Cushing Terrell

DRAINAGE LETTER
LOT 8A, CHAMBERS AND HESS SUBDIVISION

Lot 8 of Douglas 234 Filing 6, Amendment 1, Reception No. 2022004920
Parker, CO 80227

Prepared For:

SFP-E, LLC
PO Box 5350
20900 Cooley Road
Bend, OR 97701

Prepared By:

Cushing Terrell

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Cushing Terrell Project No. LSCO_21PARKER

May 21, 2024

COLORADO LICENSED PROFESSIONAL ENGINEER RONALD D. ISACKSON PE-0048663 04/04/2025

1.0 Purpose

The purpose of this Drainage Letter is to identify On-Site and Off-Site drainage patterns and to design the proposed storm sewer and inlet locations. This letter will also identify acceptable volumes to be received at the existing water quality facilities for Lot 8A of Chambers and Hess Filing No. 1. The findings of this letter are in compliance with the approved Final Drainage Report (FDR) titled "Final Drainage Report for Chambers and Hess Filing No. 1" by Rick Engineering Company dated January 25, 2021.

The proposed Les Schwab Tire Center is Lot 8A of the Chambers and Hess Subdivision and is identified as Basin A11 and parts of Basin A5 of the Chambers and Hess Basin in the Chambers and Hess FDR, which has been included in Appendix C. A future commercial development by others will consume the remainder of Basin A5. No deviation from the Final Drainage Report is expected from that future development by others.

The project site is located to the northwest of the intersection of Chambers and Hess Road in Parker, Colorado. Lot 8A sits to the north of Sliceroo Drive, a new street that runs through the subdivision. The proposed site is defined as Lot 8 of Douglas 234 Filing 6, Amendment 1, According to the Plat Thereof Recorded January 21, 2022, at Reception No. 2022004920, County of Douglas, State of Colorado. Lot 8A is currently bounded by a multi-use easement to the east, Lot 9 to the west, Lot 10 to the north, and Sliceroo Drive to the south. The developed site will include approximately 9,540 square feet (SF) of building and an additional 29,779 SF of parking and landscape area. Lot 8A is 0.903 acres in existing conditions. All 0.903 acres of the site will be disturbed during construction.

2.0 Storm Drainage Requirements and Methodologies

Site storm drainage improvements and designs are in compliance with the approved and finalized FDR for Chambers and Hess Filing No. 1 by Rick Engineering Company dated January 25, 2021. On the "Post-Development Drainage Map for Chambers & Hess Filing No. 1" plan in said report, Basin A11 was calculated to have a 100-year runoff coefficient 0.79 which yields an impervious area percentage of 68.6% using the USDCM Table 6-4 formula.

Urban Drainage and Flood Control District Denver, CO Version 2.00 spreadsheet was utilized to model the site hydrology under post-development conditions.

Storm Event Calculations: The Rational Method was selected to determine the initial runoff flows associated to the various subbasins within the subdivision. The initial design of the Permanent Control Measures (PCM) was previously approved with the Chambers and Hess FDR; conservative factors were selected based on the assumption that future sites would include small urban areas with short times of concentration. The parameters were defined and can be noted in Chapter VI: Drainage Facility Design within the Final Drainage Report for Chambers and Hess Filing No. 1 by Rick Engineering Company Dated January 25, 2021.

3.0 Existing and Pre-Development Conditions

Existing conditions of the proposed development are confined within Sub-Basin A11, A14, and A5 of the Chambers and Hess FDR. The lot and basin lines shown in Appendix C of the FDR are from previous parcel boundaries. However, drainage characteristics of these lots and basins are not expected to change.

Within the approved FDR, Sub-Basin A11 was designed for future improvements with the following runoff values: 2.2 CFS for a minor 5-year storm event and 5.0 CFS for a major 100-year storm event.

Within the approved FDR, Sub-Basin A14 was designed for future improvements with the following runoff values: 0.1 CFS for a minor 5-year storm event and 1.8 CFS for a major 100-year storm event. Of the 0.41 acres in subbasin A14, the proposed development covers approximately 6,753 square feet (0.155 acres). Proportionally, this yields a 0.68 cfs for a major 100-year storm event for the area covered by the proposed development.

Within the approved FDR, Sub-Basin A5 was designed for future improvements with the following runoff values: 2.5 CFS for a minor 5-year storm event and 5.7 CFS for a major 100-year storm event.

Basins A11, A14, and A5 eventually convey water to the outfall location of Design Point 13 as seen in Appendix C in the finalized FDR. Future development of the site will provide no negative impact to downstream infrastructure, surface waters, or properties. The site contains no presence of protected waters or flood zones. Soils encountered on this site provide good infiltration and maintain a hydraulic soil rating of B.

4.0 Post-Development Conditions

Within Lot 8A, three onsite (A, B, and C) and one offsite (OS-1) drainage basins are proposed. In interim site conditions, these offsite basins will convey runoff to several proposed onsite basins until future development on neighboring lots can take place. These offsite basins will then convey water through drainage structures on their new respective lots. Impervious area only in Basins A, B, and C should be considered for Lot 8A. Basin OS-1 include portions of the proposed shared access drive on neighboring Lots 9A and 10A which are slated for future development. At time of development of these lots they will be required to maintain a 95% or lower impervious value including these lots. The flows from these basins where however included in the inlet capacity calculations to ensure the site will function in the temporary condition.

Table 4.1: Post-Development Impervious Area and Runoff Coefficients

Basin Name	Area (AC)	NRCS Hydrologic Soil Group	Pavement	Roofs	Landscape	Percent Impervious	*C_5	*C_{100}
			100%	90%	0%			
A	0.58	B	0.52	0.00	0.06	0.90	**0.76**	**0.85**
B	0.39	B	0.00	0.23	0.17	0.53	**0.43**	**0.68**
C	0.16	B	0.02	0.00	0.15	0.11	**0.08**	**0.48**
OS-1	0.36	B	0.22	0.00	0.14	0.61	**0.50**	**0.71**
					Total =	**0.65**	**0.54**	**0.73**

Subbasin A was designed for future improvements with the following runoff values: 2.09 CFS for a minor 5-year storm event and 4.33 CFS for a major 100-year storm event.

Subbasin B was designed for future improvements with the following runoff values: 0.56 CFS for a minor 5-year storm event and 1.63 CFS for a major 100-year storm event.

Subbasin C was designed for future improvements with the following runoff values: 0.05 CFS for a minor 5-year storm event and 0.63 CFS for a major 100-year storm event. When comparing subbasin C to predeveloped conditions (subbasin Y), subbasin C increases the 100-year runoff by 0.11 cfs. However, as noted on the approved post-development drainage map, the area of subbasin A14 that covers subbasin C incorporates 0.68 cfs into the design. Therefore, there is a net decrease between subbasin C and A14 of 0.05 cfs (0.68 – 0.63 = 0.05 cfs decrease).

