

**THE CHALETS PHASE 6, 7, 8
QUAIL LANE
HUNTSVILLE, UTAH
STORM WATER STUDY**
Project No. 11N222
3-7-2012
Revised 12-20-12

General Site Information:

The proposed Phases 6, 7, and 8 of the Chalets Subdivision are located south of Quail Lane and west of Snow Basin Road in Huntsville, Utah. Construction will consist of an addition to Quail Lane and a road that will be named Hawks Lane as well as a new cul-de-sac called Hummingbird Point in Phase 8 and an emergency access drive. Construction will also include sidewalks, curb and gutter, underground utilities, and several lots prepared for development when completed. Storm water from the site will be detained at a detention pond located just north of the emergency access drive adjacent to an existing drainage. The portion of the Chalets Subdivision that will contribute flows to this detention facility has an area of about 38.7 acres. Storm water from site will be collected in inlet boxes or swales and continue via storm drain pipe or drainage swale to the detention pond and be released at 0.1 cfs per acre for the 10-year storm into the existing unnamed drainage tributary. A small portion of this subdivision area will be retained on lots as they are developed. Also a 264 acre watershed will flow along this drainage tributary as a pass-through flow through the detention pond. Storm water will then continue to the north in this system in a historical fashion to Pine View Reservoir. The attached figure shows the project site and location of storm water outfall. Detention calculations have been provided for the site. (See attached figure and calculations).

The proposed site is considered one drainage area (labeled A-1). Included in the calculations for the detention facility and flows from upstream of the site is an area labeled as "Drainage Watershed". A runoff coefficient of 0.15 was used for natural ground and landscaped areas. A runoff coefficient of 0.90 was used for asphalt, concrete, buildings, and other hard surfaced areas. An average runoff coefficient of 0.34 was calculated for the area within the Chalets contributing to the needed volume in the detention pond.

Rainfall intensities were found on the NOAA website. The values obtained were interpolated as necessary. A copy of this data is attached. As mentioned previously, the allowable release rate from the site is 0.1 cubic feet per second per acre.

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). All pipes in the project are sloped to provide the design capacity while maintaining a minimum scour velocity of 2 feet per second when the pipes are flowing full. The pipes and inlet boxes have sufficient capacity to convey the 10-year storm without surcharging. The 100 year storm will be conveyed with minimal surcharging in the inlet boxes and catch basins. The 30" pipe proposed for under the Emergency Access Road is to handle 93.4% of the 10-year flows from the area labeled "Drainage Watershed" on the attached figure. This is equivalent to 47.64 cfs. The capacity of this 30" RCP at S=6.93% is 108.0 cfs. The remaining 6.6% of the 10-yr storm plus approx. half of the flows from A-1 contribute to the proposed 18" pipe extending underneath Hawks Lane. This is 16.44 cfs. The capacity of this 18" RCP at S=5.99% is 25.7 cfs. Therefore, these two pipes are able to handle these required flows at the proposed slopes.

Orifice Plate:

An orifice plate has been sized for this site. It will be used to control the rate that storm water flows from the project. It will be located at the detention pond (See attached figure). The orifice plate will be 24.0 inches in diameter for the pond to fill completely during a 10-yr storm. The orifice is sized to accommodate pass through flows from the drainage watershed. Since the watershed is 264 acres, the pass through flow is 26.4 cfs at 0.1 cfs/acre. The orifice plate will allow 3.873 cfs (0.1 cfs/acre) from the development, as well as the 26.4 cfs from the drainage watershed to pass through without detention. As the rate of storm water into the pipes and above ground detention basins increases, the orifice plate will restrict the flow. The maximum flow through the plate will come when the detention basin reaches the maximum design depth. A detail of the orifice plate is attached.

