REPORT ON HOPI RANGE USE IN 1934
OUTSIDE OF THE 1882 BOUNDARY

by

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INTRODUCTION

Hopi grazing use in the 1934 Reservation area originated from two distinct sources. The primary source was from livestock belonging to residents of the Moenkopi area, and nearly all of this use was within the boundaries of Land Management Unit 3 (LMU-3), with some animals grazing southward into LMU-5 and northward into LMU-4. The second source of Hopi livestock in the 1934 area involved animals that freely grazed or were herded southward from District 6, (LMU-6), crossing the 1882 boundary in LMU-5 and LMU-7. This report focuses on Hopi grazing south and west of the 1882 Reservation.

In 1934, geographic areas of use and the grazing patterns developed by livestock from these two sources were different. Also, government documents describing the rangelands used by these respective groups were prepared by different offices. Accordingly, this report consists of separate analyses of grazing use by Moenkopi livestock and by District 6 livestock, followed by a general summary of Hopi livestock use within the 1934 area.

This analysis of Hopi grazing areas circa 1934 is based primarily on historical government documents. In an attempt to validate, clarify and provide a more detailed account of Hopi grazing areas, this author integrated this documentary information with what is known about the characteristics of the rangeland, the location of available stockwater and the behavior of livestock and graziers. This author also visited the area in question.

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Herding Practices Relative to Animal Distribution

Hopi livestock use of any particular range unit within the 1934 Reservation area depended upon numerous contributing variables; among these were distances from available water, from accessible forage, and from population centers. The first two of these factors involved physical, biological and behavioral limitations of the livestock. The influence that distance from villages had on grazing areas was a behavioral contribution of the stockmen. The management practiced by Hopi stockmen was the logical integration of the factors just described.

Culturally and economically, Hopi reliance on livestock production was less important than reliance on other agricultural enterprises. Villages were the principal centers of Hopi life, but livestock required the forage in the "out-country." This compelled the Hopi stockmen to leave the villages to tend their animals. Given these facts, it is logical that the Hopi practiced low intensity husbandry that would allow them to spend more time in the villages.

Biologically, sheep production requires a higher level of management than does cattle production. Unlike cattle, sheep must be herded if predation and losses during lambing are to be controlled. Sheep herding practices normally require the sheep to be taken to a common watering point each day, and returned to a

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common bedground each night. [31:37]*/ Because sheep management is so much more intensive than cattle management, the Hopis had a relatively low ratio of sheep to cattle.

Tending sheep required the stockman to spend much of his time away from the villages. Hopis set up their sheep camps close to the village so that they might return to their homes in the evening. The Hopi sheepmen evolved "herding associations" so that several family members or neighbors might share the herding responsibilities, relieving each member of a large percentage of the duties.

A significant proportion of the government documentation relative to range use in the 1934 Reservation area was prepared by Gordon B. Page. Page was a geologist who worked for the Soil Conservation Service as an Agricultural Aide. From 1935 to 1940 Page was involved with the Human Dependency Survey and with Hopi-Navajo boundary disputes. Reference to Page's documents indicates that he was responsible for compiling the information into reports, but some of the information that he used in his reports originated from other sources. It should be noted that Page's information is nearly always post-1934 and, consequently, intervening changes in conditions must be taken into account. Such changes were occurring with considerable frequency during the years immediately following 1934.

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*/ Bracketed numbers refer to documents with corresponding numbers in the list of references attached at the end of this report.

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Page reported that Hopi sheepherders were forced to keep within 10 or 12 miles of the villages and that this practice resulted in few grazing conflicts with Navajo herders outside the boundary of District 6. However, this 10-12 mile radius should only be considered a generalization, as one 1926 memo described ". . . the most successful Hopi stockman in a new location about 20 miles from a mesa, where he can pump water from a wash in high-water time." [23:3] It is likely that this Hopi stockman was herding sheep, as this intensive management is more consistent with sheep production. This description illustrates the fact that the Hopis had the technology, willingness and resources necessary to use dry ranges remote from the mesas.

The relatively high ratio of cattle to sheep is an expression of Hopi behavior regarding livestock. Cattle represented property that could be managed loosely, without constant attention that would require prolonged absence from the villages. Hopi stockmen exploited the independent abilities of their cattle to grow and reproduce. The cattle grazed freely, seeking water and forage where they could. This system of management, which allowed cattle to migrate with the seasons, was a cause of some concern to the Indian Field Service which reported in 1928 that Hopis turned their cattle afield to visit them only periodically during the year. [17:3,8] In the summer, the cattle grazed in the higher country. As winter approached, the cattle grazed south and west down the watersheds that feed the Little Colorado Basin. [19; 1:5] Cattle grazing freely or "drifting" as a legitimate management

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strategy was commonplace in the early years of the western livestock industry generally, and it was also a common management practice among the Hopi. [4:2] Since about 1935, this practice has been gradually supplanted by herd units restricted to pastures or grazing districts and subunits, largely because of efforts to control range deterioration and to maximize livestock productivity. Drifted cattle will use extensive areas of rangeland, the boundaries of their range limited only by natural barriers or (where they exist) fences.

In William Zeh's 1930 report on grazing conditions there were no specific references to grazing conflicts between the Hopi and Navajo. [10] Rather, this document stated that the Hopi had established an exclusive grazing right over a portion of the range. [10:25] By the time the Page reports were written (1938 to 1940), conflict was evident over much of the rangeland within about 12 miles of Moenkopi and other Hopi villages, especially where permanent water was available. This 12-mile radius in 1938 would approximate the boundary of the established Hopi sheep range. Beyond this imprecise boundary extensive grazing by Hopi cattle was commonplace. [1; 2:2-3; 3:19-45; 9:45; 13:8] However, comparatively few official reports expressed concern over grazing rights on these less-productive rangelands. Of those conflicts reported, lack of supervision over cattle grazing contributed most to the friction over range use, particularly when cattle got into special use areas such as gardens or lambing grounds. Lack of serious conflicts prior to 1938 was due to a number of reasons.

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In part, Hopis' prompt objections to Navajo encroachment on exclusive Hopi range caused removal of the Navajo animals before serious conflict arose. [22:2] Secondly, fewer Navajo (or Hopi) sheepmen were using the range than in the succeeding years. Also, there were relatively few Hopis who actually herded their animals. When unsupervised Hopi cattle drifted into an area already used by sheep, unless run off by herders, they would stay to graze where water and feed were available or else simply pass through, if range resources were exhausted. To a point, the greater the number of animals sharing the range, the farther the cattle would have to travel to find forage (and water).

Actual numbers of livestock are of limited value for estimating where the Hopi cattle ranged, because of the extensive drifting practices and mixed livestock ownership in some areas. A group of six cattle concentrated near a water hole one week may have been well dispersed over several thousand acres the next week. Specific areas of livestock use become even less predictable, given that most of the land surveyed in 1935-36 was classified as "Severely Grazed" in and around the 1934 Reservation area. [33] A third confounding factor involves the presence of other users in some areas who were competing for rights to use the land where cattle otherwise might have grazed (e.g., farms, corrals, lambing grounds, wood gathering areas). The following analysis of Hopi grazing areas considers these various factors and their interrelationships.

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LIVESTOCK GRAZING IN THE MOENKOPI AREA

Range rights established by the Moenkopi people were well recognized in and around the year 1934. Around 1926, the Hopis claimed that the range south of Moenkopi had been set aside for their exclusive use. [14:5] By 1930, the Navajos in the Moenkopi area had acknowledged exclusive Hopi use of some grazing land in the Moenkopi area largely because the Hopis controlled the water necessary to use the range. According to Hagerman, by 1930 the range "adjacent to and south of Moencopi Village, [mostly] in T31N R11E . . . has already been, to all intents and purposes, set aside for the use of those Moencopi Hopis by the Superintendent at Tuba City". [15:12]

In 1929, Hutton reported that the Navajos appeared agreeable to reserve for the Hopis "the land south from the Moenkopi Wash for approximately 12 miles, and from the western edge of the mesa running south of Moenkopi to the line of the Hopi reservation." [14:5] The Hopis, however, were not contented and took their sheep and allowed their cattle to graze beyond that limit. Hutton's area would include some 200,000 acres, totalling over 16,000 forage acres,*/ on Coal Mine Mesa and Moenkopi Plateau extending southward across Sand Mesa to the Dinnebito drainage.

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*/ Forage Acres (f.a.): A description of forage abundance, used in the 1935-1936 range inventory. Expressed as the percentage of one surface acre that is completely covered with forage (forage acres/surface acre). Two and one-half forage acres were considered necessary to maintain each sheep unit (SU) yearlong (SUYL). References in text to forage-acres were derived from range inventory data summarized on S.C.S. photomosaics [24].

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This description of exclusive Hopi range omits reference to other significant areas of Hopi use such as on Ward Terrace. [32:35-36]

In his 1930 grazing conditions report, Zeh explained: "The territory south of Moenkopi Wash onto the southeast boundary of the Reservation has been arbitrarily set aside for the use of the Hopi." [10:25] This description would include some 300,000 acres on Moenkopi Plateau, Coal Mine Mesa, Ward Terrace, Tohnali Mesa, Red Rock Cliffs and Newberry Mesa. An exclusive Hopi grazing area of similar size was pointed out to William Dalton in 1933 by Superintendent Walker. [12]

Page's special report on Moenkopi Village (written in 1937) included a map of the range used by Hopi sheepmen in that year, [16:37-38 and Ex. 10 thereto] an area that extended from the Moenkopi Wash to the Buck Pasture. Page also reported that Hopi cattle were grazing outside of the sheep area, to the east and west. [6] However, Page reported that the southern extent of Hopi cattle grazing was limited by the Buck Pasture fence, an improvement that did not exist in 1934. Prior to the construction of the fence in 1937, Hopi cattle grazed south of that area [13:3] as well as to the east and west.

