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File - 18 Sept, '87.*

FLASH FLOOD ON 7 AUGUST, 1987 THREATENS ARCHES NATIONAL PARK UTAH.
Paul Guardy, Superintendant of Arches National Park
William F. Case, Utah Geological and Mineral Survey.

On the 7th of August, 1987, at 6:00 PM, a thunderstorm released a torrent of water which caused over \$60,000 damage to the Moab Highway, U.S. Highway 191, and to a culvert entering Arches National Park, approximately 5 miles north of Moab Utah. The National Weather Service River Forecast Group estimates that approximately 0.75 inches fell from a solitary thundercloud in approximately one hour. The cloud was poised above the junction of the Dead Horse Point State Park/Canyonlands National Park road (Utah State Highway 313) and U.S. Highway 191. Several inches of water covered the highway junction area. During the same day flood waters from a 0.7 inch precipitation event reportedly overflowed a 6 ft. culvert in a remote section of Castle Valley, approximately 30 miles to the southeast.

Two drainages received moisture from the thunderstorm. The largest, Courthouse Wash, carried most of the precipitation volume. The discharge from Courthouse Wash into the Colorado River was so great that the river was partially dammed and water in the river backed up to a depth of 3 feet at the confluence with Courthouse Wash. The wash was large enough to handle the precipitation flow without damage.

Bloody Mary Wash also recieved rainfall. The wash parallels U.S. Highway 191 from the junction with highway 313 to the Colorado River, a few miles north of Moab. Bloody Mary Wash makes a severe bend as it enters Moad Canyon through a normally dry water gap in the cliffs near the Arches National Park visitor's center. A 1000 ft long natural raceway eroded in a limestone member of the Pennsylvanian Hermosa Formation and constriction of flow and a 15-20 ft drop at the water gap worked like the nozzle of a fire hose at the gap. Highway fill and the north lane of U.S. Highway 191 were eroded away as the water ran through the gap, swirled in a plunge pool, and deposited a boulder-bar directly downstream. The water faced one more barrier as it ran toward the Colorado. A culvert constructed by the Civilian Conservation Corps lies beneath the Arches National Park entrance road. The arched opening is about 20 ft square but could not carry the flow. Water backed-up into a large pool, which slowed the flow and may have prevented further damage downstream. The culvert was partially undermined and suffered several thousand dollars damage. Water came within 6 inches of flooding the Arches National Park entrance road. Peak flow in Bloody Marry Wash is estimated to be approximately 54,000 cubic feet/second.

TITLES:

Flash flood waters flowing through the Bloody Mary Wash water gap, looking upstream. Photo by Paul Guardy, 7 August, 1987.

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Flash flood waters below the Bloody Mary Wash water gap flowing away from the observer parallel to the Arches National Park entrance road. Photo by Paul Guardy, 7 August, 1987

Flash flood waters below the Bloody Mary Wash water gap flowing away from the observer parallel to the Arches National Park entrance road. Photo by Paul Guardy, 7 August, 1987

U.S. Highway 191 damage at the Bloody Mary Wash water gap of Bloody Mary Wash. Photo by Paul Guardy, 7 August, 1987

U.S. Highway 191 damage at the Bloody Mary Wash water gap of Bloody Mary Wash. Photo by Paul Guardy, 7 August, 1987

Boulder-bar deposited by flood waters directly below the Bloody Mary Wash water gap. Photo by Paul Guardy, 7 August, 1987

Antidunes in flood water in Moab Canyon, below the Bloody Mary Wash water gap. Photo by Paul Guardy, 7 August, 1987

Antidunes in flood water in Moab Canyon, below the Bloody Mary Wash water gap. Downstream view. Photo by Paul Guardy, 7 August, 1987

Antidunes in flood water in Moab Canyon, below the Bloody Mary Wash water gap. Downstream view. Photo by Paul Guardy, 7 August, 1987

Antidunes in flood water in Moab Canyon, below the Bloody Mary Wash water gap. Downstream view. Photo by Paul Guardy, 7 August, 1987

Culvert under Arches National Park entrance road, downstream side, after the flood. Photo by Paul Guardy, 7 August, 1987

Culvert under Arches National Park entrance road, upstream side, after the flood. Photo by Paul Guardy, 7 August, 1987

Bloody Mary Wash water gap through which flood waters flowed causing \$60,000 damage to U.S. Highway 191. Arches National Park visitor's center and entrance road is in the middle distance to the right in Moab Canyon. Photo by Paul Guardy, 7 August, 1987

View of Bloody Mary Wash water gap and geology of area. Water gap is in Hermosa Formation (Pennsylvanian).