5-YR Design Storm Runoff					
Basin	**Area (AC)**	**C**	**T_c (Min)**	**I (in/hr)**	**Q (CFS)**
A	0.58	0.76	5.00	4.71	2.09
B	0.39	0.43	13.57	3.30	0.56
C	0.16	0.08	6.29	4.42	0.05
OS-1	0.36	0.50	5.00	4.71	0.85

Table 4.2: Post-Development 24-hr Runoff (5-YR Event)

100-YR Design Storm Runoff					
Basin	**Area (AC)**	**C**	**T_c (Min)**	**I (in/hr)**	**Q (CFS)**
A	0.58	0.85	5.00	8.82	4.33
B	0.39	0.68	13.57	6.18	1.63
C	0.16	0.48	6.29	8.27	0.63
OS-1	0.36	0.71	5.00	8.82	2.26

Table 4.3: Post-Development 24-hr Runoff (100-YR Event)

5.0 Conclusion

In conclusion, when referencing the existing and proposed state as defined within the approved FDR, percent imperviousness allowed, and designed runoff demonstrated in the initial Chambers and Hess Subdivision design, the proposed Lot 8A development follows all requirements established in previous studies and will not create adverse effects to associated downstream waters or infrastructure. The Lot 8A and a portion of the Lot 9 post-development conditions result in a percent impervious of 65%, a 5-year minor storm runoff of 2.70 CFS, and a 100-year major storm runoff of 6.59 CFS. The proposed design is less than the assumed condition for future development within the approved existing Chambers and Hess FDR of 68.6% imperviousness, 4.70 CFS for the 5-year minor storm, and 10.70 CFS for the 100-year major storm event.

Sincerely,

Ian Graham, PE
Project Engineer
Cushing Terrell

Appendices

Appendix A – Vicinity Map

Appendix B – Drainage Maps

Appendix C– Historic Basin Analysis

Appendix D – Proposed Basin Analysis

Appendix E – FEMA FIRMette

Appendix A: Vicinity Map

VICINITY MAP

0 500 1000 2000

SCALE: 1" = 1000'

DENVER, CO
p 720.359.1416
f 720.359.1417

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CHAMBERS & HESS RD
PARKER, CO 80134
LES SCHWAB TIRE CENTER

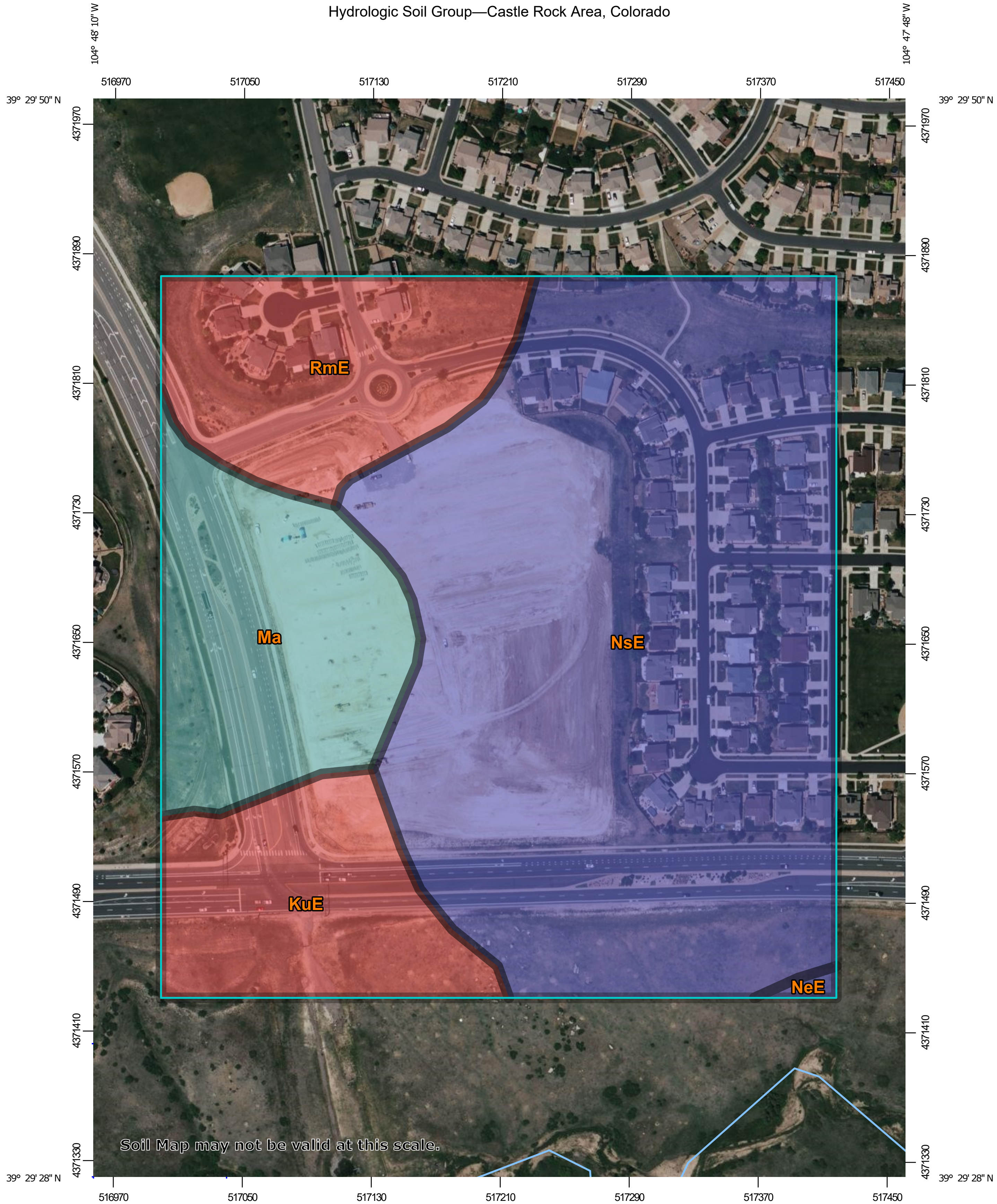
07.05.2023 TAG REVISION
LES SCHWAB TIRE CENTER

CHECKED BY
WALKER

REF SHEET

SHEET NAME
VC

Appendix B: Drainage Maps



Map Scale: 1:3,250 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

N

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado
Survey Area Data: Version 15, Sep 1, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
KuE	Kutch clay loam, 8 to 20 percent slopes	D	5.4	11.6%
Ma	Manzanola clay loam	C	6.9	15.0%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	0.1	0.3%
NsE	Newlin-Satanta complex, 5 to 20 percent slopes	B	27.9	60.3%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	6.0	12.9%
Totals for Area of Interest			**46.3**	**100.0%**