The 1937 and 1938 LMU-3 Reports stated that Hopi range use was primarily south of Moenkopi village on Coal Mine Mesa and Ward Terrace [9:45,90; 32:35]. However, the 1938 report's recommendation that Coal Mine Mesa be fenced off for exclusive use by the Hopi involved a significant reduction in size compared to the range the Hopis actually occupied [9:45,90; 32:5]. The proposed

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Hopi area was to extend southward from Moenkopi Wash to the recently constructed Buck Pasture fence. The western boundary was to be the Moenkopi escarpment and in the east a boundary was drawn north from the northern corner of Buck Pasture, thence north-northwest to the Moenkopi Wash. According to the range inventory conducted in 1934 through 1936, [8:9] this area of Coal Mine Mesa would provide about 4600 f.a. of total feed (however, this data had not then been analyzed by the government). Because of inaccessibility (due to limited water), it was assumed that the proposed area would provide the forage required to support the presumed Hopi herd, the size of which was underestimated by the government.

Page's Moenkopi Village Stock Operators and Range Report [6] elaborated slightly on Hopi range use. In addition to the primary Hopi grazing area described in the 1938 LMU-3 report [9:45] (Coal Mine Mesa and Ward Terrace), Page described Hopi sheep use as occurring close to Moenkopi Wash (in the dry season) but also noted that two bands of Hopi sheep were using the range to the north end of Pasture Canyon. In 1934, Pasture Canyon extended much farther north than it does today. [24]

The following analysis of range areas used by the Hopis in 1934 is divided into sections. Because the probability of Hopi grazing varies across the expanse potentially used by Hopi livestock, the specific areas have been included into one of these three categories: Documented Hopi Use Areas, Maximum Likelihood Hopi Use Areas, Probable Hopi Use Areas. In comparing this

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author's independent conclusions with the reports of other experts, it is interesting to note that these conclusions about Hopi livestock use are generally consistent with the findings of other experts. See reports of Ainsworth, Godfrey and Adams (1986).

Documented Hopi Use Areas

Livestock belonging to the Moenkopi Hopi were reported to be using established ranges on Moenkopi Plateau (Coal Mine Mesa and Tohnali Mesa, north of the Buck Pasture fence) and on Ward Terrace. [6; 9:45] In addition to these written records of specific Hopi grazing areas, there were references to concentrations of Hopi livestock near permanent waters, including Moenkopi Wash and Pasture Canyon. [6] These concentration areas were classified as "Very Severe Utilization" during the 1935-36 range survey.

Moenkopi Plateau south of Moenkopi Wash was also mapped as "Very Severe Utilization." [33] This heavily impacted area extended southward from Moenkopi Wash, along the western rim of the plateau for about eight miles; thence northeast along a vector passing north of Owl's Cap and Hollow Place toward Coal Mine Canyon; thence north to Moenkopi Wash. The maximum distance from any point in this area to Moenkopi Wash was about eight miles. However, at least three springs along the western rim provided stockwater, so that the maximum distance from any point in the area to permanent water was less than five miles. This 49,000 acre area of documented

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Hopi use included about 42,500 acres of suitable range*/ and is highlighted as area a on Map 1. The 1935-36 range inventory classified this as "Very Severely Utilized." [33] A history of heavy stocking yearlong was evidenced by relatively low forage ratings (.04 to .09 f.a.) and dominance by less palatable grasses (galleta and sand muhly) and shrubs (Mormon tea).

Coal Mine Mesa was also documented as a Hopi use area. According to the 1938 Land Planning Report, [9:45] Coal Mine Mesa was considered to be seasonal range (winter), subject to seasonal concentrations of people and livestock. The report stated that recent water development had caused a shift toward yearlong range, but that the area was still not being overused (classified in 1935-36 as "Proper Utilization"). [33] Prior to 1935, however, there was adequate water for flood-irrigated farms, as well as for scattered livestock use. [9:29,48] At least two reservoirs were in place prior to 1935 that would potentially store water for some yearlong cattle use, and a well (Moenkopi 3) drilled in 1928, [27]

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*/ Suitable Range is normally classified by the government as that land producing an adequate amount of forage (.01 f.a. or more), not excessively steep (less than 40 percent slope), within a reasonable distance from permanent stockwater (4 miles or less), and not susceptible to accelerated erosion. This classification is used only to help determine carrying capacities of the range to protect the more favorable rangeland from overuse. The term unsuited was not intended to imply that livestock didn't use the area. Indeed, livestock freely used unsuited range where it was accessible. A substantial portion of the land in the 1934 Reservation area was classified as unsuited and these acreages are not included in this report when the term "suitable rangeland" is used, even though such areas were used by Hopi livestock. Calculation of Suitable Range in this report is based on information from S.C.S. photomosaics [24].

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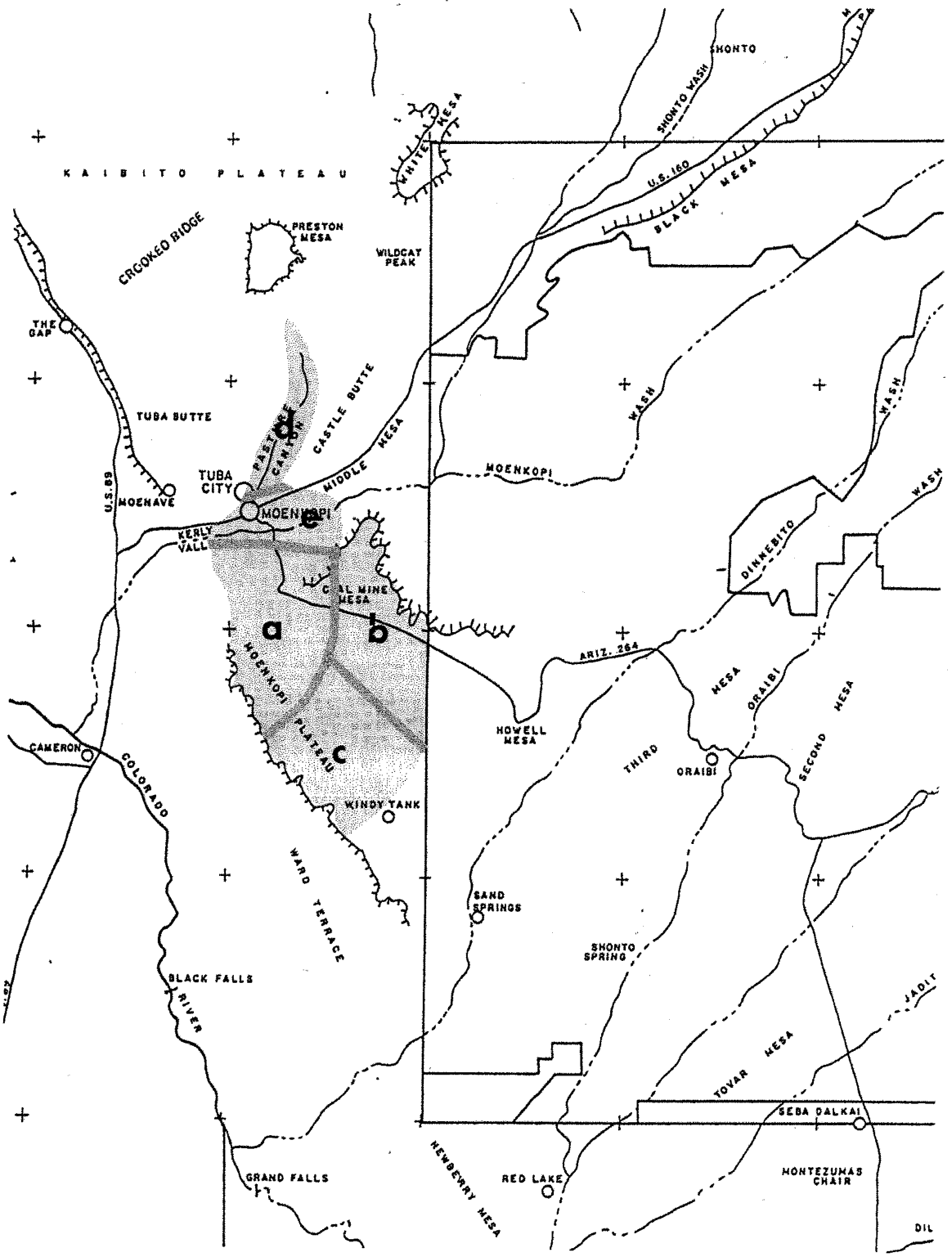

Map 1. Documented grazing areas used by the Moenkopi Hopis.

indeed already supported yearlong grazing at Little Hollow Place in 1934. On Coal Mine Mesa (Map 1, areas a, b, c) the Hopi livestock had access to some 55,200 acres of suitable rangeland (8200 f.a.) that was within reach of the available stockwater that was controlled by Hopi graziers. Map 1, area b includes 38,000 surface acres on Coal Mine Mesa, adjacent to the Executive Order boundary. Here, winter grazing resulted in better forage conditions (.10 to .22 f.a.) evidenced by greater cover of blue grama and galleta grass and less dominance by sand muhly.

On the south end of Coal Mine Mesa, three wells (probably including Little Cowboy Windmill) were reported drilled between 1935 and 1936. [34:23-29] However, several natural seeps or springs occurred within a one-mile radius of Little Cowboy Windmill. In addition to these springs, a dam built east of Goldtooth, at the head of Chiehazhahi Wash (quad 52.2)*/ shows up clearly in the 1934 aerial photographs. [24] As evidenced by the convergence of several livestock trails visible in the photographs, these waters were undoubtedly used in 1934 to support (yearlong) grazing use by Hopis, at least as far south as what would later become the southernmost Buck Pasture fence.

South of the high use area on Moenkopi Plateau and west of Coal Mine Mesa, the Plateau breaks off into Tohnali Mesa. A portion of Tohnali Mesa is documented as Hopi grazing area in 1937

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*/ The quad numbering system employed here is illustrated by a map produced as an attachment to the Aerial Photointerpretation and Mapping Report by G. Ronald Wright. Each of these quads may be broken down in turn into quarters: .1=N.W.; .2=N.E.; .3=S.W.; and .4=S.E.

