

PRELIMINARY DRAINAGE PLAN
PUDSP 20-XX ← 21-002
EGP 20-XX

SKYLINE AT LORSON RANCH

NOVEMBER, 2020

**PCD-ENGINEERING REVIEW COMMENTS
IN BLUE BOXES WITH BLUE TEXT**

Engineering Review

03/11/2021 4:20:26 PM

dsdrice

JeffRice@elpasoco.com

(719) 520-7877

EPC Planning & Community
Development Department

Also see comment letter.

Prepared for:

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

Prepared by:

Core Engineering Group, LLC
15004 1ST Avenue South
Burnsville, MN 55306
(719) 570-1100

Project No. 100.063



CORE
ENGINEERING GROUP

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FULL SPECTRUM OUTLET STRUCTURES

ENGINEER'S STATEMENT

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

Richard L. Schindler, P.E. #33997

Date

For and on Behalf of Core Engineering Group, LLC

OWNER'S STATEMENT

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

Lorson, LLC

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

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.

Jennifer Irvine
County Engineer/ECM Administrator

Date

Conditions: _____

1.0 LOCATION and DESCRIPTION

Skyline at Lorson Ranch is located east of the East Tributary of Jimmy Camp Creek. The site is located on approximately 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.

Conformance with applicable Drainage Basin Planning Studies

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

Conformance with Lorson East MDDP by Core Engineering Group

Core Engineering Group has an approved MDDP for Lorson East, which covers this study area. This 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. Ponds C1 and C3 were graded in the Early Grading Plans for Lorson Ranch East under PUDSP-16-003. 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.

address Pond C4?

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.

east side?

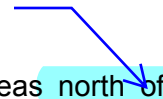
An existing electrical easement, with existing transmission towers, is located west side of this site and will be set aside as open space. It is the intent to utilize some of the open space under the towers for detention of storm flow.

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.

Basin C5.1-ex

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.

within



Basin C5.2-ex

This existing basin consists of existing flow from undeveloped areas north of 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 a 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 Woodrat Way. 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 Woodrat Way. 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, Woodrat Way 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 Woodrat Way. 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, Woodrat Way, 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 Woodrat Way. 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)

Street Slope	Residential Local		Residential Collector		Principal Arterial	
	5-year	100-year	5-year	100-year	5-year	100-year
0.5%	6.3	26.4	9.7	29.3	9.5	28.5
0.6%	6.9	28.9	10.6	32.1	10.4	31.2
0.7%	7.5	31.2	11.5	34.6	11.2	33.7
0.8%	8.0	33.4	12.3	37.0	12.0	36.0
0.9%	8.5	35.4	13.0	39.3	12.7	38.2
1.0%	9.0	37.3	13.7	41.4	13.4	40.2
1.4%	10.5	44.1	16.2	49.0	15.9	47.6
1.8%	12.0	45.4	18.4	50.4	18.0	50.4
2.2%	13.3	42.8	19.4	47.5	19.5	47.5
2.6%	14.4	40.7	18.5	45.1	18.5	45.1
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	29.7
4.5%	19.0	34.5	15.7	38.3	15.7	38.3
5.0%	19.9	33.4	15.2	37.1	15.2	37.1

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

Design Point 38

Design Point 38 is located at the NE corner of Grayling Drive and Lamprey Drive/Woodrat Way 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.

Design Point 38a

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

<u>(5-year storm)</u>	
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	
<u>(100-year storm)</u>	
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 Woodrat Way at a low point.

<u>(5-year storm)</u>	
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	
<u>(100-year storm)</u>	
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 Woodrat Way 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

<u>(5-year storm)</u>	
Tributary Basins: C10.6+C10.8+C10.9+Des.Pt.38	Inlet/MH Number: 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	
<u>(100-year storm)</u>	
Tributary Basins: C10.6+C10.8+C10.9+Des.Pt.38	Inlet/MH Number: 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 (9.96acres) 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.

6.96 acres

- Watershed Area: 9.96 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.

Detention Pond C4 ultimate conditions (from The Hills at Lorson Ranch PDR)

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...)

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.

Please use the "Four-Step Process" for selecting structural BMPs outlined in ECM Section I.7.2

- The street configuration was laid out to minimize the length of streets. Many streets are straight and perpendicular resulting in fewer intersections and lots with less wasted space.
- There are buffers that will be under the 325' wide electric transmission easement and along Grayling Drive
- Construct one Full Spectrum Detention Outlet Structure. The full spectrum detention mimics existing storm discharges and includes water quality.

Step 2: Implement BMP's that Slowly Release the Water Quality Capture Volume

Treatment and slow release of the water quality capture volume (WQCV) is required. Skyline at Lorson Ranch will construct one full spectrum stormwater detention pond outlet structure which includes Water Quality Volumes and WQ outlet structures.

Step 3: Stabilize Drainageways

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

through 2021(?)

Step 4: Implement Site Specific & Source Control BMP's

There are no potential sources of contaminants that could be introduced to the County's MS4. During construction source control will be provided with the proper installation of erosion control BMPs to limit erosion and transport of sediment. Area disturbed by construction will be seeded and mulched. Cut and fill slopes will be reseeded, and the slopes equal to or greater than three-to-one will be protected

with erosion control fabric. Silt fences will be placed at the bottom of re-vegetated and rough graded slopes. Inlet protection will be used around proposed inlets. In addition, temporary sediment traps will be constructed so runoff will be treated prior to discharge. Construction BMPs in the form of vehicle tracking control, sediment basins, concrete washout area, rock socks, buffers, and silt fences will be utilized to protect receiving waters.

