# FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 2

# EL PASO COUNTY, COLORADO

February 2019

Prepared for:
**SR Land, LLC**
**20 Boulder Crescent, Suite 210**
**Colorado Springs, CO 80903**

Prepared by:

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Project #09-007
~~DSD~~ Project #
SF-19-004

Cursory comments only provided on this report. Full review requires the Sand Creek Channel Design Report to be completed and accepted prior to an adjacent development's drainage report full review.

# FINAL DRAINAGE REPORT FOR
# HOMESTEAD AT STERLING RANCH FILING NO. 2

### DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin.

I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____

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

DEVELOPER'S STATEMENT

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

BY:_____
James F Morley

TITLE:_____
DATE:_____

ADDRESS: SR Land, LLC
20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

EL PASO COUNTY'S STATEMENT

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

BY:_____ DATE:_____
Jennifer Irvine, P.E.
County Engineer / ECM Administrator

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**APPENDIX**

# FINAL DRAINAGE REPORT FOR
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## PURPOSE

This document is the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2. This report was previously discussed, as a preliminary drainage report, 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 purpose of this document is to identify and analyze the on and offsite drainage patterns and to ensure that post development runoff is routed through the site safely and in a manner that satisfies the requirements set forth by the El Paso County Drainage Criteria Manual. The following report is an analysis of the drainage for Homestead at Sterling Ranch Filing No. 2, single family lots, onsite and offsite drainage.

## GENERAL LOCATION AND DESCRIPTION

Homestead at Sterling Ranch Filing No. 2 is located in the SE ¼ of the NW ¼, the SW ¼ of the NE ¼, and the NW ¼ of the NE ¼ of Section 33, Township 12 South, Range 65 West of the 6$^{th}$ Principal Meridian, and the NE ¼ of the SW ¼ of Section 33, Township 12 South, Range 65 West of the 6$^{th}$ Principal Meridian within unincorporated El Paso County, Colorado. The site is bound on the south by an existing detention pond, to the north by Briargate Parkway and to the east by Sand Creek. Existing Dines Boulevard runs along the western site boundary. An existing residential development, Homestead at Sterling Ranch Filing No. 1, bounds the site to the west and a future commercial parcel bounds the site to the northwest. Sterling Ranch lies within the Sand Creek Drainage Basin. Flows from this site are tributary to Sand Creek.

Homestead at Sterling Ranch Filing No. 2 consists of 29.658 acres and is presently undeveloped. Vegetation is sparse, consisting of native grasses. Existing site terrain generally slopes from north to southwest at grade rates that vary between 2% and 6%.

Land use for Homestead at Sterling Ranch Filing No. 2 is currently listed as AG (Grazing Land). Improvements proposed for the site include paved streets, trails, a full spectrum detention pond, and utilities as normally constructed for a residential development.

## SOILS

Soils for this project are delineated by the map in the appendix as Pring Coarse Sandy Loam (71) and is characterized as Hydrologic Soil Types "B". Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area". Vegetation is sparse, consisting of native grasses and weeds.

## HYDROLOGIC CALCULATIONS

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

## HYDRAULIC CALCULATIONS

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

## FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain as determined by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0535 F, effective date March 17, 1997 and revised to reflect LOMR, 08-08-O541P, dated July 23, 2009. An annotated FIRM Panel is included in the Appendix.

Call out updated FIRM Dec.7 2018

## DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual, Volumes I & II, dated November 1991, including subsequent updates. El Paso County has also adopted Chapter 6 and Section 3.2.1 of Chapter 13 in the City of Colorado Springs & El Paso County Drainage Criteria Manual Volumes I and II, dated May 2014. (Appendix I of the El Paso County's Engineering Criteria Manual (ECM), 2008). In addition to the ECM, the Urban Storm Drainage Criteria Manuals, Volumes 1-3, published by the Urban Drainage and Flood Control District (Volumes 1 & 2 dated January 2016, Volume 3 dated November 2010 and updates. Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method.

## FOUR STEP PROCESS

**Step 1 Employ Runoff Reduction Practices**. Roof drains will be directed to side yard swales and as possible to grass lined swales to aid in minimizing direct connection of impervious surfaces.

**Step 2 Implement BMPs that provide a water quality capture volume with slow release.** – An existing Full Spectrum Detention Facility (see Sterling Ranch Filing Nos. 1&2 MDDP, Pond 4) was planned and constructed to handle tributary flows for the southwest portion of the site. All remaining tributary areas from the site will be treated in a proposed temporary Full Spectrum Detention Facility, Interim Pond 1. Both ponds 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.

**Step 3 Stabilize streams.** – With the full spectrum detention facilities in place, the runoff from the proposed residential development will be reduced to predevelopment conditions. The developed discharge from the site is less that existing and therefore is not anticipated to have negative effects on downstream drainageways.

Provide information on the stabilization of Sand Creek.

**Step 4 Consider need for Industrial and Commercial BMPs.** – No industrial or commercial land uses are proposed with this development. The proposed residential development area will implement a Stormwater Management Plan (SWMP) incorporation proper housekeeping procedures. Onsite drainage will be routed through proposed private temporary Full Spectrum Detention Facility (FSD), Interim Pond 1, to minimize introduction of contaminates to the county's public drainage systems.

## EXISTING DRAINAGE CONDITIONS

The Homestead at Sterling Ranch Filing No. 2 site consists of 29.658 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 "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 (henceforth referred to as "Sterling Ranch Filing Nos. 1&2 MDDP"). Homestead at Sterling Ranch Filing No. 2 and the surrounding areas, with the exception of the existing Barbarick Subdivision, have already been graded during the overlot of the subdivision. Please refer to the Sterling Ranch Filing Nos. 1&2 MDDP by MS Civil Consultants for information on historic conditions and overlot drainage patterns.

Provide an existing conditions drainage map/plan.

## PROPOSED DRAINAGE CHARACTERISTICS

### General Concept Drainage Discussion

The following is a description of the onsite basins, offsite bypass flows and the overall drainage characteristics for the development of Sterling Ranch Filing No. 2. The development of Sterling Ranch Filing No. 2 consists of residential streets and cul-de-sacs, proposed storm drainage improvements, and lots located within the filing boundary. The proposed development results in drainage patterns and flow values that are the same or less than those in the Sterling Ranch Filing Nos. 1&2 MDDP. Surface flow is designated as Design Points (DP). The following DPs and Basins were determined using the Rational Method since this method offers a more conservative approach to drainage. It should be noted that all calculations and drainage basins have been revised to reflect the new criteria updates by the El Paso County/City of Colorado Springs Drainage Criteria Manual. For comparison, the **asterisk (*)** symbol in the detailed drainage discussions below represents each Basin or Design Point as labeled in the Sterling Ranch Filing Nos. 1&2 MDDP. Asterisk symbols on the Proposed Drainage Map in the appendix also represent Basins, Design Points and Pipe Runs as presented in the Sterling Ranch Filing Nos. 1&2 MDDP.

### Detailed Drainage Discussion (Design Points)

**DP2*,** 5.39 acres, consists of Basin B* planned residential lots and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=8.0 cfs and Q100=19.3 cfs has been calculated for DP2*. The surface runoff is routed via overlot grading and planned swales to two existing 15' CDOT Type R at-grade inlets. The flows are routed east via a 36" RCP to DP5.

**DP3***, 2.92 acres, consists of Basin C* residential lots within Homestead at Sterling Ranch Filing No. 1, and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=4.2 cfs and Q100=10.1 cfs has been calculated for DP3*. The surface runoff is routed via overlot grading and proposed swales to an existing 5' CDOT type R sump inlet. The flows captured by the inlet are routed to existing Detention Pond 4.

**DP4***, 9.36 acres, consists of Basin D* and Basin E* residential lots within Homestead at Sterling Ranch Filing No. 1 and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year and Basin F* (Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year. Developed runoff of Q5=16.1 cfs and Q100=36.7 cfs has been calculated for DP4. The surface runoff is routed via overlot grading and curb and gutter to DP4* which will be collected by a 15' CDOT type R at-grade inlet. The intercepted flow (Q5=13.3 cfs and Q100=20.0 cfs) will combine with flows from DP3* and be routed east via a 30" RCP (PR6*, Q5=16.8 cfs and Q100=29.4 cfs) to existing Detention Pond 4.

**DP5*,** 0.80 acres, consists of Basin G* residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, Basin H* existing Dines Boulevard, with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from Sterling Ranch Filing Nos. 1&2 MDDP DP4*. Developed runoff of Q5=4.2 and Q100=19.7 cfs has been calculated for DP5*. The surface runoff is routed via overlot grading and curb and gutter to DP5* which is collected by an existing 15' CDOT type R at-grade inlet. DP5* has an intercepted flow of (Q5=4.2 cfs and Q100=14.7 cfs) and of flowby of (Q5=0.0 cfs and Q100=5.0 cfs). Flowby from DP5* continues on to Sterling Ranch Filing Nos. 1&2 MDDP DP18*.

And ultimately to what Pond?

**DP6*,** 4.68 acres, consists of Sterling Ranch Filing Nos. 1&2 MDDP Basins J* and K* planned residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, Sterling Ranch Filing Nos. 1&2 MDDP Basin I* (Wheatland Drive) and Basin L* ( Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year. Developed runoff of Q5=14.1 cfs and Q100=26.7cfs has been calculated for DP6*. The surface runoff is routed via overlot grading and curb and gutter to DP6* which is collected by an existing 15' CDOT type R at-grade inlet. DP6* has an intercepted flow of (Q5=12.1 cfs and Q100=17.2 cfs) and of flowby of (Q5=2.0 cfs and Q100=9.5 cfs). Flowby from DP6* continues on to Sterling Ranch Filing Nos. 1&2 MDDP DP1*.

And ultimately to what Pond?

**DP7,** 4.42 acres, consists of Basin P proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=5.7 and Q100=13.8 cfs has been calculated for DP7. Surface runoff is routed via overlot grading and curb and gutter to DP7 which is collected by a proposed 10' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inlet are routed to existing Detention Pond 4 by proposed RCP storm sewer.

**DP8,** 3.78, acres, consists of Basin Q proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=4.9 and Q100=11.8 cfs has been calculated for DP8. Surface runoff is routed via overlot grading and curb and gutter to DP8 which is collected by a proposed 10' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inlet are routed to existing Detention Pond 4 by proposed RCP storm sewer.

**DP9,** acres, consists of Basin R proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=2.2 and Q100=5.4 cfs has been calculated for DP9. Surface runoff is routed via overlot grading and curb and gutter to DP9 which is collected by a proposed 5' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inlet combine with captured flows contributed from Design Points 7 & 8 and are routed to existing Detention Pond 4 by Pipe Run 4 (Q5=12.4 and Q100=30.1 cfs). Pipe Run 4 connects to existing Sterling Ranch Filing Nos. 1&2 MDDP Pipe Run 10* (Q5=12.5 and Q100=30.4 cfs) and is discharged into the forebay of existing Detention Pond 4. Flows contributed to the forebay of existing Detention Pond 4 are less than those anticipated by the MDDP, ~~therefore having no detrimental hydraulic affects to existing Detention Pond 4~~.

therefore Pond 4 has the capacity for SWQ and Full Spectrum Detention for these flows.

**DP10,** 9.14 , acres, consists of Basin T proposed residential lots with runoff coefficients of 0.30 for the 5-year and 0.50 for the 100-year. Developed runoff of Q5=9.4 and Q100=15.6 cfs has been calculated for DP10. Surface runoff is routed via overlot grading and curb and gutter to DP10 which is collected by a proposed 15' CDOT type R at-grade inlet. DP10 has an intercepted flow of (Q5=9.1 cfs and Q100=12.7 cfs) and of flowby of (Q5=0.3 cfs and Q100=2.9 cfs). Flows captured by the proposed 15' CDOT type R at-grade inlet are routed southwest to the proposed full spectrum detention Pond 1 by proposed RCP storm sewer.

**DP11,** 1.48 , acres, consists of Basin V1 proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=1.9 and Q100=15.6 cfs has been calculated for DP11. Surface runoff is routed via overlot grading and curb and gutter to DP11 which is collected by a proposed 15' CDOT type R at-grade inlet. DP11 has an intercepted flow of (Q5=1.9 cfs and Q100=12.7 cfs) and of flowby of (Q5=0.0 cfs and Q100=2.9 cfs). Flows captured by the proposed 15' CDOT type R at-

grade inlet are routed southwest to the proposed full spectrum detention Pond 1 by proposed RCP storm sewer.

**DP12,** 4.50, acres, consists of Basin U proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year and flowby from DP10. Developed runoff of Q5=6.2 cfs and Q100=17.2 cfs has been calculated for DP12. Surface runoff is routed via overlot grading and curb and gutter to DP12 which is collected by a proposed 10' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inlet are routed to the proposed full spectrum detention Pond 1 by proposed RCP storm sewer.

**DP13,** 0.83, acres, consists of Basin V2 proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year and flowby from DP11. Developed runoff of Q5=1.2 and Q100=5.9 cfs has been calculated for DP13. Surface runoff is routed via overlot grading and curb and gutter to DP13 which is collected by a proposed modified 5' length by 4.5' wide CDOT type R sump inlet.

**DP14,** 0.56, acres, consists of Basin W1 proposed full spectrum detention Pond 1 with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and contributed flow from PR9. Developed runoff of Q5=19.6 cfs and Q100=52.4 cfs has been calculated for DP14. All flows captured by inlets at Design Points DP10, DP11, DP12 and DP13 are routed by Pipe Run 9 (PR9, Q5=17.9 and Q100=47.1 cfs) to the forebay in Pond 1 and combine with surface runoff within Basin W1. An outlet structure with an orifice plate and restrictor plate regulates release rates and provides treatment to all flows tributary to DP14. See the Water Quality Provisions discussion in this report for more information on Pond 1.

**Detailed Drainage Discussion (Drainage Basins)**

Complete report to include the basins and design points not mentioned here. (the western 1/2 of this filing)

**Basins X, Y and W1,** 4.77 acres, consists of proposed residential backyard lots located along the east boundary of the site and outer edge of Pond 1 bank, with runoff coefficients of 0.22 and 0.08 for the 5-year and 0.46 and 0.35 for the 100-year. Developed combined runoff of Q5=2.3 cfs and Q100=8.0 cfs, Q5=2.0 cfs and Q100=7.1 cfs and Q5=0.2 cfs and Q100=1.7 cfs respectively has been calculated for the basins. Sheet flow produced within the residential backyard lots and outer edge of Pond 1 of Basins X, W1 and Y travels east towards Sand Creek.

No more than 1 acre can flow directly into Sand Creek without treatment. These areas need to be captured and treated.

## INTERIM CHANNEL IMPROVEMENTS

Slope grading and intermittent channel bank lining has been proposed for portions of the developable areas adjacent to Sand Creek to protect the developed lots and prevent excessive erosion until the DBPS recommended Sand Creek Channel improvements are installed. The proposed slope grading is intended to reduce outer bank grades and bring uniformity to areas where significant rilling and destabilization has occurred. Interim proposed channel stabilization improvements includes placement of soil riprap and Turf reinforcement matting along embankment toes and along embankment slopes, both of which will function to retain soils and vegetation during heavy rains or larger flood flow events. All disturbed areas, not hardscaped will be re-vegetated with native species, as per El Paso County erosion control standards. Storm sewer outfalls into Sand Creek shall be protected by low-tailwater riprap basins. The outfall protection is shown on the accompanying drainage map in the appendix. Refer to the Homestead Filing No.2 Grading and Erosion Control Plans for riprap and turf reinforcement map placement and construction details.

## ULTIMATE CHANNEL IMPROVEMENTS

Permanently installed check structures and rip-rap channel lining will need to be installed within Sand Creek Channel to handle the runoff from fully developed Sterling Ranch and up-gradient watershed in accordance with the Sand Creek DBPS. A discussion regarding the timing of these channel improvements is provided in a subsequent paragraph titled Sterling Ranch Filing No. 1 Subdivision Improvement agreement which follows the Construction Costs segment of this report.

## WATER QUALITY PROVISIONS

The proposed temporary Full Spectrum Detention Facility, Interim Pond 1 functions as a water quality facility for runoff produced onsite from tributary Basins T, U, V1, V2 and W1. This water quality facility is designed to treat 0.247 ac-ft of water quality storage (WQCV), 0.701 ac-feet of excess urban runoff volume (EURV) and 1.283 ac-ft of 100-year storage. An emergency spillway, riprap stilling basin and trickle channel, outlet structure, and maintenance access road has been designed for Interim Pond 1. The pond is temporary in nature and designed to provide water quality during the interim period before ultimate channel improvements to Sand Creek have been completed. Upon ultimate channel improvements to Sand Creek, the pond shall be removed and runoff shall be routed south, via the proposed 36" RCP pipe extending from the proposed modified 5'x4.5' CDOT Type R sump inlet (see Design Point 13). A drainage easement will be provided to rout the 36" RCP to a permanent FSD facility for treatment.

The WQCV and EURV required for the site has been determined using the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual - Volume II. Refer to the water quality facility sizing calculations located within the appendix of this report (see UD-Detention Worksheet in appendix).

## 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.

Update to current conditions.

## CONSTRUCTION COST OPINION – HOMESTEAD AT STERLING RANCH FIL. NO. 2

### Drainage Facilities:

Drainage improvements are planned with the development of Homestead at Sterling Ranch Filing No. 2. A majority of the construction costs have been accounted for 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. Any additional improvements and costs are listed below.

