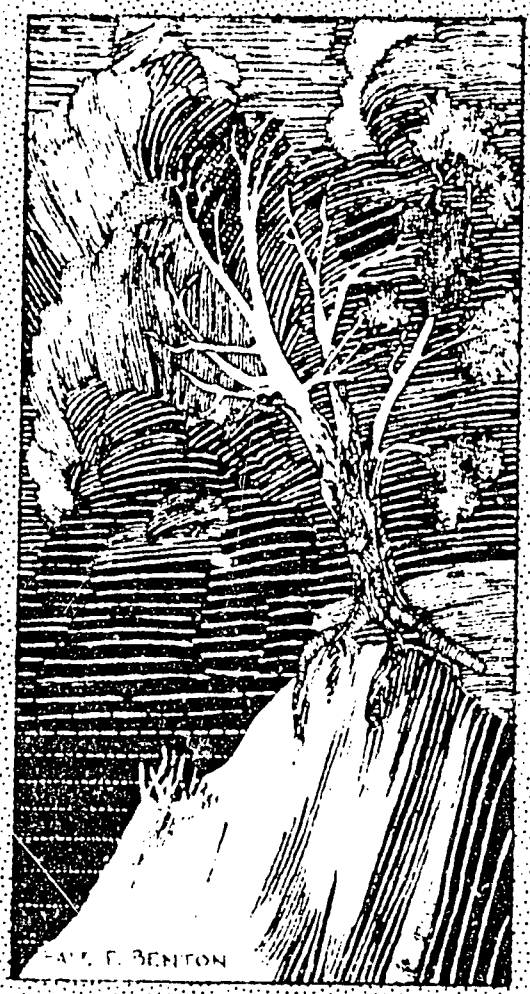

NAVAJO DISTRICT ANNUAL REPORT

1937 • 1938

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
REGION EIGHT

WR 1779

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ANNUAL REPORT OF THE NAVAJO DISTRICT OF
THE SOIL CONSERVATION SERVICE

Region 8

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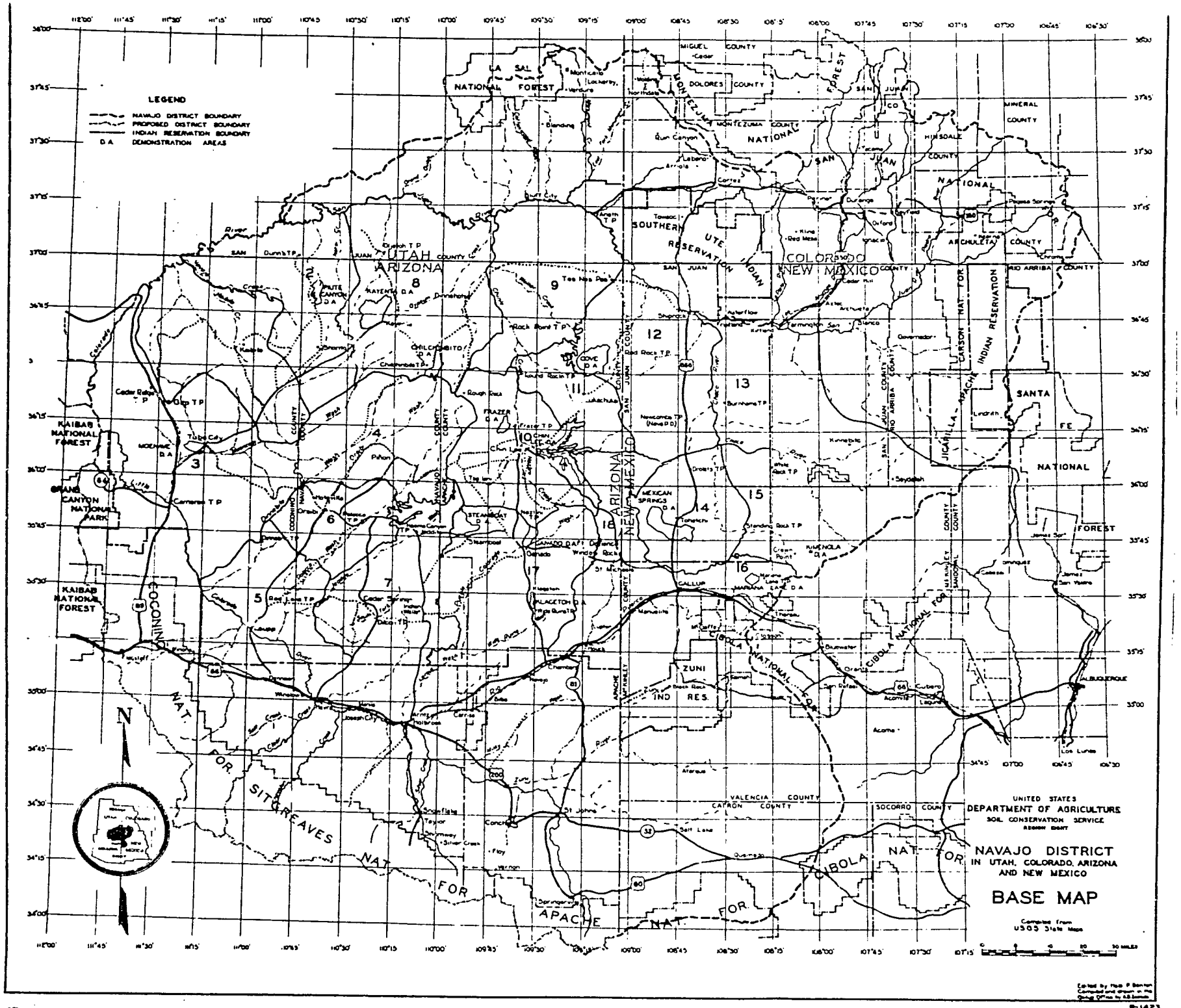

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INTRODUCTION

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INTRODUCTION

This Marks the fifth year of soil conservation effort within the Navajo District. Starting at Mexican Springs on an area of 43,000 acres later extending to embrace 15,000,000 acres of land in the Navajo and Hopi Reservations and finally during the past year spreading out to include the entire San Juan drainage and all of the Little Colorado drainage in New Mexico, covering a total of approximately 28,000,000 acres.

The program has developed from one of simple demonstration to include comprehensive plans and operations aimed to secure soil and moisture conservation throughout the entire San Juan watershed and a major portion of the Little Colorado watershed.

Although expenditures were increased during the early period, most of this expansion has taken place while appropriations have been stationary or decreasing. The expansion of work areas has been made possible by greater efficiency of operations, larger contributions by cooperators, and less intensive structural treatment.

The early demonstrational work has played an important part in making the present program possible. The demonstrational program has shown that erosion control is possible, practical, and will bring favorable economic returns. Much basic information has been gained from these demonstrational areas, information from which has been formulated the guiding principles for the present comprehensive soil and moisture conserving program. The present land management activities on the Navajo and Hopi Reservations are a direct development of the demonstration program, and the present very favorable attitude of local farmers and ranchers is largely attributed to it.

We are now entering the third stage of development of conservation practices within the Navajo District. The first stage was demonstrational; the second stage included management and operations on Indian lands; and the third stage contemplates a program of conservation covering all lands within two watershed areas.

It is hoped that the 1937-38 annual report will indicate the progress which has been made during the past year, and that this review of the work will prove helpful in shaping the future program.

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DEVELOPMENT OF COOPERATIVE RELATIONS WITH

PRIVATE, STATE, AND FEDERAL ORGANIZATIONS

State Relationship

Federal Relationsh

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DEVELOPMENT OF COOPERATIVE RELATIONS WITH PRIVATE, STATE, AND FEDERAL ORGANIZATIONS

State Relationships.

The fact that the Navajo District embraces portions of four states complicates the matter of state relationships. Variations in state requirements as well as state organizations have some influence upon the activities of the Service.

The state legislatures of New Mexico and Utah passed soil conservation district laws during 1936. Bills were introduced before the legislatures of Arizona and Colorado the same year, but failed to pass. In 1937 a "Conservation Districts" bill was reintroduced before the Arizona Legislature and again failed, but a similar action in Colorado was successful. The Colorado Soil Conservation Act became effective May 6, 1937, after unanimous approval by the legislature and signature by Governor Ammons. The Act provides authority for the organization of legal districts, locally controlled, for the purpose of preventing the further destruction of agricultural and grazing lands by wind and water erosion.

The Extension Service. The Extension Service in Colorado, New Mexico, and Arizona, has become increasingly interested in the Soil Conservation Program, with the result that the county agricultural agents have encouraged the adoption of conservation practices and assisted whenever possible in the educational program. Because of their intimate knowledge of local conditions they have provided valuable assistance in the direction of the program.

Of especial interest in Colorado is the Resettlement Project on Red Mesa, which was developed through the combined efforts of the County Agent, the Resettlement Administration, and the Soil Conservation Service. Surveys were made and a plan of conservation operations prepared covering a five year period, so designed as to effect the most efficient utilization of the land.

Through the County Agent in McKinley County, New Mexico, the Navajo District has furnished technical assistance to a number of ranchers to insure compliance with the Agricultural Conservation Program. Similar assistance was afforded ranchers in Navajo County, Arizona, and in addition, range furrowing demonstrations were made to show the most economical and effective methods of range land treatment.

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The Soil Conservation Service activities are limited in Arizona because of the lack of a state conservation districts law; however, in accordance with a memorandum of understanding with the Arizona Extension Service, a demonstrational project has been created in Doney Park, near Flagstaff, Arizona. By virtue of this memorandum, the Soil Conservation Service acts in the capacity of technical advisor and is authorized to make necessary surveys and prepare plans of conservation operations. Supervision of the project rests with the county agricultural agent, and the actual operations rest with the farm owner and operator. The project has proved very satisfactory and to date 665 acres comprising five farms have been brought under agreements, which specify that the land will be farmed in accordance with approved soil conservation practices, such as strip cropping, terracing, and contour cultivation. As a result of activities on this project a keen interest has become evident in Coconino County, and numerous requests for assistance have been received by the agricultural agent.

Working agreements have been drawn with the various state highway departments providing for erosion control work along highways. A windbreak and demonstration project has been established near Joseph City, Arizona, and a revegetation project east of Gallup along Highway 66.

Watershed Program. A greater appreciation of the watershed problem has become evident in portions of the District, but much remains to be done in education. Isolation of much of the area and preponderance of federally owned land still remains an important factor effecting lack of interest in the program.

Federal Relationships.

Cooperative agreements have been prepared with most federal agencies, the functions of which include administration of lands.

Preliminary plans have been completed with the National Park Service covering erosion control treatment at Chaco Canyon National Monument and Canyon de Chelly National Monument.

Mutually agreeable and profitable relationships have been established with the U. S. Forest Service. Plans have been completed on one project in cooperation with the San Juan Forest Service Office in Colorado, and another project has been surveyed and plans are being prepared.

In connection with the erosion control project at Doney Park, an agreement was prepared with the Coconino Forest Office

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whereby the Soil Conservation Service agreed to make surveys and prepare plans of conservation operations on the watershed lying above the farm lands and within the National Forest, and the Forest Service agrees to execute the plans.

The Navajo District furnished trees and shrubs to the Fort Valley, Forest Service Experiment Station, for observational planting and forest research work.

By mutual agreement all projects involving Public Domain are referred to the Regional Grazier of the Division of Grazing for approval before operations are initiated.

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ESTABLISHMENT OF RANGE AND LIVESTOCK MANAGEMENT
AS A PREREQUISITE TO OPERATIONS

Extent of Changes in Management.

Results of Management on Demonstration Areas.

Results of Management on Ranges Throughout the District.

Reaction of Operators to Management.

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ESTABLISHMENT OF RANGE AND LIVESTOCK MANAGEMENT AS A PREREQUISITE TO OPERATIONS

The depletion of the vegetative cover by improper use has been recognized as one of the major causes of accelerated erosion. The Navajo District of the Soil Conservation Service recognizes the necessity of restoring the vegetative cover in order to effectively aid in stopping soil and water wastage. Therefore, the establishment of range management as a prerequisite to operations has been the adopted policy.

Within the Navajo and Hopi Indian Reservations the Indian Service and the Soil Conservation Service have been jointly concerned and have coordinated their efforts to secure range control. The principal steps taken to reach this objective during the 1937-1938 fiscal year may be enumerated as follows:

1. Special grazing regulations for the Navajo and Hopi Indian Reservations and future enlargements were formulated and made effective as of July 1, 1937.

2. The establishment and filling of some forty range rider positions to assist in the administration of the stock adjustment and range control program.

3. A cattle and horse round-up was initiated to determine the numbers of these kinds of livestock which, with data from the dipping records, made it possible to determine the present stocking of the range.

4. The promulgation of the boundaries and carrying capacities of each of the eighteen land management units by the Commissioner of Indian Affairs December 28,1937.

5. The preparation of test cases by the administrative personnel of the Indian Service and the entering of these cases in the Federal Court to ascertain the Government's authority and responsibility for bringing about stock control on the Reservation ranges.

A start has been made towards stopping soil and water loss on areas outside of the Navajo Reservation. Upon some 74,000 acres now under agreement, range control has been accepted as a prerequisite to operations and is in effect.

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Extent of Changes in Management.

a. Within the Reservation.

The adjustment of livestock population to the carrying capacity of the range is one of the major problems in securing management.

The dipping records which have been taken since 1930 on the Reservation show a definite downward trend in sheep and goat numbers. However, since the earlier records did not separate Indian stock outside of the Reservation, where reduction has not been pushed, from those inside, and since the earlier records did not separate the kid* crop but grouped all classes of goats, this accumulated record is useful only to show the general trend. A compilation of the dipping records from the years 1930 to 1937 follows:

DIPPING RECORD CENSUS BY YEARS - 1930-1937
NAVAJO DISTRICT

YEAR	TOTAL GROWN SHEEP	TOTAL LAMBS	TOTAL GOATS	TOTAL ALL CLASSES SHEEP AND GOATS	PERCENTAGE INCREASE OR DECREASE FROM 1930
1930	574,821	394,237	373,531	1,297,589	
1931	631,427	345,242	393,885	1,370,554	5.4% (+)
1932	575,913	257,148	347,169	1,180,230	9.1% (—)
1933	544,726	277,772	329,994	1,152,492	11.2% (—)
1934	502,619	289,178	294,851	1,086,648	16.3% (—)
1935	548,479	250,508	145,823	944,910	27.2% (—)
1936	459,285	281,016	122,847	863,148	35.5% (—)
1937	465,120	291,208	124,298	880,626	32.2% (—)

* Only grown animals, those over six months of age, are counted against the carrying capacity of the range.

