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PRELIMINARY DRAINAGE REPORT
PROTEOS SUBDIVISION FILING NO. 4
RYDER TRUCK

Aurora, CO

01/27/2020

JN: DCS19-0085

Prepared by:
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Approved For One Year From This Date	
City Engineer	Date
Water Department	Date

Christopher S. Strawn, PE No. 36328

CERTIFICATION

I hereby certify that this Final Drainage Report for Ryder Truck was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Aurora Storm Drainage Criteria Manual for the owners thereof.

Christopher S. Strawn, PE
State of Colorado Registration No. 36328
Ware Malcomb

Date

Owner's Signature

Date

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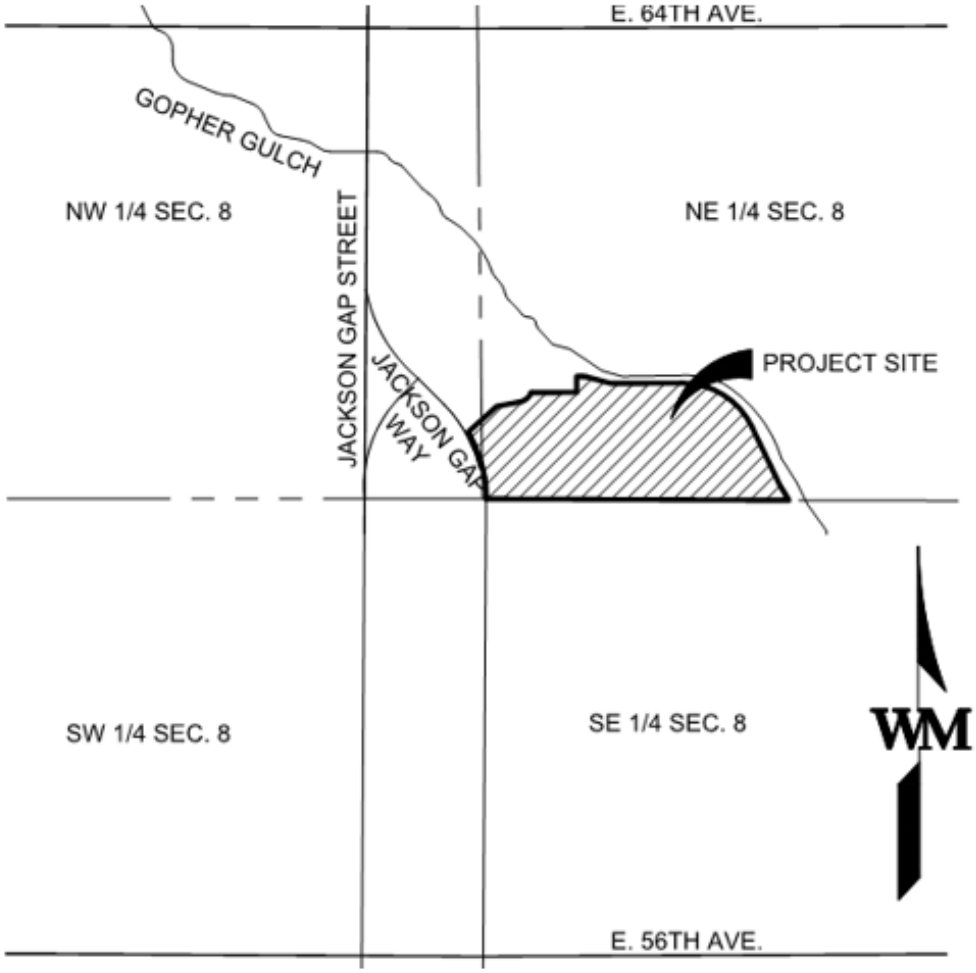
APPENDICES

I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

The legal description of the site is a Parcel of land located in the Northeast Quarter of Section 8, Township 3 South, Range 65 West of the 6th Principal Meridian, City of Aurora, County of Adams, State of Colorado. The site is bounded by Gopher Gulch on the North and East, Jackson Gap Way to the West, and the South Line of the NE Quarter Section 8 to the South. Please refer to the vicinity map below.



VICINITY MAP
SCALE: 1" = 2,000 FT

B. Proposed Development

The proposed 22.78-acre site is located on a vacant area covered with native grasses that has been historically used for agricultural purposes. The proposed development calls for the construction of a truck storage and rental facility, with 2 buildings (23,761 and 1,308 square feet), fuel tank and fuel station canopy, 28 standard vehicle parking spaces, 381 truck parking spaces, concrete pavement, landscape parking islands, and a storm water quality pond on the north side of the site. Storm water detention is not required on site, as a regional detention pond is provided adjacent to the site. A description of stormwater detention can be found in section IV of this report.

II. HISTORIC DRAINAGE

A. Overall Basin Description

The existing condition for the proposed development site consists of native grasses and generally flows from southeast to northwest. The FEMA Map 08001C0670J (FIRMette shown in Appendix A) shows the site is within Zone X, outside of the floodplain limits. The site drains north and west to Gopher Gulch and Regional Detention Pond GG2, and ultimately to East Second Creek. East Second Creek is listed as zone AE and the floodway is located approximately 3,000 feet (0.6 miles) west of the site (see site location relative to Second Creek in Appendix A).

The soils on this site area described by the National Soil Survey as 100% Weld Loam soil with 1% to 3% slopes within the site. The soils area classified as type C hydrological soil group. Group C soils are described as having a slow infiltration rate. National Soil Survey report for the site is included in Appendix A. The weighted overall imperviousness for the site was calculated using the Aurora SF2-SF3 form and is 5% and 76% for the existing and developed condition, respectively. No variances from the drainage criteria are being requested.

B. Drainage Patterns Through Property

The existing 22.78-acre site naturally divides into 3 sub basins. Drainage Area 1 is 6.76 acres in the southwest portion, and flows west to Jackson Gap Way, where it continues north via the east curb and gutter to an outlet to Pond GG. Drainage Area 2 is the largest area, 15.18 acres in the north and northeast portion, and flows north to Gopher Gulch and pond GG. Drainage Area 3 is the smallest area, 0.84 acres on the southeast corner of the property, and flows south onto the property south of the site and contributes to an inlet on the property owned by Fine Airport Parking. The proposed development will reduce the runoff leaving the site for each of these 3 areas. Drainage Maps for the existing and proposed conditions can be found in appendix D of this report. Drainages areas for the existing condition are numbered, 1, 2, & 3. Drainage areas for the proposed condition are lettered, A, B, C, etc…

Most of the runoff for the proposed development is flows to an on-site water quality pond via overland flow, curb and gutter, inlets and reinforced concrete pipe ranging from 18” to 30” in diameter. Further description of the proposed drainage is found in section IV of this report, and a final drainage map in Appendix D.

C. Outfalls Downstream from the Property

Once the runoff from the site has entered the water quality pond it will be released to Regional Detention Pond GG2, and ultimately flows to Second Creek. Regional Detention Pond GG1, GG2 and Second Creek are shown on the Master Drainage Report and Interim Drainage Plan by CVL Consultants, Aurora Case # 217173, in Appendix C.

III. DESIGN CRITERIA

A. References

This report for the proposed Ryder Truck within the Porteos Subdivision has been prepared in accordance with current City of Aurora Storm Drainage Design and Technical Criteria (SDDTC) and Urban Drainage and Flood Control District Urban Storm Design Criteria Manual (UDFCD-USDCM) Volumes 1, 2, and 3.

B. Hydrology

In accordance with the Aurora SDDTC section 3.31, the minor storm for the proposed development type is evaluated as the 2-year storm, and the major storm is evaluated as the 100-year storm. The Aurora SDDTC section 5.22 refers to the USDCM Volume 1 Figure RA-1 and Figure RA-6 to determine the 1-hour rainfall. The design storms have been evaluated with 1-hour point rainfall depths of 0.97 inches for a 2-year storm and 2.63 inches for a 100-year storm, in accordance with USDCM Volume 1 Figure RA-1 and Figure RA-6.

The peak discharge for the site was calculated using equation 5.1 from the Aurora SDDTC, the Rational Method formula: Q=CIA, where,

Q = peak discharge (cfs)
C = runoff coefficient from Table 1 from the City of Aurora SDDTC
I = rainfall intensity (inches/hour)
A = drainage area (acres)

See Appendix B for Rational Method Flow Calculations.

Runoff coefficients, or "C" values, have been calculated for the site in accordance with Table 1 of the City of Aurora SDDTC shown in Appendix C. Refer to Appendix B for the weighted "C" values used in the SF2-SF3 runoff calculations.

C. Hydraulics

Hydraulic calculations for the proposed onsite drainage patterns have been performed in accordance with SDDTC and USDCM criteria. The onsite private storm sewer system has been designed to convey runoff from 100-year event (100 year system) without surcharging. In the event of inlet clogging, overflow directions have been shown on the final drainage plan and will generally follow historical drainage patterns. AutoCAD Hydraflow was utilized to analyze the 2-year and 100-year storm events and determine the sizing of the pipes within the proposed storm sewer system.

IV. DRAINAGE PLAN

A. General Concept

Most of the Ryder Truck facility consists of asphalt paved parking area, sloping north and west between 1 and 5%. The site is divided into eleven onsite basins, plus two small offsite basins flowing onto the site. Basins A, B, C, D, E, F, G and H are onsite basins routed through the water quality pond. Basins H, I, and J are onsite basins whose runoff flows. Basins OS1 and OS2 are offsite basins on the Fine Airport Parking property that flow onto the Ryder site. All basins on the site and those draining to the site have been designated with a Basin ID. Reference the drainage map in Appendix D for the basin locations. Refer to Appendix B for hydrologic calculations for each of these basins, for sizing of the inlets, and for verifying the size and location of the pond and outlet structure. A description of the pond and outlet structure is found at the end of this section B.

B. Specific Details

A summary of peak runoff for both the developed and existing conditions are shown in the table below, followed by a description of each drainage area and design point:

DEVELOPED CONDITION RUNOFF SUMMARY

BASIN LABEL	DESIGN POINT	AREA (AC)	LOCAL (CFS)		ACCUMULATIVE (CFS)	
			Q_2	Q_{100}	Q_2	Q_{100}
A		5.14	11.6	31.4		
B		3.87	8.7	23.7		
	1				20.1	54.4
C+OS1		0.61	1.5	4.1		
D+OS2		2.42	2.8	7.7		
	2				3.9	10.5
E		0.94	2.1	5.8		
F		0.89	1.2	3.3		
	3				3.0	8.1
G		5.79	11.8	31.9		
	4				14.6	39.5
	5				17.6	47.6
H		0.94	0.5	1.4		
	6				45.9	124.5
I		1.62	0.6	1.7		
J		0.78	0.8	2.4		
K		0.27	0.1	0.4		

EXISTING CONDITION - RUNOFF SUMMARY

BASIN LABEL	DESIGN POINT	AREA (AC)	LOCAL (CFS)		ACCUMULATIVE (CFS)	
			Q_2	Q_{100}	Q_2	Q_{100}
1		6.76	1.9	5.3		
2		15.18	4.4	14.4		
3		0.84	0.2	0.6		

Drainage Area A: Drainage Area A is 5.14 acres on the east side of the site, primarily pavement and slopes northwest between 1% and 2.5%, to a 20' Type R inlet. The 100-year runoff to this inlet is 31.4 cfs. Runoff is conveyed through a 24" RCP to Design Point 1.

Drainage Area B: Drainage Area B is 3.87 acres adjacent to Area A, primarily pavement and slopes northwest between 1% and 2.5%, to a 15' Type R inlet. The 100-year runoff to this inlet is 23.7 cfs. Runoff is conveyed through a 24" RCP to Design Point 1.

Design Point 1: Design Point 1, a 4' manhole, is where runoff from Drainage Areas A & B converge. The cumulative 100-year runoff at DP1 is 54.4 cfs. This runoff is then conveyed through a 30" RCP to the Water Quality Pond.

Drainage Area C: Drainage Area C is 0.58 acres of driveway and a portion of the roof of Building 1, and receives flow from offsite area OS1, which consists of 0.03 acres of grass. Drainage Area C flows to a Double Type 16 inlet, south of building 1. The total area of C + OS1 is 0.61 acres. The 100-year runoff to this inlet is 4.1 cfs. Runoff is conveyed from double Type 16 inlet, through an 18" RCP to Design Point 2, a Triple Type 16 inlet.

Drainage Area OS1: Drainage Area OS1 is 0.03 acres of grass on the Fine Airport Parking Property, where runoff contributes to Drainage Area C.

Drainage Area D: Drainage Area D is 1.96 acres of driveway, landscaping, and a portion of the roof of Building 1, and receives flow from offsite area OS2, which consists of 0.45 acres of grass. Drainage Area D flows to Design Point 2, a Triple Type 16 inlet, south of building 1. The 100-year runoff to this inlet is 7.7 cfs.

Drainage Area OS1: Drainage Area OS1 is 0.45 acres of grass on the Fine Airport Parking Property, where runoff contributes to Drainage Area D.

Design Point 2: The cumulative 100-year runoff at Design Point 2 (Areas C, D, OS1 and OS2), a Triple Type 16 inlet, south of building 1, is 10.5 cfs, which is conveyed through an 18" RCP to Design Point 5, a 5' manhole.

Drainage area E: Drainage area E is 0.94 acres and consists of most of the parking lot on the west side of Building 1. Runoff collects in a concrete pan and flows north to a Double Type 16 inlet. The 100-year runoff to this inlet is 5.8 cfs and is conveyed north through a series of 18" RCP to Design Point 3, a 5' Type R inlet near the northwest corner of the site.

Drainage area F: Drainage area F is 0.89 acres consists of parking and drive lanes north and northwest of Building 1, and a portion of the roof of Building 1. The 100-year runoff to this inlet is 3.3 cfs, and generally sheet flows north to Design Point 3, a 5' Type R inlet near the northwest corner of the site.