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(only as far south as the north Buck Pasture fence). However, in 1934, prior to the fence's construction, a spring located along Appaloosa Ridge would have permitted cattle to graze over a considerable area extending at least four miles south of the documented area. Before the fence limited their movements, cattle would use the reservoirs on north Coal Mine Mesa, the spring on south Coal Mine Mesa and the springs along the western rim during dry months. In 1937, the Soil Conservation Service foreman supervising the construction of the Buck Pasture fence removed 200 Hopi cattle from the area being fenced which had been in the center of the best Hopi grazing area. [13:3] However, it was not reported whether Hopi cattle were removed from the thousands of acres of range south of the Buck Pasture. Thus, many more Hopi cattle may have been involved. During winter, with snow or surface water available, even as few as 200 head of Hopi cattle grazing in the Buck Pasture area would require some 2500 f.a. yearlong and would necessarily have distributed themselves over the entire area of some 28,700 acres of suitable rangeland (1780 forage acres) available to them. Map 1, area c highlights 49,000 surface acres south of the fence where forage conditions were modest (.04 to .07 f.a.) and well suited to extensive cattle grazing.

Pasture Canyon is well documented as an historical Hopi use area. As late as 1937, this area was known to support at least two bands of Hopi sheep. [6] It is of great significance that in 1934 Pasture Canyon extended much further northward than it does today. Changes in topography caused by unstable blow-sands have

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greatly shortened the canyon since that time. Analysis of the 1934 Fairchild photos indicates that the Pasture Canyon drainage extended nearly to Preston Mesa. In 1934, Hopi livestock probably ranged up the entire length of the drainage. The canyon and adjacent range, extending nearly to Preston Mesa, were classified as "Very Severely Utilized" [33] due to the presence of yearlong livestock waters. To this day, past heavy sheep-use is evidenced by the replacement of palatable shrubs by undesirable ones in Pasture Canyon. Based on summer water requirements of sheep, it is likely that the herders kept their bands near the springs (within two or three miles) during the dry months. Map 1 area d represents 15,000 acres of this summer range for documented Hopi use in Pasture Canyon. Even today, good forage grasses and browse species are found beyond these distances from permanent water. Scenarios for trailing and herding to ranges beyond this two-to-three-mile limit are discussed in the maximum likelihood and probable use sections of this report

The area immediately surrounding Moenkopi Village and Moenkopi Wash is also treated as a documented Hopi use area. Except for a few references, [6; 22] government documents neglected to elaborate on specific areas grazed by Hopi livestock. Hopi sheep were reportedly "kept close to Moenkopi Wash except period of the year when the range south of the Village is in good shape and water plentiful [sic]." [6] For the purpose of identifying unquestioned Hopi sheep-use areas, the area described as "close to Moenkopi Wash" should extend only about two miles north and south of the wash, and roughly from Ironwood Springs in the east, to the

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Moenkopi scarp in the west (approximately 18,000 acres, Map 1, area e). Other proximal areas of permanent water are also considered as documented Hopi use areas.

Available livestock water was plentiful within the Moenkopi Wash and Pasture Canyon portions of the documented Hopi range. However, most of the non-cultivated acreage was classified as "unsuited" for grazing in 1935-1936, presumably because past grazing abuse had reduced the vegetation to weeds, thus destabilizing the soils and the potential productivity on some 15,000 acres along the washes (Map 1, areas d and e). It is important to note that the most common weed, Russian thistle, is a highly productive, nutritious and palatable forage plant during mid-summer.

The areas where use by the Moenkopi Hopi was documented in government reports, [2; 6; 9; 13; 22] or where access is reasonably certain because of proximity to the documented use areas are collectively shown on Map 1 (approximately 169,000 surface areas). Areas a, d, and e were principally used as summer ranges for sheep and for cattle. Areas b and c were most important as yearlong range for cattle and horses but were also used seasonally by sheep. Documented Hopi use areas occur within quads 28, 39, 40 and 52 and total about 140,000 acres of "suitable" rangeland and about 30,000 acres, mostly along washes, which were "unsuitable" but which were undoubtedly grazed by Hopi livestock (repeated severe use contributed to the "unsuitable" classification). Hopi livestock were also documented on Ward Terrace (quads 39, 51, 52, 63, 64). However, because the records failed to specify where on Ward Terrace Hopi livestock grazed, the

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area is treated in the following section on Maximum Likelihood Hopi Use Areas.

Maximum Likelihood Hopi Use Areas

A fundamental problem for range managers in 1934 was that nearly all of the Hopi animals were trailed great distances from their summer ranges near permanent waters to winter ranges where seasonal surface water and snow could support livestock. It is noteworthy that the 1938 Land Planning Report deals mostly with overstocking problems near the population centers, and with range damage caused by excessive trampling between summer and winter use areas. Other than mention of Coal Mine Mesa as a Hopi wintering area, and the mention of Grey Mountain as winter range for Navajo sheepherders (and non-specific reference to wintering near Cedar Ridge and the Gap), there is little discussion about winter use areas or migration routes. [9:37] There are two possible explanations for this lack of attention to winter range: first, that management of winter range was considered unimportant; and second, that information about winter ranges was unavailable. Of these two possibilities, lack of information about migration routes and winter ranges is most likely responsible for the omission. Thus, it is consistent that the only Hopi use areas that were carefully described were those close to the Village and near the permanent summer waters.

From the descriptions of overgrazing by concentrations of livestock in the summer, it is apparent that livestock not needed

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near the home (such as dairy animals) would be removed from the area whenever conditions permitted. Because wintering ranges were poorly described by government personnel, winter grazing patterns must be reconstructed, based on the characteristics of the range and information from the graziers.

Range deterioration caused by the exceptionally heavy sheep use on the northwest end of Moenkopi Plateau, combined with inherently low forage production, indicates that the documented use area would hardly have supported the exclusive use by documented numbers of Hopi livestock. Therefore, it is apparent that Hopi cattle would have grazed well beyond the documented use area. In 1928, Superintendent Miller was quoted as saying that new friction had developed between the tribes because the Hopis had "spread out so much . . . far afield . . . at such distances from their mesas . . . in new territories." [17:8] The most probable areas of Hopi livestock use would be southward, along the Moenkopi Plateau, southwest off the rim of the Plateau onto the slopes of Ward Terrace, and an expanded area north of Moenkopi Wash and around Pasture Canyon.

The ranges north of Tuba City and west of White Mesa were cited as areas used by Hopi livestock in 1934. [19; 22] Because even temporary surface water appears to have been very limited in this area, a conservative estimate of the range to be included in the maximum likelihood area includes a zone extending on the west from north of Tuba City northeastward to include the excellent browse and water available in the Greasewood area, then south to

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Rare Metals and southwest to Moenkopi Wash (Map 2, area a). This area includes about 35,000 acres and provided about 1175 f.a. Past Hopi grazing in the area is supported by Hopi testimony [19] and is consistent with what is known about herding and drifting of stock.

The southern end of the Moenkopi Plateau was almost certainly an area used by Hopi livestock in 1934. Evidence indicates the Hopi grazed their livestock near the Honahni Ranch, from which access to the Buck Pasture area and the southern plateau is undeniable. [20] Also, Hopi livestock were in the vicinity of Windy Tank, a semi-permanent water about 15 miles south of the Bakalo well. [20] Livestock would likely drift south from Moenkopi Plateau and Coal Mine Mesa in winter, to Windy Tank. Otherwise, Hopi livestock could be driven into the area, even in the summer, with access to the "Salt Water well," the Appaloosa Ridge spring, and Chiehazhahi Wash reservoir. Once located at Windy Tank, range cattle had access to the Moenkopi Plateau as far south as Sand Springs Mesa. This area included about 36,700 acres of suitable range (2,000 f.a.) and was mapped as "Moderate Underutilization" [33] all the way south to Dinnebito Wash in 1935. Grazing mostly occurred on about 25,000 acres around and between Windy Tank, Salt Water well and the two springs (Gold Spring and Willow Spring) located two to three miles south of Windy Tank, along the Moenkopi scarp (Map 2, area b). Lack of abundant permanent waters precluded sheep use on southern Moenkopi Plateau. Cattle grazing far from the permanent waters into this inherently low-producing range would have been