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In 1937 the dipping records were recorded in such a manner that numbers were available by the different Land Management Units inside the Reservation. Cattle and horse counts were kept in a similar manner.. Therefore, the present stocking by the different Land Management Units taking into account all grown stock, chargeable against the carrying capacity of the range, may be summarized by the following table:

District No.	Total Acreage	Carrying Capacity S.U.Y.L.	Grown Sheep	Grown Goats	Grown Cattle	Grown Horses	Total Sheep Units	Necessary Adjustment	Per cent Overstocked
1	1035540	34221	30156	3873	1662	3054	55947	21726	38.8%
2	1094976	20506	14816	4384	472	1432	28248	7742	27.4%
3	1759336	47988	29500	3144	1352	2782	51962	3974	7.6%
4	901167	24210	26521	6044	1121	2842	51259	27049	53.0%
5	812200	27368	14242	1604	1343	1861	30523	3155	10.3%
6	499248	17863	14229	994	669	701	21404	3541	16.5%
7	991649	52936	28203	2891	1550	3474	54664	1728	3.0%
8	1450596	29978	16215	4424	788	2568	36631	6653	18.0%
9	974541	20024	22489	2915	664	2123	38675	18651	22.0%
10	791771	33674	22007	3030	618	2452	39769	6095	15.0%
11	481476	18361	11966	1793	353	1134	20841	2480	12.0%
12	1317015	52475	37484	4306	1483	3909	67267	14792	22.0%
13	396100	16703	14625	1123	683	1062	23790	7087	30.0%
14	591488	24213	24826	6147	1416	2179	47532	23319	49.0%
15	212410	7810	7933	1025	365	790	14368	6558	45.6%
16	11609	288	164	87	4	12	327	39	11.9%
17& 18	1766041	107931	75727	10035	3510	7460	137102	29171	21.0%
Totals	15087163	536549	391103	57819	18053	39835	720309	183760	25.5%

An effort to dispose of non-productive stock was the first move following the approval of the grazing regulations and the promulgation of the land management unit boundaries and carrying capacities by the Commissioner of Indian Affairs. In conformity with the grazing regulations the Navajo Tribal Council passed a resolution providing that no owner should hold in

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excess of ten head of horses and the Indians were encouraged to dispose of their surplus. Sales were held throughout the Reservation and buyers were notified. The horses offered for sale were of such poor quality that the price offered (approximately $2.50 per head) by the buyers was not attractive to the Indians. Approximately 1200 head of horses have been sold and efforts are continuing to secure additional sales.

The introduction of changes in methods of livestock management continue to be of paramount importance. A number of definite gains have been realized, particularly in the regulation of breeding and lambing dates. There are at present six community ram pastures. In addition, the Chilchinbito, Frazer, and Mariano Lake demonstration areas are stocked with community ram herds. Rams from nearby flocks are segregated except during the breeding season. Through proper stocking of these pastures the rams are kept in good condition for breeding purposes, which should be reflected in a larger lamb crop. It is also possible to control the type and quality of ram used.

The reduction of the number of rams which run with ewes year-long prevents the occurrence of winter-born lambs and the consequent high mortality because of unfavorable weather conditions. Controlled breeding ensures that lambs are dropped when weather and feed are favorable and permits a uniform lamb crop at selling time. The stocking and herding methods employed on ram pastures should also make them valuable as demonstration areas for operators in those vicinities.

The proper distribution of stock in terms of seasonal and areal use is a problem which is being met partly through the addition of permanent and semi-permanent water. The 3,000 livestock watering places within the Reservation permit a better distribution of stock than formerly over most of the area However, since these waters are not equally distributed, there are still rather large areas where proper use of range remains impossible due to lack of permanent water. Concentrations of stock around agricultural areas, trading posts, and hogans, continues as a problem, but with a large portion of the CCC-ID funds devoted to water maintenance and development, the possibilities of alleviating this situation become greater.

b. Outside the Reservation.

The interest of commercial livestock operators in approved range management has been stimulated by the Agricultural Conservation Program. Better use of the range by deferred

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and rotational grazing and additional water developments has been secured in some cases. One operator with 42,000 acres has signed an agreement which specifies a deferred use plan of management.

Results of Management on Demonstration Areas.

a. Within the Reservation.

The continued improvement of range conditions on the demonstration areas within the Reservation has been noticeable the past year. Range species show a satisfactory recovery reflected in volume growth and in some cases there has been an increased density. The better forage conditions which are a direct result of controlled management are responsible for the relatively greater lamb crops and wool clips. The figures given on each demonstration area are for 1937, since lambing and shearing are now in progress and no figures for this year are yet available.

Ganado Demonstration Area. The volume growth during the season was below average due to the late precipitation. This was particularly noticeable in blue grama and sagebrush, although bluestem, galletta, and dropseed were nearly normal and bore the brunt of the grazing. Seeding and planting areas showed satisfactory results.

The community breeding herd of 397 ewes produced 390 lambs or a 98 per cent lamb crop. These lambs averaged 73 pounds when sold. Wool clip from ewes was 6.84 pounds while that from the bucks averaged 21 pounds. Death loss has been less than three per cent annually.

Year	Mature Ewes	Lamb Crop			Wool Clip Average Individual
		Number	%	Ave. Weight*	
1934	Area fenced by June 18 and stock removed.				
1935	397	Area restocked during the fall.			
1936	397	366	93	67.25	8.17**
1937	397	390	98	73.10	6.84

*Weight at date of sale in October.
**The wool clip from 1936 was over a 13 months' period and was very dirty. The 1937 clip was clean and for a 12 months' period.

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A field day was held October 16, 1937, when the wether lambs were sold and ewe lambs turned over to their owners. The large crowd of Navajos and whites were instructed in the methods and results of management on this area.

Steamboat Demonstration Area. The favorable response of vegetation has been remarkable in this area. Although there has been little increase in densities due to natural revegetation, the increased vigor and volume growth are evident. Seedings of crested wheatgrass, b. stem, and rye have established themselves and are aiding in controlling small gullies and erodible soils. The amount of water and silt loss has been noticeably reduced.

The breeding herd of 439 ewes produced 329 lambs which were marketed with an average weight of 66 pounds. The average wool clip was 6.1 pounds for the ewes and 15.9 pounds for the rams. The latter are grazed at the Mariano Lake area when not in service.

Frazer Demonstration Area. This area has been used for the past year as a ram pasture with from 130 to 200 head being grazed. These rams are removed from the herds of surrounding Indians the early part of the year and released to them in November for breeding purposes. Fifty head of tribal bucks of an improved type were added to this herd in November.

The densities of species have remained approximately the same with the greatest improvement seen in the vigor and volume growth of the individual plants. The comparison of this properly grazed area with the over-grazed conditions existing on the outside demonstrates the marked improvement which has occurred.

There was an average wool clip of 10 pounds for each of the 133 bucks in the area last June. Administration of the area was transferred from the Range Section to the Unit Supervisor in November 1937.

Cove Demonstration Area. Vegetation has continued to improve under proper management despite the unfavorable growing conditions. Forage growth and vitality have increased but very little density increase from natural methods has been noted. Previously seeded and planted areas have responded well and in some instances the vegetation is controlling erosion.

The area was fully stocked by a breeding herd until the fall of 1937 when over half of the stock was removed by Indians because of dissension. Recent requests have been re-

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ceived from the Indians to permit addition of stock up to the carrying capacity.

A 90 per cent lamb crop with an average selling weight of 65 pounds was realized. The 392 ewes produced an average wool clip of 6.68 pounds. The nine bucks sheared an average of 16 pounds. Death loss has been about one per cent.

A range rider has been established on the area to facilitate the handling of stock, prevention of trespass, inspection of improvements. keeping of records, and the extension of demonstration area practices.

Chilchinbito Demonstration Area. This area was converted into a community ram pasture in July 1937. It has been lightly stocked since that time with 131 rams. Vegetative recovery has been satisfactory. Wind blown areas in the northeastern portion where erosion was formerly severe have been nearly stabilized. Black grama in the northeast is very noticeable, both in volume and per cent of composition when compared to 1935. Areas of blue grama under the Black Mesa rim are producing larger volumes of forage due to the increased vigor of the plants. The volume of vegetation below several small water spreaders has increased. Soil and water wastage have been materially reduced and the present favorable trend will in time reduce erosion to normal.

Mariano Lake Demonstration Area. The control of erosion on this demonstration area has been remarkable. Bluestem is rapidly covering soils in gullies, old roads, and on denuded slopes. The increased vegetation aided by mechanical structures has prevented any water or silt loss for the past two years although severe storms have occurred during that time. No appreciable number of new plants of blue grama and browse have been noticed but the old plants have increased in volume and vigor. A small area in the main valley which was artificially revegetated with bluestem and a small farm tract strip planted with bromegrass have become established. The area is used at present as a community ram pasture with rams from the Ganado, Kayenta, Steamboat, and Cove areas kept here. The present 316 sheep using the area are about one-half of the estimated carrying capacity of 590 sheep units.

Kayenta Demonstration Area. This area has been stocked slightly below the estimated carrying capacity with a breeding herd of sheep. Vegetation has increased in vigor. The annual vegetation along the southern portion has been responsible for a decrease in wind erosion. The artificially reseeded areas have been partially successful. Mechanical structures

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have reduced runoff by approximately one-half.

In 1937 the 346 lambs marked and represented a 97 per cent lamb crop with an average weight of 57.4 pounds. Ewes sheared 5.72 pounds and rams 22.75 pounds.

b. Outside the Reservation.

The area controlled by the Fort Lewis College in the San Juan drainage comprises 86,300 acres formerly leased to operators. These leases have been cancelled and fences constructed to prevent trespass of livestock from the outside.

Revegetation is proceeding rapidly and old bedgrounds are healing and being covered by perennials. With the exception of mechanical work which needs to be applied to irrigation ditches crossing the area, the increased vegetative cover should soon stop the accelerated erosion.

Results of Management on Ranges Throughout the District.

Six ram pastures, embracing a total area of approximately 77,000 acres, have been constructed on the Navajo Indian Reservation. They are all stocked at or below carrying capacity, and the rams are allowed to go out of the pasture only at certain periods for a definite length of time. These pastures are proving to be one of the most important factors in obtaining proper livestock management as well as serving as demonstration areas to the Indians living in these immediate vicinities. The evenness and conformity showing up in the lamb crops of the stockmen using these areas is surprising.

To date, approximately 65,000 acres have been placed under agreement off the Reservation (does not include Farmington or Durango). Range Management plans have been made for this entire area and one rancher, controlling something over 42,000 acres, has agreed to follow a plan of deferred and rotational grazing over the five-year period of the agreement.

Of course, we have as yet no results on these areas, but compliance records will be kept and we should have at the end of the agreement some very valuable information.

Reaction of Operators to Management.

a. Within the Reservation.

The extent or degree of cooperation between the Government and the Indians in the land management program should

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be viewed entirely from an evidential basis. The attempt to evaluate the success of the program by recourse to the personal opinions of those who are directly or indirectly concerned cannot give us an adequate picture of developments during the past year. One factor contributing to the kind of reception given the program is that it has been formulated with little or no participation by the Navajos.

The establishment of boundaries for administrative units was approved the 28th of December, 1937, by the Commissioner of Indian Affairs. These boundaries, which divide the Reservation area into eighteen administrative units, were designed to facilitate the execution of the land management program. In particular they permit the calculation of carrying capacity. They are also designed to permit the development of stock management operations on a sub-area basis.

The Grazing Regulations provide that stock operators residing in one land management unit cannot move their stock into adjacent or other units. It is believed that this principle is generally understood by the Indians, but that rights of range use antedating the establishment of these boundaries frequently do not coincide with the present administrative areas. For that reason a number of instances have arisen in which persons who formerly grazed over an area which includes portions of two administrative units have been declared in trespass since the unit in which their stock has been listed included only a portion of their range. The fact that a number of requests has been received for adjustment of unit boundaries indicates that they are not entirely satisfactory from the point of view of the Indians.

One of the important aspects of land management is the reduction of stock to carrying capacities. During the past year definite steps have been taken to achieve this objective. The Indian Service initiated distribution of stock inventory notices in several districts. These notices were for the purpose of verifying the sheep dip and round-up figures secured in the past year, and to make such adjustments as were necessary. The reaction of the Indians to these notices has not been entirely favorable. In many instances they have refused to accept the notices, probably acting on the advice of those opposed to the Government program.

The attempt to secure a reduction of horses by limiting ten to each operator has been only partially successful and has met with considerable opposition from the Indians. Agreements made with the Indians in at least two districts, No. 14

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and No. 5, for the sale of surplus horses also have been only partially successful. As a result of the opposition to the sale of horses the Government has instituted several cases in the Federal Court in an attempt to establish its right to regulate on the Reservation numbers and operation of stock.

In some areas the horse reduction program is meeting with less opposition, although it is probably incorrect to say that full cooperation has been received in any one area. The attempt to enforce the maximum limit in numbers of stock operated by any one person will probably await the outcome of the cases now in court. In any event, the attempt to reduce sheep and cattle will probably receive more opposition than has the attempt to sell excess horses.

There is considerable difficulty in evaluating the success of the stock management program which forms an integral part of the whole. As yet it is difficult to determine the amount of native cooperation that has been achieved in seasonal use of range, the improvement of herding practices, the combining of bands, and breeding practices. The use of approved methods in the demonstration areas has apparently not had an appreciable effect on Indians outside these areas. This is probably due in part at least to the failure of the Government to understand the motivating factors which determine present range use and herding methods. The establishment of ram pastures for purposes of regulating, breeding and lambing seasons has produced beneficial results, but relatively few operators whose bucks were not thus segregated have adopted these approved practices of their own accord.

The demonstration areas have not been completely effective in showing to the Indians proper methods of stock management and the advantages of proper stocking. The participation of the Indians in the demonstration areas has been generally negligible, and the main advantage to them arises from their observation and utilization of such beneficial results as have been achieved. Some plan for securing greater active participation and understanding of methods and results of the demonstration areas appears necessary.

It is difficult to assess the reasons for the acceptance or failure of acceptance of various aspects of the land management program. This much seems clear, however, and should be taken into consideration. The philosophy of the governmental land management program comes from a sophisticated type of thinking and represents a certain point in an historical process. The management practices advocated by technicians are

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based on experimental evidence in which the conclusions reached have general applicability. For the technicians and Government administrators who hold the evidential basis as the foundation for a program, there is no question of the validity and necessity of the methods and objectives. Anyone who can visualize the potential beneficial results of the experiments at the Sheep Breeding Laboratory at Ft. Wingate does not question the importance of this work. The failure has been to impress the people who are subject to a land management program of the validity of an experimental basis for a program of action. This has probably been due in large measure to the particular philosophical basis of Navajo thinking in which values of community and of family play a much greater part in influencing behavior than do the experimental pragmatic values of the technicians. The inability of the Government to secure a whole-hearted cooperation from the Indians with the program has probably been due largely to the failure to understand the motivations in Navajo life and to so adjust the procedure that Navajo values would not only not be violated, but that their strength can be directed to sustaining an effective conservation program.

The minimum essential of an effective soil conservation program is a well developed educational program for land management, carried on contemporaneously with and made an integral part of land use administration. Both the Extension and Education Divisions of the Indian Service should be brought to bear upon the problem of acquainting the Indians with the basic principles and beneficial results of conservative land use. During the year the Land Management Education Division of the Soil Conservation Service has been discontinued on the Reservation and the function of the section assumed by the Indian Service Education Division. Every effort should be made to impress the Indian Service Education Division with the importance of this phase of their work and to remind it of its obligation to divert available funds whenever possible to conservation work.

An important element in the opposition to the range management program on the Reservation has been the interference of people living off the Reservation. That this opposition has a political aspect cannot be doubted, but the fact that stock adjustment on the Reservation offers a fertile soil for sowing seeds of discontent is something that must be faced.

The strongest opposition to the program generated by those outside has been in the northeastern corner of the Reservation. In this vicinity a Navajo ex-missionary, supported by a white lawyer, has been able successfully to thwart almost every attempt of the Government to secure information or cooperation

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from the Indians living in the area. During the year these two individuals have also been able to make their influence felt throughout the entire Reservation.

Influenced apparently by the success of the opposition generated in the northeastern area similar opposition has been developed among the Indians along the southern edge of the Reservation in the vicinity of Holbrook. This opposition is being aided by a white lawyer in Arizona. Several meetings of the Indians have been held at which the Government has been severely criticized and the agitation for non-cooperation has been very strong. The Court cases which are now pending, in which an attempt is being made by legal process to secure stock reduction in the south and western parts of the Reservation, are being seized upon by the opposition leaders to consolidate their position.

b. Outside the Reservation.

There are numerous examples of conservation measures adopted by operators on the ranges throughout the District. For the most part, they are a result of the Agricultural Conservation Program. On ranges east and adjacent to the Navajo Reservation considerable water spreading has been done, and many new stock tanks are in evidence throughout the area. Stockmen are also showing increased interest in deferred grazing and rodent control. Many operators are inquiring about artificial revegetation of ranges and of abandoned pieces of cultivated land.

