PRELIMINARY AND FINAL DRAINAGE PLAN SF 233

CREEKSIDE AT LORSON RANCH FILING NO. 2

JANUARY, 2023
REV JUNE 29.2023

Prepared for:

Lorson, LLC
212 N. Wahsatch Ave, Suite 301
Colorado Springs, Colorado 80903
(719) 635-3200

Prepared by:

Core Engineering Group, LLC
15004 1ST Avenue South
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(719) 570-1100

Project No. 100.069

CORE
ENGINEERING GROUP

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ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso 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.

Richard L. Schindler, P.E. #33997 Date
For and on Behalf of Core Engineering Group, LLC

OWNER'S STATEMENT

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

Lorson, LLC 6/29/23
Date

By
Jeff Mark

Title
Manager

Address
212 N. Wahsatch Avenue, Suite 301, Colorado Springs, CO 80903

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, this development is not located within a designated floodplain as shown on Flood Insurance Rate Map Panel No. and 08041C0957 G, dated December 7, 2018. (See Appendix A, FEMA FIRM Exhibit)

Richard L. Schindler, #33997 Date

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and Engineering Criteria Manual, As Amended.

Joshua Palmer, P.E. Date
County Engineer/ECM Administrator

Conditions: _____

1.0 LOCATION and DESCRIPTION

Creekside at Lorson Ranch Filing No. 2 is located east and southeasterly of the East Tributary of Jimmy Camp Creek. The site is located on approximately 6.009 acres of vacant land. This project will develop this site into single-family residential developments. The land for the residential lots is currently owned by Lorson LLC or its nominees for Lorson Ranch.

The site is located in the Northeast 1/2 of Section 23, Township 15 South and Range 65 West of the 6th Principal Meridian. The site is bounded on the on the north by Lorson Boulevard, on the east by Trappe Drive, on the south by Luneth Drive, and the East Tributary of Jimmy Camp Creek (East Tributary) on the west. For reference, a vicinity map is included in Appendix A of this report.

Conformance with applicable Drainage Basin Planning Studies

There is an existing (unapproved) DBPS for Jimmy Camp Creek prepared by Wilson & Company in 1987, and is referenced in this report. The only major drainage improvements for this study area according to the 1987 Wilson study was the reconstruction of the East Tributary of Jimmy Camp Creek (East Tributary). In 2014 and in 2018 the East Tributary was reconstructed from downstream of Lorson Boulevard north to the northern property line of Lorson Ranch in accordance with the 1987 study. The last section of the East Tributary (to the south property line of Lorson Ranch) has been designed by Kiowa Engineering and will be completed in 2020. There are no further improvements to be made on the East Tributary. On March 9, 2015, a new DBPS for Jimmy Camp Creek and the East Tributary was completed by Kiowa Engineering. The Kiowa Engineering DBPS for Jimmy Camp Creek has not been adopted by El Paso County but is allowed for concept design. The concept design includes the East Tributary armoring concept and the full spectrum detention pond requirements. The Kiowa DBPS did not calculate drainage fees so current El Paso County drainage/bridge fees apply to this development.

Conformance with Lorson East MDDP by Core Engineering Group

Core Engineering Group has an approved MDDP for Lorson East, which covers this study area. This PDR conforms to the MDDP for Lorson East and is referenced in this report. The major infrastructure required for this site is existing Detention/WQ Pond E2 and Pond D2 and the East Tributary of Jimmy Camp Creek which was discussed above. Existing Pond E2 and Pond D2 are full spectrum detention/WQ ponds (including outlet structures) completed as part of the Creekside South at Lorson Ranch Filing No. 1 and Lorson Ranch East Filing No. 1 and detain/treats runoff from this project site for detention and water quality. There are no improvements to be made to Pond E2 and Pond D2 for this project. There are also two bridges over the East Tributary that were built in 2018 to provide access to this development across the East Tributary. The bridges are located at Fontaine Boulevard and Lorson Boulevard.

Creekside at Lorson Ranch Filing No. 2 is located within the ***"Jimmy Camp Creek Drainage Basin"***, which is a fee basin in El Paso County.

2.0 DRAINAGE CRITERIA

The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014, and the UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3 for inlet sizing and full spectrum ponds. No deviations from these published criteria are requested for this site.

The Rational Method as outlined in Section 6.3.0 of the May 2014 "Drainage Criteria Manual" and in Section 3.2.8.F of the El Paso County "Engineering Criteria Manual" was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

Current updates to the Drainage Criteria manual for El Paso County states the if detention is necessary, Full Spectrum Detention will be included in the design, based on this criteria. Full Spectrum Detention including water quality is provided in existing Pond E2 and Pond D2.

3.0 EXISTING HYDROLOGICAL CONDITIONS

This site is currently rough graded and undeveloped, with vegetation (grass with no shrubs) and moderate to steep slopes in a westerly direction to the East Tributary of Jimmy Camp Creek.

The Soil Conservation Service (SCS) classifies the soils within the Creekside at Lorson Ranch Filing No. 2 property as Manzanola Clay Loam and Wiley silt loam (see Table 3.1 below). Weathered bedrock may be encountered beneath some of the site but it can be excavated using conventional techniques.

Table 3.1: SCS Soils Survey

Soil	Hydro. Group	Shrink/Swell Potential	Permeability	Surface Runoff Potential	Erosion Hazard
52-Manzanola Clay Loam (59%)	C	Moderate to High	Slow	Medium	Moderate
108-Wiley Silt Loam	B	Moderate	Moderate	Medium	Moderate

Excerpts from the SCS "Soil Survey of El Paso County Area, Colorado" are provided in ***Appendix A*** for further reference.

In preparing hydrologic calculations for this report, the soil of each basin was weighted and used in the preparation of thig report.

This site is located adjacent to the delineated 100-year floodplain of the East Tributary of Jimmy Camp Creek per the Federal Emergency Management Agency (FEMA) Flood Rate Insurance Map (FIRM) number 08041C10957 G, effective December 7, 2018.

Basin EX-E1
This existing basin directs runoff via overland, southerly and westerly, and drains into Existing Pond E2, then outlets to the East Tributary of Jimmy Camp Creek. The existing flow from this 3.90 acre basin is 0.8cfs and 5.4cfs for the 5-year and 100-year events.

Basin EX-E2
This existing basin directs runoff via overland, northerly and easterly to an existing inlet at the SW corner of Trappe Dr/Lorson Blvd. The existing runoff from this 1.04 acre basin is 0.4cfs and 2.3cfs for the 5-year and 100-year events.

Basin EX-E3
This existing basin directs runoff via overland, northerly and easterly to an existing inlet in the south side of Lorson Blvd. The existing runoff from this 0.1 acre basin is 0.1cfs and 0.3cfs for the 5-year and 100-year events.

Basin EX-E4
This existing basin directs runoff via overland westerly directly to the East Tributary of Jimmy Camp Creek. The existing runoff from this 0.65 acre basin is 0.4cfs and 2.2cfs for the 5-year and 100-year events.
Basin EX-E5

This existing basin directs runoff via overland, southerly and westerly to an existing inlet in the north side of Luneth Drive. The existing runoff from this 0.12 acre basin is 0.1cfs and 0.4cfs for the 5-year and 100-year events.

4.0 DEVELOPED HYDROLOGICAL CONDITIONS

Hydrology for **Creekside at Lorson Ranch Filing No. 2** drainage report was based on the City of Colorado Springs/El Paso County Drainage Criteria. Sub-basins that lie within this project were determined and the 5-year and 100-year peak discharges for the developed conditions have been presented in this report. Based on these flows, storm inlets will be added when the street capacity is exceeded.

Soil types B and C have been weighted for the developed hydrologic conditions. See the appendix for the SCS Soils Map and detailed calculations.

The time of concentration for each basin was developed using an overland, ditch, street and pipe flow components. The maximum overland flow length for developed conditions was limited to 100 feet. Travel time velocities ranged from 2 to 6 feet per second. The travel time calculations are included in the back of this report.

Runoff coefficients for the various land uses were obtained from Table 6-6 dated May 2014 from the updated City of Colorado Springs/El Paso County Drainage Criteria Manual. See the appendix.

Drainage concepts for each of the basins are briefly discussed as follow:

Basin D1.1
This basin consists of runoff from residential development and the cul-de-sac in Akela Lane. Runoff will be directed towards Akela Lane, then routed north via curb/gutter to Design Point 1 and will be collected by a 5' Type R sump inlet. Runoff from this inlet is routed east in an 18" storm sewer to Trappe Drive, then north to existing pond D2 in existing storm sewer constructed as part of Lorson Ranch East Filing No. 1. For more detailed information, see the design point discussions. The developed flow from this 0.57 acre basin is 1.1cfs and 2.6cfs for the 5-year and 100-year storm event. See the appendix for detailed calculations.

Basin D1.2
This basin consists of runoff from residential development and Trappe Drive. Runoff will be directed easterly as sheet flow to Trappe Drive, then routed north via existing curb/gutter in Trappe Drive to an existing 25' Type R sump inlet. Runoff from this inlet is routed north via the existing storm drain system to the aforementioned existing Pond D2 built as part of Lorson Ranch East Filing No. 1. The proposed developed flow from this 0.55 acre basin is 1.1cfs and 2.5cfs for the 5-year and 100-year storm event. See the appendix for detailed calculations. The final drainage report for Lorson Ranch East Filing No.4 allows 0.57acres generating 1.4cfs/3.0cfs for the 5-year and 100-year storm event to drain to the existing sump inlet in this basin. The proposed flow is less than previously designed flow.

Basin D1.3
This basin consists of runoff from residential development and Lorson Blvd.. Runoff will be directed north as sheet flow to Lorson Blvd, then routed via existing curb/gutter in Lorson Blvd. to an existing 5' Type R sump inlet. Runoff from this inlet is routed north via the existing storm drain system to the existing Pond D2 built as part of Lorson Ranch East Filing No. 1. The proposed developed flow from this 0.61 acre basin is 1.5cfs and 3.3cfs for the 5-year and 100-year storm event. See the appendix for detailed calculations. The final drainage report for Lorson Ranch East Filing No.4 allows 2.0cfs/3.6cfs for the 5-year and 100-year storm event to drain to the existing sump inlet in this basin. The proposed flow is less than previously designed flow.

Basin E1.1
This basin consists of runoff from residential development and the eastern portion of Akela Lane. Runoff will be directed southwesterly and northwesterly to Akela Lane, then routed southerly and northerly via curb/gutter in Akela Lane to Design Point 2 and will be collected by a 5' Type R sump inlet. Runoff from this inlet is routed via the proposed and existing storm drain system to existing pond E2, located west of Creekside at Lorson Ranch Filing No. 2. For more detailed information, see the design point discussions. The developed flow from this 2.33 acre basin is 4.1cfs and 9.1cfs for the 5-year and 100-year storm event. See the appendix for detailed calculations.

Basin E1.2
This basin consists of runoff from residential development and the western portion of Akela Lane. Runoff will be directed southeasterly to Akela Lane, then routed southerly and northerly via curb/gutter in Akela Lane to Design Point 3 and will be collected by a 5' Type R sump inlet. Runoff from this inlet is routed via the proposed and existing storm drain system to the aforementioned existing pond E2. For more detailed information, see the design point discussions. The developed flow from this 1.27 acre basin is 2.1cfs and 4.7cfs for the 5-year and 100-year storm event. See the appendix for detailed calculations.

Basin E1.3
This basin consists of runoff from residential development and open space. Runoff sheetflows in a northerly direction to the aforementioned existing pond E2. The developed flow from this 0.32 acre basin is 0.7cfs and 1.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin E1.4
This basin consists of runoff from residential development and Luneth Drive. Runoff is directed southerly to Luneth Drive, then routed via curb/gutter in Luneth Drive to twin existing 10' Type R sump inlets. Runoff from these inlets is routed north via the storm drain system to the aforementioned existing Pond E2. The developed flow from this 0.29 acre basin is 0.7cfs and 1.5cfs for the 5-year and 100-year storm event. See the appendix for detailed calculations. The allowable flow to the existing inlets per the Creekside South at Lorson Ranch Filing No. 1 final drainage report is 0.9cfs/2.0cfs for the 5-year and 100-year storm events. The proposed flow is less than previously designed flow.

Basin E1.5
This basin consists of runoff from open space that flows west directly to the East Tributary of Jimmy Camp Creek. The developed flow from this 0.72 acre basin is 0.4cfs and 2.2cfs for the 5/100-year storm event. See the appendix for detailed calculations.