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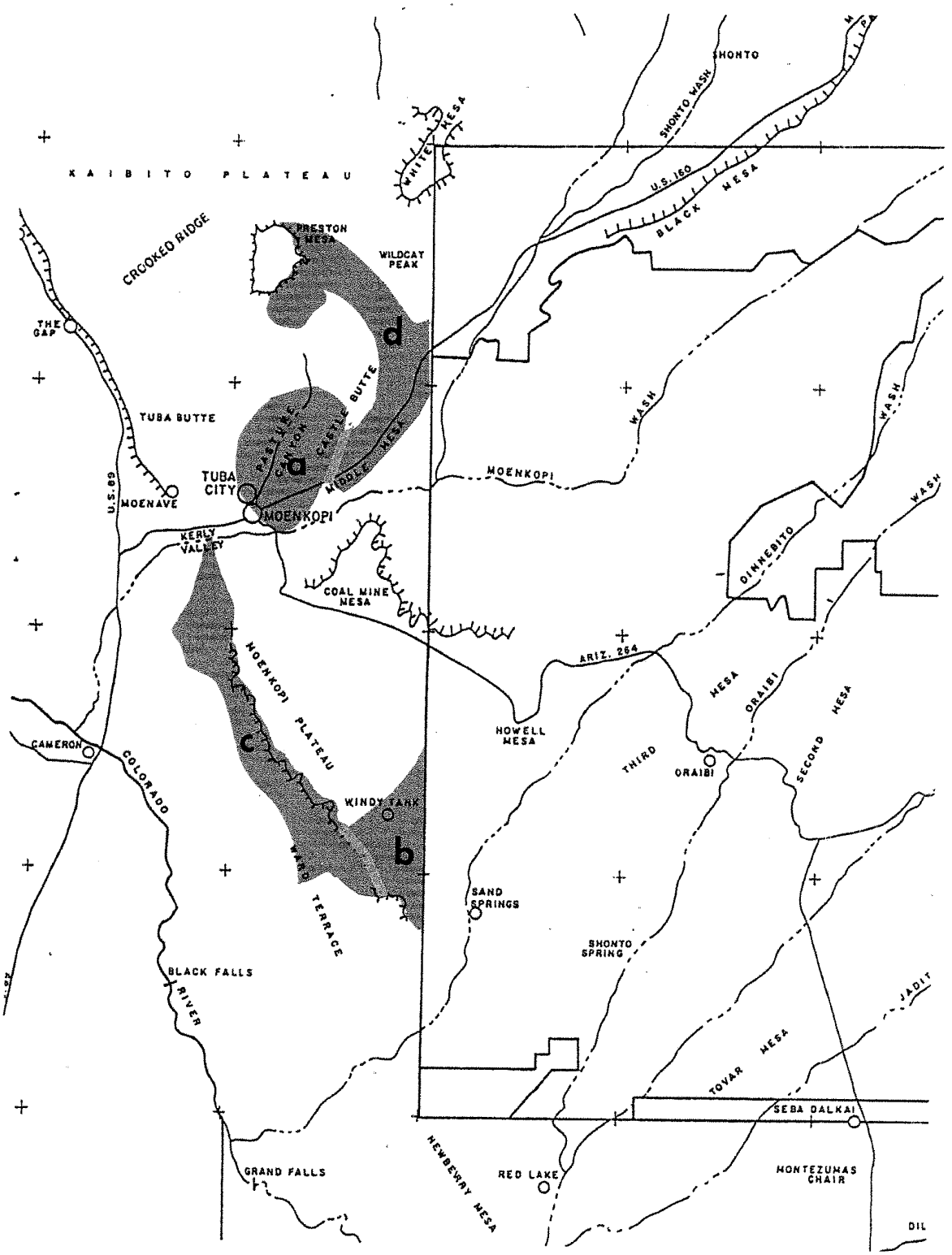

Map 2. Maximum likelihood grazing areas used by the Moenkopi Hopis.

likely only during winter, and insufficient water limited summer grazing to relatively few cattle. Therefore, stocking pressure was insufficient to cause excessive use on the range that was surveyed in 1935-36.

The Ward Terrace range was documented throughout the 1930s as being a Hopi use area. [9:45; 22:2-3; 32:35] Hopi stockmen (including Robert, Ward, and Henry Dallas) reportedly kept their herds on good grass and water in this area. [6; 29:156-57] Indeed, the land planners recognized the forage value of the sacaton grass, abundant beneath the Moenkopi scarp. Once on Ward Terrace, a herd of cattle would have access to palatable grasses extending out from the cliffs, primarily down the drainages, into the Painted Desert. This rangeland type extends across 49,000 acres along the slope of Ward Terrace, from Moenkopi Wash (39.4) in the north, to Little Mexican Spring (64.1) in the south (Map 2, area c). Much of the range on Ward Terrace is very low producing and was classified as "Unsuited for Grazing" (by sheep). However, numerous pockets and drainageways provided excellent opportunities for cattle, extending all the way from Moenkopi scarp to the Little Colorado River. The maximum likelihood Hopi grazing area on Ward Terrace includes approximately 44,700 acres of suitable range (and twice that amount of unsuitable range included in the probable use category) that was inventoried at about 1850 f.a. in 1935-36 and was classified as "Severe Over-utilization." [33] Due to the nature of the forage and the limited water that was available, there is a very high probability that only winter grazing by Hopi cattle on most of Ward Terrace

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took place in 1934. However, it is possible that cattle were maintained yearlong in the sacaton areas proximal to the drainages.

In 1934, permanent water developments were poorly distributed away from the major drainages. This characteristic is true of some 200 square miles of Kaibito Plateau, just north and slightly east of Tuba City. This area is within the 12-mile limit that Page described as the maximum distance between Hopi villages and their sheep corrals, and has been described as traditional Hopi cattle range. [19] Verifiable permanent water was available around the 43-mile long perimeter of this area in the vicinities of Greasewood Lake (located east of Pasture Canyon), Middle Mesa, Wildcat Peak, White Mesa and north and south of Preston Mesa. In 1930, there were seven reservoirs constructed within this area that would have provided seasonal water. [27] From an inspection of this area, as well as of contemporary range maps and photographs, [24; 28] it is concluded that temporary surface water from undeveloped springs or natural collection was not readily available.

Because surface water was so limited in this Kaibito Plateau area and because cattle do not perform well on snow, cattle use would likely be close to the permanent waters (within two miles) with little drift occurring between the developments. However, it would have been possible to drive cattle from one permanent water to another as was done with sheep. For short periods, under favorable conditions, cattle would be expected to

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range some distance out from these waters (four to five miles) and would have moved from one development to the next. The widespread "Severe Utilization" mapped during 1935-36 supports this contention.

Sheep herding is a far more practical and efficient use of this range. A highly probable management practice would be to keep close to the permanent waters when necessary, grazing into the undeveloped areas when possible (Map 2, area d). This scenario supports historical accounts of Hopi livestock in the vicinities of Middle Mesa, Wildcat Peak, Rat Springs, Preston Mesa and west of White Mesa, [19] and is consistent with the existence of contemporaneous Hopi corrals in the area. It is reasonable to conclude that Hopi herders took their livestock in a somewhat circular winter migration route around Middle Mesa, Wildcat Peak, Rat Springs, and Preston Mesa. Pasture Canyon certainly linked the Preston Mesa range back to the Moenkopi area in 1934. Judging from the excellent quality of the range (especially at Middle Mesa and from Wildcat Peak to Preston Mesa) and the available water at Rat Springs, this herding strategy seems logical, indeed necessary, in order to provide good forage for the documented livestock that were summered in the Pasture Canyon area. The 50,000 acre total area of rangeland used by the Hopi (Map 2, area d) includes about 38,600 suitable acres and provided approximately 2700 f.a. of feed. The total maximum likelihood area on Map 2 includes about 159,000 surface acres.

Ranging out to the northwest of Moenkopi is also a likely strategy for winter management. Hopi historically used the area immediately north of Tuba City, extending as far as Willow Springs.

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The use of this area by Hopi livestock will be discussed in the section on Probable Hopi Use Areas.

Probable Hopi Use Areas

Grazing use by drifting cattle and herded sheep probably well exceed the boundaries described under the headings documented and maximum likelihood Hopi use areas. These proximal areas deserve careful consideration because of evidence placing Hopi livestock in the vicinities of Cameron, Red Lake, and Willow Springs. [19; 6]

In 1934, Hopi livestock were grazing on Ward Terrace. At this same time livestock from the Cameron area were heavily impacting the basin along the Little Colorado River [32:26]. Midway between these two known grazing areas (mostly in quads 51.2, 51.4, 52.3, and 64.1), some 40 square miles of Ward Terrace was classified as "Unsuitable for Grazing" (by sheep). [24] This provided a formidable barrier for sheep herds that might otherwise have migrated from the Little Colorado River up to Moenkopi Plateau. This 300,000-plus acre area included at least one verifiable source of permanent water in 1934, Salt Springs. Forage production was very low and temporary surface waters would not have provided access to very many weeks of grazing. Sheepherders might have pushed a band a short distance into this area for brief periods during the year, but sheep would not be expected to fare well on the coarse sacaton grass. [30]

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Cattle usually graze singly or in small groups. Consequently, daily forage and water requirements are much less for cattle than for even a small band of sheep. It is probable that some cattle would have grazed across Ward Terrace, down one of the major washes that drain this area (Tohachi or White Water) and that they would have ultimately moved into the basin along the Little Colorado River (Map 3, area a). Grazing in the Cameron area would also have been possible by cattle or sheep coming down the Moenkopi Wash to the Little Colorado River. However, the river basin near Cameron was itself a concentration area for summer grazing, [32:26] and travel down the cultivated drainages would be discouraged by the farmers. Thus, this route would seem unlikely for livestock summering in the Moenkopi area. It is most likely that, unless driven, livestock movement between the Cameron area and Moenkopi Plateau would have been restricted to cattle drifting from east (Moenkopi Plateau) to west (Cameron area). Farther south, Moenkopi cattle grazing in Dinnebito Wash may have traveled down to the Little Colorado River along with Hopi cattle from within the 1882 boundary.

It is fairly certain that Hopi cattle grazed down into the Little Colorado Valley via at least one of these routes. Page, describing the vegetation of the Little Colorado Valley, pointed out that the "zone [of cottonwood, cactus and yucca] was the range used for winter range by Hopi cattle." [3:11]

The total area of rangeland from Ward Terrace down to the Little Colorado and from Moenkopi Wash to beyond Dinnebito Wash is

