SUB-WATERSHED PLAN

LAND MANAGEMENT UNIT NO. 17

NAVAJO DISTRICT, REGION EIGHT

SUBMITTED BY

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FD 200

SUB-WATERSHED PLAN

NAVAJO DISTRICT, REGION EIGHT

LAND MANAGEMENT UNIT NO. 17

INDEX

	Page
I. INTRODUCTION	1
II. DESCRIPTION OF UNIT NO. 17	2
A. Topography, Climate, Soils, Vegetation	2
Topography	2
Climate	4
Table I - Climatological Data	6
Soils	8
Vegetation	8
B. Degree and Cause of Erosion and vegetative depletion, etc.	9
Erosion and vegetative depletion	9
Runoff	10
Table II - Comparison of Water Supply with available Farmland	11
Table IIA - Run-off factors to be applied to areas in Acres	11A
Siltation	12
Flood damage and critical erosion areas	12
C. Land Use	12
Table III - Present Land Use - LMU #17	13
D. Land Status, Population, Nature of Human Dependency	13
Land Status	13
Population and Nature of Human Dependency	14
Table IV - Income for Unit 17	15
Table V - Per Capita Income	15
E. Land Management activities within the Unit	17
III. OBJECTIVES OF A PROGRAM FOR THE UNIT	17
IV. CONSIDERATIONS BASIC TO A PROGRAM FOR THE WHOLE UNIT	18
A. Need and practicability of adjustments in land-use and tenure	18
B. Need of further cooperative arrangements	19
C. Need of land acquisitions and recommendations for administration of acquired lands	20
D. The need of detailed study, field tests, etc.	20

FD 201

Page

E. Ability of individuals to cooperate ---------- 21

V. EROSION CONTROL MEASURES NOW IN EFFECT UNDER S. C. S. AND OTHER AGENCIES ---------- 21
A. Reference to work-area plans ---------- 21
B. Status of land-management and erosion-control 22
Table VI - Work completed in L.M.U. #17 ---- 23
C. Relation of present and proposed projects to the Unit as a whole ---------- 26
D. Personnel and Equipment in use ---------- 26

VI. PROPOSED PROGRAM ---------- 26
A. Proposals for land adjustment, acquisitions, etc. ---------- 26
B. Proposed Control Measures ---------- 26
1. Management ---------- 27
(a) Range ---------- 27
(b) Farm Management ---------- 27
(c) Irrigation ---------- 28
(d) Woodland Management ---------- 30
(e) Wildlife Management ---------- 32
(f) Roads ---------- 33
2. Supplemental erosion control and water conservation methods ---------- 34
Table VII - Work by Types Recommended for Immediate Work ---------- 35
C. Suggested priority of future work-areas, and reasons therefor ---------- 36
Table VIII - Description of Work Areas 36
(Immediate Work) ---------- 37
(Future Work) ---------- 40
(Indian Service Operations) ---------- 42
D. Future participation in the program ---------- 43
E. Estimated cost of S. C. S. part of the program 44
Table IX - Cost of Program - (Immediate Work) 45
- (Future Work) 47
F. Benefits to be derived ---------- 48

FD 202

APPENDIX I.

RANGE MANAGEMENT PLAN FOR LAND MANAGEMENT DISTRICTS 17 & 18

	Page
I. General Statement	1
Table I - Vegetative Types by Acreage and Carrying Capacity	2
II. Proper Class of Stock	2
III. Proper Numbers of Livestock	3
IV. Period of Use	4
Table II - Acreage, Carrying Capacity, and Recommended Use of Land Management Units 17 & 18	5
V. Distribution of Livestock	6

Livestock Water Maintenance and Betterment

Recommended Livestock Water Development

Desilting Plots Needed above Water Storages

FD 203

SUB-WATERSHED PLAN
NAVAJO DISTRICT
REGION EIGHT
LAND MANAGEMENT UNIT NO. 17

I. INTRODUCTION

For purposes of effective administration and land management, the Navajo and Hopi Indian Reservations, part of the Navajo District of the Soil Conservation Service, Region Eight, have been divided into eighteen units, each embracing an area of from about 600,000 to 1,400,000 acres in extent. To most effectively perform the soil and moisture conservation work on these lands, the United States Bureau of Indian Affairs and the Soil Conservation Service have planned a combined attack on the problem. A Memorandum of Understanding to this effect has been approved and signed by all required parties.

This report deals with Land Management Unit No. 17, an area of 1,164,874 acres, or about 1,820 square miles. The Unit is located in the south central portion of the Reservation on the head waters of two primary tributaries of the Little Colorado River, the Pueblo Colorado and Wide Ruins Wash. 990,474 acres of the Unit are in Apache County, Arizona, leaving 174,400 acres in Navajo County, Arizona. This is a very important Unit in which to plan soil and moisture conservation. The Unit lies in the upper reaches of the watershed and has many important values including watershed protection, range, timber and farm resources.

FD 204

At present, erosion is only slightly accelerated throughout much of the area. However, the area indicates that the continued mis-management of the resources subjects the entire area to consequent severe accelerated erosion.

II. DESCRIPTION OF UNIT NO. 17:

A. TOPOGRAPHY, CLIMATE, SOILS, VEGETATION:

Topography

The Defiance Plateau, largely capped by de Chelly sandstone and a shallow soil, forms a conspicuous part of the eastern part of the Unit. Starting at a height of nearly 8,000 feet in the northeast part of the Unit, the two main drainages, Pueblo Colorado and Wide Ruins Wash, run in a southwesterly direction and lose nearly 3,000 feet in elevation in the path across the Unit. Both are characterized by a well developed dendritic type of drainage on the plateau area and emerge into rather broad aluvial valleys at the western limb of the anticline. In the northwest corner of the Unit, the Balakai Mesa stands out prominently with a very high and steep escarpment facing Unit 10 on the east and the Steamboat Valley, a tributary of Pueblo Colorado, on the south. The Balakai Mesa is composed of the Mesa Verde and Menefee members of the Cretaceous formations. Lower members of the Cretaceous extend several miles south. These Cretaceous outcrops carry workable coal deposits in several places. The interior, western and southern part of the Unit, is characterized by rolling hills or relatively low, escarpment marked mesas.

FD 205

CV-6417-201 NN000589

The topography here still preserves the evidence of ancient Hopi lakes of Tertiary times. The lake deposits lie unconformable on a variety of formations from Dakota sandstone down to de Chelly sandstone or Moenkopi formations, depending on the locality. In many places these Tertiary deposits form the cap rock of the mesas. Present erosion conditions and silt accumulations are closely correlated with some of these ancient lake deposits.

The Pueblo Colorado expands into a rather broad valley in the vicinity of Kin-li-chee and Ganado, and for many miles dominates the surrounding landscape. A few miles south of Greasewood the river turns westward and enters Unit 7 through a narrow water gap. It leaves the reservation near Winslow and enters the Little Colorado under another name, Cottonwood Wash. Wide Ruins Wash, which drains the southern part of the Unit, enters the Little Colorado near Holbrook as Leroux Wash.

It should be mentioned that a small portion of the Chin Lee Valley is included in the northwest corner of Unit 17. Practically no drainage from this area reaches the Chin Lee Wash as it is retained in several natural lakes enroute.

Typical bad land areas are encountered in the southwest part of the Unit. Varicolored shales of the Chin Lee formation account for these beautiful, though barren, areas, which are known locally as a portion of the "Painted Desert".

A few of the volcanic necks of the extinct Hopi volcanic field extend into the Unit from the west. Volcanic ash is also an

FD 206

CV-6417-201 NN000590

easily distinguished feature of many water-transported Tertiary deposits which occur in the west and the southwest part of the Unit.

Climate

The climate is temperate and ranges from arid in the southwest to semi-arid in the north and east, and varies in regular conformity with differences in elevation. The maximum annual precipitation of fifteen to twenty inches and the shortest growing season, estimated to be about one hundred days, occur at the higher elevations up to 7,800 feet on the Defiance Plateau. The average annual precipitation and growing season in the southwest extremity of the Unit are about 9.25 inches and 155 days, respectively, at an elevation of about 5,100 feet.

From the standpoint of the dry-farming potentialities of the Unit, it is significant to note that at all stations in or near the Unit, 42% to 53% of the total annual precipitation falls during the growing season, and the first summer rains, starting in July, are the heaviest of those occurring in the growing season. Rains after the growing season are lighter. At higher elevations more moisture falls during the winter months. Individual rains in any one day may, of course, be much heavier than data indicate.

In these portions of the Unit where twelve or more inches of moisture fall in a year it should be feasible to engage in dry-farming. Uplands at such elevations usually support a Ponderosa

FD 207

CV-6417-201 NN000591

pine or mixed woodland type of vegetation, not juniper alone. At lower elevations, annual temperatures and evaporation losses are higher and soil moisture storage during the winter months is low. Therefore, natural precipitation must be supplemented by some form of irrigation. Moderate northwest winds, clear days, and cool nights prevail throughout the year. High wind velocities occur at irregular intervals during Spring months.