Required Detention:

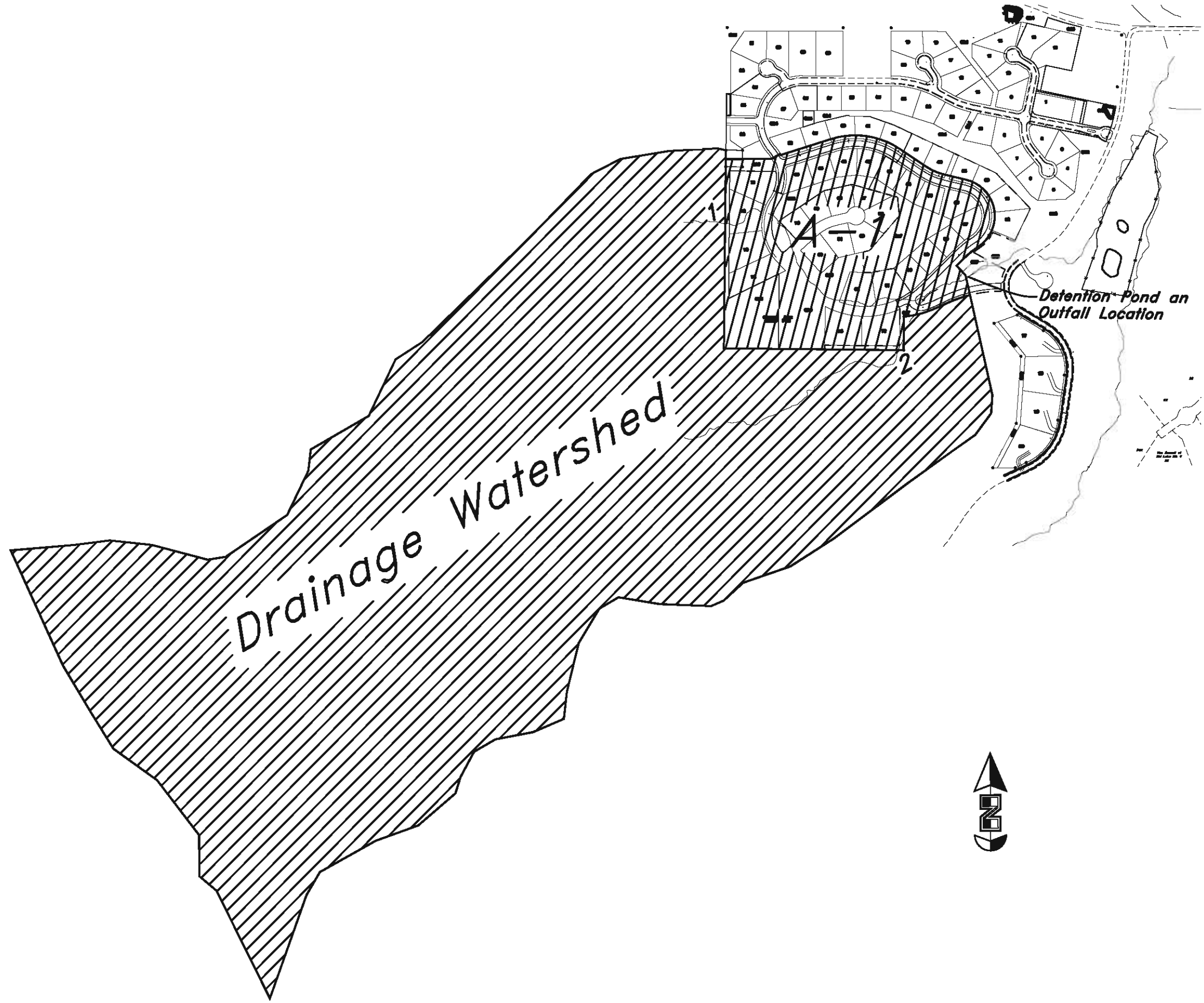
The available volume in the detention pond is 37,935 cubic feet. In addition, the pond has an extra volume of 3,641 that is below the outlet elevation, so the pond will have this extra as a constant volume. The required detention for the 10-year storm with a release rate of 0.1 cfs/acre is 35,928 cubic feet for the pond. In the event the pond experiences a storm larger than the design storm water will then spill out over a proposed overflow structure and continue to the north toward Pine View Reservoir in a historical fashion.

Great Basin Engineering, Inc.

Prepared by Ryan Bingham, P.E.



Reviewed by Mark Babbitt, P.E.