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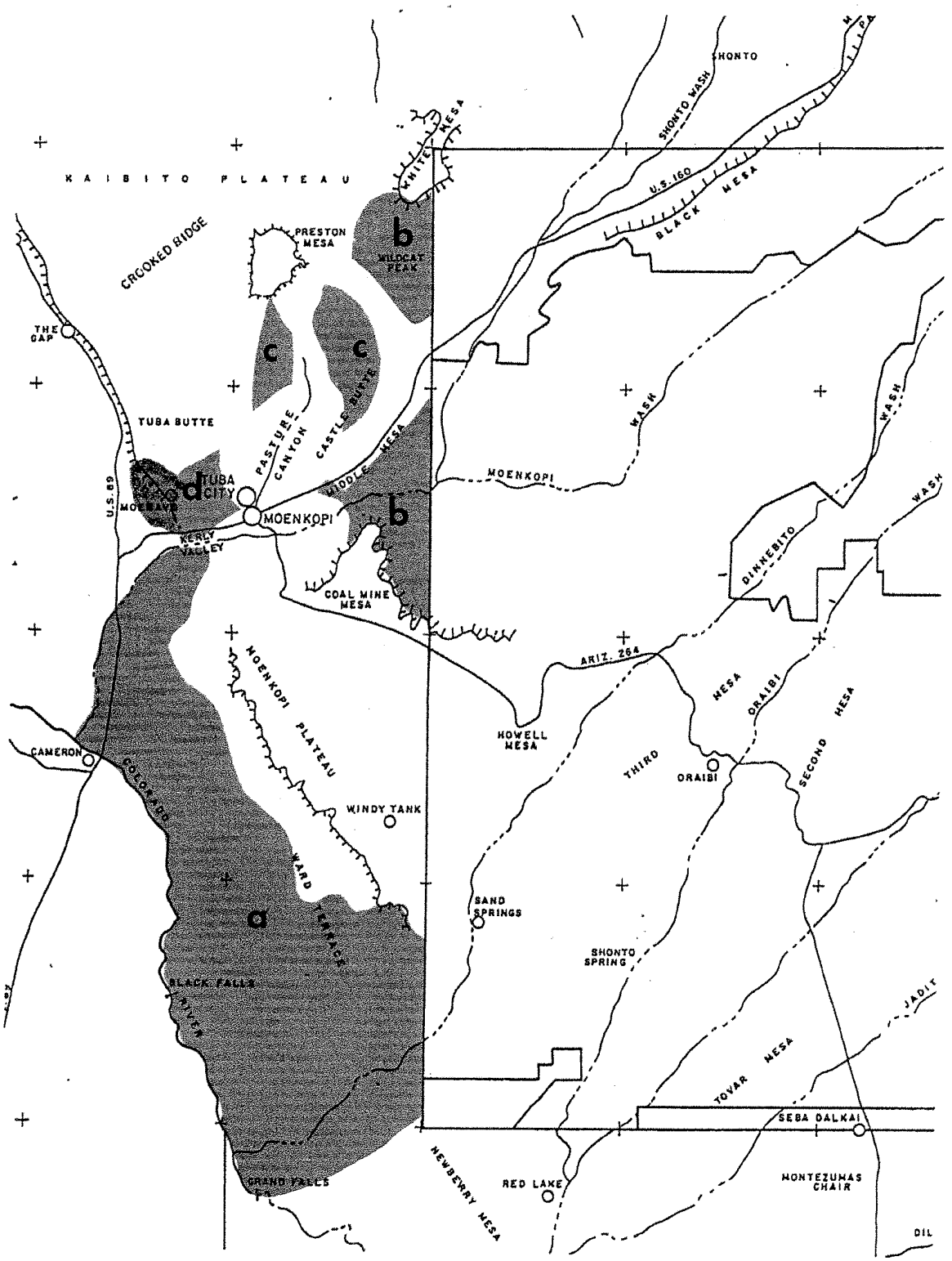

Map 3. Probable grazing areas used by the Moenkopi Hopis.

approximately 303,000 acres (Map 3, area a). However, it is probable that most grazing use was made near the drainages and in the river valley, a pattern typical of unherded Hopi cattle. [11:18,35; 16:46] This is especially applicable for the low-producing rangeland between Ward Terrace and the Little Colorado River that was classified as "Unsuited for Grazing" (by sheep) where actual forage production was restricted to frequent, small pockets of sacaton.

Because of the good water supply, the Red Lake area northeast of Moenkopi was undoubtedly used by Hopi livestock. Moenkopi villagers would have driven livestock along the roadway between Moenkopi and Red Lake, taking advantage of waters developed along the route. It is also probable that Hopi livestock were taken into the area from the west and from the southwest. Of the possible access routes to Red Lake from west of the 1882 boundary, the roadway northeast of Middle Mesa seems the most useful, and probably supported the most Hopi livestock in terms of drifting and herded animals. Map 3, area b, includes this rangeland (about 35,000 acres), plus about 15,000 acres in Coal Mine Canyon and Moenkopi Wash leading eastward from Moenkopi toward the Hopi mesas, that were probably accessed by Hopi livestock in quads 28 and 40.

Approximately 28,000 acres of range west of Middle Mesa (Map 3, area c) was not adequately watered, except seasonally, resulting in less severe overgrazing than for the ranges to the east (Map 3, area c; Map 2, area d). [33] Even though Hopi livestock had access to this dry range in summer (from Pasture Canyon on the south and west, and from Preston Mesa, Rat Springs, Middle Mesa and Greasewood Lake on the north and east), it is probable that winter was the dominant period of use because of temporarily available waters.

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The issue of grazing at Willow Springs is somewhat unclear in the documents. In 1939, Page stated that the practice of herding Hopi sheep along the rim of Moenkopi Plateau to Willow Springs had been discontinued for about 20 years. [6] Nevertheless, Hopis historically ran their livestock in the Willow Springs area, and some residual use of that area in 1934 can be inferred. Occasional use at Willow Springs, perhaps by fewer animals, was a likely occurrence (Map 3, area d). It is also likely that increases in non-Hopi livestock numbers (probably Paiute) from 1919 to 1934 effectively masked the visibility of Hopi livestock in the Willow Springs area and that the reported discontinuation of Hopi use was an inaccurate analysis of the situation. Except for a few pockets of shadscale and greasewood, 11,000 acres of uplands were dominated by sand sage and sand muhly, both low-value forage plants whose dominance is indicative of past over-use. [24] Numerous natural springs in the lowland areas had allowed historical yearlong grazing that had probably caused the severe range deterioration evidenced by the high density of rabbitbrush on 4,000 acres classified as unsuitable (within Map 3, area d). [9:29]

The total area probably used for grazing by Moenkopi Hopis includes 392,000 acres (Map 3) that extended eastward to the boundary of the 1882 Reservation, from White Mesa to Newberry Mesa. The western extent of the Hopi grazing area ran from Preston Mesa to Cameron and down the Little Colorado river to Grand Falls. Map 4 (720,000 acres highlighted) shows a compilation of the documented (169,000 acres; yellow), maximum likehood (159,000 acres; orange), and probable use areas (342,000; blue) accessed by the Moenkopi Hopis in 1934.

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USE OF THE 1934 RESERVATION AREA BY HOPI LIVESTOCK OWNED BY DISTRICT 6 RANCHERS

Documents relevant to this area include Page's reports that were apparently developed largely from the testimony of informants working with him in 1938. [1; 3; 4] Page also authored the Hopi-Navajo Boundary Report which included interviews with District Supervisors, Navajo stockmen and other sources consistent with the Human Dependency Survey. Again, the independent analysis of this author is consistent with the conclusions of other experts regarding Hopi grazing in this area. See reports of Ainsworth, Adams, and Godfrey (1986).

Documented Hopi Use Areas

In 1938, when Page collected data for his reports, Hopi grazing in LMU-3 was mostly north and west of District 6, into the Howell Mesa area and across Dinnebito Wash onto Moenkopi Plateau and the southern end of Ward Terrace. Specific areas mentioned within the 1882 boundary are considered here to the extent that livestock would range beyond the unfenced boundary.

As late as 1939, Navajo informants expressed concern over Hopi range use in LMU-3. [2:54-75] One incident involved the area extending 12 miles to the west of Dinnebito Wash for 20 miles south of the Tuba City-Hotevilla road. [2:57] If accurate, this account clearly includes Hopi use of a portion of the Moenkopi Plateau and Ward Terrace west of the 1882 boundary.

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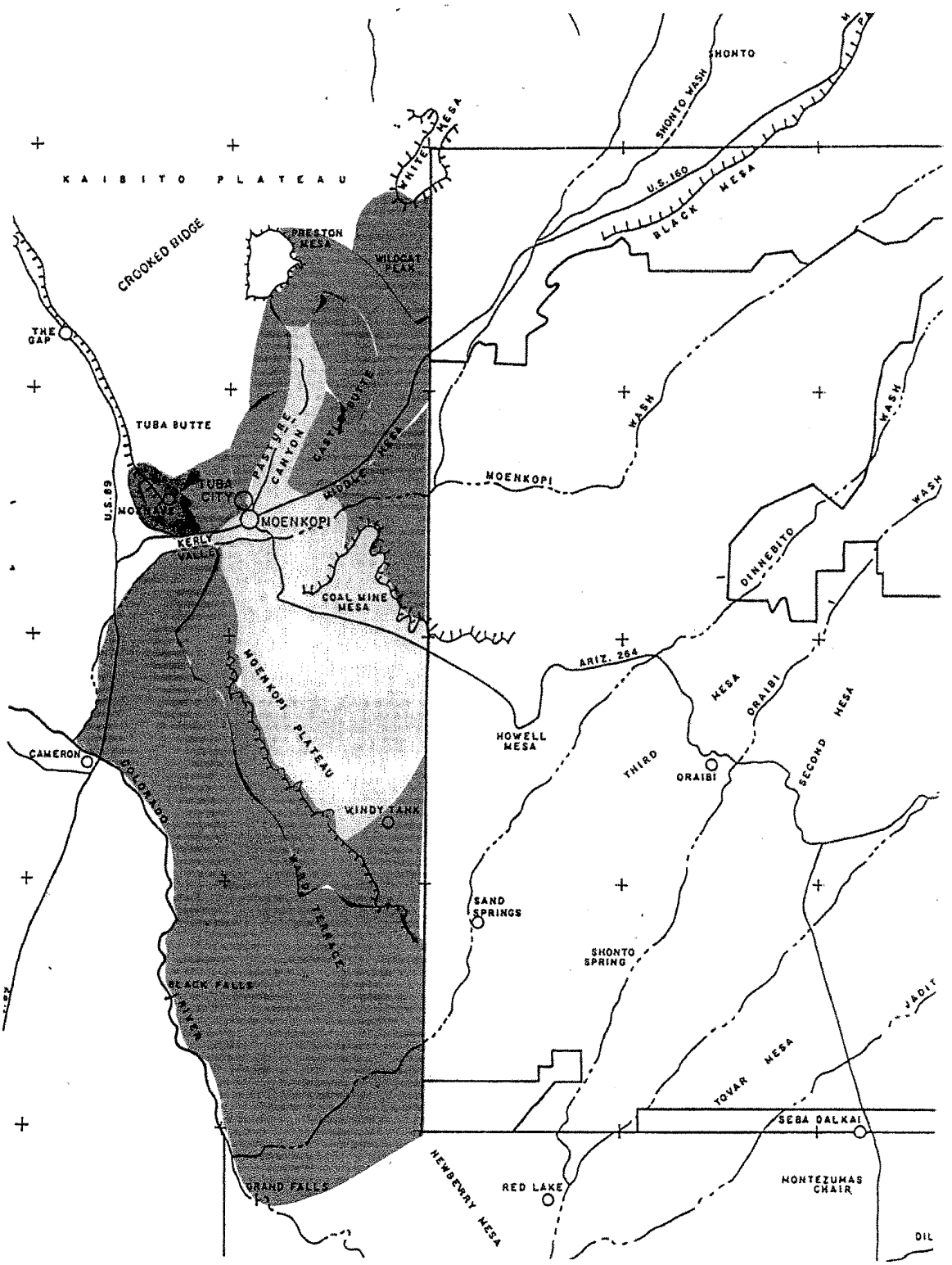

Map 4. Total estimated grazing area used by the Moenkopi Hopis.

