# 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**

303 E 17th St. #105
Denver, CO 80203
720.359.1416
www.cushingterrell.com

Cushing Terrell Project No. LSCO_21PARKER

July 11, 2023

Michael White, PE

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 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.

Both Basins A11 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 A.

## 4.0 Post-Development Conditions

Within Lot 8A, three onsite (A, B, and C) and two offsite (OS-1 and OS-2) 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. Basins OS-1 and OS-2 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 100% | Roofs 90% | Landscape 0% | Percent Impervious | *$C_5$ | *$C_{100}$ |
|---|---|---|---|---|---|---|---|---|
| A | 0.37 | A | 0.35 | 0.00 | 0.02 | 0.95 | **0.86** | **0.93** |
| B | 0.40 | A | 0.00 | 0.23 | 0.17 | 0.52 | **0.45** | **0.61** |
| C | 0.17 | A | 0.02 | 0.00 | 0.15 | 0.10 | **0.16** | **0.40** |
| OS-1 | 0.33 | A | 0.24 | 0.00 | 0.09 | 0.74 | **0.69** | **0.81** |
| OS-2 | 0.18 | A | 0.17 | 0.00 | 0.01 | 0.94 | **0.85** | **0.93** |
| | | | | | Total Onsite= | **0.61** | **0.56** | **0.70** |
| | | | | | Total = | **0.68** | **0.62** | **0.75** |

Subbasin A was designed for future improvements with the following runoff values: 1.49 CFS for a minor 5-year storm event and 3.03 CFS for a major 100-year storm event.

Subbasin B was designed for future improvements with the following runoff values: 0.61 CFS for a minor 5-year storm event and 1.54 CFS for a major 100-year storm event.

Subbasin C was designed for future improvements with the following runoff values: 0.12 CFS for a minor 5-year storm event and 0.58 CFS for a major 100-year storm event.

| 5-YR Design Storm Runoff | | | | | |
|---|---|---|---|---|---|
| **Basin** | **Area (AC)** | **C** | **$T_c$ (Min)** | **I (in/hr)** | **Q (CFS)** |
| A | 0.37 | 0.86 | 5.00 | 4.71 | 1.49 |
| B | 0.40 | 0.45 | 13.19 | 3.35 | 0.61 |
| C | 0.17 | 0.16 | 5.98 | 4.49 | 0.12 |
| OS-1 | 0.33 | 0.69 | 5.00 | 4.71 | 1.05 |
| OS-2 | 0.18 | 0.85 | 5.98 | 4.49 | 0.69 |

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 | 0.37 | 0.93 | 5.00 | 8.82 | 3.03 |
| B | 0.40 | 0.61 | 13.19 | 6.26 | 1.54 |
| C | 0.17 | 0.40 | 5.98 | 8.39 | 0.58 |
| OS-1 | 0.33 | 0.81 | 5.00 | 8.82 | 2.31 |
| OS-2 | 0.18 | 0.93 | 5.00 | 8.82 | 1.47 |

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 post-development conditions result in a percent impervious of 61%, a 5-year minor storm runoff of 3.96 CFS, and a 100-year major storm runoff of 8.93 CFS. The proposed design is less than the assumed condition for future development within the approved existing Chambers and Hess FDR of 95% imperviousness, 4.70 CFS for the 5-year minor storm, and 10.70 CFS for the 100-year major storm event.

