To:	Park City Public Works	From:	Curtis Ball	
			Stantec Consulting Services, Inc.	
File:	205303057	Date:	April 20, 2016	

Reference: **Alice Claim Storm Drainage Narrative (revised for Gully Plan)**

Alice Claim is a proposed nine lot subdivision located in Park City, Utah at the south end of town. The site is accessed by King Road, Sampson Avenue and Ridge Avenue. The site is bounded on the north by residences along King Road and Sampson Avenue, bounded on the east by hillside and Ridge Avenue, on the south by Park City's Woodside water tank site, and on the west by hillside and the extension of King Road, which cuts off the drainage from the hillside further to the west. The terrain is relatively steep, and vegetated with shrubs and grasses, and with a few conifers and aspen trees. A rip-rap channel carries the drainage from Woodside Gulch through the site running from south to north. At the north end of the project, the channel runs into a 36" pipe culvert which carries the water to the Park City storm drain system.

Because of the relatively small area of the site, the Rational Method was chosen to analyze the storm drainage. Storm Intensity values were taken from NOAA Atlas 14 for Park City, Utah using a 100 year return period. NRCS Watershed Lag methodology was used to determine the time of concentration and select the appropriate intensity. Time of concentration was calculated to be 12 minutes so the 15 minute storm intensity was used. The intensity for a 15 minute, 100 year storm event in this location is 5.04 inches per hour.

A portion of the site will remain undisturbed and the drainage patterns unchanged, draining into the Woodside Gulch drainage channel. Other small undisturbed downhill portions of the site will continue to drain down the hillside as they do now. The whole site contains 8.2 acres, but only the run-off from 7.28 acres will be affected by the proposed improvements. The 7.28 acre area was used for calculating both the pre-development and the post-development run-off values.

Run-off coefficients were chosen based on anticipated future development. A weighted run-off coefficient was determined using approximate roof areas and proposed pavement areas, and assuming natural vegetation on the landscape areas.

We are proposing to intercept the Woodside Gulch channel at the south end of the project and re-route it in 36" culvert north to lot 9 where it will resume its course in the existing channel until it enters an existing 36" culvert which empties into the Park City storm drain system. This run-off will pass through the entire site detained.

A total of five sub-basins were identified which are affected by the proposed improvements, and are labeled on the Drainage Plan as Drain Basins 1-5. Because of site constraints only Drain Basin 2 can be captured and detained. Drain Basins 1,3 and 4 are caught in catch basins and added to the Woodside Gulch flow without detention. Drain Basin 5 run-off flows directly onto the north section of the road without detention. In order to compensate for the un-detained flows, the flow from Drain Basin 2 is being "over-detained" such that all of the post-development flows combined do not exceed the pre-development flow of 12.85 cfs. The run-off released from the detention joins the flows in the new 36" culvert.

Stantec

Reference: Alice Claim Storm Drainage Narrative (revised for Gully Plan)


Due to the relatively small flows and the steepness of the on-site storm drain pipes, we propose using 15" pipe for all site storm drainage collector pipes. The 36" culvert carrying the Woodside Gulch flows was sized using HEC-HMS for drainage calculations and Bentley FlowMaster for pipe sizing. The contributing area was 224 acres and the peak discharge was 113.1 cfs using a design storm with a 100 year return period and a 24 hour duration.

Stantec Consulting Services, Inc.

Curtis Ball, P.E.
Phone: 801.743.4952
Fax: 801.266.1671
curtis.ball@stantec.com

Attachment: Vicinity Map
                    Storm Drain Plan
                    100 Yr. Storm Drainage Calculations
                    Drain Basin 2 Flow and Orifice Sizing Calculations
                    NOAA Atlas 14 printouts (precipitation and intensity)

