

# Overview of Runoff of March 11, 1995, in Fortymile Wash and Amargosa River, Southern Nevada



U.S. Department of the Interior—U.S. Geological Survey

Yucca Mountain, approximately 120 miles northwest of Las Vegas, Nev., is being studied by the U.S. Department of Energy as a potential repository for long-term storage of the Nation's high-level nuclear waste. This site-characterization study includes elements pertaining to surface-water runoff, including the potential for flooding. The U.S. Geological Survey (USGS), in cooperation with the U.S. Department of Energy, is monitoring streamflow in southern Nevada through a network of streamflow gaging stations and miscellaneous streamflow measurements in support of the site-characterization effort.

Yucca Mountain and much of the western part of the Nevada Test Site (NTS) are part of the Amargosa River drainage. The Amargosa River is a major drainage component (more than 5,000 mi<sup>2</sup>) of the unique closed-basin, hydrologic regime known as the Great Basin. Fortymile Wash and Beatty Wash (fig. 2) are the major tributaries to the upper Amargosa River, which drains through several small, populated areas downstream. This river system terminates in Death Valley, a National Park with an expanding tourist population.

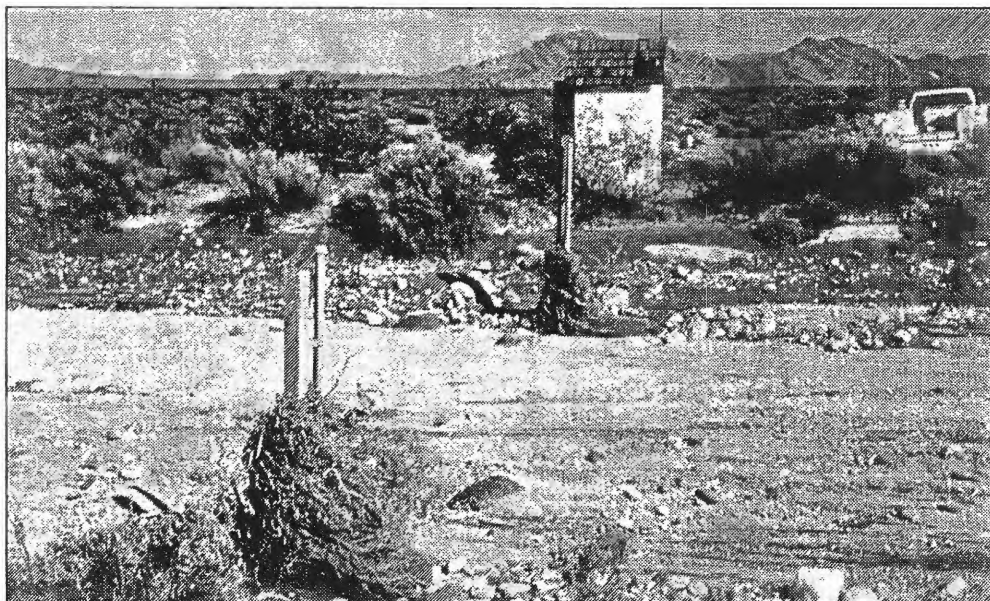
The rugged and sparsely vegetated Amargosa River drainage is within the rainshadow of the Sierra Nevada. As a result of dry, semi-arid, continental climate, flow of the Amargosa River is ephemeral except in a few relatively short reaches where discharging springs maintain small, perennial base flows. Prior to Yucca Mountain site-characterization studies, few data were available on the streamflow of the Amargosa River and its major tributaries. Flow characteristics of the basin are generally poorly understood.

Near U.S. Highway 95, the Fortymile Wash channel changes from being moderately confined to several distributary channels that are poorly confined. This poorly defined, distributary-drainage pattern persists downstream to its confluence with the

Amargosa River. Streamflow losses to infiltration and evaporation within this reach are high (Savard and Beck, 1994). The Amargosa River is likewise moderately confined upstream from Big Dune (fig. 2). Downstream from Big Dune, the river splits into several channels that are poorly defined through the Amargosa Valley farm area. These areally abrupt changes in flow-pattern and channel-geometry characteristics of Fortymile Wash and the Amargosa River, wherein moderately to well-defined channels evolve downstream into poorly defined channels, cause uncertainty regarding flow continuity within and between the two drainages. Major questions throughout the Yucca Mountain site-characterization studies are whether, under the present climatic regime, Fortymile Wash is capable of flowing to the Amargosa River, and whether Amargosa River is similarly capable of flowing from its source to Death Valley.

