MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH

SEPTEMBER 2018

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

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). Based upon Colorado Statue

something's missing?

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.

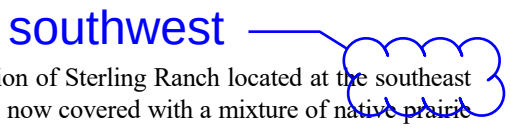
Several pond footprints were then created using AutoCAD and stage storage relationships were created for each basin and the allowable discharge rates determined by the worksheets were set as the discharge rates in the stage discharge tables in the model. The depths and volumes were then iterated for 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.

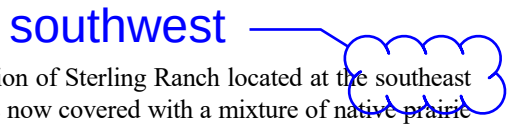
It should be noted that the proposed development of Sterling Ranch will recommend the diversion of a portion of lands and the associated runoff from the East Fork Sand Creek Basin to the Upper Sand Creek Basin which was previously discussed in the 2011 Wilson & Company Upper Sand Creek Basin Watershed 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.

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.

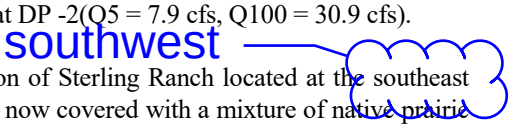
Basin EX-21 (Q5 = 13.5 cfs, Q100 = 49.0 cfs) consists of 33.3 acres located north and west of Vollmer Road and south and west of Basin EX-20A. In the existing condition the land is a mixture of developed and undeveloped 2.5 acre lots, where undeveloped ground cover consists primarily of native grasses. 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 southeast corner of the property. The area appears to 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 southeast corner of the property. The area appears to 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 southeast corner of the property. The area appears to 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 on the southern portion of the site, east of Sand Creek. This basin extends from the south boundary to the north approximately 2500 linear feet. Runoff from the basin travels from north to south until it reaches the southern boundary of the site, (at DP-5) being conveyed in small swale into the Bar J-B Acres Subdivision. The flows eventually convey to the East Fork of Sand Creek, south of Sterling Ranch.

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 Sand Creek. This 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 the southern boundary of the site, (at DP-6) being conveyed in a small swale into the Bar-J-B Acres Subdivision. The flows eventually convey to the East Fork of Sand Creek, south of Sterling Ranch.

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 10A combine at southern boundary of Sterling Ranch at DP-7 (Q5 = 57.1 cfs, Q100 = 277.9 cfs), being conveyed in a small swale into Pawnee Rancheros Subdivision No.1. The flows eventually convey to the East Fork of Sand Creek, south of Sterling Ranch.

Basin EX-11 (Q5 = 29.8 cfs, Q100 = 126.1cfs) 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 horizontal location of Stapleton Road. Runoff from the basin travels from north to south until it reaches the southern boundary of the site (at DP-56), being conveyed in a small swale into Pawnee Rancheros Subdivision No.1. Ultimately the flows from this basin are convey to the East Fork of Sand Creek, south of Sterling Ranch. (See SCDBPS, Segments, 92, pages EF-34). The anticipated SCDBPS flow at the south boundary of Sterling Ranch is Q10 =

This doesn't match the descriptions in EX-12 or SCE-15 below. Describe how this model is different from the DBPS model. Discuss/compare the difference between calculated flows and DBPS for Segments 84 and 85 and what the combined flow would be.

530cfs, Q100 = 980cfs)

Basin EX-12 (Q5 = 5.1 cfs, Q100 = 33.3 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 EX-10 and 10A combine at southern boundary of Sterling Ranch at DP-8 (Q5 = 45.1 cfs, Q100 = 220.9 cfs), conveyed in a few small swales within the Banning Lewis Ranch property. The flows are conveyed to the East Fork of Sand Creek, starting north of Woodmen Road. (See SCDBPS, Segments, 84 & 85, pages EF-34. The anticipated SCDBPS flow is Q10 = 478cfs, Q100 = 790cfs [Seg. 84], Q10 = 322cfs, Q100 = 533cfs [Seg. 85]).

Basin EX-13 (Q5 = 15.2 cfs, Q100 = 78.4 cfs) is a 89.3 acre area of land located at the east portion of the site. Runoff from the basin travels from north to south until it reaches the southern edge of Basin EX-13 at DP -8A(Q5 = 15.2 cfs, Q100 = 78.4 cfs). The runoff will be conveyed via a small swale across Basin EX-11 to DP-56.

why is this so high?

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.

State that runoff reduction practices will be utilized to the highest extent practicable in the sub-basin diversion area to minimize volumes reaching Sand Creek.

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.