Map ▾
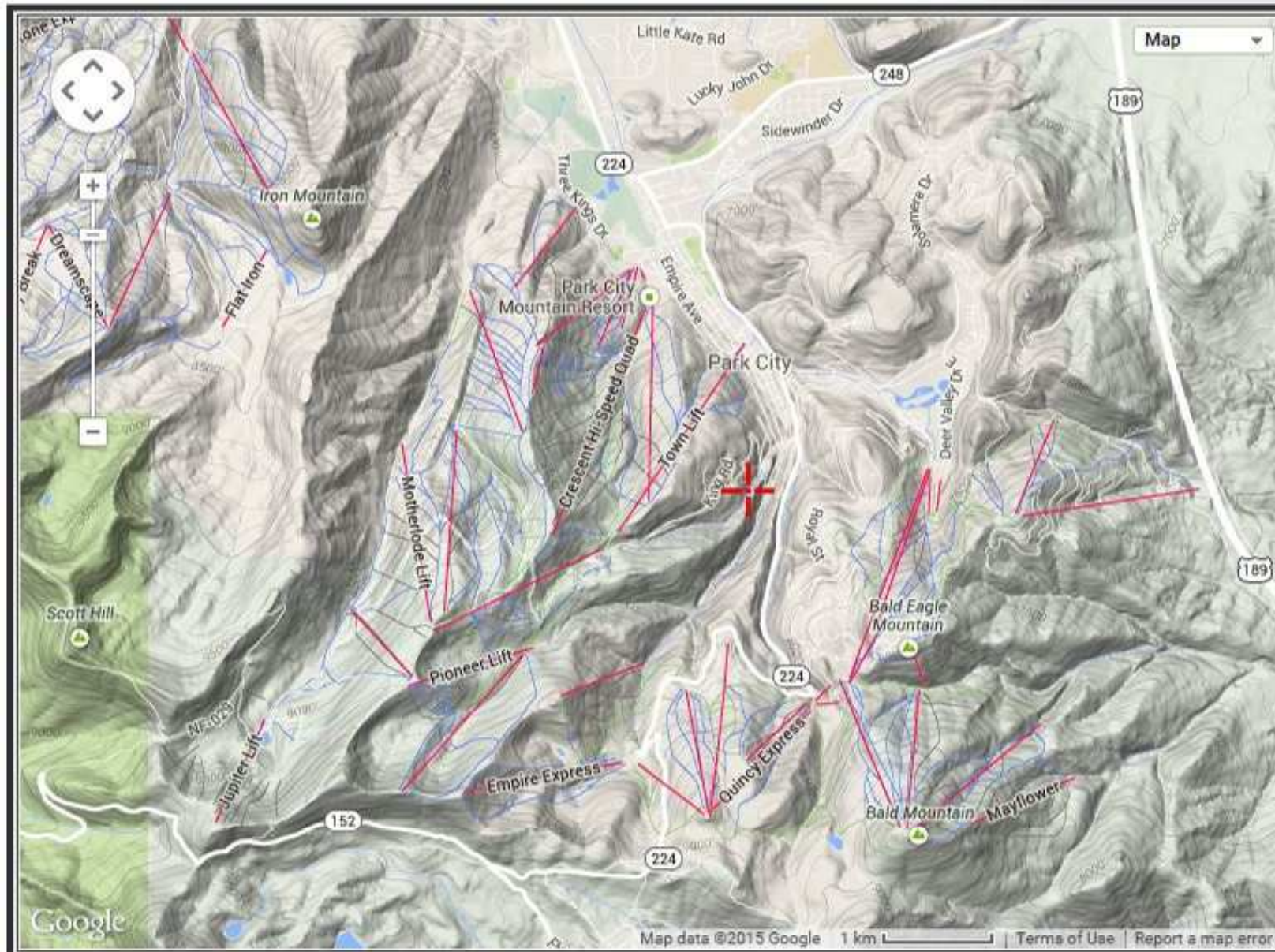
a) **Select location**
   (move crosshair or double click)
b) **Click on station icon**
   (☐ show stations on map)

LOCATION INFORMATION:
Name: Park City, Utah, US*
Latitude: 40.6360°
Longitude: -111.4982°
Elevation: 7407 ft*

* source: Google Maps

DRAIN BASIN 1

DRAIN BASIN 2

DRAIN BASIN 3

DRAIN BASIN 5

DRAIN BASIN 4

CULVERT INLET
AND 36" DRAIN PIPE
FOR STREAM
RELOCATION
INV. = 7380.93

EXISTING
DRAINAGE
CHANNEL

RELOCATE EXISTING
STREAM

4'-0"
WATERWAY

3 LF OF 18" ADS DR-21 @ 2.0%
STORM DRAIN PIPE

UNDER GROUND DETENTION
STORAGE 2100 CU. FT.
INV. = 7361.00

27 LF OF 18" ADS DR-21 @ 18.42%
STORM DRAIN PIPE

FLARED END SECTION
INLET
INV. = 7366.00

INSTALL 28 LF OF 15" ADS DR-21 @ 2.0%
STORM DRAIN PIPE

INSTALL COMBO BOX
INV. = 7359.54

21 LF 15" ADS DR-21 @ 12.48%
STORM DRAIN PIPE

INSTALL 60" STORM DRAIN MH

BOUNDARY LINE (TYP.)

BOUNDARY LINE (TYP.)