The accompanying table, No. 1, contains more detailed climatological data.

FD 208

CV-6417-201 NN000592

CV-6417-201

TABLE I

CLIMATOLOGICAL DATA (1)

Precipitation in Inches

Station	Length of Record In Years	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Chin Lee, Ariz.	20	.41	.52	.45	.44	.29	.46	1.92	1.44	1.02	.85	.41	.54	8.75
Holbrook, Ariz.	42	.62	.61	.60	.54	.27	.40	1.85	1.42	.94	.69	.72	.59	9.25
Keams Canyon, Ariz.	21	1.31	.95	.90	.66	.39	.27	2.41	1.81	.70	1.25	.70	1.08	12.43
Pinto, Ariz.	19	.91	.94	.77	.70	.29	.51	2.11	1.78	.91	1.09	.83	.99	11.83
St. Michaels, Ariz.	20	.96	.97	.95	.51	.58	.45	2.44	2.39	1.32	1.11	.68	1.01	13.15

Average Temperature in° F.

Chin Lee, Ariz.	17	27.3	33.6	40.7	48.0	57.5	67.6	73.3	71.2	62.7	50.8	38.9	27.6	49.9
Holbrook, Ariz.	40	32.8	40.0	46.0	53.3	61.1	70.3	76.0	74.8	67.6	55.0	43.3	33.8	54.5
Keams Canyon, Ariz.	16	30.4	34.2	41.7	48.6	55.5	65.1	71.0	69.1	62.2	51.2	41.1	30.3	50.0
Pinto, Ariz.	6	26.8	36.3	42.9	47.7	58.1	70.0	74.1	71.8	66.5	53.9	41.0	36.6	51.9
St. Michaels, Ariz.	20	26.2	31.4	38.3	45.8	53.4	64.4	69.2	67.4	59.1	47.6	36.9	27.2	47.2

FD 209

NN000593

CV-6417-201

CLIMATOLOGICAL DATA (Cont.)

Extreme Temperatures.

Station	Length of Record In Years	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		Annual
Chin Lee, Ariz.	17	65	69	80	85	95	103	102	99	94	90	78	65	Max.	103
	17	-27	-22	6	10	19	26	38	40	23	13	0	-27	Min.	-27
Holbrook, Ariz.	40	72	79	89	92	101	106	106	104	100	95	89	73	Max.	106
	40	-20	-10	7	13	21	31	42	40	27	15	-8	-21	Min.	-21
Keams Canyon, Ariz.	16	65	67	80	88	95	104	101	102	94	89	75	68	Max.	104
	16	-30	-5	-1	11	21	28	39	40	25	17	4	-18	Min.	-30
Pinto, Ariz.	6	65	73	78	92	92	108	107	101	96	92	78	67	Max.	108
	6	-24	-15	9	12	20	28	43	39	33	14	0	1	Min.	-24
St. Michaels, Ariz.	20	64	67	75	79	92	97	106	94	90	83	82	64	Max.	106
	20	-25	-17	-6	8	18	26	39	40	22	10	-2	-22	Min.	-25

-7-

		Frost Date		Length of Growing Season		
Station	Length of Period in Years	Avge. Date of Last Killing Frost	Avge. Date of First Killing Frost	Avge. Length Growing Season	Latest Killing Frost	Earliest Killing Frost
Chin Lee, Ariz.	18	May 27	Oct. 3	129	June 30	Sept. 12
Holbrook, Ariz.	42	May 4	Oct. 16	163	June 11	Sept. 22
Keams Canyon, Ariz.	19	May 19	Sept. 29	133	June 4	Sept. 13
Pinto, Ariz.	15	May 23	Oct. 12	142	June 16	Sept. 26
St. Michaels, Ariz.	21	May 21	Oct. 1	133	June 17	Sept. 12

(1) The above Climatological Stations, though not located within the Unit, are close enough to show indications of climate of the area. Holbrook and Pinto, Arizona, located to the south of the Unit, are comparable to the lower elevations of the Unit. St. Michaels and Keams Canyon are more comparable to the upper and medium elevations of the Unit.

FD 210

NN000594

Soils

About 82% of the soils in the Unit are residual from sandstone or shale and include miscellaneous rough broken and rough stony lands. Most of the upland soils are residual from sandstone and are more or less sandy, moderately to readily permeable, and productive within the limits imposed by the moisture supply. More than 250,000 acres, or slightly over 10% of all upland soils, however, are residual from shale and as a whole are moderately to slowly permeable. The upland soils are used almost exclusively for range or timber production and a very limited amount of dry farming. Those in the forest belt are neutral or slightly acid; others are calcareous and basic in reaction.

The valley fill soils are quite varied in all characteristics and represent a relatively small but agriculturally important group. They, as a whole, contain more soluble salts and more clay than upland soils, which are alkali free.

Those best adapted to irrigation actually constitute less than 1% of the total surface area of the Unit. Such soils have light or medium-textured, permeable surface soils, moderately permeable subsoils with a high water-holding capacity and good sub-drainage, and a low water soluble salt content.

Vegetation

Vegetation of Unit 17 is typical of the Upper Sonoran and Transition Zones. In the lower areas the principal vegetative cover comprises grassland, sagebrush, browse, and pinon - juniper woodland.

FD 211

CV-6417-201 NN000595

The areas to the north and east along Fort Defiance Mesa support typical Transition vegetation, being primarily coniferous timber. The following species are typical of the area:

GRASSES

Blue grama	(Bouteloua gracilis)
Galleta	(Hilaria jamesii)
Alkali sacaton	(Sporobolus airoides)
Sand dropseed	(Sporobolus cryptandrus)
Mountain muhly	(Muhlenbergia montanus)

SHRUBS

Big sage	(Artemisia tridentata)
Chamise	(Atriplex canescens)
Snake weed	(Chrysothamnus greenii)
Deciduous oak	(Quercus gambeli)
Mormon tea	(Ephedra spp.)
Cliff Rose	(Cowania stansburiana)

WEEDS

Russian thistle	(Salsola pestifer)
Croton	(Croton texensis)
Pingue	(Actinea floribunda)
Sunflower	(Helianthus spp.)

B. Degree and Cause of erosion and vegetative depletion, etc.

Erosion and vegetative depletion.

Erosion, especially sheet and gully, is present along the upper drainages of the Pueblo Colorado Wash in the vicinity of Cornfields, Canado and Kin-li-chee, and along the entire Wide Ruins and Klagetoh drainage. Over a large portion of the light textured soils throughout the remainder of the Unit, erosion may be classified as slight to moderate, but will increase if present

FD 212

CV-6417-201 NN000596

mis-management prevails over an extended period of time. The principal causes of the accelerated erosion lie in mis-management of farm, range, and forest soils. Improper handling of water on farm land, overuse of range resources, and clear-cutting of woodland areas, is seriously affecting the vitality of natural vegetation as an erosion preventative. Vegetative depletion has become very important along the Wide Ruins, Pueblo Colorado, and Steamboat Washes, especially around agricultural concentrations, and has resulted in the killing out of a large percentage of the perennial vegetation; in some cases, this being replaced by annual weeds and unpalatable grass and browse species.

Runoff

High runoff can be expected along the rocky soils of Fort Defiance Plateau. However, the light textured soils in the central portion of the Unit are highly permeable and little runoff can be expected. There are no gauging stations located within the Unit and runoff figures obtained have been based on estimates by measuring the various streams after floods, representing a rather mediocre method of obtaining runoff estimates but which are as nearly correct as can be obtained under the present conditions.

Table II graphically represents the annual water expectancy at various points throughout the Unit and the amount of water in relation to the amount of agricultural land. Table IIA explains the factors applied to the drainage areas to determine annual and maximum water expectancies in acre feet and second feet, respectively, varying on the physical nature of the watershed.

FD 213

CV-6417-201 NN000597

CV-6417-201

TABLE II

COMPARISON OF WATER SUPPLY WITH AVAILABLE FARM LAND *

LOCATION	WATER SUPPLY			FARM LAND			
	Annual Expectancy A/Ft.	Maximum Expectancy Sec/Ft.	Maximum Expectancy A/Ft.	Cultivated	Potential	Excess Water A/Ft.	Excess Land A.
Irrigated Land Ganado	2500		4400	341	800	400	
Quad #53 Farm #53,#54,#55	300	5000	1250	62	120		32
Greasewood	175	1870	470	325	70		[illegible]
Quad #53 Farm #17	900	9500	2375	97	130	453	
Proposed Project at Wide Ruins	870	14550	5640	41	200	145	
Kleg-e-toh Lake	940	11280	2820	279		100	
Kin-Li-Chee	Water supply exceeds available farmland. Is evident that no computation was made.			70			
Satan Butte Farms	530	6300	1600	147	64	100	

Note: The excess of 400 A. ft. of water at Ganado will be needed for privately owned land and should not be considered in the development of additional land for Indian use.

