MASTER DEVELOPMENT DRAINAGE PLAN AND FINAL DRAINAGE REPORT FOR SHILOH MESA & SHILOH MESA FILING No.1

December 2015

Prepared for:

COLA, LLC
1710 Jet Stream Drive
Colorado Springs, CO 80921
Mike DeGrant

Prepared by:

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Project #08-026

OFFICE COPY

MASTER DEVELOPMENT DRAINAGE PLAN
AND FINAL DRAINAGE REPORT FOR SHILOH MESA
& SHILOH MESA FILING NO. 1

DRAINAGE PLAN STATEMENTS

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 acceptable to the City of Colorado Springs. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M & S Civil Consultants, Inc.

DEVELOPER'S STATEMENT

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

COLA, LLC

BY: _____ DATE: 12-21-15
Mike DeGrant Authorized Rep

TITLE: Owner & Manager

ADDRESS: COLA, LLC
1710 Jet Stream Drive
Colorado Springs, CO 80921

CITY OF COLORADO SPRINGS

Filed in accordance with Section 7-7-906 of the Code of the City of Colorado Springs, 2001, as amended.

BY: _____ DATE: 1/8/16
For The City Engineer

CONDITIONS: Comments p.9, 16, 17

MASTER DEVELOPMENT DRAINAGE PLAN
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FOR SHILOH MESA & SHILOH MESA FILING NO. 1

CERTIFICATION STATEMENT

"This report and plan for the final drainage design of Master Development Drainage Plan and Final Drainage Report for Shiloh Mesa & Shiloh Mesa Filing No. 1 was prepared by me (or under my direct supervision) in accordance with the provisions of City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, Drainage Design and Technical Criteria for the owners thereof. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others."

SIGNATURE: _____

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M & S Civil Consultants, Inc.

" COLA, LLC hereby certifies that the drainage facilities for of Master Development Drainage Plan and Final Drainage Report for Shiloh Mesa & Shiloh Mesa Filing No. 1 shall be constructed according to the design presented in this report. COLA, LLC understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that the City of Colorado Springs reviews drainage plans pursuant to Colorado Revised Statutes, Title 30, Article 28 (verify reference to CRS); but cannot, on behalf of Master Development Drainage Plan and Final Drainage Report for Shiloh Mesa & Shiloh Mesa Filing No. 1, guarantee that fmal drainage design review will absolve COLA, LLC and/or their successors and /or assigns of future liability for improper design. COLA, LLC further understand that approval of the final plat does not imply approval of my engineer's drainage design."

COLA, LLC

BY: _____ DATE: 12-21-15

Mike DeGrant

MASTER DEVELOPMENT DRAINAGE PLAN
AND FINAL DRAINAGE REPORT FOR SHILOH MESA
& SHILOH MESA FILING NO. 1

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MASTER DEVELOPMENT DRAINAGE PLAN
AND FINAL DRAINAGE REPORT
FOR SHILOH MESA & SHILOH MESA FILING NO. 1

PURPOSE

This document is the Master Development Drainage Plan and Final Drainage Report for Shiloh Mesa & Shiloh Mesa Filing No. 1. The purpose of this document is to identify and analyze on and offsite drainage patterns and to ensure that post development runoff is routed through the site safely and in a manner that satisfies the requirements set forth by the Drainage Criteria Manual. The site to be known as Shiloh Mesa & Shiloh Mesa Filing No. 1 will be developed as single family lots with common areas and trails.

GENERAL LOCATION AND DESCRIPTION

Shiloh Mesa-Residential is located in Section 4, Township 13 South, Range 65 West of the 6th P.M. in the City of Colorado Springs, El Paso County, Colorado. The site is bound on the north by low density residential development and by Sand Creek. The eastern boundary is bound by the Mustang Road right-of way. The majority of the western boundary of the site is bounded by Sand Creek and future Marksheffel rights-of-way. The southern reach of the western boundary is bounded by the future alignment of N. Marksheffel Road. The southern boundary is bounded by Woodmen Valley Chapel. Woodmen Road lies beyond Woodmen Valley Chapel, approximately 1800 feet to the south. The site lies within the Sand Creek Drainage Basin. Flows from this site are tributary to Sand Creek.

The Shiloh Mesa property consists of 68.88 acres total (including the platted portion of Marksheffel Road) and the Shiloh Mesa Filing No. 1 (including the platted portion of Marksheffel Road) consist of 19.956 acres which is presently undeveloped. Vegetation is sparse, consisting of native grasses, shrubs and a few trees. Existing site terrain generally slopes from north to south and southwest at grade rates that vary between 2% and 15%.

The Shiloh Mesa & Shiloh Mesa Filing No. 1 property is currently zoned "PUD" and is proposed as a phased, Single Family Residential Development. Improvements proposed with Shiloh Mesa include paving, trails, sanitary sewer, water, storm drain, and three (3) water quality ponds to serve a total of 237 lots. Development will occur over 4 phases.

SOILS

Soils for this project are delineated by the map in the appendix as Columbine gravelly sandy loam (19) and Pring Coarse Sandy Loam (71) and is characterized as Hydrologic Soil Types "A" & "B", respectively. Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area". The study area consists of undeveloped land with sparse, grassy vegetation, shrubs, and a few trees.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual the pertinent data sheets are included in the appendix of this report.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0535 F, effective date March 17, 1997 and revised to reflect LOMR, dated December 7, 2005, the site lies adjacent to and is impacted by a SFHA Zone "AE". A zone "AE" is an area that is likely to be inundated by flows that occur during a 100-year event, for which a detailed study has been performed and for which Base Flood Elevations have been established. An annotated FIRM Panel is included in the Appendix with selected portions of Case No. 04-08- 0779P. The floodplain has been shown on the Shiloh Mesa Pre-Development and Post-Development Hydrology Maps also located in the appendix of the report

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual. Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method as required for basins having areas less than 100 acres.

EXISTING DRAINAGE CONDITIONS

The overall site consists of 68.88 acres and is situated on the northern reach of the Sand Creek Watershed (refer to the Shiloh Mesa Pre Development Hydrology Map in the appendix). This area was previously studied in the approved "Sand Creek Drainage Basin Planning Study", by Kiowa Engineering Corporation (DBPS), and subsequently in the approved "Master Development Drainage Plan for Woodmen Heights Master Plan", by Classic Consulting Engineers & Surveyors (Classic MDDP) approved August 2004 and the "Master Development Drainage Plan for Shiloh Mesa at Woodmen Heights Sand Creek Drainage Basin", by Matrix Design Group, Inc. (Matrix MDDP) approved November 2009. In order to compare past studies, a portion of the drainage basins within this study are denoted by asterisks. The drainage basins labels preceded (or followed) by an single asterisk (*) are referencing watersheds previously illustrated and/or described within the "Master Development Drainage Plan for Woodmen Heights Master Plan", by Classic Consulting Engineers, & Surveyors. Those drainage basins labels preceded (or followed) by two asterisks (**) are referencing watersheds previously illustrated and/or described within the " Master Development Drainage Plan for Shiloh Mesa at Woodmen Heights Sand Creek Drainage Basin", by Matrix Design Group Inc. that have been altered slightly by this report in size and discharge due to additional available information at the time of this report. Refer the drainage basin descriptions that follow for additional information as well as the drainage map located within the appendix of this report.

Flows tributary to the eastern boundary of this site are characterized by Basin "OS-5" in the Classic MDDP. The offsite tributary consists of 323 acres and generates 72 cfs & 340 cfs during the 5 and 100-year events, respectively (SCS method). This same basin was later studied in the Matrix MDDP and the offsite tributary consisted of 323 acres and generated 201.7 cfs & 404.0 cfs during the 5 and 100-year events, respectively (rational method). The difference in the flows note between the two

report lies in the land use and the criteria used to evaluate the basin. Per the Drainage Criteria Manual implemented by the City of Colorado Springs (at the time both reports were written) it is recommended the SCS method be utilized to evaluate a drainage basin of this size. As such, the Classic MDDP flow rates have be utilized when analyzing runoff from Basin "OS-5" (henceforth OS5* or *OS5). Per the report, in the existing condition the offsite flows from Basin OS5* cross Mustang Road via existing culverts located to the south of Kenosha Drive. The existing culvert crossing was identified in the Classic MDDP as dual 42" diameter CMP's. Based upon field investigation, conducted by M&S consultants during early 2015, the existing dual 42" diameter CMP culverts, under Mustang Road, appear to be in acceptable condition. The culverts also appear to have operated as intended from a capacity standpoint showing little to no evidence of significant degradation or erosion associated with high culvert velocities or roadway over topping due to limited capacity.

Per the Classic MDDP the existing dual 42" CMPs located along Mustang Road should be replaced by dual 60" diameter RCPs. Unfortunately, the MDDP report does not specify what development would require the replacement of the culverts, however most often, upstream development triggers and increased runoff downstream improvements. M&S Civil Consultants met with El Paso County and provided historic and draft drainage documentation for their review. In subsequent meetings and discussions, El Paso County determined that since there is no new development which is to occur upstream of the existing dual 42" culverts (as a result of this project), the existing culverts shall remain in place and no drainage improvements are required at this location with construction of the Shiloh Mesa development.

With the development of Shiloh Mesa the flows from the existing dual 42" culverts are planned to outfall on to a proposed rip rap apron prior to entering a proposed 22.7' L x 2.9' W area drain inlet. Runoff intercepted by the inlet box is planned to be routed thru the subdivision via a proposed 72" RCP. It should be noted that the referenced Classic MDDP recommended either a grass lined channel with 20' bottom width or a 72" diameter RCP, west of the existing dual 42" CMP culverts to aid in conveying runoff to the adjacent channel.

Per the discussions with El Paso County the proposed inlet box and 72" RCP are to be constructed entirely within the Shiloh Mesa property . The installation of riprap between the existing 42" CMP culverts and the inlet box, will fall within the County Rights of way and shall require additional coordination with El Paso County to obtain necessary easements and permits as well establish ownership and maintenance obligations (See proposed drainage characteristics for more discussion regarding this crossing and the proposed improvements).

It should be noted that the Shiloh Mesa property correlates with Parcels 15, 20, and a portion of Parcels 16 and 21 in the aforementioned Classic MDDP. Per the report, the Sand Creek Drainage Basin, Detention Facility No.3 will provide the necessary 100 year detention volume requirements for the site. Water quality treatment is proposed to be provided within the site. Stormwater Detention and Infiltration Design Data Sheets (SDI spreadsheets) are also been provided within appendix of this report.

The undeveloped site generally slopes from north to south and southwest at grades ranging between 2% & 15%. The majority of the steep slopes are found adjacent to the existing Sand Creek Channel, located along the western boundary of the proposed site. Offsite flows enter the site along the north boundary via the Sand Creek Channel, and as shallow concentrated flow by runoff generated over Basin OS1. In the existing condition, runoff from Basin OS1 combines with flows produced by onsite Basin H1 at Design Point H1. Offsite runoff is also accepted onsite along the eastern boundary at the above-

mentioned culvert crossing. Offsite runoff that impacts the eastern boundary is generated from Basin OS-5*. Basin OS-5* runoff crosses Mustang Road and combines with runoff from Basin's OS1 & H1 at Design Point Hl. Flows from Design Point H1 convey south across onsite Basin H2 to Design Point H2. Runoff from Basins H1, H2, OS1, & OS5* combine at Design Point H2 and discharge across the southern property boundary. Runoff generated over Basin H3 conveys south to Design Point H3, then across the southern property boundary. Runoff generated over Basin H4 conveys south to Design Point H4, then outlets into Sand Creek along the west property boundary. Runoff generated over Basin H5 conveys south to Design Point H5, then outlets into Sand Creek along the west property boundary. Runoff generated over Basin H6 conveys southwest. Basin H6 flows gather along the eastern edge of future Marksheffel Road and convey south, to Design Point H6, then across the southern property boundary. Historic flows from Design Point H2, H3, H4, H5 and H6 follow historic patterns as described in the Matrix MDDP (reference existing conditions drainage plan).

PROPOSED DRAINAGE CHARACTERISTICS

The offsite basins have been calculated using an assumed land use per the MDDP prepared by Classic Consulting Engineers & Surveyors, if these land uses later change and have an increase in runoff due to a change in impervious area these upstream owners will need to restrict flow to the runoff calculated here in this report and the MDDP report.

The following is a description of the offsite and onsite basins, offsite bypass flows, and the overall future drainage characteristics for the development of Shiloh Mesa. These calculations have been provided to show that what is proposed will be adequate to convey flows when adjacent development occurs. The following Design Points and Basins were analyzed using the Rational Method since each individual basin is less than 100 acres and the combined acreage at any Design Point is also less than 100 acres. This method offers a more conservative approach to sizing swales and storm drain.

Basin OSl, 4.3 acres, consists of developed 5-acre ranch properties. Runoff of Q5=3.8 cfs and Q100=9.0 cfs will be conveyed to Design Point OS1 via a proposed trapezoidal diversion channel. The channel will outfall to Sand Creek along the north boundary line. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin OS5*, 323 acres, consist of developed 5-acre ranch properties. Peak runoff rates reaching the east property line of Shiloh Mesa from Basin OS5* are anticipated to be as high as Q5=72 cfs and Q100=340 cfs. Runoff produced by the offsite area, downstream of Mustang Road, is to be collected by an proposed inlet at and conveyed westward underground thru Filing No. 1 and discharged into Sand Creek via a 72" RCP (pipe 2).

As previously discussed, the DBPS and MDDP ultimately recommended the eventually replacement of the 2 existing 42" CMP storm culverts under Mustang Road (upstream of the proposed inlet) with two 60" CMP culverts to improve conveyance of offsite runoff. However after discussion with El Paso County the existing 42" CMP culverts shall remain in place and additional conveyance capacity at the crossing location will not be added until future upstream development comes online. Although the future planned improvements under Mustang Road were not to be constructed with the development of Shiloh Mesa it was important to ensure that the improvements would work with the proposed onsite storm water conveyance improvements.

Due to the onsite constructions limitations and offsite topography M&S looked to evaluate other crossing structure alternatives at Mustang Road than those recommended by the past MDDP and DBPS report. Exhibit N, O and P (located in the appendix of this report) hydraulically compare the previously planned dual 60" culverts to the scenario of using a total of four 42" culverts (2 existing and

2 proposed). Specifically, exhibit N (inlet control nomograph) provides the required head to get the flow in the pipes. Exhibit O (4~42" culvert, UD-Culverts ver. 3.03) and Exhibit P (2~60" culvert, UD-Culverts ver. 3.03) compare the required head versus the existing condition (with Mustang Road crown as the limiting headwater elevation). As illustrated by the data in the appendix, the four (4) 42" culverts (2 existing and 2 proposed)would function to provide the necessary conveyance capacity needed at this location and would make use of the existing infrastructure.

With the development of Shiloh Mesa, the runoff conveyed through the two existing 42"culverts will outfall onto a proposed grouted riprap apron (sized to also accommodate 2 future 42" pipes), where they will be routed to a proposed 22.7' L x 2.92' W "CDOT style" area inlet located within the Shiloh Mesa property. The inlet box is to be connected to a proposed 72" RCP storm sewer (identified as run "2" on the Developed Conditions Drainage Exhibit). Exhibit Q (orifice vs. weir calculation sheet) has been provided to show the required headwater needed to get the 340 cfs into the proposed area inlet. The existing culverts outfall and installation of the grouted riprap within the Mustang Road ROW will require future coordination with El Paso County to obtain necessary easements, permits and ownership/maintenance obligations. Conforming to previous analysis, the Shiloh Mesa will accept historic flows that are currently crossing the property and route them to Sand Creek. As indicated by the previous reports (in particular the Matrix MDDP), the historic flow reaching this crossing location will not require water quality treatment. Ultimately, runoff discharged from the 72" will discharge out across a proposed rip rap apron constructed near the edge of the Sand Creek Channel (see discussion in following paragraph regarding interim detention pond construction). The proposed apron at the outfall of the 72" pipe will aid to dissipate energy and prevent local scour at the outlet (see following paragraph for more discussion regarding this outfall). In the event the 72" pipe or inlet box clogs, flows from Basin *OS5 will over top the high point within the western roadside swale of Mustang Road (located just to the south of the proposed inlet box) and continue south within the west road side swale to another existing swale, which runs east west approximately 200' north of the Woodmen Valley Chapel. Runoff reaching this swale will eventually outfall to the existing inlets located in the Marksheffel Road/Woodmen Road intersection.

With the development of Shiloh Mesa Filing 1, a 57,842 cu.ft. interim (temporary) detention basin shall be constructed. The interim detention basin will be located at the interim west end of the proposed 72" RCP, prior to out falling into Sand Creek. The interim detention basin banks consists of 2:1 slopes which will be blanketed with North American Green SC250 erosion control blanket. A temporary 30" RCP with flared end section will discharge approximately Q_5=72 cfs across a temporary 2.25' thick ~ D_{50}=18" riprap pad. Flows exceeding the capacity of the proposed 30" pipe will utilize a temporary 40' wide riprap protected emergency spillway which has been designed to release the differential peak flows of the 100 year peak of 340 cfs. For details and profile of the interim detention basin see sheet 4 of the "Shiloh Mesa Filing No. 1 72" Storm Sewer Plan" prepared by MS Civil Consultants, Inc., dated October 2015. It should be noted that the interim detention basin shall be maintained by the owner developer. Upon approval* of the Sand Creek Study for Shiloh Mesa, which will outline the channel stabilization improvements to adjacent Sand Creek Channel, the interim detention basin can be removed and the full construction of the 72" RCP storm sewer can be finalized and the construction of future filings may begin. For the ultimate design of the proposed 72" RCP storm sewer see "Shiloh Mesa Filing No. 1 72" Storm Sewer Plan" prepared by MS Civil Consultants, Inc., dated October 2015.

*and Construction of downstream facilities.

Basin A1, 3.78 acres, consists of proposed single family residential lots and portions of proposed local residential streets. Runoff of Q5=7.1 cfs and Q100=15.1 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed west to a low point in Moorebank Drive, and a proposed 6' D-10-R inlet in a sump condition. A proposed 24" RCP (pipe 3) will convey the intercepted flows to the proposed north WQ Sand Filtration basin (Design Point A1). The proposed north WQ Sand Filtration basin will provide approximately 3,246 cu.ft. of treatment volume. The collected and discharged runoff

will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin A2, 6.2 acres, consists of proposed single family residential lots and portions of proposed local residential streets. Runoff of Q5=9.4 cfs and Q100=20.1 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Callendale Drive (Design Point A2), and a proposed 8' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point A2 will over top the proposed localized sump condition in Callendale Drive and outfall into Kenosha Drive. A proposed 24" RCP (pipe 12) will convey intercepted runoff to the southwest where they will combine with flows carried in pipes 10, 14 and 15, prior to outfalling into the proposed central WQ Sand Filtration basin (Design Point A4). The runoff exiting the proposed central WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin A3, 2.3 acres, consists of proposed single family residential lots and portions of proposed local residential streets. Runoff of Q5=4.7 cfs and Q100=9.9 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Callendale Drive (Design point A3) and a proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point A3 will over top the proposed localized sump condition in Callendale Drive and outfall into Kenosha Drive. A proposed 18" RCP (pipe 11) will convey intercepted runoff to the south/west where it will combine with flows carried in pipes 10, 14 and 15 prior to outfalling into the proposed central WQ Sand Filtration basin (Design Point A4). The runoff existing the proposed central WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin A4, 1.2 acres, consists of proposed single family residential back lots and a proposed water quality facility. Runoff of Q5=1.6 cfs and Q100=5.3 cfs will flow, via side lot swales and will outfall to the proposed central WQ Sand Filtration basin (Design Point A4). The proposed central WQ Sand Filtration basin will provide approximately 18,800 cu.ft. of treatment volume. Runoff exiting the proposed facility will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin Bl, 1.2 acres, consists of proposed single family residential lots and portions of proposed local residential streets. Runoff of Q5=3.2 cfs and Q100=6.7 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Barraport Drive (Design Point B1) and a proposed 4' D-10-R inlet in a sump condition. I n the event of clogging, flows from Design Point B1 will over top the localized sump condition in Barraport Drive and outfall into Kenosha Drive. A proposed18" RCP (pipe 4) will convey flows to the south/west and combine with flows carried in pipes 5 and 6 which ultimately outfall to the proposed central WQ Sand Filtration basin (Design Point A4). The runoff exiting the proposed central WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin B2, 4.1 acres, consists of proposed single family residential lots and portions of proposed local residential streets. Runoff of Q5=7.6 cfs and Q100=16.3 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Barraport Drive (Design point B2), and a proposed 6' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point B2 will over top the sump condition in Barraport Drive and outfall into Kenosha Drive. A proposed 24" RCP (pipe 5) will convey flows to the south/west and combine with flows carried in pipes 4 and 6 which ultimately outfall to the proposed central WQ Sand Filtration basin (Design Point A4). Runoff exiting the proposed central WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed

rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin Cl, 1.7 acres, consists of proposed single family residential lots and portions of proposed local residential streets. Runoff of Q5=3.3 cfs and Q100=7.1 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Sandsmere Drive (Design Point Cl), and a proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point C1 will over top the localized sump condition in Sandsmere Drive and outfall into Kenosha Drive. A proposed 18" RCP (pipe 7) will convey flows to the south/west and combine with flows carried in pipes 6, 9 and 10 which ultimately outfall to the proposed central WQ Sand Filtration basin (Design Point A4). The runoff exiting the proposed central WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin C2, 4.64 acres, consists of proposed single family residential lots and portions of proposed local residential streets. Runoff of Q5=10.8 cfs and Q100=22.4 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Sandsmere Drive (Design point C2) and a proposed 10' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point C2 will over top the localized sump condition in Sandsmere Drive and outfall into Kenosha Drive. A proposed 30" RCP (pipe 8) will convey flows to the south/west and combine with flows carried in pipes 6, 9 and 10 which ultimately outfall to the proposed central WQ Sand Filtration basin (Design Point A4). Runoff exiting the proposed central WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin Dl, 4.53 acres, consists of proposed single family residential lots, portions of proposed local residential streets and a proposed water quality facility. Runoff of Q5=8.4 cfs and Q100=18.0 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Kenosha Drive (Design Point D1), and a proposed 8' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point D1 will over top the localized sump condition in Kenosha Drive and outfall into proposed Marksheffel Road. A proposed 24" RCP (pipe 23) will convey flows to the west and combine with flows carried in pipes 22 and 25 and outfall to the proposed southern WQ Sand Filtration basin(Design Point D4). The southern WQ Sand Filtration basin will provide approximately 20,989 cu.ft. of treatment volume. Runoff existing the proposed facility will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin D2, 6.18 acres, consists of proposed single family residential lots and portion of proposed local residential streets. Runoff of Q5=11.1 cfs and Q100=23.8 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to the roundabout in Kenosha Drive (Design Point D2), and a proposed 12' D-10-R inlet in an at- grade condition. In the event of clogging, flows from Design Point D5 will flow via curb and gutter east on Mulberry Drive to an undeveloped area which will convey the overflow along historic drainage patterns. The proposed at-grade inlet will intercept Q5=6.31 cfs and Q100=16.58 cfs and will have flowby of Q5=4.8 cfs and Q100=7.2 cfs. The flowby will be accounted in future drainage reports upon downstream development. A proposed 24" RCP (pipe 28) will convey flows to the west and combine with flows carried in pipes 22, 23 and 25 and outfall to the proposed southern WQ Sand Filtration basin, Design Point D4. Runoff exiting the proposed southern WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin D3, 1.72 acres, consists of proposed single family residential lots and portion of proposed local residential and collector streets. Runoff of Q5=3.5 cfs and Q100=7.4 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Codrington Place (Design Point D3), and a proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point D3 will over top the curb and outfall, via a tract, into the proposed southern WQ Sand Filtration Basin D4. A proposed 18" RCP (pipe 26) will convey flows, into the proposed southern WQ Sand Filtration basin D4. Runoff exiting the proposed southern WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin D5, 0.40 acres, consists of a proposed collector street. Runoff of Q5=1.8 cfs and Q100=3.5 cfs will flow, via curb and gutter and will be conveyed south to a low point in Kenosha Drive (Design Point D5), and a proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point D5 will over top the localized sump condition in Kenosha Drive and outfall into Marksheffel Road. A 18" RCP (pipe 24) will convey flows to the west and combine with flows carried in pipes 22 and 25 and outfall to the proposed southern WQ Sand Filtration basin (Design Point D4). The proposed southern WQ Sand Filtration basin will provide approximately 20,989 cu.ft. of treatment volume and will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin D6, 1.65 acres, consists of back yards of proposed single family residential lots located along the southern edge of the proposed development. In the developed condition runoff of Q5=3.0 cfs and Q100=6.3 cfs will sheet flow onto the undeveloped area, where it will follow historic drainage patterns. The flows will be accounted in future drainage reports upon downstream development.

Basin Fl, 2.38 acres, consists of proposed single family residential lots and portion of proposed local residential streets. Runoff of Q5=4.6 cfs and Q100=9.9 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Sandsmere Drive (Design Point F1), and a proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point F1 will over top the localized sump condition in Sandsmere Drive and outfall into Barraport Drive. A proposed 18" RCP (pipe 20) will convey flows to the south/west and combine with flows carried in pipes 18, 21 and 22 and outfall ultimately to the proposed southern WQ Sand Filtration basin (Design Point D4). Runoff exiting the proposed southern WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin F2, 2.16 acres, consists of proposed single family residential lots and portion of proposed local residential streets. Runoff of Q5=4.0 cfs and Q100=8.6 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Sandsmere Drive (Design point F2) and a proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point F2 will over top the localized sump condition in Sandsmere Drive and outfall into Barraport Drive. A proposed 18" RCP (pipe 19) will convey flows to the south/west and combine with flows carried in pipes 18, 21 and 22 and outfall ultimately to the proposed southern WQ Sand Filtration basin (Design Point D4). Runoff exiting the proposed southern WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin Gl, 1.75 acres, consists of proposed single family residential lots and portion of proposed local residential streets. Runoff of Q5=3.3 cfs and Q100=7.1 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Barraport Drive (Design Point G1), and a

proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point G1 will over top the localized sump condition in Barraport Drive and outfall into Kenosha Drive. The high point at the knuckle on Barraport Drive shall be designed/located to allow overflow to by-pass down Barraport Drive and onto Kenosha Drive. A proposed18" RCP (pipe 16) will convey flows to the south/west and combine with flows carried in pipes 18 and 22 and outfall ultimately to the proposed southern WQ Sand Filtration basin (Design Point D4). The runoff exiting the proposed southern WQ Sand Filtration basin will outfall directly into Sand Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Basin G2, 2.58 acres, consists of proposed single family residential lots and portion of local residential streets. Runoff of Q5=5.3 cfs and Q100=11.2 cfs will flow, via side lot swales, to the curb and gutter and will be conveyed south to a low point in Barraport Drive (Design Point G2) and a proposed 4' D-10-R inlet in a sump condition. In the event of clogging, flows from Design Point G2 will over top the localized sump condition in Barraport Drive and outfall into Kenosha Drive. The high point at the knuckle on Barraport Drive shall be designed/located to allow overflow to by-pass down Barraport Drive and onto Kenosha Drive. A proposed 24" RCP (pipe 17) will convey flows to the south/west and combine with flows carried in pipes 18 and 22 and outfall ultimately to the proposed southern WQ Sand Filtration basin (Design Point D4). Runoff exiting the proposed southern WQ Sand Filtration basin will outfall directly into and Creek. A proposed rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

OFFSITE DEVELOPED BASINS FROM MATRIX MDDP

Per the Matrix MDDP, Basin OS-10 (2.61 acres, Q(5)=8.8 cfs, Q(100)=16.5 cfs) and Basin OS-7 (1.32 acres, Q(5)=4.9 cfs, Q(100)=9.3 cfs), consist of a portion of the Marksheffel Road located between Cowpoke Road and Kenosha Drive. Per this report, the revised basin and flows for Basin OS-10** are 1.9 acres, and Q(5)=7.0 cfs, Q(100)=13.2 cfs and 1.8 acres, and Q(5)=6.7 cfs, Q(100)=12.5 cfs for Basin OS-7**. The size of Basin OS10** has been reduced, to concur with the reclassification of Marksheffel Road to a Type 1 Principal Arterial (107' ROW). As expected the proposed runoff flow rates are less than those proposed by the MDDP Matrix report, hence the development of this smaller basin shall not adversely affect adjacent or downstream property from the assumption made within that MDDP. Per the MDDP Matrix report the limits of Basin OS7 are from Cowpoke Road to Sand Creek. This report has included the area from Sand Creek to Kenosha Drive, thus the area for Basin OS7** has increased. We feel the intent of the development for proposed Marksheffel Road was fulled interpreted by the MDDP Matrix report as evident by the existing contour information provided in the MDDP Matrix map, Exhibit "H". The rough overlot grading for Marksheffel had been provided up to Sand Creek and shows a super elevation at the Kenosha Drive/Marksheffel Road intersection. The overlot was incorporated into the existing contours. Upon development of this area, runoff generated within Basin OS-7** and OS-10** will be routed south via curb and gutter to Design Point OS7 (Q(5)=13.7 cfs, Q(100)=25.7 cfs). Curb inlets within the roadway will capture the combined flow and shall be routed to the west through the Woodmen Heights Commercial Center storm sewer system to Sand Creek. The Location and conveyance of this storm water shall be addressed upon development of this section of Marksheffel Road in a future drainage report. In the interim, historic flows will follow historic flow patterns. (See Exhibit "H", this report).