Description

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

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

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

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

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

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

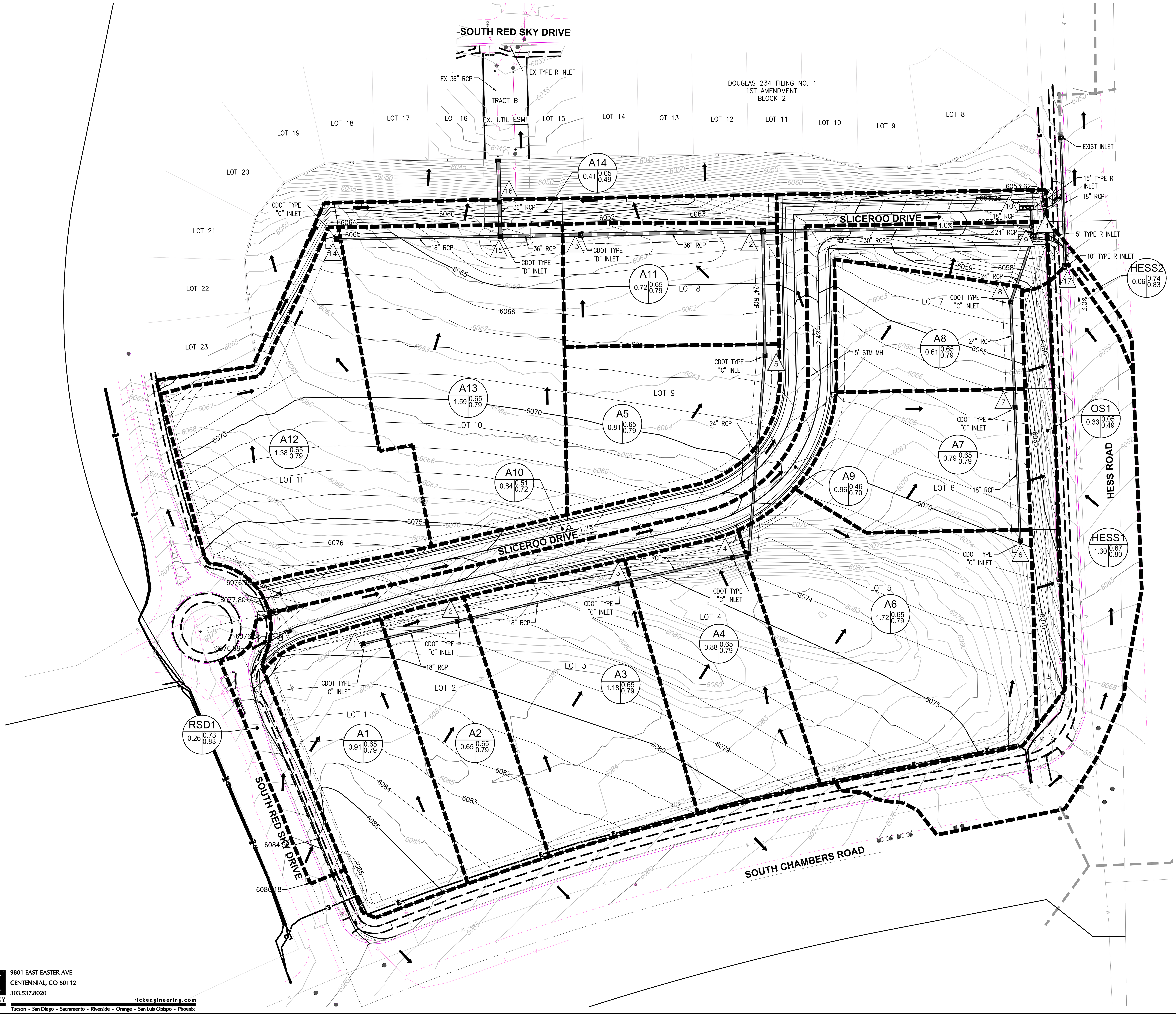
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



ORIGINAL SCALE: 1" = 50' HORIZ.

LEGEND

- BASIN ID
- 5 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- PROPOSED STORM SEWER

DESIGN POINT SUMMARY

DESIGN POINT	PEAK RUNOFF 5YR (CFS)	PEAK RUNOFF 100YR (CFS)
1	2.8	6.4
2	4.7	10.8
3	8.1	18.6
4	10.6	24.3
5	12.7	29.3
6	5.3	12.0
7	7.6	17.3
8	9.4	21.4
9	2.4	8.2
10	1.6	4.3
11	11.2	28.9
12	20.9	51.4
13	22.1	54.4
14	4.2	9.6
15	28.6	69.5
16	28.7	70.8
17	3.6	9.1

BASIN SUMMARY

BASIN	Q5 CFS	Q100 CFS
A1	2.8	6.4
A2	2.0	4.6
A3	3.6	8.2
A4	2.7	6.2
A5	2.5	5.7
A6	5.3	12.0
A7	2.4	5.5
A8	1.9	4.2
A9	1.7	4.7
A10	1.6	4.3
A11	2.2	5.0
A12	4.2	9.6
A13	4.9	11.1
A14	0.1	1.8
HESS1	3.5	7.8
HESS2	0.2	0.5
RSD1	0.9	1.9
OS1	0.1	1.4

POST-DEVELOPMENT DRAINAGE MAP FOR CHAMBERS & HESS FILING NO. 1

SHEET 2 OF 2

D-1173
DATE: JANUARY 25, 2021

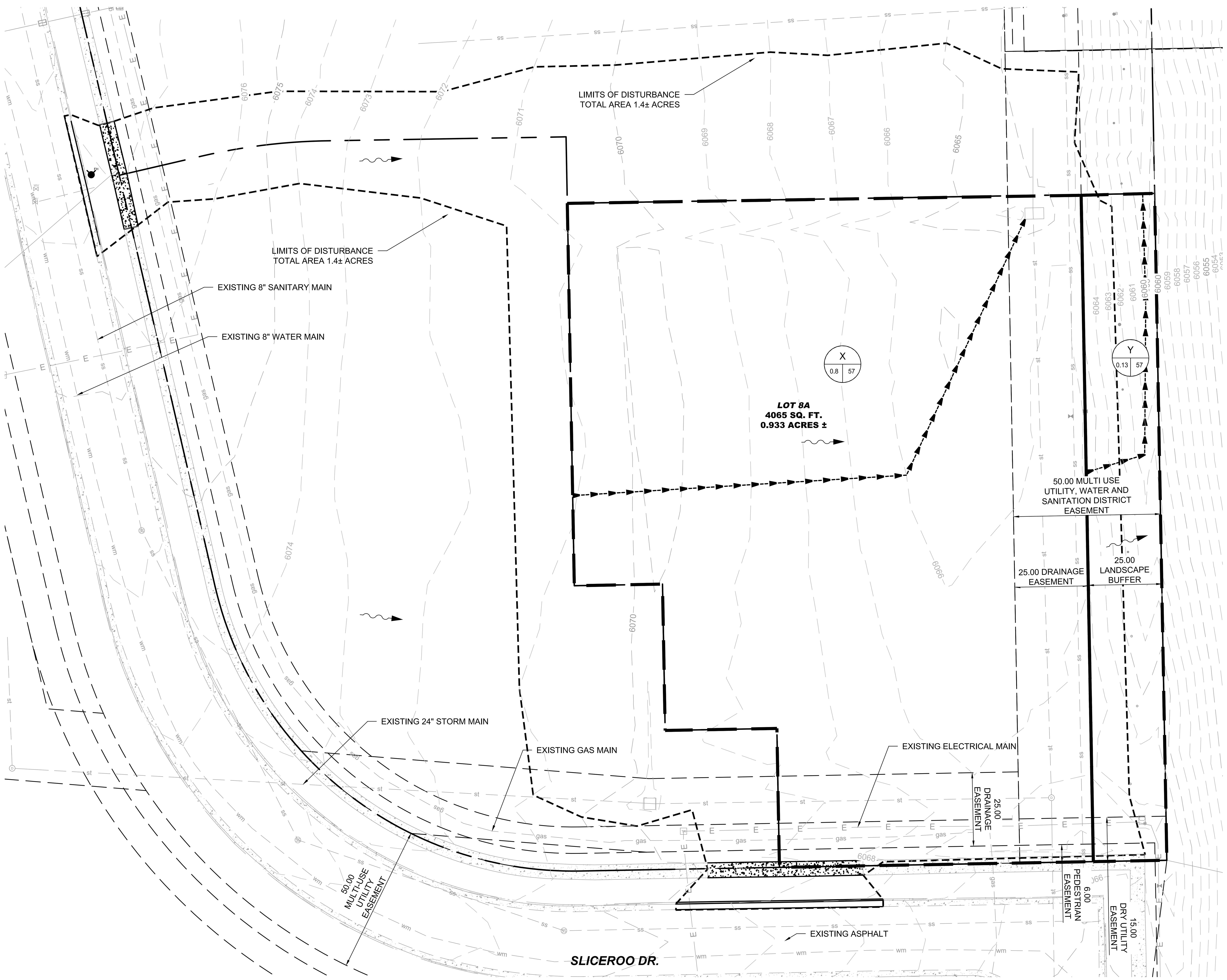
RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
rickengineering.com
Denver · Tucson · San Diego · Sacramento · Riverside · Orange · San Luis Obispo · Phoenix

