FINAL DRAINAGE PLAN
SF 22-001

SKYLINE AT LORSON RANCH

DECEMBER, 2021
REV MARCH 1, 2022
REV MAY 2, 2022

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
Burnsville, MN 55306
(719) 570-1100

Project No. 100.063

CORE
ENGINEERING GROUP

TABLE OF CONTENTS

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.

5-2-2022

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.

5/3/22

Lorson, LLC 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 08041C0976 G, dated December 7, 2018. (See Appendix A, FEMA FIRM Exhibit)

5-2-2022

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.

APPROVED
Engineering Department
07/28/2022 7:37:47 AM
dsdnijkamp
EPC Planning & Community Development Department

Date

County Engineer/ECM Administrator

Conditions: ______________________________

1.0 LOCATION and DESCRIPTION

Skyline at Lorson Ranch is located east of the East Tributary of Jimmy Camp Creek. The site is located on approximately 15.764 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 South ½ of Section 13, Township 15 South and Range 65 West of the 6th Principal Meridian. The site is bounded on the north by unplatted lands, on the west by Lorson Ranch East Filing No. 3 and The Hills at Lorson Ranch, on the east and south by unplatted land in Lorson Ranch. 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 2021. 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 FDR conforms to the MDDP for Lorson East and the PDR for “The Hills at Lorson Ranch and is referenced in this report. The major infrastructure to be constructed for “The Hills at Lorson Ranch” under PUD/SP 20-003 includes Detention/WQ Ponds C1, C2.1, C2.2, C2.3, C3 and C4. Pond C4 was graded as part of The Hills at Lorson Ranch but will require an interim outlet structure for this project. There are also two bridges over the East Tributary that was built in 2018 to provide access to this development across the East Tributary. The bridges are located at Fontaine Boulevard and Lorson Boulevard.

The Skyline at Lorson Ranch 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 will be required for this development.

3.0 EXISTING HYDROLOGICAL CONDITIONS

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

The Soil Conservation Service (SCS) classifies the soils within the Skyline at Lorson Ranch property as Nelson-Tassel fine Sandy loam and Razor clay loam [3]. The sandy loams are considered hydrologic soil group A/B soils with moderate to moderately rapid permeability. The Razor clay loams are considered hydrologic soil group C/D soils with slow permeability. All of these soils are susceptible to erosion by wind and water, have low bearing strength, moderate shrink-swell potential, and high frost heave potential (see table 3.1 below). The clay loams are difficult to vegetate and comprise of a small portion of the study area. These soils can be mitigated easily by limiting their use as topsoil since they comprise of a small portion of the study area. 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
56-Nelson – Tassel Fine Sandy Loam	B	Moderate	Moderately Rapid	Slow	Moderate
75-Razor Clay Loam	C	High	Slow	Medium	Moderate

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

For the purpose of preparing hydrologic calculations for this report, the soils of each basin are assumed to be wholly comprised of the majority soil hydrologic group.

An existing electrical easement, with existing transmission towers, is located east side of this site and will be set aside as open space. It is the intent to utilize some of the open space under the towers for detention of storm flow.

This site is not located within 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 08041C10976 G, effective December 7, 2018.

<u>Basin C5.1-ex</u>
This existing basin consists of existing flow from offsite undeveloped areas north of Lorson Ranch. Runoff flows overland to the south to the existing electric transmission lines and then drains south into

Existing Pond C3 excavated as part of Lorson Ranch East Filing No. 2 final grading. The existing runoff is 1.6cfs and 9.6cfs for the 5-year and 100-year events.

Basin C5.2-ex
This existing basin consists of existing flow from undeveloped areas within the PUD boundary. Runoff flows overland to the south to the existing electric transmission lines and then drains south into Existing Pond C3 excavated as part of Lorson Ranch East Filing No. 2 final grading. The existing runoff is 3.2cfs and 21.8cfs for the 5-year and 100-year events.

Design Point 5x
Design Point 5x is the existing flow at the electric transmission lines from Basins C5.1-ex and C5.2-ex. The existing runoff is 4.2cfs and 27.2cfs for the 5-year and 100-year events from these two basins. This flow is then routed south into Existing Pond C3.

4.0 DEVELOPED HYDROLOGICAL CONDITIONS

Hydrology for **Skyline at Lorson Ranch** 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 A/B & C/D has been assumed for the developed hydrologic conditions. See Appendix A for SCS Soils Map.

The time of concentration for each basin and sub-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 Appendix B.

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

Basin C10.6
This offsite basin consists of runoff from the north side of Grayling Drive. Runoff will be directed west to Design Point 39 in curb/gutter where it will be collected by a 25' Type R inlet. The developed flow from this basin is 1.3cfs and 3.0cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C10.7
This basin consists of runoff from residential development east of Grayling Drive and north of Garganey Lane. Runoff will be directed west to Grayling Drive, then southeasterly to Design Point 38 in curb/gutter and will continue flowing south in Grayling Drive to Design Point 39 where it will be collected by a 25' Type R inlet. The developed flow from this basin is 5.3cfs and 11.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C10.8
This basin consists of runoff from residential development and an existing water pump station located northeast of Grayling Drive. Runoff will be directed southwesterly overland to Grayling Drive, then southeasterly within the curb/gutter and will continue flowing south in Grayling Drive to Design Point 39

where it will be collected by a 25' Type R inlet. The developed flow from this basin is 3.2cfs and 7.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C10.9

This basin consists of runoff from residential development and open space under the electric transmission line located northeast of Grayling Drive. Runoff will be directed southwesterly overland to Grayling Drive and Design Point 39 where it will be collected by an existing 25' Type R inlet. The developed flow from this basin is 6.1cfs and 13.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C10.10a

This basin consists of runoff from residential development, Garganey Drive, Sora Street and Lamprey Drive. Runoff will be directed to the aforementioned streets, and then routed to Design Point 38a within the curb/gutter where it will be collected by a 20' Type R inlet on the north side of Lamprey Dr. Flows from this basin will be directed southeasterly in storm sewer to Pond C4. The developed flow from this basin is 7.4cfs and 16.4cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C10.10b

This basin consists of runoff from residential development, Lamprey Drive, and Sora Street. Runoff will be directed to Sora Street, and then routed to Design Point 38b within the curb/gutter where it will be collected by a 15' Type R inlet on the south side of Lamprey Drive. Flows from this basin will be directed southeasterly in storm sewer to Pond C4. The developed flow from this basin is 2.8cfs and 6.2cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C10.10c

This basin consists of runoff from residential development, Lamprey Drive and Sora Street. Runoff will be directed to Sora Street, and then routed to Design Point 38c within the curb/gutter where it will be collected by a 10' Type R inlet on the east side of Sora Street. Flows from this basin will be directed southeasterly in storm sewer to Pond C4. The developed flow from this basin is 3.3cfs and 7.2cfs 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.

5.0 HYDRAULIC SUMMARY

The sizing of the hydraulic structures was prepared by using the *StormSewers* 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 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)

Street Slope	Residential Local		Residential Collector		Principal Arterial	
	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
2.7%	14.7	40.6	18.4	45.0	18.4	45.0
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 38

Design Point 38 is located at the NE corner of Grayling Drive and Lamprey Drive and accepts developed flows from Basin C10.7 and existing runoff from basin C5.1-ex. The runoff will be conveyed to Design Point 39 via curb/gutter. The total flow accepted is 6.8cfs/22.1cfs in the 5/100-year storm events. The street capacity of Grayling Drive (collector street, 0.6/32.1 at 0.6% slope) is not exceeded.

Design Point 38a

Design Point 38a is located on the north side of Lamprey Dr, east of Grayling Drive.

(5-year storm)

Tributary Basins: C10.10a
Inlet/MH Number: Inlet DP-38a
Upstream flowby:
Total Street Flow: 7.4cfs

Flow Intercepted: 7.4cfs
Flow Bypassed: 0.0cfs
Inlet Size: 20' type R, on-grade

Street Capacity: Street slope = 2.2%, capacity = 13.3cfs, okay

(100-year storm)

Tributary Basins: C10.10a
Inlet/MH Number: Inlet DP-38a
Upstream flowby:
Total Street Flow: 16.4cfs

Flow Intercepted: 15.2cfs
Flow Bypassed: 1.2cfs to DP- 40
Inlet Size: 20' type R, on-grade

Street Capacity: Street slope = 2.2%, capacity = 42.8cfs (half street) is okay

The flowby from the 100yr storm is consistent with The Hills at Lorson Ranch PDR.

Design Point 38b

Design Point 38b is located on the south side of Lamprey Drive, east of Grayling Drive.

(5-year storm)

Tributary Basins: C10.10b
Inlet/MH Number: Inlet DP-38b
Upstream flowby:
Total Street Flow: 2.8cfs

Flow Intercepted: 2.8cfs
Flow Bypassed: 0.0cfs
Inlet Size: 15’ type R, on-grade

Street Capacity: Street slope = 2.7%, capacity = 14.7cfs, okay

(100-year storm)

Tributary Basins: C10.10b
Inlet/MH Number: Inlet DP-38b
Upstream flowby:
Total Street Flow: 6.2cfs

Flow Intercepted: 6.2cfs
Flow Bypassed: 0.0cfs
Inlet Size: 15’ type R, on-grade

Street Capacity: Street slope = 2.7%, capacity = 40.6cfs (half street) is okay

Design Point 38c

Design Point 38c is located on the east side of Sora Street, south of Lamprey Drive at a low point.

(5-year storm)

Tributary Basins: C10.10c
Inlet/MH Number: Inlet DP-38c
Upstream flowby:
Total Street Flow: 3.3cfs

Flow Intercepted: 3.3cfs
Flow Bypassed: 0.0cfs
Inlet Size: 10’ type R, Sump

Street Capacity: Street slope = 2.7%, capacity = 14.7cfs, okay

(100-year storm)

Tributary Basins: C10.10c
Inlet/MH Number: Inlet DP-38b
Upstream flowby:
Total Street Flow: 7.2cfs

Flow Intercepted: 7.2cfs
Flow Bypassed: 0.0cfs
Inlet Size: 10’ type R, sump

Street Capacity: Street slope = 2.7%, capacity = 40.8cfs (half street) is okay

Design Point 40
Design Point 40 is located on the north side of Grayling Drive at a low point. Peak runoff at this design point from the drainage report and plan for the "Hills at Lorson Ranch" is 14.7cfs/38.5cfs in the 5/100-year storm events. Peak runoff for "Skyline at Lorson Ranch" is 14.7cfs/38.5cfs in the 5/100-year storm events. Based on this information there is no flow increase for the 5-year event and for the 100-event. Flow from this design point on Grayling Drive will flow south into Pond C3 for WQ treatment and detention

(5-year storm)
Tributary Basins: C10.6 to C10.9+C5.1-ex **Inlet/MH Number:** Ex. Inlet DP40
Upstream flowby: 0 cfs **Total Street Flow:** 14.7cfs

Flow Intercepted: 14.7cfs **Flow Bypassed:**
Inlet Size: 25' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 10.6cfs, street capacity okay since Basin C10.9 (6.1cfs) flows directly to Inlet DP40

(100-year storm)
Tributary Basins: C10.6 to C10.9+C5.1-ex **Inlet/MH Number:** Ex. Inlet DP40
Upstream flowby: 1.2cfs from Des.Pt.38a **Total Street Flow:** 38.5cfs

Flow Intercepted: 35.6cfs **Flow Bypassed:** 2.9cfs to Des.Pt.40a (same as Hills FDR)
Inlet Size: 25' type R, sump

Street Capacity: Street slope = 0.6%, capacity = 32.1cfs (half street) street capacity okay since Basin C10.9 (13.3cfs) flows directly to Inlet DP40

6.0 DETENTION AND WATER QUALITY PONDS

Detention and Storm Water Quality for Skyline at Lorson Ranch will be provided for in Pond C3 (flow on Grayling Drive) and Pond C4 for the remainder of the site. Pond C3 was graded and the outlet structure constructed as part of The Hills at Lorson Ranch Filing No. 1. Pond C4 was graded as part of The Hills at Lorson Ranch (PUD/SP 20-003) and the outlet structure will be constructed at part of The Ridge at Lorson Ranch (PUD/SP 21-006) which includes the flow from 6.96 acres of this development as required per El Paso County criteria. The Ridge at Lorson Ranch is currently under construction and Skyline will be constructed with this project requiring the full buildout of Pond C4 and the outlet structure.

For additional information, see Drainage Report and Plan for "The Hills at Lorson Ranch", PUD/SP 20-03, CDR 20-007, revised dated 10/22/2020 and "The Ridge at Lorson Ranch", PUD/SP 21-006

Detention Pond C4 (from The Ridge at Lorson Ranch PDR, PUD/SP 21-006)
This is a permanent full spectrum detention pond that includes water quality and discharges downstream to Pond C3. Pond C4 has been graded and the existing pond forebay and low flow

channel was built as part of the CDR 20-007 project. The final outlet structure and overflow wall will be built with PUD/SP 21-006 which accounts for flow from Skyline. This project will construct an additional forebay and associated low flow channel on the west side of the pond. Pond C4 is designed in the UDCF Full Spectrum spreadsheets for Water Quality and EURV volumes. The 5-year and 100-year flow rates meet the Lorson East MDDP and have been modeled in the full spectrum worksheets. The outlet structure is a standard full spectrum extended detention basin structure and will include an emergency overflow spillway. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas.

- Watershed Area: 81.00 acres (6.96ac from Skyline)
- Watershed Imperviousness: 55%
- Hydrologic Soils Group B (40%), Group C/D (60%)
- Zone 1 WQCV: 1.488ac-ft, WSEL: 5767.97
- Zone 2 EURV: 4.477ac-ft, WSEL: 5770.41, Top outlet structure set at 5770.50, 6'x6' outlet structure
- (5-yr): 5.031ac-ft, WSEL: 5770.84, 16.5cfs
- Zone 3 (100-yr): 10.152ac-ft, WSEL: 5774.34, 43.7cfs
- Pipe Outlet: existing 24" RCP at 0.5%
- Overflow Spillway: 30' wide bottom, elevation=5775.00, 4:1 side slopes, flow depth=1.87' 1.13' freeboard
- Micropool Elevation: 5765.00

7.0 DRAINAGE AND BRIDGE FEES

Skyline at Lorson Ranch 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.