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 **Implement site specific and other source control BMPs.** – The proposed projects will use silt fence, a vehicle tracking control pad, concrete washout area, inlet protection, temporary sediment basins, mulching, reseeding, and all other normally used BMP's to mitigate the potential for erosion across the site. Each site will specifically specify the required BMPs to be used.

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 step is about permanent BMPs for high-intensity industrial and commercial uses (not construction BMPs). Address these types of uses specifically (ECM I.7.2.B.).

provide exhibit showing where (also provide with deviation request)

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.

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 = 32.2 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.

west

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 east and north of Basins SC3-73 and SC3-75. Runoff from Basins SC3-74 and SC3-82, combine at DP-74 (Q5 = 63.5 cfs, Q100 = 262.8 cfs), which is equivalent to the anticipated existing modeled flow rates of Q5 = 65.3 cfs, Q100 = 262.8 cfs.

65.3?

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.

equal to?

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). Which is less than 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 are large 30+-acre lots. Runoff from the basin continues south within the Sand Creek Channel to DP77.

38.6?

Basin SC3-89 (Q5 = 10.0 cfs, Q100 = 89.6 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.

south of Arroya Lane

Basin SC3-20 (Q5 = 15.5 cfs, Q100 = 56.6 cfs) is a 56.6 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 (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 2.5 or less acre residential lots. 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 2.5 or less acre residential lots. 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.

5 Ac. lots?

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 0.2 acres within Sterling Ranch and that all flows 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.

Basin SC3-25 (Q5 = 8.9 cfs, Q100 = 31.0 cfs) is 19.0 acres of land located both within Sterling Ranch (near the northern boundary). For the purposes of this study, it is assumed that the offsite area will be developed into 2.5 acre lots, prior to the development of the 0.2 acre lots within Sterling Ranch 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.

and in the TimberRidge development

Basin SC3-23 (Q5 = 8.3 cfs, Q100 = 28.4 cfs) is 14.5 acres of land located both within Sterling Ranch (near the northwest boundary). For the purposes of this study, it is assumed that the area will be developed into 0.4-1.0 acres 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. The released flow from FSD Pond 23 will be routed via storm sewer system south to FSD27.

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

1 to 2.5 acre lots?

1 to 2.5 acre lots?

and in the TimberRidge development

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 (near the north boundary). For the purposes of this study, it is assumed that the offsite area will be developed into 0.25-2.5 acre lots, prior to the development of the 0.4-1.0 acres lost within Sterling Ranch and that all flows will be conveyed to a single offsite FSD pond (FSD27). 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. In the event that Sterling Ranch develops prior to the adjacent offsite property 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. 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.

doesn't make sense

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 to 0.5 acres 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 0.3 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 developed condition, it is assumed that the land will be developed to a density consistent of 5 or acres lots. Runoff from the basin is anticipated to be conveyed via roadside ditches, overland earthen swales and storm sewer systems to DP69. The routed flows are anticipated to be conveyed under Vollmer via a storm sewer and will continue to Sand Creek either in a roadside swale or storm sewer. Runoff reaching the Sand Creek Channel will combine with flows from Basin SC3-19, DP70 and FSD Ponds 18 DP69 culminating in peak runoff rates of Q5 = 366.6 cfs, Q100 = 1775.7 cfs, which is less than the anticipated existing modeled flow rates of Q5 = 434.8 cfs, Q100 = 1870.4 at DP69. Runoff from DP69 continues south within the Sand Creek Channel toward DP87.

Basin SC3-12 (Q5 = 105.6 cfs, Q100 = 270.0 cfs) consists of a 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 0.1 to 0.3 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 developed condition, it is assumed that the land will be fully developed into 5 acres lots and a portions of Briargate Parkway and Vollmer Road. Runoff from the basin is anticipated to be conveyed via roadside ditches, overland earthen swales and storm sewer systems under Vollmer Road to DP26 and ultimately to Sand Creek at DP87 via a bypass storm sewer system.

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, it is assumed that the land will be utilized as open space for an FSD 15B and portions of Briargate Parkway and Vollmer Road. 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) is anticipated to 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 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 for a low to medium density residential lots ranging in size from 0.1 to 1.0 acres lots and portions of roadways. The basin also includes a small offsite area of 5 acre lots located near the northern boundary. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD16A), 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 8.8 cfs and 128.3 cfs in the 5 and 100 year events respectively.

west?

east?

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 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 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 0.3 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 Sand Creek via a bypass storm sewer system at DP68.