Design Point 3: The cumulative 100-year runoff at Design Point 3 (Areas E and F), a 5' Type R inlet, is 8.1 cfs. This point is located near the northwest corner of the site, and runoff is conveyed east through a 24" RCP to Design Point 4, a 5' manhole.

Drainage area G: Drainage area G is 5.79 acres and consists of most of the parking and driveways to the north and east of Building 1, and a portion of the roof of Building 1. Building 2 and the Fuel Canopy are also located within Drainage Area G. Runoff sheet flows northwest at slopes between 1.5% and 5.0%, collects along the north curb and gutter, and ultimately to a 20' Type R inlet. The 100-year runoff to this inlet is 31.9 cfs and is conveyed through a short 24" RCP to Design Point 4, a 5' manhole.

Design Point 4: The cumulative 100-year runoff at Design Point 4 (Areas C, D, OS1, OS2, E, F, and G), is 47.6 cfs. Runoff from Design Point 5, a 5' manhole, is conveyed through a 30" RCP to Design Point 5, another 5' manhole.

Design Point 5: The cumulative 100-year runoff at Design Point 5 (Areas C, D, OS1, OS2, E, and F), is 39.5 cfs. Runoff from Design Point 4, a 5' manhole, is conveyed through a 30" RCP to the Water Quality Pond.

Drainage area H: Drainage area H is 0.94 acres and consists of the water quality pond. Area H produces 1.4 cfs for the 100-year event. Runoff from all other contributing areas (A, B, C, D, OS1, OS2, E, F and G) converge through a 30" RCP from the south, and another 30" RCP from the east, into a 1,200-c.f. concrete forebay with baffles and 1' high concrete walls. Runoff leaves the forebay through a gap and enters a 3' wide concrete trickle channel and flows west to Design Point 6 (the 4'x4 micropool in front of the pond outlet structure).

Design Point 6: Design Point 6 is where the runoff produced from Drainage Area G converge with all other runoff contributing areas (A, B, C, D, OS1, OS2, E, F, G, and H). The cumulative 100-year runoff at Design Point 6 is 124.5 cfs.

Water Quality Pond: The requirements for this site are to detain the Water Quality Capture Volume (WQCV) only. Aurora requires an additional 20% for WQCV detention & sedimentation, per Aurora SD manual, section 3.70. The volume required for the pond was calculated using MHFD-Detention v4.0. The WQCV was calculated as 0.694 ac-ft, and an additional 1.39 ac-ft (+20%) for a total of 0.833 ac-ft (36,285 cubic feet). The MHFD Detention calculator shows zone 2 (WQCV plus 20%) is contained at a depth of 5.66 feet above the bottom elevation of 5403. The 1.2*WQCV water surface elevation is at 5403+5.66 = 5408.66. As a check, the volume provided in the pond at elevation 5409 is 0.954 ac-ft (41,546 cubic feet). Additionally, there is an emergency spillway at elevation 5410, and a berm at elevation 5411. The 100-year detention requirements are met by the adjacent off-site pond, GG1, described in the Master Drainage Report, Appendix C. All runoff that enters the outlet structure leaves north via a 36" RCP and enters the south end of Regional Detention Pond GG. The emergency spillway weir was designed with a base 40 feet wide at elevation 5410,

4:1 side slopes to the elevation 5411, and functions at a flow depth of 0.82 feet for the 100-year flow rate 125 cfs, calculated by the MHFD spreadsheet.

Drainage Area I: Drainage area I is 0.78 acres and consists of the north entrance driveway and landscaped area on the west side of the property. The 100-year developed runoff from Area I is 1.7 cfs and flows into the east gutter of Jackson Gap Road and north to off-site regional detention pond GG2. The existing condition Drainage Area 1 is 6.76 acres and produces a 100-year runoff of 5.3 cfs. Compared to the existing condition, the proposed development will produce less runoff entering the street.

Drainage Area J: Drainage Area J is 1.62 acres and consists of the landscaped areas along the north and east side of the property. This area consists entirely of grass/landscape and runoff flows directly to gopher gulch and off-site regional detention pond GG2. The 100-year developed runoff from Area J is 2.4 cfs. In the existing condition, Drainage Area 2 is 15.18 acres and 100-year runoff of 14.4 cfs. Compared to the existing condition, the proposed development will produce less runoff entering Gopher Gulch and Pond GG directly.

Drainage area K: Drainage area K is 0.27 acres and consists of the landscaped areas along the southeast side of the property. This area consists entirely of grass/landscape and runoff sheet flows south to an existing storm inlet located on the Fine Airport Parking property. The 100-year developed runoff from Area K is 0.4 cfs. In the existing condition, Drainage Area 3 is 0.84 acres and 100-year runoff of 0.6 cfs. Compared to the existing condition, the proposed development will produce less runoff to the existing inlet on the Fine Airport Parking property, through existing storm drains that flow west toward Jackson Gap, then north to an outlet to off-site regional detention pond GG2. Overall, the Ryder site and Fine Airport Parking are exchanging small sections of runoff. Ryder is taking on 0.48 acres of runoff and Fine Airport Parking is taking on 0.27 acres of runoff from each property.

V. CONCLUSION

A. Compliance with Standards

This report has been prepared in accordance with current City of Aurora Storm Drainage Design and Technical Criteria and Urban Drainage and Flood Control District Urban Storm Design Criteria Manual Volumes 1, 2, and 3. Calculations were made using Standard Form SF2, & SF3, and the MHFD Detention Calculator, version 4.0.

B. Summary of Concept

Adequate on-site drainage will be achieved via the use of concrete swales, curb and gutter, and overland flow to the proposed storm sewer system or directly into the pond. The pond will provide water quality before allowing the runoff into Regional Detention Pond GG2.

VI. REFERENCES

1. *Urban Storm Drainage Criteria Manual, volumes 1, 2, and 3*, Urban Drainage and Flood Control District, June 2001, with updates to November 2010.

2. *Natural Resources Conservation Center Web Soil Survey*, United States Department of Agriculture, site visited June 2018.

3. *Federal Emergency Management Agency Flood Insurance Rate Map*, Community-Panel Number 08001C0670J, Map Revised September 28, 2018.

4. *City of Aurora Storm Drainage Design and Technical Criteria,* City of Aurora, CO, accessed on www.AuroraGov.org on 5 June 2015.

5. *Porteos Master Drainage Report (COA EDIN 212052) Amendment No. 2 (COA EDN 217137MD1), and Interim Drainage Plan by CVL Consultants, Aurora Case #217137*

APPENDIX A
Vicinity Map
FEMA Map
Web Soil Survey

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PROJECT: RYDER TRUCK
JOB NO.: DCS19-4085
CALC. BY: Chris Johnson
DATE: 2/4/2020

Impervious Percentages - from City of Aurora Storm Drainage Design and Technical Criteria

		C-Values Based on Frequency (yrs)			
	% Imp	2	5	10	100
ASPHALT	100%	0.87	0.88	0.90	0.93
CONCRETE	96%	0.87	0.87	0.88	0.89
ROOF	90%	0.80	0.85	0.90	0.90
LANDSCAPE (2%)	5%	0.13	0.14	0.15	0.17

Corresponds to type C or D so

PROPOSED AND EXISTING COMPOSITE IMPERVIOUSNESS

		Areas (ac)				Weighted Impervious and C Values				
Basin	**Area (ac)**	**ASPHALT**	**CONCRETE**	**ROOF**	**LANDSCAPE (2%)**	**Imp.**	**C_2**	**C_5**	**C_{10}**	**C_{100}**
A	5.142		4.945	0.000	0.197	96%	0.84	0.84	0.85	0.86
B	3.873		3.836	0.000	0.037	95%	0.86	0.86	0.87	0.88
C	0.576		0.336	0.186	0.054	86%	0.78	0.80	0.82	0.83
D	1.964		1.255	0.052	0.657	65%	0.62	0.63	0.64	0.65
E	0.940		0.840	0.000	0.100	86%	0.79	0.79	0.80	0.81
F	0.888		0.392	0.128	0.368	57%	0.55	0.56	0.58	0.59
G	5.785		5.303	0.189	0.293	91%	0.83	0.83	0.84	0.85
H	0.943		0.054	0.000	0.889	10%	0.17	0.18	0.19	0.21
I	1.618		0.000	0.000	1.618	5%	0.13	0.14	0.15	0.17
J	0.779		0.188	0.000	0.591	27%	0.31	0.32	0.33	0.34
K	0.273		0.000	0.000	0.273	5%	0.13	0.14	0.15	0.17
TOTAL A-K	**22.78**					0%	0.00	0.00	0.00	0.00
OS1	0.034		0.000	0.000	0.034	5%	0.13	0.14	0.15	0.17
OS2	0.453		0.000	0.000	0.453	5%	0.13	0.14	0.15	0.17
TOTAL OS	**0.49**					0%	0.00	0.00	0.00	0.00
C+OS1	0.610		0.336	0.186	0.088	81%	0.74	0.76	0.78	0.79
D+OS2	2.417		1.255	0.052	1.110	54%	0.53	0.53	0.55	0.56
Proposed Total	22.78		17.149	0.555	5.077	76%	0.70	0.71	0.72	0.73
1	6.760		0.000	0.000	6.760	5%	0.13	0.14	0.15	0.17
2	15.180		0.000	0.000	15.180	5%	0.13	0.14	0.15	0.17
3	0.840		0.000	0.000	0.840	5%	0.13	0.14	0.15	0.17
Existing Total	22.78		0.000	0.000	22.78	5%	0.13	0.14	0.15	0.17

Calculated By: Chris Johnson
Date: 2/4/2020
Checked By:

STANDARD FORM SF-2
TIME OF CONCENTRATION SUMMARY

Project: RYDER TRUCK
Job No.: DCS19-4085

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)					t_c CHECK (URBANIZED BASINS)			FINAL t_c	REMARKS
DESIG: (1)	C_5 (2)	AREA Ac (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	Cv	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	COMP. t_c (11)	TOT. LENGTH Ft (12)	tc=(L/180)+10 Min (13)	Min (14)	
A	0.84	5.14	300	2.3	6.1	540	20	1.7	2.6	3.5	9.5	840	14.7	9.5	
B	0.86	3.87	300	1.4	6.6	620	20	2.2	3.0	3.5	10.1	920	15.1	10.1	
C+OS1	0.76	0.61	90	2.5	4.3							90	10.5	5.0	Area includes .13 AC from OS1
D+OS2	0.53	2.42	300	2.4	13.2	590	20	2.8	3.3	2.9	16.1	890	14.9	14.9	Area includes .45 AC from OS2
E	0.79	0.94	300	2.6	7.0	140	20	2.0	2.8	0.8	7.8	440	12.4	7.8	
F	0.56	0.89	300	2.6	12.1	140	20	2.0	2.8	0.8	13.0	440	12.4	12.4	
G	0.83	5.79	300	1.2	7.9	700	20	2.1	2.9	4.0	11.9	1,000	15.6	11.9	
H	0.18	0.94	200	33.0	7.3							200	11.1	7.3	Area G is the Pond
I	0.14	1.62	60	4.0	8.4							60	10.3	8.4	Proposed condition, flows offsite
J	0.32	0.78	50	20.0	3.7							50	10.3	5.0	Proposed condition, flows offsite
K	0.14	0.27	30	25.0	3.2							30	10.2	5.0	Proposed condition, flows offsite
1	0.14	6.76	300	1.8	24.6	1,000	10	1.8	1.3	12.4	37.0	1,300	17.2	17.2	Existing condition, flows offsite
2	0.14	15.18	300	2.0	23.8	1,000	10	2.0	1.4	11.8	35.5	1,300	17.2	17.2	Existing condition, flows offsite
3	0.14	0.84	300	1.0	29.9							300	11.7	29.9	Existing condition, flows offsite
			300max												

Calculated By: Chris Johnso
Date: 2/4/2020
Checked By:
2-yr, 1-hour rainfall= 0.97

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Project: RYDER TRUCK
Job No.: DCS19-4085
Design Storm: 2-YR

BASIN	DIRECT RUNOFF								TOTAL RUNOFF				STREET		PIPE						REMARKS
	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I (IN/HR)	Q (CFS)	t_c (MIN)	S (C * A) (CA)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW	DESIGN FLOW (CFS)	SLOPE (%)	PIPE DIAM. (IN.)	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
A			5.14	0.84	9.5	4.33	2.67	**11.6**	9.5	4.3	2.67	**11.6**			11.6	2.1%	30	360	12.1	0.5	
B			3.87	0.86	10.1	3.34	2.62	**8.7**	10.1	3.3	2.62	**8.7**			8.7	2.1%	24	20	10.4	0.0	
	1								10.1	7.7	2.62	**20.1**			20.1	2.1%	30	180	12.1	0.2	DP1 = Areas A, B
C+OS1			0.61	0.76	5.0	0.46	3.29	**1.5**	5.0	0.5	3.29	**1.5**			1.5	1.2%	18	160	6.5	0.4	
D+OS2			2.42	0.53	14.9	1.29	2.21	**2.8**	14.9	1.3	2.21	**2.8**			2.8						
	2								14.9	1.8	2.21	**3.9**			3.9	1.2%	18	370	6.5	0.9	DP2 = Areas (C+OS1) and (D+OS2)
E			0.94	0.79	7.8	0.74	2.88	**2.1**	7.8	0.7	2.88	**2.1**			2.1	1.2%	24	240	7.9	0.5	
F			0.89	0.56	12.4	0.50	2.40	**1.2**	12.4	0.5	2.40	**1.2**			1.2	1.2%	24	240	7.9	0.5	
	3								12.4	1.2	2.40	**3.0**			3.0						
G			5.79	0.83	11.9	4.82	2.45	**11.8**	11.9	4.8	2.45	**11.8**			11.8	1.2%	24	10	7.9	0.0	
	4								12.4	6.1	2.40	**14.6**			14.6	1.2%	24	40	7.9	0.1	DP3 = Areas E & F
	5								12.4	7.3	2.40	**17.6**			17.6	1.2%	24	130	7.9	0.3	DP4 = Areas E & F, plus (C+OS1) and (D+OS2)
H			0.94	0.18	7.3	0.17	2.94	**0.5**	7.3	0.2	2.94	**0.5**			0.5						Pond area
	6								7.4	15.7	2.93	**45.9**			45.9	2.9%	48	70	19.5	0.1	pond Outlet, All areas contribute
I			1.62	0.14	8.4	0.23	2.80	**0.6**	8.4	0.2	2.80	**0.6**									proposed - offsite to Jackson Gap Way
J			0.78	0.32	5.0	0.25	3.29	**0.8**	5.0	0.2	3.29	**0.8**									proposed - offsite to Gopher Gulch and Pond GG2
K			0.27	0.14	5.0	0.04	3.29	**0.1**	5.0	0.0	3.29	**0.1**									proposed - offsite to Fine Airport Parking property
1			6.76	0.14	17.2	0.95	2.06	**1.9**	17.2	0.9	2.06	**1.9**									existing - offsite to Jackson Gap Way
2			15.18	0.14	17.2	2.13	2.06	**4.4**	17.2	2.1	2.06	**4.4**									existing - offsite to Gopher Gulch and Pond GG2
3			0.84	0.14	29.9	0.12	1.52	**0.2**	29.9	0.1	1.52	**0.2**									existing - offsite to Fine Airport Parking property

