MEMORANDUM

To:	El Paso County - Stormwater		
From:	Scott Maier, PE (Ayres Associates)		
Date:	July 20, 2023	EPC Project No.:	PPR2315
Re:	Super Star Carwash – Claremont Business Park 2 – Drainage Compliance Letter		

Background

Super Star Carwash is planning to construct a carwash located within the Claremont Business Park 2 located at the southwest corner of Marksheffel Road and Meadowbrook Parkway. The site is currently vacant and is 1.5+/- acres.

The proposed development will consist of a 5,000+/- square foot carwash building with access drives, parking areas with vacuum bays, patio areas, and landscaping. This lot was initially contemplated for development as part of the overall development of the Claremont Business Park 2, Filing No. 2 VR 233. The overall development will construct the storm sewer system and detention pond for the overall development. The purpose of this letter is to demonstrate that the proposed development of the Super Star Carwash is in compliance with the assumptions of Claremont Business Park 2 Filing No. 2. Water quantity and that proposed development will meet water quality standards as required by El Paso County. The proposed development will discharge to an 18" RCP storm sewer system along El Jefe Heights that will be constructed as part of the overall development.

Explain where the site flow will go to a suitable outfall.

Runoff Comparison

The proposed development for the Super Star Carwash is part of Basin B within the Claremont Business Park 2 Filing No. 2 prepared by MS Civil Consultants, dated 6/11/23 as shown in the supporting documents. Below is a summary of the anticipated runoff from the overall drainage report.

Please update report in accordance with ECM 4.5
The FDR for VR233 has not been approved yet.
Please include drainage map showing basins for the lot

970.223.5556 | 3665 JFK Parkway, Bldg. 2, Suite 100 | Fort Collins, CO 80525-3152
www.AyresAssociates.com

Comparison Studies	Basin Area (acres)	Time of Concentration (min.)	Design Runoff Coefficient 5-yr	Design Runoff Coefficient 100-yr	Runoff (5 year) (CFS)	Runoff (100 year) (CFS)
Claremont Business Park 2 Filing No. 2 – Lot 1 Basin B	1.50	5.0	0.81	0.88	6.0	10.9
Super Star Carwash	1.78	5.0	C=0.49	C=0.68	3.34	10.77

The proposed development for the Super Star Carwash will have less designed runoff than those contemplated in the Claremont Business Park 2 Filing No. 2 drainage studies even after adding in the offsite areas along Marksheffel Rd and Meadowbrook Parkway.

Water Quality

Water Quality was not included as part of the improvements for the Claremont Business Park 2 Filing No. 2 overall development and is required to be constructed upon development. The Super Star Carwash proposes to construct a rain garden to serve the water quality requirements for it's development.

	WQCV Required	WQCV Provided	Method
Super Star Carwash Parking Lot and Building	0.027 Ac-Ft	0.027	Rain Garden

The rain garden is designed to have an underdrain system and an outfall to the west. As part of the proposed improvements, the site will drain a rain garden in the southern portion of the site. After treatment the rain garden will enter the overall development storm sewer system to the west and ultimately discharge into the water quantity pond southwest of the site.

Super Star Carwash will follow the "Four-Step Process" as defined below:

Step 1: Employ Runoff Reduction Practices
The proposed development utilizes reduced pavement areas with the implementation of landscaped islands in the parking lot and around the building.

Step 2: Stabilize Drainage Ways
Proposed drainage ways have been stabilized through the implementation of a concrete drainage pan for water entering the rain garden. A grass drainage swale is located along the east side of the property to capture offsite runoff that enters the property.

Step 3: Provide Water Quality Capture Volume (WQCV)
WQCV is achieved through a rain garden that treats onsite runoff. The rain garden is located at the southern portion of the property and treats building and parking lot runoff as well as offsite runoff that enters the site from the east.

Step 4: Consider Need for Industrial and Commercial BMP's
The proposed site will implement silt fence, construction entrance, concrete washout area and inlet protection to limit erosion and sediment runoff across the site.

Low Impact Development

This development will propose to construct a rain garden as part of the development. The rain garden will provide water quality benefits by providing filtration and some infiltration. The engineered media within the rain garden will provide filtration of the runoff from the site. In addition to the filtration for smaller rain events infiltration will also be a benefit of the rain garden.

Conclusion

The proposed Super Star Carwash development complies with the Claremont Business Park 2 overall drainage study. The regional drainage facility for the Claremont Business Park 2 Filing No. 2 provides the water quantity for the Super Star Carwash. The Super Star Carwash development will install the proposed rain garden to meet the water quality requirements of the onsite development.

In summary, the Super Star Carwash is in general compliance with the original development assumptions and no additional improvements to the storm sewer system beyond those noted is necessary.

If you should have any questions, please feel free to contact me at 262-522-4901.

Sincerely,

Scott Maier

There is no regional drainage facility.