Skyline at Lorson Ranch Filing No. 1 contains 15.764acres. The 2022 drainage fees are $21,134, bridge fees are $989 and Drainage Surety fees are $7,285 per impervious acre per Resolution 21-468. The following table details the drainage/bridge required for platting and Lorson Ranch intends to use the Bridge Fee credits for the bridge fees and pay drainage/surety fees unless the Jimmy Camp Creek DBPS drainage fee structure is updated by El Paso County.

Table 1: 2022 Drainage/Bridge Fees (15.764ac)

Type of Land Use	Total Area (ac)	Imperviousness	Drainage Fee	Bridge Fee	Surety Fee
Residential Area	11.404	51%	$122,916	$5,752	$42,369
Tract D - pump station	0.707	30%	$4,482	$209	$1,545
Open Space, Landscape Tracts,	3.653	2%	$1,544	$72	$532
		Total	$128,942	$6,033	$44,446

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

Item	Quantity	Unit	Unit Cost	Item Total
Soil Rip Rap	5	CY	$50/CY	$250
Inlets/Manholes	5	EA	$3000/EA	$15,000
18" Storm	41	LF	$35	$1,435
24" Storm	58	LF	$40	$2,320
30" Storm	600	LF	$45	$27,000
Pond forebay/channel	1	EA	$8,000	$8,000
			Subtotal	$54,005
			Eng/Cont (10%)	$5,400
			Total Est. Cost	$59,405

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
Skyline at Lorson Ranch 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 large open space buffers under the 325' wide electric transmission easement on the east side
- Construct one Full Spectrum Detention Outlet Structure. 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, 2018, and through 2021 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. Skyline at Lorson Ranch will construct one full spectrum stormwater extended detention basin outlet structure within existing Pond C4 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

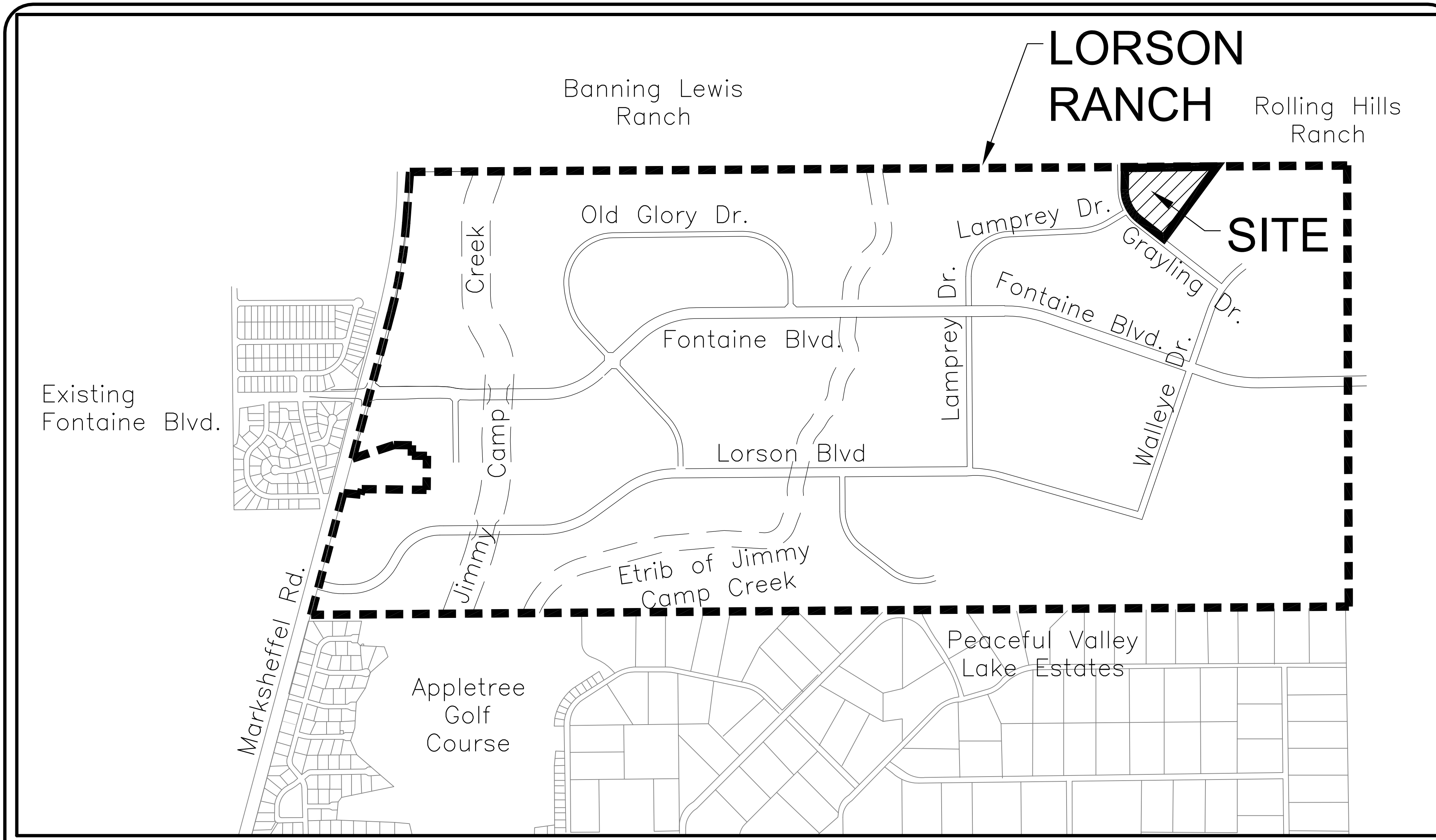
This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development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

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 Fontaine Boulevard prepared by Core Engineering Group, Reference CDR183, dated December 20, 2017
10. Final Drainage Report for Lorson Ranch East Filing No. 1 prepared by Core Engineering Group, Reference SF18-008, approved July 24, 2018
11. Final Drainage Report for Lorson Ranch East Filing No. 4 prepared by Core Engineering Group, Reference SF19-008, approved September 12, 2019
12. Final Drainage Report for The Hills at Lorson Ranch prepared by Core Engineering Group, Reference CDR20-007, approved in 2020
13. Preliminary Drainage Report for The Ridge at Lorson Ranch prepared by Core Engineering Group, Reference PUD/SP 21-006, approved on 1/12/2022

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP



VICINITY MAP

NO SCALE

CORE
ENGINEERING GROUP

15004 1ST AVE. S.
BURNSVILLE, MN 55306
PH: 719.570.1100

CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

SKYLINE AT LORSON RANCH
VICINITY MAP

SCALE:	DATE:	FIGURE NO.
NTS	NOV 5, 2020	--

E:\100\100.063\drainage\100.063-DevConditions.dwg Nov 16, 2020 - 11:45am

NOT TO SCALE

N

Legend

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

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, V, A99 With BFE or Depth Zone AE, AO, AH, VE, AR Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X Future Conditions 1% Annual Chance Flood Hazard Zone X Area with Reduced Flood Risk due to Levee. See Notes. Zone X Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard Zone X Effective LOMRs Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer Levee, Dike, or Floodwall
OTHER FEATURES	20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation Coastal Transect Base Flood Elevation Line (BFE) Limit of Study Jurisdiction Boundary Coastal Transect Baseline Profile Baseline Hydrographic Feature
MAP PANELS	Digital Data Available No Digital Data Available Unmapped

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/12/2020 at 5:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

CORE
ENGINEERING GROUP
15004 1ST AVENUE S.
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SKYLINE at LORSON RANCH FEMA MAP		
SCALE: NTS	DATE: November 2020	FIGURE NO. __

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SKYLINE at LORSON RANCH
SOILS MAP

SCALE:	DATE:	FIGURE NO.
NTS	November 2020	__

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	12.0	95.1%
75	Razor-Midway complex	D	0.6	4.9%
Totals for Area of Interest			**12.6**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

APPENDIX B – HYDROLOGY CALCULATIONS

CORE ENGINEERING GROUP

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

Calculated By: Leonard Beasley
Date: Oct. 31, 2020
Checked By: Leonard Beasley

Job No: 100.063
Project: Skyline at Lorson Ranch
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)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C5.1-ex			4.81	0.11	21.6	0.53	2.97	1.6													
C5.2-ex			13.32	0.09	25.8	1.20	2.71	3.2													
C5-ex	**5X**	18.13							31.5	1.73	2.41	4.2									

CORE ENGINEERING GROUP

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

Calculated By: Leonard Beasley
Date: Oct. 31, 2020
Checked By: Leonard Beasley

Job No: 100.063
Project: Skyline at Lorson Ranch
Design Storm: **100-Year Event (Current)**

Street or Basin	Design Point	Area Design	Direct Runoff						Total Runoff				Street		Pipe			Travel Time			Remarks
			Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C5.1-ex			4.81	0.40	21.6	1.92	4.99	9.6													
C5.2-ex			13.32	0.36	25.8	4.80	4.54	21.8													
C5-ex	**5X**	18.13							31.5	6.72	4.05	27.2									

CORE
ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Skyline at Lorson Ranch*
PROJECT NUMBER: *100.063*
ENGINEER: *LAB*
DATE: *Oct. 31, 2020*

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
C5.1-ex	56	B	3.37	70.06%	0.09	0.06	0.36	0.25	10%	Undeveloped
	75	D	1.44	29.94%	0.16	0.05	0.51	0.15	10%	Undeveloped
			4.81	100.00%		0.11		0.40		
C5.2-ex	56	B	13.01	97.67%	0.09	0.09	0.36	0.35	10%	Undeveloped
	75	D	0.31	2.33%	0.16	0.00	0.51	0.01	10%	Undeveloped
			13.32	100.00%		0.09		0.36		

18

15 **Standard Form SF-1. Time of Concentration-Current**

15 CORE ENGINEERING GROUP

15 Calculated By: Leonard Beasley Job No: 100.063

15 Date: Oct. 31, 2019 Project: Skyline at Lorson Ranch

15 Checked By: Leonard Beasley

	Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
12 12 12	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)
25	C5.1-ex	0.11	4.81	7.0	300.00	4.80%	0.27	18.51	285.00	4.80%	1.53	3.10	21.60	21.60
25	C5.2-ex	0.09	13.32	7.0	300.00	4.80%	0.26	18.88	644.00	4.90%	1.55	6.93	25.81	25.81
25	(C5-ex) **5X**	0.10	18.13	7.0	300.00	4.80%	0.27	18.69	285.00	4.80%	1.53	3.10		
25				15.0					940.00	1.17%	1.62	9.66	31.45	31.45

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

Calculated By: Leonard Beasley
Date: Nov. 4, 2020
Checked By: Leonard Beasley

Job No: 100.063
Project: Skyline at Lorson Ranch
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)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C5.1-ex			4.81	0.11	21.6	0.53	2.97	1.6													
C10.7			3.17	0.45	13.5	1.43	3.68	5.3													
C10.7 & C5.1-ex	**38**	7.98							15.6	1.96	3.46	6.8									
C10.8			1.89	0.45	12.5	0.85	3.80	3.2													
C10.9			3.82	0.46	15.7	1.76	3.45	6.1													
C10.6			0.56	0.49	6.1	0.27	4.88	1.3													
C10.6 - C10.9 & C5.1-ex		14.25							20.6	4.84	3.05	14.7									
C10.10a			3.75	0.45	8.3	1.69	4.41	7.4													
C10.10a	**38a**	3.75							8.3	1.69	4.41	7.4									
C10.10b	38b		1.67	0.45	13.6	0.75	3.67	2.8													
C10.10c	38c		1.54	0.45	6.9	0.69	4.70	3.3													

CORE
ENGINEERING GROUP

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

Calculated By: Leonard Beasley
Date: Nov. 4, 2019
Checked By: Leonard Beasley

Job No: 100.063
Project: Skyline at Lorson Ranch
Design Storm: **100 - Year Event (Proposed)**

Street or Basin	Design Point	Area Design	Direct Runoff						Total Runoff				Street		Pipe			Travel Time			Remarks
			Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C5.1-ex			4.81	0.40	21.6	1.92	4.99	9.6													
C10.7			3.17	0.59	13.5	1.87	6.18	11.6													
C5.1-ex & C10.7	**38**	7.98							15.6	3.79	5.82	22.1									
C10.8			1.89	0.59	12.5	1.12	6.37	7.1													
C10.9			3.82	0.53	15.7	2.02	5.79	11.7													
C10.6			0.56	0.65	6.1	0.36	8.19	3.0													
C10.6-C10.9 & C5.1-ex		14.25							20.6	7.30	5.11	37.3									
C10.10a			3.75	0.59	8.3	2.21	7.40	16.4													
C10.10a	**38a**	3.75							8.3	2.21	7.40	16.4									
C10.10b	38b		1.67	0.60	13.6	1.00	6.17	6.2													
C10.10c	38c		1.54	0.59	6.9	0.91	7.89	7.2													

2 15 10 10 15 15 15 15 15 15 28

CORE ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: Skyline at Lorson Ranch
PROJECT NUMBER: 100.063
ENGINEER: LAB
DATE: Nov. 2, 2020

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
C5.1-ex	56	B	3.37	70.06%	0.09	0.06	0.36	0.25	2%	Historic / Offsite
	75	D	1.44	29.94%	0.16	0.05	0.51	0.15	2%	Historic / Offsite
			4.81	100.00%		0.11		0.40		
C10.7	56	B	3.04	95.90%	0.45	0.43	0.59	0.57	65%	1/8 ac. Single Family
	75	D	0.13	4.10%	0.49	0.02	0.65	0.03	65%	1/8 ac. Single Family
			3.17	100.00%		0.45		0.59		
C10.8	56	B	1.89		0.45		0.59		65%	1/8 ac. Single Family
C10.9	56	B	3.26	85.34%	0.45	0.38	0.59	0.50	65%	1/8 ac. Single Family
	52	C	0.56	14.66%	0.49	0.07	0.65	0.10	65%	1/8 ac. Single Family
			3.82	100.00%		0.46		0.60		
C10.6	52	C	0.56		0.49		0.65		65%	1/8 ac. Single Family
C10.10a	56	B	3.75		0.45		0.59		65%	1/8 ac. Single Family
C10.10b	56	B	1.50	89.82%	0.45	0.40	0.59	0.53	65%	1/8 ac. Single Family
	75	D	0.17	10.18%	0.49	0.05	0.65	0.07	65%	1/8 ac. Single Family
			1.67	100.00%		0.45		0.60		
C10.10c	56	B	1.76		0.45		0.59		65%	1/8 ac. Single Family

