18" RCP

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft

Results

Discharge	5.25	ft^3/s
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	0.88	ft
Percent Full	100.0	%
Critical Slope	0.00588	ft/ft
Velocity	2.97	ft/s
Velocity Head	0.14	ft
Specific Energy	1.64	ft
Froude Number	0.00	
Maximum Discharge	5.65	ft^3/s
Discharge Full	5.25	ft^3/s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

18" RCP

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	0.88	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00588	ft/ft

24" RCP

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	2.00	ft
Diameter	2.00	ft

Results

Discharge	11.31	ft^3/s
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.50	ft
Top Width	0.00	ft
Critical Depth	1.21	ft
Percent Full	100.0	%
Critical Slope	0.00544	ft/ft
Velocity	3.60	ft/s
Velocity Head	0.20	ft
Specific Energy	2.20	ft
Froude Number	0.00	
Maximum Discharge	12.17	ft^3/s
Discharge Full	11.31	ft^3/s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

24" RCP

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.21	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00544	ft/ft

4905 S. 1500 W., Suite 100
Riverdale, UT 84405
www.horrocks.com

HORROCKS ENGINEERS

Riverdale Office
Tel: (801) 621-1025

Stormwater Report

Gallop Bend Subdivision – Weber County

HE Project No.: PG-888-1607

Storm Drainage System Calculations

October 2016

Dean Barker, PE
Horrocks Engineers

Existing Conditions

The proposed Gallop Bend Subdivision is located north off of 2550 South between 3500 West and 3850 West in Weber County, UT. The project will consist of 20 single family residential lots at a minimum size of 40,000 SF. The property is currently being farmed with an old farm house located off of 2550 South. The property is approximately 22.35 acres and naturally drains from the northwest corner of the parcel to the southeast corner.

The existing storm water may infiltrate in the ground as it sheet flows to an existing drainage ditch on the north side of 2550 South. The ditch drains east and ties into the existing County storm drainage system at 3500 West. The system then drains to the south to an existing drainage.

There is an existing ditch along the west property line near the existing wire fence. The ditch is only about 8 to 10 inches deep. The existing ditch catches off site runoff from the west and conveys it south to an existing pipe installed on its end tied to an existing 15" RCP below ground on 2550 South. Offsite water from the west is expected to be very minor due to the existing topography. However, this ditch should be left in place. If removed during clearing and grubbing activities, the contractor should construct a "V" ditch approximately 12" deep to historically convey water to the south.

There are existing irrigation ditches that have been used for farming activities on the site. There is an existing concrete lined channel located near the north property line that has delivered water from the Wilson Canal. This channel will be removed and abandoned in accordance with the Wilson Irrigation Co. standards and specifications. All irrigation ditches will be removed from the property in the same manner.

The Wilson Canal runs about 200' north of the north property line of the site intercepting offsite flow from the north. However, there are relatively small fields located between the canal and the project site. As these fields are irrigated, there is a potential for offsite water to run onto the north portion of the proposed site. It is recommended to install a 1' high berm along the north property line to intercept runoff/irrigation water and convey it to the east property line. A 12" deep "V" ditch should be constructed on the east property line conveying offsite and onsite runoff to the southeast corner of the site where a detention pond will be constructed. The detention pond is sized for the onsite runoff

volume with an overflow constructed to convey offsite water to the 2550 S. ditch.

Project Description

This report is intended to show that the proposed on-site storm systems are adequate for the new development and that off-site water can be conveyed through the project site properly. The grading plan is an integral part of this report and should be referred to while reviewing this document (see *Appendix A: Grading Plan*).

The project has been designed for one drainage area:

1. The stormwater runoff generated by the proposed development will be conveyed to a proposed detention pond in the southeast corner of the site by over land flow, pavement sheet flow, gutters, curb inlets, and pipes. The on-site runoff will be attenuated through the pond using an orifice plate to restrict the flow at the predeveloped rate of 0.1 cfs/acres per County standards

All off-site and on-site drainage will be conveyed separately and will not mix. However, off-site drainage may be routed to the pond overflow through perimeter ditches and conveyed to the existing ditch on 2550 South in large storm events. The drainage areas contributing to the on-site system include the roof tops, landscaped areas, sidewalks, and paved areas.