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SIGNIFICANT DEVELOPMENTS IN EROSION CONTROL OPERATIONS
OTHER THAN RANGE CONTROL

Revegetation

Arroyo Treatment

Water Spreading

Range Dikes

Contour Furrows

Water Detention

Other Erosion Control Measures

Engineering Design

Types of Equipment

Soils Analysis for Structures

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SIGNIFICANT DEVELOPMENTS IN EROSION CONTROL OPERATIONS
OTHER THAN RANGE CONTROL

Revegetation.

The results obtained by artificial revegetation during the past year have reflected the pressure placed upon the work in the form of labor and forced utilization of nursery rooted stock. This applies principally to the woody plantings both on and off the Reservation. While it is too early to make a definite statement regarding survival, it is probable that a much higher survival would have been obtained had the plans as developed been executed without additional pressures.

This past season specific plans were made by planning parties in the field, with detailed planting plans for rooted stock being drawn up by the Agronomy personnel. The land management unit surveys included joint planting recommendations of all sections comprising the survey party, and it was upon these recommendations that detailed plans were based. With additional labor and nursery stock which had to be used, plans were rendered inadequate, and with the lack of trained supervision, planting technique was far from satisfactory. During the past year 815,514 rooted plants were planted on 1,155.8 acres of the Reservation. On areas off the Reservation there were planted 13,750 rooted plants covering approximately 24 acres. The majority of those plants were species adapted to both erosion control and wildlife.

Much of this planting was executed for the protection of cut banks along both live and dry water courses, being confined to newly deposited silt bars. Planting of shrubs and trees for the protection and permanence of erosion control structures, as well as windbreak planting and the stabilization of wind-eroded areas, made up a minor percentage. Gully planting and woodlot planting completed the program.

At Leupp, Arizona, on the Navajo Reservation 241,250 trees were planted as a woodlot to provide domestic fuel for the surrounding Indian population and to encourage silt deposition on bottom lands flooded by the Little Colorado River.

In future planting, the degree of success can be greatly increased through the use of trained supervisory personnel and by the reduction of planting stock as covered by previously approved planting plans. Plans are being worked out in conjunction with the nurseries in order that rooted stock available

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will be commensurate with the District needs as covered by specific plans.

Plans for range reseeding were submitted by the Range Management personnel of sub-watershed survey parties. These plans were made principally where livestock has been reduced to carrying capacity. Much of this type of work has been done in connection with contour furrowing which substitutes strip seeding for solid seeding, or for other broadcast methods.

Some progress has been made in artificially revegetating spreading areas that have very little or no plant cover. The pronounced importance of a dense vegetative cover on water-spreading areas, throws revegetation, artificial and natural, into a prominent place in our future program.

Acreage and quantities of seed planted both on and off the Reservation are as follows:

Range Seeding

	Acres	Pounds of Seed
On Reservation	1,170	5,521
Off Reservation	45	241
Totals	1,215	5,762

Gully Planting (Seeding)

On Reservation	663,915 sq. yds.	4,302
Off Reservation	48,400 sq. yds.	330
Totals	712,315 sq. yds. or 147 acres	4,632

Contour Furrowing

On Reservation	2,319	6,792
Off Reservation	2,387	1,566
Totals	4,706	8,358

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Revegetation

	Acres	Pounds of Seed
On Reservation	1	81

Highway Planting

On Reservation	30	450

Arroyo Treatment.

Arroyos can be roughly divided into two classes for purposes of treatment.

The first includes the large or main valley arroyos with a relatively flat grade (below one per cent). The true type of this class is deep (over 15 feet) and narrow, and zigzags down the wide valley floors of the choicest drainage basins.

The other class is represented by that system of smaller gullies found in the tributary valleys or upper watershed areas. Within the Navajo District such arroyos are innumerable, which fact alone tells us that any program of mechanical treatment laid out for this class can make very little practical impression from a district-wide basis. We do not anticipate completely excluding this class of arroyos from a mechanical treatment program.

The Gallup watershed is an outstanding example where arroyo treatment on this second class of arroyos should be included in any conservation plans for the area. Wherever property values are high or impending damage to improvements is great, treatment of the small arroyos included in or contributing to damaged areas can easily be justified. Included within the demonstration areas and at Mexican Springs are examples of arroyo treatment which can be successfully applied to similar areas in the Gallup watershed.

Where brush and rock are available a relatively cheap but successful type of arroyo checks and stabilizers can be constructed. The Klagetoh Demonstration Area has specialized in that treatment. One noticeable development in this type of treatment is the scattering of the brush within the arroyo for stretches of 25, 50, or even 100 feet, rather than the bunching of it at one place. The water flows through the brush at a retarded velocity, preventing cutting and increasing silting. The

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flagstone check dams so prominently displayed at Mariano Lake Demonstration Area are very effective. They are constructed as low (1' to 2') rock bulkheads from flat rocks placed on edge across the arroyo. Two or more rows placed together with joints broken effect a rather tight dam. After a dam is silted upstream it can be raised by the original process of adding another row or two of flat rocks. After four years in operation these dams are holding up remarkably well and are recommended where unusual circumstances justify small arroyo treatment.

At Mexican Springs are located good examples of rough rock masonry structures designed to stabilize and resilt ugly arroyos in narrow valleys where no other type of treatment is possible. Application of this type can well be made where the cost item is not so important as reclaiming the damaged area.

As indicated by the discussion above and from the analysis given in last year's report, small check dams, gully plugs and related treatment do not have an important place in our future program of arroyo treatment except on special areas.

Water Spreading.

Complete diversion from arroyos to suitable spreading grounds has shown that this practice must be undertaken with caution. Spreading grounds must be adequate to take care of the maximum flow, or provisions must be made to return surplus water to the arroyo without erosion damage. Spreading devices must insure a proper distribution of the water over the spreading ground. Excessive velocities on spreading grounds must be avoided. Naturally spreading grounds are limited to relatively flat slopes where a large volume of water is to be handled.

At Mexican Springs Demonstration Area some water spreading projects have been in operation for several years. Each year certain adjustment in structures have been made to improve the operation. At the lower spreading area on Mexican Springs Wash additional spreading areas have been made available in order to overcome the difficulty encountered last summer with more water than could be handled on the spreading grounds.

At Steamboat Demonstration Area several new spreading areas have been put into operation this fiscal year with very encouraging results. Although regular storms hit the area during August, September, and October, very little water ran off the area where in former years practically every storm of any size sent a flash flood through and out of the area.

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In the Tolani Lakes district last summer's water spreading resulted in a remarkable growth on the sacaton flats. The area proved to be a favorite grazing ground for the stock (horses, cattle, and sheep) of Unit 5. During the late winter and early spring the area was literally "alive" with stock.

Outside the Reservation the water spreading structures at the Westbrook Ranch will be watched with much interest during the next rainy season to see just how they work and what the results will be.

Range Dykes.

Except in leading water to spreading ground, the use of range dykes has been largely discontinued. Their use involves a potential erosion hazard of concentrated runoff suddenly released because of failure.

Contour Furrows.

In southwestern United States climatic and soil conditions are such that erosion makes rapid inroads. With the rainfall distributed over two short periods and much of it in the form of torrential rains, there results excessive surface runoff and soil destruction. The misuse of range land has resulted in large areas being totally denuded of vegetative cover, or, at best, but sparsely covered with palatable and non-palatable grasses and weeds.

In an effort to retard this excessive runoff and to rehabilitate these range lands, both naturally and by the artificial introduction of species for seed dissemination, range furrowing has been initiated.

By developing equipment of low cost operation, furrowing on contour and seeding have been combined in one operation. Since much of this area best adapted to the use of such equipment, consists of impermeable alluvial soils, it is necessary that these soils be broken deeply to allow for water penetration and resultant storage. The equipment is designed to make a furrow eight inches wide with a subsoil breakage of a foot. The machine is equipped with a compressor and seeder, which, when the operation is complete, forms a furrow of from four to six inches deep and seeded on the sides.

There have been approximately 1,793 acres treated to contour furrows this year.

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Contour furrowing demonstrations have been carried out on various types of range land, and though the ranchers are greatly interested to see the results of this work, sufficient time has not elapsed to show any definite results.

Water Detention.

Water detention has been effected on a very limited scale. While water detention structures have a very definite and valuable function to perform, their use has been avoided until sometime in the future since at present the silt problem is such that the reservoir capacities would soon become so diminished that their effectiveness would be appreciably reduced.

Other Erosion Control Measures.

Erosion Control on Agricultural Lands. Many farming areas in the Navajo District are located in alluvial valleys, and occupy those parts of the valley floor not cut up by an arroyo. The presence of the arroyo (and it is usually there) creates an added erosion hazard, especially if irrigation farming is practiced. Water from the farms has a natural tendency to flow off the fields over the steep banks into the arroyo, thereby starting tributary gullies eating back into the farm land. Protection dykes parallel to and fifty feet or so back from the bank of the main arroyo afford security from this type of erosion by directing this waste water to points where no damage will occur. At the Dennehotso cooperative project, very commendable work of this kind has recently been completed by the Service. Among other projects of similar nature should be mentioned the one at Waterflow, New Mexico, a cooperative project outside the Reservation.

Another common erosion hazard encountered in the Navajo District is that from flash floods from drainage areas adjacent to and above the farms. Protection from this danger is generally provided by intercepting channels and earth dykes, directing the water to some side channel for disposal away from the farm land. At the Doney Park cooperative area it was necessary to adopt this means for protecting the farm land from runoff water from higher up the slope.

Contour farming, terracing, and related land layouts and farm practices that have been so much in the limelight during the past few years, have come about in response to the great need of erosion control on the dry farm areas. The Navajo District has a number of projects of this nature both within the Reservation and on the outside.

Bank Protection as Related to Agricultural Lands. The most

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important erosion hazard in many farming districts adjacent to cur main rivers or large tributaries is the tendency of the main stream to bank-cut into the valuable farm land. On the Navajo District this condition is becoming very critical along the San Juan River and its main tributaries. The damage is caused by the high spring runoff from melting snows in the high mountains of Colorado. High water each spring, not in flood proportions, is a natural and regular occurrence. Upper watershed conserva - tion measures, such as well managed grazing, et cetera, will not diminish this spring runoff below a hazardous stage. The problem of bank protection to preserve these valuable farm lands stands out as a pressing need. A comprehensive program of bank protection to insure permanency of the farm lands is called for. In a smaller degree, the same situation exists in the Little Colorado drainage.

Our Service has cooperated in several individual holdings in providing emergency protective measures. Loose rock jetties, containing from 50 to 100 cubic yards each, have been very effective as emergency measures on the Fruitland Indian Service Irrigation project. On a tributary stream at Waterflow an old practice of the local residents of stringing cottonwood trees, tied and anchored with old cable, along the base of the cutting bank has been renewed and promises to be more effective than ever, since the mechanical treatment is supplemented by controlled grazing and planting. In cooperation with the Indian Service, several bank protection projects for the protection of canals by regular bank revetment of driven wooden piles, mesh wire, and rock fill have been carried out. A good example of this kind of bank protection is within the Ganado Demonstration Area.

The use of tetrahedrons is an effective means of permanent bank protection. The line of tetrahedrons is placed in the stream bed fifty or more feet from the steep bank. They act to keep the main current of the stream outside this line, thereby allowing silting back of the line where the velocity has been retarded. Later these silt deposits afford a site for plantings and other revegetation, thus insuring permanent bank protection.

Silt Retaining Structures. Considerable thought has been given to the development of principles as applied to the mechanical treatment of resilting large arroyos.

During the past few months a new type of structure for the Navajo District has been under construction on several of the large main valleys, washes, or arroyos. The structure is an overpour dam designed to raise the stream bed by easy stages (5' to 10' for each stage), allowing for considerable silting to take

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upstream. After this silting is completed to the crest of the first stage or lift, the second lift can be constructed. Sufficient stages are added to raise the stream bed to within a few feet of the arroyo bank in order to re-establish a normal valley waterway in place of the deep arroyo. Sites for these structures were chosen where the flat valley floor extends out from the arroyo on one or both sides, to afford a satisfactory spreading ground for the larger floods.

The dam consists of a railroad rail crib made secure by driving two rows of rails across the channel, welding horizontal rails in rows about two feet apart along each of the vertical lines, and filling the inside space with large rocks. A flexible concrete mat is provided down-stream to break the impact of the water falling over the crest. The first stage of three of these structures will be in operation during the next rainy season, two on the Oraibi Wash and one on the Polacca. This type of structure promises much in the way of silt control and increased water utilization on the flat valley areas. They will be observed carefully for the next year or two.

Highway Erosion Control. In cooperation with the State Highway Departments, two types of projects have been undertaken. First, where erosion control is the main idea, and second, where a combination of erosion control and roadside beautification is sought.

In the first case three phases should be mentioned:

1. Erosion control projects to spread and utilize run-off before it reaches the highway.

2. The construction of drop inlets to road culverts to prevent headcuts working up-grade from culverts.

3. The spreading of water below the culverts to prevent gully erosion down-stream.

Several years' experience with this type of erosion control along Highway 89 in the vicinity of Cedar Ridge, Arizona, have shown the value and importance of such work. A few miles east of Gallup, New Mexico, another roadside project demonstrates similar treatment combined with planting for permanent stabilization.

The results of the tree planting initiated two years ago on the highway project near Joseph City, Arizona, on Highway 66, are extremely encouraging. The survival is high with the young trees making good growth.

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Wind Erosion Control. Properly managed grazing will have to bear the main burden of controlling wind erosion. In some cases wind fences are effective in retarding the movement of sand. In extreme cases total exclusion of livestock from the critical area is necessary until revegetation sews down the soil. At Kayenta, a wind erosion control project, taking in a feeder canal from diversion to reservoir and the canal from reservoir to land, has, after two seasons' protection, allowed the reopening of an irrigation system which for several years had been out of operation because of the wind-blown sand filling the canals. Except for some artificial seeding and some local blow hole treatment, fencing for stock exclusion was effective treatment.

Engineering Design.

Engineering design has taken a more conservative trend. A careful check is always made to see that no doubtful design is approved. Improved construction practices have been emphasized and this precaution, together with more reliable designs, have reduced structural failures.

A new feature in design is the rail and rock crib dam for silt retention, discussed under the heading of "Silt Retaining Structures".

Corewalls are designed for earth structures where the characteristics of the soil in place at the site or of the materials to be used in the structure present a failure hazard. Except in cases where an impervious foundation exists which will not be subject to any settlement the rigid type of corewall has been discontinued. It has been abandoned in favor of a flexible type of corewall made from burlap impregnated with asphalt.

Types of Equipment.

Confronted by the need for a machine capable in one operation of making at low cost a small deep furrow, seeded and compacted, the District personnel undertood to develop suitable equipment.

The original machine was built from an old, discarded, single bottom lister chassis and beam. The mold boards and point were removed and replaced with a heavy six-inch duck foot. In general appearance the resulting subsoiler resembles the "stinger" commonly used in chisel work. Immediately in front of the "stinger" a rolling cutter, made from an old circular saw, was attached to the machine. This cutter in operation makes a clean cut, rather than tearing the sod or brush, thereby making it possible for the "stinger" to follow with the least disturbance possible to any vegetation present.

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Following the "stinger" and attached to the plow beam is a steel wheel filled with concrete and shaped to fit the furrow in which it follows. This wheel weighs approximately four hundred pounds and compresses the seed into the sides of the furrow. The seeding attachment is geared to the large weighted wheel.

The desirable features of this machine are as follows:

1. Low cost operation.

2. Flexibility of use, making it adaptable to all ordinary conditions.

3. Creation of a furrow capable of increasing water penetration and storage above the ordinary class of equipment.

4. Simplification of operation in that everything is done in one operation.

5. Formation of natural seed bed, increasing possible germination and establishment of seed.

6. Sowing and compressing of the seed on the sides of the furrow instead of the bottom, thereby lessening the danger of coverage by silt and blow sand.

