GREAT BASIN ENGINEERING

THE SUMMIT AT SKI LAKE #11 AND PART OF #12
VIA MONOCO AND VIA CORTINA
UNINCORPORATED WEBER COUNTY, UTAH
STORM WATER STUDY

Project No. 96N120

10-7-2011

Revised 10-5-12

General Site Information:

The proposed Summit at Ski Lake #11 and Part of #12 is located just east of the intersection of Via Cortina and Via Monoco about a half mile south of Pineview Reservoir. Construction will consist of an addition to the Via Cortina Roadway in addition to 9 residential lots when completed. Drainage is to the north in general, toward Pineview Reservoir. Drainage is intercepted by the roadways in swales. The limits of this study encompass approximately 13.5 acres. The site is broken up into two drainage areas, A-1 and A-2. Drainage from A-1 will be intercepted by a swale along Via Monoco and be directed to a detention facility at the northeast corner of A-2. The detention pond location is shown on the attached figure. Storm water will be released into the existing swales immediately north of the detention pond at a rate of 0.1 cfs per acre and will continue northerly in this system in a historical fashion. The attached figure shows the study area and location of the drainage areas. Detention calculations have been provided for the site. (See attached calculations).

Runoff coefficients were established for each area. 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 0.29 was calculated for the site using an assumption of a building footprint of 4,000 square feet for each lot, and other hard surface areas of approximately 2,500 square feet for each lot. The roadway was also considered hardscape for these calculations.

Five minutes is the shortest time allowed using this method. Rainfall intensities were obtained from NOAA. A copy of this data is attached. The values obtained were interpolated as necessary.

Data showing area information, runoff coefficient, 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 reinforced concrete pipe (RCP). All pipes 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.

Orifice Plate:

An orifice plate will be used to control the rate that storm water flows from the project. It will be located at the catch basin in the detention pond (See attached figure). The orifice plate will be 4.42 inches in diameter. The orifice plate will allow small flows to pass through without detention. As the rate of storm water into the detention pond increases, the orifice plate will restrict the flow. The maximum flow through the plate will come when the detention pond reaches the maximum design

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depth of 53.33. A detail of the orifice plate is attached.

Required Detention:

The required detention for the 10-year storm with a release rate of 0.1 cfs/acre for the detention pond located in A-1 is 9,623 cubic feet. The available volume is 10,235 cubic feet. In the event the pond experiences a storm larger than the design storm water will then spill out to the north and continue in a historical fashion.

Great Basin Engineering, Inc.

Prepared by Ryan Bingham, P.E.

Reviewed by Mark Babbitt, P.E., P.L.S.