Design Engineer's Statement:

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

_____ _____

[Scott Maier, P.E. #_____] Date

Owner/Developer Statement:

I, the Owner/Developer had read and will comply with all of the requirements specific in the is drainage report and Plan

_____ _____

[Name, Title] Date

_____

Business Name

_____

Address

El Paso County:

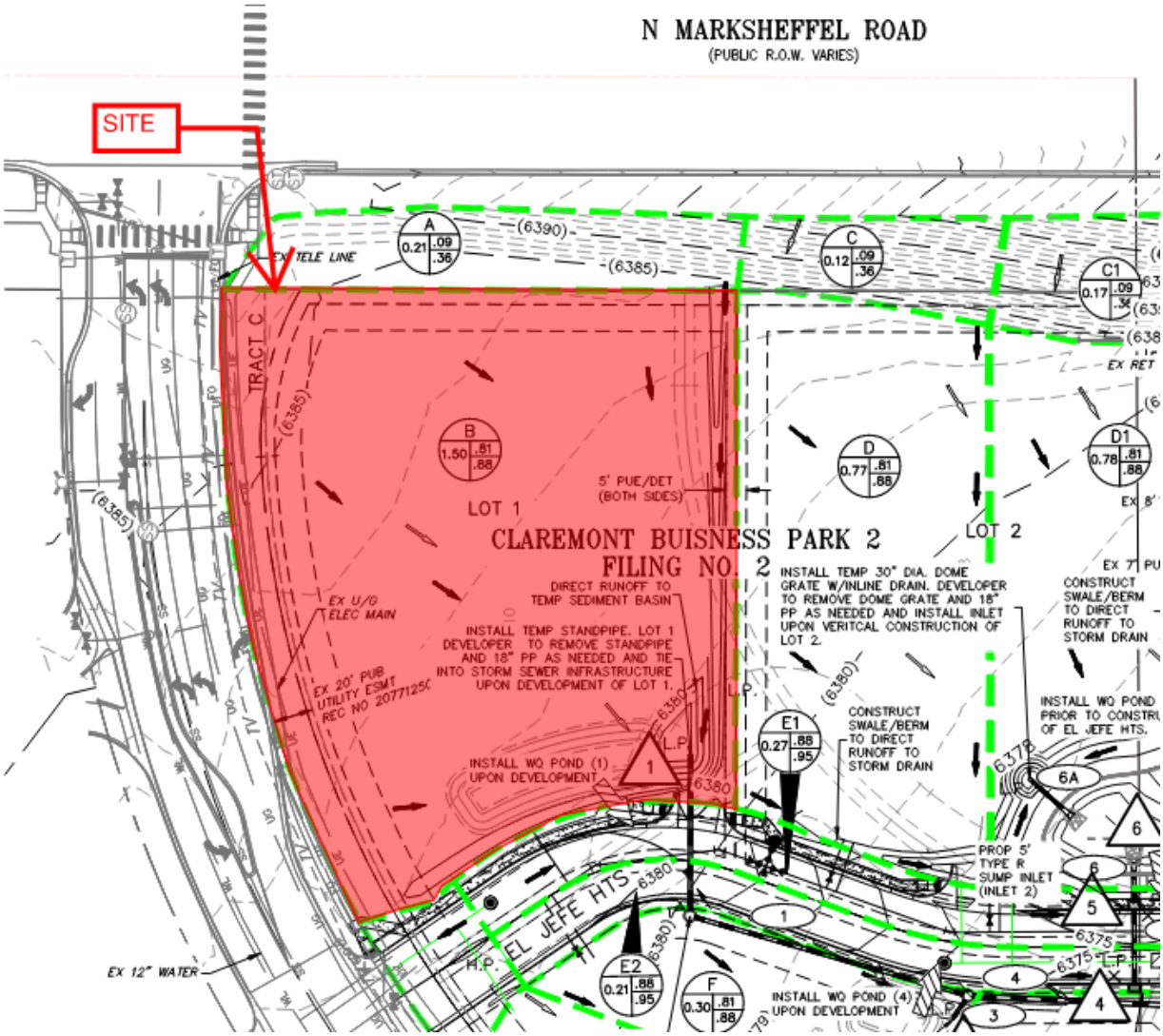
Filed in accordance with the requirements of the Drainage Criteria Manual, Volume 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as ammended

_____ _____

County Engineer/ECM Administrator Date

Conditions:

Bromley Park Filing 5 – Supporting Documents



(EXHIBIT ABOVE IS PORTION OF Claremont Business Park 2 Filing No. 2 DRAINAGE PLAN)

