

# **FINAL DRAINAGE REPORT FOR STERLING RANCH FILING NO. 2**

## **EL PASO COUNTY, COLORADO**

MARCH 2018

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Project #09-002  
DSD Project #

**SF-1820**

What about  
Pond W-5 and  
outfall?

## WETLANDS

Sterling Ranch was authorized under Section 404 of the Clean Water Act to discharge dredged and fill materials into waters of the United States to conduct work associated with construction of Sterling Ranch Residential Development in accordance with Action Number SPA-2015-00428-SCO. A copy of the permit is within the Appendix of this report. For the construction of Sterling Ranch Filing No. 1, ~2950 square feet of wetlands will be displaced and mitigated. The disturbance areas are located within the general area of Pond BB, Pond 4 and Pond 8 which outfall into the Sand Creek Channel. A mitigation area is designated on the construction drawings. Coordination with the wetlands consultant and the Army Corp of Engineers will be in conformance with the wetland permit. No other construction associated with Sterling Ranch Filing No. 1 will disturb the existing wetlands. Sterling Ranch Filing No. 2 will have significant wetland disturbance. The area(s) of mitigation will be shown on the construction drawings and Final Drainage report associated with Filing No. 2. Included in this report (in the appendix) are the memo and map from Core Consultants showing intent to have wetlands delineated in the Filing No. 2 areas of wetland disturbance and mitigation.

are?

## EXISTING DRAINAGE CONDITIONS

The Sterling Ranch Filing No. 2 site consists of 49.643 acres and is situated west of the Sand Creek Watershed. This area was previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Corporation, revised March 1996. More recently the area was studied in the "Preliminary Drainage Report for Sterling Ranch-Phase 1", dated May 2015, by M&S Civil Consultants, Inc. (henceforth referred to as "PDR"). A "Master Development Drainage Plan For Sterling Ranch", prepared by M&S Civil Consultants, Inc., dated July 2010 and "Technical Memorandum Sand Creek Channel Study (North of Woodmen Road) Hydrologic Analysis" (TM-SCCS) prepared by M&S Civil Consultants, Inc., dated July 2016, was submitted and under review but not approved. And finally this report was studied in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017.

The Sand Creek DBPS assumed the Sterling Ranch property to have a "large lot residential" use for the majority of the site. However, the proposed master plan is a mix of; school, multi-family, single-family, and commercial land uses, resulting in higher runoff. The site generally drains from north to south consisting of rolling hills. Currently, the site is used as pasture land for cattle. Sand Creek is located east of the site running north to south. This reach of drainage conveyance is not currently improved. There are a few stock ponds within the creek channel used for cattle watering. Barbed wire fences bound the entire ~1440 acres of Sterling Ranch.

Offsite flows enter Sterling Ranch from the east, west and north , described as follows;

To the west, the existing subdivision west of Vollmer Road historically drains south to the west side of Vollmer Road. A roadside ditch carries the flow southwesterly and is intercepted by the Pond 6 storm infrastructure. Flows will ultimately be released into Sand Creek. See the Historic Basin Descriptions section of this report.

To the east; Sand Creek conveys flows from north to south. Flows from Sand Creek will continue to be conveyed through Sterling Ranch. (DBPS SEG: 170, 187, 163)

To the north; Sterling Ranch Filing No. 1 flows are captured via detention ponds Pond 4 and Pond 8 and are released into Sand Creek. Flows from the Barbarick Subdivision are collected by detention ponds and

**DP28**, 33.3 acres, consists of Basin OS3 off-site Barbarick Subdivision with runoff coefficients of 0.36 for the 5-year and 0.55 for the 100-year and Basin YY future Sterling Ranch residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year. Developed runoff of Q5=25.8 cfs and Q100=60.2 cfs has been calculated for DP28. Per the "Final Drainage Report for Barbarick Subdivision Portions of Lots 1, 2 and Lots 3, 4", prepared by Matirx Design Group, dated June 6, 2016, a combined onsite flow of Q5=11.4 cfs and Q100=85.4 cfs was calculated up to the detention pond on the south boundary line of the Barbarick Subdivision. The reduction of flow, from previous reports is attributed to a reduction of Sterling Ranch Subdivision flow contributing to the OS3 basin. The release rate from the detention pond combined with Basin YY are Q5=25.8 cfs and Q100=60.2 cfs The surface runoff shall be collected by a temporary sediment basin and 36" FES and routed south via 36" RCP (PR32) to PR34. Historic flows produced by Basin OS3 will be accounted for in the calculations for detention/water quality for Pond W5. The drainage report was prepared by Matrix Design Group, 2016 for the Barbarick Subdivision and has been attached at the end of the reference section of this report. The Final Drainage Report for Filing No. 2 will address the revisions from the previous report to the new Matrix report.

This is the final drainage report, the revisions should be addressed.

In the interim, a temporary diversion swale will be constructed and will replace the construction of PR32. The diversion swale will route flows from DP28 to DP29 (Q5=41.4 cfs and Q100=97.8 cfs). Figure CU-9 Inlet Control Nomograph INT DP29 INT is provided and swale grading complies with required headwater depth. Upon development of Tract I the diversion swale will be removed and PR32 will be installed.

[Show Tract 'I' on the drainage map.](#)

**DP29**, 12.58 acres, consists of Basin XX future residential lots and streets with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year and Basin JP-1 future school site with runoff coefficients of 0.39 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=17.3 cfs and Q100=41.7 cfs has been calculated for DP29. The surface runoff will be routed via overlot grading and curb and gutter to a temporary sediment basin at DP29 which will be collected by a 36" FES. The flow will be routed west via a 36" RCP (PR33) and will combine with flow from PR32. The combined flows in PR34 (Q5=41.4 cfs and Q100=97.8 cfs) will be routed south and west via a 48" RCP to PR35.

**DP30**, 2.46 acres, consists of Basin III future open space area with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and Basin JP-7A (Sterling Ranch Road) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year. Developed runoff of Q5=6.5 cfs and Q100=13.0 cfs has been calculated for DP30. The surface runoff is routed via overlot grading and curb and gutter to DP30 which will be collected by a 15' CDOT type R at-grade inlet. The intercepted flow (Q5=6.5 cfs and Q100=11.1 cfs) will be routed south via a 24" RCP (PR34A) and will combine with flows from PR34 and PR34B. The combined flows (Q5=53.1 cfs and Q100=117.8 cfs) will be routed west via a 48" RCP (PR35) to PR39.

**DP31**, 4.64 acres, consists of Basin JJJ future residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year and Basin JP-7B (Sterling Ranch Road) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year. Developed runoff of Q5=8.4 cfs and Q100=19.8 cfs has been calculated for DP31. The surface runoff is routed via overlot grading and curb and gutter to DP31 which will be collected by a 15' CDOT type R at-grade inlet. The intercepted flow (Q5=8.2 cfs and Q100=14.2 cfs) will be routed south via a 24" RCP (PR34B) and will combine with flows from PR34 and PR34A. The combined flows (PR35, Q5=53.1 cfs and Q100=117.8 cfs) will be routed west via a 48" RCP to PR39.

**DP32**, 17.0 acres, consists of Basin OS2 off-site Barbarick Subdivision with runoff coefficients of 0.55 for the 5-year and 0.87 for the 100-year. Developed runoff of Q5=30.4 cfs and Q100=80.8 cfs has been calculated for DP32 Per the "Final Drainage Report for Barbarick Subdivision Portions of Lots 1, 2 and Lots 3, 4", prepared by Matirx Design Group, dated June 6, 2016, a combined onsite flow of Q5=3.13 cfs and Q100=11.6 cfs was calculated up to the sand filter pond on the south boundary line of the Barbarick Subdivision. The release rate from the sand filter pond combined with Lots 1 and 2 west of the sand filter pond are Q5=30.4 cfs and Q100=80.8 cfs The surface runoff shall be collected by a temporary sediment

basin and 42" FES. The flow will be routed south via 42" RCP (PR36) to PR38. Upon future development of this basin, full spectrum detention shall be required and will release to historic release rates of  $Q_5=30.4$  cfs and  $Q_{100}=80.8$  cfs. Historic flows produced by Basin OS2 will be accounted for in the calculations for detention/water quality for Pond W-5. The Final Drainage Report for Filing No. 2, will address the revisions from the previous report to the new Matrix report. See previous comment, this is Filing 2.

In the interim, a temporary diversion swale will be constructed and will replace the construction of PR36. The diversion swale will route flows from DP32 to DP33 ( $Q_5=45.9$  cfs and  $Q_{100}=115.2$  cfs). Figure CU-9 Inlet Control Nomograph INT DP33 is provided and swale grading complies with required headwater depth. Upon development of Tract H the diversion swale will be removed and PR36 will be installed.

**DP33**, 9.68 acres, consists of Basin AAA future residential lots and streets with runoff coefficients of 0.49 for the 5-year and 0.65 for the 100-year. Developed runoff of  $Q_5=17.3$  cfs and  $Q_{100}=38.5$  cfs has been calculated for DP33. The surface runoff will be routed via overlot grading and curb and gutter to a temporary sediment basin at DP33 which will be collected by a 30" FES. The flow will be routed west via a 30" RCP (PR37) and will combine with flows from PR36. The combined flows (PR38,  $Q_5=45.9$  cfs and  $Q_{100}=115.2$  cfs) will be routed south via a 48" RCP to PR39. The combined flows in PR39 ( $Q_5=98.5$  cfs and  $Q_{100}=232.0$  cfs) will be routed south via a 66" RCP to PR57.

**DP39**, 2.74 acres, consists of Basin BBB proposed residential lots and streets with runoff coefficients of 0.45 for the 5-year and 0.59 for the 100-year. Developed runoff of  $Q_5=4.8$  cfs and  $Q_{100}=10.6$  cfs has been calculated for DP39. The surface runoff is routed via overlot grading and curb and gutter to dual 10' CDOT type R at-grade inlets. The intercepted flow ( $Q_5=4.8$  cfs and  $Q_{100}=10.14$  cfs) will be routed south via an 18" RCP (PR40A, PR40B) to PR40 (18" RCP). The flows from PR40 will be routed south to PR41 (24" RCP).

