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The Navajo Atlas

THE CIVILIZATION OF THE AMERICAN INDIAN SERIES



The Navajo Atlas

Environments, Resources, People, and History of the Diné Bikeyah

By James M. Goodman

Drawings and Cartographic Assistance By Mary E. Goodman

University of Oklahoma Press : Norman and London

By JAMES M. GOODMAN

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PREFACE AND ACKNOWLEDGMENTS

The Navajo Reservation extends into three states: Arizona, New Mexico, and Utah, and covers nine counties within those states. The reservation is involved in three jurisdictional areas: federal, state, and county. Even so, the realm of Navajo cultural, social, and economic influences goes beyond the reservation to the extent that a true comprehension of Navajo land attributes must include some areas outside the reservation. Given these complexities, an interpretation of Navajo Landthe Diné Bikeyahin atlas form may be useful to both the Navajo and the non-Navajo public.

I conceived the idea for this atlas during a sabbatical leave from the University of Oklahoma in 1973-74, when I discovered that there were few cartographic materials dealing with the Navajos and their land. The atlas began to take shape with the enthusiastic encouragement of Martin A. Link, then director of the Navajo Tribal Museum and Research Department in Window Rock. Sam Day III, director of the Navajo Tribal Office of Business Management, Window Rock, gave help and guidance in obtaining funding for the first summer of data collection.

The Navajo Forest Products Industry of Navajo, New Mexico, provided the initial financial help. The attitude of mutual cooperation exhibited by the Board of Directors of the Navajo Forest Products Industry has carried through the entire project. Many of the non-Indian members of the board are beyond retirement age but continue to offer their services to the Navajo people in a most productive way. Their foresight in perceiving the need for the atlas and their efforts in its production make it a contribution of many persons.

The University of Oklahoma Research Council has supported the project through two separate grants. The Office of the Provost and the College of Arts and Sciences of the University of Oklahoma each funded research proposals relating to the project. The Science and Public Policy Program of the University of Oklahoma also provided materials and travel support in connection with another research project, which made it possible to update statistics for the atlas.

Mary E. Goodman, my wife, has contributed greatly to the completion of the atlas through her unselfish donation of more than two years of cartographic work. She also produced the drawings used in the book. Without her assistance the project never could have been completed.

Professor Jimmie L. Rogers of Edmond, Oklahoma, provided valuable assistance in collecting environmental information relating to soils and vegetation. His assistance with the soil map and the profile of the Chinle Valley and the Chuska Mountains is gratefully acknowledged. Claren M. Kidd, head of the Geology-Geophysics Library, the University of Oklahoma, provided indispensable aid in my research on mineral resources. Her cheerful and valuable assistance was of great benefit. Acknowledgment is made for help and constructive criticism offered by M. Richard Hackett, Johnie Shaw, Bill Gribb, and Ed and Shirley Pugh; they, together with Jimmie Rogers, made the long weeks spent in the field a very pleasant experience. Caroline Kline was a helpful critic in proofing early drafts of the maps. Climatic data were furnished by Professor Steve Sutherland of the University of Oklahoma.

A special acknowledgment must be given to the Sisters of the Blessed Sacrament who operate St. Michaels Indian School at St. Michaels, Arizona. They provided lodging and much space for this project during the summer of 1974. Their friendship over the years has made any visit to St. Michaels a very rewarding experience. Special gratitude is also due the Reverend Ned and Charlotte Moore, formerly of the Good Shepherd Episcopal Mission in Ft. Defiance, for their hospitality on many occasions.

The help provided by persons in Window Rock, Phoenix, and Flagstaff, Arizona; Santa Fe, Farmington, and Gallup, New Mexico; and Salt Lake City, Utah, has been too great to acknowledge properly in this space. Many city, county, state, and federal employees tolerated my numerous inquiries and responded quickly to my requests for help.

But the greatest insights into Navajo country have been given by the People, the Navajos themselves, who have shared their time and information with me people like Wade Hadley, who guided me over the remote sections of Black Mesa; Charley Billie, who took time to talk about the land and the people's attitude toward it; and Mae Yazzie John, Stella B. Brown, and others, who shared their friends and families and made it possible to develop a real sense of place of Navajo Land. To all these go my greatest thanks.

Readers of this atlas will become aware that Navajo place names are not spelled the same on all the maps. No standardization for cartographic use has been established. Navajo is a nonwritten language, hence phonetic spelling of Navajo names uses English alphabetic characters. For example, the community of Tees Too (the spelling used in the atlas) has been variously spelled in the following ways: Teec Too, Teech Toh, Tees Toh, Teas Too, Teas Toh, and Teestoh. Spelling practices vary with the

agency responsible for the maps. Where the Navajo tribal government spelling differs from the most common form, the tribal form is used, especially in such matters as organized political discussions. Thus on the map of Navajo Chapters, the Chapter name is spelled Teestoh. However, all the variant spellings used in the atlas are listed in the index, using the common form employed on either Navajo tribal maps or county highway maps as the preferred spelling.

NORMAN, OKLAHOMA
JAMES M. GOODMAN

PART I
NAVAJO COUNTRY



Photograph opposite. *A portion of Navajo country as seen from the Skylab project in September; 1. The brightly lighted east-facing escarpment of Piute Mesa is detailed in the right-hand (western) side of the photograph. The names of Piute and No Mans (bottom center) mesas suggest, with their names, the remoteness and isolated nature of the area. The western portions of Monument Valley are seen in the left side of the photography. The border between the Navajo and Hopi Indian reservations runs through the center of the area.*

Introduction to Part I

In a country that was once dominated and occupied by the American Indian, the Navajo Indian Reservation today stands as the largest remnant of Native American land. The evolution of American Indian Reservations has been strongly influenced by land ethics of the American populace and their elected representatives, and by the nature of the physical environment. These factors saw the removal of most Native American groups from their traditional homelands. Restriction of Indian groups to specified areas reservations was initiated in the early 1800s. Later, as pressures for land grew, the practice of establishing reservations became politically unpopular.

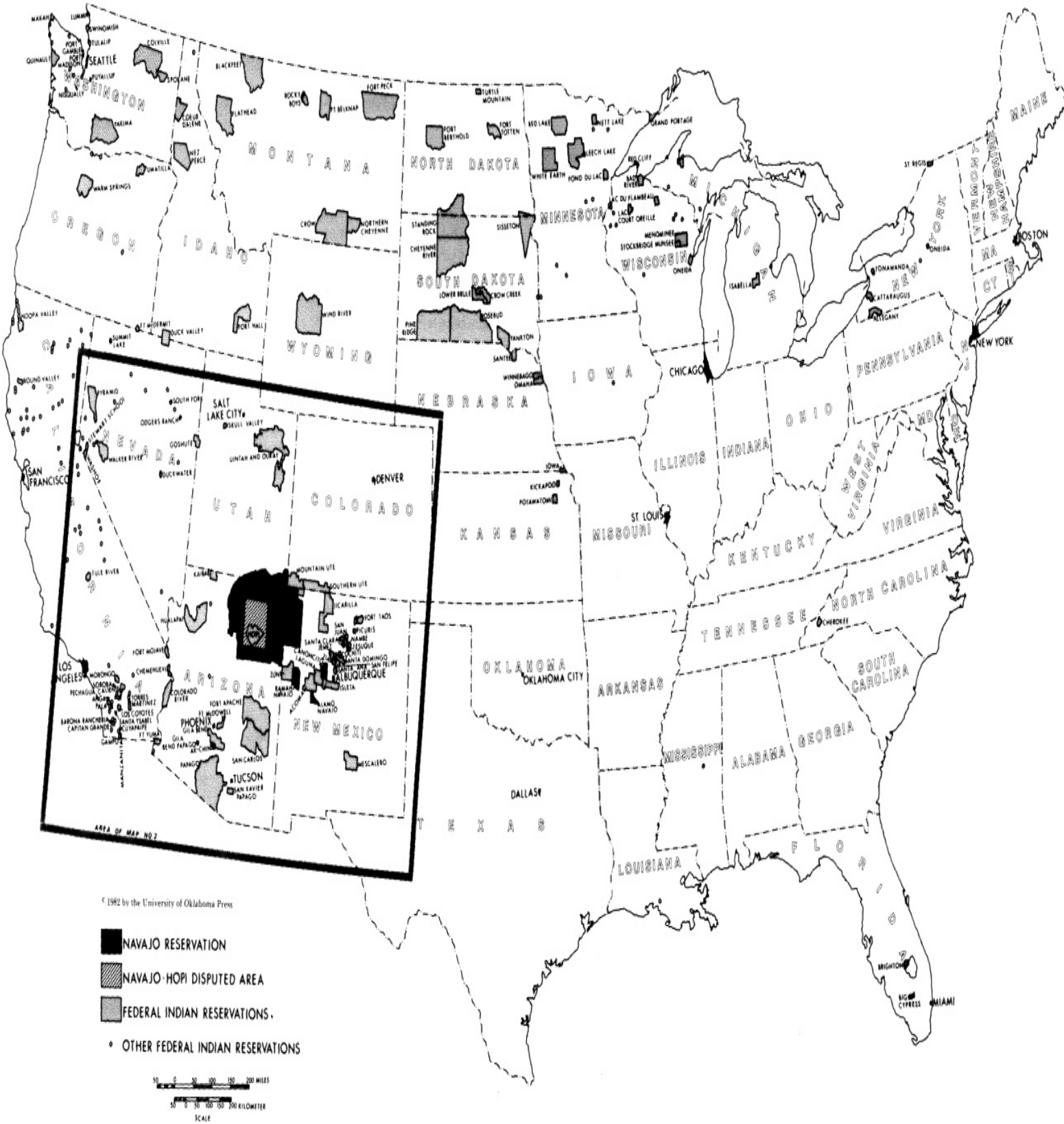
As the United States acquired areas westward from the initial thirteen states, a primary objective was to resettle Indian tribes from the east into western undeveloped areas. Indian removal from the east was almost completed by 1850. As the first map in this atlas shows, most Indian reservations lie west of the Mississippi River.

When the westward expansion of the United States reached the Great Plains and encountered the Spanish-Mexican areas of the American Southwest, attitudes within the federal government shifted the emphasis from relocation to the establishment of reservations in the areas that the tribes occupied. Furthermore, the westward expansion of non-Indian America became a leap-frogging operation when settlement advanced to the Great American Desert and news of prime agricultural lands in Oregon and gold in California reached the migrants from the east. The sparsely populated vacuum-like space between the Eastern woodlands and the West Coast valleys and shoreline became the site of most of the large reservations in the states of Idaho, Montana, North Dakota, South Dakota, Nevada, Utah, Colorado, Arizona, New Mexico, and central and eastern Washington and Oregon. Major portions of these lands are semi-arid to arid grasslands, desert basins, high plateaus, and mountainous uplands.

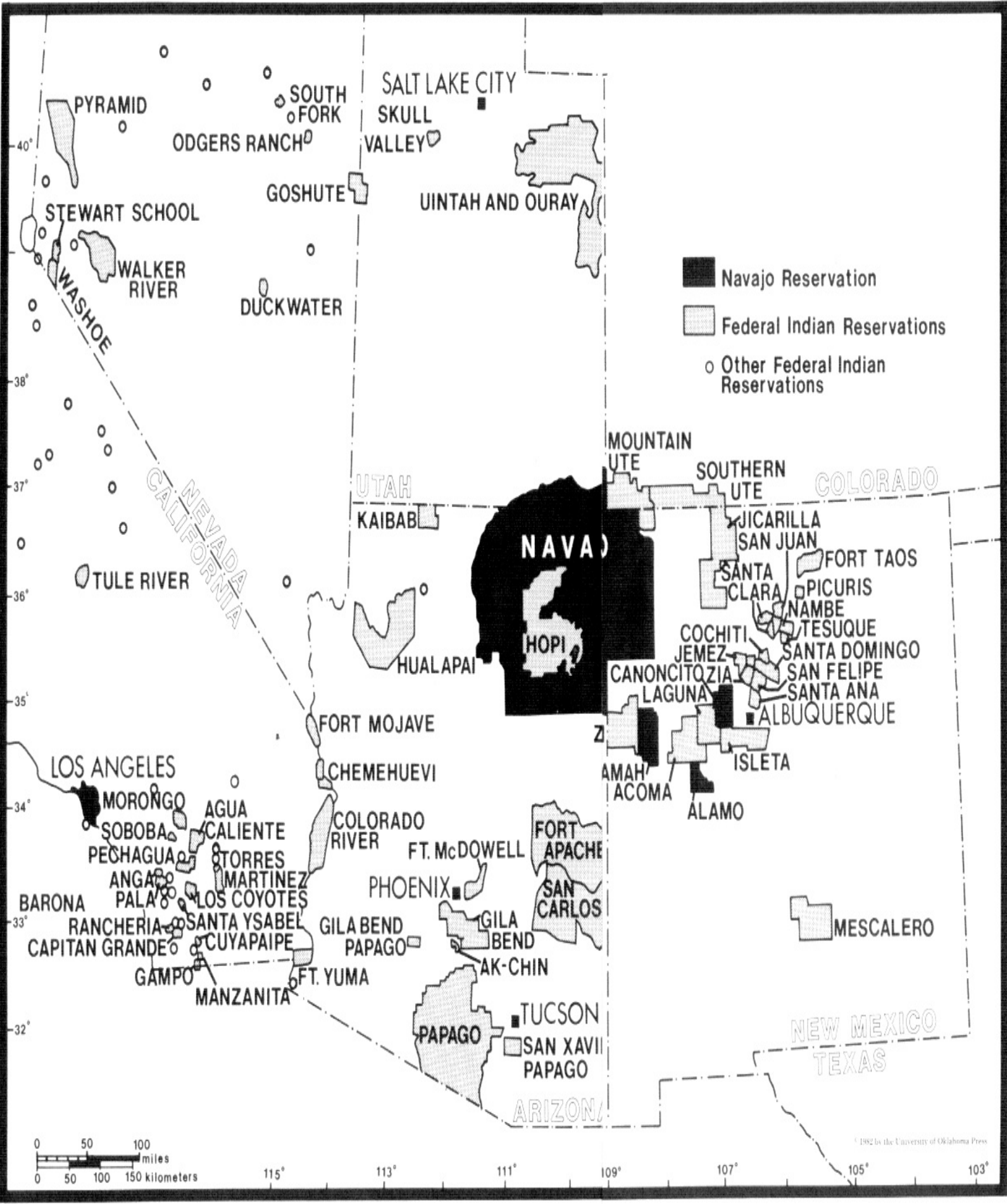
The Navajo Reservation is the largest Indian reservation. About 25,000 square miles of reservation lands extend across northeastern Arizona and adjacent New Mexico and Utah. The reservation has an area that is larger than several states. West Virginia is about the same size as the Navajo Reservation. The human population density of the reservation is about six people per square mile, a greater density than Nevada, but far below the average of about sixty people per square mile for the entire United States.

The Navajo Reservation is introduced to the readers of this book through the use of maps at several levels of scale. First, at the conterminous United States scale, with most Indian reservations displayed (Map 1). Second, at the regional scale, the situation of the Navajo land is displayed in its relationship to other Indian reservations of the American Southwest, the major physical areas, transportation networks, and urban areas (Maps 2 and g). Third, the scale increases to the Diné Bikeyah, or Navajo Land, to show the area occupied by the Navajo Reservation and the surrounding border towns where Navajo cultural, economic, and political influence is great (Map 4). Fourth, the scale is further increased to examine in more detail some of the place locations within the Diné Bikeyah that would be hopelessly lost on smaller-scale maps (Maps 5 through 9).

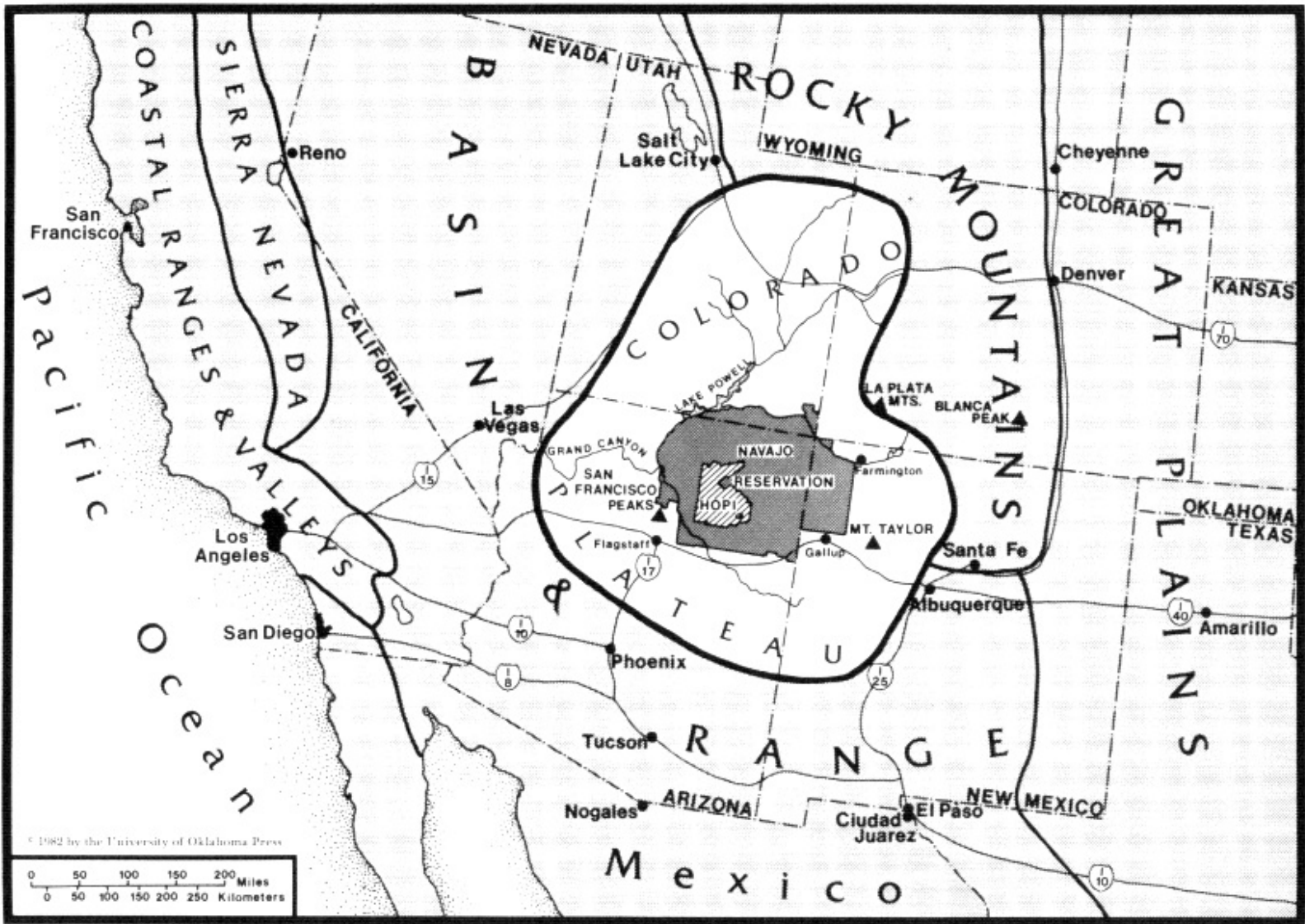
Administrative and political sub-divisions of the Navajo Reservation are presented on the final four maps of Part I. Each of these maps will be of use to the reader when other topics are considered.



Map 1.
Indian Reservation of the Conterminous United States



Map 2.
Indian Reservations of the American Southwest



Map 3.
Navajo Country: Location in the American Southwest

Navajo Country: Location in the American Southwest

The Navajo Reservation is situated in the south central portion of the Colorado Plateau (Map 3). The Colorado Plateau stands above the warmer and drier areas of the Basin and Range country and below the higher, snowy summits of the Southern Rocky Mountains.

The Basin and Range is a region of landforms composed of alternately upward and downward faulted blocks of the earth's crust that generally form linear mountain ranges with valleys, or basins, between. As the ranges are eroded, the basins are filled with sediments from them. The Basin and Range region extends from southern Oregon and Idaho southward through Nevada, western Arizona, central and southwestern New Mexico, and into Mexico.

The Southern Rocky Mountains, which extend from south central Wyoming through Colorado into northern New Mexico, are the highest of the four major landform divisions of the Rocky Mountains.

The Colorado Plateau, the site of Navajo Land, is surrounded on the west, south, and south-east by the Basin and Range region, and on the north and east by the Middle and Southern Rocky Mountains. Deep canyons, steep escarpments, and prominent buttes, all formed of colorful rock layers, are the hallmark of Colorado Plateau scenery. The Navajo Reservation lies to the east and south of the major canyon areas, occupying the uplands between the San Juan River and the Little Colorado River.

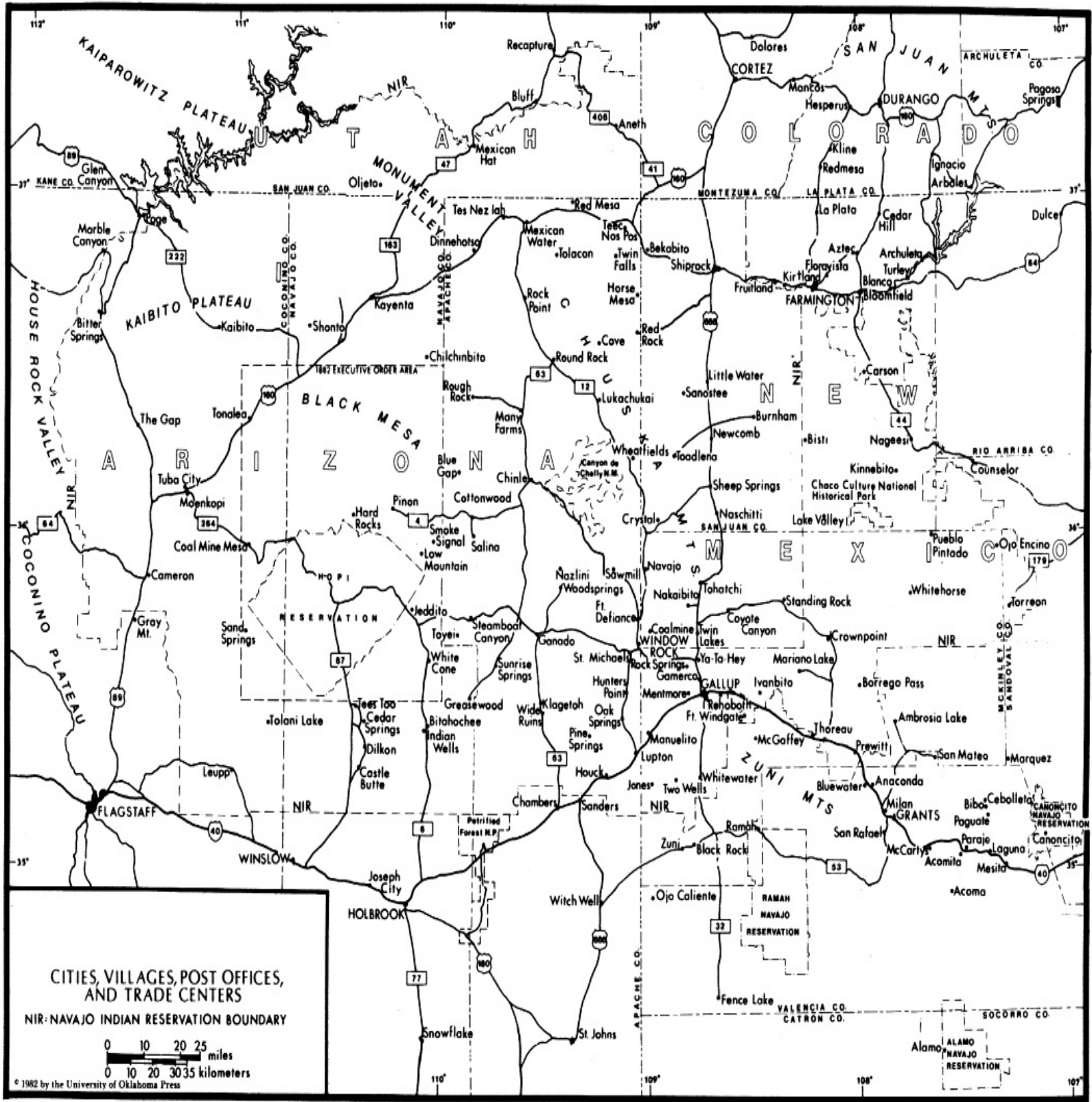
Most major transcontinental transportation routes bypass the Navajo area to focus on corridors between Los Angeles, Phoenix, Salt Lake City, and Albuquerque.

Routes radiate to the northeast and east from a concentration of transportation networks in southern California. Three major Interstate highways fan out across the Southwest. One of these, Interstate 40, passes near the south edge of the reservation and forms a vital link to the outside world. However, with the exception of Albuquerque, all of the major urban centers of the Southwest are many hours away by automobile. The reservation is relatively isolated from most major trade and financial centers.

The centrality of Navajo Land to the urban centers identified on the maps is very important when the nature of resources on the reservation is considered. Maps and

discussions in Part V demonstrate the vast reserves of energy-rich minerals beneath the reservation lands. Navajo energy resources are the nearest available to major energy consumption centers in the Southwest such as Phoenix, Tucson, Albuquerque, and Los Angeles.

Most of the northern and western reservation boundary is formed by the Colorado River and its tributary the San Juan River. This fact established the basis for Navajo water rights claims to these streams. In the warm, dry environments of the Southwest, water rights are a matter of survival. Water from the Colorado River basin supplies the needs of a vast population extending from Los Angeles to Southern Arizona, to the east slope of the Rocky Mountains in an area north of Denver, and in north central New Mexico. Large quantities of water are diverted out of the Colorado River and its tributaries: diversion by tunnel under the continental divide and the Rocky Mountains to the Great Plains and to the Rio Grande Basin; from the lower Colorado by aqueduct to Los Angeles and by the Central Arizona Project to south central Arizona. The role of Navajo water rights has been placed in a highly competitive situation. The establishment of water rights is of major importance to proposed industrial development on the Navajo Reservation.



Map 4.
Dine Bikeyah: Navajo Land

The Diné Bikeyah: Navajo Land

The Diné Bikeyah Navajo Land includes land areas beyond the reservation boundary for several reasons. In a modern sense, the influence of Navajo trade, arts and crafts, and political influence extends into the "border towns" of the reservation. Thus Flagstaff, Winslow, and Holbrook in Arizona; Gallup and Farmington in New Mexico; Cortez, Colorado; and other communities represent the interface of the Navajo world with the remainder of the United States. On the reservation proper, few towns have developed. Most reservation settlements consist of commercial service facilities, centers of tribal or federal government operations, and educational facilities. The traditional Navajo way of life is not to congregate in clustered dwellings, but the Navajo people use place names to identify central places, perhaps a post office, Chapter house, or trading post. Thus it should be noted that the place names on Map 4 do not indicate numerous towns or communities in the same sense that a similar map of non-Indian lands might. On Map 4 only the major roads (essentially those that have been paved) are shown; many other places are connected to the major road network by graded or unimproved dirt roads.

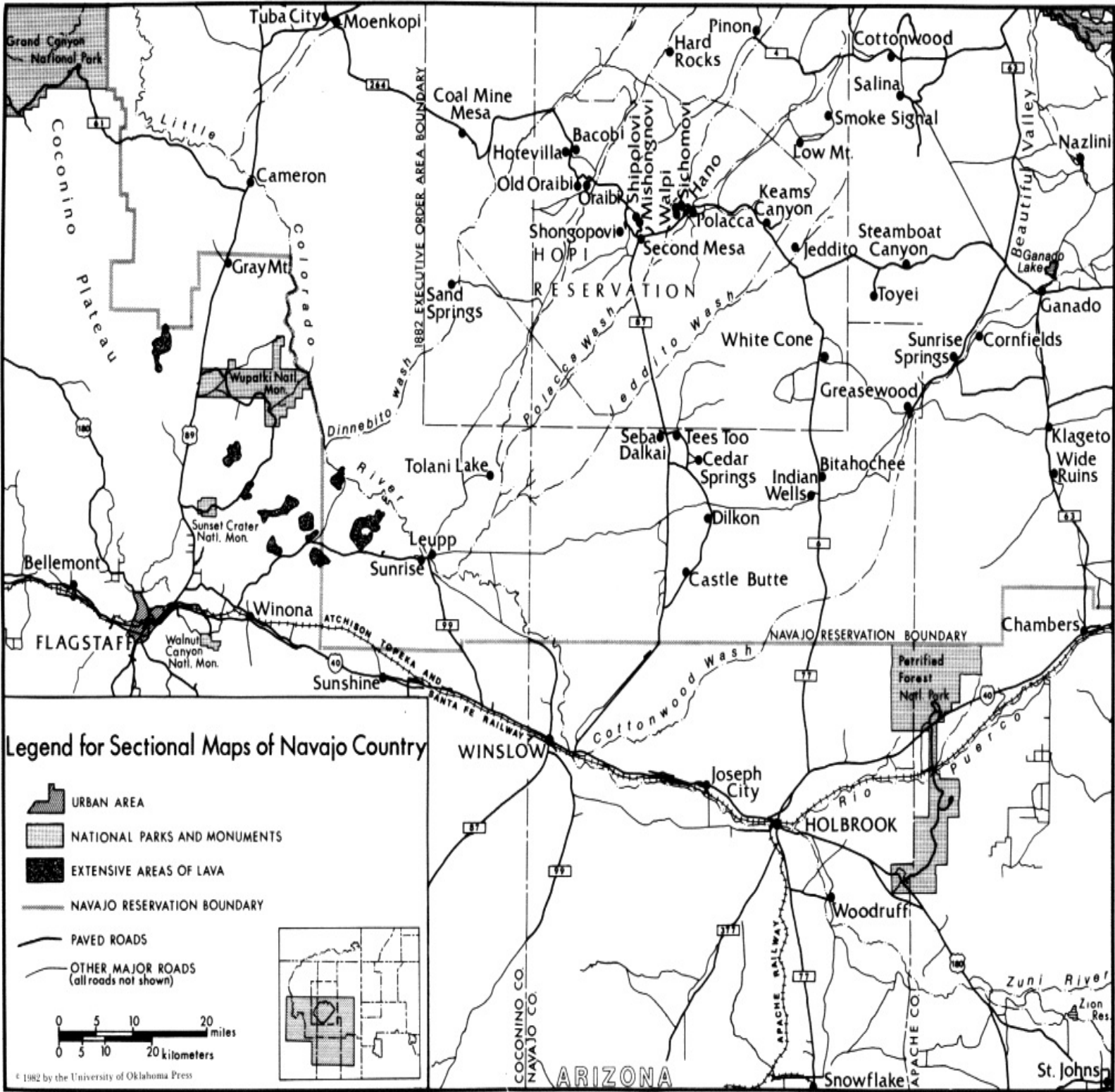
The Navajo Reservation boundary is relatively easy to follow on the map in Arizona and Utah, but it should be noted that in New Mexico two lines designate the boundary. The simple east-west line that extends from near Window Rock to near Crown-point and then northward as a straight line to a point just west of Farmington marks the eastern limit of continuous reservation land. East and south of the line just described lies the "checkerboard" portion of the reservation. Blocks of land ranging from one square mile (a section) to much larger units may be private lands, railroad land (A.T. & S.F.), state lands, or public lands, the latter chiefly managed by the Bureau of Land Management (BLM). Most of this checkerboard area is in the Eastern Navajo Agency (see Map 10).

Three Navajo Reservation areas are detached from the main reservation. The Ramah, Canoncito, and Alamo Navajo bands occupy separate reservation sites in New Mexico. Although detached from the main reservation, these three areas participate in Navajo tribal government. The origin of these reservations is discussed in Part III (see Map 28).

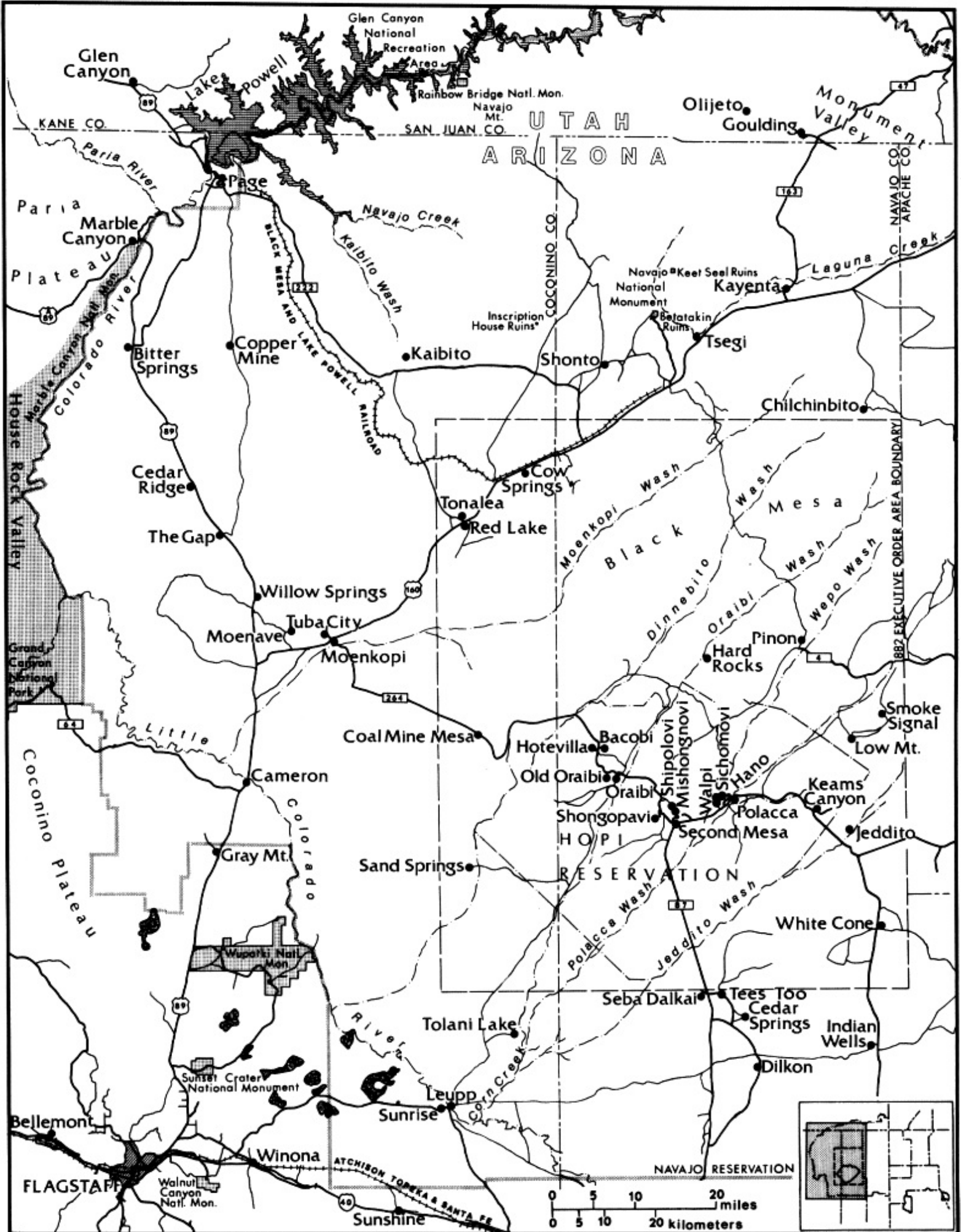
A large rectangular block (one degree of longitude by one degree of latitude) defines the 1882 Executive Order Area Reservation authorized by President Chester A. Arthur.

This unit of land, which is completely surrounded by the Navajo Reservation, was set aside for use by the Hopi Indians and other Indians whom the Secretary of the Department of the Interior would "settle" there. In the century since this area was established, lengthy disputes have arisen over jurisdiction within the area. The area that is designated Hopi Reservation in the first five parts of this atlas grew out of the creation of Land Management Districts (see Map 10) in 1934. In 1962 a court decision created the exclusive Hopi Reservation (Land Management District 6), with equal use of the remaining portion of the 1882 Executive Order Area or, as it is more commonly called, the Joint Use Area. In 1974, an Act of Congress decreed that the Joint Use Area would be divided equally between the Hopis and Navajos for their exclusive use (see Map 46). This interesting series of events is covered in more detail in Part IV.