Sincerely,

Robert Walker, 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

Cushing Terrell

CHAMBERS & HESS RD
PARKER, CO 80134

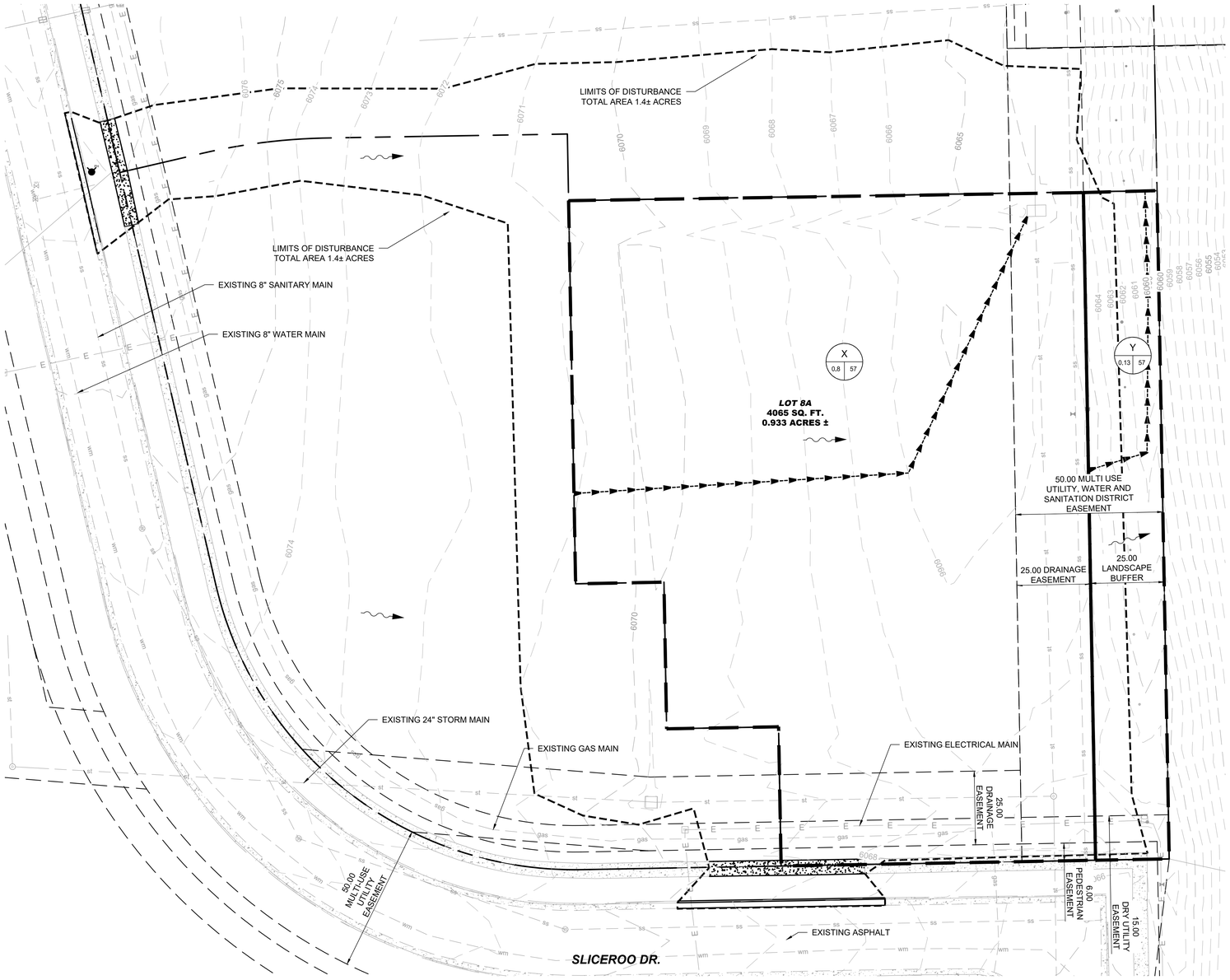
## LES SCHWAB TIRE CENTER



| 07.05.2023 | TAG | REVISION |
|---|---|---|
| LES SCHWAB TIRE CENTER | | |

| CHECKED BY | REF SHEET | SHEET NAME |
|---|---|---|
| WALKER | | VC |

# Appendix B: Drainage Maps




1 / D.1 EXISTING DRAIANGE MAP

0 10 20 40
SCALE: 1" = 20'