NOT FOR CONSTRUCTION — EXHIBIT FOR DRAINAGE STUDY REPORT ONLY

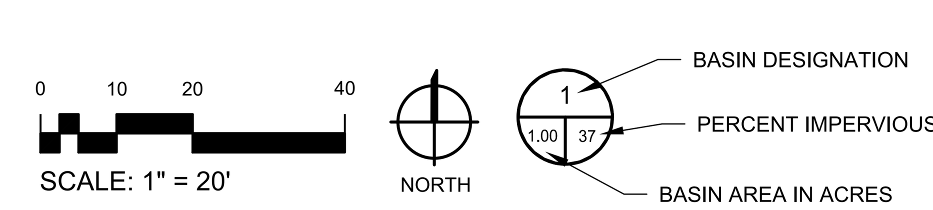
Cushing Terrell

cushingterrell.com
800.757.9522

Tires LES SCHWAB



1
D.1
EXISTING DRAIANGE MAP



LEGEND

PROPOSED

- BASIN BOUNDARY
- TIME OF CONCENTRATION FLOW PATH
- LIMITS OF PARKING LOT DETENTION
- FLOW ARROW

BASIS OF BEARING

BEARINGS ARE BASED ON THE SOUTH LINE OF THE SOUTHEAST QUARTER OF SECTION 29 TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL MERIDIAN, BEING MONUMENTED AT THE SOUTH QUARTER CORNER BY A 3.25' ALUMINUM CAP "PLS STAMPED 35593" IN A RANGE BOX, AND MONUMENTED AT THE SOUTH QUARTER CORNER BY 3.25" ALUMINUM CAP "PLS STAMPED 22561." SAID SOUTH SECTION LINE BEARS NORTH 89°15'13" EAST A DISTANCE OF 2639.29 FEET WITH ALL BEARINGS HEREON BEING RELATIVE THERETO.

PROJECT BENCHMARK

DOUGLAS COUNTY GIS BENCHMARK 1074010, STAMPED "1.074010" LOCATED ON THE WEST SIDE OF DOUBLE ANGLE ROAD, NEAR THE SOUTH ENTRANCE TO THE PARKING LOT AT 9345 DOUBLE ANGLE ROAD.
PUBLISHED NAVD 1989 ELEVATION=6028.60 FEET

BASIN TABLE

5-YR Design Storm Runoff

Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
X	0.80	0.00	19.99	2.74	0.01
Y	0.13	0.10	5.00	4.71	0.06

100-YR Design Storm Runoff

Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
X	0.80	0.01	19.99	5.12	0.04
Y	0.13	0.46	5.00	8.82	0.52