7. Furrows preventing direct runoff, making available additional moisture for existent vegetation in and adjacent to the furrow.

Other Types of Equipment. Other types of equipment used are piledrivers, power shovels, gasoline cletrac tractors, Diesel caterpillar tractors, sheepsfoot rollers, carryalls, wheel scrapers, horse-drawn fresnos, and slips.

While horse-drawn equipment and the smaller power equipment have a definite place in construction, the heavier machinery can generally be used to best advantage on most of our earthwork jobs. The carryall could be used more widely than at present and unit costs reduced considerably. They are of particular value here in this area where the soils are often very spotted and suitable soils for construction often have to be hauled considerable distances, distances not great enough, however, to warrant the use of trucks. Also, as a rule, the suitable soil occurs in a fairly shallow surface layer which can best be handled in a carryall or wheel scraper.

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Soils Analysis for Structures.

The construction program has created an additional load on the Soils Laboratory in soils analysis, but with the recently appointed personnel it is felt that the work can be kept up to date.

The following tabulation shows the number and types of analyses performed during the fiscal year 1937-1938:

No. of Samples	Type of Analysis
3135	Total Soil Samples
90	Total Water Samples Analyzed
116	Dams, Dykes, and Reservoir Sites Sampled
	Soil Analysis
1830	Pipette Mechanical Analysis
1830	Pipette Dispersion Analysis
322	Hydrometer Mechanical Analysis
1806	Total Salt by Bridge
1800	Qualitative Na_2CO_3
300	Quantitative Na_2CO_3
330	Water Holding Capacity
196	Total Gravel Determination
30	Total Quantitative Salt of Soil Extracts
22	Sand Analysis for Concrete

Laboratory analyses which have been added to the routine work in the past year are as follows:

1. Determination of particle sizes of sands and gravels for cement mistures. These analyses have been requested by the engineers for construction purposes and the data reported to them is reported according to the Bureau of Public Roads specifications.

2. Soil analyses for determining the proper misture of soils and sands to be used with an asphaltic emulsion stabilizer.

3. Quantitative and qualitative analyses determine the organic content of waters as a basis of classification for domestic, stock, and irrigation use.

Interpretations of laboratory soil analysis data are used in making recommendations for the suitability of soils for the

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construction of earth dams and other structural purposes, development of agricultural lands, location of water spreading areas, and the classification of soils for soil survey purposes. Also, within the past year, the laboratory has added the interpretation of mechanical and dispersion analysis so that recommendations may be made as to the suitability of soils for contour furrowing and chiseling.

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SPECIAL REFERENCE TO PROGRESS AND

DEVELOPMENT OF WORK ON FARM LAND

Agronomic Situation and Development
of New Farm Land on the Reservation

Agronomic Situation and Treatment of
Farm Land off the Reservation

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SPECIAL REFERENCE TO PROGRESS AND DEVELOPMENT
OF WORK ON FARM LAND

Agronomic Situation and Development of New Farm Land on The Reservation.

Work within the Reservation boundaries consists primarily of the introduction through demonstrations and field supervision, and in cooperation with other Government agencies, of soil conserving farm practices. Considerable progress has been made in correcting questionable farm practices.

Recommended practices on the Reservation for irrigated lands are as follows:

1. All the agricultural lands, to the extent of the water available, should be put under cultivation, but care should be taken that excessive grades be eliminated.

2. It is recommended in the case of new storage Reservoirs that ditches be constructed by the operators, but no new land be cleared or broken until there is water immediately available for direct application to the ground that has been prepared for irrigation.

3. Furrow irrigation is preferable to flooding, especially, as is so often the case, if there is a shortage of water. This type of irrigation should be used in orchard irrigation, even though slopes are excessive. There should be little danger from erosion with a controlled water supply at the head ditch.

During this fiscal year 593 acres have been subjugated by other governmental agencies and have followed Soil Conservation Service recommendations and procedure. The result is several hundred acres of erosion-free land for allocation to needy Indian families.

Recommended Erosion Control Measures on Dry Farms for the Reservation. The construction of level terraces on erosive slopes is recommended both as a water conservation and erosion control measure in certain specific cases. The terraces recommended are wide base, with ends open or closed as the condition justifies. These terraces are planted to cover crop for a period of two years to provide protection while the terraces are settling. It may be desirable for the terraces to remain in cover indefinitely as a precautionary strip condition.

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Twenty-two acres of terraces were constructed in cooperation with an Indian farmer for demonstration purposes.

Under many conditions strip cropping is desirable and an effective sheet erosion preventive. Native grasses, permanent pasture grass mixtures and small grains are effective and recommended in specific cases.

Contour cultivation is recommended in all field crop cultivation practice under dry farm conditions. The practice of contour listing for row crops is given major consideration, and the introduction of additional soil-saving equipment of simple design is being encouraged.

The introduction of erosion-resisting crops to replace non-erosion resisting crops now grown is being encouraged.

The watershed above all farm land should have controlled grazing to prevent damage by runoff to the agricultural land.

Agronomic Situation and Treatment of Farm Land off the Reservation.

Progress and Development of Work on Farm Lands. The agronomic work outside the Navajo Reservation boundaries has been mainly confined to the San Juan drainage in the vicinity of Farmington and Waterflow in New Mexico, and Red Mesa, Chrome, and Durango, in Colorado. During the year there have been 1370 farm acres under agreement.

Crop rotations have been introduced to insure maintenance of soil fertility, prevent erosion, control pests, insure an economic unit, and provide a balanced five-year program which may be extended for an indefinite time.

The revision and improvement of irrigation systems to reduce erosion, increase the duty of water, facilitate handling of water without causing erosion, and help eliminate the eventual necessity of drainage, has been initiated by many cooperators on the basis of our plans and recommendations.

The introduction of adapted species of plants for erosion control and increased productivity has provided an increase of supplemental feeds, thus relieving the pressure on range lands.

Contour farming and strip cropping have been introduced for erosion control and moisture conservation. Contour farming has been initiated on 154 acres of farm land.

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The introduction of chiseling, cultivation of perennial crops, renovation of grasses, was made to conserve soil and moisture by allowing greater penetration and to insure maximum returns of production.

New practices of planting, such as modified contour orchards, allowing irrigation on a proper grade, and green manure crops planted between corn rows for use the following spring were introduced.

Commercial fertilizers were used by cooperators where practical, and more attention was given the proper distribution of barnyard manure to improve soil structure, thus reducing erosion by greater moisture penetration.

Conversion of steep lands to permanent sod cover has been effected. This necessitates suitable pasture mixtures that will control erosion. Two hundred and ninety acres were converted to permanent pasture.

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DEVELOPMENT AND CHANGES

IN

DISTRICT ORGANIZATION

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DEVELOPMENT AND CHANGES IN DISTRICT ORGANIZATION

With the earlier objectives of the Navajo District remaining substantially unchanged and the District plan of attack on a watershed basis still prevailing, the organization, to effect such purposes, has remained relatively stable during the current year. A few general tendencies, however, coincident with progress and development of the program are worthy of note.

As practically all surveys have been completed and unit plans prepared for the portion of the District lying within the Navajo Reservation, there has been a partial and gradual withdrawal of all types of activity from this area, with an accompanying modification of the plan in effect last year for the administration of the Land Management program on the Reservation.

The greater part of the administration of the Land Management program has been turned over to the United States Indian Service, although a strong representation of Soil Conservation Service technical, administrative, and operations personnel has been assigned to such activity under the guidance of the Director of Land Management. The Service is represented on the Director's staff for administrative control of personnel assigned to this activity and to assist in the clearance of routine matters.

With the consolidation of all District staff members at the Gallup headquarters now going on, a strong subordinate, administrative, planning, and operations group is being set up for the Reservation as a unit to carry on the work in such area.

There has been a tendency this year toward the breaking down of strictly technical staff lines, except for section heads and their immediate assistants, and an accelerated organization on horizontal lines for better functioning of planning parties. With the various heads retaining technical control of their representatives on the four parties organized, the administrative control of those operating units has been simplified and decentralized. Material cuts in travel expense and time have presented themselves as definite future developments. The permanent frame work of each technical section has therefore been molded, not only on the basis of the individual need of the particular section but on the integration of such section with the other various branches supplying personnel for the planning party units.

With the preparation of more accurate and detailed plans before being turned over to operations groups for execution, there

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has been developed a flexible construction unit whose handling of assignments becomes more deliberate and economical as time progresses. Supervisory personnel has been decreased and decentralized for a more steady and efficient prosecution of the construction work.

The increased use of mechanical equipment has added to the skilled labor positions necessary to operate such machinery but, due to increased efficiency, unit costs have been lowered and a better quality of work accomplished without any material changes in supervisory arrangements. There have been developed in the construction unit two definitely defined positions to provide adequate assistance to the head of the unit. Due to the large territory covered by the District, a general assistant has been designated for overall supervisory purposes. There has also been established the position of Foreman Automobile Mechanic for the purpose of relieving the head of Construction Operations of detailed work in connection with the purchase, distribution, maintenance, repair, and condemnation of transportation and construction equipment and the development of special construction equipment.

Early in the year there was established for trial purposes the position of Assistant to the District Manager. By relieving the District Manager of the burdensome detail of administrative matters and assuming more or less full control of operations activities, the District Manager has been afforded more time and opportunity to perform his true function and at the same time the integrated operation of all activities has been continued by clearance through one administrative office.

During the current year there has also been established a District Personnel office. By relieving the District Manager of administrative detail in this connection and fixing certain definite responsibilities on the Personnel Section as an integral and independent unit directly responsible to the District Manager, a better relationship for the transaction of all personnel matters has been established and maintained.

With adequate provision made for all essential functions, it is anticipated and hoped that all occasion for organization and reorganization is past.

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NEW WORK AREAS

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BRIEF DESCRIPTION OF NEW WORK AREAS

Approval of the enlarged Navajo District boundary on September 7, 1937, and definite clearance for securing formal cooperative agreements in New Mexico, made available to soil conservation activities an additional area of near 12,000,000 acres outside of the Navajo Reservation.

Two major watersheds are found within the area; namely, the San Juan and Little Colorado. Watershed surveys are at present being conducted on these two drainages and upon their completion, critical areas or sub-watershed units will be designated and future work laid out on carefully established priorities. The complicated land status south of the San Juan River makes it extremely difficult in this area to arrange work according to critical areas or sub-watershed units. Almost one-half of the total acreage is included in the proposed Navajo Reservation Extension, and it is the policy of the Division of Grazing to allocate lands under their jurisdiction within this proposed extension for a period of one year only. This land occurs in such checkerboarded fashion throughout the area and within the proposed extension that it is almost impossible to find an operator who actually controls all the land he is using. A few local areas have been fairly well blocked out through a system of exchange between the Government and the Santa Fe Pacific Railway.

To more clearly describe the areas involved, the two major watersheds will be discussed separately by sub-units. The area south of the San Juan River, as discussed here, (excluding the Navajo Reservation) includes all the area between the eastern boundary of the Navajo Reservation and the Continental Divide and extends from the San Juan River south to a few miles north of Thoreau, New Mexico. The area has four principal sub-watersheds ; namely:

Chaco	1,300,000 acres
Largo	1,100,000 "
San Juan	150,000 "
La Jara	450,000 "

The total acreage involved is approximately 3,000,000 acres. Erosion conditions are from moderate to severe over the entire area, with the most critical points located principally in areas of complicated land status. In other words, where operators have definite control over the land, it is found to be in somewhat better condition both from an erosion and vegetative standpoint. The sub-watersheds are all very similar in use, grazing of livestock being the principal use made of the entire watershed.

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Almost the entire south half of this watershed with the exception of the Chaco sub-watershed, is included in the Proposed Navajo Reservation Extension, and no attempt has been made to start conservation work. The north half of the area includes a large portion of the Division of Grazing lands which were only recently allocated. Actual work on formal cooperative agreements was not started until January 1938.

Chaco Sub-watershed. Two cooperative agreements have been written and approved to date. Both are located on the Kimenola drainage which is a major tributary of the Chaco sub-watershed unit of the San Juan River Watershed. Several factors influenced the selection of this drainage: (1) because of its importance as a watershed, and the advanced stage of the erosion; (2) because it lies outside the Proposed Reservation Extension and it is possible to get cooperators who own or control the entire area used.

The total area covered by these agreements is approximately 65,000 acres, one ranch of 22,801 acres, the other of 42,214 acres.

Treatment consisted of:

1. Stocking to carrying capacity.
2. Seasonal use of certain areas.
3. Stock water developments.
4. Water spreading.
5. Contour furrowing and seeding.
6. Retirement of small areas from grazing for the time necessary to bring about revegetation.
7. Stream bed fencing and combination erosion control and wildlife planting.
8. Treatment of old and new roads to prevent continued and additional cutting.

The areas north of the San Juan River and within the new District boundaries, hold the majority of our new work areas. The area as a whole comprises some four and one-half million acres lying in the drainages of the La Plata River, Animas River, Pine River, Navajo River, and Shumway Wash, all tributaries to the San Juan River.

The status of this area compares in complications with the areas south with regard to Public Domain, Federal and State lands. It has been possible, however, to block out various portions of it as a starting place with the watershed problem ever in mind.

For greater clarification the composite area is divided into smaller units, upon which work has been executed or is being

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planned, as follows:

Red Mesa. The Red Mesa area is located in the southwest corner of Colorado on the La Plata River, tributary to the San Juan. The elevation is approximately 7,000 feet; precipitation averaging 16 to 18 inches. According to best available records the growing season averages 109 to 115 days.

Industry in this area is confined almost entirely to agriculture and livestock production. Much of the farming is carried out on a dry farming basis, however, in years of normal precipitation irrigation water is available during the spring to many of the farms located near the upper end of the mesa. The major portion of the land is in private ownership.

The native vegetative cover of the non-cultivated areas consists principally of sagebrush and pinon-juniper, which is utilized for grazing and as a source of fuel and fence posts.

In general, erosion within this area varies from slight to moderate, however, in localized areas erosion has reached a serious stage. Throughout the area a potential erosion hazard exists which can be alleviated through proper land use practices.

The proposed program of the Soil Conservation Service for this area has to date been limited to a policy of extending only technical assistance to cooperative farmers. Although activity of this Service has been limited to the Red Mesa area it is proposed that the entire area will eventually be included in our cooperative program.

To date only two farms have been surveyed and planned by the Service, however, the farm owners within the area have shown much interest in our program and activities.

La Plata. The La Plata area is also located on the La Plata River but is situated in northwestern New Mexico approximately 15 miles to the south of the Red Mesa area. The elevation is between 5,500 and 6,000 feet; annual precipitation averages between seven and nine inches. The growing season averages about 130 days.

Livestock and crop production are the principal occupations of the community. Farming is dependent almost entirely upon irrigation, the La Plata River being the source of supply of water. The agricultural lands are entirely in private ownership. Ownership of the range land is varied, much of the area being Public Domain with smaller areas of State and privately owned tracts scattered throughout.

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The native cover of the non-cultivated lands consists principally of sagebrush and pinon-juniper. These lands are utilized for grazing and post and fuel production. Severe over-use of much of the range area has resulted in serious erosion. Erosion on many of the cultivated areas is also reaching a serious stage due to improper cultural and irrigation practices.

It is proposed that the entire La Plata drainage basin will eventually be included in a unified program set up on a watershed basis, and the selection of work areas along the drainage system is aimed toward this end.

Two farms located in this area are now under agreement. CCC labor is being used to effect the work program. These two farms have a total of approximately 8,400 acres within the watershed of the La Plata River. The land owners and operators have shown much interest in our program and activities and as rapidly as possible the farms will be covered by cooperative agreements.

Waterflow. The Waterflow area is situated in northwestern New Mexico on the Shumway Arroyo, tributary to the San Juan River, adjacent to and to the west of the La Plata area.

