Paria River Streamflow and Sediment Monitoring, and Early Warning System

A joint effort between

USBR - US Bureau of Reclamation
USGS – Grand Canyon Monitoring and Research Center
USGS – Arizona District, Water Resources Discipline
USGS – Utah District, Water Resources Discipline

A presentation developed for the
Glen Canyon Dam
Adaptive Management Program
Technical Work Group Meeting
Phoenix, Arizona
May 30, 2003

Presentation Outline

Preparation

- Gage installations
- Site constraints
- Discharge ratings/calibrations developed
- Establishment of modeled/calibrated travel times between gages
- Establishment of flow thresholds and action protocols

Early Warning

- NWS, satellite imagery, news outlets
- Pagers engaged when preset thresholds exceeded

Confirmation

- Internet graphics
- Broad-band Internet technology/remote river imagery

Action

- Protocols engaged for contact by USGS/WRD of GCMRC and USBR staff

Needs

Why?

GCMRC and USBR are tasked with the job of monitoring and quantifying sediment input to the Colorado River below Glen Canyon Dam, which now only comes from Colorado River tributaries below the dam.

One of these tributaries, the Paria River, drains to the Colorado River downstream of Lee's Ferry, located upstream from Marble Canyon. This tributary, along with the Little Colorado River, now provide the majority of sediment to the Colorado River system in the Grand Canyon.

In an effort to better manage sediment fluxes to the system for the purposes of beach and habitat enhancement, GCMRC and USBR now have the information, tools, and permission to perhaps alter flows from Glen Canyon Dam when large amounts of sediment are about to enter the downstream system.

By decreasing flowrates when substantial amounts of sediment are in transport in the Paria River drainage, sediment inputs from this tributary can be stored in the Colorado River below Lee's Ferry until sufficient flows can be produced. Subsequent high flows (January?) will put the stored sediment into suspension in the river and transport it downstream to locations where it will build beaches and revitalize habitats upon deposition in eddy areas along the margins of the Colorado River.

Colorado River in Grand Canyon, 1996

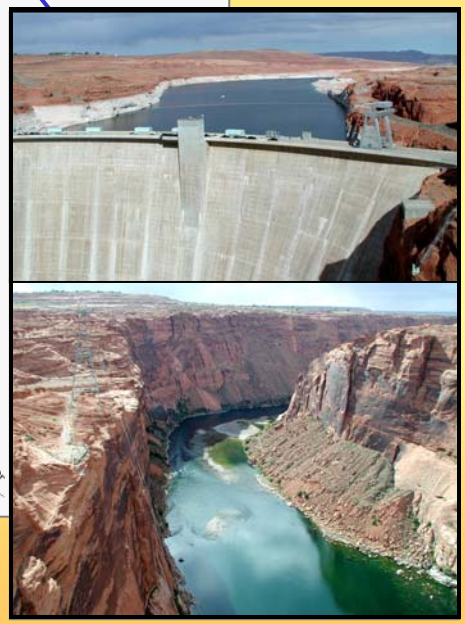
~45,000 cfs released for a period of one week

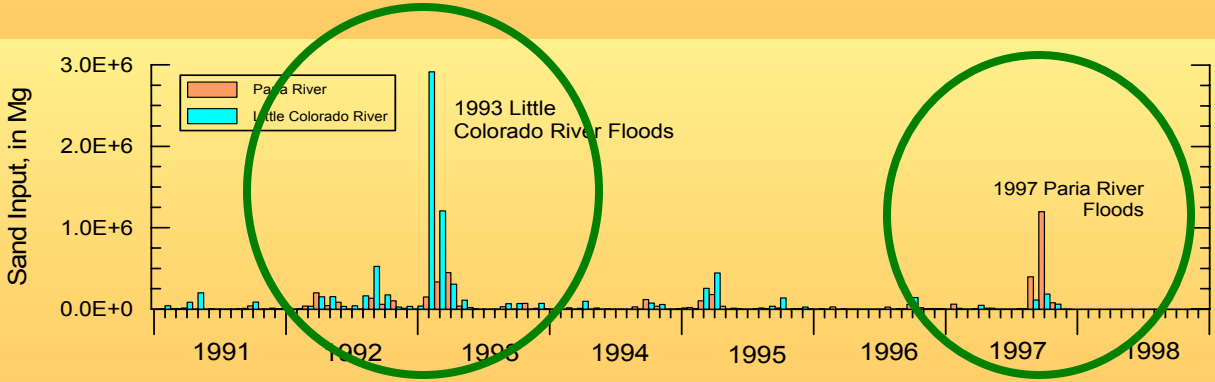
National Canyon site, Colorado River in Grand Canyon

During '96 experimental flood

After '96 experimental flood

GCMRC





Data/Images compliments of AZ District

Approach

In cooperation with Grand Canyon Monitoring and Research Center (GCMRC and USGS, Biological Resources Discipline) and the U.S. Bureau of Reclamation (USBR), the USGS Utah District (Water Resources Discipline) has installed and is currently operating and maintaining streamflow-gaging stations on the Paria River near Cannonville and near Kanab. Also, the USGS Arizona District, is operating a streamflow and sediment monitoring station on Paria River at the confluence with the Colorado River, at Lee's Ferry.

Accurate and realtime information on river stage and discharge for these stations is critical during times of high flow, which generally occur during summer and fall, especially now that GCMRC and USBR have permission to perhaps alter flows from Glen Canyon Dam when large amounts of sediment are about to enter the downstream system.

Preparation:
gage installation

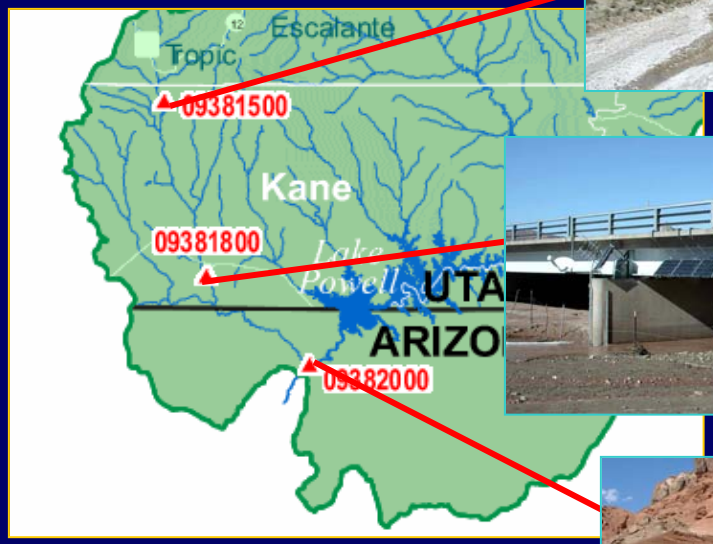
Paria River near Cannonville

Paria River near Kanab

Paria River at Lees Ferry

Preparation:

Historical information



Paria River near Cannonville

-Site reactivated Dec 2001 (BLM)
-Previous information:
-1950-55 (continuous)
-1959-74 (annual peaks, CSG)

Paria River near Kanab

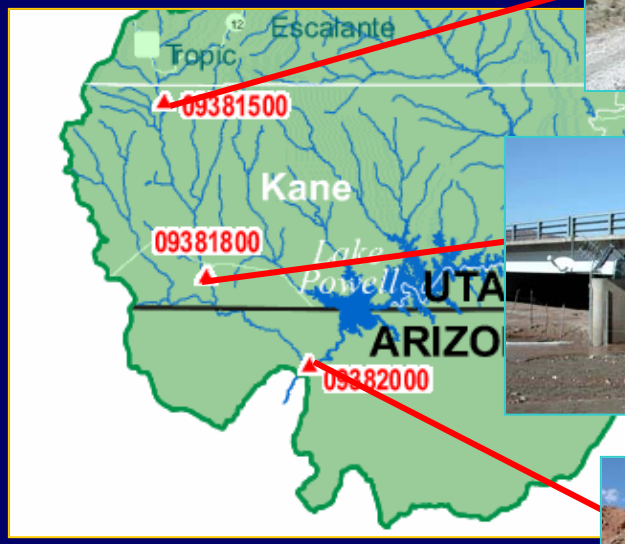
-Site activated, July 2002 (GCMRC)
-Previous information:
-1959-74 (annual peaks, CSG)

Paria River at Lees Ferry

-Site activated, 1923 (GCMRC)
-Previous information:
-1923-present (continuous)

Preparation:

