GREAT BASIN ENGINEERING INC

DAYCARE EDEN
4786 E 2600 N
EDEN, UTAH
STORM WATER STUDY
Project No. 12N244
12-13-2012
Revised 1-10-2013

General Site Information:

A Daycare Facility is located at an existing site at 4786 E 2600 N in Eden, Utah. The site features will be revised in order to accommodate Weber County requirements regarding turf grasses, parking spaces, retention volume, etc. Construction will include an alternate configuration for sidewalks, a new dumpster location, underground storm drain and sump, and re-worked landscaping areas when completed. The site has an area of about 0.687 acres. Storm water from site will be collected in an inlet box near the southwest end of the site and continue via storm drain to a proposed retention facility near that location, and be released into the ground via percolation. The attached figure shows the project site and location of retention pond. Retention calculations have been provided for the site. (See attached figure and calculations).

The proposed site is considered one drainage areas (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 0.61 was calculated for the entire site in the proposed conditions which is equivalent to about 61% of hardscape.

A time of concentration for the 100-year design storm was calculated using the FAA method and rational coefficients of 0.35 for grass and 0.91 for concrete for each of the areas. The time of concentration is 10 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.

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:

An 8" perforated PVC storm drain pipe is connected to an inlet box near the southwest end of the site. This pipe connects to a sump located in the center of a proposed retention facility. The pipe is sloped to provide the design capacity while maintaining a minimum scour velocity of 2 feet per second when the pipes are flowing full. The inlet box has more than sufficient capacity to collect the 10-year storm without surcharging.

Orifice Plate:

An orifice plate will not be used to control the rate that storm water flows from the project, as percolation will be used for all discharge for the 100-yr design storm.

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100-yr Required Retention:

For retention requirements, a percolation rate was taken from a recent percolation test performed at the retention area. A 5' dia. manhole extending down to an elevation of 87.50 at the bottom of the gravel will act as a sump with a gravel base and sides (See detail in plan set). About 62 linear feet of a 4 foot wide 3 foot deep trench surrounding an 18" diam perforated pipe will also be used just beneath the ponding area. This yields a total percolation area of about $62(3+4+3)+\pi\cdot 5^2+\pi\cdot 10(91.5-87.5)=825\,ft^2$. This gives a total release rate of 825*0.00049 = 0.404 cfs via percolation (See attached calculations). Underground storage volume equates to $62(\pi\cdot 0.75^2+.3(4\cdot 3-\pi\cdot 0.75^2))+4.5(\pi\cdot 2.5^2)+.3(4.5(\pi(5^2-3^2)))+.3(2.5(\pi\cdot 5^2))=515\,ft^3$. Aboveground storage volume is 1,701 ft^3. This gives a total available storage volume of 515+1701 = 2,216 cu. ft. with a safety factor of 1.7, the assumed release is only 0.238 cfs (i.e. 0.404/0.238 = 1.7). Using a release rate of 0.238 cfs for calculation purposes, the required retention volume is calculated to be 2,216 cu. ft (See attached calcs). Therefore, there is adequate volume in the retention facility for the 100-yr storm.

In addition to providing the required retention volume and using a safety factor with the percolation rate used for calculations, note that this percolation rate is conservative, as there will be roughly 6 to 10 feet of head on the percolation bed during the design storm, while the percolation test was only performed with roughly 0.5 feet of head.

In the event the pond experiences a storm larger than the design storm water will then spill out of the pond, flow to the west toward an existing stream about 170 feet away, and then continue to the south in that stream to Pine View Reservoir in a historical fashion.

Great Basin Engineering, Inc.

Prepared by Ryan Bingham, P.E.