REV.	DATE	DESCRIPTION

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Storm Water Study
Chalets at Ski Lake # 6, 7, 8
A part of the Southwest 1/4 of Section 13, a part of the Northeast 1/4 of Section 23, and a part of the Northwest 1/4 of Section 24, T8N, R1E, SLB&M, U.S. Survey

Jan, 2012



Storm Water Study
 Chalets Phase 6 7 8
 Huntsville, UT
 96n120 ph 5 S1 horiz-SWS.dwg
 3/7/2012

Street and Residential Hardscape Cd =	0.90
Street and Residential Landscape Cd =	0.15
Common Areas Cd =	0.15
Calculated Cd for (60') R.O.W. Sections =	0.600

1 Detained Area

RESIDENTIAL INFO

Average lot size is	21000	sq. ft.
an average home size of	4000	sq. ft.
an avg. patio/driveway size of	2500	sq. ft.
Resulting in a total landscape of	14500	sq. ft.
Resulting in a total hardscape of	6500	sq. ft.
Resulting in a Residential Cd of	0.382	

Drainage Areas	Total Area (acres)	60' Road Area (acres)	Common Area (acres)	Residential Area (acres)	C
Σ Det. Areas	38.729	6.423	13.036	19.270	0.340
Σ All Areas	38.729	6.423	13.036	19.270	0.340
A-1	38.729	6.423	13.036	19.270	0.340

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	685.00	13.00	15.03	404.00	9.35	3.26	393.00	3.28	21.56

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 "R²" values.

The equations used are:

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

where.....

	10-Yr. Coeff.
A =	3.450E-11
B =	-1.465E-08
C =	2.489E-06
D =	-2.178E-04
E =	1.059E-02
F =	-2.941E-01
G =	5.118E+00

