

LAND MANAGEMENT SURVEY

L.M. UNIT 2

SECTION OF AGRONOMY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

REGION EIGHT

NAVAHOS

1938

TC 11

RECORDS AND STATISTICS

AGRONOMY BRANCH REPORT

- on -

THE LAND MANAGEMENT STUDY

- of -

UNIT NO. 2

Survey Conducted Between
Aug. 25 and Oct. 12, 1937

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Location and Boundary:

Land Management Unit No. 2 is located in the northwestern portion of the Navajo Reservation. One-fourth of the Unit is in San Juan County, Utah, and the remainder is about equally divided between Navajo and Coconino Counties, Arizona. It lies approximately between $36^{\circ}15'$ and $37^{\circ}15'$ north latitude and between $110^{\circ}30'$ and $111^{\circ}15'$ west longitude.

Beginning at the junction of Navajo Canyon and the Colorado River and proceeding clockwise, the boundary of the Unit is as follows: It runs up the Colorado River and San Juan River, which form the Reservation boundary, for a distance of about fifty miles in a northeasterly direction; it then goes southward following the eastern edge of No Man's Mesa, the western edge of the Segi Canyon and a small drainage on Black Mesa, for a distance of about fifty-five miles to the Moencopi Wash; it then runs southwest down this wash for a distance of seventeen miles where it turns north, following a drainage divide ten miles to a high point on the rim of Black Mesa; from here it goes northwest for fifteen miles to White Mesa, then northward for fifteen miles along the eastern edge of this mesa and into Navajo Canyon; it then goes westward for thirty-five miles along the south rim of Navajo Canyon to the Colorado River, the point of origin.

The boundary, as outlined above, encloses an area of

1,094,976 acres. Included in this are the following figures:

Inaccessible and barren	-	572,292	acres
Grazing	- - - - -	721,587	"
Farming	- - - - -	1,097	"

Roads and Trails:

The roads of the Unit have been given two classifications: Graded dirt roads and unimproved roads. The graded dirt roads are those which have been bladed and are maintained at more or less regular intervals. Unimproved roads are those which are passable to cars but are not maintained. There are no improved roads either on the Unit or close to it.

The following roads are classed as graded dirt roads:

The Tuba City to Kayenta road. This road passes from east to west through the southern part of the Unit. It is maintained more than any other road in the Unit; however, it is impassable during rains and is rough at all times.

The Cow Springs to Shonto road. This road is maintained occasionally and is passable except during hard rains.

The Red Lake (Tonalea) to Inscription House, to Navajo Mountain road. This road is maintained occasionally between Red Lake and Inscription House. The part from Inscription House to Navajo Mountain is very seldom maintained and is quite rough at all times. The road is impassable during storms.

There are five truck trails classed as graded dirt roads on the Unit,

(1) The one up Black Mesa to the Kayenta Coal Mine. This is maintained frequently and is in good shape except during storms. The road is often closed by snow during the winter months.

(2) The road over Black Mesa, east of Cow Spring. This receives a little maintenance. The road is hard to get over at any time and may be impassable even during small storms.

(3) The truck trail from Inscription House to Kabitto. This is maintained infrequently and is quite rough. It may be impassable after any storm.

(4) The truck trail to Plute Mesa. This road apparently has had no maintenance since its construction. It is quite rough and has washed out in several places where it crosses the Plute Canyon drainages. It is passable for wagons but not for cars.

(5) The roads into Be-Ta-Ta-Kin Ruin from Shonto, and from the Tuba City to the Kayenta road. This is maintained occasionally. It is rough but passable at all times.

Unimproved roads are found in the southern portion of the Unit, from Black Mesa on the south as far north as Inscription House. This portion of the Unit is accessible to cars except during storms. There are a few unimproved roads on the mesa southeast of Navajo Mountain. These roads are rough but pass at most of the time.

The area north and west of Navajo Mountain does not have roads of any kind in it. Several stock trails are found in this area and are also found into Navajo Canyon, Piute Canyon, Navajo Mountain, Nakai Canyon, and Black Mesa.

Climatological Data:

Due to the fact that no climatological records have been kept in this Unit it is necessary to use the data from Lee's Ferry, Tuba City and Kayenta. The records of Kayenta will probably be more applicable to this area than those of Tuba City and Lee's Ferry.