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 0.3 acres lots as well as portions of park and open space and a small section of medium density residential (8-12du/ac). Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD14A), at the south end of the basin. The treated detained flows from the pond will discharge to DP68 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. Flows from DP87, DP21 and from FSD Ponds 13 and 14A will combine within the Sand Creek Channel at proposed Regional Pond W3 (DP68, Q5=200.3 cfs and Q100=1350.6 cfs). The purpose of the regional pond is to reduce the post development flow rates at the Sterling Ranch boundary to predevelopment rates. The combined discharge at the downstream side of the regional facility (Pond W-3) is 374.5 cfs and 2204.1 cfs in the 5 and 100 year events respectively. A concrete box culvert is recommended to convey the runoff reaching DP68 underneath proposed Sterling Ranch Road toward DP63.

see Pond W3 sheet redlines

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. Runoff discharged from the property will be collected by proposed storm sewer within Sterling Ranch and routed to DP64.

mention their detention facilities and outfalls.

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 east of Sand Creek. This portion of Sterling Ranch will consist of single family residential planned for lots ranging in size from 0.12 to 0.3 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.

west

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 east 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.

west

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 developed condition, it is assumed that the remaining large parcel are fully developed into 2.5-5 acres lots and that Vollmer Road is widened. 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 upstream of DP-61.

downstream?

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 a 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.

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 DPE3 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.

DP3E

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 DP4E.

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 discharge from DP4E, FSD Ponds E6 and Basin SCE-11 will combine within a box culvert storm sewer that conveys runoff to DP56. The peak flows at DP56 are anticipated to reach 75.4 cfs and 548.0 cfs in the 5 and 100 year events respectively. The storm sewer system and treated runoff will continue east to DP8.

south. Explain when (timing)

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 = 78.8 cfs, Q100 = 560.7 cfs. This is higher than the existing flow rates calculated by M&S for the existing condition (Q5 = 45.1 cfs, Q100 = 220.9 cfs) but is approximately equal to the flow determined by the DBPS of Q100 =

Explain differences between developed and DBPS flows. Provide deviation request for diversion.

Reword this to match comment response (no intent to increase flows...)

533cfs [Seg. 85], or less than the future flows determined in the DBPS for Seg. 84 (EF-8) of 530cfs (10 year) and 980cfs (100 year). 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, or coordinate on downstream improvements that are needed to discharge up the limits set within the current DPBS of 980 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. In no circumstance will the developed flows from Sterling Ranch exceed the Sand Creek Drainage Basin Planning Study flow amounts (assuming downstream improvements in place) , or historic flows as analyzed in this report. 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 of flow. (For instance, backyard landscaping flow) If more than the historic flow amount is proposed to be discharged, the downstream facilities shall be analyzed, designed and constructed in order to discharge more than the historic amount. Drainage easements for drainage improvements shall be obtained to discharge concentrated flows onto the adjacent property east or south of Sterling Ranch. Woodmen Road improvements were completed in approximately year 2010. Additional 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 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
DP8	560 cfs	220.9 cfs	Less than DBPS (Seg. 85)
DP8	980 cfs	533 cfs	DBPS Release w/ downstream improvements
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.

Pending deviation approval; address requirement to release at historic rates, only allowed to increase if accounted for in downstream improvements.

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	1,4111	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

decimal?

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.

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.

clarify

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. 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-E6, 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

Address proposed improvements specifically.

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.

fps?

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 3.9fps to 27.0 cfs 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 should be 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.

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

is proposed

Pond W4 exists at 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 dedicated, 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.

purchased?

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.

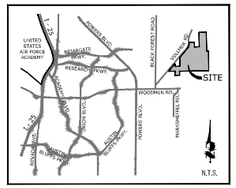
LAND USE LEGEND:

	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.
	551 AC. RESIDENTIAL: 3-5 DU/AC,	2,580 D.U.
	20 AC. RESIDENTIAL: 5-8 DU/AC,	100 D.U.
	257 AC. RESIDENTIAL: 5-8 DU/AC ACTIVE ADULT,	1,285 D.U.
	32 AC. RESIDENTIAL: 8-12 DU/AC,	302 D.U.
	41 AC. RESIDENTIAL: 12-20 DU/AC,	575 D.U.
	56 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	
	7 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 SKETCH PLAN REPORT.
2. 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:

MORLEY-BENTLEY INVESTMENTS, LLC.
20 BOULDER CRESCENT ST.
COLORADO SPRINGS, CO 80903
TEL: (719) 471-1742

Land Planning
Landscape Architecture
Urban Design

NES

N.E.S. Inc.
619 N. Cascade Avenue, Suite 200
Colorado Springs, CO 80903

Tel. 719.471.0073
Fax 719.471.0267

www.nescolorado.com

STERLING RANCH

SKETCH PLAN

MORLEY-BENTLEY INVESTMENTS, LLC.