See the Developed Conditions Hydrology Calculations in the back of this report and the Developed Conditions Drainage Map (Map Pocket) for the 5-year and 100-year storm event amounts. All developed areas within this project are directed to Existing Pond D2 or Existing Pond E2 and both existing ponds are full spectrum WQ/Detention ponds owned/maintained by Lorson Ranch Metro District. Un-developed open space tract (Basin E1.5) adjacent to the East Tributary of Jimmy Camp Creek is allowed to drain west directly to the creek.

5.0 HYDRAULIC SUMMARY

The sizing of the hydraulic structures and detentions ponds were prepared by using the *StormSewers* and *Hydrographs* computer software programs developed by Intellisolve, which conforms to the methods outlined in the "City of Colorado Springs/El Paso County Drainage Criteria Manual". Street capacities and Inlets were sized by Denver Urban Drainage's xcel spreadsheet UD-Inlet.

It is the intent of this drainage report to use the proposed curb/gutter and storm sewer in the streets to convey runoff to detention and water quality ponds then to the East Tributary of Jimmy Camp Creek. Inlet size and location are preliminary only as shown on the storm sewer layout in the appendix. See Appendix C for detailed hydraulic calculations and the storm sewer model.

Table 1: Street Capacities (100-year capacity is only ½ of street)

	Residential Local		Residential Collector		Principal Arterial	
Street Slope	5-year	100-year	5-year	100-year	5-year	100-year
0.5%	6.3	26.4	9.7	29.3	9.5	28.5
0.6%	6.9	28.9	10.6	32.1	10.4	31.2
0.7%	7.5	31.2	11.5	34.6	11.2	33.7
0.8%	8.0	33.4	12.3	37.0	12.0	36.0
0.9%	8.5	35.4	13.0	39.3	12.7	38.2
1.0%	9.0	37.3	13.7	41.4	13.4	40.2
1.4%	10.5	44.1	16.2	49.0	15.9	47.6
1.8%	12.0	45.4	18.4	50.4	18.0	50.4
2.2%	13.3	42.8	19.4	47.5	19.5	47.5
2.6%	14.4	40.7	18.5	45.1	18.5	45.1
3.0%	15.5	39.0	17.7	43.2	17.8	43.2
3.5%	16.7	37.2	16.9	41.3	17.0	41.3
4.0%	17.9	35.7	16.2	39.7	16.3	39.7
4.5%	19.0	34.5	15.7	38.3	15.7	38.3
5.0%	19.9	33.4	15.2	37.1	15.2	37.1

Note: all flows are in cfs (cubic feet per second)

Design Point 1

Design Point 1 is located at the north end of Akela Lane and accepts flows from (Basin D1.1).

(5-year storm)

Tributary Basins: D1.1 **Inlet/MH Number:** Inlet DP1

Upstream flowby: **Total Street Flow:** 1.1cfs

Flow Intercepted: 1.1cfs **Flow Bypassed:** 0

Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 6.9cfs, okay

(100-year storm)

Tributary Basins: D1.1 **Inlet/MH Number:** Inlet DP1

Upstream flowby: **Total Street Flow:** 2.6cfs

Flow Intercepted: 2.6cfs **Flow Bypassed:**

Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 28.9cfs (half street) is okay

Overflow path on this sump inlet is north directly to Lorson Boulevard.

Design Point 1a

Design Point 1a is located at the SW corner of Lorson Boulevard and Trappe Drive and is located at an existing 18" RCP storm sewer constructed as part of Lorson Ranch East Filing No. 4. The total proposed flow in the pipe is from Design Point 1 and is 1.1cfs/2.6cfs in the 5/100-year storm events. The existing storm sewer was previously designed for 2.1cfs/4.6cfs in the 5/100-year storm events in the storm sewer per Lorson Ranch East Filing No. 4 fdr (Basin D.2.10a). The proposed flows are less than the previously designed flows resulting in lower HGL's. The storm sewer flows north in existing storm sewer to Pond D2 where the runoff is detained/treated for WQ. See Lorson Ranch East Filing No. 4 drainage report.

Design Point 2

Design Point 2 is located at the east side of Akela Lane at a low point and accepts flows from Akela Lane (Basin E1.1).

(5-year storm)

Tributary Basins: E1.1 **Inlet/MH Number:** Inlet DP2
Upstream flowby: **Total Street Flow:** 4.1cfs

Flow Intercepted: 4.1cfs **Flow Bypassed:** 0
Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 6.9cfs, okay

(100-year storm)

Tributary Basins: E1.1 **Inlet/MH Number:** Inlet DP2
Upstream flowby: **Total Street Flow:** 9.1cfs

Flow Intercepted: 9.1cfs **Flow Bypassed:**
Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 28.9cfs (half street) is okay

The overflow path on this sump inlet is west directly to Existing Pond E2

Design Point 3

Design Point 3 is located at the west side of Akela Lane at a low point and accepts flows from Akela Lane (Basin E1.2).

(5-year storm)

Tributary Basins: E1.2 **Inlet/MH Number:** Inlet DP3
Upstream flowby: **Total Street Flow:** 2.1cfs

Flow Intercepted: 2.1cfs **Flow Bypassed:** 0
Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 6.9cfs, okay

(100-year storm)

Tributary Basins: E1.2 **Inlet/MH Number:** Inlet DP3
Upstream flowby: **Total Street Flow:** 4.7cfs

Flow Intercepted: 4.7cfs **Flow Bypassed:**
Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 28.9cfs (half street) is okay

The overflow path on this sump inlet is west directly to Existing Pond E2

Design Point 4

Design Point 4 is the storm sewer pipe flow in Akela Lane from Design Pt's 2 and 3. The total pipe flow is 6.2cfs/13.8cfs in the 5/100-year storm events in the 24" storm sewer. The proposed storm sewer flows south and connects to an existing manhole constructed as part of Lorson Ranch East Filing No. 4. The existing type 1 storm manhole was constructed in LRE4 to accommodate a pipe size increase from 48" to 54" RCP and to accommodate flows from the future Akela Lane. The existing manhole was also constructed with a bulkheaded opening for a future 24" storm sewer (to the north) which will be connected to for this project. Included in this report is a hydraulic model of the storm sewer system including the existing 54" storm sewer draining to Pond E2. Per the hydraulic model, the HGL's meet criteria for the 5/100 year storm sewer events and not headwaters extend into the proposed 24" storm sewer.

Overflow Swale from Trappe Drive to Des. Pt. 4

There are two existing sump inlets on Trappe Drive located east of Des. Pt. 4 that need an overflow path between lots 8 and 9 to reach Pond E2. The design flow can be taken from the Lorson Ranch East Filing No. 4 final drainage report and is the total flow in the existing 48" storm sewer pipe. The total design flow is 211.5cfs in the 100-yr storm event. A trapezoid swale (lined with TRM) with a 16' bottom, 3:1 side slopes and a 1.5' depth will convey the overflow between the lots directly to Pond E2. Hydraulic calculations for the swale can be found in the appendix. The TRM for the swale shall be American Green C350 or equal.

6.0 DETENTION AND WATER QUALITY PONDS

Detention and Storm Water Quality for Creekside at Lorson Ranch Filing No. 2 is required per El Paso County criteria. There are two existing permanent full spectrum ponds including water quality that were designed/constructed to accommodate developed runoff from this development to be in compliance with the Lorson Ranch East MDDP. The ponds have been constructed and include access roads, outlet pipes, overflow structures, and low flow channels. Existing Pond D2 treats/detains runoff for the

"D" basins (Lorson Ranch East Filing No. 1) and Existing Pond E2 treats/detains runoff for the "E" basins (Creekside South Filing No. 1). The pond spreadsheets from the full spectrum design MHFD spreadsheets are included in the appendix of this report. Both existing ponds function as designed.

Water Quality

All developed areas within this project are directed to Existing Pond D2 or Existing Pond E2 and both existing ponds are full spectrum WQ/Detention ponds owned/maintained by Lorson Ranch Metro District. Runoff from Basin E1.5 (Tract A) which is an open space tract adjacent to the East Tributary of Jimmy Camp Creek is allowed to drain west directly to the creek per ECM Appendix I.7.1.B.7 which allows runoff from undeveloped land to flow offsite without WQ.

7.0 DRAINAGE AND BRIDGE FEES

Creekside at Lorson Ranch Filing No. 2 is located within the Jimmy Camp Creek drainage basin which is currently a fee basin in El Paso County. Current El Paso County regulations require drainage and bridge fees to be paid for platting of land as part of the plat recordation process.

Table 7.1: Public Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
Inlets/Manholes	4	EA	$3000/EA	$12,000
18" Storm	160	LF	$35	$5,600
24" Storm	96	LF	$40	$3,840
			Subtotal	$21,440
			Eng/Cont (10%)	$2,144
			Total Est. Cost	$23,584

Creekside at Lorson Ranch Filing No. 2 contains 6.009acres and is in the JCC drainage basin. The 2023 drainage fees are $23,078 and thebridge fees are $1,079 per impervious acre per Resolution 21-468 . The drainage and bridge fees are calculated when the final plat is submitted and are due at plat recordation. Lorson Ranch intends to use the Bridge Fee credits for the bridge fees and pay drainage fees unless the Jimmy Camp Creek DBPS drainage fee structure is updated by El Paso County. The following table details the drainage fees for this filing:

Table 7.2: 2023 Drainage/Bridge Fees

Type of Land Use	Total Area (ac)	Imperviousness	Drainage Fee	Bridge Fee
JCC Residential Area	4.665	62%	$66,748	$3,120
Open Space, Landscape Tracts	1.344	2%	$620	$29
		Total	$67,368	$3,149

8.0 FOUR STEP PROCESS

The site has been developed to minimize wherever possible the rate of developed runoff that will leave the site and to provide water quality management for the runoff produced by the site as proposed on the development plan. The following four step process should be considered and incorporated into the storm water collection system and storage facilities where applicable.

Step 1: Employ Runoff Reduction Practices
Creekside at Lorson Ranch Filing No. 2 has employed several methods of reducing runoff.

- The street configuration was laid out to minimize the length of streets. Many streets are straight and perpendicular resulting in lots with less wasted space.
- There are open space buffers next to the East Tributary of Jimmy Camp Creek
- Utilize two existing full spectrum detention ponds for detention/water quality. The full spectrum detention mimics existing storm discharges and includes water quality.

Step 2: Stabilize Drainageways
East Tributary of Jimmy Camp Creek is a major drainageway located west of this site. In 2014 and in 2018 the East Tributary of JCC was reconstructed and stabilized per county criteria. The design included a natural sand bottom and armored sides.

Step 3: Provide Water Quality Capture Volume
Treatment of the water quality capture volume (WQCV) is required for all new developments. Creekside at Lorson Ranch Filing No. 2 will utilize the two existing full spectrum stormwater extended detention basins which include Water Quality Volumes and WQ outlet structures.

Step 4: Consider Need for Industrial and Commercial BMP's
There are no commercial or industrial areas within this site.

9.0 CONCLUSIONS

This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development discussed above are summarized as follows:

- Developed runoff will be conveyed via curb/gutter and storm sewer facilities
- The East Tributary of Jimmy Camp Creek has been reconstructed west of this study area
- Bridges over the East Tributary at Lorson Boulevard and Fontaine Boulevard and have been constructed providing access to this site.
- Detention and water quality for this site area is provided in two existing full spectrum permanent ponds
- The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties/facilities located downstream.

10.0 REFERENCES

1. City of Colorado Springs/El Paso County Drainage Criteria Manual DCM, dated November, 1991
2. Soil Survey of El Paso County Area, Colorado by USDA, SCS
3. Jimmy Camp Creek Drainage Basin Planning Study, Dated March 9, 2015, by Kiowa Engineering Corporation
4. City of Colorado Springs “Drainage Criteria Manual, Volume 2
5. El Paso County “Engineering Criteria Manual”
6. Lorson Ranch East MDDP, June 30, 2017 by Core Engineering.
7. El Paso County Resolution #15-042, El Paso County adoption of Chapter 6 and Section 3.2.1 of the City of Colorado Springs Drainage Criteria Manual dated May, 2014.
8. Lorson Ranch East MDDP prepared by Core Engineering Group, dated November 27, 2017
9. Final Drainage Report for Lorson Ranch East Filing No. 1 prepared by Core Engineering Group, Reference SF18-008, approved July 24, 2018
10. Final Drainage Report for Lorson Ranch East Filing No. 4 prepared by Core Engineering Group, Reference SF19-008, approved September 12, 2019
11. Final Drainage Report for Creekside South at Lorson Ranch Filing No. 1 prepared by Core Engineering Group, Reference SF 20-017, approved September 20, 2020

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP

VICINITY MAP
NO SCALE

CORE
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CREEKSIDE SOUTH AT LORSON RANCH FIL. NO. 2
VICINITY MAP

SCALE:	DATE:	FIGURE NO.
NTS	MAY, 2022	--

JOINS PANEL 0769

104° 37' 30.00"

38° 45' 0.00"

$^{42}89^{000m}$N

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 65 WEST.

