MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH

OCTOBER 2018

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Project #09-002
SKP-18-003
SF-17-024

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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 established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

COLORADO REGISTERED VIRGIL A. SANCHEZ 37160 PROFESSIONAL ENGINEER

DATE: 10/24/18

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

DEVELOPER'S STATEMENT

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

Morley-Bentley Investments, LLC

BY: _____ DATE: 10/24/18
James F. Morley

TITLE: Manager
BUSINESS NAME: Morley-Bentley Investments, LLC
ADDRESS: 20 Boulder Crescent, 2nd Floor
Colorado Springs, 80903

EL PASO COUNTY

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

_____ DATE: _____

County Engineer / ECM
Administrator

CONDITIONS:

MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH

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MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH

PURPOSE

This document is the Master Development Drainage Plan (MDDP) for Sterling Ranch. The purpose of this report is to identify the existing and proposed runoff patterns and peak rates of runoff and generally identify large scale drainage improvements needed to safely route stormwater to adequate outfall facilities per the current City of Colorado Springs and El Paso County Drainage Criteria. In addition this master planning, this MDDP will serve as the basis for redefining the existing and future flows within the Upper Sand Creek Basin and the main branch of the Sand Creek Channel with the change from online regional detention to offline full spectrum detention.

SITE GENERAL LOCATION AND DESCRIPTION

Sterling Ranch is a 1444 acre parcel located in Sections 27, 28, 32, 33 & 34, Township 12 South, and Section 4, Township 13 South, Range 65 West of the 6th P.M., in the City of Colorado Springs, El Paso County, Colorado. The project is located along Vollmer Road northeast of the intersection of Black Forest Road and Woodmen Road approximately 1.2 miles northeast to the southern boundary. The development is proposed to be zoned "PUD", Planned Unit Development. Development of Sterling Ranch is anticipated to be completed in multiple phases.

SOILS

The site and surrounding areas consist of well to excessively drained soils that average an annual precipitation of 15 inches and the average frost-free period of about 135 days. The site contains four types of soils; Blake Loamy Sand, Blakeland Complex, Columbine Gravelly Sandy Loam and Pring Coarse Sandy Loam. Typically, the surface layer for these four soil series is a grayish brown sandy loam.

To the east of the Sand Creek drainage drainageway, the site is generally underlain by the Blakeland (8) and Columbine (19) loamy soil series, Hydrologic Group A. To the north and east the site is underlain by the Pring soil series (71), Hydrologic Group B. To the west of Sand Creek the site is underlain by the prior mentioned soil series with the addition of the Blakeland Complex (9), Hydrologic Group A.

CLIMATE

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 15 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

FLOODPLAIN STATEMENT

The Sterling Ranch development contains a floodplain, according to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0535 F, effective date March 17, 1997. A Letter of Map Revision (LOMR) has been completed and approved by the Federal Emergency Management Agency (FEMA). See Appendix.

DRAINAGE CRITERIA

The 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 during the 2, 5, 10, 25, 50 and 100-year frequency storms for developed conditions using the SCS Method. The site is in excess of 100 acres, which according to the above referenced criteria triggers the use of the Soil Conservation Service (SCS) Method for peak runoff determination. The rational method will be used in future reports to ensure drainage structures are of adequate size to accept anticipated peak flows, and to be consistent with the future Final Drainage Reports for multiple filings within Sterling Ranch.

DRAINAGE FACILITIES

For the purposes of this document, being an MDDP analysis, minor pipes in the roadways have not been sized and considered for this study. Allowances have been made in the individual basin runoff parameters to account for such runoff; however it has not been routed herein. During the final design analysis phase in the future, this shall be accounted for in a detailed manner with sizes being identified. Similarly, pipe sizes and design information within each development "pod" have not been provided, but will be during the final design analysis phase in the future. Channel Improvements are discussed in a later section of this report.

HYDROLOGIC CRITERIA

The historic and developed drainage conditions in this report were calculated using the Soil Conservation Service (SCS) Hydrograph procedure per the El Paso County Drainage Criteria Manual. Since the majority of the drainage basins in this report exceed 100 acres in size, this method was selected for an "MDDP" level of detail. This method was also chosen to provide a comparative analysis of the pre and post development drainage flows. However, in future phases of drainage analysis for Sterling Ranch, the Rational Method will be used to analyze smaller drainage basin areas. Normally, the Rational Method is a bit more conservative, but is better used to analyze smaller basins and smaller "local" drainage facilities. The SCS procedure will be used for regional and larger drainage facilities, such as, detention ponds, channel improvements and culverts.

A short summary of the primary contributing factors for revising the hydrologic analysis include but are not limited to:

- Relocation of Marksheffel Road crossing Sand Creek from the assumed DBPS location.
- Increases in the size of upstream contributing watershed from the DBPS assumptions.
- Altering planned discharge points such as DBPS Segment 159.
- Change in the DCM criteria requiring the use of Type II storm distribution vs. Type IIA
- Minor changes in the DCM criteria, such as CN values for developments less than 2 acres
- Changes in DCM criteria implementing Offline Full Spectrum Detention in lieu of Multi Stage Online Detention Facilities.
- Desire to convert analysis from HEC-1 modeling to more recent HEC-HMS modeling software.

Previous Studies

Various master plan drainage studies and construction plans have been prepared around the development and have been considered in the collection of data for this study, they include:

- Sand Creek Drainage Basin Planning Study, Kiowa Engineering, 1996.
- Master Development Drainage Plan for Woodmen Heights Master Plan, CCES, 2004
- Master Development Drainage Plan Update for Woodmen Heights and Final Drainage Report for Forest Meadows Filing No. 1 and No.4, M&S Civil Consultants, 2006
- Sterling Ranch Sketch Plan, M&S Civil Consultants, 2008
- Master Development Drainage Plan for The Woodmen Heights Commercial Center, Matrix 2009.
- Master Development Drainage Plan and Final Drainage Report for Shiloh Mesa & Shiloh Mesa Filing No. l, M&S Civil Consultants, 2015
- Preliminary Drainage Report for Sterling Ranch - Phase I, 2016
- Sterling Ranch Filing No. 1 - Final Drainage Report, 2016
- Preliminary Bridge Design, Marksheffel Road at Sand Creek, Kiowa 2014
- Woodmen Heights Business Park, M&S Civil Consultants, 2014
- Shiloh Mesa Filing No. 1 - Marksheffel Interim Roadway Plans, M&S Civil Consultants, 2015
- Sand Creek Detention Basin Pond #3 - Schedule B Plans, Kiowa 2016

HYDROLOGY

Hydrologic Modeling

A hydrologic model was utilized to simulate storm water runoff within the existing and developed watersheds to determine peak discharges and runoff volume for various conditions. The models were developed using the U.S. Army Corps of Engineers HEC-HMS hydrologic modeling program version 4.0. The NRCS curve number loss and dimensionless unit hydrograph method was applied with HEC-HMS in accordance with the drainage criteria manual for basins larger than 640 acres.

Project Mapping

Project mapping for the hydrologic analysis consisted of USGS 7 1/2 minute quadrangle, for areas north and west of Sterling Ranch. LIDAR data was obtained for the Sterling Ranch Development and processed into 2' Contour mapping by Sandborn in 2006. LIDAR data was obtained for Woodmen Heights area and processed into 2' Contour mapping by Aerial Mapping Services in 2003.

It should be noted that there are a few open water storage areas located within the watershed, likely utilized in the past for irrigation purposes or stock watering ponds. As they are not constructed for the purposed of flood control, and are relatively small in size, they were not evaluated as effective storage within the hydrologic models.

Times of Concentration Calculations

Topographic contour data collected from both USGS mapping and produced by aerial surveys were used in determining overland flow paths, reach slopes and reach geometry. In accordance with guidance provided in TR-55 this information was evaluated to calculate times of concentration for the hydrologic analysis.

For the existing conditions models, the time of concentration calculations for sheet flow was limited to a maximum of 300 feet and a shallow concentrated flow was limited to a maximum of 2000 feet. Open channel flow velocities were determined using Bentley's FlowMaster computer program. The depth was initially calculated using a trapezoidal channel section approximated from the contour data and an assumed flow based upon a logically selected flow per acre. A roughness factor of 0.050 was assumed for channels assuming a narrow grass lined channel with mild to steep earthen side slopes. The assumptions for flow and calculated depth were then cross checked against the HEC model run output and adjusted if needed.

Similar rules were assigned for the future conditions model times of concentrations. Typically overland sheet flow was limited to a maximum of 100 feet for urban development, while sheet flow for rural development was limited to 300 feet. Shallow concentrated flows were limited to 1000 feet for urban sub-basins and less than 2000 feet for rural low density developments. The open channel flow velocities where estimated using the same process as the existing condition flows, however the channel geometry typically was reduced in width and bank slope to reflect conditions associated with man-made channels. When runoff was considered to be conveyed by storm sewer times of concentration were based upon assigning an average velocity based upon slope ranging from 6 feet per second to 15 feet per second which coincided with slopes ranging from 0.5 to 5.0%.

Lag Times

Equation 6-13 from the DCM, $T_{(lag)} = 0.6 * Tc$ was utilized to convert times of concentration to lag time. The existing conditions and developed conditions times of concentration and resultant lag times are provided in spreadsheets in Sections C and D of the attachments.

Reach Routing

Reach Routing for stream and pipe conveyance was performed within HEC HMS using the Kinematic Wave method. The Kinematic Wave method requires input parameters of channel or pipe length, channel or pipe slope, Manning's N value, channel shape, bottom width and side slope, and/or pipe diameter. Spreadsheets in Sections C and D of the attachments list the reach data that has been entered into the existing and future HEC-HMS hydrologic models. Most typically a roughness factor of 0.050 was assumed for channels assuming a narrow grass lined channel with mild to steep earthen side slopes, while a roughness value of 0.013 was utilized in modeling concrete lined conveyance structures and pipes. Labeling of the channel reaches within this HMS model have been designated by RT-X and are shown on the model schematics and on the existing and developed conditions maps included in Section A the attachments.

Runoff Curve Numbers/Impervious Percentage

The curve numbers for the existing and developed condition watersheds within the models have been assigned based upon the land use and soil type. When multiple land uses and or soil types were encountered within a basin, an area weighted composite curve number for each sub-basin was calculated. Spreadsheets are included in Sections C and D of the attachments which provide information regarding curve number information used within the models. One of the spreadsheets (which immediately follow the basin schematic) summarizes the various curve numbers and impervious percentage values for given land use and soil type which was derived from Table 6-10 of the City of Colorado Springs Drainage Criteria Manual, Volume I. The other spreadsheets provided calculate composite impervious percent and composite curve numbers for each existing and proposed basin. It should be noted, for the developed condition, where Type A soils area present but development is to occur Type B soils in the selection of curve numbers. In addition in areas where type A soil are present but the ground shows signs of disturbances CN values for these areas have been based upon Type B soils.

Initial Abstraction

In accordance with the City of Colorado Springs and El Paso County Drainage Criteria Manual, Initial Abstraction (IA) was calculated for each sub-basin using equation 6-12, Ia = 0.1 {(100/CN)-10]. The calculated values where input into the various HEC-HMS models. A table summarizing existing and future condition initial abstraction values is included attachments.

Design Rainfall

The 24-hr storm events for the 2, 5, 10, 25, 50, and 100-year recurrence intervals were evaluated. Rainfall depths were selected using the NOAA Atlas 2 isopluvial maps provided within the DCM. Rainfall amount for representative storm events were determined to be 2.1 inches for the 2-year event, 2.5 inches for the 5-year event, 3.0 inches for the 10-year event, 3.6 inches for the 25-year event, 4.1 inches for the 50-year event and 4.6 inches for the 100-year event. The 24-Hr Type II Storm with an Antecedent Moisture Condition (AMC) of II was selected in hydrologic modeling for long duration "frontal storms".

Evaluation of Other Design Storms

In accordance with the drainage criteria manual, a short duration, intense thunderstorms should be considered when conducting watershed drainage analysis. Typically, these smaller more intense storms create high runoff rates in smaller basins, and thus are typically not applicable for this large of watershed. A two- hour storm distribution was developed using the one-hour precipitation rates provided in the DCM and input into the HEC-HMS models. Results from the models were found to have a considerably smaller peak runoff rates and volumes and therefore were not included in this analysis to forgo any misinterpretation in the reported flow rates.

Existing Conditions Model

The existing condition model analyzes 26 sub-basins totaling 3,224.6 acres that are located within the Sand Creek Watershed, and 7 basins totaling 962 acres that fall within the East Fork of Sand Creek. The basins have been subdivided, whenever possible to align closely with the proposed condition analysis, the 2011 Wilson Study and Sand Creek Drainage Basin Planning Study (SCDBPS) to allow for direct comparisons. Additional delineation was performed south of Sterling Ranch to include all of the area thought to drain to the Sand Creek Channel above City Pond 3. This delineation was done using the contours provided from the relatively recent 2003 and 2006 aerial surveys. Areas considered developed in the existing condition are visible on the aerial map (see attachments). Some of these areas include the Barbarick, Highland Park, Pawnee Rancheros and Wild Ridge Subdivisions as well as several 5-acre developments within the Black Forest area. Basin areas within the existing model were calculated using AutoCAD. A schematic of the existing condition HEC-HMS model and the existing conditions composite CN & impervious % table showing the assumptions for all the sub-basins is included in Section C of the attachments. A detailed discussion regarding the existing conditions is provided in subsequent paragraphs.

Developed Conditions Model

The developed condition model analyzes 46 sub-basins totaling 3,619.0 acres that are within the Sand Creek Watershed, and 14 basins totaling 690.9 acres that contribute to the East Fork of Sand Creek. The developed condition sub-basins were delineated using the drainage patterns assumptions brought forth from various master plans, most notably the Approved Sterling Ranch Sketch Plan and the Draft MDDP for the Retreat at Timber Ridge.

In general, developed runoff produced within Sterling Ranch is to be conveyed in both natural and manmade channels, storm conveyance facilities and directed to the main branch of Sand Creek Channel and to existing swales located within the East Fork of Sand Creek Watershed. Where future development is anticipated, full spectrum water quality detention facilities are planned to reduce developed runoff rates prior to being discharged to downstream facilities. With the exception of a few areas adjacent (such as Timber Ridge) much of the areas adjacent to Sterling Ranch property boundary are anticipated to remain as in the existing condition. A schematic of the developed condition HEC-HMS model and several hydrologic summary tables are included in the appendix which summarizes the other assumptions utilized in the assembly of the model. Half size copies of the Existing Conditions Drainage Map and Developed Condition Map have been included in Section B of the attachments. Full Size Maps are provided in the back map pocket of the report. Several other supporting documents have been included in appendix for reference.

Methodology to Implementation of Full Spectrum Detention into the Developed Conditions Master Plan Model

To better control the full range of runoff rates that pass thru detention facilities and subsequently further reduce impacts caused by the urbanized runoff to the existing drainage ways, both the City of Colorado Springs and El Paso County have opted to move away from typical regional online detention with multi- stage discharge and have embraced the concept of offline Full Spectrum Detention. These types of facilities are constructed to release flow in a manner that more closely represents the undeveloped condition hydrograph over an extended period of time (typically up to 72 hours). All storage facilities will be designed to meet State Statue SB15-212/ §37-92-602(8).

A master planning level procedure was needed to allow the modeler to implement FSD ponds into the model so that the effects of lag and subsequent changes in proposed flow rates could be analyzed across the watershed despite the considerable variation in the existing and proposed basin layouts. Thereby meeting the goals of the project, but not with exhaustive fine grading and modeling that is not necessary for this level of the study.

Initially, it was anticipated that the UD-FSD_v1.12 worksheet, downloaded from the Urban Drainage and Flood Control District (UDFCD) website, could be utilized to aid in providing both stage-storage and stage-discharge curves which are needed as input data for ponds within HEC-HMS. The initial design tab within the UDFCD's excel worksheet allows the user to input several watershed and anticipated detention basin parameters as well as 1-hr rainfall depths and using embedded macros the worksheet will create both inflow and outflow hydrographs which meets the required discharges rates. Unfortunately, inflow hydrographs produced by the worksheets (using the City of Colorado Springs recommended one-hour precipitation rates) were considerably smaller than the hydrographs developed within HEC-HMS using the NRCS method and recommended 24-hr precipitation values. This rendered the pond stage-storage and storage-discharge relationships ineffective for transfer in to the modeling software.

The UDFCD worksheets were still utilized but to a smaller extent, primarily to determine the allowable release rates for the contributing watersheds. By entering the contributing watershed size, slope, length of flow, and percentage of the predevelopment soil types into each spreadsheet an allowable discharge rate was calculated for each sub-basin. These values are highlighted by a red box on UD-FSD worksheets located in Section D of the attachments.

Several pond footprints were then created using AutoCAD and stage storage relationships were created for each basin and the allowable discharge rates determined by the worksheets were set as the discharge rates in the stage discharge tables in the model. The depths and volumes were then iterated for each storm event until the HEC-HMS model produced discharge rates that closely matched the allowable or undeveloped peak release shown on the worksheets. The procedure was implemented for all FSD ponds. The water quality and detention pond summary on the proposed hydrologic conditions map shows peak inflow, allowable release, modeled release and stored volume for each modeled FSD pond. The stage discharge curves were not provided for the FSD pond as they are not intended to be design based upon the values in this report but will be individually size in subsequent reports.

For the purposes of this study, in the case where multiple basins drained to a single pond, weighted values were calculated and entered in the worksheets to determine the allowable releases. In the case of where a runoff treated by proposed FSD (or multiple FSD) drains to another FSD, the lands draining the first shall be evaluated as undeveloped when determining the allowable release rates from the downstream facilities.

It should be noted that the proposed development of Sterling Ranch will recommend the diversion of a portion of lands and the associated runoff from the East Fork Sand Creek Basin to the Upper Sand Creek Basin which was previously discussed in the 2011 Wilson & Company Upper Sand Creek Basin Watershed Study. This study confirmed the adequacy of the downstream facilities given the planned diversion, which was carried forth in the design and construction of Pond 3 and 6 located along the north side of Woodmen.

At the request of El Paso County Planning and Community Development a pre-development and emergency condition model have been requested to be analyzed in addition to the existing and developed condition models. The predevelopment model allows for additional comparison against both the existing conditions and developed models while the emergency condition model can be utilized to further ensure safety of the residents by ensuring the lots are placed outside the potential floodplain. A small discussion regarding the framework for the development of these two models is as follows:

Pre-Development Model

The pre-developed condition model analyzes the same areas and sub-basins that were analyzed in the existing conditions model. The primary difference being that the CN values utilized in the analysis have been reduced to reflect a condition prior to development. The CN values chosen for this model were limited as the basin in the existing condition lacks significant urban development and thus are consistent with agricultural lands and are centered more closely around the soil type that a specific development. As typical of rural areas the majority of runoff in the pre-developed condition is assumed to be conveyed as surface runoff thus the lag times utilized in the existing conditions analysis were brought forward for the analysis of pre-developed condition. The predevelopment model results are discussed in subsequent sections of this report, while input, output and map have been provided in the appendix.

Emergency Conditions Model

An Emergency Condition Model was developed to determine at a cursory level if a condition exists that would require mapping a flow rate greater than that of the developed condition within the main branch of the Sand Creek Channel. One concept to accomplish this without costly pond breach modeling is to re-evaluate the developed condition model under the premise that the proposed ponds located within the development are not functioning and that runoff is instead direct quickly to the main branch and evaluate if under this condition there is a greater coincidence between the local runoff and the runoff from the offsite flow conveyed within the channel. This condition could occur in the case when outlet works became clogged but would be more likely in the case when a large storm event occurred back to back.

The Emergency Condition model was developed by "turning off" the stage storage / stage discharge element of the ponds within a copy of the developed conditions model, thereby allowing the developed flow to skip the pond node. Two versions of the Emergency Conditions model were provided. The first assumes all ponds within the development including the Pond W3 were full and runoff bypasses on to the next node via the proposed downstream conveyance. The second emergency condition model "fails" all ponds except W3, to determine if this has an impact on coincidence and determine the effect at the Pond. The emergency condition model results are discussed in subsequent sections of this report, while input, output and map have been provided in the appendix. It should be noted that only the greater of the two emergency conditions will be added into the various comparison charts. Digital HEC-HMS models have been included with this submittal.

HISTORIC DRAINAGE CHARACTERISTICS

General

The ~1444 acres of Sterling Ranch resides within the northern half of the Sand Creek Drainage Basin. The Sterling Ranch development was previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Corporation, revised March 1996.

Sterling Ranch was assumed to have a "large lot residential" use for the majority of the site. The proposed master plan is a mix of school, multi-family, single-family, and commercial land uses. The site generally drains from north to south consisting of rolling hills and flat prairie grasses. The majority of the site is used as pasture land for cattle with portions previously used for gravel mining operations. A portion of the Sand Creek Channel is located in the central portion of the site running north to south. This reach of drainage conveyance is currently not improved. There are a few stock ponds adjacent to the creek used for cattle watering. Barbed wire fences bound the site generally.

To the south and east adjacent to the site there are low density residences and a few undeveloped parcels of land. To the north there are parcels of land which remain undeveloped. The west of the site is bound by existing Vollmer Road. Generally, sheet and concentrated ditch flow enter and exit the site at various locations. There are no existing drainage structures at the south and east property boundary conveying the exiting flows. Developed flows, as described in this report, will address any off site flow routing at these locations. Also, as described hereinafter, some of the historic off-site flows will continue to enter the site after site build out. Future adjacent development with a higher land use densities, will be required to detain to historic/existing conditions.

The existing drainage ways within the site (Sand Creek and minor tributary conveyances) consists of natural grasses and shrubs. Bank erosion and channel degradation is evident along the reach through the site. The stream morphology with its historic and present evolution is attributed to the bed material present being composed of primarily sand.

The existing property contains a parcel of ground that was used as a mining area for gravel and sand. This area has been excavated and reclaimed approximately ten feet below the historic ground elevation. This mining area generally drains from northwest to southeast, but does not release flows in the historical direction. Currently, the storm flows are essentially detained within the mining area. For the purpose of this study, the current mining area detention will be ignored for two reasons. 1) The historic, and SCDBPS flow patterns were analyzed without consideration of the mining area detention. 2) The development drainage pattern will redirect the developed flow from the historical path into the subdivisions to the south. More discussion of the development drainage is discussed in the next section of this report.

The following drainage basin narratives are based on information derived from field visits, USGS topographic mapping, aerial topography, field surveys and information provided by others familiar with the site. A "sheet flow" verses "concentrated ditch flow" designation was determined as best as possible from the available source topography, actual conditions may vary. Ownership was determined by the use of the El Paso County Assessor's web site as of the date of this report. A summary of peak runoff for the basins and designated design points are depicted on the Existing Conditions Drainage Map in the appendix.

EXISTING BASIN DESCRIPTIONS

Existing Sand Creek (Main Stem) Basin Flows

Basin EX-82 (Q5 = 33.2 cfs, Q100 = 132.3 cfs) is a 117.8 acre area of primarily undeveloped, pine forested land located north of Sterling Ranch and Burgess Road to the east Basin EX-81. Runoff from the basin continues south overland into Basin EX-74.

Basin EX-74 (Q5 = 36.5 cfs, Q100 = 140.7 cfs) is a 119.7 acre area of 5 and 10-acre lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch and south of Burgess Road to the east and north of Basins EX-73 and EX-75. Runoff from Basins EX-82 and EX-74 combine at DP-74 (Q5 = 65.3 cfs, Q100 = 262.8 cfs).

Basin EX-73 (Q5 = 26.4 cfs, Q100 = 102.0 cfs) is a 90.0 acre area of 5 to 40 acres lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch to the northeast of Vollmer Road. Runoff from the basin continues overland toward DP-75.

Basin EX-81 (Q5 = 70.2 cfs, Q100 = 275.7 cfs) is a 262.9 acre area of primarily undeveloped, pine forested land located north of Sterling Ranch (approx 1 mile) between Shoup and Burgess Roads to the east of Vollmer Road. Runoff from the basin continues overland south into Basin EX-75.

Basin EX-75 (Q5 = 21.5 cfs, Q100 = 82.8 cfs) is a 79.3 acre area of pine forested lots ranging in size from 2.5 to 10 acres located north of Sterling Ranch and south of Burgess Road to the east of Vollmer Road. Runoff from the basin continues to DP-75.

Basin EX-80 (Q5 = 44.3 cfs, Q100 = 171.4 cfs) is a 147.7 acre area of pine forested lots ranging in size from 2.5 to 10 acres located north of Burgess Road and to the east of Vollmer Road. Runoff from the basin continues south into Basin EX-76.

Basin EX-76 (Q5 = 23.1 cfs, Q100 = 89.6 cfs) is a 86.4 acre area consisting primarily of pine forested 2.5 acre lots located to the south of Burgess Road east of Vollmer Road. Runoff from the basin combines with flows from Basin EX-82, EX-81, EX-80, EX-75, EX-74, and EX-73 at DP-75 (Q5 = 235.1 cfs, Q100 = 950.5 cfs).

Basin EX-79 (Q5 = 57.0 cfs, Q100 = 220.1 cfs) is a 189.0 acre area of pine forested 5 to 40 acre lots located , land located north of Burgess Road to the east Basin 80. Runoff from the basin continues south overland into Basin EX-78.

Basin EX-78 (Q5 = 45.3 cfs, Q100 = 174.5 cfs) is a 155.6 acre area of 2.5-acre lots covered with a mixture of native prairie grasses and pine trees land located south of Burgess Road to the east of Basins 76. Runoff from Basins 79 and 78 combine at DP-78 (Q5 = 98.4 cfs, Q100 = 385.3 cfs).

Basin EX-77 (Q5 = 56.9 cfs, Q100 = 227.7 cfs) is a 230.6 acre area of large 30+-acre lots and portions of undeveloped lands (both

inside and outside of Sterling Ranch) covered with a mixture of native prairie grasses and pine trees land located east of Vollmer Road. Runoff from the basin and from DP 78 are collected and conveyed south with the Main Branch of Sand Creek toward DP -73

Basin EX-88 (Q5 = 36.7 cfs, Q100 = 144.4 cfs) is a 139.2 acre area of large 30+-acre lots and portions of undeveloped lands covered with a mixture of native prairie grasses and sparse pine trees to the north of Sterling Ranch. Runoff from DP 75 and 78 and Basins EX-77 and 88 combine within the Sand Creek Channel at DP-73 (Q5 = 380.7 cfs, Q100 = 1582.3 cfs).

Basin EX-6 (Q5 = 25.2 cfs, Q100 = 100.5cfs) is a 90.2 acre area of undeveloped land covered by native prairie grasses located along the northern boundary of Sterling Ranch, which is tributary to the Sand Creek channel. Runoff from Basin EX-6 combines with flows from DP-73 in Sand Creek culminating in peak runoff rates of Q5 = 388.9 cfs, Q100 = 1637.9 at DP-71.

Basin EX-5 (Q5 = 40.0 cfs, Q100 = 158.2 cfs) is a 153.9 acre area of undeveloped lands (both inside and outside of Sterling Ranch) covered with native prairie grasses located to the south and east of Vollmer Road, including a portion of the Sand Creek channel. Runoff from the basin generally travels from north to south until it reaches the Sand Creek Channel. Runoff from Basin EX5 combines with flows from DP71 at DP 69 culminating in peak runoff rates of Q5 = 434.8 cfs, Q100 = 1870.4

Basin EX-4 (Q5 = 49.9 cfs, Q100 = 197.3 cfs) is a 192.0 acre area located to the north and west of Sterling Ranch and Vollmer Road. In the existing condition the land is a mixture of lots ranging from 5 to 50 acres in size. Ground cover consists primarily of native grasses with scattered pine trees located within the northernmost portions of the basin. Runoff from the basin generally travels from north to south/southeast to culvert located at Vollmer Road. Flows utilizing the culvert and those exceeding its capacity are directed into Basin EX-4A and ultimately the Sand Creek Channel.

Basin EX-4A (Q5 = 40.8 cfs, Q100 = 160.1 cfs) is a 151.5 acre area of primarily undeveloped lands within Sterling Ranch that is covered with native prairie grasses located between Vollmer Road and the south boundary . A portion of the basin includes a segment of the Sand Creek channel as well as a small portion of land on the east side of the channel that had been previously utilized as a gravel pit. Runoff from the basin is directed to the Sand Creek Channel where it combines with runoff from Basin EX-3 and DP 69 culminating in peak runoff rates of Q5 = 430.7 cfs, Q100 = 1911.5 at DP63.

Basin EX-24 (Q5 = 16.6 cfs, Q100 = 73.0 cfs) is a 63.1 acre area of an undeveloped land located south of Sterling Ranch adjacent to Sand Creek, north of Pond 3. Most of the ground is covered with native prairie grasses. Runoff from the basin combines with flows in Sand Creek Channel from DP-63 at DP 60A totaling Q5 = 430.2 cfs, Q100 = 1913.5 cfs.

Basin EX-3 (Q5 = 36.4 cfs, Q100 = 143.1 cfs) is a 136.8 acre area located to the north and west of Sterling Ranch and Vollmer Road. In the existing condition the land is a mixture of developed and undeveloped lots ranging from 5 to 90 acres in size. Ground cover consists primarily of native grasses with scattered pine trees located within the northernmost portions of the basin. Runoff from the basin generally travels from north to south/southeast to culvert located at Vollmer Road. Flows utilizing the culvert and those exceeding its capacity are directed into Basin EX-3A.

Basin EX-3A (Q5 = 47.4 cfs, Q100 = 192.6 cfs) consists of 188.1 acres located to the south and east of Vollmer Road. The basin, in its existing condition, includes an offsite commercial /industrial development known as the Barbarick Subdivision, undeveloped portions of Sterling Ranch, as well as a small offsite strip of undeveloped 5.0 acre residential lot residential at the southeastern corner of the basin. With exception of the Barbrick development the remaining land is covered with native prairie grasses. Runoff from up-gradient Basin EX-3 and those produced form within the basin travel overland to the southern boundary of the site and DP-10 culminating to produce runoff totaling Q5 = 63.4 cfs and Q100 = 287.2.

Basin EX-25 (Q5 = 1.5 cfs, Q100 = 25.1 cfs) is a 54.4 acre area of an undeveloped land located south of Sterling Ranch adjacent to Sand Creek, north of Pond 3. Most of the ground is covered with native prairie grasses. Runoff from the basin is conveyed as surface flow to channel. Runoff from the Basin combines with flows from DP-10 and DP-60A at DP -53A (Q5 = 454.0 cfs, Q100 = 2061.5 cfs) at Pond 3.

Basin EX-20 (Q5 = 42.1 cfs, Q100 = 166.2 cfs) consists of 143.4 acres located to the west of Basin EX-3. In the existing condition the land is a mixture of developed and undeveloped lots ranging from 5 to 90 acres in size. Ground cover consists primarily of native grasses. Runoff from the basin is conveyed as surface flows to Basin EX-20A.

Basin EX-20A (Q5 = 51.9 cfs, Q100 = 194.6 cfs) consists of 179.7 acres located to northwest of Vollmer Road and south of Basin EX20. The basin is mostly developed consisting largely of 2.5 and 5.0 acre lots. Runoff from Basin 20 and 20A combine within the

existing roadside ditches and natural drainage ways within the development before combining within the roadside swale located along the west side of Vollmer Road and DP-9 totaling Q5 = 88.8 cfs and Q100 = 351.4 cfs.

Basin EX-21 (Q5 = 13.5 cfs, Q100 = 49.0 cfs) consists of 33.3 acres located north and west of Vollmer Road and south and west of Basin EX-20A. In the existing condition the land is a mixture of developed and undeveloped 2.5 acre lots, where undeveloped ground cover consists primarily of native grasses. Runoff from the basin is conveyed as surface flow to a ditch running alongside Vollmer Road. Runoff from Basin EX-21 combines with flows from DP-9 totaling Q5 = 94.3 cfs and Q100 = 380.5 cfs at DP-9A. The combined runoff continues to the southwest along Vollmer Road and Colorado Springs City Limits (at Trails at Forest Meadows Filing #4).

Basin EX-0 (Q5 = 8.2 cfs, Q100 = 32.2 cfs) is a 23.8 acre area of an undeveloped portion of Sterling Ranch located at the southwest corner of the property. The area appears to have been graded at some point in the past, but is now covered with a mixture of native prairie grasses. Runoff from the basin is conveyed to the east, prior to discharging to the property to the south at DP -1(Q5 = 8.2 cfs, Q100 = 32.2 cfs).

Basin EX-1 (Q5 = 7.9 cfs, Q100 = 30.9 cfs) is a 25.7 acre area of an undeveloped portion of Sterling Ranch located at the southwest corner of the property. The area appears to have been graded at some point in the past, but is now covered with a mixture of native prairie grasses. Runoff from the basin is conveyed as surface flow to the southern property line at DP -2(Q5 = 7.9 cfs, Q100 = 30.9 cfs).

Basin EX-2 (Q5 = 1.8 cfs, Q100 = 7.1 cfs) is a 5.5 acre area of an undeveloped portion of Sterling Ranch located at the southwest corner of the property. The area appears to have been graded at some point in the past, but is now covered with a mixture of native prairie grasses. Runoff from the basin is conveyed as surface flow to the south property line and DP -3(Q5 = 1.8 cfs, Q100 = 7.1 cfs).

Basin EX-7 (Q5 = 21.5 cfs, Q100 = 107.4 cfs) is a 165.0 acre area located in the south central portion of Sterling Ranch, east of the Sand Creek Channel. In the existing condition the basin is a mixture of undeveloped land and disturbed soils associated with a gravel pit. Where the ground remain undisturbed they are covered primarily of native grasses basin. Runoff from the basin travels from north to south until it reaches the southern boundary of the site, (at DP-4) being conveyed in a small swale into the Pawnee Rancheros Subdivision No.2. The flows eventually convey to the Sand Creek channel, south of Sterling Ranch.

Existing East Fork Sand Creek Basin Flows

Basin EX-8 (Q5 =1.7cfs, Q100 = 20.5 cfs) is a 42.0 acre area of land located within the southern portion of the site, east of Basin EX-7. This basin extends from the south boundary to the north, for approximately 2500 linear feet. Runoff from the basin travels from north to south until it reaches DP-5 to the north of the Bar J-B Acres Subdivision. The runoff from this basin forms the headwaters of the East Fork Sand Creek Sub-tributary which eventually converges with the East Fork of Sand Creek at Constitution Boulevard. This basin is similar in size, shape and location as DBPS Basin 90. The DBPS reported flows from Basin 90 (0.06 sq miles (or ~ 38acres)) are Q10 = 5.92 cfs, Q100 = 26.4 cfs. These flows combine with flows from DBPS Basin 88 at DBPS DP50. Per the DBPS the total runoff anticipated at runoff at DP50 are Q10 = 47.0 cfs, Q100 = 195.7 cfs. The flows anticipated to reach DP50 were not re-analyzed as a part of this study, and thus the DPBS values have been provided for information purposes only. Additional DBPS design points and flow rates have been provided on the Existing Conditions Map provided in the appendix of this report.

Basin EX-9 (Q5 = 23.9 cfs, Q100 = 125.2 cfs) is a 131.9 acre area of land located in the middle area of the site, east of the Sand Creek Channel and Basins EX-5, 7 & 8. This narrow, but long basin extends from the south boundary to nearly the north boundary of Sterling Ranch. Runoff from the basin travels from north to south until it reaches DP-6 at the northern end of existing Mohawk Road at the southern boundary of the site. There is limited topographic definition at the end of the road, and thus in the existing condition runoff likely flows into the entire roadway corridor which bounds both the Pawnee Rancheros No.1 and Bar-J-B Acres Subdivisions. Based upon field visitation and review of aerial mapping, flows discharging from Sterling Ranch appear to continue to flow south along the rights of way to existing culverts located at the terminus of Mohawk Road and Woodmen Road.

Based upon the data input from the DBPS TR-20 model runoff from the area in the existing condition was conveyed to Design Point 52. This could be due in part to a lack of available definition in the contour data set utilized in the larger concept study or perhaps some changes to the watershed topography as a result of gravel mining. Additional discussion regarding this and other conditions is discussed within the developed conditions section of the report.

Basin EX-10 (Q5 = 56.0 cfs, Q100 = 236.1 cfs) is a 270.7 acre area of land located along and within the northeast portion of the site,

east of Sand Creek. Runoff from the basin continues overland south into Basin EX-10A.

Basin EX-10A (Q5 = 2.2 cfs, Q100 = 43.1 cfs) is a 179.3 acre area of land located along and within the northeast portion of the site, east of Sand Creek. Runoff from Basin EX-10 and EX-10A combine at southern boundary of Sterling Ranch near DP-7, totaling Q5 = 57.1 cfs, Q100 = 277.9 cfs. Surface runoff reaching DP-7 is conveyed via a small swales and roadside ditches into Pawnee Rancheros Subdivision No.1.

Based upon the SCDBPS overlay (as shown as background on the enclosed Existing Condition Map) flows from DP7 would appear to be conveyed thru Basin 86 and to DP51, however onsite inspection coupled with aerial photography would indicate that the flows are likely routed to east to swales which do convey runoff to DP52, and that DBPS Basin 86 should be somewhat smaller than what the DBPS backdrop would indicate. A review of the DPBS input (which is provided in the appendix of this report) would indicated that runoff from this area was also routed to DP52. For information purposes, the DBPS reported flows from Basin 86 (0.33 sq miles) are Q10 = 5.92 cfs, Q100 = 26.4 cfs. Additional information regarding DP52 is discussed in subsequent paragraphs.

Basin EX-13 (Q5 = 15.2 cfs, Q100 = 78.4 cfs) is an 89.3 acre area of land located at the east portion of the site. Runoff produced within the basin travels from north to south to the eastern boundary of the site at DP-8A (Q5 = 15.2 cfs, Q100 = 78.4 cfs). The runoff from this location may have historically been directed to the east, however the construction of what are likely utility corridors along the east property line appear to direct the flow back into Basin EX-11. It should be mentioned that the DBPS also conveyed runoff from this area to the south instead of to the east, with flows ultimately reaching DP56.

Basin EX-11 (Q5 = 29.8 cfs, Q100 = 126.1 cfs) is a 209.3 acre area of land located along the eastern portion of the site. This basin extends from the south boundary northward to approximately the future location of Stapleton Road. Runoff from the basin travels from north to south, where it combines with runoff from Basin EX-13 at DP-56 prior to discharging into Pawnee Rancheros Subdivision No.1. The total estimated runoff reaching DP-56 in the existing condition has been calculated at 42.5 cfs and 202.9 cfs in the 5 and 100 year events respectively. Per the SCDBPS runoff reported to reach DBPS DP56 is 63.6 cfs and 265.0 cfs in the 10 and 100 year events respectively.

Basin EX-12 (Q5 = 5.1 cfs, Q100 = 33.3 cfs) is a 39.5 acre area of land located off-site, south of the eastern corner of Sterling Ranch. This basin extends from the south boundary of Sterling Ranch south, approximately 1200 linear feet to DP-8. Flows from DP56 combine with runoff from Basin EX-12 at DP8, where runoff totals Q5 = 45.1 cfs, Q100 = 220.9 cfs. This point has been provided as an additional point of comparison in the developed condition.

DEVELOPED DRAINAGE CHARACTERISTICS

General

A brief description of each drainage basin including historic and developed runoff rates, drainage patterns as well as existing and proposed drainage facilities for each basin is provided in this section of the report. A table of peak developed runoff for the basins and designated design points are depicted on the Developed Conditions Drainage Map in the appendix and the attached map pocket. The total runoff directed off-site shall not exceed Historic (Existing Conditions flow rates) or Sand Creek Drainage Basin Planning Study rates if adequate downstream measures are in place. A table has been provided later in this report to provide the comparison of these flows to the other modeled conditions.

Four Step Process

The Sterling Ranch Master Plan Development will adhere to the EPC drainage code and use the four step process to address both permanent and temporary BMPs for each individual development. Each Preliminary and Final drainage report for the filings in Sterling Ranch will specifically identify the following steps relevant to each filing's characteristics. Generally following the practices below;

Step 1 **Employ Runoff Reduction Practices**. – LID and/or water quality facilities will be designed for each project depending on its land use to reduce downstream transfer of sediment and pollutants. Runoff reduction practices will be utilized to the highest extent achievable in the sub-basin diversion area to minimize volumes reaching Sand Creek. Special consideration for LID concepts that slow runoff and provide volume control should be given to the developments located within the planned watershed diversion area.

Step 2 **Implement BMPs that provide a water quality capture volume with slow release.** – Using Full Spectrum Detention Facilities which will incorporate water quality capture volumes that are intended to slowly drain in 40 hours and excess urban runoff volumes that are intended to drain within 72 hours. All storage facilities will be designed to meet State Statue SB15-212/ §37-92-602(8).

Step 3 **Stabilize streams.** – With the full spectrum detention facility in place, the runoff from the developments will be reduced to predevelopment conditions. The developed discharge from the sites will be less than existing and therefore is not anticipated to have negative effects on downstream drainage ways.

Step 4 **Consider need for Industrial and Commercial BMPs.** – No industrial land uses are proposed with this development. The proposed commercial development area will implement a Stormwater Management Plan (SWMP) incorporation proper housekeeping procedures. Onsite drainage will be routed through private Full Spectrum Detention (FSD) basins to minimize introduction of contaminates to the county's public drainage systems.

INTERBASIN TRANSFER EAST FORK SAND CREEK TO MAIN STEM SAND CREEK

It should be noted that the proposed development plan for the ~1444 acre of Sterling Ranch redistributes a small percentage of the historic watershed between the Sand Creek and East Fork of Sand Creek watershed.

Based upon the survey and contour mapping, prior to development approximately 682 acres of Sterling Ranch runoff was collected by the Sand Creek watershed with the remaining 762 acres was directed to the East Fork of Sand Creek.

After development approximately 267 acres will be redirected from the East Fork Sand Creek into the Sand Creek Basin, resulting in 949 acres of Sterling Ranch directed to the Sand Creek Basin with the remaining 495 acres directed to East Fork Sand Creek.

This modification is driven primarily by maximizing the area of land that can be delivered to the sanitary sewer lift station. It should be noted that the East Fork of Sand Creek is still tributary to the Main Branch of Sand Creek, and thus this transfer is between minor watersheds, not major watershed, and that the development as planned will still function to limit discharged runoff into Sand Creek and East Tributary to the historic flow rates. An exhibit was added to the appendix, which also accompanies the deviation request that shows this basin diversion.

It should be noted that the Developed Conditions Map (provided in the appendix) illustrated the diverted acreage based upon the DPBS mapped boundary(as mapped within the SCDBPS) and diversion based upon the actual field contour data.

Drainage Basin Descriptions

Developed Sand Creek (Main Stem) Basin Flows

Basin SC3-82 (Q5 = 33.2 cfs, Q100 = 132.3 cfs) which is located north of Sterling Ranch and Burgess Road to the east Basin SC3-81, assumes that the 117.8 is primarily undeveloped, pine forested land. In this undeveloped condition runoff from the basin continues south overland into Basin SC3-74.

Basin SC3-74 (Q5 = 36.5 cfs, Q100 = 140.7cfs) is a 119.7 acre area of 5 and 10-acre lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch and south of Burgess Road to the west and north of Basins SC3-73 and SC3-75. Runoff from Basins SC3-74 and SC3-82, combine at DP-74 (Q5 = 65.3 cfs, Q100 = 262.8 cfs), which is equivalent to the anticipated existing modeled flow rates of Q5 = 65.3 cfs, Q100 = 262.8 cfs.

Basin SC3-73 (Q5 = 26.4 cfs, Q100 = 102.0 cfs) is a 90.0 acre area of 5 to 40 acres lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch to the northeast of Vollmer Road. Runoff from the Basin SC3-73 will combine with runoff from DP-74 and will continue overland towards DP-75.

Basin SC3-81 (Q5 = 70.2 cfs, Q100 = 275.7 cfs) which is located north of Sterling Ranch (approx 1 mile) between Shoup and Burgess Roads, assumes that the 262.9 acre area of primarily undeveloped, pine forested, land. In this undeveloped condition runoff from the basin continues south overland into Basin SC3-75.

Basin SC3-75 (Q5 = 21.5 cfs, Q100 = 82.8 cfs) is a 79.3 acre area of pine forested lots ranging in size from 2.5 to 10 acres located north of Sterling Ranch and south of Burgess Road to the east of Vollmer Road. Runoff from Basin SC3-74 will combine with runoff from Basin SC3-81 and will continue south overland towards DP-75. Runoff from DP75 continues south within the Sand Creek Channel to DP77.

Basin SC3-80 (Q5 = 44.3 cfs, Q100 = 171.4cfs) is a 147.7 acre area of pine forested lots ranging in size from 2.5 to 10 acres located north of Burgess Road and to the east of Vollmer Road. In this developed condition runoff from the basin continues south overland towards Basin SC3-76.

Basin SC3-76 (Q5 = 23.1 cfs, Q100 = 89.6 cfs) is a 86.4 acre area consisting primarily of pine forested 2.5 acre lots located to the south of Burgess Road east of Vollmer Road. Runoff from the basin combines with flows from Basin 82, 81, 80, 75, 74, and 73 at DP-75 (Q5 = 235.1 cfs, Q100 = 950.5 cfs). Runoff in the proposed condition is equal to the anticipated existing modeled flow rates of Q5 = 235.1 cfs, Q100 = 950.5 cfs. Runoff from DP75 continues south within the Sand Creek Channel to DP77.

Basin SC3-79 (Q5 = 57.0 cfs, Q100 = 220.1 cfs) is a 189.0 acre area of pine forested 5 to 40acre lots located , land located north of Burgess Road to the east Basin SC3-80. Runoff from the basin continues south overland into Basin SC3-78.

Basin SC3-78 (Q5 = 45.3 cfs, Q100 = 174.5 cfs) is a 155.6 acre area of 2.5-acre lots covered with a mixture of native prairie grasses and pine trees land located south of Burgess Road to the east of Basins SC3-76. Runoff from Basins SC3-79 and SC3-78 combine at DP-78 (Q5 = 98.4 cfs, Q100 = 385.3 cfs). Which is equivalent to the anticipated existing modeled flow rates of Q5 = 98.4 cfs, Q100 = 385.3 cfs).

Basin SC3-77 (Q5 = 27.6 cfs, Q100 = 109.4 cfs) is 106.9 acres which is located to the east of Vollmer Road and north of Arroya Lane, In the developed condition it is assumed that the majority of the 106.9 acre area are large 30+-acre lots. Runoff from the Basin SC3-77 will combine with runoff from DP-78 and will continue overland towards DP-77.

Basin SC3-88 (Q5 = 17.4 cfs, Q100 = 69.0 cfs) is 60.2 acres which is located to the south of Basin SC3-73. In the developed condition, it is assumed that this area is large 30+-acre lots. Runoff from the basin continues south within the Sand Creek Channel to DP77.

Basin SC3-89 (Q5 = 10.0 cfs, Q100 = 38.6 cfs) is 27.5 acres which is located to the south of Basin SC3-88. In the developed condition, it is assumed that this area will be developed into 5 or less acre residential lots. Runoff from the basin will be collect by storm sewer system and be routed east to the Sand Creek Channel to DP77.

Basin SC3-72 (Q5 = 20.2 cfs, Q100 = 76.0 cfs) is 56.2 acres which is located to the south of Basin SC3-77. In the developed condition, it is assumed that this area will be developed into 5 or less acre residential lots. Runoff produced from within the basin shall be directed to a proposed full spectrum detention facility (FSD72) located at the southwest corner of the basin. Released flows from the pond will at peak flow rates of 9.3 cfs and 73.4 cfs in the 5 and 100 year events respectively prior to reaching DP-77. Runoff from DP78, DP75, Basins SC3-77, SC3-88, SC3-89 and FSD Pond 72 combine at DP-77 at peak flow rates of 351.9cfs and 1467.7 cfs in the 5 and 100 year events respectively. Runoff from DP77 continues south within the Sand Creek Channel.

Basin SC3-20 (Q5 = 15.5 cfs, Q100 = 56.6 cfs) is a 34.2 acres offsite area located to the east of Vollmer Road and south of Arroya Lane near the northern boundary of Sterling Ranch. In the developed condition, it is assumed that this area will be developed into 2.5 or less acre residential lots. Runoff produced from within the basin shall be directed to a proposed full spectrum detention facility (FSD20) located at the southeast corner of the basin upstream of DP-73. Released flows from the pond will be routed via storms sewer and discharge into Sand Creek at peak flow rates of 2.8 cfs and 42.4 cfs in the 5 and 100 year events respectively just upstream of DP-73.

Basin SC3-24A (Q5 = 20.4 cfs, Q100 = 73.2 cfs) is a 35.7 acres offsite area located to the east of Vollmer Road near the northern boundary of Sterling Ranch. In the developed condition, it is assumed that this area will be developed into 1/2 acre to 2 1/2 residential lots as well as portions of the Sand Creek channel and open space. Runoff produced from within the basin shall be directed south to Sand Creek upstream of DP73. Runoff from DP77, Basin SC3-24A and FSD Pond 20 combine at DP-73 with peak flow rates of 354.3 cfs and 1506.7 cfs in the 5 and 100 year events respectively. Runoff from DP73 continues south within the Sand Creek Channel to DP72.

Basin SC3-24B (Q5 = 5.3 cfs, Q100 = 18.9 cfs) is a 12.2 acres offsite area located to the east of Vollmer Road near the northern

boundary of Sterling Ranch. In the developed condition, it is assumed that this area will be developed into 1/3-2 1/2 acre residential lots as well as portions of the Sand Creek channel and open space. Runoff produced from within the basin shall be directed south to Sand Creek upstream of DP72.

Basin SC3-22 (Q5 = 14.8 cfs, Q100 = 52.6 cfs) is a 33.9 acres offsite area located to the east of Vollmer Road near the northern boundary of Sterling Ranch. In the developed condition, it is assumed that this area will be developed into 2.5 or less acre residential lots. Runoff produced from within the basin shall be directed to a proposed full spectrum detention facility (FSD22) located at the southeast corner of the basin. Released flows from the pond will at peak flow rates of 5.8 cfs and 43.8 cfs in the 5 and 100 year events respectively prior to reaching DP-72. Runoff from DP73, Basin SC3-24B and FSD22 will combine at DP-72 with peak flow rates of 352.5 cfs and 1518.6 cfs in the 5 and 100 year events respectively. Runoff from DP72 continues south within the Sand Creek Channel to DP71.

Basin SC3-21 (Q5 = 10.8 cfs, Q100 = 37.5 cfs) is 23.3 acres of land located both within Sterling Ranch (near the northern boundary). For the purposes of this study, it is assumed that the area will be developed into 2.5 - 5 acre lots within Sterling Ranch and include a portion of utilities associated with the collection and storage of water. Runoff from the basin will be conveyed to a single FSD pond (FSD21). Released flows from the pond will at peak flow rates of 3.3 cfs and 30.1 cfs in the 5 and 100 year events respectively prior to reaching DP-25. Based upon the TimberRidge MDDP a pipe will be extended to collect runoff from this area. In the event that Sterling Ranch develops prior to the this basin then an FSD pond will be recommended for construction within the Boundary of Sterling Ranch and flows will be discharged at or below historic rates to the downstream parcel. Easements may be needed to accomplish this.

Basin SC3-25 (Q5 = 8.9 cfs, Q100 = 31.0 cfs) is 19.0 acres of land located both within and outside of Sterling Ranch (near the northern boundary). For the purposes of this study, it is assumed that the area will be developed into 1.0-5.0 acre lots, and that all flows will be conveyed to DP25. Runoff from Basin SC3-25 and FSD Pond 21 combine at DP-25 at peak flow rates of 9.1 cfs and 58.2 cfs in the 5 and 100 year events respectively. Runoff from DP25 will be collected by storm sewer system and be routed south to FSD27.

Basin SC3-23 (Q5 = 8.3 cfs, Q100 = 28.4 cfs) is 14.5 acres of land located both within Sterling Ranch development (near the northwest boundary). For the purposes of this study, it is assumed that the area will be developed into 1 to 2.5 acre lots within Sterling Ranch and that all flows will be conveyed to a single FSD pond (FSD23). Released flows from the pond will at peak flow rates of 2.0 cfs and 18.6 cfs in the 5 and 100 year events respectively. Based upon the TimberRidge MDDP a pipe will be extended to collect runoff from this area. The released flow from FSD Pond 23 will be routed via storm sewer system south to FSD27. In the event that Sterling Ranch develops prior to the this basin then an FSD pond will be recommended for construction within the Boundary of Sterling Ranch and flows will be discharged at or below historic rates to the downstream parcel. Easements may be needed to accomplish this. This is further mentioned in subsequent paragraphs (Basin SC3-27).

Basin SC3-26 (Q5 = 4.0 cfs, Q100 = 15.1 cfs) is a 10.0 acres offsite area located to the east of Vollmer Road near the northern boundary of Sterling Ranch. In the developed condition, it is assumed that this area will be developed into 2.5 or less acre residential lots. Runoff produced from within the basin shall be directed south to Sand Creek upstream of DP71.

Basin SC3-27 (Q5 = 51.2 cfs, Q100 = 158.3 cfs) is 70.0 acres of land located both within Sterling Ranch and in the Timber Ridge Development (near the north boundary). For the purposes of this study, it is assumed that the offsite area within the TimberRidge development will be developed (0.33 - 2.5 acre lots), before Sterling Ranch 1 to 2.5 acre lots are developed. Runoff from Basin SC3-27 will be conveyed to a single offsite FSD pond (FSD27) in accordance with the TimberRidge MDDP. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 18.4 cfs and 161.9 cfs in the 5 and 100 year events respectively just upstream of DP-71.

Runoff from Basin SC3-27, FSD 21 and FSD 23 will combine within FSD 27. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 18.4 cfs and 161.9 cfs in the 5 and 100 year events respectively just upstream of DP-71. Runoff from DP72, Basin SC3-26 and FSD27 will combine at DP-71 with peak flow rates of 349.3 cfs and 1612.2 cfs in the 5 and 100 year events respectively. Runoff from DP71 continues south within the Sand Creek Channel to DP70.

As previously discussed, In the event that Sterling Ranch develops before TimberRidge, then FSD ponds will be recommended for construction within the Boundary of Sterling Ranch and flows will be discharged at or below historic rates to the downstream parcel and eventually to Sand Creek. Coordination will be with the TimberRidge Development land owners required to establish easements to convey runoff to the Channel.

Basin SC3-17 (Q5 = 59.6 cfs, Q100 = 180.6 cfs) consists of a 70.6 acre area located within of Sterling. Ranch, that is located just the east of Vollmer Road. This portion of Sterling Ranch is planned for residential lots ranging in size from 0.2-0.33 dwelling units per acre as well as a 4 acre park site and portions of Vollmer Road. Runoff from the basin shall be collected by storm sewer systems and conveyed to a full spectrum detention pond (FSD17) located in the southeast corner of the basin, adjacent to sand creek. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 8.4 cfs and 86.1 cfs in the 5 and 100 year events respectively just upstream of DP-70. Runoff from DP 71 and FSD 17 will combine within the Sand Creek Channel at DP-70 totaling peak flow rates of 349.8 cfs and 1636.7 cfs in the 5 and 100 year events respectively. Runoff from DP70 continues south within the Sand Creek Channel toward DP69.

Basin SC3-18 (Q5 = 67.1 cfs, Q100 = 174.0 cfs) consists of a 53.8 acre area located within of Sterling. Ranch, that is located north of Briargate Parkway and east of Vollmer Road. This portion of Sterling Ranch is planned for residential lots ranging in size from 0.2 to 0.33 acres lots as well as portions of Vollmer Road and Briargate Parkway. Runoff from the basin shall be collected by storm sewer systems and conveyed to a full spectrum detention pond (FSD18) located in the southeast corner of the basin, adjacent to sand creek. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 6.3 cfs and 69.6 cfs in the 5 and 100 year events respectively just upstream of DP-69.

Basin SC3-19 (Q5 = 47.7 cfs, Q100 = 188.8 cfs) is a 184.0 acre of offsite area located to the north and west of Sterling Ranch and Vollmer Road. In the existing condition the land consists of 5 acre or greater rural lots. Runoff from the basin is conveyed via roadside ditches, overland earthen swales and storm sewer systems to the west side of Vollmer Road north of proposed Briargate Parkway. The flows are to be conveyed under Vollmer via a newly constructed storm sewer system which will discharge into Sand Creek either in a roadside swale or storm sewer system. Runoff reaching the Sand Creek Channel will combine with up gradient flows from Basin SC3-19, DP70 and FSD Ponds 18, culminating in peak runoff rates of Q5 = 366.6 cfs, Q100 = 1775.7 cfs. This is slightly less than the existing condition modeled flow rates of Q5 = 434.8 cfs, Q100 = 1870.4, at DP69.

A four (4) cell 8.5'h x10'w concrete box culvert (CBC) has been preliminarily sized to safely convey the channelized runoff under Proposed Briargate Parkway at DP69. Due to the flow rate being over 1500 cfs, the proposed culvert crossing structure at Briargate Parkway will need to meet 6.4.2 of the DCM and shall provide no less than 2.0 feet of freeboard. Concept culvert calculations indicate that the structure is adequate to pass the existing condition flows of approximately 1900 cfs. These calcs have been provided in the appendix of this report. A Condition Letter of Map Revision and Letter of Map Revision (CLOMR/LOMR) will need to be processed through the Federal Emergency Management Agency (FEMA) to revise the hydrology and subsequent peak 100 year channel flow rates. If the revised hydrology was not approved on a federal level the crossing structure would need to be sized for the current Effective 100 year flow rate of 2600 cfs. It should be noted that DBPS flow rates for Reach SC-8 (Reach 163) adjacent to this location were 2,380cfs, while the flow upstream Reach SC-9 (Reach 170) is 2,265cfs. As discussed in subsequent portions of this report the hydrology provided within this report will function to amend the DBPS rates for the Sand Creek channel, through the Sterling Ranch Development and shall be utilized as the bases for future channel stabilization efforts. The final design of the culvert crossing and final determination of approved rates will be discussed within the future Sterling Ranch Channel Design Report and Sand Creek CLOMR/LOMR documents.

Basin SC3-12 (Q5 = 105.6 cfs, Q100 = 270.0 cfs) consists of an 88.2 acre area located within of Sterling. Ranch, that is located south of Briargate Parkway and east of Vollmer Road. This portion of Sterling Ranch is planned for a commercial site and several single family residential lots ranging in size from 0.2 to 0.33 acres lots as well as portions of park and open space. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD12) located adjacent to sand creek. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 9.0 cfs and 103.1 cfs in the 5 and 100 year events respectively just upstream of DP-87.

Basin SC3-15A (Q5 = 35.5 cfs, Q100 = 141.0 cfs) is a 139.7 acre area of offsite area located to the west of Sterling Ranch and Vollmer Road. In the current condition, this offsite area is primarily undeveloped with a few 5 acres lots. Runoff from the basin is conveyed to Vollmer Road via existing earthen swales and existing roadside ditches. A proposed storm sewer system under Vollmer road will convey flows into Sterling Ranch where they will combine with onsite runoff at DP26.

Basin SC3-15B (Q5 = 14.0 cfs, Q100 = 31.9 cfs) is a 7.9 acre area located in Sterling Ranch and east of Vollmer Road. In the developed condition, this portion of Sterling Ranch is planned for open space and portions of Vollmer Road, as well as full spectrum detention pond FS15B. Runoff from the basin is anticipated to be conveyed via roadside ditches, overland earthen swales and storm sewer systems to a full spectrum detention pond (FSD15B) located in the south end of the basin. The treated detained flows from the pond (Q5 = 1.1 cfs and Q100 = 12.0) will be conveyed to DP26. The combined flows will be conveyed to Sand Creek via a bypass storm sewer system at DP87. Runoff reaching the Sand Creek Channel will combine with flows from DP69, DP26 and FSD Pond 12

at DP87 culminating in peak runoff rates within Sand Creek of Q5 = 374.6 cfs, Q100 = 1905.9 cfs.

Basin SC3-16A (Q5 = 120.4 cfs, Q100 = 351.8 cfs) consists of a 168.1 acre area located within Sterling Ranch, that is located north of Briargate Parkway and east of Sand Creek Channel. This portion of Sterling Ranch is planned to house residential development that ranges from low density rural lots 1 acres in size to medium density urban residential with lots ranging in size from 0.1 to 0.2 acres. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD16A), at the northwest corner of Briargate Parkway and Sterling Ranch Road. The treated detained flows from the pond will discharge to DP22 at peak flow rates of 8.8 cfs and 128.3 cfs in the 5 and 100 year events respectively.

Basin SC3-16B (Q5 = 53.7 cfs, Q100 = 143.8 cfs) consists of a 50.7 acre area located within Sterling Ranch, that is located north of Briargate Parkway and east of Sand Creek Channel. This portion of Sterling Ranch is planned for a low to medium density residential lots ranging in size from 0.1 to 0.2 acres lots and portions of roadways. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD16B), at the northeast corner of Briargate Parkway and Sterling Ranch Road. The treated detained flows from the pond will discharge to DP22 at peak flow rates of 0.4 cfs and 28.1 cfs in the 5 and 100 year events respectively. The combined peak flow rates from SC3-16B and FSD14A (DP22, Q5=8.8 cfs and Q100=174.9 cfs) will be conveyed south via storm sewer system to DP21.

Basin SC3-14B (Q5 = 34.3 cfs, Q100 = 94.1 cfs) consists of a 34.7 acre area located within of Sterling. Ranch, that is located between south of Briargate Parkway and east of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch is planned for a low to medium density residential lots ranging in size from 0.1 to 0.33 acres lots and portions of roadways. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD14B), at the south end of the basin. The treated detained flows from the pond will discharge to DP21 at peak flow rates of 0.3 cfs and 19.3 cfs in the 5 and 100 year events respectively. The combined peak flow rates from DP22 and FSD14B (DP21, Q5=8.8 cfs and Q100=174.9 cfs) will be conveyed to Pond W3 above the intersection of Sand Creek channel and Sterling Ranch Road.

Basin SC3-14A (Q5 = 175.4 cfs, Q100 = 466.3 cfs) consists of a 164.9 acre area located within of Sterling. Ranch, that is located between south of Briargate Parkway and east of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch is planned for a k-8 school site, several single family residential lots ranging in size from 0.2 to 0.33 acres lots as well as portions of park and open space. Runoff from the basin shall be collected and conveyed within street and storm sewer systems and directed to a full spectrum detention pond (FSD14A), at the southwest corner of the basin. The treated detained flows from the pond will discharge to Pond W3 at peak flow rates of 7.5 cfs and 142.2 cfs in the 5 and 100 year events respectively.

Basin SC3-13 (Q5 = 57.8 cfs, Q100 = 136.9 cfs) consists of a 41.0 acre area located within of Sterling. Ranch, that is located just the east of the Barbarick Subdivision and north of Sterling Ranch Road. This portion of Sterling Ranch is planned for residential lots ranging in size from 0.1 to 0.2 acres in size. Runoff from the basin shall be collected by storm sewer systems and conveyed to a full spectrum detention pond (FSD13) located in the south end of the basin, adjacent to sand creek. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 4.2 cfs and 47.2 cfs in the 5 and 100 year events respectively.

Runoff from DP87, DP21 and from FSD Ponds 13, and 14A will combine within the Sand Creek Channel at proposed Regional Pond Detention Facility W3. The purpose of the regional pond is to reduce the post development flow rates within the Sand Creek Channel at the Southern Sterling Ranch boundary to at or below the existing flow rates calculated by this report. The pond is also necessary due to the drainage basin diversion, as discussed in other parts of this report. The total combined discharge reaching the regional facility (Pond W-3) has been calculated at 374.5 cfs and 2204.1 cfs in the 5 and 100 year events respectively.

As conceptually designed the proposed facility will utilize a check/diversion wall located upstream of the existing stock pond and proposed detention facility that will function to divert base flows within the channel to aid in retaining a fixed water surface within the existing stock pond and in larger storm events diverted flows safely around the amenity to the west side to detention Pond W3. A small controlled outlet structure along with an improved downstream embankment will be added to the existing stock pond to stabilize it and retain a fixed maximum water surface elevation. In the larger detention pond eight (8) small 24" storm sewer pipe located within a separate embankment will allow for free flow discharge of 2 year runoff and begin to detain flows of 5 years and larger events. Flows exiting the small storm pipes or overtopping the separated embankment will enter a concrete forebay that conveys drainage to two (2) cell 8'h x10'w concrete box culvert (CBC) under Proposed Sterling Ranch Road to DP68. As the anticipated flow rate leaving the pond is planned to be less than 1,500 cfs, and the proposed culvert crossing is conceptually planned to have an open area of less than 200 ft sq of open area and thus will need to meet the headwater requirements of Table 6-5 of the DCM, which in this concept design is a ratio of about ~1.3. The total combined discharge calculated to leave the regional facility (Pond W-3) has been calculated at 200.3 cfs and 1,350.6 cfs in the 5 and 100 year events respectively, with a maximum 100 year water surface of 7017.3, a

HW/D ratio of ~1.3. The peak detained volume has been estimated at 78.2 ac-ft. A low point in Sterling Ranch Road will be designed adjacent to the facility to provide a safe overflow route. An exhibit showing the concept design and its various elements is included in the appendix of this report.

As previously discussed a Condition Letter of Map Revision and Letter of Map Revision (CLOMR/LOMR) will need to be processed through the Federal Emergency Management Agency (FEMA) to revise the hydrology to the Sand Creek Channel and allow for the remapping of the revised floodplains. It should be noted that the DBPS flow rates for Reach SC-8 (Reach 163) adjacent to this location were estimate to be 2,630 cfs and that the effective FEMA 100 year flow rate is 2,600cfs. A comparison table of the various flow rates is provided later in this text and on the accompanying drainage maps.

The final design of the culvert crossing and final determination of approved rates as well as the final pond design will be discussed within the future Sterling Ranch Channel Design Report and Sand Creek CLOMR/LOMR documents. No deviations for this pond and accompanying outlet structure are anticipated at this time.

It is important to note that the planned discharge outlet pipe for the FSD pond located to the west of the pond W3 will need to be extended to the downstream outlet side of the culvert to ensure that the 100 year water surface elevation with W3 does not affect the functionality of the adjacent FSD and its storm sewer systems.

In regards to timing, the need to construction this facility can be tied to the Sand Creek Channel improvements which is discussed within this report and also within the Subdivision Improvements Agreement. In no case should runoff from the East Fork of Sand Creek be diverted to the Main Branch of the Sand Creek Channel prior to the construction and of this facility.

Basin SC3-11A (Q5 = 7.8 cfs, Q100 = 24.3 cfs) consists of a 10.7 acre area located within of Sterling. Ranch, that is south of Sterling Ranch Road, west of Sand Creek. This portion of Sterling Ranch consists of single family residential for lots ranging in size from 0.2 to 0.3 acres in size and open space associated with the Sand Creek Channel. Runoff from the developed portion of the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond FSD11A. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 0.9 cfs and 12.3 cfs in the 5 and 100 year events respectively just upstream of DP-63. It should be noted that this detention facility may not be necessary if grading can be oriented to force surface runoff to the west.

Basin SC3-11B (Q5 = 81.3 cfs, Q100 = 213.7 cfs) consists of a 76.6 acre area located within of Sterling. Ranch, that is south of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch consists of single family residential planned for lots ranging in size from 0.2 to 0.3 acres in size and a portion of a park site and collector roadways. Runoff from the developed portion of the basin shall be collected and conveyed within street and storm sewer systems westward to a full spectrum detention pond FSD11B. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 4.5 cfs and 69.5 cfs in the 5 and 100 year events respectively. The runoff from DP68 and from FSD ponds 11A and 11B combine at DP63 at peak flow rates of Q5 = 201.0 cfs, Q100 = 1385.1, which is less than the anticipated existing modeled flow rates of Q5 = 430.7 cfs, Q100 = 1911.5 at DP63. Runoff from DP63 continues south within the Sand Creek Channel toward DP61.

Basin SC3-7 (Q5 = 69.9 cfs, Q100 = 157.2 cfs) consists of a 45.7 acre industrial zoned area, referred to as the Barbarick Subdivision, located outside of Sterling Ranch. Per the Final Drainage Report for Barbarick Subdivision, Portions of Lots 1, 2 and Lots 3and 4 the filing consists of four lots which upon which development will be constructed which will include adding a proposed Extended Detention Basin within Lot 4. This detention basin will provide water quality treatment for portions of Lots 1 & 2, and Lots 3 & 4. The EBD will structure will outfall at the south end of Lot 4 at the Barbarick Subdivision/Sterling Ranch property line. Per the report the proposed total outflow from the EDB pond will be Q5 = 0.3 cfs, Q100 = 45.9** cfs(**which includes pass through flows of 29.4 cfs). A second Sand Filter Basin water quality detention catchment will be provided at the southeast/downstream end of Lot 2. The SFB will outfall at the southeast corner of the Lot 2 at the Barbarick Subdivision/Sterling Ranch property line. Per the report the proposed total outflow the SFB pond will be Q5 = 0.1 cfs, Q100 = 3.6 cfs. At the initial writing of this report, neither EDB nor SFB structure has been fully constructed, and thus the assumption was made to utilize the full un-detained untreated runoff from the offsite development for onsite drainage planning purposes. Thus the downstream facilities planned within Sterling Ranch will account for the total un-detained runoff from the parcel of Q5 = 69.9 cfs, Q100 = 157.2 cfs and will plan to treat the total runoff onsite facilities. This provides a conservative approach for master planning. Runoff discharged from the property will be collected by proposed storm sewer within Sterling Ranch and routed to DP64. These facilities and their effects on drainage will be re-reviewed with subsequent drainage report and shall be implemented into final design and construction.

Basin SC3-6B (Q5=43.4 cfs, Q100=102.7 cfs) consists of a 30.9 acre area located within of Sterling Ranch, that is north of Sterling

Ranch Road and west of Sand Creek. This portion of Sterling Ranch will consist of single family residential planned for lots ranging in size from 0.1 to 0.33 acres in size, a school site and portion of the local collector roadways. Runoff from the developed portion of the basin shall be collected and conveyed within street and storm sewer systems where it combines with flows from Basin SC3-7 at DP64 (Q5 = 112.1 cfs, Q100 = 258.0 cfs). The combined runoff continues south toward Pond FSD6.

Basin SC3-6A (Q5=79.3 cfs, Q100=177.1 cfs) consists of a 49.3 acre area located within of Sterling Ranch, that is north and east of Marksheffel Road and of Sterling Ranch Road and west of Sand Creek. This portion of Sterling Ranch is planned for a commercial site and single family residential lots ranging in size from 0.2 to 0.3 acres lots as well as portions of major and local collector roadways. Developed runoff from the basin shall be conveyed within street sections and storm sewer systems and directed to FSD Pond 6.

Basin SC3-6C (Q5=72.5 cfs, Q100=181.5 cfs) consists of a 58.0 acre area located mostly within the confines of Sterling Ranch, near the south boundary of the site, west of the Sand Creek Channel. This portion of Sterling Ranch is planned for a commercial site and single family residential lots ranging in size from 0.2 to 0.3 acres lots as well as portions of major and local collector roadways. A small segment of the existing Pawnee Rancheros subdivision (5 acres lots) also falls within the basin. Where not sheet flowing into the creek, the developed runoff from the basin shall be conveyed within street sections and storm sewer systems and directed to FSD Pond 6. Runoff from DP64 and from Basins SC3-6B and 6C will combine in FSD6. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 7.5 cfs and 149.6 cfs in the 5 and 100 year events respectively. Flows from FSD6 outfall into the Sand Creek Channel at DP61.

Basin SC3-8 (Q5 = 42.1 cfs, Q100 = 166.2 cfs) consists of 143.4 acres located outside of Sterling Ranch and to the west of Basin SC3-15A. In the developed condition, it is assumed that the remaining large parcel are fully developed into 5 acres lots. Runoff from the basin is conveyed as surface flows to Basin SC3-9.

Basin SC3-9 (Q5 = 71.5 cfs, Q100 = 254.0 cfs) consists of 217.4 acres located to northwest of Vollmer Road and south of Basin SC3-8. In the current condition, much of the large parcel has been developed into 2.5-5 acres lots. The calculated runoff will assume that that Vollmer Road is widened as a part of this project. Runoff from Basins SC3-8 and SC3-9 combine within the roadside ditches and natural drainage ways within the development before combining within an upgraded roadside swale located along the west side of Vollmer Road which discharges into a full spectrum detention pond (FSD9) located at the south end of the basin. The treated detained flows from the pond are conveyed under Vollmer and along Marksheffel Road within a storm drain or stabilized channel to Sand Creek at peak flow rates of 24.9 cfs and 289.9 cfs in the 5 and 100 year events respectively just downstream of DP-61.

Basin SC3-10 (Q5 = 12.3 cfs, Q100 = 47.7 cfs) consists of 36.0 acres (located outside of Sterling Ranch), of the existing Pawnee Rancheros Filing No 2 (5 acre lots), that is located to the east of Basin SC3-6. Runoff from the basin is conveyed as surface drainage to the Sand Creek Channel, where it combines with flows discharged from FSD Ponds 6 and 9 and from DP 63 at the County/City Boundary (DP-61) at peak flow rates of 223.9 cfs and 1620.1 cfs in the 5 and 100 year events respectively. It is anticipated that easements from the owner of the property located to the south of the Sterling Ranch will be required to outfall the storm sewer from FSD6 and FSD9 as well as provide an emergency overflow route. Runoff from DP61 continues south within the Sand Creek Channel toward DP60A.

Basin SC3-5A (Q5 = 53.7 cfs, Q100 = 129.1 cfs) is a 39.1 acres offsite area located to the south of Sterling Ranch, west of the Sand Creek Channel. In the developed condition, it is assumed that this area will be developed into 0.1 acre residential lots, portions of Marksheffel Road and stabilized segments of the Sand Creek Channel. Runoff produced from within the basin shall be directed to a proposed full spectrum detention facility (FSD5) located at the southeast corner of the basin upstream of DP-60A. Released flows from the pond will discharge into Sand Creek at peak flow rates of 1.4 cfs and 30.1 cfs in the 5 and 100 year events.

Basin SC3-61 (Q5 = 22.0 cfs, Q100 = 84.8 cfs) is a 65.5 acres offsite area located to the south of Sterling Ranch east of Basin SC3-5B, that is made up of 5 acre lots. With the development of filing SC3-5B, a storm sewer bypass line will be constructed to safely convey the upstream runoff thru the development to the channel just upstream of DP-60A.

Basin SC3-5B (Q5 = 73.0 cfs, Q100 = 187.0 cfs) is a 63.0 acres offsite area located to the south of Sterling Ranch east of Basin SC3-5A. In the developed condition, it is assumed that the majority of the area will be subdivided into 0.1 acre residential lots. Water quality treatment only is anticipated for this area and thus a FSD pond has not been included in the modeling. Runoff produced from within the basin shall be directed to Sand Creek just upstream of DP-60A. The runoff from DP61, FSD5 and from Basins SC3-5B and SC3-61 combine at DP60A at peak flow rates of Q5 = 224.8 cfs, Q100 = 1661.8, which is less than the anticipated existing modeled flow rates of Q5 = 430.2 cfs, Q100 = 1913.5 at DP60A. Runoff from DP60A continues south within the Sand Creek Channel toward

DP53A.

Basin SC3-1A (Q5 = 23.3 cfs, Q100 = 68.9 cfs) is a 27.8 acres offsite area located to the south of Sterling Ranch east of Basin SC3-5A. In the developed condition, it is assumed that the majority of the area will be subdivided open space and school grounds. Runoff produced from within the basin shall be directed to a proposed full spectrum detention facility (FSD1) located at the southeast corner of the basin upstream of DP-53A and Pond 3. Released flows from the pond will discharge into Sand Creek at peak flow rates of 1.6 cfs and 25.4 cfs in the 5 and 100 year events. The runoff from DP60A and FSD pond 1combine at DP53A at peak flow rates of Q5 = 225.7 cfs, Q100 = 1668.9, which is less than the anticipated existing modeled flow rates of Q5 = 454.0 cfs, Q100 = 2061.5 at DP53A.

Proposed East Fork Sand Creek Basin Flows

Basin SCE-1 (Q5=35.9 cfs, Q100=127.4 cfs), is a 64.4 acre area located at the northeast corner of Sterling Ranch. This portion of Sterling Ranch is to be developed into low density residential lots ranging in size from 0.4 to 1 acre. A small portion of off-site is to be developed into residential lots ranging in size from 2.5 to 5 acres. Runoff produced from within the basin shall be conveyed via surface drainage and small storm sewer systems to a proposed full spectrum detention facility (FSD-E1) located at the southern end of the basin. Released flows from the pond will at peak flow rates of 5.4 cfs and 84.0 cfs in the 5 and 100 year events respectively prior to reaching DP-1E.

Basin SCE-13 (Q5 = 31.3 cfs, Q100 = 120.0 cfs) is a 78.6 acre offsite area that consists of 2.5-acre lots covered with a mixture of native prairie grasses located to the east of Sterling Ranch and Basin SCE-1. Runoff produce by the basin is anticipated to enter Basin SCE-1 and SCE-2 as surface drainage.

Basin SCE-2 (Q5=7.0 cfs, Q100=25.7 cfs), consists of a 15.0 acre strip of land located along the eastern boundary of Sterling Ranch which has been dedicated for use as an open space buffer. It is anticipated in addition to a trail system the buffer zone will house a series of small storm sewer system and a trunk main which will runoff from the adjacent offsite watershed. The discharge from FSD Pond 1E and Basins SCE13 and SCE-2 will combine within a storm sewer system at DP1E where peak flows total 38.3 cfs and 220.9 cfs in the 5 and 100 year events respectively. The proposed storm sewer system and conveyed runoff will continue south within the buffer zone to DP2E.

Basin SCE-3 (Q5=45.2 cfs, Q100=143.9 cfs) is 67.5 acres of land located along the eastern boundary of Sterling Ranch. The area is to be primarily developed into 0.5 acres with small sections of denser residential lots associated with and an active adult community ranging between 0.1-0.2 acres per lot. Runoff from the basin is to be collected within local roadways and storm sewer system and conveyed to a proposed full spectrum detention facility (FSD-E2) located at the southern end of the basin. After treatment and detention, the final release rates anticipated from FSD-E2 will total Q5=3.2 cfs Q100=74.7 cfs. The proposed storm sewer system and conveyed runoff will continue south to DP2E.

Basin SCE-14 (Q5 = 21.2 cfs, Q100 = 81.7 cfs) is a 52.5 offsite area that consists of 5.0 acre lots located to the north and east of Sterling Ranch and Basin SCE-4. Runoff produce by the basin is anticipated to enter Basin SCE-4 as surface drainage within the buffer zone.

Basin SCE-4 (Q5=19.6 cfs, Q100=62.6 cfs) consists of a 29.5 acre strip of land located along the eastern boundary of Sterling Ranch which has been dedicated for use as an open space buffer. It is anticipated in addition to a trail system the buffer zone will house a series of small storm sewer system and a trunk main which will runoff from the adjacent basins. The discharge from DP1E, FSD Pond 2E and Basin SCE-4 will combine within a storm sewer system at DP2E where peak flows total 76.8 cfs and 419.4 cfs in the 5 and 100 year events respectively. The storm sewer system and collected runoff will continue south within the buffer zone to DP3E.

Basin SCE-5 (Q5=130.6 cfs, Q100=298.4 cfs) is 85.5 acres of land located along the eastern boundary of Sterling Ranch north of proposed Briargate Parkway. The area is to be developed into residential lots associated with and an active adult community, typically ranging between 0.1-0.2 acres per lot. Runoff from the basin is to be collected within local roadways and storm sewer system and conveyed to a proposed full spectrum detention facility (FSD-E3) located at the southeastern southern end of the basin. After treatment and detention, the final release rates anticipated from FSD-E3 will total Q5=6.8 cfs Q100=101.3 cfs. The proposed storm sewer system and conveyed runoff will continue south within the buffer zone to DP3E.

Basin SCE-6 (Q5=2.5 cfs, Q100=8.6 cfs), consists of a 3.8 acre strip of land located along the eastern boundary of Sterling Ranch which has been dedicated for use as an open space buffer. It is anticipated in addition to a trail system the buffer zone will house a

series of small storm sewer system and a trunk main which will runoff from the adjacent basins. The discharge from DP2E, FSD Pond E3 and Basin SCE-6 will combine within a storm sewer system at DP3E where peak flows total 75.7 cfs and 500.1 cfs in the 5 and 100 year events respectively. The storm sewer system and collected runoff will continue south within the buffer zone to DP4E.

Basin SCE-7 (Q5=75.5 cfs, Q100=165.2 cfs) is 44.9 acres of land located within the southeastern corner of Sterling Ranch, south of Briargate Parkway. The area is to be developed into medium and high density residential lots and roadways, typically ranging between 8-20 dwelling units per acre and a small park site. Runoff from the basin is to be collected within local roadways and storm sewer system and conveyed to a proposed full spectrum detention facility (FSD-E4) located at the southeastern corner of the basin. After treatment and detention, the final release rates anticipated from FSD-E4 will total Q5=2.8 cfs Q100=43.6 cfs. The storm sewer system and treated runoff will continue east to DP4E.

Basin SCE-8 (Q5=48.4 cfs, Q100=99.9 cfs) is 25.5 acres of land located to the east of Basin SCE-7 and south of Briargate Parkway. The area is to be developed into commercial property and Banning Lewis Parkway. Runoff from the basin is to be collected within local storm sewer system and conveyed to a proposed full spectrum detention facility (FSD-E5) located at the southeastern corner of the commercial site. After treatment and detention, the final release rates anticipated from FSD-E5 will total Q5=0.2 cfs Q100=10.0 cfs. The storm sewer system and treated runoff will continue east to DP4E.

Basin SCE-9 (Q5=2.4 cfs, Q100=8.5 cfs), consists of a 4.0 acre strip of land located along the eastern boundary of Sterling Ranch which has been dedicated for use as an open space buffer. It is anticipated in addition to a trail system the buffer zone will house a series of small storm sewer system and a trunk main which will collect and convey runoff from the adjacent basins. The discharge from DP3E, FSD Ponds E4 and E5 and Basin SCE-9 will combine within a box culvert storm sewer that parallels Banning Lewis Parkway. The peak flows at DP4E is anticipated to reach 76.2 cfs and 534.8 cfs in the 5 and 100 year events respectively. The proposed storm sewer system and collected runoff will continue south within the buffer zone. The storm sewer system and treated runoff will continue east to DP56.

Basin SCE-10 (Q5=189.4 cfs, Q100=467.5 cfs) is 174.3 acres of land located within the southeastern corner of Sterling Ranch. The area is to be developed into residential lots typically ranging between 3-5 dwelling units per acre. In addition to the various local roadways, and a park site, a 10 acre elementary school site is also planned for construction within this area of Sterling Ranch. Runoff produced by the basin is to be collected within local roadways and storm sewer system and conveyed to a proposed full spectrum detention facility (FSD-E6) located at the southeastern corner of the basin. After treatment and detention, the final release rates anticipated FSD Pond E6 will total Q5=0.9 cfs Q100=123.3 cfs. The storm sewer system and treated runoff will continue east to DP56.

Basin SCE-11 (Q5=3.6 cfs, Q100=12.8 cfs), consists of a 5.8 acre strip of land located along the eastern boundary of Sterling Ranch which has been dedicated for use as an open space buffer. It is anticipated in addition to a trail system the buffer zone will house a series of small storm sewer system and a trunk main which will collect and convey runoff from the adjacent basins. The runoff entering Pond E7 is a combination of flows from DP4E, FSD Ponds E6 and Basin SCE-11. These flows total 75.4 cfs and 548.0 cfs in the 5 and 100 year events respectively. Stabilization of downstream reach(s) to accommodate developed runoff from Sterling Ranch is dependant up the timing of the construction for the downstream development and the extension of Future Banning Lewis Parkway. In the event that Sterling Ranch developed before downstream properties, it shall need be restricted to historic flows. If the downstream improvements have not been made and development within Sterling Ranch is decided upon one option to meet historic flow rate discharge would be to construct a regional detention facility as shown on the Proposed Conditions Map (Pond E7). Based upon the HEC-HMS modeling, the proposed facility would need to store approximately 28 acre feet to reduce the peak developed inflow to less than the 100 year existing flow rate of ~ 200. cfs. It should be noted that the DBPS at this location shows a proposed flow rate of Q100 = 533cfs [Seg. 85], and Q100=980 [Seg. 84].

Basin SCE-15 (Q5 = 5.1 cfs, Q100 = 33.4 cfs) is a 39.5 acre area of land located off-site, southeast of Sterling Ranch. This basin extends from the south boundary, south, approximately 1200 linear feet from Basin SCE-10. Runoff from the basin combines with flows from DP56 at DP-8 totaling Q5 = 37.2 cfs, Q100 = 200.7 cfs. These flow rates less than the calculated existing condition rates at DP8 of Q5 = 45.1 cfs, Q100 = 220.9 cfs.

South & East Boundary Discharge

The discharge of developed drainage flows from Sterling Ranch shall not adversely affect any adjacent property. The developed flows will be mitigated by the use of full spectrum detention, and other BMP's to ensure that offsite flows are at or less than historic. In no

circumstance will the developed flows from Sterling Ranch discharge exceed Historic flow rates. However, at the time of final design and development layouts for these proposed areas, some discharge of flow shall be released into the existing drainage swales to the south or east, but shall not exceed the historic amount (For instance, backyard landscaping flow). Woodmen Road improvements were completed in approximately year 2010. At that time, drainage culverts were constructed to include 3-60" RCP culverts, and 2-60" RCP culverts (SCDBPS Seg 84 & 85). These culverts will be analyzed by the upstream proposed developments (Sterling Ranch or Banning Lewis Ranch) to determine the allowable discharge under Woodmen Road.

STERLING RANCH DISCHARGE COMPARISONS

Pre/Post Development - As analyzed by M&S Civil Consultants

Design Point /	Proposed Discharge 100-year	Existing Conditions 100-year	Comments
DP1	0 cfs	32.2 cfs	Redirected to FSD-6, Revaluate with Final Design
DP2	0 cfs	30.9 cfs	Redirected to FSD-6, Revaluate with Final Design
DP3	0 cfs	7.1 cfs	Redirected to FSD-6, Revaluate with Final Design
DP4	0 cfs	107.4 cfs	Redirected to FSD-11B, Revaluate with Final Design
DP5	0 cfs	20.5 cfs	Redirected to FSD-11B, Revaluate with Final Design
DP6	0 cfs	125.2 cfs	Redirected to FSD-E6, Revaluate with Final Design
DP7	0 cfs	277.9 cfs	Redirected to FSD-E6, Revaluate with Final Design
DP56	196.4 cfs	220.9 cfs	Historic flow - Less than DBPS (Seg. 85)
DP9A	0 cfs	380.5 cfs	Bypassed to SC channel below FSD-E6
DP63	1385.1cfs*	1911.5 cfs	~218 cfs less than historic, Sets flow at MS X-ing @ 2000 cfs

*Assumes Pond W3 constructed

Per the above table, in all locations along the Sand Creek Channel or tributary to the East Fork watershed, the proposed flow rates are less than the rates specified in the existing conditions or the DBPS. . Future phasing and planning of Sterling Ranch may create the need to re-evaluate discharge flows and along the southern boundary, where topographic constraints may make slightly change the contributing drainage areas in this region.

Model Results

The following tables summarizes the modeled existing and future conditions peak discharge rates at Design Points located near the subject reach and specific locations for analysis. The flow rates are reported for the 2, 5, 10, 25, 50, and 100-year storm events. Where applicable comparison were made to the Wilson Study and the SCDBPS, refer to the Existing and Developed Hydrologic Condition Maps for a complete listing of the Basins, Design Points, and Water Quality and Detention Pond flow rate and storage summaries.

2018 HEC HMS Models, 2011 Wilson HEC-1 Model and 1996 DPBS Flow Rate Comparisons

Summary of Peak Discharges						
Design Point 69 - Proposed Briargate Parkway X-ing						
Storm Event (YR)	2	5	10	25	50	100
2018 Existing Cond. (cfs)	253	435	708	1,100	1,453	1,870
2018 Developed Cond. (cfs)	213	367	654	1,011	1,364	1,776
Design Point 77 - Arroyo Lane						
Storm Event (YR)	2	5	10	25	50	100
2018 Existing Cond. (cfs)	n/c	n/c	n/c	n/c	n/c	n/c
2018 Developed Cond. (cfs)	210	352	581	887	1,168	1,468
1996 DBPS Exist Cond. (cfs)						2,193
1996 DBPS Developed Cond. (cfs						2,262

Design Point 68 - Proposed Sterling Ranch Road X-ing						
Storm Event (YR)	2	5	10	25	50	100
2018 Existing Cond. (cfs)	n/c	n/c	n/c	n/c	n/c	n/c
2018 Developed Cond. w/o Pnd (cfs)	215	375	715	1,188	1,675	2,204
2018 Developed w/Pnd (cfs)	154	200	367	800	1,086	1,351
Design Point 63 - Southern Bndry Sterling Ranch Development						
Storm Event (YR)	2	5	10	25	50	100
2018 Existing Cond. (cfs)	251	431	713	1,113	1,496	1,912
2018 Developed Cond. w/o Pnd (cfs)	213	373	721	1,198	1,705	2,237
2018 Developed w/Pnd (cfs)	154	201	376	816	1,112	1,385
2011 Wilson (cfs)			1,066			1,791
1996 DBPS Existing Cond. (cfs)						2,508
1996 DBPS Developed Cond. (cfs)						2,689

Design Point 61 - City/County Boundary						
Storm Event (YR)	2	5	10	25	50	100
2018 Existing Cond. (cfs)	n/c	n/c	n/c	n/c	n/c	n/c
2018 Developed Cond. w/o Pnd (cfs)	214	375	783	1,370	1,967	2,607
2018 Developed w/Pnd (cfs)	157	224	428	928	1,287	1,620
2011 Wilson (cfs)			1,232			2,087
Design Point 60A - Future Marksheffel Xing						
Storm Event (YR)	2	5	10	25	50	100
2018 Existing Cond. (cfs)	248	430	707	1,113	1,497	1,914
2018 Developed Cond. w/o Pnd (cfs)	216	378	795	1,395	2,004	2,645
2018 Developed w/Pnd (cfs)	162	225	439	950	1,321	1,662
2011 Wilson (cfs)			1,265			2,133
1996 DBPS Existing Cond. (cfs)						2,629
1996 DBPS Developed Cond. (cfs)						3,295
Design Point 53A Sand Creek Pond 3 Drop Structure						
Storm Event (YR)	2	5	10	25	50	100
2018 Existing Cond. (cfs)	262	454	763	1,197	1,610	2,062
2018 Developed Cond. w/o Pnd (cfs)	215	378	792	1392	2,009	2,657
2018 Developed w/Pnd (cfs)	162	226	442	951	1,326	1,669

n/a - not calculated

Pre-Development Conditions Model Results/Output

It should be noted that initially the CN Values for the pre-development existing conditions were evaluated using Table 6-9 as recommended by Chapter 6 of the City of Colorado Springs Drainage Criteria Manual Volume I. After the analysis was ran it was determined by the design engineer that the runoff rates were significantly lower than even historic gauging data for nearby undeveloped areas. Thus a secondary predevelopment model was run using ARC-II CN values from Table 6-10. The Pre-Development conditions model resulted in an average value of 0.9 cfs per acres using the ARCII. The models were also run using the ARC I NRCS Curve number; however, the resultant average flow was only 0.20 cfs per acre. The ARC I curve seemed very low to use as a comparison, therefore the ARC II curve, 0.90 cfs/ac seams more accurate. See appendix.

Emergency Conditions Model Results/Output

The following tables illustrate the various flow rates and elapsed time (from the beginning of the storm) for the two Emergency

Condition models, which assume the on-site FSD ponds are full and the 100-year design storm is directed to the next downstream conveyance node and eventually the main Sand Creek Channel. One of the Emergency models assumes that Pond W3 functions as intended, while the other does not. In addition to the two emergency condition models, the two previous analyzed developed condition models were included. One of these being the developed condition model with all ponds functioning as intended the other assuming that all onsite FSD's function but Pond W3 was assumed to be full and flow diverted by that node.

Emergency Flow Condition (w/ Pond W3 functioning) vs. Developed Conditions Analysis (w/ Pond W3 functioning)

Design Point	Emerg. Condition (No FSD's w/Pond W3)		Developed Condition (w/FSD & w/Pond W3)	
	Flow (cfs)	Elapsed Time (hrs:min)	Flow (cfs)	Elapsed Time (hrs:min)
DP75	950.0	12:25	**950.0**	12:25
DP77	1467.2	12:35	**1467.7**	12:35
DP73	1485.9	12:35	**1506.7**	12:35
DP72	1501.4	12:40	**1518.6**	12:40
DP71	1543.4	12:40	**1612.2**	12:40
DP70	1539.7	12:45	**1636.7**	12:40
DP69	1654.1	12:45	**1775.7**	12:45
DP87	1739.7	12:50	**1905.9**	12:45
DP68	**1889.1**	12:50	**2204.1**	12:50
Pond W3	1397.6	13:10	1350.6	13:20
DP63	1418.2	13:15	1385.1	13:20
DP61	1602.3	12:30	1620.1	13:20
DP60A	1702.02	12:30	1661.8	13:20
DP53A	1710.7	12:35	1668.9	13:25

Emergency Flow Condition (w/o Pond W3) vs. Developed Conditions Analysis (w/o Pond W3)

Design Point	Emerg. Condition (No FSD's & No Pond W3)		Developed Condition (w FSD & w/o Pond W3)	
	Flow (cfs)	Elapsed Time (hrs:min)	Flow (cfs)	Elapsed Time (hrs:min)
DP75	950.0	12:25	950.0	12:25
DP77	1467.2	12:35	1467.7	12:35
DP73	1485.9	12:35	1506.7	12:35
DP72	1501.4	12:40	1518.6	12:40
DP71	1543.4	12:40	1612.2	12:40
DP70	1539.7	12:45	1637.7	12:40
DP69	1654.1	12:45	1775.7	12:45
DP87	1739.7	12:50	1905.9	12:45
DP68	1889.1	12:50	2204.1	12:50
DP63	**2022.6**	12:15	**2237.0**	12:55
DP61	2739.3	12:15	**2607.6**	12:55
DP60A	2912.2	12:20	**2645.0**	12:55
DP53A	2937.2	12:20	**2656.9**	13:005

The primary purpose of this analysis is two-fold. The first being to determine, in a cursory manner, if there is a potential failure scenario that significantly increases flood flows within the channel that might require additional preliminary planning to protect the developed property from emergency conditions; such as requiring additional set backs or additional floodplain freeboard. The second was to determine if it makes sense to submit revised hydrology as part of the CLOMR/LOMR process to lower the 100 year flow rates upon which to base the permanent channel improvements.

The analysis provided interesting results. The highest flow rates found within Sterling Ranch boundary (above DP 63) occur when the onsite FSD ponds function and the Pond at W3 is assume not to function. At a glance another caveat that may be taken from the data is that when the ponds function as intended the coincident of the local drainage and those conveyed within the channel appear not to diverge but rather more closely align.

Prior to the analysis, it was anticipated that the FEMA flow rate of ~2600cfs could be utilized as upper boundary flow rate to ensure public safety. From the analysis this appears to be a conservative approach for use in establishing the location of trail

systems and elevations upon which to establish property limits (when freeboard is added). Secondly it appears that there is significant variability across the Sterling Ranch property from which it may be beneficial to submit revised hydrology into FEMA as part of the CLOMR/LOMR process.

Reasonableness of Models

Based upon an analysis of the results, both the existing conditions and developed condition models appear to produce reasonable flow rates. Peak flow rates as a whole are down slightly from those produced by both the previous Wilson model and previous DBPS models, which seem reasonable given the revised models incorporation of lower CN values (which are attributed to rural developments and undeveloped properties) and the DCM recommendation to utilized the Type II storm distribution in lieu of the previously modeled Type IIA distribution.

As the nearest functioning stream gage for the watershed is located several miles downstream near Sand Creek Regional Detention Pond No. 1, two additional methodologies and an secondary (other than Sand Creek) published watershed study were analyzed to further evaluate the flow rates computed by the prepared HEC-HMS model.

Regression Equations

The first regression formula used as a comparison was taken from "The Analysis of the Magnitude and Frequency of Floods in Colorado," published in 2000 by the United State Geological Survey. A copy of a page from the publication containing the equation has been included in the appendix of the report. The 100 year equation which represents "Plains Regions" within the State of Colorado is as follows.

100- Year Storm Q = 1,640 * (Drainage Area) $^{0.388}$

The second regression formula evaluated was taken from the "Guidelines for Determining 100 year Flood Flows for Approximate Floodplains in Colorado." Version 6.0 published in 2004 by the US Colorado Water Conservations Board. The Northern Foothill Sub-Region equation was selected from the publication. This sub-region includes streams which are tributary to and east of the Monument Creek and Fountain Creek (downstream of Monument Creek) mainstreams. These tributary streams originate from the Black Forest/Palmer Divide area, the northeast portion of Colorado Springs, and the Black Squirrel Creek basin east of Colorado Springs. A copy of a page from the publication containing the equation has been included in the appendix of the report. The 100- year equation which represents "Northern Foothills Sub-Region" within the State of Colorado is as follows.

100- Year Storm Q = 1,343.4 * (Drainage Area) $^{0.578}$

The table below summarizes the comparison of the peak 100 year flow rates developed by the various model and regression equations, additional discussion of the results follows.

			2018 MS Civil Pre-Dev Model	2018 MS Civil Exist Cond. Model *		2018 MS Civil Prop. Cond. Model	2018 MS Civil Emergency Model **	1996 DBPS Exist Cond. Model		FEMA	USGS Re-gression Equation			CWCB Re-gression Equation		
Design Point ID	Approx.. Area (sq mi)	Approx. Area (acres)		Q100 (CFS)	CFS per Acre	Q100 (CFS)		Q100 (CFS)	% Diff Exist.		(CFS)	% Diff Exist.	% Prop.	(CFS)	% Diff Exist.	Diff Prop..
DP-73	2.52	1,613	1,548	1,582	0.98	1,507	1,507			2,600	2,347	148%	156%	2,292	145%	152%
DP-71	2.669	1,708	1,600	1,638	0.98	1,612	1,612			2,600	2,400	147%	149%	2,369	145%	147%
DP-69	3.209	2,054	1,838	1,870	0.91	1,776	1,776			2,600	2,578	138%	154%	2,636	141%	158%
DP-63*	3.446	2,205	1,870	1,912	0.87	1,385	2,237	2,508	131%	2,600	2,650	139%	149%	2,746	144%	155%
DP-60A*	3.545	2,269	1,870	1,914	0.84	1,662	2,645	2,629	137%	2,600	2,680	140%	161%	2,792	146%	168%
DP-53A*	4.138	2,648	2,001	2,062	0.78	1,669	2,656	3,225	156%		2,845	137%	170%	3,053	148%	183%

***All improvements in the Sand Creek Channel south of Sterling Ranch should be designed per the MS Civil Existing Conditions Model.**

** Highest Emergency Condition is proposed model with PNDW3 is full (bypassed)

For the 100 year return period, the USGS regression equation varied from 138% higher to 148% higher than M&S study computed existing flows and 149% to 170% higher than the Developed modeled flows. The variability to the modeled flow rates can be attributed to the following factors:

1) The equation is based on a limited number of gauging stations in the eastern plains, none of which are in the watershed or immediate general vicinity (the closest being Franktown Colorado).

2) The regression equations have a margin of error of 41% to 300% and thus may not be reliable. The study identified the plains region possessing the largest average standard errors of prediction.

3) The regression equations include only that the drainage area be utilized as a factor in determining a flow rates and do not take into account rainfall, basin shape, slope, soil type or vegetative cover.

The regression equation provided by the CWCB's Guidelines for Determining 100-Year Flood Flows for Approximate Floodplains in Colorado, varied from 141% higher to 148% higher than M&S study computed existing flows and 109% to 158% higher than the Developed modeled flows. The variability to the modeled flow rates can be attributed to the following factors:

1) The provided regression equation was developed using previous floodplain studies, not gauged data. It is unclear if any of the studies utilized are adjacent to the subject area, what physical characteristics of the studied watersheds were and what rainfall or storm distributions were utilized in the studies.

2) The study identified the Northern Foothills region possessing the largest average standard errors of prediction.

3) The regression equations include only that the drainage area be utilized as a factor in determining a flow rates and do not take into account rainfall, basin shape, slope, soil type or vegetative cover.

Other Basin Study

In addition to comparing to the regression equations provided above, the "Gieck Ranch Drainage Basin Planning Study," published in 2007, by Drexel, Barrell & Company, was also utilized as a comparison tool. The existing watershed which is located to the north and east of the City of Falcon possesses similar drainage characteristics to that of the existing evaluated watershed. A comparison of the two studied basin characteristic is as follows:

Existing Basin Condition Comparison												
	Basin Size	Basin Size	Basin Length	Upper Elev	Lower Elev	Dom. Soil	Veg. Cover	Dom. Basin	CN Value	% Imp	100 Yr Flow	Runoff/ Acre
Sterling Ranch MDDP	(Sq Mi)	(AC)	(Mi)	(Ft)	(Ft)	Types	Cond.	Slopes			(cfs)	(cfs/ac)
Upper Sand Creek	4.1	2,648	6.1	7,620	6,890	A&B	Fair-Good	1.0-8.0%	63	7	1,912	0.7
Gieck Ranch Basin												
Main Channel at Elbert Road	3.0	1,928	n/p	7,300	n/p	A&B	Fair	n/p	66	< 1	1,010	0.5
Confluence of East Fork & Main Channel	5.5	3,504	n/p	7,300	n/p	A&B	Fair	n/p	67	< 1	1,817	0.5
Gieck Ranch Basin (Overall)	22.05	14,111	15.0	7,300	6,100	A&B	Fair	0.5-5.0%	66	< 1	4,326	0.3

n/p = not provided

Sterling Ranch MDDP analyzed a Type II Storm Distribution

Gieck Ranch Basin analyzed a Type IIA Storm Distribution

For the 100 year return period, the Gieck Ranch Basin produced discharge between 0.3 and 0.5 cfs per acres in comparison to the subject basin's 0.7 cfs/acre. The variability to the modeled flow rates can be attributed to the following factors.

1) The Gieck Ranch Basins, as a whole, are slightly less impervious than the modeled watershed, which would typically result in a low discharge/acre.

2) The Gieck Ranch Basin Study utilizes a slightly higher CN value (66 vs 63) which would typically result in a higher discharge/acre.

3) The Gieck Ranch watershed has a slightly flatter topography (0.5-5% vs 0.5-8%) and appears to have slightly longer lag times (refer to GRDBPS existing conditions data), which would typically result in a low discharge/acre.

4) The Gieck Ranch Basin Study utilizes a Type IIA storm versus the subject analysis which utilizes a Type II Storm, which would typically result in a higher discharge/acre.