NOT FOR CONSTRUCTION - PRELIMINARY DESIGN

CHAMBERS & HESS RD. PARKER, CO
6-BAY LINEAR STORE

LES SCHWAB TIRE CENTER - PARKER, CO

SITE PLAN

07.11.2023
DRAWN BY | SOMA
CHECKED BY | WALKER
REVISIONS

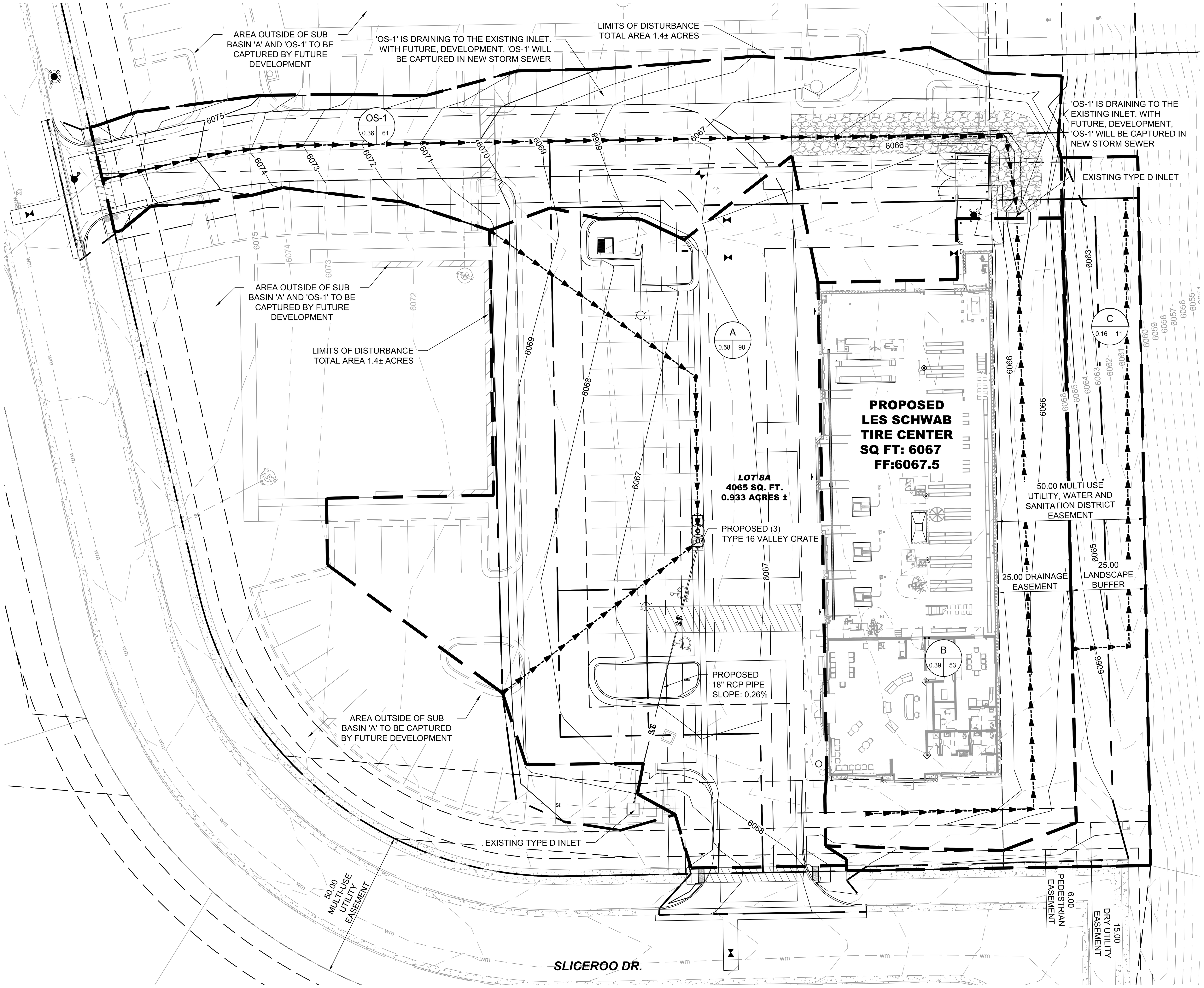
EXISTING DRAINAGE MAP

D.1

Cushing Terrell.

cushingterrell.com
800.757.9522

Tires LES SCHWAB



1 D.2 PROPOSED DRAINAGE MAP

0 10 20 40
SCALE: 1" = 20'

NORTH

1 — BASIN DESIGNATION
37 — PERCENT IMPERVIOUS
1.00 — BASIN AREA IN ACRES

LEGEND

PROPOSED

- BASIN BOUNDARY
- TIME OF CONCENTRATION FLOW PATH
- LIMITS OF PARKING LOT DETENTION

BASIS OF BEARING

BEARINGS ARE BASED ON THE SOUTH LINE OF THE SOUTHEAST QUARTER OF SECTION 29 TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL MERIDIAN, BEING MONUMENTED AT THE SOUTH QUARTER CORNER BY A 3.25' ALUMINUM CAP "PLS STAMPED 35593" IN A RANGE BOX, AND MONUMENTED AT THE SOUTH QUARTER CORNER BY 3.25" ALUMINUM CAP "PLS STAMPED 22561." SAID SOUTH SECTION LINE BEARS NORTH 89°15'13" EAST A DISTANCE OF 2639.29 FEET WITH ALL BEARINGS HEREON BEING RELATIVE THERETO.

PROJECT BENCHMARK

DOUGLAS COUNTY GIS BENCHMARK 1074010, STAMPED "1.074010" LOCATED ON THE WEST SIDE OF DOUBLE ANGLE ROAD, NEAR THE SOUTH ENTRANCE TO THE PARKING LOT AT 9345 DOUBLE ANGLE ROAD.
PUBLISHED NAVD 1989 ELEVATION=6028.60 FEET

BASIN TABLE

5-YR Design Storm Runoff

Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
A	0.58	0.76	5.00	4.71	2.09
B	0.39	0.43	13.57	3.30	0.56
C	0.16	0.08	6.29	4.42	0.05
OS-1	0.36	0.50	5.00	4.71	0.85

100-YR Design Storm Runoff

Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
A	0.58	0.85	5.00	8.82	4.33
B	0.39	0.68	13.57	6.18	1.63
C	0.16	0.48	6.29	8.27	0.63
OS-1	0.36	0.71	5.00	8.82	2.26

NOT FOR CONSTRUCTION - PRELIMINARY DESIGN

LES SCHWAB TIRE CENTER - PARKER, CO

6-BAY LINEAR STORE
12236 SLICEROO DR, PARKER, CO 80134

CIVIL CDS

04.17.2024
DRAWN BY | SOMA
CHECKED BY | WALKER
REVISIONS

PROPOSED DRAINAGE MAP

D.2

Appendix C: Historic Basin Analysis

Subject:	DRAINAGE CALCULATIONS-EXISTING		Page:	1
Project No.	LSCO_21PARKER	By: RW	Date:	09.15.23
Project Name:	LES SCHWAB TIRE CENTER - COLORADO			

Basin Name	Area (AC)	NRCS Hydrologic Soil Group	Pavement 100%	Roofs 90%	Landscape 0%	Percent Impervious	*C_5	*C_{100}
X	0.80	B	0.00	0.00	0.02	0.00	**0.00**	**0.43**
Y	0.13	B	0.00	0.00	0.17	0.00	**0.00**	**0.43**
					Total =	**0.00**	**0.00**	**0.43**

*Refer to DCM Table 6-4

Basin Data			Initial/Overland Time (T_i)			Travel Time (T_t)					Final
Basin	Area (AC)	C_5	L (FT)	Slope (%)	T_i (Min)	L (FT)	Slope (%)	C_v	V_t (FPS)	T_t (Min)	Tc (5 Min)
X	0.80	0.00	210	3.00%	19.99	0	2.00%	20	2.828427	0	19.99
Y	0.13	0.00	20	21.00%	3.25	88	2.20%	15	2.22486	0.659218	5.00

1-HR Rainfall Intensity (i)

T_c	5_{yr} (in/hr)	100_{yr} (in/hr)	T_c	5_{yr} (in/hr)	100_{yr} (in/hr)
5	4.71	8.82	25	2.42	4.53
7	4.27	7.99	30	2.18	4.08
10	3.76	7.03	35	1.99	3.72
11	3.62	6.77	40	1.83	3.42
12	3.49	6.53	45	1.70	3.18
13	3.37	6.30	50	1.59	2.97
15	3.16	5.90	55	1.49	2.79
20	2.73	5.11	60	1.40	2.63

Basin	T_c	5_{yr} (in/hr)	100_{yr} (in/hr)
X	**19.99**	**2.74**	**5.12**
Y	**5.00**	**4.71**	**8.82**

Refer to SDECM Town of Parker PG 5-1:
I_{100} = 74.1/(10+tc)^0.786
I_5 = 39.615/(10+tc)^0.786

5-YR Design Storm Runoff

Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
X	0.80	0.00	19.99	2.74	0.01
Y	0.13	0.00	5.00	4.71	0.00

100-YR Design Storm Runoff

Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
X	0.80	0.43	19.99	5.12	1.74
Y	0.13	0.43	5.00	8.82	0.49

Appendix D: Proposed Basin Analysis

Cushing Terrell	Subject:	DRAINAGE CALCULATIONS		Page:	1
	Project No.	LSCO_21PARKER	By: RW	Date:	07.07.23
	Project Name:	LES SCHWAB TIRE CENTER - COLORADO			

Basin Name	Area (AC)	NRCS Hydrologic Soil Group	Pavement 100%	Roofs 90%	Landscape 0%	Percent Impervious	*C_5	*C_{100}
A	0.58	B	0.52	0.00	0.06	0.90	**0.76**	**0.85**
B	0.39	B	0.00	0.23	0.17	0.53	**0.43**	**0.68**
C	0.16	B	0.02	0.00	0.15	0.11	**0.08**	**0.48**
OS-1	0.36	B	0.22	0.00	0.14	0.61	**0.50**	**0.71**
					Total =	**0.65**	**0.54**	**0.73**

