HCI ENGINEERING

A division of
HABERER CARPENTRY INC.

February 22, 2017

Attn: City of Albuquerque, Hydrology Department
600 2nd Street NW
Albuquerque, NM 87102

Re: 15_39 Taco Bell at Heritage Marketplace (Project File: H09D026) Drainage Calculations

To whom it may concern,

Please see the attached drainage calculations. These calculations were used to determine the runoff values for the existing and proposed site, required and proposed pond storage volumes, design the outlet structures and size the associated storm pipes. Please see below for a list of the included documents.

Sincerely,

Digitally signed by Lance VanDemark
'Date: 2017.03.01 12:55:57 -07'00

Lance VanDemark, PE 21777
The Vertex Companies, Inc.

Attachments:
DPM Weighted E Method
Pond Volume Calculations
Water Quality (First Flush) Basin Volume Calculations
Pond 1 Outlet Structure – Water Quality Capture Volume Orifice Plate Design
Pond 1 Outlet Structure – Restrictor Plate Sizing
Pond 1 Outlet Structure – Weir and Orifice Design
Pond 2 Outlet Structure – Water Quality Capture Volume Orifice Plate Design
Pond 2 Outlet Structure – Restrictor Plate Sizing
Pond 2 Outlet Structure – Weir and Orifice Design
12” Dia. Pipe Sizing
18” Dia. Pipe Sizing

621 SOUTHPARK DR., SUITE #1600 – LITTLETON, CO 80120 - (303) 979-3900 - FAX (303) 278-7814
EMAIL: COLEH@HABERERGROUP.COM

Basin Descriptions															100-Year, 6-Hour			10-Year, 6-Hour			2-Year, 6-Hour		
			Treatment A			Treatment B			Treatment C			Treatment D											
Basin	Area (sf)	Area (acres)	(sf)	(acres)	%	(sf)	(acres)	%	(sf)	(acres)	%	(sf)	(acres)	%	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
B2-A	17083	0.392	0	0	0%	0	0	0%	3765	0.086	22%	13318	0.306	78%	1.754	0.057	1.584	1.064	0.035	1.012	0.175	0.006	0.557
B2-B	2454	0.056	0	0	0%	0	0	0%	1660	0.038	68%	794	0.018	32%	1.307	0.006	0.189	0.699	0.023	0.109	0.112	0.004	0.049
B2-C	3568	0.082	0	0	0%	0	0	0%	1393	0.032	39%	2175	0.050	61%	1.587	0.011	0.310	0.928	0.030	0.192	0.152	0.005	0.099
B2-D	11300	0.259	0	0	0%	0	0	0%	1506	0.035	13%	9794	0.225	87%	1.839	0.040	1.082	1.133	0.037	0.701	0.187	0.006	0.396
B2-E	2440	0.056	0	0	0%	0	0	0%	817	0.019	33%	1623	0.037	67%	1.642	0.008	0.217	0.972	0.032	0.136	0.160	0.005	0.072
B2-F	1526	0.035	0	0	0%	0	0	0%	1526	0.035	100%	0	0.000	0%	0.990	0.003	0.101	0.440	0.014	0.052	0.064	0.002	0.016
OS-1	8659	0.199	0	0	0%	0	0	0%	0	0.000	0%	8659	0.199	100%	1.970	0.033	0.869	1.240	0.041	0.574	0.205	0.007	0.336
TOTAL	38371	0.881	0	0	0%	0	0	0%	10667	0.245	28%	27704	0.636	72%	1.698	0.125	3.482	1.018	0.033	2.203	0.168	0.005	1.190
EXISTING	38371	0.881	0	0	0%	0	0	0%	38371	0.881	100%	0	0.000	0%	0.990	0.073	2.528	0.440	0.014	1.313	0.064	0.002	0.414

Zone 1 - Excess Precipitation, E (inches) 6-Hour Storm

Treatment	100-Yr	10-Yr	2-Yr
A	0.44	0.08	0
B	0.67	0.22	0.01
C	0.99	0.44	0.12
D	1.97	1.24	0.72

Zone 1 - Peak Discharge (CFS/Acre)

Treatment	100-Yr	10-Yr	2-Yr
A	1.29	0.24	0
B	2.03	0.76	0.03
C	2.87	1.49	0.47
D	4.37	2.89	1.69

Equations

Weighted E = Ea*Aa + Eb*Ab + Ec*Ac + Ed*Ad / (Aa + Ab + Ac + Ad)

Volume = Weighted E * (Aa + Ab + Ac + Ad)

Flow = Qa*Aa + Qb*Ab + Qc*Ac + Qd*Ad

Basin	First Flush Volume (cf)
B2-A	377
B2-B	22
B2-C	62
B2-D	277
B2-E	46
B2-F	0
Total Req'd	785

First Flush Volume =
(0.44"-0.1")*Type D Area

Pond 1 Volume Calcuations				
Elevation (feet)	Area (sf)	Cumulative Vol. (cf)	Cumulative Vol. (acre-ft)	Retained 1st Flush Vol. (cf)
5174.00	22	11	0.000	
5174.25	49	20	0.000	
5174.50	80	36	0.001	
5174.75	130	61	0.001	
5175.00	187	101	0.002	
5175.25	250	157	0.004	
5175.50	320	228	0.005	
5175.75	396	318	0.007	318
5176.00	476	427	0.010	
5176.25	559	556	0.013	
5176.50	649	707	0.016	
5176.75	743	881	0.020	
5177.00	834	1078	0.025	
5177.25	917	1297	0.030	
5177.50	996	1536	0.035	
5177.75	1073	1795	0.041	Minor 2-yr WSEL
5178.00	1143	2072	0.048	5178.10
5178.25	1208	2366	0.054	
5178.50	1275	2676	0.061	Major 100-yr WSEL
5178.75	1366	3006	0.069	5178.93
5179.00	1385	3350	0.077	
5179.25	1430	3702	0.085	

Pond 2 Volume Calcuations				
Elevation (feet)	Area (sf)	Cumulative Vol. (cf)	Cumulative Vol. (acre-ft)	Retained 1st Flush Vol. (cf)
5173.00	109	21	0.000	
5173.25	287	69	0.002	
5173.50	450	160	0.004	
5173.75	532	281	0.006	281
5174.00	570	419	0.010	
5174.25	594	570	0.013	
5174.50	618	721	0.017	
5174.75	642	879	0.020	
5175.00	665	1042	0.024	
5175.25	688	1211	0.028	
5175.50	710	1386	0.032	
5175.75	731	1566	0.036	
5176.00	752	1752	0.040	Minor 2-yr WSEL
5176.25	772	1942	0.045	5176.39
5176.50	792	2138	0.049	Major 100-yr WSEL
5176.75	811	2338	0.054	5176.63
5177.00	830	2543	0.058	

Water Quality Basin B2-B Volume Calcuations				
Elevation (feet)	Area (sf)	Cumulative Vol. (cf)	Cumulative Vol. (acre-ft)	Retained 1st Flush Vol. (cf)
5179.75	342	46	0.001	
5180.00	498	149	0.003	149

Water Quality Basin B2-C Volume Calcuations				
Elevation (feet)	Area (sf)	Cumulative Vol. (cf)	Cumulative Vol. (acre-ft)	Retained 1st Flush Vol. (cf)
5181.00	166	28	0.001	
5181.25	365	92	0.002	92

Total Pond Volume	
6245 sf	0.143 acre-ft

Total Retention Volume
840 > 785 Req'd

DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: 15_39 Taco Bell Heritage

Basin ID: Pond 1

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)
(NOTE: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

Determination of MINOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	74.95	percent
Catchment Drainage Area	A =	0.449	acres
Predevelopment NRCS Soil Group	Type =	A	A, B, C, or D
Return Period for Detention Control	T =	2	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	5	minutes
Allowable Unit Release Rate	q =	0.02	cfs/acre
One-hour Precipitation	P_1 =	0.72	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.47	
Inflow Peak Runoff	Qp-in =	0.51	cfs
Allowable Peak Outflow Rate	Qp-out =	**0.01**	cfs
Mod. FAA Minor Storage Volume =		761	**cubic feet**
Mod. FAA Minor Storage Volume =		**0.017**	**acre-ft**

5 <- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
5	2.42	0.004	1.00	0.01	0.000	0.003
10	1.93	0.006	0.75	0.01	0.000	0.006
15	1.62	0.007	0.67	0.01	0.000	0.007
20	1.40	0.008	0.63	0.01	0.000	0.008
25	1.24	0.009	0.60	0.01	0.000	0.009
30	1.12	0.010	0.58	0.01	0.000	0.010
35	1.02	0.010	0.57	0.01	0.000	0.010
40	0.94	0.011	0.56	0.01	0.000	0.011
45	0.87	0.011	0.56	0.00	0.000	0.011
50	0.81	0.012	0.55	0.00	0.000	0.011
55	0.76	0.012	0.55	0.00	0.000	0.012
60	0.72	0.013	0.54	0.00	0.000	0.012
65	0.68	0.013	0.54	0.00	0.000	0.012
70	0.65	0.013	0.54	0.00	0.000	0.013
75	0.62	0.013	0.53	0.00	0.000	0.013
80	0.59	0.014	0.53	0.00	0.001	0.013
85	0.56	0.014	0.53	0.00	0.001	0.013
90	0.54	0.014	0.53	0.00	0.001	0.014
95	0.52	0.014	0.53	0.00	0.001	0.014
100	0.50	0.015	0.53	0.00	0.001	0.014
105	0.49	0.015	0.52	0.00	0.001	0.014
110	0.47	0.015	0.52	0.00	0.001	0.014
115	0.45	0.015	0.52	0.00	0.001	0.014
120	0.44	0.015	0.52	0.00	0.001	0.015
125	0.43	0.016	0.52	0.00	0.001	0.015
130	0.42	0.016	0.52	0.00	0.001	0.015
135	0.40	0.016	0.52	0.00	0.001	0.015
140	0.39	0.016	0.52	0.00	0.001	0.015
145	0.38	0.016	0.52	0.00	0.001	0.015
150	0.37	0.016	0.52	0.00	0.001	0.015
155	0.37	0.016	0.52	0.00	0.001	0.015
160	0.36	0.017	0.52	0.00	0.001	0.016
165	0.35	0.017	0.52	0.00	0.001	0.016
170	0.34	0.017	0.51	0.00	0.001	0.016
175	0.33	0.017	0.51	0.00	0.001	0.016
180	0.33	0.017	0.51	0.00	0.001	0.016
185	0.32	0.017	0.51	0.00	0.001	0.016
190	0.31	0.017	0.51	0.00	0.001	0.016
195	0.31	0.017	0.51	0.00	0.001	0.016
200	0.30	0.018	0.51	0.00	0.001	0.016
205	0.30	0.018	0.51	0.00	0.001	0.016
210	0.29	0.018	0.51	0.00	0.001	0.016
215	0.29	0.018	0.51	0.00	0.001	0.017
220	0.28	0.018	0.51	0.00	0.001	0.017
225	0.28	0.018	0.51	0.00	0.001	0.017
230	0.27	0.018	0.51	0.00	0.001	0.017
235	0.27	0.018	0.51	0.00	0.001	0.017
240	0.26	0.018	0.51	0.00	0.002	0.017
245	0.26	0.018	0.51	0.00	0.002	0.017
250	0.26	0.019	0.51	0.00	0.002	0.017
255	0.25	0.019	0.51	0.00	0.002	0.017
260	0.25	0.019	0.51	0.00	0.002	0.017
265	0.24	0.019	0.51	0.00	0.002	0.017
270	0.24	0.019	0.51	0.00	0.002	0.017
275	0.24	0.019	0.51	0.00	0.002	0.017
280	0.23	0.019	0.51	0.00	0.002	0.017
285	0.23	0.019	0.51	0.00	0.002	0.017
290	0.23	0.019	0.51	0.00	0.002	0.017
295	0.22	0.019	0.51	0.00	0.002	0.017
300	0.22	0.019	0.51	0.00	0.002	0.017

