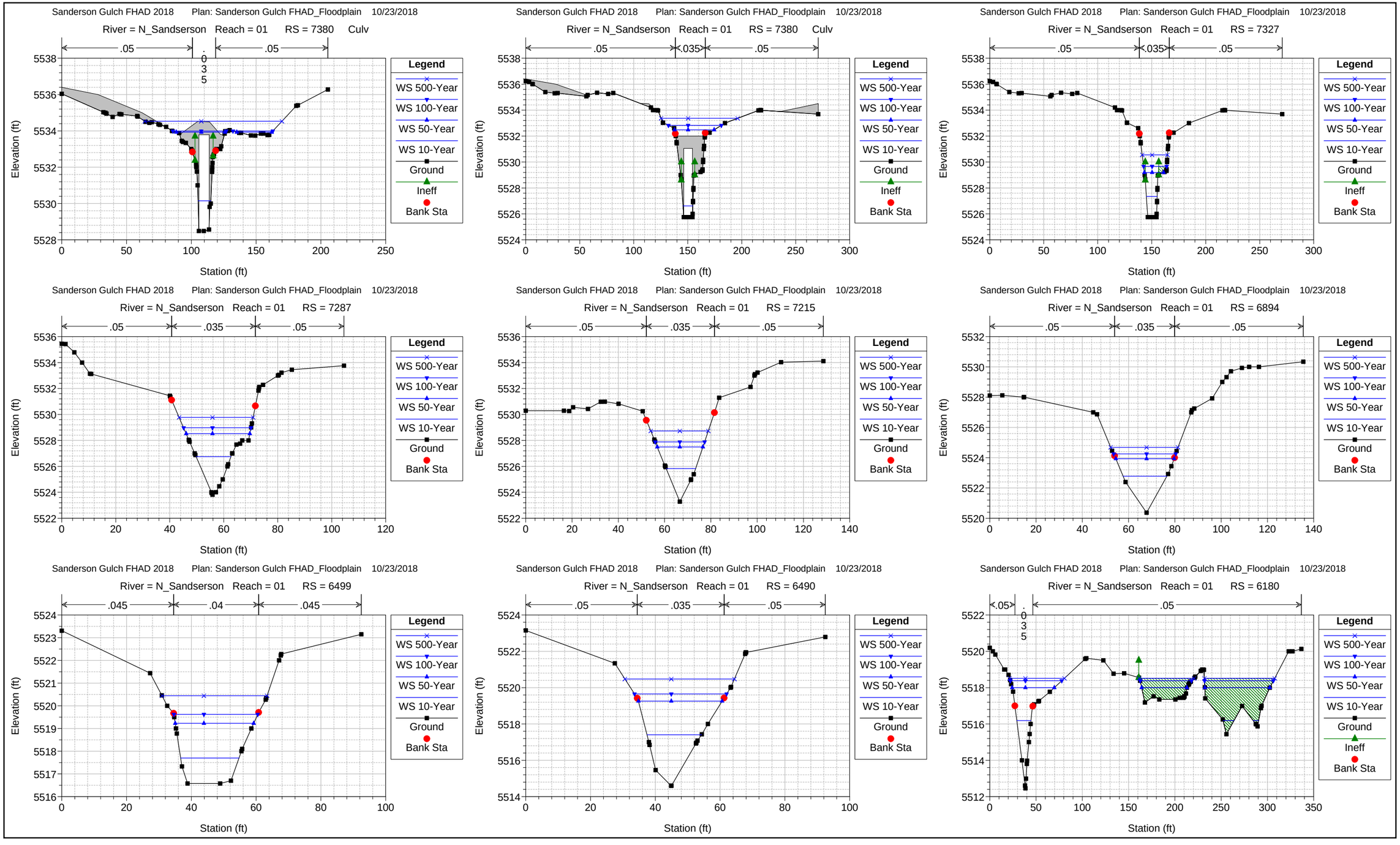
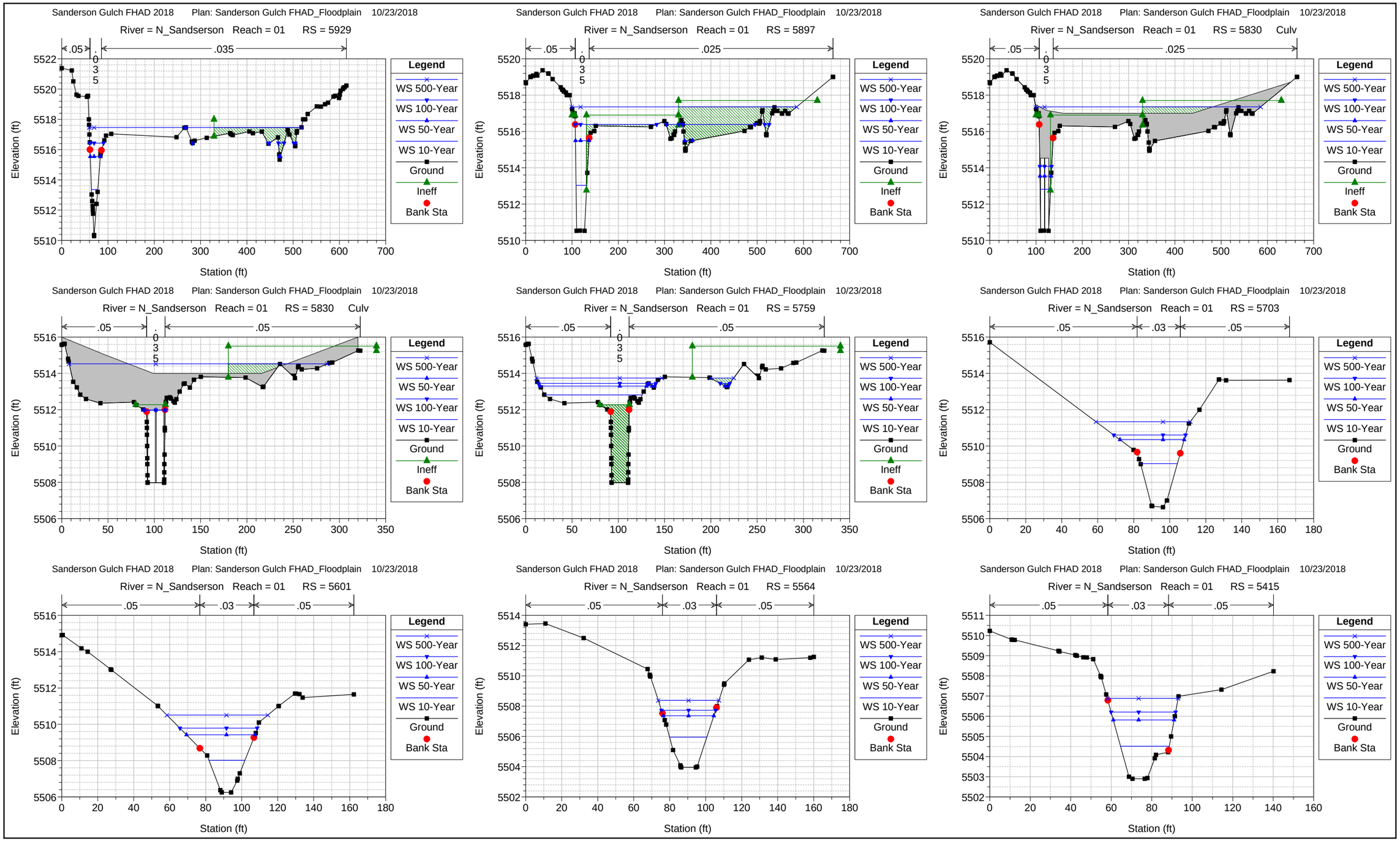
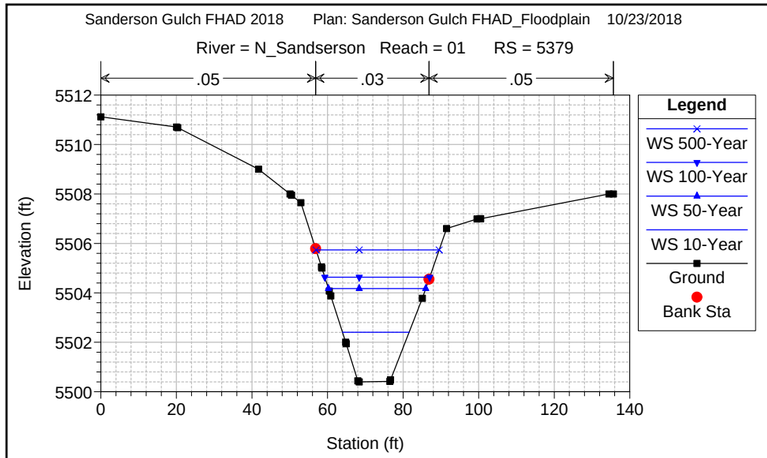
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 8249
.045 .017 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 8033
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7933
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7684
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7673
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7549
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7444
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7415
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7380 Culv
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7380 Culv
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7327
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7287
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 7215
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 6894
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 6499
.045 .04 .045
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 6490
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 6180
.05 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta



Appendix C - Hydraulic Analysis


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 5379
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.03
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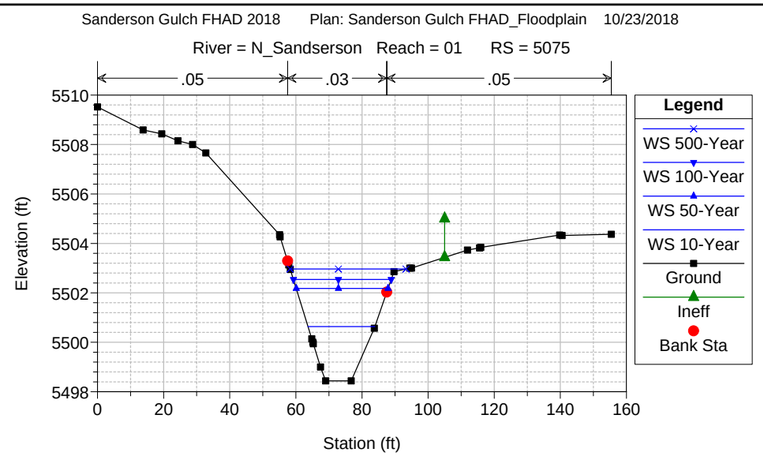
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 5075
.05
.03
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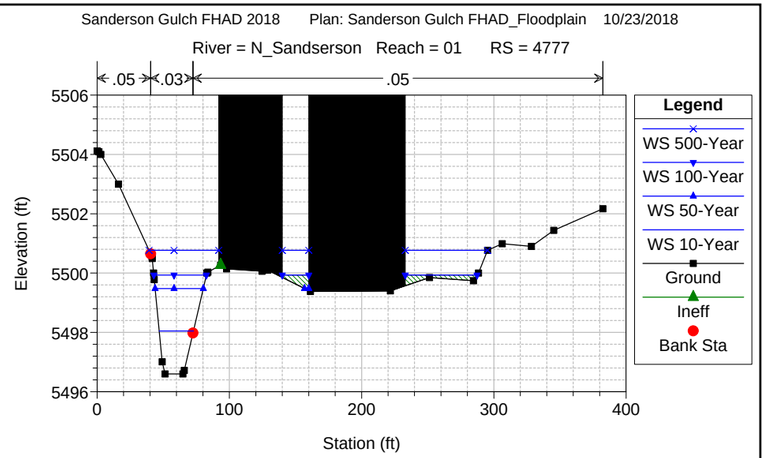
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4777
.05
.03
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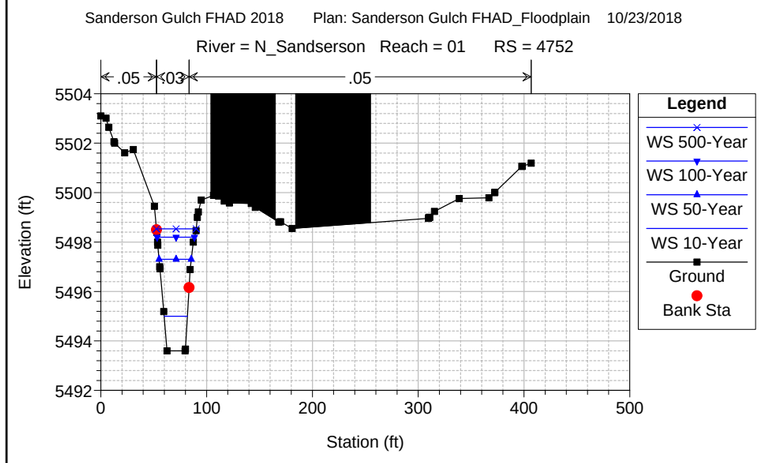
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = N_Sandserson Reach = 01 RS = 4752
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.03
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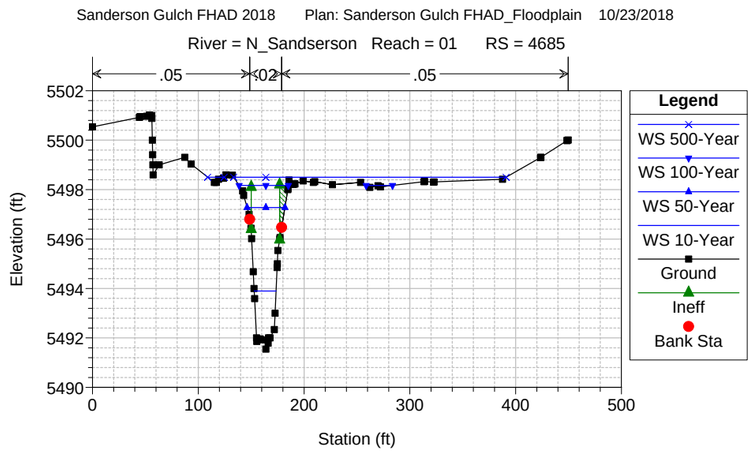
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = N_Sandserson Reach = 01 RS = 4685
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.02
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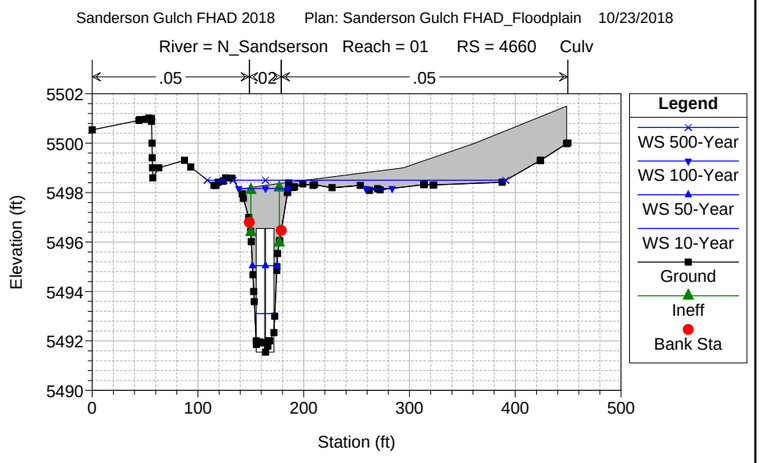
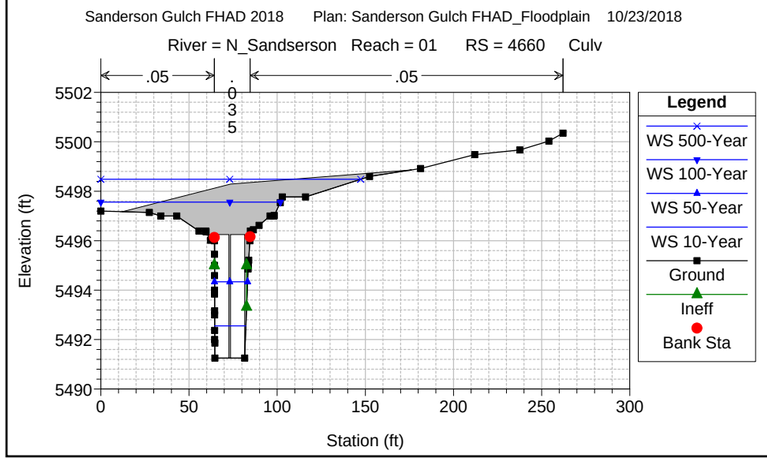
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4660 Culv
.05
.02
.05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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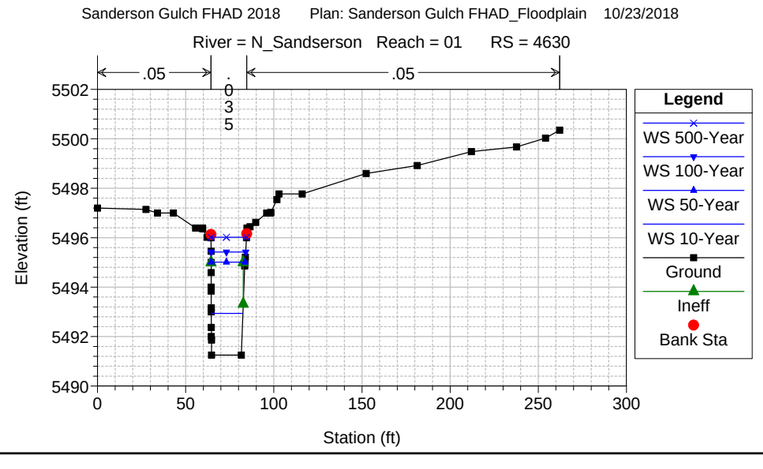
River = N_Sandserson Reach = 01 RS = 4660 Culv
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = N_Sandserson Reach = 01 RS = 4630
.05
.035
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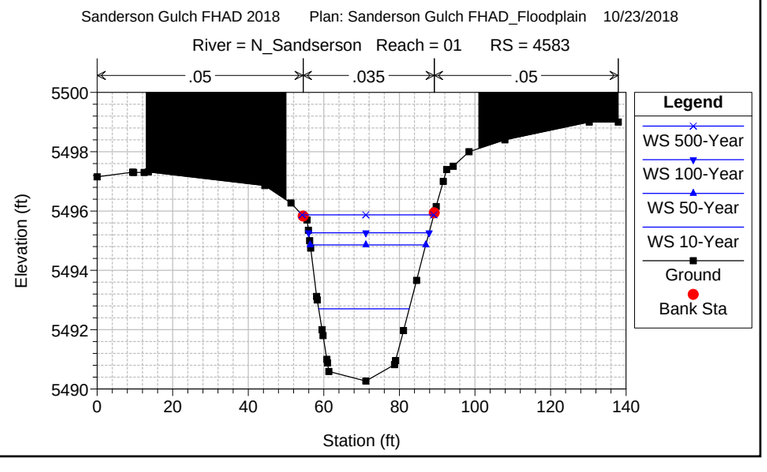
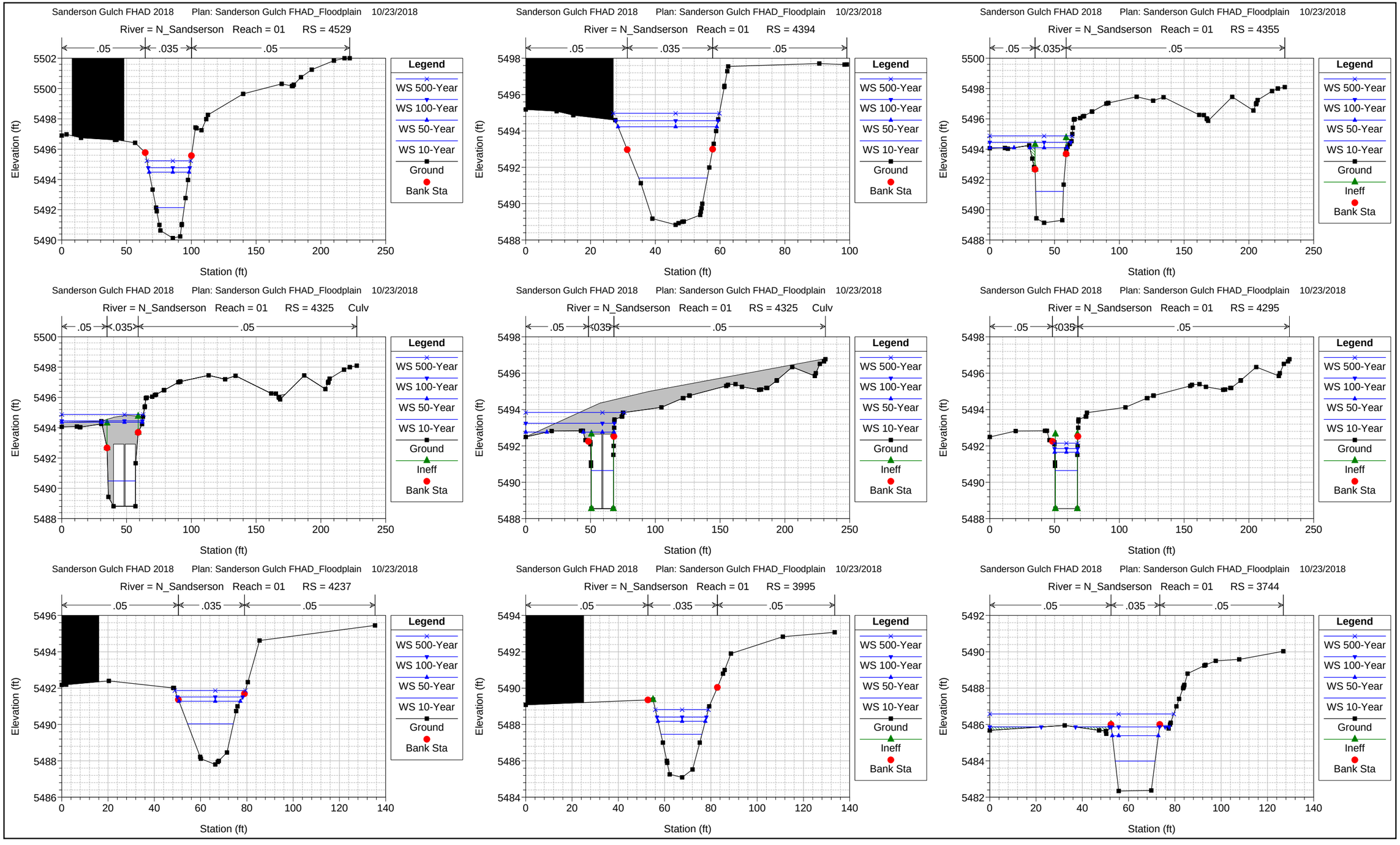
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4583
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta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River = N_Sandserson Reach = 01 RS = 4529
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4394
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4355
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4325 Culv
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4325 Culv
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4295
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 4237
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 3995
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 3744
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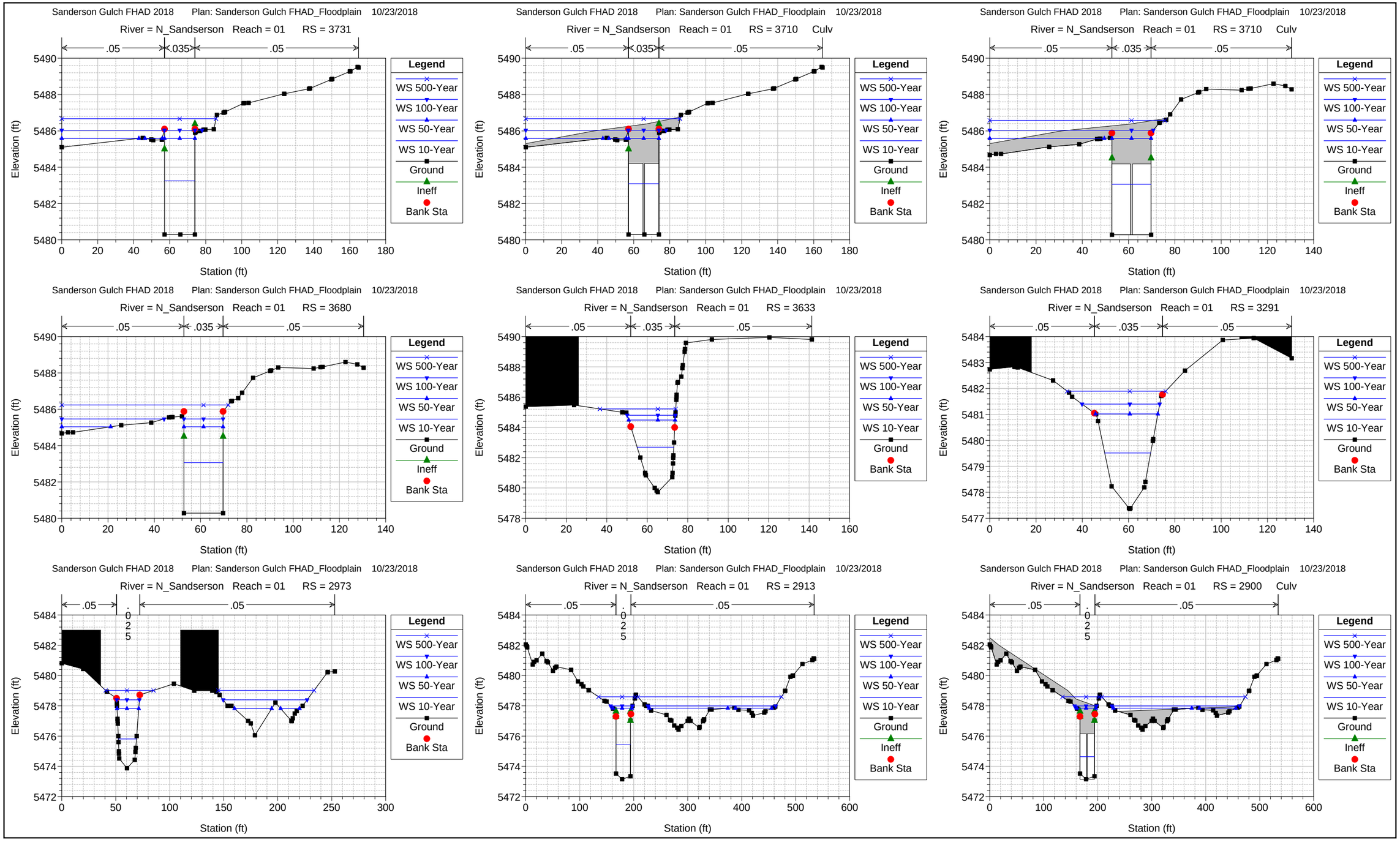
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 3731
River = N_Sandserson Reach = 01 RS = 3710 Culv
River = N_Sandserson Reach = 01 RS = 3680
River = N_Sandserson Reach = 01 RS = 3633
River = N_Sandserson Reach = 01 RS = 3291
River = N_Sandserson Reach = 01 RS = 2973
River = N_Sandserson Reach = 01 RS = 2913
River = N_Sandserson Reach = 01 RS = 2900 Culv
.05
.035
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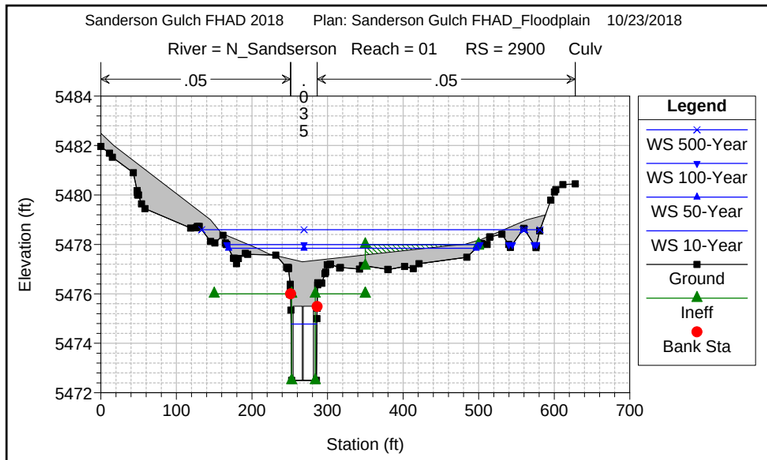
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2900 Culv
.05
.035
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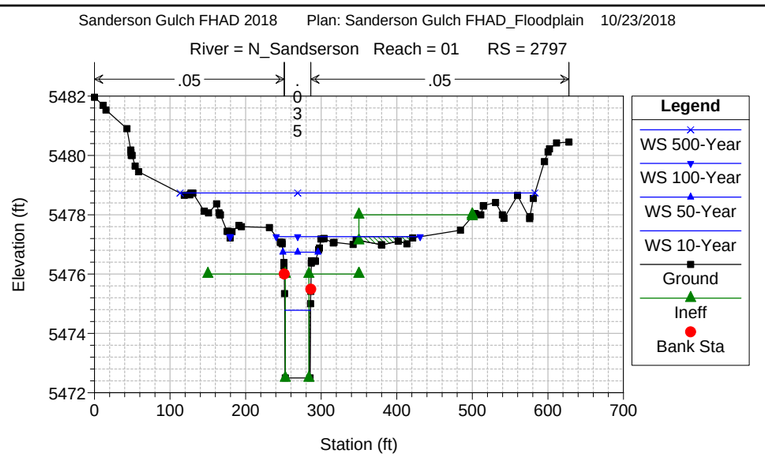
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2797
.05
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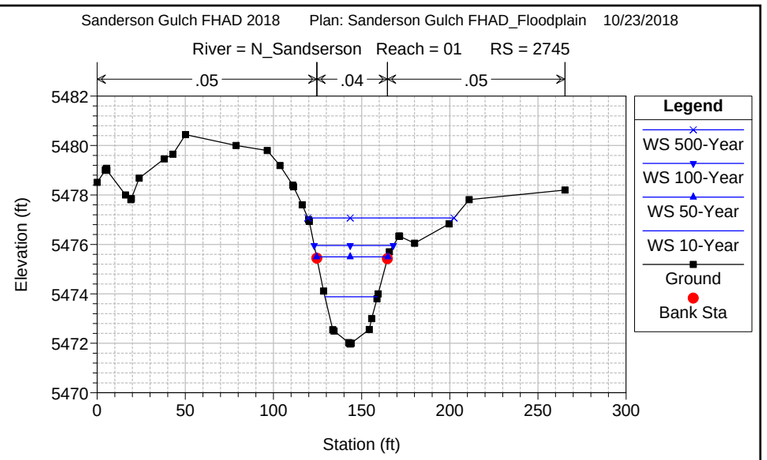
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2745
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.04
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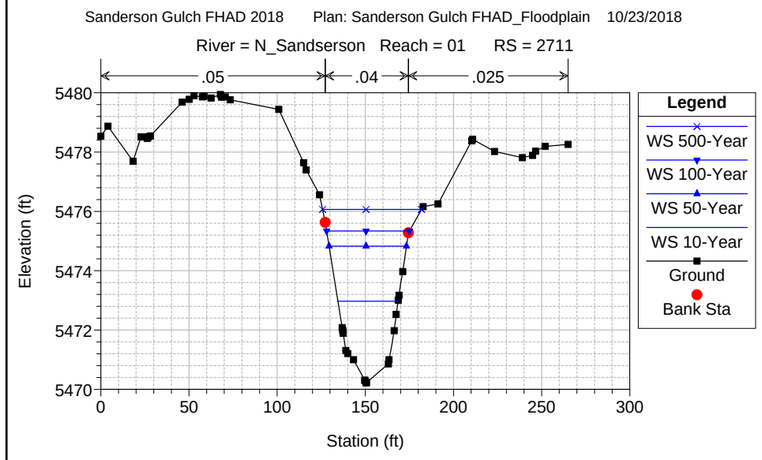
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2711
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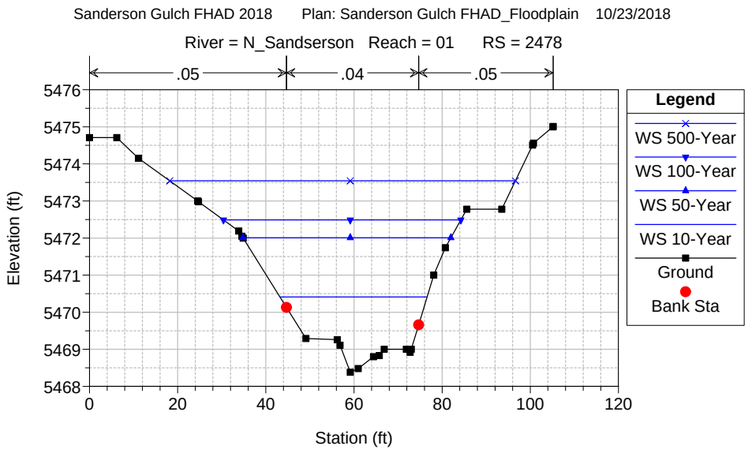
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2478
.05
.04
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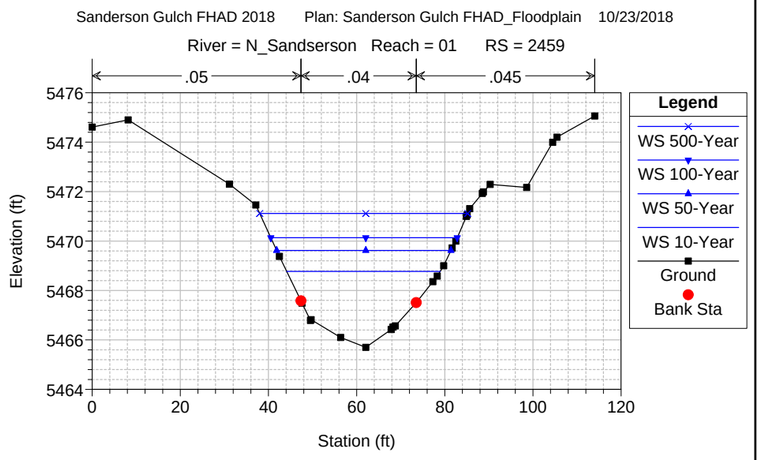
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2459
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.04
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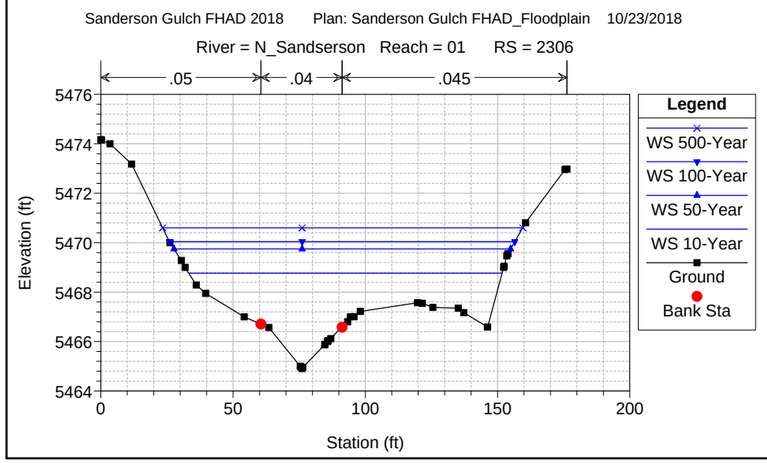
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2306
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.04
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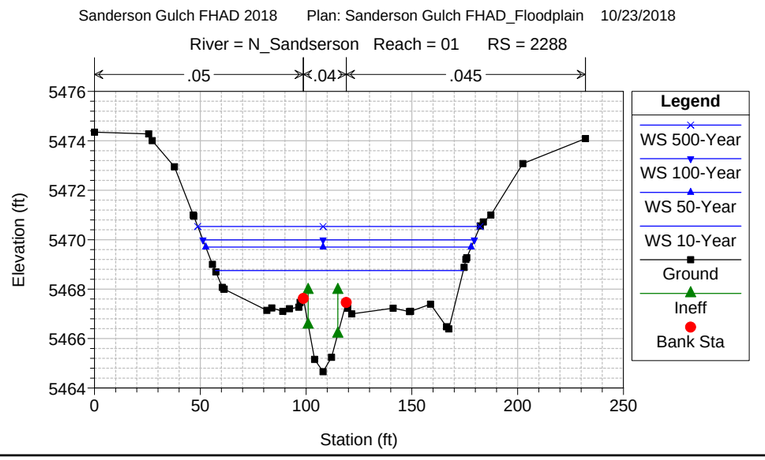
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2288
.05
.04
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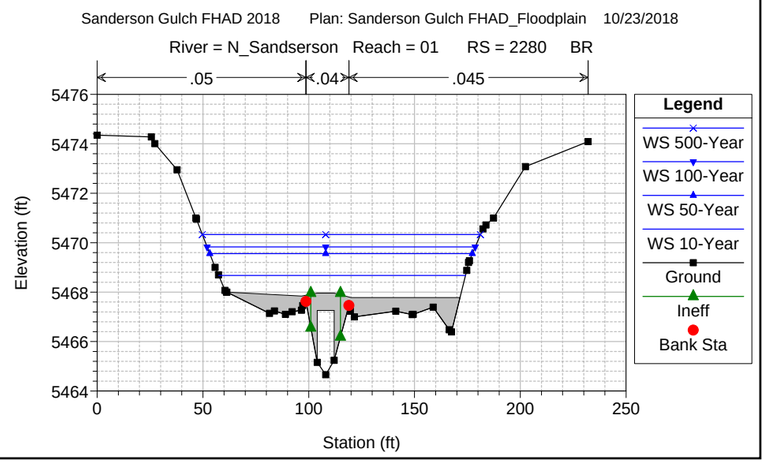
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2280 BR
.05
.04
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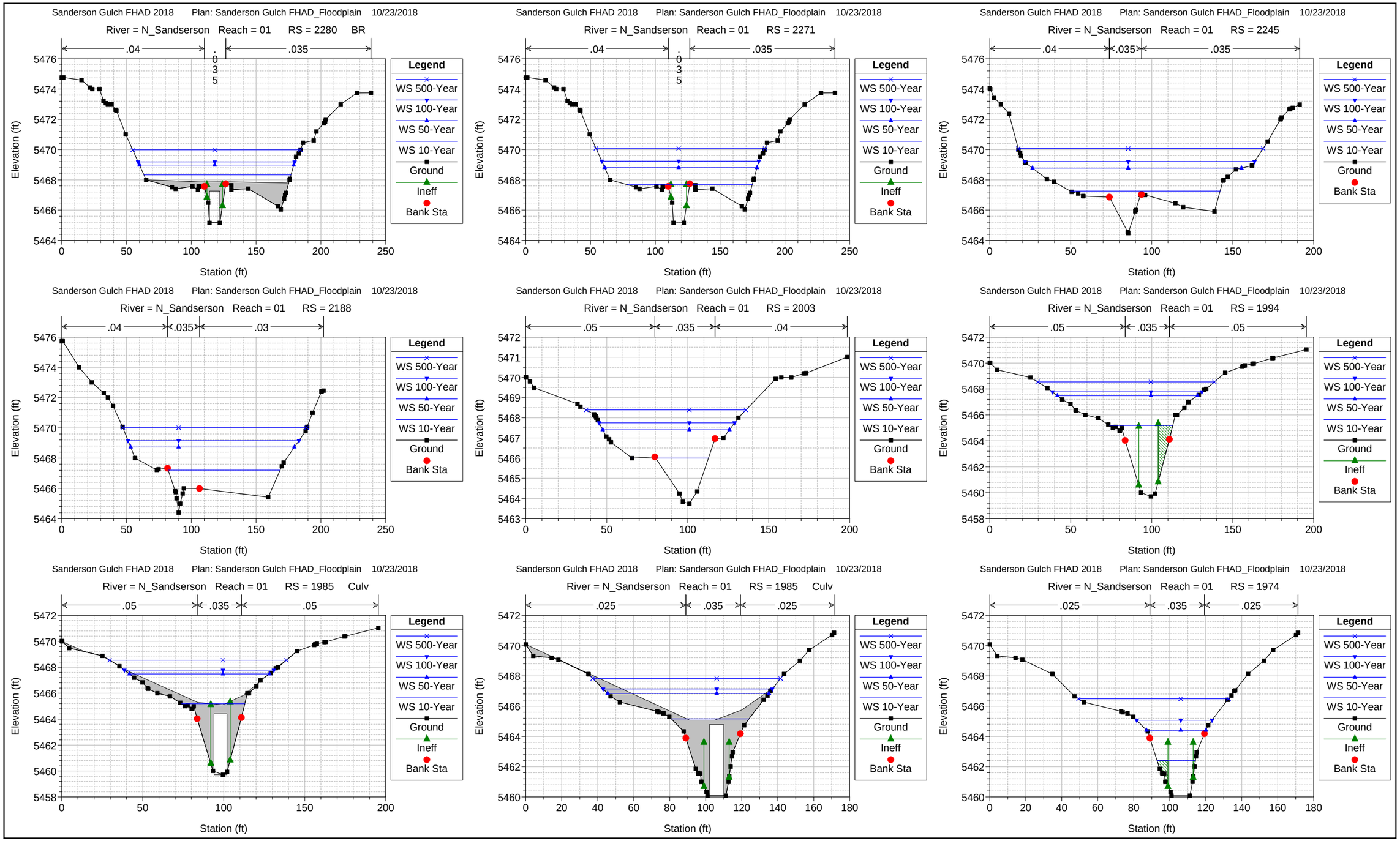
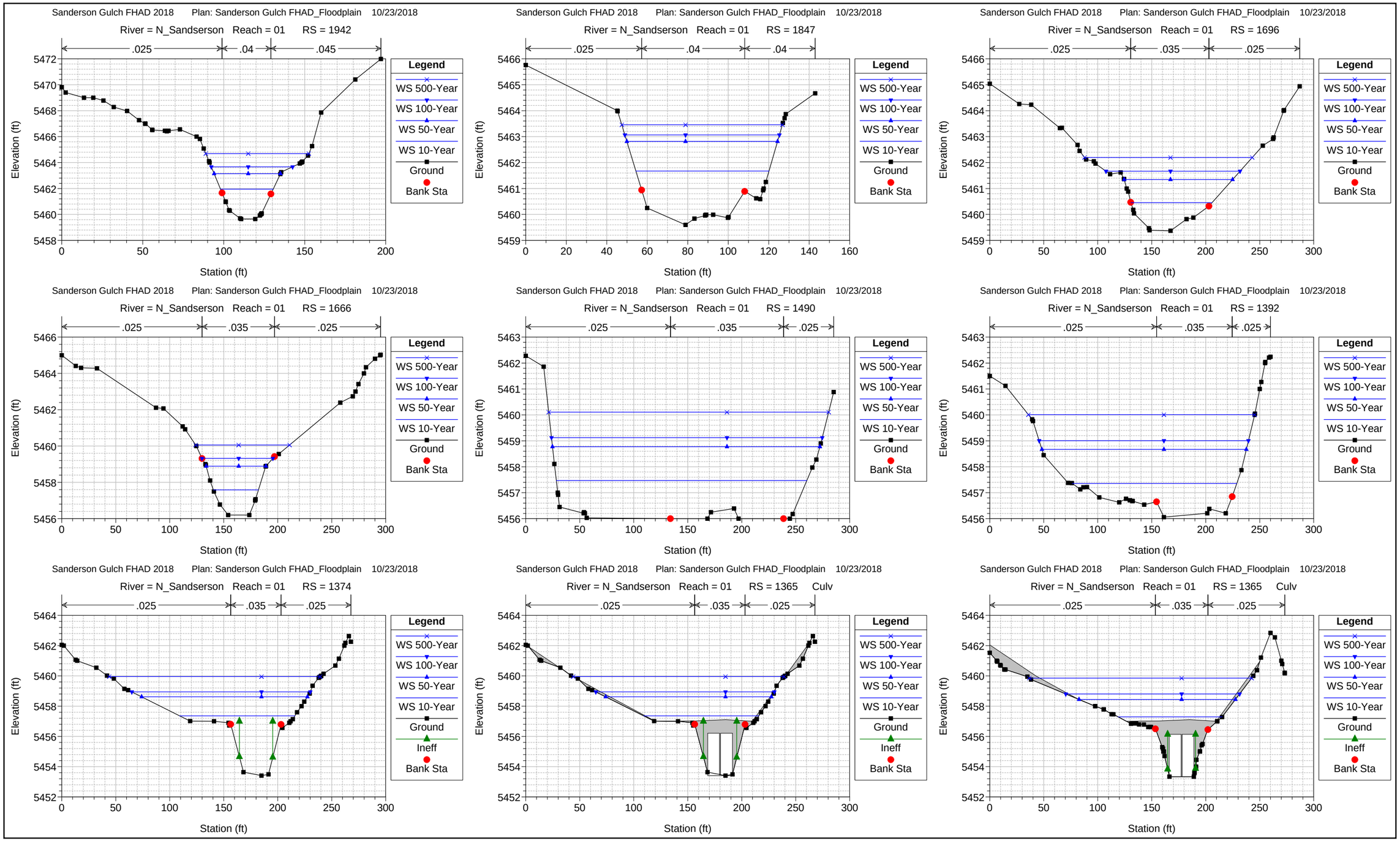
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2280 BR
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2271
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2245
.04 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2188
.04 .035 .03
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 2003
.05 .035 .04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1994
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1985 Culv
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1985 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1974
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = N_Sandserson Reach = 01 RS = 1942
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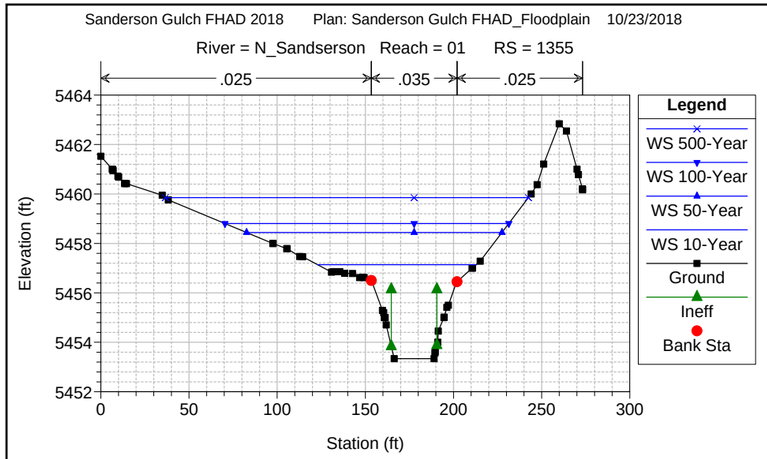
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1847
.025 .04 .04
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1696
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1666
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1490
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1392
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1374
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1365 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1365 Culv
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = N_Sandserson Reach = 01 RS = 1355
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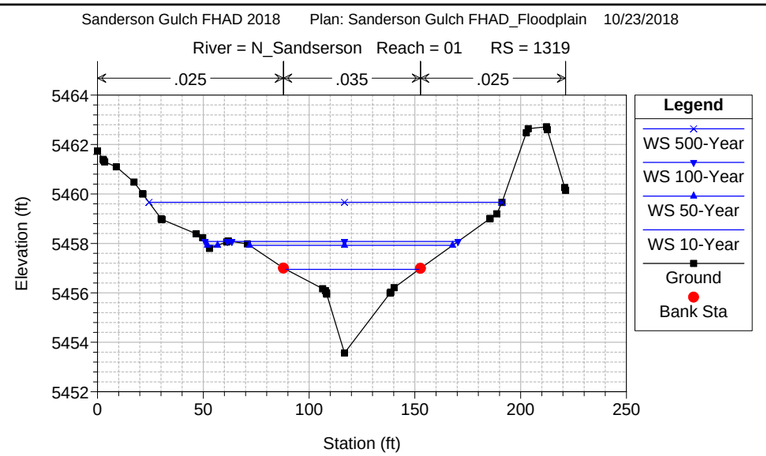
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta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River = N_Sandserson Reach = 01 RS = 1319
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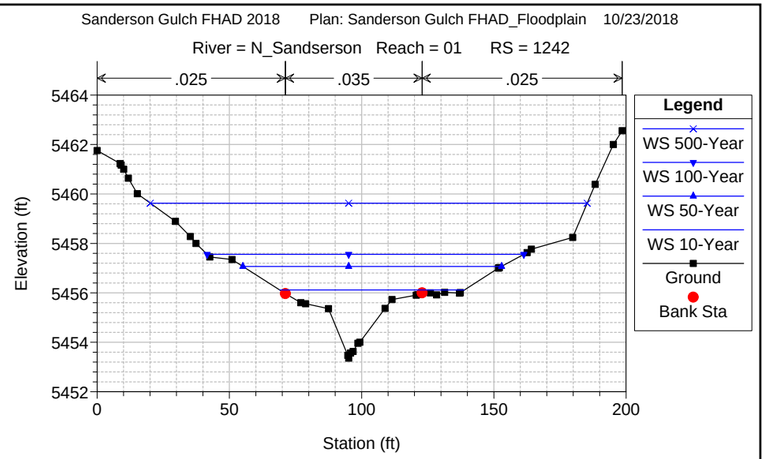
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1242
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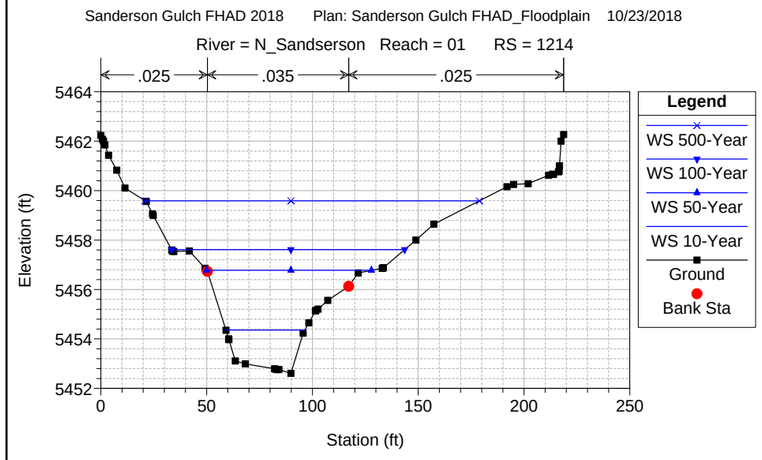
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 1214
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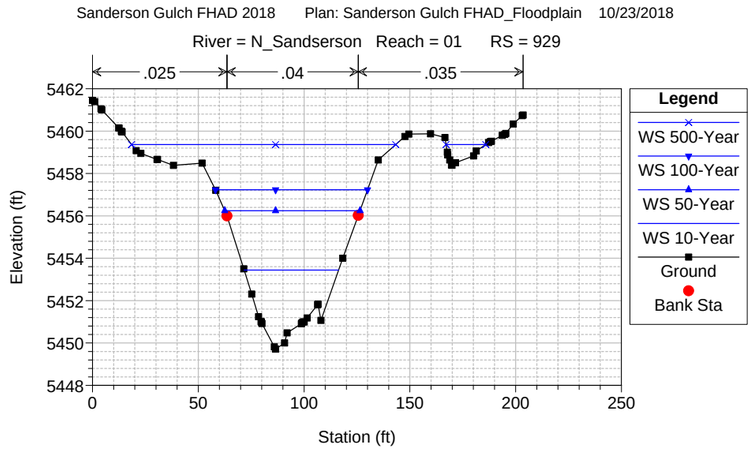
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 929
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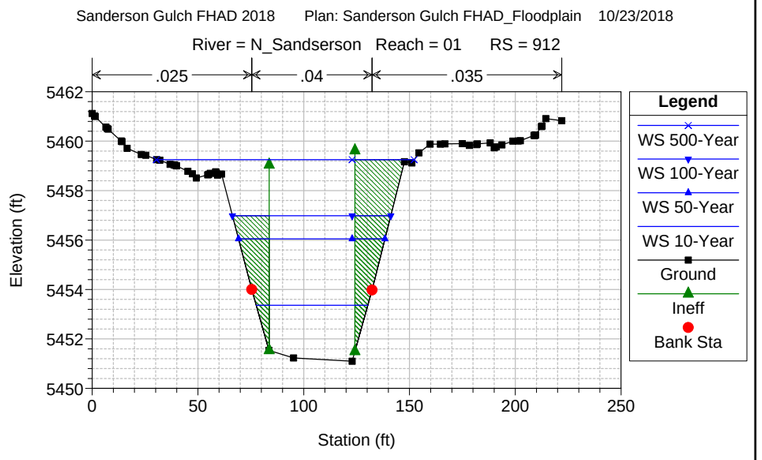
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 912
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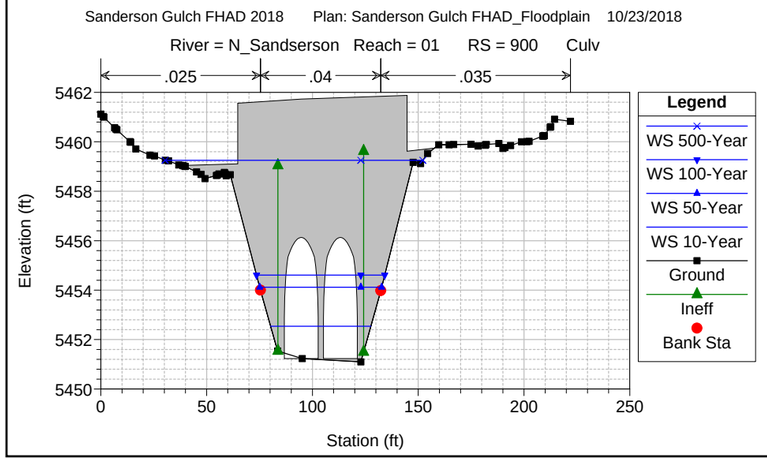
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 900 Culv
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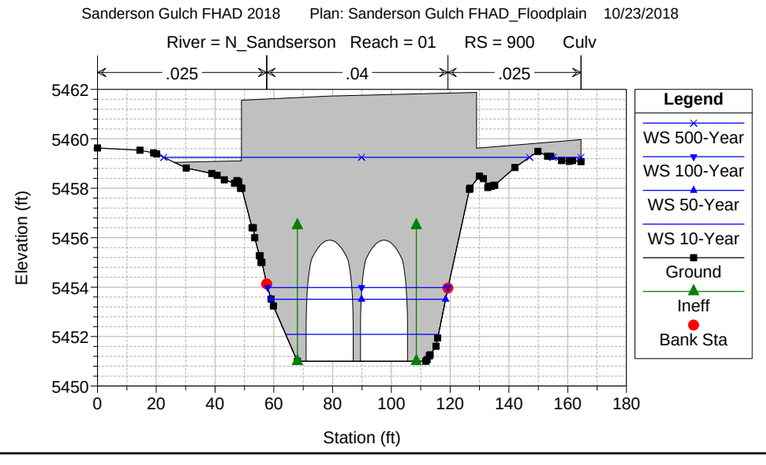
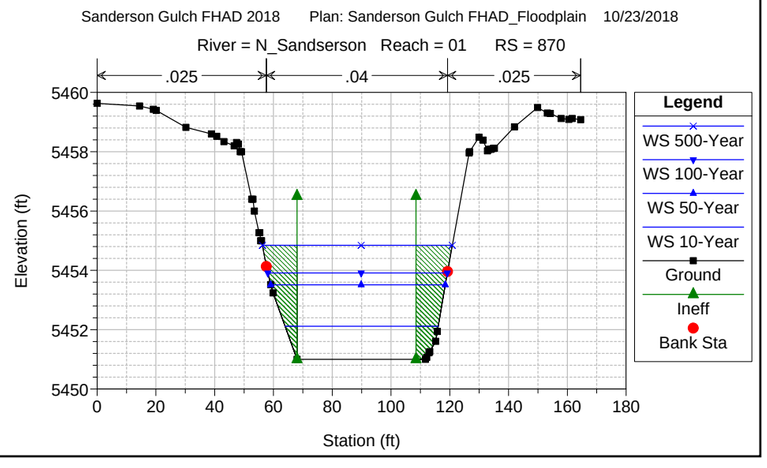
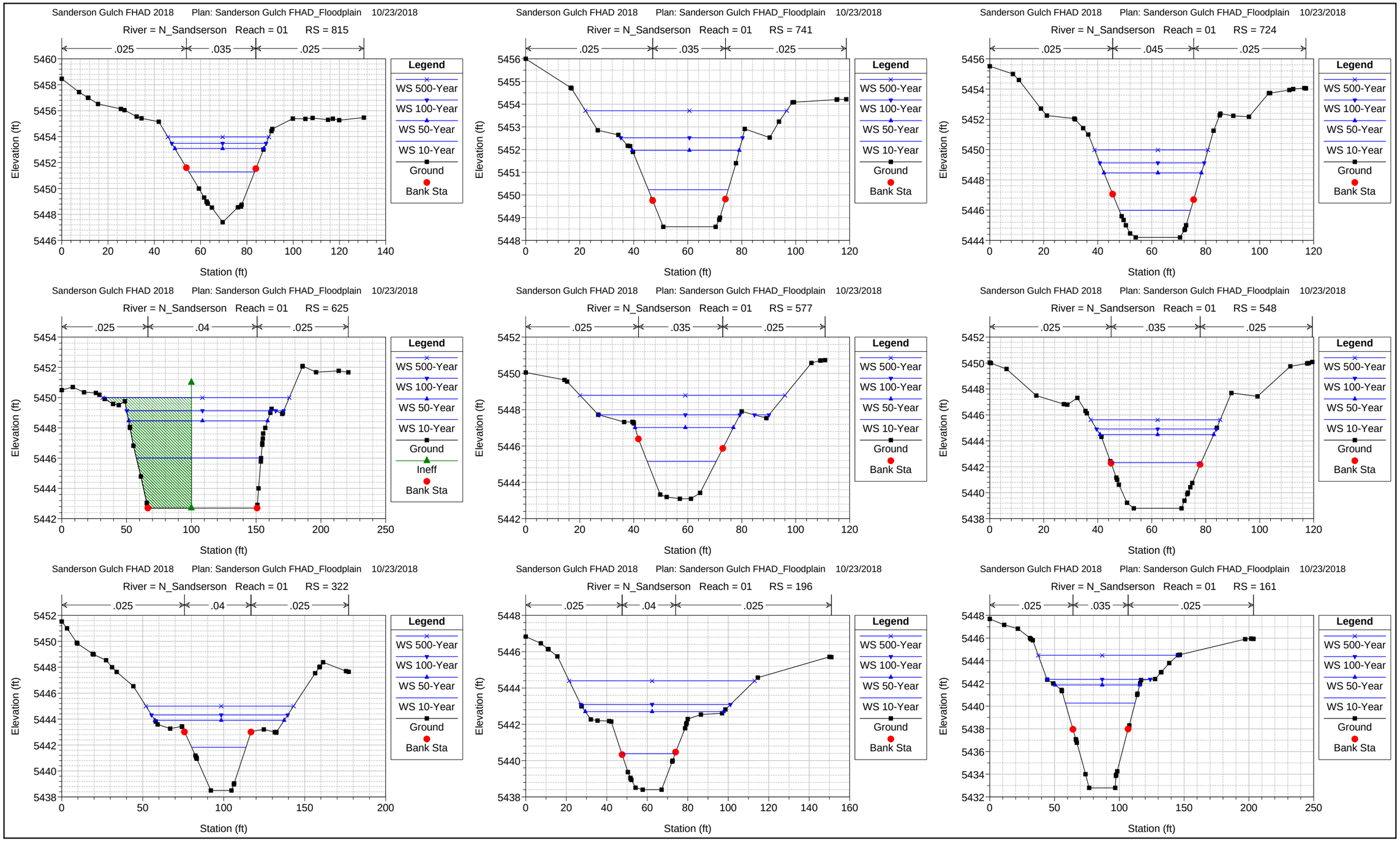
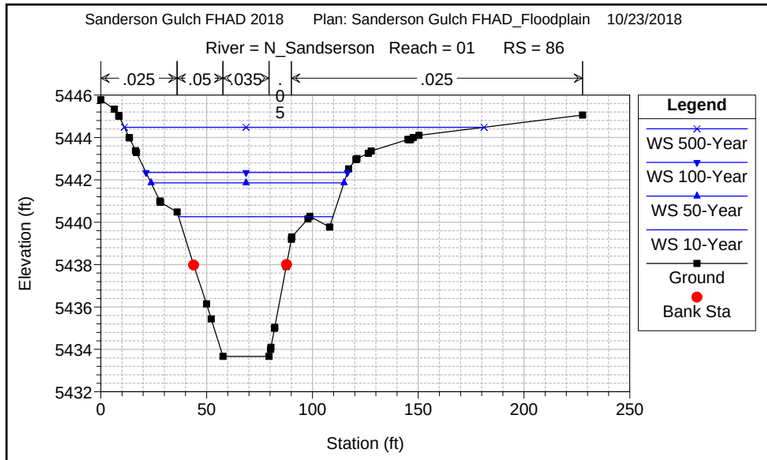
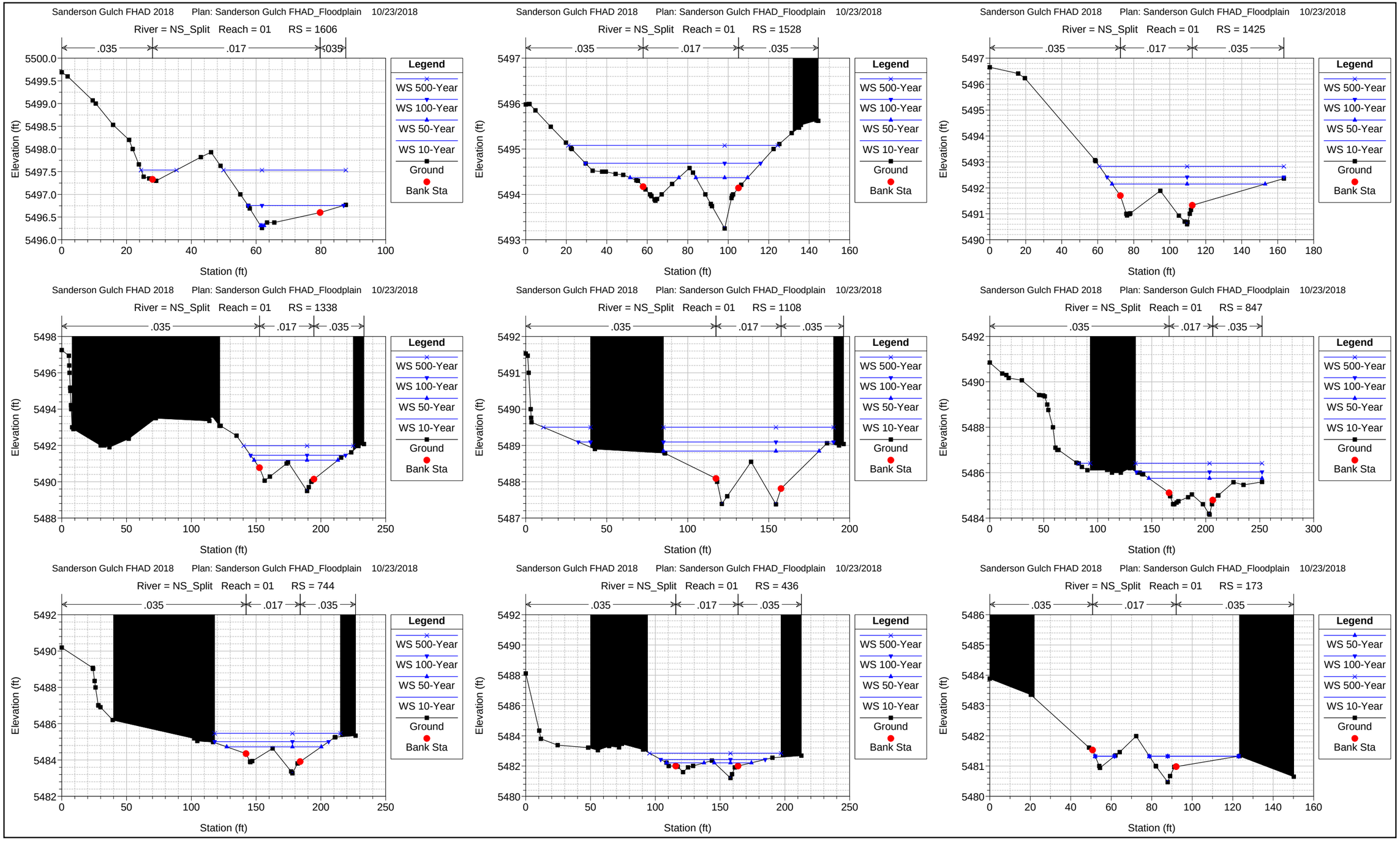
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta

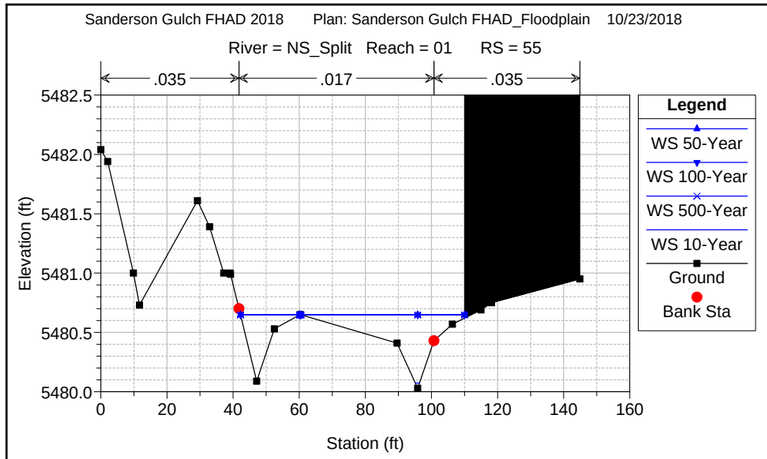

Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 900 Culv
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 870
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 815
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 741
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 724
.025 .045 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 625
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Ineff
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 577
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 548
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 322
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 196
.025 .04 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 161
.025 .035 .025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = N_Sandserson Reach = 01 RS = 86
.025
.05
.035
.025
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 1606
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 1528
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 1425
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 1338
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 1108
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 847
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 744
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 436
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 500-Year
WS 100-Year
WS 50-Year
WS 10-Year
Ground
Bank Sta
Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 173
.035 .017 .035
Elevation (ft)
Station (ft)
Legend
WS 50-Year
WS 100-Year
WS 500-Year
WS 10-Year
Ground
Bank Sta


Sanderson Gulch FHAD 2018 Plan: Sanderson Gulch FHAD_Floodplain 10/23/2018
River = NS_Split Reach = 01 RS = 55
.035
.017
.035
Elevation (ft)
5482.5
5482.0
5481.5
5481.0
5480.5
5480.0
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
WS 50-Year
WS 100-Year
WS 500-Year
WS 10-Year
Ground
Bank Sta

FIRM PANELS



PANEL 0203H

FIRM

FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 203 OF 300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CITY AND COUNTY OF DENVER	080046	0203	H

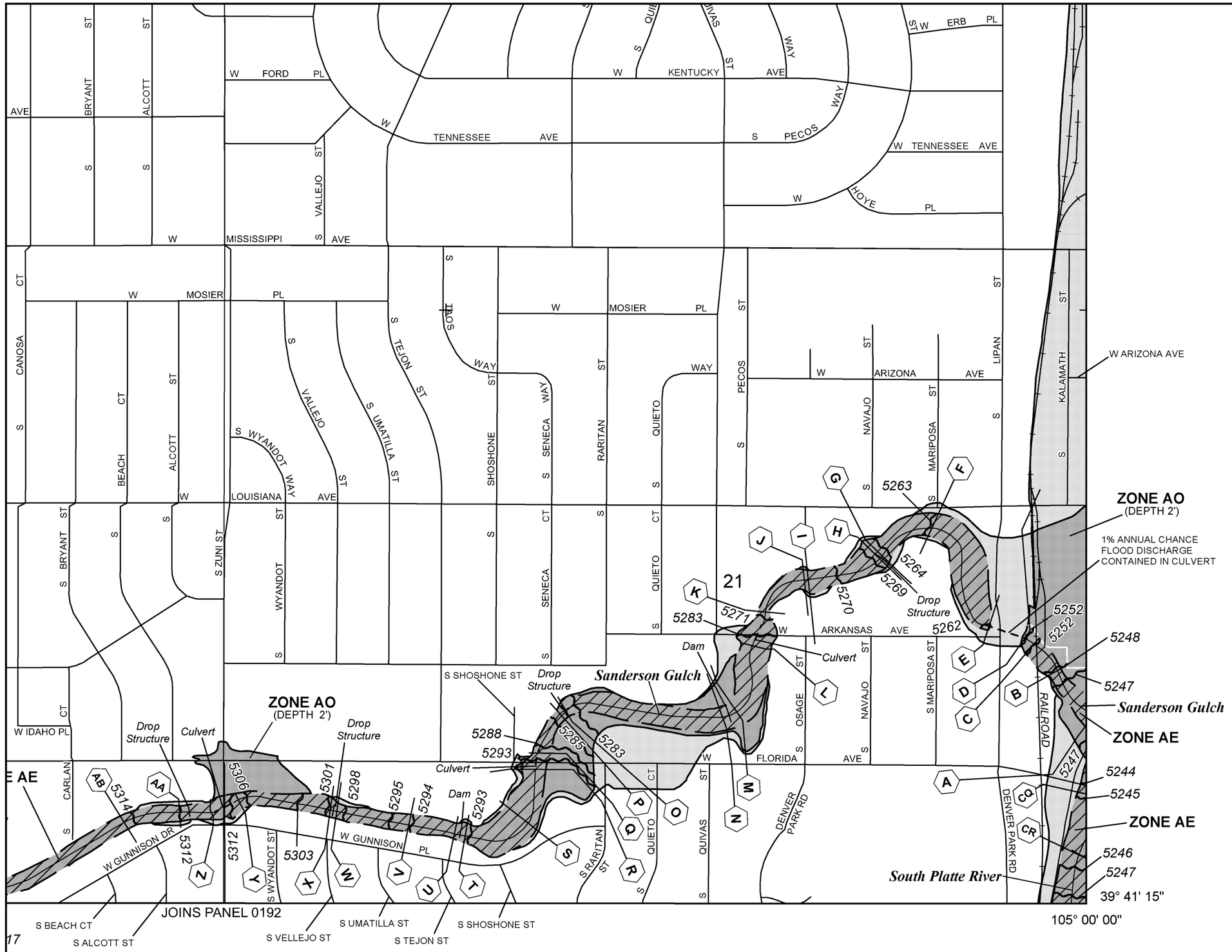
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
0800460203H
MAP REVISED
NOVEMBER 20, 2013

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



NFIP

PANEL 0184H

FIRM

FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 184 OF 300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CITY AND COUNTY OF DENVER	080046	0184	H

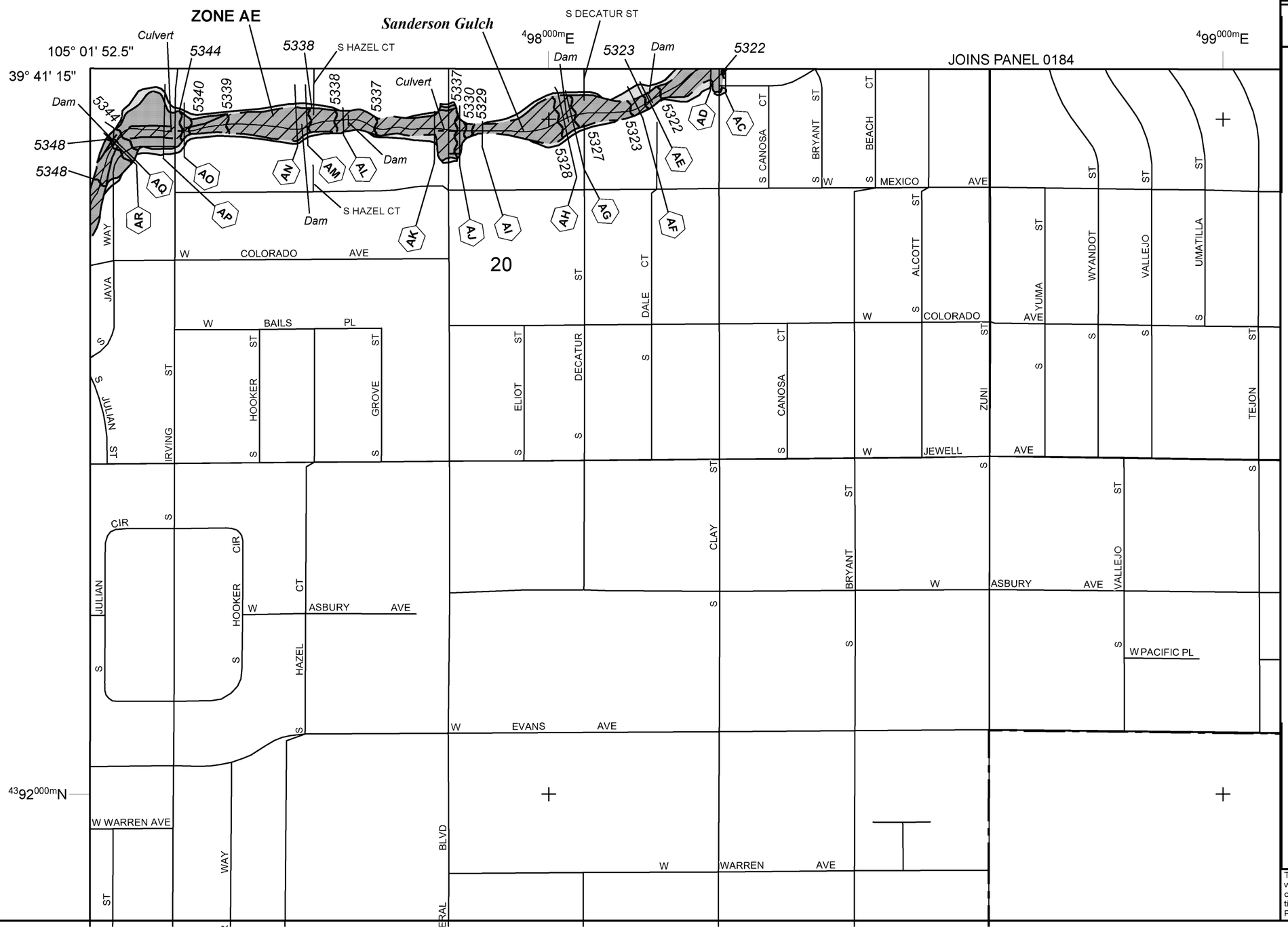
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
0800460184H
MAP REVISED
NOVEMBER 20, 2013

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000

FEET

METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0192H

FIRM

FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 192 OF 300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

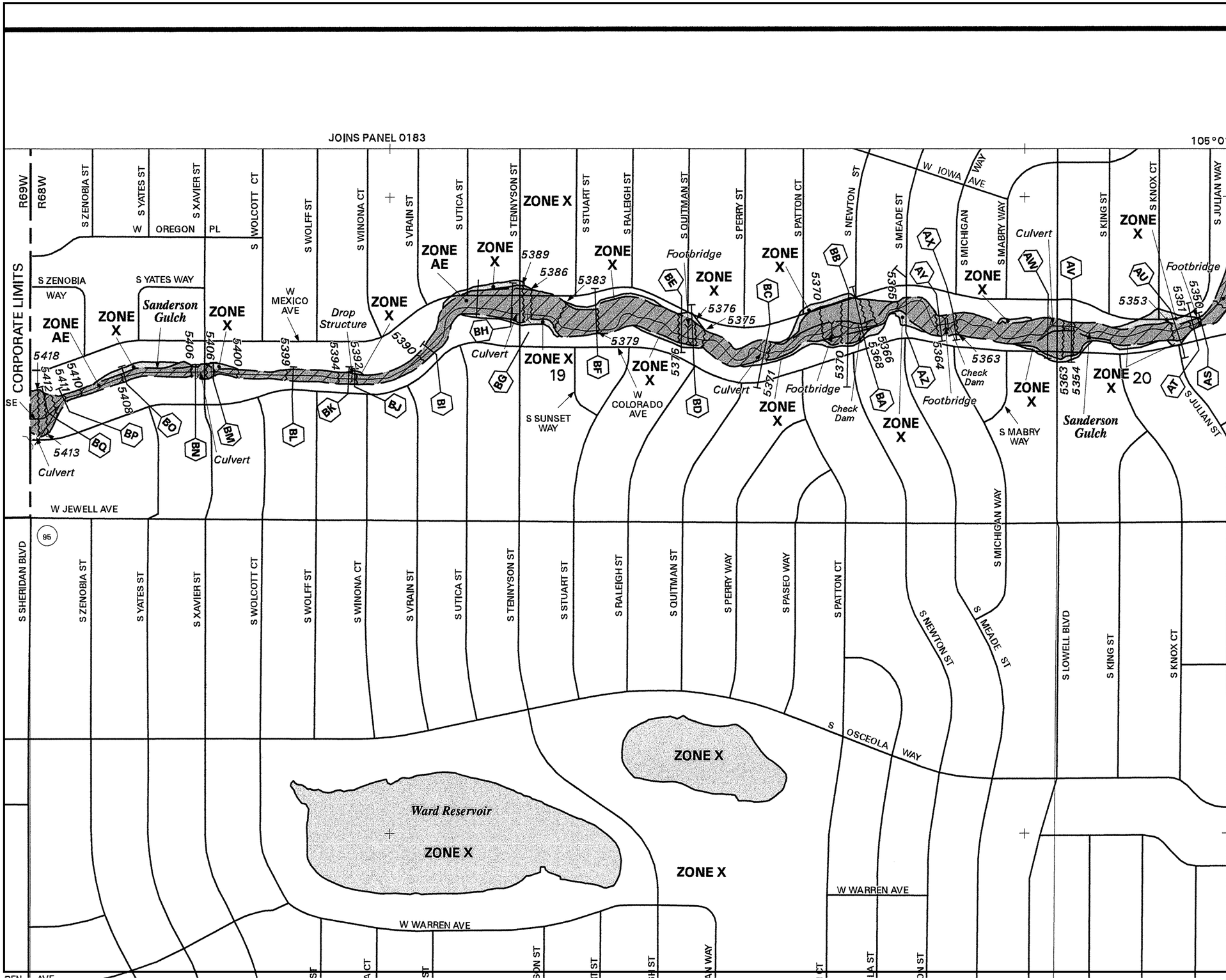
COMMUNITY	NUMBER	PANEL	SUFFIX
CITY AND COUNTY OF DENVER	080046	0192	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
0800460192H
MAP REVISED
NOVEMBER 20, 2013

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



National Flood Insurance Program at (800) 358-9620

MAP SCALE 1" = 500'

250 0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0191G

FIRM
FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 191 OF 300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DENVER, CITY AND COUNTY OF	080046	0191	G

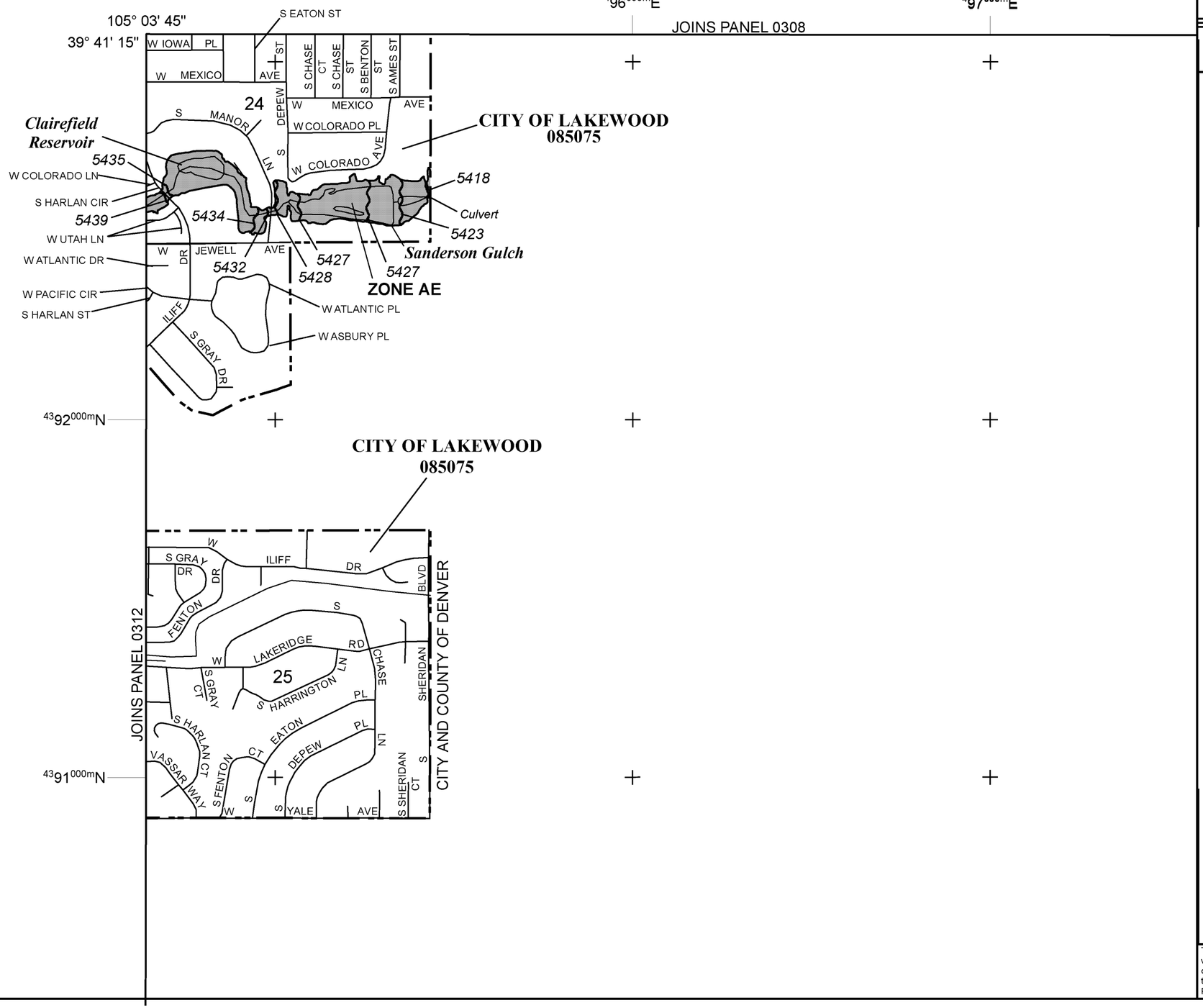
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 0800460191G

MAP REVISED: NOVEMBER 17, 2005

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 1000'

500 0 1000 2000

FEET

METERS

NFIP

PANEL 0320F

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 320 OF 675
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOW MAR, TOWN OF	080232	0320	F
JEFFERSON COUNTY	080087	0320	F
LAKEWOOD, CITY OF	085075	0320	F

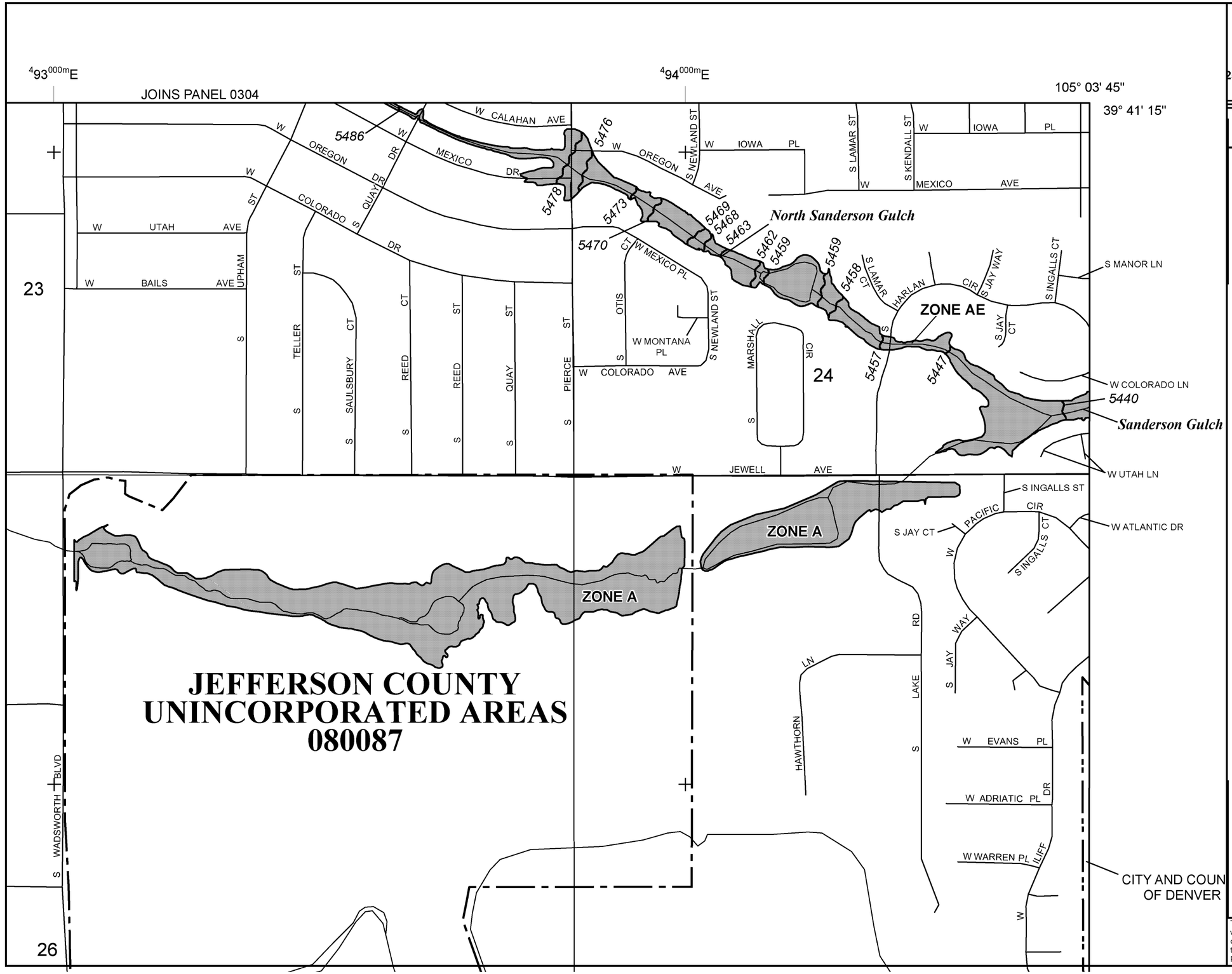
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08059C0320F
MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0312F

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 312 OF 675

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY	080087	0312	F
LAKEWOOD, CITY OF	085075	0312	F

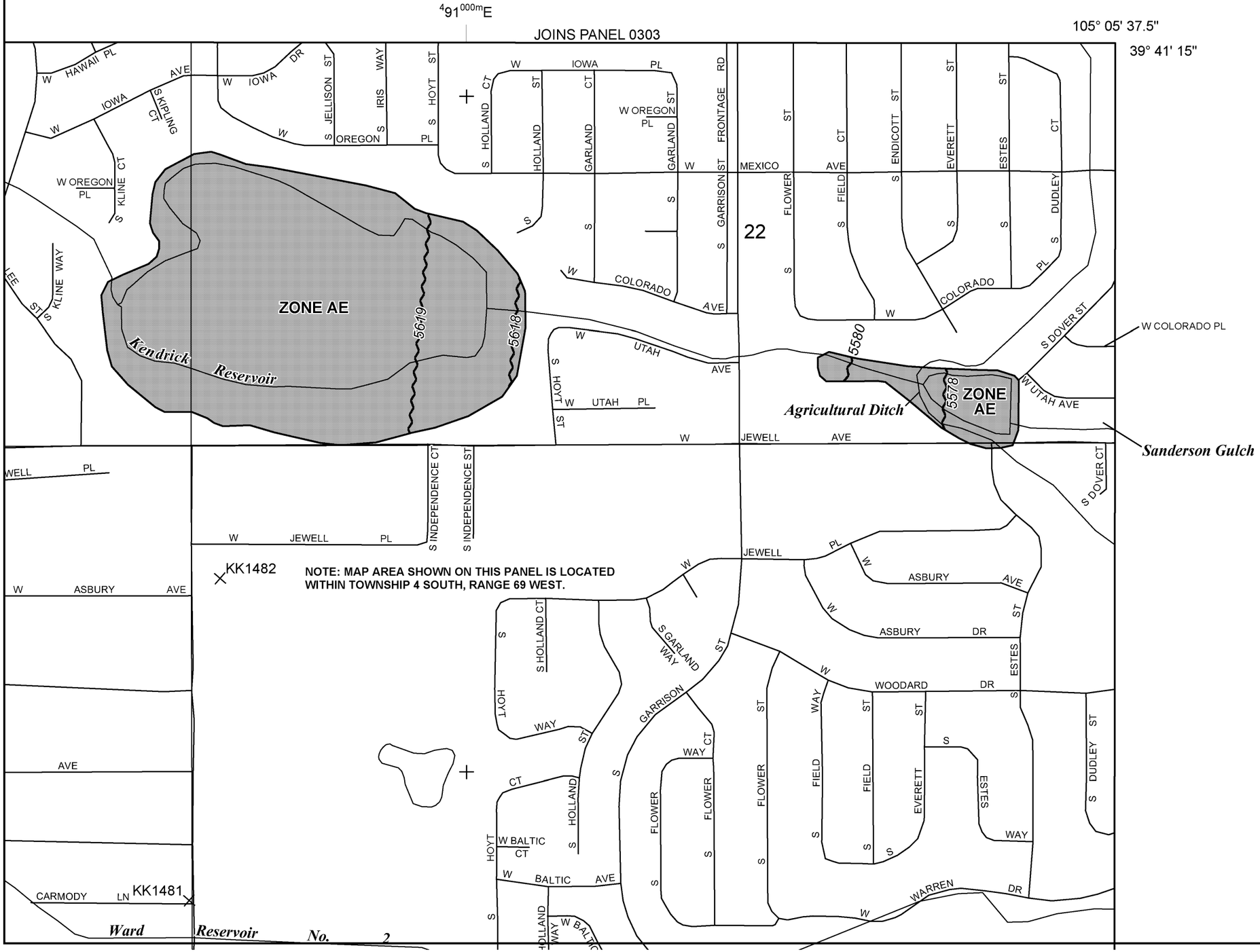
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08059C0312F

MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0311F

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 311 OF 675

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

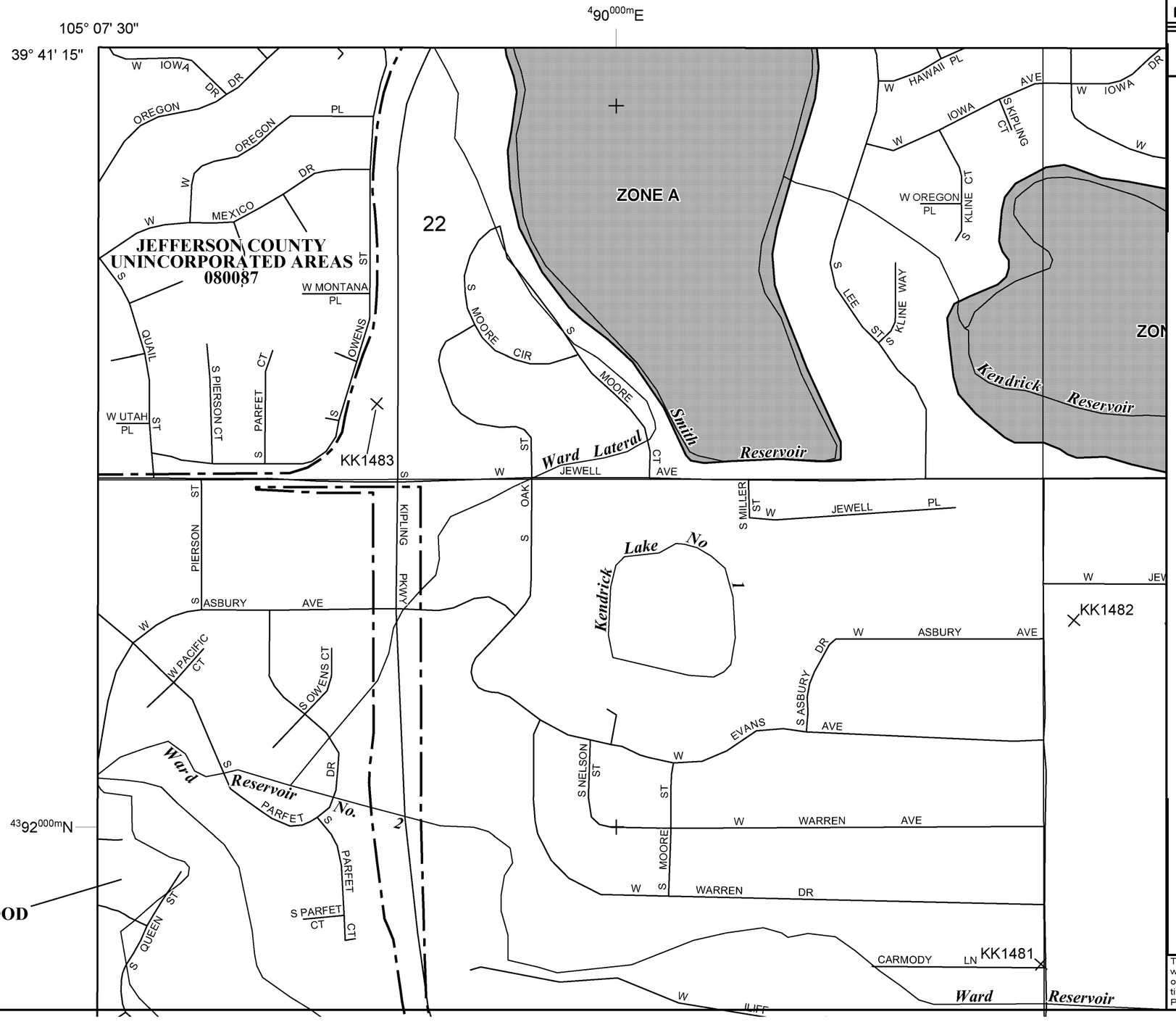
COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY	080087	0311	F
LAKEWOOD, CITY OF	085075	0311	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08059C0311F
MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0311F

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 311 OF 675

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

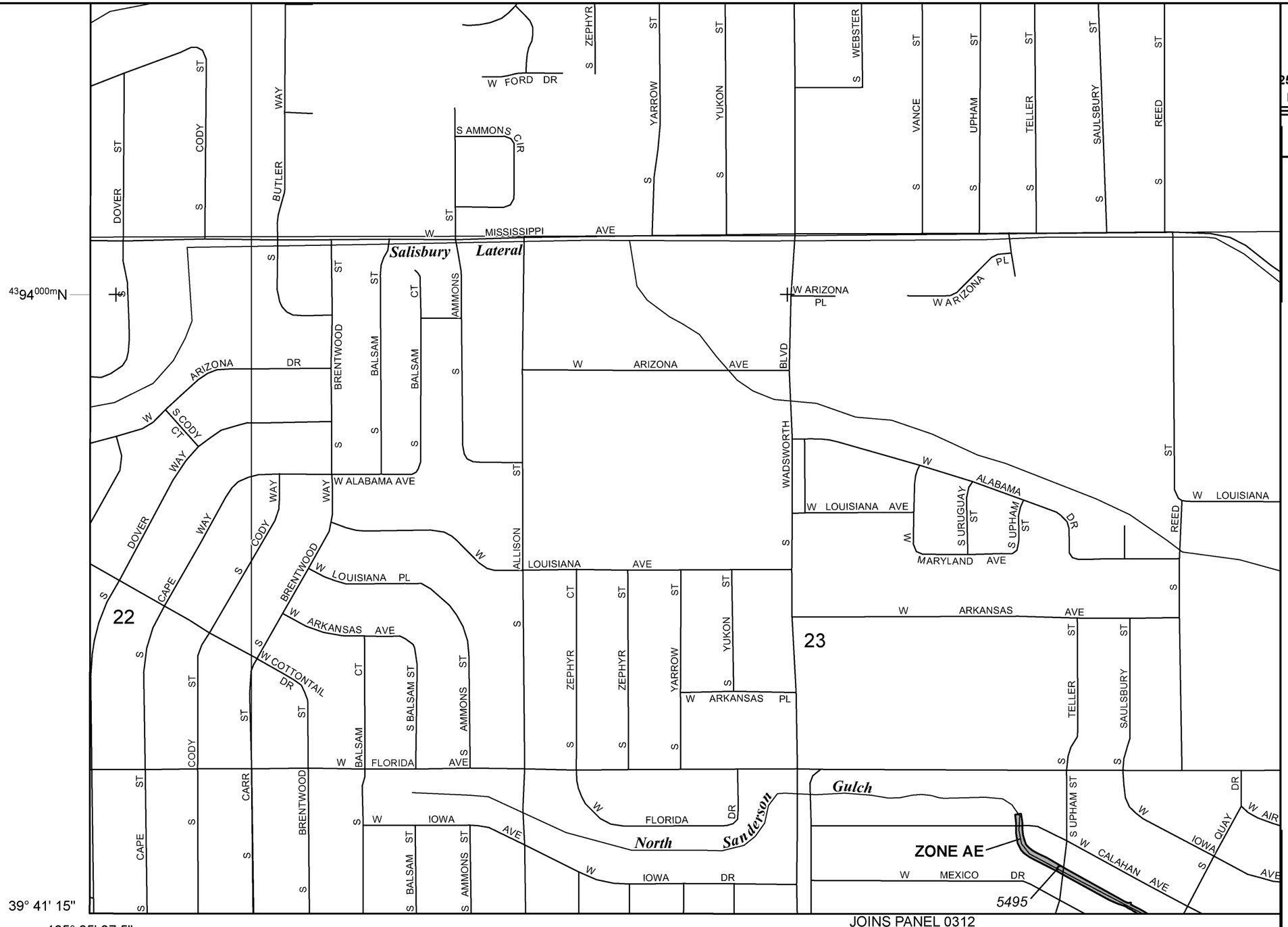
COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY	080087	0311	F
LAKEWOOD, CITY OF	085075	0311	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08059C0311F
MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0304F

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 304 OF 675
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LAKEWOOD, CITY OF	085075	0304	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08059C0304F
MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City and County of Denver Colorado	NO PROJECT	UPDATE
	COMMUNITY NO.: 080046		
IDENTIFIER	NTU_Denver_3	APPROXIMATE LATITUDE & LONGITUDE: 39.690, -105.007 SOURCE: Other DATUM: NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08004601841 DATE: November 20, 2013	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Sanderson Gulch - from approximately 450 feet downstream of South Lipan Street to approximately 100 feet downstream and from just downstream of South Zuni Street to approximately 170 feet upstream

SUMMARY OF REVISIONS

This Letter of Map Revision (LOMR) updates Zone AO depth labels that were inadvertently mislabeled on the FIRM. This LOMR does not revise the base floodplain along Sanderson Gulch as presented on the November 20, 2013 FIRM; however, the Zone AO depths were relabeled on the FIRM to match the effective source data.