NRCS Conveyance

Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
2.5	5	7	10	15	20

APPENDIX C – HYDRAULIC CALCULATIONS

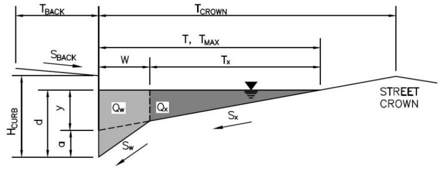
Version 4.05 Released March 2017

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

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

Project: Skyline at Lorson Ranch, 100.063

Inlet ID: Inlet DP-38a



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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 =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.018	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	9.3	9.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.0	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**14.3**	**14.3**	**cfs**
Flow Velocity within the Gutter Section	V =	6.5	6.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.1	3.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	16.7	26.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	24.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.357	0.224	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	8.8	33.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.8	30.8	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.9	9.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	13.7	42.1	cfs
Average Flow Velocity Within the Gutter Section	V =	6.5	8.5	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.0	5.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**13.7**	**32.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.52	7.19	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	1.60	inches

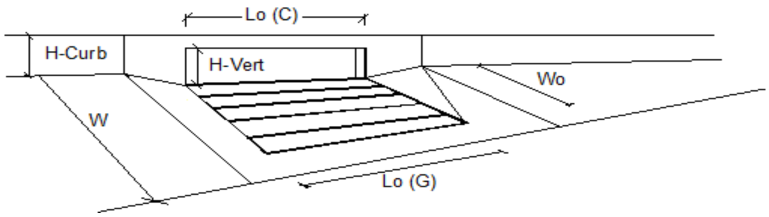
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**13.7**	**14.3**	**cfs**

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

WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	20.00	20.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MAJOR STORM		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**7.4**	**16.4**	cfs
Water Spread Width	T =	13.0	17.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.6	5.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.2	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.458	0.331	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	4.0	11.0	cfs
Discharge within the Gutter Section W	Q_w =	3.4	5.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.60	0.80	sq ft
Velocity within the Gutter Section W	V_W =	5.6	6.8	fps
Water Depth for Design Condition	d_{LOCAL} =	7.6	8.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.106	0.082	ft/ft
Required Length L_T to Have 100% Interception	L_T =	15.06	25.40	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.06	20.00	ft
Interception Capacity	Q_i =	7.4	15.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.33	1.33	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.03	0.03	
Effective (Unclogged) Length	L_e =	17.34	17.34	ft
Actual Interception Capacity	**Q_a =**	**7.4**	**15.2**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**1.2**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**7.4**	**15.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**93**	**%**

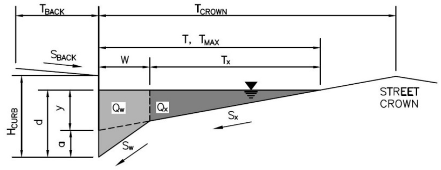
Version 4.05 Released March 2017

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

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

Project: Skyline at Lorson Ranch, 100.063

Inlet ID: Inlet DP-38b



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		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 =	0.027		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.018		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.5	5.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**15.8**	**15.8**	**cfs**
Flow Velocity within the Gutter Section	V =	7.2	7.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.4	3.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	16.7	26.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	24.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.357	0.224	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.7	36.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.7	34.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	5.4	10.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	15.1	46.4	cfs
Average Flow Velocity Within the Gutter Section	V =	7.2	9.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.3	6.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.66	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**15.1**	**30.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.52	6.85	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	1.26	inches

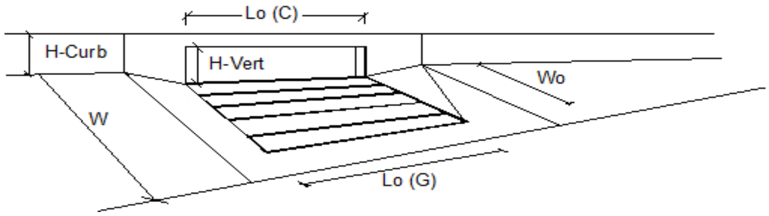
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**15.1**	**15.8**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**2.8**	**6.2**	cfs
Water Spread Width	T =	7.9	11.5	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.694	0.511	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.9	3.0	cfs
Discharge within the Gutter Section W	Q_w =	1.9	3.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.40	0.55	sq ft
Velocity within the Gutter Section W	V_W =	4.8	5.8	fps
Water Depth for Design Condition	d_{LOCAL} =	6.4	7.3	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.150	0.116	ft/ft
Required Length L_T to Have 100% Interception	L_T =	7.91	13.35	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	7.91	13.35	ft
Interception Capacity	Q_i =	2.8	6.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	13.03	13.03	ft
Actual Interception Capacity	**Q_a =**	**2.8**	**6.2**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.8**	**6.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

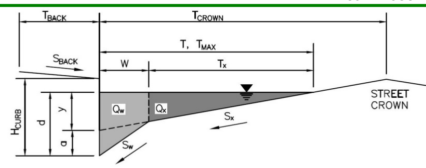
Version 4.05 Released March 2017

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

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

Project: Skyline at Lorson Ranch, 100.063

Inlet ID: Inlet DP-38c



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	0.018	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

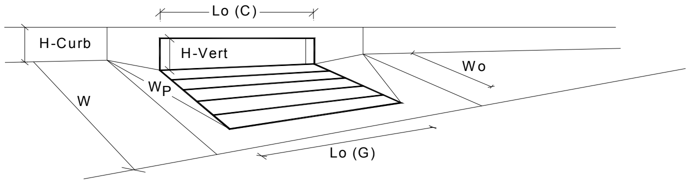
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	16.7	26.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	24.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.357	0.224	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	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) =	10.00	10.00	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	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.5	7.7	cfs
Interception with Clogging	Q_{wa} =	3.3	7.2	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.8	19.0	cfs
Interception with Clogging	Q_{oa} =	15.8	17.8	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.2	11.3	cfs
Interception with Clogging	Q_{ma} =	6.7	10.6	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**3.3**	**7.2**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.9	17.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.1	inches

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} =	0.20	0.31	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.54	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.82	0.92	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**3.3**	**7.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.3	7.2	cfs

POND C4 CALCULATIONS TAKEN FROM PUD/SP 21-006

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**R. Schindler**
Company:	**Core Engineering Group**
Date:	**March 3, 2022**
Project:	**Skyline at Lorson Ranch**
Location:	**Pond C4 - forebay design for 30" RCP from Skyline**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 55.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.550

C) Contributing Watershed Area — Area = 6.960 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = ____ in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$) — V_{DESIGN}= ____ ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$) — $V_{DESIGN\ OTHER}$= ____ ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$= 0.120 ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
- i) Percentage of Watershed consisting of Type A Soils — HSG_A = ____ %
- ii) Percentage of Watershed consisting of Type B Soils — HSG_B = ____ %
- iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = ____ %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— $EURV_{DESIGN}$ = ____ ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$= ____ ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: ____

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV) — V_{FMIN} = 0.002 ac-ft

B) Actual Forebay Volume — V_F = 0.0047 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 28.60 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.57 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ____ in

G) Rectangular Notch Width — Calculated W_N = 4.7 in

Channel Report

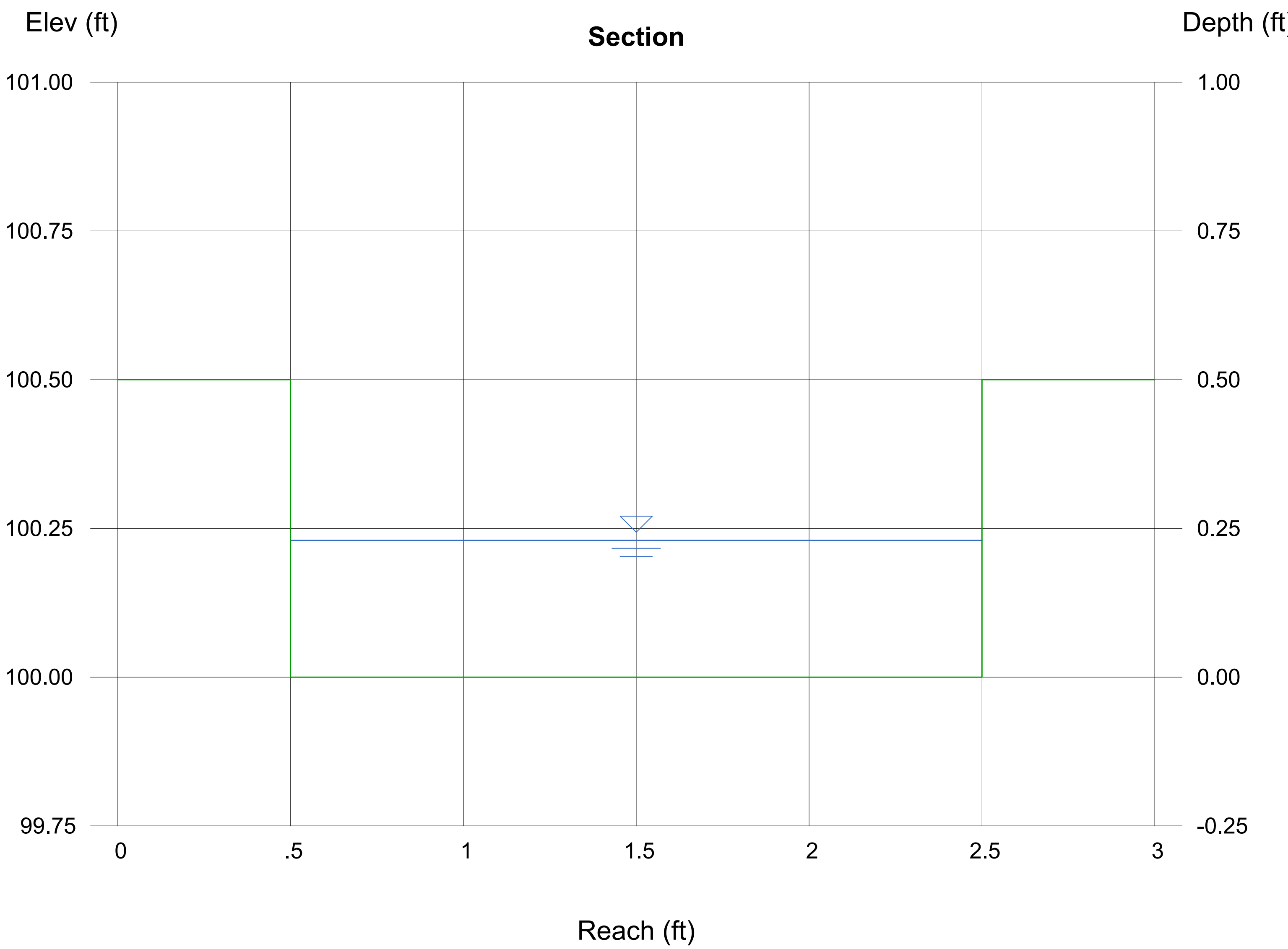
low flow for skyline forebay from 30-inch pipe- 2x0.57=1.14cfs

Rectangular
Botom Width (ft) = 2.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 1.14

Highlighted
Depth (ft) = 0.23
Q (cfs) = 1.140
Area (sqft) = 0.46
Velocity (ft/s) = 2.48
Wetted Perim (ft) = 2.46
Crit Depth, Yc (ft) = 0.22
Top Width (ft) = 2.00
EGL (ft) = 0.33

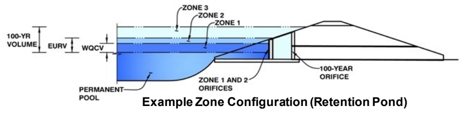


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: The Hills at Lorson Ranch

Basin ID: Pond C4



Example Zone Configuration (Retention Pond)

micropool = 0 = 5765

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	81.00	acres		
Watershed Length =	2,300	ft		
Watershed Length to Centroid =	1,200	ft		
Watershed Slope =	0.050	ft/ft		
Watershed Imperviousness =	55.00%	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		
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) =	1.488	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	4.468	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.607	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.475	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.109	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.045	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	11.748	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	13.830	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	18.178	acre-feet		inches
Approximate 2-yr Detention Volume =	3.723	acre-feet		
Approximate 5-yr Detention Volume =	5.293	acre-feet		
Approximate 10-yr Detention Volume =	6.364	acre-feet		
Approximate 25-yr Detention Volume =	6.876	acre-feet		
Approximate 50-yr Detention Volume =	7.136	acre-feet		
Approximate 100-yr Detention Volume =	7.948	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.488	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.980	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	4.225	acre-feet
Total Detention Basin Volume =	8.692	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 = 0.20 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	--	--	--	40	0.001		
5765.33	--	0.33	--	--	--	50	0.001	15	0.000
5766	--	1.00	--	--	--	630	0.014	243	0.006
5767	--	2.00	--	--	--	40,811	0.937	20,962	0.481
5768	--	3.00	--	--	--	49,929	1.146	66,332	1.523
5769	--	4.00	--	--	--	52,779	1.212	117,686	2.702
5770	--	5.00	--	--	--	55,690	1.278	171,921	3.947
5771	--	6.00	--	--	--	58,660	1.347	229,096	5.259
5772	--	7.00	--	--	--	61,704	1.417	289,278	6.641
5773	--	8.00	--	--	--	64,811	1.488	352,535	8.093
5774	--	9.00	--	--	--	67,980	1.561	418,931	9.617
5775	--	10.00	--	--	--	71,215	1.635	488,528	11.215
5776	--	11.00	--	--	--	75,000	1.722	561,636	12.893
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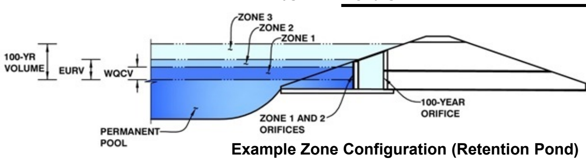
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **The Hills at Lorson Ranch**

