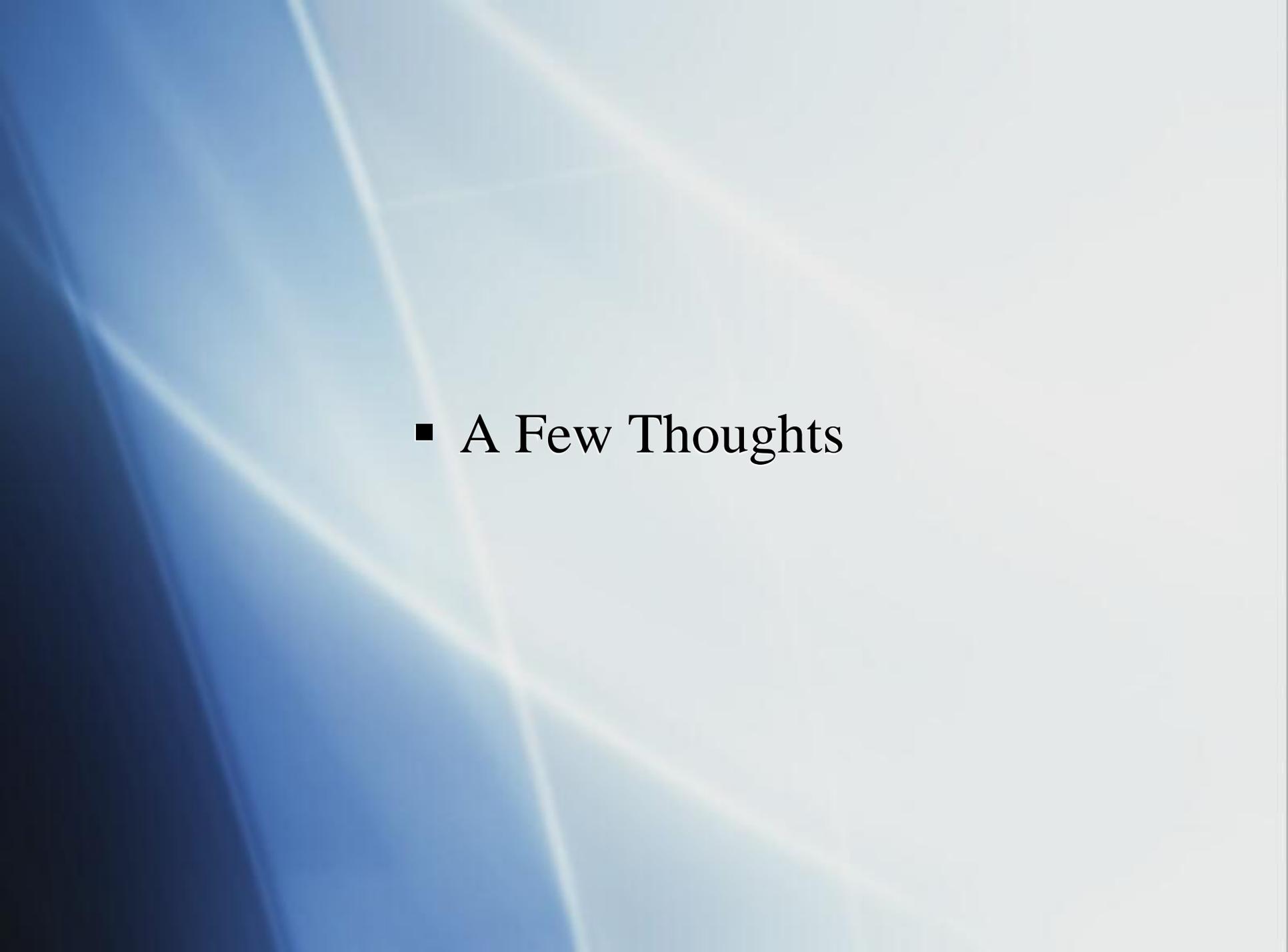


Brian McInerney
Hydrologist
National Weather Service

CBRFC Flash Flood Call
July 24th, 2012



- A Few Thoughts

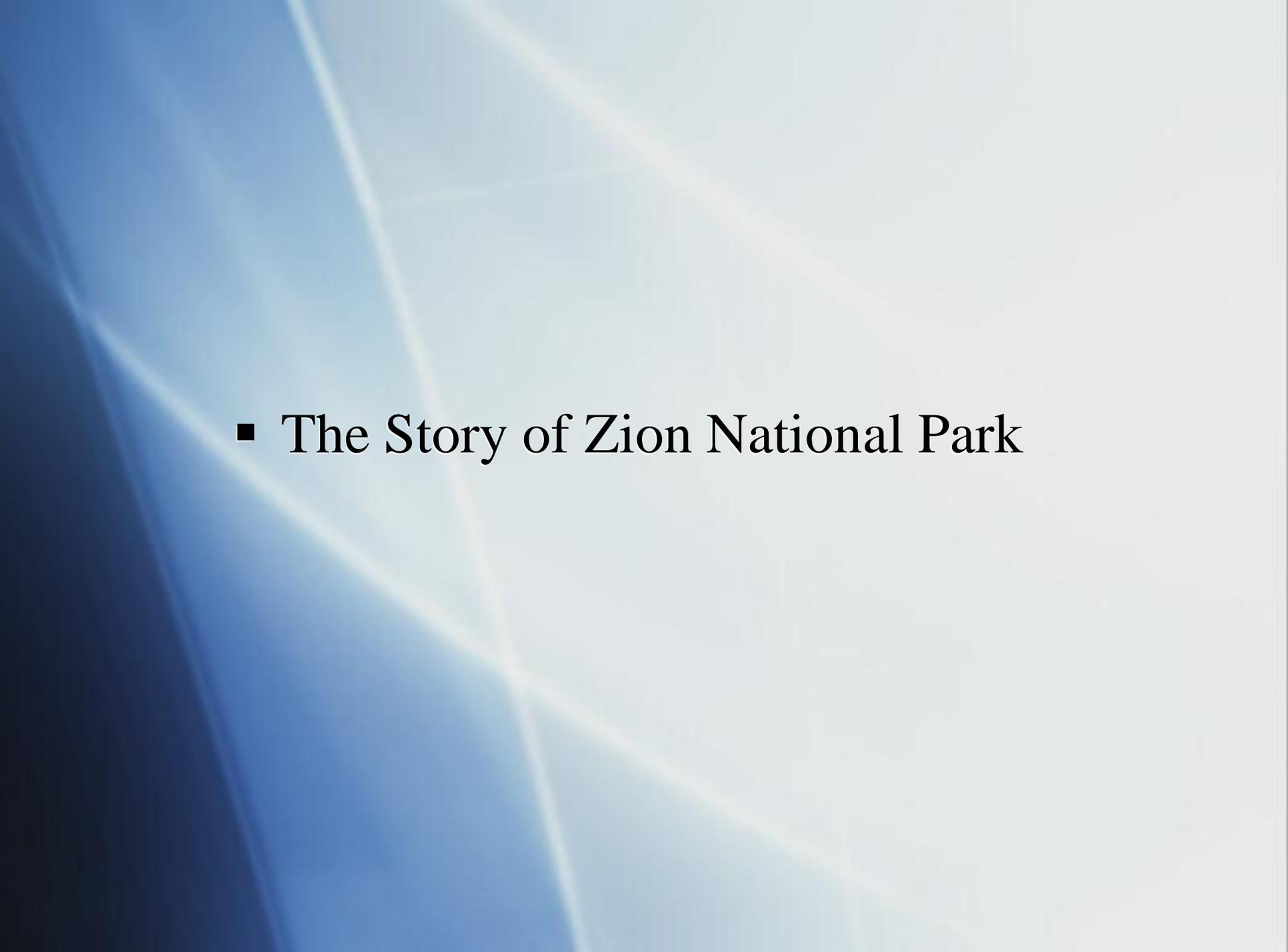
- Who Are My Customers?

- Do They Know Who I Am?

- Do I Know What They Want?

- **Have I Asked What They Want?**

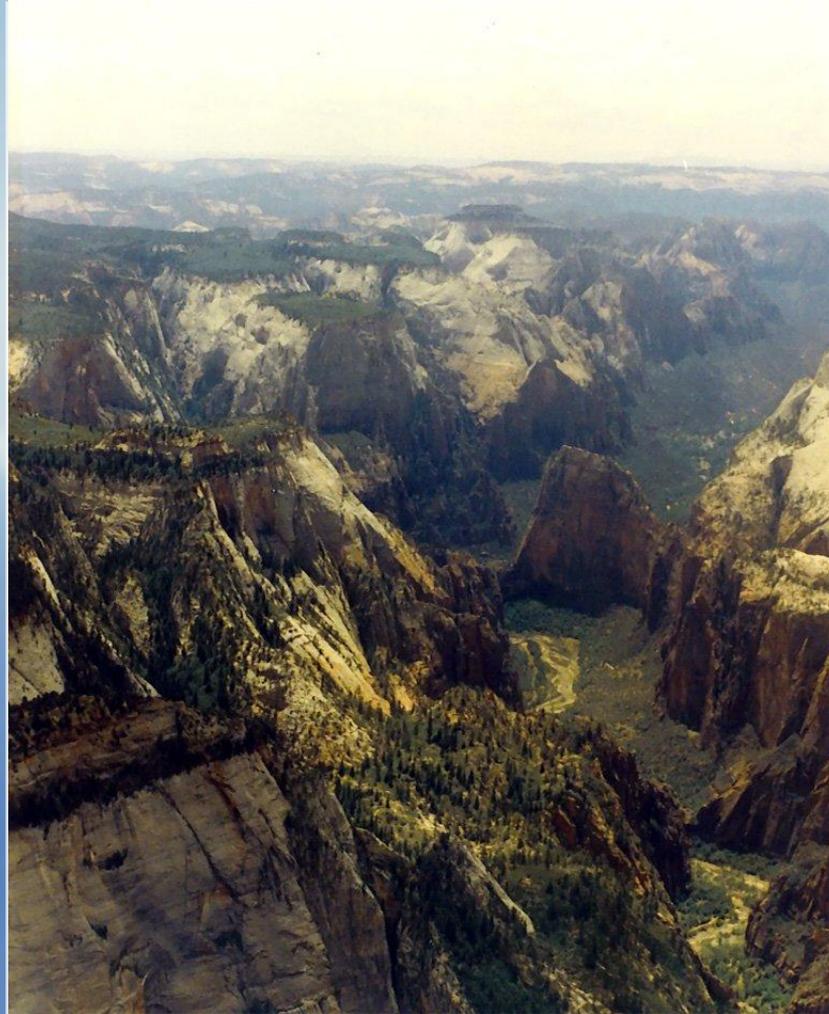
- Am I Providing It To Them?