Calculated By: Chris Johnso
Date: 2/4/2020
Checked By:
100-yr, 1-hour rainfall= 2.63

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Project: RYDER TRUCK
Job No.: DCS19-4085
Design Storm: 100-YR

BASIN	DIRECT RUNOFF								TOTAL RUNOFF				STREET		PIPE			LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	REMARKS
	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I (IN/HR)	Q (CFS)	t_c (MIN)	S (C * A) (CA)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW	DESIGN FLOW (CFS)	SLOPE (%)	PIPE DIAM. (IN.)				
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
A			5.14	0.84	9.5	4.33	7.25	**31.4**	9.5	4.3	7.25	**31.4**			31.4	2.1%	30	360	12.1	0.5	
B			3.87	0.86	10.1	3.34	7.09	**23.7**	10.1	3.3	7.09	**23.7**			23.7	2.1%	24	20	10.4	0.0	
	1								10.1	7.7	7.09	**54.4**			54.4	2.1%	30	180	12.1	0.2	DP1 = Areas A, B
C+OS1			0.61	0.76	5.0	0.46	8.92	**4.1**	5.0	0.5	8.92	**4.1**			4.1	1.2%	18	160	6.5	0.4	
D+OS2			2.42	0.53	14.9	1.29	5.98	**7.7**	14.9	1.3	5.98	**7.7**			7.7						
	2								14.9	1.8	5.98	**10.5**			10.5	1.2%	18	370	6.5	0.9	DP2 = Areas (C+OS1) and (D+OS2)
E			0.94	0.79	7.8	0.74	7.80	**5.8**	7.8	0.7	7.80	**5.8**			5.8	1.2%	24	240	7.9	0.5	
F			0.89	0.56	12.4	0.50	6.50	**3.3**	12.4	0.5	6.50	**3.3**			3.3	1.2%	24	240	7.9	0.5	
	3								12.4	1.2	6.50	**8.1**			8.1						
G			5.79	0.83	11.9	4.82	6.63	**31.9**	11.9	4.8	6.63	**31.9**			31.9	1.2%	24	10	7.9	0.0	
	4								12.4	6.1	6.51	**39.5**			39.5	1.2%	24	40	7.9	0.1	DP3 = Areas E & F
	5								12.4	7.3	6.51	**47.6**			47.6	1.2%	24	130	7.9	0.3	DP4 = Areas E & F, plus (C+OS1) and (D+OS2)
H			0.94	0.18	7.3	0.17	7.98	**1.4**	7.3	0.2	7.98	**1.4**			1.4						Pond area
	6								7.4	15.7	7.95	**124.5**			124.5	2.9%	48	70	19.5	0.1	pond Outlet, All areas contribute
I			1.62	0.14	8.4	0.23	7.59	**1.7**	8.4	0.2	7.59	**1.7**									proposed - offsite to Jackson Gap Way
J			0.78	0.34	5.0	0.27	8.92	**2.4**	5.0	0.3	8.92	**2.4**									proposed - offsite to Gopher Gulch and Pond GG2
K			0.27	0.17	5.0	0.05	8.92	**0.4**	5.0	0.0	8.92	**0.4**									proposed - offsite to Fine Airport Parking property
1			6.76	0.14	17.2	0.95	5.58	**5.3**	17.2	0.9	5.58	**5.3**									existing - offsite to Jackson Gap Way
2			15.18	0.17	17.2	2.58	5.58	**14.4**	17.2	2.6	5.58	**14.4**									existing - offsite to Gopher Gulch and Pond GG2
3			0.84	0.17	29.9	0.14	4.13	**0.6**	29.9	0.1	4.13	**0.6**									existing - offsite to Fine Airport Parking property

APPENDIX B
Hydrologic Computations
Hydraulic Computations

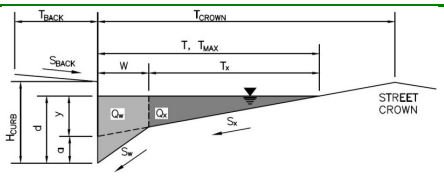
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: A



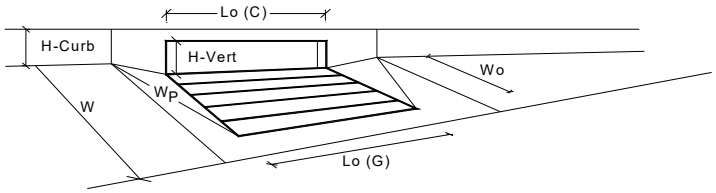
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	100.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	50.0	50.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	9.0	9.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	20.00	20.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
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} =	0.58	0.58	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.85	0.85	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**34.3**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	11.6	31.4	cfs

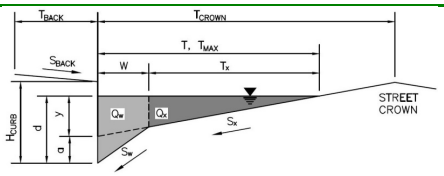
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: B



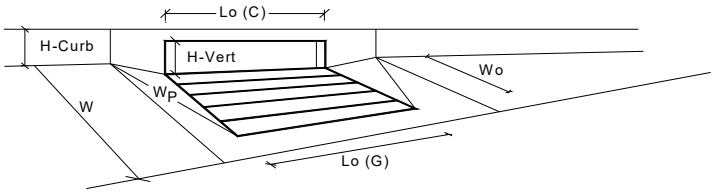
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	100.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	50.0	50.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	9.0	9.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
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} =	0.58	0.58	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.85	0.85	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**25.4**	**25.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	8.7	23.7	cfs

Warning 5: The width of unit is greater than the gutter width.

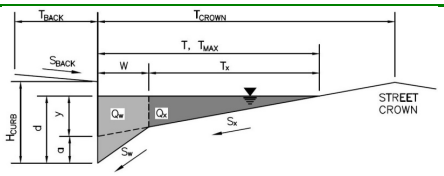
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: C



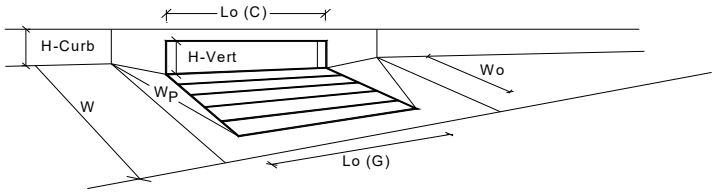
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	50.0	50.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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 =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	9.0	9.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening 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} =	0.773	0.773	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	1.00	1.00	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.5**	**8.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.5	4.1	cfs

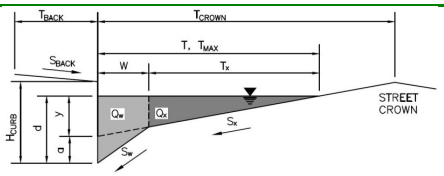
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: D



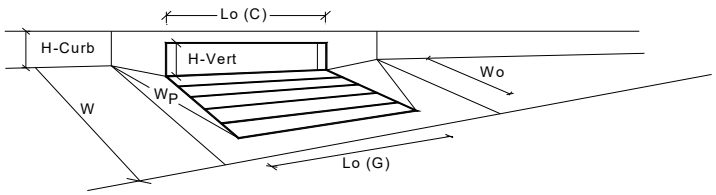
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	3.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	50.0	50.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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 =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	9.0	9.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening 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} =	0.773	0.773	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	1.00	1.00	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.5**	**8.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.8	7.7	cfs

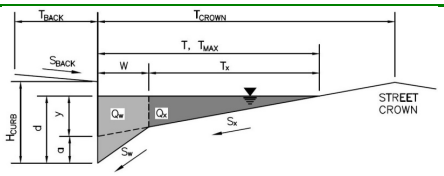
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: E



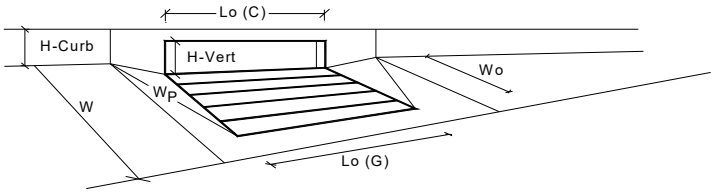
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.030	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	25.0	25.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet	Type =	CDOT Type C 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 =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	9.0	9.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	2.92	2.92	feet
Warning 5 Width of a Unit Grate	W_o =	2.92	2.92	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.70	0.70	
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) =	2.41	2.41	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.67	0.67	
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} =	0.674	0.674	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	1.00	1.00	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.2**	**8.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.1	5.8	cfs

Warning 5: The width of unit is greater than the gutter width.

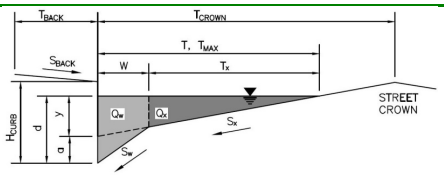
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: F



Gutter Geometry (Enter data in the blue cells)

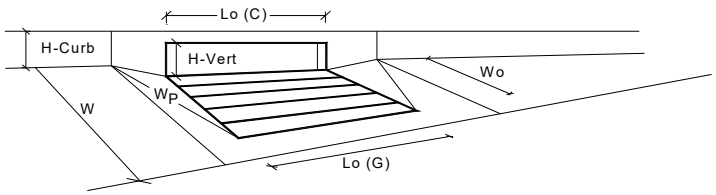
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.030	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	25.0	25.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	9.0	9.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	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 =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
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} =	0.58	0.58	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	1.00	1.00	
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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**10.7**	**10.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	3.3	cfs

Warning 5: The width of unit is greater than the gutter width.

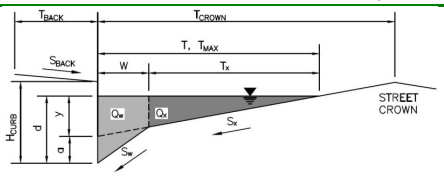
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: G



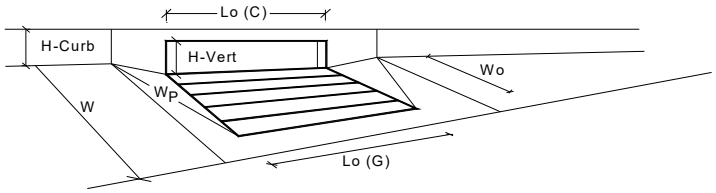
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	100.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	50.0	50.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	9.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



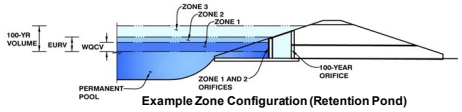
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	9.0	9.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	20.00	20.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
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} =	0.58	0.58	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.85	0.85	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**34.3**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	11.6	31.4	cfs

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)

Project: DCS19-4085 Ryder (Aurora)

Basin ID: Overall Basin *76% imperviousnessgives 0.694 ac-ft WQCV, added 20% (0.139) for user-defined zone 2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	27.30	acres
Watershed Length =	1,380	ft
Watershed Length to Centroid =	360	ft
Watershed Slope =	0.026	ft/ft
Watershed Imperviousness =	76.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Aurora - Municipal Center	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.694	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.030	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.87 in.) =	1.356	acre-feet	inches
5-yr Runoff Volume (P1 = 1.14 in.) =	1.915	acre-feet	inches
10-yr Runoff Volume (P1 = 1.39 in.) =	2.461	acre-feet	inches
25-yr Runoff Volume (P1 = 1.76 in.) =	3.342	acre-feet	inches
50-yr Runoff Volume (P1 = 2.08 in.) =	4.079	acre-feet	inches
100-yr Runoff Volume (P1 = 2.42 in.) =	4.899	acre-feet	inches
500-yr Runoff Volume (P1 = 3.3 in.) =	6.948	acre-feet	inches
Approximate 2-yr Detention Volume =	1.332	acre-feet	
Approximate 5-yr Detention Volume =	1.914	acre-feet	
Approximate 10-yr Detention Volume =	2.300	acre-feet	
Approximate 25-yr Detention Volume =	2.703	acre-feet	
Approximate 50-yr Detention Volume =	2.911	acre-feet	
Approximate 100-yr Detention Volume =	3.223	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.694	acre-feet
Zone 2 Volume (User Defined - Zone 1) =	0.139	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.833	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