DETENTION BASIN
CONTROL STRUCTURE
WITH 6" ORIFICE PLATE
INV. = 7360.94

INSTALL 60" STORM DRAIN MH
INV. (15") = 7356.92

INSTALL 60" STORM DRAIN MH

INSTALL CATCH BASIN

BOUNDARY LINE (TYP.)

122 LF 15" ADS DR-21
STORM DRAIN PIPE

RELOCATE EXISTING
STREAM

32 LF 15" ADS DR-21
STORM DRAIN PIPE

ALICE COURT

INSTALL 60" STORM DRAIN MH

STREAM RELOCATION
CULVERT AND DRAIN
PIPE OUTLET
INV. = 7330.96

PROPOSED
DRAINAGE CHANNEL

EXISTING
DRAINAGE CHANNEL

EXISTING
DRAINAGE
CHANNEL

68 LF 15" ADS DR-21
STORM DRAIN PIPE

EXISTING
DRAINAGE CULVERT

STORM DRAIN DISCHARGE
INTO EX STREAM. PROTECT
STREAM WITH RIP RAP.
INV. = 7304.39

EXISTING
DRAINAGE INLET &
36" CULVERT

EX. KING ROAD

3995 South 700 East, Suite 300
Salt Lake City, Utah 84107
www.stantec.com

Stantec

Owner/Project

Legend

NOTES:
1. MODIFICATIONS TO EXISTING DRAINING CHANNEL WILL REQUIRE STATE STREAM
    ALTERATION PERMIT.

Revision		By	Appd.	YY.MM.DD
4	NEW DRAINAGE CALCS	CB	SB	16.04.20
3	PARK CITY RE-SUBMITTAL	BD	PMD	15.03.27
2	PARK CITY RE-SUBMITTAL	CB	PMD	15.03.16
1	PARK CITY SUBMITTAL	CB	JRJ	15.01.23
Issued		By	Appd.	YY.MM.DD

File Name: C-301dp.dwg	SDJ	JRJ	EKW	14.12.19
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
No. 318693
CURTIS BALL
4/18/16
STATE OF UTAH

CALL BEFORE YOU DIG
BLUE STAKES 1 800 662 4111
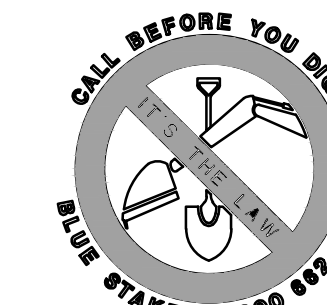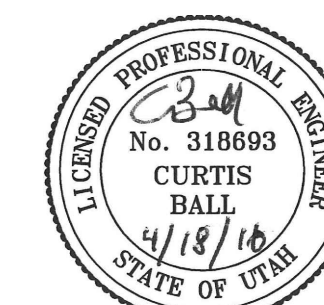
Client/Project
KING DEVELOPMENT L.L.C.
PO BOX 244
PARK CITY, UTAH 84060

