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Final Drainage Report

Hannah Ridge at Feathergrass Filing No. 3

September 5, 2017

Final Drainage Report

for

Hannah Ridge at Feathergrass Filing No. 3

Project No. 60970-F3

September 5, 2017

prepared for

Feathergrass Investments, LLC
4715 North Chestnut Street
Colorado Springs, CO 80907
719.593.8367

prepared by

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Statements and Acknowledgments

Engineer's Statement

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

David R. Gorman, P.E. Colorado No. 31672 Date
For and on Behalf of MVE, Inc.

Developer's Statement

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

Kenneth P. Driscoll, Manager Date
Feathergrass Investments, LLC
4715 North Chestnut Street
Colorado Springs, CO 80907

El Paso County

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

Jennifer Irvine, P.E., Date
County Engineer / ECM Administrator

Contents

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed Hannah Ridge at Feathergrass Filing No. 3. The development project is part of a phased residential development with approved Master Development Drainage Plan, Preliminary Drainage Report and Preliminary Plan documents on file. This report also addresses aspects of all phases (subdivision filings) of the project in order to present the drainage information in the context of the total project. The report will "identify specific solutions to problems on-site and off-site resulting from the proposed project.[1] The report and included maps present results of hydrologic and drainage facilities analyses. The report will discuss the recommended drainage improvements to the site and identify drainage requirements relative to the proposed project. This report has been prepared and submitted in accordance with the requirements of the El Paso County Final Plat approval process. An Appendix is included with this report with pertinent calculations and graphs used in the facility design and drainage analyses.

1 General Location and Description

1.1 Location

The proposed Hannah Ridge at Feathergrass Filing No. 3 site is located within the south one-half of Section 32, Township 13 South, Range 65 west of the 6th principal meridian in unincorporated El Paso County, Colorado. The site is situated on the north side of Constitution Avenue, west of Akers Drive and east of the old Rock Island Railroad right-of-way (a trail owned by the City of Colorado Springs). The proposed site is currently known as Tract FF, Hannah Ridge at Feathergrass Filing No. 1. A **Vicinity Map** is included in the **Appendix**.

Tract F, Hannah Ridge at Feathergrass Filing No. 1 (HRAFG Fil No. 1) recorded in June 2014, is adjacent along the east side of the site. Tract F is a drainage and greenway tract zoned PUD. The development of the 39 residential lots in Filing No. 2, located east of Tract F, is recently completed with streets, utilities and landscaping. Tract E HRAFG Fil No. 1 (a future park, zoned PUD) lies to the northeast of the site, Tract LL HRAFG Fil No. 1 (a future single family residential site zoned PUD) is adjacent to the northwest of the site. Tract GG HRAFG Fil No. 1 (a future single family residential site zoned PUD) lies to the west of the site and Tract BB HRAFG Fil No. 1 (a future multi-family residential site zoned RM-30) is adjacent to the south. The subject property and surrounding tracts were originally platted as the Industrial (M) zoned Akers Acres before being replatted into Hannah Ridge at Feathergrass Filing No. 1.

1.2 Description of Property

The entire Hannah Ridge at Feathergrass Filing No. 1 subdivision contained 117.81± acres. The Filing No. 1 plat included tracts for future multi-family residential, single family residential and commercial development in accordance with approved zoning and the Preliminary Plan for the site. Hannah Ridge at Feathergrass Filing No. 3 is the third phase of single family residential lots and streets which will be replatted from the 8.31± acres of the existing Tract FF.

1 DCM, 4-6.

The ground cover, which is in good condition, consists of native grasses, sparse brush and a few trees. A portion of the Filing No. 3 site has been disturbed as necessary for the construction of Filing No. 2. The existing site topography slopes to the east and south with grades that range from 1% to 8%. The existing flow path of the Sand Creek tributary that runs from north to south through the overall Hannah Ridge at Feathergrass property is located within the proposed Hannah Ridge at Feathergrass Filing No. 3 site. Once the tributary flows reach Constitution Avenue from the north, a channel/ditch cut along the north side of Constitution Avenue conveys the tributary flows to the east. Contributing on-site runoff joins the tributary flows, which are directed through the new double 10'w x 6' high Hannah Ridge Drive culvert. The flows continue east to the existing culvert crossing of Constitution Avenue, just west of Akers Drive.

Soils in this particular site as well as the entire surrounding Hannah Ridge at Feathergrass development are generally conducive for land development with some localized areas of unsuitability which shall be addressed in the site grading and drainage treatments for the proposed subdivision. These conditions are fully discussed in the project Soil, Geology and Geologic Hazard Studies and updates prepared by Entech Engineering.[2] [3] According to the National Resource Conservation Service, the dominant soil in the immediate area of the Hannah Ridge at Feathergrass Filing No. 3 site is Blakeland loamy sand (map unit 8), The Blakeland loamy sand is typically deep and somewhat excessively drained. Permeability is rapid, surface runoff is slow, and the hazard of erosion is moderate. Blakeland loamy sand is classified as being part of Hydrologic Soil Group A. The soil has good potential for urban development, but is prone to water and wind erosion if protective vegetation is removed and not mitigated by proper erosion control practices.[4] [5] A portion of the **Soil Map** and data tables from the National Cooperative Soil Survey are included in the **Appendix.**

Major drainageways through the site include the previously mentioned sub-tributary (Tributary 6) to the east fork of Sand Creek which flows into the north side of the overall Hannah Ridge property by way of an existing concrete box culvert in the old railroad embankment. The drainageway runs north to south through the site and then east along the north side of Constitution Avenue to an existing concrete box culvert crossing Constitution Avenue just west of Akers Drive. Existing Hannah Ridge Filing No. 1 and 2 are located east of this tributary. Another drainageway enters the Hannah Ridge property from the west and joins Tributary 6 along the north side of Constitution Avenue. The flows from this drainageway are conveyed by Constitution Avenue surface, a reinforced concrete pipe (RCP) located along the north side of Constitution Avenue and a old railway bridge opening on the west edge of the site.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The Hannah Ridge at Feathergrass Filing No. 3 site is located in the Sand Creek Major Drainage Basin (FOFO4000) on the east side of Colorado Springs, which contains properties in both City of Colorado Springs and unincorporated El Paso County jurisdictions. The basin is a studied basin with an approved and operative Drainage Basin Planning Study (DBPS). The Basin stretches for approximately 17 miles on the east side of Colorado Springs and drains from northeast to southwest into Fountain Creek at a point just north of the crossing of Interstate 25 and US Highway 85-87. The site is located in the southeastern portion of the Sand Creek Major Drainage Basin on a tributary with approximately 1.07 square miles of drainage area upstream of the site. A copy of a portion of the ***"Drainage Area Identification Study"***[6] **map**, showing the site location within the Basin is included in the **Appendix**.

2 Soils Rep 1
3 Soils Rep 2
4 WSS El Paso County Area, Colorado.
5 OSD
6 Drain. Area Ident. Study

The Drainage Basin Planning Study for the Sand Creek Major Drainage Basin was completed in 1996 by Kiowa Engineering Corporation.[7] The site is contained within sub-basin 12, located just upstream of Design Point No, 8, as indicated in the 1996 report. Riprap channel improvements and channel check structures are called out in the DBPS for this sub-basin. Copies of the DBPS **Drainage Planning Study Map** and pertinent pages of the DBPS **Preliminary Design Plans** showing the site location within the basin as well as the DBPS planned improvements in the subject reach are included in the **Appendix**. A portion of the major channel is located within this site and proposed improvements for a potion of the major drainage system are to be constructed as part of Hannah Ridge at Feathergrass Filing No. 3.

Kiowa Engineering also prepared a report titled "Hydrology Analysis, East Fork Sand Creek, Tributary 6", having revision date of January 18, 2007.[8] The report served to amend the DBPS and was reviewed and accepted by El Paso County Development Services during the same time frame as the Preliminary Plan approval of the Hannah Ridge at Feathergrass project. The amendment specified that the existing 7'x7' railroad culvert crossing, located approximately 1/2 mile north of Constitution Avenue is to remain in place. Said DBPS amendment indicates that the existing ponding area on the upstream side of the railroad embankment is to remain in the current and future drainage conditions, thereby reducing the resultant developed flows through the properties downstream of the embankment, including the flows through the tributary in Hannah Ridge, the Hannah Ridge Drive culvert and the Constitution Ave / Akers Drive culvert downstream of the site. The 2007 DBPS Amendment Maps and hydrologic calculations are included in the **Appendix** to this report for easy reference.

Maintenance on the existing Rock Island Trail 7'x7' box culvert at Design Point 1 will be performed in accordance with the prior BOCC conditions of approval of the Preliminary Plan. Maintenance of the box culvert will be completed with the improvements of Hannah Ridge at Feathergrass Filing No. 3.

The existing 7' x 7' concrete box culvert was constructed under the Rock Island Railroad bed. We found no information regarding date of construction. The culvert is assumed to have been constructed according to the Rock Island Railroad Engineering Design criteria being used at the time. The railroad is no longer in existence and the railroad bed has had the tracks & ties removed. The land is now owned by the City of Colorado Springs and designated as the 'Rock Island Trail' by the Colorado Springs Parks Department. The condition of the concrete box culvert was by M.V.E., Inc. approximately 7 to 10 years ago and then again recently.

In the recent observation, the box culvert was inundated with water about one foot (1') in depth at the time of observation due to rainfall and the downstream channel conditions. The ponding condition will end once downstream channel obstructions are remove with proposed new channel construction.

The walls and floors are cast in place concrete. The bottom material was observed during the earlier visit, which was during a dry period. The deck is a combination railroad rails, used as beams, spanning the cast in place walls with brick laid in between the rails. Rusting of the rails is minor and there are no visible sign of deflection in the deck rails. We could not observe if there is a cast in place deck over the rail and brick deck as there is 18' to 20' of fill over said deck. The fill slopes are well vegetated.

The cast in place concrete walls are in fair condition with some cracking & spalling evident. No structural cracks were observed. The floor had been observed in the past with some spalling. We have no knowledge that said spalling was ever repaired. Probing & measuring upstream and downstream of the structure indicate minor scour holes of 1 cubic yard plus in size. Once the ponding is relieved, the actual size of the scouring may be determined.

We have the opinion that the box culvert is structurally sound and repairs of exposed concrete surfaces should be completed. Wing wall blocking will be repointed and re-mortared where required. Also, rip-rap inlet & outlet aprons should be constructed in place. Both aprons will be Type H rip rap, 2.0 ft thick. The inlet apron will be 20' x 20' and the outlet apron will be 20' wide by 40' long. Along with installation of the aprons, earth under and adjacent to the ends of the wing walls will be replaced

7 1996 DBPS
8 2007 DBPS Amend

and re-compacted as required. Costs for concrete surface repairs, wingwall reconditioning and the addition of rip-rap aprons for the existing box culvert are listed in the Opinion of Probable Costs section of this report.

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRMs), effective March 17, 1997. [9] [10] The project site is included in Community Panel Numbers 08041C0752 F and 08041C0756 F of the FIRMs for El Paso County, Colorado. The Flood boundaries for the subject Tributary 6 of the East Fork of Sand Creek, as shown on the FIRM, was most recently revised by Letter of Map Revision (LOMR) on March 24, 2004 and September 24, 2008.[11] [12] According to the LOMR, the nearest Federal Emergency Management Agency (FEMA) designated floodplain boundary is approximately 1400 feet south of the project site, near Palmer Park Boulevard. No part of the site is shown to be included in a 100-year flood hazard area as determined by FEMA. The project site and surrounding property is Zone X, being "Areas of 500 year flood; Areas of100-year flood with average depths of less than 1 foot with drainage areas less than 1 square mile; and Areas protected by levees from the 100-year flood". A portion of the current **FEMA Flood Insurance Rate Maps** as well as maps modified by the recent LOMR's with the site delineated is included in the **Appendix.**

The construction of the Constitution Avenue at Akers Drive Concrete Box Culvert Extension project for the Tributary 6 flows downstream of Constitution Avenue was completed in 2013. The box culvert extension was designed and constructed as detailed in the approved "Drainage Report, Constitution Avenue at Akers Drive Box Culvert Extension" dated August 15, 2011 by M.V.E., Inc.[13] The design of the box culvert extension considered developed flows from the Hannah Ridge at Feathergrass site as determined in the 2007 DBPS amendment.

The construction of the Hannah Ridge Drive Concrete Box Culvert for the Tributary 6 flows along Constitution Avenue was completed in 2016. This box culvert was designed and constructed as detailed in the approved "Drainage Report for Hannah Ridge at Feathergrass Filing No. 2", dated September 21, 2015 by M.V.E., Inc.[14] The design of the box culvert extension considered developed flows from the Hannah Ridge at Feathergrass site as determined in the 2007 DBPS amendment.

The owner of the Wilshire Development, located south of the box culvert extension project site, is obligated to construct the channelization of Tributary 6 from the El Paso County owned parcels, south of Constitution Avenue to it's confluence with the East Fork Sand Creek before proceeding with any more subdivision filings within Wilshire. In the preparation of the Master Development Drainage Report for the Hannah Ridge at Feathergrass development, which was prepared in 2007 and updated in 2013, it was anticipated that the channelization would be completed during the first half of the residential development of Hannah Ridge at Feathergrass, consisting of approximately 38 acres located north of Hunter Jumper Drive and south of Winslow Park Drive. The subdivision phasing of Hannah Ridge changed from 2007 to 2013 so that 2007 Phase 1 is equal to the 2013 Phases 1, 2, 3 & 4. The approved Master Development Drainage Report analyzed the Tributary 6 drainageway downstream of Constitution Avenue and found that the development of the initial 38 acres of Hannah Ridge at Feathergrass to have negligible affects on the existing drainageway without detention.[15] Therefore, the Development of Hannah Ridge at Feathergrass Filings 1 and 2 with no on-site detention will not damage the downstream drainageway. Pertinent portions of the analysis completed as part of the MDDP for Hannah Ridge is included in this drainage report for easy reference. The need for on-site detention in the remaining phases will be determined in the Final Drainage Reports for the future phases. Once the downstream Wilshire channel improvements are completed, the needs of the drainageway regarding developed flow erosion and velocities in the tributary will be addressed. Since the Wilshire channel improvements were designed to accommodate the developed flows determined by the DBPS and the developed flows from Hannah

9 FIS
10 FIRM, Map No. 08041C0756 F
11 LOMR 2004
12 LOMR 2008
13 CBC Rep
14 HR 2 FDR
15 MDDP

Ridge do not cause the channel flow rates to be increased beyond the DBPS discharges at full basin build-out, On-site detention in Hannah Ridge will not be necessary. The Wilshire channel plans for the tributary includes the reach from the El Paso County owned parcels located south of Constitution Avenue to the confluence with the East Fork Sand Creek.

2.2 Sub-Basin Description

2.2.1 Existing Drainage Patterns (On-Site)

The northern and central portion of the total existing Hannah Ridge at Feathergrass site drains to the center from both the east and west sides, and then southerly in the tributary to East Fork Sand Creek which flows from north to south through site. The off-site tributary discharges enter from the previously mentioned existing 7'x7' culvert under the old Rock Island Railroad grade that bounds the property on the west and north. The southern portion of the site drains southerly and easterly from the old Rock Island Railroad that bounds the property on the west. The site drains into a ditch running along the north side of Constitution Avenue right-of-way. This ditch also collects the existing 42" and 60" pipe storm water discharge at the southwestern corner of the proposed Hannah Ridge Preliminary Plan. This storm sewer system was designed and constructed in 1992 by El Paso County Department of public works to collect and route existing flows from the western side of the old Rock Island Railroad. A sump area was constructed to capture existing and future developed flows from this area. An **Existing Drainage Map** is included and shows existing basin delineations.

The 8.31 acre Filing No. 3 site is contained in existing sub-basins A7 and A9 which drain south towards Constitution Avenue. The existing site sheet flows into the tributary channel and exit the Filing No. 3 site to the south into existing Tract BB.

2.2.2 Off-Site Drainage Flow Patterns

Off-site drainage flows enter the total Hannah Ridge at Feathergrass site from both the north and from the west. The hydrologic analyses used in the drainage design of the proposed subdivision considered the projected Future Land Use Conditions of the upstream sub-basins and not existing conditions. The flow rates listed below are taken from the 2007 DBPS Amendment, the 2007 Hannah Ridge at Feathergrass MDDP and the 2013 Hannah Ridge at Feathergrass Preliminary Drainage Report, which are referenced in the next section of this report.

The northern entry point is at the existing 7'x7' concrete box crossing of the north railroad embankment. The drainage sub-basin draining to the existing 7x7 box is the northern 425 acre portion of the East Fork Sand Creek Tributary 6 watershed extending from the Rock Island Railroad Right-of-Way, north to Barnes Road. A complete description of this northern upstream watershed, along with the Land Use Map used in the hydrologic analyses are contained in Kiowa Engineering's 2007 Hydrology Analysis Report, which is hereby referenced and made a part of this report.[16] The sub-basin contains a mixture of land uses including areas of undeveloped Open Space, medium density Single-Family Residential, medium-high density Single-Family Residential and Industrial / Commercial. Flows originating in this basin travel from north to south in streets, storm drains and drainageways to the railroad embankment. Flow rates are attenuated from 360 cfs to 130 cfs in the 10-yr rainfall event and from 915 cfs to 640 cfs in the 100-yr rainfall event by ponding on the upstream side of the embankment as controlled by the existing 7'x7' concrete culvert before entering the site.

Flows of Q_{10} = 130 cfs and Q_{100} = 283 cfs also enter site from the westerly 105 acre sub-basin made up of medium density Single-Family Residential property. These flows are conveyed east towards the site in a Combination of Constitution Avenue Street flow (Q_5 = 39 cfs and Q_{100} = 121 cfs), flows of Q_5 = 87 cfs and Q_{100} = 126 cfs in an existing 36"/42" pipe system along the north side of Constitution Avenue, and overland flows of Q_5 = 19 cfs and Q_{100} = 41 cfs entering through the trestle opening in the westerly railroad embankment (trail). These flows continue south and east through Hannah Ridge at Feathergrass site to the existing double 12'x6' Constitution Avenue culvert, which was recently extended to the south with combined flows of Q_{10} = 457 cfs and Q_{100} = 1076 cfs. The culvert

16 2007 DBPS Amend

delivers the flows to the tributary drainageway south of Constitution Avenue. The flows continue to flow south to East Fork of Sand Creek approximately 6500 feet south of the project site.

Considering the 8.31 acre site of Hannah Ridge at Feathergrass Filing No. 3, existing Tract F is located along the east side, which drains south into Tract BB. No flows enter the site from the east. The western part of existing sub-basin A7 drains easterly in to the site to the tributary drainageway, which conveys the flows to the south. The site also accepts the tributary flows of Q_{10} = 130 cfs and Q_{100} = 640 cfs entering from the north. All site stormwater flows of Q_{10} = 130 cfs and Q_{100} = 640 cfs exit to the south into Tract BB and are directed to the existing ditch along the north side of Constitution Avenue with combined flows of Q_{10} = 130 cfs and Q_{100} = 283 cfs.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 3 has been prepared according to the report guidelines presented in the latest edition of *City of Colorado Springs/El Paso County Drainage Criteria Manual* (DCM)[17]. The on-site (local) hydrologic analysis is based on a collection of data from the DCM, the NCSS Web Soil Survey[18], a topographic survey of the site prepared by the M.V.E., Inc., proposed site layout from the approved Preliminary Plan, property boundary information provided by M.V.E., Inc. and proposed grading and drainage system layout developed by MVE, Inc. and Classic Consulting Inc. Runoff flow data used in the preparation of the main drainage way (Tributary 6) facility design is in accordance with the hydrology presented in the 1996 DBPS as modified by the 2007 Hydrology Analysis Report. The Hydrologic Basin Map with sub-basin boundaries, design point locations and discharges from the 2007 Hydrology Analysis Report is included in the **Appendix** to this report for convenient reference.

3.2 Previous Drainage Studies

The Sand Creek Major Drainage Basin DBPS and subsequent Hydrology Analysis Report for Tributary 6 has already been discussed at length. These reports present runoff flow rates for the main drainageway (Tributary 6) through the site, that result from Developed Conditions in the subject drainage basin. These flows are used in the design and hydraulic analysis of the proposed major drainage way through the site.

Both a Master Development Drainage Report for the entire Hannah Ridge at Feathergrass and a Preliminary Drainage Report for the residential phases of the development were prepared by M.V.E., Inc. during the approval process of the PUD Plan and Preliminary Plan.[19] [20] These reports present preliminary drainage information for on-site sub-basins within the development. The preliminary information is updated, revised and expanded in this current drainage study and report.

The Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 1 was prepared by M.V.E., Inc. and dated January 31, 2014.[21] The report addressed drainage for 45 residential lots in Filing No. 1 and contains the drainage plan for the entire Hannah Ridge development. No storm drain facilities were constructed as part of Hannah Ridge at Feathergrass Filing No. 1.

3.3 Hydrologic Criteria

Flow rates at all design points in the subdivision with contributing areas greater than 100 acres are calculated using SCS hydrologic flow computation method in accordance with El Paso County criteria. Flow rates at all design points having contributing areas less than 100 acres are calculated using the Rational Method. Flow rates were calculated for 5-year, 10-year and 100-year rainfall recurrence intervals on the main drainageway and 5-year and 100-year events for the local drainage system.

17 DCM Section 4.3 and Section 4.4
18 WSS
19 MDDP
20 PDR HR PH1-3
21 HR 1 FDR

The SCS method main drainage way (offsite) hydrology flows are taken from the previously mentioned 1996 and 2007 Kiowa reports. Flow rate values were produced for both the present existing condition of the watershed and ultimate developed conditions. SCS hydrograph data for the 5-year and 100-year rainfall recurrence intervals was produced using the U.S. Army Corps of Engineers Hydrologic Engineering Center Hydrograph Modeling package (HEC-1).[22] The computer model runs are included in the **Appendix** of this report for convenience. The model utilized NOAA Rainfall Frequency data of 3.0" and 4.4" of total 24-hour precipitation depth for the 5-year and 100-year rainfall events, respectively. The SCS Type IIa rainfall distribution was used to produce the storm rainfall hydrographs. Runoff hydrographs were computed using Curve number ratings developed according to County criteria and according to existing and proposed land uses for areas in the watershed. Times of Concentration (Tc) values for basin runoff was developed using the 'Overland Flow Equation' Page 5-11 in the DCM, and the channel flow component of the Tc was computed using Manning's equation under conveyance-full conditions.

Additional Data used in the study includes soils data from the NRCS Web Soil Survey[23], Colorado Springs Utilities FIMS topographic mapping, SGS Topographic Mapping and site survey data and mapping by M.V.E., Inc.[24] [25] [26]

The Rational Method utilized 'Time Intensity-Frequency Curves' Figure 5-1 in the DCM to obtain the design rainfall values. The 'Overland Flow Equation' Page 5-11, and Manning's equation with estimated depths were used in time of concentration calculation. Table 5-1 'Recommended Average Runoff Coefficients and Percent Impervious' was utilized as a guide in estimating runoff coefficient values.

3.4 Hydraulic Criteria

The hydraulic design and analysis for the facilities in this Final Drainage Report including storm drain inlets, pipes, culverts, channels and streets have been prepared according to the provisions of the *City of Colorado Springs/El Paso County Drainage Criteria Manual* (DCM)[27]. Hydraulic properties and performance of parts of the drainage system were determined using the U.S. Army Corps of Engineers Hydraulic Engineering Center River Analysis System (HEC-RAS) modeling Package.[28] Geometric data for the model cross sections were obtained from the M.V.E., Inc. topographic mapping in combination with proposed site construction drawings. Manning's roughness coefficient values for various drainage system components are in accordance with El Paso County criteria for the particular design materials.

Storm drainage inlet and piping analyses was performed with Autodesk Storm and Sanitary Analysis 2012 computer program.[29] System profiles and output is included in the **Appendix**. Culvert calculations were performed with the use of the "HY-8" computer application developed by the Federal Highway Administration.[30] In some cases, culvert calculations were also verified for comparable results with the use of HEC-RAS's "Special Culvert" routines.

The "Rational Formula-based FAA", Section 3.2.3 of the *Urban Drainage and Flood Control District Drainage Criteria Manual, Volume 2* (UDFCD), method was used for water quality and detention storage calculations with "Recommended Percentage imperviousness Values", Table 5-1 in the DCM, used to determine the site imperviousness. These sizing calculations along with the hydraulic performance of outlet structures and drain pipes, and routing of inflow hydrographs through storage volumes and outlet structures, were performed using the detention design spreadsheet, "UD-Detention_v2.2", developed by the Urban Drainage and Flood Control District.[31]

22 HEC-1
23 WSS
24 USGS
25 FIMS
26 MVE Topo
27 DCM Section 4.3 and Section 4.4
28 HEC-RAS
29 ADSS
30 HY-8
31 UDFCD

4 Drainage Facility Design

4.1 General Concept

The proposed Hannah Ridge at Feathergrass Filing No. 3 project will consist of 39 single family lots with average lot size of 6,036 square feet. The overall single family residential development also includes park space, landscape open space and natural open space areas. There are multi-family and commercial parcels south of the single family residential development along Constitution Avenue. These parcels will be developed in accordance with future separate Preliminary Plans and Final Drainage Reports. Access to Filing No. 3 will be from the westerly extensions of existing Hunter Jumper Drive and existing Winslow Park Drive. The proposed roads will be paved county streets within 50 and 60 foot of rights-of-way.

The entire Hannah Ridge at Feathergrass residential development is continuing to be platted and constructed in phases. The drainage infrastructure will also be constructed in phases to accommodate the existing and developed drainage as the project progresses. This Phase 3 includes a large diameter storm drain pipe in existing Tract F, smaller diameter storm drain pipes in the street rights-of-way, storm drain inlets, and permanent water quality facility.

The intent of the drainage concept presented in this Final Drainage Report is to accept and route the off-site basin discharges through the site, while conveying the on-site developed major and minor storm flows safely through the site and downstream, maintaining adequate flow capacity in the surface streets, storm drain system and channels and providing overflow routing for storms greater than the major (100-year) events in accordance with El Paso County drainage criteria.

Considering the overall Hannah Ridge at Feathergrass development, the proposed conditions will route local storm water flows over the site in sheet flow, shallow concentrated flow and stream flow, depending on the existing topography and the contributing flow areas. These flows will be routed to the streets. The five year frequency storm water flows in excess of street carrying capacities will be collected and routed to the main tributary channel/pipe. Curb & gutter will be constructed on the streets and route storm water flows to storm water inlets. An underground storm drain system will be installed in the right of ways and easements to deliver street flow to the main drainage ways. The Sand Creek Tributary through the site will be improved with channel grading, bed and bank stabilization, culverts and drainage pipe. Grading operations will be done in order to improve drainage conditions and to direct runoff to desired locations. Overlot grading will be necessary for subdivision development.

Runoff from off-site and on-site will be contained in the central north-south drainageway through the site in a combination of improved open channel and storm drain conduits that leads to the existing drainage channel on the north side of Constitution Avenue. Off-site flows from the west and flows from the southwestern part of the proposed development will also continue to flow to the existing drainage channel on the north side of Constitution Avenue to the existing double 12'x6', culvert crossing of Constitution Avenue. The existing channel along Constitution Avenue will not be improved until the development of the multi-family and commercial properties along Constitution Avenue occurs.

It is intended that the drainage system be owned and maintained by El Paso County in concert with the public transportation infrastructure through the mechanism of Public Right of Way and Public Drainage Easements through the site as it develops. Access over, across and adjacent to the proposed storm drainage system components will be provided. The private water quality facilities will be owned and maintained by the Communities at Feathergrass Homeowners Association.

There are no irrigation facilities that would become an encumbrance to the drainage ways or facilities. The site will have water mains and sewer mains located in the streets. Some proposed water mains will have local lowerings installed to avoid possible conflicts with storm drain laterals. All sanitary sewer crossings of the drainage system will be in streets. The sanitary sewer mains will tend to be constructed much lower than the proposed storm drain and drainage system. No encumbrances due to utilities are anticipated.

The existing drainage conditions and the proposed drainage concept are described in more detail below. Input data and results for all calculations are included in the **Appendix**. Drainage maps for the hydrology and drainageway hydraulics are also included in the **Appendix**.

4.2 Specific Details

4.2.1 Existing Hydrologic Conditions

The off-site drainage area north of the site, Basin OSA 1 (Basin No.'s 1, 2 & 5 on 2007 DBPS Amendment map) contains 425 acres draining to Tributary 6, East Fork of Sand Creek. The Tributary runoff enters the property through the old railroad embankment by way of an existing 7'x7' concrete box culvert. Discharges of $_{Q10}$ = 360 cfs and Q_{100} = 886 cfs flow to the culvert. Flows are detained behind the embankment before entering the property so that the peak discharges flowing through are Q_{10} = 351 cfs and Q_{100} = 627 cfs. The existing 7'x7' culvert is to permanently remain in place per the 2007 DBPS Amendment.

Basins OSA2 (1.9 acres) and OSC1 (3.4 acres) comprise off-site area from the railroad embankment to the northern property boundary. The discharges generated by OSA2 are Q_5 = 2 cfs and Q_{100} = 5 cfs, which enters on-site Basin A4. The discharges generated by OSC1 are Q_5 = 5 cfs and Q_{100} = 11 cfs, which also enters on-site Basin A4 and continues to the south. Off-site Basin OSA3 (0.3 acres) is the west side of Akers Drive which drains onto the site at Electronic Drive with discharges of Q_5 = 1 cfs and Q_{100} = 2 cfs. The off-site flows on the east side of Akers Drive drains south down the street, towards Constitution Avenue and are collected in Akers Drive and directed to Tributary 6, just upstream of the Constitution Avenue CBC.

Existing Basin A4 is 38.1 acres in area and generates flows of Q_5 = 31 cfs and Q_{100} = 71 cfs. Basin A4 accepts flows from off-site Basin OSA1 on the north, OSA2 on the northeast, OSC1 on the northwest and OSA3 on the east. The combined flows travel overland to the central portion of the basin joining the flows in the tributary to East Fork of Sand Creek, traveling south to enter Basin A7 with combined flow rates of Q_{10} = 351 cfs and Q_{100} = 627 cfs.

Existing off-site drainage basins OSF1, OSF2 and OSF3, west of the site, drain easterly onto the site, into existing Basin A7. Basin OSF1 (Basin No. 3 on the 2007 DBPS Amendment Map), contains 105 acres draining towards the site from the west. Basin OSF1 discharges are discussed in detail below. Existing Basins OSF2 and OSF3 are the off-site area from the railroad embankment to the northern property boundary along the west side. Basin OSF2 (4.9 acres) delivers flows of Q_5 = 4 cfs and Q_{100} = 10 cfs to the west edge of Basin A7. Basin OSF3 (0.5 acres) generates flows of Q_5 = 1 cfs and Q_{100} = 2 cfs.

The DBPS amendment indicates total peak discharges generated by Basin OSF1 are Q_{10} = 130 cfs and Q_{100} = 283 cfs. These discharges are actually distributed among pipe flows in the Constitution Avenue storm drain system, overland flow through the trestle opening at Rock Island Trail, overland flow at the trail intersection with Constitution Avenue, and street flows in Constitution. Off-site drainage basins were delineated with the aid of previous drainage studies, including calculations by El Paso County utilized for the design of the Constitution Avenue storm drain system. Basin flows were calculated to determine runoff from different portions of Basin OSF1. There are no records available that indicate how much storm runoff is captured by the storm drain system. Every inlet and pipe in the entire existing storm drain system was not analyzed, but a reasonable estimate was made of the flows captured by the storm drain system and thereby the flow distribution, as explained below.

The off-site basin flowing to the intersection of Constitution Avenue and Canada Drive, containing residential area, produces discharges of Q_5 = 121 cfs and Q_{100} = 230 cfs. These flows reach the intersection both in the storm drain system and the streets connected to Constitution Avenue. To determine the amount of flows in the pipe system during both 5 year and 100 year rainfall events, the assumption was made that the system is flowing under pressure with the hydraulic grade line at rim elevation of the existing manhole at Constitution Avenue and Canada Drive. The assumption is reasonable since the section of storm drain at this location is limiting due to size, slope and depth. The resulting captured flow in the 36" CMP of 57 cfs is about 25% of the total 100 year discharge and about 47% of the total 5 year flow at this location. Since the upstream storm drain inlets would

generally have been designed to capture at least half of the available storm flows, it would seem that the pipe is at already at maximum capacity during both 5 year and 100 year events at this point. However, additional capacity opens up further downstream of the system as discussed below. All remaining 5-year and 100 year flows not contained within the pipe continue east in Constitution Avenue. Additional flows are collected by inlets in Constitution Avenue about 750 feet west of the Hannah Ridge property line. At this point, the existing 42" CMP carries Q_5 = 66 cfs and Q_{100} = 85 cfs towards the east (max capacity of system without flooding). In the existing condition, pipe flows of Q_5 = 66 cfs and Q_{100} = 85 cfs are maintained easterly until the manhole intersection with 48" and 60" connections opposite Shawnee Drive. Developed discharges from proposed Living Waters will enter the system just downstream of manhole near the southwest corner of the Hannah Ridge site. There is ample capacity for the Living Waters discharges in the system at this point. An additional capacity of 72 cfs is also available in the pipe system downstream of the manhole. Also, an additional 100 cfs is available downstream of the Shawnee Drive Manhole.

The existing 60" RCP discharges into the open ditch located along the north side of Constitution Avenue approximately 650 west of Hannah Ridge Drive at the southeast corner of Basin A7 (discussed below) where the Tributary 6 drainageway changes course from south to east. Flows in the pipe are Q_5 = 87 cfs and Q_{100} = 126 cfs. The combined flows at the confluence at is point are Q_{10} = 393 cfs and Q_{100} = 831 cfs.

The northeast portion of Basin OSF1, containing residential and open areas drains to the trestle opening and into the site. Flows from Allens Park Drive are discharged from a storm drain outfall just west of the trestle opening and additional overland flows from Basin OSF1, OSF2 and OSF3 join the outfall. Considering the development of Living Waters and the flows that will be directed into the pipe system, the calculated discharges at the trestle opening are Q_5 = 19 cfs and Q_{100} = 41 cfs. Flows remaining in Constitution Avenue, flowing east, are Q_5 = 39 cfs and Q_{100} = 121 cfs. It appears that the existing condition of Constitution Avenue, with these calculated flows do not meet either 5-year or 100-year street drainage criteria. The allowable street flows on the north side of Constitution Avenue are Q_5 = 14 cfs and Q_{100} = 37 cfs (64 cfs and 108 cfs actual) and the allowable street flows on the south side of Constitution Avenue are Q_5 = 14 cfs and Q_{100} = 38 cfs (0 cfs and 65 cfs actual). This is an existing off-site condition. The development of Hannah Ridge does not contribute to or exacerbate this condition. These flows remain in Constitution Avenue and continue to flow east to the Constitution Avenue Culvert at Akers Drive. No flows from Constitution Avenue enter at Hannah Ridge Drive because of a high point designed into Hannah Ridge Drive. Calculations and exhibits for the western off-site basin flows and main trunk storm drain are contained in the Hannah Ridge MDDP and Hannah Ridge Preliminary Drainage Report, referenced above. These flows continue easterly and join the previously mentioned runoff flowing from the north in existing Basins A7 and A9.

Storm Runoff from Basins A7 & A9 drain overland southeasterly towards Constitution Avenue and flow in the existing earthen channel along the north side of Constitution Avenue to the existing double 12'x6' Concrete Box Culvert (CBC). Existing Basin A7 (30.2 acres) produces runoff quantities of Q_5 = 19 cfs and Q_{100} = 45 cfs while Basin A9 (33.6 acres) produces Q_5 = 20 cfs and Q_{100} = 47 cfs. Basin A16, on the east side of Akers Drive, drains south to Constitution Avenue and then westerly along Constitution Avenue to enter the double 12'x6' CBC. Runoff from existing Basin A16 (18.0 acres) has peak rates of Q_5 = 12 cfs and Q_{100} = 26 cfs.

Hannah Ridge at Feathergrass Filing No. 3 is located within existing sub-basins A7 and A9. The proportional flow rates for only the 8.31 acres that comprise the site are Q_5 = 5 cfs and Q_{100} = 12 cfs. These flows are combined with the total A7 and A9 flows which drain south.

Basin OSA8 (16.2 acres), on the east side of Akers Drive, drains south onto the eastern section of the property with peak discharges of Q_5 = 40 cfs and Q_{100} = 78 cfs. Off-site basins OSA11 and OSA12 contain portions of Constitution Avenue. These basins drain to the existing double 12' x 6' CBC under Constitution Avenue.

The portion of Basins OSA8 and A16 discharges flowing in and being intercepted by the existing 15' and 10' curb inlets on the east side of Akers Drive and 10' inlet on the west side of Akers Drive was calculated in the design drainage memo for Akers Drive prepared by M.V.E., Inc. at the time of Akers

Drive construction.[32] The east side of Akers Dive carries flows of Q_5 = 9.2 cfs and Q_{100} = 19.2 cfs. The two existing Akers Drive inlets on the east side of the street capture the entire 9.2 cfs in the 5-year event. The inlets collect 16.1 cfs in the 100-year rainfall event, leaving 3.1 cfs to continue westerly in Constitution Avenue. The discharges flowing south, on the west side of Akers Drive, at the Constitution Avenue intersection are Q_5 = 3.6 cfs and Q_{100} = 6.8 cfs. The existing 10' curb inlet collects 3.3 cfs in the 5-year rainfall event while 0.3 cfs flows by to Constitution Avenue. In the 100-year event, 4.8 cfs is captured and 2.0 cfs flows by. All the by-passed flows travel to the low spot located just east of the double 12'x6' culvert and are collected in sump condition at an existing 5' curb inlet which drains directly into the culvert and flows south.

The **Existing Drainage Map** depicts the existing topographic mapping, drainage basin delineations, drainage patterns, existing streets, drainage facilities, and runoff quantities with a data table including drainage areas and flow rates.

4.2.2 Proposed Hydrologic Conditions

The surrounding off-site drainage basins will continue to drain to the site as in existing conditions. However, where the potential for off-site development exists, flow rates entering the property are adjusted to the developed condition. The 2007 DBPS Amendment takes into account the developed conditions of the entire Tributary 6 basin including the Hannah Ridge site and the drainage basins upstream and downstream of the site. These DBPS flow rates are utilized in this report for the main channel design.

The overall Hannah Ridge at Feathergrass site is divided into several developed drainage basins for analysis and design of the drainage system as indicated on the attached **Developed Drainage Map**. Specific drainage details are discussed according to the planned platting and construction phases. Developed runoff quantities and facilities are presented below.

Phase 1 – The first 45 residential lots were platted with Hannah Ridge at Feathergrass Filing No. 1. The lots, streets and utilities associated with the previous subdivision filing are now constructed and complete. The eastern portions of Winslow Park and Hunter Jumper Drives, both connecting to Akers Drive were constructed along with the southern section of Equine Court and all of Farrier Court. Storm flows from Basins D1 (2.07 acres), D2 (1.19 acres), D3 (0.26 acres), D4 (2.22 acres), D5 (0.74 acres) and D6 (1.31 acres) all drain to the southwest and deliver flows to Design Point 15 at the corner of Equine Court and Hunter Jumper Drive. Cross pans were constructed at the intersection of Farrier Court and Equine Court and the intersection of Hunter Jumper Drive and Equine Court. Peak flow rates on the north side of Hunter Jumper Drive at Design Point 15 are Q_5 = 19.2 cfs and Q_{100} = 38.0 cfs. The 5 year and 100 year flows are contained within the street at this location in accordance with the County's street flow criteria. Drainage Basin D9 (0.85 acres) drains west on the south side of Hunter Jumper Drive. Developed flows of Q_5 = 1.9 cfs and Q_{100} = 3.8 cfs are contained in the south curb of Hunter Jumper Drive. The area north of Phase 1 was partially graded and drains west to the Tributary on the north side of Winslow Park Drive in accordance with the approved Phase 1 Grading & Erosion Control Plan. No storm drain facilities were constructed as part of Filing No. 1. Permanent water quality facilities were provided for the initial 45 lots by a sand filter basin which was completed as part of Phase 2.

Phase 2 – Hannah Ridge at Feathergrass Filing No. 2 was platted with 39 residential lots. Both Hunter Jumper Drive and Winslow Park Drive were extended from Filing No. 1 to the west edge of Filing No. 2. Proposed Hannah Ridge Drive was constructed from Constitution Avenue north to Winslow Park Drive. Basin D7 (3.95 acres) contains the east edge of Filing No. 2 from Hunter Jumper Drive to Winslow Park Drive. The basin drains west to Hannah Ridge Drive and then south towards Hunter Jumper Drive with peak discharges of Q_5 = 8.9 cfs and Q_{100} = 17.8 cfs. Storm flows from developed Basins D1-D6, previously mentioned Design Point 15, travels west on the north side of Hunter Jumper Drive to the north east corner of Hannah Ridge Drive and Hunter Jumper Drive at Design Point 16, where they combine with Basin D7 flows. The combined discharges at DP 16 are Q_5 = 26.6 cfs and Q_{100} = 52.8 cfs. A 10' CDOT Type R Inlet collects a portion of the Basin D7 discharges from Hannah Ridge Drive at DP 16. This inlet collects 7.7 cfs during the 5-yr rainfall

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event and 11.7 cfs during the 100-yr. The remainder continues south in Hannah Ridge Drive to Basin D11. A second inlet at DP16, located on Hunter Jumper Drive, collects a portion of the flows from Basins D1-D6. The 15' inlet collect 12.0 cfs / 16.8 cfs during the 5-yr and 100-yr events, respectively. The remainder turns south and travels south in Hannah Ridge Drive, joining bypass flows from Basin D7, to a low point in Hannah Ridge Drive (DP 17). Basin D11 (1.30 acres) drains west to Hannah Ridge Drive, joining the bypass flows from DP 16. A 15' sump inlet at the low point of DP 17 collects all the runoff on the east side of Hannah Ridge Drive for the 5-yr and 100-yr rainfall events. Basin D11 contains a permanent Sand Filter Water Quality Basin, treating runoff from Filing No. 1 and Filing No. 2.

Phase 2 included the recently constructed double 10'w x 6'h Concrete Box Culvert (CBC) under Hannah Ridge Drive, located at the tributary channel on the north sided of Constitution Avenue. The Phase 2 storm drain system conveys the flows from inlets to the CBC at (DP 28). The ultimate developed flow rates of the main drainageway at DP 28 is Q_5 = 428 cfs and Q_{100} = 991 cfs. The Hannah Ridge Drive CBC transitions to the existing drainage way channel upstream and downstream of the box. The channel improvements to the drainageway itself will be accomplished in later commercial phases of the Hannah Ridge development.

Drainage Basin D8 (3.06 acres) drains east to Hannah Ridge Drive and then south to Hunter Jumper Drive with peak discharges of Q_5 = 6.8 cfs and Q_{100} = 13.4 cfs. These flows continue south in Hannah Ridge Drive to the low point at DP 18. Basin D10 (0.37), located on the south side of Hunter Jumper Drive, drains east to Hannah Ridge Drive and then south in Hannah Ridge to the low point at DP18, joining flows from Basin D8. The combined peak discharges at DP 18 are Q_5 = 8.7 cfs and Q_{100} = 18.1 cfs. A 10' sump inlet collects all the flows from the 5-yr and 100-yr rainfall events and the storm drain system conveys the flows to the existing Hannah Ridge Drive CBC constructed with Phase 2.

Basin B7, in Winslow Park Drive, accepts flows from the east end of the street which was constructed in Filing No. 1 and located in Basin B5. The ultimate developed condition will contribute developed flows to Winslow Park Drive from the north. However, in the interim condition, the undeveloped area to the north drains west towards the tributary drainageway north of the street, but does not enter Winslow Park Drive in accordance with the approved Phase 2 Grading & Erosion Control Plan. The combined flows of B5 and B7 flow west in the street to a 15' Type R inlet located just west of Hannah Ridge Drive. This inlet collects 8.4 cfs during the 5-yr rainfall event and 14.1 cfs during the 100-yr event. The remaining flows continue west in Winslow Park Drive to DP 7. An 18" RC Pipe conveys the captured flows west. A 15' Type R Sump Inlet will be constructed on the north side of the street during Phase 3. Collected runoff is directed to a new 90" RCP storm drain flowing south through existing Tract F being constructed with the Phase 3 improvements. Permanent water quality treatment for stormwater generated by these sub-basins is being constructed during Phase 3 on the north side of Winslow Park Drive, opposite the northeast corner of Filing No. 3.

Basin E6 (1.80 acres) is located on the west side of Filing No. 2 and contains proposed Half Chaps Court. The basin drains south to the cul-de-sac bulb where a 5' sump inlet collects all storm discharges of Q_5 = 4.5 cfs and Q_{100} = 9.0 cfs at DP 21. These flows will be piped to the new 90" RCP storm drain pipe to be constructed with Phase 3.

Phase 3 – The next 39 residential lots will be platted with this Hannah Ridge at Feathergrass Filing No. 3. Both Hunter Jumper Drive and Winslow Park Drive will be extended from Filing No. 2 to the west edge of Filing No. 3. Grand Prix Court and Horsemanship Court will be constructed north to south between Hunter Jumper and Winslow Park Drives. Basin B7 (0.72 acres), in Winslow Park Drive, accepts flows from the east end of the street which was constructed in Filing No. 1 and located in Basin B5. The ultimate developed condition will contribute developed flows to Winslow Park Drive from the north. However, in the interim condition, undeveloped flows are directed to the tributary drainageway, north of the Winslow Park Drive and does not enter the street. The combined flows of B5 and B7 flow west in the street to a new 15' Type R Sump Inlet on the north side of the street (DP 7), located at the east edge of Filing No. 3. A portion of these flows are collected in an existing 15' Type R inlet, constructed with Phase 2. The overflows from this inlet continue west to the new inlet at DP 7. The collected runoff is directed to a new 90" RCP storm drain flowing south

through existing Tract F which will be constructed with the Phase 3. The ultimate peak discharge at DP 7, including future developed discharges from the north side of Winslow Park Drive is Q_5 = 20.4 cfs and Q_{100} = 40.1 cfs. The inlet collects the total remaining flows of 10.5 cfs during the 5-yr rainfall event and 26.0 cfs during the 100-yr event. Permanent water quality treatment for stormwater generated by these sub-basins (DP 7) is being constructed during Phase 3 on the north side of Winslow Park Drive, opposite the northeast corner of Filing No. 3. Basin B8 (0.14 acres), located on the south side of Winslow Park Drive, drains east to Basin E6 at existing Half Chaps Court with developed peak discharges of Q_5 = 0.5 cfs and Q_{100} = 1.0 cfs. A curb opening on the south side of the street will allow the water quality capture volume to enter Tract F and flow to a permanent water quality treatment area on the north edge of Hunter Jumper Drive. This same facility will also treat runoff from Basin E-7. The remaining Basin B8 flows then travel south on the west side of Half Chaps Court to the cul-de-sac bulb where the existing 5' sump inlet constructed in Phase 2 will collect the total storm discharges of Q_5 = 4.5 cfs and Q_{100} = 9.0 cfs at DP 21. These flows will be piped to the new 90" RCP storm drain pipe to be constructed with Phase 3 in an extended 18" RC Pipe. The previously mentioned 90" RC Pipe will collect all the flows of the Tributary 6 on the north side of Winslow Park Drive (DP 14). The ultimate peak discharge entering the pipe are Q_5 = 360 cfs and Q_{100} = 640 cfs. These flows continue south in the pipe and are joined by other previously mentioned flows from DP 7 and DP 21.

Basin E2 (2.80 acres) contains the west edge of Filing No. 3 from Hunter Jumper Drive to Winslow Park Drive. The basin drains east to Grand Prix Court and then south towards Hunter Jumper Drive with peak discharges of Q_5 = 6.7 cfs and Q_{100} = 13.3 cfs. The flows travel east, across Grand Prix Court to join additional flows in Basin E3. Basin E3 (0.97 acres), located on the east side of Grand Prix Court, drains south to Hunter Jumper Drive. The basin generates runoff discharges of Q_5 = 2.5 cfs and Q_{100} = 5.0 cfs. These flows join the Basin E2 flows from the west. In the interim condition, undeveloped discharges from the west sheet flows into the rear of the lots along Grand Prix Court and will drain to the southeast. These flows approximate the small discharges (one-half of the adjacent walk-out lots) that will drain into the rear of these same lots in the ultimate condition. Combined discharges from Basins E1, E2 and E3 at DP 19 has peak discharges of Q_5 = 11.9 cfs and Q_{100} = 23.7 cfs in the ultimate condition. A portion of these flows will be collected in a new 15' Type R Inlet at the northeast corner of Grand Prix Court and Hunter Jumper Drive (DP 19). This inlet collects 8.4 cfs during the 5-yr rainfall event and 11.9 cfs during the 100-yr. A proposed 24"/30" RC Pipe will convey these flows to the east and connect to the proposed 90" RC pipe. The remainder continues east in Hunter Jumper Drive to Basin E4. Proposed Basin E4 (2.74 acres) contains the lots west of Horsemanship Court. This basin drains east to the street and then south to Hunter Jumper Drive with developed peak discharges of Q_5 = 6.7 cfs and Q_{100} = 13.3 cfs. The flows travel east, across Horsemanship Court to join additional flows in Basin E5. Basin E5 (0.90 acres) is located on the east side of Horsemanship Court. The basin drains south to the Hunter Jumper Drive with peak discharges of Q_5 = 2.3 cfs and Q_{100} = 4.7 cfs. These flows join the flows from Basins E1, E2, E3, and E4 and continue east to Basin E7. The combined discharges of Basins E1, E2, E3, E4, E5, E7 at DP 20 are Q_5 = 23.4 cfs and Q_{100} = 48.4 cfs. All of the remaining (not collected by the inlet at DP19) 5 year flows of 15 cfs and the majority of 100 year flows of 36.5 cfs are collected in a proposed 15' sump inlet on the north side of Hunter Jumper Drive. A small amount of the100 year flows cross to the south side of the street and are collected in another inlet. The collected flows are conveyed in a new 30' RC Pipe to the new 90" RCP storm drain pipe in Base E7. Basin E7 (2.33 acres) is located along the east side of Filing No. 3 and contains rear lots along proposed Horsemanship Court and existing Tract F. Tract F is an Open Space and Drainage tract which will contain the proposed 90" pipe and a permanent Sand Filter Basin, located just north of Hunter Jumper Drive. The basin drains south in Tract F with peak discharges of Q_5 = 3.3 cfs and Q_{100} = 8.1 cfs which enter the proposed Sand Filter Basin and then are collected in a proposed Type C inlet connecting to the new 30" RCP storm drain system in Hunter Jumper Drive. Basin E8 (0.65 acres) contains the south side of Hunter Jumper Drive. The basin drains east to a low point near Basin E7 with peak discharges of Q_5 = 1.8 cfs and Q_{100} = 3.6 cfs. A proposed sump 5' Type R inlet will collect the flows which are conveyed to the 30" RC Pipe in Hunter Jumper Drive and then to the proposed 90" RC Pipe.

The 2-year flows in the Hunter Jumper Drive storm drain system are extracted by a separate pipe and directed to the new Sand Filter Basin on the south side of the street in Tract BB. Any overflows in the sand filter basin are collected in an outlet box and redirected back to the 90" RC pipe. The 90" RC Pipe continues south towards the Constitution Avenue drainage ditch and will terminate at a concrete headwall with wingwalls. The existing 60" RC Pipe located along the north side of Constitution Avenue will be extended in order to connect to the same headwall. The combined main channel flows travel east to the existing Hannah Ridge Drive double box culvert and on to the east as described above.

Phases 4 through 8 – The detailed drainage information for Phases 4-8 residential development will be provided with updated drainage reports as they are platted.

4.2.3 Drainage Facilities

Proposed drainage improvements include standard CDOT Type R curb inlets, RCP storm drain pipe with minimum diameter of 18 inches, standard CDOT storm drain manholes and water quality sand filter basins. The water quality capture volume is conveyed into the sand filter basins by an RC pipeline from either the final curb inlet box or the nearest storm drain manhole. The flow out of the inlet box or manhole to the sand filter basin is limited to the flow equivalent to the 80th percentile storm or approximately one-half of the 2-year rainfall event, by the installation of a flow restrictor plate in the box. All flows greater than the WQCV will continue in the storm drain system to the main tributary channel outfall.

The sand filter basins require periodic maintenance to insure proper function. Each sand filter basin will be maintained by the Hannah Ridge Homeowners Association in accordance with the Operation and Maintenance (O & M) Manual for the sand filter basins provided for this project. Each sand filter basin is adjacent to public right-of-way, which facilitate access. Each sand filter basin is located within an easement created with the standard El Paso County Detention Basin Maintenance Agreements which is being executed with this subdivision.