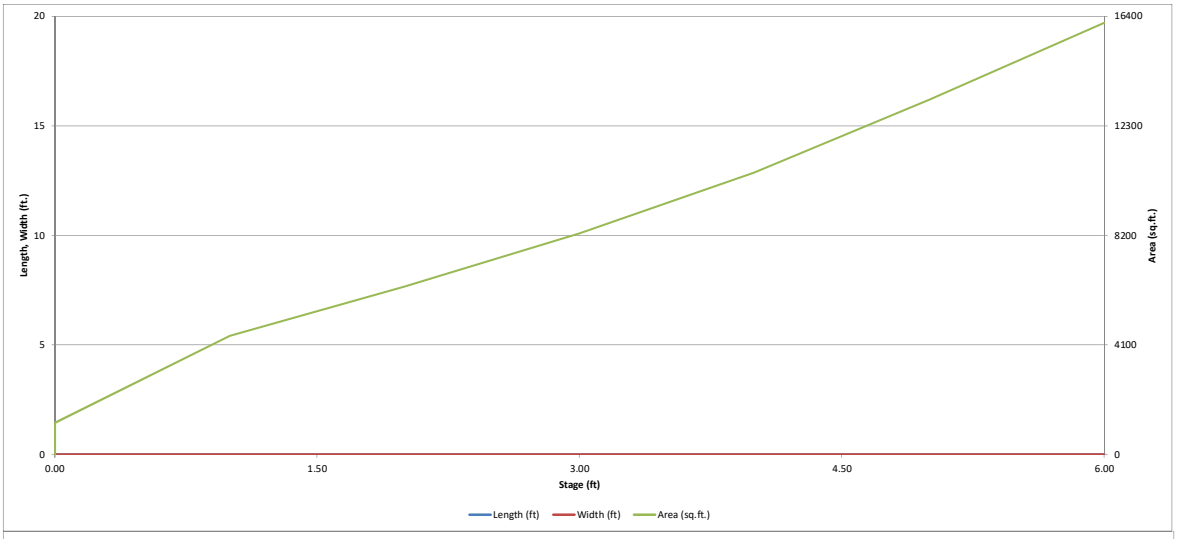
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

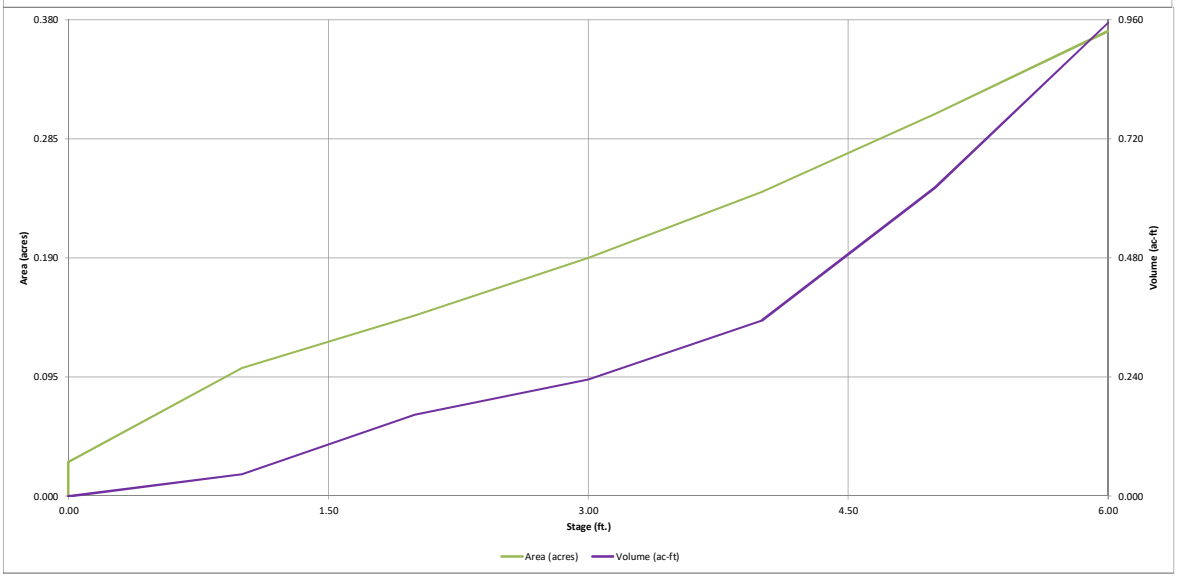
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
5403	--	0.00	--	--	--	1,190	0.027	0	0.000
5404	--	1.00	--	--	--	4,450	0.102	1,917	0.044
5405	--	2.00	--	--	--	6,280	0.144	7,137	0.164
5406	--	3.00	--	--	--	8,280	0.190	10,234	0.235
5407	--	4.00	--	--	--	10,560	0.242	15,436	0.354
5408	--	5.00	--	--	--	13,270	0.305	27,111	0.622
5409	--	6.00	--	--	--	16,160	0.371	41,546	**0.954**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)



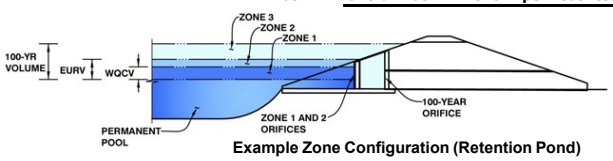


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)

Project: DCS19-4085 Ryder (Aurora)

Basin ID: Overall Basin *76% imperviousnessgives 0.694 ac-ft WQCV, added 20% (0.139) for user-defined zone 2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	5.24	0.694	Orifice Plate
Zone 2 (User)	5.66	0.139	Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.833	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.931E-02	ft²
Depth at top of Zone using Orifice Plate =	4.32	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.78	sq. inches (diameter = 1-7/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00	3.00	4.00			
Orifice Area (sq. inches)	2.78	2.78	2.78	2.78	2.78			

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft²
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

Calculated Parameters for Vertical Orifice

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

	Zone 2 Weir	Not Selected			Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.32		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.32		feet
Overflow Weir Front Edge Length =	15.67		feet	Overflow Weir Slope Length =	15.67		feet
Overflow Weir Grate Slope =	0.00		H:V	Grate Open Area / 100-yr Orifice Area =	10.81		
Horiz. Length of Weir Sides =	15.67		feet	Overflow Grate Open Area w/o Debris =	171.88		ft²
Overflow Grate Open Area % =	70%		%, grate open area/total area	Overflow Grate Open Area w/ Debris =	85.94		ft²
Debris Clogging % =	50%		%				

Calculated Parameters for Overflow Weir

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

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	15.90		ft²
Circular Orifice Diameter =	54.00		inches	Outlet Orifice Centroid =	2.25		feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.32	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.82 feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	7.14 feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.36 acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.95 acre-ft

Calculated Parameters for Spillway

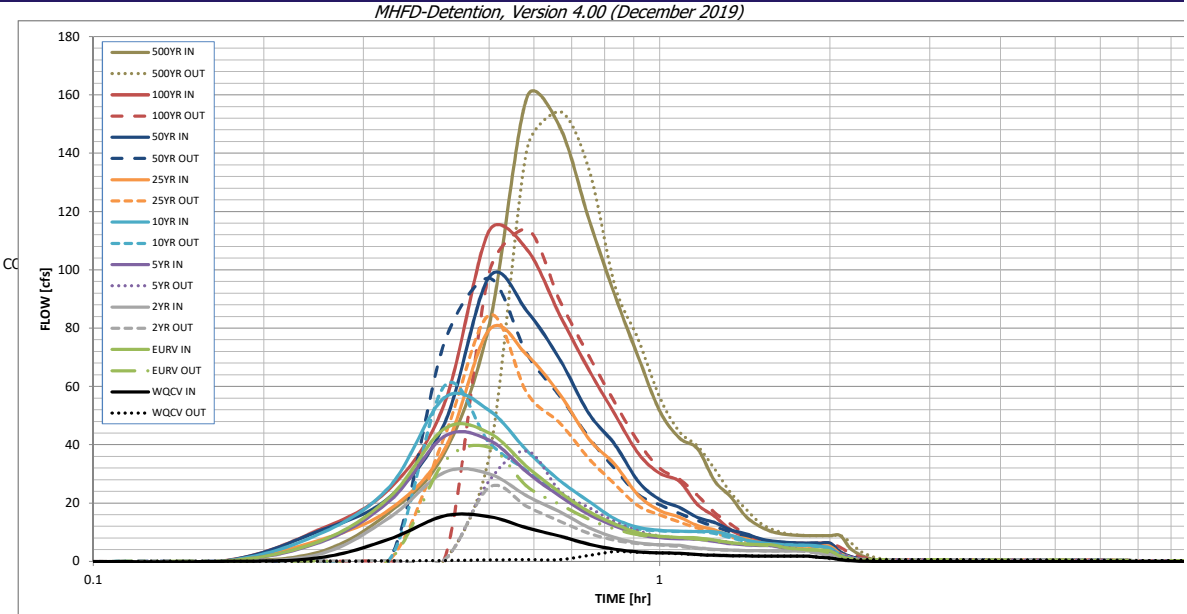
Routed Hydrograph Results

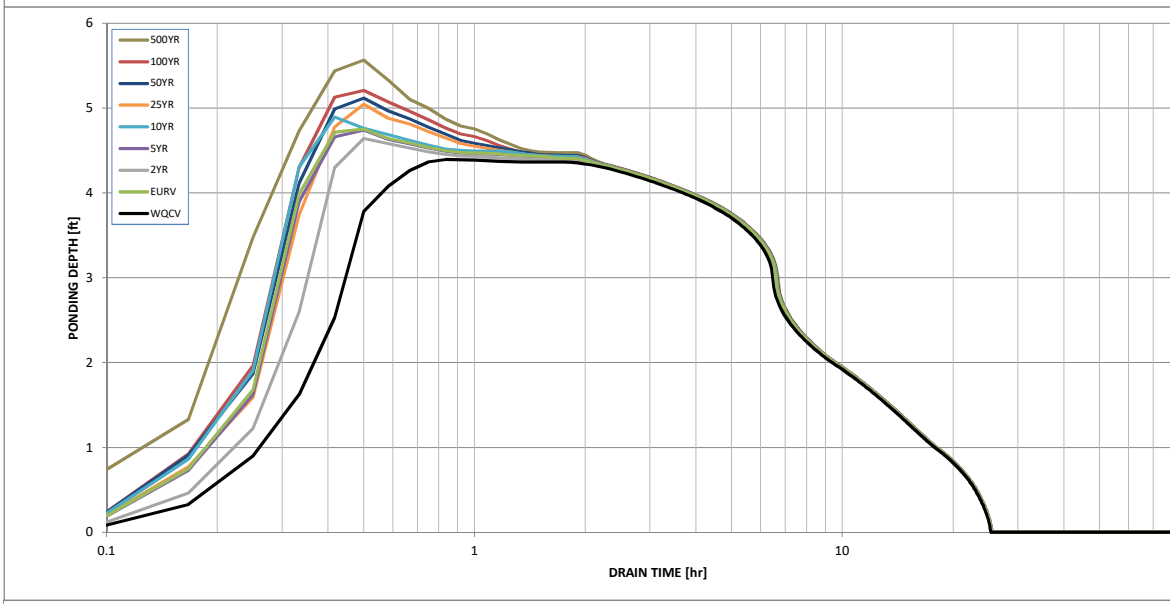
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

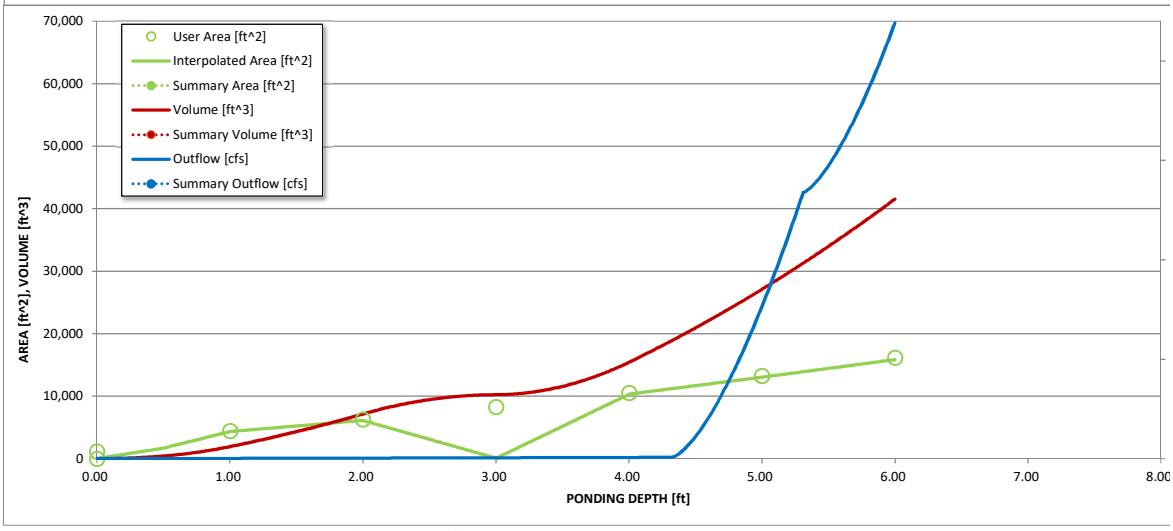
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.87	1.14	1.39	1.76	2.08	2.42	3.30
CUHP Runoff Volume (acre-ft) =	0.694	2.030	1.356	1.915	2.461	3.342	4.079	4.899	6.948
Inflow Hydrograph Volume (acre-ft) =	0.694	2.030	1.356	1.915	2.461	3.342	4.079	4.899	6.948
CUHP Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	5.4	12.1	27.7	38.0	50.1	78.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	0.0	0.0							
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.20	0.44	1.01	1.39	1.84	2.87
Peak Inflow Q (cfs) =	15.6	45.5	30.5	42.9	56.2	79.5	97.6	113.4	159.4
Peak Outflow Q (cfs) =	3.4	39.2	25.4	37.9	60.2	84.6	97.2	114.1	154.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	7.0	5.0	3.1	2.6	2.3	2.0
Structure Controlling Flow =	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	0.01	0.22	0.14	0.2	0.3	0.5	0.6	0.7	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	21	16	18	17	15	13	12	11	8
Time to Drain 99% of Inflow Volume (hours) =	**24**	21	22	22	21	20	19	18	16
Maximum Ponding Depth (ft) =	4.39	4.75	4.64	4.74	4.90	5.05	5.12	5.21	5.57
Area at Maximum Ponding Depth (acres) =	0.26	0.28	0.28	0.28	0.29	0.30	0.31	0.31	0.34
Maximum Volume Stored (acre-ft) =	0.451	0.550	0.519	0.547	0.590	0.634	0.656	0.683	0.800

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

APPENDIX C
Referenced Material
Drainage Maps

APPROVED
1/17/2019
Craig Perl

CVL CONSULTANTS

219011LTR1
2018-3048
94X

November 21, 2018

Craig Perl, P.E.
City of Aurora
Public Works Department
Engineering Control Division
15151 East Alameda Parkway
Aurora, CO 80012

Subject: Porteos F3 Drainage Letter

Dear Mr. Perl,

The following drainage conformance letter documents that existing inlets located on E.64th Ave are adequately sized to intercept flows from basin 64-1 & 64-2. Existing inlet design is from *Porteos Filing No.1 (Harvest Road and 56th Avenue),* prepared by Martin/Martin Inc., and was approved in February 2014.

