PRELIMINARY DRAINAGE PLAN
PUDSP 21-002

SKYLINE AT LORSON RANCH

NOVEMBER, 2020
REV. MAY, 2021

Prepared for:

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

Prepared by:

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Project No. 100.063

CORE
ENGINEERING GROUP

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ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Richard L. Schindler, P.E. #33997 — 9-15-2021 — Date

For and on Behalf of Core Engineering Group, LLC

COLORADO REGISTERED RICHARD LEO SCHINDLER 33997 PROFESSIONAL ENGINEER

OWNER'S STATEMENT

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

Lorson, LLC — 9/15/21 — 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)

Richard L. Schindler, #33997 — Date 9-15-2021

COLORADO REGISTERED RICHARD LEO SCHINDLER 33997 PROFESSIONAL ENGINEER

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
02/01/2022 10:48:36 AM
dsdnijkamp
EPC Planning & Community Development Department

Jennifer Irvine — Date

County Engineer/ECM Administrator

Conditions: A tract for Pond C4 shall be included in the first adjacent final plat between Skyline or The Ridge developments.

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 13.195 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.

<u>Conformance with applicable Drainage Basin Planning Studies</u>
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.

<u>Conformance with Lorson East MDDP by Core Engineering Group</u>
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.

Basin C10.10

This basin consists of runoff from residential development, Garganey Drive, Sora Street and Lamprey Drive. Runoff will be directed to the proposed street, and then routed to Design Point, 38a, 38b and 38c within the curb/gutter where it will be collected by the 3 previously discussed Type R inlets. Flows from this basin will be directed southeasterly in storm sewer to Pond C4. The total developed flow from this basin is 11.4cfs and 25.4cfs 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 preliminary only as shown on the storm sewer layout in the appendix. See Appendix C for detailed hydraulic calculations and the storm sewer model.

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

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

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

<u>Design Point 38</u>
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 (10.6/32.1 at 0.6% slope) is not exceeded.

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

<u>(5-year storm)</u>
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

<u>(100-year storm)</u>
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 = 40.8cfs (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 39 (street runoff from the west side of the inlet)

Design Point 39 is located on the east side of Grayling Drive south of Lamprey Drive and accepts developed flows from Basin C10.7, C10.8 and existing runoff from basin C5.1-ex. The runoff will be conveyed to Design Point 39 via curb/gutter on the easterly/northerly half of Grayling Drive. The total curb/gutter flow from the north side of the inlet is 8.5cfs/25.1cfs in the 5/100-year storm events. The street capacity of Grayling Drive is 10.6cfs/32.1cfs in the 5/100-year storm events at a street slope of 0.6% is not exceeded

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/38.7cfs in the 5/100-year storm events. Based on this information there is no flow increase for the 5-year event and a 0.2cfs increase for the 100-event. This slight increase will have negligible impact on storm drain system

(5-year storm)

Tributary Basins: C10.6+C10.8+C10.9+Des.Pt.38 **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+C10.8+C10.9+Des.Pt.38 **Inlet/MH Number:** Ex. Inlet DP40

Upstream flowby: 0cfs **Total Street Flow:** 38.7cfs

Flow Intercepted: 35.6cfs **Flow Bypassed:** 3.1cfs to Des.Pt 40a

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 C4. Pond C4 is graded as part of PUD/SP 20-003 and is included as required per El Paso County criteria.

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.

Detention Pond C4 (Interim Conditions with developed drainage from Skyline)

This is a permanent full spectrum detention pond that includes water quality and discharges downstream to Pond C3. Pond C4 is graded with The Hills at Lorson Ranch including a 24" pipe outlet, concrete low flow channel, and a concrete forebay on the east side of the pond. There is no full spectrum outlet structure or overflow wall for this pond. This project will construct an interim full spectrum outlet structure and additional concrete low flow channels and a new forebay for runoff from the C10.10 basins. Skyline at Lorson Ranch includes 6.96 acres of developed land that will flow directly to Pond C4 in a storm sewer system. This report includes full spectrum design for this developed area (6.96acres) calculated in the UDCF Full Spectrum spreadsheets for Water Quality and EURV volumes. The outlet structure is a standard full spectrum extended detention basin structure and has been designed with a detachable orifice plate that can be modified in the future when additional developed areas from the east flow into Pond C4. The interim full spectrum print outs are in the appendix of this report.

- Watershed Area: 6.96 acres (from Skyline only)
- Watershed Imperviousness: 55%
- Hydrologic Soils Group B (100%)
- Zone 1 WQCV: 0.128ac-ft, WSEL: 5766.50
- Zone 2 EURV: 0.418ac-ft, WSEL: 5766.93, Top outlet structure set at 5770.50, 6'x6' outlet structure set for full buildout conditions of the pond
- (5-yr): 0.375ac-ft, WSEL: 5766.89, 1.5cfs (22" wide square orifice in orifice plate)
- Zone 3 (100-yr): 0.802ac-ft, WSEL: 5767.33, 4.5cfs (22" wide square orifice in orifice plate)
- Pipe Outlet: existing 24" RCP at 0.9%
- Overflow Spillway: 30' wide bottom, elevation=5775.00, 4:1 side slopes, flow depth=1.87' 1.13' freeboard

  Micropool Elevation: 5765.00

The remaining tributary areas to the east that are from undeveloped land will enter Pond C4 per improvements made as part of The Hills at Lorson Ranch and will exit the pond through the top of the full spectrum outlet structure at elevation 5770.50. Future development to the east will only have to modify the orifice plate to meet full spectrum detention requirements since this outlet structure has been designed for future conditions.

<u>Detention Pond C4 ultimate conditions (from The Hills at Lorson Ranch PDR)</u>

This is a permanent full spectrum detention pond that includes water quality and discharges downstream to Pond C3. Pond C4 is graded with The Hills at Lorson Ranch including a 24" pipe outlet. 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 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.

- Watershed Area: 81.00 acres (Future Area)
- 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): 3.934ac-ft, WSEL: 5770.84, 16.5cfs
- Zone 3 (100-yr): 10.152ac-ft, WSEL: 5774.34, 43.7cfs
- Pipe Outlet: 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

The Hills 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.

Lorson Ranch Metro District will compile and submit to the county on a yearly basis the Drainage and bridge fees for the approved plats and shall show all credits they have received for the same yearly time frame. See Appendix F.

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

Item	Quantity	Unit	Unit Cost	Item Total
Rip Rap	5	CY	$50/CY	$250
Inlets/Manholes	2	EA	$3000/EA	$6,000
18" Storm	41	LF	$35	$1,435
24" Storm	58	LF	$40	$2,320
30" Storm	600	LF	$45	$27,000
			Subtotal	$37,005
			Eng/Cont (10%)	$3,700
			Total Est. Cost	$40,705