The following list of drainage improvements are **Non-Reimbursable.** The Reimbursable facilities are outlined in the Sterling Ranch Filing No. 1 Final Drainage Report and Sterling Ranch MDDP. Refer to the MDDP for Sterling Ranch Cost and Fee Analysis Report (February 2019).

| Item | Description | Quantity | | Unit Cost | | Cost |
|---|---|---|---|---|---|---|
| 1. | 18" RCP | 168 | LF | $40 | /LF | $6,720.00 |
| 2. | 24" RCP | 54 | LF | $50 | /LF | $2,700.00 |
| 3. | 30" RCP | 998 | LF | $65 | /LF | $64,870.00 |
| 4. | 36" RCP | 8 | LF | $75 | /LF | $600.00 |
| 5. | 42" RCP | 699 | LF | $85 | /LF | $59,415.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6. | 18" FES | 1 | EA | $325 | /EA | $325.00 |
| 8. | 42" FES | 1 | EA | $895 | /EA | $895.00 |
| 9. | 5.0'x4.5' Mod. CDOT Type R Sump Inlet | 1 | EA | $4,000 | /EA | $4,000.00 |
| 10. | 10' CDOT Type R Sump Inlet | 4 | EA | $4,700 | /EA | $18,800.00 |
| 11. | 15' CDOT Type R At-Grade Inlet | 2 | EA | $6,000 | /EA | $12,000.00 |
| 12. | 4.0' Type II MH | 1 | EA | $3,500 | /EA | $3,500.00 |
| 13. | 5.0' Type II MH | 2 | EA | $4,000 | /EA | $8,000.00 |
| 14. | 6.0' Type II MH | 1 | EA | $4,500 | /EA | $4,500.00 |
| 17. | 5.0'x6.0' MH | 2 | EA | $6,500 | /EA | $13,000.00 |
| 18. | 5.5'x5.5' MH | 1 | EA | $6,500 | /EA | $6,500.00 |
| 19. | Headwall/Wingwall | 1 | EA | $6,000 | /EA | $6,000.00 |
| 20. | Full Spectrum det. Interim Pond 1 | 1 | EA | $9,000 | /EA | $9,000.00 |
| 21. | FSD Pond 1 Outlet Structure (CMP) | 1 | EA | $2,600 | /EA | $2,600.00 |
| | | | | | **Total $** | **$223,425.00** |

## DRAINAGE & BRIDGE FEES – HOMESTEAD AT STERLING RANCH FIL. NO. 2

This site is within the Sand Creek Drainage Basin. The 2019 Drainage and Bridge Fees per El Paso County for the HOMESTEAD AT STERLING RANCH FILING NO. 2 site are as follows:

Per Homestead at Sterling Ranch Filing No. 2 Plat – **Total Area** **29.658 Acres**

**HOMESTEAD AT STERLING RANCH FILING NO. 2 FEES:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Drainage Fees:** | 29.658 | x | 46% | $ | 18,940.00 | = | $ | 258,392.36 |
| **Bridge Fees:** | 29.658 | x | 46% | $ | 5,559.00 | = | $ | 75,839.66 |
| | | | | | | **Total** | **$** | **334,232.02** |

## STERLING RANCH FILING NO. 1 - SUBDIVISION IMPROVEMENTS AGREEEMENT

Sterling Ranch Filing No. 1 final plat and SIA has been recorded, and addressed the following drainage improvements Not located/and located in the Sand Creek Channel. The following SIA paragraphs outlined drainage for Sterling Ranch in the following manner;

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

***7. Timing of Construction and Acceptance****:*

*a.* ***Drainage Improvements Not Located in Sand Creek Channel****: Except as set forth below in subsection 6.b. (drainage improvements located in Sand Creek Channel), all drainage improvements described in Exhibit A and*

*constructed within the Drainage and Landscaping Tracts identified in paragraph 2 above shall be completed by the Subdivider and District, meeting all applicable standards for preliminary acceptance, prior to the recording of the first replat of Tracts C, E, G, K or BB. In the event that a portion of the drainage improvements are not completed prior to the recording of the first replat, then prior to such recording collateral sufficient in the opinion of the County to assure completion of the improvements must be posted by the Subdivider and a deadline by which such drainage improvements shall be completed shall be established by written agreement.*

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

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

*ii. Other drainage improvements in Tract D and future tracts containing the Sand Creek Channel, such as drop structures, check structures and similar stabilization or protection improvements, will be designed and constructed by the District with the final construction drawings to be approved by the County no later than the final platting of the 700th single family lot within the boundaries of the approved Sterling Ranch Sketch Plan and the completion of all said improvements no later than the 800th single family lot with the boundaries of the approved Sterling Ranch Sketch Plan.*

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

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

## SUMMARY

Development of this site will not adversely affect the surrounding development per this final drainage report with no negative impacts to the neighboring developments. The existing and proposed drainage facilities will adequately convey, detain and route runoff from 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 HOMESTEAD AT STERLING RANCH FILING NO. 2 project(s) shall not adversely affect adjacent or downstream property.

Provide how much of tract D this filing is adjacent to. Provide the number of lots this filing represents in the above SIA. Provide the amount of the adjacent proposed improvements that need to be assured for with this project.

**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

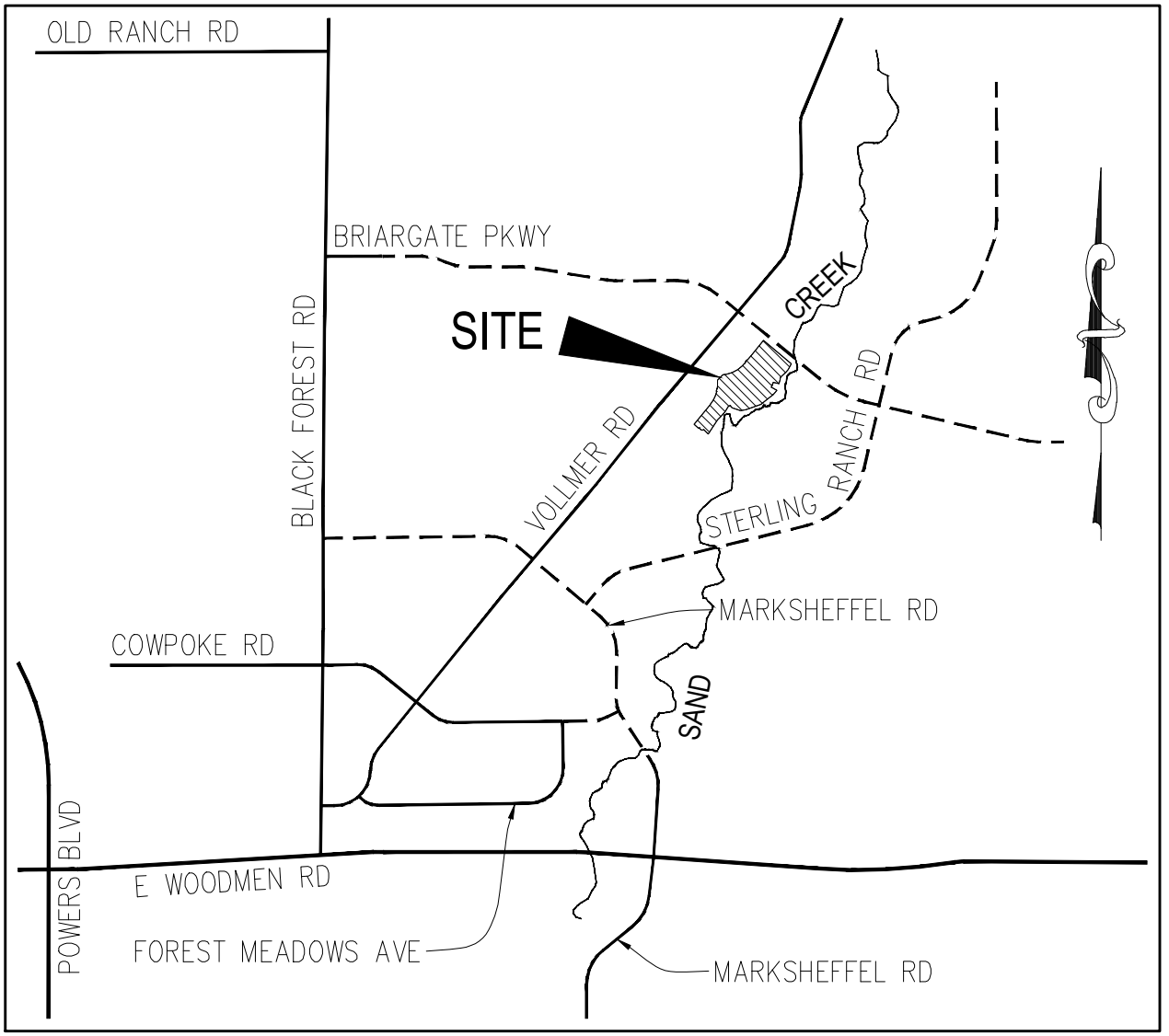
6.) "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015

7.) "Sterling Ranch-Phase 1 Onsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015

8.) "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

# APPENDIX

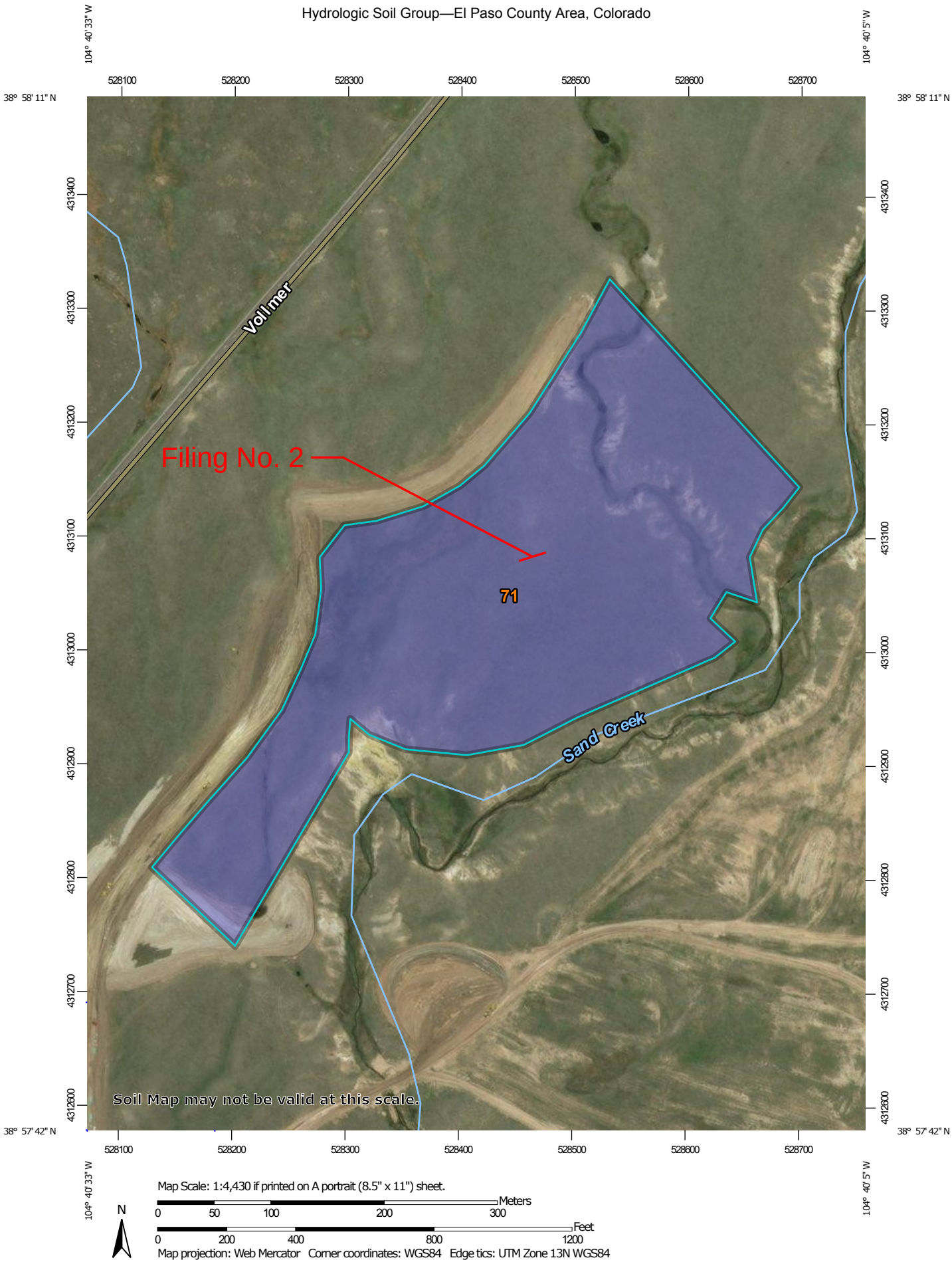
**VICINITY MAP**




# VICINITY MAP

N.T.S.

**SOILS MAP**




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

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Lines**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Points**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Water Features**

- Streams and Canals

**Transportation**

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

**Background**

- Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

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

Date(s) aerial images were photographed: May 22, 2016—Mar 9, 2017

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

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 71 | Pring coarse sandy loam, 3 to 8 percent slopes | B | 29.0 | 100.0% |
| **Totals for Area of Interest** | | | **29.0** | **100.0%** |

## Description

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

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

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

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

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

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

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

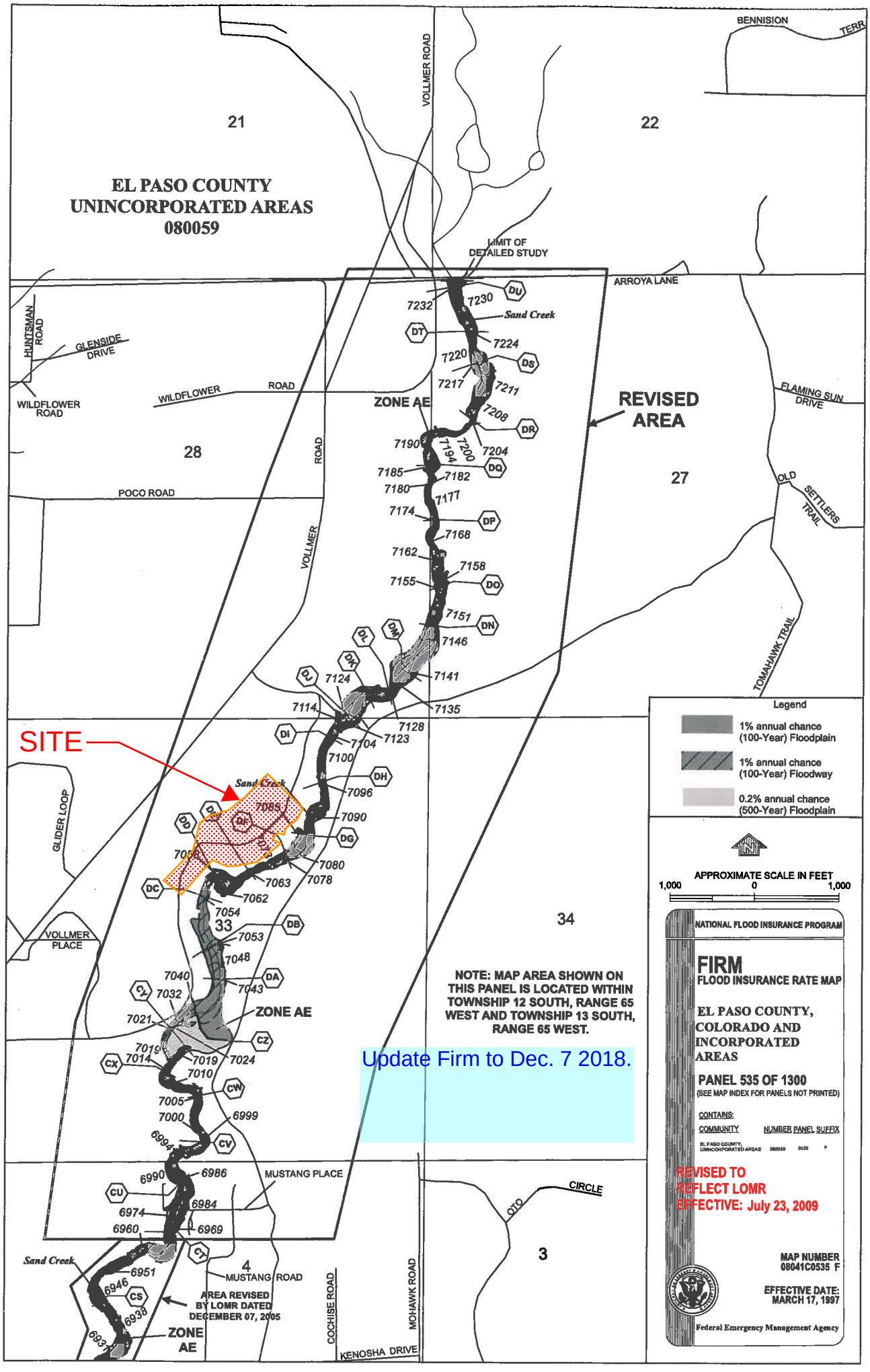
## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

**FIRM PANEL W/ REVISED LOMR**


EL PASO COUNTY
UNINCORPORATED AREAS
080059
21
22
28
27
34
3
4
33
BENNISION TERR
VOLLMER ROAD
LIMIT OF DETAILED STUDY
ARROYA LANE
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
ROAD
POCO ROAD
VOLLMER ROAD
ZONE AE
REVISED AREA
FLAMING SUN DRIVE
OLD SETTLERS TRAIL
TOMAHAWK TRAIL
SITE
Sand Creek
GLIDER LOOP
VOLLMER PLACE
ZONE AE
MUSTANG PLACE
MUSTANG ROAD
CIRCLE
OTO
COCHISE ROAD
MOHAWK ROAD
KENOSHA DRIVE
AREA REVISED BY LOMR DATED DECEMBER 07, 2005
ZONE AE
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.
Update Firm to Dec. 7 2018.
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
1,000 0 1,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0535 F
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009
MAP NUMBER 08041C0535 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

# National Flood Hazard Layer FIRMette

FEMA


## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/23/2019 at 7:09:44 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Questions concerning the VERTCON process may be mailed to NGS

