

PRELIMINARY DRAINAGE REPORT

FOR

7-Eleven Gas, C-Store & Car Wash Gun Club Road & 6th Parkway

Original Submittal: February 16, 2020

Owner/Developer/Applicant:

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Approved for one year from this date

City Engineer

Date

Water Department

Date

David Iovinelli, P.E.
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A. INTRODUCTION

1. Site Location

The proposed 7-Eleven Gas and C-Store project is located in Lot 1, Block 1 of The Cross Creek Subdivision Filing 1. The site is located in part of the Northwest Quarter of Section 7, Township 4 South, Range 65 West of the 6th Principal Meridian, City of Aurora, County of Arapahoe, State of Colorado. The site is bordered on the north by E. 2nd place, on the south by Tract A, a detention pond constructed as part of the underlying development, on the east by the Lot 2 of Block 1, and on the west by North Gun Club Road.



2. Proposed Development

The project site is Lot 1 of the Cross Creek Subdivision Filing 1. and is a 1.28 acre parcel. Lot 1 is currently zoned Mixed-Use Regional District (MU-R) and will remain as such for the proposed development.

The project site is currently undeveloped, covered with natural grasses and vegetation. The site in the existing condition has a high point on the site along the southern property line. The site generally drains to the northwest corner of the site, via sheet flow into the private drive where it collects in existing storm infrastructure. The proposed condition will mimic the existing condition in general and sheet flow to the northwest corner. Portions of flow are directed to an inlet at the southwest corner of the site. The remainder of the site will maintain historic conditions and discharge into the existing inlet at design point X, as referenced in the "Preliminary Drainage Report For Cross Creek Filing No. 4 Cross Creek Commercial" (hereafter referred to as the Master Drainage Study. Refer to the Appendix for excerpts of the report and existing drainage map. No wetlands or irrigation canals or ditches have been identified onsite.

According to the FEMA Flood Insurance Rate Map number 08005C0202L, effective date February 17, 2017, the site is currently located in Zone X which is outside of the 100-year

flood plain. A portion of the FIRM is included in Appendix A.

According to the Web Soil Survey provided by the USDA, the soils existing onsite are Bresser-Truckton sandy loams, which has low runoff class and well drained drainage class. Bresser-Truckton sandy loams are classified as hydrologic soil group B. A soil map by the Web Soil Survey is provided in Appendix A. For all runoff calculations, the site was considered to be Type B soils as it encompasses the entirety of the site.

Proposed construction will consist of a one-story, 4,000 GSF convenience store (c-store) building, gas station, 6-MPD fueling canopy, and car wash located on a 1.28 acres parcel within Lot 1 of the Cross Creek Subdivision Filing 1. The area disturbed will be 1.28 acres. In addition to the c-store, car wash and fueling canopy, drive aisles, parking, landscaping and utility services will also be constructed. Detention is provided downstream in an existing detention pond south of the site.

There are no requests for variance from the Storm Drainage and Technical Criteria Manual.

B. HISTORIC DRAINAGE

1. Overall Basin Description

The development was originally analyzed in the Preliminary Drainage Report For Cross Creek Filing No. 4 Cross Creek Commercial by JR Engineering, LLC, dated October 2020, herein referred to as the Master Drainage Study. Per this report, the project is located within sub-basin A3, which also includes the entire 1.28 acres of the project site for a total of a 2.61 acres basin. The Master Drainage Study assumed a developed percent impervious of 92.1% for sub-basin A3 with a minor flowrate of 5.87 CFS and major flowrate of 16.46 CFS. Runoff from sub-basin A3 is tributary to detention pond D-C, as identified in the Master Drainage Study, located southwest of the site. Refer to the existing drainage map in the appendix.

2. Drainage Patterns Through Property

The existing grades are generally sloping at 2% towards the northwest corner of the site where it collects in an inlet at the southwest corner of the private drive and Gun Club Road and ultimately discharges to detention pond D-C.

Per the Master Drainage study, sub-basin A3 is 2.61 acres and consists of undeveloped land but was modelled for future commercial use, with an assumed developed impervious value of 92.1%. The 2-Year and 100-year C values were determined to be 0.84 and 0.87, respectively; and anticipated 2-Year runoff flows of 5.87-cfs and 100-year runoff flows of 16.46-cfs. Flows from basin A3 are directed northwesterly via surface flows across the site and sheet flowing into the private access drive and a type r inlet at design point 1.1. Flow in the proposed condition will in general mimic historic conditions and drain to this inlet, identified as design point EX1 in the proposed drainage plan. Refer to excerpts and drainage plans in the Appendix for details.

3. Outfalls Downstream from Property

Per the Master Drainage study, "All runoff from the portion of the site that is proposed to be developed will be directed to Detention Pond D-C. These flows will be detained/treated and piped across Gun Club Road. These flows will be conveyed west

and south in a pipe running parallel to Gun Club Road. The runoff will enter a channel that drains through the existing double 6'x8' box culvert crossing E-470. This crossing daylights to another existing channel and outfalls directly into Coal Creek."

C. DESIGN CRITERIA

1. Regulations

Methods described in the MHFD Urban Storm Drainage Criteria Manual (USDCM) and in the City of Aurora Storm Drainage Design & Technical Criteria were used for the drainage design of the site. Minor and major storm elements have been analyzed for the 2- and 100-YR storms, respectively.

1. Hydrology

The Rational method, and associated design procedures identified in Section 5 of the City of Aurora Storm Drainage Design & Technical Criteria have been utilized to evaluate the anticipated runoff of the site for the 2-yr and 100-yr storm events. The rational method can be described as below:

$Q = CIA$, where

- Q = Storm runoff in cubic feet per second (cfs)
- C = Rainfall coefficients - ratio runoff to rainfall
- I = Rainfall intensity in inches per hour
- A = Drainage area in acres

Design rainfall is derived from one-hour rainfall depth (inches) from Figures RA-1 through RA-6 in USDCM, Volume 1, as referenced in section 5.22 of the Aurora Storm Criteria, and the NOAA 1-HR point precipitation values. The following one-hour rainfall depths were utilized for runoff calculations: 0.98 inches (2-yr), 2.67 inches (100-yr). Runoff coefficients were based on the type of proposed developed outlined in the USDCM. The 2-year and 100-year frequency runoff rates for historic and developed conditions are summarized in the Appendix.

2. Hydraulics

Sizing of the storm sewer was analyzed using Flowmaster V8i. Inlet sizing was completed utilizing Urban Drainage and Flood Control District UD-Inlet_v4.05 spreadsheet. The proposed onsite inlets will fully capture the 100-year storm events without exceeding 6-inches of ponding.

3. Water Quality Enhancement

Water quality for the project site is provided by an existing detention pond located directly adjacent to the south of the site, identified as detention Pond D-C in the Master Drainage Study. The proposed condition provides less flow than the condition modelled in the Master Drainage Study, therefore the detention pond has sufficient capacity. Refer to the Master Drainage Study excerpts in the appendix for details.

D. DRAINAGE PLAN

1. General Concept

The proposed development will in general conform to the drainage patterns established within the Master Drainage Study. Flow will be directed to the northwest corner of the site and discharge into the existing storm infrastructure, and ultimately detention pond D-3. A constraint of this report is that the site improvement will not increase the runoff to the existing detention and water quality facilities. The adjacent developments will not be affected by the proposed condition.

2. Specific Details

The proposed project site has been divided into the following sub-basins, shown on the included drainage map (See Appendix D).

Basin P1

Basin P1 is 0.10 acres and consists of hardscape parking and sidewalk on the north side of the building. The impervious value for the basin is 100.00%. The 2-Year and 100-year runoff coefficients are 0.87 and 0.93, respectively. The runoff for the 2-Year and 100-year storm event are 0.29-cfs and 0.84-cfs, respectively. Runoff is conveyed via sheet flow to a Type R Inlet (Inlet P-1) where the developed runoff is fully captured at Design Point 1 and ultimately drains into the existing storm infrastructure, following historic drainage patterns.

Basin P2

Basin P2 is 0.56 acres and consists of parking and the private drive east of the convenience store, and landscaping. The impervious value for the basin is 86.00%. The 2-Year and 100-year runoff coefficients are 0.76 and 0.82, respectively. The runoff for the 2-Year and 100-year storm event are 1.41-cfs and 4.15-cfs, respectively. Runoff sheet flows across the site to the northwest corner at Design Point 2 where it discharges offsite and ultimately is collected in the existing Type R inlet at the northwest corner of Gun Club Road and the private access road, following historic drainage patterns.

Basin P3

Basin P3 is 0.09 acres and consists entirely of the proposed convenience store. The impervious value for the basin is 96.00%. The 2-Year and 100-year runoff coefficients are 0.80 and 0.90, respectively. The runoff for the 2-Year and 100-year storm event are 0.24-cfs and 0.73-cfs, respectively. Runoff from the basin is collected in roof drains at Design point 3 and routed via proposed 4" PVC storm sewer to the east and north before ultimately connecting to existing storm infrastructure and following historic drainage patterns.

Basin P4

Basin P4 is 0.07 acres and consists entirely of the fueling canopy. The impervious value for the basin is 96.00%. The 2-Year and 100-year runoff coefficients are 0.80 and 0.90, respectively. The runoff for the 2-Year and 100-year storm event are 0.19-cfs and 0.57-cfs, respectively. Runoff from the basin is collected in roof drains at Design point 3 and routed via proposed 4" PVC storm sewer to the northwest where it ultimately connects to existing storm infrastructure and follows historic drainage patterns

Basin P5

Basin P5 is 0.17 acres and consists of the site access, car wash, and landscaping at the northeast corner of the site. The impervious value for the basin is 58.47%. The 2-Year and 100-year runoff coefficients are 0.53 and 0.60, respectively. The runoff for the 2-Year and 100-year storm event are 0.30-cfs and 0.92-cfs, respectively. Runoff from the basin is conveyed via sheet flow to the northeast access where it discharges offsite at Design Point 5, following historic conditions. Flows are ultimately collected in existing storm infrastructure at Design Point EX1.

Basin P6

Basin P-6 is 0.10 acres and consists entirely of landscaping at the southern perimeter of the site. The impervious value for the basin is 2.00%. The 2-Year and 100-year runoff coefficients are 0.10 and 0.15, respectively. The runoff for the 2-Year and 100-year storm event are 0.03-cfs and 0.14-cfs, respectively. Runoff from the basin is conveyed via sheet flow at Design Point 6, directly into the existing detention pond D-C to the south.

Basin P7

Basin P7 is 0.19 acres and consists of a portion of sidewalk and landscaping at the western side of the site. The impervious value for the basin is 12.32%. The 2-Year and 100-year runoff coefficients are 0.18 and 0.23, respectively. The runoff for the 2-Year and 100-year storm event are 0.11-cfs and 0.40-cfs, respectively. Runoff from the basin is conveyed via sheet flow to Gun Club Road at Design Point 7 where it is collected in a gutter and directed north where it ultimately discharges to the existing inlet, identified as Design Point EX1 in the drainage plan.

3. Detention Pond Design

Detention for this site was previously provided in the existing detention pond D-3 as identified in the Master Drainage Study. The detention pond was originally sized to include flows from the proposed site within basin A3 in the Master Drainage Study. Basin A3 in the existing condition was 92.1%. Basin A3 in the proposed condition, including the 67.19% from the proposed development of Lot 1, is 79.4%, or 12.7% less than existing. Therefore, the existing detention pond D-3 has sufficient capacity for the developed condition and does not need any modifications from existing condition.

E. DRAINAGE PLAN

1. Compliance with Standards

All facilities designed for this project have been designed to meet the requirements of City of Aurora Storm Drainage Design and Technical Criteria Manual, and the Mile High Flood Control District, and the aforementioned Master Drainage Study.

2. Variances

No variances are requested.

3. Summary of Concept

Runoff from the project site is by a proposed onsite storm system which follow historic drainage patterns and connects to an existing underground storm sewer system that

releases the runoff into the existing sub-regional detention and water quality facility. The proposed development complies with the existing drainage report and therefore no modifications to the existing storm system or pond are required. The existing detention pond releases at historic rates and the existing storm system will not be affected. Downstream impacts will be mitigated by the collection and conveyance of storm runoff. The proposed development is not anticipated to have any adverse effects to downstream facilities.

