

**GEOLOGY AND PRODUCTION HISTORY
OF THE BIG FOUR NO. 2 URANIUM
MINE NAVAJO COUNTY, ARIZONA**

by

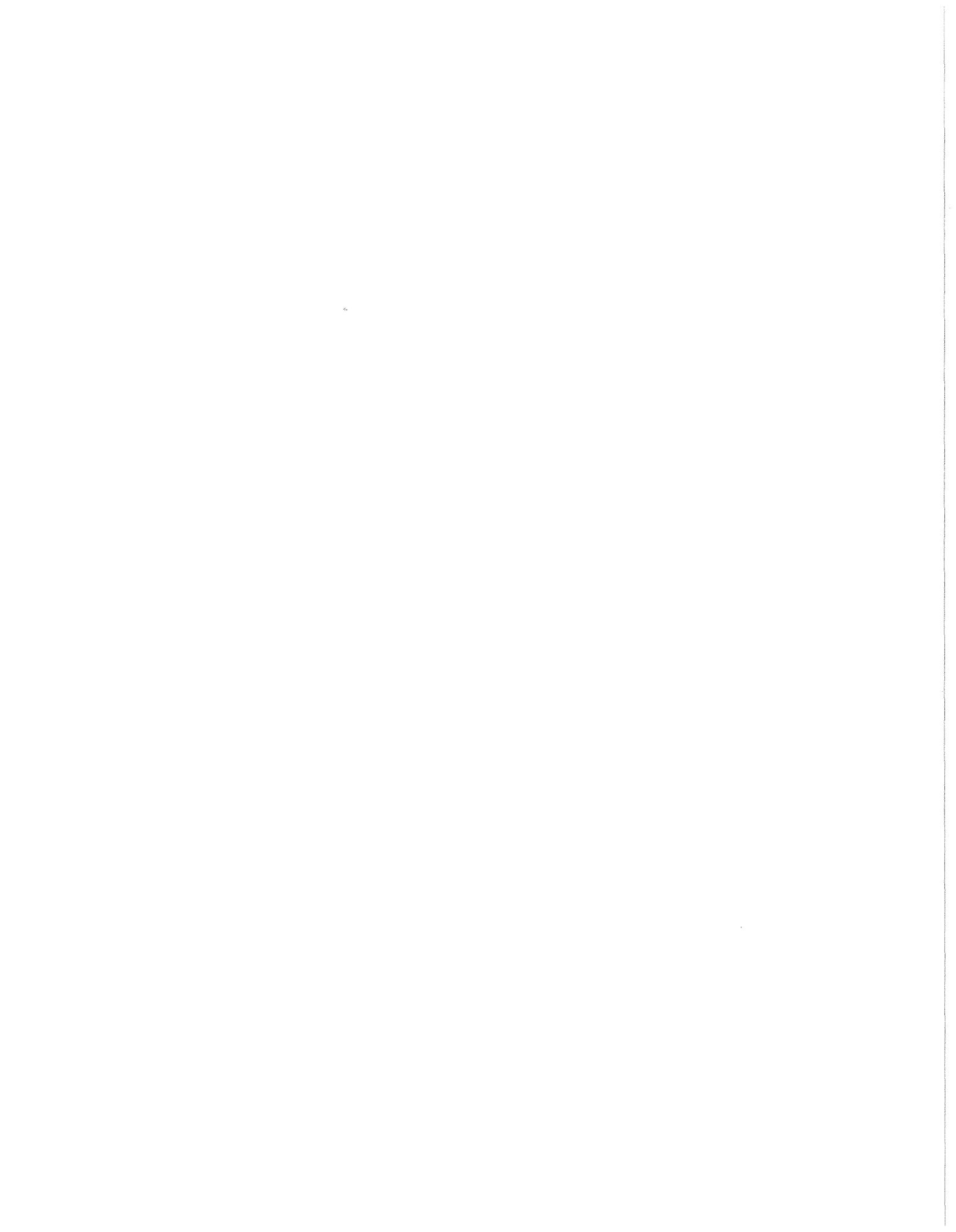
William L. Chenoweth
Consulting Geologist, Grand Junction, Colorado

Arizona Geological Survey
Contributed Report 94-G
September 1994

Arizona Geological Survey
416 W. Congress, Suite #100, Tucson, Arizona 85701

*Interpretations and conclusions in this report are those of the consultant
and do not necessarily coincide with those of the staff of the Arizona
Geological Survey*

This report is preliminary and has not been edited
or reviewed for conformity with Arizona Geological Survey standards



INTRODUCTION

The Big Four No. 2 Mine was one of several uranium deposits located by exploration drilling in the Oljeto syncline area of Monument Valley, Navajo County, Arizona. Of all of these deposits, it was one of the smallest to be mined. In his compilation of data of uranium in Arizona, Scarborough (1981, p.218) confused the Big Four No. 2 mine with the Sunlight mines on the Big Four No. 1 claim, and his data is misleading.