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below and through FEMA's Flood Hazard Mapping website at https://www.floodmaps.fema.gov/fhm/Scripts/bfe_main.asp.

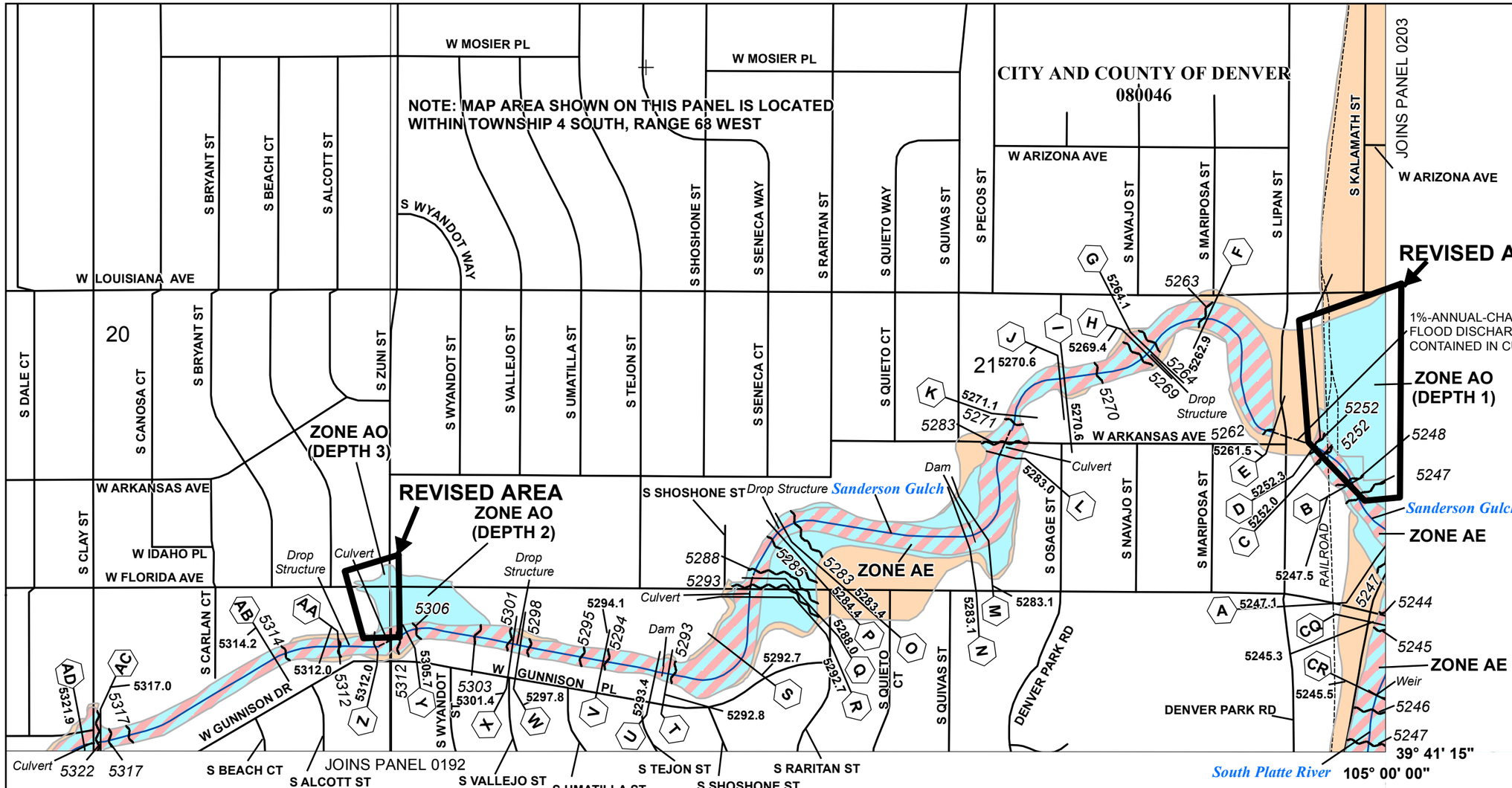
LOCAL NEWSPAPER Name: *The Denver Post*
Dates: February 12, 2015 and February 19, 2015

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination information presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

142877.PT202.BKR.15080320P.BG 102-I-C



SPECIAL FLOOD HAZARD AREAS	
	Without Base Flood Elevation (BFE) *Zone A,V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes *Zone X*

SCALE

Map Projection:
NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 184 OF 300

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
CITY AND COUNTY OF DENVER	080046	0184	H

REVISED TO REFLECT LOMR EFFECTIVE: June 19, 2015

VERSION NUMBER
1.1.1.0
MAP NUMBER
0800460184H
MAP REVISED
NOVEMBER 20, 2013

Follows Conditional Case No.: 12-08-0812R

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	Jefferson County Colorado (Unincorporated Areas)	CHANNEL RELOCATION CULVERT DETENTION BASIN	HYDRAULIC ANALYSIS HYDROLOGIC ANALYSIS UPDATED TOPOGRAPHIC DATA
	COMMUNITY NO.: 080087		
IDENTIFIER	Green Gables Redevelopment	APPROXIMATE LATITUDE & LONGITUDE: 39.681, -105.070 SOURCE: USGS QUADRANGLE DATUM: NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08059C0312F DATE: February 5, 2014	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map

FLOODING SOURCE & REVISED REACH

Sanderson Gulch - from approximately 830 feet upstream of South Lake Road to the downstream side of South Wadsworth Boulevard

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Sanderson Gulch	Zone A	Zone A	YES	YES

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearing House, 3601 Eisenhower Avenue Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

OTHER COMMUNITIES AFFECTED BY THIS REVISION

CID Number: 085075 **Name:** City of Lakewood, Colorado

AFFECTED MAP PANELS	AFFECTED PORTIONS OF THE FLOOD INSURANCE STUDY REPORT
TYPE: FIRM* NO.: 08059C0312F DATE: February 5, 2014	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearing House, 3601 Eisenhower Avenue Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

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Federal Emergency Management Agency
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LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearing House, 3601 Eisenhower Avenue Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

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Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearing House, 3601 Eisenhower Avenue Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

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Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below, and through FEMA's Flood Hazard Mapping website at
https://www.floodmaps.fema.gov/fhm/bfe_status/bfe_main.asp

LOCAL NEWSPAPER

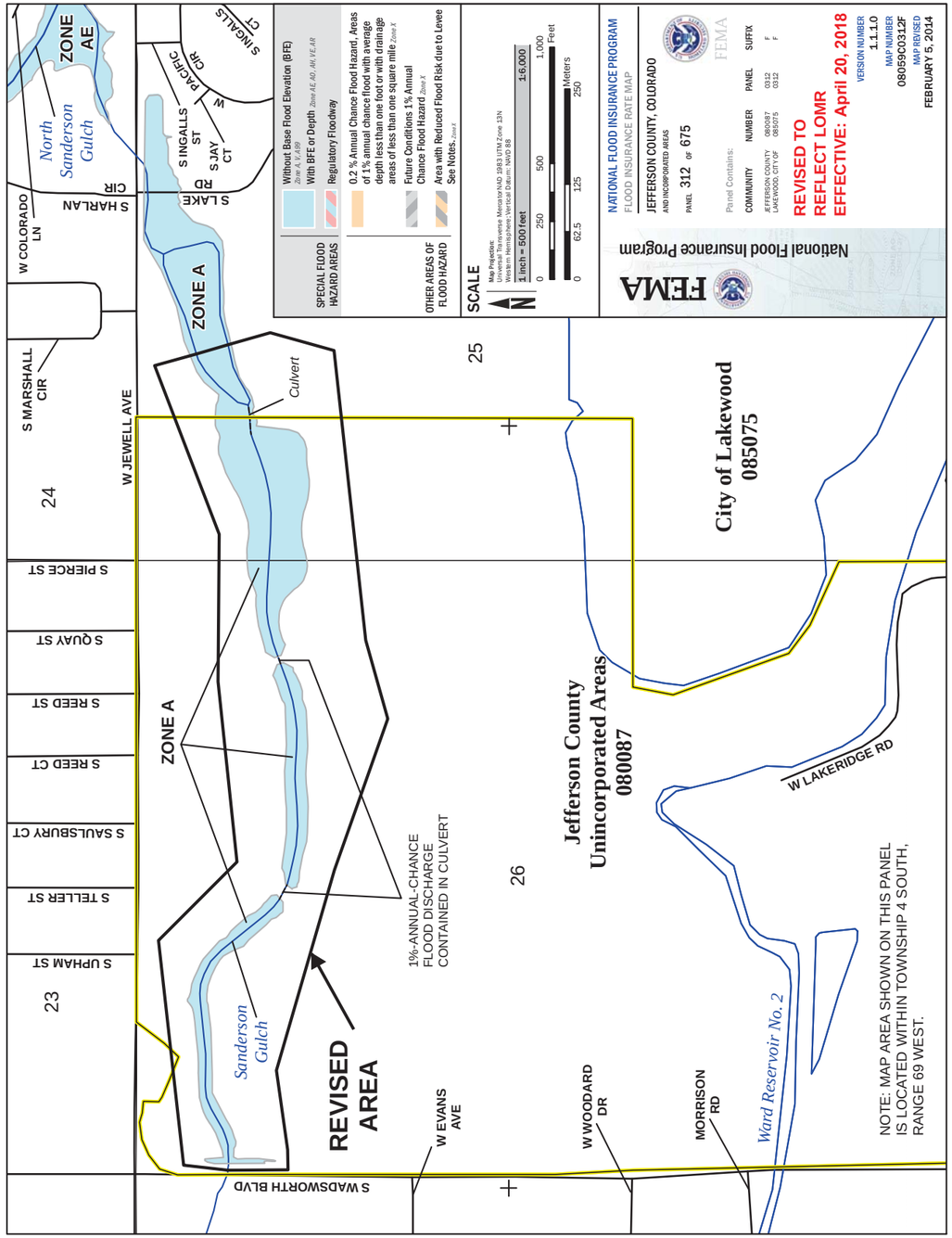
Name: *The Golden Transcript*
Dates: December 14, 2017 and December 21, 2017

Within 90 days of the second publication in the local newspaper, any interested party may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearing House, 3601 Eisenhower Avenue Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

17-08-0933P 102-I-A-C



APPENDIX D

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLES
TABLE D-2 AGREEMENT TABLES

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
Sanderson Gulch / REACH 1: South Platte River to Lipan Culvert Entrance (Denver)																					
	0+52	52	5229.7	1,256	3,248	4,112	6,330	5,238	5,238	5,238	5,244	423	5238.2	5237.8	-	964	4.3	0.0	0.0	2A	Confluence with S Platte River, floodway not defined. Manually adjusted to provide a more reasonable transition of the floodplain.
South Platte River Drive	1+00	100	Culvert																		
	1+46	146	5236.0	1,256	3,248	4,112	6,330	5246.6	5247.7	5248.0	5248.6	1214	5248.3	5248.0	-	1113	3.7	0.0	0.0	3A, 5	
	2+11	211	5236.8	1,256	3,248	4,112	6,330	5246.6	5247.7	5247.9	5248.5	942	5248.6	5247.9	-	674	6.1	0.0	0.0	1A, 5	
	5+25	525	5240.0	1,256	3,248	4,112	6,330	5246.7	5248.0	5248.6	5249.7	746	5249.6	5248.6	-	587	7.0	0.0	0.0	1A, 5	
	6+08	608	5242.3	1,256	3,248	4,112	6,330	5246.8	5249.7	5249.9	5250.3	1052	5250.5	5249.9	-	657	6.3	0.0	0.0	3A, 5	
Railroad Bridge	6+40	640	Bridge																		
	6+66	666	5242.4	1,252	3,240	4,102	6,319	5248.4	5251.7	5252.2	5253.1	519	5252.5	5252.2	-	1008	4.1	0.0	0.0	3A, 5	
	6+92	692	5242.0	1,252	3,240	4,102	6,319	5248.4	5251.5	5252.1	5253.0	463	5252.8	5252.1	-	697	5.9	0.0	0.0	3A, 5	
Lipan Street	8+10	810	Culvert																		
Sanderson Gulch / REACH 2: S. Lipan Street to Zuni Street (Denver)																					
	9+48	948	5252.9	1,252	3,240	4,102	6,319	5256.5	5259.3	5261.5	5263.4	444	5263.5	5261.5	127	500	10.4	0.0	0.0	2A	
	11+16	1116	5253.5	1,252	3,240	4,102	6,319	5258.5	5262.8	5263.8	5264.1	447	5264.2	5263.8	402	1365	3.0	0.0	0.0	4	
	14+35	1435	5254.2	1,252	3,240	4,102	6,319	5260.5	5263	5263.9	5264.1	154	5264.6	5263.9	153	668	6.1	0.0	0.0		
	18+64	1864	5255.4	1,131	2,907	3,764	5,972	5261.8	5263.9	5264.5	5266.0	99	5266.8	5264.5	98	320	11.7	0.0	0.0		
Drop 1	18+76	1876	5260.4	1,131	2,907	3,764	5,972	5264.9	5266.9	5267.7	5269.2	125	5269.4	5267.7	124	377	10.0	0.0	0.0		
	21+92	2192	5261.8	1,131	2,907	3,764	5,972	5268.0	5269.9	5270.4	5271.4	104	5271.6	5270.4	104	443	8.5	0.0	0.0		
	22+44	2244	5261.9	1,131	2,907	3,764	5,972	5268.3	5270.4	5271.1	5272.8	112	5271.9	5271.1	112	573	6.6	0.0	0.0	2A	
Pedestrian Bridge	22+52	2252	Culvert																		
	22+62	2262	5262.0	1,131	2,907	3,764	5,972	5268.4	5270.6	5271.3	5273.1	116	5272.1	5271.3	115	586	6.4	0.0	0.0	2A	
	22+88	2288	5262.1	1,131	2,907	3,764	5,972	5268.4	5270.5	5271.3	5273.0	113	5272.3	5271.3	113	503	7.5	0.0	0.0		
	25+78	2578	5263.2	1,131	2,907	3,764	5,972	5269.0	5271.0	5271.7	5272.8	68	5273.5	5271.7	67	364	10.4	0.0	0.0		
	26+48	2648	5263.4	1,131	2,907	3,764	5,972	5269.2	5272.5	5273.1	5275.8	47	5276.4	5273.2	46	272	13.9	0.0	0.0	2A	
W. Arkansas Avenue	27+15	2715	Culvert																		
	27+83	2783	5264.1	1,131	2,907	3,764	5,972	5274.9	5282.9	5283.8	5285.5	159	5284.0	5284.3	95	1134	3.3	0.5	0.5	2A, 4, 5	
	28+25	2825	5266.0	1,131	2,907	3,764	5,972	5275.1	5282.9	5283.8	5285.5	175	5284.0	5284.3	105	1311	2.9	0.5	0.5	4, 5	
	31+20	3120	5267.3	1,131	2,907	3,764	5,972	5275.3	5283.0	5284.0	5285.8	341	5284.1	5284.5	165	1638	2.3	0.5	0.5	4	
	31+71	3171	5267.5	1,131	2,907	3,764	5,972	5275.4	5283.0	5284.0	5285.8	309	5284.1	5284.5	147	1592	2.4	0.5	0.5	1A, 4	
Drop 2	31+88	3188	5271.6	1,131	2,907	3,764	5,972	5275.2	5283.0	5283.9	5285.7	240	5284.1	5284.4	145	1231	3.1	0.5	0.5	4	
	32+22	3222	5271.7	1,120	2,864	3,705	5,905	5275.7	5283.0	5283.9	5285.7	214	5284.1	5284.4	135	1090	3.4	0.5	0.5	4, 5	
	34+11	3411	5272.3	1,120	2,864	3,705	5,905	5277.4	5282.9	5283.9	5285.7	312	5284.3	5284.4	116	854	4.3	0.5	0.5	4, 5	
	36+25	3625	5272.8	1,120	2,864	3,705	5,905	5278.2	5283.1	5284.1	5285.9	190	5284.5	5284.6	119	825	4.5	0.5	0.5	4, 5	
	39+26	3926	5273.8	1,120	2,864	3,705	5,905	5279.8	5283.4	5284.3	5286.0	101	5285.0	5284.8	100	605	6.1	0.5	0.4	4, 5	
	41+81	4181	5274.4	1,120	2,864	3,705	5,905	5280.9	5284.1	5285.0	5286.8	77	5285.9	5285.4	77	531	7.0	0.3	0.2	4	
Drop 5	42+69	4269	5278.2	1,120	2,864	3,705	5,905	5282.9	5286.3	5287.7	5291.2	231	5290.6	5287.8	75	291	12.7	0.1	0.0	2A, 4	
W. Florida Avenue	43+30	4330	Culvert																		
	43+87	4387	5278.6	1,107	2,819	3,637	5,829	5288.9	5291.9	5292.5	5293.6	320	5292.9	5293.0	180	850	4.3	0.5	0.4	2A, 4	
Drop 6	44+33	4433	5284.0	1,107	2,819	3,637	5,829	5288.9	5292.0	5292.5	5293.5	189	5293.1	5293.0	170	718	5.1	0.5	0.3	4	
	45+25	4525	5284.3	1,107	2,819	3,637	5,829	5289.2	5292.1	5292.7	5293.8	156	5293.5	5293.1	156	574	6.3	0.4	0.2	4	
	48+25	4825	5285.1	1,107	2,819	3,637	5,829	5291.9	5293.7	5294.3	5295.6	167	5294.9	5294.3	166	628	5.8	0.0	0.0		
	48+74	4874	5285.3	1,107	2,819	3,637	5,829	5292.2	5294.0	5294.6	5295.9	151	5295.0	5294.6	151	691	5.3	0.0	0.0	2A	
Park Pedestrian Bridge	48+85	4885	Bridge																		
	48+93	4893	5284.5	1,107	2,819	3,637	5,829	5292.2	5294.1	5294.7	5295.9	137	5295.2	5294.7	137	626	5.8	0.0	0.0	2A	
	49+43	4943	5285.0	1,107	2,819	3,637	5,829	5292.3	5294.1	5294.7	5296.0	117	5295.5	5294.7	117	521	7.0	0.0	0.0		
	50+50	5050	5287.1	1,107	2,819	3,637	5,829	5292.6	5294.6	5295.3	5296.8	122	5296.0	5295.3	121	545	6.7	0.0	0.0		
Drop 7	50+85	5085	5288.3	1,107	2,819	3,637	5,829	5292.7	5294.7	5295.4	5296.9	114	5296.3	5295.4	112	477	7.6	0.0	0.0		
	53+83	5383	5289.1	1,107	2,819	3,637	5,829	5294.9	5297.0	5297.7	5299.2	110	5298.5	5297.7	110	501	7.3	0.0	0.0		
Drop 8	54+17	5417	5290.5	1,107	2,819	3,637	5,829	5295.1	5297.1	5297.8	5299.3	104	5298.9	5297.8	104	442	8.2	0.0	0.0		
	54+86	5486	5291.6	1,107	2,819	3,637	5,829	5296.1	5297.9	5298.5	5299.9	114	5299.6	5298.5	114	439	8.3	0.0	0.0		
Drop 9	55+20	5520	5293.4	1,107	2,819	3,637	5,829	5296.7	5298.4	5298.9	5300.2	111	5300.6	5298.9	110	356	10.2	0.0	0.0		
	60+22	6022	5296.0	1,107	2,819	3,637	5,829	5302.3	5304.1	5304.7	5306.6	71	5307.0	5304.7	71	312	11.6	0.0	0.0		
	61+28	6128	5296.4	1,107	2,819	3,637	5,829	5302.8	5304.8	5305.6	5307.4	151	5307.8	5305.6	69	330	11.0	0.0	0.0		
	61+72	6172	5296.5	1,107	2,819	3,637	5,829	5303.4	5306.7	5307.8	5310.6	203	5308.4	5307.8	87	593	6.1	0.0	0.0	2A	
S Zuni Street	62+40	6240	Culvert																		
Sanderson Gulch / REACH 3: S. Zuni Street to S. Hazel Court (Denver)																					
	63+03	6303	5297.9	1,107	2,819	3,637	5,829	5303.9	5310.5	5311.7	5313.5	332	5312.1	5312.1	290	820	5.0	0.4	0.5	2A, 4	
	63+37	6337	5298.1	1,107	2,819	3,637	5,829	5304.0	5310.4	5311.5	5313.3	331	5312.4	5311.9	281	552	6.6	0.4	0.5	1A, 4, 5	

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
	64+16	6416	5298.5	1,107	2,819	3,637	5,829	5304.4	5310.8	5311.8	5313.5	330	5312.6	5312.3	259	594	6.1	0.5	0.4	1A, 4, 5	
Drop 10	64+42	6442	5302.7	1,107	2,819	3,637	5,829	5306.5	5310.7	5311.7	5313.4	303	5312.8	5312.2	240	499	7.3	0.5	0.4	1A, 4, 5	
	65+17	6517	5303.1	1,065	2,696	3,481	5,638	5307.9	5310.9	5312.0	5313.7	213	5313.1	5312.5	94	476	7.3	0.5	0.3	4, 5	
	69+13	6913	5305.4	1,065	2,696	3,481	5,638	5311.8	5313.5	5314.5	5316.7	64	5317.0	5314.5	64	285	12.2	0.0	0.0		
	72+65	7265	5307.5	1,065	2,696	3,481	5,638	5314.0	5316.9	5317.8	5319.8	89	5318.9	5317.8	89	433	8.0	0.0	0.0		
	75+28	7528	5309.0	1,065	2,696	3,481	5,638	5315.4	5317.5	5318.5	5321.4	62	5321.2	5318.5	61	290	12.0	0.0	0.0		Blocked obstruction above WSE
	75+76	7576	5309.2	1,065	2,696	3,481	5,638	5315.8	5318.9	5320.0	5323.8	171	5321.8	5320.0	112	363	9.6	0.0	0.0	5	
	76+22	7622	5309.5	1,065	2,696	3,481	5,638	5315.6	5319.4	5321.5	5324.8	246	5322.3	5321.5	207	640	5.4	0.0	0.0	2A, 4	
S. Clay Street	76+60	7660	Culvert																		
	76+95	7695	5310.4	1,065	2,696	3,481	5,638	5319.8	5321.8	5322.5	5324.9	221	5322.9	5323.0	135	729	4.8	0.5	0.5	2A, 4	
	77+41	7741	5310.6	1,065	2,696	3,481	5,638	5319.9	5321.8	5322.4	5324.8	170	5323.1	5322.9	105	609	5.7	0.5	0.5	4, 5	
	80+43	8043	5311.9	1,065	2,696	3,481	5,638	5320.2	5322.2	5322.8	5324.7	86	5324.1	5323.3	86	438	8.0	0.5	0.3	4	
Drop 11	80+70	8070	5315.1	1,065	2,696	3,481	5,638	5319.8	5322.2	5323.0	5324.8	92	5325.1	5323.0	91	332	10.5	0.0	0.0		
	84+11	8411	5316.5	1,065	2,696	3,481	5,638	5322.8	5325.3	5326.1	5327.9	149	5327.0	5326.1	149	525	6.6	0.0	0.0		Blocked obstruction above WSE
Drop 12	84+29	8429	5318.6	1,065	2,696	3,481	5,638	5322.8	5325.3	5326.1	5327.8	134	5327.1	5326.1	133	486	7.2	0.0	0.0		Blocked obstruction above WSE
	85+31	8531	5318.5	1,065	2,696	3,481	5,638	5324.2	5326.1	5326.6	5328.3	155	5327.9	5326.6	155	442	7.9	0.0	0.0	2A	
Pedestrian Bridge	85+50	8550	Bridge																		
	85+67	8567	5318.0	1,065	2,696	3,481	5,638	5325.3	5327.1	5327.7	5328.8	178	5328.4	5327.7	178	581	6.0	0.0	0.0	2A	
	86+10	8610	5318.4	1,065	2,696	3,481	5,638	5325.2	5327.4	5328.2	5329.6	151	5329.7	5328.2	150	436	8.0	0.0	0.0		
	87+67	8767	5320.2	1,065	2,696	3,481	5,638	5326.2	5328.5	5328.9	5330.3	50	5331.0	5328.9	50	300	11.6	0.0	0.0		
	89+63	8963	5322.4	1,065	2,696	3,481	5,638	5327.0	5329.9	5330.9	5333.7	49	5333.7	5330.9	49	262	13.3	0.0	0.0		
	90+18	9018	5322.9	1,065	2,696	3,481	5,638	5328.9	5332.6	5333.9	5336.7	75	5334.5	5333.9	74	561	6.2	0.0	0.0	2A	Blocked obstruction above WSE
S. Federal Boulevard	90+80	9080	Culvert																		
	91+34	9134	5323.0	1,065	2,696	3,481	5,638	5329.4	5336.0	5337.3	5339.2	172	5337.7	5337.8	74	751	4.6	0.4	0.5	2A, 4	
	91+75	9175	5323.4	1,065	2,696	3,481	5,638	5329.1	5335.8	5337.1	5338.9	95	5337.9	5337.6	70	535	6.5	0.5	0.4	4	Blocked obstruction above WSE
	95+18	9518	5326.4	938	2,449	3,185	5,295	5332.1	5336.6	5337.9	5339.8	96	5338.3	5338.3	75	643	5.0	0.3	0.3	4	
Drop 13	95+33	9533	5328.8	938	2,449	3,185	5,295	5332.5	5336.4	5337.8	5339.6	97	5338.4	5338.1	77	505	6.3	0.3	0.3	4	
	97+39	9739	5329.7	938	2,449	3,185	5,295	5335.1	5336.8	5338.0	5340.1	110	5339.1	5338.3	78	371	8.6	0.3	0.3	4	
Sanderson Gulch / Reach 4 – S. Hazel Court to S. Tennyson Street (Denver)																					
	97+90	9790	5329.9	938	2,449	3,185	5,295	5335.9	5338.3	5339.1	5340.7	178	5339.5	5339.1	90	507	6.3	0.0	0.2	2A, 4	
Pedestrian Bridge	98+00	9800	Bridge																		
	98+16	9816	5329.8	938	2,449	3,185	5,295	5336.3	5338.6	5339.3	5341.0	194	5339.6	5339.4	90	513	6.2	0.2	0.5	2A, 4	
	98+33	9833	5329.9	938	2,449	3,185	5,295	5336.3	5338.6	5339.3	5341.0	190	5339.6	5339.5	90	500	6.4	0.2	0.5	4	
	103+12	10312	5333.2	938	2,449	3,185	5,295	5337.4	5340.0	5340.8	5342.4	93	5342.5	5340.8	93	316	10.1	0.0	0.0		
	103+93	10393	5333.8	938	2,449	3,185	5,295	5338.4	5340.4	5341.7	5344.0	76	5343.9	5341.7	75	286	11.2	0.0	0.0	2A	
S Irving Street	104+30	16408	5390.7	693	1,771	2,275	4,073	5394.3	5396.5	5397.2	5398.7	109	5398.5	5397.2	108	281	8.1	0.0	0.0		
	104+71	10471	5334.4	938	2,449	3,185	5,295	5341.0	5344.7	5345.5	5347.0	220	5345.8	5345.9	123	708	4.5	0.4	0.4	2A, 4	
	105+11	10511	5334.5	938	2,449	3,185	5,295	5341.3	5344.8	5345.6	5347.0	226	5345.8	5346.0	120	721	4.4	0.4	0.4	4	
	106+65	10665	5334.7	938	2,449	3,185	5,295	5341.5	5344.7	5345.4	5347.0	187	5346.2	5345.9	85	493	6.5	0.4	0.4	4	
	107+40	10740	5334.8	938	2,449	3,185	5,295	5341.7	5344.7	5345.3	5347.2	137	5347.0	5345.8	75	364	8.8	0.5	0.2	4	
Drop 14	107+49	10749	5338.2	938	2,449	3,185	5,295	5342.5	5345.4	5346.9	5348.1	145	5348.2	5346.9	121	393	8.1	0.1	0.0	4	
	107+86	10786	5338.4	938	2,449	3,185	5,295	5343.4	5346.8	5347.3	5348.4	133	5348.6	5347.3	133	367	8.7	0.0	0.0		IEFA above WSE
	110+46	11046	5340.0	938	2,449	3,185	5,295	5346.5	5348.4	5348.9	5350.0	64	5350.5	5348.9	64	321	9.9	0.0	0.0		
	113+10	11310	5341.7	938	2,449	3,185	5,295	5347.7	5350.2	5351.0	5353.4	74	5352.5	5351.0	74	336	9.5	0.0	0.0		
	113+65	11365	5342.0	938	2,449	3,185	5,295	5347.9	5350.2	5351.5	5355.3	76	5354.4	5351.5	66	238	13.4	0.0	0.0	2A	
Pedestrian Bridge	113+70	15140	5376.0	693	1,771	2,275	4,073	5380.3	5382.6	5383.3	5385.0	70	5384.9	5383.4	70	236	9.6	0.1	0.0		
	113+78	11378	5342.0	938	2,449	3,185	5,295	5348.2	5353.8	5354.2	5356.4	97	5355.6	5354.6	75	405	7.9	0.5	0.2	2A, 4	
	114+27	11427	5342.1	938	2,449	3,185	5,295	5348.4	5354.0	5355.1	5357.2	131	5355.9	5355.1	80	465	6.9	0.0	0.1	4	
	116+89	11689	5343.0	938	2,449	3,185	5,295	5350.4	5354.7	5355.9	5357.9	102	5356.4	5356.0	101	558	5.7	0.1	0.1	4	
	119+59	11959	5343.8	938	2,449	3,185	5,295	5351.5	5355.3	5356.4	5358.5	109	5356.8	5356.5	108	630	5.1	0.1	0.1	4	
	120+45	12045	5344.1	938	2,449	3,185	5,295	5351.6	5355.7	5356.6	5358.4	80	5358.5	5356.7	80	301	10.6	0.1	0.0	2A, 4	
S. Lowell Boulevard	121+10	14252	5367.1	693	1,771	2,275	4,073	5371.6	5373.7	5374.7	5376.8	73	5376.5	5374.7	71	228	10.0	0.0	0.0		
	121+81	12181	5347.3	938	2,449	3,185	5,295	5362.7	5364.3	5364.8	5366.0	230	5365.0	5365.3	143	1074	3.0	0.4	0.4	2A, 4	
	122+27	12227	5350.0	938	2,449	3,185	5,295	5362.7	5364.3	5364.8	5366.0	200	5365.0	5365.3	135	1129	2.8	0.5	0.4	4	
	126+12	12612	5350.5	693	1,771	2,275	4,073	5362.7	5364.3	5364.9	5366.0	100	5365.2	5365.3	99	584	3.9	0.5	0.4	4	
Drop 15	126+21	12621	5355.1	693	1,771	2,275	4,073	5362.6	5364.2	5364.7	5365.8	103	5365.3	5365.2	103	470	4.8	0.5	0.4	4	
	126+96	12696	5355.7	693	1,771	2,275	4,073	5362.7	5364.5	5365.1	5366.5	133	5365.4	5365.5	133	637	3.6	0.4	0.4	4	
	127+35	12735	5356.0	693	1,771	2,275	4,073	5362.7	5364.4	5365.0	5366.4	116	5365.5	5365.5	116	474	4.8	0.4	0.3	2A, 4	
Pedestrian Bridge	127+40	12740	Bridge																		