The runoff of March 11, 1995, provided answers to these questions about flow continuity (fig. 1). Precipitation associated with a weather disturbance moving eastward from California caused the most extensive regional runoff in Fortymile Wash and Amargosa River (fig. 2) since February 1969. Preliminary data reported for selected USGS and NTS rain gages within the study area showed that cumulative precipitation ranged from about 2 to 6 inches during March 9-11, with the larger amounts falling at the higher-altitude sites. Eyewitness accounts of snowpack conditions on Timber Mountain and Pahute Mesa just before and after the storm indicate that, in addition to rainfall, high-altitude snowmelt probably contributed to the volume of runoff in Fortymile Wash and Beatty Wash. Runoff of the Amargosa River from Eagle Mountain to Death Valley has been documented several times during site-characterization studies.

The runoff of March 11 is important because it represents the first documented case during site-characterization studies in which Fortymile Wash and Amargosa River flowed

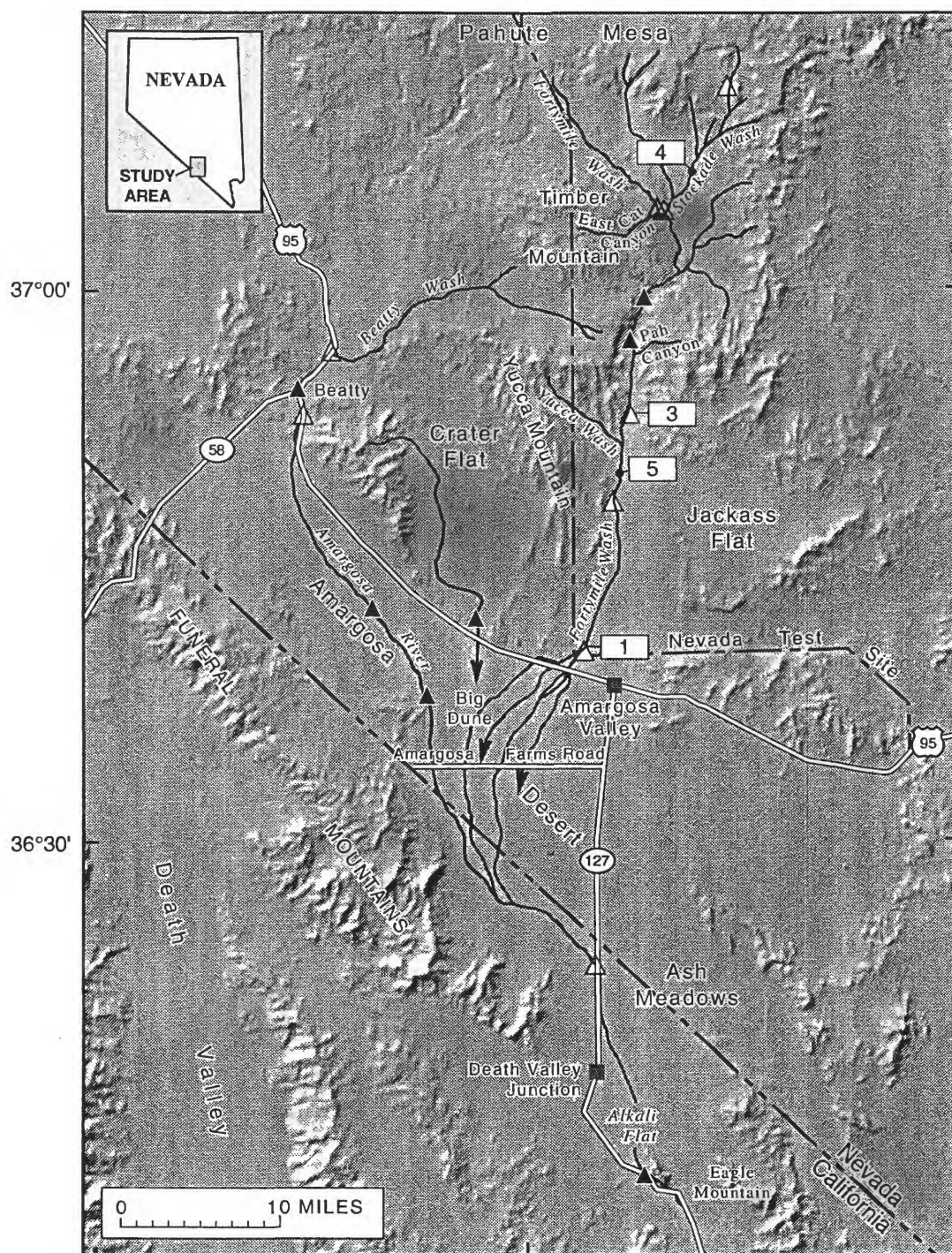


**Figure 1.** Evidence of debris-laden runoff of March 11, 1995, at Fortymile Wash near Amargosa Valley streamflow gaging station above U.S. Highway 95.

117°00'

116°30'

116°00'