F. References

1. Reports/Resources

- *Preliminary Drainage Report for Cross Creek Filing No. 4 Cross Creek Commercial*, dated October 2020 by JR Engineering, LLC
- National Flood Insurance Program Flood Insurance Rate Map (FIRM) Number 08005C0202L, revised February 17, 2017
- USDA National Resources Conservation Service Web Soil Survey

Excerpts from these reports are provided in Appendix A

a. Criteria Manuals

- *Storm Drainage Design & Technical Criteria*, October 2011.
- *Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual*, Dated March 2017.

Appendix A – Reference Materials

**Preliminary Drainage Report
For
Cross Creek Filing No. 4
Cross Creek Commercial**

Prepared For:

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APPROVED FOR ONE YEAR FROM THIS DATE	
City Engineer	Date
Aurora Water Department	Date

July 21, 2020
Revised: October 30, 2020

A. INTRODUCTION

1. Location

The site is bounded to the west by N. Gun Club Road, to the north by E. 5th Ave, to the south by E. 6th Parkway, and to the northeast by the Cross Creek Community Clubhouse. The site is approximately 31.91 acres. The Cross Creek Commercial site is within the City of Aurora, Arapahoe County, Colorado, adjacent to and just east of E-470 and south of I-70.

The site is located in the northwest quarter of Section 7, Township 6 South, Range 65 West of the 6th Principal Meridian. A Preliminary Plat for this filing has been submitted concurrently with this report.

A vicinity map is provided in the Appendix.

2. Proposed Development

Cross Creek Commercial is currently undeveloped, covered with native grass and sparsely distributed brush. The site's topography slopes from east to west with shallow grades, which are between 0.5 and 2 percent. The existing drainage pattern will generally remain to the greatest extent possible in the proposed condition. Existing detention pond D-C lies in the southwest corner of the site.

The site will consist of two proposed roads two commercial pads for development, and a tract existing detention pond D-C, which all together total approximately 5.12 acres. The remaining 26.79 acres will be future development.

Basins tributary to Pond D-C have been analyzed in detail with this report, and include the proposed 5.12 acres that is proposed to be developed, four offsite basins south of the site that are tributary to pond D-C, and Basins A-1 and A-2 that are future development. Total area tributary to Pond D-C is 25.71 acres.

Existing detention pond D-MF lies north of the site. No basins tributary to pond D-MF are proposed to develop at this time and therefore existing pond D-MF is proposed to remain in its existing historic conditions and is not part of this analysis.

Drainage for this site has been previously analyzed in the previously-approved "Cross Creek Subdivision Master Drainage Study," by High Country Engineering, Inc. revised December 10, 2002 and "Addendum I to the Final Drainage Report Cross Creek Metropolitan District" by High Country Engineering, Inc. revised October 23, 2003. These previous reports analyzed the drainage characteristics of this site and calculated the required detention and water quality control volumes (WQCV) for detention pond D-C.

storm sewer inlets.

Basin D-C (1.31 acres, 81.7% impervious) is the existing detention pond D-C. 100% impervious was assumed for the detention pond area. Runoff from this basin will sheetflow directly into detention pond D-C. Detention pond details for pond D-C are discussed in detail below.

All sump inlets have been designed to overflow into adjacent rights of way prior to inundating adjacent properties, should the inlets become clogged.

There are no known unusual drainage issues or problems associated with this development. It is anticipated that the site will be constructed in a single phase.

3. Detention Pond Design

Storm water flood detention and storm water quality management for this development will be provided within detention Pond D-C, which is located in the southwest corner of the site. Sediment and erosion control, Best Management Practices, as presented in the Urban Storm Drainage Criteria Manual, Volume III, will be implemented.

Detention Pond D-C was previously analyzed in the previously-approved "Addendum I to the Final Drainage Report, Cross Creek Metropolitan District", prepared by High Country Engineering, Inc., revised October 23, 2003. The previously-approved report assumed this site in its entirety would be commercial development. However, the current zoning for the site restricts the east portion of the site to residential, resulting in a decrease in impervious area for the area tributary to pond D-C. As a result, the required detention pond volume for pond D-C can be reduced.

The site lies with the Buckley AFB buffer zone for ponds. Detention Pond D-C is an extended detention basin in the historic condition and water quality is provided. The pond has been re-analyzed to provide a 24 hour drain time for the WQCV event, 36 hour drain time for the EURV event, and the full pond will drain within 48 hours. The pond is proposed to remain to the greatest extent possible (the pond depth, outlet structure, and south and west sides are proposed to remain, and the north and east sides are proposed to be re-graded to accommodate the proposed development). The existing outlet structure will be retrofitted with new orifice plates to provide the WQCV, EURV, and full pond drain times stated above.

In accordance with City of Aurora standards, the total pond volume is designed to detain the 100-year stormwater event plus 50% of the EURV stormwater events. An additional 1.9ft of freeboard has been provided between the top of the 100-yr water surface elevation and the overflow weir. The top of the 100-yr water surface elevation is at 5559.10 and the proposed overflow weir is at an elevation of 5561.00 and overflows to the south to E 6th Pkwy. Although City criteria requires only 1.0 foot of freeboard above the 100 year water surface elevation, the overflow weir will be installed at an elevation of 5561.00 (one foot higher than required) due

to the existing grade and sidewalk surrounding the pond being at an elevation of approximately 5560.50 adjacent to the overflow weir. The emergency spillway will be designed to current City of Aurora standards.

This site has been rezoned to R-2 since the approval of the 2003 Master Drainage Study. The re-zone restricts the east portion of the site to residential, which results in a decrease in percent impervious for the site from the percent impervious values assumed in the previously-approved Master Drainage Study. The previously-approved report assumed commercial development (95% impervious per current criteria) for the entire 31.91 acre site, whereas in the proposed condition, the west portion of the site is now anticipated to be commercial or multi-family (95% impervious) and the east portion of the site is now anticipated to be single family duplex (60% impervious). Because of the change in zoning the percent impervious value for the tributary area to pond D-C is reduced from 88.3% to 84.3%. This decrease in impervious area results in a decrease in required pond volume. Additional offsite basins within Gun Club Road, 6th Parkway, and the residential development south of the site are tributary to pond D-C as further described below and depicted in the historic drainage plans provided in the Appendix.

A summary of the historic basins tributary to pond D-C per the previously-approved “Addendum I to the Final Drainage Report, Cross Creek Metropolitan District” as well as a summary of the basins tributary to pond D-C in the proposed conditions are as follows:

Per Previously-approved report:

Pond D-C

<u>Basin Designation</u>	<u>Basin Area (acres)</u>	<u>Percent Impervious</u>
D4.1	3.8	88.3%
D4.2	2.6	88.3%
D9S	11.1	88.3%
D10.1	1.4	88.3%
D10.2	6.9	88.3%
Total to Pond D-C	25.8	88.3%

Per Previously-approved report:

Pond D-C Required 100-Yr Volume: 3.96 acre-feet

Pond D-C Required WQCV Volume: 1.02 acre-feet

Total Req'd Pond D-C Volume (100yr+WQCV): 4.97 acre-feet

Note: Onsite Basins highlighted in Yellow

Proposed Development:

Pond D-C

<u>Basin Designation</u>	<u>Basin Area (acres)</u>	<u>Percent Impervious</u>
D4.1	3.8	88.3%
D4.2	2.6	88.3%
A1	4.14	60.7%
A2	2.74	92.9%
A3	2.61	92.1%
B1	0.10	79.1%
B2	0.11	79.1%
D-C	1.31	81.7%
D10.1	1.4	88.3%
D10.2	6.9	88.3%
Total to Pond D-C	25.71	84.3%

In the Proposed Condition:

Amended Pond D-C Required 100-Yr Volume: 3.62 acre-feet

Amended Pond D-C Required WQCV (1.2WQCV): 0.826 acre-feet

Amended Total Req'd Pond D-C Volume (100yr+0.5EURV): 4.85 acre-feet

Note: Onsite Basins highlighted in Yellow

Pond Volume Summary – Detention Pond D-C

	Required Volume Per Previous Master Study	Required Volume Per This Report	Provided Pond Volume
Apron Invert (Pond Bottom)	5548.41 ft	5548.41 ft	5548.41 ft
WQCV	1.02 ac-ft	0.826 ac-ft (1.2WQCV)	0.839 ac-ft
WQCV WSEL	5552.16 ft	--	5552.90 ft
EURV/10-yr Volume	3.11 acre-ft (10-yr)	2.14 ac-ft (EURV)	2.46 ac-ft (EURV)
EURV/10-yr WSEL	5555.56 ft	--	5556.00 ft
100-yr Volume	3.96 ac-ft	3.62 ac-ft	--
100-yr + WQCV	4.97 ac-ft	--	--
100-yr + WQCV WSEL	5557.88 ft	--	--
100+0.5EURV Volume	--	4.85 ac-ft	4.90 ac-ft
100-yr + 0.5EURV WSEL	--	--	5559.10 ft
Top of Spillway Elevation	5560.41 ft	5561.00 ft	5561.00 ft
Top of Berm Elevation	N/A	5562.50 ft	5562.50 ft

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Cross Creek
Location: Aurora

Project Name: Cross Creek Commercial
Project No.: 15879.20
Calculated By: CGM
Checked By: JGS
Date: 7/9/20

ONSITE BASINS

Basin ID	Total Area (ac)	Paving, Drives, Walks, Ponds		Landscaping		Use (Commercial, Residential)		Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
A1	4.14	100%	0.090	2.2%	5%	0.011	0.0%	60.7%
A2	2.74	100%	0.300	10.9%	5%	0.081	0.1%	92.9%
A3	2.61	100%	0.350	13.4%	5%	0.102	0.2%	92.1%
TOTAL A	9.49							78.7%
B1	0.10	100%	0.078	78.0%	5%	0.022	1.1%	79.1%
B2	0.11	100%	0.086	78.0%	5%	0.024	1.1%	79.1%
TOTAL B	0.21							79.1%
D-C	1.31	100%	1.058	80.7%	5%	0.252	1.0%	81.7%
TOTAL D-C	1.31							81.7%
TOTAL ONSITE	11.01							79.0%

OFFSITE BASINS

D4.1	3.80	100%	0.000	0.0%	5%	0.000	0.0%	88.3%
D4.2	2.60	100%	0.000	0.0%	5%	0.000	0.0%	88.3%
TOTAL D4	6.40							88.3%
D10.1	1.40	100%	0.000	0.0%	5%	0.000	0.0%	88.3%
D10.2	6.90	100%	0.000	0.0%	5%	0.000	0.0%	88.3%
TOTAL D10	8.30							88.3%
TOTAL OFFSITE	14.70							88.3%

TOTAL TO DETENTION POND D-C	25.71							84.3%
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Per Table 1. City of Aurora Storm Drainage and Technical Criteria Manual:

Paving, Drives, Walks: 100% impervious
Undeveloped Areas (Lawns): 5% impervious
Commercial Areas: 95% impervious
Multi-Unit Residential (Detached): 60% impervious
Apartments: 80% impervious

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Cross Creek	Project Name: Cross Creek Commercial
Location: Aurora	Project No.: 15879.20
	Calculated By: CGM
	Checked By: JGS
	Date: 7/9/20

Basin ID	Total Area (ac)	Paved Roads/Walks/Walls			Landscaping			Use (Commercial, Residential)			Basins Total Weighted C ₂
		C ₂	Area (ac)	Weighted C ₂	C ₂	Area (ac)	Weighted C ₂	C ₂	Area (ac)	Weighted C ₂	
ONSITE BASINS											
A1	4.140	0.87	0.09	0.02	0.18	0.01	0.00	0.45	4.04	0.44	0.46
A2	2.740	0.87	0.30	0.10	0.18	0.08	0.01	0.87	2.36	0.75	0.85
A3	2.610	0.87	0.35	0.12	0.18	0.10	0.01	0.87	2.16	0.72	0.84
TOTAL A	9.490										0.68
B1	0.100	0.87	0.08	0.68	0.18	0.02	0.04	0.87	0.00	0.00	0.72
B2	0.110	0.87	0.09	0.68	0.18	0.02	0.04	0.87	0.00	0.00	0.72
TOTAL B	0.210										0.72
D-C	1.310	0.87	1.06	0.70	0.18	0.25	0.03	0.87	0.00	0.00	0.74
TOTAL D-C	1.310										0.74
TOTAL ONSITE	11.010										0.69