Hydraulic Analysis

The hydraulic analysis was completed using the rational method as was prescribed by the County *Standards*. The storage needs to be large enough to completely contain on-site runoff. Peak flow was calculated using the rational method as follows:

$$Q = ciA$$

Q = Peak Flow (cfs)
c = Rational Method Runoff Coefficient
i = Rainfall Intensity (in/hr)
A = Drainage Area (acres)

Storage

Detention Pond:

The on-site storage was calculated for a 100 year – 24 hour storm event. The allowable release rate of 2.235 cfs was used in sizing the pond. Given the total site acreage of 22.35 acres x 0.1 cfs/acres = 2.235 cfs. See appendix for runoff volume calculations and pond sizing calculations.

Area	Runoff Coefficient (c)	Drainage Area (A)
Roof/Driveways	0.95 (roof)	1.47 acres
Landscaping	0.15 (grass)	19.10 acres
Sidewalks/Pavement	0.90 (concrete)	1.78 acres
Total	0.26 (weighted)	22.35 acres

Weighted Runoff Coefficient, c : ((0.95*1.47)+(0.15*19.10)+(0.90*1.78) / 22.35 = 0.26

*note: 3,200 SF was assumed for roof/driveway areas per lot.

Storm Elapsed Time, t : 24 hours

Required Volume, V_r : 28,028 cu ft

Provided Volume of Pond, V_{pond}: 28,158 cu ft

These calculations show that there is adequate volume in the detention Pond (Pond Capacity > Required Volume). The pond will be constructed with an orifice plate restricting the flow.

Orifice Plate Calculations

Q=CAsqrt(2gh)

Q=	2.23	cfs				
H=	3.00	ft	(from high water elev. to orifice elev.)			
				A=	0.268	ft^2
g=	32.2	ft/s^2		=	38.59	in^2
C=	0.6					
			Diameter =		**7.0**	**inches**

Conveyance System

On-site Drainage Areas:

The on-site conveyance is calculated for a 10 year storm event using a time of concentration of 15 minutes. The conveyance system to the detention pond is comprised of inlets and a 15" RCP at 0.50% min. slope or greater leading to the detention pond in the southeast corner of the property.

Pipe Calculations:

Mannings roughness coefficient for 15" RCP @ 0.25% = 0.013

15 minute Time of Concentration for 50% of site to first intersection:

Q_{10} = CiA = 0.26 * 2.04 in/hr * 11.17 acres = 5.92 cfs

15 minute Time of Concentration for 100% of site at last manhole in street:

Q_{10} = CiA = 0.26 * 2.04 in/hr * 22.35 acres = 11.85 cfs

Barrel capacity for 18" RCP @ 0.25% slope = 5.65 cfs

Barrel capacity for 24" RCP @ 0.25% slope = 12.17 cfs

See calculations in appendix.

Appendix A:

Site Exhibits

Appendix B:

Hydraulic Computations

Final Engineering Drainage Report

Drainage Area 1 - Detention Pond

Project Number:	**PG-888-1607**	**Gallop Bend Subdivision**		**Agency:**	**Weber County**
Design Engineer:	**D. Barker**			**Date:**	**3-Oct-16**

2550 South Weber County, Taylor, Utah

Watershed Properties

Design Event (yr)	Drainage Area (ac)	Land Use Breakdown		[A] Watershed Area	
		Land Use Type	[C] C	(sq ft)	(ac)
100	22.35	Roof/Driveway	0.95	64000.00	1.47
Infiltration Rate (in / hr)	**Ground Water Depth (ft)**	Landscaping	0.15	832177.00	19.10
		Sidewalks/Paved	0.90	77369.00	1.78
0.00	8.00	Composite	0.26	973546.00	22.35

Detention Pond Properties

Pond Top Elev. (ft)	Pond Bottom Elev. (ft)	Ground Water Elev. (ft)	Freeboard Elev. (ft)	Infiltration Rate (ft / day)	Release Rate (cfs)
4204.00	4201.50	4196+/-	4205.00	0.00	2.235

Pond Volume Calculations

Elapsed Time (min)	[i] Rainfall Intensity (in/hr)	[Q] Accumulated Flow ciA (cfs)	Accumulated Volume (cu ft)	Allowable Release (cu ft)	Required Storage (cu ft)
10	4.97	29.11	17467.29	1341.00	16126.29
15	4.12	24.14	21728.63	2011.50	19717.13
30	2.76	16.17	29112.14	4023.00	25089.14
60	1.71	10.02	36073.74	8046.00	28027.74
120	0.94	5.48	39449.06	16092.00	23357.06
180 (3 Hrs)	0.64	3.73	40250.70	24138.00	16112.70
360 (6 Hrs)	0.36	2.08	44933.96	48276.00	0.00
720 (12 Hrs)	0.22	1.28	55186.50	96552.00	0.00
1,440 (24 Hrs)	0.12	0.71	61262.08	193104.00	0.00