GROWING SEASON				
Station	Period of Records	Average Length of Growing Season	Date of 1st Klg. Frost	Date of 1st Klg. Frost
Kayenta	1915-1930	163	June 1	Sept. 21
Tuba City	1897-1930	179	May 19	Sept. 19
Lee's Ferry	1916-1930	229	Apr. 18.	Oct. 18

ANNUAL PRECIPITATION

Station	Period of Records	J	F	M	A	M	J	J	A	S	O	N	D	Avg. An. P'cpt'n
Kayenta	1915-1930	.63	.43	.64	.42	.36	.33	1.45	1.58	.75	.91	.64	.61	8.80
Tuba City	1897-1930	.55	.54	.54	.43	.53	.19	.34	.93	.84	.68	.78	.58	6.92
Lee's Ferry	1916-1930	.34	.60	.44	.59	.26	.16	.76	.96	.59	.64	.42	.44	6.20

AVERAGE EVAPORATION IN INCHES
(1921 - 1930)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Avg. Ann.
Lee's Ferry	2.076	3.088	5.773	7.967	11.594	12.773	13.359	11.083	8.917	6.112	2.945	1.928	87.615

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TEMPERATURE RECORDS

Station	Record	Period of Records	Year												
			J	F	M	A	M	J	J	A	S	O	N	D	
Kayenta	Mean	1915-1930	27.6	37.5	44.2	51.8	61.2	70.5	76.1	75.2	65.9	54.0	40.7	30.0	52.7
"	Absolute Maximum	"													-15
"	Absolute Minimum	"													54.8
Tuba City	Mean	1898-1930	32.0	39.2	45.9	53.8	61.7	71.1	76.8	77.8	67.6	55.7	43.4	32.3	54.8
"	Absolute Maximum	"	68	73	85	88	99	104	105	108	100	95	88	70	108
"	Absolute Minimum	"	-15	-3	12	14	22	34	40	44	28	18	8	-13	-15
Lee's Ferry	Mean	1916-1930	34.8	43.9	52.9	61.1	70.5	80.2	86.9	73.7	75.8	62.3	47.2	36.4	61.3
"	Absolute Maximum	"													114
"	Absolute Minimum	"													5

AVERAGE WIND MOVEMENT IN MILES
(1921 - 1930)

Station	Year												Avg. Ann.
	J	F	M	A	M	J	J	A	S	O	N	D	
Lee's Ferry	1,058	1,216	1,975	1,889	1,940	1,737	1,570	1,392	1,267	1,223	1,057	963	17,278

In summing up these records the following figures can be applied to Unit No. 2;

Average Yearly Precipitation	8.5 inches
Average Yearly Precipitation (Black Mesa)	10-12 "
Average Yearly Precipitation (Navajo Mt.)	10-12 "
Length of Growing Season	150-160 days
Length of Growing Season (Navajo and Piute Canyons)	165-170 "

The length of the growing season will be considerably shorter than the above figures on Black Mesa and Navajo Mountain. However, there is no farming at present in either of these places.

Drainage and Runoff:

About two-thirds of the Unit drains northward into the Colorado and San Juan Rivers. Runoff from this area will be high due to the large areas of exposed sandstone, steep slopes along the sides of deep canyons, and the lack of a protective vegetative cover. Flood runoff in this area has not been calculated except at the points where projects are located. Generally speaking, no use can be made of flood water in this area because the quantity cannot be handled on the small area which would be available for water spreading. Small permanent streams in both Navajo and Piute Canyons are used for irrigation at the present time. A small permanent flow in Nakai Canyon has been used on about ten acres of land; however, no use has been made of it for the last few years.

About one-fourth of the central portion of the Unit drains to the southwest through Klethla Valley into Cow Springs Lake. Runoff from this area will be low with the exception of localized areas of steep slopes and exposed sandstone. A small area along the steep slopes of Black Mesa provides the larger portion of the runoff into Klethla Valley. Cow Springs Wash provides most of the flood water into Cow Springs Lake. There is also a permanent flow of about one second foot from this wash into the lake. All of the flow of Shonto Wash is held within the boundary of Unit No. 2. A permanent flow of approximately three-quarters of a second foot is used for irrigation purposes at Shonto. No agronomic use can be made of the drainages in Black Mesa, which flows southward into the Moencopi Wash. The runoff from this portion of the mesa is high; however, no calculations have been made of the expectancy in any of these drainages.

The drainages of this Unit were numbered on the Agronomy and Engineering map, using the same system applied to all Units of the Navajo Reservation. The following numbers were given to the main drainages of the Unit:

Colorado River	#1.0
San Juan River	#2.0
Navajo Canyon	#3.0
Plute Canyon	#4.0
Cow Springs (Begishibito) Canyon	#5.0

Shonto Wash	#6.0
Klethla Valley	#7.0
Moencopi Wash	#8.0

The annual runoff has been estimated only at those locations where it is possible to use the water for agricultural purposes or where erosion control projects were recommended.

Topography:

The elevation of this Unit ranges from 3,200 feet at the junction of the Colorado River and Navajo Canyon to 10,250 feet on Navajo Mountain.