Basin ID: **Pond C4**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.97	1.488	Orifice Plate
Zone 2 (EURV)	5.41	2.980	Rectangular Orifice
Zone 3 (100+1/2WQCV)	8.40	4.225	Weir&Pipe (Restrict)
	Total (all zones)	8.692	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.97	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	11.90	inches
Orifice Plate: Orifice Area per Row =	4.68	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	3.250E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.99	1.98					
Orifice Area (sq. inches)	4.68	4.68	4.68					

	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 =	2.97	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	5.41	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	6.00	N/A	inches
Vertical Orifice Width =	16.39		inches

Calculated Parameters for Vertical Orifi

	Zone 2 Rectangular	Not Selected
Vertical Orifice Area =	0.68	N/A
Vertical Orifice Centroid =	0.25	N/A

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	
Overflow Weir Front Edge Height, Ho =	5.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow We

	Zone 3 Weir	Not Selected
Height of Grate Upper Edge, H_t =	5.50	N/A
Overflow Weir Slope Length =	6.00	N/A
Grate Open Area / 100-yr Orifice Area =	8.02	N/A
Overflow Grate Open Area w/o Debris =	25.20	N/A
Overflow Grate Open Area w/ Debris =	12.60	N/A

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 =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

	Zone 3 Restrictor	Not Selected
Outlet Orifice Area =	3.14	N/A
Outlet Orifice Centroid =	1.00	N/A
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	10.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.13	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.87	feet
Stage at Top of Freeboard =	13.00	feet
Basin Area at Top of Freeboard =	1.72	acres
Basin Volume at Top of Freeboard =	12.89	acre-ft

micropool = 0 = 5765

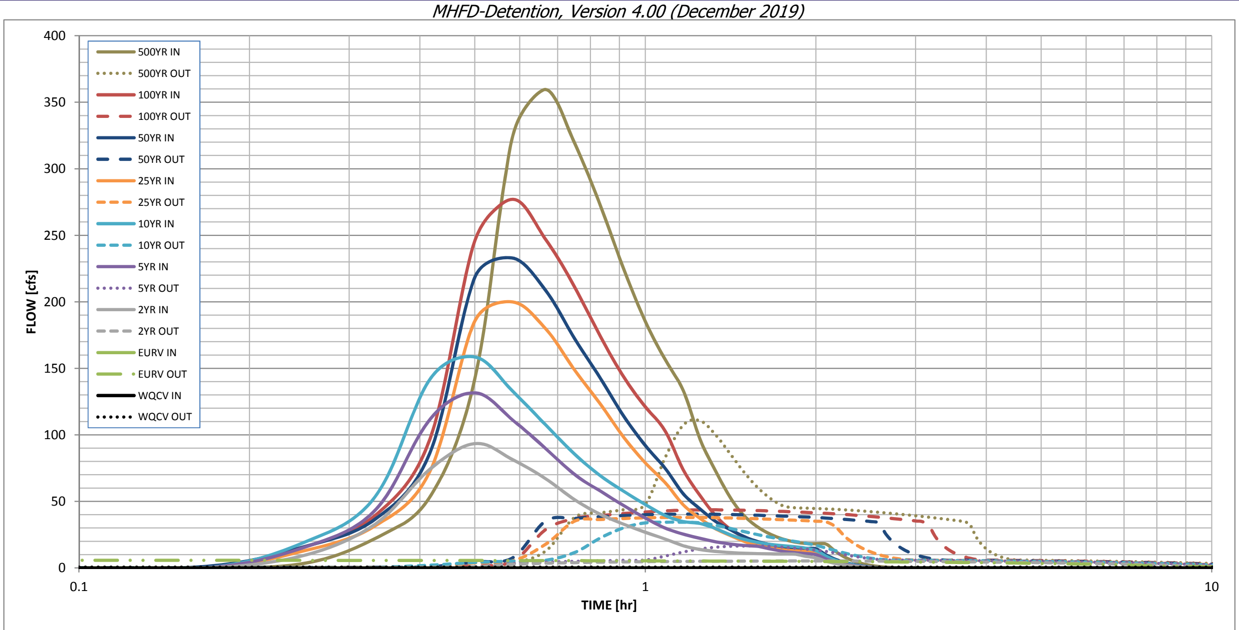
Routed Hydrograph Results

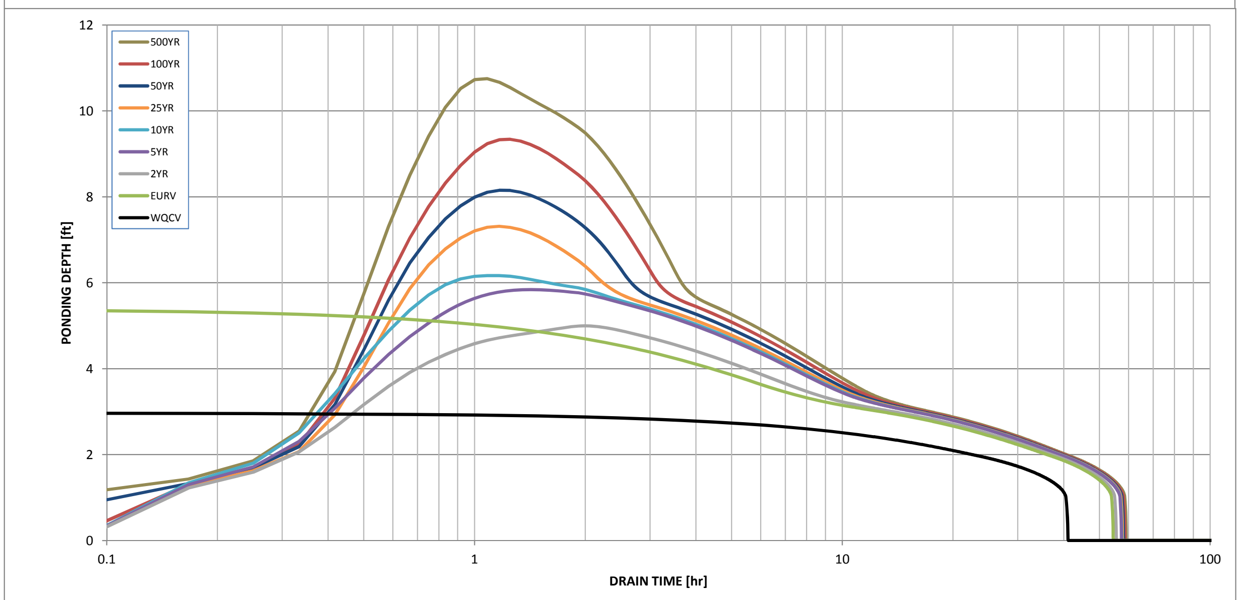
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

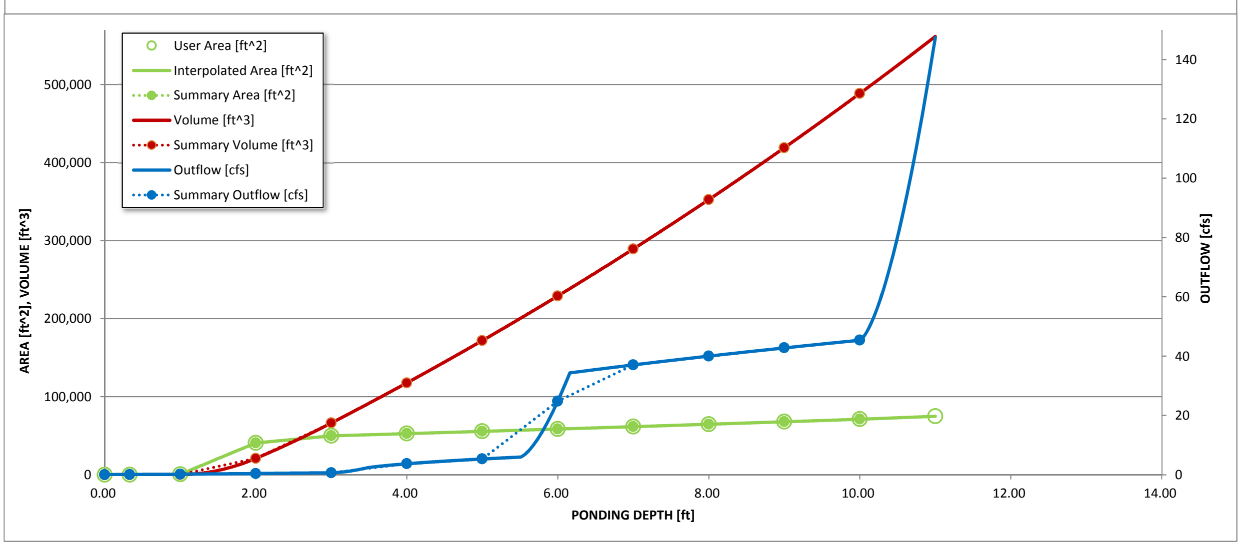
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	1.488	4.468	4.607	6.475	8.109	10.045	11.748	13.830
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.607	6.475	8.109	10.045	11.748	13.830
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	17.5	39.6	56.8	90.6	111.9	138.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.22	0.49	0.70	1.12	1.38	1.71
Peak Inflow Q (cfs) =	N/A	N/A	93.5	131.6	158.6	200.0	232.9	277.2
Peak Outflow Q (cfs) =	0.6	5.8	5.3	16.5	34.4	38.0	40.5	43.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.4	0.4	0.3
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.4	1.1	1.2	1.3	1.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	48	49	49	47	45	44	42
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	53	54	53	53	53	52
Maximum Ponding Depth (ft) =	2.97	5.41	5.00	5.84	6.17	7.31	8.15	9.34
Area at Maximum Ponding Depth (acres) =	1.14	1.31	1.28	1.34	1.36	1.44	1.50	1.59
Maximum Volume Stored (acre-ft) =	1.488	4.477	3.934	5.031	5.476	7.083	8.317	10.152

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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: *.\Outflow Hydrographs-pond C4.xlsx*

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	1.08	0.11	3.48
	0:15:00	0.00	0.00	9.55	15.60	19.32	12.98	16.07	15.80	22.32
	0:20:00	0.00	0.00	32.92	43.38	53.47	31.67	36.70	39.53	53.64
	0:25:00	0.00	0.00	74.34	111.85	142.03	72.79	86.79	97.17	142.25
	0:30:00	0.00	0.00	93.50	131.62	158.60	185.73	218.67	246.14	324.95
	0:35:00	0.00	0.00	81.33	111.11	132.69	199.96	232.94	277.21	359.64
	0:40:00	0.00	0.00	67.06	89.76	107.50	179.81	208.60	246.90	319.22
	0:45:00	0.00	0.00	51.28	70.23	85.54	148.69	172.31	211.27	272.12
	0:50:00	0.00	0.00	40.21	57.70	69.19	122.99	142.40	173.74	224.11
	0:55:00	0.00	0.00	32.87	46.75	57.49	97.93	113.76	143.17	185.13
	1:00:00	0.00	0.00	26.74	37.48	47.65	78.91	91.95	121.14	156.73
	1:05:00	0.00	0.00	21.83	29.98	39.43	64.22	74.98	103.05	133.25
	1:10:00	0.00	0.00	16.70	25.41	34.92	47.41	55.74	73.66	96.29
	1:15:00	0.00	0.00	13.82	22.23	33.34	37.17	44.19	54.17	72.10
	1:20:00	0.00	0.00	12.38	19.62	29.44	29.18	34.65	38.85	51.95
	1:25:00	0.00	0.00	11.55	17.93	24.66	24.13	28.54	28.70	38.45
	1:30:00	0.00	0.00	11.12	16.83	21.38	19.70	23.24	22.76	30.51
	1:35:00	0.00	0.00	10.79	16.17	19.14	16.72	19.67	18.74	25.11
	1:40:00	0.00	0.00	10.57	14.11	17.68	14.89	17.48	16.17	21.68
	1:45:00	0.00	0.00	10.43	12.53	16.70	13.64	15.97	14.54	19.48
	1:50:00	0.00	0.00	10.39	11.49	15.99	12.96	15.14	13.84	18.51
	1:55:00	0.00	0.00	8.80	10.81	14.89	12.55	14.64	13.56	18.10
	2:00:00	0.00	0.00	7.56	10.02	13.19	12.34	14.40	13.50	18.01
	2:05:00	0.00	0.00	5.14	6.81	8.96	8.46	9.87	9.31	12.40
	2:10:00	0.00	0.00	3.31	4.38	5.83	5.51	6.42	6.07	8.07
	2:15:00	0.00	0.00	2.13	2.77	3.73	3.57	4.15	3.92	5.21
	2:20:00	0.00	0.00	1.28	1.69	2.28	2.18	2.54	2.39	3.17
	2:25:00	0.00	0.00	0.73	1.04	1.36	1.35	1.57	1.48	1.96
	2:30:00	0.00	0.00	0.36	0.56	0.70	0.74	0.85	0.80	1.06
	2:35:00	0.00	0.00	0.14	0.23	0.27	0.31	0.35	0.33	0.43
	2:40:00	0.00	0.00	0.03	0.05	0.05	0.06	0.07	0.06	0.08
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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 4.02 (February 2020)

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]
micropool	0.00	40	0.001	0	0.000	0.00
surcharge	0.33	50	0.001	15	0.000	0.09
5766	1.00	630	0.014	243	0.006	0.17
5767	2.00	40,811	0.937	20,962	0.481	0.40
5768	3.00	49,929	1.146	66,332	1.523	0.66
5769	4.00	52,779	1.212	117,686	2.702	3.71
5770	5.00	55,690	1.278	171,921	3.947	5.32
5771	6.00	58,660	1.347	229,096	5.259	24.83
5772	7.00	61,704	1.417	289,278	6.641	37.05
5773	8.00	64,811	1.488	352,535	8.093	40.02
5774	9.00	67,980	1.561	418,931	9.617	42.78
5775	10.00	71,215	1.635	488,528	11.215	45.38

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).

