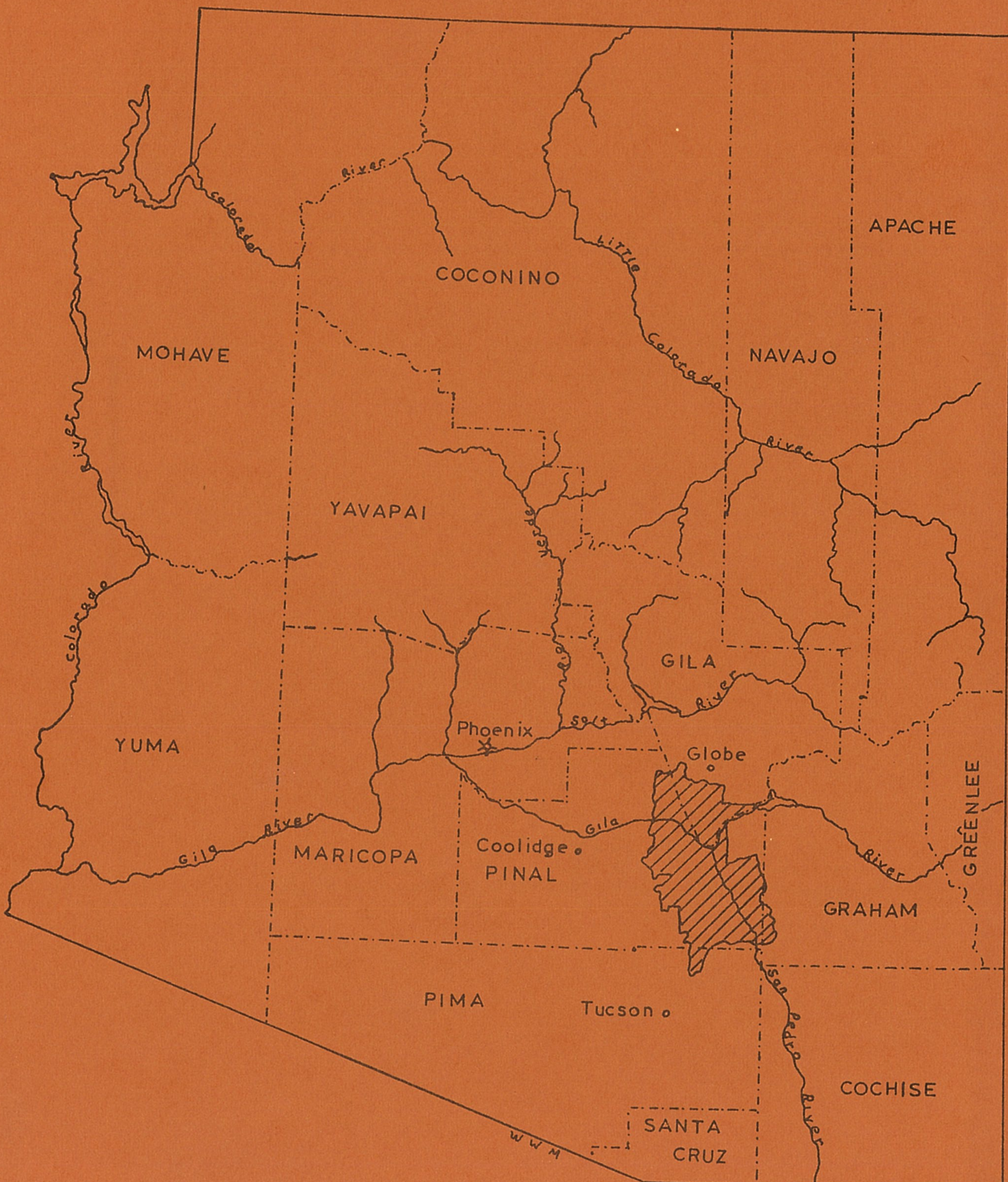
WINKELMAN NATURAL RESOURCE CONSERVATION DISTRICT

Field Report

1980



WINKELMAN NATURAL RESOURCE CONSERVATION DISTRICT

FIELD REPORT

Submitted by

W. Walter Meyer

A report to the conservation district finalizing a contract to update the Winkelman Natural Resource Conservation District records and evaluate ongoing and future programs.

1980

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INTRODUCTION

Background

The Winkelman Natural Resource Conservation District (WNRCD) was organized and became functional under the auspices of the Soil Conservation District Law, State of Arizona, in October, 1948. The Arizona State Attorney General issued the Certificate of Organization on October 4, 1948. The goal of the district is to foster and assist in programs that will ensure sustained yields of all natural resources within the district. The charter of the district instigates restoration, protection, and promotion of soil, water, forage, wildlife, and other physical resources through sound and wise land and water use practices that will benefit all responsible resource users.

Objectives

Pursuance of the district goals requires knowledge of resources and physical improvements within the district and the status of resource management programs. To acquire the needed knowledge this field investigation was instigated through a directive by the district members. The objectives of this field report are to:

(1) map ranch and farm units within the district; (2) elucidate present land status; (3) evaluate and enumerate the district's land resource areas; (4) evaluate rangeland improvement programs; (5) quantify established and needed physical improvements; (6) determine other resources in conjunction with the district rangelands.