City of Colorado Springs
080060

5733.0 I

5731.2

5730.9

5728.6

ZONE AE

5736.7

H 5726.2

14

13

REVISED AREA

5719.6

5724.3

5718.8

5718.8

REVISED AREA

ZONE AE

5718.8

5718.8

5718.8

5718.2

$^{42}88^{000m}$N

G 5711.8

Bridge

FONTAINE BLVD

5710.4

Jimmy Camp Creek - East Tributary

5709.2

5709.7

El Paso County Unincorporated Areas
080059

ZONE AE

5709.5

5709.3 F

Bridge

5709.2

5697.2

5698.8

5701.6 E

5704.7

5705.2

LORSON BLVD

ZONE AE

ZONE AE

SITE

5705.0

ZONE AE

5696

5699.8

City of Fountain
080061

APPLE TREE PL

CITY OF FOUNTAIN

EL PASO COUNTY

ROLLING RIDGE RD

23

HERITAGE RD

JOINS PANEL 0976

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*

SCALE

N

Map Projection:
Universal Transverse MercatorNAD 1983 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 62.5 125 250 Meters

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
and Incorporated Areas

PANEL 957 OF 1300

FEMA

Panel Contains:

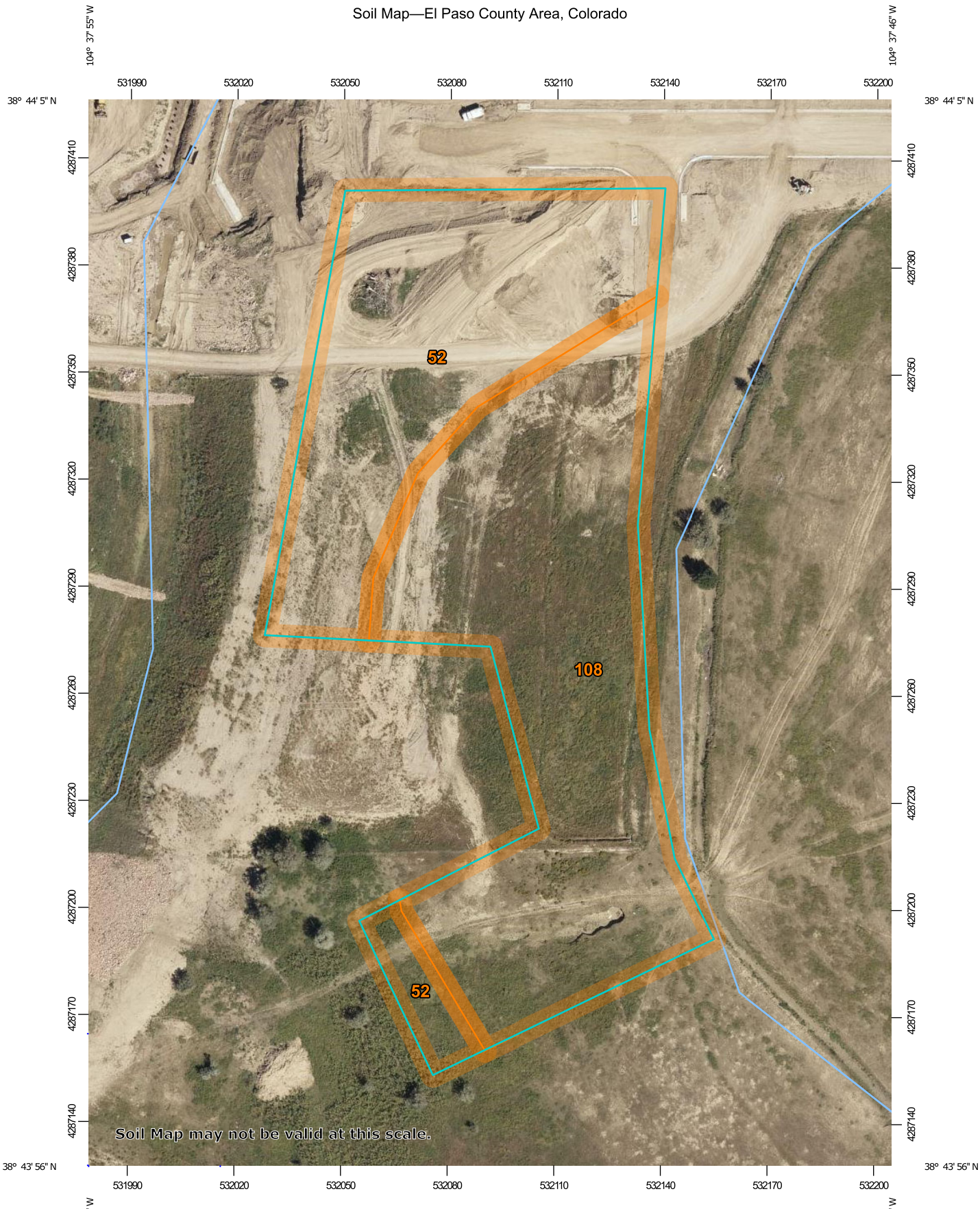
COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0957	G
EL PASO COUNTY	080059	0957	G
FOUNTAIN, CITY OF	080061	0957	G

REVISED TO REFLECT LOMR EFFECTIVE: May 4, 2020

VERSION NUMBER
1.1.1.0

MAP NUMBER
08041C0957G

MAP REVISED
DECEMBER 7, 2018



Map Scale: 1:1,460 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 14, 2018—Sep 23, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52	Manzanst clay loam, 0 to 3 percent slopes	1.9	42.2%
108	Wiley silt loam, 3 to 9 percent slopes	2.6	57.8%
Totals for Area of Interest		**4.6**	**100.0%**

El Paso County Area, Colorado

52—Manzanst clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w4nr
Elevation: 4,060 to 6,660 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Manzanst and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manzanst

Setting

Landform: Terraces, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Clayey alluvium derived from shale

Typical profile

A - 0 to 3 inches: clay loam
Bt - 3 to 12 inches: clay
Btk - 12 to 37 inches: clay
Bk1 - 37 to 52 inches: clay
Bk2 - 52 to 79 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Slightly saline (4.0 to 7.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c

Hydrologic Soil Group: C
Ecological site: R067BY037CO - Saline Overflow
Hydric soil rating: No

Minor Components

Ritoazul
Percent of map unit: 7 percent
Landform: Drainageways, interfluves
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Arvada
Percent of map unit: 6 percent
Landform: Drainageways, interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY033CO - Salt Flat
Hydric soil rating: No

Wiley
Percent of map unit: 2 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

El Paso County Area, Colorado

108—Wiley silt loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 367b
Elevation: 5,200 to 6,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Wiley and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wiley

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous silty eolian deposits

Typical profile

A - 0 to 4 inches: silt loam
Bt - 4 to 16 inches: silt loam
Bk - 16 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R067BY002CO - Loamy Plains

Other vegetative classification: LOAMY PLAINS (069AY006CO)
Hydric soil rating: No

Minor Components

Other soils
Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

APPENDIX B – HYDROLOGY CALCULATIONS

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Feb. 3, 2022
Checked By: Leonard Beasley

Job No: 100.069
Project: Creekside South at Lorson Ranch Filing No. 2
Design Storm: **5 - Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
EX-E1			3.90	0.09	35.1	0.35	2.24	0.8													
EX-E2			1.04	0.13	23.2	0.14	2.86	0.4													
EX-E3			0.10	0.13	8.0	0.01	4.46	0.1													
EX-E4			0.65	0.13	9.0	0.08	4.29	0.4													
EX-E5			0.12	0.13	9.0	0.02	4.29	0.1													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Aug, 2022
Checked By: Leonard Beasley

Job No: 100.069
Project: Creekside South at Lorson Ranch Filing No. 2
Design Storm: **100-Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
EX-E1			3.90	0.37	35.1	1.44	3.77	5.4													
EX-E2			1.04	0.46	23.2	0.48	4.81	2.3													
EX-E3			0.10	0.46	8.0	0.05	7.49	0.3													
EX-E4			0.65	0.46	9.0	0.30	7.20	2.2													
EX-E5			0.12	0.46	9.0	0.06	7.20	0.4													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Aug, 2022
Checked By: Leonard Beasley

Job No: 100.069
Project: Creekside South at Lorson Ranch Filing No. 2
Design Storm: **5 - Year Event (Proposed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
D1.1			0.57	0.48	9.7	0.27	4.18	1.1													
D1.2			0.55	0.45	7.4	0.25	4.58	1.1													
D1.3			0.61	0.49	6.0	0.30	4.90	1.5													
E1.1			2.33	0.45	11.3	1.05	3.95	4.1													
E1.2			1.27	0.45	13.2	0.57	3.71	2.1													
E1.3			0.32	0.48	7.8	0.15	4.51	0.7													
E1.4			0.29	0.48	5.9	0.14	4.93	0.7													
E1.5			0.72	0.13	10.4	0.09	4.07	0.4													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Aug, 2022
Checked By: Leonard Beasley

Job No: 100.069
Project: Creekside South at Lorson Ranch Filing No. 2
Design Storm: **100 - Year Event (Proposed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
D1.1			0.57	0.64	9.7	0.36	7.02	2.6													
D1.2			0.55	0.59	7.4	0.32	7.69	2.5													
D1.3			0.61	0.65	6.0	0.40	8.22	3.3													
E1.1			2.33	0.59	11.3	1.37	6.63	9.1													
E1.2			1.27	0.59	13.2	0.75	6.23	4.7													
E1.3			0.32	0.64	7.8	0.20	7.57	1.6													
E1.4			0.29	0.64	5.9	0.19	8.27	1.5													
E1.5			0.72	0.44	10.4	0.32	6.83	2.2													

CORE ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Creekside South at Lorson Ranch Filing No. 2*
PROJECT NUMBER: *100.069*
ENGINEER: *LAB*
DATE: *August, 2022*

Preliminary Drainage Plan
CURRENT CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	Impervious	Type of Cover
EX-E1	108	B	3.72	95.38%	0.09	0.09	0.36	0.34	100%	Undeveloped
	52	C	0.18	4.62%	0.16	0.01	0.51	0.02	80%	Undeveloped
			3.90	100.00%		0.09		0.37		
EX-E2	108	B	0.38	36.54%	0.09	0.03	0.36	0.13	10%	Undeveloped
	52	C	0.66	63.46%	0.16	0.10	0.51	0.32	10%	Undeveloped
			1.04	100.00%		0.13		0.46		
EX-E3	108	B	0.04	36.36%	0.09	0.03	0.36	0.13	10%	Undeveloped
	52	C	0.06	63.64%	0.16	0.10	0.51	0.32	10%	Undeveloped
			0.10	100.00%		0.13		0.46		
EX-E4	108	B	0.23	36.12%	0.09	0.03	0.36	0.13	10%	Undeveloped
	52	C	0.41	63.88%	0.16	0.10	0.51	0.33	10%	Undeveloped
			0.65	100.00%		0.13		0.46		
EX-E5	108	B	0.04	36.44%	0.09	0.03	0.36	0.13	10%	Undeveloped
	52	C	0.08	63.56%	0.16	0.10	0.51	0.32	10%	Undeveloped
			0.12	100.00%		0.13		0.46		

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Current

Calculated By: Leonard Beasley
Date: Feb. 3, 2022
Checked By: Leonard Beasley

Job No: 100.069
Project: Creekside South at Lorson Ranch Filing No. 2

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
EX-E1	0.09	3.72	10.0	140.00	0.71%	0.10	24.16	506.00	0.59%	0.77	10.98	35.14	35.14
EX-E2	0.13	1.04	10.0	114.00	0.88%	0.10	19.50	232.00	1.08%	1.04	3.72	23.23	23.23
EX-E3	0.13	0.10	10.0	20.00	1.00%	0.04	7.83	5.00	1.00%	1.00	0.08	7.92	7.92
EX-E4	0.13	0.65	10.0	30.00	1.00%	0.05	9.59	5.00	1.00%	1.00	0.08	9.68	9.68
EX-E5	0.13	0.12	10.0	40.00	2.00%	0.08	8.81	5.00	2.00%	1.41	0.06	8.87	8.87

