

DISCUSSION Lees Ferry is in the colorful, relatively open valley of the Colorado River (fig. 1) downstream of Glen Canyon and upstream of Marble Canyon, which is the beginning of the Grand Canyon of the Colorado River. The Paria River, an important tributary, enters the Lees Ferry area through Paria Canyon (fig. 2). Geologic mapping was undertaken to provide information about the age, distribution, and origin of surficial deposits in the near-river environment. Information about recent geologic activity is necessary to understand the rates, magnitude, and processes of environmental change along the river today. This information is also needed to evaluate the consequences of regulated streamflow, which began in 1963 with closure of Glen Canyon Dam (27 km upstream of the map area). The dam controls flooding and cuts off the supply of sediment. The resulting essentially clear water flows are erosive in a river system formerly adjusted to a large supply of sand-size sediment. These regulated flows have the potential to erode and damage the riparian environment, including near-shore archeologic features. The map shows the present configuration of pre- and postdam geomorphic features. This map information is a baseline against which future change resulting from natural causes and regulated streamflow can be measured. The Lees Ferry area is important geologically, culturally, and politically. In terms of surficial geology, the late Quaternary deposits shown on the map record the physical effects of environmental change on the Colorado River, the Paria River, and the relatively small tributaries draining the rim of Glen Canyon. Four types of surficial deposits are important in the landscape of the area: (1) gravels in high level, abandoned, channels of the Colorado River that were deposited during the late Pleistocene, probably in response to glacial activity in the Rocky Mountains; (2) terraces related to accumulation of sand in the channels of the Colorado and Paria River, resulting from changes in streamflow and sediment load; (3) debrisflow deposits at the mouths of relatively small tributaries that form bouldery fan-like surfaces; and (4) late Holocene flood deposits of the Colorado River that were laid down by unusually large floods. These prehistoric floods were substantially larger than the largest historic flood of July 1884, on the basis of the elevation of the deposits above the historic-age flood deposit

Crampton (1992) and Reilly (1999); important historical sites in the map area are identified and described by Thompson and others (1995). Located between two virtually uncrossable canyons, Glen Canyon and Marble Canyon, this area has been a Colorado River crossing since prehistoric times, even though crossing requires swimming at most river levels. The older river terrace shown on the map was used by prehistoric peoples for camping, probably close in time to fording the Colorado River, as indicated by shallow hearths and other archeologic features. The first written description of the area is the Dominguez-Escalante Journal (Chavez, 1976, p. 93–95), an account of an expedition through the Southwest in 1776. The expedition camped on the banks of the Paria River near the former junction with the Colorado River (fig. 2) from October 27 to November 1, 1776. In late 1871, the now abandoned ferry crossing (on the debris fan near the east boundary of the map area) was established by John D. Lee who also settled Lonely Dell Ranch (north of map area). In modern times, the area is important for recreation including sight seeing, hiking, fishing, and as a launching point for whitewater raft trips through Grand Canyon. Several of the mapped deposits accumulated since the area was visited by the Dominguez-Escalante Expedition. The geopolitical boundary or Compact Point between the Upper and Lower Colorado

The Lees Ferry area has a long and rich cultural history discussed by Rusho and

the seven states (Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, and California) receiving water from the upper and lower basins. To appropriate water, gaging stations that measure streamflow and sediment load were established on the south bank of the Colorado River and on the Paria River about 1 km north of the map area. Changes in streamflow at the gaging stations are described by Andrews (1990; 1991). The long-term streamflow patterns reveal important environmental changes of the 20th century, including arroyo cutting, drought, and the effects of Glen Canyon Dam. Ground control for photogrammetric construction of the topographic base map was done by the Surveying Team of the Bureau of Reclamation, Glen Canyon Environmental Studies (GCES). The deposits were mapped in the field using low-altitude (scale 1:4800) color aerial photographs taken May 30, 1993. The aerial photographs are numbered GCES 10–6 to 10–8 and 11–1 to 11–8. The geologic information was compiled on the base map using a stereo analytical plotter. The dates of the alluvial deposits were determined from dated archeologic remains, historic photographs, content of driftwood, and ring counts of living trees related to deposition

of the alluvium. In addition, the terrace sequence in the Lees Ferry area is similar to a dated terrace sequence in eastern Grand Canyon and Marble Canyon (Hereford, 1996; Hereford and others, 1993; 1996a; 1998), which permits correlation with the dated alluvium. Debrisflow deposits in the map area were subdivided on the basis of the degree of surface weathering and darkness of rock varnish, which was determined using the method of Bull (1991, p. 63-64). Varnish darkness was used to estimate the date of the debris-flow surface on basis of comparison with varnish darkness from dated debris-flow surfaces in eastern Grand Can-

yon and Marble Canyon (Hereford and others, 1996a; 1997; 1998).