Access to the storm drain system is provided by the public right-of-way and drainage easements. The storm drain system, including the 90 inch main line, all have storm drain manhole and storm inlet manholes access. All of Tract E and Tract F are being provided for Storm Drain easements. Furthermore, the Final Plat of Hannah Ridge at Feathergrass Filing No. 1 provides the necessary Drainage Easement for the main drainageway pipeline and channel downstream of Hunter Jumper Drive.

Drainage Criteria Manual Volume 2 (DCM v2) requires the consideration of a "Four Step Process to Minimize Adverse Impacts of Urbanization" for receiving waters that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long term source controls".[33] Elements of the Four Step Process is incorporated in the project and the elements are discussed below.

1) Several Runoff Reduction Practices are being employed in the project. On each residential lot, runoff from much of the impervious roof area will be routed to the pervious areas of of lawn and landscaping before entering the streets to drain to the storm drain system. Tract F, adjacent to the east side of the site, provides a Grass Buffer area where flows from a potion of Winslow Park Drive and the rear lots that abut the tract will drain. All these are factors constitute a degree of Minimized Directly Connected Impervious Area (MDCIA). Tract F also provides and overflow pathway for flows that exceed the 100-year storm in the main drainageway.

2) The project is being constructed with permanent BMP's providing Water Quality Capture Volume with slow release. Three sand filter basins will provide treatment of the WQCV for the subdivision. The sand filter basins are positioned to capture the WQCV from the lots and streets.

3) The drainage paths on the site are being stabilized with the development. The main tributary drainageway on the site is a constructed channel, the pathway of which has been modified several

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times over the the last 50 years by artificial and natural means. The portion of the constructed channel traversing north-south through Hannah Ridge at Feathergrass Filing No. 3 is being replaced by a 90 inch RC pipe system, beneath a shallow grassed swale. The pipe systems will discharge to the constructed channel located on the north side of Constitution Avenue. The channel downstream of the pipe outfall will be stabilized with rip rap lining. There are no other drainagways on the site and no additional stabilization measures are warranted.

4) The site contains no outdoor storage areas or storage of potentially harmful substances. No permanent Site Specific or Other Source Control BMP's are required. A Grading and Erosion Control Plan for the construction of the site has been prepared in accordance with the provisions of Drainage Criteria Manual Volume 2. The measures specified in the plan and ESQCP will be implemented to control erosion during the construction process.

4.3 Downstream Facilities

The existing 42"/60" RC pipe system along the north side of Constitution Avenue will be utilized for the connection of some of the proposed storm drain system in the multi-family Tracts AA and BB, which will undergo development in the future. Those tracts will have their own storm detention and water quality facilities. The hydraulic grade line will be maintained in a safe level as the County designed said system to capture developed flows from these areas as requested by the property owner.

The existing earthen channel along the north side of Constitution is adequate to carry existing and developed discharges to the existing culvert crossing of Constitution Avenue with a capacity of 2,316 cfs. The capacity of the existing double 12'x6' CBC at Constitution Avenue is adequate to carry the developed discharges from the site. The culvert has a capacity of 1,234 cfs with headwater up to the top of the concrete head wall. The calculated discharge at the culvert entrance is Q10 = 457 cfs and Q100 = 1076 cfs.

The existing drainage way downstream of Constitution Avenue was examined, considering three development conditions: Hannah Ridge Pre-Development with current upstream basin development, Hannah Ridge Phases 1 – 4 only and total Hannah Ridge build-out. The downstream drainage way consists of three distinct reaches from Constitution Avenue to the Confluence with the East Fork of Sand Creek. The channel downstream of Constitution (DP 8) to a point near the hypothetical extension of Palmer Park Boulevard (DP 6) is deep and narrow with steep side slopes. The channel from DP 6 to a future extension of River Walk Parkway (DP 7) contains a wide ponding area and sediment basin. Storm flows pass through the reach if the ponding area is filled. The downstream analysis considered no detention effects due to this reach. From DP 7 to the confluence with East Fork Sand Creek (DP 8a), the existing drainage way is wide and shallow with a less well defined flow path. This reach is an undeveloped open area and the existing characteristically wide flow path poses no dangers to structures or development. Discharge quantities were determined by modification of the Amended DBPS HEC-1 runs to reflect existing conditions with no Hannah Ridge development, development of only Phases 1 - 4 of Hannah Ridge, and Hannah Ridge fully developed. Hydrologic analyses for the downstream section is presented in the Appendix and the maps from the DBPS amendment, marked up with the existing flows are included in the map pocket.

Downstream Drainage Way Discharges						
Location	Hannah Ridge Pre - Development Q10/Q100 (cfs)		Hannah Ridge Phases 1 – 4 Only Q10/Q100 (cfs)		Hannah Ridge Phases 1 – 8 (Total) Q10/Q100 (cfs)	
(8) Constitution Ave	392	856	395	876	453	1041
(6) Extension of Palmer Park Blvd	410	1004	415	1030	577	1261
(7) Extension of River Walk Pkwy	429	1151	449	1180	629	1433
(8a) Confl. w/ E. Fork Sand Creek	609	1497	588	1523	826	1869

A basic hydraulic analysis was performed on the downstream reach to determine the adequacy of the existing drainage way in the existing condition and with Hannah Ridge development. Channel cross sections were taken with the use of recent existing topographic mapping obtained from Merrick & Co. as used in their design of the proposed Wilshire Channel. Results indicate that the downstream drainage way is adequate to deliver the existing and Hannah Ridge developed flow safely to East fork Sand Creek. The Hannah Ridge development will present no adverse effects on the existing downstream reach as the effects on the hydraulic properties are are minimal and the existing drainage way is adequate to pass the developed flows. The construction of Phase 1, by itself, creates negligible downstream impacts. Calculations are attached in the Appendix of this report. Any mitigation for potential erosion and water quality effects of the Hannah Ridge will be addressed in the Final Plat and Final Drainage Report stage of the various phases of Hannah Ridge.

The proposed downstream Wilshire channel (by others) will have a capacity of at least 1,380 cfs, well above the calculated discharge of Q100 = 1076 cfs at the downstream end of the project. The downstream drainage system appears to have adequate capacity to carry the flows from the proposed project. The flows from the proposed project will be less than those planned for in the original DBPS due the change from Industrial to residential and commercial development and also due to the accounting for the natural detention provided on the upstream side of the railway embankment.

5 Opinion of Probable Cost for Drainage Facilities

The concrete box culverts and large diameter RC Pipe conveyance indicated by the drainage plan for the Tributary 6 main drainageway are not planned in the operative DBPS. However, these improvements are a functional substitute for the rip rap channel lining and check structure which are called for in the DBPS. Therefore, the cost of constructed drainage improvements for the Tributary 6 main drainageway are reimbursable up to the cost of the rip rap lining and check structures shown in the DBPS. These costs will generate credits which will be used to pay Drainage Fees due at the time of current and future subdivision platting in this subdivision.

The costs for the DBPS Authorized Improvements are estimated in the table below:

Hannah Ridge at Feathergrass DBPS Improvements Costs (Reimbursable)				
Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Rip Rap Channel (20' BW, 4' H) L= 1350' (DBPS Sht. EF-23, EF-25)	6599	CY	$98	$646,702
Concrete Check for 20' BW channel Number = 2 (DBPS Sht. EF-23, EF-25)	6	CY	$312	$1,872
Rip Rap Channel (15' BW, 2' H) L= 840' (DBPS Sht. EF-23, EF-24)	2520	CY	$98	$246,960
Concrete Check for 15' BW channel Number = 1 (DBPS Sht. EF-24)	3	CY	$312	$936
Rip Rap Channel (30' BW, 4' H) L= 2430' (DBPS Sht. EF-21, EF-23)	14460	CY	$98	$1,417,080
Concrete Check for 30' BW channel Number = 3 (DBPS Sht. 21, 23)	12	CY	$312	$3,744
Rip Rap Channel (10' BW, 2' H) L= 660' (DBPS Sht. EF-22)	1613	CY	$98	$158,074
Concrete Check for 10' BW channel Number = 2 (DBPS Sht. EF-22)	4	CY	$312	$1,248
GRAND TOTAL				**$2,476,616**

As a component of the Tributary 6 main drainageway improvements, the proposed 90" storm drain system with associated end treatments is eligible to generate Drainage Credits up to the amount of improvements indicated in the DBPS. Costs for reimbursable drainage improvement items in Hannah Ridge Filing No. 3 are listed in the table below:

Hannah Ridge at Feathergrass Filing 3 Drainage Improvement Costs (Reimbursable)				
Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Concrete Box Culvert (10x6)	59	LF	$480.00	$28,320
90" Reinforced Concrete Pipe	1000	LF	$383.00	$383,000
60' Reinforced Concrete Pipe	360	LF	$216.00	$77,760

End Treatment- Headwall	1	EA	$3,185.00	$3,185
End Treatment- Wingwall	4	EA	$2,740.00	$10,960
End Treatment - Cutoff Wall	1	EA	$300.00	$300
Rip Rap Channel, d50 Size 6"- 24"	882	CY	$98.00	$86,436
GRAND TOTAL				**$589,961**

Costs for the non-reimbursable drainage improvements for Hannah Ridge Filing No. 3 are listed in the table below:

Hannah Ridge at Feathergrass Filing 3 Drainage Costs (Non-Reimbursable)				
Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
18" Reinforced Concrete Pipe	223	LF	$69.00	$15,387
24" Reinforced Concrete Pipe	352	LF	$84.00	$29,568
30" Reinforced Concrete Pipe	90	LF	$94.00	$8,460
18" HDPE Pipe	122	LF	$58.00	$7,076
Flared End Section (FES) HDPE	1	EA	$205.00	$205
Curb Inlet (Type R) L=5', Depth<5'	1	EA	$3,791.00	$3,791
Curb Inlet (Type R) L =15', Depth<5'	2	EA	$7,923.00	$15,846
Curb Inlet (Type R) L =15', 5'-10' Depth	2	EA	$8,000.00	$16,000
Grated Inlet (Type C), < 5' deep	2	EA	$3,270.00	$6,540
Storm MH, Box Base, Depth < 15 feet	3	EA	$8,592.00	$8,592
Perm Water Quality Sand Filter Basin	1	EA	$18,000.00	$18,000
RR Trail Culvert resurfacing	1953	SF	$1.10	$2,148
RR Trail Culvert wingwall recondition	1	LS	$2,500.00	$2,500
RR Trail Culvert riprap aprons	89	CY	$98.00	$8,722
GRAND TOTAL				**$142,835.30**

6 Drainage and Bridge Fees

The site is located in the Sand Creek Major Drainage Basin. Development in this basin carries 2017 Drainage Fees of $16,270.00 per impervious acre and Bridge Fees of $4,929.00 per impervious acre. Percent impervious is calculated using dimensions of improvements in R.O. W. and average residential footprints and driveway dimensions. The Drainage and Bridge Fees for the subdivision are calculated below:

Hannah Ridge at Feathergrass Filing No. 3

Drainage Fees:

Drainage Fees = Platted Area x %imperviousness x $16,270.00

Drainage Fees = 8.31 Ac x 0.51 x $16,270.00 = **$68,953.89**

These Drainage Fees will be paid by the Developer in the form of cash and/or credits which may be available at the time of recording of Hannah Ridge Filing No. 3.

Bridge Fees:

Bridge Fees = Platted Area x %imperviousness x $4,929.00

Bridge Fees = 8.31 Ac x 0.51 x $4,929.00 = **$20,889.59**

These Bridge Fees will be paid by the Developer at the recording of Hannah Ridge at Feathergrass Filing No. 3.

7 Conclusion

This Final Drainage Report presents a drainage concept for the proposed subdivision. The subdivision development will function to route and convey the offsite and onsite storm runoff with the site grading and drainage facilities to be provided as part of the development. The proposed project with associated improvements will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream drainage facilities.

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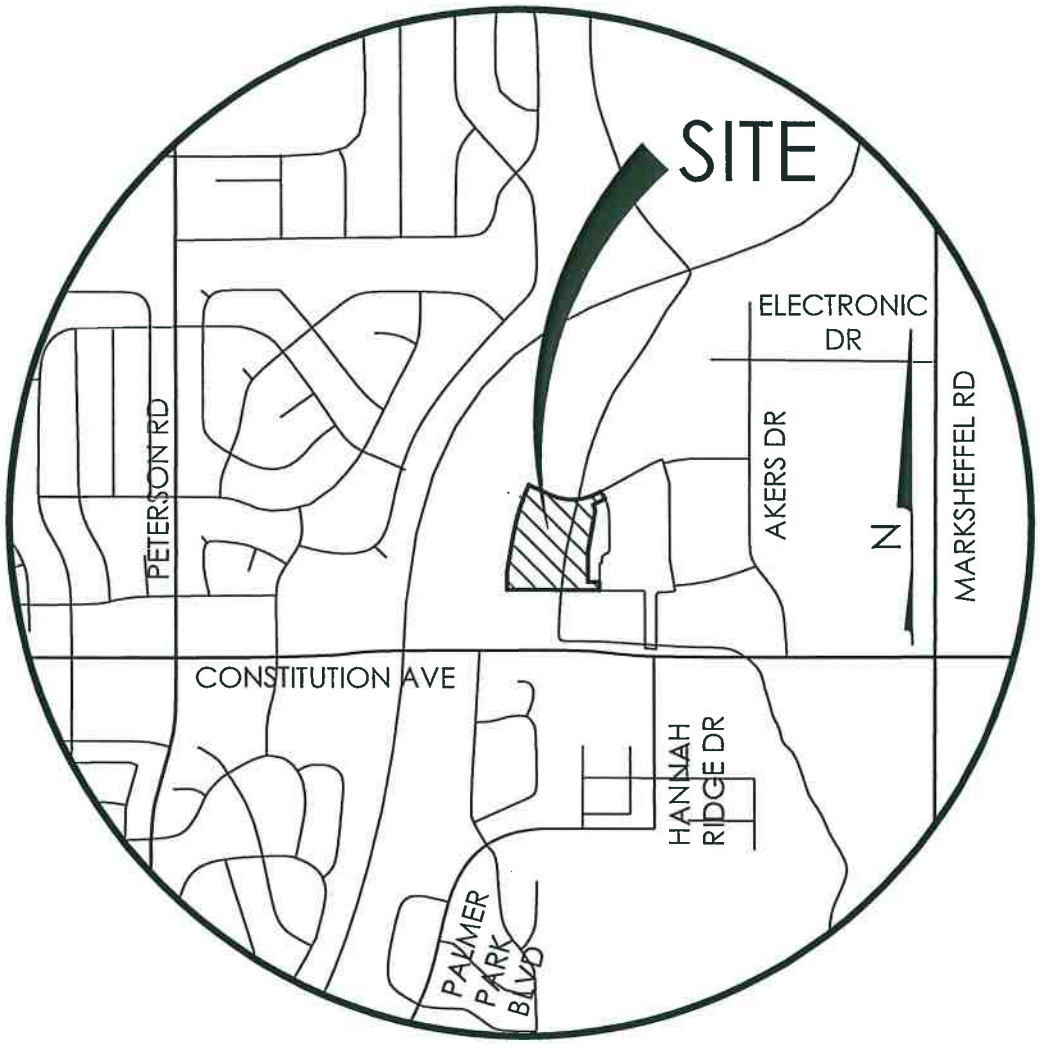
Appendices

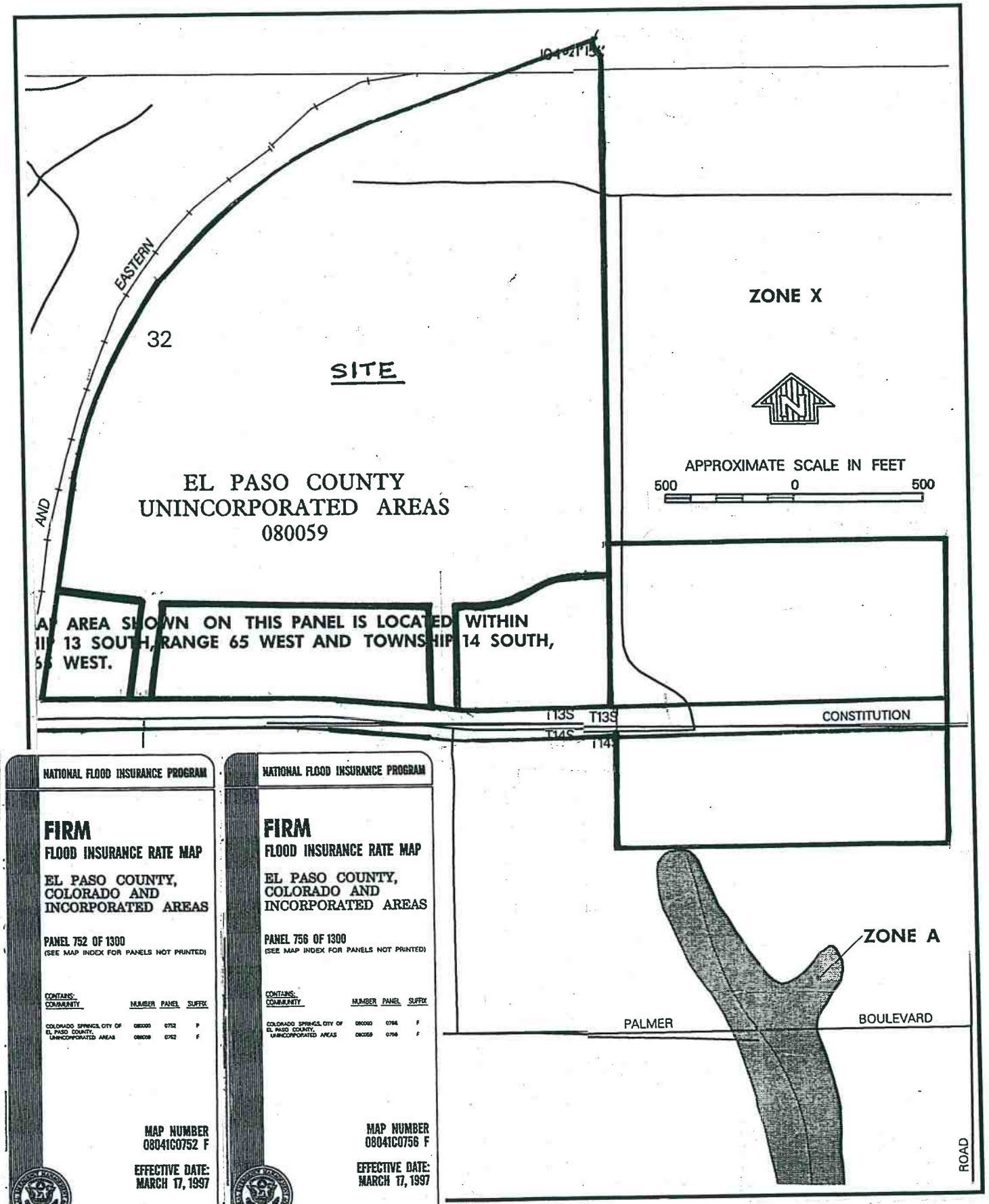
8 General Maps and Supporting Data

Vicinity Map
Portions of Flood Insurance Rate Map and LOMR Maps
Portion of Drainage Area Identification Study Map
Portion of Exhibit 1 of 1996 Sand Creek Drainage Planning Study
Hydrologic Soil Group Mapping
1996 Sand Creek Drainage Planning Study Preliminary Design Plan



VICINITY MAP

NTS



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 752 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0752	F

MAP NUMBER
08041C0752 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 756 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

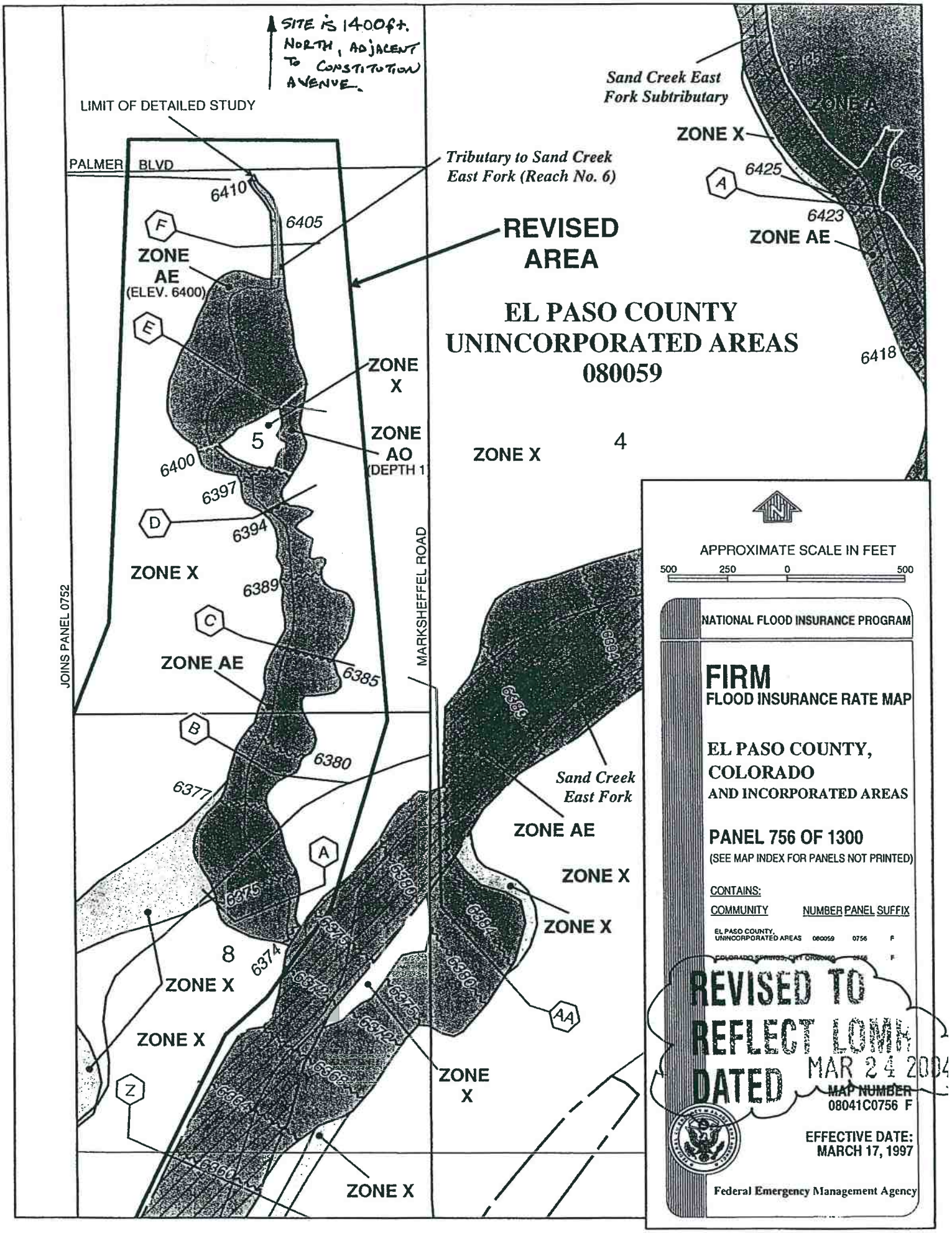
CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0756	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0756	F

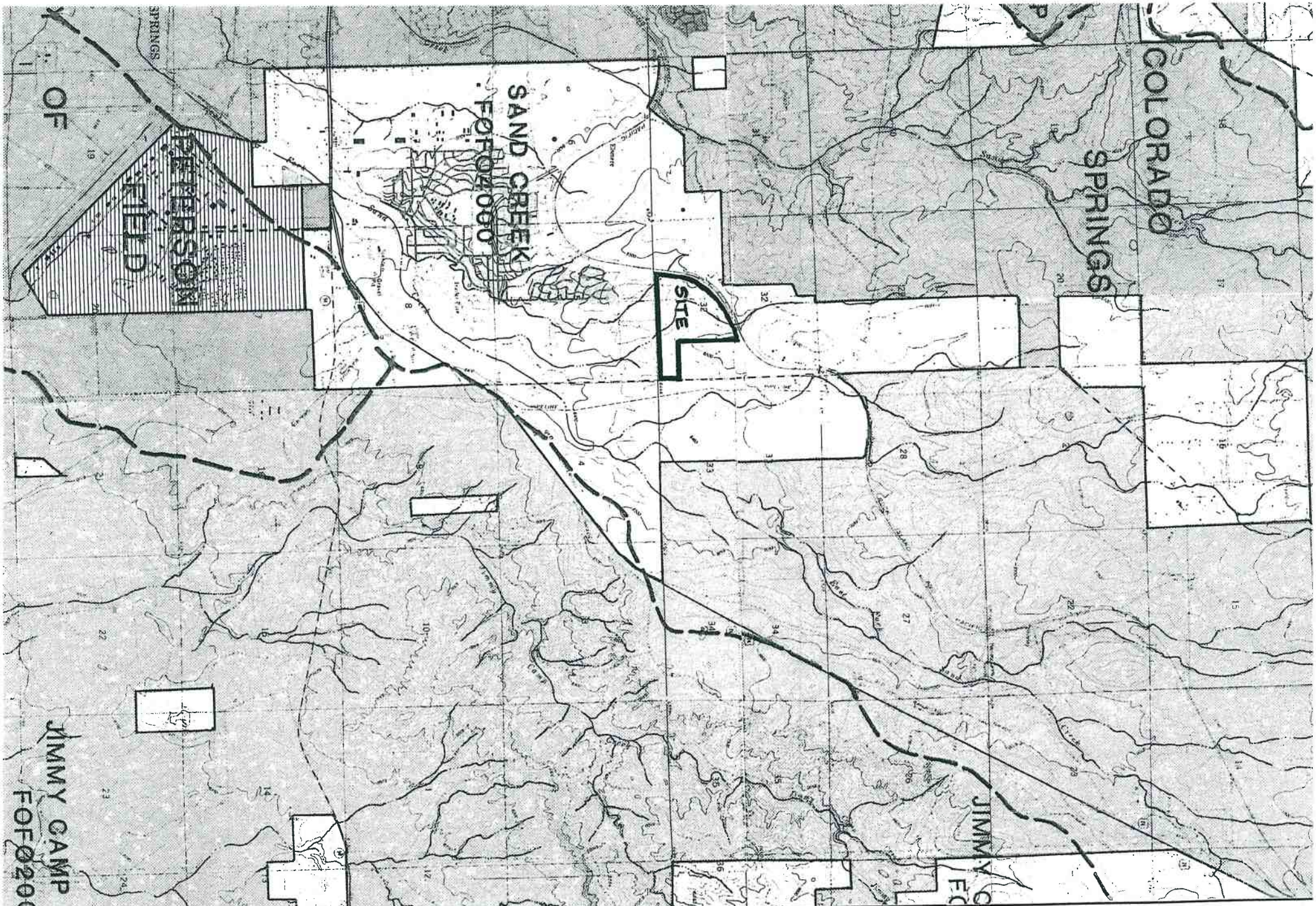
MAP NUMBER
08041C0756 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

MARCH 24, 2004 LOMR UPDATED ZONE A HAZARD AREA SHOWN ON THIS MAP.


SITE IS 1400 ft. NORTH, ADJACENT TO CONSTITUTION AVENUE.
LIMIT OF DETAILED STUDY
PALMER BLVD
Tributary to Sand Creek East Fork (Reach No. 6)
Sand Creek East Fork Subtributary
REVISED AREA
EL PASO COUNTY
UNINCORPORATED AREAS
080059
ZONE X
ZONE A
ZONE AE
(ELEV. 6400)
ZONE AO
(DEPTH 1
ZONE AE
ZONE X
ZONE AE
ZONE X
ZONE X
ZONE X
ZONE X
ZONE X
ZONE X
6410
6405
6425
6423
6418
6400
6397
6394
6389
6385
6380
6377
6375
6374
6384
6380
6375
6372
6368
6366
MARKSHEFFEL ROAD
JOINS PANEL 0752
Sand Creek East Fork
4
5
8
A
B
C
D
E
F
AA
Z
APPROXIMATE SCALE IN FEET
500 250 0 500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS
PANEL 756 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0756 F
REVISED TO REFLECT LOMR DATED MAR 24 2004
MAP NUMBER
08041C0756 F
EFFECTIVE DATE:
MARCH 17, 1997
Federal Emergency Management Agency



MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

DESIGNED	JTW, BAD	DATE	4/86
DRAWN	BMG	DATE	4/86
CHECKED	LAM	DATE	4/86
REVISED	JTW	DATE	10/88

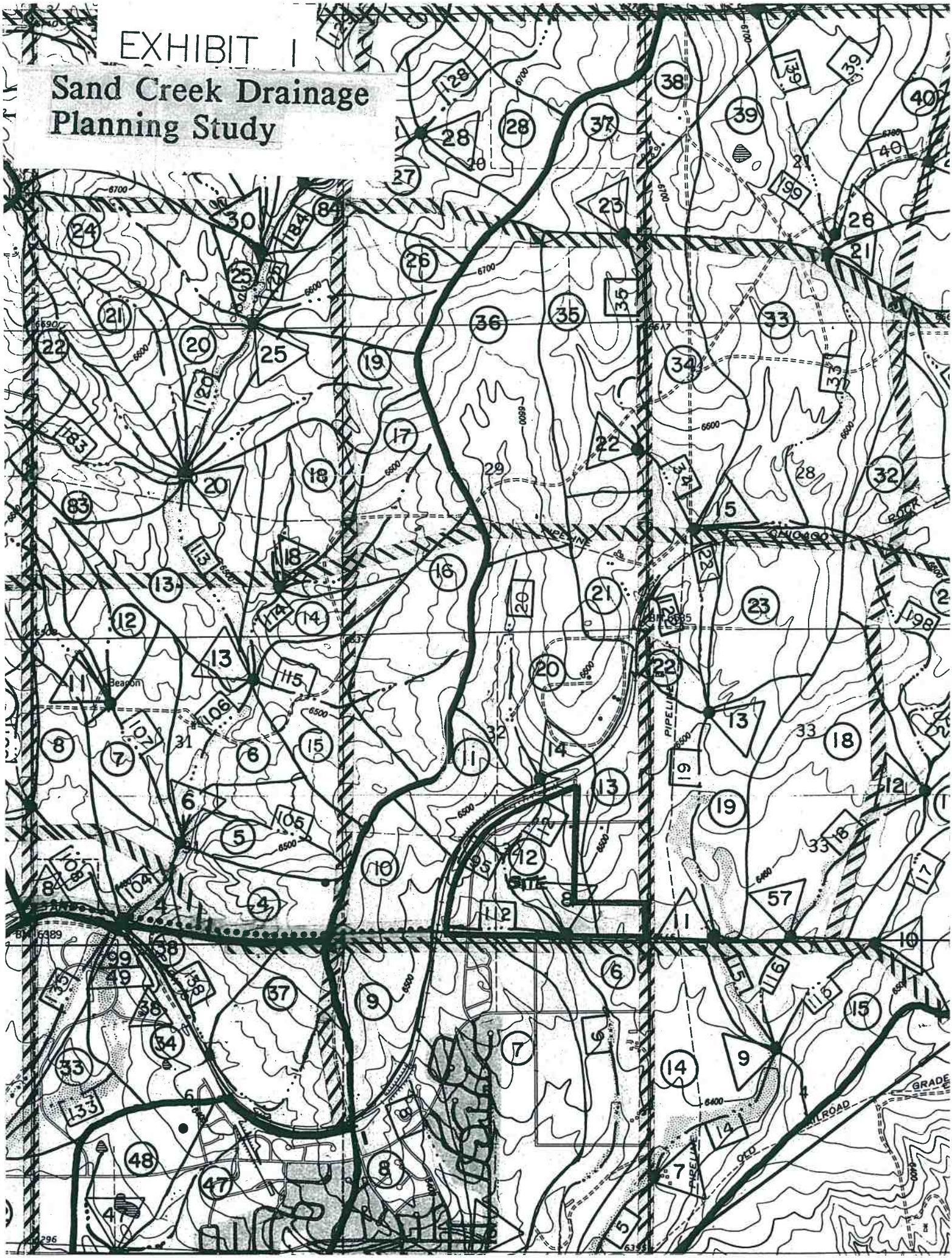
EL PASO COUNTY, COLORADO

Department of Transportation
3170 CENTURY STREET, COLORADO SPRINGS, COLORADO 80907

DRAINAGE AREA IDENTIFICATION STUDY

EXHIBIT 1

Sand Creek Drainage Planning Study



Hydrologic Soil Group—El Paso County Area, Colorado
(Hannah Ridge at Feathergrass)

Map Scale: 1:5,640 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 15, 2011—Jun 17, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	103.8	100.0%
Totals for Area of Interest			**103.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Map—El Paso County Area, Colorado
(Hannah Ridge at Feathergrass)

Map Scale: 1:5,640 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

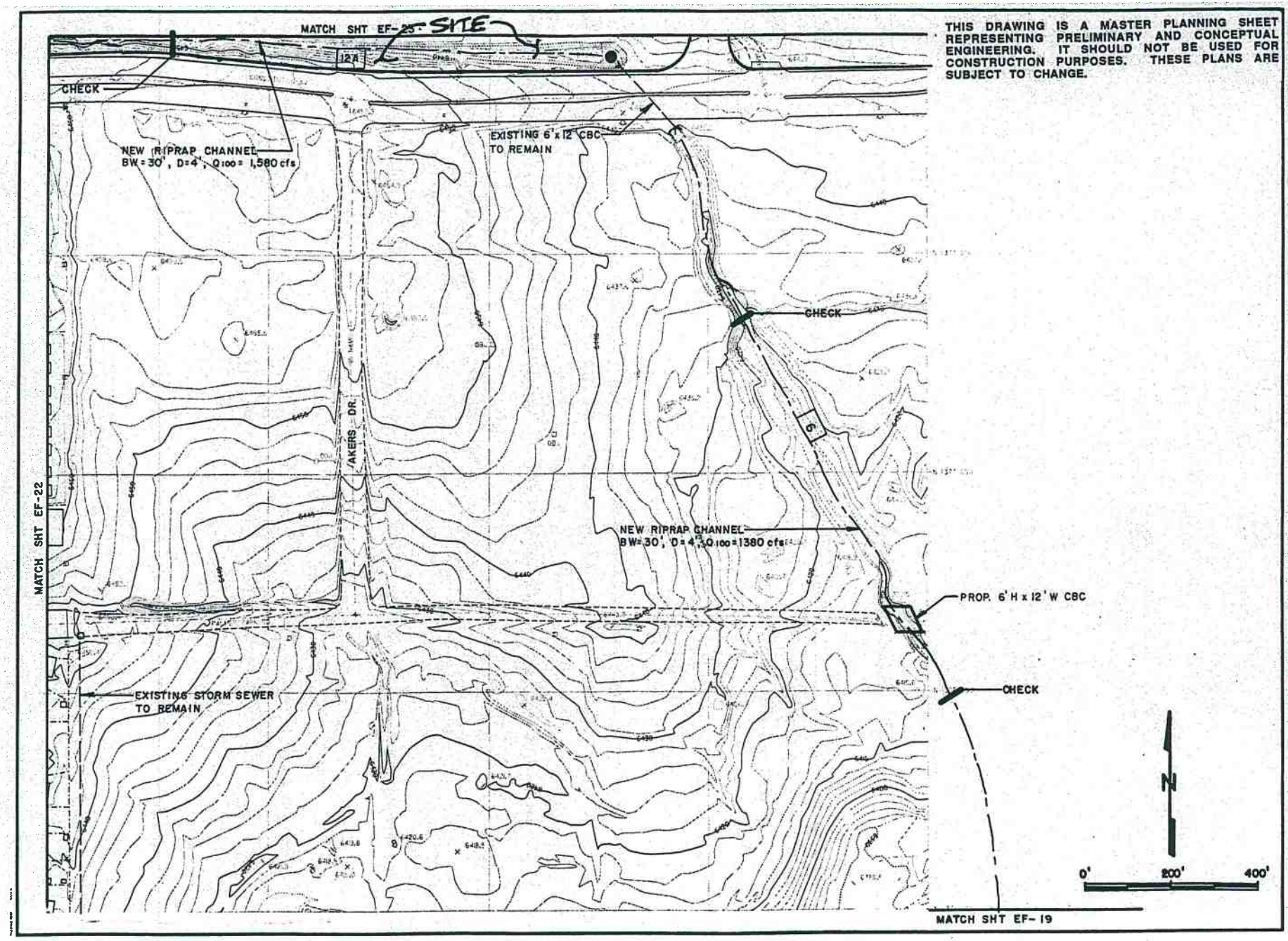
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 15, 2011—Jun 17, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	103.8	100.0%
Totals for Area of Interest		**103.8**	**100.0%**



THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. THESE PLANS ARE SUBJECT TO CHANGE.

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No:
Date:
Design:
Drawn:
Check:
Revisions:

EF-21

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. THESE PLANS ARE SUBJECT TO CHANGE.

MATCH SHT EF-21

MATCH SHT EF-24

MATCH SHT EF-20

CHECK

IMPROVED RIPRAP CHANNEL
BW=10', D=2', Q100=200cfs

0' 200' 400'

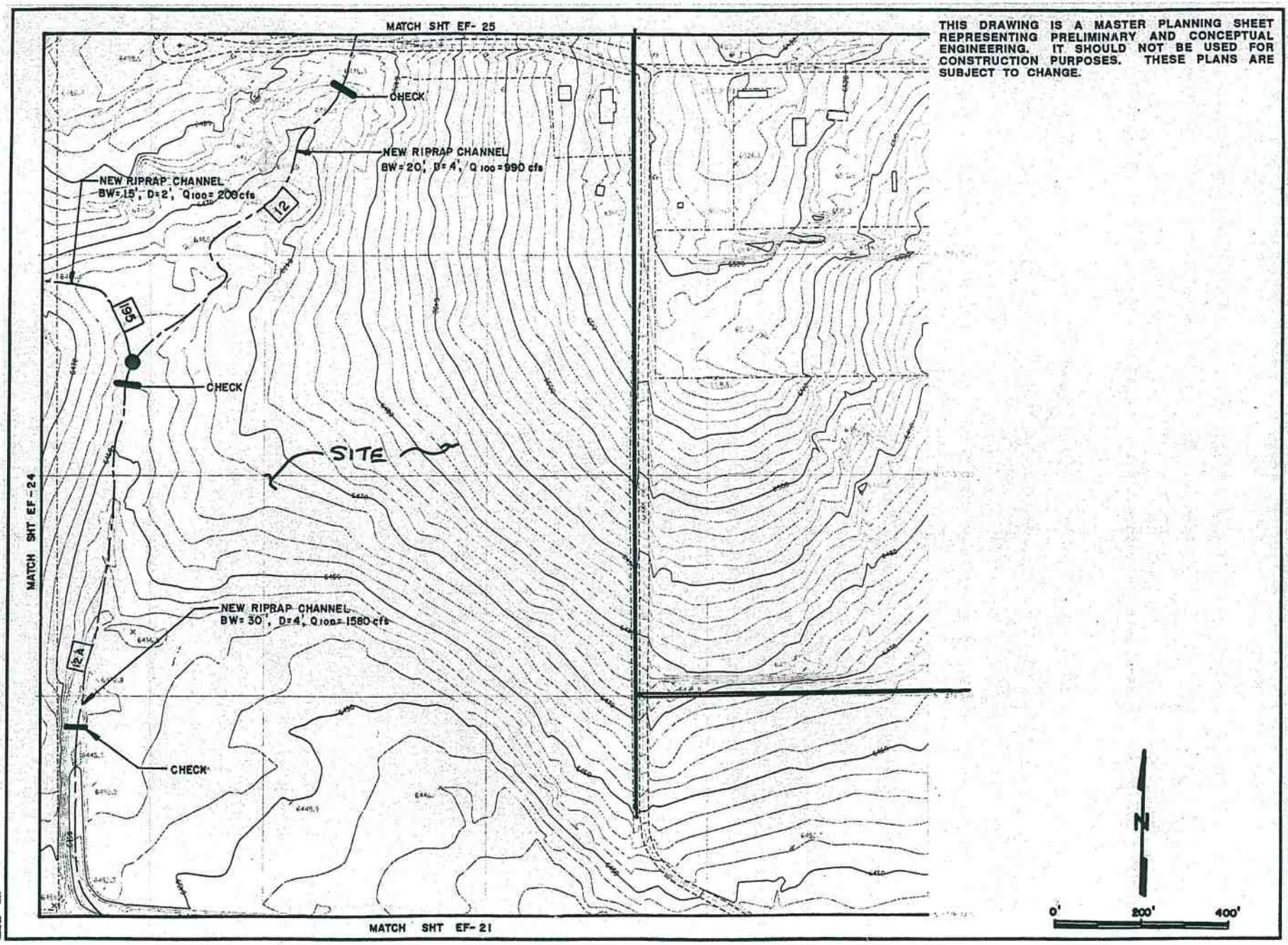
SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No.	
Date:	
Design:	
Drawn:	
Check:	
Revisions:	

EF-22

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308



THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. THESE PLANS ARE SUBJECT TO CHANGE.

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE
BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

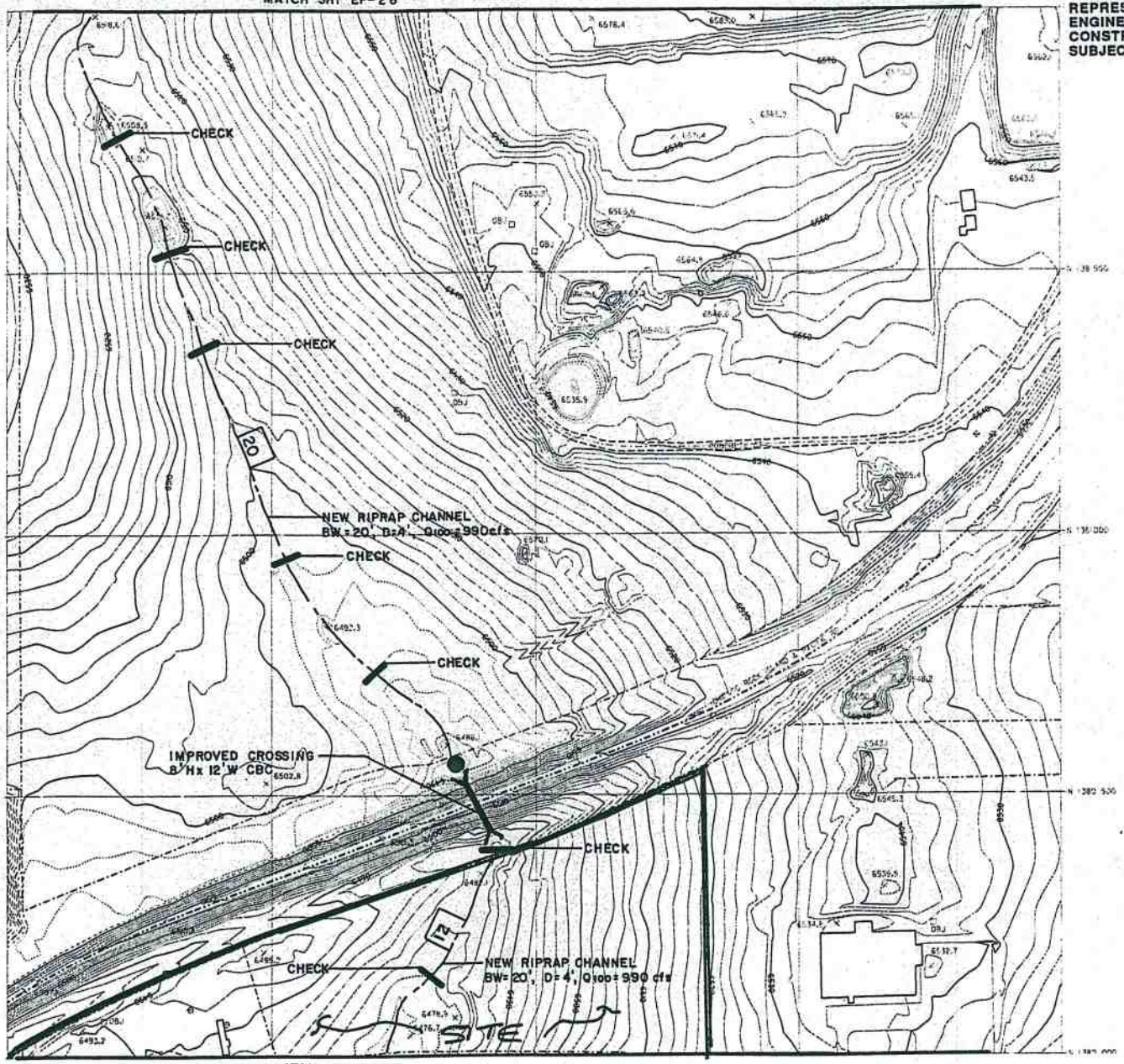
Project No:	
Date:	
Design:	
Drawn:	
Check:	
Revisions:	

EF-23

SAND CREEK DRAINAGE
BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

EF-24

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308



THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. THESE PLANS ARE SUBJECT TO CHANGE.

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE
BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No	
Date:	
Design:	
Drawn:	
Check:	
Revisions:	

EF-25

HYDROLOGIC ANALYSES

Hydrologic Analysis
Rational Method Local Drainage

M.V.E., Inc. 8/2/2013
Project No.: 60970
Project: Hannah Ridge at Feathergrass

ON-SITE RUNOFF COEFFICIENTS

Hydrologic Soil Group: A
Soil and Cover Condition: Fair

Existing Basin Conditions

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA2	Range	1.87	0.25	0.35
	Gravel	0.07	0.80	0.85
	Composite	1.94	0.27	0.37

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA3	Pavement and Roofs	0.23	0.90	0.95
	Lawns	0.03	0.25	0.35
	Composite	0.26	0.83	0.88

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSC1	Range	3.34	0.25	0.35
	Gravel	0.09	0.80	0.85
	Composite	3.43	0.26	0.36

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A4	Industrial - Light	5.90	0.70	0.80
	Range	32.20	0.25	0.35
	Composite	38.10	0.32	0.42

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA2-A4	OSA2	1.94	0.27	0.37
	OSA3	0.26	0.83	0.88
	OSC1	3.43	0.26	0.36
	A4	38.10	0.32	0.42
	Composite	43.73	0.32	0.42

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSF2	Residential - 1/8 Acre	0.50	0.60	0.70
	Gravel	0.12	0.80	0.85
	Range	4.26	0.25	0.35
	Composite	4.88	0.30	0.40

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSF3	Range	0.52	0.25	0.35
	Composite	0.52	0.25	0.35

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A7	Range	30.20	0.25	0.35
	Composite	30.20	0.25	0.35

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSB1	Pavement and Roofs	0.57	0.90	0.95
	Lawns	0.06	0.25	0.35
	Composite	0.63	0.84	0.89

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A9	Range	33.60	0.25	0.35
	Composite	33.60	0.25	0.35

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA8	Industrial - Light	16.20	0.70	0.80
	Composite	16.20	0.70	0.80

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A16	Pavement and Roofs	1.38	0.90	0.95
	Range	16.62	0.25	0.35
	Composite	18.00	0.30	0.40

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA11	Range	0.37	0.25	0.35
	Pavement and Roofs	3.34	0.90	0.95
	Composite	3.71	0.84	0.89

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA12	Range	0.21	0.25	0.35
	Pavement and Roofs	1.46	0.90	0.95
	Composite	1.67	0.82	0.87

M.V.E., Inc. 8/10/2013
Project No.: 60970
Project: Hannah Ridge at Feathergrass - Final
'(Multi-Family & Commercial Parcels Undeveloped)

ON-SITE RUNOFF COEFFICIENTS

Hydrologic Soil Group: B
Soil and Cover Condition: Fair

Developed Basin Conditions

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA2	Range	1.87	0.25	0.35
	Gravel	0.07	0.80	0.85
	Composite	1.94	0.27	0.37

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A1	Residential - 1/8 Acre	1.83	0.60	0.70
	Lawns	0.79	0.25	0.35
	Composite	2.62	0.49	0.59

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A2	Residential - 1/8 Acre	1.03	0.60	0.70
	Composite	1.03	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSA3	Pavement and Roofs	0.23	0.90	0.95
	Lawns	0.03	0.25	0.35
	Composite	0.26	0.83	0.88

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A3	Pavement and Roofs	0.23	0.90	0.95
	Lawns	0.07	0.25	0.35
	Composite	0.30	0.75	0.81

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A4	Pavement and Roofs	0.13	0.90	0.95
	Lawns	0.02	0.25	0.35
	Composite	0.15	0.81	0.87

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A5	Pavement and Roofs	0.14	0.90	0.95
	Lawns	0.05	0.25	0.35
	Composite	0.19	0.73	0.79

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
A6	Residential - 1/8 Acre	0.87	0.60	0.70
	Range	3.07	0.25	0.35
	Composite	3.94	0.33	0.43

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B1	Residential - 1/8 Acre	2.04	0.60	0.70
	Lawns	0.48	0.25	0.35
	Composite	2.52	0.53	0.63

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B2	Residential - 1/8 Acre	1.09	0.60	0.70
	Composite	1.09	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B3	Pavement and Roofs	0.21	0.90	0.95
	Lawns	0.12	0.25	0.35
	Composite	0.33	0.66	0.73

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B4	Residential - 1/8 Acre	2.01	0.60	0.70
	Composite	2.01	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSB1	Pavement and Roofs	0.57	0.90	0.95
	Lawns	0.06	0.25	0.35
	Composite	0.63	0.84	0.89

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B5	Residential - 1/8 Acre	0.22	0.60	0.70
	Pavement and Roofs	0.19	0.90	0.95
	Lawns	0.11	0.25	0.35
	Composite	0.52	0.64	0.72

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B6	Residential - 1/8 Acre	1.08	0.60	0.70
	Composite	1.08	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B7	Pavement and Roofs	0.54	0.90	0.95
	Lawns	0.18	0.25	0.35
	Composite	0.72	0.74	0.80

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B8	Pavement and Roofs	0.11	0.90	0.95
	Lawns	0.04	0.25	0.35
	Composite	0.14	0.74	0.80

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
B9	Residential - 1/8 Acre	1.60	0.60	0.70
	Parks, golf courses, etc.	4.61	0.30	0.55
	Composite	6.21	0.38	0.59

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSC1	Range	3.34	0.25	0.35
	Gravel	0.09	0.80	0.85
	Composite	3.43	0.26	0.36

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C1	Residential - 1/8 Acre	5.13	0.60	0.70
	Composite	5.13	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C2	Residential - 1/8 Acre	0.84	0.60	0.70
	Composite	0.84	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C3	Residential - 1/8 Acre	1.02	0.60	0.70
	Composite	1.02	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C4	Residential - 1/8 Acre	1.44	0.60	0.70
	Composite	1.44	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C5	Residential - 1/8 Acre	2.56	0.60	0.70
	Composite	2.56	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C6	Residential - 1/8 Acre	0.73	0.60	0.70
	Composite	0.73	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C7	Residential - 1/8 Acre	0.84	0.60	0.70
	Composite	0.84	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C8	Residential - 1/8 Acre	0.71	0.60	0.70
	Composite	0.71	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C9	Residential - 1/8 Acre	2.44	0.60	0.70
	Composite	2.44	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C10	Residential - 1/8 Acre	1.80	0.60	0.70
	Parks, golf courses, etc.	0.70	0.30	0.55
	Composite	2.50	0.52	0.66

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C11	Residential - 1/8 Acre	2.15	0.60	0.70
	Composite	2.15	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
C12	Residential - 1/8 Acre	1.47	0.60	0.70
	Composite	1.47	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D1	Residential - 1/8 Acre	2.07	0.60	0.70
	Composite	2.07	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D2	Residential - 1/8 Acre	1.19	0.60	0.70
	Composite	1.19	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D3	Pavement and Roofs	0.20	0.90	0.95
	Lawns	0.06	0.25	0.35
	Composite	0.26	0.75	0.81

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D4	Residential - 1/8 Acre	2.22	0.60	0.70
	Composite	2.22	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D5	Residential - 1/8 Acre	0.24	0.60	0.70
	Pavement and Roofs	0.24	0.90	0.95
	Lawns	0.26	0.25	0.35
	Composite	0.74	0.57	0.66

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D6	Residential - 1/8 Acre	1.31	0.60	0.70
	Composite	1.31	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D7	Residential - 1/8 Acre	3.95	0.60	0.70
	Composite	3.95	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D8	Residential - 1/8 Acre	3.06	0.60	0.70
	Composite	3.06	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D9	Range	0.52	0.25	0.35
	Pavement and Roofs	0.33	0.90	0.95
	Composite	0.85	0.50	0.58

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D10	Residential - 1/8 Acre	0.37	0.60	0.70
	Composite	0.37	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D11	Range	1.05	0.25	0.35
	Pavement and Roofs	0.25	0.90	0.95
	Composite	1.30	0.38	0.47

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
D12	Range	0.20	0.25	0.35
	Pavement and Roofs	0.32	0.90	0.95
	Composite	0.52	0.65	0.72