The following elevations have been taken from the U.S.G.S. topographical maps edited in 1891 and 1892:

Average elevation	6,000 feet
Navajo Mountain	10,250 "
Black Mesa	7,200 "
Rainbow Lodge	6,000 "
Navajo Mt. T. P. (Quinn's)	6,000 "
Inscription House T. P.	6,600 "
Shonto	6,200 "
Klethla Valley	5,800 "
Nakai Canyon	5,000 "
Plute Canyon	5,000 "
Navajo Canyon	4,600 "
Junction of Colorado and San Juan Rivers	3,500 "
Lower end of Moencopi Wash	5,400 "
Lower end of Colorado River	3,200 "

The topography of the northern two-thirds of the Unit is characterized by high mesas between large deep canyons and Navajo Mountain. The canyons are from 1500 to 2000 feet deep with steep side walls and a relatively level narrow bottom. Navajo Mountain stands 4500 feet above Rainbow Plateau, extending between Navajo and Piute Canyons. The central portion of the Unit is a gently sloping plateau bordered by White Mesa on the west and Segi Canyon on the east. This area is cut by two small canyons, Cow Springs Canyon and Shonto Canyon. The southern portion of the Unit lies on Black Mesa where the topography is very rough and is characterized by high vertical cliffs and deep canyons.

Vegetation:

The vegetation of this Unit varies from that typical of the Upper Sonoran to that of the Transition Zone. The entire area, with the exception of Navajo Mountain, falls into the Upper Sonoran zone and is typified by woodland, sage brush, and browse species.

Navajo Mountain is typified by species of the Transition Zone which includes Ponderosa pine, Limber pine, Aspen spruce and Douglas fir. The principal species found over the balance of the Unit are listed as follows:

Grasses:

Common Name

Scientific Name

Blue grama

Bouteloua gracilis

Galleta

Hilaria jamesii

Sacaton

Sporobolus aeroides

Sand dropseed

Sporobolus cryptandrus

Spiny muhley

Muhlenbergia pungens

Weeds:

Russian thistle

Salsola pestifer

Sunflower

Helianthus spp.

Colorado Beeweed

Cleomeella Spp.

Cocklebur

Xanthium commune

Shrubs:

Big Sage

Artemisia tridentata

Black Brush

Coleogyne ramosissima

Yellow bush

Chrysothamnus greenii

Snakeweed

Gutierrezia spp.

Chamise

Atriplex canescens

Mormon tea

Ephedra spp.

Greasewood

Sarcobatus vermiculatus

Trees:

Pinon

Pinus edulis

Juniper

Juniperus Monosperma

Juniper

Juniperus utahensis

Trees (Cont'd)

Ponderosa pine	Pinus ponderosa
Limber pine	Pinus flexulus
Aspen	Populus tremuloides
Cottonwood	Populus macdougalii
Oak	Quercus spp.

The vegetation exhibits two extremes of condition; under-utilization and over-utilization. Certain areas, such as the one found west of Cummings Mesa, exhibit excellent condition because the area is rather inaccessible and stock cannot get into the areas very easily. On the other hand, areas corresponding to population and livestock concentrations exhibit extreme over-use even to the extent of killing out many of the more valuable forage plants.

Woodland areas, like range, are over-utilized in vicinities of population concentrations and under-utilized in the more isolated areas. Generally speaking, the conditions of the vegetation over the entire Unit is relatively poor, showing extreme over-use in localized areas.

Soils:

With the exception of Black Mesa and Klethla Valley in the southern portion of the Unit, the soils are primarily derived from sandstone and are light textured, exhibiting high water penetration and low water retention values. Because of their

light structures they are easily susceptible to wind erosion. Large areas in the northern portion of the Unit exhibit only shallow soil cover, with much exposed rock surface. In these areas vegetative cover is scant and the erosion potential is increased.

Soils in the southern portion of the Unit, both in Kletala Valley and on Black Mesa, are of the heavier type of soil, many exhibiting a large percentage of clay. The soils in Kletala Valley are deep, with a high water holding capacity and are of the better class of soils, but the soil cover on Black Mesa is shallow, together with steep slopes and scant vegetative cover.

As a whole, the soils in the central portion of the Unit, especially those around Shonto and Inscription House, are the more productive of the Unit. A deep soil cover with high water holding capacity and low runoff is a possible explanation for their productivity.

Erosion:

The northern portion of the Unit exhibits a condition of normal geologic erosion. Here, uninfluenced by man, erosion forces have been at work on a soft sandstone, cutting deep canyons with high rock rims and practically no soil cover is left.

Wind erosion is predominant over the entire Unit, mainly because the soil is light textured and very susceptible to wind erosion upon depletion of the vegetative cover. Over-stocking

of parts of the area has been a contributing cause of accelerated wind erosion. Over the northern portion of the Unit the wind erosion has been classified as moderate. Only where there is a rather dense vegetative cover, together with a rather deep soil cover, has erosion been classified as slight. This is true of the area around Shonto.

Sheet and gully erosion are prevalent on Black Mesa and Klethla Valley, due to a heavy soil, high runoff and steep slopes. Head cutting in many of the alluvial valleys is a very important erosion factor. Many of the narrow valley fills have been virtually destroyed by gully erosion, and at present, active head-cutting back into valuable land is taking place.

Erosion over the entire area may be classified as moderate to severe, with only small areas exhibiting slight erosion.

Population and Economic Factors:

In this Unit there are 915 people or 116 consumption groups. The largest percentage of these people are living in the southern half of the Unit mainly because the northern part is very rough and hard to travel over, even on horseback.

