GREAT BASIN ENGINEERING INC

FARR FAVERO PROPERTY
2200 SOUTH 3500 WEST
WEBER COUNTY, UTAH
STORM WATER STUDY
Project No. 02N302
1-20-2015
Updated 3-11-15

General Site Information:

The proposed Farr Favero Property site is located at approximately 2200 South 3500 West in Weber County, Utah to the west of Ogden City. Construction will consist of a new residential development with roadways, curb and gutter, and sidewalk. Underground utilities such as sewer, water, storm drain, and gas lines will be installed as part of this project. Lots will be rough graded to accommodate the street designs.

The storm water that falls to the north of the existing canal on the site will be collected in inlet boxes and continue via storm drain to a detention facility at the northwest corner of the site. Storm water that falls south of the canal will drain to a detention facility at the southeast corner of the site. The site is allowed an overall unit-release of 0.1 cfs per acre into existing storm drainage systems along 2200 South Street and 3500 West Street. Drainage will continue westerly and southerly, respectively, in these systems in a historical fashion. The attached figure shows the project site and location of storm water outfall points. Detention calculations have been provided for the site. (See attached figure and calculations).

The study area is broken up into 6 drainage areas (labeled A-1 through A-6). A runoff coefficient of 0.15 is used for natural ground and landscaped areas. A runoff coefficient of 0.90 is used for asphalt, concrete, buildings, and other hard surfaced areas. An average runoff coefficient was calculated for each area. The overall coefficient for the study area is 0.32.

A time of concentration is calculated using the FAA method and rational coefficients of 0.35 for landscape and 0.91 for hardscape for each of the areas. The time of concentration ranges from about 18 to 29 minutes for each of these six areas. This time is based on the longest path inside the drainage area over grass or other vegetation, asphalt, concrete, or through a pipeline as applicable. Times calculated to be less than 5 minutes should be rounded to 5 minutes when using this method. Rainfall Intensities were taken from NOAA for pipe sizing and detention requirements. The values obtained were interpolated as necessary. A copy of this data is attached.

Data showing area information, runoff coefficient, time of concentration, peak flow, and required detention for the site is also provided and can be found in the attached calculations.

Pipe Sizes:

Storm water pipes in the project are proposed to be concrete pipe (CP), and/or reinforced concrete pipe (RCP). All pipes in the project are sloped to provide the design capacity while maintaining a minimum scour speed of at least 2 feet per second when the pipes are flowing at least half full. The pipes and inlet boxes have sufficient capacity to convey the 10-year storm without surcharging.

Orifice Plate:

TEL (801) 394-4515 • FAX (801) 392-7544 • 5746 South 1475 East • Ogden, Utah 84403 • www.greatbasinengineering.com

An orifice plate will be used to control the rate that storm water flows from the project. It will be located at the inlet-outlet structure at the ponding areas when designed. The orifice plate opening will have a diameter that allows for the detention facilities to utilize available capacity during a 10-yr storm, while allowing no more than 0.1 cfs/acre of storm water to leave the site. The orifice plate will allow small flows to pass through without detention. As the rate of storm water into the pipes and detention facility increases, the orifice plate will restrict the flow. The maximum flow through the plate will occur when the detention basin reaches the maximum design depth. A detail of an orifice plate is attached.

Required Detention:

The required detention storage volume for the 10-year storm with a release rate of 0.1 cfs/acre is 41,546 cubic feet for the entire study area. This volume is broken into two parts. The areas south of the canal, A-5 and A-6, require 10,858 cf. The remaining areas, A-1 through A-4 require the remaining volume 30,688 cf. Calculations are provided for each of these figures. Storage volume will be provided to meet this requirement. In the event the ponding areas experience a storm larger than the design storm water will then spill out onto 2200 South Street and continue westerly in a historical fashion.

Great Basin Engineering, Inc.

Prepared by Ryan Bingham, P.E.

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Lot 10 | Lot 9 Subdivision | Lot 12 | Lot 14

Allen Estates

Jeffery T. & Kathy McGary | Tracy M. & Gregory Mayer | Byron C. & Cindy D. Bosshardt | Stacie Johnson | Leon L. & Bobbi A. Medina | Kim Rupert & Leone Dorene Danae | Ryan S. & Jenny N. Lewis | Reese G. & Patsy Dahle | Vaughn & Rhondy Allen Family Living Trust

3750 West Street

Center of Section 28, T6N, R2W, SLB&M, U.S. Survey

Outfall 1

Outfall 2

S 89°13'14" E 1584.00'

Northeast corner of the Southeast 1/4 of Section 28, T6N, R2W, SLB&M, U.S. Survey

1320.00'

S 0°46'46" W 2640.00'

Weber County Fire | Charles J. Marsh | Castellano | Charles J. Marsh

S 89°13'14" E 660.00'

107.25'

S 0°46'46" W

Grover D. Underwood & wf. Julia Lavon

S 89°13'14" E 396.00'

882.75'

N 0°46'46" E 1320.00'