A map of the underground workings (Figure 1) and other data pertaining to the Big Four No. 2 Mine were recently discovered in the files of the U.S. Geological Survey (USGS) at the Denver Federal Center.¹ Warren I. Finch of the USGS permitted me to copy the map for the Arizona Geological Survey. Most of the information in this report is from U.S. Atomic Energy Commission (AEC) documents.

LOCATION AND LAND STATUS

The Big Four No. 2 Mine was approximately 15 miles north of Kayenta, Arizona, and 4.5 miles west of U.S. Highway 163 (Figure 2). The mine site has been completely reclaimed but was near the "R" in RESERVATION on the Boot Mesa topographic map (U.S. Geological Survey, 1988).

The mine was within the Navajo Indian Reservation. Mining permits and leases were issued by the Navajo Tribal Council and approved by the Bureau of Indian Affairs (BIA), U.S. Department of the Interior. Mining permits could be obtained by individual Navajos only. Permit holders could assign the mining rights to another individual or a company; like the permits, these assignments had to be approved by the Tribal Council and the BIA. Leases could be issued directly by the BIA. Permits were issued for a 2-year period and could be renewed for an additional 2 years. Leases were issued for periods up to 10 years. No more than 960 acres of tribal land could be held by any one company or individual. Both the permittee and the tribe received royalties from ore production. Based on the mine value of the ore, the tribe received between 10% and 20% royalties and the permittee between 2% and 5% royalties.

In addition to mining permits, the tribe issued drilling and exploration permits. These permits were good for 120 days and were not renewable.

¹ This information is part of the collection of geological data that was moved to the Denver Federal Center by the Department of Energy (DOE). In 1983, the uranium resource and liaison programs of the DOE were transferred from Grand Junction, Colorado, to Washington, D.C. During the next few years, all of the geologic data and publications that the AEC, Energy Research and Development Administration, and DOE had collected and produced from 1947 to 1983 were relocated to the USGS in Denver.

GEOLOGIC SETTING

The Big Four No. 2 ore deposit was one of several uranium-ore deposits that were located by "blind" drilling in the El Capitan Flat area of Monument Valley. The Flat is a large, sand-dune-covered area on the eastern side of Oljeto Wash (Figure 2). Oljeto Wash roughly follows the axis of the Oljeto syncline, which is between the Organ Rock anticline to the west and the crest of the Monument Uplift to the east. Underlying the dune sand in the Big Four area is the Upper Triassic Chinle Formation. Rocks of this formation dip approximately 2° to the west into the syncline (Witkind and Thaden, 1963).

The ore bodies at the Big Four No. 2 Mine were formed in a channel deposit in the basal portion of the Shinarump Member of the Chinle Formation. The channel, approximately 200 feet wide and 100 feet deep, was scoured into the underlying Moenkopi Formation of Lower Triassic age and filled with medium-to coarse-grained sandstone and conglomerate. Carbonaceous plant materials, including fossil logs, are abundant in the channel sediments.

Geologic studies of the Shinarump channels in Monument Valley by Young and others (1964) indicate the Big Four No. 2 deposit is in the same channel containing the Bootjack Mine to the south. North of the Big Four No. 2 mine, this channel merges with the channel containing the Big Chief, Firelight No. 6 and Alma-Seegan Mines at the South Sunlight mine.

The Big Four No. 2 deposit was unoxidized due to a perched water table in the basal Shinarump. Uraninite (uranium oxide) was the principal uranium minerals. Montrosite, a vanadium oxide, was also present, as were copper sulfides such as bornite, chalcocite, and chalcopyrite. Calcium carbonate (CaCO₃) was the principal cementing agent of the sandstone.