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

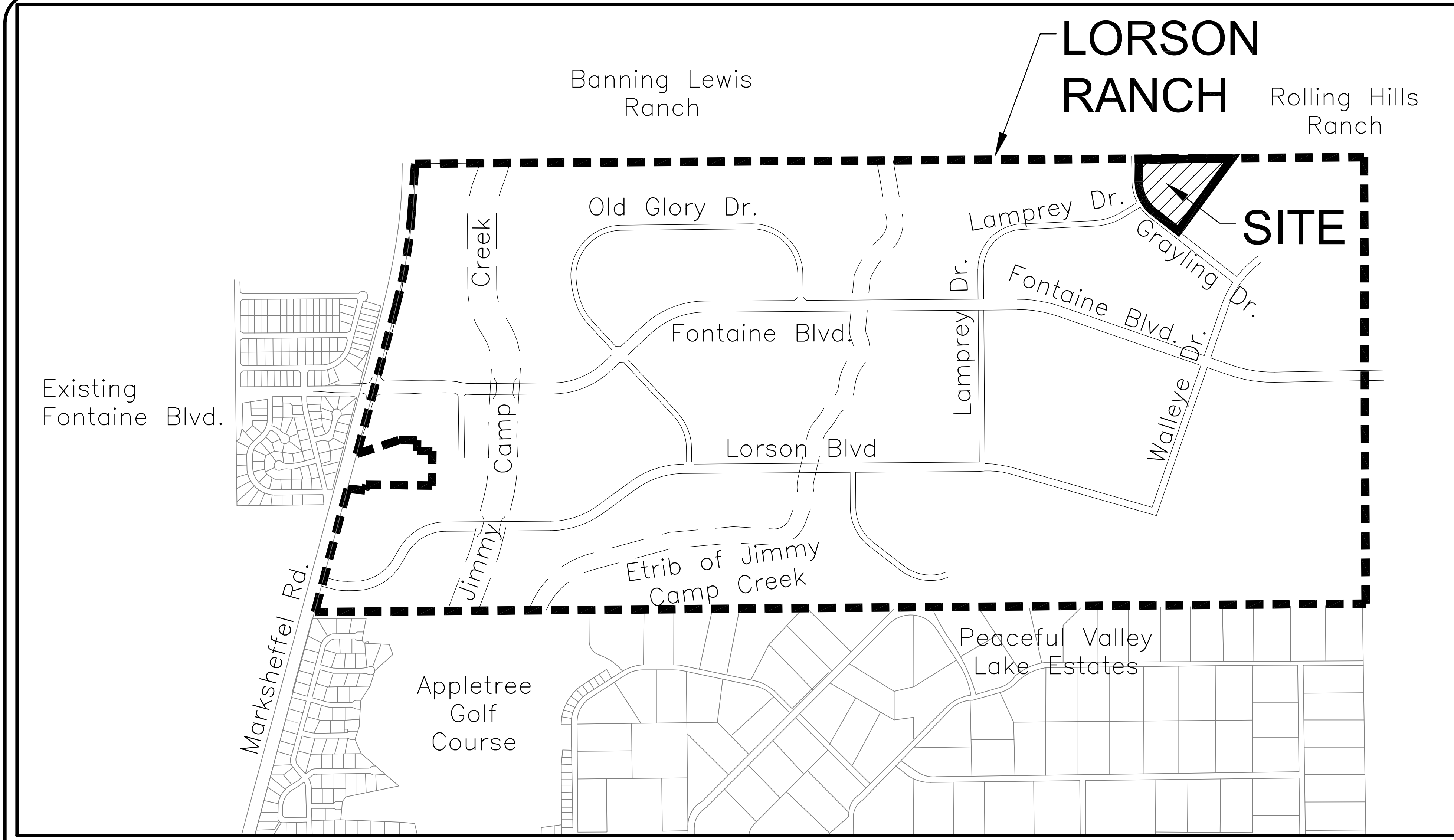
This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development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

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

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.

-N-

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15004 1ST AVENUE S.
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CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

SKYLINE at LORSON RANCH
FEMA MAP

SCALE:	DATE:	FIGURE NO.
NTS	November 2020	__

E:\100\100.063\drainage\100.063-DevConditions.dwg Nov 16, 2020 - 11:56am

CORE
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15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
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EMAIL: Rich@ceg1.com

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	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	0.11	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		

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Current

Calculated By: Leonard Beasley
Date: Oct. 31, 2019
Checked By: Leonard Beasley

Job No: 100.063
Project: Skyline at Lorson Ranch

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
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
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
(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		
			15.0					940.00	1.17%	1.62	9.66	31.45	31.45

CORE ENGINEERING GROUP

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	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	0.11	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													
C10.7, C10.8 & C5.1-ex	**39**	9.87							20.6	2.81	3.05	8.5									
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	**40**	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			1.67	0.45	13.6	0.75	3.67	2.8													
C10.10a - C10.10b	**38b**	5.42							13.7	2.44	3.66	8.9									
C10.10c			1.54	0.45	6.9	0.69	4.70	3.3													
C10.10	**38c**	6.96							13.8	3.13	3.64	11.4									

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

CORE ENGINEERING GROUP

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	Direct Runoff: Area Design	Direct Runoff: Area (A)	Direct Runoff: Runoff Coeff. (C)	Direct Runoff: tc	Direct Runoff: CA	Direct Runoff: i	Direct Runoff: Q	Total Runoff: tc	Total Runoff: Σ (CA)	Total Runoff: i	Total Runoff: Q	Street: Slope	Street: Street Flow	Pipe: Design Flow	Pipe: Slope	Pipe: Pipe Size	Travel Time: Length	Travel Time: Velocity	Travel Time: tt	Remarks
			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													
C10.7-C10.8 & C5.1-ex	**39**	9.87							20.6	4.91	5.11	25.1									
C10.9			3.82	0.60	15.7	2.29	5.79	13.3													
C10.6			0.56	0.65	6.1	0.36	8.19	3.0													
C10.6-C10.9 & C5.1-ex	**40**	14.25							20.6	7.57	5.11	38.7									
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			1.67	0.60	13.6	1.00	6.17	6.2													
C10.10a - C10.10b	**38b**	5.42							13.6	3.21	6.17	19.8									
C10.10c			1.54	0.59	6.9	0.91	7.89	7.2													
C10.10	**38c**	6.96							13.6	4.12	6.17	25.4									

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
C10.10	56	B	6.79	97.56%	0.45	0.44	0.59	0.58	65%	1/8 ac. Single Family
	75	D	0.17	2.44%	0.49	0.01	0.65	0.02	65%	1/8 ac. Single Family
			6.96	100.00%		0.45		0.59		

Standard Form SF-1. Time of Concentration-Proposed

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: Nov. 2, 2020
Checked By: Leonard Beasley

Job No: 100.063
Project: Skyline at Lorson Ranch

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
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	585.00	13.25	21.60
C10.7	0.45	3.17	7.0	100.00	5.30%	0.25	6.79	70.00	3.00%	1.21	0.96				
			20.0					917.00	3.78%	3.89	3.93				
			20.0					216.00	1.00%	2.00	1.80	13.48	1303.00	17.24	13.48
DP-38	0.25	7.98	7.0	100.00	5.30%	0.19	8.88	70.00	3.00%	1.21	0.96				
			20.0					917.00	3.78%	3.89	3.93				
			20.0					216.00	1.00%	2.00	1.80	15.57	1303.00	17.24	15.57
C10.8	0.45	1.89	20.0	78.00	5.12%	0.21	6.06	597.00	0.60%	1.55	6.42	12.49	675.00	13.75	12.49
DP-39	0.28	9.87	7.0	100.00	5.30%	0.19	8.56	70.00	3.00%	1.21	0.96				
			20.0					917.00	3.78%	3.89	3.93				
			20.0					216.00	1.00%	2.00	1.80				
			20.0					604.00	0.60%	1.55	6.50	21.75	1907.00	20.59	20.59
C10.9	0.46	3.82	7.0	100.00	5.00%	0.24	6.81	932.00	4.61%	1.50	10.34	17.15	1032.00	15.73	15.73
C10.10a	0.45	3.75	20.0	40.00	4.25%	0.14	4.62	860.00	3.77%	3.88	3.69	8.31	900.00	15.00	8.31
DP-38a	0.45	3.75	20.0	40.00	4.25%	0.14	4.62	860.00	3.77%	3.88	3.69	8.31	900.00	15.00	8.31
C10.10b	0.45	1.67	7.0	100.00	3.60%	0.22	7.72	120.00	2.89%	1.19	1.68				
			20.0					952.00	3.64%	3.82	4.16	13.55	1172.00	16.51	13.55