Per the Matrix MDDP, Basin OS-4 (1.47 acres, Q(5)=6.7 cfs, Q(100)=12.6 cfs) and Basin OS-9 (1.19 acres, Q(5)=5.5 cfs, Q(100)=10.3 cfs), is a portion of the Marksheffel Road between Kenosha Drive and Woodmen Center Drive. Per this report, the revised basin and flows are Basin OS-4** (0.9 acres, Q(5)=4.0 cfs, Q(100)=7.6 cfs) and Basin OS-9** (0.7 acres, Q(5)=3.2 cfs, Q(100)=6.0 cfs). The area

for Basin OS4** and Basin OS9** has been reduced per Marksheffel Road being reclassified to a Type 1 Principal Arterial (107' ROW). The flows are less than the MDDP Matrix report, hence the development of these basins shall not adversely affect adjacent or downstream property. Upon development of this area, runoff generated within Basin OS-4** and OS-9** will be routed south via curb and gutter to Design Points 20 and 21, Matrix MDDP (See Exhibit "H", this report). This section of Marksheffel Road has transitioned from a super elevated street to a normal crown. Curb inlets within the roadway will capture the storm water and shall be routed to the west through the Woodmen Heights Commercial Center to Sand Creek. Location and conveyance of this storm water shall be addressed upon development of this section of Marksheffel Road in a future drainage report. In the interim, Basin OS-4** will be developed as a two lane road with curb and gutter on the east side and an asphalted curb on the west side. These developed flows will be routed south via curb and gutter to a road side ditch on the northeast side of Woodmen Center Drive. Flows will be conveyed south under Woodmen Center Drive via a 24" CMP and will follow historic flow patterns south. Basin OS-9** shall not be developed at this time, and will follow historic flow patterns. Basin OS-4** and OS-9** shall have erosion control measures to mitigate runoff and erosion.

Per the Matrix MDDP, Basin OS-2 (1.27 acres, Q(5)=5.8 cfs, Q(100)=11.0 cfs) and Basin OS-3 (1.49 acres, Q(5)=6.6 cfs, Q(100)=12.3 cfs), is a portion of the Marksheffel Road between Woodmen Center Drive and Woodmen Road. Per this report, the revised basin and flows are Basin OS-2** (1.3 acres, Q(5)=5.6 cfs, Q(100)=10.5 cfs) and Basin OS-3** (1.3 acres, Q(5)=5.7 cfs, Q(100)=10.7 cfs). The area for Basin OS2** and Basin OS3** has been partially reduced per Marksheffel Road being reclassified to a Type 1 Principal Arterial (107' ROW). The flows are less than the MDDP Matrix report, hence the development of these basins shall not adversely affect adjacent or downstream property. Upon development of this area, runoff generated within Basin OS-2** and OS-3** will be routed south via curb and gutter to inlets at Design Points 29 and 30, Matrix MDDP. Existing curb inlets within the roadway will capture the storm water and shall be routed to the west through a an existing 60" RCP which releases into an existing swale to Sand Creek. Location and conveyance of this storm water shall be addressed upon development of this section of Marksheffel Road in a future drainage report. In the interim, Basin OS-2** and OS-3** shall operate in its developed/undeveloped state with existing inlets, curb and gutter established. (See Exhibit "H", this report).

SAND CREEK IMPROVEMENTS

Per the DBPS, improvements to the Sand Creek channel will be required with the development of this site (see exhibits D, E, F and G). According the DBPS approximately 2200 feet of selective lining, 300 feet of 10-yr riprap channel lining and three (3) grade control structures will be required. The approximate locations of recommended grade control structures, selective lining and 10 year rip rap has been shown on the post development drainage map in the appendix and was determined by using the DBPS stations and recognizable features within the Sand Creek basin (see Exhibits E, F and G). The exact locations of these structures will be further evaluated with the Sand Creek Channel Study and also with the PPRTA's design for the Marksheffel Road/Sand Creek crossing. The proposed structures shall be built in accordance to the standards set forth by the DBPS, City of Colorado Springs and Urban Drainage and Flood Control District Drainage Criteria Manuals (see DBPS Exhibits I, J and USDCM Exhibits K, L, M).

The proposed Sand Creek Channel Study will evaluate the need for channel improvement between Mustang Road and Pond 3 and is anticipated to be submitted following this report. The Sand Creek Channel Study will contain hydraulic modeling and will make assumptions for the crossing of Marksheffel Road over Sand Creek. Final Construction Drawings will follow the approval of the

study. Phasing for the improvements will be shown on the final construction drawings, however, it is anticipated that the phasing of the channel improvements will correlate with the phasing of the single-family development along the channel. The phasing and design of the proposed channel improvements will need to be approved by the City of Colorado Springs and will need to function with the development (This development is anticipated to have 4-5 phases, and be developed over the next 4-5 years).

WATER QUALITY

The proposed water quality facilities shown on the enclosed drainage map will provide sufficient rainfall treatment for the site. Per the Woodmen Heights MDDP, the Sand Creek Detention Facility No. 3 will provide the necessary 100 year detention storm volume for the site. The onsite sand filter (SF) water quality basins will be private and shall be maintained by the filings homeowners association. The water quality volume required for the site has been determined using the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual - Volume II. The SFWQ basins are be identified as North, Central and South and are illustrated on the Post Development Drainage Plan.

Based upon the drainage criteria the North SFWQ is required to have a minimum design volume of 3,138 cu.ft., however it has been designed by M&S Consultants to provide a WQCV of approximately 3,246 cu.ft. The Central SFWQ is required to have a minimum design volume of 17,718 cu.ft., however has been designed to provided approximately 18,800 cu.ft of water quality treatment volume. The South SFWQ is required to have a minimum design volume of 18,017 cu.ft., however has been design to include a proposed WQCV of approximately 20,989 cu.ft. All collected flows reaching the facilities shall be detained to a 12-hour drain time. Under drains shall be included in the design of the SFWQ. The under drains may be deleted if the site passes the double ring infiltrometer test. In the event the outlet boxes for the facilities clogs, runoff reaching the ponds will over top the various overflow spillways and shall be routed into Sand Creek. Rip rap aprons have been proposed at each of the ponds outfall locations to dissipate energy and prevent local scour. Storm water detention and infiltration design data sheets for the Water Quality Ponds have been included in the appendix of this report.

EROSION CONTROL

It is the policy of the City of Colorado Springs that we submit an erosion control plan with the drainage report. At this time we respectfully request that the erosion control plan be submitted in conjunction with the final grading plan. Proposed straw bale check dams, silt fence, vehicle traffic control, and reseeding are proposed as erosion control measures.

CONSTRUCTION COST OPINION

Public Drainage Facilities **Reimbursable-** 72" Storm Conveyance System **(Filing No. 1)**

Item	Description	Quantity	Unit Cost	Cost
1.	72" RCP	1119 LF	$350/LF	$ 391,650.00
2.	22.7'x3.0' CDOT Inlet	1 EA	$25,000/LF	$ 25,000.00
3.	Type 1 MH	2 EA	$10,000/EA	$ 20,000.00
			Total=	**$ 436,650.00**

Public Drainage Facilities **NON-Reimbursable**-Shiloh Mesa-Residential **(Filing No. 1)**

Item	Description	Quantity	Unit Cost	Cost
1.	18" RCP	226 LF	$40/LF	$ 9,040.00
2.	24" RCP	596 LF	$50/LF	$ 29,800.00
3.	30" RCP	587 LF	$65/LF	$ 37,570.00
4.	36" RCP	295 LF	$75/LF	$ 22,125.00
5.	42" RCP	560 LF	$85/LF	$ 47,600.00
6.	Type 1 MH	4 EA	$6,500/EA	$ 27,000.00
7.	Type 2 MH	3 EA	$4,500/EA	$ 13,500.00
8.	4' Sump Inlet	6 EA	$3,000/EA	$ 18,000.00
9.	8' Sump Inlet	1 EA	$5,000/EA	$ 5,000.00
10.	12' At-Grade Inlet	1 EA	$6,500/EA	$ 6,500.00
11.	SW-WQ Pond*	1 EA	$28,000/EA	$ 28,000.00
12.	Interim Det Pond**	1 EA	$20,500/EA	$ 20,500.00
13.	Type H Riprap***	600 CY	$350/CY	$ 29,450.00
			Total=	**$ 294,085.00**

pub.
pvt.

* Includes CDOT style box and grate, boulder retaining walls, outlet and spillway riprap protection
** Includes riprap spillway, outlet and low-flow protection
*** Includes riprap protection near Mustang Road and Interim drop from Interim Det. Pond

Public Drainage Facilities **Reimbursable-** Sand Creek Improvements **(Future Filings)**

Item	Description	Quantity	Unit Cost	Cost
1.	Channel Selective Lining	2200 LF	$150/LF	$ 330,000.00
2.	Channel 10-yr Riprap	300 LF	$150/LF	$ 45,000.00
3.	Channel Grade Control	3 EA	$150,000/EA	$ 450,000.00
4.	72" RCP	94 LF	$350/LF	$ 32,900.00
			Total=	**$ 857,900.00**

Public Drainage Facilities **NON-Reimbursable**-Shiloh Mesa-Residential **(Future Filings)**

Item	Description	Quantity	Unit Cost	Cost
1.	18" RCP	16 LF	$40/LF	$ 640.00
2.	24" RCP	753 LF	$50/LF	$ 37,650.00
3.	30" RCP	288 LF	$65/LF	$ 18,720.00
4.	36" RCP	465 LF	$75/LF	$ 34,875.00
5.	42" RCP	270 LF	$85/LF	$ 22,950.00
6.	Type 1 MH	6 EA	$6,500/EA	$ 39,000.00
7.	Type 2 MH	3 EA	$4,500/EA	$ 13,500.00
8.	4' Sump Inlet	3 EA	$3,000/EA	$ 9,000.00
9.	6' Sump Inlet	2 EA	$4,000/EA	$ 8,000.00
10.	8' Sump Inlet	2 EA	$5,000/EA	$ 10,000.00
11.	Central WQ Pond*	1 EA	$15,000/EA	$ 15,000.00
12.	North WQ Pond*	1 EA	$15,000/EA	$ 15,000.00
13.	Type VL Riprap	60 CY	$40/CY	$ 2,400.00
			Total=	**$ 226,735.00**

* Includes outlet box, grate, and outlet and spillway riprap protection

DRAINAGE, BRIDGE AND POND FEES

The Shiloh Mesa-Residential site is located within the Sand Creek Drainage Basin. The site as defined above consists of 68.88 acres. Shiloh Mesa Filing No.1 consists of 19.956 acres, the remaining future filings total 48.924 acres. The 2015 Drainage, Bridge and Pond Fees per the City of Colorado Springs for these sites are listed below:

Shiloh Mesa Residential Filing No. 1 (19.956 ac)

Drainage Fee:	$10,247/acre x 19.499*acres		$199,806.25
Bridge Fee:	$ 622/acre x 19.499* acres		$ 12,128.38
Pond Fee (Land):	$ 1,070/acre x 19.499* acres		$ 20,863.93
Pond Fee (Facilities):	$ 3,005/acre x 19.499* acres		$ 58.594.50
		Total fees:	**$291,393.06**

***100-year flood plain subtracted out from developed acreage (0.457 ac).**

Shiloh Mesa Future Residential Filings (48.924 ac)

Drainage Fee:	$10,247/acre x 45.824* acres		$469,558.83
Bridge Fee:	$ 622/acre x 45.824* acres		$ 28,502.53
Pond Fee (Land):	$ 1,070/acre x 45.824* acres		$ 49,031.68
Pond Fee (Facilities):	$ 3,005/acre x 45.824* acres		$139.763.20
		Total fees:	**$686,855.94**

***100-year flood plain subtracted out from developed acreage (3.103 ac).**

DRAINAGE COST COMPARISON AND CREDIT SUMMARY

Sand Creek Drainage Basin Planning Study Assumed Costs (Filing No. 1)

Description	DBPS Cost	Inflation Multiplier	Today's Dollars-Reimbursable
Mustang Road 2-60" CMP	$14,400	x 1.79	$0*
*Not to be installed with this Development			
Reach 150-2 Riprap lined channel	$480,000	x 1.79	$859,200.00
		Total=	**$859,200.00**

Sand Creek Drainage Basin Planning Study Assumed Costs (Future Filings)

Sand Creek 160 Selective Lining	$279,400	x 1.79	$500,126.00
Sand Creek 160 Grade Control	$64,800	x 1.79	$115,992.00
Sand Creek 160 10-yr Riprap	$71,400	x 1.79	$127,806.00
		Total=	**$743,924.00**

Public Facilities:

Total Public Reimbursable Estimated Cost-Shiloh Mesa Residential (Filing No. 1)	$ 436,650.00
Total Estimated Drainage Facility Fees (19.499 ac)	$ -199,806.25
Total Difference/Credit	**$ -236,843.75**

***Because Public Reimbursable facility costs do exceed the fees due for drainage fees, $236,843.75 is a ~~credit~~ Excess Cost at this time. Payment of Bridge and Pond Land is still required.**

Public Facilities:

Total Public Reimbursable Estimated Cost-Shiloh Mesa Residential (Future Filings)	$ 857,900.00
Total Estimated Drainage Facility Fees (45.824 ac)	$ - 469,558.83
Total Difference/Credit	**$ - 388,341.17**

***Because Public Reimbursable facility costs do exceed the fees due for drainage fees, $388,341.17 is an anticipated future credit. Payment of Bridge and Pond Land will still be required.**

Per the "Sand Creek Drainage Basin Planning Study", prepared by Kiowa Engineering, CORP., dated Rev. March 1996 (see Exhibits A, B, C, D, E, F & G), the storm sewer infrastructure replaces Reach 150-2 (Exhibit B) and Sand Creek 160 improvements (Exhibit D). The estimated storm infrastructure and Sand Creek improvement costs associated with Shiloh Mesa Filing No. 1 ($436,650) **is not** greater than the adjusted Sand Creek tributary drainage way conveyance cost estimate of $859,200. The estimated storm infrastructure and Sand Creek improvement costs associated with the future filings of Shiloh Mesa Residential ($857,900.00) **is** greater than the adjusted Sand Creek tributary drainage way conveyance cost estimate of $743,924.

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above is only an estimate of the facility cost and drainage basin fee amounts in 2015. Upon completion of the aforementioned improvements, M & S shall submit the actual construction costs to the City of Colorado Springs/City Drainage Board for reimbursement.

SUMMARY

Development of this site will not adversely affect the surrounding development per this drainage report, subsequent reports, and construction drawings for Shiloh Mesa drainage improvements. Phasing of the drainage improvements, including Sand Creek Channel Improvments, shall be determined based upon the amount of development and discharge into Sand Creek to ensure the protection of downstream facilities and property. The phasing for the improvements will be approved by the City of Colorado Springs with each phase of development submitted by final plat, and construction drawings for approval. The proposed drainage facilities will adequately convey, detain and route runoff from the site to Sand Creek. All drainage facilities described herein and shown on the included drainage map are subject to change due to formal design considerations during the construction document preparation stage. This report is in conformance with the approved "Master Development Drainage Plan for Woodmen Heights Master Plan", by Classic Consulting Engineers & Surveyors (MDDP), approved August 2004 and the "Master Development Drainage Plan for Shiloh Mesa at Woodmen Heights Sand Creek Drainage Basin", by Matrix Design Group, Inc. (Matrix MDDP) approved November 2009. Care will be taken to accommodate overland emergency flow routes on site and temporary drainage conditions. The development of the Shiloh Mesa residential subdivisions shall not adversely affect adjacent or downstream property.

REFERENCES

1.) "El Paso County and City of Colorado Springs Drainage Criteria Manual".

2.) SCS Soils Map for El Paso County.

3.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date March 17, 1997.

4.) "Sand Creek Drainage Basin Planning Study Preliminary Design Report" (DBPS), prepared by Kiowa Engineering, revised December 1998.

5.) "Master Development Drainage Plan for Woodmen Heights Master Plan", prepared by Classic Consulting Engineers & Surveyors, dated June 2004.

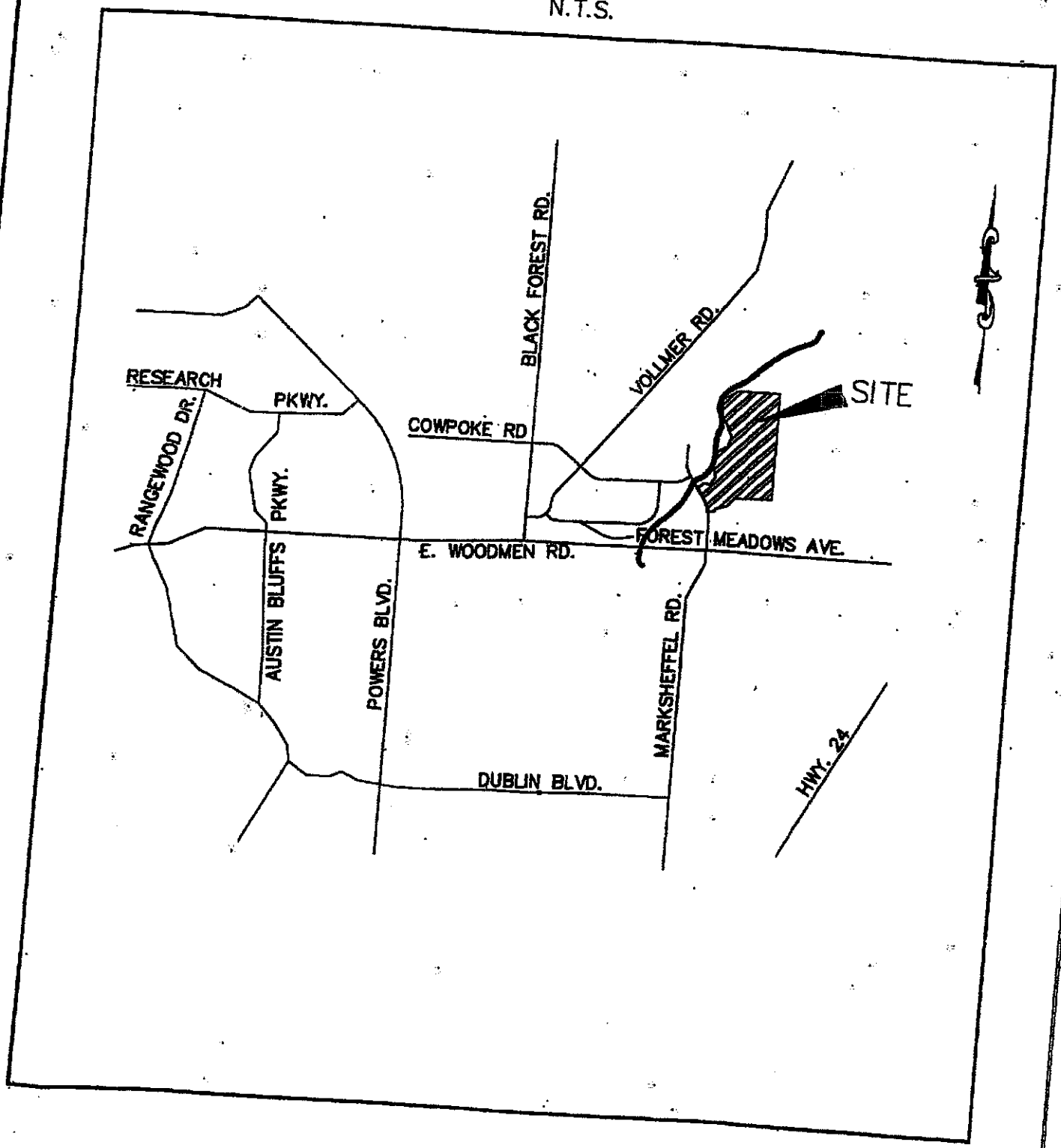
6.) "Master Development Drainage Plan for Shiloh Mesa at Woodmen Heights Sand Creek Drainage Basin", by Matrix Design Group, Inc., dated November 2009.

APPENDIX

SHILOH MESA

VICINITY MAP

N.T.S.

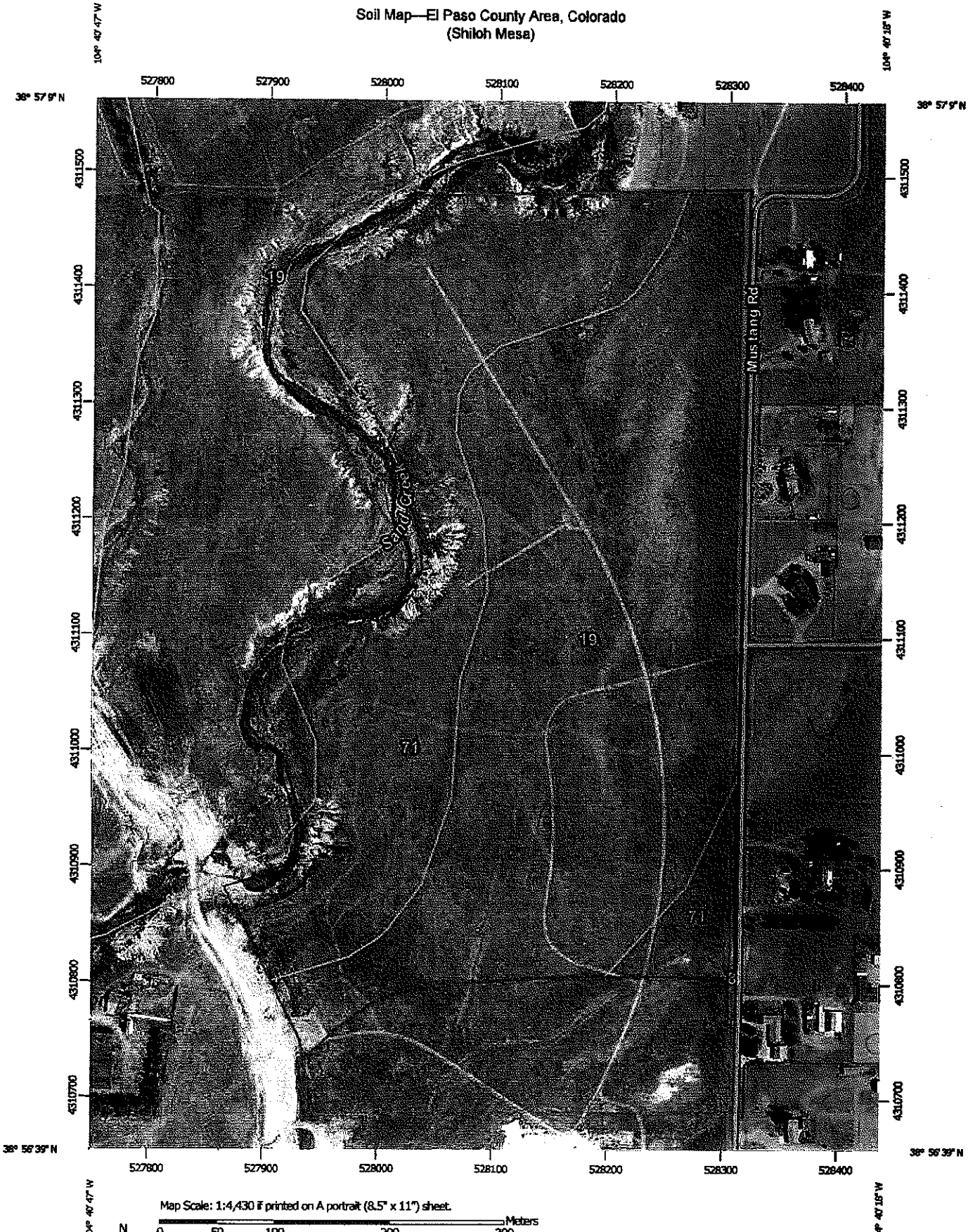


SHILOH MESA
VICINITY MAP
JOB NO. 06-026
DATE PREPARED: 9/04/2014

102 E. PIKES PEAK AVE, STE 304
COLORADO SPRINGS
COLORADO 80903

SOILS EXHIBIT

Soil Map—El Paso County Area, Colorado
(Shiloh Mesa)



Map Scale: 1:4,430 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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: http://websoilsurvey.nrcs.usda.gov
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 10, Dec 23, 2013

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—Sep 22, 2011

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 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: http://websoilsurvey.nrcs.usda.gov
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.