Mod. FAA Minor Storage Volume (cubic ft.) = **761**
Mod. FAA Minor Storage Volume (acre-ft.) = **0.0175**

Determination of MAJOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	74.95	percent
Catchment Drainage Area	A =	0.449	acres
Predevelopment NRCS Soil Group	Type =	A	A, B, C, or D
Return Period for Detention Control	T =	100	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	5	minutes
Allowable Unit Release Rate	q =	0.50	cfs/acre
One-hour Precipitation	P_1 =	1.97	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.61	
Inflow Peak Runoff	Qp-in =	1.82	cfs
Allowable Peak Outflow Rate	Qp-out =	**0.22**	cfs
Mod. FAA Major Storage Volume =		1,555	**cubic feet**
Mod. FAA Major Storage Volume =		**0.036**	**acre-ft**

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
5	6.63	0.013	1.00	0.22	0.002	0.011
10	5.28	0.020	0.75	0.17	0.002	0.018
15	4.43	0.025	0.67	0.15	0.003	0.022
20	3.84	0.029	0.63	0.14	0.004	0.025
25	3.40	0.032	0.60	0.13	0.005	0.027
30	3.06	0.035	0.58	0.13	0.005	0.029
35	2.79	0.037	0.57	0.13	0.006	0.031
40	2.56	0.039	0.56	0.13	0.007	0.032
45	2.38	0.040	0.56	0.12	0.008	0.033
50	2.22	0.042	0.55	0.12	0.009	0.033
55	2.08	0.043	0.55	0.12	0.009	0.034
60	1.97	0.044	0.54	0.12	0.010	0.034
65	1.86	0.046	0.54	0.12	0.011	0.035
70	1.77	0.047	0.54	0.12	0.012	0.035
75	1.69	0.048	0.53	0.12	0.012	0.035
80	1.61	0.049	0.53	0.12	0.013	0.036
85	1.54	0.050	0.53	0.12	0.014	0.036
90	1.48	0.050	0.53	0.12	0.015	0.036
95	1.43	0.051	0.53	0.12	0.015	0.036
100	1.38	0.052	0.53	0.12	0.016	0.036
105	1.33	0.053	0.52	0.12	0.017	0.036
110	1.28	0.053	0.52	0.12	0.018	0.036
115	1.24	0.054	0.52	0.12	0.019	0.035
120	1.21	0.055	0.52	0.12	0.019	0.035
125	1.17	0.055	0.52	0.12	0.020	0.035
130	1.14	0.056	0.52	0.12	0.021	0.035
135	1.11	0.056	0.52	0.12	0.022	0.035
140	1.08	0.057	0.52	0.12	0.022	0.034
145	1.05	0.057	0.52	0.12	0.023	0.034
150	1.02	0.058	0.52	0.12	0.024	0.034
155	1.00	0.058	0.52	0.12	0.025	0.034
160	0.98	0.059	0.52	0.12	0.026	0.033
165	0.95	0.059	0.52	0.12	0.026	0.033
170	0.93	0.060	0.51	0.12	0.027	0.033
175	0.91	0.060	0.51	0.12	0.028	0.032
180	0.89	0.061	0.51	0.12	0.029	0.032
185	0.88	0.061	0.51	0.12	0.029	0.032
190	0.86	0.062	0.51	0.12	0.030	0.031
195	0.84	0.062	0.51	0.12	0.031	0.031
200	0.83	0.062	0.51	0.12	0.032	0.031
205	0.81	0.063	0.51	0.11	0.032	0.030
210	0.80	0.063	0.51	0.11	0.033	0.030
215	0.78	0.063	0.51	0.11	0.034	0.029
220	0.77	0.064	0.51	0.11	0.035	0.029
225	0.76	0.064	0.51	0.11	0.036	0.029
230	0.74	0.065	0.51	0.11	0.036	0.028
235	0.73	0.065	0.51	0.11	0.037	0.028
240	0.72	0.065	0.51	0.11	0.038	0.027
245	0.71	0.066	0.51	0.11	0.039	0.027
250	0.70	0.066	0.51	0.11	0.039	0.026
255	0.69	0.066	0.51	0.11	0.040	0.026
260	0.68	0.066	0.51	0.11	0.041	0.025
265	0.67	0.067	0.51	0.11	0.042	0.025
270	0.66	0.067	0.51	0.11	0.043	0.025
275	0.65	0.067	0.51	0.11	0.043	0.024
280	0.64	0.068	0.51	0.11	0.044	0.024
285	0.63	0.068	0.51	0.11	0.045	0.023
290	0.62	0.068	0.51	0.11	0.046	0.023
295	0.62	0.068	0.51	0.11	0.046	0.022
300	0.61	0.069	0.51	0.11	0.047	0.022

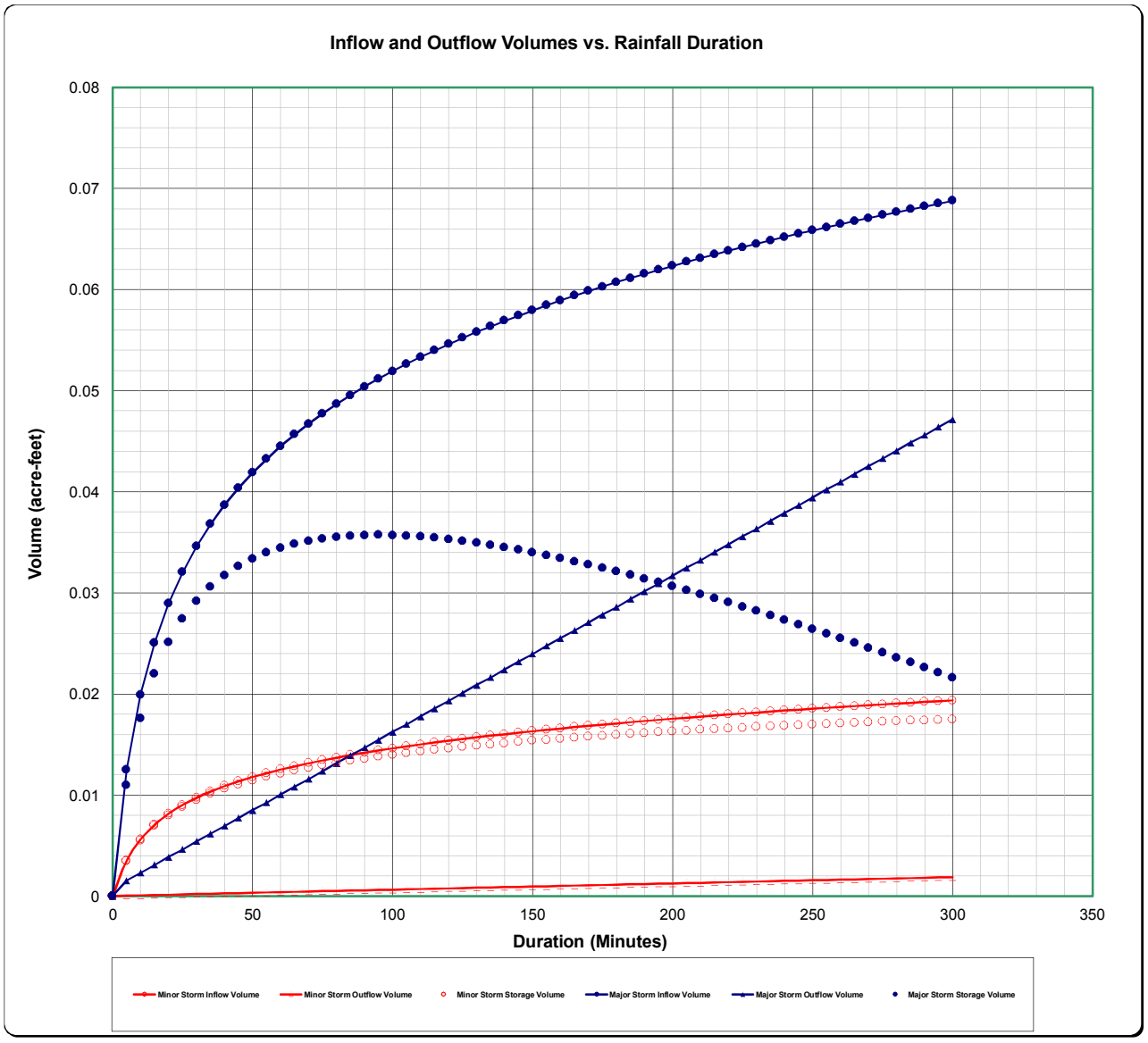
Mod. FAA Major Storage Volume (cubic ft.) = **1,555**
Mod. FAA Major Storage Volume (acre-ft.) = **0.0357**

UDFCD DETENTION BASIN VOLUME ESTIMATING WORKBOOK Version 2.34, Released November 2013

DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: 15_39 Taco Bell Heritage

Basin ID: Pond 1



DETENTION VOLUME BY THE FULL SPECTRUM METHOD

Project: Taco Bell Heritage
Basin ID: Pond 1

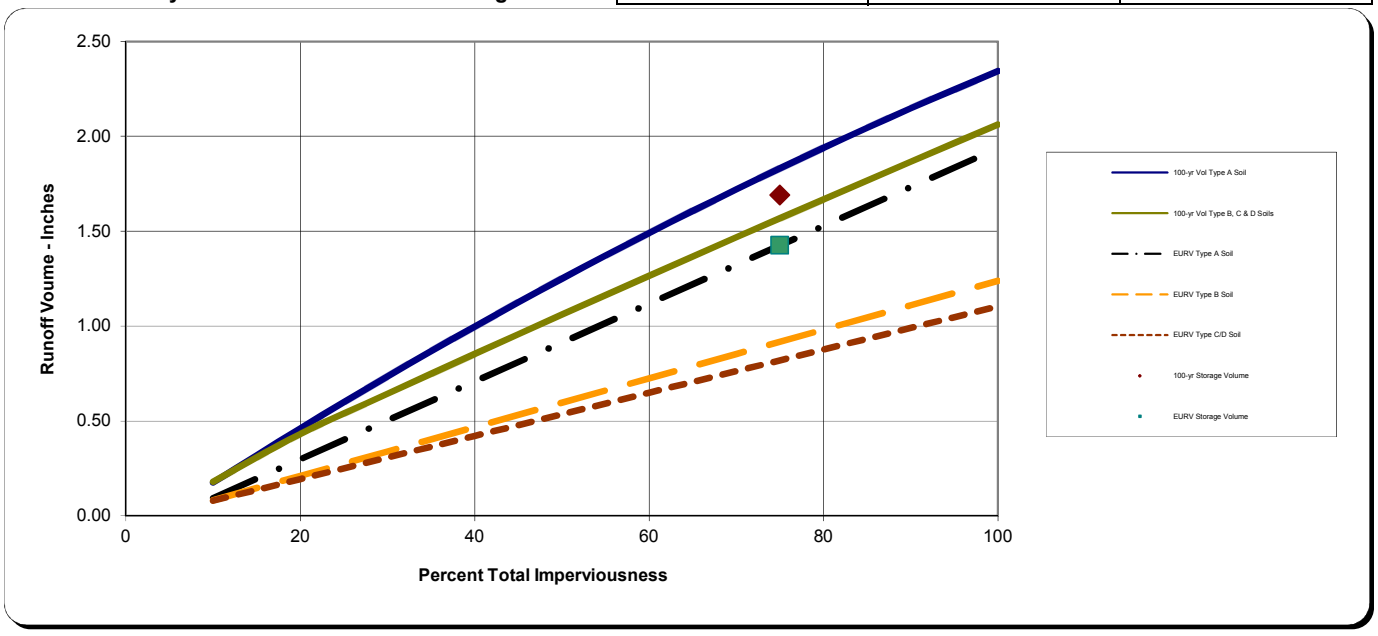
* User input data shown in blue.