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: Nov. 2, 2020
Checked By: Leonard Beasley

Job No: 100.063
Project: Skyline at Lorson Ranch

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
DP-38b	0.45	5.42	7.0	100.00	3.60%	0.22	7.72	120.00	2.89%	1.19	1.68				
			20.0					952.00	3.64%	3.82	4.16				
			RCP					35.00	0.80%	5.32	0.11	13.66	1207.00	16.71	13.66
C10.10c	0.45	1.54	20.0	37.00	2.70%	0.12	5.16	423.00	4.35%	4.17	1.69	6.85	460.00	12.56	6.85
DP-38c	0.45	6.96	7.0	100.00	3.60%	0.22	7.72	120.00	2.89%	1.19	1.68				
			20.0					952.00	3.64%	3.82	4.16				
			RCP					35.00	0.80%	5.32	0.11				
			RCP					53.00	0.69%	5.98	0.15	13.81	1260.00	17.00	13.81
C10.10	0.45	6.96	7.0	100.00	3.60%	0.22	7.72	120.00	2.89%	1.19	1.68				
			20.0					952.00	3.64%	3.82	4.16				
			RCP					35.00	0.80%	5.32	0.11				
			RCP					53.00	0.69%	5.98	0.15	13.81	1260.00	17.00	13.81
C10.6	0.49	0.56	20.0	16.00	2.00%	0.08	3.50	490.00	2.51%	3.17	2.58	6.08	506.00	12.81	6.08
DP-40	0.28	14.25	7.0	100.00	5.30%	0.19	8.56	70.00	3.00%	1.21	0.96				
			20.0					917.00	3.78%	3.89	3.93				
			20.0					216.00	1.00%	2.00	1.80				
			20.0					604.00	0.60%	1.55	6.50	21.75	1907.00	20.59	20.59

APPENDIX C – HYDRAULIC CALCULATIONS

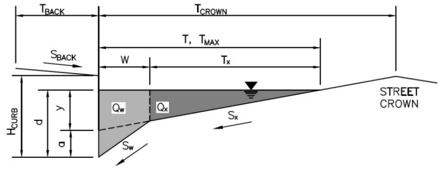
Version 4.05 Released March 2017

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} =	20.0	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} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	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 =	4.80	4.80	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 =	6.31	6.31	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	18.0	18.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.296	0.296	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	15.1	15.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	6.4	6.4	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 =**	**21.5**	**21.5**	**cfs**
Flow Velocity within the Gutter Section	V =	7.2	7.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.8	3.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	22.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	20.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.258	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	12.4	22.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	12.4	22.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	5.8	7.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	18.2	30.5	cfs
Average Flow Velocity Within the Gutter Section	V =	6.9	7.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.5	4.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.95	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**17.3**	**23.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.92	6.49	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.18	inches

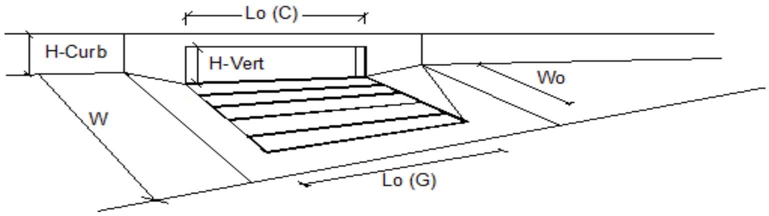
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.3**	**23.6**	**cfs**

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



		MINOR	MAJOR	
Design Information (Input)				
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: OK - Q < Allowable Street Capacity'		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	18.0	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	0.0	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**	**%**

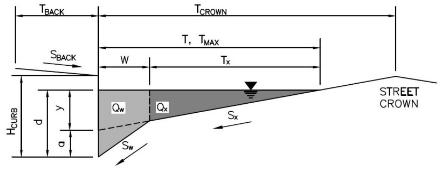
Version 4.05 Released March 2017

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} =	20.0	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} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	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 =	4.80	4.80	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 =	6.31	6.31	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	18.0	18.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.296	0.296	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	16.7	16.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	7.0	7.0	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 =**	**23.8**	**23.8**	**cfs**
Flow Velocity within the Gutter Section	V =	7.9	7.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.2	4.2	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	22.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	20.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.258	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	13.7	24.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	13.7	24.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	6.4	8.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	20.0	33.7	cfs
Average Flow Velocity Within the Gutter Section	V =	7.6	8.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.8	5.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.81	0.66	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**16.3**	**22.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.65	6.19	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

CDOT Type R Curb Opening

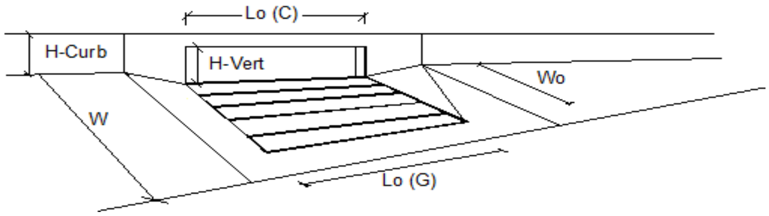
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**16.3**	**22.2**	**cfs**

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



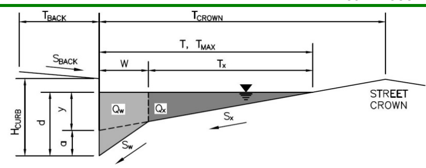
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate 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} =	20.0	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} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

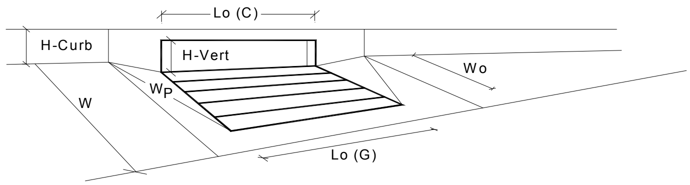
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.80	4.80	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	6.31	6.31	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	18.0	18.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.296	0.296	
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} =	18.7	22.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	20.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.258	
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



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
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
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	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

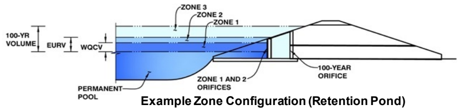
APPENDIX D – POND AND ROUTING CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: The Hills at Lorson Ranch

Basin ID: Pond C4- Interim Conditions with only developed C10.10 basins for WQ plate



Example Zone Configuration (Retention Pond)