Kathleen V. Buck Family Protection Trust

Scale: NTS

Outfall 3

N 0°46'46" E 2638.86'

S 89°13'14" E

Allan T. Clarke Trustee, ETAL | Ray W. & Diana L. Ellis Revocable Trust | Kevin A. & Jan P. Roberts | David R. Buck | J H Buck Investment, LTD | Kregg & Kami Thomassen

16.5' Private Drive for Remaining Farr Trust Parcel 150780015 to be vacated and removed

16.50' NSW

Storm Water Study
Winslow Farr Jr. Farm
2200 S 3500 W Ogden, Utah
02N302 - Favero_Option 8 - Prelim-SWS.dwg
1/20/2015

Street and Residential Hardscape Cd =	0.90
Street and Residential Landscape Cd =	0.15
Common Areas Cd =	0.2
Calculated Cd for (60') R.O.W. Sections =	0.763

6 Detained Areas

RESIDENTIAL INFO

Average lot size is	21659	sq. ft.
an average home size of	2500	sq. ft.
an avg. patio/driveway size of	1500	sq. ft.
Resulting in a total landscape of	17659	sq. ft.
Resulting in a total hardscape of	4000	sq. ft.
Resulting in a Residential Cd of	0.289	

Drainage Areas	Total Area (acres)	60' Road Area (acres)	Common Area (acres)	Residential Area (acres)	C
∑ Det. Areas	65.740	7.823	21.123	36.794	0.316
∑ All Areas	65.740	7.823	21.123	36.794	0.316
A-1	15.402	1.461	4.903	9.037	0.305
A-2	13.504	2.329	2.169	9.007	0.356
A-3	6.913	1.203	0.990	4.720	0.358
A-4	11.954	0.997	6.950	4.007	0.277
A-5	11.006	0.969	2.564	7.473	0.310
A-6	6.962	0.864	3.547	2.551	0.302

Time of Concentration--use FAA Method

For FAA Method, use C's of..

C = 0.35 for landscape

C = 0.91 for hardscape

For Concrete, use an average CL street slope

Assume Pipe Flow is at 2 ft/s

$$t_c = \frac{1.8(1.1 - C)\sqrt{L}}{\sqrt[3]{S}}$$

**Note: S is in percent

Area	Length on Landscape (ft)	Slope of Landscape (%)	Time on Landscape (min.)	Length on Hardscape (ft)	Slope of Hardscape (%)	Time on Hardscape (min.)	Length in Pipe (ft)	Time in Pipe (min.)	TC for entire Area (min.)
A-1	396.00	2.00	21.32	267.00	1.00	5.59	308.00	2.57	29.48
A-2	259.00	2.00	17.24	118.00	1.00	3.72	577.00	4.81	25.77
A-3	92.00	2.00	10.28	50.00	1.00	2.42	636.00	5.30	18.00
A-4	382.00	2.00	20.94	140.00	1.00	4.05	295.00	2.46	27.45
A-5	395.00	2.00	21.30	54.00	1.00	2.51	144.00	1.20	25.01
A-6	182.00	2.00	14.46	73.00	1.00	2.92	531.00	4.43	21.80

Rainfall Intensities
Data From NOAA

10-Year Storm Intensities

The equations used for the 10-Year Storm Intensities were found using the attached Rainfall data as well as Interpolated data from the produced graphs. The equations developed are 6th order polynomials, which give very high "R^2" values.

The equations used are:

$$I = At^6 + Bt^5 + Ct^4 + Dt^3 + Et^2 + Ft + G$$

where……

	10-Yr. Coeff.
A =	2.897E-11
B =	-1.230E-08
C =	2.089E-06
D =	-1.825E-04
E =	8.841E-03
F =	-2.445E-01
G =	4.245E+00

		Storm Intensities
AREA	Tc (minutes)	I (10-yr.) (in./hr.)
A-1	29.5	1.37
A-2	25.8	1.48
A-3	18.0	1.84
A-4	27.4	1.43
A-5	25.0	1.51
A-6	21.8	1.64

Peak Flow Information

Use Rational Method

10-Year Storm Intensities

Q=CIA

AREA	C	I10 (in./hr.)
A-1	0.305	1.369
A-2	0.356	1.483
A-3	0.358	1.842
A-4	0.277	1.429
A-5	0.310	1.510
A-6	0.302	1.641

Peak Flows

∑ detained =	31.46
A (acres)	Q (10-yr.) (cfs)
15.40	6.44
13.50	7.13
6.91	4.56
11.95	4.72
11.01	5.15
6.96	3.45