Area of Watershed (acres)	0.45	
Subwatershed Imperviousness	75.0%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	2	2
Effective Imperviousness[1]	68.7%	

Hydrologic Soil Type	**Percentage of Area**	**Area (acres)**
Type A	100.0%	0.5
Type B		0.0
Type C or D		0.0

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		**Decay Coefficient--α**
Initial--f_i	**Final--fo**	
5	1.0	0.0007

	Detention Volumes [2,5]		
	(watershed inches)	**(acre-feet)**	**Maximum Allowable Release Rate, cfs**[3]
Excess Urban Runoff Volume[4]	1.43	0.05	Design Oulet to Empty EURV in 72 Hours
100-year Detention Volume Including WQCV [5]	1.69	0.06	0.23



Notes:

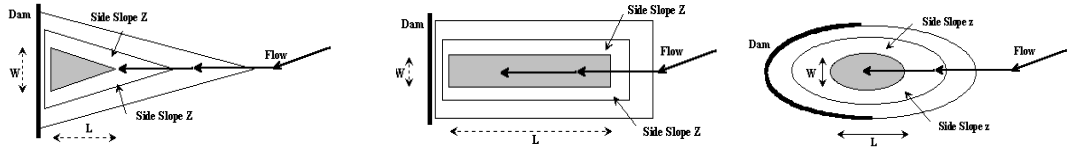
1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV



STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: **Taco Bell Heritage**
Basin ID: **Pond 1**

Design Information (Input):

Width of Basin Bottom, W = ft
Length of Basin Bottom, L = ft
Dam Side-slope (H:V), Z_d = ft/ft

Check Basin Shape

Right Triangle OR…
Isosceles Triangle OR…
Rectangle OR…
Circle / Ellipse OR…
Irregular (Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':	0.02	0.04	acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':	0.05	0.06	acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Water Surface Elevation ft (input)	Side Slope (H:V) ft/ft Below El. (input)	Basin Width at Stage ft (output)	Basin Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
5174	5174					22		0.001	0.000	
5174.25	5174.25		0.00	0.00		49	9	0.001	0.000	
5174.5	5174.5		0.00	0.00		80	25	0.002	0.001	
5174.75	5174.75		0.00	0.00		130	51	0.003	0.001	
5175	5175		0.00	0.00		187	91	0.004	0.002	
5175.25	5175.25		0.00	0.00		250	146	0.006	0.003	
5175.5	5175.5		0.00	0.00		320	217	0.007	0.005	WQCV &
5175.75	5175.75		0.00	0.00		396	306	0.009	0.007	MINOR (2-YR)
5176	5176		0.00	0.00		476	415	0.011	0.010	5,178.11
5176.25	5176.25		0.00	0.00		559	545	0.013	0.013	
5176.5	5176.5		0.00	0.00		649	696	0.015	0.016	
5176.75	5176.75		0.00	0.00		743	870	0.017	0.020	
5177	5177		0.00	0.00		834	1,067	0.019	0.024	
5177.25	5177.25		0.00	0.00		917	1,286	0.021	0.030	
5177.5	5177.5		0.00	0.00		996	1,525	0.023	0.035	
5177.75	5177.75		0.00	0.00		1073	1,783	0.025	0.041	
5178	5178		0.00	0.00		1143	2,060	0.026	0.047	
5178.25	5178.25		0.00	0.00		1208	2,354	0.028	0.054	MAJOR (100-YR)
5178.5	5178.5		0.00	0.00		1275	2,665	0.029	0.061	5,178.94
5178.75	5178.75		0.00	0.00		1366	2,995	0.031	0.069	
5179	5179		0.00	0.00		1385	3,339	0.032	0.077	
5179.25	5179.25		0.00	0.00		1430	3,691	0.033	0.085	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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							#N/A		#N/A	
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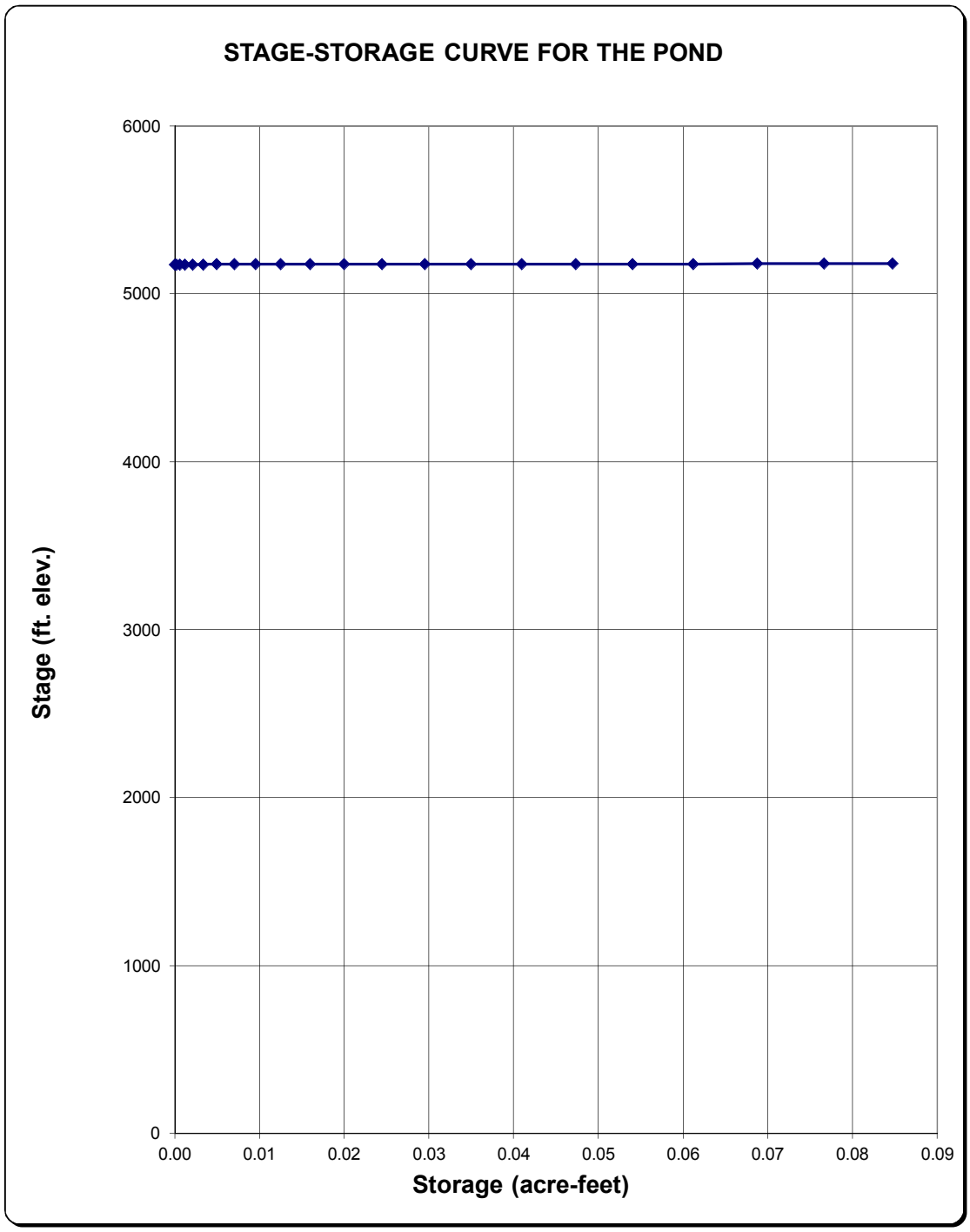
							#N/A		#N/A	

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: _____

Basin ID: _____



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: Taco Bell Heritage

Basin ID: Pond 1

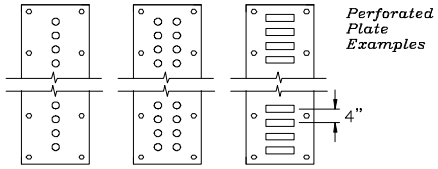
WQCV Design Volume (Input):

Catchment Imperviousness, I_a = 75.0 percent
Catchment Area, A = 0.45 acres
Depth at WQCV outlet above lowest perforation, H = 1 feet
Vertical distance between rows, h = 12.00 inches
Number of rows, NL = 2.00
Orifice discharge coefficient, C_o = 0.61
Slope of Basin Trickle Channel, S = 0.020 ft / ft
Time to Drain the Pond = 72 hours

Diameter of holes, D = 2.000 inches
Number of holes per row, N = 2

OR

Height of slot, H = inches
Width of slot, W = inches



Watershed Design Information (Input):

Percent Soil Type A = 100 %
Percent Soil Type B = %
Percent Soil Type C/D = %

Outlet Design Information (Output):

Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 1.425 watershed inches
N/A
Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 0.053 acre-feet
Outlet area per row, Ao = 0.32 square inches
Total opening area at each row based on user-input above, Ao = 6.28 square inches
Total opening area at each row based on user-input above, Ao = 0.044 square feet

3

	Central Elevations of Rows of Holes in feet																								Σ Flow
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	Row 23	
	5174.00	5175.00																							
	Collection Capacity for Each Row of Holes in cfs																								
5174.00	0.0000	0.0000																							**0.00**
5174.25	0.1068	0.0000																							**0.11**
5174.50	0.1510	0.0000																							**0.15**
5174.75	0.1850	0.0000																							**0.18**
5175.00	0.2136	0.0000																							**0.21**
5175.25	0.2388	0.1068																							**0.35**
5175.50	0.2616	0.1510																							**0.41**
5175.75	0.2826	0.1850																							**0.47**
5176.00	0.3021	0.2136																							**0.52**
5176.25	0.3204	0.2388																							**0.56**
5176.50	0.3377	0.2616																							**0.60**
5176.75	0.3542	0.2826																							**0.64**
5177.00	0.3700	0.3021																							**0.67**
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
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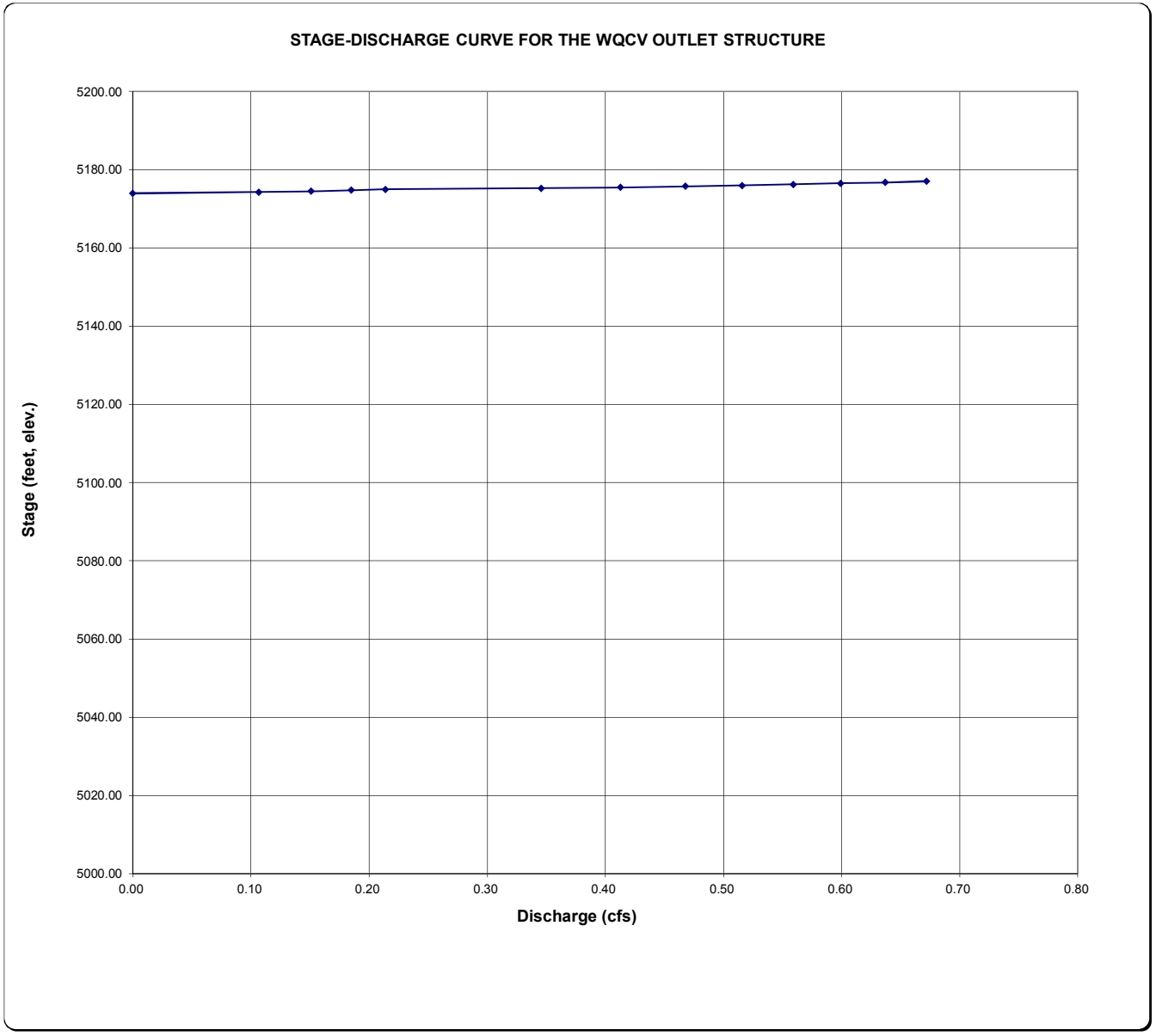
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
	#N/A	#N/A																							**#N/A**
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Worksheet Protected