* The above table represents the calculated water expectancies at various projects located throughout the Unit and represent the best available information without proper gauging stations.

FD 214

NN000598

CV-6417-201

TABLE II-A
RUN-OFF FACTORS TO BE APPLIED TO AREAS IN ACRES *

Ft.	Drainage Area Acres	Run-off Max.	Factors Annual	Remarks
1	2,520		.496	15-25% slope, long narrow drainage, some rock, 1/2 to full stand pine.
2	9,540	.190	.10	5-25% slope, open through woodland to pine, sandy loam to clay loam, some rock exposed in upper regions, (very little).
3	2,220	.632	.186	0-15% slope, open to 1/2 woodland, sandy loam to clay loam. Broad open drainage.
4	57,300	.075	.026	10-45% slope, light soil to rock outcrop. Woodland to pine. Variety of conditions. Large fan shaped area.
5	133,600	.150	.086	10-45% slope, open through woodland to pine. Broad open drainage. Variety conditions.
6	12,800	.582		10-45% slope, woodland to pine. Rock to sandy clay loam. Variety of conditions.
7	13,800		.152	5-30% slope, open to dense woodland destroyed by storm but still standing, pine at extreme head. Sandy loam.
8	4,560	.67	.270	10-25% slope. Open to scattered woodland. Sandy loam, some rock outcropping. Variety of conditions.
9	16,100		.278	Steamboat area. Largely open to woodland, 5-45% slope, sandy loam to clay. Variety of conditions. Taken inside area.
10	27,300	.340		Same as above only taken outside area. Based on waterway of bridge over wash.

*The above estimates are based on measurements of streams after floods in order to obtain some kind of an estimate on the annual and maximum expectancy of runoff.

FD 215

NN000599

Siltation.

The active sheet and gully erosion along all the major drainages, especially in the upper watershed, furnish large amounts of silt and cause severe siltation problems in the central and lower part of the drainages. Valuable agricultural and range lands are being severely affected by the deposition of silt along alluvial fans in the lower portion of the drainage.

Flood damage and critical erosion areas.

Damage to roads, agricultural land, and property is an important factor in view of the summer floods which occur in the area. A proper soil and water conservation program would tend to reduce damages from floods by obtaining a slower runoff.

The critical erosion areas within the Unit lie along the principal drainages. The area above Kin-li-chee is perhaps the most important, and areas around Ganado, Cornfields, Greasewood, Steamboat, Wide Ruins, and Tanner's Spring, constitute areas where erosion is in a critical state at the present time, and furnish large quantities of silt and flood water during the rainy season.

E. Land Use. (See Table No.III).

Of the 1,164,837 acres comprising Unit 17, 3956 acres are cultivated, 61,377 acres are waste or barren land, 590,509 acres are forest and woodland, and the remaining 572,770 acres are range lands.

FD 216

CV-6417-201 NN000600

TABLE III

PRESENT LAND USE - L. M. U. #17

Land Use		Acres	Per Cent Area
Range Land		572,807	49.17
Forest	Coniferous	109,637	9.41
	Woodland	380,872	32.70
Cultivated	Irrigated	341	.03
	Flood Irrigated	3,100	.27
	Dry Farmed	515	.04
Waste and Barren Land		61,377	5.27
Demonstration Areas		36,225	3.11
	TOTALS:	1,164,874	100.00%

Of 3,956 acres of cultivated land within the Unit, 8 per cent is irrigated, 78 per cent flood irrigated, and 13 per cent dry farmed.

Agriculture is concentrated at Ganado, Klagetoh, Cornfields, Greasewood, Satan Butte, Wide Ruins, and Kin-li-chee. There are numerous small tracts scattered throughout the Unit.

D. Land Status, Population, Nature of Human Dependency.

Land Status

The following table gives a summary of land ownership.

FD 217

CV-6417-201 NN000601

LAND STATUS - L. M. U. #17

Status	Acres	Per Cent Area
Tribal Land	1,157,159	99.34
Indian Allot.	4,705	.40
Private Land	3,030	.26
TOTALS:	1,164,874	100.00%

Map No. 1 shows the location and extent of the different classes of land ownership.

Population and Nature of Human Dependency.

Unit 17 is densely populated as compared to the rest of the reservation, having an average of two people per square mile, or a total of 5,700 in habitants comprising 525 consumption groups with an average size of 7 people each.

Valuable range, timber, and agricultural resources with available livestock water, irrigation supplies, and fuel wood have been contributing causes to the concentration of population.

Income is derived from livestock, wages, agriculture, miscellaneous which includes some $64,000.00 for the sale of pinons and rugs in the order named as shown on Table IV.

FD 218

CV-6417-201 NN000602

TABLE IV

INCOME FOR UNIT 17

Item	Commercial	%	Non-Commercial	%	Total	%
Wages	133,900.00	36			133,900.00	25
Livestock	127,700.00	34	54,110.00	32	181,810.00	34
Agriculture	5,560.00	1	114,300.00	68	119,860.00	22
Miscellaneous	69,180.00	19			69,180.00	13
Rugs	36,150.00	10			36,150.00	6
TOTALS:	372,290.00	100	168,610.00	100	540,900.00	100

The relative importance of various sources of income is shown in the per capita break-down. Unit 17 has a per capita income slightly above average for the reservation as a whole. (1)

TABLE V

PER CAPITA INCOME

Nature of Income	Income Per Capita	
Livestock	$ 49.15	
Agriculture	32.40	
Rugs	9.77	
Miscellaneous	18.70	
Excluding Wages		$ 110.02
Wages	36.20	
Including Wages		$ 146.22

(1) The per capita figures show the same general relationship to income from the various sources as Table IV.

FD 219

CV-6417-201 NN000603

In comparison with Unit 18, wage work is relatively lower due to the fact that the Unit is located farther from work centers, Fort Defiance and Window Rock. Relatively less agricultural land is allowed to remain idle which is shown in the fact that only 160 acres of the 3,956 acres cultivated, or less than 5%, were reported idle.

Timber resources in the area have not been developed. Some 75,000 or 100,000 acres of coniferous timber afford commercial logging possibilities. Plans are now being prepared by the Indian Service for commercial utilization of the area on a sustained yield basis, the proceeds to be diverted to tribal needs. Such utilization will materially increase the present income from forest resources which now embrace only fuel, posts, hogan material, and sale of pinon nuts, the latter comprising a source of cash income, and pinon nuts for home consumption.

Of the $193,000.00 of food purchased from the trader, 97%, $188,000.00, was imported into the district from outside the reservation. Nearly one-half of these imports were of staple foods such as potatoes, beans, fruit, onions, etc., that could be produced within the area under improved farming conditions and cultivation of additional land. Soil and moisture conservation on farmland is well justified in that so much of the population is dependent upon this source of income.

FD 220

CV-6417-201 NN000604

E. Land Management activities within the Unit.

Land management activities within the Unit at present include:

1. Ganado, Steamboat, and Klagetoh Demonstration Areas, Soil Conservation Service.
2. Kin-li-chee, Ganado, Cornfields, and Klagetoh irrigation projects - Irrigation Service.
3. Numerous truck trails and water developments. E. C. W.
4. One Irrigation Foreman.
5. One District Supervisor and Three Range Riders.

III. OBJECTIVES OF A PROGRAM FOR THE UNIT.

Objectives for a program for land management, Unit 17, listed in approximate order of priority: (1)

1. To reduce the present soil and moisture wastage due to severe gully and sheet erosion present over a large portion of the Pueblo Colorado and Wide Ruins drainages in the vicinity of Kin-li-chee, Ganado, Steamboat, Greasewood, and Tanner's Spring.

2. To establish and maintain an adequate vegetative cover through stock control over the entire area and revegetation of approximately 2,000 acres near Cornfields, planting windbreaks effecting 10,000 acres at Cornfields, Greasewood, Wide Ruins and Ganado, and improved range and farm practices over the entire area.

FD 221

CV-6417-201 NN000605

3. To obtain proper management of natural resources, thereby increasing yields on range, farm and timber lands.

4. To establish proper land use by retiring from cultivation sub-marginal agricultural land, and cultivated lands on excessive slopes throughout the Unit, and revegetation of retired acreages to natural cover or pasture.

5. To obtain more economic use of agricultural resources through improved methods of irrigation, water conservation on 3,925 acres of farmlands, harvesting, storing, and marketing of agricultural products.

6. To reduce harmful siltation of 17 stock water reservoirs by the construction of desilting plots.

7. To reduce the silt load of the Little Colorado and Chin Lee stream channels through protection of the upper watersheds.