Node Inlet Requirements

Size pipes for 10 year storm

Area	Node #	% of Total	Q (cfs)
A-1	1	25.0%	1.61
A-1	2	25.0%	1.61
A-1	3	15.0%	0.97
A-1	4	15.0%	0.97
A-1	5	15.0%	0.97
A-1	6	5.0%	0.32
A-2	7	10.0%	0.71
A-2	8	10.0%	0.71
A-2	9	10.0%	0.71
A-2	10	15.0%	1.07
A-2	11	5.0%	0.36
A-2	12	5.0%	0.36
A-2	13	5.0%	0.36
A-2	14	15.0%	1.07
A-2	15	25.0%	1.78
A-3	16	70.0%	3.19
A-3	17	10.0%	0.46
A-3	18	10.0%	0.46
A-3	19	10.0%	0.46
A-4	20	30.0%	1.42
A-4	21	15.0%	0.71
A-4	22	15.0%	0.71
A-4	23	35.0%	1.65
A-4	24	5.0%	0.24
A-5	25	25.0%	1.29
A-5	26	30.0%	1.54
A-5	27	30.0%	1.54
A-5	28	15.0%	0.77
A-6	29	10.0%	0.35
A-6	30	15.0%	0.52
A-6	31	25.0%	0.86
A-6	32	20.0%	0.69
A-6	33	15.0%	0.52
A-6	34	15.0%	0.52

PIPE FLOWS

Upstream Node	Downstream node	Pipe Flow (cfs)
1	Outfall 1	13.57
2	1	11.96
3	2	10.35
4	3	9.39
5	4	8.42
6	5	7.45
7	8	0.71
8	9	1.43
9	10	2.14
10	6	7.13
11	10	3.92
12	11	3.57
13	12	3.21
14	13	2.85
15	14	1.78
16	Outfall 2	9.29
17	16	6.09
18	17	5.64
19	18	5.18
20	19	4.72
21	20	3.31
22	21	2.60
23	22	1.89
24	23	0.24
25	28	4.37
26	25	3.09
27	26	1.54
28	29	5.15
29	30	5.49
30	31	6.01
31	32	6.87
32	33	7.56
33	34	8.08
34	Outfall 3	8.60

Pipe Sizes Between the Specified Nodes

Up Stream Node	Dn Stream Node	Q (cfs)	Pipe Size (in)	Design Min Slope (%)	Area (ft^2)	Rh (ft)	Manning's n	Scour Min. Slope (%)	First Trial Pipe Size
1	Outfall 1	13.57	15	4.413%	1.227	0.313	0.013	0.150%	24
		13.57	18	1.669%	1.767	0.375	0.013	0.120%	
		13.57	24	0.360%	3.142	0.500	0.013	0.080%	
2	1	11.96	15	3.428%	1.227	0.313	0.013	0.150%	24
		11.96	18	1.296%	1.767	0.375	0.013	0.120%	
		11.96	24	0.280%	3.142	0.500	0.013	0.080%	
3	2	10.35	15	2.568%	1.227	0.313	0.013	0.150%	24
		10.35	18	0.971%	1.767	0.375	0.013	0.120%	
		10.35	24	0.209%	3.142	0.500	0.013	0.080%	
4	3	9.39	15	2.111%	1.227	0.313	0.013	0.150%	24
		9.39	18	0.798%	1.767	0.375	0.013	0.120%	
		9.39	24	0.172%	3.142	0.500	0.013	0.080%	
5	4	8.42	15	1.699%	1.227	0.313	0.013	0.150%	18
		8.42	18	0.642%	1.767	0.375	0.013	0.120%	
		8.42	24	0.139%	3.142	0.500	0.013	0.080%	
6	5	7.45	15	1.331%	1.227	0.313	0.013	0.150%	18
		7.45	18	0.503%	1.767	0.375	0.013	0.120%	
		7.45	24	0.109%	3.142	0.500	0.013	0.080%	
7	8	0.71	15	0.012%	1.227	0.313	0.013	0.150%	15
		0.71	18	0.005%	1.767	0.375	0.013	0.120%	
		0.71	24	0.001%	3.142	0.500	0.013	0.080%	
8	9	1.43	15	0.049%	1.227	0.313	0.013	0.150%	15
		1.43	18	0.018%	1.767	0.375	0.013	0.120%	
		1.43	24	0.004%	3.142	0.500	0.013	0.080%	
9	10	2.14	15	0.110%	1.227	0.313	0.013	0.150%	15
		2.14	18	0.041%	1.767	0.375	0.013	0.120%	
		2.14	24	0.009%	3.142	0.500	0.013	0.080%	
10	6	7.13	15	1.219%	1.227	0.313	0.013	0.150%	18
		7.13	18	0.461%	1.767	0.375	0.013	0.120%	
		7.13	24	0.099%	3.142	0.500	0.013	0.080%	
11	10	3.92	15	0.369%	1.227	0.313	0.013	0.150%	15
		3.92	18	0.139%	1.767	0.375	0.013	0.120%	
		3.92	24	0.030%	3.142	0.500	0.013	0.080%	
12	11	3.57	15	0.305%	1.227	0.313	0.013	0.150%	15
		3.57	18	0.115%	1.767	0.375	0.013	0.120%	
		3.57	24	0.025%	3.142	0.500	0.013	0.080%	
13	12	3.21	15	0.247%	1.227	0.313	0.013	0.150%	15
		3.21	18	0.093%	1.767	0.375	0.013	0.120%	
		3.21	24	0.020%	3.142	0.500	0.013	0.080%	
14	13	2.85	15	0.195%	1.227	0.313	0.013	0.150%	15
		2.85	18	0.074%	1.767	0.375	0.013	0.120%	
		2.85	24	0.016%	3.142	0.500	0.013	0.080%	