The elevation is approximately 4,800 feet; annual precipitation averages between six and nine inches. The growing season is about 150 days.

Farming, fruit growing and livestock production are the most important industries. Farming and fruit production are confined to the lower portion of the drainage basin where the land can be irrigated from the San Juan River. The upper drainage basin of the Shumway is used entirely for grazing purposes. The agricultural lands are entirely in private ownership while the range lands are divided between Federal, State, and private interests.

Vegetative cover of the upper watershed consists of pinon-juniper and sagebrush with rather extensive areas of grass land located in the central section of the drainage basin. Overgrazing of the range lands has resulted in serious sheet and gully erosion over much of the upper portion of the basin and the increased run-off has caused serious damage to the valuable farm lands located near the lower end of the drainage. Improper tillage and irrigation practices have also contributed to the erosion damage suffered by the farms.

The Soil Conservation Service has initiated a cooperative program in this area using local labor to effect the construction

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phases of the program. Activities in this area were started late this year and little progress can be reported to date. One farm has been placed under agreement and work completed. It is proposed that the program will be extended to include the entire drainage basin.

Chromo. The Chromo area is situated on the Navajo River, tributary to the San Juan, and lies adjacent to the continental divide in the northeast corner of the Navajo District. The elevation in this area ranges from 7,500 feet to 10,000 feet, with higher peaks of the mountains extending to 12,000 feet and above. The area is typical of the higher valleys along the northern portion of the District.

The growing season is short and annual precipitation averages about 24 inches, much of which falls during the winter months.

Livestock production is the major enterprise in this area. Feed crops are produced for local winter use and very little grain or other cash crops are grown. Irrigation water from the Navajo River is used on much of the cultivated and native meadow land.

The land is divided among Federal, State and private ownership. The upper watershed is all within the National Forest. State lands comprise a relatively small portion of the area.

To date the watershed surveys on the Navajo River have not been made and therefore no definite program has been proposed for this area. The Planning Party is, however, conducting a demonstration in this area. The Soil Conservation Service will furnish only technical assistance and the plan will be effected by the cooperator.

Ignacio. The Ignacio work area is located on Spring Creek, tributary to Pine River which in turn flows into the San Juan. The elevation is about 6,500 feet; annual precipitation is approximately 17 inches. The growing season averages about 145 days.

Crop production and the raising of livestock are the major sources of income. Studies indicate that only about 20 per cent of the crops are marketed, the remaining 80 per cent being used for stock feed.

The status of ownership is widely varied, being divided between the Forest Service, Public Domain, Indian Service, State of Colorado, and private owners. Approximately 75 per cent of the agricultural land is privately owned, the remaining 25 per cent is range land, much of which is controlled by private interests.

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The predominant native vegetative cover consists of sagebrush, oak brush, and pinon-juniper. Overgrazing of the ranges and improper irrigation and cultural practices have resulted in accelerated erosion. In certain localities both sheet and gully erosion have reached particularly severe stages.

In order to establish farm demonstrations within the area, cooperative agreements were secured with seven farm owners. CCC labor was used to effect the construction phases of the program. In addition to these farms it is planned that the headwaters of the Spring Creek drainage, which lie within the National Forest, will be covered by cooperative agreement as soon as certain land exchanges can be arranged by the Forest Service. Surveys of the upper watershed have been completed and a rough draft of the plans prepared. Completion of this agreement with the Forest Service will stimulate additional interest on the part of the private owners.

Bayfield. The Bayfield area is located on Pine River approximately 12 miles to the north of the Ignacio work area. The elevation averages about 6,900 feet; annual precipitation is between 18 and 20 inches. The growing season averages 115 to 125 days.

As in other areas in this portion of the District, crop production and growing of livestock form the principal industries. The major portion of the farms are irrigated, dry farming being confined to the small areas situated above the present ditch systems and in small valleys extending back from the main drainage.

Land ownership is also varied, involving Federal, State, and private lands. The agricultural area with which the Service is most concerned is almost entirely in private ownership. Small areas of Federal lands, controlled by the Forest Service also offer outstanding opportunities to carry out worthwhile cooperative programs.

Erosion conditions within portions of this area are particularly severe. Practically the whole of the area has suffered soil losses which in numerous cases necessitate immediate action to prevent the land being rendered worthless.

Work within the Bayfield area is not as yet under way. However, an agreement with the Forest Service covering an area of 3,918 acres of seriously eroded land is in the final stages of preparation. Further agreements in this area will be forthcoming.

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Progress and Status of Work.

In addition to the above mentioned six new areas in which work has been started during this fiscal year, the Service has continued to carry on its cooperative program in those areas which were already established.

Durango. In the Durango area four new agreements have been executed since July 1, 1937, which represent a total acreage of 7,213 acres of cultivated and range lands.

Aztec. The past year has added two new agreements to this area which cover an area of 2,295 acres of both cultivated and range lands.

Farmington. Five new agreements have been added, representing 8,332.3 acres of cultivated and range lands.

In all areas, a total of twenty-one agreements and eight amendments have been written and approved since July 1, 1937; involving an area of 2[illegible],541 acres. Four additional agreements and six additional amendments are in the process of preparation at the time of this report. The surveys are completed on two more farms involving 9,320 acres, and surveys have been started, but to date are not completed on five farms involving 19,040 acres.

These work areas are so situated as to fall in line very nicely with the Watershed Survey Plan which should be completed in the near future.

The Red Mesa, La Plata, and Waterflow areas are so situated that they will eventually join, placing an exceedingly large section of northwestern New Mexico and southwestern Colorado under soil and moisture conservation treatment. These areas involve three different types of agreements, one being Soil Conservation Service technical assistance and cooperator being the work agency; one Soil Conservation Service technical assistance and CCC as work agency; and the third, Soil Conservation Service technical and also Soil Conservation Service labor.

The Ignacio and Bayfield areas occupy important positions in the northwestern portion of the Navajo District. Here again the agreements vary. Some agreements cover the lands of private owners, whereas, other agreements are with the U. S. Forest Service and cover work on Forest lands. In these work areas CCC labor will be used.

The Chromo area, for the present, will be worked with agreements covering Soil Conservation Service technical assistance and the cooperator effecting the treatment.

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The types of treatment on the San Juan Watershed are even more varied than are the types of agreements since so many conditions and situations must be taken into consideration. Altitudes range from 4,500 to 12,000 feet, with annual precipitation from about six inches to twenty-four inches and over, with growing season and temperatures varying in proportion. Land use on the San Juan area varies from the extremely small truck garden and orchard plots through the sections of small irrigated farms to the large areas of livestock range. Due to these various factors it is evident that planning of land use and treatment in the different work areas necessitates very careful study of all conditions involved in each particular area.

The Planning Party, with offices at Farmington, has been reorganized as a compact planning group supplying work for CCC enrollees and for Soil Conservation Service labor in cooperation with individual farmers, city organizations, State and Federal agencies. Members of the group have undertaken educational work at meetings of farmers, Chamber of Commerce and Lion's Club meetings and some of the same type of work has been done through the medium of the local press.

At the inception of the work in the San Juan area it was necessary to contact various individuals to solicit cooperation and consequently the work consisted almost wholly of demonstrating soil conservation practices on small and widely scattered farms of such and sundry as could be induced to cooperate. At present, owing to the previous demonstrations, it is not necessary to solicit cooperative work on the part of the Soil Conservation group, it is the farmer who does the soliciting. Owing to this fact the Service is in a better position to choose such critical areas as may be worked on a watershed basis. Although it has not been possible at this date in all cases to work the watersheds in a systematic way from the head of the drainage downwards, nevertheless all projects have been undertaken with the idea in mind that eventually they would tie in with the broader program as outlined for the control of the numbers of livestock grazing it.

It is significant to note especially that work is not only being planned for CCC enrollees and Soil Conservation Service labor to carry out, but plans have been prepared on basically sound land management principles that may be followed out by the cooperator without any other than technical assistance from the Government. In cooperation with the Soil Conservation Service, the Farm Securities Board will only make loans to farmers depending on their willingness to follow out plans made by the Soil Conservation Service. Plans have been completed on a project in cooperation with the U. S. Forest Service for erosion control measures

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and practices in the San Juan National Forest, and surveys have been made on another project in cooperation with the same agency.

TABLE SHOWING DISTRIBUTION OF AGREEMENTS BY WORK AREAS,
SAN JUAN DRAINAGE NORTH OF RIM
AS OF JUNE 10, 1938

Map* Index	Location	Number of Agreements	Cultivated	Range and Other	Total
1	Red Mesa	1	153.9	166.1	320.0
2	La Plata	1	39.1	1,924.9	1,964.0
3	Waterflow	1	98.7	179.8	277.5
4	Chromo	0	0	0	0
5	Ignacio	7	411.3	527.9	939.2
6	Bayfield	0	0	0	0
7	Durango	4	334.8	6,878.2	7,213.0
8	Aztec	2	108.0	2,187.0	2,295.0
9	Farmington	5	223.1	8,109.2	8,332.3
Totals		21	1,368.9	19,973.1	21,341.0

*See Map No. 2, appended.

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The Little Colorado Watershed in New Mexico includes all of the area south of the San Juan Watershed, or a total area of some 4,000,000 acres. Two sub-watershed units have been delineated, namely:

The Puerco of the West	850,000 acres
The Zuni	3,100,000 "

The Zuni drainage as designated here includes several large tributaries of the Little Colorado which will, no doubt, be broken down into additional sub-watershed units by the Watershed Survey Party.

Erosion is probably more severe than in the San Juan Watershed. The Puerco drainage is considered one of the major contributors of silt to the Little Colorado River.

Grazing is the principal use made of both sub-watersheds, although there is considerable farming around Ramah and in the headwaters of the Nutria drainage on the Zuni Mountains. Overgrazing has been most severe in the Atarque, Two Wells, and Ramah country of the Zuni sub-watershed, and on Indian and Public lands of both sub-watersheds.

Approximately one-fourth of this area is included in the Proposed Navajo Reservation Extension and a large area immediately south of Gallup was purchased by the Rehabilitation Administration.

Puerco Sub-watershed. An agreement with the City of Gallup has been written and will be submitted for approval upon receipt of certain land easements which are being secured by the City officials. This agreement covers about 1,800 acres, or all of the drainage known as the Little Puerco, which is an important tributary of the Puerco Sub-watershed of the Little Colorado.

The type of treatment will be:

1. Fencing and complete exclusion from grazing of livestock.
2. Contour furrowing and seeding.
3. Gully plugging.
4. Restriction of all cutting in woodland and timber.

No large mechanical structures are to be constructed at the present time.

An agreement with the Fort Wingate Sheep Breeding Laboratory has been w ritten and approved, and work completed. This

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agreement is, however, somewhat different from the usual formal cooperative agreement in that it is covered by a Memorandum of Understanding with the Indian Service, who, in cooperation with the Bureau of Animal Industry, have administrative control of the area by agreement with the U. S. War Department, owners of the land.

A. C. P. Contributions.

Some difficulty was experienced at the outset in working out a satisfactory program whereby the cooperators could make use of the monetary payments allowed under the Agricultural Conservation Program, and at the same time cooperate with the Soil Conservation Service. The result was that a complete plan of conservation operations was made for the ranch and certain projects included in this plan set aside to be completed by the cooperator with only technical assistance from the Soil Conservation Service. That is, in the case of a stock water reservoir, the Soil Conservation Service made the plans and necessary surveys but the cooperator did all the actual construction. In no case was credit given to the cooperator for work done under the Agricultural Conservation Program.

Several applications have been received from ranchers for Soil Conservation work. One request is from a large sheep company controlling over one-half million acres, lying about equally divided between the Rio Grande and Navajo Districts. That portion in the Navajo District holds a key position in the Chaco sub-water-shed of the San Juan, and in both the Puerco and Zuni sub-water-sheds of the Little Colorado.

Ranchers throughout the entire area are anxious to cooperate, and the prospects for a successful Soil Conservation Program are very good.

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COOPERATION WITH OTHER AGENCIES

Construction

Roads

Irrigation

Civilian Conservation Corps -
Indian Division

Farm Management

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COOPERATION WITH OTHER AGENCIES

Construction.

In order that both the United States Indian Service and the Soil Conservation Service on the Navajo Reservation might point their activities toward the same objectives, it was decided that the United States Indian Service divisions of Irrigation, Roads, and Civilian Conservation Corps, Indian Division, be made technically responsible to a member of the Engineering Division of the Soil Conservation Service, who would advise in the formulation and execution of plans and work programs. Through this plan it was possible to incorporate soil conservation practices in all construction activities on the Reservation.

To aid these three Indian Service divisions in the formulation of their work programs and plans, the Soil Conservation Service made available the personnel and equipment of the various sections of Agronomy, Soils, Engineering, Forestry, etc. to the greatest possible extent.

The activities of the above three Indian Service divisions are briefly summarized below.

Roads.

Very little new Construction was done during the year, due to lack of funds. Several timber bridges were built, most important of which was across the Chin Lee Wash at Many Farms, which resulted in making accessible throughout the year a large territory which formerly had been inaccessible throughout the winter months.

Much good work was accomplished by the maintenance forces in the elimination of concentration of water, in the installation of additional small drainage structures, and the relocation of short stretches of troublesome road.

Steps forward in general practice on road construction and maintenance include the elimination of road-side borrow pits, a provision that no vegetation may be disturbed outside the slopes of the roadway itself, and the elimination of any structure which will tend to aggravate the concentration of drainage.

Irrigation.

During the past year, Irrigation activities included land

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subjugation, stock water maintenance and development, the construction of diversion and storage dams, and protection work on many canals and laterals. In cooperation with the Soil Conservation Service, approximately 525 major repairs were made to water developments over the Reservation, eighteen deep wells were drilled or revamped, seven concrete and steel tanks of 8,000 to 12,500 gallons capacity were erected, and eighteen concrete troughs were built.

Many concrete and masonry drop structures were built in main canals, laterals, and waste ditches, resulting in greatly improved erosion conditions. In cooperation with the Farm Management Division, education of the Indian farmers in the correct use of water, cropping practices, and the planting of wind-breaks have eliminated a great amount of wind and water erosion.

Civilian Conservation Corps - Indian Division.

The Civilian Conservation Corps - Indian Division, during the past year built or repaired seventy-five stock water reservoirs, drilled or improved 105 wells, and developed thirteen springs on the Reservation. They also completed one large irrigation project at Lukachukai, and partially completed a large project at Many Farms, in the Chin Lee Valley.

In cooperation with other Indian Service Divisions and with the Soil Conservation Service a census of non-productive range stock was taken.

Other work completed during the year included truck and fire trail construction and maintenance, fire hazard reduction, fire suppression, telephone line construction and maintenance, fence construction, insect and rodent control, plant collection and stream-bed planting, bridges, and dwelling construction for personnel engaged in land use administration. In cooperation with the Irrigation Division many small irrigation structures were built or repaired.

Farm Management.

Early in the present fiscal year by a rearrangement of the administrative set-up the section of Farm Management was organized. Personnel from the different departments and divisions of the Government operating on the Navajo Reservation were made available to this section. Of the personnel in the Farm Management section, seven Soil Conservation employees, including the section head of Agronomy, were made available. Other employees included in Farm Management are three from the Indian Irrigation Service, four from the Indian Extension Ser-

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vice, and one from Indian Education.

Briefly the responsibilities of the section of Farm Management include the improvement of agricultural and irrigation practices, the improvement of seed through introduction and selection, the protection of agricultural land from serious wind and water erosion through proper farming methods, including windbreak planting and planting of cover crops, the protection of agricultural land and crops from rodent and insect damage, and the preparation of crop reports for all divisions requiring such reports.