- The Story of Zion National Park

Forming a Relationship

Zion National Park



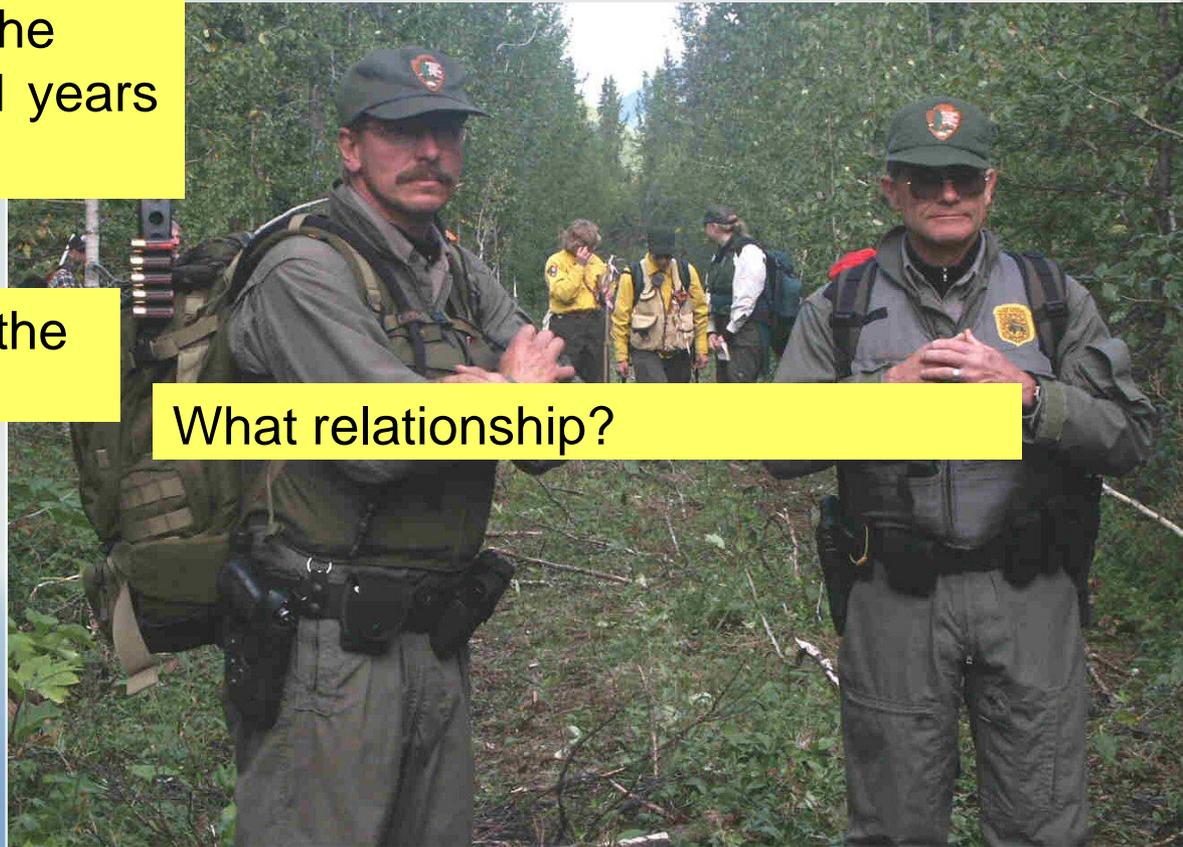
Forming a Relationship

Zion National Park

I assumed responsibility of the flash flood program about 11 years prior

I then went to Zion to talk with the Rangers on our relationship

What relationship?



Forming a Relationship

Zion National Park

After talking with them for a bit, I came right out and asked about the job we were doing

I found out we didn't understand each other



Forming a Relationship

Zion National Park

The breakthrough came when I asked a simple question

What would you like from us?



Forming a Relationship

Zion National Park

After that visit, all sorts of good things happened

In every instance, we could provide exactly what they wanted

We just never asked!



Forming a Relationship

Zion National Park

When I call, they know who I am



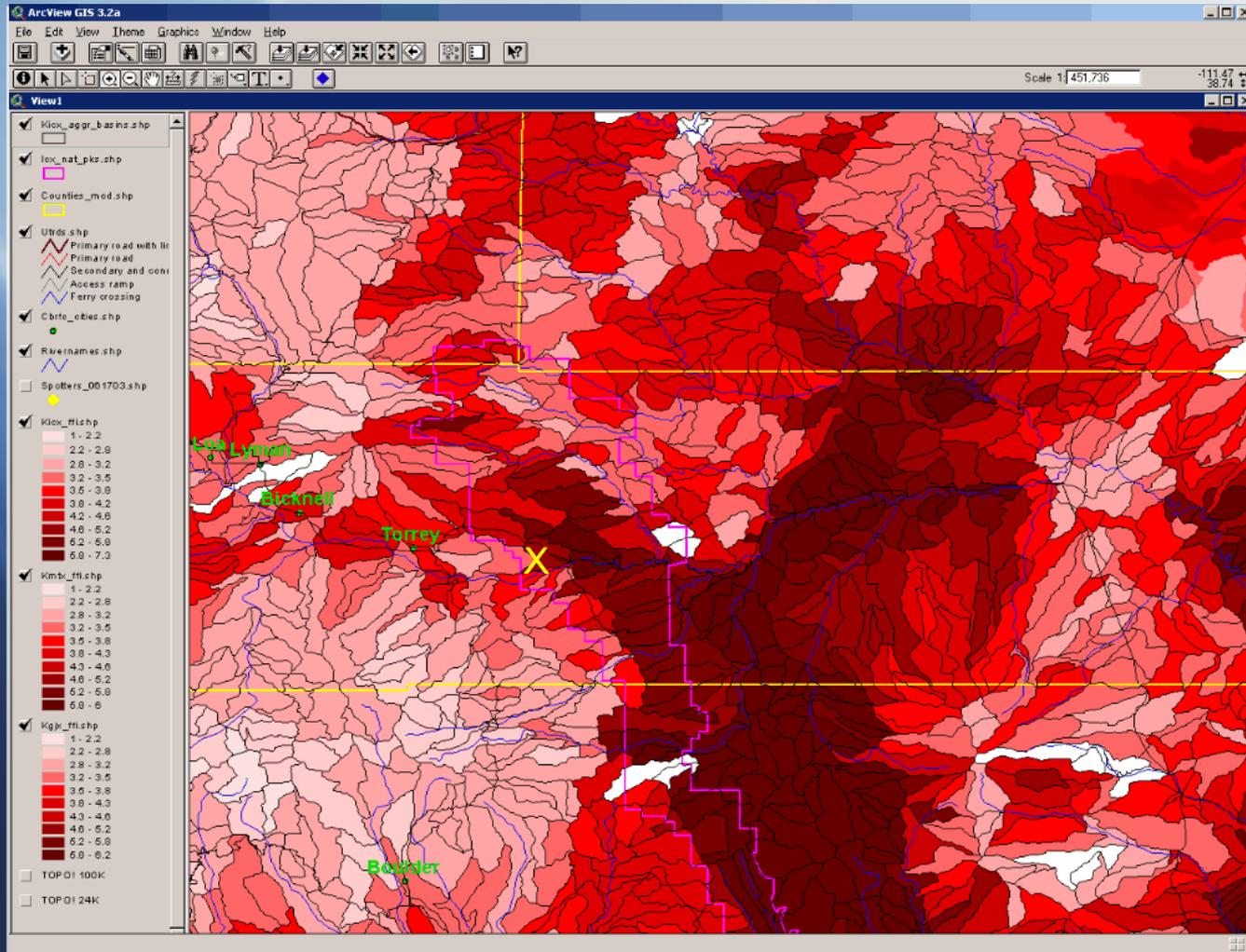
They now trust our judgement

Flash Flood Potential Product

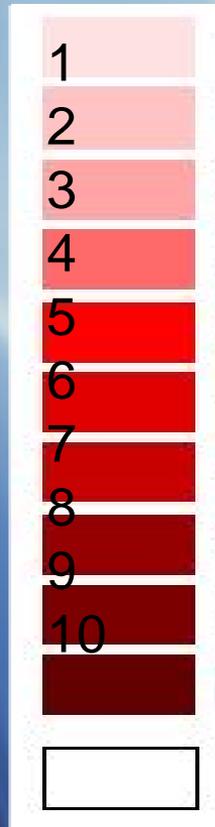
Flash Flood Potential Product

- Currently we look at the atmospheric conditions to produce the flash flood potential product
- What if we were to integrate the geography of the area with the atmospheric conditions to obtain the potential for flash flooding?
- How would we come up with the new product?

Flash Flood Potential Index



Flash Flood Potential Index



Flash flood potential is a relative scale with regard to the rainfall runoff relationship

The scale is essentially higher potential shown as a darker shade of red and a lower potential with a lighter shade

PopulateFFP_new: How it works

Dry

POP < 15* *or* PWAT < 0.87 in

Low

POP ≥ 15* *and* PWAT ≥ 0.87 in

Moderate

POP ≥ 25 *and*:
1) PWAT ≥ 1 in *or*
2) PWAT > 0.87 in *and* 700-500 wind < 20 kt

High

POP ≥ 35 *and*:
1) PWAT ≥ 1.5 in *or*
2) PWAT > 1.25 in *and* 700-500 wind < 20 kt

Very High

POP ≥ 65 *and*: PWAT ≥ 1.75 in

* user-selectable value

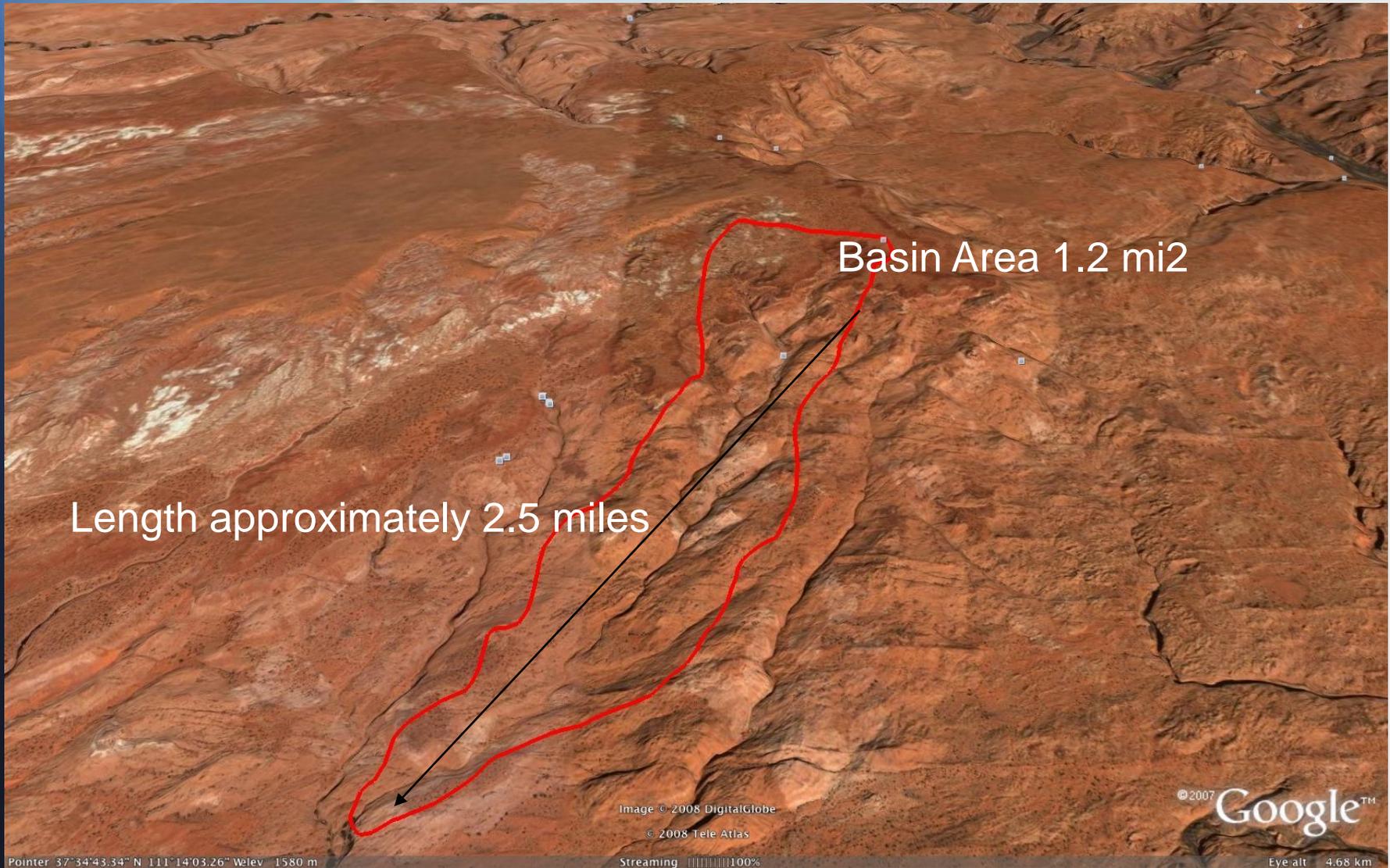
Populate_BasinFFP Matrix

FFP -->>		Dry	Low	Mod	High	Very High
CBFFPI	>= 6.7	Dry	Mod	High	High	Very High
	6.1 - 6.6	Dry	Low	Mod	High	Very High
	5.4 - 6.0	Dry	Low	Mod	High	Very High
	4.8 - 5.3	Dry	Low	Mod	High	Very High
	4.2 - 4.7	Dry	Low	Low	High	High
	3.6 - 4.1	Dry	Low	Low	Mod	High
	2.9 - 3.5	Dry	Low	Low	Mod	High
	2.3 - 2.8	Dry	Low	Low	Mod	High
	1.7 - 2.2	Dry	Low	Low	Mod	Mod
	1.0 - 1.6	Dry	Low	Low	Low	Mod