Project: Taco Bell Heritage

Basin ID: Pond 1

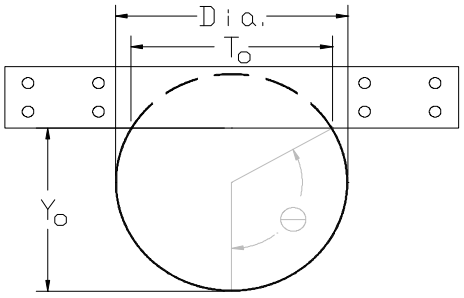


RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICA

Project: Taco Bell Heritage

Basin ID: Pond 1

X



Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)

Water Surface Elevation at Design Depth	Elev: WS =
Pipe/Vertical Orifice Entrance Invert Elevation	Elev: Invert =
Required Peak Flow through Orifice at Design Depth	Q =
Pipe/Vertical Orifice Diameter (inches)	Dia =
Orifice Coefficient	C_o =

Full-flow Capacity (Calculated)

Full-flow area	Af =
Half Central Angle in Radians	Theta =
Full-flow capacity	Qf =
	Percent of Design Flow =

Calculation of Orifice Flow Condition

Half Central Angle (0<Theta<3.1416)	Theta =
Flow area	A_o =
Top width of Orifice (inches)	T_o =
Height from Invert of Orifice to Bottom of Plate (feet)	Y_o =
Elevation of Bottom of Plate	Elev Plate Bottom Edge =
Resultant Peak Flow Through Orifice at Design Depth	Q_o =

Width of Equivalent Rectangular Vertical Orifice — **Equivalent Width =**

L ORIFICES

#1 Vertical Orifice	#2 Vertical Orifice	
5,175.75		feet
5,172.00		feet
0.60		cfs
12.0		inches
0.65		

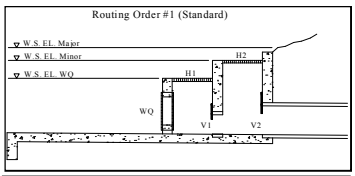
0.79		sq ft
3.14		rad
7.4		cfs
1232%		

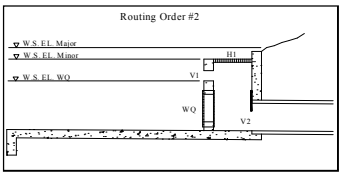
0.74		rad
0.06		sq ft
8.07		inches
0.13		feet
5,172.13		feet
0.6		cfs

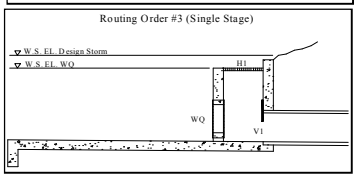
0.46		**feet**

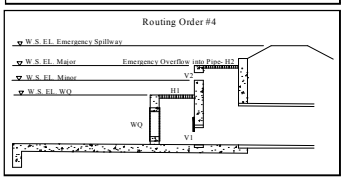
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Taco Bell Heritage
Basin ID: Pond 1


Routing Order #1 (Standard)


Routing Order #2


Routing Order #3 (Single Stage)


Routing Order #4

Current Routing Order is #3

			#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Design Information (Input):							
Circular Opening:	Diameter in Inches	Dia. =					inches
OR							
Rectangular Opening:	Width in Feet	W =	4.00		0.43		ft.
	Length (Height for Vertical)	L or H =	2.50		0.16		ft.
	Percentage of Open Area After Trash Rack Reduction	% open =	50		100		%
	Orifice Coefficient	C_o =	0.61		0.65		
	Weir Coefficient	C_w =	3.33				
	Orifice Elevation (Bottom for Vertical)	E_o =	5178.93		5,172.00		ft.
Calculation of Collection Capacity:							
	Net Opening Area (after Trash Rack Reduction)	A_o =	5.00		0.07		sq. ft.
	OPTIONAL: User-Overide Net Opening Area	A_o =					sq. ft.
	Perimeter as Weir Length	L_w =	9.00	ft.			
	OPTIONAL: User-Overide Weir Length	L_w =		ft.			
	Top Elevation of Vertical Orifice Opening, Top =				5172.16		ft.
	Center Elevation of Vertical Orifice Opening, Cen =				5172.08		ft.

Routing 3: Single Stage - Water flows through WQCV plate and #1 horizontal opening into #1 vertical opening. This flow will be applied to culvert sheet (#2 vertical & horizontal openings is not used).

			Horizontal Orifices				Vertical Orifices			
Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)	**Total Collection Capacity cfs (output)**	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
	5174.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	**0.00**	
	5174.25	0.11	0.00	0.00	0.00	0.00	0.53	0.00	**0.11**	
	5174.50	0.15	0.00	0.00	0.00	0.00	0.56	0.00	**0.15**	
	5174.75	0.18	0.00	0.00	0.00	0.00	0.59	0.00	**0.18**	
	5175.00	0.21	0.00	0.00	0.00	0.00	0.61	0.00	**0.21**	
	5175.25	0.35	0.00	0.00	0.00	0.00	0.64	0.00	**0.35**	
	5175.50	0.41	0.00	0.00	0.00	0.00	0.66	0.00	**0.41**	
	5175.75	0.47	0.00	0.00	0.00	0.00	0.69	0.00	**0.47**	
	5176.00	0.52	0.00	0.00	0.00	0.00	0.71	0.00	**0.52**	
	5176.25	0.56	0.00	0.00	0.00	0.00	0.73	0.00	**0.56**	
	5176.50	0.60	0.00	0.00	0.00	0.00	0.75	0.00	**0.60**	
	5176.75	0.64	0.00	0.00	0.00	0.00	0.78	0.00	**0.64**	
	5177.00	0.67	0.00	0.00	0.00	0.00	0.80	0.00	**0.67**	
	5177.25	#N/A	0.00	0.00	0.00	0.00	0.82	0.00	**#N/A**	
	5177.50	#N/A	0.00	0.00	0.00	0.00	0.84	0.00	**#N/A**	
	5177.75	#N/A	0.00	0.00	0.00	0.00	0.85	0.00	**#N/A**	
	5178.00	#N/A	0.00	0.00	0.00	0.00	0.87	0.00	**#N/A**	
	5178.25	#N/A	0.00	0.00	0.00	0.00	0.89	0.00	**#N/A**	
	5178.50	#N/A	0.00	0.00	0.00	0.00	0.91	0.00	**#N/A**	
	5178.75	#N/A	0.00	0.00	0.00	0.00	0.93	0.00	**#N/A**	
	5179.00	#N/A	0.56	6.48	0.00	0.00	0.94	0.00	**#N/A**	
	5179.25	#N/A	5.43	13.85	0.00	0.00	0.96	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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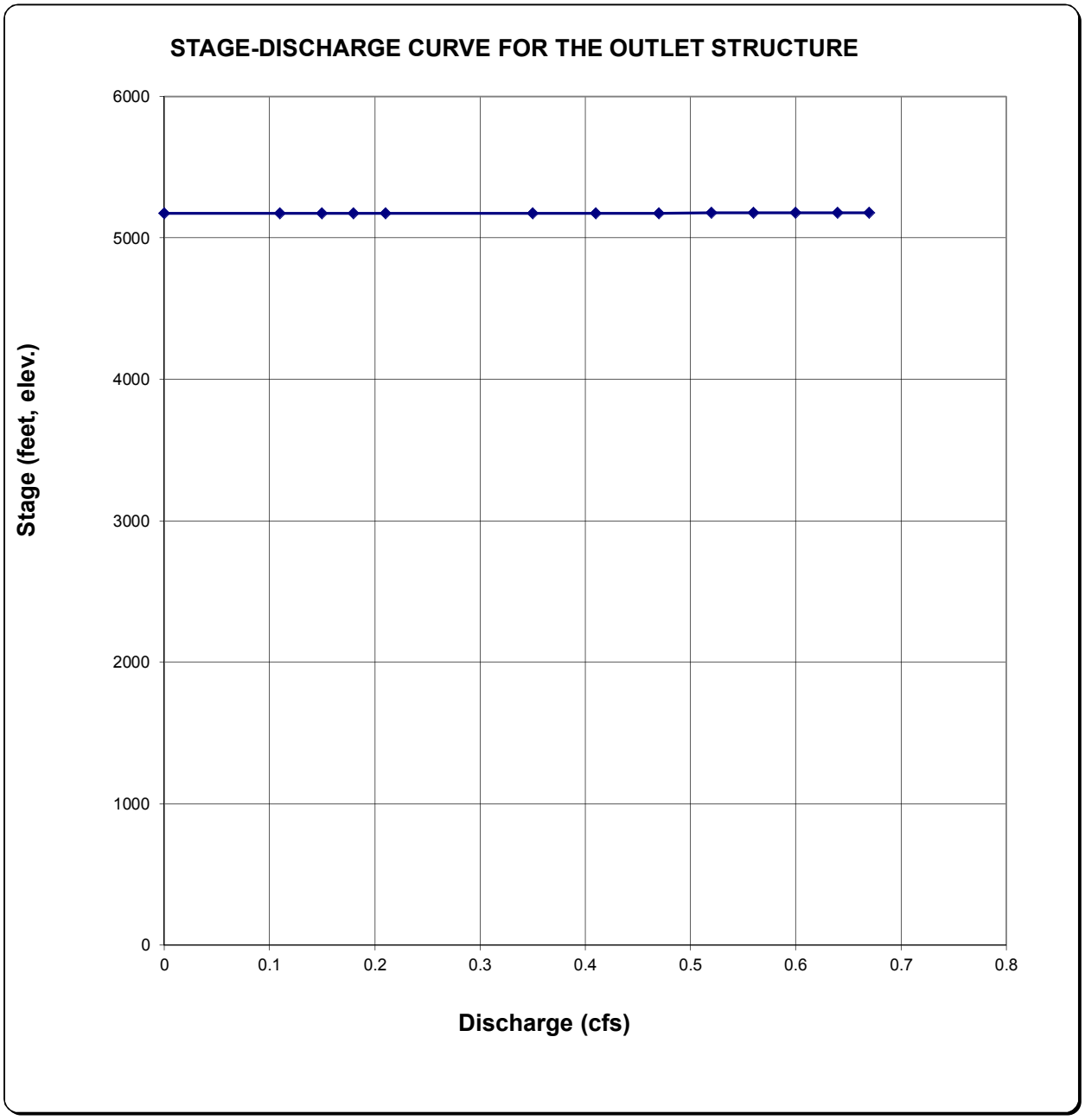
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	

STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Taco Bell Heritage
Basin ID: Pond 1



DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: 15_39 Taco Bell Heritage

Basin ID: Pond 2

(For catchments less than 160 acres only. For larger catchments, use hydrograph routing method)
(NOTE: for catchments larger than 90 acres, CUHP hydrograph and routing are recommended)

Determination of MINOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	81.90	percent
Catchment Drainage Area	A =	0.340	acres
Predevelopment NRCS Soil Group	Type =	A	A, B, C, or D
Return Period for Detention Control	T =	2	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	5	minutes
Allowable Unit Release Rate	q =	0.02	cfs/acre
One-hour Precipitation	P_1 =	0.72	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.56	
Inflow Peak Runoff	Qp-in =	0.46	cfs
Allowable Peak Outflow Rate	Qp-out =	**0.01**	cfs
Mod. FAA Minor Storage Volume =		699	**cubic feet**
Mod. FAA Minor Storage Volume =		**0.016**	**acre-ft**

5 <- Enter Rainfall Duration Incremental Increase Value Here (e.g. 5 for 5-Minutes)

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
5	2.42	0.003	1.00	0.01	0.000	0.003
10	1.93	0.005	0.75	0.01	0.000	0.005
15	1.62	0.006	0.67	0.00	0.000	0.006
20	1.40	0.007	0.63	0.00	0.000	0.007
25	1.24	0.008	0.60	0.00	0.000	0.008
30	1.12	0.009	0.58	0.00	0.000	0.009
35	1.02	0.009	0.57	0.00	0.000	0.009
40	0.94	0.010	0.56	0.00	0.000	0.010
45	0.87	0.010	0.56	0.00	0.000	0.010
50	0.81	0.011	0.55	0.00	0.000	0.010
55	0.76	0.011	0.55	0.00	0.000	0.011
60	0.72	0.011	0.54	0.00	0.000	0.011
65	0.68	0.012	0.54	0.00	0.000	0.011
70	0.65	0.012	0.54	0.00	0.000	0.012
75	0.62	0.012	0.53	0.00	0.000	0.012
80	0.59	0.012	0.53	0.00	0.000	0.012
85	0.56	0.013	0.53	0.00	0.000	0.012
90	0.54	0.013	0.53	0.00	0.000	0.012
95	0.52	0.013	0.53	0.00	0.000	0.013
100	0.50	0.013	0.53	0.00	0.000	0.013
105	0.49	0.013	0.52	0.00	0.001	0.013
110	0.47	0.014	0.52	0.00	0.001	0.013
115	0.45	0.014	0.52	0.00	0.001	0.013
120	0.44	0.014	0.52	0.00	0.001	0.013
125	0.43	0.014	0.52	0.00	0.001	0.013
130	0.42	0.014	0.52	0.00	0.001	0.014
135	0.40	0.014	0.52	0.00	0.001	0.014
140	0.39	0.014	0.52	0.00	0.001	0.014
145	0.38	0.015	0.52	0.00	0.001	0.014
150	0.37	0.015	0.52	0.00	0.001	0.014
155	0.37	0.015	0.52	0.00	0.001	0.014
160	0.36	0.015	0.52	0.00	0.001	0.014
165	0.35	0.015	0.52	0.00	0.001	0.014
170	0.34	0.015	0.51	0.00	0.001	0.014
175	0.33	0.015	0.51	0.00	0.001	0.014
180	0.33	0.015	0.51	0.00	0.001	0.015
185	0.32	0.016	0.51	0.00	0.001	0.015
190	0.31	0.016	0.51	0.00	0.001	0.015
195	0.31	0.016	0.51	0.00	0.001	0.015
200	0.30	0.016	0.51	0.00	0.001	0.015
205	0.30	0.016	0.51	0.00	0.001	0.015
210	0.29	0.016	0.51	0.00	0.001	0.015
215	0.29	0.016	0.51	0.00	0.001	0.015
220	0.28	0.016	0.51	0.00	0.001	0.015
225	0.28	0.016	0.51	0.00	0.001	0.015
230	0.27	0.016	0.51	0.00	0.001	0.015
235	0.27	0.016	0.51	0.00	0.001	0.015
240	0.26	0.017	0.51	0.00	0.001	0.015
245	0.26	0.017	0.51	0.00	0.001	0.015
250	0.26	0.017	0.51	0.00	0.001	0.016
255	0.25	0.017	0.51	0.00	0.001	0.016
260	0.25	0.017	0.51	0.00	0.001	0.016
265	0.24	0.017	0.51	0.00	0.001	0.016
270	0.24	0.017	0.51	0.00	0.001	0.016
275	0.24	0.017	0.51	0.00	0.001	0.016
280	0.23	0.017	0.51	0.00	0.001	0.016
285	0.23	0.017	0.51	0.00	0.001	0.016
290	0.23	0.017	0.51	0.00	0.001	0.016
295	0.22	0.017	0.51	0.00	0.001	0.016
300	0.22	0.017	0.51	0.00	0.001	0.016

Mod. FAA Minor Storage Volume (cubic ft.) = 699
Mod. FAA Minor Storage Volume (acre-ft.) = 0.0160

Determination of MAJOR Detention Volume Using Modified FAA Method

Design Information (Input):

Catchment Drainage Imperviousness	I_a =	81.90	percent
Catchment Drainage Area	A =	0.340	acres
Predevelopment NRCS Soil Group	Type =	A	A, B, C, or D
Return Period for Detention Control	T =	100	years (2, 5, 10, 25, 50, or 100)
Time of Concentration of Watershed	Tc =	5	minutes
Allowable Unit Release Rate	q =	0.50	cfs/acre
One-hour Precipitation	P_1 =	1.97	inches
Design Rainfall IDF Formula $i = C_1 * P_1/(C_2+T_c)^{C_3}$			
Coefficient One	C_1 =	28.50	
Coefficient Two	C_2 =	10	
Coefficient Three	C_3 =	0.789	

Determination of Average Outflow from the Basin (Calculated):

Runoff Coefficient	C =	0.68	
Inflow Peak Runoff	Qp-in =	1.53	cfs
Allowable Peak Outflow Rate	Qp-out =	**0.17**	cfs
Mod. FAA Major Storage Volume =		1,374	**cubic feet**
Mod. FAA Major Storage Volume =		**0.032**	**acre-ft**

Rainfall Duration minutes (input)	Rainfall Intensity inches / hr (output)	Inflow Volume acre-feet (output)	Adjustment Factor "m" (output)	Average Outflow cfs (output)	Outflow Volume acre-feet (output)	Storage Volume acre-feet (output)
0	0.00	0.000	0.00	0.00	0.000	0.000
5	6.63	0.011	1.00	0.17	0.001	0.009
10	5.28	0.017	0.75	0.13	0.002	0.015
15	4.43	0.021	0.67	0.11	0.002	0.019
20	3.84	0.024	0.63	0.11	0.003	0.022
25	3.40	0.027	0.60	0.10	0.004	0.024
30	3.06	0.029	0.58	0.10	0.004	0.025
35	2.79	0.031	0.57	0.10	0.005	0.026
40	2.56	0.033	0.56	0.10	0.005	0.027
45	2.38	0.034	0.56	0.09	0.006	0.028
50	2.22	0.035	0.55	0.09	0.006	0.029
55	2.08	0.037	0.55	0.09	0.007	0.029
60	1.97	0.038	0.54	0.09	0.008	0.030
65	1.86	0.039	0.54	0.09	0.008	0.030
70	1.77	0.039	0.54	0.09	0.009	0.031
75	1.69	0.040	0.53	0.09	0.009	0.031
80	1.61	0.041	0.53	0.09	0.010	0.031
85	1.54	0.042	0.53	0.09	0.011	0.031
90	1.48	0.043	0.53	0.09	0.011	0.031
95	1.43	0.043	0.53	0.09	0.012	0.031
100	1.38	0.044	0.53	0.09	0.012	0.032
105	1.33	0.044	0.52	0.09	0.013	0.032
110	1.28	0.045	0.52	0.09	0.013	0.032
115	1.24	0.046	0.52	0.09	0.014	0.032
120	1.21	0.046	0.52	0.09	0.015	0.031
125	1.17	0.047	0.52	0.09	0.015	0.031
130	1.14	0.047	0.52	0.09	0.016	0.031
135	1.11	0.048	0.52	0.09	0.016	0.031
140	1.08	0.048	0.52	0.09	0.017	0.031
145	1.05	0.048	0.52	0.09	0.018	0.031
150	1.02	0.049	0.52	0.09	0.018	0.031
155	1.00	0.049	0.52	0.09	0.019	0.031
160	0.98	0.050	0.52	0.09	0.019	0.030
165	0.95	0.050	0.52	0.09	0.020	0.030
170	0.93	0.051	0.51	0.09	0.020	0.030
175	0.91	0.051	0.51	0.09	0.021	0.030
180	0.89	0.051	0.51	0.09	0.022	0.030
185	0.88	0.052	0.51	0.09	0.022	0.029
190	0.86	0.052	0.51	0.09	0.023	0.029
195	0.84	0.052	0.51	0.09	0.023	0.029
200	0.83	0.053	0.51	0.09	0.024	0.029
205	0.81	0.053	0.51	0.09	0.025	0.028
210	0.80	0.053	0.51	0.09	0.025	0.028
215	0.78	0.054	0.51	0.09	0.026	0.028
220	0.77	0.054	0.51	0.09	0.026	0.028
225	0.76	0.054	0.51	0.09	0.027	0.027
230	0.74	0.054	0.51	0.09	0.028	0.027
235	0.73	0.055	0.51	0.09	0.028	0.027
240	0.72	0.055	0.51	0.09	0.029	0.026
245	0.71	0.055	0.51	0.09	0.029	0.026
250	0.70	0.056	0.51	0.09	0.030	0.026
255	0.69	0.056	0.51	0.09	0.030	0.025
260	0.68	0.056	0.51	0.09	0.031	0.025
265	0.67	0.056	0.51	0.09	0.032	0.025
270	0.66	0.057	0.51	0.09	0.032	0.024
275	0.65	0.057	0.51	0.09	0.033	0.024
280	0.64	0.057	0.51	0.09	0.033	0.024
285	0.63	0.057	0.51	0.09	0.034	0.023
290	0.62	0.058	0.51	0.09	0.035	0.023
295	0.62	0.058	0.51	0.09	0.035	0.023
300	0.61	0.058	0.51	0.09	0.036	0.022