Areas draining to basin 64-1 & 64-2 are recalculated based on new grading presented in Portoes F3. Flows are calculated using Rational method and UD-inlet is used to confirm inlet sizes. Recalculating the inlet sizes for new flows confirms that existing inlets (2 @ 10' Type R on-grade) have sufficient capacity to intercept the flows.

BASIN SUMMARY			
BASIN SUMMARY	AREA	Q2	Q100
ID	AC	CFS	CFS
64-1	1.95	3.2	9.4
64-2	1.94	3.2	9.3
64-3	1.42	N/A	N/A

Basin 64-2 crosses the western entrance to PA-9A Groot and will have a cross pan at that intersection. In the interim condition until the eastern portion of E. 64th Ave is completed, basin 64-3 flows east to a temporary sediment trap.

Basin delineation, Standard Forms, the UD-Inlet spreadsheet and a drainage map is provided with this conformance letter.

This letter demonstrates that Porteos F3 is in compliance with approved *Porteos Filing No.1* drainage report.

If you have any additional questions please do not hesitate to contact me directly at 720.249.3545.

Sincerely,
CVL Consultants of Colorado, Inc.

Mark Scheurer, PE, CFM
Director of Water Resources

FACSIMILE
THIS ELECTRONIC PLAN IS A FACSIMILE OF THE SIGNED AND SEALED PDF SET.

CO PROFESSIONAL ENGINEER
MARK SCHEURER, CO P.E. 48588

1-9-19
DATE

217137MD1
2013-3010
93W-X, 94-95W

CVL CONSULTANTS

10333 E Dry Creek Road, Ste 240
Englewood, Colorado 80112
www.cvlci.com

720.482.9526

PORTEOS
MASTER DRAINAGE REPORT
(COA EDN 212052)
AMENDMENT NO. 2

Prepared for:

A & C Properties Inc
4530 East Shea Boulevard #100
Phoenix, AZ 85028
Phone (602) 494-7800
Contact: Bill Wichterman

Prepared by:

CVL Consultants of Colorado, Inc.
Contact: Mark Scheurer, CFM, P.E.
Phone (720) 482-9546
Email: mscheurer@cvlci.com

CVL PROJECT NO. 8130249702

April 2017
May 2017 (Revised)
June 2017 (Revised)
August 2017 (Revised)

ACSIMILE

HIS ELECTRONIC PLAN IS A FACSIMILE OF THE SIGNED AND SEALED PDF ET

IGNATURE (PRINT): MARK SCHEURER

IGNATURE: _____ DATE: 8/25/2017

Approved For One Year From This Date
09.27.17

CDR

City Engineer _____ 09/26/2017 Date

Water Department _____ 09/22/2017 Date

TABLE OF CONTENTS

I. INTRODUCTION

A. Revisions to Master Drainage Report and Amendment No. 1

Amendment No. 2

Per agreement with the City of Aurora, Amendment No. 2 concerns itself with the improvements to the Gopher Gulch basin east of Jackson Gap and Third Creek basin. These improvements will be privately maintained by the metro district and are not UDFCD maintenance eligible.

Amendment 2 makes the following changes to previously approved MDP and Amendment # 1:

1. CUHP was revised to version 2.0.0 for all on-site basins (except S and ST basins). CUHP revisions to S and ST basins may be addressed in a future amendment at the time those basins are developed. CUHP was not updated for tributary offsite Second and Third Creek inflows to Porteos. These inflows are adopted from previously approved Master Plans.
2. Rainfall depths were updated to NOAA Atlas 14 values in accordance with current UDFCD guidelines. This results in a reduction in rainfall depths from previous analyses.
3. Permanent Pond GG3 is eliminated and permanent detention Pond GG2 has increased in size to account for the Pond GG3 detention.
4. Basin boundaries for T2, T3, T4 and GG6 are modified to reflect a realignment of 64th Ave. Basins T5, T6, T7, and T8 have been added. Associated with this, updated flows are shown in the SWMM model. The conceptual design has been updated to reflect these changes.
5. Interim detention pond GGOS2 and permanent detention pond GGOS1on the Fine Point property are removed. Detention occurs in Pond GG2.
6. Pond GGOS3 is permanent detention facility. All downstream conveyance accounts for this detention. This approach was accepted by the City of Aurora because downstream regional channels and ponds within Porteos will be privately maintained.
7. Composite channel GG-C11 is proposed as underground 4'x4' concrete box. The box and the overflow design will be designed and approved by the parcel owner at a future date.
8. Pond GG2 is sized to release 459 CFS (Both in interim and ultimate condition). This is a reduction from the Martin/Martin MDR 632 cfs ultimate release rate.
9. Pond GG2 will include a 2-year storage volume released over 20 hours to provide water quality and mitigate downstream flows while complying with the FAA rules. The analysis of 2yr event and design for 20 hr release will be addressed.

B. Details

The Harvest Road and 56th Avenue Final Drainage Report (Ref.11) documents the design of pond GG1 to provide water quality for Jackson Gap Street and detention for Planning areas 3 and 4 within basins GG9 and GG10. See Gopher Gulch and Third Creek flow differences provided at end of this section.

Pond GGOS3 is proposed as permanent local pond in this amendment. All the basins upstream of Culvert A will detain developed flows to release at the 68 cfs historic flow rates on permanent basis. The conveyance element across basin GG07 is a 4'x4' RCB which has capacity for the detained flow. An overland flow path for the developed undetained flow must be provided when basin GG07 is developed in addition to the box.

Detention Pond GG3 has been eliminated. Detention will be accomplished downstream at Pond GG2. Pond GG3 will serve as a water quality pond only. Pond GG2 will increase in total required volume from 22.2 ac-ft to 41.8 ac-ft.

The Fine Point and Porteos developments have agreed to the following: Porteos will provide detention for Fine Point in Pond GG2. Fine Point will allow for an ultimate condition channel (reach GG-C09) across its property to maintain historic conveyance. Although detention ponds have been removed, Fine Point must provide Water Quality detention on-site.

Channel GG-C11 is now an underground 4'x4' concrete box that conveys the detained flow from basin GG-OS3.

Due to FAA requirements discussed in the approved MDR, water quality utilizing the standard 40-hour release time and detention cannot be provided in the same pond. Per discussions with the city, Pond GG2 will release the 2-year volume over 20 hours to comply with the City's MS4 General Permit.

Six CUHP/SWMM analysis are presented in this amendment to the Porteos Master Drainage Plan. They are as follows:

1. *Ultimate 100-year CUHP/SWMM* analyzes the areas of Gopher Gulch and Third Creek and primarily addresses Pond GG2 sizing and revisions to Third Creek. Assumes full buildout with regional downstream improvement in place. All interim ponds are removed from this analysis. The inflow hydrograph from outfall GG-OUT is imported into the model 3. *Pond S-219 CUHP/SWMM – Porteos* to analyze the impact of full development on Pond S-219.

2. *Pond S-219 CUHP/SWMM-Update* model. This is the effective 100-year Pond S-219 model updated from CUHP v1.3.3 to v.2.0.0 and with point rainfall depths updated to NOAA Atlas 14 values. This model is from the 2011 Second Creek MDP.

3. *Pond S-219 CUHP/SWMM -Porteos* is the effective 100-year Pond S-219 model updated to CUHP v.2.0.0 and with point rainfall depths updated to NOAA Atlas 14 values. The inflow hydrograph from outfall GG-OUT is imported into this model at node 134. The comparison between models 2 and 3 was used to determine the fully developed impact. This model is from the 2011 Second Creek MDP.

4. *Interim 100-year CUHP/SWMM*: analyzes the areas of Gopher Gulch and Third Creek and primarily addresses Pond GG2 sizing and revisions to Third Creek. The interim condition assumes full buildout prior to the construction of regional downstream improvements. This plan

includes interim ponds. Pond release rates used in this Amendment comply with previously approved MDP in which the 100yr release was the lesser of existing or 1 cfs/ac. The rating curves for ponds other than GG2 are unchanged from previous reports.

5. *Interim 2-year CUHP/SWMM* Will use a different approach than what was previously approved; therefore, the 2 year models will be addressed in future PDR/FDR submittals.

6. *Interim 10-year CUHP/SWMM* is model 4 analyzed for the 10-year Interim storm event. Previously approved release rate was compared with COA allowable release rates. To be conservative, smaller number was used to determine the minimum 10-year detention volume.

7. *Ultimate 10-year CUHP/SWMM* is model analyzed for the 10-year Ultimate storm event. Previously approved release rate was compared with COA allowable release rates (Previously approved MDR 10 year release rate is 190 CFS). To be conservative, smaller number was used to determine the minimum 10-year detention volume.

8. *100-year Ultimate CUHP/SWMM*

For the Interim plan, the release rate for the site (GG-Out) was reduced from 642 cfs to 627 cfs. For the Ultimate Plan, the release rate for the site (GG-Out) reduced from 1292 cfs to 936 cfs.
* These reductions are current amendment 2 modeling compared to amendment 1.

CUHP for all hydrologic analysis was update to v2.0.0. UDFCD recalibrated CUHP to version 2.0.0 to more closely match measured peak flow data available for gaged watersheds. The update to version 2.0.0 results in significant reductions in peak discharge but no change in hydrograph runoff volumes for Porteos basins. Changes in peak flow for Porteos basins between version 1.4.4 used in the original Porteos MDP and Amend #1 and the new version 2.0.0 are shown in Tables on the following pages.

It should also be noted that the CUHP v2.0.0 requires the use of NOAA Atlas 14 point precipitation data. The 100-year 60 minute interval of 2.52 inches was used from this data. The effective Pond S-219 CUHP/SWMM model used CUHP v1.3.3. Which used a 100-year 60 minute interval of 2.65 inches. All data using the CUHP v2.0.0. uses the NOAA Atlas 14 precipitation data.

CUHP SUBBASIN PEAK FLOWS AND VOLUME COMPARISION						
CUHP BASIN	AMENDMENT NO.1			AMENDMENT NO.2		
	Area	Peak Flow	Volume	Area	Peak Flow	Volume
ID	AC	CFS	C.F	AC	CFS	C.F
GG01	30.2	147	274,300	30.2	106	269,627
GG02	59.3	299	533,014	59.3	223	522,854
GG03	86.4	431	773,700	86.4	319	776,747
GG04	47.4	237	429,683	47.4	173	419,820
GG05	8.4	32	79,995	8.4	20	75,897
GG06	80.5	405	757,894	80.5	271	726,173
GG07	87.7	452	795,889	87.7	360	780,119
GG09	45.8	189	437,070	45.8	123	413,261
GG10	46.0	230	418,124	46.0	169	406,762
GG11	18.5	79	175,781	18.5	49	165,646
GG-OS1	83.3	422	777,536	83.3	288	752,978
GG-OS2	65.7	318	627,068	65.7	206	591,208
GG-OS3	69.6	349	632,521	69.6	250	626,938
S1	30.2	196	318,853	-	-	-
S2	22.0	113	207,711	-	-	-
S3	10.4	65	108,825	-	-	-
S-OS1	7.2	33	68,198	-	-	-
ST1	35.2	165	334,977	-	-	-
ST2	62.6	305	593,245	-	-	-
ST3	21.1	93	200,962	-	-	-
T1	48.8	196	467,827	109.4	343	985,968
T2	223.1	1,024	2,152,802	45.6	159	409,859
T3	87.9	432	841,491	31.6	125	277,537
T4	67.0	319	642,385	57.3	185	515,186
T5	-	-	-	72.3	264	650,962
T6	-	-	-	58.5	192	526,972
T7	-	-	-	40.1	139	360,378
T8	-	-	-	13.2	44	116,476
TT1	112.4	578	1,028,081	108.0	394	975,537
P1	56.7	288	509,891	56.7	218	501,233
921	29.5	27	165,158	29.5	23	151,551
922	158.0	221	965,229	158.0	184	888,883
923	33.6	58	217,031	33.6	49	200,118
925	26.4	135	250,618	26.4	98	236,421
927	66.3	66	390,837	66.3	56	359,029

POND ID	POND STATUS	POND RELEASE RATE CFS AMENDMENT NO. 1	POND RELEASE RATE CFS AMENDMENT NO. 2
GG1	INTERIM	646	627
GG2	PERMANENT	397	459
GG3	REMOVED	131	-
GGOS1	REMOVED	83	-
GGOS2	REMOVED	66	-
GGOS3	PERMANENT	70	68
P1	INTERIM	57	56
T1	PERMANENT	600	572
TT1	INTERIM	112	108

A. Location

Refer to Location subsection in approved Master Drainage Report (Ref.10).