Low → Moderate and Moderate → High only for POP ≥

Egypt3

Egypt 3 Slot Canyon

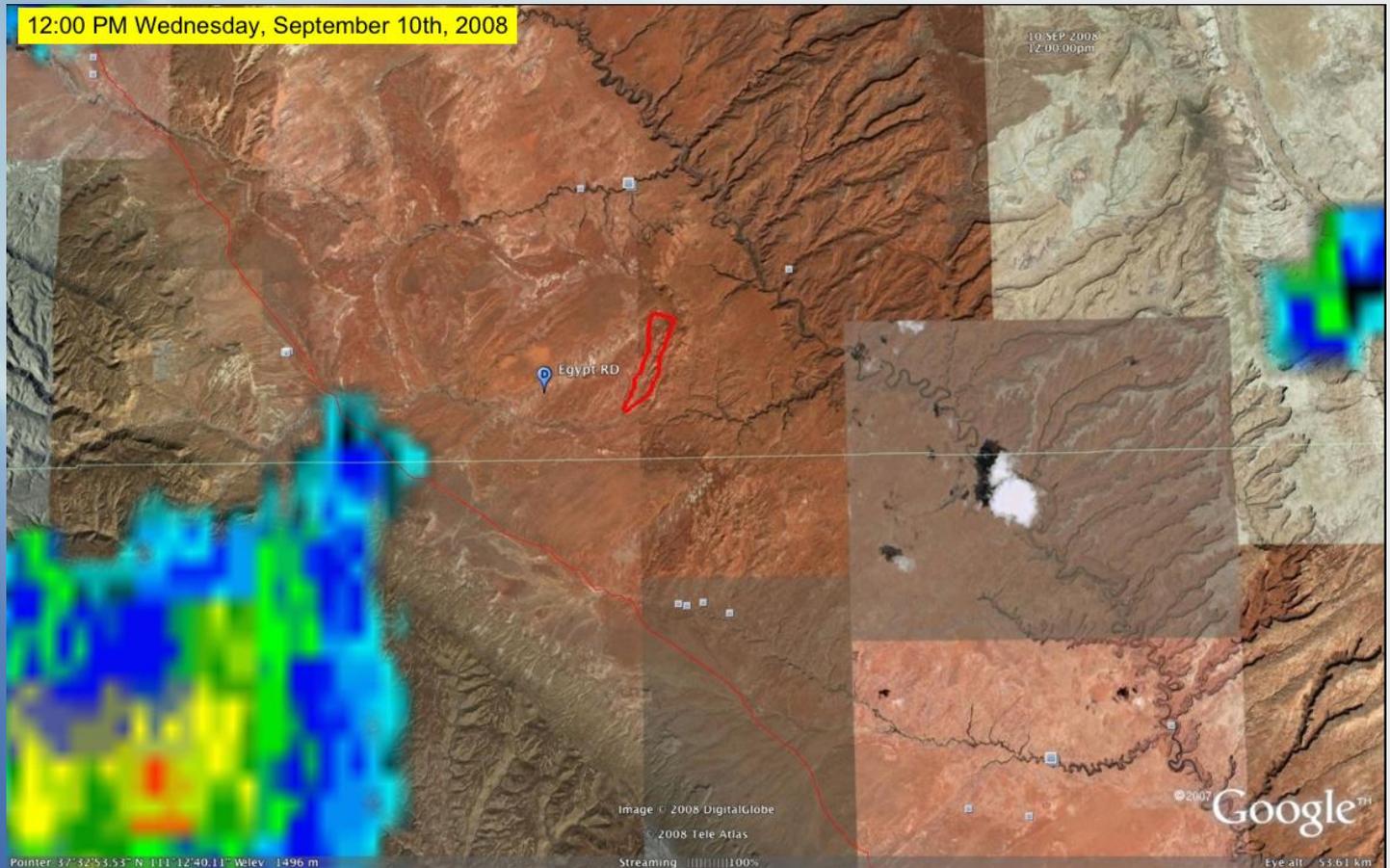
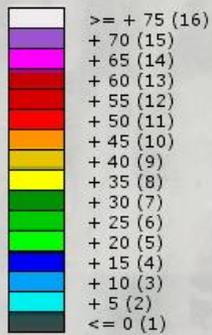


Radar Rainfall Reflectivity Loop

NEXRAD LEVEL-II
KICX - CEDAR CITY, UT
09/10/2008 18:00:54 GMT
LAT: 37/35/27 N
LON: 112/51/43 W
ELEV: 10600 FT
VCP: 11

REFLECTIVITY
ELEV ANGLE: 0.54

Legend: dBZ (Category)



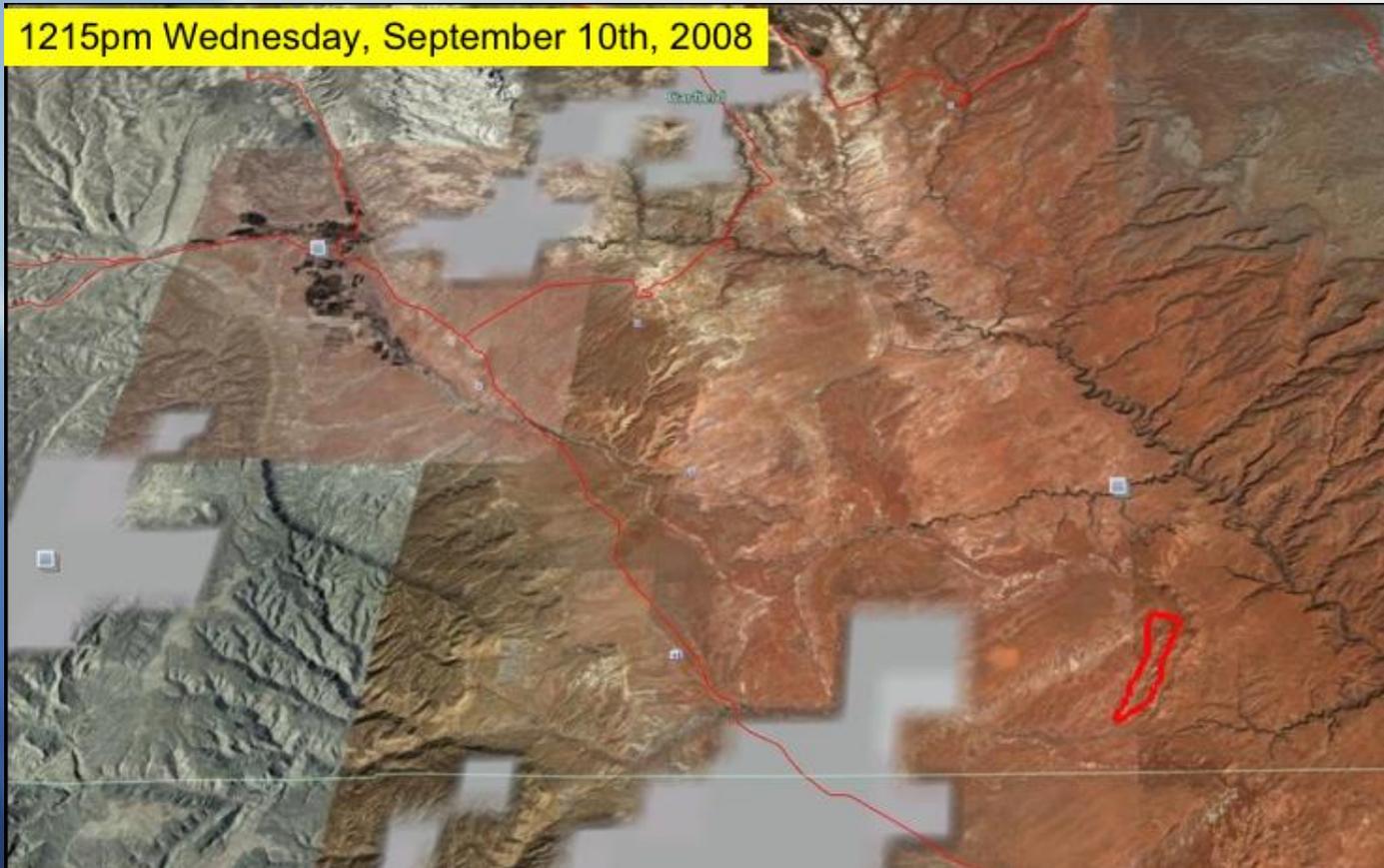
Storm Total Precipitation Loop

NEXRAD LEVEL-III
STORM TOTAL PRECIP
KICX - CEDAR CITY, UT
09/10/2008 18:00:52 GMT
LAT: 37/35/27 N
LON: 112/51/43 W
ELEV: 10756 FT
MODE/VCP: A / 11

MAX: 0.50 IN
BEG: 09/10/2008 16:43
END: 09/10/2008 18:02

Legend: IN (Category)

7.0	(15)
6.0	(14)
5.0	(13)
4.0	(12)
3.5	(11)
3.0	(10)
2.5	(9)
2.0	(8)
1.5	(7)
1.0	(6)
0.7	(5)
0.5	(4)
0.3	(3)
0.1	(2)
0.0	(1)



Egypt 3 Slot Canyon

One Hour Frequency Estimate

Precipitation Frequency Data Server

9/16/08 2:50 PM



POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14



Utah 37.585833 N 111.220556 W 5475 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Tue Sep 16 2008

[Confidence Limits](#)
[Seasonality](#)
[Location Maps](#)
[Other Info.](#)
[GIS data](#)
[Maps](#)
[Docs](#)
[U.S. Map](#)