There are no prominent population centers where the people are concentrated but there are six general areas where the people are more concentrated than over the balance of the Unit. These areas are: Klethla Valley, Shonto, Piute Canyon, Navajo Canyon, Inscription House, Navajo Mountain.

These people gain their livelihood by raising livestock, farming, weaving and from wage work. They have adapted themselves very well to the resources found in the Unit. The range is utilized by livestock and wherever possible, water supplies are used for irrigating crops; even though the locations are far from trading posts and difficult to travel into.

There are 1,097 acres of farm land or 1.19 acres per capita farmed at the present time. This can be increased to 1.46 acres per capita by the subjugation of potential land found on the survey.

The people in the Unit own 19,408 sheep and goats, 621 cattle, and 1138 horses, burros and mules. (Sheep and goat figures taken from 1937 dipping records. Cattle, horses, burros and mules figures taken from 1936 dipping records.) This is 21.21 sheep and goats per capita, .68 cattle per capita and 1.24 horses, burros and mules per capita, or 167.31 sheep and goats per consumption group, 5.35 cattle per consumption group, and 9.81 horses, burros and mules per consumption group.

When all this livestock is calculated in sheep units there are 27,582 sheep units in Unit No. 2. The range management division estimates a carrying capacity of 20,506 sheep units for this area, which will mean there must be a reduction of 7,076 sheep units or 25.7% for proper range stocking of this area.

It is believed and demonstrations have indicated that

the loss in numbers of livestock can be made up by the increased returns from improved livestock and improved range conditions resulting from proper handling.

From the results of the survey it seems that the resources within this Unit should easily support the population. It is evident that over practically the entire unit a more economic use could be made of the resources, both range and farming, and it is hoped that in the future this will be done.

Method of Locating and Numbering Farms:

Each farm was located on quadrangle half-tones, made from aerial mosaics, and numbered, using the same numbers as those used on the agricultural and water spreading surveys during 1935. The numbering begins with 1 on each quadrangle. Additional tracts of agricultural land not previously located were numbered, beginning with the number where the water spreading survey left off. A number was placed on each farm to correspond with the number on the map. The entire survey party assisted in locating additional farm tracts which has made it possible to locate an estimated 95% of all the farms. It is thought that there may be a few farms in some of the remote canyons which would account for the 5% missed. All of the farms heard of were visited with the exception of Gish Canyon, a side canyon of Navajo Canyon. In many instances it was necessary to travel by horseback to reach the farms, and because of the fact that only a certain number of

horses were available and the survey was not intensive, time did not permit looking into each canyon for farms unless there was some certainty of farming there.

Agriculture Within Unit No. 2:

This Unit is not one which would be considered favorably adapted to agriculture. This is accounted for in several ways: (1) Approximately 34% of the area is barren or inaccessible waste land. (2) Irrigation water is very limited and no irrigation storage supplies are found. (3) Dry farming is not practical, due to the low annual precipitation. (4) Possibilities for flood irrigated farms are found only in localized areas. In spite of all these unfavorable factors there are 1,097 acres of farm land now in cultivation, which provides about 1.19 acres per capita for the people of .t.

Farming in this area is practical. All scattered farms, but there are four general areas where the farming is more concentrated than that found over the balance of the Unit. These areas are: (1) Piute Canyon, (2) Navajo Canyon, (3) Shonto Canyon, and (4) Klethla Valley.

In Piute Canyon there are 119 acres which are supplied with irrigation water. The water is supplied by the flow of Piute Canyon and from several springs in side canyons. Most of the land is fairly level or it has been terraced. Head cutting and floods are often a menace to the farms and some losses occur

each year from these two factors. It is impossible to get into the canyon either by automobile or wagon. Therefore, the principal means of transportation is by horses or mules. In 1935 this area was made a demonstration area and since that time livestock grazing has been prohibited. There has been a certain amount of work done in this area by the Soil Conservation Service, a summary of which is given in the engineering report on this Unit by C. L. Moyes. Detailed maps have been prepared of most of the farm land and can be obtained by request from the Drafting Division.

Navajo Canyon is somewhat similar to Piute Canyon, but the water supply and the amount of farming are much less. There are four farms, consisting of 51 acres in this canyon, which are irrigated and the remaining 64 acres are mostly flood irrigated, with the exception of a few small dry farms. The farms in this canyon are scattered over an area of about fifteen miles. Head erosion and gullying seem to be the principal hazards these people need to combat. These are active on all the farms and should be controlled.

Corn is the main crop produced. Livestock are allowed to graze in this area and a large amount of damage has resulted to the vegetative cover. The area is inaccessible by automobile and wagon. Parts of it are inaccessible by horses at times, due to the severe gullying that is going on throughout the canyon.

In Shonto Canyon there is a combination of irrigated and

flood irrigated farming. This entire area can be reached by automobile except immediately after a flood. This canyon carries about $3/4$ second feet of water which is diverted by earth dams which flood out. At present this water is very poorly utilized. The land not irrigated is flooded by the flow of the wash. The farms are located in the bottom of Shonto Wash, where the water spreads over a large area but sometimes the flow shifts or gets extra large and crops are flooded out.