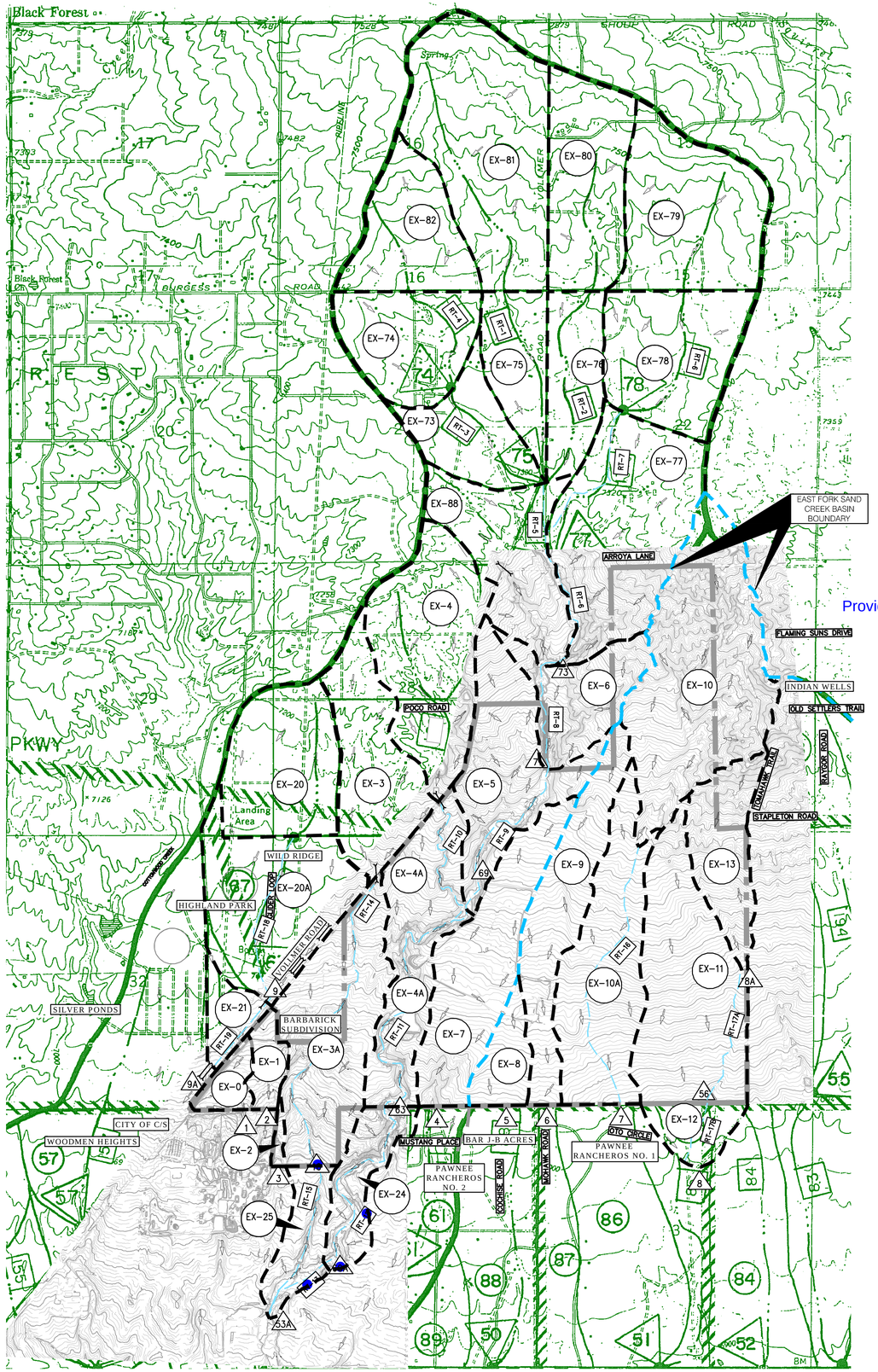
DATE: OCTOBER 29, 2007
PROJECT MGR: J.MAYNARD/J.ROMERO
PREPARED BY: J.KUHNEL/M.SWIFT

AMENDMENT

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

1
OF 1

SKP 07-007



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

Provide DP 77

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

Provide a table of SCDBPS East flows for reaches and DPs to DP50-52.