15	14	1.78	15	0.076%	1.227	0.313	0.013	0.150%	**15**
		1.78	18	0.029%	1.767	0.375	0.013	0.120%	
		1.78	24	0.006%	3.142	0.500	0.013	0.080%	
16	Outfall 2	9.29	15	2.066%	1.227	0.313	0.013	0.150%	**24**
		9.29	18	0.781%	1.767	0.375	0.013	0.120%	
		9.29	24	0.168%	3.142	0.500	0.013	0.080%	
17	16	6.09	15	0.889%	1.227	0.313	0.013	0.150%	**18**
		6.09	18	0.336%	1.767	0.375	0.013	0.120%	
		6.09	24	0.072%	3.142	0.500	0.013	0.080%	
18	17	5.64	15	0.761%	1.227	0.313	0.013	0.150%	**18**
		5.64	18	0.288%	1.767	0.375	0.013	0.120%	
		5.64	24	0.062%	3.142	0.500	0.013	0.080%	
19	18	5.18	15	0.643%	1.227	0.313	0.013	0.150%	**15**
		5.18	18	0.243%	1.767	0.375	0.013	0.120%	
		5.18	24	0.052%	3.142	0.500	0.013	0.080%	
20	19	4.72	15	0.534%	1.227	0.313	0.013	0.150%	**15**
		4.72	18	0.202%	1.767	0.375	0.013	0.120%	
		4.72	24	0.044%	3.142	0.500	0.013	0.080%	
21	20	3.31	15	0.262%	1.227	0.313	0.013	0.150%	**15**
		3.31	18	0.099%	1.767	0.375	0.013	0.120%	
		3.31	24	0.021%	3.142	0.500	0.013	0.080%	
22	21	2.60	15	0.162%	1.227	0.313	0.013	0.150%	**15**
		2.60	18	0.061%	1.767	0.375	0.013	0.120%	
		2.60	24	0.013%	3.142	0.500	0.013	0.080%	
23	22	1.89	15	0.086%	1.227	0.313	0.013	0.150%	**15**
		1.89	18	0.032%	1.767	0.375	0.013	0.120%	
		1.89	24	0.007%	3.142	0.500	0.013	0.080%	
24	23	0.24	15	0.001%	1.227	0.313	0.013	0.150%	**15**
		0.24	18	0.001%	1.767	0.375	0.013	0.120%	
		0.24	24	0.000%	3.142	0.500	0.013	0.080%	
25	28	4.37	15	0.459%	1.227	0.313	0.013	0.150%	**15**
		4.37	18	0.173%	1.767	0.375	0.013	0.120%	
		4.37	24	0.037%	3.142	0.500	0.013	0.080%	
26	25	3.09	15	0.228%	1.227	0.313	0.013	0.150%	**15**
		3.09	18	0.086%	1.767	0.375	0.013	0.120%	
		3.09	24	0.019%	3.142	0.500	0.013	0.080%	
27	26	1.54	15	0.057%	1.227	0.313	0.013	0.150%	**15**
		1.54	18	0.022%	1.767	0.375	0.013	0.120%	
		1.54	24	0.005%	3.142	0.500	0.013	0.080%	
28	29	5.15	15	0.635%	1.227	0.313	0.013	0.150%	**15**
		5.15	18	0.240%	1.767	0.375	0.013	0.120%	
		5.15	24	0.052%	3.142	0.500	0.013	0.080%	

29	30	5.49	15	0.723%	1.227	0.313	0.013	0.150%	**18**
		5.49	18	0.273%	1.767	0.375	0.013	0.120%	
		5.49	24	0.059%	3.142	0.500	0.013	0.080%	
30	31	6.01	15	0.865%	1.227	0.313	0.013	0.150%	**18**
		6.01	18	0.327%	1.767	0.375	0.013	0.120%	
		6.01	24	0.071%	3.142	0.500	0.013	0.080%	
31	32	6.87	15	1.132%	1.227	0.313	0.013	0.150%	**18**
		6.87	18	0.428%	1.767	0.375	0.013	0.120%	
		6.87	24	0.092%	3.142	0.500	0.013	0.080%	
32	33	7.56	15	1.371%	1.227	0.313	0.013	0.150%	**18**
		7.56	18	0.518%	1.767	0.375	0.013	0.120%	
		7.56	24	0.112%	3.142	0.500	0.013	0.080%	
33	34	8.08	15	1.565%	1.227	0.313	0.013	0.150%	**18**
		8.08	18	0.592%	1.767	0.375	0.013	0.120%	
		8.08	24	0.128%	3.142	0.500	0.013	0.080%	
34	Outfall 3	8.60	15	1.772%	1.227	0.313	0.013	0.150%	**18**
		8.60	18	0.670%	1.767	0.375	0.013	0.120%	
		8.60	24	0.144%	3.142	0.500	0.013	0.080%	