Since this Section was organized after the 1937 crop year was well under way many things which were considered a part of the function of this organization could not be carried out last year. One important piece of work, however, was accomplished; namely, the making of the most complete and accurate crop report which has yet been made of the production on all irrigation projects on the Reservation. In addition to this, assistance was given to a great many individuals in the handling of their agricultural operations during the latter part of the last growing season.

With the start of the 1938 growing season definite plans were made for the introduction of seed in kinds and amounts which were deemed necessary. Seed distributed by the Indian Service to Indians on the Reservation included:

Potatoes	34,000	pounds
Alfalfa	2,500	"
Oats	3,000	"
Beans	1,800	"
Garden Seed of Various Kinds	200	"

Indians in different sections of the Reservation were assisted in securing the proper kind of farm equipment including plows, cultivators, harness, grain drills, mowers, rakes, hay balers, et cetera. In addition to assisting individual Indians in their agricultural work, 565 acres of tribal land, which have been prepared for crop production but not yet assigned to Indians, were seeded to a cover crop in order to protect the land from erosion and incidentally produce some organic matter which will be returned to the land.

With the aid of contributed labor and some labor furnished by Government agencies, several small irrigation projects have been rehabilitated this season. Some of those projects were not operated last year on account of serious wind erosion and other obstacles which the individual Indians in an unorganized way were

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not able to overcome.

Rodent and insect control, which is always somewhat of a problem on small Indian farms, has been rather important this season. Fifteen thousand acres of farm land have been treated this season for rodent control and 10,000 acres of land have been treated for the control of grasshoppers and cut-worms.

When the Section of Farm Management began functioning it was soon found that some kind of agricultural organization in the larger agricultural areas was necessary for the successful carrying out of a good agricultural program. In some instances a community organization already existing has been rearranged to more nearly meet the agricultural situation and in other instances it has been necessary to effect new organizations. In five of the larger agricultural areas new farm associations have been set up and are functioning very satisfactorily, and in a number of the other communities the existing organizations have been improved upon and rearranged in order more adequately to meet the situation.

From the response which has been received by the field men in Farm Management it appears that the Farm Management Section will be successful in improving agricultural conditions and in protecting valuable farm lands from the ravages of wind and water erosion. The organization is too new to make any elaborate predictions, but we hope to be able to show more definite and conclusive accomplishments as time passes and we become better established in the agricultural communities.

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SIGNIFICANT PROGRESS AND DEVELOPMENT ON SUB-PROJECT AND CAMP AREAS, BOTH WITHIN AND WITHOUT PROJECT AREAS

Cooperation With Research

Evaluation Surveys

Surveys and Plans

Work of the Human Surveys Section

Drainage Demonstrations

Doney Park, Arizona

Contour Furrowing Demonstrations, Arizona

WR 1840

SIGNIFICANT PROGRESS AND DEVELOPMENT OF SUB-PROJECT AND CAMP AREAS, BOTH WITHIN AND WITHOUT PROJECT AREAS

Cooperation With Research.

Evaluation surveys and field tests have been carried on in two distinct ways during the past fiscal year, one in cooperation with the Research Division at the Navajo Experiment Station, and the other as evaluation surveys set up on operations work throughout the District.

On July 1, 1937, The Navajo Experiment Station was transferred to the Section of Soil and Water Conservation Experiment stations. Under a memorandum of agreement between the Navajo District and the Navajo Experiment Station, District personnel were assigned for the continuance of this work. On April 1, 1938, the Navajo District assumed direction and control of all field tests and demonstration work in that area.

A complete report of all work done under these agreements was compiled and made available to the Navajo District on May 1, 1938. The following is a brief resume of the problems studied and the results of the work to date arranged according to project outline.

Section 1, Project 1, Sub-project A. A study of the effects of livestock concentration around watering places on range vegetation.

Results: There has been a decrease in vegetative cover, although this decrease is not regular as the distance from the well increases. Parallel with the decrease in grass cover is an increase in crown spread of the shrubs present.

An exception to this general trend was noted at Moencopi where an increase in grass cover and a decrease in shrub crown spread in all but two quadrats is greater than experimental error. No satisfactory explanation for this discrepancy appears in the data so far available.

Sub-project B, Range Management Study Plots. The study of the effects of protection on range lands of the Navajo Reservation.

The results of the work to date show an apparent increase of cover of these plots. Where grazing was light, no significant difference between the open and closed plots appeared. The average

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significant absolute increase in grass cover of the closed plots ranges from 1.39 per cent to 2.85 per cent cover per quadrat. These figures represent a percentage increase taking original cover as 100 per cent of from 21 per cent to 185 per cent. The absolute increase in open plot ranges from 1.46 per cent to 5.65 per cent. With the exception of the pinon plot, where an increase of 156 plants of orotia lanata per quadrat in the enclosed plot (9,000 per cent increase) was shown, all other changes in shrub cover were small. Changes in the annual and perennial forbs all fell within the limits of experimental error.

On the cattle unit plots the data collected show such slight changes to date as to lie entirely within the limits of charting error.

Section 1, Project 1, Sub-project C, Isolation Transects. A study of different degrees of utilization on range vegetation.

This study was initiated to determine the advisability of offering total protection to range land up to a period of ten years, and to determine the correctness of present methods of range evaluation now used by the Soil Conservation Service.

Results obtained to date indicate that: under the managed grazing being practiced on the Navajo Experiment Station Area there are few, if any, differences between the open and the closed sections. However, in the two transects which are off the station and in areas subject to unrestricted grazing there are marked quantitative differences in volume growth and plant vigor in favor of the closed plot.

Section 1, Project 2, Sub-project A. This study was established to determine the increase in soil moisture resulting from terraces of various vertical intervals and the effects of this moisture on range vegetation and artificial reseeding. The data obtained so far are still too few to permit definite conclusions but appear to be sufficient to indicate trends. For ease of discussion, these have been divided into heads:

Run-off. Little or no run-off was observed from terraced plots at 7,500 feet elevation. During one rain of approximately one and one-half inches there was a little run-off from the terraced plots at 6,500 feet elevation. Run-off has usually been higher from the untreated plots than from those which were seeded but not terraced. At the 7,500 foot plot the

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seeded and unterraced plot produced more run-off during the current year than did the untreated one. This was probably due to the fact that after the first storm, which produced more run-off from the untreated plot, livestock was admitted to this area. The animals concentrated on the seed plot, overgrazed and trampled it heavily.

Soil Moisture. Soil moisture was higher in the terraced plots than on either of the unterraced checks. In June soil moisture in the unseeded plots, whether terraced or not, was slightly higher than in any of the seeded plots.

Vegetation. Due to changes in personnel, the charting methods used in 1937 were different than those of 1934, with the result that in some instances the increase in grass cover which is plainly evident from field observations, is not apparent in the data for the 7,500 foot elevation terraces. These differences more than overshadow any increase that may have occurred in the unseeded plots. Despite these differences the data for the plot which was terraced and seeded shows an increase in grass cover of 350 per cent of the original cover. The present absolute cover being 8.91 per cent per quadrat. The method for charting crown spread of shrubs was not materially changed and therefore the data are more comparable.

The number of plants has remained substantially the same since 1934. In three of the conditions established crown spread has decreased from 25 per cent to 60 per cent of the original. In the plot which was terraced and not seeded there has been an increase in crown spread of 108 per cent. There has also been a decided increase in perennial forbs in the unseeded plots and an equally apparent decrease in seeded plots.

The terraces at 6,500 foot elevation have grass as the only important vegetative cover. Differences in charting methods are the same here, but in this instance greatly overshadow vegetative recovery. The data indicate, however, that recovery is taking place, especially in the seeded plots, but an examination of the data does not disclose that terracing in itself has aided the recovery of these plots.

Section 1, Project 3, Sub-project A, Studies in Artificial Revegetation. This test was initiated to study the results of open range reseeding and the experiment under discussion deals with plantings made under conditions of severe wind erosion.

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The results are similar to those obtained for previous years on the same area, germination and fall growth have been good. However, spring winds either buried or removed the seedlings. In April, 1938, a series of wind fences were erected with the hope of alleviating this condition. These have been only partially effective and, if conditions permit, another test with the modifications indicated, will be set up.

Section II

Project 1, Bank and Bed Protection. A study to determine the effects of vegetation along banks and in stream beds on the increase in length of stream channel and upon the stabilization of flood plains and banks, thereby reducing the amount of silt contributed to master streams. This experiment has not been carried on sufficiently long to permit the vegetation to reach a size and vigor that would influence a stream channel to any great extent. Willows, however, have increased in number as much as 900 per cent over the original planting; the average, however, would be approximately 200 per cent.

Project 2, Sub-project A. This experiment was set up to furnish information relative to the fate of water on flood irrigation projects, for the purpose of placing such calculations as are necessary in the location and size of a structure on a more definite basis.

The data obtained from two diversion dams show that a total of 200.52 acre feet of water were diverted to the artificial flood plain of Deer Springs Dam in ten different flows between July 27 and September 20, the maximum area irrigated was 183 acres or a water requirement of 21.82 inches, plus 3.69 inches of rain making a total of 25.51 inches of water received.

Norcross diversion dam diverted 79.43 acre feet of water in twelve flows between May 27, and September 30, making a total of 16.70 inches of water received. Difference in duty of water on the two flood plains was probably due to greater ponding on Deer Springs and tighter soil conditions and heavier precipitation on the flood plain itself at the time of flow on Norcross.

Project 3. A study of soil deposit and transport as it is influenced by structures.

The information is derived chiefly from two diversion dams. During the first two years the basin of each of the diversion dams under discussion was large enough to hold the bed load

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and a portion of the heavier silt. The first load of 1937, however, finished filling the basins behind these dams and the last three or four flows have spilled onto the flood plains carrying their full load of silt. The gradient of the stream bed immediately above the dam was reduced but the gradient is now practically stable. Thus, while only the finer silt has been deposited on the flood plain in the past, future flows will carry almost their full load to the areas flooded.

In 1937, the flood plain of Deer Springs received an average deposition of .19 feet as compared to .018 for the previous two years, and a maximum deposition of one foot as compared to 0.3 foot for the previous years. Norcross received an average deposition of .256 feet as compared to .035 feet for the previous two years and a maximum deposition of 1.10 feet as compared to 0.89 for the previous two years.

Project 1, Sub-project A. The coordination of erosion control structures and the production of economic plants.

This study was undertaken to test the use of broadleaf trees for ornamental roadside plants. The results obtained from these experiments indicate that this practice is of doubtful value since, although the survival for the last planting has been good, the growth and vigor of the trees is very low. Rodents, insects, and drought are limiting factors. In general, it was noted that where the growth increased, the amount of water received by the tree was appreciably higher.

Planting sites were also selected behind several of the diversion dams and planted to several species of broadleaf trees. The results of these plantings were no better than for roadside crescents, although another factor, silt deposition, caused the death of many of the plants.

Project 1, Sub-project B. The incidental production of economic plants above erosion control structures.

Data obtained from these plots show little uniformity in the yield for the same crop on the various farms, nor is there any great uniformity in the yield of the same crop on different plots in the same farm. Yields of corn and oats have in general been equal to or higher than those obtained by Navajos from their flood irrigating. Yields of pinto beans are equal to those obtained by dry farming methods at higher elevations where there is considerably more rainfall. Certain biotic factors in the environment are important in determining the yields. Cutworms have caused considerable damage, especially to the legumes. Fall

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plowing where conditions permit, indicates that injury from this source can be considerably reduced. Rodents also do considerable damage to crops, rabbits and kangaroo rats being most destructive.

From the few observations made during this study it is felt that the use of areas incidental to erosion control structures has distinct possibilities in producing supplemental food and feed for the Indians and livestock.

Project 1, Sub-project C. The purpose of this study was to determine the feasibility of growing fruit trees with water concentrated by small hillside detention dykes. Data obtained to date are too meager to indicate more than trends, but it is apparent that the general survival percentage is high. It is evident, also, that the average or even the maximum growth is far less than that of trees in more moist regions. It is evident from some of the data that there was insufficient water for equal irrigations throughout the orchard and that further study will be necessary to determine the correct ratio of drainage area to the number of crescents in order to obtain maximum results.

Project 1, Sub-project D. The study of the effects of diversion irrigation on crop plants.

With the exception of Indian corn, all crops planted on this farm failed. These causes for failure were both biotic and physical. Sediment deposition in the main ditch has interfered with its proper function, resulting in the coarser sediments dropping into the ditch and leaving the finer fractions for deposition on the farm. No mechanical analysis has been made but it is apparent from observation that the soil type has become heavier.

Project 1, Sub-project E. The purpose of this study was to determine the effects of diverted water on native vegetation.

The data from the quadrats show that there has been a heavy decrease in the percentage of vegetative cover (between 34 per cent and 54 per cent) which extended 2,500 meters below the dam, beyond this the decrease becomes markedly less and in some cases shows a valid increase. These facts are in accord with the data that show that heavy silting occurred within this same distance, thus in a single season approximately 45 per cent of the vegetation in the upper one-quarter of this area has been covered with silt. The extent of the damage cannot be estimated until data are available to show the response of the vegetation to the sediment blanket to the existing conditions of increased water supply.

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Project 2. This study was undertaken to determine the behavior of certain erosion control and economic plants submitted for testing.

In the spring of 1937 there were received 56 samples of corn and a sample of quinua which had been collected in Peru and Bolivia by Mr. Charles W. Collier. Four samples of hybrid corn developed in the Indiana Experiment Station received through the courtesy of Messrs. Fred C. and Parke G. Haynes in addition to the above 14 varieties of commercial crops were tested. The results show that except for two varieties of Peruvian corn and the Indiana Experiment Station corn, the corn under consideration failed to mature. The South American corn was subject to a rather severe infection of smut, while the native Navajo corn showed but very slight infection. Of the feed crops tested Sudan grass and Japanese millet gave a dry forage yield larger than that of the Navajo oats used for this purpose. Buckwheat gave good yields but the Navajos are reluctant to use the grain. All sorghums tested failed to produce a grain crop.

Evaluation Surveys.

Evaluation surveys have been initiated in cooperation with the Division of Research to determine the effectiveness of range management, contour furrowing, water spreading, terracing, and tree, shrub, and grass planting on structural and revegetation work. Observation by means of schedules, photographs, and general narrative covering areas treated and types of treatment or practice, has been from information recorded.

A previously initiated field test was continued to evaluate the results of range reseeding and to discover the more desirable methods of planting grasses. Fenced exclosures were employed as a basis for observational comparisons.

Surveys and Plans.

During the last fiscal year surveys were completed on the Navajo and Hopi Indian Reservations. These surveys were made by a group of representatives from Agronomy, Engineering, Soils, Range Management, Woodland Management, and Wildlife Management Sections. A report for each section concerned was made and in addition one combined report taking in all section reports was prepared. During the year, basic data were secured on six land management units of the Reservation, the table below showing total acreage covered and principle usage.

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Land Mgt. Unit	Total Acreage	Barren and Waste	Used for Grazing	Used for Wood Products and Grazing	Cultivated
2	1,094,976	369,601	376,561	347,717	1,097
6	499,248	19,356	435,343	38,465	6,084
7	991,649	37,967	694,016	192,608	1,540
12	1,317,015	110,517	932,173	267,041	7,284
15	212,410	20,540	181,401	10,205	264
16	11,609	3,521	362	7,698	28
Totals	4,126,907	561,502	2,619,856	863,734	16,297

In addition to the above described inventory units 5, 17, and 18 were partially covered by detailed plans. The memorandum of understanding covering the Reservation limits operations to certain types of work until stock reduction was achieved or assured. Detailed plans, therefore, covering all that was necessary to stop soil and water wastage was restricted in accordance with the memorandum of understanding.