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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—Sep 22, 2011

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	9.7	8.2%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	63.1	53.2%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	45.8	38.6%
Totals for Area of Interest			118.7	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

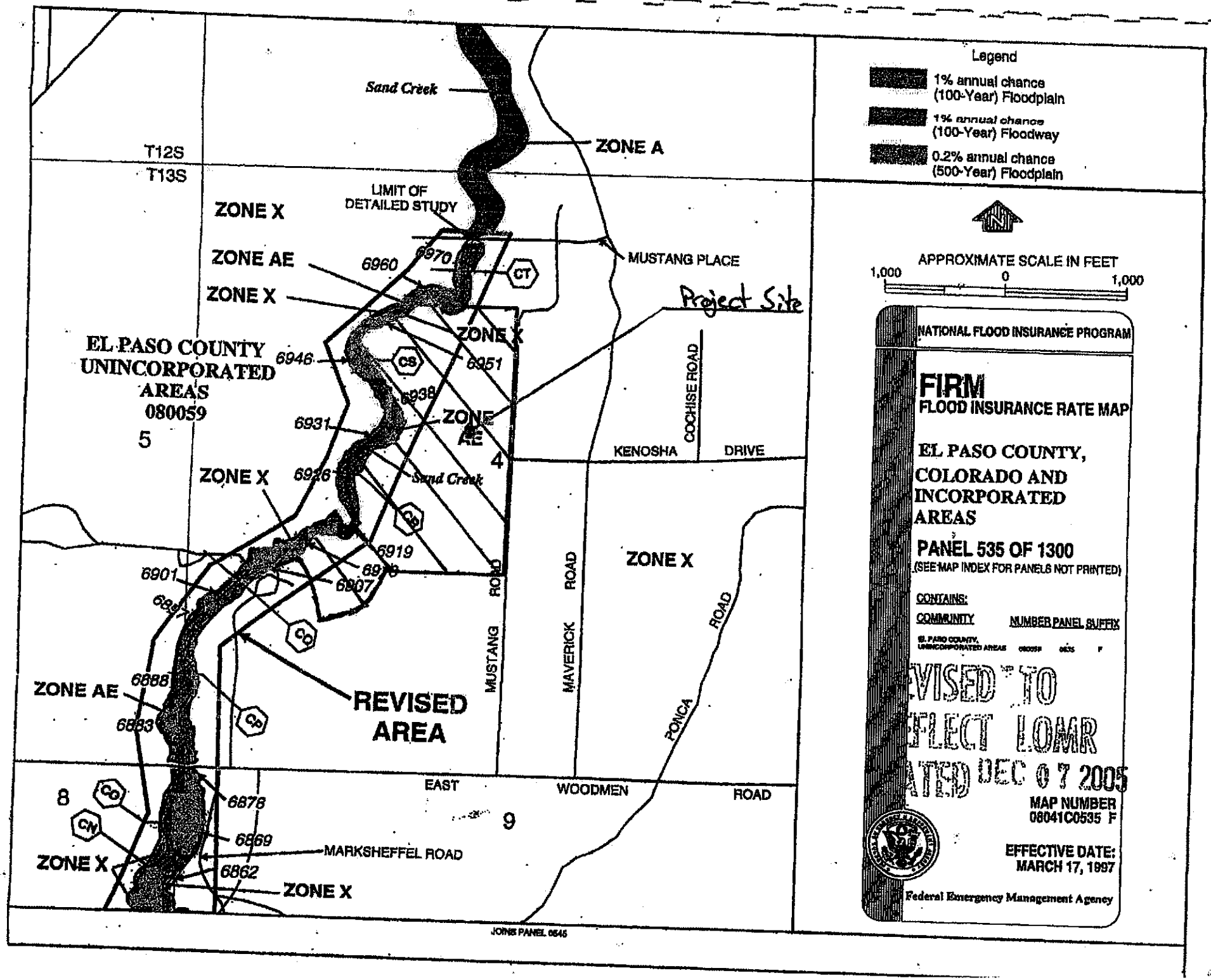
Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

ANNOTATED FIRM PANEL 08041C0535F

WITH REFERENCED PORTIONS OF

CASE No. 04-08-0779P


Sand Creek
ZONE A
T12S
T13S
LIMIT OF DETAILED STUDY
ZONE X
ZONE AE
6960
6970
CT
MUSTANG PLACE
ZONE X
Project Site
ZONE X
EL PASO COUNTY UNINCORPORATED AREAS 080059
6946
CS
6951
6938
6931
ZONE AE
COCHISE ROAD
5
4
KENOSHA
DRIVE
ZONE X
6926
Sand Creek
CR
6919
6901
6907
ZONE X
MUSTANG ROAD
MAVERICK ROAD
PONCA ROAD
CO
ZONE AE
6888
6883
CR
REVISED AREA
8
CO
6878
CW
6869
MARKSHEFFEL ROAD
ZONE X
6862
ZONE X
EAST
WOODMEN
ROAD
9
JOINS PANEL 0545
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
1,000
0
1,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY
NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0535 F
EVISED TO
FLECT LOMR
ATED DEC 07 2005
MAP NUMBER
08041C0535 F
EFFECTIVE DATE:
MARCH 17, 1997
Federal Emergency Management Agency

Federal Emergency Management Agency

Washington, D.C. 20472

AUG 15 2005

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Jim Bensberg
Chairman, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903

IN REPLY REFER TO:
Case No.: 04-08-0779P
Community Name: El Paso County, CO
Community No.: 080059
Effective Date of This Revision: **DEC 07 2005**

Dear Mr. Bensberg:

The Flood Insurance Study report and Flood Insurance Rate Map for your community have been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Federal Insurance and Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Kelly A. Bronowicz BV

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

For: Doug Bellomo, P.E., Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

List of Enclosures:
Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map
Annotated Flood Insurance Study Report

cc: Mr. Kevin Stilson, P.E., CFM
Regional Floodplain Administrator
Pikes Peak Regional Building Department

[redacted]
Kiowa Engineering Corporation

 | Issue Date: AUG 15 2005 | Effective Date: DEC 07 2005 | Case No.: 04-08-0779P | LOMR-APP

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	NO PROJECT	HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	East Woodmen Road to Mustang Place	APPROXIMATE LATITUDE & LONGITUDE: 38.946, -104.681 SOURCE: USGS QUADRANGLE DATUM: NAD 83	
FLOODING SOURCE(S) & REVISED REACH(ES)	Sand Creek - from approximately 2,200 feet downstream of East Woodmen Road to Mustang Place		

SUMMARY OF REVISIONS

Effective Flooding:	Zone A	No BFEs*	No Floodway	BFEs*	Floodway	Zone AE
Revised Flooding:	Zone AE	BFEs	Floodway	BFEs	Floodway	Zone AE
Increases:	YES	YES	YES	YES	YES	YES
Decreases:	NONE	NONE	NONE	YES	NONE	YES

* BFEs – Base Flood Elevations

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08041C0535 F Date: March 17, 1997 TYPE: FIRM NO.: 08041C0545 F Date: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 FLOODWAY DATA TABLE: 5 PROFILES: 204P and 204P(a)

* FIRM – Flood Insurance Rate Map; ** FBFM – Flood Boundary and Floodway Map; *** FHBM – Flood Hazard Boundary Map

DETERMINATION

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

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sand Creek (cont'd)								
CA	65,292	164	427	6.1	6,748.7	6,748.7	6,749.4	0.7
CB	66,092	41	223	11.7	6,761.2	6,761.2	6,762.2	1.0
CC	66,247	90	270	9.6	6,773.6	6,773.6	6,773.7	0.1
CD	67,647	50	218	11.9	6,782.6	6,782.6	6,783.3	0.7
CE	68,297	65	284	8.8	6,793.9	6,793.9	6,794.4	0.5
CF	69,147	50	213	11.7	6,804.5	6,804.5	6,804.5	0.0
CG	70,157	50	213	11.7	6,815.1	6,815.1	6,815.3	0.2
CH	70,577	205	347	7.2	6,823.9	6,823.9	6,824.5	0.6
CI	70,627	180	267	9.4	6,826.7	6,826.7	6,827.7	1.0
CJ	70,727	210	340	7.3	6,831.1	6,831.1	6,831.1	0.0
CK	70,807	195	334	7.5	6,832.5	6,832.5	6,832.5	0.0
CL	71,162	90	255	9.8	6,838.0	6,838.0	6,839.0	1.0
CM	71,977	226	503	5.2	6,847.4	6,847.4	6,848.3	0.9
CN	73,052	174	328	7.9	6,861.1	6,861.1	6,861.2	0.1
CO	73,644	237	364	7.1	6,870.2	6,870.2	6,870.2	0.0
CP	75,142	172	324	8.0	6,888.5	6,888.5	6888.7	0.2
CQ	76,161	109	283	9.2	6,903.5	6,903.5	6,903.7	0.2
CR	77,846	100	272	9.6	6,926.1	6,926.1	6,926.7	0.6
CS	79,187	117	287	9.1	6,944.1	6,944.1	6,944.1	0.0
CT	80,808	102	277	9.4	6,969.2	6,969.2	6,969.4	0.2

Revised Data

[1] Feet Above Confluence With Fountain Creek

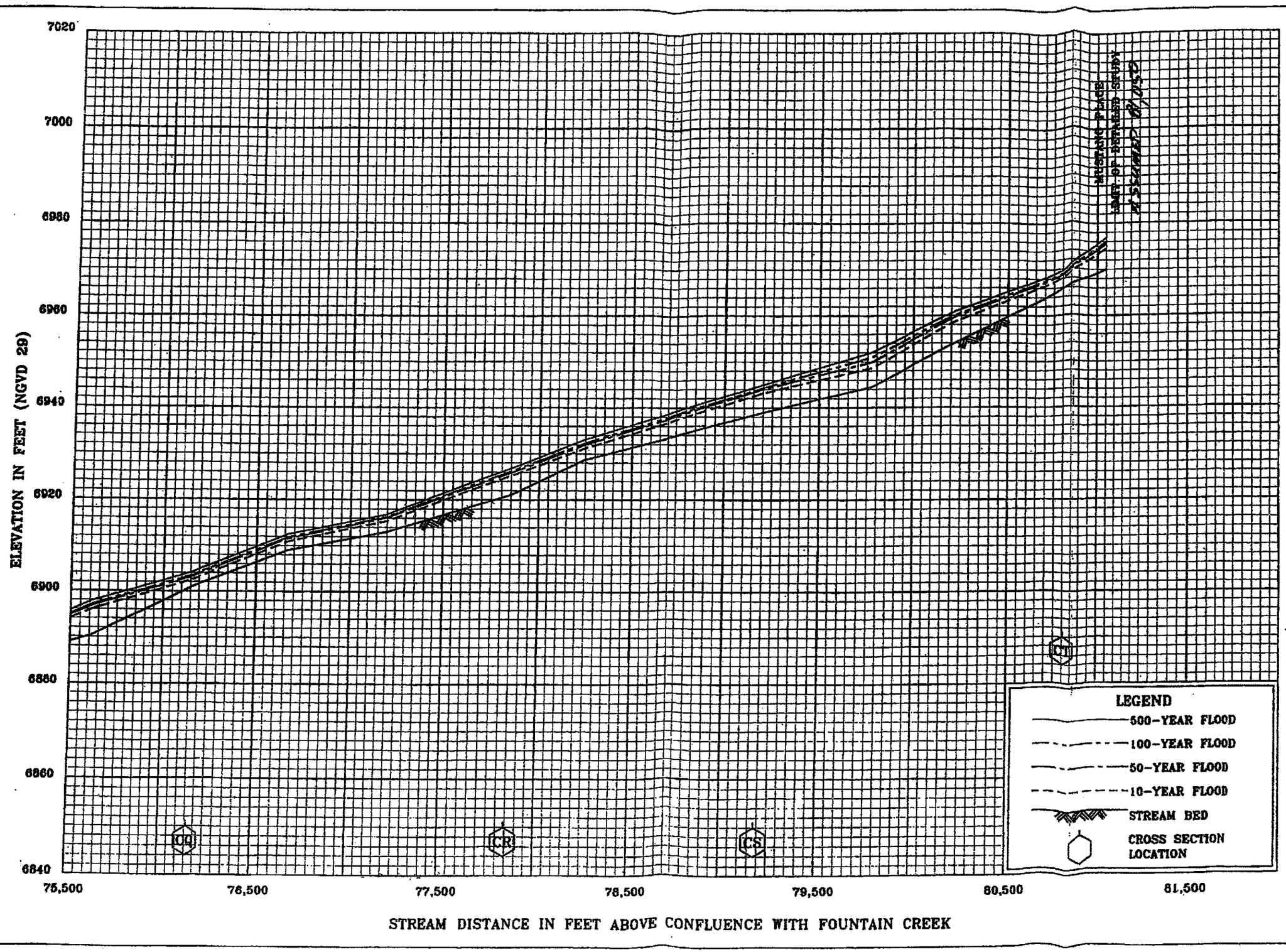
FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK

REVISED TO REFLECT LOMR DATED DEC 07 2005



REVISED TO REFLECT LOMR DATED DEC 07 2005

FLOOD PROFILES

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

204P(a)

HYDROLOGIC CALCULATIONS

Shiloh Mesa
Final Drainage Report
Area Drainage Summary

Historic Condition

From Composite Runoff Coefficient Summary				Initial / Overland				Channel/Street					Time of Travel (T_c)		INTENSITY *		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C_5	C_{100}	Length (ft)	Height (ft)	T_i (min)	$T_{i_{100}}$ (min)	Length (ft)	Slope (%)	Cv	Velocity (ft/s)	T_t (min)	TOTAL (min)	Location	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s)	Q_{100} (c.f.s)
H1	21.20	0.25	0.35	264	5	21	18.5	1847	2.1%	10	1.4	21.2	39.7		2.1	3.7	10.9	27.1
H2	5.30	0.25	0.35	300	6	21.9	19.3	397	2.0%	10	1.4	4.8	23.3		2.8	5.0	3.7	9.2
H3	10.20	0.25	0.35	300	5.4	22.7	20.0	1748	1.9%	10	1.4	21.1	41.1		2.0	3.6	5.1	12.8
H4	7.80	0.25	0.35	300	6	21.9	19.3	473	6.5%	15	3.8	2.1	23.4		2.9	5.2	5.7	14.2
H5	13.8	0.25	0.35	300	6.3	21.6	19.0	1073	3.3%	15	2.7	6.6	25.6		2.6	4.7	9.1	22.8
H6	5.40	0.25	0.35	300	5.5	22.5	19.9	718	2.0%	10	1.4	8.5	28.3		2.5	4.5	3.4	8.4
*OS1**	4.30	0.30	0.40	300	6	20.6	18.0	492	3.3%	15	2.7	3.0	21.0		2.9	5.2	3.8	9.0
*OS5**	323.00																72.0	340.0

* Intensity equations assume a minimum travel time of 5 minutes for Urbanized Basins & 10 min. for Non-Urbanized

*Master Development Drainage Plan for the Shiloh Mesa at Woodmen Heights. MASTER PLAN by UCCS.

Type of Land Surface	Cv
Heavy Meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

T_t=L/60V (Velocity From Fig. 501)

Velocity V=Cv*S^0.5, S in ft/ft

Tc Check = 10+L/180

For Urbanized basins a minimum T_c of 5.0 minutes is required.

For non-urbanized basins a minimum T_c of 10.0 minutes is required

Calculated by: ET

Date: 3/12/2015

Checked by: VAS

Shiloh Mesa
Final Drainage Report
(Area Drainage Summary)

Post Development

From Composite Runoff Coefficient Summary				*Initial / Overland*				*Channel/Street*					*Time of Travel (T_t)*		*INTENSITY* *		*TOTAL FLOWS*	
BASIN	AREA TOTAL (Acres)	C_5 (From 2007 Rainfall)	C_{100} (From 2007 Rainfall)	Length (ft)	Height (ft)	T_i (min)	T_{100} (min)	Length (ft)	Slope (%)	Cv	Velocity (fps)	T_t (min)	TOTAL (min)	Location	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (cfs)	Q_{100} (cfs)
A1	3.78	0.50	0.60	147	3	10.8	9.0	920	1.5%	20	4.3	3.6	12.5		3.7	6.7	*7.1*	*15.7*
A2	6.20	0.50	0.60	285	4.3	16.5	13.8	1660	1.8%	20	4.6	6.0	19.8		3.0	5.4	*9.4*	*20.1*
A3	2.30	0.50	0.60	72	1	8.5	7.1	995	2.1%	20	5.1	3.3	10.4		4.0	7.2	*4.7*	*9.9*
A4	1.20	0.30	0.55	150	7.5	10.8	7.4	75	24.0%	15	17.3	0.1	7.5		4.5	8.1	*1.6*	*5.3*
B1	1.30	0.60	0.70	56	1	5.8	4.6	958	2.1%	20	5.0	3.2	7.8		4.5	8.0	*3.2*	*6.7*
B2	4.10	0.50	0.60	214	5	11.7	9.7	886	2.0%	20	5.0	3.0	12.7		3.7	6.6	*7.6*	*16.3*
C1	1.70	0.50	0.60	226	6	12.2	10.2	337	1.6%	20	4.5	1.3	11.4		3.9	6.9	*3.3*	*7.1*
C2	4.64	0.60	0.70	344	10	12.2	9.8	594	2.5%	20	5.5	1.8	11.5		3.9	6.9	*10.8*	*22.4*
D1	4.53	0.50	0.60	161	4	10.6	8.8	915	1.3%	20	4.0	3.9	12.8		3.7	6.6	*8.4*	*18.0*
D2	6.18	0.50	0.60	68	1.4	7.3	6.1	1861	1.3%	20	4.1	7.7	13.7		3.6	6.4	*11.1*	*23.8*
D3	1.72	0.50	0.60	130	2	11.3	9.2	326	1.5%	20	4.2	1.3	10.5		4.0	7.2	*3.5*	*7.4*
D5	0.40	0.90	0.95	63	0.7	2.9	2.2	225	1.2%	20	3.8	1.0	5.0		5.1	9.1	*1.8*	*3.5*
D6	1.65	0.50	0.60	280	2	15.9	13.2	120	1.0%	20	3.5	0.6	13.8		3.5	6.4	*3.0*	*6.3*
F1	2.38	0.50	0.60	166	3	11.9	9.9	401	1.6%	20	4.4	1.5	11.4		3.9	6.9	*4.6*	*9.9*
F2	2.16	0.50	0.60	275	7	13.7	11.4	327	1.4%	20	4.1	1.3	12.7		3.7	6.6	*4.0*	*8.6*
G1	1.75	0.50	0.60	263	7	13.2	11.0	285	1.7%	20	4.6	1.1	12.0		3.8	6.8	*3.3*	*7.1*
G2	2.58	0.50	0.60	160	4	10.5	8.7	488	2.8%	20	4.9	1.4	10.1		4.1	7.3	*5.3*	*11.3*
*OS7***	1.8	0.90	0.95	30	0.6	1.6	1.2	1424	2.8%	19.4	2.7	8.7	9.9		4.1	7.3	*6.7*	*12.5*
*OS10***	1.9	0.90	0.95	30	0.6	1.6	1.2	1424	2.8%	19.2	2.7	8.7	10.0		4.1	7.3	*7.0*	*13.2*
*OS4***	0.9	0.90	0.95	100	4	2.4	1.8	617	2.8%	19.2	2.7	3.8	5.6		5.0	8.8	*4.0*	*7.6*
*OS9***	0.7	0.90	0.95	40	1.6	0.7	1.1	594	2.8%	19.2	2.7	3.6	5.0		5.1	9.1	*3.2*	*6.0*
*OS2***	1.3	0.90	0.95	102	2	3.9	2.3	678	2.0%	19.2	2.7	4.2	6.4		4.8	8.5	*5.6*	*10.5*
*OS3***	1.3	0.90	0.95	60	1.2	2.3	1.7	697	2.8%	19.2	2.7	4.3	6.0		4.9	8.6	*5.7*	*10.7*

*** Revised areas and flows for "Master Development Drainage Plan for Shiloh Mesa at Woodmen Heights" prepared by Matrix, approved November 2009*

* Intensity equations assume a minimum travel time of 5 minutes for Urbanized Basins & 10 min. for Non-Urbanized

"Master Development Drainage Plan for Shiloh Mesa at Woodmen Heights

Type of Land Surface	Cv
Heavy Meadow	2.5
Tillage/Field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

T_t=L/60V (Velocity From Fig. 501)

Velocity V=Cv*S^0.5, S in ft/ft

Tc Check = 10+L/180

For Urbanized basins a minimum T_c of 5.0 minutes is required.

For non-urbanized basins a minimum T_c of 10.0 minutes is required

Calculated by: ET

Date: 3/12/2015

Checked by: VAS

Shiloh Mesa
Final Drainage Report
Surface Routing Summary

Design Point(s)	Contributing Basins	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity		Flow		Comments
					I_5	I_{100}	Q_5	Q_{100}	
OS1	OS1	1.29	1.72	21.0	2.9	5.2	3.8	9.0	Channel Flow ,North Boundary
H1	H1, OS1, & *OS5	6.59	9.14	60.7	1.6	2.8	72.0	363.5	Low side of Dual Culvert Xing under Mustang
H2	H1, H2, OS1, & *OS5	7.92	11.00	60.7	1.6	2.8	84.4	370.7	Channel Flow across southern prop bndry
H3	H3	2.55	3.57	41.1	2.0	3.6	5.1	12.8	Channel Flow across southern prop bndry
H4	H4	1.95	2.73	21.4	2.9	5.2	5.7	14.2	Flows into Sand Creek
H5	H5	3.45	4.83	25.6	2.6	4.7	9.1	22.8	Flows into Sand Creek
H6	H6	1.35	1.89	28.3	2.5	4.5	3.4	8.4	Ditch flows south along east side of Marksheffel

Shiloh Mesa
Final Drainage Report
Surface Routing Summary

Design Point(s)	Contributing Basins	Equivalent CA_5	Equivalent CA_{100}	Maximum T_c	Intensity I_5	Intensity I_{100}	Flow Q_5	Flow Q_{100}	Comments
				North WQ Pond Tributary					
A1	A1	1.89	2.27	12.5	3.7	6.7	7.1	15.1	6' D-10-R Sump Inlet
									Release into North WQ Pond
				Central WQ Pond Tributary					
A2	A2	3.10	3.72	19.8	3.0	5.4	9.4	20.1	8' D-10-R Sump Inlet
A3	A3	1.15	1.38	10.4	4.0	7.2	4.7	9.9	4' D-10-R Sump Inlet
B1	B1	0.72	0.84	7.8	4.5	8.0	3.2	6.7	4' D-10-R Sump Inlet
B2	B2	2.05	2.46	12.7	3.7	6.6	7.6	16.3	6' D-10-R Sump Inlet
C1	C1	0.85	1.02	11.4	3.9	6.9	3.3	7.1	4' D-10-R Sump Inlet
C2	C2	2.78	3.25	11.5	3.9	6.9	10.8	22.4	10' D-10-R Sump Inlet
A4	C1, C2, B1, B2, A2, A3, A4	11.01	13.33	19.8	3.0	5.4	33.4	72.0	Release into Central WQ Pond
				Southern WQ Pond(s) Tributary					
G1	G1	0.88	1.05	12.0	3.8	6.8	3.3	7.1	4' D-10-R Sump Inlet
G2	G2	1.29	1.55	10.1	4.1	7.3	5.3	11.2	4' D-10-R Sump Inlet
F1	F1	1.19	1.43	11.4	3.9	6.9	4.6	9.9	4' D-10-R Sump Inlet
F2	F2	1.08	1.30	12.7	3.7	6.6	4.0	8.6	4' D-10-R Sump Inlet
D2	D2	3.09	3.71	13.7	3.6	6.4	11.1	23.8	12' D-10-R At-Grade Inlet
D1	D1	2.27	2.72	12.8	3.7	6.6	8.4	18.0	8' D-10-R Sump Inlet
D5	D5	0.36	0.38	5.0	5.1	9.1	1.8	3.5	4' D-10-R Sump Inlet
D3	D3	0.86	1.03	10.5	4.0	7.2	3.5	7.4	4' D-10-R Sump Inlet
D4	G1, G2, F1, F2, D1, D2, D3, D5	9.71	12.04	13.7	3.6	6.4	35.0	77.2	Release into Southeast WQ Pond
				Offsite Flows					
D2	Flowby D2	1.30	1.19	13.7	3.6	6.4	4.7	7.2	Flow-by
D6	D6	0.83	0.99	13.8	3.6	6.4	3.0	6.3	Sheet Flow
OS7	OS7**, OS10**	3.53	3.52	10.0	4.1	7.3	15.7	25.7	TBD
OS4	OS4**	0.81	0.86	5.6	5.0	8.8	4.0	7.6	PER MDDP MATRIX
OS9	OS9**	0.63	0.67	5.0	5.1	9.1	3.2	6.0	PER MDDP MATRIX
OS2	OS2**	1.17	1.24	6.4	4.8	8.5	5.6	10.5	PER MDDP MATRIX
OS3	OS3**	1.17	1.24	6.0	4.9	8.6	5.7	10.7	PER MDDP MATRIX

Calculated by: BT

Date: 3/16/2015

Checked by: VAS

Shiloh Mesa
ADDENDUM to FINAL DRAINAGE REPORT
(Street Capacity Summary - Initial Storm)

Street Name	Contributing Basins	Street Side (Cardinal Directions) at max Q5	Street Class	Curb Type	Street Slope (ft/ft)	Actual Q5 (cfs)	Max. Q5 (cfs) (10/12/94 Eq's)	Depth At Curb Face (ft) (Fig 7-12 Eq.)	Q5 Max. Check Max>Actual<20cfs (res ramp), 34cfs(other)	Q5 Depth Check
Kenosha Road	D1	W	Collector	Vertical	0.013	8.4	19.4	0.31	OK	OK
Kenosha Road	D2	E	Collector	Vertical	0.013	11.1	19.9	0.34	OK	OK
Kenosha Road	D5	E	Collector	Vertical	0.012	1.8	18.8	0.18	OK	OK
Codrington Place	D3	BOTH	Residential	Ramp	0.015	3.5	13.6	0.21	OK	OK
Moorebank Drive	A1	BOTH	Residential	Ramp	0.015	7.1	13.8	0.28	OK	OK
Callendale Drive	A3	W	Residential	Ramp	0.010	4.7	11.3	0.26	OK	OK
Callendale Drive	A2	E	Residential	Ramp	0.010	9.4	11.3	0.33	OK	OK
Barreport Drive	B1	W	Residential	Ramp	0.021	3.2	16.2	0.20	OK	OK
Barraport Drive	B2	E	Residential	Ramp	0.020	7.6	16.0	0.27	OK	OK
Sandsmere Drive	C1	W	Residential	Ramp	0.016	3.3	14.4	0.21	OK	OK
Sandsmere Drive	C2	E	Residential	Ramp	0.025	10.8	17.9	0.30	OK	OK
Barraport Drive	G1	W	Residential	Ramp	0.017	3.3	14.8	0.20	OK	OK
Barraport Drive	G2	E	Residential	Ramp	0.020	5.3	15.7	0.24	OK	OK
Sandsmere Drive	F1	W	Residential	Ramp	0.016	4.6	14.1	0.24	OK	OK
Sandsmere Drive	F2	E	Residential	Ramp	0.014	4.0	13.2	0.23	OK	OK
Barraport Drive	D2 *(1/2) {WILL FIX LATER CEB}	E	Residential	Ramp	0.010	5.6	11.3	0.27	OK	OK
Sandsmere Drive	C2	E	Residential	Ramp	0.029	10.8	19.2	0.29	OK	OK

Notes:
1. Cross slope of 2% assumed for all streets.

Calculated by: BT

Date: 3/20/2015

Checked by: VAS

HYDRAULIC CALCULATIONS

SHILOH MESA
FINAL DRAINAGE REPORT
(Storm Sewer Routing Summary)

Pipe Run	Contributing Design Points/Pipe Runs	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity		Flow		Comments
					I_5	I_{100}	Q_5	Q_{100}	
1	OS5*						72.0	340.0	2-60" CMP
2	OS5*						72.0	340.0	72" RCP
3	DP A1	1.89	3.27	12.5	3.7	6.7	7.1	15.1	24" RCP
4	DP B1	0.72	0.84	7.8	4.5	8.0	3.2	6.7	18" RCP
5	DP B2	2.05	2.46	12.7	3.7	6.6	7.6	16.3	24" RCP
6	PR 4 + PR 5	2.77	3.30	12.7	3.7	6.6	10.3	21.9	24" RCP
7	DP C1	0.85	1.02	11.4	3.9	6.9	3.3	7.1	18" RCP
8	DP C2	2.78	3.25	11.5	3.9	6.9	10.8	22.4	30" RCP
9	PR 7 + PR 8	3.63	4.27	11.5	3.9	6.9	14.1	29.5	30" RCP
10	PR 6 + PR 9	6.40	7.57	12.7	3.7	6.6	23.9	50.2	36" RCP
11	DP A3	1.15	1.38	10.4	4.0	7.2	4.7	9.9	18" RCP
12	DP A2	3.10	3.72	19.8	3.8	5.4	8.3	20.8	24" RCP
14	PR 11 + PR 12	4.25	5.10	19.8	3.0	5.4	12.9	27.5	30" RCP
15	PR 10 + PR 14	10.65	12.67	19.8	3.0	5.4	32.3	68.4	42" RCP
16	DP G1	0.88	1.05	12.9	3.8	6.8	3.3	7.1	18" RCP
17	DP G2	1.29	1.55	10.1	4.1	7.3	5.3	11.2	18" RCP
18	PR 16 + PR 17	2.17	2.60	12.0	3.8	6.8	8.2	17.6	24" RCP
19	DP F2	1.08	1.30	12.7	3.7	6.6	4.0	8.6	18" RCP
20	DP F1	1.19	1.43	11.4	3.9	6.9	4.6	9.9	18" RCP
21	PR19 + PR 20	2.27	2.72	12.7	3.7	6.6	8.5	18.1	24" RCP
22	PR 18 + PR 21	4.44	5.32	12.7	3.7	6.6	16.5	35.3	30" RCP
28	DP D2	1.79	2.59	13.7	3.6	6.4	6.4	16.6	24" RCP
29	PR 22 + PR 28	6.23	7.91	13.7	3.6	6.4	22.4	50.7	36" RCP
23	DP D1	2.27	2.72	12.8	3.7	6.6	8.4	18.0	24" RCP
24	DP D5	0.36	0.38	5.9	5.1	9.1	1.8	3.5	18" RCP
25	PR 29 + PR 23 + PR 24	8.85	11.81	13.7	3.6	6.4	31.9	70.6	42" RCP
26	DP D3	0.86	1.03	10.5	4.0	7.2	3.5	7.4	18" RCP
27	PR 25 + PR 26	9.71	12.04	13.7	3.6	6.4	35.0	77.2	42" RCP

NOTES:

1. Pipe sizes per preliminary design, Computations in appendix).
2. DP - DESIGN POINT
3. PR - PIPE RUN

Calculated by: ET

Date: 3/16/2015

Checked by: VAS

Free Online Manning Pipe Flow Calculator

List of Calculators Hydraulics Language

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Can you help me translate this calculator to your language or host this calculator at your web site?