9.0 CONCLUSIONS

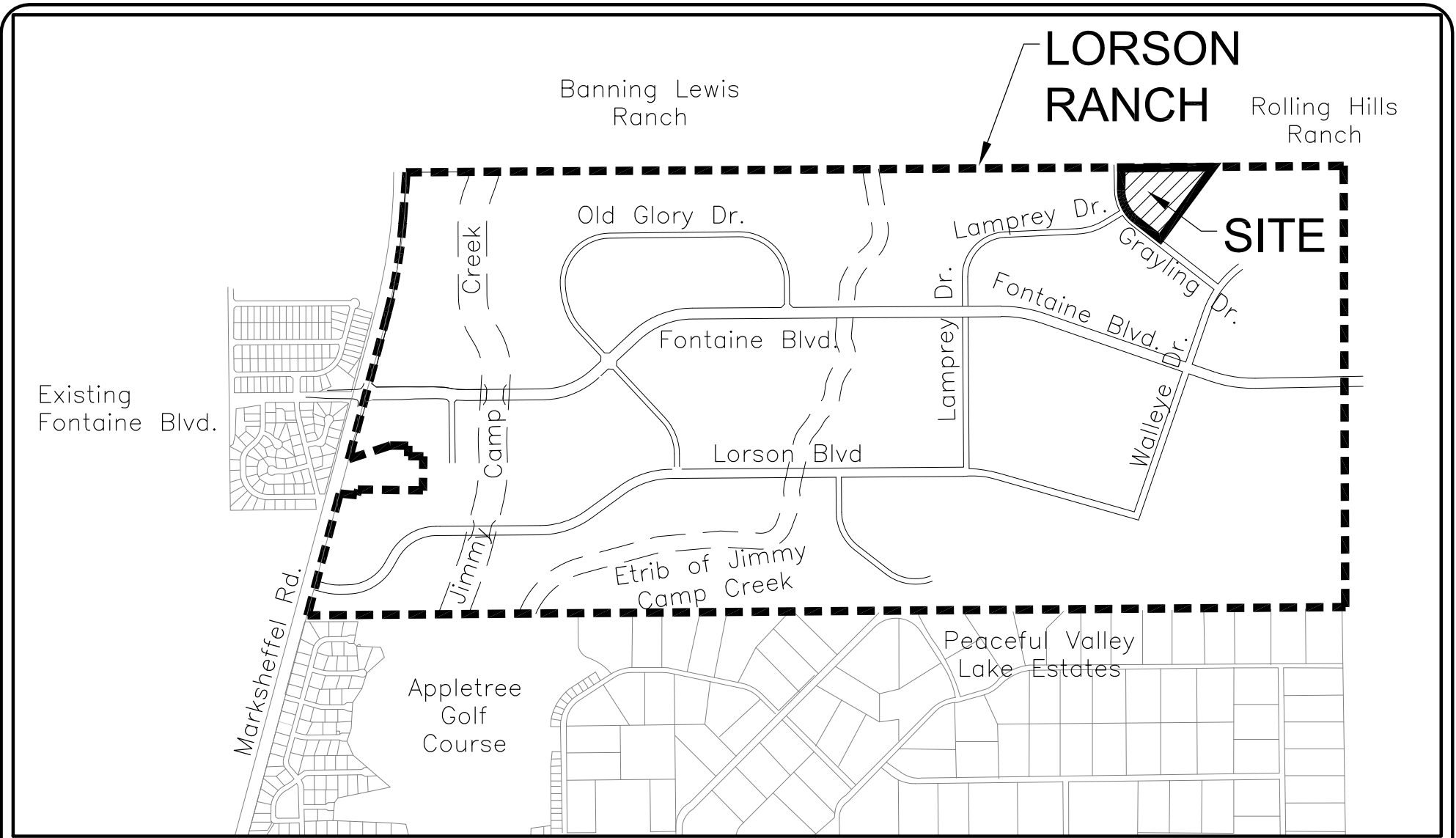
This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development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

DATE:
NOV 5, 2020

FIGURE NO.
--



CORE
ENGINEERING GROUP

15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@cegi.com

SCALE:
NTS

DATE:
November 2020

SKYLINE at LORSON RANCH
FEMA MAP

FIGURE NO. --



Legend

SEE THIS REPORT FOR DETAILED LEGEND AND CHECK MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE)
Zone A, B, X
With BFE of Depth Zone AE, AO, AH, VE, AP
Regulatory Floodway

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
Future Flood Hazard, 1% Annual Chance Flood Hazard
Area with Reduced Flood Risk due to Levee, See Notes, Zone D
Area with Flood Risk due to Levee, Zone D

OTHER AREAS OF FLOOD HAZARD
No scores, Area of Minimal Flood Hazard
Effective LOMs
Area of Undetermined Flood Hazard
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall

OTHER AREAS GENERAL STRUCTURES
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 represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/16/2020 at 10:07 AM and does not represent a field inspection. The NFHL and effective date 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 linings, flood zone backgrounds, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

NOT TO SCALE



CORE ENGINEERING GROUP

15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

SCALE:
NTS

DATE:
November 2020

FIGURE NO.
--

SKYLINE at LORSON RANCH SOILS MAP



NOT TO SCALE

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



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 (ti)				Travel Time (tt)					Final tc
BASIN or DESIGN	C ₅	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	ti minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	tt minutes	Computed tc Minutes	USDCM Recommended tc=ti+tt (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



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

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

Job No: 100.063
 Project: Skyline at Lorson Ranch
 Design Storm: **5 - Year Event (Proposed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t _c	CA	i	Q	t _c	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t	
			ac.			min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	
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)

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							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t _c	CA	-	Q	t _c	Σ (CA)	-	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t	
			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									



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

Calculated By: Leonard Beasley

Job No: 100.063

Date: Nov. 2, 2020

Project: Skyline at Lorson Ranch

Checked By: Leonard Beasley

Sub-Basin Data				Initial Overland Time (t _i)				Travel Time (t _t)					t _c Check (urbanized Basins)		Final t _c
BASIN or DESIGN	C _s	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 t _c tc=(L/180)+10 minutes	USDCM Recommended Tc=Ti+Tt (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



Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley

Job No: 100.063

Date: Nov. 2, 2020

Project: Skyline at Lorson Ranch

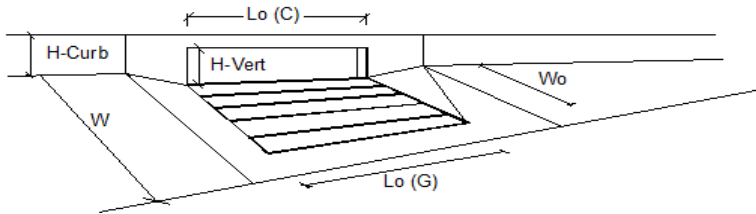
Checked By: Leonard Beasley

Sub-Basin Data				Initial Overland Time (ti)				Travel Time (tt)					tc Check (urbanized Basins)		Final tc
BASIN or DESIGN	C _s	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	ti minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	tt minutes	Computed tc Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended Tc=Ti+Tt (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

INLET ON A CONTINUOUS GRADE

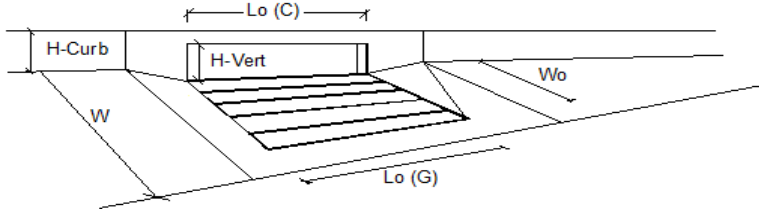
Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 20.00$	20.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_{T-G} = N/A$	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_{T-C} = 0.10$	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Design Discharge for Half of Street (from Sheet Inlet Management)	MINOR	MAJOR	
Water Spread Width	$Q_o = 7.4$	16.4	cfs
Water Depth at Flowline (outside of local depression)	T = 13.0	18.0	ft
Water Depth at Street Crown (or at T_{MAX})	d = 4.6	5.8	inches
Ratio of Gutter Flow to Design Flow	$d_{CROWN} = 0.0$	0.0	inches
Discharge outside the Gutter Section W, carried in Section T_x	$E_o = 0.458$	0.331	
Discharge within the Gutter Section W	$Q_x = 4.0$	11.0	cfs
Discharge Behind the Curb Face	$Q_w = 3.4$	5.4	cfs
Flow Area within the Gutter Section W	$Q_{BACK} = 0.0$	0.0	cfs
Velocity within the Gutter Section W	$A_w = 0.60$	0.80	sq ft
Water Depth for Design Condition	$V_w = 5.6$	6.8	fps
	$d_{LOCAL} = 7.6$	8.8	inches
Grate Analysis (Calculated)			
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o-GRATE} = N/A$	N/A	
Under No-Clogging Condition			
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	$R_s = N/A$	N/A	
Interception Capacity	$Q_i = N/A$	N/A	cfs
Under Clogging Condition			
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	$R_s = N/A$	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)			
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			
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			
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 = $Q_o - Q_a$	$Q_b = 0.0$	1.2	cfs
Summary			
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	%