8. To reduce flood hazards and flood damage endangering 3,925 acres of agricultural land throughout the area by maintaining adequate vegetative cover

(1) The above will improve human conditions by stabilizing resources upon which the inhabitants are dependent and will improve the wildlife and recreational values of the land.

IV. CONSIDERATIONS BASIC TO A PROGRAM FOR THE WHOLE UNIT.

A. Need and practicability of adjustments in land-use and tenure.

Present land-use involving timber, woodland, grass land, and farm resources under proper management will assure a normal

FD 222

CV-6417-201 NN000606

return with the exception of sub-marginal agricultural land now farmed, and an additional acreage of cultivated land on excessive slopes, the amount and location of which will be located by further investigations. These acreages should be retired from cultivation and revegetated with natural cover so that soil and water wastage will be reduced.

Exclusion of grazing on timber land is not at present warranted.

Little is known of the basis of land tenure as recognized by the Indians on the Reservation at the present time. Further information is necessary in order to determine the amount of land controlled by certain individuals and measures which should be taken to secure a more equitable and beneficial distribution of land resources. This will be especially important in obtaining livestock distribution in areas of concentrations where a large number of small bands are grazed, since small operators will not be materially affected by stock adjustments.

B. Need of further cooperative arrangements.

The tribal land in the Unit (38%) and patented Indian allotments (4,700 acres) will be administered under the direction of the Indian Service by the provisions of the Memorandum of Understanding.

Agreement with Indians when contributions of labor and teams is held a part of the project will present the only need of future cooperative arrangements.

FD 223

CV-6417-201 NN000607

C. Need of land acquisitions and recommendations for administration of acquired lands.

Approximately 2,560 acres of land belonging to the railroad company are to be reconveyed to the Government in accordance with the Act of Congress, June 14, 1934, and will be administered by the Indian Service. Control of the remainder of private land (480 acres) in scattered tracts will not be necessary unless they are found to be located at points where their control is essential for the success of various projects. Control of the latter can best be obtained through easements.

D. The need of detailed study, field tests, etc.

Further surveys for study are needed in order to determine:

1. The ownership and status of 160 acres of present idle land and its relation to the need and practicability of developing new agricultural land.
2. Proper timber management and to improve utilization of forest products and to establish appropriate grazing periods on timber land.
3. Proper adjustment of livestock numbers and seasonal use between Land Management Units 17 and 18, and between these two units and areas lying outside the Reservation.
4. The cooperative ability of the agricultural operators in the area to carry on farm practices which will conserve soil and moisture.
5. The place of commercial agriculture and human depend-

FD 224

CV-6417-201 NN000608

ency in the Unit and its relations in the program for agricultural development.

6. The present agricultural land on excessive slopes that should be retired, and to determine such compensatory land use adjustments as may be necessary.

7. The number of families residing outside the reservation that are to be moved in to lieu selections in accordance with the Act of Congress, June 14, 1934.

8. Areas of the most critical road-induced erosion.

In addition to the above, detailed soil surveys are needed in connection with mechanical treatment and plans for carrying on immediate work projects.

E. Ability of individuals to cooperate.

The inhabitants of the area are Indians. The cooperation that can be expected will not exceed 50 per cent of the labor on the various projects and should be in proportion to the benefits derived. Cooperation can be expected to a greater extent in the agricultural areas than elsewhere within the Unit.

V. EROSION CONTROL MEASURES NOW IN EFFECT UNDER S. C. S. AND OTHER AGENCIES.

A. Reference to work-area plans.

Plans completed within the area have considered the more critically eroded portions of the Unit including Ganado, Steamboat,

FD 225

CV-6417-201 NN000609

and Klagetoh Demonstration Areas, critical erosion along the principal roads, and allied projects. The plans that are submitted in this report embrace the area as a whole and outline projects which remain to be done to establish soil and moisture conservation within the area.

B. Status of land-management and erosion-control.

Table VI shows the types of work completed in the area by the various agencies.

FD 226

CV-6417-201 NN000610

CV-6417-201

TABLE VI

WORK COMPLETED IN L. M. U. #17

(a) By S. C. S.

TYPE	LOCATION	COST	
Channel Improvement	Ganado Demonstration	$ 630.69	$ 630.69
Gully Control	Klagetoh Special Area	8,364.94	
	Steamboat Cooperative Area	41,229.77	
	Above Reservoirs	1,040.10	
	Ganado Demonstration	1,931.03	
	Kin-li-chee Special Area	6,370.27	
			58,936.91
Roadside Gully Control	Ganado - Chambers Highway	9,832.59	
	Ganado - Steamboat Road	4,283.50	
	Ganado Demonstration Area	103.90	
	Steamboat Cooperative Area	98.78	
	Sunrise Roads	4,653.79	
	Klagetoh Highway	1,118.64	
			20,031.30
Farm Improvement	Ganado Demonstration	211.59	
	Klagetoh Area	1,065.20	
	Steamboat	132.65	
			1,409.44
Water Conservation	Ganado Demonstration Area	13,476.58	
	Cornfields	1,586.30	
	Kin-li-chee Special Area	477.15	
	Steamboat Demonstration Area	5,249.37	
			20,789.41

227

NN000611

CV-6417-201

TABLE VI

WORK COMPLETED IN L. M. U. #17

(a) By S.C.S. (Cont.)

TYPE	LOCATION	COST	
Fencing	Ganado Demonstration Area	$13,620.08	
	Klagetoh	1,981.91	
	Greasewood Day School	651.29	
	Pit Springs	640.89	
	Wide Ruins Day School	351.69	
	Steamboat Demonstration Area	5,173.04	
	Steamboat Day School	119.39	
	Kin-li-chee Day School	178.30	
			$22,696.59
Desilting above Tanks	Klagetoh	2,539.22	
	Ganado Demonstration Area	147.79	
	E. C. N. Tanks	1,896.36	
			4,583.37
Seed Collection	Ganado Demonstration Area	54.83	
			54.83
Revegetation	Ganado Demonstration Area	1,519.03	
	Steamboat Cooperative Area	572.46	
	Klagetoh	315.60	
			2,407.09
Bank Protection	Ganado Demonstration Area	4,026.16	
	Klagetoh	79.74	
			4,105.90
	GRAND TOTAL:		$135,645.53

ID 228

NN000612

TABLE VI

WORK COMPLETED IN L. M. U. #17

(b) By U.S.I.I.S. AND P.W.A.

		COST
IRRIGATION RESERVOIRS		
Ganado		$64,102.11
Kin-li-chee		12,330.13
Klagetoh		22,555.21
Cornfields		589.45
STOCK WATER		
4 Reservoirs	Entire Unit	
12 Springs	Entire Unit	
51 Wells	Entire Unit	

(c) By E. C. W.

TRUCK TRAILS

Summit to Klagetoh	15	Miles
Nazlini to Fluted Rock	10	"
Nazlini to Ganado	16	"
Southwest of Sunrise	3	"
Klagetoh to Greasewood	27	"
Fluted Rock to Summit	15	"

FIRE LOOKOUT - Klagetoh

SILT BARRIERS - 3 at Kin-li-chee Wash
4 at headwaters

STOCK WATER

55 Reservoirs	Entire Unit	$110,217.53
12 Springs	Entire Unit	4,812.15
25 Dug Wells	Entire Unit	7,575.05
13 Drilled Wells & Storage	Entire Unit	53,860.48

FD 229

CV-6417-201 NN000613

C. Relation of present and proposed projects to the Unit as a whole.

Projects which have been completed or are planned for the Unit have been recommended for consideration in view of soil and water conservation for the area as a whole. Steamboat and Canado Demonstration Areas, including 54,000 acres, are located at the top of critical watersheds and serve as demonstration of properly controlled watershed areas. Roadside gully control and other projects have demonstrated the necessity and desirability of such treatment. Although these acreages are small in relation to the Unit as a whole, they should serve as focal points for dissemination of knowledge as to proper land-use resulting in soil and moisture conservation.

D. Personnel and Equipment in use.

At the present time no crews are working within the area and very little equipment is present, however, with the general location of the area, any equipment that is needed for work projects can be moved from Gallup and vicinity. There are four senior foremen of labor that have been assigned to work in Land Management Units 17 and 18. Work projects in the area will not be held up because of lack of equipment or personnel.

VI. PROPOSED PROGRAM

A. Proposals for land adjustment, acquisitions, etc.

1. Adjust range use between Units 17 and 18 in accordance with the Range Management Plan.

FD 230

CV-6417-201 NN000614

2. Obtain control of such private lands as are necessary for the success of work projects.

3. After stock adjustment, establish proper balance between range sub-units.

4. Develop the use of timber resources more fully, depending on results of stock reductions.

5. Retire sub-marginal cultivated land and land on excessive slopes, the amount and location of which will be determined by further studies. Cultivate present idle land, (160 acres), in preference to the development of potential land, (1,750 acres), if the problem of land tenure can be successfully handled.