OFFSITE BASINS								
D4.1	3.80							0.87
D4.2	2.60							0.87
TOTAL D4	6.40							0.87
D10.1	1.40							0.87
D10.2	6.90							0.87
TOTAL D10	8.30							0.87

*Note: 2-yr and 100-yr C Values of 0.87 and 0.89 for offsite basins are from previously-approved drainage report

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	85	.60	.65	.70	.80
Residential:					
Single-Family (*)	60	.40	.45	.50	.60
Main Unit (detached)	75	.60	.65	.70	.80
Main Unit (attached)	75	.60	.65	.70	.80
1/2 Acre Lot or Larger	80	.65	.70	.70	.80
Apartment	80	.65	.70	.70	.80
Industrial:					
Light Industrial	80	.71	.72	.76	.82
Heavy Area	90	.80	.80	.85	.90
Parks, Cemeteries	5	.10	.10	.35	.60
Playgrounds	10	.15	.25	.35	.65
Schools	50	.45	.50	.60	.70
Railroad Yard Areas	15	.40	.45	.50	.60
Undeveloped Areas:					
Historic Flow Analysis	2				
Greenfield, Agricultural					
Off-Site Flow Analysis (when land use not defined)	45	.43	.47	.55	.65

NOTE: These Rational Formula coefficients may not be valid for large basins

(*)See Figures RO-1 through RO-3 of USDCM Volume 1 for percent impervious.

(**)Up to 5 units per acre. Single-family with more than 5 units per acre, use values for multi-unit detached

TABLE 1 (continued)

RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Streets					
Paved	100	.87	.88	.90	.93
Gravel	40	.15	.25	.35	.65
Concrete Drive and Walks	96	.87	.87	.88	.89
Roofs	90	.80	.85	.90	.90
Lawns, Sandy Soil (A and B Soils):	2	.05	.06	.08	.10
2-7% Slope		.10	.11	.13	.15
2-7% Slope		.15	.16	.18	.20
Lawns, Clay Soil (C and D Soils):	5	.13	.14	.15	.17
2-7% Slope		.18	.19	.20	.22
>7% Slope		.25	.27	.30	.35

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Cross Creek
Location: Aurora

Project Name: Cross Creek Commercial
Project No.: 15879.20
Calculated By: CGM
Checked By: JGS
Date: 7/9/20

Basin ID	Total Area (ac)	Paved Roads/Walks/Walls			Landscaping			Use (Commercial, Residential)			Basins Total Weighted C _s
		C _s	Area (ac)	Weighted C _s	C _s	Area (ac)	Weighted C _s	C _s	Area (ac)	Weighted C _s	
ONSITE BASINS											
A1	4.140	0.88	0.09	0.02	0.19	0.01	0.00	0.50	4.04	0.49	0.51
A2	2.740	0.88	0.30	0.10	0.19	0.08	0.01	0.87	2.36	0.75	0.85
A3	2.610	0.88	0.35	0.12	0.19	0.10	0.01	0.87	2.16	0.72	0.84
TOTAL A	9.490										0.70
B1	0.100	0.88	0.08	0.69	0.19	0.02	0.04	0.87	0.00	0.00	0.73
B2	0.110	0.88	0.09	0.69	0.19	0.02	0.04	0.87	0.00	0.00	0.73
TOTAL B	0.210										0.73
D-C	1.310	0.88	1.06	0.71	0.19	0.25	0.04	0.87	0.00	0.00	0.75
TOTAL D-C	1.310										0.74
TOTAL ONSITE	11.010										0.71

OFFSITE BASINS

D4.1	3.80							0.87
D4.2	2.60							0.87
TOTAL D4	6.40							0.87
D10.1	1.40							0.87
D10.2	6.90							0.87
TOTAL D10	8.30							0.87

*Note: 2-yr and 100-yr C Values of 0.87 and 0.89 for offsite basins are from previously-approved drainage report

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY				
		2	5	10	25	100
Business:						
Commercial Areas	95	.87	.87	.88	.89	.89
Neighborhood Areas	85	.60	.65	.70	.80	.80
Residential:						
Single-Family (**)	40	.45	.45	.50	.60	.60
Main Unit (detached)	60	.45	.50	.60	.70	.80
Main Unit (attached)	75	.60	.65	.70	.80	.80
1/2 Acre Lot or Larger	(*)	.30	.35	.40	.60	.60
Apartments	80	.65	.70	.70	.80	.80
Industrial:						
Light Industrial	80	.71	.72	.76	.82	.82
Heavy Industrial	90	.80	.80	.85	.90	.90
Parks, Cemeteries	5	.10	.10	.10	.35	.60
Playgrounds	10	.15	.25	.35	.65	.65
Schools	50	.45	.50	.60	.70	.70
Railroad Yard Areas	15	.40	.45	.50	.60	.60
Undeveloped Areas:						
Hillslope Flow Analysis	2					
Greenbelts, Agricultural						
Off-Site Flow Analysis						
(when land use not defined)	45	.43	.47	.55	.65	.65

NOTE: These Rational Formula coefficients may not be valid for large basins

(*)See Figures *RO-1 through RO-3* of USDCM Volume 1 for percent impervious.

(**)Up to 5 units per acre. Single-family with more than 5 units per acre, use values for multi-unit/detached

TABLE 1 (continued)

RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY				
		2	5	10	25	100
Sheet Paved	100	.87	.88	.90	.93	.93
Gravel	40	.15	.25	.35	.65	.65
Concrete Drives and Walks	96	.87	.87	.88	.89	.89
Roofs	90	.80	.85	.90	.90	.90
Lawns, Sandy Soil (A and B Soils):	2					
2% Slope	.05	.06	.08	.10	.10	.10
2-7% Slope	.10	.11	.13	.15	.15	.15
>7% Slope	.15	.16	.18	.20	.20	.20
Lawns, Clay Soil (C and D Soils):	5					
2% Slope	.13	.14	.15	.17	.17	.17
2-7% Slope	.18	.19	.20	.22	.22	.22
>7% Slope	.25	.27	.30	.35	.35	.35

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Cross Creek
 Location: Aurora
 Design Storm: 2-Year

Project Name: Cross Creek Commercial
 Project No.: 15879-20
 Calculated By: TCS
 Checked By: TCS
 Date: 7/9/20

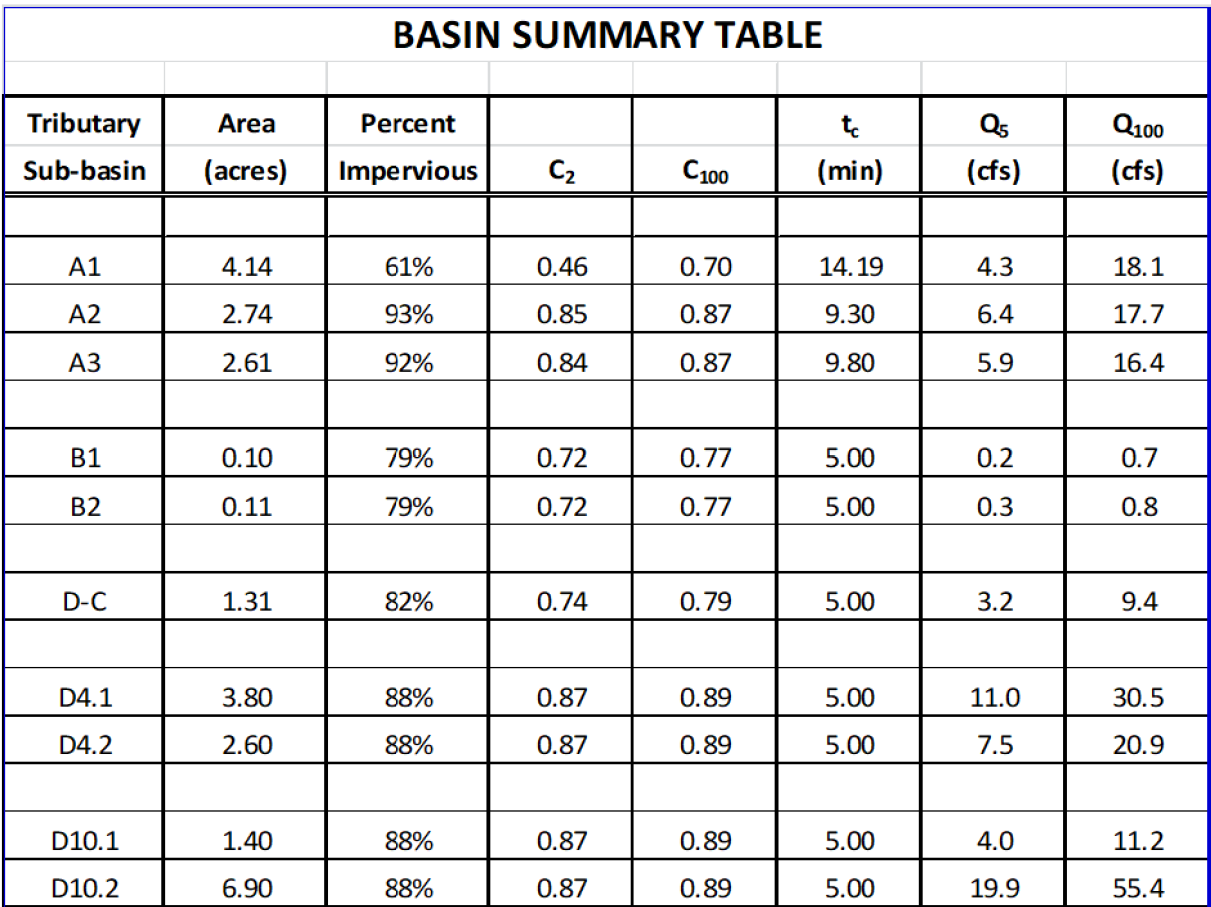
Flow	Design Point	DIRECT RUNOFF						TOTAL RUNOFF			STREET		PIPE				TRAVEL TIME			REMARKS			
		Basin ID	Area (Ac)	Runoff Coeff.	t _c (min)	C*A (Ac)	f (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	f (in/hr)	Q (cfs)	Q _{street} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)		Length (ft)	Velocity (fps)	t _t (min)
Surface	1.2	A1	4.14	0.46	14.19	1.90	2.28	4.33								4.3	1.9	1.0	18	560	5.6	1.7	Surface flow from Basin A1
Surface		A2	2.74	0.85	9.30	2.33	2.73	6.36								6.4	2.3	1.0	18	40	6.2	0.1	Captured flow by sump inlet piped to DP1.1
Surface		A3	2.61	0.84	9.80	2.20	2.67	5.87															Captured flow by sump inlet piped to DP1.1
Pipe	1.1								15.9	6.43	2.17	14.0				14.0	6.4	1.0	30	270	7.5	0.6	Captured flow by sump inlet
Surface		D-C	1.31	0.74	5.00	0.97	3.32	3.22															Combined flow from Basins A1, A2, A3
Pipe																							Surface flow from Basin D-C
Pipe	1								16.5	7.40	2.13	15.8											Pond D-C Outfall @ DP1
Surface		B2	0.11	0.72	5.00	0.08	3.32	0.27								0.3	0.1	1.0	18	40	2.4	0.3	Surface flow from Basin B2
Surface		B1	0.10	0.72	5.00	0.07	3.32	0.23															Captured flow routed to DP2.1
Pipe	2.1								5.3	0.15	3.28	0.5				0.5	0.2	1.0	24	55	2.8	0.3	Surface flow from Basin B1
Pipe	2								5.6	0.15	3.22	14.4											Combined flow from Basins B1, B2
																							Routed to DP2
																							Outfall into existing storm
																							Q=13.9cfs from previous approved report