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017

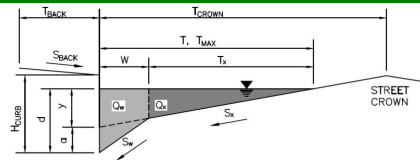


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a _{LOCAL} = 3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L _o = 15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W _o = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C _{T-G} = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C _{T-C} = 0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Design Discharge for Half of Street (from Sheet Inlet Management)			
Water Spread Width	Q _o = 2.8	6.2	cfs
Water Depth at Flowline (outside of local depression)	T = 7.9	11.5	ft
Water Depth at Street Crown (or at T _{MAX})	d = 3.4	4.3	inches
Ratio of Gutter Flow to Design Flow	d _{CROWN} = 0.0	0.0	inches
Discharge outside the Gutter Section W, carried in Section T _x	E _o = 0.694	0.511	
Discharge within the Gutter Section W	Q _s = 0.9	3.0	cfs
Discharge Behind the Curb Face	Q _w = 1.9	3.2	cfs
Flow Area within the Gutter Section W	Q _{BACK} = 0.0	0.0	cfs
Velocity within the Gutter Section W	A _w = 0.40	0.55	sq ft
Water Depth for Design Condition	V _w = 4.8	5.8	fps
	d _{LOCAL} = 6.4	7.3	inches
Grate Analysis (Calculated)			
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E _{o-GRATE} = N/A	N/A	
Under No-Clogging Condition			
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 _s = N/A	N/A	
Interception Capacity	Q _i = N/A	N/A	cfs
Under Clogging Condition			
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 _s = 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)			
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			
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			
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			
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	%

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

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

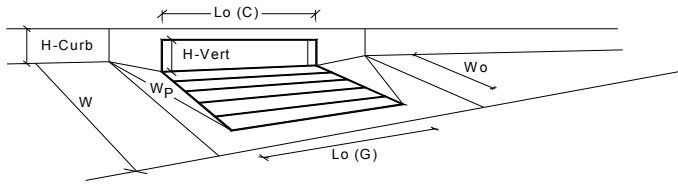
Project: Skyline at Lorson Ranch, 100.063
 Inlet ID: Inlet DP-38c



Gutter Geometry (Enter data in the blue cells)					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} =$ <input type="text" value="5.0"/> ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} =$ <input type="text" value="0.020"/> ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} =$ <input type="text" value="0.015"/>				
Height of Curb at Gutter Flow Line	$H_{CURB} =$ <input type="text" value="6.00"/> inches				
Distance from Curb Face to Street Crown	$T_{CROWN} =$ <input type="text" value="20.0"/> ft				
Gutter Width	$W =$ <input type="text" value="2.00"/> ft				
Street Transverse Slope	$S_x =$ <input type="text" value="0.020"/> ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w =$ <input type="text" value="0.083"/> ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o =$ <input type="text" value="0.000"/> ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} =$ <input type="text" value="0.018"/>				
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} =$ <table border="1" style="display: inline-table;"><tr><th>Minor Storm</th><th>Major Storm</th></tr><tr><td><input type="text" value="20.0"/></td><td><input type="text" value="20.0"/></td></tr></table> ft	Minor Storm	Major Storm	<input type="text" value="20.0"/>	<input type="text" value="20.0"/>
Minor Storm	Major Storm				
<input type="text" value="20.0"/>	<input type="text" value="20.0"/>				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} =$ <table border="1" style="display: inline-table;"><tr><th>Minor Storm</th><th>Major Storm</th></tr><tr><td><input type="text" value="6.0"/></td><td><input type="text" value="7.0"/></td></tr></table> inches	Minor Storm	Major Storm	<input type="text" value="6.0"/>	<input type="text" value="7.0"/>
Minor Storm	Major Storm				
<input type="text" value="6.0"/>	<input type="text" value="7.0"/>				
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>				
Maximum Capacity for 1/2 Street based On Allowable Spread					
Water Depth without Gutter Depression (Eq. ST-2)	<table border="1" style="display: inline-table;"><tr><th>Minor Storm</th><th>Major Storm</th></tr><tr><td><input type="text" value="4.80"/></td><td><input type="text" value="4.80"/></td></tr></table> inches	Minor Storm	Major Storm	<input type="text" value="4.80"/>	<input type="text" value="4.80"/>
Minor Storm	Major Storm				
<input type="text" value="4.80"/>	<input type="text" value="4.80"/>				
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c =$ <input type="text" value="2.0"/> inches				
Gutter Depression ($d_c - (W * S_x * 12)$)	$a =$ <input type="text" value="1.51"/> inches				
Water Depth at Gutter Flowline	$d =$ <input type="text" value="6.31"/> inches				
Allowable Spread for Discharge outside the Gutter Section W ($T - W$)	$T_x =$ <input type="text" value="18.0"/> ft				
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o =$ <input type="text" value="0.296"/>				
Discharge outside the Gutter Section W, carried in Section T_x	$Q_x =$ <input type="text" value="0.0"/> cfs				
Discharge within the Gutter Section W ($Q_T - Q_x$)	$Q_w =$ <input type="text" value="0.0"/> cfs				
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} =$ <input type="text" value="0.0"/> cfs				
Maximum Flow Based On Allowable Spread	$Q_T =$ <input type="text" value="SUMP"/> cfs				
Flow Velocity within the Gutter Section	$V =$ <input type="text" value="0.0"/> fps				
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d =$ <input type="text" value="0.0"/>				
Maximum Capacity for 1/2 Street based on Allowable Depth					
Theoretical Water Spread	<table border="1" style="display: inline-table;"><tr><th>Minor Storm</th><th>Major Storm</th></tr><tr><td><input type="text" value="18.7"/></td><td><input type="text" value="22.9"/></td></tr></table> ft	Minor Storm	Major Storm	<input type="text" value="18.7"/>	<input type="text" value="22.9"/>
Minor Storm	Major Storm				
<input type="text" value="18.7"/>	<input type="text" value="22.9"/>				
Theoretical Spread for Discharge outside the Gutter Section W ($T - W$)	$T_{x,TH} =$ <input type="text" value="16.7"/> ft				
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o =$ <input type="text" value="0.318"/>				
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{x,TH}$	$Q_{x,TH} =$ <input type="text" value="0.0"/> cfs				
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	$Q_x =$ <input type="text" value="0.0"/> cfs				
Discharge within the Gutter Section W ($Q_d - Q_x$)	$Q_w =$ <input type="text" value="0.0"/> cfs				
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} =$ <input type="text" value="0.0"/> cfs				
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q =$ <input type="text" value="0.0"/> cfs				
Average Flow Velocity Within the Gutter Section	$V =$ <input type="text" value="0.0"/> fps				
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d =$ <input type="text" value="0.0"/>				
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	$R =$ <input type="text" value="SUMP"/>				
Max Flow Based on Allowable Depth (Safety Factor Applied)	$Q_d =$ <input type="text" value="SUMP"/> cfs				
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d =$ <input type="text" value=""/> inches				
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} =$ <input type="text" value=""/> inches				
MINOR STORM Allowable Capacity is based on Depth Criterion	<table border="1" style="display: inline-table;"><tr><th>Minor Storm</th><th>Major Storm</th></tr><tr><td><input type="text" value="SUMP"/></td><td><input type="text" value="SUMP"/></td></tr></table> cfs	Minor Storm	Major Storm	<input type="text" value="SUMP"/>	<input type="text" value="SUMP"/>
Minor Storm	Major Storm				
<input type="text" value="SUMP"/>	<input type="text" value="SUMP"/>				
MAJOR STORM Allowable Capacity is based on Depth Criterion	$Q_{allow} =$ <input type="text" value="SUMP"/> cfs				