Detention Pond Sizing

North Swale Dimensions (ft)		Elevation (ft)	Area (sq ft)	Volume (cu ft)	Accumulated Volume (cu ft)
Slope (rise)	1.00	4204.00	13035.00	0.00	0.00
Slope ((run)	3.00	4203.00	11560.00	12297.50	12297.50
Top Length	165.00	4202.00	10243.00	10901.50	23199.00
Top Width	79.00	4201.50	9592.00	4958.75	28157.75
Bottom Length	141.00				
Bottom Width	73.00				

Detention Pond Outflow

Required Storage (cu ft)	Storage (cu ft)	Pond Capacity (cu ft)	Release Rate (cfs / ac)	Infiltration Surface (sq ft)	Infiltration Flow (cu ft / day)
28027.74	28027.74	28157.75	0.10	10293.00	0.00

	Time for Pond to Drain at Max Volume		Time for Pond to Infiltrate	
Detention Pond 3' Above Ground Water?	(hrs)	(days)	(hrs)	(days)
yes	3.48	0.15	#DIV/0!	#DIV/0!

HORROCKS ENGINEERS

18" RCP

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft

Results

Discharge	5.25	ft^3/s
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	0.88	ft
Percent Full	100.0	%
Critical Slope	0.00588	ft/ft
Velocity	2.97	ft/s
Velocity Head	0.14	ft
Specific Energy	1.64	ft
Froude Number	0.00	
Maximum Discharge	5.65	ft^3/s
Discharge Full	5.25	ft^3/s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

18" RCP

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	0.88	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00588	ft/ft

24" RCP

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00250	ft/ft
Normal Depth	2.00	ft
Diameter	2.00	ft

Results

Discharge	11.31	ft^3/s
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.50	ft
Top Width	0.00	ft
Critical Depth	1.21	ft
Percent Full	100.0	%
Critical Slope	0.00544	ft/ft
Velocity	3.60	ft/s
Velocity Head	0.20	ft
Specific Energy	2.20	ft
Froude Number	0.00	
Maximum Discharge	12.17	ft^3/s
Discharge Full	11.31	ft^3/s
Slope Full	0.00250	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

24" RCP

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.21	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00544	ft/ft

Appendix C:

Resources

NOAA Atlas 14, Volume 1, Version 5
Location name: Ogden, Utah, USA*
Latitude: 41.2199°, Longitude: -112.0642°
Elevation: 4252.12 ft**
* source: ESRI Maps
** source: USGS