micropool = 0 = 5765

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	6.96	acres
Watershed Length =	900	ft
Watershed Length to Centroid =	700	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 =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.128	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.412	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.379	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.531	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.664	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.836	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.979	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.158	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.525	acre-feet		inches
Approximate 2-yr Detention Volume =	0.314	acre-feet		
Approximate 5-yr Detention Volume =	0.427	acre-feet		
Approximate 10-yr Detention Volume =	0.558	acre-feet		
Approximate 25-yr Detention Volume =	0.606	acre-feet		
Approximate 50-yr Detention Volume =	0.633	acre-feet		
Approximate 100-yr Detention Volume =	0.698	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.128	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.285	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.350	acre-feet
Total Detention Basin Volume =	0.762	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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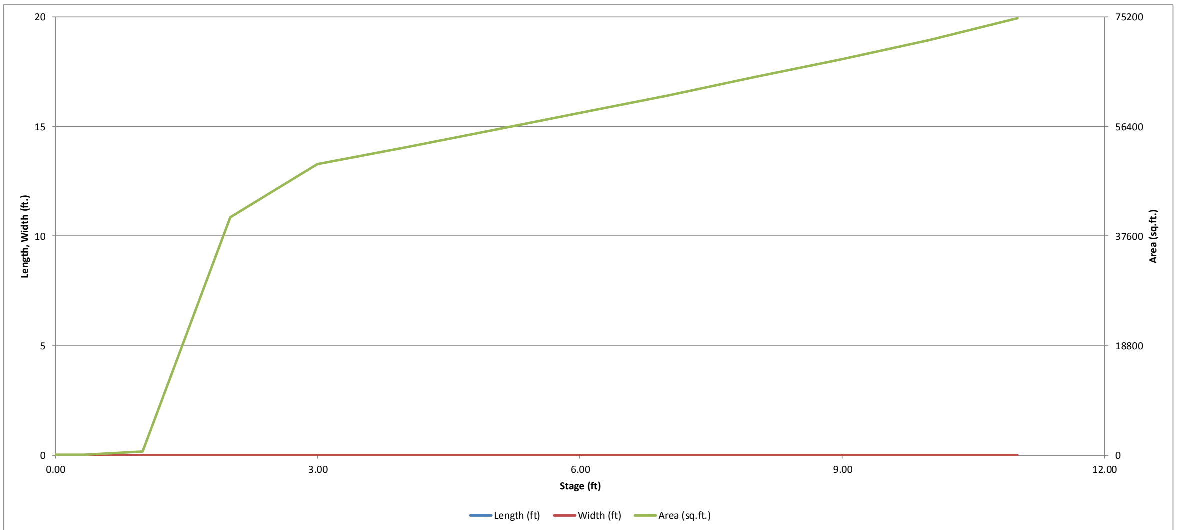
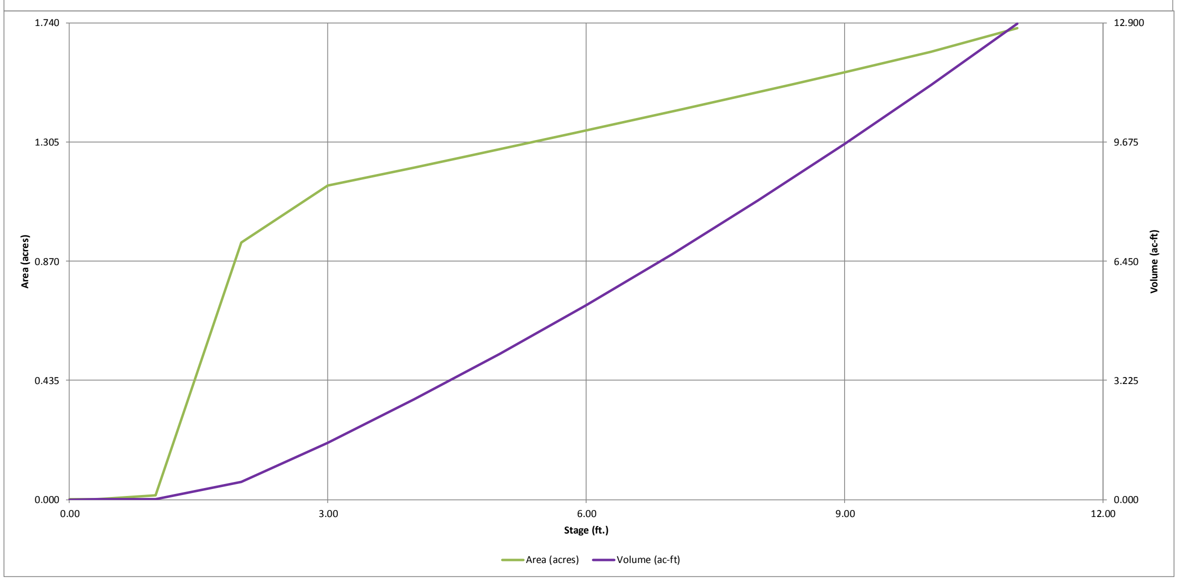
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



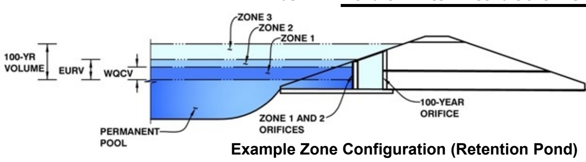


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **The Hills at Lorson Ranch**

Basin ID: **Pond C4- Interim Conditions with only developed C10.10 basins for WQ plate**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.50	0.128	Orifice Plate
Zone 2 (EURV)	1.93	0.285	Rectangular Orifice
Z3 (100+1/2WQCV)	2.30	0.350	Rectangular Orifice
Total (all zones)		0.762	

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 =	1.50	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	6.00	inches
Orifice Plate: Orifice Area per Row =	0.46	sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	3.194E-03	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	0.50	1.00					
Orifice Area (sq. inches)	0.46	0.46	0.46					

	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	Zone 3 Rectangular	
Invert of Vertical Orifice =	1.50	1.93	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	1.93	2.30	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	5.16	6.00	inches
Vertical Orifice Width =	22.00	22.00	inches

Calculated Parameters for Vertical Orifi

	Zone 2 Rectangular	Zone 3 Rectangular
Vertical Orifice Area =	0.79	0.92
Vertical Orifice Centroid =	0.22	0.25

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

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	N/A	N/A	feet
Overflow Weir Grate Slope =	N/A	N/A	H:V
Horiz. Length of Weir Sides =	N/A	N/A	feet
Overflow Grate Open Area % =	N/A	N/A	%, grate open area/total area
Debris Clogging % =	N/A	N/A	%

Calculated Parameters for Overflow We

	Not Selected	Not Selected
Height of Grate Upper Edge, H_t =	N/A	N/A
Overflow Weir Slope Length =	N/A	N/A
Grate Open Area / 100-yr Orifice Area =	N/A	N/A
Overflow Grate Open Area w/o Debris =	N/A	N/A
Overflow Grate Open Area w/ Debris =	N/A	N/A