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**May 4, 2020**
Project:	**The Hills at Lorson Ranch**
Location:	**Pond C4**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 55.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.550

C) Contributing Watershed Area — Area = 81.000 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = ____ in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * \text{Area}$) — V_{DESIGN}= 1.488 ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$ — $V_{DESIGN\ OTHER}$= ____ ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$= ____ ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
- i) Percentage of Watershed consisting of Type A Soils — HSG_A = ____ %
- ii) Percentage of Watershed consisting of Type B Soils — HSG_B = ____ %
- iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = ____ %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$ — $EURV_{DESIGN}$ = ____ ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$= ____ ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 3.00 ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: ____

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.045 ac-ft

B) Actual Forebay Volume — V_F = 0.050 ac-ft

C) Forebay Depth (D_F = 30 inch maximum) — D_F = 24.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 277.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 5.54 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ____ in

G) Rectangular Notch Width — Calculated W_N = 11.9 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Richard Schindler
Company: Core Engineering Group
Date: May 4, 2020
Project: The Hills at Lorson Ranch
Location: Pond C4

6. Trickle Channel

A) Type of Trickle Channel — Choose One: (●) Concrete ( ) Soft Bottom

F) Slope of Trickle Channel — S = 0.0050 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = 50 sq ft

C) Outlet Type — Choose One: (●) Orifice Plate ( ) Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 2.16 inches

E) Total Outlet Area — A_{ot} = 14.04 square inches

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) — D_{IS} = 4 in

B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) — V_{IS} = 194 cu ft

C) Initial Surcharge Provided Above Micropool — V_s= 16.7 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ — A_t = 440 square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) — *Other (Please describe below)*

wellscreen stainless

Other (Y/N): y

C) Ratio of Total Open Area to Total Area (only for type 'Other') — User Ratio = 0.6

D) Total Water Quality Screen Area (based on screen type) — A_{total} = 734 sq. in. **Based on type 'Other' screen ratio**

E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) — H= 2.97 feet

F) Height of Water Quality Screen (H_{TR}) — H_{TR}= 63.64 inches

G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended) — $W_{opening}$ = 12.0 inches **VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.**

Channel Report

Hydraflow Express by Intelisolve | Monday, May 4 2020, 6:54 AM

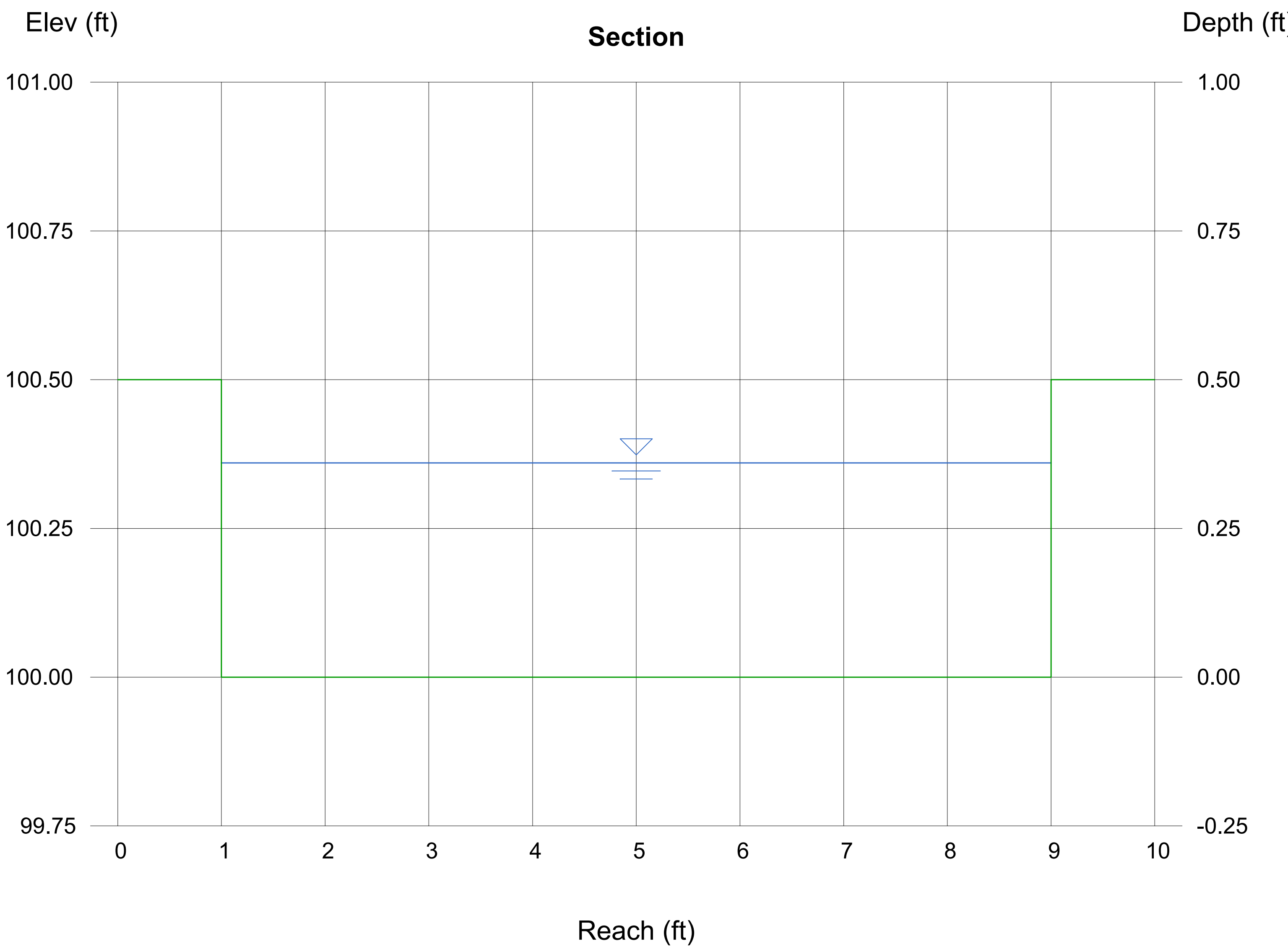
pond C4 low flow channel (2 x forebay release = 11.08cfs)

Rectangular
Botom Width (ft) = 8.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 11.08

Highlighted
Depth (ft) = 0.36
Q (cfs) = 11.08
Area (sqft) = 2.88
Velocity (ft/s) = 3.85
Wetted Perim (ft) = 8.72
Crit Depth, Yc (ft) = 0.40
Top Width (ft) = 8.00
EGL (ft) = 0.59



Weir Report

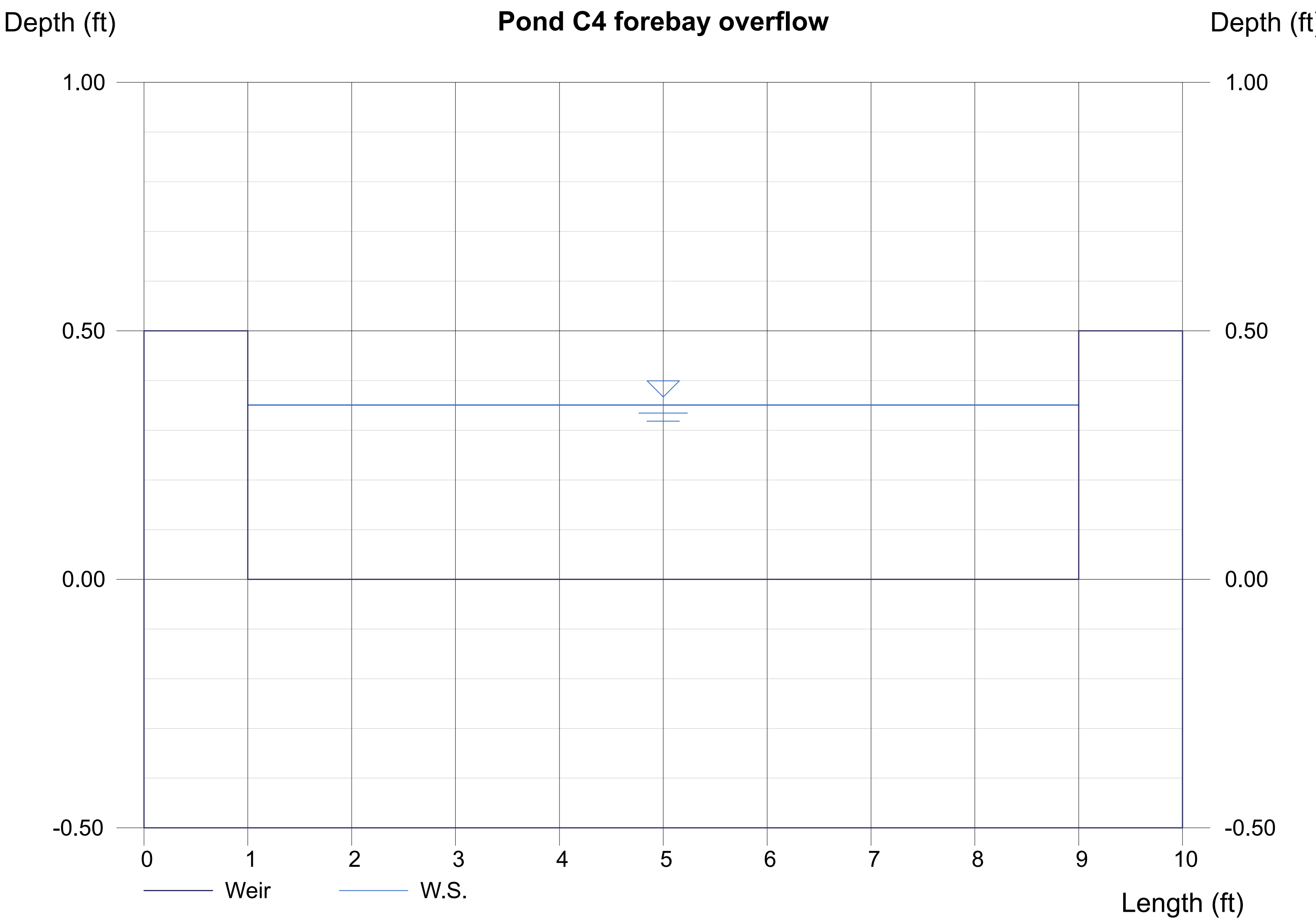
Hydraflow Express by Intelisolve | Monday, May 4 2020, 6:49 AM

Pond C4 forebay overflow

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 8.00
Total Depth (ft) = 0.50

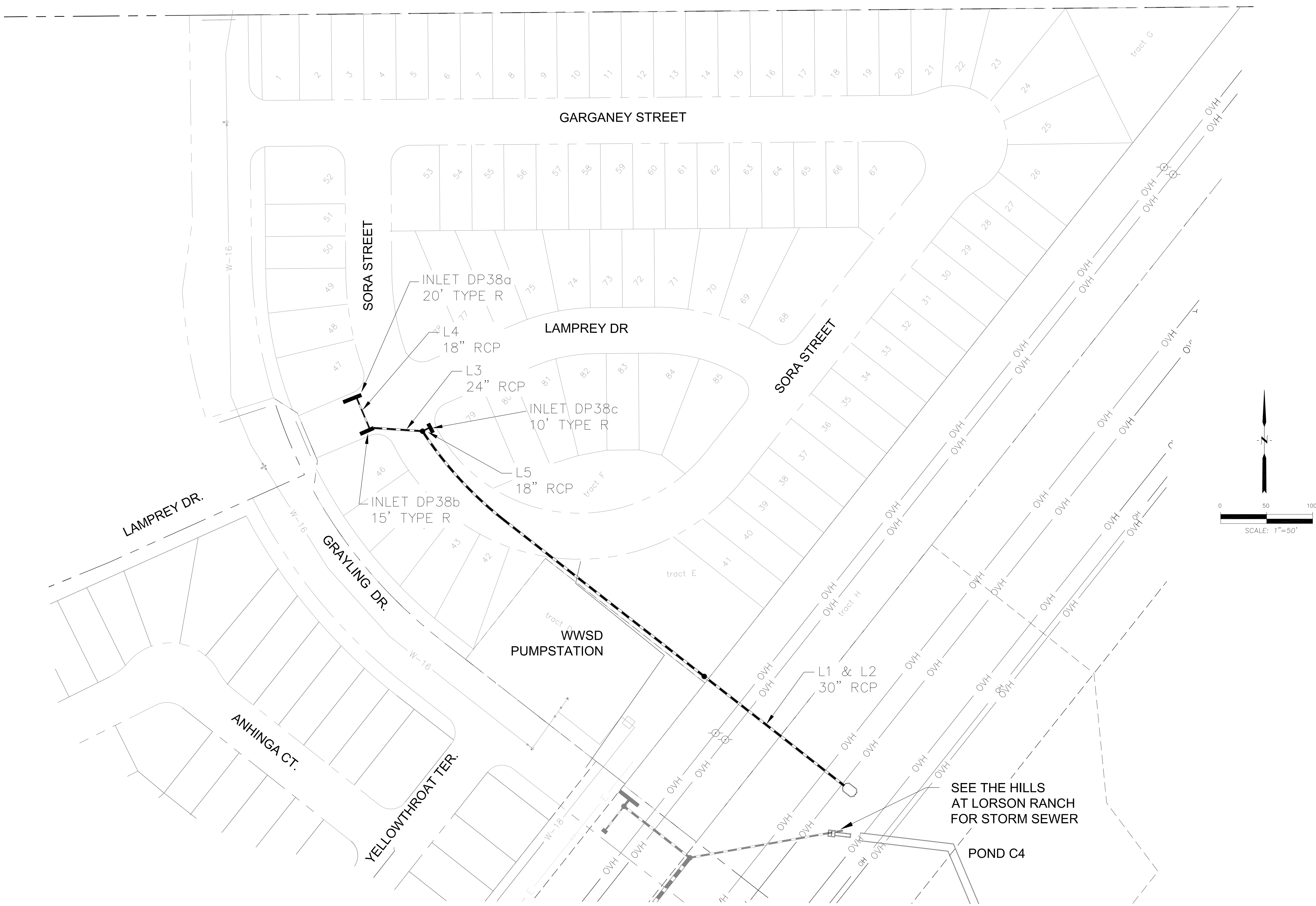
Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 5.54

Highlighted
Depth (ft) = 0.35
Q (cfs) = 5.540
Area (sqft) = 2.81
Velocity (ft/s) = 1.97
Top Width (ft) = 8.00



APPENDIX E– STORM SEWER SCHEMATIC AND HYDRAFLOW STORM SEWER CALCS

BASIN C10 STORM SCHEMATIC



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PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

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

PROJECT:
THE HILLS AT LORSON RANCH
FONTAINE BLVD. - WALLEYE DR
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

STORM SEWER SCHEMATIC
BASIN C10
SKYLINE AT LORSON RANCH

DATE
MAY 20, 2021

PROJECT NO.
100.063

SHEET NUMBER
1

TOTAL SHEETS: 1

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	13.50	30 c	193.0	5766.90	5768.06	0.601	5768.13	5769.29	n/a	5769.96 i	End
2	2	13.50	30 c	407.7	5768.16	5770.60	0.598	5769.96	5771.83	n/a	5772.50 i	1
3	3	10.20	24 c	58.1	5771.10	5771.51	0.705	5772.50	5772.64	n/a	5773.33 i	2
4	4	7.40	18 c	34.5	5772.01	5772.28	0.783	5773.33	5773.40	n/a	5773.95 i	3
5	5	3.30	18 c	7.1	5771.60	5771.74	1.985	5772.50	5772.44	n/a	5772.77 i	2

100.063-5yr STM	Number of lines: 5	Run Date: 05-02-2022

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; i - Inlet control.