Combined Detention Pond

C = 0.32

Area = 65.74 acres

Allowable Discharge Rate = 0.100 cfs/acre

Total Release Rate = 6.574 cfs

Detention Pond Sized For The 10 Year Storm

Time	Rainfall Intensity	Accumulated Volume	OR Allowable Release	Needed Detention	Needed Detention	
min	in./hr.	(CF)	(CF)	(CF)	(acre-ft)	
5	3.22	20110	1972	18138	0.416	
10	2.52	31475	3944	27531	0.632	
15	2.05	38346	5917	32430	0.744	
20	1.73	43162	7889	35273	0.810	
25	1.51	47141	9861	37280	0.856	
30	1.36	50751	11833	38918	0.893	
35	1.24	54049	13805	40243	0.924	
40	1.14	56932	15778	41155	0.945	
45	1.06	59296	17750	41546	0.954	<-Peak Detent
50	0.98	61120	19722	41398	0.950	
55	0.91	62493	21694	40799	0.937	
60	0.85	63599	23666	39932	0.917	
90	0.65	72917	35500	37417	0.859	
120	0.50	75342	47333	28009	0.643	
180	0.36	79767	70999	8767	0.201	
360	0.23	101113	141999	-40886	-0.939	
720	0.14	127627	283998	-156371	-3.590	
1440	0.09	152793	567996	-415203	-9.532	

The required capacity of the detention facility is **41546** ft^3 of water

Pond Serving A-1 through A-4

C = 0.32 Allowable Discharge Rate = 0.100 cfs/acre

Area = 47.77 acres

Total Release Rate = 4.777 cfs

Detention Pond Sized For The 10 Year Storm

Time	Rainfall Intensity	Accumulated Volume	OR Allowable Release	Needed Detention	Needed Detention
min	in./hr.	(CF)	(CF)	(CF)	(acre-ft)
5	3.22	14782	1433	13349	0.306
10	2.52	23136	2866	20270	0.465
15	2.05	28187	4299	23888	0.548
20	1.73	31727	5733	25994	0.597
25	1.51	34652	7166	27486	0.631
30	1.36	37305	8599	28706	0.659
35	1.24	39729	10032	29697	0.682
40	1.14	41849	11465	30384	0.698
45	1.06	43587	12898	30688	0.705
50	0.98	44927	14332	30596	0.702
55	0.91	45937	15765	30172	0.693
60	0.85	46749	17198	29551	0.678
90	0.65	53599	25797	27802	0.638
120	0.50	55381	34396	20985	0.482
180	0.36	58634	51594	7040	0.162
360	0.23	74325	103188	-28863	-0.663
720	0.14	93814	206375	-112561	-2.584
1440	0.09	112313	412750	-300438	-6.897