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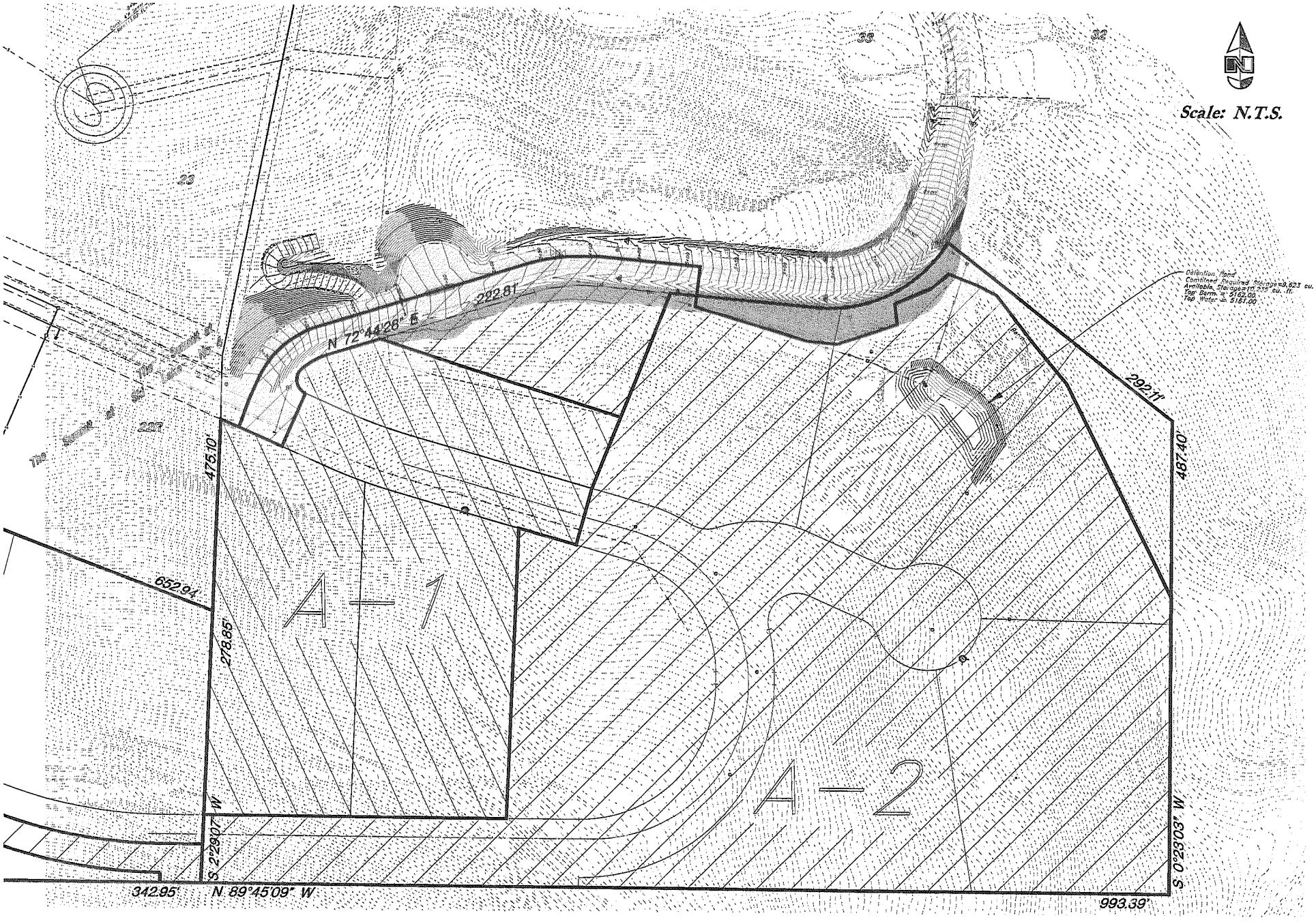

Scale: N.T.S.
33
32
23
292.81
N 72°44'26" E
292.11'
467.40'
475.10'
278.85'
652.94'
342.95'
N 89°45'09" W
S 2°29'07" W
S 0°23'03" W
993.39'
A-1
A-2
Detention Pond
Combined Required Storage = 9,623 cu. ft.
Available Storage = 11,235 cu. ft.
Top Berm = 5182.00
Top Water = 5181.00

Storm Water Study
Summit at Ski Lake #11 and Part of #12-Ray Bowden
Via Monoco and Via Cortina, Weber County, Utah
96n120summit11aimp.dwg
10/4/2011

2 Detained Areas

Hardscape Cd =	0.90
Landscape Cd =	0.15

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	588285	13.505	111000	2.548	477285	10.957	0.292
Σ All Areas	588285	13.505	111000	2.548	477285	10.957	0.292
A-1	150732	3.460	27060	0.621	123672	2.839	0.285
A-2	437553	10.045	83940	1.927	353613	8.118	0.294

Time of Concentration--use FAA Method

For FAA Method, use C's of..