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E1	Residential - 1/8 Acre	1.23	0.60	0.70
	Composite	1.23	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E2	Residential - 1/8 Acre	2.80	0.60	0.70
	Composite	2.80	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E3	Residential - 1/8 Acre	0.97	0.60	0.70
	Composite	0.97	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E4	Residential - 1/8 Acre	2.74	0.60	0.70
	Composite	2.74	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E5	Residential - 1/8 Acre	0.90	0.60	0.70
	Composite	0.90	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E6	Residential - 1/8 Acre	1.80	0.60	0.70
	Composite	1.80	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E7	Residential - 1/8 Acre	1.00	0.60	0.70
	Parks, golf courses, etc.	1.33	0.30	0.55
	Composite	2.33	0.43	0.61

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E8	Residential - 1/8 Acre	0.65	0.60	0.70
	Composite	0.65	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
E9	Range	8.63	0.25	0.35
	Composite	8.63	0.25	0.35

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSF3	Range	0.52	0.25	0.35
	Composite	0.52	0.25	0.35

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
F1	Residential - 1/8 Acre	2.41	0.60	0.70
	Composite	2.41	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
F2	Residential - 1/8 Acre	1.26	0.60	0.70
	Composite	1.26	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
F3	Residential - 1/8 Acre	3.21	0.60	0.70
	Composite	3.21	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
F4	Residential - 1/8 Acre	0.32	0.60	0.70
	Composite	0.32	0.60	0.70

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
OSF2	Residential - 1/8 Acre	0.50	0.60	0.70
	Gravel	0.12	0.80	0.85
	Range	4.26	0.25	0.35
	Composite	4.88	0.30	0.40

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
F5	Range	3.67	0.25	0.35
	Composite	3.67	0.25	0.35

Basin:	Surface Type	Area (Ac)	C_5	C_{100} / CN
G1	Range	6.18	0.25	0.35
	Composite	6.18	0.25	0.35

60970 Hannah Ridge at Feathergrass
9/5/2017

Drainage Basin Percent Impervious Calculations - Mult-Family & Commercial Parcels Undeveloped

Componant % Impervious	0%	0%	80%	95%	53%	65%	95%	7%		
Basin	Open Range (Ac)	Open Lawn (Ac)	Gravel Road (Ac)	Pavement & Roof (Ac)	6000 SF Resid. (Ac)	Mult-Fam Resid. (Ac)	Commer. (Ac)	Park (Ac)	Total Acres (Ac)	Composite % Imp. (%)
OSA2	1.87		0.07						1.94	2.9%
A1		0.79			1.83				2.62	37.0%
A2					1.03				1.03	53.0%
OSA3		0.03		0.23					0.26	84.0%
A3		0.07		0.23					0.30	72.8%
A4		0.02		0.13					0.15	82.3%
A5		0.05		0.14					0.19	70.0%
A1-A5	0.00	0.96	0.00	0.73	2.86	0.00	0.00		4.55	48.6%
A6	3.07				0.87				3.94	11.7%
OSA2,A6	4.94	0.00	0.07	0.00	0.87	0.00	0.00		5.88	8.8%
B1		0.48			2.04				2.52	42.9%
B2					1.09				1.09	53.0%
B3		0.12		0.21					0.33	60.5%
B4					2.01				2.01	53.0%
OSB1		0.06		0.57					0.63	86.0%
B5		0.11		0.19	0.22				0.52	57.1%
B6					1.08				1.08	53.0%
B7		0.18		0.54					0.72	71.3%
B8		0.04		0.11					0.15	69.7%
OSB1-B8	0.00	0.99	0.00	1.62	6.44	0.00	0.00	0.00	9.05	54.7%
B9					1.60			4.61	6.21	18.9%
OSC1	3.34		0.09						3.43	2.1%
C1					5.13				5.13	53.0%
C2					0.84				0.84	53.0%
C3					1.02				1.02	53.0%
C4					1.44				1.44	53.0%
C5					2.56				2.56	53.0%
C6					0.73				0.73	53.0%
C7					0.84				0.84	53.0%
C8					0.71				0.71	53.0%
C9					2.44				2.44	53.0%
C10					1.80			0.70	2.50	40.1%
C11					2.15				2.15	53.0%
C12					1.47				1.47	53.0%
OSC1-C12	3.34	0.00	0.09	0.00	21.13	0.00	0.00	0.70	25.26	44.8%
D1					2.07				2.07	53.0%
D2					1.19				1.19	53.0%
D3		0.06		0.20					0.26	73.1%
D4					2.22				2.22	53.0%
D5		0.26		0.24	0.24				0.74	48.0%
D6					1.31				1.31	53.0%
D7					3.95				3.95	53.0%
D1-D7	0.00	0.32	0.00	0.44	10.98	0.00	0.00	0.00	11.74	53.1%
D8					3.06				3.06	53.0%
D9	0.52			0.33					0.85	36.9%
D10					0.37				0.37	53.0%
D11	1.05			0.25					1.30	18.3%
D1-D7, D9,D11	1.57	0.32	0.00	1.02	10.98	0.00	0.00	0.00	13.89	48.9%
D12	0.20			0.32					0.52	58.5%

Basin	Open Range (Ac)	Open Lawn (Ac)	Gravel Road (Ac)	Pavement & Roof (Ac)	6000 SF Resid. (Ac)	Mult-Fam Resid. (Ac)	Commer. (Ac)	Park (Ac)	Total Acres (Ac)	Composite % Imp. (%)
D8,D10,D12	0.20	0.00	0.00	0.32	3.43	0.00	0.00	0.00	3.95	53.7%
D1-D12	1.77	0.32	0.00	1.34	14.41	0.00	0.00	0.00	17.84	49.9%
E1					1.23				1.23	53.0%
E2					2.80				2.80	53.0%
E3					0.97				0.97	53.0%
E4					2.74				2.74	53.0%
E5					0.90				0.90	53.0%
E1-E5	0.00	0.00	0.00	0.00	8.64	0.00	0.00	0.00	8.64	53.0%
E6					1.80				1.80	53.0%
E7		1.33			1.00				2.33	22.7%
E6-E7		1.33			2.80				4.13	35.9%
E8					0.65				0.65	53.0%
E1-E5,E8	0.00	0.00	0.00	0.00	9.29	0.00	0.00	0.00	9.29	53.0%
EI-E8	0.00	2.66	0.00	0.00	23.53	0.00	0.00	0.00	26.19	47.6%
E9	8.63								8.63	0.0%
E1-E9	8.63	2.66	0.00	0.00	23.53	0.00	0.00	0.00	34.82	35.8%
OSF3	0.52								0.52	0.0%
F1					2.41				2.41	53.0%
F2					1.26				1.26	53.0%
F3					3.21				3.21	53.0%
F4					0.32				0.32	53.0%
F5	3.67								3.67	0.0%
F1-F5	4.19	0.00	0.00	0.00	7.20	0.00	0.00	0.00	11.39	33.5%
G1	6.18								6.18	0.0%

M.V.E., INC.
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COLORADO SPRINGS, CO 80909
(719) 635-5736

JOB 60970-F3 HRFG FILING NO. 3
SHEET NO. 1 OF 1
CALCULATED BY DRG DATE 9/5/17
CHECKED BY _____ DATE _____
SCALE _____

SUBDIVISION IMPERVIOUSNESS

AREA OF SUBDIVISION = 8.31 ACRES

AREA OF STREET, SIDEWALK, PED RAMPS, INLETS, ETC = 2.48 ACRES

AVE. RESIDENTIAL FOOTPRINT = 1534 S.F + 20'x20.5' CONC DRIVE
39 LOTS @ 1944 S.F. = 75,816 SF = 1.74 ACRES

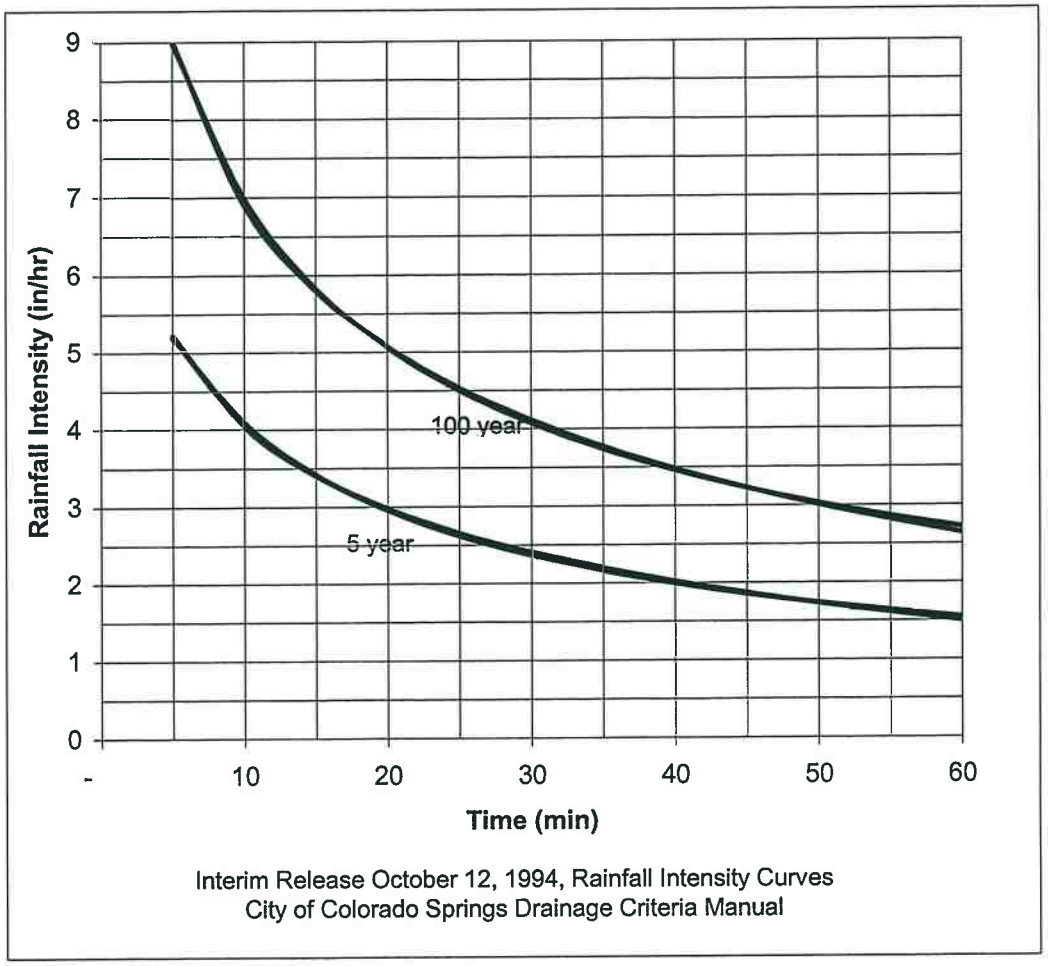
TOTAL IMPERVIOUSNESS = $\frac{2.48 + 1.74}{8.31}$ = 51 %

RAINFALL INTENSITY ESTIMATES FROM TIME OF CONCENTRATION

Time of Cont. T_c (min)	From Graph: 5 Year Intensity i_5 (in/hr)	From Graph: 100 Year Intensity i_{100} (in/hr)	Calculated: 5 Year Intensity i_5 (in/hr)	Calculated: 100 Year Intensity i_{100} (in/hr)
5	5.21	9.00	5.19	8.97
10	4.04	6.90	4.09	6.99
15	3.40	5.80	3.41	5.83
20	2.97	5.07	2.96	5.05
25	2.65	4.53	2.62	4.49
30	2.40	4.11	2.36	4.07
35	2.19	3.77	2.16	3.73
40	2.02	3.48	1.99	3.45
45	1.86	3.23	1.85	3.22
50	1.73	3.01	1.73	3.03
55	1.61	2.81	1.63	2.86
60	1.50	2.64	1.54	2.71

$i = a\,(b + D)^{-n}$

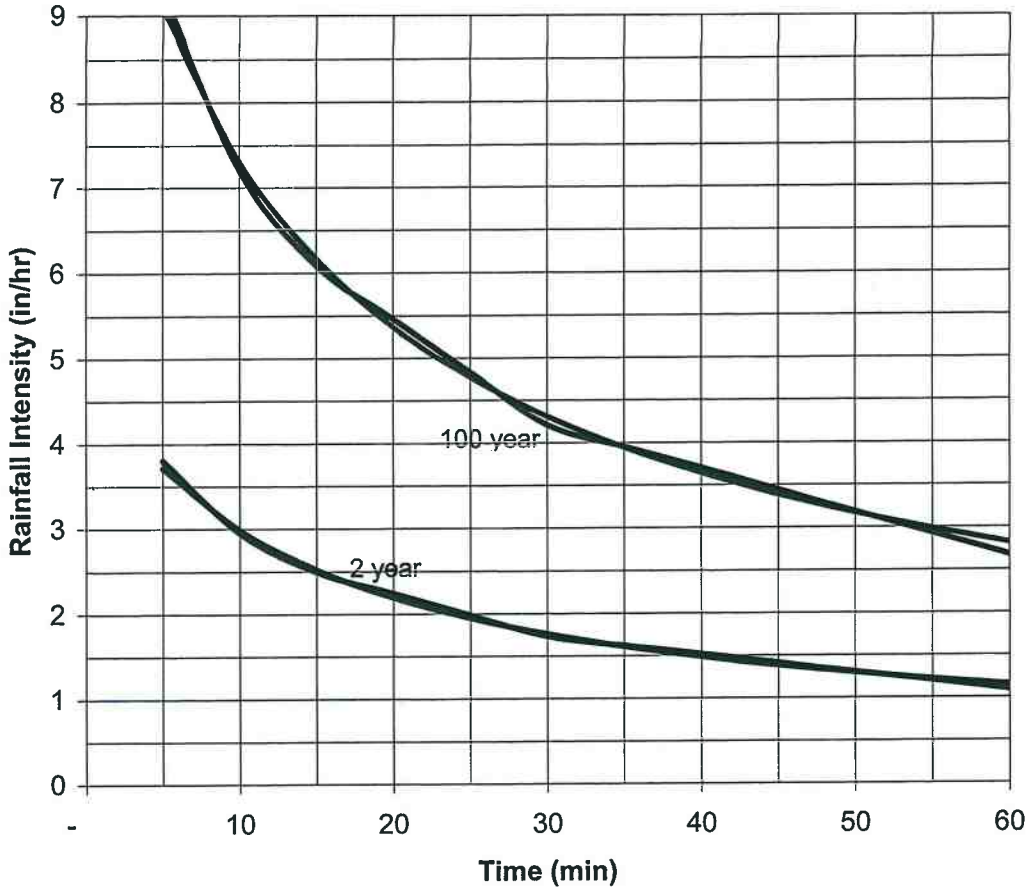
a =	34	44.4
b =	8	6
n =	0.733	0.667
D =	T_c	



Interim Release October 12, 1994, Rainfall Intensity Curves
City of Colorado Springs Drainage Criteria Manual

RAINFALL INTENSITY ESTIMATES FROM TIME OF CONCENTRATION

Time of Cont. T_c (min)	From Table: 2 Year Intensity i_5 (in/hr)	From Table: 100 Year Intensity i_{100} (in/hr)	Calculated: 2 Year Intensity i_5 (in/hr)	Calculated: 100 Year Intensity i_{100} (in/hr)
5	3.80	9.28	3.71	9.09
10	2.95	7.20	2.98	7.30
15	2.49	6.08	2.52	6.16
20	2.24	5.46	2.19	5.37
25	1.98	4.83	1.95	4.77
30	1.73	4.21	1.76	4.31
35	1.62	3.95	1.61	3.94
40	1.52	3.70	1.49	3.64
45	1.41	3.44	1.38	3.38
50	1.30	3.18	1.29	3.17
55	1.20	2.93	1.22	2.98
60	1.09	2.67	1.15	2.82
$i = a*P1/(b + D)^n$		a =	26.65	26.65
		b =	10	10
		n =	0.76	0.76
		D =	T_c	



Updated Storm Intensity Curves Memo, November 18, 2002, Derived from Rainfall Atlas III for Colorado
City of Colorado Springs Drainage Criteria Manual

M.V.E., Inc. 8/2/2013
Project No.: 60970 Project: Hannah Ridge at Feathergrass

EXISTING CONDITIONS - CHANNEL CHARACTERISTICS

Channel Type	Channel #VALUE! Number	Surface Pipe or Curb Type	Dimensions			Manning Rough. n
Overland	0	--				--
Triangular	1	Weeds	Side Slope (H:V) = 3	Side Slope (H:V) = 3	Maximum Depth (ft) = 3	0.060
Trapezoidal	2	Weeds	Side Slopes (H:V) = 3	Base Width (ft) = 20	Maximum Depth (ft) = 5	0.060
Curb/Road	3	Type 3	Road Cross Slope = 2%	FL to Crown (ft) = 13		0.016
Circular	4	RCP	Diameter (in) = 48			0.013

EXISTING CONDITIONS - TIMES OF CONCENTRATION & DISCHARGES

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	5 Year Coef. C_5	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elevation Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	5 Year Intensity i_5 (in/hr)	100 Year Intensity i_{100} (in/hr)	5 Year Discharge Q_5 (cfs)	100 Year Discharge Q_{100} (cfs)
OSA2	0	1.9	0.27	0.37	--	110	14	0.127	--	--	--	--	7.0	--	--	--	--	--
OSA2	1	1.9	0.27	0.37	0.060	350	23	0.066	5.72	0.77	1.76	3.24	1.8	8.8	4.29	7.35	2.2	5.2
OSA3	0	0.3	0.83	0.88	--	25	1	0.024	--	--	--	--	1.9	--	--	--	--	--
OSA3	3	0.3	0.83	0.88	0.016	265	5	0.020	2.06	0.20	0.79	2.60	1.7	5.0	5.19	8.97	1.1	2.1
OSC1	0	3.4	0.26	0.36	--	100	26	0.260	--	--	--	--	5.3	5.3	5.09	8.79	4.6	11.0
A4	0	38.1	0.32	0.42	--	800	46	0.058	--	--	--	--	23.2	--	--	--	--	--
A4	1	38.1	0.32	0.42	0.060	101	4	0.040	74.83	2.21	14.67	5.10	0.3	--	--	--	--	--
A4	2	38.1	0.32	0.42	0.060	400	6	0.015	74.83	1.10	25.51	2.93	2.3	25.8	2.58	4.42	31.4	70.7
OSA2-A4	A4	38.1	0.32	0.42	--	200	0	--	--	--	--	--	25.8	--	--	--	--	--
OSA2-A4	2	43.7	0.32	0.42	0.060	0	0	0.010	85.38	1.33	31.85	2.68	0.0	25.8	2.58	4.42	35.7	80.6
OSF2	0	4.9	0.30	0.40	--	290	13	0.045	--	--	--	--	15.5	--	--	--	--	--
OSF2	1	4.9	0.30	0.40	0.060	1,170	19	0.016	11.13	1.28	4.91	2.27	8.6	24.1	2.67	4.58	3.9	8.9
OSF3	0	0.5	0.25	0.35	--	50	16	0.320	--	--	--	--	3.6	5.0	5.19	8.97	0.7	1.6
OSF2+OSF3	OSF2	4.9	0.30	0.40	--	--	--	--	--	--	--	--	24.1	--	--	--	--	--
OSF2+OSF3	1	5.4	0.29	0.39	0.060	0	0	0.010	12.17	1.45	6.29	1.93	0.0	24.1	2.67	4.58	4.3	9.7
A7	0	30.2	0.25	0.35	--	563	37	0.066	--	--	--	--	20.3	--	--	--	--	--
A7	1	30.2	0.25	0.35	0.060	385	22	0.057	53.06	1.81	9.88	5.37	1.2	--	--	--	--	--
A7	2	30.2	0.25	0.35	0.060	934	10	0.011	53.06	0.99	22.73	2.33	6.7	28.1	2.45	4.22	18.5	44.6
OSB1	0	0.6	0.84	0.89	--	25	1	0.024	--	--	--	--	1.8	--	--	--	--	--
OSB1	3	0.6	0.84	0.89	0.016	670	11	0.016	5.06	0.28	1.67	3.03	3.7	5.5	5.04	8.70	2.7	4.9
A9	0	33.6	0.25	0.35	--	800	48	0.060	--	--	--	--	24.9	--	--	--	--	--
A9	1	33.6	0.25	0.35	0.060	273	16	0.059	52.98	1.80	9.77	5.42	0.8	--	--	--	--	--
A9	1	33.6	0.25	0.35	0.060	820	10	0.012	52.98	2.42	17.61	3.01	4.5	--	--	--	--	--
A9	2	33.6	0.25	0.35	0.060	250	2	0.008	52.98	1.08	24.99	2.12	2.0	32.2	2.27	3.91	19.0	45.9
OSB1+A9	A9	33.6	0.25	0.35	--	--	--	--	--	--	--	--	32.2	--	--	--	--	--
OSB1+A9	2	34.2	0.26	0.36	0.060	0	0	0.010	55.51	1.04	23.95	2.32	0.0	32.2	2.27	3.91	20.2	48.1
OSA8	0	16.2	0.70	0.80	--	665	20	0.030	--	--	--	--	13.4	--	--	--	--	--
OSA8	1	16.2	0.70	0.80	0.060	151	4	0.026	79.59	2.44	17.86	4.46	0.6	14.0	3.53	6.02	40.0	78.1
A16	0	18.0	0.30	0.40	--	650	14	0.022	--	--	--	--	29.6	--	--	--	--	--
A16	1	18.0	0.30	0.40	0.060	657	3	0.005	29.20	2.33	16.28	1.79	6.1	35.7	2.13	3.69	11.5	26.3
OSA8+A16	OSA8	16.2	0.70	0.80	--	--	--	--	--	--	--	--	14.0	--	--	--	--	--
OSA8+A16	1	34.2	0.49	0.59	0.060	620	14	0.022	123.36	2.98	26.71	4.62	2.2	--	--	--	--	--
OSA8+A16	1	34.2	0.49	0.59	0.060	500	3	0.005	123.36	3.93	46.37	2.66	3.1	19.3	3.01	5.14	50.3	103.3

M.V.E., Inc. 8/2/2013
Project No.: 60970 Project: Hannah Ridge at Feathergrass

EXISTING CONDITIONS - CHANNEL CHARACTERISTICS

Channel Type	Channel #VALUE! Number	Surface Pipe or Curb Type	Dimensions			Manning Rough. n
Overland	0	--				--
Triangular	1	Weeds	Side Slope (H:V) = 3	Side Slope (H:V) = 3	Maximum Depth (ft) = 3	0.060
Trapezoidal	2	Weeds	Side Slopes (H:V) = 3	Base Width (ft) = 20	Maximum Depth (ft) = 5	0.060
Curb/Road	3	Type 3	Road Cross Slope = 2%	FL to Crown (ft) = 13		0.016
Circular	4	RCP	Diameter (in) = 48			0.013

EXISTING CONDITIONS - TIMES OF CONCENTRATION & DISCHARGES

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	5 Year Coef. C_5	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elevation Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	5 Year Intensity i_5 (in/hr)	100 Year Intensity i_{100} (in/hr)	5 Year Discharge Q_5 (cfs)	100 Year Discharge Q_{100} (cfs)
OSA11	0	3.7	0.84	0.89	--	300	11	0.037	--	--	--	--	5.6	--	--	--	--	--
OSA11	3	3.7	0.84	0.89	0.016	347	13	0.037	28.61	0.44	4.50	6.36	0.9	--	--	--	--	--
OSA11	3	3.7	0.84	0.89	0.016	268	3	0.011	28.61	0.55	7.09	4.04	1.1	7.6	4.54	7.78	14.1	25.7
OSA12	0	1.7	0.82	0.87	--	164	2	0.012	--	--	--	--	6.3	--	--	--	--	--
OSA12	3	1.7	0.82	0.87	0.016	1,015	5	0.005	12.15	0.47	5.07	2.40	7.1	13.4	3.60	6.15	4.9	9.0

*Estimated using an initial 100 year intensity based on the corresponding Overland Time of Concentration.

**Overland Time of Concentration, $T_c = 1.87\ (1.1 - C_5)\ L^{0.5}\ S^{-0.33}$

Channel Time of Concentration calculated using average flow velocities from Manning's formula.

M.V.E., Inc. 8/10/2013
Project No.: 60970 Project: Hannah Ridge at Feathergrass - Final
(Multi-Family & Commercial Parcels Undeveloped)

DEVELOPED CONDITIONS - CHANNEL CHARACTERISTICS

Channel Type	Channel Type Number	Surface Pipe or Curb Type	Dimensions			Manning Rough. n
Overland	0	--				--
Triangular	1	Weeds	Side Slope (H:V) = 3	Side Slope (H:V) = 3	Max Depth (ft) = 3	0.060
Trapezoidal	2	Weeds	Side Slopes (H:V) = 3	Base Width (ft) = 20	Max Depth (ft) = 5	0.060
Curb/Road	3	Type 3	Road Cross Slope = 2%	FL to Crown (ft) = 13		0.016
Circular	4	RCP	Diameter (in) = 48			0.013

DEVELOPED CONDITIONS - TIMES OF CONCENTRATION & DISCHARGES

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	5 Year Coef. C_5	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	5 Year Intensity I_5 (in/hr)	100 Year Intensity I_{100} (in/hr)	5 Year Discharge Q_5 (cfs)	100 Year Discharge Q_{100} (cfs)
OSA2	0	1.9	0.27	0.37	--	110	14	0.127	--	--	--	--	7.0	--	--	--	--	--
OSA2	1	1.9	0.27	0.37	0.060	350	23	0.066	5.72	0.77	1.8	3.2	1.8	8.8	4.29	7.35	2.2	5.2
A1	0	2.6	0.49	0.59	--	70	1	0.020	--	--	--	--	7.5	--	--	--	--	--
A1	3	2.6	0.49	0.59	0.016	660	10	0.015	12.16	0.39	3.3	3.7	3.0	10.5	4.00	6.83	5.2	10.6
A2	0	1.0	0.60	0.70	--	60	1	0.020	--	--	--	--	5.8	--	--	--	--	--
A2	3	1.0	0.60	0.70	0.016	660	10	0.015	6.18	0.30	2.0	3.1	3.6	9.3	4.20	7.19	2.6	5.2
A1+A2	A1	2.6	0.49	0.59	--	--	--	--	--	--	--	--	10.5	--	--	--	--	--
A1+A2	3	3.7	0.52	0.62	0.016	1	0	0.010	17.80	0.48	5.2	3.4	0.0	10.6	4.00	6.83	7.6	15.6
OSA3	0	0.3	0.83	0.88	--	25	1	0.024	--	--	--	--	1.9	--	--	--	--	--
OSA3	3	0.3	0.83	0.88	0.016	265	5	0.020	2.06	0.20	0.8	2.6	1.7	5.0	5.19	8.97	1.1	2.1
A3	0	0.3	0.75	0.81	--	40	1	0.020	--	--	--	--	3.3	--	--	--	--	--
A3	3	0.3	0.75	0.81	0.016	375	22	0.059	2.19	0.17	0.5	4.0	1.6	5.0	5.19	8.97	1.2	2.2
OSA3+A3	OSA3	0.3	0.83	0.88	--	--	--	--	--	--	--	--	5.0	--	--	--	--	--
OSA3+A3	3	0.6	0.78	0.84	0.016	420	25	0.059	4.25	0.21	0.9	4.7	1.5	6.5	4.79	8.24	2.1	3.9
A1+A2+OSA3+A3	A1+A2	3.7	0.52	0.62	--	--	--	--	--	--	--	--	10.6	--	--	--	--	--
A1+A2+OSA3+A3	3	4.2	0.56	0.65	0.016	0	0	0.025	21.48	0.43	4.2	5.1	0.0	10.6	4.00	6.83	9.4	18.8
A4	0	0.2	0.81	0.87	--	36	1	0.022	--	--	--	--	2.5	--	--	--	--	--
A4	3	0.2	0.81	0.87	0.016	135	3	0.022	1.17	0.16	0.5	2.4	0.9	5.0	5.19	8.97	0.6	1.2
A1+A2+OSA3+A3+A4	A1+A2+OSA3+A3	4.2	0.56	0.65	--	--	--	--	--	--	--	--	10.6	--	--	--	--	--
A1+A2+OSA3+A3+A4	3	4.4	0.57	0.66	0.016	170	4	0.022	22.50	0.45	4.6	4.9	0.6	11.1	3.91	6.68	9.7	19.2
A5	0	0.2	0.73	0.79	--	36	1	0.022	--	--	--	--	3.2	--	--	--	--	--
A5	3	0.2	0.73	0.79	0.016	135	3	0.022	1.35	0.17	0.6	2.5	0.9	5.0	5.19	8.97	0.7	1.3
A6	0	3.9	0.33	0.43	--	235	13	0.055	--	--	--	--	12.6	--	--	--	--	--
A6	2	3.9	0.33	0.43	0.060	220	2	0.009	10.64	0.40	8.6	1.2	3.0	15.5	3.36	5.73	4.3	9.6
OSA2+A6	A6	3.9	0.33	0.43	--	--	--	--	--	--	--	--	15.5	--	--	--	--	--
OSA2+A6	2	5.9	0.31	0.41	0.060	0	0	0.250	15.15	0.19	3.8	4.0	0.0	15.6	3.36	5.73	6.1	13.7
B1	0	2.5	0.53	0.63	--	65	1	0.020	--	--	--	--	6.8	--	--	--	--	--
B1	3	2.5	0.53	0.63	0.016	125	3	0.020	12.94	0.37	3.1	4.1	0.5	--	--	--	--	--
B1	3	2.5	0.53	0.63	0.016	500	20	0.040	12.94	0.33	2.4	5.3	1.6	8.9	4.29	7.34	5.8	11.7
B2	0	1.1	0.60	0.70	--	80	2	0.020	--	--	--	--	6.7	--	--	--	--	--
B2	3	1.1	0.60	0.70	0.016	170	3	0.020	6.23	0.29	1.8	3.4	0.8	--	--	--	--	--
B2	3	1.1	0.60	0.70	0.016	460	19	0.040	6.23	0.26	1.4	4.5	1.7	9.2	4.23	7.23	2.8	5.5
B1+B2	B2	1.1	0.60	0.70	--	--	--	--	--	--	--	--	9.2	--	--	--	--	--
B1+B2	3	3.6	0.55	0.65	0.016	0	0	0.250	19.27	0.28	1.6	11.8	0.0	9.2	4.23	7.23	8.4	17.1
B3	0	0.3	0.66	0.73	--	40	1	0.020	--	--	--	--	4.1	--	--	--	--	--
B3	3	0.3	0.66	0.73	0.016	370	22	0.059	2.17	0.17	0.5	4.0	1.5	5.6	5.01	8.63	1.1	2.1
B4	0	2.0	0.60	0.70	--	110	2	0.020	--	--	--	--	7.8	--	--	--	--	--
B4	3	2.0	0.60	0.70	0.016	630	10	0.015	10.85	0.37	3.0	3.6	2.9	10.7	3.97	6.78	4.8	9.5
B3+B4	B4	2.0	0.60	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--	--	--
B3+B4	3	2.3	0.61	0.70	0.016	0	0	0.250	12.71	0.24	1.2	10.6	0.0	10.7	3.97	6.78	5.7	11.2
B1+B2+B3+B4	B3+B4	2.3	0.61	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--	--	--
B1+B2+B3+B4	3	6.0	0.58	0.67	0.016	0	0	0.250	30.90	0.33	2.3	13.2	0.0	10.7	3.97	6.78	13.6	27.2
OSB1	0	0.6	0.84	0.89	--	25	1	0.024	--	--	--	--	1.8	--	--	--	--	--
OSB1	3	0.6	0.84	0.89	0.016	670	11	0.016	5.06	0.28	1.7	3.0	3.7	5.5	5.04	8.70	2.7	4.9
B5	0	0.5	0.64	0.72	--	110	3	0.027	--	--	--	--	6.5	--	--	--	--	--
B5	3	0.5	0.64	0.72	0.016	100	4	0.040	3.07	0.20	0.8	3.7	0.4	7.0	4.67	8.03	1.5	3.0
OSB1+B5	B5	0.5	0.64	0.72	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
OSB1+B5	3	1.2	0.75	0.81	0.016	0	0	0.250	7.69	0.20	0.8	9.4	0.0	7.0	4.67	8.03	4.0	7.5
B1+B2+B3+B4+OSB1+B5	B1+B2+B3+B4	6.0	0.58	0.67	--	--	--	--	--	--	--	--	10.7	--	--	--	--	--
B1+B2+B3+B4+OSB1+B5	3	7.1	0.60	0.70	0.016	0	0	0.250	38.11	0.35	2.7	13.9	0.0	10.7	3.97	6.78	17.0	33.5

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	5 Year Coef. C_5	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	5 Year Intensity i_5 (in/hr)	100 Year Intensity i_{100} (in/hr)	5 Year Discharge Q_5 (cfs)	100 Year Discharge Q_{100} (cfs)
B6	0	1.1	0.60	0.70	--	60	1	0.020	--	--	--	--	5.8	--	--	--	--	--
B6	3	1.1	0.60	0.70	0.016	580	9	0.015	6.48	0.31	2.1	3.1	3.1	8.8	4.29	7.35	2.8	5.6
B1+B2+B3+B4+OSB1+B5+B6	B1+B2+B3+B4+OSB1+B5	7.1	0.60	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--	--	--
B1+B2+B3+B4+OSB1+B5+B6	3	8.2	0.60	0.70	0.016	30	1	0.040	43.94	0.51	6.1	7.2	0.1	10.8	3.96	6.76	19.5	38.5
B7	0	0.7	0.74	0.80	--	40	1	0.020	--	--	--	--	3.4	--	--	--	--	--
B7	3	0.7	0.74	0.80	0.016	635	22	0.035	5.18	0.25	1.3	4.0	2.6	6.0	4.91	8.45	2.6	4.9
B1+B2+B3+B4+OSB1+B5+B6+B7	B1+B2+B3+B4+OSB1+B5+B6	8.2	0.60	0.70	--	--	--	--	--	--	--	--	10.8	--	--	--	--	--
7 B1+B2+B3+B4+OSB1+B5+B6+B7	3	8.9	0.61	0.71	0.016	635	22	0.035	48.38	0.54	6.9	7.0	1.5	12.3	3.74	6.38	20.4	40.1
B8	0	0.1	0.74	0.80	--	40	1	0.020	--	--	--	--	3.4	--	--	--	--	--
B8	3	0.1	0.74	0.80	0.016	160	3	0.020	1.01	0.16	0.5	2.2	1.2	5.0	5.19	8.97	0.5	1.0
B9	0	6.2	0.38	0.59	--	300	6	0.020	--	--	--	--	18.6	--	--	--	--	--
B9	2	6.2	0.38	0.59	0.060	270	4	0.015	19.16	0.50	10.6	1.8	2.5	21.1	2.87	4.91	6.7	18.0
OSC1	0	3.4	0.26	0.36	--	100	26	0.260	--	--	--	--	5.3	5.3	5.09	8.79	4.6	11.0
C1	0	5.1	0.60	0.70	--	110	2	0.015	--	--	--	--	8.7	--	--	--	--	--
C1	3	5.1	0.60	0.70	0.016	915	13	0.015	26.59	0.51	6.08	4.37	3.5	12.2	3.76	6.42	11.6	23.1
OSC1+C1	C1	5.1	0.60	0.70	--	--	--	--	--	--	--	--	12.2	--	--	--	--	--
OSC1+C1	3	8.6	0.47	0.57	0.016	0	0	0.250	35.81	0.34	2.61	13.71	0.0	12.2	3.76	6.42	15.0	31.1
C2	0	0.8	0.60	0.70	--	40	1	0.015	--	--	--	--	5.2	--	--	--	--	--
C2	3	0.8	0.60	0.70	0.016	550	12	0.022	5.22	0.27	1.54	3.40	2.7	7.9	4.48	7.68	2.3	4.5
C3	0	1.0	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	--	--
C3	3	1.0	0.60	0.70	0.016	600	9	0.015	5.93	0.30	1.95	3.05	3.3	9.6	4.15	7.10	2.5	5.1
C4	0	1.4	0.60	0.70	--	165	3	0.020	--	--	--	--	9.6	--	--	--	--	--
C4	3	1.4	0.60	0.70	0.016	290	16	0.055	7.18	0.26	1.38	5.21	0.9	10.5	4.01	6.85	3.5	6.9
C5	0	2.6	0.60	0.70	--	165	7	0.042	--	--	--	--	7.5	--	--	--	--	--
C5	3	2.6	0.60	0.70	0.016	495	7	0.015	14.05	0.41	3.76	3.73	2.2	9.7	4.14	7.09	6.4	12.7
C6	0	0.7	0.60	0.70	--	65	1	0.015	--	--	--	--	6.5	--	--	--	--	--
C6	3	0.7	0.60	0.70	0.016	420	23	0.055	4.20	0.21	0.92	4.56	1.5	8.1	4.44	7.61	1.9	3.9
C7	0	0.8	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	--	--
C7	3	0.8	0.60	0.70	0.016	500	8	0.015	4.89	0.28	1.67	2.93	2.8	9.2	4.23	7.24	2.1	4.3
C8	0	0.7	0.60	0.70	--	65	1	0.015	--	--	--	--	6.5	--	--	--	--	--
C8	3	0.7	0.60	0.70	0.016	365	10	0.027	4.08	0.24	1.17	3.48	1.7	8.3	4.40	7.53	1.9	3.7
C9	0	2.4	0.60	0.70	--	115	2	0.015	--	--	--	--	8.8	--	--	--	--	--
C9	3	2.4	0.60	0.70	0.016	200	3	0.015	12.56	0.39	3.42	3.67	0.9	--	--	--	--	--
C9	3	2.4	0.60	0.70	0.016	485	13	0.027	12.56	0.35	2.75	4.57	1.8	11.5	3.85	6.58	5.6	11.2
C10	0	2.5	0.52	0.66	--	300	16	0.053	--	--	--	--	10.9	--	--	--	--	--
C10	3	2.5	0.52	0.66	0.016	265	11	0.040	11.09	0.31	2.16	5.13	0.9	11.7	3.82	6.52	4.9	10.7
C11	0	2.2	0.60	0.70	--	165	4	0.024	--	--	--	--	9.0	--	--	--	--	--
C11	3	2.2	0.60	0.70	0.016	430	7	0.015	10.99	0.37	3.09	3.56	2.0	11.0	3.93	6.71	5.1	10.1
C12	0	1.5	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	--	--
C12	3	1.5	0.60	0.70	0.016	600	9	0.015	8.55	0.34	2.56	3.34	3.0	9.3	4.20	7.19	3.7	7.4
C2+C4	C4	1.4	0.60	0.70	--	--	--	--	--	--	--	--	10.5	--	--	--	--	--
C2+C4	3	2.3	0.60	0.70	0.016	0	0	0.250	11.36	0.23	1.10	10.32	0.0	10.5	4.01	6.85	5.5	10.9
C3+C5	C5	2.6	0.60	0.70	--	--	--	--	--	--	--	--	9.7	--	--	--	--	--
C3+C5	3	3.6	0.60	0.70	0.016	0	0	0.250	19.65	0.28	1.66	11.81	0.0	9.7	4.14	7.09	8.9	17.8
C6+C10	C10	2.5	0.52	0.66	--	--	--	--	--	--	--	--	11.7	--	--	--	--	--
C6+C10	3	3.2	0.53	0.67	0.016	0	0	0.250	14.53	0.25	1.33	10.96	0.0	11.7	3.82	6.52	6.6	14.1
C8+C9	C9	2.4	0.60	0.70	--	--	--	--	--	--	--	--	11.5	--	--	--	--	--
C8+C9	3	3.2	0.60	0.70	0.016	0	0	0.250	16.22	0.26	1.44	11.27	0.0	11.5	3.85	6.58	7.3	14.5
C7+C11	C11	2.2	0.60	0.70	--	--	--	--	--	--	--	--	11.0	--	--	--	--	--
C7+C11	3	3.0	0.60	0.70	0.016	0	0	0.250	15.29	0.26	1.38	11.10	0.0	11.0	3.93	6.71	7.1	14.1
C8+C9+C7+C11	C8+C9	3.2	0.60	0.70	--	--	--	--	--	--	--	--	11.5	--	--	--	--	--
C8+C9+C7+C11	3	6.1	0.60	0.70	0.016	475	7	0.015	31.61	0.54	6.78	4.66	1.7	13.2	3.63	6.19	13.4	26.6
D1	0	2.1	0.60	0.70	--	90	2	0.020	--	--	--	--	7.1	--	--	--	--	--
D1	3	2.1	0.60	0.70	0.016	630	31	0.050	11.59	0.31	2.06	5.64	1.9	8.9	4.28	7.32	5.3	10.6
D2	0	1.2	0.60	0.70	--	75	2	0.020	--	--	--	--	6.4	--	--	--	--	--
D2	3	1.2	0.60	0.70	0.016	685	34	0.050	6.88	0.26	1.39	4.96	2.3	8.7	4.31	7.38	3.1	6.1
D1+D2	D1	2.1	0.60	0.70	--	--	--	--	--	--	--	--	8.9	--	--	--	--	--
D1+D2	3	3.3	0.60	0.70	0.016	0	0	0.250	18.26	0.27	1.57	11.60	0.0	8.9	4.28	7.32	8.4	16.7
D3	0	0.3	0.75	0.81	--	40	1	0.020	--	--	--	--	3.3	--	--	--	--	--
D3	3	0.3	0.75	0.81	0.016	320	20	0.063	1.90	0.16	0.48	3.94	1.4	5.0	5.19	8.97	1.0	1.9
D4	0	2.2	0.60	0.70	--	100	2	0.020	--	--	--	--	7.4	--	--	--	--	--
D4	3	2.2	0.60	0.70	0.016	545	22	0.040	12.20	0.32	2.31	5.29	1.7	--	--	--	--	--
D4	3	2.2	0.60	0.70	0.016	195	4	0.020	12.20	0.37	3.00	4.06	0.8	10.0	4.09	7.00	5.5	10.9
D3+D4	D4	2.2	0.60	0.70	--	--	--	--	--	--	--	--	10.0	--	--	--	--	--
D3+D4	3	2.5	0.62	0.71	0.016	0	0	0.250	13.85	0.25	1.28	10.83	0.0	10.0	4.09	7.00	6.3	12.4
D1+D2+D3+D4	D3+D4	2.5	0.62	0.71	--	--	--	--	--	--	--	--	10.0	--	--	--	--	--

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	5 Year Coef. C_5	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	5 Year Intensity i_5 (in/hr)	100 Year Intensity i_{100} (in/hr)	5 Year Discharge Q_5 (cfs)	100 Year Discharge Q_{100} (cfs)
D1+D2+D3+D4	3	5.7	0.61	0.71	0.016	0	0	0.250	31.76	0.33	2.39	13.31	0.0	10.0	4.09	7.00	14.3	28.3
D5	0	0.7	0.57	0.66	--	140	6	0.043	--	--	--	--	7.2	--	--	--	--	--
D5	3	0.7	0.57	0.66	0.016	310	13	0.040	3.87	0.22	0.97	3.98	1.3	8.5	4.36	7.46	1.9	3.6
D1+D2+D3+D4+D5	D1+D2+D3+D4	5.7	0.61	0.71	--	--	--	--	--	--	--	--	10.0	--	--	--	--	--
D1+D2+D3+D4+D5	3	6.5	0.60	0.70	0.016	0	0	0.250	35.58	0.34	2.60	13.69	0.0	10.0	4.09	7.00	16.0	31.7
D6	0	1.3	0.60	0.70	--	60	1	0.013	--	--	--	--	6.6	--	--	--	--	--
D6	3	1.3	0.60	0.70	0.016	535	22	0.040	7.52	0.27	1.60	4.69	1.9	--	--	--	--	--
D6	3	1.3	0.60	0.70	0.016	210	4	0.020	7.52	0.31	2.07	3.63	1.0	9.5	4.18	7.15	3.3	6.6
D1+D2+D3+D4+D5+D6	D1+D2+D3+D4+D5	6.5	0.60	0.70	--	--	--	--	--	--	--	--	10.0	--	--	--	--	--
D1+D2+D3+D4+D5+D6	3	7.8	0.60	0.70	0.016	35	1	0.040	42.78	0.51	5.94	7.20	0.1	10.0	4.08	6.97	19.2	38.0
D7	0	4.0	0.60	0.70	--	140	2	0.015	--	--	--	--	9.7	--	--	--	--	--
D7	3	4.0	0.60	0.70	0.016	475	19	0.040	19.58	0.38	3.32	5.90	1.3	--	--	--	--	--
D7	3	4.0	0.60	0.70	0.016	270	4	0.015	19.58	0.46	4.80	4.08	1.1	12.1	3.77	6.43	8.9	17.8
D1+D2+D3+D4+D5+D6+D7	D7	4.0	0.60	0.70	--	--	--	--	--	--	--	--	12.1	--	--	--	--	--
D1+D2+D3+D4+D5+D6+D7	3	11.7	0.60	0.70	0.016	0	0	0.250	58.18	0.41	3.76	15.47	0.0	12.1	3.77	6.43	26.6	52.8
D9	0	0.9	0.50	0.58	--	40	1	0.020	--	--	--	--	5.6	--	--	--	--	--
D9	3	0.9	0.50	0.58	0.016	585	20	0.034	4.28	0.23	1.12	3.83	2.5	8.2	4.42	7.58	1.9	3.8
D1+D2+D3+D4+D5+D6+D9	D1+D2+D3+D4+D5+D6	7.8	0.60	0.70	--	--	--	--	--	--	--	--	10.0	--	--	--	--	--
D1+D2+D3+D4+D5+D6+D9	3	8.6	0.59	0.69	0.016	300	11	0.036	46.67	0.53	6.60	7.07	0.7	10.7	3.97	6.78	20.3	40.3
D1+D2+D3+D4+D5+D6+D7+D9	D1+D2+D3+D4+D5+D6+D7	11.7	0.60	0.70	--	--	--	--	--	--	--	--	12.1	--	--	--	--	--
D1+D2+D3+D4+D5+D6+D7+D9	3	12.6	0.59	0.69	0.016	0	0	0.250	61.69	0.42	3.93	15.69	0.0	12.1	3.77	6.43	28.2	56.0
D8	0	3.1	0.60	0.70	--	120	1	0.010	--	--	--	--	10.2	--	--	--	--	--
D8	3	3.1	0.60	0.70	0.016	450	18	0.040	14.81	0.35	2.68	5.53	1.4	--	--	--	--	--
D8	3	3.1	0.60	0.70	0.016	270	4	0.015	14.81	0.41	3.89	3.81	1.2	12.8	3.68	6.28	6.8	13.4
D10	0	0.4	0.60	0.70	--	32	1	0.020	--	--	--	--	4.2	--	--	--	--	--
D10	3	0.4	0.60	0.70	0.016	330	7	0.020	2.33	0.21	0.87	2.68	2.1	6.2	4.85	8.35	1.1	2.2
D8+D10	D8	3.1	0.60	0.70	--	--	--	--	--	--	--	--	12.8	--	--	--	--	--
D8+D10	3	3.4	0.60	0.70	0.016	0	0	0.250	16.61	0.26	1.47	11.33	0.0	12.8	3.68	6.28	7.6	15.1
D11	0	1.3	0.38	0.47	--	210	4	0.019	--	--	--	--	15.9	--	--	--	--	--
D11	3	1.3	0.38	0.47	0.016	95	1	0.015	3.43	0.25	1.30	2.64	0.6	16.5	3.26	5.57	1.6	3.4
D1+D2+D3+D4+D5+D6+D9+D11	D1+D2+D3+D4+D5+D6+D9	8.6	0.59	0.69	--	--	--	--	--	--	--	--	10.7	--	--	--	--	--
D1+D2+D3+D4+D5+D6+D9+D11	3	9.9	0.56	0.66	0.016	130	2	0.015	51.42	0.64	9.77	5.27	0.4	11.2	3.90	6.67	21.9	43.7
D1+D2+D3+D4+D5+D6+D7+D9+D11	D1+D2+D3+D4+D5+D6+D7+D9	12.6	0.59	0.69	--	--	--	--	--	--	--	--	12.1	--	--	--	--	--
D1+D2+D3+D4+D5+D6+D7+D9+D11	3	13.9	0.57	0.67	0.016	140	2	0.015	65.98	0.71	11.89	5.55	0.4	12.5	3.71	6.33	29.6	59.0
D12	0	0.5	0.65	0.72	--	85	3	0.035	--	--	--	--	5.1	--	--	--	--	--
D12	3	0.5	0.65	0.72	0.016	130	2	0.015	3.33	0.24	1.25	2.67	0.8	5.9	4.93	8.50	1.7	3.2
D8+D10+D12	D8+D10	3.4	0.60	0.70	--	--	--	--	--	--	--	--	12.8	--	--	--	--	--
D8+D10+D12	3	4.0	0.61	0.70	0.016	130	2	0.015	19.19	0.45	4.66	4.12	0.5	13.3	3.61	6.16	8.7	17.1
E1	0	1.2	0.60	0.70	--	65	1	0.015	--	--	--	--	6.5	--	--	--	--	--
E1	3	1.2	0.60	0.70	0.016	615	11	0.018	7.08	0.31	2.08	3.40	3.0	9.6	4.16	7.12	3.1	6.1
E2	0	2.8	0.60	0.70	--	130	3	0.020	--	--	--	--	8.5	--	--	--	--	--
E2	3	2.8	0.60	0.70	0.016	580	11	0.020	14.63	0.39	3.47	4.22	2.3	10.8	3.96	6.77	6.7	13.3
E1+E2	E2	2.8	0.60	0.70	--	--	--	--	--	--	--	--	10.8	--	--	--	--	--
E1+E2	3	4.0	0.60	0.70	0.016	0	0	0.250	21.06	0.29	1.75	12.02	0.0	10.8	3.96	6.77	9.6	19.1
E3	0	1.0	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	--	--
E3	3	1.0	0.60	0.70	0.016	515	10	0.020	5.64	0.28	1.68	3.37	2.6	8.9	4.28	7.33	2.5	5.0
E1+E2+E3	E1+E2	4.0	0.60	0.70	--	--	--	--	--	--	--	--	10.8	--	--	--	--	--
E1+E2+E3	3	5.0	0.60	0.70	0.016	0	0	0.250	26.13	0.31	2.06	12.68	0.0	10.8	3.96	6.77	11.9	23.7
E4	0	2.7	0.60	0.70	--	125	3	0.020	--	--	--	--	8.3	--	--	--	--	--
E4	3	2.7	0.60	0.70	0.016	500	11	0.023	14.43	0.38	3.24	4.45	1.9	10.2	4.06	6.93	6.7	13.3
E1+E2+E3+E4	E1+E2+E3	5.0	0.60	0.70	--	--	--	--	--	--	--	--	10.8	--	--	--	--	--
E1+E2+E3+E4	3	7.7	0.60	0.70	0.016	295	8	0.025	40.45	0.54	6.75	5.99	0.8	11.6	3.84	6.56	17.8	35.5
E5	0	0.9	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	--	--
E5	3	0.9	0.60	0.70	0.016	460	11	0.023	5.24	0.27	1.50	3.50	2.2	8.5	4.35	7.45	2.3	4.7
E1+E2+E3+E4+E5	E1+E2+E3+E4	7.7	0.60	0.70	--	--	--	--	--	--	--	--	11.6	--	--	--	--	--
E1+E2+E3+E4+E5	3	8.6	0.60	0.70	0.016	0	0	0.250	45.16	0.37	3.11	14.52	0.0	11.6	3.84	6.56	19.9	39.7
E6	0	1.8	0.60	0.70	--	105	3	0.029	--	--	--	--	6.8	--	--	--	--	--
E6	3	1.8	0.60	0.70	0.016	575	8	0.015	10.23	0.36	2.96	3.45	2.8	9.5	4.16	7.12	4.5	9.0
E7	0	2.3	0.43	0.61	--	200	4	0.020	--	--	--	--	14.1	--	--	--	--	--
E7	3	2.3	0.43	0.61	0.016	365	7	0.019	8.58	0.33	2.34	3.66	1.7	15.8	3.33	5.69	3.3	8.1
E4+E5	E4	2.7	0.60	0.70	--	--	--	--	--	--	--	--	10.2	--	--	--	--	--
E4+E5	3	3.6	0.60	0.70	0.016	0	0	0.250	19.17	0.28	1.63	11.74	0.0	10.2	4.06	6.93	8.9	17.7
E4+E5+E7	E4+E5	3.6	0.60	0.70	--	--	--	--	--	--	--	--	10.2	--	--	--	--	--
E4+E5+E7	3	6.0	0.53	0.67	0.016	100	3	0.025	29.94	0.49	5.42	5.52	0.3	10.5	4.01	6.85	12.8	27.2
E1+E2+E3+E4+E5+E7	E1+E2+E3+E4+E5	8.6	0.60	0.70	--	--	--	--	--	--	--	--	11.6	--	--	--	--	--
E1+E2+E3+E4+E5+E7	3	11.0	0.56	0.68	0.016	100	1	0.010	55.85	0.72	12.21	4.57	0.4	12.0	3.79	6.47	23.4	48.4

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Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	5 Year Coef. C_5	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	5 Year Intensity I_5 (in/hr)	100 Year Intensity I_{100} (in/hr)	5 Year Discharge Q_5 (cfs)	100 Year Discharge Q_{100} (cfs)
E8	0	0.7	0.60	0.70	--	40	1	0.030	--	--	--	--	4.1	--	--	--	--	--
E8	3	0.7	0.60	0.70	0.016	610	16	0.025	4.10	0.24	1.21	3.39	3.0	7.1	4.65	7.98	1.8	3.6
E9	0	8.6	0.25	0.35	--	300	6	0.020	--	--	--	--	21.9	--	--	--	--	--
E9	3	8.6	0.25	0.35	0.016	550	12	0.022	14.56	0.38	3.32	4.38	2.1	--	--	--	--	--
E9	4	8.6	0.25	0.35	0.013	170	2	0.010	14.56	0.86	1.98	7.35	0.4	24.4	2.66	4.56	5.7	13.8
OSF3	0	0.5	0.25	0.35	--	50	16	0.320	--	--	--	--	3.6	5.0	5.19	8.97	0.7	1.6
F1	0	2.4	0.60	0.70	--	110	2	0.020	--	--	--	--	7.8	--	--	--	--	--
F1	3	2.4	0.60	0.70	0.016	765	13	0.018	13.01	0.38	3.31	3.93	3.2	11.0	3.92	6.70	5.7	11.3
OSF3+F1	F1	2.4	0.60	0.70	--	--	--	--	--	--	--	--	11.0	--	--	--	--	--
OSF3+F1	3	2.9	0.54	0.64	0.016	0	0	0.250	14.41	0.25	1.32	10.94	0.0	11.0	3.92	6.70	6.2	12.5
F2	0	1.3	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	--	--
F2	3	1.3	0.60	0.70	0.016	670	12	0.018	7.33	0.31	2.14	3.43	3.3	9.6	4.16	7.11	3.1	6.3
F3	0	3.2	0.60	0.70	--	140	4	0.025	--	--	--	--	8.2	--	--	--	--	--
F3	3	3.2	0.60	0.70	0.016	695	13	0.018	17.02	0.42	4.01	4.24	2.7	10.9	3.94	6.73	7.6	15.1
F2+F3	F3	3.2	0.60	0.70	--	--	--	--	--	--	--	--	10.9	--	--	--	--	--
F2+F3	3	4.5	0.60	0.70	0.016	0	0	0.250	23.70	0.30	1.92	12.37	0.0	10.9	3.94	6.73	10.6	21.1
OSF3+F1+F2+F3	OSF3+F1	2.9	0.54	0.64	--	--	--	--	--	--	--	--	11.0	--	--	--	--	--
OSF3+F1+F2+F3	3	7.4	0.58	0.68	0.016	260	7	0.025	38.53	0.53	6.55	5.88	0.7	11.8	3.81	6.51	16.2	32.5
F4	0	0.3	0.60	0.70	--	40	1	0.020	--	--	--	--	4.7	--	--	--	--	--
F4	3	0.3	0.60	0.70	0.016	220	6	0.027	2.02	0.19	0.69	2.93	1.3	6.0	4.92	8.48	0.9	1.9
OSF2	0	4.9	0.30	0.40	--	290	13	0.045	--	--	--	--	15.5	--	--	--	--	--
OSF2	3	4.9	0.30	0.40	0.016	1,170	19	0.016	11.13	0.37	3.03	3.67	5.3	20.9	2.89	4.95	4.2	9.6
F5	0	3.7	0.25	0.35	--	300	6	0.020	--	--	--	--	21.9	--	--	--	--	--
F5	3	3.7	0.25	0.35	0.016	65	3	0.046	6.19	0.25	1.32	4.70	0.2	--	--	--	--	--
F5	3	3.7	0.25	0.35	0.016	205	5	0.024	6.19	0.28	1.67	3.70	0.9	23.1	2.74	4.69	2.5	6.0
OSF2+F5	OSF2	4.9	0.30	0.40	--	--	--	--	--	--	--	--	20.9	--	--	--	--	--
OSF2+F5	1	8.6	0.28	0.38	0.060	310	3	0.010	18.49	1.70	8.72	2.12	2.4	--	--	--	--	--
OSF2+F5	4	8.6	0.28	0.38	0.013	380	4	0.010	18.49	0.97	2.35	7.88	0.8	24.1	2.67	4.58	6.4	14.8
OSF3+F1+F2+F3+F5	OSF3+F1+F2+F3	7.4	0.58	0.68	--	--	--	--	--	--	--	--	11.8	--	--	--	--	--
OSF3+F1+F2+F3+F5	3	11.1	0.47	0.57	0.016	260	8	0.031	48.44	0.56	7.20	6.73	0.6	12.4	3.72	6.36	19.3	39.9
OSF2+OSF3+F1+F2+F3+F5	OSF2	4.9	0.30	0.40	--	--	--	--	--	--	--	--	20.9	--	--	--	--	--
OSF2+OSF3+F1+F2+F3+F5	1	16.0	0.42	0.52	0.060	310	3	0.010	47.13	2.42	17.59	2.68	1.9	--	--	--	--	--
OSF2+OSF3+F1+F2+F3+F5	4	16.0	0.42	0.52	0.013	380	4	0.010	47.13	1.57	4.59	10.26	0.6	23.4	2.72	4.66	18.0	38.3
G1	0	6.2	0.25	0.35	--	300	11	0.037	--	--	--	--	17.9	--	--	--	--	--
G1	3	6.2	0.25	0.35	0.016	90	3	0.033	11.55	0.33	2.38	4.85	0.3	--	--	--	--	--
G1	4	6.2	0.25	0.35	0.013	80	18	0.225	11.55	0.36	0.56	20.46	0.1	18.3	3.09	5.29	4.8	11.4

*Estimated using an initial 100 year intensity based on the corresponding Overland Time of Concentration.