Shiloh Mesa

PIPE CULVERT

Set units: m | mm | ft | inches

Pipe diameter, d_0	18	inches
Manning roughness, n ?	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	75	%

Results:

Flow, q	9.5772	cfs
Velocity, v	6.7372	ft/sec
Velocity head, h_v	0.7054	ft
Flow area	1.4217	ft^2
Wetted perimeter	3.1416	ft
Hydraulic radius	0.4526	ft
Top width, T	1.2990	ft
Froude number, F	1.14	
Shear stress (tractive force), tau	0.7024	psf

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Free Online Manning Pipe Flow Calculator

List of Calculators Hydraulics Language

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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PIPE CULVERT

Set units: m | mm | ft | inches

Pipe diameter, d_0	24	inches
Manning roughness, n ?	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	75	%

Results:

Flow, q	20.6269	cfs
Velocity, v	8.1615	ft/sec
Velocity head, h_v	1.0362	ft
Flow area	2.5274	ft^2
Wetted perimeter	4.1887	ft
Hydraulic radius	0.6034	ft
Top width, T	1.7320	ft
Froude number, F	1.19	
Shear stress (tractive force), tau	0.9366	psf

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Free Online Manning Pipe Flow Calculator

List of Calculators Hydraulics Language

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Shiloh Mesa

PIPE CULVERT

Set units: m | mm | ft | inches

Pipe diameter, d_0	30	inches
Manning roughness, n ?	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	75	%

Results:

Flow, q	37.3990	cfs
Velocity, v	9.4706	ft/sec
Velocity head, h_v	1.3940	ft
Flow area	3.9491	ft^2
Wetted perimeter	5.2569	ft
Hydraulic radius	0.7512	ft
Top width, T	2.1650	ft
Froude number, F	1.24	
Shear stress (tractive force), tau	1.1707	psf

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Free Online Manning Pipe Flow Calculator

List of Calculators Hydraulics Language

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Shiloh Mesa

PIPE CULVERT

Set units: m | mm | ft | inches

Pipe diameter, d_0	36 inches	
Manning roughness, n ?	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0 % rise/run	
Percent of (or ratio to) full depth (100% or 1 if flowing full)	75 %	

Results:

Flow, q	80.8146	cfs
Velocity, v	10.0946	ft/sec
Velocity head, h_v	1.7776	ft
Flow area	5.6667	ft^2
Wetted perimeter	9.2831	ft
Hydraulic radius	0.9051	ft
Top width, T	2.5980	ft
Froude number, F	1.27	
Shear stress (tractive force), tau	1.4048	psf

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Free Online Manning Pipe Flow Calculator

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Shiloh Mesa

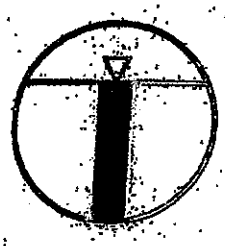
PIPE CULVERT

Set units: m | mm | ft | inches

Pipe diameter, d_0	42	inches
Manning roughness, n ?	0.13	
Pressure slope (possibly ? equal to pipe slope), S_0	1	ft rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	70	%

Results:

Flow, q	84.225	cfs
Velocity, v	11.795	ft/sec
Velocity head, h_v	2.1307	ft
Flow area	7.1437	ft^2
Wetted perimeter	6.9340	ft
Hydraulic radius	1.0300	ft
Top width, T	3.2078	ft
Froude number, F	1.38	
Shear stress (tractive force), tau	1.5297	psf



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Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D = 72 in
Depth of flow, y = 70 in
(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} = 0.013
Channel bottom slope, S = 0.006 ft/ft

Calculations

n/n_{full} = 1.013888889
Partially Full Manning roughness, n = 0.013

Calculations

Pipe Diameter, D = 6 ft
Pipe Radius, r = 3 ft

Circ. Segment Height, h = 0.167 ft

Central Angle, q = 0.67 radians
Cross-Sect. Area, A = 28.05 ft^2

Wetted Perimeter, P = 16.8 ft
Hydraulic Radius, R = 1.67 ft
Discharge, Q = 345.21 cfs
Ave. Velocity, V = 12.31 ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 99.2%

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

P

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

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SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPA1

Total Flow:

Q_5 = 7.1 cfs

Q_{100} = 15.1 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 6 foot inlet required

(Install a Public 6' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: BT

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPA2

Total Flow:

Q_5 = 9.4 cfs

Q_{100} = 20.1 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 8 foot inlet required

(Install a Public 8' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/15/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPA3

Total Flow:

Q_5 = 4.7 cfs

Q_{100} = 9.9 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPB1

Total Flow:

Q_5 = 3.2 cfs

Q_{100} = 6.7 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPB2

Total Flow:

Q_5 = 7.6 cfs

Q_{100} = 16.3 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 6 foot inlet required

(Install a Public 6' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPC1

Total Flow:

Q_5 = 3.3 cfs

Q_{100} = 7.1 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPC2

Total Flow:

Q_5 = 10.8 cfs

Q_{100} = 22.4 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 6 foot inlet required

100-Year Event: 10 foot inlet required

(Install a Public 10' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: HT

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPD1

Total Flow:

Q_5 = 8.4 cfs

Q_{100} = 18.0 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 8 foot inlet required

(Install a Public 8' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: RT

Date: 9/25/2014

Checked by: VAS

Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: Shiloh Mesa Filing No.1

Inlet ID: D2

Show Details

Design Flow: ONLY if already determined through other methods:

(local peak flow for 1/2 of street OR grass-lined channel):

* If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.

	Minor Storm	Major Storm	
$^*Q_{Known}$ =	11.1	23.8	cfs

<-- FILL IN THIS SECTION OR...

Geographic Information: (Enter data in the blue cells):

FILL IN THE SECTIONS BELOW. <--

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
- O Site is Urban
- O Site is Non-Urban

Flows Developed For:
- O Street Inlets
- O Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

Rainfall Information: Intensity I (inch/hr) = $C_1 * P_1 / (C_2 + T_c)^{C_3}$

	Minor Storm	Major Storm	
Design Storm Return Period, T_i =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	11.1	23.8	cfs

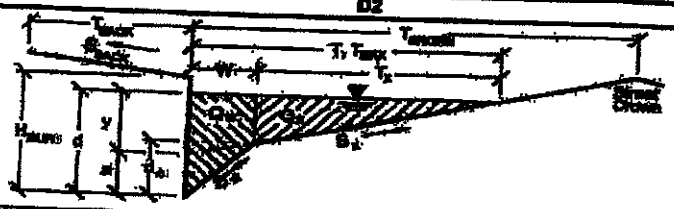
3/20/2015

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Shiloh Mesa Filing No.1

Inlet ID: D2



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	11.8 ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020 ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00 inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.0 ft
Gutter Width	W =	2.00 ft
Street Transverse Slope	S_X =	2.000 ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.125 ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022 ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	22.0	22.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.3	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

	Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	528.00	528.00	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	3.0	3.0	inches
Gutter Depression (d_C - (W * S_X * 12))	a =	-45.00	-45.00	inches
Water Depth at Gutter Flowline	d =	483.00	483.00	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	20.0	20.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.211	0.211	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	38,859.7	38,859.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	10,416.6	10,416.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	59,783.4	59,783.4	cfs
Maximum Flow Based On Allowable Spread	Q_T =	109,059.7	109,059.7	cfs
Flow Velocity within the Gutter Section	V =	129.8	129.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5,224.5	5,224.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

	Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	2.3	2.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X TH}$ =	0.3	0.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.967	0.949	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X TH}$	$Q_{X TH}$ =	0.4	1.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.4	1.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	10.9	17.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	10.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.8	28.4	cfs
Average Flow Velocity Within the Gutter Section	V =	8.4	10.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	8.5	10.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	0.95	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	11.3	22.8	cfs
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	10.92	11.40	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	11.3	22.8	cfs

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

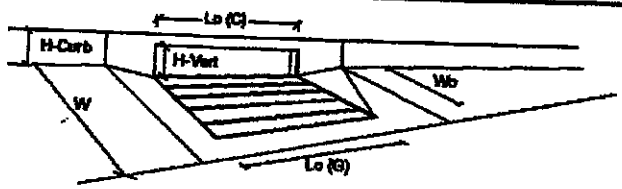
WARNING: MAJOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'

Warning 02: Max Allowable Depth for Minor Storm is greater than the Curb Height.

INLET ON A CONTINUOUS GRADE

Project: Shiloh Mesa Filing No.1

Inlet ID: D2



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	12.00	12.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MAJOR STORM		MINOR	MAJOR	
Total Inlet Interception Capacity	Q =	6.31	16.88	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	4.8	7.8	cfs
Capture Percentage = Q_a/Q_o =	C% =	57	70	%

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPD3

Total Flow:

Q_5 = 3.5 cfs

Q_{100} = 7.4 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPD5

Total Flow:

Q_5 = **1.8 cfs**

Q_{100} = **3.5 cfs**

Maximum allowable ponding depth at sump:

$Dmax_5$ = **0.50'**

$Dmax_{100}$ = **0.67'**

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPF1

Total Flow:

Q_5 = 4.6 cfs

Q_{100} = 9.9 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DP#2

Total Flow:

Q_5 = 4.0 cfs

Q_{100} = 8.6 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPG1

Total Flow:

Q_5 = 3.3 cfs

Q_{100} = 7.1 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = ' 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

SHILOH MESA
FINAL DRAINAGE REPORT
(Inlet Calculations - Sump Condition)

DPG2

Total Flow:

Q_5 = 5.3 cfs

Q_{100} = 11.2 cfs

Maximum allowable ponding depth at sump:

$Dmax_5$ = 0.50'

$Dmax_{100}$ = 0.67'

$$Qi = 1.7(Li+1.8(W))(Dmax + w/12)^{1.85}$$

where: W = 3 feet

w = 4 inches

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

(Install a Public 4' D-10-R inlet to accept both 5 yr. & 100 yr. developed flows at this design point.)

Calculated by: ET

Date: 9/25/2014

Checked by: VAS

Design Procedure Form: Sand Filter (SF)

Sheet 1 of 2

Designer: Eugene Tellez
Company: MS Civil Consultants
Date: March 17, 2015
Project: Shiloh Mesa South Water Quality Pond
Location: Northeast of Marksheffel Road and Kenosha Road Intersection

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 = 65.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a/100$): i = 0.650

C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time
$WQCV = 0.9 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$
WQCV = 0.33 watershed inches

D) Contributing Watershed Area (including sand filter area): Area = 945,256 sq ft

E) Water Quality Capture Volume (WQCV) Design Volume
$V_{WQCV} = WQCV / 12 * Area$
V_{WQCV} = 16,617 cu ft

F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm: d_6 = _____ in

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume: $V_{WQCV\ OTHER}$ = _____ 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} = 5.0 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} = 3531 sq ft

D) Actual Filter Area: A_{Actual} = 4012 sq ft

E) Volume Provided: V_T = 20989 cu ft

3. Filter Material

Choose One
- (●) 18" CDOT Class 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 = 1.8 ft

ii) Volume to Drain in 12 Hours: Vol_{12} = 16,617 cu ft

iii) Orifice Diameter, 3/8" Minimum: D_o = 0.5 in

Design Procedure Form: Sand Filter (SF)

Sheet 2 of 2

Designer:	Eugene Tellez
Company:	MB Civil Consultants
Date:	March 17, 2015
Project:	Shiloh Mesa South Water Quality Pond
Location:	Northeast of Marksheffel Road and Kenosha Road Intersection

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	Riprap pad provided where needed. Emergency overflow provided to carry excess flow.

Notes:

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Shiloh Mesa - Southern WQ Sand Filtration Basin**

Facility Location & Jurisdiction: **SW corner of the Shiloh Mesa Site, Colorado Spring**

User (Input) Watershed Characteristics

Watershed Slope =	0.011	ft/ft
Watershed Length-to-Width Ratio =	1.40	L:W
Watershed Area =	21.70	acres
Watershed Imperviousness =	65.0%	percent
Percentage Hydrologic Soil Group A =	57.4%	percent
Percentage Hydrologic Soil Group B =	42.6%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input

User Input: Detention Basin Characteristics

WQCV Design Drain Time = 12.00 hours

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	3,849	0.00	0.00
0.55	3,887	0.55	0.32
1.55	3,964	1.55	0.52
2.55	4,138	2.55	0.68
3.55	4,312	3.55	0.80
4.55	5,663	4.55	0.92
5.55	6,534	5.55	52.84
6.55	7,841	6.55	74.39
7.55	10,890	7.55	90.95
7.75	11,326	7.75	93.94

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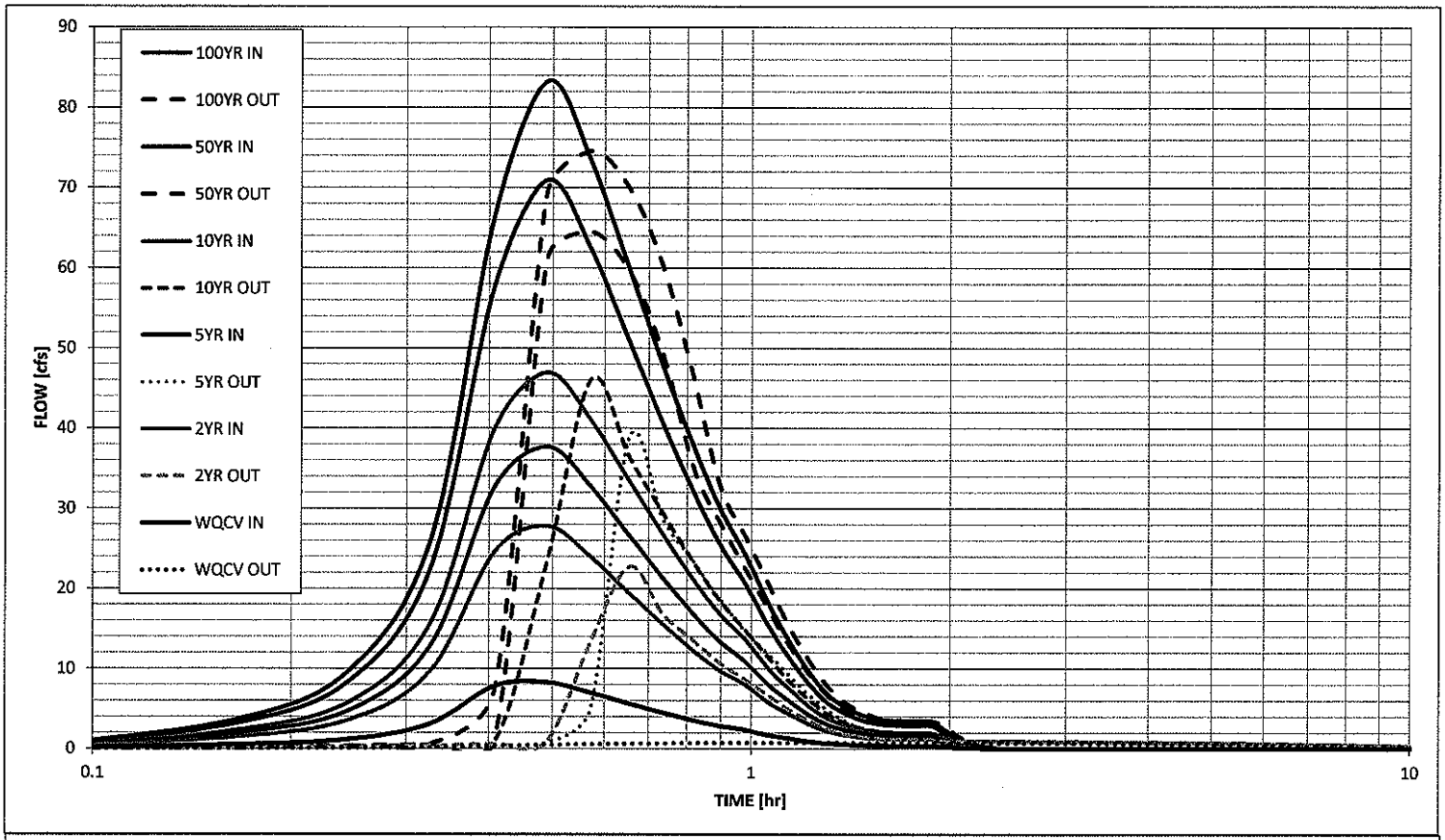
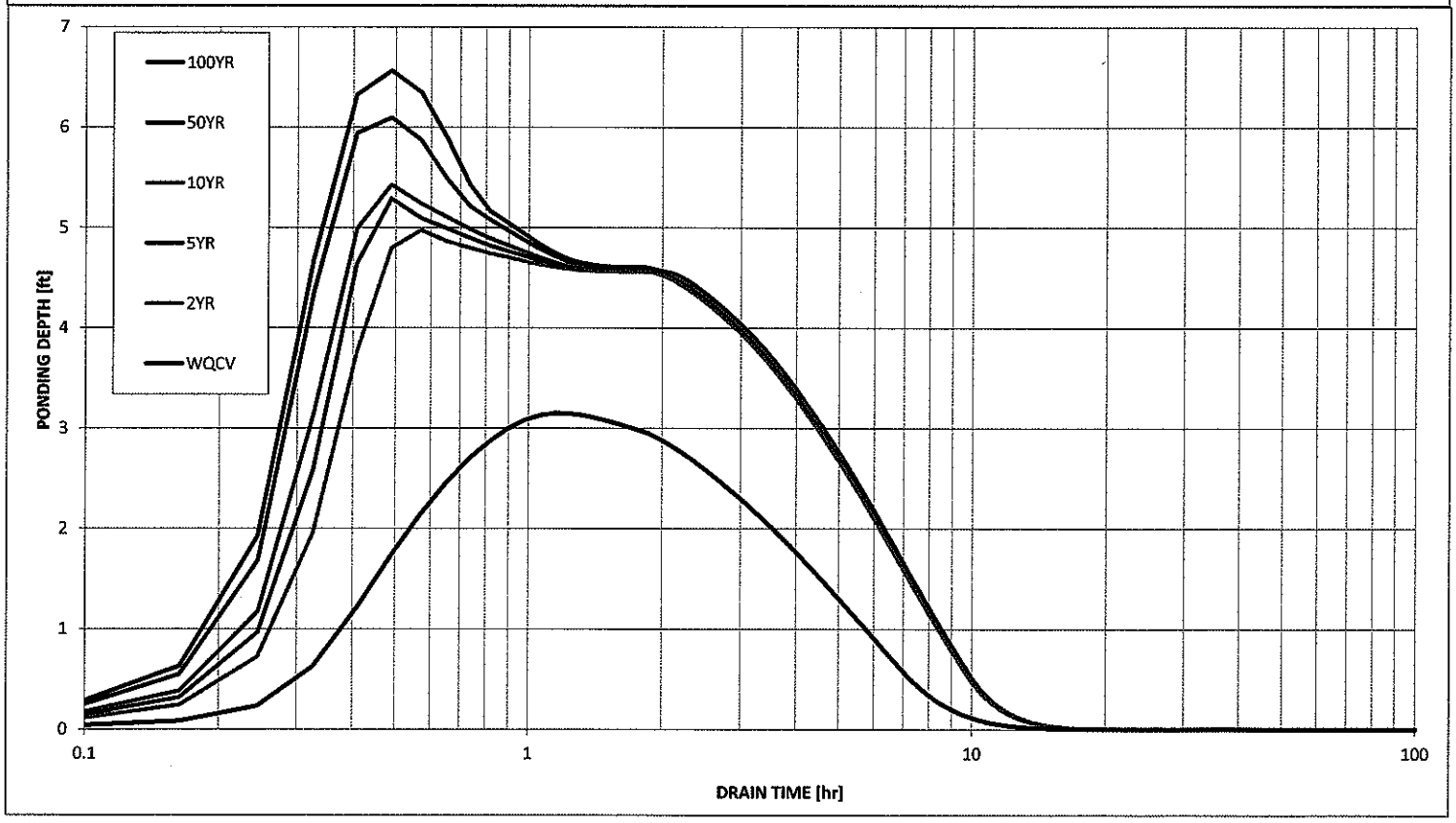
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.50	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.364	1.227	1.668	2.080	3.126	3.660	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.363	1.227	1.668	2.079	3.125	3.659	acre-ft
Time to Drain 97% of Inflow Volume =	10.0	10.3	**9.8**	9.4	8.4	8.0	hours
Time to Drain 99% of Inflow Volume =	12.0	12.3	11.8	11.4	10.7	**10.5**	hours
Maximum Ponding Depth =	3.15	4.97	5.28	5.42	6.09	6.56	ft
Maximum Ponded Area =	0.097	0.138	0.145	0.147	0.166	**0.180**	acres
Maximum Volume Stored =	0.289	0.500	0.544	0.564	0.669	0.750	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





Design Procedure Form: Sand Filter (SF)

Designer: Eugene Tellez
Company: MS Civil Consultants
Date: March 17, 2018
Project: Shiloh Mass Central Water Quality Pond
Location: Northeast of Marksheffel Road and Kenosha Road intersection

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 = 65.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a/100$): i = 0.650

C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time
$WQCV = 0.9 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$
WQCV = 0.33 watershed inches

D) Contributing Watershed Area (including sand filter area): Area = 929,574 sq ft

E) Water Quality Capture Volume (WQCV) Design Volume
$V_{WQCV} = WQCV / 12 * Area$
V_{WQCV} = 17,716 cu ft

F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm: d_6 = _____ in

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume: $V_{WQCV\ OTHER}$ = _____ 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} = 4.0 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 = 4.00 ft / ft

C) Minimum Filter Area (Flat Surface Area): A_{Min} = 3697 sq ft

D) Actual Filter Area: A_{Actual} = 5740 sq ft

E) Volume Provided: V_T = 18800 cu ft

3. Filter Material

Choose One
- (●) 18" CDOT Class 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 = 1.8 ft

ii) Volume to Drain in 12 Hours: Vol_{12} = 17,716 cu ft

iii) Orifice Diameter, 3/8" Minimum: D_O = 2 in

Design Procedure Form: Sand Filter (SF)

Designer:	Eugene Tollar
Company:	MS Civil Consultants
Date:	March 17, 2016
Project:	Shiloh Mesa Central Water Quality Pond
Location:	Northeast of Marksheffel Road and Kenosha Road Intersection

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	Riprap pad provided where needed. Emergency overflow provided to carry excess flow.

Notes:

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: Shiloh Mesa - Central WQ Sand Filtration Basin

Facility Location & Jurisdiction: Mid and west of the Shiloh Mesa Site, Colorado Spring

User (Input) Watershed Characteristics

Watershed Slope =	0.013	ft/ft
Watershed Length-to-Width Ratio =	1.18	L:W
Watershed Area =	21.34	acres
Watershed Imperviousness =	65.0%	percent
Percentage Hydrologic Soil Group A =	57.4%	percent
Percentage Hydrologic Soil Group B =	42.6%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown): User Input

User Input: Detention Basin Characteristics

WQCV Design Drain Time = 12.00 hours

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	5,740	0.00	0.00
1.00	6,970	1.00	0.69
2.00	8,233	2.00	0.93
2.50	8,407	2.50	1.05
3.00	10,237	3.00	50.30
4.00	12,023	4.00	86.35