Site constraints



Paria River near Cannonville

-Restricted access (Q and sediment)
-Environmentally sensitive

Paria River near Kanab

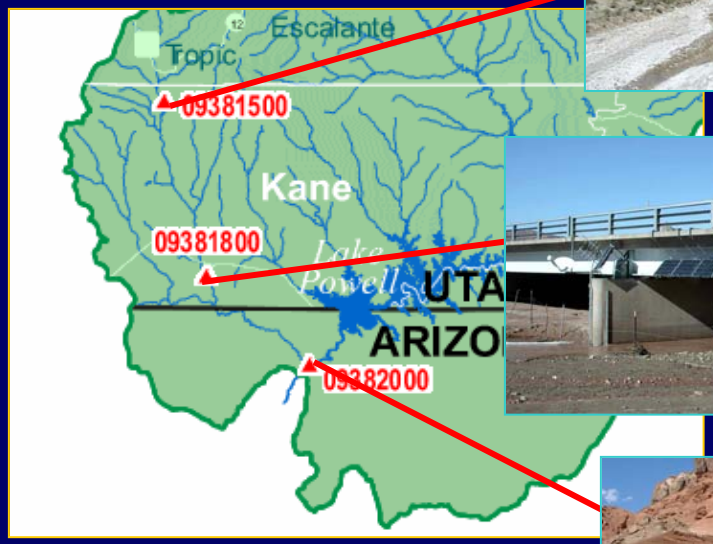
-Hazardous measurement conditions
-Environmentally sensitive
-Trigger station, but no power, cell, etc for early warning device

Paria River at Lees Ferry (operated-maintained by Arizona District/WRD)

-No major constraints

Preparation:

Discharge ratings/calibrations developed



Paria River near Cannonville

Theoretical stage-discharge rating developed

Paria River near Kanab

Low-end of stage-discharge rating developed
need new upper end
Needed for sediment model developed Topping

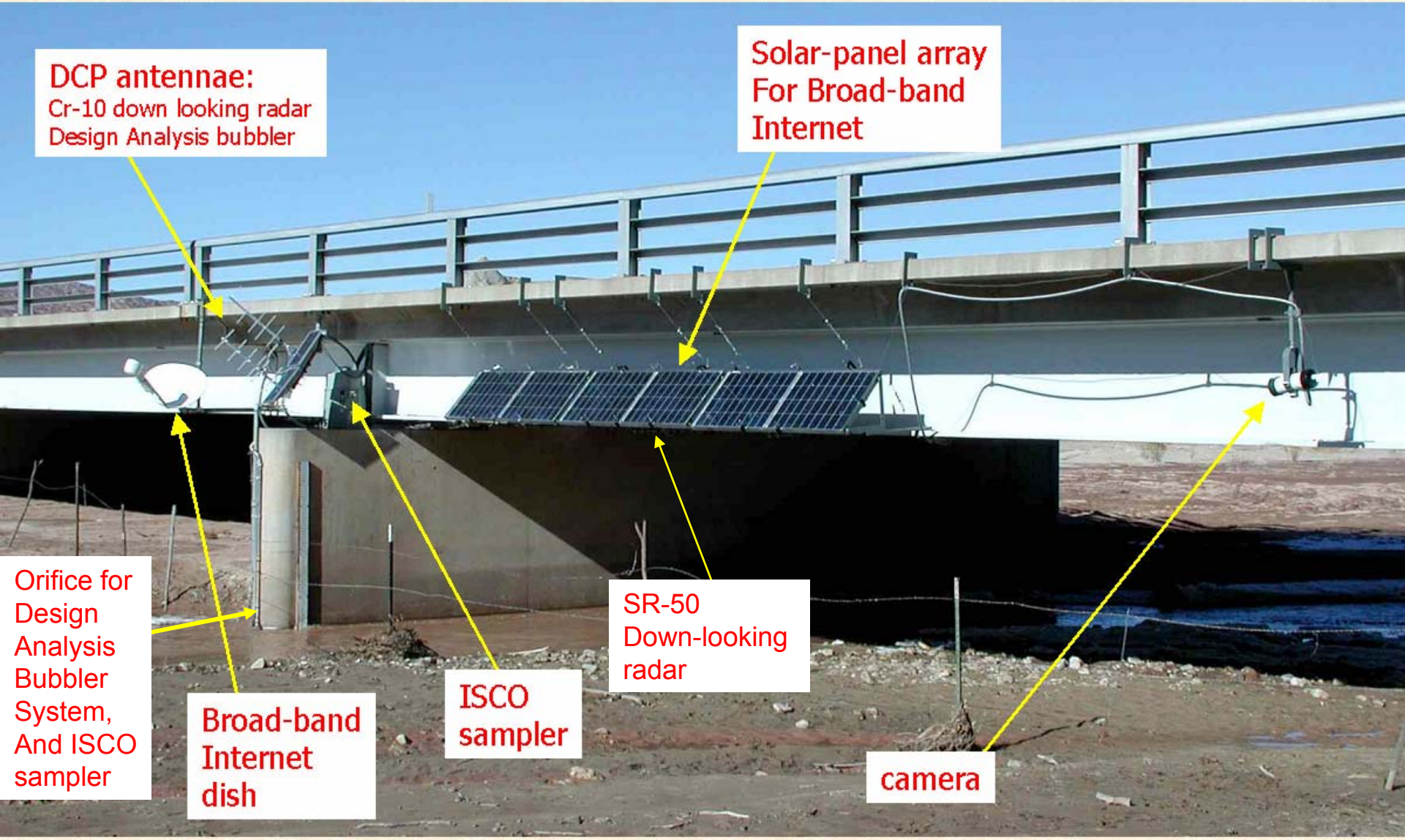
Paria River at Lees Ferry

Stage-discharge rating developed
Needed for sediment model developed Topping

Preparation:

Paria River at Kanab – new "trigger" site

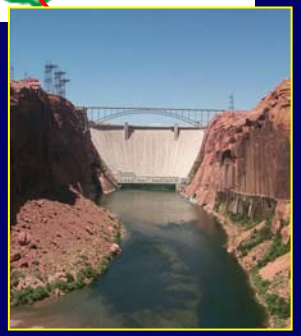
Preparation:



Paria River at Kanab

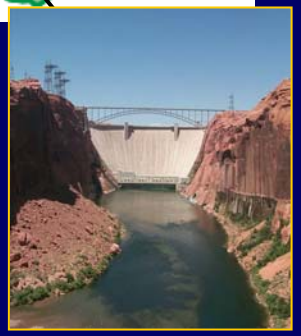
Preparation:

Establishment of modeled/calibrated travel times between gages



Preparation:

Establishment of modeled/calibrated travel times between gages

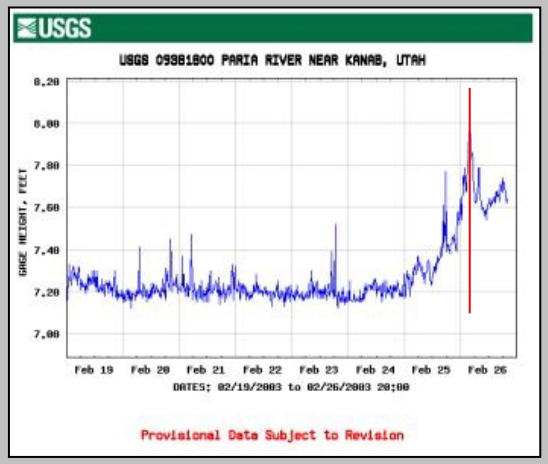


8-12 hrs
travel time

4-5 hrs
travel time

"trigger site"
Paria River near Kanab

Travel Times:



ΔT = approx 12 hrs
at approx 180 cfs

Paria Kanab (gh)

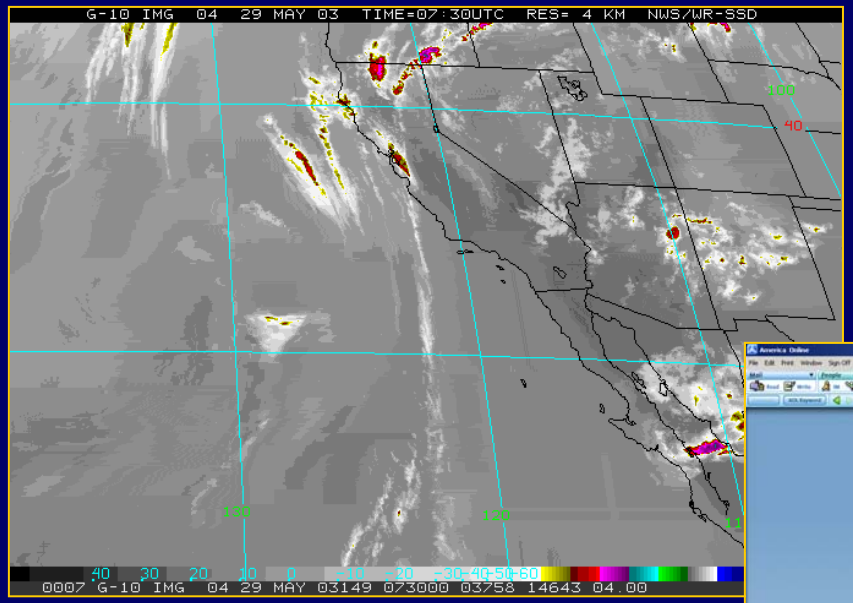
2/26/2003 3:00	7.8	
2/26/2003 3:15	7.84	
2/26/2003 3:30	7.87	
2/26/2003 3:45	7.96	
2/26/2003 4:00	7.95	
2/26/2003 4:15	7.95	