The farming in Klethla Valley is similar to the flood irrigated farming in Shonto Canyon. The farms are located on gully fans or in gully bottoms on the drainages from Black Mountain. In some instances the fans are building up and in others there is a tendency for the water to cut through. Both large and small flows are received on the farms. The soil deposits on the fans are favorable for farming and do not reduce the productivity of the land except for the amount of the crop it destroys. All of the farms are accessible by automobile.

The balance of the farming on this Unit is comprised of scattered farms which are usually located on sandy gully fans where too much water is not encountered.

The soil over the Unit is mostly favorable for farming but the available water supply is usually the limiting factor for agricultural development.

Cultural Practices:

The farming methods of the people within this Unit are mostly old fashioned. No large scale farming is found and the hand methods of producing crops are used. In most cases the agricultural crops are just a side issue and no real interest is taken in the crop production. In a few instances an effort is being made to maintain the farm land and protect it for future production but most farms are used just the way nature has provided them.

If a gully head cuts back through the farm and destroys it, the owner will move to a new location rather than try to maintain the old farm. This practice is probably more noticeable on this Unit where the farms were smaller and a small three or four acre farm would not mean much to a family when they could move to another place for growing their crops. It is true, however, that where irrigation water is supplied or where larger flood irrigated farms are located an effort is made to conserve the land.

The crops are produced almost entirely by hand. Sometimes the land is plowed but more often it is not. Planting is done entirely by hand. On the larger fields the horse drawn blade is used for cultivating and weeding, but the smaller fields are cultivated with the hoe. In the fall the crop is harvested by hand and what is not consumed is stored for winter. After the crop is harvested, livestock are allowed to run in the field and no work is done until the next spring, when planting time arrives.

Agricultural Land Classifications:

The farm land of this Unit is divided into three types:

(1) Irrigated land: This includes all farming done where permanent water is supplied for irrigation.

(2) Flood irrigated land: This includes all farming done where water is supplied to the farm from accumulated runoff from rains.

(3) Dry farming: This includes all farming done where no additional water is supplied to the farm other than the rainfall.

ACREAGE OF EACH TYPE OF LAND

Type of Land	Present Acreage	Potential Acreage
Irrigated	204	30
Flood Irrigated	840	210
Dry Farming	53	0
Total	1,097	240

The principal type of land found within this Unit is Flood Irrigated. This is accounted for by the facts that dry farming is not practical for this area and irrigation supplies are very limited, supplying only 204 acres.

Each type of land is classified according to the legend of land classification which is attached to this report, and the acreages are shown as follows:

ACREAGE ACCORDING TO EACH CLASS OF LAND

Classi- fication	Present Acreage				Potential Acreage			
	Class	Class	Class	Class	Class	Class	Class	Class
	A	B	C	G	A	B	C	G
Irrigated	189	14	0	1	10	20	0	0
Flood Irrig.	661	131	2	46	165	40	0	5
Dry Farming	0	50	3	0	0	0	0	0
Total	850	195	5	47	175	60	0	5

Agricultural Crops Produced:

The survey on this Unit was conducted during the main part of the growing season, which made it possible to determine very accurately the crops being grown.

In many instances two crops would be planted together. It was very common to find a small patch of melons, squash, or beans planted in with the corn crop. Areas of less than one-fourth acre were not reported.

Crop	Pres. Avg. Production	Exp'td Avg. Production
Corn	11 bu.	18 bu.
Squash	1000 lbs.	3000 lbs.
Peaches	75 bu.	250 bu.
Beans	150 lbs.	250-300 lbs.
Alfalfa	1.5 tons	2 tons
Oats (for hay)	1 ton	2 tons

It is expected that increased yields can be accomplished by the following:

1. More efficient use of the available water.
2. Crop rotation and soil fertility practices.
3. Contour listing, where the water is scarce, to reduce the runoff.
4. The introduction and use of ordinary farm machinery.
5. Fall plowing to reduce cutworm damage and conserve winter moisture.
6. Proper seed selection.
7. Proper seed bed preparation.
8. Planting at the proper time.
9. Proper cultivation practices.
10. Proper harvesting practices.

Suggested Crops:

Suggested crops will be about the same for the entire Unit. The principal variation will be in the type of land.

Corn is the primary crop recommended because it is most widely used and demanded by the Navajos. On the irrigated land a larger variety of crops could be produced and would probably be in great demand once the people got started growing them. Such crops as various garden vegetables, small grains and various fruits and berries could be grown on the irrigated farms in the canyons. Corn and squash are considered to be the best suited crops for the flood irrigated farms and when too much water is not encountered, small grains and beans would probably be very successful. Fall wheat could be grown to a good advantage at Shonto.

For suggested crops on individual fields, see the agronomy survey sheets attached to this report.

