GREAT BASIN ENGINEERING

# THE CHALETS PHASE 5
# OSPREY POINT AND QUAIL LANE
# HUNTSVILLE, UTAH
# STORM WATER STUDY

Project No. 11N222
12-14-2011

**General Site Information:**

The proposed Phase 5 of the Chalets Subdivision is located at the intersection of the proposed Osprey Point and existing Quail Lane in Huntsville, Utah. Construction will consist of an addition to Quail Lane as well as a new cul-de-sac called Osprey Point, sidewalks, curb and gutter, underground utilities, and eight lots prepared for development when completed. Storm water from the site will be detained at a detention pond located at the intersection of Quail Lane and Snow Basin Road which will be re-shaped to provide the required volume. The portion of the Chalets Subdivision that will contribute flows to this detention facility has an area of about 14.88 acres. Storm water from site will be collected in inlet boxes or swales and continue via storm drain to the detention pond and be released at 0.2 cfs per acre for the 10-year storm into an existing storm drain system already in place to serve much of the development. 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). 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 0.40 was calculated for the area contributing to the detention pond.

A time of concentration for the 100-year design storm was calculated using the FAA method and rational coefficients of 0.35 for landscape and 0.91 for hardscape. The time of concentration is 28 minutes. This time is based on the longest path inside the detention area over grass, asphalt, concrete, or through a pipeline as applicable. Five minutes is the shortest time allowed using this method. 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 polyvinylchloride pipes (PVC), 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 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.


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**Orifice Plate:**

An orifice plate has been used historically for this site. It needs to be resized based on the re-shaped detention pond. 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 8.3 inches in diameter for the pond to fill completely during a 10-yr storm. The orifice plate will allow small flows 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 detention pond is 12,774 cubic feet. The required detention for the 10-year storm with a release rate of 0.2 cfs/acre is 12,251 cubic feet for the pond. In the event the pond experiences a storm larger than the design storm water will then spill out into Snow Basin Road and continue to the north in a historical fashion.

Great Basin Engineering, Inc.

Prepared by Ryan Bingham, P.E.

Reviewed by Mark Babbitt, P.E.



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Scale: NTS

Re-Shaped Detention Pond
Top Water = 93.00
Top Berm = 94.00
Required Volume = 12,251
Available Volume = 12,774

A-1

Storm Water Study
Chalets Phase 5
Osprey Point and Quail Road Huntsville, UT
96n120 ph 5 S1 horiz-SWS.dwg
12/13/2011

| | |
|---|---|
| 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 | 14.877 | 3.401 | 2.308 | 9.168 | 0.396 |
| Σ All Areas | 14.877 | 3.401 | 2.308 | 9.168 | 0.396 |
| A-1 | 14.877 | 3.401 | 2.308 | 9.168 | 0.396 |

**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 | 164.00 | 30.00 | 5.56 | 684.00 | 10.00 | 4.15 | 2147.00 | 17.89 | 27.61 |

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 = | 3.450E-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 | 27.6 | 1.71 |

Peak Flow Information
Use Rational Method
10-Year Storm Intensities

Q=CIA

| AREA | C | I10 (in./hr.) |
|---|---|---|
| A-1 | 0.396 | 1.713 |

Peak Flows

| Σ detained = | 10.09 |
|---|---|
| A (acres) | Q (10-yr.) (cfs) |
| 14.88 | 10.09 |

Node Inlet Requirements

Size pipes for 10 year storm

| Area | Node # | % of Total | Q (cfs) |
|---|---|---|---|
| A-1 | 1 | 10.0% | 1.01 |
| A-1 | 2 | 8.0% | 0.81 |
| A-1 | 3 | 7.0% | 0.71 |
| A-1 | 4 | 7.0% | 0.71 |
| A-1 | 5 | 6.0% | 0.61 |
| A-1 | 6 | 6.0% | 0.61 |
| A-1 | 7 | 5.0% | 0.50 |
| A-1 | 8 | 6.0% | 0.61 |
| A-1 | 9 | 5.0% | 0.50 |
| A-1 | 10 | 6.0% | 0.61 |
| A-1 | 11 | 15.0% | 1.51 |
| A-1 | 12 | 4.0% | 0.40 |
| A-1 | 13 | 5.0% | 0.50 |
| A-1 | 14 | 5.0% | 0.50 |
| A-1 | 15 | 5.0% | 0.50 |