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

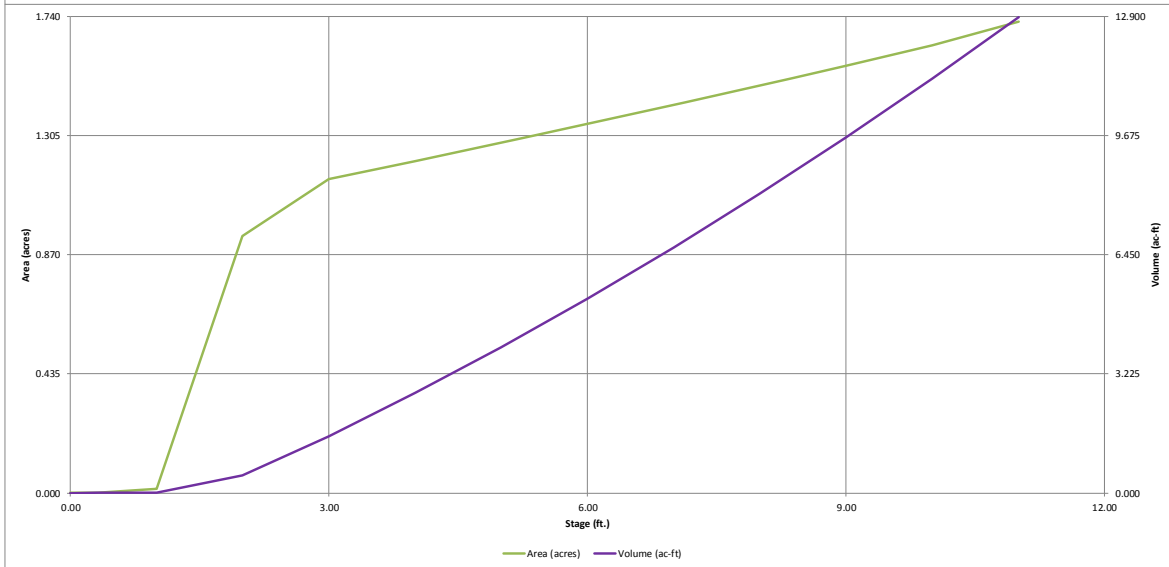
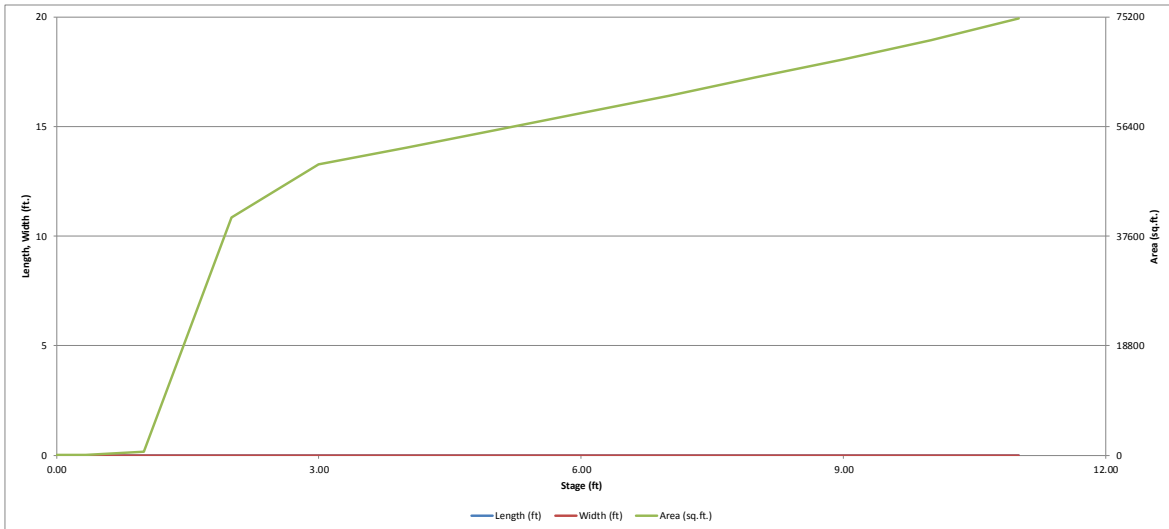


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		Type =
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	a_{local} = inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	No =
Water Depth at Flowline (outside of local depression)	4.4	5.7	Ponding Depth = inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	L_G (G) = feet
Width of a Unit Grate	N/A	N/A	W_G = feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	A_{ratio} =
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	C_r (G) =
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	C_w (G) =
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	C_o (G) =
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	10.00	10.00	L_C (C) = feet
Height of Vertical Curb Opening in Inches	6.00	6.00	H_{vert} = inches
Height of Curb Orifice Throat in Inches	6.00	6.00	H_{throat} = inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	Theta = degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	W_p = feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	C_r (C) =
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	C_w (C) =
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	C_o (C) =
Grate Flow Analysis (Calculated)	MINOR	MAJOR	
Clogging Coefficient for Multiple Units	N/A	N/A	Coef =
Clogging Factor for Multiple Units	N/A	N/A	Clog =
Grate Capacity as a Weir (based on Modified HEC22 Method)	MINOR	MAJOR	
Interception without Clogging	N/A	N/A	Q_{wi} = cfs
Interception with Clogging	N/A	N/A	Q_{ws} = cfs
Grate Capacity as an Orifice (based on Modified HEC22 Method)	MINOR	MAJOR	
Interception without Clogging	N/A	N/A	Q_{oi} = cfs
Interception with Clogging	N/A	N/A	Q_{os} = cfs
Grate Capacity as Mixed Flow	MINOR	MAJOR	
Interception without Clogging	N/A	N/A	Q_{mi} = cfs
Interception with Clogging	N/A	N/A	Q_{ms} = cfs
Resulting Grate Capacity (assumes clogged condition)	N/A	N/A	Q_{Grate} = cfs
Curb Opening Flow Analysis (Calculated)	MINOR	MAJOR	
Clogging Coefficient for Multiple Units	1.25	1.25	Coef =
Clogging Factor for Multiple Units	0.06	0.06	Clog =
Curb Opening as a Weir (based on Modified HEC22 Method)	MINOR	MAJOR	
Interception without Clogging	3.5	7.7	Q_{wi} = cfs
Interception with Clogging	3.3	7.2	Q_{ws} = cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)	MINOR	MAJOR	
Interception without Clogging	16.8	19.0	Q_{oi} = cfs
Interception with Clogging	15.8	17.8	Q_{os} = cfs
Curb Opening Capacity as Mixed Flow	MINOR	MAJOR	
Interception without Clogging	7.2	11.3	Q_{mi} = cfs
Interception with Clogging	6.7	10.6	Q_{ms} = cfs
Resulting Curb Opening Capacity (assumes clogged condition)	3.3	7.2	Q_{Curb} = cfs
Resultant Street Conditions	MINOR	MAJOR	
Total Inlet Length	10.00	10.00	L = feet
Resultant Street Flow Spread (based on street geometry from above)	11.9	17.5	T = ft
Resultant Flow Depth at Street Crown	0.0	0.0	d_{crown} = inches
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	d_{Grate} = ft
Depth for Curb Opening Weir Equation	0.20	0.31	d_{Curb} = ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.41	0.54	$RF_{Combination}$ =
Curb Opening Performance Reduction Factor for Long Inlets	0.82	0.92	RF_{Curb} =
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	RF_{Grate} =
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
	3.3	7.2	Q_s = cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	3.3	7.2	$Q_{PEAK\ REQUIRED}$ = cfs