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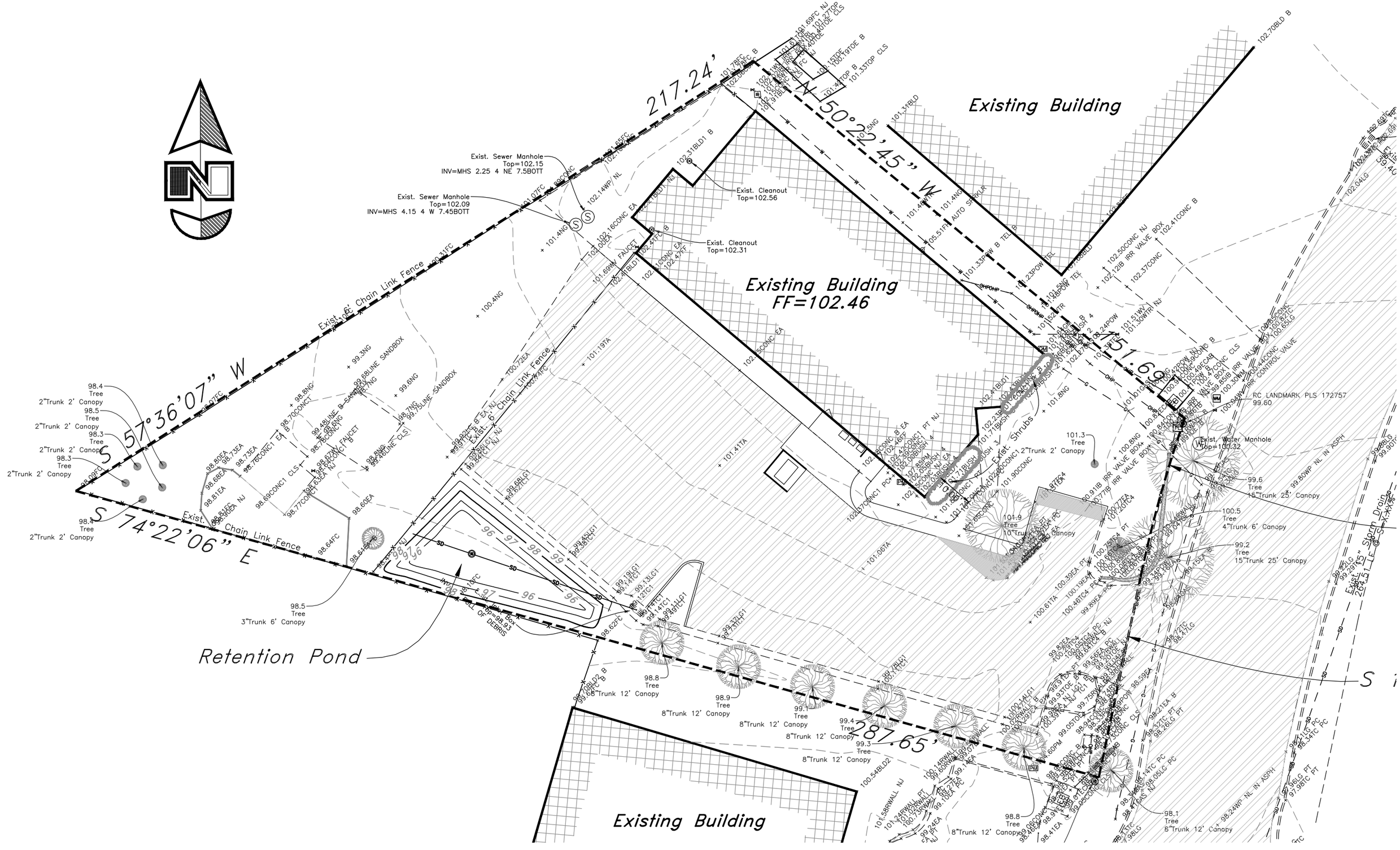
Existing Building
Existing Building
FF=102.46
Existing Building
Retention Pond
Exist. 6' Chain Link Fence
Exist. 6' Chain Link Fence
Exist. 6' Chain Link Fence
S 57°36'07" W
217.24'
N 50°23'45" W
287.65'
S 74°22'06" E
N 51.69
Exist. Sewer Manhole
Top=102.15
INV=MHS 2.25 4 NE 7.5BOTT
Exist. Sewer Manhole
Top=102.09
INV=MHS 4.15 4 W 7.45BOTT
Exist. Cleanout
Top=102.56
Exist. Cleanout
Top=102.31
Exist. Shrubs
RC LANDMARK PLS 172757
99.60
Exist. Water Manhole
Top=101.32
Exist. 15" Storm Drain
264.51 LF @ 0.50%
98.4 Tree 2"Trunk 2' Canopy
98.5 Tree 2"Trunk 2' Canopy
98.3 Tree 2"Trunk 2' Canopy
98.3 Tree 2"Trunk 2' Canopy
98.4 Tree 2"Trunk 2' Canopy
98.5 Tree 3"Trunk 6' Canopy
98.8 Tree 8"Trunk 12' Canopy
98.9 Tree 8"Trunk 12' Canopy
99.1 Tree 8"Trunk 12' Canopy
99.4 Tree 8"Trunk 12' Canopy
99.3 Tree 8"Trunk 12' Canopy
98.8 Tree 8"Trunk 12' Canopy
98.1 Tree 8"Trunk 12' Canopy
101.3 Tree
101.9 Tree 10"Trunk 4' Canopy
100.5 Tree 4"Trunk 6' Canopy
99.6 Tree 15"Trunk 25' Canopy
99.2 Tree 15"Trunk 25' Canopy

Storm Water Study
Daycare - Eden
4786 E 2600 N Eden, UT
12N244_S2.dwg
12/12/2012

1 Detained Area

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	29929	0.687	18286	0.420	11643	0.267	0.608
Σ All Areas	29929	0.687	18286	0.420	11643	0.267	0.608
A-1	29929	0.687	18286	0.420	11643	0.267	0.608

