GREAT BASIN ENGINEERING INC

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

General Site Information:

A Daycare Facility is located at an existing site at 4786 E 2600 N in Eden, Utah. The site will be revised in order to accommodate Weber County requirements regarding turf grasses, parking spaces, 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 located above ground at 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 10-yr design storm.

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Required Retention:

For retention requirements, a percolation rate was estimated. The NRCS USDA Web Soil Survey yields a Nicodemus Gravelly Loam soil type for this area. This type of soil is typical of being very deep, moderately well drained. To be conservative, a sandy silt mix was assumed which yields a percolation rate of 0.008 ft/s. A conventional safety factor of 10 for this type of application gives a design percolation rate of 0.0008 ft/s. A 5' diam manhole will act as a sump with a gravel base that has an area of about 79 square feet. About 55 linear feet of a 3 foot wide trench will also be used just beneath the ponding area. This yields a percolation area of 244 square feet, and a percolation rate of 244*0.0008 = 0.195 cfs.

The available detention volume in the ponding area is 847 cubic feet in the pond and 118 in the manhole, which gives a total of 965 cubic feet within the pond and the manhole. The required detention for the 10-year storm with a release rate of 0.1 cfs/acre is 938 cubic feet. Some additional volume is available in the gravel in the trench and the gravel surrounding the sump manhole. Thus, there is more than adequate storage capacity in the ponding area. 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 two-hundred feet away, and continue to the west in a historical fashion.

Great Basin Engineering, Inc.

Prepared by Ryan Bingham, P.E.

Reviewed by Mark Babbitt, P.E.

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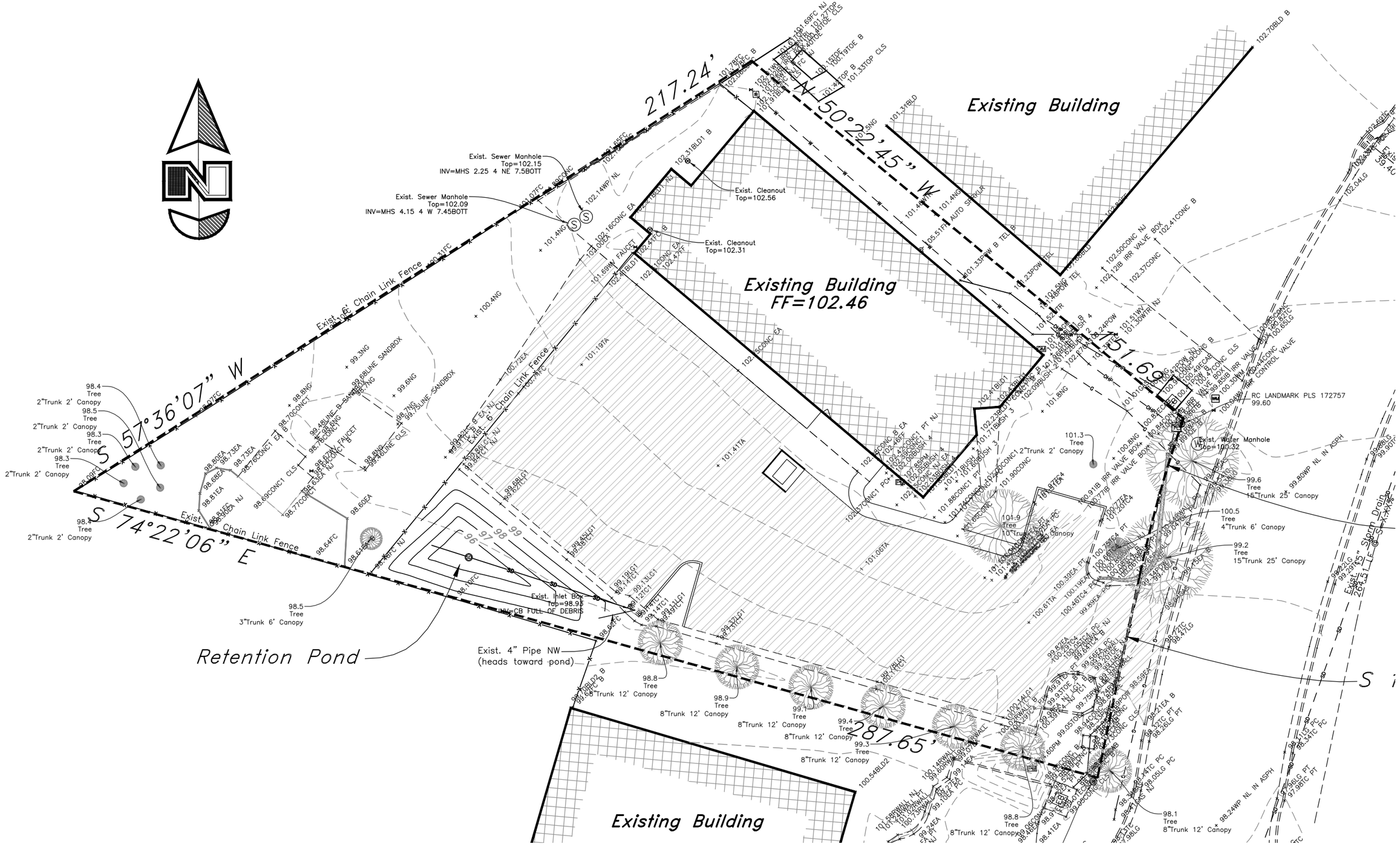

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Storm Water Study
Daycare - Eden
4786 E 2600 N Eden, UT
12N244_S2.dwg
12/12/2012

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 = 0.284 cfs/acre

Total Release Rate = 0.195 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	3.98	499	59	441	0.010	
10	3.12	783	117	666	0.015	
15	2.54	954	176	779	0.018	
20	2.14	1073	234	839	0.019	
25	1.87	1171	293	878	0.020	
30	1.67	1258	351	907	0.021	
35	1.52	1337	410	927	0.021	
40	1.40	1406	468	938	0.022	<- Max Detenti
45	1.30	1464	527	937	0.022	
50	1.20	1509	585	924	0.021	
55	1.12	1545	644	902	0.021	
60	1.05	1577	702	875	0.020	
90	0.82	1855	1053	802	0.018	
120	0.65	1965	1404	561	0.013	
180	0.46	2072	2106	-34	-0.001	
360	0.30	2672	4212	-1540	-0.035	
720	0.19	3448	8424	-4976	-0.114	
1440	0.12	4405	16848	-12443	-0.286	

So, our detention pond needs to hold 938 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


111° 50' 3"
111° 49' 57"
41° 18' 20"
41° 18' 17"
430170
430180
430190
430200
430210
430220
430230
430240
430250
430260
430270
430280
430290
4573020
4573010
4573000
4572990
4572980
4572970
4572960
4572950
NsA
Map Scale: 1:600 if printed on A size (8.5" x 11") sheet.
N
Meters
0 5 10 20 30
Feet
0 30 60 120 180

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:600 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan Area, Utah - Morgan County and Part of Weber County
Survey Area Data: Version 6, Oct 28, 2011

Date(s) aerial images were photographed: 7/17/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Morgan Area, Utah - Morgan County and Part of Weber County (UT609)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
NsA	Nicodemus gravelly loam, 0 to 3 percent slopes	1.6	100.0%
Totals for Area of Interest		**1.6**	**100.0%**