APPENDIX D – POND AND ROUTING CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

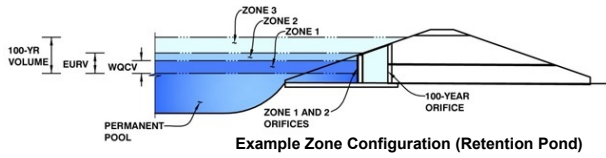
MHFD-Detention, Version 4.02 (February 2020)



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



	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
Zone 3 (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 Orific	
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 Gate 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 Gate Slope =	N/A	N/A	H:V
Horiz. Length of Weir Sides =	N/A	N/A	feet
Overflow Gate Open Area % =	N/A	N/A	% gate open area/total area
Debris Clogging % =	N/A	N/A	%

Calculated Parameters for Overflow Weir	
Not Selected	Not Selected
Height of Gate Upper Edge, H ₁ =	N/A
Overflow Weir Slope Length =	N/A
Gate Open Area / 100-yr Orifice Area =	N/A
Overflow Gate Open Area w/o Debris =	N/A
Overflow Gate Open Area w/ Debris =	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 Plate	
Not Selected	Not Selected
Outlet Orifice Area =	N/A
Outlet Orifice Centroid =	N/A
Half-Central Angle of Restrictor Plate on Pipe =	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

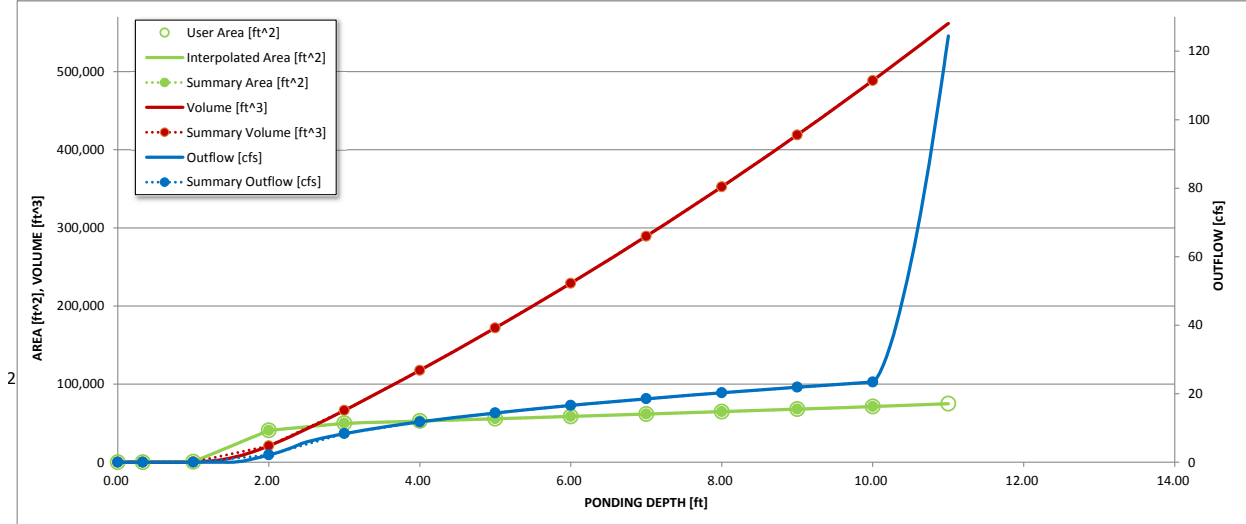
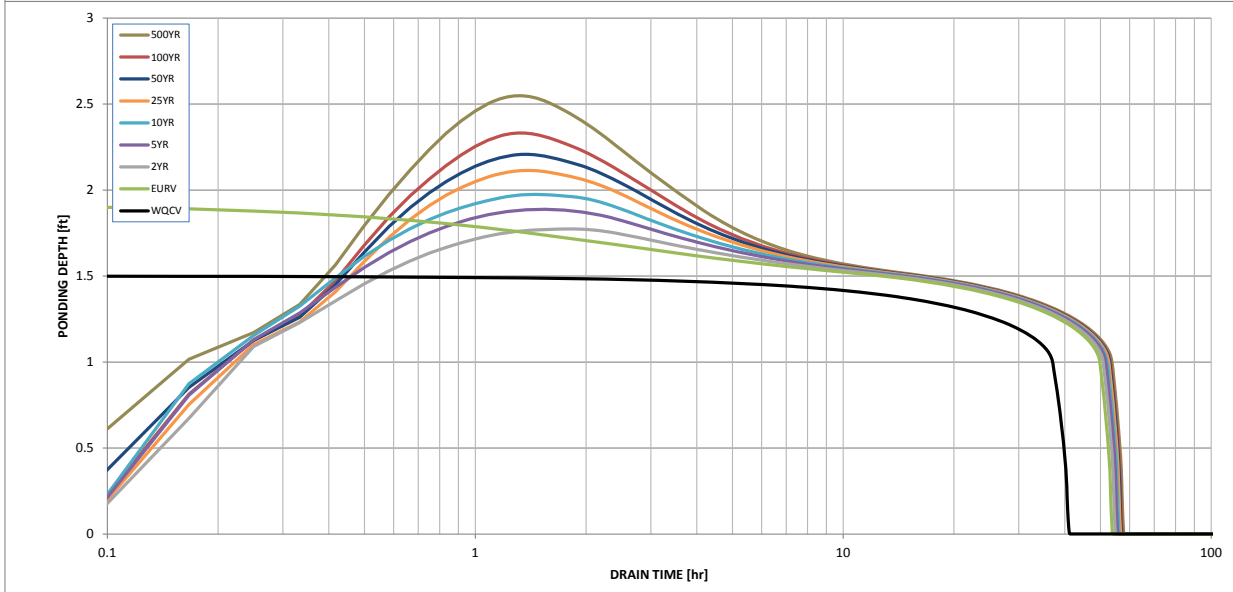
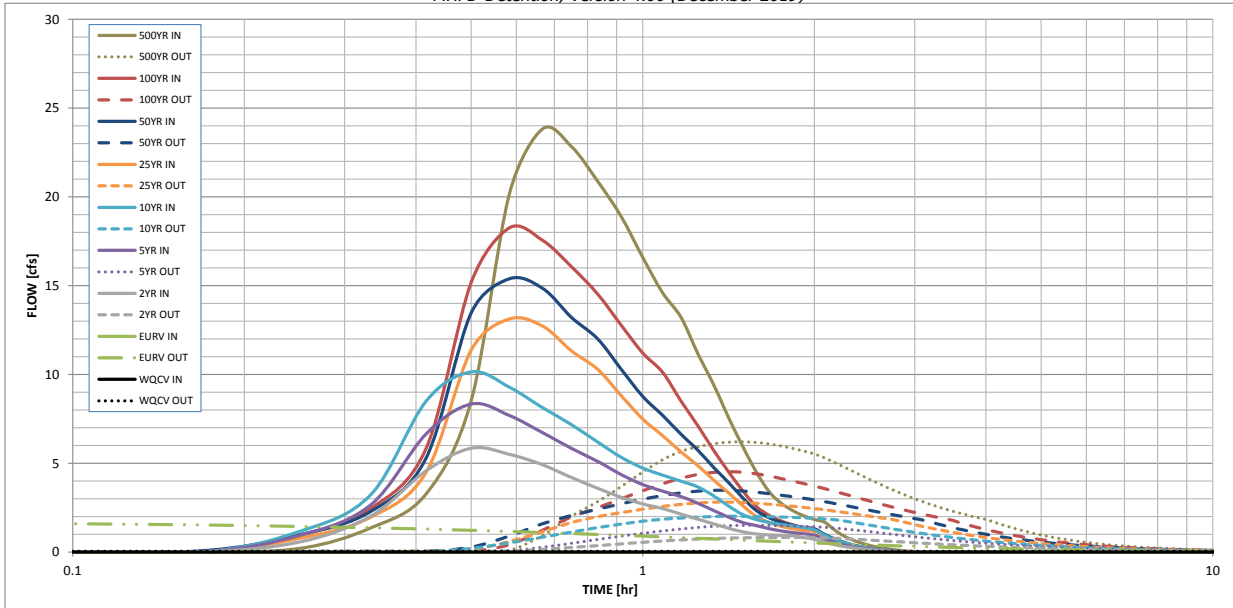
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
One-Hour Rainfall Depth (in) =	N/A	N/A	0.379	0.531	0.664	0.836	0.979	1.158
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 Gate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Gate 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)