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)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.126** (0.109-0.146)	**0.158** (0.140-0.184)	**0.217** (0.190-0.252)	**0.271** (0.236-0.316)	**0.361** (0.306-0.422)	**0.444** (0.364-0.527)	**0.544** (0.431-0.652)	**0.663** (0.505-0.811)	**0.855** (0.615-1.08)	**1.03** (0.707-1.34)
10-min	**0.192** (0.166-0.223)	**0.241** (0.213-0.280)	**0.330** (0.289-0.383)	**0.413** (0.359-0.481)	**0.549** (0.466-0.642)	**0.676** (0.555-0.802)	**0.828** (0.656-0.993)	**1.01** (0.769-1.24)	**1.30** (0.936-1.64)	**1.57** (1.08-2.03)
15-min	**0.238** (0.206-0.276)	**0.299** (0.264-0.347)	**0.409** (0.358-0.474)	**0.512** (0.445-0.596)	**0.681** (0.577-0.796)	**0.838** (0.687-0.993)	**1.03** (0.813-1.23)	**1.25** (0.953-1.53)	**1.61** (1.16-2.04)	**1.95** (1.33-2.52)
30-min	**0.321** (0.278-0.371)	**0.402** (0.356-0.468)	**0.550** (0.482-0.639)	**0.689** (0.599-0.802)	**0.916** (0.777-1.07)	**1.13** (0.925-1.34)	**1.38** (1.09-1.66)	**1.68** (1.28-2.06)	**2.17** (1.56-2.74)	**2.63** (1.80-3.39)
60-min	**0.397** (0.344-0.459)	**0.498** (0.440-0.579)	**0.681** (0.596-0.790)	**0.853** (0.741-0.992)	**1.13** (0.962-1.33)	**1.40** (1.15-1.66)	**1.71** (1.35-2.05)	**2.08** (1.59-2.55)	**2.69** (1.93-3.40)	**3.25** (2.22-4.20)
2-hr	**0.499** (0.441-0.572)	**0.625** (0.554-0.715)	**0.807** (0.711-0.926)	**0.984** (0.853-1.13)	**1.28** (1.08-1.48)	**1.55** (1.28-1.82)	**1.87** (1.50-2.23)	**2.25** (1.74-2.75)	**2.87** (2.08-3.62)	**3.44** (2.38-4.44)
3-hr	**0.585** (0.526-0.658)	**0.721** (0.646-0.814)	**0.901** (0.807-1.02)	**1.07** (0.950-1.21)	**1.34** (1.17-1.53)	**1.59** (1.36-1.84)	**1.91** (1.59-2.25)	**2.29** (1.84-2.77)	**2.91** (2.22-3.66)	**3.48** (2.54-4.48)
6-hr	**0.795** (0.727-0.873)	**0.967** (0.882-1.07)	**1.17** (1.06-1.29)	**1.35** (1.22-1.50)	**1.63** (1.45-1.82)	**1.87** (1.64-2.10)	**2.13** (1.84-2.44)	**2.43** (2.05-2.82)	**3.05** (2.48-3.69)	**3.61** (2.85-4.53)
12-hr	**1.01** (0.935-1.10)	**1.24** (1.14-1.35)	**1.49** (1.37-1.63)	**1.72** (1.56-1.88)	**2.05** (1.85-2.26)	**2.33** (2.07-2.59)	**2.62** (2.29-2.96)	**2.94** (2.52-3.37)	**3.44** (2.85-4.04)	**3.84** (3.10-4.60)
24-hr	**1.24** (1.15-1.34)	**1.52** (1.41-1.64)	**1.81** (1.68-1.96)	**2.06** (1.91-2.22)	**2.39** (2.21-2.58)	**2.65** (2.44-2.86)	**2.91** (2.67-3.15)	**3.17** (2.90-3.44)	**3.53** (3.20-4.08)	**3.88** (3.42-4.65)
2-day	**1.44** (1.34-1.55)	**1.76** (1.64-1.90)	**2.09** (1.95-2.25)	**2.36** (2.20-2.54)	**2.73** (2.54-2.93)	**3.00** (2.78-3.23)	**3.28** (3.04-3.53)	**3.56** (3.27-3.83)	**3.92** (3.58-4.24)	**4.19** (3.81-4.70)
3-day	**1.57** (1.46-1.69)	**1.92** (1.79-2.06)	**2.28** (2.13-2.45)	**2.58** (2.40-2.77)	**2.98** (2.78-3.20)	**3.30** (3.06-3.54)	**3.62** (3.34-3.89)	**3.93** (3.61-4.24)	**4.35** (3.96-4.71)	**4.67** (4.22-5.16)
4-day	**1.69** (1.58-1.82)	**2.07** (1.93-2.23)	**2.47** (2.30-2.65)	**2.80** (2.61-3.00)	**3.25** (3.02-3.48)	**3.59** (3.33-3.86)	**3.95** (3.64-4.25)	**4.31** (3.95-4.65)	**4.78** (4.34-5.19)	**5.14** (4.64-5.61)
7-day	**2.00** (1.86-2.15)	**2.44** (2.28-2.64)	**2.91** (2.71-3.13)	**3.29** (3.06-3.52)	**3.79** (3.53-4.07)	**4.18** (3.88-4.49)	**4.58** (4.23-4.91)	**4.97** (4.57-5.36)	**5.47** (5.00-5.94)	**5.85** (5.31-6.38)
10-day	**2.26** (2.10-2.43)	**2.77** (2.58-2.98)	**3.28** (3.06-3.52)	**3.68** (3.44-3.95)	**4.21** (3.93-4.51)	**4.60** (4.28-4.92)	**4.98** (4.62-5.34)	**5.35** (4.94-5.75)	**5.81** (5.35-6.26)	**6.14** (5.63-6.65)
20-day	**2.90** (2.70-3.10)	**3.55** (3.32-3.81)	**4.19** (3.92-4.49)	**4.67** (4.37-5.00)	**5.29** (4.95-5.64)	**5.72** (5.35-6.11)	**6.13** (5.73-6.55)	**6.52** (6.07-6.97)	**6.98** (6.48-7.49)	**7.29** (6.76-7.84)
30-day	**3.48** (3.25-3.71)	**4.25** (3.98-4.55)	**4.98** (4.67-5.32)	**5.54** (5.19-5.90)	**6.24** (5.85-6.64)	**6.74** (6.30-7.17)	**7.21** (6.73-7.68)	**7.64** (7.11-8.16)	**8.17** (7.57-8.74)	**8.53** (7.88-9.15)
45-day	**4.27** (4.00-4.56)	**5.21** (4.88-5.57)	**6.09** (5.71-6.49)	**6.76** (6.35-7.20)	**7.61** (7.15-8.09)	**8.21** (7.70-8.72)	**8.77** (8.21-9.32)	**9.27** (8.68-9.86)	**9.87** (9.22-10.5)	**10.2** (9.57-10.9)
60-day	**5.05** (4.73-5.38)	**6.16** (5.78-6.58)	**7.20** (6.76-7.67)	**7.99** (7.51-8.49)	**8.98** (8.44-9.54)	**9.68** (9.08-10.3)	**10.3** (9.69-11.0)	**10.9** (10.2-11.6)	**11.6** (10.8-12.4)	**12.1** (11.2-12.9)