Although some variability exists between the methodologies utilized between the GRDBPS and the subject study, overall, the comparison basin possesses similar geographic features and correspondingly produced similar runoff per acre values.

Conclusions regarding modeling

As discussed, both the existing conditions and developed condition models provided by this report appear to produce reasonable results. Peak flow rates as a whole are down slightly from those produced by both the previous Wilson models and the DBPS model, which would seem reasonable given the revised models incorporation of lower CN values (which are attributed to rural developments and undeveloped properties) and the DCM recommendation to utilized the Type II storm distribution in lieu of the previously modeled Type IIA distribution.

SAND CREEK DBPS (SCDBPS) REIMBURSABLE IMPROVEMENTS VERSUS STERLING RANCH MDDP

DBPS Segment 159, & 164 (DBPS Pages 47-48, 50A) - Western Tributary to Sand Creek Channel

The existing swale is a western Tributary of the Sand Creek. The confluence of the tributary and the main stem exists within the Woodmen Heights master plan area, south of Sterling Ranch. These two existing channel segments are proposed in the DBPS as "Improved Riprap Channel, Bottom Width 25', Depth 3', Slope 1.2%, 3' Drops @ 270' intervals, Q100=600 cfs". The two Segments are divided by "Proposed Research Parkway" (currently relocated, and known as Marksheffel Road & Research Parkway) The crossing is shown in the DPBS as; 2-6'High x 9' Wide Concrete Box Culverts. The MDDP does not propose a CBC crossing of the western tributary for Research Parkway at this location. The tributary will be crossed by Sterling Ranch Road using a ~66" RCP.

The SCDBPS does not continue the analysis northerly through the existing industrial property, which does not account for flows from the west side of Vollmer Road. This MDDP, accounts for +300 acres of property on the west side of Vollmer Road that is tributary to Segment 159 & 164. The MDDP design uses RCP to convey the existing and developed storm water to Sand Creek, in lieu of Riprap channels. Furthermore, the MDDP proposes Pond W-5, at the southeast side of Segment 159, to provide detention and water quality prior to discharge in Sand Creek. (See Detention Section of this report for more information on Pond FSD6)

DBPS Segment 163, 187, 170 & 171 (DBPS Pages 49-53) - Mainstem Sand Creek Channel

The SCDBPS for Sand Creek channel within Sterling Ranch proposes check structures, select riprap linings and grade control structures to improve the existing channel. The DPBS also states;

"Areas within the exiting floodplain or the low flow zone of the drainageway where riparian or wetland vegetation exists shall be preserved in its existing cross section. Areas disturbed by the construction of drops, grade control, culverts, or channel bank linings shall be revegetated with native species."

The SCDBPS proposes two crossings of major roadways within Sterling Ranch. The southerly one is at "Proposed Research Parkway" (currently relocated and known as Marksheffel Road & Research Parkway), which is now shown on the approved Sketch Plan for Sterling Ranch as "Sterling Ranch Road". The second major crossing is at "Proposed Banning-Lewis Parkway" (Which is now shown on the approved Sketch Plan for Sterling Ranch as "Briargate Parkway"). Per the SCDBPS the southerly crossing is proposed as; 4-10' wide x 8' High Concrete Box Culverts. s) The northerly crossing of Brairgate Parkway is proposed as; 4-10' wide x 8' High concrete box culverts. Both these proposed crossings are shown in the SCDBPS as reimbursable bridges. A second crossing of "Research Parkway is shown on the SCDBPS (6'H x 8'W CBC) east of Sand Creek along the southern boundary of Sterling Ranch (6'H x 8'W CBC). This MDDP does not propose a CBC crossing for the eastern tributary for Research Parkway at this location.

The MDDP proposes to construct the Sand Creek main stem channel improvements as suggested by the SCDBPS and per current EPC criteria. The MDDP also proposes to construct the CBC box culverts under Sterling Ranch Road and Briargate Parkway. The final design of the Sand Creek channel and crossings will determine the total number and size of structures, drops, box culverts, etc...Refer to the detailed drainage discussion for preliminary size of the two crossing based upon the MDDP hydrology Calculations have been provided in the appendix.

Additional Reimbursable improvements along the Sand Creek Channel include, as shown in the SCDBPS are; Pond Outlet Structures (Segment 170 & 163). These structures and all others along Sand Creek will be re-analyzed in the final design stage.

DBPS Segment 186 & 169 (DBPS Pages 51-52) - Western Tributary to Sand Creek Channel

The existing swale is a western Tributary of the Sand Creek. The confluence of the tributary and the main stem exists within the Sterling Ranch master plan area. These two existing channel segments are proposed in the DBPS as "Improved Riprap Channel, Bottom Width 20', Depth 3', Slope 1.3%, 3' Drops @ 450' intervals, Q100=500 cfs" (Segment 186) and Improved Riprap Channel, Bottom Width 20', Depth 2', Slope 1.8%, 3' Drops, Q100=325 cfs" (Segment 169). The two Segments are divided by "Proposed Banning-Lewis Parkway" (currently known as Briargate Parkway). The crossing is shown in the DPBS as a; 6'High x 10' Wide Concrete Box Culverts. The MDDP does not propose a CBC crossing of Briargate Parkway at this location. The SCDBPS also shows a 60" CMP culvert across Vollmer Road at the terminus of Segment 169.

The SCDBPS does not continue the analysis northerly across Vollmer Road. This MDDP, accounts for +300 acres of property on the west side of Vollmer Road that is tributary to Segment 186 & 169. The MDDP design uses RCP to convey the existing and developed storm water to Sand Creek, in lieu of riprap channels. The flows north of Briargate Parkway (Segment 169) will be diverted along the northerly right-of-way of Briargate Parkway to Sand Creek. The flows south of Briargate Parkway (Segment 186) will be conveyed to Sand Creek through the proposed development. The MDDP proposes to install a 60" RCP culvert under Vollmer Road along with Headwalls and Wing Walls. The construction of these improvements will occur with the widening of Vollmer Road and the construction of the adjacent development at Sterling Ranch.

(Refer to MDDP for Sterling Ranch Filing Nos. 1 &2, and Final Drainage Report for Sterling Ranch Filing No. 1, approved January, 2018). Construction drawings for RCP to replace Segment 186 were approved as a part of Sterling Ranch Filing No. 1, approved, January, 2017.

DBPS Segment 92 (DBPS Page EF-34) - East Fork Tributary to Sand Creek Channel

The existing swale is a part of the Eastern Tributary of Sand Creek. The confluence of the tributary and the main stem exists several miles south of the Sterling Ranch master plan area. The existing channel segments are proposed in the DBPS as "Improved Riprap Channel, Bottom Width 15', Depth 3', select bank linings. (No other data was given) The Segment terminates at the southern boundary of Sterling Ranch at "Proposed Research Parkway", and continues southerly as Segment 84. These two Segments are divided by "Proposed Research Parkway" (currently shown on the approved Sketch Plan for Sterling Ranch as Banning-Lewis Parkway) The crossing is shown in the DPBS as a; 6'High x 10' Wide Concrete Box Culverts. The MDDP does not propose a CBC crossing of Banning-Lewis Parkway at this location.

The SCDBPS (Segment 92) does not continue the analysis more than a few thousand feet north of the south boundary of Sterling Ranch. This MDDP, accounts for +1,000 acres of property north of the DBPS studied area. The MDDP design uses RCP to convey the existing and developed storm water to the Eastern Tributary of Sand Creek, in lieu of Riprap channels. Furthermore, the MDDP proposes Pond FSD-E7, at the southeast corner of Sterling Ranch, to provide detention and water quality prior to discharge in Eastern Tributary Channel of Sand Creek. (See Detention Section of this report for more information on Pond FSD-E6).

Proposed Variations to SCDBPS for Reimbursement

The MDDP identifies regional improvements for Sterling Ranch and for existing land outside the limits of Sterling Ranch to the west, north & east. The SCDBPS limited study did not address these areas. Therefore, the MDDP requests that these regional public infrastructure components be reimbursable.

Sand Creek Regional Pond W3 north of Sterling Ranch Road (See Detention Pond Section of this report for more information regarding detention ponds). The purpose of this sub-regional on-line detention facility is to control storm water events to discharge at historic levels downstream of Sterling Ranch. Therefore, the storm water flows exiting Sterling Ranch and conveyed

into the Woodmen Heights development (City of Colorado Springs) to the south are consistent. The MDDP requests that the construction of this online sub-regional pond is reimbursable.

FSD Ponds - There will be multiple Full Spectrum Detention and Water Quality Ponds (FSD Ponds) located within the Sterling Ranch development. (One off-site pond is proposed west of Vollmer Road and north of Marksheffel Road) These ponds will control both existing off-site and on-site developed storm water. The MDDP requests that the Sterling Ranch FSD Ponds be reimbursable. These ponds will also control the discharge of storm water across the Sterling Ranch development which will reduce the size and cost of public storm pipe between the ponds and discharge into Sand Creek or the Eastern Tributary of Sand Creek.

Additional Culvert crossings of Vollmer Road - Additional culverts across Vollmer Road are required to convey the storm water from the west side to the east side. The existing Vollmer Road and roadside swales are inadequate to covey the 100-year storm. The culverts and improvements to Vollmer Road will drastically improve the current storm water public infrastructure. The culverts, FSD's, and downstream storm water pipe to convey these flows to Sand Creek will be requested to be reimbursable.

Un-named easterly tributary for the Sand Creek - A second crossing of "Research Parkway is shown on the SCDBPS east of Sand Creek along the southern boundary of Sterling Ranch (6'H x 8'W CBC). The MDDP does not propose a CBC crossing for the eastern tributary for Research Parkway at this location, because Research Parkway is no longer proposed along the southern boundary of Sterling Ranch. However, the tributary for this crossing was un-studied in the SCDBPS. The MDDP for Sterling proposed storm sewer pipe and open channel to convey the developed flows into the Sand Creek Channel. The existing flows rates will be reduced but remain present for the downstream properties. See Existing Basin section of this report. The MDDP request that this Un-named tributary be considered reimbursable.

CHANNEL IMPROVEMENTS

Per the Sand Creek DBPS, Sand Creek and connected tributaries in the area of the site will require improvements. The east and west tributary reaches within the site boundary will not require improvements because they will no longer be present, as development in the areas will eliminate them, and replace them with full spectrum detentions ponds and storm sewer systems which will collect and control the discharge into Sand Creek. The western tributary reach within the site boundary will require some improvements in some areas but will also be eliminated by development and replaced with large diameter storm sewer and Pond FSD6 (Pond W5), to control the discharge into Sand Creek. However, Sand Creek itself will continue to be routed through the development.

In the existing condition the main branch of Sand Creek Channel measures ~9,850 linear feet. The existing channel bed is heavily vegetated, with native grasses and slopes typically ranging from 0.50% - 4.0%, with an average slope of 1.6%. The existing side slopes typically range from 1:1 to 10:1, and are composed of native grasses and exposed sand stone. The channel contains 3 existing stock ponds.

Per the DBPS, Reach SC-9, the recommended improvements to the channel include selective rip rap linings, grade control check structures, and drop structure improvements that are anticipated to stabilize the channel to prevent further degradation, scour and meandering. Offline Full Spectrum Detention will reduce peak flows within the channel there-by added to the integrity of the Sand Creek Channel. With stabilization and improvements to the outlet work and overflow routing paths, the existing stock ponds will be preserved as amenities for the adjacent development.

The concept design of the channel will initially be based upon the FEMA flow rate of 2,600 cfs. This is a conservative flow to allow for planning of trails and developed lots. The calculated max flow as determined with this report is ~ 2,200 cfs. This flow number will be used for the analysis of a CLOMR/LOMR for the design of the channel improvements and submittal to FEMA. Coordination with FEMA and the Army Corps of Engineers will occur prior to the submittal of the design drawings for the channel improvements. The FEMA flow rates, DBPS flow rates and those calculated by this analysis are provided in the appendix.

HEC-RAS input and output files that model the developed peak 100 year flows across the existing channel (LOMR X Sections) has been provided in the appendix as a cursory evaluation of some of the short comings of the existing channel that will need to be address with the future improvements. Based upon the model output velocities and shear in the 100 year developed condition range from 3.9 fps to 27.0 fps and 0.2 lbs/sf to 14.9 lbs/sf with depths between 0.7’ and 8.0’ in depth. The proposed channel improvements as shown in the DBPS will function to arrest erosion caused by the developed runoff while minimizing impacts to the existing vegetation.
The data is for information purposes only and is not intended to be utilized in design.

Upstream and downstream channel improvements are proposed to be similar to what was anticipated in the SCDBPS. Check structures and rip-rap lining in some locations shall be installed to handle the increase in volume of flows from the full spectrum detention ponds. In the final design stage of development, the channels will be analyzed to verify the amount of improvements necessary. The existing culverts under Mustang Place are currently inadequate. They are recommended by the SCDBPS to be enlarged to 6'Hx8'W CBC. These culverts will be analyzed at the time of final design to determine the correct size in order to accommodate the developed flows, which will be discharged from Sterling Ranch less than historic.

Channel Improvements and Wetland Mitigation

Areas with the existing floodplain or the low flow zone of the drainage ways where riparian or wetland vegetation exists 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. Coordination with the Army Corp of Engineers for permitting of wetland modifications shall be approved before construction commences. It is anticipated that a CLOMR/LOMR will be processed with the final design of the Sand Creek Channel Improvements. All requirements required by the Army Corp of Engineers will be addressed for approval.

WATER QUALITY PROVISIONS

General

The water quality capture volume (WQCV) required for the site has been determined based on the guidelines as set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual – Volume II. The final outlet facilities will be designed as part of the final construction drawings for the site. *Refer to the Drainage Map for locations of contributing watershed basins.* Water quality calculations have been made for the contributing watershed to each of the FSD ponds and the open channel segment at the south end of the development. The entire contributing watershed to the Sterling Ranch development will be treated on site.

Final Design Considerations

There are numerous final design considerations that must be performed prior to construction. Noteworthy considerations/issues include water quality management, and wetland mitigation. Additional items include, outfall piping, outlet structures, maintenance requirements, embankment linings, freeboard, emergency overflow weirs, jurisdictional dam structure design, development phasing, interim staging to historic flows until the downstream facilities can be constructed, etc. A jurisdictional dam analysis will be studied and confirmed with the Division of Water Resources, Dam Safety branch, Office of the State Engineer, prior to final design of any detention structure. Possible design of pond outfall structures include; small circular pipe release with CBC overflow, full spectrum release with water quality screening and micro pool, CBC with a weir release, or a combination of the aforementioned structures.

Full Spectrum Detention

Detention design alternatives will be investigated with each phase of development to reduce impacts on Sand Creek or tributary, stream degradation and storm water quality. Design of a Full Spectrum release detention pond will be compared to the phased amount of developed flows entering the proposed ponds at any given phase of development. The developed flows entering the detention ponds will increase as development occurs and therefore the detention ponds outlet structures may need to be modified for certain phases of development. At no time is the total amount of the 100 year flow to exceed the preliminary designed flow rates per the SCDBPS or exiting/historic flows. Full Spectrum detention will be considered for the ultimate design build out of this development.

The intention of full spectrum detention per "Concept Paper, Peak Flow Control for Full Spectrum of Design Storms, by Jim Wulliman and Ben Urbonas", is to achieve peak flows close to pre-development conditions for the full spectrum of runoff events. Therefore, by closely matching the pre-development condition, geomorphic changes in the downstream channel is less likely. "*It is expected that degradation will occur at reduced rates and, possibly, to lesser levels if runoff volume and peak rate are kept closer to predevelopment conditions"*. Therefore, the scope of channel improvements as discussed will need to be investigated at the final design stage based upon the amount of flow during different phases of development. The proposed increase in volume downstream per the redirection of area to the east and west areas of the site, will be controlled by the FSD ponds, and should not adversely affect the downstream channels due to the 72 hour pond drain time. The proposed channel improvements in the SCDBPS are still valid; however, the timing and quantity/sizing of structures may be reduced. The final size of the Sterling Ranch and other offsite FSD Ponds will have to be determined based upon the intensity of development upstream of the proposed ponds.

MAINTENANCE

The proposed detention / SWQ facilities are proposed as privately owned and maintained by the Sterling Ranch Metropolitan District. After completion of construction and upon the Board of County Commissioners acceptance, the Sand Creek channel will be owned and maintained by El Paso County along with drainage facilities within the public Right of Way.

REGIONAL DETENTION FACILITIES

A single regional online, onsite detention facility (Pond W3), upstream of Sterling Ranch Road (at DP68), is recommended to aid in the controlling of the total runoff leaving Sterling Ranch. Although the development of Sterling Ranch will require the implementation and construction of several FSD ponds to mitigate increase runoff, the total amount of runoff reaching the Sand Creek Channel is greater than historic, due to the inter-basin transfer of drainage from East Fork of Sand Creek Watershed to Sand Creek Watershed. The roadway embankment, proximity to the southern boundary and the need for a culvert crossing at this location make the location practical. A separate design report for this facility will be necessary to verify the volumetric sizing requirements.

Prior to this analysis an online regional facility was also recommended within Sterling Ranch (on the Sand Creek Channel) upstream of Briargate Parkway at DP 69. The planned implementation of offline full spectrum detention for the developable ground up-gradient of this location will alleviate the need for this facility. The culvert crossing at this location will be sized in a manner that allows for the free discharge of flow thought the structure.

POND W3

It should be noted that after the initial run of the Proposed Condition Model, it was determined that the peak developed 100-year flow reaching the subject reach were higher than the 100-year existing condition flow rates and higher than the 100-year peak flows anticipated by the Wilson Study. To reduce the runoff, a detention facility has been added to the model upstream of Sterling Ranch Road within the Sterling Ranch Development. The incorporation of this facility when coupled with multiple Full Spectrum Detention facilities will allow the development upstream of the City/County boundary to release developed discharge at a rate this is at or below the current existing flow rates. It should be noted that the location of the facility was previously planned as a regional pond /park site in the Sterling Ranch 2010 MDDP (Draft) and Sketch Plan. Stage storage and stage volume worksheets are included in the attachments for this pond. It is anticipated that this facility can be designed without having to be jurisdiction in nature. Based upon preliminary modeling the pond will reduce 100 year peak runoff rates from 2204 to less than 1400 cfs. The pond will detain a maximum of 78 acre feet at a depth of around 10 feet. The pond embankment containing the 100 year event will be separate from Sterling Ranch Road. An exhibit detailing the concept design is provided in the appendix of this report. It is important to note that this pond will allow for the free discharge of the 2 year storm and is not intended to provide water quality and will meet the state statue regarding the allowable release times.

Design point 61 is located on the maps between Sand Creek Regional Detention Pond 3 and south boundary of Sterling Ranch just upstream of Mustang Road. Future development in the watershed should attempt to mimic the flow rates provided within the report with special consideration given to the flow at the City/County boundary line at Design Point 61. It should be noted that the hydrologic calculations contained in this memorandum are intended to aid in the design of the crossing structure at Marksheffel Road north of City Pond 3 (DP 60A) and as a planning resource to limit the amount of developed runoff discharged into the Sand Creek Channel. This report is not intended to be utilized for final design of stormwater storage facilities and infrastructure. It should also be noted, that this report did not include City Pond 3 in any of its models and was only used as a comparison point.

POND W4

Pond W4 is planned for the northwest corner of Marksheffel Road and Vollmer Road. The purpose of the pond is to provide some detention of stormwater flows for the land on the west side of Vollmer Road. Currently, no public stormwater improvements exist in the developments west of Vollmer Road. Therefore, Pond W4 will collect the flows on the west side, and convey to Sand Creek. These flows are discharged directly into sand creek, bypassing Pond W5. This facility does not provide water quality treatment for the existing developments. Pond W4 is sized to maximize the area located in a tract of Land dedicated by the Final Plat for Highland Park Filing No. 2 - Tract G. The detention area could potentially be enlarged in the future if more land is purchased, and available to enlarge the pond. The design of Pond W4 will accommodate the extension of Marksheffel Road / Research Parkway and will be furthered in subsequent drainage reports. The construction of Pond W4 facilitates "solves" an

existing drainage problem in the existing right-of-way of Vollmer Road. Pond W4 and its downstream facilities will be requested to be a reimbursable facility.

POND E7

Pond E7 will be required to at the southeast corner of Sterling Ranch to detain developed flows and release at or less than Historic. The pond is necessary and should be coordinated with downstream improvements accompanying the extension of Banning Lewis Parkway and property currently under the ownership of Norwood Development.

EXISTING UTILITIES – HIGH PRESSURE GAS PIPELINES

At the southwest corner of Sterling Ranch exists three high pressure gas/petroleum pipelines. There are two 20-inch diameter and one 6-inch diameter pipelines. Special care in design and coordination with the appropriate utility agency shall be made to ensure of safety. Also, at the southwest portion of the site exists a Colorado Springs Utilities gas distribution line that serves the Barbarick Subdivision. This gas line will likely be relocated in the proposed right-of-way of the southern proposed subdivision. However, it should be noted that the gas pipelines existed pre-development. Additional utilities are present, adjacent to the Vollmer right-of-way including telephone, fiber and cable. A 10-inch diameter Colorado Springs Utilities gas pipeline exists at the southwest corner of Sterling Ranch. This gas line is within a recorded 10-foot utility easement. Currently, he gas line is proposed to remain in place without relocation.

STERLING RANCH FILING NO. 1 - SUBDIVISION IMPROVEMENTS AGREEEMENT

Sterling Ranch Filing No. 1 final plat and SIA was recorded prior to the completion of this report. The aforementioned documents outlined drainage for Sterling Ranch in the following manner;

2. Drainage and Landscaping Tracts*: Improvements on Tracts A, B, F, H, I, J, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA and CC as identified on the final plat of Filing No. 1 will be completed to the satisfaction of the County and District and, upon said completion, the improvements will be dedicated to and accepted by the District. Improvements on Tract D (Sand Creek) will be completed to the satisfaction of the County and upon said completion; the improvements will be dedicated to and accepted by the County. The ownership and maintenance of storm drain facilities and structures not located on the foregoing tracts shall be determined as follows. All storm pipes shall be owned and maintained by the District except where located in County road rights of way (see Paragraph 5 below), in which case the County shall own and maintain the storm drain facilities and structures, including but not limited to, inlets and manholes. A typical cross section describing the ownership and maintenance responsibilities of drainage improvements within County rights of way is attached as Exhibit C hereto.*

7. Timing of Construction and Acceptance*:*

a. ***Drainage Improvements Not Located in Sand Creek Channel****: Except as set forth below in subsection 6.b. (drainage improvements located in Sand Creek Channel), all drainage improvements described in Exhibit A and constructed within the Drainage and Landscaping Tracts identified in paragraph 2 above shall be completed by the Subdivider and District, meeting all applicable standards for preliminary acceptance, prior to the recording of the first replat of Tracts C, E, G, K or BB. In the event that a portion of the drainage improvements are not completed prior to the recording of the first replat, then prior to such recording collateral sufficient in the opinion of the County to assure completion of the improvements must be posted by the Subdivider and a deadline by which such drainage improvements shall be completed shall be established by written agreement.*

b. ***Drainage Improvements Located in Sand Creek Channel (Tract D):*** *The District agrees that it will construct or cause the construction of all drainage improvements to be located in Tract D as well as future tracts within Sterling Ranch containing the Sand Creek Channel in accordance with the following:*

i. Bank stabilization of the Sand Creek channel shall be required prior to any replats or other final plats adjacent to the channel. The design and installation of said improvements shall be accomplished and guaranteed through the normal subdivision review and collateralization process.

ii. Other drainage improvements in Tract D and future tracts containing the Sand Creek Channel, such as drop structures, check structures and similar stabilization or protection improvements, will be designed and constructed by the District with the final construction drawings to be approved by the County no

later than the final platting of the 700th single family lot within the boundaries of the approved Sterling Ranch Sketch Plan and the completion of all said improvements no later than the 800th single family lot with the boundaries of the approved Sterling Ranch Sketch Plan.

iii. *In order to assure completion of the drainage improvements required in Subsection 6.b.ii above as well as a fair apportionment of the costs of said drainage improvements amongst adjacent Sterling Ranch subdividers, the District agrees to establish a Sand Creek Channel Drainage Fee to be paid into a District Escrow Fund by adjacent subdividers at the time of final platting. The amount of the fee shall be a minimum of One Thousand Dollars ($1,000.00) per single family lot. The details of the proposed Sand Creek Channel Drainage Fee and the District Escrow Fund shall be agreed to by the parties in advance of the submittal of the first replat of or subdivision of the Master Pad Sites or other property located within Sterling Ranch.*

A full copy of the recorded SIA is located in the files of El Paso County and EPC Clerk and Recorders office under Reception No. 218714151

SUMMARY

Sterling Ranch contains ~1444 gross acres, not including adjacent road rights-of-way, and approximately 50 acres within the Sand Creek 100-year floodplain. The development of the site will require drainage and detention facilities to accommodate developed flows and meet El Paso County Drainage Criteria. The proposed drainage facilities will adequately convey, detain and route runoff from the site to Sand Creek or existing off-site drainage swales. All onsite and offsite drainage facilities described herein and shown on the included drainage map are subject to change due to final design considerations. If any variances of the El Paso County criteria are proposed at the time of future drainage reports or design, a deviation request must be submitted to El Paso County for approval. The drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual. **The development of Sterling Ranch will not adversely affect downstream facilities or property**. Supporting information and calculations are included in the Appendix.

REFERENCES

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs and El Paso County "Drainage Criteria Manual", October 1987, revised November 1991.

2. Soil Survey for El Paso County, Colorado, U.S. Department of Agriculture, Soil Conservation Service, June 1980.

3. Drainage Basin Planning Study for the Sand Creek Drainage Basin, Preliminary Design Report, January 1993, prepared by Kiowa Engineering Corporation, Revised March 1996.

4. Preliminary and Final Drainage Report, Barbarick Subdivision, A Replat of Lot "D", McClintock Subdivision, El Paso County, Revised August 15, 2007, prepared by Oliver E. Watts, Consulting Engineer, Inc.

5. Concept Paper – "Peak Flow Control for Full Spectrum of Design Storms", written by Jim Wulliman, P.E., Muller Engineering Company, Lakewood, CO, and Ben Urbonas, P.E., Urban Drainage & Flood Control District, Denver, CO, January 1, 2005.

6. Concept Paper – "Full Spectrum Detention to Control Stormwater Runoff", written by Jim Wulliman, P.E., Muller Engineering Company, Lakewood, CO, and Ben Urbonas, P.E., Urban Drainage & Flood Control District, Denver, CO, 2007.

7. Urban Storm Drainage Criteria Manual, Volumes 1 & 2, Urban Drainage and Flood Control District, Denver Colorado.

8. Urban Storm Drainage Criteria Manual, Volume 3 – Best Management Practices, Urban Drainage and Flood Control District, Denver, Colorado.

9. Urban Drainage and Flood Control District Website; http://www.udfcd.org/downloads/down_software.htm, Excel Spreadsheets Download, Detention Design - UD-Detention v2.2, Jan-2010 (XLS, 555 KB)

10. Master Development Drainage for Woodmen Heights Master Plan, prepared by Classic Consulting Engineers and Surveyors, June 2004.

11. Master Development Drainage Plan Update for Woodmen Heights and Final Drainage Report for Forest Meadows Filing No. 1 and No.4, M&S Civil Consultants, 2006

12. Gieck Ranch DBPS, Volume 1, Final Report, Drexel, Barrell & Co, 2007

13. Master Development Drainage Plan for The Woodmen Heights Commercial Center, Matrix 2009.

14. Master Development Drainage Plan and Final Drainage Report for Shiloh Mesa & Shiloh Mesa Filing No.l, M&S Civil Consultants, 2015

15. Preliminary Drainage Report for Sterling Ranch - Phase I, prepared by M&S Civil Consultants, May 2015

16. Draft Sterling Ranch Filing No. 1 - Final Drainage Report, 2016

17. Preliminary Bridge Design, Marksheffel Road at Sand Creek, prepared by Kiowa Engineering Corporation, dated 2014.

18. Woodmen Heights Business Park, prepared by M&S Civil Consultants, dated 2014.

19. Shiloh Mesa Filing No. 1 - Marksheffel Interim Roadway Plans, prepared by M&S Civil Consultants, 2015

APPENDIX

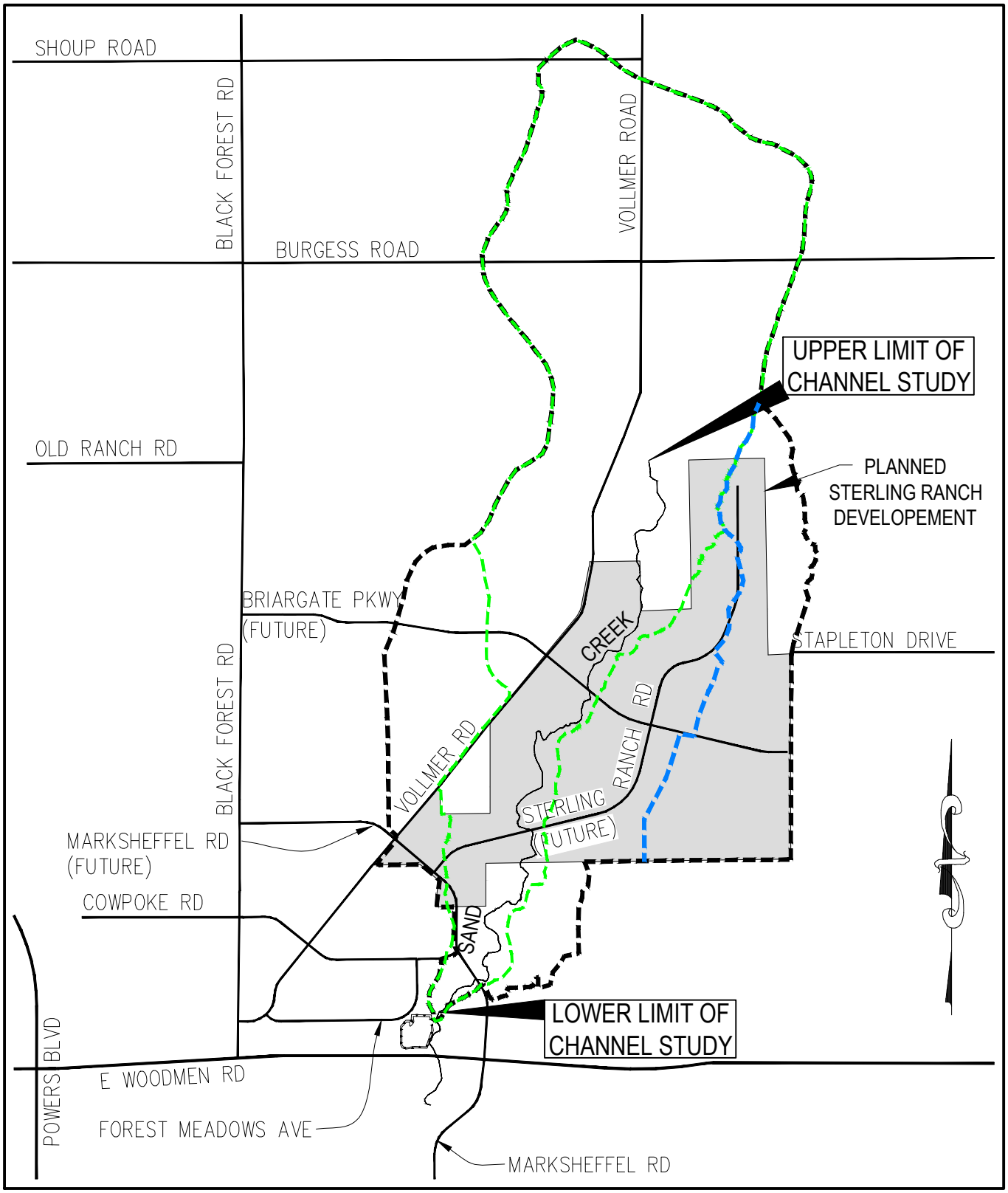
Section A.

Vicinity Map

Aerial Map

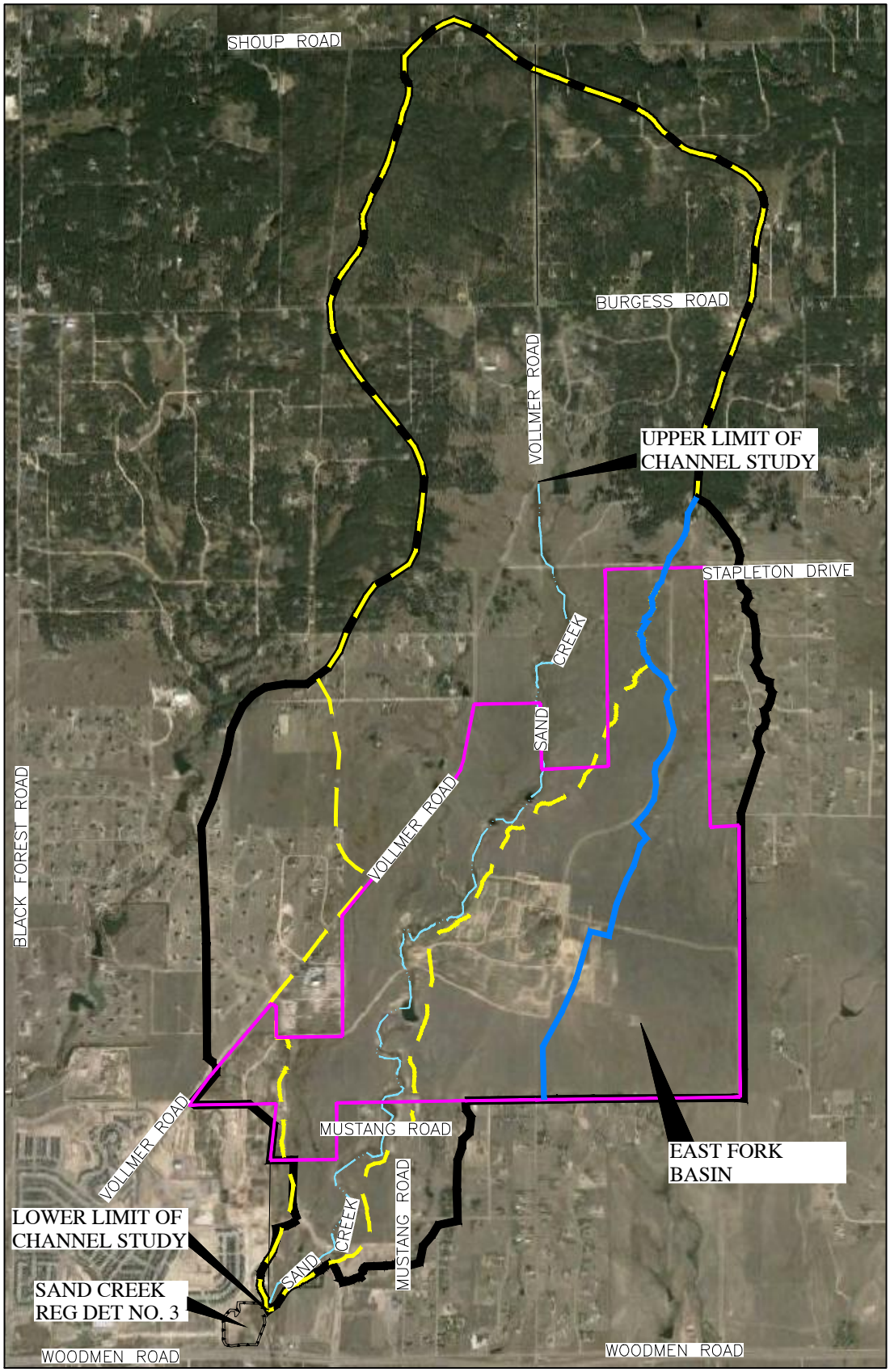
Soils Map

Sterling Ranch Sketch Plan Map



VICINITY MAP

N.T.S.



1" = 2500'

EXISTING CONDITIONS WATERSHED

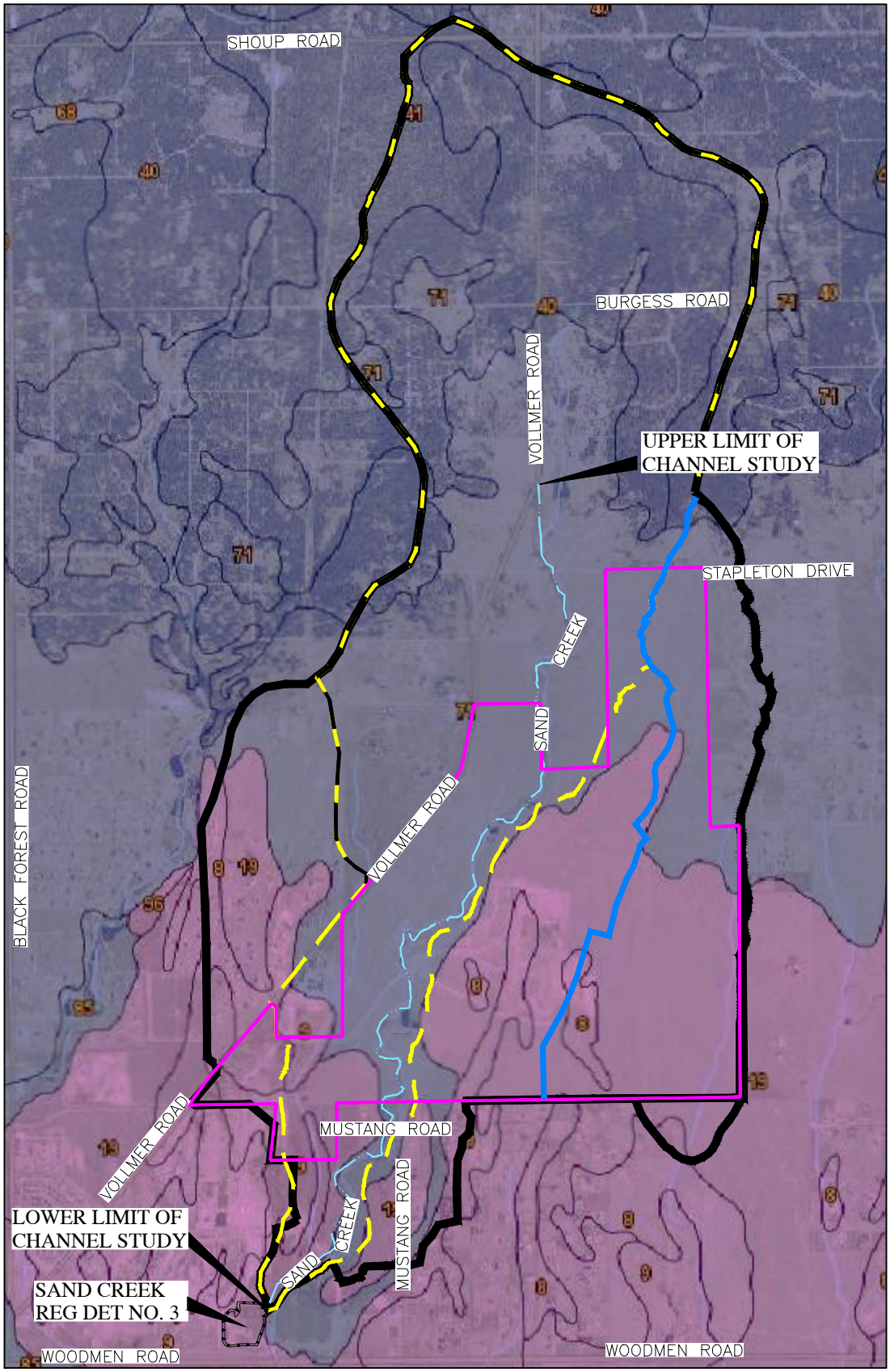
PROPOSED CONDITIONS WATERSHED

STERLING RANCH PROPERTY LIMITS

SAND CREEK/ EAST FORK BASIN BOUNDARY

STERLING RANCH MDDP
HYDROLOGIC ANALYSIS
AERIAL MAP

M&S CIVIL CONSULTANTS, INC.



1" = 2500'

HYDROLOGIC TYPE A SOILS

HYDROLOGIC TYPE B SOILS

EXISTING CONDITIONS WATERSHED

PROPOSED CONDITIONS WATERSHED

STERLING RANCH PROPERTY BNDRY

SAND CREEK/EAST FORK BASIN BOUNDARY

SUMMARY BY MAP UNIT – EL PASO COUNTY AREA COLORADO (CO625)		
MAP UNIT SYMBOL	MAP UNIT NAME	RATING
8	BLAKELAND LOAMY SAND, 1 TO 9 PERCENT SLOPES	A
9	BLAKELAND–FLUVAQUENTIC HAPLAQUOLLS	A
19	COLUMBINE GRAVELLY SANDY LOAM, 3 TO 8 PERCENT SLOPES	A
40	KETTLE GRAVELLY LOAMY SAND, 3 TO 8 PERCENT SLOPES	B
41	KETTLE GRAVELLY LOAMY SAND, 8 TO 40 PERCENT SLOPES	B
71	PRING COARSE SANDY LOAM, 3 TO 8 PERCENT SLOPES	B

STERLING RANCH MDDP

SOILS MAP

M&S CIVIL CONSULTANTS, INC.

LAND USE LEGEND:

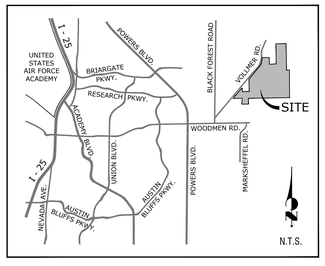
	44 AC. RESIDENTIAL: 0.2 DU/AC,	9 D.U.
	33 AC. RESIDENTIAL: 0.4 DU/AC,	13 D.U.
	35 AC. RESIDENTIAL: 1 DU/AC,	35 D.U.
	163 AC. RESIDENTIAL: 2 DU/AC,	326 D.U.
	557 AC. RESIDENTIAL: 3-5 DU/AC,	2,366 D.U.
	19 AC. RESIDENTIAL: 5-8 DU/AC,	140 D.U.
	257 AC. RESIDENTIAL: 5-8 DU/AC ACTIVE ADULT,	1,325 D.U.
	32 AC. RESIDENTIAL: 8-12 DU/AC,	320 D.U.
	40 AC. RESIDENTIAL: 12-20 DU/AC,	691 D.U.
	50 AC. COMMERCIAL	
	57 AC. ELEMENTARY / K-8 SCHOOL	
	18 AC. NEIGHBORHOOD PARK	
	30 AC. COMMUNITY PARK	
	57 AC. OPEN SPACE / PARK / GREENWAY	
	43 AC. OPEN SPACE / BUFFER	
	9 AC. UTILITY PARCEL	

TOTAL: 1,444 AC. TOTAL: 5,225 D.U. Max

SYMBOL LEGEND:

- ROAD
- FULL MOVEMENT ACCESS POINT
- 100-YEAR FLOODPLAIN
- TRAIL
- BUFFER / OS TRAIL CORRIDOR / EASEMENT
- NEIGHBORHOOD PARK
- X,XXX' ACCESS SPACING (FEET)

VICINITY MAP:



LEGAL DESCRIPTION:

THE WEST HALF OF THE WEST HALF OF THE EAST HALF AND EAST HALF OF THE WEST HALF AND THE SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 27; THE EAST HALF OF THE SOUTHEAST QUARTER AND THAT PORTION OF THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER LYING SOUTH AND EAST OF THE COUNTY ROAD KNOWN AS VOLLMER ROAD, OF SECTION 28; THE WEST HALF OF THE EAST HALF AND THE WEST HALF OF SECTION 34; THE EAST HALF AND THE EAST HALF OF THE SOUTHWEST QUARTER AND THE SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 33, AND ALL THAT PART OF THE NORTHWEST QUARTER OF SECTION 33 LYING SOUTH AND EAST OF THE COUNTY ROAD KNOWN AS VOLLMER ROAD, EXCEPT THAT PORTION OF THE SOUTHWEST QUARTER OF THE NORTHWEST QUARTER OF SAID SECTION 33 LYING SOUTH AND EAST OF SAID COUNTY ROAD AS DEEDED TO COLORADO INTERSTATE GAS COMPANY BY WARRANTY DEED RECORDED IN BOOK 1173 AT PAGE 359; AND THAT PORTION OF THE NORTHEAST QUARTER OF THE SOUTHEAST QUARTER AND THE SOUTHEAST QUARTER OF THE SOUTHEAST QUARTER LYING SOUTHEAST OF THE COUNTY ROAD KNOWN AS VOLLMER ROAD, OF SECTION 32, EXCEPT THAT PORTION OF THE NORTHEAST QUARTER OF THE SOUTHEAST QUARTER OF SAID SECTION 32 DEEDED TO J. MARCUS BROWN BY TRUSTEES' DEED RECORDED IN BOOK 3292 AT PAGE 168; ALL IN TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M., EL PASO COUNTY, COLORADO. ALL THAT PORTION OF THE NORTHWEST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 28, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M., EL PASO COUNTY, COLORADO LYING SOUTH AND EAST OF THE COUNTY ROAD (VOLLMER ROAD), ALSO: THE NORTHWEST QUARTER OF THE NORTHWEST QUARTER OF SECTION 4, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, LYING SOUTHERLY OF AN EXISTING EAST- WEST FENCE AS DESCRIBED IN SPECIAL WARRANTY DEED RECORDED DECEMBER 23, 2004 AT RECEPTION NO. 204209417, COUNTY OF EL PASO, STATE OF COLORADO, ALSO: THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 32, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M., LYING SOUTHEASTERLY OF THE PUBLIC ROAD KNOWN AS VOLLMER ROAD, EL PASO COUNTY, COLORADO, AND CONTAINING 1443.695 ACRES MORE OR LESS.

NOTES:

1. ~~MTCP, CCP, & PROPOSED CLASSIFICATION AND ROW DATA IS FOUND ON PAGE 16 OF THE 2008 SKETCH PLAN DOCUMENT~~

1. NO SCHOOL SITES ARE SHOWN IN THE ACTIVE ADULT COMMUNITY DUE TO THE NATURE OF THE USE. IF THIS USE CHANGES, OR SCHOOL-AGE CHILDREN OCCUPY THESE UNITS, SCHOOL DEDICATION WILL BE MADE.

OWNER & DEVELOPER INFO:

SR LAND, LLC.
20 BOULDER CRESCENT STREET, SUITE 102
COLORADO SPRINGS, CO 80903-3300

CHALLENGER COMMUNITIES, LLC.
8605 EXPLORER DRIVE, SUITE 250
COLORADO SPRINGS, CO 80920-1013

MORLEY BENTLEY/TRADER VICS INVESTMENTS LLC.
P.O. BOX 217
GALENA, KS 66739-0217

Overall Development Dwelling Unit Table

	HOMESTEAD FILING 1 SF-04-029	BRANDING IRON FILING 1 SF-06-017	TOTAL ENTITLED UNITS	REMAINING DEVELOPABLE UNITS	MAXIMUM DWELLING UNITS
DWELLING UNITS	72	51	123	5,102	5,225

ROAD CLASSIFICATION TABLE

Roadway	Existing	2040 MTCP	2060 MTCP/CPP	Sterling Ranch Proposed
Vollmer Road	2 lane Collector - 60'	4 lane Minor - 100'	4 lane Minor - 100'	4 lane Minor - 100'
Briargate Parkway	4 lane Principal - 160'	4 lane Principal - 130'	4 lane Principal - 130'	4 lane Principal - 130'
Banning Lewis Ranch Parkway		4 lane Principal - 130'	4 lane Principal - 130'	4 lane Principal - 130'
Marksheffel Road	2 lane Principal -	4 lane Principal - 130'	4 lane Principal - 130'	4 lane Principal - 106'

Land Planning
Landscape Architecture
Urban Design

NES

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Fax 719.471.0267

www.nescolorado.com

STERLING RANCH

SKETCH PLAN

MORLEY-BENTLEY
INVESTMENTS, LLC.

PROJECT INFO

DATE: OCTOBER 29, 2007
PROJECT MGR: J.MAYNARD/J.ROMERO
PREPARED BY: J.KUHNEL/M.SWIFT

SEAL

AMENDMENT

ISSUE INFO

DATE:	BY:	DESCRIPTION:
04-10-2008	JLK	COUNTY COMMENTS
04-30-2008	JLK	COUNTY COMMENTS
05-22-2008	JLK	COUNTY COMMENTS
10-13-2008	JLK	AMENDED SKETCH PLAN PER COUNTY COMMENTS
10-29-2008	JLK	AMENDED SKETCH PLAN PER COUNTY COMMENTS
05-22-2009	JLK	APPROVED SKETCH PLAN PER COUNTY - NOV. 2008
07-12-2018	MS	AMENDMENT
10-25-2018	BI	COUNTY COMMENTS

ISSUE/REVISION

SHEET TITLE

SHEET NUMBER

1
OF 1

PLAN FILE #

SKP 07-007

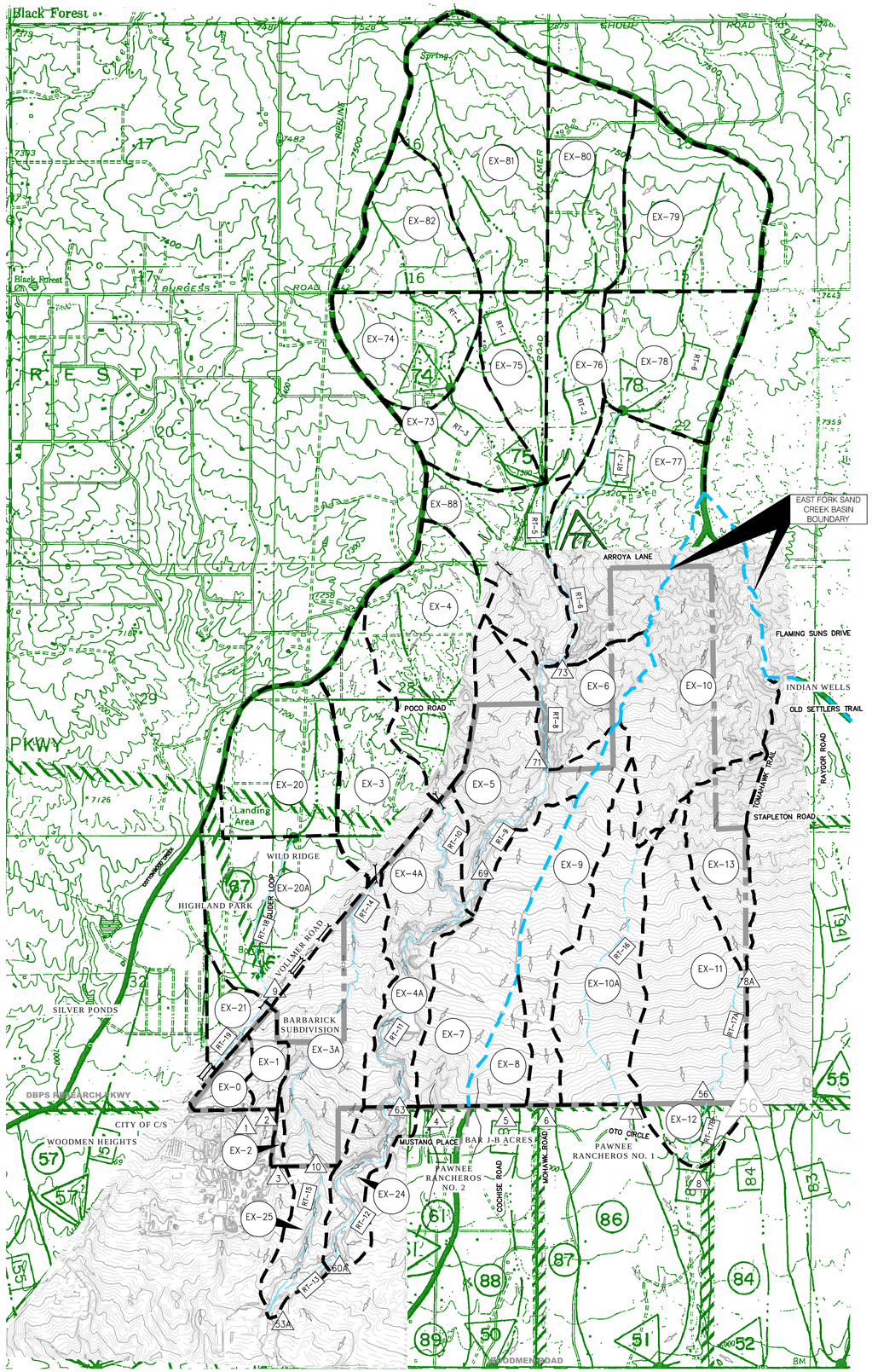
P:\Morley\Sterling Ranch\ Sketch Plan\Drawings\Planning\MP\SP_Amend_rev0618_2018.dwg | 22x42 ISO | 10/25/2018 | 11:19:48 PM | bbain

Section B.

Existing Hydrologic Conditions Map

Developed Hydrologic Conditions Map

Design Point Flow Rate Comparison



0 600 1200 2400

Scale in Feet

LEGEND

BASIN ID – SC3–77

DESIGN POINT – 87

REACH IDENTIFIER – RT–17A

BASIN BOUNDARY –

EAST FORK SAND CREEK BASIN BOUNDARY –

FLOW DIRECTION –

BASIN SUMMARY

BASIN	CN	AREA (ACRES)	AREA (SQ MI)	Q_2 (CFS)	Q_5 (CFS)	Q_{10} (CFS)	Q_{25} (CFS)	Q_{50} (CFS)	Q_{100} (CFS)
EX–0	62	23.8	0.037	5.0	8.2	13.0	19.6	25.7	32.2
EX–1	62	25.7	0.040	4.8	7.9	12.4	18.7	24.5	30.9
EX–2	62	5.5	0.009	1.1	1.8	2.8	4.3	5.6	7.1
EX–3	62	136.8	0.214	22.0	36.4	57.6	86.9	114.0	143.1
EX–3A	61	188.1	0.294	28.3	47.4	75.7	115.1	152.2	192.6
EX–4	62	192.0	0.300	30.1	49.9	79.1	119.5	157.0	197.3
EX–4A	62	151.5	0.237	24.7	40.8	64.4	97.0	127.2	160.1
EX–5	62	153.9	0.240	24.2	40.0	63.4	95.9	125.9	158.2
EX–6	62	90.2	0.141	15.3	25.5	40.1	60.7	79.9	100.5
EX–7	56	165.0	0.258	11.6	21.5	37.5	60.9	83.1	107.4
EX–8	45	42.0	0.066	0.5	1.7	4.5	9.4	14.5	20.5
EX–9	54	131.9	0.206	12.2	23.9	43.1	70.9	97.0	125.2
EX–10	60	270.7	0.423	32.7	56.0	91.1	140.1	185.9	236.1
EX–10A	41	179.3	0.280	0.6	2.2	7.3	17.4	29.1	43.1
EX–11	43	209.3	0.327	18.0	29.8	47.7	73.4	98.3	126.1
EX–12	51	39.5	0.062	2.2	5.1	10.1	17.7	25.1	33.3
EX–13	55	89.3	0.139	7.7	15.2	27.1	44.2	60.5	78.4
EX–20	62	143.4	0.224	25.4	42.1	66.7	100.7	132.3	166.2
EX–20A	64	179.7	0.281	32.2	51.9	80.5	119.8	155.9	194.6
EX–21	65	33.3	0.052	8.6	13.5	20.7	30.5	39.4	49.0
EX–24	59	63.1	0.099	9.5	16.6	27.5	42.9	57.4	73.0
EX–25	43	54.4	0.085	0.3	1.5	4.8	10.7	17.2	25.1
EX–73	63	90.0	0.141	16.4	26.4	41.3	62.1	81.3	102.0
EX–74	63	119.7	0.187	22.3	36.5	57.3	85.9	112.3	140.7
EX–75	63	79.3	0.124	13.1	21.5	33.7	50.5	66.1	82.8
EX–76	63	86.4	0.135	14.2	23.1	36.4	54.6	71.4	89.6
EX–77	62	230.6	0.360	34.7	56.9	90.6	137.5	180.9	227.7
EX–78	63	155.6	0.243	28.1	45.3	70.6	106.2	139.1	174.5
EX–79	63	189.0	0.295	34.9	57.0	89.5	134.3	175.6	220.1
EX–80	63	147.7	0.231	27.3	44.3	69.6	104.5	136.8	171.4
EX–81	62	262.9	0.411	42.6	70.2	111.0	167.4	219.6	275.7
EX–82	62	117.8	0.184	20.0	33.2	52.8	80.0	105.1	132.3
EX–88	62	139.2	0.217	22.2	36.7	58.0	87.6	115.0	144.4

DESIGN POINT SUMMARY (PEAK FLOW)

DESIGN POINT	AREA (SQ MI)	Q_2 (CFS)	Q_5 (CFS)	Q_{10} (CFS)	Q_{25} (CFS)	Q_{50} (CFS)	Q_{100} (CFS)	LOCATION
DP–74	0.371	39.3	65.3	104.8	158.9	209.1	262.8	
DP–75	1.413	141.2	235.1	376.6	566.6	750.9	950.5	
DP–78	0.538	59.7	98.4	154.0	232.6	306.2	385.3	
DP–73	2.528	225.9	380.7	618.0	957.0	1260.4	1582.3	
DP–71	2.669	229.3	388.9	629.7	978.8	1277.3	1637.9	STERLING RANCH NORTHERN BNDRY
DP–69	3.209	253.0	434.8	707.7	1100.0	1453.3	1870.4	
DP–63	3.446	251.4	430.7	713.1	1113.2	1496.2	1911.5	STERLING RANCH SOUTHERN BNDRY
DP–10	0.508	36.5	56.0	106.4	162.9	220.6	287.2	COLORADO SPRINGS/EL PASO BNDRY
DP–9A	0.557	55.3	94.3	150.3	227.7	299.5	380.5	VOLLMER/TAHITI DRIVE
DP–9	0.505	52.8	88.8	142.1	214.2	281.0	351.4	VOLLMER/LOCHWINNOCH LN
DP–8A	0.139	7.7	15.2	27.1	44.2	60.5	78.4	D/S STERLING RANCH EASTERN BNDRY
DP–8	0.528	24.2	45.1	77.8	124.4	169.5	220.9	D/S STERLING RANCH SOUTHERN BNDRY
DP–7	0.703	32.4	57.1	97.3	156.1	213.8	277.9	STERLING RANCH SOUTHERN BNDRY
DP–6	0.206	12.2	23.9	43.1	70.9	97.0	125.2	STERLING RANCH SOUTHERN BNDRY
DP–5	0.066	0.5	1.7	4.5	9.4	14.5	20.5	STERLING RANCH SOUTHERN BNDRY
DP–4	0.258	11.6	21.5	37.5	60.9	83.1	107.4	STERLING RANCH SOUTHERN BNDRY
DP–3	0.009	1.1	1.8	2.8	4.3	5.6	7.1	STERLING RANCH SOUTHERN BNDRY
DP–2	0.040	4.8	7.9	12.4	18.7	24.5	30.9	STERLING RANCH SOUTHERN BNDRY
DP–1	0.037	5.0	8.2	13.0	19.6	25.7	32.2	STERLING RANCH SOUTHERN BNDRY
DP–60A	3.545	247.7	430.2	707.1	1113.0	1496.6	1913.5	FUTURE MARKSHEFFEL X–ING
DP–56	0.466	23.2	42.5	71.9	115.6	157.4	202.9	STERLING RANCH SOUTHERN BNDRY
DP–53A	4.138	262.1	454.0	763.2	1196.5	1609.8	2061.5	SAND CREEK AND POND 3

DESIGN POINT SUMMARY (VOLUME)

DESIGN POINT	AREA (SQ MI)	V_2 (AC–FT)	V_5 (AC–FT)	V_{10} (AC–FT)	V_{25} (AC–FT)	V_{50} (AC–FT)	V_{100} (AC–FT)	LOCATION
DP–74	0.371	5.9	9.0	13.6	19.8	25.5	31.6	
DP–75	1.413	22.7	34.5	51.7	75.4	97.1	120.5	
DP–78	0.538	8.9	13.5	20.1	29.3	37.7	46.7	
DP–73	2.528	40.4	61.5	92.1	134.3	173.1	214.9	
DP–71	2.669	42.5	64.9	97.1	141.6	182.5	226.6	STERLING RANCH NORTHERN BNDRY
DP–69	3.209	50.7	77.4	116.1	169.4	218.6	271.4	
DP–63	3.446	54.1	82.5	123.8	180.8	233.3	289.9	STERLING RANCH SOUTHERN BNDRY
DP–10	0.508	7.6	11.7	17.6	25.8	33.4	41.6	COLORADO SPRINGS/EL PASO BNDRY
DP–9A	0.557	9.3	14.1	21.1	30.7	39.4	48.8	VOLLMER/TAHITI DRIVE
DP–9	0.505	8.4	12.7	19.0	27.6	35.5	44.0	VOLLMER/LOCHWINNOCH LN
DP–8A	0.139	1.3	2.1	3.4	5.2	7.0	8.9	D/S STERLING RANCH EASTERN BNDRY
DP–8	0.528	4.4	7.0	11.1	16.8	22.3	28.4	D/S STERLING RANCH SOUTHERN BNDRY
DP–7	0.703	6.1	10.0	15.9	24.3	32.4	41.3	STERLING RANCH SOUTHERN BNDRY
DP–6	0.206	2.4	4.0	6.3	9.6	12.7	16.0	STERLING RANCH SOUTHERN BNDRY
DP–5	0.066	0.2	0.4	0.8	1.4	1.9	2.6	STERLING RANCH SOUTHERN BNDRY
DP–4	0.258	2.6	4.2	6.7	10.2	13.5	17.2	STERLING RANCH SOUTHERN BNDRY
DP–3	0.009	0.1	0.2	0.3	0.5	0.6	0.8	STERLING RANCH SOUTHERN BNDRY
DP–2	0.040	0.6	0.9	1.4	2.1	2.7	3.4	STERLING RANCH SOUTHERN BNDRY
DP–1	0.037	0.6	0.9	1.3	1.9	2.5	3.1	STERLING RANCH SOUTHERN BNDRY
DP–60A	3.545	55.3	84.4	126.4	184.8	238.5	296.6	FUTURE MARKSHEFFEL X–ING
DP–56	0.466	4.0	6.3	9.9	14.9	19.8	25.1	SAND CREEK AND POND 3
DP–53A	4.138	63.0	96.4	144.7	211.8	273.9	340.9	SAND CREEK AND POND 3

EFSC DBPS DESIGN POINT SUMMARY (PEAK FLOW)

DBPS DESIGN POINT	AREA (SQ MI)	Q_{10} (CFS)	Q_{100} (CFS)
DP–50	0.32	47.0	195.7
DP–51 (BASIN 86)	0.33	17.7	74.1
DP–52	1.67	80.5	456.5
DP–56	0.79	63.6	265.0

Values reported from SCDBPS
(DP 50, 51, 52 Not analyzed as a part of this study)
DBPS Reach 85(Basin91)=Q10=28.8cfs Q100=115.2cfs

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2018 STERLING RANCH MDDP

EXISTING HYDROLOGIC CONDITIONS MAP

PROJECT NO. 09–002
FILE: \dwg\Eng Exhibits\2018–MDDP–ExistCondWSWrkMap.dwg
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS
SCALE
HORIZ: NTS
VERT: NTS
DATE: 08–22–18

DM1

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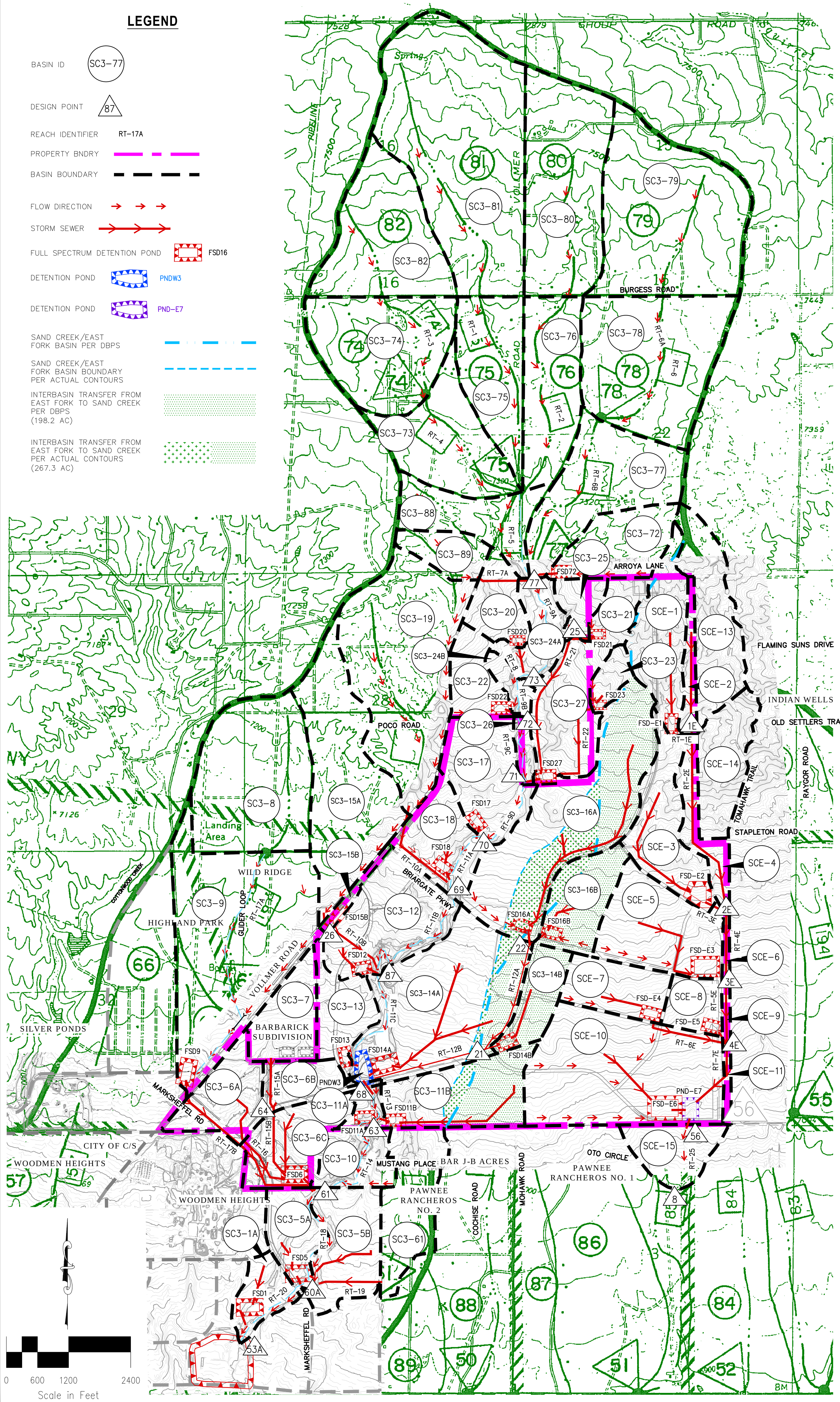

BASIN SUMMARY

BASIN	CN	AREA (ACRES)	AREA (SQ MI)	Q_2 (CFS)	Q_5 (CFS)	Q_{10} (CFS)	Q_{25} (CFS)	Q_{50} (CFS)	Q_{100} (CFS)
SC3-1A	73	27.8	0.044	16.3	23.3	33.0	45.8	57.1	68.9
SC3-5A	84	39.1	0.061	40.6	53.7	71.0	92.4	110.6	129.1
SC3-5B	81	63.0	0.098	53.8	73.0	98.5	130.8	158.6	187.0
SC3-6A	88	49.3	0.077	61.4	79.3	102.2	130.1	153.6	177.1
SC3-6B	85	30.9	0.048	32.9	43.4	57.0	73.9	88.2	102.7
SC3-6C	82	58.0	0.091	53.9	72.5	97.1	128.0	154.5	181.5
SC3-7	88	45.7	0.071	54.0	69.9	90.3	115.2	136.2	157.2
SC3-8	62	143.4	0.224	25.4	42.1	66.7	100.7	132.3	166.2
SC3-9	66	217.4	0.340	45.8	71.5	108.6	158.9	204.9	254.0
SC3-10	63	36.0	0.056	7.6	12.3	19.4	29.1	38.0	47.7
SC3-11A	70	10.7	0.017	5.3	7.8	11.3	15.9	20.0	24.3
SC3-11B	80	76.6	0.120	59.4	81.3	110.8	148.1	180.5	213.7
SC3-12	81	88.2	0.138	77.8	105.6	142.5	189.1	229.1	270.0
SC3-13	85	41.0	0.064	43.9	57.8	76.0	98.5	117.6	136.9
SC3-14A	79	164.9	0.258	127.6	175.4	239.8	321.9	393.2	466.3
SC3-14B	77	34.7	0.054	24.6	34.3	47.4	64.2	79.0	94.1
SC3-15A	62	139.7	0.218	21.3	35.5	56.3	85.3	112.1	141.0
SC3-15B	87	7.9	0.012	10.8	14.0	18.2	23.3	27.6	31.9
SC3-16A	74	168.1	0.263	84.4	120.4	170.0	234.8	292.2	351.8
SC3-16B	78	50.7	0.079	39.0	53.7	73.6	99.0	121.1	143.8
SC3-17	73	70.6	0.110	41.8	59.6	85.2	119.0	149.1	180.6
SC3-18	81	53.8	0.084	49.3	67.1	91.0	121.2	147.3	174.0
SC3-19	62	184.0	0.287	28.8	47.7	75.7	114.4	150.2	188.8
SC3-20	65	34.2	0.053	9.9	15.5	23.8	35.1	45.5	56.6
SC3-21	66	23.3	0.036	7.0	10.8	16.3	23.7	30.4	37.5
SC3-22	65	33.9	0.053	9.4	14.8	22.5	32.9	42.5	52.6
SC3-23	67	14.5	0.023	5.5	8.3	12.4	18.0	23.0	28.4
SC3-24A	65	35.7	0.056	13.0	20.4	31.1	45.7	59.0	73.2
SC3-24B	65	12.2	0.019	3.4	5.3	8.1	11.8	15.2	18.9
SC3-25	66	19.0	0.030	5.8	8.9	13.4	19.5	25.1	31.0
SC3-26	63	10.0	0.016	2.5	4.0	6.2	9.2	12.1	15.1
SC3-27	71	70.0	0.109	35.1	51.2	73.8	103.7	130.3	158.3
SC3-61	63	65.5	0.102	13.7	22.0	34.4	51.6	67.6	84.8
SC3-72	64	56.2	0.088	12.8	20.2	31.4	46.7	60.9	76.0
SC3-73	63	90.0	0.141	16.4	26.4	41.3	62.1	81.3	102.0
SC3-74	63	119.7	0.187	22.3	36.5	57.3	85.9	112.3	140.7
SC3-75	63	79.3	0.124	13.1	21.5	33.7	50.5	66.1	82.8
SC3-76	63	86.4	0.135	14.2	23.1	36.4	54.6	71.4	89.6
SC3-77	62	106.9	0.167	16.6	27.6	43.8	66.2	87.0	109.4
SC3-78	63	155.6	0.243	28.1	45.3	70.6	106.2	139.1	174.5
SC3-79	63	189.0	0.295	34.9	57.0	89.5	134.3	175.6	220.1
SC3-80	63	147.7	0.231	27.3	44.3	69.6	104.5	136.8	171.4
SC3-81	62	262.9	0.411	42.6	70.2	111.0	167.4	219.6	275.7
SC3-82	62	117.8	0.184	20.0	33.2	52.8	80.0	105.1	132.3
SC3-88	62	60.2	0.094	10.5	17.4	27.6	41.8	54.9	69.0
SC3-89	62	27.5	0.043	6.1	10	15.7	23.6	30.8	38.6
SCE-1	65	64.4	0.101	23.3	35.9	53.8	79.1	102.4	127.4
SCE-2	64	15.0	0.023	4.4	7.0	10.8	15.9	20.7	25.7
SCE-3	70	67.5	0.105	30.6	45.2	65.9	93.3	118.0	143.9
SCE-4	70	29.5	0.046	13.3	19.6	28.6	40.6	257.8	62.6
SCE-5	87	85.5	0.134	100.4	130.6	169.6	217.4	257.8	298.4
SCE-6	64	3.8	0.006	1.6	2.5	3.7	5.4	7.0	8.6
SCE-7	89	44.9	0.070	58.9	75.5	96.6	122.2	143.7	165.2
SCE-8	92	25.5	0.040	38.6	48.4	60.7	75.4	87.7	99.9
SCE-9	64	4.0	0.006	1.5	2.4	3.6	5.3	6.8	8.5
SCE-10	83	174.3	0.272	7.6	189.4	19.4	29.1	398.9	467.5
SCE-11	64	5.8	0.009	2.3	3.6	5.5	8.0	10.3	12.8
SCE-13	63	78.6	0.123	19.6	31.3	48.7	73.1	95.7	120.0
SCE-14	63	52.5	0.082	13.2	21.2	33.3	49.9	65.2	81.7
SCE-15	51	39.7	0.062	2.2	5.1	10.1	17.7	25.1	33.4

DESIGN POINT SUMMARY

DESIGN POINT	AREA (SQ MI)	Q_2 (CFS)	Q_5 (CFS)	Q_{10} (CFS)	Q_{25} (CFS)	Q_{50} (CFS)	Q_{100} (CFS)	LOCATION
DP-74	0.371	39.3	65.3	104.8	158.9	209.1	262.8	
DP-75	1.413	141.2	235.1	376.6	566.6	750.9	950.5	
DP-77	2.343	209.9	351.9	580.6	886.6	1168.4	1467.7	ARROYA LANE X-ING
DP-78	0.538	59.7	98.4	154.0	232.6	306.2	385.3	
DP-73	2.471	207.5	354.3	588.5	897.1	1187.2	1506.7	
DP-72	2.543	206.2	352.5	586.7	897.2	1195.3	1518.6	POCO ROAD X-ING
DP-71	2.757	205.9	349.3	610.5	932.4	1226.9	1612.2	STERLING RANCH NORTHERN BNDRY
DP-70	2.867	205.3	349.8	614.0	940.1	1260.6	1636.7	
DP-69	3.238	212.7	366.6	653.7	1010.6	1364.1	1775.7	BRIARGATE PARKWAY X-ING
DP-87	3.594	216.9	374.6	681.9	1072.1	1471.5	1905.9	
DP-68	4.312	214.6	374.5	714.9	1187.6	1674.9	2204.1	UPSTREAM OF POND W3
DP-64	0.119	85.9	112.1	145.9	187.5	222.6	258.0	
DP-63	4.449	154.4	201.0	375.7	815.9	1112.1	1385.1	STERLING RANCH SOUTHERN BNDRY
DP-61	5.356	156.6	223.9	428.0	928.2	1287.3	1620.1	COLORADO SPRINGS/EL PASO BNDRY
DP-60A	5.617	161.6	224.8	439.1	950.4	1320.5	1661.8	MARKSHEFFEL X-ING
DP-53A	5.661	161.6	225.7	441.8	951.1	1326.0	1668.9	SAND CREEK AND POND 3
DP-1E	0.247	23.9	38.3	70.1	132.8	173.0	220.9	
DP-2E	0.486	48.9	76.8	123.0	228.7	319.7	419.4	
DP-3E	0.626	48.5	75.7	122.2	271.1	387.1	500.1	
DP-4E	0.745	48.1	76.2	122.4	286.9	407.3	534.8	
DP-56	1.017	23.1	35.3	71.5	108.3	152.1	196.4	NEAR SE PROP CORNER
DP-8	1.079	24.1	37.2	73.5	111.3	155.4	200.7	BELOW SE PROP CORNER
DP-21	0.396	0.6	8.8	17.8	57.1	116.8	174.9	
DP-22	0.342	0.6	8.8	17.6	56.8	105.1	156.4	
DP-25	0.066	5.9	9.1	16.3	35.1	46.4	58.2	
DP-26	0.012	0.1	1.1	3.2	7.3	9.5	12.0	

DESIGN POINT SUMMARY (VOLUME)

DESIGN POINT	AREA (SQ MI)	V_2 (AC-FT)	V_5 (AC-FT)	V_{10} (AC-FT)	V_{25} (AC-FT)	V_{50} (AC-FT)	V_{100} (AC-FT)	LOCATION
DP-74	0.371	5.9	9.0	13.6	19.8	25.5	31.6	
DP-75	1.413	22.7	34.5	51.7	75.4	97.1	120.5	
DP-77	2.343	37.7	57.4	85.9	125.1	161.1	199.9	ARROYA LANE X-ING
DP-78	0.538	8.9	13.5	20.1	29.3	37.7	46.7	
DP-73	2.471	40.0	60.8	91.0	132.5	170.7	211.7	
DP-72	2.543	41.3	62.9	94.0	136.8	176.2	218.5	POCO ROAD X-ING
DP-71	2.757	46.3	70.0	104.3	151.3	194.5	240.8	STERLING RANCH NORTHERN BNDRY
DP-70	2.867	49.5	74.5	110.6	160.1	205.4	254.0	
DP-69	3.238	57.5	86.1	127.4	183.8	235.3	290.6	BRIARGATE PARKWAY X-ING
DP-87	3.594	66.5	98.9	145.6	209.1	267.1	329.1	
DP-68	4.312	81.8	123.7	183.9	264.9	338.0	415.8	UPSTREAM OF POND W3
DP-64	0.119	7.0	9.1	11.8	15.2	18.1	21.1	
DP-63	4.449	85.6	129.5	192.3	276.7	352.8	433.5	STERLING RANCH SOUTHERN BNDRY
DP-61	5.356	103.7	157.8	235.1	338.4	431.3	529.8	COLORADO SPRINGS/EL PASO BNDRY
DP-60A	5.617	111.0	168.6	250.4	359.5	457.7	561.5	MARKSHEFFEL X-ING
DP-53A	5.661	112.0	170.0	252.6	362.6	461.7	566.5	SAND CREEK AND POND 3
DP-1E	0.247	3.1	5.2	8.4	12.7	16.6	20.9	
DP-2E	0.480	6.1	10.4	16.9	25.7	33.7	42.2	
DP-3E	0.620	7.0	13.7	23.4	36.1	47.4	59.3	
DP-4E	0.736	7.6	15.6	27.2	43.0	57.2	72.0	
DP-56	1.017	7.7	16.1	28.6	51.3	71.7	92.9	NEAR SE PROP CORNER
DP-8	1.079	8.0	16.7	26.6	53.0	74.0	95.9	BELOW SE PROP CORNER
DP-21	0.396	6.3	11.3	18.3	27.5	35.6	44.0	
DP-22	0.736	6.3	10.7	16.7	24.6	31.5	38.7	
DP-25	1.017	1.3	1.9	2.8	4.1	5.2	6.4	
DP-26	1.079	0.7	0.9	1.2	1.5	1.8	2.1	

WATER QUALITY & DETENTION POND SUMMARY

FSD1						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	16.3	23.3	33.0	45.8	57.1	68.9
ALLOWABLE RELEASE (CFS)	0.1	1.7	3.3	10.9	17.5	25.5
MODELED RELEASE (CFS)	0.1	1.6	3.2	10.9	17.4	25.4
STORED VOLUME (AC-FT)	2.4	2.6	3.0	3.6	1.9	2.2

FSD5						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	40.6	53.7	71.0	92.4	110.6	129.1
ALLOWABLE RELEASE (CFS)	0.1	1.4	2.6	11.3	19.8	30.2
MODELED RELEASE (CFS)	0.1	1.4	2.6	11.2	19.7	30.1
STORED VOLUME (AC-FT)	3.0	3.2	3.8	4.1	4.7	5.2

FSD6						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	196.5	258.5	339.1	438.7	523.3	608.6
ALLOWABLE RELEASE (CFS)	0.5	7.6	14.6	58.4	99.6	149.7
MODELED RELEASE (CFS)	0.5	7.5	14.5	58.2	99.6	149.6
STORED VOLUME (AC-FT)	15.5	16.4	18.7	20.8	23.3	26.0

FSD9						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	64.6	105.6	169.5	252.3	327.1	410.1
ALLOWABLE RELEASE (CFS)	1.7	24.9	49.8	141.1	207.2	290.0
MODELED RELEASE (CFS)	1.7	24.9	49.8	141.1	207.0	289.9
STORED VOLUME (AC-FT)	8.7	8.7	9.6	10.8	12.3	13.8

FSD11A						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	5.3	7.8	11.3	15.9	20.0	24.3
ALLOWABLE RELEASE (CFS)	0.1	1.6	3.2	7.5	9.7	12.4
MODELED RELEASE (CFS)	0.2	0.9	3.0	7.5	9.7	12.3
STORED VOLUME (AC-FT)	0.3	0.3	0.4	0.4	0.5	0.6

FSD11B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	59.4	81.3	110.8	148.1	180.5	213.7
ALLOWABLE RELEASE (CFS)	0.3	4.5	8.7	29.6	47.7	69.6
MODELED RELEASE (CFS)	0.3	4.5	8.6	29.5	47.7	69.5
STORED VOLUME (AC-FT)	4.8	4.9	5.5	6.4	7.3	8.2

FSD12						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	77.8	105.6	142.5	189.1	229.1	270.0
ALLOWABLE RELEASE (CFS)	0.9	13.2	26.7	62.0	80.2	103.2
MODELED RELEASE (CFS)	0.9	9.0	26.7	61.9	80.1	103.1
STORED VOLUME (AC-FT)	5.2	5.5	5.8	6.7	7.8	8.9

FSD13						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	43.9	57.8	76.0	98.5	117.6	136.9
ALLOWABLE RELEASE (CFS)	0.4	6.1	12.3	28.6	37.0	47.6
MODELED RELEASE (CFS)	0.4	4.2	12.3	28.6	36.9	47.2
STORED VOLUME (AC-FT)	3.1	3.1	3.3	3.8	4.4	5.0

FSD14A						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	127.6	175.4	239.8	321.9	393.2	466.3
ALLOWABLE RELEASE (CFS)	0.5	7.5	14.4	56.2	95.2	142.4
MODELED RELEASE (CFS)	0.5	7.5	14.4	56.2	95.1	142.2
STORED VOLUME (AC-FT)	9.9	10.6	11.9	13.5	15.3	17.3

FSD14B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	24.6	34.3	47.4	64.2	79.0	94.1
ALLOWABLE RELEASE (CFS)	0.0	0.3	0.5	5.7	11.8	19.3
MODELED RELEASE (CFS)	0.0	0.3	0.5	4.5	11.8	19.3
STORED VOLUME (AC-FT)	1.9	2.5	3.3	3.5	3.5	3.8

FSD15B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	10.8	14.0	18.2	23.3	27.6	31.9
ALLOWABLE RELEASE (CFS)	0.1	1.6	3.2	7.3	9.5	12.0
MODELED RELEASE (CFS)	0.1	1.1	3.2	7.3	9.5	12.0
STORED VOLUME (AC-FT)	0.6	0.6	0.7	0.8	0.9	1.0

FSD16A						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	84.4	120.4	170.0	234.8	292.2	351.8
ALLOWABLE RELEASE (CFS)	0.6	8.8	17.3	56.2	88.4	128.3
MODELED RELEASE (CFS)	0.6	8.8	17.3	56.2	88.3	128.3
STORED VOLUME (AC-FT)	7.6	7.7	8.9	10.4	12.1	13.8

SAND CREEK FLOW COMPARISON CHART

DESIGN POINT	AREA (SQ MI)	Q_{100} (CFS)	DESCRIPTION
DP-77	2.343	1468	PROPOSED CONDITION
	2.91	2262	SAND CREEK DBPS
		2600	FEMA
DP-71	2.757	1612	PROPOSED CONDITION
		2260	SAND CREEK DBPS
DP-63	4.449	1385	PROPOSED CONDITION
	4.33	2630	SAND CREEK DBPS
		2600	FEMA
DP-60A	5.661	1662	PROPOSED CONDITION
	5.38	3295	SAND CREEK DBPS

EFSC DBPS DESIGN POINT SUMMARY (PEAK FLOW)

DBPS DESIGN POINT	AREA (SQ MI)	Q_{10} (CFS) (EXIST)	Q_{100} (CFS) (EXIST)	AREA (SQ MI)	Q_{10} (CFS) (PROP)	Q_{100} (CFS) (PROP)
DP-50	0.32	47.0	195.7	0.32	146.7	370.3
DP-51 (BASIN 86)	0.33	17.7	74.1	0.33	110.0	233.5
DP-52	1.67	80.5	456.5	1.67	1207.9	2123.0
DP-56	0.79	63.6	265.0	0.79	513.0	908.2

Values reported from SCDBPS, (DP 50, 51, 52 Not analyzed as a part of this study)
DBPS Reach 85(Basin91)=Q10=28.8cfs Q100=115.2cfs / Q10=345.7cfs Q100=588.9cfs
(EXISTING) (PROPOSED)

WATER QUALITY & DETENTION POND SUMMARY

FSD16B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	39.0	53.7	73.6	99.0	121.1	143.8
ALLOWABLE RELEASE (CFS)	0.0	0.4	0.7	8.3	17.2	28.2
MODELED RELEASE (CFS)	0.0	0.4	0.7	7.9	17.2	28.1
STORED VOLUME (AC-FT)	3.0	3.9	5.1	5.1	5.3	5.8

FSD17						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	41.8	59.6	85.2	119.0	149.1	180.6
ALLOWABLE RELEASE (CFS)	0.7	11.1	22.5	52.0	67.2	86.3
MODELED RELEASE (CFS)	0.7	8.4	22.4	52.0	67.2	86.1
STORED VOLUME (AC-FT)	2.6	2.6	2.8	3.4	4.0	4.7

FSD18						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	49.3	67.1	91.0	121.2	147.3	174.0
ALLOWABLE RELEASE (CFS)	0.6	9.2	18.4	42.2	54.6	69.9
MODELED RELEASE (CFS)	0.6	6.3	18.4	42.2	54.6	69.6
STORED VOLUME (AC-FT)	3.2	3.2	3.4	4.0	4.7	5.3

FSD20						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	9.9	15.5	23.8	35.1	45.5	56.6
ALLOWABLE RELEASE (CFS)	0.4	5.5	11.1	25.7	33.2	42.5
MODELED RELEASE (CFS)	0.4	2.8	10.9	25.7	33.0	42.4
STORED VOLUME (AC-FT)	0.7	0.8	0.8	0.9	1.0	1.2

FSD21						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	7.0	10.8	16.3	23.7	30.4	37.5
ALLOWABLE RELEASE (CFS)	0.3	4.0	8.0	18.3	23.7	30.3
MODELED RELEASE (CFS)	0.3	3.3	8.0	18.3	23.7	30.1
STORED VOLUME (AC-FT)	0.5	0.5	0.5	0.6	0.7	0.8

FSD22						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	9.4	14.8	22.5	32.9	42.5	52.6
ALLOWABLE RELEASE (CFS)	0.4	5.8	11.5	26.5	34.3	43.9
MODELED RELEASE (CFS)	0.4	5.8	11.4	26.5	34.3	43.8
STORED VOLUME (AC-FT)	0.6	0.6	0.7	0.8	0.9	1.0

FSD23						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	5.5	8.3	12.4	18.0	23.0	28.4
ALLOWABLE RELEASE (CFS)	0.2	2.4	4.9	11.2	14.5	18.6
MODELED RELEASE (CFS)	0.2	2.0	4.9	11.2	14.5	18.6
STORED VOLUME (AC-FT)	0.3	0.3	0.4	0.4	0.5	0.6

FSD27						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	38.8	57.6	84.1	119.7	159.2	206.3
ALLOWABLE RELEASE (CFS)	1.4	21.1	42.4	97.8	126.4	161.9
MODELED RELEASE (CFS)	1.4	18.4	42.3	97.7	126.2	161.9
STORED VOLUME (AC-FT)	2.7	2.8	2.9	3.2	3.7	4.2

FSD72						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	12.8	20.2	31.4	46.7	60.9	76.0
ALLOWABLE RELEASE (CFS)	0.6	9.6	19.3	44.4	57.4	73.4
MODELED RELEASE (CFS)	0.6	9.3	19.2	44.4	57.4	73.4
STORED VOLUME (AC-FT)	1.0	1.0	1.1	1.1	1.2	1.3

PNDW3						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	214.6	374.5	714.9	1187.6	1674.9	2204.1
MODELED RELEASE (CFS)	154.3	200.3	366.8	799.9	1085.6	1350.6
STORED VOLUME (AC-FT)	2.8	9.5	26.3	41.2	57.2	78.2

FSD-E1						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	23.3	35.9	53.8	79.1	102.4	127.4
ALLOWABLE RELEASE (CFS)	0.7	11.0	22.1	50.9	65.7	84.1
MODELED RELEASE (CFS)	0.7	5.4	19.9	48.9	62.8	84.0
STORED VOLUME (AC-FT)	1.3	1.3	1.5	1.8	2.1	2.5

FSD-E2						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	30.6	45.2	65.9	93.3	118.0	143.9
ALLOWABLE RELEASE (CFS)	0.6	9.5	19.2	45.5	59.8	77.6
MODELED RELEASE (CFS)	0.6	3.2	18.5	41.3	58.5	74.7
STORED VOLUME (AC-FT)	2.1	2.3	2.4	2.8	3.3	3.8

FSD-E3						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	100.4	130.6	169.6	217.4	257.8	298.4
ALLOWABLE RELEASE (CFS)	0.9	13.2	26.5	61.6	79.8	102.6
MODELED RELEASE (CFS)	1.0	6.8	25.7	56.0	79.8	101.3
STORED VOLUME (AC-FT)	7.0	7.2	7.7	8.9	10.1	11.4

FSD-E4						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	58.9	75.5	96.6	122.2	143.7	165.2
ALLOWABLE RELEASE (CFS)	0.3	4.4	8.8	23.0	32.2	43.7
MODELED RELEASE (CFS)	0.9	2.8	8.7	21.9	32.2	43.6
STORED VOLUME (AC-FT)	4.2	4.3	4.7	5.4	6.2	6.9

FSD-E5						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	38.6	48.4	60.7	75.4	87.7	99.9
ALLOWABLE RELEASE (CFS)	0.0	0.2	0.4	4.2	8.7	14.3
MODELED RELEASE (CFS)	0.0	0.2	0.5	2.2	5.1	10.0
STORED VOLUME (AC-FT)	3.0	3.7	4.4	4.8	5.0	5.3

FSD-E6						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	141.6	189.4	252.5	331.4	398.9	467.5
ALLOWABLE RELEASE (CFS)	0.2	1.9	3.2	37.4	77.3	125.6
MODELED RELEASE (CFS)	0.2	0.9	3.2	18.3	64.1	123.3
STORED VOLUME (AC-FT)	13.0	17.0	21.9	22.2	22.6	23.7

PND-E7						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	46.5	75.4	121.2	285.2	402.4	548.0
MODELED RELEASE (CFS)	23.1	35.3	71.5	108.3	152.1	196.4
STORED VOLUME (AC-FT)	1.0	1.8	4.6	10.5	17.9	28.0

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2018 STERLING RANCH MDDP

DEVELOPED HYDROLOGIC CONDITIONS MAP

PROJECT NO. 09-002	FILE: \dwg\Eng Exhibits\2018-MDDP-PROPCOND.dwg		
DESIGNED BY: JD	SCALE	DATE: 10-21-2018	
DRAWN BY: JD	HORIZ: 1"=2400'		DM2
CHECKED BY: VAS	VERT: 1"=2400'		

Summary of Peak Discharges						
Design Point 75						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	141	235	377	567	751	951
2018 Developed Cond. (cfs)	141	235	377	567	751	951
Design Point 77						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	n/a	n/a	n/a	n/a	n/a	n/a
2018 Developed Cond. (cfs)	210	352	581	887	1168	1468
1996 DBPS Existing Cond. (cfs)						2193
1996 DBPS Developed Cond. (cfs)						2262
Design Point 73						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	226	381	618	957	1260	1582
2018 Developed Cond. (cfs)	208	354	589	897	1187	1507
Design Point 71						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	229	389	630	979	1277	1638
2018 Developed Cond. (cfs)	206	349	611	932	1227	1612
Design Point 69						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	253	435	708	1100	1453	1870
2018 Developed Cond. (cfs)	213	367	654	1011	1364	1776
Design Point 68						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	n/a	n/a	n/a	n/a	n/a	n/a
2018 Developed Cond. w/o Pnd (cfs)	215	375	715	1188	1675	2204
2018 Developed w/Pnd (cfs) Pnd W3	154	200	367	800	1086	1351
Design Point 63						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	251	431	713	1113	1496	1912
2018 Developed Cond. w/o Pnd (cfs)	213	373	721	1198	1705	2237
2018 Developed w/Pnd (cfs)	154	201	376	816	1112	1385
2011 Wilson (cfs)			1066			1791
1996 DBPS Existing Cond. (cfs)						2508
1996 DBPS Developed Cond. (cfs)						2689
Design Point 61						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	n/a	n/a	n/a	n/a	n/a	n/a
2018 Developed Cond. w/o Pnd (cfs)	214	375	783	1370	1967	2607
2018 Developed w/Pnd (cfs)	157	224	428	928	1287	1620
2011 Wilson (cfs)			1232			2087
Design Point 60a						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	248	430	707	1113	1497	1914
2018 Developed Cond. w/o Pnd (cfs)	216	378	795	1395	2004	2645
2018 Developed w/Pnd (cfs)	162	225	439	950	1321	1662
2011 Wilson (cfs)			1265			2133
1996 DBPS Existing Cond. (cfs)						2629
1996 DBPS Developed Cond. (cfs)						3295
Design Point 53a						
Storm Event (YR)	2	5	10	25	50	100
2016 Existing Cond. (cfs)	262	454	763	1197	1610	2062
2018 Developed Cond. w/o Pnd (cfs)	215	378	792	1392	2009	2657
2018 Developed w/Pnd (cfs)	162	226	442	951	1326	1669

Section C.