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create a new stormwater facility, and
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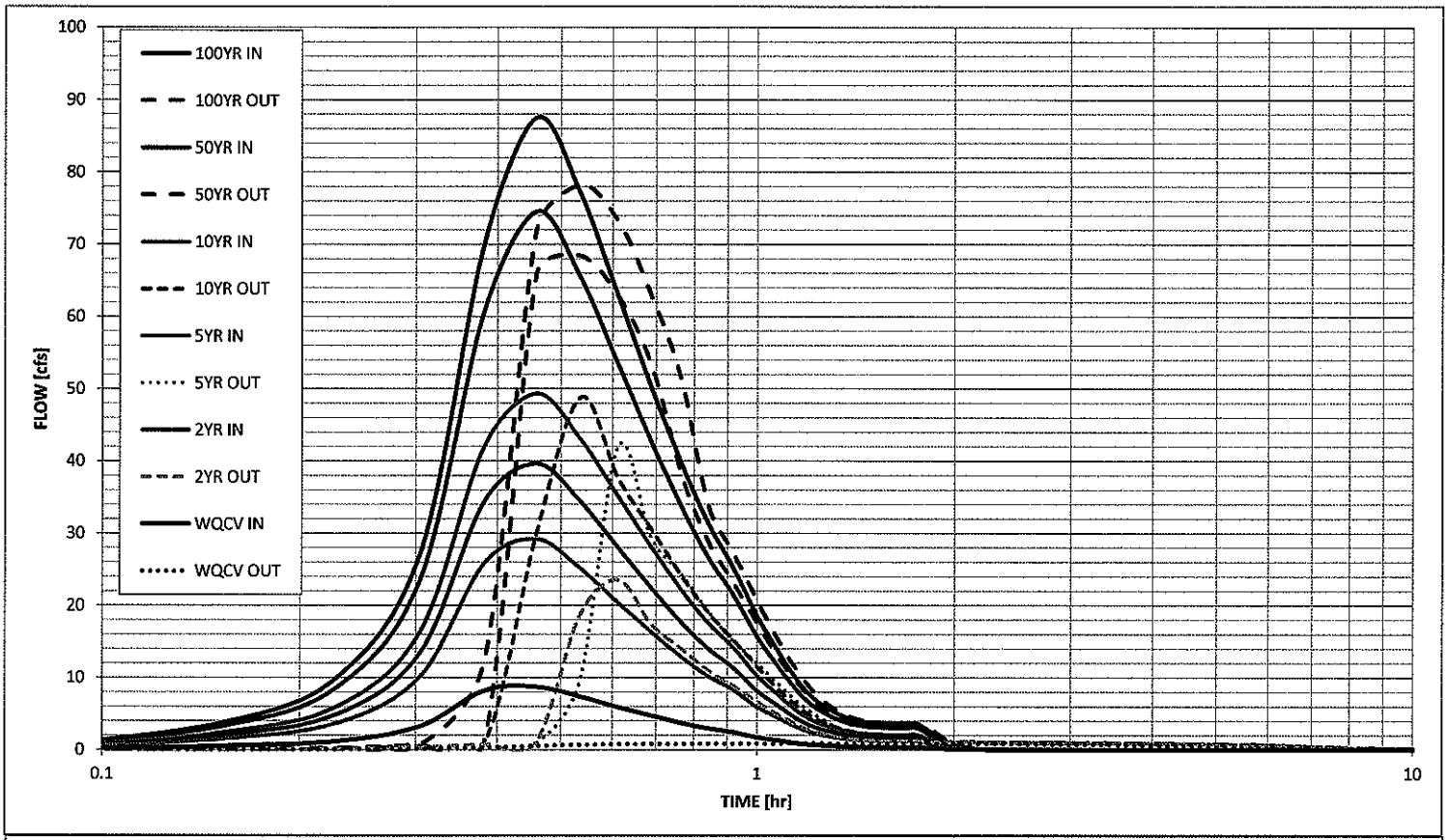
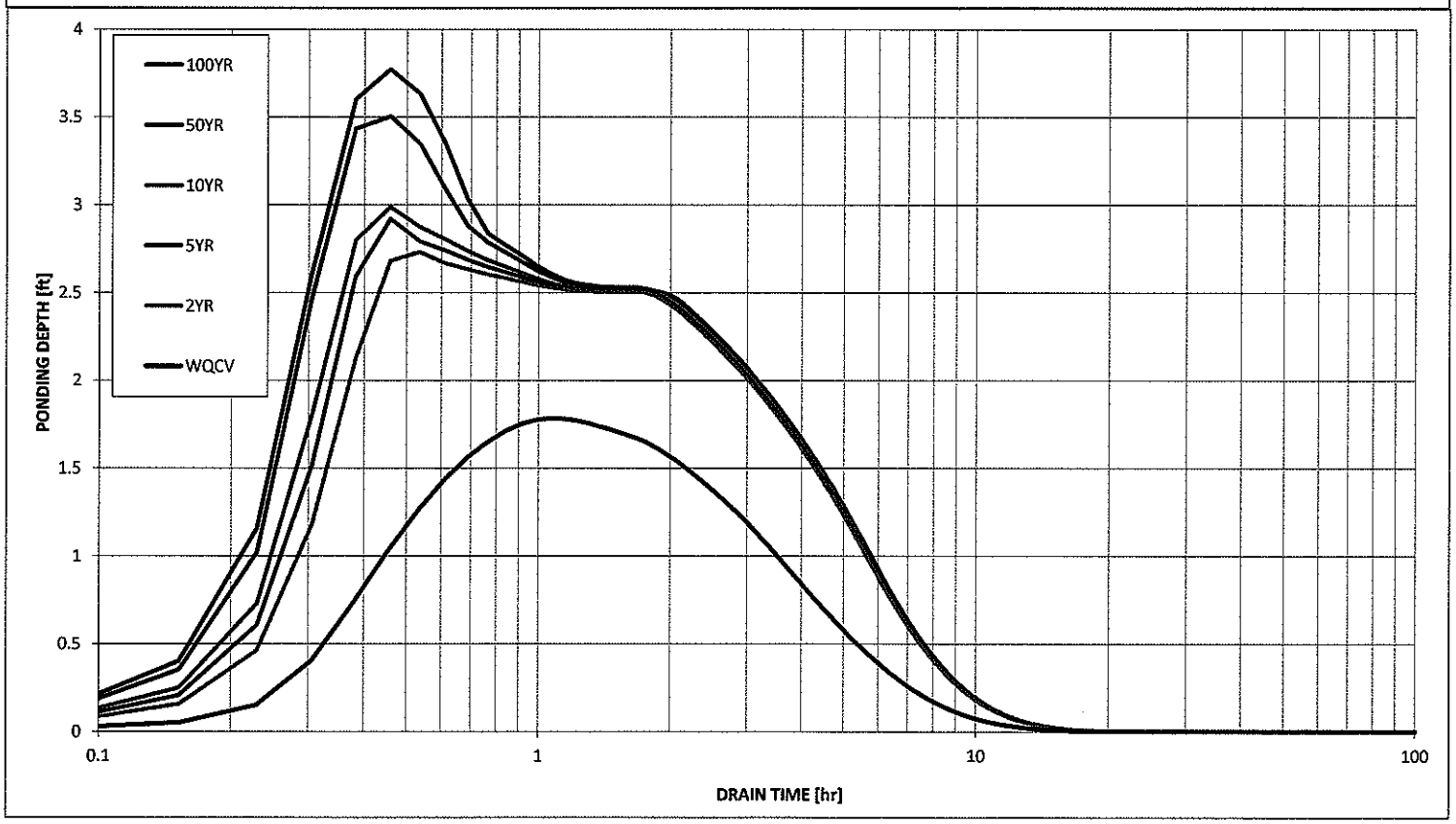
Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.50	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.358	1.207	1.641	2.045	3.074	3.599	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.357	1.206	1.640	2.045	3.074	3.599	acre-ft
Time to Drain 97% of Inflow Volume =	9.9	9.1	**8.4**	7.9	7.0	6.6	hours
Time to Drain 99% of Inflow Volume =	12.4	**11.7**	11.0	10.6	9.6	**9.3**	hours
Maximum Ponding Depth =	1.78	2.73	2.92	2.99	3.50	3.77	ft
Maximum Ponded Area =	0.183	0.212	0.228	0.234	0.256	**0.267**	acres
Maximum Volume Stored =	0.280	0.462	0.504	0.519	0.646	0.715	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





Design Procedure Form: Sand Filter (SF)

Sheet 1 of 2

Designer: Eugene Tellez
Company: MS Civil Consultants
Date: March 17, 2016
Project: Shiloh Mesa North Water Quality Pond
Location: Northeast of Marksheffel Road and Hancock Road Intersection

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 = 65.0 %
B) Tributary Area's Imperviousness Ratio ($i = i_a/100$)	i = 0.650
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time $WQCV = 0.9 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.29 watershed inches
D) Contributing Watershed Area (Including sand filter area)	Area = 164,667 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume $V_{WQCV} = WQCV / 12 * Area$	V_{WQCV} = 3,198 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = _____ in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = _____ 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} = 4.0 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 = 4.00 ft / ft
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 827 sq ft
D) Actual Filter Area	A_{Actual} = 1608 sq ft
E) Volume Provided	V_T = 3246 cu ft
3. Filter Material	Choose One: (●) 18" CDOT Class 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 = 1.8 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 3,198 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 1 - 5/16 in

Design Procedure Form: Sand Filter (SF)

Sheet 2 of 2

Designer:	Eugene Tellez
Company:	MS Civil Consultants
Date:	March 17, 2015
Project:	Shiloh Mesa North Water Quality Pond
Location:	Northeast of Marksheffel Road and Kenosha Road Intersection

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	Riprap pad provided on where needed. Emergency overflow provided to carry excess flow.

Notes:

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: Shiloh Mesa - North WQ Sand Filtration Basin

Facility Location & Jurisdiction: Northwest corner of the Shiloh Mesa Site, Colorado Spring

User (Input) Watershed Characteristics

Watershed Slope =	0.020	ft/ft
Watershed Length-to-Width Ratio =	4.81	L:W
Watershed Area =	3.78	acres
Watershed Imperviousness =	65.0%	percent
Percentage Hydrologic Soil Group A =	57.4%	percent
Percentage Hydrologic Soil Group B =	42.6%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown): User Input

User Input: Detention Basin Characteristics

WQCV Design Drain Time = 12.00 hours

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	1,154	0.00	0.00
1.00	1,917	1.00	0.18
2.00	2,810	2.00	0.26
2.50	3,311	2.50	0.28
3.00	3,833	3.00	27.55
4.00	4,966	4.00	47.54

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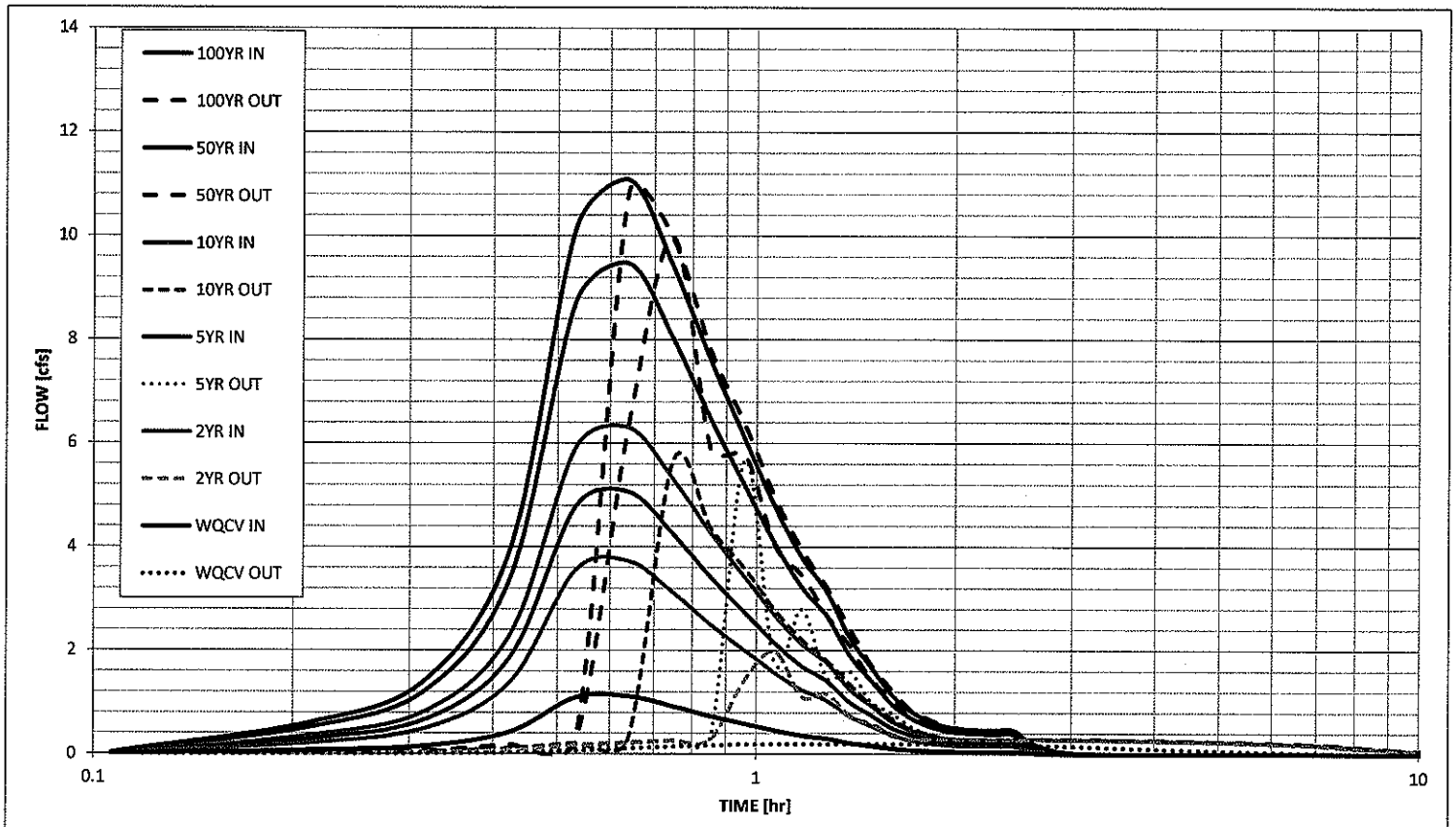
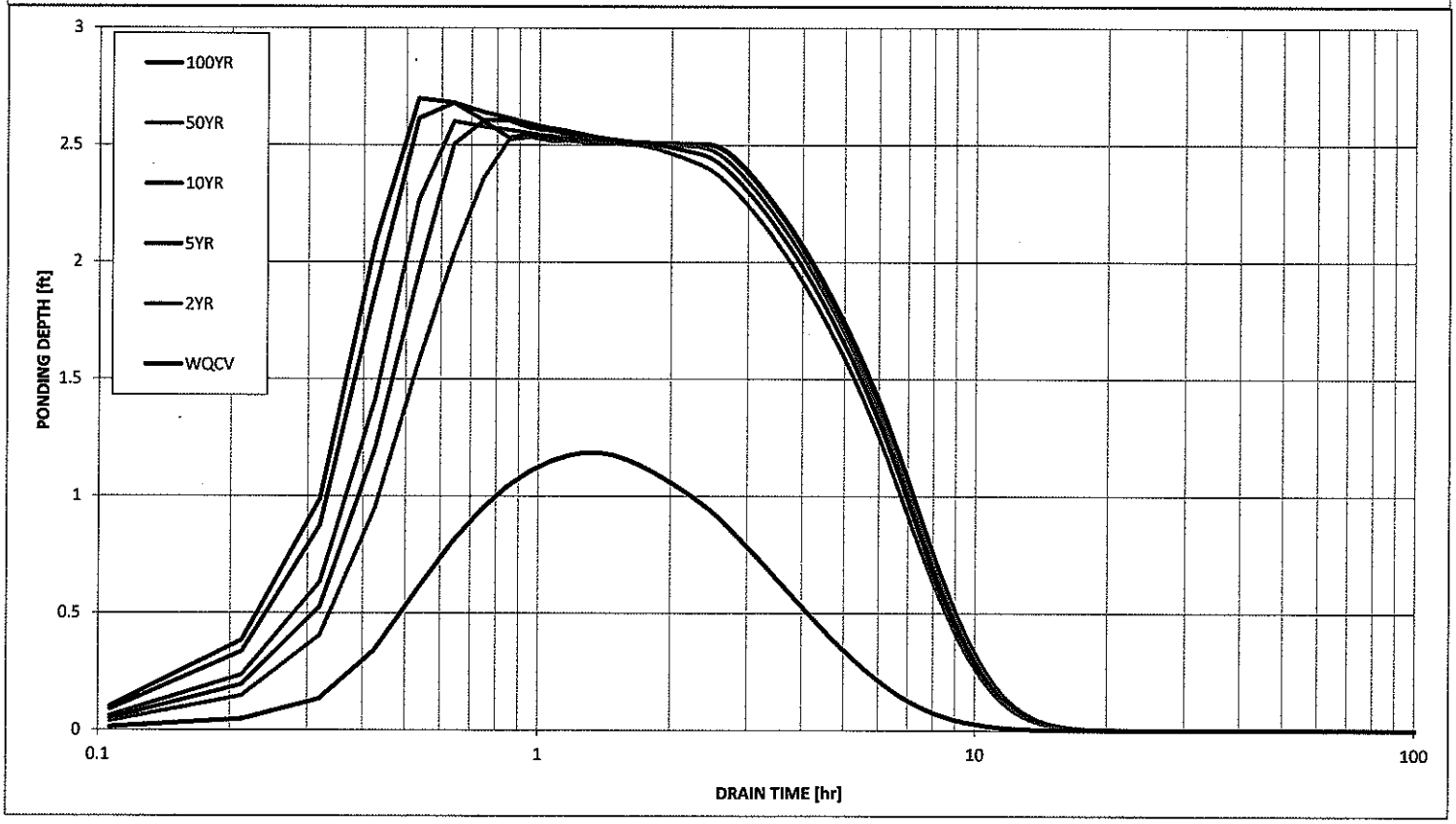
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.50	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.063	0.214	0.291	0.362	0.545	0.637	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.063	0.213	0.290	0.362	0.544	0.637	acre-ft
Time to Drain 97% of Inflow Volume =	8.2	10.3	**10.0**	9.7	9.0	8.6	hours
Time to Drain 99% of Inflow Volume =	10.2	12.5	12.0	11.8	11.1	**10.9**	hours
Maximum Ponding Depth =	1.18	2.53	2.60	2.60	2.68	2.70	ft
Maximum Ponded Area =	0.048	0.077	0.078	0.078	0.080	**0.081**	acres
Maximum Volume Stored =	0.044	0.127	0.132	0.132	0.139	0.140	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





CIVIL CONSULTANTS, INC.

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80901-1360
v 719.955.5485 f 719.444.8427

Riprap Sizing Worksheet

SHILOH MESA FILING NO. 1
EQNS. FROM UDFCD

72" RCP STRM OUTFALL @ SAND CREEK

REQ ROCK SIZE — FROUDE = 1.3
EQN MD-20 $D_a = \frac{(D_c + Y_n)}{2} = \frac{6+4.5}{2} = 5.25$
USE FIGURE MD-21 $Q/D_a^{2.5} \leq 6$ $340/5.25^{2.5} = 5.38 \leq 6$ Ok
$Y_t/D = 4.5/5.25 = 0.86$ $Q/D^{1.5} = 340/5.25^{1.5} = 28.26$
FROM FIG. MD-21 TYPE M $D_{50} = 12"$

USE TYPE H VELOCITY ON INTERIM CONDITION HIGH REUSE RIP RAP FOR ULTIMATE CONDITION

EXTENT OF PROTECTION
USE FIG. MD-23
$Y_t/D = 4.5/5.25 = 0.86$ $Q/D_a^{2.5} = 340/5.25^{2.5} = 5.38$
FROM MD-23 $\frac{1}{2\tan\theta} = 4.8$
EQN MD-23 $A_t = Q/V = 340/5.5 = 61.82$
EQN MD-22 $L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) = (4.8)\left(\frac{61.82}{4.5} - 6\right) = \boxed{37.14} < 3(D) = 3(6) = 18$
$W = 3(D) = 3(6) = \underline{18' \text{ min.}}$ THK $= 1.5(D_{50}) = 1.5 \times 1.5 = \underline{2.25' \text{ THK}}$

42" RCP STRM OUTFALL @ MUSTANG ROAD
MULTIPLE CONDUITS DISTRIBUTE TOTAL DISCHARGE AMONG INDIVIDUAL CONDUITS

REQ ROCK SIZE — FROUDE = 1.3
EQN MD-20 $D_a = \frac{(D_c + Y_n)}{2} = \frac{3.5+3.5}{2} = 3.5$ $Q = 340/2 = 170$
USE FIGURE MD-21 $Q/D_a^{2.5} \leq 6$ $170/3.5^{2.5} = 7.42 \not\leq 6.0$
INCREASE D_c BY $\frac{1}{4} D_c$ FOR EACH WHOLE NUMBER BY WHICH THE FROUDE PARAMETER IS GREATER THAN 6.0
$Q/(D_c \times 1.25)^{2.5} = 170/(3.5 \times 1.25)^{2.5} = 4.25 \leq 6.0$ Ok
$Y_t/D = 3.5/4.38 = 0.8$ $Q/D^{1.5} = 170/4.38^{1.5} = 18.55$
FROM FIG. MD-21 TYPE L $D_{50} = 9"$

USE TYPE M GROUTED LIMITED AREA BETWEEN MUSTANG RD AND PROPERTY

EXTENT OF PROTECTION
USE FIG. MD-23
$Y_t/D = 3.5/4.38 = 0.8$ $Q/D^{2.5} = 170/4.38^{2.5} = 4.23$
FROM MD-23 $\frac{1}{2\tan\theta} = 6.25$
EQN MD-23 $A_t = 170/5.5 = 30.91$
EQN MD-22 $L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) = (6.25)\left(\frac{30.91}{3.5} - 3.5\right) = \boxed{33.32} > 3.5(3) = 10.5$
$W = 3(D) = 3(3.5) = \underline{10.5' \text{ min}}$ THK $= 1.5(D_{50}) = 1.5(1) = \underline{1.5' \text{ THK}}$

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Riprap Sizing Worksheet

SHILOH MESA FILING NO. 1
EQNS. FROM UDFCD

42" RCP STRM OUTFALL @ SAND TRAP BASIN

REQ ROCK SIZE FROUDE = 0.7
USE FIG. MD-21 $Q/D^{2.5} = 71/3.5^{2.5} = 3.1 \leq 6.0$ OK
$y_t/D = 3.5/3.5 = 1.0$ $Q/D^{1.5} = 71/3.5^{1.5} = 10.8$
FROM FIG. MD-21 TYPE L = $D_{50} = 9''$

EXTENT OF PROTECTION
USE FIG. MD-23
$y_t/D = 3.5/3.5 = 1.0$ $Q/D^{2.5} = 71/3.5^{2.5} = 3.1$
FROM MD-23 $\frac{1}{2\tan\theta} = 6.7$
EQN MD-23 $A_t = Q/V = 71/5.5 = 12.91$
EQN MD-22 $L_P = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{y_t} - w\right) = (6.7)\left(\frac{12.91}{3.5} - 3.5\right) = 1.24 < 3(D) = 3(3.5) = 10.5'$ MIN
$w = 3(D) = 3(3.5) = 10.5'$ MIN THK $= 1.5(0.75) = 1.125'$ MIN

42" RCP STRM OUTFALL @ SAND CREEK

REQ ROCK SIZE FROUDE = 1.1
EQN. MD-20 $D_a = \frac{(D_c + y_n)}{2} = \frac{(3.5 + 2.58)}{2} = 3.04$
USE FIG. MD-21 $Q/D_a^{2.5} = 77.2/3.04^{2.5} = 4.79 < 6.0$ OK
$y_t/D = 2.58/3.04 = 0.84$ $Q/D^{1.5} = 77.2/3.04^{1.5} = 14.56$
FROM FIG. MD-21 TYPE L RIPRAP $D_{50} = 9''$

EXTENT OF PROTECTION
USE FIG. MD-23
$y_t/D = 2.58/3.04 = 0.84$ $Q/D^{2.5} = 77.2/3.04^{2.5} = 4.79$
FROM MD-23 $\frac{1}{2\tan\theta} = 5.6$
EQN MD-23 $A_t = Q/V = 77.2/5.5 = 14.03$
EQN MD-22 $L_P = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{y_t} - w\right) = (5.6)\left(\frac{14.03}{2.58} - 3.5\right) = 10.85 > 3(D) = 3(3.5) = 10.5$
$w = 3(D) = 3(3.5) = 10.5'$ MIN THK $= 1.5(0.75) = 1.125'$ THK

REQ ROCK SIZE FROUDE = 2.5
EQN MD-20 $D_a = \left(\frac{D_c + y_n}{2}\right) = \left(\frac{1.5 + 0.67}{2}\right) = 1.1$ $Q/D_a^{2.5} = 7.4/1.1^{2.5} = 5.83$
$y_t/D = 0.67/1.1 = 0.62$ $Q/D^{1.5} = 7.4/1.1^{1.5} = 6.41$ FROM FIG. MD-21 TYPE L $D_{50} = 9''$

EXTENT OF PROTECTION
USE FIG. MD-23
$y_t/D = 0.67/1.1 = 0.62$ $Q/D^{2.5} = 7.4/1.1^{2.5} = 6.83$ FROM MD-23 $\frac{1}{2\tan\theta} = 3.8$
EQN MD-23 $A_t = Q/V = 7.4/5.5 = 1.35$
EQN MD-22 $L_P = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{y_t} - w\right) = (3.8)\left(\frac{1.35}{.67} - 1.5\right) = 1.96 <$
$3(D) = 3(1.5) = 4.5'$
$w = 3(D) = 3(1.5) = 4.5'$ THK $= 1.5(0.75) = 1.125'$ THK

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: Shiloh Mesa - Temporary Pond

Facility Location & Jurisdiction: West edge of the Shiloh Mesa Site, Colorado Spring

User (Input) Watershed Characteristics

Watershed Slope =	0.023	ft/ft
Watershed Length-to-Width Ratio =	4.50	L:W
Watershed Area =	323.00	acres
Watershed Imperviousness =	9.0%	percent
Percentage Hydrologic Soil Group A =	73.8%	percent
Percentage Hydrologic Soil Group B =	26.2%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown): User Input

User Input: Detention Basin Characteristics

WQCV Design Drain Time = 72.00 hours

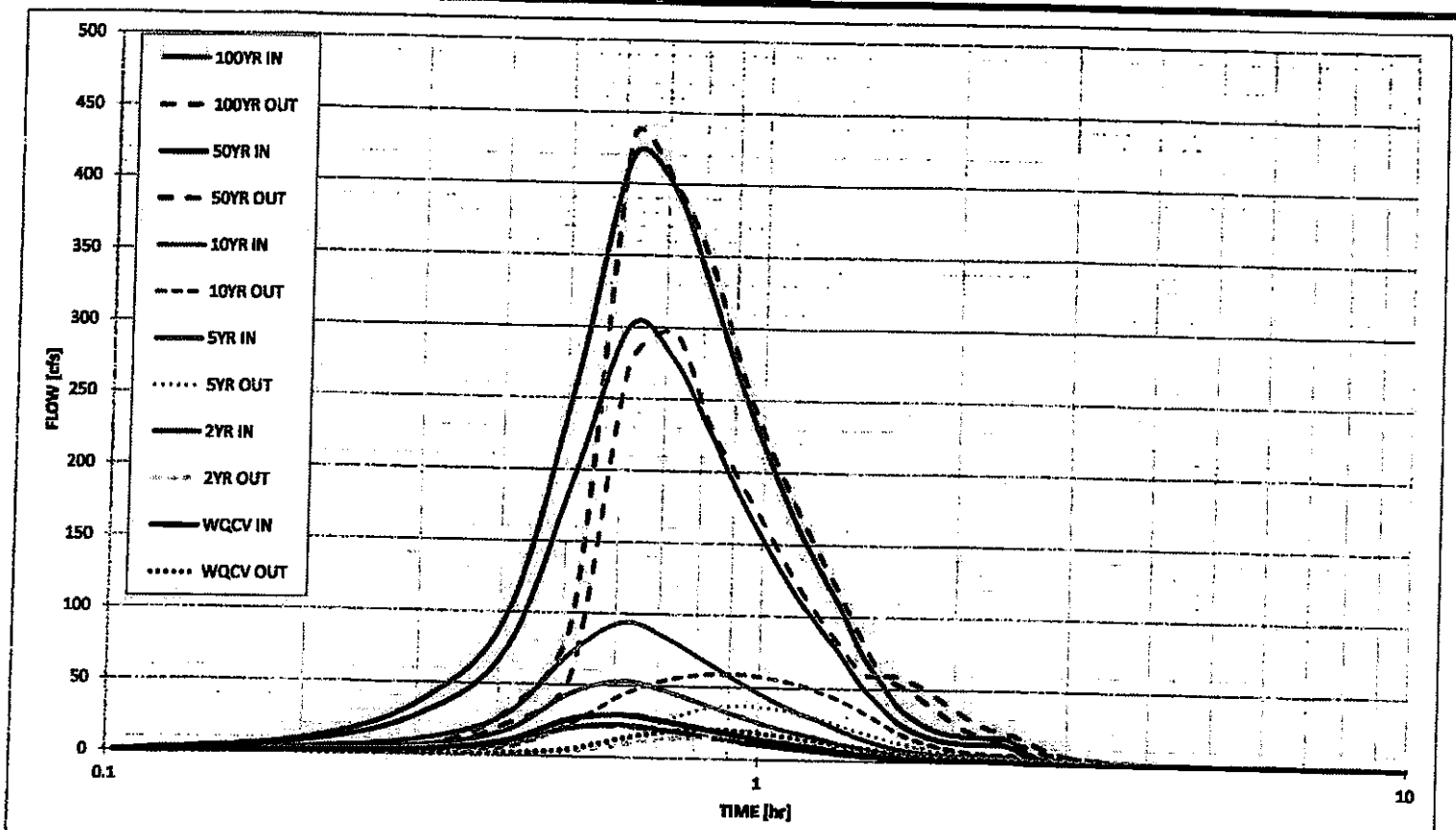
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	8,511	0.00	0.00
1.00	9,583	1.00	5.40
2.00	10,454	2.00	17.50
3.00	11,326	3.00	32.20
4.00	12,197	4.00	43.80
5.00	13,504	5.00	53.30
6.00	14,375	6.00	61.50
7.00	15,349	7.00	192.10
8.00	16,439	8.00	424.00