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Cross Creek	Project Name: Cross Creek Commercial
Location: Aurora	Project No.: 15879-20
Design Storm: 100-Year	Calculated By: JGM
	Checked By: JGS
	Date: 7/9/20

STREET	Design Point	DIRECT RUNOFF					TOTAL RUNOFF			STREET		PIPE			TRAVEL TIME		REMARKS					
		Basin ID	Area (ac)	Runoff Coeff.	t _c (min)	C* A (ac)	f (in/hr)	Q (cfs)	C* A (ac)	f (in/hr)	Q (cfs)	Q ^{street} (cfs)	C* A (ac)	Slope (%)	Q ^{pipe} (cfs)	Slope (%)		Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)	
Surface	1,2	A1	4.14	0.70	14.19	2.91	6.2	18.04							18.0	2.9	1.0	18	560	10.2	0.9	Surface flow from Basin A1 Captured flow by sump inlet piped to DP1.1
Surface		A2	2.74	0.87	9.30	2.40	7.4	17.76							17.8	2.4	1.0	18	40	10.1	0.1	Surface flow from Basin A2 Captured flow by sump inlet piped to DP1.1
Surface		A3	2.61	0.87	9.80	2.27	7.25	16.46														Surface flow from Basin A3 Captured flow by sump inlet Combined flow from Basins A1, A2, A3
Pipe	1,1								15.1	7.58	4.02	45.6			45.6	7.6	1.0	30	270	9.3	0.5	Surface flow from Basin D-C
Surface		D-C	1.31	0.79	5.00	1.04	9.02	9.38														
Pipe	1	Total Basin A Run-off																				Pond D-C Outfall @ DP1
Surface		B2	0.11	0.77	5.00	0.09	9.02	0.81	15.6	8.62	5.93	51.1										Surface flow from Basin B2 Captured flow routed to DP2.1
Surface		B1	0.10	0.77	5.00	0.08	9.02	0.72					0.8	0.1	1.0	18	40	3.4	0.2			Surface flow from Basin B1
Pipe	2,1								5.2	0.17	8.93	1.5			1.5	0.2	1.0	24	55	4.0	0.2	Combined flow from Basins B1, B2 Routed to DP2
Pipe	2								5.4	0.17	8.82	33.6										Outfall into existing storm 0-32 cfs from previous approved report

Notes: Time of concentration of 5.0 minutes conservatively assumed



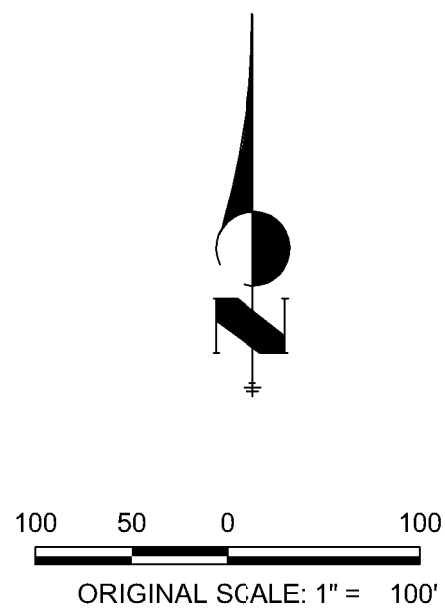
UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, JR ENGINEERING APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR
STRATEGIC CAPITAL CORP.
575 MADISON AVE
SUITE 1006
NEW YORK, NY
10022

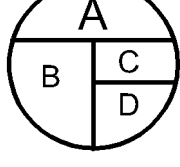

J·R ENGINEERING
A Westrian Company



Centennial 303-740-9383 • Colorado Springs 719-593-2583
Fort Collins 970-491-9888 • www.jrengineering.com



LEGEND

- | | |
|---|--|
| 5680 — | EXISTING CONTOUR |
| 5680 — | PROPOSED CONTOUR |
| ➡ | PROPOSED FLOW ARROW |
| ⇨ | EXISTING FLOW ARROW |
| — ■ — ■ — ■ — | PROPOSED STORM SEWER |
| == == == | EXISTING STORM SEWER |
|  | A = BASIN DESIGNATION
B = AREA IN ACRES
C = 2-YR RUNOFF COEFFICIENT
D = 100-YR RUNOFF COEFFICIENT |
|  | DESIGN POINT |
| | PROPERTY LINE |
| — ■ — ■ — ■ — | BASIN BOUNDARY |
| ↪ ↪ ↪ | PROPOSED DRAINAGE DITCH |

NOTE:

THE DEVELOPER SHALL HAVE A LICENSED PROFESSIONAL ENGINEER CERTIFY EACH STORMWATER DETENTION POND AND/OR WATER QUALITY BMP IS BUILT ACCORDING TO THE APPROVED PLANS AND SPECIFICATIONS AND THE REQUIRED DETENTION VOLUME, INCLUDING THE WQCV WHEN USED, IS MET. THE ENGINEER CERTIFICATION SHALL ALSO VERIFY ALL POINT-TO-POINT DIMENSIONS, ELEVATIONS, REQUIRED OUTLET ORifice PLATES FOR DETENTION AND WQCV, AND OTHER PERMANENT BMPs REQUIREMENTS ARE INSTALLED PER THE APPROVED PLANS AND SPECIFICATIONS, AND SHALL SHOW THE AS-BUILT VOLUMES FOR THE 100-YEAR, 10-YEAR STORM EVENTS, AND FOR THE WQCV, AND OTHER PERTINENT DIMENSIONS, ELEVATIONS, AND AGGREGATED REQUIREMENTS. THE WORK SHALL BE DONE BY THE CERTIFICATION. THE CERTIFICATION SHALL BE PROVIDED TO THE CITY OF AURORA ENGINEERING CONSULTANT SENIOR ENGINEER BEFORE A CERTIFICATED OF OCCUPANCY WILL BE ISSUED.



Know what's **below**.
Call before you dig.

NOTES:

- CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, OF DIMENSIONS AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. THE CITY OF AURORA, THROUGH THE DEPARTMENT OF PUBLIC WORKS, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.
- ALL STORM INFRASTRUCTURE IS PUBLIC AND SIZED FOR THE 100 YEAR STORM EVENT.
- PIPE CLASS SHALL BE CLASS III.
- PIPE BEDDING MATERIAL SHALL BE CLASS B.

BENCHMARK

THE PROJECT BENCHMARK IS THE CITY OF AURORA VERTICAL CONTROL MONUMENT 1-093.4 (COA ID 456507NW002) BEING MONUMENTED BY A 3" BRASS CAP LOCATED ON THE SOUTHEASTERLY CORNER OF A CURB OPENING INLET STRUCTURE AT THE SOUTHEASTERLY CORNER OF 6TH PARKWAY AND N. CATAWBA WAY. PUBLISHED ELEVATION = 5576.84 NAVD(88)

ENGINEER'S STATEMENT

PREPARED UNDER MY SUPERVISION

KURTIS W. WILLIAMS, P.E.
COLORADO NO. 34270
FOR AND ON BEHALF OF JR ENGINEERING, LLC.

APPROVED FOR ONE YEAR FROM THIS DATE

CITY ENGINEER DATE

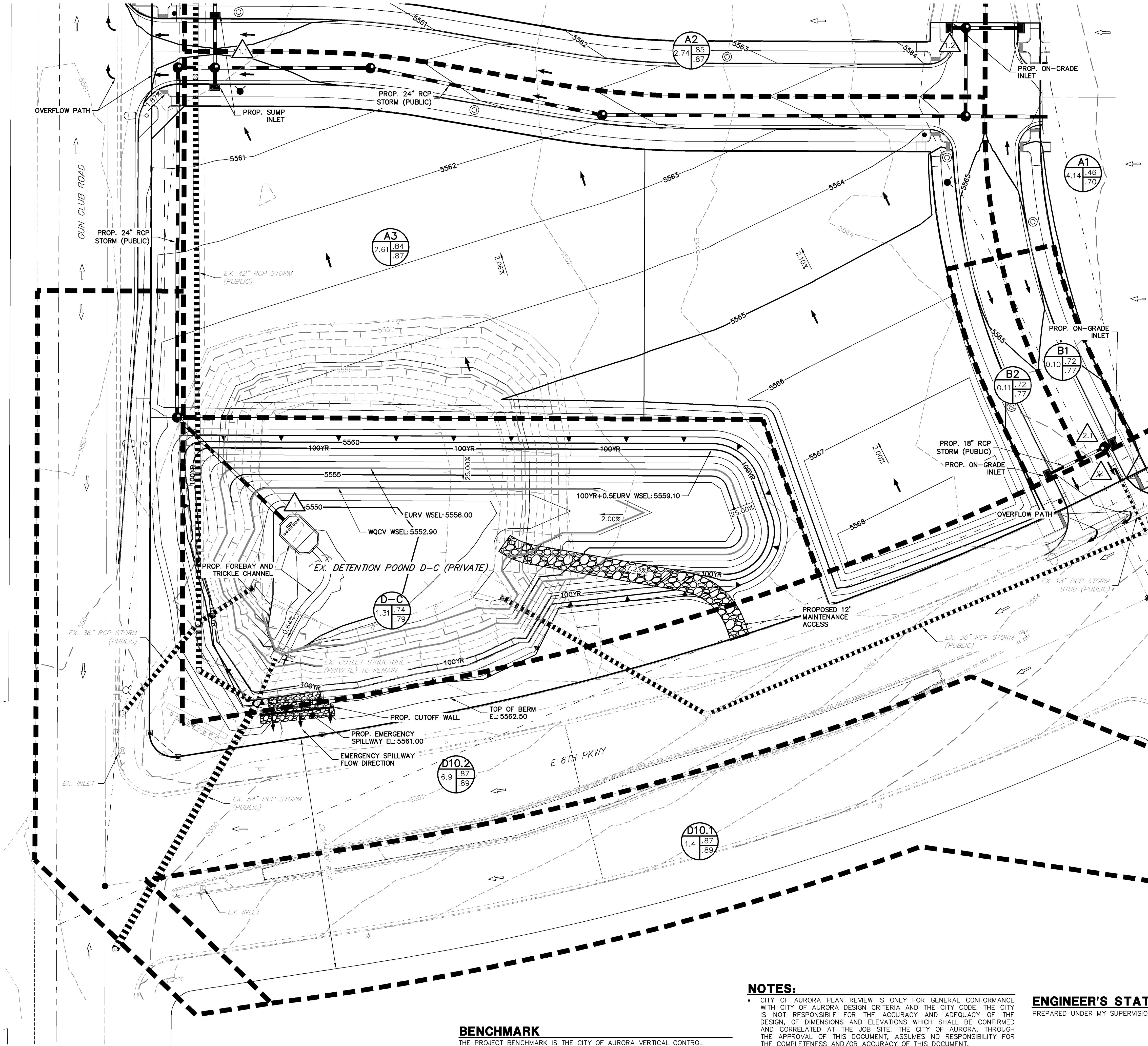
WATER DEPARTMENT	DATE
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CROSS CREEK FILING #04
CROSS CREEK COMMERCIAL
OVERALL DRAINAGE PLAN

SHEET 1 OF 2

JOB NO. 15879.20

X:\1587920\Drawings\Sheet Drawings\1587920 DROPS Detailed.dwg, 10/30/2020 2:40:12 PM, MiskellC



BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C ₂	C ₁₀₀	t _e (min)	Q _s (cfs)	Q ₁₀₀ (cfs)
A1	4.14	61%	0.46	0.70	14.19	4.3	18.1
A2	2.74	93%	0.85	0.87	9.30	6.4	17.7
A3	2.61	92%	0.84	0.87	9.80	5.9	16.4
B1	0.10	79%	0.72	0.77	5.00	0.2	0.7
B2	0.11	79%	0.72	0.77	5.00	0.3	0.8
D-C	1.31	82%	0.74	0.79	5.00	3.2	9.4
D4.1	3.80	88%	0.87	0.89	5.00	11.0	30.5
D4.2	2.60	88%	0.87	0.89	5.00	7.5	20.9
D10.1	1.40	88%	0.87	0.89	5.00	4.0	11.2
D10.2	6.90	88%	0.87	0.89	5.00	19.9	55.4