PRODUCTION HISTORY

During 1955, numerous Navajos acquired permits to hold land for mining on the sand-covered flats along El Capitan Wash, on the eastern flank of the Oljeto syncline. They applied for these permits in anticipation of exploration drilling that was to be done by companies looking for uranium deposits farther north, near the axis of the syncline. By early 1956, more than 25 square miles on the eastern flank of the Oljeto syncline were claimed by mining permits. Because of confusion and conflicts over permits, the large area west of Oljeto Wash was withdrawn for prospecting and mining by the Navajo Tribal Council on July 19, 1955 (Navajo Tribal Council, 1955).

Navajo Tribal Mining Permit (MP) No. 349 was approved to Roy and Betty Gray on November 19, 1955. This permit covered the 640 acres of the Big Four Nos. 1 through 4 claims (Figure 3). The Industrial Uranium Corporation, Salt Lake City, Utah, did exploration drilling in the area of the permit in 1956. Since this drilling located some uranium ore bodies, the firm requested the assignment of the mining rights to claims Nos. 1, 2 and 4. The assignment was approved by the BIA on September 4, 1956. Since claim No. 1 contained large ore bodies (Sunlight and South Sunlight, Table 1), Industrial

Uranium converted this 160 acres to Lease No. 14-20-5607-2292 on June 27, 1957. The assignment of claims 2 and 4 was canceled and the mining permit expired.

On April 30, 1962, Betty Johnson Gray was issued MP-5702 for the 160 acres of the original Big Four No. 2 claim. Texas Zinc Minerals Corporation obtained a drilling permit for the area of the Big Four No. 2 claim, where earlier drilling by Industrial Uranium had located some uranium mineralization. Texas Zinc's drilling located several small ore bodies. The assignment of the mining rights to MP-570 to Texas Zinc was approved on August 24, 1962.

At that time, Texas Zinc reported to the AEC that since June 26, 1962, drilling had developed 4,500 tons of ore with an average grade of 0.25 percent U_3O_8 . The ore bodies were at a depth of about 200 feet with an average thickness of 2 feet.

Texas Zinc contracted with the Fritz-Erickson Mining Company, Dove Creek, Colorado, to develop and mine the ore bodies. When the operation was examined by AEC geologists and engineers on September 5, 1962, a 450 - foot long decline with a 24 degree declination had been completed. The portal of the decline was in the southwest corner of the Big Four No. 2 claim (Figure 1).

A random room and pillar mining method was used with rubber-tired diesel equipment underground. The mine was operated on a two shift basis with an average of eight men underground and three on the surface each day. Ground water, at the rate of 50 gallons per minute, seeped into the mine workings. The initial shipment of ore to the Texas Zinc mill at Mexican Hat, Utah was made in January 1963. By March, the ore bodies were mined out and the mine was closed. The site was reclaimed and Texas Zinc canceled the assignment of the mining permit on May 3, 1963.

The Big Four No. 2 mine produced a total of 3,929.67 tons of ore with an average grade of 0.26 percent U_3O_8 (Table 1). No information is available on the copper content of the ore. All of the uranium concentrate produced the Big Four No. 2 ore was sold to the AEC. Copper recovered at the Mexican Hat mill was sold to a smelter in Arizona

Table 1 Ore production, Big Four claims, Navajo County, Arizona

MINE	YEARS SHIPPING ORE	TONS OF ORE	POUNDS % U_3O_8	% U_3O_8
Big Four No. 2	1963	3,929.7	20,444.3	0.26
Sunlight	1958-1964	55,023.5	291,461.9	0.26
Sunlight South	1962-1965	28,644.7	171,459.8	0.30

Source: Unpublished ore-production records, U.S. Atomic Energy Commission, Grand Junction, Colorado

² Legal Description of Navajo Tribal Mining Permit No. 570:

"Commencing at Corner No. 1, which point is common to corner No. 4, Big Four No. 1 Claim and which point is S 31° 06'E., 13,350 feet, S 55° 50'W., 9,167 feet and S 38° 08'W., 2,640 feet from the SE corner Section 31, T.43S., R.15E., Salt Lake

ACKNOWLEDGMENT. The manuscript was reviewed by Stephen M. Richard of the Arizona Geological Survey.