C = 0.00 for landscape

C = 0 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

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	450.00	20.00	15.47	0.00	2.00	0.00	40.00	0.33	15.81
A-2	600.00	8.33	23.92	0.00	2.00	0.00	0.00	0.00	23.92

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 =	3.245E-11
B =	-1.384E-08
C =	2.367E-06
D =	-2.087E-04
E =	1.023E-02
F =	-2.863E-01
G =	5.018E+00

Storm Intensities

AREA	Tc (minutes)	I (10-yr.) (in./hr.)
A-1	15.8	2.36
A-2	23.9	1.84

Peak Flow Information
Use Rational Method
10-Year Storm Intensities

Q=CIA

AREA	C	I10 (in./hr.)
A-1	0.285	2.357
A-2	0.294	1.836

Peak Flows

Σ detained =	7.74
A (acres)	Q (10-yr.) (cfs)
3.46	2.32
10.04	5.42

Summit at Ski Lake #11 and Part of #12-Ray Bowden

Combined Detention Pond

C = 0.29

Area = 13.51 acres

Allowable Discharge Rate = 0.100 cfs/acre

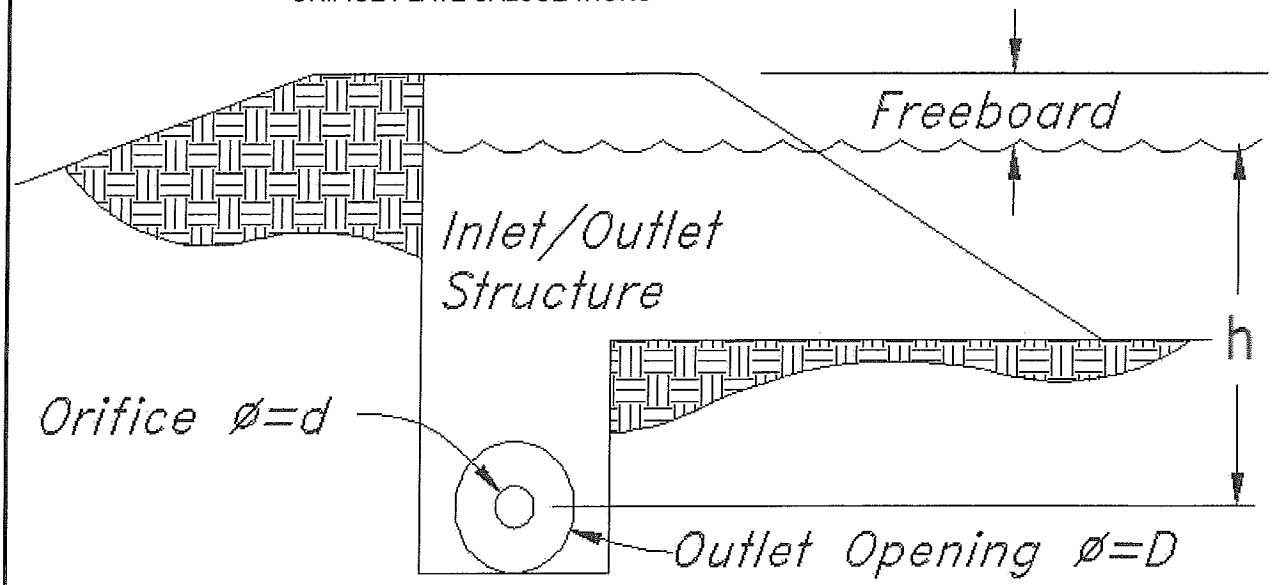
Total Release Rate = 1.351 cfs

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	3.82	4508	405	4103	0.094	
10	2.99	7064	810	6254	0.144	
15	2.43	8606	1215	7391	0.170	
20	2.05	9678	1621	8057	0.185	
25	1.79	10555	2026	8529	0.196	
30	1.60	11349	2431	8918	0.205	
35	1.46	12076	2836	9240	0.212	
40	1.35	12719	3241	9478	0.218	
45	1.25	13254	3646	9607	0.221	
50	1.16	13675	4052	9623	0.221	<- Max Detenti
55	1.08	14000	4457	9543	0.219	
60	1.01	14264	4862	9403	0.216	
90	0.77	16391	7293	9099	0.209	
120	0.62	17527	9724	7803	0.179	
180	0.55	23258	14586	8672	0.199	
360	0.33	28403	29171	-769	-0.018	
720	0.21	36226	58342	-22116	-0.508	
1440	0.13	43879	116685	-72805	-1.671	

So, our detention pond needs to hold 9623 ft^3 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= 6.5

Q = 1.351

Solving for d, we have.....