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**Latitude: 38.964784**

**Longitude: 104.67180**

**NGVD 29 height:**

**Datum shift(NAVD 88 minus NGVD 29): 1.196 meter**

1.196 meters = 3.92 feet

NAVD88 - 3.92 feet = NGVD29

## STORM 4 Outfall to Sand Creek Channel

Cross Section DE = 7071.8 NAVD88

7071.8 NAVD88 - 3.92 feet = 7067.88 NGVD29

# HYDROLOGIC CALCULATIONS

# *HOMESTEAD AT STERLING RANCH FILING NO. 2*
# *FINAL DRAINAGE REPORT*
# *(Area Drainage Summary)*

| *From Area Runoff Coefficient Summary* | | | | *OVERLAND* | | | | *STREET / CHANNEL FLOW* | | | | *Time of Travel ($T_t$)* | | *INTENSITY *** | | *TOTAL FLOWS* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BASIN** | **AREA TOTAL** *(Acres)* | $C_5$ *From DCM Table 5-1* | $C_{100}$ *From DCM Table 5-1* | $C_5$ | **Length** *(ft)* | **Height** *(ft)* | $T_C$ *(min)* | **Length** *(ft)* | **Slope** *(%)* | **Velocity** *(fps)* | $T_t$ *(min)* | **TOTAL** *(min)* | **CHECK** *(min)* | $I_5$ *(in/hr)* | $I_{100}$ *(in/hr)* | $Q_5$ *(c.f.s.)* | $Q_{100}$ *(c.f.s.)* |
| ***Proposed Area Drainage Summary*** | | | | | | | | | | | | | | | | | |
| ***ONSITE BASINS*** | | | | | | | | | | | | | | | | | |
| ***J*** | 0.43 | 0.22 | 0.46 | 0.22 | 90 | 1.8 | 12.0 | 0 | 2.0% | 3.0 | 0.0 | 12.0 | 10.5 | 4.1 | 6.8 | ***0.4*** | ***1.3*** |
| ***K*** | 0.61 | 0.22 | 0.46 | 0.22 | 75 | 1.5 | 10.9 | 0 | 2.0% | 3.0 | 0.0 | 10.9 | 10.4 | 4.1 | 6.8 | ***0.5*** | ***1.9*** |
| ***P*** | 4.42 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 1100 | 2.5% | 3.0 | 6.0 | 16.4 | 16.7 | 3.4 | 5.7 | ***5.7*** | ***13.8*** |
| ***Q*** | 3.78 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 1100 | 2.5% | 3.0 | 6.0 | 16.4 | 16.7 | 3.4 | 5.7 | ***4.9*** | ***11.8*** |
| ***R*** | 1.57 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 450 | 1.6% | 3.0 | 2.5 | 12.8 | 13.1 | 3.8 | 6.3 | ***2.2*** | ***5.4*** |
| ***T*** | 9.14 | 0.30 | 0.50 | 0.30 | 100 | 2 | 11.5 | 942 | 2.1% | 3.0 | 5.2 | 16.7 | 15.8 | 3.4 | 5.8 | ***9.4*** | ***26.4*** |
| ***U*** | 4.50 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 457 | 1.5% | 3.0 | 2.5 | 12.9 | 13.1 | 3.8 | 6.3 | ***6.4*** | ***15.6*** |
| ***V1*** | 1.48 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 600 | 2.0% | 3.0 | 3.3 | 13.6 | 13.9 | 3.7 | 6.2 | ***2.1*** | ***5.0*** |
| ***V2*** | 0.83 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 360 | 1.6% | 3.0 | 2.0 | 12.3 | 12.6 | 3.8 | 6.4 | ***1.2*** | ***2.9*** |
| ***W1*** | 0.56 | 0.08 | 0.35 | 0.08 | 35 | 8 | 3.9 | 160 | 0.5% | 2.3 | 1.2 | 5.1 | 11.1 | 5.2 | 8.7 | ***0.2*** | ***1.7*** |
| ***W2*** | 0.26 | 0.08 | 0.35 | 0.08 | 35 | 8 | 3.9 | 0 | 0.3% | 2.3 | 0.0 | 5.0 | 10.2 | 5.2 | 8.7 | ***0.1*** | ***0.8*** |
| ***X*** | 2.24 | 0.22 | 0.46 | 0.22 | 80 | 6 | 7.3 | 0 | 2.5% | 2.3 | 0.0 | 7.3 | 10.4 | 4.6 | 7.7 | ***2.3*** | ***8.0*** |
| ***Y*** | 1.97 | 0.22 | 0.46 | 0.22 | 77 | 6 | 7.1 | 0 | 2.5% | 2.3 | 0.0 | 7.1 | 10.4 | 4.6 | 7.8 | ***2.0*** | ***7.1*** |
| ***OFFSITE BASINS**** | | | | | | | | | | | | | | | | | |
| ***B**** | 5.39 | 0.38 | 0.55 | 0.38 | 60 | 1.2 | 8.0 | 1381 | 2.8% | 3.0 | 7.6 | 16.3 | 18.0 | 3.4 | 5.7 | ***8.0*** | ***19.3*** |
| ***C**** | 2.92 | 0.38 | 0.55 | 0.38 | 100 | 1.2 | 12.2 | 411 | 3.0% | 3.0 | 2.3 | 14.5 | 12.8 | 3.8 | 6.3 | ***4.2*** | ***10.1*** |
| ***D**** | 2.90 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 245 | 2.1% | 3.0 | 1.3 | 11.7 | 11.9 | 3.9 | 6.5 | ***4.3*** | ***10.4*** |
| ***E**** | 5.34 | 0.38 | 0.55 | 0.38 | 100 | 2 | 10.3 | 61 | 3.3% | 3.0 | 0.3 | 10.7 | 10.9 | 4.0 | 6.8 | ***8.2*** | ***19.9*** |
| ***F**** | 1.12 | 0.90 | 0.96 | 0.90 | 10 | 0.2 | 0.9 | 1525 | 2.8% | 3.0 | 8.4 | 9.3 | 18.5 | 4.2 | 7.1 | ***4.3*** | ***7.7*** |
| ***G**** | 0.61 | 0.22 | 0.46 | 0.22 | 100 | 2 | 12.6 | 0 | 2.2% | 3.0 | 0.0 | 12.6 | 10.6 | 4.0 | 6.8 | ***0.5*** | ***1.9*** |
| ***H**** | 0.19 | 0.90 | 0.96 | 0.90 | 10 | 0.2 | 0.9 | 280 | 2.1% | 3.0 | 1.5 | 5.0 | 11.6 | 5.2 | 8.7 | ***0.9*** | ***1.6*** |
| ***I**** | 2.10 | 0.90 | 0.96 | 0.90 | 10 | 0.2 | 0.9 | 1082 | 2.5% | 3.0 | 5.9 | 6.9 | 16.1 | 4.7 | 7.9 | ***8.9*** | ***15.9*** |
| ***L**** | 1.54 | 0.90 | 0.96 | 0.90 | 10 | 0.2 | 0.9 | 1805 | 2.1% | 3.0 | 9.9 | 10.8 | 20.1 | 4.0 | 6.7 | ***5.6*** | ***10.0*** |
| ***S**** | 1.97 | 0.08 | 0.35 | 0.08 | 60 | 10 | 5.6 | 270 | 0.5% | 2.3 | 2.0 | 7.6 | 11.8 | 4.5 | 7.6 | ***0.7*** | ***5.3*** |

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

** Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: ET/CMN
Date: 9/4/2018
Checked by: VAS

# HOMESTEAD AT STERLING RANCH FILING NO. 2
# FINAL DRAINAGE REPORT
# (Basin Routing Summary)

| *From Area Runoff Coefficient Summary* | | | | *OVERLAND* | | | | *PIPE / CHANNEL FLOW* | | | | *Time of Travel ($T_t$)* | *INTENSITY *** | | *TOTAL FLOWS* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DESIGN POINT** | **CONTRIBUTING BASINS** | **$CA_5$** | **$CA_{100}$** | **$C_5$** | **Length** *(ft)* | **Height** *(ft)* | **$T_C$** *(min)* | **Length** *(ft)* | **Slope** *(%)* | **Velocity** *(fps)* | **$T_t$** *(min)* | **TOTAL** *(min)* | **$I_5$** *(in/hr)* | **$I_{100}$** *(in/hr)* | **$Q_5$** *(c.f.s.)* | **$Q_{100}$** *(c.f.s.)* | COMMENTS |
| ***PROPOSED DRAINAGE BASIN ROUTING SUMMARY*** | | | | | | | | | | | | | | | | | |
| ***2**** | **B*** | 2.34 | 3.39 | | | | | | | | | 16.3 | 3.4 | 5.7 | ***8.0*** | ***19.3*** | (2) EX. 15' AT-GRADE INLETS |
| ***3**** | **C*** | 1.11 | 1.61 | | | | | | | | | 12.8 | 3.8 | 6.3 | ***4.2*** | ***10.1*** | EX. 6' SUMP INLET |
| ***4**** | **D*, E*, F*** | 4.14 | 5.61 | | | | | | | | | 11.7 | 3.9 | 6.5 | ***16.1*** | ***36.7*** | EX. 15' AT-GRADE INLET |
| **5*** | **G*, H*, FLOWBY DP4*** | 1.07 | 3.02 | | | | | | | | | 11.7 | 3.9 | 6.5 | ***4.2*** | ***19.7*** | EX. 15' AT-GRADE INLET |
| **6*** | **I*, J, K, L*** | 3.50 | 3.97 | | | | | | | | | 10.8 | 4.0 | 6.7 | ***14.1*** | ***26.7*** | EX. 15' AT-GRADE INLET |
| **7** | **P** | 1.68 | 2.43 | | | | | | | | | 16.4 | 3.4 | 5.7 | ***5.7*** | ***13.8*** | PROP. 10' SUMP INLET |
| **8** | **Q** | 1.44 | 2.08 | | | | | | | | | 16.4 | 3.4 | 5.7 | ***4.9*** | ***11.8*** | PROP. 10' SUMP INLET |
| ***9*** | **R** | 0.60 | 0.86 | | | | | | | | | 12.8 | 3.8 | 6.3 | ***2.2*** | ***5.4*** | PROP. 10' SUMP INLET |
| ***10*** | **T** | 2.74 | 2.69 | | | | | | | | | 15.8 | 3.4 | 5.8 | ***9.4*** | ***15.6*** | PROP. 15' AT-GRADE INLET<br>Total CA100=3.86 Split Between<br>DP10 & DP11 For Crown Overflow |
| ***11*** | **V1** | 0.56 | 2.69 | | | | | | | | | 15.8 | 3.4 | 5.8 | ***1.9*** | ***15.6*** | PROP. 15' AT-GRADE INLET<br>Total CA100=3.86 Split Between<br>DP10 & DP11 For Crown Overflow |
| ***12*** | **U, FLOWBY DP10** | 1.80 | 2.98 | | | | | | | | | 15.8 | 3.4 | 5.8 | ***6.2*** | ***17.2*** | PROP. 10' SUMP INLET |
| ***13*** | **V2, FLOWBY DP11** | 0.32 | 0.96 | | | | | | | | | 13.6 | 3.7 | 6.2 | ***1.2*** | ***5.9*** | PROP. MODIFIED<br>5'x4.5' SUMP INLET |
| ***14*** | **W1, PR9** | 5.35 | 8.52 | | | | | | | | | 13.6 | 3.7 | 6.2 | ***19.6*** | ***52.4*** | CUMULATIVE<br>DETENTION POND |

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

** Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: ET/CMN
Date: 9/4/2018
Checked by: VAS

# *HOMESTEAD AT STERLING RANCH FILING NO. 2*
# *DRAINAGE CALCULATIONS*
# *(Storm Sewer Routing Summary)*

| *PIPE RUN* | *Contributing Pipes/Design Points* | *Equivalent $CA_5$* | *Equivalent $CA_{100}$* | *Maximum $T_C$* | *Intensity*** | | *Flow* | | PIPE SIZE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | *$I_5$* | *$I_{100}$* | *$Q_5$* | *$Q_{100}$* | |
| *1* | **DP7** | 1.68 | 2.43 | 16.4 | 3.4 | 5.7 | ***5.7*** | ***13.8*** | 24" RCP |
| *2* | **DP8** | 1.44 | 2.08 | 16.4 | 3.4 | 5.7 | ***4.9*** | ***11.8*** | 18" RCP |
| *3* | **PR1, PR2** | 3.12 | 4.51 | 16.4 | 3.4 | 5.7 | ***10.6*** | ***25.7*** | 24" RCP |
| *4* | **DP9, PR3** | 3.71 | 5.37 | 17.0 | 3.3 | 5.6 | ***12.4*** | ***30.1*** | 30" RCP |
| *5* | **DP10** | 2.64 | 2.20 | 15.8 | 3.4 | 5.8 | ***9.1*** | ***12.7*** | 18" RCP |
| *6* | **DP11** | 0.55 | 2.20 | 15.8 | 3.4 | 5.8 | ***1.9*** | ***12.7*** | 18" RCP |
| *7* | **PR5, PR6** | 3.19 | 4.39 | 16.0 | 3.4 | 5.7 | ***10.9*** | ***25.3*** | 30" RCP |
| *8* | **DP12** | 1.80 | 2.98 | 15.8 | 3.4 | 5.8 | ***6.2*** | ***17.2*** | 24" RCP |
| *9* | **DP13, PR7, PR8** | 5.31 | 8.33 | 16.6 | 3.4 | 5.7 | ***17.9*** | ***47.1*** | 42" RCP |
| *10* | **UD-Detention _v3.07** | | | | | | ***0.8*** | ***23.5*** | Outlet Structure & 18" CMP |
| *11* | **Pipe Run continued from MDDP DP15* to Sand Creek. Flow values are that of MDDP Pipe Run 15* (PR15*).** | | | | | | ***42.1*** | ***76.8*** | 42" RCP |

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

** Intensity equations assume a minimum travel time of 5 minutes.

DP - Design Point
EX - Existing Design Point
FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: CMN
Date: 9/4/2018
Checked by: VAS

# HYDRAULIC CALCULATIONS

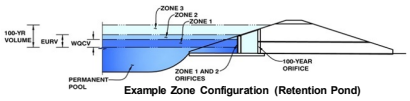
| *Weighted Percent Imperviousness of FSD Pond 1* | | | | |
|---|---|---|---|---|
| ***Contributing Basins*** | ***Area (Acres)*** | ***$C_5$*** | ***Impervious % (I)*** | ***(Acres)*(I)*** |
| ***T*** | 9.14 | 0.30 | 40 | 365.60 |
| ***U*** | 4.50 | 0.38 | 53 | 238.50 |
| ***V1*** | 1.48 | 0.38 | 53 | 78.44 |
| ***V2*** | 0.83 | 0.38 | 53 | 43.99 |
| ***W1*** | 0.56 | 0.08 | 2 | 1.12 |
| ***Totals*** | ***16.51*** | | | ***727.65*** |
| ***Imperviousness of FSD Pond 1*** | ***44.1*** | **%** | | |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

**UD-Detention, Version 3.07 (February 2017)**

**Project:** Homestead At Sterling Ranch Filings No. 2

**Basin ID:** Pond 1, CMP Outlet Structure




**Example Zone Configuration (Retention Pond)**

Centroid 1stOrifice= 76.17

**Required Volume Calculation**

| | | |
|---|---|---|
| Selected BMP Type = | EDB | |
| Watershed Area = | 16.51 | acres |
| Watershed Length = | 825 | ft |
| Watershed Slope = | 0.020 | ft/ft |
| Watershed Imperviousness = | 44.10% | percent |
| Percentage Hydrologic Soil Group A = | 0.0% | percent |
| Percentage Hydrologic Soil Group B = | 100.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |
| Desired WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |
| Water Quality Capture Volume (WQCV) = | 0.262 | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.771 | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.614 | acre-feet |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.847 | acre-feet |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.177 | acre-feet |
| 25-yr Runoff Volume (P1 = 2 in.) = | 1.710 | acre-feet |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 2.073 | acre-feet |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 2.550 | acre-feet |
| 500-yr Runoff Volume (P1 = 0 in.) = | 0.000 | acre-feet |
| Approximate 2-yr Detention Volume = | 0.574 | acre-feet |
| Approximate 5-yr Detention Volume = | 0.795 | acre-feet |
| Approximate 10-yr Detention Volume = | 1.075 | acre-feet |
| Approximate 25-yr Detention Volume = | 1.190 | acre-feet |
| Approximate 50-yr Detention Volume = | 1.247 | acre-feet |
| Approximate 100-yr Detention Volume = | 1.412 | acre-feet |

**Note: L / W Ratio < 1**

**L / W Ratio = 0.9**

Optional User Override 1-hr Precipitation

| | |
|---|---|
| 1.19 | inches |
| 1.50 | inches |
| 1.75 | inches |
| 2.00 | inches |
| 2.25 | inches |
| 2.52 | inches |
| | inches |

**Stage-Storage Calculation**

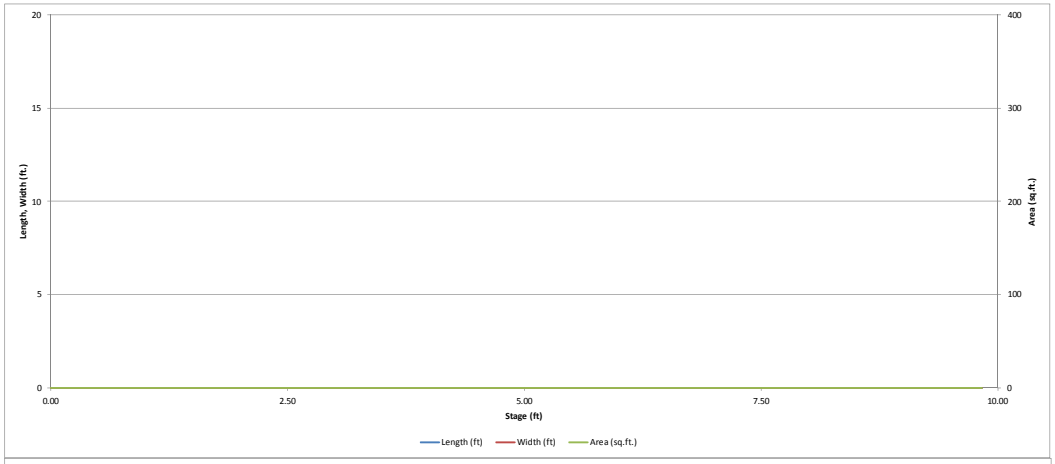
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.262 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.508 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.642 | acre-feet |
| Total Detention Basin Volume = | 1.412 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | ft^3 |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | user | ft |
| Slope of Trickle Channel ($S_{TC}$) = | user | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |
| Initial Surcharge Area ($A_{ISV}$) = | user | ft^2 |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | ft^2 |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | ft^3 |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | ft^2 |
| Volume of Main Basin ($V_{MAIN}$) = | user | ft^3 |
| Calculated Total Basin Volume ($V_{total}$) = | user | acre-feet |

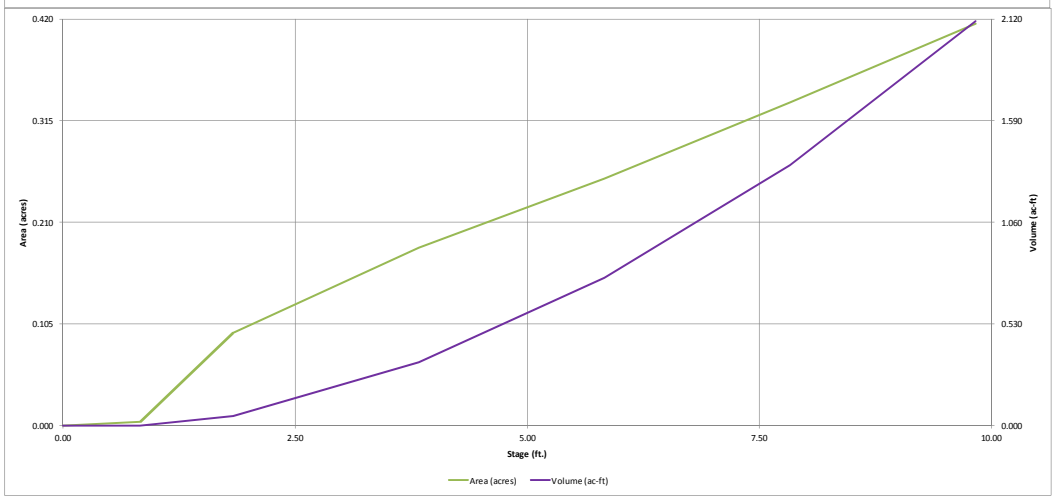
Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area (ft^2) | Optional Override Area (ft^2) | Area (acre) | Volume (ft^3) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Top of Micropool** | -- | 0.00 | -- | -- | -- | 8 | 0.000 | | |
| **LF 7077** | -- | 0.83 | -- | -- | -- | 179 | 0.004 | 76 | 0.002 |
| **7078** | -- | 1.83 | -- | -- | -- | 4,187 | 0.096 | 2,219 | 0.051 |
| **7080** | -- | 3.83 | -- | -- | -- | 8,006 | 0.184 | 14,455 | 0.332 |
| **7082** | -- | 5.83 | -- | -- | -- | 11,107 | 0.255 | 33,568 | 0.771 |
| **7084** | -- | 7.83 | -- | -- | -- | 14,530 | 0.334 | 59,204 | 1.359 |
| **7086** | -- | 9.83 | -- | -- | -- | 18,088 | 0.415 | 91,822 | 2.108 |

## DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



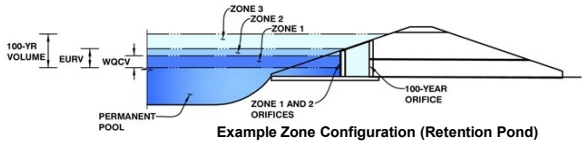



# Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

**Project:** Homestead at Sterling Ranch Filing No. 2

**Basin ID:** Pond 1, CMP Outlet Structure




Example Zone Configuration (Retention Pond)

| | Stage (ft) | Zone Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 3.44 | 0.262 | Orifice Plate |
| Zone 2 (EURV) | 5.83 | 0.508 | Rectangular Orifice |
| Zone 3 (100-year) | 7.99 | 0.642 | Weir&Pipe (Restrict) |
| | | 1.412 | Total |

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

| | | |
|---|---|---|
| Underdrain Orifice Invert Depth = | N/A | ft (distance below the filtration media surface) |
| Underdrain Orifice Diameter = | N/A | inches |

**Calculated Parameters for Underdrain**

| | | |
|---|---|---|
| Underdrain Orifice Area = | N/A | $ft^2$ |
| Underdrain Orifice Centroid = | N/A | 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 = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) |
| Depth at top of Zone using Orifice Plate = | 3.44 | ft (relative to basin bottom at Stage = 0 ft) |
| Orifice Plate: Orifice Vertical Spacing = | N/A | inches |
| Orifice Plate: Orifice Area per Row = | N/A | inches |

**Calculated Parameters for Plate**

| | | |
|---|---|---|
| WQ Orifice Area per Row = | N/A | $ft^2$ |
| Elliptical Half-Width = | N/A | feet |
| Elliptical Slot Centroid = | N/A | feet |
| Elliptical Slot Area = | N/A | $ft^2$ |

**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 | 1.10 | 2.20 | | | | | |
| Orifice Area (sq. inches) | 0.79 | 0.79 | 0.79 | | | | | |

| | 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)**

| | Zone 2 Rectangular | Not Selected | |
|---|---|---|---|
| Invert of Vertical Orifice = | 3.44 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Depth at top of Zone using Vertical Orifice = | 5.83 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Vertical Orifice Height = | 2.00 | N/A | inches |
| Vertical Orifice Width = | 5.50 | | inches |

**Calculated Parameters for Vertical Orifice**

| | Zone 2 Rectangular | Not Selected | |
|---|---|---|---|
| Vertical Orifice Area = | 0.08 | N/A | $ft^2$ |
| Vertical Orifice Centroid = | 0.08 | N/A | feet |

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

| | Zone 3 Weir | Not Selected | |
|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | 5.83 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Overflow Weir Front Edge Length = | 3.54 | N/A | feet |
| Overflow Weir Slope = | 0.00 | N/A | H:V (enter zero for flat grate) |
| Horiz. Length of Weir Sides = | 3.54 | N/A | feet |
| Overflow Grate Open Area % = | 87% | N/A | %, grate open area/total area |
| Debris Clogging % = | 50% | N/A | % |

**Calculated Parameters for Overflow Weir**

| | Zone 3 Weir | Not Selected | |
|---|---|---|---|
| Height of Grate Upper Edge, $H_t$ = | 5.83 | N/A | feet |
| Over Flow Weir Slope Length = | 3.54 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 6.87 | N/A | should be $\geq 4$ |
| Overflow Grate Open Area w/o Debris = | 10.93 | N/A | $ft^2$ |
| Overflow Grate Open Area w/ Debris = | 5.47 | N/A | $ft^2$ |

**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 = | 2.50 | N/A | ft (distance below basin bottom at Stage = 0 ft) |
| Outlet Pipe Diameter = | 18.00 | N/A | inches |
| Restrictor Plate Height Above Pipe Invert = | 15.20 | | inches |

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**

| | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|
| Outlet Orifice Area = | 1.59 | N/A | $ft^2$ |
| Outlet Orifice Centroid = | 0.68 | N/A | feet |
| Half-Central Angle of Restrictor Plate on Pipe = | 2.33 | N/A | radians |

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

| | | |
|---|---|---|
| Spillway Invert Stage= | 7.99 | ft (relative to basin bottom at Stage = 0 ft) |
| Spillway Crest Length = | 20.00 | feet |
| Spillway End Slopes = | 4.00 | H:V |
| Freeboard above Max Water Surface = | 1.00 | feet |

**Calculated Parameters for Spillway**

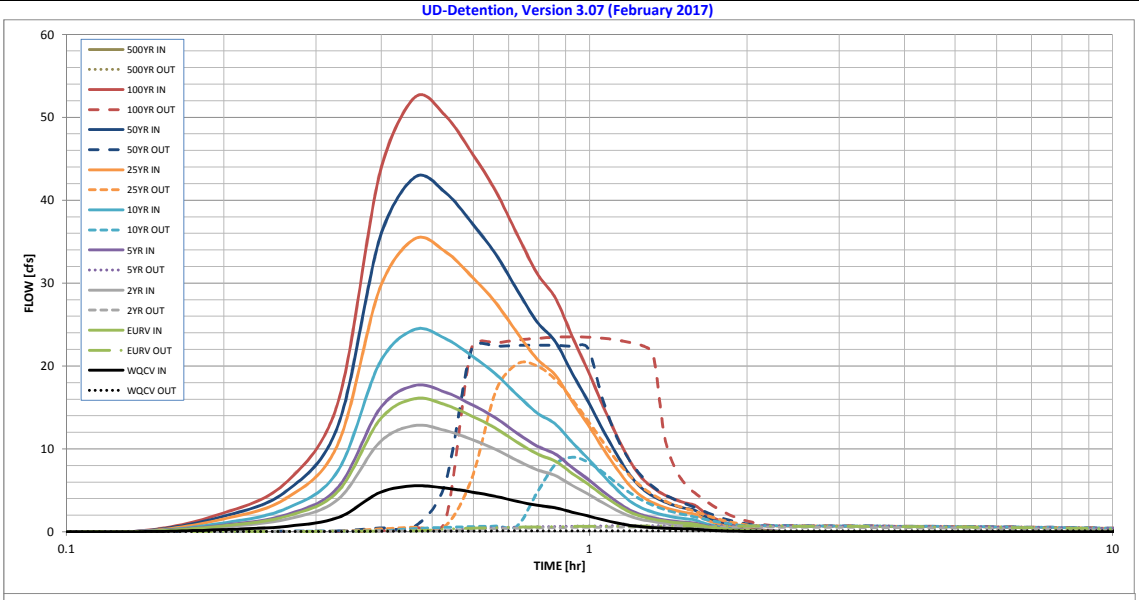
| | | |
|---|---|---|
| Spillway Design Flow Depth= | 0.84 | feet |
| Stage at Top of Freeboard = | 9.83 | feet |
| Basin Area at Top of Freeboard = | 0.42 | acres |

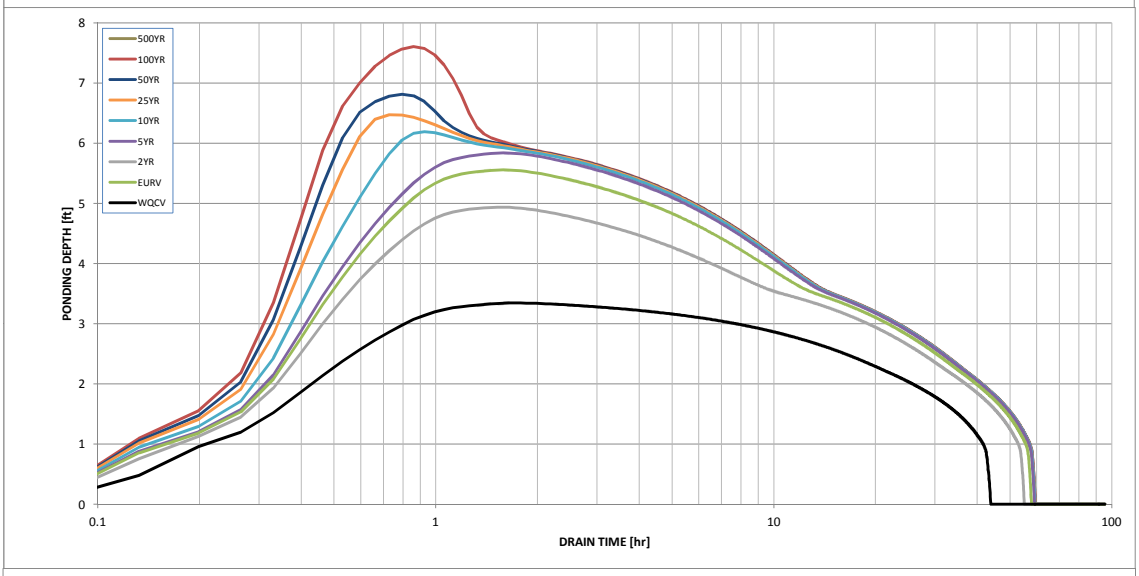
**Routed Hydrograph Results**

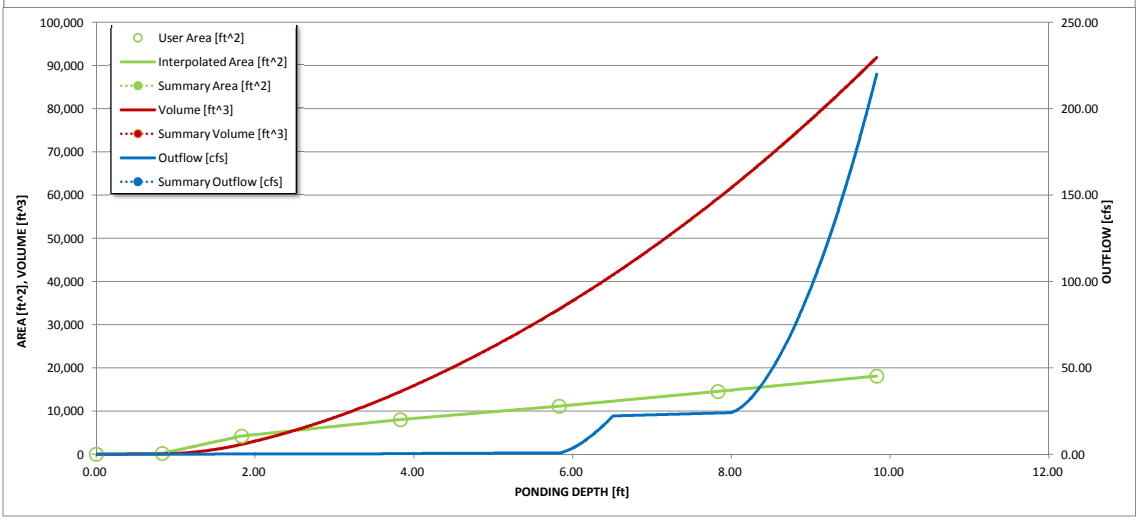
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | 0.53 | 1.07 | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 0.00 |
| Calculated Runoff Volume (acre-ft) = | 0.262 | 0.771 | 0.614 | 0.847 | 1.177 | 1.710 | 2.073 | 2.550 | 0.000 |
| OPTIONAL Override Runoff Volume (acre-ft) = | | | | | | | | | |
| Inflow Hydrograph Volume (acre-ft) = | 0.262 | 0.770 | 0.613 | 0.846 | 1.175 | 1.709 | 2.073 | 2.549 | #N/A |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | 0.00 | 0.00 | 0.02 | 0.03 | 0.27 | 0.86 | 1.19 | 1.58 | 0.00 |
| Predevelopment Peak Q (cfs) = | 0.0 | 0.0 | 0.3 | 0.5 | 4.5 | 14.2 | 19.6 | 26.1 | 0.0 |
| Peak Inflow Q (cfs) = | 5.5 | 16.1 | 12.8 | 17.6 | 24.4 | 35.3 | 42.7 | 52.4 | #N/A |
| Peak Outflow Q (cfs) = | 0.1 | 0.7 | 0.6 | 0.8 | 9.0 | 20.3 | 22.5 | 23.5 | #N/A |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.7 | 2.0 | 1.4 | 1.1 | 0.9 | #N/A |
| Structure Controlling Flow = | Plate | Vertical Orifice 1 | Vertical Orifice 1 | Overflow Grate 1 | 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 | 0.0 | 0.8 | 1.8 | 2.0 | 2.1 | #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) = | 40 | 50 | 48 | 50 | 48 | 45 | 43 | 40 | #N/A |
| Time to Drain 99% of Inflow Volume (hours) = | **42** | 54 | 52 | 55 | 54 | 53 | 52 | 51 | #N/A |
| Maximum Ponding Depth (ft) = | 3.34 | 5.55 | 4.94 | 5.84 | 6.19 | 6.47 | 6.81 | 7.60 | #N/A |
| Area at Maximum Ponding Depth (acres) = | 0.16 | 0.25 | 0.22 | 0.25 | 0.27 | 0.28 | 0.29 | 0.32 | #N/A |
| Maximum Volume Stored (acre-ft) = | 0.247 | 0.701 | 0.556 | 0.771 | 0.865 | 0.942 | 1.039 | 1.283 | #N/A |

# Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)




| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|---|---|---|---|
| minimum bound | | | |
| maximum bound | | | |

# Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

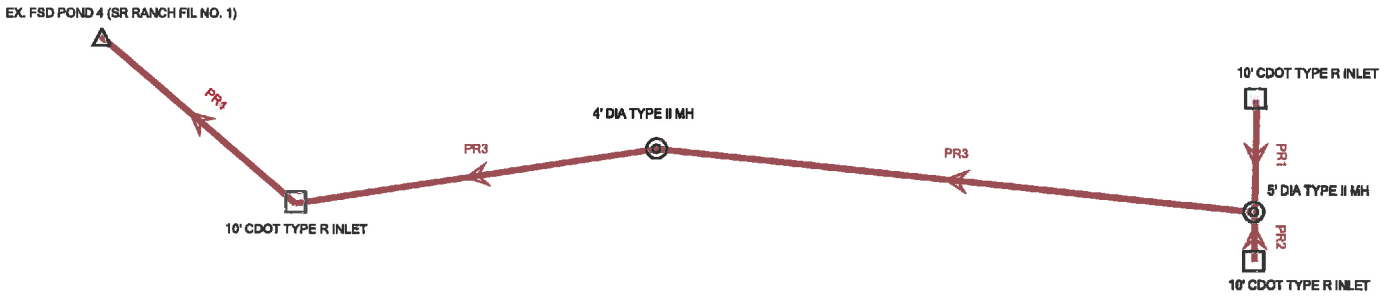
**Storm Inflow Hydrographs** **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

| Time Interval | SOURCE | WORKBOOK | WORKBOOK | WORKBOOK | WORKBOOK | WORKBOOK | WORKBOOK | WORKBOOK | WORKBOOK | #N/A |
|---|---|---|---|---|---|---|---|---|---|---|
| | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 3.97 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 0:03:58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| Hydrograph | 0:07:56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| Constant | 0:11:55 | 0.25 | 0.71 | 0.57 | 0.78 | 1.07 | 1.53 | 1.83 | 2.23 | #N/A |
| 1.259 | 0:15:53 | 0.67 | 1.91 | 1.53 | 2.10 | 2.89 | 4.16 | 5.02 | 6.13 | #N/A |
| | 0:19:51 | 1.72 | 4.92 | 3.94 | 5.39 | 7.42 | 10.68 | 12.88 | 15.74 | #N/A |
| | 0:23:49 | 4.72 | 13.51 | 10.81 | 14.81 | 20.39 | 29.33 | 35.36 | 43.18 | #N/A |
| | 0:27:47 | 5.54 | 16.08 | 12.83 | 17.65 | 24.41 | 35.33 | 42.75 | 52.41 | #N/A |
| | 0:31:46 | 5.27 | 15.35 | 12.24 | 16.85 | 23.34 | 33.82 | 40.94 | 50.24 | #N/A |
| | 0:35:44 | 4.79 | 13.98 | 11.14 | 15.34 | 21.24 | 30.78 | 37.26 | 45.72 | #N/A |
| | 0:39:42 | 4.26 | 12.50 | 9.95 | 13.72 | 19.03 | 27.62 | 33.47 | 41.10 | #N/A |
| | 0:43:40 | 3.66 | 10.80 | 8.59 | 11.87 | 16.49 | 23.99 | 29.10 | 35.81 | #N/A |
| | 0:47:38 | 3.19 | 9.41 | 7.48 | 10.33 | 14.34 | 20.84 | 25.30 | 31.17 | #N/A |
| | 0:51:37 | 2.89 | 8.52 | 6.78 | 9.37 | 13.00 | 18.90 | 22.93 | 28.22 | #N/A |
| | 0:55:35 | 2.36 | 7.05 | 5.59 | 7.75 | 10.79 | 15.74 | 19.12 | 23.57 | #N/A |
| | 0:59:33 | 1.91 | 5.76 | 4.56 | 6.34 | 8.86 | 12.96 | 15.78 | 19.47 | #N/A |
| | 1:03:31 | 1.45 | 4.45 | 3.51 | 4.91 | 6.89 | 10.14 | 12.38 | 15.32 | #N/A |
| | 1:07:29 | 1.06 | 3.32 | 2.61 | 3.67 | 5.19 | 7.70 | 9.44 | 11.73 | #N/A |
| | 1:11:28 | 0.78 | 2.40 | 1.89 | 2.65 | 3.77 | 5.65 | 6.95 | 8.68 | #N/A |
| | 1:15:26 | 0.61 | 1.86 | 1.47 | 2.05 | 2.89 | 4.30 | 5.27 | 6.56 | #N/A |
| | 1:19:24 | 0.50 | 1.53 | 1.21 | 1.68 | 2.37 | 3.50 | 4.29 | 5.31 | #N/A |
| | 1:23:22 | 0.43 | 1.30 | 1.03 | 1.43 | 2.01 | 2.96 | 3.62 | 4.48 | #N/A |
| | 1:27:20 | 0.38 | 1.14 | 0.90 | 1.25 | 1.76 | 2.59 | 3.16 | 3.91 | #N/A |
| | 1:31:19 | 0.34 | 1.02 | 0.81 | 1.13 | 1.58 | 2.32 | 2.83 | 3.50 | #N/A |
| | 1:35:17 | 0.32 | 0.94 | 0.75 | 1.04 | 1.45 | 2.13 | 2.60 | 3.21 | #N/A |
| | 1:39:15 | 0.23 | 0.69 | 0.55 | 0.76 | 1.07 | 1.57 | 1.92 | 2.38 | #N/A |
| | 1:43:13 | 0.17 | 0.51 | 0.40 | 0.56 | 0.78 | 1.15 | 1.40 | 1.73 | #N/A |
| | 1:47:11 | 0.12 | 0.37 | 0.30 | 0.41 | 0.57 | 0.84 | 1.03 | 1.27 | #N/A |
| | 1:51:10 | 0.09 | 0.27 | 0.22 | 0.30 | 0.42 | 0.63 | 0.76 | 0.95 | #N/A |
| | 1:55:08 | 0.06 | 0.20 | 0.16 | 0.22 | 0.31 | 0.45 | 0.55 | 0.69 | #N/A |
| | 1:59:06 | 0.04 | 0.14 | 0.11 | 0.15 | 0.22 | 0.32 | 0.39 | 0.49 | #N/A |
| | 2:03:04 | 0.03 | 0.10 | 0.08 | 0.11 | 0.16 | 0.23 | 0.29 | 0.36 | #N/A |
| | 2:07:02 | 0.02 | 0.07 | 0.05 | 0.07 | 0.11 | 0.16 | 0.20 | 0.25 | #N/A |
| | 2:11:01 | 0.01 | 0.04 | 0.03 | 0.04 | 0.06 | 0.10 | 0.12 | 0.16 | #N/A |
| | 2:14:59 | 0.01 | 0.02 | 0.01 | 0.02 | 0.03 | 0.05 | 0.07 | 0.09 | #N/A |
| | 2:18:57 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.02 | 0.03 | 0.04 | #N/A |
| | 2:22:55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | #N/A |
| | 2:26:53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:30:52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:34:50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:38:48 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:42:46 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:46:44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:50:43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:54:41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 2:58:39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:02:37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:06:35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:10:34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:14:32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:18:30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:22:28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:26:26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:30:25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:34:23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:38:21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:42:19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:46:17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:50:16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:54:14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 3:58:12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:02:10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:06:08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:10:07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:14:05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:18:03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:22:01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:25:59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:29:58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:33:56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:37:54 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:41:52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |
| | 4:45:50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | #N/A |