Storm Intensities		
AREA	Tc (minutes)	I (10-yr.) (in./hr.)
A-1	21.6	1.99

Peak Flow Information
Use Rational Method
10-Year Storm Intensities

$$Q=CIA$$

AREA	C	I10 (in./hr.)
A-1	0.340	1.990

Peak Flows	
Σ detained =	26.21
A (acres)	Q (10-yr.) (cfs)
38.73	26.21

Combined Detention Pond

C = Allowable Discharge Rate = cfs/acre

Area = acres

Total Release Rate = cfs

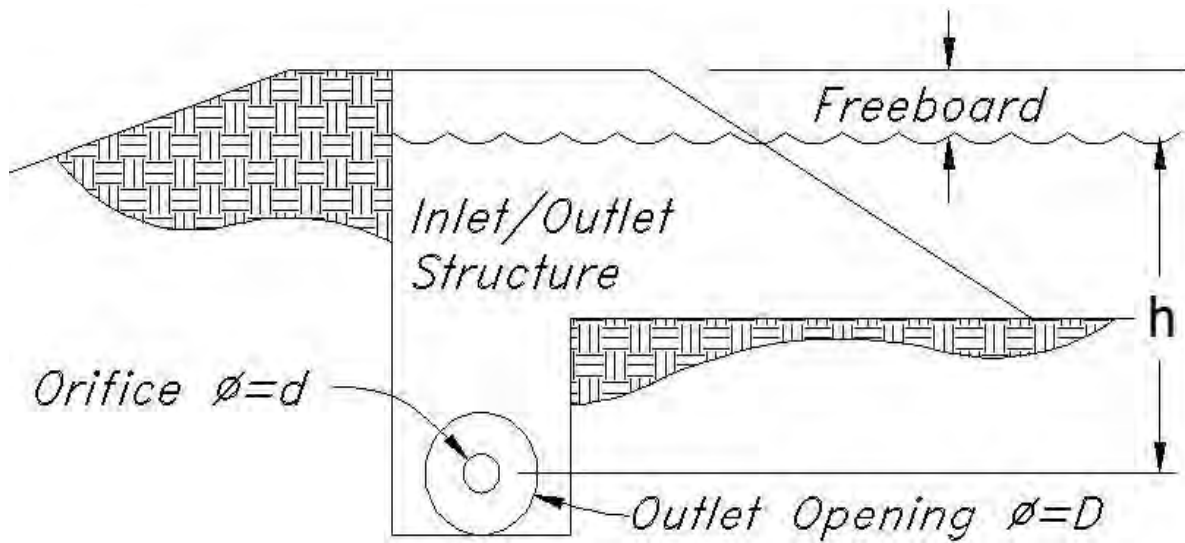
Detention Pond Sized For The Year Storm

Time min	Rainfall Intensity in./hr.	Accumulated Volume (CF)	OR		Needed Detention (acre-ft)
			Allowable Release (CF)	Needed Detention (CF)	
5	3.89	15359	1162	14197	0.326
10	3.04	24041	2324	21717	0.499
15	2.47	29277	3486	25791	0.592
20	2.08	32929	4647	28282	0.649
25	1.82	35936	5809	30127	0.692
30	1.63	38662	6971	31691	0.728
35	1.49	41163	8133	33030	0.758
40	1.37	43369	9295	34074	0.782
45	1.27	45204	10457	34747	0.798
50	1.18	46656	11619	35038	0.804
55	1.10	47793	12781	35013	0.804
60	1.03	48752	13942	34810	0.799
90	0.80	56842	20914	35928	0.825
120	0.63	59684	27885	31799	0.730
180	0.44	63026	41827	21199	0.487
360	0.28	80525	83654	-3129	-0.072
720	0.18	103573	167308	-63736	-1.463
1440	0.11	128612	334617	-206005	-4.729

<-Peak Detenti

So, our detention pond needs to hold ft³ of water

ORIFICE PLATE CALCULATIONS



$$Q = 0.62 \cdot A_o \cdot \sqrt{2 \cdot g \cdot h}$$

Q = Total Discharge Rate

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

$$g = 32.2$$

$$h = 3.75$$

$$Q = 30.247$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{2 \cdot g \cdot h}}}$$

Substituting Q, G, and H, we have.....

$$d = 2.00 \text{ feet}$$

OR

$$d = 24.0 \text{ inches}$$

Storm Water Study
 Watershed draining toward Chalets Subdivision
 Huntsville, UT
 96n120 ph 5 S1 horiz-SWS.dwg
 3/7/2012

1 Detained Area

Hardscape Cd =	0.90
Landscape Cd =	0.15

DRAINAGE WATERSHED

Drainage Areas	Total Area (ft ²)	Total Area (acres)	Hardscape Area (ft ²)	Hardscape Area (acres)	Landscape Area (ft ²)	Landscape Area (acres)	C
Σ Det. Areas	11488726	263.745	0	0.000	11488726	263.745	0.150
Σ All Areas	11488726	263.745	0	0.000	11488726	263.745	0.150
A-1	11488726	263.745	0	0.000	11488726	263.745	0.150

Time of Concentration--use FAA Method

For FAA Method, use C's of..

C = 0.35 for landscape
 C = 0.91 for hardscape

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

Assume Pipe Flow is at 2 ft/s

**Note: S is in percent, 5 min is smallest allowed Tc

DRAINAGE WATERSHED

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	5964.00	13.23	44.08	0.00	2.00	0.00	0.00	0.00	44.08

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 high "R²" values.

The equations used are:

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

where.....

	10-Yr. Coeff.
A =	3.450E-11
B =	-1.465E-08
C =	2.489E-06
D =	-2.178E-04
E =	1.059E-02
F =	-2.941E-01
G =	5.118E+00

DRAINAGE WATERSHED		Storm Intensities
AREA	Tc (minutes)	I (10-yr.) (in./hr.)
A-1	44.1	1.29