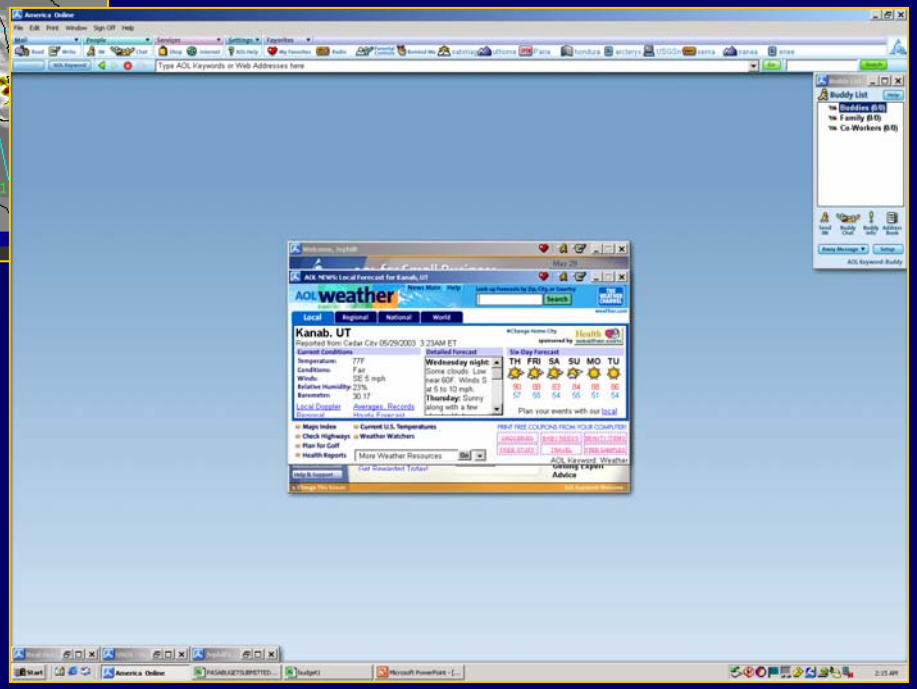
Paria Lees Ferry (gh & Q)

2/26/2003 14:30	5.87	176
2/26/2003 14:45	5.89	179
2/26/2003 15:00	5.89	179
2/26/2003 15:15	5.9	183
2/26/2003 15:30	5.9	183
2/26/2003 15:45	5.9	183
2/26/2003 16:00	5.89	179
2/26/2003 16:15	5.89	179
2/26/2003 16:30	5.89	179
2/26/2003 16:45	5.87	176
2/26/2003 17:00	5.86	174

Early Warning:

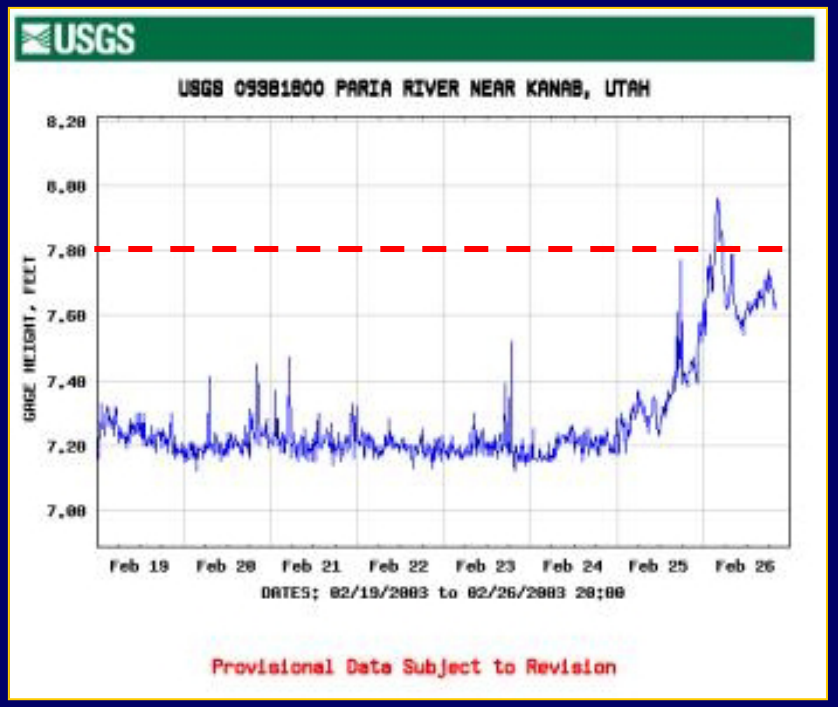
NWS, satellite imagery, news outlets





Early Warning:

Pagers engaged when preset thresholds exceeded



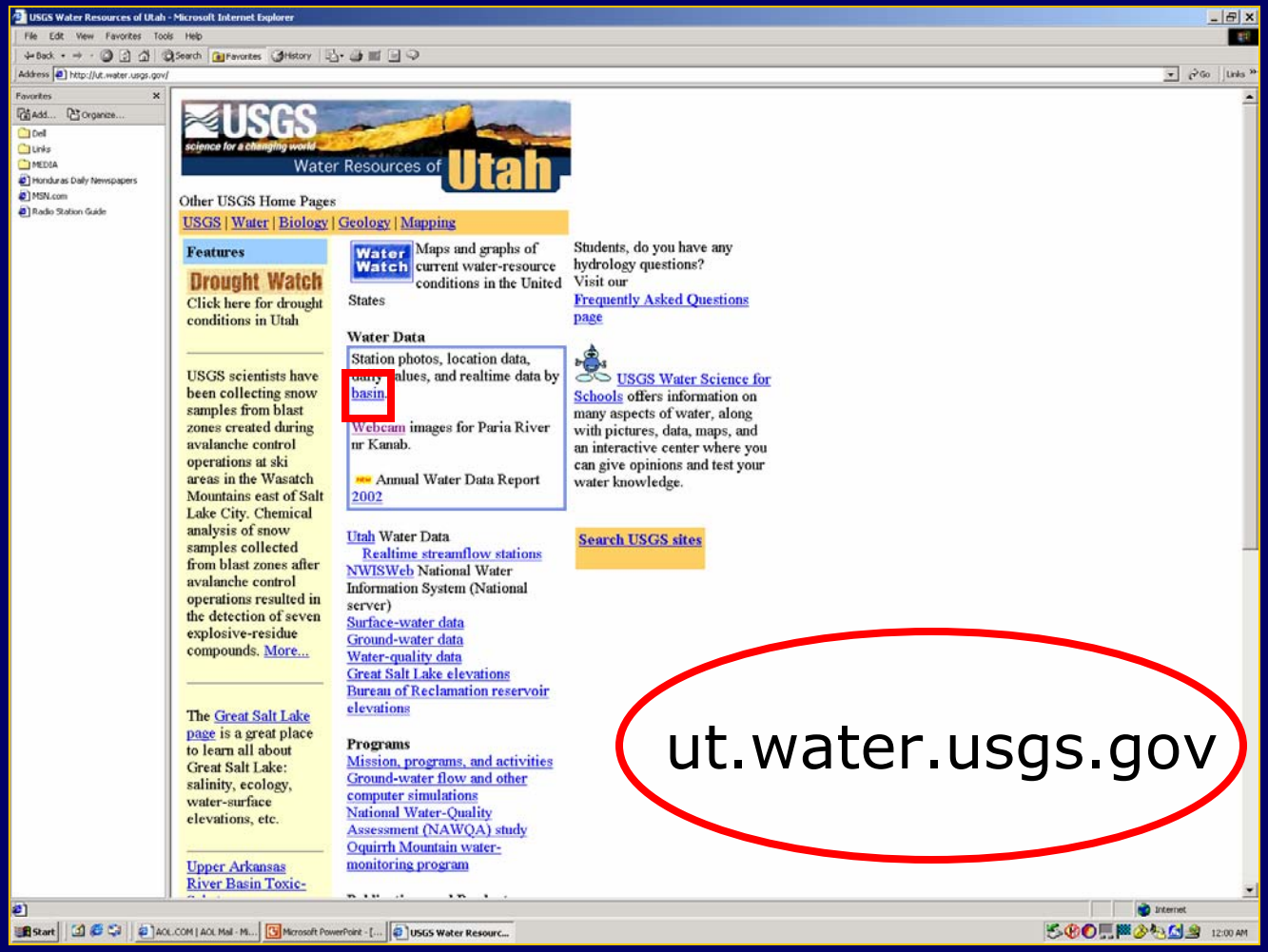
Paria River near Cannonville
Paria River at Kanab

stage/streamflow

*Random DCP transmissions when preset thresholds exceeded

Confirmation:

Internet graphics



Confirmation:

State Basins Map - Microsoft Internet Explorer

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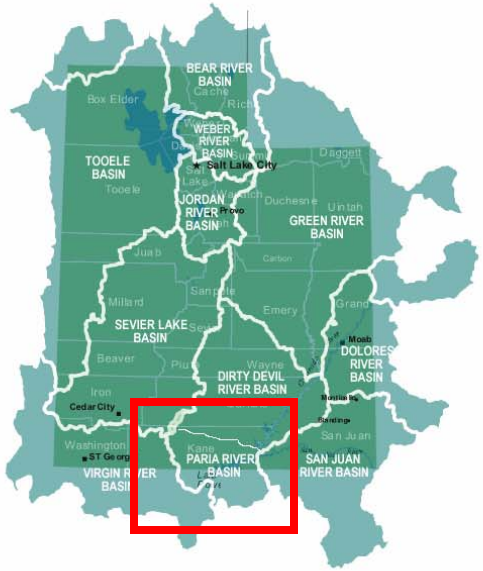
Address http://ut.water.usgs.gov/Basins/index.html

Favorites

Add... Organize...

Dell
Links
MEDIA
Honduras Daily Newspapers
MSN.com
Radio Station Guide

USGS



Click on basin to show stations within that area.

URL:http://ut.water.usgs.gov /Basins/index.html

return to Utah home page

U.S. Department of the Interior
U.S. Geological Survey
2329 Orton Circle, West Valley City, Ut, 84119
Maintainer: GS-W-UT_Web_Requests@usgs.gov
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Paria River Basin - Microsoft Internet Explorer

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PARIA RIVER BASIN

Click on station number to show station data

URL:http://ut.water.usgs.gov /Basins/PariaRiverBasin/index.html

return to Utah home page

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U.S. Geological Survey
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Confirmation:

Confirmation:

Real-time data for USGS 09381500 PARIA RIVER NEAR CANNONVILLE, UTAH - Microsoft Internet Explorer

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Address http://ut.waterdata.usgs.gov/nwis/uv/?site_no=09381500&PARAmeter_dc=00065,00060,00010,72020

Favorites

Add... Organize...

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Links
MEDIA
Honduras Daily Newspapers
MSN.com
Radio Station Guide

USGS 09381500 PARIA RIVER NEAR CANNONVILLE, UTAH

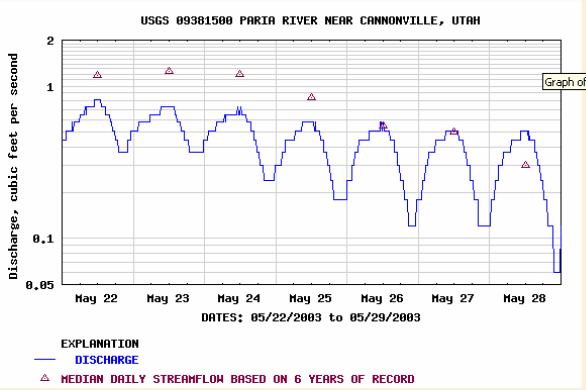
PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site: Real-time GO

Available Parameters	Output format	Days	
All 2 parameters available at this site 00060 Discharge (DD 01) 00065 Gage height (DD 02)	Graph	7 (1-31)	get data

Discharge, cubic feet per second

Most recent value: .12 05-29-2003 00:00



Download a presentation-quality graph Parameter Code 00060; DD 01

Daily mean flow statistics for 5/29 based on 6 years of record in ft^3/sec

Current Flow	Minimum	Mean	Maximum	80 percent exceedence	50 percent exceedence	20 percent exceedence
.12	0.00	.53	1.9	.040	.35	1.32

Percent exceedance means that 80, 50, or 20 percent of all daily mean flows for 5/29 have been greater than the value shown.

Done Internet

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Confirmation:

Broad-band Internet technology/remote river imagery for Paria River at Kanab

Because there is little to no room for error, multiple systems are required to ensure accurate acquisition of realtime information. However, for this extremely remote site, no power is available, the site is out of cellular phone coverage, no phone lines, and, again, the site is in an environmentally sensitive area. Solution for the required redundancy and confirmation of flows for this trigger site -- a new fully enclosed system needed to be designed -- a system never before used for such a purpose – realtime viewing of hydrologic conditions at a fully remote site.

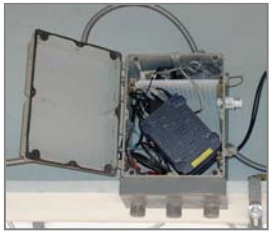
Broadband Internet

The primary components of the system consist of a full array of solar panels, large high-capacity batteries, battery regulators, a computer processor, a web camera, and a broadband satellite dish.

Axis 2420 network camera

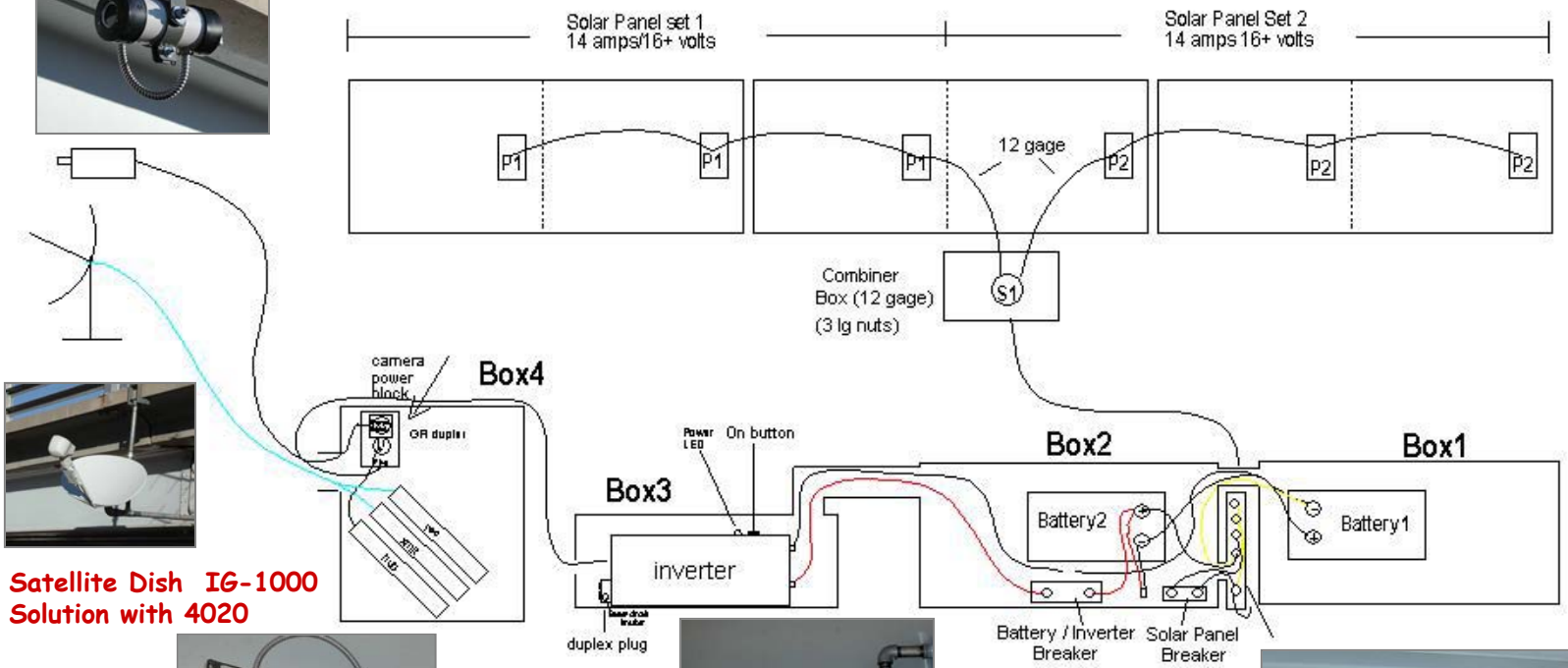
6 80-watt solar panels

Satellite Dish IG-1000
Solution with 4020



Inverter: 24 volt, 2400 watt inverter
Controller: 40 amp charge regulator

Batteries: two 256 ah sealed batteries



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Water Resources of Utah

Other USGS Home Pages

USGS | Water | Biology | Geology | Mapping

Features

Drought Watch

NEW USGS scientists have been collecting snow samples from blast zones created during avalanche control operations at ski areas in the Wasatch Mountains east of Salt Lake City. Chemical analysis of snow samples collected from blast zones after avalanche control operations resulted in the detection of seven explosive-residue compounds. More...