**Overland Time of Concentration, $T_c = 1.87\ (1.1 - C_5)\ L^{0.5}\ S^{-0.33}$

Channel Time of Concentration calculated using average flow velocities from Manning's formula.

M.V.E., Inc. 8/17/2013
Project No.: 60970 Project: Hannah Ridge at Feathergrass - Final
(Multi-Family & Commercial Parcels Undeveloped) 2-year for water quality

DEVELOPED CONDITIONS - CHANNEL CHARACTERISTICS

Channel Type	Channel Type Number	Surface Pipe or Curb Type	Dimensions			Manning Rough. n
Overland	0	--				--
Triangular	1	Weeds	Side Slope (H:V) = 3	Side Slope (H:V) = 3	Max Depth (ft) = 3	0.060
Trapezoidal	2	Weeds	Side Slopes (H:V) = 3	Base Width (ft) = 20	Max Depth (ft) = 5	0.060
Curb/Road	3	Type 3	Road Cross Slope = 2%	FL to Crown (ft) = 13		0.016
Circular	4	RCP	Diameter (in) = 48			0.013

DEVELOPED CONDITIONS - TIMES OF CONCENTRATION & DISCHARGES

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	2 Year Coef. C_2	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	2 Year Intensity i_5 (in/hr)	2 Year Discharge Q2 (cfs)
OSA2	0	1.9	0.27	0.37	--	110	14	0.127	--	--	--	--	7.0	--	--	--
OSA2	1	1.9	0.27	0.37	0.060	350	23	0.066	2.21	0.54	0.9	2.6	2.3	9.3	3.06	1.6
A1	0	2.6	0.49	0.59	--	70	1	0.020	--	--	--	--	7.5	--	--	--
A1	3	2.6	0.49	0.59	0.016	660	10	0.015	4.71	0.28	1.6	2.9	3.8	11.3	2.84	3.7
A2	0	1.0	0.60	0.70	--	60	1	0.020	--	--	--	--	5.8	--	--	--
A2	3	1.0	0.60	0.70	0.016	660	10	0.015	2.36	0.22	1.0	2.4	4.5	10.3	2.95	1.8
A1+A2	A1	2.6	0.49	0.59	--	--	--	--	--	--	--	--	11.3	--	--	--
A1+A2	3	3.7	0.52	0.62	0.016	1	0	0.010	6.89	0.34	2.5	2.7	0.0	11.4	2.84	5.4
OSA3	0	0.3	0.83	0.88	--	25	1	0.024	--	--	--	--	1.9	--	--	--
OSA3	3	0.3	0.83	0.88	0.016	265	5	0.020	2.06	0.20	0.8	2.6	1.7	5.0	3.71	0.8
A3	0	0.3	0.75	0.81	--	40	1	0.020	--	--	--	--	3.3	--	--	--
A3	3	0.3	0.75	0.81	0.016	375	22	0.059	2.19	0.17	0.5	4.0	1.6	5.0	3.71	0.8
OSA3+A3	OSA3	0.3	0.83	0.88	--	--	--	--	--	--	--	--	5.0	--	--	--
OSA3+A3	3	0.6	0.78	0.84	0.016	420	25	0.059	4.25	0.21	0.9	4.7	1.5	6.5	3.45	1.5
A1+A2+OSA3+A3	A1+A2	3.7	0.52	0.62	--	--	--	--	--	--	--	--	11.4	--	--	--
A1+A2+OSA3+A3	3	4.2	0.56	0.65	0.016	0	0	0.025	8.31	0.31	2.1	4.0	0.0	11.4	2.84	6.7
A4	0	0.2	0.81	0.87	--	36	1	0.022	--	--	--	--	2.5	--	--	--
A4	3	0.2	0.81	0.87	0.016	135	3	0.022	1.17	0.16	0.5	2.4	0.9	5.0	3.71	0.5
A1+A2+OSA3+A3+A4	A1+A2+OSA3+A3	4.2	0.56	0.65	--	--	--	--	--	--	--	--	11.4	--	--	--
A1+A2+OSA3+A3+A4	3	4.4	0.57	0.66	0.016	170	4	0.022	8.71	0.32	2.2	3.9	0.7	12.1	2.76	6.8
A5	0	0.2	0.73	0.79	--	36	1	0.022	--	--	--	--	3.2	--	--	--
A5	3	0.2	0.73	0.79	0.016	135	3	0.022	1.35	0.17	0.55	2.45	0.9	5.0	3.71	0.5
A1+A2+OSA3+A3+A4+A5	A1+A2+OSA3+A3+A4	4.4	0.57	0.66	--	--	--	--	--	--	--	--	12.1	--	--	--
A1+A2+OSA3+A3+A4+A5	4	4.6	0.57	0.67	0.013	8	0	0.010	9.16	0.68	1.43	6.42	0.0	12.1	2.76	7.2
A6	0	3.9	0.33	0.43	--	235	13	0.055	--	--	--	--	12.6	--	--	--
A6	2	3.9	0.33	0.43	0.060	220	2	0.009	4.20	0.23	4.8	0.9	4.2	16.8	2.39	3.1
OSA2+A6	A6	3.9	0.33	0.43	--	--	--	--	--	--	--	--	16.8	--	--	--
OSA2+A6	2	5.9	0.31	0.41	0.060	0	0	0.250	5.98	0.11	2.2	2.8	0.0	16.8	2.39	4.3
B1	0	2.5	0.53	0.63	--	65	1	0.020	--	--	--	--	6.8	--	--	--
B1	3	2.5	0.53	0.63	0.016	125	3	0.020	4.98	0.27	1.5	3.3	0.6	--	--	--
B1	3	2.5	0.53	0.63	0.016	500	20	0.040	4.98	0.24	1.2	4.2	2.0	9.4	3.05	4.1
B2	0	1.1	0.60	0.70	--	80	2	0.020	--	--	--	--	6.7	--	--	--
B2	3	1.1	0.60	0.70	0.016	170	3	0.020	2.40	0.21	0.9	2.7	1.0	--	--	--
B2	3	1.1	0.60	0.70	0.016	460	19	0.040	2.40	0.18	0.7	3.5	2.2	9.9	3.00	2.0
B1+B2	B2	1.1	0.60	0.70	--	--	--	--	--	--	--	--	9.9	--	--	--
B1+B2	3	3.6	0.55	0.65	0.016	0	0	0.250	7.41	0.20	0.8	9.3	0.0	9.9	3.00	6.0
B3	0	0.3	0.66	0.73	--	40	1	0.020	--	--	--	--	4.1	--	--	--
B3	3	0.3	0.66	0.73	0.016	370	22	0.059	2.17	0.17	0.5	4.0	1.5	5.6	3.59	0.8
B4	0	2.0	0.60	0.70	--	110	2	0.020	--	--	--	--	7.8	--	--	--
B4	3	2.0	0.60	0.70	0.016	630	10	0.015	4.20	0.26	1.5	2.8	3.7	11.5	2.82	3.4
B3+B4	B4	2.0	0.60	0.70	--	--	--	--	--	--	--	--	11.5	--	--	--
B3+B4	3	2.3	0.61	0.70	0.016	0	0	0.250	4.93	0.17	0.6	8.4	0.0	11.5	2.82	4.0
B1+B2+B3+B4	B3+B4	2.3	0.61	0.70	--	--	--	--	--	--	--	--	11.5	--	--	--
B1+B2+B3+B4	3	6.0	0.58	0.67	0.016	0	0	0.250	11.97	0.23	1.1	10.4	0.0	11.5	2.82	9.7
OSB1	0	0.6	0.84	0.89	--	25	1	0.024	--	--	--	--	1.8	--	--	--
OSB1	3	0.6	0.84	0.89	0.016	670	11	0.016	5.06	0.28	1.7	3.0	3.7	5.5	3.61	1.9
B5	0	0.5	0.64	0.72	--	110	3	0.027	--	--	--	--	6.5	--	--	--
B5	3	0.5	0.64	0.72	0.016	100	4	0.040	1.18	0.15	0.4	3.0	0.6	7.1	3.36	1.1
OSB1+B5	B5	0.5	0.64	0.72	--	--	--	--	--	--	--	--	7.1	--	--	--
OSB1+B5	3	1.2	0.75	0.81	0.016	0	0	0.250	2.96	0.15	0.4	7.4	0.0	7.1	3.36	2.9

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	2 Year Coef. C_2	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	2 Year Intensity I_5 (in/hr)	2 Year Discharge Q2 (cfs)
B1+B2+B3+B4+OSB1+B5	B1+B2+B3+B4	6.0	0.58	0.67	--	--	--	--	--	--	--	--	11.5	--	--	--
B1+B2+B3+B4+OSB1+B5	3	7.1	0.60	0.70	0.016	0	0	0.250	14.77	0.25	1.3	11.0	0.0	11.5	2.82	12.1
B6	0	1.1	0.60	0.70	--	60	1	0.020	--	--	--	--	5.8	--	--	--
B6	3	1.1	0.60	0.70	0.016	580	9	0.015	2.48	0.22	1.0	2.5	3.9	9.7	3.02	2.0
B1+B2+B3+B4+OSB1+B5+B6	B1+B2+B3+B4+OSB1+B5	7.1	0.60	0.70	--	--	--	--	--	--	--	--	11.5	--	--	--
B1+B2+B3+B4+OSB1+B5+B6	3	8.2	0.60	0.70	0.016	30	1	0.040	17.03	0.37	3.0	5.7	0.1	11.6	2.81	13.9
B7	0	0.7	0.74	0.80	--	40	1	0.020	--	--	--	--	3.4	--	--	--
B7	3	0.7	0.74	0.80	0.016	635	22	0.035	5.18	0.25	1.3	4.0	2.6	6.0	3.53	1.9
B1+B2+B3+B4+OSB1+B5+B6+B7	B1+B2+B3+B4+OSB1+B5+B6	8.2	0.60	0.70	--	--	--	--	--	--	--	--	11.6	--	--	--
B1+B2+B3+B4+OSB1+B5+B6+B7	3	8.9	0.61	0.71	0.016	635	22	0.035	18.75	0.39	3.4	5.6	1.9	13.5	2.64	14.4
B8	0	0.1	0.74	0.80	--	40	1	0.020	--	--	--	--	3.4	--	--	--
B8	3	0.1	0.74	0.80	0.016	160	3	0.020	1.01	0.16	0.46	2.20	1.2	5.0	3.71	0.4
B1+B2+B3+B4+OSB1+B5+B6+B7+B8	B1+B2+B3+B4+OSB1+B5+B6+B7	8.9	0.61	0.71	--	--	--	--	--	--	--	--	13.5	--	--	--
B1+B2+B3+B4+OSB1+B5+B6+B7+B8	4	9.0	0.62	0.71	0.013	8	0	0.010	19.08	0.98	2.40	7.95	0.0	13.5	2.63	14.7
B9	0	6.2	0.38	0.59	--	300	6	0.020	--	--	--	--	18.6	--	--	--
B9	2	6.2	0.38	0.59	0.060	270	4	0.015	7.61	0.29	6.0	1.3	3.5	22.2	2.08	4.9
OSC1	0	3.4	0.26	0.36	--	100	26	0.260	--	--	--	--	5.3	5.3	3.65	3.3
C1	0	5.1	0.60	0.70	--	110	2	0.015	--	--	--	--	8.7	--	--	--
C1	3	5.1	0.60	0.70	0.016	915	13	0.015	10.35	0.37	2.99	3.46	4.4	13.1	2.67	8.2
OSC1+C1	C1	5.1	0.60	0.70	--	--	--	--	--	--	--	--	13.1	--	--	--
OSC1+C1	3	8.6	0.47	0.57	0.016	0	0	0.250	13.94	0.25	1.28	10.85	0.0	13.1	2.67	10.7
C2	0	0.8	0.60	0.70	--	40	1	0.015	--	--	--	--	5.2	--	--	--
C2	3	0.8	0.60	0.70	0.016	550	12	0.022	1.98	0.19	0.74	2.68	3.4	8.6	3.15	1.6
C3	0	1.0	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--
C3	3	1.0	0.60	0.70	0.016	600	9	0.015	2.28	0.21	0.95	2.41	4.2	10.5	2.93	1.8
C4	0	1.4	0.60	0.70	--	165	3	0.020	--	--	--	--	9.6	--	--	--
C4	3	1.4	0.60	0.70	0.016	290	16	0.055	2.80	0.18	0.68	4.13	1.2	10.7	2.90	2.5
C5	0	2.6	0.60	0.70	--	165	7	0.042	--	--	--	--	7.5	--	--	--
C5	3	2.6	0.60	0.70	0.016	495	7	0.015	5.43	0.29	1.84	2.95	2.8	10.3	2.95	4.5
C6	0	0.7	0.60	0.70	--	65	1	0.015	--	--	--	--	6.5	--	--	--
C6	3	0.7	0.60	0.70	0.016	420	23	0.055	1.61	0.15	0.45	3.60	1.9	8.5	3.17	1.4
C7	0	0.8	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--
C7	3	0.8	0.60	0.70	0.016	500	8	0.015	1.88	0.20	0.81	2.32	3.6	9.9	2.99	1.5
C8	0	0.7	0.60	0.70	--	65	1	0.015	--	--	--	--	6.5	--	--	--
C8	3	0.7	0.60	0.70	0.016	365	10	0.027	1.57	0.17	0.57	2.76	2.2	8.7	3.13	1.3
C9	0	2.4	0.60	0.70	--	115	2	0.015	--	--	--	--	8.8	--	--	--
C9	3	2.4	0.60	0.70	0.016	200	3	0.015	4.89	0.28	1.68	2.91	1.1	--	--	--
C9	3	2.4	0.60	0.70	0.016	485	13	0.027	4.89	0.25	1.35	3.61	2.2	12.2	2.75	4.0
C10	0	2.5	0.52	0.66	--	300	16	0.053	--	--	--	--	10.9	--	--	--
C10	3	2.5	0.52	0.66	0.016	265	11	0.040	4.35	0.23	1.07	4.07	1.1	12.0	2.78	3.6
C11	0	2.2	0.60	0.70	--	165	4	0.024	--	--	--	--	9.0	--	--	--
C11	3	2.2	0.60	0.70	0.016	430	7	0.015	4.29	0.27	1.52	2.82	2.5	11.5	2.82	3.6
C12	0	1.5	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--
C12	3	1.5	0.60	0.70	0.016	600	9	0.015	3.28	0.24	1.25	2.63	3.8	10.1	2.97	2.6
C2+C4	C4	1.4	0.60	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--
C2+C4	3	2.3	0.60	0.70	0.016	0	0	0.250	4.44	0.17	0.54	8.19	0.0	10.7	2.90	4.0
C3+C5	C5	2.6	0.60	0.70	--	--	--	--	--	--	--	--	10.3	--	--	--
C3+C5	3	3.6	0.60	0.70	0.016	0	0	0.250	7.60	0.20	0.81	9.34	0.0	10.3	2.95	6.3
C2+C4+C3+C5	C2+C4	2.3	0.60	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--
C2+C4+C3+C5	4	5.9	0.60	0.70	0.013	28	0	0.010	11.41	0.76	1.67	6.84	0.1	10.8	2.89	10.2
OSC1+C1+C2+C4+C3+C5	OSC1+C1	8.6	0.47	0.57	--	--	--	--	--	--	--	--	13.1	--	--	--
OSC1+C1+C2+C4+C3+C5	4	14.4	0.52	0.62	0.013	230	2	0.010	25.76	1.15	2.97	8.67	0.4	13.5	2.64	19.8
C6+C10	C10	2.5	0.52	0.66	--	--	--	--	--	--	--	--	12.0	--	--	--
C6+C10	3	3.2	0.53	0.67	0.016	0	0	0.250	5.70	0.18	0.65	8.71	0.0	12.0	2.78	4.8
C8+C9	C9	2.4	0.60	0.70	--	--	--	--	--	--	--	--	12.2	--	--	--
C8+C9	3	3.2	0.60	0.70	0.016	0	0	0.250	6.32	0.19	0.71	8.93	0.0	12.2	2.75	5.2
C7+C11	C11	2.2	0.60	0.70	--	--	--	--	--	--	--	--	11.5	--	--	--
C7+C11	3	3.0	0.60	0.70	0.016	0	0	0.250	5.96	0.18	0.68	8.80	0.0	11.5	2.82	5.1
C8+C9+C7+C11	C8+C9	3.2	0.60	0.70	--	--	--	--	--	--	--	--	12.2	--	--	--
C8+C9+C7+C11	3	6.1	0.60	0.70	0.016	475	7	0.015	12.31	0.39	3.34	3.69	2.1	14.3	2.57	9.5
C6+C10+C8+C9+C7+C11	C8+C9+C7+C11	6.1	0.60	0.70	--	--	--	--	--	--	--	--	14.3	--	--	--
C6+C10+C8+C9+C7+C11	3	9.4	0.58	0.69	0.016	0	0	0.010	18.49	0.48	5.33	3.47	0.0	14.3	2.57	13.9
OSC1+C1+C2+C4+C3+C5+C6+C10+C8+C9+C7+C11	C6+C10+C8+C9+C7+C11	9.4	0.58	0.69	--	--	--	--	--	--	--	--	14.3	--	--	--
OSC1+C1+C2+C4+C3+C5+C6+C10+C8+C9+C7+C11	3	23.8	0.54	0.65	0.016	0	0	0.010	44.10	0.66	10.23	4.31	0.0	14.3	2.57	33.1
OSC1+C1+C2+C4+C3+C5+C6+C10+C8+C9+C7+C11+C1	OSC1+C1+C2+C4+C3+C5+C6+C10+C8+C9+C7+C	23.8	0.54	0.65	--	--	--	--	--	--	--	--	14.3	--	--	--
OSC1+C1+C2+C4+C3+C5+C6+C10+C8+C9+C7+C11+C1	4	25.3	0.55	0.65	0.013	62	1	0.010	47.05	1.57	4.59	10.25	0.1	14.4	2.56	35.3

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Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	2 Year Coef. C_2	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	2 Year Intensity I_6 (in/hr)	2 Year Discharge Q2 (cfs)
D1	0	2.1	0.60	0.70	--	90	2	0.020	--	--	--	--	7.1	--	--	--
D1	3	2.1	0.60	0.70	0.016	630	31	0.050	4.47	0.22	1.00	4.45	2.4	9.4	3.05	3.8
D2	0	1.2	0.60	0.70	--	75	2	0.020	--	--	--	--	6.4	--	--	--
D2	3	1.2	0.60	0.70	0.016	685	34	0.050	2.64	0.18	0.67	3.92	2.9	9.4	3.06	2.2
D1+D2	D1	2.1	0.60	0.70	--	--	--	--	--	--	--	--	9.4	--	--	--
D1+D2	3	3.3	0.60	0.70	0.016	0	0	0.250	7.04	0.20	0.77	9.17	0.0	9.4	3.05	6.0
D3	0	0.3	0.75	0.81	--	40	1	0.020	--	--	--	--	3.3	--	--	--
D3	3	0.3	0.75	0.81	0.016	320	20	0.063	1.90	0.16	0.48	3.94	1.4	5.0	3.71	0.7
D4	0	2.2	0.60	0.70	--	100	2	0.020	--	--	--	--	7.4	--	--	--
D4	3	2.2	0.60	0.70	0.016	545	22	0.040	4.72	0.23	1.13	4.18	2.2	--	--	--
D4	3	2.2	0.60	0.70	0.016	195	4	0.020	4.72	0.26	1.47	3.21	1.0	10.6	2.91	3.9
D3+D4	D4	2.2	0.60	0.70	--	--	--	--	--	--	--	--	10.6	--	--	--
D3+D4	3	2.5	0.62	0.71	0.016	0	0	0.250	5.36	0.18	0.63	8.58	0.0	10.6	2.91	4.4
D1+D2+D3+D4	D3+D4	2.5	0.62	0.71	--	--	--	--	--	--	--	--	10.6	--	--	--
D1+D2+D3+D4	3	5.7	0.61	0.71	0.016	0	0	0.250	12.28	0.24	1.17	10.52	0.0	10.6	2.91	10.1
D5	0	0.7	0.57	0.66	--	140	6	0.043	--	--	--	--	7.2	--	--	--
D5	3	0.7	0.57	0.66	0.016	310	13	0.040	1.49	0.16	0.47	3.15	1.6	8.8	3.12	1.3
D1+D2+D3+D4+D5	D1+D2+D3+D4	5.7	0.61	0.71	--	--	--	--	--	--	--	--	10.6	--	--	--
D1+D2+D3+D4+D5	3	6.5	0.60	0.70	0.016	0	0	0.250	13.76	0.25	1.27	10.82	0.0	10.6	2.91	11.4
D6	0	1.3	0.60	0.70	--	60	1	0.013	--	--	--	--	6.6	--	--	--
D6	3	1.3	0.60	0.70	0.016	535	22	0.040	2.89	0.20	0.78	3.70	2.4	--	--	--
D6	3	1.3	0.60	0.70	0.016	210	4	0.020	2.89	0.22	1.01	2.87	1.2	10.2	2.96	2.3
D1+D2+D3+D4+D5+D6	D1+D2+D3+D4+D5	6.5	0.60	0.70	--	--	--	--	--	--	--	--	10.6	--	--	--
D1+D2+D3+D4+D5+D6	3	7.8	0.60	0.70	0.016	35	1	0.040	16.54	0.36	2.91	5.68	0.1	10.7	2.90	13.6
D7	0	4.0	0.60	0.70	--	140	2	0.015	--	--	--	--	9.7	--	--	--
D7	3	4.0	0.60	0.70	0.016	475	19	0.040	7.66	0.28	1.64	4.68	1.7	--	--	--
D7	3	4.0	0.60	0.70	0.016	270	4	0.015	7.66	0.33	2.37	3.23	1.4	12.8	2.70	6.4
D1+D2+D3+D4+D5+D6+D7	D7	4.0	0.60	0.70	--	--	--	--	--	--	--	--	12.8	--	--	--
D1+D2+D3+D4+D5+D6+D7	3	11.7	0.60	0.70	0.016	0	0	0.250	22.75	0.29	1.86	12.25	0.0	12.8	2.70	19.1
D9	0	0.9	0.50	0.58	--	40	1	0.020	--	--	--	--	5.6	--	--	--
D9	3	0.9	0.50	0.58	0.016	585	20	0.034	1.63	0.17	0.54	3.02	3.2	8.8	3.12	1.3
D1+D2+D3+D4+D5+D6+D9	D1+D2+D3+D4+D5+D6	7.8	0.60	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--
D1+D2+D3+D4+D5+D6+D9	3	8.6	0.59	0.69	0.016	300	11	0.036	18.05	0.38	3.23	5.58	0.9	11.6	2.81	14.4
D1+D2+D3+D4+D5+D6+D7+D9	D1+D2+D3+D4+D5+D6+D7	11.7	0.60	0.70	--	--	--	--	--	--	--	--	12.8	--	--	--
D1+D2+D3+D4+D5+D6+D7+D9	3	12.6	0.59	0.69	0.016	0	0	0.250	24.12	0.30	1.94	12.43	0.0	12.8	2.70	20.2
D8	0	3.1	0.60	0.70	--	120	1	0.010	--	--	--	--	10.2	--	--	--
D8	3	3.1	0.60	0.70	0.016	450	18	0.040	5.80	0.25	1.32	4.38	1.7	--	--	--
D8	3	3.1	0.60	0.70	0.016	270	4	0.015	5.80	0.30	1.92	3.02	1.5	13.4	2.64	4.9
D10	0	0.4	0.60	0.70	--	32	1	0.020	--	--	--	--	4.2	--	--	--
D10	3	0.4	0.60	0.70	0.016	330	7	0.020	2.33	0.21	0.87	2.68	2.1	6.2	3.49	0.8
D8+D10	D8	3.1	0.60	0.70	--	--	--	--	--	--	--	--	13.4	--	--	--
D8+D10	3	3.4	0.60	0.70	0.016	0	0	0.250	6.51	0.19	0.72	8.99	0.0	13.4	2.64	5.4
D11	0	1.3	0.38	0.47	--	210	4	0.019	--	--	--	--	15.9	--	--	--
D11	3	1.3	0.38	0.47	0.016	95	1	0.015	1.36	0.18	0.65	2.10	0.8	16.6	2.40	1.2
D1+D2+D3+D4+D5+D6+D9+D11	D1+D2+D3+D4+D5+D6+D9	8.6	0.59	0.69	--	--	--	--	--	--	--	--	11.6	--	--	--
D1+D2+D3+D4+D5+D6+D9+D11	3	9.9	0.56	0.66	0.016	130	2	0.015	19.88	0.46	4.78	4.16	0.5	12.1	2.76	15.5
D1+D2+D3+D4+D5+D6+D7+D9+D11	D1+D2+D3+D4+D5+D6+D7+D9	12.6	0.59	0.69	--	--	--	--	--	--	--	--	12.8	--	--	--
D1+D2+D3+D4+D5+D6+D7+D9+D11	3	13.9	0.57	0.67	0.016	140	2	0.015	25.79	0.50	5.87	4.39	0.5	13.3	2.65	21.2
D12	0	0.5	0.65	0.72	--	85	3	0.035	--	--	--	--	5.1	--	--	--
D12	3	0.5	0.65	0.72	0.016	130	2	0.015	1.27	0.18	0.60	2.10	1.0	6.1	3.51	1.2
D8+D10+D12	D8+D10	3.4	0.60	0.70	--	--	--	--	--	--	--	--	13.4	--	--	--
D8+D10+D12	3	4.0	0.61	0.70	0.016	130	2	0.015	7.52	0.32	2.30	3.26	0.7	14.1	2.59	6.2
D1+D2+D3+D4+D5+D6+D7+D9+D11+D8+D10+D12	D8+D10+D12	4.0	0.61	0.70	--	--	--	--	--	--	--	--	14.1	--	--	--
D1+D2+D3+D4+D5+D6+D7+D9+D11+D8+D10+D12	4	17.8	0.58	0.68	0.013	42	0	0.005	32.77	1.54	4.46	7.34	0.1	14.2	2.58	26.7
E1	0	1.2	0.60	0.70	--	65	1	0.015	--	--	--	--	6.5	--	--	--
E1	3	1.2	0.60	0.70	0.016	615	11	0.018	2.72	0.22	1.01	2.68	3.8	10.4	2.94	2.2
E2	0	2.8	0.60	0.70	--	130	3	0.020	--	--	--	--	8.5	--	--	--
E2	3	2.8	0.60	0.70	0.016	580	11	0.020	5.69	0.28	1.70	3.34	2.9	11.4	2.83	4.8
E1+E2	E2	2.8	0.60	0.70	--	--	--	--	--	--	--	--	11.4	--	--	--
E1+E2	3	4.0	0.60	0.70	0.016	0	0	0.250	8.19	0.21	0.86	9.52	0.0	11.4	2.83	6.9
E3	0	1.0	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--
E3	3	1.0	0.60	0.70	0.016	515	10	0.020	2.17	0.20	0.82	2.66	3.2	9.6	3.03	1.8
E1+E2+E3	E1+E2	4.0	0.60	0.70	--	--	--	--	--	--	--	--	11.4	--	--	--
E1+E2+E3	3	5.0	0.60	0.70	0.016	0	0	0.250	10.16	0.22	1.01	10.04	0.0	11.4	2.83	8.5
E4	0	2.7	0.60	0.70	--	125	3	0.020	--	--	--	--	8.3	--	--	--
E4	3	2.7	0.60	0.70	0.016	500	11	0.023	5.61	0.27	1.59	3.52	2.4	10.7	2.91	4.8

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	2 Year Coef. C_2	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft^2)	Flow Velocity v (ft/s)	Time of Cont** T_c (min)	Total Time T_c (min)	2 Year Intensity I_5 (in/hr)	2 Year Discharge Q2 (cfs)	
E1+E2+E3+E4	E1+E2+E3	5.0	0.60	0.70	--	--	--	--	--	--	--	--	11.4	--	--	--	-
E1+E2+E3+E4	3	7.7	0.60	0.70	0.016	295	8	0.025	15.73	0.38	3.32	4.73	1.0	12.4	2.73	12.7	-
E5	0	0.9	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	-
E5	3	0.9	0.60	0.70	0.016	460	11	0.023	2.01	0.19	0.73	2.76	2.8	9.1	3.09	1.7	-
E1+E2+E3+E4+E5	E1+E2+E3+E4	7.7	0.60	0.70	--	--	--	--	--	--	--	--	12.4	--	--	--	-
E1+E2+E3+E4+E5	3	8.6	0.60	0.70	0.016	0	0	0.250	17.56	0.27	1.53	11.49	0.0	12.4	2.73	14.2	-
E6	0	1.8	0.60	0.70	--	105	3	0.029	--	--	--	--	6.8	--	--	--	-
E6	3	1.8	0.60	0.70	0.016	575	8	0.015	3.94	0.26	1.45	2.73	3.5	10.3	2.95	3.2	-
E7	0	2.3	0.43	0.61	--	200	4	0.020	--	--	--	--	14.1	--	--	--	-
E7	3	2.3	0.43	0.61	0.016	365	7	0.019	3.40	0.24	1.17	2.91	2.1	16.2	2.43	2.4	-
E6+E7	E7	2.3	0.43	0.61	--	--	--	--	--	--	--	--	16.2	--	--	--	-
E6+E7	3	4.1	0.50	0.65	0.016	0	0	0.019	6.38	0.29	1.88	3.39	0.0	16.2	2.43	5.0	-
E4+E5	E4	2.7	0.60	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--	-
E4+E5	3	3.6	0.60	0.70	0.016	0	0	0.250	7.45	0.20	0.80	9.30	0.0	10.7	2.91	6.3	-
E4+E5+E7	E4+E5	3.6	0.60	0.70	--	--	--	--	--	--	--	--	10.7	--	--	--	-
E4+E5+E7	3	6.0	0.53	0.67	0.016	100	3	0.025	11.64	0.35	2.67	4.37	0.4	11.1	2.87	9.1	-
E1+E2+E3+E4+E5+E7	E1+E2+E3+E4+E5	8.6	0.60	0.70	--	--	--	--	--	--	--	--	12.4	--	--	--	-
E1+E2+E3+E4+E5+E7	3	11.0	0.56	0.68	0.016	100	1	0.010	21.72	0.51	6.01	3.61	0.5	12.9	2.69	16.6	-
E8	0	0.7	0.60	0.70	--	40	1	0.030	--	--	--	--	4.1	--	--	--	-
E8	3	0.7	0.60	0.70	0.016	610	16	0.025	4.10	0.24	1.21	3.39	3.0	7.1	3.36	1.3	-
E1+E2+E3+E4+E5+E8	E1+E2+E3+E4+E5	8.6	0.60	0.70	--	--	--	--	--	--	--	--	12.4	--	--	--	-
E1+E2+E3+E4+E5+E8	4	9.3	0.60	0.70	0.013	50	1	0.010	18.88	0.98	2.38	7.93	0.1	12.5	2.72	15.2	-
E9	0	8.6	0.25	0.35	--	300	6	0.020	--	--	--	--	21.9	--	--	--	-
E9	3	8.6	0.25	0.35	0.016	550	12	0.022	5.79	0.28	1.66	3.49	2.6	--	--	--	-
E9	4	8.6	0.25	0.35	0.013	170	2	0.010	5.79	0.55	1.03	5.60	0.5	25.0	1.95	4.2	-
OSF3	0	0.5	0.25	0.35	--	50	16	0.320	--	--	--	--	3.6	5.0	3.71	0.5	-
F1	0	2.4	0.60	0.70	--	110	2	0.020	--	--	--	--	7.8	--	--	--	-
F1	3	2.4	0.60	0.70	0.016	765	13	0.018	5.04	0.28	1.62	3.10	4.1	11.9	2.78	4.0	-
OSF3+F1	F1	2.4	0.60	0.70	--	--	--	--	--	--	--	--	11.9	--	--	--	-
OSF3+F1	3	2.9	0.54	0.64	0.016	0	0	0.250	5.58	0.18	0.64	8.66	0.0	11.9	2.78	4.4	-
F2	0	1.3	0.60	0.70	--	60	1	0.015	--	--	--	--	6.3	--	--	--	-
F2	3	1.3	0.60	0.70	0.016	670	12	0.018	2.81	0.22	1.04	2.71	4.1	10.5	2.93	2.2	-
F3	0	3.2	0.60	0.70	--	140	4	0.025	--	--	--	--	8.2	--	--	--	-
F3	3	3.2	0.60	0.70	0.016	695	13	0.018	6.61	0.30	1.97	3.35	3.5	11.6	2.81	5.4	-
F2+F3	F3	3.2	0.60	0.70	--	--	--	--	--	--	--	--	11.6	--	--	--	-
F2+F3	3	4.5	0.60	0.70	0.016	0	0	0.250	9.20	0.21	0.94	9.79	0.0	11.6	2.81	7.5	-
OSF3+F1+F2+F3	OSF3+F1	2.9	0.54	0.64	--	--	--	--	--	--	--	--	11.9	--	--	--	-
OSF3+F1+F2+F3	3	7.4	0.58	0.68	0.016	260	7	0.025	14.93	0.38	3.22	4.64	0.9	12.8	2.69	11.5	-
F4	0	0.3	0.60	0.70	--	40	1	0.020	--	--	--	--	4.7	--	--	--	-
F4	3	0.3	0.60	0.70	0.016	220	6	0.027	2.02	0.19	0.69	2.93	1.3	6.0	3.54	0.7	-
OSF2	0	4.9	0.30	0.40	--	290	13	0.045	--	--	--	--	15.5	--	--	--	-
OSF2	3	4.9	0.30	0.40	0.016	1,170	19	0.016	4.41	0.27	1.51	2.92	6.7	22.2	2.07	3.0	-
F5	0	3.7	0.25	0.35	--	300	6	0.020	--	--	--	--	21.9	--	--	--	-
F5	3	3.7	0.25	0.35	0.016	65	3	0.046	2.46	0.18	0.66	3.74	0.3	--	--	--	-
F5	3	3.7	0.25	0.35	0.016	205	5	0.024	2.46	0.20	0.84	2.94	1.2	23.4	2.02	1.9	-
OSF2+F5	OSF2	4.9	0.30	0.40	--	--	--	--	--	--	--	--	22.2	--	--	--	-
OSF2+F5	1	8.6	0.28	0.38	0.060	310	3	0.010	7.33	1.21	4.36	1.68	3.1	--	--	--	-
OSF2+F5	4	8.6	0.28	0.38	0.013	380	4	0.010	7.33	0.61	1.22	6.00	1.1	26.3	1.89	4.5	-
OSF3+F1+F2+F3+F5	OSF3+F1+F2+F3	7.4	0.58	0.68	--	--	--	--	--	--	--	--	12.8	--	--	--	-
OSF3+F1+F2+F3+F5	3	11.1	0.47	0.57	0.016	260	8	0.031	18.77	0.40	3.53	5.31	0.8	13.7	2.62	13.6	-
OSF3+F1+F2+F3+F5+F4	OSF3+F1+F2+F3+F5	11.1	0.47	0.57	--	--	--	--	--	--	--	--	13.7	--	--	--	-
OSF3+F1+F2+F3+F5+F4	4	11.4	0.47	0.57	0.013	35	0	0.010	19.44	0.99	2.43	8.00	0.1	13.7	2.62	14.0	-
OSF2+OSF3+F1+F2+F3+F5	OSF2	4.9	0.30	0.40	--	--	--	--	--	--	--	--	22.2	--	--	--	-
OSF2+OSF3+F1+F2+F3+F5	1	16.0	0.42	0.52	0.060	310	3	0.010	18.68	1.71	8.79	2.13	2.4	--	--	--	-
OSF2+OSF3+F1+F2+F3+F5	4	16.0	0.42	0.52	0.013	380	4	0.010	18.68	0.97	2.36	7.90	0.8	25.5	1.93	12.8	-
G1	0	6.2	0.25	0.35	--	300	11	0.037	--	--	--	--	17.9	--	--	--	-
G1	3	6.2	0.25	0.35	0.016	90	3	0.033	4.59	0.24	1.19	3.86	0.4	--	--	--	-
G1	4	6.2	0.25	0.35	0.013	80	18	0.225	4.59	0.23	0.30	15.47	0.1	18.4	2.28	3.5	-

*Estimated using an initial 100 year intensity based on the corresponding Overland Time of Concentration.

**Overland Time of Concentration, $T_c = 1.87\ (1.1 - C_5)\ L^{0.5}\ S^{-0.33}$

Channel Time of Concentration calculated using average flow velocities from Manning's formula.

Hydrologic Analysis
HEC-1

East Fork Sand Creek Tributary 6

(Excerpts from DBPS Amendment by Kiowa Engineers)

HYDROLOGY ANALYSIS
EAST FORK SAND CREEK
TRIBUTARY 6

EL PASO COUNTY, COLORADO

Prepared for

Mr. Chuck Crum

MVE, Inc.

1903 Lelaray Street Suite 200

Colorado Springs, Colorado 80909

Prepared by

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904

Project number 06040

August 31, 2006

Revised December 15, 2006

Revised January 18, 2007

Hydrologic Analysis
HEC-1

Main Line Tributary 6
Existing Condition Input/Output Data (Kiowa Eng)

```
*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*                JUN  1998              *
*              VERSION 4.1              *
*                                       *
*  RUN DATE   04SEP07  TIME  11:53:45   *
*                                       *
*****************************************
```


```
***************************************
*                                     *
*    U.S. ARMY CORPS OF ENGINEERS     *
*    HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET          *
*        DAVIS, CALIFORNIA 95616      *
*            (916) 756-1104           *
*                                     *
***************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX  XXXXX          XXX
```

— Full Reach Existing Condition with Undeveloped Hannah Ridge —
Kiowa Engineering 9/3/07 — Not Considered / Included in DBPS Amendment

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT

PAGE 1

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  1       ID
  2       ID          East Fork Subtributary hydrology  PN:  06040
  3       ID          Existing devel   condition with storage at RR Embankment
  4       ID          Sand Creek DBPS Hydrology update
  5       ID          Existing culvert under RR in-place and no blockage
                      10- and 100 Year, 24 hr Type IIA  Storm  FN efstd.dat
          *DIAGRAM
  6       IT       5       0       0     300
  7       IO       5       0
  8       JR    PREC     .68     1.0

  9       KK       5
 10       KM       RUNOFF - Sub-basin 5
 11       BA     .20
 12       IN     15
```

```
 53        RS      1    ELEV     83
 54        SQ      0      75    325    480    575    675    775    850
 55        SE     83      86     90     92     94     96     98    100
 56        SV      0      .4     .8    1.7    4.6    8.9   17.6   31.6

 57        KK  RT-2B
 58        KM          ROUTE FLOW FROM DB14 TO DP-4A
 59        RD   2650    .005   .025          TRAP     16      4

 60        KK      3
 61        KM          RUNOFF FROM SUB-BASIN 3
 62        BA   .164
 63        LS      0    74.9
 64        UD    .12

 65        KK  RT-3A
 66        KM          ROUTE RUNOFF FROM SB 3 TO RT-3
 67        RD   1300     .02   .013          CIRC    3.5

 68        KK   RT-3
 69        KM          ROUTE RUNOFF FROM RT-3A TO DP 4A
 70        RD    500     .02   .013          CIRC      5

 71        KK      4
 72        KM          RUNOFF FROM SUB-BASIN 4
 73        BA   .147
 74        LS      0      69
 75        UD   .144

 76        KK  DP-4A
 77        KM          COMBINE RUNOFF FROM RT-3, RT-2B AND SB 4
 78        HC      3

 79        KK  RT-2A
 80        KM          ROUTE RUNOFF FROM DP 4A TO DP 8
 81        RD   1200    .007   .035          TRAP     30      3
```

1

HEC-1 INPUT

PAGE 3

```
LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 82        KK     12
 83        KM          RUNOFF FROM SUB-BASIN 12
 84        BA   .053
 85        LS      0      69
 86        UD   .058

 87        KK     13
 88        KM          RUNOFF FROM SUB-BASIN 13
 89        BA   .047
 90        LS      0      69
 91        UD    .06
```

H.R. SITE

H.R. SITE

H.R. SITE

HYDROGRAPH AT						
+	2	.32	1	FLOW	181.	429.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-14	.66	1	FLOW	360.	886.
				TIME	6.25	6.17
ROUTED TO						
+	DB-14	.66	1	FLOW	351.	627.
				TIME	6.25	6.33
			**	PEAK STAGES IN FEET **		
			1	STAGE	90.33	95.05
				TIME	6.25	6.33
ROUTED TO						
+	RT-2B	.66	1	FLOW	340.	624.
				TIME	6.33	6.42
HYDROGRAPH AT						
+	3	.16	1	FLOW	130.	283.
				TIME	6.00	6.00
ROUTED TO						
+	RT-3A	.16	1	FLOW	126.	273.
				TIME	6.08	6.00
ROUTED TO						
+	RT-3	.16	1	FLOW	126.	270.
				TIME	6.08	6.00
HYDROGRAPH AT						
+	4	.15	1	FLOW	74.	183.
				TIME	6.08	6.08
3 COMBINED AT						
+	DP-4A	.98	1	FLOW	393.	831.
				TIME	6.33	6.08
ROUTED TO						
+	RT-2A	.98	1	FLOW	384.	824.
				TIME	6.42	6.17
HYDROGRAPH AT						
+	12	.05	1	FLOW	37.	85.
				TIME	6.00	6.00
HYDROGRAPH AT						
+	13	.05	1	FLOW	32.	75.
				TIME	6.00	6.00

TO CULVERT

OUT D/S SIDE

3 COMBINED AT						
+	DP-8	1.08	1	FLOW	392.	856.
				TIME	6.42	6.17
ROUTED TO						
+	RT-6A	1.08	1	FLOW	390.	852.
				TIME	6.42	6.17
ROUTED TO						
+	RT6	1.08	1	FLOW	385.	835.
				TIME	6.42	6.17
HYDROGRAPH AT						
+	6	.12	1	FLOW	144.	269.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP -6	1.20	1	FLOW	410.	1004.
				TIME	6.42	6.17
ROUTED TO						
+	RT-7	1.20	1	FLOW	402.	993.
				TIME	6.50	6.25
HYDROGRAPH AT						
+	7	.17	1	FLOW	69.	174.
				TIME	6.17	6.17
2 COMBINED AT						
+	DP-7	1.37	1	FLOW	429.	1151.
				TIME	6.50	6.17
ROUTED TO						
+	RT-8	1.37	1	FLOW	444.	1144.
				TIME	6.50	6.42
HYDROGRAPH AT						
+	9	.14	1	FLOW	72.	159.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	11	.15	1	FLOW	134.	275.
				TIME	6.08	6.00
ROUTED TO						
+	DB11	.15	1	FLOW	52.	56.
				TIME	6.25	6.33

** PEAK STAGES IN FEET **

1	STAGE	6443.93	6446.82
	TIME	6.25	6.33

← EXISTING CONDITION CONSTITUTION CULVERT

Hydrologic Analysis
HEC-1

Main Line Tributary 6
DBPS Developed Condition Input/Output Data (Kiowa Eng)

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*               JUN   1998             *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   24MAY13  TIME  15:09:53  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1          ID        East Fork Subtributary Hydrology PN:  60970
   2          ID        Future developed condition (onsite and offsite) with storage at RR Emban
   3          ID        Existing RR culvert in place and no blockage.
   4          ID        5 yr, 10 yr and 100 Year, 24 hr Typoe IIA Storm  FN efscdv.dat
              *DIAGRAM
   5          IT       5       0       0     300
   6          IO       5       0
   7          JR    PREC     .59     .68     1.0

   8          KK       5
   9          KM        RUNOFF - Sub-basin 5
  10          BA     .20
  11          IN      15
  12          PB     4.4
  13          PC  0.0000  0.0005  0.0015  0.0030  0.0045  0.0060  0.0080  0.0100  0.0120  0.0143
  14          PC  0.0165  0.0188  0.0210  0.0233  0.0255  0.0278  0.0320  0.0390  0.0460  0.0530
  15          PC  0.0600  0.0750  0.1000  0.4000  0.7000  0.7250  0.7500  0.7650  0.7800  0.7900
```

```
58          RD    2650    .005    .025            TRAP      16       4

59          KK       3
60          KM        RUNOFF FROM SUB-BASIN 3
61          BA    .164
62          LS       0    74.9
63          UD    0.12

64          KK    RT-3A
65          KM        ROUTE RUNOFF FROM SB-3 TO RT-3
66          RD    1300     .02    .013            CIRC     3.5

67          KK    RT-3
68          KM        ROUTE RUNOFF FROM RT-3A TO DP 4A
69          RD     500     .02    .013            CIRC       5

70          KK       4
71          KM        RUNOFF FROM SUB-BASIN 4
72          BA    .147
73          LS       0    83.5
74          UD   0.144

75          KK    DP-4A
76          KM        COMBINE RUNOFF FROM RT-3, RT-2B AND SB 4
77          HC       3

78          KK    RT-2A
79          KM        ROUTE RUNOFF FROM DP 4A TO DP 8
80          RD    1200    .007    .035            TRAP      30       3

81          KK      12
82          KM        RUNOFF FROM SUB-BASIN 12
83          BA    .053
84          LS       0      92
85          UD   0.058
```



```
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

86          KK      13
87          KM        RUNOFF FROM SUB-BASIN 13
88          BA    .047
89          LS       0    88.5
90          UD    0.06

91          KK    DP-8
92          KM        COMBINE RUNOFF FROM RT-2A SUB-BASIN 12 AND SUB-BASIN 13
93          HC       3

94          KK    RT-6A
95          KM        ROUTE RUNOFF FROM DP 8 TO RT 6
96          RD     600     .02     .03            TRAP       2       3

97          KK    RT-6
```

				TIME	6.08	6.08	6.00	
ROUTED TO								
+	RT-5A	.20	1	FLOW	108.	151.	322.	
				TIME	6.08	6.08	6.08	
ROUTED TO								
+	RT-5	.20	1	FLOW	104.	142.	313.	
				TIME	6.17	6.17	6.08	
HYDROGRAPH AT								
+	1	.14	1	FLOW	86.	117.	242.	
				TIME	6.08	6.08	6.00	
2 COMBINED AT								
+	DP-1	.34	1	FLOW	180.	255.	551.	
				TIME	6.08	6.08	6.08	
ROUTED TO								
+	RT-1	.34	1	FLOW	170.	245.	518.	
				TIME	6.33	6.25	6.25	
HYDROGRAPH AT								
+	2	.32	1	FLOW	145.	207.	467.	
				TIME	6.08	6.08	6.08	
2 COMBINED AT								
+	DP-14 (IN)	.66	1	FLOW	261.	374.	915.	FLOW TO CULVERT
				TIME	6.25	6.25	6.17	
ROUTED TO								
+	DB-14 (OUT)	.66	1	FLOW	250.	360.	640.	OUT D/S SIDE
				TIME	6.25	6.25	6.33	
			** PEAK STAGES IN FEET **					
			1	STAGE	88.80	90.45	95.31	
				TIME	6.25	6.25	6.33	
ROUTED TO								
+	RT-2B	.66	1	FLOW	245.	352.	636.	
				TIME	6.42	6.33	6.42	
HYDROGRAPH AT								
+	3	.16	1	FLOW	93.	130.	283.	
				TIME	6.00	6.00	6.00	
ROUTED TO								
+	RT-3A	.16	1	FLOW	92.	126.	273.	
				TIME	6.08	6.08	6.00	
ROUTED TO								
+	RT-3	.16	1	FLOW	91.	126.	270.	
				TIME	6.08	6.08	6.00	
HYDROGRAPH AT								

+		4	.15	1	FLOW	139.	179.	333.
					TIME	6.08	6.00	6.00
	3 COMBINED AT							
+		DP-4A	.98	1	FLOW	289.	428.	991.
					TIME	6.42	6.33	6.08
	ROUTED TO							
+		RT-2A	.98	1	FLOW	288.	425.	948.
					TIME	6.42	6.33	6.17
	HYDROGRAPH AT							
+		12	.05	1	FLOW	90.	107.	168.
					TIME	6.00	6.00	6.00
	HYDROGRAPH AT							
+		13	.05	1	FLOW	70.	85.	139.
					TIME	6.00	6.00	6.00
	3 COMBINED AT							
+		DP-8	1.08	1	FLOW	342.	457.	1076. CONSTITUTION CULVERT
					TIME	6.00	6.00	6.08
	ROUTED TO							
+		RT-6A	1.08	1	FLOW	328.	448.	1069.
					TIME	6.00	6.08	6.08
	ROUTED TO							
+		RT-6	1.08	1	FLOW	326.	447.	1044.
					TIME	6.08	6.08	6.08
	HYDROGRAPH AT							
+		6	.12	1	FLOW	111.	144.	269.
					TIME	6.00	6.00	6.00
	2 COMBINED AT							
+		DP-6	1.20	1	FLOW	437.	588.	1299.
					TIME	6.08	6.08	6.08
	ROUTED TO							
+		RT-7	1.20	1	FLOW	419.	570.	1296.
					TIME	6.17	6.17	6.17
	HYDROGRAPH AT							
+		7	.17	1	FLOW	92.	125.	255.
					TIME	6.17	6.17	6.17
	2 COMBINED AT							
+		DP-7	1.37	1	FLOW	511.	695.	1551. DOWNSTREAM REACH
					TIME	6.17	6.17	6.17
	ROUTED TO							
+		RT-8	1.37	1	FLOW	552.	685.	1481.
					TIME	6.42	6.42	6.42

HYDRAULIC ANALYSES

Street Flow Capacity Calculations

Project No.: 60970
Project Name: Hannah Ridge at Feathergrass
Date: 9/5/17

Where does the extra 38 cfs go?