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO.2
PROPOSED DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			ROOFS 0.73-0.81 COMMERCIAL AREAS 0.81-0.88 ASPHALT DRIVES 0.90-0.96				*LANDSCAPED AREAS 0.16-0.41 GRAVEL STORAGE YARD 0.30-0.50 LIGHT INDUST AREAS 0.59-0.70*				*PARKS 0.12-0.39 GREENBELTS/AGRI. 0.09-0.36*				*WEIGHTED*		
BASIN	TOTAL AREA *(SF)*	TOTAL AREA *(Acres)*	AREA *(Acres)*	C_2	C_5	C_{100}	AREA *(Acres)*	C_2	C_5	C_{100}	AREA *(Acres)*	C_2	C_5	C_{100}	C_2	C_5	C_{100}
A	*9300.8*	**0.21**	0.00	0.89	0.90	0.96	0.00	0.07	0.16	0.41	0.21	0.03	0.09	0.36	***0.03***	***0.09***	***0.36***
B	*65284.4*	**1.50**	1.50	0.79	0.81	0.88	0.00	0.23	0.30	0.50	0.00	0.05	0.12	0.39	***0.79***	***0.81***	***0.88***
C	*5372.3*	**0.12**	0.00	0.89	0.90	0.96	0.00	0.07	0.16	0.41	0.12	0.03	0.09	0.36	***0.03***	***0.09***	***0.36***
C1	*7457.3*	**0.17**	0.00	0.89	0.90	0.96	0.00	0.07	0.16	0.41	0.17	0.03	0.09	0.36	***0.03***	***0.09***	***0.36***
[illegible]	[illegible]	[illegible]	0.77	0.79	0.81	0.88	0.00	0.23	0.30	0.50	0.00	0.05	0.12	0.39	[illegible]	[illegible]	[illegible]

(EXHIBIT ABOVE IS PORTION OF Claremont Business Park 2 Filing No. 2 Proposed Drainage Calculations-Area Runoff Coefficient Summary)

FINAL DRAINAGE REPORT FOR CLAREMONT BUSINESS PARK 2 FILING NO.2
PROPOSED DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary					OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T_t)		INTENSITY *			TOTAL FLOWS		
BASIN	AREA TOTAL (Acres)	C_2	C_5	C_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	*TOTAL (min)	CHECK (min)	I_2 (in/hr)	I_5 (in/hr)	I_{100} (in/hr)	Q_2 (c.f.s.)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
		From DCM Table 5-1																		
A	0.21	0.03	0.09	0.36	0.09	40	5.0	5.0	0	0.0%	0.0	0.0	5.0	10.2	4.1	5.2	8.7	*0.0*	*0.1*	*0.7*
B	1.50	0.79	0.81	0.88	0.81	80	1.0	4.4	240	1.7%	2.6	1.5	5.9	11.8	3.9	4.9	8.3	*4.6*	*6.0*	*10.9*
C	0.12	0.03	0.09	0.36	0.09	40	16.0	3.4	0	0.0%	0.0	0.0	5.0	10.2	4.1	5.2	8.7	*0.0*	*0.1*	*0.4*
C1	0.17	0.03	0.09	0.36	0.09	60	22.0	4.3	0	0.0%	0.0	0.0	5.0	10.3	4.1	5.2	8.7	*0.0*	*0.1*	*0.5*
D	0.77	0.79	0.81	0.88	0.81	60	1.2	3.2	250	1.6%	2.5	1.6	5.0	11.7	4.1	5.2	8.7	*2.5*	*3.2*	*5.9*
D1	0.78	0.79	0.81	0.88	0.81	60	1.2	3.2	250	1.6%	2.5	1.6	5.0	11.7	4.1	5.2	8.7	*2.5*	*3.3*	*6.0*
E1	0.27	0.87	0.88	0.95	0.88	30	0.6	1.7	280	2.0%	2.8	1.7	5.0	11.7	4.1	5.2	8.7	*1.0*	*1.2*	*2.2*
E2	0.21	0.87	0.88	0.95	0.88	30	0.6	1.7	280	2.0%	2.8	1.7	5.0	11.7	4.1	5.2	8.7	*0.7*	*1.0*	*1.7*
F	0.30	0.79	0.81	0.88	0.81	60	1.2	3.2	150	1.3%	2.3	1.1	5.0	11.2	4.1	5.2	8.7	*1.0*	*1.2*	*2.3*
G1	0.27	0.25	0.30	0.52	0.30	30	1.0	5.3	0	0.0%	0.0	0.0	5.3	10.2	4.1	5.1	8.5	*0.3*	*0.4*	*1.2*
G2	1.15	0.79	0.81	0.88	0.81	60	0.6	4.1	400	1.0%	2.0	3.3	7.4	12.6	3.7	4.6	7.7	*3.3*	*4.3*	*7.8*
H1	0.16	0.03	0.09	0.36	0.09	76	20.0	5.4	0	0.0%	0.0	0.0	5.4	10.4	4.0	5.1	8.5	*0.0*	*0.1*	*0.5*
H2	0.40	0.03	0.09	0.36	0.09	100	17.0	7.2	0	0.0%	0.0	0.0	7.2	10.6	3.7	4.6	7.8	*0.0*	*0.2*	*1.1*
H3	0.04	0.03	0.09	0.36	0.09	100	17.0	7.2	0	2.0%	1.4	0.0	7.2	10.6	3.7	4.6	7.8	*0.0*	*0.0*	*0.1*
H4	0.10	0.03	0.09	0.36	0.09	100	17.0	7.2	0	0.0%	0.0	0.0	7.2	10.6	3.7	4.6	7.8	*0.0*	*0.0*	*0.3*
I1	0.55	0.82	0.83	0.90	0.83	100	3.0	3.4	216	2.5%	3.2	1.1	5.0	11.8	4.1	5.2	8.7	*1.8*	*2.3*	*4.3*
I2	0.48	0.77	0.79	0.87	0.79	50	2.0	2.5	261	1.0%	2.0	2.2	5.0	11.7	4.1	5.2	8.7	*1.5*	*2.0*	*3.6*