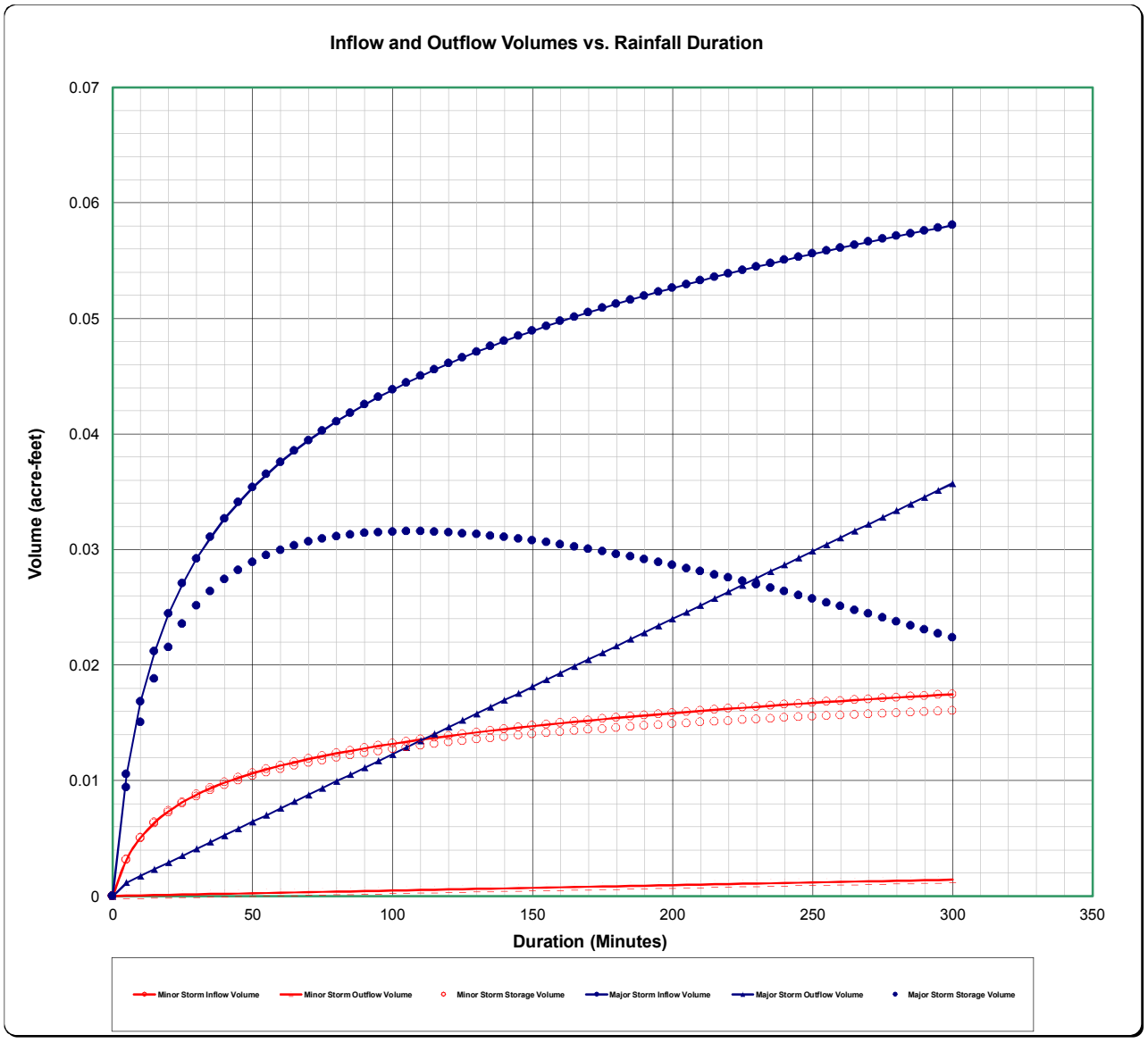
Mod. FAA Major Storage Volume (cubic ft.) = 1,374
Mod. FAA Major Storage Volume (acre-ft.) = 0.0315

UDFCD DETENTION BASIN VOLUME ESTIMATING WORKBOOK Version 2.34, Released November 2013

DETENTION VOLUME BY THE MODIFIED FAA METHOD

Project: 15_39 Taco Bell Heritage

Basin ID: Pond 2



DETENTION VOLUME BY THE FULL SPECTRUM METHOD

Project: Taco Bell Heritage
Basin ID: Pond 2

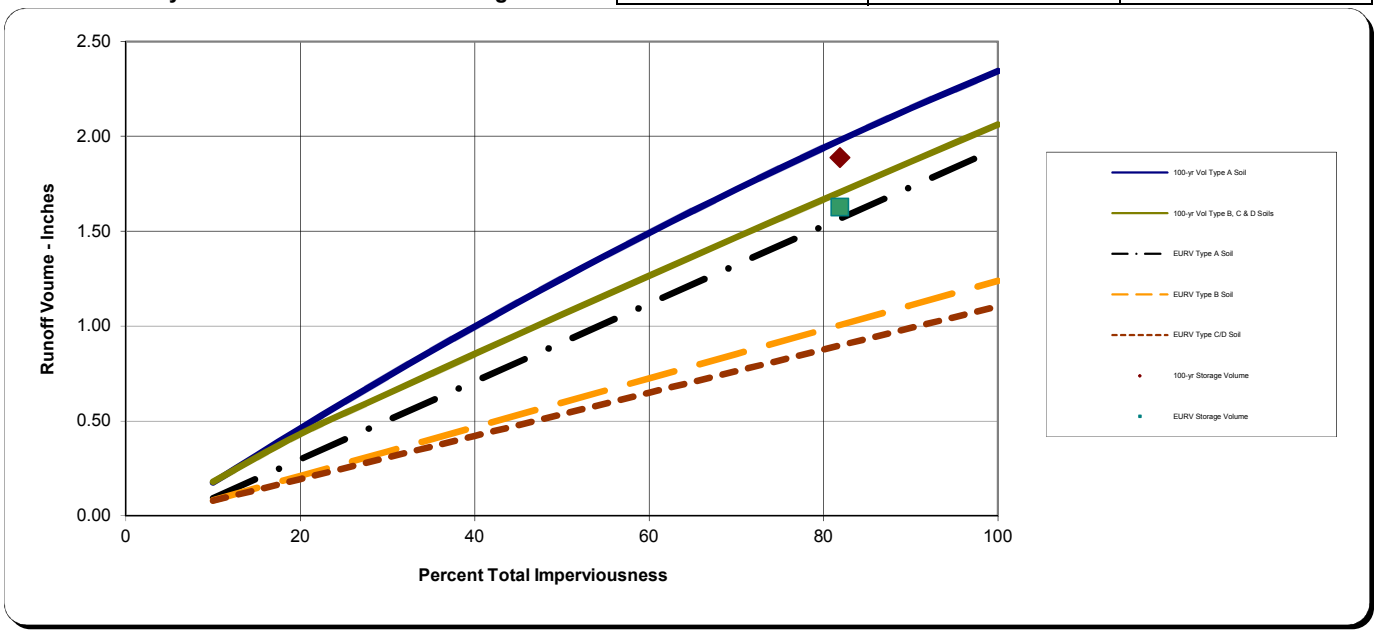
* User input data shown in blue.

Area of Watershed (acres)	0.34	
Subwatershed Imperviousness	81.9%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	2	2
Effective Imperviousness[1]	77.6%	

Hydrologic Soil Type	**Percentage of Area**	**Area (acres)**
Type A	100.0%	0.3
Type B		0.0
Type C or D		0.0

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		**Decay Coefficient--α**
Initial--f_i	**Final--fo**	
5	1.0	0.0007

	Detention Volumes [2,5]		**Maximum Allowable Release Rate, cfs**[3]
	(watershed inches)	**(acre-feet)**	
Excess Urban Runoff Volume[4]	1.63	0.05	Design Oulet to Empty EURV in 72 Hours
100-year Detention Volume Including WQCV [5]	1.89	0.05	0.17



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

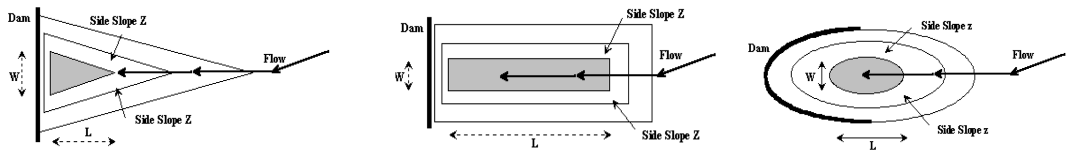
3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: **Taco Bell Heritage**
Basin ID: **Pond 2**



Design Information (Input):

Width of Basin Bottom, W	=		ft
Length of Basin Bottom, L	=		ft
Dam Side-slope (H:V), Z_d	=		ft/ft

Check Basin Shape

Right Triangle		OR…
Isosceles Triangle		OR…
Rectangle		OR…
Circle / Ellipse		OR…
Irregular		(Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':	0.02	0.03	acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':	0.05	0.05	acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Water Surface Elevation ft (input)	Side Slope (H:V) ft/ft Below El. (input)	Basin Width at Stage ft (output)	Basin Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
5173	5173					109		0.003	0.000	
5173.25	5173.25		0.00	0.00		287	50	0.007	0.001	
5173.5	5173.5		0.00	0.00		450	142	0.010	0.003	
5173.75	5173.75		0.00	0.00		532	264	0.012	0.006	
5174	5174		0.00	0.00		570	402	0.013	0.009	
5174.25	5174.25		0.00	0.00		594	548	0.014	0.013	
5174.5	5174.5		0.00	0.00		618	699	0.014	0.016	WQCV &
5174.75	5174.75		0.00	0.00		642	857	0.015	0.020	MINOR (2-YR)
5175	5175		0.00	0.00		665	1,020	0.015	0.023	5,176.39
5175.25	5175.25		0.00	0.00		688	1,189	0.016	0.027	
5175.5	5175.5		0.00	0.00		710	1,364	0.016	0.031	
5175.75	5175.75		0.00	0.00		731	1,544	0.017	0.035	
5176	5176		0.00	0.00		752	1,729	0.017	0.040	
5176.25	5176.25		0.00	0.00		772	1,920	0.018	0.044	
5176.5	5176.5		0.00	0.00		792	2,115	0.018	0.049	
5176.75	5176.75		0.00	0.00		811	2,316	0.019	0.053	
5177	5177		0.00	0.00		830	2,521	0.019	0.058	
							#N/A		#N/A	MAJOR (100-YR)
							#N/A		#N/A	5,176.63
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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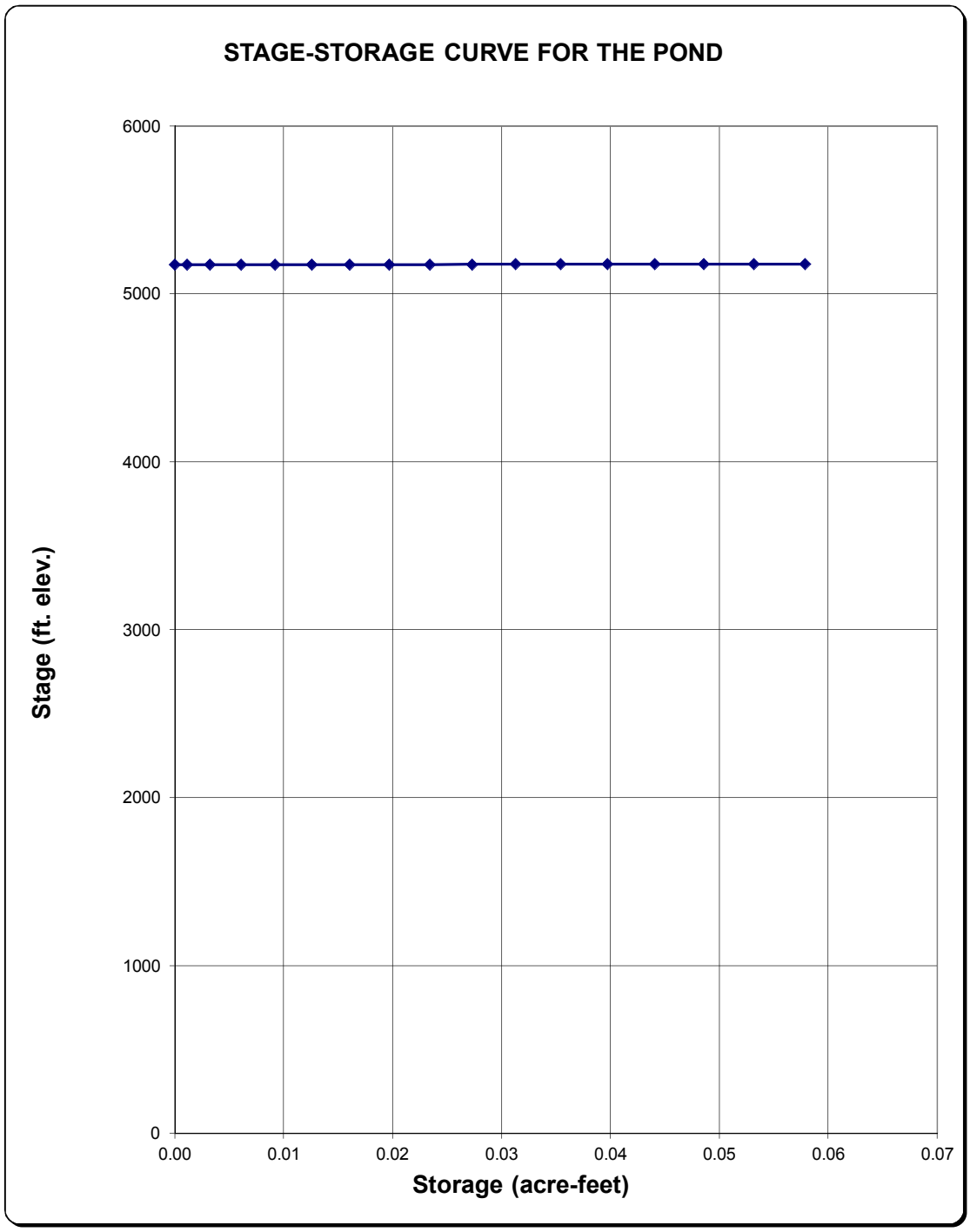
							#N/A		#N/A	
							#N/A		#N/A	