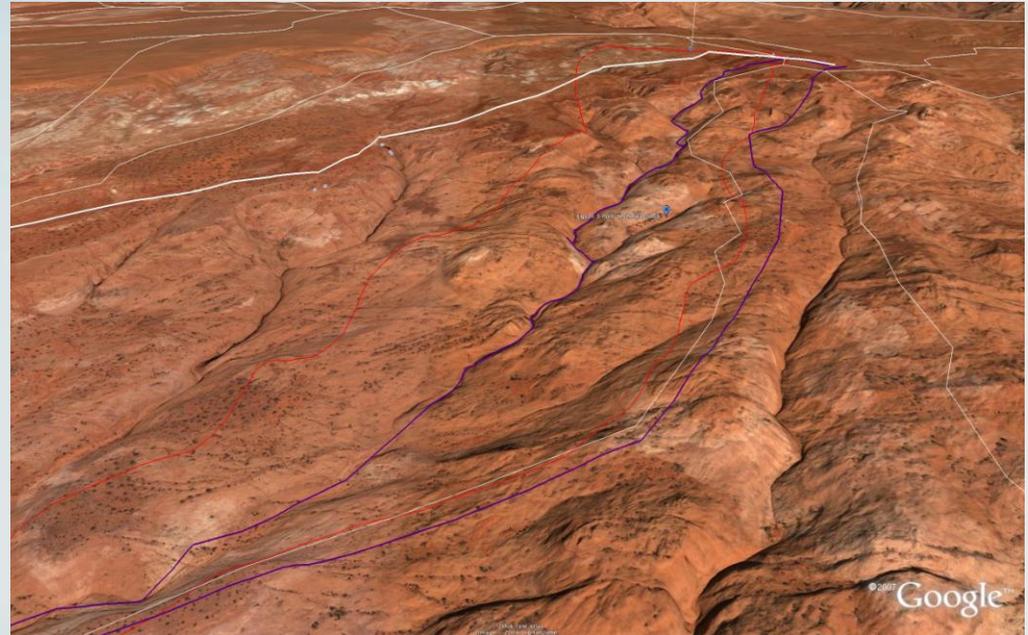
Precipitation Frequency Estimates (inches)																		
ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.11	0.17	0.21	0.29	0.36	0.43	0.48	0.60	0.74	0.90	1.00	1.14	1.31	1.46	1.82	2.20	2.60	2.97
2	0.15	0.22	0.28	0.37	0.46	0.55	0.61	0.75	0.92	1.14	1.26	1.44	1.66	1.85	2.32	2.79	3.29	3.77
5	0.20	0.31	0.39	0.52	0.65	0.74	0.81	0.95	1.16	1.47	1.63	1.85	2.14	2.40	3.01	3.56	4.22	4.82
10	0.26	0.39	0.49	0.66	0.81	0.92	0.98	1.13	1.35	1.74	1.94	2.19	2.54	2.85	3.55	4.17	4.94	5.63
25	0.34	0.52	0.65	0.87	1.08	1.21	1.26	1.40	1.63	2.13	2.38	2.69	3.10	3.48	4.31	5.00	5.92	6.75
50	0.42	0.64	0.79	1.07	1.32	1.48	1.51	1.62	1.85	2.44	2.74	3.08	3.55	3.98	4.90	5.63	6.68	7.60
100	0.51	0.78	0.96	1.30	1.61	1.80	1.83	1.90	2.09	2.77	3.14	3.51	4.03	4.52	5.53	6.29	7.46	8.48
200	0.62	0.94	1.17	1.57	1.94	2.19	2.20	2.26	2.40	3.11	3.56	3.97						
500	0.79	1.20	1.49	2.01	2.48	2.81	2.82	2.88	2.94	3.60	4.16	4.62						
1000	0.95	1.44	1.78	2.40	2.98	3.38	3.39	3.44	3.49	3.99	4.66	5.15						

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the [documentation](#) for more information. NOTE: Formatting forces estimates near zero to appear as zero.

0.30 inches of rainfall in 1 hour occurs statistically at least once a year over this area.

Egypt3 Peak Flow Estimate

- Drainage area: 1.2 mi²
- Rainfall Estimate: 0.30"/hr
- Land Surface:
 - Impervious Navajo Sandstone
 - Absence of Vegetation
 - Steep slot canyon
- Time of Concentration or water to flow from top of slot canyon to outlet was calculated to be approximately 30 minutes
- Time to Peak, which is the time from the beginning of rainfall to the time of peak discharge was estimated to be 24 minutes
- Peak Discharge was estimated to be approximately 450 cfs.
- With channel dimensions as they are, it is probable that depth of flood exceeded 20 ft.
- Actual calculations and analysis methods are available

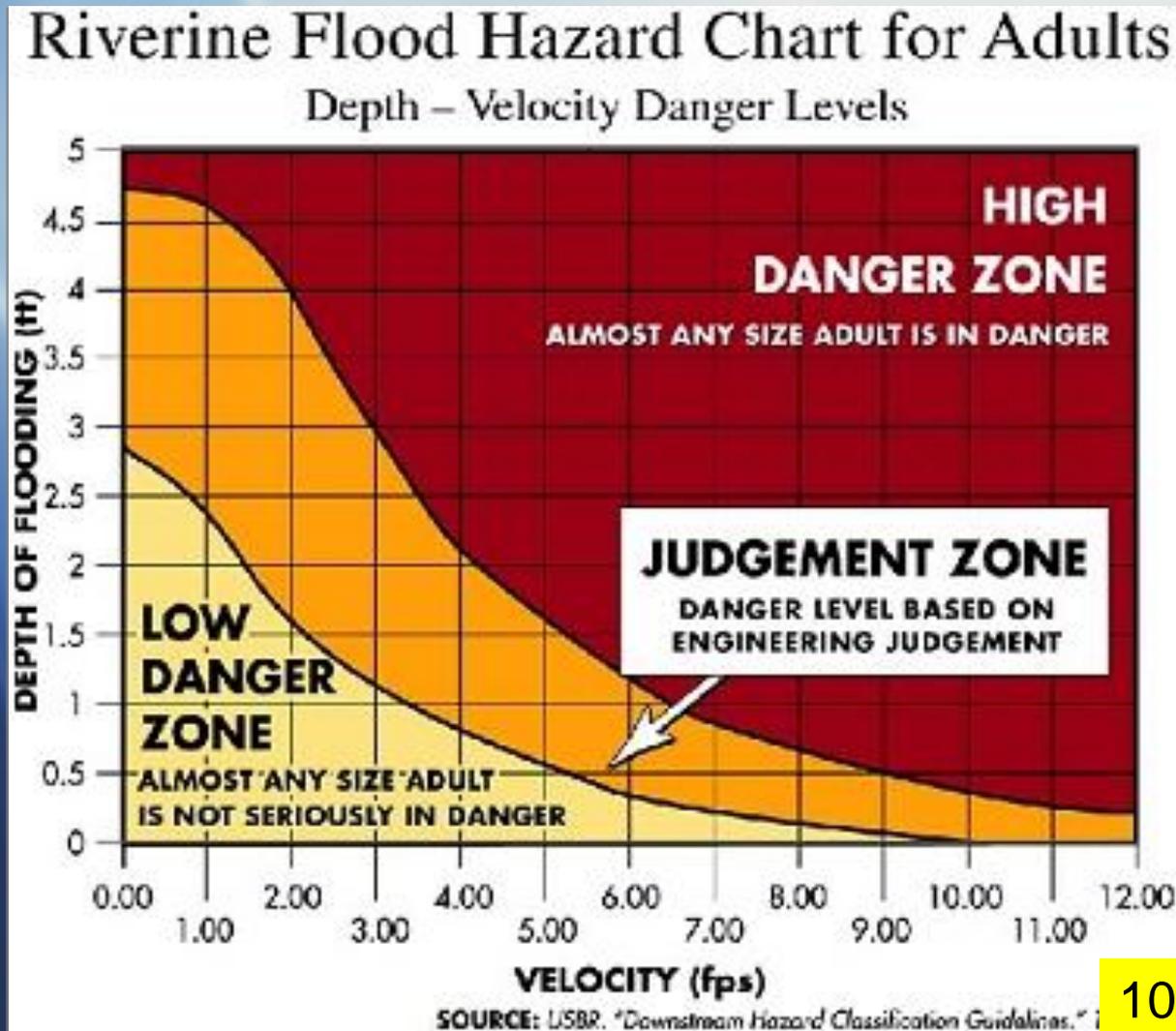


How Much Does a Flash Flood Weigh?

- Largest Elephant = 24,000 lbs
- Flow
- 1 cu ft. = 7.4805 gallons
- 1 cu ft. = 62.42 lbs
- 1000 cu ft./sec = 62,420 lbs/sec
- 1000 cfs = 2.6 Large Elephants rolling by each second



Venturing Into a Flash Flood

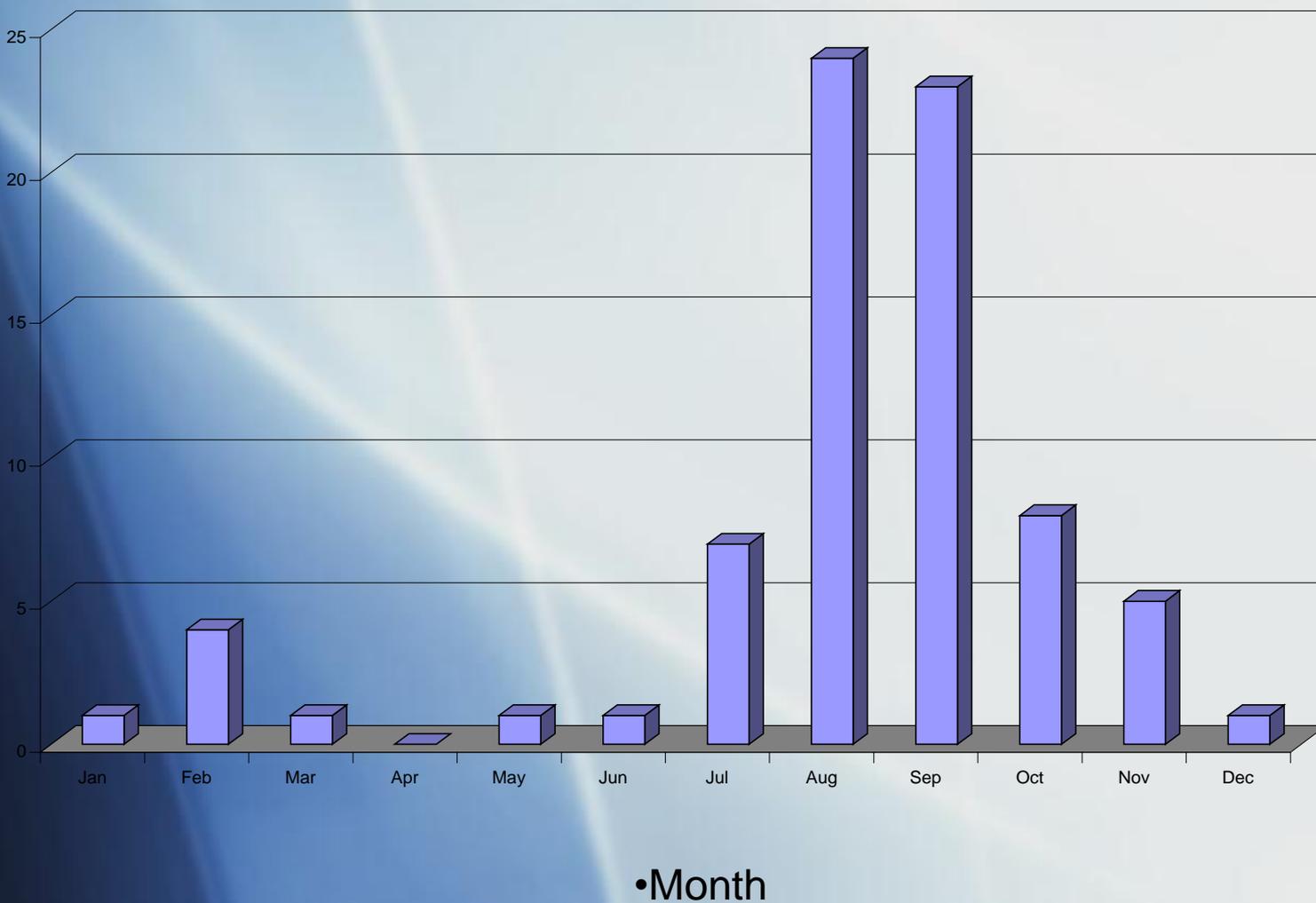




Paria River near Lees Ferry Climatology

Number of events exceeding river flows of 700 cfs

1924 through 2004



Salt Lake City WFO use of the FFPI

FFMP

Storm Detected → Precipitation Intensity Quantified → Precipitation Volume Quantified → Warning?