2 10 10 15 15 15 15 15 15 28

CORE ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Creekside South at Lorson Ranch 2*
PROJECT NUMBER: *100.069*
ENGINEER: *LAB*
DATE: Aug, 2022

Preliminary Drainage Plan
PROPOSED CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	Impervious	Type of Cover
D1.1	108	B	0.09	15.79%	0.45	0.07	0.59	0.09	65%	1/8 ac. Single Family
	52	C	0.48	84.21%	0.49	0.41	0.65	0.55	65%	1/8 ac. Single Family
			0.57	100.00%		0.48		0.64		
D1.2	108	B	0.53	96.36%	0.45	0.43	0.59	0.57	65%	1/8 ac. Single Family
	52	C	0.02	3.64%	0.49	0.02	0.65	0.02	65%	1/8 ac. Single Family
			0.55	100.00%		0.45		0.59		
D1.3	108	B	0.00	0.00%	0.45	0.00	0.59	0.00	65%	1/8 ac. Single Family
	52	C	0.61	100.00%	0.49	0.49	0.65	0.65	65%	1/8 ac. Single Family
			0.61	100.00%		0.49		0.65		
E1.1	108	B	2.32	99.57%	0.45	0.45	0.59	0.59	65%	1/8 ac. Single Family
	52	C	0.01	0.43%	0.49	0.00	0.65	0.00	65%	1/8 ac. Single Family
			2.33	100.00%		0.45		0.59		
E1.2	108	B	1.19	93.70%	0.45	0.42	0.59	0.55	65%	1/8 ac. Single Family
	52	C	0.08	6.30%	0.49	0.03	0.65	0.04	65%	1/8 ac. Single Family
			1.27	100.00%		0.45		0.59		
E1.3	108	B	0.06	18.75%	0.45	0.08	0.59	0.11	65%	1/8 ac. Single Family
	52	C	0.26	81.25%	0.49	0.40	0.65	0.53	65%	1/8 ac. Single Family
			0.32	100.00%		0.48		0.64		
E1.4	108	B	0.04	13.79%	0.45	0.06	0.59	0.08	65%	1/8 ac. Single Family
	52	C	0.25	86.21%	0.49	0.42	0.65	0.56	65%	1/8 ac. Single Family
			0.29	100.00%		0.48		0.64		
E1.5	108	B	0.30	41.67%	0.10	0.04	0.35	0.15	10%	OPEN SPACE
	52	C	0.42	58.33%	0.15	0.09	0.50	0.29	10%	OPEN SPACE
			0.72	100.00%		0.13		0.44		

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: Nov. 23, 2021
Checked By: Leonard Beasley

Job No: 100.069
Project: Creeksid South at Lorson Ranch 2

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
D1.1	0.48	0.57	20.0	94.00	2.24%	0.19	8.35	156.00	1.00%	2.00	1.30	9.65	250.00	11.39	9.65
D1.2	0.45	0.55	20.0	37.00	2.00%	0.11	5.70	258.00	1.60%	2.53	1.70	7.40	295.00	11.64	7.40
D1.3	0.61	0.55	20.0	50.00	2.00%	0.17	5.00	100.00	0.70%	1.67	1.00	5.99	150.00	10.83	5.99
E1.1	0.45	2.33	20.0	74.00	2.17%	0.16	7.85	413.00	1.00%	2.00	3.44	11.29	487.00	12.71	11.29
E1.2	0.45	1.27	20.0	97.00	2.00%	0.18	9.23	484.00	1.00%	2.00	4.03	13.26	581.00	13.23	13.23
E1.3	0.48	0.32	20.0	92.00	2.72%	0.20	7.75	0.00	0.00%	0.00	0.00	7.75	92.00	10.51	7.75
E1.4	0.49	0.29	20.0	39.00	2.56%	0.13	5.06	183.00	3.55%	3.77	0.81	5.87	222.00	11.23	5.87
E1.5	0.13	0.72	20.0	70.00	2.00%	0.10	11.70	5.00	25.00%	10.00	0.01	11.71	75.00	10.42	11.71

APPENDIX C – HYDRAULIC CALCULATIONS

Channel Report

Hydraflow Express by Intelisolve | Wednesday, Apr 27 2022, 12:5 PM

Overflow Swale

Trapezoidal

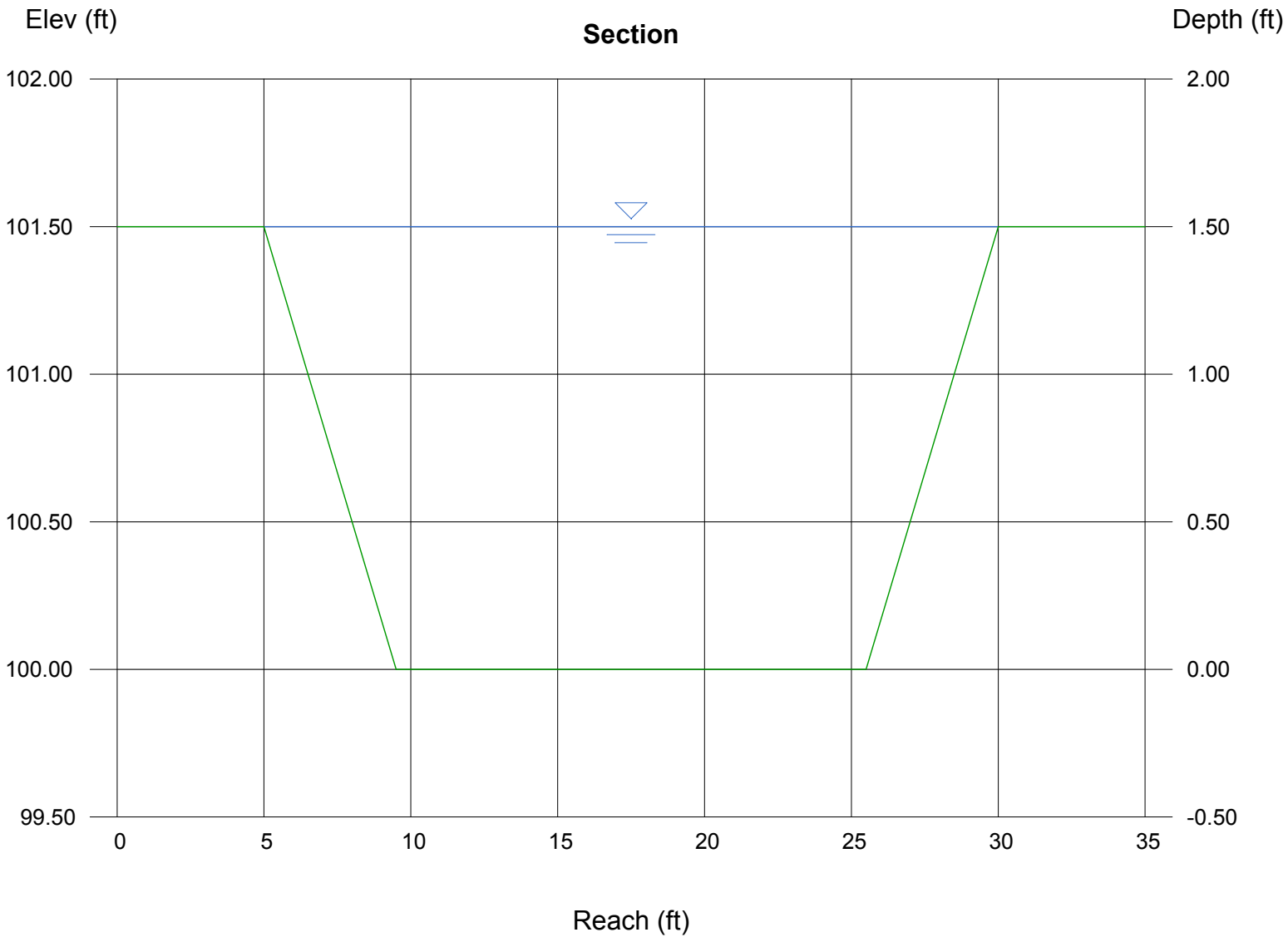
Botom Width (ft)	= 16.00
Side Slope (z:1)	= 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 1.50
Q (cfs)	= 215.42
Area (sqft)	= 30.75
Velocity (ft/s)	= 7.01
Wetted Perim (ft)	= 25.49
Crit Depth, Yc (ft)	= 1.43
Top Width (ft)	= 25.00
EGL (ft)	= 2.26



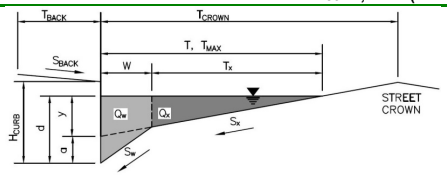
Version 4.05 Released March 2017

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

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

Project: Creekside South at Lorson Ranch Filing No. 2, #100.069

Inlet ID: Inlet I-1, DP-1 (D1.1)



Gutter Geometry (Enter data in the blue cells)

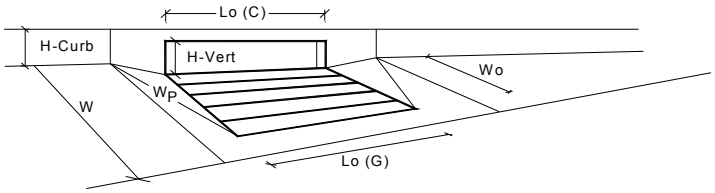
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	47.0	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} =	0.017	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.5	24.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.9	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)		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 =	3.4	4.5	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} =	0.12	0.21	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.44	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.98	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 =**	**1.1**	**2.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.1	2.6	cfs

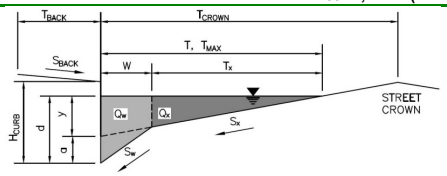
Version 4.05 Released March 2017

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

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

Project: Creekside South at Lorson Ranch Filing No. 2, #100.069

Inlet ID: Inlet I-2, DP-2 (E1.1)



Gutter Geometry (Enter data in the blue cells)

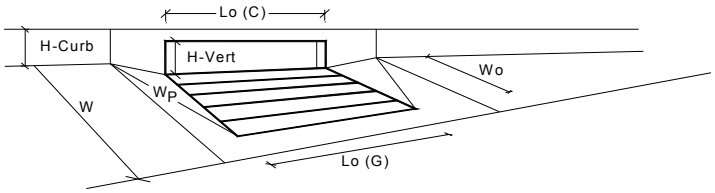
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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} =	0.017	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.5	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.9	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			
Type of Inlet	Type =	MINOR: CDOT Type R Curb Opening	MAJOR: 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 =	5.4	7.9	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} =	0.28	0.49	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.69	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 =**	**4.1**	**9.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.1	9.1	cfs

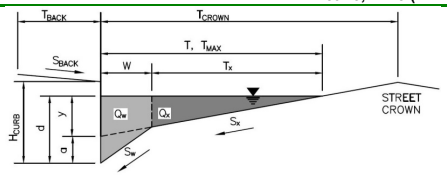
Version 4.05 Released March 2017

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

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

Project: Creekside South at Lorson Ranch Filing No. 2, #100.069

Inlet ID: Inlet I-3, DP-3 (E1.2)



Gutter Geometry (Enter data in the blue cells)

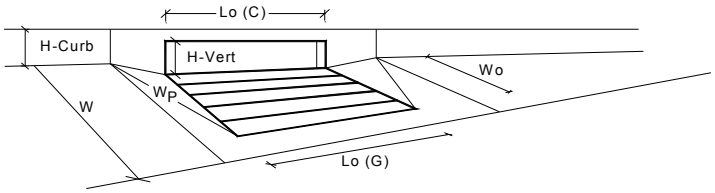
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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} =	0.017	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.5	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.9	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**