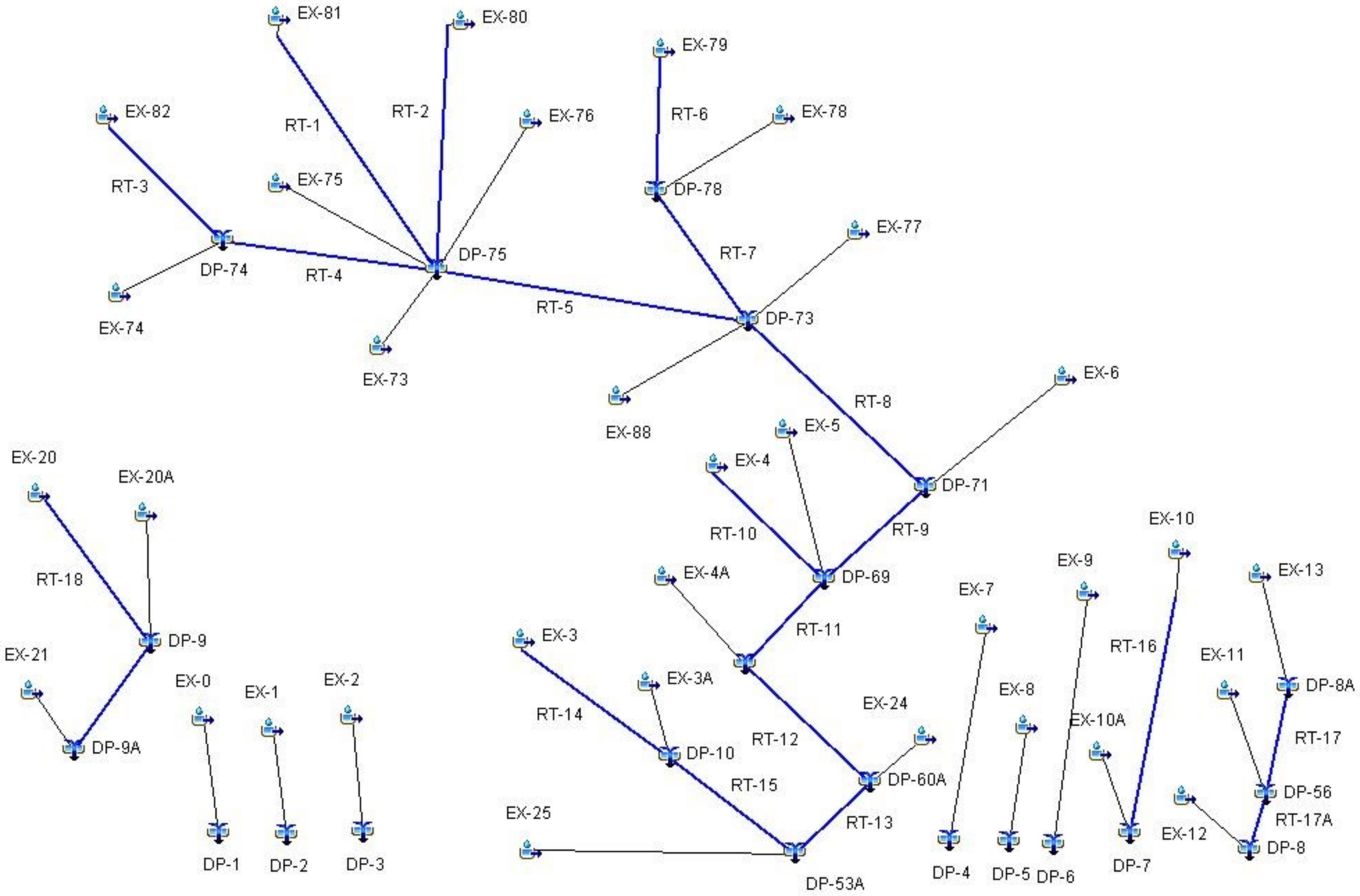
Existing Conditions HEC-HMS Schematic

DCM Land Use/Impervious %/Curve Number Table

Existing Conditions Composite Curve Number & Impervious % Table

Existing Conditions Lag Time Calculations

Existing Conditions Initial Abstraction Values



EXISTING CONDITIONS
HEC-HMS SCHEMATIC

Sterling Ranch MDDP

Hydrologic Study - Land Use / Imperivous % / CN Table

Land Use	Percent Impervious	Curve Number (CN) Hydrologic Soil Type	
		A	B
Woods/Grass	0	41	62
Grassland (Rangeland)	0	41	62
Exclusion (Floodplain Rangeland)	0.5	41	62
> 5 Acre Rural Residential	7	42	63
5 Acre Rural Residential	10	44	63
2-2.5 Acre Rural Residential	12	46	65
1 Acre Single Family Urban	20	51	68
1/2 Acre Single Family Urban	25	54	70
1/3 Acre Single Family Urban	30	57	72
1/4 Acre Single Family Urban	38	61	75
1/5 Acre Single Family Urban	45	65	83
1/8 Acre Single Family Urban	65	77	85
8-12 DU/AC Multifamiily	70	79	87
12-20 DU/AC Multifamily	80	86	90
Schools	55	71	81
Roads - Paved	100	98	98
Commercial and Business	95	89	92
Industrial	72	81	88
Open Space (Parks)	10	43	64
Utilities	60	74	83
Gravel Pit	27	--	71

Taken from DCM Table 6-10 (NRCS CN ARC II)

Sterling Ranch MDDP

Sand Creek and East Fork Sand Creek - Existing Condition Composite CN & Impervious % Table

6/21/2018

Basin	Basin	Basin	Basin	Sub-Area 1		HSG	UA CN	CN	Sub-Area 2		HSG	UA CN	CN
ID	Area	Area	Area	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value
	(SF)	(AC)	(SQ MI)	(AC)	(%)			(used)	(AC)	(%)			(used)
EX-0	1034765	23.8	0.037	23.8	0	A	41	62					
EX-1	1120663	25.7	0.040	25.7	0	A	41	62					
EX-2	238567	5.5	0.009	5.5	0	A	41	62					
EX-3	5956997	136.8	0.214	91.4	0	B	62	62	45.3	10	B	63	63
EX-3A	8193769	188.1	0.294	69.6	0	A	41	41	23.2	72	A	81	88
EX-4	8363354	192.0	0.300	119.4	0	B	62	62	17.3	5	B	62	62
EX-4A	6600380	151.5	0.237	5.8	0	A	41	41	95.0	0	B	62	62
EX-5	6703477	153.9	0.240	126.9	0	B	62	62	27.0	0.5	B	62	62
EX-6	3928504	90.2	0.141	73.5	2	B	62	62	16.7	0.5	B	62	62
EX-7	7187603	165.0	0.258	74.8	0	A	41	41	19.8	0	B	62	62
EX-8	1828489	42.0	0.066	36.7	0	A	41	41	5.2	27	A	56	71
EX-9	5747518	131.9	0.206	72.5	0	A	41	41	47.9	27	A	56	71
EX-10	11793328	270.7	0.423	34.0	0	A	41	41	122.0	0	B	62	62
EX-10A	7809034	179.3	0.280	177.7	0	A	41	41	1.5	0	B	62	62
EX-11	9119024	209.3	0.327	193.2	0	A	41	41	16.2	0	B	62	62
EX-12	1719818	39.5	0.062	22.1	0	A	41	41	17.4	10	A	44	63
EX-13	3888572	89.3	0.139	29.9	0	A	41	41	36.2	0	B	62	62
EX-20	6246166	143.4	0.224	32.4	0	A	41	63	75.8	0	B	62	62
EX-20A	7828526	179.7	0.281	48.2	10	A	44	63	82.4	12	A	46	65
EX-21	1448905	33.3	0.052	33.3	12	B	65	65					
EX-24	2750098	63.1	0.099	10.1	0	A	41	41	13.6	10	A	44	63
EX-25	2370050	54.4	0.085	42.6	0	A	41	41	6.2	0.5	A	41	41
EX-73	3921483	90.0	0.141	90.0	5	B	63	63					
EX-74	5213558	119.7	0.187	119.7	10	B	63	63					
EX-75	3452599	79.3	0.124	79.3	10	B	63	63					
EX-76	3761442	86.4	0.135	67.2	10	B	63	63	19.2	0	B	62	62
EX-77	10046025	230.6	0.360	222.7	2	B	62	62	7.9	0.5	B	62	62
EX-78	6778000	155.6	0.243	155.6	10	B	63	63					
EX-79	8231666	189.0	0.295	189.0	7	B	63	63					
EX-80	6434190	147.7	0.231	147.7	7	B	63	63					
EX-81	11449750	262.9	0.411	262.9	2	B	62	62					
EX-82	5130284	117.8	0.184	117.8	2	B	62	62					
EX-88	6062553	139.2	0.217	133.6	2	B	62	62	5.5	0.5	B	62	62

Basin	Sub-Area 3		HSG	UA CN	CN	Sub-Area 4		HSG	UA CN	CN	Sub-Area 5		HSG	UA CN	CN
ID	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value
	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)
EX-0															
EX-1															
EX-2															
EX-3															
EX-3A	61.0	0	B	62	62	27.5	72	B	88	88	6.4	10	A	44	63
EX-4	55.4	10	B	63	63										
EX-4A	43.9	0.5	B	62	62	6.8	27	A	56	71					
EX-5															
EX-6															
EX-7	58.7	27	A	56	71	11.7	27	B	71	71					
EX-8															
EX-9	11.5	0	B	62	62										
EX-10	28.4	7	B	63	63	86.3	10	B	63	63					
EX-10A															
EX-11															
EX-12															
EX-13	16.9	2	B	62	62	6.3	7	B	63	63					
EX-20	35.1	10	B	63	63										
EX-20A	6.7	0	B	62	62	42.3	10	B	63	63					
EX-21															
EX-24	39.4	0.5	B	62	62										
EX-25	5.4	0.5	B	62	62										
EX-73															
EX-74															
EX-75															
EX-76															
EX-77															
EX-78															
EX-79															
EX-80															
EX-81															
EX-82															
EX-88															

Basin	Sub-Area 6		HSG	UA CN	CN	Sub-Area 7		HSG	UA CN	CN	Sub-Area 8		HSG	UA CN	CN	Sub-Area 9		HSG	UA CN	CN	Sub-Areas	% HSG	% HSG	Weighted	Weighted
ID	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Total	A	B	Sub Areas Imp	Sub Area CN
	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(Check)	%	%	%	No.
EX-0																					24	100	0	0	62
EX-1																					26	100	0	0	62
EX-2																					5	100	0	0	62
EX-3																					137	0	100	3	62
EX-3A																					188	53	47	20	61
EX-4																					192	0	100	3	62
EX-4A																					151	8	92	1	62
EX-5																					154	0	100	0	62
EX-6																					90	0	100	2	62
EX-7																					165	81	12	12	56
EX-8																					42	88	12	3	45
EX-9																					132	91	9	10	54
EX-10																					271	13	87	4	60
EX-10A																					179	99	1	0	41
EX-11																					209	92	8	0	43
EX-12																					39	56	44	4	51
EX-13																					89	34	66	1	55
EX-20																					143	23	77	2	62
EX-20A																					180	73	27	11	64
EX-21																					33	0	100	12	65
EX-24																					63	38	62	2	59
EX-25																					54	90	10	0	43
EX-73																					90	0	100	5	63
EX-74																					120	0	100	10	63
EX-75																					79	0	100	10	63
EX-76																					86	0	100	8	63
EX-77																					231	0	100	2	62
EX-78																					156	0	100	10	63
EX-79																					189	0	100	7	63
EX-80																					148	0	100	7	63
EX-81																					263	0	100	2	62
EX-82																					118	0	100	2	62
EX-88																					139	0	100	2	62

Sterling Ranch Master Development Drainage Plan

Sand Creek & East Sand Creek Basins - Existing Condition - Lag Time Calculations

6/21/2018

Basin	OVERLAND FLOW					SHALLOW GUTTER FLOW				SHALLOW CHANNEL FLOW				STORM SEWER FLOW				CHANNELIZED FLOW				Tc	TLag
ID	P2	n	Length	Slope	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Total	0.6*Tc
	(in)		(ft)	(%)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(min)	(min)
EX-0	2.1	0.15	160	2.5	16.1	0	0	0	0	1200	20	2.0	10.0	0	0	0	0.0	0	0.0	0.0	0.0	26.1	15.7
EX-1	2.1	0.15	200	2.0	21.1	0	0	0	0	1450	32	2.3	10.5	0	0	0	0.0	0	0.0	0.0	0.0	31.6	18.9
EX-2	2.1	0.15	200	1.5	23.6	0	0	0	0	1050	27	2.5	7.0	0	0	0	0.0	0	0.0	0.0	0.0	30.6	18.4
EX-3	2.1	0.15	300	5.3	19.7	0	0	0	0.0	1100	40	2.9	6.3	0	0	0	0.0	3540	2.7	4.1	14.4	40.4	24.2
EX-3A	2.1	0.15	200	3.0	17.9	0	0	0	0.0	1200	26	2.3	8.7	0	0	0	0.0	3360	2.1	4.5	12.4	39.0	23.4
EX-4	2.1	0.15	300	4.7	20.8	0	0	0	0.0	770	22	2.7	4.8	0	0	0	0.0	3900	3.0	4.0	16.3	41.8	25.1
EX-4A	2.1	0.15	200	3.0	17.9	0	0	0	0.0	250	8	2.8	1.5	0	0	0	0.0	5190	1.9	4.3	20.1	39.5	23.7
EX-5	2.1	0.15	200	4.0	16.0	0	0	0	0.0	1050	34	2.8	6.3	0	0	0	0.0	4425	2.3	3.8	19.4	41.6	25.0
EX-6	2.1	0.15	300	5.0	20.2	0	0	0	0.0	250	11	3.2	1.3	0	0	0	0.0	3490	2.3	3.8	15.3	36.8	22.1
EX-7	2.1	0.15	300	2.0	29.1	0	0	0	0.0	1650	42	2.4	11.5	0	0	0	0.0	3950	2.1	4.2	15.7	56.3	33.8
EX-8	2.1	0.15	200	2.0	21.1	0	0	0	0.0	1600	35	2.3	11.6	0	0	0	0.0	0	0.0	0.0	0.0	32.7	19.6
EX-9	2.1	0.15	200	2.0	21.1	0	0	0	0.0	800	26	2.8	4.8	0	0	0	0.0	3775	2.1	4.0	15.7	41.5	24.9
EX-10	2.1	0.15	300	5.3	19.7	0	0	0	0.0	880	32	2.9	5.1	0	0	0	0.0	6133	2.2	4.6	22.2	47.0	28.2
EX-10A	2.1	0.15	200	2.0	21.1	0	0	0	0.0	1440	35	2.4	10.0	0	0	0	0.0	5500	2.0	3.5	26.2	57.2	34.3
EX-11	2.1	0.15	200	4.0	16.0	0	0	0	0.0	1620	44	2.6	10.4	0	0	0	0.0	3000	2.7	4.0	12.5	38.8	23.3
EX-12	2.1	0.15	200	3.0	17.9	0	0	0	0.0	250	8	2.8	1.5	0	0	0	0.0	820	2.7	2.6	5.3	24.7	14.8
EX-13	2.1	0.15	200	9.0	11.5	0	0	0	0.0	250	12	3.4	1.2	0	0	0	0.0	4325	2.9	3.7	19.5	32.2	19.3
EX-20	2.1	0.15	300	3.8	22.5	0	0	0	0.0	730	40	3.5	3.5	0	0	0	0.0	2200	3.6	4.3	8.5	34.5	20.7
EX-20A	2.1	0.15	300	4.0	22.1	0	0	0	0.0	650	20	2.7	4.0	0	0	0	0.0	4450	1.8	4.2	17.7	43.7	26.2
EX-21	2.1	0.15	200	4.5	15.2	0	0	0	0.0	1175	42	2.9	6.8	0	0	0	0.0	915	1.7	2.5	6.1	28.1	16.8
EX-24	2.1	0.15	200	4.4	15.3	0	0	0	0.0	0	0	0.0	0.0	0	0	0	0.0	2400	2.3	3.1	12.9	28.2	16.9
EX-25	2.1	0.15	150	4.0	12.7	0	0	0	0.0	0	0	0.0	0.0	0	0	0	0.0	2700	1.6	3.1	14.5	27.2	16.3
EX-73	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1650	3.3	2.9	9.5	0	0	0	0.0	1230	3.3	4.2	4.9	38.1	22.9
EX-74	2.1	0.15	300	4.7	20.8	0	0	0	0.0	2000	3.5	2.8	11.9	0	0	0	0.0	770	2.6	3.9	3.3	35.9	21.6
EX-75	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1200	4.1	2.7	7.4	0	0	0	0.0	2300	2.8	3.1	12.4	43.5	26.1
EX-76	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1160	3.4	3.1	6.2	0	0	0	0.0	3025	2.6	3.6	14.0	44.0	26.4
EX-77	2.1	0.15	300	4.7	20.8	0	0	0	0.0	1600	4.0	3.4	7.8	0	0	0	0.0	4850	2.1	5.1	15.8	44.4	26.7
EX-78	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1560	4.1	3.3	7.9	0	0	0	0.0	1850	3.2	4.5	6.9	38.5	23.1
EX-79	2.1	0.15	300	4.0	22.1	0	0	0	0.0	1740	5.6	3.5	8.3	0	0	0	0.0	1100	1.8	3.0	6.1	36.5	21.9
EX-80	2.1	0.15	300	5.0	20.2	0	0	0	0.0	1625	4.9	3.4	8.0	0	0	0	0.0	2140	2.8	4.1	8.7	36.9	22.1
EX-81	2.1	0.15	300	6.7	18.0	0	0	0	0.0	2000	5.0	3.4	9.8	0	0	0	0.0	3600	3.1	4.9	12.2	40.0	24.0
EX-82	2.1	0.15	300	3.3	23.7	0	0	0	0.0	2000	4.7	3.3	10.1	0	0	0	0.0	625	3.2	4.1	2.5	36.4	21.8
EX-88	2.1	0.15	300	4.7	20.8	0	0	0	0.0	1750	4.1	3.4	8.6	0	0	0	0.0	2760	3.1	4.0	11.5	40.8	24.5

DCM TABLE 6-25 WAS USED FOR SHALLOW CONCENTRATED SWALE & GUTTER FLOW
N VALUE FOR OVERLAND FLOW WAS ASSUMED TO BE 0.15 FOR ALL BASINS
A ROUGHNESS COEFFICENT OF 0.050 WAS USED FOR EARTHEN CHANNEL BOTTOMS
A ROUGHNESS COEFFICENT OF 0.013 WAS USED FOR CONCRETE LINED CONVEYANCES

Sterling Ranch Master Development Drainage Plan

Sand Creek and East Fork Sand Creek Basins - Existing Conditions - Initial Abstraction Values

6/21/2018

Basin ID	Composite CN Value	Initial Abstraction (in)
EX-0	62	0.613
EX-1	62	0.613
EX-2	62	0.613
EX-3	62	0.613
EX-3A	61	0.639
EX-4	62	0.613
EX-4A	62	0.613
EX-5	62	0.613
EX-6	62	0.613
EX-7	56	0.786
EX-8	45	1.222
EX-9	54	0.852
EX-10	60	0.667
EX-10A	41	1.439
EX-11	43	1.326
EX-12	51	0.961
EX-13	55	0.818
EX-20	62	0.613
EX-20A	64	0.563
EX-21	65	0.538
EX-24	59	0.695
EX-25	43	1.326
EX-73	63	0.587
EX-74	63	0.587
EX-75	63	0.587
EX-76	63	0.587
EX-77	62	0.613
EX-78	63	0.587
EX-79	63	0.587
EX-80	63	0.587
EX-81	62	0.613
EX-82	62	0.613
EX-88	62	0.613

Sterling Ranch Master Development Drainage Plan
Hydrologic Study - Existing Conditions - Reach Data
6/20/2018

Reach ID	Reach Length L1 (ft)	Reach Vert. Drop H1 (ft)	Reach Slope S1 %	Mannings N Value n	Reach Side Slope SS (H/V)	Bottom Width BW (ft)	Diameter D (ft)
RT-1	3975	100	2.5%	0.05	10	6	N/A
RT-2	4570	120	2.6%	0.05	10	6	N/A
RT-3	2360	65	2.8%	0.05	10	6	N/A
RT-4	2695	65	2.4%	0.05	10	6	N/A
RT-5	4100	92	2.2%	0.05	6	10	N/A
RT-6	3030	100	3.3%	0.05	10	6	N/A
RT-7	6145	122	2.0%	0.05	10	6	N/A
RT-8	2160	42	1.9%	0.05	6	15	N/A
RT-9	3565	66	1.9%	0.05	6	30	N/A
RT-10	3165	68	2.1%	0.05	6	6	N/A
RT-11	6400	96	1.5%	0.05	4	40	N/A
RT-12	4375	74	1.7%	0.05	6	40	N/A
RT-13	1480	22	1.5%	0.05	6	40	N/A
RT-14	6365	136	2.1%	0.05	4	6	N/A
RT-15	3130	74	2.4%	0.05	4	8	N/A
RT-16	5575	138	2.5%	0.05	10	6	N/A
RT-17A	2675	72	2.7%	0.05	6	6	N/A
RT-17B	1300	32	2.5%	0.05	6	6	N/A
RT-18	3400	74	2.2%	0.05	10	6	N/A
RT-19	1670	22	1.3%	0.05	6	6	N/A

Section D.

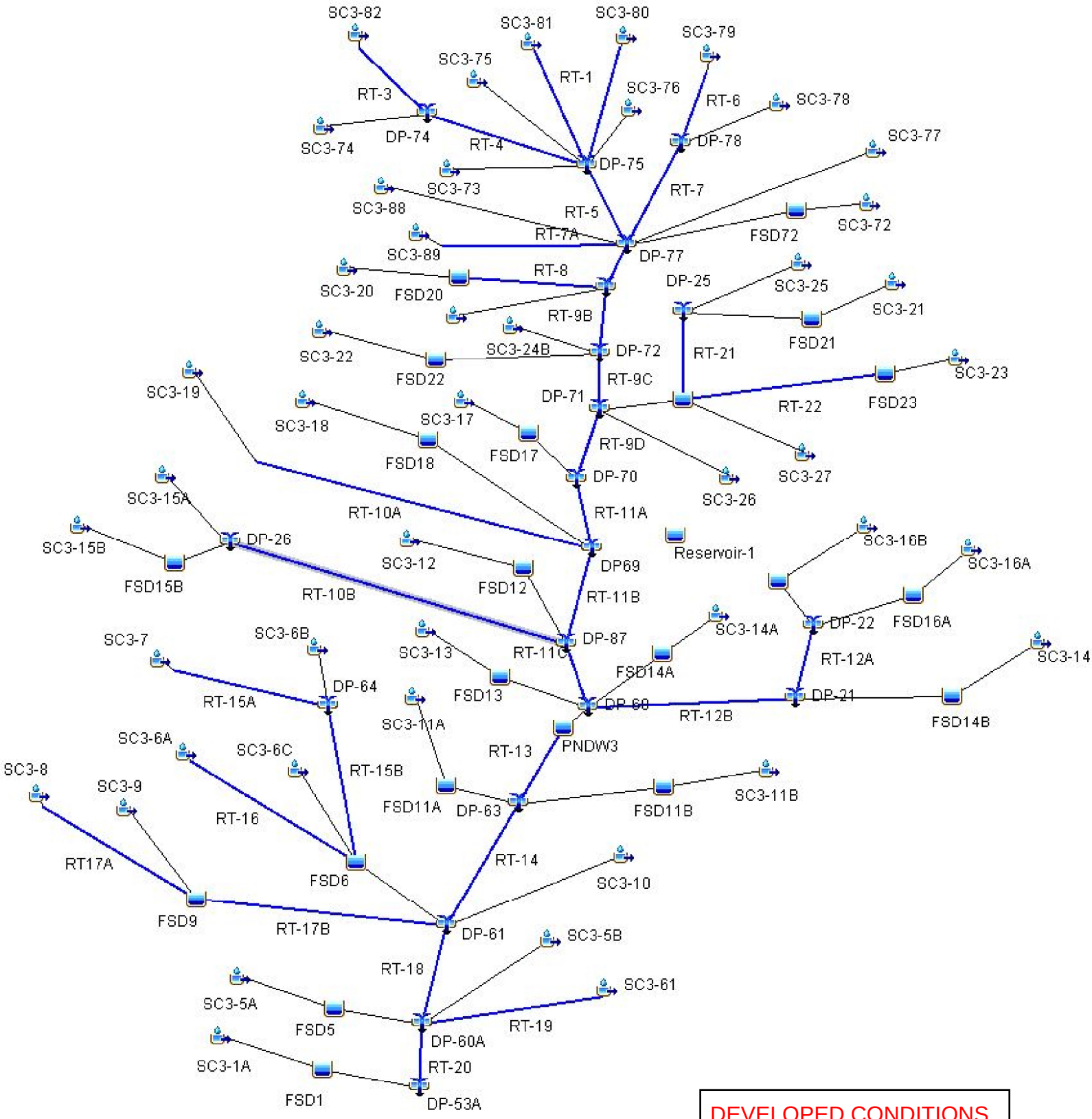
Developed Conditions HEC-HMS Schematic

DCM Land Use/Impervious %/Curve Number Table

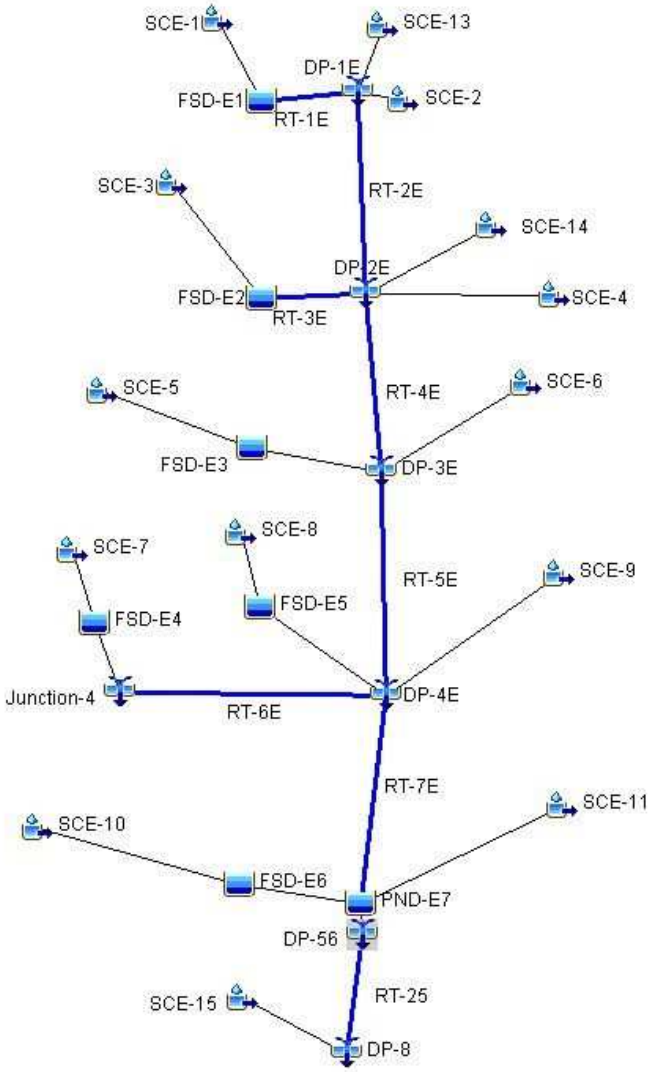
Developed Conditions Composite Curve Number & Impervious % Table

Developed Conditions Lag Time Calculations

Developed Conditions Initial Abstraction Values



DEVELOPED CONDITIONS
HEC-HMS SCHEMATIC -
SAND CREEK BASIN



PROPOSED CONDITIONS -
EAST FORK BASIN
HEC-HMS SCHEMATIC

Sterling Ranch MDDP

Hydrologic Study - Land Use / Imperivous % / CN Table

Land Use	Percent Impervious	Curve Number (CN) Hydrologic Soil Type	
		A	B
Woods/Grass	0	41	62
Grassland (Rangeland)	0	41	62
Exclusion (Floodplain Rangeland)	0.5	41	62
> 5 Acre Rural Residential	7	42	63
5 Acre Rural Residential	10	44	63
2-2.5 Acre Rural Residential	12	46	65
1 Acre Single Family Urban	20	51	68
1/2 Acre Single Family Urban	25	54	70
1/3 Acre Single Family Urban	30	57	72
1/4 Acre Single Family Urban	38	61	75
1/5 Acre Single Family Urban	45	65	83
1/8 Acre Single Family Urban	65	77	85
8-12 DU/AC Multifamiily	70	79	87
12-20 DU/AC Multifamily	80	86	90
Schools	55	71	81
Roads - Paved	100	98	98
Commercial and Business	95	89	92
Industrial	72	81	88
Open Space (Parks)	10	43	64
Utilities	60	74	83
Gravel Pit	27	--	71

Taken from DCM Table 6-10 (NRCS CN ARC II)

Sterling Ranch Master Development Drainage Plan

Sand Creek - Developed Conditions Composite CN & Impervious % Table

8/21/2018

Basin ID	Basin Area (SF)	Basin Area (AC)	Basin Area (SQ MI)	Sub-Area 1 Area (AC)	Sub-Area 1 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 2 Area (AC)	Sub-Area 2 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 3 Area (AC)	Sub-Area 3 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)
SC3-1A	1212906	27.8	0.044	5.5	10	A	43	64	15.3	55	A	71	81	7.1	0.5	B	62	62
SC3-5A	1704646	39.1	0.061	28.2	65	A	77	85	5.5	100	A	98	98	5.4	0.5	B	62	62
SC3-5B	2744509	63.0	0.098	36.3	65	A	77	85	10.4	0.5	B	62	62	16.2	65	B	85	85
SC3-6A	2147750	49.3	0.077	13.0	45	A	65	83	21.7	70	A	79	87	9.1	95	A	89	92
SC3-6B	1345036	30.9	0.048	13.6	45	A	65	83	6.6	55	A	71	81	3.8	100	A	98	98
SC3-6C	2526273	58.0	0.091	5.0	10	A	43	64	45.4	45	A	65	83	5.2	60	A	74	83
SC3-7	1989744	45.7	0.071	21.9	72	A	81	88	23.8	72	B	88	88					
SC3-8	6246166	143.4	0.224	32.4	0	A	41	63	75.8	0	B	62	62	35.1	10	B	63	63
SC3-9	9468334	217.4	0.340	48.2	10	A	44	63	115.75	12	A	46	65	6.0	100	A	98	98
SC3-10	1566853	36.0	0.056	20.0	10	A	44	63	8.6	0.5	B	62	62	7.5	10	B	63	63
SC3-11A	465880	10.7	0.017	6.7	0.5	B	62	62	4.0105	45	B	83	83					
SC3-11B	3336117	76.6	0.120	9.2	12	A	46	65	47.604	45	A	65	83	0.9	100	A	98	98
SC3-12	3841948	88.2	0.138	16.0	0.5	B	62	62	52.1	65	B	85	85	16.3	85	B	92	92
SC3-13	1787204	41.0	0.064	41.0	65	B	85	85										
SC3-14A	7182038	164.9	0.258	8.3	10	A	43	64	90.6	45	A	65	83	32.1	55	A	71	81
SC3-14B	1509758	34.7	0.054	14.3	45	A	65	65	14.3	70	A	79	79	6.1	100	A	98	98
SC3-15A	6085114	139.7	0.218	94.6	0	B	62	62	45.3	10	B	63	63					
SC3-15B	342108	7.9	0.012	5.8	45	B	83	83	2.1	100	B	98	98					
SC3-16A	7323250	168.1	0.263	70.1	65	A	77	77	12.7	65	A	77	85	5.4	65	B	85	85
SC3-16B	2206662	50.7	0.079	47.3	65	A	77	77	3.3	100	A	98	98					
SC3-17	3074520	70.6	0.110	34.6	25	B	70	70	12.8	0.5	B	62	62	20.8	45	B	83	83
SC3-18	2342278	53.8	0.084	32.0	45	B	83	83	12.6	0.5	B	62	62	9.0	100	B	98	98
SC3-19	8013764	184.0	0.287	58.3	10	B	63	63	16.1	5	B	62	62	109.5	0	B	62	62
SC3-20	1488941	34.2	0.053	34.2	12	B	65	65										
SC3-21	1017108	23.3	0.036	15.5	10	B	63	63	5.5	12	B	65	65	2.4	60	B	83	83
SC3-22	1477445	33.9	0.053	33.9	12	B	65	65										
SC3-23	631852	14.5	0.023	11.9	20	B	68	68	2.6	12	B	65	65					
SC3-24A	1555391	35.7	0.056	2.3	25	B	70	70	6.9	20	B	68	68	13.9	12	B	65	65
SC3-24B	531941	12.2	0.019	1.7	30	B	72	72	5.6	0.5	B	62	62	4.9	12	B	65	65
SC3-25	827073	19.0	0.030	7.1	20	B	68	68	7.1	12	B	65	65	4.7	10	B	63	63
SC3-26	433949	10.0	0.016	2.1	12	B	65	65	7.9	0.5	B	62	62					
SC3-27	3049699	70.0	0.109	58.4	30	B	72	72	1.6	25	B	70	70	6.6	20	B	68	68
SC3-61	2855199	65.5	0.102	46.5	10	A	44	63	19.0	10	B	63	63					
SC3-72	2448505	56.2	0.088	35.2	12	B	65	65	21.1	2	B	62	62					
SC3-73	3921483	90.0	0.141	90.0	5	B	63	63										
SC3-74	5213558	119.7	0.187	119.7	10	B	63	63										
SC3-75	3452599	79.3	0.124	79.3	10	B	63	63										
SC3-76	3761442	86.4	0.135	67.2	10	B	63	63	19.2	0	B	62	62					
SC3-77	4658020	106.9	0.167	99.1	2	B	62	62	7.9	0.5	B	62	62					
SC3-78	6778000	155.6	0.243	155.6	10	B	63	63										
SC3-79	8231666	189.0	0.295	189.0	7	B	63	63										
SC3-80	6434190	147.7	0.231	147.7	7	B	63	63										
SC3-81	11449750	262.9	0.411	262.9	2	B	62	62										
SC3-82	5130284	117.8	0.184	117.8	2	B	62	62										
SC3-88	2622908	60.2	0.094	54.7	2	B	62	62	5.5	0.5	B	62	62					
SC3-89	1199327	27.5	0.043	27.5	2	B	62	62										

Basin ID	Sub-Area 4 Area (AC)	Sub-Area 4 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 5 Area (AC)	Sub-Area 5 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 6 Area (AC)	Sub-Area 6 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 7 Area (AC)	Sub-Area 7 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 8 Area (AC)	Sub-Area 8 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 9 Area (AC)	Sub-Area 9 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)
SC3-1A																														
SC3-5A																														
SC3-5B																														
SC3-6A	5.6	100	A	98	98																									
SC3-6B	5.4	55	B	81	81	1.5	100	B	98	98																				
SC3-6C	2.6	100	A	98	98																									
SC3-7																														
SC3-8																														
SC3-9	42.899	10	B	63	63	4.4	100	B	98	98																				
SC3-10																														
SC3-11A																														
SC3-11B	5.3	12	B	65	65	13.6	45	B	83	83																				
SC3-12	3.8	10	B	69	69																									
SC3-13																														
SC3-14A	1.0	100	B	98	98	4.6	100	A	98	98	10.1	0.5	B	62	62	18.1	10	B	64	64										
SC3-14B																														
SC3-15A																														
SC3-15B																														
SC3-16A	34.5	25	B	70	70	1.8	30	B	72	72	26.2	25	A	54	54	6.5	20	B	68	68	10.9	100	A	98	98					
SC3-16B																														
SC3-17	2.321	100	B	98	98																									
SC3-18																														
SC3-19																														
SC3-20																														
SC3-21																														
SC3-22																														
SC3-23																														
SC3-24A	12.6	0.5	B	62	62																									
SC3-24B																														
SC3-25																														
SC3-26																														
SC3-27	3.3	12	B	65	65																									
SC3-61																														
SC3-72																														
SC3-73																														
SC3-74																														
SC3-75																														
SC3-76																														
SC3-77																														
SC3-78																														
SC3-79																														
SC3-80																														
SC3-81																														
SC3-82																														
SC3-88																														
SC3-89																														

Basin ID	Sub-Areas Total (Check)	% HSG A %	% HSG B %	Weighted Sub Areas Imp %	Weighted Sub Area CN No.
SC3-1A	28	74	26	32	73
SC3-5A	39	86	14	61	84
SC3-5B	63	58	42	54	81
SC3-6A	49	100	0	71	88
SC3-6B	31	78	22	58	85
SC3-6C	58	100	0	46	82
SC3-7	46	48	52	72	88
SC3-8	143	23	77	2	62
SC3-9	217	78	22	15	66
SC3-10	36	55	45	8	63
SC3-11A	11	100	0	17	70
SC3-11B	77	75	25	39	80
SC3-12	88	0	100	55	81
SC3-13	41	0	100	65	85
SC3-14A	165	82	18	40	79
SC3-14B	35	0	100	65	77
SC3-15A	140	0	100	3	62
SC3-15B	8	0	100	60	87
SC3-16A	168.0	71	29	51	74
SC3-16B	50.7	100	0	67	78
SC3-17	70.6	0	100	29	73
SC3-18	53.7	0	100	44	81
SC3-19	184	0	100	4	62
SC3-20	34	0	100	12	65
SC3-21	23	0	100	16	66
SC3-22	34	0	100	12	65
SC3-23	15	0	100	19	67
SC3-24A	35.7	0	100	10	65
SC3-24B	12.2	0	100	9	65
SC3-25	19	0	100	15	66
SC3-26	10	0	100	3	63
SC3-27	70	0	100	28	71
SC3-61	65.5	71	29	10	63
SC3-72	56.2	0	100	8	64
SC3-73	90	0	100	5	63
SC3-74	120	0	100	10	63
SC3-75	79	0	100	10	63
SC3-76	86	0	100	8	63
SC3-77	107	0	100	2	62
SC3-78	156	0	100	10	63
SC3-79	189	0	100	7	63
SC3-80	148	0	100	7	63
SC3-81	263	0	100	2	62
SC3-82	118	0	100	2	62
SC3-88	60	0	100	2	62
SC3-89	28	0	100	2	62

Sterling Ranch MDDP - East Fork Basin

Hydrologic Study - Developed Condition Composite CN & Impervious % Table

Basin ID	Basin Area (SF)	Basin Area (AC)	Basin Area (SQ MI)	Sub-Area 1 Area (AC)	Sub-Area 1 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 2 Area (AC)	Sub-Area 2 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 3 Area (AC)	Sub-Area 3 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)
SCE-1	2805264	64.4	0.101	21.2	10	B	63	63	22.2	12	B	65	65	21.1	20	B	68	68
SCE-2	655113	15.0	0.023	15.0	10	B	64	64										
SCE-3	2939174	67.5	0.105	60.2	25	B	70	70	7.3	25	A	54	70					
SCE-4	1287039	29.5	0.046	29.5	25	B	70	70										
SCE-5	3726038	85.5	0.134	85.1	70	A	87	87	0.4	70	B	79	87					
SCE-6	166759	3.8	0.006	3.8	10	A	43	64										
SCE-7	1955020	44.9	0.070	18.84	70	A	79	87	26.04	80	B	86	90					
SCE-8	1108602	25.5	0.040	25.5	95	A	89	92										
SCE-9	175063	4.0	0.006	4.0	10	A	43	64										
SCE-10	7591841	174.3	0.272	174.3	45	A	65	83										
SCE-11	253349	5.8	0.009	5.8	10	A	43	64										
SCE-13	3423352	78.6	0.123	78.6	10	B	63	63										
SCE-14	2286292	52.5	0.082	52.5	10	B	63	63										

Basin ID	Sub-Area 4 Area (AC)	Sub-Area 4 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 5 Area (AC)	Sub-Area 5 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 6 Area (AC)	Sub-Area 6 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 7 Area (AC)	Sub-Area 7 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 8 Area (AC)	Sub-Area 8 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)	Sub-Area 9 Area (AC)	Sub-Area 9 Imp (%)	HSG Type	UA CN Value	CN Value (HSG B)
SCE-1																														
SCE-2																														
SCE-3																														
SCE-4																														
SCE-5																														
SCE-6																														
SCE-7																														
SCE-8																														
SCE-9																														
SCE-10																														
SCE-11																														
SCE-13																														
SCE-14																														

Basin ID	Sub-Areas Total (Check)	% HSG A %	% HSG B %	Weighted Sub Areas Imp %	Weighted Sub Area CN No.
SCE-1	64	0	100	14	65
SCE-2	15	0	100	10	64
SCE-3	68	11	89	25	70
SCE-4	30	0	100	25	70
SCE-5	86	99	1	70	87
SCE-6	4	100	0	10	64
SCE-7	45	42	58	76	89
SCE-8	26	100	0	95	92
SCE-9	4	100	0	10	64
SCE-10	174	100	0	45	83
SCE-11	6	100	0	10	64
SCE-13	79	0	100	10	63
SCE-14	53	0	100	10	63

Sterling Ranch Master Development Drainage Plan

Sand Creek Basin - Developed Condition - Lag Time Calculations

8/21/2018

Basin	OVERLAND FLOW					SHALLOW GUTTER FLOW				SHALLOW CHANNEL FLOW				STORM SEWER FLOW				CHANNELIZED FLOW				Tc	TLag
ID	P2	n	Length	Slope	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Total	0.6*Tc
	(in)		(ft)	(%)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(min)	(min)
SC3-1A	2.1	0.15	100	1.5	13.6	200	1	0.5	1.5	0	0	0	0	800	2.3	8	1.7	0	0	0	0	16.7	10.0
SC3-5A	2.1	0.15	100	2.0	12.1	900	2.0	2.0	2.9	0	0	0	0	600	1.7	8	1.3	0	0	0	0	16.2	9.7
SC3-5B	2.1	0.15	100	2.0	12.1	975	2.5	2.5	3.1	0	0	0	0	1250	1.0	6	3.5	0	0	0	0	18.7	11.2
SC3-6A	2.1	0.15	100	2.0	12.1	1250	2.2	2.2	2.9	0	0	0	0	1030	1.9	8	2.1	0	0	0	0	17.1	10.3
SC3-6B	2.1	0.15	100	2.0	12.1	300	2.0	2.0	2.8	0	0	0	0	1300	2.2	8	2.7	0	0	0	0	17.6	10.6
SC3-6C	2.1	0.15	100	2.0	12.1	950	1.9	1.9	2.8	0	0	0	0	1195	1.7	8	2.5	0	0	0	0	17.4	10.4
SC3-7	2.1	0.15	100	3.0	10.3	0	0	0	0	1175	28	3.0	6.5	0	0	0	0	730	2.7	4.1	3.0	19.8	11.9
SC3-8	2.1	0.15	300	3.8	22.5	0	0	0	0	730	40	3.5	3.5	0	0	0	0	2200	3.6	4.3	8.5	34.5	20.7
SC3-9	2.1	0.15	300	4.0	22.1	0	0	0	0	650	20	2.7	4.0	0	0	0	0	4450	1.8	4.2	17.7	43.7	26.2
SC3-10	2.1	0.15	250	3.2	20.9	0	0	0	0	400	20	3.5	1.9	0	0	0	0	1150	2.0	3.0	6.4	29.2	17.5
SC3-11A	2.1	0.15	100	2.0	12.1	280	10	3.6	3.7	0	0	0	0	100	2.0	8	0.2	0	0	0	0	16.0	9.6
SC3-11B	2.1	0.15	100	2.0	12.1	550	12	2.2	2.9	0	0	0	0	2700	1.6	8	5.6	0	0	0	0	20.6	12.4
SC3-12	2.1	0.15	100	2.0	12.1	1000	30	3.0	3.5	0	0	0	0	400	3.0	10	0.7	0	0	0	0	16.3	9.8
SC3-13	2.1	0.15	100	2.0	12.1	820	18	2.2	3.0	0	0	0	0	1025	1.8	8	2.1	0	0	0	0	17.2	10.6
SC3-14A	2.1	0.15	100	3.0	10.3	875	22	2.5	3.0	0	0	0	0	2575	1.8	8	5.4	0	0	0	0	18.6	11.2
SC3-14B	2.1	0.15	100	2.0	12.1	930	22	2.4	3.1	0	0	0	0	1050	2.3	8	2.2	0	0	0	0	17.4	10.4
SC3-15A	2.1	0.15	300	5.3	19.7	0	0	0	0	1100	40	2.9	6.3	0	0	0	0	4163	2.5	4.1	16.9	42.9	25.8
SC3-15B	2.1	0.15	50	2.0	6.9	1380	23	1.0	2.6	0	0	0	0	0	0	0	0	315	3.8	4.1	1.3	10.8	6.5
SC3-16A	2.1	0.15	100	2.0	12.1	900	28	3.1	3.5	0	0	0	0	4485	2.3	8	9.3	0	0	0	0	24.9	15.0
SC3-16B	2.1	0.15	100	3.0	10.3	0	0	2.4	0	700	20	3.4	3.4	1290	3.6	12	1.8	0	0	0	0	15.5	9.3
SC3-17	2.1	0.15	100	3.0	10.3	0	0	0	0	700	20	3.4	3.4	1290	3.6	12	1.8	0	0	0	0	15.5	8.5
SC3-18	2.1	0.15	100	3.0	10.3	0	0	0	0	800	22	3.4	3.9	200	4.0	12	0.3	0	0	0	0	14.5	8.6
SC3-19	2.1	0.15	300	4.7	20.8	0	0	0	0	770	22	2.7	4.8	0	0	0	0	3900	3.0	4.0	16.3	41.8	25.1
SC3-20	2.1	0.15	200	4.0	16.0	0	0	0	0	70	2	2.7	0.4	0	0	0	0	975	4.3	3.1	5.2	21.6	13.0
SC3-21	2.1	0.15	200	4.0	16.0	0	0	0	0	630	26	3.1	3.4	0	0	0	0	875	3.4	3.4	4.3	23.6	14.2
SC3-22	2.1	0.15	200	4.0	16.0	0	0	0	0	400	16	3.0	2.2	0	0	0	0	1350	2.8	3.4	6.6	24.8	14.9
SC3-23	2.1	0.15	200	5.0	14.6	0	0	0	0	275	12	3.3	1.4	200	4.0	12	0.3	450	3.5	2.8	2.7	18.9	11.4
SC3-24A	2.1	0.15	200	3.0	17.9	0	0	0	0	495	18	2.9	2.8	0	0	0	0	1780	1.6	2.9	10.2	31.0	18.6
SC3-24B	2.1	0.15	200	3.0	17.9	0	0	0	0	320	14	3.3	1.6	0	0	0	0	930	4.5	2.9	5.3	24.9	14.9
SC3-25	2.1	0.15	200	6.0	13.6	0	0	0	0	340	20	2.7	2.1	600	2.0	8	1.3	960	1.9	2.1	7.6	24.5	14.7
SC3-26	2.1	0.15	100	2.0	12.1	0	0	0	0	0	0	0	0	0	0	0	0	1300	1.7	2.0	10.8	22.9	13.8
SC3-27	2.1	0.15	100	3.0	10.3	900	28.0	3.1	3.5	0	0	0	0	1800	2.0	8	3.8	0	0	0	0	17.5	10.5
SC3-61	2.1	0.15	200	3.0	17.9	0	0	0	0	0	0	0	0	0	0	0	0	2500	1.8	3.4	12.3	30.2	18.1
SC3-72	2.1	0.15	250	4.0	19.1	0	0	0	0	1025	4.4	3.8	4.5	0	0	0	0	1595	4.4	4.0	6.6	30.2	18.1
SC3-73	2.1	0.15	300	3.3	23.7	0	0	0	0	1650	3.3	2.9	9.5	0	0	0	0	1230	3.3	4.2	4.9	38.1	22.9
SC3-74	2.1	0.15	300	4.7	20.8	0	0	0	0	2000	2.6	2.8	11.9	0	0	0	0	770	2.6	3.9	3.3	35.9	21.6
SC3-75	2.1	0.15	300	3.3	23.7	0	0	0	0	1200	2.8	2.7	7.4	0	0	0	0	2300	2.8	3.1	12.4	43.5	26.1
SC3-76	2.1	0.15	300	3.3	23.7	0	0	0	0	1160	2.6	3.1	6.2	0	0	0	0	3025	2.6	3.6	14.0	44.0	26.4
SC3-77	2.1	0.15	300	4.7	20.8	0	0	0	0	1250	2.7	2.7	7.7	0	0	0	0	3600	2.7	4.4	13.6	42.1	25.3
SC3-78	2.1	0.15	300	3.3	23.7	0	0	0	0	1560	3.2	3.3	7.9	0	0	0	0	1850	3.2	4.5	6.9	38.5	23.1
SC3-79	2.1	0.15	300	4.0	22.1	0	0	0	0	1740	1.8	3.5	8.3	0	0	0	0	1100	1.8	3.0	6.1	36.5	21.9
SC3-80	2.1	0.15	300	5.0	20.2	0	0	0	0	1625	2.8	3.4	8.0	0	0	0	0	2140	2.8	4.1	8.7	36.9	22.1
SC3-81	2.1	0.15	300	6.7	18.0	0	0	0	0	2000	3.1	3.4	9.8	0	0	0	0	3600	3.1	4.9	12.2	40.0	24.0
SC3-82	2.1	0.15	300	3.3	23.7	0	0	0	0	2000	3.2	3.3	10.1	0	0	0	0	625	3.2	4.1	2.5	36.4	21.8
SC3-88	2.1	0.15	300	4.7	20.8	0	0	0	0	825	3.8	3.3	4.2	0	0	0	0	2400	3.8	3.9	10.3	35.2	21.1
SC3-89	2.1	0.15	200	4.0	16.0	0	0	0	0	910	4.1	4.0	3.8	0	0	0	0	830	4.1	3.5	4.0	23.7	14.2

DCM TABLE 6-25 WAS USED FOR SHALLOW CONCENTRATED SWALE & GUTTER FLOW
N VALUE FOR OVERLAND FLOW WAS ASSUMED TO BE 0.15 FOR ALL BASINS
A ROUGHNESS COEFFICENT OF 0.050 WAS USED FOR EARTHEN CHANNEL BOTTOMS
A ROUGHNESS COEFFICENT OF 0.013 WAS USED FOR CONCRETE LINED CONVEYANCES

Sterling Ranch MDDP - East Fork Basin

Hydrologic Study - Developed Condition - Lag Time Calculations

Basin	OVERLAND FLOW					SHALLOW GUTTER FLOW				SHALLOW CHANNEL FLOW				STORM SEWER FLOW				CHANNELIZED FLOW				Tc	TLag
ID	P2	n	Length	Slope	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Total	0.6*Tc
	(in)		(ft)	(%)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(min)	(min)
SCE-1	2.1	0.15	100	3.9	9.3	500	2.8	0.5	1.5	0	0	0.0	0.0	1500	1.2	8	3.1	0	0.0	0.0	0.0	13.9	8.3
SCE-2	2.1	0.15	100	2.0	12.1	50	3.0	2.0	2.9	0	0	0.0	0.0	1800	1.4	8	3.8	0	0.0	0.0	0.0	18.7	11.2
SCE-3	2.1	0.15	100	2.0	12.1	350	2.0	2.0	2.8	0	0	0.0	0.0	2000	1.4	8	4.2	0	0.0	0.0	0.0	19.1	11.4
SCE-4	2.1	0.15	75	2.0	9.6	25	3.3	1.9	2.8	0	0	0.0	0.0	3350	0.6	8	7.0	0	0.0	0.0	0.0	19.4	11.6
SCE-5	2.1	0.15	150	3.0	14.2	830	2.7	2.7	2.8	0	0	0.0	0.0	556	1.2	7	1.3	0	0.0	0.0	0.0	18.3	11.0
SCE-6	2.1	0.15	25	2.0	4.0	25	3.1	3.0	2.8	0	0	0.0	0.0	123	1.5	8	0.3	0	0.0	0.0	0.0	7.0	4.2
SCE-7	2.1	0.15	100	2.0	12.1	400	2.9	2.1	2.8	0	0	0.0	0.0	754	1.8	7	1.8	0	0.0	0.0	0.0	16.7	10.0
SCE-8	2.1	0.15	100	2.0	12.1	300	2.8	3.4	2.8	0	0	0.0	0.0	650	1.5	7	1.5	0	0.0	0.0	0.0	16.4	9.9
SCE-9	2.1	0.15	35	2.0	5.2	25	3.5	3.6	3.7	0	0	0.0	0.0	100	2.0	8	0.2	0	0.0	0.0	0.0	9.1	5.5
SCE-10	2.1	0.15	150	2.0	16.7	900	2.5	2.2	2.9	0	0	0.0	0.0	2700	1.6	8	5.6	0	0.0	0.0	0.0	25.3	15.2
SCE-11	2.1	0.15	25	2.0	4.0	25	3	3.0	3.5	0	0	0.0	0.0	400	3.0	7	1.0	0	0.0	0.0	0.0	8.4	5.1
SCE-13	2.1	0.15	160	2.0	17.6	500	2.5	2.5	3.1	0	0	0.0	0.0	500	2.4	6	1.4	0	0.0	0.0	0.0	22.1	13.3
SCE-14	2.1	0.15	160	2.0	17.6	450	2.5	2.2	2.9	0	0	0.0	0.0	500	2.0	8	1.0	0	0.0	0.0	0.0	21.6	12.9

DCM TABLE 6-25 WAS USED FOR SHALLOW CONCENTRATED SWALE & GUTTER FLOW
N VALUE FOR OVERLAND FLOW WAS ASSUMED TO BE 0.15 FOR ALL BASINS
A ROUGHNESS COEFFICENT OF 0.050 WAS USED FOR EARTHEN CHANNEL BOTTOMS
A ROUGHNESS COEFFICENT OF 0.013 WAS USED FOR CONCRETE LINED CONVEYANCES

Sterling Ranch MDDP
Hydrologic Study -Developed Conditions - Reach Data
8/21/2018

Reach ID	Reach Length L1 (ft)	Reach Vert. Drop H1 (ft)	Reach Slope S1 %	Mannings N Value n	Reach Side Slope SS (H/V)	Bottom Width BW (ft)	Diameter D ft
RT-1	3975	100	2.5%	0.05	10	6	N/A
RT-2	4570	120	2.6%	0.05	10	6	N/A
RT-3	2360	65	2.8%	0.05	10	6	N/A
RT-4	2695	65	2.4%	0.05	10	6	N/A
RT-5	4100	92	2.2%	0.05	6	10	N/A
RT-6A	3030	100	3.3%	0.05	10	6	N/A
RT-6B	6145	122	2.0%	0.05	10	6	N/A
RT-7A	1050	35	3.3%	0.013			4
RT-8	625	24	3.8%	0.013			2
RT-9A	2600	40	1.5%	0.05	6	30	N/A
RT-9B	760	17	2.2%	0.05	6	30	N/A
RT-9C	1450	26	1.8%	0.05	6	30	N/A
RT-9D	1490	28	1.9%	0.05	6	30	N/A
RT-10A	1940	42	2.2%	0.013			5
RT-10B	1560	42	2.7%	0.013			5
RT-11A	1275	26	2.0%	0.05	6	30	N/A
RT-11B	2960	46	1.6%	0.05	6	30	N/A
RT-12A	2590	40	1.5%	0.05	6	40	
RT-12B	4200	66	1.6%	0.035	4	15	
RT-13	1550	20	1.3%	0.05	6	40	N/A
RT-14	1765	35	2.0%	0.05	6	40	N/A
RT-15A	900	24	2.7%	0.013			4
RT-15B	1450	30	2.1%	0.013			6
RT-16	1250	24	1.9%	0.013			3.5
RT-17A	5000	108	2.2%	0.04	4	4	N/A
RT-17B	3675	76	2.1%	0.013			4
RT-18	2500	41	1.6%	0.05	6	40	N/A
RT-19	1200	6	0.5%	0.013			6
RT-20	1480	22	1.5%	0.05	6	40	N/A
RT-21	3300	75	2.3%	0.013			3.5
RT-22	2000	38	1.9%	0.013			3

Sterling Ranch - East Fork Basin
Hydrologic Study - Developed Conditions - Reach Data

Reach ID	Reach Length L1 (ft)	Reach Vert. Drop H1 (ft)	Reach Slope S1 %	Mannings N Value n	Reach Side Slope SS (H/V)	Bottom Width BW (ft)	Diameter D ft
RT-1E	300	6	2.0%	0.013	N/A	N/A	4
RT-2E	2000	40	2.0%	0.013	N/A	N/A	4
RT-3E	400	10	2.5%	0.013	N/A	N/A	4
RT-4E	3600	90	2.5%	0.013	N/A	N/A	4
RT-5E	1250	31	2.5%	0.013	N/A	N/A	5
RT-6E	1485	37	2.5%	0.013	N/A	N/A	4
RT-7E	1410	35	2.5%	0.013	N/A	N/A	6

Section E.

Allowable Release Rates (Full Spectrum Detention Pond Worksheets)

Pond Volume Calculations

Composite FSD Calculations

Pond PNDW3 Exhibits

Briargate Parkway Culvert Calculations

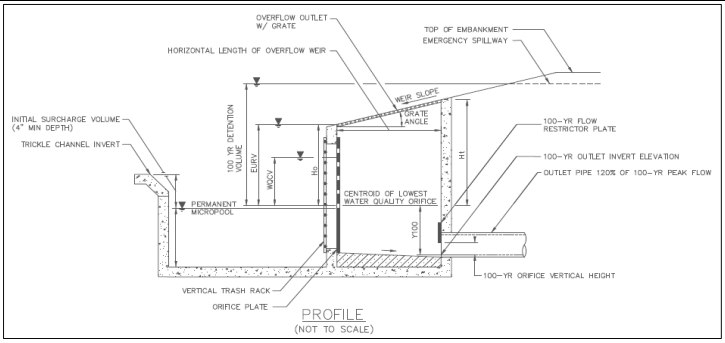
Sterling Ranch Road Culvert Calculations

Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD1



User Input: Watershed Parameters

Watershed Area =	27.80	acres
Watershed Length =	1,523	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	32.0%	percent
Percentage Hydrologic Soil Group A =	74%	percent
Percentage Hydrologic Soil Group B =	26%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	39,601	ft^3
Routed EURV =	0.907	acre-ft
Routed EURV =	39,501	ft^3
Calc. vs. Req Volume % Diff =	**-0.3%**	
EURV Drain Time =	51.53	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	3.60	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	145	ft^2
Maximum EURV Ponding Depth =	3.33	ft
Depth Where Basin Floor Meets Side Slopes =	1.61	ft

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.6	ft
Grate Open Area / 100-yr Orifice Area =	102.7	should be $\geq$ 4
Overflow Weir Slope Length =	8.2	ft
Overflow Grate Open Area w/o Debris =	185	ft^2

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	3.6	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	32.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	8.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	1.67	1.67	30.00					
Stage [ft]	0.00	1.20	2.40					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	21.0	in
100-Year Restrictor Plate Height =	14.7	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	1.80	ft^2
100-Year Orifice Centroid =	0.68	ft
Half-Central Angle of Plate on Pipe =	1.98	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	5.2	ft (relative to lowest WQ orifice)
Spillway Crest Length =	23	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

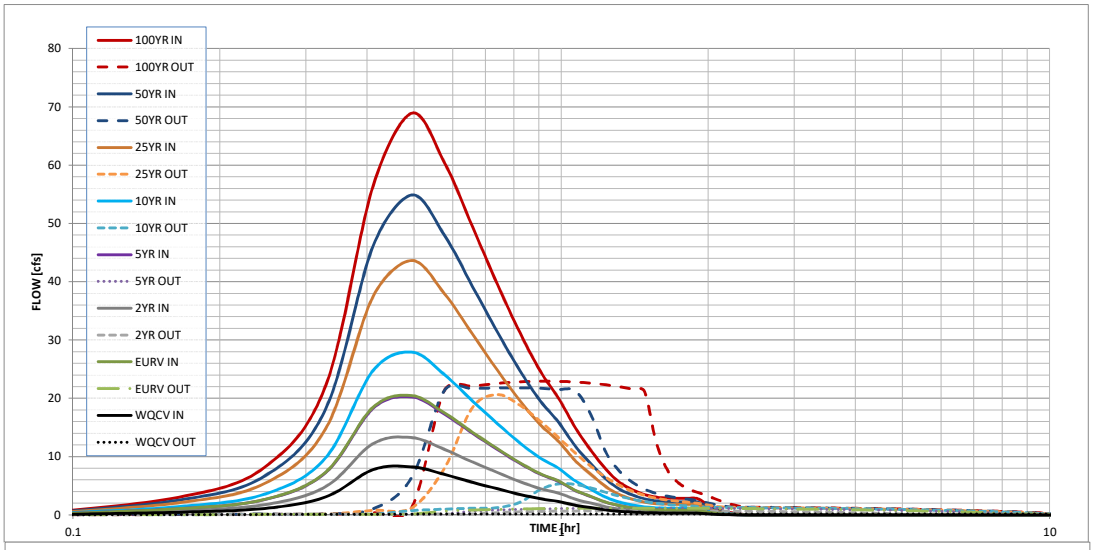
Calculated Spillway Parameters

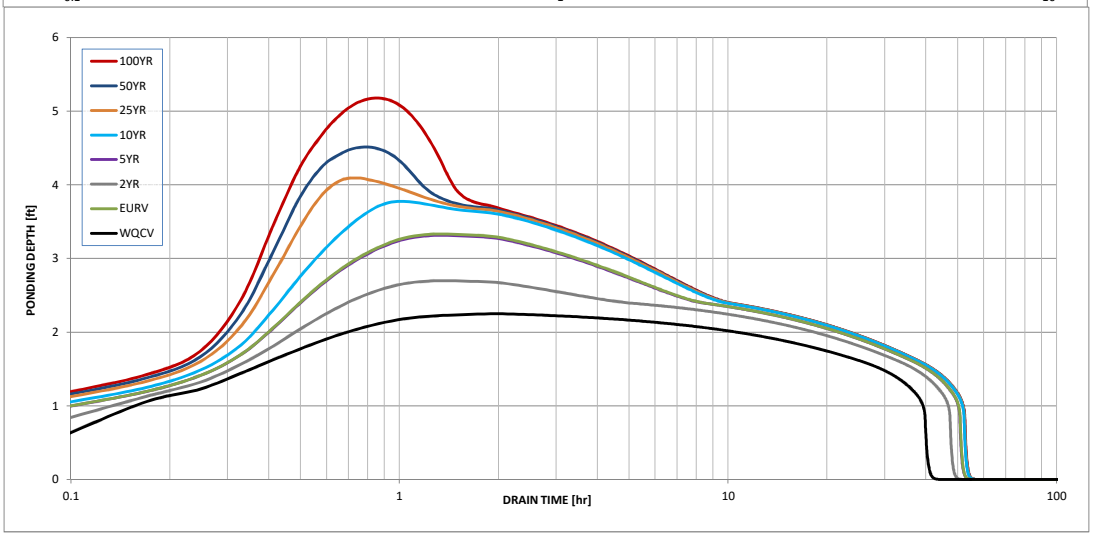
Depth of Flow through Spillway =	0.9	ft
Stage at Top of Freeboard =	7.1	ft
Detention Basin Area at Top of Freeboard =	0.66	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.365	0.909	0.588	0.900	1.244	1.947	2.445	3.059	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.364	0.909	0.588	0.899	1.243	1.947	2.444	3.059	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.06	0.12	0.39	0.63	0.92	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.1	1.7	3.3	10.9	17.5	25.5	cfs
Peak Inflow Q	8.2	20.4	13.3	20.2	27.9	43.6	54.9	68.9	cfs
Peak Outflow Q	0.1	1.2	0.7	1.1	5.3	20.6	21.8	22.9	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.7	1.6	1.9	1.2	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	N/A	0.0	0.1	0.1	0.1	fps
Time to Drain Detention Basin	**40**	52	48	51	53	53	53	53	hours
Maximum Ponding Depth	2.25	3.33	2.70	3.31	3.78	4.09	4.51	5.17	ft
Maximum Ponded Area	0.387	0.443	0.409	0.441	0.466	0.484	0.506	0.545	acres
Maximum Volume Stored	0.343	0.791	0.520	0.782	0.992	1.142	1.348	1.698	ac-ft



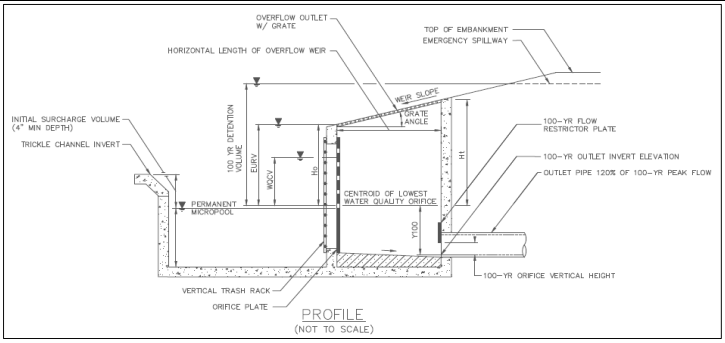


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD5



User Input: Watershed Parameters

Watershed Area =	39.10	acres
Watershed Length =	2,000	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.0%	percent
Percentage Hydrologic Soil Group A =	86%	percent
Percentage Hydrologic Soil Group B =	14%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	124,762	ft^3
Routed EURV =	2.862	acre-ft
Routed EURV =	124,679	ft^3
Calc. vs. Req Volume % Diff =	**-0.1%**	
EURV Drain Time =	73.88	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	309	ft^2
Maximum EURV Ponding Depth =	5.73	ft
Depth Where Basin Floor Meets Side Slopes =	1.73	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	6.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	18.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	6.3	ft
Grate Open Area / 100-yr Orifice Area =	7.1	should be $\geq$ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	13	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	4.26	4.26	21.10					
Stage [ft]	0.00	2.00	4.00					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	21.0	in
100-Year Restrictor Plate Height =	15.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	1.84	ft^2
100-Year Orifice Centroid =	0.70	ft
Half-Central Angle of Plate on Pipe =	2.01	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	7.7	ft (relative to lowest WQ orifice)
Spillway Crest Length =	43	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

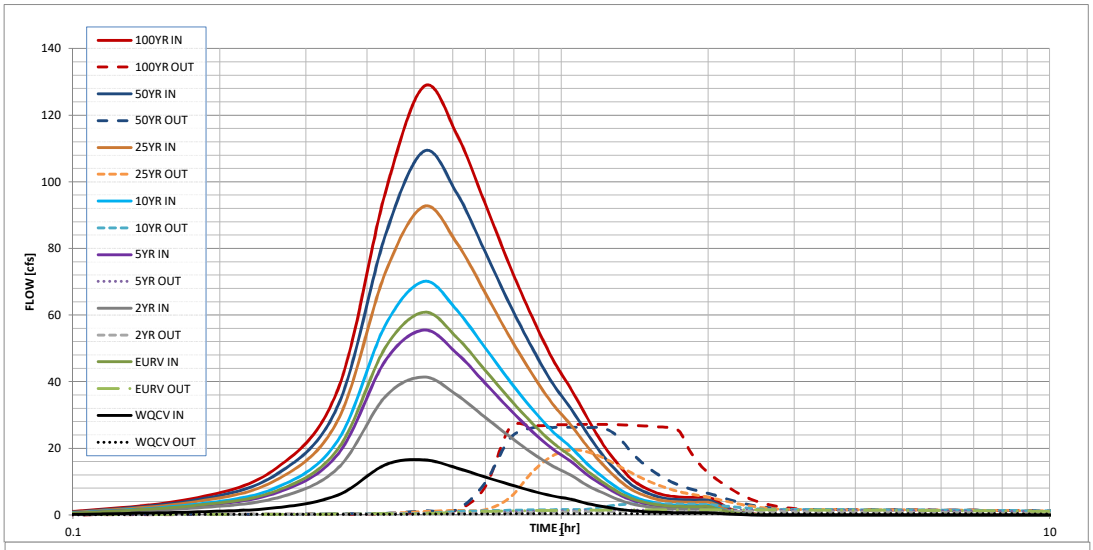
Calculated Spillway Parameters

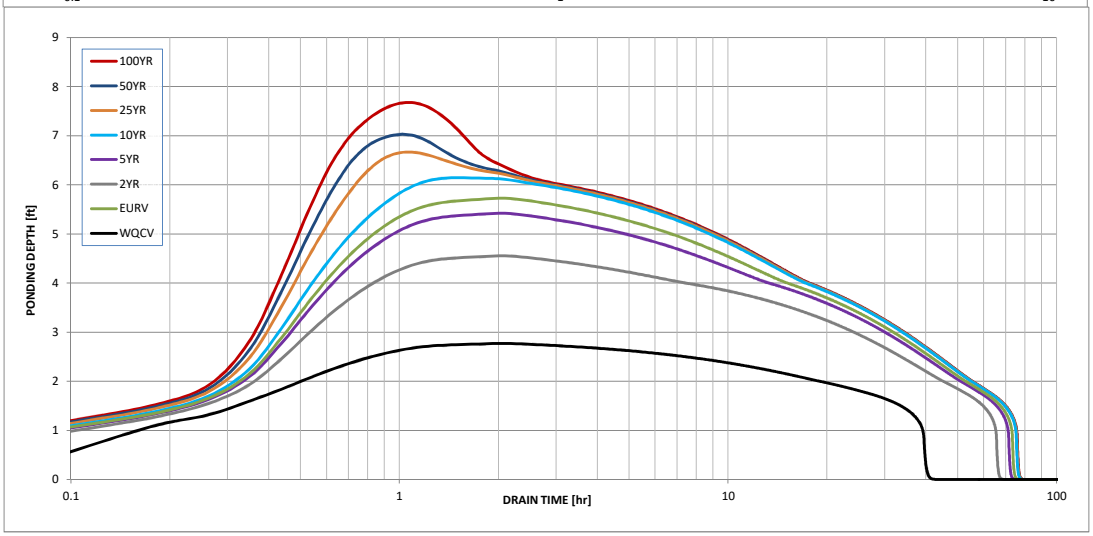
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	9.7	ft
Detention Basin Area at Top of Freeboard =	1.04	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.781	2.864	1.956	2.617	3.293	4.340	5.117	6.027	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.780	2.864	1.955	2.617	3.292	4.339	5.113	6.020	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.04	0.07	0.29	0.51	0.77	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.1	1.4	2.6	11.3	19.8	30.2	cfs
Peak Inflow Q	16.6	60.8	41.4	55.5	70.0	92.5	109.2	128.6	cfs
Peak Outflow Q	0.4	1.5	1.1	1.4	3.4	19.5	26.3	27.3	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	1.0	1.3	1.7	1.3	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	N/A	0.1	1.4	1.9	1.9	fps
Time to Drain Detention Basin	**40**	74	66	72	76	76	76	76	hours
Maximum Ponding Depth	2.77	5.73	4.55	5.42	6.15	6.67	7.03	7.68	ft
Maximum Ponded Area	0.560	0.750	0.673	0.730	0.779	0.818	0.842	0.890	acres
Maximum Volume Stored	0.726	2.664	1.826	2.434	2.983	3.402	3.698	4.263	ac-ft



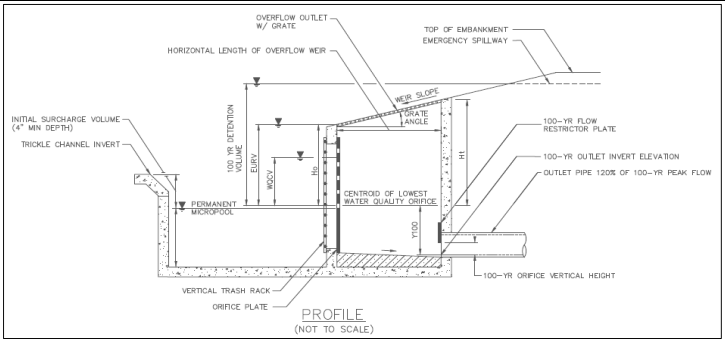


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD6



User Input: Watershed Parameters

Watershed Area =	183.90	acres
Watershed Length =	4,209	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.0%	percent
Percentage Hydrologic Soil Group A =	83%	percent
Percentage Hydrologic Soil Group B =	17%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	584,892	ft^3
Routed EURV =	13.430	acre-ft
Routed EURV =	585,016	ft^3
Calc. vs. Req Volume % Diff =	**0.0%**	
EURV Drain Time =	73.57	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	1454	ft^2
Maximum EURV Ponding Depth =	5.77	ft
Depth Where Basin Floor Meets Side Slopes =	3.30	ft

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	6.3	ft
Grate Open Area / 100-yr Orifice Area =	6.3	should be ≥ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	62	ft^2

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	6.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	86.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	15.26	15.26	116.17					
Stage [ft]	0.00	2.00	4.00					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	48.0	in
100-Year Restrictor Plate Height =	35.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	9.82	ft^2
100-Year Orifice Centroid =	1.62	ft
Half-Central Angle of Plate on Pipe =	2.05	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	7.7	ft (relative to lowest WQ orifice)
Spillway Crest Length =	203	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

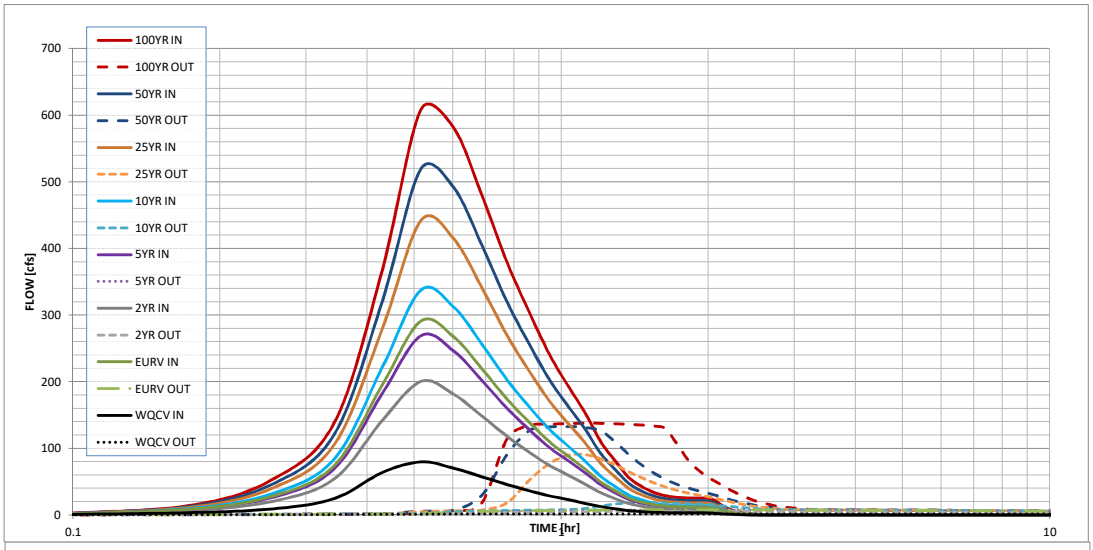
Calculated Spillway Parameters

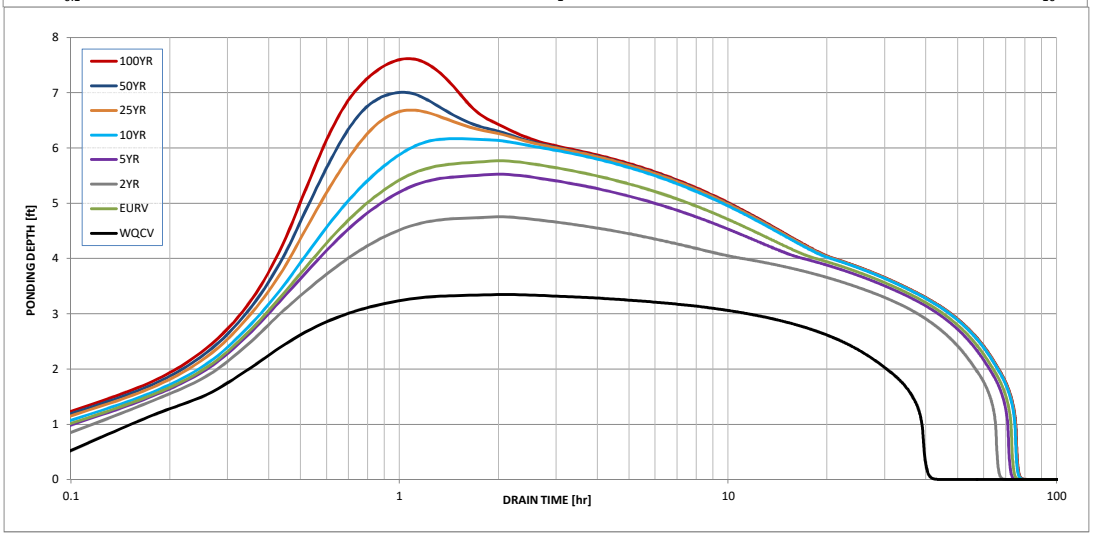
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	9.7	ft
Detention Basin Area at Top of Freeboard =	4.57	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	3.671	13.427	9.238	12.399	15.601	20.527	24.207	28.510	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	3.684	13.468	9.263	12.439	15.647	20.599	24.291	28.602	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.04	0.08	0.32	0.54	0.81	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.5	7.6	14.6	58.4	99.6	149.7	cfs
Peak Inflow Q	79.5	290.8	200.6	268.8	337.3	442.1	519.5	608.6	cfs
Peak Outflow Q	1.5	7.4	5.3	6.9	18.1	90.3	132.8	137.8	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.9	1.2	1.5	1.3	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	N/A	0.1	1.1	2.0	2.1	fps
Time to Drain Detention Basin	**40**	74	66	72	76	76	76	76	hours
Maximum Ponding Depth	3.35	5.77	4.76	5.52	6.17	6.68	7.01	7.61	ft
2.8 Maximum Ponded Area	3.553	3.926	3.768	3.894	3.990	4.070	4.135	4.233	acres
Maximum Volume Stored	3.451	12.517	8.609	11.549	14.094	16.170	17.519	20.049	ac-ft





Initial Design for Full Spectrum Detention Basins

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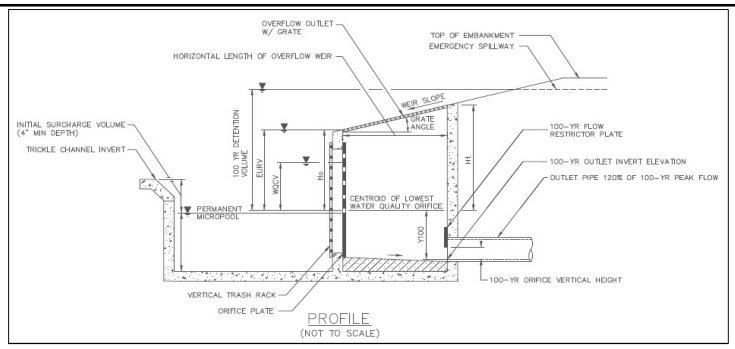
Project: Sterling Ranch MDDP

Basin ID: FSD11A



User Input: Watershed Parameters

Watershed Area =	10.70	acres
Watershed Length =	1,400	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	17.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	7,791	ft^3
Routed EURV =	0.178	acre-ft
Routed EURV =	7,761	ft^3
Calc. vs. Req Volume % Diff =	**-0.4%**	
EURV Drain Time =	61.35	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	2.80	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	36	ft^2
Maximum EURV Ponding Depth =	2.71	ft
Depth Where Basin Floor Meets Side Slopes =	1.21	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	2.8	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	8.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	3.1	ft
Grate Open Area / 100-yr Orifice Area =	6.7	should be $\geq$ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	6	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	0.42	0.42	0.42					
Stage [ft]	0.00	0.93	1.87					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	18.0	in
100-Year Restrictor Plate Height =	8.8	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	0.86	ft^2
100-Year Orifice Centroid =	0.42	ft
Half-Central Angle of Plate on Pipe =	1.55	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	5.4	ft (relative to lowest WQ orifice)
Spillway Crest Length =	9	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

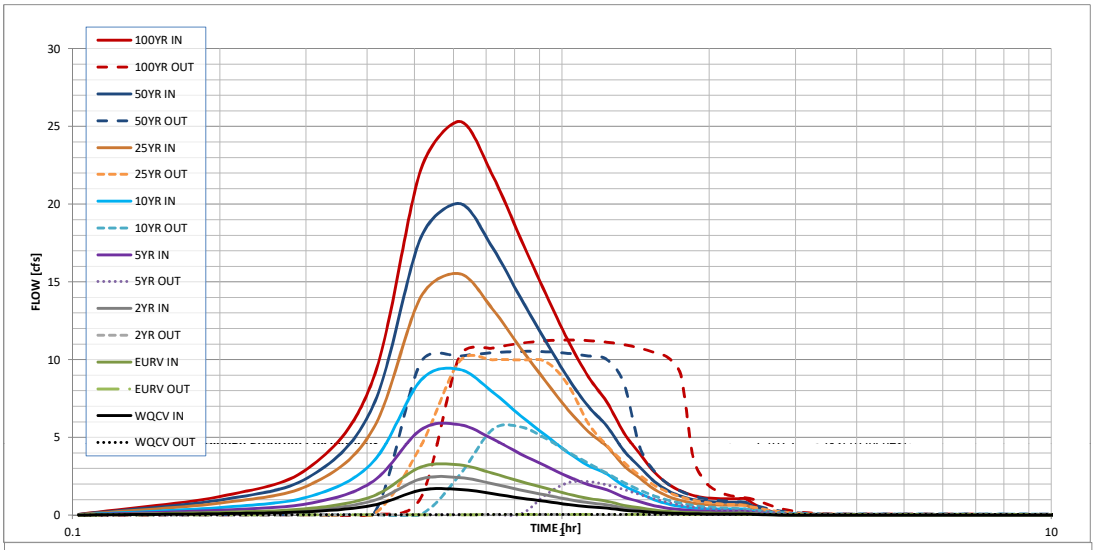
Calculated Spillway Parameters

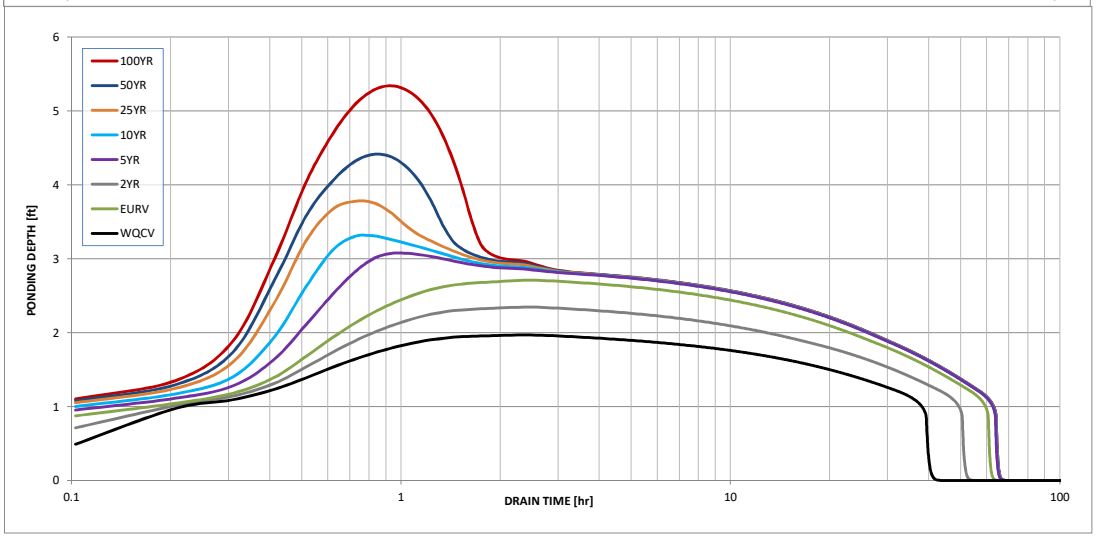
Depth of Flow through Spillway =	0.8	ft
Stage at Top of Freeboard =	7.2	ft
Detention Basin Area at Top of Freeboard =	0.28	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.092	0.179	0.134	0.322	0.519	0.863	1.115	1.410	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.091	0.178	0.133	0.322	0.519	0.863	1.115	1.410	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.15	0.30	0.70	0.90	1.16	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.1	1.6	3.2	7.5	9.7	12.4	cfs
Peak Inflow Q	1.7	3.2	2.4	5.8	9.4	15.5	20.0	25.3	cfs
Peak Outflow Q	0.0	0.1	0.0	2.2	5.7	10.0	10.5	11.3	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	1.4	1.8	1.3	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.4	0.9	1.7	1.8	1.9	fps
Time to Drain Detention Basin	**40**	61	51	64	65	65	65	65	hours
Maximum Ponding Depth	1.97	2.71	2.35	3.07	3.31	3.77	4.41	5.34	ft
2.8 Maximum Ponded Area	0.104	0.123	0.113	0.134	0.140	0.155	0.175	0.207	acres
Maximum Volume Stored	0.084	0.168	0.125	0.215	0.247	0.316	0.421	0.598	ac-ft





Initial Design for Full Spectrum Detention Basins

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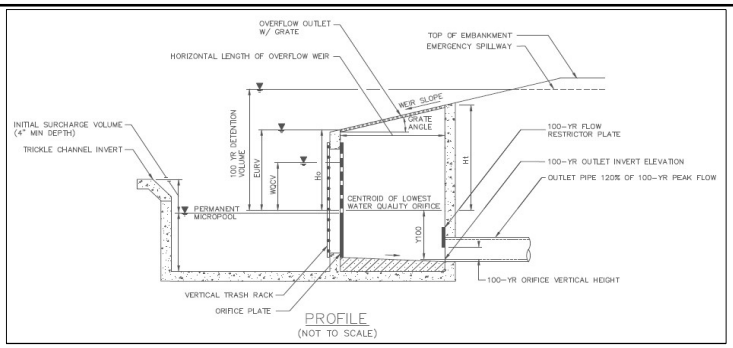
Project: Sterling Ranch MDDP

Basin ID: FSD11B



User Input: Watershed Parameters

Watershed Area =	76.60	acres
Watershed Length =	2,500	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	39.0%	percent
Percentage Hydrologic Soil Group A =	75%	percent
Percentage Hydrologic Soil Group B =	25%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	139,156	ft^3
Routed EURV =	3.190	acre-ft
Routed EURV =	138,972	ft^3
Calc. vs. Req Volume % Diff =	**-0.1%**	
EURV Drain Time =	73.12	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.60	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	448	ft^2
Maximum EURV Ponding Depth =	4.47	ft
Depth Where Basin Floor Meets Side Slopes =	2.13	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.6	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	42.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	4.9	ft
Grate Open Area / 100-yr Orifice Area =	6.5	should be $\geq$ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	30	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	5.04	5.04	10.39					
Stage [ft]	0.00	1.53	3.07					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	33.0	in
100-Year Restrictor Plate Height =	24.3	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	4.69	ft^2
100-Year Orifice Centroid =	1.12	ft
Half-Central Angle of Plate on Pipe =	2.06	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	6.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	70	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

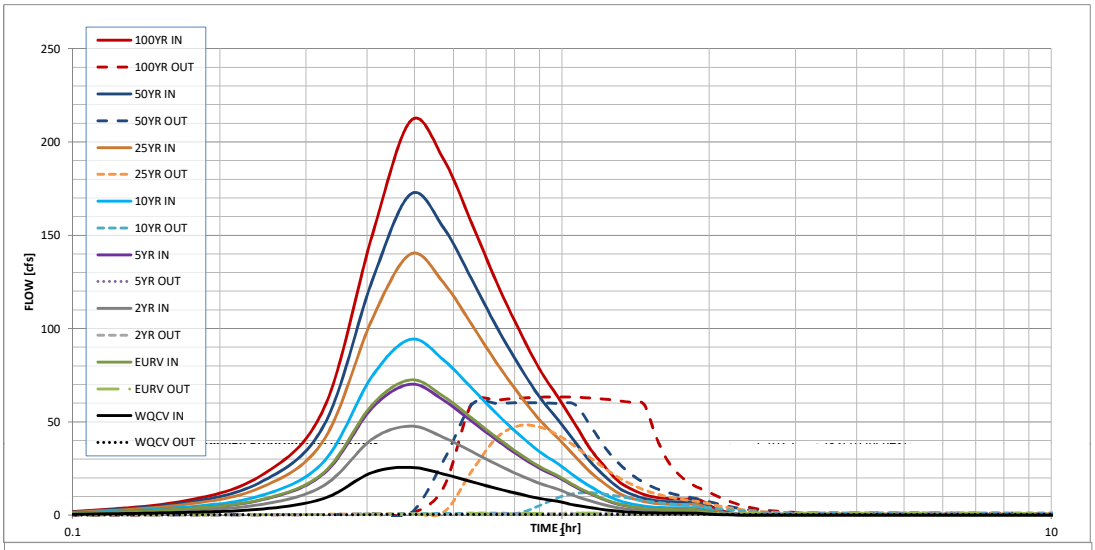
Calculated Spillway Parameters

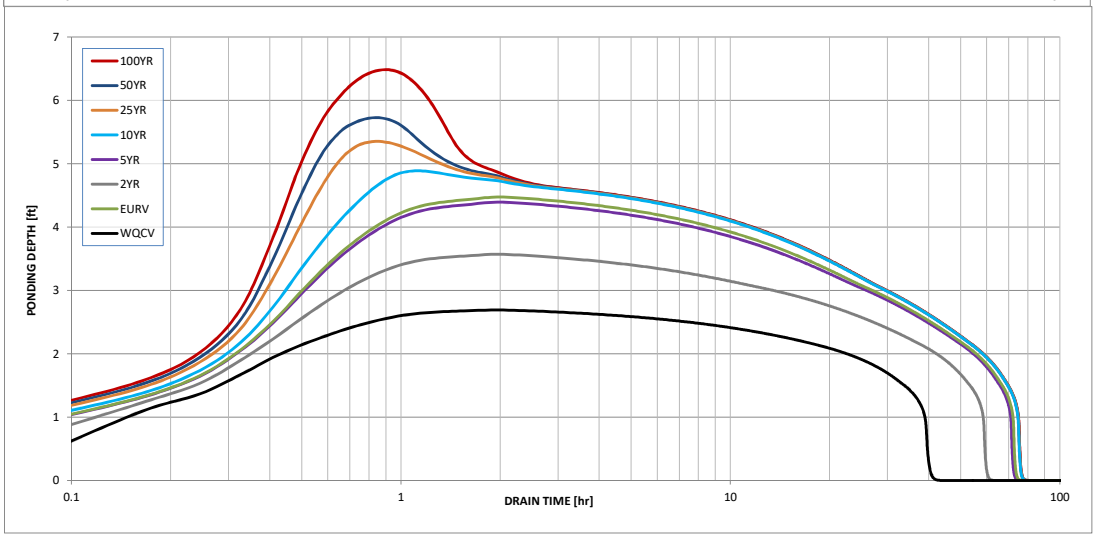
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	8.5	ft
Detention Basin Area at Top of Freeboard =	1.56	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	1.131	3.195	2.114	3.094	4.147	6.143	7.556	9.274	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	1.131	3.194	2.113	3.093	4.147	6.138	7.550	9.270	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.06	0.11	0.39	0.62	0.91	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.3	4.5	8.7	29.6	47.7	69.6	cfs
Peak Inflow Q	25.6	72.4	47.7	70.1	94.3	139.9	172.1	211.2	cfs
Peak Outflow Q	0.5	1.1	0.8	1.0	12.1	48.0	60.2	63.3	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.2	1.4	1.6	1.3	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	N/A	0.3	1.5	1.9	2.0	fps
Time to Drain Detention Basin	**40**	73	60	72	76	76	76	76	hours
Maximum Ponding Depth	2.69	4.47	3.57	4.39	4.89	5.35	5.72	6.48	ft
2.8 Maximum Ponded Area	1.041	1.192	1.113	1.185	1.227	1.268	1.303	1.373	acres
Maximum Volume Stored	1.064	3.052	2.007	2.953	3.551	4.128	4.612	5.627	ac-ft



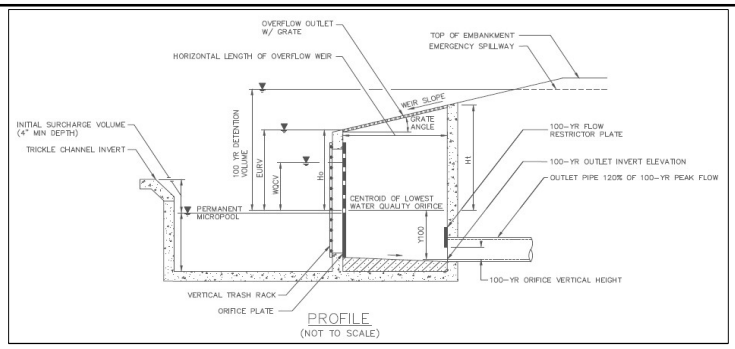


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD12



User Input: Watershed Parameters

Watershed Area =	88.20	acres
Watershed Length =	4,200	ft
Watershed Slope =	0.021	ft/ft
Watershed Imperviousness =	55.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	228,233	ft^3
Routed EURV =	5.232	acre-ft
Routed EURV =	227,912	ft^3
Calc. vs. Req Volume % Diff =	**-0.1%**	
EURV Drain Time =	69.19	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.75	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	642	ft^2
Maximum EURV Ponding Depth =	4.50	ft
Depth Where Basin Floor Meets Side Slopes =	2.59	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.8	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	63.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.0	ft
Grate Open Area / 100-yr Orifice Area =	6.3	should be $\geq$ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	45	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	6.93	6.93	46.31					
Stage [ft]	0.00	1.58	3.17					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	42.0	in
100-Year Restrictor Plate Height =	29.5	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	7.22	ft^2
100-Year Orifice Centroid =	1.37	ft
Half-Central Angle of Plate on Pipe =	1.99	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	6.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	92	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

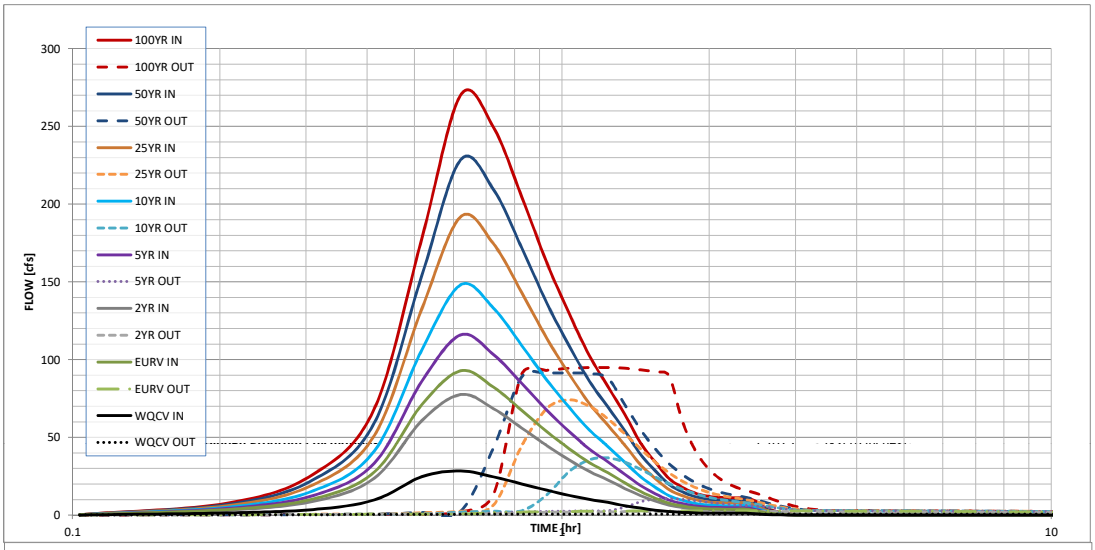
Calculated Spillway Parameters

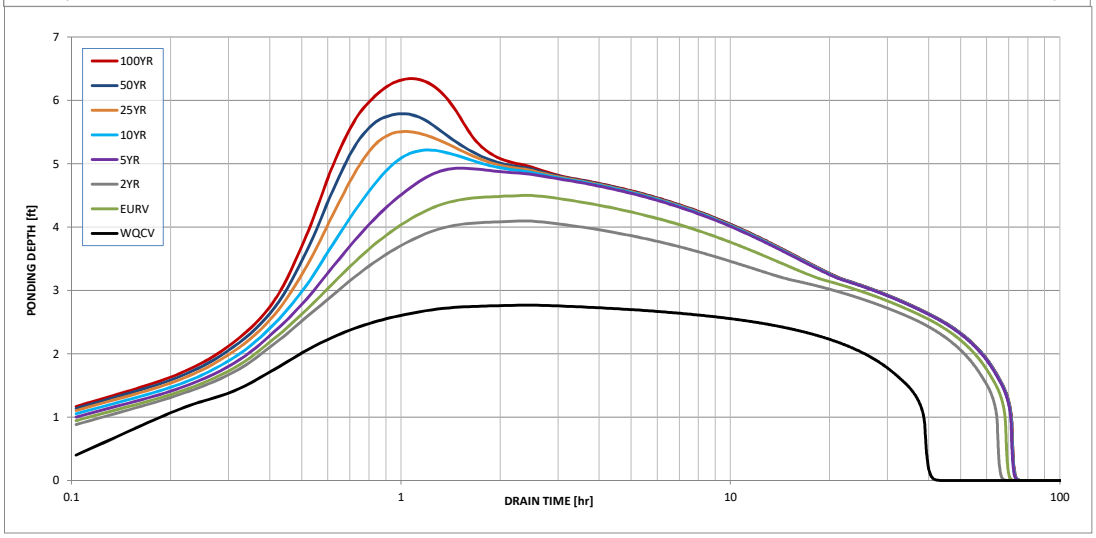
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	8.5	ft
Detention Basin Area at Top of Freeboard =	2.46	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	1.620	5.240	4.373	6.529	8.327	10.805	12.889	15.258	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	1.597	5.159	4.312	6.432	8.211	10.654	12.706	15.044	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.15	0.30	0.70	0.91	1.17	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.9	13.2	26.7	62.0	80.2	103.2	cfs
Peak Inflow Q	28.5	92.9	77.6	115.9	148.0	191.8	228.4	269.9	cfs
Peak Outflow Q	0.6	2.7	2.3	10.8	36.9	74.1	91.4	95.0	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.8	1.4	1.2	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.2	0.7	1.5	1.9	2.0	fps
Time to Drain Detention Basin	40	69	65	72	72	72	72	72	hours
Maximum Ponding Depth	2.77	4.50	4.10	4.93	5.21	5.51	5.78	6.33	ft
2.8 Maximum Ponded Area	1.793	1.983	1.938	2.033	2.065	2.100	2.133	2.196	acres
Maximum Volume Stored	1.480	4.747	3.958	5.609	6.200	6.813	7.398	8.588	ac-ft





Initial Design for Full Spectrum Detention Basins

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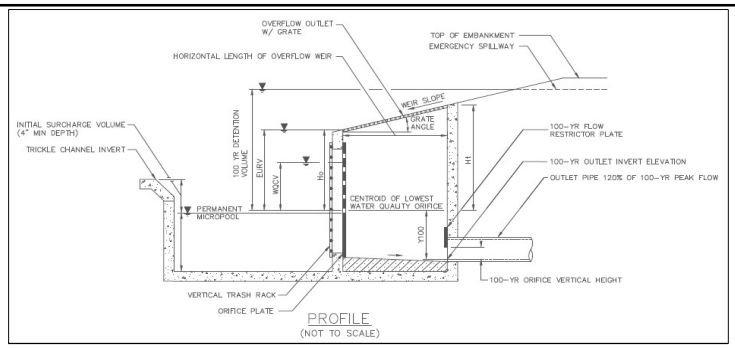
Project: Sterling Ranch MDDP

Basin ID: FSD13



User Input: Watershed Parameters

Watershed Area =	41.00	acres
Watershed Length =	2,725	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	65.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	127,071	ft^3
Routed EURV =	2.910	acre-ft
Routed EURV =	126,749	ft^3
Calc. vs. Req Volume % Diff =	**-0.3%**	
EURV Drain Time =	69.56	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	344	ft^2
Maximum EURV Ponding Depth =	3.83	ft
Depth Where Basin Floor Meets Side Slopes =	2.33	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	37.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	4.3	ft
Grate Open Area / 100-yr Orifice Area =	7.7	should be $\geq$ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	27	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	3.79	3.79	29.26					
Stage [ft]	0.00	1.33	2.67					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	27.0	in
100-Year Restrictor Plate Height =	22.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	3.47	ft^2
100-Year Orifice Centroid =	1.00	ft
Half-Central Angle of Plate on Pipe =	2.25	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	5.3	ft (relative to lowest WQ orifice)
Spillway Crest Length =	60	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

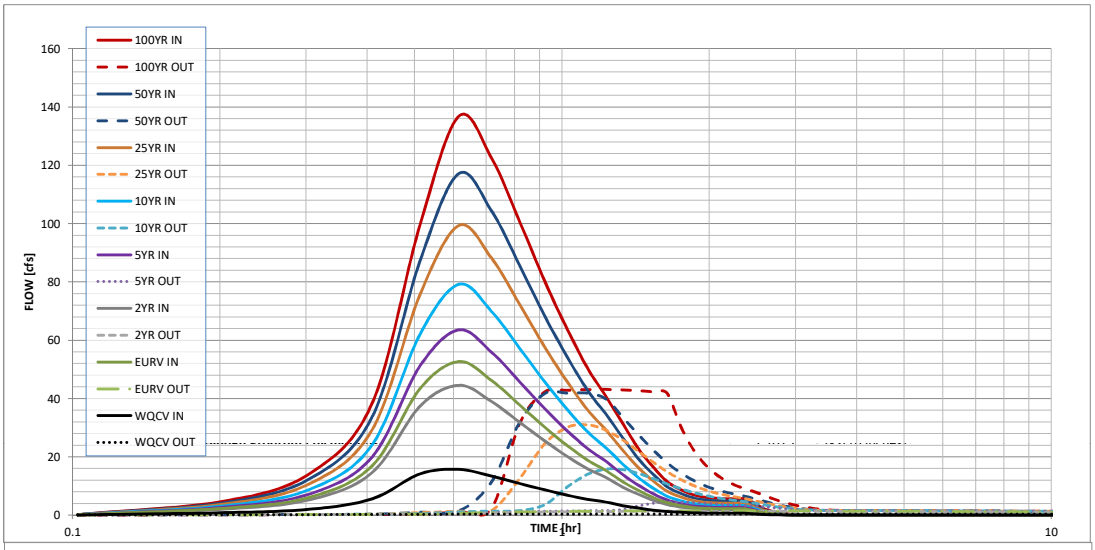
Calculated Spillway Parameters

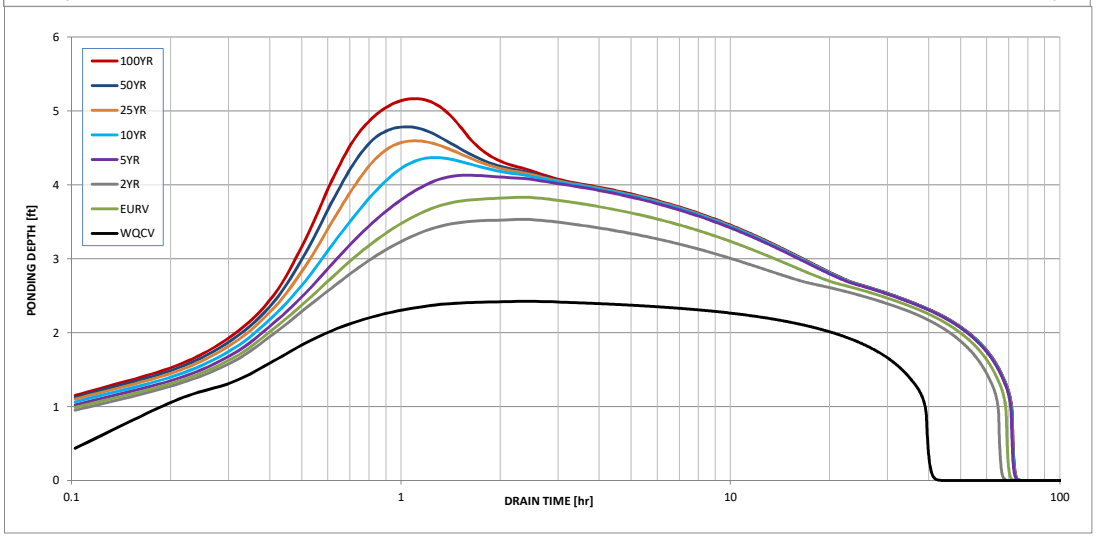
Depth of Flow through Spillway =	0.8	ft
Stage at Top of Freeboard =	7.1	ft
Detention Basin Area at Top of Freeboard =	1.73	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.868	2.917	2.473	3.509	4.366	5.474	6.444	7.537	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.868	2.917	2.472	3.508	4.366	5.468	6.443	7.530	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.15	0.30	0.70	0.90	1.16	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.4	6.1	12.3	28.6	37.0	47.6	cfs
Peak Inflow Q	15.7	52.7	44.5	63.5	79.2	99.3	117.1	136.8	cfs
Peak Outflow Q	0.3	1.5	1.3	4.5	15.7	31.0	41.9	43.1	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.7	1.3	1.1	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.1	0.5	1.1	1.5	1.5	fps
Time to Drain Detention Basin	**40**	70	66	72	72	72	72	73	hours
Maximum Ponding Depth	2.42	3.83	3.53	4.13	4.37	4.59	4.78	5.16	ft
2.8 Maximum Ponded Area	1.267	1.398	1.371	1.426	1.449	1.473	1.490	1.528	acres
Maximum Volume Stored	0.807	2.684	2.269	3.105	3.448	3.782	4.064	4.633	ac-ft





Initial Design for Full Spectrum Detention Basins

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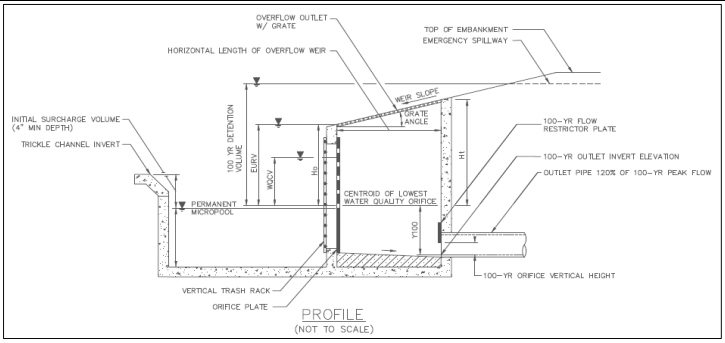
Project: Sterling Ranch MDDP

Basin ID: FSD14A



User Input: Watershed Parameters

Watershed Area =	164.90	acres
Watershed Length =	3,423	ft
Watershed Slope =	0.021	ft/ft
Watershed Imperviousness =	40.0%	percent
Percentage Hydrologic Soil Group A =	82%	percent
Percentage Hydrologic Soil Group B =	18%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	309,659	ft^3
Routed EURV =	7.126	acre-ft
Routed EURV =	310,429	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	59.71	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	5.60	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	979	ft^2
Maximum EURV Ponding Depth =	6.53	ft
Depth Where Basin Floor Meets Side Slopes =	2.55	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	5.6	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	15.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	6.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	7.1	ft
Grate Open Area / 100-yr Orifice Area =	10.9	should be $\geq$ 4
Overflow Weir Slope Length =	6.2	ft
Overflow Grate Open Area w/o Debris =	65	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	15.00	15.00	15.00					
Stage [ft]	0.00	1.87	3.73					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	42.0	in
100-Year Restrictor Plate Height =	25.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	5.97	ft^2
100-Year Orifice Centroid =	1.18	ft
Half-Central Angle of Plate on Pipe =	1.76	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	11.0	Warning, Spillway flowing during 100 year event
Spillway Crest Length =	96	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

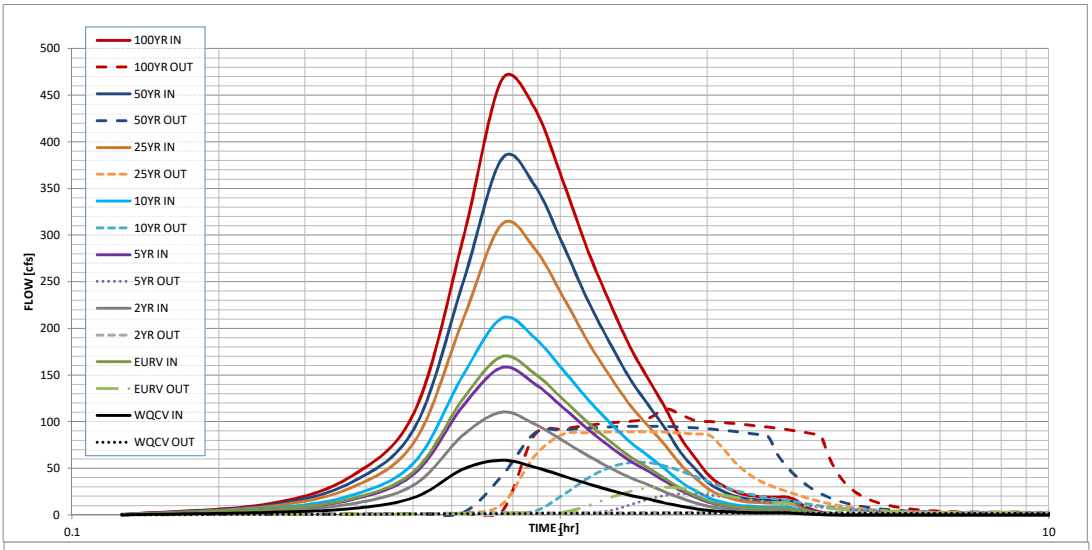
Calculated Spillway Parameters

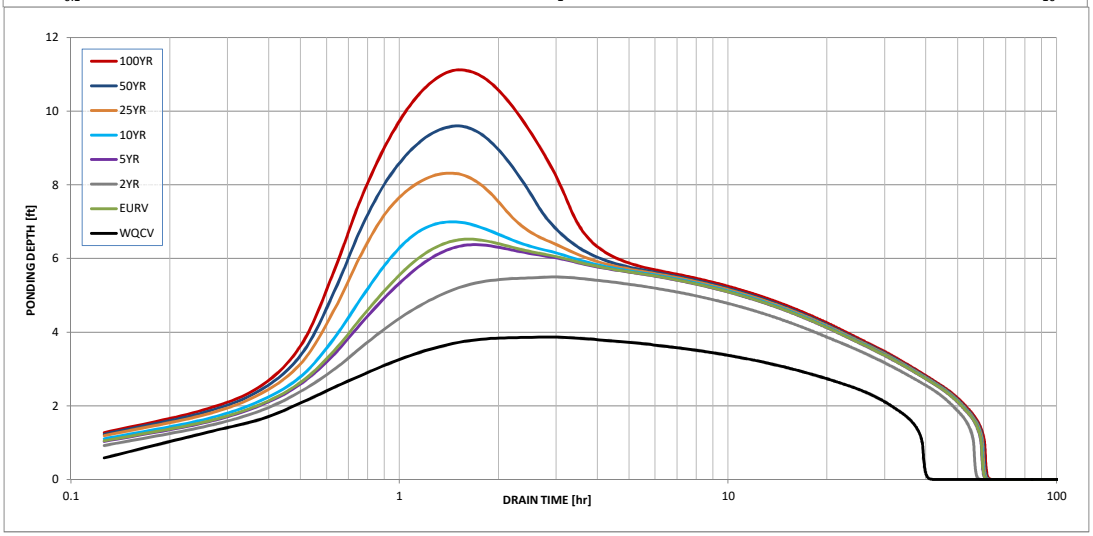
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	13.0	ft
Detention Basin Area at Top of Freeboard =	3.00	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	2.471	7.109	4.625	6.628	8.841	13.098	16.077	19.714	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	4.002	11.501	7.490	10.721	14.303	21.202	26.025	31.917	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.05	0.09	0.34	0.58	0.86	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.5	7.5	14.4	56.2	95.2	142.4	cfs
Peak Inflow Q	58.5	169.5	110.2	158.0	210.7	311.5	381.5	466.3	cfs
Peak Outflow Q	1.9	29.8	2.8	22.7	56.1	89.2	94.9	113.4	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	3.0	3.9	1.6	1.0	0.8	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.3	0.8	1.3	1.4	1.7	fps
Time to Drain Detention Basin	**40**	60	57	60	60	60	61	61	hours
Maximum Ponding Depth	3.87	6.53	5.50	6.37	6.99	8.31	9.59	11.12	ft
2.8 Maximum Ponded Area	1.926	2.233	2.112	2.215	2.288	2.451	2.613	2.812	acres
Maximum Volume Stored	3.618	9.147	6.912	8.797	10.189	13.321	16.568	20.711	ac-ft