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

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

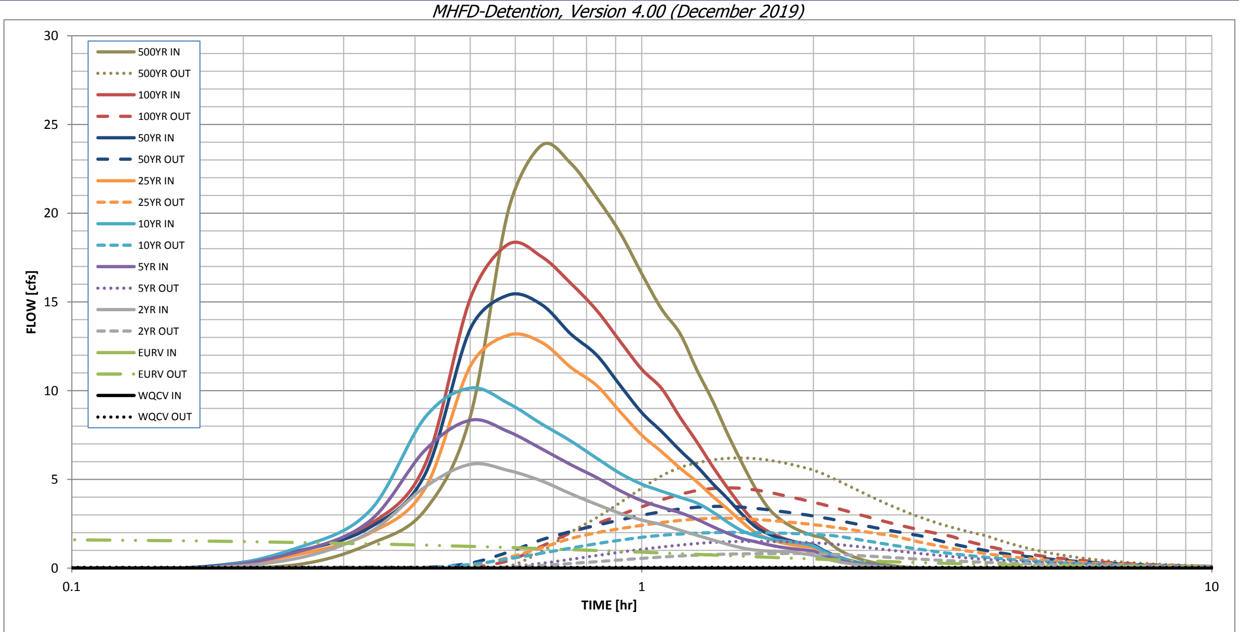
Routed Hydrograph Results

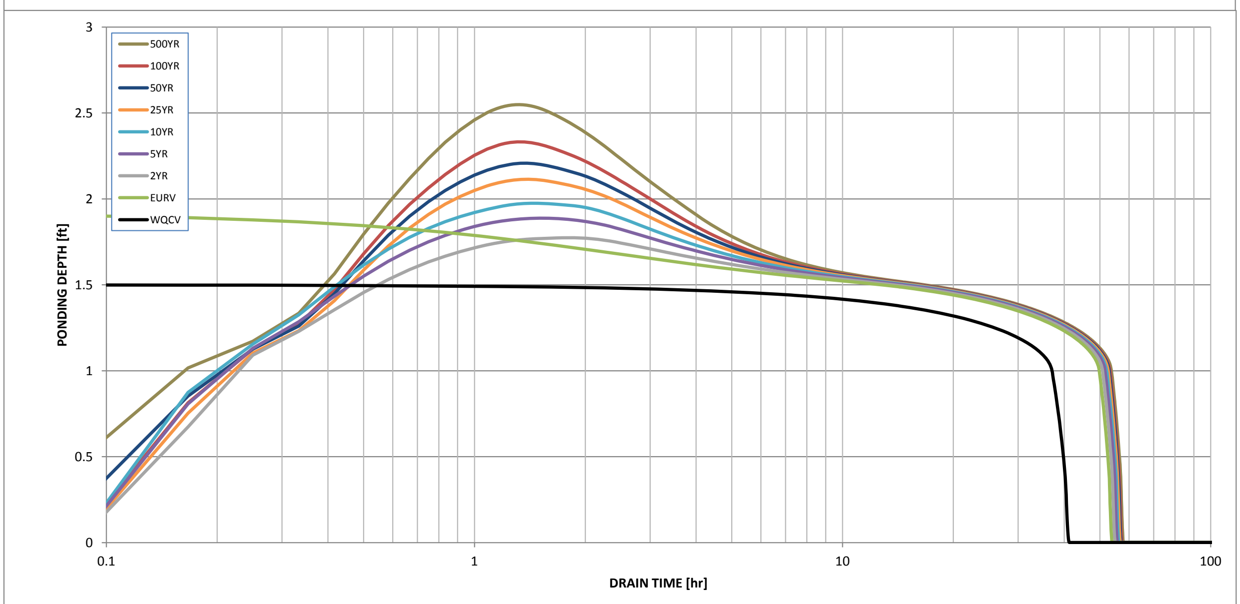
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

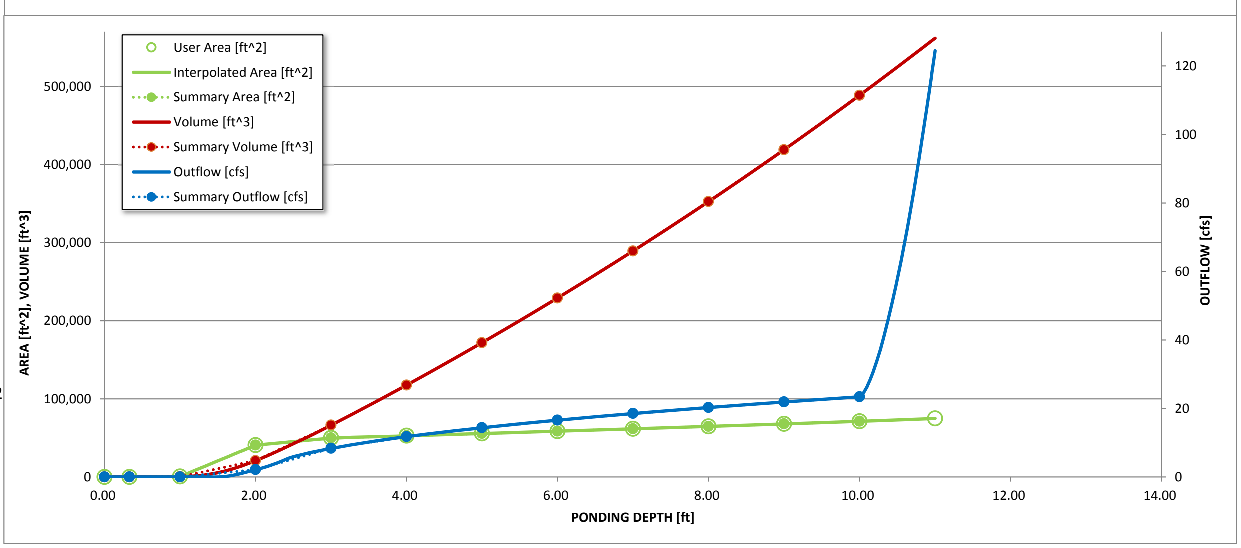
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.128	0.412	0.379	0.531	0.664	0.836	0.979	1.158
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.379	0.531	0.664	0.836	0.979	1.158
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.7	1.9	2.9	5.2	6.5	8.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.28	0.42	0.75	0.94	1.20
Peak Inflow Q (cfs) =	N/A	N/A	5.9	8.3	10.1	13.1	15.4	18.3
Peak Outflow Q (cfs) =	0.0	1.7	0.8	1.5	2.0	2.8	3.5	4.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.7	0.5	0.5	0.5
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 2	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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) =	38	47	49	48	47	46	45	43
Time to Drain 99% of Inflow Volume (hours) =	**40**	51	52	52	52	52	51	51
Maximum Ponding Depth (ft) =	1.50	1.93	1.77	1.89	1.97	2.11	2.21	2.33
Area at Maximum Ponding Depth (acres) =	0.48	0.87	0.72	0.83	0.91	0.96	0.98	1.01
Maximum Volume Stored (acre-ft) =	0.128	0.418	0.290	0.375	0.454	0.586	0.673	0.802