NORTH

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

## 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 |

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Tires LES SCHWAB

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

# LES SCHWAB TIRE CENTER - PARKER, CO

NOT FOR CONSTRUCTION - PRELIMINARY DESIGN

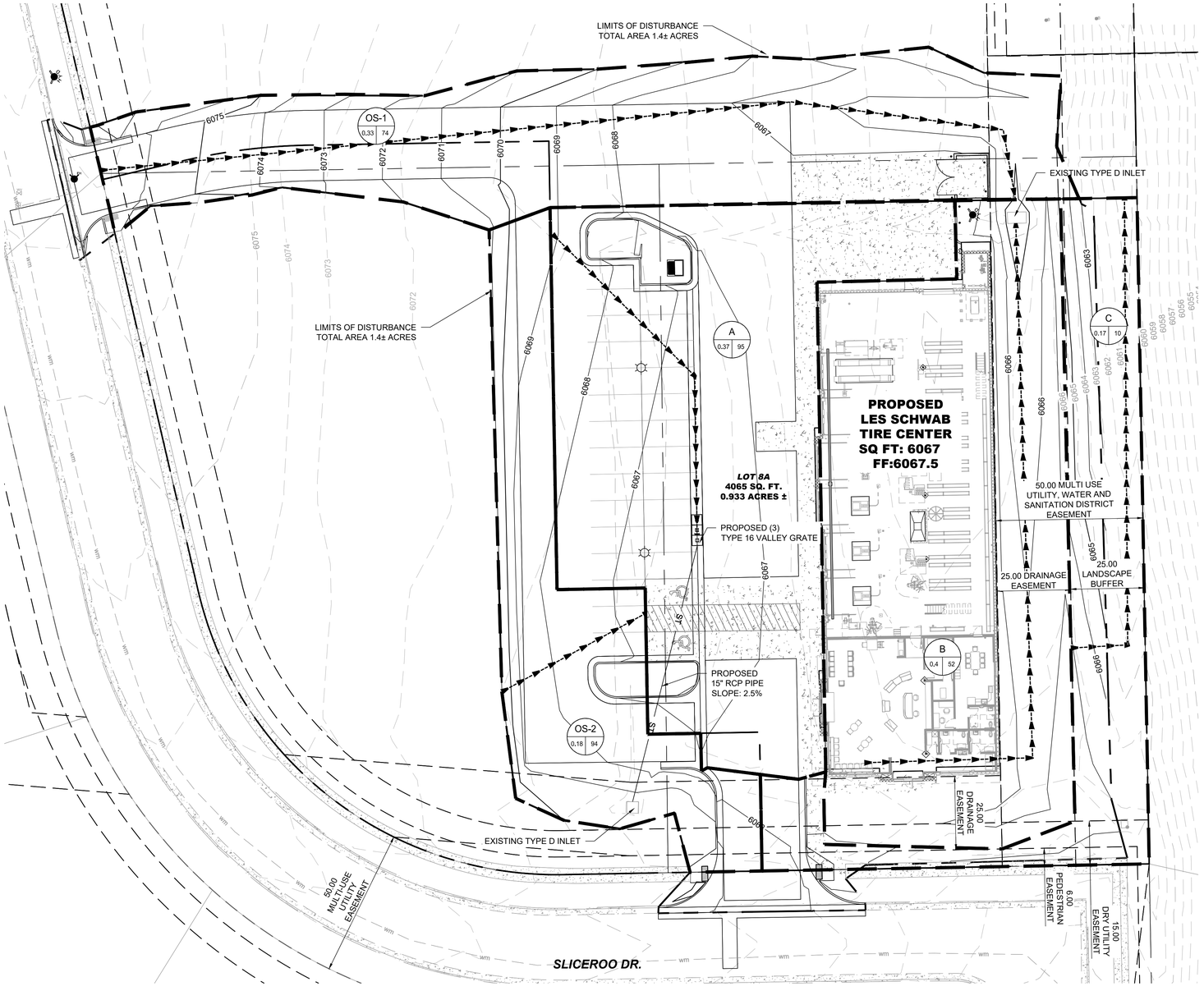


SITE PLAN

07.11.2023
DRAWN BY | SOMA
CHECKED BY | WALKER
REVISIONS

EXISTING DRAINAGE MAP

D.1




1 / D.2 PROPOSED DRAINAGE MAP

SCALE: 1" = 20'

NORTH

1 / 1.00 / 37 — BASIN DESIGNATION / PERCENT IMPERVIOUS / 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 | 0.37 | 0.86 | 5.00 | 4.71 | 1.49 |
| B | 0.40 | 0.45 | 13.19 | 3.35 | 0.61 |
| C | 0.17 | 0.16 | 5.98 | 4.49 | 0.12 |
| OS-1 | 0.33 | 0.69 | 5.00 | 4.71 | 1.05 |
| OS-2 | 0.18 | 0.85 | 5.98 | 4.49 | 0.69 |

**100-YR Design Storm Runoff**

| Basin | Area (AC) | C | $T_c$ (Min) | I (in/hr) | Q (CFS) |
|---|---|---|---|---|---|
| A | 0.37 | 0.93 | 5.00 | 8.82 | 3.03 |
| B | 0.40 | 0.61 | 13.19 | 6.26 | 1.54 |
| C | 0.17 | 0.40 | 5.98 | 8.39 | 0.58 |
| OS-1 | 0.33 | 0.81 | 5.00 | 8.82 | 2.31 |
| OS-2 | 0.18 | 0.93 | 5.00 | 8.82 | 1.47 |