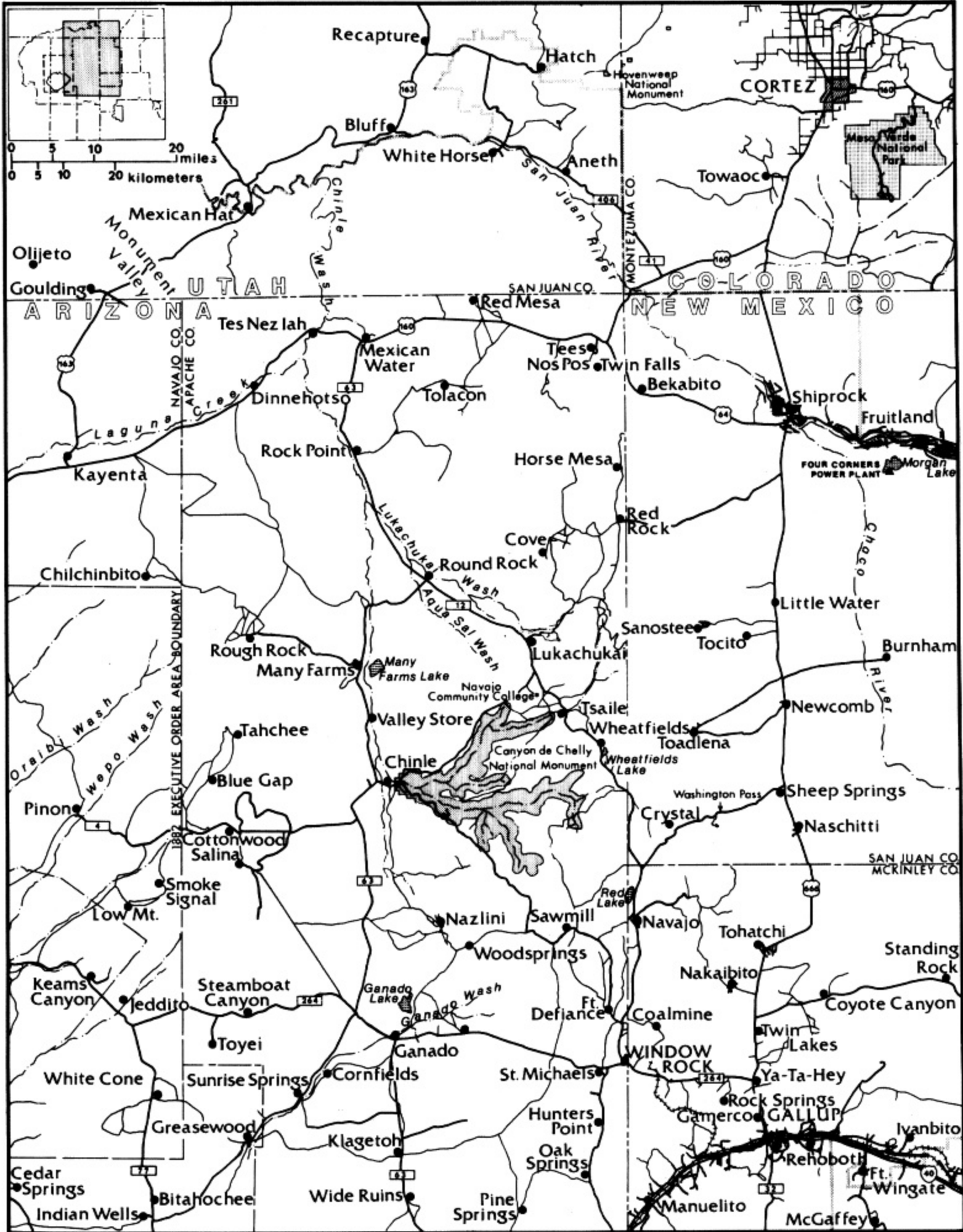
Maps 5-9 provide more details of the Diné Bideyah. Although there are numerous place names on these maps, the reader should keep in mind that only one or two buildings may mark a given location; many people who claim to be from Salina, for example, may actually live several miles from the trading post and school which are represented by the dot on the map. A final point: although there is a maze of roads in this country, few are considered all-weather roads and fewer still are paved, although the number of paved roads is increasing each year. On the sectional maps only a select number of the non-paved roads are shown.



Map 5.
Sectional Map of Navajo Country: Southwest

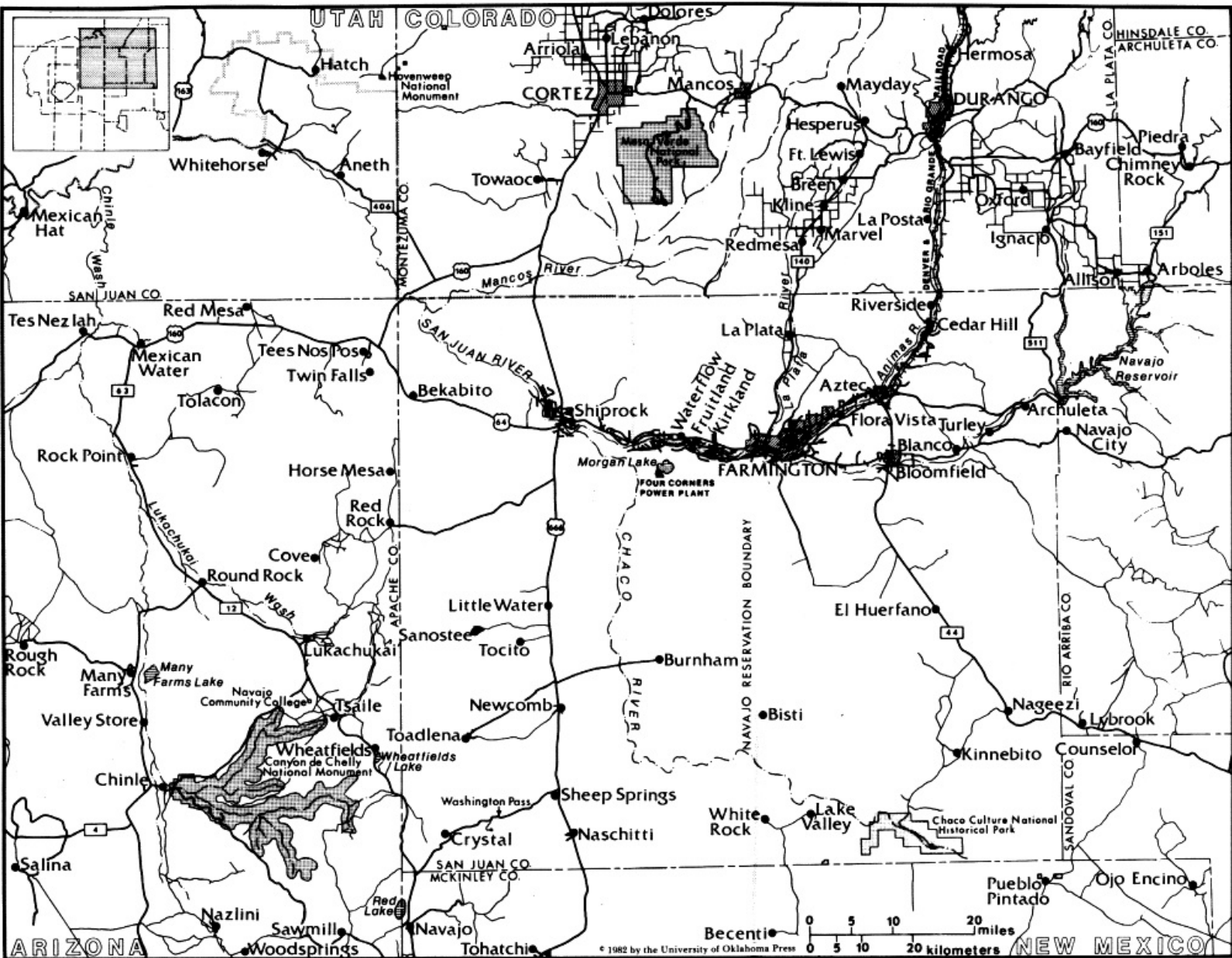


Map 6.
Sectional Map of Navajo Country: West

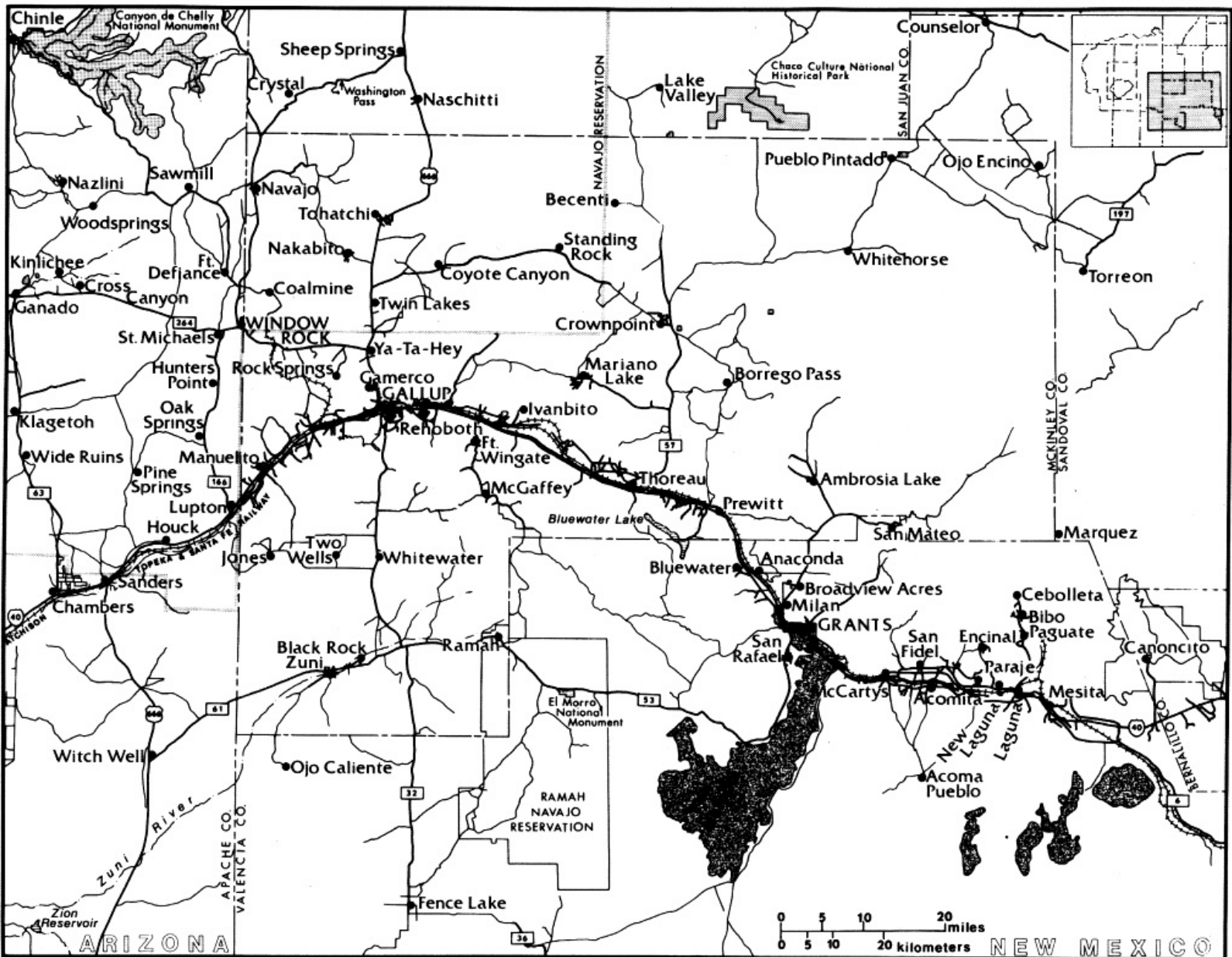


Map 7.

Sectional Map of Navajo Country: Central



Map 8.
Sectional Map of Navajo Country: Northeast



Map 9.
Sectional Map of Navajo Country: Southeast

Administrative and Political Subdivisions

The Navajo Reservation is divided into several administrative and political sections. Maps 10, 11, 12, and 13 display these divisions. The variety of subdivisions is a result of the complex status of the reservation within the realms of Navajo tribal government, state relations, and federal jurisdiction.

Agencies and Land Management Districts (Map 10) are designed to decentralize administration of services by the Bureau of Indian Affairs, United States Department of the Interior, and to place supervision of land management within areas of similar physical environments and size. The location of each agency headquarters is designated on the map. These agency headquarters are generally clusters of office buildings and residences for Indian and non-Indian federal government employees. The importance of these places is a reflection of the fact that the largest employers of Navajo people are the federal and tribal governments. The current agencies were defined in 1955, with Window Rock as the headquarters of the Navajo area. Ramah, Canoncito, and Alamo reservations are assigned to the Eastern Navajo Agency.

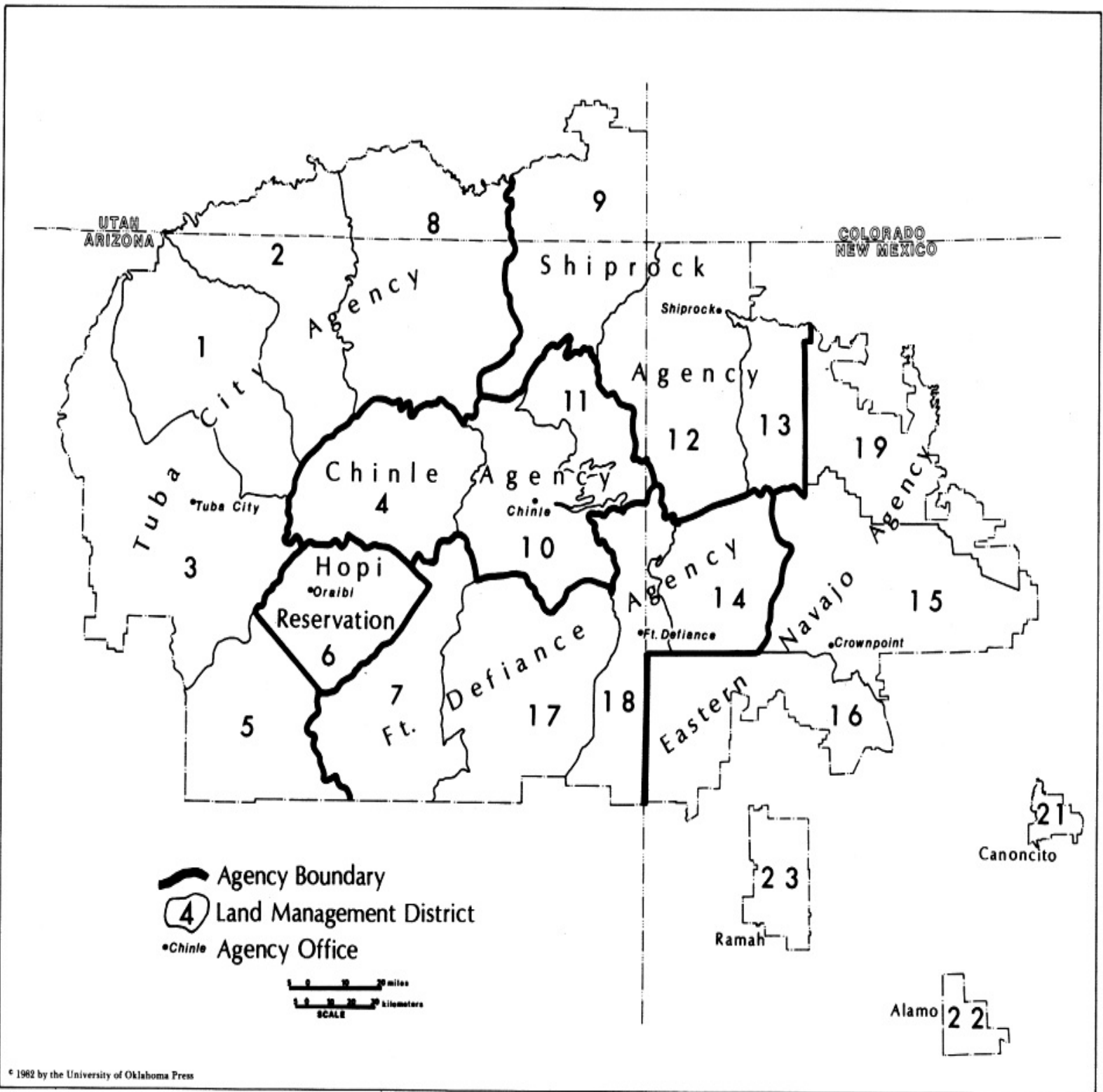
Land Management Districts (Map 10) were established in 1936. At that time a rapidly growing Navajo population that depended on a livestock grazing industry had seriously overgrazed reservation range lands, which in turn increased the rate of soil erosion. The objective of the management was and is to keep the number of livestock in balance with range conditions. The Land Management Districts are periodically sampled to determine their capacity to support livestock grazing; this information is used to set herd size, a function of the grazing committee of each of the Navajo Chapters.

Navajo people as a voting bloc have demonstrated considerable political power in recent county, state, and national elections. Map 11 shows the Navajo voting precincts in the 1976 presidential election. Voter registration programs have been effective in turning out a very high percentage of Navajo voters on election dates. The Navajo have become increasingly aware of their rights and power in selecting local and state representatives. In the 1976 election approximately 75 percent of the Arizona registered voters were instrumental in selecting a new United States senator. In this case the tribal leadership strongly supported a Democrat, even though they are traditionally Republican.

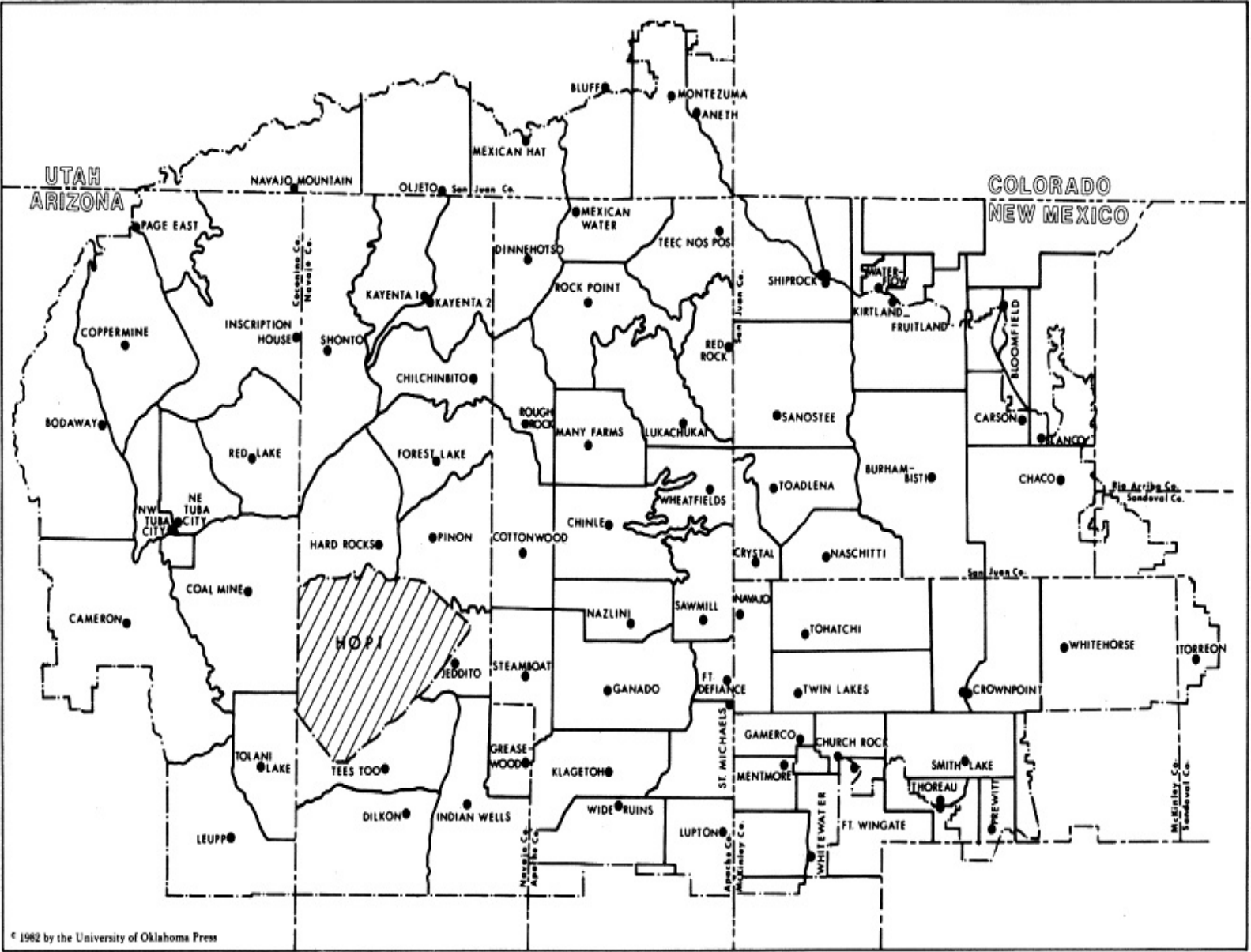
The basis of local government for the Navajo Reservation is the Chapter (see Map 12). The Chapter system was initiated in 1922 as a means of improving agricultural conditions at a local level. Later the Chapter became the basic political subdivision of Navajo Tribal government. The Chapters elect representatives to the Navajo Tribal Council, the legislative branch of Navajo government.

Navajo tribal government before the 1920s was not centrally organized. Traditionally, the People were organized in numerous bands, each with an appointed chief. The discovery of oil on the reservation in 1921 created the need for a central Indian authority with which the federal government could interact in providing the leases needed for mineral development. Initially a business council of three Navajos appointed by the BIA dealt with lease giants. Since this select group was not representative of the Tribe, steps were taken in 1923 to choose representatives from each of the several Navajo Agencies then in existence. It was not until after World War II, however, that the Navajo Tribal Council was given recognition as a viable and stabilized body.

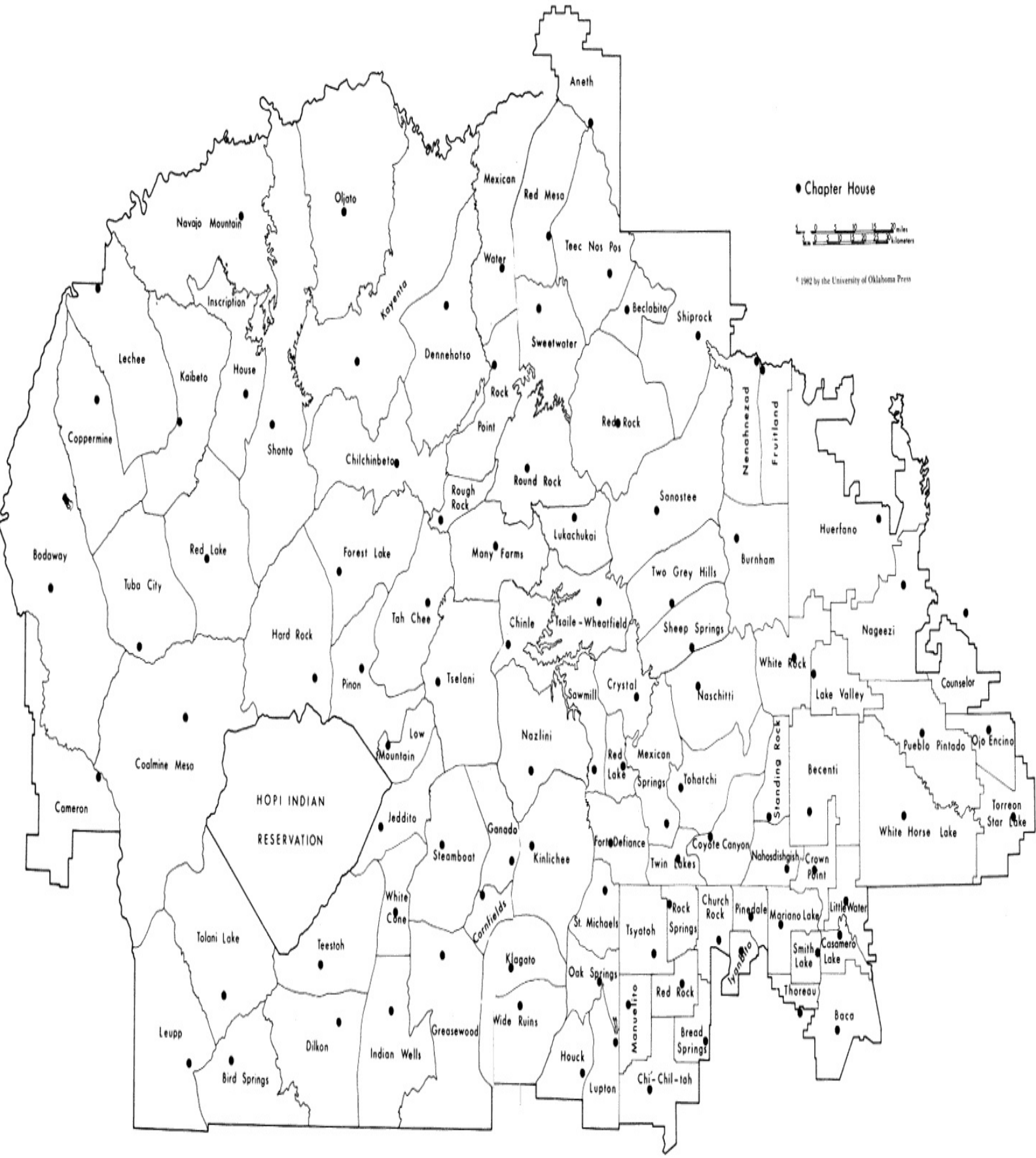
The human population of the reservation has continued to increase since the inception of a Navajo Tribal Council and the Chapter system, and changes have been made to maintain balanced representation in the Council. A map of Navajo Election Districts (Map 13) displays the 1976 population and the number of delegates (council-persons) from each district to the Tribal Council. Each district is composed of one or more Chapters. There are a total of seventy-four delegates. A council chairman and vice-chairman are elected at large by popular vote to serve four-year terms of office.



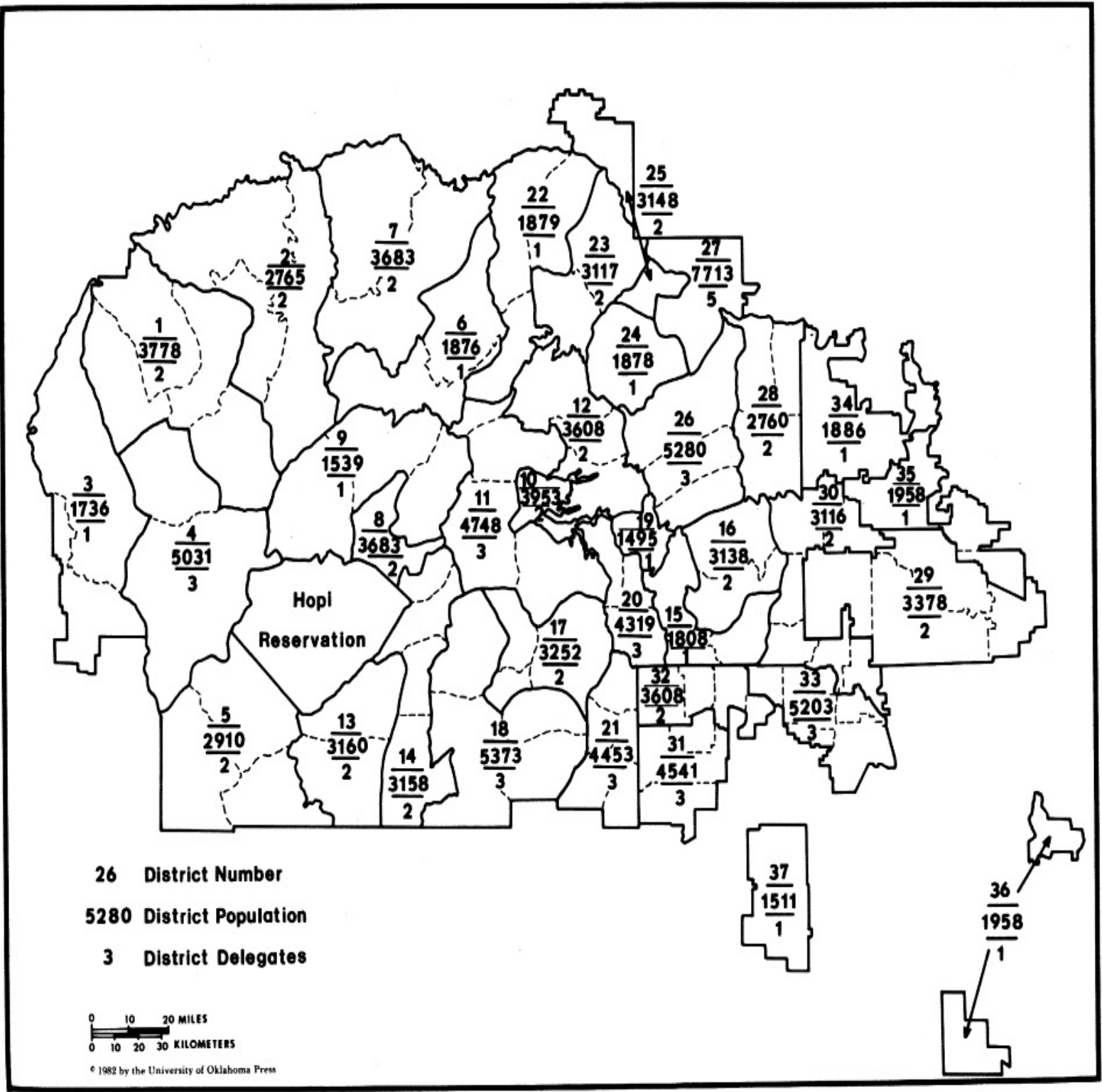
Map 10.
Agencies and Land Management Districts



Map 11.
Voting Precincts, 1976



Map 12.
Navajo Chapters



Map 13.
Navajo Tribal Election Districts

PART II
THE PHYSICAL ENVIRONMENT



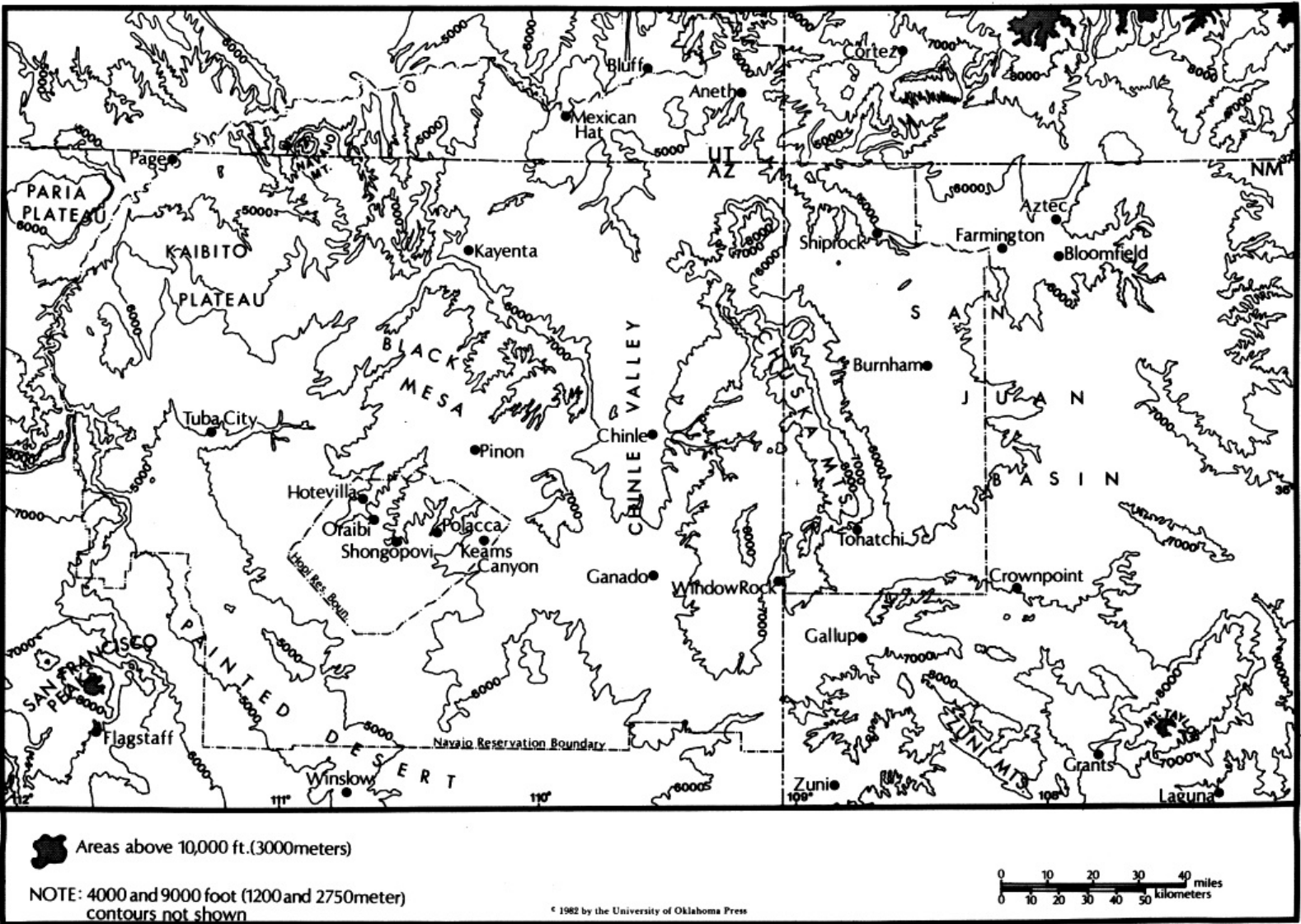
Monument Valley, a well-known image of the Navajo country, displays but one of several environmental conditions common to the Diné Bikeyah. This area of sandstone buttes and steep-walled mesas is located in the high desert lands of the Colorado Plateau.

Introduction to Part II

As shown on Map 3, Navajo Land occupies the south central portions of the Colorado Plateau, a curiously unique region in the Southwest. Standing well above the lower, warmer, and drier basins of Nevada, southern Arizona, southwestern New Mexico, and the Rio Grande Valley from Albuquerque southward, the Plateau has more tolerable summers, but much colder winters. In contrast, the Rocky Mountains of Colorado and New Mexico tower to greater elevations than most of the Plateau and form an effective barrier to the frigid Canadian air masses which sweep southward along the Great Plains during the winter. The Rocky Mountains supply most of the water which drains across the Colorado Plateau; most Colorado Plateau water drains to the Basin and Range region. Storms approaching from the Pacific Ocean are highly modified after passing over the coastal mountains of California and the deserts of the Basin and Range. The air is generally much drier and somewhat warmer when it reaches the western and southern edges of the Plateau.

Location within the bounds of one large physical region does not assure uniformity throughout Navajo Land. There are a variety of physical environments in the Navajo country. These environments are examined in a series of maps: first through the landforms and geology of the area, then the climates, the vegetation associations and their distributions, the soils and their potential for irrigation, the pattern of streams and volumes of water carried, and, finally, the availability, quantity, and quality of ground water. The first set of maps—landforms, geology, climate, and vegetation, Maps 14 through 20—provides many of the essential elements for subdividing Navajo Land into smaller units to provide the reader with a better understanding of the physical environments of the Diné Bideyah.

Maps 21 through 25 display many of the water resources of the Navajo physical environment. It may be useful to compare these maps with the maps that show population distribution, agricultural activities, and mineral resource development in Part IV and Part V.



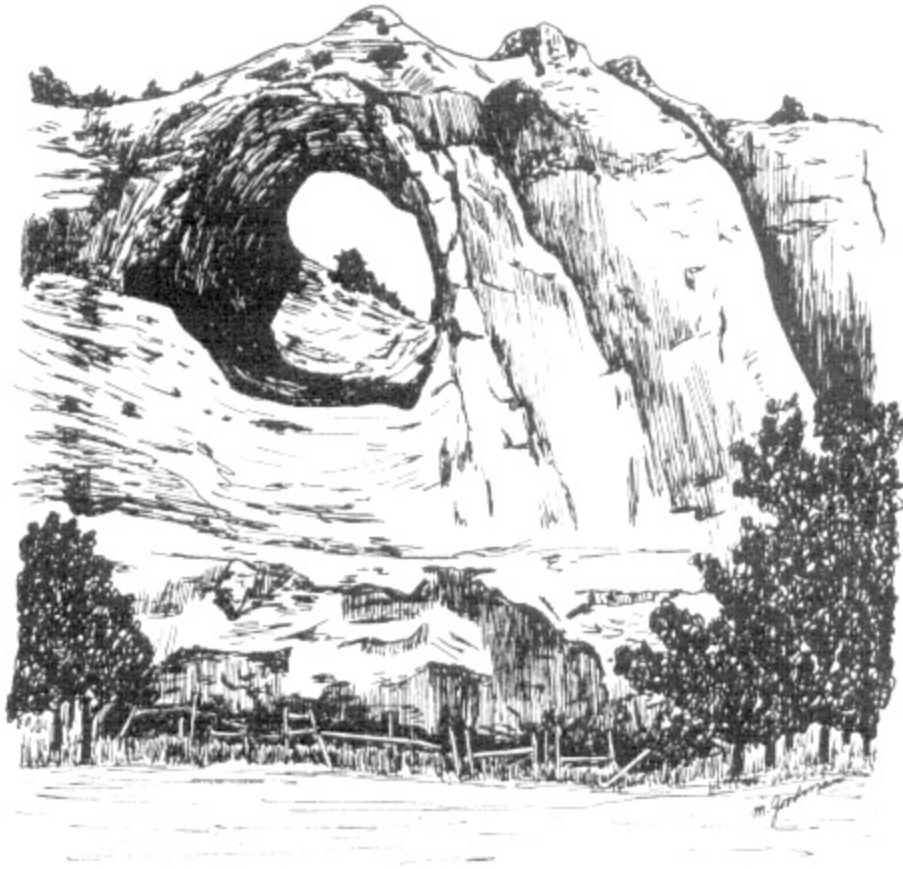
Map 14.
Elevations Streams Not Shown

Elevations

Elevation plays a major role in determining the character of environments, especially in regions of arid or semi-arid climates. A difference of several thousand feet of vertical distance above sea level can often be translated into several inches of mean annual precipitation and several degrees difference in mean annual temperatures. The Navajo region has a considerable range in elevations (see Map 14). For example, the Chuska Mountains stand between 4,000 and 5,000 feet (1,200 to 1,500 meters) above the San Juan Basin; and the northeastern escarpment of Black Mesa rises sharply some 1,500 feet (450 meters) above the Chinle Valley.

