GREAT BASIN ENGINEERING INC

GRANT TRUCKING TRUCK MAINTENANCE SHOP
910 WEST 24TH STREET
OGDEN, UTAH 84401
STORM WATER STUDY
Project No. 15N231
8-18-2016

General Site Information:

The proposed maintenance shop site is located at 910 West 24th Street along the east side of Interstate 15 in Ogden, Utah. Construction will consist of a new commercial building, gravel parking lots, and concrete paving with underground utilities when completed.

Storm water from the site will be collected in inlet boxes and catch basins and will continue via storm drain to the northwest end of the site. Storm water will be retained in an existing retention pond located at that end of the site. The attached figure shows the project site and location of the pond. Retention calculations have been provided for the site. (See attached figure and calculations).

The study area is broken up into 2 drainage areas (labeled A-1 and A-2). 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 of 0.70 was calculated for A-1 and 0.73 for A-2. This yields a coefficient of 0.71 for the study area as a whole.

Times of concentration are calculated using the FAA method assuming flow resistance coefficients of K=0.35 for landscape and K=0.91 for hardscape for each of the areas. The times of concentration are about 10 and 13 minutes respectively for areas A-1 and A-2. These times are based on the hydraulically longest drainage path inside each respective drainage area over grass or other vegetation, asphalt, concrete, and/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 the NOAA website for pipe sizing and detention requirements. The values obtained were interpolated as necessary. A copy of these data is attached.

Data showing area information, runoff coefficient, time of concentration, peak flow, and required detention for the site are 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 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.

Required Detention:

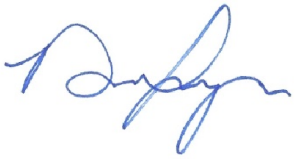
The required retention for the 100-year storm is 18,005 cubic feet for the entire study area. This retention volume is calculated without percolation or evaporation. The existing retention pond will be expanded as needed to provide the design volume of 20,925 cubic feet. In the event the retention facility experiences a storm larger than the design storm water will then spill out into a stream along the west perimeter of the site and continue westerly in a historical fashion.

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

GREAT BASIN ENGINEERING INC

Great Basin Engineering, Inc.

Prepared by Devin Marie Lujan, E.I.T.



Reviewed by Ryan Bingham, P.E.

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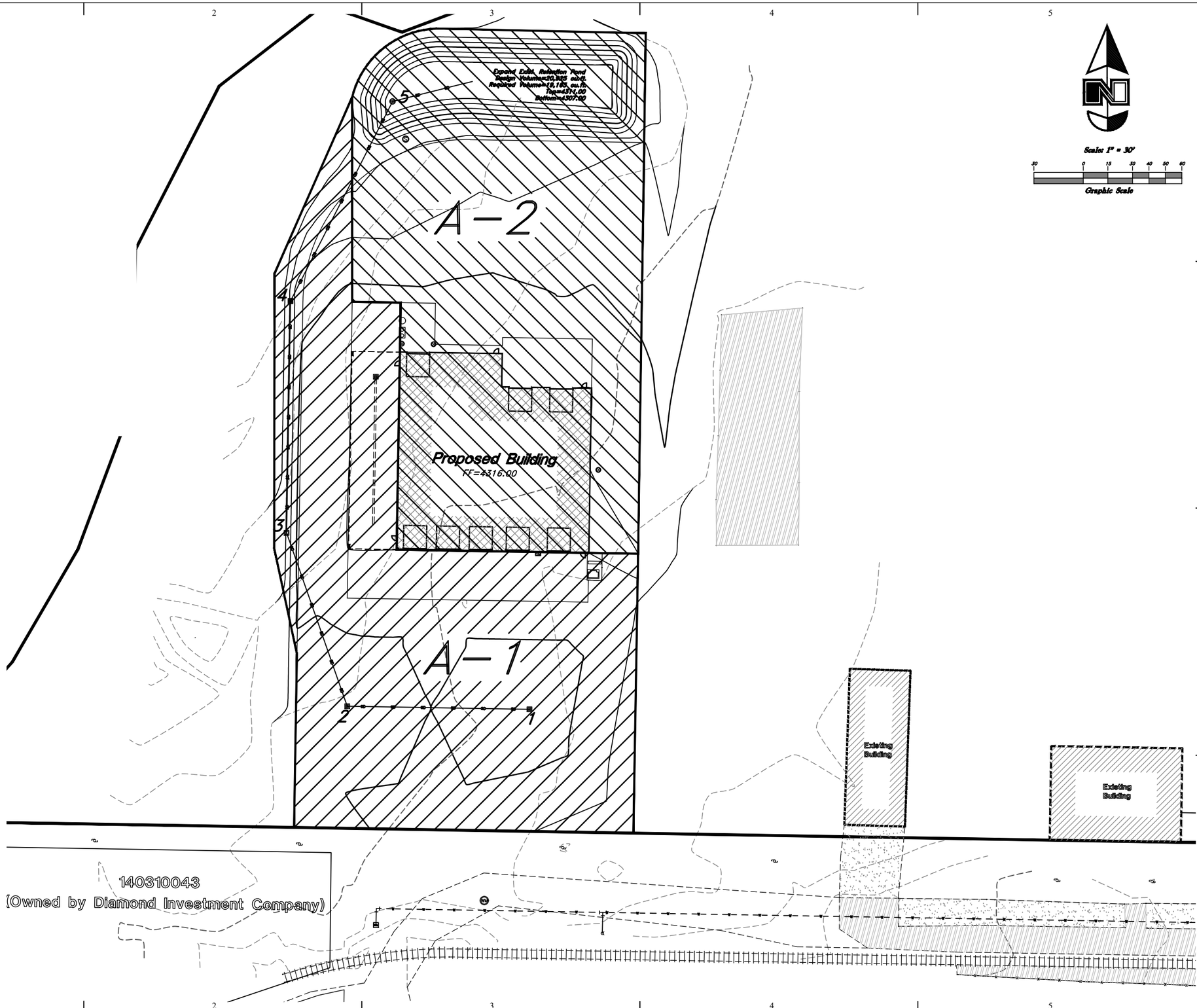