(EXHIBIT ABOVE IS PORTION OF Claremont Business Park 2 Filing No. 2 Proposed Drainage Calculations-Area Drainage Summary)

Super Star Carwash Onsite Drainage Calculations

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Super Star Carwash Soil Information

Map Scale: 1:834 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 40 80 160 240

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	0.0	0.5%
10	Blendon sandy loam, 0 to 3 percent slopes	B	1.4	58.1%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	1.0	41.3%
Totals for Area of Interest			**2.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

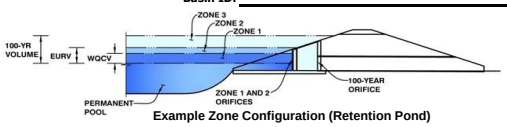
Super Star Carwash Onsite Water Quality Basin Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**RG**	
Watershed Area =	1.37	acres
Watershed Length =	330	ft
Watershed Length to Centroid =	165	ft
Watershed Slope =	0.013	ft/ft
Watershed Imperviousness =	59.60%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	120	hours
Location for 1-hr Rainfall Depths =	Parker - Town Hall	

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) =	0.027	acre-feet	0.027	acre-feet
Excess Urban Runoff Volume (EURV) =	0.099	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.82 in.) =		acre-feet		inches
5-yr Runoff Volume (P1 = 1.1 in.) =		acre-feet		inches
10-yr Runoff Volume (P1 = 1.34 in.) =		acre-feet		inches
25-yr Runoff Volume (P1 = 1.69 in.) =		acre-feet		inches
50-yr Runoff Volume (P1 = 1.98 in.) =		acre-feet		inches
100-yr Runoff Volume (P1 = 2.29 in.) =		acre-feet		inches
500-yr Runoff Volume (P1 = 3.08 in.) =		acre-feet		inches
Approximate 2-yr Detention Volume =		acre-feet		
Approximate 5-yr Detention Volume =		acre-feet		
Approximate 10-yr Detention Volume =		acre-feet		
Approximate 25-yr Detention Volume =		acre-feet		
Approximate 50-yr Detention Volume =		acre-feet		
Approximate 100-yr Detention Volume =		acre-feet		

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
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 = 0.20 ft

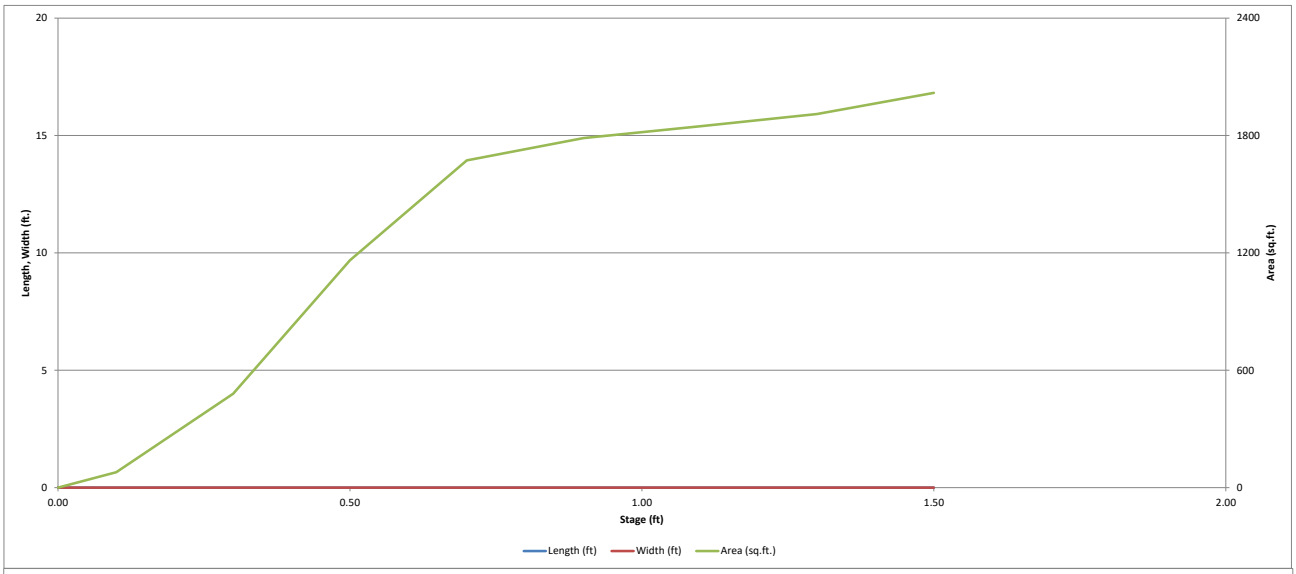
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Media Surface	--	0.00	--	--	--	0	0.000		
6377.6	--	0.10	--	--	--	79	0.002	4	0.000
6377.8	--	0.30	--	--	--	480	0.011	60	0.001
6378	--	0.50	--	--	--	1,162	0.027	224	0.005
6378.2	--	0.70	--	--	--	1,673	0.038	507	0.012
6378.4	--	0.90	--	--	--	1,787	0.041	853	0.020
6378.6	--	1.10	--	--	--	1,847	0.042	1,217	0.028
6378.8	--	1.30	--	--	--	1,910	0.044	1,593	0.037
6379	--	1.50	--	--	--	2,018	0.046	1,985	0.046