This claim coincides with Page's reporting that one group of Hopi stockmen from Hotevilla ran cattle west of Howell Mesa on Moenkopi Plateau near well no. 178 and south to Dinnebito Trading Post. [2:3] It is unlikely that these livestock remained east of the then-unfenced 1882 boundary. These accounts would link District 6 cattle with Moenkopi Plateau, and would form a bridge between Hopi livestock originating from Moenkopi Village and District 6.

Navajo interviews reported by Page in 1939 state that Hopi sheep bands ranged out across Dinnebito Wash to the west of Blue Point. This place on Dinnebito Wash is less than three miles east of the western 1882 boundary in LMU-3. Numerous routes were available that provided access from the Dinnebito drainage onto Moenkopi Plateau. Page's record establishes Hopi sheep corrals built on the east side of Dinnebito Wash, sufficiently near the incident reported by the Navajo to corroborate it. [2:54-75; 4:map following p. 34]

One report in LMU-3 discussed Hopi cattle grazing from Oraibi Wash as far as Sand Springs Trading Post. [1:2] In 1938 the number of cattle owned by the Hopi stockmen directly responsible for that livestock grazing totalled 318 head. [1:9] The area of conflict extended from Shanto Springs to Sand Springs and was partly due to Navajo encroachment onto established Hopi range. [1:5-6] The 32,000 acres west of the 1882 boundary where Hopis (primarily from Third Mesa) had established range rights (Map 5, area a) fall entirely within the area described as documented and maximum likelihood range of the Moenkopi Hopis (Maps 1 and 2).

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Some 25 years preceding 1934, Navajo farmers ended their attempted encroachment in the 1882 Reservation along the Oraibi Wash and had moved back down the Oraibi Wash, from Shanto Springs to Tolani Lakes. [1:6] Page reported that the southward movement of the farms was followed by a similar retreat by the Navajo herders. This was in turn followed by southward re-establishment of Hopi range rights.

In 1930, Fiske reported that Hopi cattle were allowed to graze out beyond their "territory" after the rains, when range conditions were good. [18:10] In 1934, most Hopi livestock ranging southward out of the District 6 area probably crossed the then-unfenced 1882 boundary in LMU-5. The presence of Hopi cattle in LMU-5 is supported by conflicting numbers of known Navajo cattle (749 head accounted for in 1936 Navajo livestock movement report) and those cattle observed at LMU-5 dipping stations (915 head in 1936). In 1937 only 120 head of Navajo cattle were known to range near Sand Springs, yet 509 head of cattle were dipped in the Sand Springs vat in that year. In addition to the cattle from First Mesa that grazed down Jeddito Wash as far as Tolani Lakes, [1:4] livestock from all three mesas "habitually" crossed the entire District 6 boundary from Tovar Mesa to Sand Springs. [1:5] Cattle from Oraibi and Bacabi were also reported as far south as Sand Springs Trading Post and south to the lower part of Tovar Mesa, to the 1882 southern boundary. [5:1]

In 1939, the District Supervisor confirmed that Hopi cattle, having grazed south of Tovar Mesa, were in conflict with

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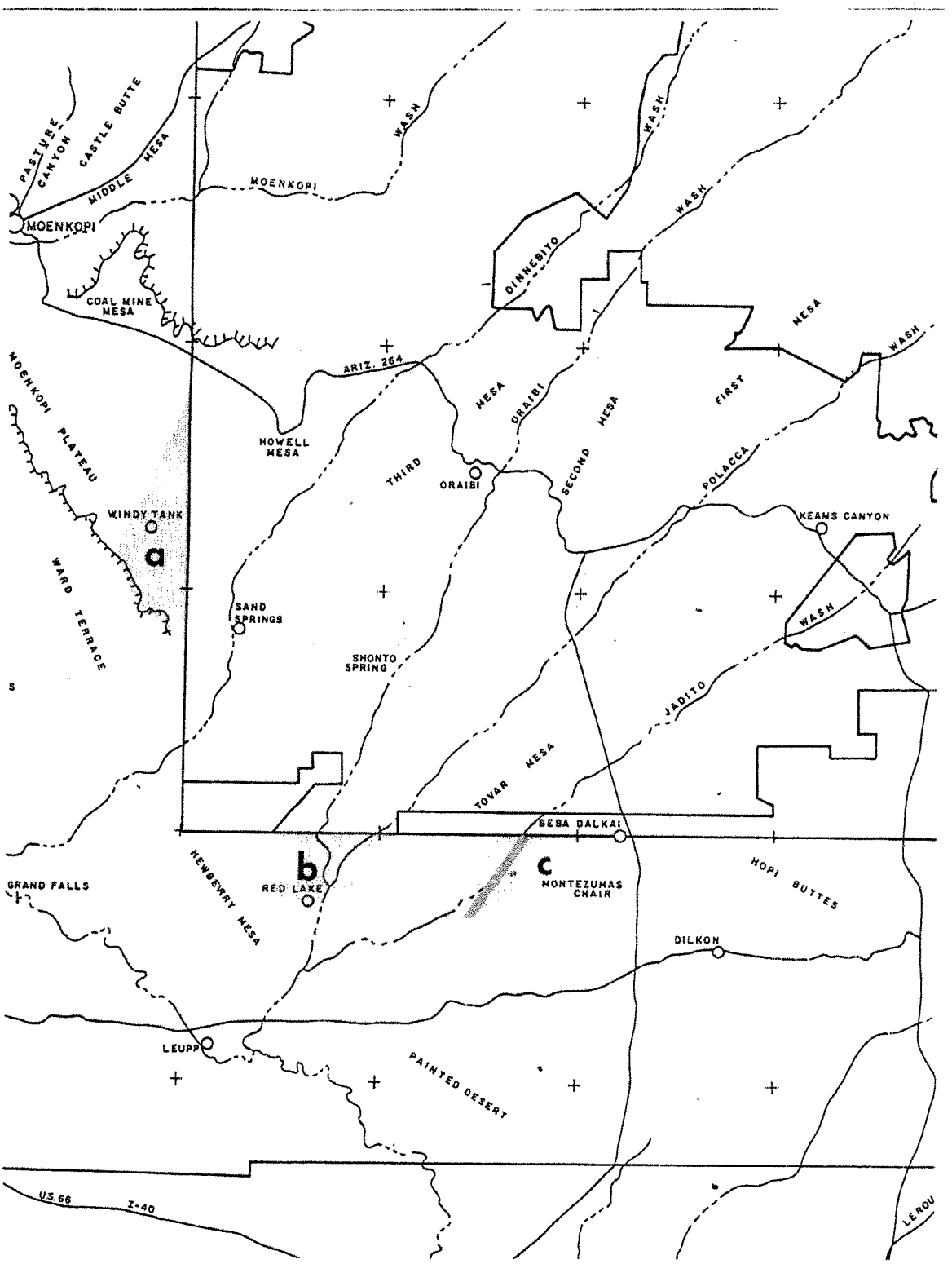

Map 5. Documented grazing areas used by the District-6 Hopis.

Navajo lambing operations. [2:30] Although the extent of the range used to the south of Tovar Mesa was not specified, it was almost certainly beyond the 1882 boundary, as the southern point of Tovar Mesa is within 6/10 mile of the unfenced boundary. These cattle described by the District Supervisor may well be among those reported by Page in the area of Tolani Lakes. [1:6]

A Navajo interview in 1939 also mentioned that Hopi cattle were drifting down near Red Lake. [2:64-65] However, this informant believed these cattle belonged to Scott, a Hopi who had built a home and fenced pasture in LMU-3 in about 1934. Hopi testimony confirmed that in the 1920s and 30s, Simon Scott and three other Hopi stockmen (George Lomayesva, Roger Quochetewa, and Ralph Hootewa) had run their cattle toward Red Lake and on to the Little Colorado River. [26:112]

From the preceding information, it is substantiated that Hopi cattle were still grazing into the area of Tolani Lakes and at least as far as Red Lake in 1938. It is not clear where all of these livestock originated, but the foregoing reports suggest that they may have come from at least four different herd units: the First Mesa and Polacca groups (including Lomayesva) grazing down Jeddito and Polacca Washes and crossing over Tovar Mesa; Third Mesa stockmen (including Hootewa and Quochetewa) using range southward out of District 6, through the Dinnebito Wash access; and Scott's cattle coming from west of the Dinnebito Wash. Although not reported, it is also possible that other cattle from Hopi concentration areas at Comar and Burro Springs and from

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elsewhere along Dinnebito and Oraibi Washes were grazing down to Tolani Lakes.

The rangelands leading to the Tolani Lakes region and eventually to the Little Colorado from the north include the drainage systems of the Oraibi and Polacca Washes (approximately 30,000 acres). Jeddito Wash enters the region from the east and feeds into the Little Colorado River 12 miles south-southwest of the day school at Seba Dalkai. Approximately 64,000 acres of range are included in this documented Hopi use area (Map 5, area b). However, the rangeland close to the washes had been subjected to overuse, [33] especially by unherded cattle, [16:46] and was considered to be either in very low carrying capacity or unsuited for grazing. [24] This poor condition was characterized by an abundance of weedy plants. Away from immediate water the ranges were less severely abused and would have provided suitable grazing. The ranges along the drainages were probably the grazing areas most used by the Hopis in 1934.