Base from U.S. Geological Survey digital elevation data, 1:250,000, 1987, and digital data, 1:100,000, 1981-89; Universal Transverse Mercator projection, Zone 11. Shaded-relief base from 1:250,000-scale Digital Elevation Model; sun illumination from northwest at 30 degrees above horizon

#### EXPLANATION

△ Streamflow recording site

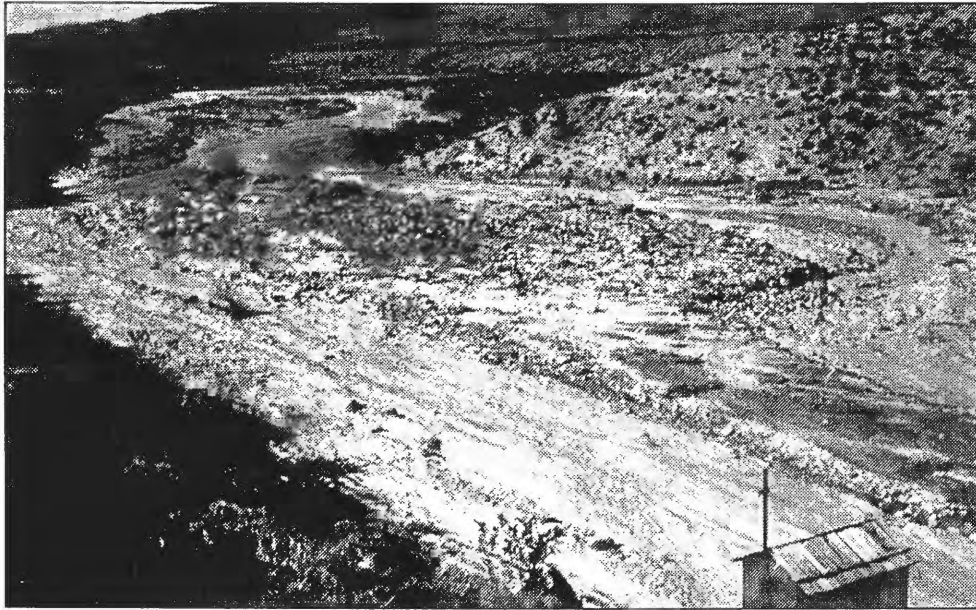
▲ Miscellaneous streamflow measurement site

— Stream channel with flow on March 11, 1995

1 Approximate location of photograph—Number corresponds to figure

**Figure 2.** Geographic setting and surface flow paths during the March 11, 1995, runoff in Fortymile Wash and Amargosa River.





**Figure 3.** Bank erosion and sediment deposition in Fortymile Wash at Narrows as a result of runoff of March 11, 1995.

simultaneously throughout their entire Nevada reaches. These two fluvial systems were last reported to have flowed extensively within Nevada in February 1969 before site characterization started. The 1969 flood is overall the largest known in the Amargosa River system during the last 25 years. Flow in Fortymile Wash was first documented during site-characterization studies in March 1983, shortly before the initial streamflow gaging stations were installed. The Wash had flow again three times during July and August 1984 as the result of severe but localized convective storms. The extent of flows beyond the boundaries of NTS were not investigated for these early 1980's runoffs.