Peak Flow Information
Use Rational Method
10-Year Storm Intensities

$Q=CIA$

DRAINAGE WATERSHED

AREA	C	I10 (in./hr.)
A-1	0.150	1.289

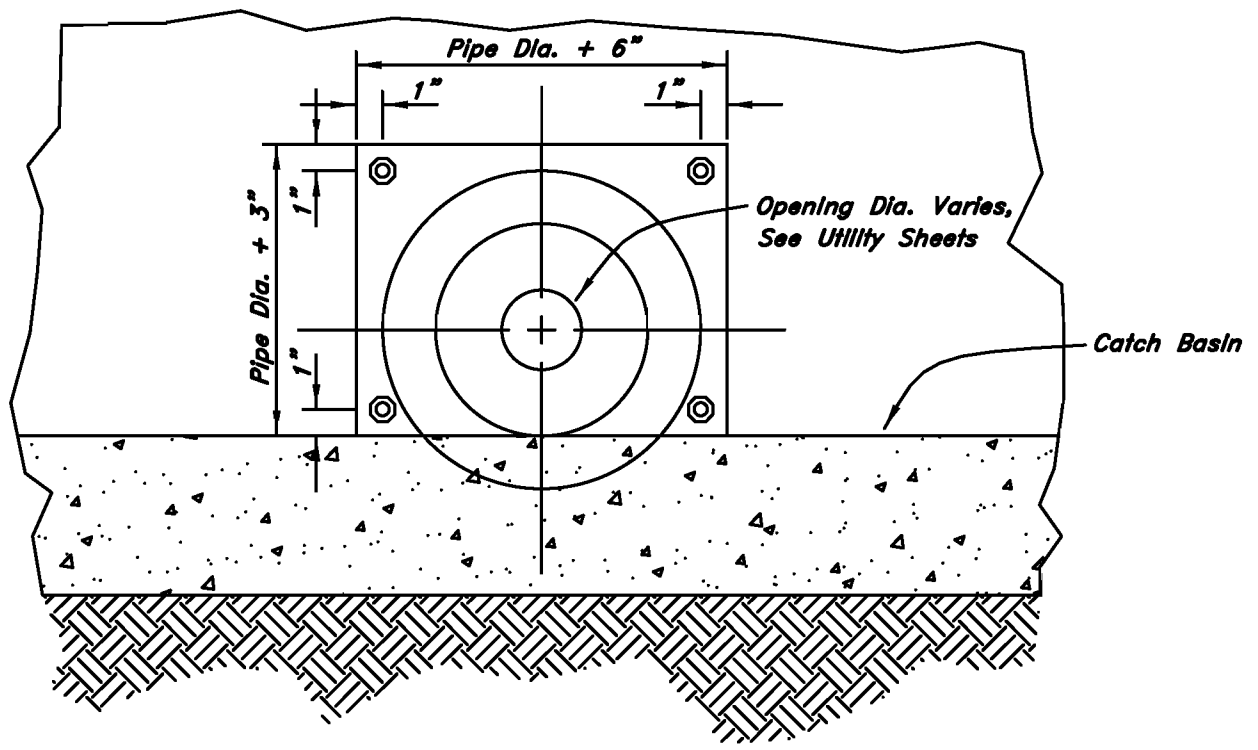
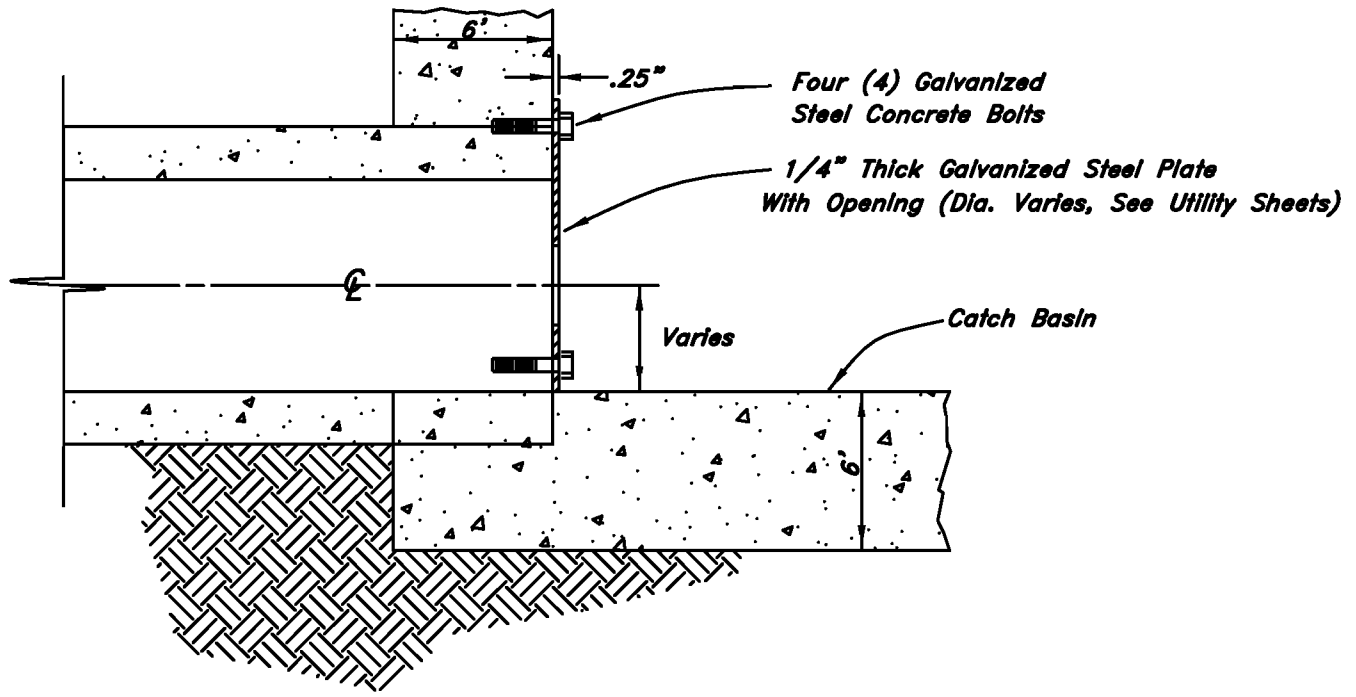
Peak Flows