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: _____

Basin ID: _____



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

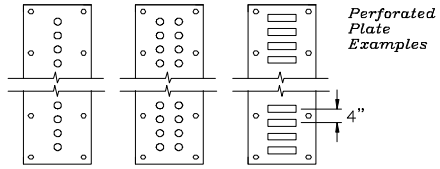
Project: Taco Bell Heritage
Basin ID: Pond 2

WQCV Design Volume (Input):

Catchment Imperviousness, I_a =	81.9	percent			
Catchment Area, A =	0.34	acres	Diameter of holes, D =	2.000	inches
Depth at WQCV outlet above lowest perforation, H =	1	feet	Number of holes per row, N =	2	
Vertical distance between rows, h =	12.00	inches		**OR**	
Number of rows, NL =	2.00				
Orifice discharge coefficient, C_o =	0.61		Height of slot, H =		inches
Slope of Basin Trickle Channel, S =	0.020	ft / ft	Width of slot, W =		inches
Time to Drain the Pond =	72	hours			

Watershed Design Information (Input):

Percent Soil Type A =	100	%
Percent Soil Type B =		%
Percent Soil Type C/D =		%



Outlet Design Information (Output):

Excess Urban Runoff Volume (From 'Full-Spectrum Sheet')	1.627	watershed inches
	N/A	
Excess Urban Runoff Volume (From 'Full-Spectrum Sheet')	**0.046**	**acre-feet**
Outlet area per row, Ao =	0.28	square inches
Total opening area at each row based on user-input above, Ao =	6.28	square inches
Total opening area at each row based on user-input above, Ao =	0.044	square feet

3

	Central Elevations of Rows of Holes in feet																							Σ Flow
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	Row 23	
	5174.00	5175.00																							
	Collection Capacity for Each Row of Holes in cfs																								
5173	0.0000	0.0000																							0.00
5173.25	0.0000	0.0000																							0.00
5173.50	0.0000	0.0000																							0.00
5173.75	0.0000	0.0000																							0.00
5174.00	0.0000	0.0000																							0.00
5174.25	0.1068	0.0000																							0.11
5174.50	0.1510	0.0000																							0.15
5174.75	0.1850	0.0000																							0.18
5175.00	0.2136	0.0000																							0.21
5175.25	0.2388	0.1068																							0.35
5175.50	0.2616	0.1510																							0.41
5175.75	0.2826	0.1850																							0.47
5176.00	0.3021	0.2136																							0.52
5176.25	0.3204	0.2388																							0.56
5176.50	0.3377	0.2616																							0.60
5176.75	0.3542	0.2826																							0.64
5177.00	0.3700	0.3021																							0.67
	#N/A	#N/A																							#N/A
	#N/A	#N/A																							#N/A
	#N/A	#N/A																							#N/A
	#N/A	#N/A																							#N/A
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	#N/A	#N/A																							#N/A
	#N/A	#N/A																							#N/A
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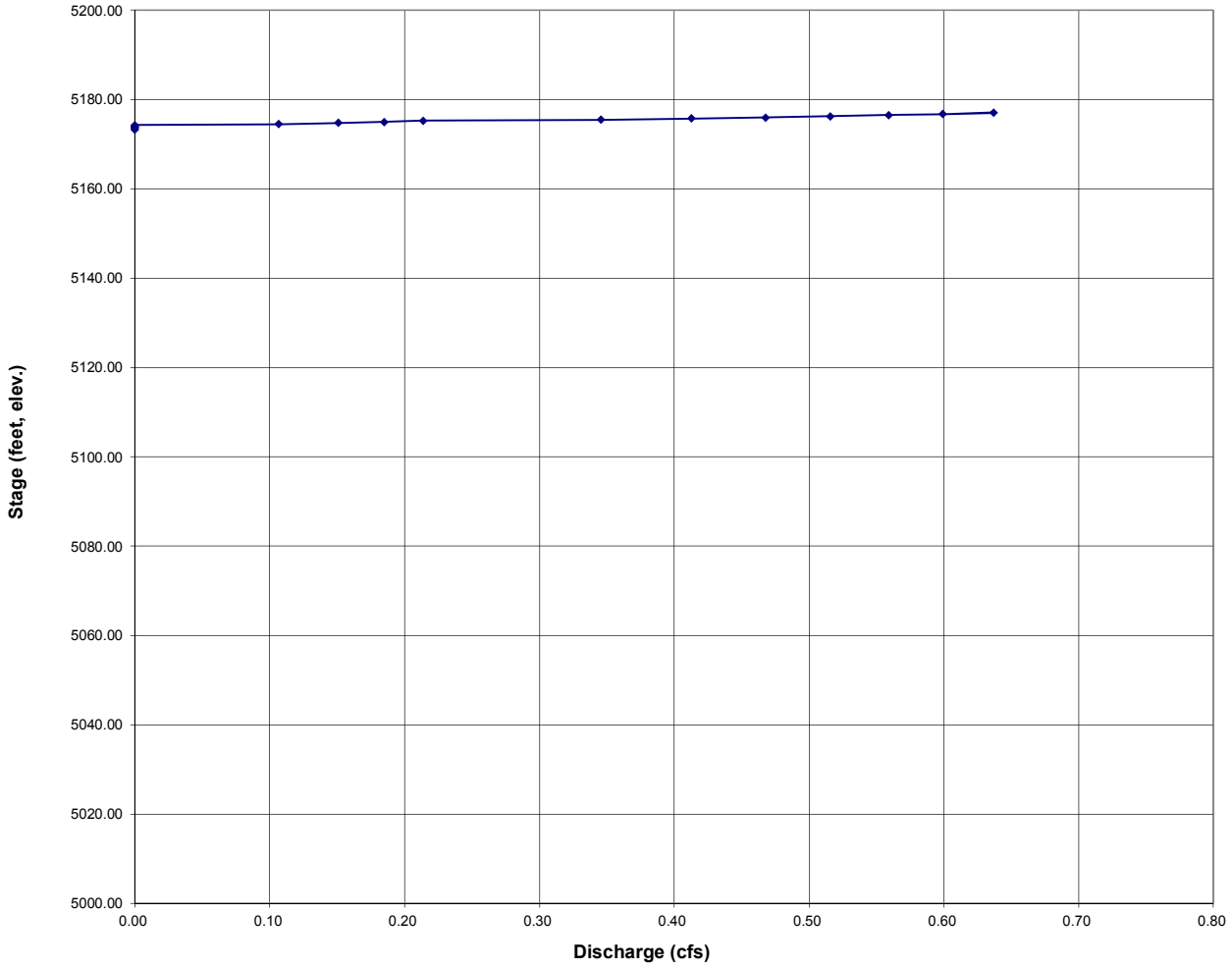
	#N/A	#N/A																							#N/A
	#N/A	#N/A																							#N/A
	#N/A	#N/A																							#N/A
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Worksheet Protected

Project: Taco Bell Heritage
Basin ID: Pond 2

STAGE-DISCHARGE CURVE FOR THE WQCV OUTLET STRUCTURE

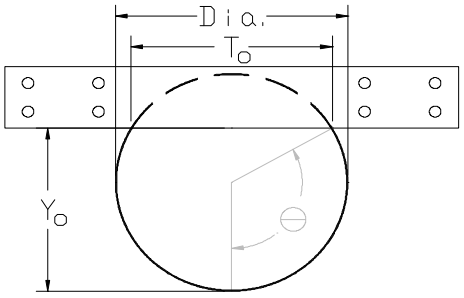


RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICA

Project: Taco Bell Heritage

Basin ID: Pond 2

X



Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)

Water Surface Elevation at Design Depth	Elev: WS =
Pipe/Vertical Orifice Entrance Invert Elevation	Elev: Invert =
Required Peak Flow through Orifice at Design Depth	Q =
Pipe/Vertical Orifice Diameter (inches)	Dia =
Orifice Coefficient	C_o =

Full-flow Capacity (Calculated)

Full-flow area	Af =
Half Central Angle in Radians	Theta =
Full-flow capacity	Qf =
	Percent of Design Flow =

Calculation of Orifice Flow Condition

Half Central Angle (0<Theta<3.1416)	Theta =
Flow area	A_o =
Top width of Orifice (inches)	T_o =
Height from Invert of Orifice to Bottom of Plate (feet)	Y_o =
Elevation of Bottom of Plate	Elev Plate Bottom Edge =
Resultant Peak Flow Through Orifice at Design Depth	Q_o =

Width of Equivalent Rectangular Vertical Orifice — **Equivalent Width =**

L ORIFICES

#1 Vertical Orifice	#2 Vertical Orifice	
5,173.75		feet
5,170.95		feet
0.50		cfs
12.0		inches
0.65		

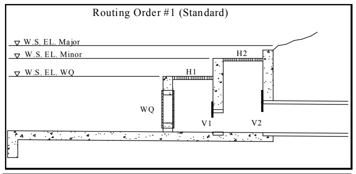
0.79		sq ft
3.14		rad
6.2		cfs
1242%		

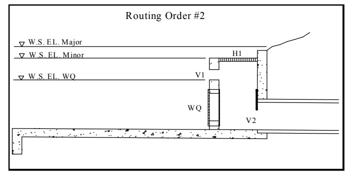
0.73		rad
0.06		sq ft
7.99		inches
0.13		feet
5,171.08		feet
0.5		cfs

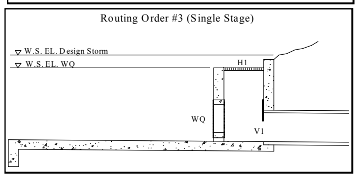
0.46		**feet**

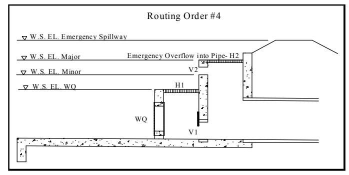
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Taco Bell Heritage
Basin ID: Pond 2









Current Routing Order is #3

Design Information (Input):

			#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Circular Opening:	Diameter in Inches	Dia. =					inches
OR							
Rectangular Opening:	Width in Feet	W =	4.00		0.46		ft.
	Length (Height for Vertical)	L or H =	2.50		0.13		ft.
	Percentage of Open Area After Trash Rack Reduction	% open =	50		100		%
	Orifice Coefficient	C_o =	0.61		0.65		
	Weir Coefficient	C_w =	3.33				
	Orifice Elevation (Bottom for Vertical)	E_o =	5176.63		5,170.95		ft.