Outside the Reservation surveys and detailed plans were made on the following areas:

Area	Acreage
Pitt Ranch	42,214
Smith Ranch	23,000
Westbrook Ranch	22,802
Gallup Watershed	2,000
Durango-Farmington Area	21,341
Chaco National Monument	22,400
Total	133,784

Several miscellaneous surveys were made by different sections. Agronomy completed detailed surveys on 1,055 acres in Doney Park, Arizona. The section of Range Management made an extensive survey on approximately 70,000 acres in the Puerco River drainage above Fort Wingate.

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Range plans were prepared for the handling of stock on the Mexican Springs Area, an area on which the livestock administration was recently made the responsibility of the Navajo District.

Utilization Surveys were made on the following areas and acreages both in the fall of 1937 and the spring of 1938. The purpose is to get a more accurate check on the estimated carrying capacity given each area.

Area	Acreage
Fort Wingate	19,680
Kayenta	38,223
Chilchinbito	16,586
Cove	29,376
Ganado	7,800
Klagetoh	3,899
Steamboat	24,526
Frazer	5,627
Mariano Lake*	7,005
Mexican Springs*	44,082

Watershed Surveys. During the year there have been organized on the Navajo District Watershed Survey parties to conduct reconnaissance surveys of both the San Juan and Little Colorado watersheds. The Regional Watershed Surveys unit arrived on the Navajo District about the middle of May and after a short period of training of Navajo District personnel were able to equip a second Watershed Surveys unit. This second unit comprised of an engineer, a soils scientist, and a range examiner has assumed responsibility for the survey of the Little Colorado watershed. The Regional unit has proceeded to the San Juan.

Working in conjunction with each party are an hydrologist, procuring data on flood damage, and two socio-economists conducting human surveys.

The surveys are proceeding at the rate of approximately 250,000 acres a day and are being conducted in accordance with the procedures laid down for Watershed Surveys. These ultra-extensive surveys will provide material on which priorities of work areas can be established by tributary watersheds. The field work should

* Note: These two areas surveyed in spring of 1938, only.

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be completed by August 1 and the reports approximately two months later.

Snow Surveys and Stream-flow Measurements. What started in a very modest way in 1935 to observe the snow fall in the Lukachukai Mountains, has gradually developed into a three way cooperative enterprise for the measurement of winter snow accumulations in the above mentioned mountains, with an idea of correlating these measurements with spring run-off in the important drainages heading in these mountains.

In 1936, snow measuring instruments were borrowed from the Bureau of Agricultural Engineering. The first actual snow measurements were made in March, 1937 by the Soil Conservation Service and Indian Service personnel as a sort of week-end snow excursion. Two standard snow survey courses are now established, and measurements were made during the first week in April by Soil Conservation Service and Indian Service personnel.

The marked deficiency of run-off records covering the Reservation has finally led to the detail of one man by the Indian Service to the measuring and rating of the main Reservation streams. The Soil Conservation Service is cooperating to the extent of contributing gasoline for the operation of the car used by this man. At present about ten staff gages have been installed covering the important Reservation streams. Volunteer observers of the gages will have to be depended on for many of the records, but until the project can be properly financed to insure more accurate records, the arrangement will be better than no record at all.

The Work of the Human Surveys Section.

During the past year the collection of basic socio-economic data on the Reservation has been practically completed. With the exception of those areas where anti-Government opposition was most bitter and the Indians refused to give information, schedules have been taken throughout the Reservation. Fifteen of the eighteen Land Management Units, representing about 85 per cent of the population, are completely covered. In the remaining three units, in the opposition area, partial coverage on economic phases and almost complete coverage on population have been procured.

In addition to the schedule material procured in the hogan-to-hogan survey, schedules have now been secured from all the trading posts doing business with the Indians on and off the Reservation -- 175 posts in all.

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From these two sources of information plus the agronomic and cropping data obtainable from the Agronomy Section, the livestock figures obtainable from the Range Management Section and the wage data obtainable from the agencies employing Indians, it is now possible to develop for the first time a realistic picture of Navajo income and dependence upon resources. The work of the section at present is largely the compilation, graphing, charting, and interpretation of this mass of material.

From the available material, socio-economic reports are being prepared for each Land Management Unit. In addition to these reports the plotting of many items of the basic data on maps and charts indicates the necessity for considering other homogeneous units of land use on the Reservation. To be able to describe the Navajo Reservation in terms of these homogeneous units will be a decided advantage in preparing land management plans adapted to the needs of both land and people.

More and more during the past year, there has been a closer realization on the part both of Soil Conservation Service and Indian Service personnel that the land management problem on the Reservation is in significant part a human one. It has become evident that stock adjustment, agricultural development, and conservation operations are not possible without full consideration of the potentialities of the Indians to participate and cooperate in them.

In this connection it has been found highly desirable to carry on certain special studies closely related to the Land Management program and suggested by practical operational needs and the economic data. During the past six months the time of one trained man has been devoted rather continuously to special problems. From these investigations has come information which discloses a social mechanism among the Navajos out of which can probably be created a more efficient type of cooperative farming unit than has so far been developed by the administration. Similar investigations are now being extended to stock raising communities and it is evident that a similar, though not identical, type of social mechanism operates among the stock raisers. To understand these native mechanisms and to realize their adaptabilities for purposes of obtaining proper livestock management should go far in solving the complicated problem of livestock adjustment on the Reservation. Several additional studies designed to throw light on administrative problems of land management are projected for the ensuing year. A sympathetic understanding of the interrelationships that exist between the various social and economic acti-

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vities of the Navajo people will make it possible to devise plans that will be acceptable to them or that will not break down because they cut across fundamental values or mechanisms of the native social and economic organizations.

The enlargement of the Navajo District during the past year to include approximately 10,000,000 acres of non-Reservation lands has thrown an increased responsibility on the Section, a responsibility which it has not yet been possible to discharge. Some small amount of material of economic nature has been collected for certain portions of the San Juan country in Colorado in which Soil Conservation Service operations are being carried on. In addition, some further investigation has been made of the Spanish-American settlement of Concho in central Arizona. Both of the contributions have been localized studies unrelated to the watershed picture, but neither time nor personnel has allowed for serious extension of our work to the entire San Juan and Little Colorado watersheds.

Recently, as elsewhere related, the Watershed Surveys unit of the Regional Office has come to the Navajo District for purposes of conducting surveys on the two watersheds within the District. In connection with the socio-economic part of this survey, this section has detailed two men to this work for a period of approximately four months. Until the watershed surveys have been completed and specific problems and priorities have been suggested from this material, it will be inadvisable to carry on extensive socio-economic work. Until that time, most of the effort of the Section will be concentrated on the Reservation where the problem of land management is of the utmost importance--a problem necessitating full consideration of the human factor.

Drainage Demonstrations.

Like many irrigated farming areas, portions of numerous farms lying along the San Juan River and its main tributaries have suffered greatly from seepage. Much arable land has already been lost to cultivation from seep conditions and a good deal more is in danger of being rendered unsuitable for cultivation.

Special permission was obtained from Washington to demonstrate a conservation measure in the way of drainage. A small dragline machine was used to dig drainage ditches on two farms. Results obtained on both farms have been highly satisfactory. Fields that had not produced a crop of anything but salt grass for the past four years are now being returned to cultivation; other fields previously too wet to be plowed have been dired sufficiently to permit of plowing and seeding to green fertilizer crops.

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The results obtained have shown the farmers in the San Juan Valley that seep lands can be brought back into productivity to the extent that one large farming community has rented a dragline machine and has drained and recovered a large portion of the lands that had been abandoned on account of the alkali conditions brought about by seepage.

Doney Park, Arizona.

Cooperative work between the Extension Service of the University of Arizona and the Soil Conser ation Service has been initiated on dry farms at Doney Park near Flagstaff, Arizona.

The adjustment of use from hay meadows to the present clean cultivated crop has resulted in increased erosion, both by wind and water. Unless this condition can be changed the ultimate result would be that of complete abandonment due to loss of soil and fertility.

The agricultural land embraces approximately 2,000 acres at limited frost-free elevations. The present production of the area is high, with rather high market value. Five operators operating 655 acres of farm land are at present under agreement. The recommended practices introduced and incorporated in the Plans of Conservation Operations were: strip cropping, terracing, rotation of crops and contour cultivation. Over 400 acres of terrace, strip cropping and contour cultivation have been developed, even though difficulties were experienced due to the short work seasons of last fall and this spring.

With the program entering the first growing season, the farmers are entirely satisfied and encouraged with the results shown thus far. Little or no damage was observed following the first storm, and real benefits are expected during the summer period of heavy rainfall.

Contour Furrowing Demonstration.

Requests through the County Agricultural Agent of Navajo County, Arizona, were made for a demonstration of range furrowing to conform to the A. A. A. program. The resulting large attendance of interested ranchers pointed toward the adoption of a uniform practice, and eliminated the exaggerated idea of costs. Intervals, and size of furrow. The most desirable type of furrow for this particular locality was demonstrated.

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WILDLIFE MANAGEMENT

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WILDLIFE MANAGEMENT

During the year the Wildlife Management Section has been engaged in the preparation of surveys and plans, planting activities, and has cooperated with other government agencies in wildlife activities. Rodent and insect control surveys in cooperation with the Indian Service and Soil Conservation Service Engineering Section were initiated both on and off the Reservation.

Wildlife Surveys.

During the course of the year extensive wildlife surveys on the Navajo Reservation, begun in 1935 as an integral portion of the land management unit surveys, were completed. Surveys covered all of Land Management Unit 7 except 150,000 acres surveyed in June, 1937; all of Units 2 and 12; [illegible] those portions of Units 15 and 16 within the present Reservation [illegible]daries. The following is a summary tabulation of the Reser[illegible] surveys:

Land Management Unit No. [illegible]	--	774,082 acres
Land Management Unit No. 2	--	1,094,976 acres
Land Management Unit No. 12	--	1,282,526 acres
Land Management Units Nos. 15 & 16	--	215,589 acres
Total		3,367,173 acres

Most of the wildlife survey report on Land Management Unit 6 was written during the year.

These surveys consisted of gathering and reporting data on the numbers, distribution, and economic status of the various wildlife forms present (waterfowl, game mammals, fish, non-game species, furbearers, insect pests and plant diseases of range, woodland, forest, and farms, and rodents). Emphasis was placed on environmental conditions present, and potential game species, and recommendations were made for wildlife development.

In addition, extensive wildlife surveys were made on several smaller areas, including Fort Wingate, Chaco Canyon National Monument, and the Be-ta-ta-kin Ruins portion of the Navajo National Monument.

Planting.

The Section cooperated with the Sections of Agronomy and Woodland Management both in making erosion control planting plans

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and in their execution, resulting in establishment of more and improved wildlife environments. Through cooperation with the District and Regional nurseries excellent erosion control-wildlife plants were made available for use. Those included such species as Virginia creeper, Siberian pea tree, hackberry, Russian olive, wild olive, honey locust, mulberry, wild plum, apricot, apple, blackberry, squawberry (Rhus), snowberry, buffalo berry, Osage orange, and grape. Special attention was given to hackberry. Seeds of the species were gathered from plants growing on the Navajo District and these were propagated in the Shiprock Nursery. A hybrid rose possessing an unusually large fruit also received special attention.

Cooperation with Other Agencies.

Contact was made with the Gallup, New Mexico, and the Flagstaff, Arizona, Game Protective Associations. The annual meetings of the Arizona and New Mexico State Game Protective Associations at Flagstaff and Santa Fe respectively were attended by a member of the Section, who took active part in adoption of resolutions officially approving wildlife conservation activities.

Rodent and Insect Control.

During the year the Section cooperated with the Indian Service in rodent and insect control conducted by that Agency. Approximately one-third of the time of the agricultural aide was given to technical supervision of this work.

Intensive surveys of several areas both inside and outside the Reservation were made at the request of the Section of Engineering to determine the need for rodent control for maintenance of construction work. These surveys will be used as a basis for a rodent control plan and estimate for the fiscal year 1939.

Miscellaneous.

Several areas in the Farmington-Durango project were retired to a joint use in creating an improved wildlife habitat and in controlling erosion.

The necessity of preservation of wildlife has been demonstrated on farms under cooperative agreements. The effect of this on the farming community has resulted in a petition to the State authorities to set aside a strip twelve miles long and three miles wide along the La Plata River as a refuge for game birds. Farmers have also posted their individual farms against hunting and trapping.

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A considerable amount of stream-bed fencing in connection with planting operations and desilting plots gives promise of resulting in an improved wildlife environment on the District.

Generally better cooperative relations established with other Sections resulted in more effective wildlife work. It is felt that considerable progress was made in this direction during the year.

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WOODLAND MANAGEMENT DEVELOPMENT

Fire Protection

Saw Mill Practice

Utilization

Timber Surveys

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WOODLAND MANAGEMENT DEVELOPMENT

The Woodland Management Section during the past year devoted a major portion of its time to the making of timber and woodland surveys both on and off the Reservation.

The section has also cooperated with the Agronomy Section in the supervision of planting and taken an active part in the preparation of planting plans. Several detailed planting plans have been developed for the coming year and an active program is expected.

There are some excellent opportunities for woodland planting in conjunction with other erosion control measures already effected or which are soon to be developed.

The Woodland and Wildlife Sections are working hand in hand in the preparation of planting plans and in the selection of species for use.

During the past year surveys have been performed from which management plans for the proper regulation of use of forest resources will be prepared.

Fire Protection.

The fire season on the Navajo Reservation starts about the fifteenth of May and ends in October; a slight break occurs the last week of June and the first three weeks of July during which period summer rains usually eliminate much of the hazard. The submission of this report therefore comes near the middle of the season and for proper understanding of the situation it is necessary to divide the report into calendar years. Last year's report gave a total protected acreage of 3,465,000 divided into 465,000 acres of yellow pine and 3,000,000 acres of woodland. There has been no change in these figures but more complete protection has been obtained by the construction of a lookout tower on Mt. Fowell in the eastern part of the Reservation. The tower is operated on a cooperative basis by the Navajo Service and the Forest Service. The Navajo Service built the tower, equipped it, constructed a road to it and developed a spring. The Forest Service furnishes the personnel and transportation. The new tower has been triangulated with towers at Tohatchi, Washington Pass, Klagetoh, and McGaffey--the latter on the Cibola National Forest. It strengthens the Navajo Service detection system and also materially strengthens the Forest Service system over what is termed the McGaffey-Danoffville area. It eliminates many of the areas that were blind to other towers.

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Fires.

In the calendar year of 1937 there occurred a total of 67 fires. The cause, classification, area burned, and loss is tabulated below:

Classification:

Lightning	51		
Campers	7		
Smokers	1		
Debris burning	1		
Incendiary	5		
Miscellaneous	2		
Total	67	Class A	62
		Class B	5
Acres Burned	11		
Loss Valued at	$50.00		

The report for the 1938 calendar year is, of course, not complete. Thus far there have been fifty-one fires covering 150 acres. Four of the fires have been of Class C, six of Class B, and the balance of Class A. The total loss up to date has been in excess of $500.00. The increase in size of fires and of resulting loss has been the result of the exceedingly dry, hot weather and high winds prevalent since the first of May.

The losses would unquestionably have been even greater had it not been for the radio equipment that the Indian Service has installed. A 250-watt station has been installed at Window Rock; a 150-watt station at Tuba City; and a 150-watt station at Crownpoint. Mr. Kenefick, Assistant Forester for Soil Conservation Service in charge of fire protection; Mr. Hamilton, Assistant Forester for Soil Conservation Service in charge of forest activities on the Navajo Reservation, and the Fire Dispatcher have each been provided with two-way sets which makes it possible to carry on cummication with the Dispatcher or with the Director of Land Use at Window Rock direct from the fire line. This equipment has unquestionably saved a considerable amount of forested area.

Saw Mill Practice.