Legend

(Note: All items may not appear on drawing)

San. Sewer Manhole	S
Water Manhole	W
Storm Drain Manhole	SD
Cleanout	CO
Electrical Manhole	E
Catch Basins	
Exist. Fire Hydrant	
Fire Hydrant	
Exist. Water Valve	
Water Valve	
Sanitary Sewer	S
Culinary Water	W
Gas Line	G
Irrigation Line	IW
Storm Drain	SD
Telephone Line	T
Secondary Waterline	SW
Power Line	P
Fire Line	F
Land Drain	LD
Power pole	
Power pole w/guy	
Light Pole	
Fence	
Flowline of ditch	
Overhead Power line	OHP
Corrugated Metal Pipe	CMP
Concrete Pipe	CP
Reinforced Concrete Pipe	RCP
Ductile Iron	DI
Polyvinyl Chloride	PVC
Top of Asphalt	TA
Edge of Asphalt	EA
Centerline	CL
Flowline	FL
Finish Floor	FF
Top of Curb	TC
Top of Wall	TW,
Top of Walk	TW
Top of Concrete	TCN
Natural Ground	NG
Finish Grade	FG
Match Existing	ME
Fire Department Connection	FDC
Finish Contour	90
Exist. Contour	90
Finish Grade	95.37A
Exist. Grade	95.72TA
Ridge Line	R
Direction of Flow	
Existing Asphalt	
New Asphalt	
Heavy Duty Asphalt	
Existing Concrete	
New Concrete	
Spill Curb & Gutter	
Demo Tree	

IF SHEET IS LESS THAN 22"x 34"
IT IS A REDUCED PRINT.
REDUCE SCALE ACCORDINGLY

Scale 1" = 30'

30 0 15 30 40 50 60

Graphic Scale

CLH ARCHITECTS ENGINEERS
Case, Lowe & Hart, Inc.• 2484 Washington Blvd.
Suite 510 • Ogden, Utah • 84401
801.399.5821 • Fax 801.399.0728• www.clhae.com

CONSULTANTS

STAMP

Dave R. GRANT

GRANT TRUCKING TRUCK MAINTENANCE SHOP

910 W 24th STREET
OGDEN, UTAH 84401

MARK	DATE	DESCRIPTION

ISSUE DATE:	AUG 28, 2015
PROJECT NO:	15460
CAD DWG FILE:	
DRAWN BY:	
CHK'D BY:	

PERMIT SET

AUG 19, 2016

SHEET TITLE

Storm Water Study

SHEET NO:

SWS

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W:\15N231 Grant Trucking\DWG\15N231-S2.dwg, 8/22/2016 11:22:39 AM, DevinL,
1:2.01143

Storm Water Calculations
Grant Trucking Truck Maintenance Shop
910 West 24th Street, Ogden UT
15N231-S1-SWS.dwg

8/18/2016

2 Detained Areas

Hardscape C =	0.90
Landscape C =	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
∑ Det. Areas	101371	2.327	75786	1.740	25585	0.587	0.711
∑ All Areas	101371	2.327	75786	1.740	25585	0.587	0.711
A-1	50292	1.155	36582	0.840	13710	0.315	0.696
A-2	51079	1.173	39204	0.900	11875	0.273	0.726

Time of Concentration--use FAA Method

For FAA Method, use K's of..