LEGEND

- 5680

5680
- EXISTING CONTOUR
PROPOSED CONTOUR
PROPOSED FLOW ARROW
EXISTING FLOW ARROW
PROPOSED STORM SEWER
EXISTING STORM SEWER
A = BASIN DESIGNATION
B = AREA IN ACRES
C = 2-YR RUNOFF COEFFICIENT
D = 100-YR RUNOFF COEFFICIENT
DESIGN POINT
PROPERTY LINE
BASIN BOUNDARY
PROPOSED DRAINAGE DITCH

NOTE:
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APPROVED FOR ONE YEAR FROM THIS DATE

CITY ENGINEER _____ DATE _____
WATER DEPARTMENT _____ DATE _____

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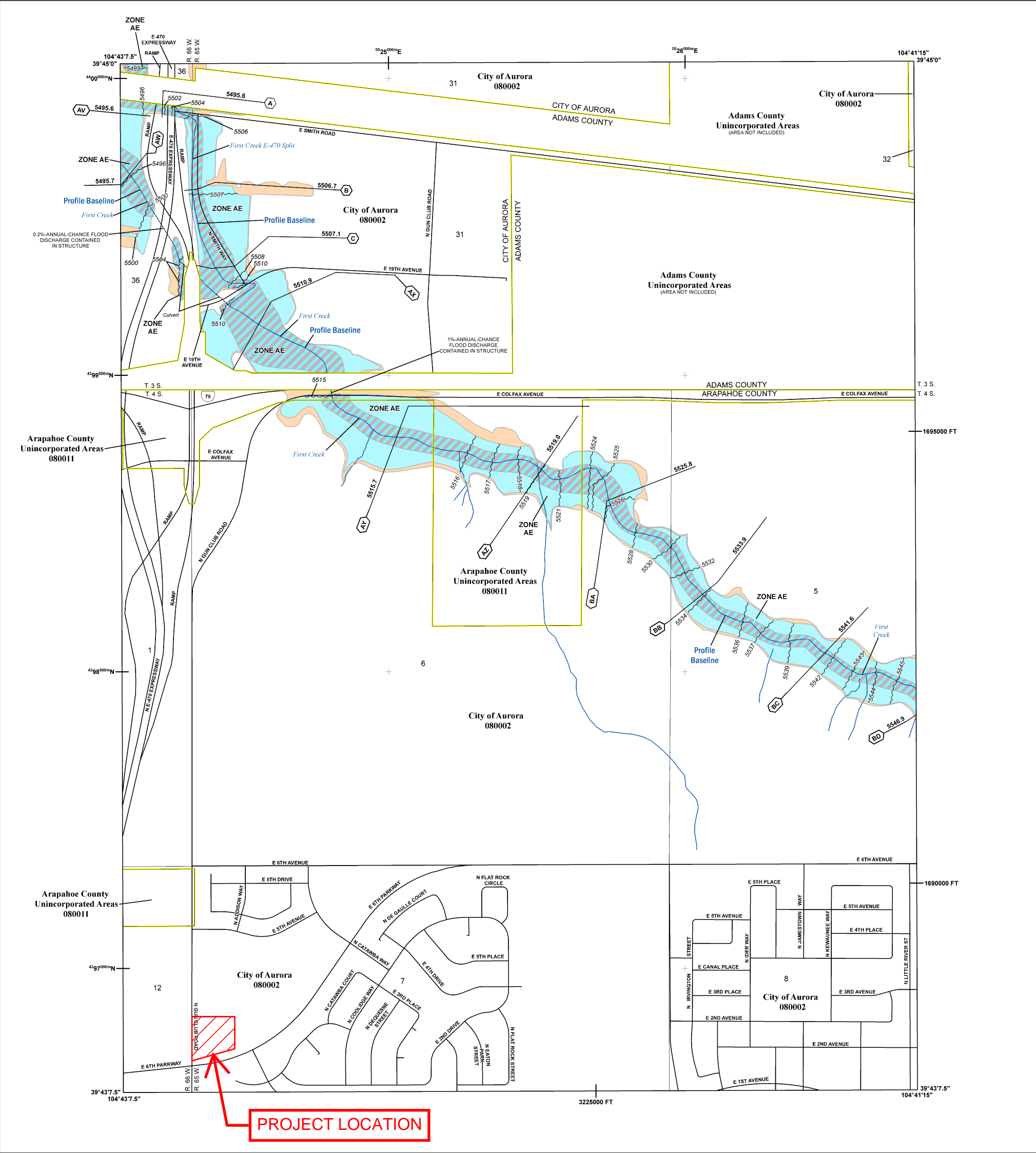
CROSS CREEK FILING #04
CROSS CREEK COMMERCIAL

DRAINAGE PLAN

SHEET 2 OF 2

JOB NO. 15879.20

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE AGENCIES, OR ENGINEERING APPROVES THEIR USE, THESE DRAWINGS ARE DESIGNATED BY WRITTEN AUTHORIZATION.



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTP://MSC.FEMA.GOV](http://msc.fema.gov)

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A.V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
OTHER AREAS OF FLOOD HAZARD		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 Zone X
OTHER AREAS		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee See Notes. Zone X
GENERAL STRUCTURES		NO SCREEN Areas of Minimal Flood Hazard Zone X
		Area of Undetermined Flood Hazard Zone D
OTHER FEATURES		Channel, Culvert, or Storm Sewer Accredited or Provisionally Accredited Levee, Dike, or Floodwall
		Non-accredited Levee, Dike, or Floodwall
OTHER FEATURES		Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
		Coastal Transect
OTHER FEATURES		Coastal Transect Baseline
		Profile Baseline
OTHER FEATURES		Hydrographic Feature
		Base Flood Elevation Line (BFE)
OTHER FEATURES		Limit of Study
		Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at <http://msc.fema.gov>. Available products may include: previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided by the Arapahoe County and Cities of Aurora and Littleton GIS depts. The coordinate system used for production of the digital FIRM is Universal Transverse Mercator, Zone 13N, referenced to the North American Datum of 1983 and the GRS 1980 spheroid, Western Hemisphere.

SCALE

Map Projection:
NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 500 feet
1:6,000

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

PANEL LOCATOR

FEMA
National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

ARAPAHOE COUNTY, COLORADO
And Incorporated Areas

PANEL 202 OF 725

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
ARAPAHOE COUNTY	080011	0202	L
AURORA, CITY OF	080002	0202	L

VERSION NUMBER
2.3.3.2

MAP NUMBER
08005C0202L

MAP REVISED
FEBRUARY 17, 2017



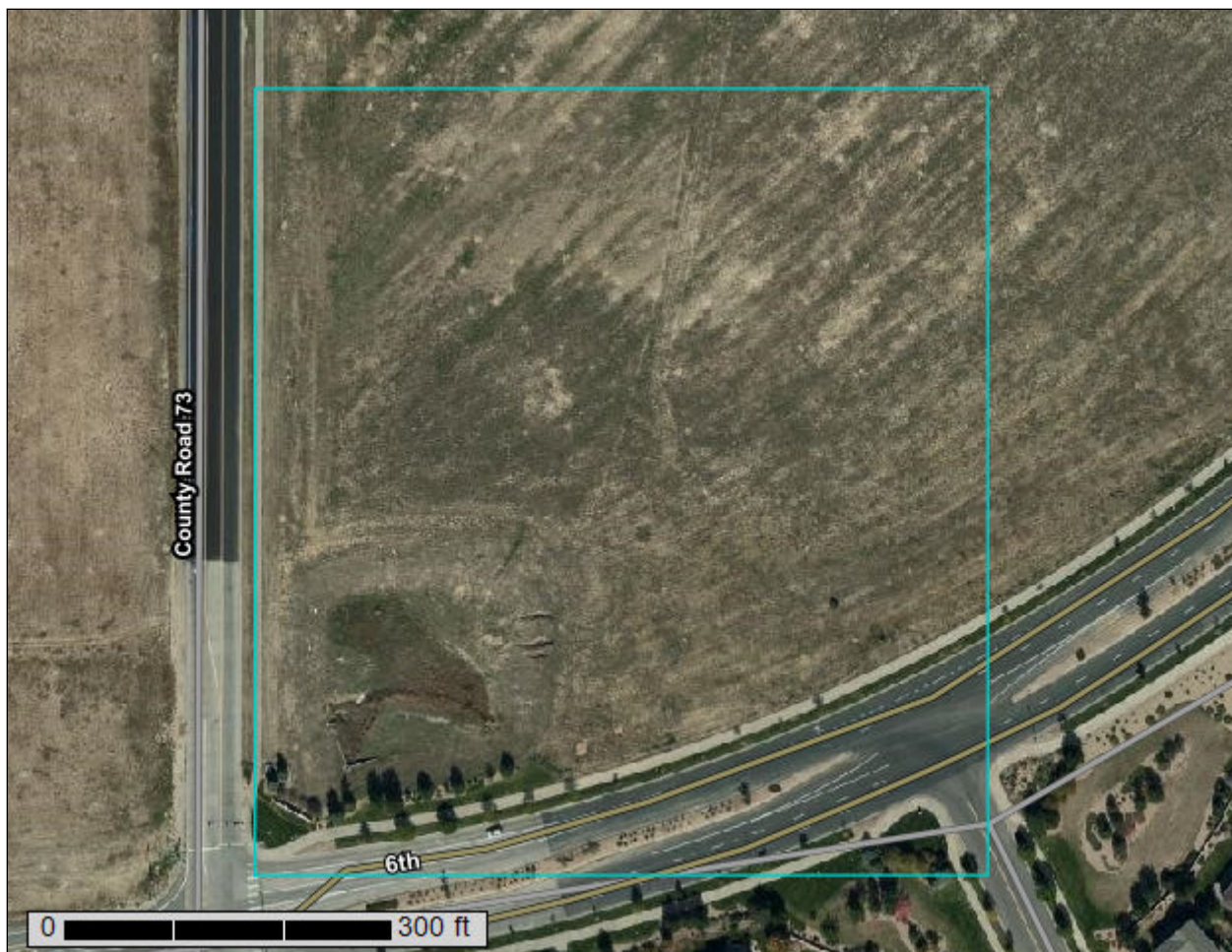
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Arapahoe County, Colorado**



February 3, 2021

Custom Soil Resource Report Soil Map



Soil Map may not be valid at this scale.

























Map Scale: 1:1,590 if printed on A portrait (8.5" x 11") sheet.