Three major areas of relatively lower elevations, that is, below 6,000 feet, extend in a general southeast to northeast direction across the reservation: the Painted Desert, the Chinle Valley, and the San Juan Basin. These three broad lower areas separate four higher areas: the San Francisco Peaks, Black Mesa, the Chuska Mountains, and the Rocky Mountains.





Landforms

Landforms are a product of the dynamic interaction between the atmosphere and the outermost portion of the solid earth—the lithosphere. Landforms reflect the internal structure of the earth's crust and geomorphic processes, mechanical and chemical, generated by the atmosphere. Forces arising from these two sources result in such landforms as volcanos, lava flows, up-faulted mountain blocks—all products of structural processes within the crust; and canyons, buttes, sand dunes—examples of erosional and depositional actions created by atmospheric forces.

The Navajo landscape displays many grand examples of the processes which operate to produce landforms, and most of them are vividly displayed, since the climates are semi-arid to arid and a dense vegetation mantle is usually absent. In general, the Navajo area is dominated by sedimentary rocks—those composed of sediments, commonly clay, silt, sand, pebbles, cobbles, boulders—and evaporites such as gypsum and limestones. For the most part the layers of sedimentary rock are nearly horizontal in attitude (see Map 15). The horizontal beds are interrupted in places by prominent monoclinical structures, broad up warps (domes) or down warps (basins). Igneous rocks—rocks which at the time of their emplacement were molten—can be found widely scattered over the surface of the Navajo region and play an important role in the distinction of many of the landforms.

Map 15 provides a perspective of the rich variety of landforms in Navajo country. The placement of the landforms is largely a result of tectonic (earth building) actions and drainage pattern evolution. For example, Black Mesa is capped by lower Cretaceous sandstones (see Map 16); these rocks are formed into a broad, saucer-like structure (a structural basin) with a faint hexagonal outline. The Black Mesa structure stands higher to the northeast (see Map 14). Consequently, streams drain off the mesa toward the southwest into the Little Colorado River system. Very little active downcutting now occurs in these valleys. In fact, much of the sediment, sands, silts, and clays that are washed downstream to the southwest are picked up by strong southwesterly winds and blown back upstream.

The surface geology of Navajo Land (Map 16) displays the extensive nature of Mesozoic age strata. The Mesozoic rocks represent all three of the Mesozoic periods: Triassic, Jurassic, and Cretaceous. The older Triassic rocks are most prominently represented by the soft and colorful shales, mudstones, and siltstones that are

associated with the Painted Desert, Petrified Forest, and Beautiful Valley, a portion of the Chinle Valley. The youngest of the Mesozoic strata, the Cretaceous age rocks, are significant for the extensive coal seams that they contain. The main areas of coal production, Black Mesa, San Juan Basin, and the Gallup area (see Map 36) occur in the Cretaceous strata. Intermediate in age are the younger Triassic to Jurassic transition periods. Rocks of these ages, such as the Navajo sandstone formation, are usually found in prominent ridges and escarpments.

The oldest rocks of the reservation, pre-Cambrian, Cambrian, Mississippian, and Pennsylvanian, are exposed in one relatively small area along the eastern flank of the Defiance Plateau (an arch or anticlinal structure near Window Rock). Permian sedimentary rocks are exposed along the crest of the Defiance Plateau, in Canyon de Chelly and Canyon del Muerto, in Monument Valley, and in the extreme western section of the reservation at Marble Canyon.

The younger, slightly indurated Tertiary sediments and volcanic rocks occur on the crest of the Chuska-Carrizo mountain systems and in the vicinity of the Hopi Buttes. Quarternary unconsolidated sediments are widely distributed across Navajo lands as a result of stream disposition, dune accumulation, and large landslide masses along the eastern edge of the Chuska Mountains.

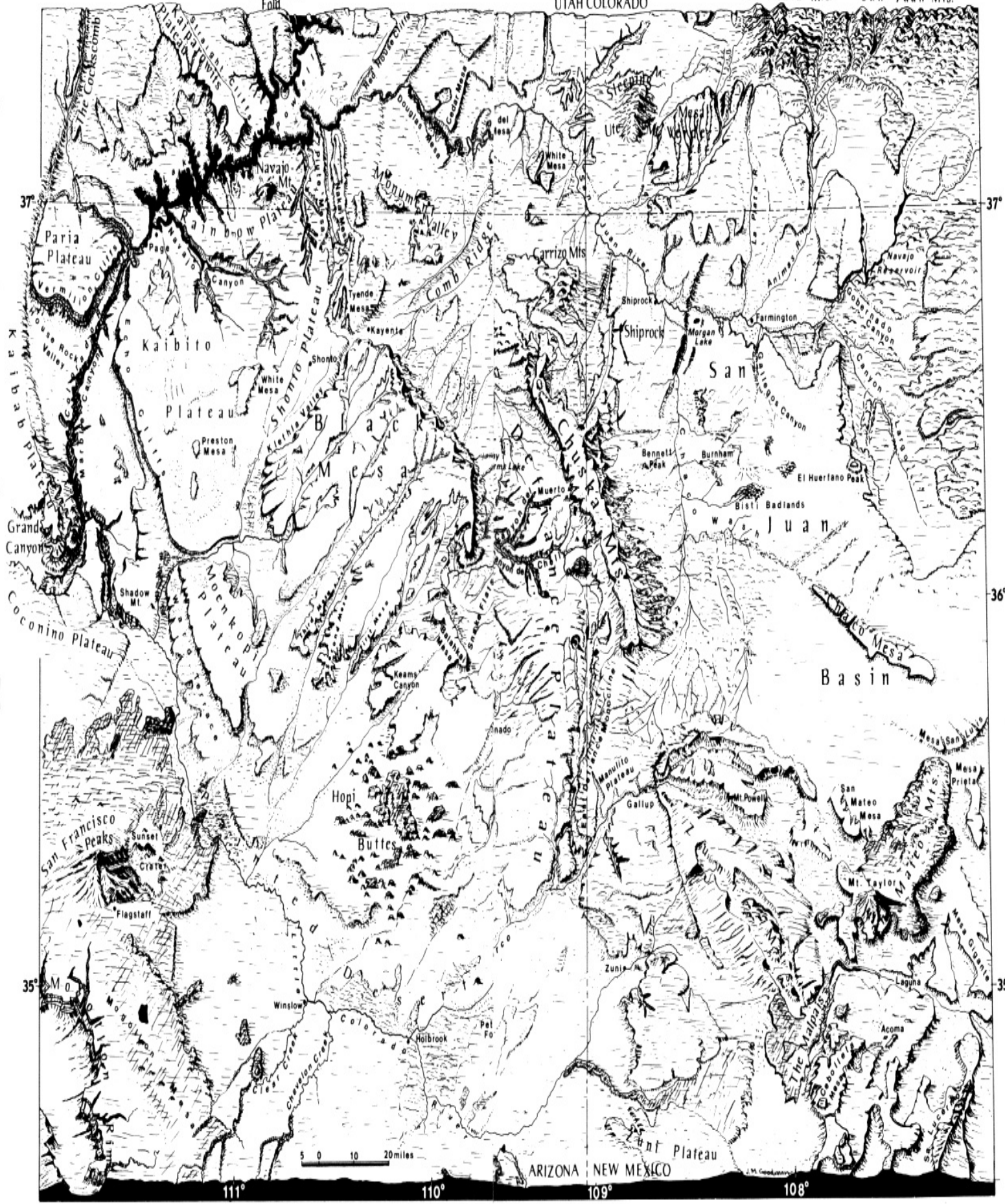
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COLORADO PLATEAU ROCKY MOUNTAINS

Waterpocket
Falls

UTAH COLORADO

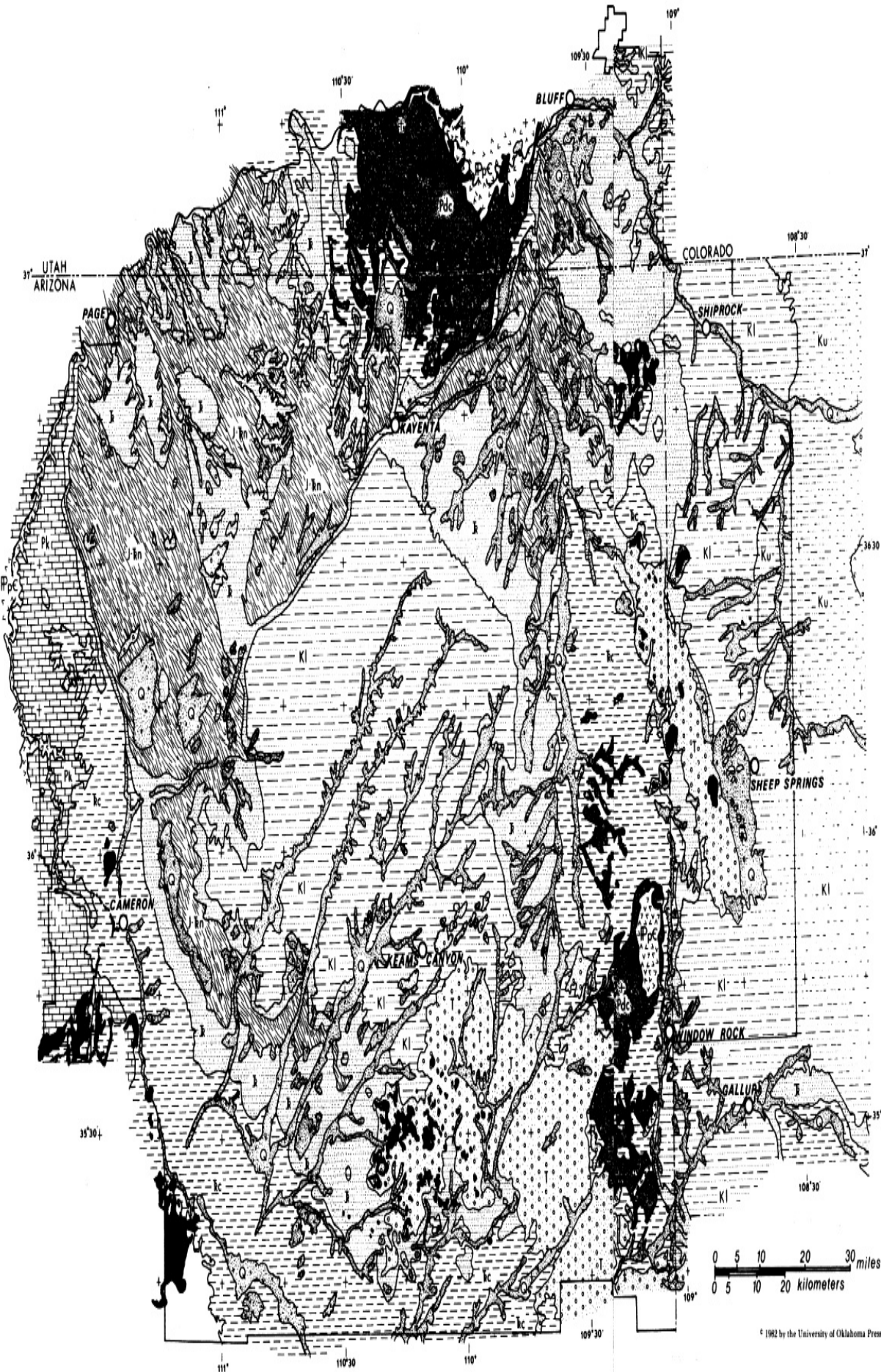
La Plata Mts. San Juan Mts.



111° 110° 109° 108°

ARIZONA NEW MEXICO

Map 15.
Landforms



QUATERNARY

Q Alluvium (sediments deposited by streams), dune sand, playas (lake bed deposits), landslide deposit.

TERTIARY

Ku Sandstones, gravels, siltstones, shales, and some volcanic materials.

CRETACEOUS (Upper Younger)

Ku Shales, siltstones, sandstone and coal. Located in San Juan Basin of New Mexico and Colorado.

CRETACEOUS (Lower Older)

Kl Sandstone, shales, siltstone and coal. Located chiefly in uplands of Black Mesa and the outer margins of San Juan Basin.

JURASSIC - TRIASSIC

J Sandstones, siltstones, intermixed with shales, and some limestones, all younger than Navajo.

K Sandstones distinctly crossbedded, forms prominent cliffs.

J Sandstones and siltstones older than Navajo.

TRIASSIC

Kc Chinle formation, chiefly shales, with siltstones and sandstone. Associated with "painted deserts" and petrified log fragments.

PERMIAN

Pk Kaibab limestone (the rim rock of the Grand Canyon) and underlying sandstones and siltstones.

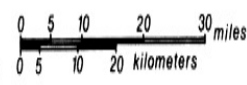
Pdc DeChelly sandstone and related shales, siltstones of the Defiance Plateau and Monument Valley.

PENNSYLVANIAN, MISSISSIPPIAN, CAMBRIAN, PRECAMBRIAN

Ppc Shales, siltstones, limestone, sandstones and metamorphosed rocks.

IGNEOUS ROCKS

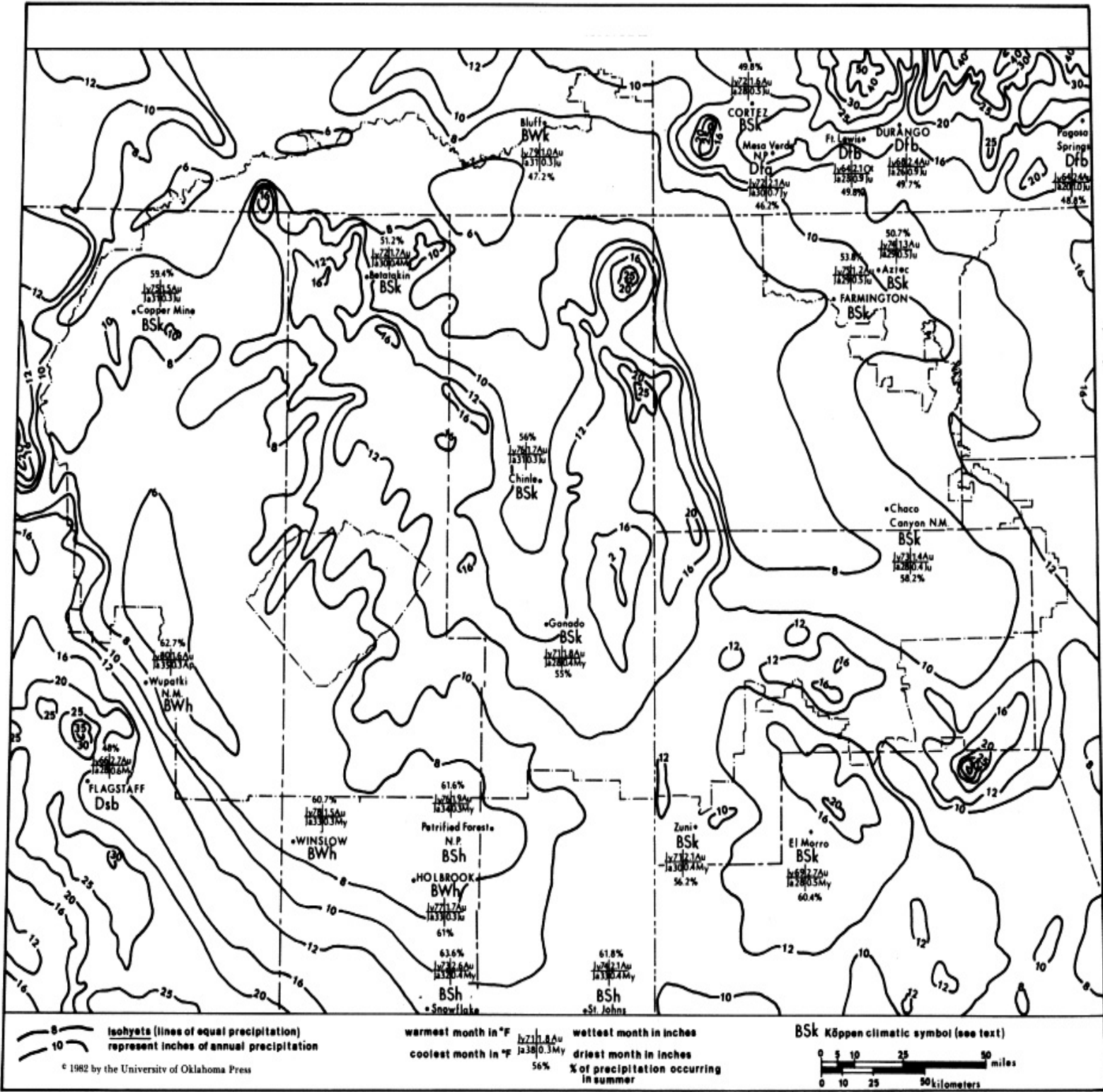
I Lavas, tuffs, brecciated rocks, of both intrusive and extrusive structures.



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Map 16.

Surface Geology



Map 17.
Climate

Climate

The climate of Navajo Land is strongly influenced by: elevation; distance from the Pacific Ocean and the nature of intervening land surfaces; distance from the Gulf of Mexico and the nature of the intervening land surfaces; and the barrier of the Rocky Mountains to the northeast. Climatic character is essentially a result of the interaction between temperatures and precipitation. Temperatures are directly related to evaporation rates and directly influence the type of vegetation, which in turn has an effect on moisture utilization as measured by transpiration from plants.

There is a clear relationship between the average annual precipitation and the elevation. If one compares Maps 17 (Climates) and 14 (Elevation), these relationships are obvious. Greater quantities of precipitation occur in the higher elevations: for example, the more than 16 inches at Navajo Mountain, more than 30 inches at Mt. Taylor, and more than 35 inches in the San Francisco Peaks. Lower elevations have lower precipitation amounts. In the Little Colorado River Valley, Winslow, Holbrook, and Petrified Forest all receive less than 8 inches annually.

There are two sources of moist air masses that influence this region. By far the most important source is the Pacific Ocean. The Gulf of Mexico is a very minor source, since the steering winds that move the air masses in the lower atmosphere are generally from west to east in this latitude. Vast land areas and mountain ranges separate the Navajo lands from these two sources of moisture, consequently the air masses are considerably drier by the time they move across the Diné Bikeyah.

Winter temperatures are not as severe as one might expect, given the high elevation of the region. The very cold outbreaks of winter Canadian air masses that are common to the Great Plains are blocked by the barrier of the Rocky Mountains.

Although the vicinity of the Four Corners region is an area of cyclogenesis (storm generation), storms originating within this region are not excessively warm or cold, nor do they contain much moisture at the 3,000- to 7,000-foot elevation levels. However, moisture drawn in at levels above 7,000 feet is blocked by mountainous barriers that cause the air masses to be lifted, cooled, and condensed, sometimes resulting in precipitation.

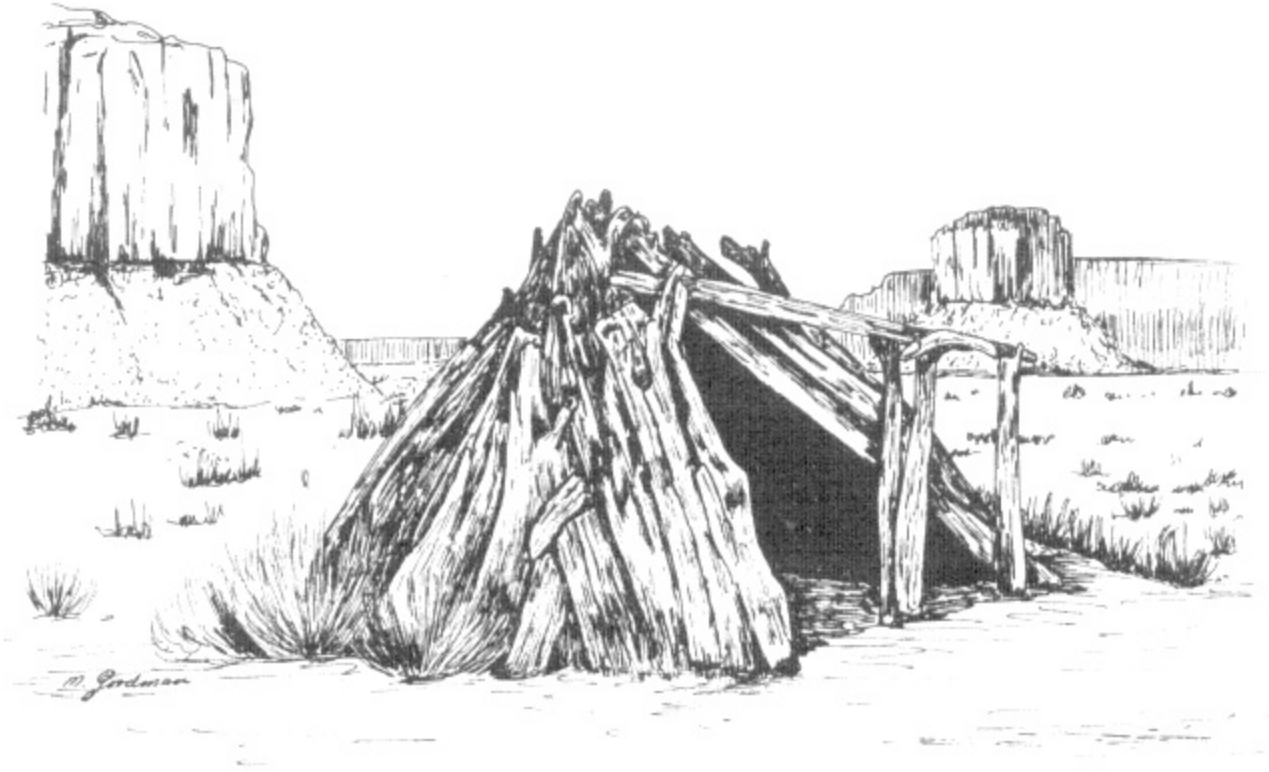
Two types of climate are generally typical of the area: dry, and humid continental. These climatic types are based on temperatures, precipitation amounts, and the

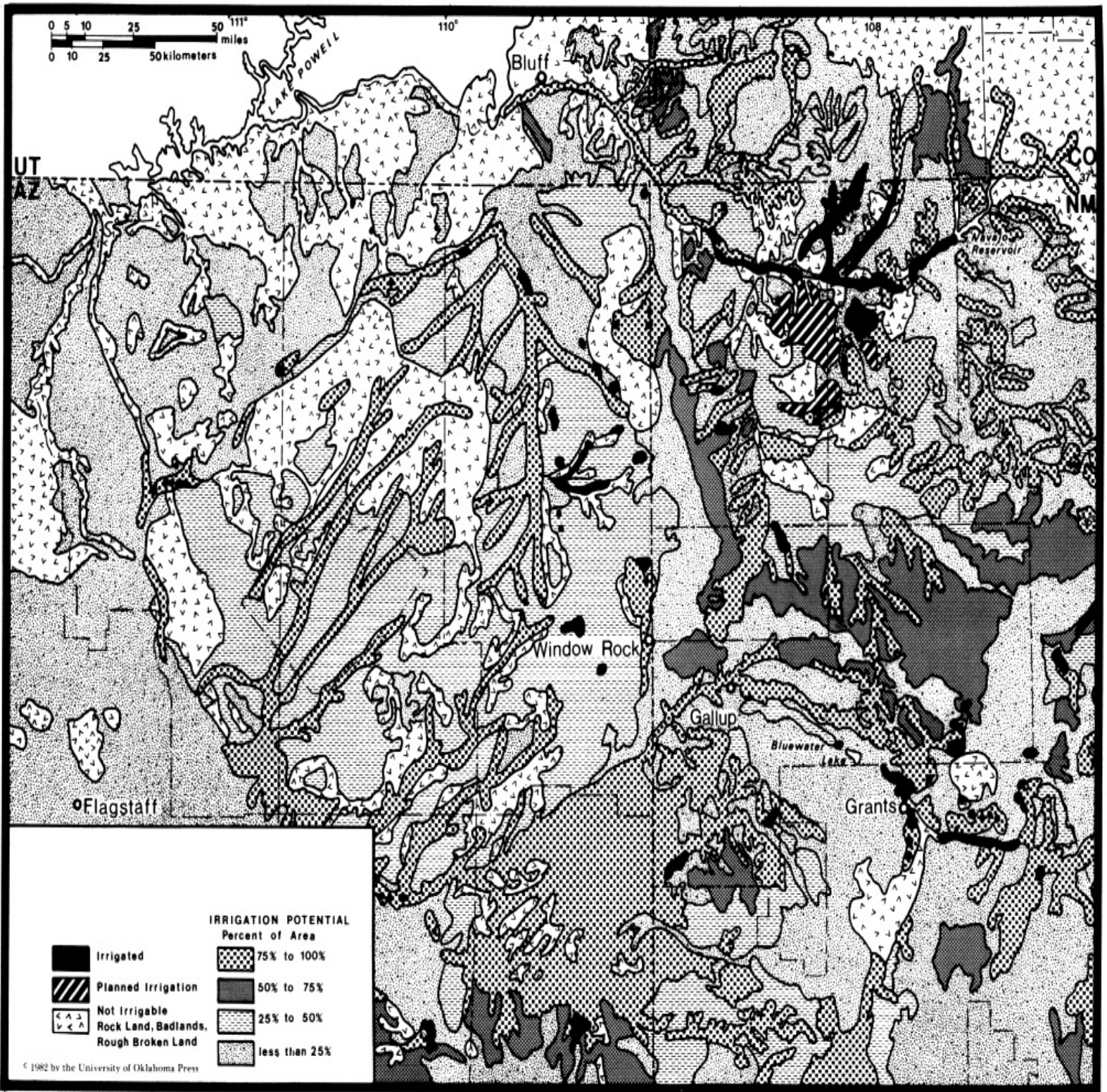
seasonal pattern of precipitation. The distance between climate data recording stations is rather great; therefore, exact boundaries between the climate types are difficult to draw precisely. Only the climate at the point of the station is plotted on Map 17. All climates are indicated by the Köppen climatic symbols, consisting of three letters.

The B climates are the dry climates. BW represents desert and BS represents steppe. In a general way, these arid climates are defined by the potential loss of moisture through evaporation: if the potential loss by evaporation is greater than the average annual precipitation the climate is dry (B). The potential for moisture loss is a function of the annual average temperature and the season in which the precipitation occurs. If the average precipitation at a weather recording station is less than half of the potential loss, the climate is considered desert; if the precipitation is greater than half of the potential loss, the climate is defined as steppe. The third letter of the dry climate symbols indicates the nature of the temperature of the coldest month: a lower case *h* indicates that all months average 32°F or warmer; a lower case *k* indicates that at least one month has an average temperature below 32°F.

Stations that have a symbol of D are generally termed humid, or moist, continental climates. Continental evokes an image of conditions having great temperature ranges and cold, snowy winters. All of the D stations in the Navajo area are in Colorado, with the exception of Flagstaff. All of the Colorado stations are further defined as Dr, with the second letter indicating that the precipitation is not seasonally concentrated. Flagstaff's Ds indicates its relationship to the precipitation patterns of the Pacific coast areas of northwest Mexico and southern California, that is, dry summers and a winter concentration of precipitation. The third letter of the D climates indicates the summer temperatures. Mesa Verde's Dfa indicates a hot summer, whereas Flagstaff's Dsb indicates that the average temperature of the warmest month is less than 71.6°F (22°C).

Although data are not available for much of the reservation, it can be assumed that many of the areas above 7,500 to 8,000 feet would have D climates. Certainly the vegetation in the higher areas is not that of a steppe or desert. Most of the areas occupied by the Navajo people are primarily steppe (BS) and secondarily desert (BW).



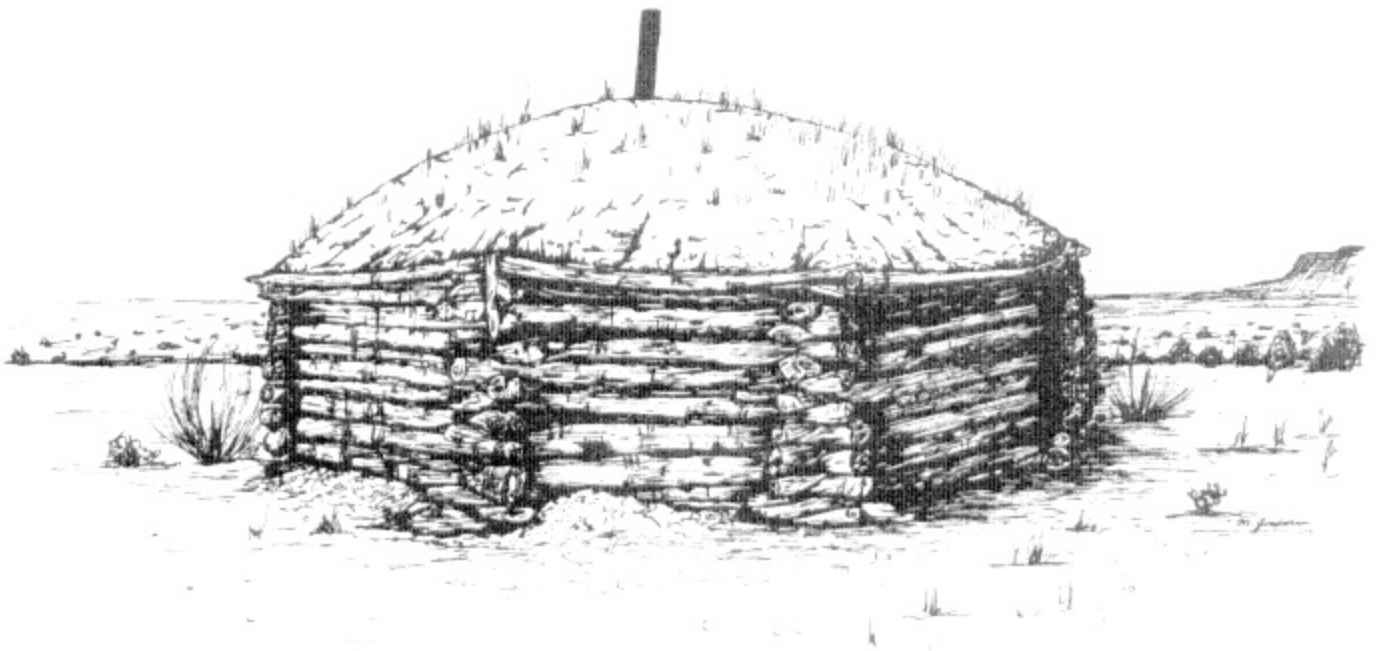




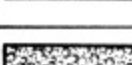




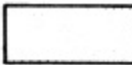

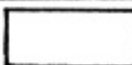



Map 18.
Soil Associations: Potential For Irrigation

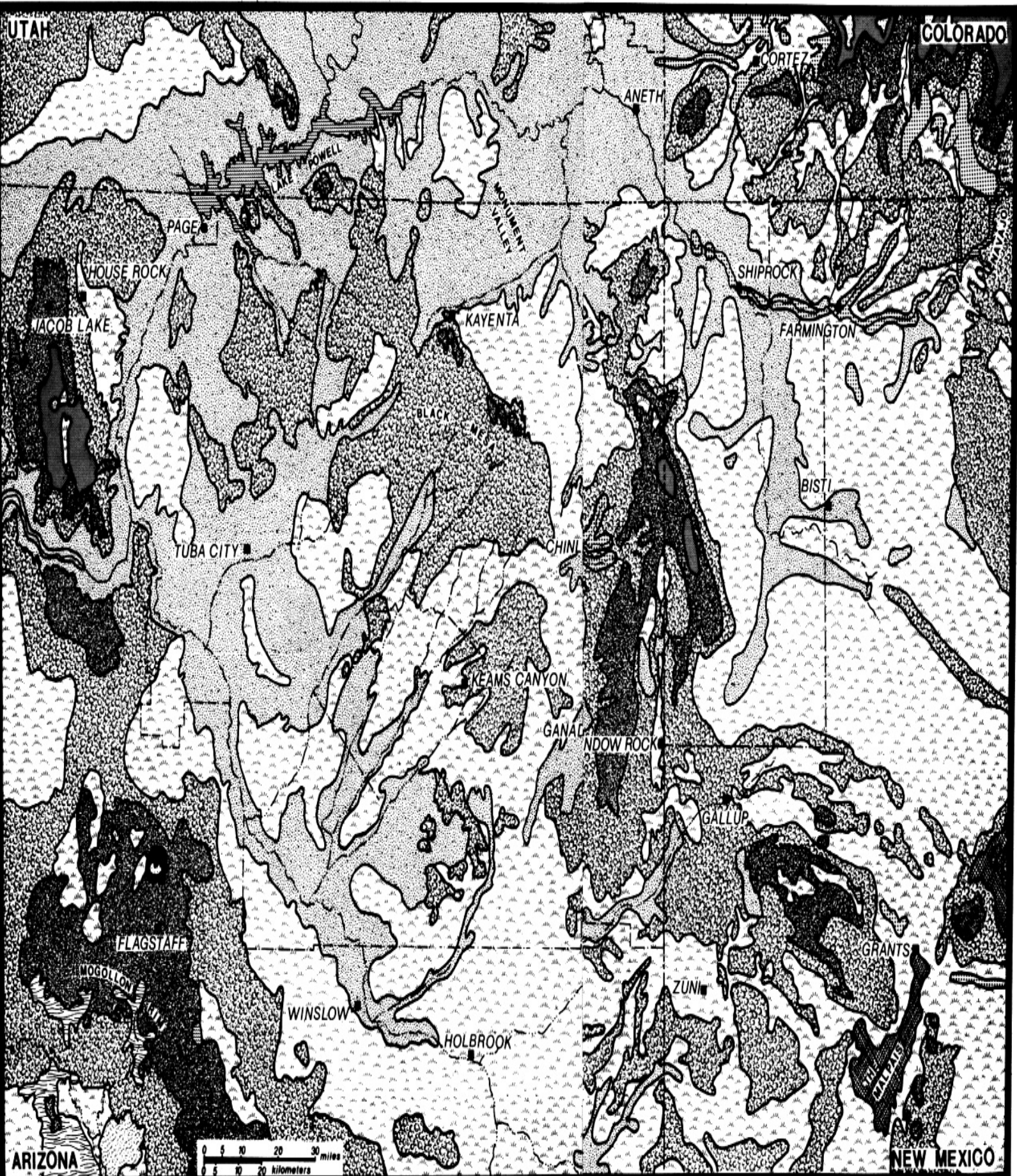
Soils and Natural Vegetation Associations

Information on soils and natural vegetation is particularly limited in the Navajo area. Most of the soils are thin and stony; all reflect the general aridity of the region. Some of these soils will, however, respond to irrigation and can be used for agricultural purposes. The actual portion of the reservation irrigated is a small percentage of the total area and reflects the scarcity of water. Many areas that could be irrigated obviously never will be because of limited surface and ground water (see Maps 21 through 25). The sizeable planned irrigation areas in New Mexico are parts of the Navajo Indian Irrigation Project (see Map 40). The areas marked as not irrigable are quite extensive throughout the Navajo lands.

The Natural Vegetation Associations chart and key, opposite, refers to those associations shown on Map 19. Generally, the vegetation associations within the Navajo area relate to climates (Map 17) in the following sequence: the lower Sonoran is desert (BW), the upper Sonoran is steppe (BS), and the Canadian and Hudsonian are humid continental (D).