Street Flow Capacity Calculations (1/2 Street)

		Street Data																								
Street Name	Station	ROW Width Wr (ft)	FL-Crown Distance Tc (ft)	Street Cr Slope Sx (ft/ft)	Street Lg Slope So (ft/ft)	Curb Type	Note	Drainage Basin	Basin Q5 (cfs)	Basin Q100 (cfs)	Contrib Basin Area (%)	Gutter Width Tg (ft)	Curb Height Hc (ft)	Section Res Factor n	Gutter Cr Slope Sg (ft/ft)	Slope Sb (ft/ft)	FL Depth to Crown (ft)	5-yr FL Depth d (ft)	**5-year Capacity Qcap (cfs)**	**5-year Actual Flow (cfs)**		**5-year Flow to Crown (cfs)**	**5-year Crown Spillover (cfs)**	100-yr FL Depth d (ft)	**100-year Capacity Qcap (cfs)**	**100-year Actual Flow (cfs)**	
Breeches Way	PVC 1+59.16 L	50	14	0.020	0.020	VERT		C2	2.3	4.5	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.50	**17.3**	2.3	OK	8.1	0.0	0.72	**49.9**	4.5	OK
Breeches Way	PVC 1+59.16 R	50	14	0.020	0.020	VERT		C3	2.5	5.1	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.50	**17.3**	2.5	OK	8.1	0.0	0.72	**49.9**	5.1	OK
Breeches Way	PVC 2+69.72 L	50	14	0.020	0.040	VERT		C2,C4	5.5	10.9	48%	2.0	0.50	0.016	0.083	0.020	0.41	0.50	**24.5**	2.6	OK	11.5	0.0	0.72	**70.5**	5.2	OK
Breeches Way	PVC 2+69.72 R	50	14	0.020	0.040	VERT		C3,C5	8.9	17.8	52%	2.0	0.50	0.016	0.083	0.020	0.41	0.50	**24.5**	4.6	OK	11.5	0.0	0.72	**70.5**	9.3	OK
Breeches Way	PVC 4+15.43 L	50	17	0.020	0.020	VERT		C6	1.9	3.9	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**16.9**	1.9	OK	13.0	0.0	0.66	**42.3**	3.9	OK
Breeches Way	PVC 4+15.43 R	50	17	0.020	0.020	VERT		C7	2.1	4.3	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**16.9**	2.1	OK	13.0	0.0	0.66	**42.3**	4.3	OK
Breeches Way	PVC 5+34.89 L	50	17	0.020	0.030	VERT		C6,C10	6.6	14.1	31%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**20.8**	2.0	OK	15.9	0.0	0.66	**51.8**	4.4	OK
Breeches Way	PVC 5+34.89 R	50	17	0.020	0.030	VERT		C7,C11	7.3	14.5	37%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**20.8**	2.7	OK	15.9	0.0	0.66	**51.8**	5.4	OK
Breeches Way	PVT 5+84.89 L	50	17	0.020	0.020	VERT		C10	4.9	10.7	89%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**16.9**	4.4	OK	13.0	0.0	0.66	**42.3**	9.5	OK
Breeches Way	PVT 5+84.89 R	50	17	0.020	0.020	VERT		C7,C8,C9,C13	13.4	26.6	95%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**16.9**	12.7	OK	13.0	0.0	0.66	**42.3**	25.3	OK
Constitution Ave (Exist)	Trail to Shawnee	120	34	0.013	0.046	VERT	1 - 10' lane clear	offsite	39.0	121.0	100%	2.0	0.50	0.016	0.083	0.020	0.58	0.50	**33.8**	39.0	X	30.3	0.0	0.92	**363.3**	121.0	OK
Constitution Ave (Exist)	Shawnee to HR Dr	120	34	0.026	0.010	VERT	1 - 10' lane clear	offsite	39.0	121.0	100%	2.0	0.50	0.016	0.083	0.020	1.00	0.50	**9.7**	39.0	X	7.0	0.0	1.00	**83.3**	121.0	X
Constitution Ave (Exist)	HR Dr to Akers	120	34	0.020	0.018	VERT	1 - 10' lane clear	offsite	39.0	121.0	100%	2.0	0.50	0.016	0.083	0.020	0.81	0.50	**15.5**	39.0	X	11.8	0.0	1.00	**162.8**	121.0	OK
Grand Prix	PC 1+53.88 L	50	17	0.020	0.021	RAMP		E3	2.5	5.0	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**13.4**	2.5	OK	13.4	N/A	0.66	**43.6**	5.0	OK
Grand Prix	PC 1+53.88 R	50	17	0.020	0.021	RAMP		E2	6.7	13.3	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**13.4**	6.7	OK	13.4	N/A	0.66	**43.6**	13.3	OK
Grand Prix	PVC 13+48.64 L	50	17	0.020	0.015	RAMP		C7,C8,C9,C11	13.4	26.6	82%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**11.2**	11.0	OK	11.2	N/A	0.66	**36.6**	21.8	OK
Grand Prix	PVC 13+48.64 R	50	17	0.020	0.015	RAMP		C12	3.7	7.4	71%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**11.2**	2.6	OK	11.2	N/A	0.66	**36.6**	5.3	OK
Grand Prix	PVT 14+91.64 L	50	17	0.020	0.040	RAMP		C10	4.9	10.7	89%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**18.4**	4.4	OK	18.4	N/A	0.66	**59.8**	9.5	OK
Grand Prix	PVT 14+91.64 R	50	17	0.020	0.040	RAMP		C12	3.7	7.4	29%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**18.4**	1.1	OK	18.4	N/A	0.66	**59.8**	2.1	OK
Dapples Court	PVT 1+54.50 L	50	14	0.020	0.040	RAMP		B1	5.8	11.7	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**11.5**	5.8	OK	11.5	N/A	0.72	**70.5**	11.7	OK
Dapples Court	PVT 1+54.50 R	50	14	0.020	0.040	RAMP		B2	2.8	5.5	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**11.5**	2.8	OK	11.5	N/A	0.72	**70.5**	5.5	OK
Dapples Court	PVT 6+29.63 L	50	14	0.020	0.020	RAMP		B1	5.8	11.7	21%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**8.1**	1.2	OK	8.1	N/A	0.72	**49.9**	2.5	OK
Dapples Court	PVT 6+29.63 R	50	14	0.020	0.020	RAMP		B2	2.8	5.5	32%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**8.1**	0.9	OK	8.1	N/A	0.72	**49.9**	1.8	OK
Equine Court	PC 1+46.00 L	50	17	0.020	0.020	RAMP		D6	3.3	6.6	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**13.0**	3.3	OK	13.0	N/A	0.66	**42.3**	6.6	OK
Equine Court	PC 1+46.00 R	50	17	0.020	0.020	VERT		D1,D2,D3,D4	14.3	28.3	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**16.9**	14.3	OK	13.0	1.3	0.66	**42.3**	28.3	OK
Equine Court	PVT 3+04.95 L	50	17	0.020	0.040	RAMP		D6	2.8	5.6	76%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**18.4**	2.1	OK	18.4	N/A	0.66	**59.8**	4.3	OK
Equine Court	PVT 3+04.95 R	50	17	0.020	0.040	RAMP		D1,D2,D3,D4	2.8	5.6	96%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**18.4**	2.7	OK	18.4	N/A	0.66	**59.8**	5.4	OK
Equine Court	PC 9+56.53 L	50	17	0.020	0.015	RAMP		B6	2.8	1.4	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**11.2**	2.8	OK	11.2	N/A	0.66	**36.6**	1.4	OK
Equine Court	PC 9+56.53 R	50	17	0.020	0.015	VERT		B1,B2,B3,B4	13.6	27.2	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**14.7**	13.6	OK	11.2	2.4	0.66	**36.6**	27.2	OK
Equine Court	PC 16+58.82 L	50	14	0.020	0.015	RAMP		A2	2.6	5.2	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**7.1**	2.6	OK	7.1	N/A	0.72	**43.2**	5.2	OK
Equine Court	PC 16+58.82 R	50	14	0.020	0.015	RAMP		A1	5.2	10.6	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**7.1**	5.2	OK	7.1	N/A	0.72	**43.2**	10.6	OK
Farrier Court	PVT 1+49.50 L	50	14	0.020	0.050	RAMP		D1	5.3	10.6	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**12.9**	5.3	OK	12.9	N/A	0.72	**78.9**	10.6	OK
Farrier Court	PVT 1+49.50 R	50	14	0.020	0.050	RAMP		D2	3.1	6.1	100%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**12.9**	3.1	OK	12.9	N/A	0.72	**78.9**	6.1	OK
Half Chaps Court	PC 4+84.69 L	50	14	0.020	0.010	RAMP		E6	4.5	9.0	84%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**5.8**	3.8	OK	5.8	N/A	0.72	**35.3**	7.6	OK
Half Chaps Court	PC 4+84.69 R	50	14	0.020	0.015	RAMP		E6	4.5	9.0	16%	2.0	0.50	0.016	0.083	0.020	0.41	0.41	**7.1**	0.7	OK	7.1	N/A	0.72	**43.2**	1.4	OK
Hannah Ridge Drive	PVC 2+42.90 L	80	26	0.020	0.040	VERT	Center Median	D12	1.6	3.4	58%	2.0	0.50	0.016	0.083	0.020	0.65	0.50	**23.1**	0.9	OK	16.0	0.0	0.78	**111.3**	2.0	OK
Hannah Ridge Drive	PVC 2+42.90 R	80	26	0.020	0.040	VERT	Center Median	D11	1.7	3.2	41%	2.0	0.50	0.016	0.083	0.020	0.65	0.50	**23.1**	0.7	OK	16.0	0.0	0.78	**111.3**	1.3	OK
Hannah Ridge Drive	PVT 4+12.90 L	60	17	0.020	0.015	VERT	Center Median	D8,D10,D12	8.7	17.1	93%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**14.7**	8.1	OK	11.2	0.0	0.76	**54.3**	15.9	OK
Hannah Ridge Drive	PVT 4+12.90 L	60	17	0.020	0.015	VERT	need u/s Inlet	D1-D7,D9,D11	29.6	59.0	96%	2.0	0.50	0.016	0.083	0.020	0.47	0.50	**14.7**	28.4	X	11.2	17.2	0.76	**54.3**	56.6	X
Hannah Ridge Drive	PC 5+75.00 L	60	17	0.020	0.015	RAMP		D8	6.8	13.4	81%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**11.2**	5.5	OK	11.2	N/A	0.76	**54.3**	10.9	OK
Hannah Ridge Drive	PC 5+75.00 R	60	17	0.020	0.015	RAMP		D7	8.9	17.8	91%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**11.2**	8.1	OK	11.2	N/A	0.76	**54.3**	16.2	OK
Hannah Ridge Drive	PVT 8+47.03 L	60	17	0.020	0.040	RAMP		D8	6.8	13.4	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**18.4**	6.8	OK	18.4	N/A	0.76	**88.7**	13.4	OK
Hannah Ridge Drive	PVT 8+47.03 R	60	17	0.020	0.040	RAMP		D7	8.9	17.8	62%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**18.4**	5.5	OK	18.4	N/A	0.76	**88.7**	11.0	OK
Horsemanship Court	PC 1+40.00 L	50	17	0.020	0.023	RAMP		E5	2.3	4.7	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**14.0**	2.3	OK	14.0	N/A	0.66	**45.5**	4.7	OK
Horsemanship Court	PC 1+40.00 R	50	17	0.020	0.023	RAMP		E4	6.7	13.3	100%	2.0	0.50	0.016	0.083	0.020	0.47	0.47	**14.0**	6.7	OK	14.0	N/A	0.66	**45.5**	13.3	OK
Hunter Jumper Drive	PC 3+18.00 L	60	20	0.020	0.025	VERT		F2,F3	10.6	21.1	34%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**18.1**	3.6	OK	17.3	0.0	0.70	**67.0**	7.2	OK
Hunter Jumper Drive	PC 3+18.00 R	60	20	0.020	0.025	VERT		OF3,F1	6.2	12.5	100%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**18.1**	6.2	OK	17.3	0.0	0.70	**67.0**	12.5	OK
Hunter Jumper Drive	PC 5+89.38 L	60	20	0.020	0.028	VERT		E1,E2	9.6	19.1	37%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**19.3**	3.6	OK	18.5	0.0	0.70	**71.5**	7.1	OK
Hunter Jumper Drive	PC 5+89.38 R	60	20	0.020	0.028	VERT		E8	1.8	3.6	31%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**19.3**	0.6	OK	18.5	0.0	0.70	**71.5**	1.1	OK
Hunter Jumper Drive	PC 6+63.38 L	60	20	0.020	0.028	VERT		E1,E2,E3	11.9	23.7	100%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**19.3**	11.9	OK	18.5	0.0	0.70	**71.5**	23.7	OK
Hunter Jumper Drive	PC 6+63.38 R	60	20	0.020	0.025	VERT		E8	1.8	3.6	35%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**18.3**	0.6	OK	17.5	0.0	0.70	**67.7**	1.3	OK
Hunter Jumper Drive	PC 8+84.38 L	60	20	0.020	0.025	VERT		E1,E2,E3,E4	17.8	35.5	69%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**18.3**	12.3	OK	17.5	0.0	0.70	**67.7**	24.5	OK
Hunter Jumper Drive	PC 8+84.38 R	60	20	0.020	0.025	VERT		E8	1.8	3.6	74%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**18.3**	1.3	OK	17.5	0.0	0.70	**67.7**	2.7	OK
Hunter Jumper Drive	PVC 9+51.84 L	60	20	0.020	0.025	VERT	need u/s Inlet	E1,E2,E3,E4,E5	19.9	39.7	100%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**18.3**	19.9	X	17.5	0.0	0.70	**67.7**	39.7	OK
Hunter Jumper Drive	PVC 9+51.84 R	60	20	0.020	0.025	VERT		E8	1.8	3.6	77%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**18.3**	1.4	OK	17.5	0.0	0.70	**67.7**	2.8	OK
Hunter Jumper Drive	PC 14+53.18 L	60	20	0.020	0.020	VERT		D8	6.8	13.4	20%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**16.3**	1.4	OK	15.7	0.0	0.70	**60.5**	2.7	OK
Hunter Jumper Drive	PC 14+53.18 R	60	20	0.020	0.020	VERT		D10	1.1	2.2	100%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**16.3**	1.1	OK	15.7	0.0	0.70	**60.5**	2.2	OK
Hunter Jumper Drive	PVC 15+23.86 L	60	20	0.020	0.015	VERT	need u/s Inlet	D1,D2,D3,D4,D5,D6	19.2	38.0	100%	2.0	0.50	0.016	0.083	0.020	0.53	0.50	**14.1**	19.2	X	13.6	0.0	0.70	**52.4**	38.0	OK

Hydraulic Analysis
Autodesk Storm and Sanitary Analysis

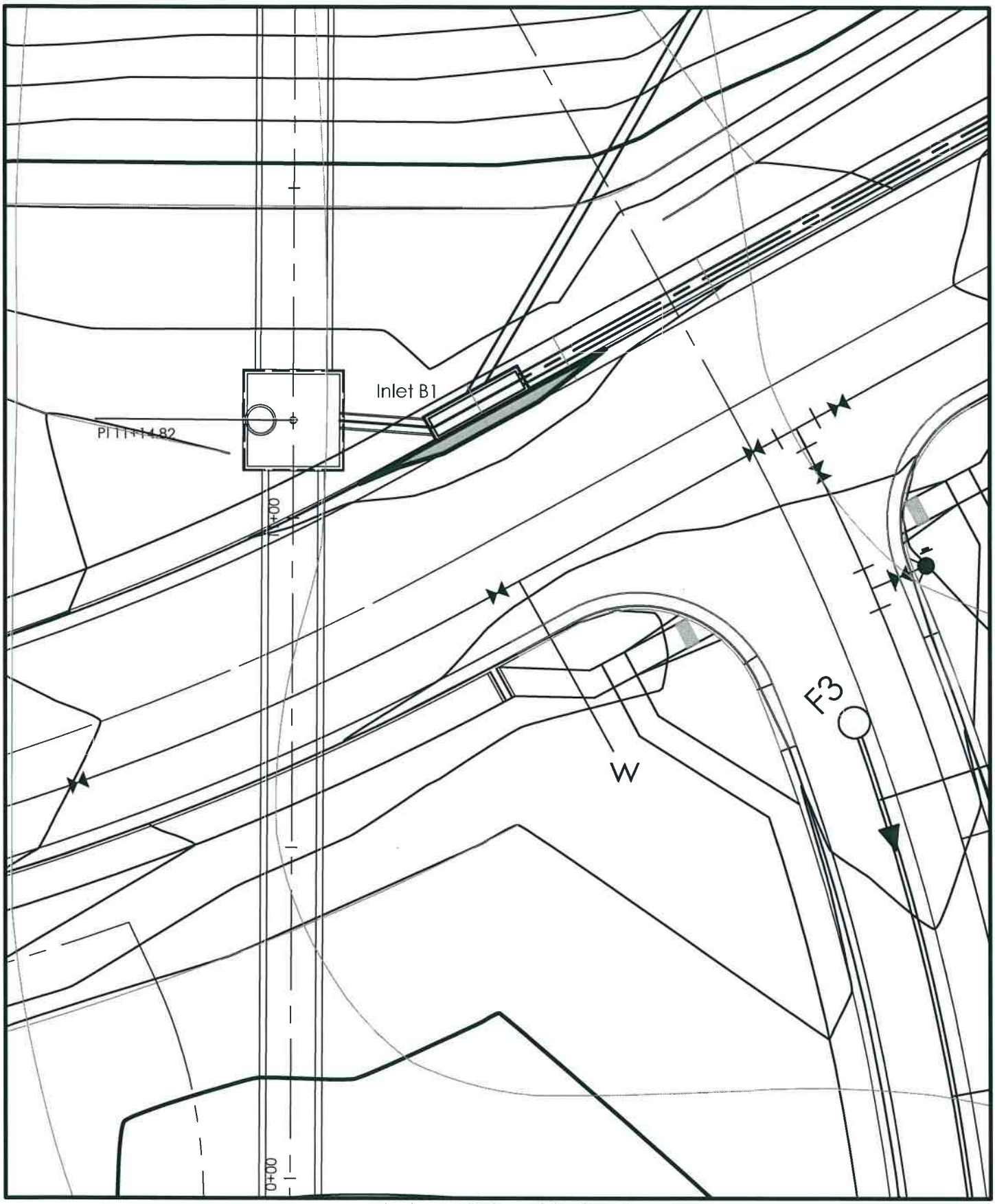
Storm Drain Inlet and Pipe System

Inlet Summary - 5-year - Hannah Ridge at Feathergrass

SN	Element ID	Description	Inlet Location	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Max (Rim) Offset (ft)	Roadway Long. Slope (ft/ft)	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Interc. by Inlet (cfs)	Peak Flow Bypass. Inlet (cfs)	Inlet Effic. during Peak (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)
1	SDINLET A1	10' Type R	On Sag	6487.22	6496.07	8.85	N/A	9.23	9.23	N/A	N/A	N/A	21.57	6496.51	0.43
2	SDINLET A2	5' Type R	On Sag	6484.80	6496.07	11.27	N/A	0.72	0.72	N/A	N/A	N/A	2.23	6496.12	0.04
3	SDINLET B1	15' Type R	On Sag	6461.42	6467.30	5.88	N/A	9.16	0.84	N/A	N/A	N/A	16.49	6467.62	0.32
4	SDINLET B2	15' Type R	On Grade	6465.75	6470.75	5.00	0.040	18.30	18.30	9.9	8.4	53.9	15.88	6471.19	0.44
5	SDINLET C1	5' Type R	On Sag	6464.97	6469.97	5.00	N/A	3.69	3.69	N/A	N/A	N/A	15.33	6470.27	0.31
6	SDINLET C3	10' Type R	On Sag	6464.42	6469.42	5.00	N/A	6.60	6.60	N/A	N/A	N/A	16.79	6469.76	0.34
7	SDINLET C4	15' Type R	On Sag	6464.42	6469.42	5.00	N/A	12.18	12.18	N/A	N/A	N/A	20.90	6469.84	0.42
8	SDINLET C6	10' Type R	On Sag	6468.92	6473.92	5.00	N/A	5.51	5.51	N/A	N/A	N/A	14.73	6474.22	0.29
9	SDINLET C7	15' Type R	On Sag	6468.92	6473.92	5.00	N/A	8.90	8.90	N/A	N/A	N/A	16.09	6474.24	0.32
10	SDINLET C8	10' Type R	On Sag	6474.99	6479.99	5.00	N/A	10.22	8.62	N/A	N/A	N/A	23.44	6480.45	0.46
11	SDINLET C9	10' Type R	On Grade	6477.00	6481.75	4.75	0.015	6.62	6.62	4.9	1.7	74.1	12.76	6482.13	0.38
12	SDINLET D2	15' Type R	On Sag	6445.29	6450.29	5.00	N/A	12.43	3.86	N/A	N/A	N/A	21.24	6450.65	0.37
13	SDINLET D3	10' Type R	On Sag	6444.93	6449.93	5.00	N/A	9.78	9.78	N/A	N/A	N/A	22.62	6450.38	0.45
14	SDINLET D5	15' Type R	On Grade	6447.45	6451.95	4.50	0.015	19.34	19.34	12.0	7.4	61.8	19.77	6452.47	0.52
15	SDINLET D6	15' Type R	On Grade	6448.81	6453.80	5.00	0.015	9.02	9.02	7.7	1.3	85.5	14.53	6454.22	0.42
16	SDINLET E3	5' Type R	On Sag	6452.87	6457.86	5.00	N/A	1.80	1.80	N/A	N/A	N/A	7.06	6458.00	0.14
17	SDINLET E4	15' Type R	On Sag	6452.87	6457.86	5.00	N/A	12.46	9.33	N/A	N/A	N/A	21.28	6458.27	0.41
18	SDINLET E5	15' Type R	On Grade	6460.43	6465.43	5.00	0.028	11.94	11.94	8.4	3.6	70.1	14.35	6465.84	0.41
19	SDINLET E6	5' Type R	On Sag	6454.61	6459.45	4.83	N/A	5.18	5.18	N/A	N/A	N/A	20.59	6459.86	0.41
20	SDINLET F3	10' Type R	On Sag	6461.95	6466.95	5.00	N/A	5.13	5.13	N/A	N/A	N/A	13.52	6467.22	0.27
21	SDINLET F4	15' Type R	On Sag	6461.95	6466.95	5.00	N/A	13.45	13.45	N/A	N/A	N/A	22.63	6467.40	0.45

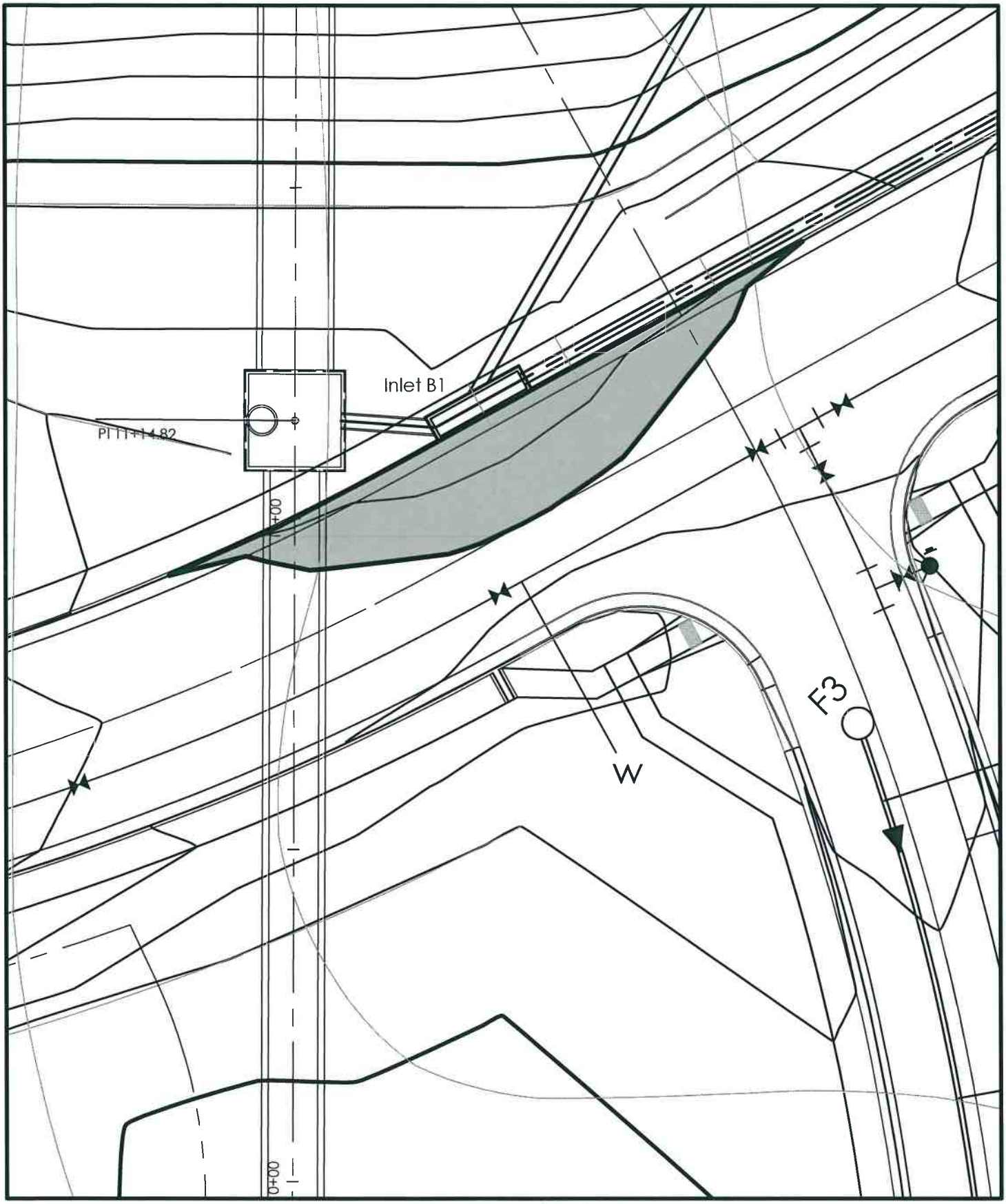
Inlet Summary - 100-year - Hannah Ridge at Feathergrass

SN	Element ID	Description	Inlet Location	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Max (Rim) Offset (ft)	Roadway Long. Slope (ft/ft)	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Interc. by Inlet (cfs)	Peak Flow Bypass Inlet (cfs)	Inlet Effic. during Peak (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)
1	SDINLET A1	10' Type R	On Sag	6487.22	6496.07	8.85	N/A	18.5	18.5	N/A	N/A	N/A	37.5	6496.82	0.75
2	SDINLET A2	5' Type R	On Sag	6484.80	6496.07	11.27	N/A	1.4	1.4	N/A	N/A	N/A	4.3	6496.16	0.09
3	SDINLET B1	15' Type R	On Sag	6461.42	6467.30	5.88	N/A	24.8	2.7	N/A	N/A	N/A	36.7	6468.02	0.71
4	SDINLET B2	15' Type R	On Grade	6465.75	6470.75	5.00	0.040	39.0	39.0	14.1	24.9	36.3	21.5	6471.31	0.56
5	SDINLET C1	5' Type R	On Sag	6464.97	6469.97	5.00	N/A	7.4	7.4	N/A	N/A	N/A	26.6	6470.50	0.53
6	SDINLET C3	10' Type R	On Sag	6464.42	6469.42	5.00	N/A	14.2	14.2	N/A	N/A	N/A	30.7	6470.04	0.61
7	SDINLET C4	15' Type R	On Sag	6464.42	6469.42	5.00	N/A	24.2	24.2	N/A	N/A	N/A	36.0	6470.14	0.72
8	SDINLET C6	10' Type R	On Sag	6468.92	6473.92	5.00	N/A	11.1	11.1	N/A	N/A	N/A	25.2	6474.42	0.50
9	SDINLET C7	15' Type R	On Sag	6468.92	6473.92	5.00	N/A	17.9	17.9	N/A	N/A	N/A	28.7	6474.50	0.57
10	SDINLET C8	10' Type R	On Sag	6474.99	6479.99	5.00	N/A	24.0	17.6	N/A	N/A	N/A	46.0	6480.88	0.89
11	SDINLET C9	10' Type R	On Grade	6477.00	6481.75	4.75	0.015	13.6	13.6	7.2	6.4	52.8	17.2	6482.22	0.47
12	SDINLET D2	15' Type R	On Sag	6445.29	6450.29	5.00	N/A	28.3	4.3	N/A	N/A	N/A	40.5	6451.03	0.75
13	SDINLET D3	10' Type R	On Sag	6444.93	6449.93	5.00	N/A	18.2	18.2	N/A	N/A	N/A	36.9	6450.67	0.74
14	SDINLET D5	15' Type R	On Grade	6447.45	6451.95	4.50	0.015	38.1	38.1	16.8	21.2	44.2	25.8	6452.59	0.64
15	SDINLET D6	15' Type R	On Grade	6448.81	6453.80	5.00	0.015	18.5	18.5	11.7	6.8	63.1	19.4	6454.32	0.51
16	SDINLET E3	5' Type R	On Sag	6452.87	6457.86	5.00	N/A	3.6	3.6	N/A	N/A	N/A	15.1	6458.16	0.30
17	SDINLET E4	15' Type R	On Sag	6452.87	6457.86	5.00	N/A	28.7	18.0	N/A	N/A	N/A	41.0	6458.65	0.79
18	SDINLET E5	15' Type R	On Grade	6460.43	6465.43	5.00	0.028	23.7	23.7	11.9	11.8	50.3	19.0	6465.93	0.51
19	SDINLET E6	5' Type R	On Sag	6454.61	6459.45	4.83	N/A	9.8	9.8	N/A	N/A	N/A	32.5	6460.10	0.65
20	SDINLET F3	10' Type R	On Sag	6461.95	6466.95	5.00	N/A	6.1	6.1	N/A	N/A	N/A	15.8	6467.27	0.32
21	SDINLET F4	15' Type R	On Sag	6461.95	6466.95	5.00	N/A	33.3	33.3	N/A	N/A	N/A	46.2	6467.88	0.92



HRFG Fil 3
Inlet B1
5 Yr

MVE, INC.
ENGINEERS SURVEYORS
1903 lelaray street
colorado springs
719.635.5736
suite 200
co 80909
www.mvecivil.com



HRFG Fil 3
Inlet B1
100 yr

MVE, INC.
ENGINEERS SURVEYORS
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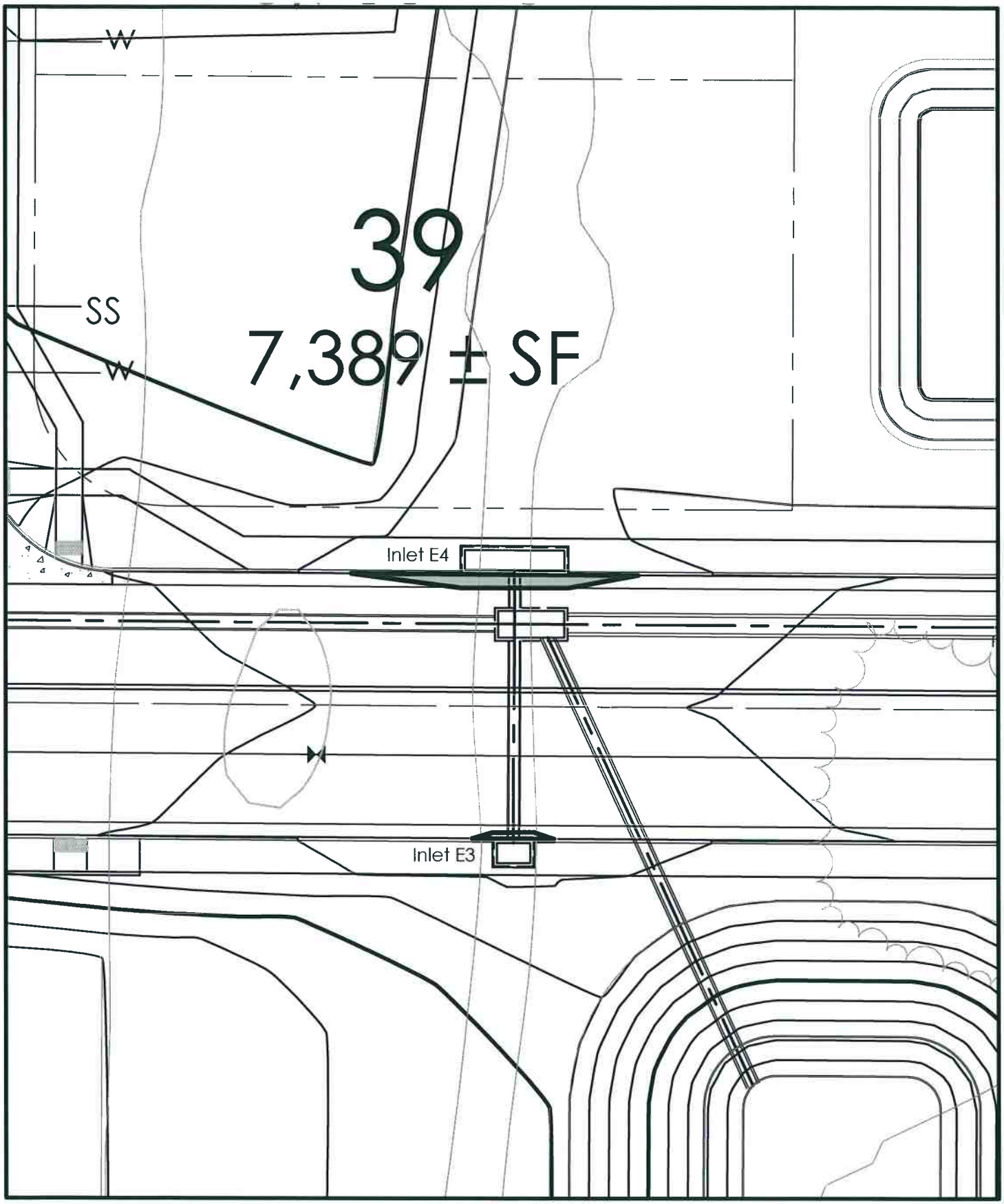

HRFG Fil 3
Inlet E3 & E4
5 Yr

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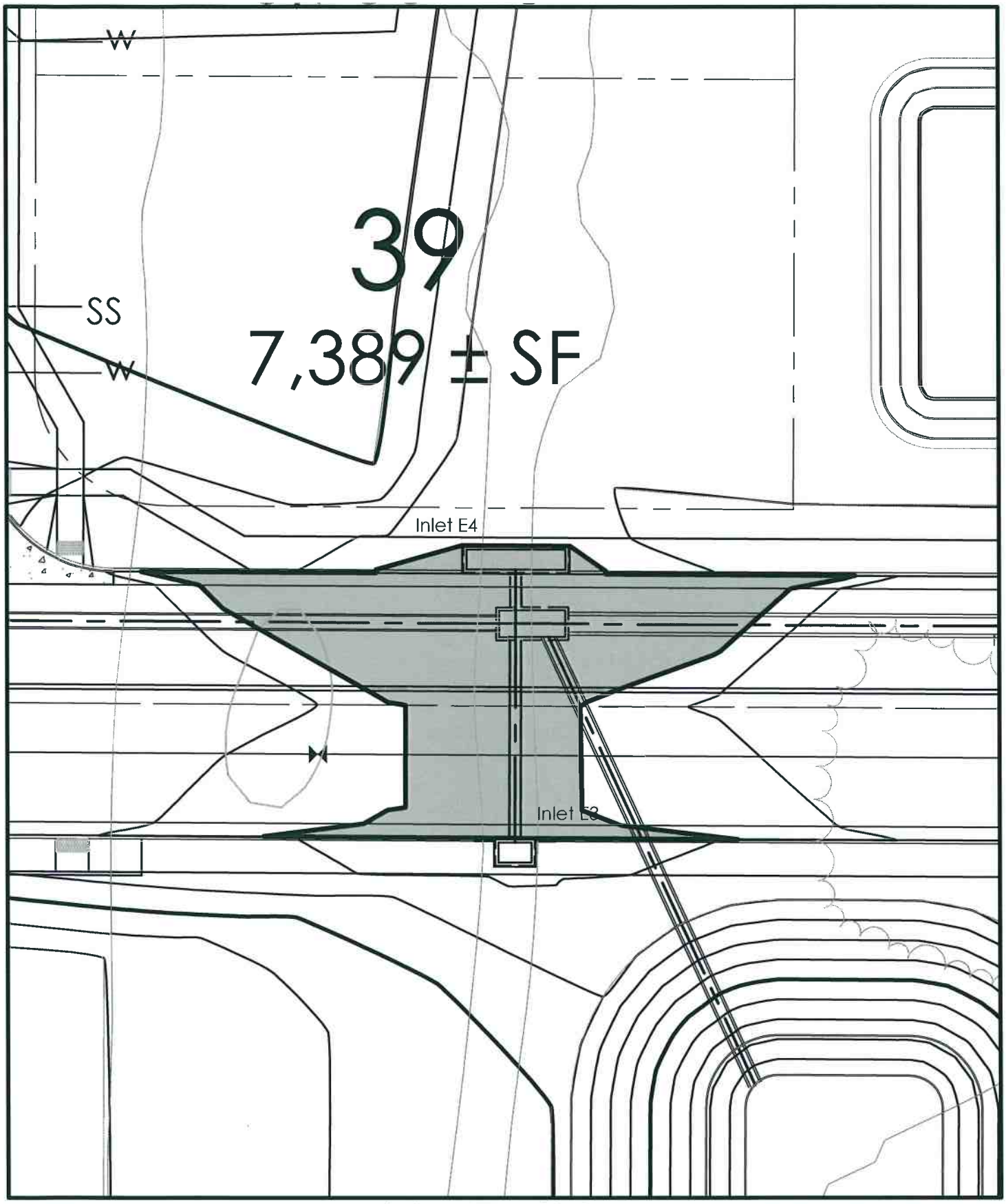

HRFG Fil 3
Inlet E3 & E4
100 Yr

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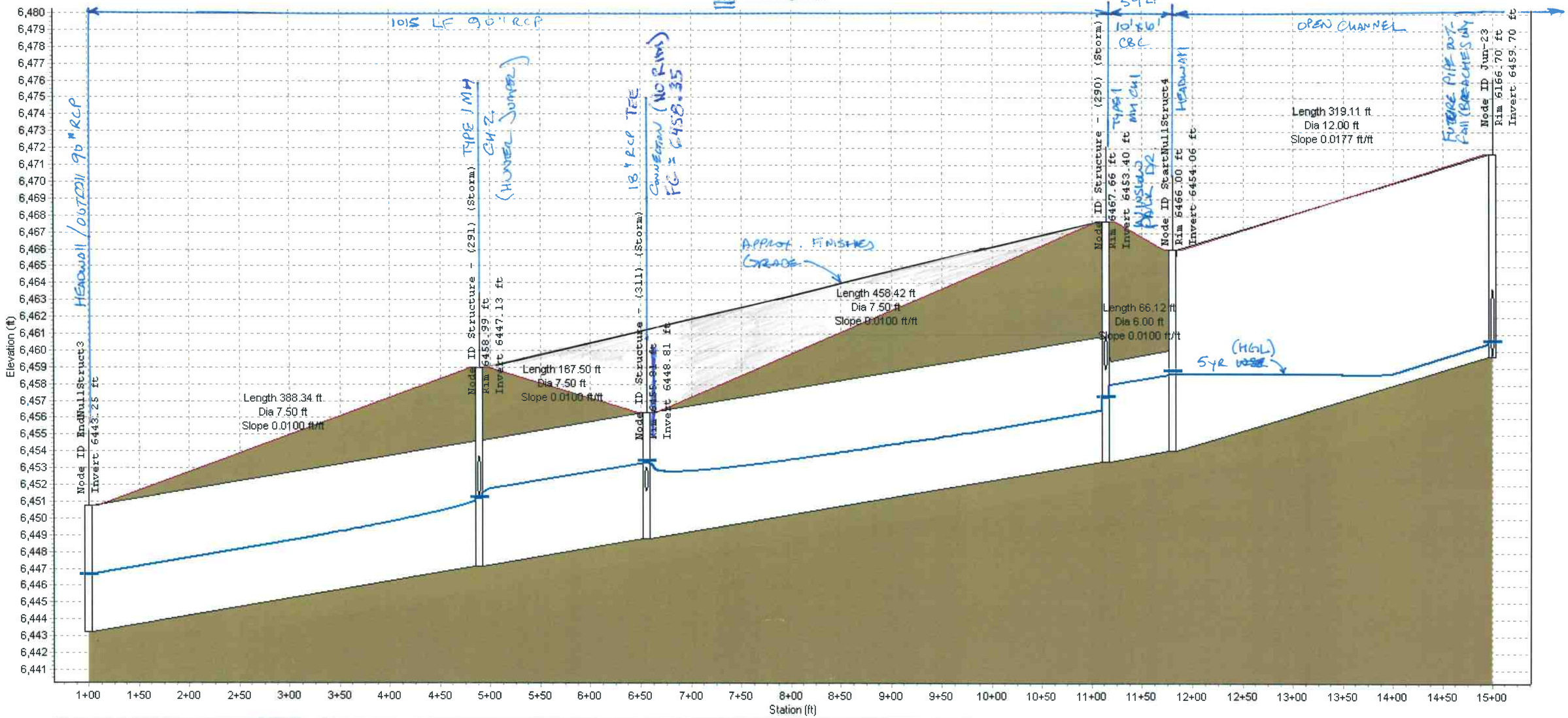
MAIN CHANNEL

HYDRAULIC ANALYSIS OF 90" & 10'x6' CBC

5YR - 2 HOUR STORM



Node ID:		Structure - (291) (Storm)	Structure - (311) (Storm)	Structure - (290) (Storm)	StartNullStruct4	Jun-23
Rim (ft):		6458.99	6455.81	6467.66	6466.00	6166.70
Invert (ft):	6443.25	6447.13	6448.81	6453.40	6454.06	6459.70
Min Pipe Cover (ft):		4.35	0.00		0.00	0.00
Max HGL (ft):	6446.65	6451.22	6453.44	6457.31	6458.80	6460.61

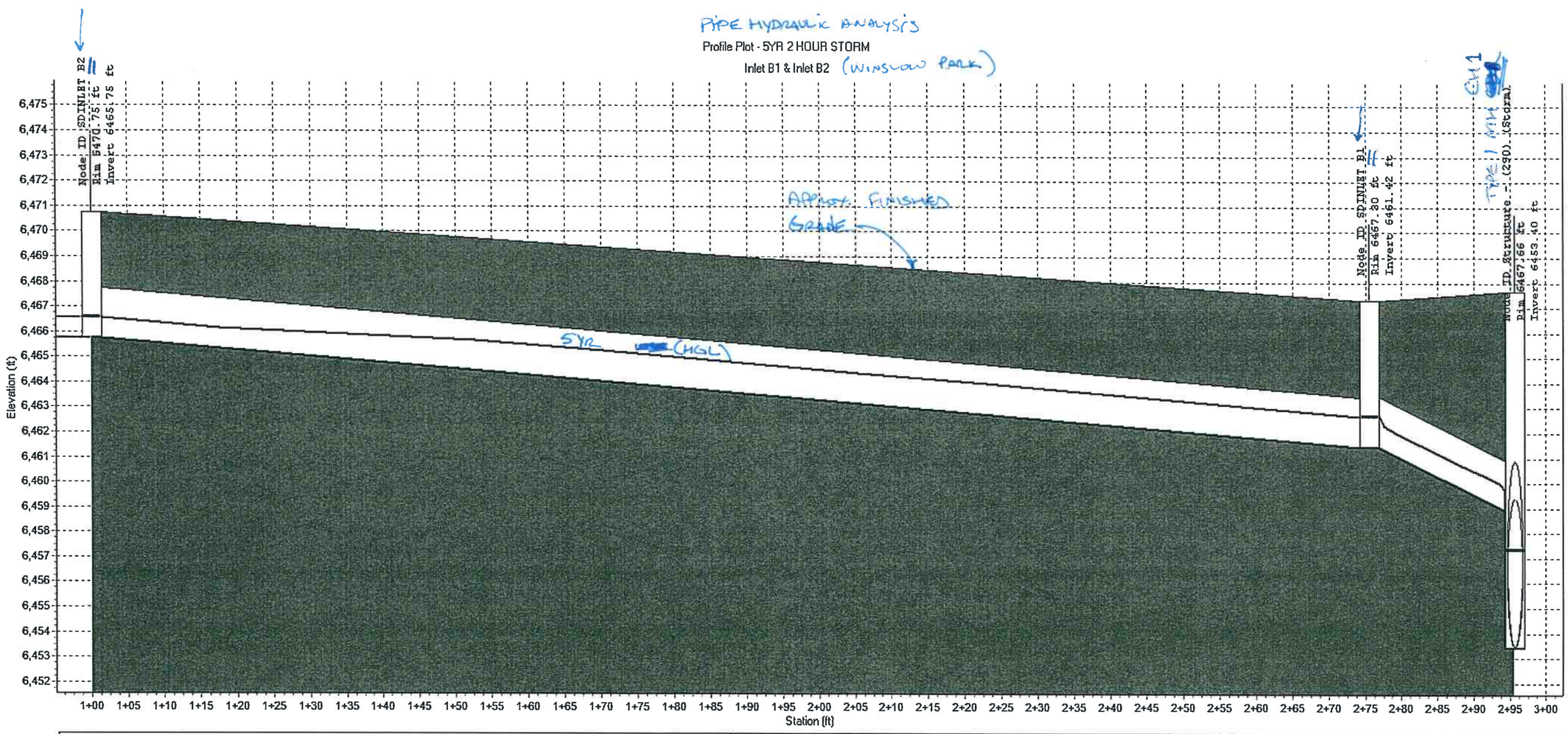
Link ID:	Link-60	{Storm}.Pipe - (248) (2) (Storm)	{Storm}.Pipe - (248) (Storm)	{Storm}.Pipe - (249) (Storm)	Link-69
Length (ft):	388.34	167.50	458.42	66.12	319.11
Dia (ft):	7.50	7.50	7.50	6.00	12.00
Slope (ft/ft):	0.0100	0.0100	0.0100	0.0100	0.0177
Up Invert (ft):	6447.13	6448.81	6453.40	6454.06	6459.70
Dn Invert (ft):	6443.25	6447.14	6448.81	6453.40	6454.06
Max Q (cfs):	280.61	273.23	272.27	270.47	274.80
Max Vel (ft/s):	12.71	10.36	10.51	6.26	3.49
Max Depth (ft):	3.75	4.36	4.27	4.32	2.82

DNSTREAM INV.