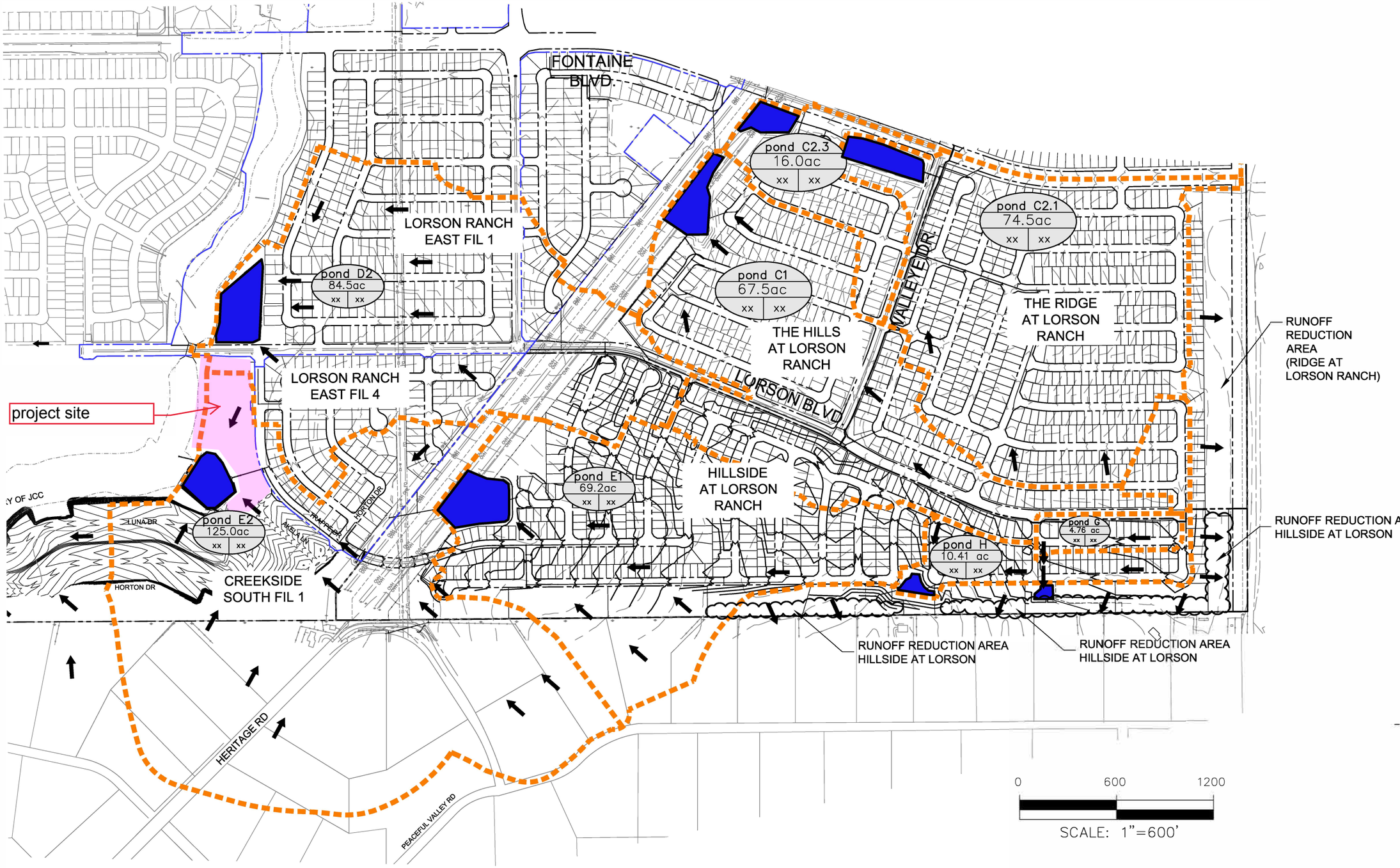
INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening			
Type of Inlet	Type =	MINOR: CDOT Type R Curb Opening	MAJOR: 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 =	4.2	5.7	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} =	0.18	0.31	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	0.73	
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 =**	**2.1**	**4.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.1	4.7	cfs

APPENDIX D – POND AND ROUTING CALCULATIONS



CORE ENGINEERING GROUP

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CREEKSIDE SOUTH AT LORSON RANCH FIL 2
WATER QUALITY & POND TRIBUTARY AREAS

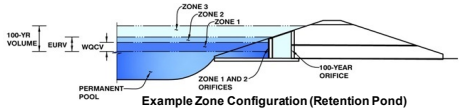
SCALE:	DATE:	FIGURE NO.
NTS	APRIL, 2022	1

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Creekside South Filing No. 2

Basin ID: Pond D2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	84.50	acres
Watershed Length =	2,200	ft
Watershed Length to Centroid =	1,100	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	55.00%	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
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.552	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	5.006	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.691	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.579	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.219	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.357	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	12.122	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	14.334	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	18.867	acre-feet		inches
Approximate 2-yr Detention Volume =	3.815	acre-feet		
Approximate 5-yr Detention Volume =	5.188	acre-feet		
Approximate 10-yr Detention Volume =	6.771	acre-feet		
Approximate 25-yr Detention Volume =	7.361	acre-feet		
Approximate 50-yr Detention Volume =	7.683	acre-feet		
Approximate 100-yr Detention Volume =	8.478	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.552	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.454	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	4.248	acre-feet
Total Detention Basin Volume =	9.254	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

micro pool: 5695

Depth Increment = 0.20 ft

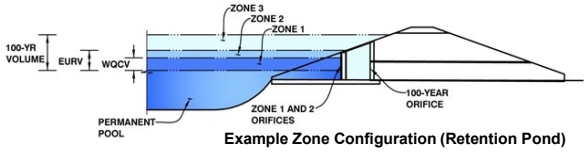
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	20	0.000		
5695.33	--	0.33	--	--	--	100	0.002	20	0.000
5696	--	1.00	--	--	--	1,074	0.025	413	0.009
5697	--	2.00	--	--	--	48,988	1.125	25,443	0.584
5698	--	3.00	--	--	--	72,821	1.672	86,348	1.982
5699	--	4.00	--	--	--	76,610	1.759	161,063	3.698
5700	--	5.00	--	--	--	80,493	1.848	239,615	5.501
5701	--	6.00	--	--	--	84,486	1.940	322,104	7.394
5702	--	7.00	--	--	--	88,582	2.034	408,638	9.381
5703	--	8.00	--	--	--	92,768	2.130	499,313	11.463
5704	--	9.00	--	--	--	97,047	2.228	594,221	13.641
5705	--	10.00	--	--	--	102,033	2.342	693,761	15.927

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Creekside South Filing No. 2**

Basin ID: **Pond D2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.74	1.552	Orifice Plate
Zone 2 (EURV)	4.74	3.454	Rectangular Orifice
3 (100+1/2WQCV)	6.94	4.248	Weir&Pipe (Restrict)
Total (all zones)		9.254	

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 Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	3.125E-02	ft^2
Depth at top of Zone using Orifice Plate =	2.74	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	9.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	4.50	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	0.80	1.60	2.40				
Orifice Area (sq. inches)	4.50	4.50	4.50	4.50				

	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			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.80	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.14	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	4.88	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.42	N/A	feet
Vertical Orifice Height =	10.00	N/A	inches				
Vertical Orifice Width =	2.00		inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.00	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	20.02	N/A	feet
Overflow Weir Grate Slope =	20.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.81	N/A	
Horiz. Length of Weir Sides =	20.00	N/A	feet	Overflow Grate Open Area w/o Debris =	63.36	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	31.68	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	10.91	N/A	ft^2
Outlet Pipe Diameter =	54.00	N/A	inches	Outlet Orifice Centroid =	1.64	N/A	feet
Restrictor Plate Height Above Pipe Invert =	35.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.87	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.02	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.87	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	11.89	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.34	acres
Freeboard above Max Water Surface =	3.00	feet	Basin Volume at Top of Freeboard =	15.93	acre-ft

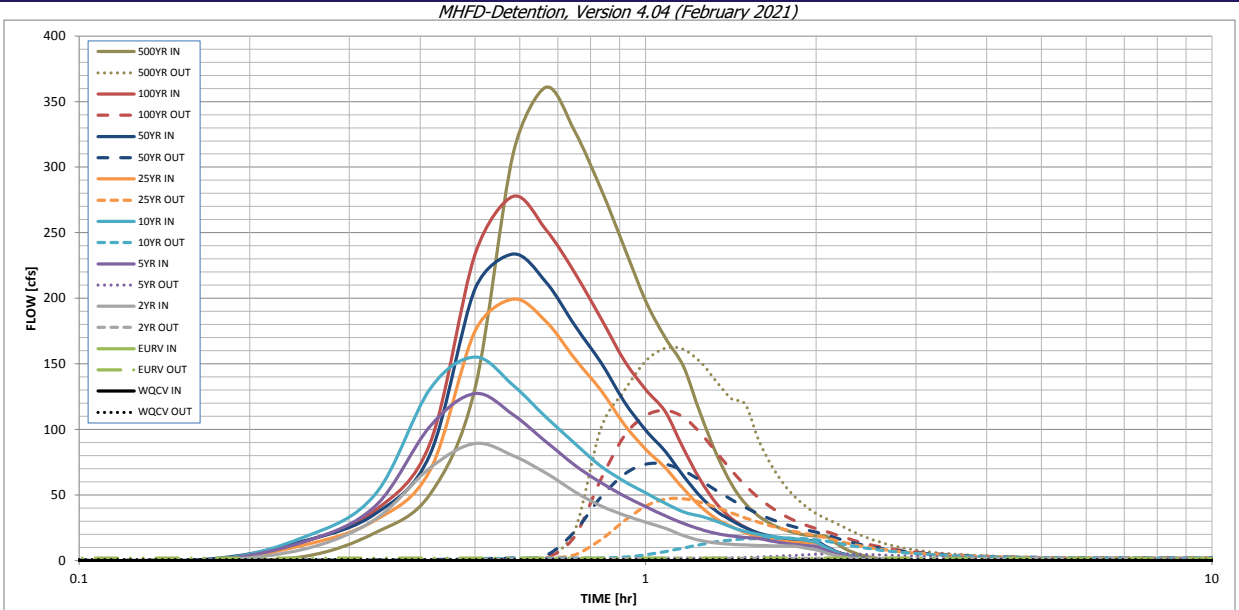
Calculated Parameters for Spillway

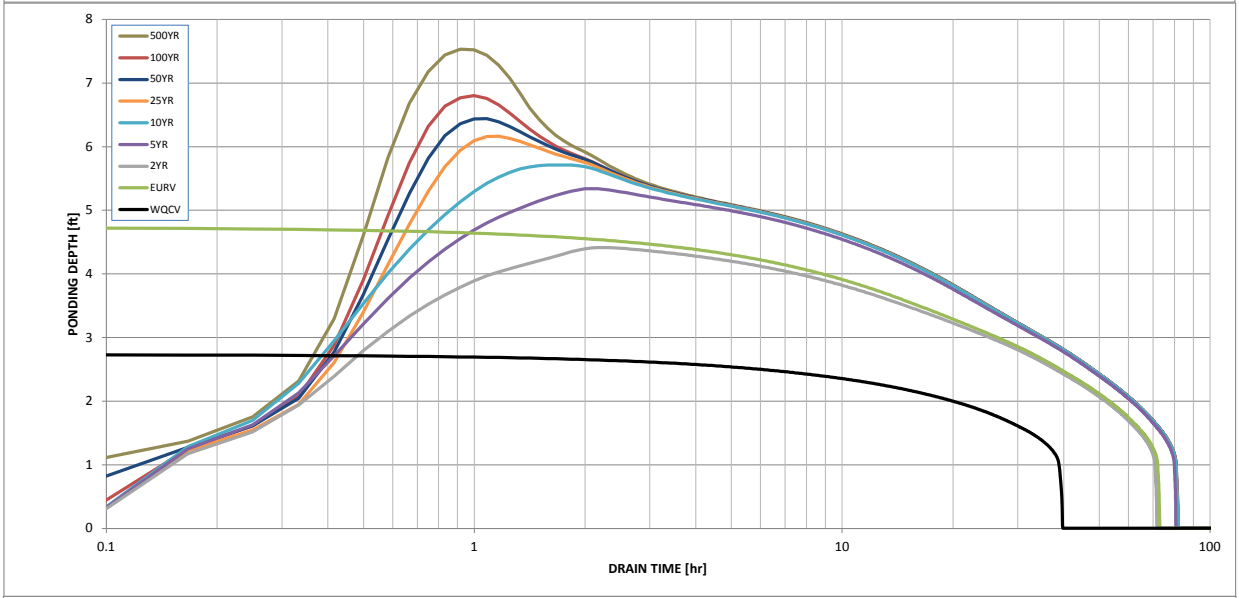
Routed Hydrograph Results *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