**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 | 3 | 1.01 | 15 | 0.024% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 1.01 | 18 | 0.009% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 1.01 | 21 | 0.004% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 2 | 3 | 0.81 | 15 | 0.016% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 0.81 | 18 | 0.006% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 0.81 | 21 | 0.003% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 3 | 4 | 2.52 | 15 | 0.153% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.52 | 18 | 0.058% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.52 | 21 | 0.025% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 4 | 5 | 3.23 | 15 | 0.250% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 3.23 | 18 | 0.095% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 3.23 | 21 | 0.042% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 5 | 6 | 3.83 | 15 | 0.352% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 3.83 | 18 | 0.133% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 3.83 | 21 | 0.059% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 6 | 8 | 4.94 | 15 | 0.586% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 4.94 | 18 | 0.222% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 4.94 | 21 | 0.097% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 7 | 6 | 0.50 | 15 | 0.006% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 0.50 | 18 | 0.002% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 0.50 | 21 | 0.001% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 8 | 9 | 5.55 | 15 | 0.738% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 5.55 | 18 | 0.279% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 5.55 | 21 | 0.123% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 9 | 10 | 6.06 | 15 | 0.878% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 6.06 | 18 | 0.332% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 6.06 | 21 | 0.146% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 10 | 11 | 6.66 | 15 | 1.063% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 6.66 | 18 | 0.402% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 6.66 | 21 | 0.177% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 11 | 12 | 8.17 | 15 | 1.601% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 8.17 | 18 | 0.605% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 8.17 | 21 | 0.266% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 12 | 13 | 8.58 | 15 | 1.763% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 8.58 | 18 | 0.667% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 8.58 | 21 | 0.293% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 13 | 14 | 9.08 | 15 | 1.977% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 9.08 | 18 | 0.748% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 9.08 | 21 | 0.329% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 14 | 15 | 9.59 | 15 | 2.202% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 9.59 | 18 | 0.833% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 9.59 | 21 | 0.366% | 2.405 | 0.438 | 0.013 | 0.100% | |
| 15 | Outlet | 10.09 | 18 | 0.923% | 1.767 | 0.375 | 0.013 | 0.120% | 18 |
| | | 10.09 | 21 | 0.406% | 2.405 | 0.438 | 0.013 | 0.100% | |
| | | 10.09 | 24 | 0.199% | 3.142 | 0.500 | 0.013 | 0.080% | |