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
	127+46	12746	5356.0	693	1,771	2,275	4,073	5362.9	5364.6	5365.2	5366.7	115	5365.7	5365.6	115	483	4.7	0.4	0.3	2A, 4	
	127+71	12771	5356.1	693	1,771	2,275	4,073	5363.0	5364.8	5365.4	5367.0	117	5365.7	5365.7	117	567	4.0	0.3	0.3	4	
	129+49	12949	5357.0	693	1,771	2,275	4,073	5363.0	5364.9	5365.6	5367.3	168	5366.0	5365.9	168	533	4.3	0.3	0.2	4	
	131+10	13110	5357.8	693	1,771	2,275	4,073	5363.4	5365.0	5365.4	5366.9	70	5366.7	5365.6	69	280	8.1	0.2	0.1	4	
	132+07	13207	5358.2	693	1,771	2,275	4,073	5363.6	5365.3	5365.8	5367.5	53	5367.4	5365.9	53	233	9.8	0.1	0.0	4	
	132+49	13249	5358.5	693	1,771	2,275	4,073	5364.0	5366.2	5367.0	5369.7	67	5367.8	5367.0	66	330	6.9	0.0	0.0	2A	
Pedestrian Bridge	132+55	13255	Bridge																		
	132+59	13259	5358.5	693	1,771	2,275	4,073	5364.0	5366.5	5367.4	5369.8	66	5368.1	5367.4	66	334	6.8	0.0	0.0	2A	
	132+83	13283	5358.0	693	1,771	2,275	4,073	5364.0	5366.6	5367.4	5369.7	51	5368.3	5367.4	50	314	7.3	0.0	0.0		
Drop 16	132+88	13288	5361.5	693	1,771	2,275	4,073	5364.8	5366.9	5367.7	5370.7	50	5369.8	5367.7	50	199	11.4	0.0	0.0		
	133+27	13327	5361.8	693	1,771	2,275	4,073	5365.8	5368.1	5369.2	5371.3	118	5370.2	5369.2	117	306	7.4	0.0	0.0		
	135+78	13578	5363.4	693	1,771	2,275	4,073	5367.9	5370.0	5370.5	5372.1	117	5371.9	5370.5	117	264	8.6	0.0	0.0		
	138+86	13886	5365.0	693	1,771	2,275	4,073	5370.2	5372.3	5372.9	5374.0	136	5373.4	5372.9	135	450	5.1	0.0	0.0		
	142+52	14252	5367.1	693	1,771	2,275	4,073	5371.6	5373.7	5374.7	5376.8	73	5376.5	5374.7	71	228	10.0	0.0	0.0		
	143+02	14302	5367.5	693	1,771	2,275	4,073	5372.5	5374.9	5375.9	5378.2	95	5377.6	5376.0	73	242	9.4	0.1	0.0	2A, 4	
Pedestrian Bridge	143+10	14310	Bridge																		
	143+17	14317	5367.7	693	1,771	2,275	4,073	5373.5	5376.8	5377.1	5379.2	119	5378.1	5377.6	76	363	6.6	0.5	0.4	2A, 4	
	143+67	14367	5368.0	693	1,771	2,275	4,073	5373.6	5377.0	5377.7	5379.4	126	5378.4	5378.1	88	376	6.0	0.4	0.3	4	
	146+50	14650	5371.0	693	1,771	2,275	4,073	5376.0	5378.0	5378.6	5380.1	145	5379.0	5378.9	144	500	4.6	0.2	0.2	4	
	151+40	15140	5376.0	693	1,771	2,275	4,073	5380.3	5382.6	5383.3	5385.0	70	5384.9	5383.4	70	236	9.6	0.1	0.0	4	Blocked obstruction above WSE
	152+30	15230	5377.0	693	1,771	2,275	4,073	5381.7	5383.7	5384.9	5388.3	71	5387.1	5384.9	49	198	11.5	0.0	0.0	2A	Blocked obstruction above WSE
S. Tennyson Street	152+75	15275	Culvert																		
Sanderson Gulch / Reach 5 – S. Tennyson Street to Sheridan Boulevard (Denver)																					
	153+21	15321	5378.6	693	1,771	2,275	4,073	5388.2	5389.5	5389.8	5390.9	326	5390.1	5390.3	120	554	4.1	0.5	0.5	3A, 4, 5	
	153+81	15381	5379.0	693	1,771	2,275	4,073	5388.2	5389.5	5389.8	5390.9	145	5390.2	5390.3	116	493	4.6	0.5	0.4	3A, 4, 5	
	156+41	15641	5380.9	693	1,771	2,275	4,073	5388.3	5389.7	5390.0	5390.7	71	5390.9	5390.4	71	336	6.8	0.5	0.3	4	Blocked obstruction above WSE
	159+64	15964	5383.1	693	1,771	2,275	4,073	5389.1	5391.9	5393.0	5394.7	89	5394.5	5393.0	89	259	8.8	0.0	0.0		
	163+01	16301	5385.4	693	1,771	2,275	4,073	5391.5	5394.3	5395.0	5396.3	91	5395.7	5395.0	90	375	6.1	0.0	0.0		
	163+52	16352	5385.7	693	1,771	2,275	4,073	5391.7	5394.6	5395.3	5396.8	83	5395.8	5395.3	83	424	5.4	0.0	0.0		
Drop 18	163+63	16363	5389.7	693	1,771	2,275	4,073	5392.4	5394.4	5395.1	5396.8	80	5396.6	5395.1	77	247	9.2	0.0	0.0		
	164+08	16408	5390.7	693	1,771	2,275	4,073	5394.3	5396.5	5397.2	5398.7	109	5398.5	5397.2	108	281	8.1	0.0	0.0		
	164+48	16448	5391.6	693	1,771	2,275	4,073	5395.2	5397.1	5397.8	5399.4	117	5398.9	5397.8	98	287	7.9	0.0	0.0	2A, 4	
Pedestrian Bridge	164+60	16460	Bridge																		
	164+75	16475	5391.5	693	1,771	2,275	4,073	5397.0	5398.6	5399.0	5400.0	135	5399.6	5399.4	79	375	6.1	0.4	0.5	2A, 4	
	165+15	16515	5391.6	693	1,771	2,275	4,073	5397.0	5398.5	5399.0	5400.1	141	5399.8	5399.4	71	312	7.3	0.4	0.4	4	
	166+76	16676	5392.2	676	1,726	2,223	3,987	5397.3	5398.7	5399.3	5401.6	116	5401.6	5399.3	47	195	11.4	0.0	0.0		
	170+19	17019	5393.6	676	1,726	2,223	3,987	5399.2	5401.9	5402.9	5403.8	201	5404.3	5402.9	46	250	8.9	0.0	0.0		Blocked obstruction above WSE
	170+66	17066	5393.7	676	1,726	2,223	3,987	5399.5	5402.7	5403.8	5407.9	218	5404.6	5403.8	49	322	6.9	0.0	0.0	2A	Blocked obstruction above WSE
S. Xavier Street	171+00	17100	Culvert																		
	171+37	17137	5394.1	676	1,726	2,223	3,987	5401.7	5406.3	5406.5	5407.9	380	5407.0	5407.0	204	546	4.1	0.5	0.4	3A, 4, 5	
	171+63	17163	5394.9	676	1,726	2,223	3,987	5401.9	5406.5	5406.7	5407.8	364	5407.1	5407.1	200	605	3.7	0.4	0.4	1A, 2B, 4, 5	
Drop 19	171+74	17174	5399.5	676	1,726	2,223	3,987	5401.8	5406.4	5406.6	5407.8	368	5407.4	5407.1	205	420	5.3	0.4	0.3	1A, 2B, 4, 5	
	172+21	17221	5399.9	676	1,726	2,223	3,987	5403.3	5405.8	5407.6	5408.8	365	5408.8	5407.6	202	328	6.8	0.0	0.0	1A, 2B, 4, 5	
	174+44	17444	5401.6	676	1,726	2,223	3,987	5405.9	5408.5	5409.1	5410.5	201	5410.4	5409.1	196	285	7.8	0.0	0.0	4, 5	
	177+91	17791	5403.7	676	1,726	2,223	3,987	5408.4	5410.9	5411.9	5414.8	36	5414.6	5411.9	35	174	12.8	0.0	0.0		Blocked obstruction above WSE
	179+71	17971	5404.9	676	1,726	2,223	3,987	5410.6	5413.9	5415.0	5418.2	89	5415.7	5415.0	89	352	6.3	0.0	0.0		
	180+39	18039	5405.6	676	1,726	2,223	3,987	5411.0	5414.1	5415.1	5418.3	164	5416.7	5415.1	110	234	9.5	0.0	0.0		
Sanderson Gulch / Reach 6 – Sheridan Boulevard to Confluence with North Sanderson Gulch (Lakewood)																					
S Sheridan Boulevard	181+10	18110	Culvert																		
	181+82	18182	5407.0	676	1,726	2,223	3,987	5411.6	5418.7	5419.6	5420.8	174	5420.1	5420.1	131	556	4.0	0.5	0.4	2A, 4	
	181+90	18190	5410.8	676	1,726	2,223	3,987	5413.5	5418.7	5419.7	5421.0	199	5420.2	5420.1	133	525	4.2	0.4	0.4	4	
	181+92	18192	5413.0	676	1,726	2,223	3,987	5417.5	5418.9	5419.6	5421.0	200	5420.2	5419.9	133	378	5.9	0.3	0.4	4	
	182+55	18255	5413.6	630	1,618	2,115	3,774	5418.6	5419.9	5420.3	5421.6	224	5420.6	5420.7	130	580	3.6	0.4	0.4	4	
	184+07	18407	5415.0	630	1,618	2,115	3,774	5418.7	5420.2	5420.6	5422.0	223	5420.8	5421.0	223	926	2.3	0.4	0.3	4	
Drop 20	185+31	18531	5422.5	630	1,618	2,115	3,774	5424.4	5425.6	5426.6	5427.1	429	5427.1	5426.6	428	479	4.4	0.0	0.0		
	185+54	18554	5422.5	639	1,636	2,134	3,779	5425.2	5426.9	5427.2	5427.8	419	5427.2	5427.2	419	1670	1.3	0.0	0.0		
	189+94	18994	5422.3	639	1,636	2,134	3,779	5425.2	5426.9	5427.2	5428.0	345	5427.3	5427.2	345	1540	1.4	0.0	0.0		
	194+49	19449	5422.2	639	1,636	2,134	3,779	5425.2	5427.0	5427.2	5427.9	162	5427.4	5427.2	162	655	3.3	0.0	0.0		
	195+26	19526	5422.0	639	1,636	2,134	3,779	5425.4	5427.4	5428.2	5430.1	55	5430.0	5428.2	55	199	10.7	0.0	0.0		IEFA above WSE

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
Depew Street Pedestrian Bridge	195+35	19535	Bridge																		
	195+46	19546	5422.1	639	1,636	2,134	3,779	5426.8	5429.4	5431.1	5433.1	235	5431.4	5431.1	97	566	3.8	0.0	0.0	2A, 4	
	195+67	19567	5422.6	639	1,636	2,134	3,779	5426.9	5429.7	5431.3	5433.2	335	5431.4	5431.3	132	989	2.2	0.0	0.0	2A, 4	
	196+34	19634	5424.0	639	1,636	2,134	3,779	5426.5	5429.5	5431.2	5433.0	124	5431.5	5431.2	99	486	4.4	0.0	0.0	4	
Drop 21	196+93	19693	5426.4	639	1,636	2,134	3,779	5428.1	5429.7	5431.3	5433.0	78	5432.1	5431.3	78	306	7.0	0.0	0.0	2A	
S. Manor Lane	197+16	19716	Culvert																		
	197+39	19739	5426.5	603	1,526	2,003	3,566	5429.4	5432.2	5434.0	5436.9	87	5434.4	5434.0	86	487	5.1	0.0	0.0	2A	
	197+79	19779	5428.0	603	1,526	2,003	3,566	5430.1	5431.9	5433.9	5436.8	157	5434.7	5433.9	157	314	6.8	0.0	0.0	2A	
Clairfield Reservoir	197+90	19790	Inl Struct																		
	197+91	19791	5428.0	603	1,526	2,003	3,566	5432.6	5435.9	5436.4	5437.5	265	5436.6	5436.4	265	891	3.3	0.0	0.0	2A	
	199+02	19902	5428.0	657	1,781	2,215	3,746	5432.8	5436.1	5436.6	5437.8	336	5436.6	5436.6	336	2074	1.1	0.0	0.0		
	203+02	20302	5428.0	657	1,781	2,215	3,746	5432.7	5436.1	5436.6	5437.8	374	5436.7	5436.6	374	1159	1.9	0.0	0.0		
	205+29	20529	5428.0	657	1,781	2,215	3,746	5432.8	5436.1	5436.7	5437.9	344	5436.7	5436.7	344	2165	1.0	0.0	0.0		
	209+53	20953	5428.2	657	1,781	2,215	3,746	5432.8	5436.1	5436.6	5437.8	102	5437.2	5436.6	102	406	5.5	0.0	0.0		
Drop 22	210+25	21025	5432.1	560	1,464	1,819	3,278	5433.9	5436.3	5436.8	5438.1	62	5438.0	5436.8	62	232	9.0	0.0	0.0	2A	
S Harlan Circle	210+50	21050	Culvert																		
	210+84	21084	5432.3	560	1,464	1,819	3,278	5435.9	5439.1	5440.2	5443.9	91	5440.5	5440.2	91	517	4.3	0.0	0.0	2A	
	211+36	21136	5431.5	560	1,464	1,819	3,278	5436.0	5439.3	5440.4	5444.0	122	5440.6	5440.4	122	680	2.7	0.0	0.0		
	213+58	21358	5432.3	560	1,464	1,819	3,278	5436.0	5439.3	5440.4	5444.0	88	5440.8	5440.4	87	389	4.7	0.0	0.0		
	214+11	21411	5433.3	560	1,464	1,819	3,278	5437.2	5439.4	5440.5	5444.0	93	5441.0	5440.5	93	328	5.5	0.0	0.0	2A	
Pedestrian Crossing	214+30	21430	Culvert																		
	214+44	21444	5433.7	560	1,464	1,819	3,278	5440.2	5441.7	5442.2	5444.2	120	5442.4	5442.2	120	560	3.3	0.0	0.0	2A	
	214+60	21460	5433.7	560	1,464	1,819	3,278	5440.2	5441.8	5442.3	5444.3	125	5442.4	5442.3	125	654	2.8	0.0	0.0		
Sanderson Gulch / Reach 7 – North Sanderson Gulch Confluence to Green Gables Entrance Road (Lakewood)																					
	21574	21574	5433.7	300	645	1,021	1,839	5440.3	5441.9	5442.4	5444.5	141	5442.4	5442.4	140	670	1.5	0.0	0.0		
	21588	21588	5433.8	300	645	1,021	1,839	5440.3	5441.9	5442.4	5444.5	122	5442.5	5442.4	122	450	2.3	0.0	0.0	2A	
Trail Crossing	21600	21600	Culvert																		
	21617	21617	5434.0	300	645	1,021	1,839	5440.3	5441.9	5442.4	5444.5	94	5442.5	5442.4	94	380	2.7	0.1	0.1	2A, 4	
	21644	21644	5433.7	300	645	1,021	1,839	5440.3	5441.9	5442.4	5444.5	82	5442.6	5442.4	82	314	3.3	0.1	0.0	4	
	21733	21733	5434.5	300	645	1,021	1,839	5440.4	5442.0	5442.5	5444.5	55	5442.7	5442.5	55	264	3.9	0.0	0.0	4	
	21768	21768	5435.0	300	645	1,021	1,839	5440.4	5442.0	5442.5	5444.5	56	5442.8	5442.5	56	307	4.4	0.0	0.0	2A, 4	
W Jewell Avenue	21950	21950	Culvert																		
	22127	22127	5442.2	287	626	990	1,774	5443.5	5449.1	5452.4	5452.7	339	5452.5	5452.9	58	428	2.3	0.5	0.5	2A, 4	
	22138	22138	5442.1	287	626	990	1,774	5444.6	5449.1	5452.4	5452.7	334	5452.5	5452.9	44	384	2.6	0.5	0.5	2B, 4	
	22199	22199	5443.1	287	626	990	1,774	5445.6	5449.0	5452.4	5452.6	278	5452.5	5452.8	43	313	3.2	0.5	0.5	2B, 4	
Drop 23	22245	22245	5446.9	287	626	990	1,774	5450.4	5451.4	5452.3	5453.8	238	5453.6	5452.3	41	107	9.2	0.0	0.0	3B, 4, 5	
	22374	22374	5448.5	287	626	990	1,774	5451.4	5452.7	5453.7	5454.7	101	5454.0	5453.7	65	237	4.2	0.0	0.0	3B, 4, 5	
	22465	22465	5449.1	287	626	990	1,774	5451.7	5452.6	5453.6	5454.6	91	5454.3	5453.6	59	153	6.5	0.0	0.0		
	22516	22516	5450.6	287	626	990	1,774	5453.6	5454.6	5455.4	5456.8	82	5456.8	5455.4	47	125	9.6	0.0	0.0	2A	
S Lake Road	22530	22530	Bridge																		
	22565	22565	5451.0	287	626	990	1,774	5454.3	5455.8	5457.0	5458.7	82	5457.4	5457.2	59	212	4.7	0.1	0.1	2A, 4	
	22600	22600	5451.4	287	626	990	1,774	5455.2	5456.2	5457.1	5458.9	42	5458.5	5457.2	42	109	9.1	0.1	0.0	4	
	22725	22725	5452.4	282	604	961	1,697	5456.6	5457.6	5458.2	5459.6	37	5459.7	5458.2	36	102	9.5	0.0	0.0	4	
Drop 24	22757	22757	5457.4	282	604	961	1,697	5460.9	5461.9	5462.3	5462.6	268	5462.7	5462.3	68	131	7.4	0.0	0.5	4	
	22788	22788	5458.2	282	604	961	1,697	5461.2	5462.2	5462.8	5463.3	235	5463.3	5463.1	101	213	4.5	0.3	0.2	2A, 4	
Shwayder Pond Berm	22800	22800	Culvert																		
	22816	22816	5458.5	282	604	961	1,697	5462.8	5463.5	5463.9	5464.4	319	5464.0	5463.9	295	525	1.8	0.0	0.0	2A, 4	
	22851	22851	5458.5	282	604	961	1,697	5462.8	5463.5	5464.0	5464.5	286	5464.0	5464.0	286	1291	0.7	0.0	0.0		
	23168	23168	5458.4	282	604	961	1,697	5462.8	5463.5	5464.0	5464.6	174	5464.0	5464.0	174	766	1.3	0.0	0.0		
	23464	23464	5458.3	282	604	961	1,697	5462.8	5463.5	5464.0	5464.6	107	5464.1	5464.0	107	523	1.8	0.0	0.0		
	23572	23572	5458.2	282	604	961	1,697	5462.7	5463.5	5464.0	5464.6	163	5464.1	5464.0	79	353	2.7	0.0	0.0	2A	
Green Gables Entrance Road	23650	23650	Culvert																		
Sanderson Gulch / Reach 8 – Green Gables Country Club (Jefferson County)																					
	23715	23715	5460.7	282	604	961	1,697	5466.7	5472.4	5473.1	5473.9	435	5473.1	5473.1	435	2280	0.4	0.0	0.0	2A, 4	
	23724	23724	5458.2	310	931	1,212	1,822	5466.8	5472.4	5473.1	5473.9	451	5473.1	5473.1	451	2543	0.5	0.0	0.0	2A, 4	
	23863	23863	5461.9	310	931	1,212	1,822	5466.8	5472.4	5473.1	5473.9	374	5473.1	5473.1	374	3046	0.4	0.0	0.0	2A	
	23978	23978	5462.3	310	931	1,212	1,822	5466.8	5472.4	5473.1	5473.9	317	5473.1	5473.1	317	2337	0.5	0.0	0.0		

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
	24069	24069	5462.8	310	931	1,212	1,822	5466.8	5472.4	5473.1	5473.9	255	5473.1	5473.1	254	1650	0.7	0.0	0.0		
	24222	24222	5464.5	310	931	1,212	1,822	5466.9	5472.4	5473.1	5473.9	242	5473.1	5473.1	242	1353	0.9	0.0	0.0		
	24387	24387	5466.3	295	895	1,168	1,752	5468.6	5472.4	5473.1	5474.0	186	5473.2	5473.2	185	840	1.4	0.0	0.0		
	24419	24419	5466.3	295	895	1,168	1,752	5468.8	5472.4	5473.1	5473.9	142	5473.2	5473.1	142	594	2.0	0.0	0.0		
	24517	24517	5467.2	295	895	1,168	1,752	5469.7	5472.5	5473.2	5474.0	94	5473.4	5473.2	94	359	3.3	0.0	0.0	4	
	24644	24644	5468.0	295	895	1,168	1,752	5471.0	5472.9	5473.6	5474.6	85	5474.1	5473.6	85	281	4.2	0.0	0.0	4	
	24683	24683	5468.2	295	895	1,168	1,752	5471.4	5473.4	5474.0	5475.0	61	5474.3	5474.0	61	291	4.0	0.0	0.0		
	24693	24693	5466.5	295	895	1,168	1,752	5471.4	5473.3	5474.0	5474.9	45	5474.4	5474.0	45	237	5.0	0.0	0.0	2A	
Cart Path	24720	24720	Culvert																		
	24746	24746	5468.3	295	895	1,168	1,752	5471.4	5473.4	5474.1	5475.1	47	5474.6	5474.1	47	215	5.8	0.0	0.0	2A	
	24753	24753	5468.9	295	895	1,168	1,752	5471.5	5473.6	5474.4	5475.6	60	5474.7	5474.4	60	270	4.3	0.0	0.0		
	24785	24785	5469.3	295	895	1,168	1,752	5471.6	5473.7	5474.5	5475.7	88	5474.9	5474.5	88	291	4.0	0.0	0.0	4	
	24802	24802	5469.5	295	895	1,168	1,752	5471.9	5473.9	5474.6	5475.9	93	5475.0	5474.6	92	295	4.0	0.0	0.0		
	24842	24842	5469.3	295	895	1,168	1,752	5472.3	5474.1	5474.8	5476.1	98	5475.2	5474.8	98	323	3.6	0.0	0.0	4	
	24873	24873	5469.7	295	895	1,168	1,752	5472.5	5474.3	5475.0	5476.2	98	5475.3	5475.0	98	362	3.2	0.0	0.0		
	24907	24907	5473.1	242	761	1,003	1,492	5474.9	5475.9	5476.2	5476.9	77	5477.3	5476.2	77	139	7.2	0.0	0.0		
	24944	24944	5473.7	242	761	1,003	1,492	5475.8	5476.9	5477.3	5478.0	88	5478.0	5477.3	88	189	5.3	0.0	0.0		
	25097	25097	5474.4	242	761	1,003	1,492	5477.0	5478.5	5479.0	5479.9	91	5479.4	5479.0	91	272	3.7	0.0	0.0		
	25124	25124	5474.4	242	761	1,003	1,492	5477.1	5478.7	5479.2	5480.0	92	5479.5	5479.2	92	272	3.7	0.0	0.0		
	25157	25157	5474.3	242	761	1,003	1,492	5477.2	5478.8	5479.4	5480.2	92	5479.7	5479.4	92	274	3.7	0.0	0.0		
	25266	25266	5475.1	242	761	1,003	1,492	5477.7	5479.4	5480.0	5480.9	93	5480.3	5480.0	93	278	3.6	0.0	0.0		
	25299	25299	5475.3	242	761	1,003	1,492	5477.9	5479.6	5480.2	5481.2	94	5480.4	5480.2	94	339	3.0	0.0	0.0		
	25332	25332	5478.5	242	761	1,003	1,492	5480.7	5481.8	5482.2	5482.8	94	5483.2	5482.2	94	188	5.3	0.0	0.0	2A	
	25365	25365	5478.9	242	761	1,003	1,492	5481.3	5482.7	5483.1	5483.8	90	5483.7	5483.1	90	218	4.6	0.0	0.0	2A	
	25475	25475	5479.6	242	761	1,003	1,492	5482.1	5483.7	5484.2	5485.0	91	5484.6	5484.2	91	256	3.9	0.0	0.0		
	25564	25564	5480.0	242	761	1,003	1,492	5482.5	5484.2	5484.7	5485.6	84	5485.1	5484.7	84	254	4.0	0.0	0.0		
	25608	25608	5480.2	242	761	1,003	1,492	5482.7	5484.4	5485.0	5485.8	82	5485.4	5485.0	81	244	4.1	0.0	0.0		
	25670	25670	5480.5	242	761	1,003	1,492	5483.1	5484.9	5485.4	5486.4	64	5485.7	5485.4	64	271	3.7	0.0	0.0		
	25691	25691	5480.6	242	761	1,003	1,492	5483.1	5484.9	5485.4	5486.3	53	5485.8	5485.4	53	213	5.1	0.0	0.0	2A	
Cart Path	25730	25730	Culvert																		
	25773	25773	5480.8	242	761	1,003	1,492	5483.1	5485.0	5485.7	5486.7	48	5486.1	5485.7	48	194	5.2	0.0	0.0		IEFA above WSE
	25786	25786	5480.9	242	761	1,003	1,492	5483.2	5485.2	5485.9	5487.1	70	5486.2	5485.9	70	262	3.8	0.0	0.0		
	25803	25803	5481.1	242	761	1,003	1,492	5483.2	5485.2	5485.9	5487.1	79	5486.3	5485.9	79	252	4.0	0.0	0.0		
	25823	25823	5480.9	242	761	1,003	1,492	5483.6	5485.5	5486.2	5487.3	80	5486.4	5486.2	80	293	3.4	0.0	0.0		
	25856	25856	5483.3	242	761	1,003	1,492	5485.6	5486.6	5486.9	5487.5	71	5487.8	5486.9	71	137	7.3	0.0	0.0		
	25890	25890	5483.5	242	761	1,003	1,492	5486.2	5487.3	5487.7	5488.2	80	5488.3	5487.7	80	194	5.2	0.0	0.0	4	
	25923	25923	5483.9	242	761	1,003	1,492	5486.3	5487.7	5488.2	5488.9	85	5488.6	5488.2	85	219	4.6	0.0	0.0		
	25956	25956	5484.0	242	761	1,003	1,492	5486.6	5488.0	5488.5	5489.4	82	5489.0	5488.5	82	231	4.3	0.0	0.0	4	
	25989	25989	5484.1	242	761	1,003	1,492	5486.8	5488.4	5488.9	5489.8	83	5489.3	5488.9	82	244	4.1	0.0	0.0		
	26023	26023	5485.2	242	761	1,003	1,492	5487.1	5488.7	5489.2	5490.1	82	5489.5	5489.2	82	242	4.2	0.0	0.0		
	26056	26056	5486.9	242	761	1,003	1,492	5489.6	5490.7	5491.0	5491.6	79	5491.9	5491.1	79	150	6.7	0.1	0.0	4	
	26089	26089	5487.6	242	761	1,003	1,492	5490.1	5491.3	5491.6	5492.3	66	5492.6	5491.6	66	136	7.4	0.0	0.0	2A	
	26230	26230	5488.5	242	761	1,003	1,492	5491.3	5492.8	5493.3	5494.1	63	5494.0	5493.3	63	168	6.0	0.0	0.0	2A	
	26373	26373	5488.9	242	761	1,003	1,492	5491.9	5493.6	5494.2	5495.1	72	5494.8	5494.2	72	191	5.3	0.0	0.0	2A	
	26407	26407	5489.0	242	761	1,003	1,492	5492.0	5493.8	5494.4	5495.2	65	5495.0	5494.4	65	181	5.5	0.0	0.0	2A	
	26471	26471	5489.3	242	761	1,003	1,492	5492.3	5494.1	5494.8	5495.7	66	5495.3	5494.8	66	198	5.1	0.0	0.0	2A	
	26667	26667	5490.7	242	761	1,003	1,492	5493.2	5495.0	5495.6	5496.5	62	5496.2	5495.6	62	179	5.6	0.0	0.0	2A	
	26731	26731	5491.0	242	761	1,003	1,492	5493.5	5495.2	5495.8	5496.7	59	5496.6	5495.8	59	160	6.3	0.0	0.0	2A	
	26925	26925	5491.7	242	761	1,003	1,492	5494.7	5496.5	5497.2	5498.1	67	5497.7	5497.2	67	194	5.2	0.0	0.0	2A	
	27021	27021	5492.5	242	761	1,003	1,492	5495.0	5496.9	5497.5	5498.4	51	5497.8	5497.5	51	229	4.4	0.0	0.0	2A	
Sanderson Gulch / Reach 9 –S. Wadsworth Blvd. to S. Allison Street (Lakewood)																					
	27050	27050	5498.9	242	761	1,003	1,492	5500.2	5501.4	5501.8	5502.6	42	5503.2	5501.8	42	110	9.1	0.0	0.0		IEFA above WSE
	27058	27058	5505.5	242	761	1,003	1,492	5505.8	5506.2	5506.3	5506.6	460	5506.7	5506.7	-	169	6.0	0.3	0.5	2B, 4, 5	
	27121	27121	5506.1	0	96	297	648	5506.4	5506.8	5506.9	5507.2	460	5507.0	5507.3	-	424	0.7	0.4	0.4		
	27170	27170	5504.8	0	96	297	648	5506.4	5506.8	5507.0	5507.3	640	5507.0	5507.4	-	1187	0.3	0.4	0.4		
	27400	27400	5510.9	0	96	297	648	5509.7	5511.1	5511.5	5511.9	538	5511.8	5511.5	-	77	3.8	0.0	0.0	1A, 5	
	27624	27624	5516.0	0	96	297	648	5515.5	5516.0	5516.3	5516.7	708	5516.6	5516.3	-	74	4.0	0.0	0.0	1A, 5	
	27867	27867	5517.2	0	96	297	648	5517.0	5517.7	5518.0	5518.3	689	5518.2	5518.0	-	81	3.8	0.0	0.0	3A, 5	
	28069	28069	5518.4	0	96	297	648	5518.5	5519.4	5519.9	5520.4	85	5520.3	5519.9	-	60	4.9	0.0	0.0		