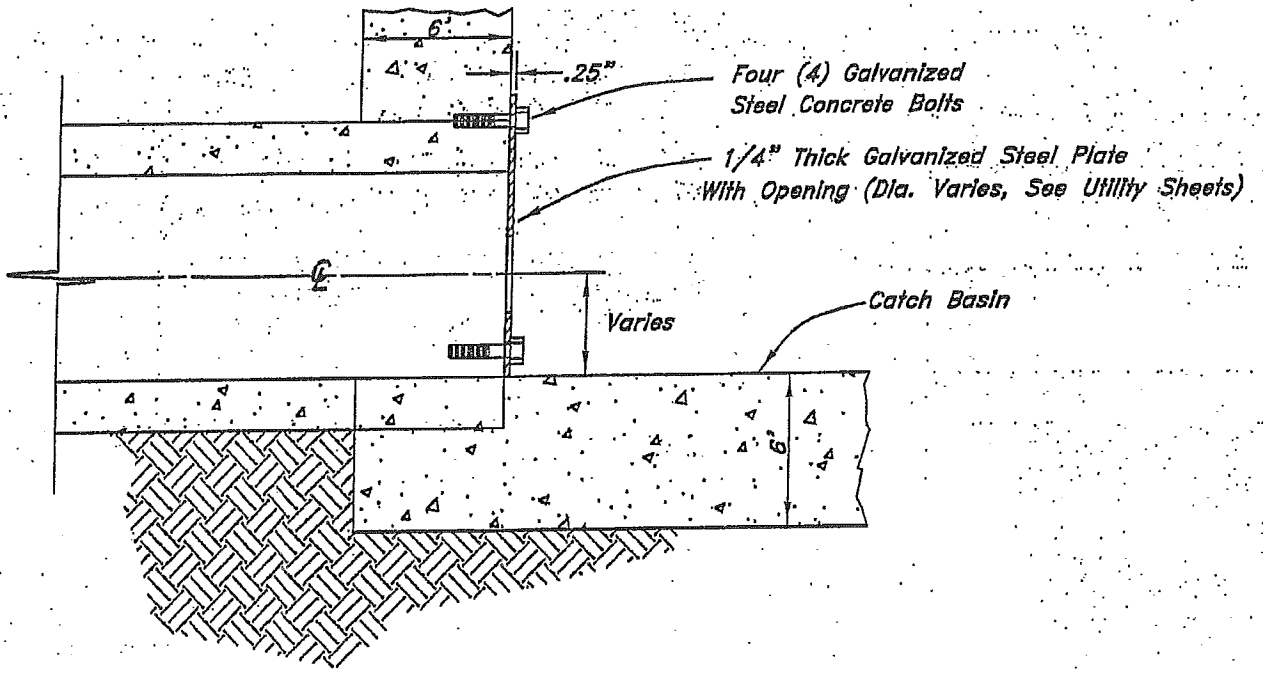
$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{2 \cdot g \cdot h}}}$$