REFERENCES

- Navajo Tribal Council, 1955, Resolution of the Advisory Committee of the Navajo Tribal Council No. AGJ-26-55, 1p.
- Scarborough, R.B., 1981, Radioactive occurrences and uranium production in Arizona, final report: Arizona Bureau of Geology and Mineral Technology Open-File Report 81-1, 297 p., scale 1:250,000, 21 sheets.
- U.S. Geological Survey, 1988, Boot Mesa quadrangle, Arizona-Utah: 7.5-minute series (topographic), provisional, scale 1:24,000.
- Witkind, I.L., and Thaden, R.E., 1963, Geology and uranium-vanadium deposits of the Monument Valley area, Apache and Navajo Counties, Arizona, with sections on Serpentine at Garnet Ridge, by H.E. Malde and R.E. Thaden, and Mineralogy and paragenesis of the ore deposit at the Monument No. 2 and Cato Sells mines, by D.H. Johnson: U.S. Geological Survey Bulletin 1103, 171p., 7 sheets.
- Young, R.C., Malan, R.C., and Gray, I.B., 1964, Geologic map showing uranium deposits and Shinarump channels in the Monument Valley district, San Juan County, Utah, Navajo and Apache Counties, Arizona: U.S. Department of Energy Preliminary Map 34, scale 1:95,000.

Baseline and Meridian; thence S 51° 52' E., 2,640 feet to corner No. 2; thence S 38° 08' W., 2,640 feet to corner No. 3; thence N 51° 52' W., 2,640 feet to corner No. 4; thence N 38° 08' E., 2,640 feet to corner No. 1, the point of beginning, contains 160 acres, more or less."

- From the files of the Navajo Tribal Mining Department, Window Rock, Arizona.