**DP39A**, 8.47 acres, consists of Basin BBB proposed residential lots and streets with runoff coefficients of 0.45 for the 5-year and 0.59 for the 100-year. Developed runoff of  $Q_5=12.4$  cfs and  $Q_{100}=27.3$  cfs has been calculated for DP39A. The surface runoff is routed via overlot grading and curb and gutter to dual 10' CDOT type R at-grade inlets. The intercepted flow ( $Q_5=11.36$  cfs and  $Q_{100}=17.86$  cfs) will be routed east via an 18" RCP (PR41A) and a 24" RCP (PR41B). The combined flows from PR41B and PR40 ( $Q_5=15.5$  cfs and  $Q_{100}=26.9$  cfs) will be routed south via a 24" RCP to PR41.

**DP44**, 3.59 acres, consists of Basin HHH undisturbed gas line easements and minimal rear residential lots with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year. Developed runoff of  $Q_5=1.0$  cfs and  $Q_{100}=7.7$  cfs has been calculated for DP44. The surface runoff is routed via historic drainage patterns and overlot grading to a temporary sediment basin at DP44 which will be collected by an 18" FES. The flow will be routed west via an 18" RCP (PR47) and will combine with flows at DP40 and PR42 (24" RCP). Call out what permanent drainage feature replaces the temporary sediment basin at DP 44

**DP40**, 3.12 acres, consists of Basin CCC proposed residential lots and streets with runoff coefficients of 0.49 for the 5-year and 0.62 for the 100-year and flowby from DP39 and DP39A. Developed runoff of  $Q_5=6.0$  cfs and  $Q_{100}=20.2$  cfs has been calculated for DP40. The surface runoff is routed via overlot grading and curb and gutter to dual 15' CDOT type R at-grade inlets at DP40. The flow will be routed west via a 24" RCP (PR42) and will combine with flow from PR47. The combined flows in PR42 ( $Q_5=4.8$  cfs and  $Q_{100}=15.8$  cfs) will be routed south to PR48 (36" RCP). The combined flows from PR42 and PR41 will be routed south and west via a 36" RCP (PR48,  $Q_5=23.0$  cfs and  $Q_{100}=52.3$  cfs). These flows are then routed to DP45.

**DP43A**, 19.14 acres, consists of Basin FFF proposed residential lots and streets with runoff coefficients of 0.49 for the 5-year and 0.62 for the 100-year. Developed runoff of  $Q_5=35.0$  cfs and  $Q_{100}=74.3$  cfs has been calculated for DP43A. The surface runoff is routed via overlot grading to a temporary sediment basin

(Q5=208.9 cfs and Q100=481.1 cfs) will be routed south via an 84" RCP to Detention Pond W-5 (DP57). Flows will outfall into a concrete lined forebay. Figure CU-9 Inlet Control Nomograph DP43A is provided and swale grading complies with required headwater depth

**DP56**, 8.17 acres total, consists of Basin RRR future commercial site with runoff coefficients of 0.81 for the 5-year and 0.88 for the 100-year, Basin PPP1 future residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year and Basin QQQ undisturbed gas line easements with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year. Developed runoff of Q5=5.7 cfs and Q100=20.5 cfs has been calculated for DP56. The surface runoff is routed via historic drainage patterns and overlot grading to DP56 which will be collected by a 24" FES. The flow will be routed south via a 24" RCP (PR57A) and will combine with flows from PR57 and PR44. The combined flows in PR58 (Q5=209.5 cfs and Q100=483.5 cfs) will be routed south via an 84" RCP to Detention Pond W-5 (DP57). Flows will outfall into a concrete lined forebay. Figure CU-9 Inlet Control Nomograph DP43A is provided and swale grading complies with required headwater depth

**DP57**, 7.95 acres, consists of Basin UUU (**Detention Pond W-5**) with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year. Contributing surface runoff to detention pond W-5 include Basin PPP2 0.75 acres, future residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, Basin TTT 1.38 acres, future open space with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and Basin OS4 5.13 acres, existing residential lots with runoff coefficients of 0.20 for the 5-year and 0.44 for the 100-year. The combined upstream developed runoff of Q5=217.4 cfs and Q100=517.9 cfs has been calculated for DP57. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff calculated onsite. The pond is designed to treat approx 175.6 acres, and provide 2.97 ac-ft of water quality storage and 17.37 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.07 workbook. The detention pond will be private and shall be maintained by the Sterling Ranch Metropolitan District. Access shall be granted to the owner and El Paso County for access and maintenance of the private detention pond. A private maintenance agreement document shall accompany the submittal. In the event of clogging or total inlet failure, flows at DP57 will over top the emergency spillway and outfall into Sand Creek. A rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet. The peak release rate from pond W-5 (PR71, Q5=2.5 cfs and Q100=149.7 cfs ) will outfall, via a 48" RCP into Sand Creek. The summed flows (PR71 & PR67, Q5=42.2 cfs and Q100=472.4 cfs ) will routed via a 84" RCP (PR74) to DP68 and outfall into Sand Creek. Impacts from the outfall into Sand Creek will be addressed in the revised TM-SCCS.

Spell out this acronym and call out that this outfall will be constructed with this development.

The water quality volume and 100-year volume required for the site has been determined using the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual Chapter 6-Volume II. Refer to the Detention Basin Design sheets located within the appendix of this report.

## **Design Points Tributary to Sand Creek Filing No. 2**

**DP47A**, 3.12 acres, consists of Basin RP-3B (Vollmer Road) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from DP16 (in the future developed condition). Developed runoff of Q5=11.1 cfs and Q100=24.4 cfs has been calculated for DP47A. In the interim the surface runoff is routed to a road side swale to DP47A which will be collected by a 2.91' x 5.67' CDOT Type D inlet. In the interim a riprap apron will be constructed to dissipate energy and prevent local scour at the outlet.

In the future, upon full build out of Vollmer Road, the surface runoff will be routed via curb and gutter to DP47A which will be collected by a 15' CDOT type R at-grade inlet. The intercepted flow (PR68, Q5=10.0 cfs and Q100=15.8 cfs) will be routed north via a 30" RCP to DP60.

**DP48A**, 4.12 acres, consists of Basin RP-3A (Vollmer Road) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from DP17 (in the future developed condition). Developed runoff of Q5=13.5 cfs and Q100=26.6 cfs has been calculated for DP48A. In the interim the surface runoff will sheet flow and be routed to a roadside swale and ultimately to DP60.

In the future, upon full build out of Vollmer Road, the surface runoff will be routed via curb and gutter to DP48A which will be collected by a 15' CDOT type R at-grade inlet. The intercepted flow (Q5=11.4 cfs and Q100=16.5 cfs) will combine with flows from PR68 and be routed west via a 30" RCP (PR69). The cumulative flows in PR69 (Q5=21.2 cfs and Q100=31.9 cfs) will outfall into a proposed road side swale and be routed to DP60. Upon full build out a riprap apron will be constructed to dissipate energy and prevent local scour at the outlet.

**DP69**, 15.73 acres, consists of Sub-Basin OS20A partially developed low density residential with runoff coefficients of 0.10 for the 5-year and 0.36 for the 100-year. Calculated runoff of Q5=4.5 cfs and Q100=27.4 cfs has been calculated for DP69. The flow will be routed south via a 24" RCP (PR73) under Glider Loop. The surface runoff is routed via historic drainage patterns and a 4' wide road side swale to DP60. A riprap apron will be constructed to dissipate energy and prevent local scour at the outlet. (See swale and riprap calculations and specification sheet for fabric in appendix). DP69 calculations are for sizing the culvert under Glider Loop. The acreage and flows for DP69 is included in the final DP60.

**DP70**, 36.32 acres, consists of Sub-Basin OS20B partially developed low density residential with runoff coefficients of 0.10 for the 5-year and 0.36 for the 100-year and flows from DP69. Calculated runoff of Q5=15.0 cfs and Q100=90.7 cfs has been calculated for DP70. The flow will be routed south via an existing 24" CMP under Glider Loop. The surface runoff is routed via historic drainage patterns swale to DP60. The existing roadside swale will provide adequate drainage, assuming the swale has been maintained. The acreage and flows for DP70 is included in the final DP60.

**DP71**, 106.79 acres, consists of Sub-Basin OS20C partially developed low density residential with runoff coefficients of 0.10 for the 5-year and 0.36 for the 100-year and flows from DP70. Calculated runoff of Q5=25.6 cfs and Q100=154.4 cfs has been calculated for DP70. The flow will be routed south via an existing 24" CMP under the entrance to an existing Gas substation. The surface runoff is routed via historic drainage patterns swale to DP60. The existing roadside swale will provide adequate drainage, assuming the swale has been maintained. The acreage and flows for DP71 is included in the final DP60.

**DP60**, 308 acres, consists of Basin OS20 (off-site basin) partially developed low density residential with runoff coefficients of 0.10 for the 5-year and 0.36 for the 100-year and flow from PR69. Calculated runoff of Q5=59.7 cfs and Q100=316.2 cfs has been calculated for DP60. The existing roadside swale will provide adequate drainage, assuming the swale has been maintained. Flows in the swale will be routed through an existing 3.5' X5.5' HECMP to DP 49 (Pond W-4). A rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

**DP47 & DP47-1**, 2.05 acres, consists of Basin RP-4B (Vollmer Road) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from DP47A (in the future condition). Developed runoff of Q5=7.7 cfs and Q100=20.4 cfs has been calculated for DP47. In the interim the surface runoff is routed to a road side swale to DP47A which will be collected by a 2.91' x 5.67' CDOT Type D inlet. In the interim a riprap apron will be constructed to dissipate energy and prevent local scour at the outlet.

In the future, upon full build out of Vollmer Road, the surface runoff is routed via curb and gutter to DP47 & DP47-1 which will be collected by a 2-10' CDOT type R at-grade inlets. The captured flow (Q5=7.7 cfs and Q100=17.6 cfs) will be routed west via a 30" RCP (PR61) to PR62.

Comments to highlighted text above: Show the existing 24 inch pipes on the proposed drainage map. Include discussion as to how the overflows in this area impact the development of Filing 2. (Some portion of these flows over tops Vollmer continues through Barbarick Subdivision and needs to be addressed in this report) Also, does the 3.5' x 5.5' HECMP and inlet conditions handle the 100 year storm? Does it overtop and flow towards the proposed housing area?

**DP48 & DP48-1**, 1.94 acres, consists of Basin RP-4A (Vollmer Road) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from DP48A(in the future condition). Developed runoff of Q5=8.2 cfs and Q100=21.0 cfs has been calculated for DP48. In the interim the surface runoff will sheet flow into and be routed to a roadside swale and ultimately to DP49.