The required capacity of the detention facility is **30688** ft^3 of water

Pond Serving A-5 and A-6

C = 0.31 Allowable Discharge Rate = 0.100 cfs/acre

Area = 17.97 acres

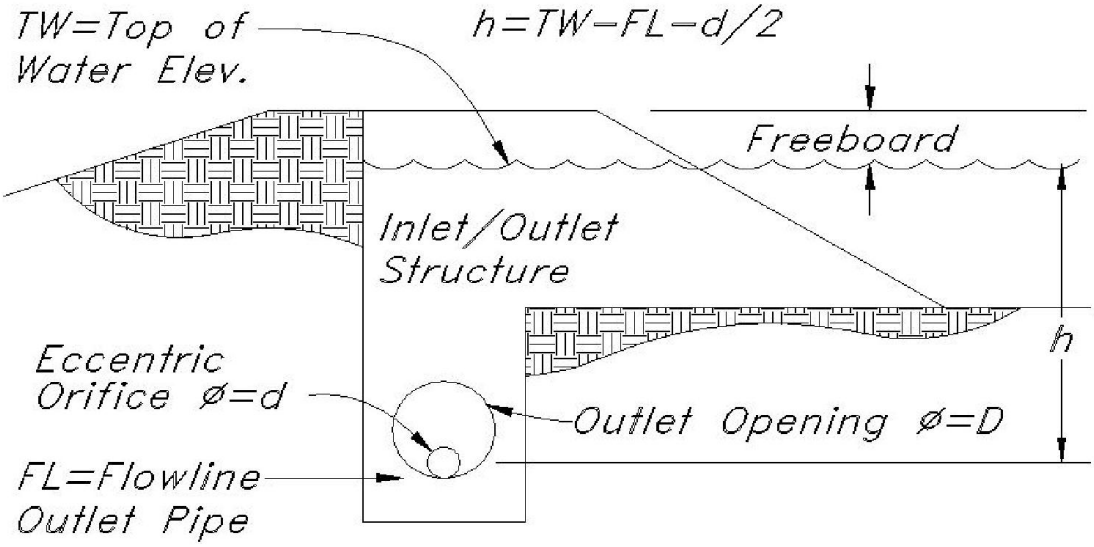
Total Release Rate = 1.797 cfs

Detention Pond Sized For The 10 Year Storm

Time	Rainfall Intensity	Accumulated Volume	OR Allowable Release	Needed Detention	Needed Detention
min	in./hr.	(CF)	(CF)	(CF)	(acre-ft)
5	3.22	5328	539	4789	0.110
10	2.52	8339	1078	7261	0.167
15	2.05	10159	1617	8542	0.196
20	1.73	11435	2156	9279	0.213
25	1.51	12489	2695	9794	0.225
30	1.36	13446	3234	10211	0.234
35	1.24	14319	3773	10546	0.242
40	1.14	15083	4312	10771	0.247
45	1.06	15710	4851	10858	0.249
50	0.98	16193	5390	10802	0.248
55	0.91	16557	5930	10627	0.244
60	0.85	16850	6469	10381	0.238
90	0.65	19318	9703	9615	0.221
120	0.50	19961	12937	7024	0.161
180	0.36	21133	19406	1727	0.040
360	0.23	26788	38811	-12023	-0.276
720	0.14	33813	77623	-43810	-1.006
1440	0.09	40480	155245	-114765	-2.635

The required capacity of the detention facility is **10858** ft^3 of water

ORIFICE PLATE CALCULATIONS



Q = Total Discharge Rate

$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \sqrt{\left(TW - FL - d/2\right)}}}}$$