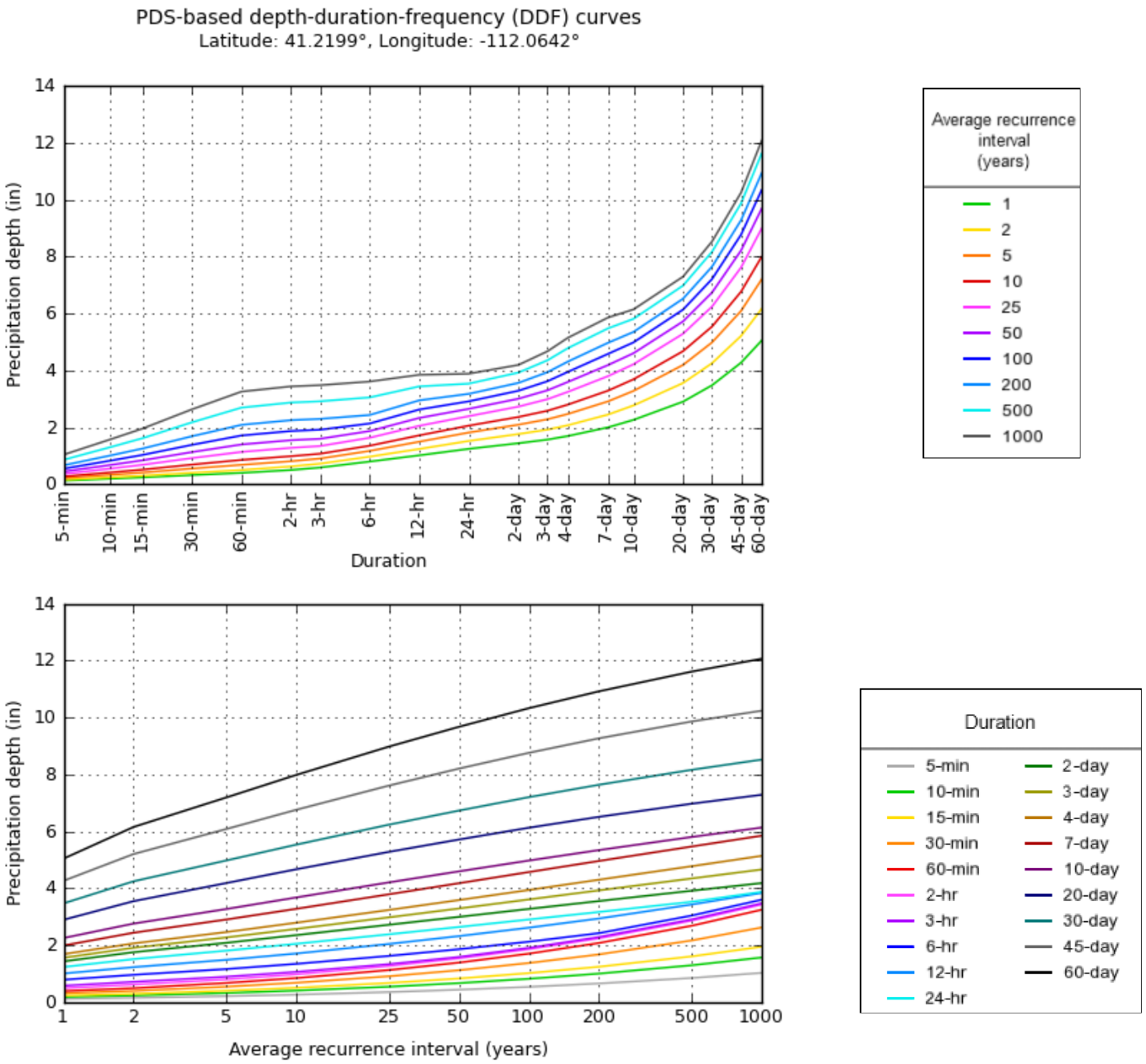
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