Σ detained =	50.98
A (acres)	Q (10-yr.) (cfs)
263.74	50.98

Node Inlet Requirements

Size pipes for **10** year storm

Area	Node #	% of Total	Q (cfs)
A-1	1	6.6%	3.34
A-1	2	93.4%	47.64



Orifice Plate Detail



NOAA Atlas 14, Volume 1, Version 5
 Location name: Huntsville, Utah, US*
 Coordinates: 41.2460, -111.7989
 Elevation: 5120ft*
 * 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 & aeriels](#)

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	1.84 (1.61-2.12)	2.33 (2.05-2.69)	3.17 (2.76-3.65)	3.92 (3.40-4.52)	5.12 (4.34-5.96)	6.24 (5.14-7.33)	7.55 (6.02-8.99)	9.11 (7.01-11.1)	11.7 (8.46-14.6)	14.1 (9.71-18.1)
10-min	1.40 (1.22-1.62)	1.78 (1.57-2.05)	2.41 (2.11-2.77)	2.98 (2.59-3.44)	3.90 (3.31-4.54)	4.75 (3.91-5.58)	5.75 (4.59-6.83)	6.94 (5.33-8.42)	8.87 (6.44-11.1)	10.7 (7.39-13.7)
15-min	1.16 (1.01-1.34)	1.46 (1.29-1.70)	1.99 (1.74-2.29)	2.46 (2.14-2.85)	3.22 (2.73-3.75)	3.92 (3.23-4.61)	4.75 (3.79-5.65)	5.73 (4.41-6.96)	7.33 (5.32-9.18)	8.84 (6.10-11.4)
30-min	0.780 (0.682-0.900)	0.988 (0.870-1.14)	1.34 (1.17-1.54)	1.66 (1.44-1.92)	2.17 (1.84-2.53)	2.64 (2.18-3.10)	3.20 (2.55-3.80)	3.86 (2.97-4.69)	4.94 (3.58-6.18)	5.95 (4.11-7.65)
60-min	0.483 (0.422-0.557)	0.611 (0.539-0.706)	0.829 (0.725-0.955)	1.03 (0.891-1.19)	1.34 (1.14-1.56)	1.64 (1.35-1.92)	1.98 (1.58-2.35)	2.39 (1.84-2.90)	3.06 (2.22-3.83)	3.68 (2.54-4.73)
2-hr	0.314 (0.280-0.357)	0.392 (0.350-0.447)	0.507 (0.448-0.576)	0.615 (0.538-0.702)	0.791 (0.678-0.910)	0.952 (0.798-1.11)	1.14 (0.928-1.35)	1.37 (1.07-1.65)	1.74 (1.28-2.15)	2.08 (1.46-2.64)
3-hr	0.241 (0.217-0.270)	0.299 (0.269-0.335)	0.373 (0.333-0.418)	0.443 (0.393-0.498)	0.556 (0.484-0.629)	0.661 (0.563-0.755)	0.787 (0.654-0.913)	0.936 (0.753-1.11)	1.18 (0.902-1.44)	1.40 (1.03-1.78)
6-hr	0.166 (0.152-0.182)	0.203 (0.186-0.223)	0.245 (0.223-0.270)	0.283 (0.256-0.313)	0.340 (0.304-0.379)	0.388 (0.342-0.435)	0.443 (0.384-0.504)	0.506 (0.429-0.582)	0.630 (0.516-0.740)	0.742 (0.591-0.895)
12-hr	0.107 (0.098-0.118)	0.131 (0.120-0.145)	0.158 (0.144-0.175)	0.182 (0.165-0.201)	0.218 (0.195-0.243)	0.248 (0.218-0.278)	0.280 (0.242-0.318)	0.314 (0.266-0.362)	0.367 (0.302-0.433)	0.411 (0.330-0.494)