In the future, upon full build out of Vollmer Road, the surface runoff is routed via curb and gutter to DP48 & DP48-1 which will be collected by a 2-10' CDOT type R at-grade inlets. The flow will combine with flows from PR61 and be routed west to via a 30" RCP (PR62) to a ~~riprap~~ forebay. The cumulative flows in PR62 (Q5=15.8 cfs and Q100=38.2 cfs) will outfall into a proposed roadside swale, see appendix for open channel calculator sheet. The vegetated grass swale will facilitate sedimentation and filtering while limiting erosion. A riprap apron will be constructed to dissipate energy and prevent local scour at the outlet. Flows in the swale will be routed to DP 49 (Pond W-4). **The forebay will have to meet the**

**Please clarify when (Pond W-4) will be constructed requirements of a FS detention facility**

**DP72**, 8.87 acres, consists of Sub-Basin OS21A partially developed low density residential with runoff coefficients of 0.11 for the 5-year and 0.37 for the 100-year and flows from DP60. Calculated runoff of Q5=71.9 cfs and Q100=345.9 cfs has been calculated for DP72. The flow will be routed south via a proposed 15' swale to DP49. The acreage and flows for DP72 is included in the final DP49.

**Call out the type of material (armoring) needed for flows this high in a swale.**

**DP73**, 8.76 acres, consists of Sub-Basin OS21C partially developed low density residential with runoff coefficients of 0.11 for the 5-year and 0.37 for the 100-year and flows from DP72. Calculated runoff of Q5=3.2 cfs and Q100=18.1 cfs has been calculated for DP73. In the interim the surface runoff is routed to via a road side swale to DP73 which will be collected by a 2.91' x 5.67' CDOT Type D inlet. In the interim a 24" RCP pipe (PR76) will route flows to a concrete forebay in Pond W-4. The acreage and flows for DP73 is included in the final DP49.

**DP49**, 33.0 acres, consists of Basin OS21 (**Interim Detention Pond W-4**) with runoff coefficients of 0.11 for the 5-year and 0.37 for the 100-year, flow from DP60 and PR62. The combined upstream developed runoff of Q5=72.9 cfs and Q100=367.1 cfs has been calculated for DP49. The proposed interim Detention Pond functions to provide full spectrum detention and water quality for runoff calculated onsite. The pond is designed to treat approx 352.2 acres, and provide 1.75 ac-ft of water quality storage and 7.67 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.06 workbook. The detention pond will be private and shall be maintained by the Sterling Ranch Metropolitan District. Access shall be granted to the owner and El Paso County for access and maintenance of the private detention pond. A private maintenance agreement document shall accompany the submittal. In the event of clogging or total inlet failure, flows at DP49 will over top the emergency spillway and outfall into the existing roadside swale parallel to Vollmer Road. A rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet. The peak release rate from pond W-4 (PR63, Q5=15.4 cfs and Q100=289.4 cfs ) will be routed south, via a 66" RCP to PR65.

A preliminary design of detention pond W-4 has been used to calculate potential volume. Upon future upstream development, expansion of Pond W-4 will need to be finalized. Per the "Technical Memorandum Sand Creek Channel Study (North of Woodmen Road) Hydrologic Analysis" prepared by MS Civil Consultants, Inc., dated October 2016 (see appendix for Map), the fully developed runoff of Q5=112.8 cfs and Q100=429.4 cfs has been calculated for DP49. The potential ultimate Detention Pond functions to provide full spectrum detention and water quality for runoff calculated onsite. The pond is designed to treat approx 352.2 acres, and provide 2.06 ac-ft of water quality storage and 11.12 ac-ft of 100-year storage. Volumes were designed per the UDFCD manual and per the Detention Design-UD-Detention v3.06 workbook. The peak release rate from pond W-4 (PR63, Q5=20.8 cfs and Q100=289.4 cfs ) will be routed south, via a 66" RCP to PR65. Minor modifications will be required to outlet structure and spillway to comply with Detention Design-UD-Detention v3.06 workbook. Again, the ultimate design and analysis will need to be finalized upon upstream development and location of Marksheffel Road.

The water quality volume and 100-year volume required for the site has been determined using the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual Chapter 6-Volume II. Refer to the Detention Basin Design sheets located within the appendix of this report.

**DP50**, 8.56 acres, consists of Basin JP-11 a future commercial parcel with runoff coefficients of 0.81 for the 5-year and 0.88 for the 100-year. Developed runoff of  $Q_5=29.4$  cfs and  $Q_{100}=53.7$  cfs has been calculated for DP50. In the undeveloped condition, runoff of  $Q_5=2.0$  cfs and  $Q_{100}=15.0$  cfs are routed via historic drainage patterns and proposed swales to DP50. The surface runoff will be collected by a 36" FES. The flows will be routed south via a 36" RCP (PR64) to PR65. The accumulated flow in PR65 ( $Q_5=32.0$  cfs and  $Q_{100}=309.9$  cfs) will be routed south to PR67. Upon future development of this basin, full spectrum detention shall be required and will release to historic release rates of  $Q_5=2.0$  cfs and  $Q_{100}=15.0$  cfs.

**DP53**, 5.37 acres, consists of Basin JP-12 a future commercial parcel with runoff coefficients of 0.81 for the 5-year and 0.88 for the 100-year. Developed runoff of  $Q_5=19.8$  cfs and  $Q_{100}=36.1$  cfs has been calculated for DP53. In the undeveloped condition, runoff of  $Q_5=1.4$  cfs and  $Q_{100}=10.0$  cfs are routed via historic drainage patterns and proposed swales to DP53. The surface runoff will be collected by a 30" FES. The flows will be routed south via a 30" RCP (PR66) to PR67. The accumulated flow in PR67 ( $Q_5=39.1$  cfs and  $Q_{100}=322.7$  cfs) will be routed via a 72" RCP south to Sand Creek (DP68). Upon future development of this basin, full spectrum detention shall be required and will release to historic release rates of  $Q_5=1.4$  cfs and  $Q_{100}=10.0$  cfs. The summed flows at DP68 (PR74,  $Q_5=42.2$  cfs and  $Q_{100}=472.4$  cfs) will outfall into Sand Creek. Impacts from the outfall into Sand Creek will be addressed in the revised TM-SCCS. A riprap apron will be constructed to dissipate energy and prevent local scour at the outlet.

**DP54**, 1.21 acres, consists of Basin RP-7D (Marksheffel Road) with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and DP51 flowby. Undeveloped runoff of  $Q_5=0.4$  cfs and  $Q_{100}=3.5$  cfs has been calculated for DP54. Undeveloped flows will be routed to a temporary sediment basin via overlot grading as shown on the "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015, which will route flows via historic drainage patterns to Sand Creek. ~~Erosion control will be provided.~~ **How?**

**DP55**, 1.28 acres, consists of Basin RP-7C (Marksheffel Road) with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and DP51 flowby. Undeveloped runoff of  $Q_5=0.4$  cfs and  $Q_{100}=4.9$  cfs has been calculated for DP55. Undeveloped flows will be routed to a temporary sediment basin via overlot grading as shown on the "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015, which will route flows via historic drainage patterns to Sand Creek. Erosion control will be provided.

**DP 54 and DP 55 developed flows will need to be treated in a permanent facility.**

**Basin SSS**, 1.21 acres, consists of the backyards of future residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year. Developed runoff of  $Q_5=1.1$  cfs and  $Q_{100}=3.8$  cfs has been calculated for this basin. Developed flows will be sheet flow into Sand Creek. Erosion control will be provided.

There will be bank stabilization improvements to the Sand Creek Drainage Channel with the development of the STERLING RANCH FILING NOS. 2 site to maintain the integrity of pond W-5. However, channel improvements for Sand Creek (checks, drops, etc...) will be installed in accordance with the Subdivision Improvement Agreement.

## DETENTION PONDS

**Detention Pond W-5**, has combined upstream developed runoff of  $Q_5=217.4$  cfs and  $Q_{100}=517.9$  cfs. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff



calculated onsite. The pond is designed to treat approx 175.6 acres, and provide 2.97 ac-ft of water quality storage and 17.37 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.05 workbook. See Sand Creek Channel Study-Future Hydrologic Conditions Map in the appendix. Impacts from the outfall into Sand Creek will be addressed in the revised TM-SCCS.

**Detention Pond W-4**, has combined upstream developed runoff of Q5=72.9 cfs and Q100=367.1 cfs. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff calculated onsite. The pond is designed to treat approx 352.2 acres, and provide 1.75 ac-ft of water quality storage and 7.67 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.05 workbook. See Sand Creek Channel Study-Future Hydrologic Conditions Map in the appendix. Impacts from the outfall into Sand Creek will be addressed in the revised TM-SCCS.

The detention ponds will be private and shall be maintained by the Sterling Ranch Metropolitan District. Access shall be granted to the owner and El Paso County for access and maintenance of the private detention pond. A private maintenance agreement document shall accompany the submittal. In the event of clogging or total inlet failure, flows will over top the emergency spillway and outfall into Sand Creek. A rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

The water quality volume and 100-year volume required for the site has been determined using the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual Chapter 6 - Volume II. Refer to the Detention Basin Design sheets located within the appendix of this report.

## **EROSION CONTROL**

It is the policy of the El Paso County that a grading and erosion control plan be submitted with the drainage report. EPC approved “Early Grading Plan for Sterling Ranch Phase I Onsite Grading & Erosion Control”, November 18, 2015. And “Early Grading Plan for Sterling Ranch Phase I Offsite Grading & Erosion Control”, December 3, 2015. Grading and Erosion control operations are currently underway (August 2016). Grading and Erosion Control will cease with the final development of the site in the next 12-36 months.

## **CHANNEL IMPROVEMENTS**

Per the Sand Creek DBPS, Sand Creek and connected tributaries in the area of the site will require improvements. The east tributary reaches within the site boundary (DBPS SEG: 169, 186, 164, 159) will not require improvements because they will no longer be present, as development in the areas will eliminate them, and replace them with, a storm sewer system to discharge into Sand Creek. Sand Creek itself will continue to be routed through the development. Per the DBPS, selective rip rap linings, grade control check structures, and drop structure improvements are required to stabilize the channel to prevent further degradation, scour and meandering. Full Spectrum Detention will also be used on its benefits to the integrity of the Sand Creek Channel. A separate document with detailed alternative sections, HEC-RAS analyses, etc. will be submitted with for the applicable and adjoining areas of development, in accordance with SIA requirements.