Initial Design for Full Spectrum Detention Basins

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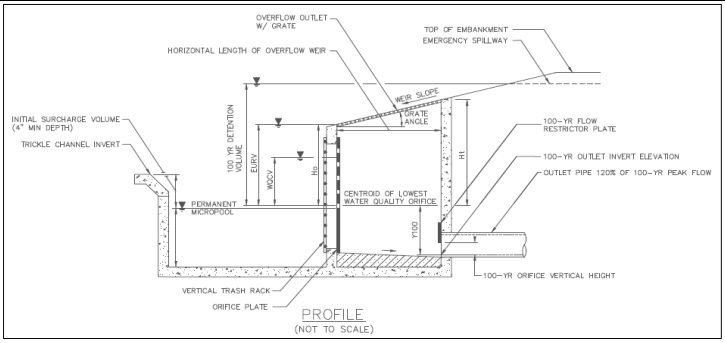
Project: Sterling Ranch MDDP

Basin ID: FSD14B



User Input: Watershed Parameters

Watershed Area =	34.70	acres
Watershed Length =	2,875	ft
Watershed Slope =	0.024	ft/ft
Watershed Imperviousness =	65.0%	percent
Percentage Hydrologic Soil Group A =	100%	percent
Percentage Hydrologic Soil Group B =	0%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	121,920	ft^3
Routed EURV =	2.805	acre-ft
Routed EURV =	122,198	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	92.82	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	3.75	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	291	ft^2
Maximum EURV Ponding Depth =	3.71	ft
Depth Where Basin Floor Meets Side Slopes =	2.46	ft

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.3	ft
Grate Open Area / 100-yr Orifice Area =	34.6	should be $\geq$ 4
Overflow Weir Slope Length =	6.2	ft
Overflow Grate Open Area w/o Debris =	43	ft^2

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	3.8	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	10.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	6.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	2.50	5.00	5.50					
Stage [ft]	0.00	1.25	2.50					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	18.0	in
100-Year Restrictor Plate Height =	12.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	1.25	ft^2
100-Year Orifice Centroid =	0.56	ft
Half-Central Angle of Plate on Pipe =	1.91	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	5.0	ft (relative to lowest WQ orifice)
Spillway Crest Length =	20	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

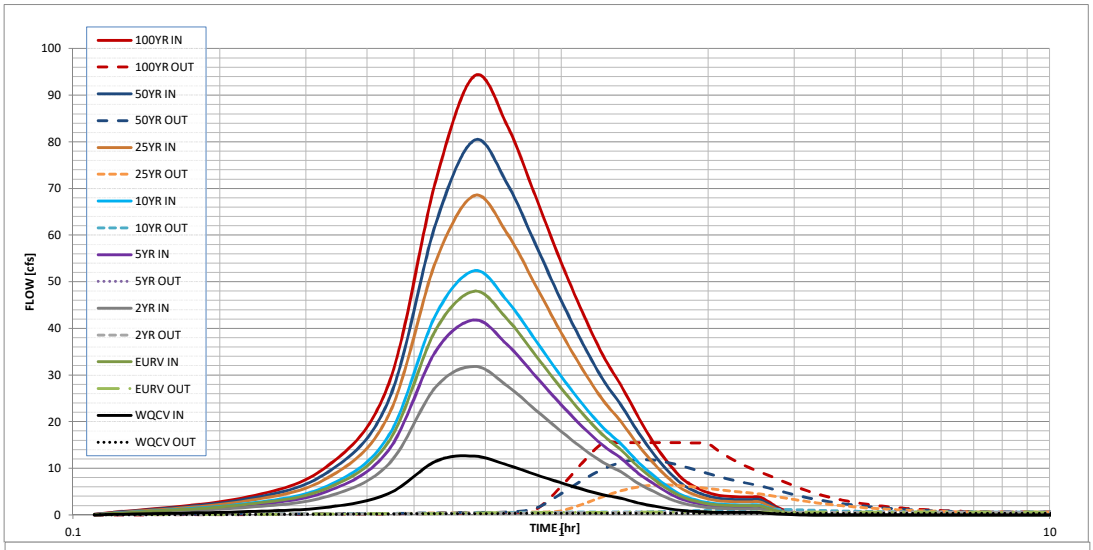
Calculated Spillway Parameters

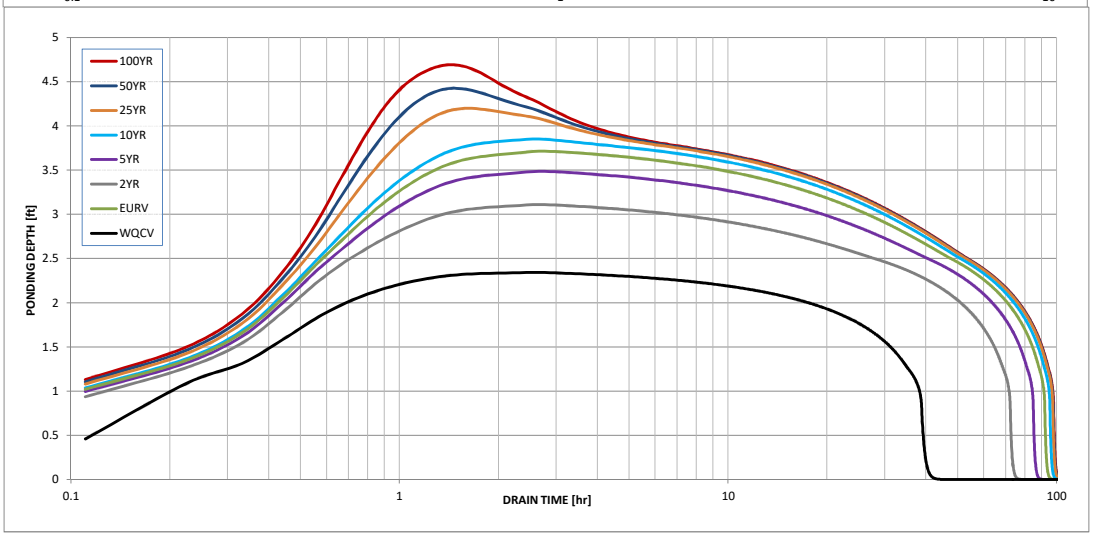
Depth of Flow through Spillway =	1.2	ft
Stage at Top of Freeboard =	7.2	ft
Detention Basin Area at Top of Freeboard =	1.95	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.735	2.799	1.865	2.444	3.052	3.977	4.661	5.461	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.752	2.867	1.910	2.503	3.125	4.073	4.774	5.591	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.01	0.01	0.16	0.34	0.56	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.0	0.3	0.5	5.7	11.8	19.3	cfs
Peak Inflow Q	12.6	48.0	31.9	41.8	52.4	68.4	80.3	94.1	cfs
Peak Outflow Q	0.3	0.6	0.5	0.6	1.2	6.4	11.9	15.5	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	2.0	2.5	1.1	1.0	0.8	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	N/A	0.0	0.1	0.3	0.3	fps
Time to Drain Detention Basin	**40**	93	73	86	96	98	99	99	hours
Maximum Ponding Depth	2.34	3.71	3.11	3.49	3.85	4.20	4.42	4.69	ft
2.8 Maximum Ponded Area	1.254	1.576	1.515	1.552	1.590	1.625	1.648	1.675	acres
Maximum Volume Stored	0.693	2.747	1.812	2.391	2.967	3.524	3.892	4.334	ac-ft



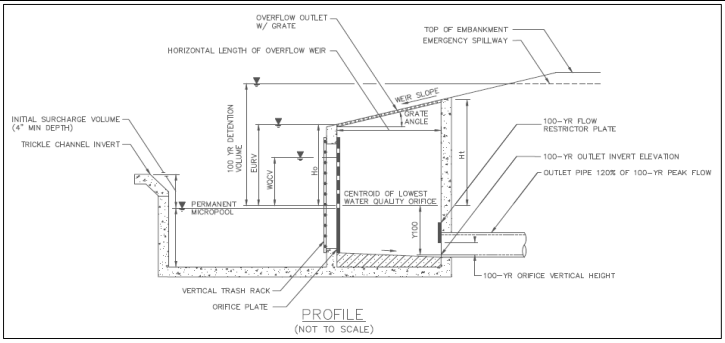


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD15B



User Input: Watershed Parameters

Watershed Area =	7.90	acres
Watershed Length =	826	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	60.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	22,457	ft^3
Routed EURV =	0.517	acre-ft
Routed EURV =	22,505	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	66.73	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	2.60	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	62	ft^2
Maximum EURV Ponding Depth =	3.03	ft
Depth Where Basin Floor Meets Side Slopes =	1.71	ft

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	3.1	ft
Grate Open Area / 100-yr Orifice Area =	7.6	should be $\geq$ 4
Overflow Weir Slope Length =	2.1	ft
Overflow Grate Open Area w/o Debris =	6	ft^2

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	2.6	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	4.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	2.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	1.30	1.00	1.00					
Stage [ft]	0.00	0.87	1.73					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	18.0	in
100-Year Restrictor Plate Height =	8.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	0.76	ft^2
100-Year Orifice Centroid =	0.39	ft
Half-Central Angle of Plate on Pipe =	1.46	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	4.6	ft (relative to lowest WQ orifice)
Spillway Crest Length =	6	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

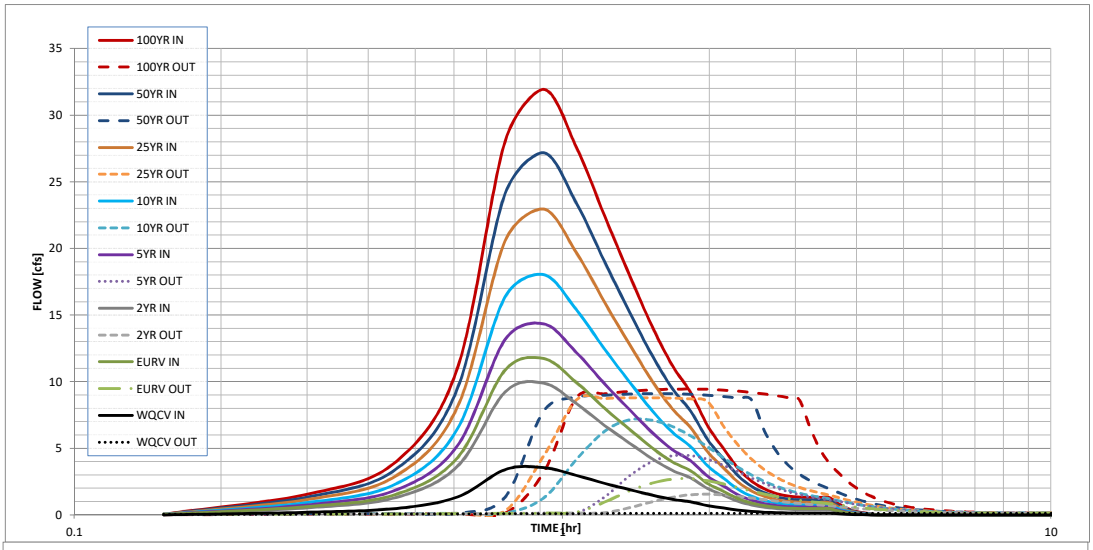
Calculated Spillway Parameters

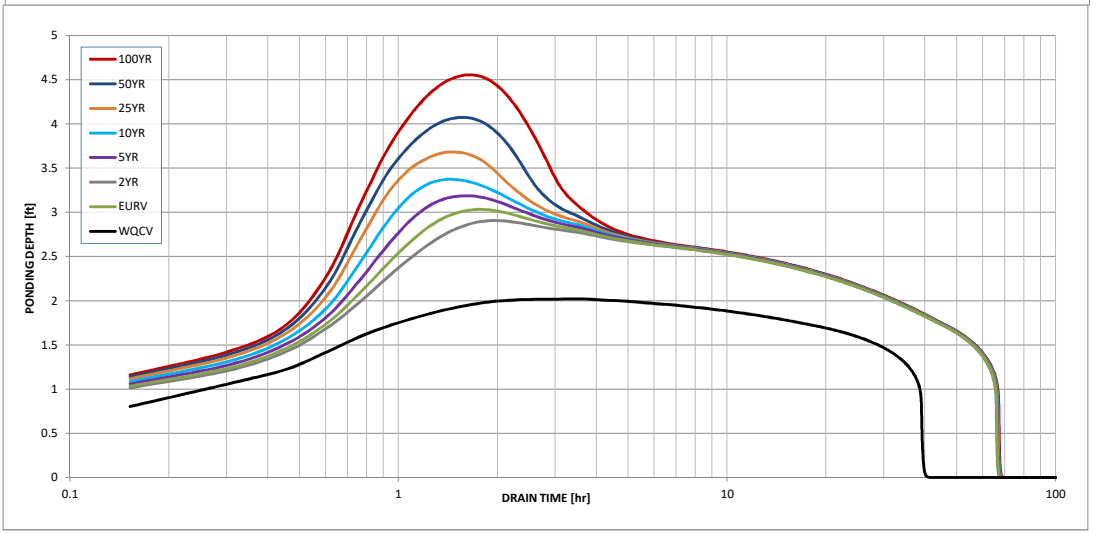
Depth of Flow through Spillway =	0.8	ft
Stage at Top of Freeboard =	6.4	ft
Detention Basin Area at Top of Freeboard =	0.68	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.155	0.516	0.434	0.630	0.794	1.011	1.198	1.409	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.291	0.965	0.812	1.179	1.485	1.894	2.244	2.639	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.21	0.41	0.93	1.20	1.52	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.1	1.6	3.2	7.3	9.5	12.0	cfs
Peak Inflow Q	3.6	11.7	9.9	14.3	18.0	23.0	27.2	31.9	cfs
Peak Outflow Q	0.1	2.7	1.5	4.4	7.1	8.8	9.1	9.4	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	2.7	2.2	1.2	1.0	0.8	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.7	1.2	1.5	1.5	1.6	fps
Time to Drain Detention Basin	**40**	67	66	67	67	67	67	68	hours
Maximum Ponding Depth	2.02	3.03	2.90	3.18	3.37	3.68	4.07	4.55	ft
Maximum Ponded Area	0.427	0.482	0.475	0.490	0.501	0.518	0.542	0.570	acres
Maximum Volume Stored	0.260	0.720	0.659	0.793	0.885	1.043	1.251	1.520	ac-ft





Initial Design for Full Spectrum Detention Basins

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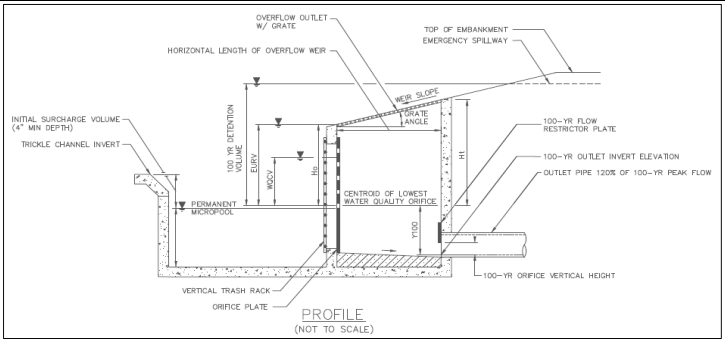
Project: Sterling Ranch MDDP

Basin ID: FSD16A



User Input: Watershed Parameters

Watershed Area =	168.10	acres
Watershed Length =	8,560	ft
Watershed Slope =	0.028	ft/ft
Watershed Imperviousness =	51.0%	percent
Percentage Hydrologic Soil Group A =	71%	percent
Percentage Hydrologic Soil Group B =	29%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	423,688	ft^3
Routed EURV =	10.484	acre-ft
Routed EURV =	456,677	ft^3
Calc. vs. Req Volume % Diff =	7.8%	
EURV Drain Time =	67.17	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	1159	ft^2
Maximum EURV Ponding Depth =	6.13	ft
Depth Where Basin Floor Meets Side Slopes =	2.91	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	6.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	12.0	ft
Overflow Weir Slope =	0	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	6.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	6.0	ft
Grate Open Area / 100-yr Orifice Area =	9.9	should be $\geq$ 4
Overflow Weir Slope Length =	6.0	ft
Overflow Grate Open Area w/o Debris =	50	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	7.80	24.00	24.00	24.00				
Stage [ft]	0.00	1.50	3.00	4.50				

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	42.0	in
100-Year Restrictor Plate Height =	22.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	5.10	ft^2
100-Year Orifice Centroid =	1.05	ft
Half-Central Angle of Plate on Pipe =	1.62	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	9.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	93	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

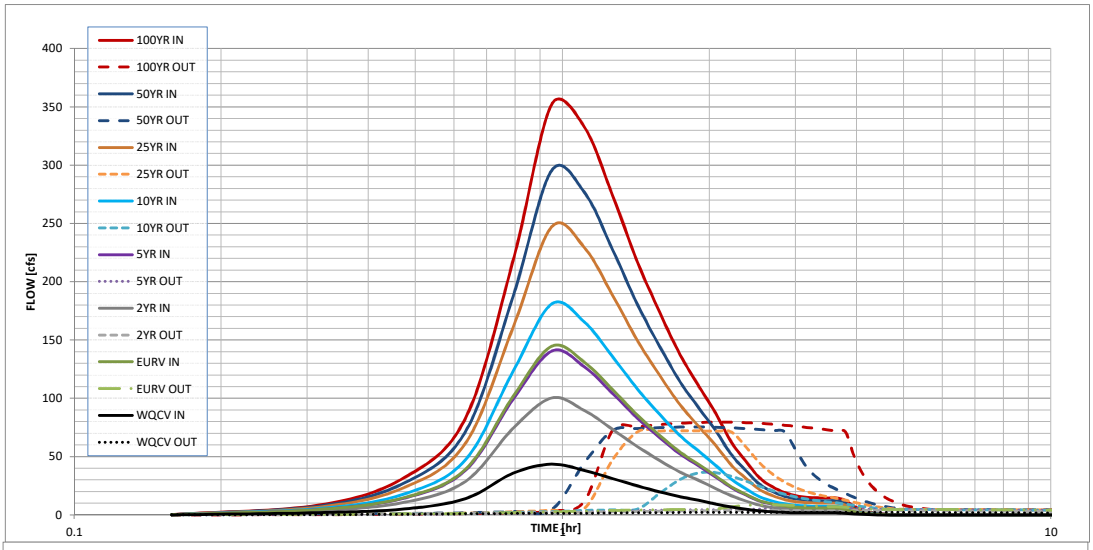
Calculated Spillway Parameters

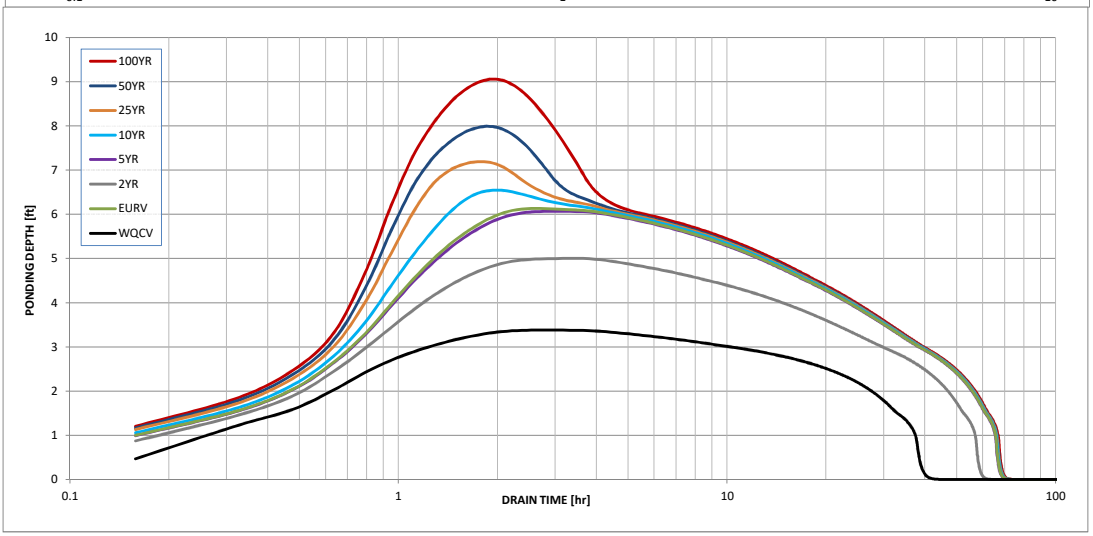
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	11.5	ft
Detention Basin Area at Top of Freeboard =	3.75	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	2.928	9.727	6.736	9.443	12.175	16.695	20.008	23.931	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	3.704	12.299	8.516	11.947	15.398	21.122	25.323	30.283	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.05	0.10	0.33	0.53	0.76	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.6	8.8	17.3	56.2	88.4	128.3	cfs
Peak Inflow Q	43.3	144.6	100.2	140.5	180.8	247.1	295.3	351.8	cfs
Peak Outflow Q	2.1	8.5	3.8	6.1	36.2	72.2	75.5	79.6	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.7	2.1	1.3	0.9	0.6	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.0	0.6	1.3	1.4	1.4	fps
Time to Drain Detention Basin	**39**	67	59	67	68	68	68	68	hours
Maximum Ponding Depth	3.38	6.13	5.01	6.07	6.54	7.19	7.99	9.05	ft
Maximum Ponded Area	2.604	2.973	2.819	2.963	3.029	3.119	3.233	3.388	acres
Maximum Volume Stored	3.217	10.872	7.612	10.679	12.110	14.094	16.624	20.150	ac-ft





Initial Design for Full Spectrum Detention Basins

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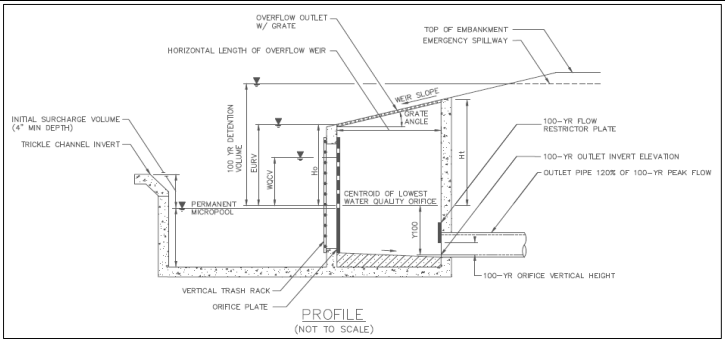
Project: Sterling Ranch MDDP

Basin ID: FSD16B



User Input: Watershed Parameters

Watershed Area =	50.70	acres
Watershed Length =	3,347	ft
Watershed Slope =	0.024	ft/ft
Watershed Imperviousness =	67.0%	percent
Percentage Hydrologic Soil Group A =	100%	percent
Percentage Hydrologic Soil Group B =	0%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	185,182	ft^3
Routed EURV =	5.152	acre-ft
Routed EURV =	224,421	ft^3
Calc. vs. Req Volume % Diff =	21.2%	
EURV Drain Time =	75.49	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	5.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	439	ft^2
Maximum EURV Ponding Depth =	4.31	ft
Depth Where Basin Floor Meets Side Slopes =	2.49	ft

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.0	ft
Grate Open Area / 100-yr Orifice Area =	25.2	should be $\geq$ 4
Overflow Weir Slope Length =	6.0	ft
Overflow Grate Open Area w/o Debris =	46	ft^2

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	5.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	11.0	ft
Overflow Weir Slope =	0	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	6.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	2.10	10.00	10.00	40.00				
Stage [ft]	0.00	1.25	2.50	3.75				

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	30.0	in
100-Year Restrictor Plate Height =	12.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	1.83	ft^2
100-Year Orifice Centroid =	0.58	ft
Half-Central Angle of Plate on Pipe =	1.37	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	6.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	40	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

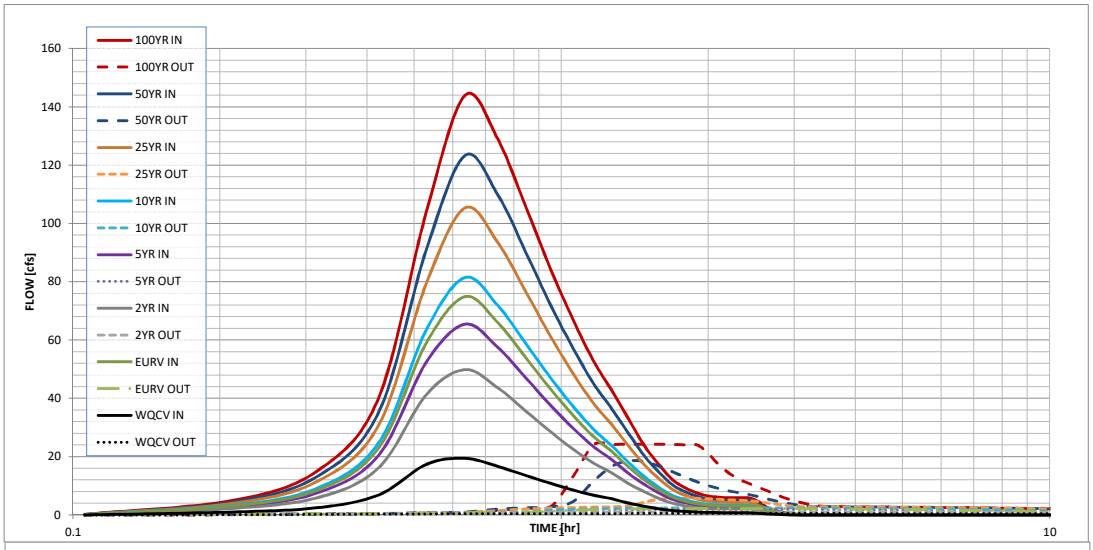
Calculated Spillway Parameters

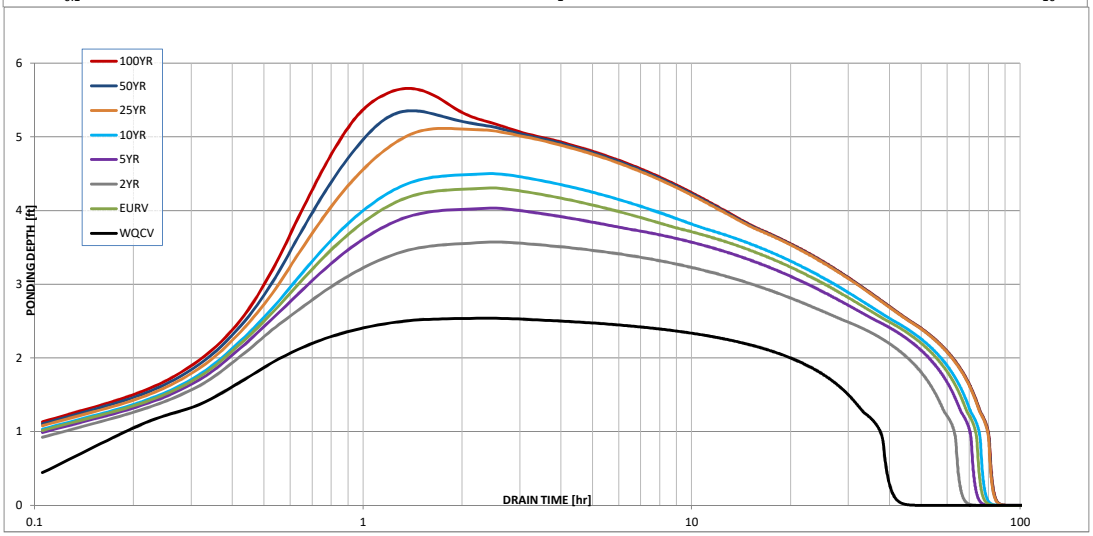
Depth of Flow through Spillway =	0.9	ft
Stage at Top of Freeboard =	8.4	ft
Detention Basin Area at Top of Freeboard =	2.20	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.50	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	1.107	4.251	2.847	3.720	4.627	5.977	6.988	8.165	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	1.107	4.251	2.846	3.719	4.626	5.970	6.984	8.156	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.01	0.01	0.16	0.34	0.56	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.0	0.4	0.7	8.3	17.2	28.2	cfs
Peak Inflow Q	19.4	74.8	49.9	65.4	81.4	105.2	123.2	143.8	cfs
Peak Outflow Q	0.6	2.2	1.0	1.8	2.4	5.8	18.5	24.3	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	4.3	3.4	0.7	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	N/A	N/A	0.1	0.3	0.5	fps
Time to Drain Detention Basin	40	75	65	73	77	82	82	82	hours
Maximum Ponding Depth	2.54	4.31	3.57	4.03	4.50	5.11	5.35	5.66	ft
2.8 Maximum Ponded Area	1.553	1.735	1.659	1.707	1.757	1.822	1.848	1.881	acres
Maximum Volume Stored	1.013	3.926	2.673	3.451	4.266	5.360	5.800	6.366	ac-ft





Initial Design for Full Spectrum Detention Basins

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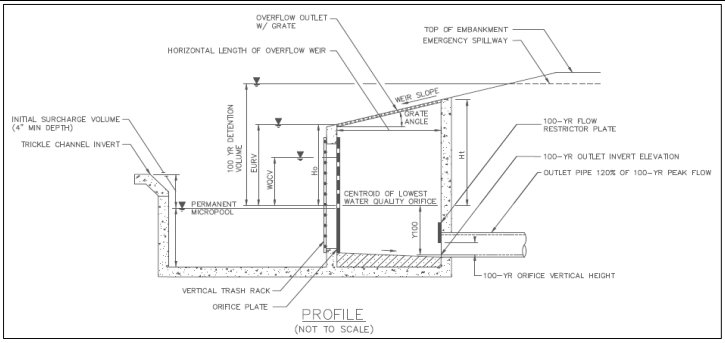
Project: Sterling Ranch MDDP

Basin ID: FSD_SC3-17



User Input: Watershed Parameters

Watershed Area =	70.60	acres
Watershed Length =	3,734	ft
Watershed Slope =	0.027	ft/ft
Watershed Imperviousness =	23.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	71,251	ft^3
Routed EURV =	1.640	acre-ft
Routed EURV =	71,451	ft^3
Calc. vs. Req Volume % Diff =	**0.3%**	
EURV Drain Time =	62.94	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.50	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	297	ft^2
Maximum EURV Ponding Depth =	4.49	ft
Depth Where Basin Floor Meets Side Slopes =	1.68	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.5	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	52.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	4.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.5	ft
Grate Open Area / 100-yr Orifice Area =	28.2	should be $\geq$ 4
Overflow Weir Slope Length =	4.1	ft
Overflow Grate Open Area w/o Debris =	150	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	3.54	3.54	3.54					
Stage [ft]	0.00	1.50	3.00					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	36.0	in
100-Year Restrictor Plate Height =	25.4	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	5.33	ft^2
100-Year Orifice Centroid =	1.18	ft
Half-Central Angle of Plate on Pipe =	1.99	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	8.3	ft (relative to lowest WQ orifice)
Spillway Crest Length =	57	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

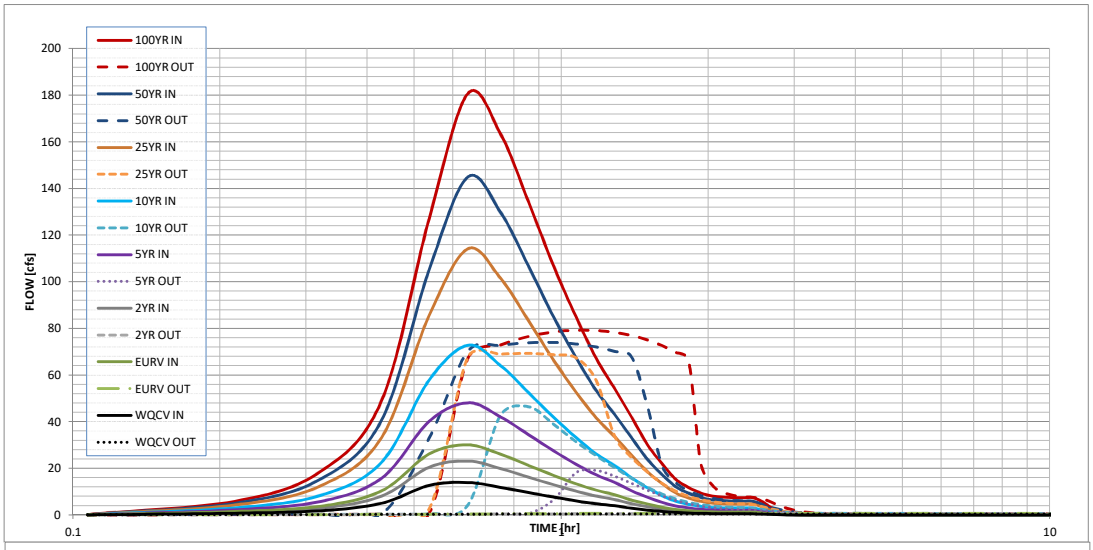
Calculated Spillway Parameters

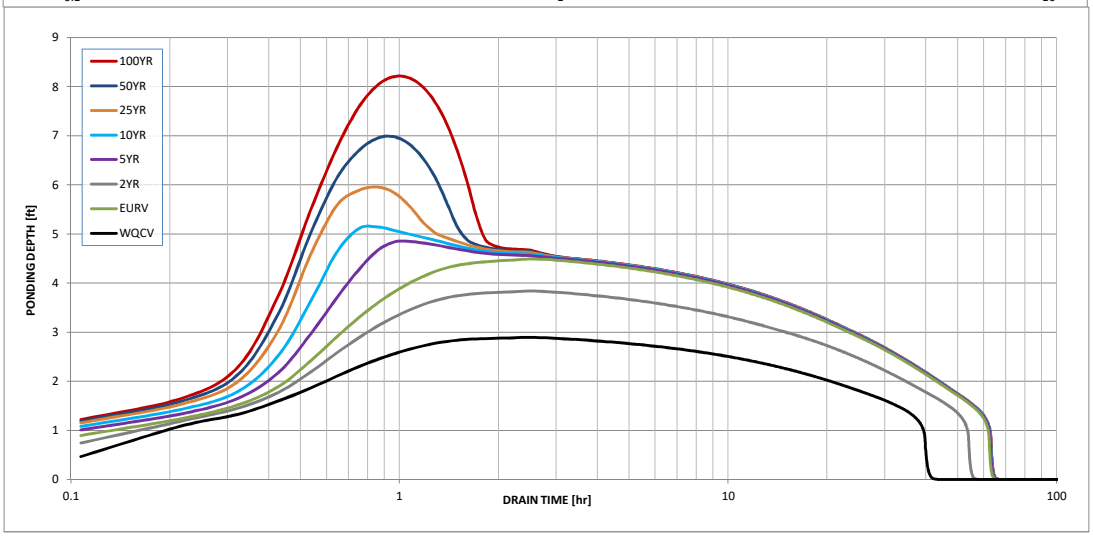
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	10.3	ft
Detention Basin Area at Top of Freeboard =	1.02	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.750	1.636	1.259	2.617	3.938	6.163	7.827	9.766	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.799	1.741	1.340	2.787	4.193	6.558	8.327	10.392	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.16	0.32	0.74	0.95	1.22	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.7	11.1	22.5	52.0	67.2	86.3	cfs
Peak Inflow Q	13.8	30.0	23.1	48.1	72.7	114.0	144.8	180.6	cfs
Peak Outflow Q	0.3	0.6	0.5	19.1	46.4	69.2	73.9	79.2	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	1.7	2.1	1.3	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.1	0.3	0.5	0.5	0.5	fps
Time to Drain Detention Basin	**40**	63	55	64	64	64	64	64	hours
Maximum Ponding Depth	2.90	4.49	3.84	4.85	5.14	5.95	6.98	8.21	ft
2.8 Maximum Ponded Area	0.515	0.611	0.570	0.633	0.651	0.704	0.774	0.862	acres
Maximum Volume Stored	0.736	1.635	1.249	1.860	2.044	2.596	3.354	4.360	ac-ft





Initial Design for Full Spectrum Detention Basins

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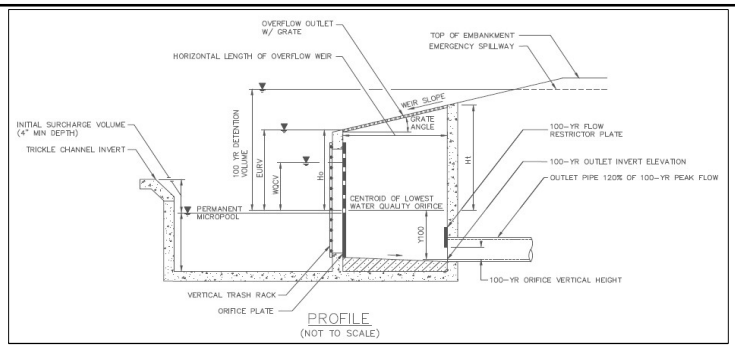
Project: Sterling Ranch MDDP

Basin ID: FSD_SC3-18



User Input: Watershed Parameters

Watershed Area =	53.70	acres
Watershed Length =	2,800	ft
Watershed Slope =	0.027	ft/ft
Watershed Imperviousness =	44.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	109,200	ft^3
Routed EURV =	2.513	acre-ft
Routed EURV =	109,456	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	69.70	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.20	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	337	ft^2
Maximum EURV Ponding Depth =	4.05	ft
Depth Where Basin Floor Meets Side Slopes =	2.08	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.2	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	51.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	4.5	ft
Grate Open Area / 100-yr Orifice Area =	7.6	should be $\geq$ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	37	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	3.80	3.80	16.52					
Stage [ft]	0.00	1.40	2.80					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	33.0	in
100-Year Restrictor Plate Height =	25.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	4.83	ft^2
100-Year Orifice Centroid =	1.15	ft
Half-Central Angle of Plate on Pipe =	2.11	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	6.4	ft (relative to lowest WQ orifice)
Spillway Crest Length =	84	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

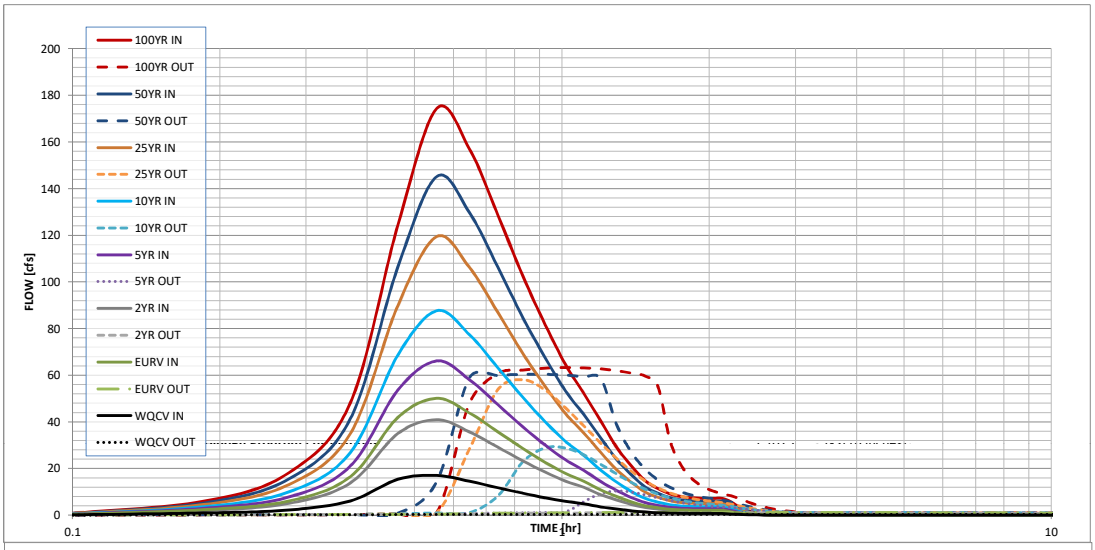
Calculated Spillway Parameters

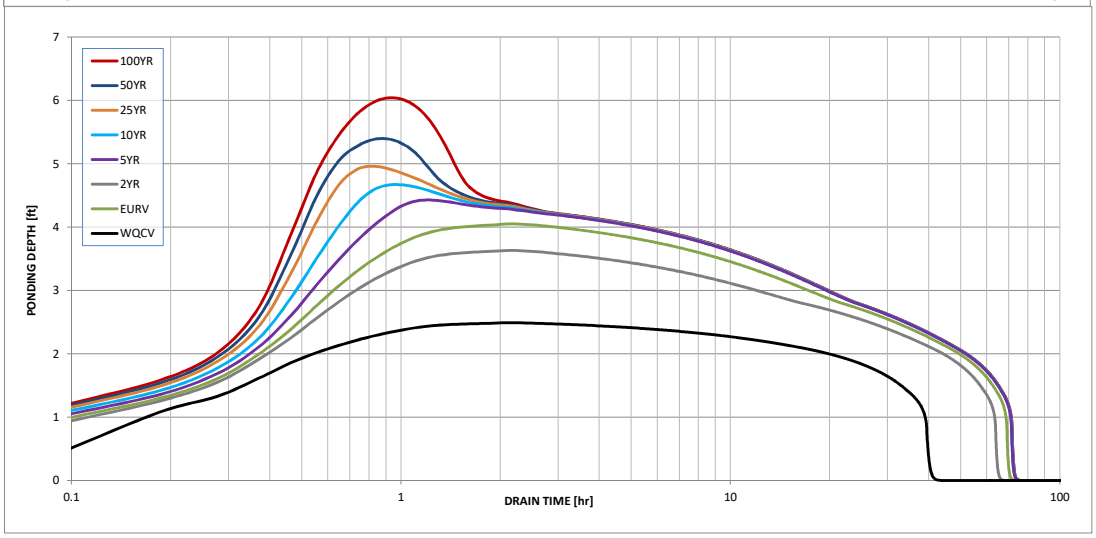
Depth of Flow through Spillway =	0.8	ft
Stage at Top of Freeboard =	8.2	ft
Detention Basin Area at Top of Freeboard =	1.42	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.852	2.507	2.049	3.293	4.357	5.928	7.196	8.650	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.851	2.506	2.049	3.292	4.356	5.921	7.192	8.643	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.17	0.34	0.79	1.02	1.30	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.6	9.2	18.4	42.2	54.6	69.9	cfs
Peak Inflow Q	17.1	50.1	40.9	66.1	87.7	119.4	145.1	174.3	cfs
Peak Outflow Q	0.3	1.1	0.9	10.4	28.8	58.0	60.3	63.2	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	1.1	1.6	1.4	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.2	0.7	1.5	1.6	1.7	fps
Time to Drain Detention Basin	**40**	70	64	72	72	72	72	72	hours
Maximum Ponding Depth	2.49	4.05	3.63	4.43	4.67	4.96	5.39	6.04	ft
2.8 Maximum Ponded Area	0.934	1.059	1.025	1.091	1.111	1.134	1.172	1.230	acres
Maximum Volume Stored	0.796	2.351	1.916	2.757	3.021	3.347	3.843	4.630	ac-ft





Initial Design for Full Spectrum Detention Basins

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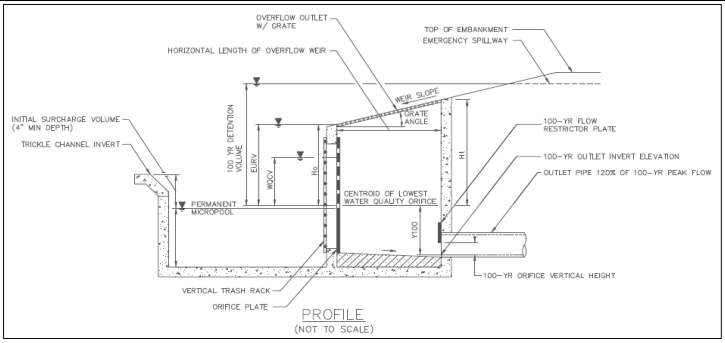
Project: Sterling Ranch MDDP

Basin ID: FSD20



User Input: Watershed Parameters

Watershed Area =	34.20	acres
Watershed Length =	4,925	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	12.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	17,095	ft^3
Routed EURV =	0.394	acre-ft
Routed EURV =	17,163	ft^3
Calc. vs. Req Volume % Diff =	**0.4%**	
EURV Drain Time =	57.58	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.50	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	88	ft^2
Maximum EURV Ponding Depth =	4.31	ft
Depth Where Basin Floor Meets Side Slopes =	1.16	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.5	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	8.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	4.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.5	ft
Grate Open Area / 100-yr Orifice Area =	8.3	should be $\geq$ 4
Overflow Weir Slope Length =	4.1	ft
Overflow Grate Open Area w/o Debris =	23	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	1.10	0.50	0.50					
Stage [ft]	0.00	1.25	2.50					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	24.0	in
100-Year Restrictor Plate Height =	20.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	2.80	ft^2
100-Year Orifice Centroid =	0.90	ft
Half-Central Angle of Plate on Pipe =	2.30	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	999.0	ft (relative to lowest WQ orifice)
Spillway Crest Length =	999	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

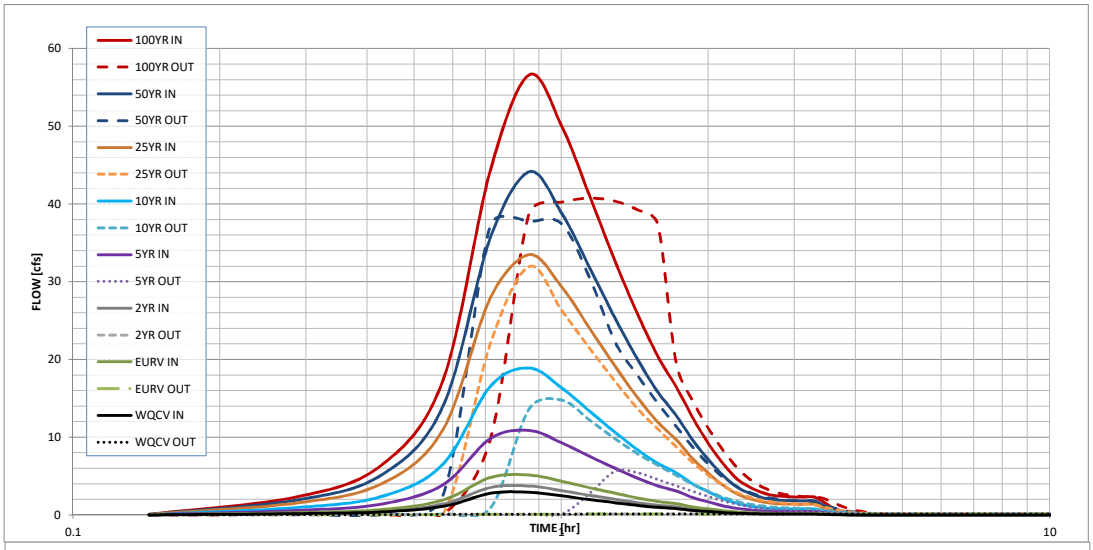
Calculated Spillway Parameters

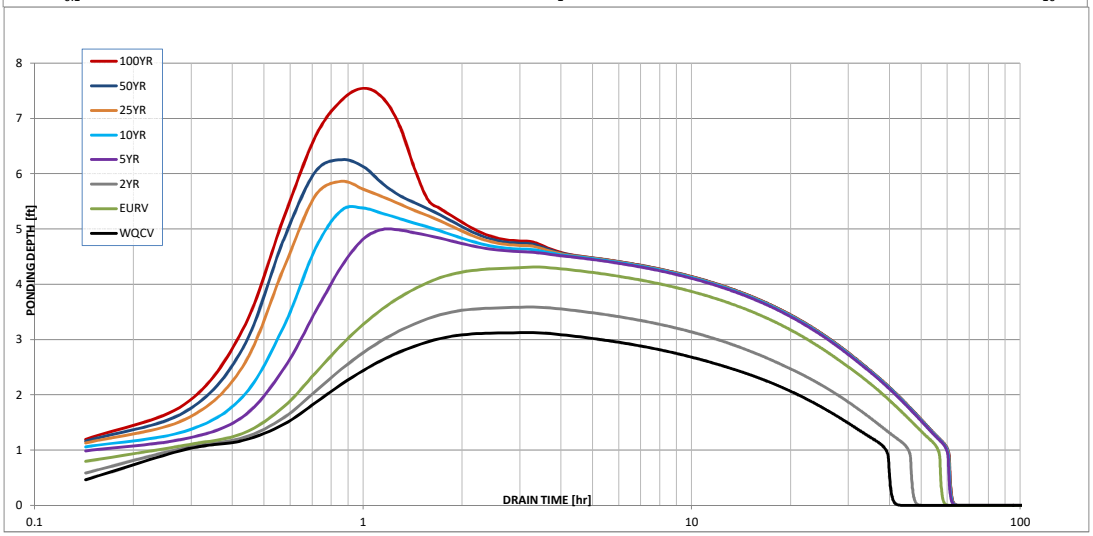
Depth of Flow through Spillway =	0.0	ft
Stage at Top of Freeboard =	1000.0	ft
Detention Basin Area at Top of Freeboard =	0.51	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.222	0.392	0.284	0.833	1.453	2.572	3.377	4.323	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.224	0.395	0.286	0.840	1.465	2.594	3.405	4.359	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.16	0.32	0.75	0.97	1.24	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.4	5.5	11.1	25.7	33.2	42.5	cfs
Peak Inflow Q	2.9	5.1	3.7	10.9	18.9	33.5	44.1	56.6	cfs
Peak Outflow Q	0.1	0.1	0.1	5.6	14.7	31.9	37.7	40.7	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	1.0	1.3	1.2	1.1	1.0	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.2	0.6	1.4	1.6	1.8	fps
Time to Drain Detention Basin	**40**	58	47	61	61	62	62	62	hours
Maximum Ponding Depth	3.13	4.31	3.59	4.99	5.37	5.86	6.25	7.55	ft
2.8 Maximum Ponded Area	0.121	0.156	0.134	0.177	0.190	0.207	0.221	0.271	acres
Maximum Volume Stored	0.201	0.364	0.259	0.477	0.547	0.644	0.728	1.046	ac-ft





Initial Design for Full Spectrum Detention Basins

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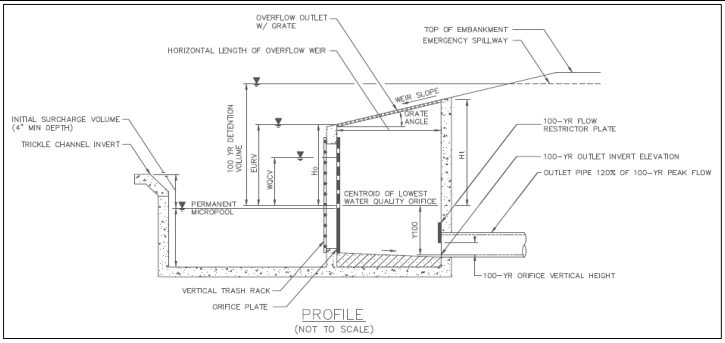
Project: Sterling Ranch MDDP

Basin ID: FSD21



User Input: Watershed Parameters

Watershed Area =	23.30	acres
Watershed Length =	4,875	ft
Watershed Slope =	0.039	ft/ft
Watershed Imperviousness =	16.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	15,890	ft^3
Routed EURV =	0.366	acre-ft
Routed EURV =	15,949	ft^3
Calc. vs. Req Volume % Diff =	**0.4%**	
EURV Drain Time =	57.32	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	75	ft^2
Maximum EURV Ponding Depth =	3.58	ft
Depth Where Basin Floor Meets Side Slopes =	1.20	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	5.5	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	4.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.0	ft
Grate Open Area / 100-yr Orifice Area =	8.3	should be $\geq$ 4
Overflow Weir Slope Length =	4.1	ft
Overflow Grate Open Area w/o Debris =	16	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	0.85	0.85	0.85					
Stage [ft]	0.00	1.33	2.67					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	24.0	in
100-Year Restrictor Plate Height =	14.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	1.90	ft^2
100-Year Orifice Centroid =	0.66	ft
Half-Central Angle of Plate on Pipe =	1.74	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	6.1	ft (relative to lowest WQ orifice)
Spillway Crest Length =	20	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

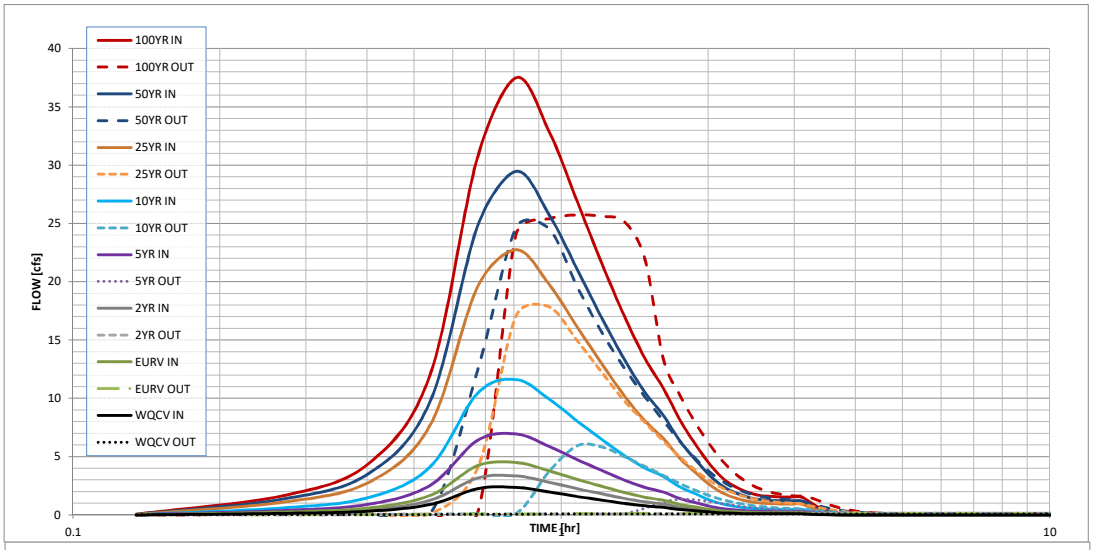
Calculated Spillway Parameters

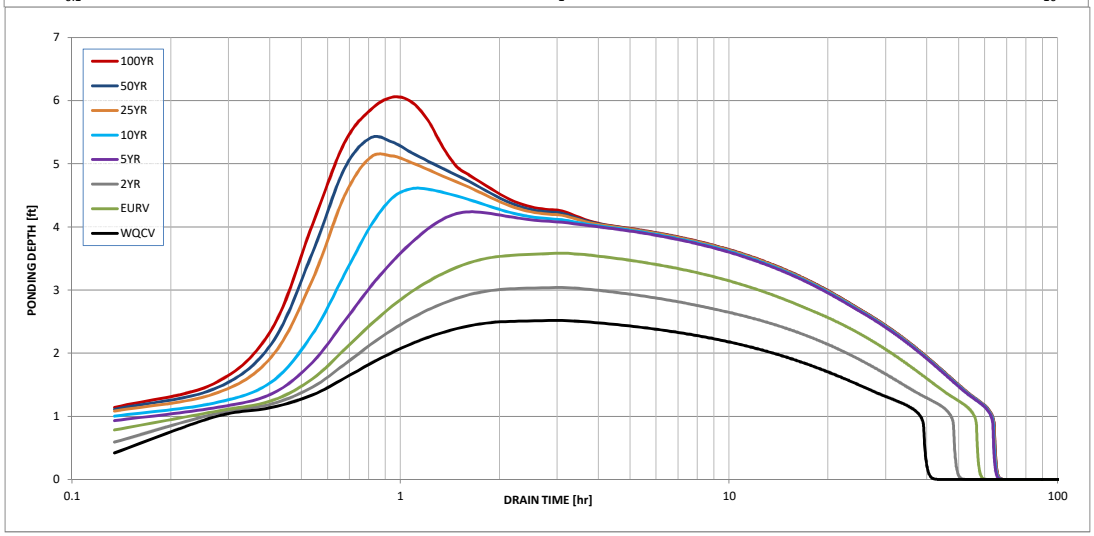
Depth of Flow through Spillway =	0.7	ft
Stage at Top of Freeboard =	7.8	ft
Detention Basin Area at Top of Freeboard =	0.31	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.25	1.50	2.00	2.25	2.52	in
Calculated Runoff Volume	0.190	0.365	0.271	0.563	0.945	1.855	2.403	3.046	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.170	0.326	0.242	0.503	0.846	1.661	2.152	2.728	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.17	0.34	0.79	1.02	1.30	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.3	4.0	8.0	18.3	23.7	30.3	cfs
Peak Inflow Q	2.3	4.5	3.3	6.9	11.6	22.7	29.5	37.5	cfs
Peak Outflow Q	0.1	0.1	0.1	1.3	5.9	17.8	24.7	25.7	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.3	0.7	1.0	1.0	0.8	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.1	0.4	1.1	1.5	1.6	fps
Time to Drain Detention Basin	**40**	57	49	64	65	65	65	65	hours
Maximum Ponding Depth	2.52	3.58	3.04	4.24	4.60	5.12	5.41	6.05	ft
Maximum Ponded Area	0.123	0.154	0.137	0.174	0.187	0.205	0.215	0.239	acres
Maximum Volume Stored	0.153	0.299	0.220	0.407	0.473	0.574	0.634	0.781	ac-ft





Initial Design for Full Spectrum Detention Basins

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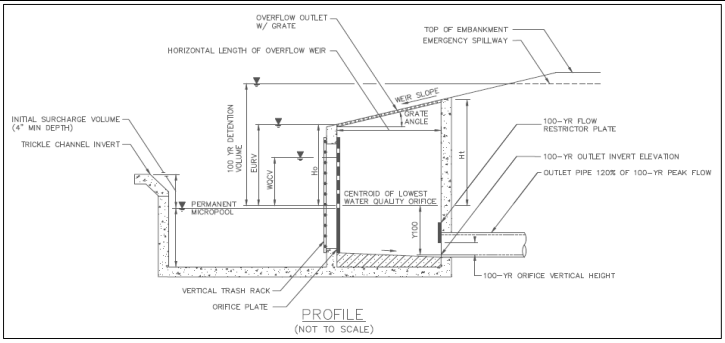
Project: Sterling Ranch MDDP

Basin ID: FSD22



User Input: Watershed Parameters

Watershed Area =	33.90	acres
Watershed Length =	5,900	ft
Watershed Slope =	0.038	ft/ft
Watershed Imperviousness =	12.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	16,945	ft^3
Routed EURV =	0.390	acre-ft
Routed EURV =	17,002	ft^3
Calc. vs. Req Volume % Diff =	**0.3%**	
EURV Drain Time =	55.62	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	3.50	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	87	ft^2
Maximum EURV Ponding Depth =	3.32	ft
Depth Where Basin Floor Meets Side Slopes =	1.29	ft

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.0	ft
Grate Open Area / 100-yr Orifice Area =	8.2	should be $\geq$ 4
Overflow Weir Slope Length =	6.2	ft
Overflow Grate Open Area w/o Debris =	26	ft^2

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	3.5	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	6.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	6.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	1.00	1.00	1.00					
Stage [ft]	0.00	1.17	2.33					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	27.0	in
100-Year Restrictor Plate Height =	20.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	3.16	ft^2
100-Year Orifice Centroid =	0.92	ft
Half-Central Angle of Plate on Pipe =	2.07	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	6.8	ft (relative to lowest WQ orifice)
Spillway Crest Length =	22	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

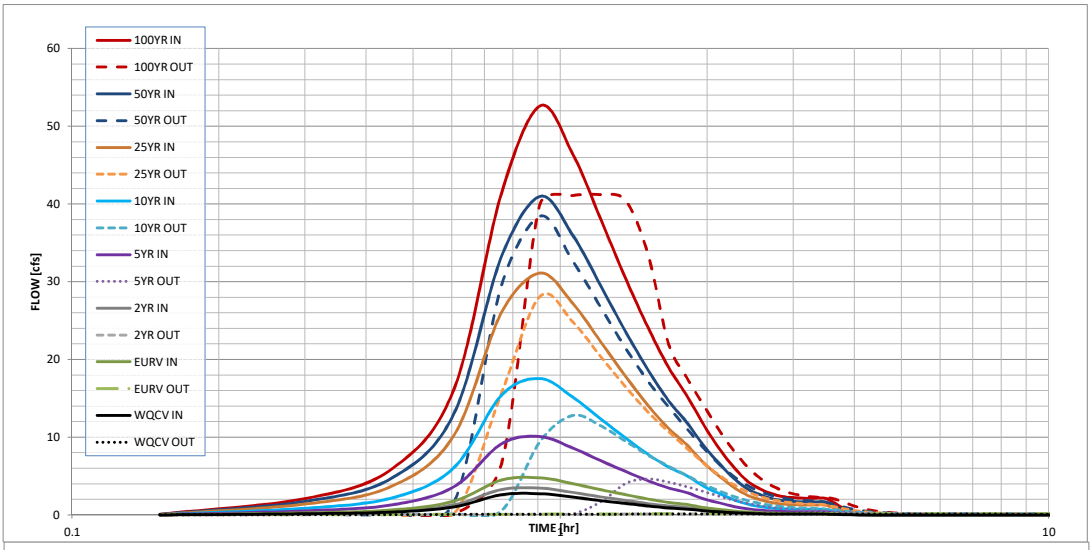
Calculated Spillway Parameters

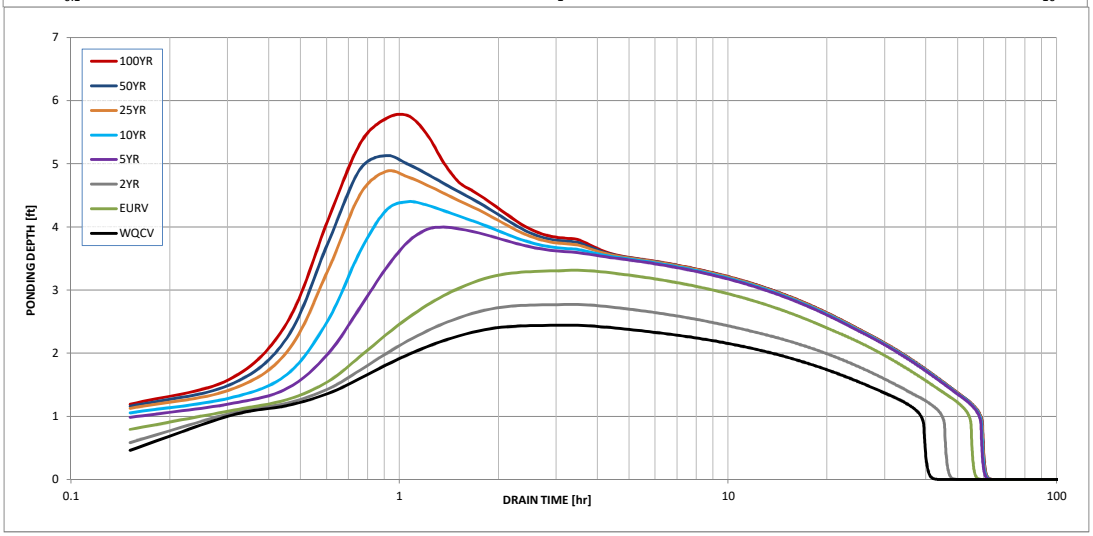
Depth of Flow through Spillway =	0.8	ft
Stage at Top of Freeboard =	8.6	ft
Detention Basin Area at Top of Freeboard =	0.42	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.220	0.389	0.282	0.826	1.440	2.549	3.347	4.285	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.220	0.389	0.281	0.825	1.440	2.549	3.347	4.285	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.17	0.34	0.78	1.01	1.29	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.4	5.8	11.5	26.5	34.3	43.9	cfs
Peak Inflow Q	2.7	4.8	3.5	10.1	17.6	31.1	41.0	52.6	cfs
Peak Outflow Q	0.1	0.1	0.1	4.6	12.8	28.1	38.4	41.2	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.8	1.1	1.1	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	Grate	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.2	0.5	1.1	1.5	1.6	fps
Time to Drain Detention Basin	**40**	56	46	60	60	60	60	60	hours
Maximum Ponding Depth	2.44	3.32	2.77	4.00	4.40	4.88	5.13	5.76	ft
2.8 Maximum Ponded Area	0.166	0.196	0.177	0.220	0.236	0.254	0.264	0.290	acres
Maximum Volume Stored	0.196	0.354	0.252	0.496	0.588	0.704	0.770	0.945	ac-ft



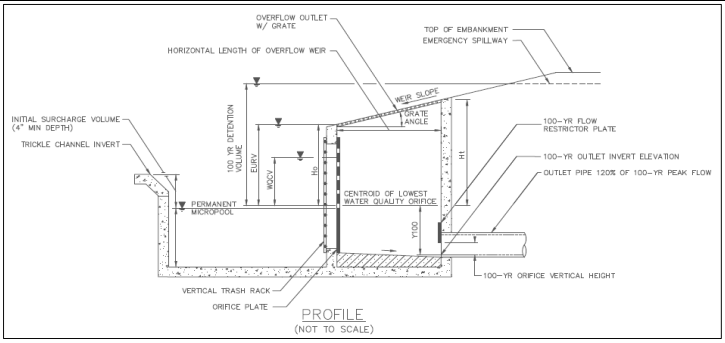


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD23



User Input: Watershed Parameters

Watershed Area =	14.50	acres
Watershed Length =	2,730	ft
Watershed Slope =	0.036	ft/ft
Watershed Imperviousness =	19.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	11,905	ft^3
Routed EURV =	0.274	acre-ft
Routed EURV =	11,942	ft^3
Calc. vs. Req Volume % Diff =	**0.3%**	
EURV Drain Time =	61.48	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	3.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	53	ft^2
Maximum EURV Ponding Depth =	3.20	ft
Depth Where Basin Floor Meets Side Slopes =	1.29	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	3.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	4.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	5.0	ft
Grate Open Area / 100-yr Orifice Area =	9.8	should be $\geq$ 4
Overflow Weir Slope Length =	4.1	ft
Overflow Grate Open Area w/o Debris =	9	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	0.73	0.73	0.73					
Stage [ft]	0.00	1.00	2.00					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	18.0	in
100-Year Restrictor Plate Height =	9.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	0.88	ft^2
100-Year Orifice Centroid =	0.43	ft
Half-Central Angle of Plate on Pipe =	1.57	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	6.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	10	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

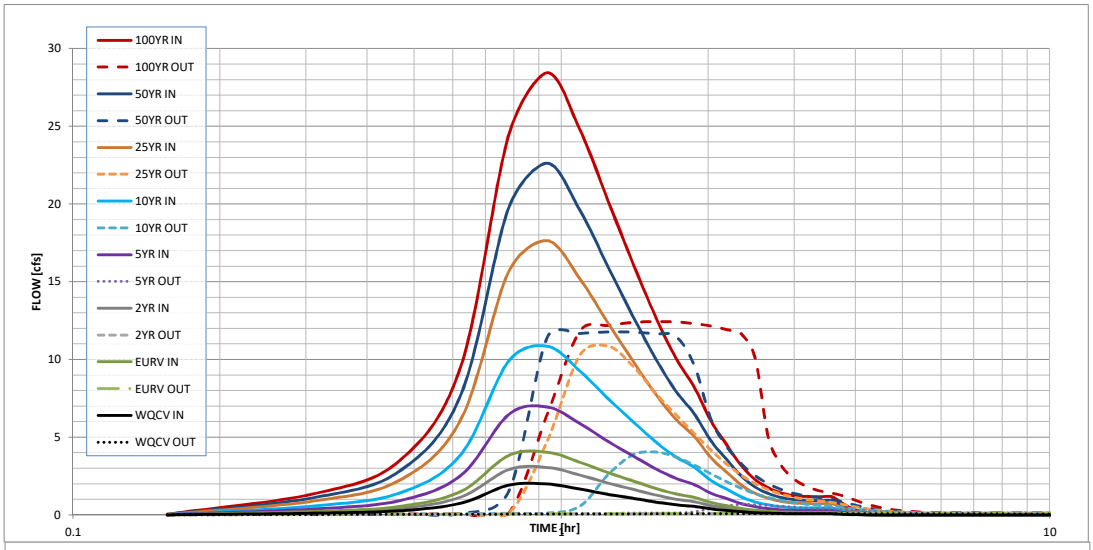
Calculated Spillway Parameters

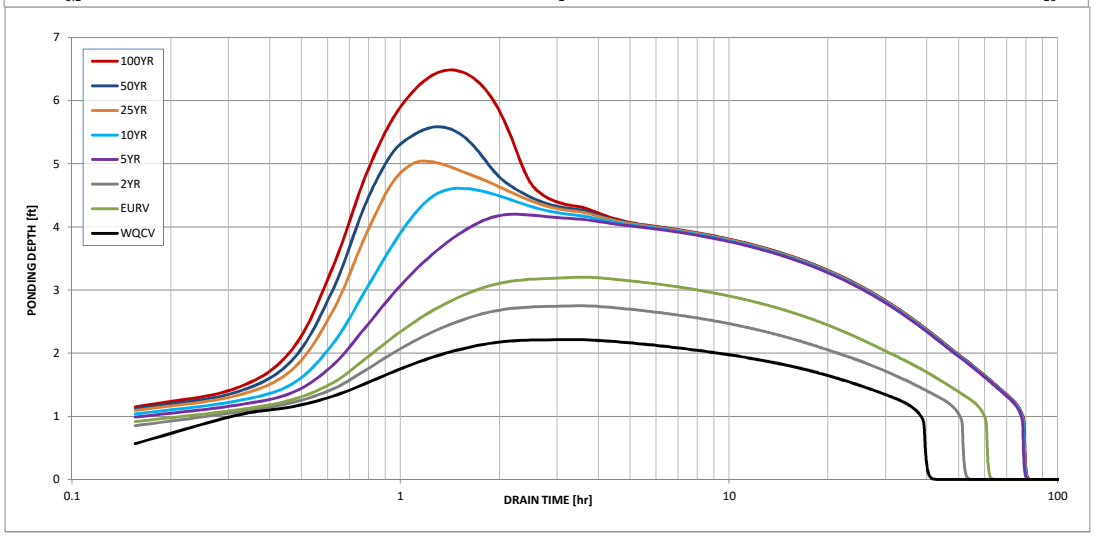
Depth of Flow through Spillway =	0.7	ft
Stage at Top of Freeboard =	8.2	ft
Detention Basin Area at Top of Freeboard =	0.39	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.135	0.273	0.207	0.470	0.739	1.202	1.543	1.943	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.167	0.337	0.256	0.582	0.914	1.488	1.910	2.405	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.17	0.34	0.77	1.00	1.28	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.2	2.4	4.9	11.2	14.5	18.6	cfs
Peak Inflow Q	2.0	4.0	3.1	6.9	10.9	17.6	22.6	28.4	cfs
Peak Outflow Q	0.1	0.1	0.1	0.7	4.0	10.8	11.8	12.4	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.3	0.8	1.0	0.8	0.7	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.1	0.4	1.2	1.3	1.4	fps
Time to Drain Detention Basin	**40**	61	52	79	79	80	80	80	hours
Maximum Ponding Depth	2.22	3.20	2.75	4.20	4.61	5.03	5.58	6.48	ft
2.8 Maximum Ponded Area	0.149	0.181	0.166	0.216	0.231	0.247	0.269	0.308	acres
Maximum Volume Stored	0.148	0.310	0.232	0.507	0.600	0.700	0.842	1.103	ac-ft



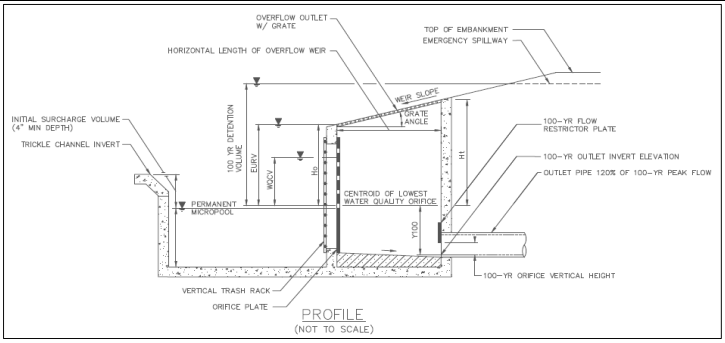


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD27



User Input: Watershed Parameters

Watershed Area =	126.80	acres
Watershed Length =	11,100	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	18.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	98,204	ft^3
Routed EURV =	2.261	acre-ft
Routed EURV =	98,504	ft^3
Calc. vs. Req Volume % Diff =	**0.3%**	
EURV Drain Time =	57.37	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	5.50	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	448	ft^2
Maximum EURV Ponding Depth =	5.28	ft
Depth Where Basin Floor Meets Side Slopes =	1.64	ft

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	7.5	ft
Grate Open Area / 100-yr Orifice Area =	8.5	should be $\geq$ 4
Overflow Weir Slope Length =	8.2	ft
Overflow Grate Open Area w/o Debris =	87	ft^2

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	5.5	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	15.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	8.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	5.25	5.25	5.25					
Stage [ft]	0.00	1.83	3.67					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	48.0	in
100-Year Restrictor Plate Height =	36.4	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	10.22	ft^2
100-Year Orifice Centroid =	1.67	ft
Half-Central Angle of Plate on Pipe =	2.11	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	8.9	ft (relative to lowest WQ orifice)
Spillway Crest Length =	66	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

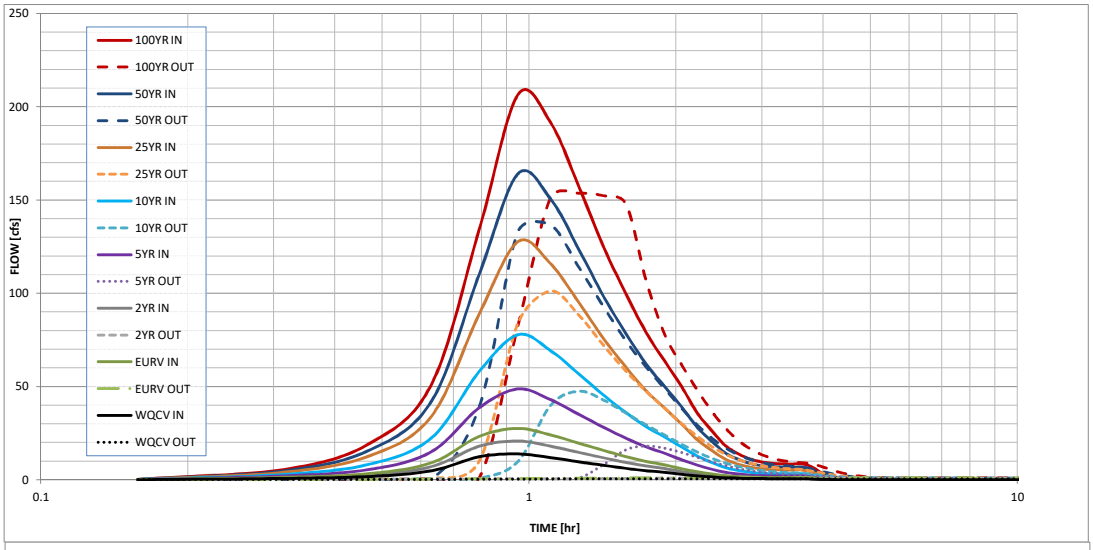
Calculated Spillway Parameters

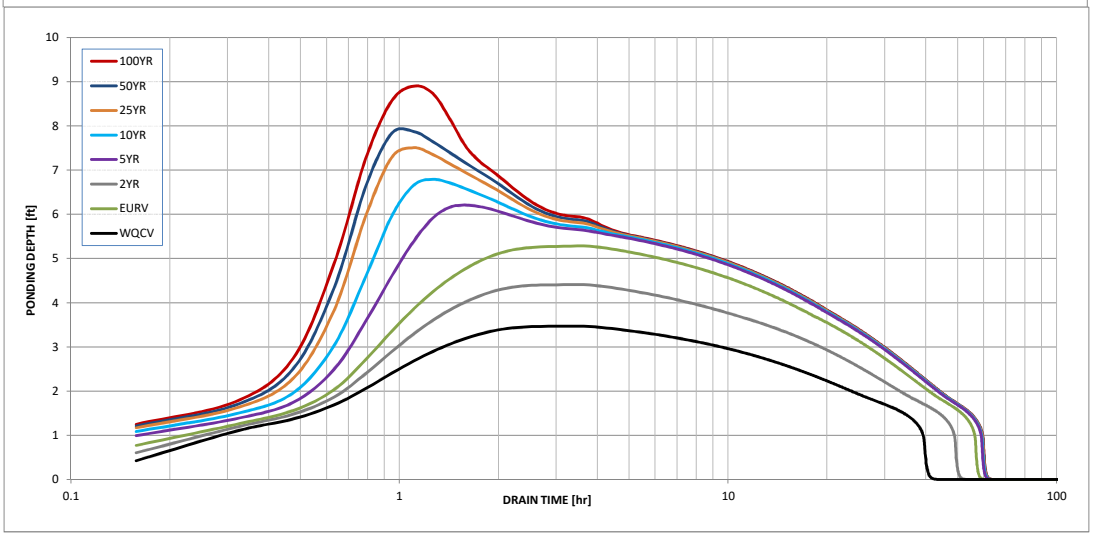
Depth of Flow through Spillway =	1.0	ft
Stage at Top of Freeboard =	10.9	ft
Detention Basin Area at Top of Freeboard =	1.05	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	1.132	2.254	1.696	3.968	6.306	10.372	13.358	16.852	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	1.182	2.354	1.771	4.144	6.586	10.827	13.947	17.600	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.17	0.33	0.77	1.00	1.28	cfs/acre
Undeveloped Peak Q	0.0	0.0	1.4	21.1	42.4	97.8	126.4	161.9	cfs
Peak Inflow Q	13.8	27.5	20.7	48.7	77.7	127.6	164.0	206.3	cfs
Peak Outflow Q	0.6	1.0	0.8	18.1	47.5	101.2	136.6	153.5	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.9	1.1	1.0	1.1	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	Grate	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.2	0.5	1.1	1.6	1.8	fps
Time to Drain Detention Basin	**40**	57	50	60	60	60	61	61	hours
Maximum Ponding Depth	3.47	5.28	4.41	6.21	6.79	7.51	7.87	8.90	ft
2.8 Maximum Ponded Area	0.539	0.650	0.596	0.710	0.749	0.799	0.825	0.899	acres
Maximum Volume Stored	1.041	2.118	1.575	2.748	3.171	3.727	4.027	4.911	ac-ft



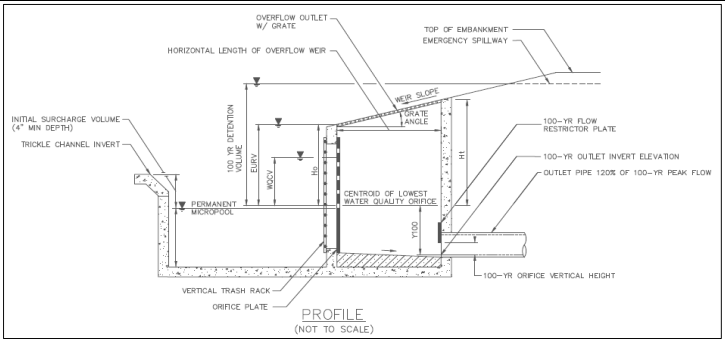


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD72



User Input: Watershed Parameters

Watershed Area =	56.20	acres
Watershed Length =	9,675	ft
Watershed Slope =	0.045	ft/ft
Watershed Imperviousness =	8.0%	percent
Percentage Hydrologic Soil Group A =	0%	percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	18,130	ft^3
Routed EURV =	0.418	acre-ft
Routed EURV =	18,210	ft^3
Calc. vs. Req Volume % Diff =	**0.4%**	
EURV Drain Time =	55.70	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	4.70	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	102	ft^2
Maximum EURV Ponding Depth =	4.46	ft
Depth Where Basin Floor Meets Side Slopes =	1.14	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	4.7	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	12.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	6.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	6.2	ft
Grate Open Area / 100-yr Orifice Area =	9.3	should be $\geq$ 4
Overflow Weir Slope Length =	6.2	ft
Overflow Grate Open Area w/o Debris =	52	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	1.50	0.20	0.20					
Stage [ft]	0.00	1.57	3.13					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	36.0	in
100-Year Restrictor Plate Height =	26.5	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	5.58	ft^2
100-Year Orifice Centroid =	1.22	ft
Half-Central Angle of Plate on Pipe =	2.06	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	8.0	ft (relative to lowest WQ orifice)
Spillway Crest Length =	26	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

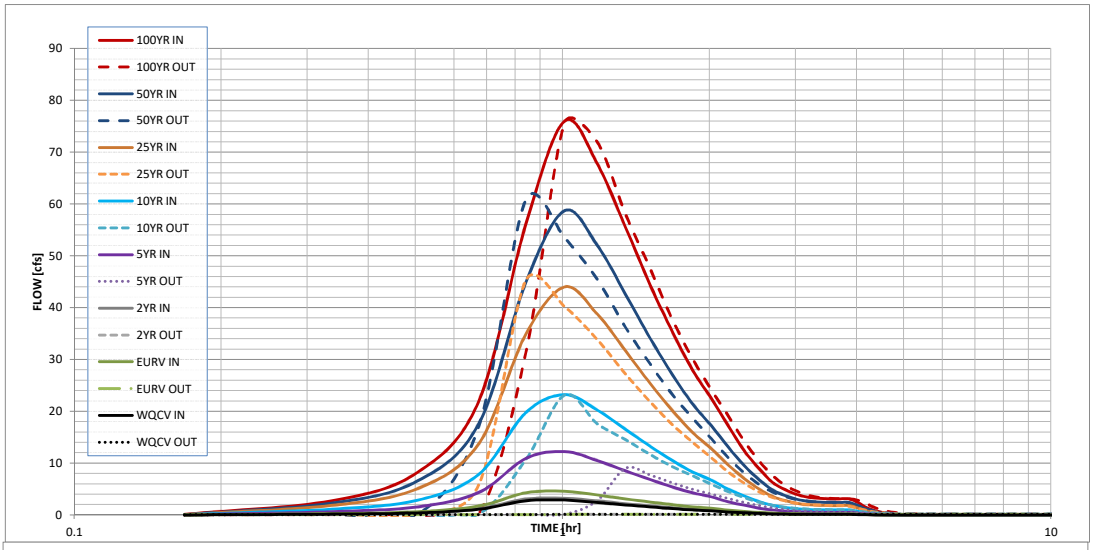
Calculated Spillway Parameters

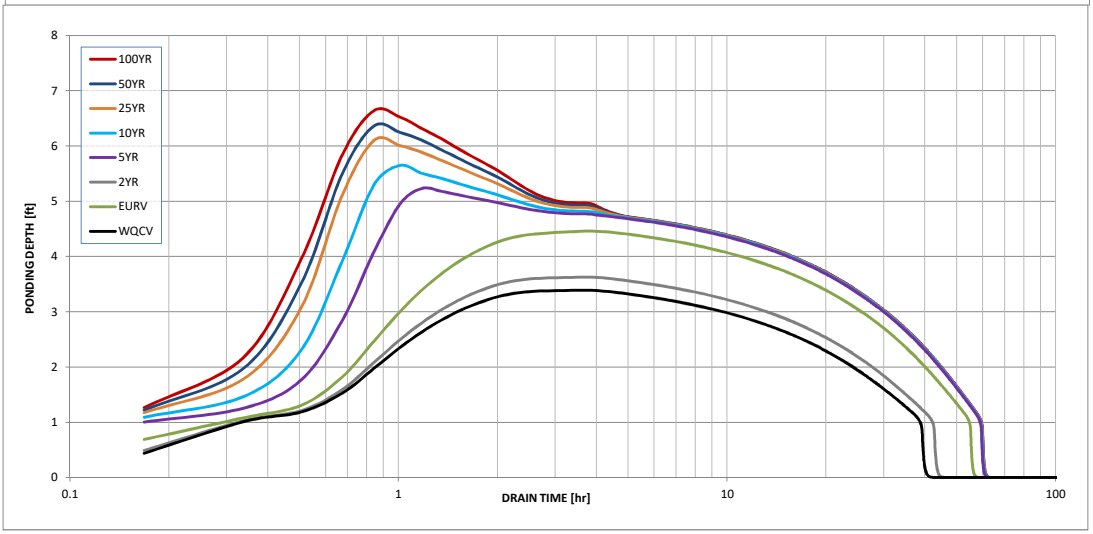
Depth of Flow through Spillway =	0.9	ft
Stage at Top of Freeboard =	9.9	ft
Detention Basin Area at Top of Freeboard =	0.37	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.259	0.416	0.290	1.109	2.116	3.979	5.301	6.860	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.258	0.415	0.290	1.109	2.116	3.979	5.300	6.856	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.17	0.34	0.79	1.02	1.31	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.6	9.6	19.3	44.4	57.4	73.4	cfs
Peak Inflow Q	2.8	4.6	3.2	12.2	23.2	44.0	58.7	76.0	cfs
Peak Outflow Q	0.1	0.1	0.1	9.0	23.1	45.2	60.8	75.5	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.9	1.2	1.0	1.1	1.0	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	Grate	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.2	0.4	0.9	1.2	1.5	fps
Time to Drain Detention Basin	**40**	56	43	60	60	60	60	61	hours
Maximum Ponding Depth	3.39	4.46	3.63	5.23	5.65	6.10	6.36	6.64	ft
Maximum Ponded Area	0.125	0.157	0.132	0.182	0.196	0.211	0.221	0.231	acres
Maximum Volume Stored	0.228	0.379	0.259	0.510	0.589	0.680	0.737	0.800	ac-ft



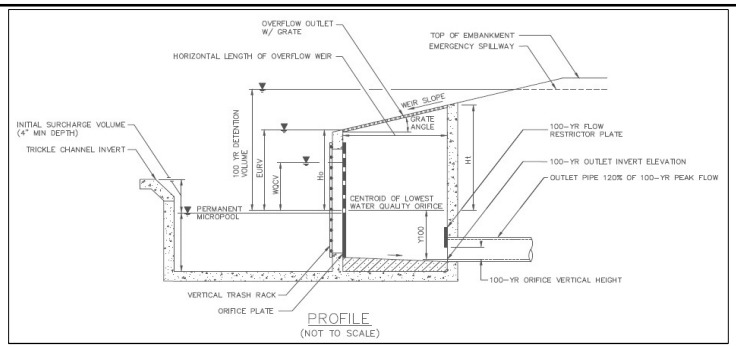


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD-E1



User Input: Watershed Parameters

Watershed Area =	64.40	acres
Watershed Length =	3,000	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	14.0%	percent
Percentage Hydrologic Soil Group A =		percent
Percentage Hydrologic Soil Group B =	100%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	38,021	ft^3
Routed EURV =	0.876	acre-ft
Routed EURV =	38,177	ft^3
Calc. vs. Req Volume % Diff =	**0.4%**	
EURV Drain Time =	43.54	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	188	ft^2
Maximum EURV Ponding Depth =	5.39	ft
Depth Where Basin Floor Meets Side Slopes =	1.20	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	6.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	8.3	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	5.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	7.3	ft
Grate Open Area / 100-yr Orifice Area =	6.9	should be $\geq$ 4
Overflow Weir Slope Length =	5.2	ft
Overflow Grate Open Area w/o Debris =	30	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	2.00	2.00	35.00	100.00	150.00			
Stage [ft]	0.00	2.00	4.00	6.00	8.00			

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	30.0	in
100-Year Restrictor Plate Height =	25.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	4.37	ft^2
100-Year Orifice Centroid =	1.13	ft
Half-Central Angle of Plate on Pipe =	2.30	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	12.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	30	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

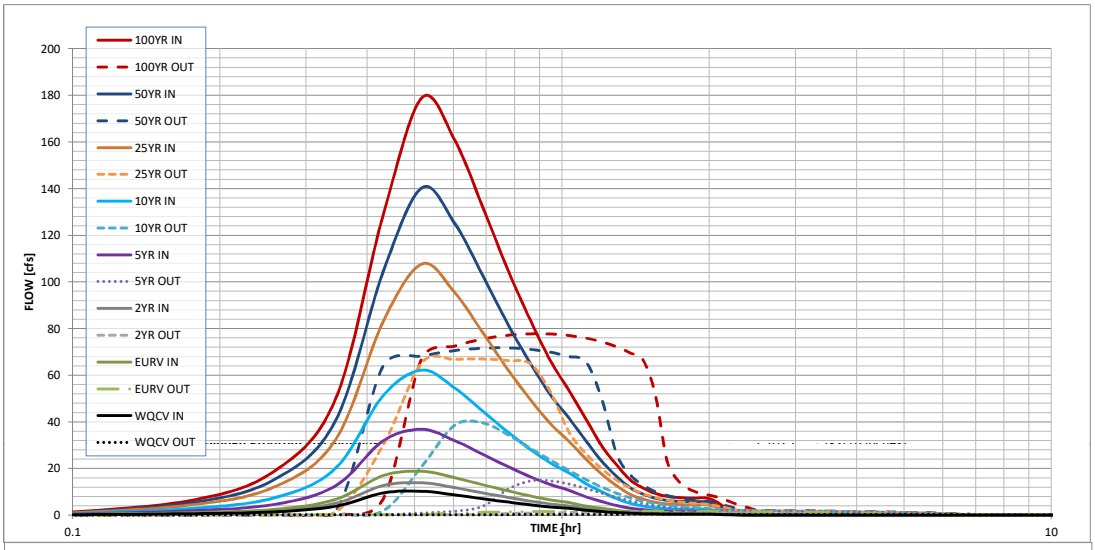
Calculated Spillway Parameters

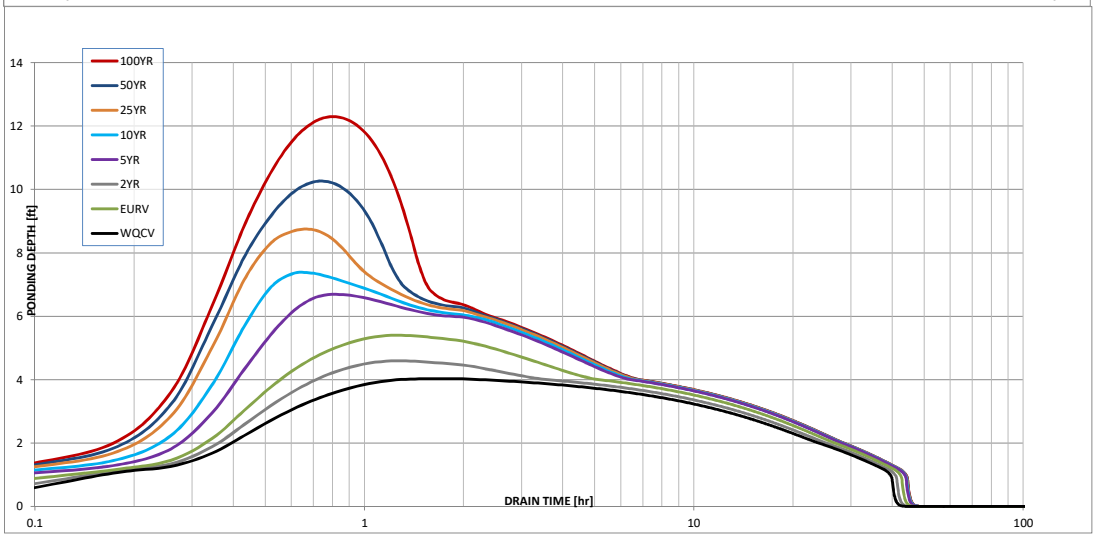
Depth of Flow through Spillway =	1.4	ft
Stage at Top of Freeboard =	14.9	ft
Detention Basin Area at Top of Freeboard =	0.59	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.474	0.873	0.641	1.718	2.892	4.985	6.500	8.280	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.473	0.872	0.641	1.717	2.891	4.984	6.492	8.276	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.19	0.38	0.86	1.11	1.41	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.8	12.2	24.2	55.2	71.3	91.0	cfs
Peak Inflow Q	10.2	18.7	13.8	36.8	62.1	107.7	140.4	178.9	cfs
Peak Outflow Q	0.4	1.7	1.2	14.7	39.5	66.9	71.7	77.8	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	1.2	1.6	1.2	1.0	0.9	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	100yr Outlet	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.3	1.1	1.8	1.8	1.8	fps
Time to Drain Detention Basin	**41**	44	42	45	45	45	45	45	hours
Maximum Ponding Depth	4.03	5.39	4.60	6.68	7.36	8.74	10.24	12.29	ft
2.8 Maximum Ponded Area	0.190	0.239	0.210	0.291	0.320	0.383	0.459	0.572	acres
Maximum Volume Stored	0.431	0.724	0.545	1.064	1.274	1.756	2.389	3.444	ac-ft





Initial Design for Full Spectrum Detention Basins

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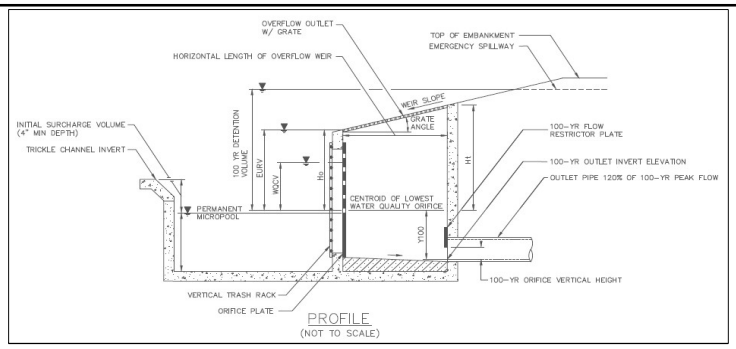
Project: Sterling Ranch MDDP

Basin ID: FSD-E2



User Input: Watershed Parameters

Watershed Area =	67.50	acres
Watershed Length =	4,788	ft
Watershed Slope =	0.027	ft/ft
Watershed Imperviousness =	25.0%	percent
Percentage Hydrologic Soil Group A =	11%	percent
Percentage Hydrologic Soil Group B =	89%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	74,020	ft^3
Routed EURV =	1.704	acre-ft
Routed EURV =	74,248	ft^3
Calc. vs. Req Volume % Diff =	**0.3%**	
EURV Drain Time =	70.51	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	300	ft^2
Maximum EURV Ponding Depth =	4.74	ft
Depth Where Basin Floor Meets Side Slopes =	1.44	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	6.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	8.3	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	5.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	7.3	ft
Grate Open Area / 100-yr Orifice Area =	6.9	should be $\geq$ 4
Overflow Weir Slope Length =	5.2	ft
Overflow Grate Open Area w/o Debris =	30	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	1.00	75.00	50.00	100.00				
Stage [ft]	0.00	2.00	4.00	6.00				

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	4.0	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	30.0	in
100-Year Restrictor Plate Height =	25.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	4.37	ft^2
100-Year Orifice Centroid =	1.13	ft
Half-Central Angle of Plate on Pipe =	2.30	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	12.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	30	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

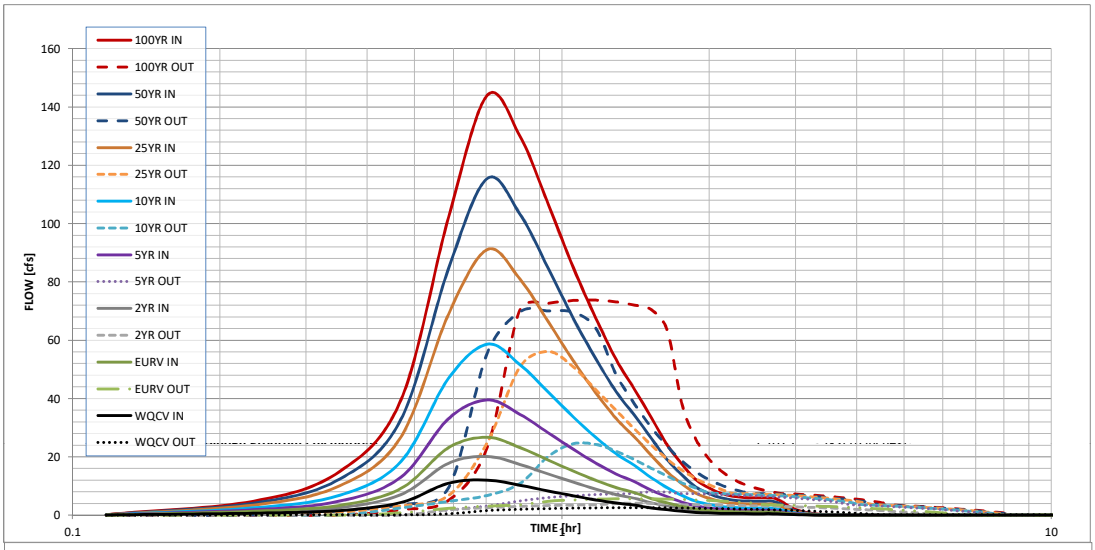
Calculated Spillway Parameters

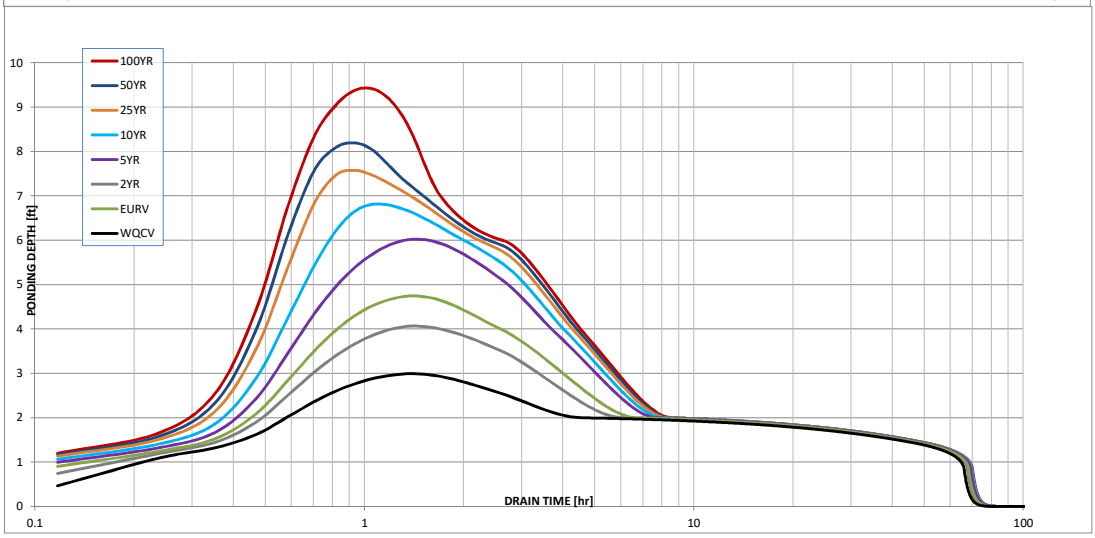
Depth of Flow through Spillway =	1.4	ft
Stage at Top of Freeboard =	14.9	ft
Detention Basin Area at Top of Freeboard =	0.89	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.758	1.699	1.282	2.509	3.699	5.741	7.268	9.062	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.758	1.699	1.282	2.509	3.699	5.734	7.261	9.061	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.14	0.28	0.67	0.89	1.15	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.6	9.5	19.2	45.5	59.8	77.6	cfs
Peak Inflow Q	12.0	26.7	20.2	39.5	58.6	91.1	115.4	143.9	cfs
Peak Outflow Q	2.6	5.7	4.1	8.1	24.4	56.1	70.0	73.8	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.8	1.3	1.2	1.2	1.0	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.0	0.4	1.4	1.8	1.9	fps
Time to Drain Detention Basin	**68**	71	70	71	72	72	72	72	hours
Maximum Ponding Depth	2.99	4.74	4.06	6.03	6.81	7.57	8.19	9.42	ft
2.8 Maximum Ponded Area	0.323	0.406	0.373	0.473	0.516	0.560	0.596	0.673	acres
Maximum Volume Stored	0.517	1.153	0.888	1.717	2.102	2.514	2.871	3.649	ac-ft





Initial Design for Full Spectrum Detention Basins

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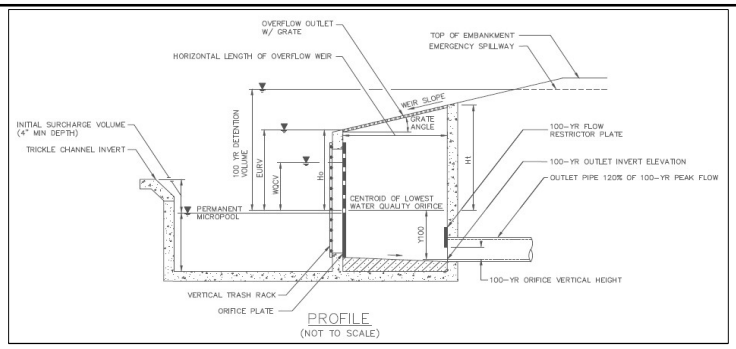
Project: Sterling Ranch MDDP

Basin ID: FSD-E3



User Input: Watershed Parameters

Watershed Area =	85.50	acres
Watershed Length =	4,010	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	70.0%	percent
Percentage Hydrologic Soil Group A =	1%	percent
Percentage Hydrologic Soil Group B =	99%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	287,504	ft^3
Routed EURV =	6.614	acre-ft
Routed EURV =	288,104	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	68.08	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	776	ft^2
Maximum EURV Ponding Depth =	5.53	ft
Depth Where Basin Floor Meets Side Slopes =	2.36	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	6.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	8.3	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	5.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	7.3	ft
Grate Open Area / 100-yr Orifice Area =	6.9	should be $\geq$ 4
Overflow Weir Slope Length =	5.2	ft
Overflow Grate Open Area w/o Debris =	30	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	5.00	25.00	100.00	100.00	150.00			
Stage [ft]	0.00	2.00	4.00	6.00	7.00			

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	4.0	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	30.0	in
100-Year Restrictor Plate Height =	25.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	4.37	ft^2
100-Year Orifice Centroid =	1.13	ft
Half-Central Angle of Plate on Pipe =	2.30	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	12.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	30	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