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

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	29.00	1.50	6.35	134.00	2.00	3.14	46.00	0.38	9.88

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 =	3.520E-11
B =	-1.490E-08
C =	2.524E-06
D =	-2.203E-04
E =	1.071E-02
F =	-2.986E-01
G =	5.234E+00

		Storm Intensities
AREA	Tc (minutes)	I (10-yr.) (in./hr.)
A-1	9.9	3.14

Peak Flow Information
Use Rational Method
10-Year Storm Intensities

Q=CIA

AREA	C	I10 (in./hr.)
A-1	0.608	3.139

Peak Flows

Σ detained =	1.31
A (acres)	Q (10-yr.) (cfs)
0.69	1.31

Daycare - Eden

Combined Detention Pond

C = 0.61

Area = 0.69 acres

Allowable Discharge Rate = 0.346 cfs/acre

Total Release Rate = 0.238 cfs

Detention Pond Sized For The 100 Year Storm

Time	Rainfall Intensity	Accumulated Volume	OR Allowable Release	Needed Detention	Needed Detention	
min	in./hr.	(CF)	(CF)	(CF)	(acre-ft)	
5	7.62	955	71	884	0.020	
10	5.97	1496	143	1354	0.031	
15	4.85	1824	214	1610	0.037	
20	4.09	2052	285	1767	0.041	
25	3.57	2240	356	1883	0.043	
30	3.20	2409	428	1981	0.045	
35	2.92	2563	499	2064	0.047	
40	2.69	2698	570	2128	0.049	
45	2.49	2809	641	2168	0.050	
50	2.31	2896	713	2183	0.050	
55	2.15	2963	784	2179	0.050	
60	2.01	3020	855	2164	0.050	
90	1.55	3499	1283	2216	0.051	<- Max Detention
120	1.21	3634	1711	1924	0.044	
180	0.81	3665	2566	1099	0.025	
360	0.46	4170	5132	-962	-0.022	
720	0.29	5290	10264	-4974	-0.114	
1440	0.17	6283	20528	-14245	-0.327	