● - Adjust labels (marked with dots) for legibility

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

2018 STERLING RANCH MDDP

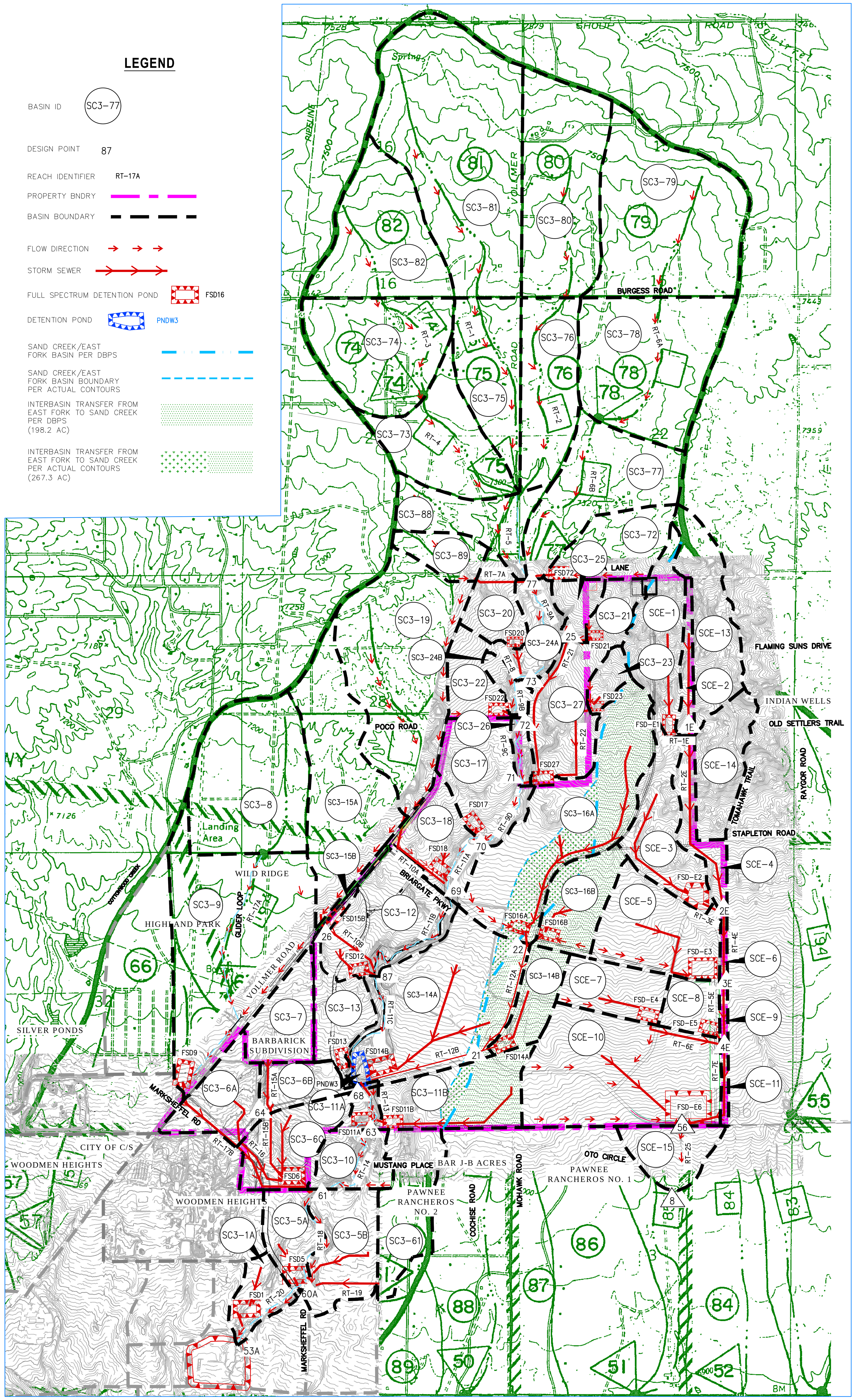
EXISTING HYDROLOGIC CONDITIONS MAP

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

File: Q:\00002A\Sterling Ranch District\dwg\Eng Exhibits\2018 MDDP\2018-MDDP-ExistCondWSWrkMap.dwg Plotstamp: 9/25/2018 9:48 AM

Add corresponding DP/general location after each pond ID.



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	133.1
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	STERILNG RANCH ROAD X-ING
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	46.5	75.4	121.2	285.2	402.4	548.0	NEAR SE PROP CORNER
DP-8	1.079	47.9	78.8	128.4	289.4	417.0	560.7	BELOW SE PROP CORNER

These need to be less than historic

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	STERILNG RANCH ROAD X-ING
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	7.8	16.4	29.0	52.2	72.8	94.2	NEAR SE PROP CORNER
DP-8	1.079	8.2	17.0	30.0	53.8	75.1	97.2	BELOW SE PROP CORNER

0 600 1200 2400
Scale in Feet

WATER QUALITY & DETENTION POND SUMMARY

FSD1

STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	16.3	23.2	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

WATER QUALITY & DETENTION POND SUMMARY

FSD16B

STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	39.0	53.9	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)	9.8	26.2	44.2	76.7	100.0	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)	0.6	1.5	2.9	4.7	6.3	8.1

FSD-E2

STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	20.2	39.5	58.6	91.1	115.4	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)	0.5	1.5	3.1	5.2	7.2	9.2