*Refer to USDCM Table 6-4

Basin Data			Initial/Overland Time (T_i)			Travel Time (T_t)					Final
Basin	Area (AC)	C_5	L (FT)	Slope (%)	T_i (Min)	L (FT)	Slope (%)	C_v	V_t (FPS)	T_t (Min)	Tc (5 Min)
A	0.58	0.76	68	3.80%	3.22	62	0.80%	20	1.788854	0.577651	5.00
B	0.39	0.43	58	0.50%	11.55	182	1.00%	15	1.5	2.022222	13.57
C	0.16	0.08	20	12.00%	3.65	152	3.10%	15	2.641023	0.959224	6.29
OS-1	0.36	0.50	100	4.20%	6.71	0	2.00%	20	2.828427	0	5.00

1-HR Rainfall Intensity (i)

T_c	5_{yr} (in/hr)	100_{yr} (in/hr)	T_c	5_{yr} (in/hr)	100_{yr} (in/hr)
5	4.71	8.82	25	2.42	4.53
7	4.27	7.99	30	2.18	4.08
10	3.76	7.03	35	1.99	3.72
11	3.62	6.77	40	1.83	3.42
12	3.49	6.53	45	1.70	3.18
13	3.37	6.30	50	1.59	2.97
15	3.16	5.90	55	1.49	2.79
20	2.73	5.11	60	1.40	2.63

Basin	T_c	5_{yr} (in/hr)	100_{yr} (in/hr)
A	**5.00**	**4.71**	**8.82**
B	**13.57**	**3.30**	**6.18**
C	**6.29**	**4.42**	**8.27**
OS-1	**5.00**	**4.71**	**8.82**

Refer to SDECM Town of Parker PG 5-1:
I_{100} = 74.1/(10+tc)^0.786
I_5 = 39.615/(10+tc)^0.786

5-YR Design Storm Runoff

Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
A	0.58	0.76	5.00	4.71	2.09
B	0.39	0.43	13.57	3.30	0.56
C	0.16	0.08	6.29	4.42	0.05
OS-1	0.36	0.50	5.00	4.71	0.85

100-YR Design Storm Runoff

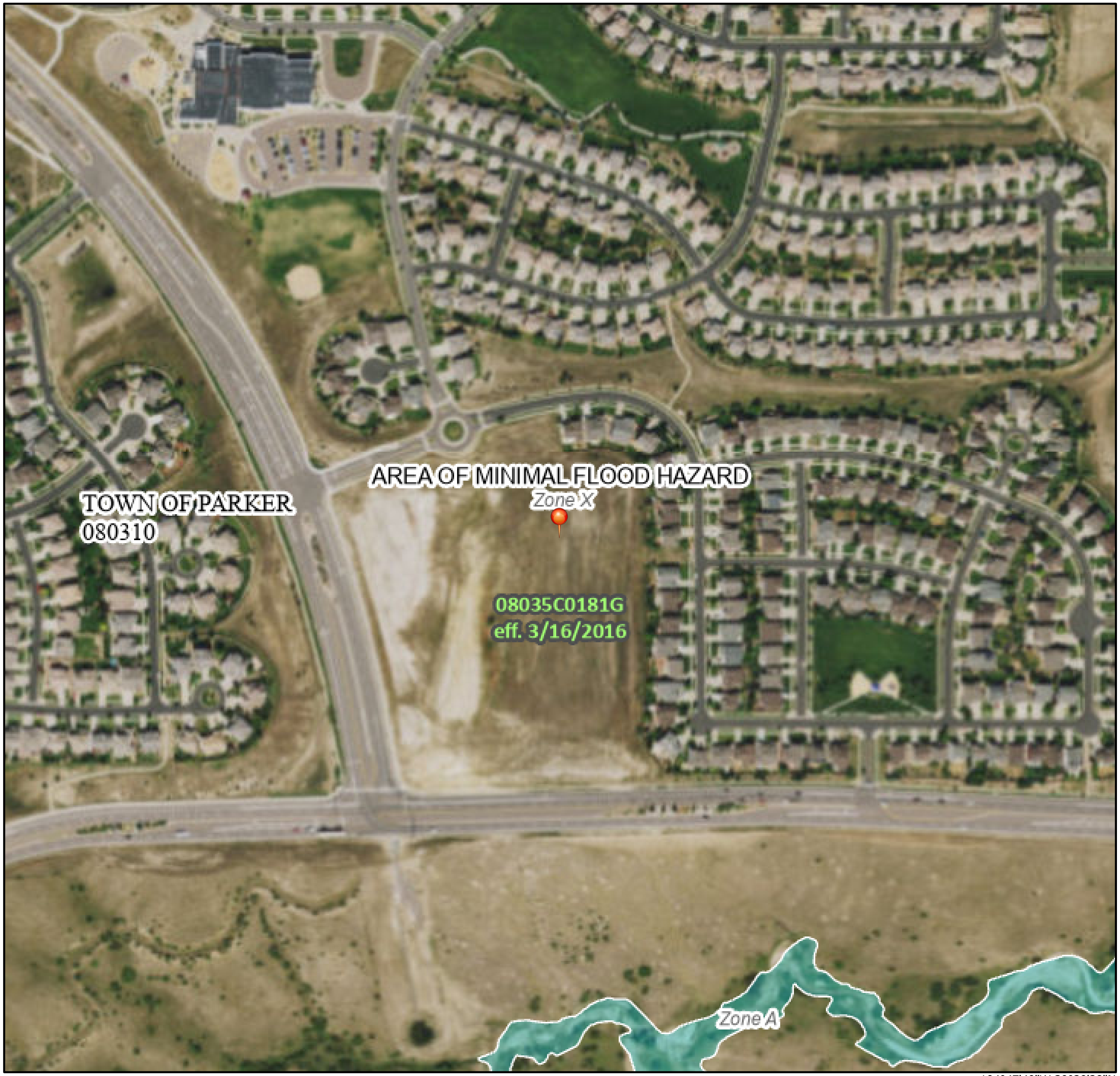
Basin	Area (AC)	C	T_c (Min)	I (in/hr)	Q (CFS)
A	0.58	0.85	5.00	8.82	4.33
B	0.39	0.68	13.57	6.18	1.63
C	0.16	0.48	6.29	8.27	0.63
OS-1	0.36	0.71	5.00	8.82	2.26

Appendix E: FEMA FIRMette

National Flood Hazard Layer FIRMette

FEMA

104°48'18"W 39°29'56"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

104°47'40"W 39°29'28"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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

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

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/22/2021 at 6:47 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.