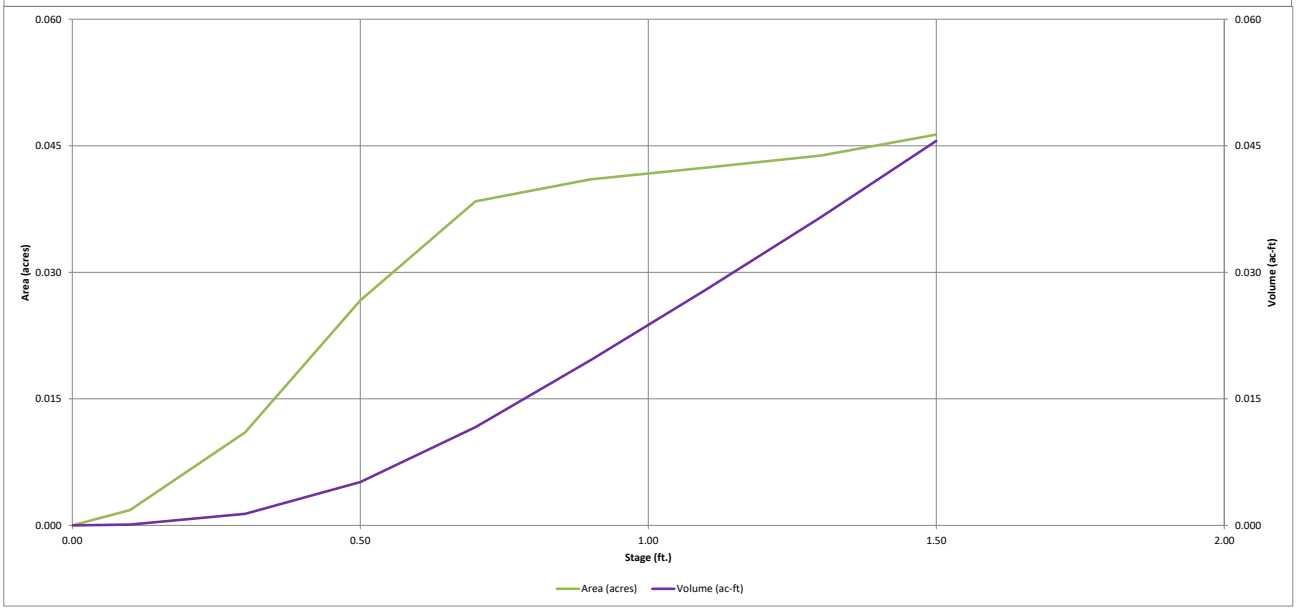
Include all sheets

Correct for Colorado Springs

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)



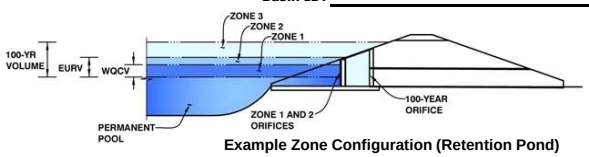


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1	#N/A		Filtration Media
Zone 2			
Zone 3			
Total (all zones)			

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

Underdrain Orifice Invert Depth =	1.52	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.76	inches	Underdrain Orifice Centroid =	0.03	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)

Centroid of Lowest Orifice =		ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =		inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		sq. inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (optional)	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)								
Orifice Area (sq. inches)								

	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 =			ft^2
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)

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft^2
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft^2
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			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=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =	feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =	acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =	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) =	N/A	N/A	0.82	1.10	1.34	1.69	1.98	2.29	3.08
CUHP Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =									
CUHP Predevelopment Peak Q (cfs) =									
OPTIONAL Override Predevelopment Peak Q (cfs) =									
Predevelopment Unit Peak Flow, q (cfs/acre) =									
Peak Inflow Q (cfs) =									
Peak Outflow Q (cfs) =									
Ratio Peak Outflow to Predevelopment Q =									
Structure Controlling Flow =									
Max Velocity through Grate 1 (fps) =									
Max Velocity through Grate 2 (fps) =									
Time to Drain 97% of Inflow Volume (hours) =									
Time to Drain 99% of Inflow Volume (hours) =									
Maximum Ponding Depth (ft) =									
Area at Maximum Ponding Depth (acres) =									
Maximum Volume Stored (acre-ft) =									