K =	0.35	for landscape
K =	0.91	for hardscape

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

Assume Pipe Flow is at 2 ft/s Scour Speed

**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	30.00	1.70	6.20	60.00	1.70	2.22	216.00	1.80	10.22
A-2	65.00	2.00	8.64	233.00	2.00	4.14	0.00	0.00	12.78

Rainfall Intensities
Data From NOAA

10-Year and 100-Year Intensities

The equations used for the 10-Year and 100-Year Intensities were found using the attached Rainfall data as well as Interpolated data where applicable.

Storm Intensities

AREA	Tc (minutes)	I (10-yr.) (in./hr.)	I (100-yr.) (in./hr.)
A-1	10.2	2.52	5.04
A-2	12.8	2.30	4.59

Peak Flow Information
Use Rational Method
10-Year and 100-Year Intensities

Q=CIA

					Peak Flows	
				∑ detained =	3.98	7.95
AREA	C	I10 (in./hr.)	I100 (in./hr.)	A (acres)	Q (10-yr.) (cfs)	Q (100-yr.) (cfs)
A-1	0.696	2.521	5.042	1.15	2.02	4.05
A-2	0.726	2.295	4.590	1.17	1.95	3.91

Node Inlet Requirements

Size pipes for 10 year storm

Area	Node #	% of Total	Q (cfs)
A-1	1	35.0%	0.71
A-1	2	35.0%	0.71
A-1	3	0.0%	0.00
A-1	4	30.0%	0.61
A-2	5	100.0%	1.95

PIPE FLOWS

Upstream Node	Downstream node	Pipe Flow (cfs)
1	2	0.71
2	3	1.42
3	4	1.42
4	5	2.02
5	Outfall	3.98

Options for 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	2	0.71	6	1.142%	0.196	0.125	0.011	1.000%	8
		0.71	8	0.246%	0.349	0.167	0.011	0.400%	
		0.71	10	0.075%	0.545	0.208	0.011	0.280%	
2	3	1.42	6	4.567%	0.196	0.125	0.011	1.000%	10
		1.42	8	0.985%	0.349	0.167	0.011	0.400%	
		1.42	10	0.299%	0.545	0.208	0.011	0.280%	
3	4	1.42	6	4.567%	0.196	0.125	0.011	1.000%	10
		1.42	8	0.985%	0.349	0.167	0.011	0.400%	
		1.42	10	0.299%	0.545	0.208	0.011	0.280%	
4	5	2.02	8	2.009%	0.349	0.167	0.011	0.400%	12
		2.02	10	0.611%	0.545	0.208	0.011	0.280%	
		2.02	12	0.323%	0.785	0.250	0.013	0.200%	
5	Outfall	3.98	10	2.359%	0.545	0.208	0.011	0.280%	15
		3.98	12	1.246%	0.785	0.250	0.013	0.200%	
		3.98	15	0.379%	1.227	0.313	0.013	0.150%	