36°51´45″

36°51′30″

River Basin is in the Lees Ferry area. A compact drawn up in 1922 allocates water among

We were introduced to the archeology of the Lees Ferry area by National Park Service archeologists Timothy W. Burchette, Helen C. Fairley, Lisa M. Leap, and Lynn A. Neal. These people kindly shared information about the location and age of archeologic sites in the Lees Ferry area. Funding for this research was provided by the Bureau of Reclamation with the support of Signa Larralde and David L. Wegner. Grand Canyon National Park Archeologist Janet R. Balsom developed the program for geoarcheologic research along the Colorado River from Glen Canyon to the mouth of Grand Canyon. REFERENCES CITED Andrews, E.D., 1990, The Colorado River; a perspective from Lees Ferry, Arizona, in Wol-

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PARIA GLEN CANYON PLATEAU NATIONAL RECREATION AREA this map INDIAN RESERVATION

LOCATION OF MAP AREA, WESTERN GRAND CANYON, ARIZONA

5 KILOMETERS

whitewater rafting in the Grand Canyon, and hiking. The area was developed for recreation beginning in 1963. This development resulted in the disturbed areas, roads, parking areas, boat launching ramps, and National Park Service (NPS) facilities shown on the geologic map and figure 1A. Traditional uses were agriculture, livestock raising, hydraulic mining, and transportation. Interestingly, this early activity was less visible in the landscape than development for recreation, as shown by figure 1 (A and B). The landscape of the Lonely Dell Ranch area has changed the least from human activity (fig. 2). Hiking is the principal recreational use of this area, leaving little mark on the landscape, as suggested by figure 2A. The once productive agricultural fields near the ranch are now abandoned (fig. 2B). The orchards are maintained by the NPS, but the surrounding fields are not irrigated or planted. Future NPS plans include small native grass plots for restoration projects (K. Crumbo, oral commun.). The channel of the Colorado River is substantially narrower than in 1921 (fig. 1). The width of the channel immediately downstream of the right-bank cableway is about 50 m less than in 1921. Most of this decrease is from aggradation of the pre-dam terrace (pt) on a sand bar visible in the 1921 photograph (fig. 1B). Aerial photographs show that the former sandbar had become vegetated by at least 1937. The relatively low flows after the 1921 flood of 6,250 m^3/s (220,000 ft³/s) resulted in deposition of sand on a floodplain in the former channel adjacent to the terrace rise of the intermediate terrace (it). The pre-dam terrace (pt) has evidently been little affected by regulated streamflow since closure of Glen Canyon Dam in 1963. Steep banks have been cut into the terrace; otherwise it has not been eroded any more than the width of the post-dam zone (pdz), which varies from 0–20 m at this locality. Vegetation on all the terraces has also changed substantially. In 1923, sandbar willow was the dominant shrub and saltcedar was probably absent (Turner and Karpiscak, 1980), whereas today saltcedar is the dominant shrub and less than two dozen willow remain only as stumps in the mapped area. The channel of the Paria River is also substantially narrower than in 1921 (fig. 2). This decrease in channel width began during the early 1940s (Hereford, 1986). Aggradation along with narrowing of the former channel (fig. 2A) built up the modern terrace of the Paria River (pmt). In addition, the junction of the Paria with the Colorado River shifted southwest 1.5 km (0.9 mi) in 1912 according to Reilly (1999). A photograph taken in 1873 (Turner and Karpis-

cak, 1980, fig. 32A) shows the mouth of the river southwest of the long-term parking lot, on

what is now the pre-dam terrace. This junction was abandoned after 1912 and before 1917 and

was subsequently covered by deposition of the pre-dam terrace (pt) and modern terrace of the

Present (1996) and Past (1921) Views of the Lees Ferry Area

past 75 years (figs. 1 and 2). These rematched photos capture two unrelated types of change.

width of the channels of the Colorado and Paria Rivers.