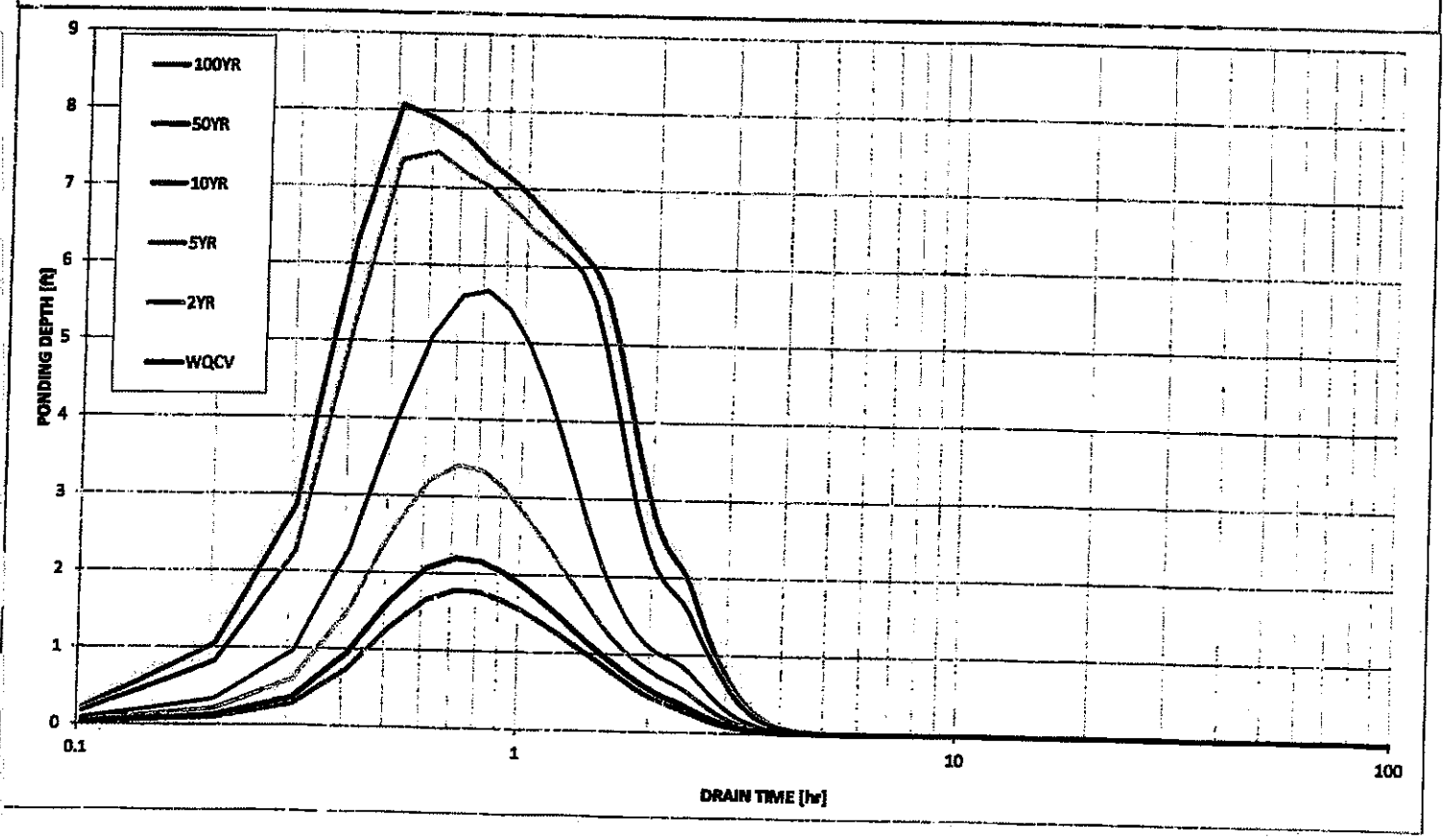
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.50	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	1.648	1.245	2.932	5.168	16.667	23.379	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	1.648	1.244	2.932	5.162	16.659	23.378	acre-ft
Time to Drain 97% of Inflow Volume =	2.7	2.7	2.6	2.6	2.1	2.1	hours
Time to Drain 99% of Inflow Volume =	3.2	3.2	3.2	3.1	2.9	2.8	hours
Maximum Ponding Depth =	2.20	1.78	3.40	5.66	7.45	8.07	WARNING!
Maximum Ponded Area =	0.244	0.236	0.268	0.323	0.364	0.377	acres
Maximum Volume Stored =	0.485	0.386	0.793	1.461	2.073	2.278	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





MATCH SHT 49

6990

SCORPIUS ROAD

ADD 2-48"CMP's w/FES
EXISTING 48" CMP TO REMAIN
10-YR CAPACITY

END DRAINAGEWAY

KENOSHA ROAD

01-CUL-54
18"CMP

6978.3

REMOVE EX
42" CMPs

IMPROVED GRASSLINED CHANNEL
BW=20', d=3, S=1.3%
Q100=310 cfs

NEW TWIN 60"CMPs w/FES

MUSTANG ROAD

MAVERICK ROAD

FOR CHANNEL DATA,
SEE SHT 46

MATCH SHT 47

EXHIBIT "A"

THIS DRAWING IS A MASTER PLANNING SHE.. PRELIMINARY AND CONCEPTUAL REPRESENTING ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

0' 200' 400'

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

SAND CREEK DRAINAGE
BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No.	90-04-09
Date:	12/92
Design:	RMW
Drawn:	EAK
Check:	
Revisions:	

47 R

TABLE VIII-3: SAND CREEK DRAINAGE BASIN PLANNING STUDY
TRIBUTARY DRAINAGEWAY CONVEYANCE COST ESTIMATE
SAND CREEK, CENTER TRIBUTARY AND WEST FORK SAND CREEK

SEGMENT NUMBER	REACH NUMBER	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	LENGTH OF GRADE CONTROL (FT)	TOTAL REIMBURSABLE COSTS	TOTAL COST
147-2	"	"	1150	200	1	30	$235,400	$235,400
153-1	"	"	600	150	0	0	$90,000	$90,000
153-2	"	"	450	150	0	0	$67,500	$67,500
152-1	SC-7	100-YEAR GRASSLINED	1650	150	0	0	$247,500	$247,500
152-2	"	"	800	150	2	100	$138,000	$138,000
150-1	"	100-YEAR STORM SEWER 36" RCP	800	58	0	0	$46,400	$46,400
150-2	"	100-YEAR RIPRAP	2400	200	0	0	$480,000	$480,000
161-1	"	100-YEAR GRASSLINED	550	150	0	0	$82,500	$82,500
154	SC-8	"	2100	200	10	600	$528,000	$528,000
157	"	"	2400	200	13	520	$573,600	$573,600
155-1	"	100-YEAR GRASSLINED	550	175	4	140	$121,450	$121,450
159	"	100-YEAR RIPRAP	3450	200	14	840	$841,200	$841,200
164	"	"	1350	200	5	200	$306,000	$306,000
186	"	"	2250	200	5	200	$486,000	$486,000
169	"	"	650	175	1	40	$120,950	$120,950
173	SC-9	"	950	175	8	320	$223,850	$223,850
WEST FORK SAND CREEK								
154-1	WF-1	100-YEAR RIPRAP	1550	223	2	100	$0	$363,650
161	"	"	600	223	2	80	$0	$148,200
164-2	"	100-YEAR GRASSLINED	500	150	0	0	$0	$75,000
164-4	"	100-YEAR RIPRAP	2500	175	9	280	$0	$487,900
165-1	"	"	1350	175	0	0	$0	$236,250
TOTAL SAND CREEK TRIBUTARY DRAINAGEWAYS							$7,420,650	$12,543,750

EXHIBIT "B"

TABLE VIII-4: SAND CREEK DRAINAGE BASIN PLANNING STUDY
ROADWAY CULVERT CROSSING COST ESTIMATE
SAND CREEK BASINS

ROADWAY	REACH NUMBER	DRAINAGEWAY SEGMENT	CROSSING TYPE	LENGTH	UNIT	UNIT COST	TOTAL COST	TOTAL REIMBURSABLE COST
		SAND CREEK						
GRANADA DRIVE	SC-1	107	2-4'H x 10'W CBC	60	LF	$650	$39,000	$0
DELTA DRIVE	SC-1	"	"	80	LF	$650	$52,000	$0
SONOMA DRIVE	SC-1	"	"	60	LF	$650	$39,000	$0
SAN MARCOS ROAD	SC-1	"	"	80	LF	650	$52,000	$0
EL MORRO ROAD	SC-1	113	2-5'H x 8'W CBC	60	LF	$540	$32,400	$0
DELTA DRIVE	SC-1	"	"	90	LF	$540	$48,600	$0
WAYNOKA ROAD	SC-4	135-2	50' BRIDGE	3200	SF	$80	$256,000	$256,000
TUIT BLVD	SC-5	183	2- 6'Hx8'W CBC	80	LF	$600	$48,000	$48,000
PETERSON ROAD	SC-6	127	2- 6'Hx12'W CBC	120	LF	$870	$104,400	$104,400
JEDEDIAH SMITH RD.	SC-6	156	2- 8'Hx10'W CBC	120	LF	$750	$90,000	$90,000
PETERSON ROAD	SC-6	140	6'Hx7'W CBC	100	LF	$270	$27,000	$27,000
DUBLIN BOULEVARD	SC-6	142	6'Hx9'W CBC	100	LF	$360	$36,000	$36,000
JEDEDIAH SMITH RD.	SC-6	143	6'Hx10'W CBC	80	LF	$390	$31,200	$31,200
DUBLIN BOULEVARD	SC-6	145	"	120	LF	$390	$46,800	$46,800
PETERSON ROAD	SC-6	142	6'Hx9'W CBC	200	LF	$360	$72,000	$72,000
CALIFORNIA DRIVE	SC-6	152-1	4'Hx8'W CBC	40	LF	$270	$10,800	$0
"	SC-6	153	48-INCH RCP	40	LF	$80	$3,200	$0
VOLLMER ROAD	SC-6	155-1	2-60-INCH RCP	60	LF	$240	$14,400	$0
WOODMEN ROAD	SC-6	152-1	4'Hx6'W CBC	300	LF	$240	$72,000	$72,000
WOODMEN ROAD	SC-6	153-1	4'Hx4'W CBC	400	LF	$210	$84,000	$84,000
VOLLMER ROAD	SC-6	154	2-6'Hx10'W CBC	80	LF	$690	$55,200	$0
MUSTANG ROAD	SC-7	150-2	2-60-INCH CMP	60	LF	$240	$14,400	$0
KENOSHA ROAD	SC-7	161-1	2-48-INCH CMP	60	LF	$160	$9,600	$0
RESEARCH PARKWAY	SC-8	159	2-6'Hx9'W CBC	120	LF	$660	$79,200	$79,200
RESEARCH PARKWAY	SC-8	157	6'Hx12'W CBC	120	LF	$870	$104,400	$104,400
MUSTANG PLACE	SC-8	160	6'Hx8'W CBC	40	LF	$330	$13,200	$0
MUSTANG PLACE	SC-8	161-2	2-48-INCH CMP	40	LF	$160	$6,400	$0
RESEARCH PARKWAY	SC-8	"	6'Hx8'W CBC	40	LF	$330	$13,200	$13,200

EXHIBIT "C"

TABLE VIII-2: SAND CREEK DRAINAGE BASIN PLANNING STUDY
DRAINAGEWAY CONVEYANCE COST ESTIMATE
WITH SELECTED DETENTION ALTERNATIVES

SEGMENT NUMBER	REACH NUMBER	SEGMENT LENGTH (FT)	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	GRADE CONTROL LENGTH (FT)	TOTAL REIMBURSABL COSTS	TOTAL COST
148-2	"	2600	"	2150	127	5	620	$384,650	$384,650
151	SC-8	1700	10-YEAR RIPRAP	500	238	3	250	$164,000	$164,000
160	"	5100	SEL. LININGS (1 SIDE)	4400	127	6	720	$688,400	$688,400
			10-YR RIPRAP	600	238	0	0	$142,800	$142,800
163	"	6300	SEL. LININGS (1 SIDE)	2600	127	15	1200	$546,200	$546,200
			10-YR RIPRAP	350	238	0	0	$83,300	$83,300
187	"	1200	SEL. LININGS (1 SIDE)	0	0	2	160	$28,800	$28,800
170	SC-9	3200	"	0	0	4	320	$57,600	$57,600
171	"	5000	"	0	0	2	170	$30,600	$30,600
172	"	3650	"	0	0	2	150	$27,000	$27,000
TOTAL SAND CREEK DRAINAGEWAY								$15,560,220	$18,279,420

EXHIBIT "D"

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

MATCH STA 760+50 SHT 48

MATCH STA 47A

MATCH SHT 47B

MATCH STA 752+60 SHT 46

6958x74

6925x85

6925x92

6920x49

DISTURBED AREA

200'

400'

IMPROVED RIPRAP CHANNEL
BW=40', d=3', S=1.0%
3' DROPS @ 250' INTERVALS
Q100=950 cfs

CHANNEL IMPROVEMENTS

151	N/A	SELECTIVE RIPRAP LINING AND GRADE CONTROL
160		

FOR PROFILE SEE SHEET P-13

PROPOSED MARKSHEFFEL ROAD

EX EMBANKMENTS TO BE REMOVED

STA 756+00 CHECK

STA 748+00 CHECK

STA 738+00 CHECK

PRESERVE EX. VEGETATION & FLOODPLAIN

SAND CREEK

TRIPLE 10'x10' CBC

6950

6940

6930

6920

6910

735

740

745

750

755

760

151

146

160

Exhibit "E"

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1309

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No.	90-04-09
Date:	9-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

MATCH SHT 50A

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

IMPROVED RIPRAP CHANNEL
BW = 25', d = 3', S = 1.2%
3' DROPS @ 270' INTERVALS
Q100 = 600 cfs

164

7010

PROPOSED RESEARCH PARKWAY

7000

7003.45

106

7000.12

6987 (NEW 2-6'H x 6'W CBC
100-YR CAPACITY

FOR CHANNEL DATA,
SEE SHT 47

6980

MATCH SHT 48 A

0' 200' 400'

159

END FLOODPLAIN
DELINEATION

STA 768+00 CHECK

MATCH STA 768+80 SHT 48

CHANNEL IMPROVEMENTS

SELECTIVE RIPRAP LINING
AND GRADE CONTROL

FOR PROFILE SEE SHEETS P-13 AND P-14

160

SAND CREEK

REACH SC-2

PRESERVE EX VEGETATION
& FLOODPLAIN

6960

EXHIBIT "F"

MATCH STA 760+30 SHT 47

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

SAND CREEK DRAINAGE
BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No.	20-01-00
Date:	9-92
Design:	RNW
Drawn:	ZAK
Check:	RNW
Revision:	

MATCH STA 791 + 30 SHT 50

AREAS WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS SECTION. AREAS DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OR CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

4-10'W x 8'H CBC
100-YR. CAP

STA 788+00 CHECK

PROPOSED RESEARCH PARKWAY

STA 782+50 CHECK

NEW 6'H x 8'W CBC
100-YR CAPACITY

109
7023.68

EAST FORK SAND
CREEK BASIN

REMOVE EX.
36" x 58" CMPE

STA 776+00 CHECK

MUSTANG PLACE

EX. 36" CMP
TO REMAIN

TWIN 6'H x 9'W CBC
100-YR CAPACITY

NEW 2-48" CMP w/ FES
100-YR CAPACITY

7015.65

SAND CREEK
REACH SC-8

7008x12

MATCH STA 769+80 SHT 48

01-OUT-48
18" CMP

CHANNEL IMPROVEMENTS

7000

160 N/A SELECTIVE RIPRAP LININGS AND GRADE CONTROL

163

FOR PROFILE SEE SHEET P-14

MATCH SHT 47A

EXIST STA 791

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

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No. 80-06-07
Date: 8-92
Designed: RWW
Drawn: EAK
Check: RWW
Revisions:

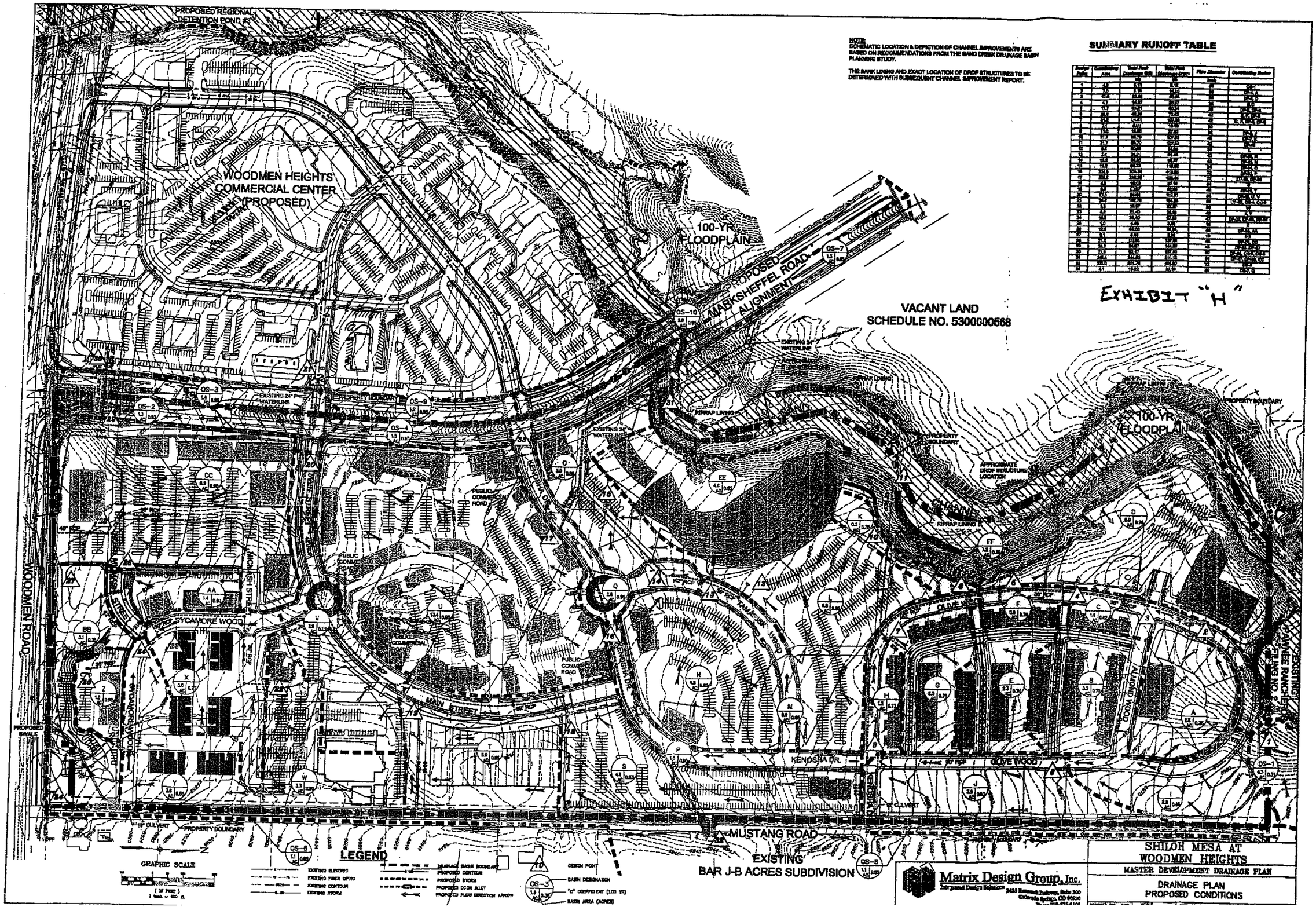
NOTE:
SCHEMATIC LOCATION & DEPICTION OF CHANNEL IMPROVEMENTS ARE BASED ON RECOMMENDATIONS FROM THE SAND CREEK DRAINAGE BASIN PLANNING STUDY.

THE BANK LINING AND EXACT LOCATION OF DROP STRUCTURES TO BE DETERMINED WITH SUBSEQUENT CHANNEL IMPROVEMENT REPORT.

SUMMARY RUNOFF TABLE

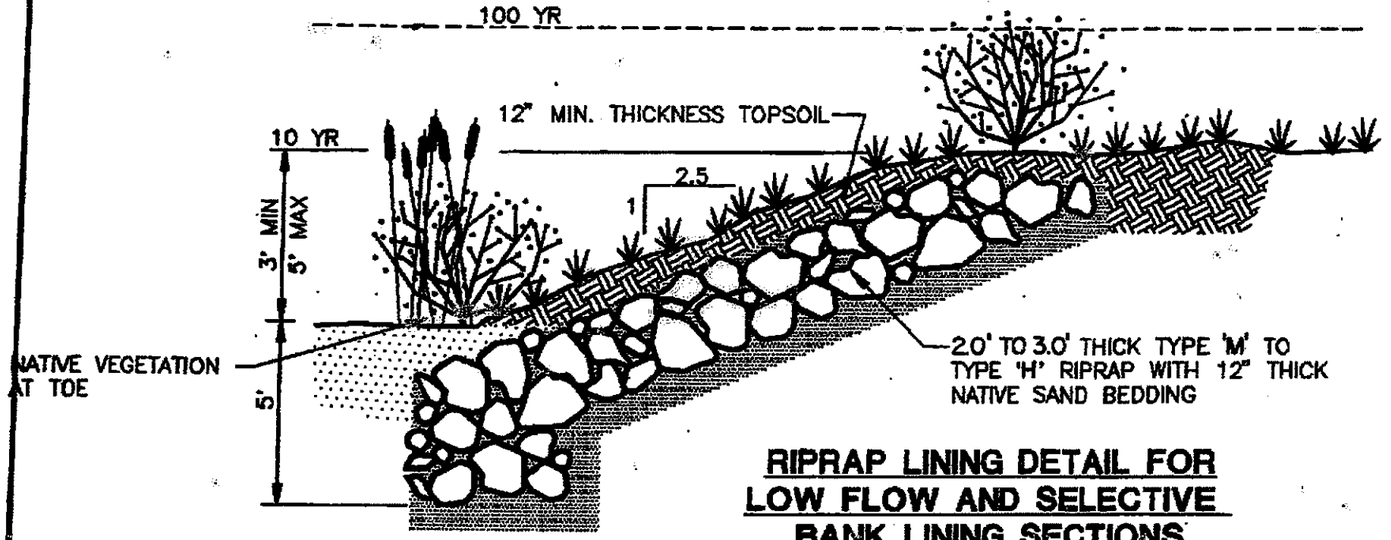
Design Point	Contributing Area	Total Peak Discharge (cfs)	Total Peak Discharge (cfs)	Pipe Diameter	Contributing Basins
	ac	cfs	cfs	inch	
1	4.8	9.6	9.6	18	OS-1
2	7.2	14.5	14.5	24	OS-1, A
3	12.0	33.8	33.8	30	OS-1, A, B
4	4.7	17.0	17.0	24	OS-1, A, B, C
5	1.7	6.7	6.7	18	OS-1, A, B, C, D
6	10.7	40.5	40.5	30	OS-1, A, B, C, D, E
7	8.5	32.5	32.5	30	OS-1, A, B, C, D, E, F
8	2.5	9.4	9.4	18	OS-1, A, B, C, D, E, F, G
9	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H
10	11.6	44.0	44.0	30	OS-1, A, B, C, D, E, F, G, H, J
11	10.7	40.5	40.5	30	OS-1, A, B, C, D, E, F, G, H, J, K
12	1.2	4.5	4.5	18	OS-1, A, B, C, D, E, F, G, H, J, K, L
13	1.2	4.5	4.5	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M
14	2.4	9.1	9.1	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N
15	4.3	16.3	16.3	24	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O
16	3.5	13.3	13.3	24	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P
17	36.8	114.3	114.3	42	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q
18	1.2	4.5	4.5	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R
19	4.8	18.2	18.2	24	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S
20	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T
21	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U
22	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V
23	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W
24	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X
25	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y
26	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z
27	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA
28	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB
29	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC
30	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD
31	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD, EE
32	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD, EE, FF
33	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD, EE, FF, GG
34	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD, EE, FF, GG, HH
35	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD, EE, FF, GG, HH, II
36	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD, EE, FF, GG, HH, II, JJ
37	2.1	8.0	8.0	18	OS-1, A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, BB, CC, DD, EE, FF, GG, HH, II, JJ, KK

EXHIBIT "H"



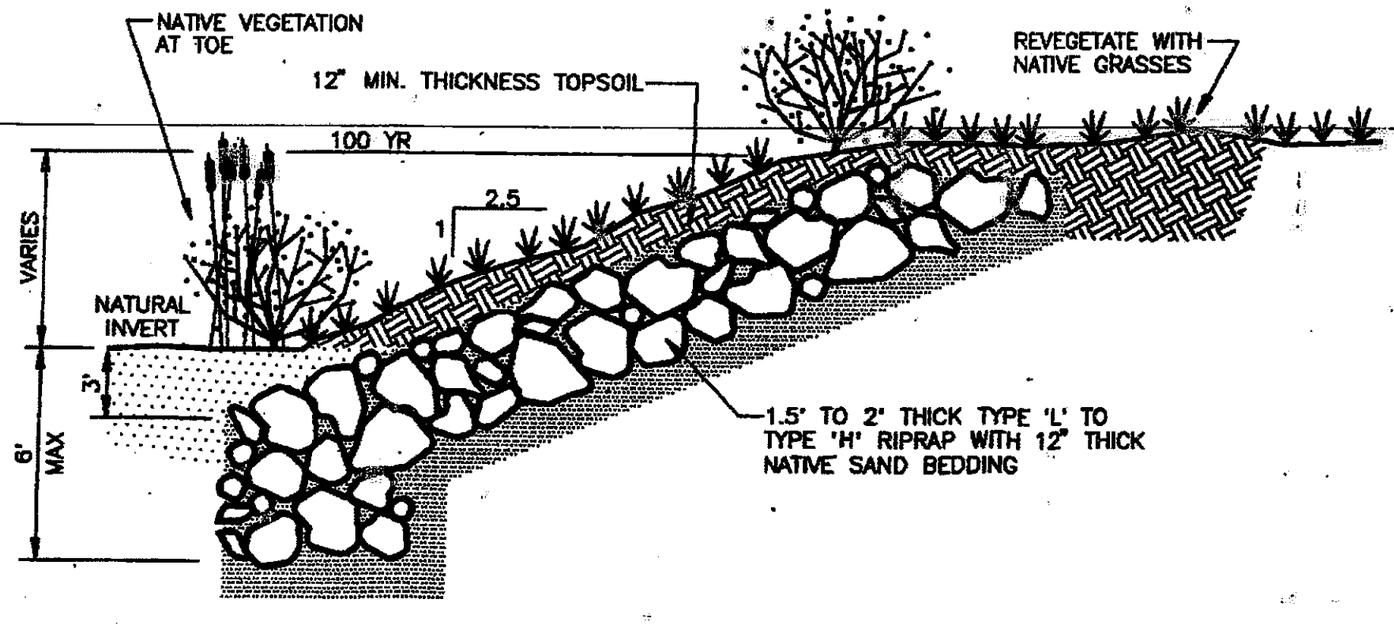
SHILOH MESA AT WOODMEN HEIGHTS
MASTER DEVELOPMENT DRAINAGE PLAN
DRAINAGE PLAN
PROPOSED CONDITIONS

Matrix Design Group, Inc.
Integrated Design Solutions
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920



RIPRAP LINING DETAIL FOR LOW FLOW AND SELECTIVE BANK LINING SECTIONS

NTS



RIPRAP LINING DETAIL FOR 100 YR CHANNEL SECTIONS

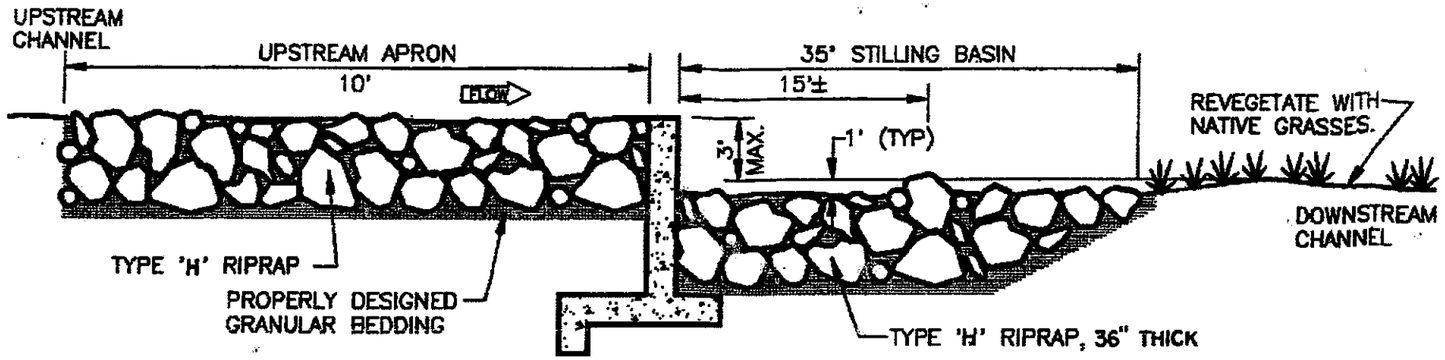
NTS

EXHIBIT "I"

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1309

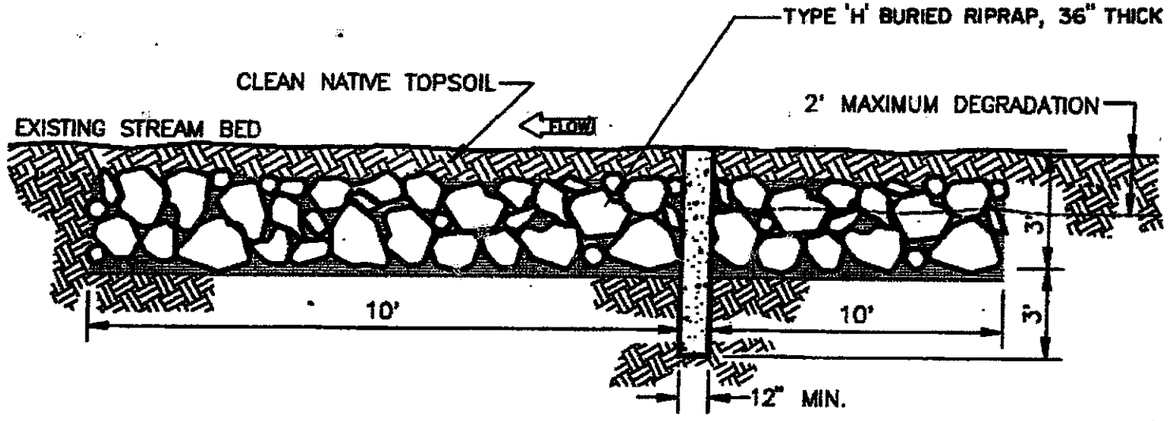
SAND CREEK DRAINAGE BASIN PLANNING STUDY

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



TYPICAL DROP STRUCTURE
GENERALIZED PROFILE
NTS

NOTE: DIMENSIONS OF APRON, STILLING BASIN, RIPRAP, AND CHECK STRUCTURE IS TO BE DETERMINED DURING FINAL DESIGN.