FFPI

Where is the Rainfall Occuring → Reference the FFPI → Terrestrial Response?

Issue Flash Flood Warning

Wait a Volume Scan or Two

National Weather Service Forecast Office
Salt Lake City, UT

HOME NEWS ORGANIZATION

Search NWS ALL NOAA Go

Watches, Warnings, Advisories



Current Flash Flood Warnings

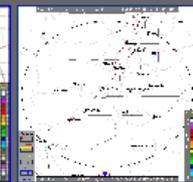
No Flash Flood Warnings Currently in Effect

Flash Flood Potential:	Today	Tomorrow
Arches Natl Park	Low	Low
Bryce Canyon Natl Park	Low	Low
Capitol Reef Natl Park	Low	Low
Canyonlands Natl Park	Low	Low
Glen Canyon Rec Area	Low	Low
Grand Staircase/Escalante	Low	Low
San Rafael Swell	Low	Low
Zion Natl Park	Low	Low

Cedar City Radar



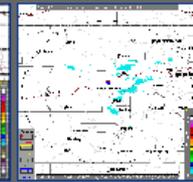
Cedar City Precip



Grand Jct Radar



Grand Jct Precip



Local Links - NWS Salt Lake City

Additional Weather Info

Hazardous Weather Outlook	Recent Local Storm Reports	Visible Satellite Image	Regional Radar Display
Area Forecast Discussion	Severe Weather/Flash Flood Safety	Infrared Satellite Image	Local River Flood Information

Webmaster

US Dept of Commerce
 National Oceanic and Atmospheric Administration
 National Weather Service
 Salt Lake City Weather Forecast Office
 2242 West North Temple
 Salt Lake City, Utah 84116

Tel: (801) 524-5133

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Google Earth Flash Flood Climatology

Fly to e.g., 1600 Pennsylvania Ave, 2001

40.5436, -110.3294

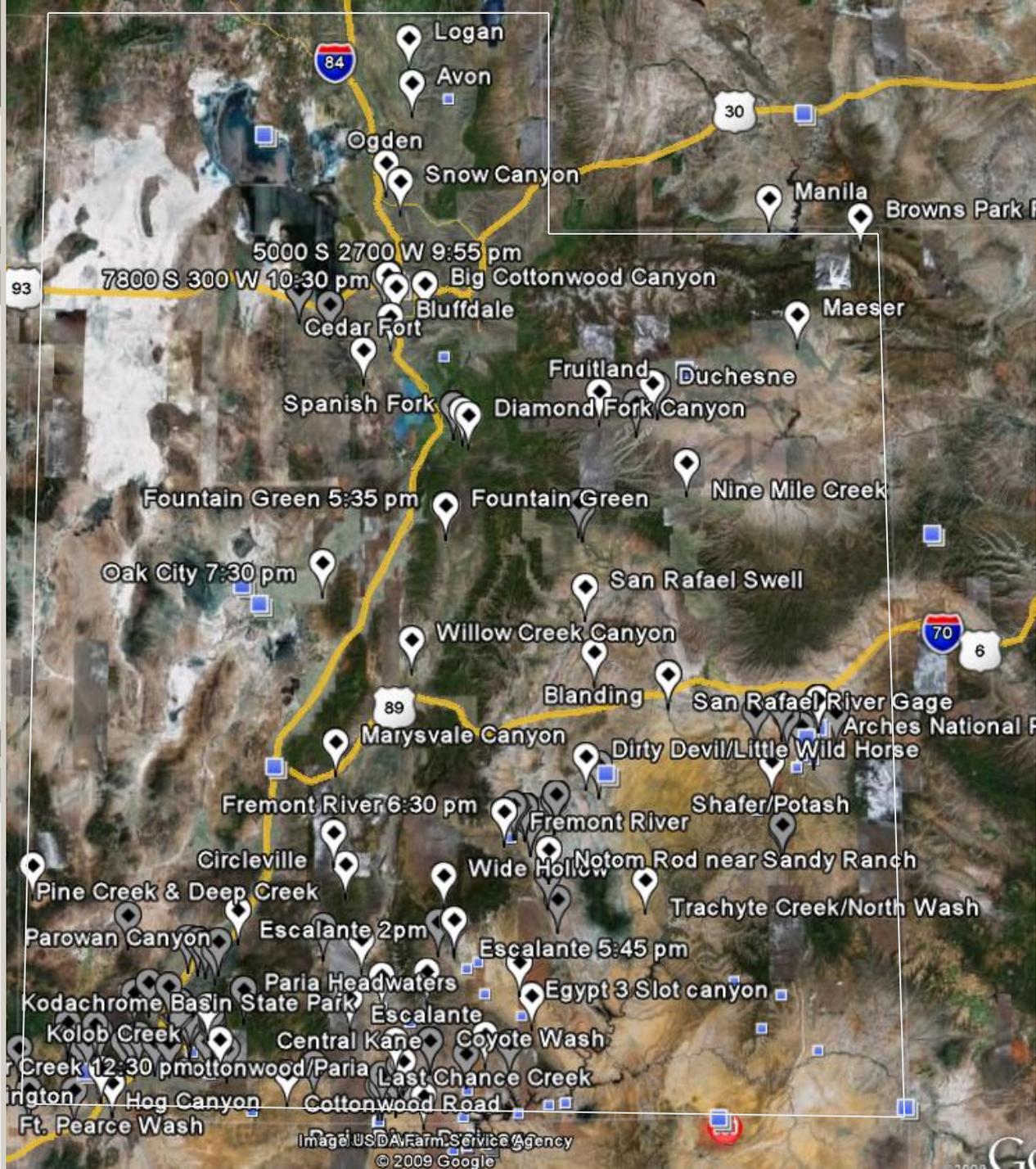
- yellowstone raws
- Yellowstone poderosa RX

Places Add Content

- My Places
- Temporary Places
- SLC_FF_Events.kmz
 - FF SA Display
 - All Events
 - 2005 Events
 - 2006 Events
 - 2007 Events
 - 2008 Events
 - 2009 Events
 - September
 - [Paria River gage](#)
Date:9/14/2009
Links: [click to load](#)
 - Regional Radar/Warnings

Layers

- Primary Database
- Geographic Web
- Roads
- 3D Buildings
- Street View
- Borders and Labels
- Traffic
- Weather
- Gallery
- Ocean
- Global Awareness
- Places of Interest
- More
- Terrain



Fly to e.g., 1600 Pennsylvania Ave, 2000

40.5436, -110.3294



- yellowstone raws
- Yellowstone ponderosa RX



Places

Add Content

- Paria_sep14_modified1.kmz
 - Paria 2009
 - [Paria River gage](#)
 - Date: 9/14/2009
 - Time: 6:00 pm
 - Locations
 - Cottonwood Canyo...
 - Paria River
 - Paria River Drainage
 - Buckskin Gulch
 - Buckskin Gulch
 - Radar data
 - Reflectivity
 - One hour precip
 - Storm total precip
 - Paria_sep14_modified.kmz
 - Paria_sep14_new.kmz
 - Paria_final.kmz

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Paria River gage

Date: 9/14/2009

Time: 6:00 pm

Description: Large flash flood along the Paria spiked the Paria gage near Kanab to over 7000cfs. Numerous thunderstorms across the state, with precipitable water values across the south near an inch.

Links: [event hydrograph](#)

[event photographs](#)

[event summary](#)

[real time river data](#)

Directions: [To here](#) [From here](#)

Paria River gage

Paria River gage

Buckskin Gulch

Paria River

Buckskin Gulch

Search

Fly To Find Businesses Directions

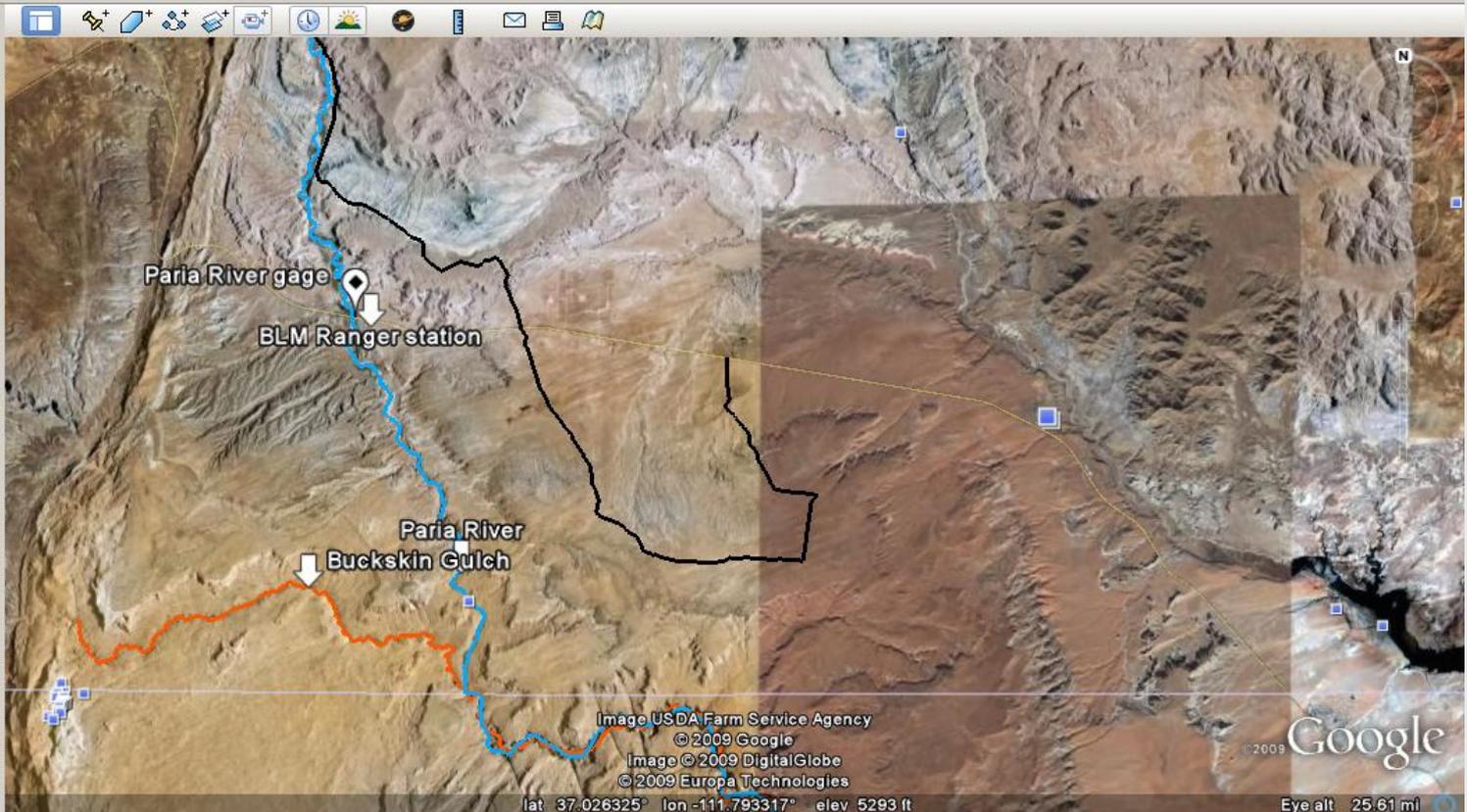
Fly to e.g., 1600 Pennsylvania Ave, 2001