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	0.06	0.01	0.21
	0:15:00	0.00	0.00	0.57	0.94	1.16	0.78	0.97	0.95	1.36
	0:20:00	0.00	0.00	2.02	2.66	3.23	1.97	2.29	2.46	3.27
	0:25:00	0.00	0.00	4.57	6.65	8.49	4.49	5.29	5.83	8.53
	0:30:00	0.00	0.00	5.85	8.34	10.15	11.37	13.47	15.18	20.15
	0:35:00	0.00	0.00	5.51	7.69	9.29	13.13	15.39	18.25	23.83
	0:40:00	0.00	0.00	4.92	6.73	8.14	12.73	14.86	17.56	22.83
	0:45:00	0.00	0.00	4.20	5.84	7.18	11.32	13.21	16.07	20.89
	0:50:00	0.00	0.00	3.59	5.11	6.20	10.29	12.01	14.53	18.89
	0:55:00	0.00	0.00	3.08	4.36	5.33	8.81	10.29	12.77	16.60
	1:00:00	0.00	0.00	2.71	3.80	4.73	7.49	8.77	11.21	14.60
	1:05:00	0.00	0.00	2.45	3.43	4.33	6.56	7.70	10.13	13.22
	1:10:00	0.00	0.00	2.14	3.12	4.00	5.64	6.64	8.50	11.17
	1:15:00	0.00	0.00	1.85	2.75	3.66	4.86	5.73	7.11	9.39
	1:20:00	0.00	0.00	1.58	2.33	3.16	4.04	4.75	5.70	7.52
	1:25:00	0.00	0.00	1.34	1.96	2.58	3.31	3.89	4.48	5.90
	1:30:00	0.00	0.00	1.14	1.66	2.10	2.59	3.03	3.42	4.49
	1:35:00	0.00	0.00	1.02	1.49	1.83	2.00	2.33	2.56	3.39
	1:40:00	0.00	0.00	0.97	1.32	1.67	1.66	1.93	2.06	2.74
	1:45:00	0.00	0.00	0.94	1.19	1.55	1.45	1.68	1.75	2.33
	1:50:00	0.00	0.00	0.92	1.10	1.47	1.32	1.51	1.53	2.04
	1:55:00	0.00	0.00	0.81	1.03	1.38	1.22	1.39	1.38	1.84
	2:00:00	0.00	0.00	0.72	0.95	1.25	1.16	1.32	1.27	1.69
	2:05:00	0.00	0.00	0.56	0.73	0.96	0.89	1.00	0.95	1.26
	2:10:00	0.00	0.00	0.42	0.55	0.72	0.66	0.74	0.69	0.92
	2:15:00	0.00	0.00	0.32	0.41	0.53	0.49	0.55	0.52	0.68
	2:20:00	0.00	0.00	0.24	0.31	0.39	0.37	0.41	0.39	0.51
	2:25:00	0.00	0.00	0.18	0.22	0.29	0.27	0.30	0.29	0.38
	2:30:00	0.00	0.00	0.13	0.16	0.21	0.19	0.22	0.21	0.27
	2:35:00	0.00	0.00	0.09	0.11	0.15	0.14	0.16	0.15	0.20
	2:40:00	0.00	0.00	0.06	0.08	0.11	0.10	0.11	0.11	0.14
	2:45:00	0.00	0.00	0.04	0.05	0.07	0.07	0.07	0.07	0.09
	2:50:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.06
	2:55:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	3:00:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	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	0.01
5766	1.00	630	0.014	243	0.006	0.03
5767	2.00	40,811	0.937	20,962	0.481	2.15
5768	3.00	49,929	1.146	66,332	1.523	8.37
5769	4.00	52,779	1.212	117,686	2.702	11.78
5770	5.00	55,690	1.278	171,921	3.947	14.39
5771	6.00	58,660	1.347	229,096	5.259	16.59
5772	7.00	61,704	1.417	289,278	6.641	18.53
5773	8.00	64,811	1.488	352,535	8.093	20.29
5774	9.00	67,980	1.561	418,931	9.617	21.91
5775	10.00	71,215	1.635	488,528	11.215	23.41

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'.

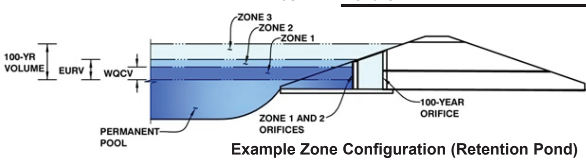
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

full buildout of Pond C4 from The Hills at Lorson Ranch PDR

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
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

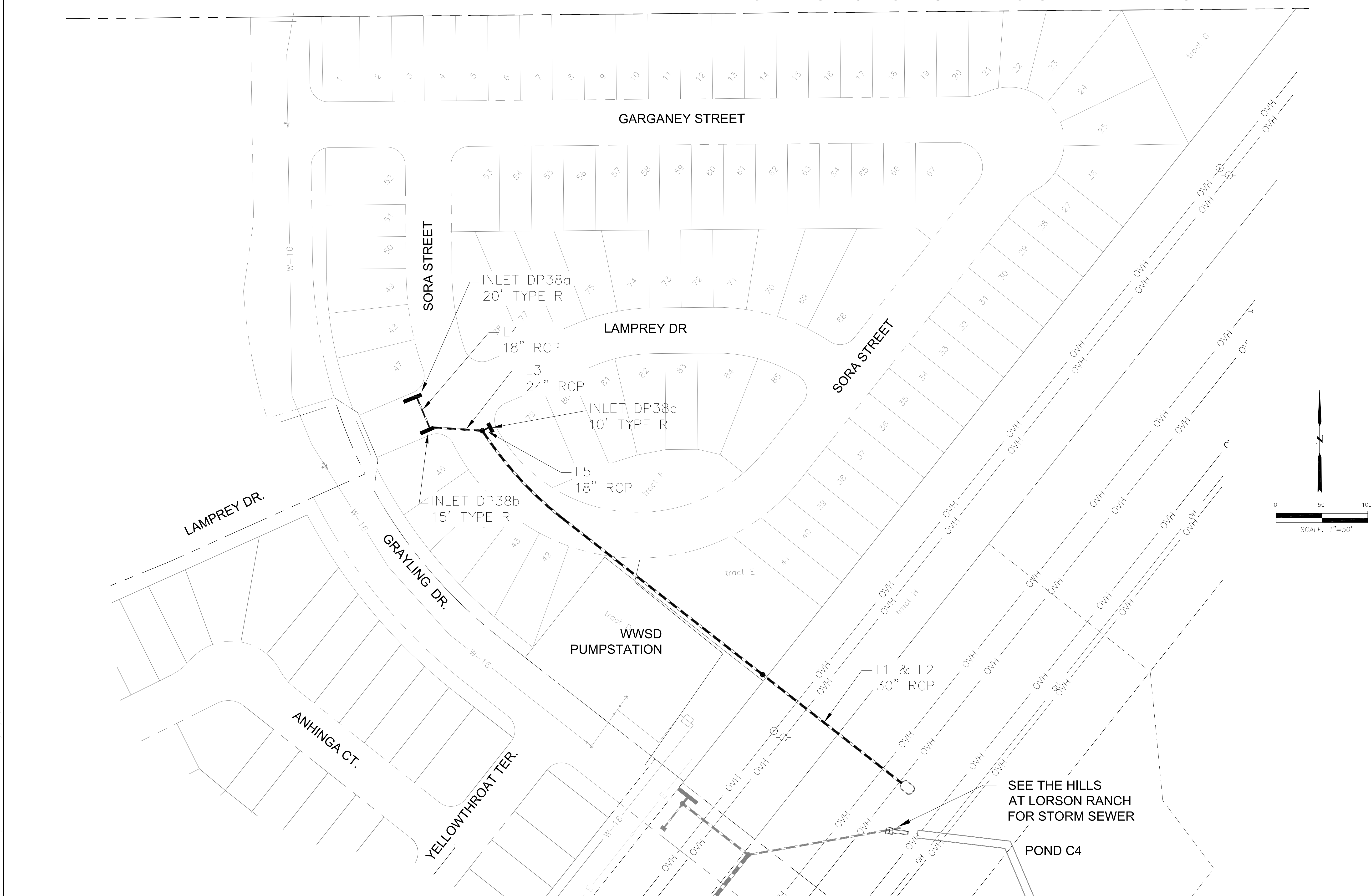
Routed Hydrograph Results

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

APPENDIX E– STORM SEWER SCHEMATIC AND HYDRAFLOW STORM SEWER CALCS

BASIN C10 STORM SCHEMATIC



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BURNSVILLE, MN 55306
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	498.0	5766.90	5769.99	0.621	5768.13	5771.22	n/a	5771.22 j	End
2	2	13.50	30 c	108.2	5769.99	5770.66	0.618	5771.59	5771.89	n/a	5772.55 i	1
3	3	10.20	24 c	56.6	5771.16	5771.55	0.688	5772.55	5772.68	n/a	5773.37 i	2
4	4	7.40	18 c	36.1	5772.05	5772.34	0.803	5773.37	5773.43	n/a	5774.06 i	3
5	5	3.30	18 c	7.8	5771.66	5771.82	2.042	5772.55	5772.51	n/a	5772.86 i	2