In the 1939 Page boundary report, nearly all references to grazing in LMU-7 involved rangeland north of the southern 1882 boundary line. It was documented that Hopi sheep and cattle were (presently) grazing as far south in the Jeddito valley as spring no. 132 and the unfenced executive order boundary. [5:1] The report from the District Supervisor in LMU-5 places Hopi cattle in lambing grounds south of Tovar Mesa, most likely in the Jeddito valley. [2:30] These reports support Page's statement that cattle ranged down Jeddito Wash as far south as Tolani Lakes in LMU-5. [1:5] In 1930, this winter use by Hopi cattle may have been that

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described by Fiske as "permitted" grazing. [18:10] The cattle Page referred to may have been among those belonging to Hopi individuals with permits issued for yearlong grazing in LMU-7 in 1938. [1:4]

Cattle grazing down Jeddito Wash to Tolani Lakes grazed through some 15,000 acres in LMU-7, south of the boundary to the northwest portion of quad 78.2 (Map 5, area c). This rangeland was a well-watered mosaic of desert grassland and salt shrub types reported to have the potential to support dense livestock populations (0.1-.2 f.a.).

Grazing by Hopi sheep seems to have caused little conflict south of the 1882 boundary, as herders were limited as to movement away from established corrals and waters. However, Page's 1938 survey of Hopi corrals documented semi-permanent use of ranges at the southern extreme of District 6, [3:map following p. 34] that would have allowed daily access by sheep to ranges within LMU-7 and south of the 1882 boundary. The presence of Hopi corrals and Hopi range in close proximity to the 1882 boundary was confirmed by Centerwall in 1942. [25:map]

Page's report does not describe how far south Hopi sheep use extended from these corrals except to say that specific conflicts with sheep-use were few because the bands did not range out very far from corrals and water. Therefore, sheep use areas will be considered only if they were within a reasonable distance such that sheep could be grazed out and back to the corrals at night (three miles). Under these conditions, access to the area in

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LMU-7, south of the 1882 boundary, was possible from only two of the corrals on Page's maps. The area accessed by these sheep would be within the documented use area described for cattle grazing in the Jeddito drainage (Map 5, area c). The total area depicted on Map 5 includes 111,000 acres of documented use rangeland.

Maximum Likelihood Hopi Use Areas

In addition to the link with Hopi use on Moenkopi Plateau, the documented use areas establish reasonable access to the range along the Dinnebito watershed west of the 1882 boundary from Sand Springs to the Little Colorado River. This zone would include some of LMU-3 in quads 64.2, 64.3, 64.4 and 76.1. The area was well supplied with temporary water and provided desirable winter forages on a belt of gentle terrain. An area in LMU-5 (quads 64.4 and 76.2) also was accessible on the east side of the Dinnebito Wash drainage (Map 6, area a). These 37,000 acres were within the area most likely used by cattle grazing off the Moenkopi Plateau from both the Moenkopi and the Hotevilla-Howell Mesa herds, as well as those originating from within District 6.

Hopi cattle using the range from Tolani Lakes to Red Lake and on to the Little Colorado River [1:4,6; 2:64-65; 3:20; 26:112] had easy access to the entire area in quad 77, east of the Newberry Mesa scarp. Although the upland ranges were relatively well watered for cattle winter range, use was heaviest in the drainages, and significant grazing by cattle was not common on the uplands. Of the upland areas surrounding the major drainages (Map 6, area b), the

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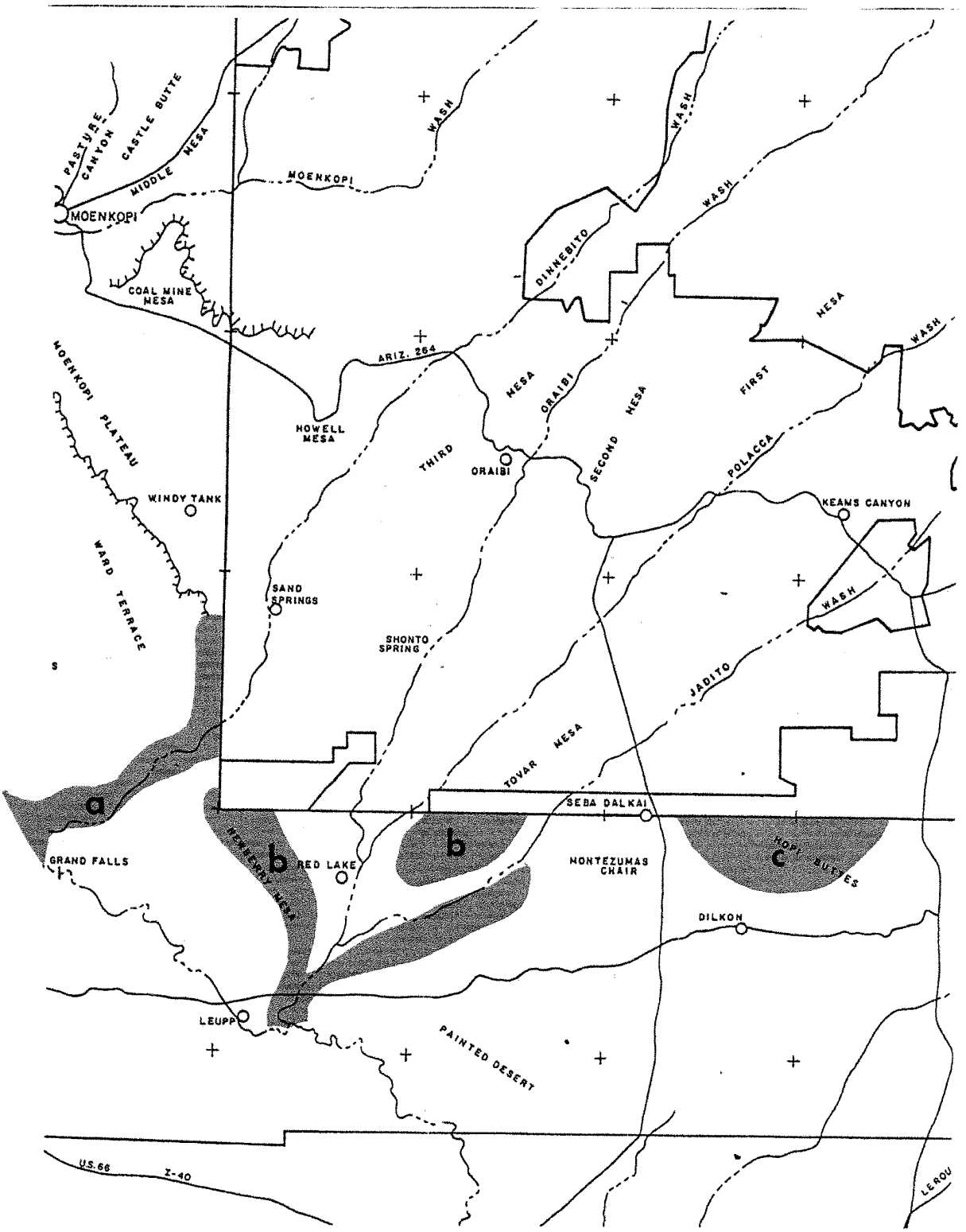

Map 6. Maximum likelihood grazing areas used by the District-6 Hopis.

range on Newberry Mesa, for several miles west of the Oraibi-Leupp road, was most likely to attract cattle to the available surface water and relatively abundant forage. This area adjoins the probable use area of the Moenkopi livestock. Other maximum likelihood areas south of Tovar Mesa and Jeddito Wash contribute to the 86,000 acre total shown on Map 6, area b.

Page's 1938 report, based largely on information from Bennet Cooka, indicated that Hopi stockmen had established an accepted historical grazing right in the area of the Hopi Buttes some thirty years prior to 1934. Hopi livestock grazing throughout the Hopi Buttes in the 1934 period were counted in Page's survey, but no conflict was noted. It would appear that historical use of the Buttes area by Hopi livestock [19; 3:20; 1:2] was sufficiently established in 1934 that conflicts did not arise. Lack of controversy may be partly due to the good relations (through marriage and employment) reportedly existing between some First Mesa Hopi and their Navajo neighbors. Thus, the area lacked the visibility necessary to be referenced in the District 6 Boundary Report four years later.

The greatest use of the Hopi Buttes area south of the 1882 boundary was made by Pavatea's cattle, and probably occurred in the vicinity of Cedar Springs to Na Ah Tee Canyon (Map 6, area c). This area includes about 38,000 acres of range that was exceptionally well watered by natural springs, some of which had even been developed prior to 1934. Cattle grazing into this area was likely for Hopi herds (including Lomayesva cattle) which used the Red Buttes and White Cone areas [19; 26:112; 21:64], before moving down to the Tolani Lakes region. [3:20; 1:4,6] The total surface area depicted on Map 6 includes 161,000 acres of maximum likelihood rangeland.

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Probable Hopi Use Areas

Because of the lack of natural boundaries and because of the presence of excellent forage and water, Hopi livestock in the Hopi Buttes area would have grazed out from the Cedar Springs area for approximately five miles in a radius east, south, and west from this central point (Map 7, area a) consisting of some 63,000 acres of rangeland (50,000 acres suitable).

Hopi cattle that reached the Tolani Lakes area were not restricted from migrating to the Little Colorado basin near Leupp (Map 7, area b). It is probable that Hopi livestock belonging to at least four stockmen [26:112] grazed as far as that natural barrier and continued grazing for some distance up and down the east bank of the Little Colorado River. This is consistent with Page's description of the Hopi cattle's winter range. [3:11] The total area involved is likely about 31,000 acres along the north side of the river valley. However, it is possible that this use area extended downriver to the northwest, joining with the area of river valley probably grazed by the Moenkopi cattle (Map 3, area a).