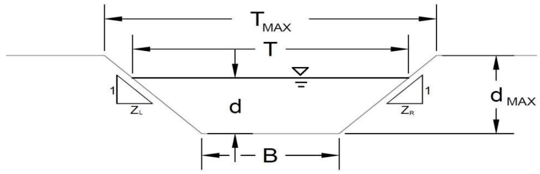
Appendix F: Inlet Capacity Calculations

Existing Inlet in Grass Swale Behind Les Schwab

MHFD-Inlet, Version 5.02 (August 2022)

AREA INLET IN A SWALE

LSCO_22Parker
Existing Swale Inlet



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

	NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	
	Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030
	Channel Invert Slope	S_O =	0.0100 ft/ft
	Bottom Width	B =	3.41 ft
Warning 01	Left Side Slope	Z1 =	0.25 ft/ft
Warning 01	Right Side Sloe	Z2 =	0.25 ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ○ Non-Cohesive
- ⦿ Cohesive
- ○ Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**15.00**	**15.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.16**	**1.16**	**ft**

Allowable Channel Capacity Based On Channel Geometry		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**17.4**	**17.4**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**1.16**	**1.16**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**1.7**	**3.9**	**cfs**
Water Depth	d =	**0.26**	**0.44**	**ft**

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'

Existing Inlet in Grass Swale Behind Les Schwab

MHFD-Inlet, Version 5.02 (August 2022)

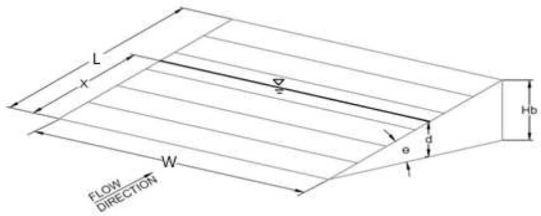
AREA INLET IN A SWALE

LSCO_22Parker

Existing Swale Inlet

Inlet Design Information (Input)

Type of Inlet	CDOT TYPE D (Parallel)	Inlet Type =	CDOT TYPE D (Parallel)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	6.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.38	
Grate Discharge Coefficient		C_d =	0.76	
Orifice Coefficient		C_o =	0.50	
Weir Coefficient		C_w =	1.62	



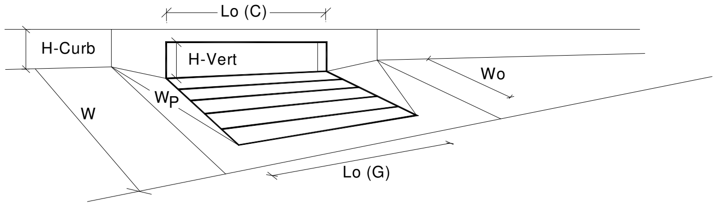
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.26	0.44	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.4**	**7.5**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

Warning 01: Sideslope steepness exceeds USDCM Volume I recommendation.
Warning 02: Depth (d) exceeds USDCM Volume I recommendation.

Triple Type 16 Inlet Located In Parking Lot

INLET IN A SUMP OR SAG LOCATION

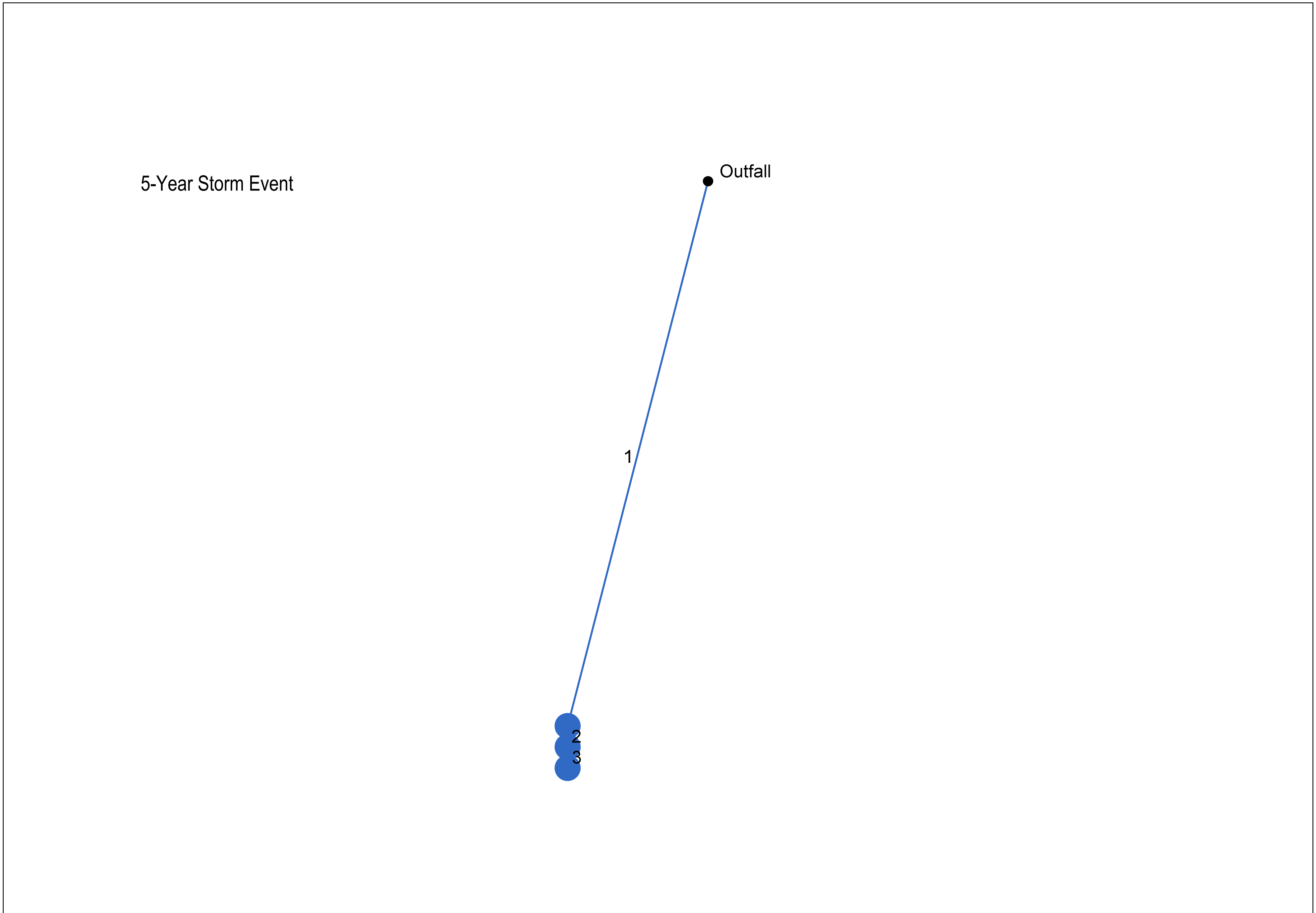
MHFD-Inlet, Version 5.03 (August 2023)



		MINOR	MAJOR	
Design Information (Input) — Denver No. 16 Valley Grate				
Type of Inlet	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.3	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.42	0.56	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.41	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.6**	**5.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.1	4.3	cfs

Appendix G: HGL Calculations

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: LSCO_Parker.stm	Number of lines: 3	Date: 3/12/2024

Structure Report

5-Year Storm Event

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
3	Structure - (65)	Manhole	6066.18	Cir	4.00	4.00	18	Cir	6060.40			
2	Structure - (68)	Manhole	6066.16	Cir	4.00	4.00	18	Cir	6060.38	18	Cir	6060.38
1	Structure - (66)	Manhole	6066.13	Cir	4.00	4.00	18	Cir	6060.36	18	Cir	6060.36

Project File: LSCO_Parker.stm	Number of Structures: 3	Run Date: 3/12/2024

Storm Sewer Summary Report

5-Year Storm Event

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
3	Pipe - (43)	2.90	18	Cir	3.527	6060.38	6060.40	0.568	6061.03	6061.05	0.25	6061.05	2	Manhole
2	Pipe - (45)	2.89	18	Cir	3.457	6060.36	6060.38	0.579	6061.47	6061.03	0.04	6061.03	1	Manhole
1	Pipe - (44)	2.89	18	Cir	93.613	6059.89	6060.36	0.502	6061.39	6061.45	0.02	6061.47	End	Manhole

Project File: LSCO_Parker.stm	Number of lines: 3	Run Date: 3/12/2024

NOTES: Return period = 5 Yrs.