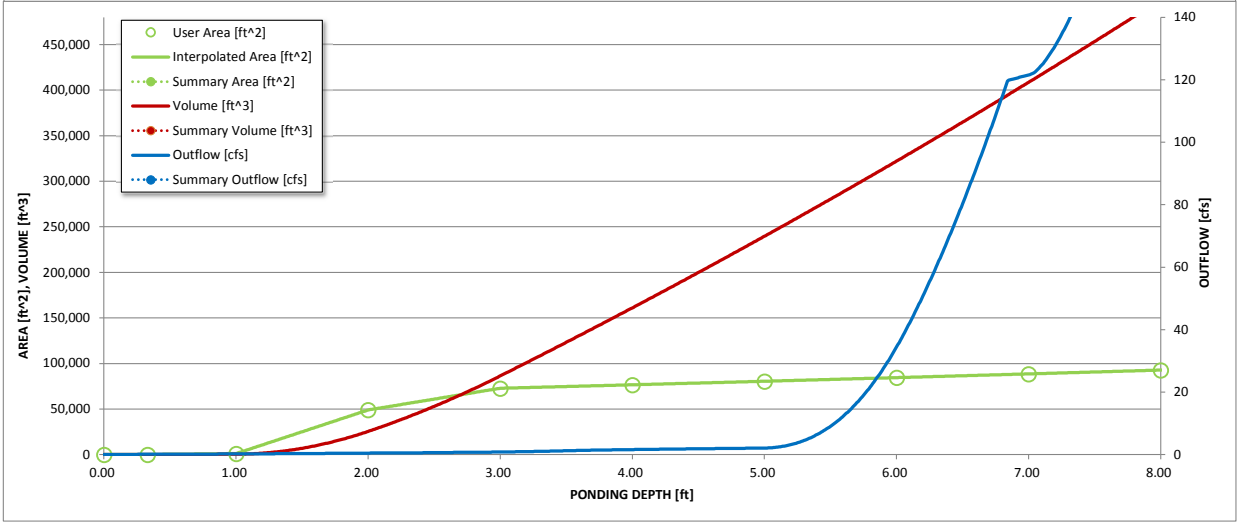
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.552	5.006	4.691	6.579	8.219	10.357	12.122	14.334	18.867
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.691	6.579	8.219	10.357	12.122	14.334	18.867
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	11.2	31.0	47.0	81.8	103.0	129.7	180.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.37	0.56	0.97	1.22	1.54	2.13
Peak Inflow Q (cfs) =	N/A	N/A	89.3	127.5	155.1	199.5	233.7	277.7	360.9
Peak Outflow Q (cfs) =	0.7	1.9	1.8	5.2	17.1	47.2	73.5	114.4	161.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.4	0.6	0.7	0.9	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.7	1.1	1.8	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	67	74	73	71	69	67	64
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	71	79	79	78	78	77	75
Maximum Ponding Depth (ft) =	2.74	4.74	4.41	5.34	5.71	6.16	6.44	6.80	7.53
Area at Maximum Ponding Depth (acres) =	1.53	1.82	1.80	1.88	1.91	1.95	1.98	2.01	2.08
Maximum Volume Stored (acre-ft) =	1.566	5.023	4.426	6.134	6.836	7.686	8.237	8.956	10.451

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	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]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.10	3.24
	0:15:00	0.00	0.00	8.87	14.50	17.97	12.07	15.06	14.71	21.12
	0:20:00	0.00	0.00	31.56	41.53	50.43	30.75	35.73	38.34	50.84
	0:25:00	0.00	0.00	70.78	102.59	131.08	69.16	81.33	89.82	131.28
	0:30:00	0.00	0.00	89.31	127.46	155.15	174.84	207.05	233.53	309.93
	0:35:00	0.00	0.00	80.02	111.27	133.66	199.46	233.72	277.73	360.92
	0:40:00	0.00	0.00	66.74	90.80	109.54	182.46	212.61	252.58	327.25
	0:45:00	0.00	0.00	52.58	72.78	89.37	153.85	179.21	219.43	283.77
	0:50:00	0.00	0.00	41.76	59.54	72.09	129.94	151.23	184.95	239.22
	0:55:00	0.00	0.00	34.69	49.34	60.61	103.99	121.34	152.70	198.22
	1:00:00	0.00	0.00	29.29	41.14	51.61	84.99	99.56	130.53	169.83
	1:05:00	0.00	0.00	24.55	34.12	43.65	70.79	83.19	113.56	147.84
	1:10:00	0.00	0.00	19.05	28.31	37.06	54.73	64.44	85.27	111.69
	1:15:00	0.00	0.00	15.29	23.80	33.84	41.36	48.87	61.15	81.48
	1:20:00	0.00	0.00	13.41	20.72	30.08	31.93	37.79	43.65	58.55
	1:25:00	0.00	0.00	12.41	18.82	25.52	26.00	30.73	32.27	43.35
	1:30:00	0.00	0.00	11.88	17.61	22.21	21.34	25.04	25.26	33.93
	1:35:00	0.00	0.00	11.56	16.81	20.00	18.10	21.03	20.81	27.89
	1:40:00	0.00	0.00	11.31	14.94	18.46	16.13	18.57	17.83	23.84
	1:45:00	0.00	0.00	11.14	13.38	17.42	14.80	16.91	15.83	21.12
	1:50:00	0.00	0.00	11.04	12.32	16.68	13.93	15.81	14.62	19.45
	1:55:00	0.00	0.00	9.54	11.58	15.63	13.46	15.21	14.19	18.81
	2:00:00	0.00	0.00	8.23	10.75	13.96	13.16	14.84	14.00	18.53
	2:05:00	0.00	0.00	5.87	7.70	9.91	9.51	10.69	10.16	13.43
	2:10:00	0.00	0.00	3.92	5.12	6.63	6.34	7.12	6.81	8.99
	2:15:00	0.00	0.00	2.61	3.38	4.43	4.27	4.79	4.59	6.05
	2:20:00	0.00	0.00	1.68	2.15	2.87	2.77	3.11	2.97	3.91
	2:25:00	0.00	0.00	1.03	1.36	1.80	1.76	1.97	1.89	2.48
	2:30:00	0.00	0.00	0.58	0.83	1.07	1.08	1.21	1.16	1.51
	2:35:00	0.00	0.00	0.28	0.43	0.53	0.57	0.63	0.60	0.78
	2:40:00	0.00	0.00	0.10	0.17	0.19	0.22	0.24	0.23	0.29
	2:45:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.02	0.03
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

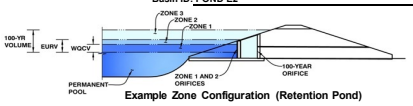
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Creekside South FDR

Basin ID: POND E2



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	125.00	acres
Watershed Length =	2,900	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	35.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	40.0%	percent
Percentage Hydrologic Soil Groups C/D =	60.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	1.732	acre-feet
Excess Urban Runoff Volume (EURV) =	4.232	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.645	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	5.556	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	7.847	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	12.045	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	14.974	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	18.724	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	3.411	acre-feet
Approximate 5-yr Detention Volume =	5.233	acre-feet
Approximate 10-yr Detention Volume =	6.508	acre-feet
Approximate 25-yr Detention Volume =	7.293	acre-feet
Approximate 50-yr Detention Volume =	7.634	acre-feet
Approximate 100-yr Detention Volume =	9.039	acre-feet

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) =	1.732	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.500	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	5.673	acre-feet
Total Detention Basin Volume =	9.905	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 = 0.2 ft

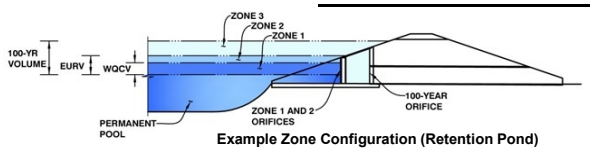
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	20	0.000		
5693.33	--	0.33	--	--	--	50	0.001	11	0.000
5694	--	1.00	--	--	--	2,250	0.052	760	0.017
5695	--	2.00	--	--	--	35,024	0.804	19,070	0.438
5696	--	3.00	--	--	--	62,057	1.425	67,959	1.560
5697	--	4.00	--	--	--	65,120	1.495	131,548	3.020
5698	--	5.00	--	--	--	68,248	1.567	198,232	4.551
5699	--	6.00	--	--	--	71,443	1.640	268,077	6.154
5700	--	7.00	--	--	--	74,705	1.715	341,151	7.832
5701	--	8.00	--	--	--	78,040	1.792	417,524	9.585
5702	--	9.00	--	--	--	81,442	1.870	497,265	11.416

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Creekside South FDR

Basin ID: POND E2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.13	1.732	Orifice Plate
Zone 2 (EURV)	4.80	2.500	Rectangular Orifice
(100+1/2WQCV)	8.18	5.673	Weir&Pipe (Restrict)
		9.905	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 Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	3.646E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.12	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	5.25	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.00	2.00	3.00				
Orifice Area (sq. inches)	5.25	5.25	5.25	5.25				

	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 =	3.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	4.80	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	4.00	N/A	inches
Vertical Orifice Width =	18.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.50	N/A	ft^2
Vertical Orifice Centroid =	0.17	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.85	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	17.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	6.70	N/A	feet
Overflow Grate Open Area % =	70%	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 =	5.85	N/A	feet
Over Flow Weir Slope Length =	6.70	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.34	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	79.73	N/A	ft^2
Overflow Grate Open Area w/ Debris =	39.87	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 =	0.10	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	48.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	12.57	N/A	ft^2
Outlet Orifice Centroid =	2.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.20	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	55.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.50	feet

Calculated Parameters for Spillway

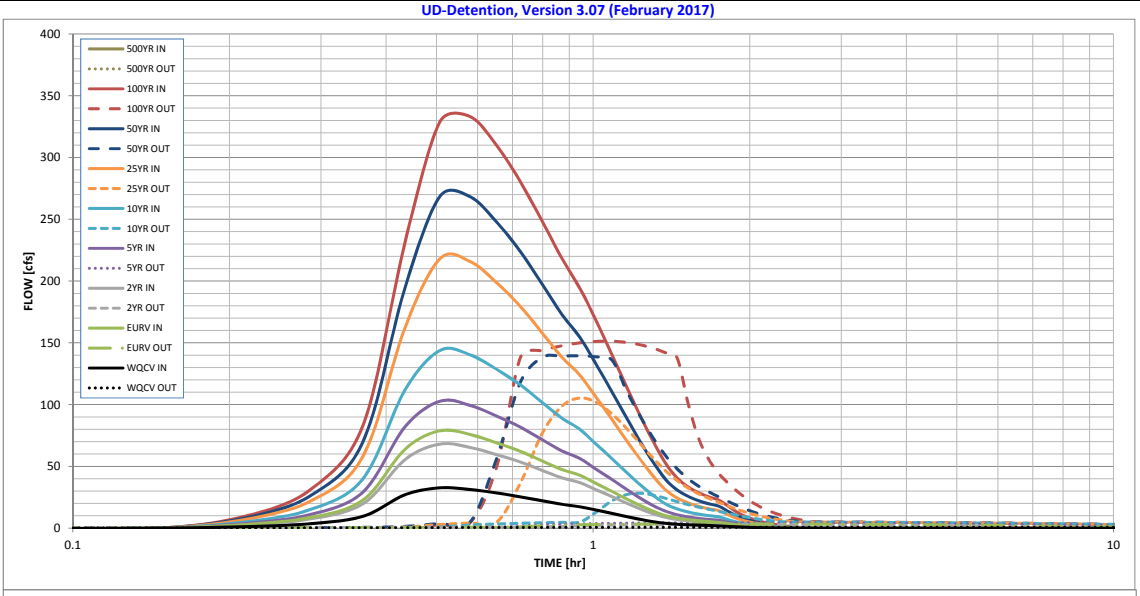
Spillway Design Flow Depth=	1.51	feet
Stage at Top of Freeboard =	10.21	feet
Basin Area at Top of Freeboard =	1.87	acres