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
	28383	28383	5521.8	0	96	297	648	5521.8	5522.7	5523.1	5523.6	81	5523.5	5523.1	-	60	5.0	0.0	0.0	2A, 4, 5	
Sanderson Gulch / Reach 10 – S. Allison Street to Jewell Park Pond (Lakewood)																					
	28656	28656	5529.8	0	96	297	648	5529.8	5530.3	5530.7	5531.0	142	5530.9	5530.8	70	61	4.8	0.2	0.3		
	28677	28677	5521.8	166	560	739	1,091	5526.0	5530.3	5530.7	5531.3	129	5530.9	5531.2	47	292	2.5	0.5	0.5	3B, 4	
	28858	28858	5525.8	143	487	640	944	5528.5	5530.3	5530.8	5531.7	31	5532.0	5530.8	31	73	8.7	0.0	0.0		
	28886	28886	5528.1	143	487	640	944	5529.6	5531.2	5531.7	5532.4	62	5532.9	5531.7	29	72	8.8	0.0	0.0	2A	
S Ammons Street	28910	28910	Culvert																		
	28952	28952	5528.7	143	487	640	944	5532.3	5536.3	5536.7	5537.3	88	5536.8	5537.1	38	253	2.5	0.4	0.4	2A, 4, 5	
	28972	28972	5529.2	143	487	640	944	5532.3	5536.2	5536.7	5537.2	80	5536.9	5537.1	37	199	3.2	0.4	0.4	2B, 4, 5	
	29187	29187	5531.0	143	487	640	944	5533.9	5535.8	5536.3	5537.3	25	5537.7	5536.8	25	80	8.0	0.5	0.1	4	
	29219	29219	5533.7	143	487	640	944	5535.0	5536.5	5536.9	5537.9	58	5538.5	5536.9	21	64	10.0	0.0	0.0	2A	
S Balsam Street	29250	29250	Culvert																		
	29281	29281	5533.7	143	487	640	944	5537.7	5541.9	5542.5	5543.0	85	5542.6	5542.9	28	233	2.7	0.4	0.5	1B, 2A, 4, 5	
	29301	29301	5534.1	143	487	640	944	5537.6	5541.9	5542.4	5542.9	72	5542.6	5542.9	30	186	3.4	0.4	0.4	4, 5	
	29468	29468	5537.5	143	487	640	944	5541.5	5542.8	5543.2	5544.1	34	5544.4	5543.2	33	75	8.6	0.0	0.0	5	
	29483	29483	5538.1	143	487	640	944	5542.0	5543.3	5543.8	5544.5	35	5544.6	5543.8	35	91	7.1	0.0	0.0	5	
	29670	29670	5541.0	143	487	640	944	5544.7	5545.9	5546.4	5547.2	36	5547.5	5546.4	36	77	8.3	0.0	0.0	5	
	29693	29693	5541.9	143	487	640	944	5545.3	5546.5	5546.9	5547.4	36	5547.8	5546.9	36	85	7.6	0.0	0.0	5	
	29840	29840	5542.7	143	487	640	944	5546.2	5547.9	5548.3	5548.9	27	5549.4	5548.3	27	76	8.5	0.0	0.0		
	29879	29879	5543.3	143	487	640	944	5546.6	5548.8	5549.5	5550.6	54	5549.8	5549.5	32	146	4.4	0.0	0.0	2A	
S Carr Street	29920	29920	Culvert																		
	29959	29959	5545.7	143	487	640	944	5549.6	5553.4	5553.8	5554.3	113	5553.9	5554.3	40	258	2.5	0.5	0.5	2A, 4, 5	
	29983	29983	5546.7	143	487	640	944	5549.8	5553.3	5553.7	5554.1	87	5554.1	5554.2	37	141	4.5	0.5	0.5	4, 5	
	30143	30143	5549.1	143	487	640	944	5552.4	5553.9	5554.4	5555.3	28	5555.7	5554.4	28	70	9.1	0.0	0.0		
	30176	30176	5549.4	143	487	640	944	5553.0	5554.9	5555.7	5556.7	49	5556.1	5555.7	35	126	5.1	0.0	0.0	2A	
S Cody Street	30210	30210	Culvert																		
	30242	30242	5551.5	143	487	640	944	5554.7	5558.3	5558.8	5559.1	110	5559.0	5559.3	35	215	3.0	0.5	0.5	1B, 2A, 4, 5	
	30267	30267	5552.0	143	487	640	944	5554.4	5558.3	5558.8	5559.0	78	5559.1	5559.2	31	152	4.2	0.5	0.5	4	
	30600	30600	5554.4	143	487	640	944	5558.0	5559.1	5559.6	5560.4	27	5560.9	5559.7	26	73	8.8	0.1	0.0	4	
	30648	30648	5558.2	143	487	640	944	5560.9	5562.4	5562.8	5563.8	37	5564.0	5562.9	36	78	8.2	0.1	0.0	4	
	30952	30952	5562.3	143	487	640	944	5565.6	5566.9	5567.4	5568.3	29	5568.7	5567.4	29	71	9.0	0.0	0.0	4	
	31183	31183	5567.8	143	487	640	944	5570.7	5572.3	5572.8	5574.0	30	5574.1	5572.8	30	71	9.0	0.0	0.0		IEFA above WSE, Blocked obstruction above WSE
Drop 35	31225	31225	5568.9	95	337	442	653	5571.6	5573.7	5574.4	5575.1	24	5574.6	5574.4	23	132	3.4	0.0	0.0	2A	Blocked obstruction above WSE
Jewell Park Rese	31240	31240	Bridge																		
	31253	31253	5574.2	95	337	442	653	5575.4	5576.7	5577.1	5578.0	321	5577.5	5577.1	321	707	5.1	0.0	0.0	2A	Blocked obstruction above WSE
Sanderson Gulch / Reach 11 - Jewell Park Pond to Kendrick Reservoir (Lakewood)																					
	31299	31299	5572.0	112	392	503	756	5575.6	5577.1	5577.7	5578.6	318	5577.7	5577.7	318	1726	0.3	0.0	0.0		Blocked obstruction above WSE
	31702	31702	5572.0	112	392	503	756	5575.6	5577.1	5577.7	5578.6	175	5577.7	5577.7	175	762	0.7	0.0	0.0		Blocked obstruction above WSE
	31745	31745	5572.0	112	392	503	756	5575.6	5577.1	5577.7	5578.6	41	5578.3	5577.7	41	83	6.1	0.0	0.0	2A	Blocked obstruction above WSE
Jewell Park Rese	31770	31770	Culvert																		
	31798	31798	5572.6	112	392	503	756	5580.1	5580.6	5580.7	5581.0	251	5580.7	5580.7	251	792	0.6	0.0	0.0	2A	
	31852	31852	5573.2	112	392	503	756	5580.1	5580.6	5580.7	5581.0	238	5580.7	5580.7	237	799	0.6	0.0	0.0		
	32249	32249	5575.9	94	337	432	643	5580.0	5580.3	5580.6	5581.1	46	5581.3	5580.6	46	66	6.5	0.0	0.0		
	32544	32544	5580.0	94	337	432	643	5582.3	5584.1	5584.5	5585.1	26	5585.3	5584.5	26	58	7.4	0.0	0.0		
	32581	32581	5580.3	94	337	432	643	5583.3	5585.0	5585.5	5586.3	29	5586.0	5585.5	29	80	5.4	0.0	0.0	2A	
S Garrison Street	32660	32660	Culvert																		
	32749	32749	5586.5	94	337	432	643	5596.9	5597.7	5597.9	5598.2	137	5597.9	5598.3	62	349	1.2	0.5	0.5	2A, 4	
	32754	32754	5591.4	94	337	432	643	5596.9	5597.7	5597.9	5598.2	136	5597.9	5598.3	61	311	1.4	0.5	0.5	4	
	32802	32802	5592.0	94	337	432	643	5596.9	5597.7	5597.9	5598.2	135	5597.9	5598.3	60	312	1.4	0.5	0.5	4	
	33247	33247	5595.7	4	10	12	16	5596.9	5597.7	5597.9	5598.3	41	5597.9	5598.4	41	68	0.2	0.5	0.5	4	
	33639	33639	5598.8	4	10	12	16	5599.3	5599.5	5599.6	5599.7	9	5599.8	5599.6	9	3	3.6	0.0	0.0		
	33768	33768	5598.8	4	10	12	16	5600.0	5600.5	5600.6	5600.7	17	5600.6	5600.6	17	15	0.8	0.0	0.0		
	33942	33942	5616.9	4	10	12	16	5617.2	5617.3	5617.3	5617.4	13	5617.5	5617.3	13	4	3.2	0.0	0.0		IEFA above WSE
Kendrick Reservoir	33960	33960	Bridge																		
	33973	33973	5617.2	4	10	12	16	5617.5	5617.6	5617.7	5617.8	43	5617.7	5617.7	43	14	0.8	0.0	0.0		

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
Sanderson Gulch / Reach 12 – Kendrick Reservoir to Smith Reservoir (Lakewood)																					
	34195	34195	5616.0	77	214	263	376	5617.5	5617.7	5617.7	5617.8	557	5617.7	5617.7	557	915	0.3	0.0	0.0		
	34654	34654	5616.0	77	214	263	376	5617.5	5617.7	5617.7	5617.8	887	5617.7	5617.7	887	1391	0.2	0.0	0.0		
	35102	35102	5616.0	77	214	263	376	5617.5	5617.7	5617.7	5617.8	1049	5617.7	5617.7	1049	1724	0.2	0.0	0.0		
	35447	35447	5616.0	77	214	263	376	5617.5	5617.7	5617.7	5617.8	1077	5617.7	5617.7	1077	1727	0.2	0.0	0.0		

Notes:

1A. Floodplain/Floodway top width includes high ground.
1B. Floodplain top width includes high ground.
2A. Floodplain/Floodway top width includes IEFA.
2B. Floodplain top width includes IEFA.
3A. Floodplain/Floodplain top width includes high ground and IEFA.
3B. Floodplain top width includes high ground and IEFA.
4. Encroachments for floodway are included.
5. Blocked obstruction.

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
North Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
North Sanderson Gulch Split Flow in W Kalahan Avenue – S Pierce Street to 100 Feet downstream of W Calahan Street Crossing at North Sanderson Gulch (Lakewood)																					
	0+55	55	5480.0	0	30	30	30	5480.1	5480.7	5480.7	5480.7	99	5480.7	5480.7	77	13	2.3	0.0	0.0		
	1+73	173	5480.5	0	30	30	30	5480.5	5481.3	5481.3	5481.3	98	5481.5	5481.4	40	9	3.5	0.0	0.1		
	4+36	436	5481.2	0	33	100	290	5481.3	5482.2	5482.4	5482.9	83	5482.6	5482.5	48	27	3.7	0.0	0.1		
	7+44	744	5483.3	0	146	250	480	5483.3	5484.7	5485.0	5485.5	88	5485.4	5485.1	42	43	5.9	0.1	0.2		
	8+47	847	5484.2	0	240	375	640	5484.2	5485.8	5486.0	5486.4	116	5486.5	5486.1	42	57	6.6	0.1	0.3		
	11+08	1108	5487.4	0	235	345	611	5487.4	5488.8	5489.1	5489.5	164	5489.5	5489.2	42	54	6.4	0.1	0.4		
	13+38	1338	5489.5	0	202	310	567	5489.6	5491.2	5491.5	5492.0	74	5492.0	5491.5	43	51	6.1	0.1	0.2		
	14+25	1425	5490.6	0	202	310	567	5490.7	5492.2	5492.4	5492.8	98	5492.8	5492.5	42	50	6.2	0.1	0.3		
	15+28	1528	5493.3	0	62	143	330	5493.3	5494.4	5494.7	5495.1	87	5495.0	5494.7	48	31	4.6	0.0	0.1		
	16+06	1606	5496.3	0	0	19	158	5496.3	5496.3	5496.8	5497.5	59	5496.9	5496.8	52	6	3.0	0.0	0.0		
North Sanderson Gulch / Reach NS1 – Sanderson Gulch Confluence to S. Pierce Street (Lakewood)																					
	0+86	86	5433.7	272	902	1,155	1,722	5440.3	5441.9	5442.4	5444.5	95	5442.5	5442.4	95	438	2.6	0.0	0.0		
	1+61	161	5432.8	272	902	1,155	1,722	5440.3	5441.9	5442.4	5444.5	80	5442.5	5442.4	80	396	2.9	0.0	0.0		
Drop N1	1+96	196	5438.4	272	902	1,155	1,722	5440.4	5442.7	5443.1	5444.4	74	5444.1	5443.1	74	153	7.5	0.0	0.0		
	3+22	322	5438.5	272	902	1,155	1,722	5441.8	5443.9	5444.3	5445.0	84	5444.8	5444.3	84	216	5.3	0.0	0.0		
	5+48	548	5438.8	272	902	1,155	1,722	5442.3	5444.5	5444.9	5445.6	44	5445.5	5444.9	44	193	6.0	0.0	0.0		
Drop N2	5+77	577	5443.1	272	902	1,155	1,722	5445.2	5447.0	5447.7	5448.8	63	5449.1	5447.7	63	128	9.1	0.0	0.0	1A	
	6+25	625	5442.7	272	902	1,155	1,722	5446.0	5448.5	5449.1	5450.0	122	5449.3	5449.1	122	619	3.3	0.0	0.0	2A	
	7+24	724	5444.2	272	902	1,155	1,722	5446.0	5448.5	5449.1	5450.0	39	5450.2	5449.1	39	142	8.1	0.0	0.0		
Drop N3	7+41	741	5448.6	272	902	1,155	1,722	5450.2	5452.0	5452.5	5453.7	45	5454.0	5452.5	45	124	9.3	0.0	0.0		
	8+15	815	5447.4	272	902	1,155	1,722	5451.3	5453.1	5453.5	5454.0	41	5454.6	5453.5	41	139	8.3	0.0	0.0		
Drop N4	8+70	870	5451.0	272	902	1,155	1,722	5452.1	5453.5	5453.9	5454.9	61	5455.4	5453.9	61	156	9.8	0.0	0.0	2A	
S Harlan Circle	9+00	900	Culvert																		
	9+12	912	5451.1	272	902	1,155	1,722	5453.4	5456.1	5457.0	5459.3	73	5457.4	5457.0	73	329	5.0	0.0	0.0	2A	
	9+29	929	5449.7	272	902	1,155	1,722	5453.4	5456.2	5457.2	5459.4	72	5457.4	5457.2	72	317	3.6	0.0	0.0		
	12+14	1214	5452.6	272	902	1,155	1,722	5454.4	5456.8	5457.6	5459.6	110	5458.0	5457.6	110	256	4.5	0.0	0.0		
Drop N5	12+42	1242	5453.4	260	855	1,089	1,625	5456.1	5457.1	5457.6	5459.6	120	5458.1	5457.6	119	185	5.9	0.0	0.0		
	13+19	1319	5453.6	260	855	1,089	1,625	5457.0	5457.9	5458.1	5459.7	122	5458.7	5458.1	122	174	6.3	0.0	0.0	1A	
	13+55	1355	5453.3	260	855	1,089	1,625	5457.1	5458.4	5458.8	5459.9	161	5459.0	5458.8	161	360	3.0	0.0	0.0	2A	
Pedestrian Crossing	13+65	1365	Culvert																		
	13+74	1374	5453.4	260	855	1,089	1,625	5457.4	5458.6	5458.9	5460.0	165	5459.1	5458.9	165	378	2.9	0.0	0.0	2A	
Drop N6	13+92	1392	5456.1	260	855	1,089	1,625	5457.4	5458.7	5459.0	5460.0	193	5459.1	5459.0	193	415	2.6	0.0	0.0		
	14+90	1490	5456.0	260	855	1,089	1,625	5457.5	5458.8	5459.1	5460.1	251	5459.2	5459.1	250	710	1.5	0.0	0.0		
	16+66	1666	5456.2	260	855	1,089	1,625	5457.6	5458.9	5459.3	5460.1	69	5460.4	5459.3	69	134	8.1	0.0	0.0		
Drop N7	16+96	1696	5459.4	260	855	1,089	1,625	5460.5	5461.4	5461.7	5462.2	124	5462.4	5461.7	124	167	6.5	0.0	0.0		
	18+47	1847	5459.6	260	855	1,089	1,625	5461.7	5462.8	5463.1	5463.5	76	5463.6	5463.1	76	194	5.6	0.0	0.0		
	19+42	1942	5459.7	260	855	1,089	1,625	5462.0	5463.1	5463.7	5464.7	50	5465.1	5463.8	50	126	8.7	0.1	0.0	4	
	19+74	1974	5460.1	260	855	1,089	1,625	5462.4	5464.4	5465.1	5466.5	42	5466.5	5465.1	42	117	9.3	0.1	0.0	2A, 4	
Pedestrian Crossing	19+85	1985	Culvert																		
	19+94	1994	5459.7	260	855	1,089	1,625	5465.2	5467.5	5467.8	5468.5	92	5468.2	5467.8	92	279	3.9	0.0	0.0	2A	
Drop N8	20+03	2003	5463.7	260	855	1,089	1,625	5466.0	5467.4	5467.8	5468.4	84	5468.8	5467.8	83	157	7.0	0.0	0.0		
	21+88	2188	5464.4	260	855	1,089	1,625	5467.2	5468.7	5469.2	5470.0	132	5469.3	5469.2	132	346	3.1	0.0	0.0		
	22+45	2245	5464.5	260	855	1,089	1,625	5467.3	5468.8	5469.2	5470.1	142	5469.4	5469.2	141	303	3.6	0.0	0.0		
	22+71	2271	5465.2	260	855	1,089	1,625	5467.7	5468.8	5469.2	5470.1	121	5469.6	5469.2	121	243	4.5	0.0	0.0	2A	
Trail Bridge	22+80	2280	Bridge																		
	22+88	2288	5464.7	260	855	1,089	1,625	5468.8	5469.7	5470.0	5470.5	128	5470.2	5470.0	128	352	3.1	0.0	0.0	2A	
	23+06	2306	5464.9	260	855	1,089	1,625	5468.8	5469.8	5470.0	5470.6	131	5470.2	5470.0	130	372	2.9	0.0	0.0		
	24+59	2459	5465.7	260	855	1,089	1,625	5468.8	5469.6	5470.1	5471.1	42	5471.6	5470.2	42	122	9.0	0.1	0.0	4	
Drop N9	24+78	2478	5468.4	260	855	1,089	1,625	5470.4	5472.0	5472.5	5473.5	54	5473.8	5472.5	53	129	8.5	0.0	0.0		
	27+11	2711	5470.2	260	855	1,089	1,625	5473.0	5474.8	5475.3	5476.1	47	5476.1	5475.3	46	161	6.8	0.0	0.0		
Drop N10	27+45	2745	5472.0	260	855	1,089	1,625	5473.9	5475.5	5476.0	5477.1	45	5477.4	5476.0	44	116	9.4	0.0	0.0		
	27+97	2797	5472.5	260	855	1,089	1,625	5474.8	5476.7	5477.3	5478.7	251	5477.9	5477.3	105	183	6.0	0.0	0.0	2A, 4	

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE
North Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR FLOW (CFS)	50-YR FLOW (CFS)	100-YR FLOW (CFS)	500-YR FLOW (CFS)	10-YR WSEL (FT)	50-YR WSEL (FT)	100-YR WSEL (FT)	500-YR WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
North Sanderson Gulch / Reach NS2 – S. Pierce Street to Wadsworth Boulevard (Lakewood)																					
S Pierce Street	29+00	2900	Culvert																		
	29+13	2913	5473.2	260	855	1,089	1,625	5475.4	5477.8	5478.0	5478.6	450	5478.7	5478.5	299	313	3.5	0.5	0.2		
	29+73	2973	5473.9	176	562	725	1,092	5475.8	5477.8	5478.4	5479.0	178	5479.2	5478.4	141	122	5.9	0.0	0.1		
	32+91	3291	5477.4	176	549	665	832	5479.5	5481.0	5481.4	5481.9	34	5482.7	5481.4	33	76	8.8	0.0	0.0		
	36+33	3633	5479.7	176	446	505	642	5482.7	5484.5	5484.8	5485.2	24	5485.4	5484.8	22	81	6.2	0.0	0.0		
	36+80	3680	5480.3	176	342	337	305	5483.1	5485.0	5485.5	5486.2	71	5485.7	5485.5	18	88	3.8	0.0	0.0		
S Quay Drive	37+10	3710	Culvert																		
	37+31	3731	5480.3	176	352	380	482	5483.3	5485.6	5486.0	5486.7	78	5486.2	5486.2	17	100	3.8	0.2	0.2		
	37+44	3744	5482.3	176	352	380	482	5484.0	5485.4	5485.9	5486.6	78	5486.5	5486.1	21	66	5.8	0.2	0.1		
	39+95	3995	5485.1	176	357	410	511	5487.5	5488.2	5488.4	5488.8	78	5489.5	5488.4	21	49	8.4	0.0	0.0		
	42+37	4237	5487.8	176	390	445	555	5490.0	5491.3	5491.5	5491.9	28	5492.2	5491.5	28	65	6.9	0.0	0.0		
	42+95	4295	5488.6	176	390	445	555	5490.7	5491.7	5491.9	5492.2	18	5492.8	5491.9	18	57	8.0	0.0	0.0		
S Upham Street	43+25	4325	Culvert																		
	43+55	4355	5489.1	176	530	612	792	5491.2	5494.1	5494.5	5494.9	63	5494.9	5494.6	62	120	5.1	0.2	0.1		
	43+94	4394	5488.8	176	530	612	792	5491.4	5494.2	5494.6	5495.0	31	5495.0	5494.7	31	125	4.9	0.2	0.2		
	45+29	4529	5490.1	176	592	736	964	5492.1	5494.5	5494.8	5495.2	32	5495.6	5495.0	32	110	6.7	0.2	0.1		
	45+83	4583	5490.3	176	592	736	964	5492.7	5494.9	5495.3	5495.9	33	5495.9	5495.4	32	119	6.2	0.1	0.1		
	46+30	4630	5491.3	176	592	736	964	5492.9	5495.0	5495.4	5496.0	20	5496.9	5495.5	19	77	9.5	0.1	0.0		
W Calahan Avenue	46+60	4660	Culvert																		
	46+85	4685	5491.6	176	592	755	1,122	5493.9	5497.3	5498.2	5498.5	223	5498.6	5498.2	37	158	4.8	0.1	0.0		
	47+52	4752	5493.6	176	592	755	1,122	5495.0	5497.3	5498.2	5498.5	237	5498.9	5498.3	37	119	6.3	0.1	0.0		
Drop N11	47+77	4777	5496.6	176	592	755	1,122	5498.1	5499.5	5499.9	5500.8	245	5501.1	5499.9	40	92	8.3	0.0	0.0		
	50+75	5075	5498.4	140	475	606	898	5500.6	5502.2	5502.5	5503.0	30	5503.5	5502.5	29	78	7.7	0.0	0.0		
	53+79	5379	5500.4	140	475	606	898	5502.4	5504.2	5504.6	5505.7	28	5505.6	5504.6	28	77	7.9	0.0	0.0		
Drop N12	54+15	5415	5502.9	140	475	606	898	5504.5	5505.8	5506.2	5506.9	32	5507.4	5506.2	32	72	8.5	0.0	0.0		
	55+64	5564	5504.0	140	475	606	898	5506.0	5507.4	5507.7	5508.4	30	5508.7	5507.7	30	75	8.1	0.0	0.0		
Drop N13	56+01	5601	5506.3	140	475	606	898	5508.0	5509.4	5509.8	5510.5	43	5510.9	5509.8	43	77	7.9	0.0	0.0		
	57+03	5703	5506.6	140	475	606	898	5509.0	5510.4	5510.6	5511.3	44	5511.7	5510.6	40	77	7.9	0.0	0.0		
	57+59	5759	5508.0	140	475	606	898	5512.8	5513.3	5513.5	5513.7	207	5513.9	5513.8	73	181	6.2	0.3	0.5		
North Sanderson Gulch / Reach NS3 – S. Wadsworth Boulevard to S. Balsam Court (Lakewood)																					
S Wadsworth Boulevard	58+30	5830	Culvert																		
	58+97	5897	5510.5	140	475	606	898	5513.0	5515.5	5516.4	5517.4	419	5516.7	5516.4	33	142	4.7	0.0	0.0		
	59+29	5929	5510.3	140	475	606	898	5513.4	5515.5	5516.4	5517.5	445	5517.3	5516.4	30	81	7.4	0.0	0.0		
	61+80	6180	5512.5	97	329	419	619	5516.2	5518.0	5518.4	5518.5	284	5518.8	5518.4	40	87	4.8	0.0	0.0		
	64+90	6490	5514.6	97	329	419	619	5517.4	5519.3	5519.7	5520.5	28	5520.1	5519.7	28	77	5.4	0.0	0.0		
Drop N14	64+99	6499	5516.6	97	329	419	619	5517.7	5519.2	5519.6	5520.4	26	5520.4	5519.6	26	60	7.0	0.0	0.0		
	68+94	6894	5520.4	97	329	419	619	5522.8	5523.9	5524.3	5524.7	26	5525.1	5524.3	26	57	7.3	0.0	0.0		
	72+15	7215	5523.3	97	329	419	619	5525.8	5527.5	5527.9	5528.7	21	5528.9	5527.9	21	52	8.1	0.0	0.0		
	72+87	7287	5523.8	97	329	419	619	5526.8	5528.5	5529.0	5529.8	25	5529.7	5529.0	25	64	6.6	0.0	0.0		
	73+27	7327	5525.8	97	329	419	619	5527.4	5529.2	5529.7	5530.6	21	5531.3	5529.7	21	45	10.2	0.0	0.0		
S Allison Street	73+80	7380	Culvert																		
	74+15	7415	5528.5	97	329	419	619	5531.2	5533.9	5534.0	5534.5	77	5534.7	5534.5	52	106	4.5	0.5	0.3		
	74+44	7444	5528.9	97	329	419	619	5531.3	5534.2	5534.5	5534.8	28	5534.9	5534.7	28	90	4.7	0.2	0.2		
	75+49	7549	5529.6	97	329	419	619	5532.2	5534.5	5534.8	5535.4	27	5535.2	5535.0	27	89	4.7	0.2	0.1		
	76+73	7673	5530.7	97	329	419	619	5532.8	5534.8	5535.2	5535.8	21	5536.0	5535.3	21	60	6.9	0.1	0.0		
Drop N16	76+84	7684	5533.2	97	329	419	619	5534.5	5535.8	5536.1	5536.8	24	5537.2	5536.1	24	51	8.3	0.0	0.0		
	79+33	7933	5535.5	97	329	419	619	5537.7	5539.2	5539.5	5540.1	23	5540.5	5539.5	23	54	7.7	0.0	0.0		
	80+33	8033	5536.6	97	329	419	619	5538.5	5540.2	5540.7	5541.5	22	5541.2	5540.7	22	69	6.1	0.0	0.0		
S Balsam Ct	82+49	8249	5542.5	97	329	419	619	5543.6	5544.3	5544.5	5544.9	66	5545.1	5544.5	51	67	6.3	0.0	0.0		
	85+23	8523	5546.3	97	329	419	619	5547.6	5548.3	5548.4	5548.8	67	5549.0	5548.4	57	67	6.2	0.0	0.0		
	88+01	8801	5550.5	59	199	252	369	5551.7	5552.2	5552.3	5552.5	62	5552.7	5552.3	54	47	5.3	0.0	0.0		
	90+65	9065	5555.2	59	199	252	369	5556.3	5556.8	5556.9	5557.2	59	5557.4	5557.0	52	48	5.3	0.0	0.0		
	93+39	9339	5559.3	59	199	252	369	5560.5	5561.0	5561.2	5561.5	66	5561.7	5561.2	53	47	5.3	0.0	0.0		
S Dover Ct	96+04	9604	5561.9	59	199	252	369	5562.8	5563.3	5563.4	5563.7	63	5563.9	5563.4	59	50	5.0	0.0	0.0		
	98+55	9855	5565.6	37	128	162	239	5566.4	5566.8	5566.9	5567.1	58	5567.2	5566.9	56	35	4.6	0.0	0.0		

TABLE D-1 FLOODPLAIN AND FLOODWAY DATA TABLE

North Sanderson Gulch

REFERENCE LOCATION	RIVER STATION	CROSS SECTION	THALWEG ELEVATION (FT)	PEAK DISCHARGES				WATER SURFACE ELEVATION				100-YEAR FLOODPLAIN		100-YEAR FLOODWAY (0.5' HGL/ EGL)						NOTE	COMMENTS
				10-YR	50-YR	100-YR	500-YR	10-YR	50-YR	100-YR	500-YR										
				FLOW (CFS)	FLOW (CFS)	FLOW (CFS)	FLOW (CFS)	WSEL (FT)	WSEL (FT)	WSEL (FT)	WSEL (FT)	WIDTH (FT)	EGL (FT)	WSEL (FT)	WIDTH (FT)	AREA (SQ FT)	VELOCITY (FT/S)	HGL SURCHARGE (FT)	EGL SURCHARGE (FT)		
	101+28	10128	5570.1	37	128	162	239	5570.9	5571.3	5571.4	5571.6	61	5571.8	5571.4	51	34	4.7	0.0	0.0		
S Endicott Street	106+24	10624	5579.4	37	128	162	239	5580.2	5580.7	5580.8	5581.0	54	5581.1	5580.8	54	35	4.6	0.0	0.0		
	108+80	10880	5585.6	37	128	162	239	5586.2	5586.7	5586.8	5587.0	55	5587.1	5586.8	39	33	5.0	0.0	0.1		
S Garrison Street	114+51	11451	5594.4	28	97	123	182	5594.7	5594.8	5594.9	5595.0	163	5595.0	5594.9	97	36	3.4	0.0	0.1		

Notes:

1A. Floodplain/Floodway top width includes high ground.
1B. Floodplain top width includes high ground.
2A. Floodplain/Floodway top width includes IEFA.
2B. Floodplain top width includes IEFA.
3A. Floodplain/Floodplain top width includes high ground and IEFA.
3B. Floodplain top width includes high ground and IEFA.
4. Encroachments for floodway are included.
5. Blocked obstruction.

