Analysis of Floods and Debris Flow Hazards Following Short Duration, High Intensity Rainfall Events on Las Conchas and Track Fire Burn Scar Areas during Summer 2011, Northern New Mexico

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USGS science for a changing world

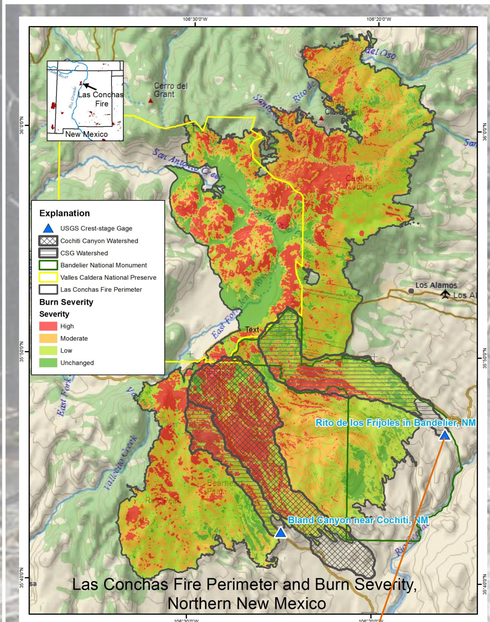
Las Conchas Fire

Fire Stats

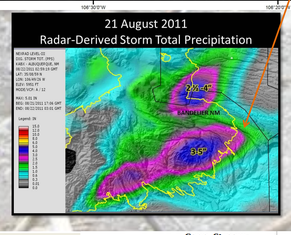
Date Started:	June 26, 2011
Date Contained:	Aug. 1, 2011
Cause:	Human
Size:	156,593 acres
Residences:	63 destroyed
Outbuildings:	49 destroyed;

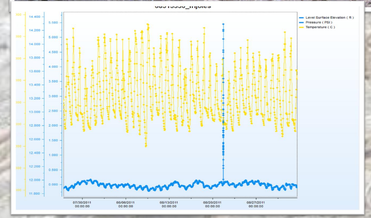
Flood Stats

Watershed (Canyon):	Frijoles	Bland	Cochiti
Date of Storm:	Aug. 21	Aug 22	Aug 22
Max precip intensity:	3"/hour	2.5"/hour	2.5"/hour
Radar-derived storm total:	2-3"	3-4"	3-4"
Watershed Area:	18.4 mi²	7.5mi²	29.1mi²
Percent watershed burned:	92%	96%	84%
COMPUTED FLOOD FLOW	7,000ft³/s	undetermined	undetermined



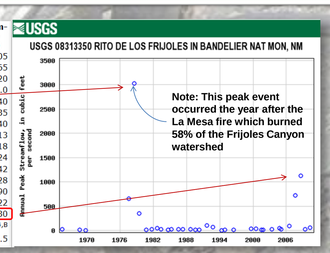
Las Conchas Fire Perimeter and Burn Severity, Northern New Mexico

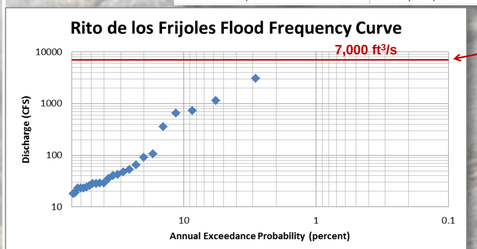




Peak Flow file for crest-stage gage on Rito de los Frijoles in Frijoles Canyon.

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1965	Jun. 18, 1965	1.49	19.0
1968	Aug. 11, 1968	0.95	8.80
1969	Sep. 12, 1969	0.65	4.60
1977	Jul. 05, 1977	5.02	653[E]
1978	Jul. 21, 1978	6.34	3,030
1979	Jun. 03, 1979	3.81	354
1980	Aug. 27, 1980	2.31	12.0
1981	Sep. 05, 1981	2.67	28.0
1982	Sep. 16, 1982	2.93	47.0
1983	May 04, 1983	2.56	23.0
1984	Aug. 20, 1984	2.26	9.00
1985	Mar. 12, 1985	2.68	29.0
1986	Jun. 27, 1986	2.56	23.0
1987	Apr. 19, 1987	2.67	29.0
1988	Sep. 10, 1988	2.56	23.0
1989	Aug. 09, 1989	2.46	18.0
1990	Mar. 23, 1990	2.15	8.00
1991	Aug. 19, 1991	4.15	105
1992	Sep. 15, 1992	3.44	65
1994	May 03, 1994	2.05	6.20
1995	Nov. 12, 1994	2.29	13.0
1996	Jun. 29, 1996	2.19	9.40
1999	Aug. 10, 1999	2.77	35
2000	Jun. 28, 2000	2.66	40
2001	Jul. 02, 2001	2.29	13
2002	Nov. 05, 2001	2.39	18
2003	May 26, 2003	2.47	24
2004	Sep. 26, 2004	2.53	42
2005	Feb. 12, 2005	3.82	28
2006	Jul. 29, 2006	3.21	90
2007	Aug. 29, 2007	4.68	722
2008	Aug. 04, 2008	5.12	1,130
2009	2009	2.57[4]	25.9[4,B]
2010	Apr. 17, 2010	2.89	53.5