NATURAL VEGETATION ASSOCIATIONS		
ASSOCIATIONS	LIFE ZONE and approximate ELEVATION RANGE	CHARACTERISTICS
NAVAJO AREA  Spruce, Fir, & Aspen  Ponderosa Pine  Douglas Fir	HUDSONIAN 9,500–11,300 feet 2,895–3446 meters CANADIAN & TRANSITION 7,500–9,500 feet 2,286–2,895 meters	Vertical arrangements from highest to lowest elevation: spruce-fir → aspen-Douglas fir-ponderosa pine → ponderosa pine-gambel oak. Open areas of mountain grasslands exist in Chuska Mts. and Kaibab Plateau. Precipitation ranges from 15–40 inches (38–102 cm). Mean monthly temperatures range from 65°F to 25°F (18°C to –4°C).
 Piñon-Juniper-Sagebrush  Desert Grassland  Colorado Plateau Desert Scrub	UPPER SONORAN 5,000–7,500 feet 1,524–2,286 meters  LOWER SONORAN less than 5,000 feet less than 1,524 meters	Piñon pine in the higher, more moist areas grades downward into a juniper-piñon mix and finally into sagebrush alone. Sagebrush is commonly associated with deep soils. Short grasses generally occur when the soils are shallow. In the lower drier elevations of these zones, desert scrub (such as saltbush, greasewood and shadscale in addition to some drought-resistant grasses—alkali sacaton, Indian rice grass, etc. prevail where soils are calcareous and salty. Precipitation ranges from about 6–16 inches (15–41 cm) annually; mean monthly temperatures range from 32°F–77°F (0°C–25°C).
AREAS MARGINAL TO NAVAJO LAND  Alpine Tundra  Chaparral  Mohave Desert Scrub  Sonoran Desert Scrub	ALPINE TUNDRA over 11,500 feet over 3,005 meters UPPER SONORAN 4,000–6,000 feet 1,220–1,830 meters LOWER SONORAN 2,500–5,000 feet 762–1,525 meters LOWER SONORAN 3,000–4,000 feet 915–1,220 meters	Vegetation is sparse or absent. All mean temperatures average below 50°F (10°C), many below 32°F (0°C). Mogollon chaparral occurs on steep, stony slopes which face south and are generally warm 41°F–75°F (5°C–24°C) and subhumid precipitation ranges 14–30 inches (36–76 cm). Small bushy trees prevail—turbinella oak, mountain mahogany, etc. Large areas of rock outcrop; shallow soils on steep slopes. Some short grasses; Joshua tree, blackbush and twinberry. Precipitation range: 6–10 inches (15–25 cm); mean monthly temperatures range between 36°F–87°F (2°C–31°C). Grasses (bush muhly, black grama, three awn species, etc.) and chamiza, mesquite, creosote bush, etc. 11–14 inches (28–36 cm) annual precipitation; mean monthly temperature range between 43°F–80°F (6°C–27°C).
NO NATURAL VEGETATION  Cropland  Lava with no or scant vegetation cover		



Map 19.

Natural Vegetation Associations

Topographic Profile: Black Mesa to the San Juan Basin

THIS vertical profile, Map 20, displays a number of physical phenomena along a west to east traverse from the vicinity of Pinon, Arizona, to the vicinity of Sheep Springs, New Mexico (see Map 4). A variety of natural associations within the Navajo landscape is illustrated.

Geologically, the eastern side of the Black Mesa basin is linked to the Defiance Arch by the West Defiance Monocline. The Cretaceous rocks which cap the Black Mesa are indicated by the K; these are underlain by Jurassic (J) age siltstones, shales, and sandstones (see Map 16). Black Mesa is dissected by several southwestward-flowing intermittent streams: Wepo, Burnt Corn, and Polacca washes. These washes are all ephemeral streams, and their valleys generally contain excellent alluvial soils. Slight variations in elevation and soil cause alteration between piñon-juniper and grasses-sagebrush vegetation zones; with the edaphic, or soil, influence exerting the most control.

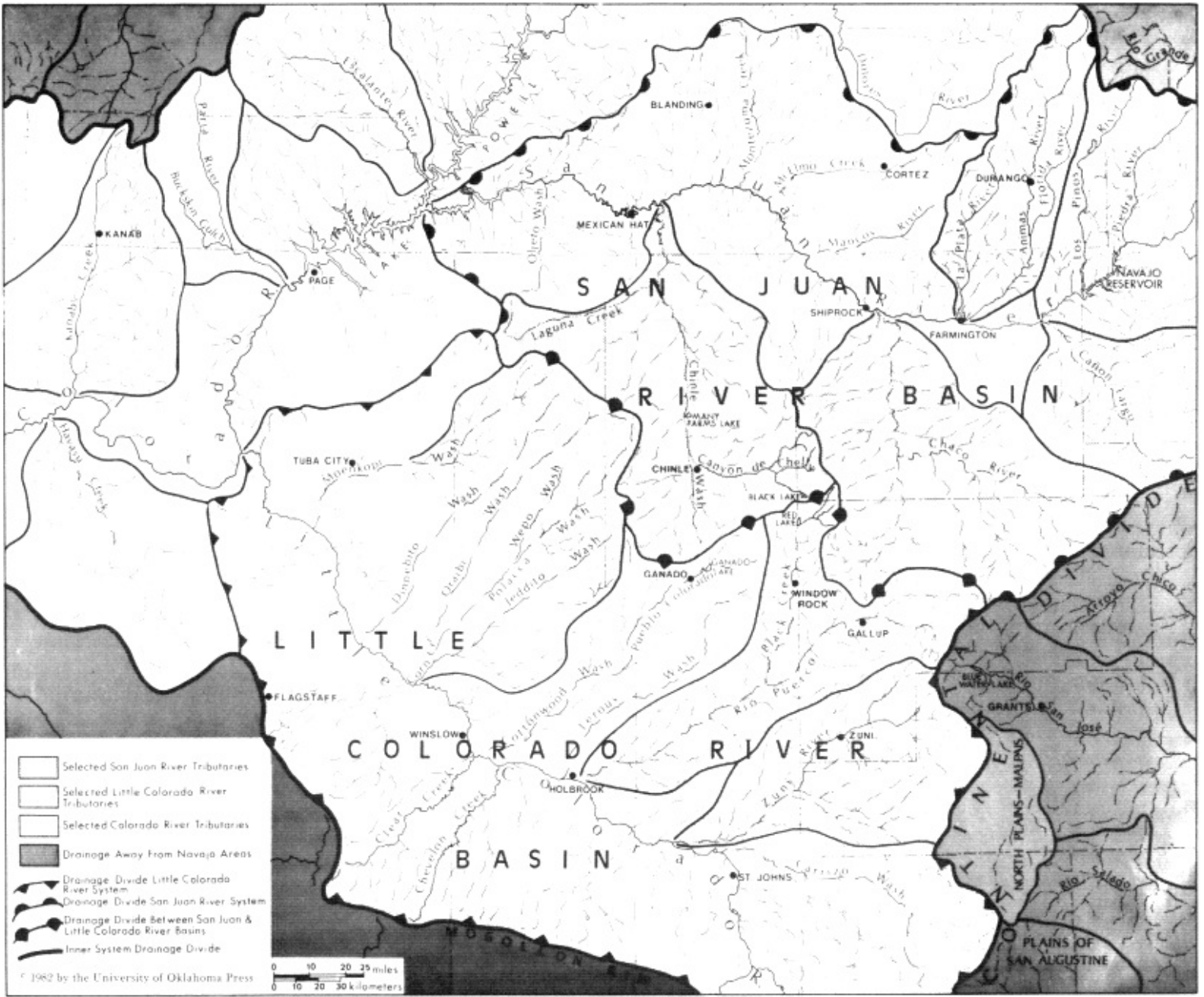
The sandstones of the Wingate formation (TRW) and the variegated shales of the Chinle formation (TRC) form the base upon which sandy alluviums (water deposited minerals) and sand dunes merge

eastward to the brightly colored badlands of Beautiful Valley (see Map 15, Landforms).

The surface climbs eastward away from the Chinle Valley and onto the Defiance Arch. Although not shown on this profile, Canyon de Chelly and Canyon del Muerto have been eroded into the de Chelly sandstone of Permian age (Pdc). Piñon-juniper forests become common at about 6,500 feet; at about 7,200 feet ponderosa pines dominate the vegetation associations. From Chinle Valley eastward, elevation becomes the dominant influence on vegetation. Only in the deeper alluvial soils of the Red Lake-Black Salt valley area does sagebrush become a dominant. The soils are generally shallow and droughty, although deeper accumulations of alluvial soils occur in some valley areas.

The highest portion of the profile occurs in the Chuska Mountains. The Chuska sandstone (Tc), capped in some places by lava flows (Te), lies upon the crest of the East Defiance monocline to produce the spine of the mountains. The eastward-facing escarpment of this range has a relief of about 3,000 feet. Much of this escarpment is littered by landslides (Qls) that form a jumbled series of steep slopes. Transition from the ponderosa pine, Douglas fir, and spruce forest on the mountain summit to the desert scrub of the San Juan Basin is rapid and sharply defined.

The profile presented here incorporates most of the environments common to about 80 percent of the Navajo landscape.



Map 21.
Stream Systems

Stream Systems

Almost all the landscapes of the earth exhibit a network of stream channels. Regardless of precipitation quantities, channels usually exist as indicators of the overland flow of water from higher to lower elevations. Stream channels may be grouped into one of two general types: permanent stream channels are those that are occupied by water at all times; and ephemeral, or intermittent, channels have a discharge for a while after precipitation but are dry most of the time.

Navajo lands are chiefly confined to the Colorado River System, the major drainage basin in the southwestern United States. Colorado River waters have a high premium in that considerable quantities of the basin's total discharge have been claimed by water consumers beyond the basin's divide. Water is diverted, "exported," from the headwaters of the Colorado under the Front Range of the Rocky Mountains to the Great Plains; from the headwaters of the San Juan River to the Rio Chama, a tributary of the Rio Grande; and by way of an aqueduct from the lower Colorado at Lake Havasu to urban areas of coastal Southern California.

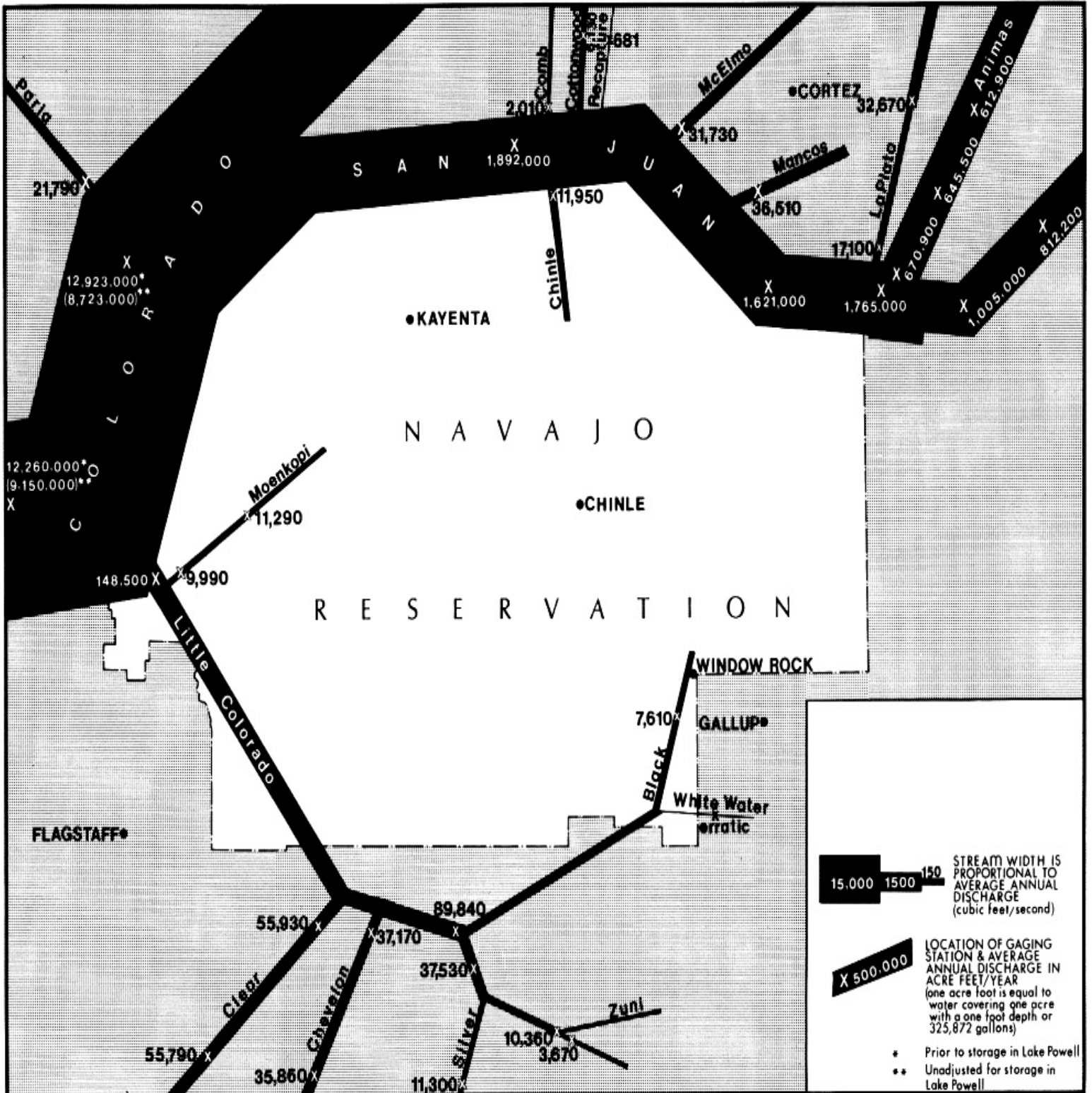
Streams in the Navajo country are chiefly ephemeral. Only the channels of the San Juan and Colorado rivers have continuous discharges. The surface area of the Navajo Reservation is about equally partitioned by the drainage divide between the San Juan River and the Little Colorado River. The Alamo and Canoncito Navajo reservations lie east of the Continental Divide, within the Atlantic drainage system of the Rio Grande.

On Map 21, several selected tributaries of the San Juan and Little Colorado rivers have been singled out for further discussion. In the San Juan Basin all of the Navajo streams are left bank tributaries of the San Juan River (that is, the tributaries enter from the left side when one faces downstream on the main channel). The left bank tributaries head in regions that are dominated by steppe and desert climates; these streams, the Chinle Wash and the Chaco Wash, are ephemeral. The San Juan's right bank tributaries upstream from the La Plata River head in the San Juan Range of the Rocky Mountains; all are permanent streams. Collectively, the right bank tributaries of the San Juan have about sixty-four times as much average annual discharge as the left bank tributaries (see Map 22), or about 98 percent of the total input in the San Juan System.

Navajo streams draining into the Little Colorado System are also totally ephemeral.

These right bank tributaries head in arid to semi-arid regions, whereas several of the left bank non-Navajo streams form along the crest of the Mogollon Rim and collect larger quantities of water from the elevated southern edge of the Colorado Plateau. The main channel of the Little Colorado is ephemeral almost all the way to its confluence with the Colorado River at the head of the Grand Canyon. Just west of Cameron (see Map 5) a series of large springs discharge into the deep canyon of the Little Colorado; upstream from this point the channel is usually a parched ribbon of sand.





Map 22.
Navajo Streams: Average Annual Discharge

Navajo Water Supply

THE CHIEF PROBLEM involving surface waters on the Navajo Reservation is that no permanent stream flows through the area. If the Little Colorado's minimal discharge is ignored (see Map 22), then all channel flow of a dependable nature rings the Reservation to the north and west. Once the San Juan River passes Comb ash (at Comb Ridge, see Map 15), the channels of the San Juan and the mainstream Colorado rivers are contained in teep-walled gorges with no flood plains useable for irrigation. Waters in these gorges are practically inaccessible to an economy in which electricity is generally not available for pumps to lift water from canyon floor to surrounding upland. Moreover, most of the land near the river downstream from Comb Ridge could not be irrigated effectively because of the rocky, rugged terrain.

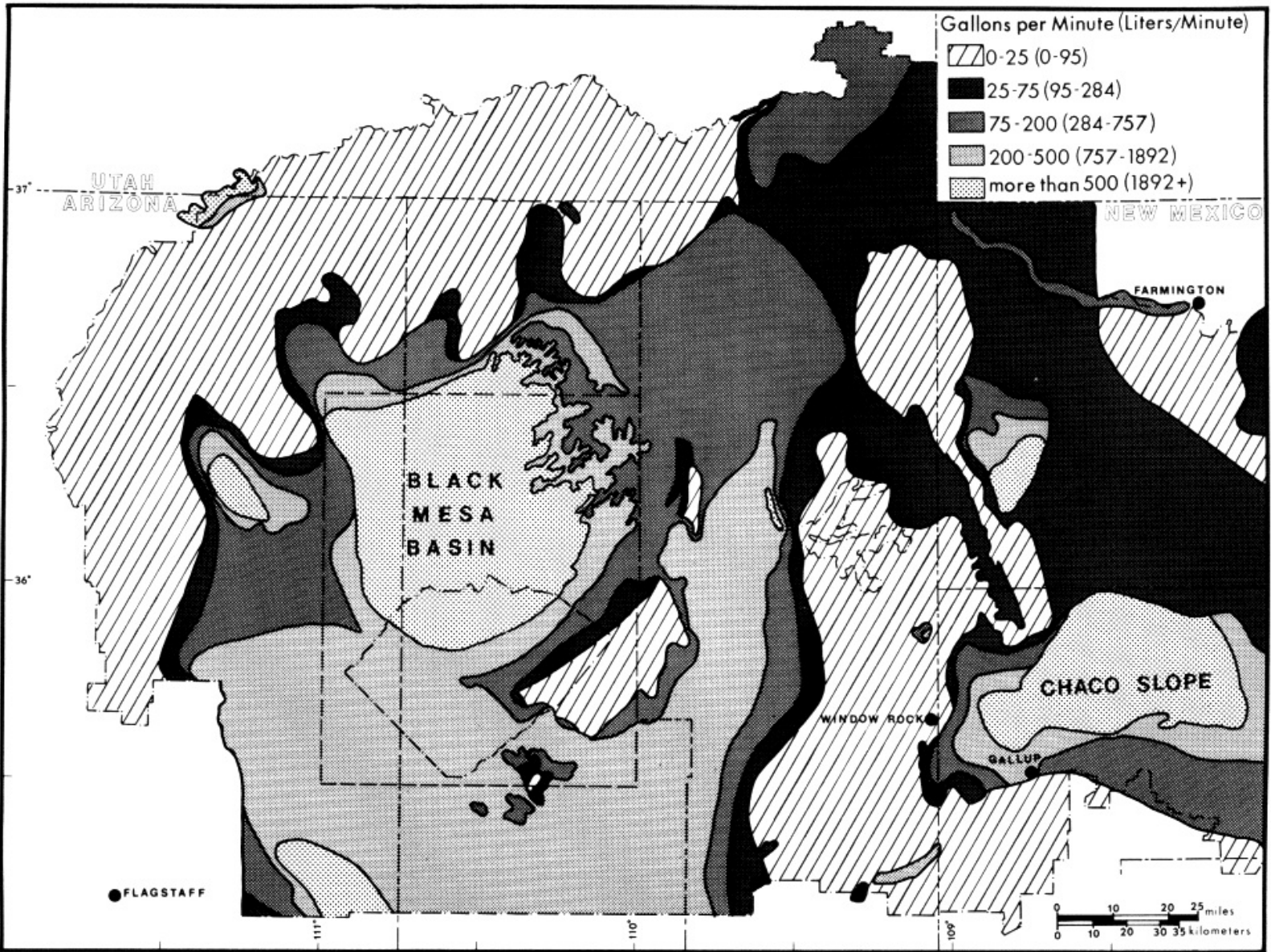
Maps 23 and 24 display a highly generalized pattern of chemical and hydrologic properties in Navajo area ground water. The Chaco Slope and the Black Mesa Basin are the two principal areas where ground water is abundant and has a relatively low dissolved solid content. But the Chaco Slope is the only one that has a near-surface occurrence of water. The depth of water levels in Black Mesa is beyond the range of the Navajo rancher's windmills. The lack of electric power prevents the individual Navajo from using ground water sources which are more than several hundred feet below the surface (see Map 41). However, with the aid of electricity, Peabody Coal Company pumps large quantities of ground water from beneath Black Mesa for use in a slurry pipeline to transport coal to power stations on the Arizona-California border.

Practically all of the ground water is hard. According to a water hardness classification system developed by the United States Geological Survey, soft water has less than sixty dissolved parts of mineral matter per million parts of water (expressed hereafter as milligrams per litermg/1. There are 1,000,000 milligrams of water in one liter). Very hard water has over 180 mg/1. As indicated on Map 24, the "best" mapped class of ground water has less than 500 mg/1. The dissolved minerals which impart objectionable qualities to the water and sometimes render it useless are bicarbonates, sulfates, and chlorides.

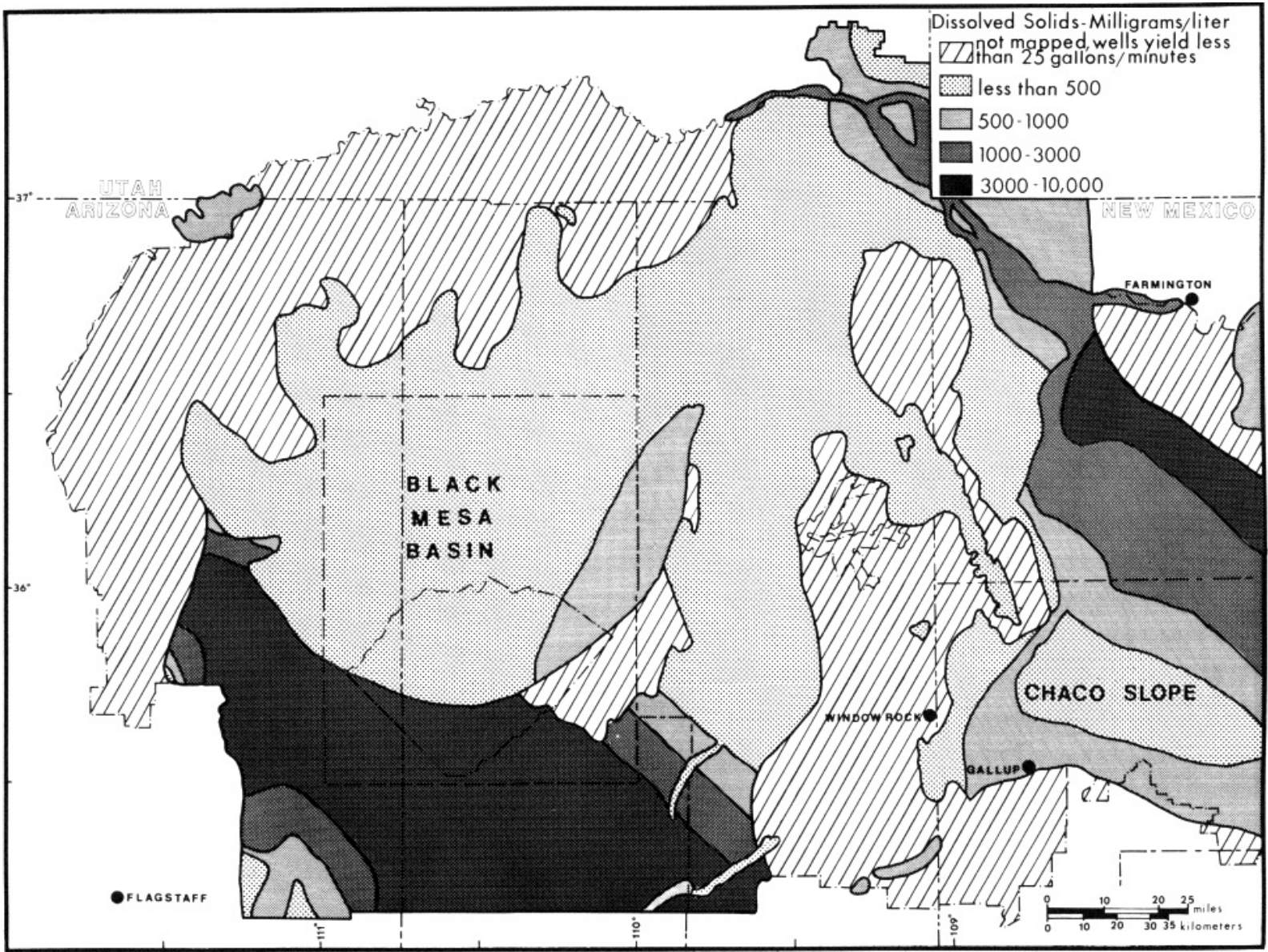
According to the United States Public Health Service standards for drinking water, any water with dissolved solids exceeding 500 mg/1 is not potable. Irrigation water is considered unsuitable for most irrigation conditions if its dissolved content exceeds 1,750 mg/1 (California State Water Quality Control Board). Water used for stock

varies in its definition of fitness. Undoubtedly the quality of the water will affect livestock productivity; however, criteria range widely from state to state. For example, water is deemed unfit for livestock if it exceeds 2,500 mg/l in Colorado, 4,500 mg/l in Montana, and 7,000 mg/l in South Dakota.

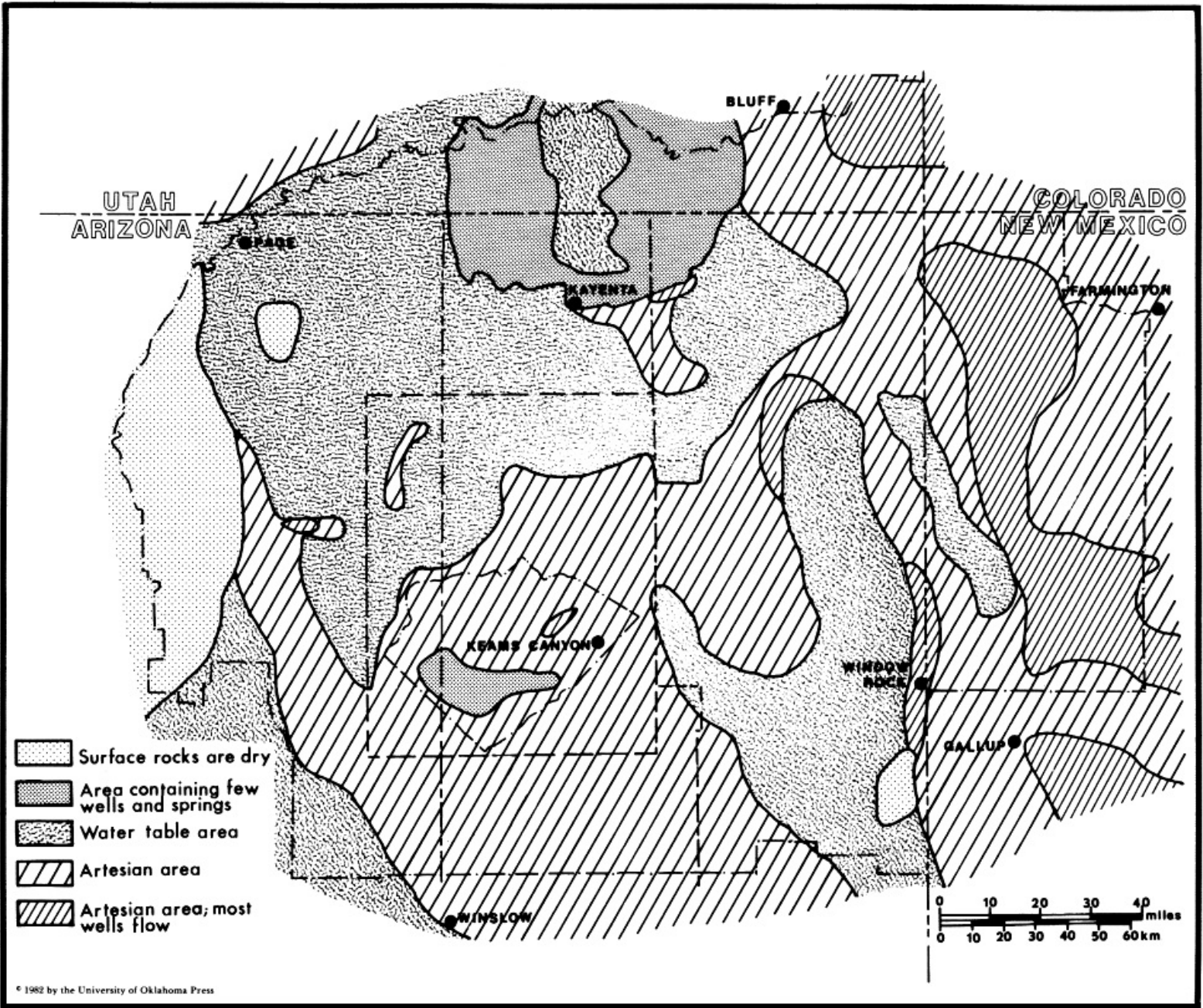
Although a number of wells exist across the reservation, the depth of the wells becomes crucial if hand pumps and wind power are used to lift the water. Some water tables are simply beyond the limits of human and wind power. In times of drought, water tables can drop to a point of creating a dry well. It is not uncommon for some Navajo people to have to transport water fifty or more miles for their stock and to their homes. Electric power is available for pumping water in relatively few areas of the reservation (see Map 39). Consequently, deep sources of ground water can be used only by those Navajos in areas with electric service, or by industries with their own power sources.



Map 23.
Ground Water, Quantity



Map 24.
Ground Water, Quality



Map 25.
Generalized Artesian And Water-Table Areas of Consolidated Aquifers

PART III
NAVAJO HISTORY



A means of transportation from the past; today the pickup truck has replaced the horse-drawn wagon as a symbol of prestige for the Navajo and a useful means of conveyance in livestock operations. Photographed by [unreadable]

Introduction to Part III

During the period between about A.D. 1350 and A.D. 1700, two very different human groups entered what is now called the American Southwest. Before this immigration, the area was dominated by Puebloan peoples. The newcomers were several groups of Apachean people, who arrived from the north and east, and Spanish explorers and colonizers, who approached from the south. The Apachean people, the first to arrive, settled in areas not normally utilized by the village-dwelling Puebloans. The Apachean people lived in small groups and sustained themselves by hunting and sometimes by farming as well. One element of a larger Apachean group that moved into the Colorado Plateau and became known as the Navajos developed certain cultural traits that may be used to distinguish them from other Apachean peoples. These cultural modifications are most likely to relate to their contacts with Puebloan groups partly through trade and partly from intertribal marriages.

The arrival of the Spanish, the other group, in the mid-sixteenth century had great impact on Pueblo and Navajo lifestyles. The Spanish contacts with the Navajos first came in the period 1540-82. A party from Coronado's 1540 expedition entered the area of the Hopi mesas, Province of Tusayan, and the 1582 expedition of Antonio de Espejo encountered the "Querechos" Indians in the vicinity of present day Laguna, New Mexico. The "Querechos" have been identified by historians as Navajo Apaches. Navajos probably occupied an area which extended from an interface with Pueblo villages west of the Rio Grande and Chama valleys of Northern New Mexico to the Hopi mesas.

By the early 1800s the Navajos had become a threat to Spanish settlements. The introduction of horses and sheep into the region by the Spanish and the acquisition of these animals by raiding Navajos had improved the resource base of the Indians, providing them with greater mobility and reducing their dependence upon hunting and crude farming for subsistence.

Following the termination of Spanish rule in 1821 and the transition to Mexican control, the isolated units of European-Mestizo settlements in the vicinity of Navajo country became something of a political vacuum, lacking significant political support from Mexico. Into this vacuum entered the initial Anglo-American movements from the east. The Southwest now entered another crucial phase of developmenta phase which followed the three hundred years of Apachean and Spanish penetrations,

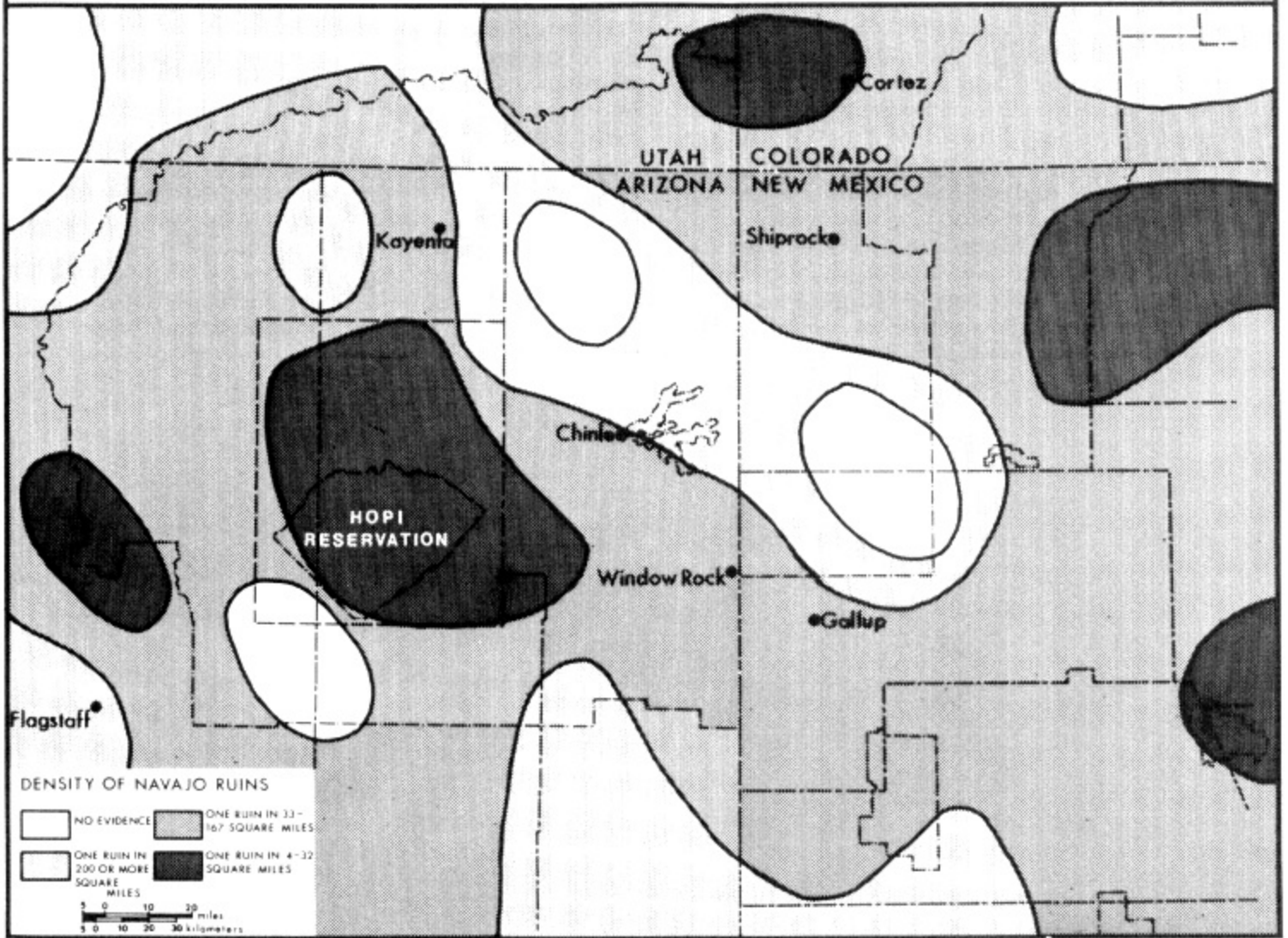
cultural compromise, the evolution of the Spanish-American, or Hispano, of northern New Mexico, and the evolution of a Navajo tribe.

During the mid-1800s, Anglo representation in the Navajo area was chiefly by military groups, traders, and federal government representatives; no major thrust of Anglo settlers entered the region in the early stages of United States control. During the first half-century of Anglo control, Hispano elements expanded their settlements westward beyond the Rio Grande corridor into lands that were formerly the range of Apachean groups. Some Anglo cattlemen and farmers also advanced into the southern Colorado Plateau and met the Hispano advances. The range of Navajos was diminished, and Anglo frontiers approached the Navajo area from all sides.