Location map is shown as below.

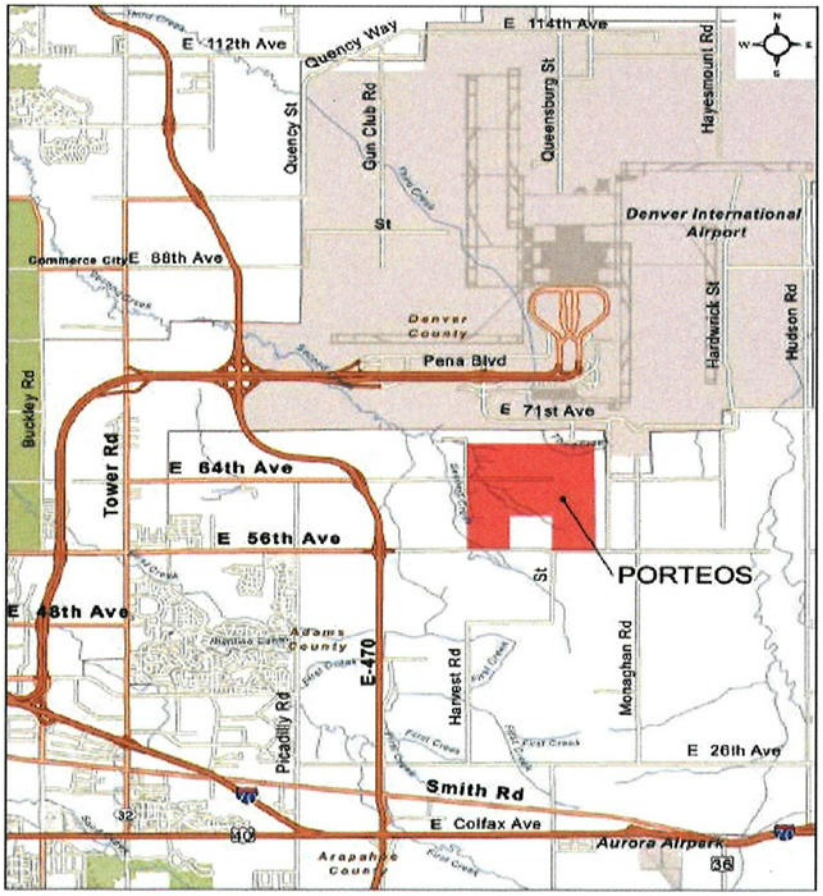


Figure 1.1 – Vicinity Map

B. Proposed Development

Refer to Proposed Development subsection in approved Porteos Master Drainage Report (Ref.10).

II. HISTORIC DRAINAGE

Refer to Historic Drainage section in approved Porteos Master Drainage Report (Ref.10).

The hydrologic modeling for the Olsson MDP was provided to Martin/Martin on Feb. 16th, 2012. This modeling was used to determine the existing flows for comparison to the proposed condition modeling. CVL received Martin/Martin's model for use in this analysis.

III. DESIGN CRITERIA

A. List References

See section VI of drainage report.

The USDCM dated January 2016 replaces the USDCM dated November 2010.

B. Hydrologic Criteria

Refer to Hydrologic Criteria subsection in approved Porteos Master Drainage Report (Ref.10).

The USDCM dated January 2016 replaces the USDCM dated November 2010.

CUHP v2.0.0 was used for the hydrologic analysis. The 2nd Creek (US of DIA) MDP was updated from CUHP v1.3.3. The previous master drainage report and Amendment No.1 were updated from CUHP v1.4.4. Per the CUHP Manual updated with the v2.0.0 release, v2.0.0 results in lower peak flows than v1.4.4. Which is reflected in this amendment.

C. Hydraulic Criteria

Refer to Hydraulic Criteria subsection in approved Porteos Master Drainage Report (Ref.10).

The USDCM dated January 2016 replaces the USDCM dated November 2010.

Revised channel and culvert sizing are provided in the Appendix.

Revised CUHP/SWMM analysis for the interim and ultimate conditions are provided in the appendix.

Hydraulic criteria for the City of Aurora was used where applicable. The channel improvements and Pond GG2 will be privately maintained and are not UDFCD maintenance eligible.

IV. DRAINAGE PLAN

A. General Concept

Refer to General Concept subsection in approved Porteos Master Drainage Report (Ref.10).

B. Specific Details

Refer to Hydrologic Criteria subsection in approved Porteos Harvest Road and 56th Avenue Master Drainage Report (Ref.10).

Specific changes are noted in the introduction of this amendment. Please refer to the Appendices for the supporting calculations. The conceptual design, flows, and pond sizes are shown on the drainage maps.

Ponds GG1, TT1, P1, TT1, and T1 stage-discharge were not changed from previous reports. The new size and release rate reflects the update to CUHP v2.0.0 and rainfall from NOAA Atlas 14.

The impact of the fully developed Porteos site on Pond S-219 was investigated in this amendment. The Second Creek (US DIA) CUHP/SWMM analysis established an 80% impervious area for the Porteos site. The approved 2012 Porteos MDR and subsequent Amendment #1 increased the imperviousness from 80% to 85%. The effect of this increased imperviousness on Pond S-219 required volume was not evaluated previously.

In the 2011 MDP, the Second Creek (US DIA) 100-year CUHP (v.1.3.3) and SWMM analysis resulted in a Pond S-219 volume of 795.9 AC/FT with a peak release rate of 500.32 cfs. The updated Second Creek (US DIA) 100-year CUHP (v.2.0.0) and SWMM analysis results in a Pond S-219 volume of 733.12 AC/FT with a peak release rate of 493.0 cfs.

The Second Creek (US DIA) SWMM model was then updated to include the inflows from the Ultimate Porteos model. Junction 134 in the Second Creek (US DIA) SWMM model corresponds to the outlet of the Porteos site at outfall node GG-OUT. The upstream basins 28, 29, 30, 31, 32, 33, 34 from node 134 were removed and replaced with the inflow hydrograph from the model 1 *Ultimate 100-year CUHP/SWMM* outfall GG-OUT. A portion of basin 35 is located outside Porteos boundary. Updated CUHP parameters are used for Basin 35.

This results in a Pond S-219 volume of 721.10 AC/FT and a peak release rate of 491.54 cfs. The maximum total inflow of 932.94 cfs is the same for GG-OUT and node 134. This demonstrates the proposed Ultimate development does not negatively impact Pond S-219.

POND S-219 SUMMARY RESULTS

DESIGN	UNITS	SWMM MODEL		
		MDP	UPDATED [1]	PROPOSED [2]
VOLUME	AC-FT	795.9	733.12	721.10
RELEASE	CFS	500.32	493.0	492

Notes:
1. MDP modeling updated to CUHP 2.0.0 and rainfall from NOAA Atlas 14.
2. MDP watershed modeling updated to CIHP 2.0.0, rainfall from NOAA Atlas 14, and amendment #2 proposed Porteos outflow hydrograph inserted at SWMM node 134.

V. CONCLUSIONS

The Porteos Property is proposed to be a mixed use commercial/industrial development south of DIA. The proposed drainage plan is to provide for safe and efficient conveyance of flows through the Property in compliance with the regional watershed concept.

Under interim condition, the absence of major downstream drainage infrastructure; a combination of permanent and interim ponds are proposed to control flows to approximate existing condition levels, until such time as the downstream facilities are completed.

Permanent sub-regional ponds have been identified to provide reduction of flows to allow for reduced channel and culvert sizes. This reduction is applied to privately maintained infrastructure.

The stormwater quality control requirements for Porteos are to be provided by the individual parcels.

A. Compliance with Standards

The proposed drainage plan and the analysis provided with this Master Drainage Report Amendment was prepared in compliance with the City's Criteria Manual (Reference No. 1). The proposed drainage plan also follows the recommendation of the regional studies for each of the three watersheds impacted by the development of the Porteos Project.

Full spectrum detention is in conflict with FAA regulations and cannot be provided on this property. This MDP does not address the layout or sizing of water quality facilities. This will be addressed by the developers of individual parcel.

B. Summary of Concept

Refer to Summary of Concept subsection in approved Porteos Master Drainage Report (Ref.10).

The proposed interim drainage concept allows for the development of the Porteos property prior to the construction of Pond S-219.

VI. LIST OF REFERENCES

1. City of Aurora, Storm Drainage Design and Technical Criteria Manual, Aurora, Colorado, effective date October 11, 2010.

2. Urban Drainage and Flood Control District (UDFCD) Drainage Criteria Manual, Volumes 1, 2, and 3, November 2016.

3. Web Soil Survey, Natural Resources Conservation Service, United States Department of Agriculture, Available at http://websoilsurvey.nrcs.usda.gov, accessed 11/17/2011.

4. Second Creek (Upstream of Denver International Airport) – Major Drainageway Plan – Conceptual Design Report, prepared by Olsson Associates and Matrix Design Group, Inc., for Urban Drainage and Flood Control District, City of Aurora, September 2011.

5. Flood Hazard Area Delineation – Second Creek (Upstream of Denver International Airport), prepared by Olsson Associates and Matrix Design Group, Inc., for Urban Drainage and Flood Control District, City of Aurora, May 2011.

6. Third Creek and Barr Lake Drainage – Outfall Planning Study – Preliminary Design, prepared by Kiowa Engineering Corporation, for Urban Drainage and Flood Control District, Adams County, City of Arvada, City of Brighton, City of Commerce City, City and County of Denver, July 1990.

7. Preliminary Design Report for Lower Box Elder Creek Watershed, prepared by Wright Water Engineers, Inc., for Urban Drainage and Flood Control District, Adams County, City and County of Denver, October 2001.

8. Federal Aviation Administration Advisory Circular No. 150/5200-33B, Subject: Hazardous Wildlife Attractants On or Near Airports, Dated: 8/28/2007.

9. Porteos-Master Drainage Report (COA#212052), prepared by Martin/Martin Consulting Engineers, City of Aurora, April 2013.

10. Porteos-Master Drainage Report (COA#212052), Amendment No. 1 letter, prepared by Martin/Martin Consulting Engineers, City of Aurora, September 4, 2013.

11. Porteos Filing No. 1 Harvest Road and 56th Avenue City of Aurora, Colorado Final Drainage report (COA# 214020), Martin/Martin, 2012.

12. DIA Drainage Master Plan, Prepared by Moser, 2010.

APPENDICES

A. EXCERPTS FROM REFERENCES

B. HYDROLOGIC ANALYSIS

C. HYDRAULIC ROUTING

D. HYRDRAULIC COMPUTATONS

DRAINAGE MAPS
(Submitted as separate document)

C. HYDRAULIC ROUTING

PORTEOS INTERIM 10-YEAR
PORTEOS INTERIM 100-YEAR
PORTEOS ULTIMATE 10-YEAR
PORTEOS ULTIMATE 100-YEAR
PORTEOS S-219 CUHP-PORTEOS
PORTEOS S-219 CUHP-UPDATE MODEL (SECOND CREEK u/s DIA)