100.063-5yr STM | Number of lines: 5 | Run Date: 11-19-2020

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

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	1	28.60	30 c	498.0	5766.90	5769.99	0.621	5768.72	5771.83	0.17	5772.00	End
2	2	28.60	30 c	108.2	5769.99	5770.66	0.618	5772.32	5772.67	n/a	5773.51 i	1
3	3	21.40	24 c	56.6	5771.16	5771.55	0.688	5773.51*	5774.02*	n/a	5774.43 i	2
4	4	15.20	18 c	36.1	5772.05	5772.34	0.803	5774.43*	5775.18*	n/a	5776.08 i	3
5	5	7.20	18 c	7.8	5771.66	5771.82	2.042	5773.51*	5773.55*	0.26	5773.81	2

100.063-100yr STM	Number of lines: 5	Run Date: 11-19-2020

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

APPENDIX F – 2019 Annual Report of Drainage/Bridge Fee Credits

2020 Lorson Ranch Drainage/Surety Fees and Drainage Fee Report

	Subdivision Name	Drainage Fee	Surety	pay out	Credits	Credit balance
06-491	credit established				$ 6,804,637.69	$ 6,804,637.69
06-491	payout			$ (403,041.97)		$ 6,401,595.72
07-485	payout			$ (223,130.33)		$ 6,178,465.39
07-485	Ponderosa Filing No. 1	$ (151,208.00)				$ 6,027,257.39
10-255	payout			$ (238,680.00)		$ 5,788,577.39
12-117	payout			$ (65,250.00)		$ 5,723,327.39
12-117	Ponderosa Filing No. 2	$ (192,765.00)				$ 5,530,562.39
12-117	Pioneer Landing	$ (219,500.00)				$ 5,311,062.39
12-117	Townhomes at Lorson	$ (68,512.50)				$ 5,242,549.89
13-055	payout			$ (187,200.00)		$ 5,055,349.89
13-478	payout			$ (146,790.00)		$ 4,908,559.89
15-015	Ponderosa Filing No. 2		$ (89,957.00)			$ 4,818,602.89
15-015	Pioneer Landing		$ (102,433.00)			$ 4,716,169.89
15-015	Townhomes at Lorson		$ (31,972.50)			$ 4,684,197.39
15-015	Buffalo Crossing No. 2	$ (182,228.00)	$ (85,040.00)			$ 4,416,929.39
15-239	payout			$ (145,620.00)		$ 4,271,309.39
15-473	payout	$ (149,292.00)				$ 4,122,017.39
16-091	credit established				$ 745,604.28	$ 4,867,621.67
	Meadows Filing No. 1	$ (181,578.00)	$ (84,736.00)			$ 4,601,307.67
	Meadows Filing No. 2	$ (224,587.00)	$ (104,808.00)			$ 4,271,912.67
	Allegiant at Lorson	$ (162,021.00)	$ (75,610.00)			$ 4,034,281.67
	Buffalo Crossing No. 1	$ (78,975.00)	$ (36,855.00)			$ 3,918,451.67
						$ 3,918,451.67
	Meadows 3	$ (287,820.00)	$ (134,316.00)			$ 3,496,315.67
	Meadows 4	$ (464,200.00)	$ (216,626.00)			$ 2,815,489.67
	Pioneer Landing 2	$ (370,756.00)	$ (165,095.00)			$ 2,279,638.67
	Carriage Meadows South	$ (844,538.00)	$ (376,066.00)			$ 1,059,034.67
	Carriage Meadows North	$ (296,184.00)	$ (132,618.00)			$ 630,232.67
	Pioneer Landing 3	$ (15,832.00)	$ (7,089.00)			$ 607,311.67
	Lorson Ranch East Filing No. 1	$ (899,058.00)	$ (380,859.00)			$ (672,605.33)
20-17	credit established				$ 984,434.42	$ 311,829.09

Drainage Fee Pre-Credit Analysis

	Subdivision Name	Drainage Fee	Surety	pay out	Credits	Credit balance
	CDR 19-002 (CD's not approved yet)				$ 2,074,670.20	$ 2,074,670.20
	Lorson Ranch East Filing No. 2	$ (322,236.00)	$ (136,506.00)			$ 1,615,928.20
	Lorson Ranch East Filing No. 3	$ (177,213.00)	$ (70,354.00)			$ 1,368,361.20
	Creekside at Lorson filing 1	$ (429,894.00)	$ (170,669.00)			$ 767,798.20
	Lorson Ranch East Filing No. 4	$ (475,387.00)	$ (188,729.00)			$ 103,682.20
	totals	$ (6,193,784.50)	$ (2,590,338.50)	$ (1,409,712.30)	$ 10,609,346.59	