FSD-E3

STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	104.2	144.8	178.1	219.9	256.9	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)	0.9	3.2	6.3	10.1	13.4	16.7

FSD-E4

STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	61.4	82.0	100.1	123.0	142.9	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)	0.4	1.7	3.3	5.3	7.1	8.8

FSD-E5

STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	43.3	55.0	65.5	76.9	87.8	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)	0.0	0.1	0.3	1.3	2.3	3.4

FSD-E6

STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	123.9	167.9	219.7	319.1	385.9	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)	0.1	0.5	1.4	8.7	15.0	21.4

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	2689	SAND CREEK DBPS
		2600	FEMA
DP-60A	5.661	1662	PROPOSED CONDITION
	5.38	3295	SAND CREEK DBPS

Add DP56

Provide a table of SCDBPS East flows for reaches and DPs to DP50-52.

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

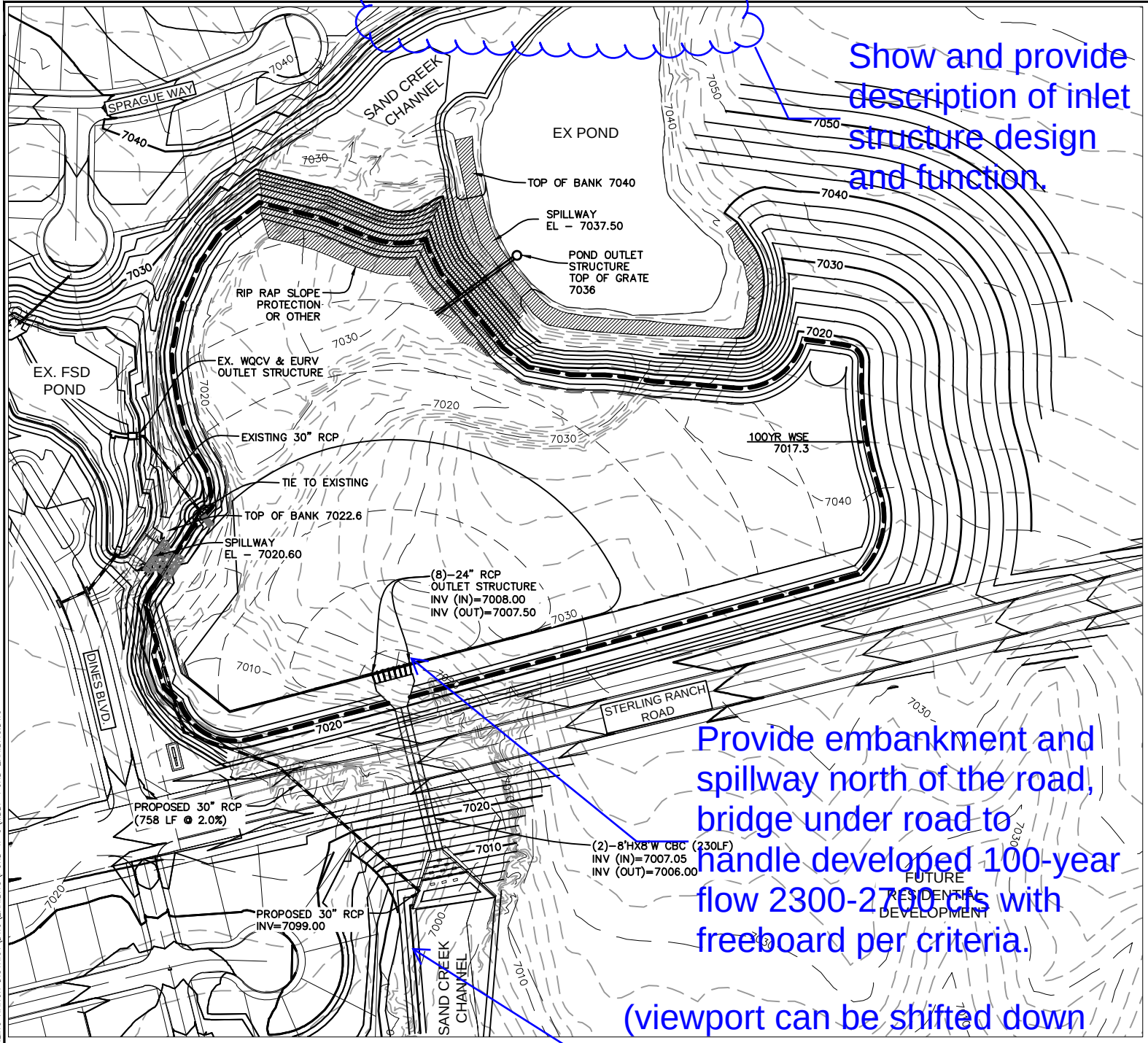
2018 STERLING RANCH MDDP

DEVELOPED HYDROLOGIC CONDITIONS MAP

PROJECT NO. 09-002	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: 08-26-2018	DM2

File: O:\09002A\Sterling Ranch District\dwg\Eng Exhibits\2018 MDDP\2018-MDDP-InterimCondMSWkMap.dwg Plotstamp: 9/25/2018 12:32 PM

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



Show and provide description of inlet structure design and function.