PF graphical



NOAA Atlas 14, Volume 1, Version 5

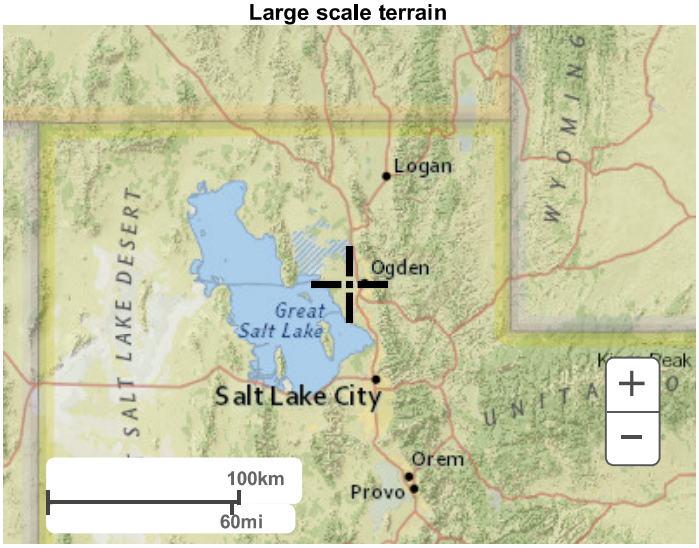
Created (GMT): Mon Oct 3 22:24:43 2016

Back to Top

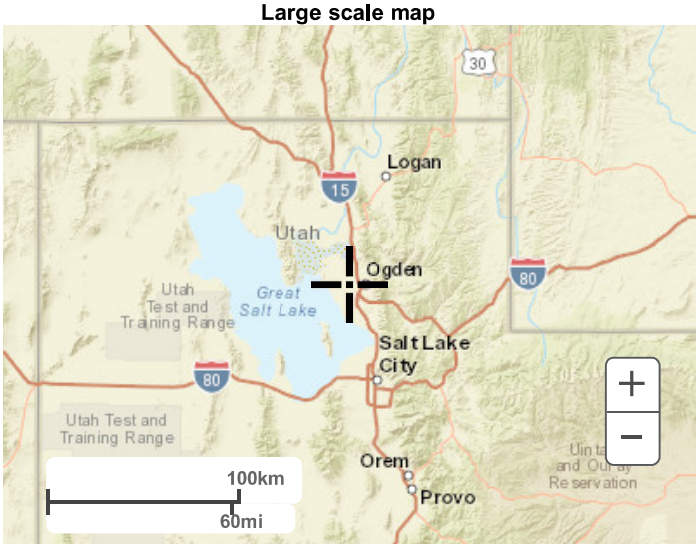
Maps & aerials

Small scale terrain

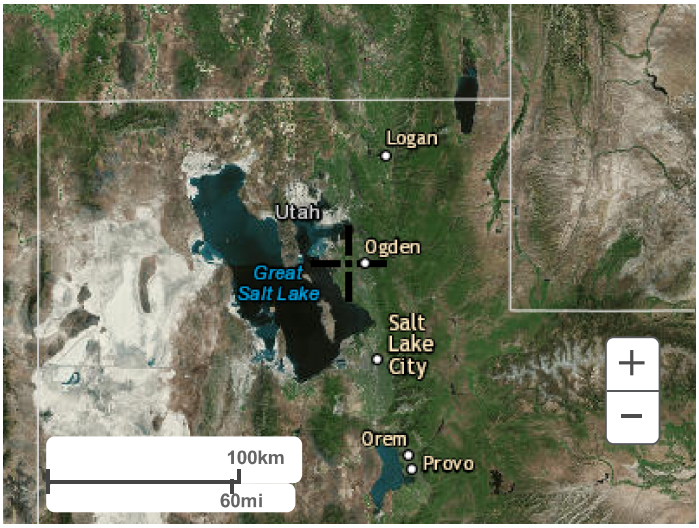
Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix D:

Geotechnical Report