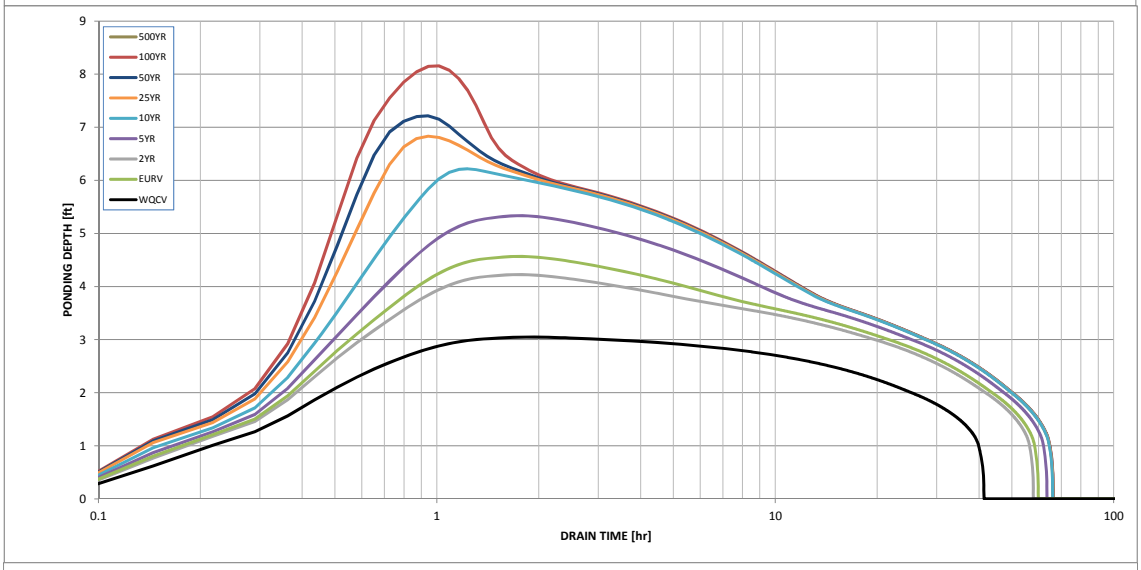
Routed Hydrograph Results

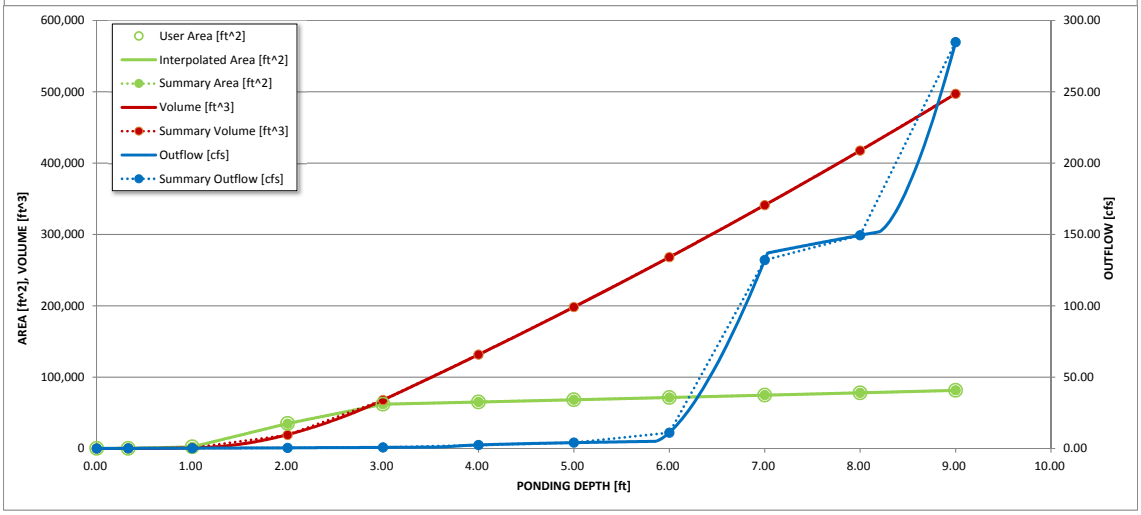
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	1.732	4.232	3.645	5.556	7.847	12.045	14.974	18.724	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.732	4.233	3.646	5.554	7.843	12.049	14.970	18.731	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.10	0.34	0.87	1.17	1.53	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	2.0	12.4	42.6	108.8	146.0	191.3	0.0
Peak Inflow Q (cfs) =	32.7	78.8	68.1	102.8	143.9	218.1	268.6	333.2	#N/A
Peak Outflow Q (cfs) =	0.8	3.5	2.9	4.5	28.3	105.4	139.5	151.3	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.7	1.0	1.0	0.8	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 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	N/A	0.3	1.2	1.7	1.8	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	54	53	56	56	53	50	47	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	57	56	60	62	60	59	58	#N/A
Maximum Ponding Depth (ft) =	3.05	4.57	4.23	5.34	6.22	6.83	7.22	8.16	#N/A
Area at Maximum Ponding Depth (acres) =	1.43	1.54	1.51	1.59	1.66	1.70	1.73	1.80	#N/A
Maximum Volume Stored (acre-ft) =	1.617	3.868	3.351	5.072	6.500	7.541	8.194	9.855	#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.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	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]
4.35 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:04:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:08:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:13:03	1.41	3.27	2.85	4.14	5.52	7.70	9.01	10.37	#N/A
1.150	0:17:24	3.85	9.08	7.89	11.67	15.93	23.16	27.80	33.01	#N/A
	0:21:45	9.88	23.32	20.26	29.97	40.92	59.52	71.52	85.08	#N/A
	0:26:06	27.12	63.93	55.56	82.12	111.96	162.49	194.97	231.60	#N/A
	0:30:27	32.68	78.81	68.07	102.79	143.86	218.07	268.59	328.95	#N/A
	0:34:48	31.28	75.85	65.39	99.41	140.34	215.86	268.33	333.22	#N/A
	0:39:09	28.47	69.09	59.51	90.75	128.54	198.71	247.77	309.79	#N/A
	0:43:30	25.54	62.24	53.59	81.79	115.94	179.40	223.77	280.34	#N/A
	0:47:51	22.18	54.46	46.84	71.70	101.90	158.21	197.69	248.77	#N/A
	0:52:12	19.27	47.54	40.86	62.68	89.18	138.61	173.27	218.72	#N/A
	0:56:33	17.48	42.91	36.92	56.45	80.09	123.94	154.56	194.41	#N/A
	1:00:54	14.56	35.97	30.91	47.48	67.69	105.56	132.19	167.27	#N/A
	1:05:15	11.99	29.81	25.59	39.40	56.27	87.89	110.16	140.09	#N/A
	1:09:36	9.38	23.63	20.24	31.36	45.03	70.81	89.08	114.35	#N/A
	1:13:57	7.13	18.25	15.60	24.32	35.07	55.41	69.87	90.57	#N/A
	1:18:18	5.23	13.64	11.62	18.26	26.47	42.08	53.31	70.11	#N/A
	1:22:39	3.98	10.23	8.73	13.63	19.64	31.02	39.45	52.59	#N/A
	1:27:00	3.24	8.22	7.04	10.91	15.64	24.52	30.97	40.57	#N/A
	1:31:21	2.74	6.92	5.93	9.17	13.12	20.51	25.81	33.46	#N/A
	1:35:42	2.40	6.02	5.16	7.96	11.36	17.71	22.23	28.67	#N/A
	1:40:03	2.15	5.38	4.62	7.11	10.13	15.75	19.75	25.34	#N/A
	1:44:24	1.98	4.93	4.23	6.50	9.26	14.36	17.97	22.96	#N/A
	1:48:45	1.46	3.68	3.15	4.89	7.04	11.13	14.09	18.26	#N/A
	1:53:06	1.06	2.66	2.28	3.53	5.08	8.02	10.16	13.22	#N/A
	1:57:27	0.78	1.97	1.68	2.62	3.77	5.95	7.53	9.76	#N/A
	2:01:48	0.58	1.46	1.25	1.95	2.80	4.42	5.58	7.26	#N/A
	2:06:09	0.42	1.07	0.92	1.43	2.06	3.27	4.14	5.39	#N/A
	2:10:30	0.30	0.77	0.66	1.03	1.49	2.37	3.00	3.95	#N/A
	2:14:51	0.22	0.56	0.48	0.75	1.08	1.71	2.17	2.86	#N/A
	2:19:12	0.15	0.39	0.33	0.52	0.76	1.22	1.56	2.09	#N/A
	2:23:33	0.09	0.25	0.21	0.34	0.50	0.82	1.05	1.44	#N/A
	2:27:54	0.05	0.14	0.12	0.20	0.30	0.49	0.64	0.91	#N/A
	2:32:15	0.02	0.07	0.05	0.09	0.14	0.25	0.33	0.50	#N/A
	2:36:36	0.00	0.02	0.01	0.03	0.05	0.08	0.12	0.21	#N/A
	2:40:57	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	#N/A
	2:45:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:49:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:54:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:58:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:02:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:07:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:11:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:15:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:20:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:24:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:28:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:33:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:37:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:41:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:46:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:50:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:54:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:59:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:03:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:07:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:12:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:16:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:21:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:25:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:29:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:34:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:38:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:42:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:47:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:51:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:55:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:00:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:04:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:08:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:13:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

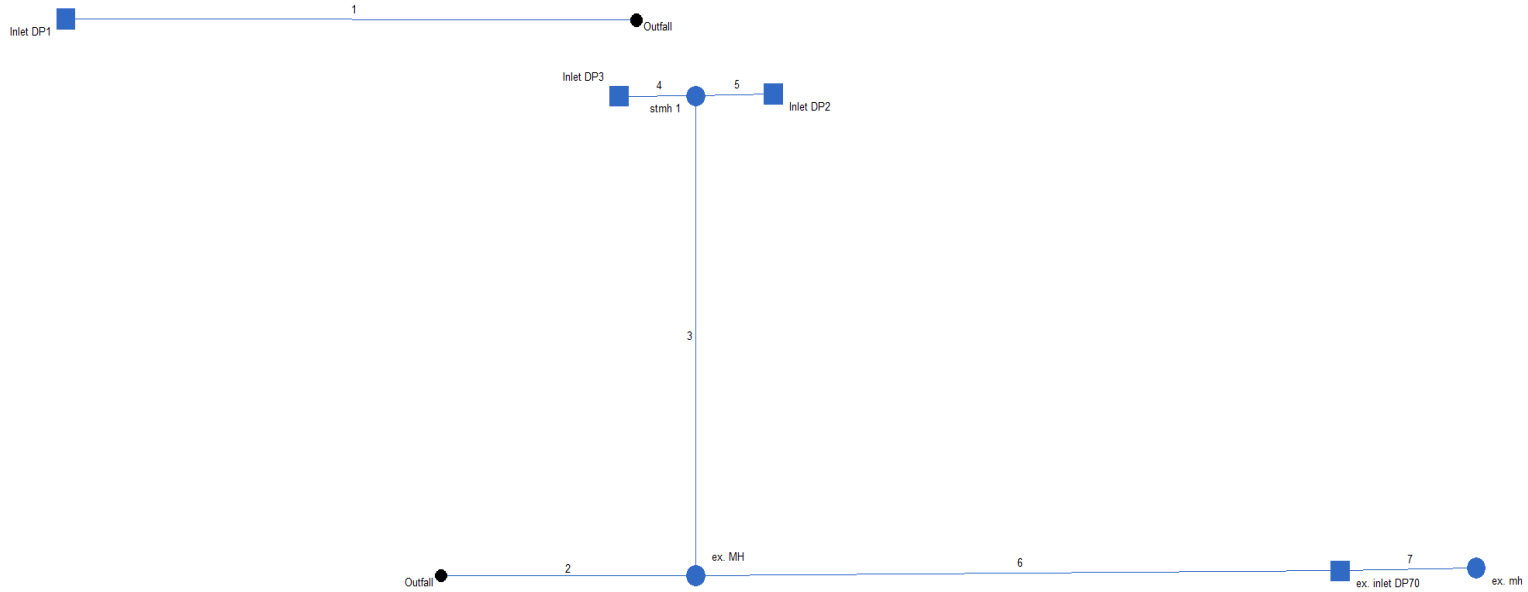
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
5693	0.00	20	0.000	0	0.000	0.00
5693.33	0.33	49	0.001	11	0.000	0.10
5694	1.00	2,217	0.051	760	0.017	0.17
5695	2.00	34,696	0.797	19,070	0.438	0.42
5696	3.00	62,057	1.425	67,959	1.560	0.73
5697	4.00	65,120	1.495	131,548	3.020	2.47
5698	5.00	68,248	1.567	198,232	4.551	4.08
5699	6.00	71,443	1.640	268,077	6.154	11.09
5700	7.00	74,705	1.715	341,151	7.832	132.07
5701	8.00	78,040	1.792	417,524	9.585	149.44
5702	9.00	81,442	1.870	497,265	11.416	284.79