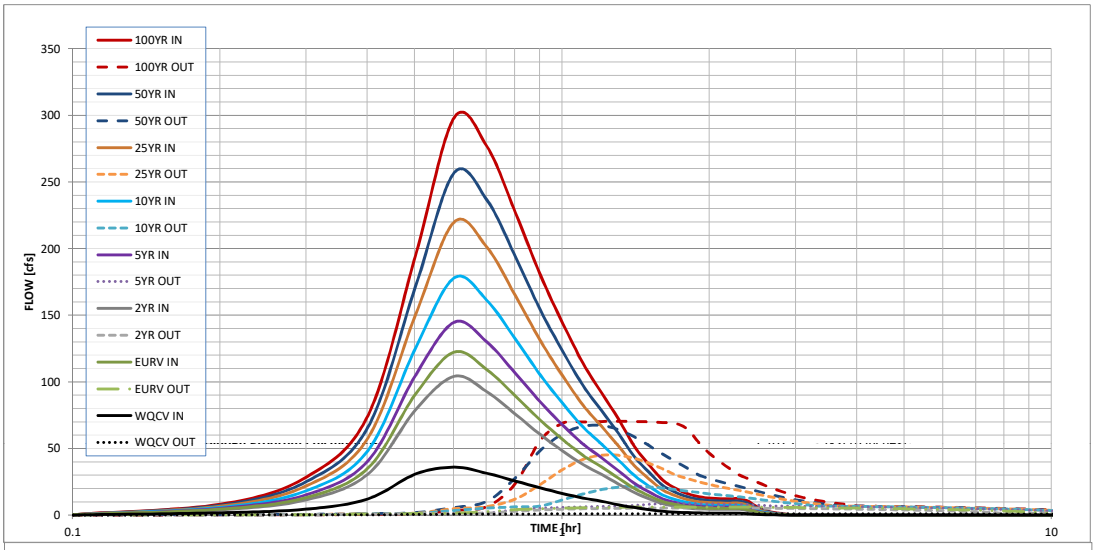
Calculated Spillway Parameters

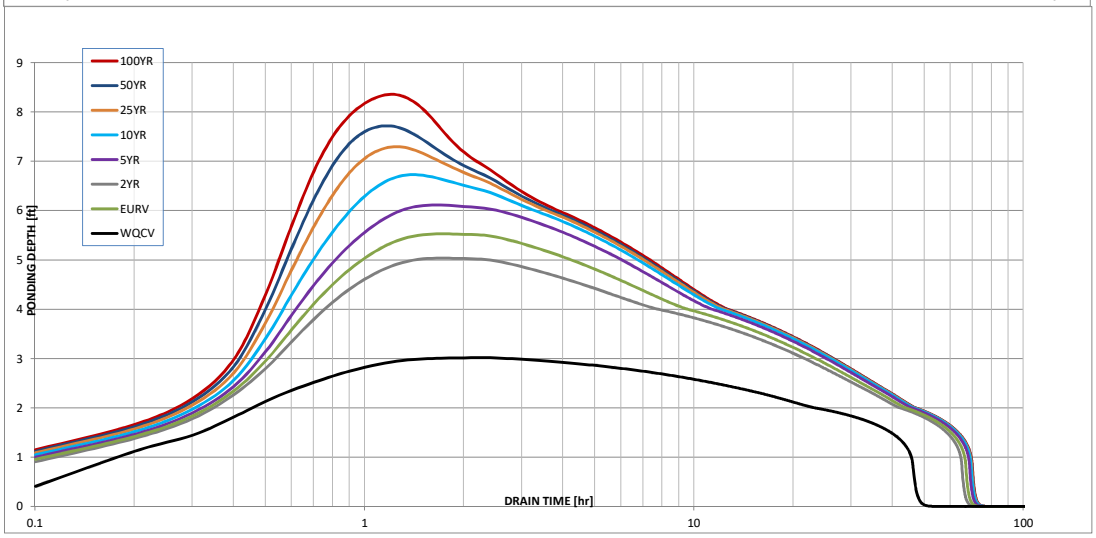
Depth of Flow through Spillway =	1.4	ft
Stage at Top of Freeboard =	14.9	ft
Detention Basin Area at Top of Freeboard =	2.53	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	1.960	6.600	5.620	7.799	9.607	11.871	13.892	16.162	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	1.959	6.591	5.616	7.798	9.598	11.867	13.889	16.160	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.15	0.31	0.72	0.93	1.20	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.9	13.2	26.5	61.6	79.8	102.6	cfs
Peak Inflow Q	36.0	122.4	104.2	144.8	178.1	219.9	256.9	298.4	cfs
Peak Outflow Q	1.1	6.1	5.2	8.6	21.6	45.0	67.4	70.5	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	0.7	0.8	0.7	0.8	0.7	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	Grate	Grate	Grate	Grate	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	0.0	0.4	1.0	1.7	1.7	fps
Time to Drain Detention Basin	**47**	68	66	70	71	71	71	71	hours
Maximum Ponding Depth	3.02	5.53	5.04	6.11	6.73	7.29	7.71	8.36	ft
2.8 Maximum Ponded Area	1.473	1.727	1.675	1.788	1.855	1.916	1.962	2.034	acres
Maximum Volume Stored	1.780	5.792	4.949	6.812	7.940	8.999	9.815	11.100	ac-ft





Initial Design for Full Spectrum Detention Basins

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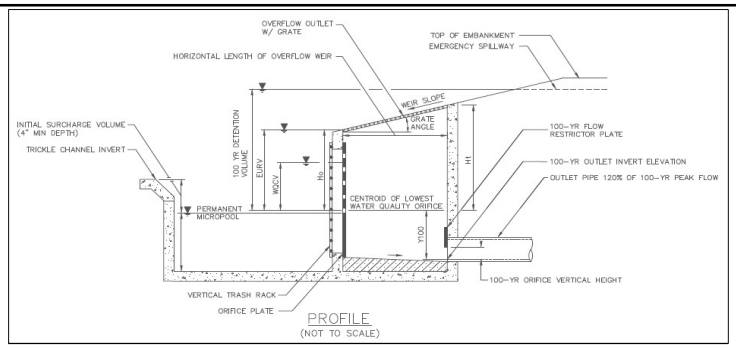
Project: Sterling Ranch MDDP

Basin ID: FSD-E4



User Input: Watershed Parameters

Watershed Area =	44.90	acres
Watershed Length =	2,648	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	76.0%	percent
Percentage Hydrologic Soil Group A =	42%	percent
Percentage Hydrologic Soil Group B =	58%	percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	176,497	ft^3
Routed EURV =	4.060	acre-ft
Routed EURV =	176,858	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	71.55	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	452	ft^2
Maximum EURV Ponding Depth =	5.55	ft
Depth Where Basin Floor Meets Side Slopes =	1.95	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	8.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	1.0	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	1.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	8.3	ft
Grate Open Area / 100-yr Orifice Area =	0.1	should be $\geq$ 4
Overflow Weir Slope Length =	1.0	ft
Overflow Grate Open Area w/o Debris =	1	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	1.50	9.00	35.00	90.00				
Stage [ft]	0.00	1.00	4.00	5.00				

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	2.5	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	36.0	in
100-Year Restrictor Plate Height =	105.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	7.07	ft^2
100-Year Orifice Centroid =	1.50	ft
Half-Central Angle of Plate on Pipe =	3.14	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	10.0	ft (relative to lowest WQ orifice)
Spillway Crest Length =	20	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

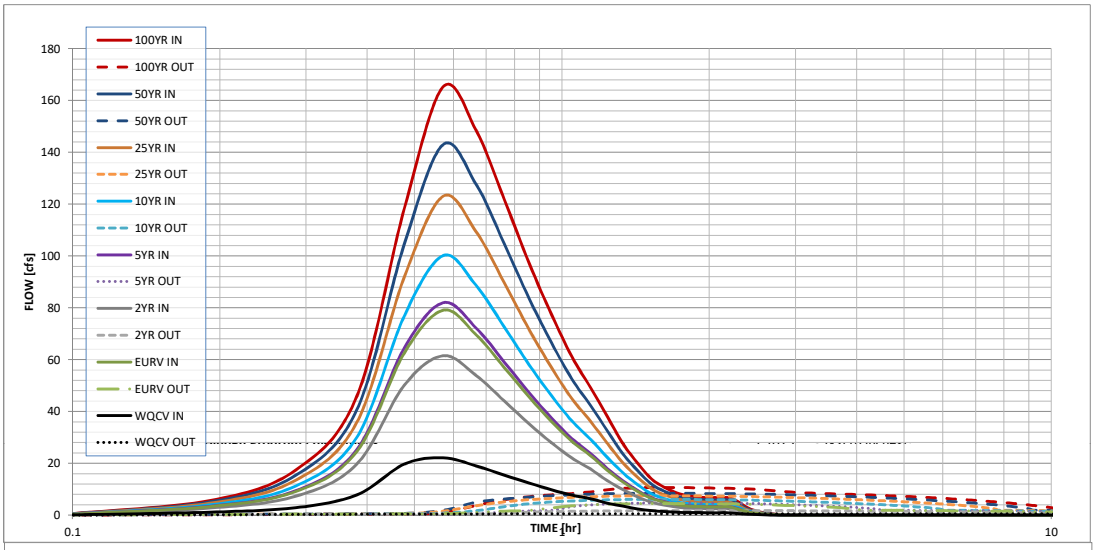
Calculated Spillway Parameters

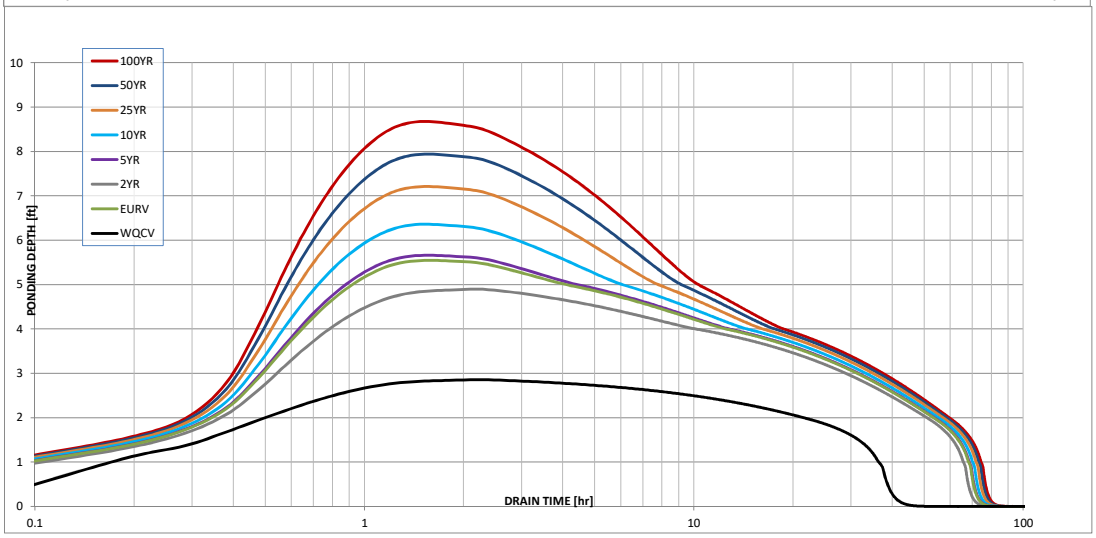
Depth of Flow through Spillway =	1.7	ft
Stage at Top of Freeboard =	12.7	ft
Detention Basin Area at Top of Freeboard =	1.68	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	1.141	4.052	3.156	4.200	5.126	6.293	7.306	8.447	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	1.141	4.051	3.156	4.200	5.123	6.285	7.301	8.445	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.01	0.10	0.20	0.51	0.72	0.97	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.3	4.4	8.8	23.0	32.2	43.7	cfs
Peak Inflow Q	22.1	79.1	61.4	82.0	100.1	123.0	142.9	165.2	cfs
Peak Outflow Q	0.5	4.4	1.8	4.7	6.1	7.5	8.4	10.7	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	1.1	0.7	0.3	0.3	0.2	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	
Max Velocity through Grate	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.9	fps
Time to Drain Detention Basin	**40**	72	69	72	74	75	77	78	hours
Maximum Ponding Depth	2.86	5.55	4.89	5.66	6.36	7.21	7.94	8.68	ft
2.8 Maximum Ponded Area	0.834	1.042	0.990	1.051	1.108	1.181	1.244	1.310	acres
Maximum Volume Stored	1.059	3.578	2.915	3.698	4.451	5.429	6.307	7.253	ac-ft





Initial Design for Full Spectrum Detention Basins

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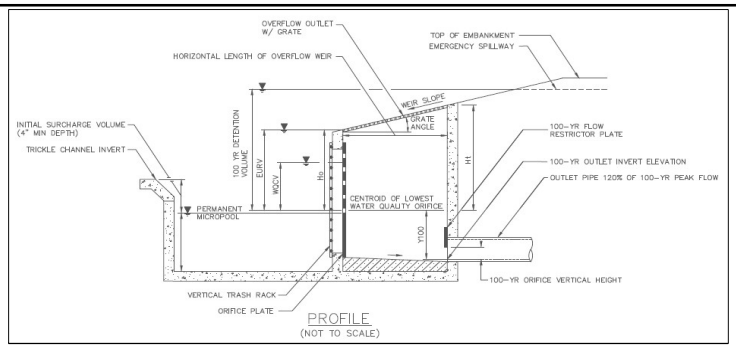
Project: Sterling Ranch MDDP

Basin ID: FSD-E5



User Input: Watershed Parameters

Watershed Area =	25.50	acres
Watershed Length =	2,215	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	95.0%	percent
Percentage Hydrologic Soil Group A =	100%	percent
Percentage Hydrologic Soil Group B =		percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	145,627	ft^3
Routed EURV =	3.350	acre-ft
Routed EURV =	145,941	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	64.38	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	376	ft^2
Maximum EURV Ponding Depth =	5.76	ft
Depth Where Basin Floor Meets Side Slopes =	1.82	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	7.5	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	8.3	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	5.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	8.8	ft
Grate Open Area / 100-yr Orifice Area =	6.9	should be $\geq$ 4
Overflow Weir Slope Length =	5.2	ft
Overflow Grate Open Area w/o Debris =	30	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	6.00	8.00	5.00	30.00				
Stage [ft]	0.00	2.00	4.00	6.00				

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	4.0	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	30.0	in
100-Year Restrictor Plate Height =	25.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	4.37	ft^2
100-Year Orifice Centroid =	1.13	ft
Half-Central Angle of Plate on Pipe =	2.30	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	12.5	ft (relative to lowest WQ orifice)
Spillway Crest Length =	30	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

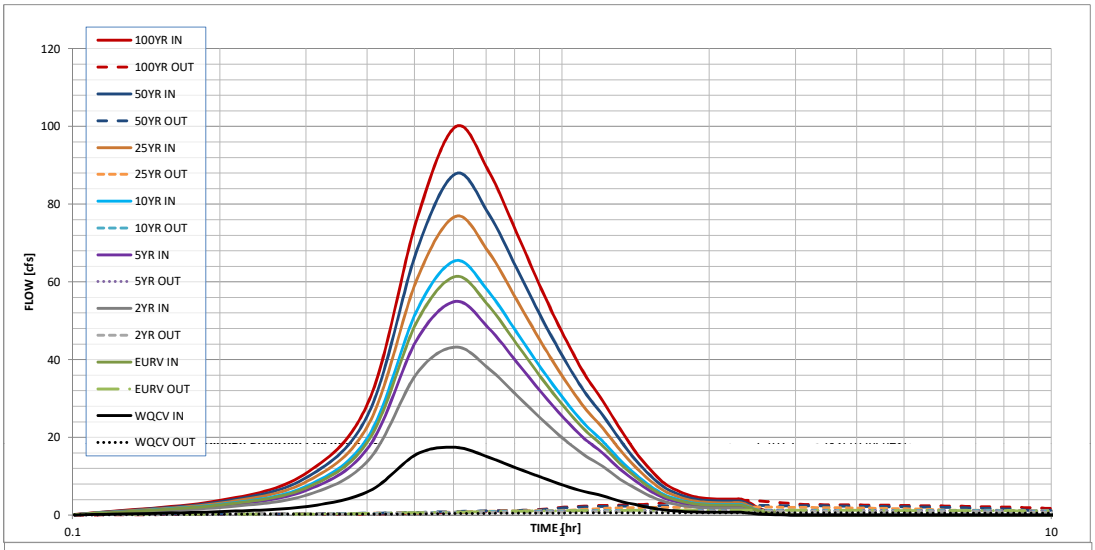
Calculated Spillway Parameters

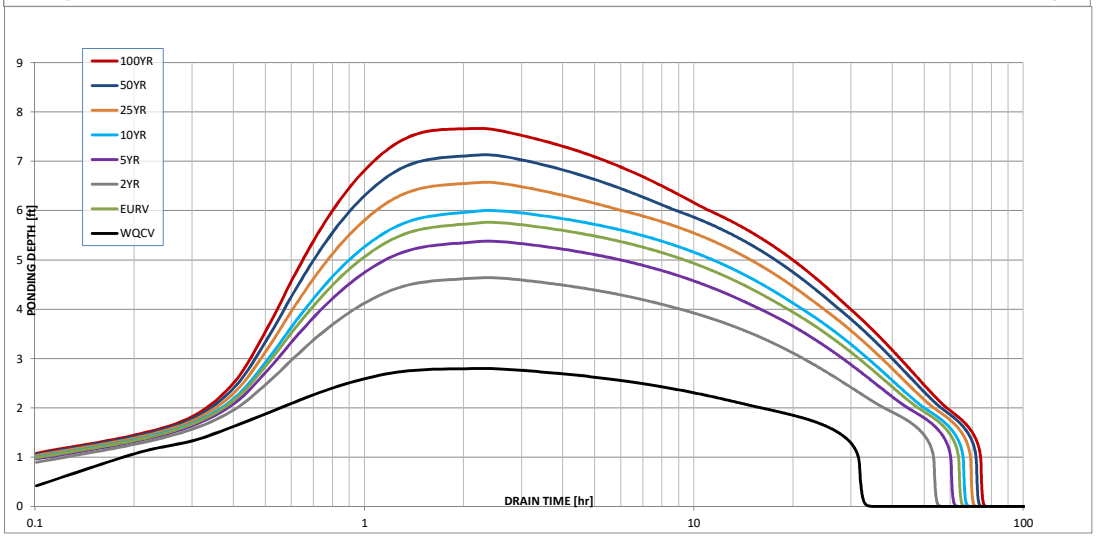
Depth of Flow through Spillway =	1.4	ft
Stage at Top of Freeboard =	14.9	ft
Detention Basin Area at Top of Freeboard =	1.45	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	0.950	3.343	2.367	2.998	3.563	4.177	4.768	5.420	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	0.949	3.343	2.367	2.997	3.562	4.177	4.767	5.419	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.01	0.01	0.16	0.34	0.56	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.0	0.2	0.4	4.2	8.7	14.3	cfs
Peak Inflow Q	17.4	61.4	43.3	55.0	65.5	76.9	87.8	99.9	cfs
Peak Outflow Q	0.6	1.2	1.0	1.2	1.3	2.1	2.5	3.8	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	5.4	3.6	0.5	0.3	0.3	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	
Max Velocity through Grate	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	fps
Time to Drain Detention Basin	**32**	64	54	61	66	70	73	75	hours
Maximum Ponding Depth	2.80	5.76	4.64	5.38	6.00	6.58	7.13	7.67	ft
2.8 Maximum Ponded Area	0.668	0.876	0.795	0.847	0.894	0.937	0.979	1.022	acres
Maximum Volume Stored	0.855	3.141	2.204	2.807	3.352	3.877	4.408	4.947	ac-ft



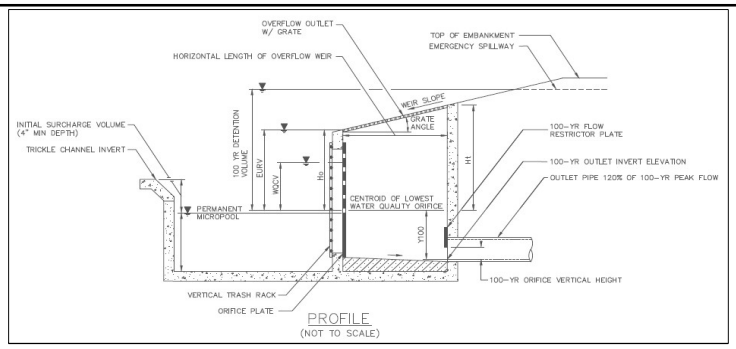


Initial Design for Full Spectrum Detention Basins

Worksheet Protected

Project: Sterling Ranch MDDP

Basin ID: FSD-E6



User Input: Watershed Parameters

Watershed Area =	174.30	acres
Watershed Length =	4,086	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	45.0%	percent
Percentage Hydrologic Soil Group A =	100%	percent
Percentage Hydrologic Soil Group B =		percent
Percentage Hydrologic Soil Groups C/D =		percent
Location for 1-hr Rainfall Depths =	User Input	

Calculated Watershed Parameters

Required EURV =	382,495	ft^3
Routed EURV =	8.801	acre-ft
Routed EURV =	383,378	ft^3
Calc. vs. Req Volume % Diff =	**0.2%**	
EURV Drain Time =	72.60	hrs

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Detention Basin Length-to-Width Ratio =	2.00	L:W
Basin Side Slope (Above Basin Floor) =	4.00	H:V
Available EURV Ponding Depth =	6.00	ft (relative to lowest WQ orifice)
WQCV Design Drain Time =	40	hours

Calculated Detention Basin Parameters

Surface Area of Initial Surcharge Volume =	1110	ft^2
Maximum EURV Ponding Depth =	5.56	ft
Depth Where Basin Floor Meets Side Slopes =	2.66	ft

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	6.0	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	8.3	ft
Overflow Weir Slope =	4	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	5.0	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	% of open area clogged w/ debris

Calculated Overflow Grate Parameters

Height of Grate Upper Edge H_t =	7.3	ft
Grate Open Area / 100-yr Orifice Area =	6.9	should be $\geq$ 4
Overflow Weir Slope Length =	5.2	ft
Overflow Grate Open Area w/o Debris =	30	ft^2

User Input: Water Quality Orifices [numbered from lowest to highest]

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Area [sq inch]	6.00	25.00	175.00					
Stage [ft]	0.00	2.00	4.00					

	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16
Area [sq inch]								
Stage [ft]								

User Input: 100-Year Orifice Parameters

100-Year Restrictor Type =	Circular Pipe w/ Plate	
100-Year Orifice Invert Depth =	4.0	ft (below the lowest WQ orifice)
100-Year Outlet Pipe Diameter =	30.0	in
100-Year Restrictor Plate Height =	25.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	4.37	ft^2
100-Year Orifice Centroid =	1.13	ft
Half-Central Angle of Plate on Pipe =	2.30	radians

User Input: Emergency Spillway Parameters

Spillway Crest Stage =	9.0	ft (relative to lowest WQ orifice)
Spillway Crest Length =	30	ft
Spillway End Slopes =	4.00	H:V
Freeboard above Spillway =	1.00	ft

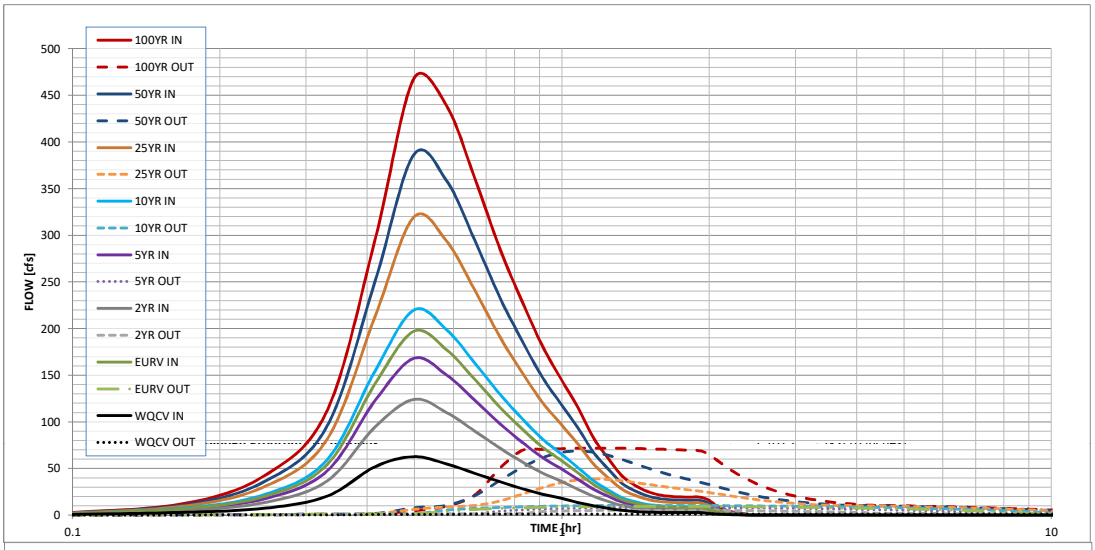
Calculated Spillway Parameters

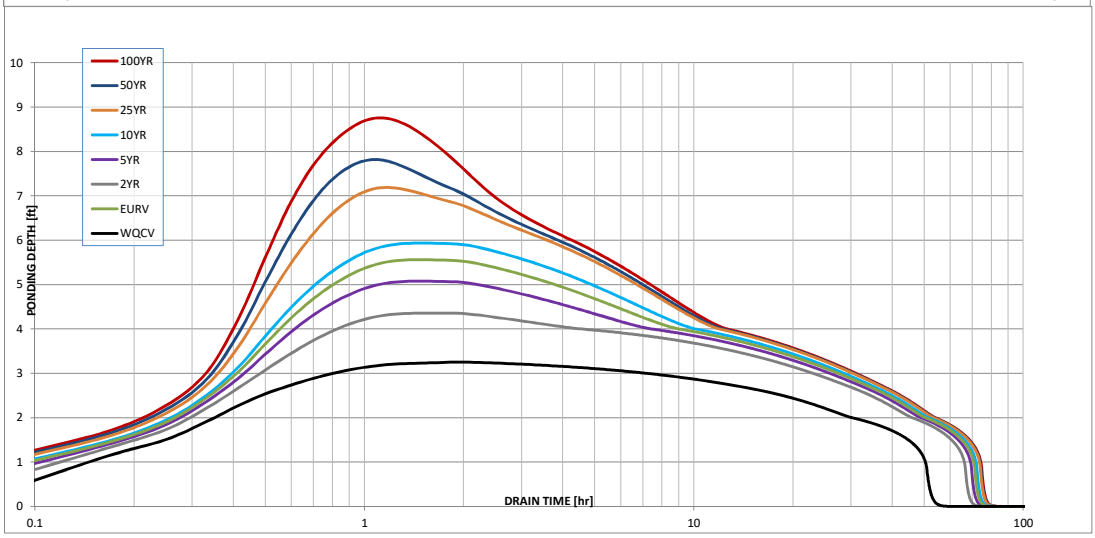
Depth of Flow through Spillway =	1.4	ft
Stage at Top of Freeboard =	11.4	ft
Detention Basin Area at Top of Freeboard =	3.13	acres

Initial Design for Full Spectrum Detention Basins

Routed Hydrograph Results For **2:1 L:W Rectangular Basin with 0.005 ft/ft Slope Trickle Channel**

Design Storm Return Period	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	
One-Hour Rainfall Depth	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	in
Calculated Runoff Volume	2.803	8.781	5.518	7.473	9.788	14.258	17.295	21.017	acre-ft
OPTIONAL Override Runoff Volume									acre-ft
Inflow Hydrograph Volume	2.803	8.773	5.517	7.470	9.787	14.257	17.287	21.015	acre-ft
Undeveloped Peak Flow Rate Per Acre (q)	0.00	0.00	0.00	0.01	0.02	0.21	0.44	0.72	cfs/acre
Undeveloped Peak Q	0.0	0.0	0.2	1.9	3.2	37.4	77.3	125.6	cfs
Peak Inflow Q	62.5	197.1	123.9	167.9	219.7	319.1	385.9	467.5	cfs
Peak Outflow Q	1.3	9.4	5.2	8.0	10.3	38.9	68.8	71.8	cfs
Ratio Peak Outflow to Undeveloped Q	N/A	N/A	N/A	4.2	3.2	1.0	0.9	0.6	Ratio
Structure Controlling Flow	WQ Plate	WQ Plate	WQ Plate	WQ Plate	WQ Plate	Grate	100yr Outlet	100yr Outlet	
Max Velocity through Grate	N/A	N/A	N/A	N/A	N/A	0.9	1.8	1.9	fps
Time to Drain Detention Basin	**52**	73	68	71	74	76	76	76	hours
Maximum Ponding Depth	3.25	5.56	4.35	5.08	5.94	7.19	7.81	8.75	ft
2.8 Maximum Ponded Area	2.083	2.359	2.213	2.299	2.405	2.562	2.643	2.766	acres
Maximum Volume Stored	2.625	7.754	4.992	6.627	8.648	11.755	13.383	15.922	ac-ft





Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD1

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	30,456.00	15,228.00	0.35	0.35
2.00	33,376.00	31,916.00	0.73	1.08
3.00	36,424.00	34,900.00	0.80	1.88
4.00	39,600.00	38,012.00	0.87	2.76
5.00	42,906.00	41,253.00	0.95	3.70
6.00	46,336.00	44,621.00	1.02	4.73
7.00	49,896.00	48,116.00	1.10	5.83
8.00	53,584.00	51,740.00	1.19	7.02
9.00	57,400.00	55,492.00	1.27	8.29

Total = 361,278 CF

Total = 8.3 Ac-ft

At Elevation 3.33, the Storage is 2.17 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD5

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	20,604.00	10,302.00	0.24	0.24
2.00	23,100.00	21,852.00	0.50	0.74
3.00	25,724.00	24,412.00	0.56	1.30
4.00	28,476.00	27,100.00	0.62	1.92
5.00	31,356.00	29,916.00	0.69	2.61
6.00	34,364.00	32,860.00	0.75	3.36
7.00	37,500.00	35,932.00	0.82	4.19
8.00	40,764.00	39,132.00	0.90	5.09
9.00	44,156.00	42,460.00	0.97	6.06

Total = 263,966 CF

Total = 6.1 Ac-ft

At Elevation 8.17, the Storage is 5.25 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD6

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	34,700.00	17,350.00	0.40	0.40
2.00	109,730.00	72,215.00	1.66	2.06
3.00	165,688.00	137,709.00	3.16	5.22
4.00	172,584.00	169,136.00	3.88	9.10
5.00	179,608.00	176,096.00	4.04	13.14
6.00	186,760.00	183,184.00	4.21	17.35
7.00	194,040.00	190,400.00	4.37	21.72
8.00	201,448.00	197,744.00	4.54	26.26
9.00	208,984.00	205,216.00	4.71	30.97

Total = 1,349,050 CF

Total = 31.0 Ac-ft

At Elevation 7.99, the Storage is 26.213 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD9

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	25,583.00	12,791.50	0.29	0.29
2.00	45,506.00	35,544.50	0.82	1.11
3.00	49,261.00	47,383.50	1.09	2.20
4.00	53,164.00	51,212.50	1.18	3.37
5.00	57,214.00	55,189.00	1.27	4.64
6.00	61,412.00	59,313.00	1.36	6.00
7.00	65,757.00	63,584.50	1.46	7.46
8.00	70,250.00	68,003.50	1.56	9.02
9.00	74,890.00	72,570.00	1.67	10.69
10.00	79,677.00	77,283.50	1.77	12.46
11.00	84,612.00	82,144.50	1.89	14.35
12.00	89,694.00	87,153.00	2.00	16.35
14.00	103,000.00	192,694.00	4.42	20.77
	Total =	904,867 CF		
		Total =	20.8 Ac-ft	

At Elevation 10.71, the Storage is 13.802 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD11A

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	3,864.00	1,932.00	0.04	0.04
2.00	5,000.00	4,432.00	0.10	0.15
3.00	6,264.00	5,632.00	0.13	0.28
4.00	7,656.00	6,960.00	0.16	0.44
5.00	9,196.00	8,426.00	0.19	0.63
6.00	10,824.00	10,010.00	0.23	0.86
7.00	12,600.00	11,712.00	0.27	1.13
8.00	14,504.00	13,552.00	0.31	1.44

Total = 62,656 CF

Total = 1.4 Ac-ft

At Elevation 4.94, the Storage is 0.617 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD11B

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	52,456.00	26,228.00	0.60	0.60
2.00	56,376.00	54,416.00	1.25	1.85
3.00	60,424.00	58,400.00	1.34	3.19
4.00	64,600.00	62,512.00	1.44	4.63
5.00	68,904.00	66,752.00	1.53	6.16
6.00	73,336.00	71,120.00	1.63	7.79
7.00	77,896.00	75,616.00	1.74	9.53
8.00	82,584.00	80,240.00	1.84	11.37
9.00	87,400.00	84,992.00	1.95	13.32

Total = 580,276 CF

Total = 13.3 Ac-ft

At Elevation 6.25, the Storage is 8.226 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD12

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	30,866.68	15,433.34	0.35	0.35
2.00	76,123.46	53,495.07	1.23	1.58
3.00	86,496.00	81,309.73	1.87	3.45
4.00	91,584.00	89,040.00	2.04	5.49
5.00	96,800.00	94,192.00	2.16	7.66
6.00	102,144.00	99,472.00	2.28	9.94
7.00	107,616.00	104,880.00	2.41	12.35
8.00	113,216.00	110,416.00	2.53	14.88
9.00	118,944.00	116,080.00	2.66	17.55

Total = 764,318 CF

Total = 17.5 Ac-ft

At Elevation 5.55, the Storage is 8.911 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD13

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	27,552.00	13,776.00	0.32	0.32
2.00	54,036.00	40,794.00	0.94	1.25
3.00	58,100.00	56,068.00	1.29	2.54
4.00	62,290.00	60,195.00	1.38	3.92
5.00	66,612.00	64,451.00	1.48	5.40
6.00	71,060.00	68,836.00	1.58	6.98
7.00	75,636.00	73,348.00	1.68	8.67
8.00	80,340.00	77,988.00	1.79	10.46

Total = 455,456 CF

Total = 10.5 Ac-ft

At Elevation 4.74, the Storage is 5.017 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD14A

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	34,700.00	17,350.00	0.40	0.40
2.00	109,730.00	72,215.00	1.66	2.06
3.00	165,688.00	137,709.00	3.16	5.22
4.00	172,584.00	169,136.00	3.88	9.10
5.00	179,608.00	176,096.00	4.04	13.14
6.00	186,760.00	183,184.00	4.21	17.35
7.00	194,040.00	190,400.00	4.37	21.72
8.00	201,448.00	197,744.00	4.54	26.26
9.00	208,984.00	205,216.00	4.71	30.97

Total = 1,349,050 CF

Total = 31.0 Ac-ft

At Elevation 6.032, the Storage is 17.488 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD14B

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	18,943.00	9,471.50	0.22	0.22
2.00	43,220.00	31,081.50	0.71	0.93
3.00	46,969.00	45,094.50	1.04	1.97
4.00	50,873.00	48,921.00	1.12	3.09
5.00	54,930.00	52,901.50	1.21	4.30
6.00	59,144.00	57,037.00	1.31	5.61
7.00	63,512.00	61,328.00	1.41	7.02
8.00	68,024.00	65,768.00	1.51	8.53
9.00	70,710.00	69,367.00	1.59	10.12
10.00	77,514.00	74,112.00	1.70	11.82

Total = 515,082 CF

Total = 11.8 Ac-ft

At Elevation 4.6, the Storage is 3.818 Ac-ft.
#NUM!

Calculated by: DLM
Date: 8/21/2018
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD15B

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	8,576.00	4,288.00	0.10	0.10
2.00	10,224.00	9,400.00	0.22	0.31
3.00	12,000.00	11,112.00	0.26	0.57
4.00	13,904.00	12,952.00	0.30	0.87
5.00	15,936.00	14,920.00	0.34	1.21
6.00	18,096.00	17,016.00	0.39	1.60
7.00	20,384.00	19,240.00	0.44	2.04
8.00	22,800.00	21,592.00	0.50	2.54
9.00	25,304.00	24,052.00	0.55	3.09

Total = 134,572 CF

Total = 3.1 Ac-ft

At Elevation 7.41, the Storage is 2.245 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD16A

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	30,866.68	15,433.34	0.35	0.35
2.00	76,123.46	53,495.07	1.23	1.58
3.00	86,496.00	81,309.73	1.87	3.45
4.00	91,584.00	89,040.00	2.04	5.49
5.00	96,800.00	94,192.00	2.16	7.66
6.00	102,144.00	99,472.00	2.28	9.94
7.00	107,616.00	104,880.00	2.41	12.35
8.00	113,216.00	110,416.00	2.53	14.88
9.00	118,944.00	116,080.00	2.66	17.55

Total = 764,318 CF

Total = 17.5 Ac-ft

At Elevation 7.59, the Storage is 13.842 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD16B

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	18,943.00	9,471.50	0.22	0.22
2.00	43,220.00	31,081.50	0.71	0.93
3.00	46,969.00	45,094.50	1.04	1.97
4.00	50,873.00	48,921.00	1.12	3.09
5.00	54,930.00	52,901.50	1.21	4.30
6.00	59,144.00	57,037.00	1.31	5.61
7.00	63,512.00	61,328.00	1.41	7.02
8.00	68,024.00	65,768.00	1.51	8.53
9.00	70,710.00	69,367.00	1.59	10.12
10.00	77,514.00	74,112.00	1.70	11.82

Total = 515,082 CF

Total = 11.8 Ac-ft

At Elevation 6.14, the Storage is 5.81 Ac-ft.
#NUM!

Calculated by: DLM
Date: 8/21/2018
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD17

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	21,618.00	10,809.00	0.25	0.25
2.00	24,523.00	23,070.50	0.53	0.78
3.00	27,481.00	26,002.00	0.60	1.37
4.00	30,595.00	29,038.00	0.67	2.04
5.00	33,863.00	32,229.00	0.74	2.78
6.00	37,286.00	35,574.50	0.82	3.60
7.00	40,864.00	39,075.00	0.90	4.49
8.00	44,579.00	42,721.50	0.98	5.48
9.00	48,485.00	46,532.00	1.07	6.54

Total = 285,052 CF

Total = 6.5 Ac-ft

At Elevation 7.22, the Storage is 4.711 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD18

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	24,300.00	12,150.00	0.28	0.28
2.00	39,456.00	31,878.00	0.73	1.01
3.00	42,864.00	41,160.00	0.94	1.96
4.00	46,400.00	44,632.00	1.02	2.98
5.00	50,064.00	48,232.00	1.11	4.09
6.00	53,856.00	51,960.00	1.19	5.28
7.00	57,776.00	55,816.00	1.28	6.56
8.00	61,824.00	59,800.00	1.37	7.93

Total = 345,628 CF

Total = 7.9 Ac-ft

At Elevation 4.15, the Storage is 3.146 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD20

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	9,292.00	4,646.00	0.11	0.11
2.00	10,676.00	9,984.00	0.23	0.34
3.00	12,430.00	11,553.00	0.27	0.60
4.00	14,013.00	13,221.50	0.30	0.90
5.00	15,785.00	14,899.00	0.34	1.25
6.00	17,656.00	16,720.50	0.38	1.63
7.00	19,626.00	18,641.00	0.43	2.06
8.00	21,985.00	20,805.50	0.48	2.54
9.00	24,472.00	23,228.50	0.53	3.07

Total = 133,699 CF

Total = 3.1 Ac-ft

At Elevation 4.83, the Storage is 1.188 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD21

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	9,292.00	4,646.00	0.11	0.11
2.00	10,676.00	9,984.00	0.23	0.34
3.00	12,430.00	11,553.00	0.27	0.60
4.00	14,013.00	13,221.50	0.30	0.90
5.00	15,785.00	14,899.00	0.34	1.25
6.00	17,656.00	16,720.50	0.38	1.63
7.00	19,626.00	18,641.00	0.43	2.06
8.00	21,985.00	20,805.50	0.48	2.54
9.00	24,472.00	23,228.50	0.53	3.07

Total = 133,699 CF

Total = 3.1 Ac-ft

At Elevation 3.52, the Storage is 0.759 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD22

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	8,576.00	4,288.00	0.10	0.10
2.00	10,224.00	9,400.00	0.22	0.31
3.00	12,000.00	11,112.00	0.26	0.57
4.00	13,904.00	12,952.00	0.30	0.87
5.00	15,936.00	14,920.00	0.34	1.21
6.00	18,096.00	17,016.00	0.39	1.60
7.00	20,384.00	19,240.00	0.44	2.04
8.00	22,800.00	21,592.00	0.50	2.54
9.00	25,304.00	24,052.00	0.55	3.09

Total = 134,572 CF

Total = 3.1 Ac-ft

At Elevation 3.24, the Storage is 0.641 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD23

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	8,576.00	4,288.00	0.10	0.10
2.00	10,224.00	9,400.00	0.22	0.31
3.00	12,000.00	11,112.00	0.26	0.57
4.00	13,904.00	12,952.00	0.30	0.87
5.00	15,936.00	14,920.00	0.34	1.21
6.00	18,096.00	17,016.00	0.39	1.60
7.00	20,384.00	19,240.00	0.44	2.04
8.00	22,800.00	21,592.00	0.50	2.54
9.00	25,304.00	24,052.00	0.55	3.09

Total = 134,572 CF

Total = 3.1 Ac-ft

At Elevation 3.1, the Storage is 0.599 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD27

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	18,943.00	9,471.50	0.22	0.22
2.00	43,220.00	31,081.50	0.71	0.93
3.00	46,969.00	45,094.50	1.04	1.97
4.00	50,873.00	48,921.00	1.12	3.09
5.00	54,930.00	52,901.50	1.21	4.30
6.00	59,144.00	57,037.00	1.31	5.61
7.00	63,512.00	61,328.00	1.41	7.02
8.00	68,024.00	65,768.00	1.51	8.53
9.00	70,710.00	69,367.00	1.59	10.12
10.00	77,514.00	74,112.00	1.70	11.82

Total = 515,082 CF

Total = 11.8 Ac-ft

At Elevation 4.93, the Storage is 4.219 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD72

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	9,292.00	4,646.00	0.11	0.11
2.00	10,676.00	9,984.00	0.23	0.34
3.00	12,430.00	11,553.00	0.27	0.60
4.00	14,013.00	13,221.50	0.30	0.90
5.00	15,785.00	14,899.00	0.34	1.25
6.00	17,656.00	16,720.50	0.38	1.63
7.00	19,626.00	18,641.00	0.43	2.06
8.00	21,985.00	20,805.50	0.48	2.54
9.00	24,472.00	23,228.50	0.53	3.07

Total = 133,699 CF

Total = 3.1 Ac-ft

At Elevation 4.61, the Storage is 1.113 Ac-ft.
#NUM!

Calculated by: DLM
Date: 6/21/2016
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

PndW3

	Elevation	SF	CF	Storage AF	Storage Sum
8	0.00	0.00			0
8.50	0.50	1,571.00	392.75	0.01	0.01
9.00	1.00	27,436.00	7,251.75	0.17	0.18
9.50	1.50	84,167.00	27,900.75	0.64	0.82
10.00	2.00	154,134.00	59,575.25	1.37	2.18
10.50	2.50	235,036.00	97,292.50	2.23	4.42
11.00	3.00	315,608.00	137,661.00	3.16	7.58
11.50	3.50	376,789.00	173,099.25	3.97	11.55
12.00	4.00	408,079.00	196,217.00	4.50	16.06
14.00	6.00	454,812.00	862,891.00	19.81	35.87
16.00	8.00	479,806.00	934,618.00	21.46	57.32
18.00	10.00	505,210.00	985,016.00	22.61	79.93
20.00	12.00	530,466.00	1,035,676.00	23.78	103.71
22.00	14.00	571,448.00	1,101,914.00	25.30	129.01
		Total =	5,619,505 CF		
			Total =	129.0 Ac-ft	

At Elevation 13, the Storage is 116.358 Ac-ft.
#NUM!

Calculated by: DLM
Date: 8/21/2018
Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD-E1

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	21,618.00	10,809.00	0.25	0.25
2.00	24,523.00	23,070.50	0.53	0.78
3.00	27,481.00	26,002.00	0.60	1.37
4.00	30,595.00	29,038.00	0.67	2.04
5.00	33,863.00	32,229.00	0.74	2.78
6.00	37,286.00	35,574.50	0.82	3.60
7.00	40,864.00	39,075.00	0.90	4.49
8.00	44,579.00	42,721.50	0.98	5.48
9.00	48,485.00	46,532.00	1.07	6.54

Total = 285,052 CF

Total = 6.5 Ac-ft

Calculated by: JD

Date: 6/21/2018

Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD-E2

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	21,618.00	10,809.00	0.25	0.25
2.00	24,523.00	23,070.50	0.53	0.78
3.00	27,481.00	26,002.00	0.60	1.37
4.00	30,595.00	29,038.00	0.67	2.04
5.00	33,863.00	32,229.00	0.74	2.78
6.00	37,286.00	35,574.50	0.82	3.60
7.00	40,864.00	39,075.00	0.90	4.49
8.00	44,579.00	42,721.50	0.98	5.48
9.00	48,485.00	46,532.00	1.07	6.54

Total = 285,052 CF

Total = 6.5 Ac-ft

Calculated by: JD

Date: 6/21/2018

Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD-E3

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	30,866.68	15,433.34	0.35	0.35
2.00	76,123.46	53,495.07	1.23	1.58
3.00	86,496.00	81,309.73	1.87	3.45
4.00	91,584.00	89,040.00	2.04	5.49
5.00	96,800.00	94,192.00	2.16	7.66
6.00	102,144.00	99,472.00	2.28	9.94
7.00	107,616.00	104,880.00	2.41	12.35
8.00	113,216.00	110,416.00	2.53	14.88
9.00	118,944.00	116,080.00	2.66	17.55

Total = 764,318 CF

Total = 17.5 Ac-ft

Calculated by: DLM

Date: 6/21/2016

Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD-E4

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	18,943.00	9,471.50	0.22	0.22
2.00	43,220.00	31,081.50	0.71	0.93
3.00	46,969.00	45,094.50	1.04	1.97
4.00	50,873.00	48,921.00	1.12	3.09
5.00	54,930.00	52,901.50	1.21	4.30
6.00	59,144.00	57,037.00	1.31	5.61
7.00	63,512.00	61,328.00	1.41	7.02
8.00	68,024.00	65,768.00	1.51	8.53
9.00	70,710.00	69,367.00	1.59	10.12
10.00	77,514.00	74,112.00	1.70	11.82

Total = 515,082 CF

Total = 11.8 Ac-ft

Calculated by: DLM

Date: 6/21/2016

Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD-E5

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	20,604.00	10,302.00	0.24	0.24
2.00	23,100.00	21,852.00	0.50	0.74
3.00	25,724.00	24,412.00	0.56	1.30
4.00	28,476.00	27,100.00	0.62	1.92
5.00	31,356.00	29,916.00	0.69	2.61
6.00	34,364.00	32,860.00	0.75	3.36
7.00	37,500.00	35,932.00	0.82	4.19
8.00	40,764.00	39,132.00	0.90	5.09
9.00	44,156.00	42,460.00	0.97	6.06

Total = 263,966 CF

Total = 6.1 Ac-ft

Calculated by: DLM

Date: 6/21/2016

Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD-E6

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	35,000.00	17,500.00	0.40	0.40
2.00	110,000.00	72,500.00	1.66	2.07
3.00	166,000.00	138,000.00	3.17	5.23
4.00	175,000.00	170,500.00	3.91	9.15
5.00	180,000.00	177,500.00	4.07	13.22
6.00	190,000.00	185,000.00	4.25	17.47
7.00	195,000.00	192,500.00	4.42	21.89
8.00	205,000.00	200,000.00	4.59	26.48
9.00	210,000.00	207,500.00	4.76	31.24

Total = 1,361,000 CF

Total = 31.2 Ac-ft

Calculated by: DLM

Date: 6/21/2016

Checked by:

Sterling Ranch MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

PND-E7

Elevation	SF	CF	Storage AF	Storage Sum
0.00	0.00			0
1.00	35,000.00	17,500.00	0.40	0.40
2.00	110,000.00	72,500.00	1.66	2.07
3.00	165,500.00	137,750.00	3.16	5.23
4.00	176,000.00	170,750.00	3.92	9.15
5.00	179,100.00	177,550.00	4.08	13.22
6.00	191,000.00	185,050.00	4.25	17.47
7.00	285,000.00	238,000.00	5.46	22.94
8.00	310,000.00	297,500.00	6.83	29.77
9.00	325,000.00	317,500.00	7.29	37.05

Total = 1,614,100 CF

Total = 37.1 Ac-ft

Calculated by: DLM

Date: 6/21/2016

Checked by:

Sterling Ranch
MDDP - Developed Conditions
Water Quality Control Volume Sizing Worksheet

FSD6

CONTRUBUTING BASINS	ACREAGE AC	SOILS A%	SOILS B%	IMPERVIOUS %	SLOPE %
SC3-6A	49.30	100	0	71	2.0
SC3-6B	30.90	78	22	58	2.0
SC3-6C	58	100	0	46	1.8
SC3-7	45.7	48	52	72	2.7
COMBINED ACREAGE	183.90				
COMB. % IMPERVIOUS				61%	
COMB. % A SOILS		83%			
COMB. % B SOILS			17%		
COMB. SLOPE					2.1%

Sterling Ranch
MDDP - Developed Conditions
Water Quality Control Volume Sizing Worksheet

FSD9

CONTRUBUTING BASINS	ACREAGE AC	SOILS A%	SOILS B%	IMPERVIOUS %	SLOPE %
SC3-8	143.40	23	77	2	2.0
SC3-9	217.40	78	22	15	1.8
COMBINED ACREAGE	360.80				
COMB. % IMPERVIOUS				10%	
COMB. % A SOILS		56%			
COMB. % B SOILS			44%		
COMB. SLOPE					1.9%

Sterling Ranch MDDP
Hydrologic Study - Interim Conditions
Water Quality Control Volume Sizing Worksheet

FSD27

CONTRUBUTING BASINS	ACREAGE AC	SOILS A%	SOILS B%	IMPERVIOUS %	SLOPE %
SC3-21	23.3	0	100	0	3.9
SC3-23	14.5	0	100	0	3.6
SC3-25	19	0	100	15	4.0
SC3-27	70	0	100	28	3.2
* basins SC3-21 & 23 have been treated by ponds, thus imp = 0%					
COMBINED ACREAGE	126.80				
COMB. % IMPERVIOUS				18%	
COMB. % A SOILS		0%			
COMB. % B SOILS			100%		
COMB. SLOPE					3.5%

Sterling Ranch MDDP

Pond W3 Outlet HW/D calculations

	Pipe Size	24	g	32.2
Pipe	Q	CLH^1.5	A	3.142
	Q	CA2gH^0.5	C	0.6

Max Ponding Depth = Spillway of Local WQ pond 20.6

Actual El	Rel El	Centroid	Head	Area	Q Per Pipe	2 Pipes	3 Pipes	4 Pipes	5 Pipes	6 Pipes	7 Pipes	8 Pipes	9 Pipes	10 Pipes
(ft)	(ft)	(ft)	(ft)	(sq ft)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
7.5	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0	0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.5	0.5	0.2949	0.2051	0.61	1.3	2.7	4.0	5.3	6.7	8.0	9.3	10.6	12.0	13.3
9	1.5	0.5756	0.9244	1.57	7.3	14.5	21.8	29.1	36.3	43.6	50.9	58.1	65.4	72.7
9.5	2.0	0.8286	1.1714	2.53	13.2	26.4	39.6	52.7	65.9	79.1	92.3	105.5	118.7	131.8
10	2.5	1	1.5	3.14	18.5	37.1	55.6	74.1	92.6	111.2	129.7	148.2	166.7	185.3
10.5	3.0	1	2	3.14	21.4	42.8	64.2	85.6	107.0	128.4	149.7	171.1	192.5	213.9
11	3.5	1	2.5	3.14	23.9	47.8	71.8	95.7	119.6	143.5	167.4	191.3	215.3	239.2
11.5	4.0	1	3	3.14	26.2	52.4	78.6	104.8	131.0	157.2	183.4	209.6	235.8	262.0
12	4.5	1	3.5	3.14	28.3	56.6	84.9	113.2	141.5	169.8	198.1	226.4	254.7	283.0
12.5	5.0	1	4	3.14	30.3	60.5	90.8	121.0	151.3	181.5	211.8	242.0	272.3	302.5
13	5.5	1	4.5	3.14	32.1	64.2	96.3	128.4	160.4	192.5	224.6	256.7	288.8	320.9
13.5	6.0	1	5	3.14	33.8	67.6	101.5	135.3	169.1	202.9	236.8	270.6	304.4	338.2
14	6.5	1	5.5	3.14	35.5	70.9	106.4	141.9	177.4	212.8	248.3	283.8	319.3	354.7
14.5	7.0	1	6	3.14	37.1	74.1	111.2	148.2	185.3	222.3	259.4	296.4	333.5	370.5
15	7.5	1	6.5	3.14	38.6	77.1	115.7	154.3	192.8	231.4	270.0	308.5	347.1	385.6
15.5	8.0	1	7	3.14	40.0	80.0	120.1	160.1	200.1	240.1	280.1	320.2	360.2	400.2
16	8.5	1	7.5	3.14	41.4	82.9	124.3	165.7	207.1	248.6	290.0	331.4	372.8	414.3
16.5	9.0	1	8	3.14	42.8	85.6	128.4	171.1	213.9	256.7	299.5	342.3	385.1	427.8
17	9.5	1	8.5	3.14	44.1	88.2	132.3	176.4	220.5	264.6	308.7	352.8	396.9	441.0
17.5	10.0	1	9	3.14	45.4	90.8	136.1	181.5	226.9	272.3	317.7	363.0	408.4	453.8
18	10.5	1	9.5	3.14	46.6	93.2	139.9	186.5	233.1	279.7	326.4	373.0	419.6	466.2
18.5	11.0	1	10	3.14	47.8	95.7	143.5	191.3	239.2	287.0	334.8	382.7	430.5	478.3
19	11.5	1	10.5	3.14	49.0	98.0	147.0	196.1	245.1	294.1	343.1	392.1	441.1	490.2
19.5	12.0	1	11	3.14	50.2	100.3	150.5	200.7	250.8	301.0	351.2	401.3	451.5	501.7
20	12.5	1	11.5	3.14	51.3	102.6	153.9	205.2	256.5	307.8	359.1	410.4	461.7	513.0
20.5	13.0	1	12	3.14	52.4	104.8	157.2	209.6	262.0	314.4	366.8	419.2	471.6	524.0
21	13.5	1	12.5	3.14	53.5	107.0	160.4	213.9	267.4	320.9	374.4	427.8	481.3	534.8

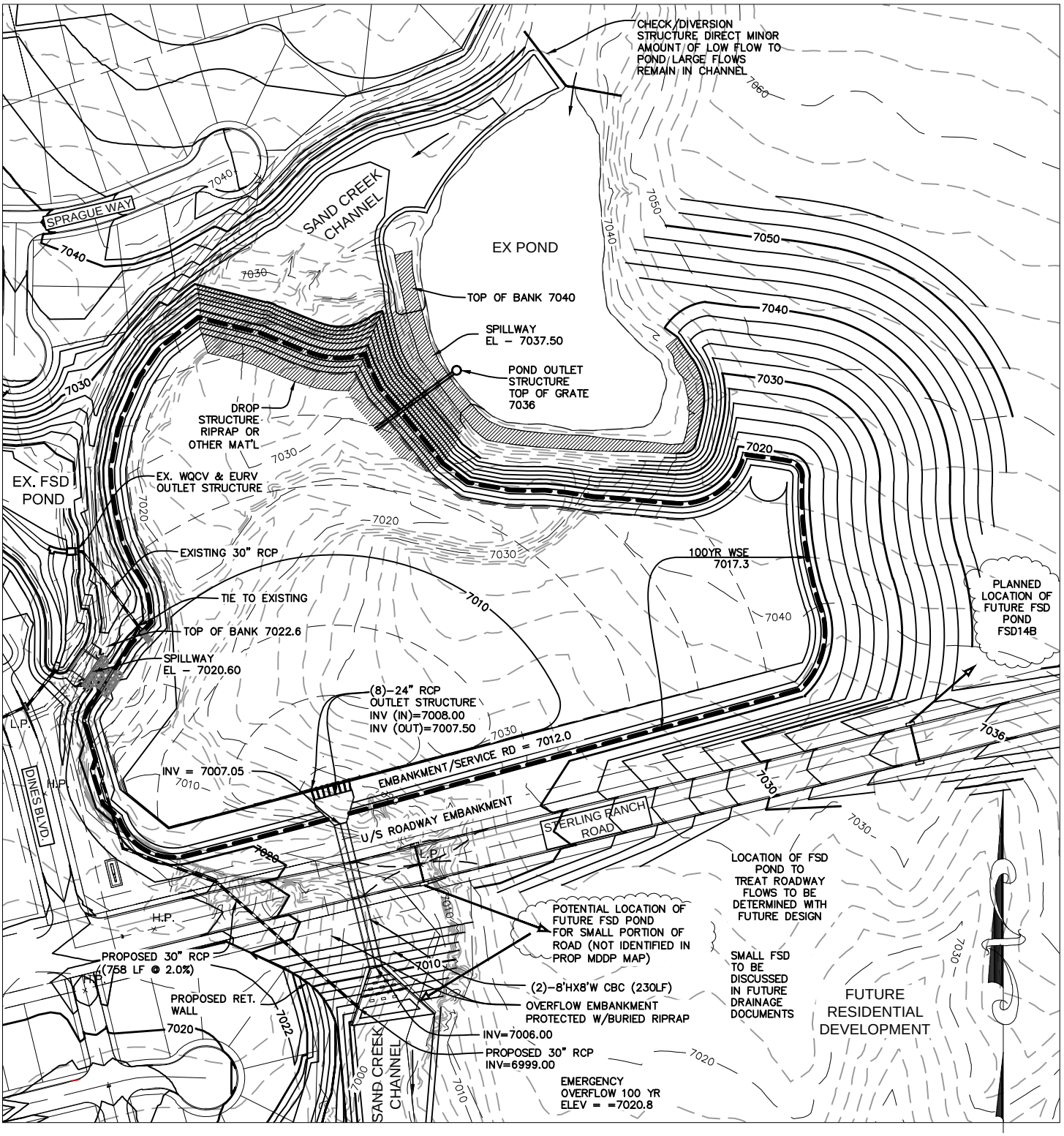
Sterling Ranch MDDP

Pond W3 Outlet HW/D calculations

				8x8 box	hw/d	0.0625	
Weir	L	138			g	32.2	7.0
	Q	CLH^1.5	C	1.3	A	553	
	Q	CA2gH^0.5	C	0.6			

Entered into HEC-HMS

Actual El	Rel El	Height	Length	Q weir	A	Q orifice	Qallow	HW	Q culvert	from CM	program	volume
(ft)	(ft)	(ft)	(ft)	(cfs)	(sq ft)	(cfs)	(cfs)	(ft)	hw/d (cfs)	(critical)	Q	
7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.000		0.0	0.000
8.0	0.0	0	0.0	0.0	0.0	0.0	0.0		0.000		0.0	0.001
8.5	0.5	0	0.0	0.0	0.0	0.0	10.6		0.063		10.6	0.010
9.0	1.5	0	0.0	0.0	0.0	0.0	58.1		0.188		58.1	0.180
9.5	2.0	0	0.0	0.0	0.0	0.0	105.5		0.250		105.5	0.820
10.0	2.5	0.0	0.0	0.0	0.0	0.0	148.2		0.313		148.2	2.180
10.5	3.0	0.0	0.0	0.0	0.0	0.0	171.1		0.375		171.1	4.420
11.0	3.5	0.0	0.0	0.0	0.0	0.0	191.3		0.438		191.3	7.580
11.5	4.0	0.0	0.0	0.0	0.0	0.0	209.6		0.500		209.6	11.580
12.0	4.5	0.0	0.0	0.0	0	0.0	226.4	5.0	0.563	300	226.4	16.060
12.5	5.0	0.5	75.0	34.5	645	5379.2	276.5	5.5	0.625	504	276.5	21.010
13.0	5.5	1.0	79.0	102.7	750	6756.0	359.4	6.0	0.688	568	359.4	25.960
13.5	6.0	1.5	84.0	200.6	847.0	8156.6	471.2	6.5	0.750	675	471.2	30.910
14.0	6.5	2.0	93.0	342.0	944.0	9642.1	625.8	7.0	0.813	740	625.8	35.870
14.5	7.0	2.5	98.0	503.6	1034.0	11132.7	800.0	7.5	0.875	814	800.0	41.230
15.0	7.5	3.0	102.7	693.7	1118.0	12624.6	1002.3	8.0	0.938	923	923.0	46.590
15.5	8.0	3.5	107.4	914.2	1199.0	14141.3	1234.4	8.5	1.000	1000	1000.0	51.960
16.0	8.5	4.0	112.1	1165.8	1274.0	15639.4	1497.2	9.0	1.063	1088	1088.0	57.320
16.5	9.0	4.5	116.0	1439.5	1345.0	17134.3	1781.8	9.5	1.125	1100	1100.0	62.970
17.0	9.5	5.0	121.4	1764.5	1410.0	18592.8	2117.3	10.0	1.188	1190	1190.0	68.630
17.5	10.0	5.5	126.0	2112.8	1470.0	20019.7	2475.8	10.5	1.250	1292	1292.0	74.280
18.0	10.5	6.0	130.7	2497.2	1527.0	21435.9	2870.1	11.0	1.313	1376	1376.0	79.930
18.5	11.0	6.5	135.4	2917.0	1578.0	22794.1	3299.6	11.5	1.375	1460	1460.0	85.880
19.0	11.5	7.0	140.1	3373.1	1624.0	24101.4	3765.2	12.0	1.438	1536	1536.0	91.820
19.5	12.0	7.5	144.8	3866.4	1665.0	25351.8	4267.7	12.5	1.500	1620	1620.0	97.770
20.0	12.5	8.0	149.6	4400.6	1702.0	26555.1	4810.9	13.0	1.563	1690	1690.0	103.710
20.5	13.0	8.5	166.6	5367.2	1702.0	27180.0	5786.4	13.5	1.625	1752	1752.0	110.030
21.0	13.5	9.0	166.6	5847.7	1702.0	27790.9	6275.5	14.0	1.688	1825	1825.0	116.360



Q_{100}= 2204.1 CFS (IN)

Q_{100}= 1350.6 CFS (OUT)

100YR= 78.2 AC-FT

STERLING RANCH POND PNDW3

CONCEPT

SCALE 1"=200'

100YR WSE= 7017.3

TOP OF EMBANKMENT = 7019 US / 7018.5 DS

100 YR OVERFLOW WSE= 7021.3 US / 7020.8 DS (2.3*)

*BASED UPON REVISED FEMA FLOW RATE TO ~ 2200 CFS

M&S CIVIL CONSULTANTS, INC.

15 NORTH NEVADA AVENUE
COLORADO SPRINGS,
COLORADO 80903

v 719.955.5485
f 719.444.8427

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Oct 24 2018

Box Culvert at Sterling Ranch Road (Pond W3)

Invert Elev Dn (ft)	=	7006.00
Pipe Length (ft)	=	210.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	7007.05
Rise (in)	=	96.0
Shape	=	Box
Span (in)	=	96.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

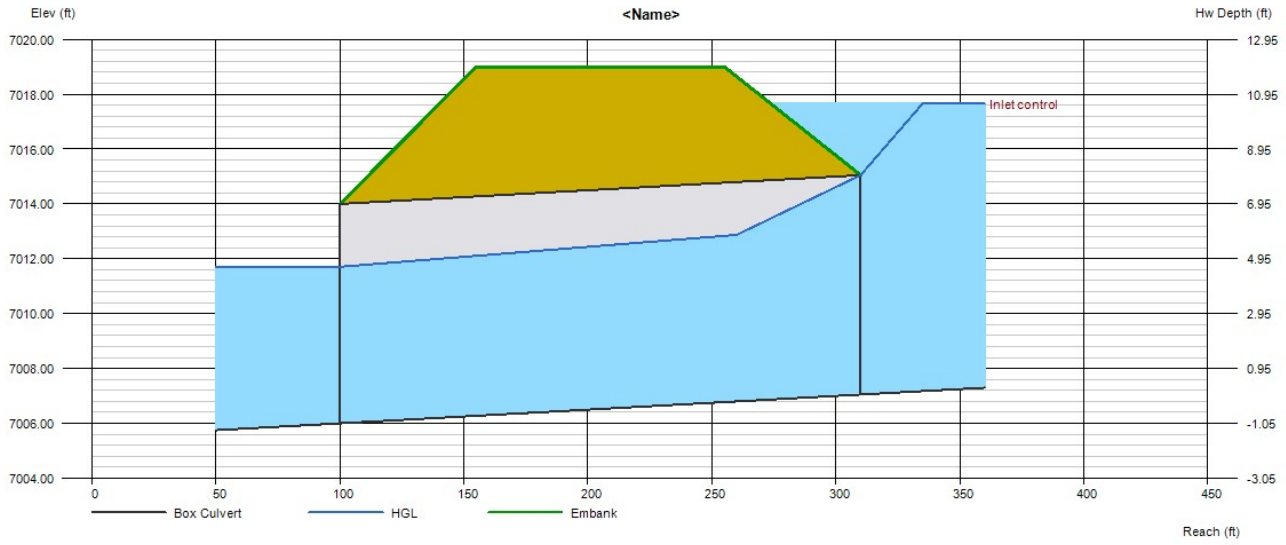
Top Elevation (ft)	=	7019.00
Top Width (ft)	=	100.00
Crest Width (ft)	=	1000.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	2600.00
Tailwater Elev (ft)	=	Critical

Highlighted

Qtotal (cfs)	=	1400.00
Qpipe (cfs)	=	1400.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	15.32
Veloc Up (ft/s)	=	14.14
HGL Dn (ft)	=	7011.71
HGL Up (ft)	=	7013.24
Hw Elev (ft)	=	7017.66
Hw/D (ft)	=	1.33
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
100.00	100.00	0.00	7.02	5.86	10.68	12.80
200.00	200.00	0.00	8.87	7.38	16.92	20.31
300.00	300.00	0.00	10.08	8.45	22.32	26.61
400.00	400.00	0.00	11.06	9.31	27.12	32.23
500.00	500.00	0.00	11.75	10.03	31.92	37.39
600.00	600.00	0.00	12.38	10.66	36.36	42.22
700.00	700.00	0.00	12.87	11.22	40.80	46.79
800.00	800.00	0.00	13.33	11.73	45.00	51.14
900.00	900.00	0.00	13.75	12.20	49.08	55.31
1000.00	1000.00	0.00	14.11	12.64	53.16	59.33
1100.00	1100.00	0.00	14.44	13.05	57.12	63.22
1200.00	1200.00	0.00	14.76	13.43	60.96	67.00
1300.00	1300.00	0.00	15.05	13.80	64.80	70.66
1400.00	1400.00	0.00	15.32	14.14	68.52	74.24
1500.00	1500.00	0.00	15.57	14.47	72.24	77.73
1600.00	1600.00	0.00	15.82	14.79	75.84	81.14
1700.00	1621.49	78.51	15.88	14.85	76.56	81.87
1800.00	1631.93	168.07	15.89	14.89	77.04	82.22
1900.00	1639.26	260.74	15.91	14.91	77.28	82.46
2000.00	1643.90	356.10	15.90	14.92	77.52	82.62
2100.00	1649.87	450.13	15.91	14.94	77.76	82.82
2200.00	1655.13	544.87	15.94	14.96	77.88	82.99
2300.00	1659.91	640.09	15.96	14.97	78.00	83.15
2400.00	1665.32	734.68	15.96	14.99	78.24	83.33
2500.00	1670.87	829.13	15.97	15.00	78.48	83.52
2600.00	1675.71	924.29	15.99	15.02	78.60	83.68

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
7006.89	7008.12	7008.69	0.20
7007.41	7008.74	7009.69	0.33
7007.86	7009.27	7010.53	0.44
7008.26	7009.74	7011.29	0.53
7008.66	7010.17	7012.00	0.62
7009.03	7010.57	7012.66	0.70
7009.40	7010.95	7013.29	0.78
7009.75	7011.31	7013.89	0.86
7010.09	7011.66	7014.47	0.93
7010.43	7011.99	7015.03	1.00
7010.76	7012.32	7015.58	1.07
7011.08	7012.63	7016.56	1.19
7011.40	7012.94	7017.09	1.25
7011.71	7013.24	7017.66	1.33
7012.02	7013.53	7018.28	1.40
7012.32	7013.81	7018.93	1.49
7012.38	7013.87	7019.08	1.50
7012.42	7013.90	7019.15	1.51
7012.44	7013.92	7019.20	1.52
7012.46	7013.94	7019.23	1.52
7012.48	7013.95	7019.28	1.53
7012.49	7013.97	7019.31	1.53
7012.50	7013.98	7019.35	1.54
7012.52	7013.99	7019.38	1.54
7012.54	7014.01	7019.42	1.55
7012.55	7014.02	7019.46	1.55

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Oct 24 2018

Box Culvert at Briargate Parkway

Invert Elev Dn (ft)	=	7191.50
Pipe Length (ft)	=	250.00
Slope (%)	=	0.01
Invert Elev Up (ft)	=	7191.53
Rise (in)	=	102.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	4
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

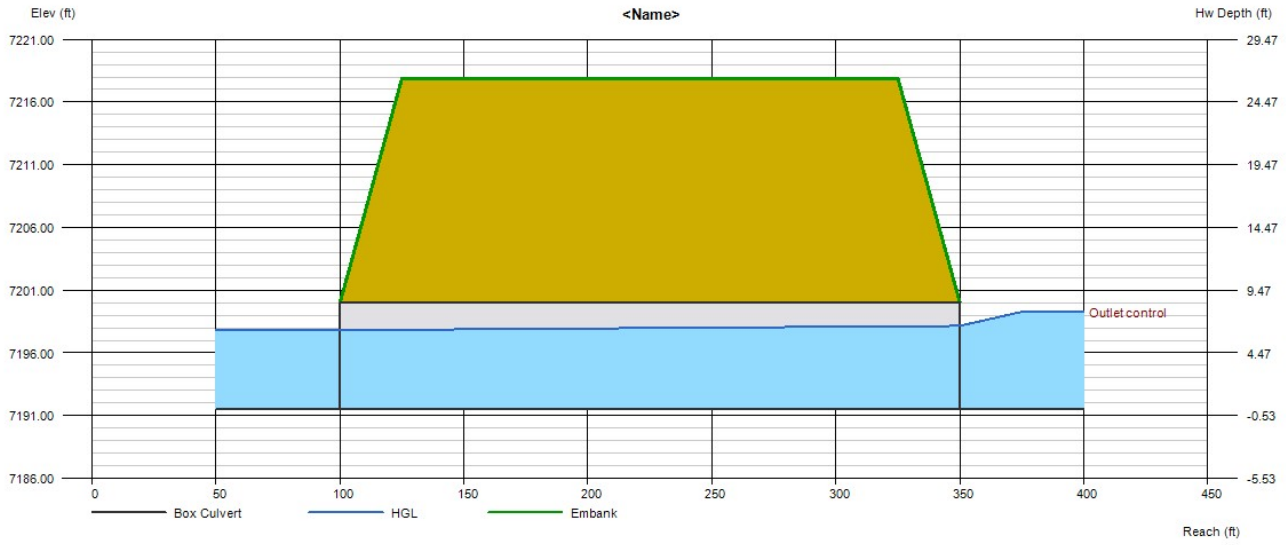
Top Elevation (ft)	=	7217.90
Top Width (ft)	=	200.00
Crest Width (ft)	=	1000.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	2700.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	1900.00
Qpipe (cfs)	=	1900.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.53
Veloc Up (ft/s)	=	7.18
HGL Dn (ft)	=	7197.81
HGL Up (ft)	=	7198.15
Hw Elev (ft)	=	7199.27
Hw/D (ft)	=	0.91
Flow Regime	=	Outlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
100.00	100.00	0.00	0.55	0.55	54.47	54.13
200.00	200.00	0.00	1.06	1.07	56.52	56.30
300.00	300.00	0.00	1.55	1.55	58.23	58.01
400.00	400.00	0.00	2.01	2.01	59.75	59.65
500.00	500.00	0.00	2.45	2.45	61.15	61.17
600.00	600.00	0.00	2.88	2.87	62.47	62.72
700.00	700.00	0.00	3.30	3.28	63.71	64.08
800.00	800.00	0.00	3.70	3.66	64.89	65.51
900.00	900.00	0.00	4.09	4.04	66.02	66.76
1000.00	1000.00	0.00	4.47	4.41	67.11	68.09
1100.00	1100.00	0.00	4.84	4.76	68.17	69.39
1200.00	1200.00	0.00	5.20	5.10	69.19	70.65
1300.00	1300.00	0.00	5.56	5.43	70.20	71.89
1400.00	1400.00	0.00	5.90	5.74	71.16	73.22
1500.00	1500.00	0.00	6.24	6.05	72.11	74.41
1600.00	1600.00	0.00	6.57	6.34	73.04	75.69
1700.00	1700.00	0.00	6.90	6.63	73.95	76.96
1800.00	1800.00	0.00	7.22	6.90	74.84	78.21
1900.00	1900.00	0.00	7.53	7.18	75.71	79.44
2000.00	2000.00	0.00	7.84	7.44	76.57	80.67
2100.00	2100.00	0.00	8.14	7.68	77.41	81.99
2200.00	2200.00	0.00	8.43	7.93	78.25	83.18
2300.00	2300.00	0.00	8.73	8.17	79.07	84.48
2400.00	2400.00	0.00	9.01	8.40	79.87	85.76
2500.00	2500.00	0.00	9.30	8.62	80.67	87.04
2600.00	2600.00	0.00	9.58	8.83	81.45	88.31

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
7196.04	7196.04	7196.05	0.53
7196.21	7196.22	7196.25	0.55
7196.35	7196.36	7196.42	0.57
7196.48	7196.50	7196.59	0.60
7196.60	7196.63	7196.76	0.62
7196.71	7196.76	7196.94	0.64
7196.81	7196.87	7197.10	0.66
7196.91	7196.99	7197.28	0.68
7197.00	7197.09	7197.45	0.70
7197.09	7197.20	7197.63	0.72
7197.18	7197.31	7197.80	0.74
7197.27	7197.42	7197.98	0.76
7197.35	7197.52	7198.16	0.78
7197.43	7197.63	7198.35	0.80
7197.51	7197.73	7198.53	0.82
7197.59	7197.84	7198.71	0.85
7197.66	7197.94	7198.90	0.87
7197.74	7198.05	7199.09	0.89
7197.81	7198.15	7199.27	0.91
7197.88	7198.25	7199.46	0.93
7197.95	7198.36	7199.65	0.96
7198.02	7198.46	7199.83	0.98
7198.09	7198.57	7199.07	0.89
7198.16	7198.68	7199.29	0.91
7198.22	7198.78	7199.52	0.94
7198.29	7198.89	7200.44	1.05

Section F.

Pre-Developed Conditions HEC-HMS Schematic

Pre-Developed DCM Land Use/Impervious %/Curve Number Table

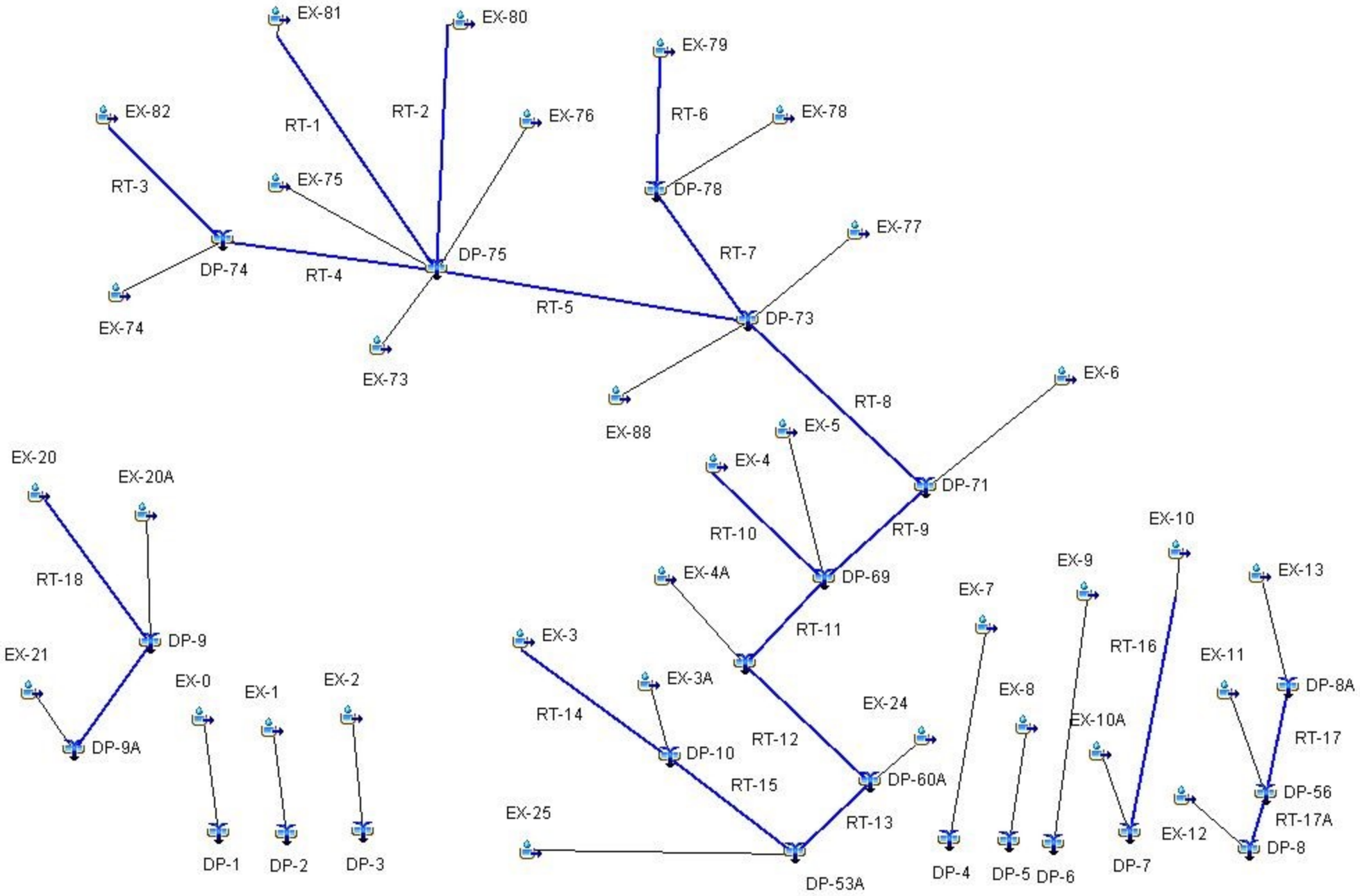
Pre-Developed Conditions Composite Curve Number & Impervious % Table

Pre-Developed Conditions Lag Time Calculations

Pre-Developed Conditions Initial Abstraction Values

ARC I vs ARC II Runoff Comparison Table

Pre-Developed Hydrologic Conditions Map



PRE-DEV CONDITIONS
HEC-HMS SCHEMATIC

Sterling Ranch MDDP

Sand Creek and East Fork Sand Creek - Predevelopment Condition Composite CN & Impervious % Table

8/21/2018

Basin	Basin	Basin	Basin	Sub-Area 1		HSG	UA CN	CN	Sub-Area 2		HSG	UA CN	CN	Sub-Area 3		HSG	UA CN	CN	Sub-Area 4		HSG	UA CN	CN	Sub-Area 5		HSG	UA CN	CN	Sub-Area 6		HSG	UA CN	CN	Sub-Area 7		HSG	UA CN	CN	Sub-Area 8		HSG	UA CN	CN	Sub-Area 9		HSG	UA CN	CN	Sub-Areas	% HSG	% HSG	Weighted	Weighted
ID	Area	Area	Area	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Area	Imp	Type	Value	Value	Total	A	B	Sub Areas Imp	Sub Area CN
	(SF)	(AC)	(SQ MI)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(AC)	(%)			(used)	(Check)	%	%	%	No.
EX-0	1034765	23.8	0.037	23.8	0	A	41	62																																									24	100	0	0	62
EX-1	1120663	25.7	0.040	25.7	0	A	41	62																																									26	100	0	0	62
EX-2	238567	5.5	0.009	5.5	0	A	41	62																																									5	100	0	0	62
EX-3	5956997	136.8	0.214	136.8	0	B	62	62																																									137	0	100	0	62
EX-3A	8193769	188.1	0.294	99.2	0	A	41	41	88.4	0	B	62	62																																				188	53	47	0	51
EX-4	8363354	192.0	0.300	192.0	0	B	62	62																																									192	0	100	0	62
EX-4A	6600380	151.5	0.237	12.6	0	A	41	41	138.8	0	B	62	62																																				151	8	92	0	60
EX-5	6703477	153.9	0.240	153.9	0	B	62	62																																									154	0	100	0	62
EX-6	3928504	90.2	0.141	90.2	0	B	62	62																																									90	0	100	0	62
EX-7	7187603	165.0	0.258	133.5	0	A	41	41	31.5	0	B	62	62																																				165	81	19	0	45
EX-8	1828489	42.0	0.066	42.0	0	A	41	41																																									42	100	0	0	41
EX-9	5747518	131.9	0.206	120.4	0	A	41	41	11.5	0	B	62	62																																				132	91	9	0	43
EX-10	11793328	270.7	0.423	34.0	0	A	41	41	236.7	0	B	62	62																																				271	13	87	0	59
EX-10A	7809034	179.3	0.280	177.7	0	A	41	41	1.5	0	B	62	62																																				179	99	1	0	41
EX-11	9119024	209.3	0.327	193.2	0	A	41	41	16.2	0	B	62	62																																				209	92	8	0	43
EX-12	1719818	39.5	0.062	39.5	0	A	41	41																																									39	100	0	0	41
EX-13	3888572	89.3	0.139	29.9	0	A	41	41	59.4	0	B	62	62																																				89	34	66	0	55
EX-20	6246166	143.4	0.224	32.4	0	A	41	63	111.0	0	B	62	62																																				143	23	77	0	62
EX-20A	7828526	179.7	0.281	130.7	0	A	44	63	49.0	0	B	62	62																																				180	73	27	0	63
EX-21	1448905	33.3	0.052	33.3	0	B	62	62																																									33	100	0	0	62
EX-24	2750098	63.1	0.099	23.7	0	A	41	41	39.4	0	B	62	62																																				63	38	62	0	54
EX-25	2370050	54.4	0.085	48.8	0	A	41	41	5.4	0	B	62	62																																				54	90	10	0	43
EX-73	3921483	90.0	0.141	90.0	0	B	62	62																																									90	0	100	0	62
EX-74	5213558	119.7	0.187	119.7	0	B	62	62																																									120	0	100	0	62
EX-75	3452599	79.3	0.124	79.3	0	B	62	62																																									79	0	100	0	62
EX-76	3761442	86.4	0.135	86.4	0	B	62	62																																									86	0	100	0	62
EX-77	10046025	230.6	0.360	230.6	0	B	62	62																																									231	0	100	0	62
EX-78	6778000	155.6	0.243	155.6	0	B	62	62																																									156	0	100	0	62
EX-79	8231666	189.0	0.295	189.0	0	B	62	62																																									189	0	100	0	62
EX-80	6434190	147.7	0.231	147.7	0	B	62	62																																									148	0	100	0	62
EX-81	11449750	262.9	0.411	262.9	0	B	62	62																																									263	0	100	0	62
EX-82	5130284	117.8	0.184	117.8	0	B	62	62																																									118	0	100	0	62
EX-88	6062553	139.2	0.217	139.2	0	B	62	62																																									139	0	100	0	62

Sterling Ranch Master Development Drainage Plan

Sand Creek & East Sand Creek Basins - Predevelopment Conditions - Lag Time Calculations

8/21/2018

Basin	OVERLAND FLOW					SHALLOW GUTTER FLOW				SHALLOW CHANNEL FLOW				STORM SEWER FLOW				CHANNELIZED FLOW				Tc	TLag
ID	P2	n	Length	Slope	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Length	Slope	Vel	Tt	Total	0.6*Tc
	(in)		(ft)	(%)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(ft)	(%)	(fps)	(min)	(min)	(min)
EX-0	2.1	0.15	160	2.5	16.1	0	0	0	0	1200	20	2.0	10.0	0	0	0	0.0	0	0.0	0.0	0.0	26.1	15.7
EX-1	2.1	0.15	200	2.0	21.1	0	0	0	0	1450	32	2.3	10.5	0	0	0	0.0	0	0.0	0.0	0.0	31.6	18.9
EX-2	2.1	0.15	200	1.5	23.6	0	0	0	0	1050	27	2.5	7.0	0	0	0	0.0	0	0.0	0.0	0.0	30.6	18.4
EX-3	2.1	0.15	300	5.3	19.7	0	0	0	0.0	1100	40	2.9	6.3	0	0	0	0.0	3540	2.7	4.1	14.4	40.4	24.2
EX-3A	2.1	0.15	200	3.0	17.9	0	0	0	0.0	1200	26	2.3	8.7	0	0	0	0.0	3360	2.1	4.5	12.4	39.0	23.4
EX-4	2.1	0.15	300	4.7	20.8	0	0	0	0.0	770	22	2.7	4.8	0	0	0	0.0	3900	3.0	4.0	16.3	41.8	25.1
EX-4A	2.1	0.15	200	3.0	17.9	0	0	0	0.0	250	8	2.8	1.5	0	0	0	0.0	5190	1.9	4.3	20.1	39.5	23.7
EX-5	2.1	0.15	200	4.0	16.0	0	0	0	0.0	1050	34	2.8	6.3	0	0	0	0.0	4425	2.3	3.8	19.4	41.6	25.0
EX-6	2.1	0.15	300	5.0	20.2	0	0	0	0.0	250	11	3.2	1.3	0	0	0	0.0	3490	2.3	3.8	15.3	36.8	22.1
EX-7	2.1	0.15	300	2.0	29.1	0	0	0	0.0	1650	42	2.4	11.5	0	0	0	0.0	3950	2.1	4.2	15.7	56.3	33.8
EX-8	2.1	0.15	200	2.0	21.1	0	0	0	0.0	1600	35	2.3	11.6	0	0	0	0.0	0	0.0	0.0	0.0	32.7	19.6
EX-9	2.1	0.15	200	2.0	21.1	0	0	0	0.0	800	26	2.8	4.8	0	0	0	0.0	3775	2.1	4.0	15.7	41.5	24.9
EX-10	2.1	0.15	300	5.3	19.7	0	0	0	0.0	880	32	2.9	5.1	0	0	0	0.0	6133	2.2	4.6	22.2	47.0	28.2
EX-10A	2.1	0.15	200	2.0	21.1	0	0	0	0.0	1440	35	2.4	10.0	0	0	0	0.0	5500	2.0	3.5	26.2	57.2	34.3
EX-11	2.1	0.15	200	4.0	16.0	0	0	0	0.0	1620	44	2.6	10.4	0	0	0	0.0	3000	2.7	4.0	12.5	38.8	23.3
EX-12	2.1	0.15	200	3.0	17.9	0	0	0	0.0	250	8	2.8	1.5	0	0	0	0.0	820	2.7	2.6	5.3	24.7	14.8
EX-13	2.1	0.15	200	9.0	11.5	0	0	0	0.0	250	12	3.4	1.2	0	0	0	0.0	4325	2.9	3.7	19.5	32.2	19.3
EX-20	2.1	0.15	300	3.8	22.5	0	0	0	0.0	730	40	3.5	3.5	0	0	0	0.0	2200	3.6	4.3	8.5	34.5	20.7
EX-20A	2.1	0.15	300	4.0	22.1	0	0	0	0.0	650	20	2.7	4.0	0	0	0	0.0	4450	1.8	4.2	17.7	43.7	26.2
EX-21	2.1	0.15	200	4.5	15.2	0	0	0	0.0	1175	42	2.9	6.8	0	0	0	0.0	915	1.7	2.5	6.1	28.1	16.8
EX-24	2.1	0.15	200	4.4	15.3	0	0	0	0.0	0	0	0.0	0.0	0	0	0	0.0	2400	2.3	3.1	12.9	28.2	16.9
EX-25	2.1	0.15	150	4.0	12.7	0	0	0	0.0	0	0	0.0	0.0	0	0	0	0.0	2700	1.6	3.1	14.5	27.2	16.3
EX-73	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1650	3.3	2.9	9.5	0	0	0	0.0	1230	3.3	4.2	4.9	38.1	22.9
EX-74	2.1	0.15	300	4.7	20.8	0	0	0	0.0	2000	3.5	2.8	11.9	0	0	0	0.0	770	2.6	3.9	3.3	35.9	21.6
EX-75	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1200	4.1	2.7	7.4	0	0	0	0.0	2300	2.8	3.1	12.4	43.5	26.1
EX-76	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1160	3.4	3.1	6.2	0	0	0	0.0	3025	2.6	3.6	14.0	44.0	26.4
EX-77	2.1	0.15	300	4.7	20.8	0	0	0	0.0	1600	4.0	3.4	7.8	0	0	0	0.0	4850	2.1	5.1	15.8	44.4	26.7
EX-78	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1560	4.1	3.3	7.9	0	0	0	0.0	1850	3.2	4.5	6.9	38.5	23.1
EX-79	2.1	0.15	300	4.0	22.1	0	0	0	0.0	1740	5.6	3.5	8.3	0	0	0	0.0	1100	1.8	3.0	6.1	36.5	21.9
EX-80	2.1	0.15	300	5.0	20.2	0	0	0	0.0	1625	4.9	3.4	8.0	0	0	0	0.0	2140	2.8	4.1	8.7	36.9	22.1
EX-81	2.1	0.15	300	6.7	18.0	0	0	0	0.0	2000	5.0	3.4	9.8	0	0	0	0.0	3600	3.1	4.9	12.2	40.0	24.0
EX-82	2.1	0.15	300	3.3	23.7	0	0	0	0.0	2000	4.7	3.3	10.1	0	0	0	0.0	625	3.2	4.1	2.5	36.4	21.8
EX-88	2.1	0.15	300	4.7	20.8	0	0	0	0.0	1750	4.1	3.4	8.6	0	0	0	0.0	2760	3.1	4.0	11.5	40.8	24.5

DCM TABLE 6-25 WAS USED FOR SHALLOW CONCENTRATED SWALE & GUTTER FLOW
N VALUE FOR OVERLAND FLOW WAS ASSUMED TO BE 0.17 FOR ALL BASINS
A ROUGHNESS COEFFICENT OF 0.050 WAS USED FOR EARTHEN CHANNEL BOTTOMS
A ROUGHNESS COEFFICENT OF 0.020 WAS USED FOR CONCRETE LINED CONVEYANCES

Sterling Ranch Master Development Drainage Plan

Sand Creek and East Fork Sand Creek Basins - Predevelopment Conditions - Initial Abstraction Values

8/21/2018

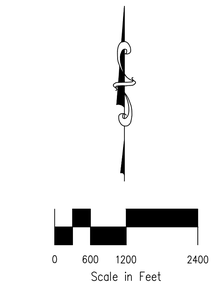
Basin ID	Composite CN Value	Initial Abstraction (in)
EX-0	62	0.613
EX-1	62	0.613
EX-2	62	0.613
EX-3	62	0.613
EX-3A	51	0.961
EX-4	62	0.613
EX-4A	60	0.667
EX-5	62	0.613
EX-6	62	0.613
EX-7	45	1.222
EX-8	41	1.439
EX-9	43	1.326
EX-10	59	0.695
EX-10A	41	1.439
EX-11	43	1.326
EX-12	41	1.439
EX-13	55	0.818
EX-20	62	0.613
EX-20A	63	0.587
EX-21	62	0.613
EX-24	54	0.852
EX-25	43	1.326
EX-73	62	0.613
EX-74	62	0.613
EX-75	62	0.613
EX-76	62	0.613
EX-77	62	0.613
EX-78	62	0.613
EX-79	62	0.613
EX-80	62	0.613
EX-81	62	0.613
EX-82	62	0.613
EX-88	62	0.613

Sterling Ranch and Creek Channel Study - Mustang Road to Pond 3
Hydrologic Study - Predevelopment Conditions - Reach Data
8/21/2018

Reach ID	Reach Length L1 (ft)	Reach Vert. Drop H1 (ft)	Reach Slope S1 %	Mannings N Value n	Reach Side Slope SS (H/V)	Bottom Width BW (ft)	Diameter D (ft)
RT-1	3975	100	2.5%	0.05	10	6	N/A
RT-2	4570	120	2.6%	0.05	10	6	N/A
RT-3	2360	65	2.8%	0.05	10	6	N/A
RT-4	2695	65	2.4%	0.05	10	6	N/A
RT-5	4100	92	2.2%	0.05	6	10	N/A
RT-6	3030	100	3.3%	0.05	10	6	N/A
RT-7	6145	122	2.0%	0.05	10	6	N/A
RT-8	2160	42	1.9%	0.05	6	15	N/A
RT-9	3565	66	1.9%	0.05	6	30	N/A
RT-10	3165	68	2.1%	0.05	6	6	N/A
RT-11	6400	96	1.5%	0.05	4	40	N/A
RT-12	4375	74	1.7%	0.05	6	40	N/A
RT-13	1480	22	1.5%	0.05	6	40	N/A
RT-14	6365	136	2.1%	0.05	4	6	N/A
RT-15	3130	74	2.4%	0.05	4	8	N/A
RT-16	5575	138	2.5%	0.05	10	6	N/A
RT-17A	2675	72	2.7%	0.05	6	6	N/A
RT-17B	1300	32	2.5%	0.05	6	6	N/A
RT-18	3400	74	2.2%	0.05	10	6	N/A
RT-19	1670	22	1.3%	0.05	6	6	N/A

Sterling Ranch MDDP
ARC I vs ARC II Comparison
Condition : Predevelopment

CNs	ARC I				CNs	ARC II		
	A	Q			A	Q		
Basin	acres	cfs	cfs/acre		acres	cfs	cfs/acre	
EX-0	23.8	32.2	1.4		23.8	0.1	0.0	
EX-1	25.7	30.9	1.2		25.7	0.1	0.0	
EX-2	5.5	7.1	1.3		5.5	0.0	0.0	
EX-3	136.8	143.1	1.0		136.8	45.5	0.3	
EX-3A	188.1	119.4	0.6		188.1	13.6	0.1	
EX-4	192	197.3	1.0		192	62.0	0.3	
EX-4A	151.5	147.2	1.0		151.5	42.2	0.3	
EX-5	153.9	158.2	1.0		153.9	49.8	0.3	
EX-6	90.2	100.5	1.1		90.2	31.6	0.4	
EX-7	165	56.1	0.3		165	2.3	0.0	
EX-8	42	14.7	0.4		42	0.1	0.0	
EX-9	131.9	46.8	0.4		131.9	0.9	0.0	
EX-10	270.7	226	0.8		270.7	60.4	0.2	
EX-10A	179.3	43.1	0.2		179.3	0.6	0.0	
EX-11	209.3	77.5	0.4		209.3	1.4	0.0	
EX-12	39.5	16.3	0.4		39.5	0.1	0.0	
EX-13	89.3	78.4	0.9		89.3	15.0	0.2	
EX-20	143.4	166.2	1.2		143.4	30.8	0.2	
EX-20A	179.7	187.3	1.0		179.7	3.8	0.0	
EX-21	33.3	43.6	1.3		33.3	13.7	0.4	
EX-24	63.1	57.8	0.9		63.1	10.0	0.2	
EX-25	54.4	25.1	0.5		54.4	0.4	0.0	
EX-73	90	98	1.1		90	31.0	0.3	
EX-74	119.7	135.2	1.1		119.7	42.2	0.4	
EX-75	79.3	79.6	1.0		79.3	24.9	0.3	
EX-76	86.4	86	1.0		86.4	27.0	0.3	
EX-77	230.6	227.7	1.0		230.6	71.6	0.3	
EX-78	155.6	167.6	1.1		155.6	53.1	0.3	
EX-79	189	211.5	1.1		189	66.3	0.4	
EX-80	147.7	164.7	1.1		147.7	51.7	0.4	
EX-81	262.9	275.7	1.0		262.9	87.8	0.3	
EX-82	117.8	132.3	1.1		117.8	41.4	0.4	
EX-88	139.2	144.4	1.0		139.2	45.7	0.3	
			0.9				0.2	



LEGEND

BASIN ID – SC3–77

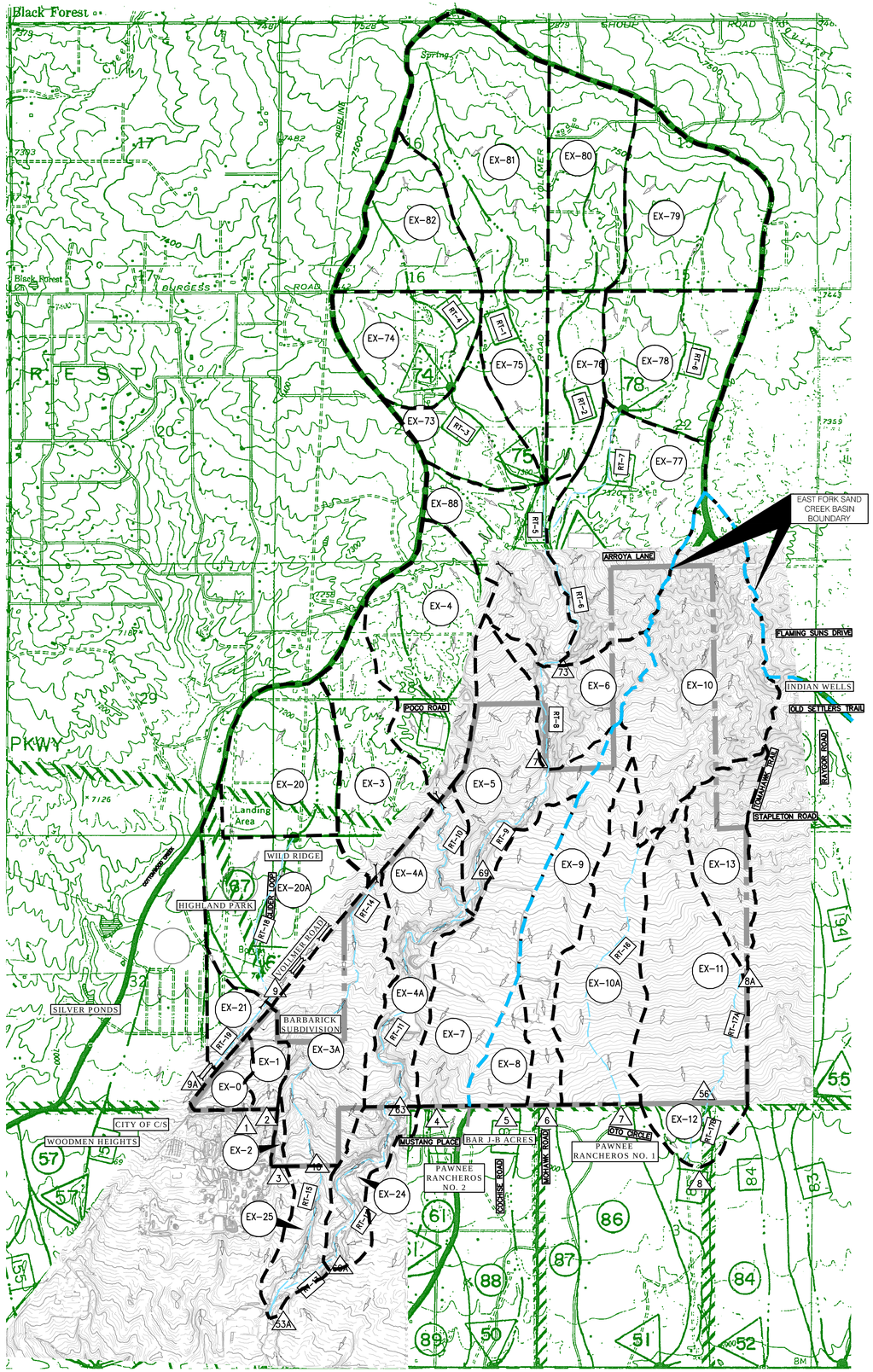
DESIGN POINT – 87

REACH IDENTIFIER – RT–17A

BASIN BOUNDARY –

EAST FORK SAND CREEK BASIN BOUNDARY

FLOW DIRECTION –



BASIN SUMMARY- ARC II

BASIN	CN	AREA (ACRES)	AREA (SQ MI)	Q_2 (CFS)	Q_5 (CFS)	Q_{10} (CFS)	Q_{25} (CFS)	Q_{50} (CFS)	Q_{100} (CFS)
EX–0	62	23.8	0.037	5.0	8.2	13.0	19.6	25.7	32.2
EX–1	62	25.7	0.040	4.8	7.9	12.4	18.7	24.5	30.9
EX–2	62	5.5	0.009	1.1	1.8	2.8	4.3	5.6	7.1
EX–3	62	136.8	0.214	22.0	36.4	57.6	86.9	114.0	143.1
EX–3A	51	188.1	0.294	8.1	18.1	35.9	63.1	89.7	119.4
EX–4	62	192.0	0.300	30.1	49.9	79.1	119.5	157.0	197.3
EX–4A	60	151.5	0.237	20.5	35.1	57.1	87.7	116.3	147.2
EX–5	62	153.9	0.240	24.2	40.0	63.4	95.9	125.9	158.2
EX–6	62	90.2	0.141	15.3	25.2	40.1	60.7	79.9	100.5
EX–7	45	165.0	0.258	1.6	5.2	12.7	25.8	39.6	56.1
EX–8	41	42.0	0.066	0.1	0.6	2.3	5.7	9.8	14.7
EX–9	43	131.9	0.206	0.8	3.1	9.0	20.1	32.1	46.8
EX–10	59	270.7	0.423	29.6	51.8	85.5	133.0	177.4	226.0
EX–10A	41	179.3	0.280	0.6	2.2	7.3	17.4	29.1	43.1
EX–11	43	209.3	0.327	1.2	5.0	14.9	33.2	53.5	77.5
EX–12	41	39.5	0.062	0.1	0.6	2.5	6.4	10.9	16.3
EX–13	55	89.3	0.139	7.7	15.2	27.1	44.2	60.5	78.4
EX–20	62	143.4	0.224	25.4	42.1	66.7	100.7	132.3	166.2
EX–20A	63	179.7	0.281	29.7	48.5	76.1	114.2	149.4	187.3
EX–21	62	33.3	0.052	6.6	11.0	17.5	26.4	34.7	43.6
EX–24	54	63.1	0.099	5.3	10.5	19.0	31.9	44.2	57.8
EX–25	43	54.4	0.085	0.3	1.5	4.8	10.7	17.2	25.1
EX–73	62	90.0	0.141	15.0	24.7	38.9	59.1	77.8	98.0
EX–74	62	119.7	0.187	20.4	34.0	54.0	81.8	107.5	135.2
EX–75	62	79.3	0.124	12.1	20.0	31.8	48.1	63.3	79.6
EX–76	62	86.4	0.135	13.1	21.5	34.3	52.0	68.4	86.0
EX–77	62	230.6	0.360	34.7	56.9	90.6	137.5	180.9	227.7
EX–78	62	155.6	0.243	25.7	42.3	66.7	101.0	133.1	167.6
EX–79	62	189.0	0.295	32.1	53.0	84.4	127.8	168.1	211.5
EX–80	62	147.7	0.231	25.0	41.2	65.6	99.5	130.9	164.7
EX–81	62	262.9	0.411	42.6	70.2	111.0	167.4	219.6	275.7
EX–82	62	117.8	0.184	20.0	33.2	52.8	80.0	105.1	132.3
EX–88	62	139.2	0.217	22.2	36.7	58.0	87.6	115.0	144.4

DESIGN POINT SUMMARY (PEAK FLOW) - ARC II

DESIGN POINT	AREA (SQ MI)	Q_2 (CFS)	Q_5 (CFS)	Q_{10} (CFS)	Q_{25} (CFS)	Q_{50} (CFS)	Q_{100} (CFS)	LOCATION
DP–74	0.371	37.7	63.3	101.8	155.1	204.6	257.7	
DP–75	1.413	134.2	225.8	365.5	551.1	734.9	929.5	
DP–78	0.538	54.6	91.8	145.0	221.5	292.7	370.0	
DP–73	2.528	216.8	365.4	597.5	925.2	1231.8	1547.5	
DP–71	2.669	217.7	372.1	608.9	948.0	1249.4	1600.2	STERLING RANCH NORTHERN BNDRY
DP–69	3.209	239.5	406.4	683.6	1070.8	1426.2	1838.0	
DP–63	3.446	238.5	410.2	690.6	1082.7	1455.5	1869.8	STERLING RANCH SOUTHERN BNDRY
DP–10	0.508	27.0	47.9	81.4	130.3	175.1	233.3	COLORADO SPRINGS/EL PASO BNDRY
DP–9A	0.557	52.7	90.6	144.8	221.7	291.4	369.4	VOLLMER/TAHITI DRIVE
DP–9	0.505	50.5	85.9	138.0	209.0	275.0	344.0	VOLLMER/LOCHWINNOCH LN
DP–8A	0.139	7.7	15.2	27.1	44.2	60.5	78.4	D/S STERLING RANCH EASTERN BNDRY
DP–8	0.528	8.6	20.3	43.0	79.8	118.8	162.5	D/S STERLING RANCH SOUTHERN BNDRY
DP–7	0.703	29.6	53.2	91.4	149.6	205.2	267.4	STERLING RANCH SOUTHERN BNDRY
DP–6	0.206	0.8	3.1	9.0	20.1	32.1	46.8	STERLING RANCH SOUTHERN BNDRY
DP–5	0.066	0.1	0.6	2.3	5.7	9.8	14.7	STERLING RANCH SOUTHERN BNDRY
DP–4	0.258	1.6	5.2	12.7	25.8	39.6	56.1	STERLING RANCH SOUTHERN BNDRY
DP–3	0.009	1.1	1.8	2.8	4.3	5.6	7.1	STERLING RANCH SOUTHERN BNDRY
DP–2	0.040	4.8	7.9	12.4	18.7	24.5	30.9	STERLING RANCH SOUTHERN BNDRY
DP–1	0.037	5.0	8.2	13.0	19.6	25.7	32.2	STERLING RANCH SOUTHERN BNDRY
DP–60A	3.545	235.1	407.3	686.6	1081.2	1457.9	1869.8	FUTURE MARKSHEFFEL X–ING
DP–56	0.466	8.5	19.8	41.5	76.3	112.7	154.8	STERLING RANCH SOUTHERN BNDRY
DP–53A	4.138	245.9	427.9	724.1	1146.1	1550.9	2001.0	SAND CREEK AND POND 3

DESIGN POINT SUMMARY (VOLUME) - ARC II

DESIGN POINT	AREA (SQ MI)	V_2 (AC–FT)	V_5 (AC–FT)	V_{10} (AC–FT)	V_{25} (AC–FT)	V_{50} (AC–FT)	V_{100} (AC–FT)	LOCATION
DP–74	0.371	5.7	8.7	13.1	19.1	24.8	30.8	
DP–75	1.413	21.3	32.7	49.3	72.3	93.5	116.4	
DP–78	0.538	8.2	12.5	18.9	27.7	35.8	44.6	
DP–73	2.528	37.6	57.8	87.4	128.3	166.0	206.6	
DP–71	2.669	39.4	60.7	91.8	134.9	174.6	217.3	STERLING RANCH NORTHERN BNDRY
DP–69	3.209	46.8	72.2	109.5	161.1	208.7	259.9	
DP–63	3.446	48.1	74.6	113.9	168.3	218.8	273.0	STERLING RANCH SOUTHERN BNDRY
DP–10	0.508	5.0	8.2	12.9	19.6	25.9	32.9	COLORADO SPRINGS/EL PASO BNDRY
DP–9A	0.557	8.7	13.2	19.9	29.2	37.7	46.8	VOLLMER/TAHITI DRIVE
DP–9	0.505	7.9	12.1	18.2	26.6	34.3	42.6	VOLLMER/LOCHWINNOCH LN
DP–8A	0.139	1.3	2.1	3.4	5.2	6.9	8.8	D/S STERLING RANCH EASTERN BNDRY
DP–8	0.528	2.1	3.9	7.0	11.7	16.4	21.7	D/S STERLING RANCH SOUTHERN BNDRY
DP–7	0.703	5.5	9.1	14.7	22.8	30.6	39.2	STERLING RANCH SOUTHERN BNDRY
DP–6	0.206	0.5	1.0	2.0	3.6	5.2	7.1	STERLING RANCH SOUTHERN BNDRY
DP–5	0.066	0.1	0.3	0.5	1.0	1.5	2.0	STERLING RANCH SOUTHERN BNDRY
DP–4	0.258	0.8	1.6	3.1	5.2	7.4	9.9	STERLING RANCH SOUTHERN BNDRY
DP–3	0.009	0.1	0.2	0.3	0.3	0.6	0.8	STERLING RANCH SOUTHERN BNDRY
DP–2	0.040	0.6	0.9	1.4	2.1	2.7	3.3	STERLING RANCH SOUTHERN BNDRY
DP–1	0.037	0.6	0.9	1.3	1.9	2.5	3.1	STERLING RANCH SOUTHERN BNDRY
DP–60A	3.545	47.9	74.6	114.1	169.2	220.4	275.5	FUTURE MARKSHEFFEL X–ING
DP–56	0.466	2.0	3.7	6.6	10.9	15.1	19.9	STERLING RANCH SOUTHERN BNDRY
DP–53A	4.138	52.6	82.5	126.9	189.1	247.1	310.0	SAND CREEK AND POND 3

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

2018 STERLING RANCH MDDP

PREDEV. HYDROLOGIC CONDITIONS MAP

PROJECT NO. 09–002
FILE: \dwg\Eng Exhibits\2018–MDDP–PredevCondWSMrkMap–ARCI.dwg
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS
SCALE
HORIZ: NTS
VERT: NTS
DATE: 08–22–18
DM1

Section G.