0 20 40 80 120 Meters

0 50 100 200 300 Feet

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

MAP LEGEND

	Area of Interest (AOI)		Spoil Area
	Area of Interest (AOI)		Stony Spot
Soils			Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features		Water Features	
	Blowout		Streams and Canals
	Borrow Pit	Transportation	
	Clay Spot		Rails
	Closed Depression		Interstate Highways
	Gravel Pit		US Routes
	Gravelly Spot		Major Roads
	Landfill		Local Roads
	Lava Flow		Background
	Marsh or swamp		Aerial Photography
	Mine or Quarry		
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: Arapahoe County, Colorado
Survey Area Data: Version 16, Jun 4, 2020

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

Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 2018

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BvC	Bresser-Truckton sandy loams, 3 to 5 percent slopes	6.6	59.7%
FdB	Fondis silt loam, 1 to 3 percent slopes	2.8	24.8%
NrB	Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes	1.7	15.5%
Totals for Area of Interest		11.1	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

Arapahoe County, Colorado

BvC—Bresser-Truckton sandy loams, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 34y5

Elevation: 4,500 to 6,800 feet

Mean annual precipitation: 12 to 18 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 125 to 180 days

Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Bresser and similar soils: 55 percent

Truckton and similar soils: 30 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bresser

Setting

Landform: Playas, drainageways, stream terraces

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Noncalcareous sandy alluvium and/or noncalcareous sandy eolian deposits

Typical profile

H1 - 0 to 6 inches: sandy loam

H2 - 6 to 26 inches: sandy clay loam, clay loam

H2 - 6 to 26 inches: sandy loam, coarse sandy loam, gravelly sandy loam

H3 - 26 to 32 inches: loamy coarse sand, gravelly loamy sand

H3 - 26 to 32 inches:

H3 - 26 to 32 inches:

H4 - 32 to 60 inches:

H4 - 32 to 60 inches:

Properties and qualities

Slope: 3 to 5 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Available water capacity: Very high (about 13.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4e

Custom Soil Resource Report

Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Description of Truckton

Setting

Landform: Ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits

Typical profile

H1 - 0 to 5 inches: sandy loam
H2 - 5 to 20 inches: sandy loam
H3 - 20 to 60 inches: sandy loam, loamy sand, loamy coarse sand
H3 - 20 to 60 inches:
H3 - 20 to 60 inches:

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 13.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Nunn

Percent of map unit: 8 percent
Hydric soil rating: No

Ascalon

Percent of map unit: 7 percent
Hydric soil rating: No

FdB—Fondis silt loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 34yh
Elevation: 4,700 to 6,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Fondis and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fondis

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty and/or loamy

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 27 inches: clay
H3 - 27 to 60 inches: clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water capacity: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: R049XY202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Weld

Percent of map unit: 10 percent

Hydric soil rating: No

Buick

Percent of map unit: 5 percent

Hydric soil rating: No

NrB—Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 34yw

Elevation: 4,500 to 6,800 feet

Mean annual precipitation: 12 to 18 inches

Mean annual air temperature: 46 to 57 degrees F

Frost-free period: 115 to 180 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 40 percent

Bresser and similar soils: 25 percent

Ascalon and similar soils: 20 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Streams, stream terraces, playas

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Eolian deposits

Typical profile

H1 - 0 to 8 inches: loam

H2 - 8 to 28 inches: clay loam, clay

H2 - 8 to 28 inches: sandy clay loam, fine sandy loam, sandy loam

H3 - 28 to 60 inches:

H3 - 28 to 60 inches:

H3 - 28 to 60 inches:

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Custom Soil Resource Report

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water capacity: Very high (about 20.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3c

Hydrologic Soil Group: C

Ecological site: R049XY202CO - Loamy Foothill

Hydric soil rating: No

Description of Bresser

Setting

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Noncalcareous sandy alluvium and/or noncalcareous sandy eolian deposits

Typical profile

H1 - 0 to 6 inches: sandy loam

H2 - 6 to 26 inches: sandy clay loam, clay loam

H2 - 6 to 26 inches: loamy coarse sand, gravelly loamy sand

H3 - 26 to 60 inches:

H3 - 26 to 60 inches:

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Available water capacity: Very high (about 12.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e

Land capability classification (nonirrigated): 4c

Hydrologic Soil Group: B

Ecological site: R049XY202CO - Loamy Foothill

Hydric soil rating: No

Description of Ascalon

Setting

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Reworked by wind outwash

Custom Soil Resource Report

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 17 inches: sandy clay loam, sandy loam
H2 - 6 to 17 inches: fine sandy loam, loamy fine sand, sandy loam
H3 - 17 to 60 inches:
H3 - 17 to 60 inches:
H3 - 17 to 60 inches:

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very high (about 16.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XY202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Olney

Percent of map unit: 10 percent
Hydric soil rating: No

Aquic ustochrepts

Percent of map unit: 5 percent
Landform: Swales
Hydric soil rating: Yes

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Appendix B – Hydrologic Computations

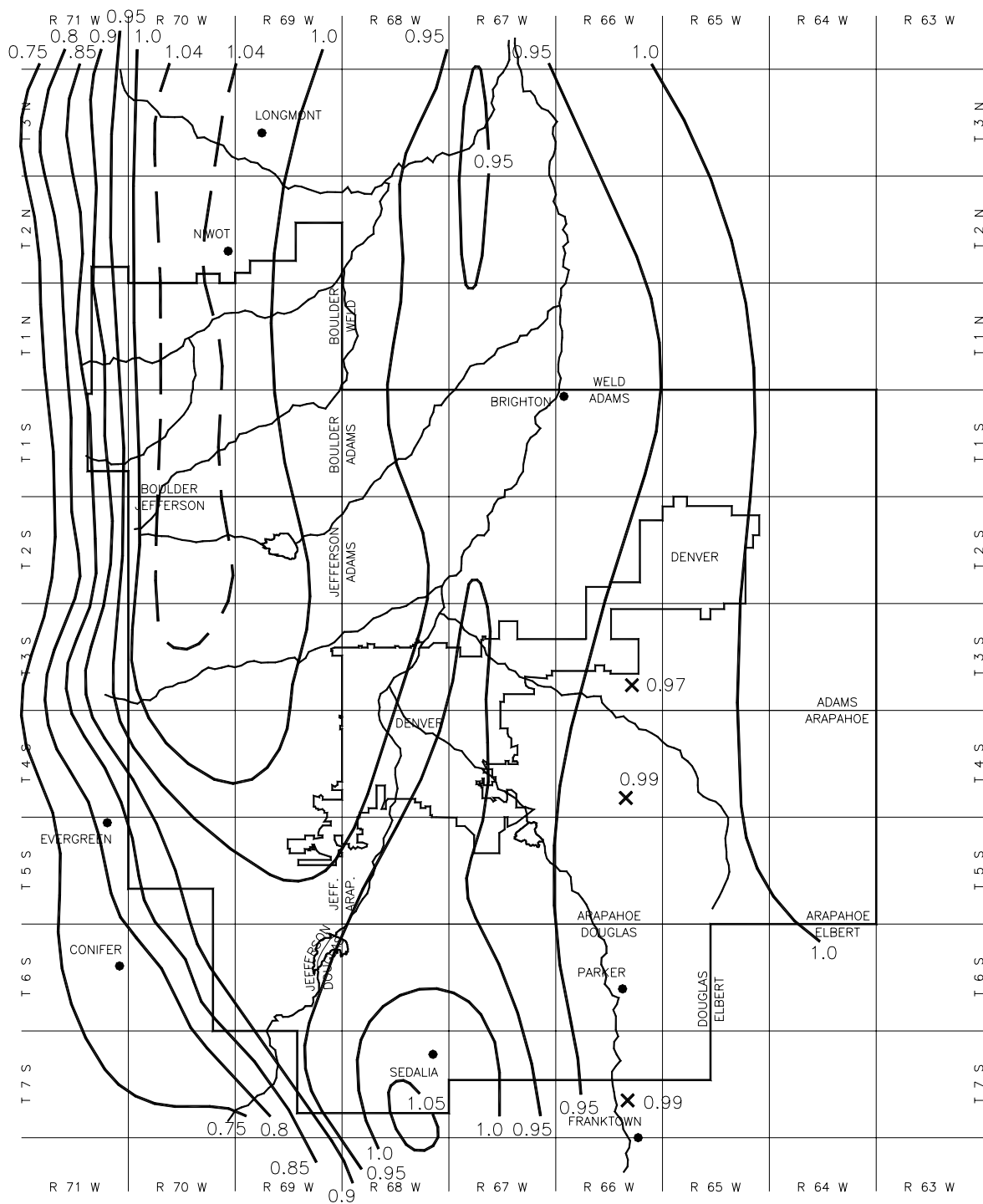


Figure RA-1—Rainfall Depth-Duration-Frequency: 2-Year, 1-Hour Rainfall

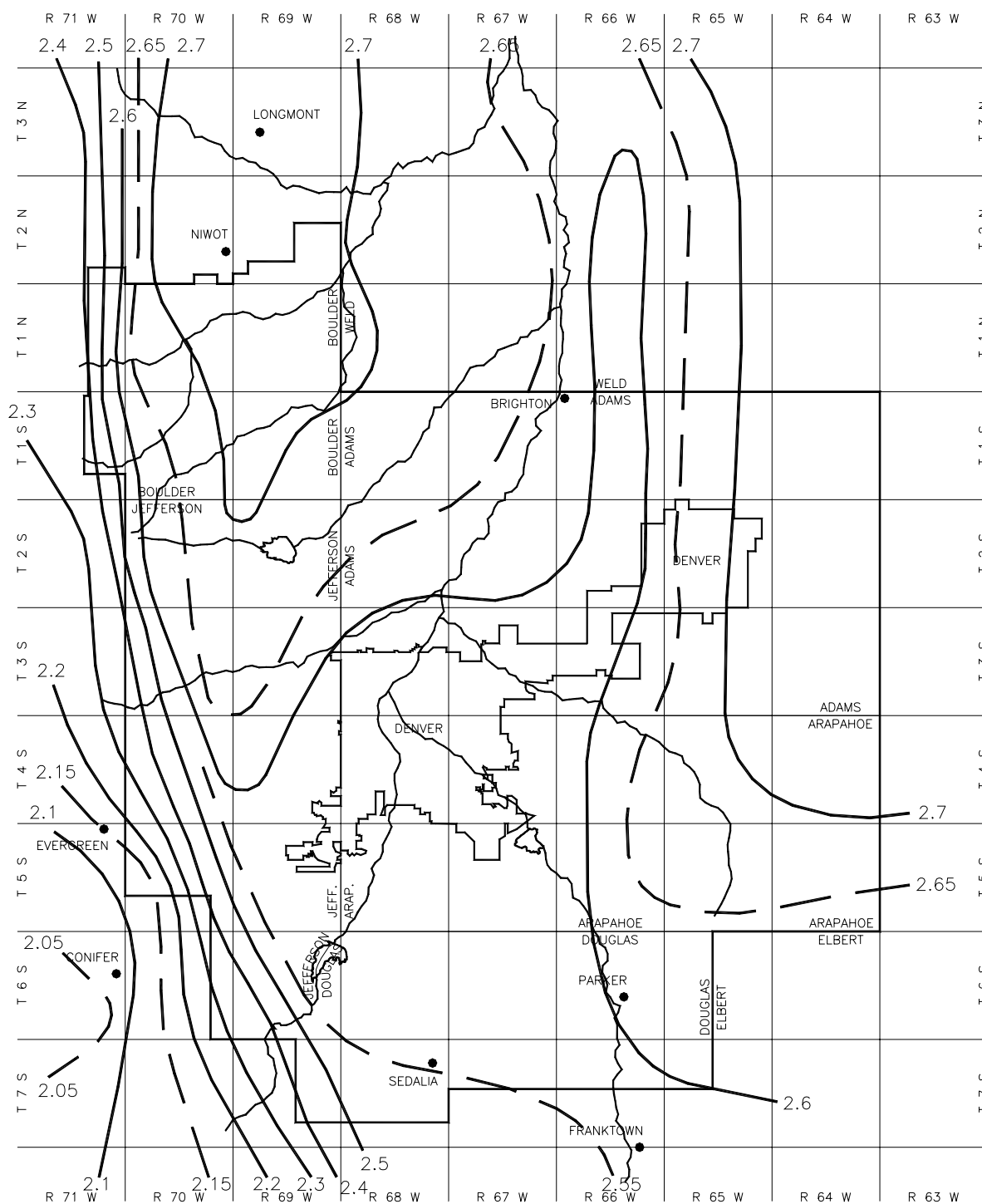


Figure RA-6—Rainfall Depth-Duration-Frequency: 100-Year, 1-Hour Rainfall

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
<u>Business:</u>					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	85	.60	.65	.70	.80
<u>Residential:</u>					
Single-Family (**)	(*)	.40	.45	.50	.60
Multi-Unit (detached)	60	.45	.50	.60	.70
Multi-Unit (attached)	75	.60	.65	.70	.80
1/2 Acre Lot or Larger	(*)	.30	.35	.40	.60
Apartments	80	.65	.70	.70	.80
<u>Industrial:</u>					
Light Areas	80	.71	.72	.76	.82
Heavy Areas	90	.80	.80	.85	.90
<u>Parks, Cemeteries</u>	5	.10	.10	.35	.60
<u>Playgrounds</u>	10	.15	.25	.35	.65
<u>Schools</u>	50	.45	.50	.60	.70
<u>Railroad Yard Areas</u>	15	.40	.45	.50	.60
<u>Undeveloped Areas:</u>					
Historic Flow Analysis, Greenbelts, Agricultural	2	(See "Lawns")			
Off-Site Flow Analysis (when land use not defined)	45	.43	.47	.55	.65

TABLE 1 (continued)

RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
<u>Streets:</u>					
Paved	100	.87	.88	.90	.93
Gravel	40	.15	.25	.35	.65
<u>Concrete Drive and Walks</u>	96	.87	.87	.88	.89
<u>Roofs</u>	90	.80	.85	.90	.90
<u>Lawns, Sandy Soil (A and B Soils):</u>	2				
2% Slope		.05	.06	.08	.10
2-7% Slope		.10	.11	.13	.15
>7% Slope		.15	.16	.18	.20
<u>Lawns, Clay Soil (C and D Soils):</u>	5				
2% Slope		.13	.14	.15	.17
2-7% Slope		.18	.19	.20	.22
>7% Slope		.25	.27	.30	.35

NOTE: These Rational Formula coefficients may not be valid for large basins

(*)See Figures RO-3 through RO-5 of USDCM Volume 1 for percent impervious.