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
Sanderson Gulch / REACH 1: South Platte River to Lipan Culvert Entrance (Denver)																
	52	0+52	52.0	52	52	52	52	52	212	423	-	-	5237.8	5237.8		Confluence with S Platte River, floodway not defined. Manually adjusted to provide a more reasonable transition of the floodplain.
South Platte River Drive	100	1+00	48.0	48	48	100	100	100								
	146	1+46	46.0	46	46	146	146	146	1035	1214	-	-	5248.0	5248.0		
	211	2+11	65.0	65	65	211	211	211	841	942	-	-	5247.9	5247.9		Manually adjusted to provide a more reasonable transition of the floodplain. Floodway not defined.
	525	5+25	314.0	314	314	525	525	525	645	746	-	-	5248.6	5248.6		
	608	6+08	83.0	83	83	608	608	608	669	1052	-	-	5249.9	5249.9		
Railroad Bridge	640	6+40	32.0	32	32	640	640	640								
	666	6+66	26.0	26	26	666	666	666	463	519	-	-	5252.2	5252.2		Manually adjusted to provide a more reasonable transition of the floodplain. Floodway not defined.
	692	6+92	26.0	26	26	692	692	692	420	463	-	-	5252.1	5252.1		
Lipan Street	810	8+10	118.0	118	118	810	810	810								
Sanderson Gulch / REACH 2: S. Lipan Street to Zuni Street (Denver)																
	948	9+48	138	138	138	948	948	948	129	444	-	127	5261.5	5261.5		See Note 1. Manually adjusted floodplain to represent shallow surface flows across S Lipan St.
	1116	11+16	168	168	168	1116	1116	1116	449	447	402	402	5263.8	5263.8		
	1435	14+35	319	319	319	1435	1435	1435	152	154	154	153	5263.9	5263.9		
	1864	18+64	429	429	429	1864	1864	1864	65	99	65	98	5264.5	5264.5		Manually adjusted to provide a more reasonable transition of the floodplain and floodway.
Drop 1	1876	18+76	12	12	12	1876	1876	1876	125	125	-	124	5267.7	5267.7		See Note 1.
	2192	21+92	316	316	316	2192	2192	2192	104	104	104	104	5270.4	5270.4		
	2244	22+44	52	52	52	2244	2244	2244	112	112	112	112	5271.1	5271.1		
Pedestrian Bridge	2252	22+52	8.0	8	8	2252	2252	2252								
	2262	22+62	10	10	10	2262	2262	2262	115	116	115	115	5271.3	5271.3		
	2288	22+88	26	26	26	2288	2288	2288	113	113	113	113	5271.3	5271.3		
	2578	25+78	290	290	290	2578	2578	2578	67	68	67	67	5271.7	5271.7		
	2648	26+48	70	70	70	2648	2648	2648	46	47	46	46	5273.1	5273.1		
W. Arkansas Avenue	2715	27+15	67.0	67	67	2715	2715	2715								
	2783	27+83	68	68	68	2783	2783	2783	159	159	95	95	5283.8	5283.8		
	2825	28+25	42	42	42	2825	2825	2825	175	175	105	105	5283.8	5283.8		
	3120	31+20	295	295	295	3120	3120	3120	342	341	165	165	5284.0	5284.0		
	3171	31+71	51	51	51	3171	3171	3171	309	309	146	147	5284.0	5284.0		
Drop 2	3188	31+88	17	17	17	3188	3188	3188	238	240	141	145	5283.9	5283.9		
	3222	32+22	34	34	34	3222	3222	3222	165	214	135	135	5283.9	5283.9		Manually adjusted to represent split flow in floodplain.
	3411	34+11	189	189	189	3411	3411	3411	206	312	116	116	5283.9	5283.9		Manually adjusted to represent split flow in floodplain.
	3625	36+25	214	214	214	3625	3625	3625	157	190	118	119	5284.1	5284.1		Manually adjusted to represent split flow in floodplain.
	3926	39+26	301	301	301	3926	3926	3926	101	101	101	100	5284.3	5284.3		
	4181	41+81	255	255	255	4181	4181	4181	77	77	77	77	5285.0	5285.0		
Drop 5	4269	42+69	88	88	88	4269	4269	4269	52	231	52	75	5287.7	5287.7		Manually adjusted to represent floodplain split flow along W Florida Ave.
W. Florida Avenue	4330	43+30	61.0	61	61	4330	4330	4330								

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
	4387	43+87	57	57	57	4387	4387	4387	320	320	180	180	5292.5	5292.5		
Drop 6	4433	44+33	46	46	46	4433	4433	4433	189	189	170	170	5292.5	5292.5		
	4525	45+25	92	92	92	4525	4525	4525	156	156	156	156	5292.7	5292.7		
	4825	48+25	300	300	300	4825	4825	4825	165	167	165	166	5294.3	5294.3		
	4874	48+74	49	49	49	4874	4874	4874	151	151	151	151	5294.6	5294.6		
Park Pedestrian Bridge	4885	48+85	11.0	11	11	4885	4885	4885								
	4893	48+93	8	8	8	4893	4893	4893	137	137	137	137	5294.7	5294.7		
	4943	49+43	50	50	50	4943	4943	4943	117	117	117	117	5294.7	5294.7		
	5050	50+50	107	107	107	5050	5050	5050	121	122	121	121	5295.3	5295.3		
Drop 7	5085	50+85	35	35	35	5085	5085	5085	112	114	112	112	5295.4	5295.4		
	5383	53+83	298	298	298	5383	5383	5383	114	110	114	110	5297.7	5297.7		
Drop 8	5417	54+17	34	34	34	5417	5417	5417	113	104	113	104	5297.8	5297.8		
	5486	54+86	69	69	69	5486	5486	5486	114	114	114	114	5298.5	5298.5		
Drop 9	5520	55+20	34	34	34	5520	5520	5520	110	111	-	110	5298.9	5298.9		See Note 1.
	6022	60+22	502	502	502	6022	6022	6022	71	71	71	71	5304.7	5304.7		
	6128	61+28	106	106	106	6128	6128	6128	69	151	69	69	5305.6	5305.6		Manually adjusted floodplain to represent shallow surface flows across S Zuni St.
	6172	61+72	44	44	44	6172	6172	6172	88	203	88	87	5307.8	5307.8		
S Zuni Street	6240	62+40	68.0	68	68	6240	6240	6240								
Sanderson Gulch / REACH 3: S. Zuni Street to S. Hazel Court (Denver)																
	6303	63+03	63	63	63	6303	6303	6303	332	332	290	290	5311.7	5311.7		
	6337	63+37	34	34	34	6337	6337	6337	332	331	282	281	5311.5	5311.5		
	6416	64+16	79	79	79	6416	6416	6416	329	330	259	259	5311.8	5311.8		
Drop 10	6442	64+42	26	26	26	6442	6442	6442	302	303	240	240	5311.7	5311.7		
	6517	65+17	75	75	75	6517	6517	6517	111	213	93	94	5312.0	5312.0		Manually adjusted to provide a more reasonable transition of the floodplain.
	6913	69+13	396	396	396	6913	6913	6913	64	64	-	64	5314.5	5314.5		See Note 1.
	7265	72+65	352	352	352	7265	7265	7265	90	89	90	89	5317.8	5317.8		
	7528	75+28	263	263	263	7528	7528	7528	62	62	-	61	5318.5	5318.5		See Note 1.
	7576	75+76	48	48	48	7576	7576	7576	171	171	138	112	5320.0	5320.0		
	7622	76+22	46	46	46	7622	7622	7622	247	246	207	207	5321.5	5321.5		
S. Clay Street	7660	76+60	38.0	38	38	7660	7660	7660								
	7695	76+95	35	35	35	7695	7695	7695	220	221	135	135	5322.5	5322.5		
	7741	77+41	46	46	46	7741	7741	7741	170	170	105	105	5322.4	5322.4		
	8043	80+43	302	302	302	8043	8043	8043	86	86	86	86	5322.8	5322.8		
Drop 11	8070	80+70	27	27	27	8070	8070	8070	92	92	-	91	5323.0	5323.0		See Note 1.
	8411	84+11	341	341	341	8411	8411	8411	148	149	148	149	5326.1	5326.1		
Drop 12	8429	84+29	18	18	18	8429	8429	8429	133	134	133	133	5326.1	5326.1		
	8531	85+31	102	102	102	8531	8531	8531	155	155	-	155	5326.6	5326.6		See Note 1.
Pedestrian Bridge	8550	85+50	19.0	19	19	8550	8550	8550								
	8567	85+67	17	17	17	8567	8567	8567	178	178	178	178	5327.7	5327.7		
	8610	86+10	43	43	43	8610	8610	8610	150	151	-	150	5328.2	5328.2		See Note 1.
	8767	87+67	157	157	157	8767	8767	8767	50	50	50	50	5328.9	5328.9		
	8963	89+63	196	196	196	8963	8963	8963	49	49	-	49	5330.9	5330.9		See Note 1.
	9018	90+18	55	55	55	9018	9018	9018	74	75	-	74	5333.9	5333.9		See Note 1.
S. Federal Boulevard	9080	90+80	62.0	62	62	9080	9080	9080								
	9134	91+34	54	54	54	9134	9134	9134	172	172	74	74	5337.3	5337.3		
	9175	91+75	41	41	41	9175	9175	9175	95	95	70	70	5337.1	5337.1		

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
	9518	95+18	343	343	343	9518	9518	9518	97	96	75	75	5337.9	5337.9		
Drop 13	9533	95+33	15	15	15	9533	9533	9533	97	97	77	77	5337.8	5337.8		
	9739	97+39	206	206	206	9739	9739	9739	111	110	78	78	5338.0	5338.0		
Sanderson Gulch / Reach 4 – S. Hazel Court to S. Tennyson Street (Denver)																
	9790	97+90	51	51	51	9790	9790	9790	178	178	90	90	5339.1	5339.1		
Pedestrian Bridge	9800	98+00	10.0	10	10	9800	9800	9800								
	9816	98+16	16	16	16	9816	9816	9816	194	194	90	90	5339.3	5339.3		
	9833	98+33	17	17	17	9833	9833	9833	190	190	90	90	5339.3	5339.3		
	10312	103+12	479	479	479	10312	10312	10312	93	93	-	93	5340.8	5340.8		See Note 1.
	10393	103+93	81	81	81	10393	10393	10393	75	76	-	75	5341.7	5341.7		See Note 1.
S Irving Street	10430	104+30	37.0	37	37	10430	10430	10430								
	10471	104+71	41	41	41	10471	10471	10471	221	220	123	123	5345.5	5345.5		
	10511	105+11	40	40	40	10511	10511	10511	226	226	120	120	5345.6	5345.6		
	10665	106+65	154	154	154	10665	10665	10665	182	187	85	85	5345.4	5345.4		
	10740	107+40	75	75	75	10740	10740	10740	75	137	75	75	5345.3	5345.3		Manually adjusted to provide a more reasonable transition of the floodplain.
Drop 14	10749	107+49	9	9	9	10749	10749	10749	146	145	129	121	5346.9	5346.9		
	10786	107+86	37	37	37	10786	10786	10786	132	133	-	133	5347.3	5347.3		See Note 1.
	11046	110+46	260	260	260	11046	11046	11046	64	64	64	64	5348.9	5348.9		
	11310	113+10	264	264	264	11310	11310	11310	74	74	74	74	5351.0	5351.0		
	11365	113+65	55	55	55	11365	11365	11365	41	76	41	66	5351.5	5351.5		Manually adjusted to provide a more reasonable transition of the floodplain and floodway.
Pedestrian Bridge	11370	113+70	5.0	5	5	11370	11370	11370								
	11378	113+78	8	8	8	11378	11378	11378	99	97	77	75	5354.2	5354.2		
	11427	114+27	49	49	49	11427	11427	11427	131	131	77	80	5355.1	5355.1		
	11689	116+89	262	262	262	11689	11689	11689	102	102	102	101	5355.9	5355.9		
	11959	119+59	270	270	270	11959	11959	11959	108	109	108	108	5356.4	5356.4		
	12045	120+45	86	86	86	12045	12045	12045	80	80	80	80	5356.6	5356.6		
S. Lowell Boulevard	12110	121+10	65.0	65	65	12110	12110	12110								
	12181	121+81	71	71	71	12181	12181	12181	230	230	143	143	5364.8	5364.8		
	12227	122+27	46	46	46	12227	12227	12227	200	200	135	135	5364.8	5364.8		
	12612	126+12	385	385	385	12612	12612	12612	100	100	100	99	5364.9	5364.9		
Drop 15	12621	126+21	9	9	9	12621	12621	12621	104	103	103	103	5364.7	5364.7		
	12696	126+96	75	75	75	12696	12696	12696	133	133	133	133	5365.1	5365.1		
	12735	127+35	39	39	39	12735	12735	12735	116	116	116	116	5365.0	5365.0		
Pedestrian Bridge	12740	127+40	5.0	5	5	12740	12740	12740								
	12746	127+46	6	6	6	12746	12746	12746	115	115	115	115	5365.2	5365.2		
	12771	127+71	25	25	25	12771	12771	12771	117	117	117	117	5365.4	5365.4		
	12949	129+49	178	178	178	12949	12949	12949	168	168	168	168	5365.6	5365.6		
	13110	131+10	161	161	161	13110	13110	13110	69	70	69	69	5365.4	5365.4		
	13207	132+07	97	97	97	13207	13207	13207	53	53	53	53	5365.8	5365.8		
	13249	132+49	42	42	42	13249	13249	13249	67	67	67	66	5367.0	5367.0		
Pedestrian Bridge	13255	132+55	6.0	6	6	13255	13255	13255								
	13259	132+59	4	4	4	13259	13259	13259	66	66	66	66	5367.4	5367.4		
	13283	132+83	24	24	24	13283	13283	13283	51	51	51	50	5367.4	5367.4		
Drop 16	13288	132+88	5	5	5	13288	13288	13288	50	50	-	50	5367.7	5367.7		See Note 1.

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
	13327	133+27	39	39	39	13327	13327	13327	118	118	118	117	5369.2	5369.2		
	13578	135+78	251	251	251	13578	13578	13578	117	117	117	117	5370.5	5370.5		
	13886	138+86	308	308	308	13886	13886	13886	135	136	135	135	5372.9	5372.9		
	14252	142+52	366	366	366	14252	14252	14252	71	73	-	71	5374.7	5374.7		See Note 1.
	14302	143+02	50	50	50	14302	14302	14302	73	95	73	73	5375.9	5375.9		
Pedestrian Bridge	14310	143+10	8.0	8	8	14310	14310	14310								
	14317	143+17	7	7	7	14317	14317	14317	118	119	76	76	5377.1	5377.1		
	14367	143+67	50	50	50	14367	14367	14367	126	126	88	88	5377.7	5377.7		
	14650	146+50	283	283	283	14650	14650	14650	144	145	144	144	5378.6	5378.6		
	15140	151+40	490	490	490	15140	15140	15140	70	70	70	70	5383.3	5383.3		
	15230	152+30	90	90	90	15230	15230	15230	49	71	-	49	5384.9	5384.9		See Note 1.
S. Tennyson Street	15275	152+75	45.0	45	45	15275	15275	15275								
Sanderson Gulch / Reach 5 – S. Tennyson Street to Sheridan Boulevard (Denver)																
	15321	153+21	46	46	46	15321	15321	15321	325	326	121	120	5389.8	5389.8		
	15381	153+81	60	60	60	15381	15381	15381	145	145	117	116	5389.8	5389.8		
	15641	156+41	260	260	260	15641	15641	15641	72	71	72	71	5390.0	5390.0		
	15964	159+64	323	323	323	15964	15964	15964	88	89	-	89	5393.0	5393.0		See Note 1.
	16301	163+01	337	337	337	16301	16301	16301	90	91	90	90	5395.0	5395.0		
	16352	163+52	51	51	51	16352	16352	16352	83	83	83	83	5395.3	5395.3		
Drop 18	16363	163+63	11	11	11	16363	16363	16363	77	80	77	77	5395.1	5395.1		
	16408	164+08	45	45	45	16408	16408	16408	109	109	-	108	5397.2	5397.2		See Note 1.
	16448	164+48	40	40	40	16448	16448	16448	117	117	98	98	5397.8	5397.8		
Pedestrian Bridge	16460	164+60	12.0	12	12	16460	16460	16460								
	16475	164+75	15	15	15	16475	16475	16475	136	135	79	79	5399.0	5399.0		
	16515	165+15	40	40	40	16515	16515	16515	140	141	71	71	5399.0	5399.0		
	16676	166+76	161	161	161	16676	16676	16676	47	116	-	47	5399.3	5399.3		See Note 1 for XS 16676. Manually adjusted to represent floodplain split flow along W Colorado Ave.
	17019	170+19	343	343	343	17019	17019	17019	46	201	46	46	5402.9	5402.9		
	17066	170+66	47	47	47	17066	17066	17066	49	218	49	49	5403.8	5403.8		
S. Xavier Street	17100	171+00	34.0	34	34	17100	17100	17100								
	17137	171+37	37	37	37	17137	17137	17137	379	380	205	204	5406.5	5406.5		
	17163	171+63	26	26	26	17163	17163	17163	363	364	203	200	5406.7	5406.7		
Drop 19	17174	171+74	11	11	11	17174	17174	17174	364	368	202	205	5406.6	5406.6		
	17221	172+21	47	47	47	17221	17221	17221	365	365	203	202	5407.6	5407.6		
	17444	174+44	223	223	223	17444	17444	17444	201	201	196	196	5409.1	5409.1		
	17791	177+91	347	347	347	17791	17791	17791	35	36	-	35	5411.9	5411.9		See Note 1.
	17971	179+71	180	180	180	17971	17971	17971	90	89	90	89	5415.0	5415.0		
	18039	180+39	68	68	68	18039	18039	18039	54	164	54	110	5415.1	5415.1		Manually adjusted floodplain and floodway to represent shallow surface flows along S Sheridan Blvd.
Sanderson Gulch / Reach 6 – Sheridan Boulevard to Confluence with North Sanderson Gulch (Lakewood)																
S Sheridan Boulevard	18110	181+10	71.0	71	71	18110	18110	18110								
	18182	181+82	72	72	72	18182	18182	18182	176	174	131	131	5419.6	5419.6		
	18190	181+90	8	8	8	18190	18190	18190	200	199	133	133	5419.7	5419.7		
	18192	181+92	2	2	2	18192	18192	18192	199	200	133	133	5419.6	5419.6		
	18255	182+55	63	63	63	18255	18255	18255	224	224	130	130	5420.3	5420.3		
	18407	184+07	152	152	152	18407	18407	18407	224	223	224	223	5420.6	5420.6		
Drop 20	18531	185+31	124	124	124	18531	18531	18531	428	429	-	428	5426.6	5426.6		See Note 1.

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
	18554	185+54	23	23	23	18554	18554	18554	419	419	419	419	5427.2	5427.2		
	18994	189+94	440	440	440	18994	18994	18994	345	345	345	345	5427.2	5427.2		
	19449	194+49	455	455	455	19449	19449	19449	162	162	162	162	5427.2	5427.2		
	19526	195+26	77	77	77	19526	19526	19526	55	55	55	55	5428.2	5428.2		
ɒew Street Pedestrian Bri	19535	195+35	9.0	9	9	19535	19535	19535								
	19546	195+46	11	11	11	19546	19546	19546	240	235	97	97	5431.1	5431.1		
	19567	195+67	21	21	21	19567	19567	19567	335	335	132	132	5431.3	5431.3		
	19634	196+34	67	67	67	19634	19634	19634	124	124	98	99	5431.2	5431.2		
Drop 21	19693	196+93	59	59	59	19693	19693	19693	77	78	77	78	5431.3	5431.3		
S. Manor Lane	19716	197+16	23.0	23	23	19716	19716	19716								
	19739	197+39	23	23	23	19739	19739	19739	158	87	88	86	5434.0	5434.0		Manually adjusted floodplain and floodway to represent shallow surface flows across S Manor Lane.
	19779	197+79	40	40	40	19779	19779	19779	157	157	157	157	5433.9	5433.9		
Clairfield Reservoir	19790	197+90	11.0	11	11	19790	19790	19790								
	19791	197+91	1	1	1	19791	19791	19791	265	265	265	265	5436.4	5436.4		
	19902	199+02	111	111	111	19902	19902	19902	337	336	337	336	5436.6	5436.6		
	20302	203+02	400	400	400	20302	20302	20302	374	374	374	374	5436.6	5436.6		
	20529	205+29	227	227	227	20529	20529	20529	344	344	344	344	5436.7	5436.7		
	20953	209+53	424	424	424	20953	20953	20953	102	102	102	102	5436.6	5436.6		
Drop 22	21025	210+25	72	72	72	21025	21025	21025	62	62	62	62	5436.8	5436.8		
S Harlan Circle	21050	210+50	25.0	25	25	21050	21050	21050								
	21084	210+84	34	34	34	21084	21084	21084	91	91	91	91	5440.2	5440.2		
	21136	211+36	52	52	52	21136	21136	21136	122	122	122	122	5440.4	5440.4		
	21358	213+58	222	222	222	21358	21358	21358	87	88	-	87	5440.4	5440.4		See Note 1.
	21411	214+11	53	53	53	21411	21411	21411	93	93	93	93	5440.5	5440.5		
Pedestrian Crossing	21430	214+30	19.0	19	19	21430	21430	21430								
	21444	214+44	14	14	14	21444	21444	21444	120	120	-	120	5442.2	5442.2		See Note 1.
	21460	214+60	16	16	16	21460	21460	21460	125	125	125	125	5442.3	5442.3		
Sanderson Gulch / Reach 7 – North Sanderson Gulch Confluence to Green Gables Entrance Road (Lakewood)																
	21574	215+74	114	114	114	21574	21574	21574	141	141	141	140	5442.4	5442.4		
	21588	215+88	14	14	14	21588	21588	21588	122	122	122	122	5442.4	5442.4		
Trail Crossing	21600	216+00	12.0	12	12	21600	21600	21600								
	21617	216+17	17	17	17	21617	21617	21617	94	94	94	94	5442.4	5442.4		
	21644	216+44	27	27	27	21644	21644	21644	81	82	81	82	5442.4	5442.4		
	21733	217+33	89	89	89	21733	21733	21733	55	55	55	55	5442.5	5442.5		
	21768	217+68	35	35	35	21768	21768	21768	55	56	56	56	5442.5	5442.5		
W Jewell Avenue	21950	219+50	182.0	182	182	21950	21950	21950								
	22127	221+27	177	177	177	22127	22127	22127	339	339	61	58	5452.4	5452.4		
	22138	221+38	11	11	11	22138	22138	22138	331	334	44	44	5452.4	5452.4		
	22199	221+99	61	61	61	22199	22199	22199	278	278	43	43	5452.4	5452.4		
Drop 23	22245	222+45	46	46	46	22245	22245	22245	238	238	39	41	5452.3	5452.3		
	22374	223+74	129	129	129	22374	22374	22374	100	101	68	65	5453.7	5453.7		
	22465	224+65	91	91	91	22465	22465	22465	59	91	59	59	5453.6	5453.6		Manually adjusted to represent floodplain split flow.
	22516	225+16	51	51	51	22516	22516	22516	47	82	-	47	5455.4	5455.4		See Note 1. Manually adjusted to represent floodplain split flow.
S Lake Road	22530	225+30	14.0	14	14	22530	22530	22530								
	22565	225+65	35	35	35	22565	22565	22565	82	82	59	59	5457.0	5457.0		

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
	22600	226+00	35	35	35	22600	22600	22600	42	42	42	42	5457.1	5457.1		
	22725	227+25	125	125	125	22725	22725	22725	37	37	37	36	5458.2	5458.2		
Drop 24	22757	227+57	32	32	32	22757	22757	22757	271	268	68	68	5462.3	5462.3		
	22788	227+88	31	31	31	22788	22788	22788	235	235	100	101	5462.8	5462.8		
Shwayder Pond Berm	22800	228+00	12.0	12	12	22800	22800	22800								
	22816	228+16	16	16	16	22816	22816	22816	315	319	294	295	5463.9	5463.9		
	22851	228+51	35	35	35	22851	22851	22851	286	286	286	286	5464.0	5464.0		
	23168	231+68	317	317	317	23168	23168	23168	172	174	172	174	5464.0	5464.0		
	23464	234+64	296	296	296	23464	23464	23464	107	107	107	107	5464.0	5464.0		
	23572	235+72	108	108	108	23572	23572	23572	79	163	79	79	5464.0	5464.0		Manually adjusted to provide a more reasonable transition of the floodplain.
Green Gables Entrance Road	23650	236+50	78.0	78	78	23650	23650	23650								
Sanderson Gulch / Reach 8 – Green Gables Country Club (Jefferson County)																
	23715	237+22	65	65	65	23715	23715	23715	417	435	417	435	5473.1	5473.1		
	23724	23724	9	9	9	23724	23724	23724	445	451	445	451	5473.1	5473.1		
	23863	23863	139.0	139	139	23863	23863	23863	373	374	373	374	5473.1	5473.1		
	23978	23978	115	115	115	23978	23978	23978	316	317	316	317	5473.1	5473.1		
	24069	24069	91	91	91	24069	24069	24069	254	255	254	254	5473.1	5473.1		
	24222	24222	153	153	153	24222	24222	24222	242	242	242	242	5473.1	5473.1		
	24387	24387	165	165	165	24387	24387	24387	185	186	185	185	5473.1	5473.1		
	24419	24419	32.0	32	32	24419	24419	24419	142	142	142	142	5473.1	5473.1		
	24517	24517	98	98	98	24517	24517	24517	94	94	94	94	5473.2	5473.2		
	24644	24644	127	127	127	24644	24644	24644	86	85	86	85	5473.6	5473.6		
	24683	24683	39	39	39	24683	24683	24683	60	61	60	61	5474.0	5474.0		
	24693	24693	10	10	10	24693	24693	24693	46	45	46	45	5474.0	5474.0		
Cart Path	24720	24720	27.0	27	27	24720	24720	24720								
	24746	24746	26	26	26	24746	24746	24746	48	47	48	47	5474.1	5474.1		
	24753	24753	7	7	7	24753	24753	24753	60	60	60	60	5474.4	5474.4		
	24785	24785	32	32	32	24785	24785	24785	88	88	88	88	5474.5	5474.5		
	24802	24802	17	17	17	24802	24802	24802	93	93	93	92	5474.6	5474.6		
	24842	24842	40	40	40	24842	24842	24842	98	98	98	98	5474.8	5474.8		
	24873	24873	31	31	31	24873	24873	24873	98	98	98	98	5475.0	5475.0		
	24907	24907	34	34	34	24907	24907	24907	77	77	-	77	5476.2	5476.2		See Note 1.
	24944	24944	37	37	37	24944	24944	24944	88	88	88	88	5477.3	5477.3		
	25097	25097	153	153	153	25097	25097	25097	91	91	91	91	5479.0	5479.0		
	25124	25124	27.0	27	27	25124	25124	25124	91	92	91	92	5479.2	5479.2		
	25157	25157	33	33	33	25157	25157	25157	91	92	91	92	5479.4	5479.4		
	25266	25266	109	109	109	25266	25266	25266	93	93	93	93	5480.0	5480.0		
	25299	25299	33	33	33	25299	25299	25299	94	94	94	94	5480.2	5480.2		
	25332	25332	33	33	33	25332	25332	25332	94	94	-	94	5482.2	5482.2		See Note 1.
	25365	25365	33.0	33	33	25365	25365	25365	91	90	91	90	5483.1	5483.1		
	25475	25475	110	110	110	25475	25475	25475	92	91	92	91	5484.2	5484.2		
	25564	25564	89	89	89	25564	25564	25564	83	84	83	84	5484.7	5484.7		
	25608	25608	44	44	44	25608	25608	25608	82	82	82	81	5485.0	5485.0		
	25670	25670	62	62	62	25670	25670	25670	64	64	64	64	5485.4	5485.4		
	25691	25691	21	21	21	25691	25691	25691	53	53	53	53	5485.4	5485.4		
Cart Path	25730	25730	39.0	39	39	25730	25730	25730								

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
	25773	25773	43	43	43	25773	25773	25773	47	48	47	48	5485.7	5485.7		
	25786	25786	13	13	13	25786	25786	25786	70	70	70	70	5485.9	5485.9		
	25803	25803	17	17	17	25803	25803	25803	81	79	81	79	5485.9	5485.9		
	25823	25823	20	20	20	25823	25823	25823	79	80	79	80	5486.2	5486.2		
	25856	25856	33	33	33	25856	25856	25856	71	71	-	71	5486.9	5486.9		See Note 1.
	25890	25890	34	34	34	25890	25890	25890	80	80	80	80	5487.7	5487.7		
	25923	25923	33	33	33	25923	25923	25923	85	85	85	85	5488.2	5488.2		
	25956	25956	33	33	33	25956	25956	25956	82	82	82	82	5488.5	5488.5		
	25989	25989	33	33	33	25989	25989	25989	83	83	83	82	5488.9	5488.9		
	26023	26023	34	34	34	26023	26023	26023	82	82	82	82	5489.2	5489.2		
	26056	26056	33	33	33	26056	26056	26056	79	79	79	79	5491.0	5491.0		
	26089	26089	33	33	33	26089	26089	26089	66	66	-	66	5491.6	5491.6		See Note 1.
	26230	26230	141	141	141	26230	26230	26230	63	63	63	63	5493.3	5493.3		
	26373	26373	143	143	143	26373	26373	26373	72	72	72	72	5494.2	5494.2		
	26407	26407	34	34	34	26407	26407	26407	65	65	65	65	5494.4	5494.4		
	26471	26471	64	64	64	26471	26471	26471	66	66	66	66	5494.8	5494.8		
	26667	26667	196	196	196	26667	26667	26667	62	62	62	62	5495.6	5495.6		
	26731	26731	64	64	64	26731	26731	26731	59	59	59	59	5495.8	5495.8		
	26925	26925	194	194	194	26925	26925	26925	67	67	67	67	5497.2	5497.2		
	27021	27021	96	96	96	27021	27021	27021	51	51	51	51	5497.5	5497.5		
Sanderson Gulch / Reach 9 –S. Wadsworth Blvd. to S. Allison Street (Lakewood)																
	27050	27050	29	29	29	27050	27050	27050	42	42	42	42	5501.8	5501.8		
	27058	27058	8	8	8	27058	27058	27058	462	460	144	-	5506.3	5506.3		
	27121	27121	63.0	63	63	27121	27121	27121	462	460	-	-	5506.9	5506.9		
	27170	27170	49	49	49	27170	27170	27170	639	640	-	-	5507.0	5507.0		
	27400	27400	230	230	230	27400	27400	27400	537	538	-	-	5511.5	5511.5		
	27624	27624	224	224	224	27624	27624	27624	708	708	-	-	5516.3	5516.3		
	27867	27867	243	243	243	27867	27867	27867	689	689	-	-	5518.0	5518.0		
	28069	28069	202.0	202	202	28069	28069	28069	85	85	-	-	5519.9	5519.9		
	28383	28383	314	314	314	28383	28383	28383	81	81	-	-	5523.1	5523.1		
Sanderson Gulch / Reach 10 – S. Allison Street to Jewell Park Pond (Lakewood)																
	28656	28656	273	273	273	28656	28656	28656	142	142	70	70	5530.7	5530.7		
	28677	28677	21	21	21	28677	28677	28677	129	129	46	47	5530.7	5530.7		
	28858	28858	181	181	181	28858	28858	28858	31	31	-	31	5530.8	5530.8		See Note 1.
	28886	28886	28	28	28	28886	28886	28886	30	62	30	29	5531.7	5531.7		Manually adjusted to provide a more reasonable transition of the floodplain.
S Ammons Street	28910	28910	24.0	24	24	28910	28910	28910								
	28952	28952	42	42	42	28952	28952	28952	88	88	38	38	5536.7	5536.7		
	28972	28972	20	20	20	28972	28972	28972	80	80	37	37	5536.7	5536.7		
	29187	29187	215.0	215	215	29187	29187	29187	25	25	25	25	5536.3	5536.3		
	29219	29219	32	32	32	29219	29219	29219	21	58	21	21	5536.9	5536.9		Manually adjusted to provide a more reasonable transition of the floodplain.
S Balsam Street	29250	29250	31.0	31	31	29250	29250	29250								
	29281	29281	31	31	31	29281	29281	29281	85	85	28	28	5542.5	5542.5		
	29301	29301	20	20	20	29301	29301	29301	71	72	30	30	5542.4	5542.4		
	29468	29468	167.0	167	167	29468	29468	29468	34	34	-	33	5543.2	5543.2		See Note 1.
	29483	29483	15	15	15	29483	29483	29483	35	35	35	35	5543.8	5543.8		
	29670	29670	187	187	187	29670	29670	29670	36	36	-	36	5546.4	5546.4		See Note 1.
	29693	29693	23	23	23	29693	29693	29693	37	36	37	36	5546.9	5546.9		

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City and County of Denver / City of Lakewood
Flooding Source: Sanderson Gulch - 0.5' ΔEGL
Reach: Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
	29840	29840	147	147	147	29840	29840	29840	27	27	27	27	5548.3	5548.3		
	29879	29879	39	39	39	29879	29879	29879	33	54	33	32	5549.5	5549.5		
S Carr Street	29920	29920	41.0	41	41	29920	29920	29920								
	29959	29959	39	39	39	29959	29959	29959	113	113	40	40	5553.8	5553.8		
	29983	29983	24.0	24	24	29983	29983	29983	87	87	37	37	5553.7	5553.7		
	30143	30143	160	160	160	30143	30143	30143	28	28	-	28	5554.4	5554.4		See Note 1.
	30176	30176	33	33	33	30176	30176	30176	36	49	36	35	5555.7	5555.7		
S Cody Street	30210	30210	34.0	34	34	30210	30210	30210								
	30242	30242	32	32	32	30242	30242	30242	111	110	35	35	5558.8	5558.8		
	30267	30267	25.0	25	25	30267	30267	30267	77	78	31	31	5558.8	5558.8		
	30600	30600	333	333	333	30600	30600	30600	27	27	27	26	5559.6	5559.6		
	30648	30648	48	48	48	30648	30648	30648	37	37	35	36	5562.8	5562.8		
	30952	30952	304	304	304	30952	30952	30952	29	29	29	29	5567.4	5567.4		
	31183	31183	231	231	231	31183	31183	31183	30	30	-	30	5572.8	5572.8		See Note 1.
Drop 35	31225	31225	42	42	42	31225	31225	31225	24	24	24	23	5574.4	5574.4		
Jewell Park Rese	31240	31240	15.0	15	15	31240	31240	31240								
	31253	31253	13	13	13	31253	31253	31253	321	321	321	321	5577.1	5577.1		
Sanderson Gulch / Reach 11 - Jewell Park Pond to Kendrick Reservoir (Lakewood)																
	31299	31299	46	46	46	31299	31299	31299	318	318	318	318	5577.7	5577.7		
	31702	31702	403	403	403	31702	31702	31702	175	175	175	175	5577.7	5577.7		
	31745	31745	43	43	43	31745	31745	31745	41	41	41	41	5577.7	5577.7		
Jewell Park Rese	31770	31770	25.0	25	25	31770	31770	31770								
	31798	31798	28	28	28	31798	31798	31798	251	251	251	251	5580.7	5580.7		
	31852	31852	54	54	54	31852	31852	31852	237	238	237	237	5580.7	5580.7		
	32249	32249	397.0	397	397	32249	32249	32249	45	46	-	46	5580.6	5580.6		See Note 1.
	32544	32544	295	295	295	32544	32544	32544	26	26	26	26	5584.5	5584.5		
	32581	32581	37	37	37	32581	32581	32581	29	29	29	29	5585.5	5585.5		
S Garrison Street	32660	32660	79.0	79	79	32660	32660	32660								
	32749	32749	89	89	89	32749	32749	32749	137	137	62	62	5597.9	5597.9		
	32754	32754	5	5	5	32754	32754	32754	136	136	61	61	5597.9	5597.9		
	32802	32802	48	48	48	32802	32802	32802	135	135	60	60	5597.9	5597.9		
	33247	33247	445	445	445	33247	33247	33247	41	41	41	41	5597.9	5597.9		
	33639	33639	392	392	392	33639	33639	33639	8	9	8	9	5599.6	5599.6		
	33768	33768	129	129	129	33768	33768	33768	17	17	17	17	5600.6	5600.6		
	33942	33942	174	174	174	33942	33942	33942	13	13	13	13	5617.3	5617.3		
Kendrick Reservoir	33960	33960	18.0	18	18	33960	33960	33960								
	33973	33973	13	13	13	33973	33973	33973	43	43	43	43	5617.7	5617.7		
Sanderson Gulch / Reach 12 – Kendrick Reservoir to Smith Reservoir (Lakewood)																
	34195	34195	222	222	222	34195	34195	34195	557	557	557	557	5617.7	5617.7		
	34654	34654	459	459	459	34654	34654	34654	885	887	885	887	5617.7	5617.7		
	35102	35102	448	448	448	35102	35102	35102	1049	1049	1049	1049	5617.7	5617.7		
	35447	35447	345	345	345	35447	35447	35447	1076	1077	1076	1077	5617.7	5617.7		