TYPICAL EROSION CONTROL
CHECK PROFILE
NTS

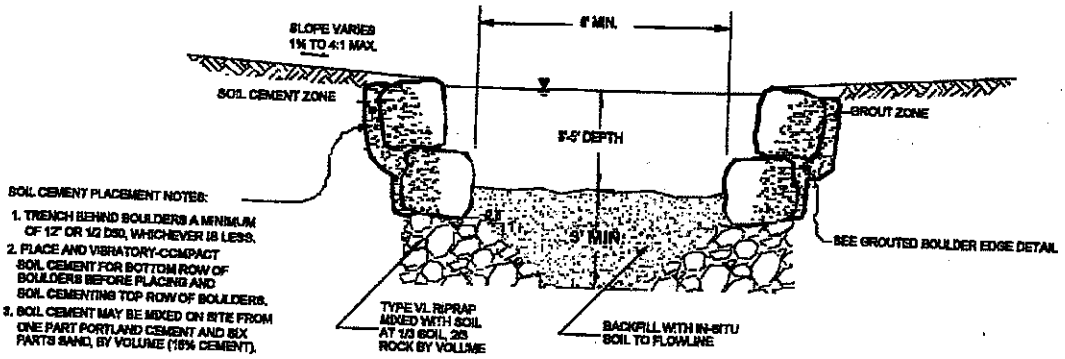
EXHIBIT "J"

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

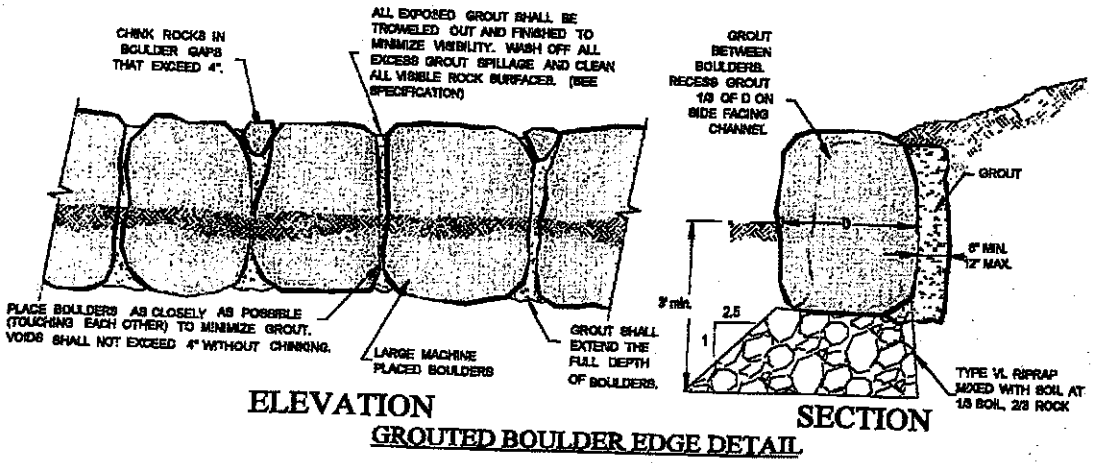
SAND CREEK DRAINAGE
BASIN PLANNING STUDY

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

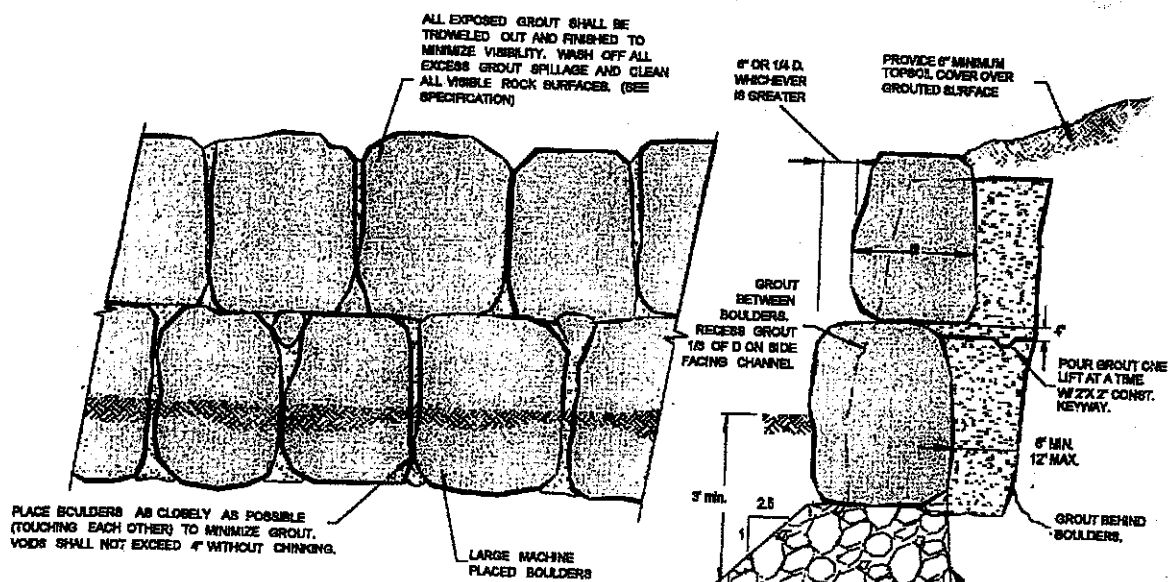
CS-7



BOULDER EDGED LOW FLOW CHANNEL CROSS-SECTION



GROUTED BOULDER EDGE DETAIL



GROUTED BOULDER STACKED WALL EDGE

Figure MD-19—Details for Boulder Edge Treatment of a Low-Flow Channel

EXHIBIT "K"

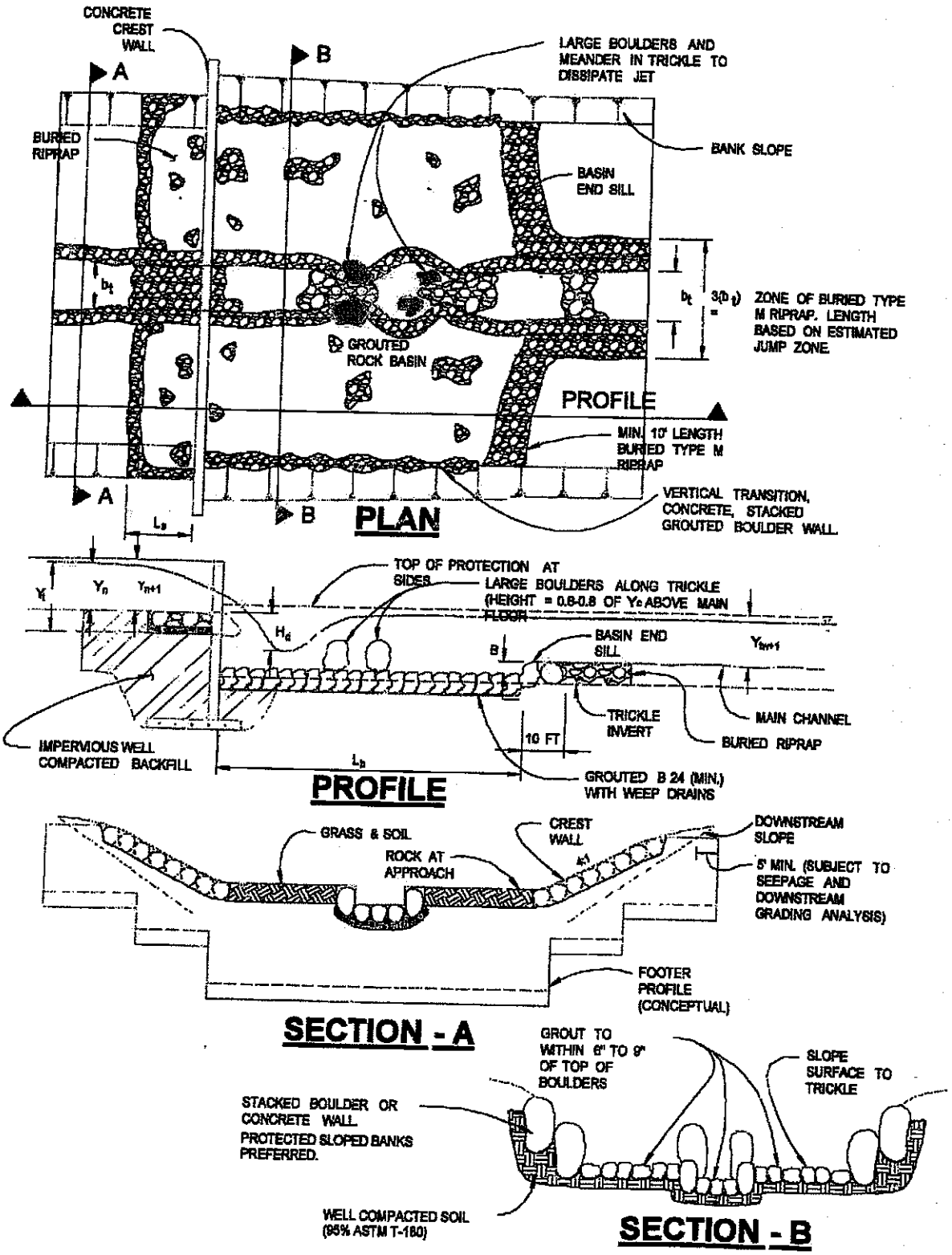


Figure HS-9—Vertical Hard Basin Drop

EXHIBIT "I"

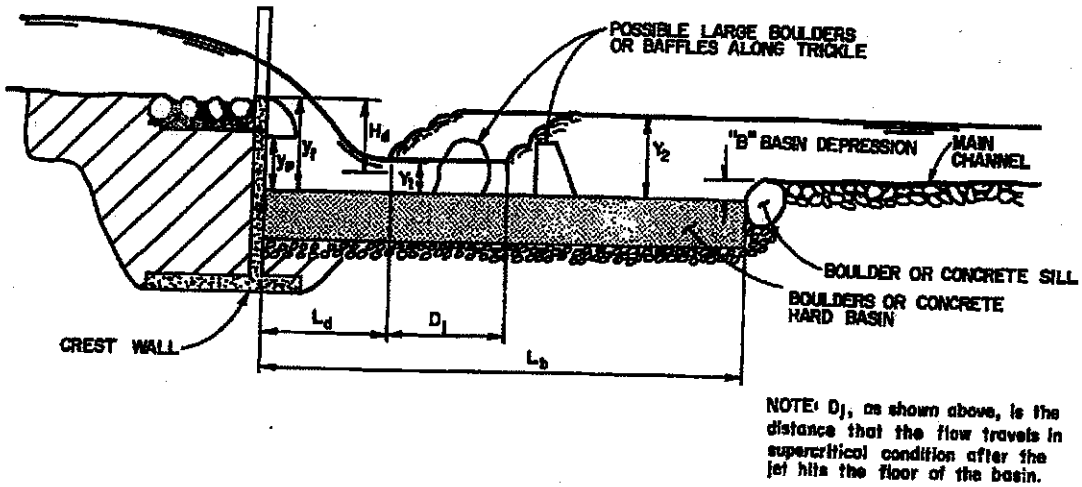


Figure HS-10—Vertical Drop Hydraulic System

EXHIBIT "M"

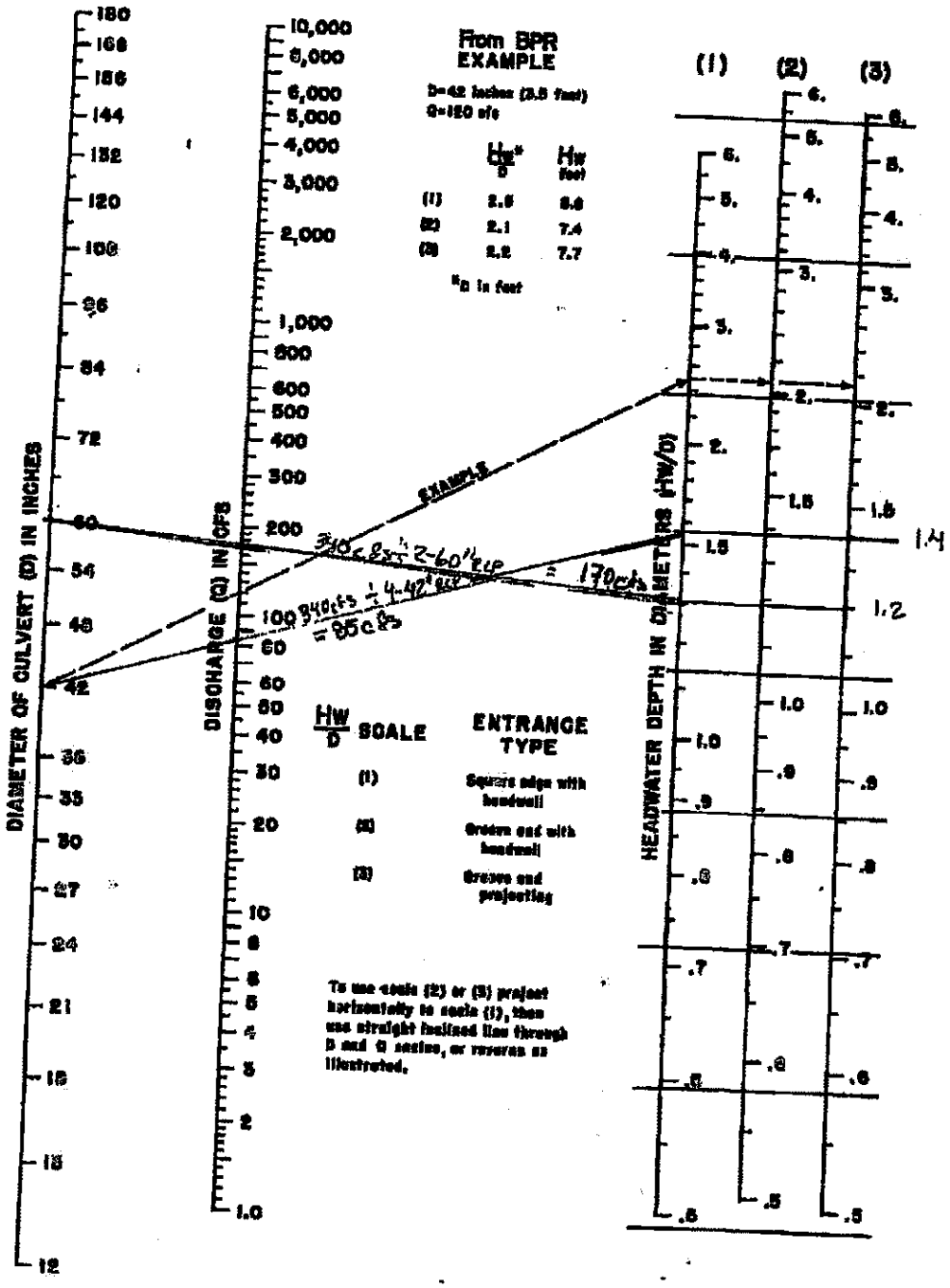
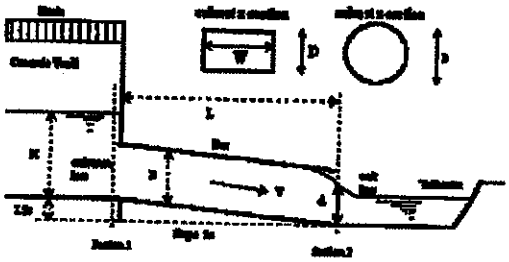


Figure CU-9—Inlet Control Nomograph—Example

EXHIBIT N

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: SHILOH MESA FILING NO. 1
Basin ID: 4-42" CULVERTS @ MUSTANG ROAD
Status:



Design Information (Input):

Circular Culvert: Barrel Diameter in Inches — D = 42 Inches
Inlet Edge Type (choose from pull-down list) — Grooved End Projection

OR:

Box Culvert: Barrel Height (Rise) in Feet — Height (Rise) = ft.
Barrel Width (Span) in Feet — Width (Span) = ft.
Inlet Edge Type (choose from pull-down list) — Square Edge w/ 30-78 deg. Flared Wingwall

Number of Barrels	No =	4
Inlet Elevation at Culvert Invert	Inlet Elev =	39.96 ft. elev.
Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./ft h.)	Outlet Elev =	39.19 ft. elev.
Culvert Length in Feet	L =	49.21 ft.
Manning's Roughness	n =	0.013
Bend Loss Coefficient	K_b =	0
Exit Loss Coefficient	K_x =	1

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.29
Sum of All Loss Coefficients	K_s =	1.49
Orifice Inlet Condition Coefficient	C_d =	0.66
Minimum Energy Condition Coefficient	KE_{low} =	-0.0421

Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
39.96		0.00	0.00	0.00	No Flow (WS < Inlet)	N/A
40.46		5.20	113.02	5.20	Min. Energy. Eqn.	INLET
40.96		24.80	126.87	24.80	Min. Energy. Eqn.	INLET
41.46		54.00	134.41	54.00	Min. Energy. Eqn.	INLET
41.96		89.20	148.24	89.20	Regression Eqn.	INLET
42.46		130.40	167.35	130.40	Regression Eqn.	INLET
42.96		178.40	186.58	178.40	Regression Eqn.	INLET
43.46		228.40	228.55	228.40	Regression Eqn.	INLET
43.96		274.00	287.19	274.00	Regression Eqn.	INLET
44.46		314.40	337.79	314.40	Regression Eqn.	INLET
44.96		350.40	382.09	350.40	Regression Eqn.	INLET
45.46		382.40	421.85	382.40	Regression Eqn.	INLET
45.96		411.80	458.10	411.80	Regression Eqn.	INLET
46.46		438.80	491.83	438.80	Regression Eqn.	INLET
46.96		464.40	523.29	464.40	Regression Eqn.	INLET
47.46		488.40	552.99	488.40	Regression Eqn.	INLET
47.96		511.60	581.43	511.60	Regression Eqn.	INLET
48.46		533.20	608.37	533.20	Regression Eqn.	INLET
48.96		554.40	634.04	554.40	Regression Eqn.	INLET
49.46		575.20	658.96	575.20	Regression Eqn.	INLET
49.96		594.80	682.62	594.80	Regression Eqn.	INLET
50.46		614.00	705.76	614.00	Regression Eqn.	INLET
50.96		631.60	728.18	631.60	Orifice Eqn.	INLET
51.46		648.40	749.82	648.40	Orifice Eqn.	INLET
51.96		664.80	770.97	664.80	Orifice Eqn.	INLET
52.46		680.80	791.95	680.80	Orifice Eqn.	INLET
52.96		696.40	811.49	696.40	Orifice Eqn.	INLET
53.46		711.60	830.67	711.60	Orifice Eqn.	INLET
53.96		726.80	850.00	726.80	Orifice Eqn.	INLET
54.46		741.20	868.63	741.20	Orifice Eqn.	INLET

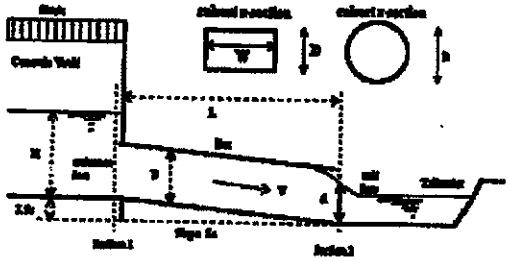
TOP of MUSTANG RD +/-

Processing Time: 00.16 Seconds

EXHIBIT O

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: SHILOH MESA FILING NO. 1
Basin ID: 2-60" CULVERTS @ MUSTANG ROAD
Status:



Design Information (Input):

Circular Culvert: Barrel Diameter in Inches	D =	60 Inches
Inlet Edge Type (choose from pull-down list)		Square End with Headwall
OR:		
Box Culvert: Barrel Height (Rise) in Feet	Height (Rise) =	ft.
Barrel Width (Span) in Feet	Width (Span) =	ft.
Inlet Edge Type (choose from pull-down list)		Square Edge w/ 30-75 deg. Flared Wingwall
Number of Barrels	No =	2
Inlet Elevation at Culvert Invert	Inlet Elev =	38.96 ft. elev.
Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./ft h.)	Outlet Elev =	38.26 ft. elev.
Culvert Length in Feet	L =	49.21 ft.
Manning's Roughness	n =	0.013
Bend Loss Coefficient	K_b =	0
Exit Loss Coefficient	K_x =	1

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.50
Friction Loss Coefficient	K_f =	0.18
Sum of All Loss Coefficients	K_t =	1.68
Orifice Inlet Condition Coefficient	C_o =	0.85
Minimum Energy Condition Coefficient	KE_{min} =	-0.0029

Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
38.96		0.00	0.00	0.00	No Flow (WS < Inlet)	N/A
39.46		3.00	74.95	3.00	Min. Energy. Eqn.	INLET
39.96		12.00	104.62	12.00	Min. Energy. Eqn.	INLET
40.46		32.80	133.13	32.80	Min. Energy. Eqn.	INLET
40.96		56.40	158.18	56.40	Min. Energy. Eqn.	INLET
41.46		85.60	158.11	85.60	Min. Energy. Eqn.	INLET
41.96		113.80	169.11	113.80	Regression Eqn.	INLET
42.46		146.80	171.56	146.80	Regression Eqn.	INLET
42.96		180.80	184.51	180.80	Regression Eqn.	INLET
43.46		217.80	201.58	201.58	Regression Eqn.	OUTLET
43.96		254.40	203.49	203.49	Regression Eqn.	OUTLET
44.46		289.20	288.42	288.42	Regression Eqn.	OUTLET
44.96		321.40	317.12	317.12	Regression Eqn.	OUTLET
45.46		351.20	350.78	351.20	Regression Eqn.	INLET
45.96		378.60	399.65	378.60	Regression Eqn.	INLET
46.46		404.20	436.06	404.20	Regression Eqn.	INLET
46.96		428.00	467.83	428.00	Regression Eqn.	INLET
47.46		450.40	496.43	450.40	Regression Eqn.	INLET
47.96		471.80	527.25	471.80	Regression Eqn.	INLET
48.46		492.00	554.59	492.00	Regression Eqn.	INLET
48.96		511.20	580.65	511.20	Regression Eqn.	INLET
49.46		529.80	606.59	529.80	Regression Eqn.	INLET
49.96		547.80	629.54	547.80	Regression Eqn.	INLET
50.46		564.80	652.59	564.80	Regression Eqn.	INLET
50.96		581.60	674.58	581.60	Regression Eqn.	INLET
51.46		597.80	696.45	597.80	Regression Eqn.	INLET
51.96		613.60	717.35	613.60	Regression Eqn.	INLET
52.46		629.20	737.70	629.20	Regression Eqn.	INLET
52.96		644.20	757.46	644.20	Regression Eqn.	INLET
53.46		659.00	776.75	659.00	Regression Eqn.	INLET

TOP OF MUSTANG RD. ↑

Processing Time: 00.14 Seconds

width	2.916667
length	22.66667
perimeter	51.16667

area	66.11111
blockage	0.5
blockage	4

open area	33.05556
avail perm.	47.16667

39.19	0
39.315	0.125
39.44	0.25
39.565	0.375
39.69	0.5
39.815	0.625
39.94	0.75
40.065	0.875
40.19	1
40.315	1.125
40.44	1.25
40.565	1.375
40.69	1.5
40.815	1.625
40.94	1.75
41.065	1.875
41.19	2
41.315	2.125
41.44	2.25
41.565	2.375
41.69	2.5
41.815	2.625
41.94	2.75
42.065	2.875

Orifice	Weir
0	0
56.27217	6.461925
79.58086	18.27708
97.46625	33.57715
112.5443	51.6954
125.8284	72.24652
137.8381	94.97051
148.8822	119.6765
159.1617	146.2167
168.8165	174.472
177.9482	204.344
186.6337	235.7496
194.9325	268.6172
202.8922	302.8844
210.5512	338.4963
217.9412	375.4039
225.0887	413.5632
232.0161	452.9344
238.7426	493.4813
245.2847	535.1707
251.6568	577.9721
257.8715	621.8574
263.9399	666.8005
269.8718	712.777

ORIFICE VS WEIR
FOR
2.92' x 22.67' CDOT TYPE D INLET.

EXHIBIT Q

Brandy Williams <BrandyWilliams@elpasoco.com>
to Virgil, Elizabeth, me, Darin, Steve

Aug 19

Virgil,

I. The additional 42" drainage pipe(s) across Mustang Road are not necessary at this time, as no additional upstream development is proposed with this submittal.

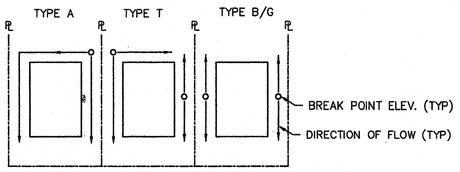
2. The only structures to be allowed in the right-of-way per the County Engineer, are extensions of the existing 42" CMP culverts to the City/County boundary and/or grouted rip-rap, depending upon the ultimate design of the downstream conveyance system.

If you have any questions or need additional information please email or call, 520-6813.

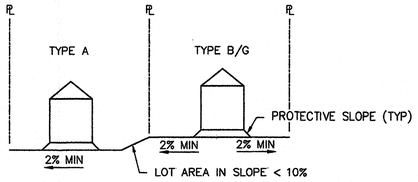
Thank you,

Brandy R. Williams, P.E.