Super Star Carwash Onsite Runoff Calculations

Calculation of Peak Runoff using Rational Method

Designer: Scott Maier
Company: Ayres Associates
Date: 6/23/2023
Project: SUPER STAR CAR WASH
Location: MEADOWBROOK, Mesa County

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.83	1.11	1.38	1.69	2.17	2.58	3.14
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Basin A1	0.03	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	10.00			0.250	0.48	50.00			0.010	20	2.00	0.42	0.90	9.36	5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	0.07	0.10	0.12	0.15	0.20	0.23	0.29
					0.89				0.96						0.41								0.83																
Basin A2	0.97	B	74.0	0.59	0.62	0.65	0.71	0.74	0.77	0.81	100.00			0.250	3.01	200.00			0.010	20	2.00	1.67	4.68	15.14	5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	1.59	2.26	2.97	3.97	5.29	6.54	8.34
					0.66				0.80						2.75								4.41																
Basin A3	0.29	B	0.0	0.00	0.00	0.06	0.25	0.33	0.43	0.54	10.00			0.020	5.00	100.00			0.010	15	1.50	1.11	6.11	27.85	10.00	2.23	3.00	3.73	4.57	5.87	6.98	8.50	0.00	0.00	0.06	0.33	0.56	0.86	1.32
					0.02				0.35						4.91								6.02		5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	0.00	0.02	0.08	0.41	0.70	0.89	1.66
Basin A4	0.11	B	0.0	0.00	0.00	0.06	0.25	0.33	0.43	0.54	10.00			0.020	5.00	20.00			0.020	20	2.83	0.12	5.11	26.26	10.00	2.23	3.00	3.73	4.57	5.87	6.98	8.50	0.00	0.00	0.02	0.13	0.21	0.33	0.50
					0.02				0.35						4.91								5.02																
Basin A5	0.12	B	0.0	0.00	0.00	0.06	0.25	0.33	0.43	0.54	20.00			0.250	3.07	50.00			0.030	20	3.46	0.24	3.31	26.53	10.00	2.23	3.00	3.73	4.57	5.87	6.98	8.50	0.00	0.00	0.03	0.14	0.23	0.36	0.55
					0.02				0.35						3.01								3.26																
Basin B1	0.11	B	100.0	0.84	0.86	0.86	0.88	0.89	0.89	0.90	120.00			0.043	2.97	120.00			0.043	20	4.15	0.48	3.45	9.42	5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	0.26	0.35	0.44	0.55	0.72	0.86	1.06
					0.89				0.96						2.57								3.05		5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	0.26	0.37	0.44	0.55	0.72	0.92	1.06
Basin Off	0.18	B	65.0	0.50	0.54	0.58	0.66	0.69	0.73	0.77																													
					0.59				0.75																5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	0.25	0.40	0.49	0.68	0.92	1.18	1.48
Rain Garden	1.63	B	47.0	0.35	0.38	0.44	0.54	0.59	0.64	0.71																													
					0.43				0.60																5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	1.58	2.64	3.33	5.08	7.08	8.56	12.29
Total Site	1.81	B	54.0	0.41	0.44	0.49	0.59	0.63	0.68	0.73																													
					0.49				0.68																5.00	2.80	3.76	4.68	5.73	7.36	8.75	10.65	2.06	3.34	4.17	6.10	8.38	10.77	14.14

Provide the drainage and basin map the goes with this in the report.

Super Star Carwash Onsite Inlet Calculations

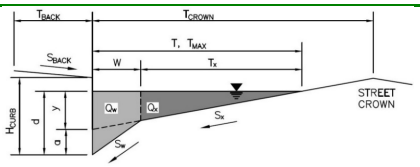
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **Super Star Car Wash - Meadowbrook**

Inlet ID: **Basin A1**



Gutter Geometry:			
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} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	10.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.048	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 =	0.007	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	5.76	5.76	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.42	0.42	inches
Water Depth at Gutter Flowline	d =	6.18	6.18	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	9.0	9.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.257	0.257	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.0	8.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.8	2.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.8**	**10.8**	**cfs**
Flow Velocity within the Gutter Section	V =	1.5	1.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.8	0.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	9.7	9.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.7	8.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.265	0.265	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	7.3	7.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.6	2.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.9	9.9	cfs
Average Flow Velocity Within the Gutter Section	V =	1.4	1.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.7	0.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.9**	**9.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	6.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

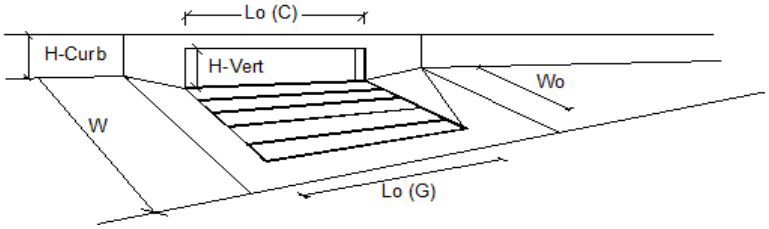
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**9.9**	**9.9**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type C Grate)	Type =	CDOT Type C Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	0.0	0.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	2.92	2.92	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	2.92	2.92	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.1	0.3	cfs
Water Spread Width	T =	1.6	2.2	ft
Water Depth at Flowline (outside of local depression)	d =	1.3	1.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.968	0.849	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.0	cfs
Discharge within the Gutter Section W	Q_w =	0.1	0.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.07	0.10	sq ft
Velocity within the Gutter Section W	V_W =	1.7	2.1	fps
Water Depth for Design Condition	d_{LOCAL} =	1.3	1.7	inches