PIPE HYDRAULIC ANALYSIS

Profile Plot - 5YR 2 HOUR STORM

Inlet B1 & Inlet B2 (WINSLOW PARK)



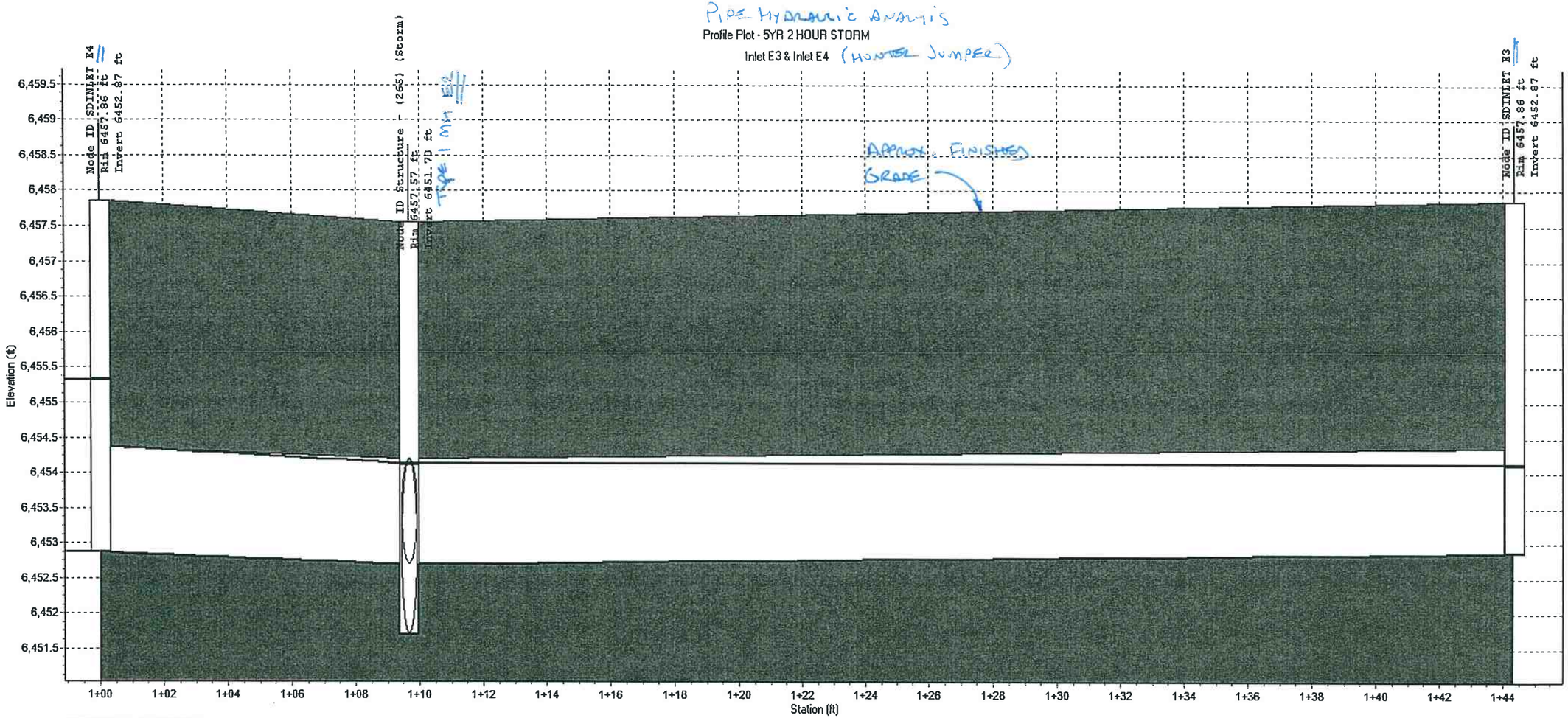
Node ID:	SDINLET B2		SDINLET B1	
Rim (ft):	6470.75		6467.30	6467.66
Invert (ft):	6465.75		6461.42	6453.40
Min Pipe Cover (ft):				
Max HGL (ft):	6466.55		6462.64	6457.31

Link ID:	Link-51	Link-06
Length (ft):	175.54	19.91
Dia (in):	24.00	24.00
Slope (ft/ft):	0.0247	0.1267
Up Invert (ft):	6465.75	6461.42
Dn Invert (ft):	6461.42	6458.90
Max Q (cfs):	9.86	18.45
Max Vel (ft/s):	7.25	12.38
Max Depth (ft):	1.00	0.96

PIPE HYDRAULIC ANALYSIS

Profile Plot - 5YR 2 HOUR STORM

Inlet E3 & Inlet E4 (HOOTER JUMPER)



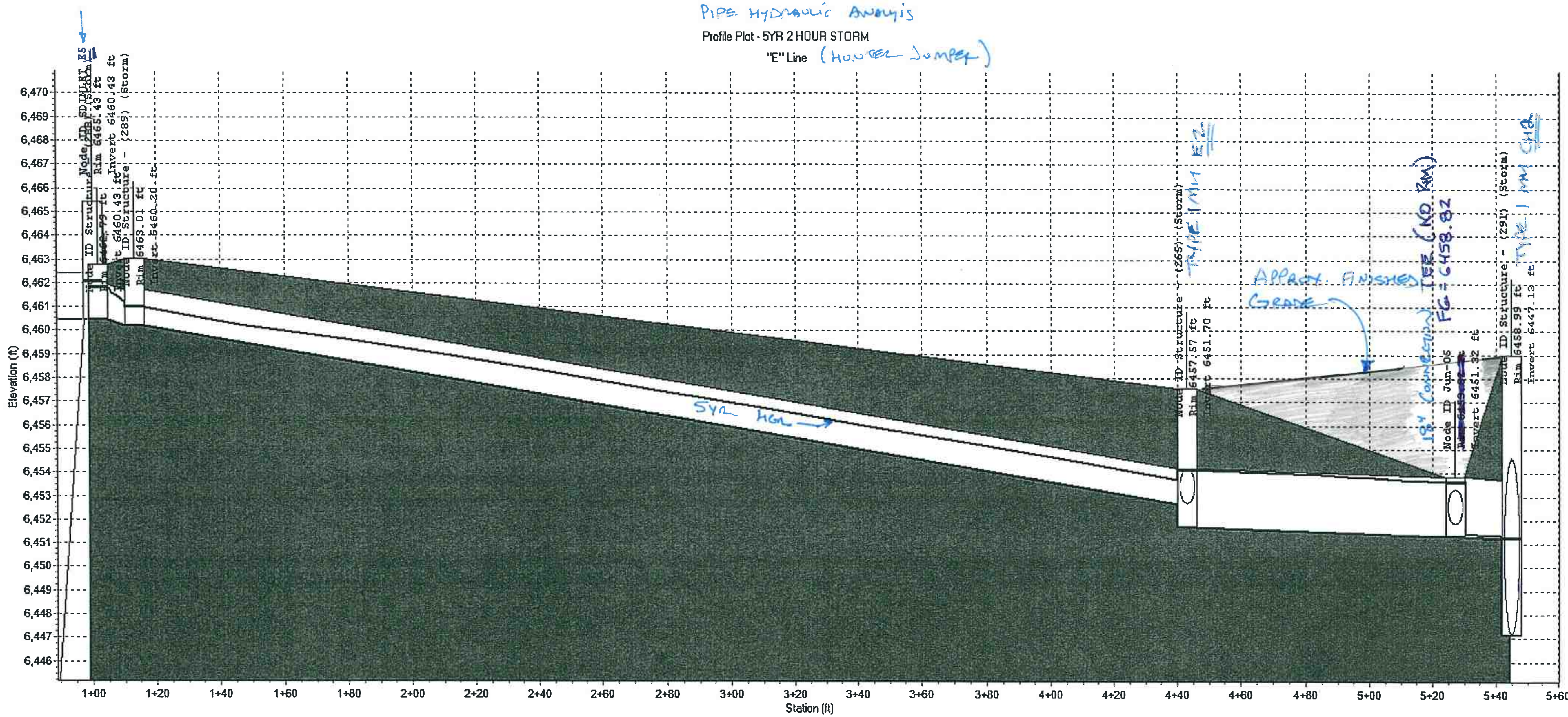
Node ID:	SDINLET E4	Structure - (265) (Storm)	SDINLET E3
Rim (ft):	6457.86	6457.57	6457.86
Invert (ft):	6452.87	6451.70	6452.87
Min Pipe Cover (ft):		3.37	
Max HGL (ft):	6455.32	6454.12	6454.13

Link ID:	{Storm}.Pipe - (197) (Storm)	{Storm}.Pipe - (198) (Storm)
Length (ft):	9.66	34.67
Dia (in):	18.00	18.00
Slope (ft/ft):	0.0176	0.0049
Up Invert (ft):	6452.87	6452.87
Dn Invert (ft):	6452.70	6452.70
Max Q (cfs):	12.89	1.72
Max Vel (ft/s):	7.35	2.63
Max Depth (ft):	1.46	1.34

Pipe Hydraulic Analysis

Profile Plot - 5YR 2 HOUR STORM

"E" Line (Hunter Jumper)



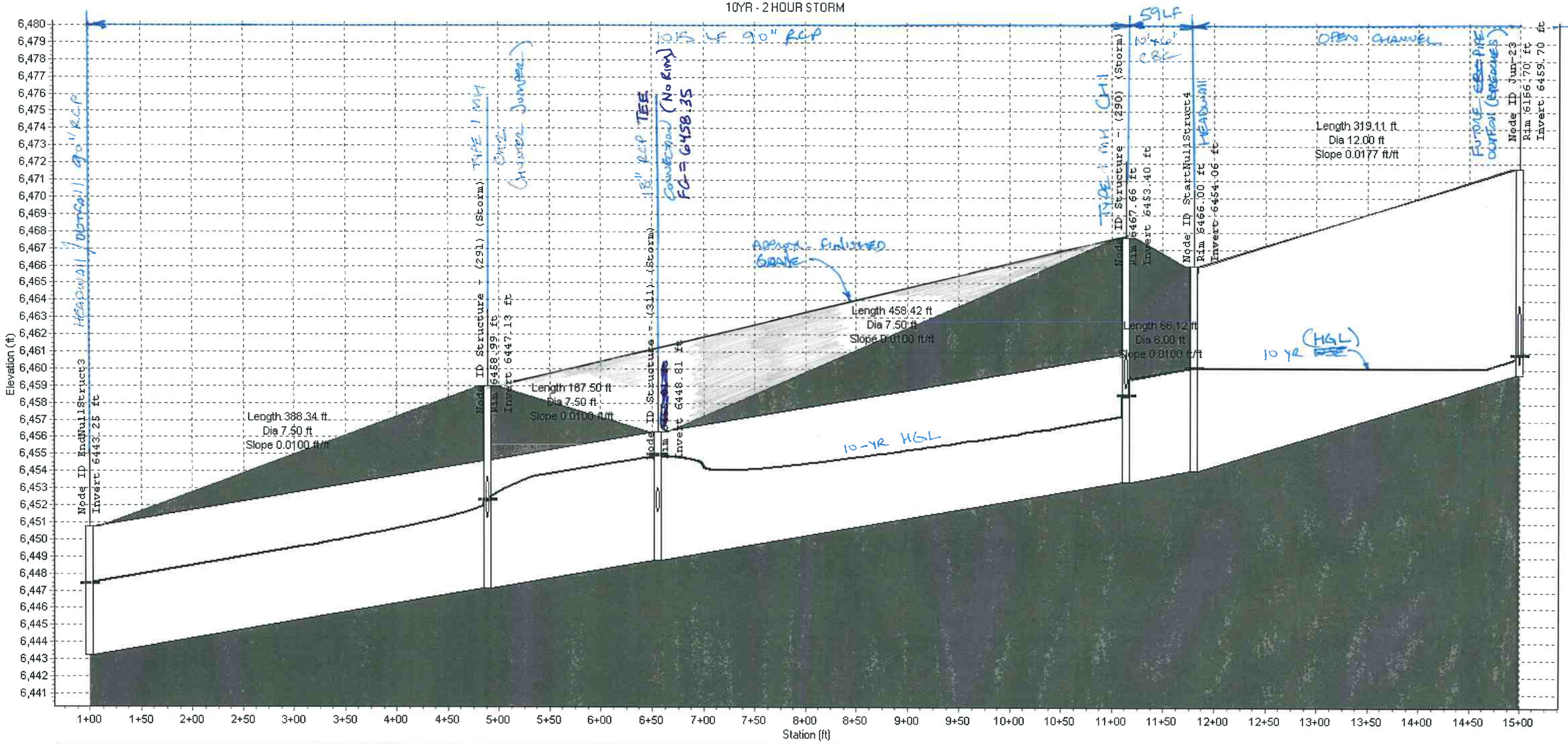
Node ID:	SDINbuctur5- (289) (Storm)	Structure - (265) (Storm)	Jun-05	
Rim (ft):	6465242S6463.01	6457.57	6453.82	6458.99
Invert (ft):	6460.043S460.20	6451.70	6451.32	6447.13
Min Pipe Cover (ft):	0 36 1.31	3.37	0.00	4.35
Max HGL (ft):	6460.080S460.97	6454.12	6453.61	6451.22

Link ID:		{Storm}.Pipe - (110) (Storm)	{Storm}.Pipe - (201) (2) (Storm)	Link-14
Length (ft):	1.511.54	329.65	84.29	17.74
Dia (in):	24.008.00	18.00	30.00	30.00
Slope (ft/ft):	0.0000200	0.0228	0.0045	0.0056
Up Invert (ft):	64606480.43	6460.20	6451.70	6451.32
Dn Invert (ft):	64606480.20	6452.70	6451.32	6451.22
Max Q (cfs):	8.368.35	8.29	20.64	22.94
Max Vel (ft/s):	3.346.20	7.83	4.31	5.59
Max Depth (ft):	1.491.07	1.10	2.36	1.95

MAIN CHANNEL

HYDRAULIC ANALYSIS OF 90" & 10'x6' CBC

10YR - 2 HOUR STORM



Node ID:		Structure - (291) (Storm)	Structure - (311) (Storm)	Structure - (290) (Storm)	StartNullStruct4	Jun-23
Rim (ft):		6458.99	6455.81	6467.66	6466.00	6166.70
Invert (ft):	6443.25	6447.13	6448.81	6453.40	6454.06	6459.70
Min Pipe Cover (ft):			0.00		0.00	0.00
Max HGL (ft):	6447.41	6452.30	6454.95	6458.44	6460.08	6460.81

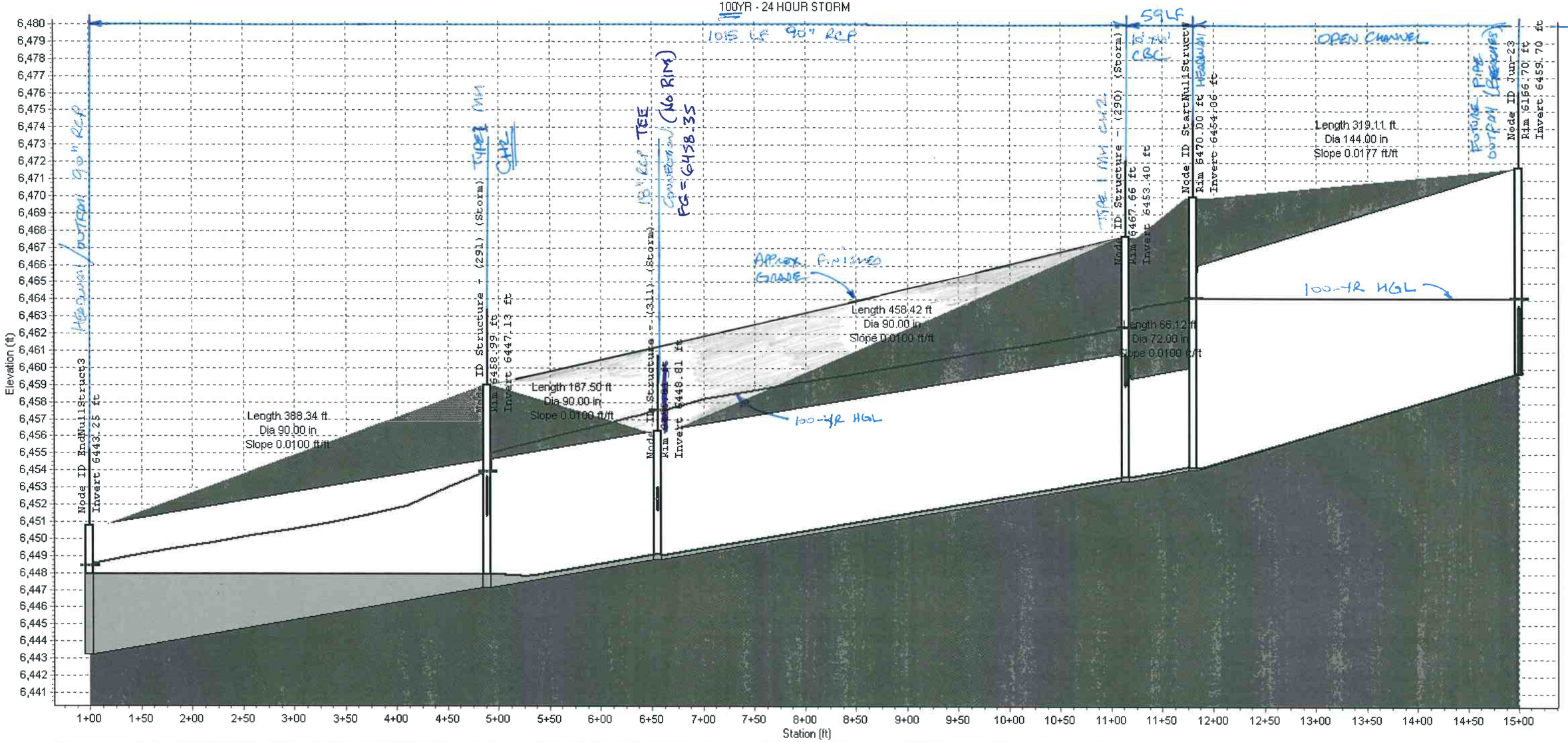
Link ID:	Link-60	{Storm}.Pipe - (248) (2) (Storm)	{Storm}.Pipe - (248) (Storm)	{Storm}.Pipe - (249) (Storm)	Link-69
Length (ft):	388.34	167.50	458.42	66.12	319.11
Dia (ft):	7.50	7.50	7.50	6.00	12.00
Slope (ft/ft):	0.0100	0.0100	0.0100	0.0100	0.0177
Up Invert (ft):	6447.13	6448.81	6453.40	6454.06	6459.70
Dn Invert (ft):	6443.25	6447.14	6448.81	6453.40	6454.06
Max Q (cfs):	394.72	386.80	385.96	383.67	388.10
Max Vel (ft/s):	13.66	10.90	10.95	6.96	3.83
Max Depth (ft):	4.67	5.65	5.59	5.52	3.56

DOWNSTREAM INV.

MAIN CHANNEL

HYDRAULIC ANALYSIS OF 90" & 10'x6' CBC

100YR - 24 HOUR STORM



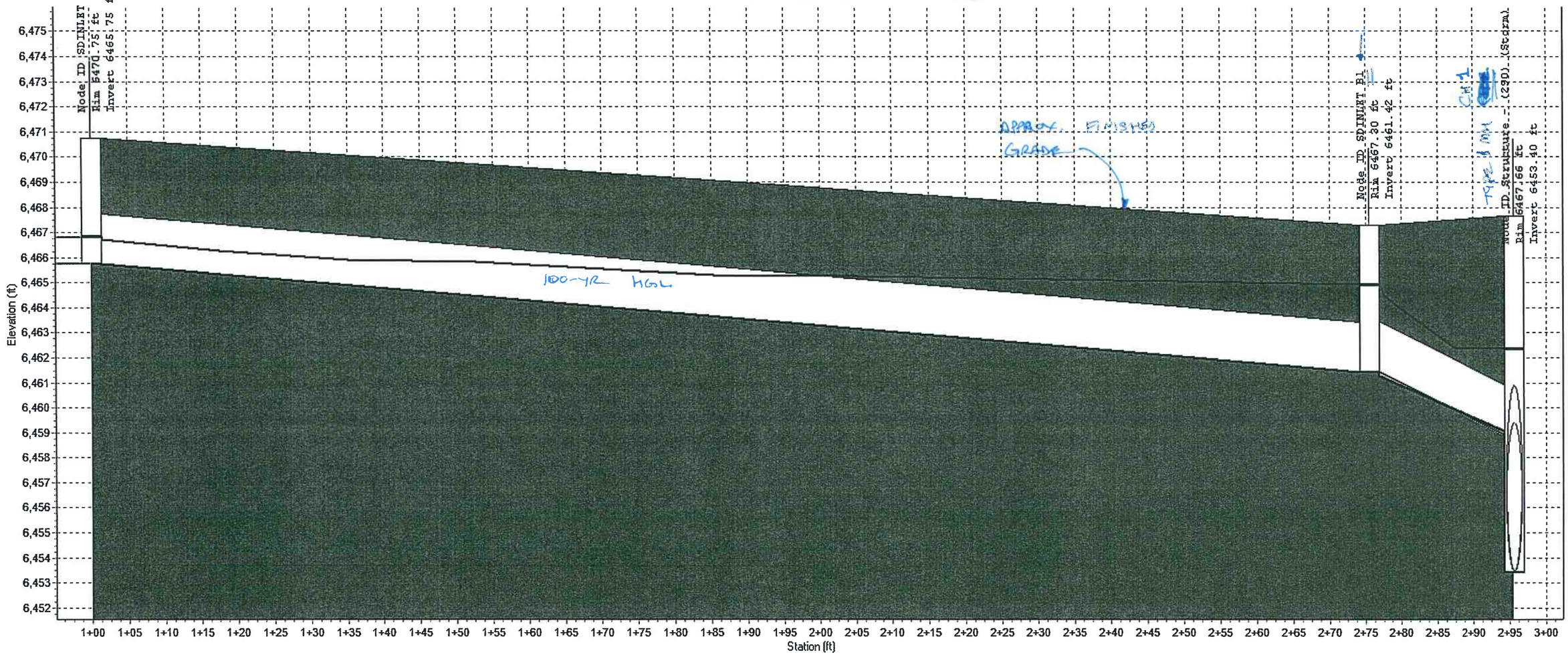
Node ID:		Structure - (291) (Storm)	Structure - (311) (Storm)	Structure - (290) (Storm)	StartNullStruct4	Jun-23
Rim (ft):		6458.99	6455.81	6467.66	6470.00	6166.70
Invert (ft):	6443.25	6447.13	6448.81	6453.40	6454.06	6459.70
Min Pipe Cover (ft):		4.35	0.00	6.77	3.94	0.00
Max HGL (ft):	6448.39	6453.89	6457.52	6462.35	6464.10	6464.08

Link ID:	Link-60	{Storm}.Pipe - (248) (2) (Storm)	{Storm}.Pipe - (248) (Storm)	{Storm}.Pipe - (249) (Storm)	Link-69
Length (ft):	388.34	167.50	458.42	66.12	319.11
Dia (in):	90.00	90.00	90.00	72.00	144.00
Slope (ft/ft):	0.0100	0.0100	0.0100	0.0100	0.0177
Up Invert (ft):	6447.13	6448.81	6453.40	6454.06	6459.70
Dn Invert (ft):	6443.25	6447.14	6448.81	6453.40	6454.06
Max Q (cfs):	541.22	541.16	540.56	540.54	603.10
Max Vel (ft/s):	14.41	12.49	12.24	9.01	2.41
Max Depth (ft):	5.95	7.13	7.50	6.00	7.19

PIPE HYDRAULIC ANALYSIS

Profile Plot - 100YR 24 HOUR STORM

Inlet B1 & Inlet B2 (WINSLOW PARK)

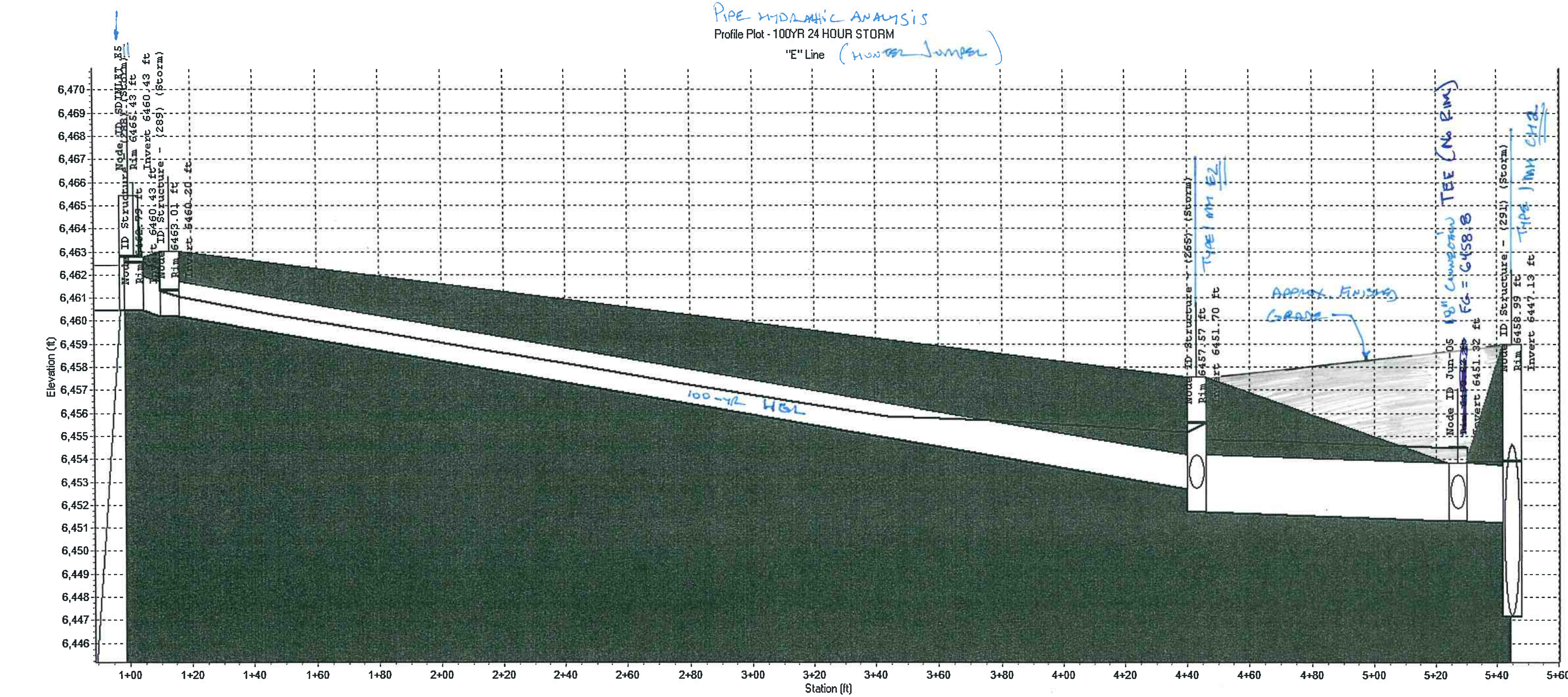


Node ID:	SDINLET B2		SDINLET B1	
Rim (ft):	6470.75		6467.30	6467.66
Invert (ft):	6465.75		6461.42	6453.40
Min Pipe Cover (ft):				6.77
Max HGL (ft):	6466.79		6464.91	6462.35
Link ID:	Link-51		Link-06	
Length (ft):	175.54		19.91	
Dia (in):	24.00		24.00	
Slope (ft/ft):	0.0247		0.1267	
Up Invert (ft):	6465.75		6461.42	
Dn Invert (ft):	6461.42		6458.90	
Max Q (cfs):	14.04		39.37	
Max Vel (ft/s):	7.10		15.04	
[illegible]	1.52		1.53	

Pipe hydraulic analysis

Profile Plot - 100YR 24 HOUR STORM

"E" Line (Hunter Jumper)



Node ID:	SD Structure E5 - (289) (Storm)	Structure - (265) (Storm)	Jun-05	
Rim (ft):	6465.43 6463.01	6457.57	6453.82	6458.99
Invert (ft):	6460.43 6460.20	6451.70	6451.32	6447.13
Min Pipe Cover (ft):	0.36 1.31	3.37	0.00	4.35
Max HGL (ft):	6461.32	6455.58	6454.51	6453.89

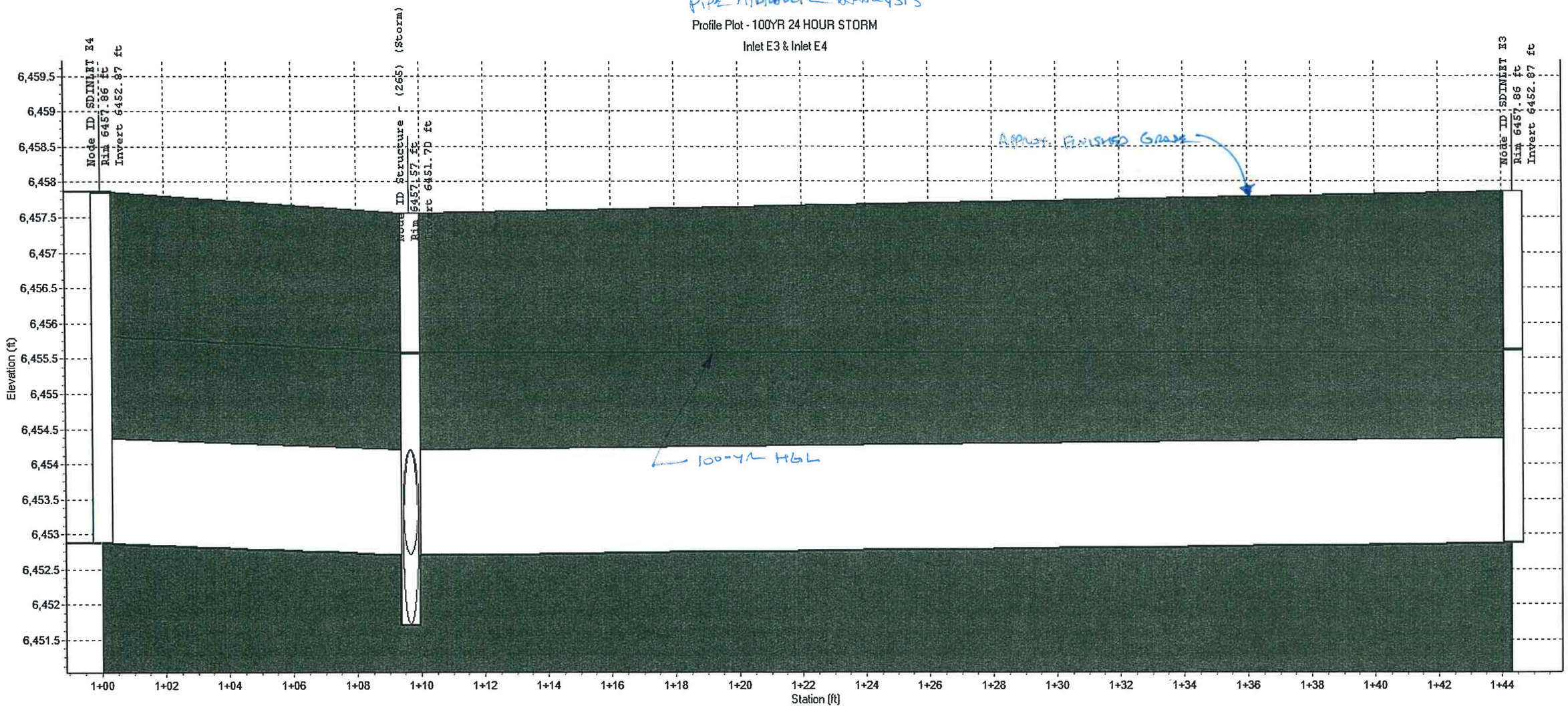
Link ID:		{Storm}.Pipe - (110) (Storm)	{Storm}.Pipe - (201) (2) (Storm)	Link-14
Length (ft):	1.5 11.54	329.65	84.29	17.74
Dia (in):	24.00 18.00	18.00	30.00	30.00
Slope (ft/ft):	0.0 0.0200	0.0228	0.0045	0.0056
Up Invert (ft):	6460 6460.43	6460.20	6451.70	6451.32
Dn Invert (ft):	6460 6460.20	6452.70	6451.32	6451.22
Max Q (cfs):	11.9 11.91	11.82	30.07	35.68
Max Vel (ft/s):	3.7 7.28	7.80	6.13	7.64
[illegible]		1.31	2.50	2.50

Autodesk Storm and Sanitary Analysis

PIPE HYDRAULIC ANALYSIS

Profile Plot - 100YR 24 HOUR STORM

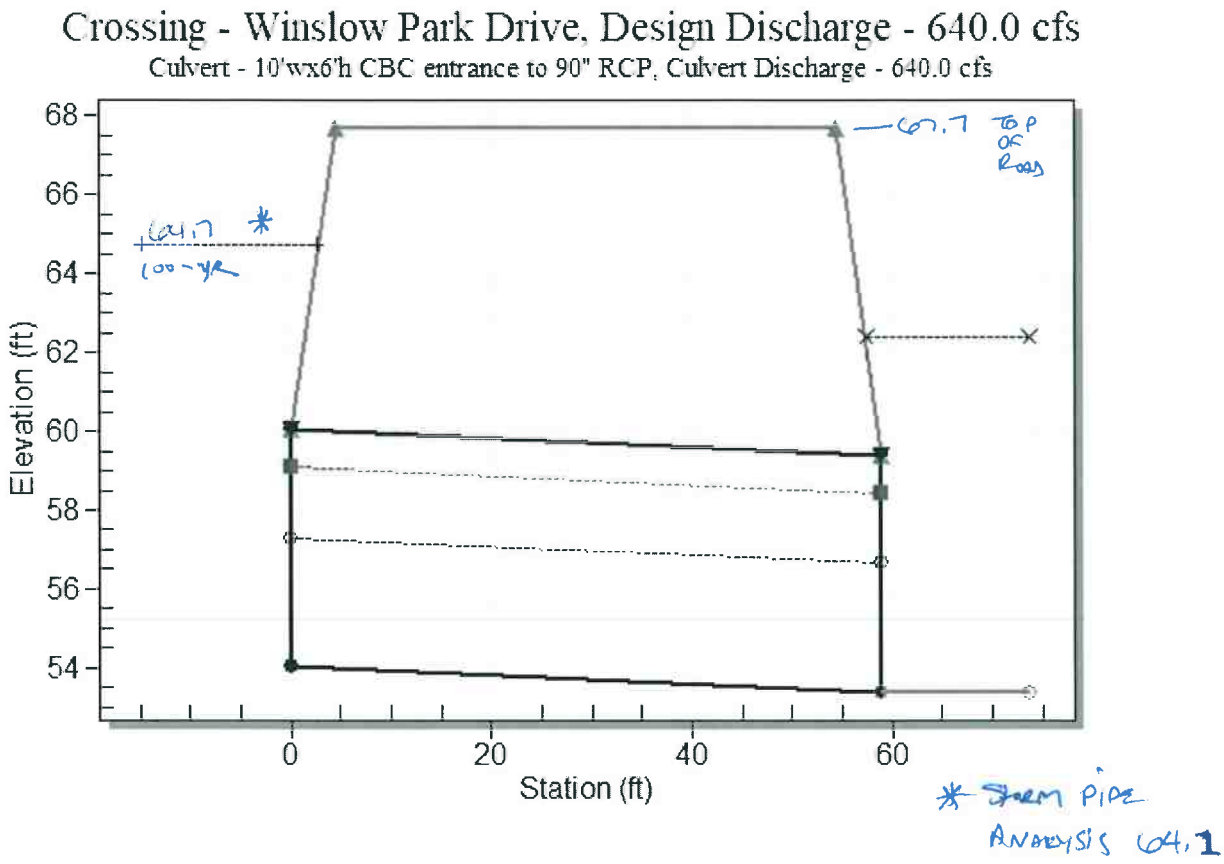
Inlet E3 & Inlet E4



Node ID:	SDINLET E4	Structure - (265) (Storm)	SDINLET E3
Rim (ft):	6457.86	6457.57	6457.86
Invert (ft):	6452.87	6451.70	6452.87
Min Pipe Cover (ft):		3.37	
Max HGL (ft):	6457.86	6455.58	6455.61

Link ID:	{Storm}.Pipe - (197) (Storm)	{Storm}.Pipe - (198) (Storm)
Length (ft):	9.66	34.67
Dia (in):	18.00	18.00
Slope (ft/ft):	0.0176	0.0049
Up Invert (ft):	6452.87	6452.87
Dn Invert (ft):	6452.70	6452.70
Max Q (cfs):	17.51	3.63
Max Vel (ft/s):	9.91	2.70
Max Depth (ft):	1.50	1.50

Water Surface Profile Plot for Culvert: 10'wx6'h CBC entrance to 90" RCP



Site Data - 10'wx6'h CBC entrance to 90" RCP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 54.06 ft

Outlet Station: 59.00 ft

Outlet Elevation: 53.40 ft

Number of Barrels: 1

Culvert Data Summary - 10'wx6'h CBC entrance to 90" RCP

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 6.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: 1:1 Bevel (45° flare) Wingwall

Inlet Depression: None

Table 1 - Summary of Culvert Flows at Crossing: Winslow Park Drive

Headwater Elevation (ft)	Total Discharge (cfs)	10'wx6'h CBC entrance to 90" RCP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
58.18	250.00	250.00	0.00	1
58.62	289.00	289.00	0.00	1
59.05	328.00	328.00	0.00	1
59.61	367.00	367.00	0.00	1
60.14	406.00	406.00	0.00	1
60.75	445.00	445.00	0.00	1
61.54	484.00	484.00	0.00	1
62.36	523.00	523.00	0.00	1
63.21	562.00	562.00	0.00	1
63.86	601.00	601.00	0.00	1
64.74	640.00	640.00	0.00	1
67.70	962.93	962.93	0.00	Overtopping

Stormwater Quality Sand Filter Basin Sizing Calculations
UDFCD Design Worksheets

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.06, November 2016) — Sheet 1 of 2

Designer: D. Gorman
Company: M.V.E., Inc.
Date: August 7, 2017
Project: Hannah Ridge at Feathergrass Filing No. 3
Location: Sand Filter "B" (for Basins OSB1-B7 and Basins OSC1-C12 - Combined)

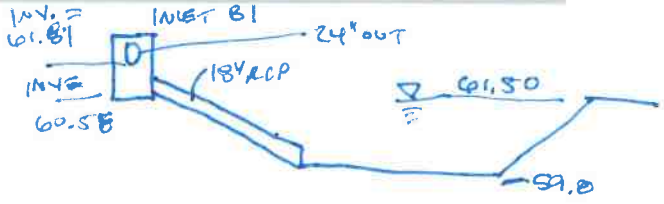
1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 46.3 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.463
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.16 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 1,488,420 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume $V_{WQCV} = WQCV / 12 * Area$	V_{WQCV} = 19,485 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 19,031 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = _____ cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 2.5 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 3.00 ft / ft **DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE**
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 8614 sq ft
D) Actual Filter Area	A_{Actual} = 8839 sq ft
E) Volume Provided	V_T = 25850 cu ft
3. Filter Material	Choose One: (●) 18" CDOT Class B or C Filter Material ( ) Other (Explain): _____
4. Underdrain System	
A) Are underdrains provided?	Choose One: (●) YES ( ) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 2.0 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 19,031 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 2 in

$Q_2 = 14.4$ cfs

$Q_{WQCV} = 1/2 Q_2 = 7.2$ cfs

PIPE SIZE INTO SAND FILTER @ INLET B1 = 18"

W/ RESTRICTOR PLATE 0.70' ABOVE INVERT



Design Procedure Form: Sand Filter (SF)

Designer: D. Gorman
Company: M.V.E., Inc.
Date: August 7, 2017
Project: Hannah Ridge at Feathergrass Filing No. 3
Location: Sand Filter "B" (for Basins OSB1-B7 and Basins OSC1-C12 - Combined)

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ◉ NO
6-7. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	FES and Rip Rap Pad at pipe outlet locations

Notes:

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm (CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	CUHP 100-Year Event		

Max Intensity for Optional User Defined Storm: 0

Designer:	D. Gorman
Company:	M.V.E., Inc.
Date:	August 7, 2017
Project:	Hannah Ridge at Feathergrass
Location:	Sand Filter "B" (for Basins OSB1-B8 and Basins OSC1-C12 - Combined)

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	OSB1-B8	OSC1-C45
Receiving Pervious Area Soil Type	Loamy Sand	Loamy Sand
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	8.910	25.260
Directly Connected Impervious Area (DCIA, acres)	3.480	7.030
Unconnected Impervious Area (UIA, acres)	2.110	6.850
Receiving Pervious Area (RPA, acres)	2.330	7.340
Separate Pervious Area (SPA, acres)	0.990	4.040
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	8.910	25.260
Directly Connected Impervious Area (DCIA, %)	39.1%	27.8%
Unconnected Impervious Area (UIA, %)	23.7%	27.1%
Receiving Pervious Area (RPA, %)	26.2%	29.1%
Separate Pervious Area (SPA, %)	11.1%	16.0%
A_R (RPA / UIA)	1.104	1.072
I_a Check	0.480	0.480
f / I for WQCV Event:	3.2	3.2
f / I for 10-Year Event:	0.5	0.5
f / I for 100-Year Event:	0.4	0.4
f / I for Optional User Defined Storm CUHP:		
IRF for WQCV Event:	0.59	0.59
IRF for 10-Year Event:	0.89	0.89
IRF for 100-Year Event:	0.91	0.91
IRF for Optional User Defined Storm CUHP:		
Total Site Imperviousness: I_{total}	62.7%	54.9%
Effective Imperviousness for WQCV Event:	53.1%	44.0%
Effective Imperviousness for 10-Year Event:	60.0%	51.9%
Effective Imperviousness for 100-Year Event:	60.6%	52.5%
Effective Imperviousness for Optional User Defined Storm CUHP:		

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	12.5%	13.6%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	4.4%	5.8%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	3.3%	4.4%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**57.0%**
Total Site Effective Imperviousness for WQCV Event:	**46.3%**
Total Site Effective Imperviousness for 10-Year Event:	**54.0%**
Total Site Effective Imperviousness for 100-Year Event:	**54.6%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

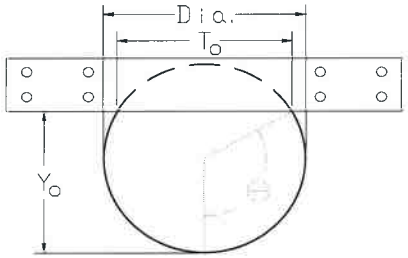
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICAL ORIFICES

Project: Hannah Ridge at Feathergrass

Basin ID: WQ inlet at Inlet B1 to Sand Filter B for Basins OSB1 to B7

X



		#1 Vertical Orifice	#2 Vertical Orifice	
Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)				
Water Surface Elevation at Design Depth	Elev: WS =	63.81		feet
Pipe/Vertical Orifice Entrance Invert Elevation	Elev: Invert =	60.56		feet
Required Peak Flow through Orifice at Design Depth	Q =	7.20		cfs
Pipe/Vertical Orifice Diameter (inches)	Dia =	18.0		inches
Orifice Coefficient	C_o =	0.65		
Full-flow Capacity (Calculated)				
Full-flow area	Af =	1.77		sq ft
Half Central Angle in Radians	Theta =	3.14		rad
Full-flow capacity	Qf =	14.6		cfs
	Percent of Design Flow =	202%		
Calculation of Orifice Flow Condition				
Half Central Angle (0<Theta<3.1416)	Theta =	1.51		rad
Flow area	A_o =	0.81		sq ft
Top width of Orifice (inches)	T_o =	17.96		inches
Height from Invert of Orifice to Bottom of Plate (feet)	Y_o =	0.70		feet
Elevation of Bottom of Plate	Elev Plate Bottom Edge =	61.26		feet
Resultant Peak Flow Through Orifice at Design Depth	Q_o =	7.2		cfs
Width of Equivalent Rectangular Vertical Orifice	**Equivalent Width =**	**1.16**		**feet**

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.06, November 2016)

Designer: D. Gorman
Company: M.V.E., Inc.
Date: August 7, 2017
Project: Hannah Ridge at Feathergrass Filing No. 3
Location: Sand Filter "E1" (for Basins B8 & E7)

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 44.7 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.447
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.15 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 186,546 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume $V_{WQCV} = WQCV / 12 * Area$	V_{WQCV} = 2,390 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 2,334 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = _____ cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 2.0 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 3.00 ft / ft **DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE**
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 1042 sq ft
D) Actual Filter Area	A_{Actual} = 1052 sq ft
E) Volume Provided	V_T = 3013 cu ft
3. Filter Material	Choose One: (◉) 18" CDOT Class B or C Filter Material ( ) Other (Explain): _____
4. Underdrain System	
A) Are underdrains provided?	Choose One: (◉) YES ( ) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 2.0 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 2,334 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 1 - 1 / 16 in

FLOW ENTEL OVERLAND
NO PIPE INLET
$Q_2 = 1.9 + 0.4 = 2.3$
$Q_{WQCV} = 1/2 Q_2 = 1.2$ cfs

Design Procedure Form: Sand Filter (SF)

Designer: D. Gorman
Company: M.V.E., Inc.
Date: August 7, 2017
Project: Hannah Ridge at Feathergrass Filing No. 3
Location: Sand Filter "E1" (for Basins B8 & E7)

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ◉ NO
6-7. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	FES and Rip Rap Pad at pipe outlet locations

Notes:

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches	Designer:	D. Gorman
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.50	inches	Company:	M.V.E., Inc.
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches	Date:	August 7, 2017
Optional User Defined Storm	CUHP			Project:	Hannah Ridge at Feathergrass Filing No. 3
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event			Location:	Sand Filter "E1" (for Basins B8 & E7)
Max Intensity for Optional User Defined Storm	0				

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**E7,B8**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	4.280													
Directly Connected Impervious Area (DCIA, acres)	0.960													
Unconnected Impervious Area (UIA, acres)	1.600													
Receiving Pervious Area (RPA, acres)	1.720													
Separate Pervious Area (SPA, acres)	0.000													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	4.280													
Directly Connected Impervious Area (DCIA, %)	22.4%													
Unconnected Impervious Area (UIA, %)	37.4%													
Receiving Pervious Area (RPA, %)	40.2%													
Separate Pervious Area (SPA, %)	0.0%													
A_R (RPA / UIA)	1.075													
I_a Check	0.480													
f / I for WQCV Event:	3.2													
f / I for 10-Year Event:	0.5													
f / I for 100-Year Event:	0.4													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.59													
IRF for 10-Year Event:	0.89													
IRF for 100-Year Event:	0.91													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	59.8%													
Effective Imperviousness for WQCV Event:	44.7%													
Effective Imperviousness for 10-Year Event:	55.6%													
Effective Imperviousness for 100-Year Event:	56.4%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT*: Reduce Detention By:	18.5%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	7.4%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	5.5%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**59.8%**
Total Site Effective Imperviousness for WQCV Event:	**44.7%**
Total Site Effective Imperviousness for 10-Year Event:	**55.6%**
Total Site Effective Imperviousness for 100-Year Event:	**56.4%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Sep 6 2017

WINSLOW PARK DRIVE - STA 10+18 - 17.5' RT

Basin B8 NW corner Winslow & Halfchaps - WQCV 85th Percentile Storm

Gutter	
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.016

Highlighted	
Depth (ft)	= 0.15
Q (cfs)	= 0.200
Area (sqft)	= 0.14
Velocity (ft/s)	= 1.40
Wetted Perim (ft)	= 2.02
Crit Depth, Yc (ft)	= 0.15
Spread Width (ft)	= 1.86
EGL (ft)	= 0.18

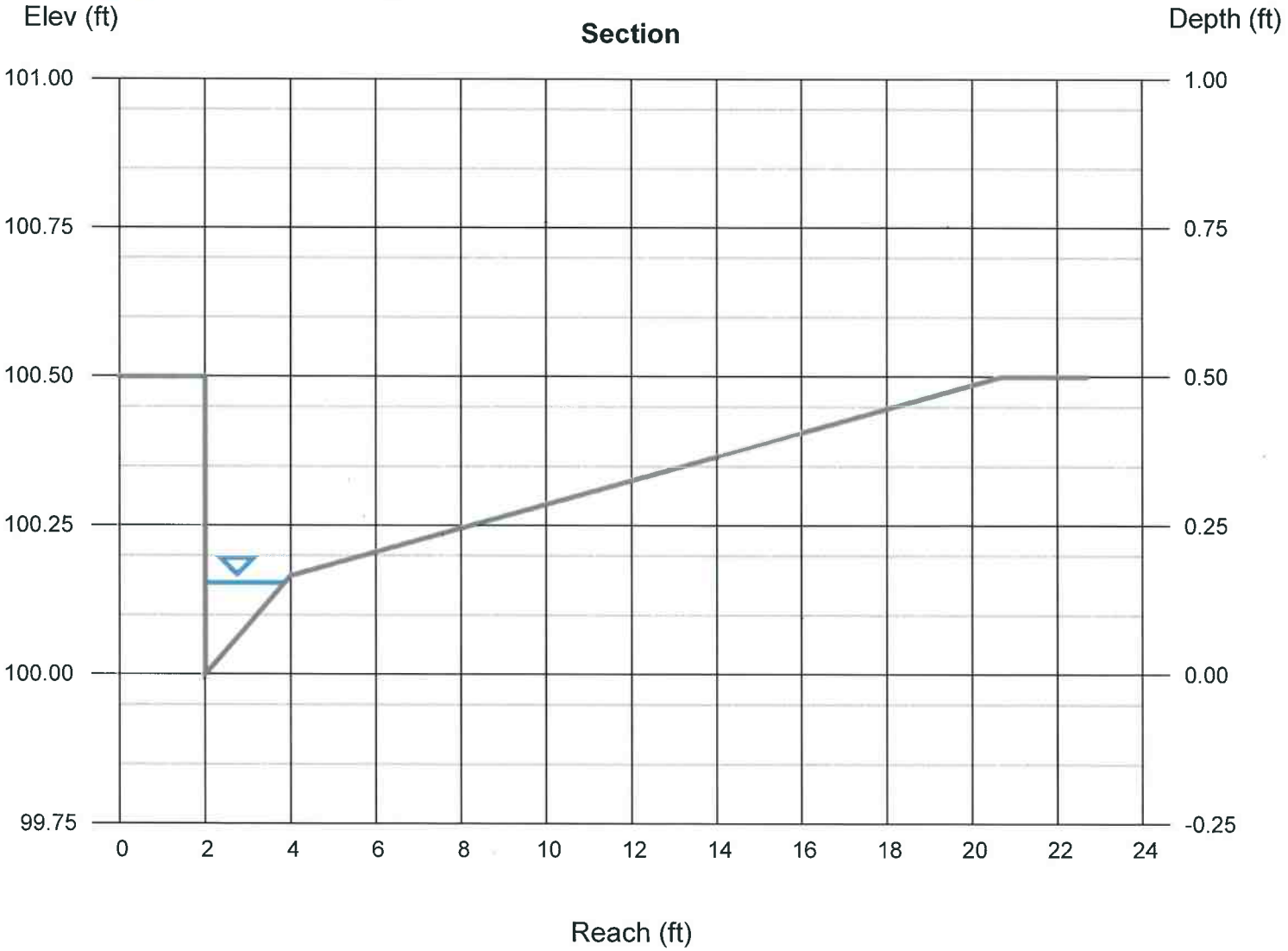
Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.20

$Q_2 = 0.4$ cfs

$Q_{WQCV} = 1/2 Q_2 = 0.2$ cfs

DEPTH AT FL = 0.15'



Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Sep 6 2017

WINDSOR PARK DRIVE STA 10+13 -17.5' RT.