(**)Up to 5 units per acre. Single-family with more than 5 units per acre, use values for multi-unit/detached

Runoff Coefficients

Corridor / Design Package: 7-Eleven - Gun Club Road
System Name: Developed Condition

Computed: DSI
Checked: KH

Date: 2/24/2021
Date: 2/24/2021

Sub-Basin Data			Composite C			Sub Area (Pavement)				Sub Area (Roof)				Sub Area(Lawns B Group soils)			
Basin ID	Description	Total Area (ac)	C ₂	C ₁₀₀	i	C ₂	C ₁₀₀	i	Area (ac)	C ₂	C ₁₀₀	i	Area (ac)	C ₂	C ₁₀₀	i	Area (ac)
P1	PARKING, SIDEWALK	0.10	0.87	0.93	100.00	0.87	0.93	100	0.100	0.80	0.90	96	0.000	0.10	0.15	2	0.000
P2	HARDSCAPE, LANDSCAPING	0.56	0.76	0.82	86.00	0.87	0.93	100	0.480	0.80	0.90	96	0.000	0.10	0.15	2	0.080
P3	C-STORE BUILDING	0.09	0.80	0.90	96.00	0.87	0.93	100	0.000	0.80	0.90	96	0.090	0.10	0.15	2	0.000
P4	6MPD FUEL CANOPY	0.07	0.80	0.90	96.00	0.87	0.93	100	0.000	0.80	0.90	96	0.070	0.10	0.15	2	0.000
P5	CAR WASH, DRIVE, LANDSCAPING	0.17	0.53	0.60	58.47	0.87	0.93	100	0.050	0.80	0.90	96	0.050	0.10	0.15	2	0.070
P6	LANDSCAPING	0.10	0.10	0.15	2.00	0.87	0.93	100	0.000	0.80	0.90	96	0.000	0.10	0.15	2	0.100
P7	LANDSCAPING, SIDEWALK	0.19	0.18	0.23	12.32	0.87	0.93	100	0.020	0.80	0.90	96	0.000	0.10	0.15	2	0.170
	<i>On-site Composite</i>	1.28	0.61	0.67	67.19	0.87	0.93	100	0.650	0.80	0.90	96	0.21	0.10	0.15	2	0.420

Standard Form SF-1 . Time of Concentration

Corridor / Design Package: 7-Eleven - Gun Club Road
System Name: Developed Condition

Computed: DSI
Checked: MK

Date: 2/24/2021
Date: 2/24/2021

SUB-BASIN DATA				INITIAL/OVERLAND FLOW (t _i)			TRAVEL TIME (t _t) Type of Land Surface							Total t _c = t _i + t _t (min)	Tc CHECK (Urbanized basins)				FINAL Tc (min)
Basin ID	Description	C _s	Area (ac)	Length (ft)	Slope (ft/ft)	t _i (min)	Length (ft)	Slope (ft/ft)	Code	Description	Convey Coef (C _v)	V	t _t (min)		Urban (Yes /No)	Length (ft)	T _c max (min)	T _c max > t _c	
P1	PARKING, SIDEWALK	0.87	0.10	25	0.021	1.6	47.5	0.025	6	Areas and shallow paved sv	20	3.162	0.25	1.88	Yes	73	0.40	Regional Tc	5.00
P2	HARDSCAPE, LANDSCAPING	0.76	0.56	45	0.02	3.3	211.0	0.023	6	Areas and shallow paved sv	20	3.033	1.16	4.44	Yes	256	1.42	Regional Tc	5.00
P3	C-STORE BUILDING	0.80	0.09	25	0.02	2.2	0.0	0	6	Areas and shallow paved sv	20	0	0.00	2.15	Yes	25	0.14	Regional Tc	5.00
P4	6MPD FUEL CANOPY	0.80	0.07	18.3	0.02	1.8	0.0	0	6	Areas and shallow paved sv	20	0	0.00	1.84	Yes	18	0.10	Regional Tc	5.00
P5	CAR WASH, DRIVE, LANDSCAPING	0.53	0.17	25	0.02	4.1	99.2	0.035	6	Areas and shallow paved sv	20	3.742	0.44	4.52	Yes	124	0.69	Regional Tc	5.00
P6	LANDSCAPING	0.10	0.10	25	0.235	3.2	5.0	0.25	3	Short pasture and lawns	7	3.5	0.02	3.21	Yes	30	0.17	Regional Tc	5.00
P7	LANDSCAPING, SIDEWALK	0.18	0.19	25	0.045	5.1	9.2	0.045	3	Short pasture and lawns	7	1.485	0.10	5.15	Yes	34	0.19	Regional Tc	5.15

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

 Corridor / Design Package: 7-Eleven - Gun Club Road
 System Name: Developed Condition

 Computed: DSI Date: 2/24/2021
 Checked: MK Date: 2/24/2021

 Design Storm: Proposed 2-yr P = 0.98 in

LOCATION		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE		TRAVEL TIME			REMARKS	
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C.A. (AC)	IN / HR	Q (CFS)	t _c (MIN)	SUM (C' A)(AC)	IN / HR	Q(CFS)	SLOPE(%)	STREETFLOW (C)	DESIGNFLOW (C)	SLOPE(%)	PIPE SIZE(IN)	LENGTH(FT)	VELOCITY(FPS)		t _t (MIN)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
P1	PARKING, SIDEWALK	1	P1	0.10	0.87	5.00	0.087	3.32	0.29					1	1	1	1	1	1			
P2	HARDSCAPE, LANDSCAPING	2	P2	0.56	0.76	5.00	0.426	3.32	1.41					1	1	1	1	1	1			
P3	C-STORE BUILDING	3	P3	0.09	0.80	5.00	0.072	3.32	0.24					1	1	1	1	1	1			
P4	6MPD FUEL CANOPY	4	P4	0.07	0.80	5.00	0.056	3.32	0.19					1	1	1	1	1	1			
P5	CAR WASH, DRIVE, LANDSCAPING	5	P5	0.17	0.53	5.00	0.091	3.32	0.30					1	1	1	1	1	1			
P6	LANDSCAPING	6	P6	0.10	0.10	5.00	0.010	3.32	0.033					1	1	1	1	1	1			
P7	LANDSCAPING, SIDEWALK	7	P7	0.19	0.18	5.15	0.034	3.30	0.11					1	1	1	1	1	1			

 Design Storm: Proposed 100-yr P = 2.67 in

LOCATION		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE		TRAVEL TIME			REMARKS	
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	IN / HR	Q (CFS)	t_c (MIN)	SUM (C+A)(AC)	IN / HR	Q(CFS)	SLOPE(%)	STREETFLOW (C)	DESIGNFLOW (C)	SLOPE(%)	PIPE SIZE(IN)	LENGTH(FT)	VELOCITY(FPS)		t_t (MIN)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
P1	PARKING, SIDEWALK	1	P1	0.10	0.93	5.00	0.09	9.06	0.84					1	1	1	1	1	1			
P2	HARDSCAPE, LANDSCAPING	2	P2	0.56	0.82	5.00	0.46	9.06	4.15					1	1	1	1	1	1			
P3	C-STORE BUILDING	3	P3	0.09	0.90	5.00	0.08	9.06	0.73					1	1	1	1	1	1			
P4	6MPD FUEL CANOPY	4	P4	0.07	0.90	5.00	0.06	9.06	0.57					1	1	1	1	1	1			
P5	CAR WASH, DRIVE, LANDSCAPING	5	P5	0.17	0.60	5.00	0.10	9.06	0.92					1	1	1	1	1	1			
P6	LANDSCAPING	6	P6	0.10	0.15	5.00	0.02	9.06	0.14					1	1	1	1	1	1			
P7	LANDSCAPING, SIDEWALK	7	P7	0.19	0.23	5.15	0.04	8.98	0.40					1	1	1	1	1	1			

- (1) Basin Description linked to C-Value Sheet
 (2) Basin Design Point
 (3) Enter the Basin Name from C Value Sheet
 (4) Basin Area linked to C-Value Sheet
 (5) Composite C linked to C-Value Sheet
 (6) Time of Concentration linked to C-Value Sheet

- (7) =Column 4 x Column 5
 (8) = $28.5^*P/(10+Column\ 6)^{0.786}$
 (9) =Column 7 x Column 8
 (10) =Column 6 + Column 21
 (11) Add the Basin Areas (7) to get the combined basin AC
 (12) = $28.5^*P/(10+Column\ 10)^{0.786}$

- (13) Sum of Qs
 (14) Additional Street Overland Flow
 (15) Additional Street Overland Flow
 (16) Design Pipe Flow
 (17) Pipe Slope
 (18) Pipe Size

- (19) Additional Flow Length
 (20) Velocity
 (21) =Column 19 / Column 20 / 60

Impervious Comparison					
Existing			Proposed		
Area		Impervious	Area		Impervious
A3	2.61	92.1%	Lot 1	1.28	67.2%
			Lot 2	1.03	95.0%
			A3 - Landscaping	0.102	5.0%
			A3 - Hardscape	0.35	100.0%
			Total	2.76	79.4%

Appendix C – Hydraulic Computations

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP1
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	In Sump
Inlet Type	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows	
Minor Q_{Known} (cfs)	0.3
Major Q_{Known} (cfs)	0.8
Bypass (Carry-Over) Flow from Upstream	
Receive Bypass Flow from:	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0
Watershed Characteristics	
Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	
Watershed Profile	
Overland Slope (ft/ft)	
Overland Length (ft)	
Channel Slope (ft/ft)	
Channel Length (ft)	
Minor Storm Rainfall Input	
Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	
Major Storm Rainfall Input	
Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.3
Major Total Design Peak Flow, Q (cfs)	0.8
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A
Minor Storm (Calculated) Analysis of Flow Time	
C	N/A
C_5	N/A
Overland Flow Velocity, V_i	N/A
Channel Flow Velocity, V_t	N/A
Overland Flow Time, T_i	N/A
Channel Travel Time, T_t	N/A
Calculated Time of Concentration, T_c	N/A
Regional T_c	N/A
Recommended T_c	N/A
T_c selected by User	N/A
Design Rainfall Intensity, I	N/A
Calculated Local Peak Flow, Q_p	N/A
Major Storm (Calculated) Analysis of Flow Time	
C	N/A
C_5	N/A
Overland Flow Velocity, V_i	N/A
Channel Flow Velocity, V_t	N/A
Overland Flow Time, T_i	N/A
Channel Travel Time, T_t	N/A
Calculated Time of Concentration, T_c	N/A
Regional T_c	N/A
Recommended T_c	N/A
T_c selected by User	N/A
Design Rainfall Intensity, I	N/A
Calculated Local Peak Flow, Q_p	N/A

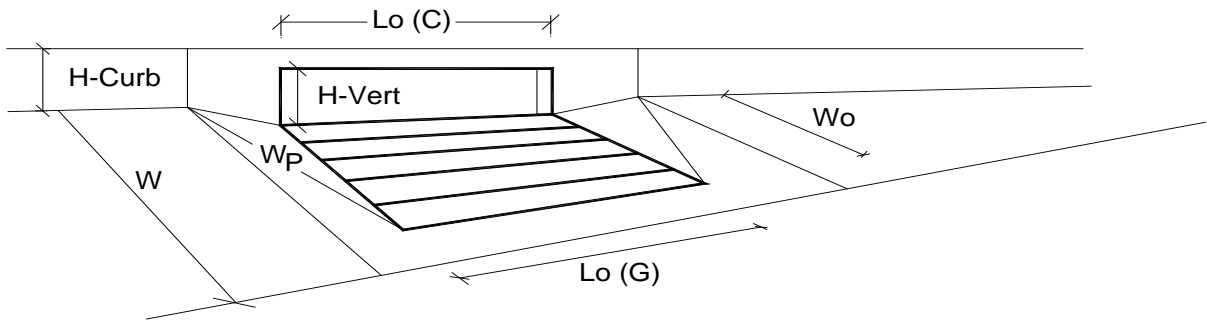
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)	
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)	
Project:	Enter Your Project Name Here
Inlet ID:	DP1

The diagram illustrates the cross-section of a gutter and street. Key dimensions include: T_{BACK} (width behind curb), T and T_{MAX} (widths at different depths), T_{CROWN} (width to street crown), W (gutter width), T_x (width at depth x), S_{BACK} (side slope), S_w (gutter cross slope), S_x (street longitudinal slope), H_{CURB} (curb height), d (depth at curb), y (depth at gutter), and a (depth at gutter flowline). The 'STREET CROWN' is indicated on the right.