Evidence of Prehistoric Navajo Inhabitation

Evidence of Navajo settlements in the pre-European period has been obtained through archaeological investigations. Since these investigations are expensive, archaeological research is chiefly generated by needs other than pure scientific curiosity. Two major investigations in Navajo country have been connected with the environmental impact studies in the Navajo Reservoir area and the land dispute between the Navajo and Hopi tribes over land rights in the Joint Use Area (Executive Order Reservation of 1882). Other environmental impact studies are now or soon will be under way, so that fuel resources can be developed throughout Navajo Land. Map 26 displays the density of sites where evidence of Navajo settlement has been discovered. The concentration of ruin sites appears to be related to the piñon-juniper zones where hunting, gathering, and alluvial farming could be practiced.

data from David Brugge and Lee J. Correll



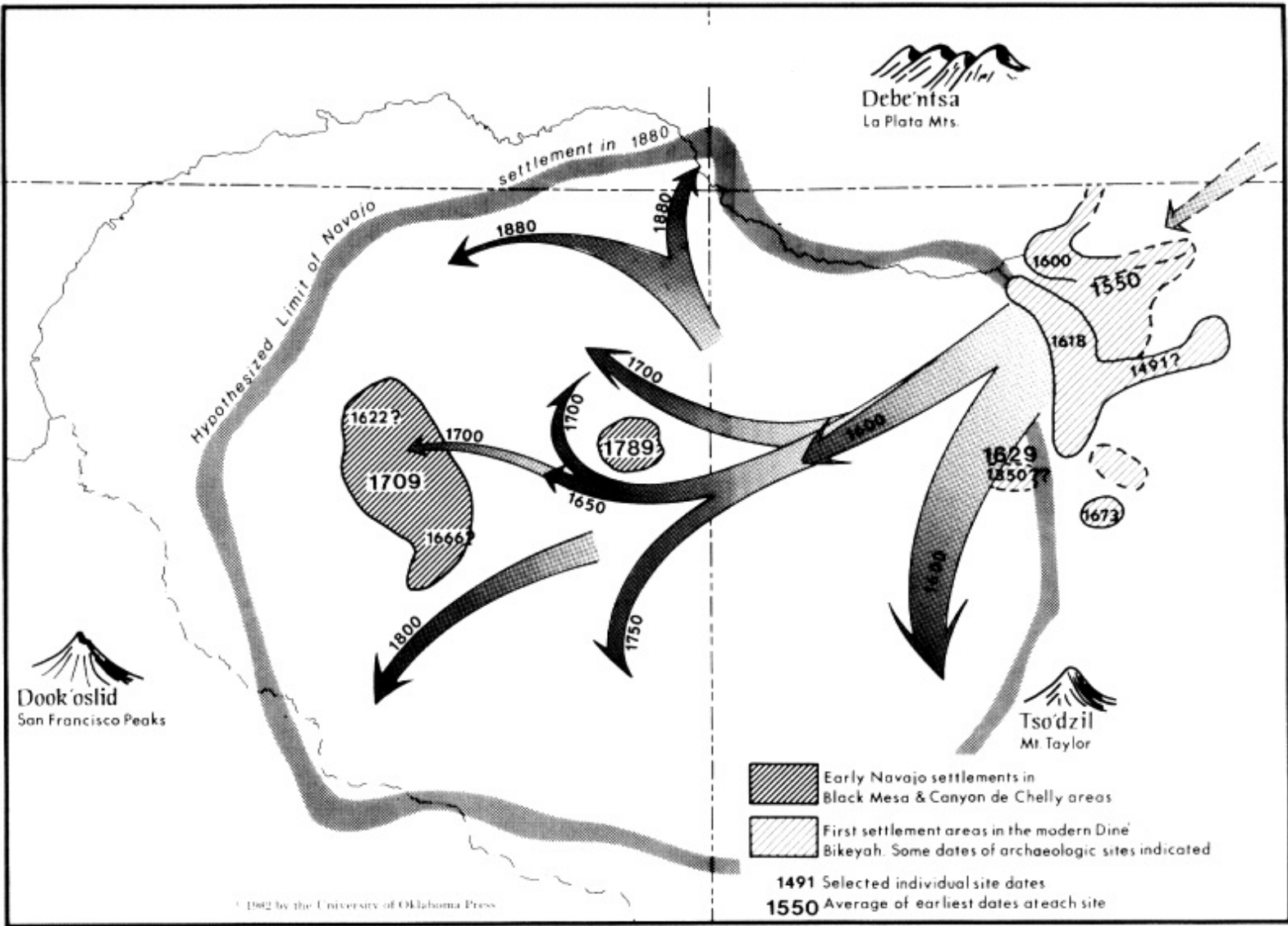
Map 26.
Evidence of Prehistoric Navajo Inhabitation

Navajo Migrations

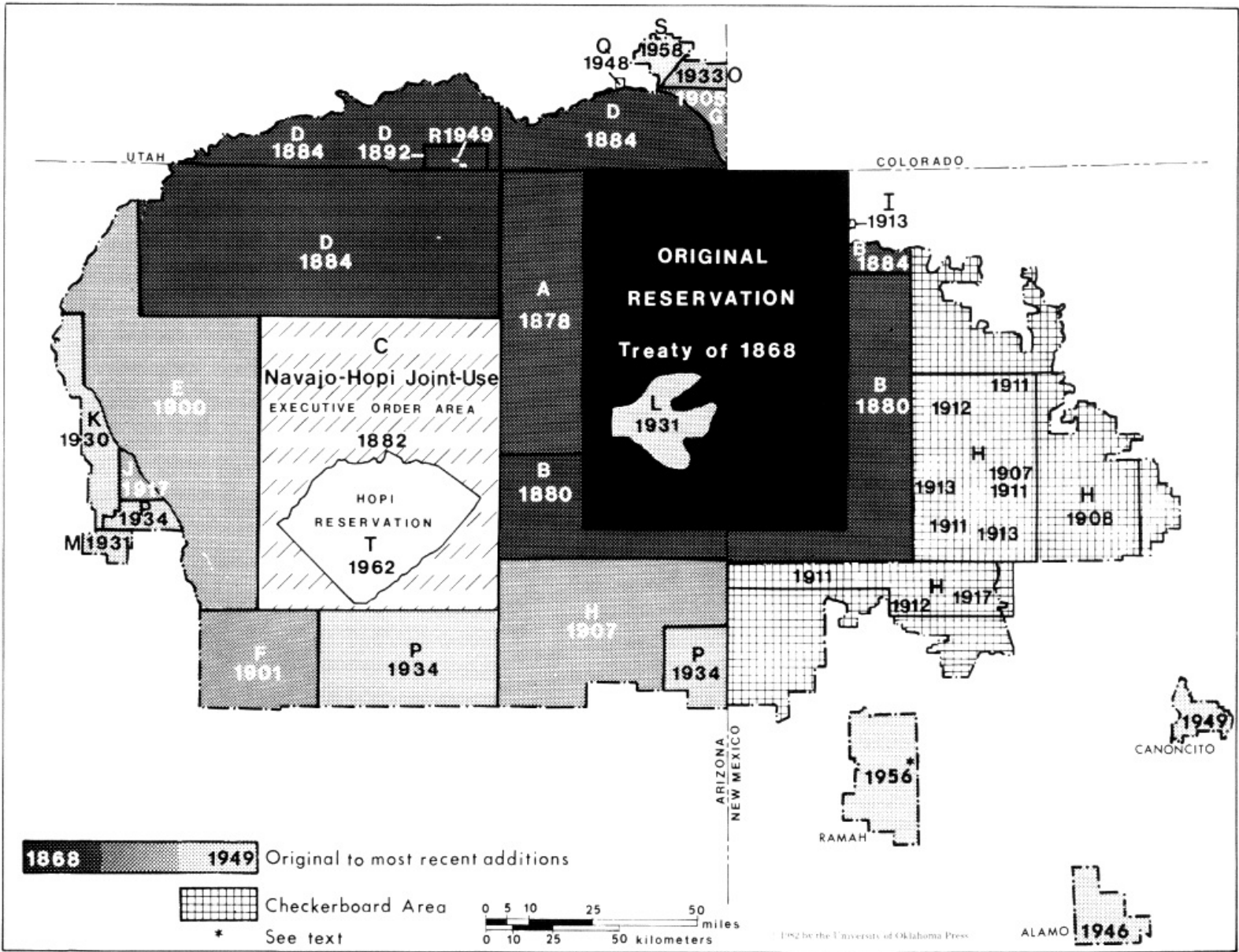
Although there is disagreement about the path of Navajo migrations, all investigations suggest that the Navajos and other Apachean tribes were late to arrive on the southwestern scene, that they are the southernmost group of Athapascan-speaking Indians, and that most likely these people were among the last of the American Indians to have migrated out of Asia to North America.

Migration routes of the Navajos southward from the main center of Athapascan language in Western Canada, are difficult to reconstruct. One line of thought is that the routes came through the Basin and Range areas of Utah and, perhaps, Nevada. Another line of reasoning has the route southward on the Great Plains along the edge of the Rocky Mountains. The oldest sites of Navajo inhabitation are found in the Largo and Gobernador canyons of New Mexico. The Navajos may or may not have crossed the San Luis Valley of the Rio Grande to reach these canyons. James Hester* has envisioned the spread of Navajo settlement across the reservation as shown on Map 27. Probably the Navajos did not move together as a group but as independent, separated bands. When population pressure on the land was low, migrations ranged over wide areas. According to Navajo tradition, settlements were confined to the land between the four Navajo sacred mountains which define the Navajo homeland. Map 27 shows three of the mountains, the fourth, Sierra Blanca (Blanca Peak), is in Colorado, east of the area delimited by this map.

*James J. Hester, *Early, Navajo Migrations and Acculturations in the Southwest*, Museum of New Mexico Papers in Anthropology No. 6, 1962.



Map 27.
Navajo Migrations: Prehistorical to 1800



Map 28.
Evolution of The Navajo Reservation

Evolution of the Navajo Reservation

In its 110-year history, the Navajo Reservation has witnessed numerous changes in its areal extent, and modifications of the boundaries are continuing at the present time. Map 28 shows, by a series of gray shades, the growth of reservation land. The darkest areas are the oldest, the lighter are the newer areas.

The Navajo Reservation from the beginning was too small to accommodate the tribe. The extent of the territory occupied by the Navajo people and the basis of their pre-reservation subsistence economy was never well understood by upper-level officials of the Bureau of Indian Affairs. Consequently, numerous additions to the 1868 reservation were made, a fact which eventually caused non-Indians of the area to become concerned about the continuing expansion of the reservation. Eventually the role of reservation establishment was removed from the executive branch and placed in the legislative branch of the federal government.

The Treaty of 1868, between the Navajo tribe and the United States, established the original reservation. However, at that time many Navajo people lived beyond the reservation bounds. In the ten-to twenty-year period following the treaty, the reservation was expanded westward to Glen Canyon, northward to the San Juan River in Utah, and lightly southward and eastward.

One area of Navajo country needs special attention. An Executive Order Reservation for the Hopi then called Moqui Indians and other Indians that the Secretary of Interior might direct to be settled there was established in 1882. In the years following this decree, some of the Navajo Indians were given recognition as being settled in this area, although the Hopis complained strongly. Almost immediately after the executive order was signed, a persistent struggle developed for rights within the area.

In 1962 a decision by a United States District Court (*Healing v. Jones*) parceled the 1882 Executive Order Reservation into two units: the diamond-shaped Exclusive Hopi Reservation, and the Navajo-Hopi Joint Use Area (JUA), the latter primarily occupied by Navajos. This court action did not calm the debate over use rights within the JUA; consequently the United States Congress in 1974 enacted a law that led to the even division of the JUA into exclusive Navajo and Hopi areas. In recognition of the displacement of Navajo people from land awarded to the Hopis, Congress further provided the right of the Navajo tribe to purchase land along the external boundary of

the Navajo Reservation. Part VI of this atlas contains four maps that treat the population distribution and environmental character of the former 1882 Executive Order Reservation and show the disposition of the area between the two tribes (see Maps 45-48).

After establishment of the Executive Order Area in 1882, the next major additions of land occurred in the first decade of the twentieth century. These additions extended the reservation westward to the Little Colorado River and southward toward the main line of the Santa Fe Railroad. A series of seemingly almost capricious Executive Orders added and subtracted land tracts in the "checkerboard" area of New Mexico. Today the so-called checkerboard is approximately two-thirds Indian lands; most of that remaining is public or state land, many of the parcels are no more than one square mile in size.

Two Congressional Acts now prohibit the President of the United States from making additions to reservations by Executive Order, placing the responsibility of reservation delimitation with the Congress. In 1917, an act of Congress pertaining to reservations in Arizona and New Mexico was passed; in 1927 another act of Congress prohibited changes in any previously created Indian reservation except by acts of Congress.

Action by Congress in the 1930s filled out the exterior bounds of the Arizona portion of the Reservation. In 1958, an area near Page, in the vicinity of Lake Powell, was exchanged by the Navajos for an addition of land in the Aneth area of Utah.

The Alamo, or Puertocito, Navajo Reservation was created in 1946. This reservation was formed when the federal and Navajo tribal governments purchased lands to consolidate the reservation. Ca-noncito was recognized that is, surveyed as a separate but fragmented unit as early as 1910. However, it was not until 1949 that it gained reservation status, after a series of land exchanges and purchases provided a contiguous unit.

Inhabitants of Ramah live on checkerboard parcels within the simplified boundaries shown on most maps. Most of the continuous areas of this reservation were gained by exchange of land between Navajo and federal, state, or private land holders. Additional property also was purchased with funds provided through public laws. Some of the land was purchased from the Picuris and Pojoaque Indian pueblos. Although parcels of land were held by the Navajos before then, the public laws that provided for the present configuration were enacted in 1956.



PART IV
NAVAJO POPULATION



Navajo shepherd. A sight that was more familiar in years past, sheep herding remains a traditional, if not totally viable, economic base that developed during early Spanish contacts. Photographed by [unreadable]



Yazzi Camp, an extended family settlement. The rectangular one- to three-room houses are occupied by members of several families interrelated by common blood lines and marriage. The symmetrically rounded buildings are hogwaddies, traditional Navajo houses. Sheep corrals and stacks of firewood suggest a subsistence mode of life support. The utility poles carry telephone service into the encampment. Radiating patterns of roads are common to most clusters of the dispersed dwellings in Navajo country.

Introduction to Part IV

The exact population of the Navajo Tribe living on the reservation is unknown. Census takers have difficulty reaching hogans located miles from the nearest paved road, and if they do not speak Navajo, no data can be collected from non-English speaking Navajos. In the 1970 United States Census the Navajo population was reported to be about 90,000 people; the BIA reported 105,000 people for the same date. Since the Navajos are closely tied to the land they live on, many may be reported as residents even though they live away from the enumeration district.

The accuracy of records of past Navajo populations is highly suspect. Still, some figures from past records may provide a sense of the rapid increase in population.

The recent growth rate of Navajo population has been about 4 percent per annum. At this rate the population will double its current figure of about 150,000 in some 17 years. In other words, by 1995, the reservation could have a population of more than 300,000 people.

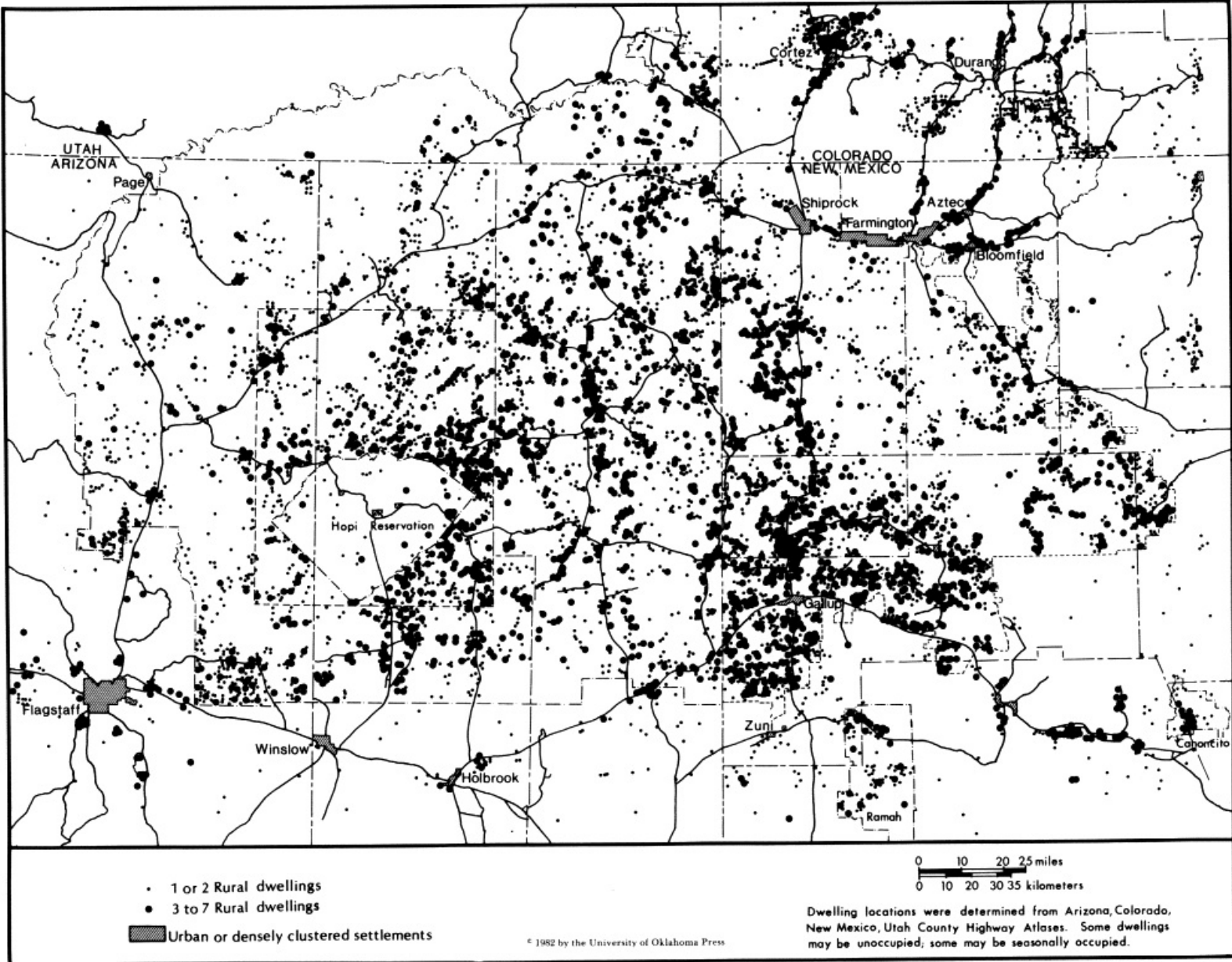
Economic development (discussed in Part V) has the potential of producing radical changes when

Navajo Population Figures

Year	Population	Source
1855	7,500	BIA
1869	7,151	BIA
1875	11,768	Terrell, <i>The Navajos</i>
1885	21,003	BIA
1895	20,500	BIA
1905	26,390	BIA
1922	30,052	BIA
1931	41,281	BIA
1947	56,000	Dale, <i>The Indians of the Southwest</i>
1958	85,000	Kluckholm and Leighton, <i>The Navajo</i>

1970	105,000	BIA
1975	151,354	BIA
1980	160,000	BIA (estimate)
1980	146,000	U.S. Census Office (estimate)

coupled with the social pressures brought about by population growth. Age-sex diagrams (Graphs 1 and 2) reveal a tendency toward a lessening of population growth, but for the Navajos the real danger of too many people for the land resource base continues to hang like a specter over the horizon.



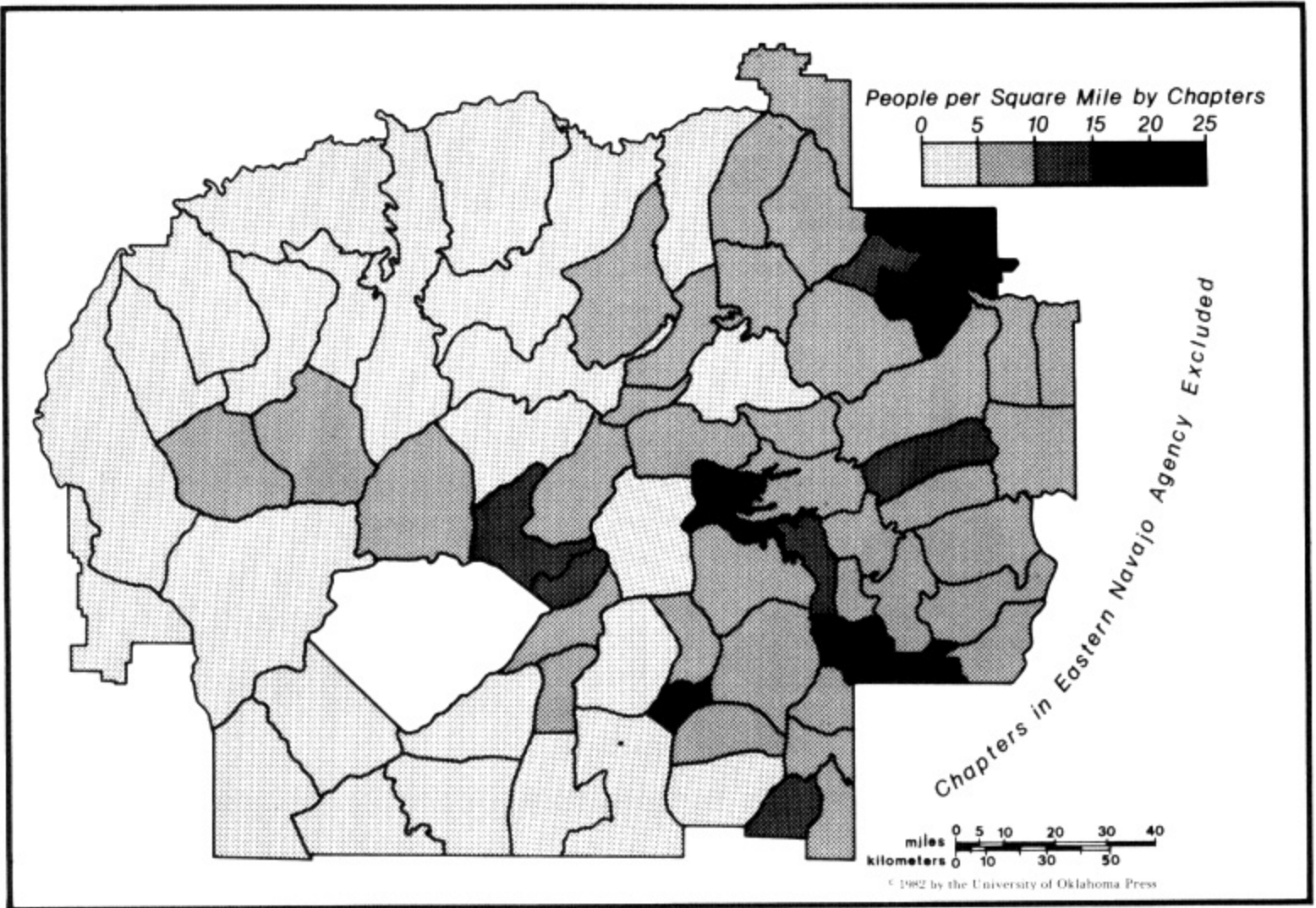
Map 29.
Rural Dwellings

Rural Dwellings and Population Density

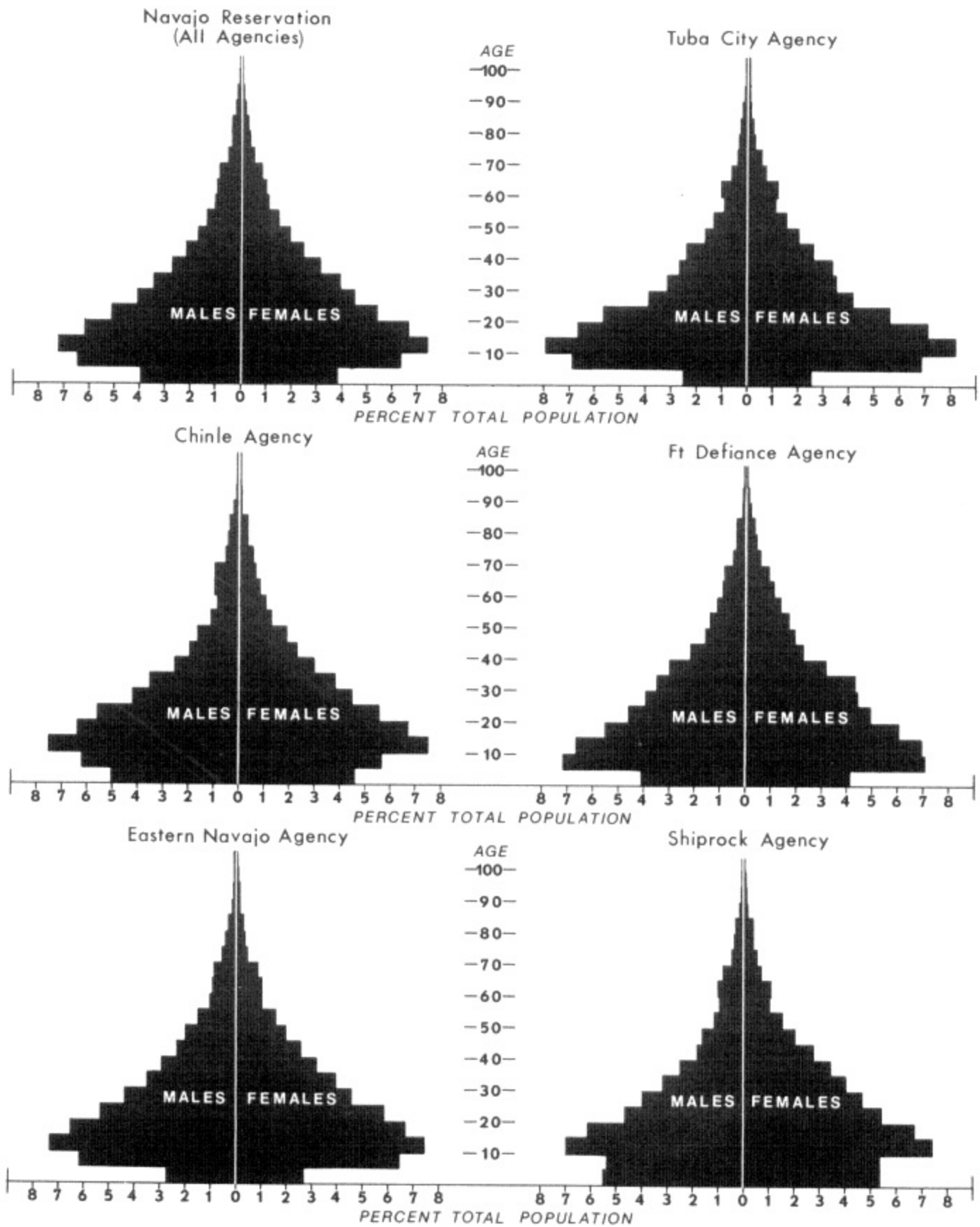
Most non-Indians and Puebloan Indians such as the Zuñis and the Hopis tend to concentrate their people in villages, towns, or cities. But the Navajos traditionally are not village dwellers. The map of rural dwellings plainly illustrates this fact (see Map 29). The Navajo reservation boundary clearly marks a difference in rural dwelling density between Navajo and non-Navajo lands.

The clusters of rural dwellings off the reservation generally mark valleys and water sources. This situation is particularly true in the San Juan valley near Farmington and Bloomfield and along the right-bank tributaries of the San Juan River. On the Navajo Reservation the dots used to symbolize the dwellings have some degree of significance beyond representing the numbers of buildings. Since most of the Navajo people are herders, their grazing area is indicated by the clustering and extent of the dot symbols. If this map is compared to maps demonstrating characteristics of the livestock industry (Maps 31 and 34), the great pressures exerted upon the land-resource base become obvious.

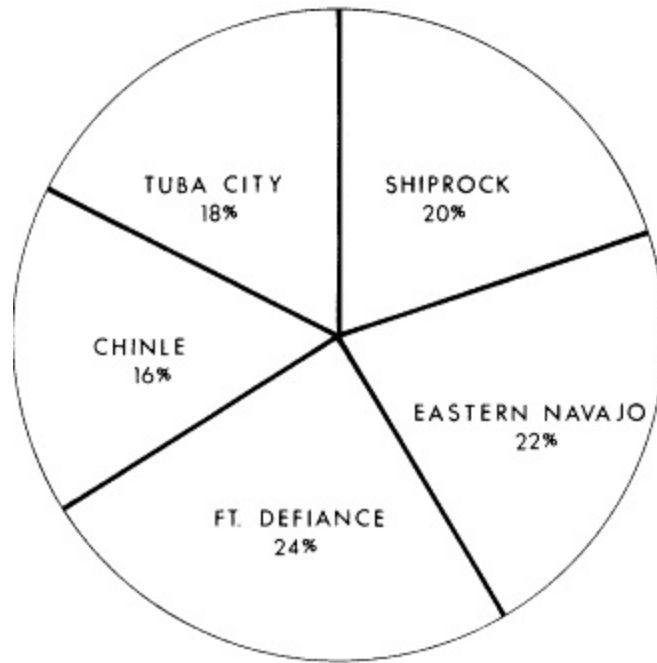
Map 30 presents the population density by Chapters. The average population density for the reservation is between five and six people per square mile. Some Chapters in the vicinity of Chinle, Window Rock, and Shiprock demonstrate the impact that government service and commercial industries have had on population concentration. In these centers the Navajos' traditional herdsman's life-style has been modified.



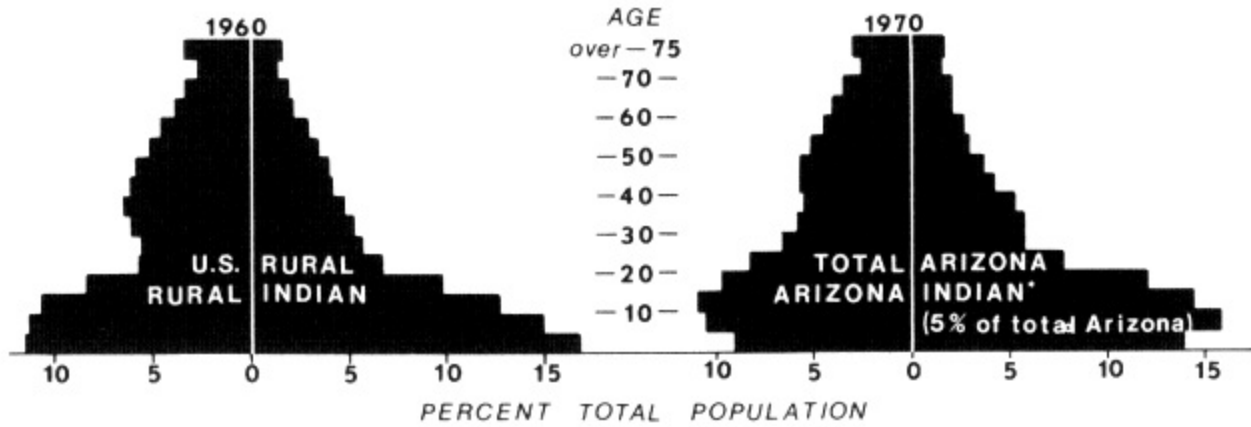
Map 30.
Population Density Per Square Mile



Graph 1.
Age/Sex Structure of Navajo Population, 1973



Graph 2.
Distribution of Population by Agency, 1973



Graph 3.
Comparison of Age Structure: Indian And Non-Indian

Structure of the Navajo Population

The population pyramids of Navajo Agency population shown on the graphs reveal two interesting trends. The shape of the pyramids from the ten-year level to older ages reveals a classic configuration of third-world populationexploding population growth. When the zero- to ten-year portion on the pyramid is added, an arrest of population growth is noted. The impact of reduced population growth cannot be fully understood at this time. An awareness of the problem of population explosion apparently has had some influence on family planning and attitudes toward family size, but so, too, have the level of education attainment and employment opportunities. The relative sizes of the Agency populations are displayed on the pie graph, Graph 2.

The Indian and non-Indian rural populations are compared on another population pyramid graph, Graph 3. The total United States rural population in 1960 is compared to the total Indian rural population in the same year. The explosive growth of rural Indian population is in contrast to an age distribution that indicates an outward migration of rural non-Indians in the groups of persons ages twenty to thirty-five.

The 1970 graph compares the total Arizona population to the total Arizona Indian population. Indians composed only 5 percent of the total 1970 Arizona population, therefore Indian characteristics are of minor bearing on the total Arizona side of the graph. Reduction in population growth is evident in both groups. The total Arizona population reveals what has happened to a population characterized by large immigrations of non-Indians from other parts of the nation to the glamour of the "sun belt life." Arizona is one of the most rapidly growing states in the nation.



PART V
LIVELIHOOD, RESOURCES, and SERVICES



The Four Corners power plant typifies modern resource development on the Navajo Reservation. The operation of the Utah International Company is visible near the power plant and beyond the San Juan. The San Juan Valley are seen in the foreground. These farm lands are outside the reservation; here the channel of the river. In the background the Chuska Mountains on the horizon are partly obliterated by the power plant. Shiprock is barely visible in the upper right corner of the

Introduction to Part V

In the early 1970s approximately 12 percent of the total Navajo population was employed in on-reservation activities other than the traditional herding and the crafts industries such as silversmithing and rug weaving. Some Navajos are employed in off-reservation jobs, but the percentage is probably low.

Pastoral activities are family oriented, with older adults and children alike involved in tending herds of sheep and goats. An agricultural census of Navajo livestock in 1969 counted nearly 700,000 sheep, 125,000 goats, 20,000 horses and 30,000 head of cattle. These livestock were managed on some 10,700 grazing permits. If an average of four people are engaged in the management of each of these herds, then approximately 40,000 people are engaged in the livestock industry about one-third to one-fourth of the total population.

Any figures on livestock population are highly questionable. Reliable data are difficult to obtain, since livestock herd size is regulated by the forage production of the Navajo range. Herd size is set by Chapter grazing committees, but it is doubtful that rigid enforcement occurs. However, preliminary Census of Agriculture reports for 1974 and 1978 suggest that the sheep population for counties located within the reservation in the states of Arizona and New Mexico has declined at an average annual rate of about 5 percent since 1974.

Work on the reservation in non-pastoral and non-cottage industry activities is dominated by government employment in the BIA, the Navajo Tribe, the Office of Navajo Economic Opportunity, the Public Health Service, and the schools. These activities account for 66 percent of the employment. Other occupations are in manufacturing and processing, 9 percent (although this percentage has dropped in the post-1975 period because of the closing of Fairchild Semi-Conductor Co.); agriculture and forestry, 6 percent; commercial trades and services, 6 percent; construction, 5 percent; mining, 4 percent; tourism, 2 percent; and transportation, communications, and utilities, 2 percent.

Two problem areas are evident: grazing pressure in the drought-stricken ranges is far too high; and public service makes up too high a proportion of the total employment. A number of resource and industrial development plans currently being promoted may relieve some of the present economic handicaps. The maps in Part V graphically

display a number of the problems and the proposed economic developments. The services needed for the population that is developing industrial activities based on resource extraction are of concern to the tribal government. Utilities, schools, and health facilities are widely and sparsely distributed across the reservation.

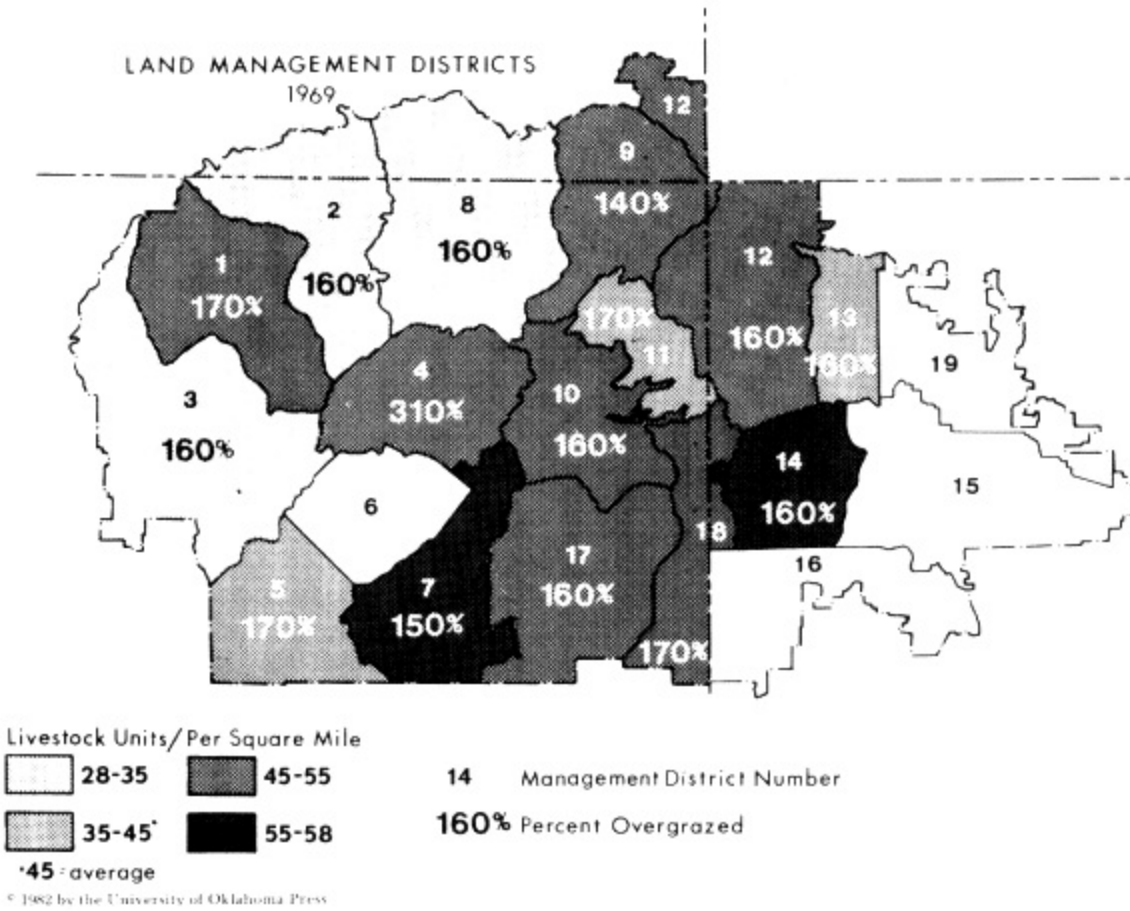
Livestock and Grazing

The grazing capacity of a range is strongly influenced by climate and livestock management. Climate will affect the biomass, that is, the variety of plants and the volume of edible material. Climatic characteristics such as the variability of precipitation from year to year and the annual ranges of temperatures determine the rate of growth and the ability of forage plants to survive and thrive.