6. Acquire control of 2,560 acres of railroad land and such other private land as is required for the success of projects.

B. Proposed Control Measures.

1. Management

(a) Range

1. Adjust stock to carrying capacity in accordance with the Range Management Plan of Units 17 and 18.

2. Use the range areas during the proper season as established in the Range Management Plan.

FD 231

CV-6417-201 NN000615

3. Obtain distribution of livestock equitable to the distribution of range resources by proper herding, salting, and development and maintenance of livestock water supplies.

4. Improve animal husbandry practices.

(b) Farm Management.

1. Improve 3,925 acres of marginal farm land by rearranging fields and introducing and encouraging improved cultivation practices.

2. Retire from cultivation and revegetate submarginal land and cultivated land located on excessive slopes which present erosion hazards.

3. Improve farm practices by:

((a)) Improving border and furrow irrigation methods now employed on approximately 800 acres of irrigated farmland at Canado and introducing similar methods on farms where they are not now used.

((b)) Strip-cropping with small grains or grasses as sheet erosion control measures and encouraging fall listing as a water conservation and wind erosion control measure on 400 acres of dry land farms scattered throughout the area. Listing should be encouraged

FD 232

CV-6417-201 NN000616

in preference to plowing.

((c)) Encouraging contour farming wherever feasible, arranging crops in strips in conjunction with terraces or borders.

((d)) Introducing and encouraging the use of adaptable and improved varieties of seed, certified against noxious weeds, encouraging seed selection for increased yields and crop improvement, and encouraging crop suitable for human consumption.

((e)) Encouraging farming of present idle land.

((f)) Following practice of leaving crop refuse on the field in the form of high stubble as a soil and moisture conservation measure.

((g)) Introducing improved horse-drawn farm equipment.

((h)) Introducing methods of storage to conserve crops for winter use.

FG 233

CV-6417-201 NN000617

(e). Irrigation

Regular irrigation systems are in operation at Kin-li-chee, Ganado, Klagetoh, and Cornfields. Water storage is provided at Ganado and Klagetoh.

The system of storage at Ganado is unique. There are two reservoirs involved. The larger, with a capacity of some twenty-five hundred acre-feet, is situated in a small side basin to which a control dam on the main Pueblo Colorado wash diverts water to the reservoir. The Indian Service attendant operates the diversion so that the floods of high silt content are passed down stream, and the more normal run of "good" water is taken into the reservoir.

The second reservoir is located on an important tributary of the Pueblo Colorado, a mile or two above the larger reservoir. It acts as an equalizing and desiltin reservoir. Water accumulations in the upper reservoir are drawn off to the lower one so that at all times there is adequate equalizing storage available for new floods.

At present a little less than 600 acres are irrigated, but the storage water supply and available land practically assure that this amount can be more than doubled. Supervision of irrigation farming is a prerequisite to expansion. This service is being increased so there is a chance for expansion in the immediate future. Land preparation will have to precede this expansion.

Storm water from surrounding hills is a menace to canals and irrigated fields. This is a desirable site for an erosion control project on farm lands.

FD 234

CV-6417-201 NN000618

At Kin-li-chee erosion control, especially gully control, is a more important factor in the future operation of the irrigation project than at any of the other irrigation projects in the Unit. Only part of the system is working now because of the extreme proportions of gully erosion. Plans to cover an adequate distribution system, land preparation, and erosion control should be made together if this project is to be "put on its feet".

At Klagetoh, farm lands and canals need protection from the floods from side drainages. Additional preparation of land for irrigation farming is needed.

There are large quantities of water in the Wide Ruins drainage, below the Klagetoh irrigation project, which can be put to profitable irrigation use as soon as erosion control on watershed and along stream channels has stabilized the main water course and removed the silt hazard.

At Cornfields the project is struggling against the wild Pueblo Colorado. The heavy silt flows and the flashy nature of the streamflow have made it difficult to maintain headworks at the diversion site and to keep the canals from becoming silted.

Cornfields is typical of the Pueblo Colorado river valley below Ganado for many miles. Herein lies the greatest chance for irrigation expansion in Unit 17, as soon as erosion control on the drainage higher up will make it possible to control the water for use on these valley lands.

FD 235

CV-6417-201 NN000619

(d) Woodland Management.

A large portion of Unit '7 lying in the north and east portions is covered with pinon-juniper woodland and coniferous timber, furnishing a valuable natural resource in fuel, posts, hogan material, and commercial timber. Production and beneficial use of this natural resource involves:

1. Maintenance of adequate fire supression and fire protection systems throughout the area, including maintenance of fire roads and trails, and employment of necessary personnel required for look-outs and fire fighting crews.
2. Reduction of fire, and insect and fungi infestation hazards insofar as possible.
3. Reduction of stock to carrying capacity and obtaining proper distribution and seasonal use that will result in the minimum damage to reproduction in forested areas.
4. Cutting and marking of timber in commercial areas in accordance with general plans to be prepared by the Woodland Management Section in conjunction with the Indian Service, such plans to be dependent upon a policy and program formulated for the timber resources of the reservation as a whole. The collection

FD 236

CV-6417-201 NN000620

of data for the formulation of such a program will be completed in the near future and a program outlined.

(e) Wildlife Management

Any problem of soil and moisture conservation will benefit and improve the habitats for wildlife. Fenced plots around reservoirs will mean an additional area for feeding and resting places for birdlife and game in general. Plans put into effect by the various divisions can, with slight modification, be fitted in to a program for the betterment of wildlife conditions. Such modifications when warranted can best be worked out during field surveys. The following recommendations for wildlife management are made:

1. Game species

Game species aside from mourning doves are absent. When conditions are sufficiently improved by proper management of range resources and supplemental planting, scaled quail may be planted in favorable places along Wide Ruins Wash and below Ganado. Other introductions will be in limited numbers as local conditions permit.

2. Rodent Control

160,000 acres of Rodent Control for initial treatment and 150,000 acres for re-treatment, is recommended on range land at a cost of $16,000. and $12,000. respectively. Rodent control should precede planting provided there is a severe rodent infestation in the area involved, and should cover from 500 to 1,000 acres around

FD 237

CV-6417-201 NN000621

each planting site depending upon local conditions. Mechanical structures should be protected from possible loss through rodents by affecting rodent control in the immediate vicinity in approximately 2,000 acres around each area treated. Approximately 25,000 acres should be treated around planting sites and areas involving mechanical treatment at a cost of $5,500.00. Rodent control on farmland is recommended for approximately 75,000 acres at a cost of $11,250.00, as follows:

Greasewood	10,000	Acres
Cornfields	8,000	"
East of Steamboat D.A.	8,000	"
Wide Ruins	12,000	"
Klagetoh	4,000	"
South of Nazlini	5,000	"
Sunrise	2,000	"
Ganado	16,000	"
Northeast of Klagetoh	10,000	"

In this way, farming will be protected from severe losses sustained by rodent damage to crops.

(f) Roads

In the area there are approximately 1,650 miles of existing and abandoned roads that are presenting an erosion hazard by the formation of gullies. The principal roads of the area should be maintained in such a way as to reduce erosion hazard by installation of water turnouts, grade stabilizers, and rock checks on the more severe gullies. Abandoned roads or secondary roads should be provided with sufficient grade stabilizers and turnouts so as to prevent the concentration of water with subsequent washing and

FD 238

CV-6417-201 NN000622

gully formation. The location of the more critical road induced erosion will be determined by further studies.