**Combined Detention Pond**

C = 0.40

Area = 14.88 acres

Allowable Discharge Rate = 0.200 cfs/acre

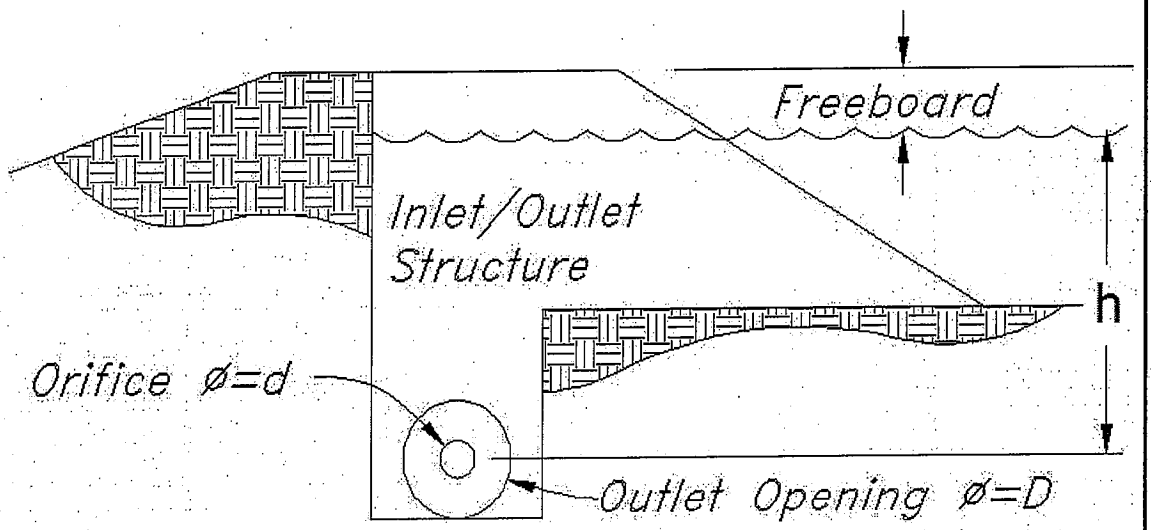
Total Release Rate = 2.975 cfs

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 | 3.89 | 6868 | 893 | 5975 | 0.137 | |
| 10 | 3.04 | 10750 | 1785 | 8964 | 0.206 | |
| 15 | 2.47 | 13091 | 2678 | 10413 | 0.239 | |
| 20 | 2.08 | 14724 | 3570 | 11154 | 0.256 | |
| 25 | 1.82 | 16069 | 4463 | 11606 | 0.266 | |
| 30 | 1.63 | 17288 | 5356 | 11932 | 0.274 | |
| 35 | 1.49 | 18406 | 6248 | 12158 | 0.279 | |
| 40 | 1.37 | 19392 | 7141 | 12251 | 0.281 | <-Peak Detent |
| 45 | 1.27 | 20213 | 8033 | 12179 | 0.280 | |
| 50 | 1.18 | 20862 | 8926 | 11936 | 0.274 | |
| 55 | 1.10 | 21371 | 9819 | 11552 | 0.265 | |
| 60 | 1.03 | 21799 | 10711 | 11088 | 0.255 | |
| 90 | 0.80 | 25417 | 16067 | 9350 | 0.215 | |
| 120 | 0.63 | 26687 | 21422 | 5265 | 0.121 | |
| 180 | 0.44 | 28182 | 32134 | -3952 | -0.091 | |
| 360 | 0.28 | 36006 | 64267 | -28261 | -0.649 | |
| 720 | 0.18 | 46312 | 128534 | -82222 | -1.888 | |
| 1440 | 0.11 | 57508 | 257069 | -199560 | -4.581 | |

So, our detention pond needs to hold 12251 $ft^3$ 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= 2.5

Q = 2.975

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 = 0.694 feet

OR

d = 8.327 inches

www.nws.noaa.gov

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 depth | Units: english | Time series type: partial duration