ALICE CLAIM
Park City, Utah

Title
DRAINAGE PLAN

Project No. 205303057	Scale 1"=40'	
Drawing No. C301	Sheet of	Revision 0
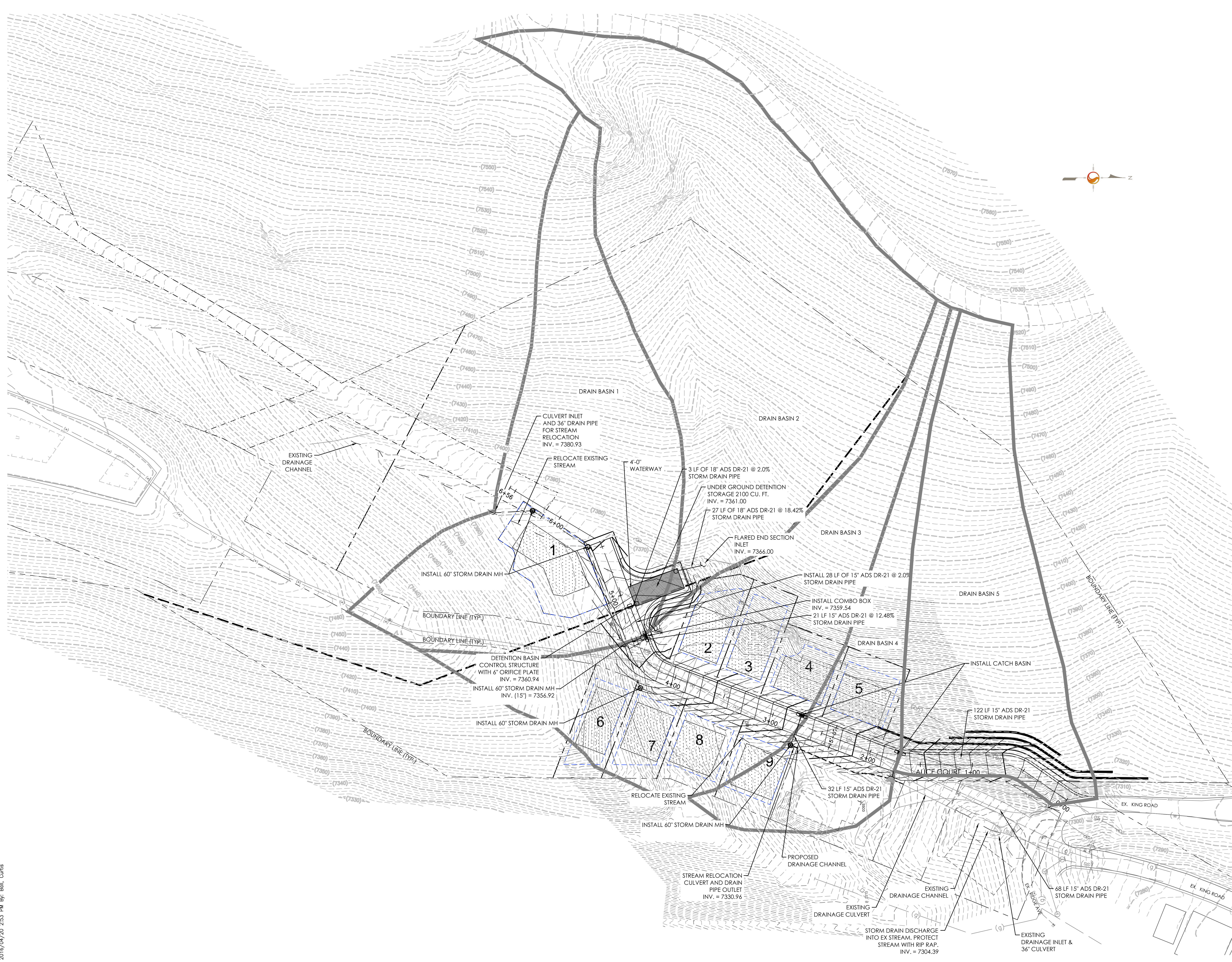
ALICE CLAIM SUBDIVISION - PARK CITY, UTAH
ON-SITE RUNOFF / DETENTION 100 YEAR STORM
4/20/2016

AREA PRE-DEVELOPMENT (SF) =	317328	SF
AREA PRE-DEVELOPMENT (AC) =	7.28	ACRES

Proposed Development

Runoff Coefficient:

Desc.	Area (A)	Coeff. (C)	CA
Roof	16500	0.95	15675.0
Pavement	13521	0.9	12168.9
Landscape (steep slope, heavy soil)	287307	0.35	100557.5

Sum = 317328   128401.35   **"C" =** **0.40**

*Runoff Coefficient (C) from Park City Drainage Design Manual

POST-DEVELOPMENT OUTFALL RATE (Q)= CIA

		Q =	14.86 cfs	
WEIGHTED 'C' (post-dev) =	0.40	C=	0.40	(Weighted post-dev. C based on Park City Drainage Design Manual)
ALLOWABLE OUTFALL RATE Qall (CFS) =	12.85	I =	5.04 in/hr	(From NOAA Atlas 14 upper 90% confidence interval for Storm Duration = Tc)
(predevelopment flow rate)		A =	7.28 acres	
POST-DEVELOPMENT FLOW (CFS) =	14.86	Tc =	15 min	(select closest {15,30, 60, 360, 720, 1440} min from Tc Calc below)
Q difference (Post - Pre) (cfs) =	2.01		(Post-development flow must be reduced by this amount using detention; see Drain Basin 2 spreadsheet).	

Storm Duration (min.)	Rainfall Total (in.)	Storm Runoff (cu.ft.)	Discharge (cu.ft.)	Storage Req'd (cu.ft.)	
15	1.26	13482	11565	1917	Runoff = Total Rainfall x CA
30	1.70	18190	23131	-4941	Discharge = Time x Qall
60	2.10	22470	46262	-23791	Storage Factor of Safety = 0.9
360	2.58	27606	277570	-249964	Required Storage = (Runoff - Discharge) / (Storage Factor of Safety)
720	3.17	33919	555140	-521221	
1440	3.62	38734	1110281	-1071546	

Runoff = Total Rainfall x CA
Discharge = Time x Qall
Storage Factor of Safety = 0.9
Required Storage = (Runoff - Discharge) / (Storage Factor of Safety)

Required Storage = **2130** cu.ft.
= 15930 gal.