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800.757.9522

Tires LES SCHWAB

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

# LES SCHWAB TIRE CENTER - PARKER, CO

NOT FOR CONSTRUCTION - PRELIMINARY DESIGN



SITE PLAN

07.11.2023
DRAWN BY | SOMA
CHECKED BY | WALKER
REVISIONS

PROPOSED DRAINAGE MAP

D.2

# Appendix C: Historic Basin Analysis

Cushing Terrell

| | | | | | |
|---|---|---|---|---|---|
| Subject: | DRAINAGE CALCULATIONS-EXISTING | | | 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 | *$C_5$ | *$C_{100}$ |
|---|---|---|---|---|---|---|---|---|
| X | 0.80 | A | 0.00 | 0.00 | 0.02 | 0.00 | **0.00** | **0.01** |
| Y | 0.13 | A | 0.00 | 0.00 | 0.17 | 0.00 | **0.10** | **0.46** |
| | | | | | Total = | **0.00** | **0.02** | **0.07** |

*Refer to COS DCM Table 6-6 & Equation 6-6*

| 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 | 0.10 | 20 | 21.00% | 2.94 | 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 | 0.10 | 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 |

# Appendix D: Proposed Basin Analysis

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| | | | |
|---|---|---|---|
| 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 | 0.37 | A | 0.35 | 0.00 | 0.02 | 0.95 | **0.86** | **0.93** |
| B | 0.40 | A | 0.00 | 0.23 | 0.17 | 0.52 | **0.45** | **0.61** |
| C | 0.17 | A | 0.02 | 0.00 | 0.15 | 0.10 | **0.16** | **0.40** |
| OS-1 | 0.33 | A | 0.24 | 0.00 | 0.09 | 0.74 | **0.69** | **0.81** |
| OS-2 | 0.18 | A | 0.17 | 0.00 | 0.01 | 0.94 | **0.85** | **0.93** |
| | | | | | Total = | **0.68** | **0.62** | **0.75** |

*Refer to COS DCM Table 6-6 & Equation 6-6*

| 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 | 0.37 | 0.86 | 68 | 3.80% | 2.34 | 62 | 0.80% | 20 | 1.788854 | 0.577651 | 5.00 |
| B | 0.40 | 0.45 | 58 | 0.50% | 11.17 | 182 | 1.00% | 15 | 1.5 | 2.022222 | 13.19 |
| C | 0.17 | 0.16 | 20 | 12.00% | 3.34 | 152 | 3.10% | 15 | 2.641023 | 0.959224 | 5.98 |
| OS-1 | 0.33 | 0.69 | 100 | 4.20% | 4.65 | 0 | 2.00% | 20 | 2.828427 | 0 | 5.00 |
| OS-2 | 0.18 | 0.85 | 55 | 4.00% | 2.08 | 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** | **13.19** | **3.35** | **6.26** |
| **C** | **5.98** | **4.49** | **8.39** |
| **OS-1** | **5.00** | **4.71** | **8.82** |
| **OS-2** | **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 | 0.37 | 0.86 | 5.00 | 4.71 | 1.49 |
| B | 0.40 | 0.45 | 13.19 | 3.35 | 0.61 |
| C | 0.17 | 0.16 | 5.98 | 4.49 | 0.12 |
| OS-1 | 0.33 | 0.69 | 5.00 | 4.71 | 1.05 |
| OS-2 | 0.18 | 0.85 | 5.98 | 4.49 | 0.69 |

**100-YR Design Storm Runoff**

| Basin | Area (AC) | C | $T_c$ (Min) | I (in/hr) | Q (CFS) |
|---|---|---|---|---|---|
| A | 0.37 | 0.93 | 5.00 | 8.82 | 3.03 |
| B | 0.40 | 0.61 | 13.19 | 6.26 | 1.54 |
| C | 0.17 | 0.40 | 5.98 | 8.39 | 0.58 |
| OS-1 | 0.33 | 0.81 | 5.00 | 8.82 | 2.31 |
| OS-2 | 0.18 | 0.93 | 5.00 | 8.82 | 1.47 |