A field reconnaissance after the storm of March 1995 indicated moderate runoff throughout Fortymile Wash (figs. 1 and 2), several of its main tributaries (East Cat Canyon Wash, Stockade Wash, Pah Canyon Wash, and Yucca Wash), and several minor tributaries that drain the eastern flank of Yucca Mountain (fig. 2). The Amargosa River also flowed, from above Beatty past the California-Nevada State line, with a large percentage of the flow contributed by Beatty Wash (fig. 2).

The duration of flow in Fortymile Wash was approximately 10 to 12 hours. U.S. Highway 95 was closed from about 8:00 a.m. to about 5:30 p.m. on March 11 because of the streamflow (Trooper William Graham, Nevada Highway Patrol, oral communication, 1995). All evidence indicated heavy debris transport. Bank erosion and sediment deposition were observed along most of Fortymile Wash (fig. 3) within the NTS with sediment deposits as thick as 5 feet in some areas. Other effects of the Fortymile Wash runoff include damage to the Stockade Wash culverts at Airport Road on Pahute Mesa (fig. 4), sediment deposition on H Road where it crosses Fortymile Wash east of Yucca Mountain (fig. 5) and on Amargosa Farm Road in Amargosa Valley. A near tragedy occurred at the H-Road crossing when an NTS worker was swept away by an initial flow surge while attempting to cross Fortymile Wash during the early morning of March 11. His account of the event described the surge as a "5- to 6-foot wall of water and clattering rocks" followed by a rapidly rising water level that moved at high velocities (Augustine Passalacqua, TRW Environmental Safety Systems, Inc., oral communication, 1995).

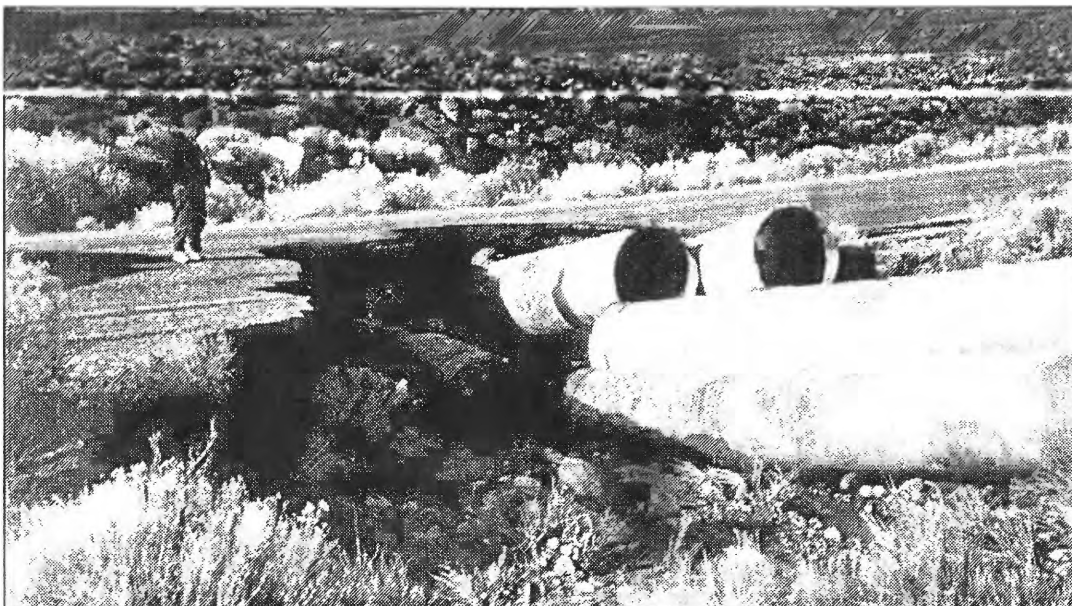
Amargosa River runoff duration was also approximately 10 to 12 hours. Minor bank erosion and sediment deposition were observed along the Amargosa River from Beatty to Amargosa Valley. Amargosa Farm Road acquired additional sediment deposits as a result of the Amargosa River flow.