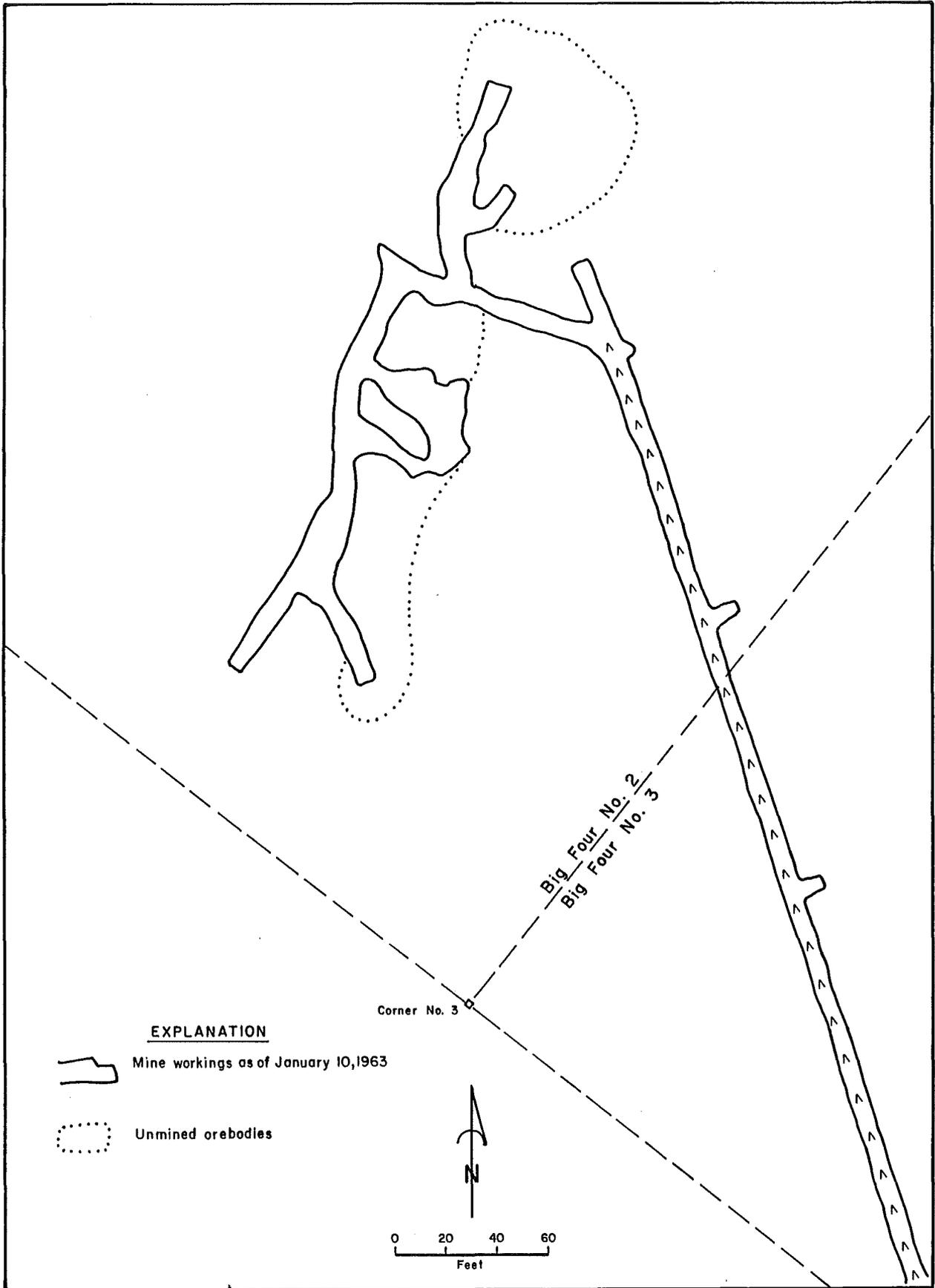


Figure 1. Plan map of the Big Four No. 2 uranium mine ,Navajo County ,Arizona

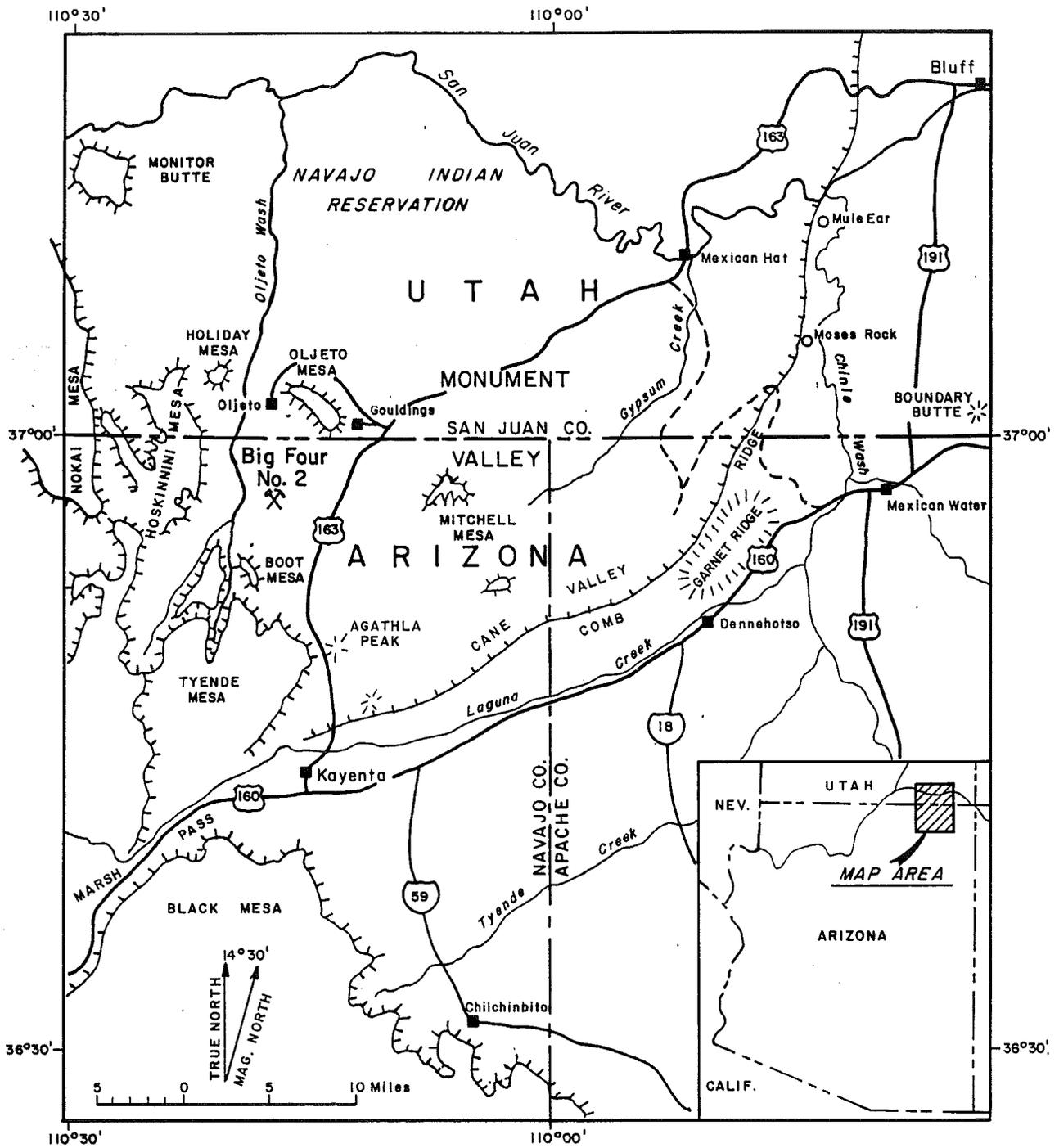


Figure 2. Index map of Monument Valley, Arizona-Utah, showing the location of the Big Four No. 2 uranium mine.