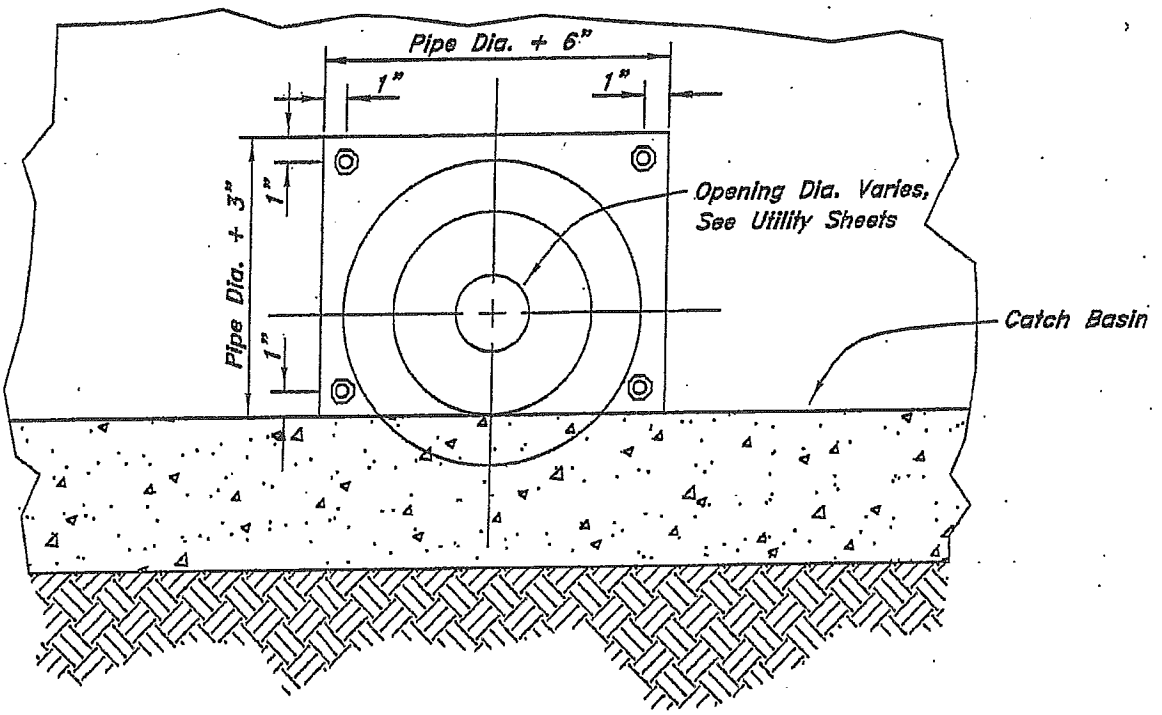
Substituting Q, G, and H, we have.....

d = 0.368 feet

OR

d = 4.418 inches





Orifice Plate Detail

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

DATA DESCRIPTION

Data type: precipitation intensity | Units: english | Time series type: partial duration

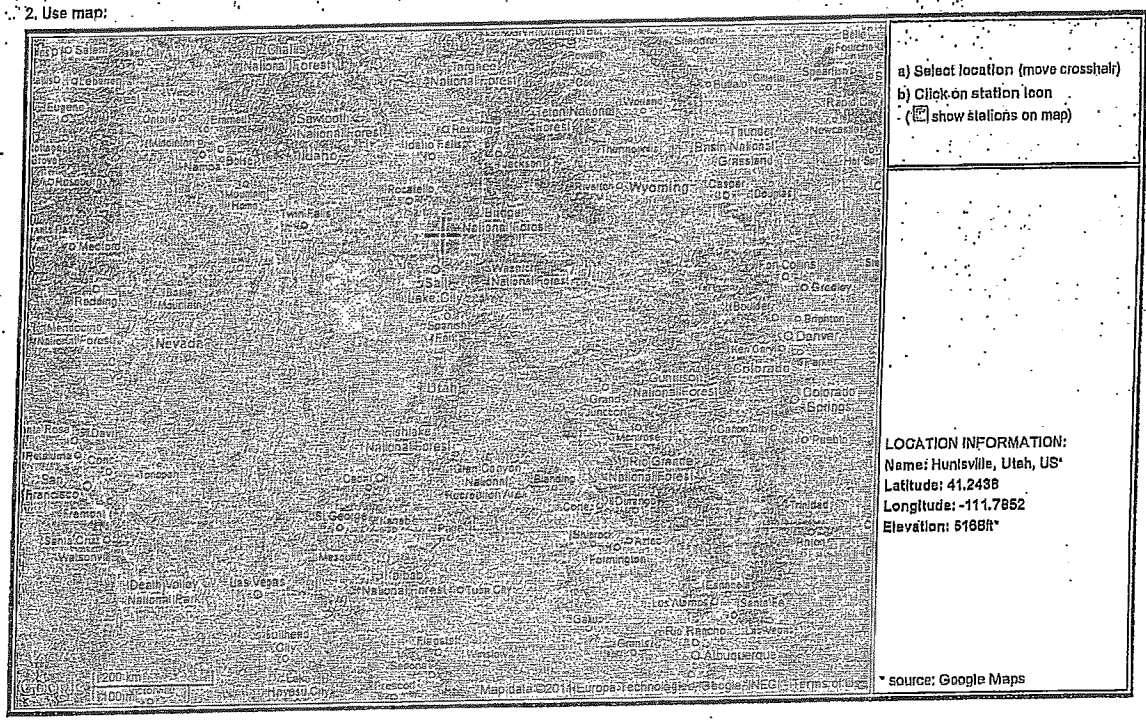
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 41.2438 longitude: -111.78517 submit