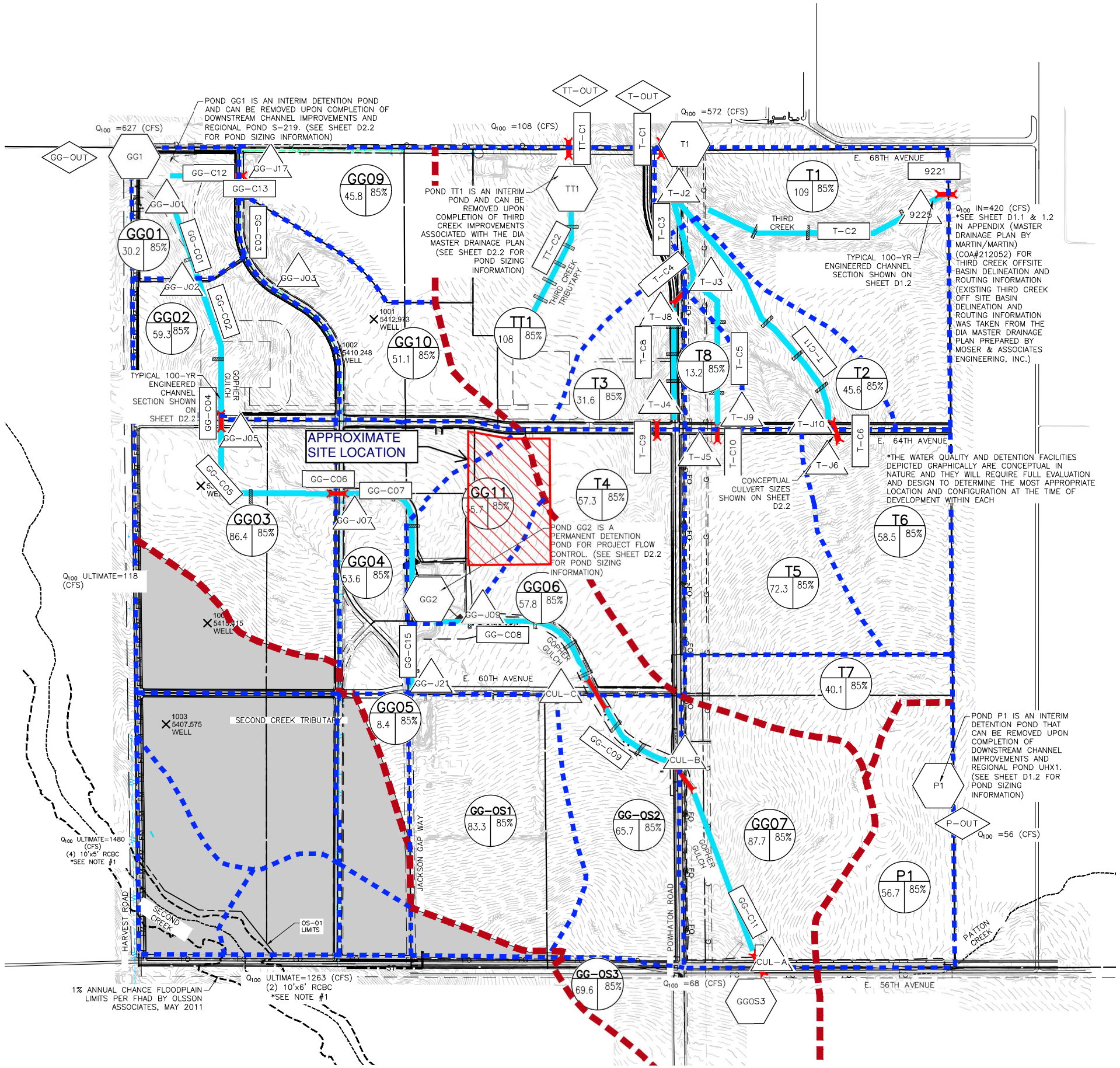
****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
921n	921	9225	CONDUIT	400.0	9.7967	0.0100
9220n	9220	9222	CONDUIT	400.0	0.2500	0.0100
9221	9222	9225	CONDUIT	737.0	1.0855	0.0400
922n	922	9220	CONDUIT	400.0	15.4305	0.0100
923n	923	9220	CONDUIT	400.0	5.2573	0.0100
925n	925	9222	CONDUIT	400.0	7.2691	0.0100
9270n	9270	9225	CONDUIT	400.0	12.0873	0.0400
927n	927	9270	CONDUIT	400.0	11.3219	0.0100
POND-GG1	GG-J01	POND-GG1	CONDUIT	518.6	0.3856	0.0450
GG-C01	GG-J02	GG-J01	CONDUIT	830.0	0.7229	0.0450
GG-C02	GG-J04	GG-J02	CONDUIT	1340.0	0.9702	0.0450
GG-C03	GG-J03	GG-J17	CONDUIT	1385.0	1.8956	0.0130
GG-C04	GG-J05	GG-J04	CONDUIT	177.2	0.5643	0.0130
GG-C05	GG-J06	GG-J05	CONDUIT	1624.1	0.4926	0.0450
GG-C06	GG-J07	GG-J06	CONDUIT	135.4	0.7386	0.0130
GG-C07	GG-J08	GG-J07	CONDUIT	583.9	1.8841	0.0450
GG-C08	Culvert-C	GG-J23	CONDUIT	2025.0	0.2173	0.0400
GG-C09	Culvert-B	Culvert-C	CONDUIT	1577.0	0.2397	0.0400
GG-C11	Culvert-A	Culvert-B	CONDUIT	2063.0	0.2545	0.0130
GG-C12	GG-J16	POND-GG1	CONDUIT	977.0	0.5118	0.0250
GG-C13	GG-J17	GG-J16	CONDUIT	150.0	0.5000	0.0130
GG-C15	GG-J21	GG-J20	CONDUIT	1372.5	1.2387	0.0250
GG-D01	GG01	GG-J01	CONDUIT	442.4	0.2260	0.0100
GG-D05	GG02	GG-J02	CONDUIT	533.6	0.1874	0.0100
GG-D06	GG10	GG-J03	CONDUIT	528.3	0.1893	0.0100
GG-D07	GG03	GG-J05	CONDUIT	400.5	0.2497	0.0100
GG-D08	GG04	GG-J07	CONDUIT	401.7	0.2489	0.0100
GG-D09	GG-J20	GG-J09	CONDUIT	218.0	0.2294	0.0100
GG-D10	GG-J09	POND-GG2	CONDUIT	225.9	0.2214	0.0100
GG-D11	GG06	GG-J23	CONDUIT	522.1	0.1915	0.0100
GG-D14	GG07	Culvert-B	CONDUIT	669.5	6.4087	0.0100
GG-D17	GG09	GG-J17	CONDUIT	499.9	0.2501	0.0100
GG-D19	GG05	GG-J21	CONDUIT	352.0	0.2841	0.0100

Referenced from MDP (2017 Amendment) (COA EDN 217127)

GG-D20	GG-OS1	GG-J21	CONDUIT	959.1	0.1043	0.0100
GG-D21	GG-J23	GG-J09	CONDUIT	400.0	0.1250	0.0100
GG-D22	GG-OS2	Culvert-C	CONDUIT	400.0	7.6725	0.0100
P-D1	P1	POND-P1	CONDUIT	378.6	0.2642	0.0100
T_D3	T3	T-J8	CONDUIT	400.0	-1.2501	0.0100
T-C1	T-1Out	T-OUT	CONDUIT	123.7	0.8082	0.0130
T-C10	T-J5	T-J9	CONDUIT	200.0	0.5000	0.0100
T-C11	T-J10	T-J2a	CONDUIT	1990.0	2.4631	0.0250
T-C2	9225	T-J1	CONDUIT	2445.4	1.1451	0.0450
T-C3	T-J3	T-J2	CONDUIT	572.0	2.0984	0.0450
T-C4	T-J8	T-J3	CONDUIT	166.7	3.0015	0.0130
T-C5	T-J9	T-J3	CONDUIT	2882.6	1.2143	0.0250
T-C6	T-J6	T-J10	CONDUIT	200.0	1.0001	0.0130
T-C7	T-7_DS	T-J5	CONDUIT	2000.0	1.5502	0.0250
T-C8	T-J4	T-J8	CONDUIT	1214.0	1.8949	0.0250
T-C9	T4	T-J4	CONDUIT	200.0	0.5000	0.0100
T-D1	T-J1	T-J2	CONDUIT	378.7	0.0003	0.0100
T-D2	T1	T-J1	CONDUIT	508.8	0.1966	0.0100
T-D3	T-J2	POND-T1	CONDUIT	409.5	0.2442	0.0100
T-D4	T2	T-J2a	CONDUIT	660.1	0.1515	0.0100
T-D5	T5	T-J5	CONDUIT	400.0	0.5000	0.0100
T-D6	T6	T-J6	CONDUIT	400.0	0.5000	0.0100
T-D7	T7	T-7_DS	CONDUIT	248.4	0.8053	0.0130
TT-C1	TT-J1	TT-OUT	CONDUIT	118.8	0.8414	0.0130
TT-C2	TT1	TT-J2	CONDUIT	1349.5	2.2977	0.0250
TT-D1	TT-J2	POND-TT1	CONDUIT	173.0	2.8914	0.0100
T_D8	T8	T-J9	CONDUIT	400.0	0.2500	0.0100
GG-D16	GG-OS3	POND-GGOS3	CONDUIT	627.2	0.1993	0.0100
GG-D12	GG11	GG-J09	CONDUIT	400.0	0.1250	0.0100
T-D4a	T-J2a	T-J2	CONDUIT	400.0	0.2500	0.0100
OUTFALL-GG2	POND-GG2	GG-J08	OUTLET			
OUTFALL-T1	POND-T1	T-1Out	OUTLET			
OUTFALL-GGOS3	POND-GGOS3	Culvert-A	OUTLET			
OUTFALL-GG1	POND-GG1	GG-OUT	OUTLET			
OUTFALL-TT1	POND-TT1	TT-J1	OUTLET			
OUTFALL-P1	POND-P1	P-OUT	OUTLET			

217137



DRAINAGE LEGEND

- CULVERT CROSSINGS
- OPEN CHANNEL
- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- MAJOR BASIN LINES
- MINOR BASIN LINES
- 1% ANNUAL CHANCE FLOOD LIMITS (FHAD, OLSSON ASSOCIATES, MAY 2011)
- CONCEPTUAL 4 FOOT DROP STRUCTURE LOCATIONS
- 2ND CREEK BASIN (NOT MODIFIED IN THIS AMENDMENT 2)

SCHEMATIC LEGEND

- SUB-CATCHMENT
- DETENTION ELEMENT
- DESIGN POINT/DESIGN FLOW
- CONVEYANCE ELEMENT
- OUTFALL ELEMENT

BASIN — T1 48.8 85% — % IMPERVIOUSNESS
AREA IN ACRES

NOTES:

1. FUTURE CONDITION FLOWS AND CULVERT SIZES FOR THE MAIN STEM OF SECOND CREEK WERE TAKEN FROM THE SECOND CREEK MAJOR DRAINAGEWAY PLAN, PREPARED BY OLSSON ASSOCIATES AND MATRIX DESIGN GROUP INC., DATED SEPTEMBER 2011. VALUES REPRESENT THE SELECTED PLAN.
2. EXISTING CONTOURS PROVIDED BY USGS DIGITAL ELEVATION MODELING. ELEVATIONS SHOWN ARE PER VERTICAL DATUM NAVD 1988. MARTIN/MARTIN APPLIES NO GUARANTEE TO THE ACCURACY OF THE TOPOGRAPHY SHOWN.
3. 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 APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

FACSIMILE

THIS ELECTRONIC PLAN IS A FACSIMILE OF THE SIGNED AND SEALED PDF SET

SIGNATURE (PRINT): MARK SCHEURER

SIGNATURE: _____ DATE: 8/25/2017

APPROVED FOR ONE YEAR FROM THIS DATE

09.27.17

CITY ENGINEER — DATE 09/26/2017

WATER DEPARTMENT — DATE 09/22/2017

PREPARED UNDER THE SUPERVISION OF

MARK SCHEURER
COLORADO P.E. 48988

APPROVED ON 09.27.17

No.	Revisions	Date	Init.	Appr.	Date

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Tel: 720.482.9526
Fax: 720.482.9546

A&C PROPERTIES INC
4530 EAST SHEA BOULEVARD
PHOENIX, AZ 85028
Tel: (602.494.1800)

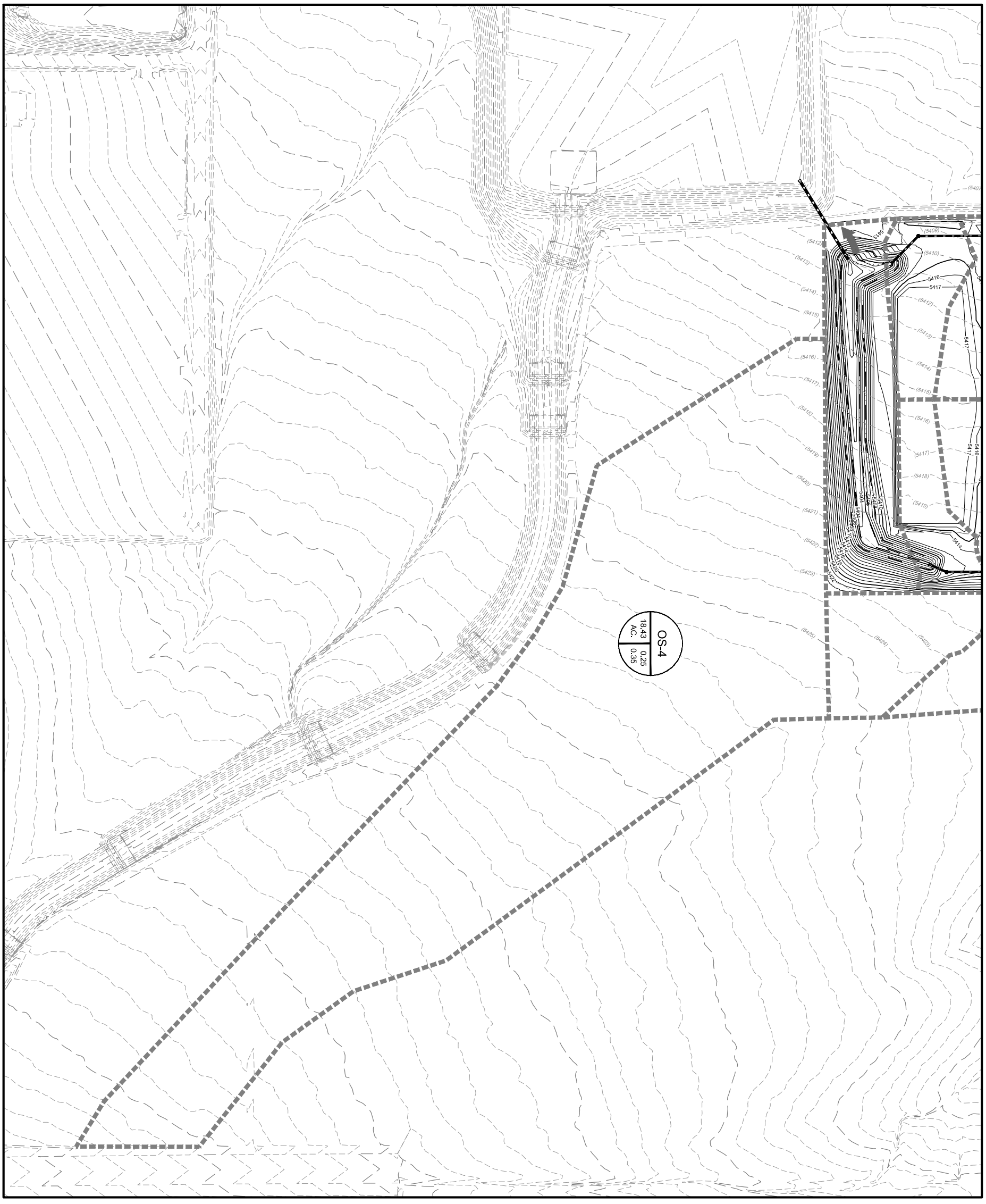
PORTEOS

INTERIM DRAINAGE PLAN

SCALE: AS SHOWN
FILE NO: 8130249.02
DRAWN BY: AYK
CHECKED BY: MRS
DATE: NOVEMBER 2016

SHEET NUMBER D1.1

N:\PROJECTS\PORTEOS\DOCS\DRAINAGE\MASTER DRAINAGE AMENDMENT\AUG 2016 DRAINAGE MAP\INTERIM DRAINAGE MAP.DWG, ASHUNDK, 8/25/17



CAUTION: IF THIS SHEET IS NOT 24"x36" IT IS A REDUCED PRINT

SHEET
EX-1

JOB NO.:	DEN18-0009
PA / PM:	PG
DRAWN BY:	ANM
DATE:	09/24/2018

NO.	DATE	REMARKS
1	9/20/2018	1ST SWMP SUBMITTAL
2	10/24/2018	FIRST CITY SUBMITTAL
3	10/30/2018	2ND SWMP SUBMITTAL
4	11/16/2018	3RD SWMP SUBMITTAL
5	12/11/2018	2ND CD SUBMITTAL

PORTEOS SUBDIVISION FILING NO. 3
CONSTRUCTION DOCUMENTS

FINAL DRAINAGE PLAN - EXHIBIT 1

FOR AND ON BEHALF OF WARE MALCOMB

990 south broadway
suite 230
denver, co 80209
p 303.561.3333
waremalcomb.com

WARE MALCOMB
LEADING DESIGN FOR COMMERCIAL REAL ESTATE

NOT FOR CONSTRUCTION

APPENDIX D
Drainage Plan Sheets

CAUTION: IF THIS SHEET IS NOT 24"x36" IT IS A REDUCED PRINT

BASIS OF BEARINGS:

BEARINGS ARE BASED ON THE SOUTH LINE OF THE NORTH HALF OF SECTION 8, WITH A PLATTED BEARING OF NORTH 89°44'07" WEST

WARE MALCOMB assumes no responsibility for utility locations. The utilities shown on this drawing have been plotted from the best available information. It is, however, the contractors responsibility to field verify the location of all utilities prior to the commencement of any construction.