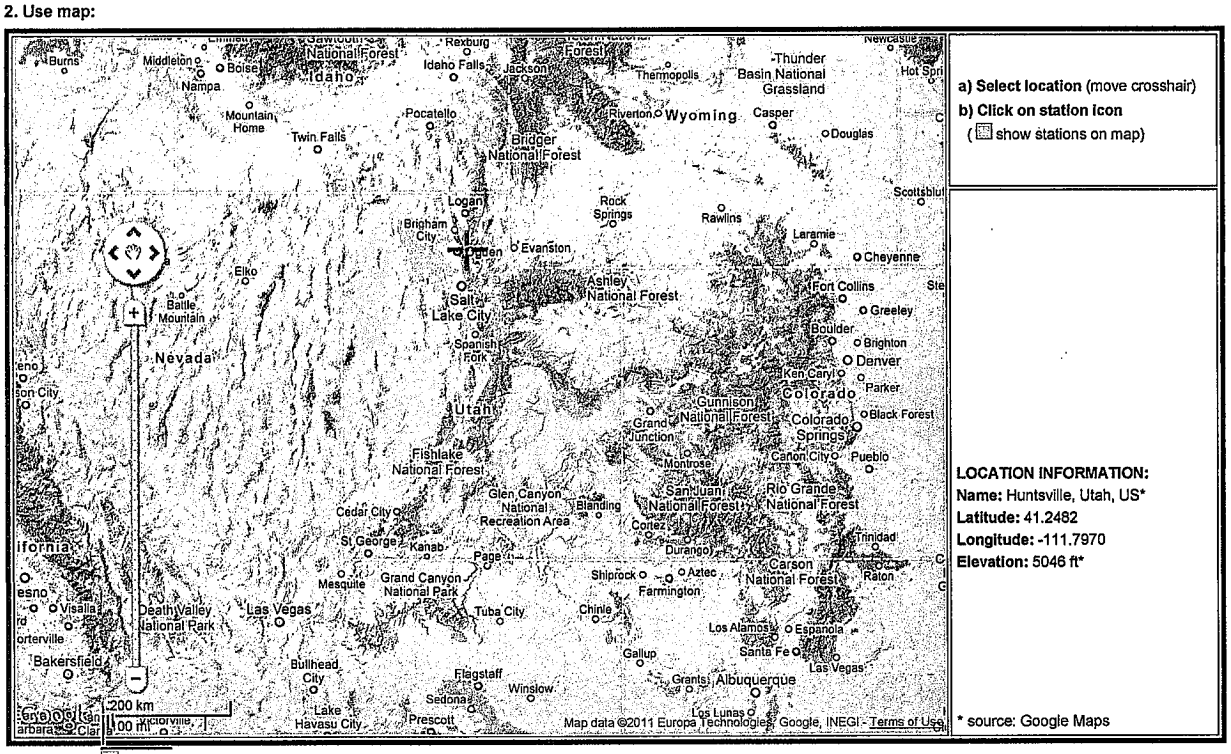
### SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 41.2482 longitude: -111.7970 submit

b) Select station: select station

2. Use map:




## POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

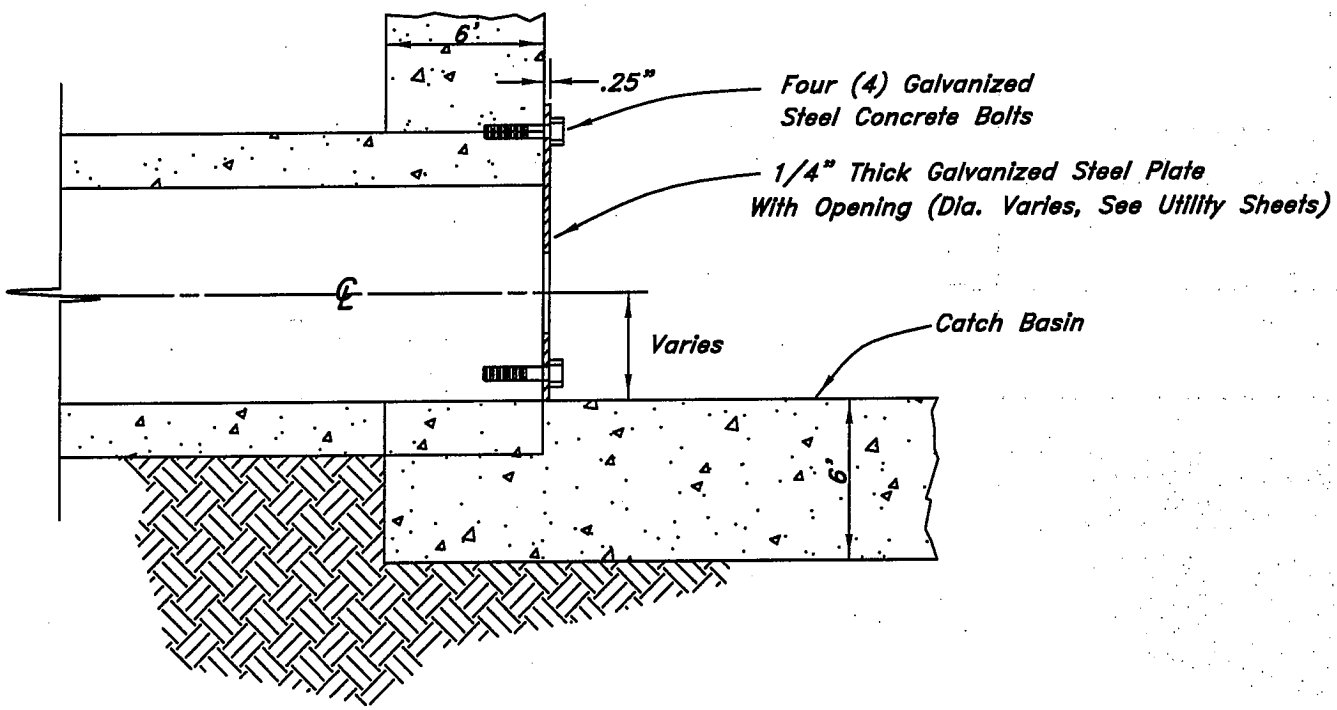
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 1, Version 5