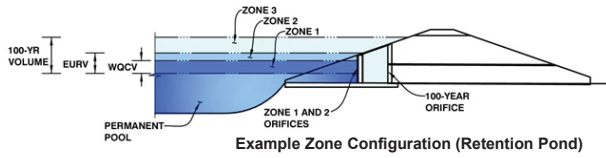
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

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**



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

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

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

Calculated Parameters for Underdrain		
Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

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

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

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

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

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.97	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	5.41	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	6.00	N/A	inches
Vertical Orifice Width =	16.39	N/A	inches

Calculated Parameters for Vertical Orific		
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 Weir		
Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H ₁ =	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	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate		
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

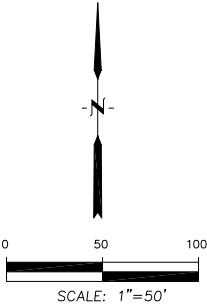
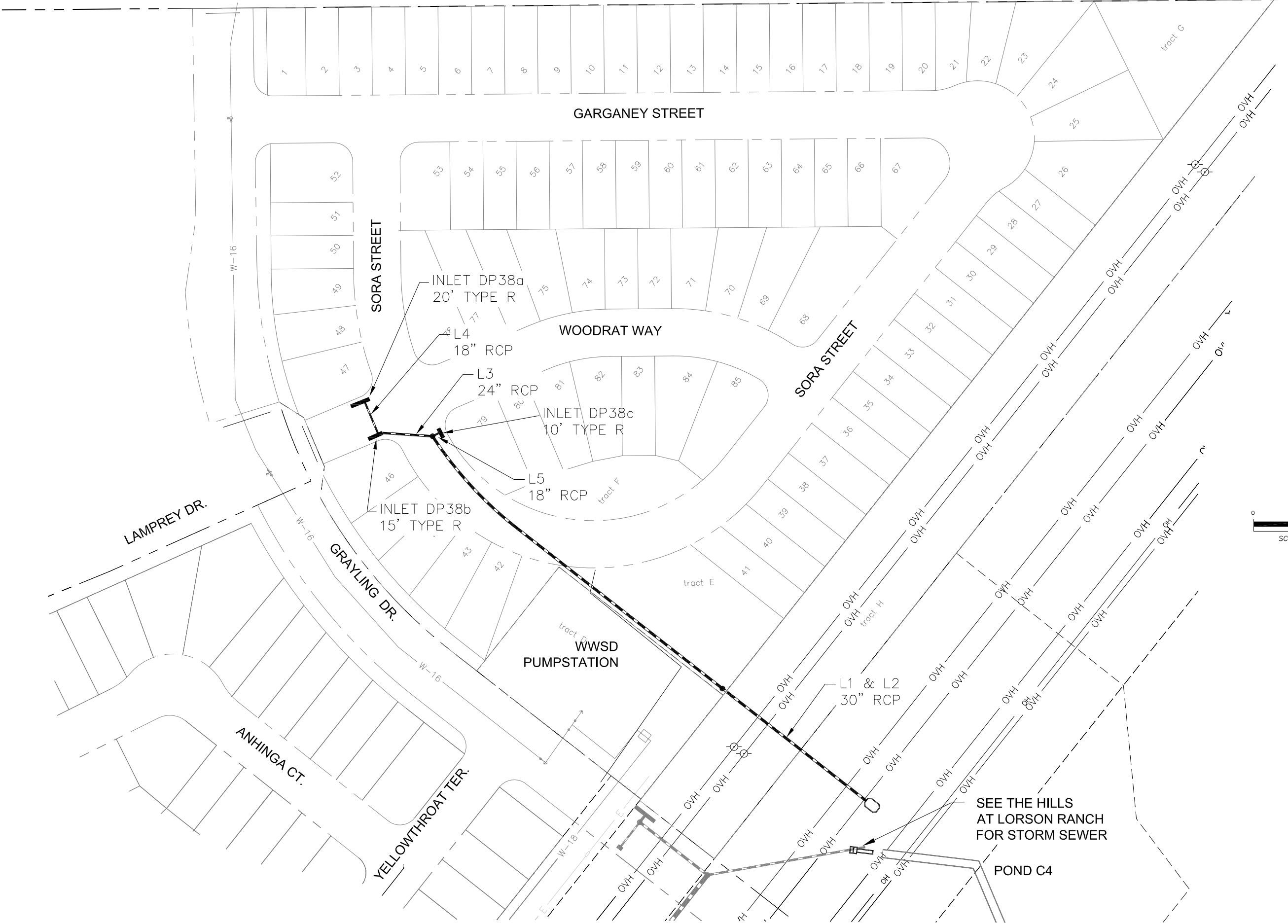
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
One-Hour Rainfall Depth (in) =	1.488	4.468	4.607	6.475	8.109	10.045	11.748	13.830
CUHP Runoff Volume (acre-ft) =	N/A	N/A	4.607	6.475	8.109	10.045	11.748	13.830
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	17.5	39.6	56.8	90.6	111.9	138.5
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.22	0.49	0.70	1.12	1.38	1.71
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	93.5	131.6	158.6	200.0	232.9	277.2
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	5.3	16.5	34.4	38.0	40.5	43.7
Peak Inflow Q (cfs) =	N/A	N/A	N/A	0.4	0.6	0.4	0.4	0.3
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 Gate 1 (fps) =	N/A	N/A	N/A	0.4	1.1	1.2	1.3	1.4
Max Velocity through Gate 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