2. Supplemental erosion control and water conservation methods.

In addition to the management measures previously discussed, supplementary structural treatment is required in certain portions of the Unit. The types of treatment proposed are listed below. The order of listing indicates only roughly the extent to which each method will be used: land use adjustment, cooperative ability on the part of the Indians, progress of the stock reduction program, and certain policy determinations yet to be made with regard to much of the work on agricultural land will probably necessitate the reconsideration of certain proposed treatments. For similar reasons it is extremely difficult to determine at this time the relative extent of the various treatments in future work. The following list covers only the immediate work projects, and shows the relative expenditures on the various types of supplementary erosion control structures:

FD 239

CV-6417-201 NN000623

TABLE VII

WORK BY TYPES RECOMMENDED FOR IMMEDIATE WORK

For Immediate Work		Estimated Cost
Earthwork dikes, dams, diversions, to protect head cuts		$10,500.00
Fencing:		
Desilting plots (1,060 acres, 17 plots)	$6,240.00	
Water spreading areas	2,100.00	8,340.00
Livestock Water:		
Development	3,475.00	
Maintenance and Betterment	9,010.00	12,485.00
Water Spreading		1,100.00
Gully Control:		
Brush work	2,650.00	
Log and rock drops and checks	3,415.00	
On abandoned roads	4,500.00	10,565.00
Silt Barriers		10,000.00
Rodent Control		44,500.00
Contour Furrowing		1,000.00
Planting and Revegetation		12,500.00
Broad-based terraces on farmland		2,000.00

G. Suggested priority of future work-areas, and reasons therefor.

The following tables list in order of priority the future work areas:

FD 240

CV-6417-201 NN000624

The following gives a description of work areas listed for immediate, future, and Indian Service Operations:

TABLE VIII

DESCRIPTION OF WORK AREAS (IMMEDIATE WORK) *

(Based on order of proposed surveys)

PROJECT	AFFECTED ACREAGE	RECOMMENDED TREATMENT	REMARKS
(1) Abandoned and Present Roads (300 miles)	25,000	Turn outs, Dikes, Grade Stabilizers, Small spreaders.	Of the 1,650 miles of roads presenting serious erosion hazard, 300 of the more critical portions can be selected.
(2) Canado Farming Area	350 A. Farm 2,000 A. Range	Flood control and Erosion control on and adjacent to farmland and irrigation system. Gully planting.	This rather stable farming area is in need of serious consideration in order that serious soil and water wastage is reduced.
(3) Dry Farms	400 Cultivated	Broad-based terraces, Head cut Protection, etc.	These are scattered farms on higher elevations and should be treated for soil and moisture conservation.
(4) Livestock Water Maintenance and Betterment	Entire Unit	Maintenance and betterment of 49 reservoirs, springs and wells.	Needed in order to establish livestock distribution over the area.
(5) Desilting Plots	Entire Unit	Fence 17 desilting plots above stock tanks to prevent harmful siltation.	These vary in size from 40 to 100 acres each. 1,062 acres are to be fenced.
(6) Livestock Water Development	Entire Unit	Develop 5 supplies - 1 reservoir, 2 shallow wells, 2 springs.	Needed to obtain proper livestock distribution.

FO 241

CV-6417-201

NN000625

CV-6417-201

TABLE VIII
DESCRIPTION OF WORK AREAS (IMMEDIATE WORK)

(Based on order of proposed surveys)

PROJECT	AFFECTED ACREAGE	RECOMMENDED TREATMENT	REMARKS
(7) Water Spreading Thief Mt.	1,400	Diversion, spreaders, fencing, possible revegetation.	Water Conservation Erosion Control. Fencing in order to obtain control.
(8) Silt Barrier Steamboat		Silt Retention, Soil Conservation. Experimentation.	Location to be determined and plans prepared.
(9) Rodent Control	410,000	Initial Treatment 160,000 A. Retreatment 150,000 A. Around Farms 75,000 A. Around Structures and Planting 25,000 A.	Severe losses are being sustained through rodent damage in these areas.
(10) General Erosion Control Canada Vicinity	8,000 Range	Gully control, small spreaders, brush and rock gully plugs. Revegetation.	To be done only if reasonable assurance of range control.
(11) General Erosion Control Steamboat Vicinity	1,600 Range	Gully control, small spreaders, rock and brush work, revegetation. Head cut protection.	To be done only if reasonable assurance of range control.
(12) General Erosion Control Greasewood Area	1,400	Gully control, small spreaders, rock and brush work, revegetation. Head cut protection.	To be done only if reasonable assurance of range control.
(13) Tanner Spring Vicinity	2,800	Gully control, small spreaders, rock and brush work, revegetation. Head cut protection.	To be done only if reasonable assurance of range control.

FD 242

NN000626

CV-6417-201

TABLE VIII

DESCRIPTION OF WORK AREAS (IMMEDIATE WORK)

(Based on order of proposed surveys)

PROJECT	AFFECTED ACREAGE	RECOMMENDED TREATMENT	REMARKS
(14) Kin-li-chee Farming Area	155 A. Farm 750 A. Range	Head cut protection. Subjugation (to be done by U.S.I.S.)	These flood irrigated Farms are being fast destroyed by head cuts.
(15) Canado Flood Irr. Farms	10	Head cut protection. Subjugation (to be done by U.S.I.S.)	These flood irrigated Farms are being fast destroyed by head cuts.
(16) Balakai Mesa Farms	11	Head cut protection. Subjugation (to be done by U.S.I.S.)	These flood irrigated Farms are being fast destroyed by head cuts.
(17) Klagetoh Farms	3	Head cut protection. Subjugation (to be done by U.S.I.S.)	These flood irrigated Farms are being fast destroyed by head cuts.
(18) Windbreak Planting	10,000	Planting windbreaks as erosion control measure.	At Wide Ruins, Greasewood, Cornfields, and Satan Butte Farms.

FD 243

NN000627

•Demonstration areas located in Unit 17 bear an important place in the program for soil and water conservation throughout the entire area by demonstrating proper land-use on approximately 40,000 acres. At the present time, approximately $6,000.00 maintenance on structures at Canado and Steamboat Demonstration Areas is needed. Such work would replace the structures which were washed out by floods last rainy season.

In addition to this maintenance the demonstration of proper range management and animal husbandry practices is to be carried out at Canado and Steamboat Demonstration Areas entailing the employment of sheep herders, camp tenders, and sheep shearers, used in connection with the handling of 900 sheep at Steamboat and 400 at Canado. The cost of range management and animal husbandry practices is estimated at $4,000.00. Incidental expense in connection with sheep production in providing demonstration include the maintenance of corrals, the purchase of ear tags, branding fluid, and such other miscellaneous materials that are needed for proper handling of sheep.

FD 244

CV-6417-201 NN000628

CV-6417-201

TABLE VIII
DESCRIPTION OF WORK AREAS - (FUTURE WORK)

PROJECT	AFFECTED ACREAGE	RECOMMENDED TREATMENT	REMARKS
General Erosion Control Ganado Vicinity	35,000 Range	Small spreaders, gully plugs, (rock and brush).	Extensive treatment can be made after proper range control is established.
General Erosion Control Steamboat Vicinity	80,000	Small spreaders, gully plugs, (rock and brush).	Extensive treatment can be made after proper range control is established.
General Erosion Control Greasewood Vicinity	4,100	Small spreaders, gully plugs, (rock and brush).	Extensive treatment can be made after proper range control is established.
Balakai Mesa Vicinity	45,000	Small spreaders, gully plugs, (rock and brush).	Extensive treatment can be made after proper range control is established.
Tanner's Wash Vicinity	13,000	Small spreaders, gully plugs, (rock and brush).	Extensive treatment can be made after proper range control is established.
Klagetoh Vicinity	8,100	Small spreaders, gully plugs, (rock and brush).	Extensive treatment can be made after proper range control is established.
General Erosion Control Entire Unit	75,000	Small spreaders, gully plugs, (rock and brush).	Extensive treatment can be made after proper range control is established.

III 245

NN000629

TABLE VIII

DESCRIPTION OF WORK AREAS - (FUTURE WORK)

PROJECT	AFFECTED ACREAGE	RECOMMENDED TREATMENT	REMARKS
Abandoned Roads	150,000	Thank-u-mams, dikes, spreaders, turnouts, etc.	These can be worked after stock control and as time and budget permits.

FD 246

CV-6417-201

NN000630

CV-6417-201

TABLE VIII

DESCRIPTION OF WORK AREAS - (INDIAN SERVICE OPERATIONS)

PROJECT	AFFECTED ACREAGE	RECOMMENDED TREATMENT	REMARKS
(1) Road Maintenance	Entire Unit. Approx. 500 Miles	Regular maintenance and erosion control provisions.	Roads without maintenance frequently cause severe gully erosion and should therefore bear special consideration.
(2) Rodent Control	As Need Arises	Control in areas where damage increases, especially farmland.	Retreatment and initial treatment as local conditions need.
(3) Subjugation of Farm Land	1,200	Leveling, bordering farmland	Needed for betterment of farms.

FD 247

NN000631

D. Future participation in the program.

1. Future participation in the program by individuals will consist primarily of contributions of teams and labor on the various projects in accordance with the benefits derived, and in compliance with management plans which are to be administered by the Indian Service to secure the proper management of range, farm, woodland, and other natural resources.

2. The Federally owned lands in Unit 17 will be administered under the Memorandum of Understanding between the Indian Service and Soil Conservation Service. The participation of each agency in the program is set forth in this plan as specifically as it is possible to do so at the present time. In general, the Indian Service will be responsible for the administration of plans as prepared for the area, while the Soil Conservation Service will furnish cooperation in the form of technicians for additional surveys and studies where needed for the formation of plans for soil and water conservation and management of natural resources. A large portion of the actual soil and water conservation will be carried on by the Soil Conservation Service. Soil Conservation Service personnel is available for the formation of plans for the area. The acquisition of 2,560 acres of railroad land in the Unit should be one of the objectives of the Indian Service.