40.5436, -110.3294

yellowstone raws
Yellowstone ponderosa RX

Places Add Content

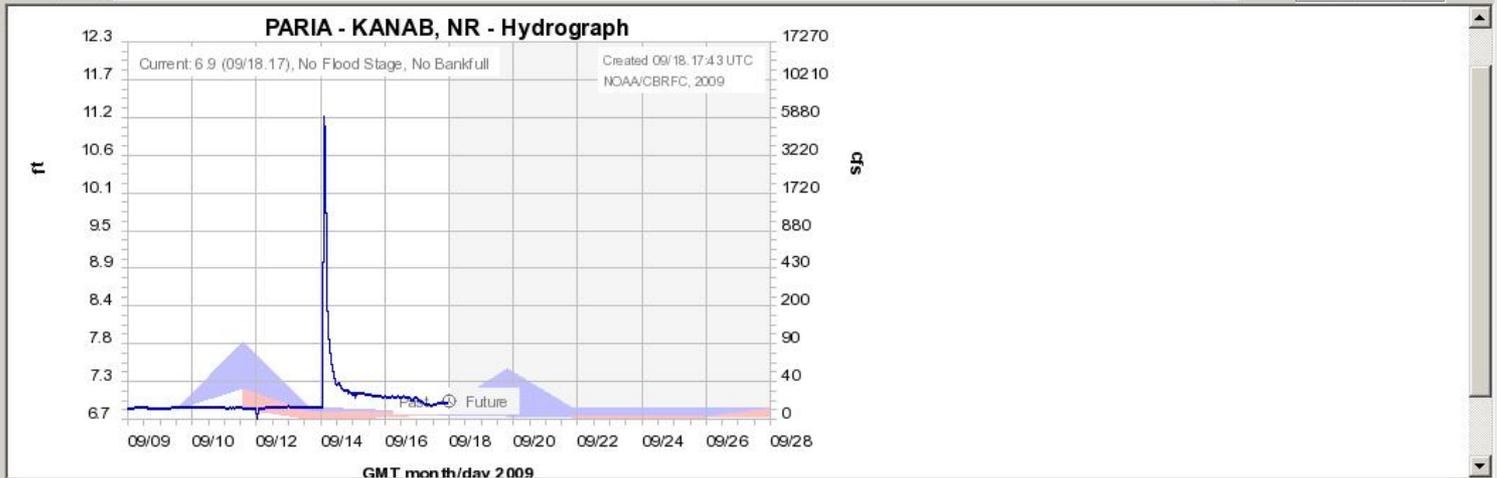
- Paria River gage
 - Date: 9/14/2009
 - Time: 6:00 pm
- Locations
 - BLM Ranger station
 - Cottonwood Canyon ...
 - Paria River
 - Paria River Drainage
 - Buckskin Gulch
 - Buckskin Gulch
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 - Reflectivity
 - One hour precip
 - Storm total precip
- birdseye
- FF SA Display
- 2008 radar
- 2007



http://ww2.slc.noaa.gov/Saltlake/projects/ff_events/2009/September/Paria/pariahydrograph.jpg

Layers

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Search

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Fly to e.g., 1600 Pennsylvania Ave, 2000

40.5436, -110.3294

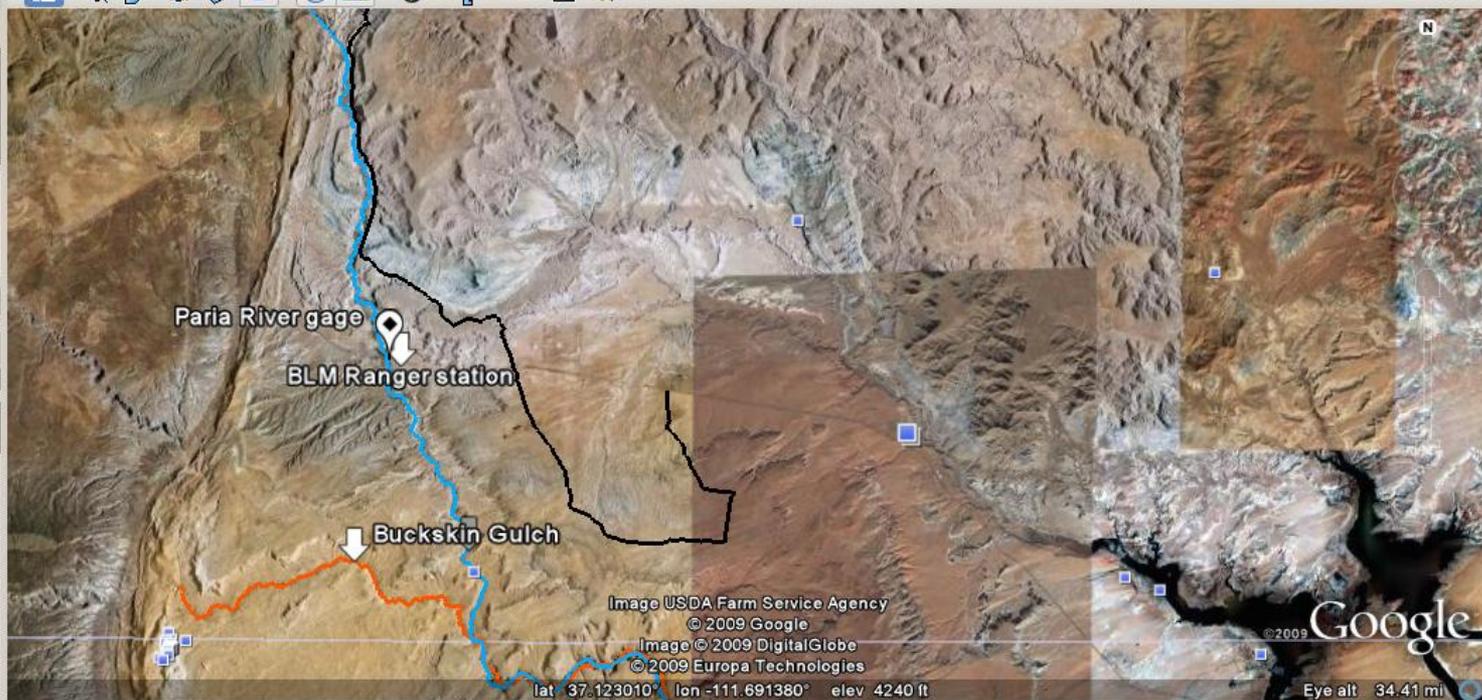
yellowstone raws
Yellowstone poderosa RX

Places Add Content

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http://ww2.slc.noaa.gov/Saltlake/projects/ff_events/2009/September/Paria/paria.html

The Paria river is typically more of a trickle, as evidenced in the photos below:



September 14th Paria flood pictures

Sep 14, 2009 12:34 pm

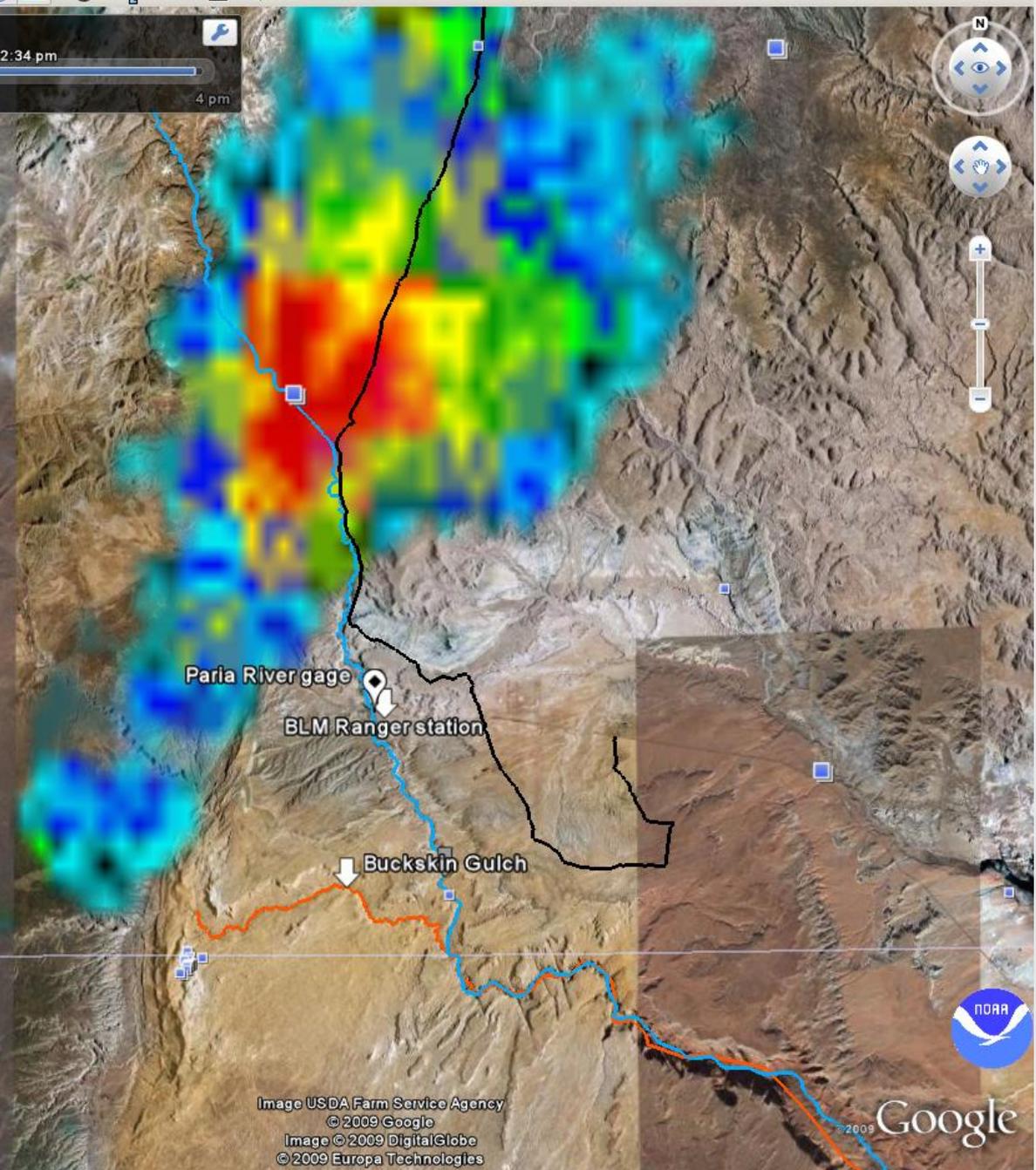
11 am 4 pm

NEXRAD LEVEL-II
KICX - CEDAR CITY, UT
09/14/2009 19:30:02 GMT
LAT: 37/35/27 N
LON: 112/51/43 W
ELEV: 10600 FT
VCP: 12

REFLECTIVITY
ELEV ANGLE: 0.53

Legend: dBZ (Category)

>= + 75 (16)
+ 70 (15)
+ 65 (14)
+ 60 (13)
+ 55 (12)
+ 50 (11)
+ 45 (10)
+ 40 (9)
+ 35 (8)
+ 30 (7)
+ 25 (6)
+ 20 (5)
+ 15 (4)
+ 10 (3)
+ 5 (2)
<= 0 (1)



Sep 14, 2009 1:12 pm

Navigation controls including a compass, zoom in (+) and zoom out (-) buttons, and a home button.