Rainfall total from NOAA Atlas 14 Vol. 1 Version 5 (Upper bound of 90% confidence interval)

Pre-Development

ALLOWABLE OUTFALL RATE (Qall)= CIA

Qall =	12.85 cfs	
C=	0.35	(predevelopment coefficient from Park City Drainage Design Manual)
I =	5.04 in/hr	(From NOAA Atlas 14 upper 90% confidence interval for Storm Duration = Tc)
A =	7.28 acres	
Tc =	15 min	(select closest {15,30, 60, 360, 720, 1440} min from Tc Calc below)

BASIN	AREA (acres)	AREA (mi^2)	HSG	LAND	Lag Time (min)	Tc (min)	L (feet)	Hi-Elev (feet)	Lo-Elev (feet)	Y (slope%)	S (inches)	CN
1	7.28	0.011	C	MTN.	7	12						
							1264.3	7529	7303	18	4.29	70

HSG~ HYDROLOGIC SOIL GROUP
Tc~ TIME OF CONCENTRATION(HOURS)
L~ HYDRAULIC LENGTH OF WATERSHED (FEET)   S=1000/RCN-10
Y~ AVERAGE SLOPE OF LAND
S~ MAXIMUM RETENTION IN THE WATERSHED(INCHES)
CN~ SCS CURVE NUMBER (CN = 70 Brush: Fair condition (50-75% cover) for HSG C)

NOTE: CALCULATED USING THE NRCS WATERSHED LAG METHOD

DRAIN BASIN 2
Note: This spreadsheet estimates the runoff produced by the small "side" basin (Drain Basin 2) that feeds into Woodside Gulch
        just upstream of the developed area for alice claim. This is the only basin physically detained in the detention gallery.

Intensity and Precipitation Table

	10-yr	10-yr	100-yr	100-yr	500-yr	500-yr
Storm	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall
Duration	Total	Total	Total	Total	Total	Total
(min.)	(in/hr)	(in.)	(in/hr)	(in.)	(in/hr)	(in.)
15	2.480	0.62	5.040	1.260	8.160	2.04
30	1.670	0.84	3.400	1.700	5.500	2.75
60	1.030	1.03	2.100	2.100	3.400	3.40
360	0.265	1.69	0.430	2.580	0.638	3.83
720	0.168	2.02	0.264	3.170	0.359	4.31
1440	0.105	2.52	0.151	3.620	0.187	4.48

*From NOAA Atlas 14 (Upper Bound 90% Confidence Interval)

Rational Method Runoff Estimation: Q=CiA

Q(peak) =   4.26 cfs
C=   0.35 (run-off coefficient from Park City Drainage Design Manual)
I =   5.040 in/hr (Intensity From NOAA Atlas 14 upper 90% confidence interval for Storm Duration = Tc)
A =   2.42 acres
Tc =   15 min (select closest {15,30, 60, 360, 720, 1440} min from Tc Calc below)

	C	Intensity (in/hr)	Area (Acres)	Q(peak) (cfs)	Pre-Detention Runoff (cu.ft)	Storage Required (cu.ft)[1]	Post-Detention Runoff (cu.ft)[2]
100-year	0.35	5.040	2.42	4.26	3869	2130	1739

[1] Storage Required is calcuated in the "Detention-Match-Predev-rev.xls" spreadsheet

[2] Post-Detention Runoff Volume = Pre-Detention Runoff - Storage Volume. Post detention-runoff must be >0 cu.ft.

Q difference (Post - Pre) (cfs) =   2.01   (from "Detention-Match-Predev-rev.xls" spreadsheet)
Qout, Detention Discharge Rate (cfs) =   **2.25**   (to be released from detention)

Orifice Size: Max. Orifice Head (H, ft.) =   **5** ft.   Qall = CA (2gH)^0.5   Solving for "A"
                    Orifice Coefficient (C) =   **0.6**   **A =**   0.2093 s.f. =   **30.14** sq. in.
                    Orifice Diameter (in.) =   **6.19**   (H is preliminary)

NOAA Atlas 14, Volume 1, Version 5
Location name: Park City, Utah, US*
Latitude: 40.6360°, Longitude: -111.4982°
Elevation: 7407 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