The total 94,000 acre area outside the 1882 Reservation probably grazed by District 6 livestock included the Hopi Buttes area on the east to the Little Colorado River on the southwest. Much of the range used by District 6 Hopis was shared with their cousins from Moenkopi (Map 8).

Map 8 (366,000 acres highlighted) shows a compilation of documented (111,000 acres; yellow), maximum likelihood (161,000 acres; orange), and probably use areas (94,000 acres; blue) accessed by the District 6 Hopis in 1934.

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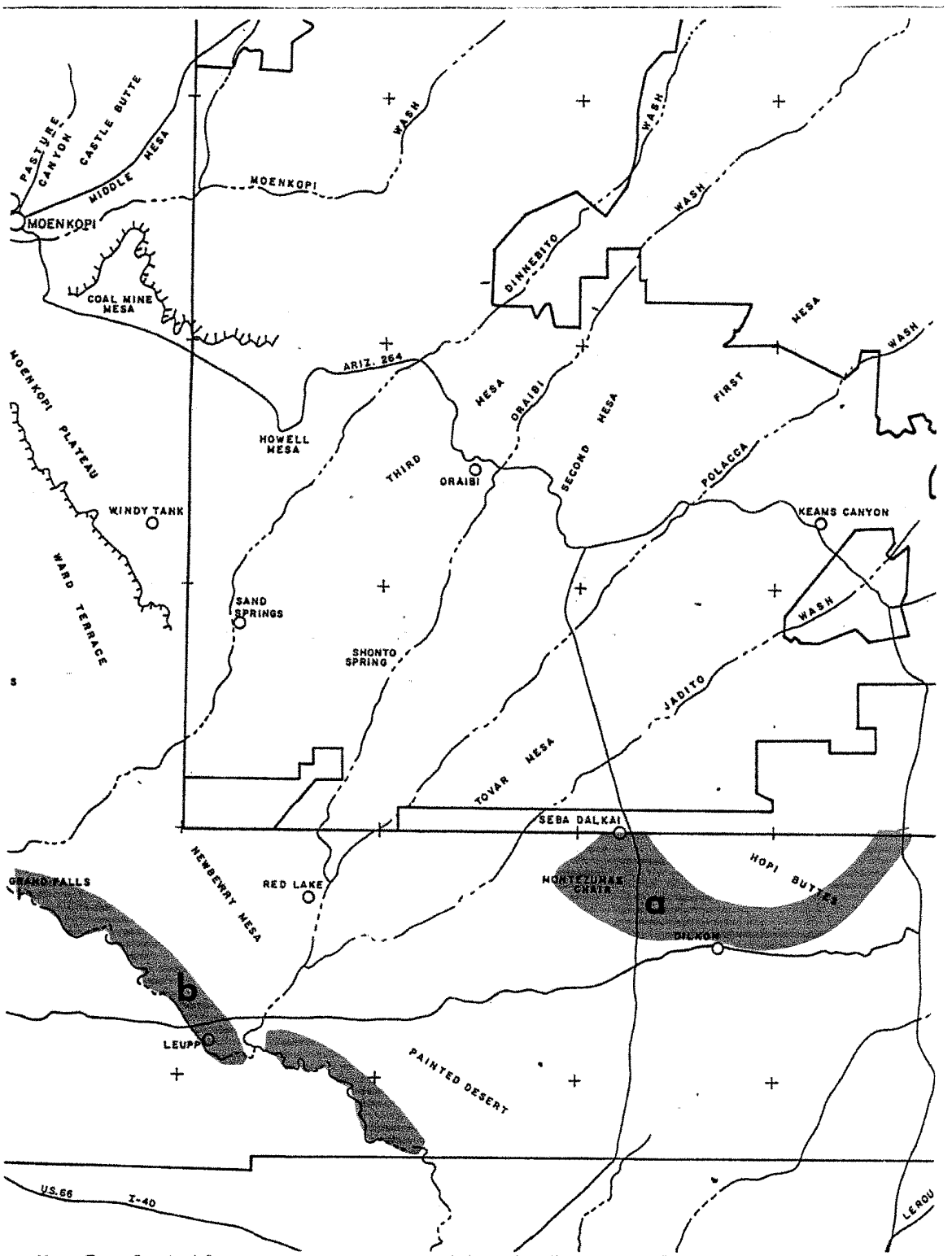
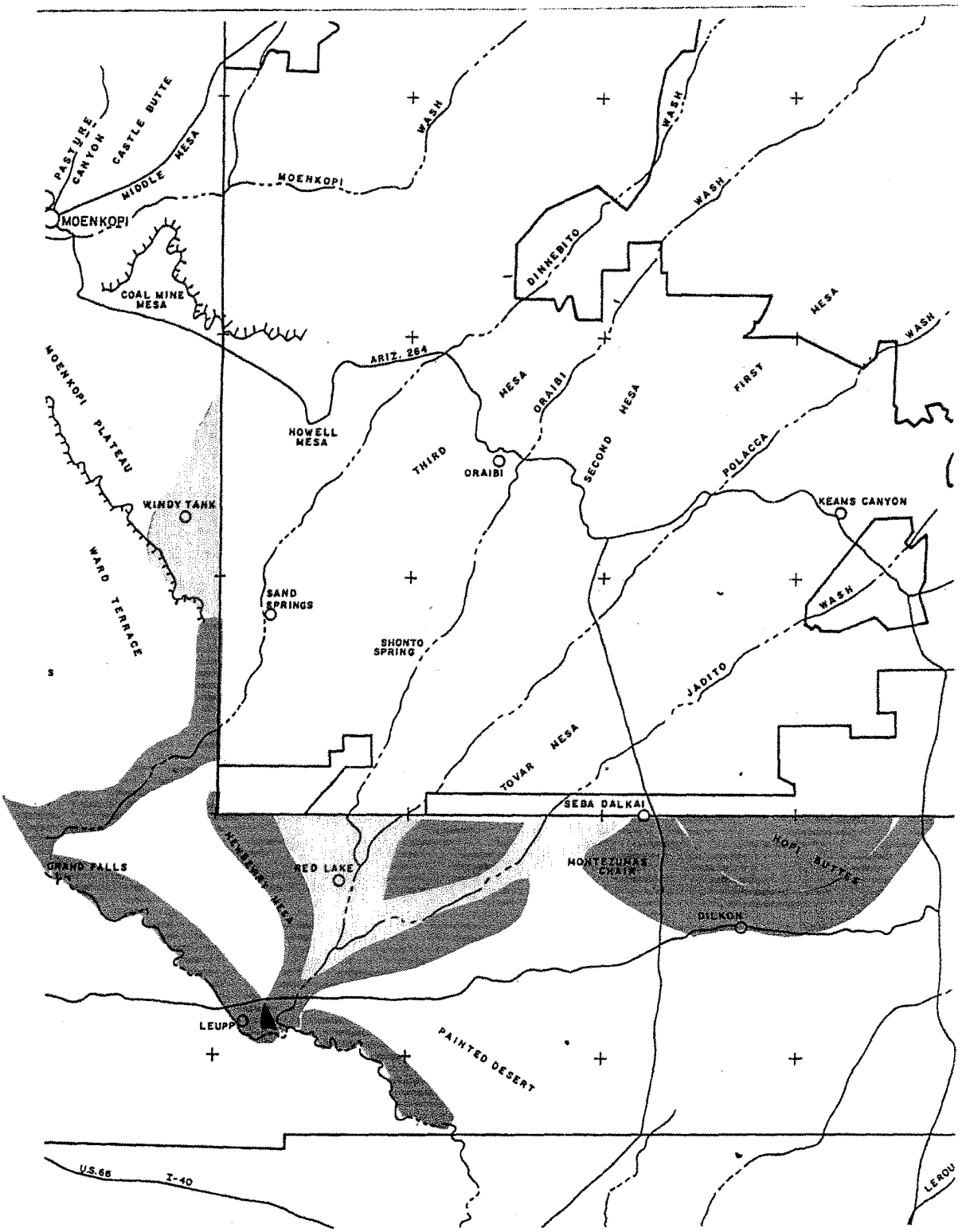


Map 7. Probable grazing areas used by the District-6 Hopis.



Map 8. Total estimated grazing area used by the District-6 Hopis.

CONCLUSIONS

It is clear that in 1934 the Hopi were using established ranges beyond the 1882 boundary. Approximately 280,000 acres of rangeland (210,000 suitable) have been described as documented Hopi grazing areas, including the ranges in and near Moenkopi and Pasture Canyon Washes, Moenkopi Plateau, Coal Mine Mesa, and the Tolani Lakes/Jeddito Wash region (Maps 1 and 5). It is probable that the rangelands on Moenkopi Plateau and Coal Mine Mesa were exclusively used by the Hopis, as they had control of the water and were not disposed to share their resources. Navajos trespassing into the Hopi grazing area were promptly removed.

Beyond the documented Hopi use areas, approximately 320,000 acres of rangelands (270,000 suitable) would have attracted Hopi livestock to available water and forage (Maps 2 and 6). These maximum likelihood Hopi use areas are proximal to the documented Hopi areas and use of these ranges is inferred from what is known of livestock and stockman behavior and from the overstocked conditions that forced livestock and herders to seek greener pastures. A portion of the maximum likelihood area (Map 6, area c) was probably used exclusively by Hopi stockmen.

Because the Hopi considered that all of the rangelands discussed were theirs to use and because the livestock and herders were not restricted by fences or natural barriers, it is probable that Hopi livestock grazed beyond the areas described as documented and maximum likelihood use areas (Maps 3 and 7). Although

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the exact extent of additional Hopi use in 1934 is difficult to specify, the 486,000 acres of rangeland (300,000 suitable) identified as probably used by the Hopi is somewhat conservative in that the area potentially grazed by Hopi livestock in 1934 is several times larger than the area where grazing was most probable.

The total surface area encompassed by all of the suitable and unsuitable rangeland areas referred to above in the foregoing summary of Hopi livestock use during 1934 is 1,647 square miles or 1,054,000 acres.

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