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 volume of flows from the full spectrum detention ponds. In the final design stage of the applicable and adjoining development, the channels will be analyzed to verify the amount of improvements necessary.

**The approved Subdivision Improvements Agreement for Sterling Ranch Filing No. 2 address the timing and funding for channel improvements.**

Channel Improvements and Wetland Mitigation

Areas with the existing floodplain or the low flow zone of the drainageways 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 a wetland consultant will take place for mitigation of the disturbed wetlands. Included in this report (in the appendix) are the memo and map from Core Consultants showing intent to have wetlands delineated in the Filing No. 2 areas of wetland disturbance.

**CONSTRUCTION COST OPINION – FILING NO. 2**

**Drainage Facilities:**

Item	Description	Quantity	Unit Cost		Cost
1	18"RCP	595	\$40 /LF	\$	23,800.00
2	24" RCP	591	\$50 /LF	\$	29,550.00
3	30" RCP	382	\$65 /LF	\$	24,830.00
4	36" RCP	1375	\$75 /LF	\$	103,125.00
5	42" RCP	1238	\$85 /LF	\$	105,230.00
6	48" RCP	1158	\$150 /LF	\$	173,700.00
7	54" RCP	344	\$200 /LF	\$	68,800.00
8	66" RCP	1863	\$300 /LF	\$	558,900.00
9	72" RCP	2562	\$350 /LF	\$	896,700.00
10	78" RCP	240	\$400 /LF	\$	96,000.00
11	84" RCP	299	\$450 /LF	\$	134,550.00
12	24" FES	2	\$335 /EA	\$	670.00
13	30" FES	3	\$475 /EA	\$	1,425.00
14	36" FES	2	\$775 /EA	\$	1,550.00
15	42" FES	3	\$895 /EA	\$	2,685.00
16	48" FES	1	\$1096 /EA	\$	1,096.00
17	84" Headwall	2	\$10000 /EA	\$	20,000.00
18	15' CDOT Type R At-Grade	8	\$6000 /EA	\$	48,000.00
19	10' CDOT Type R At-Grade	4	\$5000 /EA	\$	20,000.00
20	2.9'x5.5' CDOT TYPE D	3	\$3500 /EA	\$	10,500.00
21	Storm Sewer MH, box base < 15 feet	15	\$10000 /EA	\$	150,000.00
22	Storm Sewer MH, box base ~ 15 feet-20 feet	4	\$15000 /EA	\$	60,000.00
23	Storm Sewer MH, box base > 20 feet	1	\$20000 /EA	\$	20,000.00
24	*Detention Pond W-5	1	\$200000 /EA	\$	200,000.00
25	*Detention Pond W-4	1	\$200000 /EA	\$	200,000.00
26	Mod CDOT Outlet Structure	2	\$15000 /EA	\$	30,000.00
<b>Total</b>				<b>\$</b>	<b>2,981,111.00</b>

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary  
 Comment on highlighted text. The SIA did not call out the channel improvements that need to be constructed with this Filing. 1. Channel improvements need to be constructed that protect the outfall. 2. These improvements need to be evaluated due to the channel being unimproved for a long distance downstream. 3. Call out that all Sterling Ranch portions of Sand creek will be maintained by the Sterling ranch district until the channel is improved and accepted.

from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above is only an estimate of the facility cost and drainage basin fee amounts in 2017.

**DRAINAGE & BRIDGE FEES – FILING NO. 2**

This site is within the Sand Creek Drainage Basin. The 2017 Drainage and Bridge Fees per El Paso County for the STERLING RANCH FILING NO. 1 site are as follows: **(see next sheet for itemized statement)**

Per Sterling Ranch Filing No.2 Plat –	<b>Total Area</b>	<b>49.643 Acres</b>
<b>FILING NO. 2 FEES:</b>		
<b>Drainage Fees:</b>	<b>(See attached Spreadsheet)</b>	<b>\$ 583,073.57</b>
<b>Bridge Fees:</b>	<b>(See attached Spreadsheet)</b>	<b>\$ 176,647.86</b>

**STERLING RANCH TOTAL:**

**Sand Creek Channel Improvements (DBPS Estimate – 2017 dollars)** **\$8,237,679.00**

**Sand Creek Bridge Improvements (DBPS Estimate – 2017 dollars)** **\$1,904,456.00**

**DRAINAGE & BRIDGE FEES - FILING NO. 2 - CONTNUED**

An Intergovernmental Agreement for the Establishment of The Sterling Ranch Storm-Water Escrow Fund and the Subdivision Improvements Agreement Sterling Ranch Filing No. 2, address the timing of drainage improvement and fees. The above cost estimate is for informational purposes only. Final drainage improvement costs will be determined post construction.

**SUMMARY**

Development of this site will not adversely affect the surrounding development per this final drainage report with no negative impact of the neighboring developments. The proposed drainage facilities will adequately convey, detain and route runoff from the tributary and onsite flows to the Sand Creek Drainage channel. Full Spectrum Detention and Water Quality Ponds will be used to discharge developed flows into Sand Creek per the Urban Drainage criteria flow rates, which are at or less than the historic flow. Care will be taken during construction to accommodate overland flow routes onsite and temporary drainage conditions. The development of the STERLING RANCH FILING NO. 2 project(s) shall not adversely affect adjacent or downstream property.

Include a section called "Four Step Process" that discusses the process the developer/engineer followed in the design of the stormwater management & treatment for this Site.

Include a tabulation of the offsite/channel improvements that need to be constructed with Filing 2.

clarify where this comparison applies.

**STERLING RANCH FILING NO. 2 - TRACTS AND RIGHT-OF-WAY - DRAINAGE & BRIDGE FEES (2018)**

TRACT/ROW	SIZE/ACRE	USE	MAINTENANCE	OWNERSHIP	% Impervious	DRAINAGE FEE	FEE	BRIDGE FEE	FEE
A	0.391	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	29.0%	\$ 17,197	\$ 1,949.97	\$ 5,210	\$ 590.76
B	0.658	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	29.0%	\$ 17,197	\$ 3,281.53	\$ 5,210	\$ 994.17
C	0.845	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	24.0%	\$ 17,197	\$ 3,487.55	\$ 5,210	\$ 1,056.59
D	2.159	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	13.0%	\$ 17,197	\$ 4,826.68	\$ 5,210	\$ 1,462.29
E	19.674	ZERO LOT LINE FUTURE SINGLE FAMILY RESIDENTIAL LOTS	SR LAND, LLC	SR LAND, LLC	70.0%	\$ 17,197	\$ 236,833.64	\$ 5,210	\$ 71,751.08
F	1.231	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	4.0%	\$ 17,197	\$ 846.78	\$ 5,210	\$ 256.54
G	0.249	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	2.0%	\$ 17,197	\$ 85.64	\$ 5,210	\$ 25.95
H	0.062	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	2.0%	\$ 17,197	\$ 21.32	\$ 5,210	\$ 6.46
I	0.5	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY/MAIL KIOSK	SRMD #1	SRMD #1	15.0%	\$ 17,197	\$ 1,289.78	\$ 5,210	\$ 390.75
J	0.379	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	30.0%	\$ 17,197	\$ 1,955.30	\$ 5,210	\$ 592.38
K	0.387	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	30.0%	\$ 17,197	\$ 1,996.57	\$ 5,210	\$ 604.88
49 LOTS	11.871	SINGLE FAMILY RESIDENTIAL LOTS	SRMD #1	SRMD #1	70.0%	\$ 17,197	\$ 142,901.91	\$ 5,210	\$ 43,293.54
ROW	4.734	ROAD RIGHTS OF WAY (STERLING RANCH ROAD)	EPC	EPC	95.0%	\$ 17,197	\$ 77,340.07	\$ 5,210	\$ 23,430.93
ROW	3.525	ROAD RIGHTS OF WAY (MARKSHEFFEL ROAD)	EPC	EPC	95.0%	\$ 17,197	\$ 57,588.45	\$ 5,210	\$ 17,446.99
ROW	2.979	ROAD RIGHTS OF WAY (VOLLMER ROAD, ULTIMATE)	EPC	EPC	95.0%	\$ 17,197	\$ 48,668.37	\$ 5,210	\$ 14,744.56
						<b>TOTAL FEES</b>	<b>\$ 583,073.57</b>	<b>BRIDGE FEE</b>	<b>\$ 176,647.86</b>
<b>49.644</b>	<b>TOTAL AREA</b>								

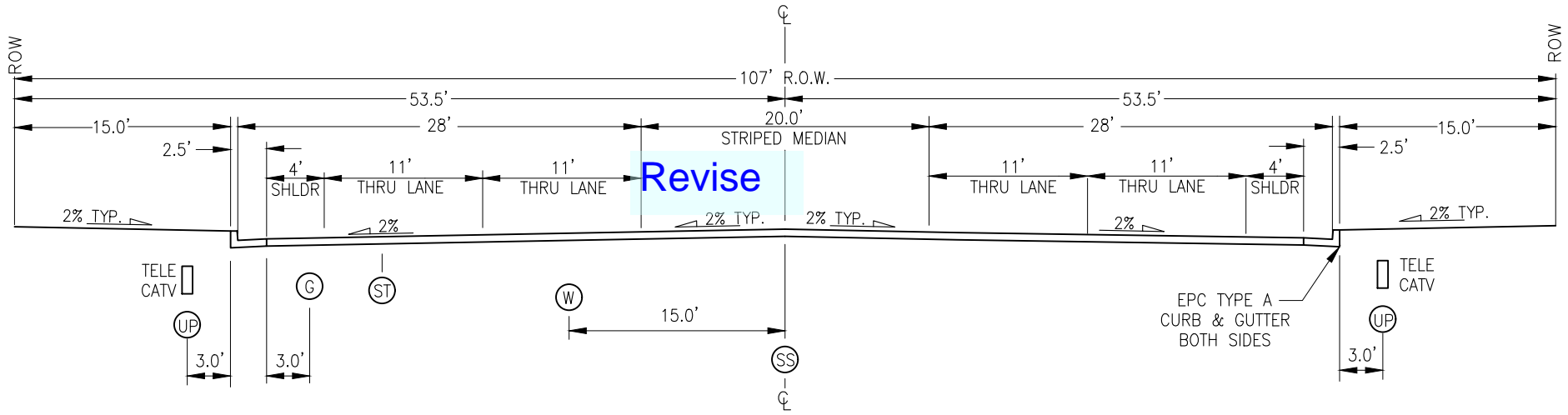
\*SRMD#1 = STERLING RANCH METROPOLITAN DISTRICT NO. 1

(Not checked this review)