b) Select station: select station

2. Use map:



POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 1, Version 5

PF tabular | PF graphical | Supplementary information | Print Page

PDS-based 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	1.81 (1.58-2.09)	2.29 (2.02-2.65)	3.11 (2.72-3.59)	3.85 (3.34-4.45)	5.04 (4.27-5.88)	6.14 (5.06-7.24)	7.45 (5.94-8.87)	8.99 (6.91-10.9)	11.6 (8.34-14.4)	13.9 (9.58-17.9)
10-min	1.38 (1.21-1.59)	1.74 (1.54-2.02)	2.36 (2.07-2.73)	2.93 (2.54-3.39)	3.84 (3.25-4.46)	4.68 (3.85-5.51)	5.67 (4.52-6.75)	6.85 (5.26-8.32)	8.77 (6.35-11.0)	10.6 (7.28-13.6)
15-min	1.14 (0.996-1.32)	1.44 (1.27-1.67)	1.96 (1.71-2.26)	2.42 (2.10-2.80)	3.17 (2.69-3.70)	3.87 (3.18-4.55)	4.68 (3.74-5.58)	5.66 (4.35-6.88)	7.24 (5.25-9.08)	8.73 (6.02-11.2)
30-min	0.768 (0.670-0.885)	0.970 (0.854-1.12)	1.32 (1.16-1.52)	1.63 (1.42-1.89)	2.14 (1.81-2.49)	2.60 (2.14-3.06)	3.15 (2.52-3.76)	3.81 (2.93-4.63)	4.88 (3.53-6.11)	5.88 (4.05-7.56)
60-min	0.475 (0.415-0.548)	0.600 (0.528-0.695)	0.815 (0.713-0.940)	1.01 (0.876-1.17)	1.32 (1.12-1.54)	1.61 (1.33-1.90)	1.95 (1.56-2.33)	2.36 (1.81-2.88)	3.02 (2.19-3.76)	3.64 (2.51-4.66)
2-hr	0.309 (0.274-0.351)	0.386 (0.343-0.440)	0.498 (0.441-0.567)	0.605 (0.530-0.690)	0.779 (0.666-0.896)	0.939 (0.785-1.09)	1.13 (0.914-1.33)	1.35 (1.05-1.63)	1.72 (1.25-2.13)	2.05 (1.44-2.61)
3-hr	0.237 (0.214-0.265)	0.294 (0.265-0.329)	0.367 (0.328-0.411)	0.436 (0.387-0.490)	0.547 (0.477-0.619)	0.651 (0.555-0.744)	0.776 (0.644-0.900)	0.922 (0.742-1.09)	1.16 (0.889-1.43)	1.39 (1.02-1.76)
6-hr	0.162 (0.148-0.178)	0.199 (0.182-0.219)	0.249 (0.229-0.264)	0.276 (0.251-0.307)	0.334 (0.298-0.371)	0.381 (0.336-0.427)	0.435 (0.377-0.494)	0.497 (0.421-0.572)	0.619 (0.507-0.726)	0.729 (0.580-0.890)
12-hr	0.105 (0.096-0.115)	0.128 (0.117-0.141)	0.164 (0.141-0.170)	0.178 (0.161-0.196)	0.213 (0.190-0.237)	0.242 (0.213-0.272)	0.273 (0.236-0.311)	0.306 (0.260-0.353)	0.359 (0.296-0.423)	0.402 (0.322-0.484)
24-hr	0.067 (0.061-0.073)	0.082 (0.075-0.089)	0.097 (0.089-0.107)	0.111 (0.101-0.121)	0.129 (0.117-0.141)	0.143 (0.130-0.155)	0.157 (0.142-0.172)	0.172 (0.154-0.188)	0.191 (0.171-0.216)	0.206 (0.183-0.245)
2-day	0.040 (0.036-0.043)	0.048 (0.045-0.053)	0.058 (0.053-0.063)	0.066 (0.060-0.072)	0.076 (0.069-0.083)	0.084 (0.077-0.092)	0.092 (0.084-0.101)	0.100 (0.091-0.110)	0.111 (0.100-0.122)	0.119 (0.105-0.132)
3-day	0.029 (0.027-0.032)	0.036 (0.033-0.039)	0.043 (0.040-0.047)	0.049 (0.045-0.053)	0.057 (0.052-0.062)	0.063 (0.058-0.068)	0.070 (0.063-0.076)	0.076 (0.068-0.083)	0.085 (0.076-0.093)	0.091 (0.081-0.100)