Goal-seek Δ to zero by changing d

TW =		
FL =		
Q =	6.574	cfs
trial d=	0.25	ft
Δ =		ft
d =		inches

NOAA Atlas 14, Volume 1, Version 5
Location name: Ogden, Utah, US*
Latitude: 41.2250°, Longitude: -112.0690°
Elevation: 4258 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.51 (1.31–1.75)	1.90 (1.68–2.21)	2.59 (2.27–3.01)	3.25 (2.82–3.78)	4.32 (3.66–5.05)	5.33 (4.37–6.31)	6.52 (5.16–7.82)	7.94 (6.06–9.72)	10.2 (7.37–12.9)	12.4 (8.47–16.0)
10-min	1.15 (0.996–1.33)	1.45 (1.27–1.68)	1.97 (1.73–2.29)	2.47 (2.15–2.88)	3.29 (2.79–3.85)	4.05 (3.32–4.80)	4.96 (3.93–5.95)	6.05 (4.61–7.40)	7.80 (5.61–9.86)	9.44 (6.45–12.2)
15-min	0.952 (0.824–1.10)	1.19 (1.05–1.39)	1.63 (1.43–1.89)	2.04 (1.78–2.38)	2.72 (2.30–3.18)	3.35 (2.74–3.97)	4.10 (3.25–4.92)	5.00 (3.81–6.12)	6.45 (4.64–8.14)	7.80 (5.33–10.1)
30-min	0.640 (0.556–0.740)	0.804 (0.710–0.934)	1.10 (0.962–1.27)	1.38 (1.20–1.60)	1.83 (1.55–2.14)	2.25 (1.85–2.67)	2.76 (2.19–3.31)	3.36 (2.56–4.12)	4.34 (3.12–5.48)	5.25 (3.59–6.78)
60-min	0.396 (0.344–0.458)	0.497 (0.439–0.578)	0.679 (0.595–0.788)	0.851 (0.740–0.990)	1.13 (0.960–1.32)	1.39 (1.14–1.65)	1.71 (1.35–2.05)	2.08 (1.59–2.55)	2.69 (1.93–3.39)	3.25 (2.22–4.20)
2-hr	0.249 (0.220–0.286)	0.312 (0.276–0.357)	0.402 (0.354–0.462)	0.491 (0.426–0.564)	0.637 (0.542–0.740)	0.772 (0.640–0.908)	0.932 (0.746–1.12)	1.12 (0.866–1.38)	1.43 (1.04–1.81)	1.72 (1.19–2.22)
3-hr	0.194 (0.175–0.218)	0.239 (0.215–0.270)	0.300 (0.268–0.338)	0.355 (0.316–0.402)	0.446 (0.388–0.509)	0.530 (0.452–0.613)	0.636 (0.528–0.747)	0.762 (0.611–0.921)	0.968 (0.737–1.22)	1.16 (0.844–1.49)
6-hr	0.132 (0.121–0.145)	0.161 (0.147–0.178)	0.195 (0.177–0.215)	0.225 (0.203–0.250)	0.272 (0.242–0.304)	0.311 (0.273–0.350)	0.355 (0.306–0.406)	0.404 (0.340–0.470)	0.508 (0.413–0.616)	0.601 (0.473–0.755)
12-hr	0.084 (0.077–0.091)	0.102 (0.095–0.112)	0.124 (0.114–0.135)	0.142 (0.129–0.155)	0.170 (0.153–0.187)	0.193 (0.172–0.214)	0.217 (0.190–0.245)	0.244 (0.208–0.279)	0.284 (0.236–0.334)	0.318 (0.257–0.381)
24-hr	0.052 (0.048–0.056)	0.063 (0.059–0.068)	0.075 (0.070–0.081)	0.085 (0.079–0.092)	0.099 (0.092–0.107)	0.110 (0.101–0.119)	0.121 (0.111–0.131)	0.132 (0.120–0.143)	0.147 (0.133–0.169)	0.161 (0.142–0.193)