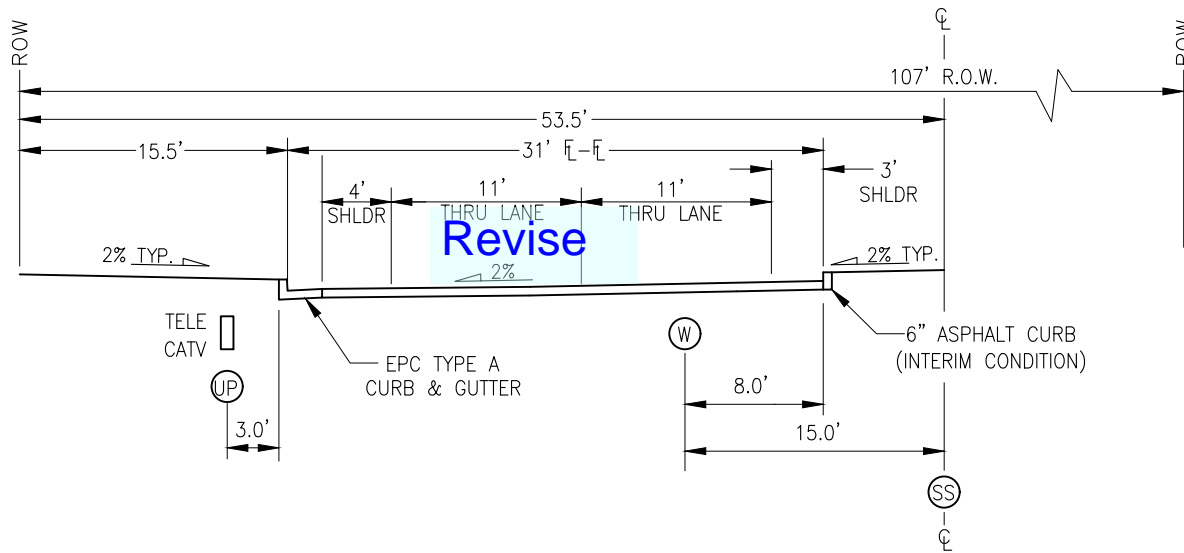
## REFERENCES

- 1.) "El Paso County and City of Colorado Springs Drainage Criteria Manual, Vol I & II".
- 2.) "Urban Storm Drainage Criteria Manuals, Volumes 1-3"
- 3.) NRSC Web Soil Survey Map for El Paso County. <http://websoilsurvey.nrcs.usda.gov>
- 4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date March 17, 1997.
- 5.) "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Corporation, revised March 1996
- 6.) "Preliminary Drainage Report for Sterling Ranch-Phase 1", dated May 2015, by M&S Civil Consultants, Inc.
- 7.) "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015
- 8.) "Sterling Ranch-Phase 1 Onsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015
- 9.) "Final Drainage Report for Barbarick Subdivision, Portions of Lots 1, 2 and Lots 3 & 4, by Matrix Design Group, dated June 2016.
- 10.) "Preliminary and Final Drainage Report, Barbarick Subdivision, A Replat of Lot "D", McClintock Subdivision", El Paso County, Revised August 15, 2007, prepared by Oliver E. Watts, Consulting Engineer, Inc.
- 11.) "Master Development Drainage Plan For Sterling Ranch", prepared by M&S Civil Consultants, Inc., dated July 2010 (Draft not approved)
- 12.) "Technical Memorandum Sand Creek Channel Study (North of Woodmen Road) Hydrologic Analysis" (TM-SCCS) prepared by M&S Civil Consultants, Inc., dated July 2016
- 13.) "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2 and Final Drainage Report for Sterling Ranch Filing No. 1", prepared by M&S Civil Consultants, Inc., dated April 2017

**MDDP ...  
2018 (TBD)**

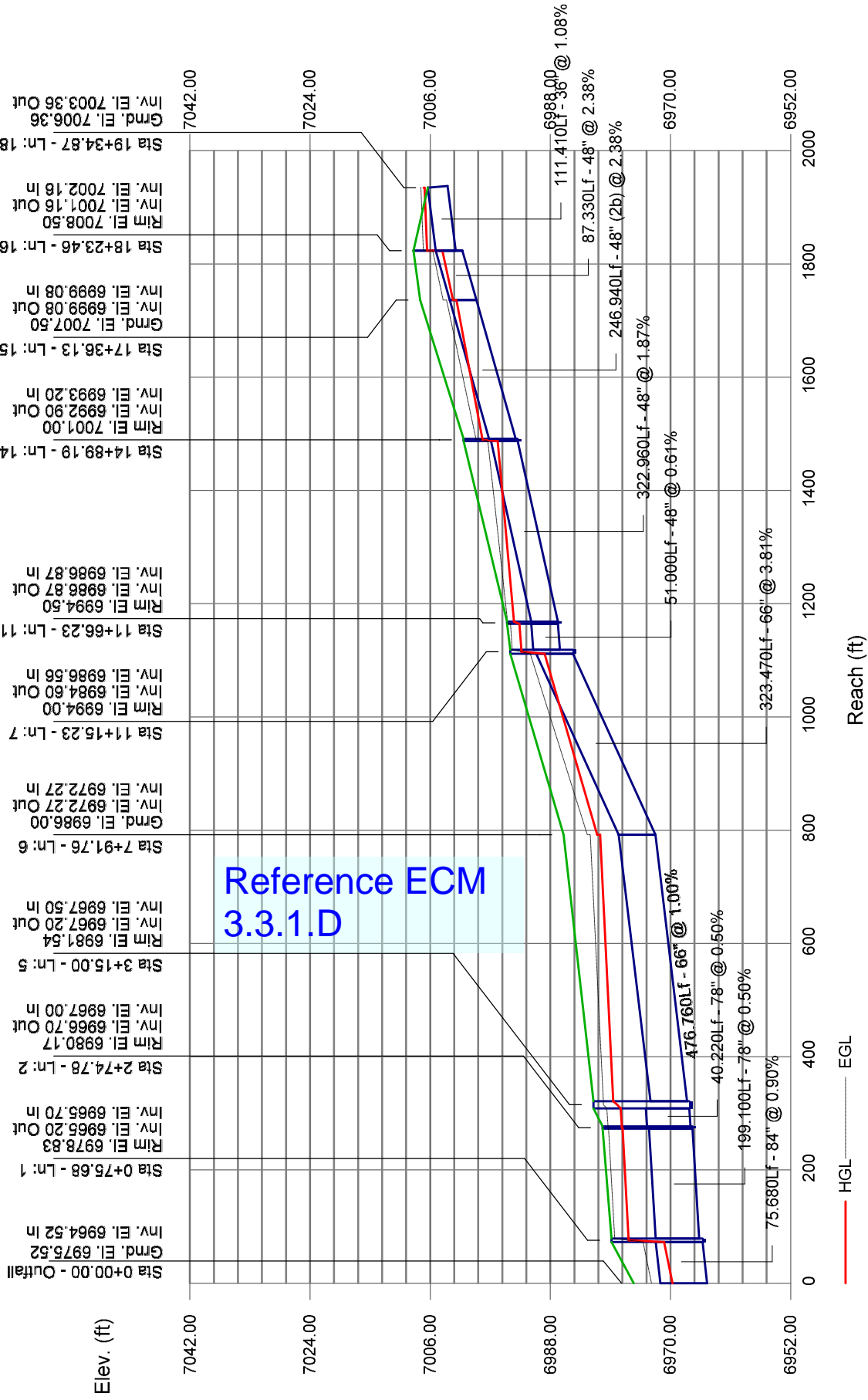


**"ULTIMATE" MARKSHEFFEL ROAD**  
**(MODIFIED) 4 LANE URBAN PRINCIPAL ARTERIAL CROSS SECTION**  
 SCALE: NTS



**"INTERIM" MARKSHEFFEL ROAD**  
**(MODIFIED) 4 LANE URBAN PRINCIPAL ARTERIAL CROSS SECTION**  
 SCALE: NTS

## Storm 14, 17

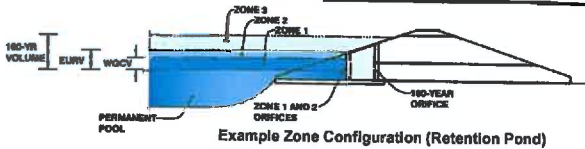




# Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **STERLING RANCH FILING NO. 2**  
Basin ID: **POND W-5**



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.99	3.141	Orifice Plate
Zone 2 (EURV)	6.46	7.356	Orifice Plate
Zone 3 (100-year)	8.13	6.610	Weir&Pipe (Restrict)
		17.107	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =  ft (distance below the filtration media surface)  
Underdrain Orifice Diameter =  inches

Calculated Parameters for Underdrain  
Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  inches  
Orifice Plate: Orifice Area per Row =  sq. inches (use rectangular openings)

Calculated Parameters for Plate  
WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.15	4.31					
Orifice Area (sq. inches)	12.55	12.55	12.55					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected
Invert of Vertical Orifice =	N/A	N/A
Depth at top of Zone using Vertical Orifice =	N/A	N/A
Vertical Orifice Diameter =	N/A	N/A

ft (relative to basin bottom at Stage = 0 ft)  
ft (relative to basin bottom at Stage = 0 ft)  
inches

Calculated Parameters for Vertical Orifice  
Vertical Orifice Area =  ft<sup>2</sup>  
Vertical Orifice Centroid =  feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, H <sub>o</sub> =	5.46	N/A
Overflow Weir Front Edge Length =	20.00	N/A
Overflow Weir Slope =	0.00	N/A
Horiz. Length of Weir Sides =	6.00	N/A
Overflow Grate Open Area % =	70%	N/A
Debris Clogging % =	50%	N/A

ft (relative to basin bottom at Stage = 0 ft)  
feet  
H:V (enter zero for flat grate)  
feet  
%, grate open area/total area  
%

Calculated Parameters for Overflow Weir  
Height of Grate Upper Edge, H<sub>g</sub> =  feet  
Over Flow Weir Slope Length =  feet  
Grate Open Area / 100-yr Orifice Area =  should be ≥ 4  
Overflow Grate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris =  ft<sup>2</sup>