EXISTING CONDITION - RUNOFF SUMMARY

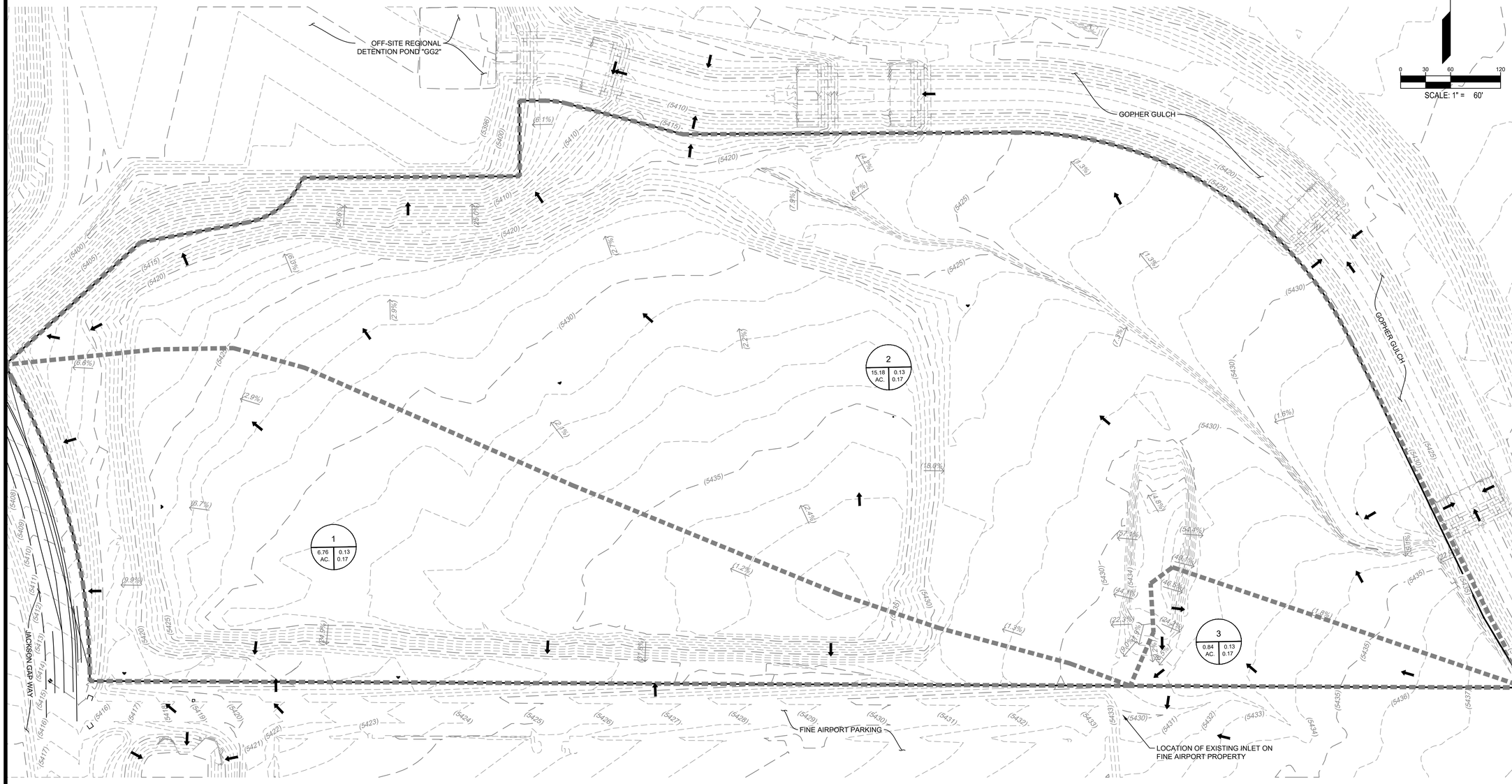
BASIN LABEL	DESIGN POINT	AREA (AC)	LOCAL (CFS)		ACCUMULATIVE (CFS)	
			Q_2	Q_{100}	Q_2	Q_{100}
1		6.76	1.9	5.3		
2		15.18	4.4	14.4		
3		0.84	0.2	0.6		

LEGEND:

- PROPERTY LINE
- 6810 PROPOSED 5' CONTOUR
- 5809 PROPOSED 1' CONTOUR
- (5810) EXISTING 5' CONTOUR
- (5809) EXISTING 1' CONTOUR
- PROPOSED STORM LINE
- EXISTING STORM LINE
- PROPOSED STORM INLET
- PROPOSED SIDEWALK
- XX.XX PROPOSED SPOT ELEVATION (AT FLOWLINE UNLESS OTHERWISE INDICATED)
- X.XX% PROPOSED SLOPE AND DIRECTION
- PROPOSED CURB & GUTTER
- EXISTING CURB & GUTTER
- FLOW DIRECTION
- DRAINAGE SUB-BASINS

DRAINAGE AREA (LABEL) — A
AREA (ACRES) — 0.00 AC. — 0.74
2-YR RUNOFF COEFFICIENT — 0.85
100-YR RUNOFF COEFFICIENT

1 DESIGN POINT



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FOR AND ON BEHALF OF WARE MALCOMB

PORTEOS SUBD. FILING NO. 4
RYDER TRUCK
EXISTING DRAINAGE MAP

NO.	DATE	REMARKS

JOB NO.:	DCS19-4085
PA / PM:	C. STRAWN
DRAWN BY:	C. JOHNSON
DATE:	11/4/2019

SHEET

CAUTION: IF THIS SHEET IS NOT 24"x36" IT IS A REDUCED PRINT

BASIS OF BEARINGS:

BEARINGS ARE BASED ON THE SOUTH LINE OF THE NORTH HALF OF SECTION 8, WITH A PLATTED BEARING OF NORTH 89°44'07" WEST

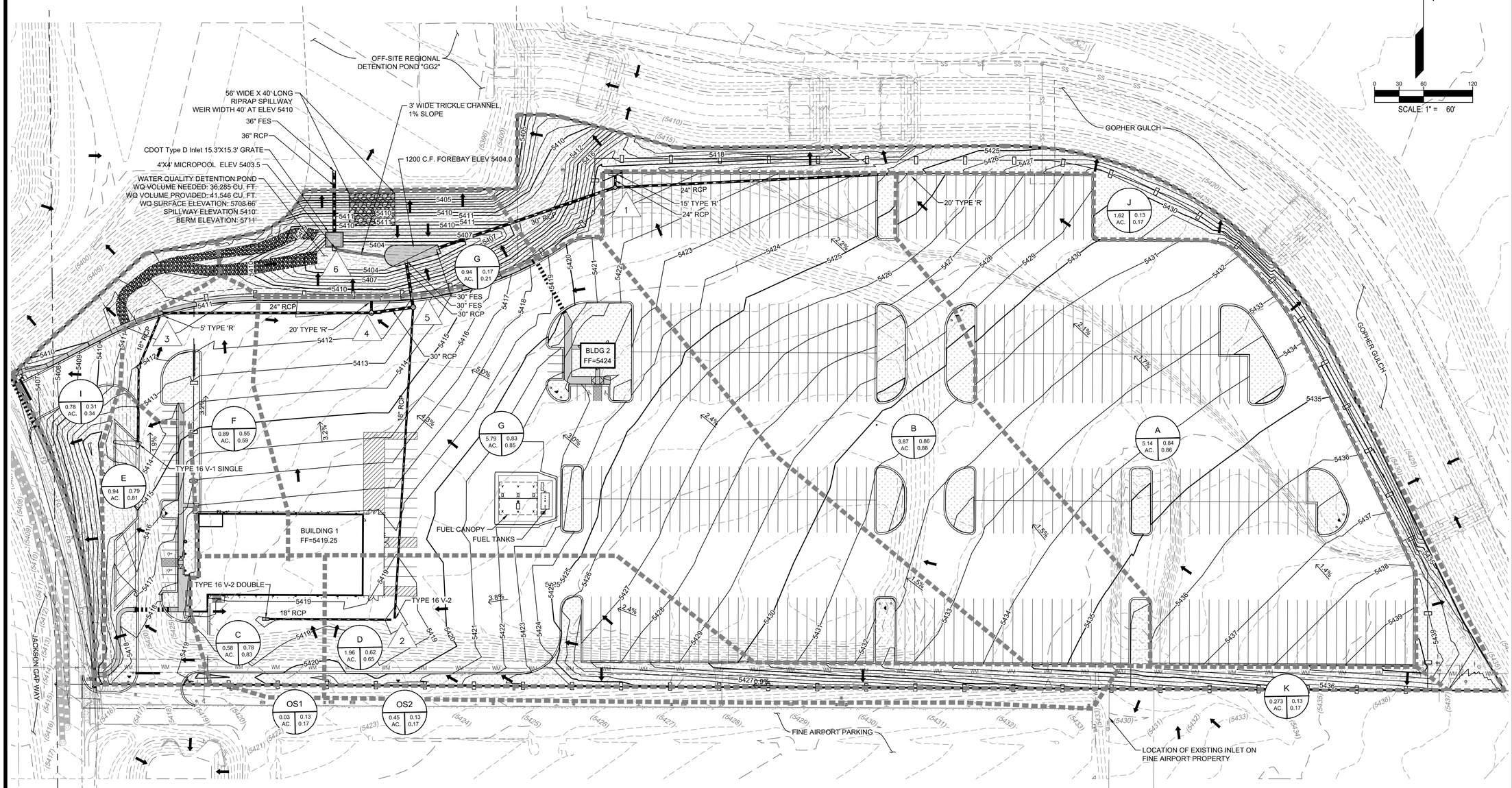
WARE MALCOMB assumes no responsibility for utility locations. The utilities shown on this drawing have been plotted from the best available information. It is, however, the contractors responsibility to field verify the location of all utilities prior to the commencement of any construction.

DEVELOPED CONDITION - RUNOFF SUMMARY

BASIN LABEL	DESIGN POINT	AREA (AC)	LOCAL (CFS)		ACCUMULATIVE (CFS)	
			Q_2	Q_{100}	Q_2	Q_{100}
A		5.14	11.6	31.4		
B		3.87	8.7	23.7		
	1				20.1	54.4
C+OS1		0.61	1.5	4.1		
D+OS2		2.42	2.8	7.7		
	2				3.9	10.5
E		0.94	2.1	5.8		
F		0.89	1.2	3.3		
	3				3.0	8.1
G		5.79	11.8	31.9		
	4				14.6	39.5
	5				17.6	47.6
H		0.94	0.5	1.4		
	6				45.9	124.5
I		1.62	0.6	1.7		
J		0.78	0.8	2.4		
K		0.27	0.1	0.4		

LEGEND:

- PROPERTY LINE
- PROPOSED 5' CONTOUR (5810)
- PROPOSED 1' CONTOUR 5809
- EXISTING 5' CONTOUR (5810)
- EXISTING 1' CONTOUR (5809)
- PROPOSED STORM LINE
- EXISTING STORM LINE
- PROPOSED STORM INLET
- PROPOSED SIDEWALK
- PROPOSED SPOT ELEVATION (AT FLOWLINE UNLESS OTHERWISE INDICATED) XX.XX
- PROPOSED SLOPE AND DIRECTION X.XX%
- PROPOSED CURB & GUTTER
- EXISTING CURB & GUTTER
- FLOW DIRECTION
- DRAINAGE SUB-BASINS
- DRAINAGE AREA (LABEL) A; AREA (ACRES) 0.00 AC.; 2-YR RUNOFF COEFFICIENT 0.74; 100-YR RUNOFF COEFFICIENT 0.85
- DESIGN POINT 1



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suite 230
denver, co 80209
p. 303.561.3333
waremalcomb.com

FOR AND ON BEHALF OF WARE MALCOMB

PORTEOS SUBD. FIL. NO. 4
RYDER TRUCK
OVERALL DRAINAGE PLAN

NO.	DATE	REMARKS

JOB NO.:	DCS19-4085
PA / PM:	C. STRAWN
DRAWN BY:	C. JOHNSON
DATE:	11/4/2019

SHEET