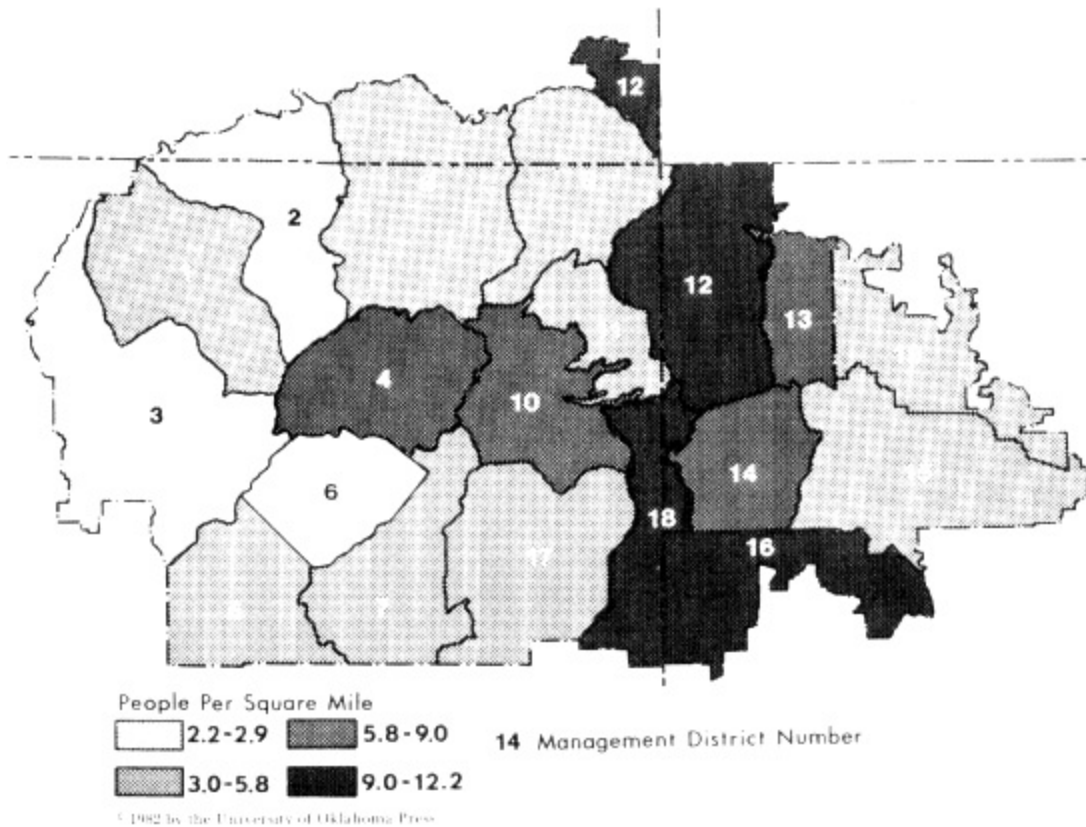
Use of the ranges to support grazing animals becomes a crucial factor in determining grazing capacity. If animals are confined to limited areas, they have a tendency to eat plants down to the ground surface and thereby reduce the seed production which provides for reproduction of the plants. If a single area is constantly trodden, hoof damage to the soil and plant cover alike promotes erosion and a lowering of the potential for plant growth.

Navajo Land has very few fences; livestock grazing cannot be easily controlled. Providing a rest for select grazing lands becomes nearly impossible, and grasses and other browse vegetation do not recover easily in an arid environment. With a constantly increasing human population, sheep and goat herd size has increased, biomass has decreased, and a vicious cycle of range deterioration has been established.

The information on Maps 31, 32, 33, and 34 is conservative; the livestock population is probably much greater except in the former 1882 Executive Order Area and the carrying capacity is probably lower. Over many parts of the reservation, human population continues to increase. Sheep population increases in some areas, and is being reduced in parts of Districts 1, 2, 3, 4, 5, 7, and 8, which extend into the former Navajo-Hopi Joint Use Area. The percentage of overgrazed areas increases annually, since herd size is seldom reduced, droughts persist, and biomass becomes less each year.

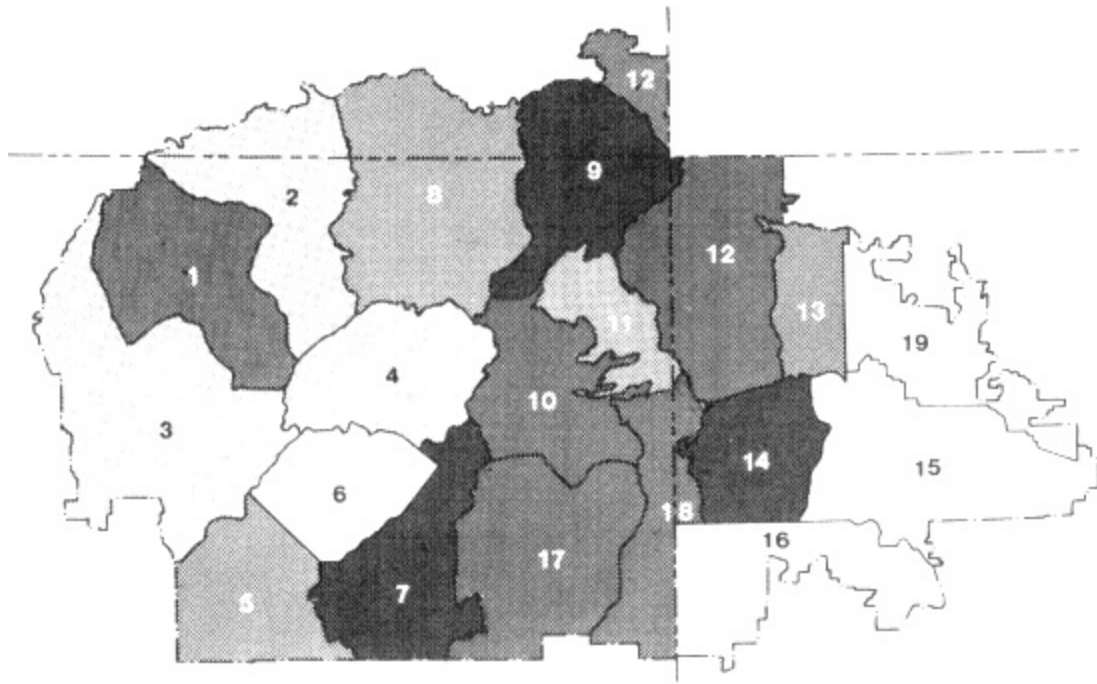


Map 31.
Livestock: Unit Density And Overgrazing



Map 32.

Human Population Density, 1974



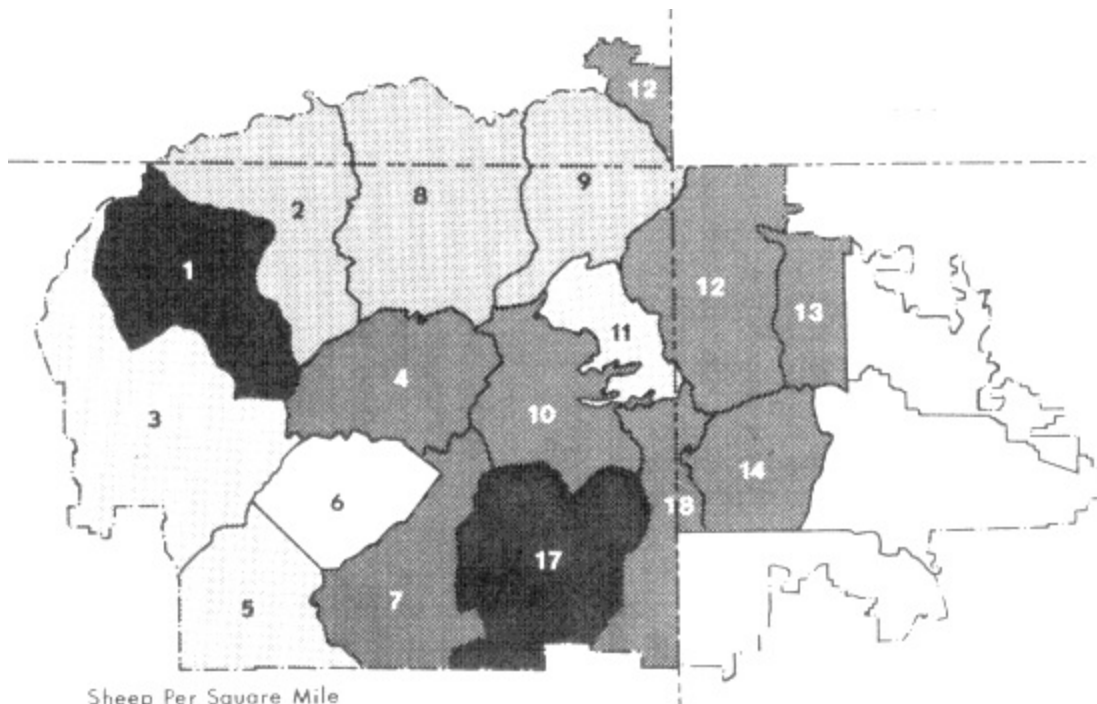
Capacity in Number of Sheep Per Square Mile for One Year 1969



*27: average

** Note: 5 Sheep: 1 Cow, 6 Sheep: 1 Horse

Map 33.
Grazing Land Capacity

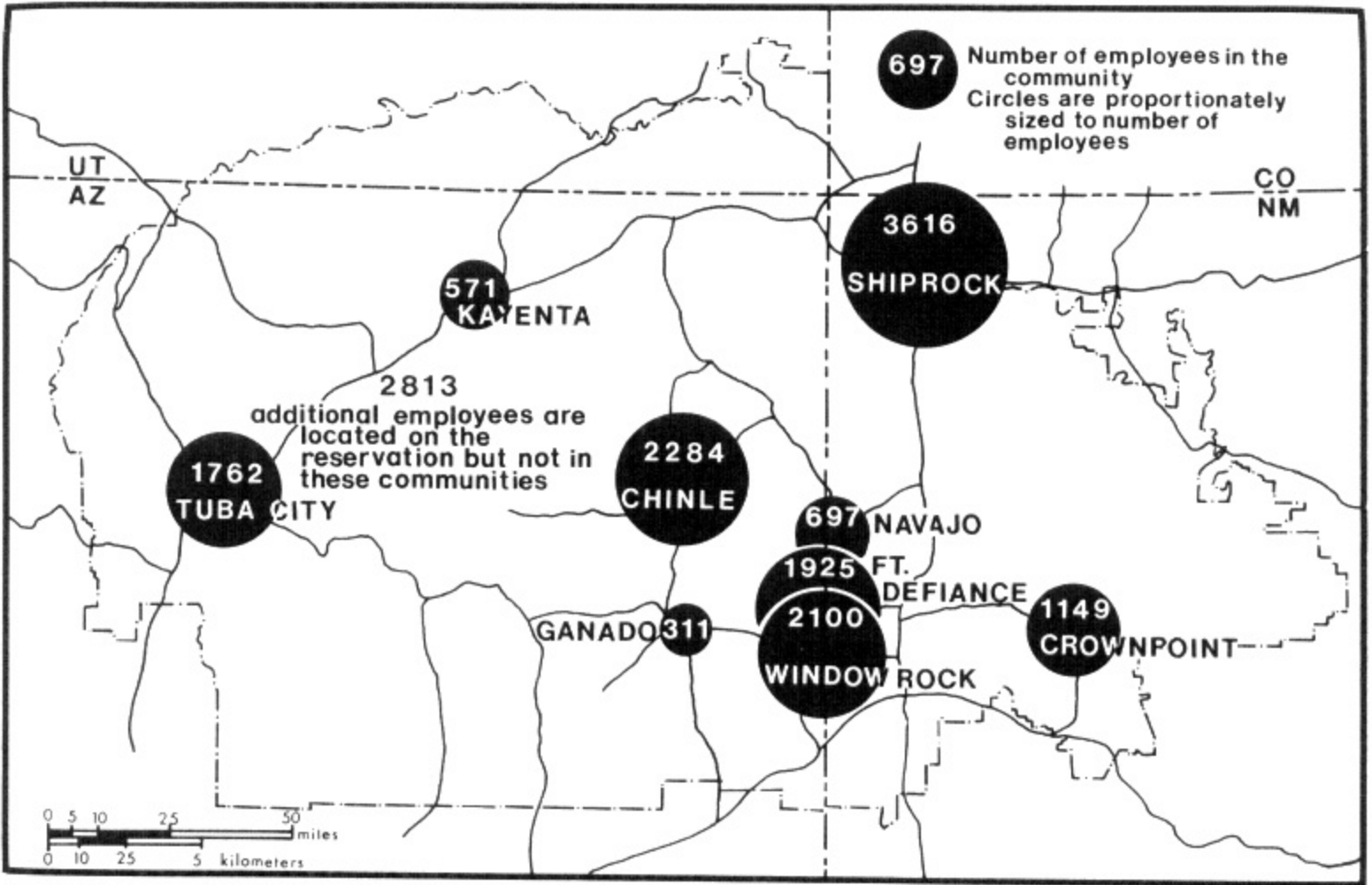


Sheep Per Square Mile



*21: average

Map 34.
Sheep Population Density, 1969



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Map 35.
Navajo Employment on Reservation, 1973

Navajo Employment on the Reservation

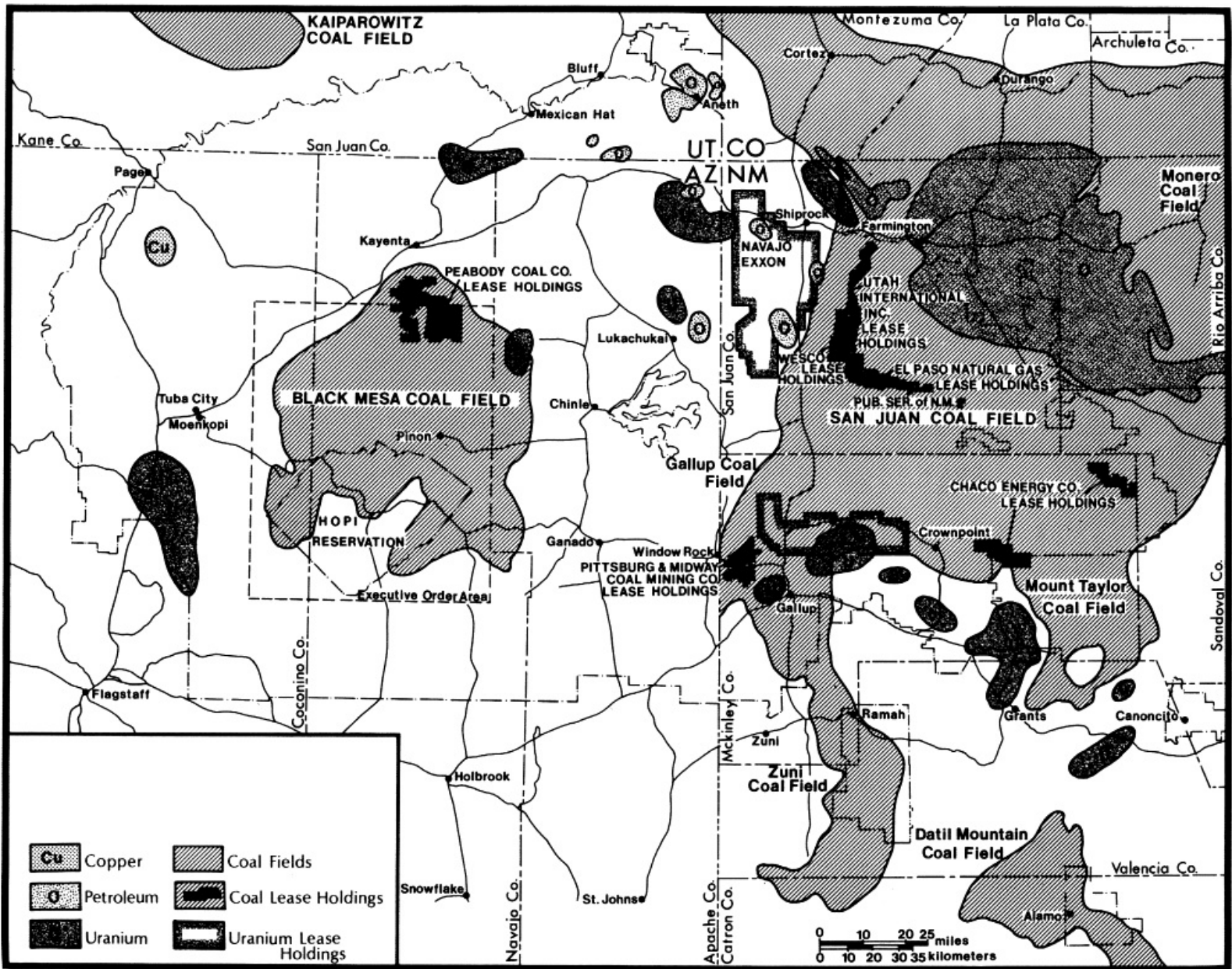
There are nine community centers on the reservation where approximately 84 percent of the Navajo people are employed. The remaining 16 percent are employed at scattered locations such as mine sites and irrigation project sites.

Information on employment released by the Office of Program Development of the Navajo Tribe indicates that about 20,000 people are employed on the reservation. Approximately 71 percent of these are Navajos. As indicated earlier, two-thirds of the employed are in public services: health; education, and government. Public services, centered in agency headquarters at Shiprock, Chinle, Fort Defiance, Tuba City, and Crownpoint, account for 62 percent of all employed. When Window Rock, the seat of tribal government and the BIA reservation headquarters, is added to the agencies, nearly three-fourths of all employment is at these sites.

The community of Navajo is unique among the towns on the reservation. Navajo, New Mexico, is the site of the Navajo Forest Products Industry. This tribal enterprise is highly successful, well managed, and a tribute to well-conceived, self-sustaining industry based on local resources. It is a successful model for other tribal industries. The community of Navajo is planned to serve the needs of the Industry's employees, therefore it is the only totally industrial community on the reservation. In the same way, the proposed "Newtown" will serve the Navajo Indian Irrigation Project and possibly coal gasification operations.

Kayenta is a limited trade service center and education complex site. Ganado is a medical and education service center. Neither place plays a major role in government operations. However, each is important to some extent in tourism on the reservation (see Map 44). Ganado is the site of the Hubbell Trading Post National Historical Site. Kayenta is at a major highway junction for routes to Monument Valley Tribal Park and Navajo National Monument. Kayenta is one of the few Navajo communities with motel facilities; it also is situated near the major coal-mining operations on Black Mesa.





Map 36.
Mineral Resources

Mineral Resources

Mineral resources are the Navajo Tribe's principal source of income. Fuel minerals are by far the most significant element of the mineral resources. Petroleum, natural gas, coal, and uranium account for royalty income paid to the tribal government and payrolls to Navajo workers.

Petroleum and natural gas production started in the 1920s and since that time has accounted for the largest portion of royalty income. As petroleum production declines, coal seems destined to become the major source of income. Uranium deposits are quite extensive on and near the reservation; the unknown amount of reserves and uncertainties of national priorities in nuclear energy development leave this mineral's future role in the reservation economy open to question.

The San Juan basin, both structurally and topographically, has long been noted for its fuel mineral reserves. Petroleum and natural gas occur extensively across this area. Western San Juan production occurs chiefly in the Little Water field near Tohatchi and the Rattlesnake field near Shiprock. Another field is near Lukachuki. A third major field is located near Aneth in the Blanding basin of Utah. The oil produced is distributed by a series of pipelines which cross the reservation near most of these fields (see Map 38).

Coal is found in extensive deposits in several structural basins on or near the reservation. With the current push to convert energy-generating facilities from petroleum fuel to coal, these deposits are becoming increasingly significant. Three major areas of coal production occur on or near Navajo lands. Again the San Juan basin emerges as a major center of reserves. Large leases have been granted to Utah International, a subsidiary of General Electric, and to El Paso Natural Gas Company-Consolidated Coal Company.

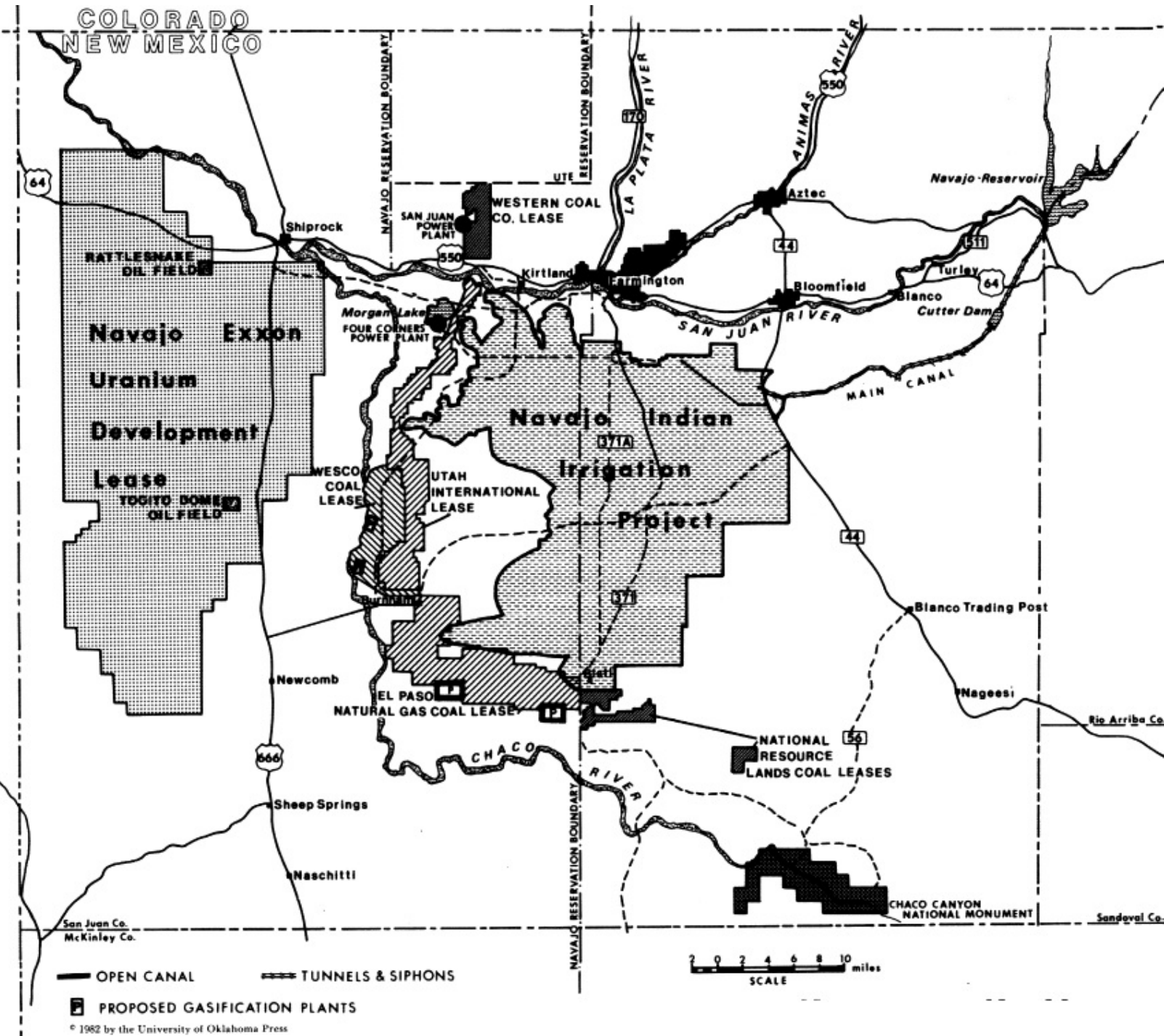
The Pittsburg and Midway Coal Company, a subsidiary of Gulf Oil, operates in the Gallup coal field. It is ideally located with respect to the main line of the Santa Fe railroad. Coal produced by the Pittsburg and Midway Company is transported by train to the Cholla Power Plant (see Map 38) near Holbrook, Arizona. The third major region is the Black Mesa area. Peabody Coal Company has large leases near the northern edge of the mesa, and prospects appear excellent for exploitable seams to extend south over major portions of the mesa as well (see Part VI). Peabody's coal is

shipped by electric railroad to the Navajo power plant near Page, Arizona, and by slurry pipeline to the Mojave Power Plant near Bullhead City, Arizona.

Uranium deposits are widely scattered over the Diné Bikeyah. Major mining operations are concentrated in the Mount Taylor region near Grants, New Mexico. Kerr-McGee has a large lease near Gallup, New Mexico, and the Exxon Company in partnership with the Navajo Tribe seeks to develop a huge exploration lease in the extreme western San Juan Basin on the Navajo Reservation. Some uranium production has occurred in Monument Valley, and other potential mining areas exist in the western portion of the reservation.

There are deposits of low-grade copper on the Kaibito Plateau south of Page.

The importance of the fuel minerals, especially coal, found on Navajo land is great. Map 38 indicates the amount of electrical energy which is generated and shipped beyond the region's boundaries. But the extent of the reserves is also a cause for concern, since energy minerals notoriously bring a boom and bust economy. Strip mining will ravage large areas that will be difficult to reclaim and, at best, will have a very slow recovery rate. Life-styles of the Navajos will be severely modified. Furthermore, to this date, little attention has been given to using Navajo resources for the internal economic improvement of the reservation. As the following maps indicate, most of the benefits of mineral production are realized beyond the reservation boundaries.



MAP 37.
Energy Development in Northwestern New Mexico

Energy Development in Northwestern New Mexico

Existing and proposed energy generation facilities have had and will have tremendous impact upon northwestern New Mexico and the eastern Navajo Reservation. When the developing Navajo Indian Irrigation Project and Navajo-Exxon uranium development leases are also considered, the total areal extent of resources development dominates the landscape.

Utah International, after obtaining from the Navajo tribe a coal-mining lease on more than 31,000 acres, interested a consortium of electrical companies (Western Energy Supply and Transmission Associates, WEST) in developing the Four Corners Power Plant. Five generating units have been constructed, with a capacity output of 2,085,000 kilowatts. Arizona Public Service Company operates all of the five units. Arizona Public Service Company has full ownership of units one, two, and three (575,000 kw). Units four and five (with a total capacity of 1,510,000 kw) are jointly owned by: Southern California Edison Company (48 percent, or 724,800 kw), Arizona Public Service (15 percent, or 226,500 kw), Public Service Company of New Mexico (13 percent, or 196,300 kw), Salt River Project (10 percent, or 151,000 kw), Tucson Gas and Electric Company (7 percent, or 105,700 kw), and El Paso Electric Company (7 percent, or 105,700 kw).

The southernmost portion of the Utah International lease is proposed for mining to supply the needs of a proposed coal-gasification plant to be constructed near Burnham. The Western Gasification Company (WESCO) is a joint venture between the Pacific Coal Gasification Company (a subsidiary of the Pacific Lighting Corporation) and the Transwestern Coal Gasification Company (a subsidiary of Texas Eastern Transmission Corporation of Houston). Gas produced at this site would enter Trans-western's transcontinental pipeline at Gallup.

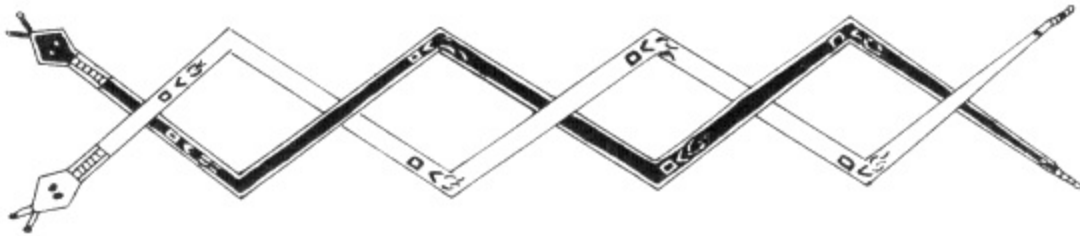
The El Paso Natural Gas Company-Consolidated Coal Company's lease of 40,000 acres is meant to supply their coal-gasification plants with the raw materials needed to produce synthetic natural gas. The gas would be distributed through the El Paso pipeline network, which extends from Texas to California with links to systems in the Pacific Northwest.

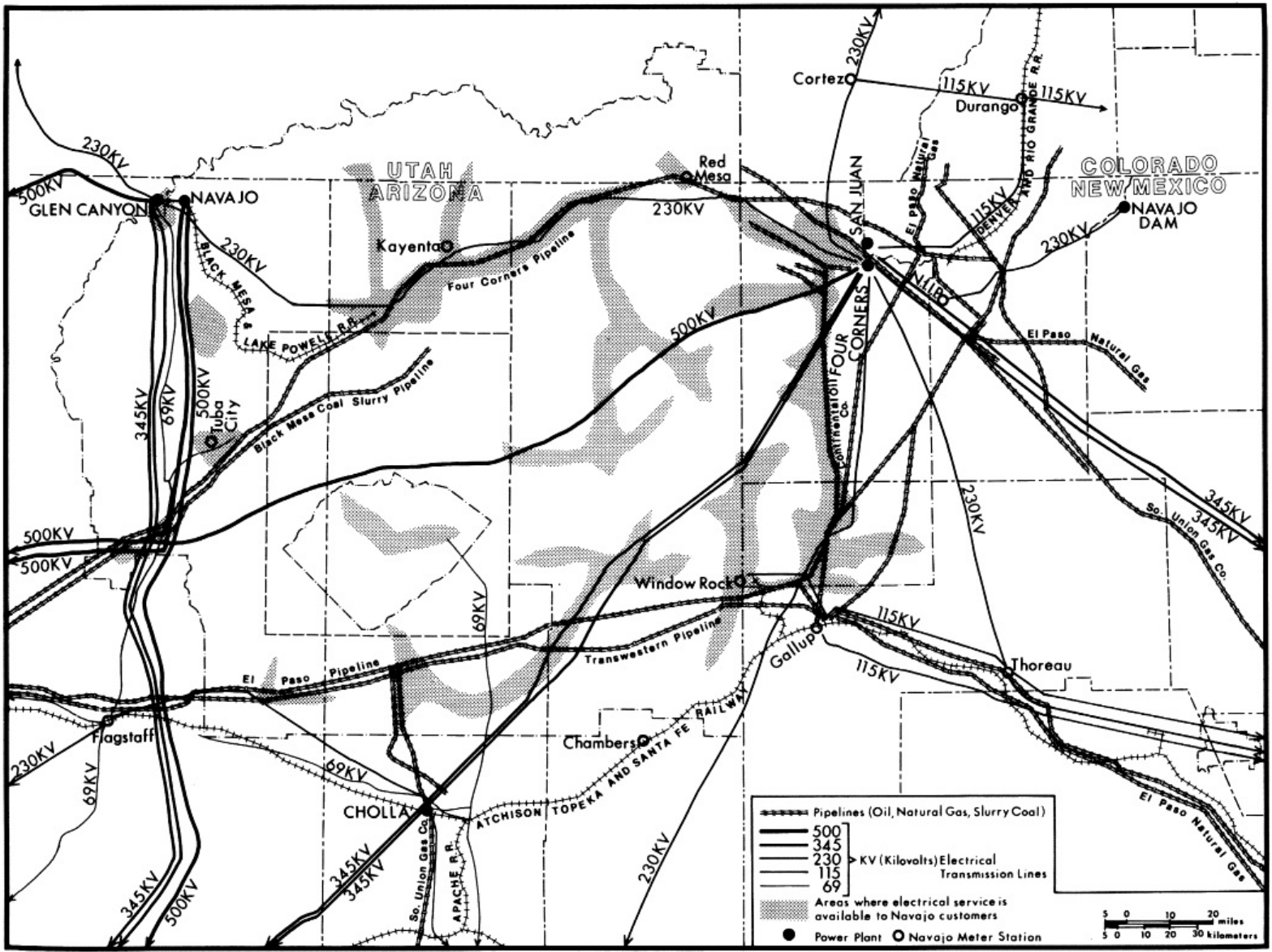
Just north of the San Juan River, and immediately south of the Mountain Ute Reservation, a joint venture of Public Service Company of New Mexico and Tucson

Gas and Electric Company led to the construction of the San Juan Power Plant. Coal is mined in the area surrounding the plant, and additional reserves are leased in the vicinity of Bisti (just east of the El Paso site). Four generating units are proposed; two are currently in operation.

The Navajo-Exxon uranium lease is initially for exploratory purposes. If feasible reserves are discovered, mills will probably be developed in the area. The lease agreement was approved by the secretary of the interior, acting in the trusteeship role for the Navajo Indians, in 1977.

The Navajo Indian Irrigation Project is explained in more detail on Map 43. The sizeable area it occupies and its relative location to other projects in northwest New Mexico have important economic impact both on and off the reservation. The sites of several proposed new communities to service the needs of employees of the proposed projects are indicated on Map 38.





Map 38.
Major Electrical Transmission Lines, Pipelines, And Railroads

Electric Transmission Lines, Pipelines, and Railroads

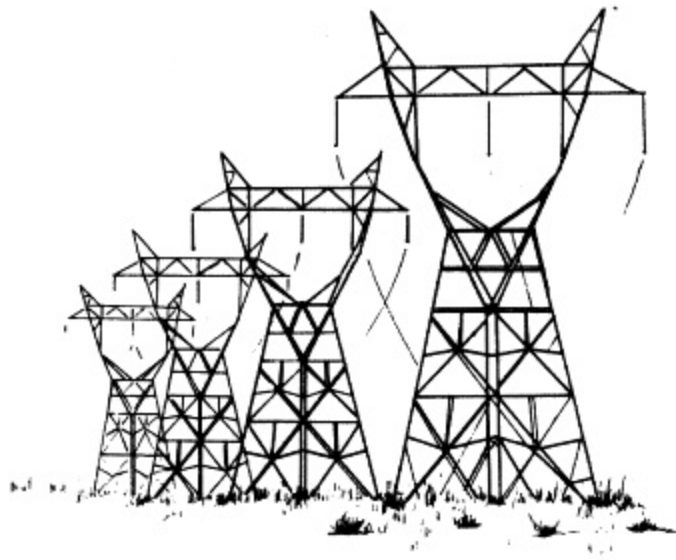
The most important product of Navajo resources is energy. Five major power plants located on or near the Navajo Reservation generate electricity that is distributed westward to southern California, southward to cities in southern Arizona and to the Salt River Project, and eastward to Albuquerque and into western Texas, especially to the El Paso area. In addition, the networks displayed on Map 38 are linked to the Utah Power and Light Company system.