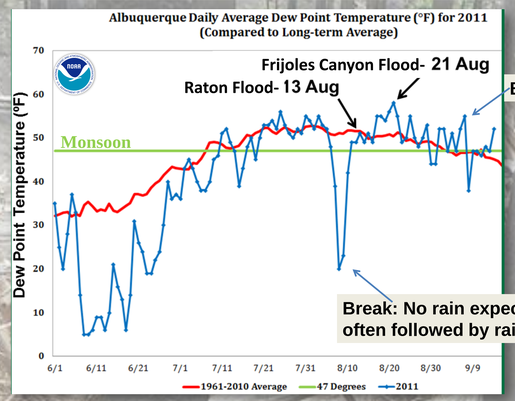
The flood of August 21 is the largest flood on record at this site and it has a corresponding low annual exceedance probability.

INTRODUCTION

During the summer of 2011, wildfires burned nearly 500,000 acres of forested lands in the State of New Mexico. Two of the fires in northern New Mexico included the Las Conchas wildfire, the largest in the state's history and the Track Fire, which burned much of the Raton Creek watershed, upstream of the City of Raton. Following the Las Conchas and Track Fires, several high volume (low frequency) floods occurred in and downstream of burn scar areas as the result of intense but otherwise typical summer monsoonal rainstorm events. Personnel from the U. S. Geological Survey (USGS) and National Weather Service (NWS) visited significantly impacted portions of both burn areas, and collected data to support numerical modeling (slope-area computations) and documentation of high volume floods downstream of burn scar areas.

Monsoon "Bursts" & "Breaks" are often forecast days in advance

NWS knows when heavy rains are coming but can't predict where they will occur.



STORMS

Partial Duration Series (PDS)-based precipitation frequency estimates (as shown below) indicate that the storms that contributed to these floods are relatively rare. However, it is important to realize that these frequency estimates are point based (rain gage) and not derived from radar based precipitation estimates. They predict the probability of a high intensity storm occurring at a specific point on the ground and not the probability of a storm with this intensity occurring somewhere in northern New Mexico. Storms of this intensity are not unusual, they occur every summer in the mountainous regions of northern New Mexico.

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
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PDS-based 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	0.214 (0.186–0.247)	0.278 (0.241–0.321)	0.371 (0.321–0.428)	0.441 (0.381–0.509)	0.538 (0.462–0.620)	0.611 (0.523–0.704)	0.689 (0.586–0.793)	0.769 (0.651–0.887)	0.879 (0.735–1.02)	0.967 (0.802–1.12)
10-min	0.326 (0.283–0.376)	0.423 (0.367–0.488)	0.564 (0.488–0.652)	0.672 (0.580–0.774)	0.819 (0.704–0.944)	0.930 (0.797–1.07)	1.05 (0.892–1.21)	1.17 (0.990–1.35)	1.34 (1.12–1.55)	1.47 (1.22–1.71)
15-min	0.404 (0.350–0.466)	0.524 (0.455–0.605)	0.700 (0.605–0.808)	0.833 (0.719–0.961)	1.02 (0.872–1.17)	1.15 (0.987–1.33)	1.30 (1.11–1.50)	1.45 (1.23–1.67)	1.66 (1.39–1.92)	1.83 (1.51–2.12)
30-min	0.544 (0.472–0.628)	0.705 (0.612–0.816)	0.942 (0.815–1.09)	1.12 (0.969–1.29)	1.37 (1.18–1.58)	1.55 (1.33–1.79)	1.75 (1.49–2.02)	1.96 (1.65–2.25)	2.23 (1.87–2.58)	2.46 (2.04–2.86)
60-min	0.673 (0.584–0.777)	0.873 (0.758–1.01)	1.17 (1.01–1.35)	1.39 (1.20–1.60)	1.69 (1.45–1.95)	1.92 (1.65–2.22)	2.17 (1.84–2.50)	2.42 (2.05–2.79)	2.76 (2.31–3.19)	3.04 (2.52–3.53)
[illegible]	0.792	1.02	1.34	1.60	1.95	2.23	2.53	2.85	3.28	3.63