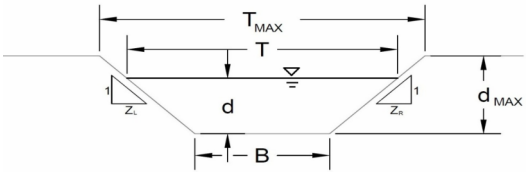
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	2.92	2.92	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	-0.487	0.496	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	9.94	9.94	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.61	0.55	
Interception Capacity	Q_i =	0.1	0.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.50	0.50	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	1.46	1.46	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	6.91	6.91	fps
Interception Rate of Frontal Flow	R_f =	1.00	1.00	
Interception Rate of Side Flow	R_x =	0.24	0.20	
Actual Interception Capacity	**Q_a =**	**0.0**	**0.1**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.1**	**0.1**	**cfs**

Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	N/A	N/A	ft/ft
Required Length L_T to Have 100% Interception	L_T =	N/A	N/A	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	N/A	N/A	ft
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	N/A	N/A	
Effective (Unclogged) Length	L_e =	N/A	N/A	ft
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**N/A**	**N/A**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.0**	**0.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**-12**	**60**	**%**

AREA INLET IN A SWALE

Super Star Car Wash - Meadowbrook
Rain Garden Outlet Structure



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

	NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	B	
	Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
	Channel Invert Slope	S_O =	0.0050	ft/ft
	Bottom Width	B =	10.00	ft
Warning 01	Left Side Slope	Z1 =	0.50	ft/ft
Warning 01	Right Side Sloe	Z2 =	0.50	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	**T_{MAX} =**	**12.20**	**13.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	**d_{MAX} =**	**1.10**	**1.50**	**ft**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Maximum Allowable Top Width	**T_{MAX} =**	**12.20**	**13.00**	**ft**
Water Depth	d =	2.20	3.00	ft
Flow Area	A =	24.42	34.50	sq ft
Wetted Perimeter	P =	14.92	16.71	ft
Hydraulic Radius	R =	1.64	2.06	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.080	0.057	
Flow Velocity	V =	1.82	3.02	fps
Velocity-Depth Product	VR =	2.99	6.24	ft^2/s
Hydraulic Depth	D =	2.00	2.65	ft
Froude Number	Fr =	0.23	0.33	
Maximum Flow Based on Allowable Water Depth	**Q_T =**	**44.5**	**104.3**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Maximum Allowable Water Depth	**d_{MAX} =**	**1.10**	**1.50**	**ft**
Top Width	T =	11.10	11.50	ft
Flow Area	A =	11.61	16.13	sq ft
Wetted Perimeter	P =	12.46	13.35	ft
Hydraulic Radius	R =	0.93	1.21	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.315	0.170	
Flow Velocity	V =	0.32	0.70	fps
Velocity-Depth Product	VR =	0.30	0.85	ft^2/s
Hydraulic Depth	D =	1.05	1.40	ft
Froude Number	Fr =	0.05	0.10	
Maximum Flow Based On Allowable Water Depth	**Q_d =**	**3.7**	**11.3**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**3.7**	**11.3**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	**d_{allow} =**	**1.10**	**1.50**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	**Q_o =**	**2.6**	**8.6**	**cfs**
Water Depth	**d =**	**0.91**	**1.45**	**ft**
Top Width	T =	10.91	11.45	ft
Flow Area	A =	9.46	15.52	sq ft
Wetted Perimeter	P =	12.02	13.24	ft
Hydraulic Radius	R =	0.79	1.17	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.322	0.213	
Flow Velocity	V =	0.28	0.55	fps
Velocity-Depth Product	VR =	0.22	0.65	ft^2/s
Hydraulic Depth	D =	0.87	1.36	ft
Froude Number	Fr =	0.05	0.08	

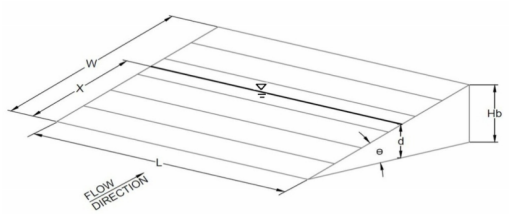
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

AREA INLET IN A SWALE

Super Star Car Wash - Meadowbrook
Rain Garden Outlet Structure

Inlet Design Information (Input)

Type of Inlet	CDOT Type C (Depressed)	Inlet Type =	CDOT Type C (Depressed)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.84	
Orifice Coefficient		C_o =	0.56	
Weir Coefficient		C_w =	1.81	