## Scenario: 100 yr

STRM 1 & 2



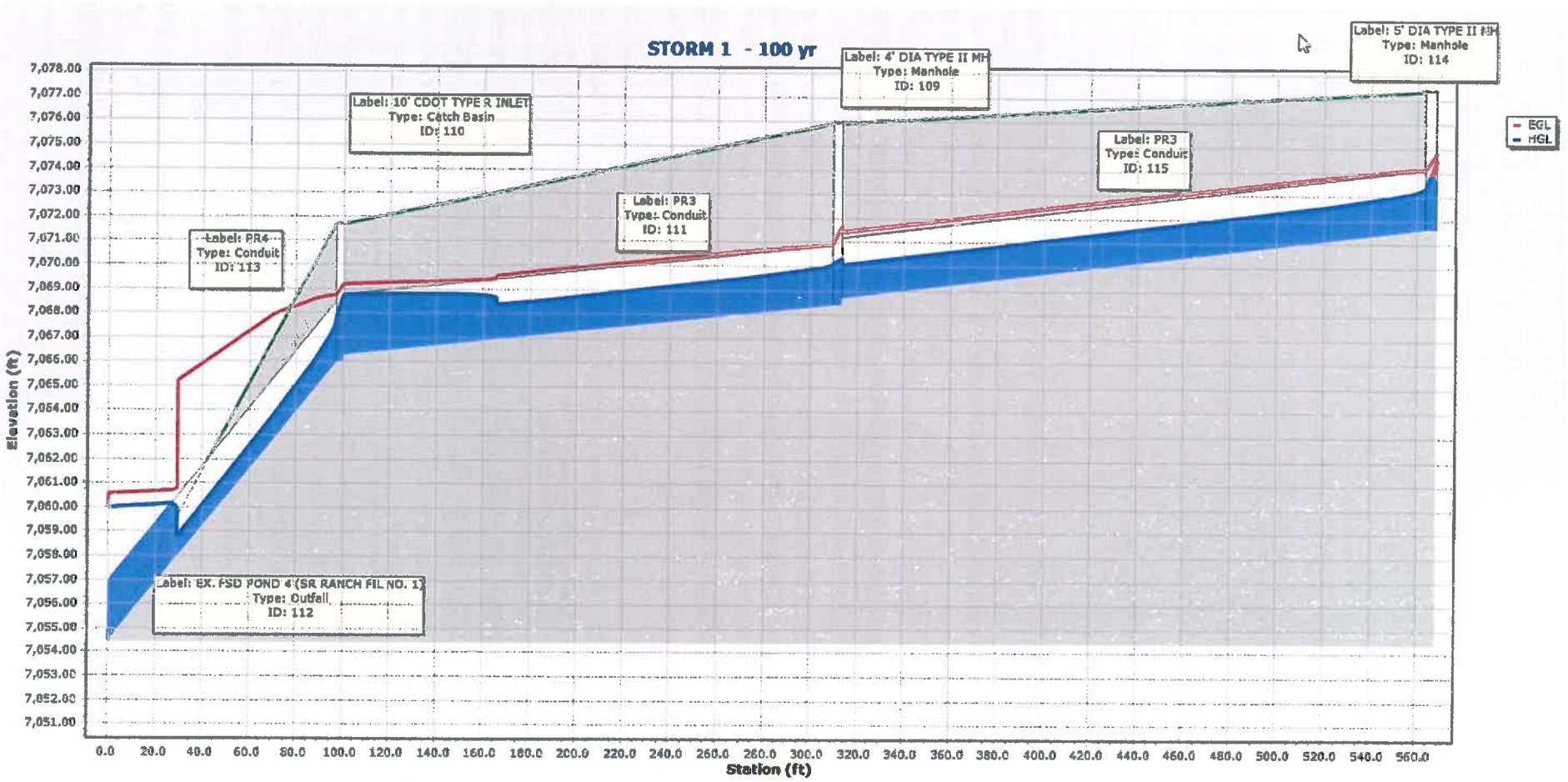


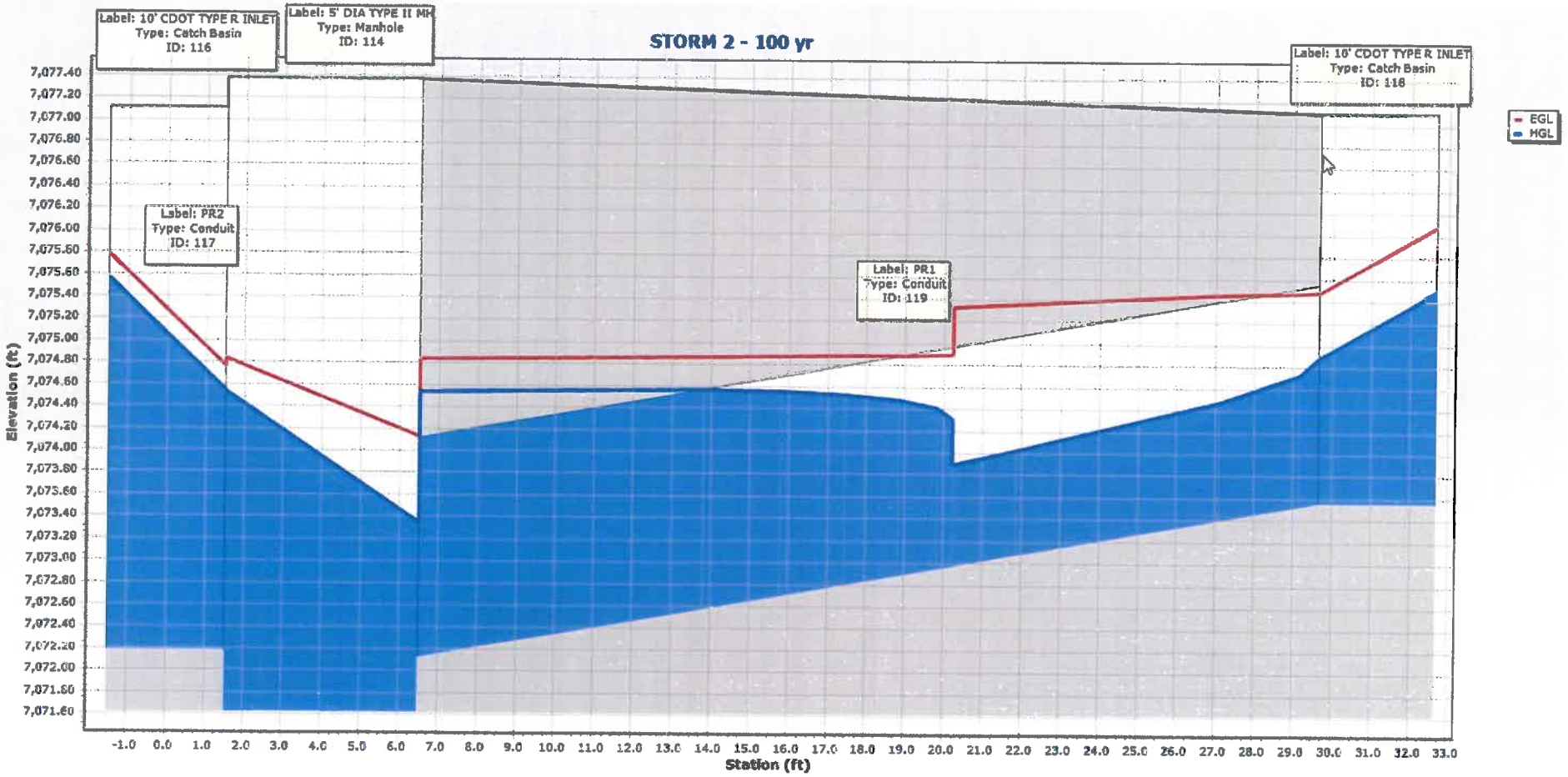

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

# Conduit FlexTable: Table - 1 STRM 1&2

| Label | Upstream Structure | Rise (ft) | Flow (cfs) | Flow / Capacity (Design) (%) | Length (Unified) (ft) | Velocity (ft/s) | Froude Number (Normal) | Depth (Normal) (ft) | Depth (Critical) (ft) |
|---|---|---|---|---|---|---|---|---|---|
| PR3 | 4' DIA TYPE II MH | | 25.70 | 62.7 | 213.1 | 8.82 | 1.432 | 1.43 | 1.73 |
| PR4 | 10' CDOT TYPE R INLET | | 30.10 | 21.5 | 98.7 | 22.71 | 5.300 | 0.79 | 1.87 |
| PR3 | 5' DIA TYPE II MH | | 25.70 | 58.4 | 254.1 | 9.31 | 1.557 | 1.37 | 1.73 |
| PR2 | 10' CDOT TYPE R INLET | | 11.80 | 37.9 | 3.2 | 3.76 | 2.023 | 0.85 | 1.23 |
| PR1 | 10' CDOT TYPE R INLET | | 13.80 | 26.6 | 27.2 | 13.97 | 3.425 | 0.70 | 1.34 |

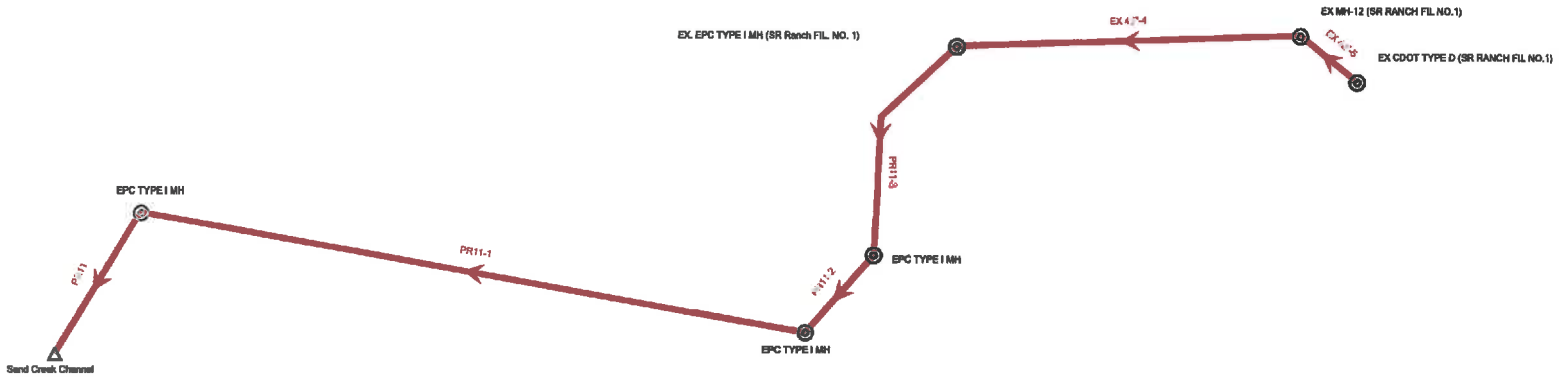
| Hydraulic Grade Line (In) (ft) | Hydraulic Grade Line (Out) (ft) | Headloss (ft) | Upstream Structure Hydraulic Grade Line (In) (ft) | Upstream Structure Velocity (In-Governing) (ft/s) | Upstream Structure Headloss Coefficient | Upstream Structure Headloss (ft) | Elevation Ground (Start) (ft) | Invert (Start) (ft) | Invert (Stop) (ft) |
|---|---|---|---|---|---|---|---|---|---|
| 7,070.13 | 7,068.77 | 1.36 | 7,070.34 | 9.31 | 0.270 | 0.21 | 7,075.93 | 7,068.40 | 7,066.27 |
| 7,067.84 | 7,060.00 | 7.84 | 7,068.77 | 5.24 | 1.020 | 0.93 | 7,071.69 | 7,065.97 | 7,054.50 |
| 7,073.35 | 7,070.07 | 3.27 | 7,074.54 | 4.39 | 1.520 | 1.19 | 7,077.37 | 7,071.62 | 7,068.70 |
| 7,074.55 | 7,074.54 | 0.01 | 7,075.57 | 3.76 | 1.000 | 1.02 | 7,077.10 | 7,072.18 | 7,072.12 |
| 7,074.89 | 7,074.54 | 0.35 | 7,075.49 | 6.18 | 1.020 | 0.61 | 7,077.10 | 7,073.55 | 7,072.12 |


STORM 1 - 100 yr
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 110
Label: 4' DIA TYPE II MH
Type: Manhole
ID: 109
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: PR4
Type: Conduit
ID: 113
Label: PR3
Type: Conduit
ID: 111
Label: PR3
Type: Conduit
ID: 115
Label: EX. FSD POND 4 (SR RANCH FIL NO. 1)
Type: Outfall
ID: 112
EGL
HGL
Elevation (ft)
Station (ft)
7,078.00
7,077.00
7,076.00
7,075.00
7,074.00
7,073.00
7,072.00
7,071.00
7,070.00
7,069.00
7,068.00
7,067.00
7,066.00
7,065.00
7,064.00
7,063.00
7,062.00
7,061.00
7,060.00
7,059.00
7,058.00
7,057.00
7,056.00
7,055.00
7,054.00
7,053.00
7,052.00
7,051.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
460.0
480.0
500.0
520.0
540.0
560.0


STORM 2 - 100 yr
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 116
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 118
Label: PR2
Type: Conduit
ID: 117
Label: PR1
Type: Conduit
ID: 119
EGL
HGL
Elevation (ft)
7,077.40
7,077.20
7,077.00
7,076.80
7,076.60
7,076.40
7,076.20
7,076.00
7,075.80
7,075.60
7,075.40
7,075.20
7,075.00
7,074.80
7,074.60
7,074.40
7,074.20
7,074.00
7,073.80
7,073.60
7,073.40
7,073.20
7,073.00
7,072.80
7,072.60
7,072.40
7,072.20
7,072.00
7,071.80
7,071.60
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0
Station (ft)