A real attempt has been made to operate the Navajo Sawmill in such a manner as to provide cheap material to the Government and to the Navajos, and at the same time establish sound silvicultural practice in the forested areas. A system of marking has been adopted which makes it possible to remove from the woods only

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those trees that are overmature and will not last through the next decade. Obviously, this type of marking results in a high percentage of low-grade material. So far, it has averaged on a grade yield only 10 to 15 per cent Clear and Select and about 10 per cent #1 Common; the balance is #3 and #4 Shop and what is termed locally as #2 and #3 Common. It would perhaps be impossible to operate on a commercial basis with such low grades unless the operator were equipped with a cutup plant and a factory where finished products would be manufactured. In other words, commercial operation for the manufacture and sale of lumber would be practically impossible with such a low percentage of upper grades. A private operator would have to convert his lumber into a finished product, such as boxes or other wood items, or cut more heavily in order to show a profit. The Government sawmill on the other hand has been able to operate successfully on a non- profit basis on the 40 to 50 per cent of the merchantable stand which should be cut. The lowest limit to which cutting can proceed without loss is 2,000 feet per acre. Naturally there are many areas that fall below this limit but there are other areas that far exceed it and on which good profit is made. It has been possible by use of the profits on the better areas to extend cutting into many sub-marginal areas which are incapable of carrying themselves. The total area placed in improved silvicultural condition and on which greater yields of merchantable timber are to be expected has thus been increased with no outlay of funds. In order to allocate costs by areas, complete yield and cost records are kept for each cutting plot. Plots are selected on the basis of volume and need for treatment. After its selection each plot is surveyed with chain and compass, outlined with blazes, mapped, and subjected to vegetative inventory. Reproduction is classified and counted. All trees above sixteen inches are classified according to Dunning's Tree Class System. Trees to be removed are then marked and again classified according to Dunning's System so that the grade yield for each class can be determined. Annual increment is obtained and tabulated for sample trees selected for that purpose. After preliminary work is complete the fallers go into the area and wherever possible fall the trees parallel to the contours. Skidding is also done along the contours. This produces small contour furrows which prevent runoff. The furrows not only accumulate moisture and duff, but become concentration lines for available seed and thus aid in stand regeneration. Brush disposal is accomplished by lopping and scattering slash over the contour furrows, roads, and other potential areas for reproduction. Considerable quantities are also used for plugging gullies, washed out roads, and other areas of erosion. Since this type of logging started, 1,500 acres have been treated in this manner. The stand itself is in much better silvical condition and all draws, roads, and even small finger gullies have been plugged with the debris made during the operation. It has been definitely proven that a timber operation can be conducted on the conservation basis and

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done economically. Logs from the operation have been taken to the Navajo Sawmill, converted into lumber and sold exclusively to the Government and to the Navajo Indians at a very reasonable cost. The whole operation has been worked out on a basis that makes it self-liquidating.

Utilization of Forest Products.

An attempt has been made during the past few years to get a satisfactory check on the actual utilization made of the various tree species on the Navajo Reservation. In last year's report were entered certain figures to illustrate the amount of control that had been obtained in both the Yellow Pine and the Pinon-Juniper Woodland types. These figures obviously did not in any way illustrate the extensive uncontrolled utilization of forest products. They simply gave the information available from the cutting permits that had been issued, it being estimated that only about sixty per cent of the forest products utilized had been cut on permit. There has been little if any increase in per cent of permit-cut material this year. The total volume of material used has, however, increased. Reported totals of forest products cut under permit is as follows:

House Logs	8,212
Pine Stays	80,000
Juniper Posts	45,863
Oak Posts	25,340
Poles	12,068
Pinon Props	4,048
Christmas Trees	None
Ponderosa Pine Timber	3,000,560 feet BM

As compared to last year's report, these figures show a reduction in cutting of pine stays and pinon props, and the complete elimination of Christmas trees. A survey of the Reservation indicated that the cutting of Pinon for mine props has, in past years severely depleted a considerable woodland area close to mining sites. In some instances local areas were entirely denuded with the resultant elimination of other vegetation. It has been possible to considerably reduce the extensive cutting of Pinon props by the substitution of material from the Ponderosa Pine logging operation on the Defiance Plateau. Tops of the Ponderosa Pine trees cut in the logging operation are now cut into mine props. This makes it possible to get an exceedingly close utilization of the Ponderosa Pine timber and also reduce drain in the Pinon woodlands. Furthermore, it is possible to furnish these props at a lower cost than the independently cut Pinon props. The Ponderosa Pine props cost 25¢ apiece, whereas, the Pinon props have been

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costing the Government 35¢, not including stumpage cost. Again, since the Pinon woodlands have the additional value of producing Pinon nuts and occupy areas that are heavily overgraze it was necessary to divert some of the use load to the Ponderosa Pine area which is over-mature and badly in need of cutting. The reduction in number of pine stays cut this year as compared to last year has also come as a result of lumbering in the Ponderosa Pine area. A considerable number of stays are now supplied from the sawmill where they are made from edgings and at a lower cost than the independently cut and hand-split stays.

The cutting of Christmas trees was eliminated because reproduction of species suitable for this purpose is very limited on the Reservation. The best Christmas trees are those found growing in open spaces where reproduction is scattered and difficult to secure. Trees grown in such areas are symmetrical, better formed, denser, and in every way more desirable than those found in clumps where thinning is silviculturally permissible. Such cutting has therefore been eliminated as completely as possible.

It is necessary to further direct utilization to Ponderosa Pine and conserve the extensively over-used Pinon. By so doing, the Pinon pine stands can be better preserved, reproduction in the woodlands will be increased, a larger Pinon crop will result, and considerable harmful wagon travel through the woodlands will be eliminated. The extension of innumerable wagon tracks through the woodland areas has contributed much toward gullying. The wide distribution of the Pinon-Juniper woodland together with its general low density makes its primary function one of watershed control; for this reason utilization of the type should be confined as nearly as possible to the cutting of fence posts and fuel wood for local consumption. Naturally in many instances it will be absolutely necessary to use Pinon and Juniper for other purposes since the Ponderosa Pine area is limited, centralized, and too far removed from many parts of the Reservation. Wherever possible, however, utilization should be directed to the timber area and the load that the Pinon-Juniper areas have carried in the past should be lightened.

One of the purposes of the surveys of the Land Management Districts was to locate areas where utilization of the woodland types has been such that it could continue without danger of depletion. In other areas only moderate use can be made, and considerable areas will be totally destroyed unless they are given a complete rest. Areas to be subjected to full use, partial use, and no use, have all been mapped and the District Supervisors and others in charge of administration of the districts have been instructed to direct utilization toward the better areas.

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Forest Practice. Improved utilization practices have been employed during the three years the permit system has been in operation. It is recognized that even now the regulations are rather general and are only applied to the estimated fifty to sixty per cent of the cutting that actually is done under permit; it must at the same time be remembered that forest practices are largely controlled by education and tradition and must change slowly. In time, certainly, a further increase in per cent of permit cutting and a closer adherence to proper forest practices can be expected.

Utilization of Yellow Pine. Navajo utilization of the Ponderosa Pine has in the past been extremely limited. During the last three years it has been possible to direct the cutting increasingly toward the Pine belt. This has accomplished very desirable results both in the Pine and in the other forested areas. Thinnings have been made in the dense clumps; the manner in which slash has been scattered has provided better seedbeds; the scattered tops and limbs have aided in grazing control as the Navajos have found that there are certain hazards connected with driving sheep through slash. The small slash covered areas unquestionably will support the clumps of reproduction in years to come. Even during the first year after cutting vegetative recovery in the debris covered areas is considerable and they become increasingly efficient in controlling runoff. The twigs and needles establish duff coverage, and the increased moisture together with mechanical protection makes for ideal seedbed conditions.

Timber Surveys.

During the past year a complete survey was made of the Ponderosa Pine Forest area. From the aerial pictures and from the land classification maps it was determined that about 500,000 acres of land could be classified as Ponderosa Pine. It was then necessary to determine what portion of this area should be classified as primarily of value for watershed protection and what part would normally fall within the sphere of a commercial timber operation. The survey field work was all completed on a cooperativebasis between the Soil Conservation Service and the Indian Service. Topographic features, the natural division of the timber area, and economic considerations made it necessary to make the survey in two sections, namely: (1) The Defiance Plateau area. (2) The Tsaileo area. Because the two areas are definitely tied together on a watershed basis, a general management plan should embrace the entire timber belt. Reasons given above, however, have made it advisable to prepare a specific plan for each area. The initial plan for the Tsaileo area has been completed, but some revision is necessary. The plan for the Defiance Plateau area is now being compiled and will be ready for presentation in the very near future.

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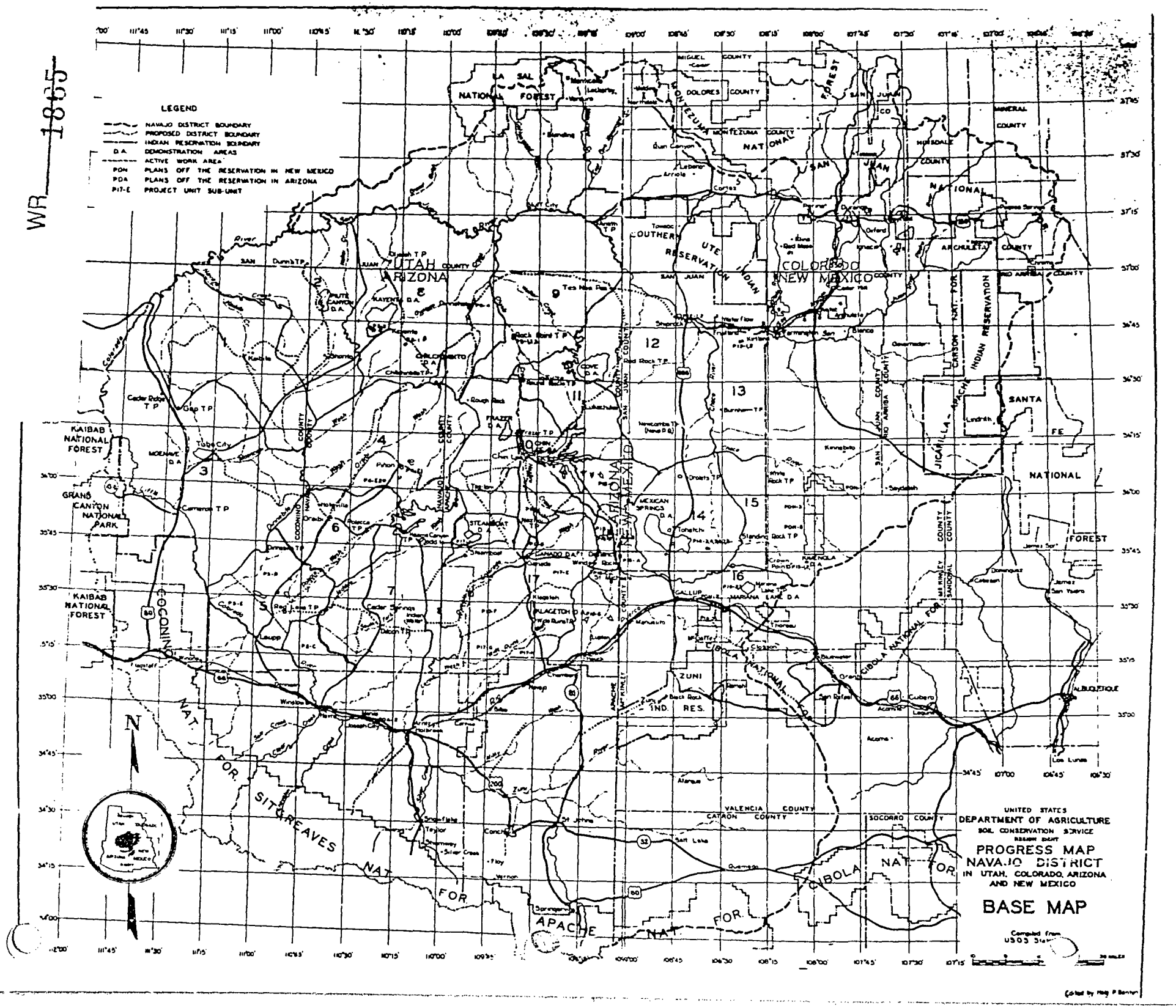

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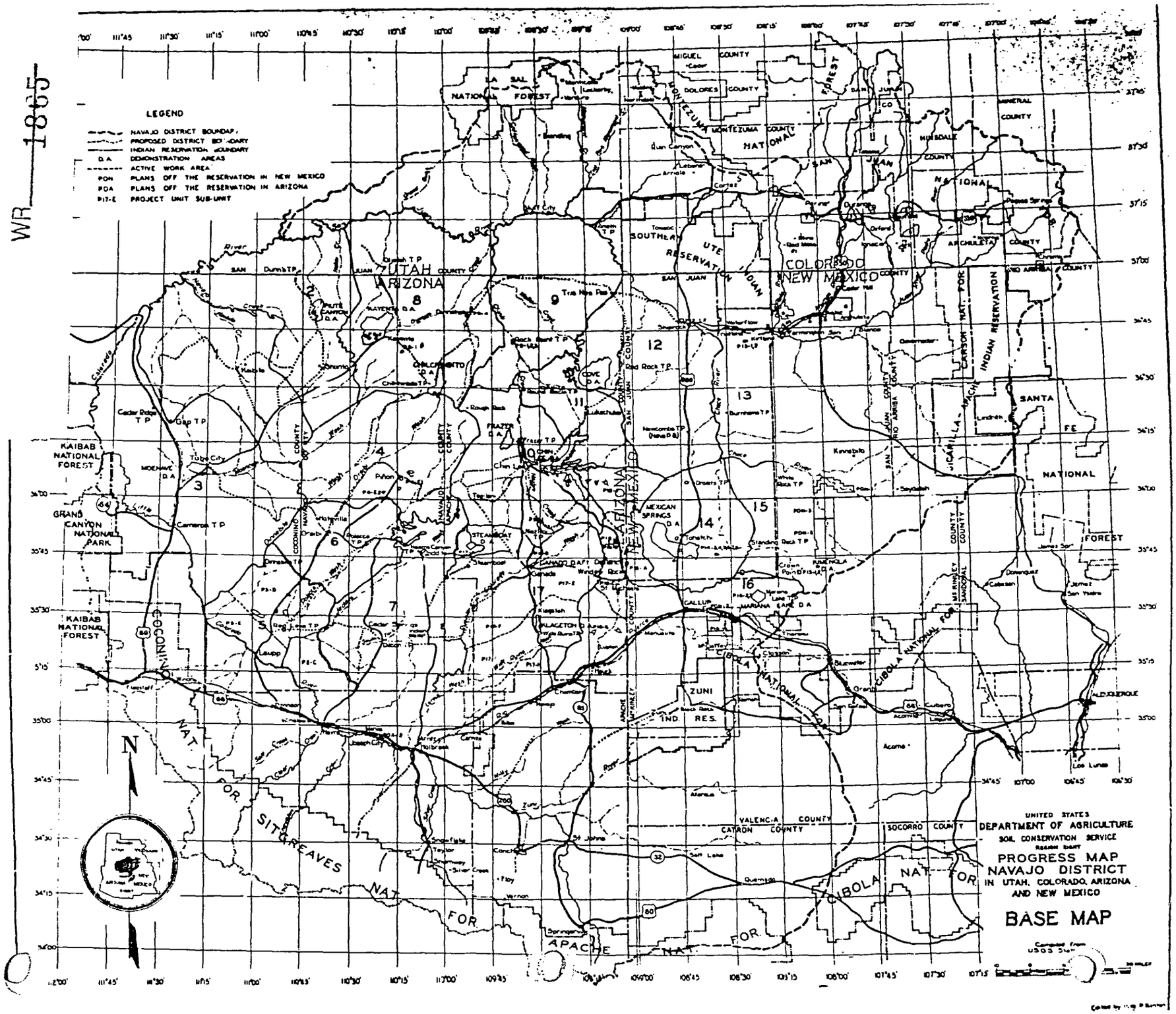

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