The landscape reflects changes in local land use along the Colorado River and a decrease in the

The landscape of the Lees Ferry and Lonely Dell Ranch area has changed noticeably in the

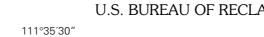
Present land use is now almost entirely recreational, involving fishing, launching point for

SCALE 1:2 000 CONTOUR INTERVAL 1 METER NATIONAL GEODETIC VERTICAL DATUM OF 1929

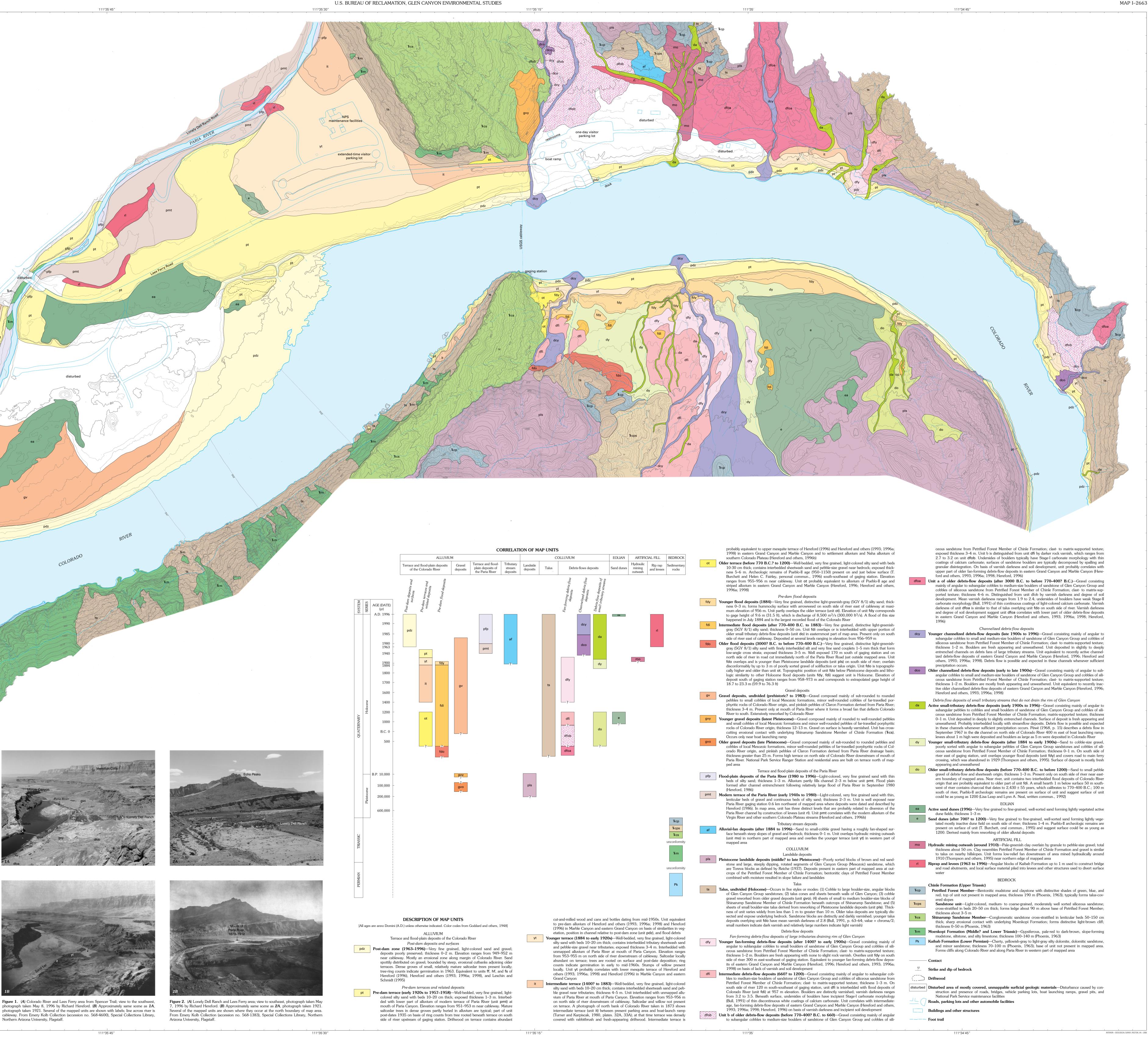


111°36′ 111°36′15″ Compiled by Photogrammetry Section, Branch of Astrogeology, Flagstaff, Arizona Aerial photography of 5 May 1993, Approximate scale 1:4,800 Ground control by Glen Canyon Environmental Studies Survey Department

Paria River.



Prepared in cooperation with the





MAP SHOWING QUATERNARY GEOLOGY AND GEOMORPHOLOGY OF THE LEES FERRY AREA, ARIZONA

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