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	28.60	30 c	193.0	5766.90	5768.06	0.601	5768.69	5769.98	n/a	5771.04 i	End
2	2	28.60	30 c	407.7	5768.16	5770.60	0.598	5771.04	5772.85	n/a	5773.26 i	1
3	3	21.40	24 c	58.1	5771.10	5771.51	0.705	5773.26*	5773.78*	n/a	5774.39 i	2
4	4	15.20	18 c	34.5	5772.01	5772.28	0.783	5774.39*	5775.11*	n/a	5776.02 i	3
5	5	7.20	18 c	7.1	5771.60	5771.74	1.985	5773.26*	5773.29*	0.26	5773.55	2

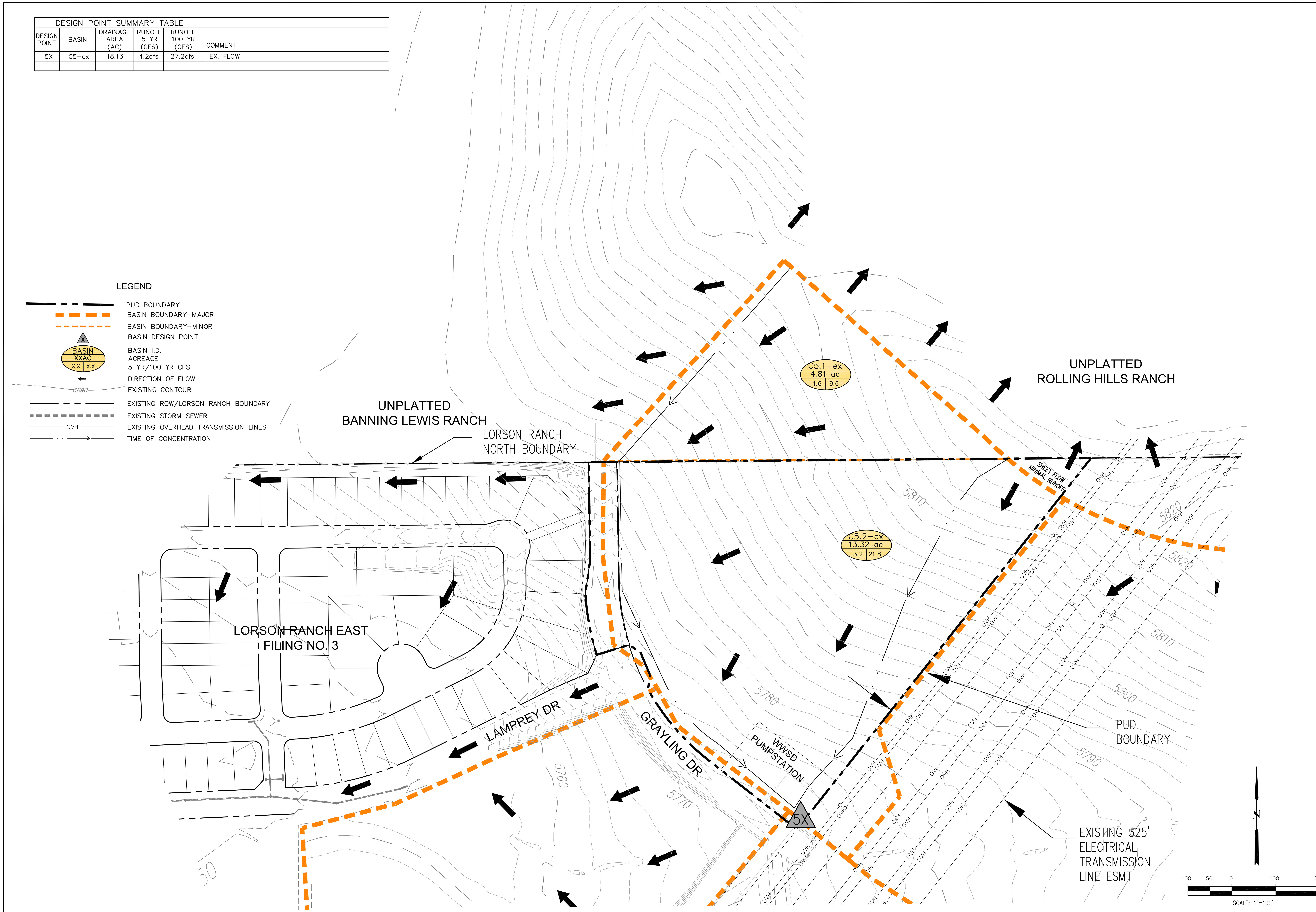
100.063-100yr STM	Number of lines: 5	Run Date: 05-02-2022

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; i - Inlet control.

MAP POCKET

DESIGN POINT SUMMARY TABLE

DESIGN POINT	BASIN	DRAINAGE AREA (AC)	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)	COMMENT
5X	C5-ex	18.13	4.2cfs	27.2cfs	EX. FLOW



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EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

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

PROJECT:
THE HILLS AT LORSON RANCH
EAST OF POWERLINES
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED:
CHECKED: RLS

EXISTING CONDITIONS PUD / PRELIMINARY PLAN SKYLINE AT LORSON RANCH

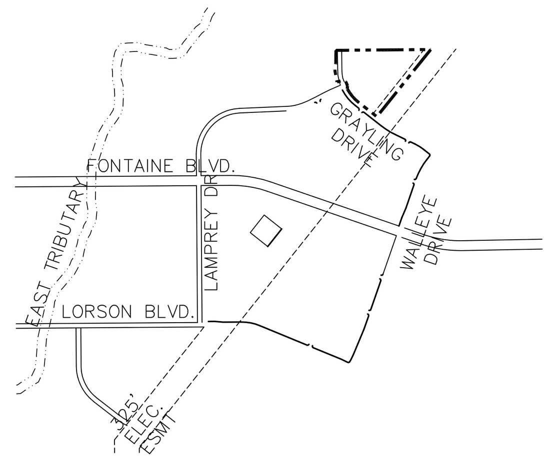
DATE: MAY 20, 2021
PROJECT NO. 100.063
SHEET NUMBER 1
TOTAL SHEETS: 1

LEGEND

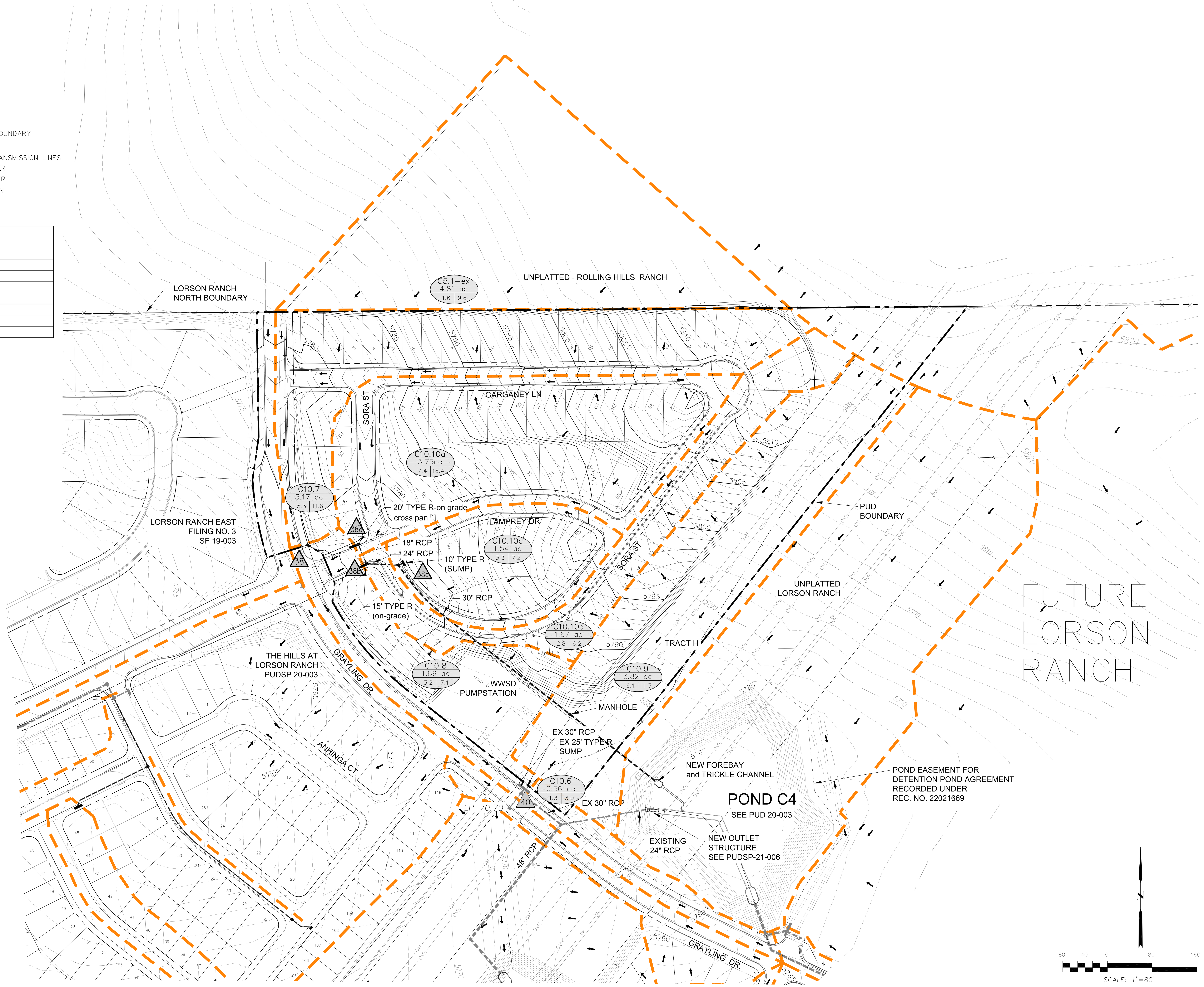
- PUD BOUNDARY
- BASIN BOUNDARY
- BASIN DESIGN POINT (X)
- DENOTES OVERALL BASIN — BASIN I.D. (BASIN), ACREAGE (XX AC), 5 YR/100 YR CFS (X.X | X.X)
- DIRECTION OF FLOW
- EXISTING CONTOUR (6690)
- PROPOSED CONTOUR (6670)
- ROW/LORSON RANCH BOUNDARY
- EXISTING STORM SEWER
- EXISTING OVERHEAD TRANSMISSION LINES (OVH)
- PROPOSED STORM SEWER
- PROPOSED CURB/GUTTER
- TIME OF CONCENTRATION
- HP — HIGH POINT
- LP — LOW POINT

RUNOFF SUMMARY

D.P.	AREA (acres)	5 YEAR cfs	100 YEAR cfs	NOTES
38	7.98 ac	6.8	22.1	STREET FLOW
38a	3.75 ac	7.4	16.4	STREET FLOW
38b	1.67 ac	2.8	6.2	STREET FLOW
38c	1.54 ac	3.3	7.2	STREET FLOW
40	14.25 ac	14.7	38.5	STREET FLOW



VICINITY MAP
NO SCALE



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NO.	DESCRIPTION	DATE

PREPARED FOR:
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(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
THE HILLS AT LORSON RANCH
FONTAINE BLVD - WALLEYE DRIVE
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

DEVELOPED CONDITIONS SKYLINE AT LORSON RANCH C10 BASIN

DATE
MARCH, 2022

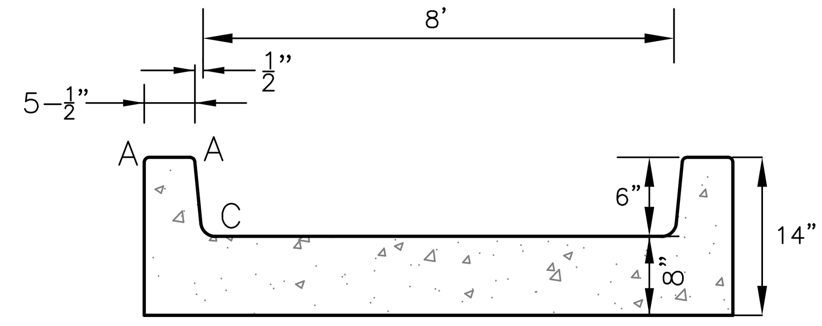
PROJECT NO.
100.063

SHEET NUMBER
1

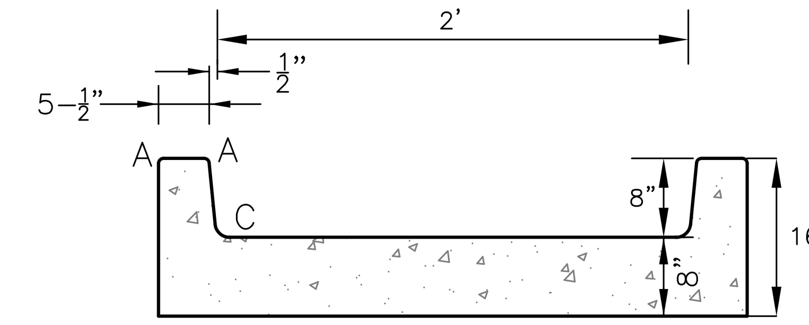
TOTAL SHEETS: 1

NOTES
1. ALL SPOT ELEVATIONS ARE FLOW LINE UNLESS OTHERWISE NOTED.
2. SEE GRADING PLAN FOR GRADING INFORMATION.
3. ALL STORM SEWER SHALL BE CLASS III RCP.
4. ALL MHs SHALL BE TYPE 1 UNLESS OTHERWISE NOTED.