Peak flow in Fortymile Wash was significantly attenuated when the flow split into several distributary channels near U.S. Highway 95. Peak flow was attenuated further when a part of the distributed flow was diverted to the west for about 6 miles along the north shoulder of U.S. Highway 95 before turning southward again. The Amargosa River peak flow attenuated between Beatty and Big Dune. Downstream from Big Dune, the flow turned southward and split into several shallow distributary channels through the Amargosa Valley farm area.

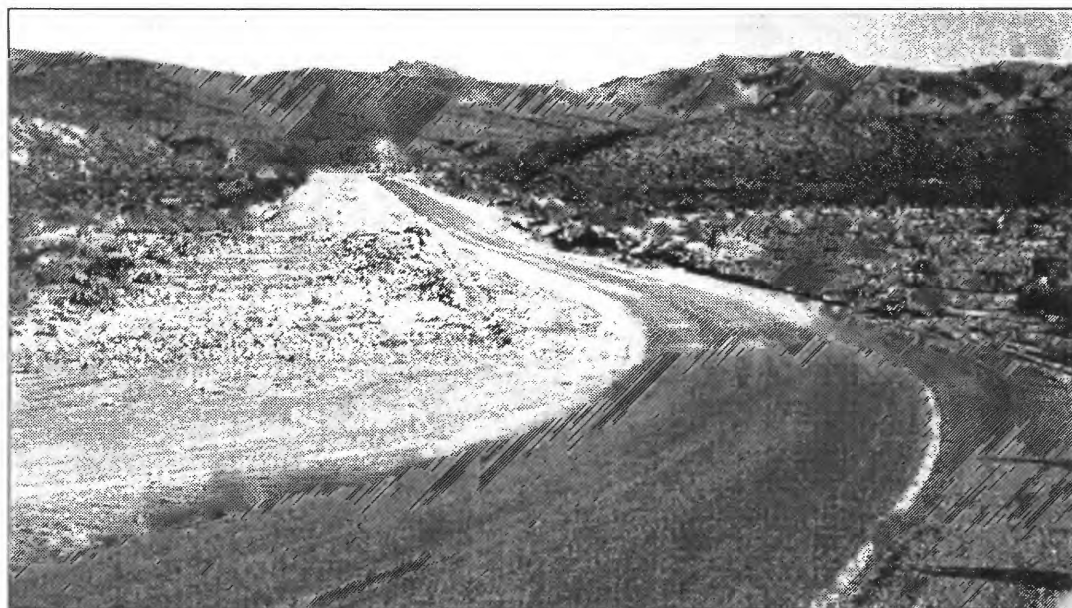
Peak flows for Fortymile Wash and Amargosa River were again attenuated at the confluence of the two streams near the southeast end of the Funeral Mountains. Flow within this broad, flat confluence area was slow and shallow (only inches deep) owing to the absence of well-defined channels and the low land-surface gradient. The merged flow of Fortymile Wash and Amargosa River converged into a shallowly incised, well-vegetated channel just upstream of California Highway 127 and flowed into the broad Alkali Flat near Death Valley Junction. The cumulative Fortymile Wash and Amargosa River runoff flowed through Alkali Flat where it combined with other runoff to the Amargosa River caused by localized precipitation near Eagle Mountain. The multi-source runoff then flowed to Death Valley (Larry Anderson, U.S. Bureau of Reclamation, oral communication, 1995).

The information provided by the USGS surface-water monitoring program documented flow from the headwater areas of Fortymile and Beatty Washes, and the combined flow downstream past Death Valley Junction that resulted from moderate runoff. This documentation confirms that Fortymile Wash and Amargosa River have the potential, in the present climatic regime, to transport dissolved and particulate material beyond the confines of NTS and the Yucca Mountain areas during moderate and more severe streamflow.

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**Figure 4.** Culvert damage from runoff of March 11, 1995, along Stockade Wash at Airport Road, Nevada Test Site.



**Figure 5.** H-Road crossing Fortymile Wash, Nevada Test Site. Debris from runoff of March 11, 1995, was bulldozed to both shoulders of the road. Site is where NTS worker was swept downstream.

## Selected References

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