Note:

1. To prevent negative surcharge, floodway top width was set conincident with the floodplain.

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City of Lakewood
Flooding Source: North Sanderson Gulch - 0.5' ΔEGL
Reach: North Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
North Sanderson Gulch Split Flow in W Kalahan Avenue – S Pierce Street to 100 Feet downstream of W Calahan Street Crossing at North Sanderson Gulch (Lakewood)																
S Pierce Street	55	0+55	55	55	55	55	55	55	68	99	68	77	5480.7	5480.7	OK	
	173	1+73	118	118	118	173	173	173	71	98	40	40	5481.3	5481.3	OK	Manually adjusted floodplain to provide a smooth transition within a split flow area.
	436	4+36	263	263	263	436	436	436	81	83	48	48	5482.4	5482.4	OK	
	744	7+44	308	308	308	744	744	744	88	88	42	42	5485.0	5485.0	OK	
S Quay Drive	847	8+47	103	103	103	847	847	847	116	116	42	42	5486.0	5486.0	OK	
	1108	11+08	261	261	261	1108	1108	1108	158	164	42	42	5489.1	5489.1	OK	
	1338	13+38	230	230	230	1338	1338	1338	73	74	43	43	5491.5	5491.5	OK	
	1425	14+25	87	87	87	1425	1425	1425	98	98	42	42	5492.4	5492.4	OK	
S Upham Street	1528	15+28	103	103	103	1528	1528	1528	87	87	48	48	5494.7	5494.7	OK	
	1606	16+06	78	78	78	1606	1606	1606	29	59	52	52	5496.8	5496.8	OK	Manually adjusted floodplain to provide a smooth transition within a split flow area.
North Sanderson Gulch / Reach NS1 – Sanderson Gulch Confluence to S. Pierce Street (Lakewood)																
	86	0+86	86	86	86	86	86	86	95	95	95	95	5442.4	5442.4		
	161	1+61	75	75	75	161	161	161	80	80	80	80	5442.4	5442.4		
Drop N1	196	1+96	35	35	35	196	196	196	74	74	-	74	5443.1	5443.1		See Note 1.
	322	3+22	126	126	126	322	322	322	84	84	84	84	5444.3	5444.3		
	548	5+48	226	226	226	548	548	548	44	44	44	44	5444.9	5444.9		
Drop N2	577	5+77	29	29	29	577	577	577	63	63	63	63	5447.7	5447.7		
	625	6+25	48	48	48	625	625	625	121	122	121	122	5449.1	5449.1		
	724	7+24	99	99	99	724	724	724	39	39	39	39	5449.1	5449.1		
Drop N3	741	7+41	17	17	17	741	741	741	45	45	-	45	5452.5	5452.5		See Note 1.
	815	8+15	74	74	74	815	815	815	41	41	41	41	5453.5	5453.5		
Drop N4	870	8+70	55	55	55	870	870	870	61	61	61	61	5453.9	5453.9		
S Harlan Circle	900	9+00	30.0	30	30	900	900	900								
	912	9+12	12	12	12	912	912	912	75	73	75	73	5457.0	5457.0		
	929	9+29	17	17	17	929	929	929	72	72	72	72	5457.2	5457.2		
	1214	12+14	285	285	285	1214	1214	1214	110	110	110	110	5457.6	5457.6		
Drop N5	1242	12+42	28	28	28	1242	1242	1242	120	120	120	119	5457.6	5457.6		
	1319	13+19	77	77	77	1319	1319	1319	120	122	120	122	5458.1	5458.1		
	1355	13+55	36	36	36	1355	1355	1355	161	161	161	161	5458.8	5458.8		
Pedestrian Crossing	1365	13+65	10.0	10	10	1365	1365	1365								
	1374	13+74	9	9	9	1374	1374	1374	165	165	165	165	5458.9	5458.9		
Drop N6	1392	13+92	18	18	18	1392	1392	1392	194	193	194	193	5459.0	5459.0		
	1490	14+90	98	98	98	1490	1490	1490	251	251	251	250	5459.1	5459.1		
	1666	16+66	176	176	176	1666	1666	1666	66	69	-	69	5459.3	5459.3		See Note 1.
Drop N7	1696	16+96	30	30	30	1696	1696	1696	124	124	-	124	5461.7	5461.7		See Note 1.
	1847	18+47	151	151	151	1847	1847	1847	76	76	76	76	5463.1	5463.1		
	1942	19+42	95	95	95	1942	1942	1942	50	50	50	50	5463.7	5463.7		
	1974	19+74	32	32	32	1974	1974	1974	42	42	42	42	5465.1	5465.1		

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City of Lakewood
Flooding Source: North Sanderson Gulch - 0.5' ΔEGL
Reach: North Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
Pedestrian Crossing	1985	19+85	11.0	11	11	1985	1985	1985								
	1994	19+94	9	9	9	1994	1994	1994	92	92	-	92	5467.8	5467.8		See Note 1.
Drop N8	2003	20+03	9	9	9	2003	2003	2003	84	84	-	83	5467.8	5467.8		See Note 1.
	2188	21+88	185	185	185	2188	2188	2188	132	132	132	132	5469.2	5469.2		
	2245	22+45	57	57	57	2245	2245	2245	142	142	142	141	5469.2	5469.2		
	2271	22+71	26	26	26	2271	2271	2271	121	121	121	121	5469.2	5469.2		
Trail Bridge	2280	22+80	9.0	9	9	2280	2280	2280								
	2288	22+88	8	8	8	2288	2288	2288	128	128	128	128	5470.0	5470.0		
	2306	23+06	18	18	18	2306	2306	2306	131	131	131	130	5470.0	5470.0		
	2459	24+59	153	153	153	2459	2459	2459	42	42	42	42	5470.1	5470.1		
Drop N9	2478	24+78	19	19	19	2478	2478	2478	54	54	-	53	5472.5	5472.5		See Note 1.
	2711	27+11	233	233	233	2711	2711	2711	47	47	47	46	5475.3	5475.3		
Drop N10	2745	27+45	34	34	34	2745	2745	2745	45	45	-	44	5476.0	5476.0		See Note 1.
	2797	27+97	52	52	52	2797	2797	2797	252	251	105	105	5477.3	5477.3		
North Sanderson Gulch / Reach NS2 – S. Pierce Street to Wadsworth Boulevard (Lakewood)																
S Pierce Street	2900	29+00	2900.0	2,900	2,900	2900	2900	2900								
	2913	29+13	13	13	13	2913	2913	2913	306	450	181	299	5478.0	5478.0		Manually adjusted floodplain and floodway to provide a smooth transition within a split flow area.
	2973	29+73	60	60	60	2973	2973	2973	176	178	141	141	5478.4	5478.4		
	3291	32+91	318	318	318	3291	3291	3291	34	34	34	33	5481.4	5481.4		
	3633	36+33	342	342	342	3633	3633	3633	24	24	22	22	5484.8	5484.8		
	3680	36+80	47	47	47	3680	3680	3680	70	71	17	18	5485.5	5485.5		
S Quay Drive	3710	37+10	30.0	30	30	3710	3710	3710								
	3731	37+31	21	21	21	3731	3731	3731	78	78	17	17	5486.0	5486.0		
	3744	37+44	13	13	13	3744	3744	3744	78	78	21	21	5485.9	5485.9		
	3995	39+95	251	251	251	3995	3995	3995	21	78	21	21	5488.4	5488.4		Manually adjusted floodplain to provide a smooth transition within a split flow area.
	4237	42+37	242	242	242	4237	4237	4237	28	28	28	28	5491.5	5491.5		
	4295	42+95	58	58	58	4295	4295	4295	18	18	18	18	5491.9	5491.9		
S Upham Street	4325	43+25	30.0	30	30	4325	4325	4325								
	4355	43+55	30	30	30	4355	4355	4355	62	63	25	62	5494.5	5494.5		
	4394	43+94	39	39	39	4394	4394	4394	32	31	26	31	5494.6	5494.6		
	4529	45+29	135	135	135	4529	4529	4529	32	32	32	32	5494.8	5494.8		
	4583	45+83	54	54	54	4583	4583	4583	32	33	32	32	5495.3	5495.3		
	4630	46+30	47	47	47	4630	4630	4630	20	20	20	19	5495.4	5495.4		
W Calahan Avenue	4660	46+60	30.0	30	30	4660	4660	4660								
	4685	46+85	25	25	25	4685	4685	4685	145	223	37	37	5498.2	5498.2		Manually adjusted floodplain to provide a smooth transition.
	4752	47+52	67	67	67	4752	4752	4752	35	237	35	37	5498.2	5498.2		
Drop N11	4777	47+77	25	25	25	4777	4777	4777	245	245	40	40	5499.9	5499.9		
	5075	50+75	298	298	298	5075	5075	5075	30	30	30	29	5502.5	5502.5		
	5379	53+79	304	304	304	5379	5379	5379	28	28	28	28	5504.6	5504.6		

TABLE D-2 - AGREEMENT TABLE: FDT - PROFILE - MAP

PROJECT NAME: Sanderson Gulch FHAD Update **CASE/PROJECT No:** 106427

Community(ies): City of Lakewood
Flooding Source: North Sanderson Gulch - 0.5' ΔEGL
Reach: North Sanderson Gulch

Engineer: Robert Krehbiel / Hung-Teng Ho
Date: 10/24/2018

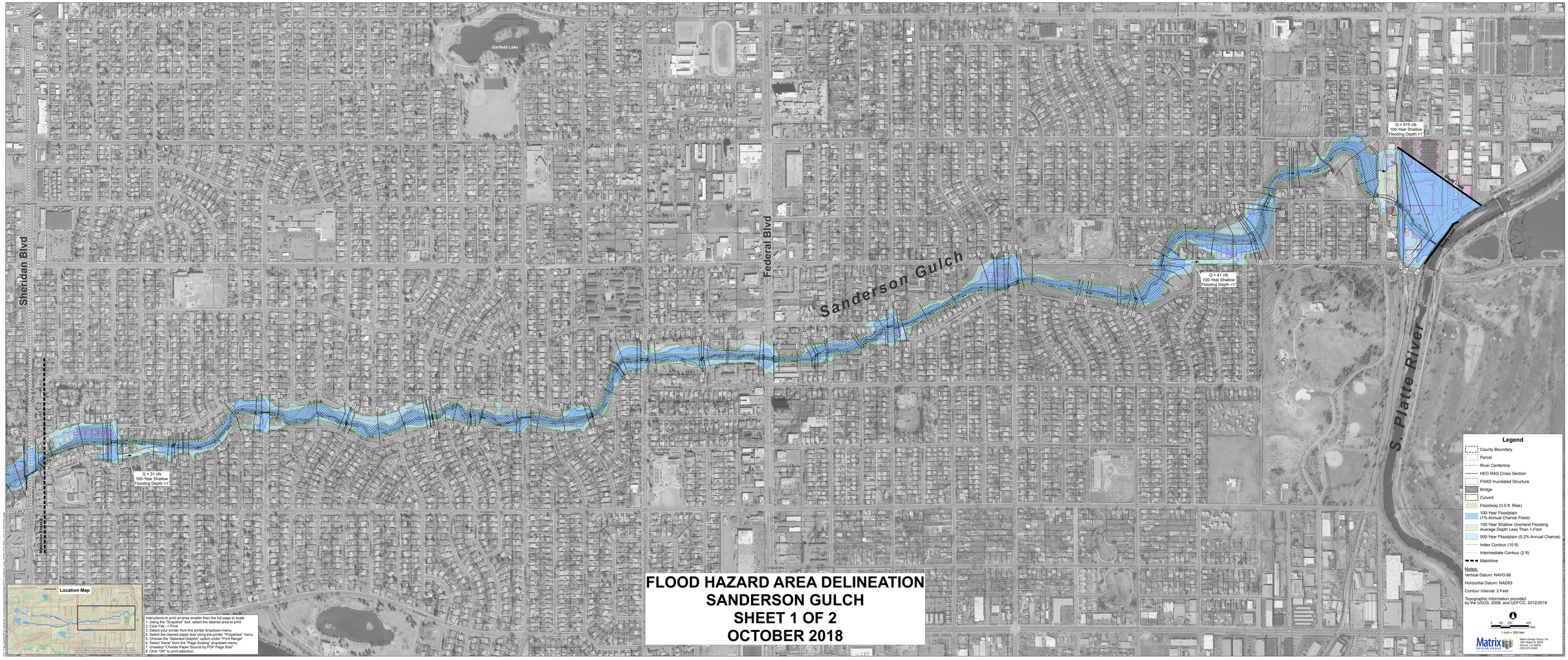
Reference Location	Cross Section	River Station	Distance b/a RS, ft			Cumulative Distance, ft			FP Width, ft		FW Width, ft		BFE, ft		BFE Loc.	Comments and/or Explanations
			Model	Profile	Map	Model	Profile	Map	Model	Map	Model	Map	Model	Profile		
Drop N12	5415	54+15	36	36	36	5415	5415	5415	32	32	-	32	5506.2	5506.2		See Note 1.
	5564	55+64	149	149	149	5564	5564	5564	30	30	30	30	5507.7	5507.7		
Drop N13	5601	56+01	37	37	37	5601	5601	5601	43	43	39	43	5509.8	5509.8		
	5703	57+03	102	102	102	5703	5703	5703	40	44	40	40	5510.6	5510.6		
	5759	57+59	56	56	56	5759	5759	5759	207	207	73	73	5513.5	5513.5		
North Sanderson Gulch / Reach NS3 – S. Wadsworth Boulevard to S. Balsam Court (Lakewood)																
S Wadsworth Boulevard	5830	58+30	5830.0	5,830	5,830	5830	5830	5830								
	5897	58+97	67	67	67	5897	5897	5897	419	419	33	33	5516.4	5516.4		
	5929	59+29	32	32	32	5929	5929	5929	445	445	30	30	5516.4	5516.4		
	6180	61+80	251	251	251	6180	6180	6180	284	284	40	40	5518.4	5518.4		
	6490	64+90	310	310	310	6490	6490	6490	28	28	28	28	5519.7	5519.7		
Drop N14	6499	64+99	9	9	9	6499	6499	6499	26	26	26	26	5519.6	5519.6		
	6894	68+94	395	395	395	6894	6894	6894	27	26	27	26	5524.3	5524.3		
	7215	72+15	321	321	321	7215	7215	7215	21	21	21	21	5527.9	5527.9		
	7287	72+87	72	72	72	7287	7287	7287	25	25	25	25	5529.0	5529.0		
	7327	73+27	40	40	40	7327	7327	7327	21	21	21	21	5529.7	5529.7		
S Allison Street	7380	73+80	53.0	53	53	7380	7380	7380								
	7415	74+15	35	35	35	7415	7415	7415	77	77	52	52	5534.0	5534.0		
	7444	74+44	29	29	29	7444	7444	7444	28	28	27	28	5534.5	5534.5		
	7549	75+49	105	105	105	7549	7549	7549	27	27	27	27	5534.8	5534.8		
	7673	76+73	124	124	124	7673	7673	7673	21	21	21	21	5535.2	5535.2		
Drop N16	7684	76+84	11	11	11	7684	7684	7684	24	24	-	24	5536.1	5536.1		See Note 1.
	7933	79+33	249	249	249	7933	7933	7933	23	23	23	23	5539.5	5539.5		
	8033	80+33	100	100	100	8033	8033	8033	22	22	22	22	5540.7	5540.7		
S Balsam Ct	8249	82+49	216.0	216	216	8249	8249	8249	66	66	52	51	5544.5	5544.5		
	8523	85+23	274	274	274	8523	8523	8523	67	67	57	57	5548.4	5548.4		
	8801	88+01	278	278	278	8801	8801	8801	61	62	54	54	5552.3	5552.3		
	9065	90+65	264	264	264	9065	9065	9065	59	59	52	52	5556.9	5556.9		
	9339	93+39	274	274	274	9339	9339	9339	64	66	53	53	5561.2	5561.2		
S Dover Ct	9604	96+04	265.0	265	265	9604	9604	9604	63	63	60	59	5563.4	5563.4		
	9855	98+55	251	251	251	9855	9855	9855	58	58	57	56	5566.9	5566.9		
	10128	101+28	273	273	273	10128	10128	10128	61	61	51	51	5571.4	5571.4		
S Endicott Street	10624	106+24	496	496	496	10624	10624	10624	54	54	-	54	5580.8	5580.8		See Note 1.
	10880	108+80	256	256	256	10880	10880	10880	56	55	40	39	5586.8	5586.8		
S Garrison Street	11451	114+51	571	571	571	11451	11451	11451	162	163	97	97	5594.9	5594.9		

Note:

1. To prevent negative surcharge, floodway top width was set conincident with the floodplain.

APPENDIX E

FLOOD MAPS



FLOOD HAZARD AREA DELINEATION
SANDERSON GULCH
SHEET 1 OF 2
OCTOBER 2018

Location Map

Instructions to print an area smaller than the full page to scale:
1. Using the "Snapshot" tool, select the desired area to print.
2. Click File --> Print
3. Select your printer from the printer dropdown menu.
4. Select the desired paper size using the printer "Properties" menu.
5. Choose the "Selected Graphic" option under "Print Range"
6. Select "None" from the "Page Scaling" dropdown menu.
7. Unselect "Choose Paper Source by PDF Page Size".
8. Click "OK" to print selection.

Legend

- County Boundary
- Parcel
- River Centerline
- HEC-RAS Cross Section
- FHAD Inundated Structure
- Bridge
- Culvert
- Floodway (0.5 ft. Rise)
- 100-Year Floodplain (1% Annual Chance Flood)
- 100-Year Shallow Overland Flooding Average Depth Less Than 1-Foot
- 500-Year Floodplain (0.2% Annual Chance)
- Index Contour (10 ft)
- Intermediate Contour (2 ft)
- Matchline

Notes:

Vertical Datum: NAVD 88

Horizontal Datum: NAD83

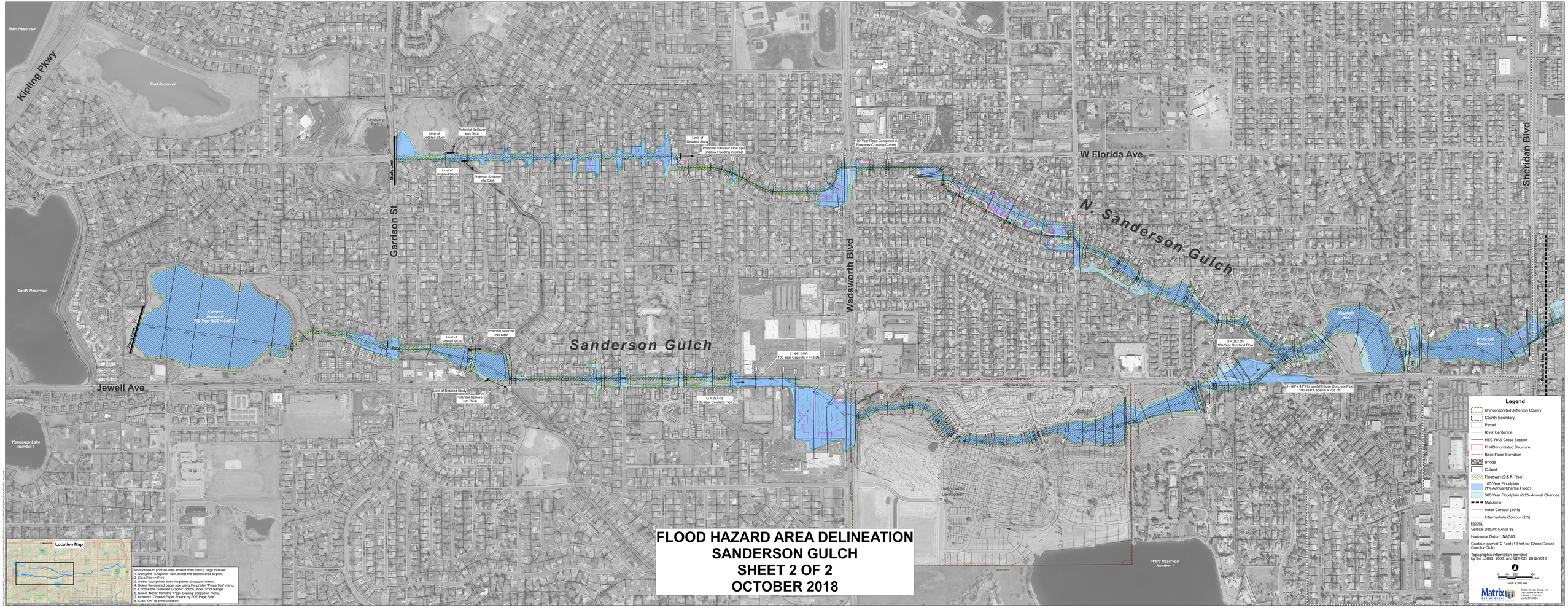
Contour Interval: 2 Feet

Topographic information provided by the USGS, 2008, and UDFCD, 2012/2018

0 100 200 400 Feet

1 inch = 200 feet

Matrix Design Group, Inc
2435 Research Pkwy
Denver, CO 80912
(303) 972-2200



FLOOD HAZARD AREA DELINEATION
SANDERSON GULCH
SHEET 2 OF 2
OCTOBER 2018

APPENDIX F

FLOOD PROFILES

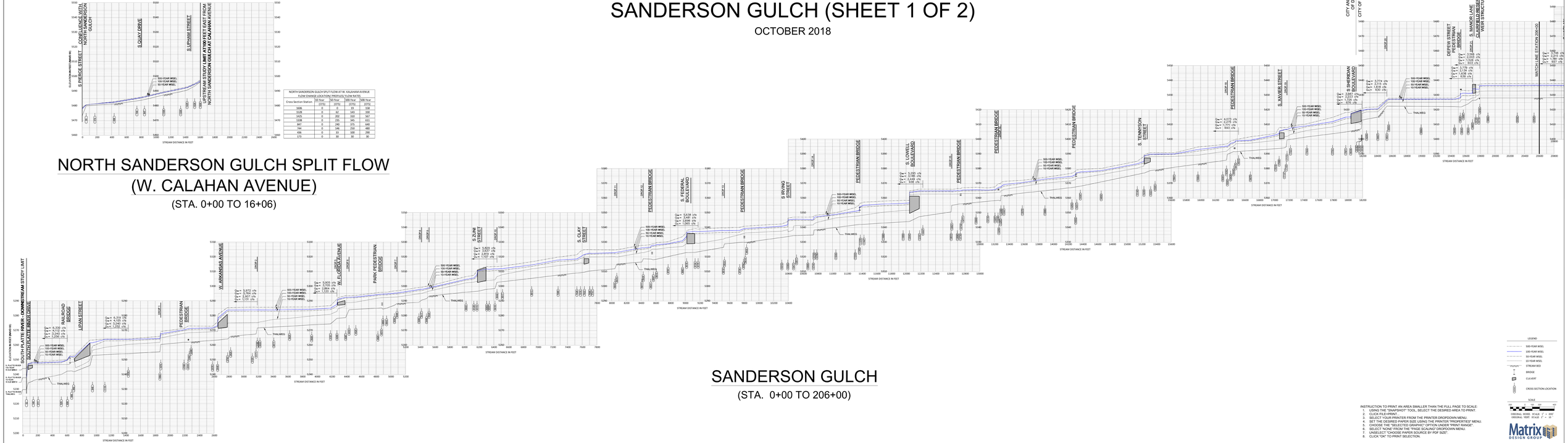
FLOOD HAZARD AREA DELINEATION UPDATE
SANDERSON GULCH (SHEET 1 OF 2)

OCTOBER 2018

NORTH SANDERSON GULCH SPLIT FLOW AT W. KALAHAN AVENUE FLOW CHANGE LOCATION / PROFILE/ FLOW RATES				
Cross Section Station	10-Year (CFS)	50-Year (CFS)	100-Year (CFS)	500-Year (CFS)
3506	0	0	19	158
3528	0	62	143	330
3425	0	202	310	567
3308	0	235	345	613
847	0	240	375	640
744	0	346	250	480
436	0	33	100	290
173	0	30	30	30

NORTH SANDERSON GULCH SPLIT FLOW
(W. CALAHAN AVENUE)

(STA. 0+00 TO 16+06)



SANDERSON GULCH

(STA. 0+00 TO 206+00)

LEGEND

- 500-YEAR WSEL
- 100-YEAR WSEL
- 50-YEAR WSEL
- 10-YEAR WSEL
- STREAM BED
- BRIDGE
- CULVERT
- CROSS SECTION LOCATION

SCALE

0 250 500 1000 1500 2000 2500 3000 3500 4000

ORIGINAL WIDE SCALE 1" = 500'
ORIGINAL YEAR SCALE 1" = 10'

INSTRUCTION TO PRINT AN AREA SMALLER THAN THE FULL PAGE TO SCALE:

1. USING THE "SNAPSHOT" TOOL, SELECT THE DESIRED AREA TO PRINT.
2. CLICK FILE=PRINT...
3. SELECT YOUR PRINTER FROM THE PRINTER DROPDOWN MENU.
4. SET THE "DESIRED PAPER SIZE" USING THE PRINTER "PROPERTIES" MENU.
5. CHOOSE THE "SELECTED GRAPHIC" OPTION UNDER "PRINT RANGE".
6. SELECT "NONE" FROM THE "PAGE SCALING" DROPDOWN MENU.
7. UNSELECT "CHOOSE PAPER SOURCE BY PDF SIZE".
8. CLICK "OK" TO PRINT SELECTION.

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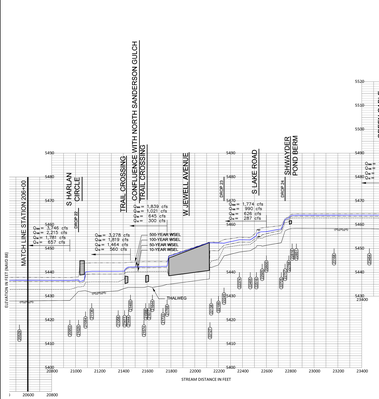
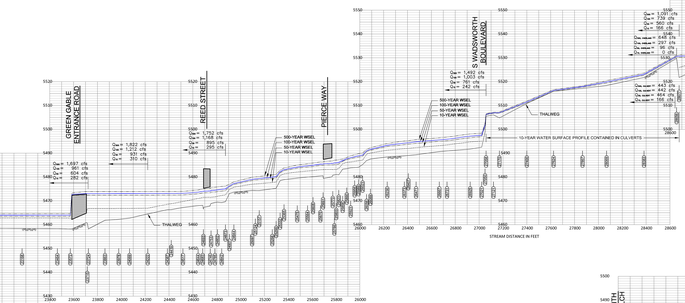
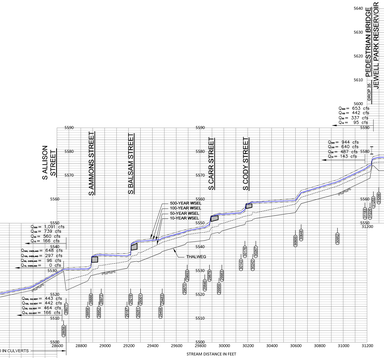
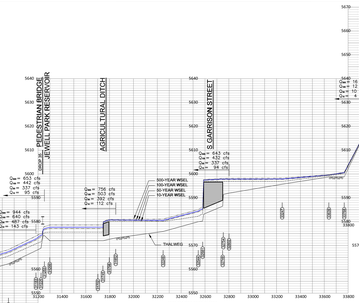
FLOOD HAZARD AREA DELINEATION UPDATE
SANDERSON GULCH (SHEET 2 OF 2)

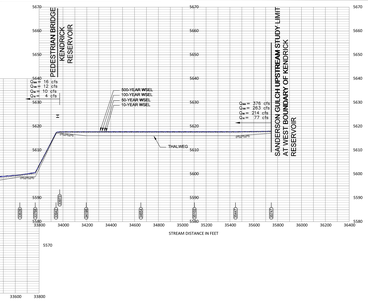
OCTOBER 2018

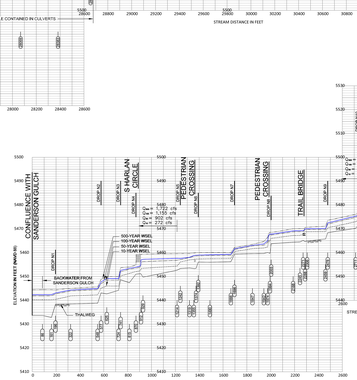


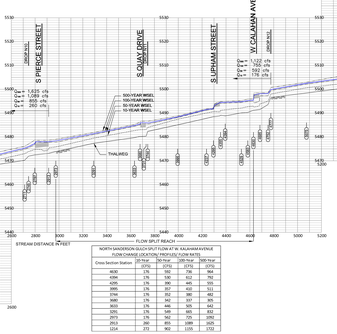


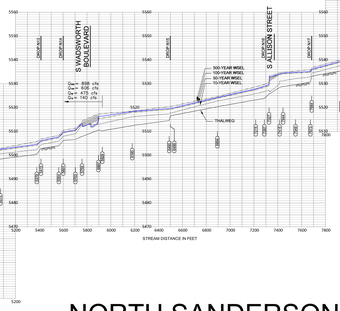


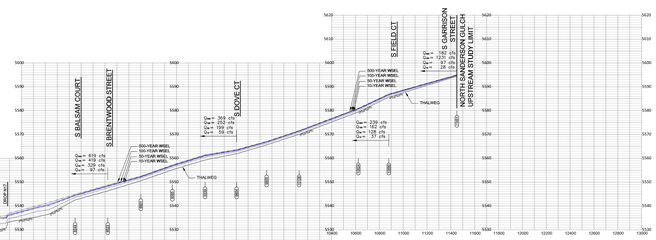












SANDERSON GULCH

(STA. 206+00 TO 357+47)

NORTH SANDERSON GULCH SPLIT FLOW AT W. KALAHAN AVENUE
FLOW CHANGE LOCATION / PROFILES FLOW NOTE

Cross Section Station	100-Year (CFS)	50-Year (CFS)	10-Year (CFS)	Split Flow (CFS)
6830	175	592	795	564
6384	175	530	612	792
6085	175	499	612	531
5945	175	372	420	531
5766	175	352	380	482
5680	175	342	317	325
3633	175	646	505	642
3291	175	549	505	833
2973	175	342	159	3292
2573	175	342	159	3292
2224	272	468	1205	3722

NORTH SANDERSON GULCH

(STA. 0+00 TO 114+51)

LEGEND

- 500-YEAR WSEL
- 100-YEAR WSEL
- 50-YEAR WSEL
- 10-YEAR WSEL
- STREAM BED
- BRIDGE
- CULVERT
- CROSS SECTION LOCATION

SCALE

ORIGINAL SIZE: 30"x36" SCALE: 1" = 300'
ORIGINAL SIZE: 11"x17" SCALE: 1" = 50'

INSTRUCTION TO PRINT AN AREA SMALLER THAN THE FULL PAGE TO SCALE:

1. USING THE "SNAPSHOT" TOOL, SELECT THE DESIRED AREA TO PRINT.
2. SELECT "PRINT".
3. SELECT YOUR PRINTER FROM THE PRINTER DROPDOWN MENU.
4. SET THE DESIRED PAPER SIZE USING THE PRINTER "PROPERTIES" MENU.
5. CHOOSE THE "SELECTED GRAPHIC" OPTION UNDER "PRINT RANGE".
6. SELECT "NONE" FROM THE "PAGE SCALING" DROPDOWN MENU.
7. UNSELECT "CHOOSE PAPER SOURCE BY PDF SIZE".
8. CLICK "OK" TO PRINT SELECTION.

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