Agricultural Pests: (Weeds, Rodents, Insects)

Weeds: No large amount of harmful weeds were noticed on the farms of this Unit but in several places along Klethla Valley cockle bur was found to be very numerous, especially along the gullies. They are so located that the seed is carried on to the farm land and cause considerable damage to the crops where they are not cultivated out. The weeds are found around the edges where the cultivations do not reach and this provides a

constant seed source for the weeds to spread onto the cultivated portion of the field.

Various annual weeds are a constant menace to the farmers but they can be controlled by proper cultivation practices.

Rodents and Predators: Prairie dog infestations over most of the farmland are very light and found only in localized areas, principally south of Inscription House.

Kangaroo rats are present in fairly large numbers over practically all of the farmland and several complaints were made that these rodents ate the seed in the spring when it was planted. Control measures would probably help considerably to increase crop production where these rats are the most active.

It is also estimated that considerable damage is done to farm crops, on farms adjoining pinon and juniper areas, by squirrels, chipmunks, and miscellaneous mice but this damage is small compared to kangaroo rat damage.

Coyotes are found on this Unit in moderate numbers and several farm owners reported a little damage to their melon crops by these animals.

Insects: The principal insects which are causing damage to farm crops are the cutworm, army worm, and corn ear worm. A few grasshoppers were observed but no serious damage was found.

Control measures for the three above named worms would help considerably toward increasing crop production.

Agronomy Observations for Each Sub-unit
of Unit No. 2:

Unit No. 2 was divided into nine sub-units by the study group for the purpose of discussing the problems within smaller areas and to give special attention to locations where work is needed. The sub-units are shown on the map and numbered.

The following table shows the farms as they are divided into each of the sub-units:

Sub-unit	Quad No.	Location	Farm Numbers
1			0
2	91	110°45' x 37°15'	1, 2, 3
	92	110°45' x 37°00'	1, 1.1, 2, 3, 4, 5, 6, 7
	100	110°30' x 37°00'	12, 13, 14, 15, 16, 17, 18
	101	110°30' x 37°15'	4, 5, 6
3			0
4	100	110°30' x 37°00'	4, 5, 6, 7, 8
	101	110°30' x 37°15'	1, 2, 3, 7
5	92	110°45' x 37°00'	8, 9, 10, 11, 12, 13
	93	110°45' x 36°45'	37, 38, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 57, 58, 59, 60, 61, 66.
6	100	110°30' x 37°00'	1, 1.1, 1.2, 1.3, 1.4, 1.5, 2, 2.1, 3, 9, 10, 11
7	93	110°45' x 36°45'	14, 15, 19, 20, 21, 22, 23, 25, 53, 55, 56, 62, 63, 64, 65
	99	110°30' x 36°45'	27, 44, 45

developments which are very doubtful.

Sub-unit No. 2: Rainbow Plateau.

This sub-unit consists mostly of plateau, rolling hills, and canyons. About half of it is accessible by automobile and the balance can only be traveled by horse back or afoot. All of the farmland within this sub-unit is located approximately in the southern half.

There are 82 acres farmed at the present time, with seven acres of potential land:

12 acres are irrigated from springs.

67 acres are flood irrigated.

3 acres are dry farming.

The two irrigated farms, Nos. 5 and 6, Quad 101, are located in the lower part of Piute Canyon below small springs which supply them with irrigation water. The water is collected in small reservoirs and used as soon as the reservoir is full. These farms could be improved by constructing some more terraces and increasing the capacity of the reservoirs but no work was recommended because of their inaccessibility. A good variety of crops are being grown at the present time.

There is one other small irrigated peach orchard which gets its water from a stock reservoir. It is located southeast of Navajo Mountain (farm No. 3, quad 92). The trees in this tract should be pruned and cared for during the summer. From

Sub-unit	Quad No.	Location	Farm Numbers
8	93	110°45' x 36°45'	11, 12, 13, 154
	94	110°45' x 36°30'	23, 24, 28, 29, 48, 49
	98	110°30' x 36°30'	1, 3, 4, 5, 5.1, 6, 7, 8, 9, 10, 11, 12, 13, 13.1, 14, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32,
	99	110°30' x 36°45'	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 21.1, 22, 22.1, 23, 24, 25, 26, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56
9	98	110°30' x 36°30'	2, 15, 16, 18, 19, 20, 29

The following is a general agronomy inventory of each sub-unit:

Sub-unit No. 1: Cummings Mesa.

This sub-unit consists mostly of rough, broken, irregular country; varying from steep, inaccessible Cummings Mesa to many deep rough gullies. Rock outcroppings are very numerous and the large number of gullies make it very difficult to travel over. A small part of this area is used by livestock but most of it is waste land.

No farming is located in this sub-unit and, due to the inaccessibility of the area, no survey was made for potential

developments which are very doubtful.

Sub-unit No. 2: Rainbow Plateau.

This sub-unit consists mostly of plateau, rolling hills, and canyons. About half of it is accessible by automobile and the balance can only be traveled by horse back or afoot. All of the farmland within this sub-unit is located approximately in the southern half.

There are 82 acres farmed at the present time, with seven acres of potential land;

12 acres are irrigated from springs.

67 acres are flood irrigated.