# Scenario: 100 yr

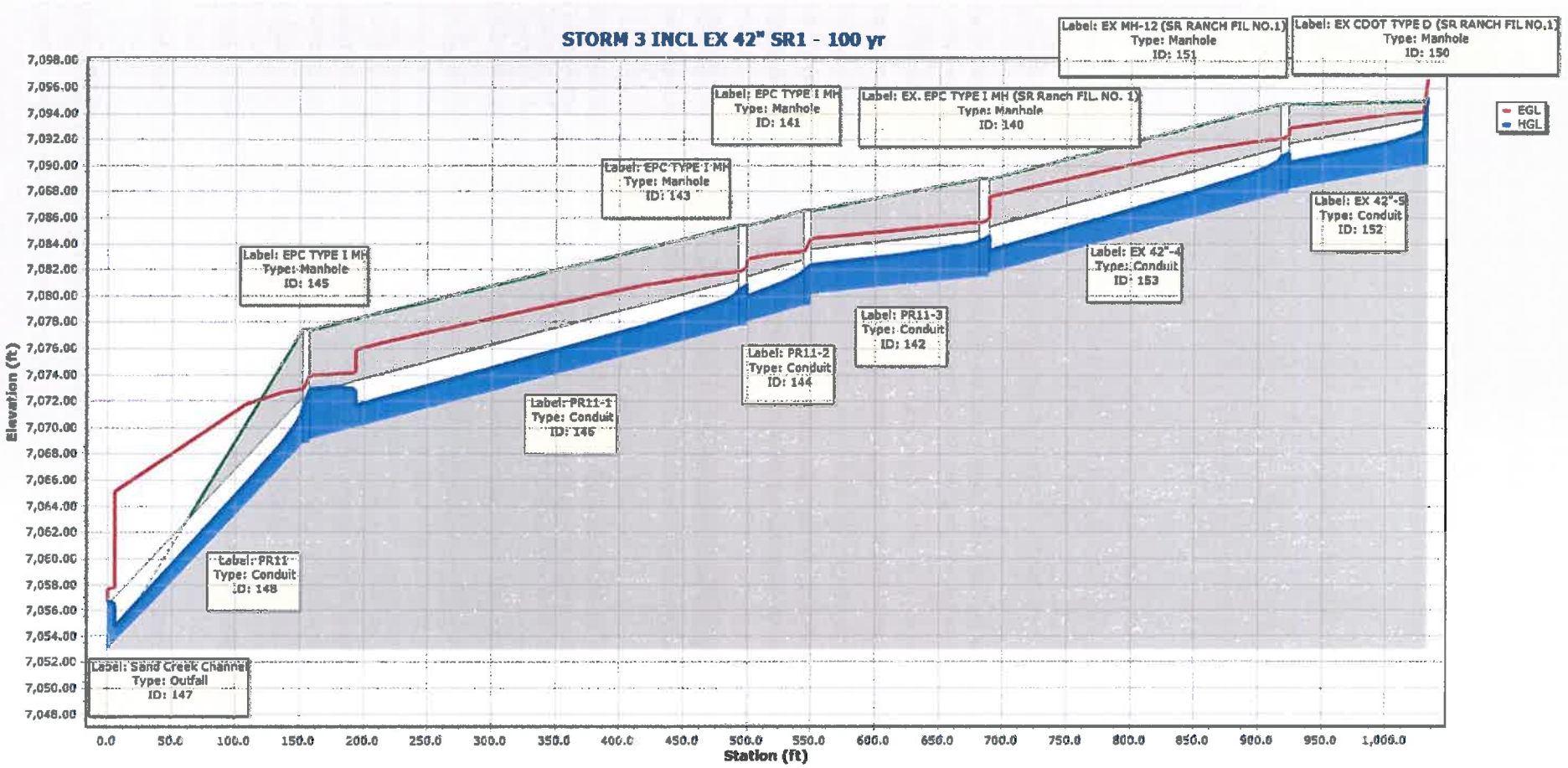
STORM 3 INCL EX 42" SR1



# Conduit FlexTable: Table - 1 STRM 3 INCL 42" SR1

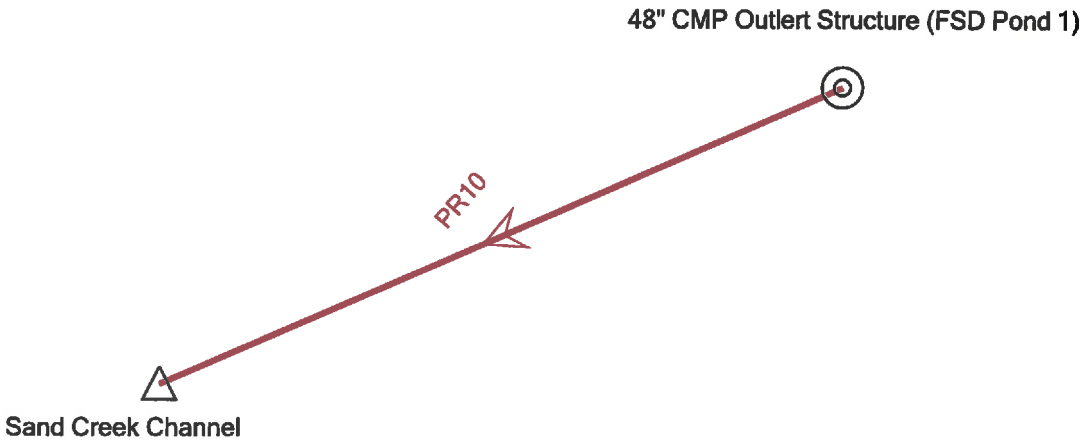
| Label | Upstream Structure | Rise (ft) | Flow (cfs) | Flow / Capacity (Design) (%) | Length (Unified) (ft) | Velocity (ft/s) | Froude Number (Normal) | Depth (Normal) (ft) | Depth (Critical) (ft) |
|---|---|---|---|---|---|---|---|---|---|
| PR11-3 | EX. EPC TYPE I MH (SR Ranch FIL. NO. 1) | | 76.80 | 76.4 | 138.4 | 11.50 | 1.432 | 2.29 | 2.74 |
| PR11-2 | EPC TYPE I MH | | 76.80 | 47.5 | 50.8 | 16.58 | 2.541 | 1.70 | 2.74 |
| PR11-1 | EPC TYPE I MH | | 76.80 | 48.1 | 341.2 | 16.43 | 2.507 | 1.71 | 2.74 |
| PR11 | EPC TYPE I MH | | 76.80 | 23.9 | 155.1 | 27.41 | 5.244 | 1.16 | 2.74 |
| EX 42"-5 | EX CDOT TYPE D (SR RANCH FIL NO.1) | | 76.80 | 58.8 | 110.4 | 14.12 | 1.992 | 1.93 | 2.74 |
| EX 42"-4 | EX MH-12 (SR RANCH FIL NO.1) | | 76.80 | 47.3 | 235.2 | 16.64 | 2.553 | 1.69 | 2.74 |

| Hydraulic Grade Line (In) (ft) | Hydraulic Grade Line (Out) (ft) | Headloss (ft) | Upstream Structure Hydraulic Grade Line (In) (ft) | Upstream Structure Velocity (In-Governing) (ft/s) | Upstream Structure Headloss Coefficient | Upstream Structure Headloss (ft) | Elevation Ground (Start) (ft) | Invert (Start) (ft) | Invert (Stop) (ft) |
|---|---|---|---|---|---|---|---|---|---|
| 7,084.23 | 7,082.43 | 1.80 | 7,084.61 | 9.24 | 0.270 | 0.38 | 7,088.97 | 7,081.49 | 7,080.11 |
| 7,082.05 | 7,080.82 | 1.23 | 7,082.43 | 11.32 | 0.270 | 0.38 | 7,086.56 | 7,079.31 | 7,078.00 |
| 7,080.44 | 7,072.98 | 7.46 | 7,080.82 | 9.24 | 0.270 | 0.38 | 7,085.36 | 7,077.70 | 7,069.11 |
| 7,071.55 | 7,056.70 | 14.85 | 7,072.98 | 7.98 | 1.020 | 1.43 | 7,077.40 | 7,068.81 | 7,053.00 |
| 7,092.81 | 7,091.03 | 1.78 | 7,095.29 | 9.50 | 1.770 | 2.48 | 7,095.00 | 7,090.07 | 7,088.21 |
| 7,090.65 | 7,084.61 | 6.04 | 7,091.03 | 9.24 | 0.270 | 0.38 | 7,094.77 | 7,087.91 | 7,081.79 |


STORM 3 INCL EX 42" SR1 - 100 yr
Label: EX MH-12 (SR RANCH FIL NO.1)
Type: Manhole
ID: 151
Label: EX CDOT TYPE D (SR RANCH FIL NO.1)
Type: Manhole
ID: 150
Label: EPC TYPE I MH
Type: Manhole
ID: 141
Label: EX. EPC TYPE I MH (SR Ranch FIL NO. 1)
Type: Manhole
ID: 140
Label: EPC TYPE I MH
Type: Manhole
ID: 143
Label: EPC TYPE I MH
Type: Manhole
ID: 145
Label: EX 42"-5
Type: Conduit
ID: 152
Label: EX 42"-4
Type: Conduit
ID: 153
Label: PR11-3
Type: Conduit
ID: 142
Label: PR11-2
Type: Conduit
ID: 144
Label: PR11-1
Type: Conduit
ID: 146
Label: PR11
Type: Conduit
ID: 148
Label: Sand Creek Channel
Type: Outfall
ID: 147
EGL
HGL
Elevation (ft)
Station (ft)
7,098.00
7,096.00
7,094.00
7,092.00
7,090.00
7,088.00
7,086.00
7,084.00
7,082.00
7,080.00
7,078.00
7,076.00
7,074.00
7,072.00
7,070.00
7,068.00
7,066.00
7,064.00
7,062.00
7,060.00
7,058.00
7,056.00
7,054.00
7,052.00
7,050.00
7,048.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1,000.0

## Scenario: 100 yr

STRM 4

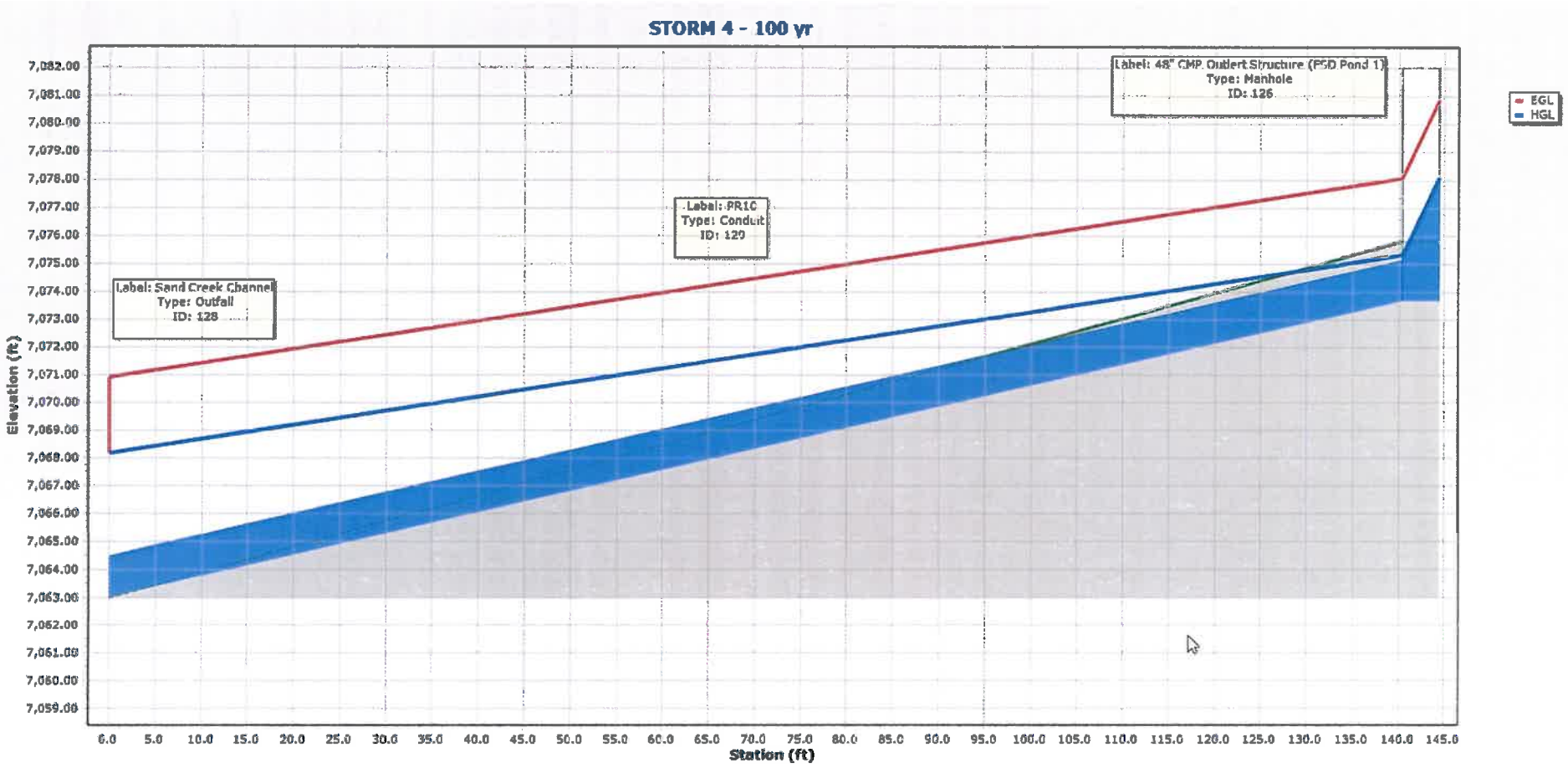


# Conduit FlexTable: Table - 1 STRM 4

| Label | Upstream Structure | Rise (ft) | Flow (cfs) | Flow / Capacity (Design) (%) | Length (Unified) (ft) | Velocity (ft/s) | Froude Number (Normal) | Depth (Normal) (ft) |
|---|---|---|---|---|---|---|---|---|
| PR10 | 48" CMP Outlert Structure (FSD Pond 1) | | 23.50 | 81.7 | 142.4 | 13.30 | 3.315 | 1.03 |

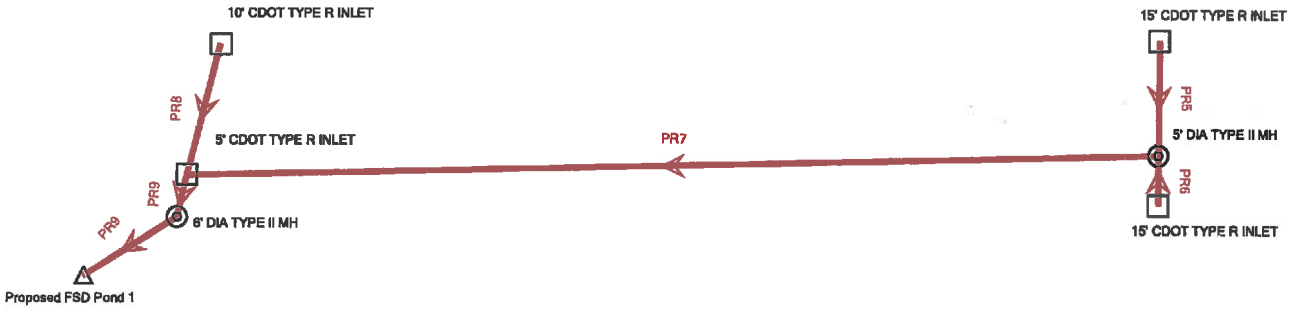
| Depth (Critical) (ft) | Hydraulic Grade Line (In) (ft) | Hydraulic Grade Line (Out) (ft) | Headloss (ft) | Upstream Structure Hydraulic Grade Line (In) (ft) | Upstream Structure Velocity (In-Governing) (ft/s) | Upstream Structure Headloss Coefficient | Upstream Structure Headloss (ft) | Elevation Ground (Start) (ft) |
|---|---|---|---|---|---|---|---|---|
| 1.48 | 7,075.33 | 7,068.20 | 7.13 | 7,078.13 | 13.30 | 1.020 | 2.80 | 7,075.83 |

| Invert (Start) (ft) | Invert (Stop) (ft) |
|---|---|
| 7,073.67 | 7,063.00 |


STORM 4 - 100 yr
Label: 48" CMP Outlert Structure (P5D Pond 1)
Type: Manhole
ID: 126
Label: PR1C
Type: Conduit
ID: 129
Label: Sand Creek Channel
Type: Outfall
ID: 128
EGL
HGL
Elevation (ft)
7,082.00
7,081.00
7,080.00
7,079.00
7,078.00
7,077.00
7,076.00
7,075.00
7,074.00
7,073.00
7,072.00
7,071.00
7,070.00
7,069.00
7,068.00
7,067.00
7,066.00
7,065.00
7,064.00
7,063.00
7,062.00
7,061.00
7,060.00
7,059.00
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0 90.0 95.0 100.0 105.0 110.0 115.0 120.0 125.0 130.0 135.0 140.0 145.0
Station (ft)