4-day	0.024 (0.022-0.028)	0.030 (0.027-0.032)	0.036 (0.033-0.039)	0.041 (0.037-0.044)	0.047 (0.043-0.052)	0.053 (0.048-0.057)	0.058 (0.053-0.063)	0.064 (0.057-0.070)	0.071 (0.064-0.078)	0.077 (0.068-0.085)
7-day	0.017 (0.016-0.019)	0.021 (0.019-0.023)	0.026 (0.023-0.028)	0.029 (0.026-0.031)	0.033 (0.030-0.036)	0.037 (0.033-0.040)	0.040 (0.037-0.045)	0.044 (0.040-0.049)	0.049 (0.044-0.055)	0.053 (0.047-0.059)
10-day	0.014 (0.013-0.015)	0.017 (0.015-0.018)	0.020 (0.018-0.022)	0.023 (0.021-0.025)	0.026 (0.024-0.028)	0.028 (0.026-0.031)	0.031 (0.028-0.034)	0.033 (0.030-0.037)	0.037 (0.033-0.040)	0.039 (0.035-0.043)
20-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.013 (0.012-0.014)	0.015 (0.013-0.016)	0.017 (0.015-0.018)	0.018 (0.017-0.020)	0.019 (0.018-0.021)	0.021 (0.019-0.023)	0.022 (0.020-0.025)	0.024 (0.021-0.026)
30-day	0.007 (0.007-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.015)	0.015 (0.013-0.016)	0.016 (0.014-0.017)	0.017 (0.015-0.018)	0.018 (0.016-0.020)	0.019 (0.017-0.021)
45-day	0.006 (0.005-0.007)	0.008 (0.007-0.008)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.014)	0.014 (0.013-0.015)	0.015 (0.014-0.016)	0.016 (0.014-0.017)
60-day	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.009)	0.010 (0.009-0.011)	0.011 (0.010-0.012)	0.012 (0.011-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.014)	0.014 (0.013-0.015)

[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.

Estimates from the table in csv format: precipitation frequency estimates [Submit]

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