Background photo by Stephen Monroe, NPS

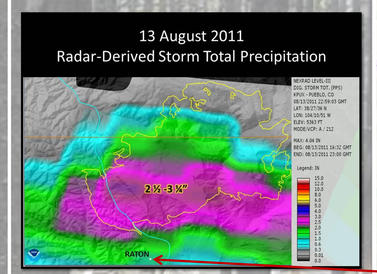
Track Fire

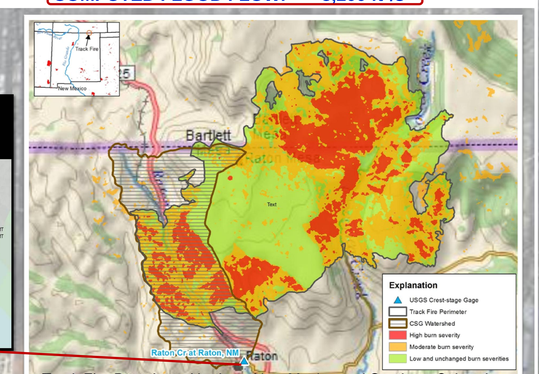
Fire Stats

Date Started:	June 27, 2011
Date Contained:	June 29, 2011
Cause:	Human
Size:	27,792 acres

Flood Stats

Date of Storm:	Aug. 13
Max precip intensity:	3"/hour
Radar-derived storm total:	2-4 inches
Watershed Area:	15.1 mi²
Percent of watershed burned:	57%
COMPUTED FLOOD FLOW:	5,200 ft³/s

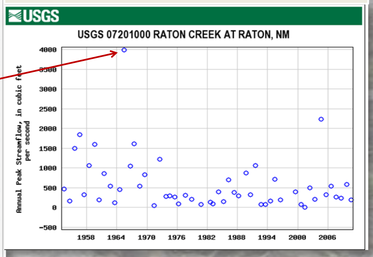


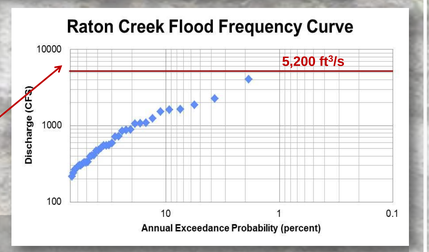


Track Fire Burn Area, Northern New Mexico and Southern Colorado

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1953	Jul. 11, 1953	2.88	470
1954	Aug. 06, 1954	1.32	165
1955	Aug. 19, 1955	5.82	1,500
1956	Aug. 19, 1956	6.50	1,850
1957	Jul. 09, 1957	2.25	330
1958	Jun. 06, 1958	5.00	1,060
1959	Aug. 07, 1959	6.09	1,600
1960	Jul. 07, 1960	1.54	200
1961	Jul. 07, 1961	4.24	860
1962	Sep. 28, 1962	2.10	548
1963	Aug. 04, 1963	1.07	116
1964	Aug. 09, 1964	1.88	462
1965	Jun. 17, 1965	14.80	3,990
1966	Aug. 21, 1966	3.54	1,050
1967	Jun. 17, 1967	5.15	1,610
1968	Aug. 10, 1968	2.08	540
1969	Jul. 17, 1969	2.88	837
1971	May 29, 1971	0.55	52.0
1972	Aug. 04, 1972	4.05	1,220
1973	Sep. 27, 1973	1.41	283
1974	Aug. 1974	1.45	297[B]
1975	Jul. 08, 1975	1.38	273
1976	Apr. 30, 1976	0.75	88.0
1977	Aug. 17, 1977	1.49	312
1979	Nov. 04, 1978	1.19	212
1980	Sep. 15, 1980	0.74	86.0
1982	Aug. 16, 1982	0.93	134
1983	Feb. 20, 1983	0.76	91.0
1984	Apr. 1984	1.72	404[B]
1985	Mar. 10, 1985	1.00	152
1986	Apr. 03, 1986	2.51	705
1987	May 03, 1987	1.68	388
1988	Mar. 12, 1988	1.45	297
1989	Sep. 05, 1989	3.01	878
1990	Aug. 23, 1990	1.52	323
1991	Aug. 11, 1991	3.60	1,070
1992	Aug. 24, 1992	0.74	86.0
1993	Jul. 15, 1993	0.73	84.0
1994	Aug. 10, 1994	1.04	163
1995	May 29, 1995	2.48	710
1996	Jul. 27, 1996	1.16	201
1999	Jul. 06, 1999	1.71	400
2000	Aug. 18, 2000	0.68	74
2001	2001		0.0[B]
2002	Jun. 14, 2002	1.98	500
2003	2003	1.17[4]	205[4,B]
2004	Aug. 06, 2004	6.78	2,240
2005	Aug. 11, 2005	1.52	323
2006	Aug. 18, 2006	2.09	544
2007	Aug. 22, 2007	1.35	262
2008	Aug. 07, 2008	1.27	236
2009	Sep. 12, 2009	2.18	581
2010	Jul. 31, 2010	1.13	191

Peak Flow file for crest-stage gage on Raton Creek in the City of Raton, New Mexico





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REFERENCES

Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfie debris flow hazard assessment for the area burned by the 2011 Track Fire, northeastern New Mexico and southeastern Colorado: U.S. Geological survey Open-file Report 2011-1257, 9p.

Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfire preliminary debris flow hazard assessment for the area burned by the 2011 Las Conchas Fire in north-central New Mexico: U.S. Geological Survey Open-File Report 2011–1308, 11 p.