## Scenario: 100 yr

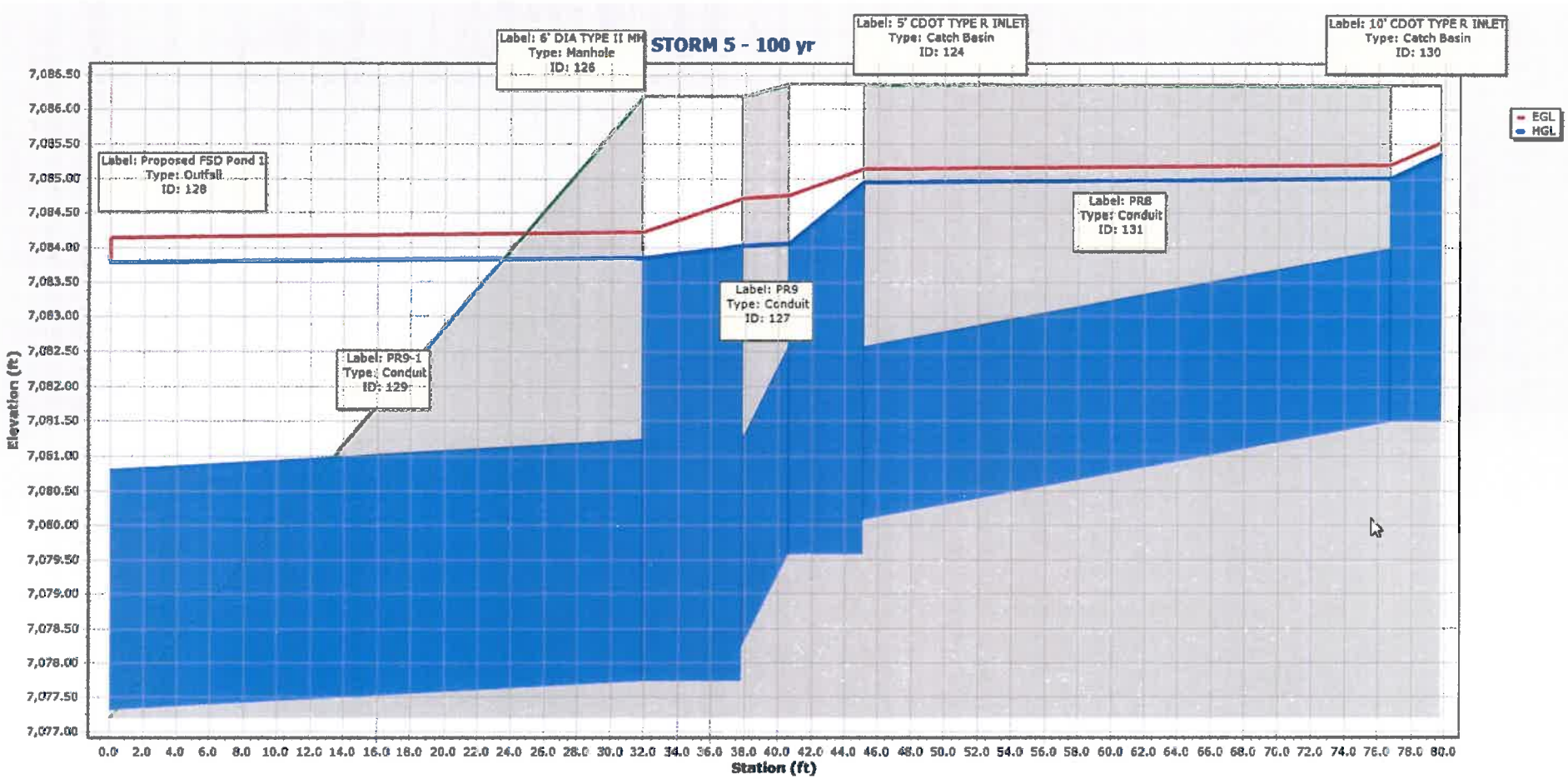
STRM 5,6,7

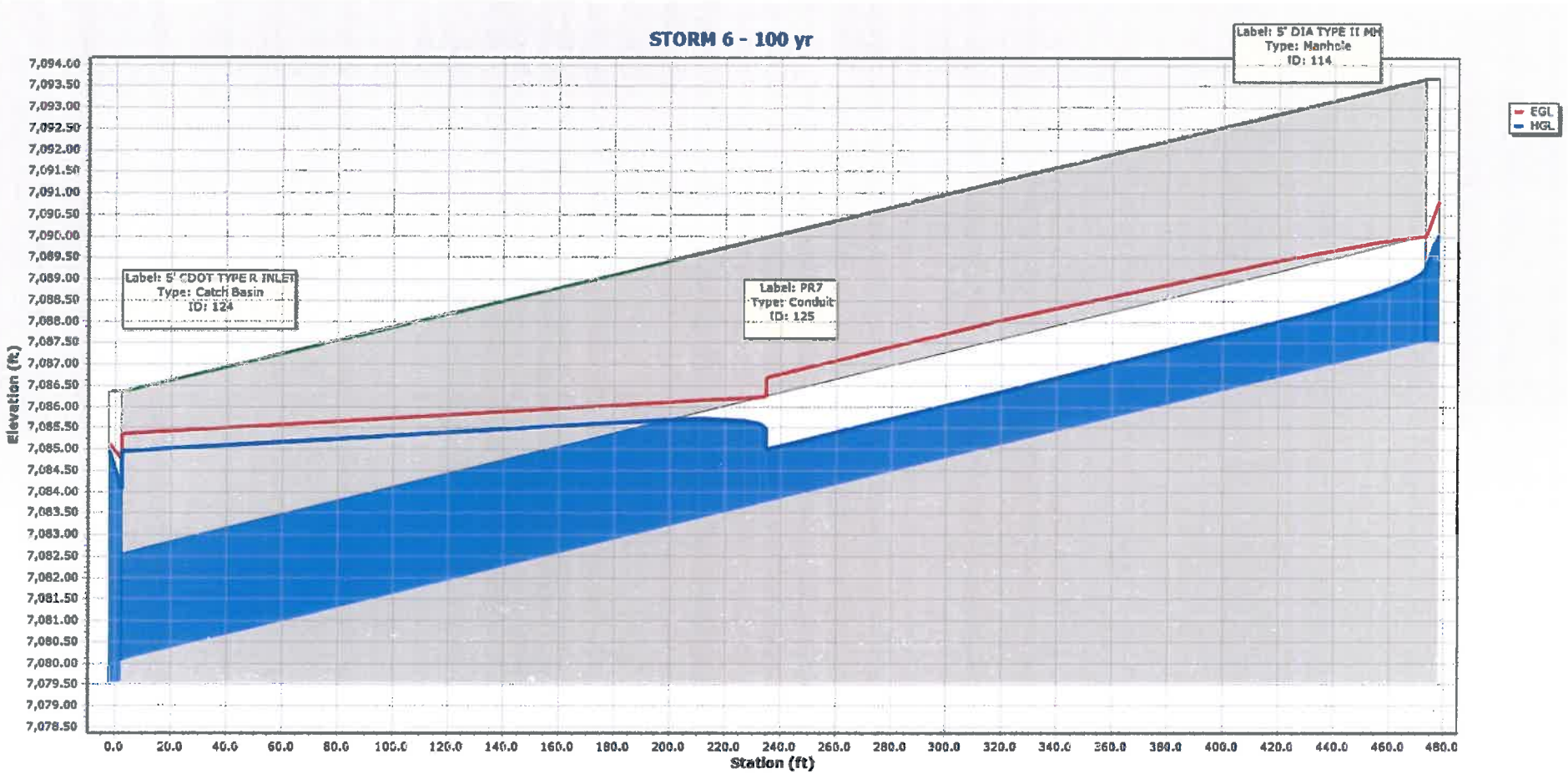


# Conduit FlexTable: Table - 1 STRM 5,6,7

| Label | Upstream Structure | Rise (ft) | Flow (cfs) | Flow / Capacity (Design) (%) | Length (Unified) (ft) | Velocity (ft/s) | Froude Number (Normal) | Depth (Normal) (ft) | Depth (Critical) (ft) |
|---|---|---|---|---|---|---|---|---|---|
| PR6 | 15' CDOT TYPE R INLET | | 12.70 | 85.5 | 2.5 | 7.19 | 1.674 | 1.07 | 1.34 |
| PR5 | 15' CDOT TYPE R INLET | | 12.70 | 55.2 | 26.5 | 13.34 | 2.948 | 0.80 | 1.34 |
| PR7 | 5' DIA TYPE II MH | | 25.30 | 49.2 | 475.5 | 10.43 | 1.867 | 1.24 | 1.71 |
| PR9 | 5' CDOT TYPE R INLET | | 47.10 | 17.3 | 8.0 | 6.66 | 6.560 | 0.84 | 2.24 |
| PR9-1 | 6' DIA TYPE II MH | | 47.10 | 42.6 | 34.9 | 4.90 | 1.755 | 1.60 | 2.14 |
| PR8 | 10' CDOT TYPE R INLET | | 17.20 | 20.9 | 35.4 | 3.50 | 3.114 | 0.78 | 1.40 |

| Hydraulic Grade Line (In) (ft) | Hydraulic Grade Line (Out) (ft) | Headloss (ft) | Upstream Structure Hydraulic Grade Line (In) (ft) | Upstream Structure Velocity (In-Governing) (ft/s) | Upstream Structure Headloss Coefficient | Upstream Structure Headloss (ft) | Elevation Ground (Start) (ft) | Invert (Start) (ft) | Invert (Stop) (ft) |
|---|---|---|---|---|---|---|---|---|---|
| 7,090.47 | 7,090.43 | 0.04 | 7,091.28 | 7.19 | 1.020 | 0.82 | 7,093.41 | 7,088.59 | 7,088.54 |
| 7,091.15 | 7,090.43 | 0.72 | 7,092.07 | 7.62 | 1.020 | 0.92 | 7,093.57 | 7,089.81 | 7,088.54 |
| 7,089.25 | 7,084.94 | 4.31 | 7,090.43 | 7.19 | 1.520 | 1.17 | 7,093.68 | 7,087.54 | 7,080.07 |
| 7,084.06 | 7,084.02 | 0.04 | 7,084.94 | 3.50 | 1.280 | 0.88 | 7,086.36 | 7,079.57 | 7,078.23 |
| 7,083.85 | 7,083.77 | 0.08 | 7,084.02 | 6.66 | 0.470 | 0.18 | 7,086.18 | 7,077.73 | 7,077.31 |
| 7,085.01 | 7,084.94 | 0.06 | 7,085.34 | 3.50 | 1.770 | 0.34 | 7,086.34 | 7,081.49 | 7,080.07 |


STORM 5 - 100 yr
Label: 6" DIA TYPE II MH
Type: Manhole
ID: 126
Label: 5' CDOT TYPE R INLET
Type: Catch Basin
ID: 124
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 130
Label: Proposed FSD Pond 1
Type: Outfall
ID: 128
Label: PR8
Type: Conduit
ID: 131
Label: PR9
Type: Conduit
ID: 127
Label: PR9-1
Type: Conduit
ID: 129
EGL
HGL
Elevation (ft)
7,086.50
7,086.00
7,085.50
7,085.00
7,084.50
7,084.00
7,083.50
7,083.00
7,082.50
7,082.00
7,081.50
7,081.00
7,080.50
7,080.00
7,079.50
7,079.00
7,078.50
7,078.00
7,077.50
7,077.00
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0
Station (ft)


STORM 6 - 100 yr
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: 5' CDOT TYPE R INLET
Type: Catch Basin
ID: 124
Label: PR7
Type: Conduit
ID: 125
EGL
HGL
Elevation (ft)
Station (ft)
7,094.00
7,093.50
7,093.00
7,092.50
7,092.00
7,091.50
7,091.00
7,090.50
7,090.00
7,089.50
7,089.00
7,088.50
7,088.00
7,087.50
7,087.00
7,086.50
7,086.00
7,085.50
7,085.00
7,084.50
7,084.00
7,083.50
7,083.00
7,082.50
7,082.00
7,081.50
7,081.00
7,080.50
7,080.00
7,079.50
7,079.00
7,078.50
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
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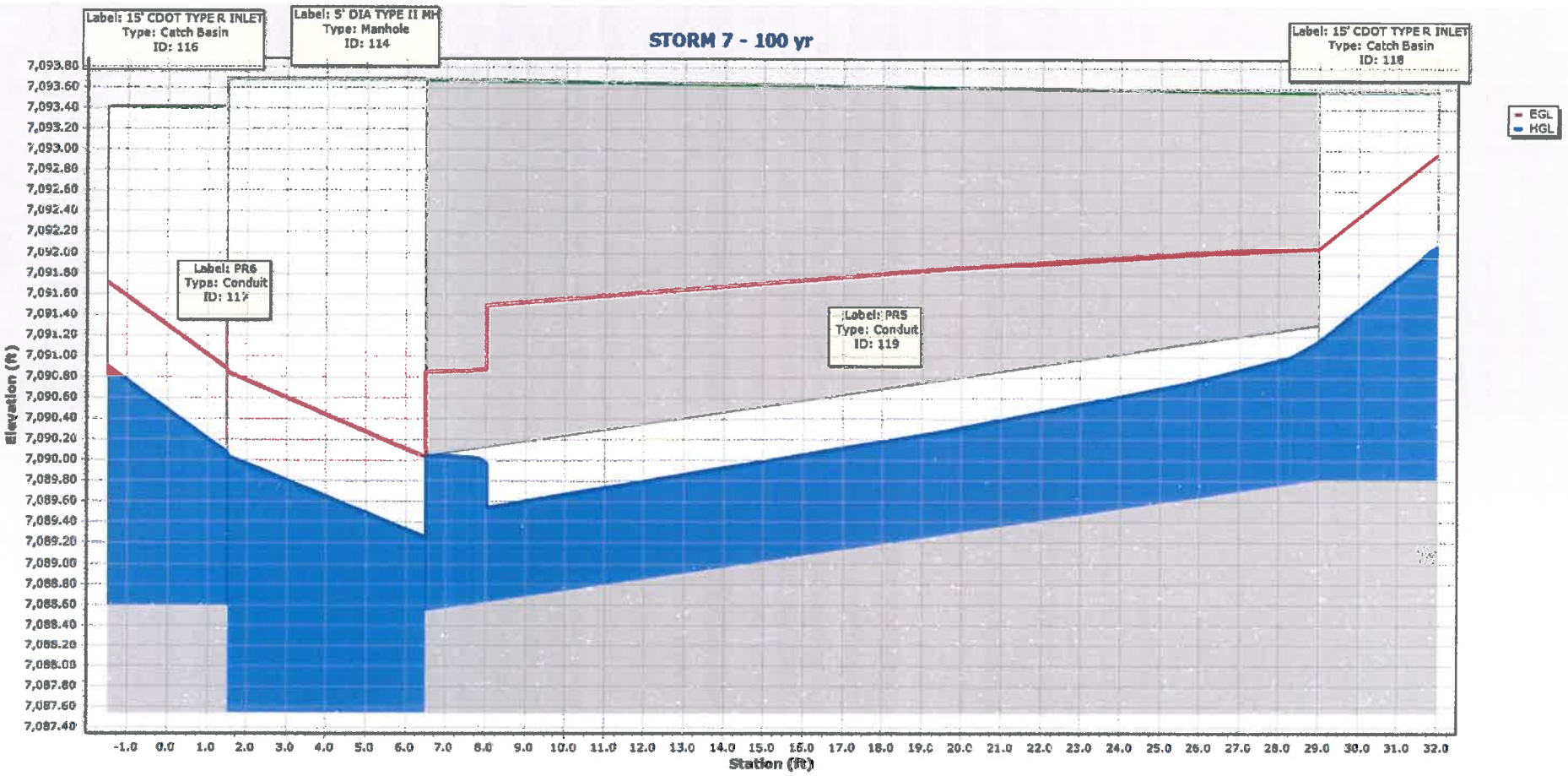
380.0
400.0
420.0
440.0
460.0
480.0


STORM 7 - 100 yr
Label: 15' CDOT TYPE R INLET
Type: Catch Basin
ID: 116
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: 15' CDOT TYPE R INLET
Type: Catch Basin
ID: 118
Label: PR6
Type: Conduit
ID: 117
Label: PR5
Type: Conduit
ID: 119
EGL
HGL
Elevation (ft)
Station (ft)

CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: Homestead Filing No. 2

DATE:

# Riprap Apron For Pond 1

## Riprap Sizing

$Q_{100} = 47.1$ cfs (Pipe Run 9)

$D_c = 42" = 3.5'$

$\frac{Q}{D^{2.5}} < 6$ Then use Figure 9-38 (UDFCD Vol. 2)

$\frac{47.1}{(3.5)^{2.5}} = 2.05 < 6$ Therefore use Figure 9-38 and $Y_s/D_c = 0.40$ & $\frac{Q}{D^{1.5}} = \frac{47.1}{(3.5)^{1.5}} = 7.19$

**Use Type L $D_{50} = 9"$**

## Riprap Depth

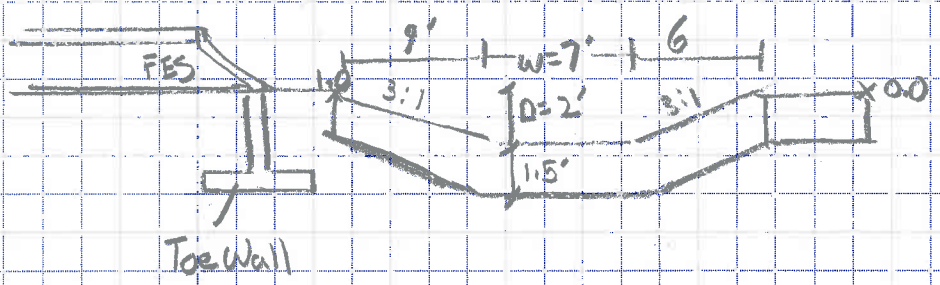
$T = 2D_{50}$

$= 2(9")$

**$T = 18"$ or $1.5'$**

## Low Tailwater Riprap Basin

42" Pipe



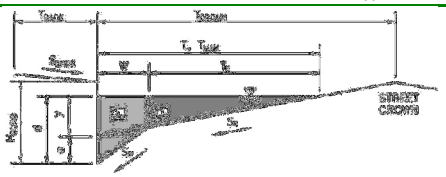
Version 4.05 Released March 2017

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

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

**Project:** Enter Your Project Name Here

**Inlet ID:** Inlet DP 7




**Gutter Geometry (Enter data in the blue cells)**

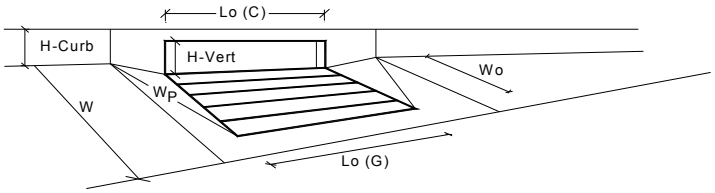
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 8.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 17.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.020 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.000 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.020 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 5.1 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| **MINOR STORM Allowable Capacity is based on Depth Criterion** | | | | |
| **MAJOR STORM Allowable Capacity is based on Depth Criterion** | **$Q_{allow}$ =** | **SUMP** | **SUMP** | **cfs** |

# INLET IN A SUMP OR SAG LOCATION

**Version 4.05 Released March 2017**




| **Design Information (Input)** | CDOT Type R Curb Opening | | MINOR | MAJOR | |
|---|---|---|---|---|---|
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | | No = | 2 | 2 | |
| Water Depth at Flowline (outside of local depression) | | Ponding Depth = | 5.1 | 7.8 | inches |
| **Grate Information** | | | MINOR | MAJOR | ☑ Override Depths |
| Length of a Unit Grate | | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | | $W_o$ = | N/A | N/A | feet |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | | $C_o$ (G) = | N/A | N/A | |
| **Curb Opening Information** | | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat (see USDCM Figure ST-5) | | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | | $C_o$ (C) = | 0.67 | 0.67 | |
| **Low Head Performance Reduction (Calculated)** | | | MINOR | MAJOR | |
| Depth for Grate Midwidth | | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | | $d_{Curb}$ = | 0.26 | 0.48 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | | $RF_{Combination}$ = | 0.48 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | | $RF_{Curb}$ = | 0.88 | 1.00 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | | $RF_{Grate}$ = | N/A | N/A | |
| | | | MINOR | MAJOR | |
| **Total Inlet Interception Capacity (assumes clogged condition)** | | **$Q_a$ =** | **6.7** | **18.7** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | | $Q_{PEAK\ REQUIRED}$ = | 5.7 | 13.8 | cfs |

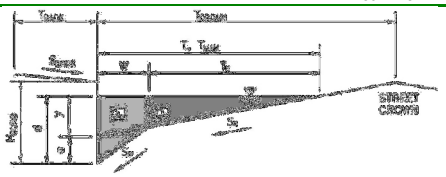
Version 4.05 Released March 2017

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

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

**Project:** Enter Your Project Name Here

**Inlet ID:** Inlet DP 8




**Gutter Geometry (Enter data in the blue cells)**

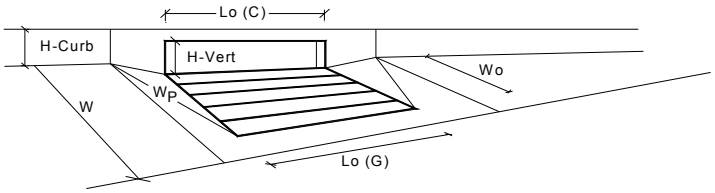
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 8.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 17.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.020 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.000 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.020 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 5.1 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| **MINOR STORM Allowable Capacity is based on Depth Criterion** | | | | |
| **MAJOR STORM Allowable Capacity is based on Depth Criterion** | **$Q_{allow}$ =** | **SUMP** | **SUMP** | **cfs** |

# INLET IN A SUMP OR SAG LOCATION

**Version 4.05 Released March 2017**




| **Design Information (Input)** | CDOT Type R Curb Opening | | MINOR | MAJOR | |
|---|---|---|---|---|---|
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | | No = | 2 | 2 | |
| Water Depth at Flowline (outside of local depression) | | Ponding Depth = | 5.1 | 7.8 | inches |
| **Grate Information** | | | MINOR | MAJOR | ☑ Override Depths |
| Length of a Unit Grate | | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | | $W_o$ = | N/A | N/A | feet |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | | $C_o$ (G) = | N/A | N/A | |
| **Curb Opening Information** | | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat (see USDCM Figure ST-5) | | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | | $C_o$ (C) = | 0.67 | 0.67 | |
| **Low Head Performance Reduction (Calculated)** | | | MINOR | MAJOR | |
| Depth for Grate Midwidth | | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | | $d_{Curb}$ = | 0.26 | 0.48 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | | $RF_{Combination}$ = | 0.48 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | | $RF_{Curb}$ = | 0.88 | 1.00 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | | $RF_{Grate}$ = | N/A | N/A | |
| | | | MINOR | MAJOR | |
| **Total Inlet Interception Capacity (assumes clogged condition)** | | **$Q_a$ =** | **6.7** | **18.7** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | | $Q_{PEAK\ REQUIRED}$ = | 4.9 | 11.8 | cfs |