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

APPENDIX E– STORM SEWER SCHEMATIC AND HYDRAFLOW STORM SEWER CALCS

Hydraflow Plan View



Creekside South 2 - 5yr	No. Lines: 7	06-15-2022

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1		1.10	18 c	125.8	5704.30	5705.56	1.003	5704.70	5705.96	n/a	5705.96 j	End
2		75.90	54 c	56.2	5695.49	5695.83	0.600	5699.99	5700.05	0.37	5700.42	End
3		6.20	24 c	96.4	5701.16	5702.60	1.493	5701.80	5703.48	n/a	5703.48	2
4		2.10	18 c	16.9	5703.40	5703.57	1.008	5703.85	5704.13	0.19	5704.32	3
5		4.10	18 c	17.2	5703.40	5703.57	0.991	5704.05	5704.39	0.27	5704.66	3
6		69.70	48 c	142.0	5699.16	5702.00	2.000	5700.78	5704.99	0.37	5705.36	2
7		64.10	48 c	30.0	5702.30	5702.60	1.001	5705.36	5705.17	0.88	5706.05	6

Creekside South 2 - 5yr | Number of lines: 7 | Run Date: 06-15-2022

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1		2.60	18 c	125.8	5704.30	5705.56	1.002	5704.92	5706.18	n/a	5706.18 j	End
2		225.3	54 c	56.2	5695.49	5695.83	0.605	5699.99*	5700.73*	1.56	5702.29	End
3		13.80	24 c	96.4	5701.16	5702.60	1.493	5705.11*	5705.47*	0.30	5705.77	2
4		4.70	18 c	16.9	5703.40	5703.57	1.008	5705.96*	5705.99*	0.11	5706.10	3
5		9.10	18 c	17.2	5703.40	5703.57	0.991	5705.77*	5705.90*	0.41	5706.31	3
6		211.5	48 c	142.0	5699.16	5702.00	2.000	5702.61*	5706.40*	2.20	5708.60	2
7		174.5	48 c	30.0	5702.30	5702.60	1.001	5710.01*	5710.45*	3.00	5713.45	6

Creekside South 2 - 100yr | Number of lines: 7 | Run Date: 06-15-2022

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

MAP POCKET

LEGEND

BASIN BOUNDARY

BASIN DESIGN POINT

BASIN I.D.
ACREAGE
5 YR/100 YR CFS

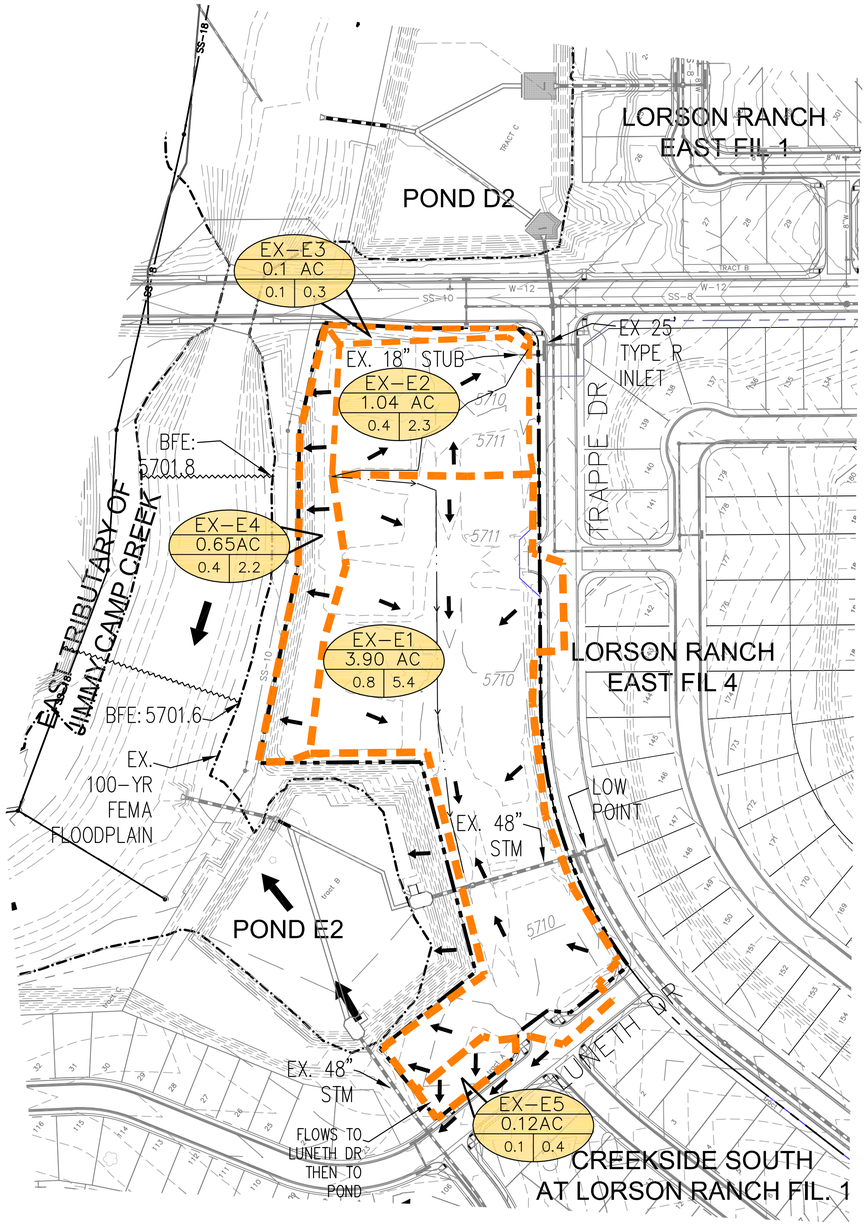
DIRECTION OF FLOW

6690 EXISTING CONTOUR

TIME OF CONCENTRATION

PRELIMINARY PLAN SITE AREA

100-YR FLOODPLAIN (FEMA)



CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L SCHINDLER, P.E.
EMAIL: rlsch@egi.com

DATE

DESCRIPTION

NO.

PREPARED FOR:
LORSON LLC
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903 (719) 635-3200
CONTACT: JEFF MARK

PROJECT:
CREEKSIDE SOUTH
TRAPPE DRIVE - HORTON DR
EL PASO COUNTY, COLORADO

DRAWN: LAB
DESIGNED: LAB
CHECKED: RLS

EXISTING CONDITIONS
CREEKSIDE SOUTH
AT LORSON RANCH FILING NO. 2

DATE:
AUGUST, 2022

PROJECT NO.
100.069

SHEET NUMBER
1

TOTAL SHEETS: 1

N

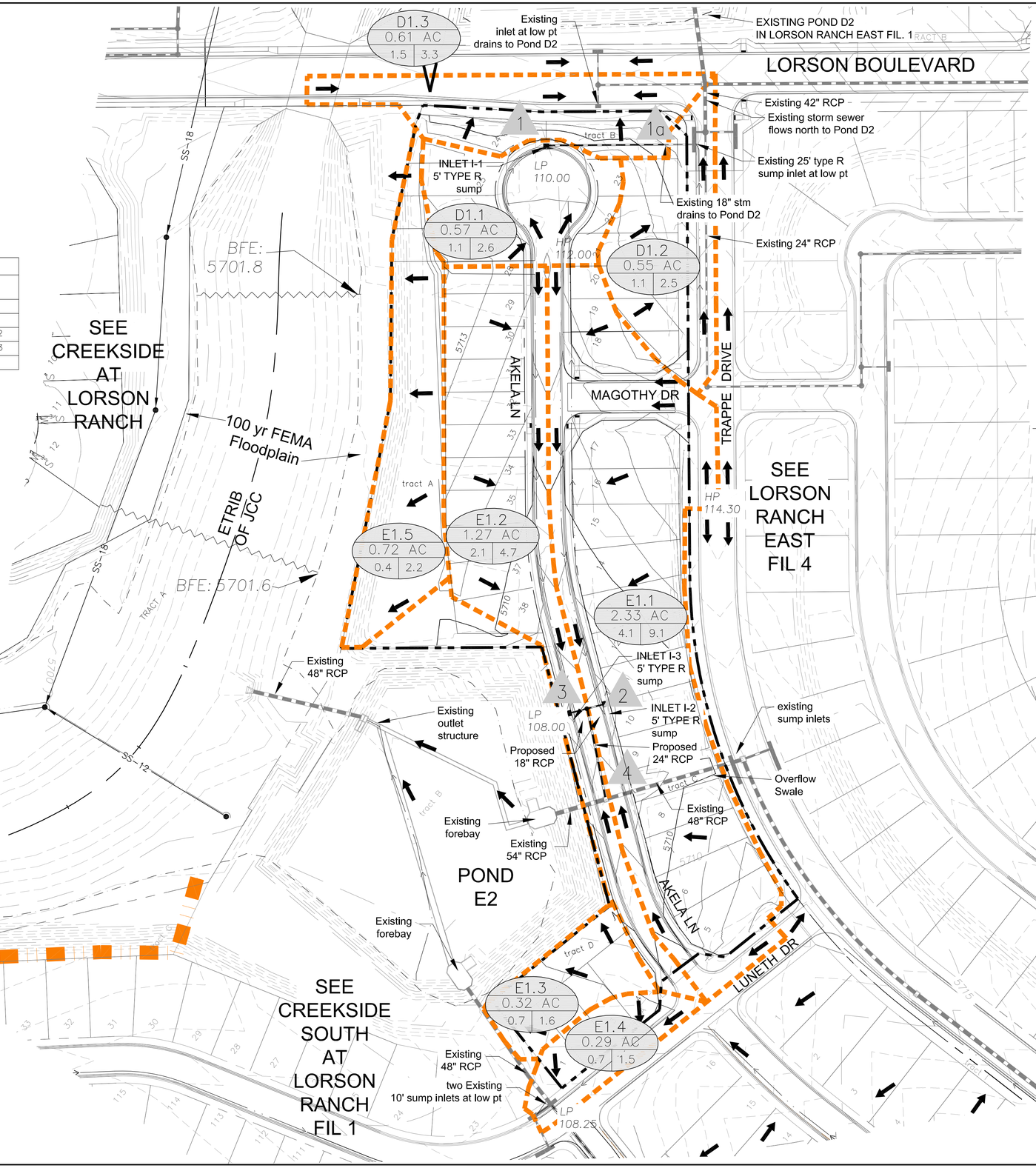
100 50 0 100 200
SCALE: 1"=100'

LEGEND

- DRAINAGE BASIN BOUNDARY
- SITE BOUNDARY
- BASIN (XX AC / X.X | X.X) — DENOTES OVERALL BASIN — BASIN I.D., ACREAGE, 5 YR/100 YR CFS
- DIRECTION OF FLOW
- 5690 — EXISTING CONTOUR
- 5670 — PROPOSED CONTOUR
- HP — HIGH POINT
- LP — LOW POINT
- TIME OF CONCENTRATION
- 100-YR FLOODPLAIN (FEMA)

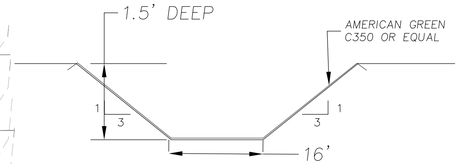
RUNOFF SUMMARY

D.P.	AREA Ac.	5 YEAR cfs	100 YEAR cfs	NOTES
1	0.57	1.1	2.6	OVERLAND FLOW TO INLET DP-1
1A		1.1	2.6	FLOW IN EX. 18" STM SWR.
2	2.33	4.1	9.1	OVERLAND FLOW TO INLET DP-2
3	1.27	2.1	4.7	OVERLAND FLOW TO INLET DP-3
4	3.60	6.2	13.8	PIPE FLOW (DP2+DP3)



PBMP SUMMARY TABLE

BASINS	PBMP	NOTES
D1.1–D1.3	POND D2	EX. FULL SPECTRUM POND IN LRE1
E1.1–E1.4	POND E2	EX. FULL SPECTRUM POND IN CREEKSIDE SOUTH FIL. NO. 1
E1.5	N/A	OPEN SPACE TRACT DRAINING TO EAST TRIB. OF JCC ALLOWED PER ECM Appendix I.7.1.B.7



OVERFLOW SWALE

60 30 0 60 120

SCALE: 1"=60'

CORE ENGINEERING GROUP
15004 1ST AVE. S.
MINNEAPOLIS, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

DATE

DESCRIPTION

NO.

PREPARED FOR:
LORSON, LLC
212 N. WAHSATCH AVE., SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
CREEKSIDE SOUTH FIL. 2
TRAPPE DRIVE - MAGOTHY DR
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

DEVELOPED CONDITIONS CREEKSIDE SOUTH AT LORSON RANCHFILING NO. 2

DATE
AUG, 2022

PROJECT NO.
100.069

SHEET NUMBER
1

TOTAL SHEETS: 1

P:\100.100.069 drainage\100.069-DrainageDevelopedConditions (2).dwg, Aug 24, 2022 - 9:37am