Duration	PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]									
	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.130 (0.115–0.152)	0.165 (0.146–0.192)	0.226 (0.198–0.263)	0.282 (0.245–0.329)	0.373 (0.314–0.437)	0.458 (0.374–0.541)	0.557 (0.440–0.667)	0.675 (0.511–0.822)	0.865 (0.620–1.08)	1.04 (0.710–1.33)
10-min	0.198 (0.175–0.231)	0.252 (0.222–0.292)	0.344 (0.302–0.400)	0.429 (0.372–0.500)	0.568 (0.477–0.666)	0.697 (0.570–0.824)	0.849 (0.669–1.02)	1.03 (0.777–1.25)	1.32 (0.943–1.65)	1.58 (1.08–2.03)
15-min	0.246 (0.217–0.286)	0.312 (0.275–0.362)	0.427 (0.374–0.496)	0.532 (0.461–0.620)	0.704 (0.592–0.825)	0.864 (0.706–1.02)	1.05 (0.830–1.26)	1.27 (0.964–1.55)	1.63 (1.17–2.04)	1.96 (1.34–2.52)
30-min	0.332 (0.292–0.386)	0.421 (0.370–0.488)	0.575 (0.504–0.668)	0.717 (0.621–0.835)	0.947 (0.797–1.11)	1.16 (0.951–1.38)	1.42 (1.12–1.70)	1.71 (1.30–2.09)	2.20 (1.58–2.75)	2.64 (1.81–3.39)
60-min	0.410 (0.361–0.477)	0.521 (0.458–0.604)	0.712 (0.624–0.827)	0.888 (0.769–1.03)	1.17 (0.986–1.38)	1.44 (1.18–1.70)	1.75 (1.38–2.10)	2.12 (1.61–2.59)	2.72 (1.95–3.40)	3.27 (2.23–4.19)
2-hr	0.525 (0.471–0.596)	0.651 (0.584–0.740)	0.852 (0.758–0.969)	1.04 (0.914–1.19)	1.35 (1.15–1.55)	1.63 (1.36–1.89)	1.97 (1.59–2.32)	2.38 (1.84–2.86)	3.03 (2.21–3.75)	3.63 (2.53–4.61)
3-hr	0.613 (0.556–0.687)	0.757 (0.688–0.847)	0.958 (0.862–1.07)	1.15 (1.03–1.28)	1.45 (1.26–1.63)	1.71 (1.46–1.95)	2.03 (1.68–2.35)	2.41 (1.93–2.88)	3.05 (2.33–3.79)	3.65 (2.66–4.65)
6-hr	0.831 (0.766–0.911)	1.02 (0.939–1.12)	1.24 (1.14–1.37)	1.45 (1.32–1.59)	1.75 (1.57–1.93)	2.00 (1.76–2.23)	2.28 (1.97–2.58)	2.61 (2.20–2.99)	3.19 (2.61–3.83)	3.72 (2.95–4.70)
12-hr	1.08 (0.994–1.18)	1.32 (1.22–1.45)	1.60 (1.47–1.75)	1.84 (1.68–2.02)	2.20 (1.98–2.43)	2.49 (2.21–2.77)	2.81 (2.45–3.17)	3.16 (2.69–3.62)	3.67 (3.04–4.31)	4.11 (3.32–4.93)
24-hr	1.38 (1.27–1.49)	1.69 (1.56–1.84)	2.04 (1.88–2.21)	2.32 (2.13–2.52)	2.71 (2.48–2.94)	3.02 (2.75–3.28)	3.34 (3.02–3.62)	3.66 (3.30–3.98)	4.10 (3.66–4.48)	4.44 (3.94–4.98)
2-day	1.65 (1.53–1.79)	2.04 (1.88–2.21)	2.45 (2.26–2.66)	2.79 (2.57–3.03)	3.26 (2.99–3.54)	3.63 (3.31–3.95)	4.00 (3.64–4.36)	4.39 (3.96–4.79)	4.90 (4.38–5.38)	5.30 (4.70–5.84)
3-day	1.86 (1.71–2.02)	2.29 (2.11–2.49)	2.76 (2.54–3.00)	3.15 (2.89–3.43)	3.69 (3.38–4.02)	4.12 (3.75–4.49)	4.55 (4.13–4.98)	5.00 (4.50–5.48)	5.61 (5.00–6.18)	6.08 (5.37–6.73)
4-day	2.06 (1.90–2.24)	2.53 (2.33–2.76)	3.06 (2.82–3.34)	3.51 (3.21–3.82)	4.12 (3.76–4.50)	4.60 (4.18–5.03)	5.11 (4.61–5.60)	5.62 (5.05–6.18)	6.32 (5.61–6.98)	6.86 (6.04–7.62)
7-day	2.52 (2.31–2.76)	3.10 (2.84–3.40)	3.74 (3.42–4.10)	4.27 (3.90–4.68)	5.00 (4.55–5.49)	5.57 (5.04–6.13)	6.16 (5.55–6.79)	6.76 (6.04–7.47)	7.57 (6.71–8.42)	8.20 (7.20–9.16)
10-day	2.89 (2.66–3.16)	3.56 (3.27–3.89)	4.28 (3.92–4.66)	4.85 (4.43–5.29)	5.61 (5.11–6.12)	6.18 (5.62–6.76)	6.77 (6.12–7.41)	7.34 (6.61–8.06)	8.09 (7.23–8.93)	8.67 (7.69–9.61)
20-day	3.85 (3.53–4.18)	4.74 (4.35–5.15)	5.63 (5.18–6.12)	6.33 (5.81–6.88)	7.23 (6.63–7.86)	7.88 (7.21–8.58)	8.53 (7.77–9.29)	9.15 (8.31–10.0)	9.93 (8.97–10.9)	10.5 (9.44–11.5)
30-day	4.70 (4.34–5.07)	5.76 (5.33–6.23)	6.82 (6.30–7.36)	7.65 (7.04–8.26)	8.71 (8.00–9.41)	9.49 (8.68–10.3)	10.2 (9.35–11.1)	11.0 (9.99–11.9)	11.9 (10.8–13.0)	12.6 (11.3–13.7)
45-day	5.84 (5.41–6.32)	7.16 (6.62–7.76)	8.46 (7.81–9.16)	9.47 (8.73–10.3)	10.8 (9.91–11.7)	11.7 (10.7–12.7)	12.7 (11.6–13.8)	13.6 (12.3–14.8)	14.7 (13.3–16.1)	15.5 (14.0–17.0)
60-day	6.97 (6.45–7.52)	8.56 (7.93–9.25)	10.1 (9.34–10.9)	11.3 (10.4–12.2)	12.7 (11.7–13.8)	13.8 (12.7–14.9)	14.8 (13.6–16.1)	15.8 (14.4–17.1)	17.0 (15.5–18.5)	17.9 (16.2–19.5)