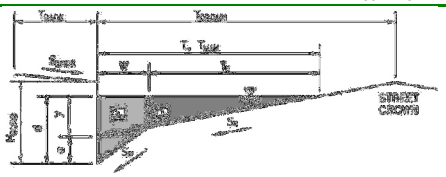
Version 4.05 Released March 2017

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

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

**Project:** Enter Your Project Name Here

**Inlet ID:** Inlet DP 9




**Gutter Geometry (Enter data in the blue cells)**

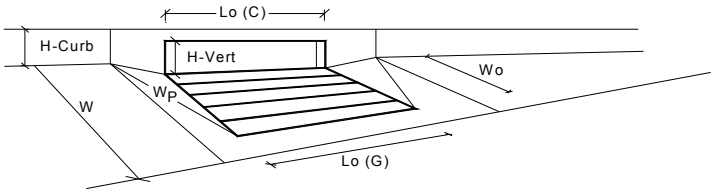
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 8.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 17.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.020 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.000 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.020 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 5.1 | 8.0 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| **MINOR STORM Allowable Capacity is based on Depth Criterion** | | | | |
| **MAJOR STORM Allowable Capacity is based on Depth Criterion** | **$Q_{allow}$ =** | **SUMP** | **SUMP** | **cfs** |

# INLET IN A SUMP OR SAG LOCATION

**Version 4.05 Released March 2017**




| **Design Information (Input)** | CDOT Type R Curb Opening | | MINOR | MAJOR | |
|---|---|---|---|---|---|
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | | Ponding Depth = | 5.1 | 7.8 | inches |
| **Grate Information** | | | MINOR | MAJOR | ☑ Override Depths |
| Length of a Unit Grate | | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | | $W_o$ = | N/A | N/A | feet |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | | $C_o$ (G) = | N/A | N/A | |
| **Curb Opening Information** | | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat (see USDCM Figure ST-5) | | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | | $C_o$ (C) = | 0.67 | 0.67 | |
| **Low Head Performance Reduction (Calculated)** | | | MINOR | MAJOR | |
| Depth for Grate Midwidth | | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | | $d_{Curb}$ = | 0.26 | 0.48 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | | $RF_{Combination}$ = | 0.65 | 1.00 | |
| Curb Opening Performance Reduction Factor for Long Inlets | | $RF_{Curb}$ = | 1.00 | 1.00 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | | $RF_{Grate}$ = | N/A | N/A | |
| | | | MINOR | MAJOR | |
| **Total Inlet Interception Capacity (assumes clogged condition)** | | **$Q_a$ =** | **3.7** | **9.0** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | | $Q_{PEAK\ REQUIRED}$ = | 2.2 | 5.4 | cfs |

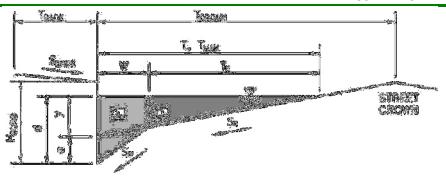
Version 4.05 Released March 2017

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

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

**Project:** Enter Your Project Name Here

**Inlet ID:** Inlet DP 10




**Gutter Geometry (Enter data in the blue cells)**

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 8.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 17.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.020 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.022 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.020 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 5.1 | 7.8 | inches |
| Allow Flow Depth at Street Crown (leave blank for no) | | ☐ | ☑ | check = yes |

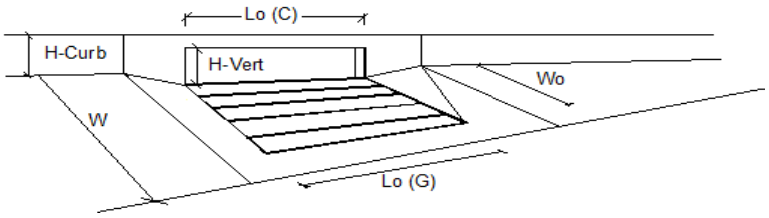
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| **MINOR STORM Allowable Capacity is based on Depth Criterion** | | | | |
| **MAJOR STORM Allowable Capacity is based on Depth Criterion** | **$Q_{allow}$ =** | **9.4** | **29.1** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

**Version 4.05 Released March 2017**




| **Design Information (Input)** | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | CDOT Type R Curb Opening | Type = | CDOT Type R Curb Opening | |
| Local Depression (additional to continuous gutter depression 'a') | | $a_{LOCAL}$ = | 3.0 | 3.0 inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | | No = | 1 | 1 |
| Length of a Single Unit Inlet (Grate or Curb Opening) | | $L_o$ = | 15.00 | 15.00 ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | | $W_o$ = | N/A | N/A ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | | $C_f$-G = | N/A | N/A |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | | $C_f$-C = | 0.10 | 0.10 |

| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
|---|---|---|---|---|
| **Total Inlet Interception Capacity** | **Q =** | **9.1** | **12.7** | **cfs** |
| **Total Inlet Carry-Over Flow (flow bypassing inlet)** | **$Q_b$ =** | **0.3** | **2.9** | **cfs** |
| **Capture Percentage = $Q_a/Q_o$ =** | **C% =** | **97** | **82** | **%** |

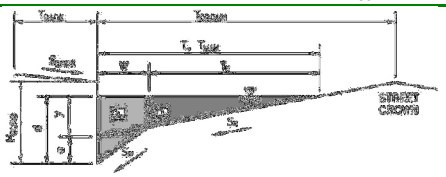
Version 4.05 Released March 2017

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

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

**Project:** Enter Your Project Name Here

**Inlet ID:** Inlet DP 11




**Gutter Geometry (Enter data in the blue cells)**

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 8.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 17.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.020 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.022 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.020 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 5.1 | 7.8 | inches |
| Allow Flow Depth at Street Crown (leave blank for no) | | ☐ | ☑ | check = yes |

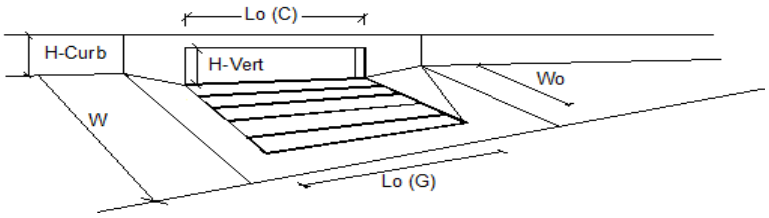
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| **MINOR STORM Allowable Capacity is based on Depth Criterion** | | | | |
| **MAJOR STORM Allowable Capacity is based on Depth Criterion** | **$Q_{allow}$ =** | **9.4** | **29.1** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

**Version 4.05 Released March 2017**




| **Design Information (Input)** | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | CDOT Type R Curb Opening | Type = | CDOT Type R Curb Opening | |
| Local Depression (additional to continuous gutter depression 'a') | | $a_{LOCAL}$ = | 3.0 | 3.0 inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | | No = | 1 | 1 |
| Length of a Single Unit Inlet (Grate or Curb Opening) | | $L_o$ = | 15.00 | 15.00 ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | | $W_o$ = | N/A | N/A ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | | $C_f$-G = | N/A | N/A |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | | $C_f$-C = | 0.10 | 0.10 |

| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
|---|---|---|---|---|
| **Total Inlet Interception Capacity** | **Q =** | **1.9** | **12.7** | **cfs** |
| **Total Inlet Carry-Over Flow (flow bypassing inlet)** | **$Q_b$ =** | **0.0** | **2.9** | **cfs** |
| **Capture Percentage = $Q_a/Q_o$ =** | **C% =** | **100** | **82** | **%** |

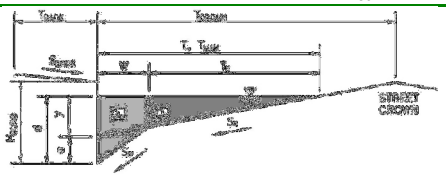
Version 4.05 Released March 2017

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

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

**Project:** Enter Your Project Name Here

**Inlet ID:** Inlet DP 12




**Gutter Geometry (Enter data in the blue cells)**

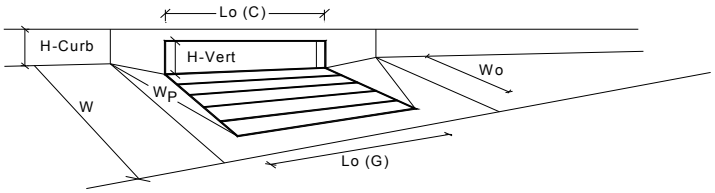
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 8.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 17.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.020 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.000 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.020 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 5.1 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| **MINOR STORM Allowable Capacity is based on Depth Criterion** | | | | |
| **MAJOR STORM Allowable Capacity is based on Depth Criterion** | **$Q_{allow}$ =** | **SUMP** | **SUMP** | **cfs** |

# INLET IN A SUMP OR SAG LOCATION

**Version 4.05 Released March 2017**




| **Design Information (Input)** | CDOT Type R Curb Opening | | MINOR | MAJOR | |
|---|---|---|---|---|---|
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | | No = | 2 | 2 | |
| Water Depth at Flowline (outside of local depression) | | Ponding Depth = | 5.1 | 7.8 | inches |
| **Grate Information** | | | MINOR | MAJOR | ☑ Override Depths |
| Length of a Unit Grate | | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | | $W_o$ = | N/A | N/A | feet |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | | $C_o$ (G) = | N/A | N/A | |
| **Curb Opening Information** | | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat (see USDCM Figure ST-5) | | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | | $C_o$ (C) = | 0.67 | 0.67 | |
| **Low Head Performance Reduction (Calculated)** | | | MINOR | MAJOR | |
| Depth for Grate Midwidth | | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | | $d_{Curb}$ = | 0.26 | 0.48 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | | $RF_{Combination}$ = | 0.48 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | | $RF_{Curb}$ = | 0.88 | 1.00 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | | $RF_{Grate}$ = | N/A | N/A | |
| | | | MINOR | MAJOR | |
| **Total Inlet Interception Capacity (assumes clogged condition)** | | **$Q_a$ =** | **6.7** | **18.7** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | | $Q_{PEAK\ REQUIRED}$ = | 6.2 | 17.2 | cfs |

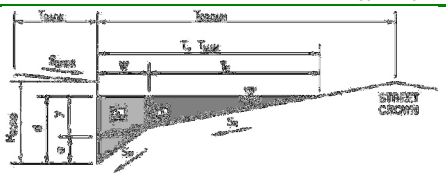
Version 4.05 Released March 2017

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

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

**Project:** Enter Your Project Name Here

**Inlet ID:** Inlet DP 13




**Gutter Geometry (Enter data in the blue cells)**

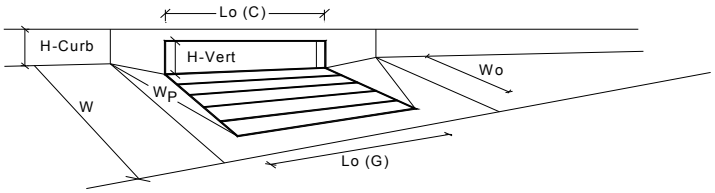
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 8.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 17.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.020 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.000 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.020 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 5.1 | 5.1 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| **MINOR STORM Allowable Capacity is based on Depth Criterion** | | | | |
| **MAJOR STORM Allowable Capacity is based on Depth Criterion** | **$Q_{allow}$ =** | **SUMP** | **SUMP** | **cfs** |

# INLET IN A SUMP OR SAG LOCATION

**Version 4.05 Released March 2017**




| **Design Information (Input)** | CDOT Type R Curb Opening | | MINOR | MAJOR | |
|---|---|---|---|---|---|
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | | Ponding Depth = | 5.1 | 7.8 | inches |
| **Grate Information** | | | MINOR | MAJOR | ☑ Override Depths |
| Length of a Unit Grate | | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | | $W_o$ = | N/A | N/A | feet |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | | $C_o$ (G) = | N/A | N/A | |
| **Curb Opening Information** | | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat (see USDCM Figure ST-5) | | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | | $C_o$ (C) = | 0.67 | 0.67 | |
| **Low Head Performance Reduction (Calculated)** | | | MINOR | MAJOR | |
| Depth for Grate Midwidth | | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | | $d_{Curb}$ = | 0.26 | 0.48 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | | $RF_{Combination}$ = | 0.65 | 1.00 | |
| Curb Opening Performance Reduction Factor for Long Inlets | | $RF_{Curb}$ = | 1.00 | 1.00 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | | $RF_{Grate}$ = | N/A | N/A | |
| | | | MINOR | MAJOR | |
| **Total Inlet Interception Capacity (assumes clogged condition)** | | **$Q_a$ =** | **3.7** | **9.0** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | | $Q_{PEAK\ REQUIRED}$ = | 1.2 | 5.9 | cfs |

**DRAINAGE MAP**

# HOMESTEAD AT STERLING RANCH FILING NO. 2

COUNTY OF EL PASO, STATE OF COLORADO

# PROPOSED DRAINAGE MAP

FEBRUARY 2019


LEGEND

- BASIN DESIGNATION (Z, 25, .25, .35, C5, C100, ACRES)
- PIPE RUN REFERENCE LABEL
- SURFACE DESIGN POINT
- BASIN BOUNDARY
- EXISTING CONTOUR
- PROP CONTOUR
- HOMESTEAD FILING NOS. 2&3 BOUNDARY
- PROPOSED STORM SEWER PIPE
- EXISTING STORM SEWER PIPE
- CROSSPAN
- INLET
- EXISTING FLOW DIRECTION ARROW
- PROPOSED FLOW DIRECTION ARROW
- FLARED END SECTION
- H.P. HIGH POINT
- L.P. LOW POINT

## STORM SEWER SUMMARY

| PIPE RUN | $Q_5$ | $Q_{100}$ | PIPE SIZE | CONTRIBUTING PIPES/DESIGN POINTS |
|---|---|---|---|---|
| 1 | 5.7 | 13.8 | 18" RCP | DP7 |
| 2 | 4.9 | 11.8 | 18" RCP | DP8 |
| 3 | 10.6 | 25.7 | 24" RCP | PR1, PR2 |
| 4 | 12.4 | 30.1 | 30" RCP | DP9, PR3 |
| 5 | 9.1 | 12.7 | 18" RCP | DP10 |
| 6 | 1.9 | 12.7 | 18" RCP | DP11 |
| 7 | 10.9 | 25.3 | 30" RCP | PR5, PR6 |
| 8 | 6.2 | 17.2 | 24" RCP | DP12 |
| 9 | 17.9 | 47.1 | 42" RCP | DP13, PR7, PR8 |
| 10 | 0.8 | 23.5 | 18" CMP | OUTLET STRUC. |
| 11 | 42.1 | 76.8 | 42" RCP | CONTINUED FROM MDDP DP15* |
| 4* | 21.8 | 42.1 | 36" RCP | SEE MDDP* |
| 6* | 16.8 | 29.4 | 30" RCP | SEE MDDP* |
| 10* | 12.5 | 30.4 | 30" RCP | SEE MDDP* |

## BASIN SUMMARY

| BASIN | AREA (ACRES) | $Q_5$ | $Q_{100}$ |
|---|---|---|---|
| ONSITE BASINS | | | |
| J | 0.43 | 0.4 | 1.3 |
| K | 0.61 | 0.5 | 1.9 |
| P | 4.42 | 5.7 | 13.8 |
| Q | 3.78 | 4.9 | 11.8 |
| R | 1.57 | 2.2 | 5.4 |
| T | 9.14 | 9.4 | 26.4 |
| U | 4.50 | 6.4 | 15.6 |
| V1 | 1.48 | 2.1 | 5.0 |
| V2 | 0.83 | 1.2 | 2.9 |
| W1 | 0.56 | 0.2 | 1.7 |
| W2 | 0.26 | 0.1 | 0.8 |
| X | 2.24 | 2.3 | 8.0 |
| Y | 1.97 | 2.0 | 7.1 |
| OFFSITE BASINS* | | | |
| B* | 5.39 | 8.0 | 19.3 |
| C* | 2.92 | 4.2 | 10.1 |
| D* | 2.90 | 4.3 | 10.4 |
| E* | 5.34 | 8.2 | 19.9 |
| F* | 1.12 | 4.3 | 7.7 |
| G* | 0.61 | 0.5 | 1.9 |
| H* | 0.19 | 0.9 | 1.6 |
| I* | 2.10 | 8.9 | 15.9 |
| L* | 1.54 | 5.6 | 10.0 |
| S* | 1.97 | 0.7 | 5.3 |

## FULL SPECTRUM DETENTION INTERIM POND 1

| | |
|---|---|
| WQ VOLUME | 0.247 AC-FT |
| EURV VOLUME | 0.701 AC-FT |
| 100 YR STORAGE VOLUME | 1.283 AC-FT |
| 100 YR WATER SURFACE EL | 7083.77 |
| SPILLWAY CREST EL | 7084.16 |
| TOP OF EMBANKMENT EL | 7086.00 |
| SPILLWAY DESIGN FLOW DEPTH | 0.84 FT |

## DESIGN POINT SUMMARY

| DESIGN POINT | $Q_5$ | $Q_{100}$ | BASIN | STRUCTURE |
|---|---|---|---|---|
| 2* | 8.0 | 19.3 | B* | (2) EX. 15' AT-GRADE INLETS |
| 3* | 4.2 | 10.1 | C* | EX. 6' SUMP INLET |
| 4* | 16.1 | 36.7 | D*, E*, F* | EX. 15' AT-GRADE INLET |
| 5* | 4.2 | 19.7 | G*, H*, FLOWBY DP4* | EX. 15' AT-GRADE INLET |
| 6* | 14.1 | 26.7 | I*, J*, K*, L* | EX. 15' AT-GRADE INLET |
| 7 | 5.7 | 13.8 | P | PROP. 10' SUMP INLET |
| 8 | 4.9 | 11.8 | Q | PROP. 10' SUMP INLET |
| 9 | 2.2 | 5.4 | R | PROP. 5' SUMP INLET |
| 10 | 9.4 | 15.6 | T | PROP. 15' AT-GRADE INLET |
| 11 | 1.9 | 15.6 | V1 | PROP. 15' AT-GRADE INLET |
| 12 | 6.2 | 17.2 | U, FLOWBY DP10 | PROP. 10' SUMP INLET |
| 13 | 1.2 | 5.9 | V2, FLOWBY DP11 | PROP. 5' SUMP INLET |
| 14 | 19.6 | 52.4 | W1, PR9 | CUMULATIVE DETENTION POND |

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

Refer to Homestead at Sterling Ranch Filing No. 2 Grading and Erosion Control Plan for additional interim channel stabilization improvements.

All elevations provided on map are referenced in NGVD29

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


HOMESTEAD AT STERLING RANCH FIL. NO. 2

PROPOSED DRAINAGE MAP

PROJECT NO. 09-007
DESIGNED BY: CMN
DRAWN BY: CMN
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=100' VERTICAL: N/A
DATE: 02/14/2019
SHEET 1 OF 1
PDM

File: O:\09007A\Sterling Ranch No 6\dwg\Eng Exhibits\Prop. Drain. Map Homestead Fil. No 2.dwg Plotstamp: 2/22/2019 8:22 AM