Curb Opening Basin B8 to Sand Filter WQCV- 85th Percentile storm

Rectangular Weir

Crest	= Sharp
Bottom Length (ft)	= 1.00
Total Depth (ft)	= 0.38

Calculations

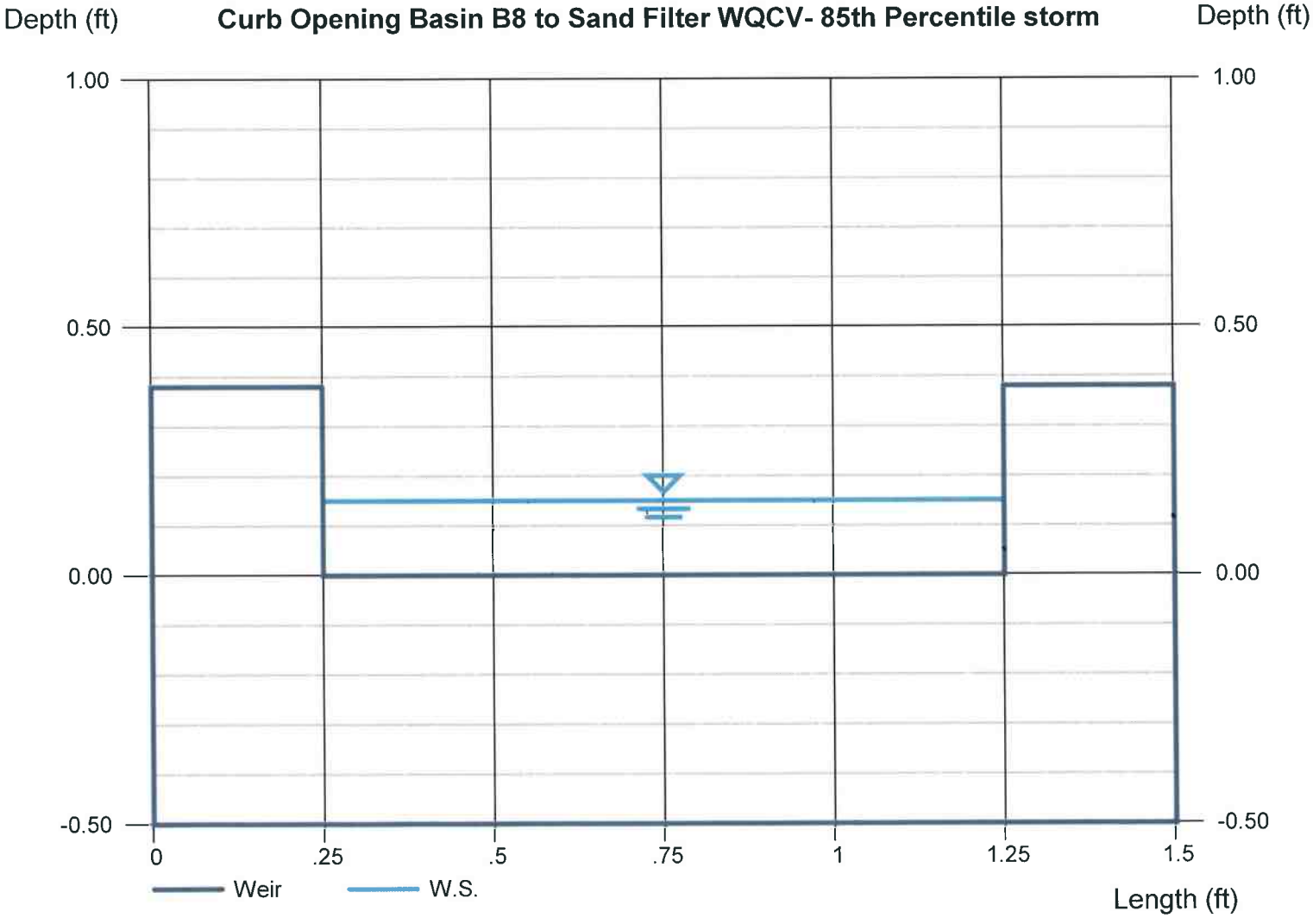
Weir Coeff. Cw	= 3.33
Compute by:	Known Depth
Known Depth (ft)	= 0.15

Highlighted

Depth (ft)	= 0.15
Q (cfs)	= 0.193
Area (sqft)	= 0.15
Velocity (ft/s)	= 1.29
Top Width (ft)	= 1.00

DEPTH AT CURB FL = 0.15'

Q_{WIER} = 0.2 cfs = Q_{WQCV}



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Sep 6 2017

WINSLOW PARK DRIVE STA 10+18 -17.5' RT

Basin B8 NW corner Winslow & Halfchaps - 5-yr

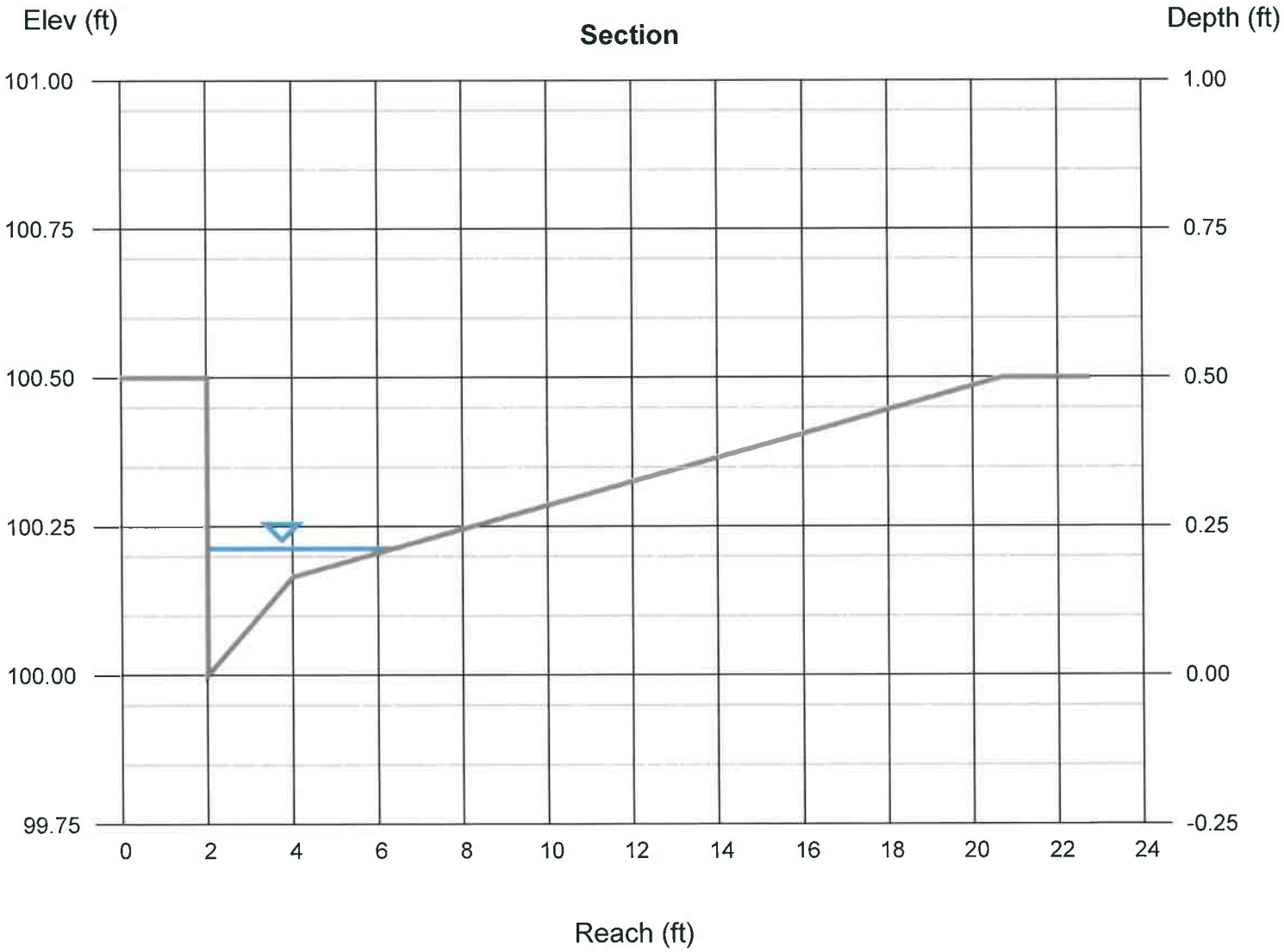
Gutter	
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.016

Highlighted	
Depth (ft)	= 0.21
Q (cfs)	= 0.500
Area (sqft)	= 0.32
Velocity (ft/s)	= 1.59
Wetted Perim (ft)	= 4.57
Crit Depth, Yc (ft)	= 0.22
Spread Width (ft)	= 4.35
EGL (ft)	= 0.25

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 0.50

$Q_5 = 0.5$ cfs

depth at FL = 0.21'



Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Sep 6 2017

Curb Opening Basin B8 to Sand Filter-5 yr

WINSLOW PARK DRIVE STA 10+18 – 17.5' RT

Rectangular Weir

Crest	= Sharp
Bottom Length (ft)	= 1.00
Total Depth (ft)	= 0.38

Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Depth
Known Depth (ft)	= 0.21

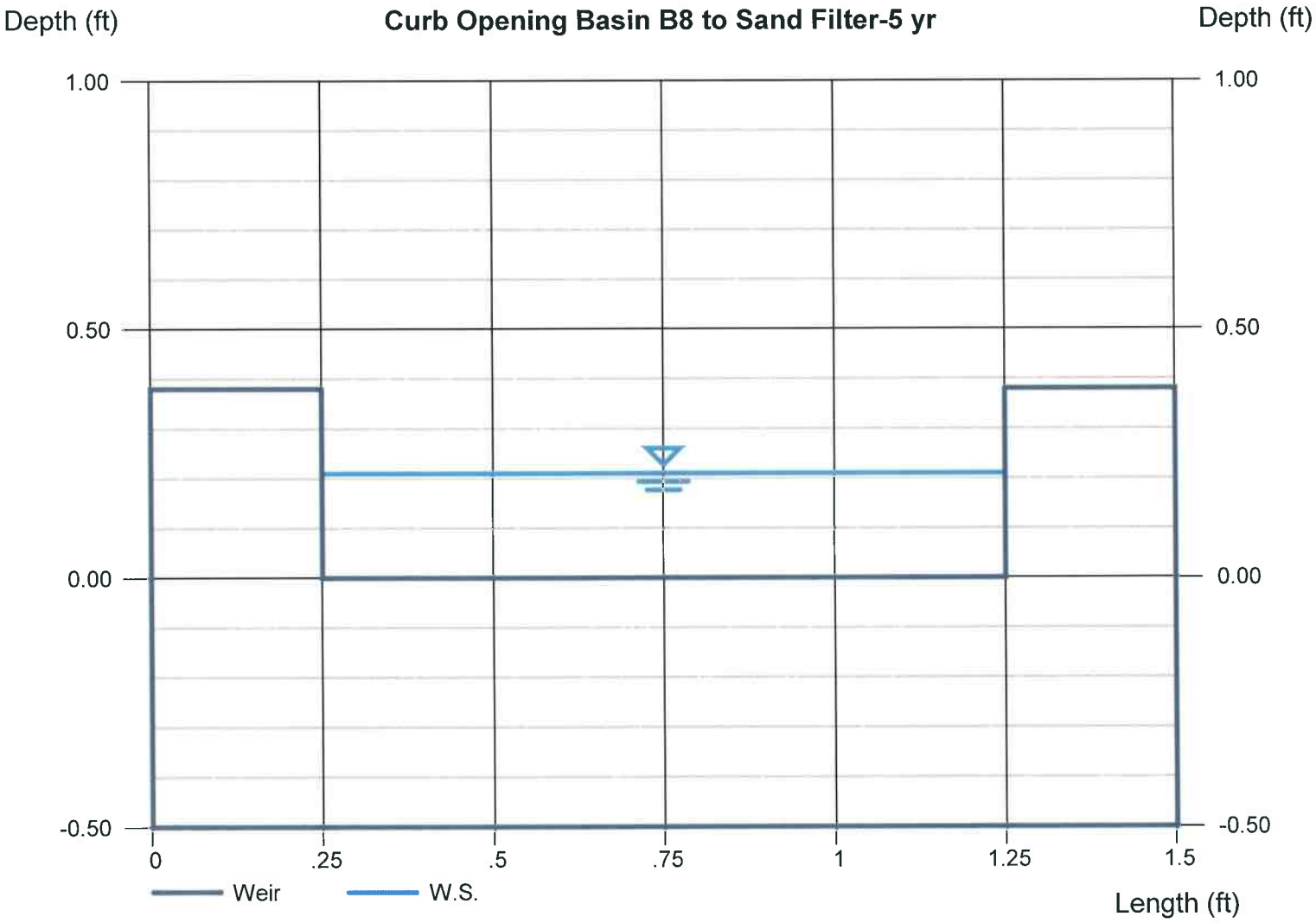
Highlighted

Depth (ft)	= 0.21
Q (cfs)	= 0.320
Area (sqft)	= 0.21
Velocity (ft/s)	= 1.53
Top Width (ft)	= 1.00

5yr DEPTH AT FE = 0.21'

Q_{WEIR} = 0.3 CFS → TO POND E1

BYPASS = 0.2 CFS → HALF CROPS CT.



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Sep 6 2017

WINSLOW PARK DR STA 10+18 -17.5' RT

Basin B8 NW corner Winslow & Halfchaps - 100-yr

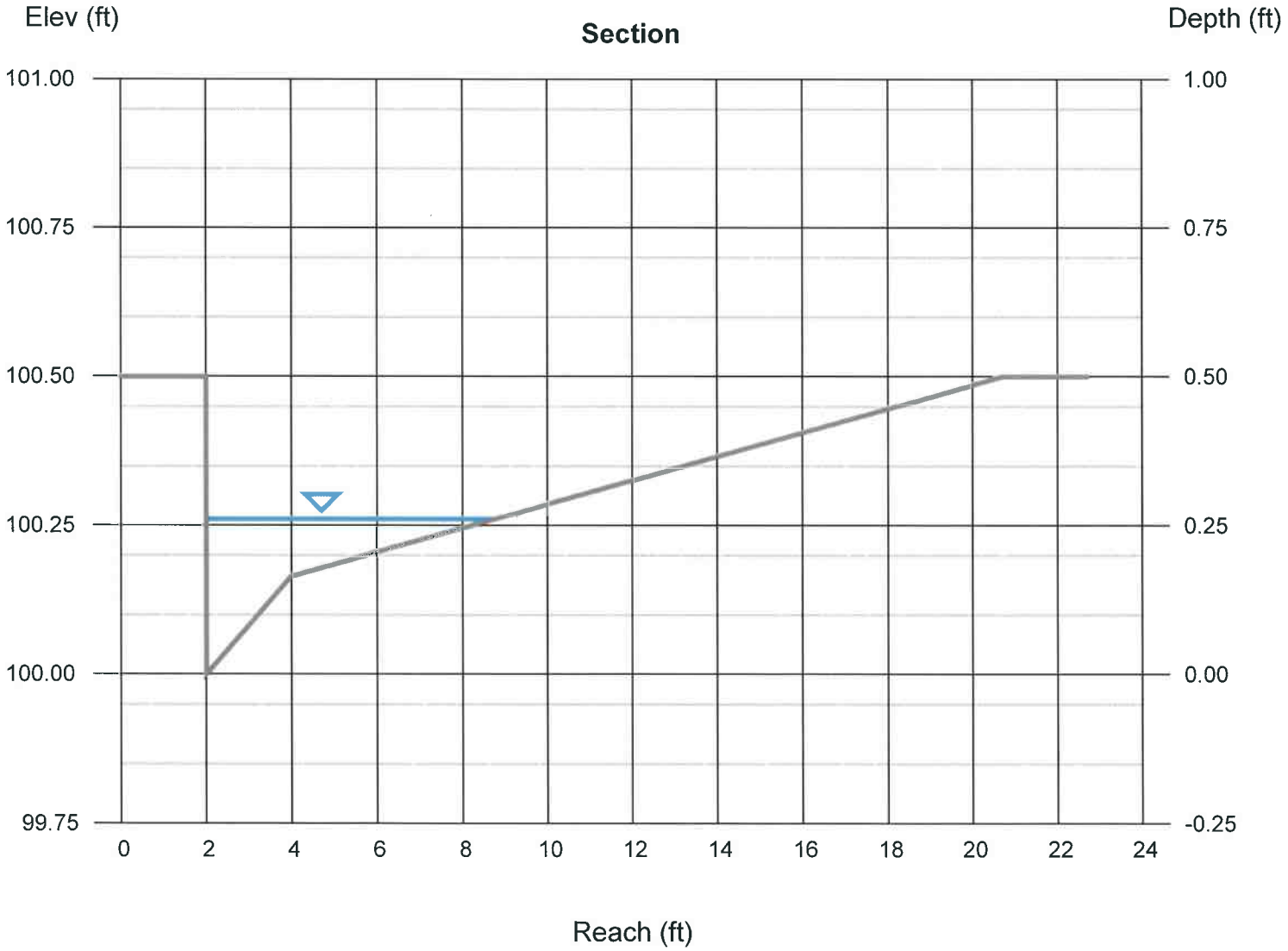
Gutter	
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.016

Highlighted	
Depth (ft)	= 0.26
Q (cfs)	= 1.000
Area (sqft)	= 0.58
Velocity (ft/s)	= 1.72
Wetted Perim (ft)	= 7.02
Crit Depth, Yc (ft)	= 0.27
Spread Width (ft)	= 6.75
EGL (ft)	= 0.31

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 1.00

$Q_{100} = 1.0$ CFS

DEPTH AT FL = 0.26'



Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Sep 6 2017

WINSLOW PARK DRIVE STA 10+18 -12.5' RT

Curb Opening Basin B8 to Sand Filter-100 yr

Rectangular Weir

Crest	= Sharp
Bottom Length (ft)	= 1.00
Total Depth (ft)	= 0.38

Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Depth
Known Depth (ft)	= 0.26

Highlighted

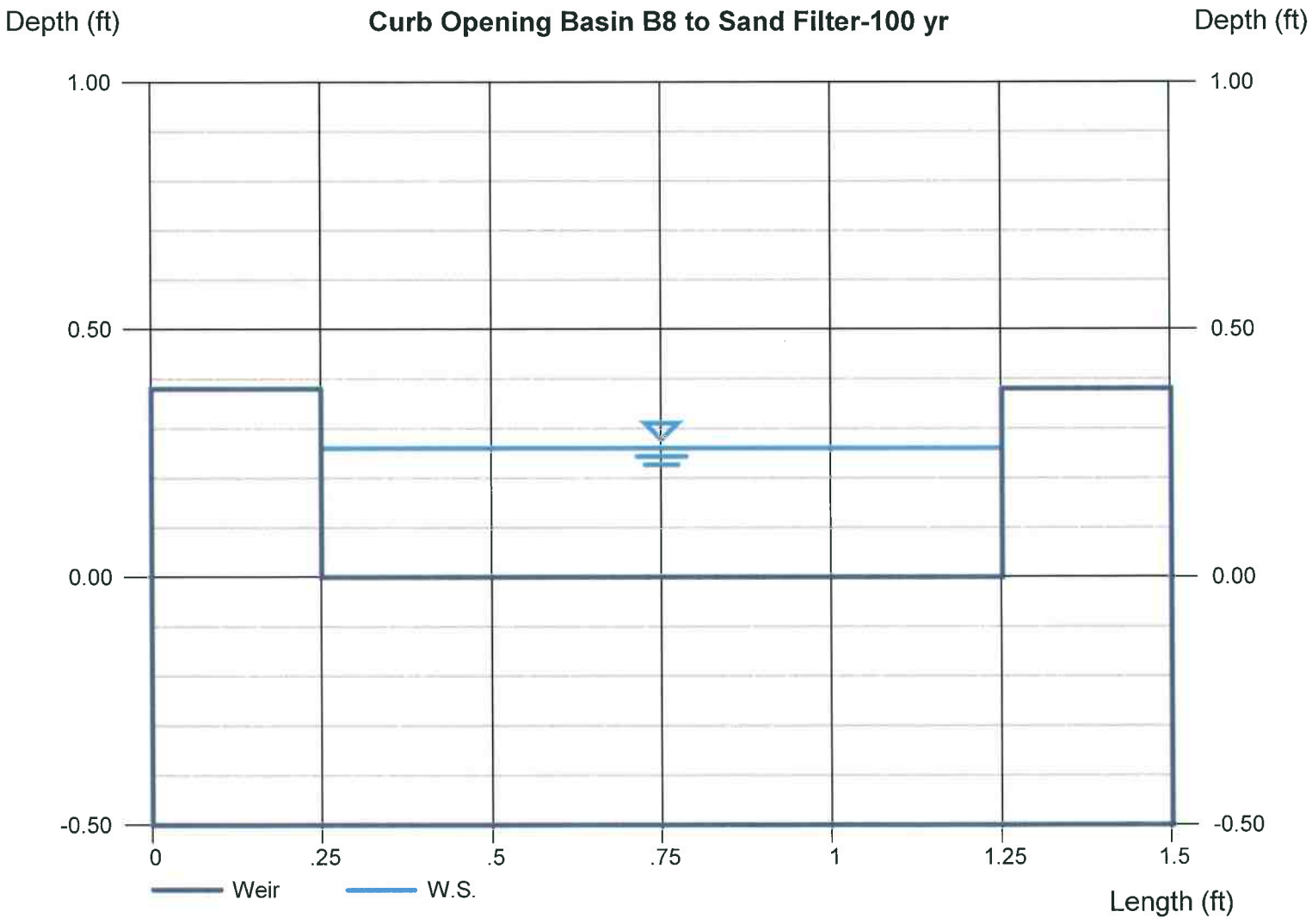
Depth (ft)	= 0.26
Q (cfs)	= 0.441
Area (sqft)	= 0.26
Velocity (ft/s)	= 1.70
Top Width (ft)	= 1.00

100 yr

DEPTH AT FL = 0.26'

Q_{INTO} = 0.4 CFS → TO POND E1

BYPASS = 0.6 CFS → HALF CHAPS Ct.



Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.06, November 2016)

Designer: D. Gorman
Company: M.V.E., Inc.
Date: August 7, 2017
Project: Hannah Ridge at Feathergrass Filing No. 3
Location: Sand Filter "E2" (for Basins E1-E5, E8)

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 51.4 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.514
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.17 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 405,049 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume $V_{WQCV} = WQCV / 12 * Area$	V_{WQCV} = 5,673 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 5,541 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = _____ cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 2.0 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 3.00 ft / ft **DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE**
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 2602 sq ft
D) Actual Filter Area	A_{Actual} = 2919 sq ft
E) Volume Provided	V_T = 7378 cu ft
3. Filter Material	Choose One: (●) 18" CDOT Class B or C Filter Material ( ) Other (Explain): _____
4. Underdrain System	
A) Are underdrains provided?	Choose One: (●) YES ( ) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 2.0 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 5,541 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 1 - 11 / 16 in

$Q_2 = 15.2$ cfs

$Q_{WQCV} = 1/2 Q_2 = 7.6$ cfs

PIPE SIZE INTO SAND FILTER = 18" @ SDMH E2

W/ RESTRICTOR PLATE @ 0.66' ABOVE INVERT

Design Procedure Form: Sand Filter (SF)

Designer: D. Gorman
Company: M.V.E., Inc.
Date: August 7, 2017
Project: Hannah Ridge at Feathergrass Filing No. 3
Location: Sand Filter "E2" (for Basins E1-E5, E8)

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ◉ NO
6-7. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	FES and Rip Rap Pad at pipe outlet locations

Notes:

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	D. Gorman
Company:	M.V.E., Inc.
Date:	August 7, 2017
Project:	Hannah Ridge at Feathergrass Filing No. 3
Location:	Sand Filter "E2" (for Basins E1-E5, E8)

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	E1-E5,E8
Receiving Pervious Area Soil Type	Loamy Sand
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	9.300
Directly Connected Impervious Area (DCIA, acres)	2.870
Unconnected Impervious Area (UIA, acres)	3.180
Receiving Pervious Area (RPA, acres)	3.250
Separate Pervious Area (SPA, acres)	0.000
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	9.300
Directly Connected Impervious Area (DCIA, %)	30.9%
Unconnected Impervious Area (UIA, %)	34.2%
Receiving Pervious Area (RPA, %)	34.9%
Separate Pervious Area (SPA, %)	0.0%
A_R (RPA / UIA)	1.022
I_a Check	0.490
f / I for WQCV Event:	3.2
f / I for 10-Year Event:	0.5
f / I for 100-Year Event:	0.4
f / I for Optional User Defined Storm CUHP:	
IRF for WQCV Event:	0.60
IRF for 10-Year Event:	0.89
IRF for 100-Year Event:	0.91
IRF for Optional User Defined Storm CUHP:	
Total Site Imperviousness: I_{total}	65.1%
Effective Imperviousness for WQCV Event:	51.4%
Effective Imperviousness for 10-Year Event:	61.2%
Effective Imperviousness for 100-Year Event:	62.0%
Effective Imperviousness for Optional User Defined Storm CUHP:	

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT*: Reduce Detention By:	17.4%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	6.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	4.5%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**65.1%**
Total Site Effective Imperviousness for WQCV Event:	**51.4%**
Total Site Effective Imperviousness for 10-Year Event:	**61.2%**
Total Site Effective Imperviousness for 100-Year Event:	**62.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

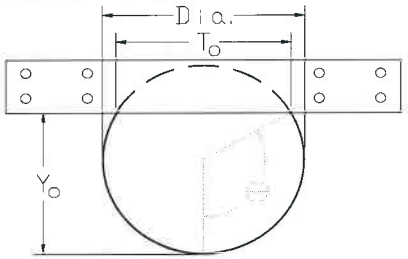
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICAL ORIFICES

Project: Hannah Ridge at Feathergrass

Basin ID: WQ inlet at MH E2 to Sand Filter E2 for Basins E1-E5, E8

X



	#1 Vertical Orifice	#2 Vertical Orifice	
Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)			
Water Surface Elevation at Design Depth — Elev: WS =	54.71		feet
Pipe/Vertical Orifice Entrance Invert Elevation — Elev: Invert =	50.58		feet
Required Peak Flow through Orifice at Design Depth — Q =	7.60		cfs
Pipe/Vertical Orifice Diameter (inches) — Dia =	18.0		inches
Orifice Coefficient — C_o =	0.65		
Full-flow Capacity (Calculated)			
Full-flow area — Af =	1.77		sq ft
Half Central Angle in Radians — Theta =	3.14		rad
Full-flow capacity — Qf =	17.0		cfs
Percent of Design Flow =	223%		
Calculation of Orifice Flow Condition			
Half Central Angle (0<Theta<3.1416) — Theta =	1.45		rad
Flow area — A_o =	0.75		sq ft
Top width of Orifice (inches) — T_o =	17.87		inches
Height from Invert of Orifice to Bottom of Plate (feet) — Y_o =	0.66		feet
Elevation of Bottom of Plate — Elev Plate Bottom Edge =	51.24		feet
Resultant Peak Flow Through Orifice at Design Depth — Q_o =	7.6		cfs
Width of Equivalent Rectangular Vertical Orifice — **Equivalent Width =**	**1.14**		**feet**

10 Downstream Hydrologic & Hydraulic Analysis *

Full Reach Developed Condition Hydrology with Developed Hannah Ridge (Directly From DBPS Hydrology Update – Kiowa Engineering 1/18/07) 10-yr, 100-year

Full Reach Existing Condition Hydrology with totally undeveloped Hannah Ridge (Directly From DBPS Hydrology Update – Kiowa Engineering 1/18/07) 10-yr, 100-year

Full Reach Existing Condition Hydrology with Fully Developed Hannah Ridge (Modified from From DBPS Hydrology Update) 10-yr, 100-year

Full Reach Existing Offsite Conditions Hydrology with Only Hannah Ridge Phases 1 – 4 Developed (Modified from From DBPS Hydrology Update) 10-yr, 100-year

HEC-RAS Data and output - Existing Condition Hydrology with totally undeveloped Hannah Ridge

HEC-RAS Data and output - Existing Condition Hydrology with Fully Developed Hannah Ridge

HEC-RAS Data and output - Existing Offsite Conditions Hydrology with Only Hannah Ridge Phases 1 – 4 Developed

* FROM HANNAH RIDGE AT FEATHERGRASS MDDP
M.V.E., INC. , NOV. 15, 2007

HANNAH RIDGE AT FEATHERGRASS
MASTER DRAINAGE DEVELOPMENT PLAN

November 15, 2007
Project No. 60754

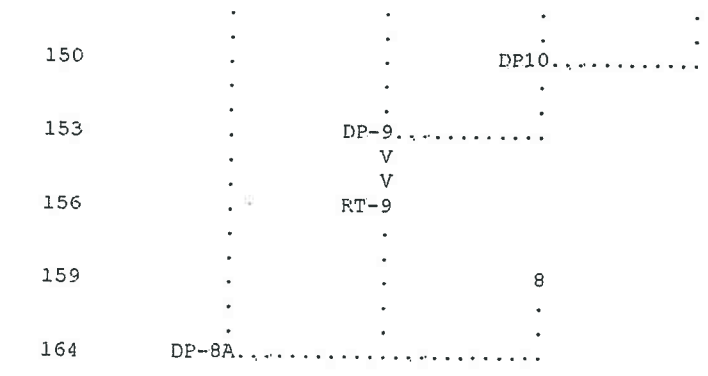
PREPARED FOR:

FEATHERGRASS INVESTMENTS, LLC
4715 North Chestnut Street
Colorado Springs, CO 80907
(719) 593-8367

Kenneth P. Driscoll, Manager

PREPARED BY:

M.V.E., Inc.
1903 Lelaray Street, Suite 200
Colorado Springs, CO 80909
(719) 635-5736



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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*                                         *
*    U.S. ARMY CORPS OF ENGINEERS         *
*    HYDROLOGIC ENGINEERING CENTER        *
*          609 SECOND STREET              *
*        DAVIS, CALIFORNIA 95616          *
*          (916) 756-1104                 *
*                                         *
*******************************************
```

FULL REACH DEVELOPED CONDITION W/ DEVELOPED HANNAH RIDGE
FROM DBPS HYDROLOGY UPDATE - KIOWA ENG 1/18/07

East Fork Subtributary Hydrology PN: 06040
Future developed condition with storge at RR Embankment
Sand Creek DBPS Hydrology update
Existing culvert under RR in-place and no blockage
10- and 100 Year, 24 hr Type IIA Storm FN efstd.dat

```
  7 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1   0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2   0  ENDING DATE
                     NDTIME       0055  ENDING TIME
                      ICENT         19  CENTURY MARK

                  COMPUTATION INTERVAL      .08 HOURS
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TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.68 1.00

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .68	RATIO 2 1.00
HYDROGRAPH AT						
+	5	.20	1	FLOW	154.	326.
				TIME	6.08	6.00
ROUTED TO						
+	RT-5A	.20	1	FLOW	151.	322.
				TIME	6.08	6.08
ROUTED TO						
+	RT-5	.20	1	FLOW	142.	313.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	1	.14	1	FLOW	117.	242.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP-1	.34	1	FLOW	255.	551.
				TIME	6.08	6.08
ROUTED TO						
+	RT-1	.34	1	FLOW	245.	518.
				TIME	6.25	6.25

HYDROGRAPH AT						
+	2	.32	1	FLOW	207.	467.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-14	.66	1	FLOW	374.	915. ← INFLOW TO RR
				TIME	6.25	6.17
ROUTED TO						
+	DB-14	.66	1	FLOW	360.	640. ← OUTFLOW FROM RR
				TIME	6.25	6.33
			**	PEAK STAGES IN FEET **		
			1	STAGE	90.45	95.31
				TIME	6.25	6.33
ROUTED TO						
+	RT-2B	.66	1	FLOW	352.	636.
				TIME	6.33	6.42
HYDROGRAPH AT						
+	3	.16	1	FLOW	130.	283.
				TIME	6.00	6.00
ROUTED TO						
+	RT-3A	.16	1	FLOW	126.	273.
				TIME	6.08	6.00
ROUTED TO						
+	RT-3	.16	1	FLOW	126.	270.
				TIME	6.08	6.00
HYDROGRAPH AT						
+	4	.15	1	FLOW	179.	333.
				TIME	6.00	6.00
3 COMBINED AT						
+	DP-4A	.98	1	FLOW	428.	991.
				TIME	6.33	6.08
ROUTED TO						
+	RT-2A	.98	1	FLOW	425.	948.
				TIME	6.33	6.17
HYDROGRAPH AT						
+	12	.05	1	FLOW	107.	168.
				TIME	6.00	6.00
HYDROGRAPH AT						
+	13	.05	1	FLOW	85.	139.
				TIME	6.00	6.00

3 COMBINED AT						
+	DP-8	1.08	1	FLOW	457.	1076.
				TIME	6.00	6.08
ROUTED TO						
+	RT-6A	1.08	1	FLOW	448.	1069.
				TIME	6.08	6.08
ROUTED TO						
+	RT6	1.08	1	FLOW	447.	1044.
				TIME	6.08	6.08
HYDROGRAPH AT						
+	6	.12	1	FLOW	144.	269.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP -6	1.20	1	FLOW	588.	1299.
				TIME	6.08	6.08
ROUTED TO						
+	RT-7	1.20	1	FLOW	570.	1296.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	7	.17	1	FLOW	125.	255.
				TIME	6.17	6.17
2 COMBINED AT						
+	DP-7	1.37	1	FLOW	695.	1561.
				TIME	6.17	6.17
ROUTED TO						
+	RT-8	1.37	1	FLOW	685.	1481.
				TIME	6.42	6.42
HYDROGRAPH AT						
+	9	.14	1	FLOW	72.	159.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	11	.15	1	FLOW	134.	275.
				TIME	6.08	6.00
ROUTED TO						
+	DB11	.15	1	FLOW	52.	56.
				TIME	6.25	6.33

** PEAK STAGES IN FEET **

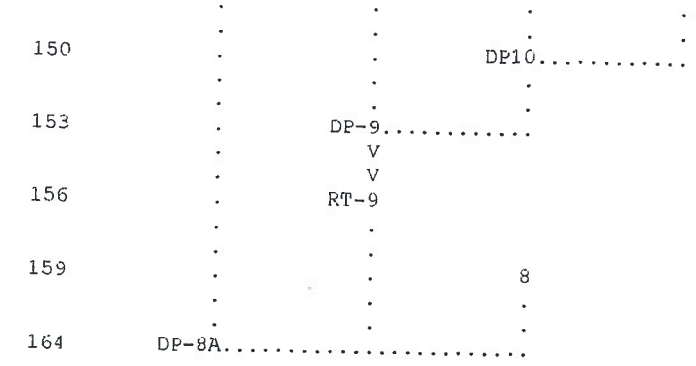
1	STAGE	6443.93	6446.82
	TIME	6.25	6.33

ROUTED TO						
+	RT11A	.15	1	FLOW	52.	56.
				TIME	6.33	6.42
ROUTED TO						
+	RT11B	.15	1	FLOW	52.	56.
				TIME	6.33	6.50
HYDROGRAPH AT						
+	10	.07	1	FLOW	61.	122.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP10	.22	1	FLOW	110.	175.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-9	.36	1	FLOW	177.	325.
				TIME	6.17	6.17
ROUTED TO						
+	RT-9	.36	1	FLOW	174.	321.
				TIME	6.25	6.25
HYDROGRAPH AT						
+	8	.19	1	FLOW	187.	353.
				TIME	6.17	6.08
3 COMBINED AT						
+	D9-8A	1.91	1	FLOW	925.	2088.
				TIME	6.42	6.25

1

8A

*** NORMAL END OF HEC-1 ***



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

– FULL REACH EXIST CONDITION W/ UNDEVELOPED HANNAH RIDGE –
KISWA ENG. 9/5/07

East Fork Subtributary hydrology PN: 06040
Existing devel condition with storage at RR Embankment
Sand Creek DBPS Hydrology update
Existing culvert under RR in-place and no blockage
10- and 100 Year, 24 hr Type IIA Storm FN efstd.dat

7 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0055	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS

TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.68 1.00

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .68	RATIO 2 1.00
HYDROGRAPH AT						
+	5	.20	1	FLOW	154.	326.
				TIME	6.08	6.00
ROUTED TO						
+	RT-5A	.20	1	FLOW	151.	322.
				TIME	6.08	6.08
ROUTED TO						
+	RT-5	.20	1	FLOW	142.	313.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	1	.14	1	FLOW	117.	242.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP-1	.34	1	FLOW	255.	551.
				TIME	6.08	6.08
ROUTED TO						
+	RT-1	.34	1	FLOW	245.	518.
				TIME	6.25	6.25

HYDROGRAPH AT						
+	2	.32	1	FLOW	181.	429.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-14	.66	1	FLOW	360.	886.
				TIME	6.25	6.17
ROUTED TO						
+	DB-14	.66	1	FLOW	351.	627.
				TIME	6.25	6.33
			**	PEAK STAGES IN FEET **		
			1	STAGE	90.33	95.05
				TIME	6.25	6.33
ROUTED TO						
+	RT-2B	.66	1	FLOW	340.	624.
				TIME	6.33	6.42
HYDROGRAPH AT						
+	3	.16	1	FLOW	130.	283.
				TIME	6.00	6.00
ROUTED TO						
+	RT-3A	.16	1	FLOW	126.	273.
				TIME	6.08	6.00
ROUTED TO						
+	RT-3	.16	1	FLOW	126.	270.
				TIME	6.08	6.00
HYDROGRAPH AT						
+	4	.15	1	FLOW	74.	183.
				TIME	6.08	6.08
3 COMBINED AT						
+	DP-4A	.98	1	FLOW	393.	831.
				TIME	6.33	6.08
ROUTED TO						
+	RT-2A	.98	1	FLOW	384.	824.
				TIME	6.42	6.17
HYDROGRAPH AT						
+	12	.05	1	FLOW	37.	85.
				TIME	6.00	6.00
HYDROGRAPH AT						
+	13	.05	1	FLOW	32.	75.
				TIME	6.00	6.00

3 COMBINED AT						
+	DP-8	1.08	1	FLOW	392.	856.
				TIME	6.42	6.17
ROUTED TO						
+	RT-6A	1.08	1	FLOW	390.	852.
				TIME	6.42	6.17
ROUTED TO						
+	RT6	1.08	1	FLOW	385.	835.
				TIME	6.42	6.17
HYDROGRAPH AT						
+	6	.12	1	FLOW	144.	269.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP -6	1.20	1	FLOW	410.	1004.
				TIME	6.42	6.17
ROUTED TO						
+	RT-7	1.20	1	FLOW	402.	993.
				TIME	6.50	6.25
HYDROGRAPH AT						
+	7	.17	1	FLOW	69.	174.
				TIME	6.17	6.17
2 COMBINED AT						
+	DP-7	1.37	1	FLOW	429.	1151.
				TIME	6.50	6.17
ROUTED TO						
+	RT-8	1.37	1	FLOW	444.	1144.
				TIME	6.50	6.42
HYDROGRAPH AT						
+	9	.14	1	FLOW	72.	159.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	11	.15	1	FLOW	134.	275.
				TIME	6.08	6.00
ROUTED TO						
+	DB11	.15	1	FLOW	52.	56.
				TIME	6.25	6.33

** PEAK STAGES IN FEET **

1	STAGE	6443.93	6446.82
	TIME	6.25	6.33

ROUTED TO						
+	RT11A	.15	1	FLOW	52.	56.
				TIME	6.33	6.42
ROUTED TO						
+	RT11B	.15	1	FLOW	52.	56.
				TIME	6.33	6.50
HYDROGRAPH AT						
+	10	.07	1	FLOW	61.	122.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP10	.22	1	FLOW	110.	175.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-9	.36	1	FLOW	177.	325.
				TIME	6.17	6.17
ROUTED TO						
+	RT-9	.36	1	FLOW	174.	321.
				TIME	6.25	6.25
HYDROGRAPH AT						
+	8	.19	1	FLOW	77.	194.
				TIME	6.17	6.17
3 COMBINED AT						
+	DP-8A	1.91	1	FLOW	609.	1497.
				TIME	6.50	6.42

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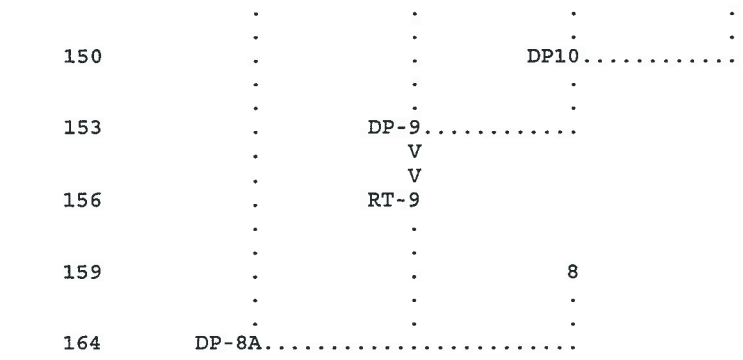
*** NORMAL END OF HEC-1 ***



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN  1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   19OCT07  TIME  09:48:32   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

_FULL REACH EXIST CONDITION W/ DEVELOPED HANNAH RIDGE

East Fork Subtributary Hydrology PN: 60754
Existing Offsite Development Condition with Developed On-Site Hannah with storage at RR Embankment, Existing RR culvert in place and no blockage.
10- and 100 Year, 24 hr Typoe IIA Storm FN efsceo.dat

```
  7 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2    0  ENDING DATE
                     NDTIME        0055  ENDING TIME
                      ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL      .08 HOURS
```

TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.68 1.00

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .68	RATIO 2 1.00
HYDROGRAPH AT						
+	5	.20	1	FLOW	154.	326.
				TIME	6.08	6.00
ROUTED TO						
+	RT-5A	.20	1	FLOW	151.	322.
				TIME	6.08	6.08
ROUTED TO						
+	RT-5	.20	1	FLOW	142.	313.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	1	.14	1	FLOW	117.	242.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP-1	.34	1	FLOW	255.	551.
				TIME	6.08	6.08
ROUTED TO						
+	RT-1	.34	1	FLOW	245.	518.
				TIME	6.25	6.25

HYDROGRAPH AT						
+	2	.32	1	FLOW	181.	429.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-14	.66	1	FLOW	360.	886.
				TIME	6.25	6.17
ROUTED TO						
+	DB-14	.66	1	FLOW	351.	627.
				TIME	6.25	6.33
			** PEAK STAGES IN FEET **			
			1	STAGE	90.33	95.05
				TIME	6.25	6.33
ROUTED TO						
+	RT-2B	.66	1	FLOW	340.	624.
				TIME	6.33	6.42
HYDROGRAPH AT						
+	3	.16	1	FLOW	130.	283.
				TIME	6.00	6.00
ROUTED TO						
+	RT-3A	.16	1	FLOW	126.	273.
				TIME	6.08	6.00
ROUTED TO						
+	RT-3	.16	1	FLOW	126.	270.
				TIME	6.08	6.00
HYDROGRAPH AT						
+	4	.15	1	FLOW	179.	333.
				TIME	6.00	6.00
3 COMBINED AT						
+	DP-4A	.98	1	FLOW	416.	966.
				TIME	6.33	6.08
ROUTED TO						
+	RT-2A	.98	1	FLOW	406.	931.
				TIME	6.33	6.17
HYDROGRAPH AT						
+	12	.05	1	FLOW	107.	168.
				TIME	6.00	6.00
HYDROGRAPH AT						
+	13	.05	1	FLOW	85.	139.
				TIME	6.00	6.00

3 COMBINED AT						
+	DP-8	1.08	1	FLOW	453.	1041.
				TIME	6.00	6.08
ROUTED TO						
+	RT-6A	1.08	1	FLOW	438.	1033.
				TIME	6.00	6.08
ROUTED TO						
+	RT-6	1.08	1	FLOW	436.	1006.
				TIME	6.08	6.17
HYDROGRAPH AT						
+	6	.12	1	FLOW	144.	269.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP-6	1.20	1	FLOW	577.	1261.
				TIME	6.08	6.08
ROUTED TO						
+	RT-7	1.20	1	FLOW	560.	1259.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	7	.17	1	FLOW	69.	174.
				TIME	6.17	6.17
2 COMBINED AT						
+	DP-7	1.37	1	FLOW	629.	1433.
				TIME	6.17	6.17
ROUTED TO						
+	RT-8	1.37	1	FLOW	632.	1391.
				TIME	6.42	6.42
HYDROGRAPH AT						
+	9	.14	1	FLOW	72.	159.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	11	.15	1	FLOW	134.	275.
				TIME	6.08	6.00
ROUTED TO						
+	DB11	.15	1	FLOW	52.	56.
				TIME	6.25	6.33

** PEAK STAGES IN FEET **

1	STAGE	6443.93	6446.82
	TIME	6.25	6.33

ROUTED TO						
+	RT11A	.15	1	FLOW	52.	56.
				TIME	6.33	6.42
ROUTED TO						
+	RT11B	.15	1	FLOW	52.	56.
				TIME	6.33	6.50
HYDROGRAPH AT						
+	10	.07	1	FLOW	61.	122.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP10	.22	1	FLOW	110.	175.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-9	.36	1	FLOW	177.	325.
				TIME	6.17	6.17
ROUTED TO						
+	RT-9	.36	1	FLOW	174.	321.
				TIME	6.25	6.25
HYDROGRAPH AT						
+	8	.19	1	FLOW	77.	194.
				TIME	6.17	6.17
3 COMBINED AT						
+	DP-8A	1.91	1	FLOW	826.	1869.
				TIME	6.42	6.25

1

*** NORMAL END OF HEC-1 ***

```
  164       DP-8A.....................

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*               JUN   1998             *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   13NOV07  TIME  11:49:01  *
*                                      *
****************************************
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```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

- Existing offsite conditions w/ Hannah Ridge phases 1-4 developed only

East Fork Subtributary Hydrology PN: 60754
Existing Offsite Development Condition with Developed Phase 1-4 Hannah only
with storage at RR Embankment, Existing RR culvert in place and no
blockage.
10- and 100 Year, 24 hr Typoe IIA Storm FN efscdph1.dat