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

NO.	DESCRIPTION	DATE

PREPARED FOR: **LORSON, LLC**
 212 N. WAHSATCH AVE., SUITE 301
 COLORADO SPRINGS, COLORADO 80903
 CONTRACT: JEFF MARK

DRAWN: RLS
 DESIGNED: LAB
 CHECKED: LAB

STORM SEWER SCHEMATIC
BASIN C10
SKYLINE AT LORSON RANCH

DATE	NOV 30, 2020
PROJECT NO.	100.063
SHEET NUMBER	1
TOTAL SHEETS:	1

P:\100\100.063\100.063-Storm_Schematic.dwg, Dec 29, 2020, 8:35am

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

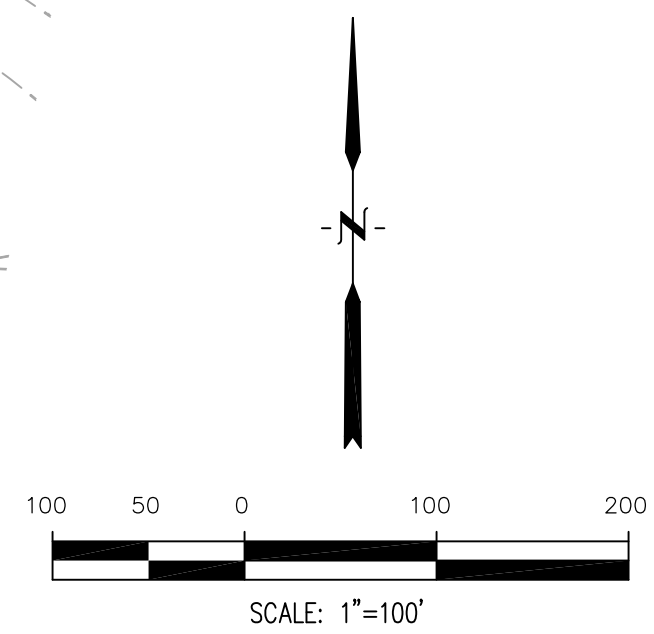
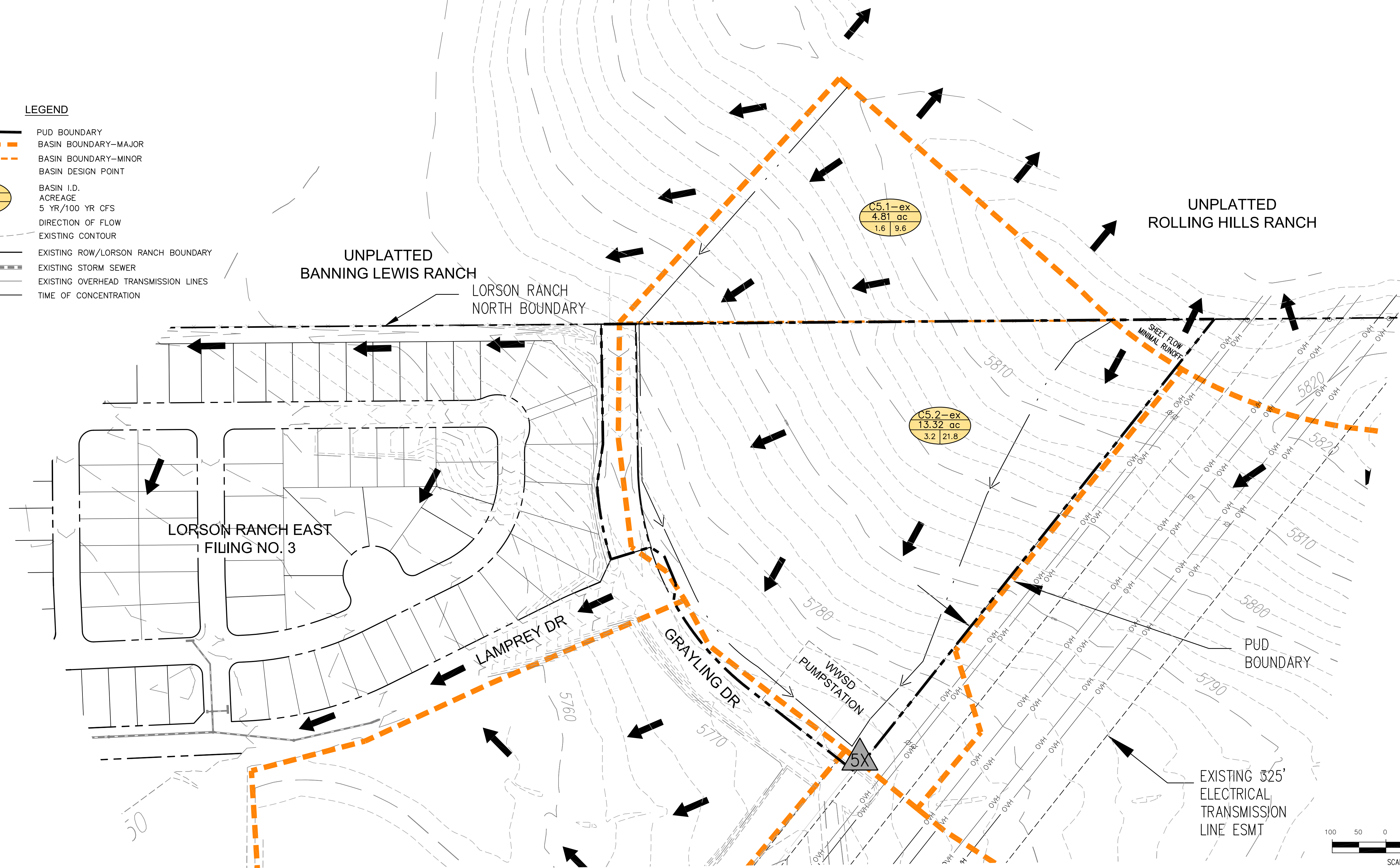
MAP POCKET