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jul 10 2023

## Basin B Swale

**Triangular**

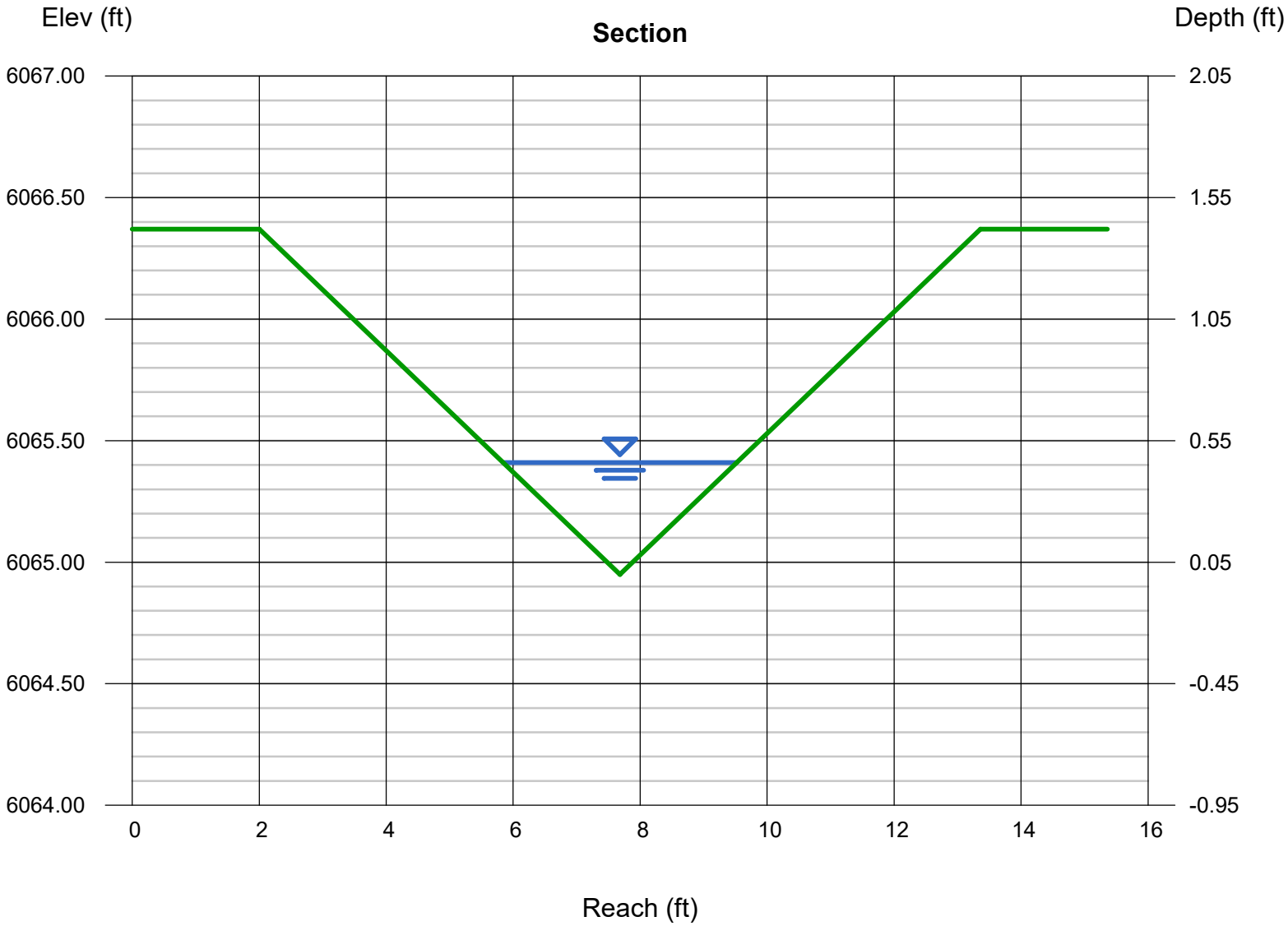
| | |
|---|---|
| Side Slopes (z:1) | = 4.00, 4.00 |
| Total Depth (ft) | = 1.42 |
| Invert Elev (ft) | = 6064.95 |
| Slope (%) | = 1.00 |
| N-Value | = 0.030 |

**Calculations**

| | |
|---|---|
| Compute by: | Known Q |
| Known Q (cfs) | = 1.54 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 0.46 |
| Q (cfs) | = 1.540 |
| Area (sqft) | = 0.85 |
| Velocity (ft/s) | = 1.82 |
| Wetted Perim (ft) | = 3.79 |
| Crit Depth, Yc (ft) | = 0.40 |
| Top Width (ft) | = 3.68 |
| EGL (ft) | = 0.51 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jul 10 2023