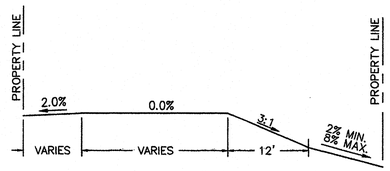
Development Services Department
El Paso County
2880 International Circle, Suite 110
Colorado Springs, CO 80910
719.520.6813
BrandyWilliams@elpasoco.com



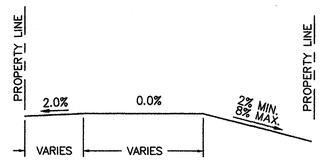
LOT DRAINAGE TYPES AND SWALE DIRECTION
NOT TO SCALE



TYPICAL LOT SECTION DETAIL
NOT TO SCALE



LOT TEMPLATE "G"
NOT TO SCALE



LOT TEMPLATE "B"
NOT TO SCALE

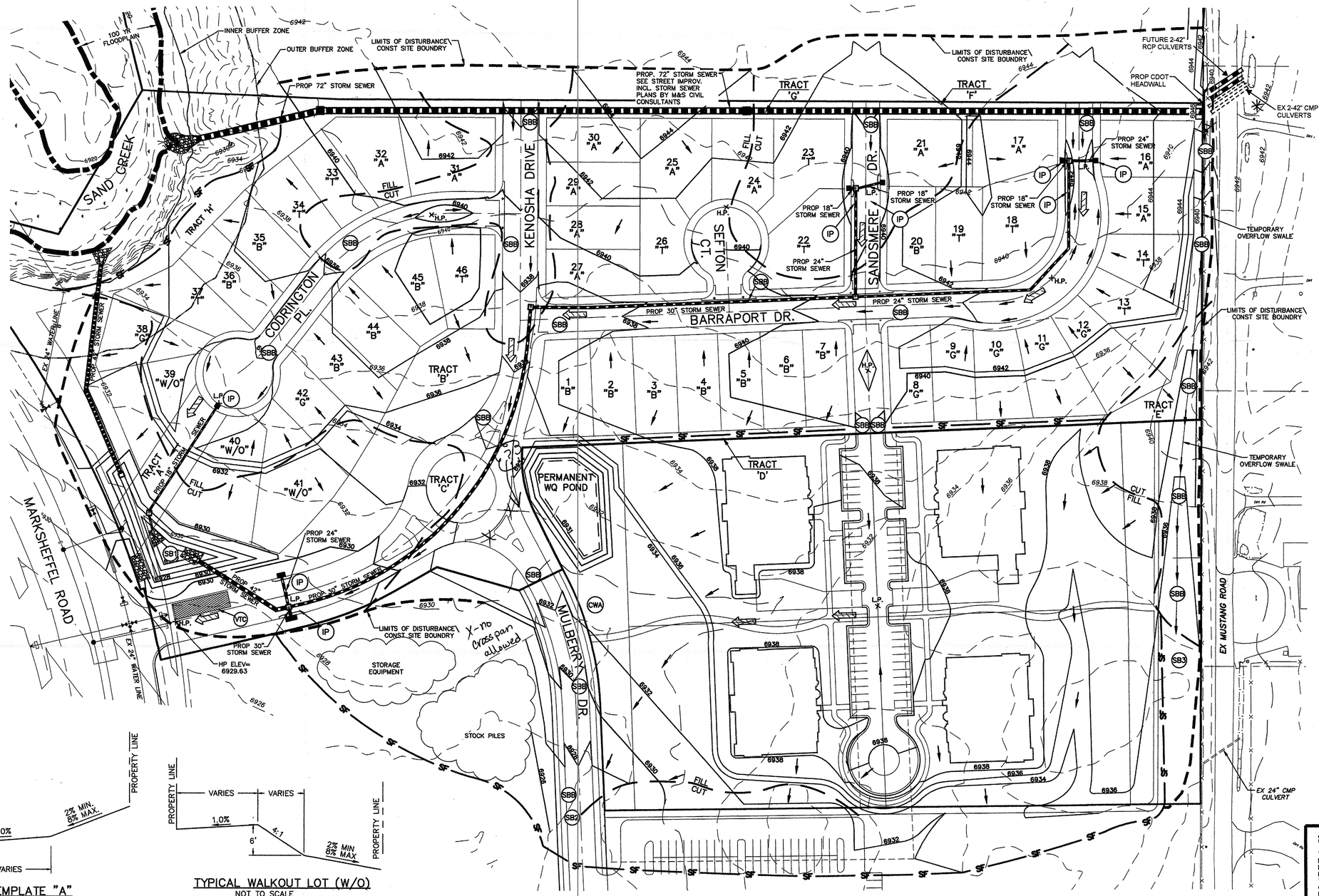
1" = 60'

0 30 60 120'
Scale in Feet

LEGEND

A	A LOT
B	B LOT
W/O	WALK-OUT LOT
T	TRANSITION LOT
L.P./H.P.	LOW POINT/HIGH POINT
6920	PROPOSED MAJOR CONTOUR
6918	PROPOSED MINOR CONTOUR
6920	EXISTING MAJOR CONTOUR
6918	EXISTING MINOR CONTOUR
	PROPOSED PROPERTY LINE
	FILING BOUNDARY LINE
	LIMITS OF DISTURBANCE
	CURB & GUTTER FLOW LINE
	PROPOSED STORM DRAIN
	EXISTING STORM DRAIN
	INLET
	FLOW DIRECTION
	OVERFLOW DIRECTION
	EXISTING FLOW
IP	INLET PROTECTION
SBB	STRAW BALE BARRIER
VTC	VEHICLE TRACKING
SB	TEMPORARY SEDIMENT BASIN
CWA	CONCRETE WASHOUT AREA
SF	SILT FENCE
	SWALE

* County concurance prior to any work in County ROW.



LOT TEMPLATE "A"
NOT TO SCALE

TYPICAL WALKOUT LOT (W/O)
NOT TO SCALE

Em 2/26/15

STATEMENT:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN; THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

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FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

SHILOH MESA FILING NO. 1

GRADING & EROSION CONTROL

PROJECT NO. 08-026 | FILE: V:\eng\Cons...Drgs\Grad.Ero...Con.\GR02.dwg | SCALE HORIZ: 1"=60' VERT: N/A | DATE: 2/13/2015 | SHEET 2 OF 3 | GR02

DESIGNED BY: VAS
DRAWN BY: BB
CHECKED BY: VAS

102 E. PIKES PEAK AVE., Ste 306
COLORADO SPRINGS, CO
80903-1360
v 719.955.5485
f 719. 444.8427
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APP'D. BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE OR LIABLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

SHILOH MESA
POST DEVELOPMENT DRAINAGE PLAN-MARKSHEFFEL ROAD
DECEMBER 2015

LEGEND

DESIGN POINT (1)
FLOW DIRECTION
EMERGENCY OVERFLOW
BASIN DESIGNATION (A; 5.0 ACRES; .25 C100; .35 C5)
PROPOSED MINOR CONTOUR
PROPOSED MAJOR CONTOUR
EXISTING MINOR CONTOUR
EXISTING MAJOR CONTOUR
BASIN BOUNDARY
EMERGENCY OVERFLOW PATH
SAND FILTRATION BASIN
PIPE RUN IDENTIFIER
SELECTIVE LINING
GRADE CONTROL

DRAINAGE NOTES

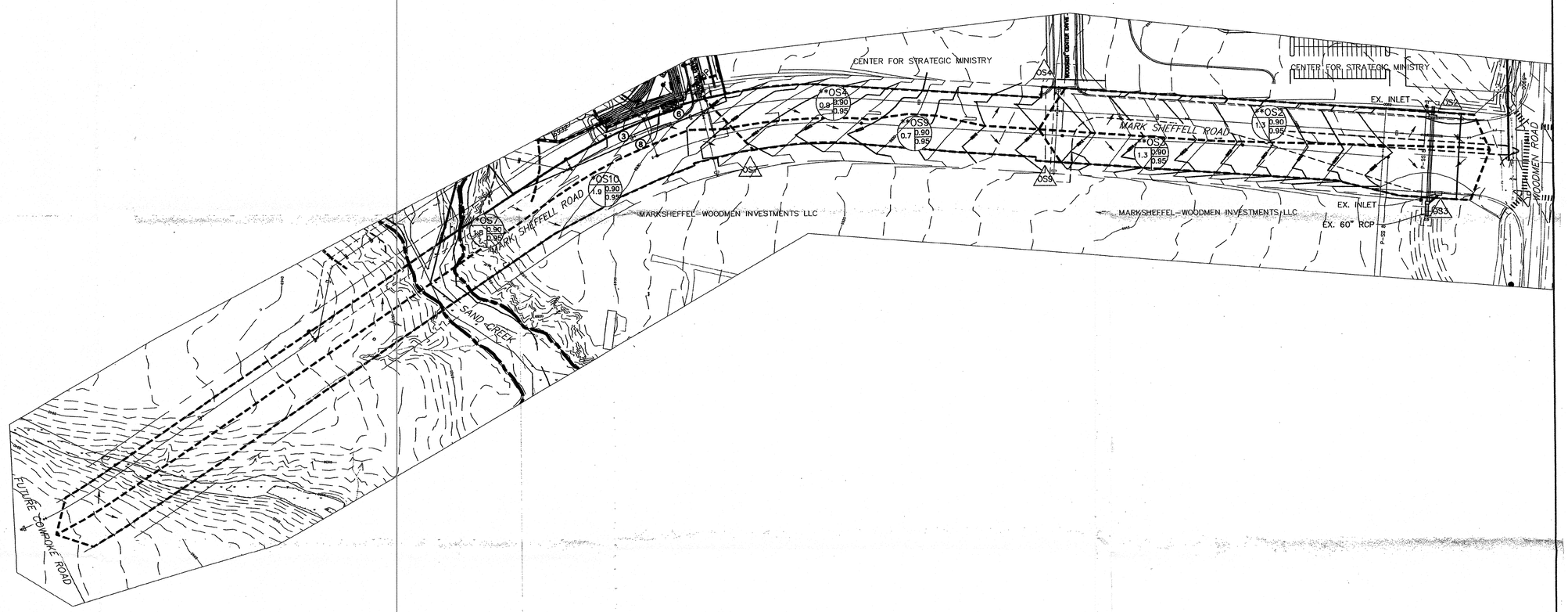
1. PROPOSED TYPE D-10-R DROP INLET, SUMP & AT-GRADE COND'N
2. PROPOSED STORM SEWER PIPE
3. PROPOSED FABRICATED END SECTION
4. REMOVE & REPLACE EX. CMP PIPES W/ PROPOSED RCBC CROSSING
5. PROPOSED STORM DRAIN HEADWALL
6. PROPOSED WATER QUALITY FEATURE – SAND FILTRATION BASIN
7. PROPOSED POND OUTLET, DESIGNED TO BYPASS Q100
8. PROPOSED RIPRAP APRON
9. PROPOSED TRAPEZOIDAL DIVERSION CHANNEL

BASIN SUMMARY TABLE			
BASIN ID	BASIN AREA (Acres)	FLOW Q5 (CFS)	FLOW Q100 EST. (CFS)
OS7**	1.8	6.7	12.5
OS10**	1.9	7.0	13.2
OS4**	0.9	4.0	7.6
OS9**	0.7	3.2	6.0
OS2**	1.3	5.6	10.5
OS3**	1.3	5.7	10.7

**Q5 & Q100 REVISED AREAS AND FLOWS FOR "MASTER DEVELOPMENT DRAINAGE PLAN FOR SHILOH MESA AT WOODMEN HEIGHTS" PREPARED B MATRIX APPROVED NOVEMBER 2009

DESIGN POINT SUMMARY TABLE			
DESIGN PT.	PEAK Q5 (CFS)	PEAK Q100 (CFS)	COMMENTS
OFFSITE TRIBUTARY			
OS7	13.7	25.7	TBD
OS4	4.0	7.6	PER MDDP MATRIX
OS9	3.2	6.0	PER MDDP MATRIX
OS2	5.6	10.5	PER MDDP MATRIX
OS3	5.7	10.7	PER MDDP MATRIX

NORTH
1" = 100'



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AR PUD 14-00692

102 E. PIKES PEAK AVE., STE 306
COLORADO SPRINGS,
COLORADO 80903
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f 719.448.8427
CIVIL CONSULTANTS, INC.

SHILOH-MESA
POST DEVELOPMENT DRAINAGE PLAN-MARKSHEFFEL

PROJECT NO. 08-026		FILE: O:\08026\DWG\DEV PLAN\Drainage\DP2	
DESIGNED BY: VAS	SCALE	DATE: 6/08/2015	
DRAWN BY: ET	HORIZ: 1"=100'	SHEET 3 OF 3	DP2
CHECKED BY: VAS	VERT: N/A		

SHILOH MESA
POST DEVELOPMENT DRAINAGE PLAN
DECEMBER 2015

NORTH
1" = 100'

LEGEND

- DESIGN POINT
- FLOW DIRECTION
- EMERGENCY OVERFLOW
- BASIN DESIGNATION (A; 5.0 ACRES; .25 C100; .35 C5)
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- BASIN BOUNDARY
- EMERGENCY OVERFLOW PATH
- SAND FILTRATION BASIN
- PIPE RUN IDENTIFIER
- SELECTIVE LINING
- GRADE CONTROL

DRAINAGE NOTES

1. PROPOSED TYPE D-10-R DROP INLET, SUMP & AT-GRADE COND'N
2. PROPOSED STORM SEWER PIPE
3. PROPOSED FABRICATED END SECTION
5. PROPOSED STORM DRAIN HEADWALL
6. PROPOSED WATER QUALITY FEATURE – SAND FILTRATION BASIN
7. PROPOSED POND OUTLET, DESIGNED TO BYPASS Q100
8. PROPOSED RIPRAP APRON
9. PROPOSED TRAPEZOIDAL DIVERSION CHANNEL

BASIN SUMMARY TABLE

BASIN ID	BASIN AREA (Acres)	FLOW Q5 (CFS)	FLOW Q100 EST. (CFS)
OS1*	4.3	3.8	9.0
OS5*	323	72.0	340.0
A1	3.78	7.1	15.1
A2	6.20	9.4	20.1
A3	2.30	4.7	9.9
A4	1.20	1.6	5.3
B1	1.20	3.2	6.7
B2	4.10	7.6	16.3
C1	1.70	3.3	7.1
C2	4.64	10.8	22.4
D1	4.53	8.4	18.0
D2	6.18	11.1	23.8
D3	1.72	3.5	7.4
D5	0.40	1.8	3.5
D6	1.65	3.0	6.3
F1	2.38	4.6	9.9
F2	2.16	4.0	8.6
G1	1.75	3.3	7.1
G2	2.58	5.3	11.2
OS7**	1.8	6.7	12.5
OS10**	1.9	7.0	13.2

*Q5 & Q100 REFERENCED FROM "MASTER DEVELOPMENT DRAINAGE PLAN FOR SHILOH MESA AT WOODMEN HEIGHTS", PREPARED BY MATRIX

**Q5 & Q100 REVISED AREAS AND FLOWS FOR "MASTER DEVELOPMENT DRAINAGE PLAN FOR SHILOH MESA AT WOODMEN HEIGHTS", PREPARED BY MATRIX

PIPE TABLE

PIPE #	DIA.(IN.) & MTL	FLOW Q5 (CFS)	FLOW Q100 (CFS)
1	*2- 42" RCP	72.0	340.0
2	72" RCP	72.0	340.0
3	24" RCP	7.1	15.1
4	18" RCP	3.2	6.7
5	24" RCP	7.6	16.3
6	24" RCP	10.3	21.9
7	18" RCP	3.3	7.1
8	30" RCP	10.8	22.4
9	30" RCP	14.1	29.5
10	36" RCP	23.9	50.2
11	18" RCP	4.7	9.9
12	24" RCP	8.3	20.8
14	30" RCP	12.9	27.5
15	42" RCP	32.3	68.4
16	18" RCP	3.3	7.1
17	18" RCP	5.3	11.2
18	24" RCP	8.2	17.6
19	18" RCP	4.0	8.6
20	18" RCP	4.6	9.9
21	24" RCP	8.5	18.1
22	30" RCP	16.5	35.3
23	24" RCP	8.4	18.0
24	18" RCP	1.8	3.5
25	42" RCP	31.9	70.6
26	18" RCP	3.5	7.4
27	42" RCP	35.0	77.2
28	24" RCP	6.4	16.6
29	36" RCP	22.4	50.7

* PROPOSED DUEL - 42" RCP TO BE USED IN CONJUNCTION WITH EXISTING DUAL - 42" CMP. TO BE INSTALLED WITH UPSTREAM DEVELOPMENT.
(CULVERTS TO PROVIDE EQUIVALENT FLOW AREA OF 2 - 60" RCP CULVERTS)

DESIGN POINT SUMMARY TABLE

DESIGN PT.	PEAK Q5 (CFS)	PEAK Q100 (CFS)	COMMENTS
NORTH WQ POND TRIBUTARY			
A1	7.1	15.1	6-FT SUMP D-10-R
			RELEASE INTO N. WQ POND
CENTRAL WQ POND TRIBUTARY			
A2	9.4	20.1	8-FT SUMP D-10-R
A3	4.7	9.9	4-FT SUMP D-10-R
B1	3.2	6.7	4-FT SUMP D-10-R
B2	7.6	16.3	6-FT SUMP D-10-R
C1	3.3	7.1	4-FT SUMP D-10-R
C2	10.8	22.4	10-FT SUMP D-10-R
A4	33.4	72.0	RELEASE INTO C. WQ POND
SOUTHERN WQ POND TRIBUTARY			
D1	8.4	18.0	8-FT SUMP D-10-R
D2	11.1	23.8	12-FT AT-GRADED-10-R
D3	3.5	7.4	4-FT SUMP D-10-R
F1	4.6	9.9	4-FT SUMP D-10-R
F2	4.0	8.6	4-FT SUMP D-10-R
G1	3.3	7.1	4-FT SUMP D-10-R
G2	5.3	11.2	4-FT SUMP D-10-R
D5	1.8	3.5	4-FT SUMP D-10-R
D4	35.0	77.2	RELEASE INTO S. WQ POND
OS7 OFFSITE TRIBUTARY			
OS7,OS10	11.4	21.5	TBD
D2	4.7	7.2	FLOW-BY
D6	3.0	6.3	SHEET FLOW

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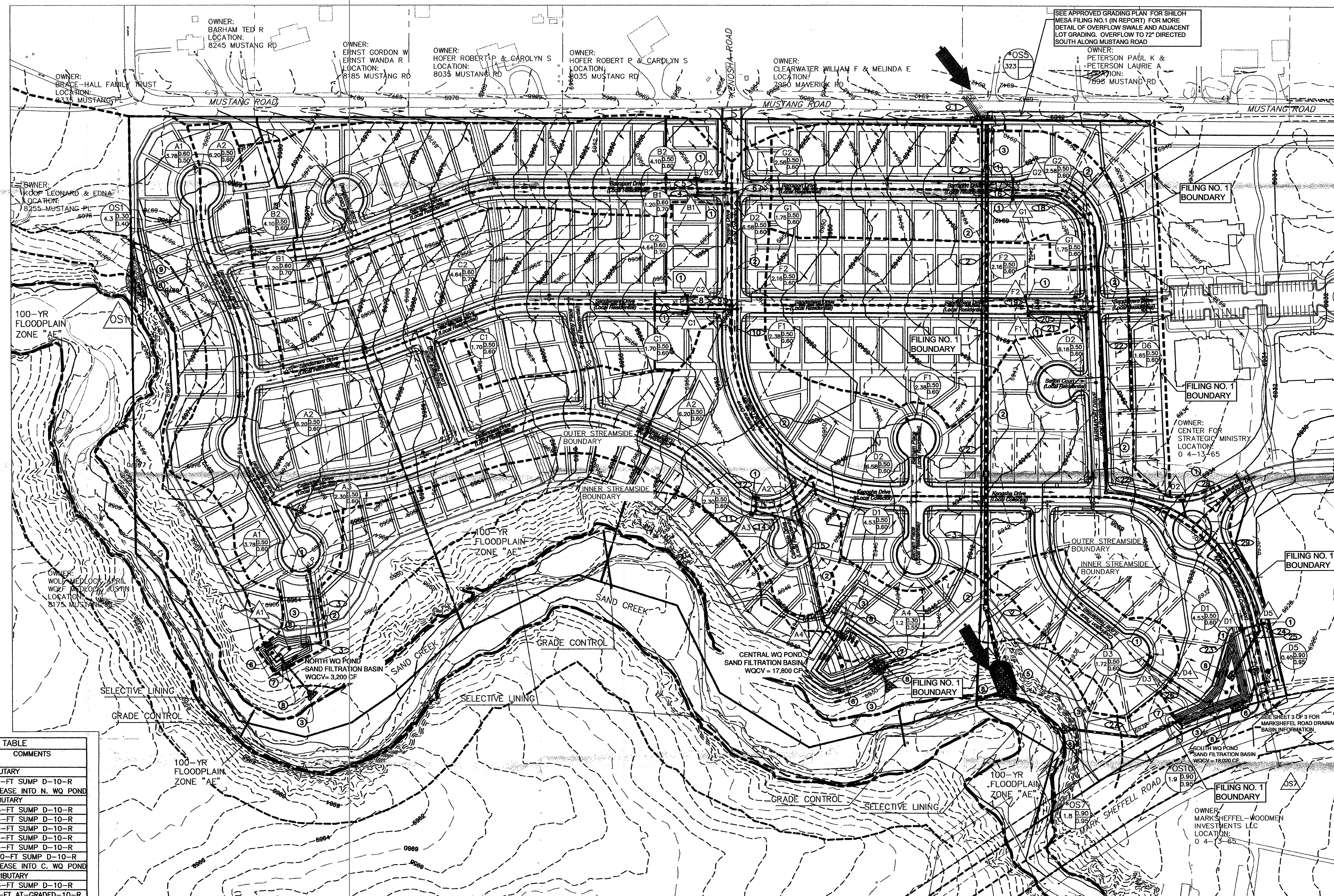

AR PUD 14-00692

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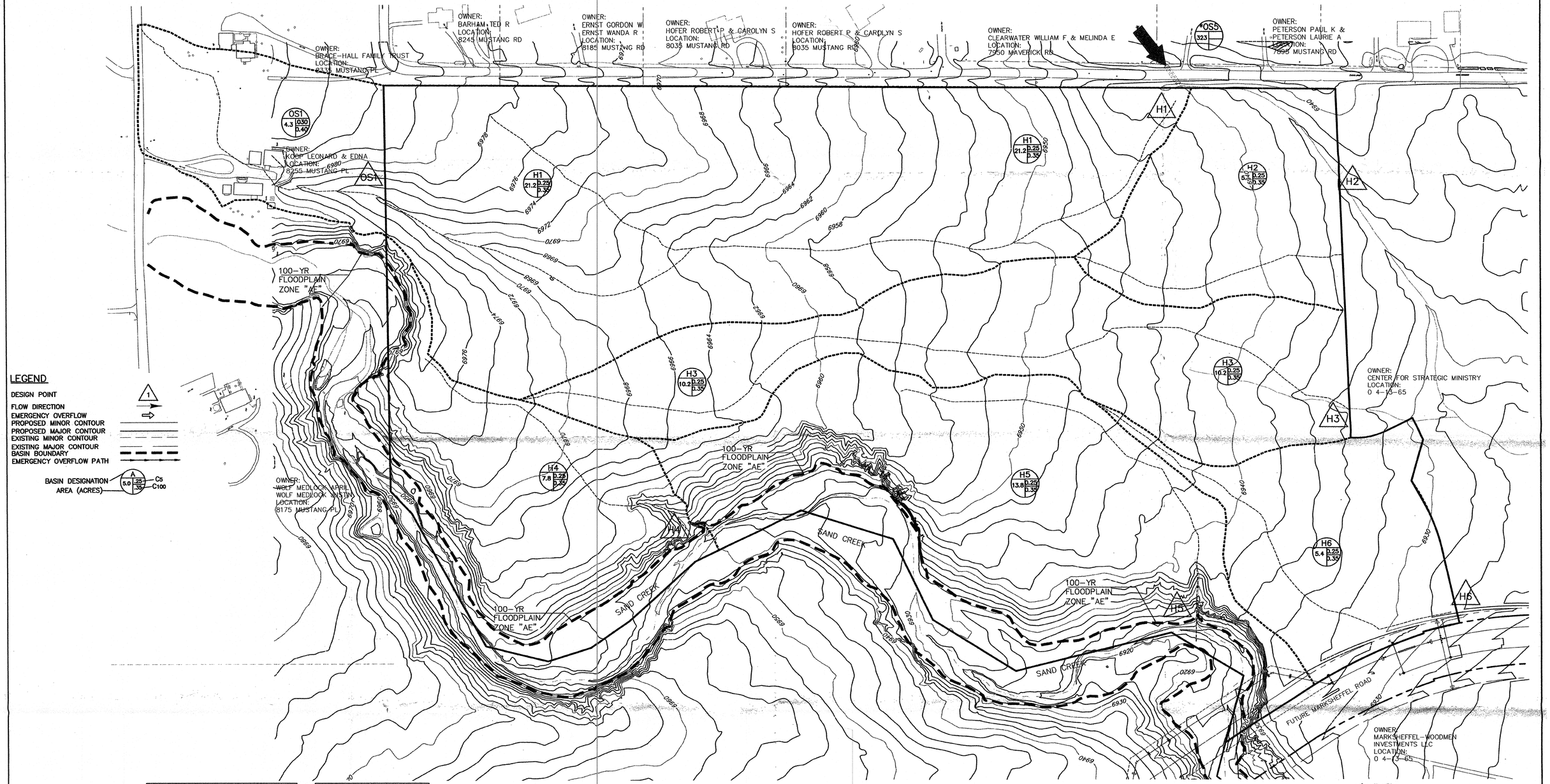
102 E. PIKES PEAK AVE., STE 306
COLORADO SPRINGS, COLORADO 80903
v 719.955.5485
f 719.444.8427

SHILOH-MESA		
POST DEVELOPMENT DRAINAGE PLAN		
PROJECT NO. 08-026	FILE: O:\08026\Documents\Reports\Drainage\DP	
DESIGNED BY: VAS	SCALE	DATE: 6/08/2015
DRAWN BY: ET	HORIZ: 1"=100'	SHEET 2 OF 3
CHECKED BY: VAS	VERT: N/A	DP-1

SHILOH MESA
PRE- DEVELOPMENT HYDROLOGY MAP
DECEMBER 2015



LEGEND

- DESIGN POINT
- FLOW DIRECTION
- EMERGENCY OVERFLOW
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- BASIN BOUNDARY
- EMERGENCY OVERFLOW PATH
- BASIN DESIGNATION / AREA (ACRES) — A, 5.0, .25, .35, C5, C100

NORTH
1" = 100'

SHILOH MESA
PRE DEV. HYDROLOGY MAP
MS JOB NO. 08-026
DATE PREPARED: SEPT. 6, 2014
PLOT DATE:APRIL 2, 2015

BASIN TABLE			
BASIN ID	BASIN AREA (ACRES)	FLOW Q5 (CFS)	FLOW Q100 EST. (CFS)
H1	21.2	10.9	27.1
H2	5.3	3.7	9.2
H3	10.2	5.1	12.8
H4	7.8	5.7	14.2
H5	13.8	9.1	22.8
H6	5.4	3.4	8.4
OS1	4.3	3.8	9.0
*OS5	323.0	72	340

DESIGN POINT TABLE		
DESIGN PT.	PEAK Q5 (CFS)	PEAK Q100 (CFS)
H1	72.0	365.5
H2	84.4	370.7
H3	5.1	12.8
H4	5.7	14.2
H5	9.1	22.8
H6	3.4	8.4
OS1	3.8	9.0

*OS5
PEAK FLOWRATES REFERENCED FROM THE MDDP FOR WOODMEN HEIGHTS MASTER PLAN. FLOWS FROM REF'D BASIN *OS5 ADDED TO DESIGN POINTS H1 & H2. Tc VALUES ASSUMED TO BE COINCIDENTAL.

NOTE: FLOWS FROM REF'D BASIN *OS5 ADDED TO H1 & H2. Tc VALUES ASSUMED TO BE COINCIDENTAL.

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COLORADO 80903
v 719.955.5485
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CIVIL CONSULTANTS, INC.

SHILOH-MESA

PRE- DEVELOPMENT HYDROLOGY MAP

PROJECT NO. 08-026	FILE: O:\08026\DWG\DEVELOPMENT\Drainage\.dwg		
DESIGNED BY: VAS	SCALE	DATE: 6/08/2015	
DRAWN BY: ET	HORIZ: 1"=100'	SHEET 1 OF 3	HM
CHECKED BY: VAS	VERT: N/A		