Effective FIRM

Effective LOMR

Existing Conditions HEC-RAS Model

EL PASO COUNTY
UNINCORPORATED AREAS
080059

Sterling Ranch

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.

APPROXIMATE SCALE IN
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PANEL 535 OF 1300
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CONTAINS:
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EL PASO COUNTY,
UNINCORPORATED AREAS

Federal Emergency M

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was extracted using F-MIT On-Line. This map
or amendments which may have been made su
title block. For the latest product information a
Program flood maps check the FEMA Flood M

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GLIDER LOOP
VOLLMER PLACE
TAHITI DRIVE
ROAD
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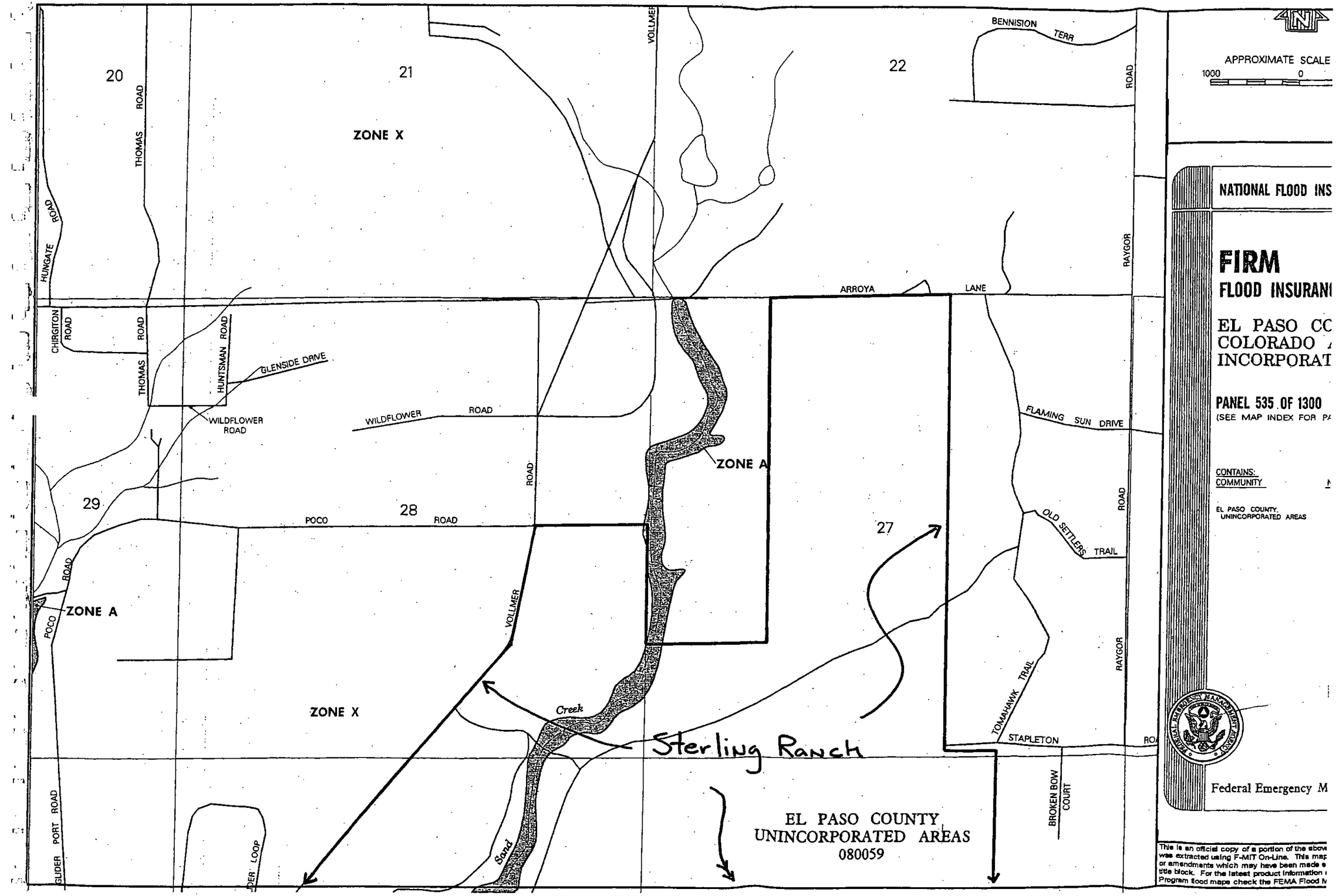
33
34
Sand
ZONE A
T12S
T13S
MUSTANG PLACE
ZONE X
5
4
3
KENOSHA DRIVE
COCHISE ROAD
MOHAWK ROAD
CIRCLE
OTO
Creek
MUSTANG ROAD
MAVERICK ROAD
PONCA ROAD
BRUCE ROAD
ZONE A
LIMIT OF DETAILED STUDY
Sand
6878
EAST
WOODMEN
ROAD
JOINS PANEL 0529


20
21
22
ZONE X
THOMAS ROAD
HUNGATE ROAD
CHIRGITON ROAD
THOMAS ROAD
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
VOLLMER ROAD
BENNISION TERR
RAYGOR ROAD
ARROYA LANE
FLAMING SUN DRIVE
ZONE A
29
28
POCO ROAD
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OLD SETTLERS TRAIL
RAYGOR ROAD
POCO ROAD
ZONE A
VOLLMER
ZONE X
Creek
Sterling Ranch
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PANEL 535 OF 1300
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was extracted using F-MIT On-Line. This map
or amendments which may have been made s
title block. For the latest product information
Program flood maps check the FEMA Flood M

FEMA LOMR

Federal Emergency Management Agency

Washington, D.C. 20472

March 6, 2009

RECEIVED
NOV 20 2014
VERSION 1

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Dennis Hisey
Chairman, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903-2208

IN REPLY REFER TO:
Case No.: 08-08-0541P
Community Name: El Paso County, CO
Community No.: 080059
Effective Date of
This Revision: **July 23, 2009**

Dear Mr. Hisey:

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, 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,

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

For: William R. Blanton Jr., CFM, Chief
Engineering Management Branch
Mitigation Directorate

List of Enclosures:

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

cc: Mr. Tim Condit
Floodplain Engineer
El Paso County
Regional Building Floodplain Administration

Mr. Richard Wray, P.E.
Kiowa Engineering Corporation

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	Sand Creek Letter of Map Revision, Mustang Place to Arroya Lane	APPROXIMATE LATITUDE & LONGITUDE: 38.971, -104.668 SOURCE: USGS QUADRANGLE DATUM: NAD 27	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08041C0535 F DATE: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 *PROFILE(S): 204P(a), 204P(b), 204P(c) AND 204P(d)* FLOODWAY DATA TABLE: 5

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

FLOODING SOURCE(S) & REVISED REACH(ES)

Sand Creek - from approximately 360 feet downstream of Mustang Place to just downstream of Arroya Lane

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Sand Creek	Zone A	Zone AE	YES	YES
	No BFEs*	BFEs	YES	NONE
	No Floodway	Floodway	YES	NONE

* BFEs - Base Flood Elevations

DETERMINATION

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

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map 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.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

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

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

COMMUNITY REMINDERS

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

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

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

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map 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.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

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

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

STATUS OF THE COMMUNITY NFIP MAPS

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

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map 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.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD 29)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Sand Creek	Just upstream of Mustang Place	None	6,984	08041C0535 F
	Just downstream of Arroya Lane	None	7,238	08041C0535 F

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

A notice of changes will be published in the *Federal Register*. A short notice also will be published in your local newspaper on or about the dates listed below. Please refer to FEMA's website at https://www.floodmaps.fema.gov/fhm/Scripts/bfe_main.asp for a more detailed description of proposed BFE changes, which will be posted within a week of the date of this letter.

LOCAL NEWSPAPER Name: *El Paso County News*
Dates: 03/18/09 03/25/09

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.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation 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	6,888.7	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	142	310	8.4	6,969.2	6,969.2	6,969.2	0.0
CU	81,501	120	342	7.6	6,986.1	6,986.1	6,986.5	0.4
CV	82,281	124	295	8.8	6,997.4	6,997.4	6,997.4	0.0
CW	82,897	64	237	11.0	7,005.3	7,005.3	7,006.1	0.8
CX	83,517	90	266	9.8	7,013.9	7,013.9	7,013.9	0.0
CY	84,087	70	244	10.7	7,024.3	7,024.3	7,024.3	0.0
CZ	84,473	160	322	8.1	7,040.2	7,040.2	7,040.2	0.0

Revised Data From LOMR Dated Dec. 7, 2005

Revised Data

[1] Feet Above Confluence With Fountain Creek

REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK

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)								
DA	85,073	139	456	5.7	7,043.0	7,043.0	7,043.1	0.1
DB	85,483	170	328	7.9	7,053.4	7,053.4	7,053.5	0.1
DC	86,103	100	274	9.5	7,054.4	7,054.4	7,054.4	0.0
DD	86,673	197	434	6.0	7,061.7	7,061.7	7,062.0	0.3
DE	87,073	83	270	9.6	7,068.2	7,068.2	7,068.3	0.1
DF	87,573	98	325	8.0	7,077.7	7,077.7	7,077.9	0.2
DG	88,003	135	304	8.6	7,085.1	7,085.1	7,085.1	0.0
DH	88,738	89	263	9.9	7,096.9	7,096.9	7,096.9	0.0
DI	89,303	74	249	10.4	7,104.1	7,104.1	7,104.3	0.2
DJ	89,663	143	309	8.4	7,123.2	7,123.2	7,123.2	0.0
DK	90,058	140	426	6.1	7,125.1	7,125.1	7,125.2	0.1
DL	90,348	102	276	9.4	7,127.6	7,127.6	7,127.8	0.2
DM	90,698	300	398	6.5	7,141.0	7,141.0	7,141.0	0.0
DN	91,388	120	292	8.9	7,148.5	7,148.5	7,148.6	0.1
DO	91,868	105	313	8.3	7,155.2	7,155.2	7,155.9	0.7
DP	92,748	65	239	10.9	7,173.8	7,173.8	7,173.8	0.0
DQ	93,468	117	288	9.0	7,184.6	7,184.6	7,184.6	0.0
DR	94,448	81	260	10.0	7,204.5	7,204.5	7,204.6	0.1
DS	95,343	100	274	9.5	7,216.8	7,216.8	7,217.2	0.4
DT	95,723	77	252	10.3	7,224.2	7,224.2	7,224.3	0.1
DU	96,333	90	266	9.8	7,232.5	7,232.5	7,233.0	0.5

REVISED TO REFLECT LOMR

[1] Feet Above Confluence With Fountain Creek

EFFECTIVE: July 23, 2009

TABLE 5

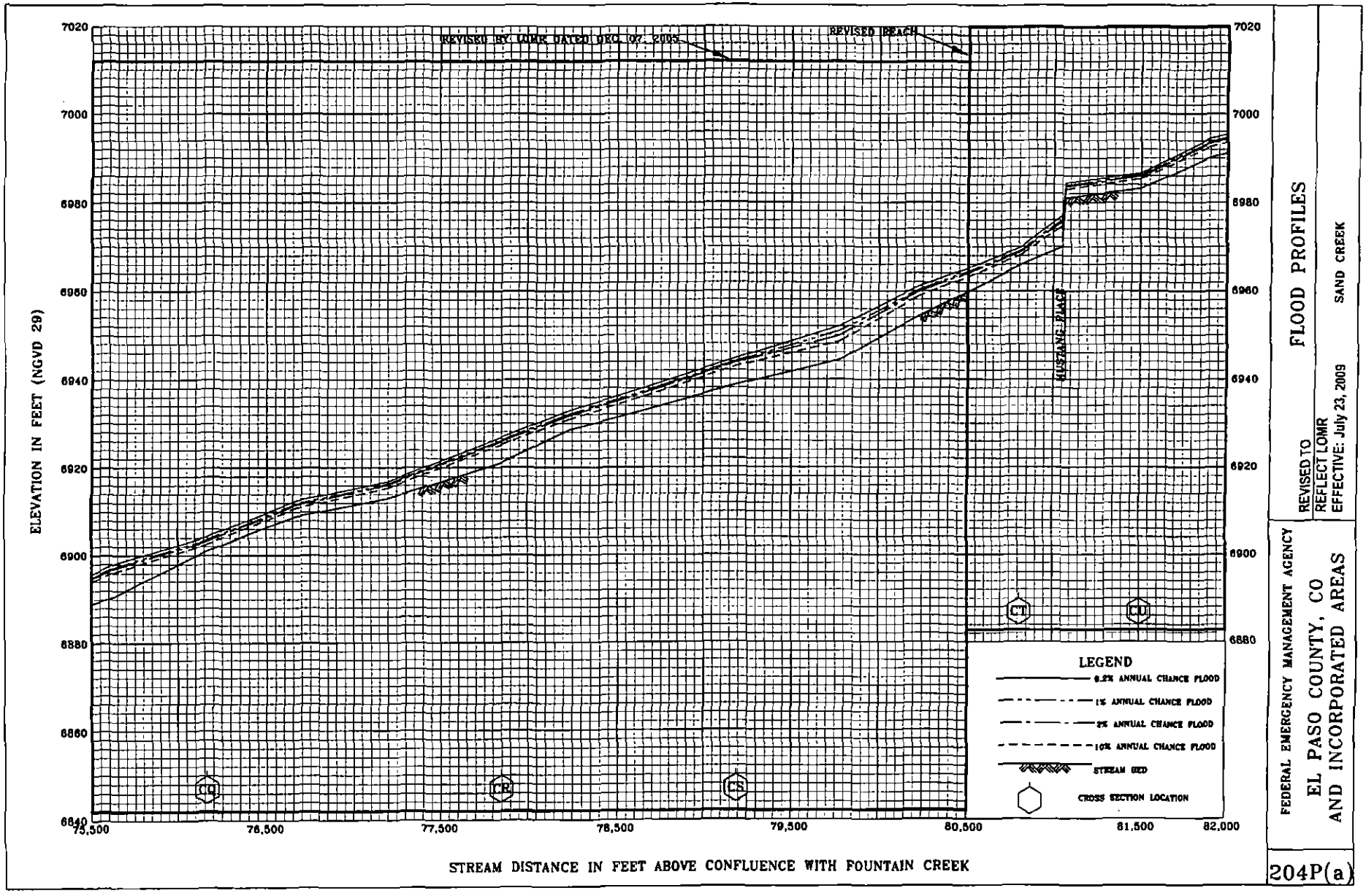
FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK



FLOOD PROFILES

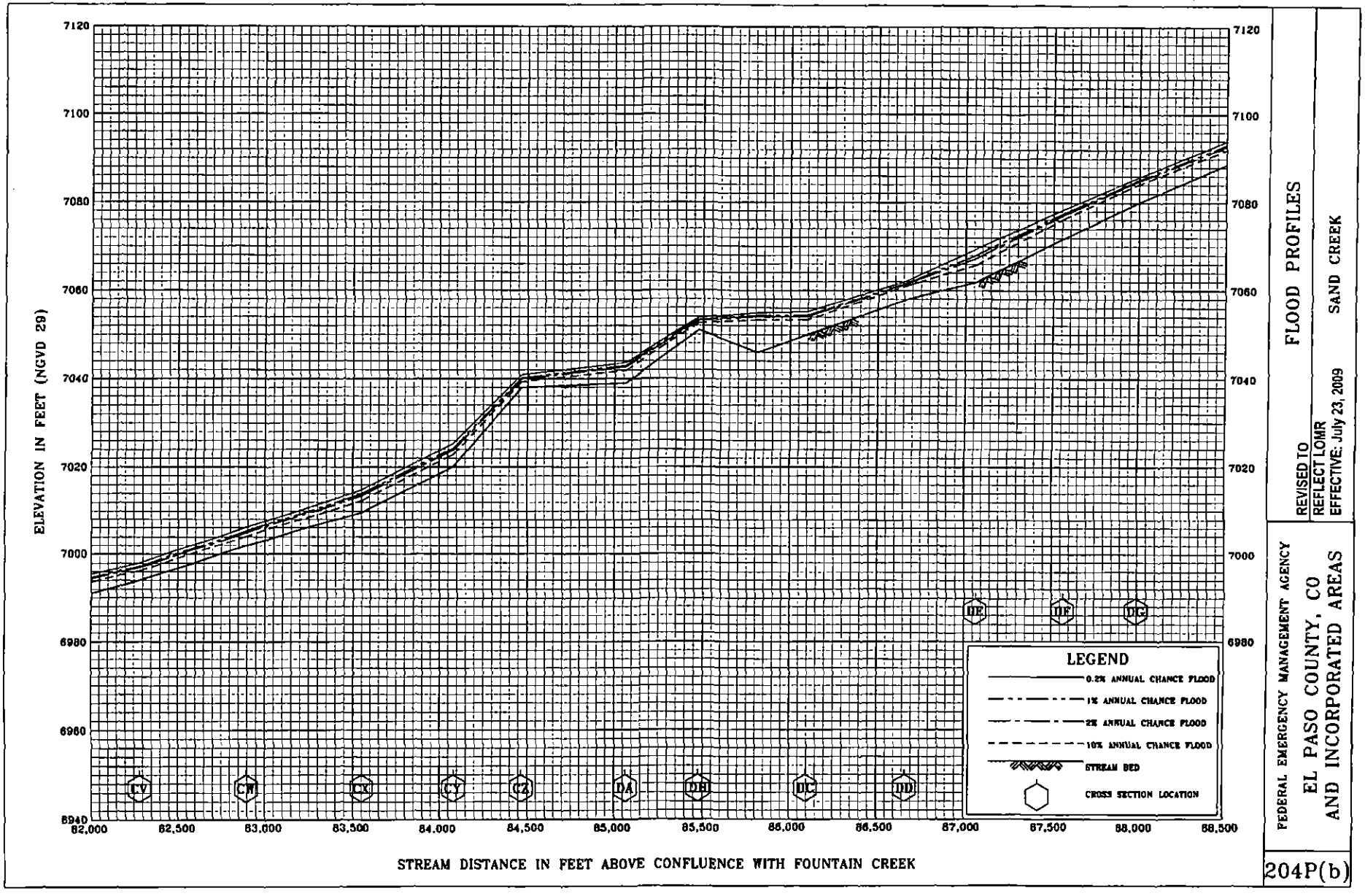
REVISED TO REFLECT LOMR
EFFECTIVE: July 23, 2009

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

204P(a)



FLOOD PROFILES

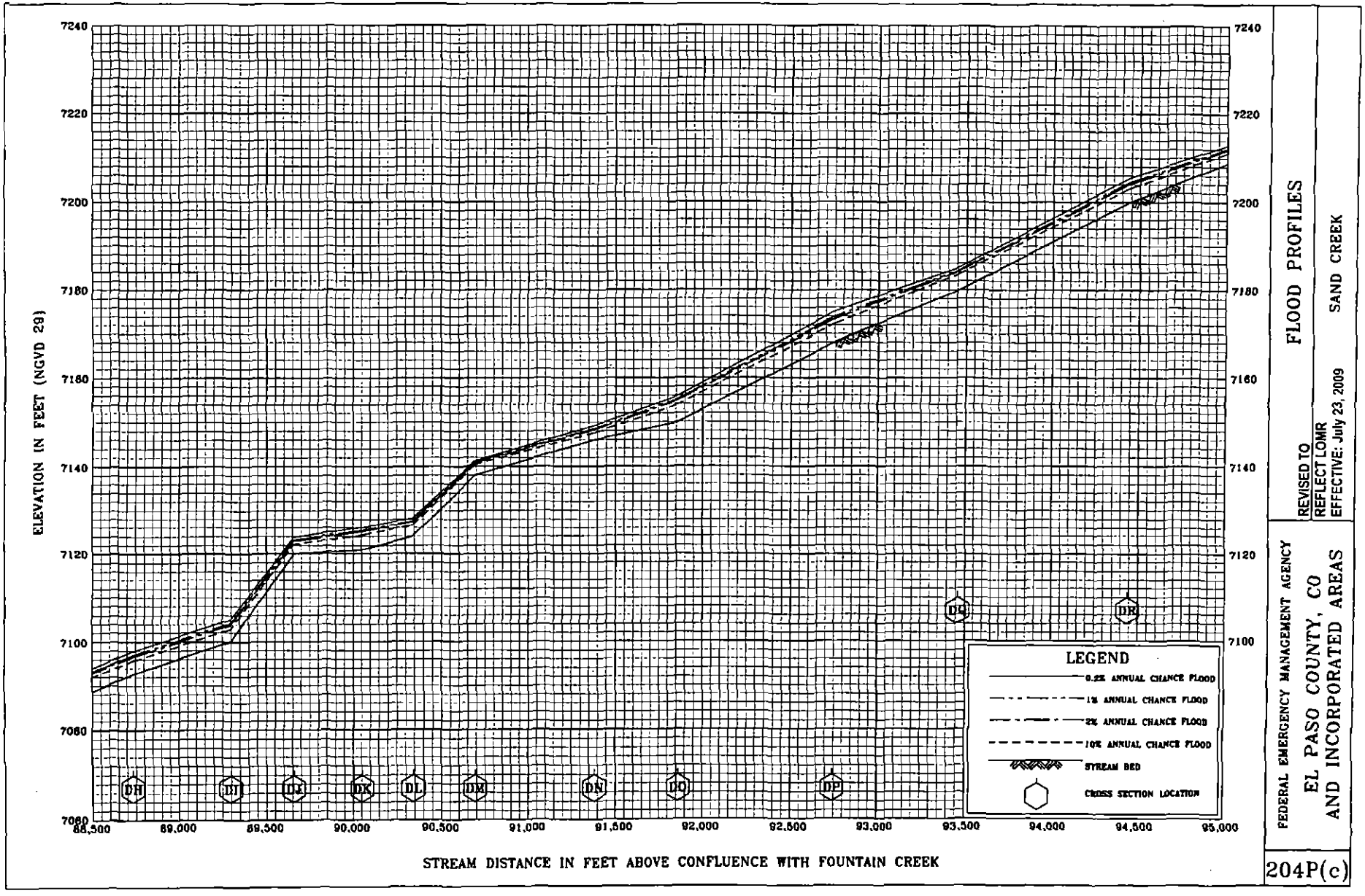
REVISED TO
REFLECT LOMR
EFFECTIVE: July 23, 2009

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

204P(b)



FLOOD PROFILES

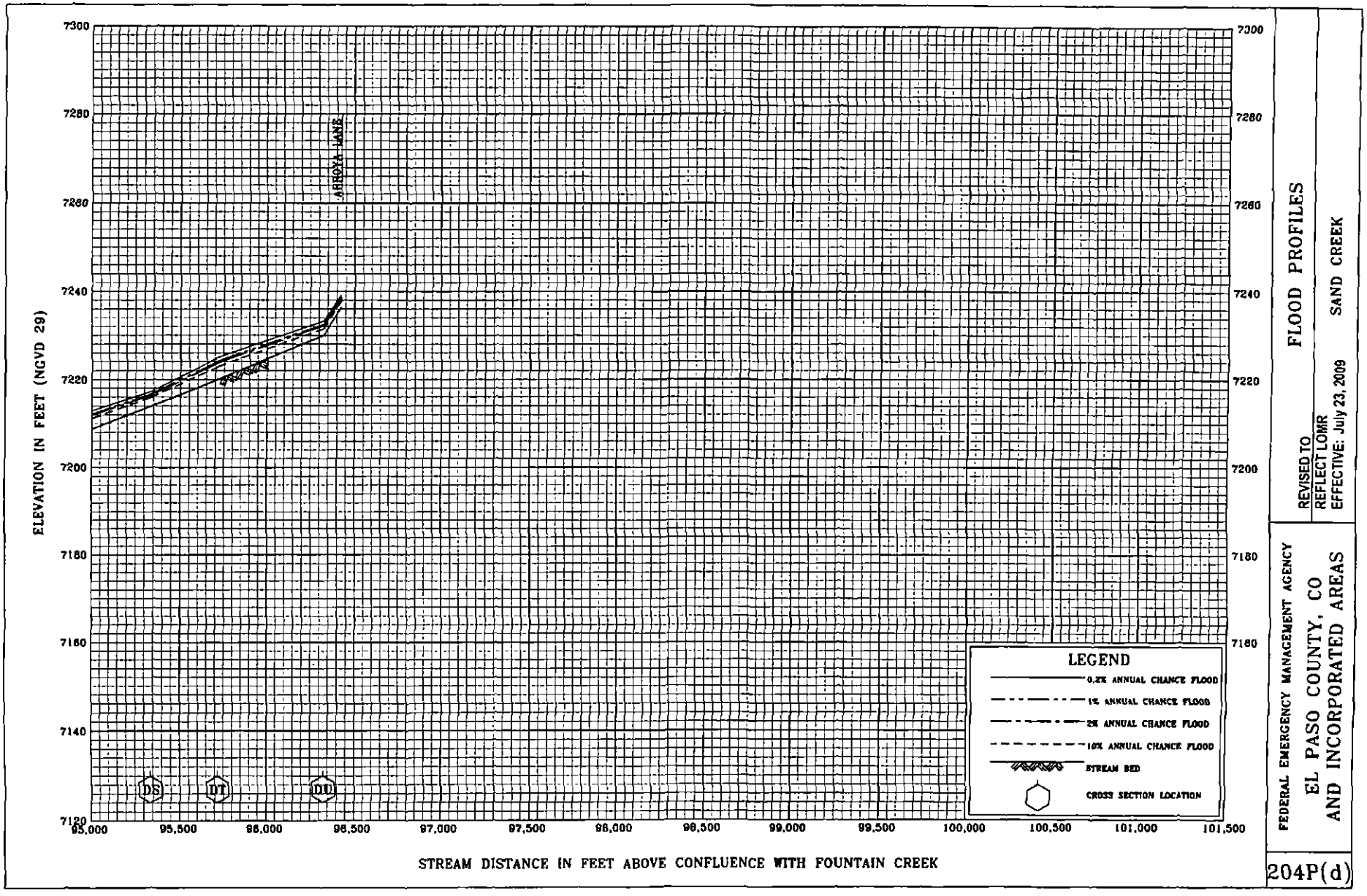
REVISED TO REFLECT LOMR
EFFECTIVE: July 23, 2009

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

204P(c)



FLOOD PROFILES

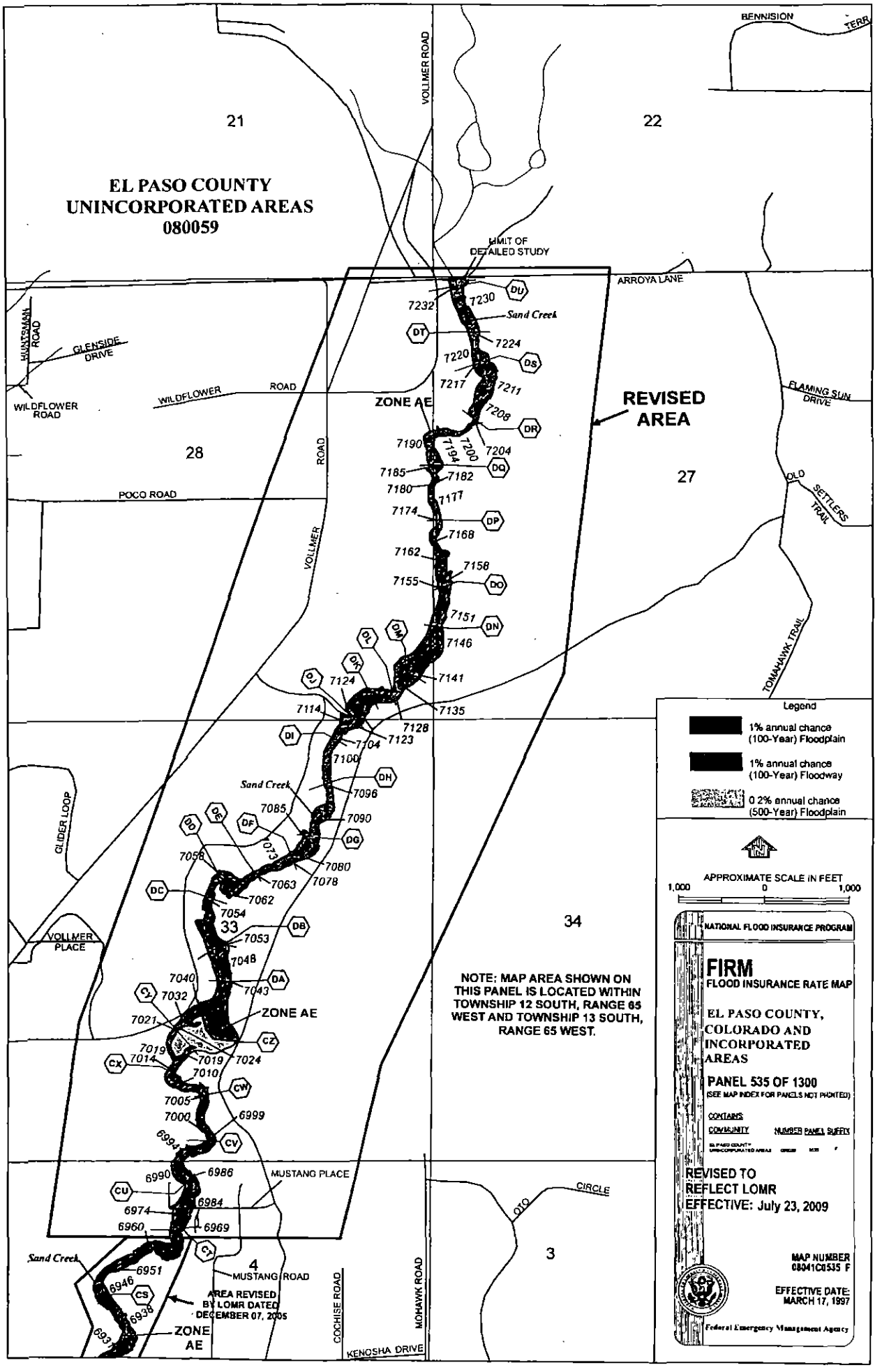
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

204P(d)


EL PASO COUNTY
UNINCORPORATED AREAS
080059
21
22
28
27
34
3
4
33
LIMIT OF DETAILED STUDY
ARROYA LANE
BENNISION TERR
VOLLMER ROAD
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
POCO ROAD
VOLLMER ROAD
FLAMING SUN DRIVE
OLD SETTLERS TRAIL
TOMAHAWK TRAIL
GLIDER LOOP
VOLLMER PLACE
MUSTANG PLACE
MUSTANG ROAD
COCHISE ROAD
MOHAWK ROAD
KENOSHA DRIVE
CIRCLE
OTO
Sand Creek
ZONE AE
REVISED AREA
AREA REVISED BY LOMR DATED DECEMBER 07, 2005
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.
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
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009
MAP NUMBER 08041C0535 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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

PROJECT DATA
Project Title: Sterling
Project File : stlmr.prj
Run Date and Time: 9/25/2018 1:02:31 PM

Project in English units

Project Description:
SAND CREEK LOMR AT STERLING RANCH
10-, 50-, 100-, AND
500-YEAR RECURRENCE INTERVALS
PROJECT NUMBER 08014 ZONE
RUN
VERTICAL DATUM: NGVD 1929
10-YEAR FREQUENCY
FN:STLMR.dat XSEC L TO R ORIENTED DOWNSTREAM

PLAN DATA

Plan Title: Plan 02
Plan File : o:\09002A\Sterling Ranch District\Documents\Reports\Drainage\2018 MDDP\HEC-RAS\Existing Conditions\stlmr.p02

Geometry Title: Imported Geom 01
Geometry File : o:\09002A\Sterling Ranch District\Documents\Reports\Drainage\2018 MDDP\HEC-RAS\Existing Conditions\stlmr.g01

Flow Title : Flow 02
Flow File : o:\09002A\Sterling Ranch District\Documents\Reports\Drainage\2018 MDDP\HEC-RAS\Existing Conditions\stlmr.f02

Plan Summary Information:
Number of: Cross Sections = 34 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20

Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

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

FLOW DATA

Flow Title: Flow 02
Flow File : o:\09002A\Sterling Ranch District\Documents\Reports\Drainage\2018 MDDP\HEC-RAS\Existing Conditions\stlmr.f02

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	34	1467.7
RIVER-1	Reach-1	29	1506.7
RIVER-1	Reach-1	28	1518.6
RIVER-1	Reach-1	27	1612.2
RIVER-1	Reach-1	24	1636.7
RIVER-1	Reach-1	20	1775.7
RIVER-1	Reach-1	13	1905.9
RIVER-1	Reach-1	8	2204.1

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	PF 1	Critical	Critical

GEOMETRY DATA

Geometry Title: Imported Geom 01
Geometry File : o:\09002A\Sterling Ranch District\Documents\Reports\Drainage\2018 MDDP\HEC-RAS\Existing Conditions\stlmr.g01

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 34

INPUT
Description: 25
DOWNSTREAM ARROYO LANE

Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

1000	7250	1089.3	7244	1174.3	7240	1249.3	7238	1282.9	7236.5
1354.5	7236.5	1404.2	7236.5	1411.1	7238	1451	7240	1556.3	7250
1588.1	7252	1670.1	7254	1779.2	7256	1881.9	7258	1983	7260

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1174.3	.027	1451	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1174.3	1451	100	100	140	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 33

INPUT
Description: 24

Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7250	1087.8	7244	1112.8	7242	1149.2	7240	1198.5	7238
1241.7	7236	1261.8	7230	1341.4	7230	1373.5	7230	1378.8	7232
1396.4	7234	1413.4	7236	1436.5	7240	1464.4	7246	1475.7	7248
1591.1	7248	1662	7250						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1241.7	.027	1396.4	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1241.7	1396.4	580	610	530	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 32

INPUT
Description: 23

Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7240	1021.8	7238	1040	7236	1056	7234	1071	7232
1077.5	7230	1108.8	7230	1128.1	7228	1138.3	7226	1151.7	7220
1170.1	7220.4	1223.7	7222	1253.5	7224	1280	7226	1309.3	7228
1400.5	7230	1443.6	7232	1490.3	7236	1537.8	7238	1657.2	7238
1719.5	7240								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1138.3	.027	1280	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1138.3	1280	360	380	420	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 31

INPUT
Description: 22

Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7230	1051	7224	1067.1	7222	1083	7220	1147.9	7218
1166.9	7216	1221	7214	1242.3	7214	1267.1	7214.5	1349.3	7216
1357.3	7220	1506.9	7222	1551	7224	1602.1	7226		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1147.9	.027	1349.3	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1147.9	1349.3	850	895	690	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 30

INPUT
Description: 21

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7220	1023	7218	1048	7216	1079.8	7214	1112.3	7212
1125.6	7210	1137.3	7206	1158.9	7206	1165.6	7204	1173.9	7202
1192.5	7200	1194.3	7200	1196.2	7200	1239.9	7202	1249.5	7206
1264.4	7208	1289.9	7210	1397.3	7212	1552.5	7214		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1165.6	.027	1239.9	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1165.6	1239.9	940	980	1060	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 29

INPUT
Description: 20

Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7200	1033.6	7184	1159.9	7182	1165.3	7180	1166.9	7180
1192.8	7182	1197.1	7184	1200.9	7186	1265.4	7186	1275.7	7190
1291.7	7200								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1033.6	.027	1197.1	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1033.6 1197.1 670 720 690 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 28

INPUT
Description: 19

Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7180	1017.4	7172	1024.3	7170	1031.5	7168	1038	7168
1055.1	7170	1075.2	7172	1085.1	7176	1089	7178	1092	7180
1096.8	7182	1124.8	7184	1137.7	7186	1151.6	7188	1181.8	7190

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1017.4	.027	1075.2	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1017.4 1075.2 780 880 820 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 27

INPUT
Description: 18

Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7170	1027.3	7166	1040.3	7164	1051.5	7162	1064.6	7160
1081.2	7158	1097.5	7156	1107.1	7154	1124.4	7152	1148	7152
1167.2	7154	1203.5	7154	1222.8	7152	1229.7	7150	1234.8	7150
1240.8	7150	1244.3	7152	1249.4	7154	1260.5	7156	1272.4	7158
1299.6	7160	1305.9	7162	1309.8	7164	1344.1	7166	1362.2	7168

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1203.5	.027	1249.4	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1203.5 1249.4 470 480 420 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 26

INPUT
Description: 17

Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7160	1060	7152	1110	7150	1135	7148	1165	7146
1265	7146	1275	7148	1290	7150	1448	7156	1550	7160

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1110	.027	1290	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1110	1290	710	690	520	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 25

INPUT
Description: 16

Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7150	1038.6	7148	1070.1	7144	1090.2	7142	1104	7140
1191.3	7140.5	1281.8	7140	1292.6	7138	1295.7	7138	1347.8	7139
1436.5	7140	1478.1	7142	1508.6	7144	1549	7146	1588	7148
1638	7150								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1090.2	.027	1478.1	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1090.2	1478.1	410	350	230	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 24

INPUT
Description: 15

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7140	1011	7138	1025.5	7136	1036.7	7134	1044.2	7132
1049.2	7130	1057.5	7128	1066	7126	1074.3	7124	1081.8	7124
1114.5	7124.5	1142.3	7126	1181.8	7126	1190.5	7128	1234.9	7130
1336.6	7132	1396.4	7134	1432.6	7134	1464.9	7138	1494.9	7140

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1057.5	.027	1190.5	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1057.5	1190.5	230	290	280	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 23

INPUT
Description: 14.5

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7140	1021	7138	1032	7136	1043	7134	1056	7132
1072	7130	1081	7128	1090	7126	1110	7124	1179	7124
1188	7122	1195	7121	1214	7121	1243	7121	1249	7122
1303	7126	1357	7128	1382	7130	1403	7132	1519	7140

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1179	.027	1249	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1179	1249	320	395	360	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 22

INPUT
Description: 14

Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7130	1036.3	7126	1051.9	7124	1064.3	7122	1110.6	7120
1201.2	7122	1242.6	7124	1330.3	7124	1383.9	7124	1403	7126
1426.9	7128	1489.7	7130						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1051.9	.027	1242.6	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1051.9	1242.6	320	360	370	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 21

INPUT
Description: 13

Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7120	1014.5	7118	1027.6	7116	1046.2	7114	1079.1	7112
1080.7	7110	1101.7	7108	1111	7106	1134.6	7104	1140.2	7102
1187.6	7100	1207.4	7100	1211.9	7102	1224.4	7104	1232	7106
1240.3	7108	1246.5	7110	1256.8	7112	1278.4	7114	1303.9	7116
1342.1	7118	1406.1	7120						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

1000	.04	1134.6	.027	1224.4	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1134.6 1224.4 450 565 750 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 20

INPUT
Description: 12

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7110	1017.8	7108	1026.9	7106	1035.3	7104	1042.2	7102
1047	7100	1051.8	7098	1059.2	7096	1081.3	7094	1115.4	7092.6
1138.9	7094	1143.1	7096	1147.3	7098	1161.5	7100	1177.4	7102
1194.2	7104	1215.1	7106	1249.9	7108	1327.7	7110		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1059.2	.027	1143.1	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1059.2 1143.1 840 735 880 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 19

INPUT
Description: 11

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7100	1009.4	7098	1018.9	7096	1031.5	7094	1052	7092
1069.3	7090	1078.5	7088	1079.6	7086	1090.1	7084	1168.2	7082
1175.9	7080	1184.5	7082	1187	7084	1202.2	7084	1208	7082
1216.7	7082	1225.2	7084	1291.9	7086	1310.5	7088	1356.6	7090

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1079.6	.027	1291.9	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1079.6 1291.9 510 430 420 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 18

INPUT
Description: 10.5

Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7090	1060	7084	1090	7080	1110	7076	1150	7074
1170	7072	1175	7074	1215	7076	1245	7080	1350	7090

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1150	.027	1175	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1150	1175	460	500	500	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 17

INPUT
Description: 10

Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7080	1023	7078	1037.6	7076	1040.5	7074	1046.9	7072
1055.2	7070	1076.7	7068	1087.9	7066	1090.4	7064	1098.9	7062
1109.5	7062	1111.3	7062	1126.4	7064	1128.6	7066	1155.1	7068
1176.9	7070	1192.3	7072	1201	7074	1212.1	7076	1229.4	7078
1250.1	7080								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1087.9	.027	1128.6	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1087.9	1128.6	405	400	391	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 16

INPUT
Description: 9.5

Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7072	1003	7060	1004	7058	1025	7058	1031	7060
1037	7060	1254	7060	1296	7062	1318	7064	1357	7066
1373	7068								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1004	.027	1025	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1004	1025	210	570	310	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 15

INPUT
Description: 9

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7070	1069.9	7068	1097.3	7066	1116	7064	1134	7062
1154	7060	1173	7058	1176	7052	1196.1	7050	1206.1	7050
1240.4	7052	1272.1	7054	1288.6	7056	1293.5	7058	1298.8	7060
1320.2	7062	1337.5	7064	1340.3	7066	1364.6	7068	1391.3	7070

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1173	.027	1293.5	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1173	1293.5	270	285	310	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 14

INPUT
Description: 8.5

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7070	1013	7066	1035	7056	1047	7054	1059	7052
1064	7050	1070	7048	1099	7046	1103	7046	1127	7048
1141	7052	1158	7054	1171	7056	1208	7056	1258	7054
1273	7056	1297	7058	1323	7060	1353	7062	1382	7063

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1064	.027	1127	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1064	1127	270	335	420	.1	.3

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 13

INPUT
Description: 8

Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7070	1049	7068	1088.3	7066	1120	7064	1154	7062
1191	7060	1232	7058	1272.3	7056	1313	7054	1361.3	7052
1454.3	7051	1528.9	7052	1585.1	7054	1630.5	7056	1673.4	7058

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

1000	.04	1313	.027	1585.1	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1313 1585.1 450 410 370 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 12

INPUT
Description: 7.5

Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7050	1030	7042	1050	7040	1100	7039	1165	7040
1175	7042	1190	7044	1290	7050				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1030	.027	1175	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1030 1175 750 600 450 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 11

INPUT
Description: 7

Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7044	1021.5	7042	1042.2	7040.5	1562.8	7040.5	1624.8	7040.5
1646.9	7040	1657.6	7038	1796.4	7038	1817.2	7044	1843.6	7046

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1021.5	.027	1817.2	.04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1021.5 1817.2 260 385 380 .1 .3
Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 10

INPUT
Description: 6

Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7030	1027	7028	1055.9	7026	1063.5	7024	1071.3	7022
1083.4	7020	1117.7	7018	1145.3	7018	1155.9	7020	1163.5	7022

1176	7026	1185.2	7028	1207.9	7030	1233.2	7032	1288	7030
1373.5	7028	1382.1	7026	1388.6	7022	1413	7020	1420.4	7020
1440.2	7020	1451.4	7022	1457	7024	1461.1	7028	1475	7030
1508.3	7034	1547	7038	1701	7040				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1373.5	.027	1461.1	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1373.5	1461.1	260	530	360	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
1000	1240	

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 9

INPUT
Description: 5

Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7022	1048.8	7020	1067.4	7018	1085.9	7016	1093.4	7010
1122.5	7009.7	1145	7010	1151.1	7012	1179.5	7014	1188.5	7016
1197	7018	1207.2	7020	1217	7022	1225.8	7024	1263.7	7026
1263.7	7028								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1085.9	.027	1188.5	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1085.9	1188.5	450	655	570	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 8

INPUT
Description: 4

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7020	1014	7018	1033.5	7016	1042.7	7014	1044.9	7012
1047	7010	1053	7004	1075	7002	1127.3	7002	1145.8	7004
1152.9	7006	1163	7008	1190.6	7010				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1047	.027	1163	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1047	1163	660	615	470	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 7

INPUT
Description: 3

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7010	1006	7008	1011.5	7006	1015	7004	1018.8	7002
1029.8	7000	1039.9	6998	1050.4	6996	1072.4	6994	1089.6	6994
1096.5	6994	1159.1	6996	1170.2	6998	1188.1	7000	1221.9	7002
1243.9	7004	1265.9	7006	1291.2	7008	1398.7	7010		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1039.9	.027	1170.2	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1039.9	1170.2	380	385	340	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 6

INPUT
Description: 2

Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	7000	1007.1	6998	1013.7	6996	1068.3	6996	1069.7	6994
1073.8	6992	1145	6990.1	1181.7	6992	1193.4	6994	1199.4	6996
1207.2	6998	1219	7000	1235.2	7002	1271.6	7004	1364	7006
1393.1	7008	1423.9	7010						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1069.7	.027	1193.4	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1069.7	1193.4	250	395	450	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 5

INPUT
Description: 1

Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6990	1020	6988	1031.3	6986	1042.7	6984	1096.3	6983.1
1171.8	6984	1179.1	6986	1181.5	6988	1212.6	6990	1274.2	6992
1396.8	6994								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1031.3	.027	1179.1	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1031.3	1179.1	360	430	340	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 4

INPUT
Description: 0.5
MUSTANG PLACE

Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6994	1054.6	6992	1112.6	6990	1173	6988	1220	6986
1258	6984	1298	6982	1370	6981	1417	6982	1453	6984
1488	6986	1528	6988	1583	6990	1706	6992		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.02	1112.6	.02	1583	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1112.6	1583	20	20	20	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 3

INPUT
Description: 3910

Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6980	1020	6978	1035	6978	1070	6976	1098	6974
1126	6972	1133	6970	1136	6970	1143	6972	1169	6974
1181	6976	1216	6980						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1098	.027	1169	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1098	1169	292	242	262	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 2

INPUT
Description: 3920

Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6980	1026	6978	1031	6976	1036	6974	1039	6972
1055	6970	1067	6968	1084	6966	1097	6966	1198	6968
1204	6970	1216	6972	1226	6974	1231	6976	1241	6978
1367	6978	1397	6980						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1055	.027	1204	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1055	1204	769	584	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 1

INPUT
Description: 3930

Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	6970	1033	6968	1047	6966	1061	6964	1071	6962
1089	6960	1125	6958	1152	6956	1167	6954.2	1174	6956
1180	6958	1188	6960	1194	6962	1200	6964	1206	6966
1227	6968	1237	6971						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.04	1089	.027	1188	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1089	1188	423	449	.1	.3

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	34	.04	.027	.04
Reach-1	33	.04	.027	.04
Reach-1	32	.04	.027	.04
Reach-1	31	.04	.027	.04
Reach-1	30	.04	.027	.04
Reach-1	29	.04	.027	.04
Reach-1	28	.04	.027	.04
Reach-1	27	.04	.027	.04
Reach-1	26	.04	.027	.04
Reach-1	25	.04	.027	.04
Reach-1	24	.04	.027	.04
Reach-1	23	.04	.027	.04
Reach-1	22	.04	.027	.04
Reach-1	21	.04	.027	.04
Reach-1	20	.04	.027	.04
Reach-1	19	.04	.027	.04
Reach-1	18	.04	.027	.04
Reach-1	17	.04	.027	.04
Reach-1	16	.04	.027	.04
Reach-1	15	.04	.027	.04
Reach-1	14	.04	.027	.04
Reach-1	13	.04	.027	.04
Reach-1	12	.04	.027	.04
Reach-1	11	.04	.027	.04

Reach-1	10	.04	.027	.04
Reach-1	9	.04	.027	.04
Reach-1	8	.04	.027	.04
Reach-1	7	.04	.027	.04
Reach-1	6	.04	.027	.04
Reach-1	5	.04	.027	.04
Reach-1	4	.02	.02	.02
Reach-1	3	.04	.027	.04
Reach-1	2	.04	.027	.04
Reach-1	1	.04	.027	.04

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	34	100	100	140
Reach-1	33	580	610	530
Reach-1	32	360	380	420
Reach-1	31	850	895	690
Reach-1	30	940	980	1060
Reach-1	29	670	720	690
Reach-1	28	780	880	820
Reach-1	27	470	480	420
Reach-1	26	710	690	520
Reach-1	25	410	350	230
Reach-1	24	230	290	280
Reach-1	23	320	395	360
Reach-1	22	320	360	370
Reach-1	21	450	565	750
Reach-1	20	840	735	880
Reach-1	19	510	430	420
Reach-1	18	460	500	500
Reach-1	17	405	400	391
Reach-1	16	210	570	310
Reach-1	15	270	285	310
Reach-1	14	270	335	420
Reach-1	13	450	410	370
Reach-1	12	750	600	450
Reach-1	11	260	385	380
Reach-1	10	260	530	360
Reach-1	9	450	655	570
Reach-1	8	660	615	470
Reach-1	7	380	385	340
Reach-1	6	250	395	450
Reach-1	5	360	430	340
Reach-1	4	20	20	20
Reach-1	3	292	242	262
Reach-1	2	769	584	455
Reach-1	1	423	449	471

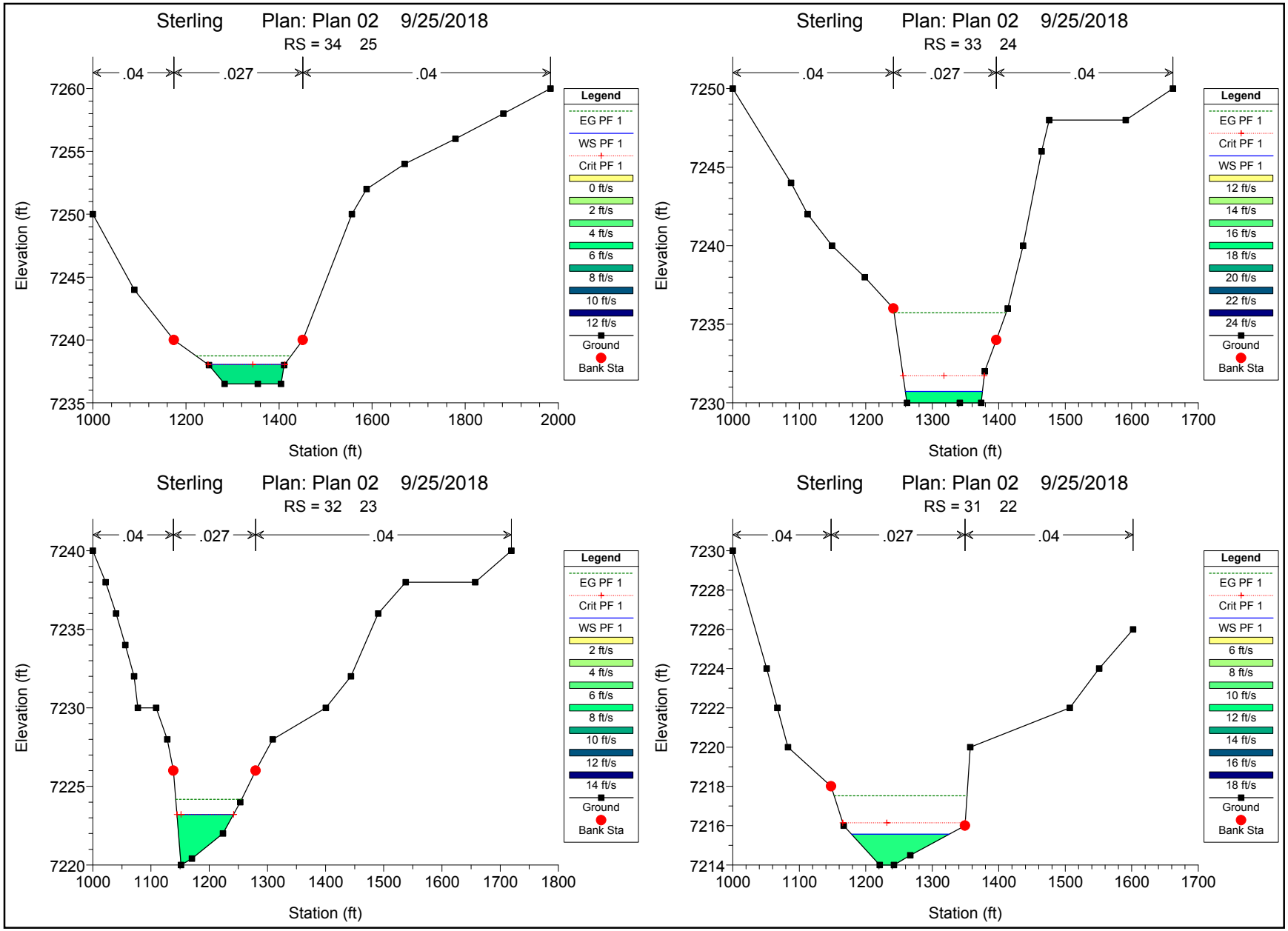
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.

Reach-1	34	.1	.3
Reach-1	33	.1	.3
Reach-1	32	.1	.3
Reach-1	31	.1	.3
Reach-1	30	.1	.3
Reach-1	29	.1	.3
Reach-1	28	.1	.3
Reach-1	27	.1	.3
Reach-1	26	.1	.3
Reach-1	25	.1	.3
Reach-1	24	.1	.3
Reach-1	23	.1	.3
Reach-1	22	.1	.3
Reach-1	21	.1	.3
Reach-1	20	.1	.3
Reach-1	19	.1	.3
Reach-1	18	.1	.3
Reach-1	17	.1	.3
Reach-1	16	.1	.3
Reach-1	15	.1	.3
Reach-1	14	.1	.3
Reach-1	13	.1	.3
Reach-1	12	.1	.3
Reach-1	11	.1	.3
Reach-1	10	.1	.3
Reach-1	9	.1	.3
Reach-1	8	.1	.3
Reach-1	7	.1	.3
Reach-1	6	.1	.3
Reach-1	5	.1	.3
Reach-1	4	.1	.3
Reach-1	3	.1	.3
Reach-1	2	.1	.3
Reach-1	1	.1	.3

HEC-RAS Plan: Mixed Flow Regime River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	34	PF 1	1467.70	7236.50	7238.05	7238.05	7238.74	0.009855	6.64	221.10	164.89	1.01
Reach-1	33	PF 1	1467.70	7230.00	7230.72	7231.72	7235.74	0.170756	17.97	81.66	116.00	3.78
Reach-1	32	PF 1	1467.70	7220.00	7223.21	7223.22	7224.18	0.008797	7.90	185.68	97.22	1.01
Reach-1	31	PF 1	1467.70	7214.00	7215.57	7216.15	7217.53	0.048676	11.22	130.79	147.15	2.10
Reach-1	30	PF 1	1467.70	7200.00	7203.43	7203.43	7204.60	0.008091	8.69	170.57	75.35	1.00
Reach-1	29	PF 1	1506.70	7180.00	7183.02	7183.96	7186.43	0.070756	14.81	101.74	99.32	2.58
Reach-1	28	PF 1	1518.60	7168.00	7172.59	7172.59	7173.99	0.007793	9.49	160.71	60.54	1.01
Reach-1	27	PF 1	1612.20	7150.00	7153.12	7154.55	7158.38	0.062111	20.11	102.34	79.25	2.62
Reach-1	26	PF 1	1612.20	7146.00	7147.87	7147.87	7148.69	0.009175	7.25	222.25	137.44	1.01
Reach-1	25	PF 1	1612.20	7138.00	7140.57	7140.60	7141.05	0.013188	5.58	289.01	348.28	1.08
Reach-1	24	PF 1	1636.70	7124.00	7125.84	7126.96	7131.04	0.084200	18.30	89.45	72.67	2.91
Reach-1	23	PF 1	1636.70	7121.00	7124.66	7123.90	7125.22	0.002661	6.29	327.74	181.58	0.61
Reach-1	22	PF 1	1636.70	7120.00	7122.67	7122.67	7123.43	0.009308	6.99	234.12	154.83	1.00
Reach-1	21	PF 1	1636.70	7100.00	7101.53	7103.27	7112.81	0.235265	26.95	60.74	59.54	4.70
Reach-1	20	PF 1	1775.70	7092.60	7096.23	7096.23	7097.44	0.008123	8.84	201.10	85.22	1.01
Reach-1	19	PF 1	1775.70	7080.00	7083.85	7084.57	7086.23	0.037289	12.37	143.59	112.72	1.93
Reach-1	18	PF 1	1775.70	7072.00	7076.58	7077.08	7078.38	0.010209	12.85	218.23	112.28	1.20
Reach-1	17	PF 1	1775.70	7062.00	7065.44	7066.93	7070.10	0.029026	17.33	102.48	39.37	1.89
Reach-1	16	PF 1	1775.70	7058.00	7061.02	7061.36	7062.19	0.011448	12.29	315.28	272.61	1.25
Reach-1	15	PF 1	1775.70	7050.00	7053.14	7053.70	7055.09	0.017825	11.22	158.29	83.01	1.43
Reach-1	14	PF 1	1775.70	7046.00	7053.93	7050.04	7054.15	0.000388	3.87	525.71	110.04	0.26
Reach-1	13	PF 1	1905.90	7051.00	7053.06	7053.06	7053.73	0.009868	6.53	291.69	223.19	1.01
Reach-1	12	PF 1	1905.90	7039.00	7040.53	7041.51	7044.40	0.084191	15.77	120.83	122.98	2.81
Reach-1	11	PF 1	1905.90	7038.00	7040.57	7040.57	7040.87	0.013490	4.39	434.58	764.11	1.03
Reach-1	10	PF 1	1905.90	7020.00	7021.98	7023.64	7029.18	0.096467	21.53	88.53	62.38	3.19
Reach-1	9	PF 1	1905.90	7009.70	7012.96	7013.26	7014.62	0.010845	10.32	184.74	75.09	1.16
Reach-1	8	PF 1	2204.10	7002.00	7004.62	7005.04	7006.44	0.014168	10.81	203.90	95.64	1.31
Reach-1	7	PF 1	2204.10	6994.00	6996.88	6997.13	6998.28	0.012094	9.48	232.39	118.18	1.19
Reach-1	6	PF 1	2204.10	6990.10	6993.39	6993.40	6994.51	0.008369	8.47	260.36	118.90	1.01
Reach-1	5	PF 1	2204.10	6983.10	6984.77	6985.60	6987.69	0.049868	13.71	160.80	136.34	2.23
Reach-1	4	PF 1	2204.10	6981.00	6983.60	6983.61	6984.45	0.005021	7.38	298.65	179.82	1.01
Reach-1	3	PF 1	2204.10	6970.00	6973.71	6975.64	6983.30	0.131502	24.83	88.76	63.26	3.70
Reach-1	2	PF 1	2204.10	6966.00	6968.46	6968.97	6970.25	0.021923	10.75	205.08	135.13	1.54
Reach-1	1	PF 1	2204.10	6954.20	6959.61	6959.93	6961.26	0.011315	10.32	213.67	90.37	1.18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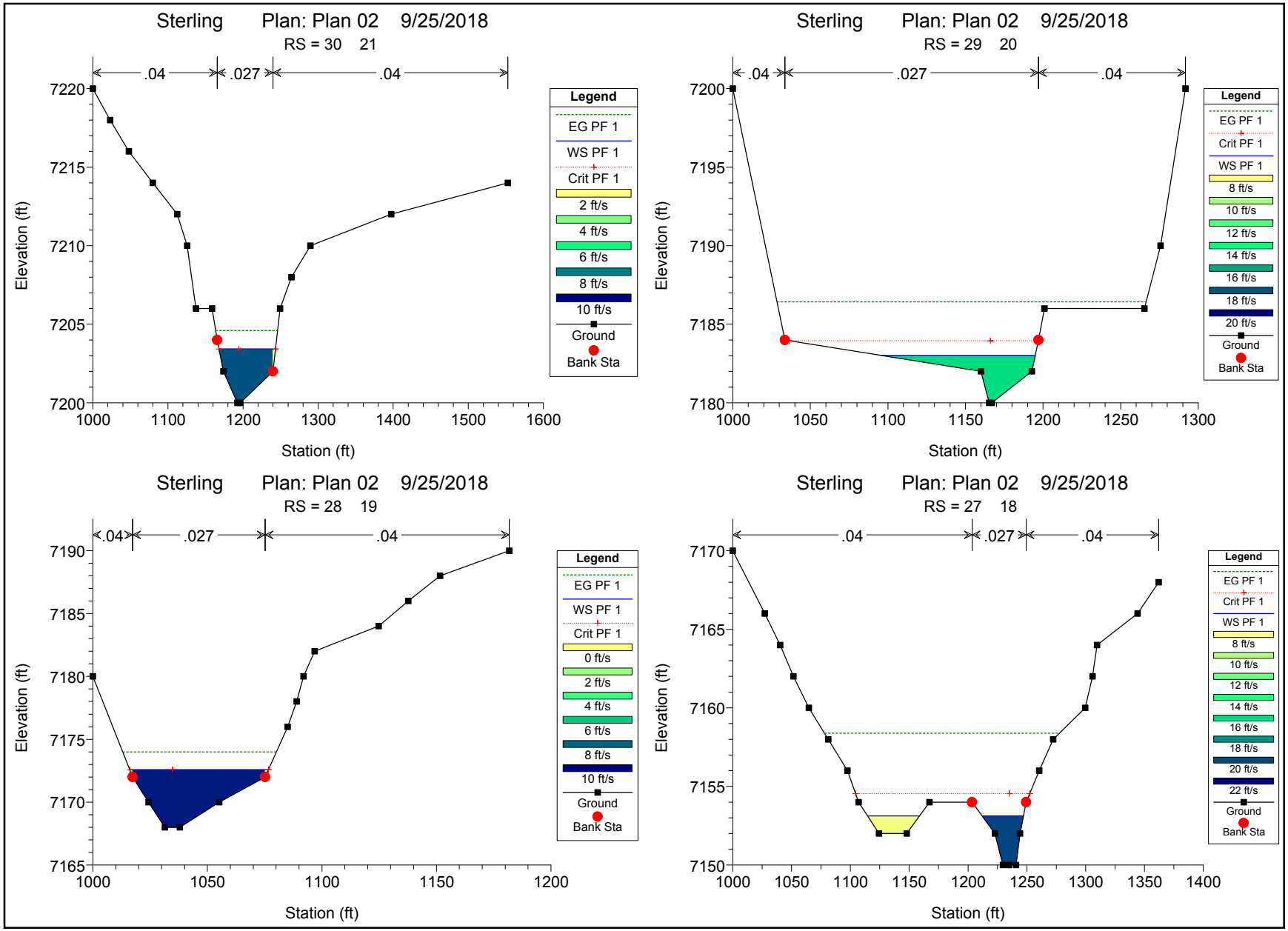
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 33 24
.04 .027 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 32 23
.04 .027 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 31 22
.04 .027 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
Ground
Bank Sta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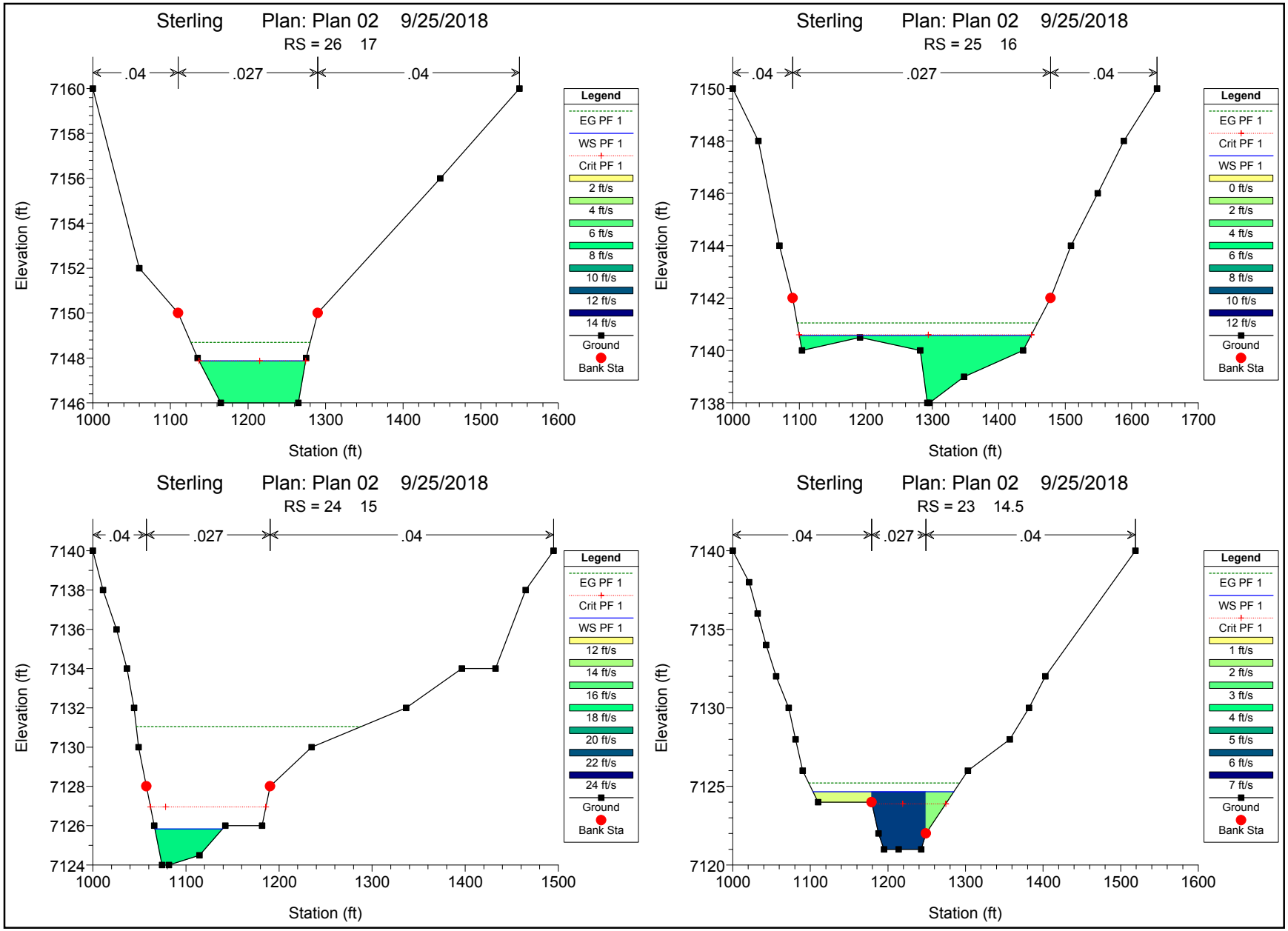
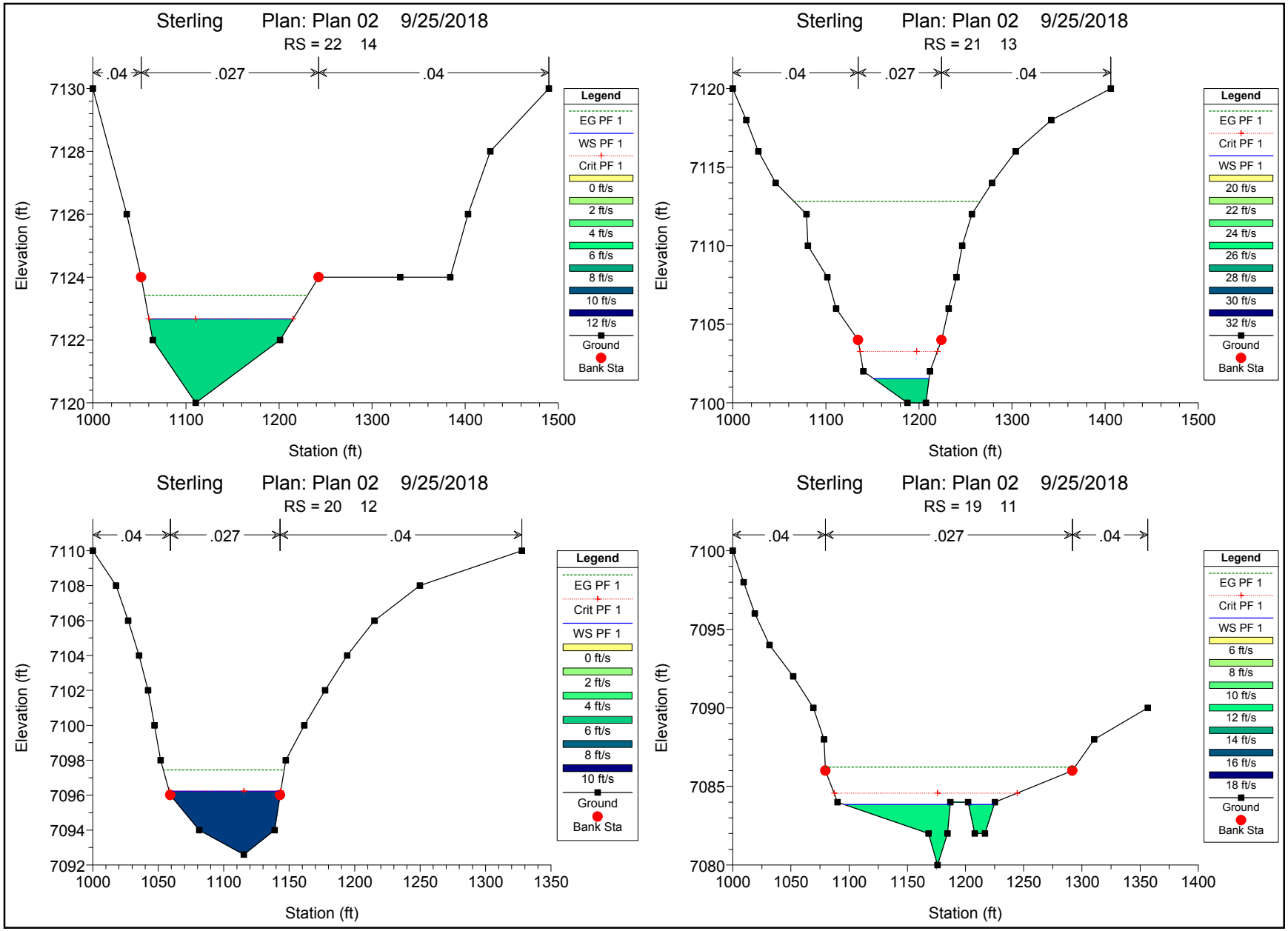
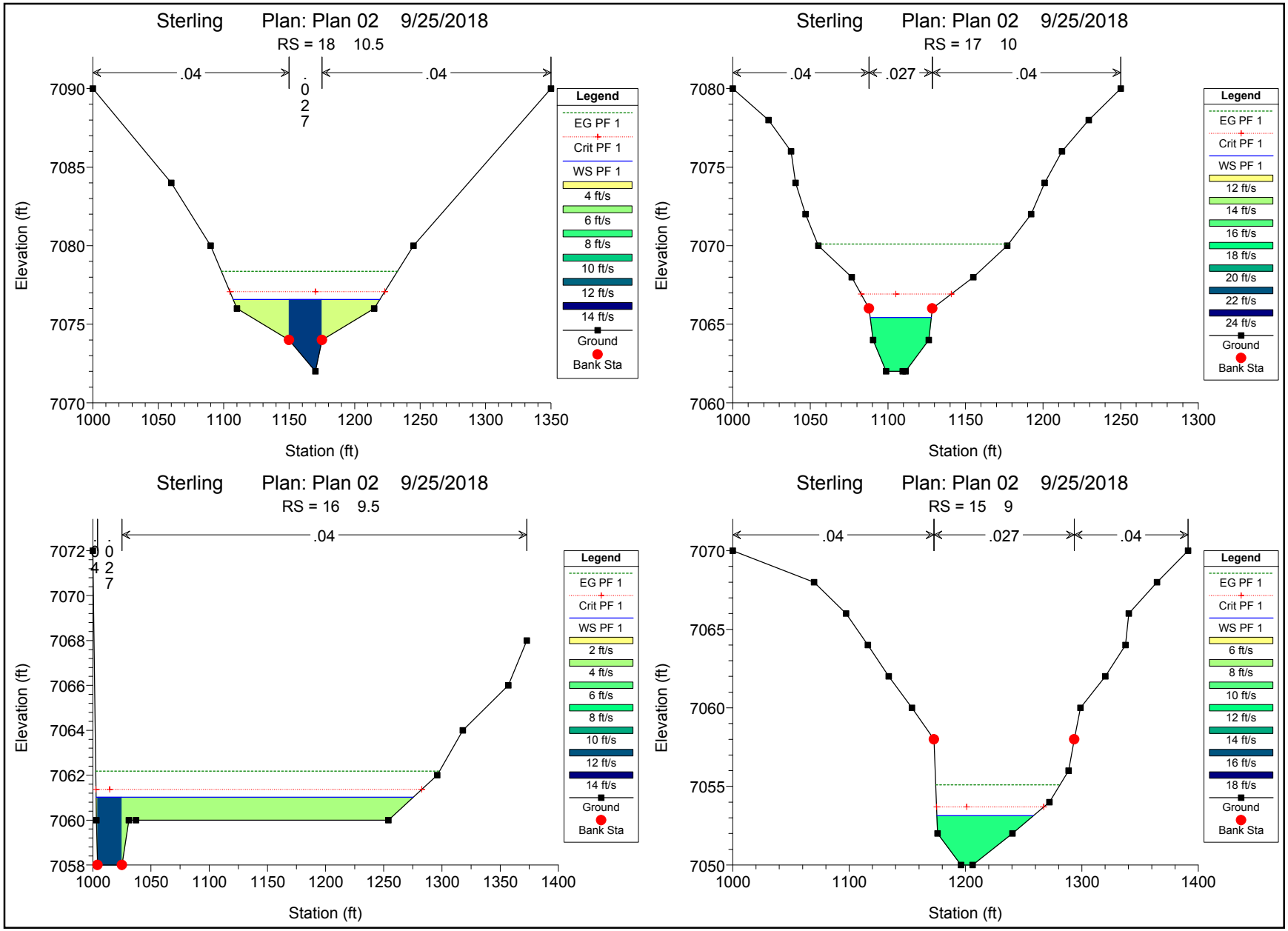
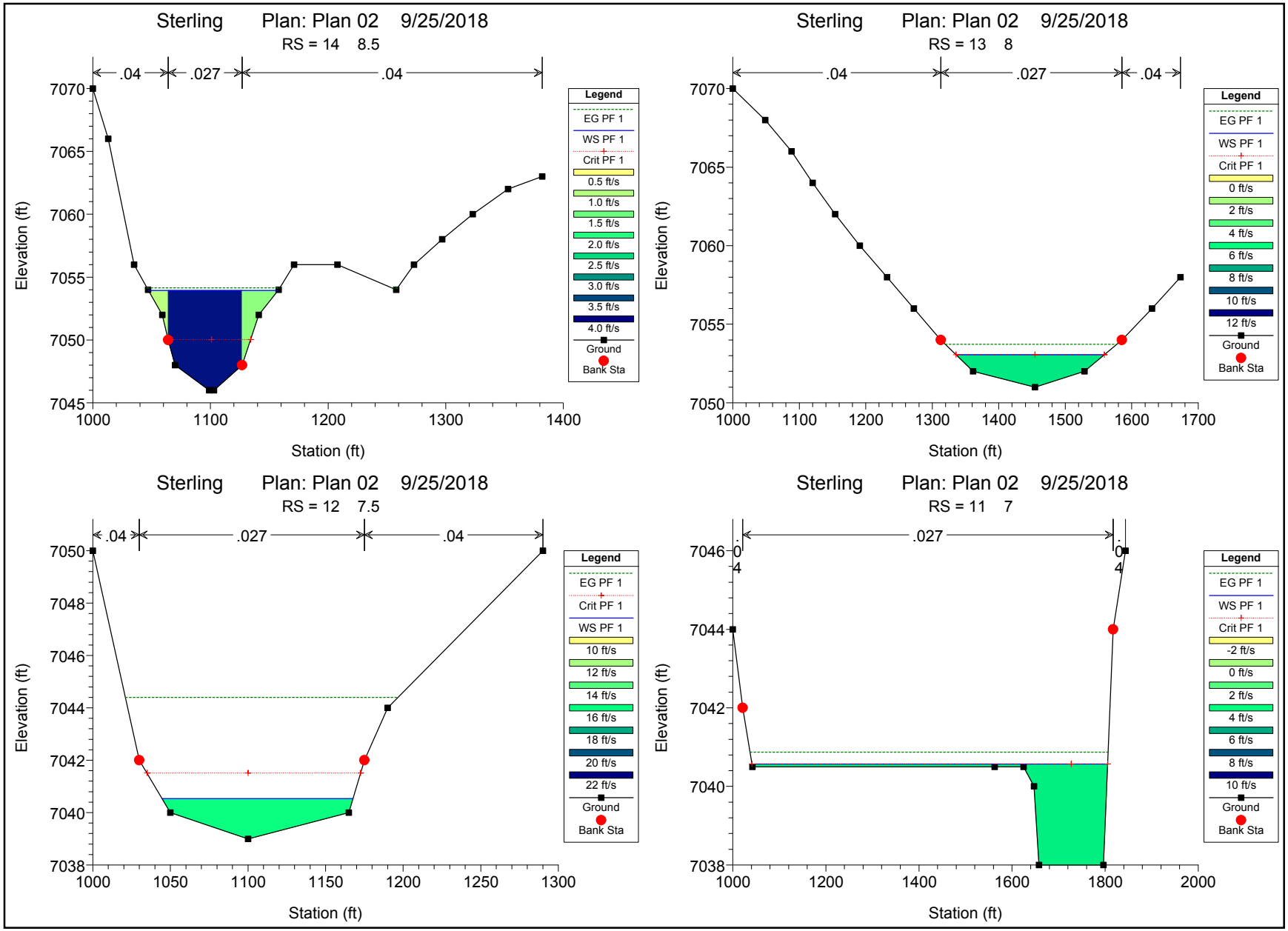
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 29 20
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 28 19
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 27 18
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta


Sterling Plan: Plan 02 9/25/2018
RS = 26 17
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 25 16
Sterling Plan: Plan 02 9/25/2018
RS = 24 15
Sterling Plan: Plan 02 9/25/2018
RS = 23 14.5


Sterling Plan: Plan 02 9/25/2018
RS = 22 14
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 21 13
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
32 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 20 12
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 19 11
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
Ground
Bank Sta


Sterling Plan: Plan 02 9/25/2018
RS = 18 10.5
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 17 10
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 16 9.5
.04
.027
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 15 9
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
Ground
Bank Sta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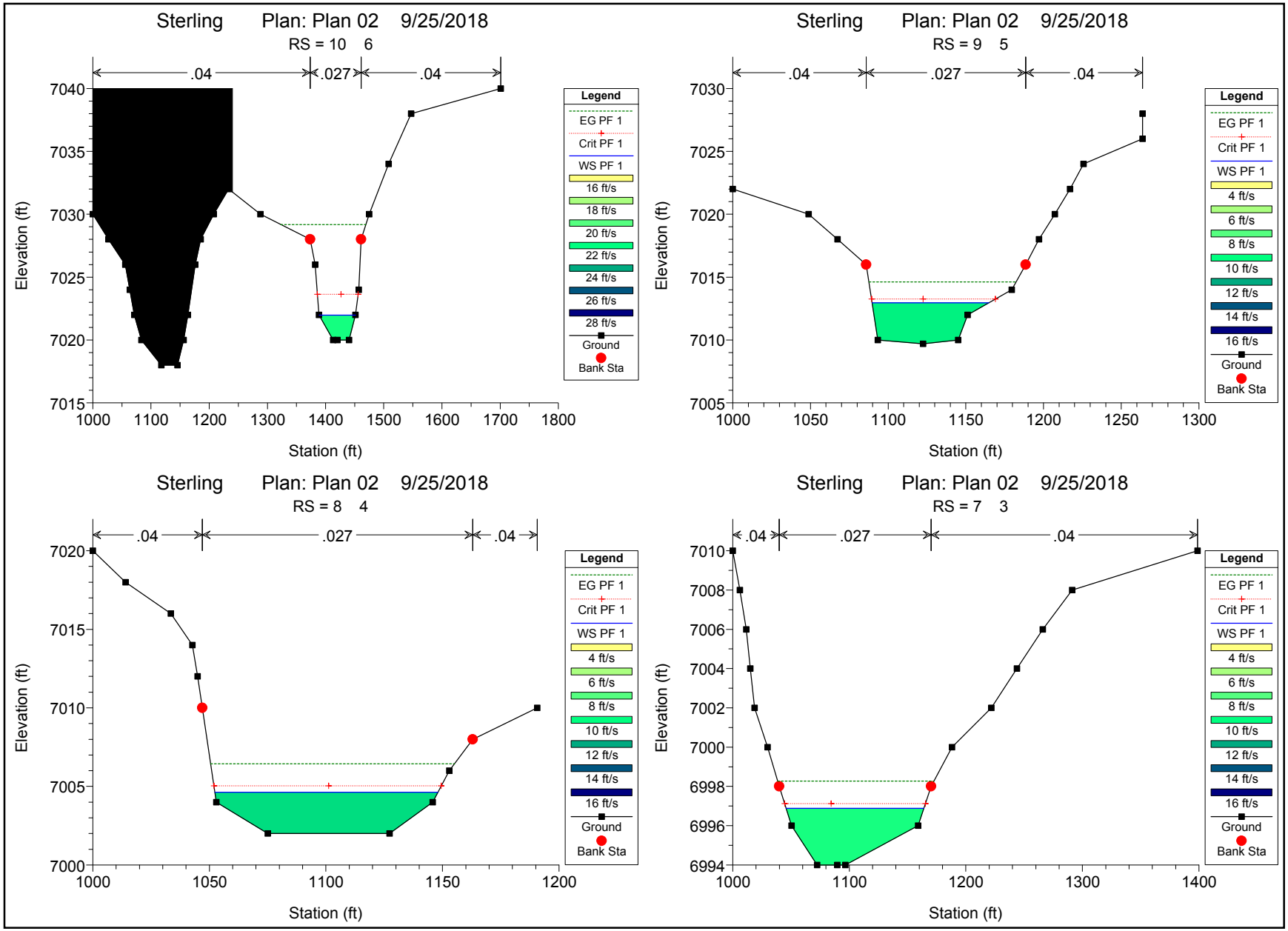
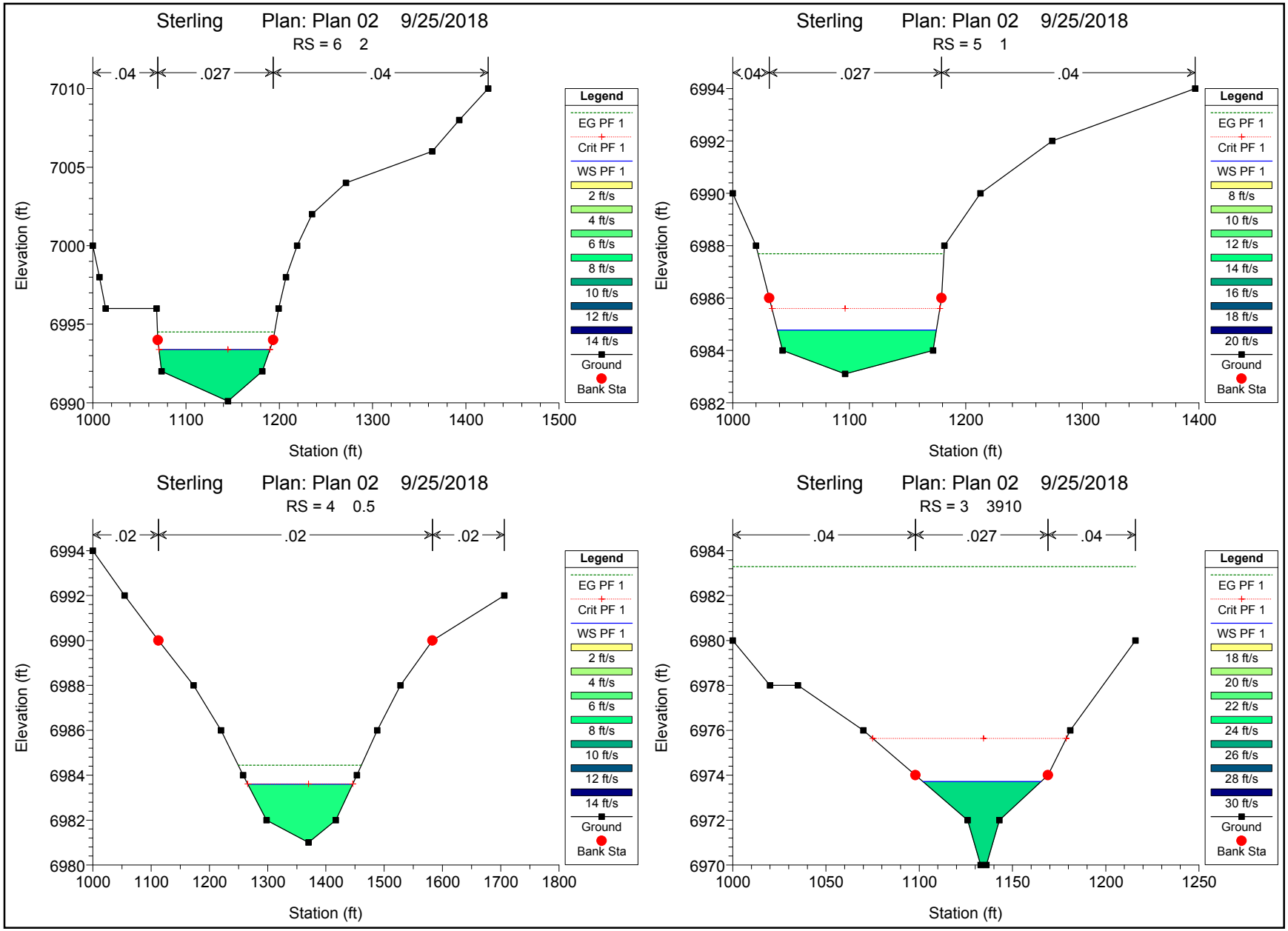
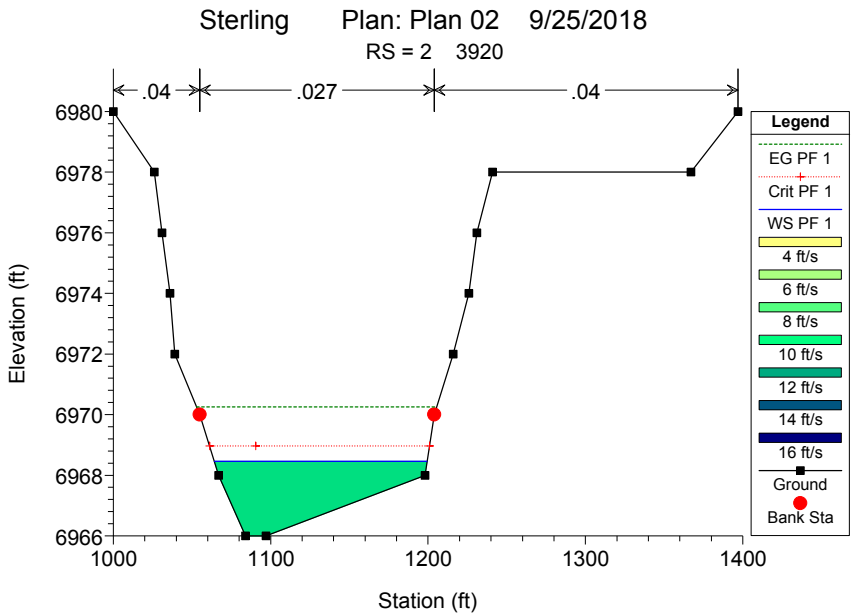
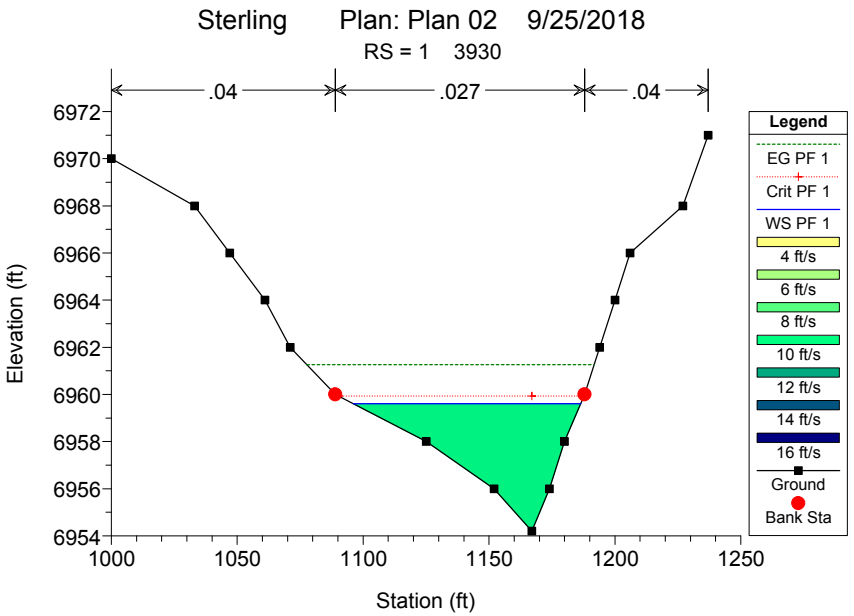
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
3.0 ft/s
3.5 ft/s
4.0 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 13 8
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 12 7.5
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 11 7
.027
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
-2 ft/s
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta


Sterling Plan: Plan 02 9/25/2018
RS = 10 6
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 9 5
Sterling Plan: Plan 02 9/25/2018
RS = 8 4
Sterling Plan: Plan 02 9/25/2018
RS = 7 3

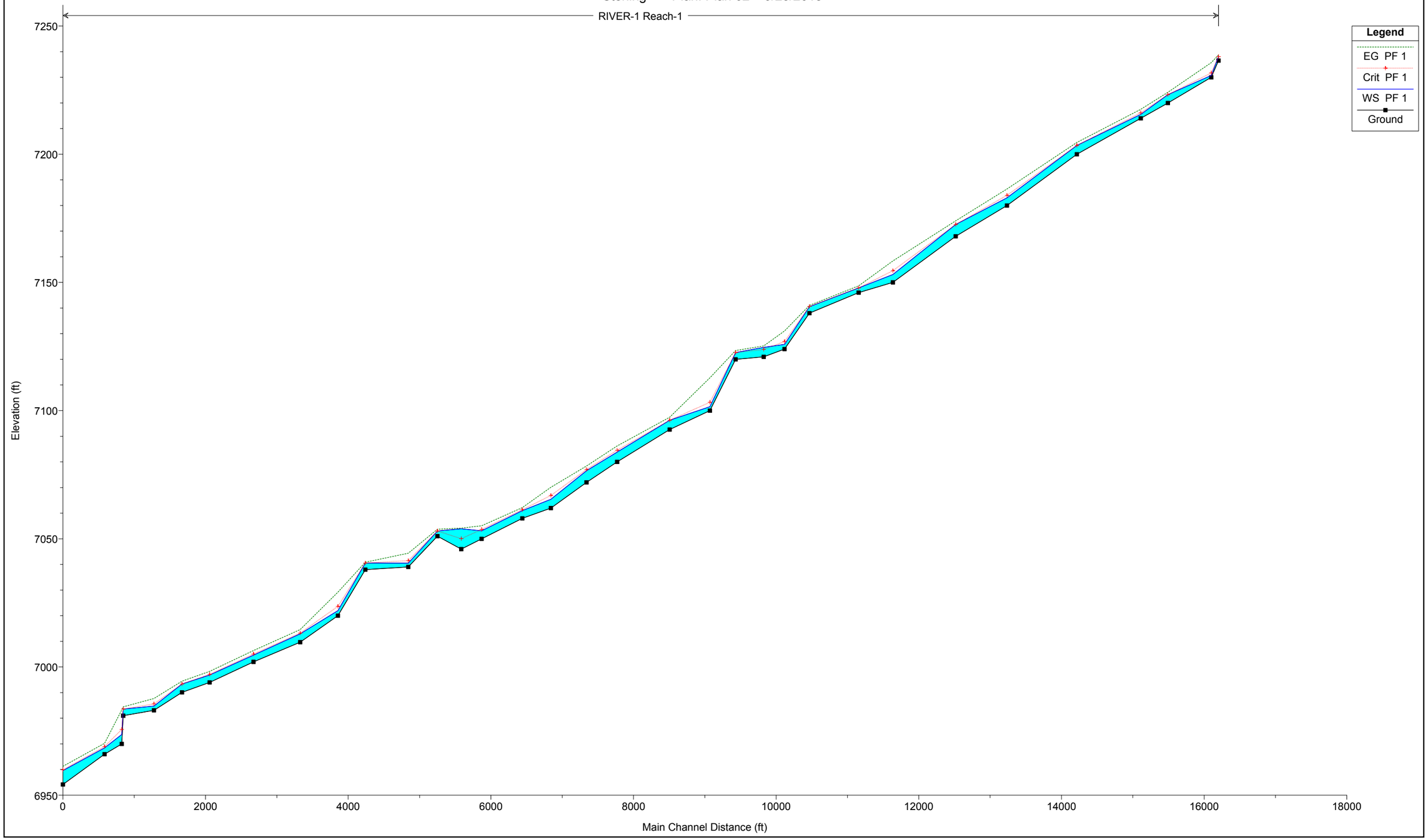

Sterling Plan: Plan 02 9/25/2018
RS = 6 2
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 5 1
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 4 0.5
.02
.02
.02
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Sterling Plan: Plan 02 9/25/2018
RS = 3 3910
.04
.027
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta


Sterling Plan: Plan 02 9/25/2018
RS = 2 3920
.04
.027
.04
6980
6978
6976
6974
6972
6970
6968
6966
Elevation (ft)
1000
1100
1200
1300
1400
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta


Sterling Plan: Plan 02 9/25/2018
RS = 1 3930
.04
.027
.04
6972
6970
6968
6966
6964
6962
6960
6958
6956
6954
Elevation (ft)
1000
1050
1100
1150
1200
1250
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta

Sterling Plan: Plan 02 9/25/2018

RIVER-1 Reach-1



HEC-RAS Developed Condition Channel Analysis				
River Station	**Q Total (cfs)**	**Velocity (ft/s)**	**Shear (lb/sq ft)**	**Max. Channel Depth (ft)**
34	1467.7	6.64	0.82	1.55
33	1467.7	17.97	7.49	0.72
32	1467.7	7.9	1.04	3.21
31	1467.7	11.22	2.7	1.57
30	1467.7	8.69	1.18	3.43
29	1506.7	14.81	4.49	3.02
28	1518.6	9.49	1.33	4.59
27	1612.2	20.11	6.88	3.12
26	1612.2	7.25	0.92	1.87
25	1612.2	5.58	0.68	2.57
24	1636.7	18.3	6.45	1.84
23	1636.7	6.29	0.55	3.66
22	1636.7	6.99	0.88	2.67
21	1636.7	26.95	14.9	1.53
20	1775.7	8.84	1.21	3.63
19	1775.7	12.37	2.92	3.85
18	1775.7	12.85	2.24	4.58
17	1775.7	17.33	4.55	3.44
16	1775.7	12.29	2.16	3.02
15	1775.7	11.22	2.1	3.14
14	1775.7	3.87	0.16	7.93
13	1905.9	6.53	0.8	2.06
12	1905.9	15.77	5.16	1.53
11	1905.9	4.39	0.48	2.57
10	1905.9	21.53	8.51	1.98
9	1905.9	10.32	1.64	3.26
8	2204.1	10.81	1.88	2.62
7	2204.1	9.48	1.48	2.88
6	2204.1	8.47	1.14	3.29
5	2204.1	13.71	3.67	1.67
4	2204.1	7.38	0.52	2.6
3	2204.1	24.83	11.39	3.71
2	2204.1	10.75	2.07	2.46
1	2204.1	10.32	1.65	5.41
Min		**3.87**	**0.16**	**0.72**
Max		**26.95**	**14.9**	**7.93**

Section H.