```
  7 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN           5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME         0000  STARTING TIME
                        NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      2    0  ENDING DATE
                    NDTIME         0055  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL      .08 HOURS
                       TOTAL TIME BASE   24.92 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                      NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
```

.68 1.00

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

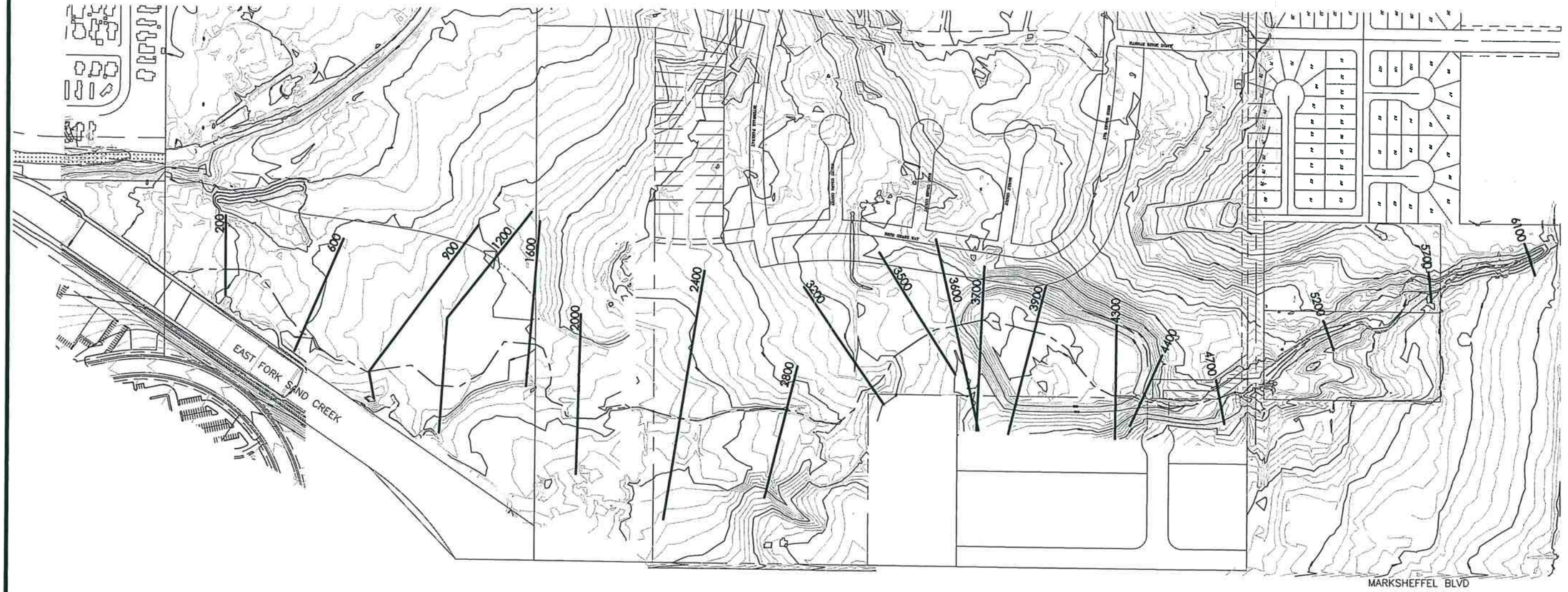
OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .68	RATIO 2 1.00
HYDROGRAPH AT						
+	5	.20	1	FLOW	154.	326.
				TIME	6.08	6.00
ROUTED TO						
+	RT-5A	.20	1	FLOW	151.	322.
				TIME	6.08	6.08
ROUTED TO						
+	RT-5	.20	1	FLOW	142.	313.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	1	.14	1	FLOW	117.	242.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP-1	.34	1	FLOW	255.	551.
				TIME	6.08	6.08
ROUTED TO						
+	RT-1	.34	1	FLOW	245.	518.
				TIME	6.25	6.25
HYDROGRAPH AT						
+	2	.32	1	FLOW	181.	429.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-14	.66	1	FLOW	360.	886.
				TIME	6.25	6.17
ROUTED TO						
+	DB-14	.66	1	FLOW	351.	627.
				TIME	6.25	6.33
			** PEAK STAGES IN FEET **			
			1	STAGE	90.33	95.05
				TIME	6.25	6.33
ROUTED TO						
+	RT-2B	.66	1	FLOW	340.	624.

				TIME	6.33	6.42
HYDROGRAPH AT						
+	3	.16	1	FLOW	130.	283.
				TIME	6.00	6.00
ROUTED TO						
+	RT-3A	.16	1	FLOW	126.	273.
				TIME	6.08	6.00
ROUTED TO						
+	RT-3	.16	1	FLOW	126.	270.
				TIME	6.08	6.00
HYDROGRAPH AT						
+	4	.15	1	FLOW	90.	205.
				TIME	6.08	6.08
3 COMBINED AT						
+	DP-4A	.98	1	FLOW	397.	853.
				TIME	6.33	6.08
ROUTED TO						
+	RT-2A	.98	1	FLOW	387.	842.
				TIME	6.42	6.17
HYDROGRAPH AT						
+	12	.05	1	FLOW	37.	85.
				TIME	6.00	6.00
HYDROGRAPH AT						
+	13	.05	1	FLOW	42.	89.
				TIME	6.00	6.00
3 COMBINED AT						
+	DP-8	1.08	1	FLOW	395.	876.
				TIME	6.42	6.17
ROUTED TO						
+	RT-6A	1.08	1	FLOW	394.	873.
				TIME	6.42	6.17
ROUTED TO						
+	RT-6	1.08	1	FLOW	390.	862.
				TIME	6.42	6.17
HYDROGRAPH AT						
+	6	.12	1	FLOW	144.	269.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP-6	1.20	1	FLOW	415.	1030.
				TIME	6.42	6.17

ROUTED TO						
+	RT-7	1.20	1	FLOW	408.	1014.
				TIME	6.50	6.25
HYDROGRAPH AT						
+	7	.17	1	FLOW	69.	174.
				TIME	6.17	6.17
2 COMBINED AT						
+	DP-7	1.37	1	FLOW	449.	1180.
				TIME	6.25	6.17
ROUTED TO						
+	RT-8	1.37	1	FLOW	436.	1164.
				TIME	6.58	6.42
HYDROGRAPH AT						
+	9	.14	1	FLOW	72.	159.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	11	.15	1	FLOW	134.	275.
				TIME	6.08	6.00
ROUTED TO						
+	DB11	.15	1	FLOW	52.	56.
				TIME	6.25	6.33
			** PEAK STAGES IN FEET **			
			1	STAGE	6443.93	6446.82
				TIME	6.25	6.33
ROUTED TO						
+	RT11A	.15	1	FLOW	52.	56.
				TIME	6.33	6.42
ROUTED TO						
+	RT11B	.15	1	FLOW	52.	56.
				TIME	6.33	6.50
HYDROGRAPH AT						
+	10	.07	1	FLOW	61.	122.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP10	.22	1	FLOW	110.	175.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP-9	.36	1	FLOW	177.	325.
				TIME	6.17	6.17
ROUTED TO						
+	RT-9	.36	1	FLOW	174.	321.

				TIME	6.25	6.25
HYDROGRAPH AT						
+	8	.19	1	FLOW	77.	194.
				TIME	6.17	6.17
3 COMBINED AT						
+	DP-8A	1.91	1	FLOW	588.	1523.
				TIME	6.50	6.33

*** NORMAL END OF HEC-1 ***



MONUMENT VALLEY ENGINEERS INC.

*** ENGINEERS *** SURVEYORS ***

1903 LELARAY ST., COLORADO SPRINGS, COLORADO 80909

(719) 635-5736

HYDR. MAP—TRIB. E. FORK SAND CR.

HEC-RAS Version 4.0 Beta
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX   XXXX
X     X  X        X           X  X     X    X       X
X     X  X        X    X      X   X    X    X       X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: Hanna Ridge - d/s Reach EFSC w/ HANNAH RIDGE DEVELOPED (FULL DEV.)
Project File : 60754EFSC.prj
Run Date and Time: 10/22/2007 9:20:14 AM

Project in English units

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PLAN DATA

Plan Title: Hannah Ridge - EFSC - D/S
Plan File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSC.p05

Geometry Title: Hannah Ridge - EFSC - D/S
Geometry File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSC.g04

Flow Title : Hannah Ridge - EFSC - D/S
Flow File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSC.f04

Plan Summary Information:
Number of: Cross Sections = 19 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

****

FLOW DATA

Flow Title: Hannah Ridge - EFSC - D/S
Flow File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSC.f04

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	6100	1041
RIVER-1	Reach-1	4700	1261
RIVER-1	Reach-1	3200	1433
RIVER-1	Reach-1	200	1433

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	PF 1		Normal S = 0.0125

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	6100	.045	.035	.045
Reach-1	5700	.045	.035	.045
Reach-1	5200	.045	.035	.045
Reach-1	4700	.045	.035	.045
Reach-1	4400	.045	.035	.045
Reach-1	4300	.045	.035	.045
Reach-1	3900	.045	.035	.045
Reach-1	3700	.045	.035	.045
Reach-1	3600	.045	.035	.045
Reach-1	3500	.045	.035	.045
Reach-1	3200	.045	.035	.045
Reach-1	2800	.045	.035	.045
Reach-1	2400	.045	.035	.045
Reach-1	2000	.045	.035	.045
Reach-1	1600	.045	.035	.045
Reach-1	1200	.045	.035	.045
Reach-1	900	.045	.035	.045
Reach-1	600	.045	.035	.045
Reach-1	200	.045	.035	.045

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	6100	390	400	370
Reach-1	5700	410	500	420
Reach-1	5200	470	500	470
Reach-1	4700	320	300	260
Reach-1	4400	80	100	140
Reach-1	4300	300	400	360
Reach-1	3900	190	200	220
Reach-1	3700	80	100	130
Reach-1	3600	80	100	150
Reach-1	3500	280	300	290
Reach-1	3200	490	400	310
Reach-1	2800	370	400	380
Reach-1	2400	370	400	410
Reach-1	2000	270	400	200

*Reach-1	*	1600	* 350*	400*	230*
*Reach-1	*	1200	* 120*	300*	270*
*Reach-1	*	900	* 330*	300*	360*
*Reach-1	*	600	* 330*	400*	430*
*Reach-1	*	200	* 0*	0*	0*

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
*Reach-1	* 6100	* .1*	.3*
*Reach-1	* 5700	* .1*	.3*
*Reach-1	* 5200	* .1*	.3*
*Reach-1	* 4700	* .1*	.3*
*Reach-1	* 4400	* .1*	.3*
*Reach-1	* 4300	* .1*	.3*
*Reach-1	* 3900	* .1*	.3*
*Reach-1	* 3700	* .1*	.3*
*Reach-1	* 3600	* .1*	.3*
*Reach-1	* 3500	* .1*	.3*
*Reach-1	* 3200	* .1*	.3*
*Reach-1	* 2800	* .1*	.3*
*Reach-1	* 2400	* .1*	.3*
*Reach-1	* 2000	* .1*	.3*
*Reach-1	* 1600	* .1*	.3*
*Reach-1	* 1200	* .1*	.3*
*Reach-1	* 900	* .1*	.3*
*Reach-1	* 600	* .1*	.3*
*Reach-1	* 200	* .1*	.3*

Profile Output Table - User Table 1

Reach	River Sta	Profile	Length Chnl (ft)	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Max Chl Dpth (ft)	Vel Chnl (ft/s)	Top Width (ft)	Froude # Chl
Reach-1	200	PF 1		1433.00	6364.10	6365.54	1.44	5.26	269.73	0.86
Reach-1	600	PF 1	400.00	1433.00	6369.50	6370.84	1.34	5.26	413.69	0.90
Reach-1	900	PF 1	300.00	1433.00	6372.09	6374.05	1.96	4.43	683.65	0.65
Reach-1	1200	PF 1	300.00	1433.00	6373.55	6375.31	1.75	2.99	711.13	0.42
Reach-1	1600	PF 1	400.00	1433.00	6375.00	6376.54	1.54	4.31	502.46	0.66
Reach-1	2000	PF 1	400.00	1433.00	6376.90	6379.15	2.25	4.57	256.03	0.69
Reach-1	2400	PF 1	400.00	1433.00	6381.76	6383.60	1.84	5.80	304.15	0.93
Reach-1	2800	PF 1	400.00	1433.00	6385.00	6387.85	2.85	6.05	320.76	0.74
Reach-1	3200	PF 1	400.00	1433.00	6392.00	6394.37	2.37	6.19	326.62	0.90
Reach-1	3500	PF 1	300.00	1261.00	6396.28	6398.02	1.74	4.78	338.38	0.78
Reach-1	3600	PF 1	100.00	1261.00	6396.50	6398.90	2.40	5.35	161.37	0.78
Reach-1	3700	PF 1	100.00	1261.00	6390.20	6399.39	9.19	0.67	329.30	0.05
Reach-1	3900	PF 1	200.00	1261.00	6390.00	6399.39	9.39	0.35	472.10	0.02
Reach-1	4300	PF 1	400.00	1261.00	6391.47	6399.39	7.92	0.60	315.47	0.04
Reach-1	4400	PF 1	100.00	1261.00	6395.90	6400.89	4.98	10.33	75.10	0.85
Reach-1	4700	PF 1	300.00	1261.00	6402.00	6405.06	3.06	8.33	79.02	0.99
Reach-1	5200	PF 1	500.00	1041.00	6407.37	6411.46	4.09	9.67	49.76	0.90
Reach-1	5700	PF 1	500.00	1041.00	6411.39	6416.46	5.07	11.01	38.10	0.92
Reach-1	6100	PF 1	400.00	1041.00	6419.00	6423.85	4.85	11.58	21.65	1.00

HEC-RAS Version 4.0 Beta
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X     X    X   X
XXXXXXX  XXXX     X       XXX XXXX      XXXXXX    XXXX
X     X  X        X           X  X      X    X        X
X     X  X        X    X      X   X     X    X        X
X     X  XXXXXX    XXXX       X    X    X    X    XXXXX
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PROJECT DATA
Project Title: Hanna Ridge - d/s Reach EFSC w/ Hannah Ridge Undeveloped
Project File : 60754EFSCex.prj
Run Date and Time: 10/22/2007 9:36:22 AM

Project in English units

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PLAN DATA

Plan Title: Hannah Ridge - EFSC - D/S
Plan File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCex.p05

Geometry Title: Hannah Ridge - EFSC - D/S
Geometry File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCex.g04

Flow Title : Hannah Ridge - EFSC - D/S
Flow File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCex.f04

Plan Summary Information:

Number of:	Cross Sections	= 19	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

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FLOW DATA

Flow Title: Hannah Ridge - EFSC - D/S
Flow File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCex.f04

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	6100	856
RIVER-1	Reach-1	4700	1004
RIVER-1	Reach-1	3200	1151
RIVER-1	Reach-1	200	1151

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	PF 1		Normal S = 0.0125

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	6100	.045	.035	.045
Reach-1	5700	.045	.035	.045
Reach-1	5200	.045	.035	.045
Reach-1	4700	.045	.035	.045
Reach-1	4400	.045	.035	.045
Reach-1	4300	.045	.035	.045
Reach-1	3900	.045	.035	.045
Reach-1	3700	.045	.035	.045
Reach-1	3600	.045	.035	.045
Reach-1	3500	.045	.035	.045
Reach-1	3200	.045	.035	.045
Reach-1	2800	.045	.035	.045
Reach-1	2400	.045	.035	.045
Reach-1	2000	.045	.035	.045
Reach-1	1600	.045	.035	.045
Reach-1	1200	.045	.035	.045
Reach-1	900	.045	.035	.045
Reach-1	600	.045	.035	.045
Reach-1	200	.045	.035	.045

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	6100	390	400	370
Reach-1	5700	410	500	420
Reach-1	5200	470	500	470
Reach-1	4700	320	300	260
Reach-1	4400	80	100	140
Reach-1	4300	300	400	360
Reach-1	3900	190	200	220
Reach-1	3700	80	100	130
Reach-1	3600	80	100	150
Reach-1	3500	280	300	290
Reach-1	3200	490	400	310
Reach-1	2800	370	400	380
Reach-1	2400	370	400	410
Reach-1	2000	270	400	200

*Reach-1	* 1600	* 350*	400*	230*	
*Reach-1	* 1200	* 120*	300*	270*	
*Reach-1	* 900	* 330*	300*	360*	
*Reach-1	* 600	* 330*	400*	430*	
*Reach-1	* 200	* 0*	0*	0*	

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
*Reach-1	* 6100	* .1*	.3*
*Reach-1	* 5700	* .1*	.3*
*Reach-1	* 5200	* .1*	.3*
*Reach-1	* 4700	* .1*	.3*
*Reach-1	* 4400	* .1*	.3*
*Reach-1	* 4300	* .1*	.3*
*Reach-1	* 3900	* .1*	.3*
*Reach-1	* 3700	* .1*	.3*
*Reach-1	* 3600	* .1*	.3*
*Reach-1	* 3500	* .1*	.3*
*Reach-1	* 3200	* .1*	.3*
*Reach-1	* 2800	* .1*	.3*
*Reach-1	* 2400	* .1*	.3*
*Reach-1	* 2000	* .1*	.3*
*Reach-1	* 1600	* .1*	.3*
*Reach-1	* 1200	* .1*	.3*
*Reach-1	* 900	* .1*	.3*
*Reach-1	* 600	* .1*	.3*
*Reach-1	* 200	* .1*	.3*

Profile Output Table - User Table 1

Reach	River Sta	Profile	Length Chnl (ft)	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Max Chl Dpth (ft)	Vel Chnl (ft/s)	Top Width (ft)	Froude # Chl
Reach-1	200	PF 1		1151.00	6364.10	6365.40	1.30	4.83	262.28	0.84
Reach-1	600	PF 1	400.00	1151.00	6369.50	6370.72	1.22	4.87	370.19	0.88
Reach-1	900	PF 1	300.00	1151.00	6372.09	6373.92	1.83	4.23	640.19	0.65
Reach-1	1200	PF 1	300.00	1151.00	6373.55	6375.17	1.62	2.78	694.72	0.40
Reach-1	1600	PF 1	400.00	1151.00	6375.00	6376.41	1.41	4.03	489.40	0.65
Reach-1	2000	PF 1	400.00	1151.00	6376.90	6379.00	2.10	4.12	232.10	0.66
Reach-1	2400	PF 1	400.00	1151.00	6381.76	6383.46	1.70	5.41	294.21	0.93
Reach-1	2800	PF 1	400.00	1151.00	6385.00	6387.69	2.69	5.68	315.32	0.72
Reach-1	3200	PF 1	400.00	1151.00	6392.00	6394.22	2.22	5.75	291.06	0.87
Reach-1	3500	PF 1	300.00	1004.00	6396.28	6397.87	1.58	4.52	328.02	0.79
Reach-1	3600	PF 1	100.00	1004.00	6396.50	6398.75	2.25	4.73	153.71	0.71
Reach-1	3700	PF 1	100.00	1004.00	6390.20	6399.13	8.93	0.56	324.09	0.04
Reach-1	3900	PF 1	200.00	1004.00	6390.00	6399.13	9.13	0.29	469.40	0.02
Reach-1	4300	PF 1	400.00	1004.00	6391.47	6399.14	7.66	0.49	313.17	0.03
Reach-1	4400	PF 1	100.00	1004.00	6395.90	6400.46	4.56	9.44	63.93	0.81
Reach-1	4700	PF 1	300.00	1004.00	6402.00	6404.75	2.75	7.76	76.29	0.99
Reach-1	5200	PF 1	500.00	856.00	6407.37	6411.09	3.72	9.12	47.80	0.90
Reach-1	5700	PF 1	500.00	856.00	6411.39	6416.02	4.63	10.37	36.41	0.91
Reach-1	6100	PF 1	400.00	856.00	6419.00	6423.30	4.30	10.96	21.15	1.00

HEC-RAS Version 4.0 Beta
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
X     X  X        X             X  X    X    X       X
X     X  X        X    X        X   X   X    X       X
X     X  XXXXXX    XXXX        X    X  X    X   XXXXX
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PROJECT DATA
Project Title: Hanna Ridge - d/s Reach EFSC WITH HANNAH RIDGE PHASE I DEVELOPED ONLY
Project File : 60754EFSCPH1.prj
Run Date and Time: 11/15/2007 10:31:16 AM

Project in English units

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PLAN DATA

Plan Title: Hannah Ridge - EFSC - D/S
Plan File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCPH1.p05

Geometry Title: Hannah Ridge - EFSC - D/S
Geometry File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCPH1.g04

Flow Title : Hannah Ridge - EFSC - D/S
Flow File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCPH1.f04

Plan Summary Information:

Number of:	Cross Sections	= 19	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

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FLOW DATA

Flow Title: Hannah Ridge - EFSC - D/S
Flow File : C:\Documents and Settings\User\My Documents\HEC Data\RAS\Hannah\60754EFSCPH1.f04

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	6100	876
RIVER-1	Reach-1	4700	1030
RIVER-1	Reach-1	3200	1180
RIVER-1	Reach-1	200	1180

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	PF 1		Normal S = 0.0125

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	6100	.045	.035	.045
Reach-1	5700	.045	.035	.045
Reach-1	5200	.045	.035	.045
Reach-1	4700	.045	.035	.045
Reach-1	4400	.045	.035	.045
Reach-1	4300	.045	.035	.045
Reach-1	3900	.045	.035	.045
Reach-1	3700	.045	.035	.045
Reach-1	3600	.045	.035	.045
Reach-1	3500	.045	.035	.045
Reach-1	3200	.045	.035	.045
Reach-1	2800	.045	.035	.045
Reach-1	2400	.045	.035	.045
Reach-1	2000	.045	.035	.045
Reach-1	1600	.045	.035	.045
Reach-1	1200	.045	.035	.045
Reach-1	900	.045	.035	.045
Reach-1	600	.045	.035	.045
Reach-1	200	.045	.035	.045

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	6100	390	400	370
Reach-1	5700	410	500	420
Reach-1	5200	470	500	470
Reach-1	4700	320	300	260
Reach-1	4400	80	100	140
Reach-1	4300	300	400	360
Reach-1	3900	190	200	220
Reach-1	3700	80	100	130
Reach-1	3600	80	100	150
Reach-1	3500	280	300	290
Reach-1	3200	490	400	310
Reach-1	2800	370	400	380
Reach-1	2400	370	400	410
Reach-1	2000	270	400	200

*Reach-1	* 1600	* 350*	400*	230*
*Reach-1	* 1200	* 120*	300*	270*
*Reach-1	* 900	* 330*	300*	360*
*Reach-1	* 600	* 330*	400*	430*
*Reach-1	* 200	* 0*	0*	0*

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
*Reach-1	* 6100	* .1*	.3*
*Reach-1	* 5700	* .1*	.3*
*Reach-1	* 5200	* .1*	.3*
*Reach-1	* 4700	* .1*	.3*
*Reach-1	* 4400	* .1*	.3*
*Reach-1	* 4300	* .1*	.3*
*Reach-1	* 3900	* .1*	.3*
*Reach-1	* 3700	* .1*	.3*
*Reach-1	* 3600	* .1*	.3*
*Reach-1	* 3500	* .1*	.3*
*Reach-1	* 3200	* .1*	.3*
*Reach-1	* 2800	* .1*	.3*
*Reach-1	* 2400	* .1*	.3*
*Reach-1	* 2000	* .1*	.3*
*Reach-1	* 1600	* .1*	.3*
*Reach-1	* 1200	* .1*	.3*
*Reach-1	* 900	* .1*	.3*
*Reach-1	* 600	* .1*	.3*
*Reach-1	* 200	* .1*	.3*

Profile Output Table - User Table 1

Reach	River Sta	Profile	Length Chnl (ft)	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Max Chl Dpth (ft)	Vel Chnl (ft/s)	Top Width (ft)	Froude # Chl
Reach-1	200	PF 1		1180.00	6364.10	6365.41	1.31	4.88	263.06	0.84
Reach-1	600	PF 1	400.00	1180.00	6369.50	6370.73	1.23	4.91	373.94	0.88
Reach-1	900	PF 1	300.00	1180.00	6372.09	6373.93	1.84	4.25	643.17	0.65
Reach-1	1200	PF 1	300.00	1180.00	6373.55	6375.19	1.64	2.80	696.47	0.41
Reach-1	1600	PF 1	400.00	1180.00	6375.00	6376.43	1.43	4.06	492.03	0.65
Reach-1	2000	PF 1	400.00	1180.00	6376.90	6379.02	2.12	4.16	232.56	0.66
Reach-1	2400	PF 1	400.00	1180.00	6381.76	6383.48	1.72	5.44	295.79	0.92
Reach-1	2800	PF 1	400.00	1180.00	6385.00	6387.71	2.71	5.72	315.89	0.72
Reach-1	3200	PF 1	400.00	1180.00	6392.00	6394.25	2.25	5.76	296.99	0.86
Reach-1	3500	PF 1	300.00	1030.00	6396.28	6397.88	1.59	4.58	328.68	0.80
Reach-1	3600	PF 1	100.00	1030.00	6396.50	6398.77	2.27	4.79	154.73	0.72
Reach-1	3700	PF 1	100.00	1030.00	6390.20	6399.16	8.96	0.57	324.67	0.04
Reach-1	3900	PF 1	200.00	1030.00	6390.00	6399.16	9.16	0.29	469.71	0.02
Reach-1	4300	PF 1	400.00	1030.00	6391.47	6399.16	7.69	0.51	313.43	0.03
Reach-1	4400	PF 1	100.00	1030.00	6395.90	6400.51	4.61	9.52	64.51	0.81
Reach-1	4700	PF 1	300.00	1030.00	6402.00	6404.79	2.79	7.78	76.67	0.98
Reach-1	5200	PF 1	500.00	876.00	6407.37	6411.14	3.77	9.16	48.05	0.90
Reach-1	5700	PF 1	500.00	876.00	6411.39	6416.08	4.69	10.44	36.61	0.91
Reach-1	6100	PF 1	400.00	876.00	6419.00	6423.35	4.35	11.06	21.19	1.01

HEC-RAS Plan: EFSC River: RIVER-1 Reach: Reach-1 Profile: PF 1 HANNAH RIDGE UNDEVELOPED

Reach	River Sta	Profile	Length Chnl	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Top Width	Froude # Chl
			(ft)	(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)	
Reach-1	200	PF 1		1151.00	6364.10	6365.40	1.30	4.83	262.28	0.84
Reach-1	600	PF 1	400.00	1151.00	6369.50	6370.72	1.22	4.87	370.19	0.88
Reach-1	900	PF 1	300.00	1151.00	6372.09	6373.92	1.83	4.23	640.19	0.65
Reach-1	1200	PF 1	300.00	1151.00	6373.55	6375.17	1.62	2.78	694.72	0.40
Reach-1	1600	PF 1	400.00	1151.00	6375.00	6376.41	1.41	4.03	489.40	0.65
Reach-1	2000	PF 1	400.00	1151.00	6376.90	6379.00	2.10	4.12	232.10	0.66
Reach-1	2400	PF 1	400.00	1151.00	6381.76	6383.46	1.70	5.41	294.21	0.93
Reach-1	2800	PF 1	400.00	1151.00	6385.00	6387.69	2.69	5.68	315.32	0.72
Reach-1	3200	PF 1	400.00	1151.00	6392.00	6394.22	2.22	5.75	291.06	0.87
Reach-1	3500	PF 1	300.00	1004.00	6396.28	6397.87	1.58	4.52	328.02	0.79
Reach-1	3600	PF 1	100.00	1004.00	6396.50	6398.75	2.25	4.73	153.71	0.71
Reach-1	3700	PF 1	100.00	1004.00	6390.20	6399.13	8.93	0.56	324.09	0.04
Reach-1	3900	PF 1	200.00	1004.00	6390.00	6399.13	9.13	0.29	469.40	0.02
Reach-1	4300	PF 1	400.00	1004.00	6391.47	6399.14	7.66	0.49	313.17	0.03
Reach-1	4400	PF 1	100.00	1004.00	6395.90	6400.46	4.56	9.44	63.93	0.81
Reach-1	4700	PF 1	300.00	1004.00	6402.00	6404.75	2.75	7.76	76.29	0.99
Reach-1	5200	PF 1	500.00	856.00	6407.37	6411.09	3.72	9.12	47.80	0.90
Reach-1	5700	PF 1	500.00	856.00	6411.39	6416.02	4.63	10.37	36.41	0.91
Reach-1	6100	PF 1	400.00	856.00	6419.00	6423.30	4.30	10.96	21.15	1.00

Hannah Ridge Developed

HEC-RAS Plan: EFSC River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Length Chnl	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Top Width	Froude # Chl
			(ft)	(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)	
Reach-1	200	PF 1		1433.00	6364.10	6365.54	1.44	5.26	269.73	0.86
Reach-1	600	PF 1	400.00	1433.00	6369.50	6370.84	1.34	5.26	413.69	0.90
Reach-1	900	PF 1	300.00	1433.00	6372.09	6374.05	1.96	4.43	683.65	0.65
Reach-1	1200	PF 1	300.00	1433.00	6373.55	6375.31	1.75	2.99	711.13	0.42
Reach-1	1600	PF 1	400.00	1433.00	6375.00	6376.54	1.54	4.31	502.46	0.66
Reach-1	2000	PF 1	400.00	1433.00	6376.90	6379.15	2.25	4.57	256.03	0.69
Reach-1	2400	PF 1	400.00	1433.00	6381.76	6383.60	1.84	5.80	304.15	0.93
Reach-1	2800	PF 1	400.00	1433.00	6385.00	6387.85	2.85	6.05	320.76	0.74
Reach-1	3200	PF 1	400.00	1433.00	6392.00	6394.37	2.37	6.19	326.62	0.90
Reach-1	3500	PF 1	300.00	1261.00	6396.28	6398.02	1.74	4.78	338.38	0.78
Reach-1	3600	PF 1	100.00	1261.00	6396.50	6398.90	2.40	5.35	161.37	0.78
Reach-1	3700	PF 1	100.00	1261.00	6390.20	6399.39	9.19	0.67	329.30	0.05
Reach-1	3900	PF 1	200.00	1261.00	6390.00	6399.39	9.39	0.35	472.10	0.02
Reach-1	4300	PF 1	400.00	1261.00	6391.47	6399.39	7.92	0.60	315.47	0.04
Reach-1	4400	PF 1	100.00	1261.00	6395.90	6400.89	4.98	10.33	75.10	0.85
Reach-1	4700	PF 1	300.00	1261.00	6402.00	6405.06	3.06	8.33	79.02	0.99
Reach-1	5200	PF 1	500.00	1041.00	6407.37	6411.46	4.09	9.67	49.76	0.90
Reach-1	5700	PF 1	500.00	1041.00	6411.39	6416.46	5.07	11.01	38.10	0.92
Reach-1	6100	PF 1	400.00	1041.00	6419.00	6423.85	4.85	11.58	21.65	1.00

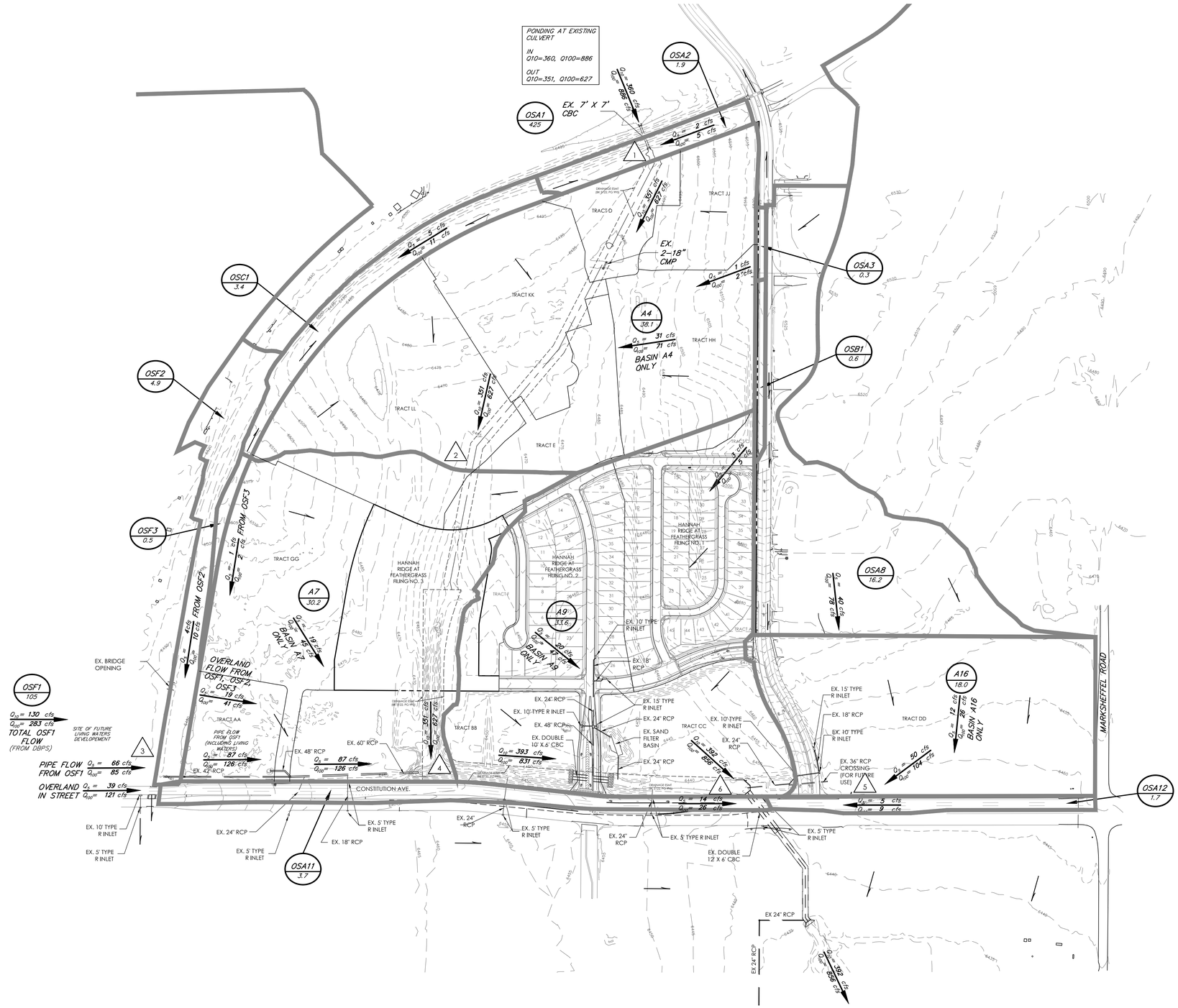
HEC-RAS Plan: EFSC River: RIVER-1 Reach: Reach-1 Profile: PF 1

HANNAH RIDGE – PHASE 1 ONLY

Reach	River Sta	Profile	Length Chnl	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Top Width	Froude # Chl
			(ft)	(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)	
Reach-1	200	PF 1		1180.00	6364.10	6365.41	1.31	4.88	263.06	0.84
Reach-1	600	PF 1	400.00	1180.00	6369.50	6370.73	1.23	4.91	373.94	0.88
Reach-1	900	PF 1	300.00	1180.00	6372.09	6373.93	1.84	4.25	643.17	0.65
Reach-1	1200	PF 1	300.00	1180.00	6373.55	6375.19	1.64	2.80	696.47	0.41
Reach-1	1600	PF 1	400.00	1180.00	6375.00	6376.43	1.43	4.06	492.03	0.65
Reach-1	2000	PF 1	400.00	1180.00	6376.90	6379.02	2.12	4.16	232.56	0.66
Reach-1	2400	PF 1	400.00	1180.00	6381.76	6383.48	1.72	5.44	295.79	0.92
Reach-1	2800	PF 1	400.00	1180.00	6385.00	6387.71	2.71	5.72	315.89	0.72
Reach-1	3200	PF 1	400.00	1180.00	6392.00	6394.25	2.25	5.76	296.99	0.86
Reach-1	3500	PF 1	300.00	1030.00	6396.28	6397.88	1.59	4.58	328.68	0.80
Reach-1	3600	PF 1	100.00	1030.00	6396.50	6398.77	2.27	4.79	154.73	0.72
Reach-1	3700	PF 1	100.00	1030.00	6390.20	6399.16	8.96	0.57	324.67	0.04
Reach-1	3900	PF 1	200.00	1030.00	6390.00	6399.16	9.16	0.29	469.71	0.02
Reach-1	4300	PF 1	400.00	1030.00	6391.47	6399.16	7.69	0.51	313.43	0.03
Reach-1	4400	PF 1	100.00	1030.00	6395.90	6400.51	4.61	9.52	64.51	0.81
Reach-1	4700	PF 1	300.00	1030.00	6402.00	6404.79	2.79	7.78	76.67	0.98
Reach-1	5200	PF 1	500.00	876.00	6407.37	6411.14	3.77	9.16	48.05	0.90
Reach-1	5700	PF 1	500.00	876.00	6411.39	6416.08	4.69	10.44	36.61	0.91
Reach-1	6100	PF 1	400.00	876.00	6419.00	6423.35	4.35	11.06	21.19	1.01

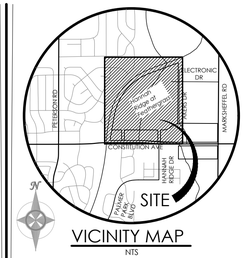
E. Fork Sand Creek - Reach downstream of Constitution Ave.

River Sta	H.R. Undev W.S. Elev (ft)	H.R. Dev W.S. Elev (ft)	Difference from Exist (ft)	H.R. PH1 W.S. Elev (ft)	Difference from Exist (ft)
200	6365.40	6365.54	0.14	6365.41	0.01
600	6370.72	6370.84	0.12	6370.73	0.01
900	6373.92	6374.05	0.13	6373.93	0.01
1200	6375.17	6375.31	0.14	6375.19	0.02
1600	6376.41	6376.54	0.13	6376.43	0.02
2000	6379.00	6379.15	0.15	6379.02	0.02
2400	6383.46	6383.60	0.14	6383.48	0.02
2800	6387.69	6387.85	0.16	6387.71	0.02
3200	6394.22	6394.37	0.15	6394.25	0.03
3500	6397.87	6398.02	0.15	6397.88	0.01
3600	6398.75	6398.90	0.15	6398.77	0.02
3700	6399.13	6399.39	0.26	6399.16	0.03
3900	6399.13	6399.39	0.26	6399.16	0.03
4300	6399.14	6399.39	0.25	6399.16	0.02
4400	6400.46	6400.89	0.43	6400.51	0.05
4700	6404.75	6405.06	0.31	6404.79	0.04
5200	6411.09	6411.46	0.37	6411.14	0.05
5700	6416.02	6416.46	0.44	6416.08	0.06
6100	6423.30	6423.85	0.55	6423.35	0.05



EXISTING SUMMARY RUNOFF TABLE				
BASIN or DESIGN POINT	CONTRIBUTING BASINS	CONTRIBUTING AREA (AC)	5-YR(Q5) RUNOFF (CFS)*	100-YR (Q100) RUNOFF (CFS)
OSA1 (IN)		425	360 *	886 (IN)
1 (OUT)	OSA1	425	351 *	627 (OUT)
OSA2		1.9	2	5
OSA3		0.3	1	2
OSC1		3.4	5	11
A4		38.1	31	71
2	OSA1, OSA2, OSA3, OSC1, A4	468.7	351 *	627
3	OSF1	105	130 *	283
OSF2		4.9	4	9
OSF3		0.5	1	2
A7		30.2	19	45
4	OSA1, OSA2, OSA3, OSC1, A4, OSF1, OSF2, OSF3, F7	137.1	393 *	831
OSB1		0.6	3	5
A9		33.6	19	46
OSA8		16.2	40	78
A16		18.0	12	26
5	OSA8, A16	34.2	50	103
OSA11		3.7	12	21
OSA12		1.7	5	9
6	OSA1, OSA2, OSA3, OSC1, A4, OSF1, OSF2, OSF3, A7, A9, OSB1, OSA8, A16, OSA11, OSA12	650.5	392 *	856

* NOTE: MAIN CHANNEL MINOR STORM FLOW RATES ARE10-YEAR IN ACCORDANCE WITH DRAINAGE BASIN PLANNING STUDY



VICINITY MAP
NTS

BENCHMARK

THE BENCHMARK FOR THESE PLANS IS THE TOP OF #4 REBAR, PANEL POINT NO. 1, LOCATED ON THE SOUTH EDGE OF CONSTITUTION AVE AND THE WEST EDGE OF THE ROCK ISLAND TRAIL, 535 FEET WEST OF THE CENTERLINE OF SHAWNEE DR. ELEVATION = 6486.63. (EPC DATUM ELEVATION = 6485.29).

N

50 0 100 200 400

1" = 200' 1:2,400

LEGEND

- EXISTING INDEX CONTOUR (7300)
- EXISTING STORM DRAIN CURB INLET
- EXISTING STORM DRAIN LINE (24" RCP)
- EXISTING PROPERTY LINE
- EXISTING ROAD
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN DESIGNATION (OSA2 / 14.9)
- DRAINAGE BASIN AREA (A5 / 2.6)
- FLOW DIRECTION AND QUANTITIES (Q_5 = 3.3 cfs, Q_{100} = 7.4 cfs)
- FLOW DIRECTION
- DESIGN POINT (2)

MVE, INC.
ENGINEERS, SURVEYORS
1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

Hannah Ridge at Feathergrass

EXISTING DRAINAGE MAP

MVE PROJECT **60970**
MVE DRAWING 60970111-F3

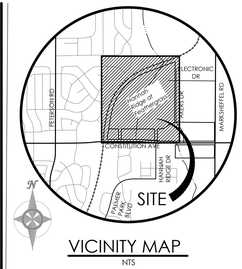
Apri 20, 2017
SHEET 1 OF 1

LEGEND

- 7300 — EXISTING INDEX CONTOUR
- EXISTING STORM DRAIN CURB INLET
- 24" RCP — EXISTING STORM DRAIN LINE
- EXISTING PROPERTY LINE
- EXISTING ROAD
- DRAINAGE BASIN BOUNDARY
- OSA2 / 14.9 — DRAINAGE BASIN DESIGNATION
- A5 / 2.6 — DRAINAGE BASIN AREA
- Q_5 = 3.3 cfs, Q_{100} = 7.4 cfs — FLOW DIRECTION AND QUANTITIES
- FLOW DIRECTION
- 2 — DESIGN POINT

DEVELOPED SUMMARY RUNOFF TABLE					
BASIN or DESIGN POINT	CONTRIBUTING BASINS	CONTRIBUTING AREA (AC)	5-YR(Q5) RUNOFF (CFS)*	100-YR (Q100) RUNOFF (CFS)	DESCRIPTION
OSA1 (IN)		425	374 *	915 (IN)	
1 (OUT)	OSA1	425	360 *	640 (OUT)	EX 7x7 CBC
2	OSA1, OSA2, A6	430.8	360 *	640 *	12'Wx6'H CBC
3	A1,A2,OSA3,A3	4.2	9.4	18.8	CROSS PAN
4	A1,A2,OSA3,A3,A4	4.4	9.7	19.2	10' TYPE R INLET (SUMP)
5	A5	0.2	0.7	1.3	5' TYPE R INLET (SUMP)
6	OSB1,B1,B2,B3,B4,B5,B6	8.2	19.5	38.5	CROSS PAN
7	OSB1,B1,B2,B3,B4,B5,B6,B7	8.9	20.4	40.1	15' TYPE R (SUMP),15' TYPE R INLETS
8	OSC1,C1	8.6	15.0	31.1	10' TYPE R (SUMP),10' TYPE R INLETS
9	C3,C5	3.6	8.9	17.8	15' TYPE R INLET (SUMP)
10	C2,C4	2.3	5.5	10.9	10' TYPE R INLET (SUMP)
11	C7,C8,C9,C11	6.1	13.4	26.6	15' TYPE R INLET (SUMP)
12	C6,C10	3.2	6.6	14.1	10' TYPE R INLET (SUMP)
13	C12	1.5	3.7	7.4	5' TYPE R INLET (SUMP)
14	OSA1-A6,OSB1-B9, OSC1-C12	476	360 *	640 *	10'Wx6'H CBC & 90" RCP
15	D1,D2,D3,D4,D5,D6	7.8	19.2	38.0	CROSS PAN
16	D1,D2,D3,D4,D5,D6,D7	11.7	26.6	52.8	10' TYPE R & 15' TYPE R INLETS
17	D1-D7,D9,D11	13.9	29.6	59.0	15' TYPE R INLET (SUMP)
18	D8,D10,D12	4.0	8.7	17.1	10' TYPE R INLET (SUMP)
19	E1,E2,E3	5.0	11.9	23.7	15' TYPE R INLET
20	E1,E2,E3,E4,E5,E7	11.0	23.4	48.4	15' TYPE R (SUMP),TYPE C INLETS
21	E6	1.8	4.5	9.0	5' TYPE R INLET (SUMP)
22	E8	0.7	1.8	3.6	5' TYPE R INLET (SUMP)
23	OSF1,F1,F2,F3	7.4	16.2	32.5	CROSS PAN
24	OSF1,F1,F2,F3,F5	11.0	23.4	48.4	15' TYPE R (SUMP),TYPE C INLETS
25	F4	0.3	0.9	1.9	5' TYPE R INLET (SUMP)
26	OSF2	4.9	4.2	9.6	TYPE D INLET (SUMP)
27	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5	619	428 *	991 *	OPEN CHANNEL
28	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12	647	428 *	991 *	DBL 10'Wx6'H CBC
29	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12, G1	685	457 *	1076 *	EXISTING DBL 12'Wx6'H CBC

* NOTE: MAIN CHANNEL MINOR STORM FLOW RATES ARE 10-YEAR IN ACCORDANCE WITH DRAINAGE BASIN PLANNING STUDY



VICINITY MAP
NTS

BENCHMARK

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N

50 0 100 200 400

1" = 200' 1:2,400

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1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

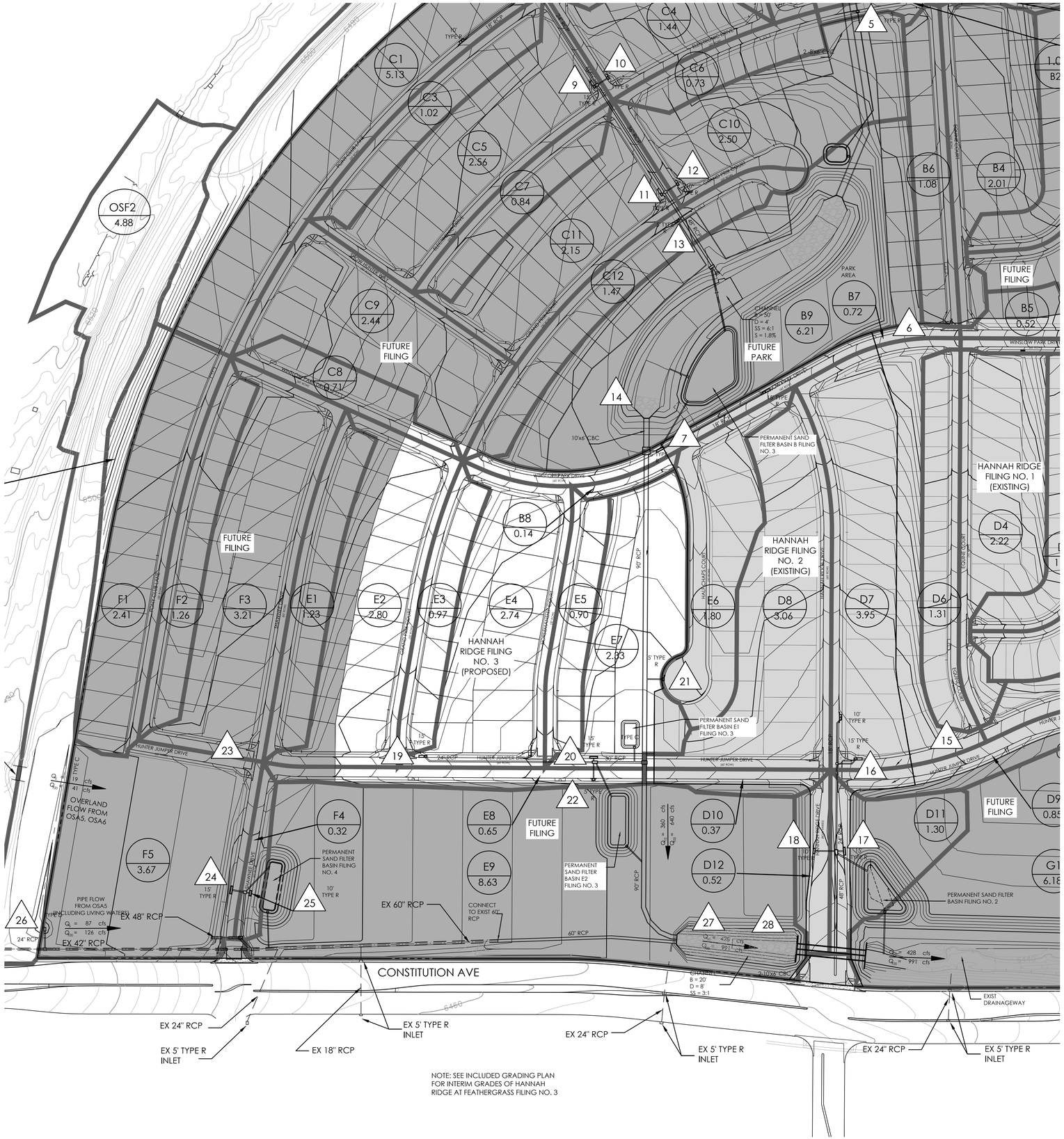
DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

Hannah Ridge at Feathergrass

Filing No. 3
DEVELOPED
Drainage Map

MVE PROJECT 60970
MVE DRAWING 60970112-F3

September 5, 2017
SHEET 1 OF 2



NOTE: SEE INCLUDED GRADING PLAN FOR INTERIM GRADES OF HANNAH RIDGE AT FEATHERGRASS FILING NO. 3

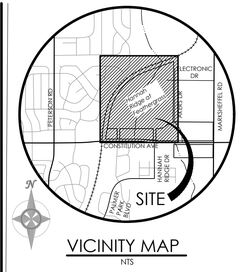
LEGEND

- EXISTING INDEX CONTOUR (7300)
- EXISTING STORM DRAIN CURB INLET
- EXISTING STORM DRAIN LINE (24" RCP)
- EXISTING PROPERTY LINE
- EXISTING ROAD
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN DESIGNATION (OSA2, 14.9) (A5, 2.6)
- DRAINAGE BASIN AREA
- FLOW DIRECTION AND QUANTITIES (Q_5 = 3.3 cfs, Q_{100} = 7.4 cfs)
- FLOW DIRECTION
- DESIGN POINT (2)

DEVELOPED SUMMARY RUNOFF TABLE

BASIN or DESIGN POINT	CONTRIBUTING BASINS	CONTRIBUTING AREA (AC)	5-YR(Q5) RUNOFF (CFS)*	100-YR (Q100) RUNOFF (CFS)	DESCRIPTION
OSA1 (IN)		425	374 *	915 (IN)	
1 (OUT)	OSA1	425	360 *	640 (OUT)	EX 7x7 CBC
2	OSA1, OSA2, A6	430.8	360 *	640 *	12'Wx6'H CBC
3	A1,A2,OSA3,A3	4.2	9.4	18.8	CROSS PAN
4	A1,A2,OSA3,A3,A4	4.4	9.7	19.2	10' TYPE R INLET (SUMP)
5	A5	0.2	0.7	1.3	5' TYPE R INLET (SUMP)
6	OSB1,B1,B2,B3,B4,B5,B6	8.2	19.5	38.5	CROSS PAN
7	OSB1,B1,B2,B3,B4,B5,B6,B7	8.9	20.4	40.1	15' TYPE R (SUMP),15' TYPE R INLETS
8	OSC1,C1	8.6	15.0	31.1	10' TYPE R (SUMP),10' TYPE R INLETS
9	C3,C5	3.6	8.9	17.8	15' TYPE R INLET (SUMP)
10	C2,C4	2.3	5.5	10.9	10' TYPE R INLET (SUMP)
11	C7,C8,C9,C11	6.1	13.4	26.6	15' TYPE R INLET (SUMP)
12	C6,C10	3.2	6.6	14.1	10' TYPE R INLET (SUMP)
13	C12	1.5	3.7	7.4	5' TYPE R INLET (SUMP)
14	OSA1-A6,OSB1-B9, OSC1-C12	476	360 *	640 *	10'Wx6'H CBC & 90" RCP
15	D1,D2,D3,D4,D5,D6	7.8	19.2	38.0	CROSS PAN
16	D1,D2,D3,D4,D5,D6,D7	11.7	26.6	52.8	10' TYPE R & 15' TYPE R INLETS
17	D1-D7,D9,D11	13.9	29.6	59.0	15' TYPE R INLET (SUMP)
18	D8,D10,D12	4.0	8.7	17.1	10' TYPE R INLET (SUMP)
19	E1,E2,E3	5.0	11.9	23.7	15' TYPE R INLET
20	E1,E2,E3,E4,E5,E7	11.0	23.4	48.4	15' TYPE R (SUMP),TYPE C INLETS
21	E6	1.8	4.5	9.0	5' TYPE R INLET (SUMP)
22	E8	0.7	1.8	3.6	5' TYPE R INLET (SUMP)
23	OSF1,F1,F2,F3	7.4	16.2	32.5	CROSS PAN
24	OSF1,F1,F2,F3,F5	11.0	23.4	48.4	15' TYPE R (SUMP),TYPE C INLETS
25	F4	0.3	0.9	1.9	5' TYPE R INLET (SUMP)
26	OSF2	4.9	4.2	9.6	TYPE D INLET (SUMP)
27	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5	619	428 *	991 *	OPEN CHANNEL
28	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12	647	428 *	991 *	DBL 10'Wx6'H CBC
29	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12, G1	685	457 *	1076 *	EXISTING DBL 12'Wx6'H CBC

* NOTE: MAIN CHANNEL MINOR STORM FLOW RATES ARE 10-YEAR IN ACCORDANCE WITH DRAINAGE BASIN PLANNING STUDY



VICINITY MAP
NTS

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N

10 0 50 100 200
1" = 100' 1:1,200

MVE, INC. ENGINEERS / SURVEYORS
1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

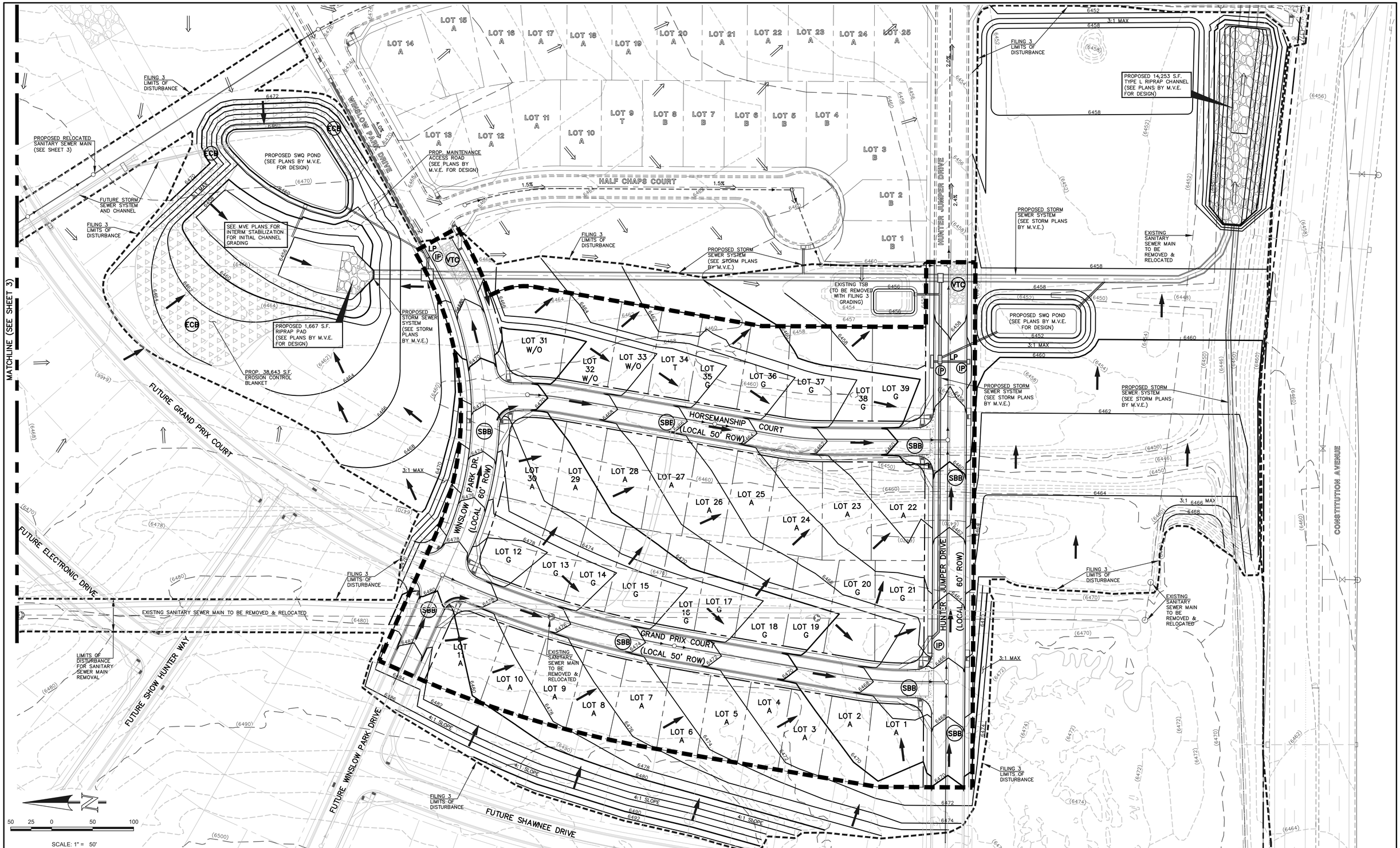
DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

Hannah Ridge at Feathergrass

Filing No. 3
DEVELOPED DRAINAGE MAP

MVE PROJECT 60970
MVE DRAWING 60970112-F3

September 5, 2017
SHEET 2 **OF** 2



LEGEND

EXISTING CONTOUR	(6060)	INLET PROTECTION (IP)
PROPOSED CONTOUR	6060	SILT FENCE (SF)
FILING LINE		VEHICLE TRACKING CONTROL (VTC)
A LOT	"A"	EROSION CONTROL BLANKET (ECB)
B LOT	"B"	(2) STRAW BALE CHECK DAM (BOTH SIDES OF ROADWAY) (SBB)
WALKOUT LOT	"W/O"	
GARDEN LOT	"G"	
TRANSITION LOT	"T"	
PROPOSED FLOW		
EXISTING FLOW		

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
811
UTILITY NOTIFICATION OF COLORADO
IT'S THE LAW

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NO.	REVISION	DATE

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE R. CAMPBELL, COLORADO P.E. #29794 DATE

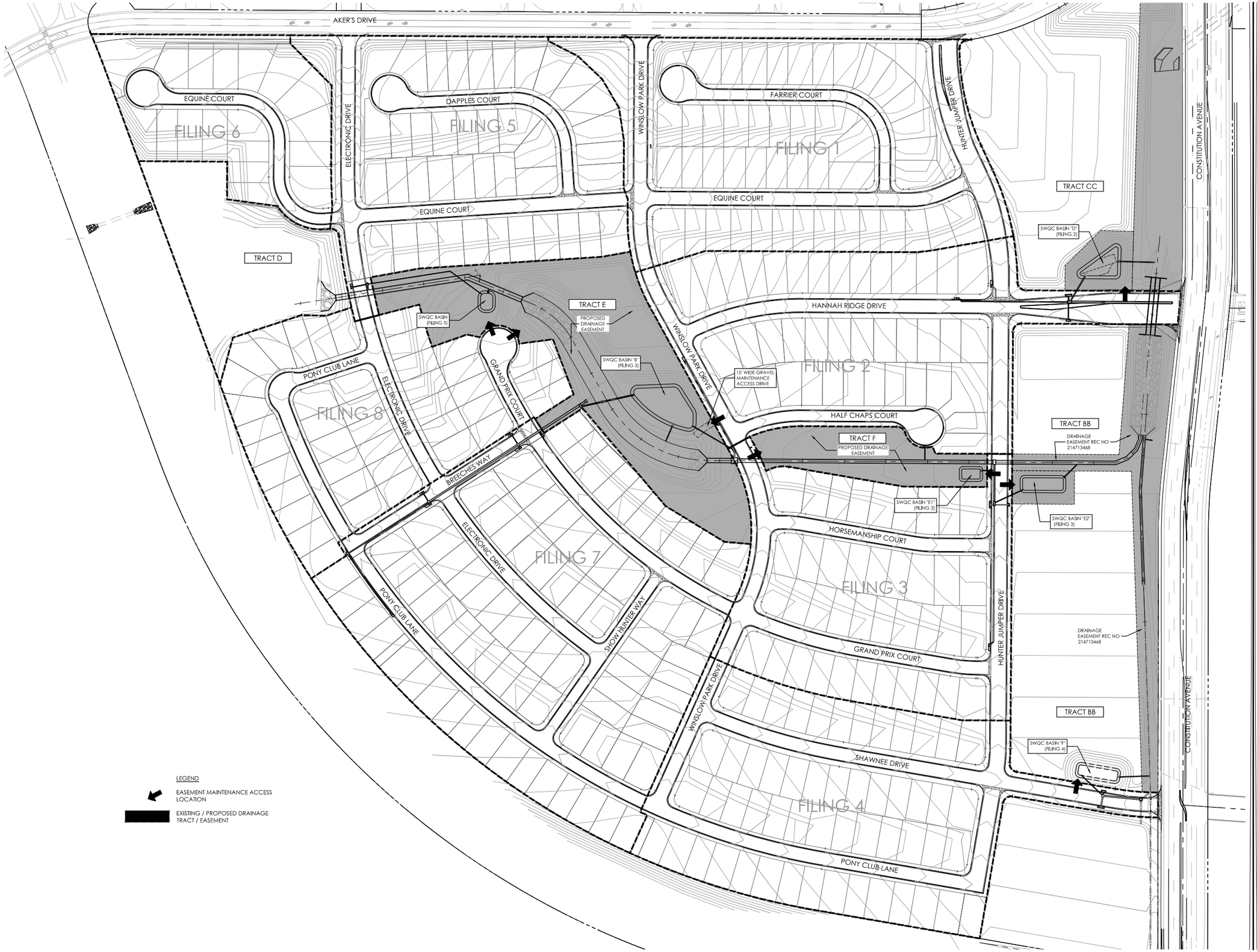
CLASSIC CONSULTING ENGINEERS & SURVEYS SM
6385 Corporate Drive, Suite 101 (719)785-0790
Colorado Springs, Colorado 80919 (719)785-0799(Fax)

HANNAH RIDGE AT FEATHERGRASS
FILING NO. 3
GRADING AND EROSION CONTROL PLAN

CLASSIC CONSULTING ENGINEERS & SURVEYORS

DESIGNED BY	KRC	SCALE		DATE	04/11/17
DRAWN BY	MES	(H) 1"= 50'		SHEET	2 OF 5
CHECKED BY		(V) 1"= N/A		JOB NO.	1116.03

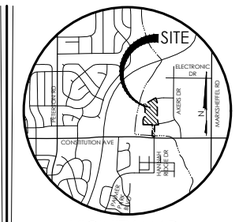
N:\1116\03\DRAWINGS\CONSTRUCTION\1160-FIL3-GC-02.dwg, 9/5/2017 9:01:04 AM, 1:1



LEGEND

EASEMENT MAINTENANCE ACCESS LOCATION

EXISTING / PROPOSED DRAINAGE TRACT / EASEMENT



VICINITY MAP

NTS

BENCHMARK

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BASIS OF BEARINGS: BEARING REFERRED TO HEREIN ARE BASED ON THE SOUTH LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 32, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M. ASSUMED TO BEAR N89°53'50"E.

N

10 0 50 100 200

1" = 100' 1:1,200

MVE, INC.
ENGINEERS / SURVEYORS
1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

DESIGNED BY DRG
DRAWN BY TJW
CHECKED BY
AS-BUILTS BY
CHECKED BY

Hannah Ridge
at Feathergrass

EASEMENT AND MAINTENANCE ACCESS EXHIBIT

MVE PROJECT **60970**

MVE DRAWING 069-StormMaint

SEPTEMBER 5, 2017

SHEET 1