P. Guarby

On the 7th of August, 1987, at 6:00 P.M., a thunderstorm released a torrent of water which caused over \$100,000 damage to the Moab highway (U.S. Highway 191) and to a culvert entering Arches National Park. The National Weather Service River Forecast group reported that 1-1.5 inches of rain fell from a solitary thundercloud in approximately one hour. The cloud was poised above the Dead Horse Point/Canyonlands National Park Road (Utah State Highway 313) and the Moab Highway. Several inches of water covered the highways at the junction.

There are two main channels to the Colorado River from this location. Courthouse Wash is the larger and drains through Arches National Park with its mouth near the Moab Highway bridge. Bloody Mary Wash drains along the side of the Moab Highway past the Visitor Center to Arches.

Courthouse Wash is the larger of the two and in this case carried a greater volume of runoff. Witnesses reported that it's discharge into the Colorado River was so forceful that it acted as a dam. Normal river flow was stopped and the Colorado rose about three feet above this point. Courthouse Wash is large enough to handle this volume and suffered no damage.

Bloody Mary Wash is much smaller and could not handle the run off from the thunderstorm. This wash makes a severe bend as it enters Moab Canyon (Arches National Park Visitor Center area) and is squeezed through a narrow opening in the cliffs. Constriction of the water and a 15-20 foot drop in elevation worked like the nozzle of a high pressure hose. Highway fill and the north lane of the Moab Highway were eroded away as the water ran through the gap, swirled in a plunge pool, and left a boulder-bar directly downstream. The water faced one more barrier as it ran toward the Colorado. A culvert constructed by the Civilian Conservation Corps lies under the Arches National Park entrance road. The arched opening is about 20 feet by 20 feet but could not carry the flow. Water was backed into a large pool, which slowed the flow and may have prevented further damage downstream. The culvert was partially undermined and suffered several thousand dollars worth of damage. Water came within 6 inches of flooding the Arches National Park road.

Peak discharge is estimated to be approximately 54,000 cfs, as much as if a 35 foot high dam had instantaneously failed.

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August Flash Flood Causes Highway Damage Near Moab
William F Case, Utah Geological & Mineral Survey

On the 7th of August, 1987, at 6:00 PM, a thunderstorm released a torrent of water which caused over \$60,000 damage to the Moab highway (U S Highway 191) near the Arches National Park entrance. The National Weather Service River Forecast group reported that 1-1.5 inches of rain fell from a solitary thundercloud in approximately one hour. The cloud was poised above the junction of the Dead Horse Point/Canyonlands National Park road (Utah State Highway 313) and the Moab highway. Several inches of rainwater covered the highways at the junction. Part of the rainfall accumulated in an small, 2 mi², unnamed drainage basin and rushed down a normally dry channel which parallels the Moab highway. The channel and highway make a severe bend and squeeze through a narrow gap in the surrounding cliffs before entering Moab Canyon where the Arches National Park entrance is located. Highway fill and the east lane of the highway were eroded at the gap as flood waters flowed over a 15 ft limestone bench, swirled in a plunge pool, and rushed through the constriction leaving a boulder-bar directly downstream. Water flowed in a natural raceway eroded in the limestone for about 1,000 ft upstream of the falls. Peak discharge is estimated to be approximately 54,000 cfs, as much as if a 35 ft high dam had instantaneously failed. Once beyond the gap flood waters spread out on the wide Moab Canyon floor and made their way to the Colorado River peacefully, although they missed flooding the Arches National Park road by only 6 inches in depth.

CALCULATIONS:

Location of cross-section: at U-10 marking on rock, 450 ft from waterfall and highway damage area.

Manning n=0.025 (streambed of bedrock (Ls) and sand)

Slope, s=0.03 ft/ft; (elevation change=480 ft (4600-4120 ft), horizontal distance=16,000 ft)

Depth of channel, d=8 ft; Width of channel, w=43 ft; Area, A=344 ft²; Hydraulic Radius, R=59 ft, note: channel is rectangular in x-section.

Peak discharge formula: (Mannings equation of flow)

$$Q \text{ (cfs)} = (1.49/n) * (A) * (R)^{0.67} * (S)^{0.5}$$

$$Q \text{ (cfs)} = (59.6) * (344) * (15.4) * (0.17) = 53,675 \text{ cfs.}$$

Dam height formula: (Bureau of Reclamation, Guidelines for defining inundated areas downstream from Bureau of Reclamation dams, 1982).

$$\text{Discharge} = 75 * (\text{depth})^{1.85}$$

REFERENCES:

NWS River Forecast office, 524-5133 (William J Alder).

Arches National Park Office, 259-8161 (Paul Guardy, superintendent).

PICTURES:

W F Case: (taken 20 August, 1987)

1. Eroded highway fill and plunge pool area looking downstream.
2. Eroded highway, plunge pool, and Arches National Park entrance, looking downstream.
3. View looking upstream into plunge pool, waterfall, and eroded fill. Boulder-bar deposited beyond gap is evident.
4. Upstream view of plunge pool with boulder strewn floor, waterfall, and hanging guard rail.

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