## Basin OS-1 Swale

**Triangular**

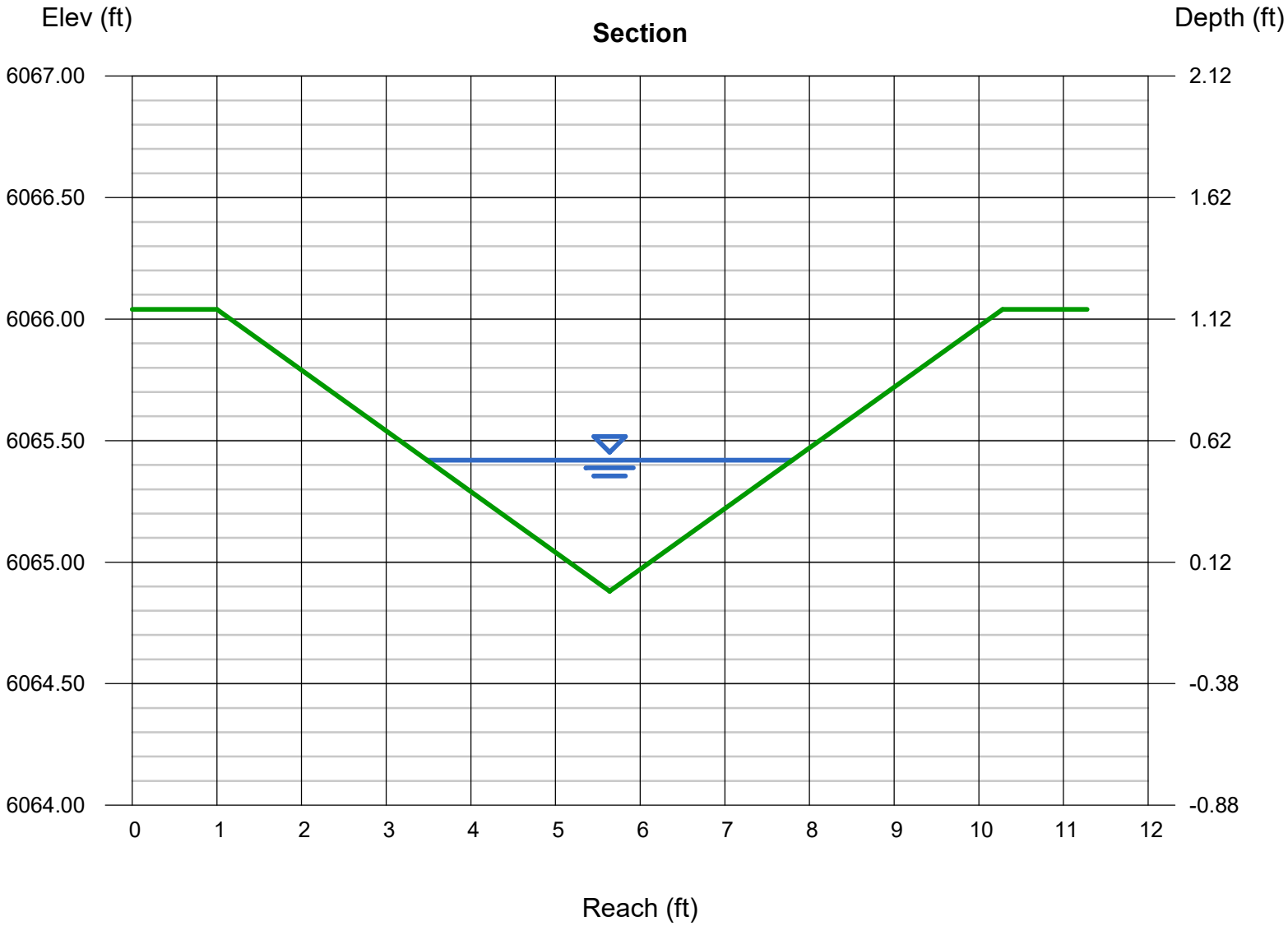
| | |
|---|---|
| Side Slopes (z:1) | = 4.00, 4.00 |
| Total Depth (ft) | = 1.16 |
| Invert Elev (ft) | = 6064.88 |
| Slope (%) | = 1.00 |
| N-Value | = 0.030 |

**Calculations**

| | |
|---|---|
| Compute by: | Known Q |
| Known Q (cfs) | = 2.31 |

**Highlighted**

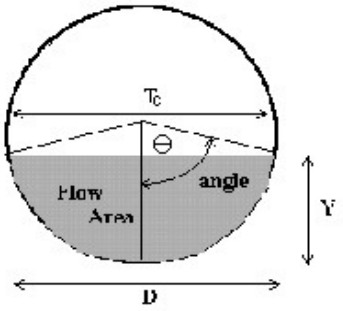
| | |
|---|---|
| Depth (ft) | = 0.54 |
| Q (cfs) | = 2.310 |
| Area (sqft) | = 1.17 |
| Velocity (ft/s) | = 1.98 |
| Wetted Perim (ft) | = 4.45 |
| Crit Depth, Yc (ft) | = 0.47 |
| Top Width (ft) | = 4.32 |
| EGL (ft) | = 0.60 |



# CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project: LSCO_21PARKER**
**Pipe ID: 15"RCP**




| Design Information (Input) | | | |
|---|---|---|---|
| Pipe Invert Slope | So = | 0.0250 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 15.00 | inches |
| Design discharge | Q = | 4.50 | cfs |

| Full-Flow Capacity (Calculated) | | | |
|---|---|---|---|
| Full-flow area | Af = | 1.23 | sq ft |
| Full-flow wetted perimeter | Pf = | 3.93 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 10.24 | cfs |

| Calculation of Normal Flow Condition | | | |
|---|---|---|---|
| Half Central Angle (0<Theta<3.14) | Theta = | 1.50 | radians |
| Flow area | An = | 0.56 | sq ft |
| Top width | Tn = | 1.25 | ft |
| Wetted perimeter | Pn = | 1.87 | ft |
| Flow depth | Yn = | 0.58 | ft |
| Flow velocity | Vn = | 8.08 | fps |
| Discharge | Qn = | 4.50 | cfs |
| Percent of Full Flow | Flow = | 43.9% | of full flow |
| Normal Depth Froude Number | $Fr_n$ = | 2.13 | supercritical |

| Calculation of Critical Flow Condition | | | |
|---|---|---|---|
| Half Central Angle (0<Theta-c<3.14) | Theta-c = | 1.96 | radians |
| Critical flow area | Ac = | 0.90 | sq ft |
| Critical top width | Tc = | 1.16 | ft |
| Critical flow depth | Yc = | 0.86 | ft |
| Critical flow velocity | Vc = | 5.00 | fps |
| Critical Depth Froude Number | $Fr_c$ = | 1.00 | |

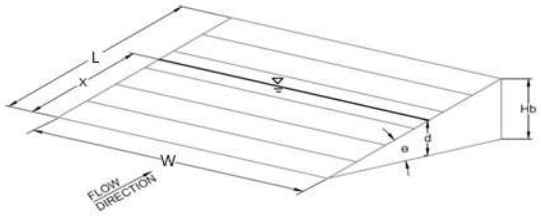
# AREA INLET IN A SWALE

**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** | **%** |

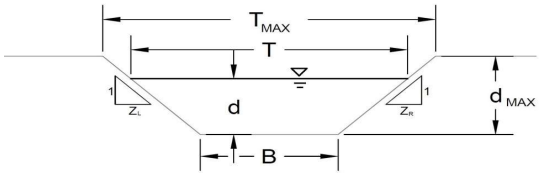
**Warning 01: Sideslope steepness exceeds USDCM Volume I recommendation.**

**Warning 02: Depth (d) exceeds USDCM Volume I recommendation.**

# 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** |

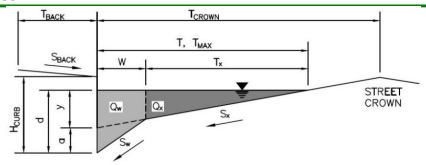
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

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

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

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

**Project:** **LSCO_22Parker**
**Inlet ID:** **Proposed parking Inlet**




Gutter Geometry:

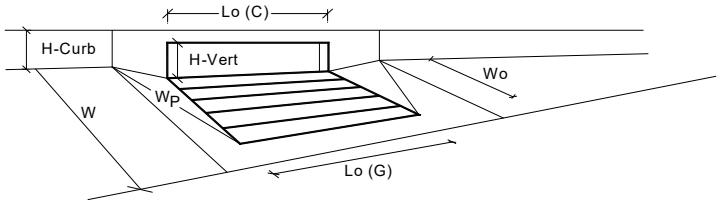
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 0.0 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 80.0 | ft |
| Gutter Width | W = | 3.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.010 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.000 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.012 | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | Minor Storm | Major Storm | |
|---|---|---|---|
| MINOR STORM Allowable Capacity is not applicable to Sump Condition | | | |
| MAJOR STORM Allowable Capacity is not applicable to Sump Condition | | | |
| **$Q_{allow}$ =** | **SUMP** | **SUMP** | **cfs** |