Sand Creek DBPS Maps/Exhibits

DBPS Improvement Overlays 1-3

LEGEND

- MULTI-FAMILY RESIDENTIAL
- SINGLE FAMILY RESIDENTIAL
- LARGE LOT RESIDENTIAL
- OFFICE / RETAIL / COMMERCIAL
- INDUSTRIAL
- INSTITUTIONAL
- OPEN SPACE / PARK
- AGRICULTURAL / RANCHETTE (5 Ac+)

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

SAND CREEK DRAINAGE BASIN PLANNING STUDY

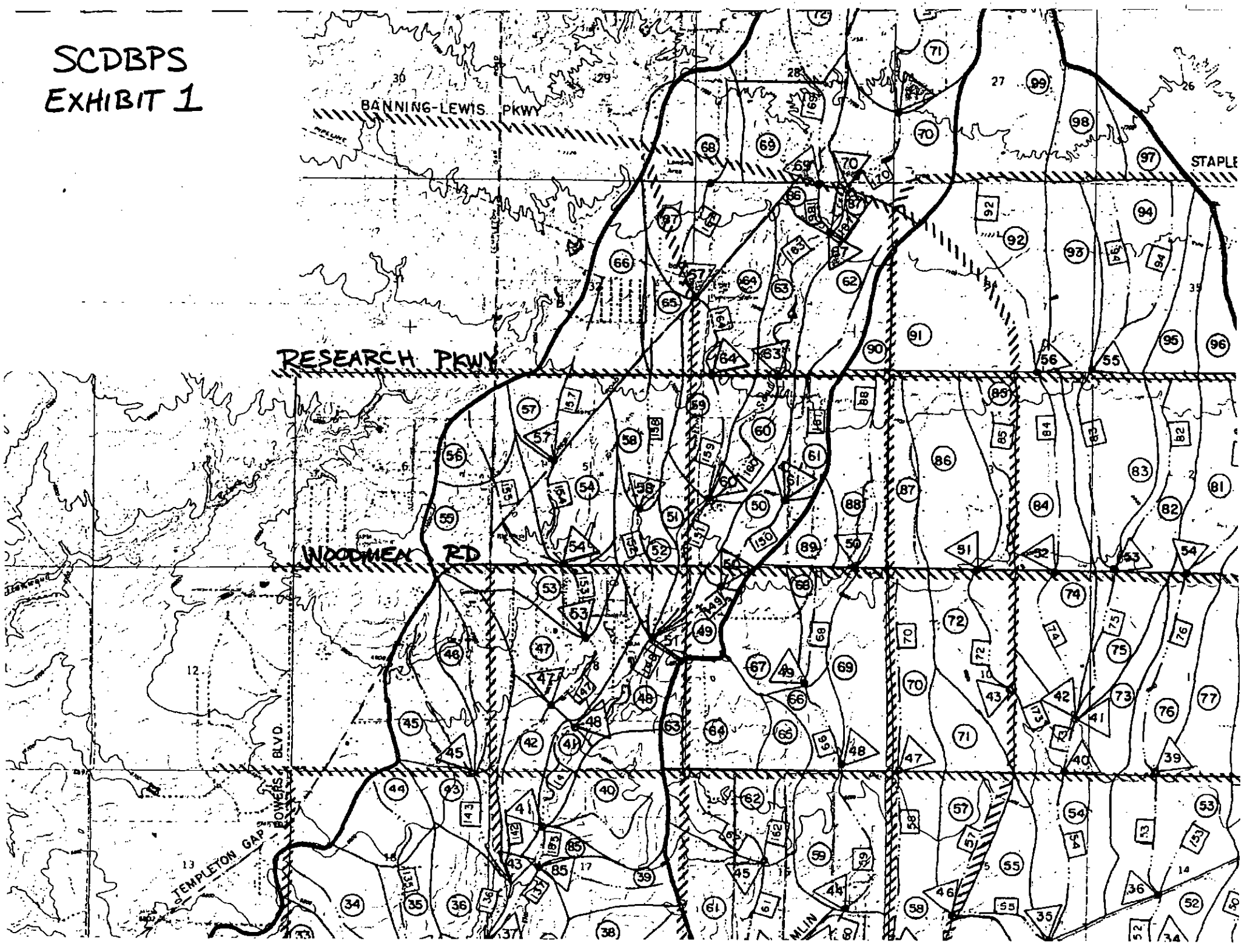
PROPOSED LAND USE

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

7

FIG. II-3

SCDBPS
EXHIBIT 1



0 STRUCTURE 74	.37		
ALTERNATE 1		359.60	126.47
0 STRUCTURE 71	3.27		
ALTERNATE 1		2164.36	657.56
0 STRUCTURE 70	3.38		
ALTERNATE 1		2250.89	674.44
0 STRUCTURE 69	.50		
ALTERNATE 1		421.60	163.65
0 STRUCTURE 67	.49		
ALTERNATE 1		115.21	28.30
0 STRUCTURE 64	.74		
ALTERNATE 1		171.33	39.77
0 STRUCTURE 63	4.33		
ALTERNATE 1		2507.72	745.76
0 STRUCTURE 61	.38		
ALTERNATE 1		74.13	9.56

1

2,092.8 AC.

2,291.2 AC

320.0 AC

313.6 AC.

473.6 AC

2,771.2 AC.

243.2 AC.

$Q_{100} = 1.0342$ cfs/Ac.

$Q_{100} = 0.982$ cfs/Ac.

$Q_{100} = 1.3175$ cfs/Ac.

$Q_{100} = 0.367$ cfs/Ac. TOO LOW!

$Q_{100} = 0.362$ cfs/Ac. TOO LOW!

$Q_{100} = 0.905$ cfs/Ac.

$Q_{100} = 0.313$ cfs/Ac. TOO LOW!

@ Vollmer Rd

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2
0 STRUCTURE 60	5.38		
ALTERNATE 1		2629.17	758.15
0 STRUCTURE 58	.27		
ALTERNATE 1		340.04	180.19
0 STRUCTURE 57	.47		
ALTERNATE 1		125.16	24.16
0 STRUCTURE 54	1.12		
ALTERNATE 1		376.37	77.12
0 STRUCTURE 53	1.29		
ALTERNATE 1		443.39	87.07
0 STRUCTURE 51	6.60		
ALTERNATE 1		2765.51	760.77
0 STRUCTURE 50	.51		
ALTERNATE 1		88.40	10.56
0 STRUCTURE 48	6.79		
ALTERNATE 1		2750.40	752.66
0 STRUCTURE 47	1.55		

56?

0 STRUCTURE 45	.47		
ALTERNATE 1		236.75	57.32
0 STRUCTURE 43	2.36		
ALTERNATE 1		719.91	132.78
0 STRUCTURE 41	7.13		
ALTERNATE 1		2768.64	756.58
0 STRUCTURE 37	9.98		
ALTERNATE 1		3229.68	840.57
0 STRUCTURE 35	.58		
ALTERNATE 1		447.07	172.89

1

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2
0 STRUCTURE 33	.40		
ALTERNATE 1		615.37	303.41
0 STRUCTURE 30	12.19		
ALTERNATE 1		3611.70	990.87
0 STRUCTURE 29	10.63		
ALTERNATE 1		3279.76	842.94
0 STRUCTURE 28	.49		
ALTERNATE 1		417.34	165.65
0 STRUCTURE 25	12.61		
ALTERNATE 1		3667.23	1060.82
0 STRUCTURE 20	13.51		
ALTERNATE 1		4033.53	1515.93
0 STRUCTURE 18	.30		
ALTERNATE 1		379.16	180.46
0 STRUCTURE 13	14.50		
ALTERNATE 1		4714.28	1802.53
0 STRUCTURE 11	.29		
ALTERNATE 1		424.02	214.85
0 STRUCTURE 9	.39		
ALTERNATE 1		934.34	515.64
0 STRUCTURE 8	15.65		
ALTERNATE 1		5614.92	2216.70
0 STRUCTURE 6	15.26		

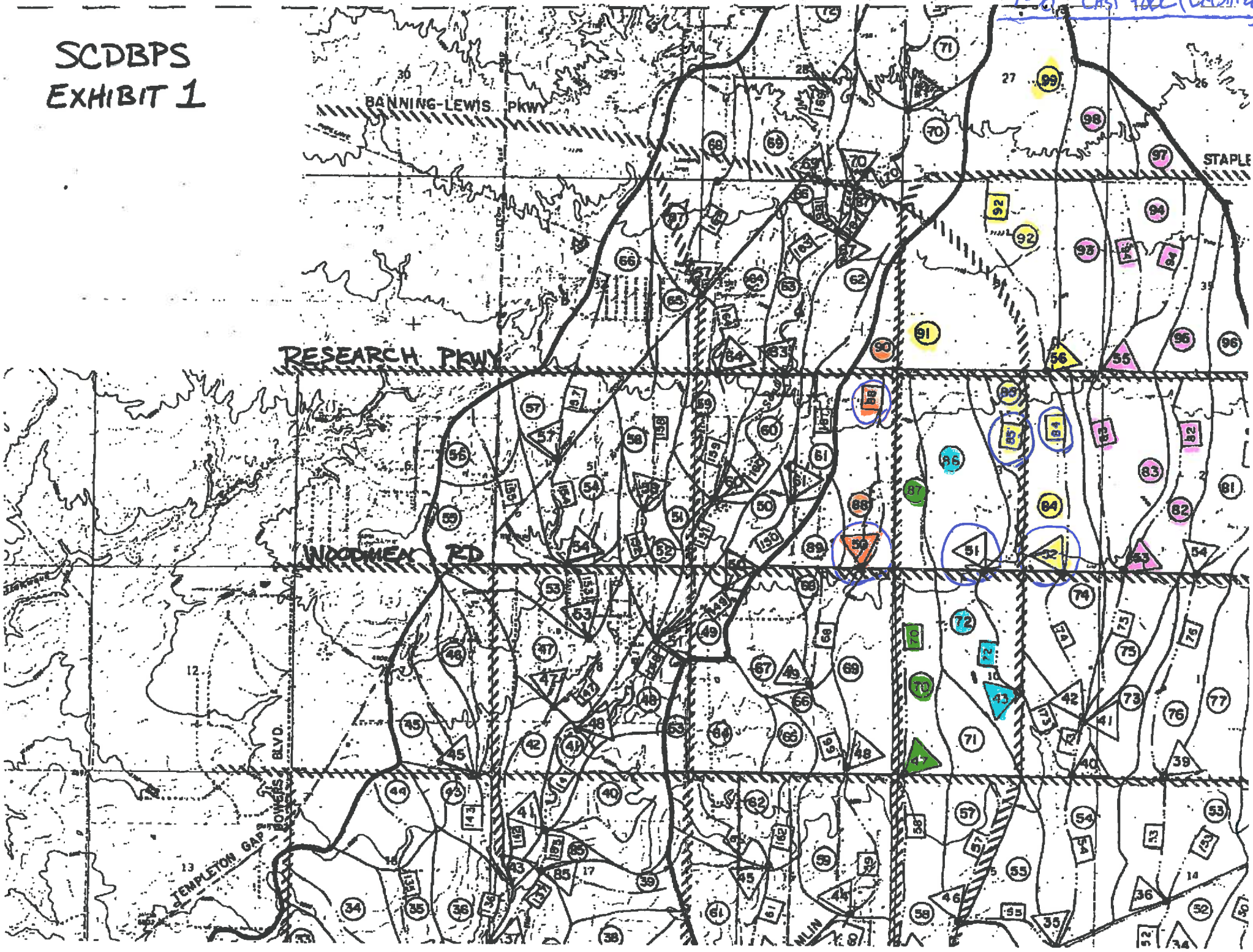
Technical Addendum

TR 20 Input/Output for the East Fork Sand Creek

Future Basin Conditions, 10- and 100-year

SCDBPS
EXHIBIT 1

7-8 EAST FORK (EXISTING)



EFSCEX24.DAT

```
******************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*****************

JOB TR-20                                                          NOPLOTS
TITLE 001 EXISTING CONDITION - E. FORK SAND CREEK TRIB. - ARIES PROPERTIES  efsc
TITLE     24 HR TYPE IIA CURVE
 5 RAINFL 1                    .50
 8                  0.000       .0025       0.005       .0075       0.010
 8                  0.015       0.020       0.025       0.030       0.050
 8                  0.060       0.100       0.700       0.750       0.780
 8                  0.798       0.820       0.830       0.840       0.850
 8                  0.860       0.865       0.870       0.885       0.890
 8                  0.900       0.905       0.910       0.915       0.921
 8                  0.927       0.933       0.940       0.945       0.950
 8                  0.955       0.960       0.965       0.970       0.975
 8                  0.980       0.983       0.985       0.988       0.990
 8                  0.993       0.995       0.998       1.000       1.000
 9 ENDTBL
 6 RUNOFF 1  80        1         0.07        55.0        0.41          1
 6 REACH  3  79   1    2       5597.0         1.7        1.25
 6 RUNOFF 1  79        1         0.28        55.0        0.35          1
 6 ADDHYD 4     38 1 2 3                                               1
 6 REACH  3 150   3    1       6574.0         1.1         1.4
 6 RUNOFF 1  78        2         0.37        55.0        1.47          1
 6 REACH  3  51   2    3       1531.0         1.0         1.4
 6 RUNOFF 1  51        4         0.11        55.0        0.09          1
 6 ADDHYD 4     37 3 4 2                                               1
 6 REACH  3  50   2    3       3000.0         1.1         1.4
 6 RUNOFF 1  50        2         0.36        60.0        0.49          1
 6 RUNOFF 1  49        4         0.28        56.0        0.53          1
 6 REACH  3 152   4    5       2682.0         1.0         1.4
 6 ADDHYD 4     33 2 5 6
 6 ADDHYD 4     33 6 1 5
 6 ADDHYD 4     33 5 3 1
 6 REACH  3  47   1    2       4678.0         0.2         1.7
 6 RUNOFF 1  48        1         0.27        60.0        1.39          1
 6 REACH  3 147   1    3       6040.0         1.1         1.4
 6 RUNOFF 1  47        1         0.62        60.0        0.91          1
 6 ADDHYD 4     32 1 3 4
 6 ADDHYD 4     32 4 2 1                                               1
 6 REACH  3 145   1    2       3802.0         0.2         1.7
 6 RUNOFF 1  45        1         0.500       60.0        0.34          1
 6 ADDHYD 4     29 1 2 3                                               1
 6 RUNOFF 1  81        1         0.38        60.0        0.39          1
 6 RUNOFF 1  96        2         0.13        60.0        0.88          1
 6 REACH  3  81   2    4       6389.0         1.4         1.3
 6 ADDHYD 4     54 4 1 2                                               1
 6 REACH  3  76   2    1       5702.0         1.9         1.3
 6 RUNOFF 1  76        2         0.24        60.0        0.34          1
1

**********************80-80 LIST OF INPUT DATA (CONTINUED)**********************
```

```
 6 ADDHYD 4    39 1 2 4                                             1
 6 REACH  3  53   4   1    3453.0      1.1       1.4
 6 RUNOFF 1  53       2      0.33     60.0      0.45                1
 6 RUNOFF 1  77       4      0.23     60.0      1.68                1
 6 REACH  3 153   4   5    3379.0       .7       1.4
 6 ADDHYD 4    36 1 2 4
 6 ADDHYD 4    36 4 5 1                                             1
 6 REACH  3  52   1   2    1584.0      0.3       1.6
 6 RUNOFF 1  52       1      0.19     60.0      0.37                1
 6 ADDHYD 4    34 2 1 4                                             1
 6 REACH  3  46   4   1    3770.0      0.3       1.6
 6 RUNOFF 1  46       2      0.26     60.0      0.66                1
 6 ADDHYD 4    31 1 2 4                                             1
 6 REACH  3 145   4   1      3600      0.2       1.7
 6 ADDHYD 4    29 1 3 2                                             1
 6 RUNOFF 1  93       1      0.26     62.0      1.12                1
 6 RUNOFF 1  94       3      0.40     62.0      0.30                1
 6 RUNOFF 1  98       4      0.16     63.0      0.43                1
 6 REACH  3 194   4   5    5914.0      1.8       1.3
 6 RUNOFF 1  97       4      0.13     60.0      0.43                1
 6 REACH  3  94   4   6    5914.0      1.7       1.3
 6 ADDHYD 4    55 1 3 7
 6 ADDHYD 4    55 7 5 1
 6 ADDHYD 4    55 1 6 3                                             1
 6 REACH  3  83   3   1    6124.0      1.9       1.3
 6 RUNOFF 1  83       3      0.34     60.0      1.52                1
 6 RUNOFF 1  95       4      0.14     60.0      1.38                1
 6 REACH  3  82   4   5    5808.0      1.4       1.3
 6 RUNOFF 1  82       4      0.25     60.0      0.31                1
 6 ADDHYD 4    53 1 3 6
 6 ADDHYD 4    53 6 5 1
 6 ADDHYD 4    53 1 4 3                                             1
 6 REACH  3  75   3   1    4013.0      1.9       1.3
 6 RUNOFF 1  75       3      0.16     60.0      0.69                1
 6 ADDHYD 4    41 1 3 4                                             1
 6 REACH  3  73   4   1    1610.0      0.8       1.5
 6 RUNOFF 1  73       3      0.28     60.0      1.57                1
 6 ADDHYD 4    40 1 3 4                                             1
 6 RUNOFF 1  99       1      0.45     60.0      1.14                1
 6 REACH  3  92   1   3    5650.0      2.1       1.3
 6 RUNOFF 1  92       5      0.34     60.0      0.28                1
 6 ADDHYD 4    56 3 5 1                                             1
 6 REACH  3  84   1   3    5491.0      2.0       1.3
 6 RUNOFF 1  84       5      0.27     60.0      0.29                1
 6 ADDHYD 4    52 3 5 1                                             1
 6 RUNOFF 1  91       3      0.42     60.0      1.14                1
1
```

*********************80-80 LIST OF INPUT DATA (CONTINUED)*********************

```
 6 REACH  3  85   3   5    6178.0      1.4       1.3
 6 ADDHYD 4    52 1 5 3                                             1
```

```
  6 RUNOFF 1  85        1        0.19        60.0        0.36          1
  6 ADDHYD 4     52 1 3 5                                             1
  6 REACH  3  74    5   6     4066.0         1.9         1.3
  6 RUNOFF 1  74        1        0.19        60.0        0.21          1
  6 ADDHYD 4     42 1 6 5                                             1
  6 REACH  3  73    5   1     1610.0         0.8         1.5
  6 ADDHYD 4     40 1 4 3
  6 RUNOFF 1  86        1        0.33        60.0        1.48          1
  6 REACH  3  72    1   4     3500.0         1.7         1.3
  6 RUNOFF 1  72        1        0.29        60.0        0.88          1
  6 ADDHYD 4        1 4 5                                             1
  6 REACH  3 173    5   1     1864.0         2.0         1.3
  6 ADDHYD 4     40 1 3 4                                             1
  6 RUNOFF 1  71        1        0.13        60.0        0.75          1
  6 REACH  3  57    1   3     4102.0          .7         1.4
  6 RUNOFF 1  57        1        0.18        60.0        1.25          1
  6 ADDHYD 4     46 1 3 5                                             1
  6 REACH  3  55    5   1     3000.0         2.9         1.4
  6 RUNOFF 1  55        3        0.17        62.0        1.00          1
  6 RUNOFF 1  54        5        0.31        62.0        1.54          1
  6 REACH  3  54    4   6     4974.0         0.5         1.6
  6 ADDHYD 4     35 6 1 4
  6 ADDHYD 4     35 4 3 1
  6 ADDHYD 4     35 1 5 3                                             1
  6 REACH  3  44    3   1     5016.0         0.5         1.6
  6 RUNOFF 1  56        3        0.09        62.0        0.39          1
  6 REACH  3 144    3   4     4419.0          .9         1.6
  6 RUNOFF 1  43        5        0.16        57.0        0.45          1
  6 REACH  3 146    5   3     1200            1.9         1.3
  6 RUNOFF 1  44        5        0.29        60.0        0.24          1
  6 ADDHYD 4     30 3 4 6
  6 ADDHYD 4     30 6 1 3
  6 ADDHYD 4     30 3 5 1                                   1 1   1   1
  6 REACH  3  45    1   3     2893.0         0.1         1.7
  6 ADDHYD 4     29 2 3 1                                     1 1   1   1
  6 REACH  3  28    1   2     3168.0         0.1         1.7
  6 RUNOFF 1  29        3        0.17        62.0        0.73          1
  6 REACH  3 128    3   1     3131.0         0.5         1.5
  6 RUNOFF 1  27        3        0.15        60.0        0.28          1
  6 RUNOFF 1  28        4        0.32        60.0        0.37          1
  6 ADDHYD 4     19 2 1 5
  6 ADDHYD 4     19 5 3 1
  6 ADDHYD 4     19 1 4 2                                     1 1   1   1
  6 REACH  3  26    2   1     3221.0         0.2         1.7
1
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
  6 RUNOFF 1  26        2        0.47        50.0        0.90          1
  6 ADDHYD 4     18 1 2 3                                             1
  6 REACH  3  25    3   1     2323.0         0.2         1.7
  6 RUNOFF 1  25        2        0.26        60.0        0.29          1
```

```
 6 ADDHYD 4     17 1 2 3                                                  1
 6 REACH  3  24    3    1        2524.0          0.2          1.7
 6 RUNOFF 1  24         2          0.28         56.0         0.16         1
 6 ADDHYD 4     12 1 2 3
 6 RUNOFF 1  41         1          0.16         57.0         0.75         1
 6 REACH  3  31    1    2        3358.0          1.1          1.5
 6 RUNOFF 1  31         1          0.24         61.0         0.18         1
 6 ADDHYD 4     20 1 2 4                                                  1
 6 REACH  3  30    4    1        2323.0          1.6          1.6
 6 RUNOFF 1  30         2          0.10         62.0         0.08         1
 6 ADDHYD 4     16 1 2 4                                                  1
 6 REACH  3 124    4    1        4594.0          0.7          1.6
 6 RUNOFF 1  32         2          0.15         52.0         0.91         1
 6 REACH  3 198    2    4        5227.0          1.2          1.6
 6 ADDHYD 4     12 1 4 2
 6 ADDHYD 4     12 2 3 1                                                  1
 6 REACH  3  18    1    2        3696.0          0.2          1.7
 6 RUNOFF 1  18         7          0.40         57.0         0.78         1
 6 ADDHYD 4     57 2 7 1                                        1 1   1   1
 6 RUNOFF 1  87         2          0.15         60.0         1.35         1
 6 REACH  3  70    2    3        5613.0          1.2          1.3
 6 RUNOFF 1  70         2          0.26         60.0         0.88         1
 6 ADDHYD 4     47 2 3 4                                                  1
 6 REACH  3  58    4    2        5016.0          1.6          1.3
 6 RUNOFF 1  58         3          0.28         60.0         0.55         1
 6 ADDHYD 4     28 2 3 4                                                  1
 6 REACH  3  42    4    2        2746.0          1.2          1.4
 6 RUNOFF 1  42         3          0.20         54.0         0.37         1
 6 ADDHYD 4     27 2 3 4                                                  1
 6 REACH  3  40    4    2        2218.0          1.2          1.4
 6 RUNOFF 1  40         3          0.14         60.0         1.11         1
 6 ADDHYD 4     26 2 3 4                                                  1
 6 REACH  3 199    4    2         216.0           .3          1.6
 6 RUNOFF 1  90         3          0.06         60.0         0.63         1
 6 REACH  3  88    3    4        5597.0          1.9          1.3
 6 RUNOFF 1  88         3          0.26         60.0         0.29         1
 6 ADDHYD 4     50 3 4 5                                                  1
 6 REACH  3  68    5    3        3643.0          1.7          1.3
 6 RUNOFF 1  89         4          0.10         60.0         0.46         1
 6 REACH  3  68    4    5        3643.0          1.7          1.3
 6 RUNOFF 1  67         6          0.19         60.0         0.89         1
 6 RUNOFF 1  68         4          0.10         60.0         0.22         1
1
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
 6 ADDHYD 4     49 3 5 7
 6 ADDHYD 4     49 7 6 3
 6 ADDHYD 4     49 3 4 5                                                  1
 6 REACH  3  66    5    3        2531.0          1.3          1.5
 6 RUNOFF 1  66         4          0.11         60.0         0.19         1
 6 RUNOFF 1  69         5          0.23         60.0         1.42         1
```

```
  6 ADDHYD 4     48 3 4 6
  6 ADDHYD 4     48 6 5 3                                                  1
  6 REACH  3  59    3    4        5158.0          0.6          1.6
  6 RUNOFF 1  59         3          0.32         55.0         0.44         1
  6 ADDHYD 4     44 3 4 5                                                  1
  6 REACH  3  60    5    3        1373.0          0.8          1.5
  6 RUNOFF 1  60         4          0.08         62.0         0.19         1
  6 ADDHYD 4     25 3 4 5                                                  1
  6 REACH  3  39    5    3        4963.0          0.3          1.7
  6 RUNOFF 1  39         4          0.48         60.0         0.45         1
  6 ADDHYD 4     21 3 4 5
  6 ADDHYD 4     21 5 2 3                                                  1
  6 RUNOFF 1  63         2          0.06         60.0          .67         1
  6 REACH  3  62    2    4        3432.0          1.5          1.3
  6 RUNOFF 1  64         2          0.20         60.0         0.63         1
  6 REACH  3  62    2    5        3432.0          1.5          1.3
  6 RUNOFF 1  65         2          0.07         60.0         0.52         1
  6 REACH  3 162    2    6        2445.0          1.9          1.2
  6 RUNOFF 1  62         2          0.25         60.0         0.19         1
  6 ADDHYD 4     45 4 5 7
  6 ADDHYD 4     45 7 6 4
  6 ADDHYD 4     45 4 2 5                                                  1
  6 REACH  3  61    5    2        3152.0          1.7          1.3
  6 RUNOFF 1  61         4          0.35         61.0         0.44         1
  6 ADDHYD 4     24 2 4 5                                                  1
  6 REACH  3 139    5    2        4488.0          1.1          1.4
  6 ADDHYD 4     21 2 3 4                                                  1
  6 REACH  3  33    4    2        7445.0          0.1          1.7
  6 RUNOFF 1  33         3          0.50         59.0         1.37         1
  6 RUNOFF 1  34         4          0.23         62.0         0.59         1
  6 ADDHYD 4     15 2 3 5
  6 ADDHYD 4     15 5 4 2                                                  1
  6 RUNOFF 1  37         3          0.20         74.0         0.78         1
  6 RUNOFF 1  38         4          0.12         62.0         0.89         1
  6 ADDHYD 4     23 3 4 5                                                  1
  6 REACH  3  35    5    3        3252.0          1.7          1.2
  6 RUNOFF 1  35         4          0.26         62.0         0.87         1
  6 ADDHYD 4     22 3 4 5                                                  1
  6 REACH  3  34    5    3        1816.0          1.0          1.4
  6 ADDHYD 4     15 2 3 4                                     1 1   1    1
1
```

```
**********80-80 LIST OF INPUT DATA (CONTINUED)**********

  6 REACH  3  22    4    2        3062.0           .6          1.6
  6 RUNOFF 1  21         3          0.10         62.0         0.53         1
  6 REACH  3 122    3    4        2503.0          1.1          1.4
  6 RUNOFF 1  22         3          0.13         62.0         0.07         1
  6 RUNOFF 1  23         5          0.20         58.0         0.91         1
  6 ADDHYD 4     13 2 4 6
  6 ADDHYD 4     13 6 3 2
  6 ADDHYD 4     13 2 5 3                                                  1
```

```
  6 REACH  3  19   3   2       3802.0        -0.1         1.7
  6 RUNOFF 1  19       6         0.29        60.0        0.51          1
  6 ADDHYD 4    11 2 6 7                                              1
  6 REACH  3  15   7   2       2571.0         0.3         1.6
  6 RUNOFF 1  16       3         0.38        60.0        0.89          1
  6 REACH  3  17   3   4       3274.0         1.4         1.3
  6 RUNOFF 1  17       3         0.13        60.0        0.22          1
  6 ADDHYD 4    10 3 4 5                                              1
  6 REACH  3 115   5   3       2820.0         1.2         1.4
  6 RUNOFF 1  15       4         0.25        60.0        0.21          1
  6 REACH  3 116   1   5       2260.0         0.2         1.6
  6 ADDHYD 4     9 2 3 1
  6 ADDHYD 4     9 1 5 2
  6 ADDHYD 4     9 2 4 1                                   1 1   1   1
  6 REACH  3  14   1   2       3448.0         0.2         1.7
  6 RUNOFF 1  14       1         0.35        60.0        0.44          1
  6 ADDHYD 4     7 1 2 3                                     1 1   1   1
  6 REACH  3   5   3   1       4910.0         0.2         1.6
  6 RUNOFF 1   5       2         0.18        60.0        0.14          1
  6 RUNOFF 1  36       3         0.39        62.0        0.96          1
  6 REACH  3  20   3   4       3960.0          .4         1.5
  6 RUNOFF 1  20       3         0.30        52.0        0.30          1
  6 ADDHYD 4    14 3 4 5                                              1
  6 REACH  3  12   5   3       3221.0         1.3         1.5
  6 RUNOFF 1  10       4         0.13        64.0        0.18          1
  6 REACH  3 112   4   5       2250.0         0.8         1.6
  6 RUNOFF 1  11       4         0.10        67.0        0.22          1
  6 REACH  3 195   4   6       2788.0         1.4         1.5
  6 RUNOFF 1  12       4         0.22        60.0        0.14          1
  6 ADDHYD 4     8 5 6 7
  6 ADDHYD 4     8 7 4 5
  6 ADDHYD 4     8 5 3 4                                               1
  6 REACH  3   6   4   3       8976.0         0.6         1.6
  6 RUNOFF 1   6       4         0.29        51.0        0.23          1
  6 RUNOFF 1  13       5         0.13        60.0        0.20          1
  6 REACH  3   6   5   6       8976.0         0.6         1.6
  6 ADDHYD 4     5 1 2 5
  6 ADDHYD 4     5 5 3 1
1


**********80-80 LIST OF INPUT DATA (CONTINUED)**********

  6 ADDHYD 4     5 1 6 2
  6 ADDHYD 4     5 2 4 1                                               1
  6 REACH  3   4   1   2       2851.0         0.2         1.6
  6 RUNOFF 1   9       1         0.14        69.0        0.17          1
  6 REACH  3   8   1   3       3907.0         6.0         1.4
  6 RUNOFF 1   8       1         0.19        61.0        0.07          1
  6 RUNOFF 1   7       4         0.38        60.0        0.15          1
  6 ADDHYD 4     6 3 1 5
  6 ADDHYD 4     6 5 4 1                                               1
  6 REACH  3 104   1   3       4066.0         0.8         1.5
```

```
  6 RUNOFF 1   4        1         0.59        60.0        0.32          1
  6 ADDHYD 4     4 3 1 4
  6 ADDHYD 4     4 4 2 1                                                1
  6 REACH  3   3   1   2       2482.0         0.1         1.7
  6 RUNOFF 1   3        1         0.16        54.0        0.03          1
  6 ADDHYD 4     3 1 2 3                                                1
  6 REACH  3   2   3   1       3432.0         0.2         1.7
  6 RUNOFF 1   2        2         0.36        53.0         .50          1
  6 ADDHYD 4     2 1 2 3                                                1
  6 REACH  3   1   3   1       7234.0         0.3         1.7
  6 RUNOFF 1   1        2         0.48        59.0.       0.59          1
  6 ADDHYD 4     1 1 2 3                                     1 1   1   1
    ENDATA
  7 LIST
  7 INCREM 6                  .100
  7 COMPUT 7  80        1         0.0         4.5         1.01 2  01  01
    ENDCMP 1
  7 COMPUT 7  80        1         0.0         3.0         1.01 2  01  02
    ENDCMP 1
    ENDJOB 2
0*******************************END OF 80-80
 TR20 XEQ 11/ 1/94     8:51      EXISTING CONDITION - E. FORK SAND CREEK TRIB. - ARIES
PROPERTIES  efsc              JOB  1   SUMMARY
      REV PC/09/83               24 HR TYPE IIA CURVE
PAGE  47


 SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND
ALTERNATES

 XSECTION/          DRAINAGE
 STRUCTURE            AREA       STORM NUMBERS.....
   ID               (SQ MI)          1         2

0 STRUCTURE  57        13.25
+_____________________________
    ALTERNATE    1                2327.06    437.16
0 STRUCTURE  56          .79
+_____________________________
    ALTERNATE    1                264.97     63.55
0 STRUCTURE  55          .95
+_____________________________
    ALTERNATE    1                382.37    100.37
0 STRUCTURE  54          .51
+_____________________________
    ALTERNATE    1                233.41     54.41
0 STRUCTURE  53         1.68
+_____________________________
    ALTERNATE    1                408.37     92.90
0 STRUCTURE  52         1.67
+_____________________________
    ALTERNATE    1                456.52     80.53
0 STRUCTURE  50          .32
```

	ALTERNATE	1	195.69	47.03
0	STRUCTURE 49	.71		
	ALTERNATE	1	259.42	53.24
0	STRUCTURE 48	1.05		
	ALTERNATE	1	302.95	64.80
0	STRUCTURE 47	.41		
	ALTERNATE	1	97.23	21.20
0	STRUCTURE 46	.31		
	ALTERNATE	1	82.43	17.85
0	STRUCTURE 45	.58		
	ALTERNATE	1	231.49	56.32
0	STRUCTURE 44	1.37		
	ALTERNATE	1	330.27	64.06
0	STRUCTURE 43	.62		
	ALTERNATE	1	130.96	29.36
1				

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID		DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2
0	STRUCTURE 42	1.86		
	ALTERNATE	1	433.01	74.19
0	STRUCTURE 41	1.84		
	ALTERNATE	1	434.47	97.80
0	STRUCTURE 40	4.60		
	ALTERNATE	1	954.16	205.67
0	STRUCTURE 39	.75		
	ALTERNATE	1	272.49	46.44
0	STRUCTURE 38	.35		

0 XSECTION 78		.37	
+			
ALTERNATE	1	53.51	8.20
0 XSECTION 79		.28	
+			
ALTERNATE	1	120.26	15.46
0 XSECTION 80		.07	
+			
ALTERNATE	1	26.79	3.44
0 XSECTION 81		.38	
+			
ALTERNATE	1	231.83	54.37
0 XSECTION 82		.25	
+			
ALTERNATE	1	179.92	42.65
0 XSECTION 83		.34	
+			
ALTERNATE	1	74.70	17.83
0 XSECTION 84		.27	
+			
ALTERNATE	1	202.20	48.75
0 XSECTION 85		.19	
+			
ALTERNATE	1	126.04	28.77

1

TR20 XEQ 11/ 1/94 8:51 EXISTING CONDITION - E. FORK SAND CREEK TRIB. - ARIES
PROPERTIES efsc JOB 1 SUMMARY
REV PC/09/83 24 HR TYPE IIA CURVE
PAGE 57

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID		DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2
0 XSECTION 85		.33		
+				
ALTERNATE	1		[illegible]	[illegible]
0 XSECTION		.15		
+				
ALTERNATE	1		[illegible]	
0 XSECTION 88		.26		
+				
ALTERNATE	1		194.71	46.95
0 XSECTION 89		.10		
+				
ALTERNATE	1		55.87	12.82

```
0 XSECTION    90              .06
+_____________________________
    ALTERNATE     1                    26.44       5.92
0 XSECTION    91              .42
+_____________________________
    ALTERNATE     1                   115.21      26.84
0 XSECTION    92              .34
+_____________________________
    ALTERNATE     1                   258.24      62.77
0 XSECTION    93              .26
+_____________________________
    ALTERNATE     1                    84.37      22.26
0 XSECTION    94              .40
+_____________________________
    ALTERNATE     1                   338.85      93.80
0 XSECTION    95              .14
+_____________________________
    ALTERNATE     1                    33.06       7.84
0 XSECTION    96              .13
+_____________________________
    ALTERNATE     1                    43.53       9.96
0 XSECTION    97              .13
+_____________________________
    ALTERNATE     1                    75.27      17.48
0 XSECTION    98              .16
+_____________________________
    ALTERNATE     1                   114.71      32.65
0 XSECTION    99              .45
+_____________________________
    ALTERNATE     1                   123.44      28.76
1END OF  1 JOBS IN THIS RUN
```

EFSCFUT.DAT

```
******************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY******************

JOB TR-20                                                          NOPLOTS
TITLE 001 FUTURE CONDITION - E. FORK SAND CREEK TRIB. - ARIES PROPERTIES  EFSCFU
TITLE     24 HR TYPE IIA CURVE
 5 RAINFL 1                    .50
 8                  0.000       .0025       0.005       .0075       0.010
 8                  0.015       0.020       0.025       0.030       0.050
 8                  0.060       0.100       0.700       0.750       0.780
 8                  0.798       0.820       0.830       0.840       0.850
 8                  0.860       0.865       0.870       0.885       0.890
 8                  0.900       0.905       0.910       0.915       0.921
 8                  0.927       0.933       0.940       0.945       0.950
 8                  0.955       0.960       0.965       0.970       0.975
 8                  0.980       0.983       0.985       0.988       0.990
 8                  0.993       0.995       0.998       1.000       1.000
 9 ENDTBL
 6 RUNOFF 1  80        1         0.07        68.0        0.41          1
 6 REACH  3  79   1    2       5597.0         1.7        1.25
 6 RUNOFF 1  79        1         0.28        70.0        0.35          1
 6 ADDHYD 4    38 1 2 3                                                1
 6 REACH  3 150   3    1       6574.0         1.1         1.4
 6 RUNOFF 1  78        2         0.37        77.0        1.47          1
 6 REACH  3  51   2    3       1531.0         1.0         1.4
 6 RUNOFF 1  51        4         0.11        71.0        0.09          1
 6 ADDHYD 4    37 3 4 2                                                1
 6 REACH  3  50   2    3       3000.0         1.1         1.4
 6 RUNOFF 1  50        2         0.36        74.0        0.49          1
 6 RUNOFF 1  49        4         0.28        68.0        0.53          1
 6 REACH  3 152   4    5       2682.0         1.0         1.4
 6 ADDHYD 4    33 2 5 6
 6 ADDHYD 4    33 6 1 5
 6 ADDHYD 4    33 5 3 1
 6 REACH  3  47   1    2       4678.0         0.2         1.7
 6 RUNOFF 1  48        1         0.27        68.0        1.39          1
 6 REACH  3 147   1    3       6040.0         1.1         1.4
 6 RUNOFF 1  47        1         0.62        78.0        0.91          1
 6 ADDHYD 4    32 1 3 4
 6 ADDHYD 4    32 4 2 1                                                1
 6 REACH  3 145   1    2       3802.0         0.2         1.7
 6 RUNOFF 1  45        1        0.500        84.0        0.34          1
 6 ADDHYD 4    29 1 2 3                                                1
 6 RUNOFF 1  81        1         0.38        69.0        0.39          1
 6 RUNOFF 1  96        2         0.13        68.0        0.88          1
 6 REACH  3  81   2    4       6389.0         1.4         1.3
 6 ADDHYD 4    54 4 1 2                                                1
 6 REACH  3  76   2    1       5702.0         1.9         1.3
 6 RUNOFF 1  76        2         0.24        81.0        0.34          1
1

**********************80-80 LIST OF INPUT DATA (CONTINUED)**********************
```

```
  6 ADDHYD 4     39 1 2 4                                                  1
  6 REACH  3  53    4    1        3453.0          1.1          1.4
  6 RUNOFF 1  53         2          0.33         75.0         0.45         1
  6 RUNOFF 1  77         4          0.23         83.0         1.68         1
  6 REACH  3 153    4    5        3379.0           .7          1.4
  6 ADDHYD 4     36 1 2 4
  6 ADDHYD 4     36 4 5 1                                                  1
  6 REACH  3  52    1    2        1584.0          0.3          1.6
  6 RUNOFF 1  52         1          0.19         78.0         0.37         1
  6 ADDHYD 4     34 2 1 4                                                  1
  6 REACH  3  46    4    1        3770.0          0.3          1.6
  6 RUNOFF 1  46         2          0.26         80.0         0.66         1
  6 ADDHYD 4     31 1 2 4                                                  1
  6 REACH  3 145    4    1          3600          0.2          1.7
  6 ADDHYD 4     29 1 3 2                                                  1
  6 RUNOFF 1  93         1          0.26         76.0         1.12         1
  6 RUNOFF 1  94         3          0.40         68.0         0.30         1
  6 RUNOFF 1  98         4          0.16         63.0         0.43         1
  6 REACH  3 194    4    5        5914.0          1.8          1.3
  6 RUNOFF 1  97         4          0.13         63.0         0.43         1
  6 REACH  3  94    4    6        5914.0          1.7          1.3
  6 ADDHYD 4     55 1 3 7
  6 ADDHYD 4     55 7 5 1
  6 ADDHYD 4     55 1 6 3                                                  1
  6 REACH  3  83    3    1        6124.0          1.9          1.3
  6 RUNOFF 1  83         3          0.34         73.0         1.52         1
  6 RUNOFF 1  95         4          0.14         68.0         1.38         1
  6 REACH  3  82    4    5        5808.0          1.4          1.3
  6 RUNOFF 1  82         4          0.25         86.0         0.31         1
  6 ADDHYD 4     53 1 3 6
  6 ADDHYD 4     53 6 5 1
  6 ADDHYD 4     53 1 4 3                                                  1
  6 REACH  3  75    3    1        4013.0          1.9          1.3
  6 RUNOFF 1  75         3          0.16         79.0         0.69         1
  6 ADDHYD 4     41 1 3 4                                                  1
  6 REACH  3  73    4    1        1610.0          0.8          1.5
  6 RUNOFF 1  73         3          0.28         81.0         1.57         1
  6 ADDHYD 4     40 1 3 4                                                  1
  6 RUNOFF 1  99         1          0.45         68.0         1.14         1
  6 REACH  3  92    1    3        5650.0          2.1          1.3
  6 RUNOFF 1  92         5          0.34         88.0         0.28         1
  6 ADDHYD 4     56 3 5 1                                                  1
  6 REACH  3  84    1    3        5491.0          2.0          1.3
  6 RUNOFF 1  84         5          0.27         92.0         0.29         1
  6 ADDHYD 4     52 3 5 1                                                  1
  6 RUNOFF 1  91         3          0.42         92.0         1.14         1
1

 ************************80-80 LIST OF INPUT DATA (CONTINUED)**********************

  6 REACH  3  85    3    5        6178.0          1.4          1.3
  6 ADDHYD 4     52 1 5 3                                                  1
```

```
 6 RUNOFF 1  85       1        0.19        92.0        0.36          1
 6 ADDHYD 4    52 1 3 5                                             1
 6 REACH  3  74    5   6     4066.0         1.9         1.3
 6 RUNOFF 1  74        1        0.19        87.0        0.21          1
 6 ADDHYD 4    42 1 6 5                                             1
 6 REACH  3  73    5   1     1610.0         0.8         1.5
 6 ADDHYD 4    40 1 4 3
 6 RUNOFF 1  86        1        0.33        80.0        1.48          1
 6 REACH  3  72    1   4     3500.0         1.7         1.3
 6 RUNOFF 1  72        1        0.29        84.0        0.88          1
 6 ADDHYD 4    43 1 4 5                                             1
 6 REACH  3 173    5   1     1864.0         2.0         1.3
 6 ADDHYD 4    40 1 3 4                                             1
 6 RUNOFF 1  71        1        0.13        85.0        0.75          1
 6 REACH  3  57    1   3     4102.0          .7         1.4
 6 RUNOFF 1  57        1        0.18        79.0        1.25          1
 6 ADDHYD 4    46 1 3 5                                             1
 6 REACH  3  55    5   1     3000.0         2.9         1.4
 6 RUNOFF 1  55        3        0.17        86.0        1.00          1
 6 RUNOFF 1  54        5        0.31        76.0        1.54          1
 6 REACH  3  54    4   6     4974.0         0.5         1.6
 6 ADDHYD 4    35 6 1 4
 6 ADDHYD 4    35 4 3 1
 6 ADDHYD 4    35 1 5 3                                             1
 6 REACH  3  44    3   1     5016.0         0.5         1.6
 6 RUNOFF 1  56        3        0.09        84.0        0.39          1
 6 REACH  3 144    3   4     4419.0          .9         1.6
 6 RUNOFF 1  43        5        0.16        86.0        0.45          1
 6 REACH  3 146    5   3     1200            1.9         1.3
 6 RUNOFF 1  44        5        0.29        83.0        0.24          1
 6 ADDHYD 4    30 3 4 6
 6 ADDHYD 4    30 6 1 3
 6 ADDHYD 4    30 3 5 1                                       1 1   1   1
 6 REACH  3  45    1   3     2893.0         0.1         1.7
 6 ADDHYD 4    29 2 3 1                                       1 1   1   1
 6 REACH  3  28    1   2     3168.0         0.1         1.7
 6 RUNOFF 1  29        3        0.17        90.0        0.73          1
 6 REACH  3 128    3   1     3131.0         0.5         1.5
 6 RUNOFF 1  27        3        0.15        86.0        0.28          1
 6 RUNOFF 1  28        4        0.32        83.0        0.37          1
 6 ADDHYD 4    19 2 1 5
 6 ADDHYD 4    19 5 3 1
 6 ADDHYD 4    19 1 4 2                                       1 1   1   1
 6 REACH  3  26    2   1     3221.0         0.2         1.7
1

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

 6 RUNOFF 1  26        2        0.47        81.0        0.90          1
 6 ADDHYD 4    18 1 2 3                                             1
 6 REACH  3  25    3   1     2323.0         0.2         1.7
 6 RUNOFF 1  25        2        0.26        74.0        0.29          1
```

```
 6 ADDHYD 4     17 1 2 3                                                  1
 6 REACH  3  24    3    1        2524.0          0.2          1.7
 6 RUNOFF 1  24         2          0.28         88.0         0.16         1
 6 ADDHYD 4     12 1 2 3
 6 RUNOFF 1  41         1          0.16         95.0         0.75         1
 6 REACH  3  31    1    2        3358.0          1.1          1.5
 6 RUNOFF 1  31         1          0.24         86.0         0.18         1
 6 ADDHYD 4     20 1 2 4                                                  1
 6 REACH  3  30    4    1        2323.0          1.6          1.6
 6 RUNOFF 1  30         2          0.10         83.0         0.08         1
 6 ADDHYD 4     16 1 2 4                                                  1
 6 REACH  3 124    4    1        4594.0          0.7          1.6
 6 RUNOFF 1  32         2          0.15         82.0         0.91         1
 6 REACH  3 198    2    4        5227.0          1.2          1.6
 6 ADDHYD 4     12 1 4 2
 6 ADDHYD 4     12 2 3 1                                                  1
 6 REACH  3  18    1    2        3696.0          0.2          1.7
 6 RUNOFF 1  18         7          0.40         83.0         0.78         1
 6 ADDHYD 4     57 2 7 1                                      1 1   1     1
 6 RUNOFF 1  87         2          0.15         68.0         1.35         1
 6 REACH  3  70    2    3        5613.0          1.2          1.3
 6 RUNOFF 1  70         2          0.26         81.0         0.88
 6 ADDHYD 4     47 2 3 4                                                  1
 6 REACH  3  58    4    2        5016.0          1.6          1.3
 6 RUNOFF 1  58         3          0.28         79.0         0.55
 6 ADDHYD 4     28 2 3 4                                                  1
 6 REACH  3  42    4    2        2746.0          1.2          1.4
 6 RUNOFF 1  42         3          0.20         84.0         0.37
 6 ADDHYD 4     27 2 3 4                                                  1
 6 REACH  3  40    4    2        2218.0          1.2          1.4
 6 RUNOFF 1  40         3          0.14         72.0         1.11
 6 ADDHYD 4     26 2 3 4                                                  1
 6 REACH  3 199    4    2         216.0           .3          1.6
 6 RUNOFF 1  90         3          0.06         92.0         0.63
 6 REACH  3  88    3    4        5597.0          1.9          1.3
 6 RUNOFF 1  88         3          0.26         68.0         0.29
 6 ADDHYD 4     50 3 4 5                                                  1
 6 REACH  3  68    5    3        3643.0          1.7          1.3
 6 RUNOFF 1  89         4          0.10         68.0         0.46
 6 REACH  3  68    4    5        3643.0          1.7          1.3
 6 RUNOFF 1  67         6          0.19         75.0         0.89
 6 RUNOFF 1  68         4          0.10         74.0         0.22
1
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
 6 ADDHYD 4     49 3 5 7
 6 ADDHYD 4     49 7 6 3
 6 ADDHYD 4     49 3 4 5
 6 REACH  3  66    5    3        2531.0          1.3          1.5
 6 RUNOFF 1  66         4          0.11         74.0         0.19
 6 RUNOFF 1  69         5          0.23         74.0         1.42
```

```
 6 ADDHYD 4     48 3 4 6
 6 ADDHYD 4     48 6 5 3                                                  1
 6 REACH  3  59    3    4        5158.0          0.6          1.6
 6 RUNOFF 1  59         3          0.32         63.0         0.44
 6 ADDHYD 4     44 3 4 5                                                  1
 6 REACH  3  60    5    3        1373.0          0.8          1.5
 6 RUNOFF 1  60         4          0.08         63.0         0.19
 6 ADDHYD 4     25 3 4 5                                                  1
 6 REACH  3  39    5    3        4963.0          0.3          1.7
 6 RUNOFF 1  39         4          0.48         73.0         0.45
 6 ADDHYD 4     21 3 4 5
 6 ADDHYD 4     21 5 2 3                                                  1
 6 RUNOFF 1  63         2          0.06         77.0          .67
 6 REACH  3  62    2    4        3432.0          1.5          1.3
 6 RUNOFF 1  64         2          0.20         75.0         0.63
 6 REACH  3  62    2    5        3432.0          1.5          1.3
 6 RUNOFF 1  65         2          0.07         75.0         0.52
 6 REACH  3 162    2    6        2445.0          1.9          1.2
 6 RUNOFF 1  62         2          0.25         63.0         0.19
 6 ADDHYD 4     45 4 5 7
 6 ADDHYD 4     45 7 6 4
 6 ADDHYD 4     45 4 2 5
 6 REACH  3  61    5    2        3152.0          1.7          1.3
 6 RUNOFF 1  61         4          0.35         63.0         0.44
 6 ADDHYD 4     24 2 4 5
 6 REACH  3 139    5    2        4488.0          1.1          1.4
 6 ADDHYD 4     21 2 3 4                                                  1
 6 REACH  3  33    4    2        7445.0          0.1          1.7
 6 RUNOFF 1  33         3          0.50         81.0         1.37
 6 RUNOFF 1  34         4          0.23         89.0         0.59
 6 ADDHYD 4     15 2 3 5
 6 ADDHYD 4     15 5 4 2                                                  1
 6 RUNOFF 1  37         3          0.20         88.0         0.78
 6 RUNOFF 1  38         4          0.12         72.0         0.89
 6 ADDHYD 4     23 3 4 5                                                  1
 6 REACH  3  35    5    3        3252.0          1.7          1.2
 6 RUNOFF 1  35         4          0.26         92.0         0.87
 6 ADDHYD 4     22 3 4 5                                                  1
 6 REACH  3  34    5    3        1816.0          1.0          1.4
 6 ADDHYD 4     15 2 3 4                                    1 1  .1    1
1
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
 6 REACH  3  22    4    2.       3062.0           .6          1.6
 6 RUNOFF 1  21         3          0.10         88.0         0.53
 6 REACH  3 122    3    4        2503.0          1.1          1.4
 6 RUNOFF 1  22         3          0.13         88.0         0.07
 6 RUNOFF 1  23         5          0.20         88.0         0.91
 6 ADDHYD 4     13 2 4 6
 6 ADDHYD 4     13 6 3 2
 6 ADDHYD 4     13 2 5 3                                                  1
```

```
 6 REACH  3  19   3   2      3802.0       0.1        1.7
 6 RUNOFF 1  19       6        0.29      89.0       0.51
 6 ADDHYD 4    11 2 6 7                                    1
 6 REACH  3  15   7   2      2571.0       0.3        1.6
 6 RUNOFF 1  16       3        0.38      84.0       0.89
 6 REACH  3  17   3   4      3274.0       1.4        1.3
 6 RUNOFF 1  17       3        0.13      84.0       0.22
 6 ADDHYD 4    10 3 4 5                                    1
 6 REACH  3 115   5   3      2820.0       1.2        1.4
 6 RUNOFF 1  15       4        0.25      92.0       0.21
 6 REACH  3 116   1   5      2260.0       0.2        1.6
 6 ADDHYD 4     9 2 3 1
 6 ADDHYD 4     9 1 5 2
 6 ADDHYD 4     9 2 4 1                             1 1   1   1
 6 REACH  3  14   1   2      3448.0       0.2        1.7
 6 RUNOFF 1  14       1        0.35      92.0       0.44
 6 ADDHYD 4     7 1 2 3                               1 1   1   1
 6 REACH  3   5   3   1      4910.0       0.2        1.6
 6 RUNOFF 1   5       2        0.18      68.0       0.14
 6 RUNOFF 1  36       3        0.39      82.0       0.96
 6 REACH  3  20   3   4      3960.0        .4        1.5
 6 RUNOFF 1  20       3        0.30      85.0       0.30
 6 ADDHYD 4    14 3 4 5                                    1
 6 REACH  3  12   5   3      3221.0       1.3        1.5
 6 RUNOFF 1  10       4        0.13      77.0       0.18
 6 REACH  3 112   4   5      2250.0       0.8        1.6
 6 RUNOFF 1  11       4        0.10      81.0       0.22
 6 REACH  3 195   4   6      2788.0       1.4        1.5
 6 RUNOFF 1  12       4        0.22      87.0       0.14
 6 ADDHYD 4     8 5 6 7
 6 ADDHYD 4     8 7 4 5
 6 ADDHYD 4     8 5 3 4
 6 REACH  3   6   4   3      8976.0       0.6        1.6
 6 RUNOFF 1   6       4        0.29      86.0       0.23
 6 RUNOFF 1  13       5        0.13      87.0       0.20
 6 REACH  3   6   5   6      8976.0       0.6        1.6
 6 ADDHYD 4     5 1 2 5
 6 ADDHYD 4     5 5 3 1
1
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
 6 ADDHYD 4     5 1 6 2
 6 ADDHYD 4     5 2 4 1                                     1
 6 REACH  3   4   1   2      2851.0       0.2        1.6
 6 RUNOFF 1   9       1        0.14      77.0       0.17
 6 REACH  3   8   1   3      3907.0       6.0        1.4
 6 RUNOFF 1   8       1        0.19      77.0       0.07
 6 RUNOFF 1   7       4        0.38      92.0       0.15
 6 ADDHYD 4     6 3 1 5
 6 ADDHYD 4     6 5 4 1                                     1
 6 REACH  3 104   1   3      4066.0       0.8        1.5
```

```
  6 RUNOFF 1    4          1          0.59          79.0          0.32
  6 ADDHYD 4      4 3 1 4
  6 ADDHYD 4      4 4 2 1                                                    1
  6 REACH  3    3    1     2       2482.0           0.1          1.7
  6 RUNOFF 1    3          1          0.16          86.0          0.03
  6 ADDHYD 4      3 1 2 3                                                    1
  6 REACH  3    2    3     1       3432.0           0.2          1.7
  6 RUNOFF 1    2          2          0.36          87.0          .50
  6 ADDHYD 4      2 1 2 3                                                    1
  6 REACH  3    1    3     1       7234.0           0.3          1.7
  6 RUNOFF 1    1          2          0.48          74.0          0.59
  6 ADDHYD 4      1 1 2 3                                        1 1    1    1
    ENDATA
  7 LIST
  7 INCREM 6                      .100
  7 COMPUT 7   80          1          0.0           4.5          1.01 2   01   01
    ENDCMP 1
  7 COMPUT 7   80          1          0.0           3.0          1.01 2   01   02
    ENDCMP 1
    ENDJOB 2
0*********************************END OF 80-80
```

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2
0 STRUCTURE 57	13.25		
ALTERNATE 1		9380.66	4159.64
0 STRUCTURE 56	.79		
ALTERNATE 1		908.24	513.01
0 STRUCTURE 55	.95		
ALTERNATE 1		578.03	208.89
0 STRUCTURE 54	.51		
ALTERNATE 1		424.46	152.28
0 STRUCTURE 53	1.68		
ALTERNATE 1		920.47	409.07
0 STRUCTURE 52	1.67		
ALTERNATE 1		2123.02	1207.83
0 STRUCTURE 50	.32		
ALTERNATE 1		370.33	146.67
0 STRUCTURE 48	1.05		
ALTERNATE 1		710.04	262.76
0 STRUCTURE 47	.41		
ALTERNATE 1		304.02	143.02
0 STRUCTURE 46	.31		
ALTERNATE 1		297.63	142.77
0 STRUCTURE 44	1.37		
ALTERNATE 1		862.57	273.03
0 STRUCTURE 43	.62		
ALTERNATE 1		476.47	232.90
0 STRUCTURE 42	1.86		
ALTERNATE 1		2231.32	1229.48
0 STRUCTURE 41	1.84		
ALTERNATE 1		1049.46	451.68

1

	ALTERNATE	1	415.50	151.50
0	XSECTION 82	.25		
	ALTERNATE	1	612.72	337.39
0	XSECTION 83	.34		
	ALTERNATE	1	168.42	67.89
0	XSECTION 84	.27		
	ALTERNATE	1	789.72	477.54
0	XSECTION 85	.19		
	ALTERNATE	1	533.08	321.56
0	XSECTION 86	.33		
	ALTERNATE	1	233.45	109.91
0	XSECTION 87	.15		
	ALTERNATE	1	62.33	21.59
0	XSECTION 91	.42		
	ALTERNATE	1	588.90	345.73
0	XSECTION 92	.34		
	ALTERNATE	1	897.75	511.02
0	XSECTION 93	.26		
	ALTERNATE	1	191.42	82.66
0	XSECTION 94	.40		
	ALTERNATE	1	481.55	177.09
1				

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2
0 XSECTION 95	.14		
ALTERNATE 1		56.86	19.71
0 XSECTION 96	.13		

Future Condition - E. Fork
24 HR Type IIA curve

X SECTION/ STRUCTURE ID	AREA (SQ MI)	STORM 1	STORM 2	
ALTERNATE 1		415.50	151.50	
0 XSECTION 82	.25			
ALTERNATE 1		612.72	337.39	
0 XSECTION 83	.34			
ALTERNATE 1		168.42	67.89	
* 0 XSECTION 84	.27			
ALTERNATE 1		789.72	477.94	SOUTHEAST CORNER OF STERLING RANCH
* 0 XSECTION 85	.19			
ALTERNATE 1		533.08	321.56	
0 XSECTION 86	.33			
ALTERNATE 1		233.45	109.91	
0 XSECTION 87	.15			
ALTERNATE 1		62.33	21.59	
0 XSECTION 91	.42			
ALTERNATE 1		588.90	345.73	
* 0 XSECTION 92	.34			
ALTERNATE 1		897.75	511.02	SOUTHEAST CORNER OF STERLING RANCH
0 XSECTION 93	.26			
ALTERNATE 1		191.42	82.66	
0 XSECTION 94	.40			
ALTERNATE 1		481.55	177.09	
1				

TR20 XEQ 11/ 1/94 8:54 FUTURE CONDITION - E. FORK SAND CREEK TRIB. - ARIES
PROPERTIES EFSCFU JOB 1 SUMMARY
REV PC/09/83 24 HR TYPE IIA CURVE
PAGE 51

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2
0 XSECTION 95	.14		
ALTERNATE 1		56.86	19.71
0 XSECTION 96	.13		

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AN

	XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2	
0	XSECTION 154	.47			
	ALTERNATE 1		1017.74	575.37	
0	XSECTION 155	.15			
	ALTERNATE 1		315.06	160.42	
0	XSECTION 157	.31			
	ALTERNATE 1		663.21	372.02	
0	XSECTION 158	.10			
	ALTERNATE 1		213.73	110.85	
0	XSECTION 159	.74			
	ALTERNATE 1		953.85	480.27	SR - SOUTH END - Tributary (WEST)
0	XSECTION 160	4.33			
	ALTERNATE 1		2631.18	769.08	SR - OFF SITE - SAND CREEK
	XSECTION 161	.25			
	ALTERNATE 1		373.47	198.93	SR - OFF SITE - Tributary PAWNEE RANCHEROS NO. 2
0	XSECTION 163	4.17			
	ALTERNATE 1		2632.31	782.48	SR - SAND CREEK
0	XSECTION 164	.49			
	ALTERNATE 1		612.79	301.40	SR - SOUTH END - Tributary (WES
0	XSECTION 167	.22			
	ALTERNATE 1		206.19	86.72	
0	XSECTION 169	.25			
	ALTERNATE 1		327.64	124.18	SR NORTH END - Tributary (WEST)
0	XSECTION 170	3.27			
	ALTERNATE 1		2264.65	664.95	SR NORTH END - SAND CREEK
0	XSECTION 171	2.91			
	ALTERNATE 1		2130.34	630.48	NORTH OF SR - SAND CREEK
0	XSECTION 172	1.39			
	ALTERNATE 1		1026.56	333.92	

1

MATCH SHT 55 STA 905+00

CHANNEL IMPROVEMENTS

SEGMENT NO.	Q-10 CHANNEL	CHANNEL TYPE
170	670 / 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
171	630 / 2170	

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.

STR 890+50 CHECK

Sterling Ranch

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

0' 200' 400'

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

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 SHEET 54 STA 883+00

7180

7180x45

7170

7160

Sterling Ranch (whole sheet)

7136.67

DI-POND-36

EX EMBANKMENT TO REMAIN. PROVIDE OUTLET STRUCTURE.

GRADE CONTROL

870 SAND CREEK

REACH 36-3

CHANNEL IMPROVEMENTS

SEGMENT NO.	STA	CHANNEL TYPE
	DOWN / UP	
170	670	SELECTIVE RIPRAP LININGS AND
	2250	GRADE CONTROL

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.

7130

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

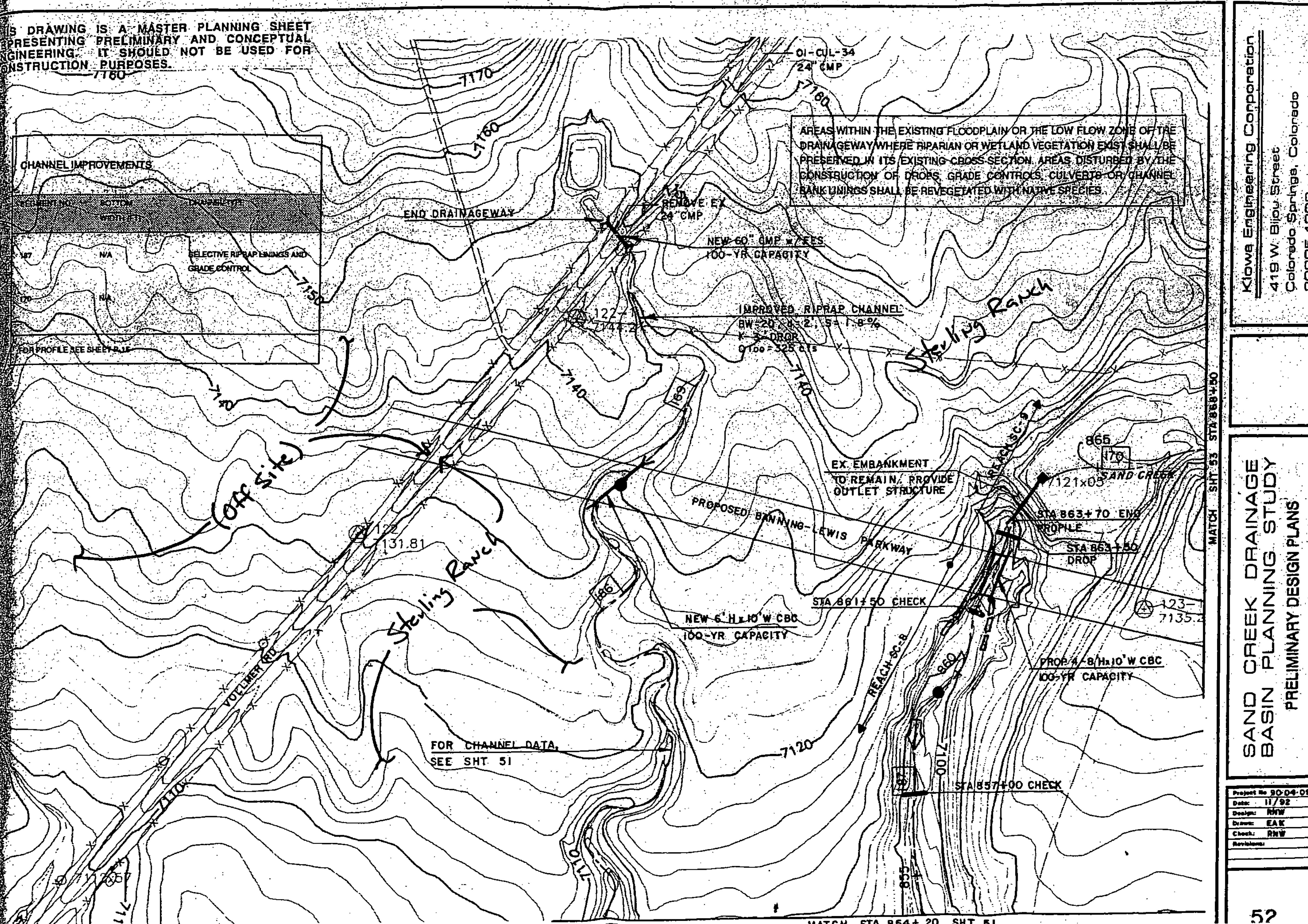
N

0' 200' 400'

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1949

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

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



S DRAWING IS A MASTER PLANNING SHEET PRESENTING PRELIMINARY AND CONCEPTUAL GINEERING. IT SHOULD NOT BE USED FOR NSTRUCTION PURPOSES.
CHANNEL IMPROVEMENTS
SELECTIVE RIPRAP LININGS AND GRADE CONTROL
N/A
N/A
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.
OI-CUL-34
24" CMP
END DRAINAGEWAY
REMOVE EX. 24" CMP
NEW 60" CMP w/ FES
100-YR CAPACITY
IMPROVED RIPRAP CHANNEL
Q100 = 325 cfs
Sterling Ranch
(Off site)
Sterling Ranch
Sterling Ranch
EX. EMBANKMENT TO REMAIN, PROVIDE OUTLET STRUCTURE
PROPOSED BANNING-LEWIS PARKWAY
SAND CREEK
7121x05
STA 863+70 END PROFILE
STA 863+50 DROP
STA 861+50 CHECK
NEW 6' H x 10' W CBC
100-YR CAPACITY
PROP 4-8' H x 10' W CBC
100-YR CAPACITY
REACH SC-8
FOR CHANNEL DATA, SEE SHT 51
STA 857+00 CHECK
VOLLMER RD
MATCH SHT 53 STA 868+50
MATCH STA 854+20 SHT 51
7170
7160
7150
7140
7120
7110
7100
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: 11/92
Design: RNW
Drawn: EAK
Check: RNW
Revisions:
52

MATCH STA 854+20 SHT 52

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

IMPROVED RIPRAP CHANNEL
BW=20', d=3', S=1.3%
3' DROPS @ 450' INTERVALS
Q100=500 cfs

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.

STA 852+00 CHECK
STA 847+00 CHECK
STA 844+00 CHECK
STA 840+00 CHECK
STA 836+00 CHECK
STA 833+00 CHECK
STA 829+00 CHECK
STA 825+00 CHECK
STA 822+00 CHECK

REACH 8 SAND CREEK

Sterling Ranch (whole sheet)

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
187	N/A	

FOR PROFILE SEE SHEETS P-14 AND P15

MATCH STA 820+00 SHT 50

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:	11/92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

MATCH STA 820+00 SHT 51

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

STA 818+00 CHECK

SAND CREEK REACH SC-8

PROVIDE 100-YR CAPACITY OUTLET CONTROL STRUCTURE

WATER SURFACE

01-PND-43

EX EMBANKMENT TO REMAIN

STA 808+00 CHECK

STA 802+00 CHECK

STA 798+00 CHECK

STA 795+00 CHECK

STA 792+00 CHECK

Sterling Ranch (whole sheet)

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (ft)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

FOR PROFILE SEE SHEET P-14

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.

MATCH STA 781+20 SHT 49

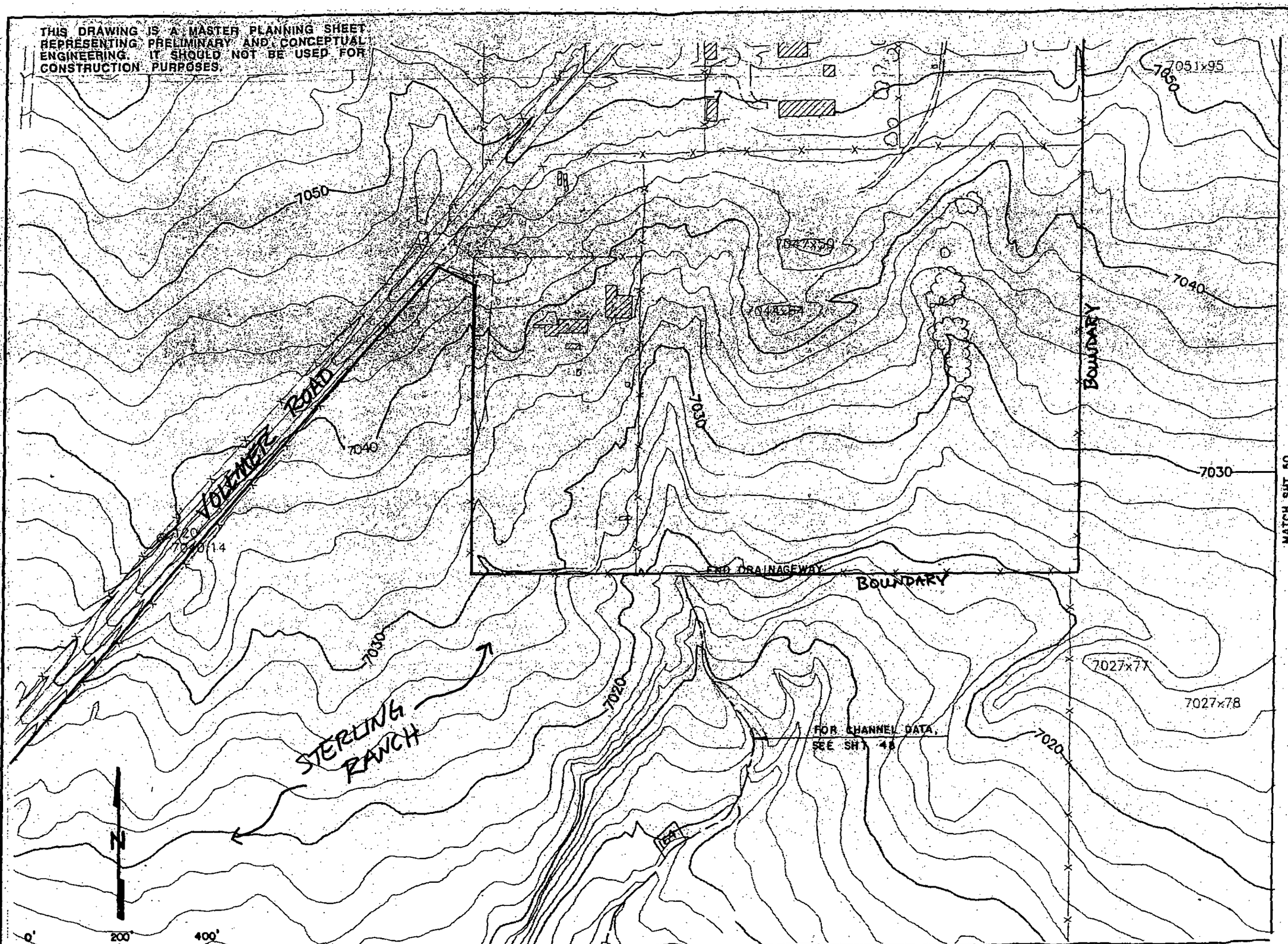
Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1309

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No.	90-04-02
Date:	11/92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

50

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



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905 (719) 471-1742

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No.	90.04.02
Date:	12/92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

50A

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.

Sterling Ranch

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

(OFF SITE)

109
7025.68

EAST FORK SAND CREEK BASIN

REMOVE EX 36"x58" CMPE

MUSTANG PLACE

EX 54" CMP TO REMAIN

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

STA 776+00 CHECK

TWIN 6'H x 8'W CBC
10-YR CAPACITY

7015.65

7008x12

SAND CREEK REACH SC-8

MATCH STA 769+80 SHT 48

01-CUE-48
18" CMP

7000

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (ft)	CHANNEL TYPE
160	N/A	SELECTIVE RIP-RAP LININGS AND GRADE CONTROL
163		

EOB PROFILE SEE SHEET P-14

0' 200' 400'

Kiowa Engineering Corporation
419 W. 8th Street
Colorado Springs, Colorado
80905-5605

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No	90-04-0
Date:	8-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

49

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
Q_{100} = 600 cfs

STERLING RANCH

PROPOSED RESEARCH PARKWAY

BOUNDARY

7000.12

6987 (NEW 2-6' R x 8' W CBC
100-YR CAPACITY

FOR CHANNEL DATA, SEE SHT 47

6980

BOUNDARY

END FLOODPLAIN DELINEATION

STA 768+00 CHECK

MATCH STA 768+80 SHT 49

STERLING RANCH

BOUNDARY

* WOODMEN HEIGHTS *

6960

SAND CREEK

PRESERVE EX VEGETATION & FLOODPLAIN

MATCH SHT 48A

0 200' 300'

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
1&2	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

FOR PROFILE SEE SHEETS P-13 AND P-14

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905 (719) 635-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No.	90-04-09
Date:	9-92
Designed:	RNW
Drawn:	EAK
Checked:	RNW
Revisions:	

48

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

MATCH STA 760+30 SHT 48

6960

6958x74

STA 758+00 CHECK

6950

6940

DISTURBED AREA

N

0 200' 400'

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

6950

6940

MATCH STA 47A

6930

PROPOSED MARKSHEFFEL ROAD

STA 748+00 CHECK

PRESERVE EX. VEGETATION & FLOODPLAIN

EX EMBANKMENTS TO BE REMOVED

6930

6920x48

6925x95

6925x92

CHANNEL IMPROVEMENTS

REACH NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
151	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
160		

6920

6934x59

STA 738+00 CHECK

6910

6920

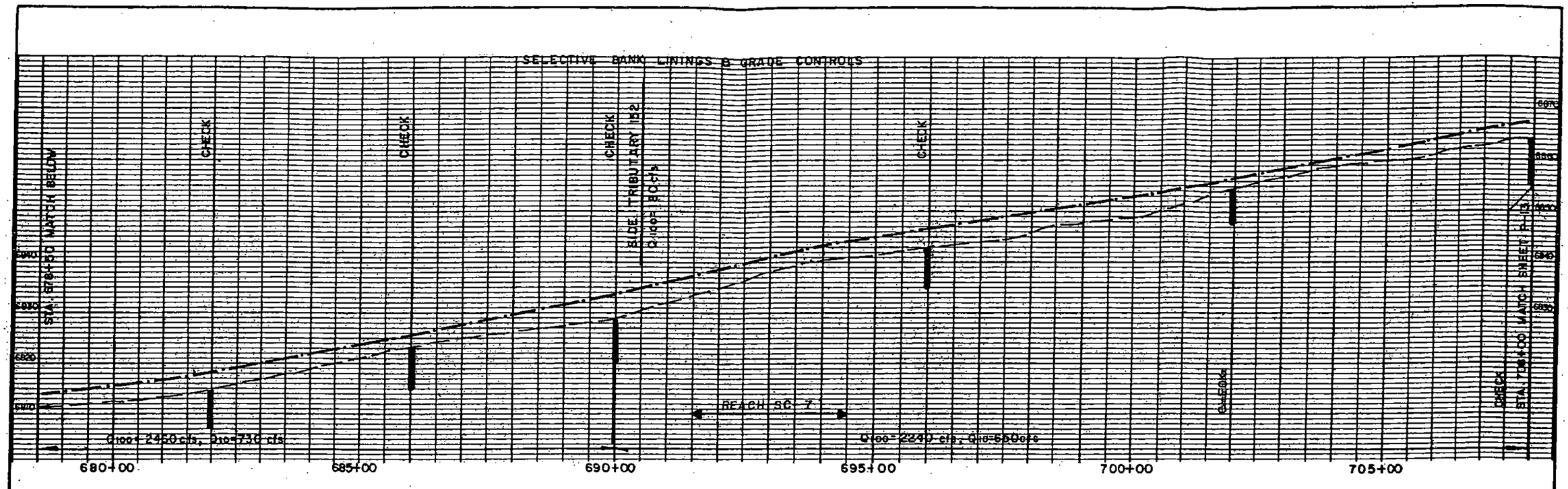
TRIPLE 10' x 10' CBC

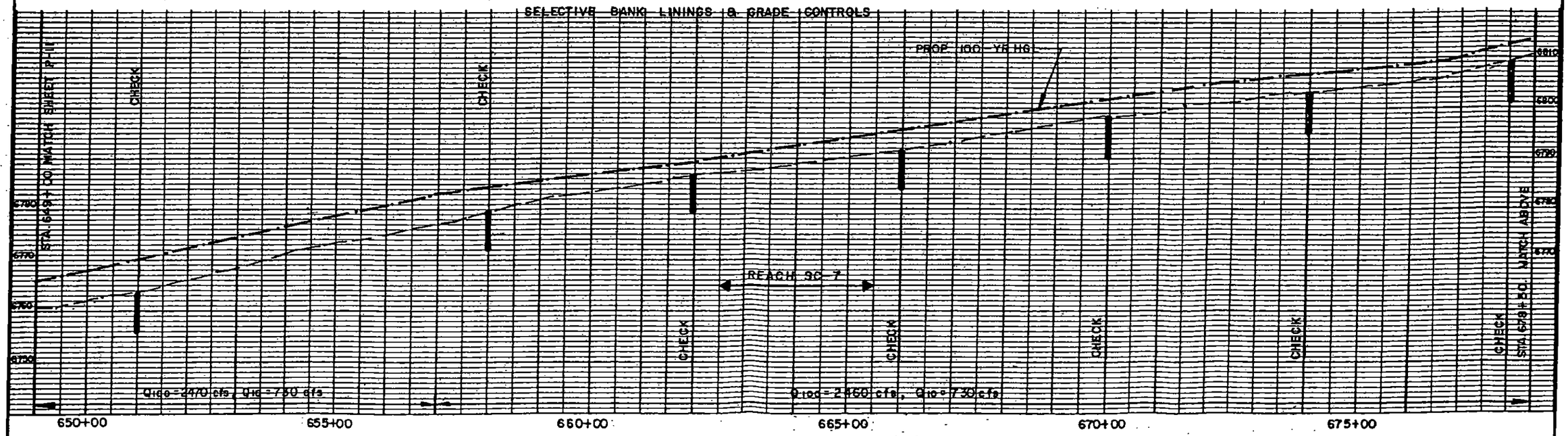
MATCH SHT 47B

Kiowa Engineering Corporation
419 W. 8th Street
Colorado Springs, Colorado
80905-1308

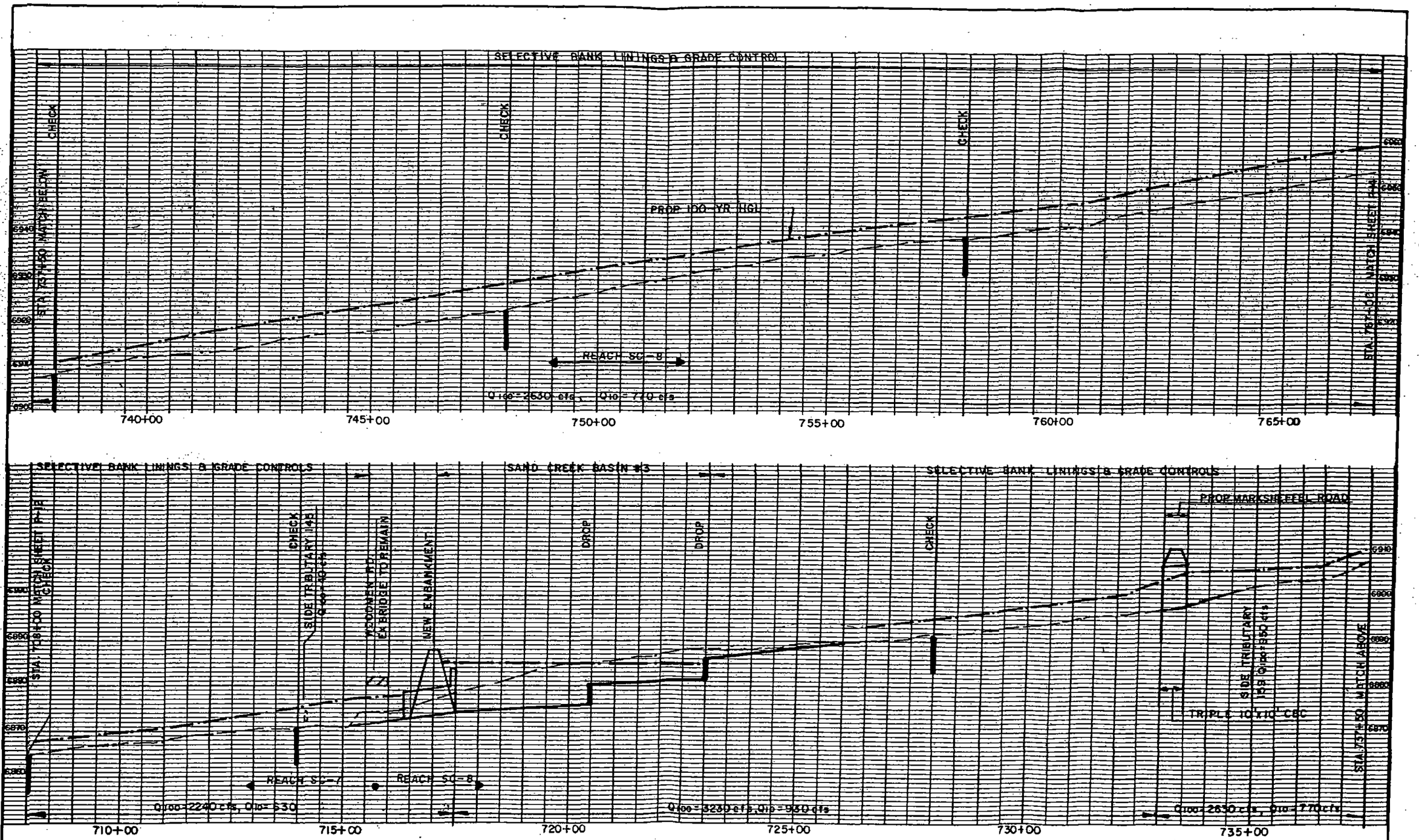
SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

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

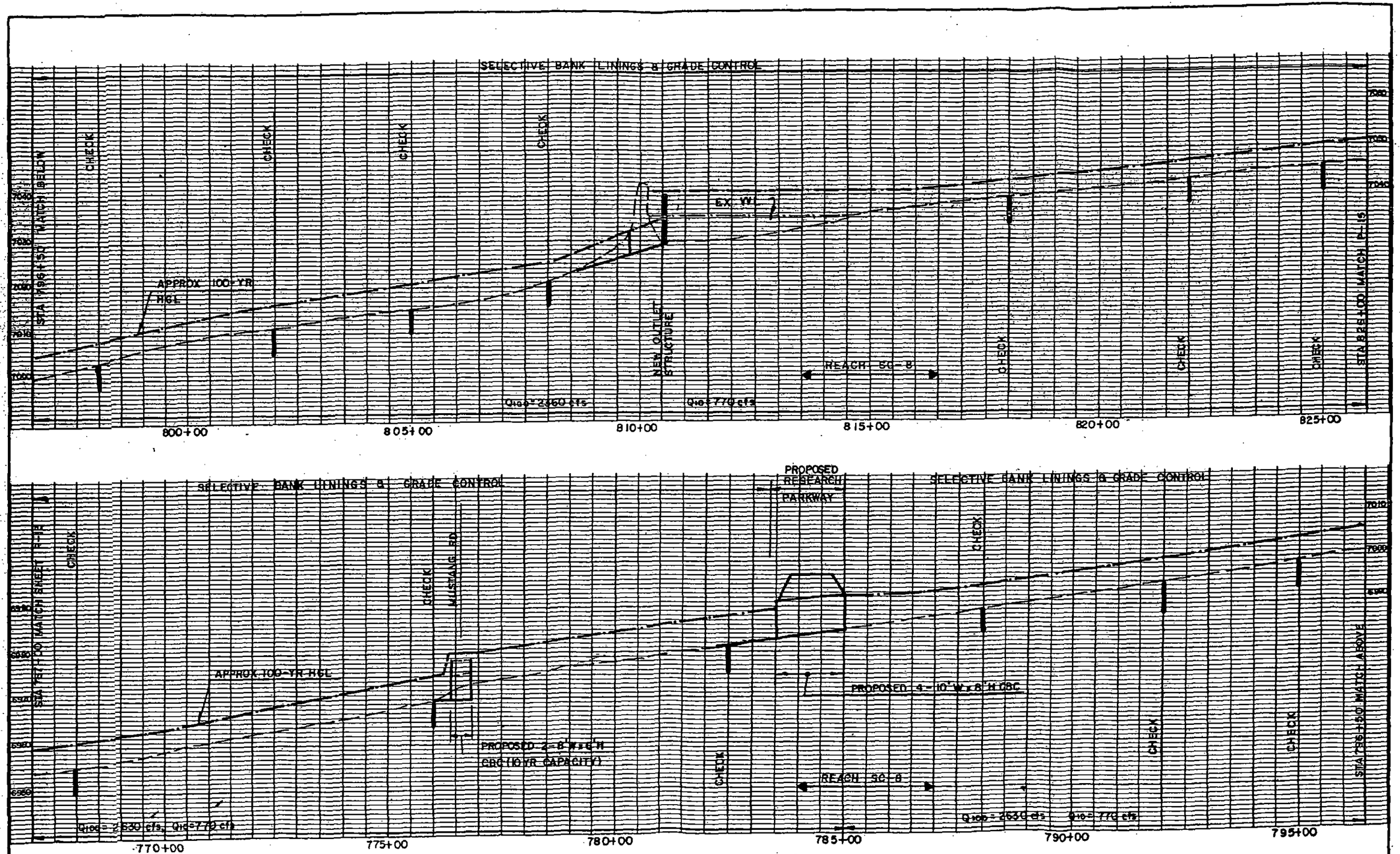




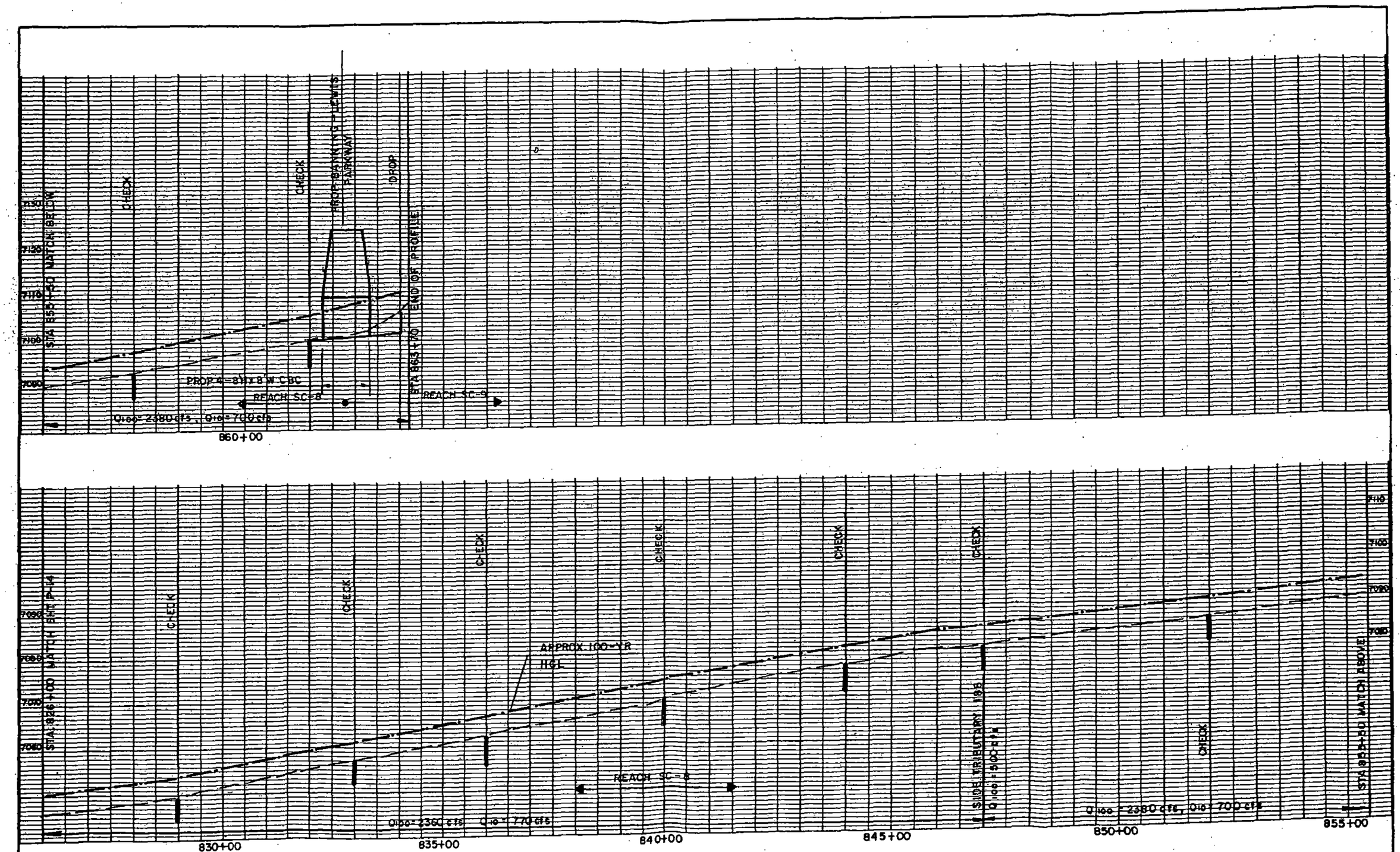
Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED JYC DATE DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	SAND CREEK Station 649+00 to 708+00	P-12



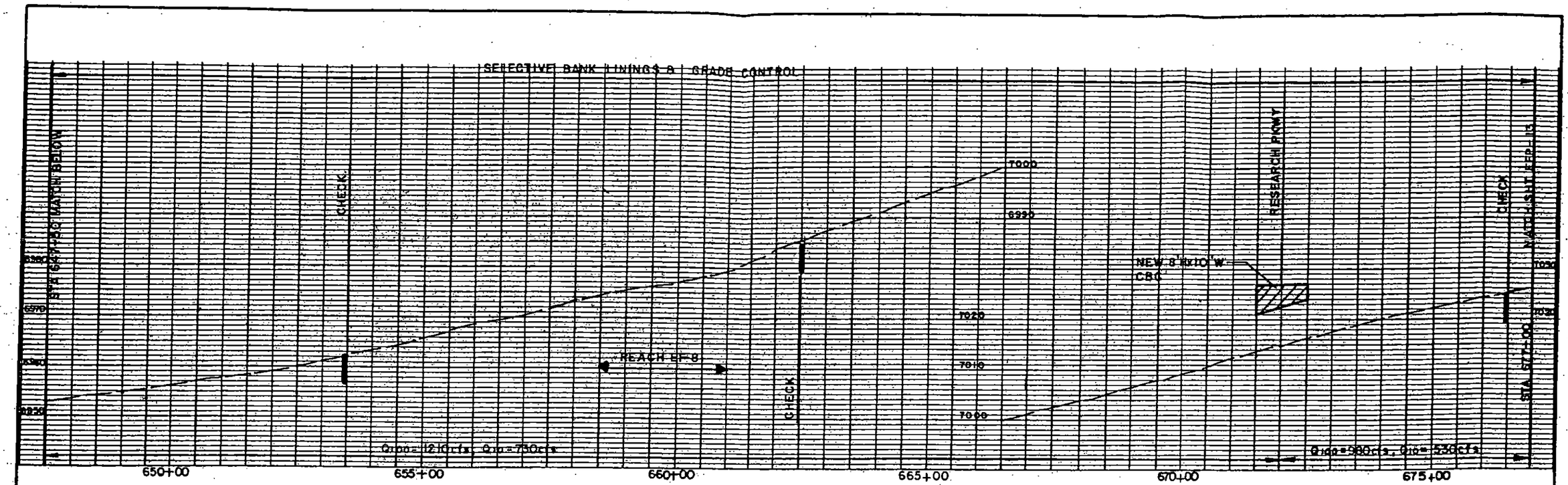
Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED JYC DATE DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	SAND CREEK Station 708+00 to 767+00	P-13

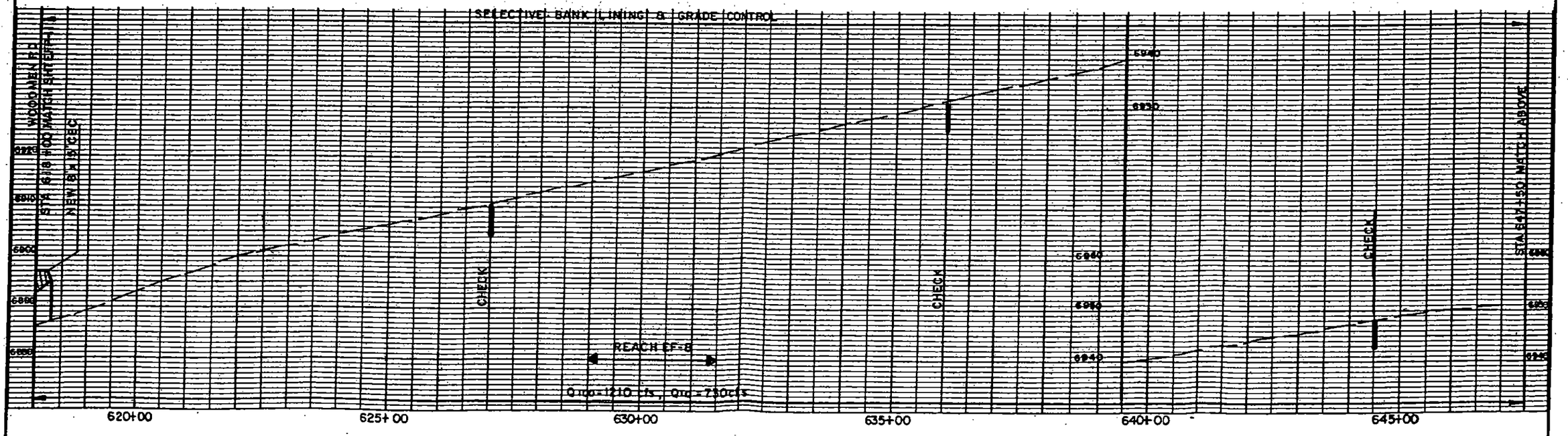


Kiowa Engineering Corporation	DESIGNED RNW DATE /92 CHECKED JYC DATE /92 DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	SAND CREEK Station 767+00 to 826+00	P-14

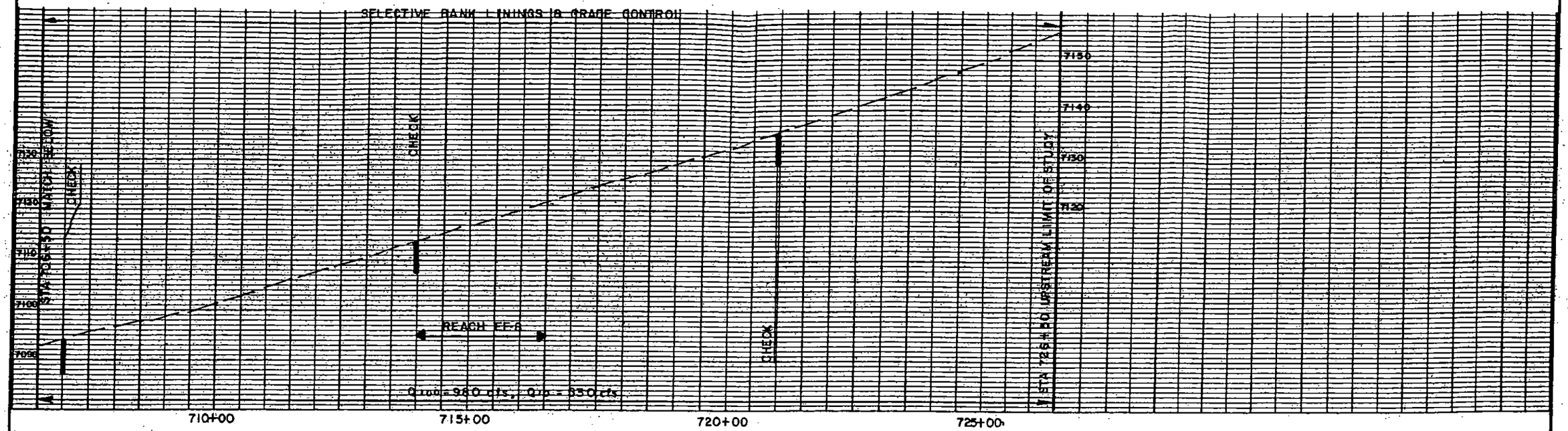


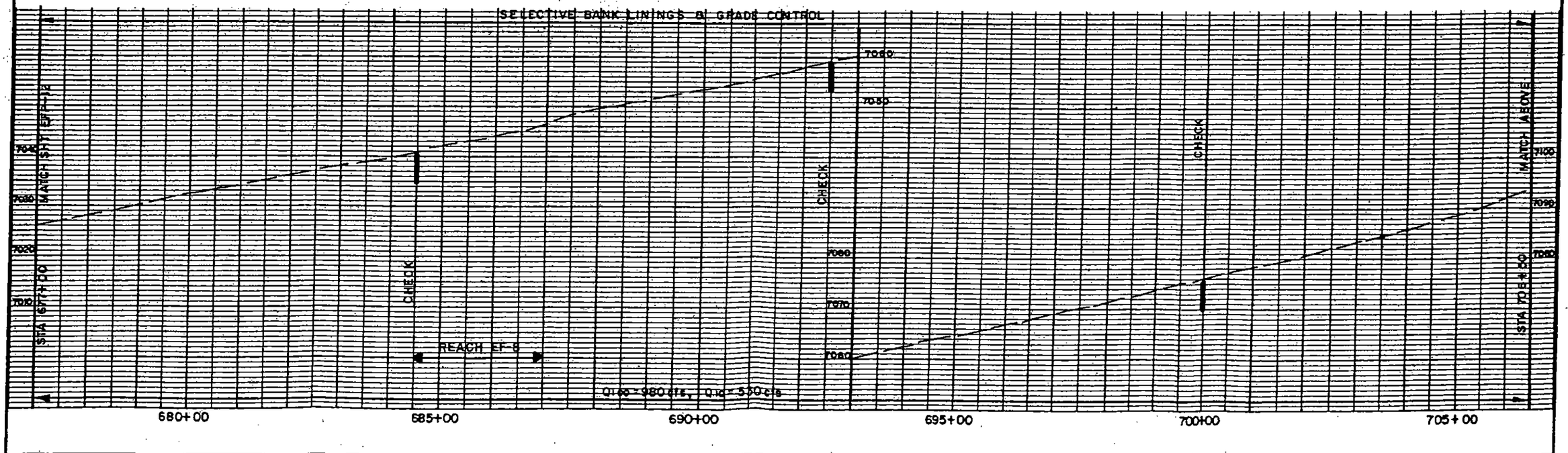
Kiowa Engineering Corporation	DESIGNED RNW DATE /92 CHECKED JYC DATE /92 DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	SAND CREEK STA 826+00 to 863+70	P-15





Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED DATE DRAWN EAR DATE REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	EAST FORK SAND CREEK Station 618+00 to 677+00	EFP-12





Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED DATE DRAWN EAK DATE REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	EAST FORK SAND CREEK Station 677+00 to 726+50	EFP-13

0 500 1000 2000
Scale in Feet

LEGEND

REACH IDENTIFIER 92

REACH IDENTIFIER 170

PROPERTY BNDRY

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
84	20	SELECTIVE BANK LININGS 3' DEPTH
92	15	SELECTIVE BANK LININGS 3' DEPTH
82	10	SELECTIVE BANK LININGS 2' DEPTH
81	15	SELECTIVE BANK LININGS 2' DEPTH

FOR PROFILE SEE SHEETS EFP-12, EFP-13, WBP-3, WBP-4

UPSTREAM LIMIT OF STUDY
STA 721+00 CHECK
STA 714+00 CHECK
STA 707+00 CHECK
STA 700+00 CHECK
STA 692+50 CHECK
STA 684+50 CHECK
STA 676+50 CHECK
NEW 10' x 8' CBC
UPSTREAM LIMIT OF STUDY
STA 662+50 CHECK
STA 653+50 CHECK
STA 644+50 CHECK
STA 636+00 CHECK
CHECK
SELECTIVE BANK LININGS & GRADE CONTROL
Gravel Pit
RESEARCH PARKWAY
KENOSHA RD.
MUSTANG RD
MAVERICK RD.
PONCA RD
PAWNEE RD
BRULE RD.
WOODMEN RD.
EAST FORK SAND CREEK
7100
7000
6900
7031
7122
34
3
4
5
6
88
89
92
85
MATCH SHT EF 32

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

2018 STERLING RANCH MDDP

DBPS MAP OVERLAY

PROJECT NO. 08-035
FILE: \dwg\Eng Exhibits\2018-MDDP-PROPCOND.dwg
DESIGNED BY: JD
DRAWN BY: JD
CHECKED BY: VAS
SCALE
HORIZ: 1"=2400'
VERT: 1"=2400'
DATE: 06-26-2018

DBPS-1

0 500 1000 2000

Scale in Feet

LEGEND

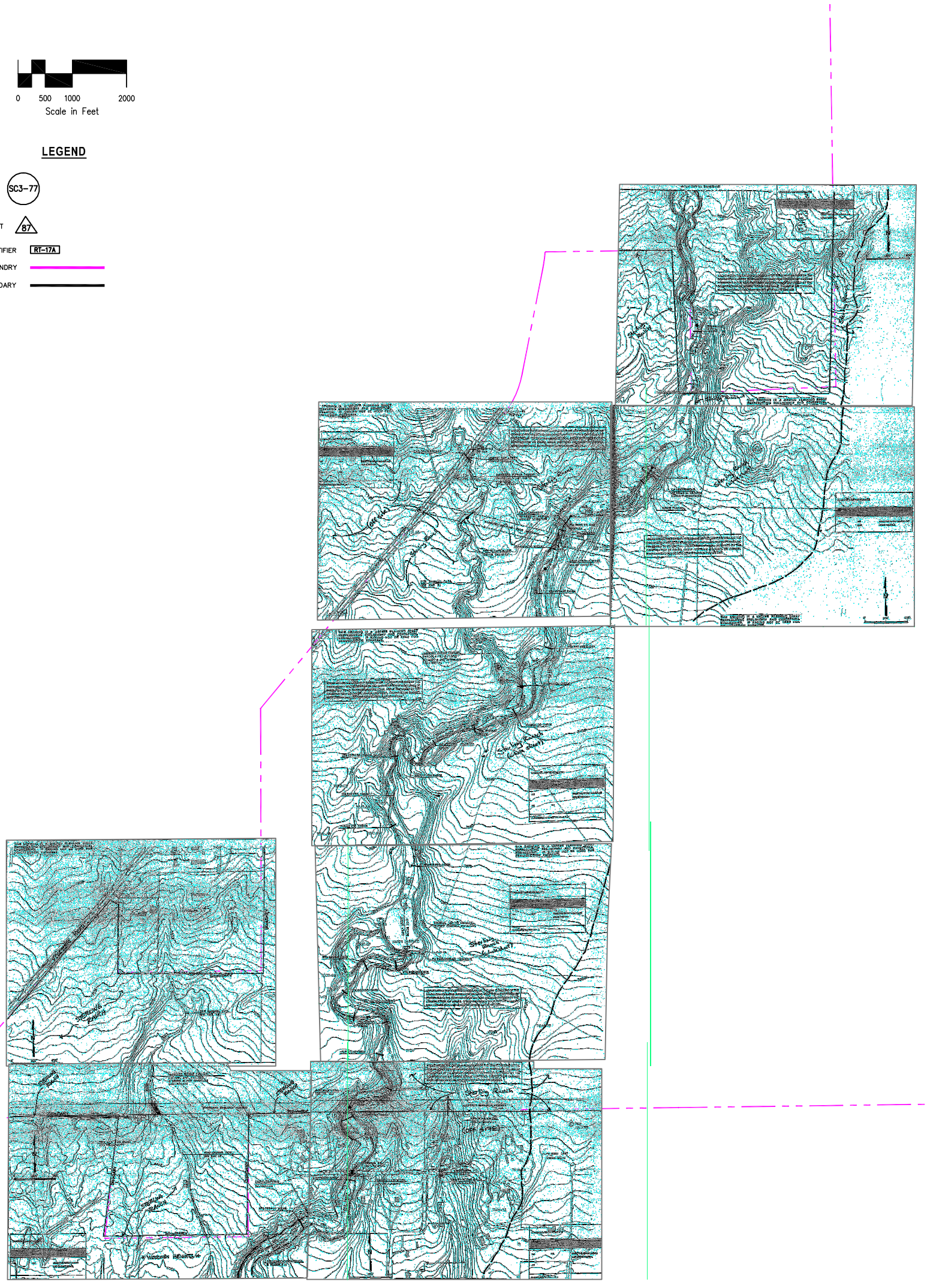
BASIN ID SC3-77

DESIGN POINT 87

REACH IDENTIFIER RT-17A

PROPERTY BNDRY

BASIN BOUNDARY



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20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

2018 STERLING RANCH MDDP

DBPS MAP OVERLAY

PROJECT NO. 09-002		FILE: \dwg\Eng Exhibits\DPBS overlay.dwg	
DESIGNED BY: DLM	SCALE	DATE: 08-26-2018	
DRAWN BY: DLM	HORIZ: 1"=1000'		DPBS-2
CHECKED BY: VAS	VERT: N/A		

0 500 1000 2000

Scale in Feet

LEGEND

REACH IDENTIFIER

PROPERTY BNDRY

STERLING RANCH BOUNDARY

CHANNEL IMPROVEMENTS

SEGMENT NO.	Q10 Q100	CHANNEL TYPE
170	670 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
171	630 2170	

CHECK

SAND CREEK REACH SC-9

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
187	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
170	N/A	

REMOVE EX 24" CMP

NEW 60" CMP w/FES 100-YR CAPACITY

IMPROVED RIPRAP CHANNEL BW=20' D=2, S=1.8% 3' DROP Q100=325 CFS

PROP 6'Hx10' CBC 100-YR CAPACITY

CHANNEL IMPROVEMENTS

SEGMENT NO.	Q10 Q100	CHANNEL TYPE
170	570 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

GRADE CONTROL

DROP STRUCTURE

PROP 8'Hx10' CBC 100-YR CAPACITY

IMPROVED RIPRAP CHANNEL BW=20', D=3', S=1.3% 3' DROPS @450' INTERVALS Q100=500CFS

SAND CREEK REACH SC-8

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
187	N/A	

PROVIDE 100-YR CAPACITY OUTLET CONTROL STRUCTURE

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

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

PROP 4'Wx10'H CBC 100-YR CAPACITY

NEW 2 - 6'H x 9'W CBC 100-YR CAPACITY

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
160	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
163		

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
160	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

M&S CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

2018 STERLING RANCH MDDP

DBPS MAP OVERLAY

PROJECT NO. 09-002		FILE: \dwg\Eng Exhibits\DPBS overlay.dwg	
DESIGNED BY: DLM	SCALE	DATE: 08-26-2018	
DRAWN BY: DLM	HORIZ: 1"=1000'		DPBS-3
CHECKED BY: VAS	VERT: N/A		

0 500 1000 2000
Scale in Feet

LEGEND

REACH IDENTIFIER

DBPS CHANNEL IMPROVEMENTS SEGMENT NO. 163

PROPERTY BNDRY

PROPOSED STORM SEWER

DETENTION POND

NOTE:

* CHECK STRUCTURES MAY BE RELOCATED THROUGHOUT SAND CREEK CHANNEL UPON FINAL ENGINEERING DESIGN

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
187	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
170	N/A	

CHANNEL IMPROVEMENTS

SEGMENT NO.	Q10 Q100	CHANNEL TYPE
170	570 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

CHANNEL IMPROVEMENTS

SEGMENT NO.	Q10 Q100	CHANNEL TYPE
170	670 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
171	630 2170	

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
187	N/A	

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
160	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
160	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
163		

STERLING RANCH BOUNDARY
SAND CREEK REACH SC-9
SAND CREEK REACH SC-8
SAND CREEK REACH SC-6
MDDP PROP. Q_{100}=1518.6
CHECK
DBPS Q_{100}=2260.0
MDDP EX. Q_{100}=1637.9
MDDP PROP. Q_{100}=1612.2
REMOVE EX 24" CMP
NEW 60" CMP w/FES 100-YR CAPACITY
100 YR RUNOFF TO BE CONVEYED IN PIPE OR SWALE TO CHANNEL UPSTREAM OF BRIARGATE PARKWAY
IMPROVED RIPRAP CHANNEL BW=20' D=2' S=1.8% 3' DROP Q100=325 CFS
GRADE CONTROL
MDDP PROP. Q_{100}=1636.7
DROP STRUCTURE
PROP 8'H x10'W CBC 100-YR CAPACITY
PROP 6'Hx10'W CBC 100-YR CAPACITY
CHECK
MDDP EX. Q_{100}=1870.4
MDDP PROP. Q_{100}=1775.7
PROP (3) 8X10 CBC 100-YR STRUCTURE TO BE RELOCATED BASED UPON REVISED ROADWAY ALIGNMENT
IMPROVED RIPRAP CHANNEL BW=20', D=2', S=1.3% 3' DROPS @450' INTERVALS Q100=500CFS
VOLLMER ROAD
BRIARGATE PKWY
FUTURE STERLING RANCH RD
PROP. STORM SEWER TO REPLACE CHANNEL
FUTURE BRIARGATE PKWY
MDDP PROP. Q_{100}=1905.9
LOW FLOWS TO EX. POND, LARGE FLOWS TO REMAIN IN CHANNEL
LOW FLOW OUTLET STRUCTURE
EX. POND
CHECK RELOCATE
PROP. DETENTION POND
PROP. STORM SEWER TO REPLACE CHANNEL
PROP (2) 8X8 CBC 100-YR STRUCTURE
MDDP PROP. Q_{100}=2204.1 (IN)
MDDP PROP. Q_{100}=1350.6 (OUT)
FUTURE STERLING RANCH RD
PROP. STORM SEWER
DPBS Q_{100}=2689.0
MDDP EX. Q_{100}=1911.5
MDDP PROP. Q_{100}=1385.1
IMPROVED RIPRAP CHANNEL BW=25', D=3', S=1.2% 3' DROPS @ 270' INTERVALS Q100=600CFS
PROP 4'W x10'H CBC 100 YR CAPACITY
PROP 6'H x8'W CBC 100-YR CAPACITY
RESEARCH PARKWAY
PROP DETENTION POND (OPTIONAL)
PROP 10'W x8'H CBC 100-YR CAPACITY
NEW 2 - 8'H x 9'W CBC 100-YR CAPACITY
MARKSHEFFEL RD
MDDP PROP. Q_{100}=1620.1

w/ SR improvements

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

2018 STERLING RANCH MDDP

DBPS MAP OVERLAY

PROJECT NO. 09-002
FILE: \dwg\Eng Exhibits\DPBS overlay.dwg
DESIGNED BY: DLM
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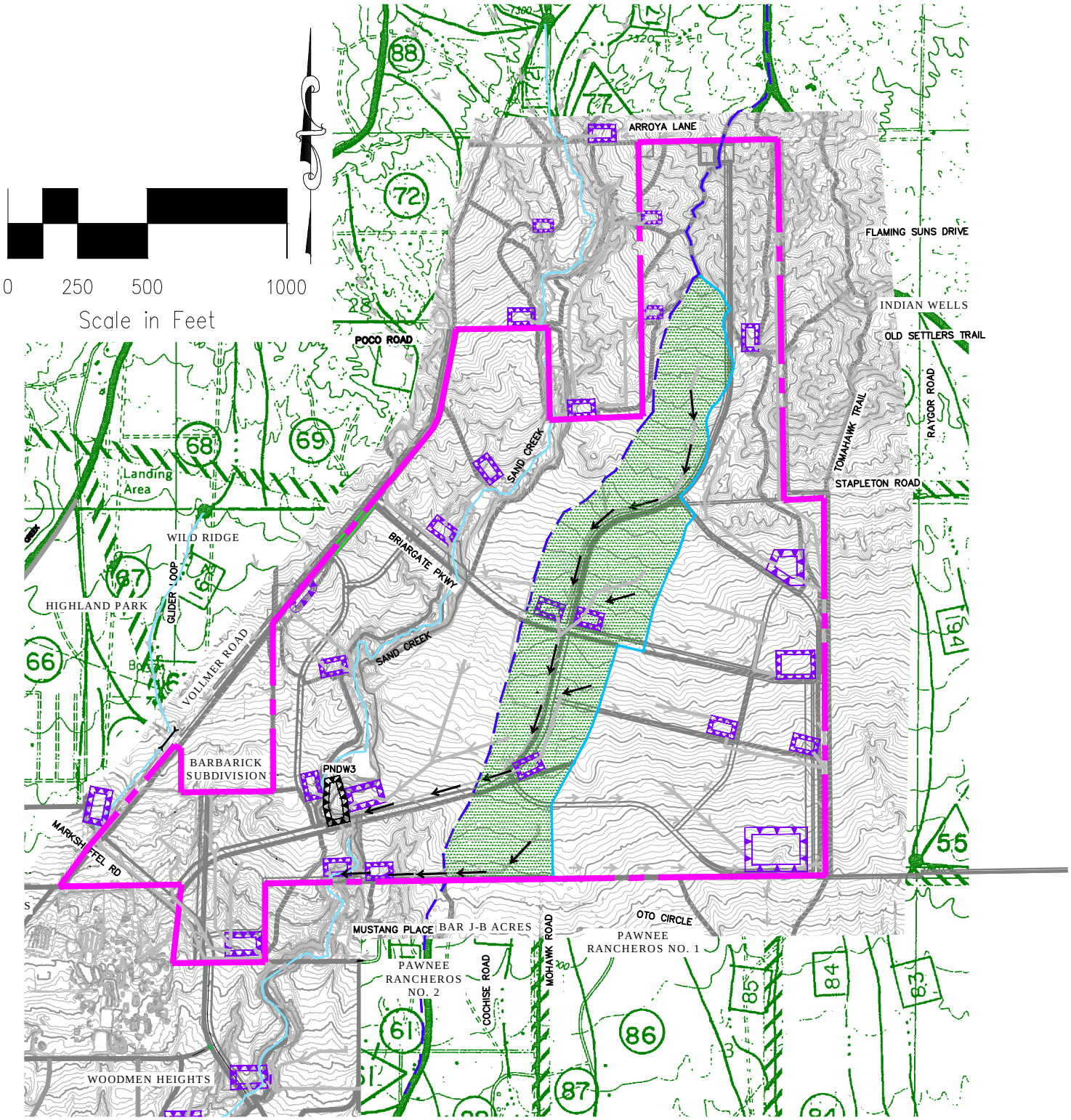
DPBS-3A

STERLING RANCH DRAINAGE DIVERSION EXHIBIT



PROPERTY BNDRY

HISTORIC SC/EFSC BNDRY LINE

PROPOSED SC/EFSC BNDRY LINE

BASIN DIVERSION AREA (EAST FORK SAND CREEK TO SAND CREEK) * ~267.3 AC

PNDW3 POND W3 WILL BE UTILIZED TO AID IN REDUCING CHANNELIZED RUNOFF TO HISTORIC LEVELS.