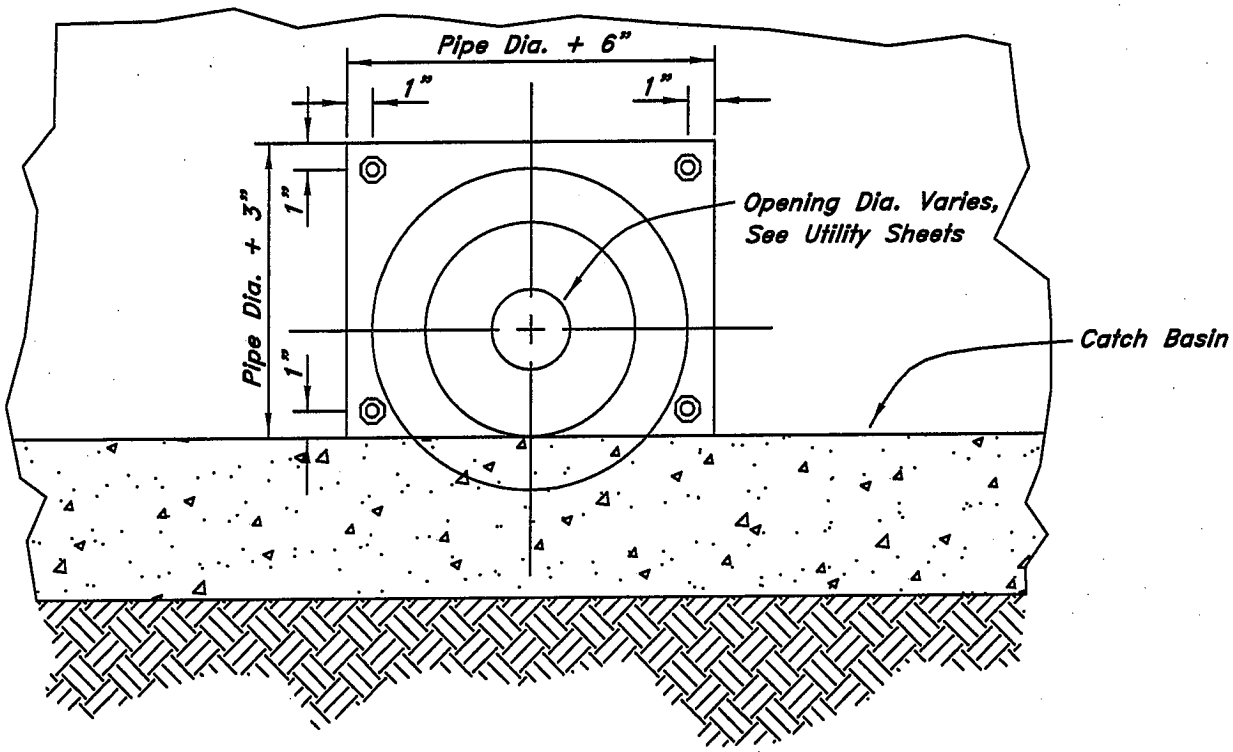
Print Page

PF tabular

**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 | 1.84 (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) |




# Orifice Plate Detail