Calculation of Collection Capacity:

Net Opening Area (after Trash Rack Reduction)	A_o =	5.00		0.06		sq. ft.
OPTIONAL: User-Overide Net Opening Area	A_o =					sq. ft.
Perimeter as Weir Length	L_w =	9.00	ft.			
OPTIONAL: User-Overide Weir Length	L_w =		ft.			
Top Elevation of Vertical Orifice Opening, Top =				5171.08		ft.
Center Elevation of Vertical Orifice Opening, Cen =				5171.02		ft.

Routing 3: Single Stage - Water flows through WQCV plate and #1 horizontal opening into #1 vertical opening. This flow will be applied to culvert sheet (#2 vertical & horizontal openings is not used).

			Horizontal Orifices				Vertical Orifices			
Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)	**Total Collection Capacity cfs (output)**	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
	5173.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	**0.00**	
	5173.25	0.00	0.00	0.00	0.00	0.00	0.47	0.00	**0.00**	
	5173.50	0.00	0.00	0.00	0.00	0.00	0.49	0.00	**0.00**	
	5173.75	0.00	0.00	0.00	0.00	0.00	0.52	0.00	**0.00**	
	5174.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	**0.00**	
	5174.25	0.11	0.00	0.00	0.00	0.00	0.56	0.00	**0.11**	
	5174.50	0.15	0.00	0.00	0.00	0.00	0.58	0.00	**0.15**	
	5174.75	0.18	0.00	0.00	0.00	0.00	0.60	0.00	**0.18**	
	5175.00	0.21	0.00	0.00	0.00	0.00	0.62	0.00	**0.21**	
	5175.25	0.35	0.00	0.00	0.00	0.00	0.64	0.00	**0.35**	
	5175.50	0.41	0.00	0.00	0.00	0.00	0.66	0.00	**0.41**	
	5175.75	0.47	0.00	0.00	0.00	0.00	0.68	0.00	**0.47**	
	5176.00	0.52	0.00	0.00	0.00	0.00	0.70	0.00	**0.52**	
	5176.25	0.56	0.00	0.00	0.00	0.00	0.71	0.00	**0.56**	
	5176.50	0.60	0.00	0.00	0.00	0.00	0.73	0.00	**0.60**	
	5176.75	0.64	1.25	8.48	0.00	0.00	0.75	0.00	**0.75**	
	5177.00	0.67	6.75	14.89	0.00	0.00	0.76	0.00	**0.76**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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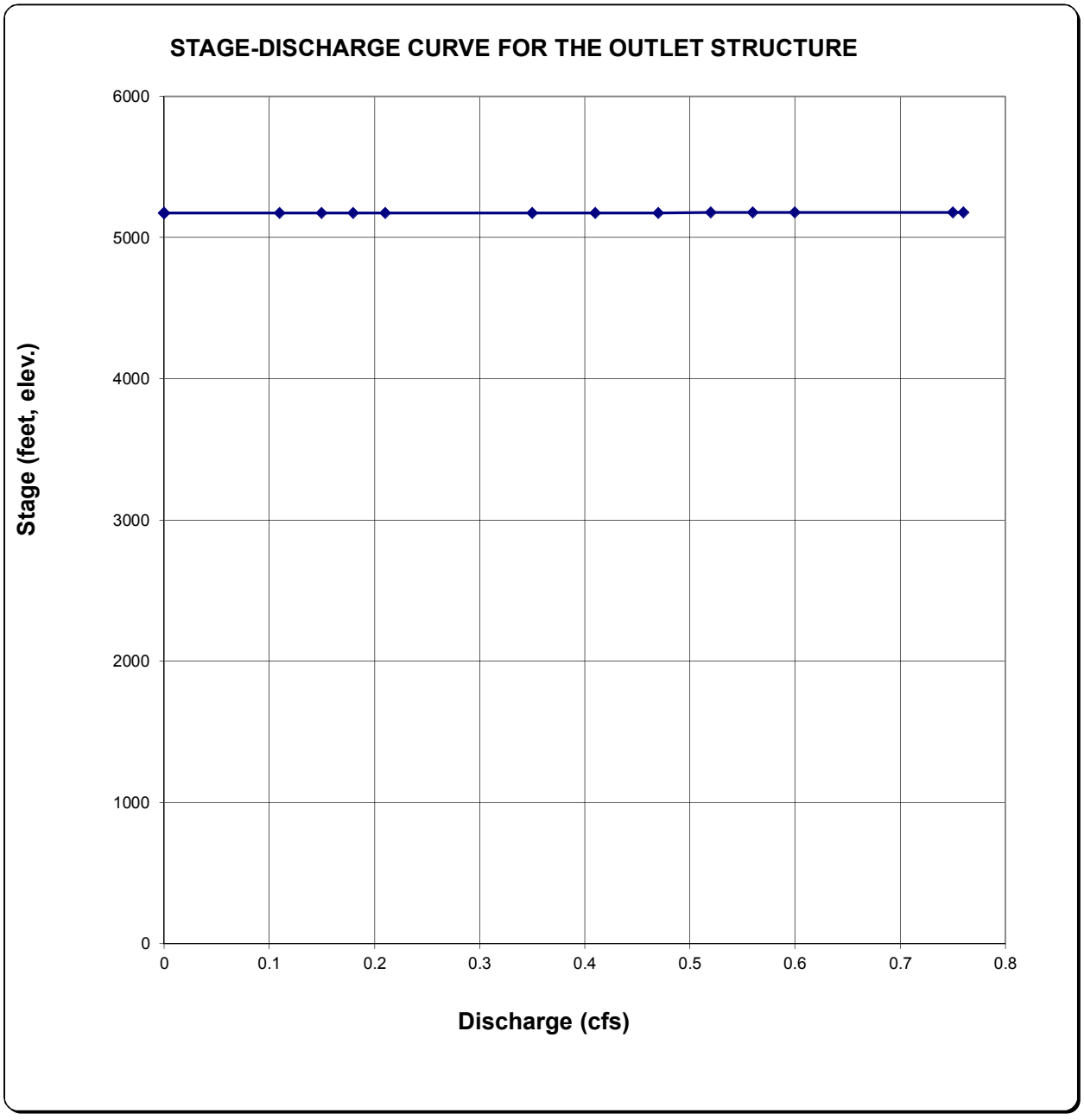
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Taco Bell Heritage
Basin ID: Pond 2



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Feb 10 2017

12 in. Pipe @ 0.50%

Circular

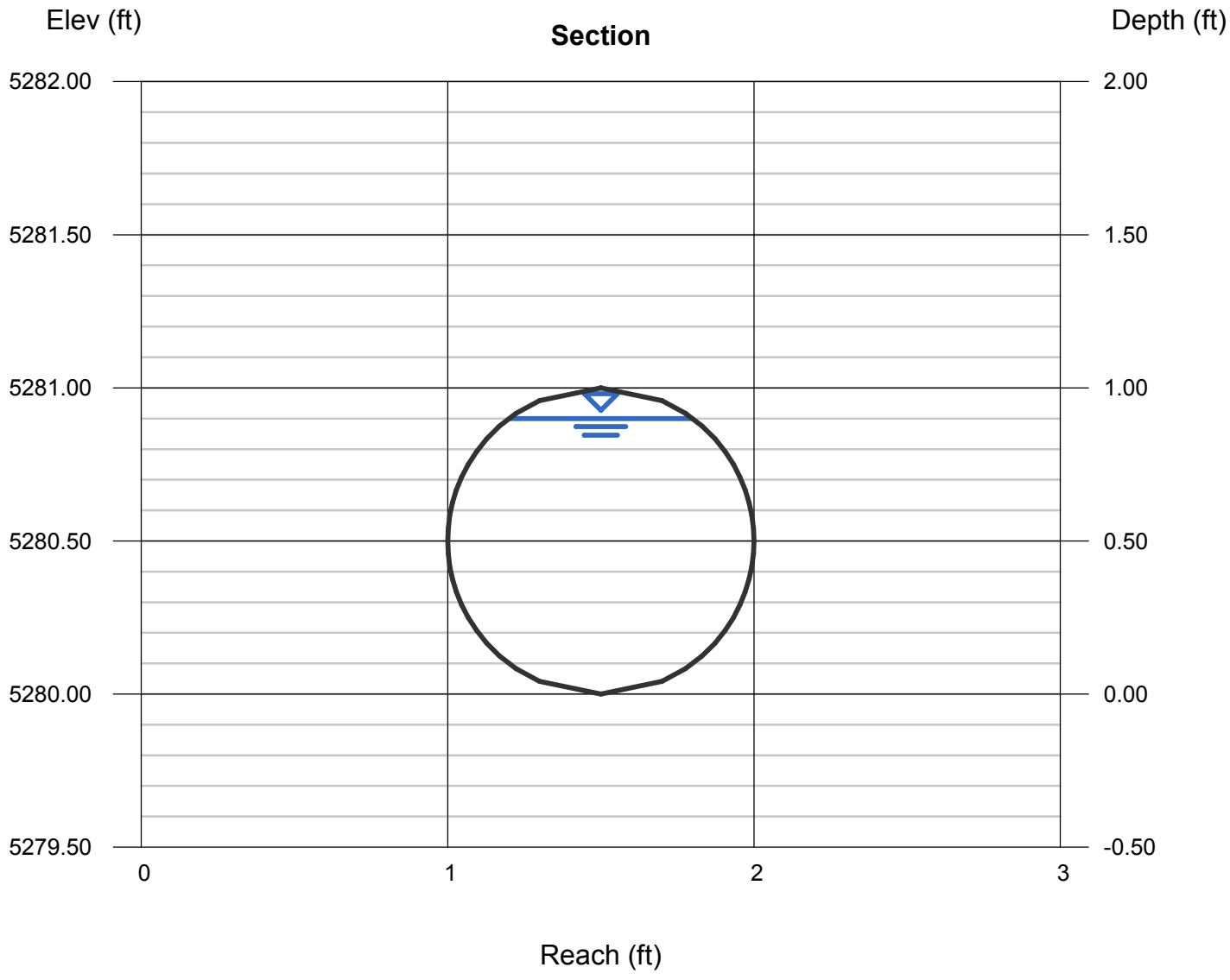
Diameter (ft)	= 1.00
Invert Elev (ft)	= 5280.00
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.90
Q (cfs)	= 2.685
Area (sqft)	= 0.74
Velocity (ft/s)	= 3.60
Wetted Perim (ft)	= 2.50
Crit Depth, Yc (ft)	= 0.71
Top Width (ft)	= 0.60
EGL (ft)	= 1.10



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Feb 10 2017

18 in. Pipe @ 8.00%

Circular

Diameter (ft)	= 1.50
Invert Elev (ft)	= 5280.00
Slope (%)	= 8.00
N-Value	= 0.013

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 1.35
Q (cfs)	= 31.67
Area (sqft)	= 1.68
Velocity (ft/s)	= 18.89
Wetted Perim (ft)	= 3.75
Crit Depth, Yc (ft)	= 1.50
Top Width (ft)	= 0.90
EGL (ft)	= 6.90