Provide embankment and spillway north of the road, bridge under road to handle developed 100-year flow 2300-2700 cfs with freeboard per criteria.

(viewport can be shifted down to keep the same scale)

Q_{100}= 2204.1 CFS (IN)

Q_{100}= 1350.6 CFS (OUT)

100YR= 78.2 AC-FT

100YR WSE= 7017.3

SCALE 1"=200'

STERLING RANCH POND PNDW3

M&S CIVIL CONSULTANTS, INC.

15 NORTH NEVADA AVENUE
COLORADO SPRINGS,
COLORADO 80903

v 719.955.5485
f 719.444.8427

O:\09002\STERLING RANCH DISTRICT\DWG\EXHIBITS\POND W-3\MDDP POND EXHIBITS.DWG

Culvert Report

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)	=	96.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	3
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

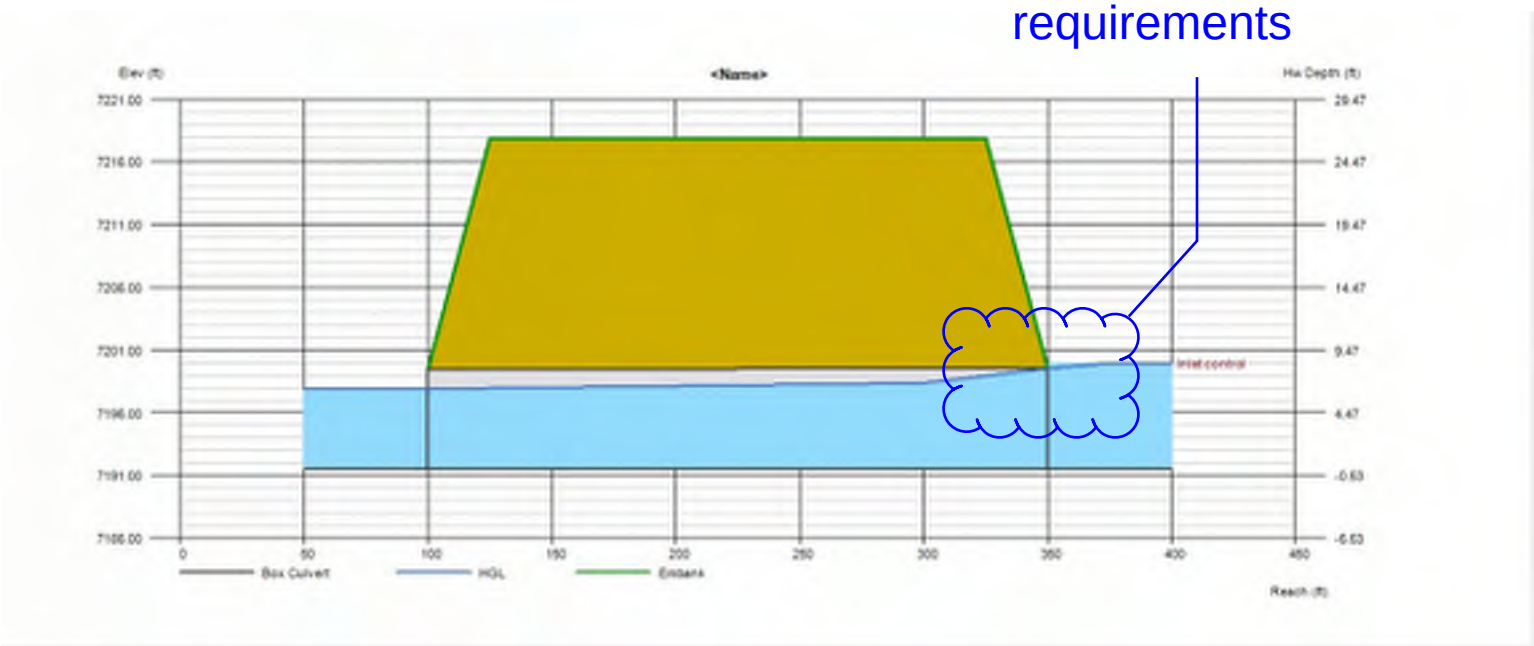
Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	2700.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	1800.00
Qpipe (cfs)	=	1800.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.37
Veloc Up (ft/s)	=	8.61
HGL Dn (ft)	=	7197.91
HGL Up (ft)	=	7198.50
Hw Elev (ft)	=	7199.96
Hw/D (ft)	=	1.05
Flow Regime	=	Inlet Control