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	0.83	N/A
Outlet Pipe Diameter =	48.00	N/A
Restrictor Plate Height Above Pipe Invert =	41.80	N/A

ft (distance below basin bottom at Stage = 0 ft)  
inches  
inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Outlet Orifice Area =  ft<sup>2</sup>  
Outlet Orifice Centroid =  feet  
Half-Central Angle of Restrictor Plate on Pipe =  radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =  ft (relative to basin bottom at Stage = 0 ft)  
Spillway Crest Length =  feet  
Spillway End Slopes =  H:V  
Freeboard above Max Water Surface =  feet

Calculated Parameters for Spillway  
Spillway Design Flow Depth =  feet  
Stage at Top of Freeboard =  feet  
Basin Area at Top of Freeboard =  acres

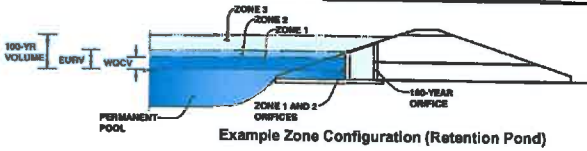
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (In) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	3.141	10.497	7.750	10.345	13.246	17.269	20.902	25.403	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	3.141	10.497	7.750	10.338	13.238	17.265	20.898	25.397	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.14	0.43	0.71	1.11	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.4	3.0	24.4	74.7	124.9	195.0	0.0
Peak Inflow Q (cfs) =	68.7	223.2	166.3	219.9	279.1	362.1	432.3	520.3	#N/A
Peak Outflow Q (cfs) =	1.4	2.5	2.2	2.5	27.5	87.4	142.2	149.7	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.1	1.2	1.1	0.8	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	2.0	1.7	1.7	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	77	65	76	78	76	74	73	#N/A
Time to Drain 98% of Inflow Volume (hours) =	40	82	69	81	84	84	83	82	#N/A
Maximum Ponding Depth (ft) =	3.90	6.37	5.57	6.32	6.83	7.29	7.62	8.19	#N/A
Area at Maximum Ponding Depth (acres) =	2.09	3.57	3.22	3.56	3.77	3.96	4.08	4.25	#N/A
Maximum Volume Stored (acre-ft) =	2.970	10.164	7.449	10.021	11.853	13.630	14.958	17.374	#N/A

Adjust to be <1; provide comparison to historic drainage area allowable flows for all return periods.

## Detention Basin Outlet Structure Design

Project: **STERLING RANCH FILING NO. 2**  
 Basin ID: **POND W-4 INTERIM**



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.93	1.967	Orifice Plate
Zone 2 (EURV)	4.99	0.953	Orifice Plate
Zone 3 (100-year)	12.40	9.315	Weir&Pipe (Restrict)
		12.235	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =  ft (distance below the filtration media surface)  
 Underdrain Orifice Diameter =  inches

Calculated Parameters for Underdrain  
 Underdrain Orifice Area =  ft<sup>2</sup>  
 Underdrain Orifice Centroid =  feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =  ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
 Orifice Plate: Orifice Vertical Spacing =  inches  
 Orifice Plate: Orifice Area per Row =  sq. inches (use rectangular openings)

Calculated Parameters for Plate  
 WQ Orifice Area per Row =  ft<sup>2</sup>  
 Elliptical Half-Width =  feet  
 Elliptical Slot Centroid =  feet  
 Elliptical Slot Area =  ft<sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.66	3.33					
Orifice Area (sq. inches)	6.80	6.80	6.80					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice  
 Vertical Orifice Area =  ft<sup>2</sup>  
 Vertical Orifice Centroid =  feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H <sub>o</sub> =	4.99	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	20.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	% grate open area/total area
Debris Clogging % =	30%	N/A	%

Calculated Parameters for Overflow Weir  
 Height of Grate Upper Edge, H<sub>1</sub> =  feet  
 Overflow Weir Slope Length =  feet  
 Grate Open Area / 100-yr Orifice Area =  should be ≥ 4  
 Overflow Grate Open Area w/o Debris =  ft<sup>2</sup>  
 Overflow Grate Open Area w/ Debris =  ft<sup>2</sup>

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.58	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	55.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	58.80	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
 Outlet Orifice Area =  ft<sup>2</sup>  
 Outlet Orifice Centroid =  feet  
 Half-Central Angle of Restrictor Plate on Pipe =  radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =  ft (relative to basin bottom at Stage = 0 ft)  
 Spillway Crest Length =  feet  
 Spillway End Slopes =  H:V  
 Freeboard above Max Water Surface =  feet

Calculated Parameters for Spillway  
 Spillway Design Flow Depth =  feet  
 Stage at Top of Freeboard =  feet  
 Basin Area at Top of Freeboard =  acres

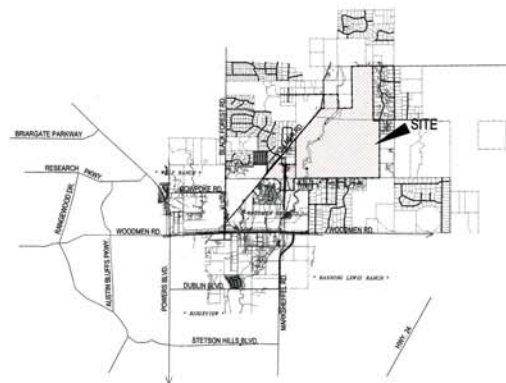
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.53	3.29
Calculated Runoff Volume (acre-ft) =	1.967	2.920	1.778	4.643	8.198	16.469	22.829	30.940	49.821
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.966	2.919	1.777	4.642	8.194	16.455	22.814	30.925	49.804
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.07	0.15	0.41	0.60	0.84	1.31
Predevelopment Peak Q (cfs) =	0.0	0.0	1.8	26.0	52.1	145.5	212.0	295.1	462.9
Peak Inflow Q (cfs) =	24.1	36.0	21.8	57.5	101.6	202.9	279.6	368.4	549.8
Peak Outflow Q (cfs) =	0.9	1.2	0.8	15.4	56.8	162.6	237.7	289.4	357.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	1.1	1.1	1.1	1.0	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.6	1.9	2.7	3.3	4.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	45	54	43	55	51	43	38	32	23
Time to Drain 99% of Inflow Volume (hours) =	47	57	45	60	58	54	52	49	43
Maximum Ponding Depth (ft) =	3.68	4.69	3.47	5.53	6.24	7.35	7.97	9.25	13.00
Area at Maximum Ponding Depth (acres) =	0.83	0.91	0.81	0.98	1.04	1.14	1.19	1.31	1.66
Maximum Volume Stored (acre-ft) =	1.752	2.645	1.580	3.430	4.145	5.362	6.082	7.666	13.226

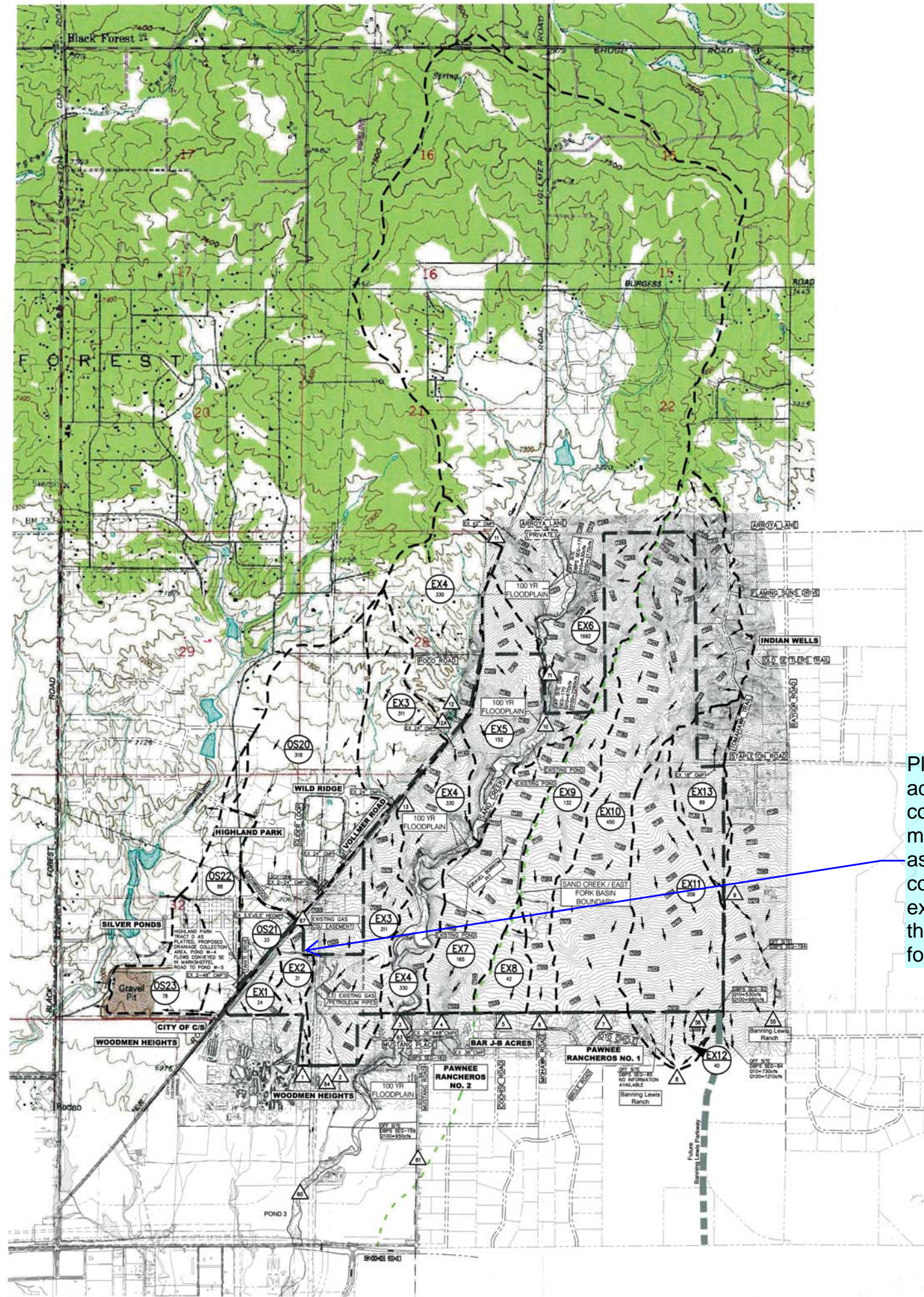
This presents a safety issue

Provide the SDI worksheets that demonstrate the detention ponds comply with Colorado Revised Statute 37-92-602(8). Provide this as a separate document.