	confirmed with resolution
	current credit balance

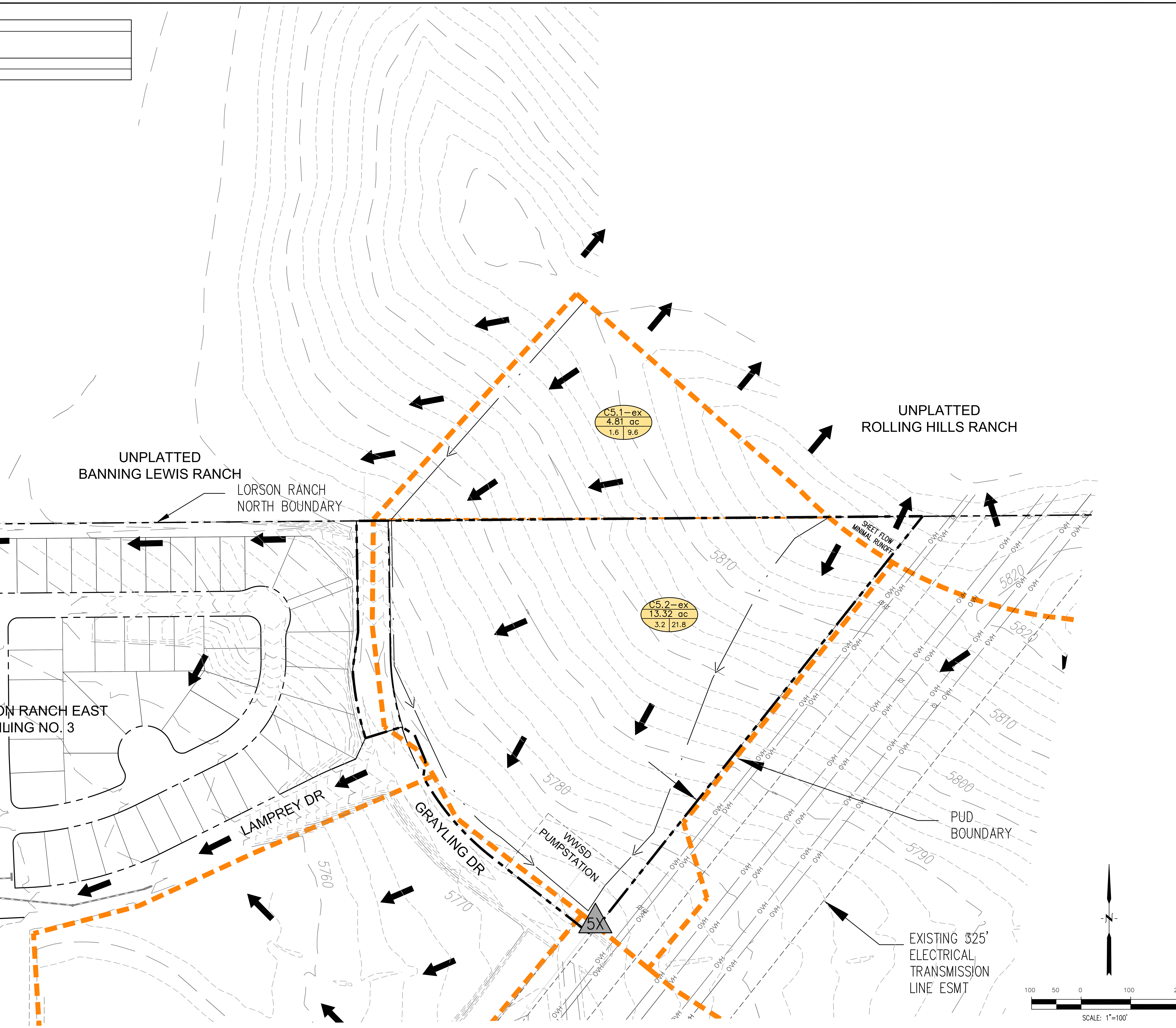
MAP POCKET

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

LEGEND

PUD BOUNDARY
BASIN BOUNDARY-MAJOR
BASIN BOUNDARY-MINOR
BASIN DESIGN POINT
BASIN I.D.
ACREAGE
5 YR/100 YR CFS
DIRECTION OF FLOW
EXISTING CONTOUR
EXISTING ROW/LORSON RANCH BOUNDARY
EXISTING STORM SEWER
EXISTING OVERHEAD TRANSMISSION LINES
TIME OF CONCENTRATION



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BURNSVILLE, MN 55306
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CONTACT: RICHARD L. SCHINDLER, P.E.
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

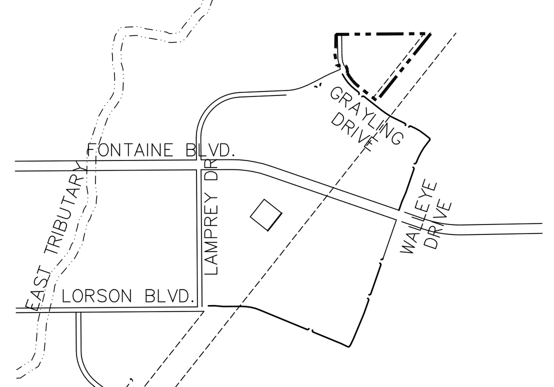
TOTAL SHEETS: 1

LEGEND

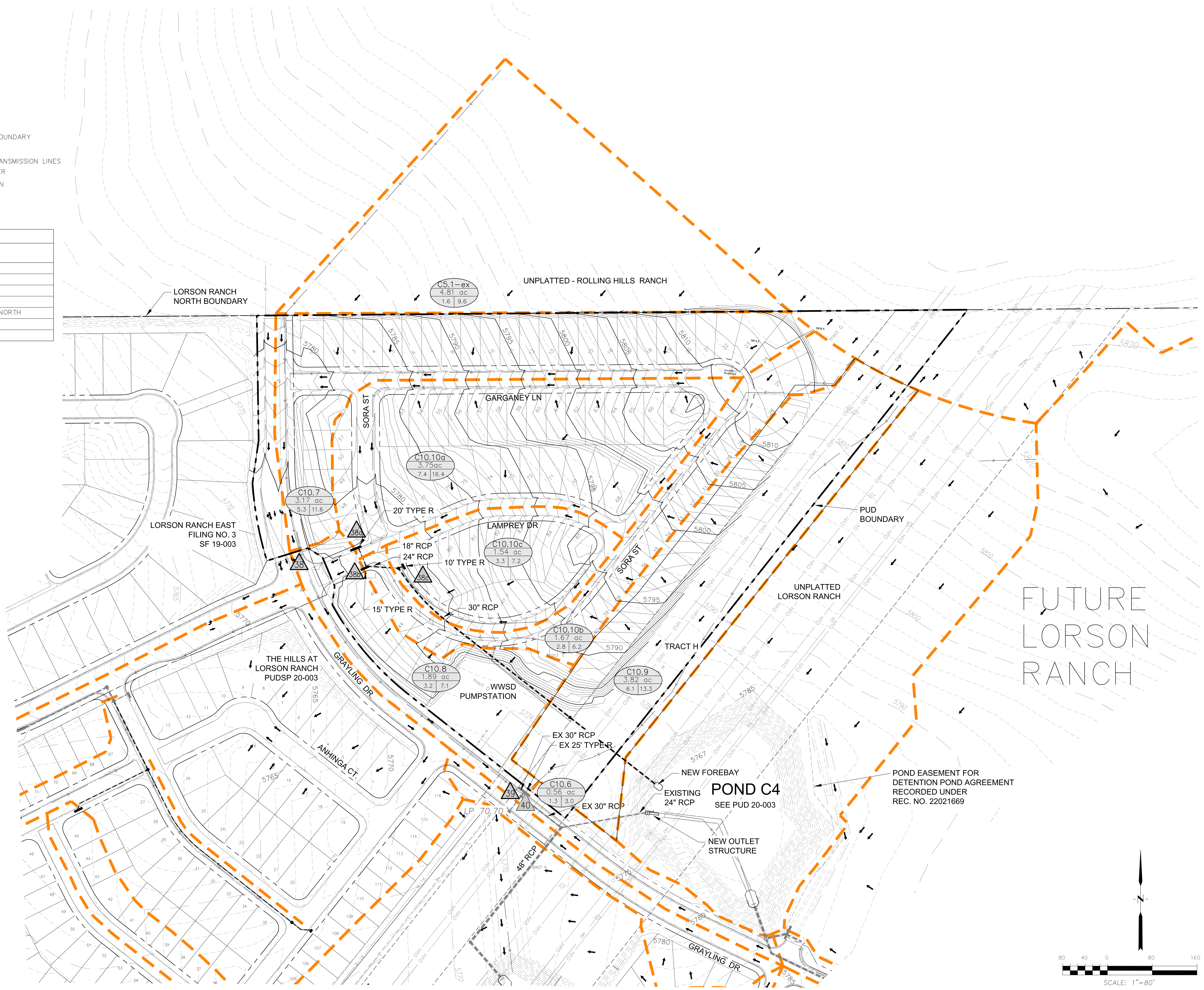
- PUD BOUNDARY
- BASIN BOUNDARY
- BASIN DESIGN POINT
- DENOTES OVERALL BASIN — BASIN I.D. / ACREAGE / 5 YR/100 YR CFS (BASIN XX AC X.X X.X)
- DIRECTION OF FLOW
- EXISTING CONTOUR (6690)
- PROPOSED CONTOUR (6670)
- ROW/LORSON RANCH BOUNDARY
- EXISTING STORM SEWER
- EXISTING OVERHEAD TRANSMISSION LINES (OVH)
- PROPOSED STORM SEWER
- 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	5.42 ac	2.8	6.2	STREET FLOW
38c	6.96 ac	3.3	7.2	STREET FLOW
39	9.87 ac	8.5	25.1	STREET FLOW FROM NORTH
40	14.25 ac	14.7	38.7	STREET FLOW



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

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 DRIVE
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

DEVELOPED CONDITIONS
SKYLINE AT LORSON RANCH
C10 BASIN

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