Address bridge culvert freeboard requirements



Culvert Report

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)	=	7027.00
Top Width (ft)	=	100.00
Crest Width (ft)	=	1000.00

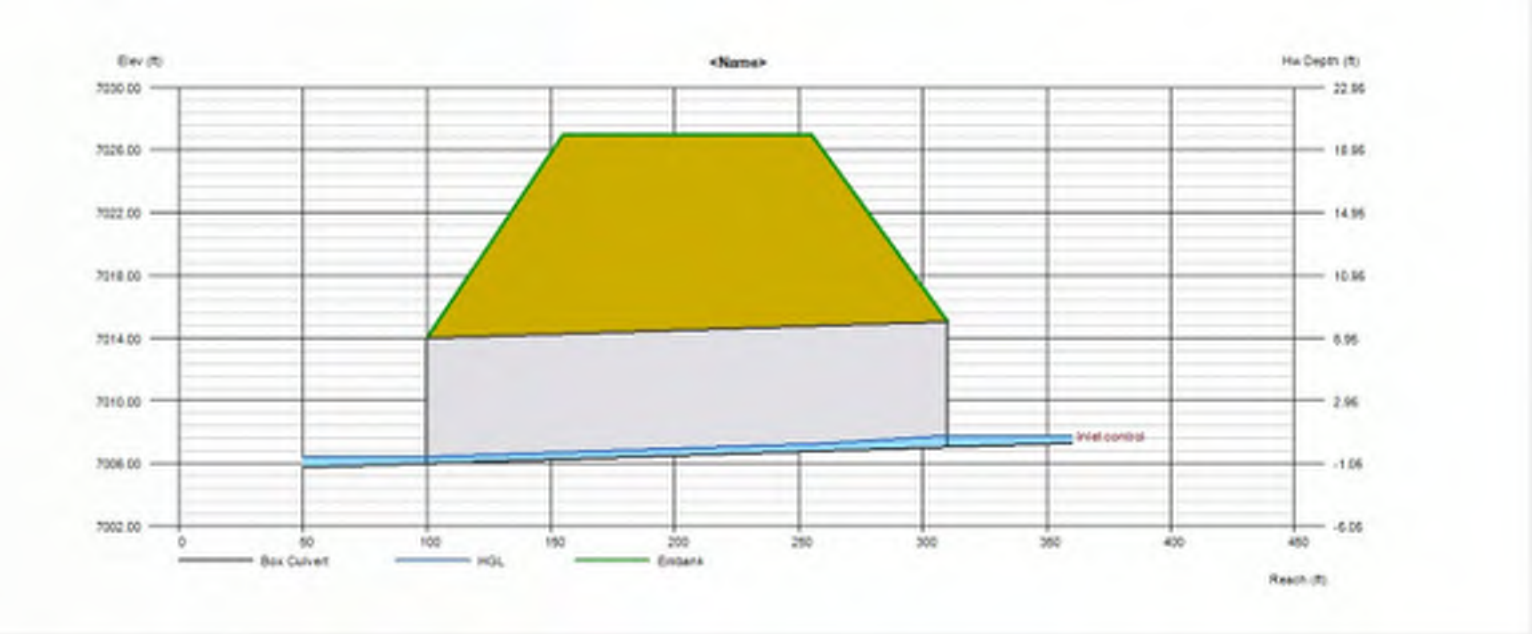
Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	2600.00
Tailwater Elev (ft)	=	Critical

Highlighted

Qtotal (cfs)	=	30.00
Qpipe (cfs)	=	30.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.36
Veloc Up (ft/s)	=	3.92
HGL Dn (ft)	=	7006.43
HGL Up (ft)	=	7007.53
Hw Elev (ft)	=	7007.76
Hw/D (ft)	=	0.09
Flow Regime	=	Inlet Control

?



Adjust (show proposed)

provide flow arrows

Show and label existing and proposed road alignments.

Label MDDP developed Q100 for each segment.

See comment letter.

LEGEND

0 500 1000 2000 Scale in Feet

REACH IDENTIFIER

PROPERTY BNDRY

2018 STERLING RANCH MDDP

DBPS MAP OVERLAY

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PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

PROJECT NO. 09-002	FILE: \dwg\Eng Exhibits\DPBS overlay.dwg		
DESIGNED BY: DLM	SCALE	DATE: 08-26-2018	DPBS-3
DRAWN BY: DLM	HORIZ: 1"=1000'		
CHECKED BY: VAS	VERT: N/A		