## **DRAINAGE MAPS**



**STERLING RANCH**  
N.T.S.



**HISTORIC CONDITION**

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q <sub>10</sub> (CFS)	Q <sub>100</sub> (CFS)
EX-1	24	3	40
EX-2	31	3	45
EX-3	311	49	341
EX-4	330	71	353
EX-5	152	14	209
EX-6	1692	118	2168
EX-7	165	12	197
EX-8	42	4	64
EX-9	132	11	149
EX-10	450	48	474
EX-11	209	17	261
EX-12	40	5	65
EX-13	89	6	114
OS-20	318	61	310
OS-21	33	8	38
OS-22	88	18	91
OS-23	78	34	84

\* NOTE: BASINS OS-22 & OS-23 NOT PART OF THIS REPORT. FLOWS FOLLOW HISTORIC PATTERNS ON THE WESTSIDE OF VOLLMER ROAD.

**HISTORIC CONDITION**

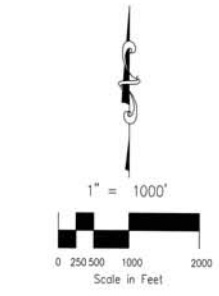
DESIGN POINTS							
DESIGN POINT	SQ. MI.	Q <sub>10</sub> (CFS)	Q <sub>100</sub> (CFS)	SQ. MI.	DBPS Q <sub>10</sub>	DBPS Q <sub>100</sub>	DBPS DP/D
1	0.09	5	84				
2	0.49	55	465	0.74	465	64	
3	0.52	139	2610	4.33	2552	63	
4	0.26	12	197				
5	0.07	4	64				
6	0.21	11	149				
7	0.70	48	474				
8	0.39	18	305				
9	0.14	6	114				
10	2.64	122	2245	3.27	2245	71	
11	0.09	5	83				
12A	0.01	3	16				
12	0.27	10	200				
13	0.17	6	126				

\* NOTE: SQ. MI. ARE NOT CONSISTANT AT EACH DESIGN POINT DP-DBPS

\* NOTE: DBPS FLOWS ARE FOR THE EXISTING CONDITION

# NO DATA GIVEN IN DBPS

Please provide an additional existing condition drainage map at the same scale as the proposed condition map. This exhibit should show the show the boundary for this site.



**LEGEND**

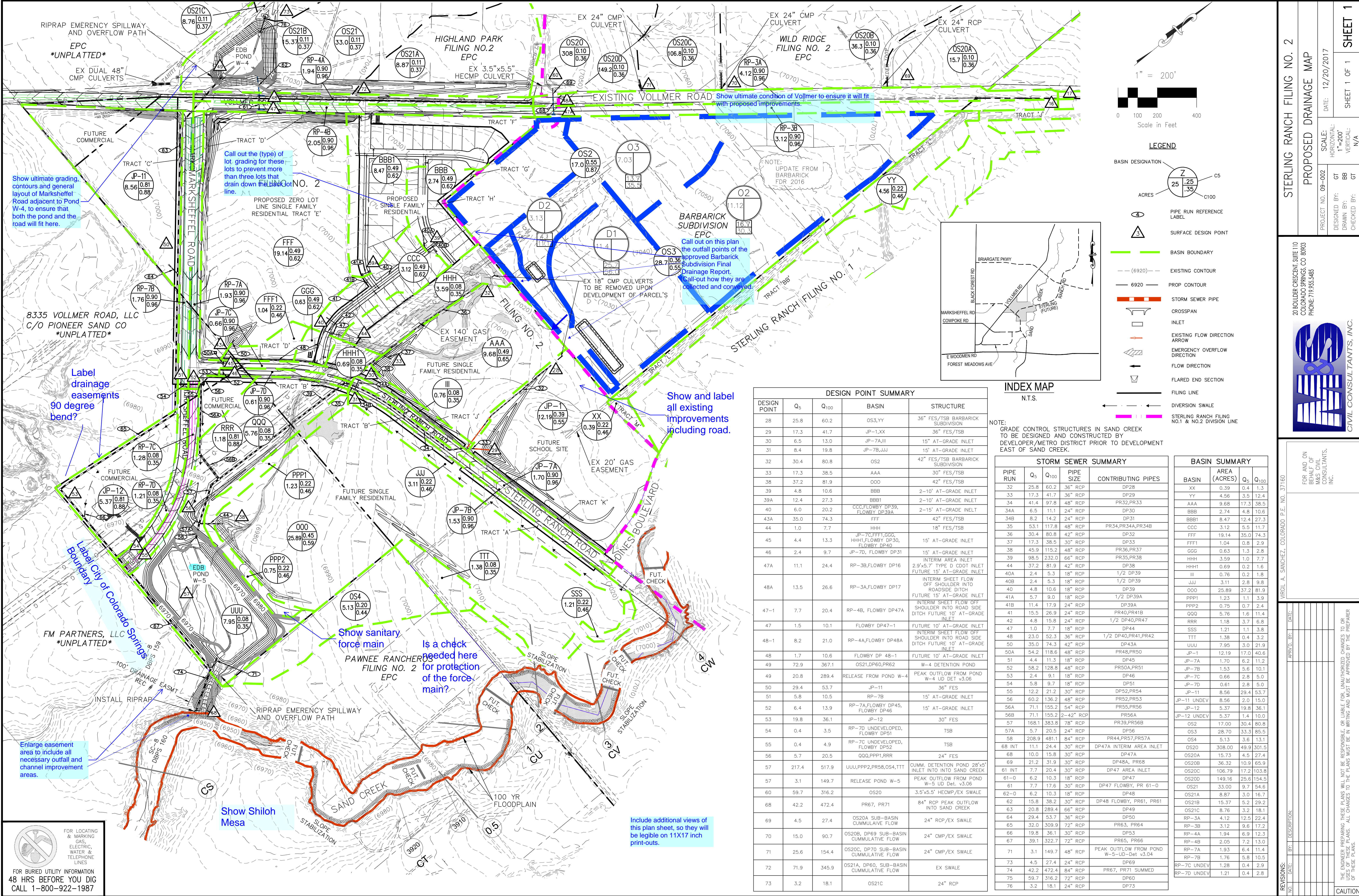
- EXISTING MDDP BASIN ACREAGE
- EXISTING FLOW RELEASE POINT
- FLOW DIRECTION
- BASIN BOUNDARY
- PROPERTY BOUNDARY
- EXISTING CONTOUR
- CULVERT PIPE

102 E. PIKES PEAK AVE. STE 306  
COLORADO SPRINGS, CO 80903  
(719) 955-5485, FAX (719) 444-8427

**STERLING RANCH MDDP**  
**HISTORIC - DRAINAGE MAP**

PROJECT NO. 09-001 FILE: \*\\dwg\Dev Plan\09001-MDDP HISTORIC  
DESIGNED BY: VAS SCALE DATE: 03/16/15  
DRAWN BY: VAS HORIZ: 1"=500'  
CHECKED BY: VAS VERT: N/A

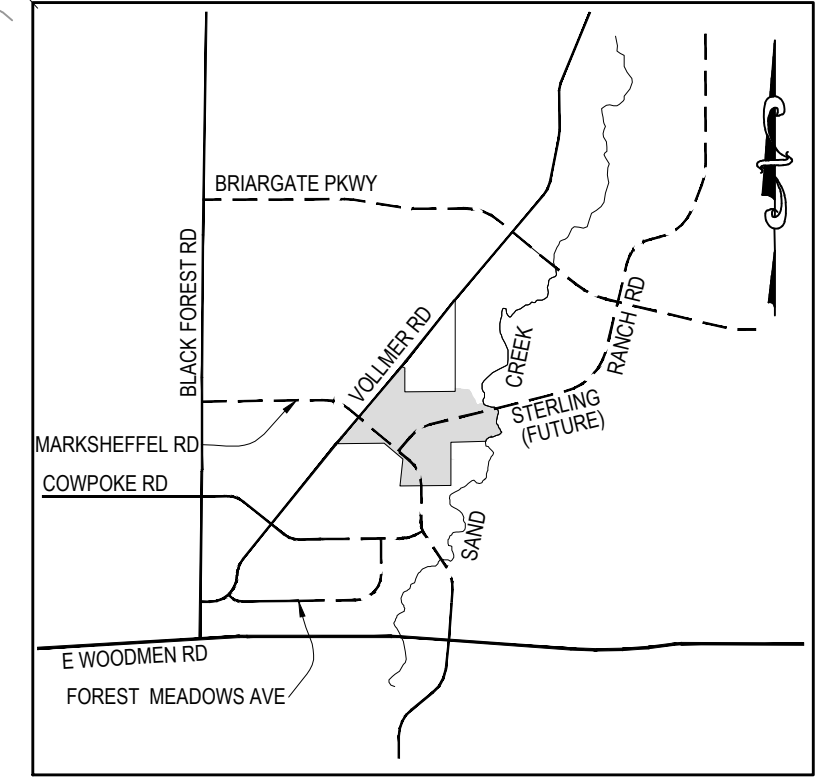
SHEET 1 OF 1



STERLING RANCH FILING NO. 2  
 PROPOSED DRAINAGE MAP  
 DATE: 12/20/2017  
 PROJECT NO. 09-002  
 SCALE: HORIZONTAL: 1"=200' VERTICAL: N/A  
 DESIGNED BY: GT  
 DRAWN BY: BT  
 CHECKED BY: N/A  
 SHEET 1 OF 1  
 SHEET 1

**LEGEND**

- BASIN DESIGNATION: Z, C5, C100
- ACRES: 25, 25, 35
- PIPE RUN REFERENCE LABEL: 4
- SURFACE DESIGN POINT: 3
- BASIN BOUNDARY: (Green dashed line)
- EXISTING CONTOUR: (6920 dashed line)
- PROP CONTOUR: (6920 solid line)
- STORM SEWER PIPE: (Red dashed line)
- CROSSSPAN: (Red rectangle)
- INLET: (Red trapezoid)
- EXISTING FLOW DIRECTION: (Red arrow)
- EMERGENCY OVERFLOW DIRECTION: (Red arrow with 'E')
- FLOW DIRECTION: (Black arrow)
- FLARED END SECTION: (Black arrow with 'F')
- FILING LINE: (Black line)
- DIVERSION SWALE: (Black line with 'S')
- STERLING RANCH FILING NO.1 & NO.2 DIVISION LINE: (Pink dashed line)