POTENTIAL LOCATION FOR FULL SPECTRUM DETENTION POND

*ALL DIVERTED RUNOFF SHALL BE DIRECTED TO FULL SPECTRUM DETENTION PONDS PRIOR TO DISCHARGE INTO SAND CREEK CHANNEL. WHENEVER POSSIBLE ADDITIONAL LID BMP'S WILL BE UTILIZED TO REDUCE INCREASES IN RUNOFF VOLUMES.

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

SHEET 1 OF 1

Table VIII-1: Unit Construction Costs

Item	Unit	Unit Cost	Comments
CHANNEL AND HYDRAULIC STRUCTURES			
Channel earthwork	CY	$8	
Filter material	Ton	$25	
Structural concrete	CY	$250	
Seeding and mulching	SF	$0.15	
Riprap Type H	CY	$30	
Riprap Type M	CY	$24	
12 foot wide gravel trail	LF	$15	Maintenance trail
Erosion netting	SY	$1.75	
Topsoil	CY	$12	
STORM SEWERS RCP/CMP			
18-inch	LF	$20	
24-inch	LF	$25	
30-inch	LF	$42	
36-inch	LF	$58	
42-inch	LF	$75	
48-inch	LF	$80	
60-inch	LF	$120	
ROADWAY CROSSINGS			
Structural Concrete, in-place	CY	$300	
Wingwalls/headwalls	EA	$5,000	
Bridges	SF	$80	Based on area of roadway deck.
4' high CBC, 4'-10' wide	LF	$210-320	
6' high CBC, 8'-12' wide	LF	$270-510	
7' x7' CBC	LF	$300	
Twin 4' high CBC, 4'-10' wide	LF	$480-650	
Twin 5'x 8' CBC	LF	$540	
Twin 6' high CBC, 8'-15' wide	LF	$600-1200	
Twin 8'x 10' CBC	LF	$750	
Triple 5'x 8' CBC	LF	$900	
Triple 6'x 14' CBC	LF	$1410	
Triple 6'x 16' CBC	LF	$1770	
Triple 8'x 10' CBC	LF	$1110	
Triple 10'x 10' CBC	LF	$1260	
4-bay 5' x 8' CBC	LF	$1200	
4-bay 8' x 10' CBC	LF	$1560	
DETENTION BASINS			
Outlet structures, non jurisdictional	EA	$10,000	
Outlet structures, jurisdictional	EA	$15,000	
Unit storage cost	AF	$10,000	
MITIGATION	AC	$4,000	
LAND ACQUISITION			
Detention basins	AC	$15,900	Based on park land fee.

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
UPPER SAND CREEK									
104	SC-4	1950	10-YEAR RIPRAP	1150	238	3	420	$420,700	$420,700
106	SC-5	3100	SEL LININGS	650	238	1	120	$173,300	$173,300
113	"	3600	"	750	238	0	0	$178,500	$178,500
120	"	2650	"	1000	238	5	340	$290,700	$290,700
			SEL. LININGS (1 SIDE)	350	127	0	0	$44,450	$44,450
125	SC-6	1200	"	300	127	2	260	$84,900	$84,900
184	"	1400	"	0	0	3	360	$64,800	$64,800
129	"	4050	"	2050	127	9	900	$422,350	$422,350
			10-YEAR RIPRAP	300	238	0	0	$71,400	$71,400
137	"	4150	SEL. LININGS (1 SIDE)	3750	127	6	900	$638,250	$638,250
185	"	1100	"	350	127	2	240	$87,650	$87,650
141	SC-7	3200	"	3000	127	4	310	$436,800	$436,800
148-1	"	3300	"	3150	127	8	850	$553,050	$553,050

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

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
28	EF-5	4200	"	3500	185	6	480	$815,500	$815,500
45	EF-6	1800	"	1400	185	6	480	$427,000	$427,000
44	"	4880	"	4080	185	11	990	$1,101,300	$1,101,300
54	EF-7	5070	"	4220	228	15	1950	$1,644,660	$1,644,660
73	"	1600	100-YEAR RIPRAP	1600	205	1	60	$349,000	$349,000
74A	"	950	"	950	268	3	120	$296,600	$296,600
74	"	3000	"	3000	234	8	400	$842,000	$842,000
84	EF-8	5400	SELECTIVE LININGS	5300	93	5	200	$562,900	$562,900
92	"	5450	"	5400	93	7	280	$600,200	$600,200
TOTAL EAST FORK SAND CREEK DRAINAGEWAY								$15,674,470	$17,106,670

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

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
TUTT 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	136	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

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
BANNING-LEWIS PRKW	SC-8	186	6'Hx10'W CBC	120	LF	$390	$46,800	$46,800
ARROYO LANE	SC-9	171	6'Hx12'W CBC	80	LF	$510	$40,800	$0
VOLLMER ROAD	SC-8	169	60-INCH CMP	80	LF	$120	$9,600	$0
"	SC-9	173	"	80	LF	$120	$9,600	$0
BURGESS ROAD	SC-9	176	42-INCH CMP	80	LF	$75	$6,000	$0
"	SC-9	178	2-42-INCH CMP	80	LF	$150	$12,000	$0
		CENTER TRIBUTARY						
TERMINAL AVENUE	CT-2	144	4-5'Hx8'W CBC	60	LF	$1,200	$72,000	$0
OMAHA BOULEVARD	CT-2	146-2	3-4'Hx9'W CBC	80	LF	$900	$72,000	$0
		WEST FORK SAND CREEK						
WOOTEN ROAD	WF-1	153	2-4'Hx6'W CBC	100	LF	$480	$48,000	$0
EDISON AVENUE	WF-1	153	2-4'Hx6'W CBC	60	LF	$240	$14,400	$0
PALMER PARK BLVD.	WF-1	154-2	2-4'Hx10'W CBC	80	LF	$540	$43,200	$0
CHICAGO RI RR	WF-1	165-1	4'Hx8'W CBC	220	LF	$270	$59,400	$0
HALF MOON DRIVE	WF-1	165-2	4'Hx6'W CBC	60	LF	$240	$14,400	$0
TOTAL CULVERT CONSTRUCTION COSTS, SAND CREEK							$1,902,600	$1,111,000

TABLE VIII-4: SAND CREEK DRAINAGE BASIN PLANNING STUDY
CONT'D ROADWAY CULVERT CROSSING COST ESTIMATE
EAST FORK SAND CREEK BASINS

ROADWAY	REACH NUMBER	DRAINAGEWAY SEGMENT	CROSSING TYPE	LENGTH	UNIT	UNIT COST	TOTAL COST	TOTAL REIMBURSABLE COSTS
		EAST FORK SAND CREEK						
WESTERN DRIVE	EF-2	104	4'H x 7'W CBC	60	LF	$280	$16,800	$0
PALMER PARK BLVD	EF-2	6	6'H x 12'W CBC	80	LF	$380	$30,400	$30,400
FUTURE AKERS	EF-2	84	6'H x 10'W CBC	60	LF	$350	$21,000	$21,000
CHICAGO & RI RR	EF-2	20	8'H x 12'W CBC	120	LF	$800	$96,000	$96,000
BANNING LEWIS PRKWY	EF-4	17	2-5'H x 8'W CBC	450	LF	650	$292,500	$292,500
STAPLETON DRIVE	EF-4	17	2-5'H x 6'W CBC	180	LF	$500	$90,000	$90,000
STAPLETON DRIVE	EF-4	124A	2-6'H x 8'W CBC	200	LF	$600	$120,000	$120,000
STAPLETON DRIVE	EF-4	124A	6'H x 8'W CBC	175	LF	$270	$47,250	$47,250
STAPLETON DRIVE	EF-4	124A	6'H x 8'W CBC	175	LF	$270	$47,250	$47,250
NORTH CAREFREE	EF-4	30	8'H x 8'W CBC	150	LF	$400	$60,000	$60,000
BANNING-LEWIS PRKWY	EF-4	30	8'H x 8'W CBC	195	LF	$400	$78,000	$78,000
BARNES ROAD	EF-4	31	8'H x 8'W CBC	250	LF	$400	$100,000	$100,000
BRIDLESPUR RD	EF-5	144	6'H x 5'W CBC	150	LF	$250	$37,500	$37,500
BANNING-LEWIS PRKWY	EF-7	55	6'H x 10'W CBC	300	LF	$350	$105,000	$105,000
DUBLIN ROAD	EF-7	57	5'H x 10'W CBC	150	LF	$320	$48,000	$48,000
BANNING-LEWIS PRKWY	EF-7	173	8'H x 8'W CBC	350	LF	$270	$94,500	$94,500
WOODMEN ROAD	EF-8	84	8'H x 15'W CBC	100	LF	$750	$75,000	$75,000
RESEARCH PARKWAY	EF-7	83	8'H x 8'W CBC	180	LF	$270	$48,600	$48,600
RESEARCH PARKWAY	EF-8	84	8'H x 10'W CBC	180	LF	$350	$63,000	$63,000
		EAST FORK SUB-TRIB						
STAPLETON DRIVE	EFST-2	42	8'Hx9'W CBC	180	LF	$300	$54,000	$54,000
BRIDLESPUR RD	EFST-2	58	8'Hx8'W CBC	150	LF	$270	$40,500	$40,500
DUBLIN ROAD	EFST-2	70	5'Hx8'W CBC	150	LF	$250	$37,500	$37,500

Table VIII-7:

SAND CREEK DRAINAGE BASIN PLANNING STUDY
BRIDGE CROSSING COST ESTIMATE
SAND CREEK DRAINAGE BASINS

ROADWAY	REACH NUMBER	DRAINAGEWAY SEGMENT	CROSSING TYPE	JURISIDICTION CITY	JURISIDICTION COUNTY	SIZE	UNIT	UNIT COST	TOTAL COST COUNTY	TOTAL COST CITY
		SAND CREEK								
CHELTON ROAD	SC-1	115	210' TWO-SPAN BRIDGE	X		16800	SF	$80	$0	$1,344,000
STETSON HILLS BLVD.	SC-6	130	3- 8'Hx10'W CBC	X		200	LF	$1,110	$0	$222,000
JEDEDIAH SMITH RD.	SC-6	137	3- 8'Hx10'W CBC	X		60	LF	$1,110	$0	$66,600
PETERSON ROAD	SC-6	141	80' CLEAR SPAN BRIDGE	X		6400	SF	$80	$0	$512,000
DUBLIN BOULEVARD	SC-7	141	80' CLEAR SPAN BRIDGE	X		6400	SF	$80	$0	$512,000
MARKSHEFFEL ROAD	SC-8	151	3- 10'Hx10'W CBC		X	80	LF	$1,260	$100,800	$0
RESEARCH PARKWAY	SC-8	163	4- 8'Hx10'W CBC		X	80	LF	$1,560	$124,800	$0
BANNING-LEWIS PRKWY	SC-8	187	4- 8'Hx10'W CBC		X	80	LF	$1,560	$124,800	$0
		CENTER TRIBUTARY								
W. FRONTAGE ROAD	CT-1	142	3- 6'Hx16'W CBC		X	60	LF	$1,770	$106,200	$0
US 24 BYPASS	CT-1	142	3- 6'Hx14'W CBC		X	150	LF	$1,410	$211,500	$0
E. FRONTAGE RD, US 24	CT-1	142	3- 6'Hx14'W CBC		X	60	LF	$1,410	$84,600	$0
BIJOU STREET, US 24	CT-1	142	3- 6'Hx14'W CBC		X	60	LF	$1,410	$84,600	$0
PLATTE AVENUE, US 24	CT-2	142	3- 6'Hx14'W CBC		X	120	LF	$1,410	$169,200	$0
GALLEY ROAD	CT-4	144	3- 5'Hx8'W CBC		X	100	LF	$900	$90,000	$0
		WEST FORK SAND CREEK								
GALLEY ROAD	WF-2	155	54' CLEAR SPAN BRIDGE	X		5130	SF	$80	$0	$410,400
PALMER PARK BLVD.	WF-2	156	54' CLEAR SPAN BRIDGE	X		5130	SF	$80	$0	$410,400
CONSTITUTION AVE.	WF-3	159	40' CLEAR SPAN BRIDGE	X		3200	SF	$80	$0	$256,000
MAIZELAND ROAD	WF-3	170	30' CLEAR SPAN BRIDGE	X		2400	SF	$80	$0	$192,000
SO. CAREFREE	WF-3	170	2- 6'Hx15'W CBC	X		80	LF	$1,200	$0	$96,000
TOTAL BRIDGE CONSTRUCTION COSTS, SAND CREEK									$1,096,500	$4,021,400

Table VIII-9: SAND CREEK DRAINAGE BASIN PLANNING STUDY
CITY BRIDGE FEE CALCULATION

ROADWAY	CROSSING TYPE	TOTAL COST	TOTAL CITY COST (1)	TOTAL REIMBURSABLE COST
SAND CREEK				
CHELTON ROAD	210' TWO-SPAN BRIOGE	$1,344,000	$201,600	$1,142,400
STETSON HILLS	3- 8'Hx10'W CBC	$222,000	$84,360	$137,640
JEDEDIAH SMITH RD.	3- 8'Hx10'W BOX CULVERT	$66,600	$9,990	$56,610
PETERSON ROAD	80' CLEAR SPAN BRIDGE	$512,000	$194,560	$317,440
DUBLIN BOULEVARD	80' CLEAR SPAN BRIDGE	$512,000	$194,560	$317,440
WEST FORK SAND CREEK				
GALLEY ROAD	54' CLEAR SPAN BRIOGE	$410,400	$410,400	$0
PALMER PARK BLVD.	54' CLEAR SPAN BRIDGE	$410,400	$410,400	$0
CONSTITUTION AVE.	40' CLEAR SPAN BRIDGE	$256,000	$256,000	$0
MAIZELAND ROAD	30' CLEAR SPAN BRIDGE	$192,000	$192,000	$0
SOUTH CAREFREB CIRCLE	2- 8'Hx15'W CBC	$96,000	$96,000	$0
EAST FORK SAND CREEK				
STAPLETON PARKWAY	2-10'H x 10'W CBC	$210,000	$138,600	$71,400
BANNING LEWIS PARKWAY	2-10'H x 14'W CHC	$375,000	$288,750	$86,250
NORTH CAREFREE CIRCLE	2-10'H x 14'W CBC	$187,500	$103,125	$84,375
BARNES ROAD	150' TWO SPAN BRIDGE	$720,000	$475,200	$244,800
BRIDLESPUR ROAD	2-8'H x 9'W CBC	$108,750	$59,813	$48,937
DUBLIN ROAD	150' TWO SPAN BRIDGE	$720,000	$396,000	$324,000
EAST FORK SUB-TRIBUTARY				
BARNES ROADWAY	2- 10'H x 12'W CHC	$253,000	$166,980	$86,020
NORTH CAREFREE CIRCLE	2- 8'H x 10'W CBC	$142,500	$78,375	$64,125
EAST BIERSTADT CREEK				
UN-NAMED ROADWAY	2- 10'H x 14'W CBC	$312,500	$193,750	$118,750
WEST BIERSTADT CREEK				
UN-NAMED ROADWAY	2- 10'H x 12'W CBC	$198,000	$122,760	$75,240
TOTAL ROADWAY CONSTRUCTION COSTS		$7,248,650	$4,073,223	$3,175,428
10% ENGINEERING		$724,865	$407,322	$317,543
5% CONTINGENCY		$362,433	$203,661	$158,771
TOTALS		$8,335,948	$4,684,206	$3,651,742
TOTAL UNPLATTED ACREAGE IN CITY				11312
CITY BRIDGE FEE ($/ACRE)				$323

(1) FEES HAVE BEEN CALCULATED PER CITY ORDINANCE 15-3-1001, ARTERIAL ROADWAY BRIDGES.
CITY IS RESPONSIBLE FOR COST OF BRIDGE IN EXCESS OF 68-FEET AS MEASURED PERPENDICULARLY TO THE ROADWAY CENTERLINE UP TO AND NOT EXCEEDING THE ROAD RIGHT-OF-WAY WIDTH.

Table VIII-10: SAND CREEK DRAINAGE BASIN PLANNING STUDY
COUNTY BRIDGE FEE CALCULATION

ROADWAY	CROSSING TYPE	TOTAL COST	TOTAL COUNTY COST	TOTAL REIMBURSABLE COST
SAND CREEK				
MARKSHEFFEL ROAD	3- 10'Hx10'W CBC	$100,800	$0	$100,800
RESEARCH PARKWAY	4-8'Hx10'W CBC	$124,800	$0	$124,800
BANNING-LEWIS PARKWAY	4-8'Hx10'W CBC	$124,800	$0	$124,800
CENTER TRIBUTARY SAND CREEK				
W. FRONTAGE US 24 (1)	3-6'Hx16'W CBC	$106,200	$0	$0
US 24 (POWERS) (1)	3-6'Hx14'W CBC	$211,500	$0	$0
E. FRONTAGE US 24 (1)	3-6'Hx14'W CBC	$84,600	$0	$0
BIJOU STREET (1)	3-6'Hx14'W CBC	$84,600	$0	$0
PLATTE AVENUE (1)	3-6'Hx14'W CBC	$169,200	$0	$0
GALLEY ROAD	3-5'Hx8'W CBC	$90,000	$56,700	$33,300
EAST FORK SAND CREEK				
UN-NAMED ROAD, PETERSON AFB	140' TWO SPAN BRIDGE	$336,000	$0	$0
PETERSON ROAD	3-9'H X 16'W CBC	$144,000	$0	$144,000
OMAHA BLVD EXTENDED	3-9'H X 16'W CBC	$144,000	$0	$144,000
MARKSHEFFEL ROAD	120' TWO SPAN BRIDGB	$672,000	$0	$672,000
EAST FORK SUBTRIBUTARY				
GENOA DRIVE	2-6'H X 14'W CBC	$84,000	$0	$84,000
TOTAL ROADWAY CONSTRUCTION COSTS		$2,476,500	$56,700	$1,427,700
10% ENGINEERING		$247,650	$5,670	$142,770
5% CONTINGENCY		$123,825	$2,835	$71,385
COUNTY BRIDGE OUTSTANDING CLAIMS				$1,083,133
TOTALS		$2,847,975	$65,205	$2,724,988
TOTAL UNPLATTED ACREAGE IN COUNTY				7497
COUNTY BRIDGE FEE ($/ACRE)				$363

(1) BRIDGES ON CENTER TRIBUTARY FUNDED THROUGH US 24 BYPASS PHASE II PROJECT.

Section I.

Other Supporting Documents

DEVELOPED CONDITIONS

WOODMEN HEIGHTS

MASTER DEVELOPMENT DRAINAGE PLAN

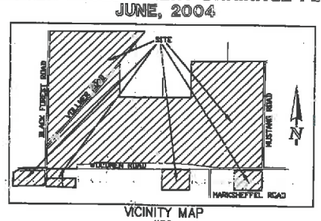
JUNE, 2004

PIPE RUN SUMMARY

0 36" RCP @ 1.00%	5A 72" RCP @ 1.00%	10 48" RCP @ 1.00%	17 72" RCP @ 1.00%	25 66" RCP @ 1.00%	33 36" RCP @ 1.00%	41 60" RCP @ 1.00%	
1 18" RCP @ 1.00%	6 48" RCP @ 1.00%	11 48" RCP @ 1.00%	18 48" RCP @ 1.00%	26 66" RCP @ 1.00%	34 78" RCP @ 1.00%	42 42" RCP @ 1.00%	
2 36" RCP @ 1.00%	7 42" RCP @ 1.00%	12 30" RCP @ 1.00%	19 30" RCP @ 1.00%	27 24" RCP @ 1.00%	35 42" RCP @ 1.00%	43 36" RCP @ 1.00%	
3 54" RCP @ 1.00%	7A 78" RCP @ 1.00%	12A 48" RCP @ 1.00%	20 36" RCP @ 1.00%	28 66" RCP @ 1.00%	36 78" RCP @ 1.00%	44 54" RCP @ 1.00%	
3A 54" RCP @ 1.00%	8 42" RCP @ 1.00%	13 36" RCP @ 1.00%	21 36" RCP @ 1.00%	29 18" RCP @ 1.00%	37 42" RCP @ 1.00%	45 54" RCP @ 1.00%	
3B 66" RCP @ 1.00%	8A 66" RCP @ 1.00%	14 66" RCP @ 1.00%	22 30" RCP @ 1.00%	30 72" RCP @ 1.00%	38 54" RCP @ 1.00%		
4 66" RCP @ 1.00%	8B 72" RCP @ 1.00%	15 66" RCP @ 1.00%	23 36" RCP @ 1.00%	31 36" RCP @ 1.00%	39 42" RCP @ 1.00%		
5 42" RCP @ 1.00%	9 42" RCP @ 1.00%	16 48" RCP @ 1.00%	24 36" RCP @ 1.00%	32 72" RCP @ 1.00%	40 48" RCP @ 1.00%		

VICINITY MAP

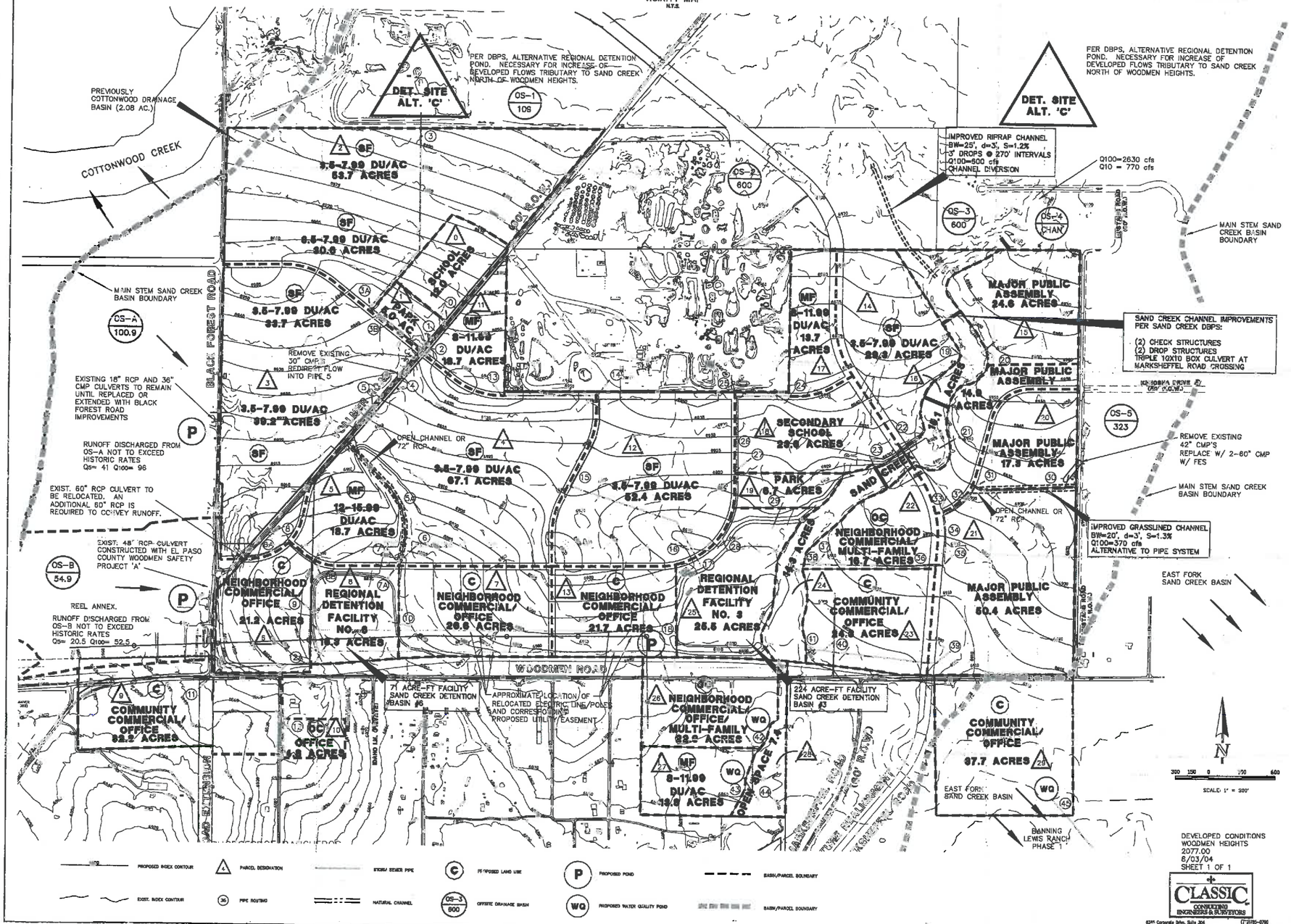
N.T.S.



PARCEL RUNOFF SUMMARY

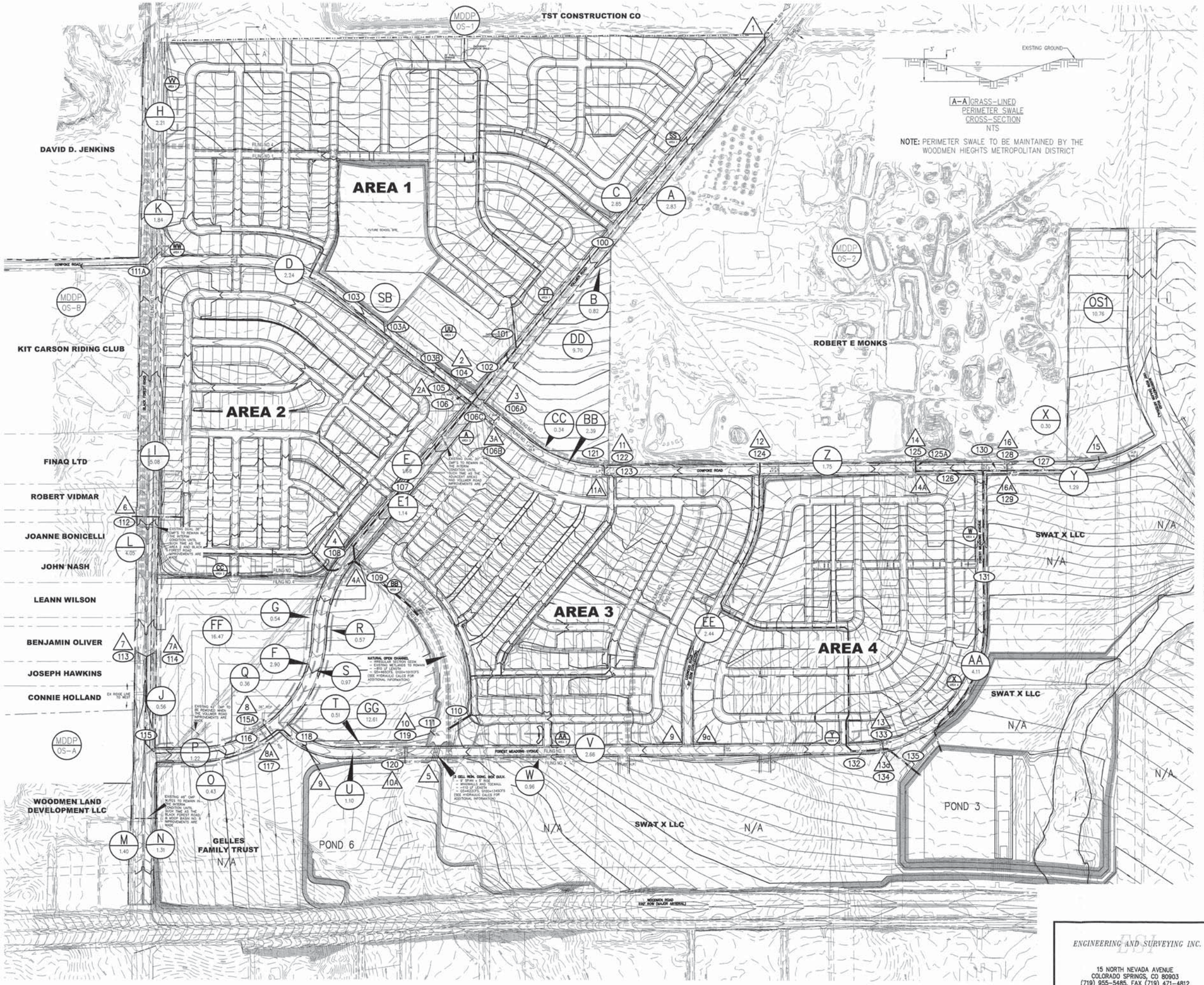
0 Q5 = 19 CFS Q100 = 40 CFS	7 Q5 = 64 CFS Q100 = 118 CFS	14 Q5 = 31 CFS Q100 = 61 CFS	21 Q5 = 43 CFS Q100 = 170 CFS	28 Q5 = 1.6 CFS Q100 = 5.7 CFS	OS-1 Q5 = 4 CFS Q100 = 68 CFS		
1 Q5 = 1.0 CFS Q100 = 1.5 CFS	8 Q5 = 5.5 CFS Q100 = 28 CFS	15 Q5 = 66 CFS Q100 = 130 CFS	22 Q5 = 40 CFS Q100 = 73 CFS	29 Q5 = 90 CFS Q100 = 184 CFS	OS-2 Q5 = 20.5 CFS Q100 = 352.8 CFS		
2 Q5 = 84 CFS Q100 = 178 CFS	9 Q5 = 64 CFS Q100 = 118 CFS	16 Q5 = 1.6 CFS Q100 = 14.1 CFS	23 Q5 = 36 CFS Q100 = 108 CFS		OS-3 Q5 = 65 CFS Q100 = 163 CFS		
3 Q5 = 56 CFS Q100 = 101 CFS	10 Q5 = 11.5 CFS Q100 = 31 CFS	17 Q5 = 22 CFS Q100 = 46 CFS	24 Q5 = 1.5 CFS Q100 = 13.3 CFS		OS-4 Q5 = 215 CFS Q100 = 810 CFS		
4 Q5 = 51 CFS Q100 = 140 CFS	11 Q5 = 21 CFS Q100 = 43 CFS	18 Q5 = 73 CFS Q100 = 84 CFS	25 Q5 = 8.4 CFS Q100 = 32 CFS		OS-5 Q5 = 216 CFS Q100 = 940 CFS		
5 Q5 = 39 CFS Q100 = 76 CFS	12 Q5 = 40 CFS Q100 = 110 CFS	19 Q5 = 5.5 CFS Q100 = 8.2 CFS	26 Q5 = 65 CFS Q100 = 160 CFS		OS-6 Q5 = 800 CFS Q100 = 2288 CFS		
6 Q5 = 37 CFS Q100 = 42 CFS	13 Q5 = 53 CFS Q100 = 84 CFS	20 Q5 = 28 CFS Q100 = 58 CFS	27 Q5 = 34 CFS Q100 = 83 CFS		OS-7 Q5 = 75 CFS Q100 = 340 CFS		

OFFSITE RUNOFF SUMMARY



DEVELOPED CONDITIONS
WOODMEN HEIGHTS
2077.00
6/03/04
SHEET 1 OF 1

CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 Corporate Drive, Suite 204 Colorado Springs, Colorado 80919
(719)785-0790 (719)785-0799 (Fax)



OFFSITE & ROADWAY DESIGN POINT SUMMARY

Design Point	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	STRUCTURE
1	80.6	195.5	TO ENTER PROPOSED FES
2	12.6	35.1	10' D–10–R SUMP INLET
2A	20.1	39.1	10' D–10–R SUMP INLET
3	8.5	10.5	4' D–10–R SUMP INLET
3A	5.5	10.5	4' D–10–R SUMP INLET
4	6.3	11.9	–
4A	5.6	10.8	–
7	21.9	41.2	16' D–10–R SUMP INLET
7A	22.8	41.1	16' D–10–R SUMP INLET
8	18.8	35.9	8' D–10–R SUMP INLET
8A	8.2	15.6	8' D–10–R SUMP INLET
10	27.8	53.9	10' D–10–R SUMP INLET
10A	8.0	15.6	10' D–10–R SUMP INLET
11	5.4	10.6	4' D–10–R SUMP INLET
11A	5.4	10.4	4' D–10–R SUMP INLET
13	15.1	30.1	6' D–10–R SUMP INLET
13A	7.9	14.7	6' D–10–R SUMP INLET
14	3.9	7.2	4' D–10–R SUMP INLET
14A	3.9	7.2	4' D–10–R SUMP INLET
16	3.2	6.1	4' D–10–R SUMP INLET
16A	3.2	6.1	4' D–10–R SUMP INLET

OFFSITE AND ROADWAY BASINS STORM SEWER SUMMARY

PIPE RUN	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	PIPE SIZE
100	80.6	195.5	48" RCP
101	109.4	243.2	48" RCP
102	190.0	439.4	66" RCP
103	52.5	110.3	48" RCP
103A	40.1	71.4	30" RCP
103B	92.6	181.7	54" RCP
104	15.0	33.8	24" RCP
105	15.0	33.8	24" RCP
106	122.7	249.2	66" RCP
106A	5.5	10.5	24" RCP
106B	5.5	10.5	24" RCP
106C	10.9	21.0	30" RCP
107	324.0	711.6	84" RCP
108	140.9	304.1	84" RCP
109	464.9	1015.1	108" RCP
110	127.1	267.2	66" RCP
111	30.2	62.7	36" RCP
BOX	622.2	1345.1	3–9'X5'
112	41.0	96.0	54" RCP
113	23.0	40.4	30" RCP
114	22.0	40.4	30" RCP
115	44.0	80.9	42" RCP
115A	39.7	82.5	36" RCP
116	49.6	101.0	42" RCP
117	12.6	24.1	18" RCP
118	97.6	188.7	60" RCP
119	15.3	29.7	18" RCP
120	30.5	59.3	18" RCP
121	24.2	50.3	36" RCP
122	28.9	59.3	36" RCP
123	33.5	68.0	36" RCP
124	108.0	305.0	60" RCP
125	108.0	305.0	60" RCP
125A	111.8	312.2	60" RCP
126	115.7	319.4	66" RCP
127	26.3	54.6	36" RCP
128	3.2	6.1	18" RCP
129	3.2	6.1	18" RCP
130	31.7	65.0	36" RCP
131	147.3	384.5	72" RCP
132	194.2	486.8	72" RCP
133	11.0	21.5	30" RCP
134	11.0	21.5	30" RCP
135	216.1	529.7	84" RCP

OFFSITE & ROADWAY BASIN SUMMARY

BASIN	AREA (Acres)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
A	2.8	10.1	19.0
B	0.8	0.8	2.1
C	2.8	10.2	19.1
D	2.2	8.7	16.3
E	1.7	6.3	11.9
E1	1.4	4.8	9.1
F	0.9	12.8	24.0
G	0.5	0.6	1.4
H	0.9	8.7	16.3
I	0.9	17.3	32.5
J	0.6	0.6	1.5
K	1.8	7.2	13.6
L	4.1	14.5	27.2
M	1.4	6.2	11.6
N	1.3	5.8	10.8
O	0.4	0.5	1.2
P	1.2	5.6	10.5
Q	0.4	0.4	1.0
R	0.6	0.6	1.5
S	1.0	4.2	7.9
T	0.5	0.5	1.3
U	1.1	5.0	9.3
V	2.66	10.1	19.0
W	1.0	0.5	2.3
X	0.3	0.3	0.8
Y	1.3	5.6	10.5
Z	1.8	7.7	14.4
AA	4.1	15.6	29.4
BB	2.4	11.0	20.6
CC	0.3	0.4	0.9
DD	9.7	24.2	50.3
EE	2.4	9.7	18.2
FF	16.5	39.7	82.5
GG	12.6	30.2	62.7
OS1	10.7	26.3	54.6

NOTE:
PROPOSED GRADING SHOWN OUTSIDE OF THE FOREST MEADOWS DEVELOPMENT AREAS (INCLUDING DETENTION PONDS 3 AND 6) IS HIGHLY CONCEPTUAL IN NATURE AND HAS BEEN SHOWN FOR INFORMATION ONLY. AS EACH INDIVIDUAL ADJACENT SITE IS DEVELOPED, A DRAINAGE REPORT AND ASSOCIATED GRADING PLAN DOCUMENT WILL BE REQUIRED PER CITY OF COLORADO SPRINGS GUIDELINES.

LEGEND

- SB — SEDIMENT BASIN
- A / 2.00 — BASIN LABEL / ACREAGE
- 200 — PIPE REFERENCE LABELS
- 2A — SURFACE DESIGN POINT
- FLOW DIRECTION
- BASIN BOUNDARY
- 6920 — EXISTING CONTOUR
- 6920 — PROPOSED CONTOUR
- STORM SEWER PIPE
- CROSSPAN
- INLET
- MANHOLE
- FLARED END SECTION
- PERIMETER SWALE
- FILING LINE
- N/A — THESE PROPERTIES WILL BE ADDRESSED IN SUBSEQUENT FINAL DRAINAGE REPORTS SPECIFIC TO THESE AREAS.

ENGINEERING AND SURVEYING INC.
15 NORTH NEVADA AVENUE
COLORADO SPRINGS, CO 80903
(719) 955–5485, FAX (719) 471–4812

FOREST MEADOWS – OFFSITE & ROADWAYS
DRAINAGE MAP

PROJECT NO. 08–001		FILE: *\dwg\Dev. Plan\08001 – Drainage Plan	
DESIGNED BY:	BES	SCALE	DATE: 1/5/06
DRAWN BY:	BVDP	HORIZ: 1"=100'	SHEET 1 OF 6
CHECKED BY:	VAS	VERT: N/A	D1

SHILOH MESA
POST DEVELOPMENT DRAINAGE PLAN
DECEMBER 2015

NORTH
1" = 100'

LEGEND

DESIGN POINT
FLOW DIRECTION
EMERGENCY OVERFLOW
BASIN DESIGNATION (A / 5.0 / .25 / .30 / C100 / ACRES / Q5)
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
13	30" RCP	12.9	27.5
14	42" RCP	32.3	68.4
15	18" RCP	3.3	7.1
16	18" RCP	5.3	11.2
17	24" RCP	8.2	17.6
18	18" RCP	4.0	8.6
19	18" RCP	4.6	9.9
20	24" RCP	8.5	18.1
21	30" RCP	16.5	35.3
22	24" RCP	8.4	18.0
23	18" RCP	1.8	3.5
24	42" RCP	31.9	70.6
25	18" RCP	3.5	7.4
26	42" RCP	35.0	77.2
27	24" RCP	6.4	16.6
28	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

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

OWNER: BARHAM TED R
LOCATION: 8245 MUSTANG RD
OWNER: ERNST GORDON W / ERNST WANDA R
LOCATION: 8185 MUSTANG RD
OWNER: HOFER ROBERT P & CAROLYN S
LOCATION: 8035 MUSTANG RD
OWNER: HOFER ROBERT P & CAROLYN S
LOCATION: 8035 MUSTANG RD
OWNER: CLEARWATER WILLIAM F & MELINDA E
LOCATION: 7950 MAVERICK RD
OWNER: PETERSON PAUL K & PETERSON LAURIE A
LOCATION: 7895 MUSTANG RD
OWNER: BRACE-HALL FAMILY TRUST
LOCATION: 8215 MUSTANG RD
OWNER: LEDOUX LEONARD & EDNA
LOCATION: 8255 MUSTANG PL
OWNER: WOLF-LEDOUX, AARIL WOLF-LEDOUX, JUSTIN
LOCATION: 8175 MUSTANG RD
OWNER: CENTER FOR STRATEGIC MINISTRY
LOCATION: 0 4-13-65
OWNER: MARK SHEFFELL-WOODMEN INVESTMENTS LLC
LOCATION: 0 4-13-65

MUSTANG ROAD
MARK SHEFFELL ROAD
ENOSHA ROAD
SAND CREEK
OUTER STREAMSIDE BOUNDARY
INNER STREAMSIDE BOUNDARY
100-YR FLOODPLAIN ZONE "AE"
FILING NO. 1 BOUNDARY
GRADE CONTROL
SELECTIVE LINING
NORTH WQ POND SAND FILTRATION BASIN WQCV= 3,200 CF
CENTRAL WQ POND SAND FILTRATION BASIN WQCV = 17,800 CF
SOUTH WQ POND SAND FILTRATION BASIN WQCV = 19,000 CF

SEE APPROVED GRADING PLAN FOR SHILOH MESA FILING NO.1 (IN REPORT) FOR MORE DETAIL OF OVERFLOW SWALE AND ADJACENT LOT GRADING. OVERFLOW TO 72" DIRECTED SOUTH ALONG MUSTANG ROAD

SEE SHEET 3 OF 3 FOR MARKSHEFFEL ROAD DRAINAGE BASIN INFORMATION.

AR PUD 14-00692

CIVIL CONSULTANTS, INC.
102 E. PIKES PEAK AVE., STE 306
COLORADO SPRINGS, COLORADO 80903
v 719.955.5485
f 719.444.0427

SHILOH-MESA
POST DEVELOPMENT DRAINAGE PLAN

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

PRELIMINARY DRAINAGE REPORT – BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	TOTAL FLOWS Q(5) (cfs)	TOTAL FLOWS Q(100) (cfs)
A1	0.77	1.79	5.12	0.14	120	2.4	15.1	740	2.8%	1.6	7.8	22.9	2.31	2.89	4.84	1.8	5	25
A2	0.41	0.97	2.76	0.14	300	12	19.0	400	4.0%	2.0	3.3	22.3	2.34	2.92	4.91	1.0	3	14
A3	0.35	0.83	2.36	0.14	300	8	21.7	400	3.0%	1.7	3.8	25.6	2.18	2.72	4.57	0.8	2	11
A4	0.25	0.42	0.92	0.20	180	8	13.3	180	4.0%	2.0	1.5	14.8	2.63	3.54	5.94	0.7	1	5
A5	0.33	0.77	2.20	0.14	280	10	19.1					19.1	2.53	3.16	5.31	0.8	2	12
B1	1.13	2.63	7.52	0.14	300	10.5	19.9	1280	3.2%	1.8	11.9	31.8	1.92	2.39	4.02	2.2	6	30
B2	0.48	1.12	3.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.2	3	17
B3	1.28	1.69	3.05	0.14	300	10.5	19.9	370	1.9%	1.2	5.0	24.9	2.21	2.76	4.63	2.8	5	14
B4	0.78	1.82	5.20	0.14	300	10.5	19.9					19.9	2.48	3.10	5.20	1.9	6	27
C1	1.13	2.13	5.25	0.17	300	12	18.4	600	2.0%	2.8	3.5	21.9	2.36	2.95	4.95	2.7	6	26
C2	0.52	0.86	1.89	0.20	300	14	16.9					16.9	2.67	3.34	5.61	1.4	3	11
C3	0.77	1.46	3.61	0.17	300	17	16.4					16.4	2.71	3.39	5.68	2.1	5	21
D1	1.02	1.28	2.72	0.21	200	4	18.0	600	2.0%	2.8	3.5	21.6	2.38	2.98	5.00	2.4	4	14
D2	2.54	3.53	6.63	0.25	150	3	15.0	900	3.0%	3.5	4.3	19.3	2.51	3.14	5.28	6.4	11	35
D3	0.68	0.85	1.81	0.21	150	3	15.6	375	2.0%	2.8	2.2	17.8	2.61	3.26	5.48	1.8	3	10
D4	1.36	1.84	3.30	0.27	150	3	14.6	600	3.9%	3.7	2.7	17.3	2.64	3.31	5.56	3.6	6	18
D5	2.30	3.20	6.02	0.25	150	3	15.0	1050	2.9%	3.2	5.5	20.5	2.44	3.05	5.13	5.6	10	31
D6	2.75	3.83	7.19	0.25	150	3	15.0	1200	2.0%	2.8	7.1	22.0	2.36	2.94	4.94	6.5	11	36
D7	0.19	0.43	1.11	0.16	150	3	16.5					16.5	2.70	3.37	5.67	0.5	1	6
D8	0.29	0.40	0.75	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.0	2	6
D9	0.38	0.53	0.99	0.25	70	2.8	8.1					8.1	3.54	4.44	7.46	1.3	2	7
D10	0.31	0.43	0.80	0.25	80	3.2	8.7					8.7	3.46	4.34	7.29	1.1	2	6
E	1.16	1.17	1.25	0.35	30	7.5	2.9	400	5.0%	2.2	3.0	5.9	3.93	4.92	8.27	4.5	6	10
F1	0.54	1.63	6.52	0.09	60	3	8.3	2400	2.0%	1.4	28.3	36.6	1.75	2.19	3.68	1.0	4	24
F2	0.14	0.41	1.66	0.09	60	6	6.6	1200	2.0%	1.4	14.1	20.7	2.43	3.03	5.09	0.3	1	8
H	0.40	0.94	2.68	0.14	300	11	19.6	900	2.0%	1.4	10.6	30.2	1.98	2.47	4.15	0.8	2	11
OS-1A	0.14	0.43	1.73	0.09	300	15	18.6	400	5.0%	4.5	1.5	20.1	2.47	3.08	5.18	0.4	1	9
OS-1B	0.70	2.11	8.42	0.09	300	15	18.6	1200	5.0%	4.5	4.5	23.0	2.30	2.88	4.83	1.6	6	41
OS-2A	0.06	0.18	0.72	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.1	0.6	4
OS-2B	0.07	0.21	0.83	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.6	4
OS-2C	0.45	1.34	5.36	0.09	300	12	20.0	1000	3.0%	3.5	4.8	24.8	2.21	2.77	4.64	1.0	4	25
OS-2D	0.03	0.08	0.31	0.09	250	12	17.2					17.2	2.65	3.32	5.57	0.07	0.3	2
OS-2E	0.09	0.28	1.12	0.09	300	12	20.0					20.0	2.47	3.09	5.19	0.2	0.9	6
OS-3	0.42	0.74	2.21	0.08	300	10	21.4	250	3.0%	3.5	1.2	22.6	2.32	2.90	4.87	1	2	11
OS-5	0.55	2.21	9.85	0.08	300	12	20.2	1500	3.0%	3.5	7.2	27.4	2.10	2.62	4.39	1	6	42

PRELIMINARY DRAINAGE REPORT – BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS AREA (AC)	C(2)	C(50)	C(100)	LANDSCAPE / DEVELOPED AREAS AREA (AC)	C(2)	C(5)	C(100)	WEIGHTED C(2)	WEIGHTED C(5)	WEIGHTED C(100)	WEIGHTED CA CA(2)	CA(5)	CA(100)
A1	12.8	0.00	0.89	0.95	0.96	12.80	0.06	0.14	0.40	0.06	0.14	0.40	**0.77**	**1.79**	**5.12**
A2	6.9	0.00	0.89	0.95	0.96	6.90	0.06	0.14	0.40	0.06	0.14	0.40	**0.41**	**0.97**	**2.76**
A3	5.9	0.00	0.89	0.95	0.96	5.90	0.06	0.14	0.40	0.06	0.14	0.40	**0.35**	**0.83**	**2.36**
A4	2.1	0.00	0.89	0.95	0.96	2.10	0.12	0.20	0.44	0.12	0.20	0.44	**0.25**	**0.42**	**0.92**
A5	5.5	0.00	0.89	0.95	0.96	5.50	0.06	0.14	0.40	0.06	0.14	0.40	**0.33**	**0.77**	**2.20**
B1	18.8	0.00	0.89	0.95	0.96	18.80	0.06	0.14	0.40	0.06	0.14	0.40	**1.13**	**2.63**	**7.52**
B2	8.0	0.00	0.89	0.95	0.96	8.00	0.06	0.14	0.40	0.06	0.14	0.40	**0.48**	**1.12**	**3.20**
B3	6.10	1.10	0.89	0.95	0.96	5.00	0.06	0.14	0.40	0.21	0.28	0.50	**1.28**	**1.69**	**3.06**
B4	13.0	0.00	0.89	0.95	0.96	13.00	0.06	0.14	0.40	0.06	0.14	0.40	**0.78**	**1.82**	**5.20**
C1	12.5	0.00	0.89	0.95	0.96	12.50	0.09	0.17	0.42	0.09	0.17	0.42	**1.13**	**2.13**	**5.25**
C2	4.3	0.00	0.89	0.95	0.96	4.30	0.12	0.20	0.44	0.12	0.20	0.44	**0.52**	**0.86**	**1.89**
C3	8.6	0.00	0.89	0.95	0.96	8.60	0.09	0.17	0.42	0.09	0.17	0.42	**0.77**	**1.46**	**3.61**
D1	6.0	0.00	0.89	0.95	0.96	6.00	0.17	0.21	0.45	0.17	0.21	0.45	**1.02**	**1.28**	**2.72**
D2	14.1	0.00	0.89	0.95	0.96	14.10	0.18	0.25	0.47	0.18	0.25	0.47	**2.54**	**3.53**	**6.63**
D3	4.0	0.00	0.89	0.95	0.96	4.00	0.17	0.21	0.45	0.17	0.21	0.45	**0.68**	**0.85**	**1.81**
D4	6.8	0.00	0.89	0.95	0.96	6.80	0.20	0.27	0.49	0.20	0.27	0.49	**1.36**	**1.84**	**3.30**
D5	12.8	0.00	0.89	0.95	0.96	12.80	0.18	0.25	0.47	0.18	0.25	0.47	**2.30**	**3.20**	**6.02**
D6	15.3	0.00	0.89	0.95	0.96	15.30	0.18	0.25	0.47	0.18	0.25	0.47	**2.75**	**3.83**	**7.19**
D7	2.7	0.00	0.89	0.95	0.96	2.70	0.07	0.16	0.41	0.07	0.16	0.41	**0.19**	**0.43**	**1.11**
D8	1.6	0.00	0.89	0.95	0.96	1.60	0.18	0.25	0.47	0.18	0.25	0.47	**0.29**	**0.40**	**0.75**
D9	2.1	0.00	0.89	0.95	0.96	2.10	0.18	0.25	0.47	0.18	0.25	0.47	**0.38**	**0.53**	**0.99**
D10	1.7	0.00	0.89	0.95	0.96	1.70	0.18	0.25	0.47	0.18	0.25	0.47	**0.31**	**0.43**	**0.80**
E	1.3	1.30	0.89	0.95	0.96	0.00	0.18	0.25	0.47	0.89	0.90	0.96	**1.16**	**1.17**	**1.25**
F1	18.1	0.00	0.89	0.95	0.96	18.10	0.03	0.09	0.36	0.03	0.09	0.36	**0.54**	**1.63**	**6.52**
F2	4.6	0.00	0.89	0.95	0.96	4.60	0.03	0.09	0.36	0.03	0.09	0.36	**0.14**	**0.41**	**1.66**
H	6.7	0.00	0.89	0.95	0.96	6.70	0.06	0.14	0.40	0.06	0.14	0.40	**0.40**	**0.94**	**2.68**
OS-1A	4.8	0.00	0.89	0.95	0.96	4.80	0.03	0.09	0.36	0.03	0.09	0.36	**0.14**	**0.43**	**1.73**
OS-1B	23.4	0.00	0.89	0.95	0.96	23.40	0.03	0.09	0.36	0.03	0.09	0.36	**0.70**	**2.11**	**8.42**
OS-2A	2.0	0.00	0.89	0.95	0.96	2.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.06**	**0.18**	**0.72**
OS-2B	2.3	0.00	0.89	0.95	0.96	2.30	0.03	0.09	0.36	0.03	0.09	0.36	**0.07**	**0.21**	**0.83**
OS-2C	14.9	0.00	0.89	0.95	0.96	14.90	0.03	0.09	0.36	0.03	0.09	0.36	**0.45**	**1.34**	**5.36**
OS-2D	0.85	0.00	0.89	0.95	0.96	0.85	0.03	0.09	0.36	0.03	0.09	0.36	**0.03**	**0.08**	**0.31**
OS-2E	3.1	0.00	0.89	0.95	0.96	3.10	0.03	0.09	0.36	0.03	0.09	0.36	**0.09**	**0.28**	**1.12**
OS-3	5.7	0.35	0.89	0.95	0.96	5.35	0.02	0.08	0.35	0.07	0.13	0.39	**0.42**	**0.74**	**2.21**
OS-5	27.6	0.00	0.89	0.95	0.96	27.60	0.02	0.08	0.35	0.02	0.08	0.35	**0.55**	**2.21**	**9.66**

PRELIMINARY DRAINAGE REPORT – SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Culvert / Inlet Size
1	OS-5 (27.6 ac.)	2.21	9.66	27.4	2.62	4.39	6	42	EX. 48" CMP
2	OS-3 (5.7 ac.)	0.74	2.21	22.6	2.90	4.87	2	11	24" RCP
3	DP-2, A-1 (18.5 ac.)	2.54	7.33	23.6	2.84	4.76	7	35	30" RCP
4	A2 (6.9 ac.)	0.97	2.76	22.3	2.92	4.91	3	14	24" RCP
5	DP-3, DP-4, A3 (31.3 ac.)	4.33	12.45	25.6	2.72	4.57	12	57	DUAL 30" RCP CULVERTS
6	**OS-3, A1, A2, A3 and A4 (POND B INFLOW - 33.4 ac.)**	4.75	13.37	26.6	2.66	4.47	**13**	**60**	
7	B1 (18.8 ac.)	2.63	7.52	31.8	2.39	4.02	6	30	30" RCP
8	B3 (6.1 ac.)	1.69	3.06	24.9	2.76	4.63	5	14	5' Type R sump inlets
9	**B1, B2 and B3 (POND C INFLOW - 32.9ac.)**	5.44	13.78	34.8	2.26	3.79	**12**	**52**	
10	C1, OS-1A (17.3 ac.)	2.56	6.98	23.4	2.85	4.79	7	33	30" RCP
11	C2 (4.3 ac.)	0.86	1.89	16.9	3.34	5.61	3	11	5' Type R sump inlets
12	D2, OS-2A (16.1 ac.)	3.71	7.35	20.0	3.09	5.19	11	38	10' Type R sump inlets
13	D1, OS-2B (8.3 ac.)	1.49	3.55	21.6	2.98	5.00	4	18	5' Type R sump inlets
14	D3, OS-2D (4.85 ac.)	0.93	2.12	17.8	3.26	5.48	3	12	5' Type R sump inlets
15	D5, OS-2E (15.9 ac.)	3.48	7.13	20.5	3.05	5.13	11	37	10' Type R sump inlets
16	D4 6.8 ac.)	1.84	3.30	17.3	3.31	5.56	6	18	5' Type R sump inlets
17	D6 (15.3 ac.)	3.83	7.19	22.0	2.94	4.94	11	36	10' Type R sump inlets
18	**DP-10 Thru DP-17 and OS-1B, OS-2C, D7 (POND D INFLOW - 129.9 ac.)**	22.55	54.40	27.8	2.60	4.36	**59**	**237**	

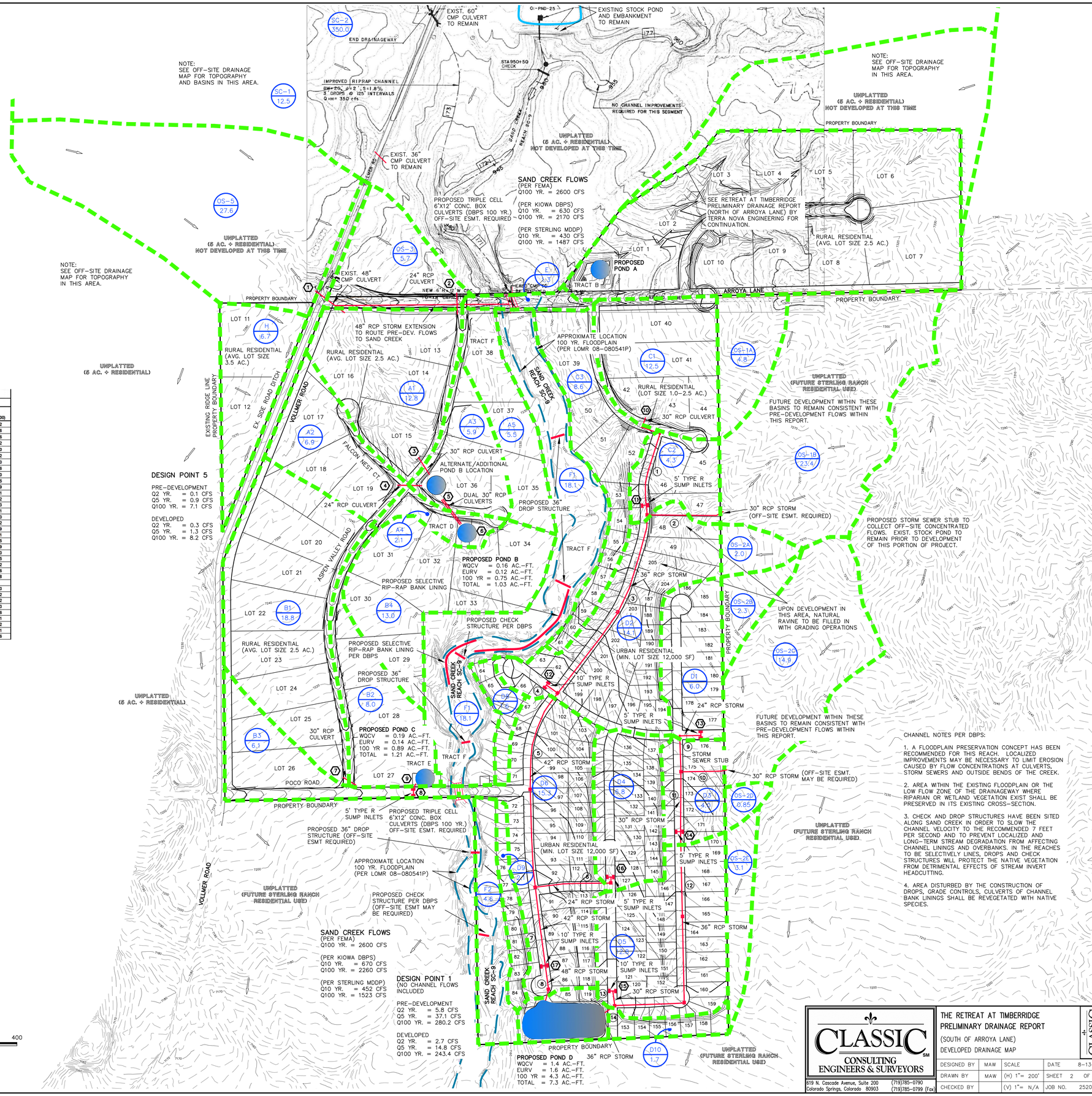
LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY	
BASIN IDENTIFIER / AREA IN ACRES	B8 10.0
DESIGN POINT	1
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
PROPOSED DRAINAGE IMPROVEMENTS	
PROPOSED DETENTION/SWQ POND	

N

200 100 0 200 400

SCALE: 1" = 200'



CLASSIC CONSULTING ENGINEERS & SURVEYORS
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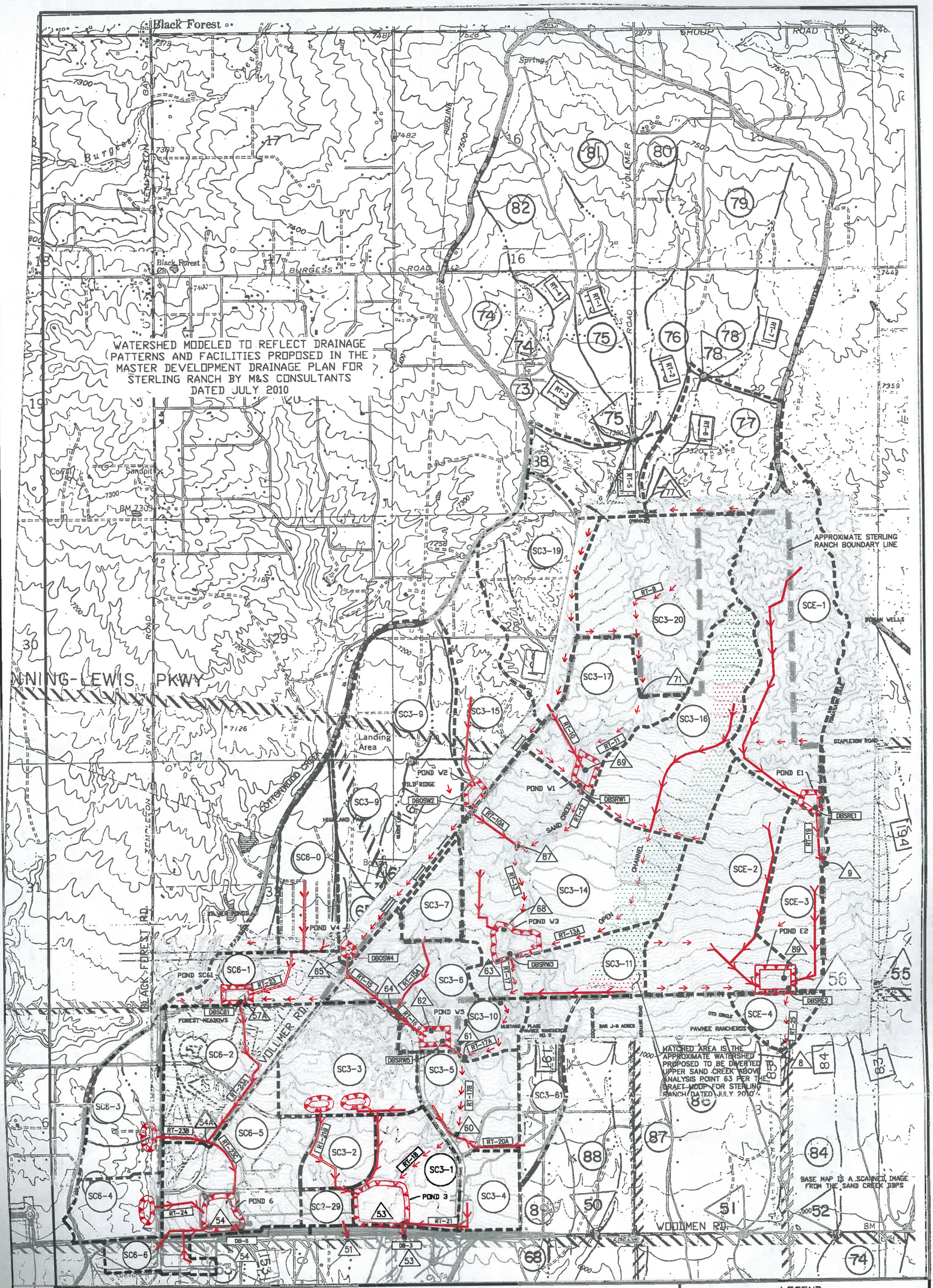
(719)785-0790 (719)785-0799 (Fax)

THE RETREAT AT TIMBERRIDGE
PRELIMINARY DRAINAGE REPORT
(SOUTH OF ARROYA LANE)
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE	8-13-18
DRAWN BY	MAW	(H) 1"= 200'	SHEET	2 OF 2
CHECKED BY		(V) 1"= N/A	JOB NO.	2520.00


WATERSHED MODELED TO REFLECT DRAINAGE PATTERNS AND FACILITIES PROPOSED IN THE MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH BY M&S CONSULTANTS DATED JULY 2010
APPROXIMATE STERLING RANCH BOUNDARY LINE
HATCHED AREA IS THE APPROXIMATE WATERSHED PROPOSED TO BE DIVERTED UPPER SAND CREEK ABOVE ANALYSIS POINT 63 PER THE DRAFT MDDP FOR STERLING RANCH DATED JULY 2010.
BASE MAP IS A SCANNED IMAGE FROM THE SAND CREEK DBPS
Black Forest
VOLLMER ROAD
WOODMEN RD.
POND W1
POND W2
POND W3
POND W4
POND W5
POND 3
POND 6
POND E1
POND E2
POND SC61
SAND CREEK
COTTONWOOD CREEK
SC3-19
SC3-20
SC3-17
SC3-16
SC3-15
SC3-14
SC3-11
SC3-10
SC3-9
SC3-7
SC3-6
SC3-5
SC3-4
SC3-3
SC3-2
SC3-1
SC2-29
SC6-0
SC6-1
SC6-2
SC6-3
SC6-4
SC6-5
SC6-6
SCE-1
SCE-2
SCE-3
SCE-4
DBSRW1
DBSRW2
DBSRW3
DBSRE1
DBSRE2
DBOSW2
DBOSW4
DBSC61
DB-3
DB-8
RT-1
RT-2
RT-3
RT-4
RT-5
RT-8
RT-10
RT-11
RT-12A
RT-13
RT-13A
RT-15A
RT-16
RT-17
RT-17A
RT-17B
RT-18
RT-19
RT-20A
RT-21
RT-23A
RT-23B
RT-23C
RT-24
RT-25
RT-26
LEGEND
HEC 1 BASIN I.D.
HEC 1 ANALYSIS POINT
HEC 1 ROUTING ELEMENT I.D.
STORM SEWER
DETENTION POND
REFER TO EXHIBIT 2 OF THE "DESIGN ANALYSIS REPORT FOR "SAND CREEK DETENTION BASIN No. 2" FOR AREA SOUTH OF WOODMEN ROAD
NOVEMBER 2011
UPPER SAND CREEK BASIN
WATERSHED MAP
REVISED TO REFLECT DRAFT 2010 STERLING RANCH MDDP
WILSON & COMPANY
Engineers & Architects
1000'
2000'

Sand Creek Channel Study

Basin Runoff comparison as it relates to Rainfall Distribution

Proprosed Condition Analysis

Rainfall Distribution Drainage Basin	SCSII Q100 (CFS)	SCSIIA Q100 (CFS)	% difference
SC3-16	563.4	680.4	121%
SC3-14	577.7	669.7	116%
SC3-9	269.5	318.2	118%
SC3-19	231.4	266.3	115%
SC3-77	202.4	235.9	117%
SC3-15	188.3	218.9	116%
SC3-8	173.8	199.9	115%
SC3-12	270	310.4	115%
SC3-23	116	134.6	116%
SC3-11B	213.7	251.8	118%
SC3-17	169.2	190.8	113%
SC3-61	84.8	99.4	117%
SC3-21	87.9	101.4	115%
SC3-18	174	198.5	114%
SC3-6A	177.1	208.6	118%
SC3-6C	181.5	209.1	115%
SC3-1A	133.1	152.1	114%
SC3-7	157.2	186.3	119%
SC3-13	136.9	158.5	116%
SC3-5A	129.1	151.1	117%
SC3-6B	102.7	118.9	116%
SC3-11A	24.3	27.8	114%
SC3-10	47.7	55.6	117%
SC3-5B	187	216.9	116%
SC3-81	303.4	353	116%
SC3-88	113.9	133.4	117%
SC3-20	73.5	84.9	116%
SC3-76	89.6	103.2	115%
SC3-75	84.9	97.8	115%
SC3-79	220.1	255.5	116%
SC3-78	174.5	203.9	117%
SC3-80	171.4	199.2	116%
SC3-74	140.7	163	116%
SC3-73	102	119.1	117%
SC3-82	91.9	109.1	119%
SC3-22	56.5	65.2	115%
Average			116%

Existing Conditions Analysis

Rainfall Distribution	SCSII Q100 (CFS)	SCSIIA Q100 (CFS)	% difference
EX-81	275.7	321.6	117%
EX-74	140.7	163	116%
EX-82	132.3	153.1	116%
EX-80	171.4	199.2	116%
EX-73	102	119.1	117%
EX-76	89.6	103.2	115%
EX-75	82.8	95.3	115%
EX-79	220.1	255.5	116%
EX-78	174.5	203.9	117%
EX-77	227.7	262	115%
EX-88	144.4	167.1	116%
EX-6	100.5	116.6	116%
EX-4	197.3	226.3	115%
EX-5	158.2	181.7	115%
EX-4A	160.1	187.1	117%
OS-24	73	84.3	115%
EX-3A	192.6	224.2	116%
EX-3	143.1	166.4	116%
OS-25	25.1	28.8	115%
Average			116%

MATCH STA 47A

6958x74

DISTURBED AREA

0 200' 400'

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

FILLED (FUTURE)

STA 758+00 CHECK

STA 748+00 CHECK

STA 738+00 CHECK

SAND CREEK

PROPOSED MARKSHEFFEL ROAD

EX. EMBANKMENT TO BE REMOVED

PRESERVE EX. VEGETATION & FLOODPLAIN

MATCH SHT 47B

CHANNEL IMPROVEMENTS

SEGMENT NO	BOTTOM WIDTH (FT)	CHANNEL TYPE
151	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

2630 DBPS FLOW RATE

CHANNEL IMPROVEMENTS 3225

SEGMENT NO	BOTTOM WIDTH (FT)	CHANNEL TYPE

Protection Criteria

CONSTRUCTION PURPOSES.

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:	9-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

2630

DBPS FLOW RATE

3225

POND 3

CHANNEL IMPROVEMENTS

SEGMENT NO	BOTTOM WIDTH (FT)	CHANNEL TYPE
148-2	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
151		

FOR PROFILE SEE SHEET P-13

MATCH SHT 468

STA 738+00 CHECK

CONSTRUCTION PURPOSES.

SAND CREEK

STA 728+00 CHECK

PRESERVE EX FLOODPLAIN & VEGETATION

100-YR POOL

FOREBAY

STA 723+00 DROP

WQ POOL

STA 720+50 DROP

OUTLET STRUCTURE

NEW 2-8'H x12'W CBC

REACH SC-1

REACH SC-2

WOODMEN ROAD

STA 714+00 CHECK

EX BRIDGE TO REMAIN UNTIL ROADWAY WIDENING OCCURS

PROPOSED MARKSHEFFEL ROAD

MARKSHEFFEL RD.

PROP 36"RCP w/FES 800 L.F.

IMPROVED RIPRAP CHANNEL
BW= 15', d = 3', S = 1.4%
Qipo = 470 cfs

OUTLET STRUCTURE

DROP

100-YR POOL

WQ POOL

FOREBAY

EAST FORK SAND CREEK BASIN

Detention Criteria

Basin: Sand Creek No. 3

	Storage (AF)	Discharge (cfs)
WQ	27.0	8.1
100-year	140	2240

Q100 In: 3230 Tributary Area: 3456 acres

Detention Criteria

Basin: Sand Creek No. 4

	Storage (AF)	Discharge (cfs)
WQ	8.2	2.5
100-year	46	41

Q100 In: 467 Tributary Area: 32[illegible]

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

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

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No. 90-04-09
Date: 9-92

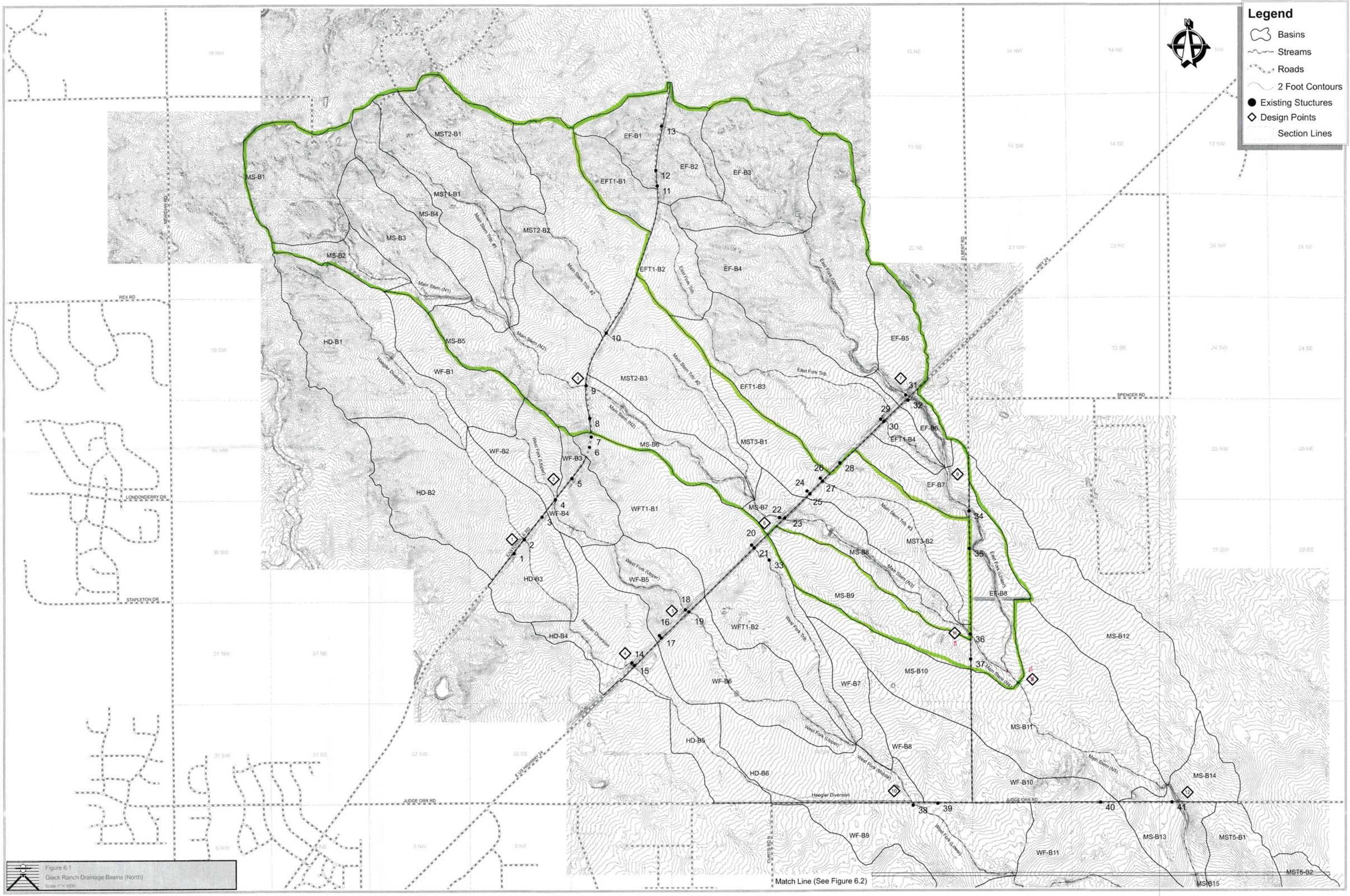


Figure 6.1
Gleck Ranch Drainage Basins (North)
Scale 1" = 1000'

Guidelines For Determining 100-Year Flood Flows For Approximate Floodplains in Colorado

Version 6.0

Department of Natural Resources
Colorado Water Conservation Board
Flood Protection Program
1313 Sherman Street, Room 721
Denver, Colorado 80203
www.cwcb.state.co.us

June 2004

A = Drainage Area, square miles (1<A<26)
Q = 100 year peak flow, cfs

ARK-5: NORTHERN FOOTHILLS SUBREGION; EAST OF MONUMENT CREEK AND FOUNTAIN CREEK

This subregion includes streams which are tributary to and east of the Monument Creek and Fountain Creek (downstream of Monument Creek) mainstems. These tributary streams originate from the Black Forest/Palmer Divide area, the northeast portion of Colorado Springs, and the Black Squirrel Creek basin east of Colorado Springs. The subregion is bounded as follows:

- On the south by the basin divide between the following watersheds:
    1. streams flowing into the Arkansas River or Fountain Creek downstream of its confluence with Williams Creek; and
    2. the Chico Creek watershed;
- On the east by the eastern basin boundary of the Chico Creek/Black Squirrel Creek basin;
- On the north by the Arkansas River-South Platte River basin divide;
- On the west by the Monument Creek mainstem; and
- And on the west by the Fountain Creek mainstem (downstream of its confluence with Monument Creek)

The regression equation for this subregion is only valid for tributary streams that have drainage areas between 4 mi^2 and 75 mi^2. The mainstems of Fountain Creek and Monument Creek are exempt from this subregion due to available detailed hydrology information on these streams. Stream reaches within the incorporated area of Colorado Springs are also exempt from this subregion. Any future study in this subregion involving the Fountain Creek mainstem, Monument Creek mainstem, or streams within the City of Colorado Springs should be performed using detailed methods. A detailed study or other hydrologic analysis must be performed for projects involving streams with drainage areas that fall outside of the applicable range.

The equation for subregion ARK-4b is:

$$\mathbf{Q = 1343.4(A)^{.578}}$$

Where:

A = Drainage Area, square miles (4<A<75)
Q = 100 year peak flow, cfs

ARK-6: SOUTHERN MOUNTAINS SUBREGION (No Regression)

At the time of this publication, there was insufficient data to obtain a meaningful regression equation within the southern mountains subregion. The streams in the southern mountains subregion have 100% of their *drainage basins* above an elevation of about 7500' MSL. The southern mountains subregion is bounded as follows:

USGS
science for a changing world

Prepared in cooperation with the
Colorado Department of Transportation
and the Bureau of Land Management

Analysis of the Magnitude and Frequency of Floods in Colorado

Water-Resources Investigations Report 99–4190

U.S. Department of the Interior
U.S. Geological Survey

Table 1. Regional flood-frequency equations, Colorado

[Q, discharge, in cubic feet per second; A, drainage area, in square miles; P, mean annual precipitation, in inches; S, mean drainage-basin slope, in foot per foot]

Recurrence interval, in years	Regression equation	Standard error of the model, in percent	Average standard error of prediction, in percent
Mountain region			
2	$Q = 11.0\ (A)^{0.663}\ (S+1.0)^{3.465}$	58	52
5	$Q = 17.9\ (A)^{0.677}\ (S+1.0)^{2.739}$	48	47
10	$Q = 23.0\ (A)^{0.685}\ (S+1.0)^{2.364}$	44	45
25	$Q = 29.4\ (A)^{0.695}\ (S+1.0)^{2.004}$	41	44
50	$Q = 34.5\ (A)^{0.700}\ (S+1.0)^{1.768}$	41	44
100	$Q = 39.5\ (A)^{0.706}\ (S+1.0)^{1.577}$	42	44
200	$Q = 44.6\ (A)^{0.710}\ (S+1.0)^{1.408}$	44	45
500	$Q = 51.5\ (A)^{0.715}\ (S+1.0)^{1.209}$	48	47
Rio Grande region			
2	$Q = 0.03\ (A)^{0.979}\ (P)^{1.615}$	78	61
5	$Q = 0.12\ (A)^{0.940}\ (P)^{1.384}$	64	55
10	$Q = 0.25\ (A)^{0.914}\ (P)^{1.277}$	58	53
25	$Q = 0.52\ (A)^{0.884}\ (P)^{1.117}$	53	51
50	$Q = 0.81\ (A)^{0.864}\ (P)^{1.121}$	51	50
100	$Q = 1.19\ (A)^{0.846}\ (P)^{1.074}$	50	49
200	$Q = 1.67\ (A)^{0.828}\ (P)^{1.036}$	49	49
500	$Q = 2.48\ (A)^{0.808}\ (P)^{0.995}$	50	49
Southwest region			
2	$Q = 28.7\ (A)^{0.699}$	85	62
5	$Q = 50.5\ (A)^{0.693}$	74	58
10	$Q = 66.0\ (A)^{0.697}$	71	57
25	$Q = 86.3\ (A)^{0.704}$	71	57
50	$Q = 102.0\ (A)^{0.709}$	73	58
100	$Q = 118.4\ (A)^{0.715}$	76	59
200	$Q = 135.5\ (A)^{0.720}$	79	60
500	$Q = 159.4\ (A)^{0.728}$	85	62
Northwest region			
2	$Q = 0.39\ (A)^{0.684}\ (P)^{1.304}$	83	62
5	$Q = 2.84\ (A)^{0.674}\ (P)^{0.833}$	71	58
10	$Q = 7.56\ (A)^{0.671}\ (P)^{0.601}$	68	56
25	$Q = 20.6\ (A)^{0.669}\ (P)^{0.362}$	67	56
50	$Q = 38.8\ (A)^{0.667}\ (P)^{0.210}$	67	56
100	$Q = 104.7\ (A)^{0.624}$	75	59
200	$Q = 118.5\ (A)^{0.624}$	78	60
500	$Q = 137.6\ (A)^{0.623}$	83	61
Plains region			
2	$Q = 39.0\ (A)^{0.486}$	233	93
5	$Q = 195.8\ (A)^{0.399}$	204	89
10	$Q = 364.6\ (A)^{0.400}$	212	90
25	$Q = 725.3\ (A)^{0.395}$	232	92
50	$Q = 1116\ (A)^{0.392}$	250	95
100	$Q = 1640\ (A)^{0.388}$	267	96
200	$Q = 2324\ (A)^{0.385}$	285	98
500	$Q = 3534\ (A)^{0.380}$	306	100

Table 6-9. NRCS Curve Numbers for Pre-Development Thunderstorms Conditions (ARC I)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	47	61	72	77
Fair condition (grass cover 50% to 75%)	-----	-----	---	29	48	61	69
Good condition (grass cover > 75%)	-----	-----	---	21	40	54	63
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	95	95	95	95
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	95	95	95	95
Paved; open ditches (including right-of-way)	-----	-----	---	67	77	83	85
Gravel (including right-of-way)	-----	-----	---	57	70	77	81
Dirt (including right-of-way)	-----	-----	---	52	66	74	77
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	42	58	70	75
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	91	91	91	91
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	58	72	81	87
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	58	72	81	87
	Crop residue cover (CR)	Poor	---	57	70	79	85
		Good	---	54	67	75	79
Row crops	Straight row (SR)	Poor	---	52	64	75	81
		Good	---	46	60	70	77
	SR + CR	Poor	---	51	63	74	79
		Good	---	43	56	66	70
	Contoured (C)	Poor	---	49	61	69	75
		Good	---	44	56	66	72
	C + CR	Poor	---	48	60	67	74
		Good	---	43	54	64	70
	Contoured & terraced (C&T)	Poor	---	45	54	63	66
		Good	---	41	51	60	64
	C&T+ CR	Poor	---	44	53	61	64
		Good	---	40	49	58	63
Small grain	SR	Poor	---	44	57	69	75
		Good	---	42	56	67	74
	SR + CR	Poor	---	43	56	67	72
		Good	---	39	52	63	69
	C	Poor	---	42	54	66	70
		Good	---	40	53	64	69
	C + CR Poor	Poor	---	41	53	64	69
		Good	---	39	52	63	67
	C&T	Poor	---	40	52	61	66
		Good	---	38	49	60	64
	C&T+ CR	Poor	---	39	51	60	64
		Good	---	37	48	58	63
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	---	45	58	70	77
		Good	---	37	52	64	70
	C	Poor	---	43	56	67	70
		Good	---	34	48	60	67
	C&T	Poor	---	42	53	63	67
		Good	---	30	46	57	63

Table 6-9. (continued)

Other Agricultural Lands[1]	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D
Pasture, grassland, or range—continuous forage for grazing[4]	-----	Poor	---	47	61	72	77
	-----	Fair	---	29	48	61	69
	-----	Good	---	21	40	54	63
Meadow—continuous grass, protected from grazing and generally mowed for hay	-----	-----	---	15	37	51	60
Brush—brush-weed-grass mixture with brush the major element[5]	-----	Poor	---	28	46	58	67
	-----	Fair	---	18	35	49	58
	-----	Good	---	15	28	44	53
Woods—grass combination (orchard or tree farm)[6]	-----	Poor	---	36	53	66	72
	-----	Fair	---	24	44	57	66
	-----	Good	---	17	37	52	61
Woods[7]	-----	Poor	---	26	45	58	67
	-----	Fair	---	19	39	53	61
	-----	Good	---	15	34	49	58
Farmsteads—buildings, lanes, driveways, and surrounding lots	-----	-----	---	38	54	66	72
Arid and Semi-arid Rangelands[1]	**Treatment**	**Hydrologic Condition[8]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element	-----	Poor	---	-----	63	74	85
	-----	Fair	---	-----	51	64	77
	-----	Good	---	-----	41	54	70
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	-----	Poor	---	-----	45	54	61
	-----	Fair	---	-----	28	36	42
	-----	Good	---	-----	15	23	28
Pinyon-juniper—pinyon, juniper, or both; grass understory	-----	Poor	---	-----	56	70	77
	-----	Fair	---	-----	37	53	63
	-----	Good	---	-----	23	40	51
Sagebrush with grass understory	-----	Poor	---	-----	46	63	70
	-----	Fair	---	-----	30	42	49
	-----	Good	---	-----	18	27	34
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus	-----	Poor	---	42	58	70	75
	-----	Fair	---	34	52	64	72
	-----	Good	---	29	47	61	69

[1.] Average runoff condition, and Ia = 0.1S.

[2.] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3.] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness. Poor: Factors impair infiltration and tend to increase runoff. Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

[4.] Poor: <50%) ground cover or heavily grazed with no mulch. Fair: 50 to 75% ground cover and not heavily grazed. Good: > 75% ground cover and lightly or only occasionally grazed.

[5.] Poor: <50% ground cover. Fair: 50 to 75% ground cover. Good: >75% ground cover.

[6.] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[7.] Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning. Fair: Woods are grazed but not burned, and some forest litter covers the soil. Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

[8.] Poor: <30% ground cover (litter, grass, and brush overstory). Fair: 30 to 70% ground cover. Good: > 70% ground cover.

Table 6-10. NRCS Curve Numbers for Frontal Storms & Thunderstorms for Developed Conditions (ARCII)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	68	79	86	89
Fair condition (grass cover 50% to 75%)	-----	-----	---	49	69	79	84
Good condition (grass cover > 75%)	-----	-----	---	39	61	74	80
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	98	98	98	98
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	98	98	98	98
Paved; open ditches (including right-of-way)	-----	-----	---	83	89	92	93
Gravel (including right-of-way)	-----	-----	---	76	85	89	91
Dirt (including right-of-way)	-----	-----	---	72	82	87	89
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	96	96	96	96
Urban districts:							
Commercial and business	-----	-----	85	89	92	94	95
Industrial	-----	-----	72	81	88	91	93
Residential districts by average lot size:							
1/8 acre or less (town houses)	-----	-----	65	77	85	90	92
1/4 acre	-----	-----	38	61	75	83	87
1/3 acre	-----	-----	30	57	72	81	86
1/2 acre	-----	-----	25	54	70	80	85
1 acre	-----	-----	20	51	68	79	84
2 acres	-----	-----	12	46	65	77	82
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	77	86	91	94
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	77	86	91	94
	Crop residue cover (CR)	Poor	---	76	85	90	93
		Good	---	74	83	88	90
Row crops	Straight row (SR)	Poor	---	72	81	88	91
		Good	---	67	78	85	89
	SR + CR	Poor	---	71	80	87	90
		Good	---	64	75	82	85
	Contoured (C)	Poor	---	70	79	84	88
		Good	---	65	75	82	86
	C + CR	Poor	---	69	78	83	87
		Good	---	64	74	81	85
	Contoured & terraced (C&T)	Poor	---	66	74	80	82
		Good	---	62	71	78	81
	C&T+ CR	Poor	---	65	73	79	81
		Good	---	61	70	77	80
Small grain	SR	Poor	---	65	76	84	88
		Good	---	63	75	83	87
	SR + CR	Poor	---	64	75	83	86
		Good	---	60	72	80	84
	C	Poor	---	63	74	82	85
		Good	---	61	73	81	84
	C + CR Poor	Poor	---	62	73	81	84
		Good	---	60	72	80	83
	C&T	Poor	---	61	72	79	82
		Good	---	59	70	78	81
	C&T+ CR	Poor	---	60	71	78	81
		Good	---	58	69	77	80

Table 6-10. (continued)

Other Agricultural Lands[1]	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D
Pasture, grassland, or range—continuous forage for grazing[4]	-----	Poor	---	68	79	86	89
	-----	Fair	---	49	69	79	84
	-----	Good	---	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay	-----	-----	---	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element[5]	-----	Poor	---	48	67	77	83
	-----	Fair	---	35	56	70	77
	-----	Good	---	30	48	65	73
Woods—grass combination (orchard or tree farm)[6]	-----	Poor	---	57	73	82	86
	-----	Fair	---	43	65	76	82
	-----	Good	---	32	58	72	79
Woods[7]	-----	Poor	---	45	66	77	83
	-----	Fair	---	36	60	73	79
	-----	Good	---	30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots	-----	-----	---	59	74	82	86
Arid and Semi-arid Rangelands[1]	**Treatment**	**Hydrologic Condition[8]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element	-----	Poor	---	-----	80	87	93
	-----	Fair	---	-----	71	81	89
	-----	Good	---	-----	62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	-----	Poor	---	-----	66	74	79
	-----	Fair	---	-----	48	57	63
	-----	Good	---	-----	30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory	-----	Poor	---	-----	75	85	89
	-----	Fair	---	-----	58	73	80
	-----	Good	---	-----	41	61	71
Sagebrush with grass understory	-----	Poor	---	-----	67	80	85
	-----	Fair	---	-----	51	63	70
	-----	Good	---	-----	35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus	-----	Poor	---	63	77	85	88
	-----	Fair	---	55	72	81	86
	-----	Good	---	49	68	79	84

: Ia = 0.1 S

2. Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

3. Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness. Poor: Factors impair infiltration and tend to increase runoff. Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

4. Poor: <50%) ground cover or heavily grazed with no mulch. Fair: 50 to 75% ground cover and not heavily grazed. Good: > 75% ground cover and lightly or only occasional

5. Poor: <50% ground cover. Fair: 50 to 75% ground cover. Good: >75% ground cover.

6. CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods

7. Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning. Fair: Woods are grazed but not burned, and some forest litter covers the soil. Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

8. Poor: <30% ground cover (litter, grass, and brush overstory). Fair: 30 to 70% ground cover. Good: > 70% ground cover.

4.6 Lag Time

While the NRCS curve numbers are used to calculate the volume of runoff and magnitude of losses, to transform the volume of runoff into a hydrograph using the NRCS dimensionless unit hydrograph, the lag time must be specified. The lag time is defined as the time from the centroid of the rainfall distribution of a storm to the peak discharge produced by the watershed. For this Manual, the lag time is defined as a fraction of the time of concentration (t_c) as shown in Equation 6-13.

$$t_{lag} = 0.6 \cdot t_c \qquad \text{(Eq. 6-13)}$$

Figure 6-25. Estimate of Average Concentrated Shallow Flow