1 CURVE DATA ID
2 CURB TRANSITIONS
3 PEDESTRIAN RAMP, SEE SHEET C10.1

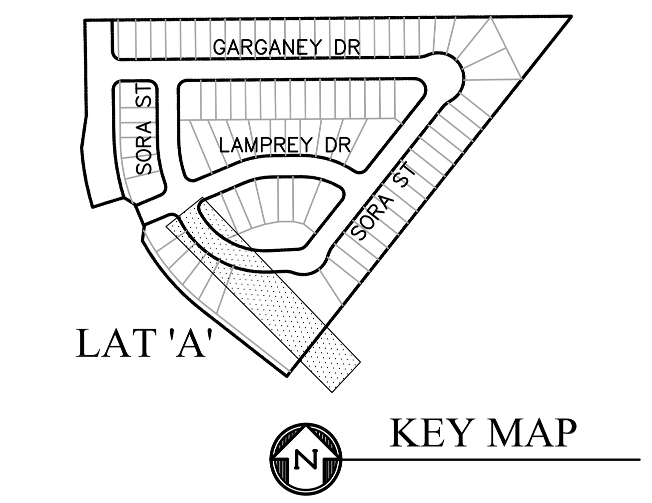


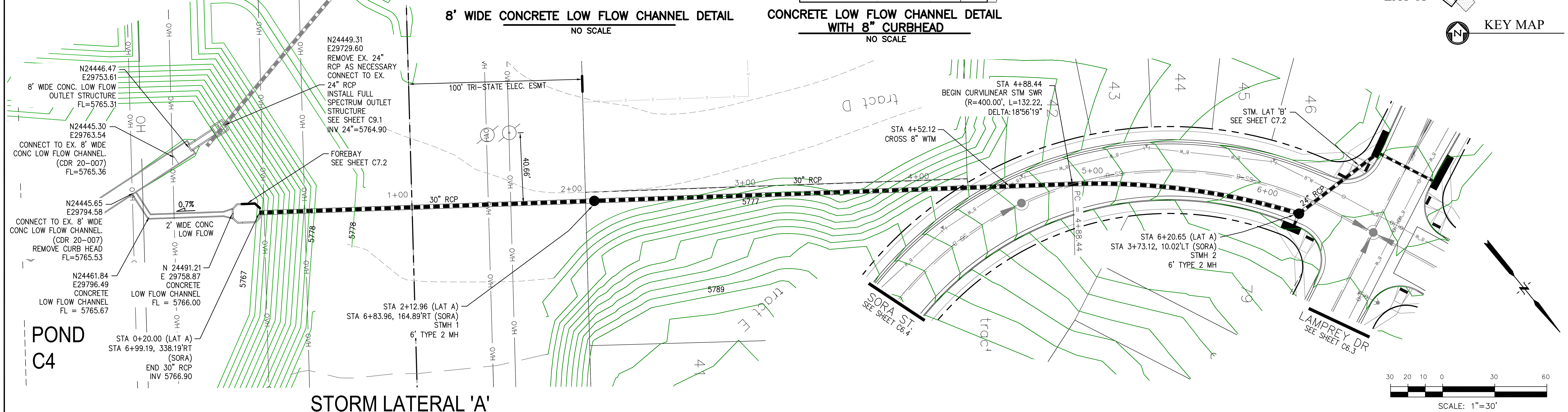
8' WIDE CONCRETE LOW FLOW CHANNEL DETAIL
NO SCALE



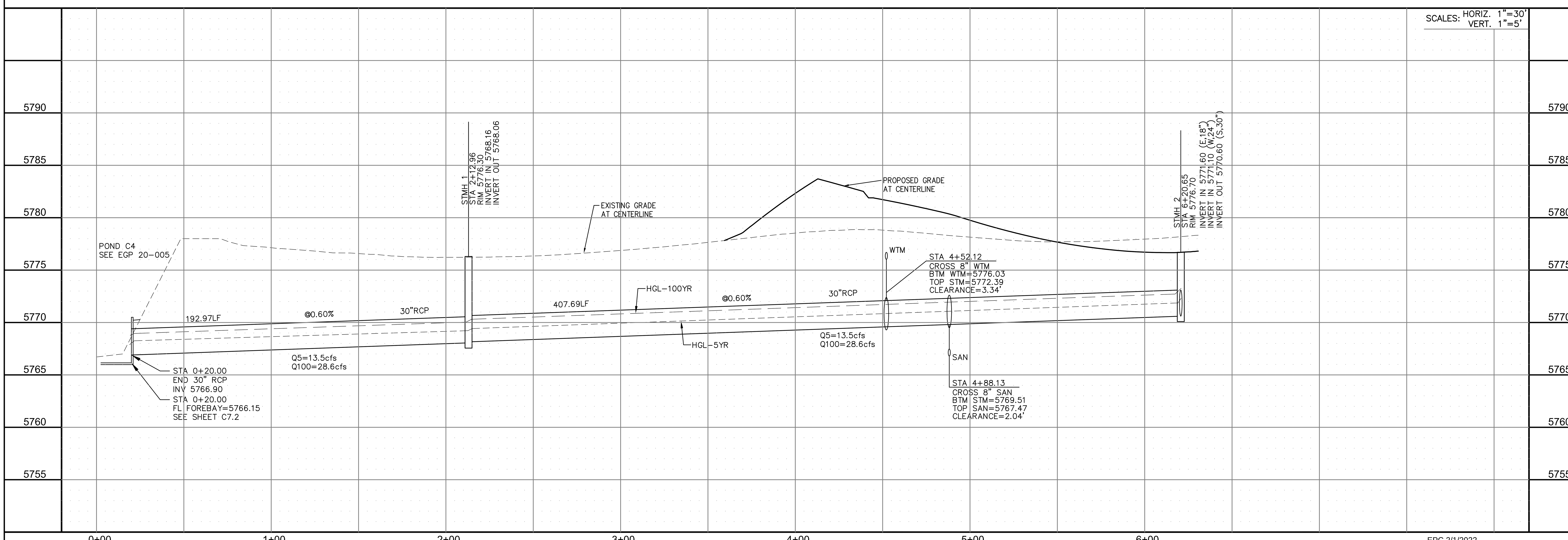
CONCRETE LOW FLOW CHANNEL DETAIL WITH 8" CURBHEAD
NO SCALE

LENGTH FOR RADII
A = 1/2"
C = 1-1/2"





STORM LATERAL 'A'



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NO.	DESCRIPTION	DATE

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(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
SKYLINE AT LORSON RANCH
GRAYLING DR – LAMPREY DR
COLORADO SPRINGS, COLORADO