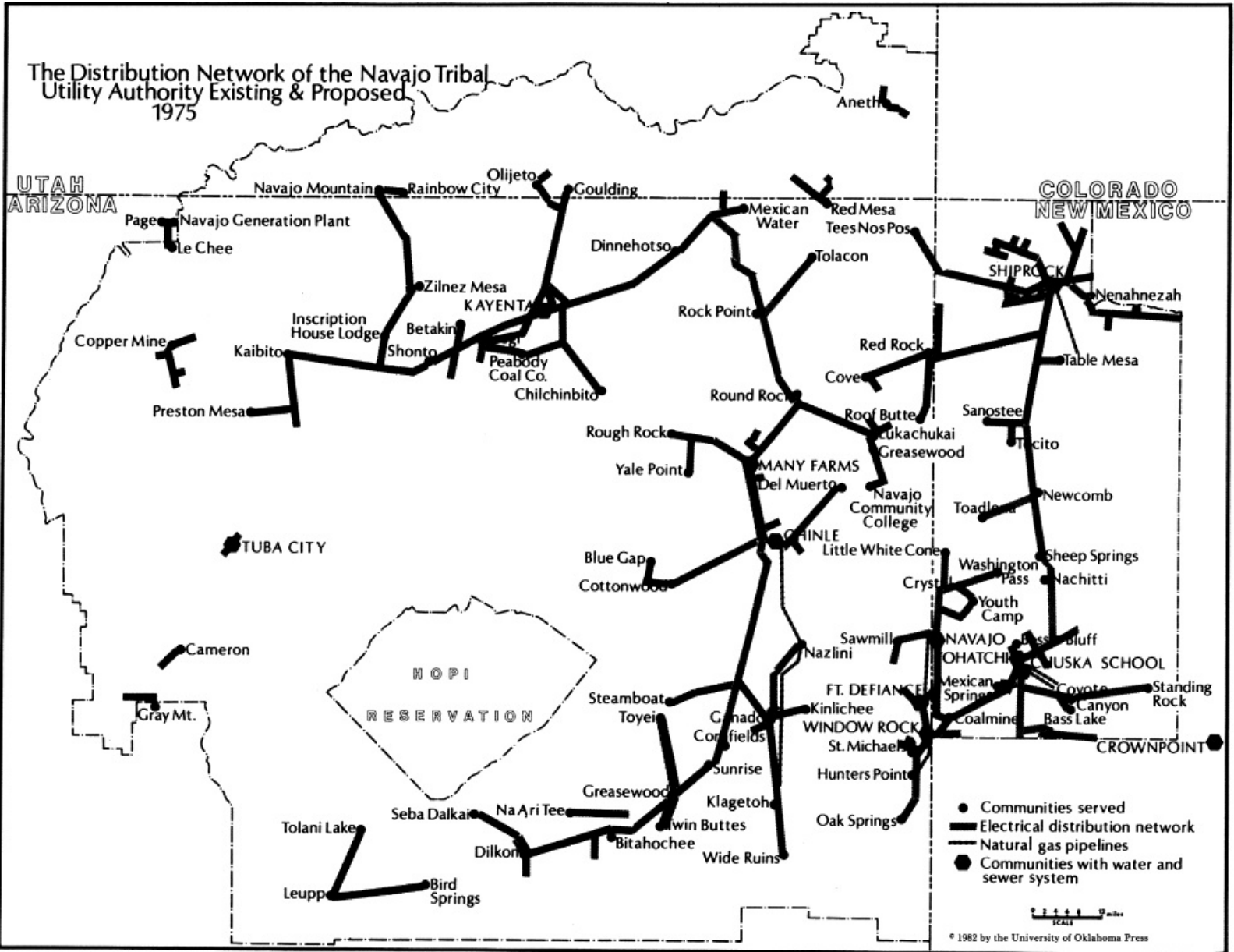
Most of the electricity produced in the Navajo area is fueled by Navajo coal. The major exceptions are the Glen Canyon Dam Power Plant and the Navajo Reservoir Plant. The latter will supply energy to operate the Navajo Agricultural Products Industry, the producing agency for the Navajo Indian Irrigation Project.

Most power plants are served by coal mined adjacent to the plant. However, Black Mesa coal is carried by the Black Mesa and Lake Powell (electric) railroad to the Navajo Power Plant and also by a slurry pipeline to Southern California Edison Company's Mojave generating plant near Bullhead City, Arizona. The slurry pipeline is supplied with ground water from deep wells beneath Black Mesa.

Pipelines for oil and natural gas form part of a transcontinental system. The main routes parallel the Atchison, Topeka, and Santa Fe Railroad and Interstate Highway 40.

Only limited areas of the Navajo Reservation have access to electricity; these are indicated by the stippled pattern on the map. The Navajo people have but a small share of the tremendous power generated from their resources. Map 39 displays the reservation areas serviced by electric power.





Map 39.
Electricity, Natural Gas, Water And Sewer Systems

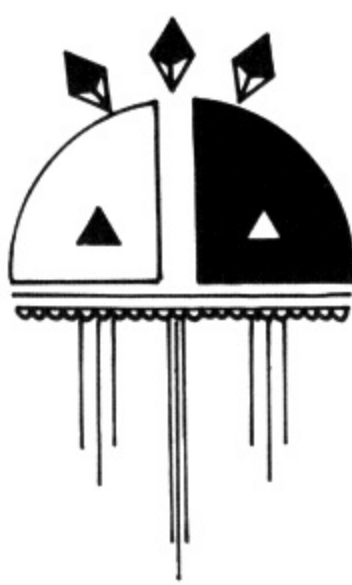
Navajo Tribal Utilities

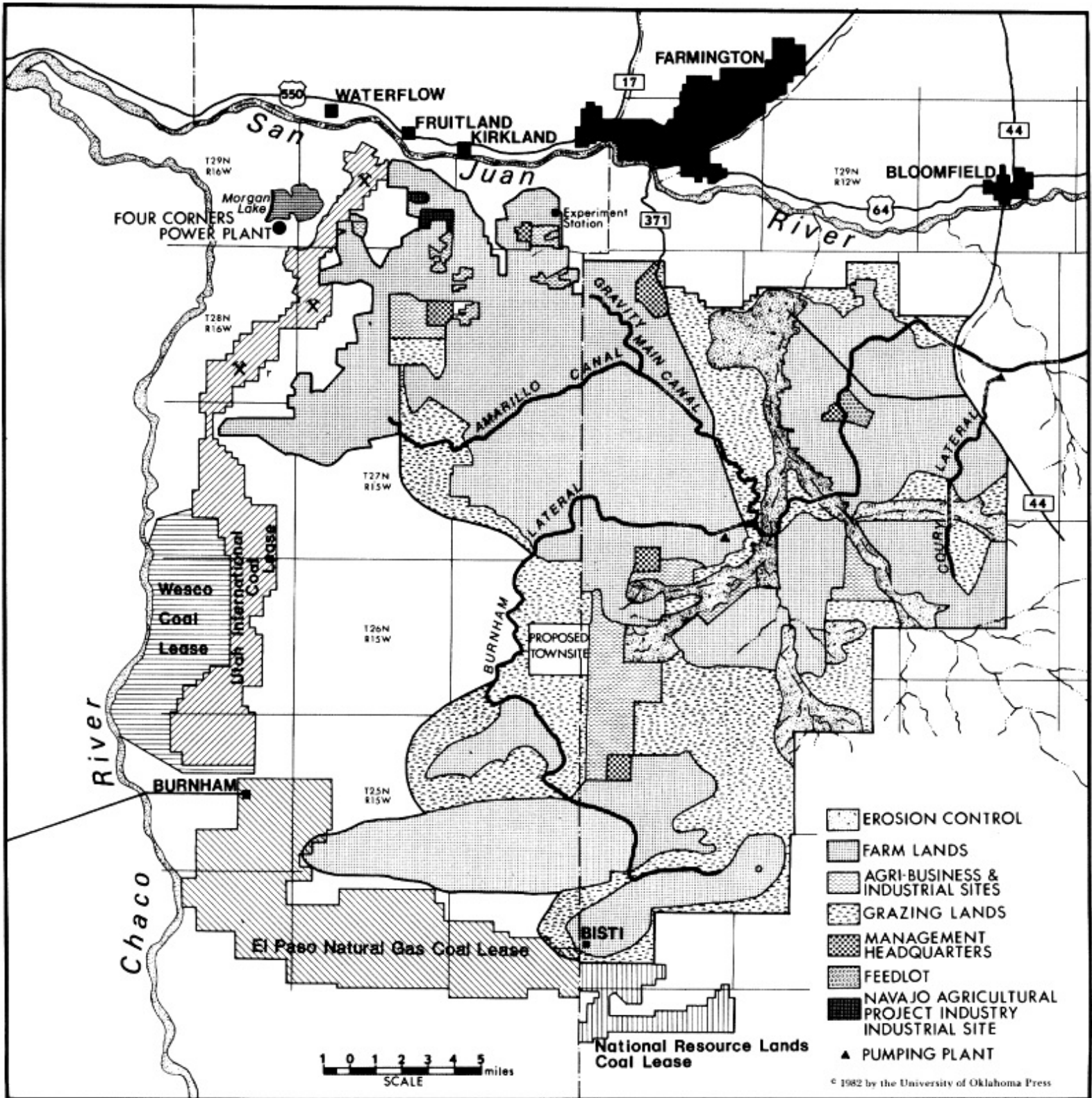
The Navajo Tribe maintains a Navajo Tribal Utility Authority responsible for purchasing electricity and natural gas and distributing it to Navajo customers. In cooperation with the Public Health Service, some communities have sewage treatment facilities and water distribution systems. All other communities generally develop water supplies from individual wells.

Four major corridors of electrical service are apparent from Map 39. The two major corridors parallel the eastern and western flanks of the Chuska Mountains-Defiance Arch uplands. One extends from Shiprock southward to Window Rock, hooking back north to Navajo and Crystal. The other follows the Chinle Valley from Mexican Water to Chinle. A third swings west and south from Ganado to Dilkon and Seba Dalkai. The fourth corridor extends along the lowland passages from Mexican Water to Kaibito. The western reservation has points of service at LeChee, Copper Mine, Tuba City, Cameron-Gray Mountain and in the Leupp area. Large areas centered around Black Mesa and the extreme eastern reservation in New Mexico have no electric service.

Only ten communities on the reservation have water and sewer systems. Individual sites, of course, may operate their own inside water systems and septic tanks. A large number of Navajo people still must depend on transporting water from wells, which may be miles distant from their homes, and many people are still using outhouses.

Sizable areas of the reservation totally lack utility service. Many Navajo homes are lighted by gasoline lantern, water is carried indoors by hand, and if television is available it must be powered by a gasoline-fueled electric generator. These are the homes that are usually many miles from the nearest grocery store, automobile service station, and educational, medical, and social services. Yet many of these home sites are within view of the high-capacity electrical transmission lines that gird the reservation; and any Navajo there can look skyward on a clear day and see the condensation trail of an airliner that will arrive in Los Angeles, Chicago, or Dallas before he can reach the nearest trading post.





Map 40.
Navajo Indian Irrigation Project

The Navajo Indian Irrigation Project

The Navajo Indian Irrigation Project (NIIP) involves the use of water impounded in the Navajo Reservoir on the upper San Juan River to irrigate a proposed 110,000 acres of cropland. Water is transported from the reservoir by a system of open canals and pipelines, with attendant lift stations and siphons, to the sprawling irrigation site (see Map 40). A long series of lateral canals distributes the water across the project, where it is delivered to the croplands by overhead sprinkler systems. The first crop production from the project, chiefly barley and cabbages, came from 10,000 acres during the growing season of 1976.

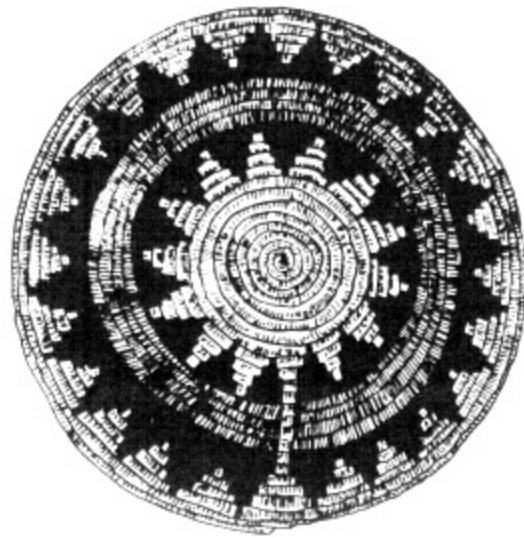
The planned land uses of the irrigation project are displayed on Map 40. A tribal enterprise, the Navajo Agricultural Products Industry, manages the project. The entire project is commercial rather than subsistent in nature, with the largest single use being for irrigated crops. Agri-business plant sites are designated on the maps, along with an experimental research station. Grazing lands and a feedlot program will be used for livestock production.

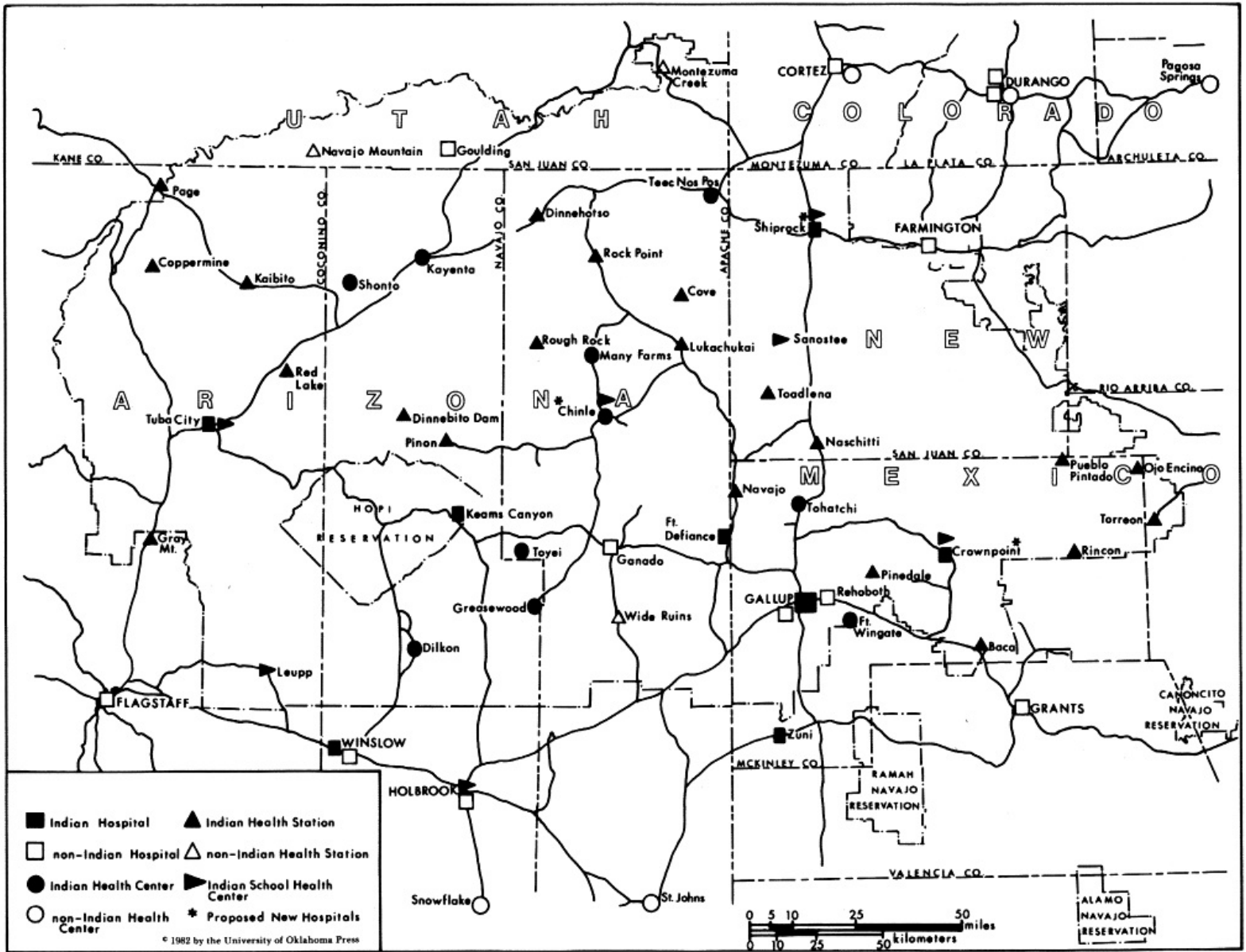
By the summer of 1981, approximately 40,000 acres of cropland were in use. The principal crops at that time were alfalfa, pinto beans, corn, barley, and milo. The acreages devoted to alfalfa production follow the initial plantings of barley, which is used as a seedbed. Much of the grain and forage crop production will be used to supply feed for the cattle feedlot operation that is scheduled to begin production in 1982. Another recently proposed crop is Christmas trees, the suitability of which is open to question.

Electrical power to operate the water transfer from the Navajo Reservoir to the irrigation site and subsequently to distribute it to the field is purchased from the New Mexico Public Service Company. The initial design of the irrigation project, approved by an Act of Congress in 1962, called for the construction of an electric generating station at the Navajo Reservoir dam. Proposals to establish this station have been rejected, but not yet abandoned. If constructed, the generating station would make the project more self-sufficient.

A townsite to house project workers has been initiated. This site, named Ojo Amarillo, now contains several dozen recently constructed homes. Ojo Amarillo is also considered as a possible housing site for workers at the proposed coal-gasification

plants near Burnham. Some irrigation project workers have been housed in small low-income type housing near the NIIP in Farmington.





Map 41.
Medical Facilities

Medical Facilities

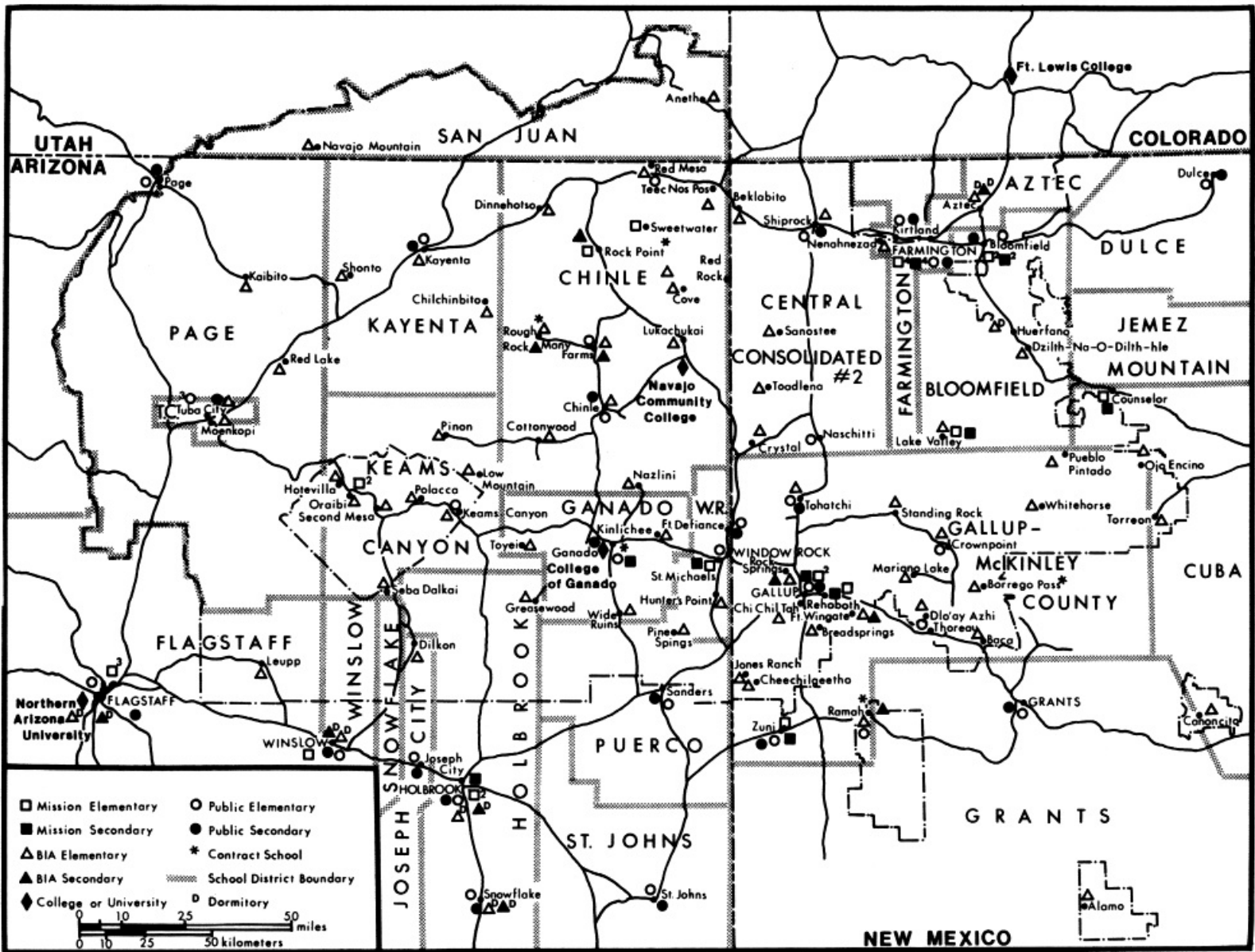
Medical facilities are widely dispersed and vary in the type of services rendered. Most of the facilities on the reservation are operated by the Public Health Service. Several border towns, such as Winslow and Gallup, have Indian hospitals or other service facilities. Several private or church-operated hospitals serve the Indian population on the reservation, and the Navajo Tribal Health Authority plans to add an American Indian Medical School.

Several items in the legend on Map 41 need further explanation. A Health Center is staffed with a health professional, that is, a medical doctor and/or a registered nurse and/or a dentist, and is open at least forty hours a week, catering to the general community. School Health Centers have the same criteria, but primarily serve the school, though sometimes service may be provided to the community.

Health Stations are staffed by medical doctors, but operate only a limited period per week, perhaps one day each week. The Health Stations represent the outposts of medical care on the reservation.

Banks

Banks are relative newcomers to the reservation. Although a greater number of Navajos participate in a cash economy than ever before, banking systems are generally not used by the non-salaried Indian. Since most cash flows off the reservation because of a lack of Navajo entrepreneurship on the reservation, bank deposits are found in border towns. There are only four branch banks on the entire reservation. One savings and loan association has recently opened an office in Window Rock.



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Map 43.
Educational Facilities

Educational Facilities

The establishment of the Navajo Reservation by treaty in 1868 greatly changed the life-style of the Navajo people. Long accustomed to ranging over large areas of land, living in isolated extended-family units, and communicating with each other only in an oral (unwritten) language, they were now exposed to spreading Anglo social and economic structures and obliged to communicate in English. The burden of bilingualism was placed on the Navajos, rarely on the people with whom they were forced to interact. The necessity for education was obvious to both parties, and the Treaty of 1868 provided for the establishment of schools for Navajo children.

Success in creating productive schools, however, was extremely slow in coming. Partly because of poor road conditions and lack of transportation, boarding schools initially were established to provide a central place to bring students. Thus each boarding school had to serve a large area of the reservation. These schools worked many hardships on Indian families. The children were removed from their family environment for the extended period of the school year, a situation that promoted loneliness and mistrust of the non-Indian system, and education, even at the elementary level, was in English only. Before the 1890s the teachers were also missionaries, generally bent upon introducing Christianity to replace traditional Navajo religious thought and practices. Even after 1896, when civil servants replaced the missionary-teacher, an insensitivity toward, and a lack of understanding of Navajo cultural traits often prevailed. Compulsory school attendance, after 1887, caused an increase in the number of boarding schools.

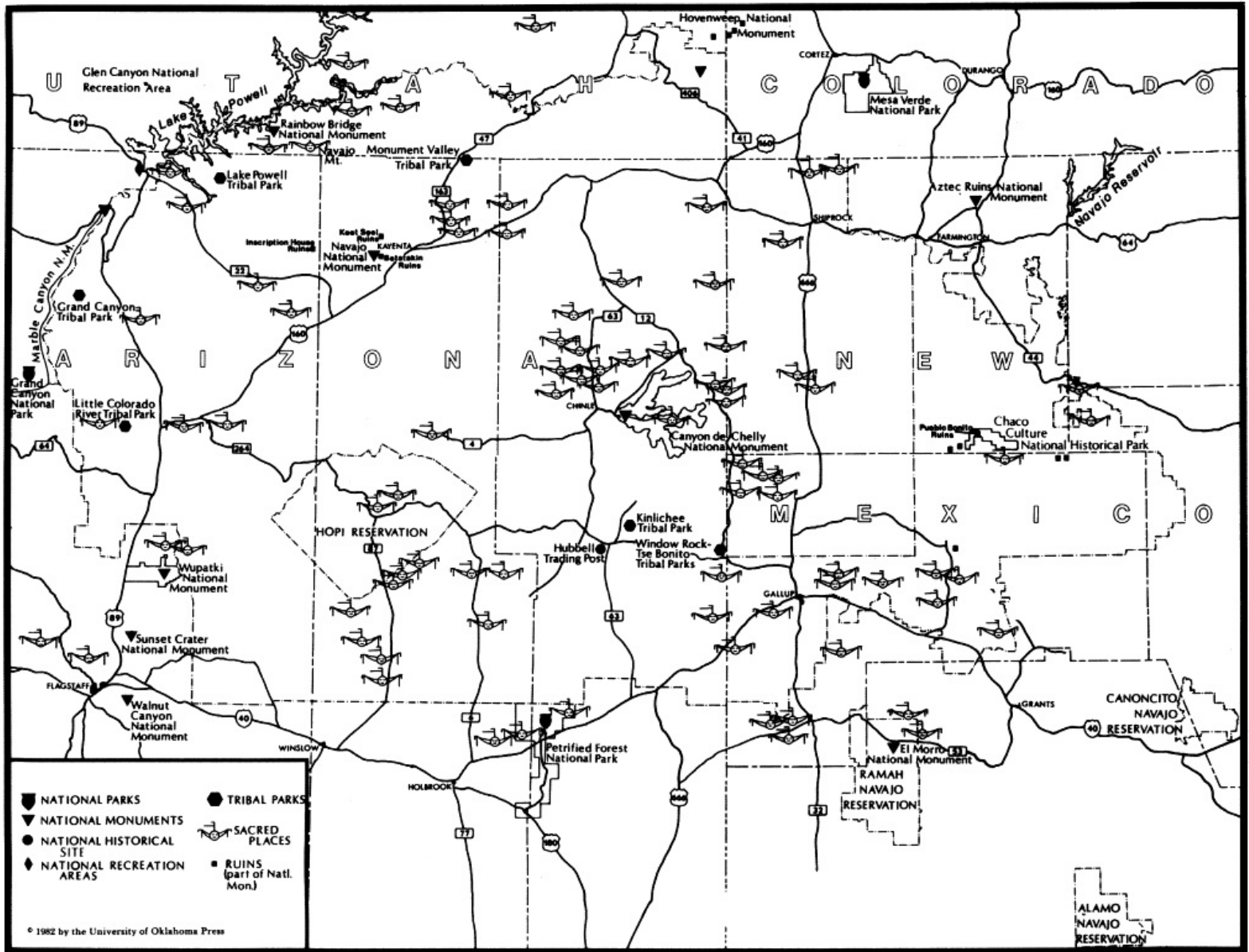
In addition to federally maintained schools, several mission schools supported by organized religious groups have provided years of service to the Navajo people. With a growing appreciation of Navajo tradition and culture, they have shown dedication and devoted attention to the education of Indian children, children who use English as a second language and many of whom still must live away from their families during the school year. They have eased the way, for many Navajos, into the modern reservation world.

Navajos generally did not gain much control over their children's education until the 1960s, when community-controlled "contract schools" were established. These schools, still limited in number, are funded under contract with the Bureau of Indian Affairs and allow a local (community) school board to control the school. The Rough

Rock Demonstration School was the first contract school organized. This school has been a leader in innovative education based on needs perceived by the local community. Experimental programs in bilingual early-school education have been introduced, as well as adult-level training of Navajo medicine men in a bold attempt to preserve cultural traits of the people along with the development of skills to interact with nonreservation society and economics. The formation of special curricula and supporting printed materials has been an interesting outgrowth of this phase of Indian self-determination.

Navajo interest in higher education led to the establishment of the Navajo Community College in 1969. Originally located at Many Farms High School, the college opened a new campus in 1974 at Tsaile, Arizona. The Navajo Community College is the first institution of higher education operated by an Indian tribe. The College of Ganado, a junior college in Ganado, Arizona, was incorporated in 1972, as the successor of the Ganado Mission School.

Several four-year state supported colleges are located near the reservation: Ft. Lewis College in Durango, Colorado; Northern Arizona University in Flagstaff; and the University of New Mexico's branch campuses in Gallup and Farmington. Although most Navajo students begin their higher education in reservation states or neighboring states, programs for and special attention to Indian students on campuses across the United States have encouraged Navajo college-bound students to travel farther from home.



Map 44.
Parks And Sacred Places

Parks and Sacred Places

The Diné Bideyah is a land of great historical and cultural interest. It is also a land of spectacular scenery. Within the reservation and near its boundaries there are an amazing number of national parks, recreational areas, and historic sites. In addition, the Navajo Tribe has created several tribal parks which complement the national park system.

The Navajo people have extremely strong ties to their land. Their attitude toward the land is reflected in their mythology and their traditional religion. The earth is referred to as "our mother"; and the care of the land and the idea of being in harmony with the land is central to Navajo spiritual beliefs. The Navajos define the limits of their land by the four sacred mountains: Blanca Peak, Colorado (Sis Naaini), sacred mountain of the east; Mount Taylor, New Mexico (Tsoodzil), sacred mountain of the south; San Francisco Peaks, Arizona (Dook'o'oostiid), sacred mountain of the west; and the La Plata Mountains, Colorado (Dibe' Nitsaa), sacred mountains of the north. Around the areas in which they live, the people have designated many "sacred places" or points of special meaning. Sacred in a traditional Navajo religious way, these places are preserved and protected. They are not usually identified or made available to the general public.

The United States government, through the Department of the Interior's National Park Service, operates several units which are of extreme importance to students of prehistory and history of the American Southwest. On the Navajo Reservation there are four national monuments: Navajo National Monument, Canyon de Chelly National Monument, El Morro National Monument, and Rainbow Bridge National Monument. Chaco Culture National Historical Park is located within the checkerboard area of the Eastern Navajo Agency. Hubbell Trading Post National Historic Site is located at Ganado, Arizona, and is on the reservation. Six additional national monuments are located near the reservation: Marble Canyon National Monument, Arizona; Wupatki National Monument, Arizona; Sunset Crater National Monument, Arizona; Walnut Canyon National Monument, Arizona; Aztec Ruins National Monument, New Mexico; and Hovenweep National Monument, located in both Utah and Colorado. Mesa Verde National Park, Grand Canyon National Park, and Petrified Forest National Park are also adjacent to the reservation. Lake Powell, one of the largest man-made reservoirs in the United States, was created in the mid 1960s with the completion of the Glen

Canyon Dam on the Colorado River in northwestern Arizona and southern Utah. Now Lake Powell stretches from Glen Canyon Dam, near Page, Arizona, to the southwestern edge of Canyonlands National Park in Utah. In 1966 the National Park Service established the Glen Canyon National Recreation Area.

Two of the National Monuments on the reservation are essential to the study of the prehistory of the area. Canyon de Chelly and Navajo National Monument contain excellent examples of structures built by early inhabitants of the Colorado Plateau. The Anasazi, the ancient ones, who most likely were the predecessors of the modern Puebloan Indian tribes, constructed a series of cliff dwellings in the deep recesses of the walls of Canyon de Chelly and Canyon del Muerto, both in the Canyon de Chelly National Monument, and in the sheer rock walls at Inscription House, Keet Seel, and Betatakin, within the bounds of Navajo National Monument. Canyon de Chelly occupies a special place in both Navajo mythology and Navajo history. Superb natural landscapes are formed by the massive sandstone-walled canyons that have rims mantled with pine and an abundance of scrubs and forbs. Both the natural and the human history of these areas are highly significant to the understanding of how nature operates within the plateau environments of the Southwest and how people have managed the resource base of the country. These areas also provide a lesson not yet fully understood on the question of large tracts of abandoned land and the disappearance of seemingly well-established and flourishing populations.

The former Chaco Canyon National Monument is now a part of Chaco Culture National Historical Park. Although it is not on the Navajo Reservation, it lies within the checkerboard area of the Eastern Navajo Agency. This park is the most singularly interesting archaeological site within the Southwest. It apparently supported a large Anasazi population within a regional network of other centers, probably including those in Mesa Verde National Park and Aztec Ruins National Monument.

Walnut Canyon and Wupatki National Monuments lie just beyond the southwestern corner of the reservation. Both are the sites of dwellings that have been dated to the period of the twelfth and thirteenth centuries A.D. Walnut Canyon ruins are located on the steep slopes of limestone-rimmed canyons that lead south to the Mogollon Rim. Wupatki lies on an upland just north of Sunset Crater National Monument. In these two sites, and especially at Wupatki, an interface between two or more prehistoric Indian groups can be seen. The Sinagua lived at Walnut Canyon and Wupatki, but the latter was also the home site for the Anasazi, Hohokam,

and the Cohonina. Sunset Crater is a monument to the volcanic forces that created the symmetrically smooth slopes of Sunset Crater, the adjacent lava flows, and the alpine peaks of the San Francisco volcanic field.

Grand Canyon National Park and Marble Canyon National Monument display the awesome power of tectonic movements that elevated huge masses of rock to form the Colorado Plateau, and the persistent erosion of the Colorado River that carved the deep and colorful canyon known as Grand. Rainbow Bridge National Monument is an example of the weathering processes of the Colorado Plateau that produce natural bridges, arches, and alcoves in canyon walls.

At Petrified Forest National Park the brightly-colored shales and fossil logs of the area represent an episode in time when the land surface that today is northern Arizona was a tropical or subtropical lowland, sluggishly drained and covered with a forest composed of pine-like trees, palms, ferns, and flowering plants. Today the landscape is almost a mile above sea level, arid, treeless, and located in the mid-latitudes.

Hubbell Trading Post National Historic Site preserves an operating trading post with an illustrious past. The influence of traders upon the Navajo people is vividly exemplified in the events of Lorenzo Hubbell's life. His advice and marketing skills encouraged the Navajo weavers around Ganado to develop their own distinctive rug patterns, often using a color that became known as Ganado red. The buildings of the trading post are excellent examples of frontier architecture and building techniques.

Of the several tribal parks, Monument Valley is by far the best known. The massive, well-defined buttes of red sandstone and shales tower above a sand-covered valley floor. The rather primitive dirt road of the park leads the visitor into the deep recesses of the expansive valley, where the imposing monoliths and constantly shifting patterns of light form panoramas of unforgettable beauty. Even in the snow of winter, Monument Valley has an aura of pristine nature.



PART VI
THE DISPUTED NAVAJO-HOPI LANDS



This view near the Coal Mine Mesa Chapter House is in the former Navajo-Hopi Joint Use Area and the surrounding lands that once supplied the needs of Navajo people living nearby have been awa

Introduction to Part VI

The turmoil associated with the 1882 Executive Order Area (EOA) Reservation (Map 28) and the recent redrafting of a boundary between the Hopi Reservation and the surrounding Navajo Reservation deserves special attention. To this point in this atlas the 1882 EOA and District 6 (Maps 28 and 10) have been recognized as distinct elements because descriptive information has been collected by these units. But in 1977 the old outlines of the 1882 EOA and the 1963 Exclusive Hopi Reservation which were used to define the Navajo-Hopi Joint Use Area (JUA) were dissolved, along with the JUA. Now only one boundary exists, and it separates land that is exclusively Navajo from land that is exclusively Hopi. The 1882 EOA and the 1963 JUA no longer exist.

The 1882 Executive Order Reservation was ill conceived; it was created in an atmosphere of confusion, misunderstanding, and haste. The Executive Order that established the reservation (see Maps 6, 7, 8, and 28) was brief. It defined a quadrangular area that was one degree of latitude in length along the eastern and western boundaries and one degree of longitude in length along the northern and southern boundaries, that is, about 70 miles north-south by about 56.5 miles east-west. Further, the order withdrew the area from the public domain, thus making any non-Indian settlement thereon illegal. Unfortunately the terse language was imprecise in the phrase ". . . for the use and occupancy of the Moqui [Hopi] and such other Indians as the Secretary of Interior may see fit to settle thereon." This phrase specifically recognized the Hopis (then called Moqui) but not the Navajos as being settled in the area; conversely, it did not give the Hopis an exclusive right to the entire area.