GRANT TRUCKING

Retention Volume without Percolation

100-yr 24-hr Storm

C	=	0.71	
i	=	0.126	in/hr
A	=	2.33	acres
t	=	86400	seconds

V	=	18005	cubic feet

NOAA Atlas 14, Volume 1, Version 5
Location name: Ogden, Utah, US*
Latitude: 41.2240°, Longitude: -112.0060°
Elevation: 4269 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	1.55 (1.36-1.79)	1.94 (1.73-2.26)	2.66 (2.34-3.07)	3.34 (2.89-3.86)	4.43 (3.76-5.17)	5.46 (4.48-6.44)	6.68 (5.29-7.98)	8.14 (6.20-9.95)	10.5 (7.55-13.3)	12.7 (8.68-16.4)
10-min	1.18 (1.03-1.36)	1.48 (1.31-1.72)	2.02 (1.78-2.35)	2.54 (2.20-2.94)	3.37 (2.86-3.93)	4.15 (3.40-4.90)	5.08 (4.02-6.08)	6.20 (4.72-7.57)	8.00 (5.74-10.1)	9.68 (6.61-12.5)
15-min	0.976 (0.848-1.13)	1.22 (1.08-1.42)	1.68 (1.47-1.94)	2.10 (1.82-2.43)	2.79 (2.36-3.25)	3.43 (2.81-4.05)	4.20 (3.32-5.02)	5.12 (3.90-6.25)	6.61 (4.75-8.34)	8.00 (5.46-10.3)
30-min	0.656 (0.572-0.758)	0.826 (0.730-0.956)	1.13 (0.988-1.30)	1.41 (1.23-1.64)	1.88 (1.59-2.19)	2.31 (1.89-2.73)	2.83 (2.24-3.38)	3.45 (2.63-4.21)	4.45 (3.20-5.62)	5.39 (3.67-6.96)
60-min	0.407 (0.354-0.469)	0.511 (0.451-0.592)	0.697 (0.612-0.806)	0.875 (0.759-1.01)	1.16 (0.984-1.35)	1.43 (1.17-1.69)	1.75 (1.39-2.09)	2.13 (1.63-2.61)	2.75 (1.98-3.48)	3.34 (2.27-4.31)
2-hr	0.258 (0.228-0.296)	0.324 (0.287-0.370)	0.416 (0.368-0.478)	0.506 (0.440-0.582)	0.658 (0.560-0.766)	0.795 (0.662-0.938)	0.960 (0.771-1.15)	1.16 (0.894-1.42)	1.48 (1.07-1.87)	1.77 (1.22-2.29)
3-hr	0.201 (0.181-0.226)	0.248 (0.222-0.279)	0.309 (0.277-0.348)	0.366 (0.325-0.413)	0.458 (0.400-0.523)	0.544 (0.465-0.629)	0.654 (0.544-0.771)	0.784 (0.630-0.956)	0.996 (0.759-1.26)	1.19 (0.870-1.54)
6-hr	0.137 (0.125-0.151)	0.167 (0.152-0.184)	0.201 (0.182-0.222)	0.232 (0.208-0.257)	0.279 (0.248-0.312)	0.319 (0.280-0.360)	0.364 (0.314-0.416)	0.414 (0.348-0.482)	0.520 (0.422-0.637)	0.616 (0.485-0.781)
12-hr	0.087 (0.080-0.094)	0.106 (0.098-0.115)	0.127 (0.117-0.139)	0.146 (0.133-0.160)	0.175 (0.158-0.193)	0.198 (0.177-0.221)	0.224 (0.196-0.252)	0.251 (0.215-0.288)	0.292 (0.243-0.344)	0.326 (0.264-0.391)
24-hr	0.054 (0.050-0.058)	0.066 (0.061-0.071)	0.078 (0.073-0.084)	0.089 (0.083-0.095)	0.103 (0.096-0.111)	0.114 (0.106-0.123)	0.126 (0.116-0.135)	0.137 (0.126-0.148)	0.153 (0.139-0.174)	0.165 (0.148-0.198)
2-day	0.031 (0.029-0.033)	0.038 (0.036-0.041)	0.045 (0.042-0.048)	0.051 (0.048-0.055)	0.059 (0.055-0.063)	0.065 (0.061-0.070)	0.071 (0.066-0.076)	0.077 (0.071-0.083)	0.085 (0.078-0.092)	0.092 (0.083-0.100)
3-day	0.023 (0.021-0.024)	0.028 (0.026-0.030)	0.033 (0.031-0.035)	0.037 (0.035-0.040)	0.043 (0.040-0.046)	0.048 (0.044-0.051)	0.052 (0.049-0.056)	0.057 (0.053-0.061)	0.063 (0.058-0.068)	0.068 (0.062-0.074)
4-day	0.018 (0.017-0.020)	0.022 (0.021-0.024)	0.027 (0.025-0.029)	0.030 (0.028-0.032)	0.035 (0.033-0.038)	0.039 (0.036-0.042)	0.043 (0.040-0.046)	0.047 (0.043-0.051)	0.052 (0.048-0.057)	0.056 (0.051-0.061)
7-day	0.012 (0.012-0.013)	0.015 (0.014-0.016)	0.018 (0.017-0.019)	0.020 (0.019-0.022)	0.024 (0.022-0.025)	0.026 (0.024-0.028)	0.029 (0.027-0.031)	0.031 (0.029-0.034)	0.034 (0.032-0.037)	0.037 (0.034-0.040)
10-day	0.010 (0.009-0.011)	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.020)	0.020 (0.019-0.021)	0.022 (0.020-0.023)	0.024 (0.022-0.025)	0.026 (0.024-0.028)	0.027 (0.025-0.029)
20-day	0.006 (0.006-0.007)	0.008 (0.007-0.008)	0.009 (0.009-0.010)	0.010 (0.010-0.011)	0.012 (0.011-0.012)	0.013 (0.012-0.013)	0.014 (0.013-0.014)	0.014 (0.013-0.015)	0.015 (0.014-0.017)	0.016 (0.015-0.017)
30-day	0.005 (0.005-0.005)	0.006 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.009-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.011)	0.011 (0.011-0.012)	0.012 (0.011-0.013)	0.013 (0.012-0.014)
45-day	0.004 (0.004-0.004)	0.005 (0.005-0.005)	0.006 (0.006-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.009)	0.009 (0.009-0.010)	0.010 (0.009-0.011)	0.010 (0.010-0.011)
60-day	0.004 (0.003-0.004)	0.005 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.006)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.009)	0.009 (0.008-0.010)

[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