# INLET IN A SUMP OR SAG LOCATION

*MHFD-Inlet, Version 5.02 (August 2022)*



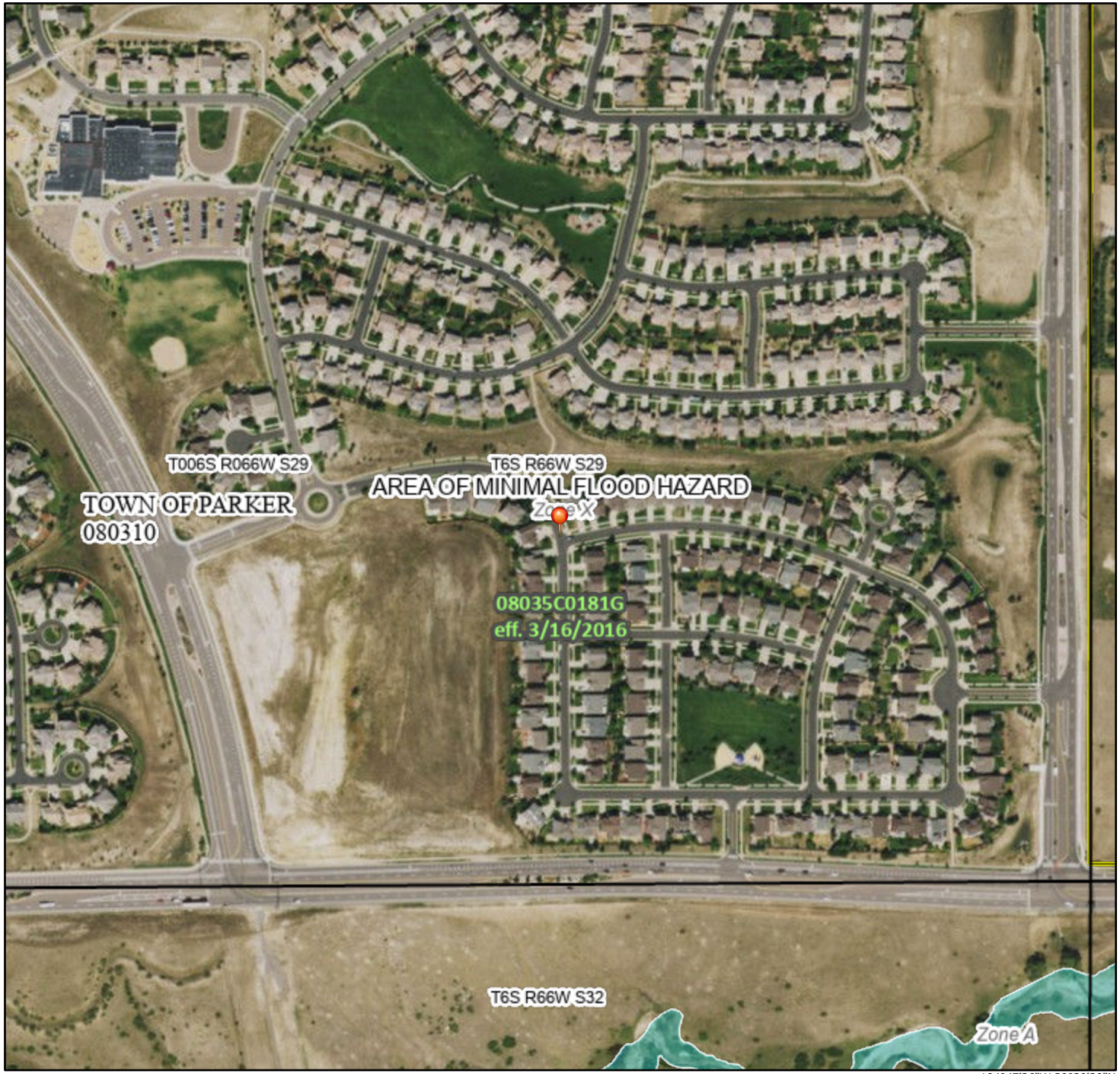

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | Denver No. 16 Valley Grate | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | $a_{local}$ = | 2.00 | 2.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | No = | 3 | 3 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 4.4 | 5.6 | 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 (see USDCM Figure ST-5) | 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 | 0.52 | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | N/A | N/A | ft |
| Grated Inlet Performance Reduction Factor for Long Inlets | $RF_{Grate}$ = | 0.42 | 0.53 | |
| 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** | **4.6** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)** | $Q_{PEAK\ REQUIRED}$ = | 2.2 | 4.5 | cfs |

# Appendix E: FEMA FIRMette

# National Flood Hazard Layer FIRMette

FEMA

104°48'13"W 39°29'58"N




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

1:6,000

104°47'36"W 39°29'30"N

*Basemap Imagery Source: USGS National Map 2023*

## Legend

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

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

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

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

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

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