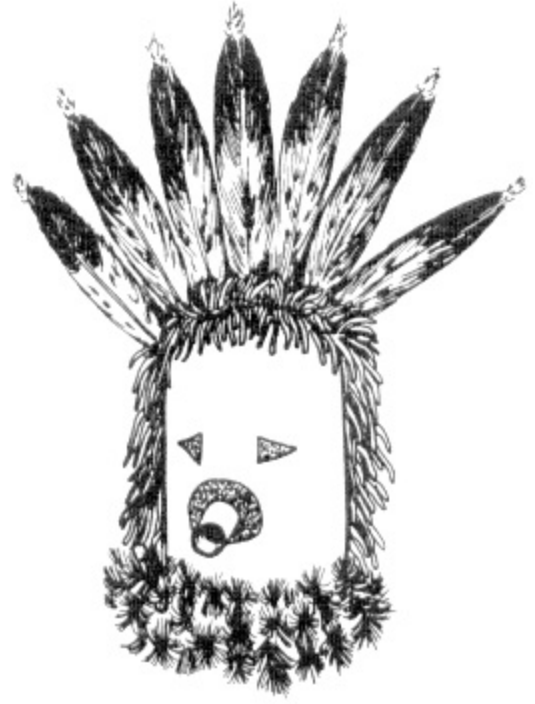
The weakness of the order that allowed a conflict to develop and persist for a century revolves around the following inadequacies. First, the bounds of the Executive Order Area (EOA) did not encompass all the Hopi villages; Moenkopi village was not enclosed within the EOA. Second, the bounds were extended well north of the three main clusters of Hopi settlements First, Second, and Third mesas into an area that at the time, was occupied by Navajos. Third, exclusive use rights were not defined, thus providing the basis for the conflict arising from the two distinctively different settlement habits of the Navajo and Hopi people. Fourth, the recommendation for the creation of the reservation was not based on a firsthand examination of the needs of the Hopis or the Navajos, but came from a frustrated, poorly-prepared Indian agent

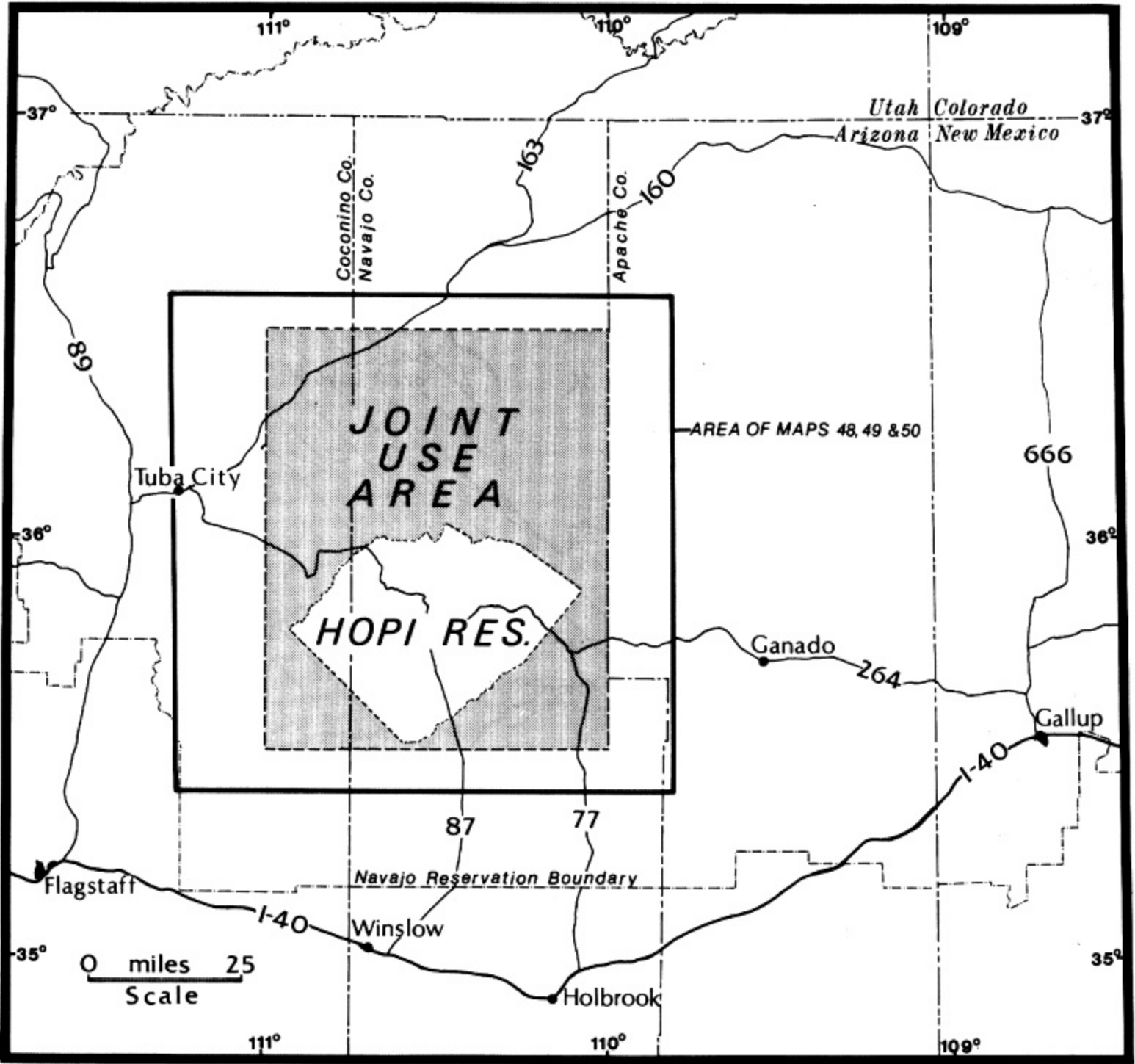
whose chief intent seemingly was to remove from the Hopi villages two non-Indians who challenged his authority. Further, the commissioner of Indian Affairs did not require a full investigation of the effects of the creation of the area upon its inhabitants, probably because he was embarrassed by his inaccuracies in declaring that the Hopi Reservation did exist when in fact one did not. In his attempts to enforce his own illegal order to remove the two interlopers, "mischief makers," the commissioner acted hastily. The Hopi agent, like most other agents at this time, was trained as a missionary and viewed the presence of Mormon settlements near the Hopis as a threat to the federal government's influence on these Indians. In addition, the commissioner failed to weigh the recommendations of his inspectors in the field, especially of one who had collected extensive field intelligence and had recommended that the northern portion of the EOA area be assigned to the Navajo Reservation. Earlier recommendations that outlined Hopi claims as determined by other Indian Affairs representatives were also ignored by the commissioner.

During the century of existence of the area, friction developed between the two tribes. The Land Management Districts (see Map 10) created in the 1930s provided for District Six, a 630,000-acre tract in the 1882 Executive Order Area. District Six contained most (but not all) of the land upon which the Hopis resided. In 1934, District Six was recognized as exclusive Hopi land; Navajo settlement was excluded from the area. An Act of Congress in 1958 (Public Law 85-547) provided that use rights of the two tribes in the 1882 Executive Order Area would be determined in federal district court. A decision rendered in 1963 (*Healing v. Jones*) confirmed the Hopis' exclusive rights to District Six, and decreed that both tribes held "joint, undivided and equal rights and interests" in the balance of the rectangular tract (see Map 45). The results of these decisions divided the 1882 Executive Order Area into two regions: the Exclusive Hopi Reservation (District Six), and the Joint Use Area.

The Joint Use Area was dominated by Navajo settlements about 8,000 Navajos lived in the area. There was no practical way to provide each tribe with a 50 percent interest in a tract of land which the court had declared as being "undivided." The problem of limited land area for resettlement of Navajos elsewhere, and, more important, a strong emotional tie between the Navajos and the land where they were born and where their ancestors had lived, caused the Navajo Tribe to offer to purchase the Hopi interest in the Joint Use Area. The Hopi Tribal Government refused to sell.

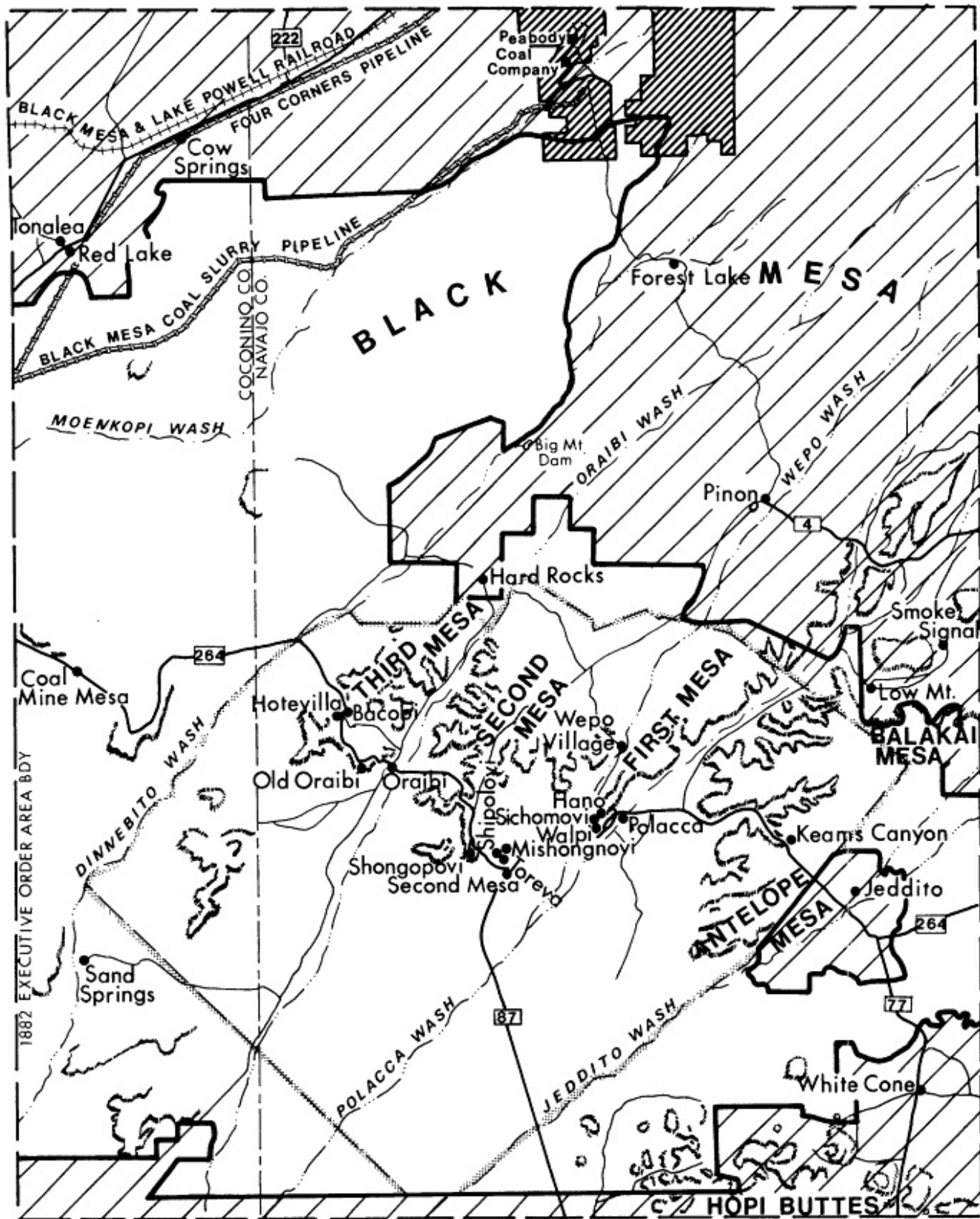
In 1974, an Act of Congress provided for the partition of the Joint Use Area by the federal district court. A court decision was handed down in 1977: a boundary was established dividing the Joint Use Area into an exclusive Hopi use area to be appended to District Six and an exclusive Navajo use area to be appended to the surrounding Navajo Reservation. The 1882 Executive Order Area and the Joint Use Area passed into the pages of history after creating untold court costs, much conflict between two tribes who basically have very little animosity toward one another, and emotional hardships which have been and will continue to be heaped upon the Navajos who do not really understand why they must leave their land because of decisions made years ago in places far away.







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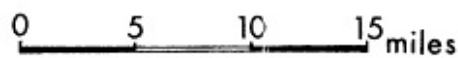
Map 45.
The Disputed Lands: The 1962 Division



 Peabody Coal Company Leases

 Navajo-Hopi Reservation Boundary Established by Court Decision 1977

 Areas Designated for Exclusive Navajo Use



Map 46.
The 1977 Disposition of The Joint Use Area

Disposition of the Joint Use Area

The division of the Joint Use Area by the federal district court is exhibited on Map 46. The relatively small Hopi Tribe, some five to seven thousand persons, will gain sizable areas of land surrounding the Hopi mesas. The Hopi Indians are village dwellers and farmers. In prehistoric periods the ancestors of the modern Hopis probably lived in the canyons west of Kayenta (Navajo National Monument area) or in the Flagstaff area, or in both regions. Sometime before the arrival of the Navajos, the early Hopis migrated to the sites of their historic villages on Antelope, First, Second, and Third Mesas. The village dwelling pattern of the Hopis probably was related to the defensive advantages which mesa-top locations afforded. The early villages on Antelope Mesa are ruins today, but well-defined and inhabited settlements still exist on the other mesas. Tracts of land in the valleys are farmed, and herds of cattle, sheep, and goats are grazed on the sparse pastures of the region. In recent decades some Hopi people have established housing sites off the mesas, and new villages, such as Polacca and New Oraibi, have grown.

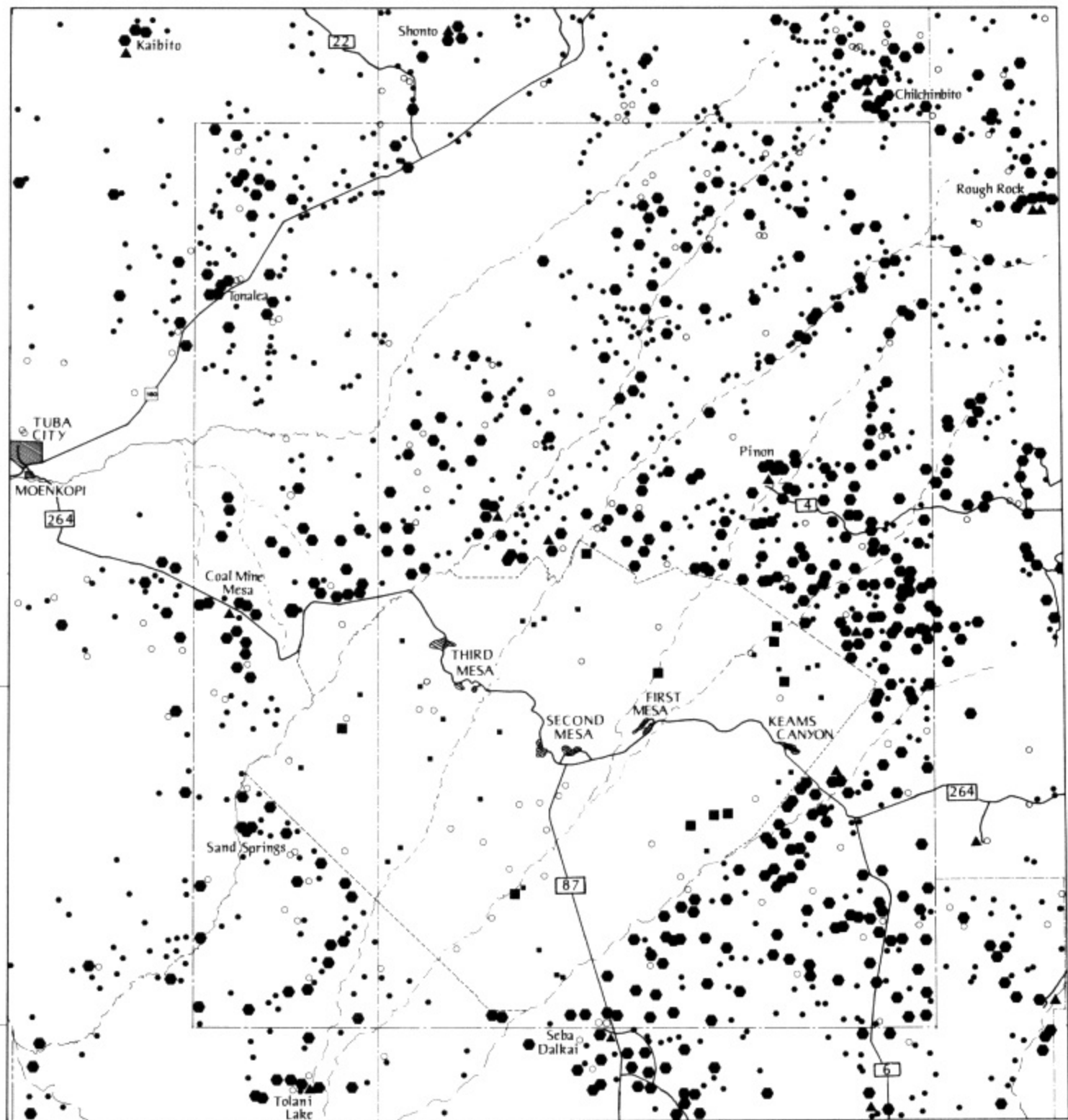
The Navajos, unlike the Hopis, live widely dispersed across the land (see Map 47). Their pastoral lifestyle places them in open areas where herds can be grazed. Although the Navajos do some farming, they have not developed the art of dry-land farming to the same extent as the Hopis. Map 47 displays the contrast in settlement patterns between the two Indian tribes.

The environment of the 1882 Executive Order Area is illustrated on Map 48. Climatically, the region changes from a desert in the southwest to a piñon-juniper steppe in the northeast. Streams which head in the higher elevations of northeast Black Mesa are intermittent, but active enough in the past to have produced alluvial-filled valleys with excellent soils and to have carried quantities of sediments to the lowlands southwest of Black Mesa, where alluvium and reworked alluvial sands in the form of dunes are spread over extensive areas. In the localities where Polacca, Wepo, Oraibi, and Dinnebito washes emerge from the valleys of Black Mesa, the Hopis practice much of their farming activity.

The Wepo formation (Cretaceous age, see Map 16) contains numerous seams of coal. Peabody Coal Company has extensive leases in the northern portion of Black Mesa (see Map 36), but vast reserves of coal underlie most all of the Black Mesa surface (see Map 48). Under the provision of Public Law 93-531 (1974), regardless of surface

right disposition, mineral rights will be jointly shared by the Navajo and Hopi tribes. It would appear that mining activities could be extended into other sections of Black Mesa. Since much of the addition to the Hopi Reservation extends northward to the vicinity of the current Peabody Company leases, and since Navajo people will be relocated from this area, possibly these lands will be free for the extension of mining operations.

Reclamation of land damaged by surface mining operations in the Black Mesa environment has yet to be proven. Although spoil banks have been reshaped and planted in piñon pine, juniper, and grasses, long-term questions regarding pollution of the valley floors and ground waters by the liberation of sulphur compounds and other noxious materials during the mining operation have not been answered. The amount of precipitation on Black Mesa is low, and the growing season is short. The survival of plants placed on the reclaimed lands is uncertain. The best soils are developed on the alluviums of the valley floors, and ground water that can be pumped by wind machines is stored in these alluvial materials. Since the Navajo people of Black Mesa are without benefit of electric power to pump water from deep aquifers, the valley ground waters and their quality are extremely important to the continuance of human life there.



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DWELLINGS

Navajo • 1 or 2 ■ Hopi
 • 3 to 7

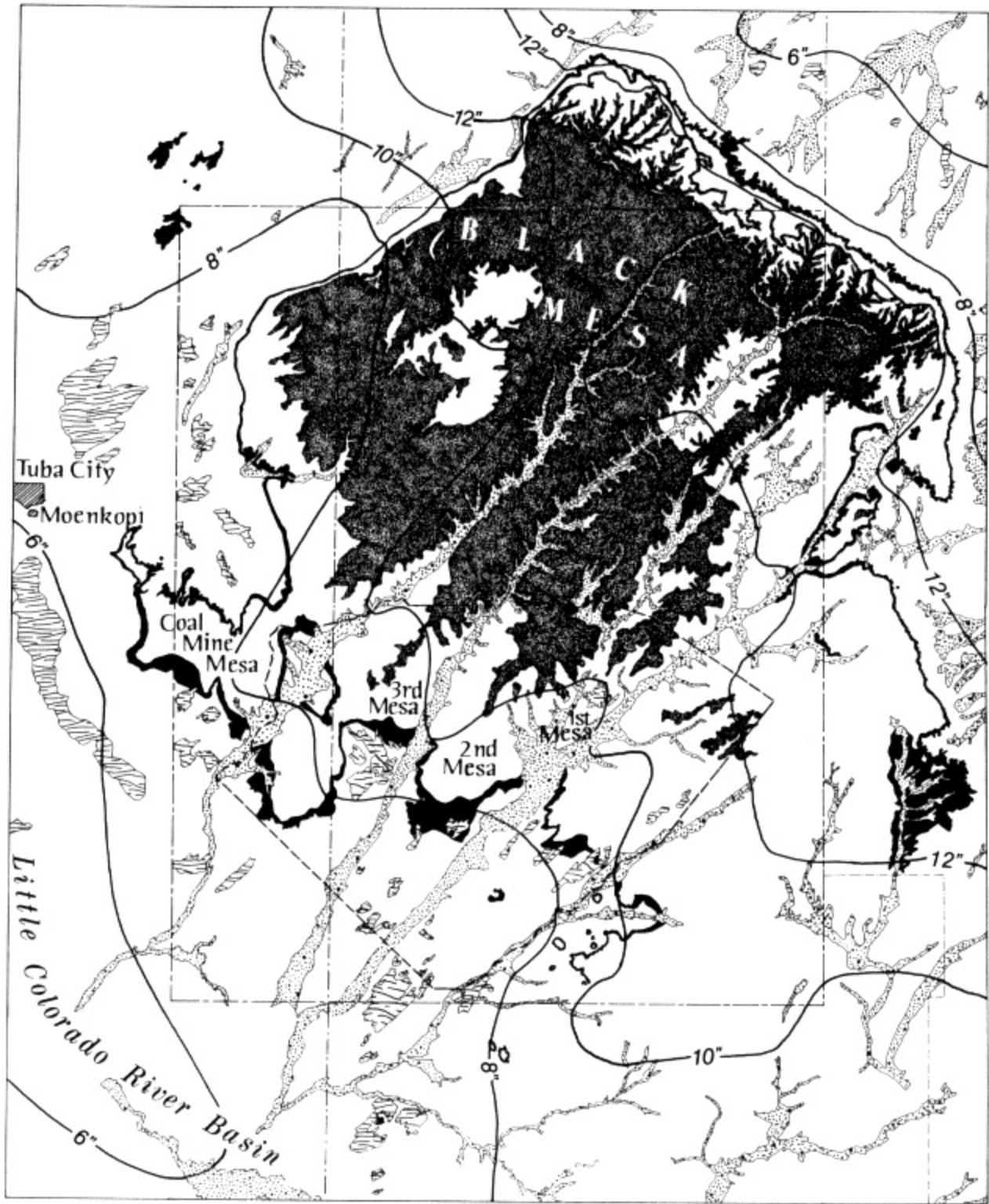
▲ School ▨ Village ○ Well

0 ————— 25
 miles

Dwelling locations were determined from Arizona County Highway Atlases of Apache, Coconino, & Navajo Counties. Some dwellings may be unoccupied; some may be seasonally occupied.

Map 47.

Rural Dwellings, 1972



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Map 48.

Physical Environment: Alluvium, Dunes, Coal-Bearing Formations, And Annual Isohyets



SELECTED REFERENCES

Part I: Navajo Country

Map 1, Indian Lands in the Conterminous United States, and *Map 2, Indian Reservations of the American Southwest*, are adapted from Bureau of Indian Affairs, "Indian Land Areas General (map, scale 1:5,000,000), United States Department of the Interior, 1973.

Map 3, Navajo Country, Location in the American Southwest, contains geomorphic region boundaries that are adapted from Nevin M. Fenneman, *Physiography of the United States*, vols. 1 and 2, New York: McGraw-Hill, 1931-33.

Map 4. Diné Bikeyah: Navajo Land combines materials from a series of United States Geological Survey maps and Navajo tribal maps.

Maps 5 through 9, Sectional Maps of Navajo Country, were prepared on a base map adapted from the United States Geological Survey's Series of 1° latitude by 2° longitude maps at a scale of 1:250,000. Place names, highways, and boundary lines were adapted from highway maps prepared by the states of Arizona, Colorado, New Mexico, and Utah, and from maps published by the Navajo Tribe, Window Rock. Some updating was done by field checking in the period 1974-76.

Map 10, Agencies and Land Management Districts, is based on information provided by the Office of Information and Statistics, Navajo Area Office, Bureau of Indian Affairs, Window Rock.

Map 11, Voting Precincts, *Map 12, Navajo Chapters*, and *Map 13, Navajo Tribal Election Districts*, are based on materials prepared in the Office of Program Development, the Navajo Tribe, Window Rock, and by the Office of Information and Statistics, Navajo Area Office, Bureau of Indian Affairs, Window Rock.

Part II: The Physical Environment

Map 14, Elevations, contains contours that were generalized from the following quadrangles of the United States Geological Survey's 1° latitude by 2° longitude, 1:

250,000 Series: Aztec (1954-61); Albuquerque (1954-62); Socorro (1952-62); Durango (1945); Cortez (1956-61); Shiprock (1954-63); Gallup (1954-62); St. Johns (1954-62); Escalante (1956-62); Marble Canyon (1956-63); Flagstaff (1954-63); and Holbrook (1954).

Map 15, Landforms, is an interpretation of the landforms based on the maps listed in reference to Map 14, and in addition, on remotely sensed images (both photographic and electro-magnetic images obtained from U-2 aircraft, satellite platforms, and the Skylab manned satellite) from programs of the National Aeronautical and Space Agency (NASA), Land Satellite (LANDSAT), and Earth Resources Technology Satellite (ERTS). Oblique aerial photographs taken by the author on several aerial reconnaissances and numerous surface observations provided the basis for this interpretation.

Map 16, Surface Geology, has been generalized from M. E. Cooley et al., *Regional Hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah*, United States Geological Survey Professional Paper 521-A, 1969.

Map 17, Climate, is derived from two sources. The isohyets are generalized from state maps of Arizona, Colorado, New Mexico, and Utah (scale 1:500,000) prepared by the Water Supply Forecast Unit, United States Weather Bureau, Salt Lake City, Utah. The Koppen climatic classifications were obtained, with permission, from Steven M. Sutherland, *Climates of the United States, 1941-1970* (map), 1977.

Map 18, Soil Associations: Potential for Irrigation, is abstracted from the following sources: (a) A series of County Soil Maps prepared by the Department of Agronomy, New Mexico State University. (b) A series of County Soil Maps prepared by the Soil Conservation Service, United States Department of Agriculture (for Utah, Colorado, and Arizona). (c) Agricultural Experiment Station and Cooperative Extension Service, "Irrigated Areas in Arizona" (map), University of Arizona, 1963. (d) Department of Agronomy, "New Mexico Suitability of Land for Irrigation" (map, scale 1:1,500,000), New Mexico State University, 1972.

Taxonomic systems vary in each of the four states in which the sources were obtained. Consequently, a high degree of generalization was necessary when soil types were extended from one state into another. This cartographic challenge was not, unfortunately, unique to soils.

Map 19, Natural Vegetation Associations. Natural vegetation regions in the Arizona portion of the map were adapted from D. E. Brown, "The Natural Vegetative Communities of Arizona" (map, scale 1:500,000), Arizona Resources Information

System, 1973. Brown's map was compared to remotely sensed images obtained from NASA's ERTS and LANDSAT series for winter and summer seasons for the period 1972-76; and adjustments were made where field observations made in the summer of 1976 gave cause. The extensive natural vegetation regions across state borders and the identification of other, non-Arizona, regions were made from the ERTS and LANDSAT images.

The chart outlining the characteristics of the vegetation association is adapted from: *Guide to Improvement of Arizona Rangeland*, The University of Arizona Cooperative Extension Service and Agricultural Experiment Station Bulletin A-58, 1973, and C. H. Lowe and D. E. Brown, *The Natural Vegetation of Arizona*, Arizona Resource Information System, 1973.

Map 20, Topographic Profile: Black Mesa to the Chuska Mountains. Data plotted on this profile were collected in the field by Jimmie L. Rogers and James M. Goodman during the summer of 1975.

Map 21, Stream Systems. The drainage network was taken from the United States Geological Survey Series of 1° latitude by 2° longitude maps at a scale of 1:250,000. See reference for Map 14 for complete list of quadrangles.

Map 22, Navajo Streams: Average Annual Discharge. Data were obtained from annual *Water Supply Papers: Colorado Basin*, United States Geological Survey.

Map 23, Ground Water Quality; Map 24, Ground Water Quantity; and Map 25, Generalized Artesian and Water-Table Areas of the Consolidated Aquifers. These three maps are abstracted and generalized from: E. H. McGavock and R. J. Edmonds, *Availability of Ground Water for Irrigation, Municipal, or Industrial Use in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah*, United States Geological Survey, Miscellaneous Investigations, Series 1-878, 1975.

Part III: Navajo History

Map 26, Evidence of Prehistoric Navajo Inhabitation. Unpublished data for this map were made available by Martin Link, the Navajo Tribal Museum, Window Rock.

Map 27, Navajo Migrations: Prehistorical to 1800, is based on material published in J. J. Hester, *Early Navajo Migrations and Acculturations in the Southwest*, Museum of New Mexico Papers in Anthropology No. 6, 1962, and on unpublished data provided by Martin Link, the Navajo Tribal Museum, Window Rock.

Map 28, Evolution of the Navajo Reservation. The basic source for Navajo Reservation modifications is Charles J. Kappler, *Indian Affairs: Laws and Treaties*, vols. 1 and 2, 58 Cong. 2 sess., 1904, Sen. Doc. 319, Washington: Government Printing Office, 1904. Research by J. Lee Correl, Office of Museum and Research, the Navajo Tribe, Window Rock, provided further guidance.

Part IV: Population

Map 29, Rural Dwellings, was constructed of data that were collected from County Highway maps:

Rio Arriba County, New Mexico (1:126,720), New Mexico State Highway Department

Sandoval County, New Mexico (1:126,720), New Mexico State Highway Department

San Juan County, New Mexico (1:126,720), New Mexico State Highway Department

McKinley County, New Mexico (1:190,080), New Mexico State Highway Department

Valencia County, New Mexico (1:190,080), New Mexico State Highway Department

Catron County, New Mexico (1:126,720), New Mexico State Highway Department

Socorro County, New Mexico (1:126,720), New Mexico State Highway Department

Atlas of Navajo County, Arizona (1:126,720), Arizona State Highway Department

Atlas of Apache County, Arizona (1:126,720), Arizona State Highway Department
Atlas of Coconino County, Arizona (1:126,720), Arizona State Highway Department
Montezuma County, Colorado (1:126,720), Colorado Division of Highways
La Plata County, Colorado (1:126,720), Colorado Division of Highways
Archuleta County, Colorado (1:126,720), Colorado Division of Highways
Kane County, Utah (1:126,720), Utah State Highway Department
San Juan County, Utah (1:126,720), Utah State Highway Department

Map 30, Population Density per Square Mile, is based on information provided by the Office of Information and Statistics, Navajo Area Office, Bureau of Indian Affairs, Window Rock, 1973, 1974, 1976.

Graph 1, Age/Sex Structure of Navajo Population, and *Graph 3, Comparison of Age Structure: Indian and Non-Indian*, were constructed from figures contained in *American Indians*, Bureau of Census, U.S. Department of Commerce Subject Report PC(2)-1F, 1970, and data from the Office of Information and Statistics, Navajo Area Office, Bureau of Indian Affairs, Window Rock.

Graph 2, Distribution of Population by Agency, was drawn from data provided by the Office of Information and Statistics, Navajo Area Office, Bureau of Indian Affairs, Window Rock.

Part V: Livelihood, Resources, and Services

Map 31, Livestock: Unit Density and Overgrazing, *Map 32, Human Population Density, 1974*, *Map 33, Grazing Land Capacity*, and *Map 34, Sheep Population Density*, were constructed from data obtained from the Office of Land Operations, the Navajo Tribe, Window Rock.

Map 35, Navajo Employment on Reservation, is based on data provided by the Office of Program Development, the Navajo Tribe, Window Rock.

Map 36, Mineral Resources, and *Map 37, Energy Development in Northwestern New Mexico*. The original working base map of *Minerals*, with emphasis on coal, was compiled by Claren M. Kidd. The final map was modified with additions from several sources not available to Ms. Kidd. The following constitute the major published sources for these maps:

- P. Averitt and R. B. O'Sullivan, "Coal," *Mineral and Water Resources of Arizona*, Arizona Bureau of Mines Bulletin No. 180, 1969, pp. 59-69.
- E. C. Beaumont, "The Impact of Coal on Northwestern New Mexico," New Mexico State Bureau of Mines and Mineral Resources Memoir No. 25, 1971, pp. 172-75.
- E. C. Beaumont, "Coal Bearing Formations in the Western Part of the San Juan Basin of New Mexico," *Guidebook of San Juan-San Miguel-La Plata Region*, New Mexico Geological Society, 19th Field Conference, 1968, pp. 11-23.
- E. C. Beaumont and G. H. Dixon, "Geology of the Kayenta and Chilchubito Quadrangles, Navajo County, Arizona," United States Geological Survey Bulletin 1202-A, 1965.
- M. E. Cooley, J. W. Harshbarger, J. P. Akers, and W. F. Hardt, *Regional Hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico and Utah*, United States Geological Survey Professional Paper 521-A, 1969.
- J. E. Fassett and J. S. Hinds, *Geology and Fuel Resources of the Fruitland and Kirtland Shale of the San Juan Basin, New Mexico and Colorado*, United States Geological Survey Professional Paper 676, 1971.
- F. E. Kottowski, "The Economic Geology of Coal in New Mexico," New Mexico Bureau of Mines and Mineral Resources Circular No. 71, 1974.
- F. E. Kottowski and E. C. Beaumont, "Strip Mining of Coal in New Mexico," New Mexico Bureau of Mines and Mineral Resources Circular No 114, 1971.
- H. W. Peirce and J. C. Wilt, "Coal, Oil, Natural Gas, Helium and Uranium in Arizona," Arizona Bureau of Mines Bulletin No. 182, 1970.
- C. B. Read, "Coal Resources of New Mexico," United States Geological Survey Circular No. 89, 1950.
- J. W. Shoemaker, E. C. Beaumont, and F. E. Kottowski, "Strippable Low Sulfur Coal Resources of the San Juan Basin in New Mexico and Colorado," New Mexico Bureau of Mines and Mineral Resources Memoir No. 25, 1971.
- In addition, unpublished materials were obtained from the Office of Minerals, the Navajo Tribe, Window Rock.
- Graphic displays appearing in several environmental statements were also used in the construction of the *Mineral Resources* map:
- Final Environmental Statement: Western Gasification Company (WESCO) Coal Gasification Project and Expansion of Navajo Mine by Utah International Inc., San Juan County, New Mexico*, 2 vols., Bureau of Reclamation, Department of the Interior, 1976.
- Draft Environmental Impact Statement: Navajo-Exxon*

Uranium Development, The Planning Support Group, Bureau of Indian Affairs, n.d.

Final Environmental Statement: El Paso Coal Gasification Project, San Juan County, New Mexico, Bureau of Reclamation, Department of the Interior, 1977.

Map 38, Major Electric Transmission Lines, Pipelines and Railroads. Power plant locations and electric transmission lines data were obtained from Arizona Public Service Company, the managing partner of the Four Corners power plant. Pipeline data were provided by Office of Mineral Resources, the Navajo Tribe, Window Rock.

Map 39, Electricity, Natural Gas, Water and Sewer Systems, is based on information obtained from the Navajo Tribal Utilities Authority, Ft. Defiance, Arizona.

Map 40, Navajo Indian Irrigation Project, is abstracted from maps and diagrams furnished by the Navajo Agricultural Products Industry, Farmington, New Mexico.

Map 41, Medical Facilities, information provided by the Navajo Health Authority, the Navajo Tribe, St. Michaels, Arizona.

Map 42, Bank Deposits. Information was obtained from: Arizona Bankers Association, Phoenix; The Regional Administrator of National Banks, Twelfth National Bank Region, Denver (data for Colorado); Department of Banking, State of New Mexico, Santa Fe; State Bankers Association (of Utah), Salt Lake City.

Map 43, Education Facilities. Information was taken from several sources including: Office of Education, the Navajo Tribe, Window Rock; Office of Indian Education Programs, Bureau of Indian Affairs, Haskell College, Lawrence, Kansas; *Arizona Educational Directory*, Arizona Department of Education, 1973; and Division of Indian Education, New Mexico State Department of Education, Santa Fe.

Map 44, Parks and Sacred Places. Data provided by the Parks and Recreation Department, the Navajo Tribe, Window Rock.

Part VI: The Disputed Navajo-Hopi Lands

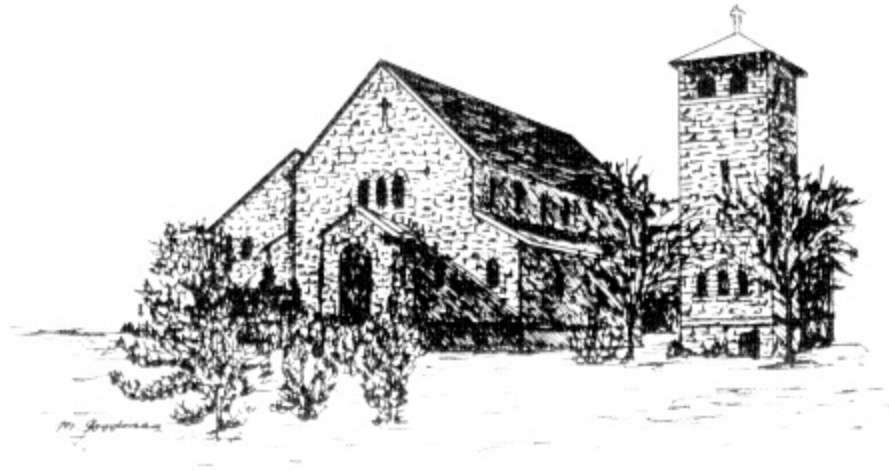
Map 45, The Disputed Lands: The 1962 Division, was constructed from United States Geological Survey maps and Arizona Highway Department maps. See references to Maps 4 through 9 and Map 14.

Map 46, The 1977 Disposition of the Joint Use Area. Boundary positions were

obtained from the Joint Use Area Administration Office, Bureau of Indian Affairs, Flagstaff, Arizona.

Map 47, Rural Dwellings, 1972, utilizes information from Atlas of Navajo County, Arizona (1:126,720), 1971, Arizona State Highway Department; and Atlas of Coconino County, Arizona (1:126,720), 1971, Arizona State Highway Department.

Map 48, Physical Environment: Alluvium, Dunes, Coal-bearing Formations, and Annual Isohyets. This map is compiled from the sources used for Maps 16, 17, and 18.





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