T41N, R19E

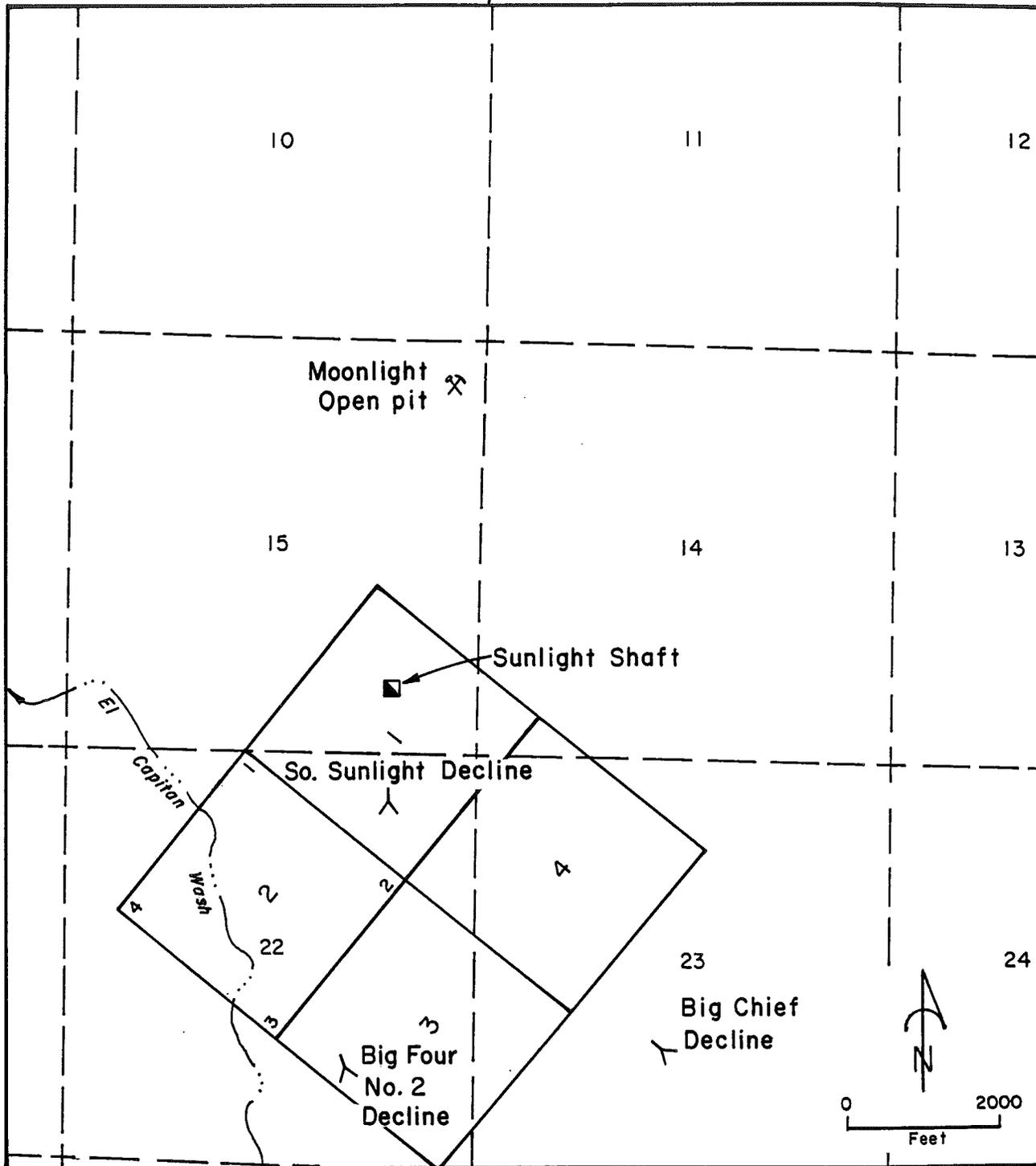


Figure 3. Index map showing the location of the Big Four claims, Navajo County, Arizona, from AEC files