So, our detention pond needs to hold 2216 ft^3 of water

NOAA Atlas 14, Volume 1, Version 5
Location name: Eden, Utah, US*
Coordinates: 41.3050, -111.8330
Elevation: 4958ft*
* 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	**1.90** (1.66–2.18)	**2.39** (2.12–2.76)	**3.24** (2.84–3.73)	**4.02** (3.49–4.62)	**5.24** (4.45–6.07)	**6.36** (5.27–7.45)	**7.68** (6.17–9.11)	**9.25** (7.16–11.2)	**11.8** (8.63–14.8)	**14.2** (9.89–18.3)
10-min	**1.44** (1.26–1.66)	**1.82** (1.61–2.10)	**2.47** (2.17–2.84)	**3.05** (2.66–3.52)	**3.98** (3.39–4.62)	**4.84** (4.00–5.66)	**5.85** (4.70–6.93)	**7.04** (5.45–8.53)	**9.00** (6.56–11.2)	**10.8** (7.52–13.9)
15-min	**1.19** (1.04–1.37)	**1.50** (1.33–1.74)	**2.04** (1.79–2.34)	**2.53** (2.20–2.91)	**3.30** (2.80–3.82)	**4.00** (3.31–4.68)	**4.83** (3.88–5.73)	**5.82** (4.50–7.04)	**7.44** (5.42–9.28)	**8.96** (6.22–11.5)
30-min	**0.802** (0.702–0.922)	**1.01** (0.898–1.17)	**1.37** (1.21–1.58)	**1.70** (1.48–1.96)	**2.22** (1.89–2.57)	**2.69** (2.23–3.15)	**3.26** (2.61–3.86)	**3.92** (3.03–4.74)	**5.01** (3.65–6.25)	**6.03** (4.19–7.73)
60-min	**0.496** (0.434–0.570)	**0.627** (0.556–0.724)	**0.850** (0.746–0.977)	**1.05** (0.916–1.21)	**1.37** (1.17–1.59)	**1.67** (1.38–1.95)	**2.01** (1.62–2.39)	**2.43** (1.88–2.94)	**3.10** (2.26–3.87)	**3.73** (2.59–4.78)
2-hr	**0.326** (0.290–0.370)	**0.408** (0.364–0.464)	**0.526** (0.466–0.597)	**0.638** (0.560–0.726)	**0.818** (0.703–0.939)	**0.984** (0.826–1.14)	**1.18** (0.960–1.38)	**1.41** (1.11–1.69)	**1.78** (1.32–2.20)	**2.13** (1.51–2.70)
3-hr	**0.250** (0.225–0.280)	**0.310** (0.279–0.347)	**0.386** (0.345–0.432)	**0.459** (0.408–0.515)	**0.574** (0.501–0.649)	**0.682** (0.583–0.779)	**0.812** (0.677–0.941)	**0.964** (0.779–1.14)	**1.21** (0.931–1.47)	**1.44** (1.06–1.82)
6-hr	**0.173** (0.159–0.190)	**0.212** (0.194–0.234)	**0.256** (0.233–0.282)	**0.296** (0.267–0.327)	**0.356** (0.317–0.396)	**0.406** (0.357–0.455)	**0.462** (0.400–0.525)	**0.526** (0.446–0.606)	**0.653** (0.536–0.768)	**0.768** (0.612–0.924)
12-hr	**0.112** (0.103–0.124)	**0.138** (0.126–0.152)	**0.166** (0.151–0.183)	**0.191** (0.173–0.211)	**0.229** (0.204–0.255)	**0.260** (0.229–0.292)	**0.293** (0.254–0.334)	**0.329** (0.280–0.379)	**0.384** (0.317–0.453)	**0.429** (0.345–0.515)
24-hr	**0.073** (0.067–0.081)	**0.090** (0.082–0.099)	**0.107** (0.098–0.118)	**0.122** (0.111–0.134)	**0.142** (0.129–0.157)	**0.158** (0.143–0.174)	**0.174** (0.157–0.192)	**0.191** (0.170–0.210)	**0.213** (0.189–0.235)	**0.230** (0.203–0.261)
2-day	**0.044** (0.040–0.049)	**0.054** (0.049–0.060)	**0.064** (0.059–0.071)	**0.073** (0.066–0.081)	**0.085** (0.077–0.094)	**0.094** (0.085–0.104)	**0.104** (0.093–0.115)	**0.113** (0.101–0.125)	**0.126** (0.112–0.140)	**0.136** (0.119–0.151)
3-day	**0.033** (0.030–0.036)	**0.040** (0.037–0.045)	**0.048** (0.044–0.053)	**0.055** (0.050–0.061)	**0.064** (0.058–0.071)	**0.072** (0.064–0.079)	**0.079** (0.071–0.087)	**0.086** (0.077–0.096)	**0.097** (0.085–0.107)	**0.104** (0.092–0.116)
4-day	**0.027** (0.025–0.030)	**0.034** (0.031–0.037)	**0.040** (0.037–0.044)	**0.046** (0.042–0.051)	**0.054** (0.049–0.059)	**0.060** (0.054–0.066)	**0.067** (0.060–0.073)	**0.073** (0.065–0.081)	**0.082** (0.072–0.091)	**0.089** (0.078–0.099)
7-day	**0.019** (0.018–0.022)	**0.024** (0.022–0.026)	**0.029** (0.026–0.032)	**0.033** (0.029–0.036)	**0.038** (0.034–0.042)	**0.042** (0.038–0.047)	**0.047** (0.042–0.052)	**0.051** (0.045–0.057)	**0.057** (0.050–0.064)	**0.062** (0.054–0.070)
10-day	**0.016** (0.014–0.017)	**0.019** (0.017–0.021)	**0.023** (0.021–0.025)	**0.026** (0.023–0.029)	**0.030** (0.027–0.033)	**0.033** (0.030–0.036)	**0.036** (0.032–0.040)	**0.039** (0.035–0.043)	**0.043** (0.038–0.048)	**0.046** (0.040–0.051)
20-day	**0.010** (0.009–0.011)	**0.013** (0.012–0.014)	**0.015** (0.014–0.016)	**0.017** (0.015–0.018)	**0.019** (0.017–0.021)	**0.021** (0.019–0.023)	**0.022** (0.020–0.025)	**0.024** (0.022–0.026)	**0.026** (0.023–0.029)	**0.027** (0.024–0.030)
30-day	**0.008** (0.008–0.009)	**0.010** (0.009–0.011)	**0.012** (0.011–0.013)	**0.014** (0.012–0.015)	**0.015** (0.014–0.017)	**0.017** (0.015–0.018)	**0.018** (0.016–0.020)	**0.019** (0.017–0.021)	**0.021** (0.019–0.023)	**0.022** (0.020–0.024)
45-day	**0.007** (0.006–0.008)	**0.009** (0.008–0.009)	**0.010** (0.009–0.011)	**0.011** (0.010–0.012)	**0.013** (0.012–0.014)	**0.014** (0.013–0.015)	**0.015** (0.014–0.017)	**0.016** (0.015–0.018)	**0.018** (0.016–0.019)	**0.018** (0.017–0.020)
60-day	**0.006** (0.006–0.007)	**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** (0.014–0.017)	**0.016** (0.014–0.017)

[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