3 acres are dry farming.

The two irrigated farms, Nos. 5 and 6, Quad 101, are located in the lower part of Piute Canyon below small springs which supply them with irrigation water. The water is collected in small reservoirs and used as soon as the reservoir is full. These farms could be improved by constructing some more terraces and increasing the capacity of the reservoirs but no work was recommended because of their inaccessibility. A good variety of crops are being grown at the present time.

There is one other small irrigated peach orchard which gets its water from a stock reservoir. It is located southeast of Navajo Mountain (farm No. 3, quad 92). The trees in this tract should be pruned and cared for during the summer. From

the indications the owner expected the farm to take care of itself and he would harvest the crop. No treatment was recommended on this field but the cultural methods should be improved.

The flood irrigated farms are somewhat scattered over the lower part of the sub-unit. They are all located along gully bottoms or on gully fans. Crops are raised quite successfully on the gully fans under the present system and if the owners will put in a few borders and ditches to help spread the water, their crops can be produced about as well as if expensive structures are put in. Where too much water is not expected, the farms can be improved by contour listing.

Sub-unit No. 3: Navajo Mountain.

This sub-unit is made up entirely of Navajo Mountain which is a steep, rough, heavily timbered mountain. No present or potential farming is located in this area.

Sub-unit No. 4: Piute Mesa.

This sub-unit is located in the northeastern part of Unit No. 2. It is made up mostly of rough canyons and mesas. There are a few roads accessible to automobiles but most of the area can be traveled over only by horses or afoot. The area in general is very rocky and a large percentage is waste land.

Farming is found in two general locations:

1. Along Nezki Wash on Piute Mesa.
2. In the head of Naka Canyon.

All of the farms in this sub-unit are flood irrigated.

The farms in Nezki Wash, Nos. 1, 2, and 3, comprise 46 acres of present land and 25 acres of potential. These farms are located in the bottom and along the sides of the wash. The water needs to be spread out more uniformly over the entire area but due to the fact that I saw a flood about three feet deep and 25 feet wide, pass over these farms, no subjugation recommendations were made. This flood is probably one of the extremes that happen very seldom. But the area is rather isolated and ordinarily a fair crop can be produced under the present conditions.

The farms in Nakai Canyon, Nos. 5, 6, 7 and 8, are not accessible by automobile. No. 5 is just a new farm that has been cleared and no crops produced as yet. None of the farms receive water from the main part of the canyon but they do get flood water from the side drainages. Farms Nos. 6 and 7 have been bordered to handle the flood water and no further subjugation work is recommended.

There is a permanent flow of water in this canyon but a diversion would be very expensive and there is not over forty or fifty acres of irrigable land.

Water spreading area No. 4, quad 100, is located on a large gully fan. The fan covers approximately one hundred acres but it is only recommended that about twenty acres of the best situated land be used for farming. The main drawback to

this area would be the danger of a break flood covering the area.

Sub-unit No. 5: Navajo Canyon.

This sub-unit consists of the major drainageways into Navajo Canyon and the canyon itself. The area is very rough and cut up by gullies, most of it inaccessible by automobile. All of the farming in this sub-unit is located in the canyons and is inaccessible by automobile. For this reason no work was recommended on these farms.

In all, approximately 115 acres are farmed at the present time and there are 14 acres of potential land. The type of farming is divided as follows:

51	acres	present	irrigated
54	"	present	flood irrigated
10	"	"	dry farming
10	"	potential	irrigated
4	"	d "	flood irrigated.

There are two general farming areas. The one is in the upper part of the canyon near Inscription House ruins, and the other is in the lower part of the canyon.

Three farms, Nos. 8, 9 and 13, located in the lower part of Navajo Canyon, quad 92, are irrigated from springs. No. 9 consisting of about 15 acres, is the largest. This farm could be greatly improved by erosion control protection to keep the flood water off the land and to check the head gullies which are

starting. It could also be improved by increasing the water storage but none of this work was recommended because of its inaccessibility. Farm No. 13 is similar to No. 9 except that it is smaller, consisting of about five acres. Due to its inaccessibility, no work was recommended.

Among the farms in the upper part of the canyon, only one is irrigated. This is farm No. 44. The flow of trail canyon is diverted by an earth diversion which floods out with a large flow of the wash. The farmland is bordered at present and fairly well taken care of. Corn and peaches are the principal crops grown. The acreage of this farm is about twenty acres of present land and five acres of potential. No subjugation work was recommended.

Tracts Nos. 42 and 60, quad 93, are the most important among the flood irrigated farms. Both of these farms are located in side canyons of the main part of Navajo Canyon. At the present time the water fans out over these farms but head gullies are cutting back and if they are allowed to keep on progressing, a channel will be cut so deep that the water will be unavailable for farming, but due to the inaccessibility of this area no recommendations were made, except that the Indians who own these fields endeavor to check the head erosion.

The balance of the flood irrigated farms are usually located on small gully fans and require no work. The dry farms found in this sub-unit are small and will only produce crops on

the more favorable years.