NEXRAD LEVEL-II
 KICX - CEDAR CITY, UT
 09/14/2009 20:08:23 GMT
 LAT: 37/35/27 N
 LON: 112/51/43 W
 ELEV: 10600 FT
 VCP: 12

REFLECTIVITY
 ELEV ANGLE: 0.53

Legend: dBZ (Category)

>= + 75	(16)
+ 70	(15)
+ 65	(14)
+ 60	(13)
+ 55	(12)
+ 50	(11)
+ 45	(10)
+ 40	(9)
+ 35	(8)
+ 30	(7)
+ 25	(6)
+ 20	(5)
+ 15	(4)
+ 10	(3)
+ 5	(2)
<= 0	(1)

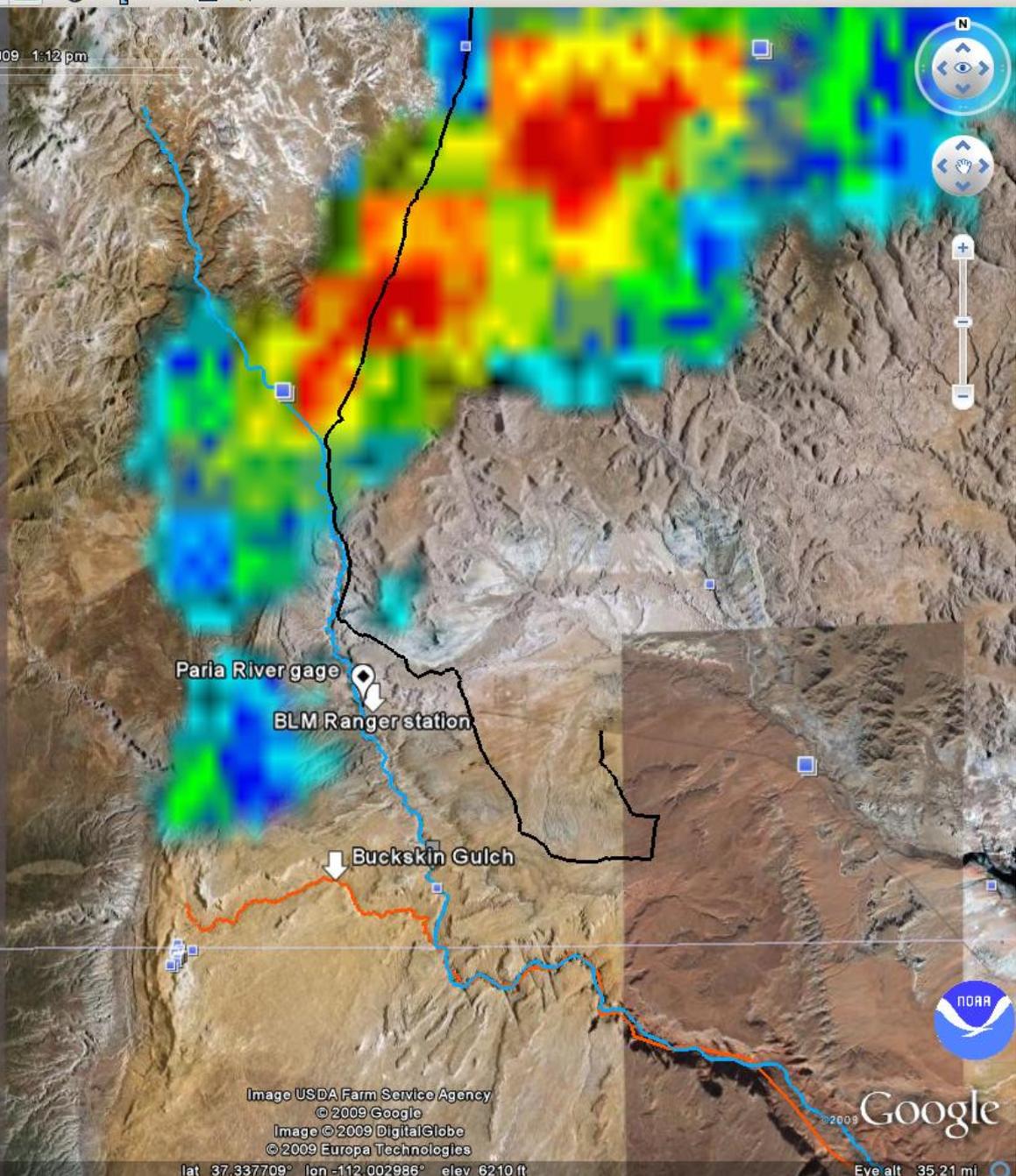


Image USDA Farm Service Agency
 © 2009 Google
 Image © 2009 DigitalGlobe
 © 2009 Europa Technologies



© 2009 Google

lat 37.337709° lon -112.002986° elev 6210 ft

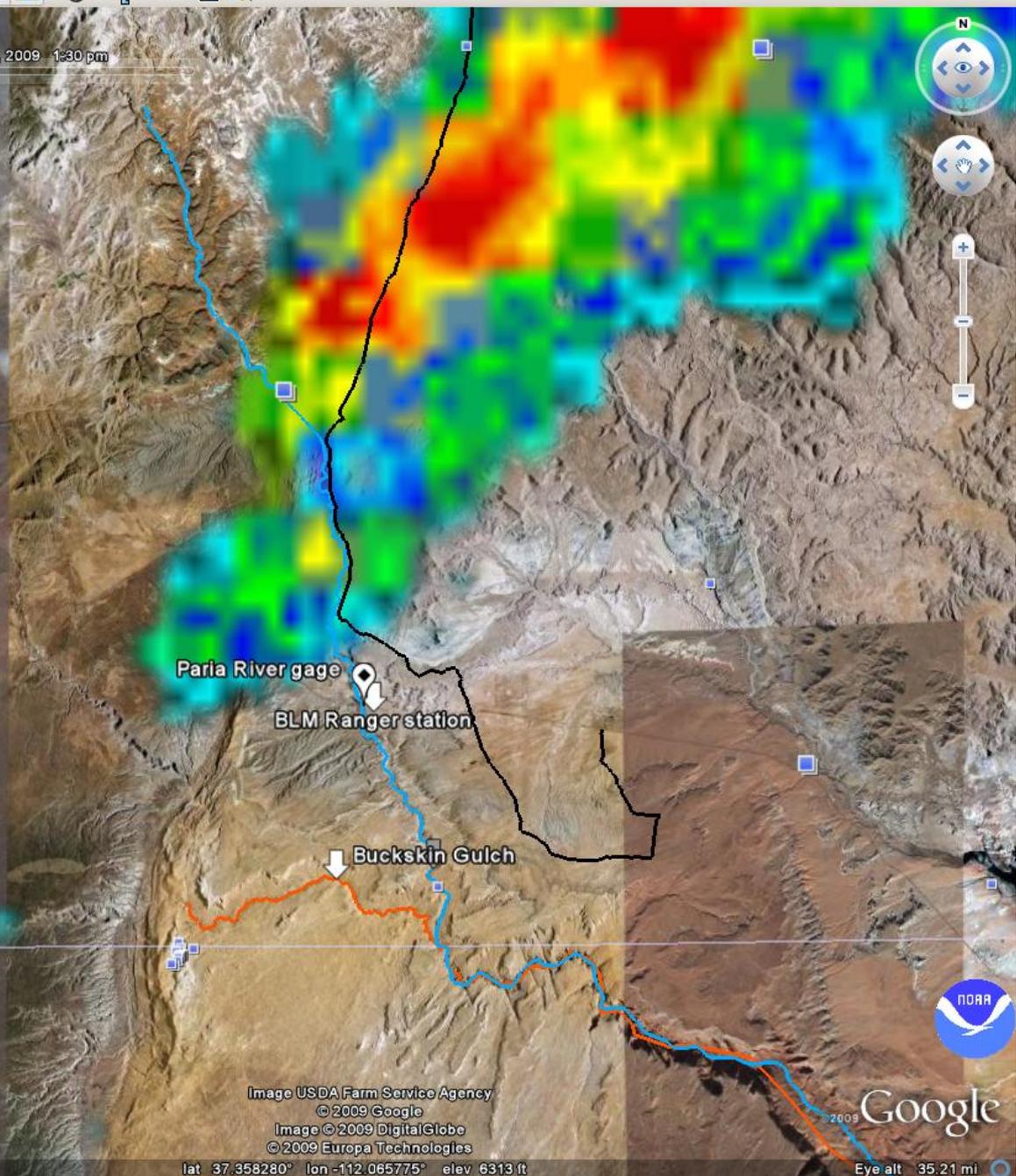
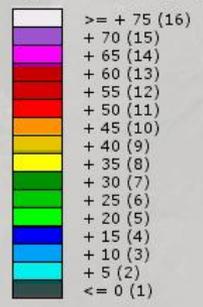
Eye alt 35.21 mi

Sep 14, 2009 1:30 pm

NEXRAD LEVEL-II
KICX - CEDAR CITY, UT
09/14/2009 20:21:09 GMT
LAT: 37/35/27 N
LON: 112/51/43 W
ELEV: 10600 FT
VCP: 12

REFLECTIVITY
ELEV ANGLE: 0.53

Legend: dBZ (Category)