[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

NOAA Atlas 14, Volume 1, Version 5
Location name: Park City, Utah, US*
Latitude: 40.6360°, Longitude: -111.4982°
Elevation: 7407 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

Duration	Average recurrence interval (years)

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	1.56 (1.38–1.82)	1.98 (1.75–2.30)	2.71 (2.38–3.16)	3.38 (2.94–3.95)	4.48 (3.77–5.24)	5.50 (4.49–6.49)	6.68 (5.28–8.00)	8.10 (6.13–9.86)	10.4 (7.44–13.0)	12.5 (8.52–16.0)
10-min	1.19 (1.05–1.39)	1.51 (1.33–1.75)	2.06 (1.81–2.40)	2.57 (2.23–3.00)	3.41 (2.86–4.00)	4.18 (3.42–4.94)	5.09 (4.01–6.10)	6.16 (4.66–7.51)	7.90 (5.66–9.88)	9.50 (6.49–12.2)
15-min	0.984 (0.868–1.14)	1.25 (1.10–1.45)	1.71 (1.50–1.98)	2.13 (1.84–2.48)	2.82 (2.37–3.30)	3.46 (2.82–4.09)	4.21 (3.32–5.04)	5.09 (3.86–6.20)	6.53 (4.68–8.16)	7.85 (5.36–10.1)
30-min	0.664 (0.584–0.772)	0.842 (0.740–0.976)	1.15 (1.01–1.34)	1.43 (1.24–1.67)	1.89 (1.59–2.22)	2.33 (1.90–2.75)	2.83 (2.23–3.39)	3.43 (2.60–4.18)	4.40 (3.15–5.50)	5.29 (3.61–6.78)
60-min	0.410 (0.361–0.477)	0.521 (0.458–0.604)	0.712 (0.624–0.827)	0.888 (0.769–1.03)	1.17 (0.986–1.38)	1.44 (1.18–1.70)	1.75 (1.38–2.10)	2.12 (1.61–2.59)	2.72 (1.95–3.40)	3.27 (2.23–4.19)
2-hr	0.262 (0.236–0.298)	0.326 (0.292–0.370)	0.426 (0.379–0.484)	0.520 (0.457–0.593)	0.675 (0.577–0.774)	0.816 (0.680–0.945)	0.986 (0.794–1.16)	1.19 (0.918–1.43)	1.52 (1.11–1.87)	1.82 (1.26–2.30)
3-hr	0.204 (0.185–0.229)	0.252 (0.229–0.282)	0.319 (0.287–0.357)	0.381 (0.341–0.428)	0.481 (0.420–0.542)	0.570 (0.486–0.649)	0.677 (0.560–0.783)	0.802 (0.642–0.960)	1.02 (0.775–1.26)	1.22 (0.886–1.55)
6-hr	0.139 (0.128–0.152)	0.171 (0.157–0.187)	0.208 (0.191–0.229)	0.242 (0.220–0.266)	0.292 (0.262–0.323)	0.333 (0.294–0.372)	0.381 (0.330–0.430)	0.435 (0.368–0.498)	0.533 (0.436–0.639)	0.621 (0.493–0.785)
12-hr	0.089 (0.083–0.098)	0.109 (0.101–0.120)	0.132 (0.122–0.145)	0.153 (0.140–0.167)	0.182 (0.164–0.201)	0.207 (0.184–0.230)	0.233 (0.203–0.263)	0.262 (0.223–0.300)	0.305 (0.252–0.358)	0.341 (0.275–0.409)