One of the outstanding needed improvements for this area is the exclusion of livestock from the drainage areas above the farm land. This would allow the vegetation to make a growth that would help protect the farmland against floods which destroy the crops and form gullies through the land.

Detailed soils and engineering maps have been made of the upper portion of this canyon where the main farming area is found, and they are filed with the Drafting Division.

Sub-unit No. 6: Piute Canyon.

This sub-unit comprises the Piute Canyon Demonstration Area. It is all in the head of Piute Canyon. Some of the best farms within the Unit are located in this canyon. The main drawback to this area is the fact that it cannot be reached by wagon or automobile. Due to this fact, any work that is done in the canyon is very expensive. It is for this reason that improvements which would ordinarily be recommended on accessible land, were not recommended on the farms in this canyon.

The estimated acreage for this sub-unit is shown as follows:

119 acres present irrigated

10 " dry farming

Some of the farms are supplied by water from small springs but the largest acreage is supplied with water from the two diversions in the canyon. Both of these diversions are small earth

dykes constructed by the Indians when they want to use the water. They flood out with each large flow of the wash, but they are easily reconstructed and work very successfully. Most of the land is fairly level and well adapted to farming.

✓ Head gullies, caused by excess flood water and waste irrigation water, are cutting into many of the farms in this area and they should be checked before severe damage results.

Potential land is extremely limited, due primarily to the fact that the canyon is narrow and bordered on each side by rocky cliffs. For this reason every effort possible on the Indians' part should be exercised to save the land they now have.

One big asset to this area is the fact that they have livestock exclusion. This gives the vegetation a chance to make a growth that will be of value as watershed protection.

Sub-unit No. 7: Inscription House.

This sub-unit consists mostly of rolling wooded hills and open, somewhat rolling plateau. Most of it is accessible by automobile. There is not such a large amount of farming but small farms are fairly well scattered over the entire sub-unit.

All of the farms in this sub-unit are classed as flood irrigated. They comprise a total of 98 acres of present land and 25 acres of potential land. Farms Nos. 15, 21 and 25 have received work recently by the Government. Nos. 15 and 21 have a system of dykes to spread the water and handle it from one

end of the field to the other. No. 25 has a partial diversion to take water out on two sides of the gully. But the land has not as yet been subjugated to its full extent. One tract is used at the lower end where the gully partially fans, but in order to use this diversion as it was intended, the farm should be relocated immediately below the diversion and bordered. All of the other farms in this sub-unit were located in gully bottoms or on gully fans and no additional work was recommended other than proper cultural practices.

Sub-unit No. 8: Shonto.

This sub-unit is different from the previous sub-units discussed in several respects. It consists mostly of rolling hills and plateau, and is all accessible by automobile. Farming is found well scattered over the entire area. Two noticeable concentrations were at Shonto and Klethla Valley.

Most of the farming in this sub-unit is flood irrigated. The acreages for each type are shown as follows:

21	acres	present	irrigated.
525	"	"	flood irrigated.
28	"	"	dry farming.
25	"	potential	irrigated.
121	"	"	flood irrigated.

No potential dry farming was recommended, due to the low annual rainfall.

This sub-unit contains the largest acreage of farmland and the largest number of farms. This is because there are more people in this sub-unit and the entire area is accessible to the people. This sub-unit and No. 7 are the only ones where any subjugation work can be recommended on the farm land. Practically all of the farms are either flood irrigated or affected by floods, with the exception of the few dry farms found within this sub-unit. The farms are usually located in gully bottoms or on gully fans.

The farms which it was considered advisable to recommend work on have been divided into six divisions as they are grouped and could be worked each as a unit. These divisions are listed as follows:

1. Farms 11, 12, 13, Quad 93, Badger Springs.
2. Farms 4, 5, 5.1, 6, 23, Quad 98, Klethla Valley.
3. Farm 14, Quad 98, Klethla Valley.
4. Farm 26, Quad 99, North of Shonto.
5. Farm 47, Quad 99, North of Shonto.

Details of the recommended work on these farms can be found in the list of priority projects where all of these farms are listed in their order of priority. None of the farms will require any large amount of work.

Sub-unit No. 9: Black Mesa.

This sub-unit consists of the country on top of Black Mesa.

The entire sub-unit is rough and mountainous. There are several roads through the area but the larger part of it is inaccessible by automobile. Very little farming is practiced throughout the area, which may be accounted for in two ways: First, the people do not live in this area much during the summer. Second, the area is rough and most of it can only be traveled over by horse-back. This makes farm locations scarce and difficult to operate.

In this sub-unit there are seven farms. Two of them are accessible by automobile and the other five are in Blue Canyon and cannot be reached by automobile. The total acreage of the farms in this sub-unit is shown as follows:

21 acres flood irrigated
3 " dry farming
3 " potential flood irrigated.

No subjugation work is recommended in this sub-unit.

The following table is compiled to show the acreage of each crop produced on each type of land by sub-units, also, the percentage of each crop that is produced by each sub-unit;

Sub-unit No. 1

No Farming