The Great Salt Lake page is a great place to learn all about Great Salt Lake: salinity, ecology, water-surface

Water Watch Maps and graphs of current water-resource conditions in the United States

Water Data

Station photos, location data, daily values, and realtime data by basin

NEW Webcam images for Paria River nr Kanab.

Utah Water Data

Realtime streamflow stations

NWISWeb National Water Information System (National server)

Surface-water data

Ground-water data

Water-quality data

Great Salt Lake elevations

Bureau of Reclamation reservoir elevations

Programs

Mission, programs, and activities

Ground-water flow and other computer simulations

National Water-Quality Assessment (NAWQA) study

Students, do you have any hydrology questions? Visit our Frequently Asked Questions page

USGS Water Science for Schools offers information on many aspects of water, along with pictures, data, maps, and an interactive center where you can give opinions and test your water knowledge.

Search USGS sites

Realtime Images Available via USGS/Utah Website

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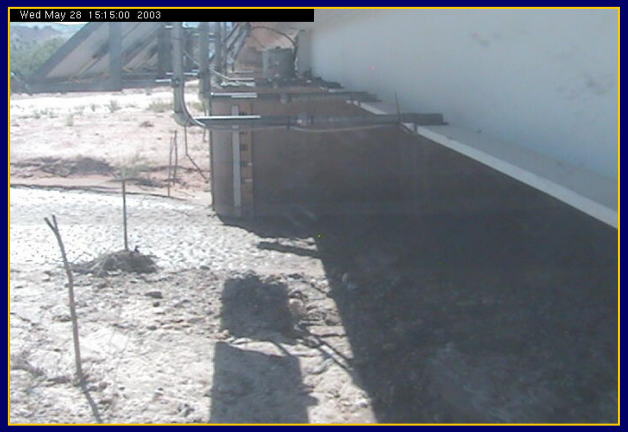
USGS
science for a changing world

Webcam at USGS Streamflow-Gaging Station 09381800 Paria River near Kanab, Utah

Current view of the streamflow-gaging station at Paria River near Kanab, Utah

In cooperation with Grand Canyon Monitoring and Research Center (GCMRC and USGS, Biological Resources Division) and the U.S. Bureau of Reclamation (USBR), the USGS Utah District (Water Resources Division) has installed and is currently operating and maintaining a streamflow-gaging station on the Paria River at Highway US89. Highly accurate and realtime information on river stage and discharge for this station is critical during times of high flow, which generally occur during summer and fall. GCMRC and USBR are tasked with the job of monitoring and quantifying sediment input to the Colorado River below Glen Canyon Dam, which now only comes from Colorado River tributaries below the dam. One of these tributaries, the Paria River, drains to the Colorado River downstream of Lee's Ferry, located upstream from Marble Canyon. This tributary, along with the Little Colorado River, now provide the majority of sediment to the Colorado River system in the Grand Canyon. In an effort to better manage sediment fluxes to the system for the purposes of beach and habitat enhancement, GCMRC and USBR now have the information, tools, and permission to perhaps alter flows from Glen Canyon Dam when large amounts of sediment are about to enter the downstream system. By decreasing flowrates when substantial amounts of sediment are in transport in the Paria River drainage, sediment inputs from this tributary can be stored in

Images acquired May 28, 2003



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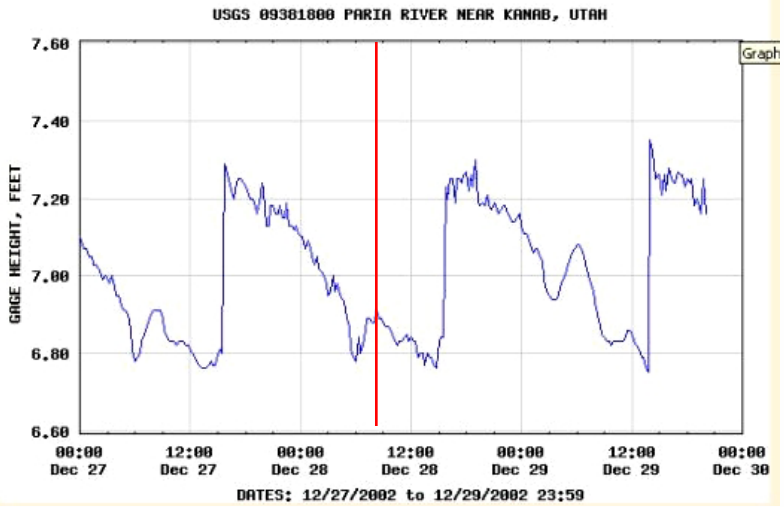
Paria River Cam

Dec 28, 07:25:20 2002



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Paria River nr Kanab, Utah

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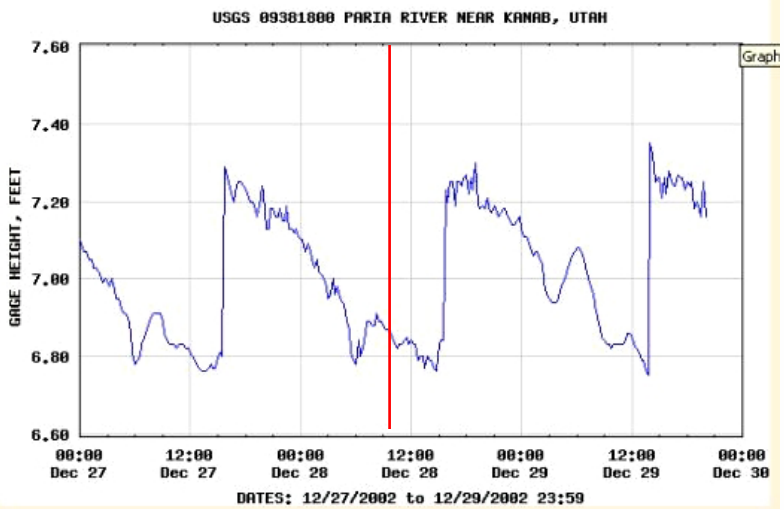
Paria River Cam

Dec 28, 09:18:06 2002



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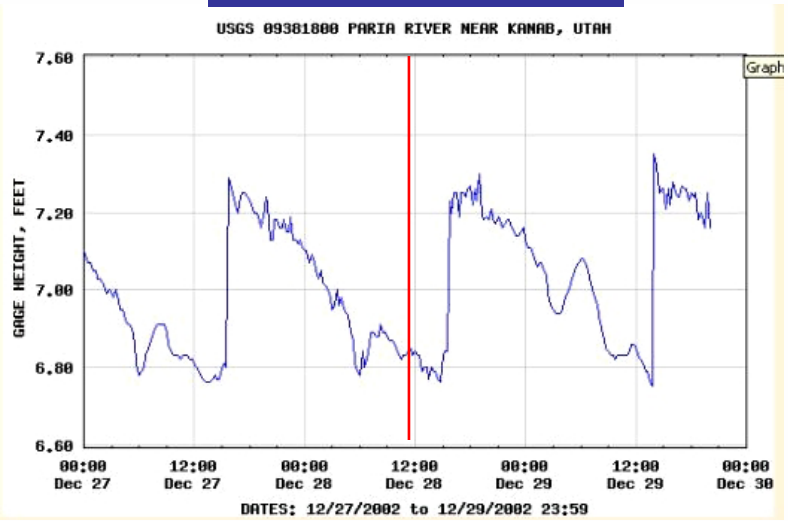
Paria River Cam