Gutter Geometry (Enter data in the blue cells)					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 0.5$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} =$ 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	$T_{CROWN} = 19.0$ ft				
Gutter Width	$W = 1.00$ ft				
Street Transverse Slope	$S_x = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.012$				
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} =$ <table border="1"><thead><tr><th>Minor Storm</th><th>Major Storm</th></tr></thead><tbody><tr><td>19.0</td><td>19.0</td></tr></tbody></table> ft	Minor Storm	Major Storm	19.0	19.0
Minor Storm	Major Storm				
19.0	19.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} =$ <table border="1"><thead><tr><th>Minor Storm</th><th>Major Storm</th></tr></thead><tbody><tr><td>6.0</td><td>6.0</td></tr></tbody></table> inches	Minor Storm	Major Storm	6.0	6.0
Minor Storm	Major Storm				
6.0	6.0				
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>				
MINOR STORM Allowable Capacity is based on Depth Criterion					
MAJOR STORM Allowable Capacity is based on Depth Criterion					
$Q_{allow} =$	<table border="1"><thead><tr><th>Minor Storm</th><th>Major Storm</th></tr></thead><tbody><tr><td>SUMP</td><td>SUMP</td></tr></tbody></table> cfs	Minor Storm	Major Storm	SUMP	SUMP
Minor Storm	Major Storm				
SUMP	SUMP				

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 = CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)		a _{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.3	5.3	inches
Grate Information		MINOR		MAJOR	
Length of a Unit Grate		L _o (G) =	N/A	N/A	feet
Width of a Unit Grate		W _o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A _{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C _f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C _w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C _o (G) =	N/A	N/A	
Curb Opening Information		MINOR		MAJOR	
Length of a Unit Curb Opening		L _o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H _{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H _{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W _p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C _f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C _w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C _o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR		MAJOR	
Depth for Grate Midwidth		d _{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d _{Curb} =	0.36	0.36	ft
Combination Inlet Performance Reduction Factor for Long Inlets		RF _{Combination} =	0.68	0.68	
Curb Opening Performance Reduction Factor for Long Inlets		RF _{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF _{Grate} =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)		MINOR		MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		Q _a =	4.8	4.8	cfs
		Q _{PEAK REQUIRED} =	0.3	0.8	cfs

18" RCP

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	1.00	%
Diameter	18.00	in
Discharge	0.75	ft ³ /s

Results

Normal Depth	0.27	ft
Flow Area	0.22	ft ²
Wetted Perimeter	1.32	ft
Hydraulic Radius	0.17	ft
Top Width	1.15	ft
Critical Depth	0.32	ft
Percent Full	18.1	%
Critical Slope	0.00501	ft/ft
Velocity	3.44	ft/s
Velocity Head	0.18	ft
Specific Energy	0.46	ft
Froude Number	1.40	
Maximum Discharge	11.30	ft ³ /s
Discharge Full	10.50	ft ³ /s
Slope Full	0.00005	ft/ft
Flow Type	SuperCritical	

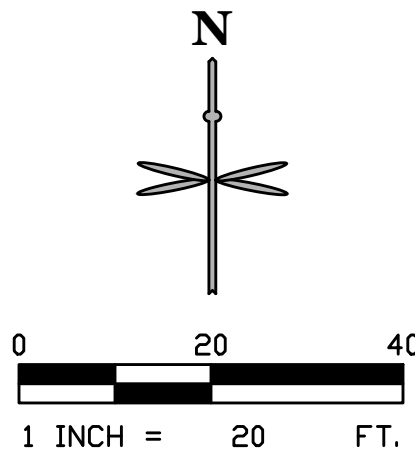
GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	18.09	%
Downstream Velocity	Infinity	ft/s

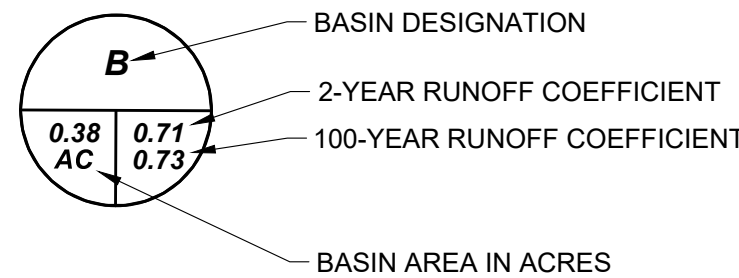
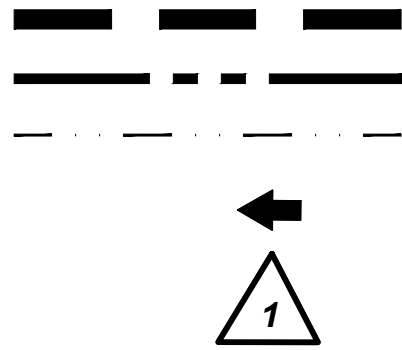
Appendix D – Drainage Plans



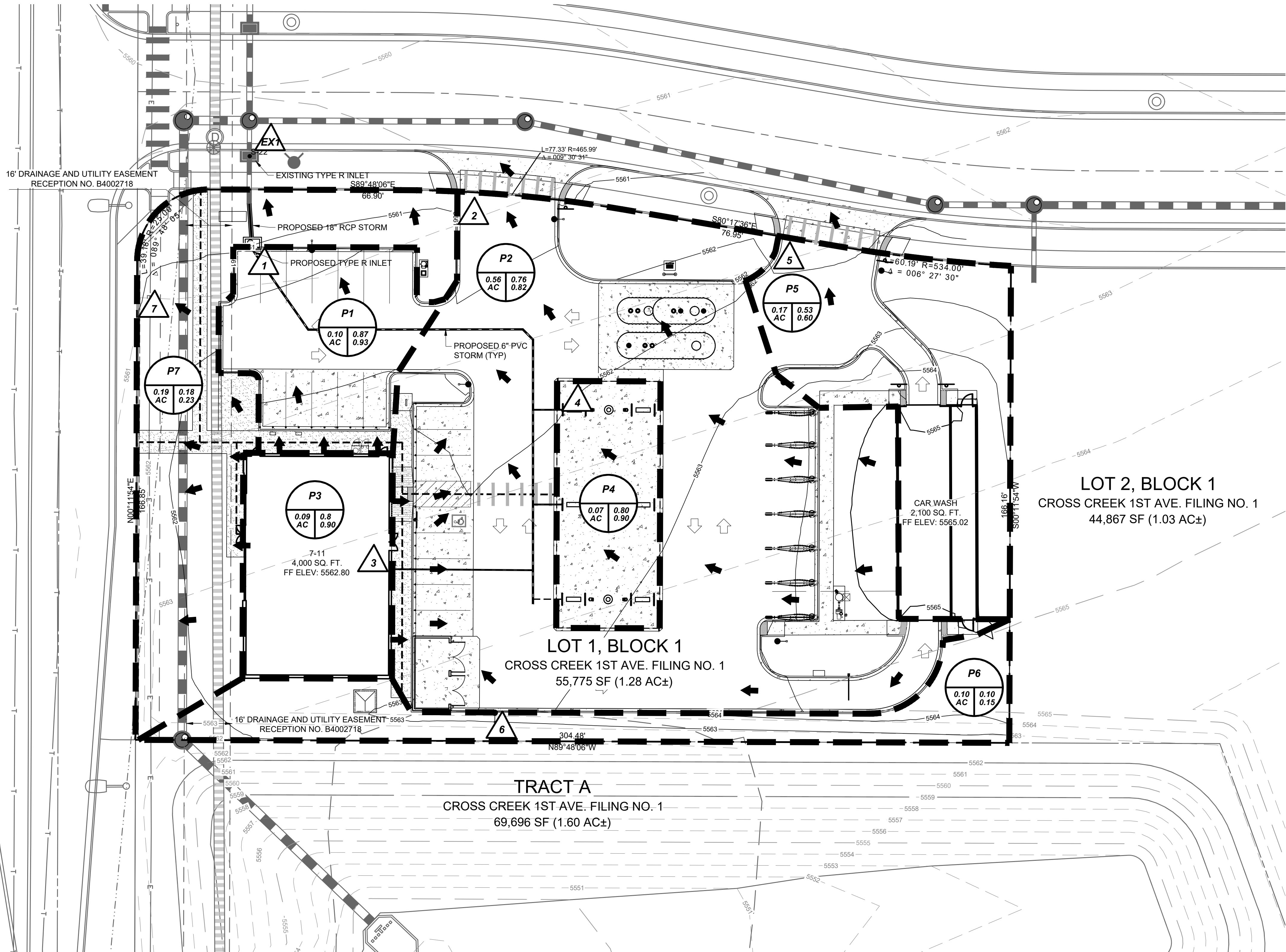
GENERAL NOTES

1. ALL STORM INFRASTRUCTURE IS PRIVATE AND SHALL BE MAINTAINED BY OWNER.
2. ALL EXISTING UTILITIES AND SITE FEATURES TO REMAIN UNLESS NOTED OTHERWISE.
3. ALL ELEVATIONS ARE FLOWLINE TO FLOWLINE UNLESS OTHERWISE NOTED.

LEGEND



Basin ID	Total Area (ac)	C2	C100	i	2-YEAR FLOW (CFS)	100-YEAR FLOW (CFS)
P1	0.10	0.87	0.93	100.00	0.29	0.84
P2	0.56	0.76	0.82	86.00	1.41	4.15
P3	0.09	0.80	0.90	96.00	0.24	0.73
P4	0.07	0.80	0.90	96.00	0.19	0.57
P5	0.17	0.53	0.60	58.47	0.30	0.92
P6	0.10	0.10	0.15	2.00	0.03	0.14
P7	0.19	0.18	0.23	12.32	0.11	0.40
On-site Composite	1.28	0.61	0.67	67.19	2.58	7.75



APPROVED FOR ONE YEAR FROM THIS DATE

CITY ENGINEER

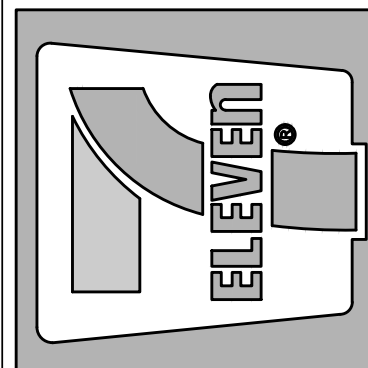
DATE

WATER DEPARTMENT

DATE

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501 S Cherry St, Suite 300
Denver, CO 80246
303-572-7997 www.ees.us.com



7-ELEVEN AT CROSS CREEK
LOT 1, BLOCK 1, CROSS CREEK 1ST AVENUE SUBDIVISION, AURORA, COLORADO
PROPOSED DRAINAGE PLAN

PROJECT NO.: 7EL052.01
DESIGNED BY: MRD
DRAWN BY: MRD
DATE: 02/12/2021

D1.0
SHEET 1 OF 1