24-hr	0.068 (0.063-0.075)	0.084 (0.077-0.091)	0.100 (0.092-0.109)	0.113 (0.104-0.124)	0.132 (0.121-0.144)	0.146 (0.133-0.160)	0.161 (0.146-0.176)	0.176 (0.159-0.193)	0.196 (0.176-0.220)	0.212 (0.188-0.250)
2-day	0.041 (0.038-0.044)	0.050 (0.046-0.055)	0.060 (0.055-0.065)	0.067 (0.062-0.074)	0.078 (0.072-0.085)	0.087 (0.079-0.094)	0.095 (0.087-0.104)	0.103 (0.094-0.113)	0.115 (0.103-0.126)	0.123 (0.110-0.136)
3-day	0.030 (0.028-0.033)	0.037 (0.034-0.040)	0.044 (0.041-0.048)	0.050 (0.046-0.055)	0.059 (0.054-0.064)	0.065 (0.059-0.071)	0.072 (0.065-0.078)	0.078 (0.071-0.085)	0.087 (0.078-0.096)	0.094 (0.084-0.103)
4-day	0.025 (0.023-0.027)	0.031 (0.028-0.033)	0.037 (0.034-0.040)	0.042 (0.038-0.045)	0.049 (0.045-0.053)	0.054 (0.049-0.059)	0.060 (0.054-0.065)	0.066 (0.059-0.072)	0.073 (0.066-0.080)	0.079 (0.070-0.087)
7-day	0.018 (0.016-0.019)	0.021 (0.020-0.024)	0.026 (0.024-0.028)	0.029 (0.027-0.032)	0.034 (0.031-0.037)	0.038 (0.034-0.041)	0.042 (0.038-0.046)	0.045 (0.041-0.050)	0.051 (0.045-0.056)	0.055 (0.048-0.061)
10-day	0.014 (0.013-0.015)	0.017 (0.016-0.019)	0.021 (0.019-0.022)	0.023 (0.021-0.025)	0.027 (0.024-0.029)	0.029 (0.027-0.032)	0.032 (0.029-0.035)	0.034 (0.031-0.038)	0.038 (0.034-0.041)	0.040 (0.036-0.044)
20-day	0.009 (0.009-0.010)	0.011 (0.011-0.012)	0.014 (0.012-0.015)	0.015 (0.014-0.016)	0.017 (0.016-0.019)	0.019 (0.017-0.020)	0.020 (0.018-0.022)	0.021 (0.020-0.023)	0.023 (0.021-0.025)	0.024 (0.022-0.027)
30-day	0.008 (0.007-0.008)	0.009 (0.009-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.015 (0.014-0.016)	0.016 (0.015-0.018)	0.017 (0.016-0.019)	0.019 (0.017-0.020)	0.020 (0.018-0.021)
45-day	0.006 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.009-0.010)	0.010 (0.009-0.011)	0.012 (0.011-0.013)	0.013 (0.012-0.014)	0.014 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.014-0.017)	0.016 (0.015-0.018)
60-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.010)	0.010 (0.010-0.011)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.014)	0.014 (0.013-0.015)	0.014 (0.013-0.016)

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](#)