The duration of this program cannot be considered less than a generation, and in all probability will continue even longer.

FD 248

CV-6417-201 NN000632

E. Estimated cost of S. C. S. part of the program.

The estimated cost of the program for Unit 17 is shown in the following table. The immediate and future work have been segregated primarily on the basis of range control, a number of the projects being limited because of the present conditions of mis-use of range land. Estimates have been prepared only tentatively to cover the work projects. Table IX shows the cost and relative contribution for the various projects excluding Indian Service operations.

FD 249

CV-6417-201 NN000633

CV-6417-201

TABLE IX

COST OF PROGRAM - (IMMEDIATE WORK)

Project	Treatment	Acreage Affected	Estimated Cost	S. C. S.	U. S. I. S.	Annual Maintenance
(1) Erosion Control along abandoned Roads(300 miles)	Turnouts, grade stabilizers, dikes.	25,000	$4,500.00	$4,500.00		$ 450.00
(2) Canado Farming Area	General Flood and Erosion Control on and adjacent to Farmland. Gully planting.	350 Farm 2000 Range	32,500.00	7,500.00	$25,000.00	
(3) Dry Farms	Erosion Control and Water Conservation	400 Farm	2,000.00	2,000.00		Negligible
(4) Livestock Water Maintenance and Betterment	Maintenance of 49 supplies.	Entire Unit	17,470.00	9,010.00	8,460.00	1,500.00
(5) Desilting Plots	Fence 17 Desilting Plots	Entire Unit	6,240.00	6,240.00		600.00
(6) Livestock Water Development	Develop 5 Supplies	Entire Unit	3,475.00	2,250.00	1,225.00	275.00
(7) Water Spreading Thief Mt.	Water Spreading	1,400	3,400.00	3,400.00		300.00
(8) Silt Barrier	Prevention of Harmful Siltation		10,000.00	10,000.00		Negligible
(9) Rodent Control	Prairie dog and Kangaroo Rat Control	410,000	44,750.00	11,000.00	33,750.00	

FD 250

NN000634

TABLE IX

COST OF PROGRAM - (IMMEDIATE WORK) *

PROJECT	Treatment	Acreage Affected	Estimated Cost	S. C. S.	U. S. I. S.	Annual Maintenance
(10) Ganado Vicinity	General Erosion Control on Range Land	8,000 Range	$3,800.00	$3,800.00		$ 400.00
(11) Steamboat Vicinity	General Erosion Control on Range Land	1,600	2,200.00	2,200.00		200.00
(12) Greasewood Vicinity	General Erosion Control on Range Land	1,400	165.00	165.00		Negligible
(13) Tanner's Spring Vicinity	General Erosion Control on Range Land	2,200	2,100.00	2,100.00		200.00
(14) Kin-li-chee Farm Area	Head cut protection	155 Farm 750 Range	6,000.00	2,250.00	$3,750.00	500.00
(15) Ganado Flood Irr. Farms	Head cut protection	10	350.00	200.00	150.00	Negligible
(16) Balakai Mesa Farms	Head cut protection	12	350.00	350.00		50.00
(17) Klagetoh Farms	Head cut protection	3	150.00	150.00		Negligible
(18) Windbreak Plantings	Wind erosion control on farmland	10,000	10,000.00	10,000.00		Negligible
*(19) Ganado and Steamboat	Maintenance and Demonstration of Range Management and Animal Husbandry	34,000	10,000.00	10,000.00		

FD 251

CV-6417-201

NN000635

TABLE IX

COST OF PROGRAM - (FUTURE WORK)

Project	Treatment	Acreage Affected	Estimated Cost	S. C. S.	U. S. F. S.	Annual Maintenance
Canado Vicinity	General Erosion Control	35,000	$8,000.00	$8,000.00		$800.00
Steamboat Vicinity	General Erosion Control	80,000	20,000.00	20,000.00		2,000.00
Greasewood Vicinity	General Erosion Control	4,100	1,700.00	1,700.00		170.00
Balakai Mesa Vicinity	General Erosion Control	45,000	16,000.00	16,000.00		1,600.00
Tanner's Wash Vicinity	General Erosion Control	15,000	4,500.00	4,500.00		450.00
Klagetoh Vicinity	General Erosion Control	8,100	6,000.00	6,000.00		600.00
General Erosion Control Entire Unit	General Erosion Control	75,000	22,500.00	22,500.00		1,500.00
Abandoned Roads 1,350 Miles	General Erosion Control	150,000	20,000.00	20,000.00		1,500.00

FD 252

CV-6417-201

NN000636

F. Benefits to be derived.

Public and private benefits to be derived from a program of soil and water conservation embracing the proper management of the natural resources of the area will be far reaching. Certain individuals will obtain more benefit than others but the program as a whole will not only benefit the inhabitants (3,700 people), but by controlling erosion and water wastage in the area, 1,164,875 acres - the entire watershed of the Little Colorado River will be to a lesser degree affected.

The stabilization of the livestock industry in the area by the proper management of 572,800 acres of range land and 490,500 acres of woodland and coniferous timberland will relieve the present condition of overgrazing and give added security for those who are at present or in the future partially or wholly dependent upon the livestock industry as a source of income. Controled grazing with the resulting increase in vegetative cover will reduce erosion and flood hazards to farmland, and under proper management, yields will be increased and the farming industry stabilized so as to give security to those dependent upon agriculture as a source of income.

490,500 acres of timber and woodland furnish a valuable resource in posts, hogan material, and commercial timber, as well as a valuable watershed value. Proper management will insure stable production and prolonged life of this resource and do much to reduce flood hazards, harmful siltation, and soil and water wastage.

FD 253

CV-6417-201 NN000637

By the control of the area, harmful siltation in the lower drainages will be lessened, and the area as a silt contributor to Boulder Dam will become less important.

FD 254

CV-6417-201 NN000638

APPENDIX I.

Range Management Plan for Land Management Districts 17 & 18

I. General Statement

Land management districts 17 and 18 are to be combined as far as range use is concerned. This is necessary in order to balance winter and summer range, to take care of existing inter-district use, and to secure a more equal distribution of range rights.

The combined area of the two districts has been divided into twenty-three sub-units for administrative purposes.

The vegetation of Unit 18, with the exception of small localized areas east of Monument Canyon, south of Houck and Allentown, and east of Pine Springs is in poor condition, lacking in vigor, and resulting in low volume growth. Range in Unit 17 is as a whole good, with poor conditions existing around agricultural concentrations, trading posts, day schools, and in the Kin-Li-Chee sub-unit.

Vegetative types comprising the area are summarized in the following table showing acreage and carrying capacity. For location and distribution of the various vegetative types see map.

FD 255

CV-6417-201 NN000639

TABLE I

Vegetative Types by Acreage and Carrying Capacity

	Type	Surface Acres	Percent Tot. Ar.	Forage Acres	Carrying Cap'y SU YL	Carrying Cap'y % Tot.
1.	Grassland	485,734	26.12	90,884	36,354	32.2
2.	Meadow	1,290	.07	171	68	?
3.	Woods	1,866	.10	61	24	?
4.	Sagebrush	206,231	11.09	49,474	19,790	17.5
5.	Browse	94,500	5.08	13,725	5,490	4.9
6.	Coniferous Timber	237,217	12.76	33,197	13,278	11.8
7.	Waste	25,081	1.35			
8.	Barren	69,180	3.73			
9.	Woodland	686,390	36.91	90,048	36,019	31.9
10.	Aspen	190	?	9	4	?
	Cultivated	15,730	.84			
	Demonstration Areas	36,225	1.95	4,698	1,619	1.7
	Total -	1,859,615	100.00%	282,267	112,646	100.00%

II. Proper Class of Stock

The vegetation of the area can be utilized with either sheep and goats or cattle and horses. However, sheep should be favored over other kinds of livestock. Horses in excess of needs should be removed.

At present the incomplete figures indicate the following numbers of the different kinds of livestock now using the ranges.

Kind of Stock	Numbers (not complete)	Converted to Sheep Units	% of Total
Horses	7,507	37,535	27.76
Cattle	3,510	14,040	10.38
Sheep	72,908	72,908	53.92
Goats	10,723	10,723	7.94
Totals for Area		135,206	100.00

FD 256

CV-6417-201 NN000640

III. Proper Numbers of Livestock.

The estimated carrying capacity of Units 17 and 18 is 112,646 sheep units year-long. Unit #18-13, however, lies outside of the reservation boundary and livestock will not be reduced outside at the present time. This leaves a carrying capacity inside the reservation of 109,030 sheep units year-long. Incomplete figures indicate that the area is approximately 14 per cent overstocked or 17,539 sheep units over the carrying capacity. A more complete stocking record is in the process of being determined. Decisions on the correct unit to assign owners of inter-district livestock and the deciding of a permanent location of Nomadic operators are the two most important factors to be determined in order to gain an accurate stocking record.