Dec 28, 11:28:04 2002



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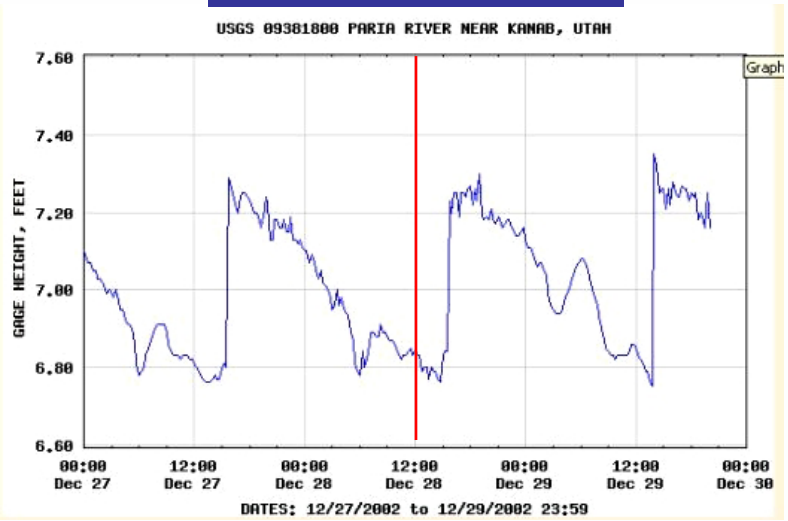
Paria River Cam

Dec 28, 11:55:20 2002



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Paria River nr Kanab, Utah

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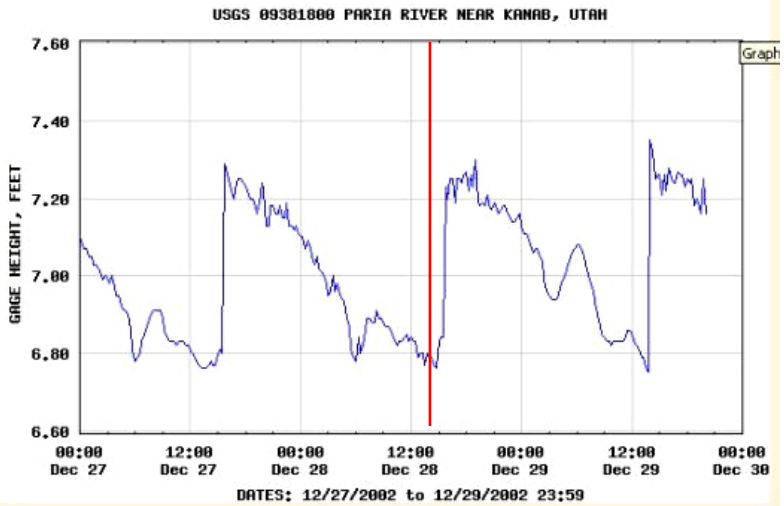
Paria River Cam

Dec 28, 13:48:04 2002



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Paria River nr Kanab, Utah

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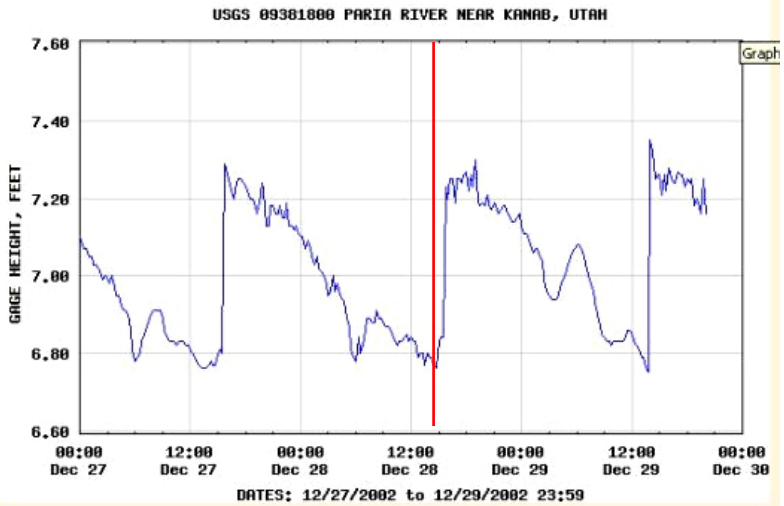
Paria River Cam

Dec 28, 14:39:47 2002



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Paria River nr Kanab, Utah

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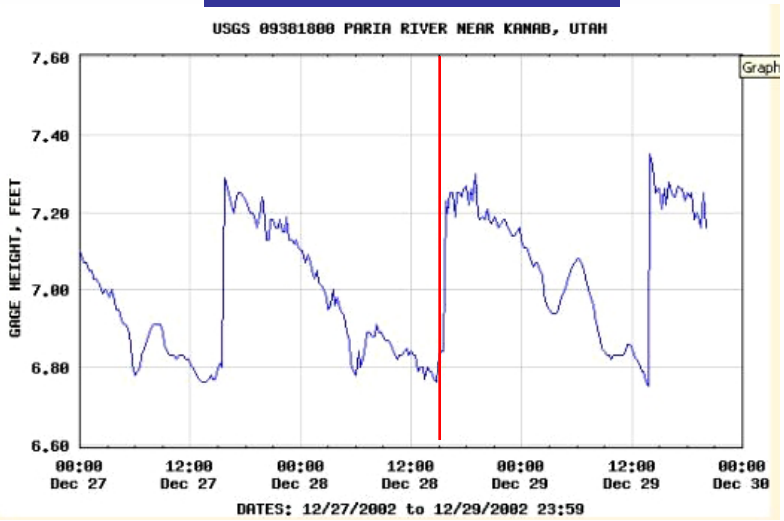
Paria River Cam

Dec 28, 15:01:45 2002



Digital Output:

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Paria River nr Kanab, Utah

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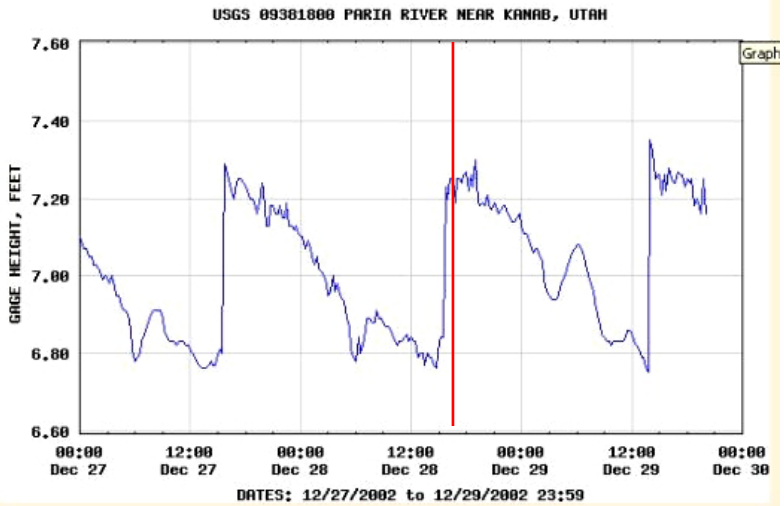
Paria River Cam

Dec 28, 16:29:43 2002



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Paria River nr Kanab, Utah

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Paria River Cam

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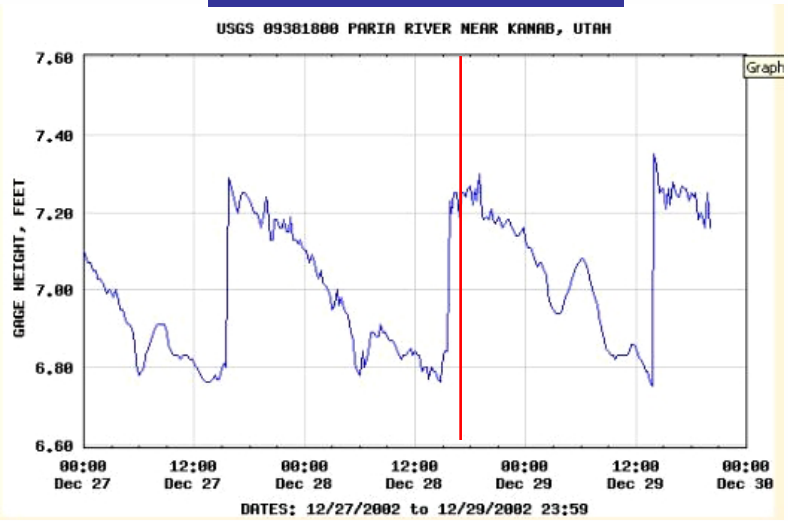