24-hr	0.058 (0.053–0.062)	0.071 (0.065–0.077)	0.085 (0.078–0.092)	0.097 (0.089–0.105)	0.113 (0.103–0.123)	0.126 (0.115–0.137)	0.139 (0.126–0.151)	0.153 (0.138–0.166)	0.171 (0.153–0.186)	0.185 (0.164–0.208)
2-day	0.034 (0.032–0.037)	0.042 (0.039–0.046)	0.051 (0.047–0.055)	0.058 (0.054–0.063)	0.068 (0.062–0.074)	0.076 (0.069–0.082)	0.083 (0.076–0.091)	0.091 (0.083–0.100)	0.102 (0.091–0.112)	0.110 (0.098–0.122)
3-day	0.026 (0.024–0.028)	0.032 (0.029–0.035)	0.038 (0.035–0.042)	0.044 (0.040–0.048)	0.051 (0.047–0.056)	0.057 (0.052–0.062)	0.063 (0.057–0.069)	0.069 (0.063–0.076)	0.078 (0.069–0.086)	0.084 (0.075–0.093)
4-day	0.021 (0.020–0.023)	0.026 (0.024–0.029)	0.032 (0.029–0.035)	0.037 (0.033–0.040)	0.043 (0.039–0.047)	0.048 (0.044–0.052)	0.053 (0.048–0.058)	0.059 (0.053–0.064)	0.066 (0.058–0.073)	0.072 (0.063–0.079)
7-day	0.015 (0.014–0.016)	0.018 (0.017–0.020)	0.022 (0.020–0.024)	0.025 (0.023–0.028)	0.030 (0.027–0.033)	0.033 (0.030–0.036)	0.037 (0.033–0.040)	0.040 (0.036–0.044)	0.045 (0.040–0.050)	0.049 (0.043–0.055)
10-day	0.012 (0.011–0.013)	0.015 (0.014–0.016)	0.018 (0.016–0.019)	0.020 (0.018–0.022)	0.023 (0.021–0.026)	0.026 (0.023–0.028)	0.028 (0.025–0.031)	0.031 (0.028–0.034)	0.034 (0.030–0.037)	0.036 (0.032–0.040)
20-day	0.008 (0.007–0.009)	0.010 (0.009–0.011)	0.012 (0.011–0.013)	0.013 (0.012–0.014)	0.015 (0.014–0.016)	0.016 (0.015–0.018)	0.018 (0.016–0.019)	0.019 (0.017–0.021)	0.021 (0.019–0.023)	0.022 (0.020–0.024)
30-day	0.007 (0.006–0.007)	0.008 (0.007–0.009)	0.009 (0.009–0.010)	0.011 (0.010–0.011)	0.012 (0.011–0.013)	0.013 (0.012–0.014)	0.014 (0.013–0.015)	0.015 (0.014–0.017)	0.017 (0.015–0.018)	0.017 (0.016–0.019)
45-day	0.005 (0.005–0.006)	0.007 (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 (0.011–0.014)	0.014 (0.012–0.015)	0.014 (0.013–0.016)
60-day	0.005 (0.004–0.005)	0.006 (0.006–0.006)	0.007 (0.006–0.008)	0.008 (0.007–0.008)	0.009 (0.008–0.010)	0.010 (0.009–0.010)	0.010 (0.009–0.011)	0.011 (0.010–0.012)	0.012 (0.011–0.013)	0.012 (0.011–0.014)

[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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