Search

Fly To Find Businesses Directions

Fly to e.g., 1600 Pennsylvania Ave, 2000

40.5436, -110.3294

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- Yellowstone ponderosa RX

Places Add Content

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Date: 9/14/2009
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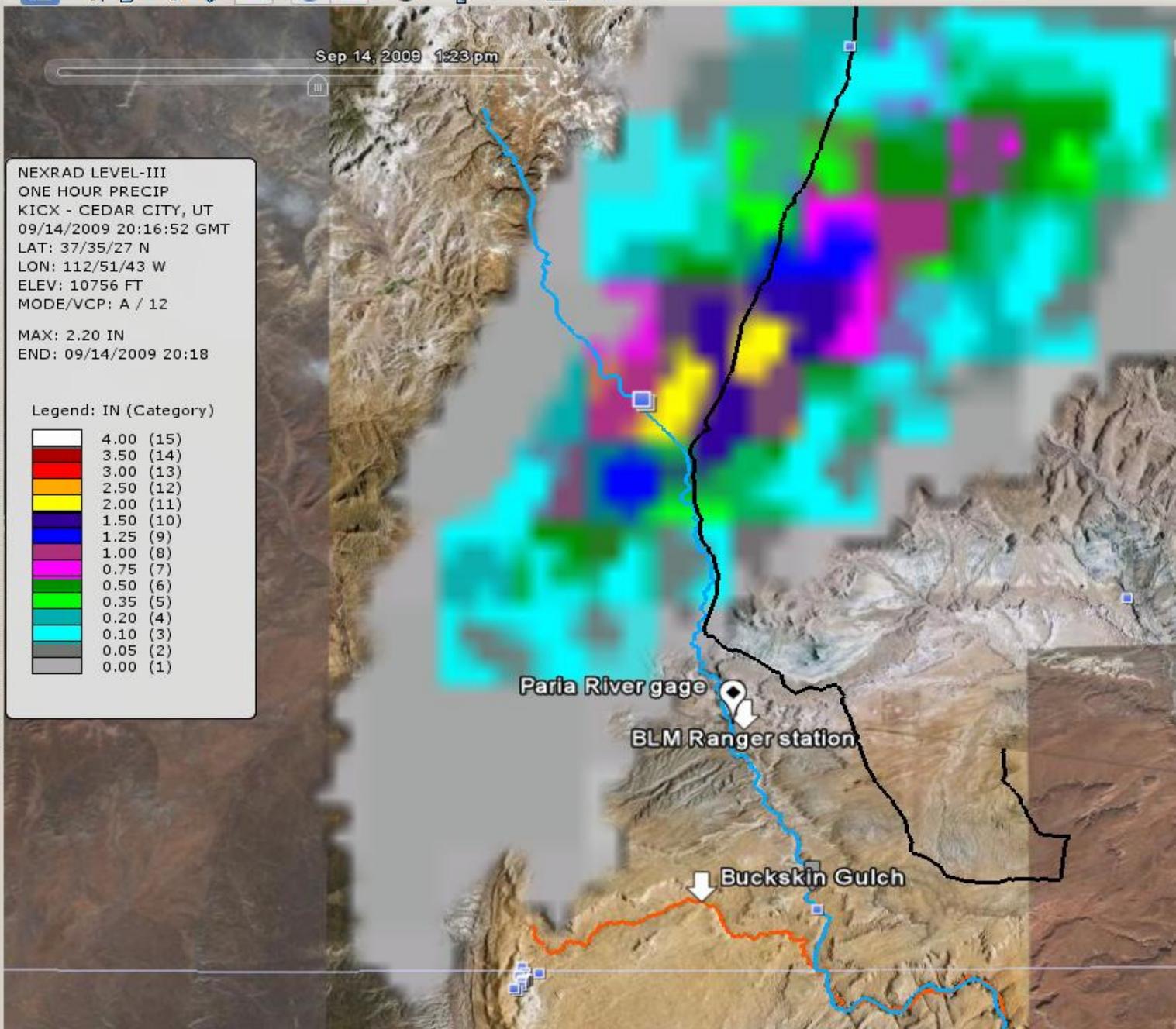
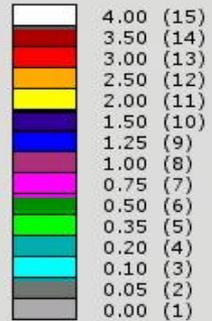
Layers

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NEXRAD LEVEL-III
ONE HOUR PRECIP
KICX - CEDAR CITY, UT
09/14/2009 20:16:52 GMT
LAT: 37/35/27 N
LON: 112/51/43 W
ELEV: 10756 FT
MODE/VCP: A / 12

MAX: 2.20 IN
END: 09/14/2009 20:18

Legend: IN (Category)



Paria River gage

BLM Ranger station

Buckskin Gulch

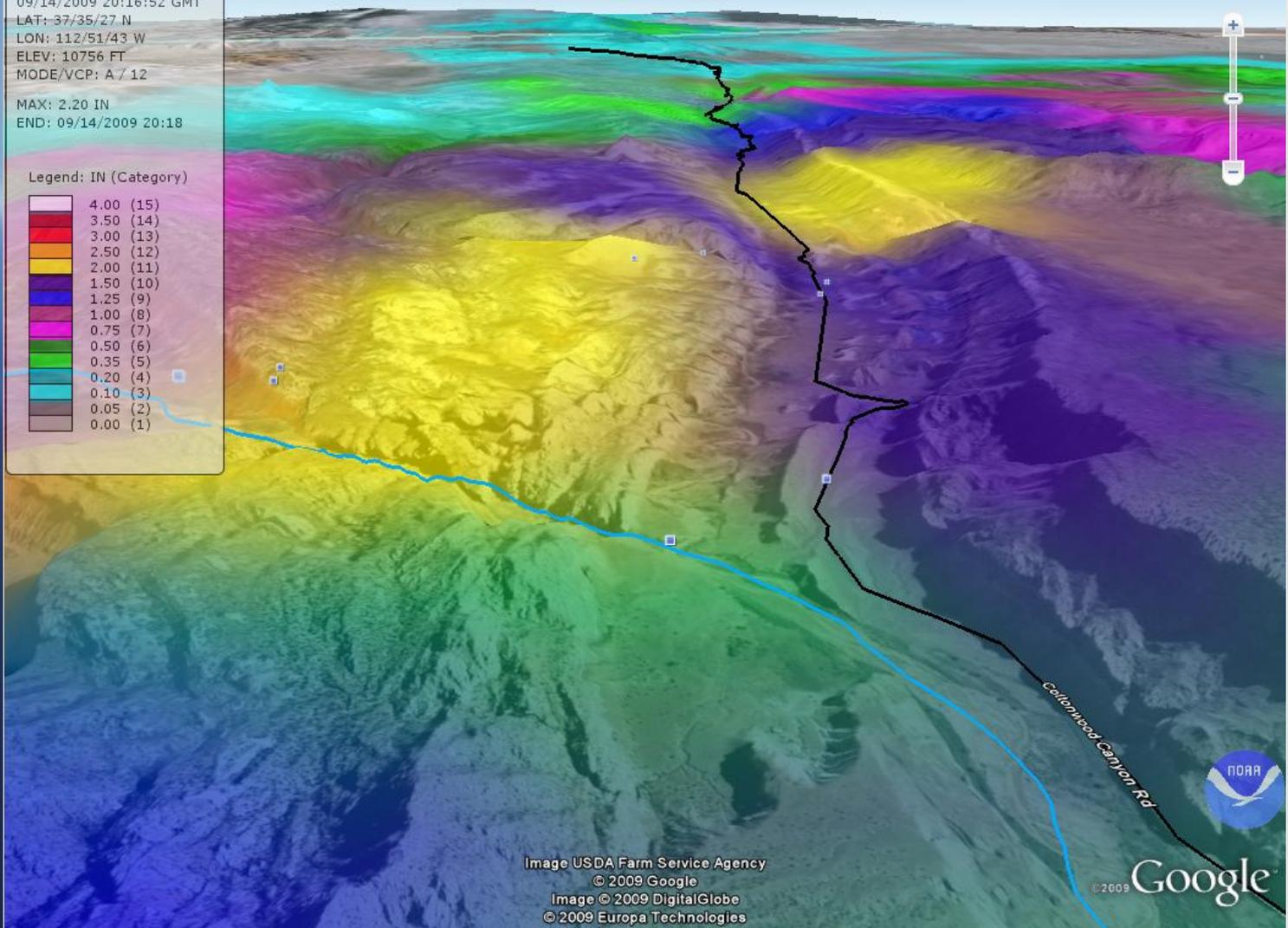
Sep 14, 2009 1:19 pm



NEXRAD LEVEL-III
 ONE HOUR PRECIP
 KICX - CEDAR CITY, UT
 09/14/2009 20:16:52 GMT
 LAT: 37/35/27 N
 LON: 112/51/43 W
 ELEV: 10756 FT
 MODE/VCP: A / 12

MAX: 2.20 IN
 END: 09/14/2009 20:18

Legend: IN (Category)



Search

Fly To Find Businesses Directions

Fly to e.g., 1600 Pennsylvania Ave, 2001

40.5436, -110.3294

- yellowstone raws
- Yellowstone poderosa RX

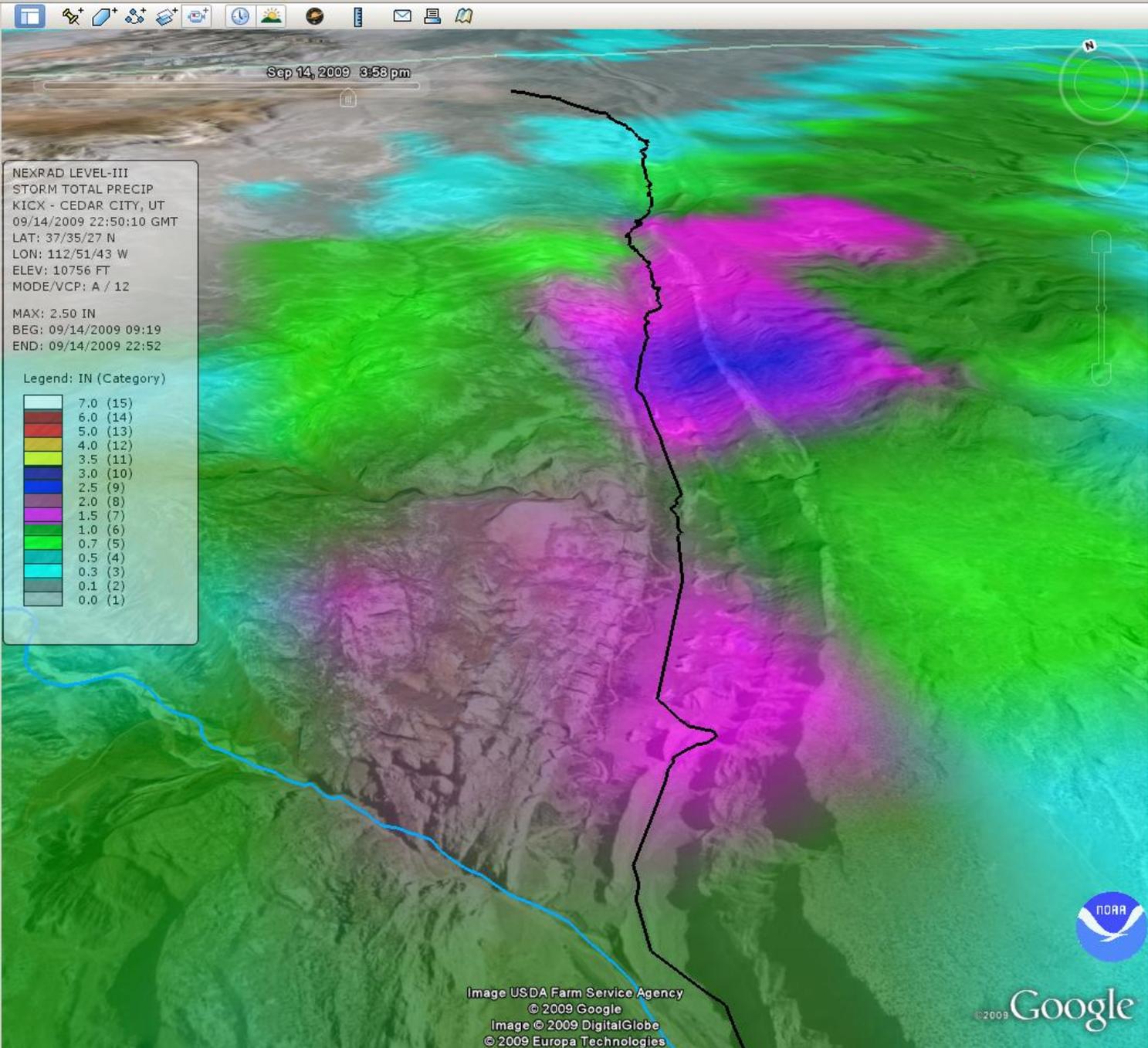
Places

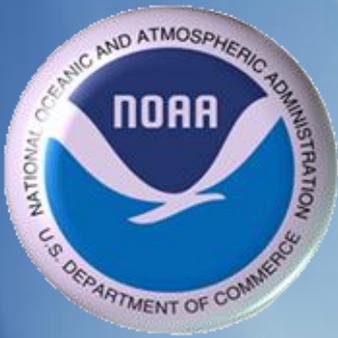
Add Content

- Paria River gage
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Contact Information

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