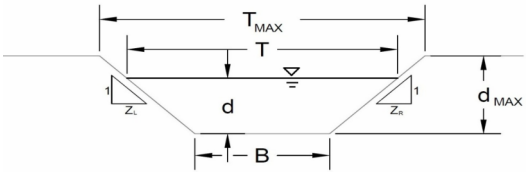
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.91	2.45	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	ft
Inclined Side Weir Flow	Q_{ws} =	24.9	36.3	cfs
Base Weir Flow	Q_{wb} =	35.6	51.9	cfs
Interception Without Cloggging	Q_{wi} =	85.5	124.5	cfs
Interception With Clogging	Q_{wa} =	42.7	62.3	cfs
Grate Capacity as an Orifice				
Interception Without Clogging	Q_{oi} =	39.3	44.5	cfs
Interception With Clogging	Q_{oa} =	19.6	22.3	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**19.6**	**22.3**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

Warning 01: Sideslope steepness exceeds USDCM Volume I recommendation.

AREA INLET IN A SWALE

Super Star Car Wash - Meadowbrook

Basin A4



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	B	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	10.00	ft/ft
Right Side Sloe	Z2 =	20.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	15.00	15.00	ft
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.50	0.50	ft

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	0.9	0.9	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.37	0.37	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.0	0.3	cfs
Water Depth	d =	0.03	0.21	ft

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

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

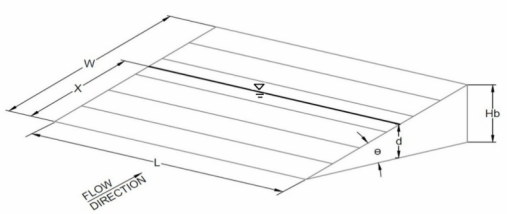
AREA INLET IN A SWALE

Super Star Car Wash - Meadowbrook

Basin A4

Inlet Design Information (Input)

Type of Inlet	CDOT Type C (Depressed)	Inlet Type =	CDOT Type C (Depressed)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.84	
Orifice Coefficient		C_o =	0.56	
Weir Coefficient		C_w =	1.81	

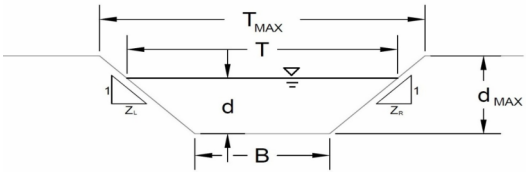


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.03	1.21	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.5**	**15.6**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

AREA INLET IN A SWALE

Super Star Car Wash - Meadowbrook

Basin A5



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	B	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	10.00	ft/ft
Right Side Sloe	Z2 =	10.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	10.00	10.00	ft
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.50	0.50	ft

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	0.5	0.5	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.30	0.30	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.0	0.3	cfs
Water Depth	d =	0.03	0.23	ft

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

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

AREA INLET IN A SWALE

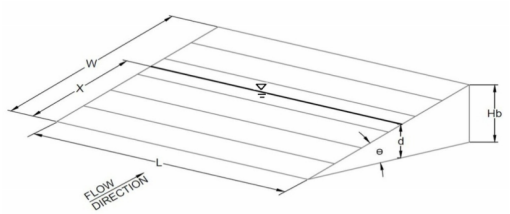
Super Star Car Wash - Meadowbrook

Basin A5

Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C

Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	ft
Length of Grate	L =	3.00	ft
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	ft
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.96	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	

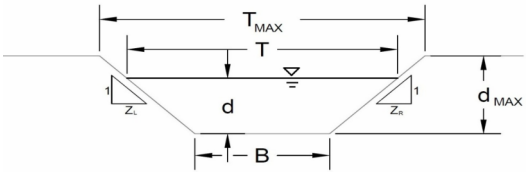


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.03	0.23	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.1**	**2.0**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

AREA INLET IN A SWALE

Super Star Car Wash - Meadowbrook

Basin A3



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	B	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Sloe	Z2 =	5.00	ft/ft

Check one of the following soil types:

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

Choose One:
- (•) **Non-Cohesive**
- ( ) **Cohesive**
- ( ) **Paved**

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**10.00**	**10.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.50**	**0.50**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**1.1**	**1.1**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.50**	**0.50**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.0**	**0.9**	**cfs**
Water Depth	**d** =	**0.05**	**0.45**	**ft**

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

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

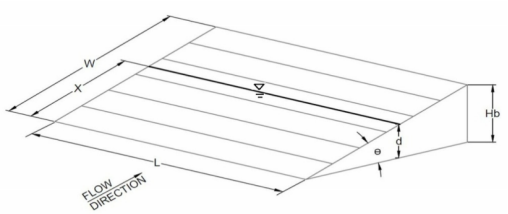
AREA INLET IN A SWALE

Super Star Car Wash - Meadowbrook

Basin A3

Inlet Design Information (Input)

Type of Inlet	CDOT Type C (Depressed)	Inlet Type =	CDOT Type C (Depressed)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.84	
Orifice Coefficient		C_o =	0.56	
Weir Coefficient		C_w =	1.81	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.05	1.45	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.6**	**17.1**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**