**DESIGN POINT SUMMARY**

DESIGN POINT	Q <sub>5</sub>	Q <sub>100</sub>	BASIN	STRUCTURE
28	25.8	60.2	OS3,YY	36" FES/TSB BARBARICK SUBDIVISION
29	17.3	41.7	JP-1,XX	36" FES/TSB
30	6.5	13.0	JP-7A,III	15" AT-GRADE INLET
31	8.4	19.8	JP-7B,III	15" AT-GRADE INLET
32	30.4	80.8	OS2	42" FES/TSB BARBARICK SUBDIVISION
33	17.3	38.5	AAA	30" FES/TSB
38	37.2	81.9	000	42" FES/TSB
39	4.8	10.6	BBB	2-10" AT-GRADE INLET
39A	12.4	27.3	BBB1	2-10" AT-GRADE INLET
40	6.0	20.2	CCC,FLOWBY DP39, FLOWBY DP39A	2-15" AT-GRADE INLET
43A	35.0	74.3	FFF	42" FES/TSB
44	1.0	7.7	HHH	18" FES/TSB
45	4.4	13.3	JP-7C,FFF,GGG, HHH,FLOWBY DP30, FLOWBY DP40	15" AT-GRADE INLET
46	2.4	9.7	JP-7D, FLOWBY DP31	15" AT-GRADE INLET
47A	11.1	24.4	RP-3B,FLOWBY DP16	INTERIM AREA INLET 2.9x5.7" TYPE D CDDT INLET FUTURE 15" AT-GRADE INLET
48A	13.5	26.6	RP-3A,FLOWBY DP17	INTERIM SHEET FLOW OFF SHOULDER INTO ROADSIDE DITCH FUTURE 15" AT-GRADE INLET
47-1	7.7	20.4	RP-4B, FLOWBY DP47A	INTERIM SHEET FLOW OFF SHOULDER INTO ROAD SIDE DITCH FUTURE 10" AT-GRADE INLET
47	1.5	10.1	FLOWBY DP47-1	FUTURE 10" AT-GRADE INLET
48-1	8.2	21.0	RP-4A,FLOWBY DP48A	INTERIM SHEET FLOW OFF SHOULDER INTO ROAD SIDE DITCH FUTURE 10" AT-GRADE INLET
48	1.7	10.6	FLOWBY DP 48-1	FUTURE 10" AT-GRADE INLET
49	72.9	367.1	OS21,DP60,PR62	W-4 DETENTION POND
49	20.8	289.4	RELEASE FROM POND W-4	PEAK OUTFLOW FROM POND W-4 UD Det v3.06
50	29.4	53.7	JP-11	36" FES
51	5.8	10.5	RP-7B	15" AT-GRADE INLET
52	6.4	13.9	RP-7A,FLOWBY DP45, FLOWBY DP46	15" AT-GRADE INLET
53	19.8	36.1	JP-12	30" FES
54	0.4	3.5	RP-7D UNDEVELOPED, FLOWBY DP51	TSB
55	0.4	4.9	RP-7C UNDEVELOPED, FLOWBY DP52	TSB
56	5.7	20.5	000,PPP1,RRR	24" FES
57	217.4	517.9	UUU,PPP2,PR58,054,TTT	CUMM. DETENTION POND 28'x5' INLET INTO SAND CREEK
57	3.1	149.7	RELEASE POND W-5	PEAK OUTFLOW FROM POND W-5 UD Det. v3.06
60	59.7	316.2	OS20	3.5'x5.5' HECMP/EX SWALE
68	42.2	472.4	PR67, PR71	84" RCP PEAK OUTFLOW INTO SAND CREEK
69	4.5	27.4	OS20A SUB-BASIN CUMMULATIVE FLOW	24" RCP/EX SWALE
70	15.0	90.7	OS20B, DP69 SUB-BASIN CUMMULATIVE FLOW	24" CMP/EX SWALE
71	25.6	154.4	OS20C, DP70 SUB-BASIN CUMMULATIVE FLOW	24" CMP/EX SWALE
72	71.9	345.9	OS21A, DP60, SUB-BASIN CUMMULATIVE FLOW	EX SWALE
73	3.2	18.1	OS21C	24" RCP

**INDEX MAP**  
N.T.S.

NOTE: GRADE CONTROL STRUCTURES IN SAND CREEK TO BE DESIGNED AND CONSTRUCTED BY DEVELOPER/METRO DISTRICT PRIOR TO DEVELOPMENT EAST OF SAND CREEK.

**STORM SEWER SUMMARY**

PIPE RUN	Q <sub>5</sub>	Q <sub>100</sub>	PIPE SIZE	CONTRIBUTING PIPES
32	25.8	60.2	36" RCP	DP28
33	17.3	41.7	36" RCP	DP29
34	41.4	97.8	48" RCP	PR32,PR33
34A	6.5	11.1	24" RCP	DP30
34B	8.2	14.2	24" RCP	DP31
35	53.1	117.8	48" RCP	PR34,PR34A,PR34B
36	30.4	80.8	42" RCP	DP32
37	17.3	38.5	30" RCP	DP33
38	45.9	115.2	48" RCP	PR36,PR37
39	98.5	232.0	66" RCP	PR35,PR38
44	37.2	81.9	42" RCP	DP38
40A	2.4	5.3	18" RCP	1/2 DP39
40B	2.4	5.3	18" RCP	1/2 DP39
40	4.8	10.6	18" RCP	DP39
41A	5.7	9.0	18" RCP	1/2 DP39A
41B	11.4	17.9	24" RCP	DP39A
41	15.5	26.9	24" RCP	PR40,PR41B
42	4.8	15.6	24" RCP	1/2 DP40,PR47
47	1.0	7.7	18" RCP	DP44
48	23.0	52.3	36" RCP	1/2 DP40,PR41,PR42
50	35.0	74.3	42" RCP	DP43A
50A	54.2	118.6	48" RCP	PR48,PR50
51	4.4	11.3	18" RCP	DP45
52	58.2	128.8	48" RCP	PR50A,PR51
53	2.4	9.1	18" RCP	DP46
54	5.8	9.7	18" RCP	DP51
55	12.2	21.2	30" RCP	DP52,PR54
56	60.2	136.2	48" RCP	PR52,PR53
56A	71.1	155.2	54" RCP	PR55,PR56
56B	71.1	155.2	2-42" RCP	PR56A
57	168.1	383.8	78" RCP	PR39,PR56B
57A	5.7	20.5	24" RCP	DP56
58	208.9	481.1	84" RCP	PR44,PR57,PR57A
68 INT	11.1	24.4	30" RCP	DP47A INTERIM AREA INLET
68	10.0	15.8	30" RCP	DP47A
69	21.2	31.9	30" RCP	DP48A, PR68
61 INT	7.7	20.4	30" RCP	DP47 AREA INLET
61-0	6.2	10.3	18" RCP	DP47
61	7.7	17.6	30" RCP	DP47 FLOWBY, PR 61-0
62-0	6.2	10.3	18" RCP	DP48
62	15.8	38.2	30" RCP	DP48 FLOWBY, PR61, PR61
63	20.8	289.4	66" RCP	DP49
64	29.4	53.7	36" RCP	DP50
65	32.0	309.9	72" RCP	PR63, PR64
66	19.8	36.1	30" RCP	DP53
67	39.1	322.7	72" RCP	PR65, PR66
71	3.1	149.7	48" RCP	PEAK OUTFLOW FROM POND W-5 UD-Det. v3.04
73	4.5	27.4	24" RCP	DP69
74	42.2	472.4	84" RCP	PR67, PR71 SUMMED
75	59.7	316.2	72" RCP	DP60
76	3.2	18.1	24" RCP	DP73

**BASIN SUMMARY**

BASIN	AREA (ACRES)	Q <sub>5</sub>	Q <sub>100</sub>
XX	0.39	0.4	1.3
YY	4.56	3.5	12.4
AAA	9.68	17.3	38.5
BBB	2.74	4.8	10.6
BBB1	8.47	12.4	27.3
CCC	3.12	5.5	11.7
FFF	19.14	35.0	74.3
FFF1	1.04	0.8	2.9
GGG	0.63	1.3	2.8
HHH	3.59	1.0	7.7
HHH1	0.69	0.2	1.6
III	0.76	0.2	1.8
JJJ	3.11	2.8	9.8
OOO	25.89	37.2	81.9
PPP1	1.23	1.1	3.9
PPP2	0.75	0.7	2.4
QQQ	5.76	1.6	11.4
RRR	1.18	3.7	6.8
SSS	1.21	1.1	3.8
TTT	1.38	0.4	3.2
UUU	7.95	3.0	21.9
JP-1	12.19	17.0	40.6
JP-7A	1.70	6.2	11.2
JP-7B	1.53	5.6	10.1
JP-7C	0.66	2.8	5.0
JP-7D	0.61	2.8	5.0
JP-11	8.56	29.4	53.7
JP-11 UNDEV	8.56	2.0	15.0
JP-12	5.37	19.8	36.1
JP-12 UNDEV	5.37	1.4	10.0
OS2	17.00	30.4	80.8
OS3	28.70	33.3	85.5
OS4	5.13	3.6	13.1
OS20	308.00	49.9	301.5
OS20A	15.73	4.5	27.4
OS20B	36.32	10.9	65.9
OS20C	106.79	17.2	103.8
OS20D	149.16	25.6	154.5
OS21	33.00	9.7	54.6
OS21A	8.87	3.0	16.7
OS21B	15.37	5.2	29.2
OS21C	8.76	3.2	18.1
RP-3A	4.12	12.5	22.4
RP-3B	3.12	9.6	17.2
RP-4A	1.94	6.9	12.3
RP-4B	2.05	7.2	13.0
RP-7A	1.93	6.4	11.4
RP-7B	1.76	5.8	10.5
RP-7C UNDEV	1.28	0.4	2.9
RP-7D UNDEV	1.21	0.4	2.8

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES

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

STERLING RANCH FILING NO. 2  
 PROPOSED DRAINAGE MAP  
 PROJECT NO. 09-002  
 DATE: 12/20/2017  
 SCALE: HORIZONTAL: 1"=200' VERTICAL: N/A  
 DESIGNED BY: GT  
 DRAWN BY: BT  
 CHECKED BY: N/A  
 SHEET 1 OF 1  
 SHEET 1

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

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

CAUTION

File: 0:\00002A\Sterling Ranch District - Filing 2\Map\Eng\Emblish\EPD\FR Filing 2-Proposed Drainage Map Filing 2.dwg Plotstamp: 3/7/2018 1:38 PM