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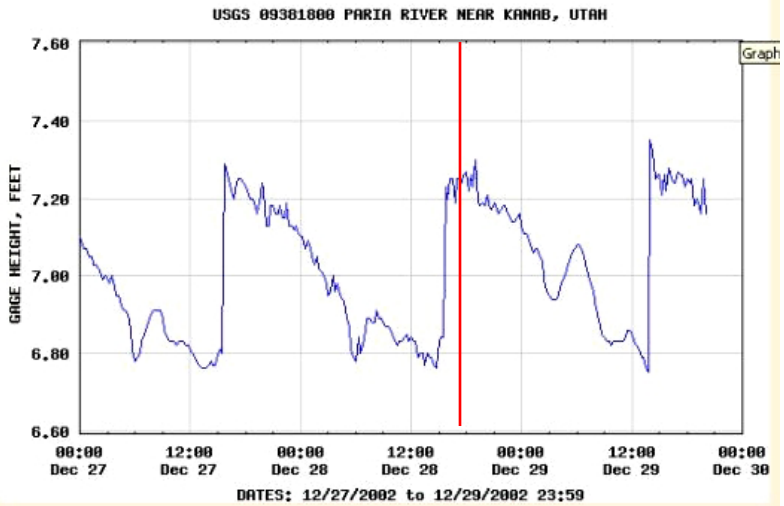

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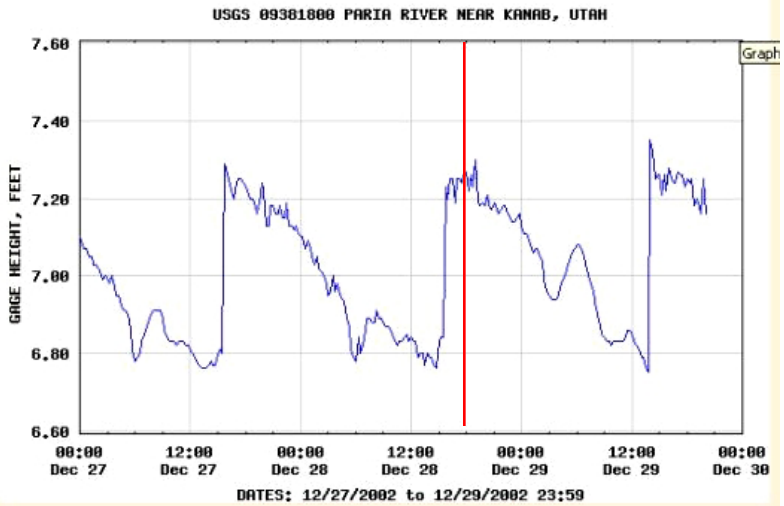

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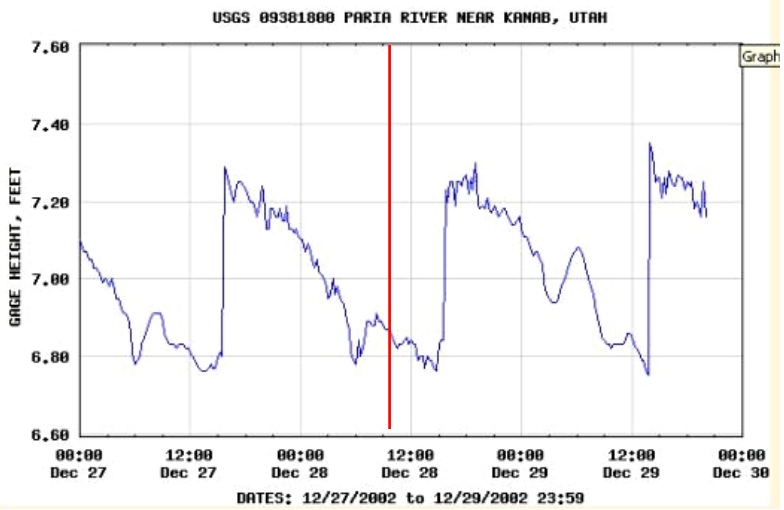

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Paria River Cam

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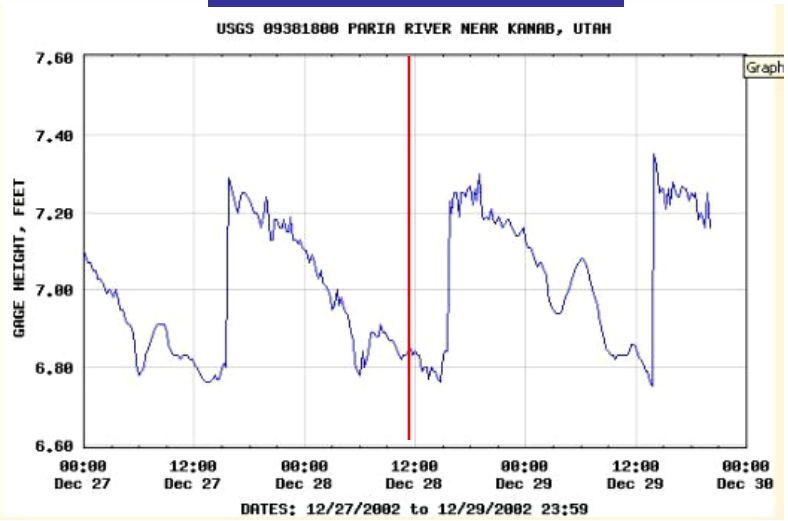

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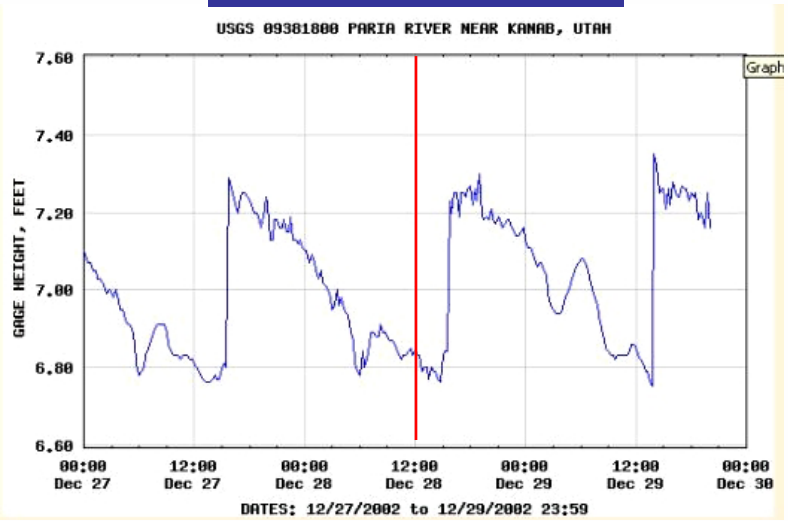

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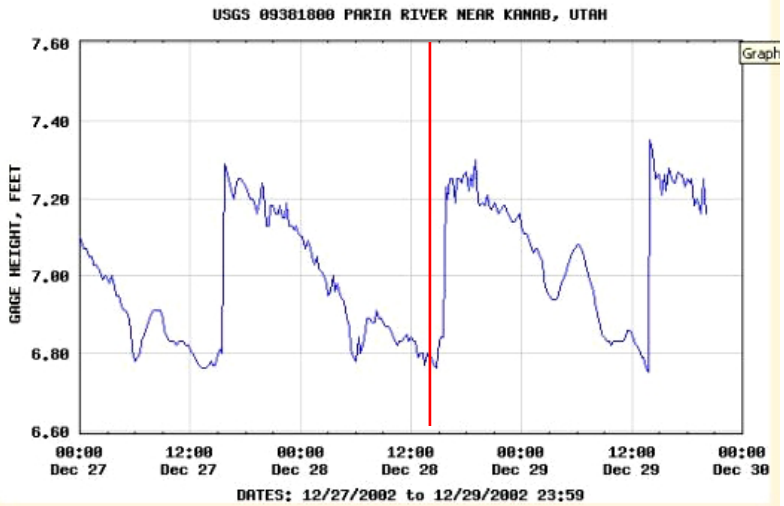

Digital Output:

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Paria River Cam

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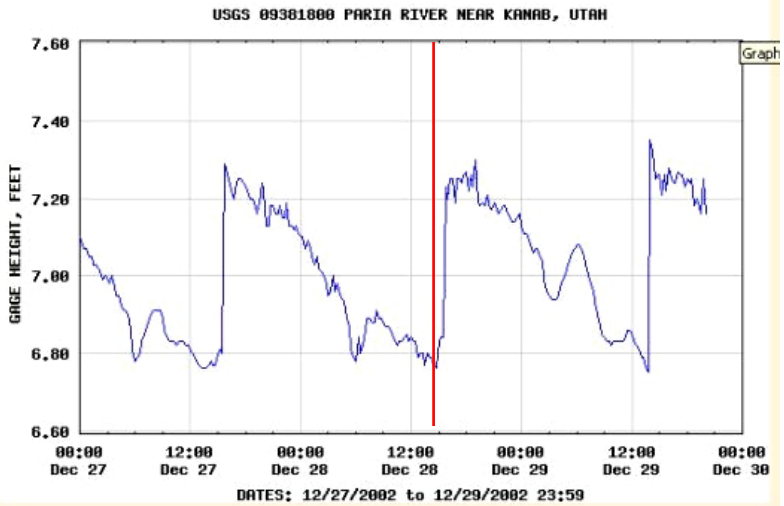