Unit 18 is overstocked by a much larger per cent than Unit 17. Unit 18 also has relatively many more small owners. Because of these two factors, adjustments between the two units will be necessary. The grazing regulations will change range use to a more equal basis. Therefore, areas now being used by large herds in Unit 17 should be available after reductions to some of the smaller herds of Unit 18. The many sub-units made on the area will be a deciding aid in allocating range use.

The order of livestock reductions is suggested as follows:

FD 257

CV-6417-201 NN000641

1. Horses - remove least desirable first.

2. Cattle - remove steers, barren cows, old cows, and old bulls first; then remove individuals of undesirable market type and quality.

3. Goats - leave ample number to fulfill needs for milk.

4. Sheep - remove wethers, old ewes, and undesirable rams first; then remove individuals of undesirable market type and quality.

IV. Period of Use

Because of climatic conditions such as deep snow, and lack of browse much of the area in District 18 has been classed as summer range. Areas falling in this classification include the Forest Defiance Mesa, Chuska Mountains, and in the vicinity of Crystal (see Map #6). The areas so designated take care of some 63,010 sheep units for the approximate period June 16 to November 15. To balance this large summer use necessitates movement of stock from Unit 17 into the summer ranges of Units 18 and likewise shifting of stock from Unit 18 to winter range in Unit 17. This practice exists at present to a limited extent but not in a systematic manner. The summer and winter usage may make opportunities available for banding of small herds into larger sized bands which would be desirable from the range standpoint. The adjustment of use between winter and summer range is a large problem and revision of the plan as written is expected to be made as more detailed knowledge is gathered and administrative policies developed.

A tabular range management plan follows:

FD 258

CV-6417-201 NN000642

TABLE II

ACREAGE, CARRYING CAPACITY, AND RECOMMENDED USE OF LAND MANAGEMENT UNITS 17 AND 18

Sub-Unit	Surface Acres	Forage Acres	Carrying Capacity S.U. Y.L.	Recommended Season and Number in Sheep Units		
				Yearlong	Summer 6-16/11-15	Winte 11-16/6-
18 - 3	40,623	7,185	2,874	2,874		
18 - 4	51,079	5,660	2,264	2,264		
18 - 8	18,720	1,659	664	664		
18 - 11	75,735	7,858	3,143	3,143		
18 - 12	57,868	5,732	2,293	2,293		
18 - 13	90,624	9,041	3,616	3,616		
18 - 14	2,504	283	113	113		
18 - 2	148,667	22,920	9,168		22,003	
18 - 5	23,760	1,883	753		1,808	
18 - 7a	12,772	2,007	803		1,927	
18 - 7b	17,995	2,814	1,126		2,701	
18 - 7c	47,540	11,626	4,650		11,161	
18 - 1	10,303	1,114	446			76
18 - 9	29,102	3,421	1,368			2,34
18 - 10	46,051	5,993	2,397			4,10
18 - 6	21,432	2,435	974			1,67
Sub-total for L.M.U. 18	694,777	91,631	36,652	14,967	39,600	8,88
Ganado D.A.	7,800	1,236	412	412		
Steamboat D.A.	24,526	2,826	942	942		
Klagetoh D.A.	3,899	.636	.265	.265		
17 - 3	122,804	22,010	8,804	8,804		
17 - 4	206,585	41,730	16,692	16,692		
17 - 7	77,567	10,128	4,051		9,723	
17 - 8	36,416	8,819	3,528		8,466	
17 - 9	21,970	5,438	2,175		5,220	
17 - 1	56,898	10,317	4,127	797		5,70
17 - 2	186,922	38,929	15,572	3,006		21,54
17 - 5	318,992	34,849	13,939	2,691		19,28
17 - 6	100,459	13,718	5,487	1,060		7,58
Sub-total for L.M.U. 17	1,164,838	190,636	75,994	34,669	23,410	54,12
GRAND TOTAL for L.M.U. 17 and 18	1,859,615	282,267	112,646	49,636	63,010	63,01

FD 259

CV-6417-201 NN000643

V. Distribution of Livestock

As can be seen by the present stocking, the majority of livestock run is composed of sheep and goats. Ordinarily this class of livestock distribution should be expected since a herder is always in attendance and a minimum number of waters to effect distribution are planned. However, Navajo customs in the herding of sheep do not necessarily secure the desired distribution because of the long established practice of herding out of the camp or hogan in a radial manner until forage is depleted, and then moving to a new site. This undesirable method is practiced more by thesmaller bands than by the larger bands. To correct this faulty management, two suggestions have been offered:

(1) To encourage the banding of small herds into a larger herd which could be taken out over the range away from the living quarters. This should be possible with sheep belonging to related families.

(2) The multiple corral system, which calls for several corrals advantageously located throughout the range where use could be rotated at considerable benefit to range and livestock.

Black Creek Valley in Unit 18 and the Kin-Li-Chee sub-unit in Unit 17 present a need for initiating one of the above corrective

FD 260

CV-6417-201 NN000644

measures. Both the farming and livestock industry would profit. These valleys have numerous farms and operators could spend more of their time farming, reduce the concentration of sheep and goats around the farms thereby reducing the accompanying erosion, and benefiting the stock. The moving of livestock to summer and winter ranges could be more efficiently handled by combining the many small herds into herds of 800 head or more for grazing.

FD 261

CV-6417-201 NN000645

CV-6417-201

RECOMMENDED LIVESTOCK WATER DEVELOPMENT

DISTRICT 17.

PROJECT NO.	LOCATION	NATURE OF WORK	ESTIMATED COST
17-M-83 *	109°15' x 36°00' 11 1/4"W x 11 7/8"S	Dig out and prepare to collect the water. Put in 20' concrete trough. Fix so that floods will not wash out or fill up	350.00
17-M-84	109° x 45' x 36°00' 8 1/8"S x 6 3/4"W	Develop and run into 40' concrete trough	500.00
17-M-233 *	109°30' x 35°30' 9"S x 12"W	Dig well, put up windmill, 15,000 tank, 40' concrete trough, float and float box	875.00
17-M-237	109°30' x 36°00' 3 1/8"W x 16"S	Build surface tank with cap. of 5 acre feet	1,250.00
17-M-238	109°15' x 35°45' 6 mi. east of the north end of Klag-e-toh D.A.	Develop spring and pipe water into a 40' concrete trough or Dig shallow well and equip with hand pump and 40' concrete trough	500.00
		TOTAL 5 DEVELOPMENTS	$3,475.00

* To be done by U. S. I. S.

HD 262

NN000646

CV-6417-201

DESILTING PLOTS NEEDED ABOVE WATER STORAGES - - DISTRICT 17

PROJECT NO.	LOCATION	ACREAGE	MILES FENCE	ESTIMATED COST
17-M-23	109°30' x 35°45' - 3/4" W x 10¼" S	80	1-3/4	$ 440.00
17-M-93	109°30' x 35°45' - 7 7/8" W x 10 3/4" S	80	1-1/2	400.00
17-M-113	109°30' x 35°30' - 4" W x 18	40	1	280.00
17-M-131	109°15' x 35°30' - 10 3/10" W x 16 1/2"S	80	1 1/2	400.00
17-M-182	109°45' x 35°30' - 1 7/10"W x 6 7/10"S	80	1 1/2	400.00
17-M-198	109°30' x 35°45' - 11 1/5"W x 1 1/2"S	52	1 1/2	400.00
17-M-210	109°45' x 35°45'	100	1 1/2	400.00
17-M-14	109°15' x 35°45' - 10"Sx6"W	60	1 1/4	350.00
17-M-106	109°30' x 35°45' - 13 7/8"S x 8 7/8"W	60	1 1/4	350.00
17-M-107	109°30' x 35°45' - 7 3/4" W x 16" S	50	1 1/4	350.00
17-M-108	109°30' x 35°45' - 6 1/2" W x 15"S	50	1 1/4	350.00
17-M-11[illegible]	109°30' x 35°30' - 7 3/4"W x 1 7/8"S	50	1 1/4	350.00
17-M-136	109°15' x 35°30' - 11 7/10"W x 14 1/10"S	50	1 1/4	350.00
17-M-142	109°15' x 35°30' - 9"W x 12"S	50	1 1/4	350.00
17-M-222	109°15' x 35°30' - 13 3/4" W x 15 7/8"	80 to 100	1 3/4	440.00
17-M-237	109°30' x 36°00' - 16W x 3 1/8" S	40	1	280.00
17-M-223	109°30' x 35°30' - 4 7/8" W x 15 7/8" S	40 to 60	1 1/4	350.00
	TOTAL - 17 Projects	1,062	25 Miles	$6,240.00

HD 263

NN000647