DRAWN: RLS
DESIGNED: RLS
CHECKED: RLS

STORM SEWER LATERAL STORM LATERAL 'A' AND POND C4 IMPROVEMENTS

COLORADO LICENSED PROFESSIONAL ENGINEER 33997 9-15-2021

DATE: SEPT 15, 2021

PROJECT NO. 100.063

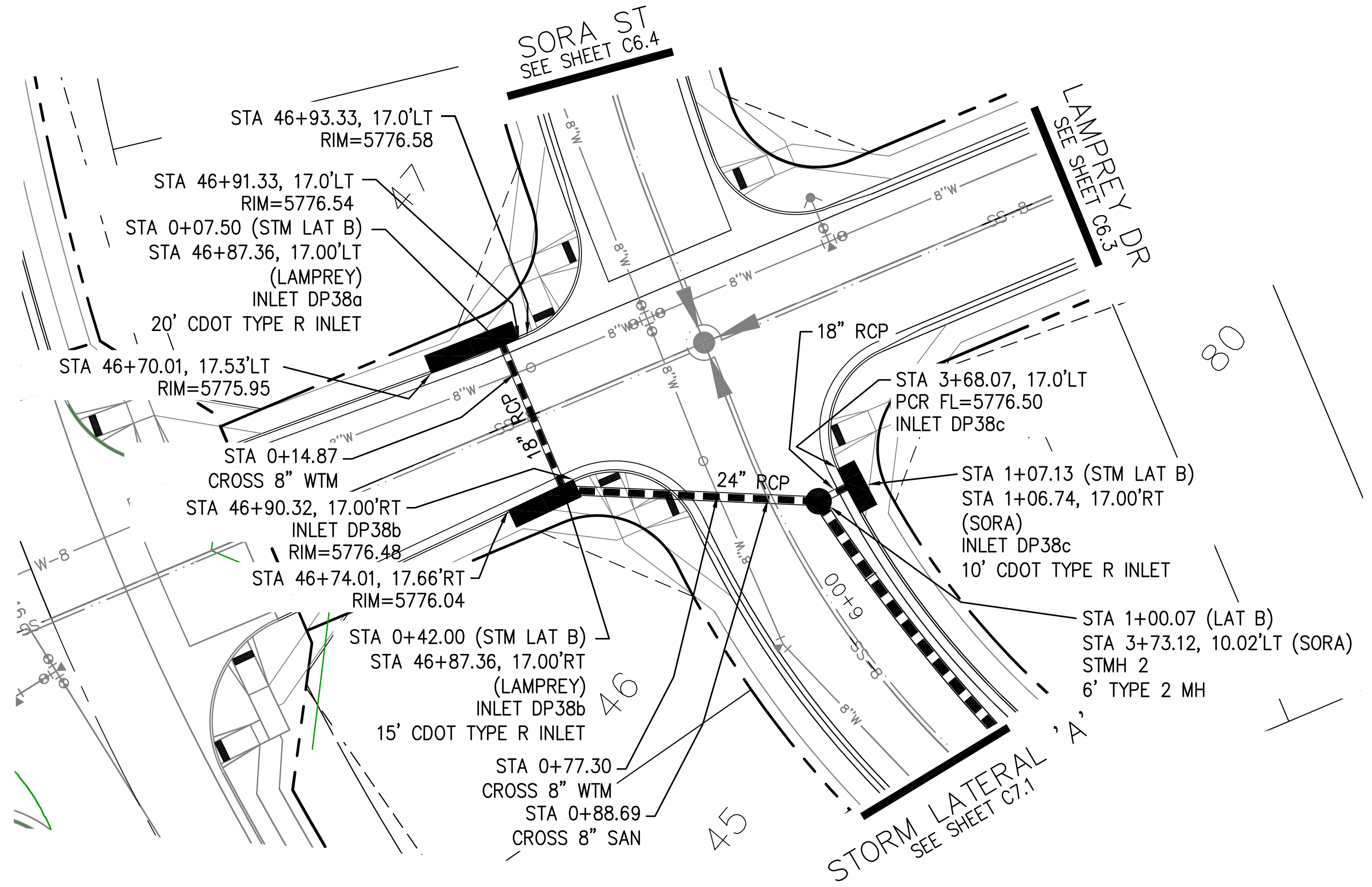
SHEET NUMBER C7.1

TOTAL SHEETS: 18

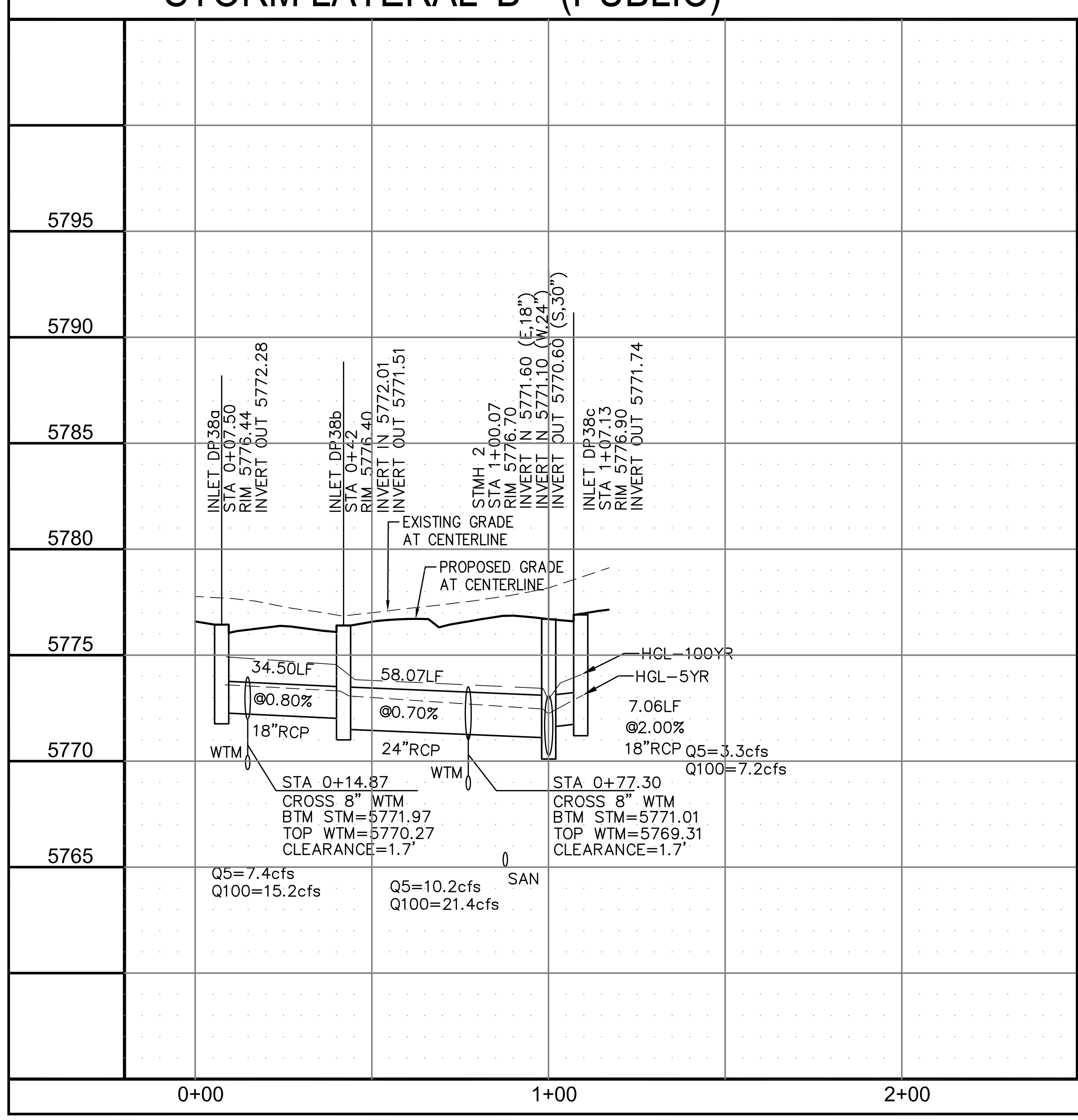
NOTES
1. ALL SPOT ELEVATIONS ARE FLOW LINE UNLESS OTHERWISE NOTED.
2. SEE GRADING PLAN FOR GRADING INFORMATION.
3. ALL STORM SEWER SHALL BE CLASS III RCP.
4. ALL MHs SHALL BE TYPE 1 UNLESS OTHERWISE NOTED.

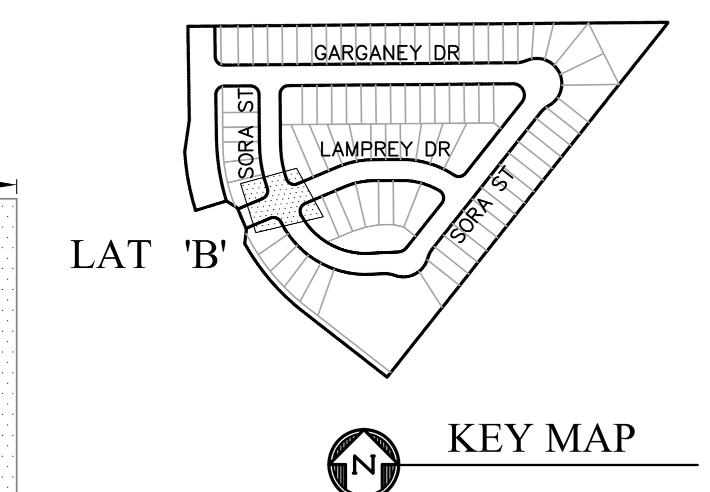
1 CURVE DATA ID
2 CURB TRANSITIONS
3 PEDESTRIAN RAMP, SEE SHEET C10.1

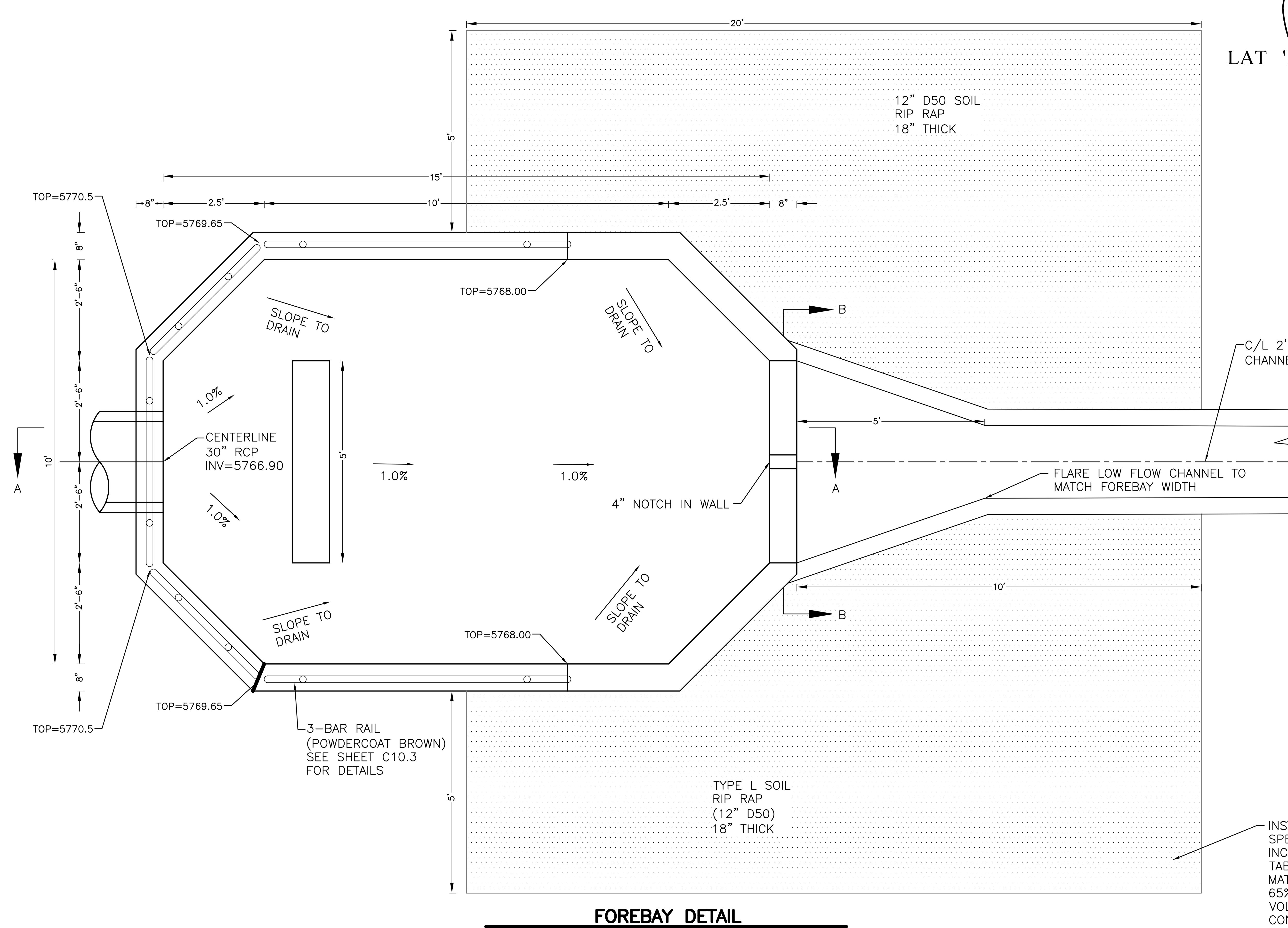
SCALE: 1"=30'



STORM LATERAL 'B' (PUBLIC)

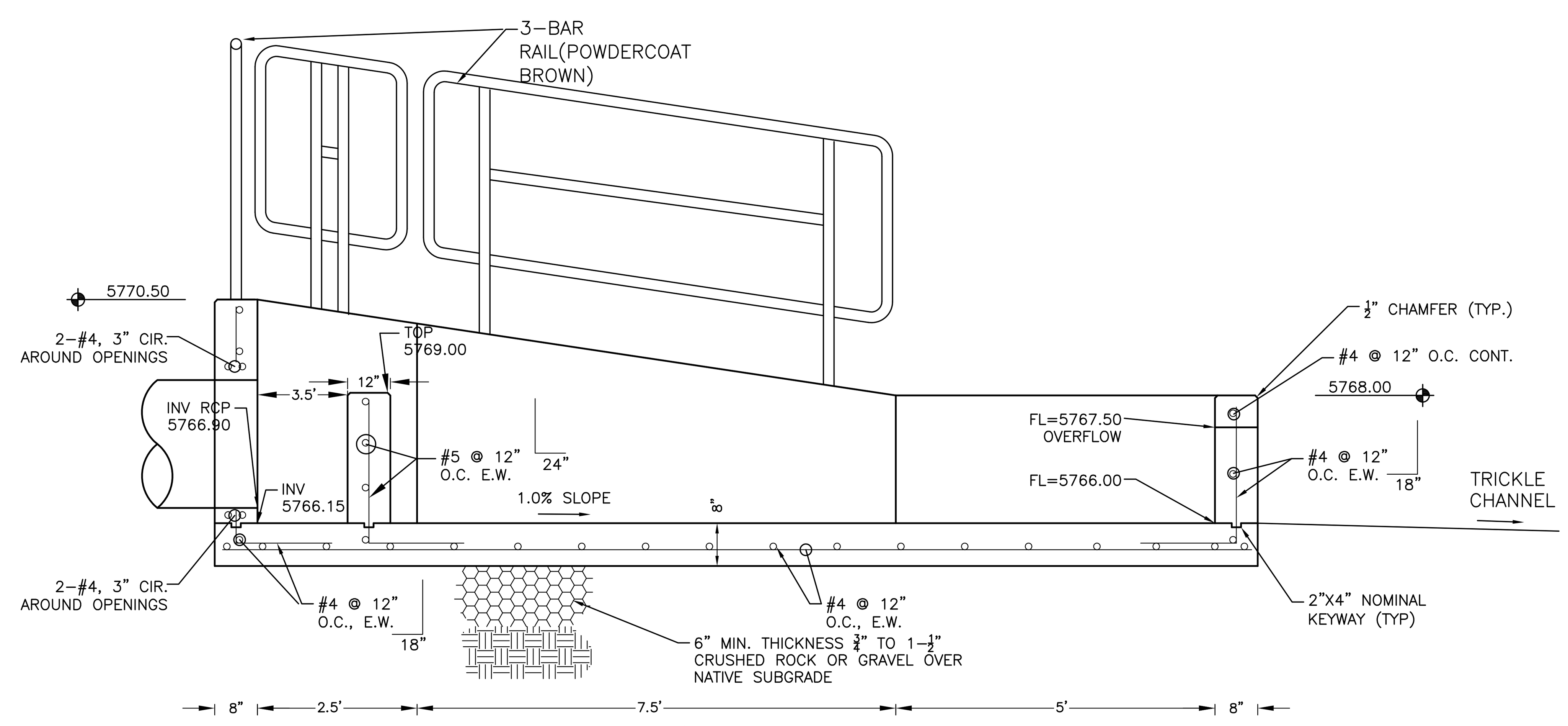




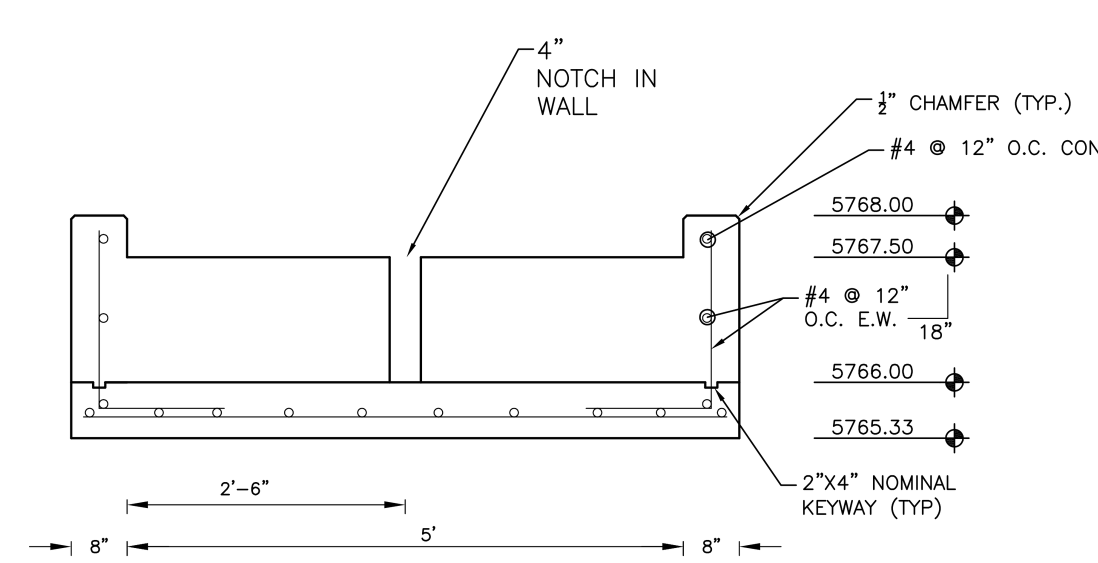


INSTALL SOIL RAP PER MHFD SPECIFICATION SECTION 31-37-00 INCLUDING RIP RAP SPECIFICATIONS IN TABLE 1 OF SAID SPECIFICATIONS SOIL MATERIAL SHALL BE TOPSOIL MIXED WITH 65% RIP RAP AND 35% TOPSOIL BY VOLUME. ALL SOIL RIP RAP SHALL CONSIST OF A UNIFORM MIXTURE OF SOIL AND RIP RAP WITHOUT VOIDS.

FOREBAY DETAIL
NO SCALE



FOREBAY SECTION A-A
NO SCALE



FOREBAY SECTION B-B
NO SCALE

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PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

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

PROJECT:
SKYLINE AT LORSON RANCH
GRAYLING DR - LAMPREY DR
COLORADO SPRINGS, COLORADO

DRAWN: RLS
DESIGNED: RLS
CHECKED: RLS

STORM SEWER LATERAL STORM LATERAL 'B' AND POND C4 FOREBAY

DATE:
DEC 20, 2021

PROJECT NO.
100.063

SHEET NUMBER
C7.2
TOTAL SHEETS: 17