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Paria River Cam

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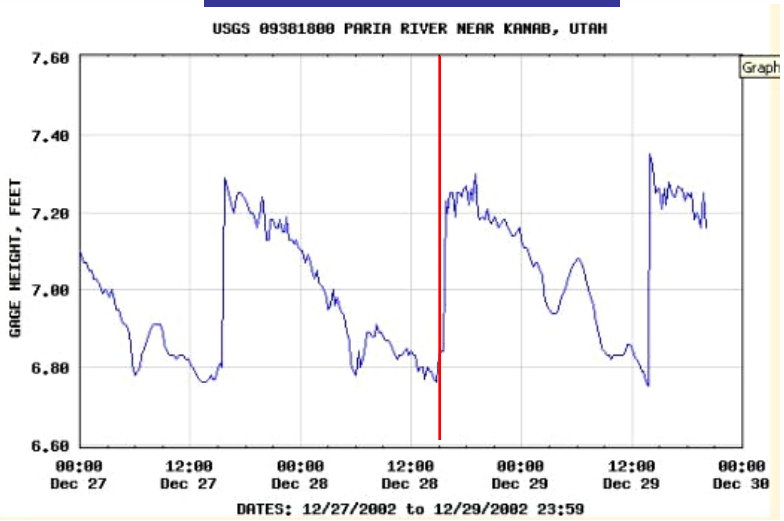

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Paria River Cam

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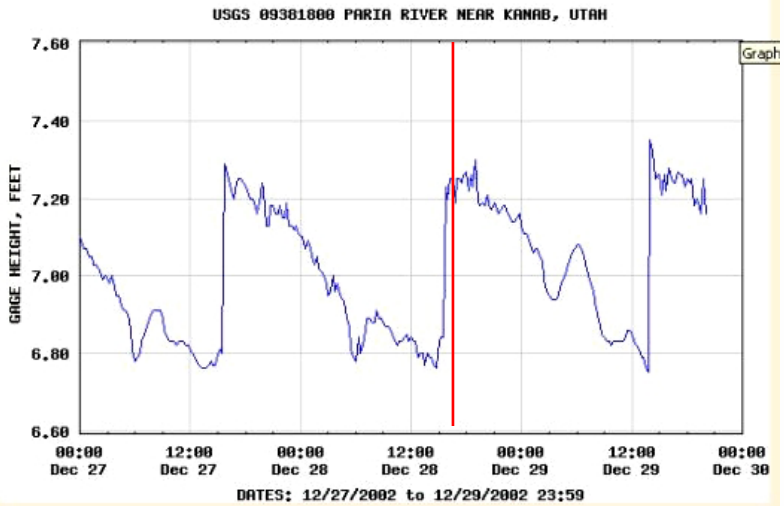

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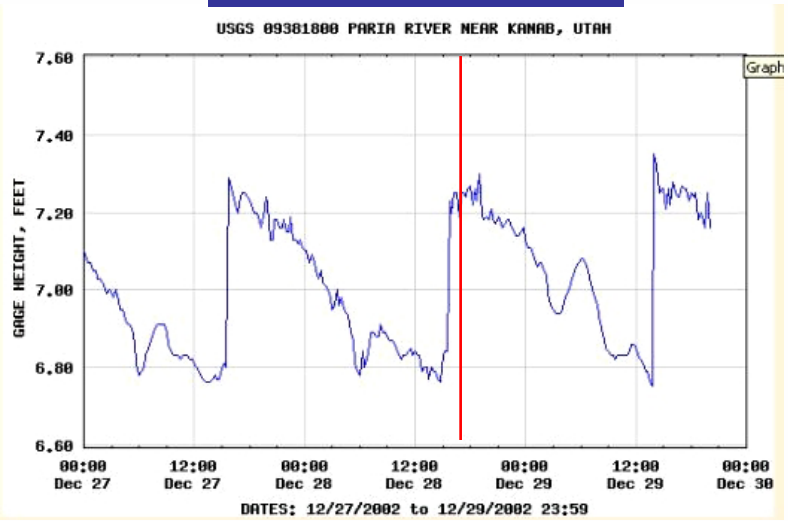

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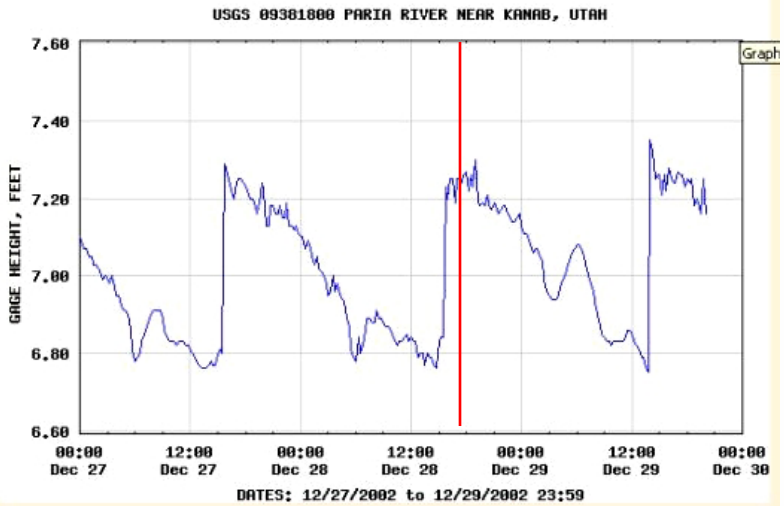

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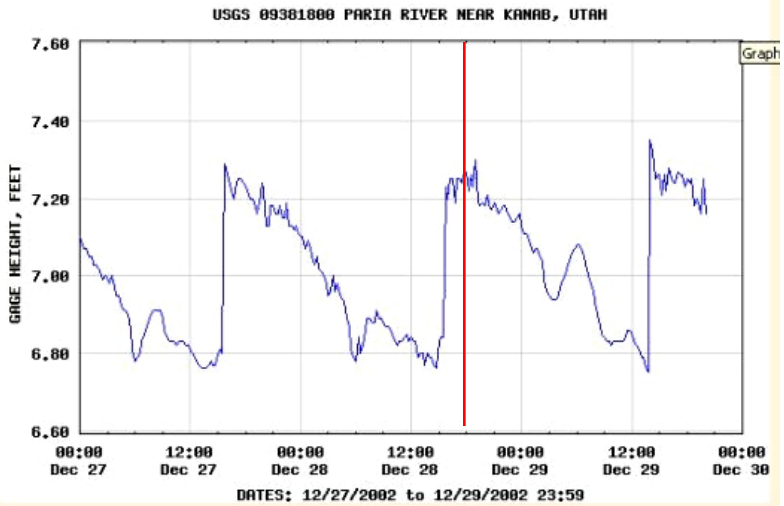

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Action:

Protocols engaged for contact by USGS/WRD of GCMRC and USBR staff

Initial actions (tentative):

at

- When preliminary thresholds are reached at either the trigger site (Paria River Kanab) or the upstream station at Cannonville, USGS SLC will contact USGS Cedar City and USGS Flagstaff to indicate highwater may be on its way downstream (trial and error – evolving – process in 2003)

- When secondary thresholds are exceeded at Paria River near Kanab, USGS SLC again will contact USGS Cedar City and USGS Flagstaff to mobilize for discharge and suspended sediment measurements, and to acquire automatically collected samples. USGS SLC will contact USBR SLC and GCMRC Flagstaff

- At this point, the trigger at Paria River near Kanab will have been met, so to speak, and further action will be in the hands of USBR

- USGS SLC will continue to monitor streamflow and sediment loads passing the stations, and regularly update USBR SLC and GCMRC on status

Needs:

- Refine and finalize protocols

- Better coordination between USGS/WRD Utah, USGS/WRD Arizona (June/July 2003), and meetings with GCMRC

- Additional sediment and travel time information for refinement of David Topping's model

- A stage-discharge rating has been developed for the low-flows at Paria River near Kanab, but the "upper" end of the rating curve needs development. This should be completed during summer 2003