2-day	0.030 (0.028–0.032)	0.037 (0.034–0.039)	0.043 (0.040–0.047)	0.049 (0.046–0.053)	0.057 (0.053–0.061)	0.062 (0.058–0.067)	0.068 (0.063–0.073)	0.074 (0.068–0.079)	0.081 (0.074–0.088)	0.087 (0.079–0.097)
3-day	0.022 (0.020–0.023)	0.027 (0.025–0.029)	0.032 (0.029–0.034)	0.036 (0.033–0.038)	0.041 (0.038–0.044)	0.046 (0.042–0.049)	0.050 (0.046–0.054)	0.054 (0.050–0.059)	0.060 (0.055–0.065)	0.065 (0.058–0.071)
4-day	0.018 (0.016–0.019)	0.021 (0.020–0.023)	0.026 (0.024–0.027)	0.029 (0.027–0.031)	0.034 (0.031–0.036)	0.037 (0.035–0.040)	0.041 (0.038–0.044)	0.045 (0.041–0.048)	0.050 (0.045–0.054)	0.053 (0.048–0.058)
7-day	0.012 (0.011–0.013)	0.014 (0.013–0.016)	0.017 (0.016–0.019)	0.019 (0.018–0.021)	0.022 (0.021–0.024)	0.025 (0.023–0.027)	0.027 (0.025–0.029)	0.029 (0.027–0.032)	0.032 (0.030–0.035)	0.035 (0.031–0.038)
10-day	0.009 (0.009–0.010)	0.011 (0.011–0.012)	0.014 (0.013–0.015)	0.015 (0.014–0.016)	0.017 (0.016–0.019)	0.019 (0.018–0.020)	0.021 (0.019–0.022)	0.022 (0.021–0.024)	0.024 (0.022–0.026)	0.025 (0.023–0.028)
20-day	0.006 (0.006–0.006)	0.007 (0.007–0.008)	0.009 (0.008–0.009)	0.010 (0.009–0.010)	0.011 (0.010–0.012)	0.012 (0.011–0.013)	0.013 (0.012–0.014)	0.014 (0.013–0.014)	0.014 (0.013–0.016)	0.015 (0.014–0.016)
30-day	0.005 (0.004–0.005)	0.006 (0.005–0.006)	0.007 (0.006–0.007)	0.008 (0.007–0.008)	0.009 (0.008–0.009)	0.009 (0.009–0.010)	0.010 (0.009–0.011)	0.011 (0.010–0.011)	0.011 (0.010–0.012)	0.012 (0.011–0.013)
45-day	0.004 (0.004–0.004)	0.005 (0.004–0.005)	0.006 (0.005–0.006)	0.006 (0.006–0.007)	0.007 (0.007–0.007)	0.008 (0.007–0.008)	0.008 (0.008–0.009)	0.009 (0.008–0.009)	0.009 (0.008–0.010)	0.009 (0.009–0.010)
60-day	0.003 (0.003–0.004)	0.004 (0.004–0.005)	0.005 (0.005–0.005)	0.006 (0.005–0.006)	0.006 (0.006–0.007)	0.007 (0.006–0.007)	0.007 (0.007–0.008)	0.008 (0.007–0.008)	0.008 (0.007–0.009)	0.008 (0.008–0.009)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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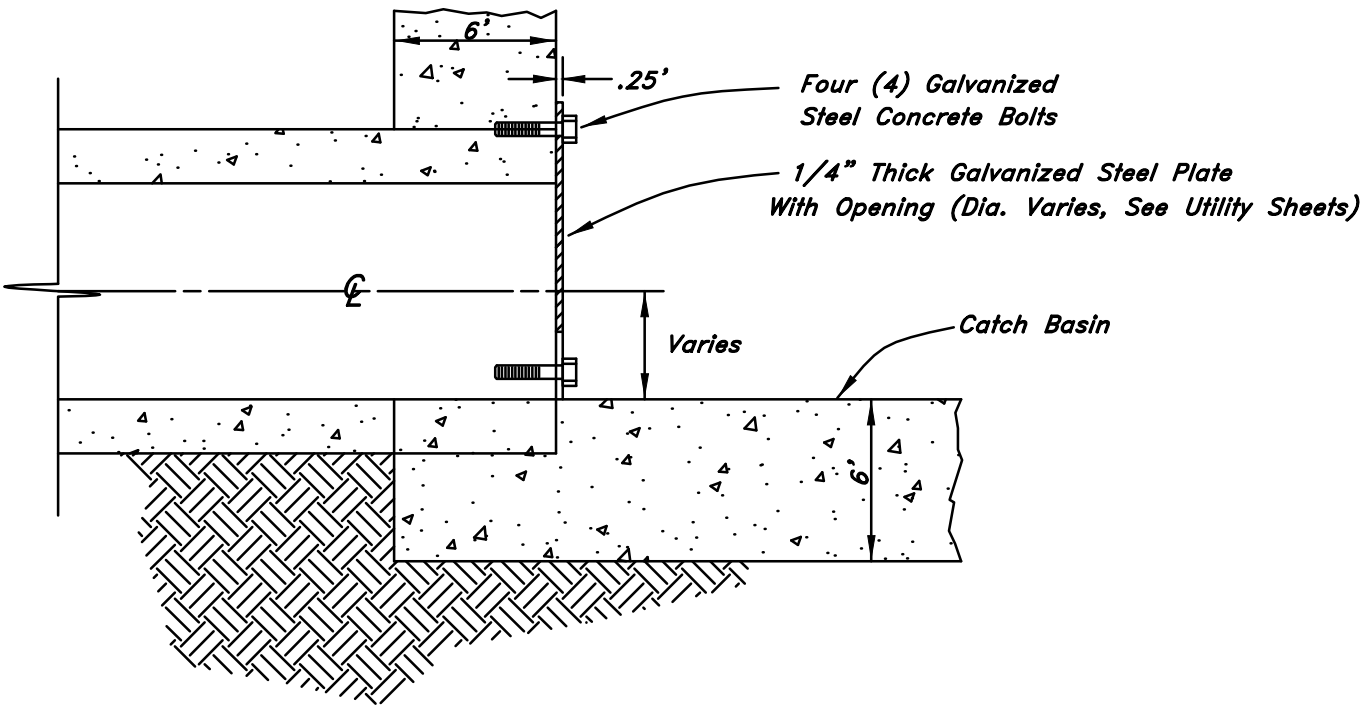
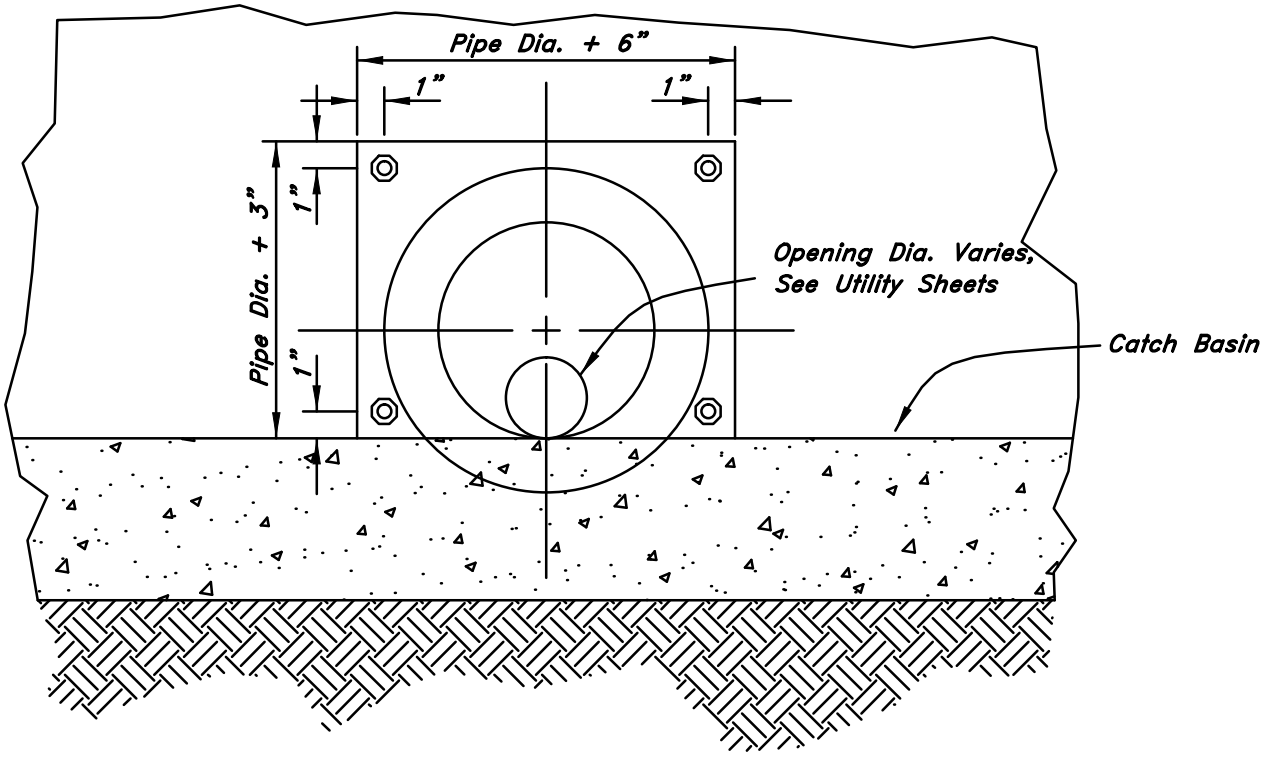
PF graphical





Restriction Plate Detail