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

**EXISTING CONDITIONS
 PUD / PRELIMINARY PLAN
 SKYLINE AT LORSON RANCH**

LEGEND

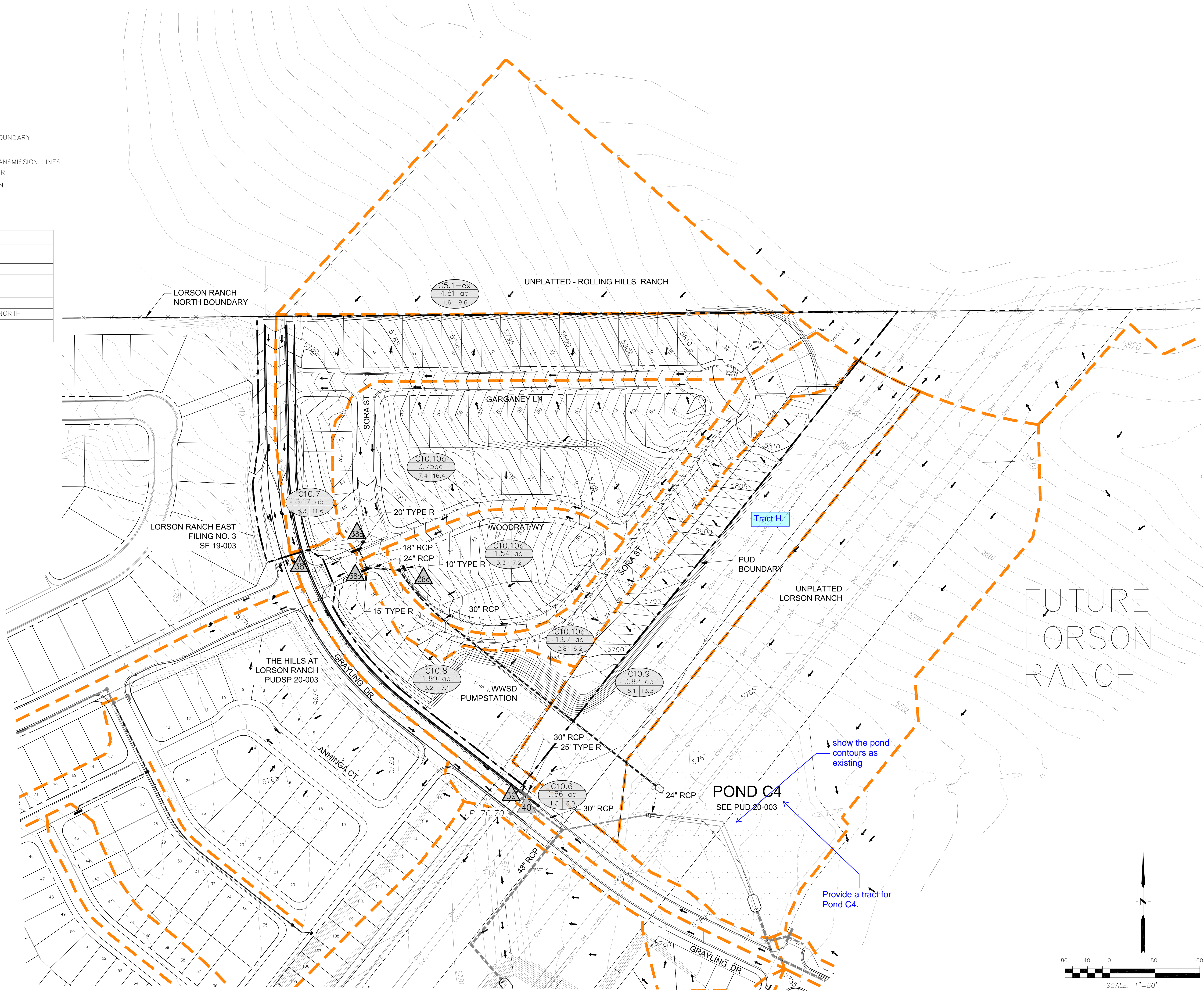
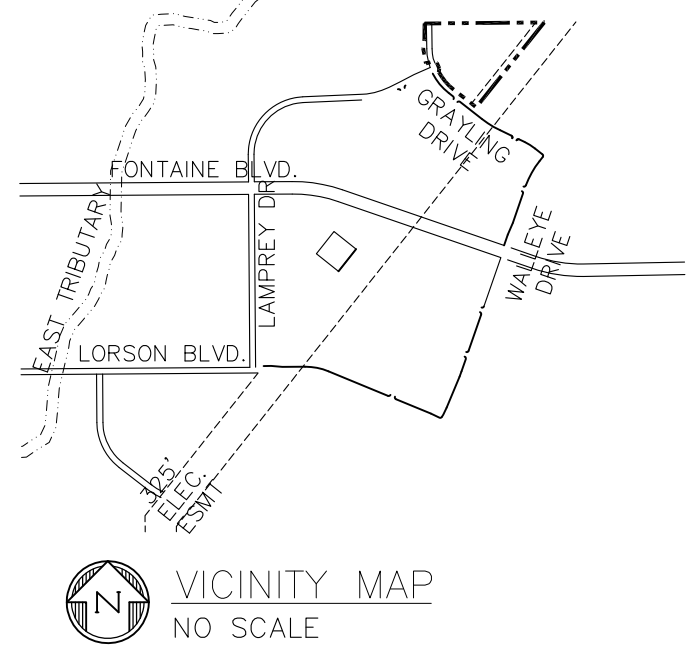
- PUD BOUNDARY
- BASIN BOUNDARY-MAJOR
- BASIN BOUNDARY-MINOR
- BASIN DESIGN POINT
- BASIN I.D. ACREAGE 5 YR/100 YR CFS
- DIRECTION OF FLOW
- EXISTING CONTOUR
- EXISTING ROW/LORSON RANCH BOUNDARY
- EXISTING STORM SEWER
- EXISTING OVERHEAD TRANSMISSION LINES
- TIME OF CONCENTRATION



LEGEND

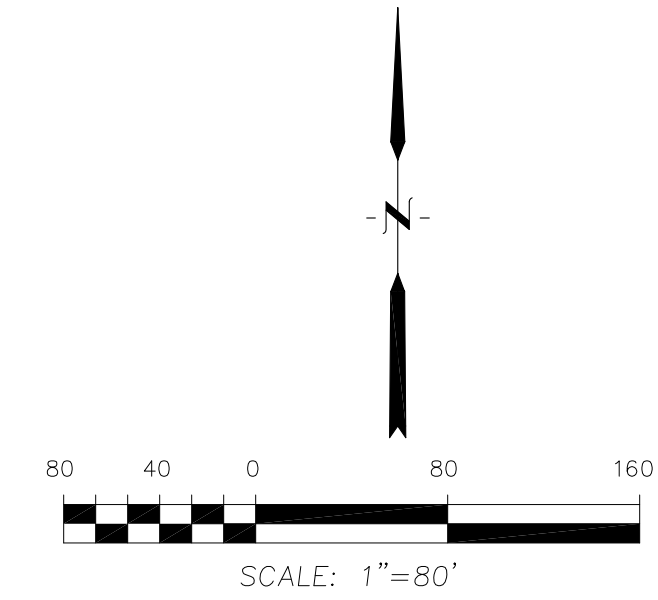
- PUD BOUNDARY
- BASIN BOUNDARY
- BASIN DESIGN POINT
- BASIN I.D.
XX AC
5 YR/100 YR CFS
- DIRECTION OF FLOW
- EXISTING CONTOUR
- PROPOSED CONTOUR
- ROW/LORSON RANCH BOUNDARY
- EXISTING STORM SEWER
- EXISTING OVERHEAD TRANSMISSION LINES
- PROPOSED STORM SEWER
- TIME OF CONCENTRATION
- HP
HIGH POINT
- 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



show the pond contours as existing

Provide a tract for Pond C4.



CORE ENGINEERING GROUP
 15004 1ST AVE. S.
 BURNSVILLE, MN 55306
 PH: 763-570-1100
 FAX: 763-570-1100
 EMAIL: Rich@cegroup.com

PROJECT: THE HILLS AT LORSON RANCH
 212 N. WAHSAKACH AVE. SUITE 301
 COLORADO SPRINGS, COLORADO 80903
 CONTACT: JEFF MARK

DRAWN: RL6
 DESIGNED: LAB
 CHECKED: LAB

**DEVELOPED CONDITIONS
 SKYLINE AT LORSON RANCH
 C10 BASIN**

DATE: NOV 30, 2020
 PROJECT NO.: 100.063
 SHEET NUMBER: 1
 TOTAL SHEETS: 1