Hydraulic Grade Line Computations

5-Year Storm Event

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
3	18	2.90	6060.38	6061.03	0.65	0.73	3.98	0.25	6061.27	0.000	3.527	6060.40	6061.05	0.65**	0.73	3.98	0.25	6061.29	0.000	0.000	n/a	1.00	0.25
2	18	2.89	6060.36	6061.47	1.11	0.73	2.07	0.25	6061.71	0.000	3.457	6060.38	6061.03	0.65**	0.73	3.98	0.25	6061.27	0.000	0.000	n/a	0.15	0.04
1	18	2.89	6059.89	6061.39	1.50	1.77	1.63	0.04	6061.43	0.076	93.613	6060.36	6061.45	1.09	1.37	2.11	0.07	6061.52	0.099	0.087	0.082	0.30	0.02

Project File: LSCO_Parker.stm	Number of lines: 3	Run Date: 3/12/2024

Notes: ; ** Critical depth. ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

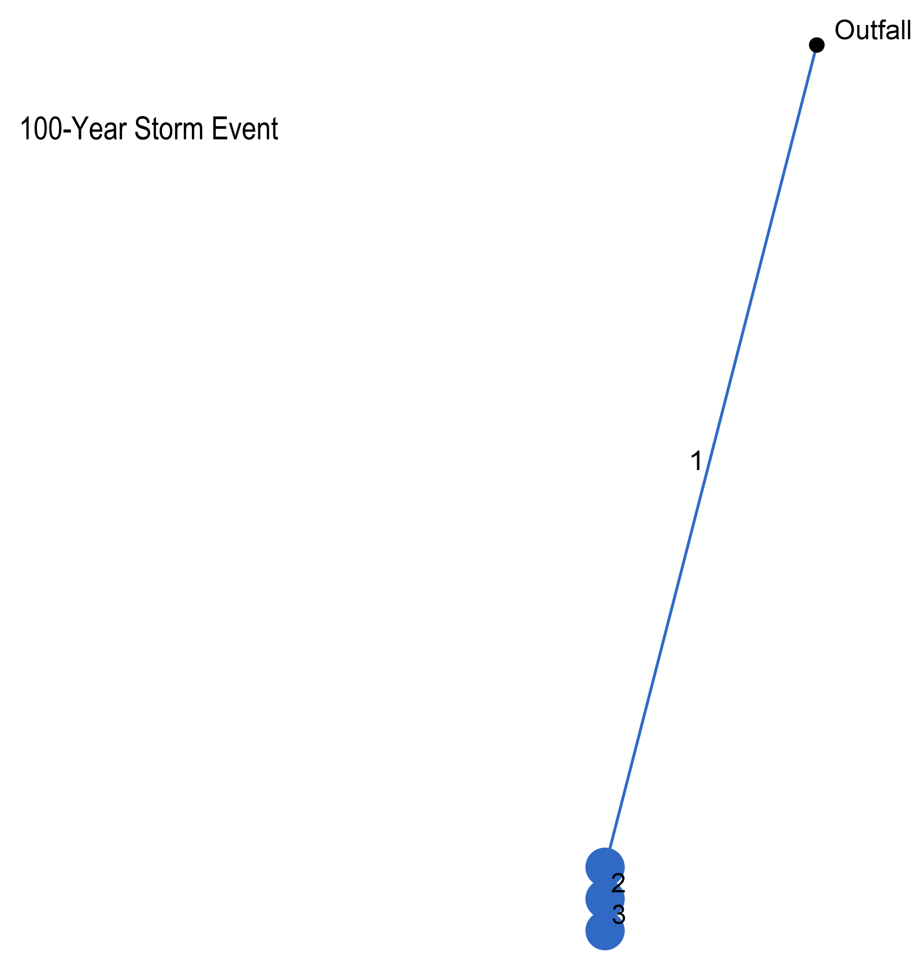
Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: LSCO_Parker.stm	Number of lines: 3	Date: 3/12/2024

Structure Report

100-Year Storm Event

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
3	Structure - (65)	Manhole	6066.18	Cir	4.00	4.00	18	Cir	6060.40			
2	Structure - (68)	Manhole	6066.16	Cir	4.00	4.00	18	Cir	6060.38	18	Cir	6060.38
1	Structure - (66)	Manhole	6066.13	Cir	4.00	4.00	18	Cir	6060.36	18	Cir	6060.36

Project File: LSCO_Parker.stm | Number of Structures: 3 | Run Date: 3/12/2024

Storm Sewer Summary Report

100-Year Storm Event

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
3	Pipe - (43)	4.33	18	Cir	3.527	6060.38	6060.40	0.568	6061.18	6061.20	0.32	6061.20	2	Manhole
2	Pipe - (45)	4.33	18	Cir	3.457	6060.36	6060.38	0.579	6061.56	6061.18	0.05	6061.18	1	Manhole
1	Pipe - (44)	4.33	18	Cir	93.613	6059.89	6060.36	0.502	6061.39	6061.52	0.04	6061.56	End	Manhole

Project File: LSCO_Parker.stm | Number of lines: 3 | Run Date: 3/12/2024

NOTES: Return period = 100 Yrs.

Hydraulic Grade Line Computations

100-Year Storm Event

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
(1)	(in) (2)	(cfs) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(ft) (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(K) (23)	(ft) (24)
3	18	4.33	6060.38	6061.18	0.80	0.95	4.54	0.32	6061.50	0.000	3.527	6060.40	6061.20	0.80**	0.96	4.54	0.32	6061.52	0.000	0.000	n/a	1.00	0.32
2	18	4.33	6060.36	6061.56	1.20	0.95	2.86	0.32	6061.88	0.000	3.457	6060.38	6061.18	0.80**	0.95	4.54	0.32	6061.50	0.000	0.000	n/a	0.15	0.05
1	18	4.33	6059.89	6061.39	1.50	1.77	2.45	0.09	6061.48	0.170	93.613	6060.36	6061.52	1.16	1.46	2.96	0.14	6061.65	0.192	0.181	0.169	0.30	0.04

Project File: LSCO_Parker.stm	Number of lines: 3	Run Date: 3/12/2024

Notes: ; ** Critical depth. ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

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Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).