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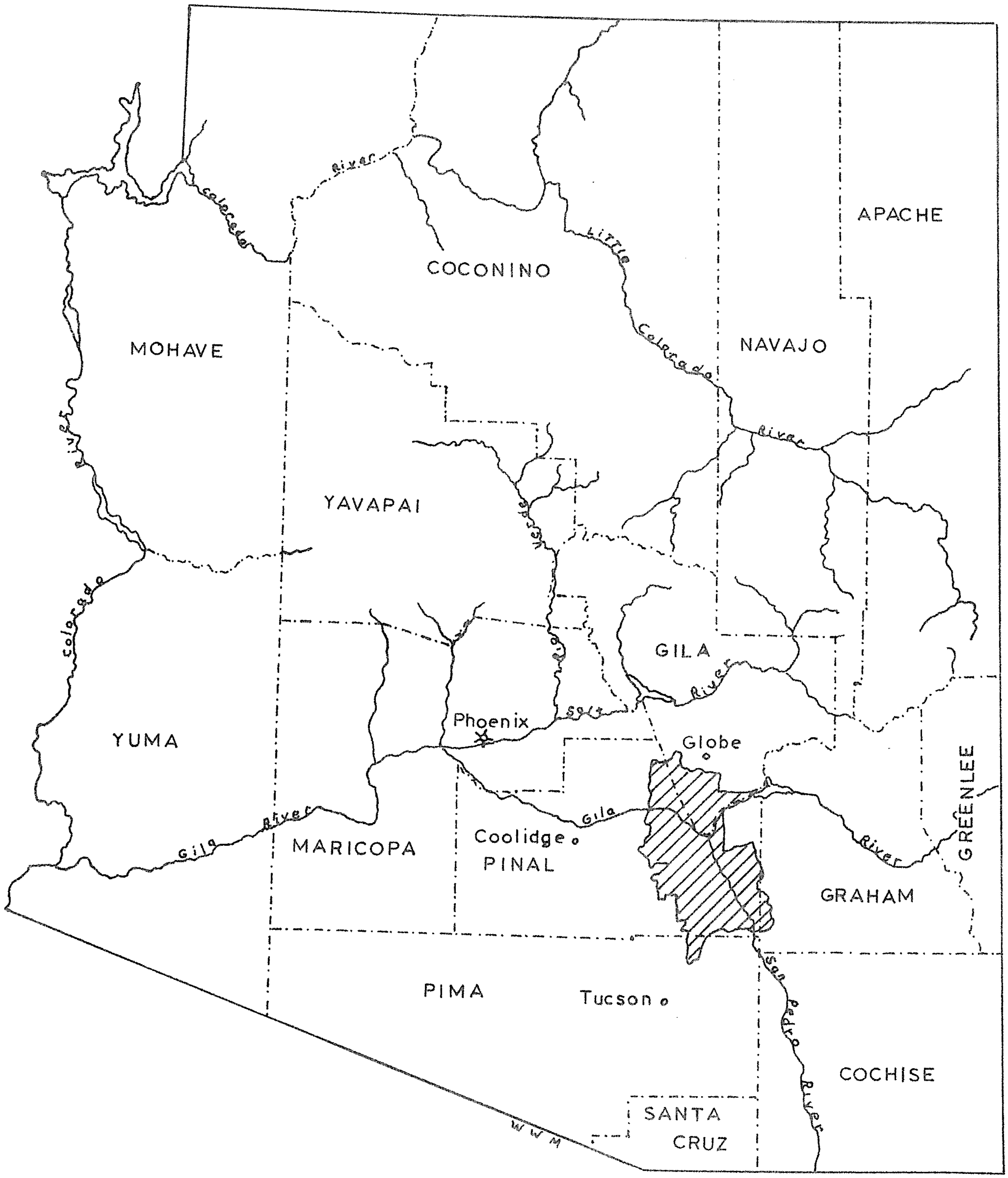

DESCRIPTION OF THE WINKELMAN NATURAL RESOURCE CONSERVATION DISTRICT

The WNRCD is in southeastern Arizona with rangelands that are located in eastern Pinal County, southern Gila County, western Graham County, and northern Pima County. Rangelands vary in elevation from 1,800 to 9,000 Feet (549-2,743 m) and encompass vegetative zones that range from Upper Sonoran Desert Shrub to Plateau Coniferous Forest. The climate within the district is varied; average annual rainfall ranges from 14 to 25 inches (356-635 mm) with mean daily temperatures of 80.4 F (26.9 C) maximum to 48.5 F (9.2 C) minimum in the lower elevations and 60.6 F (15.9 C) maximum to 38.5 F (3.6 C) minimum at the higher elevations.

The major community centers in the district are Dudleyville, Hayden, Kearny, Kelvin, Mammoth, Oracle, San Manuel, and Winkelman. The communities of Globe and Superior lie just outside the resource district yet serve the residents of the district. Residential developments are commonplace along the Aravaipa, Dripping Springs, Gila and San Pedro Valleys. Urban development utilizes 18,650 acres or 2.3% of the district. The mining industry provides the major employment and generates most revenues within these communities.

The geology of the district is extremely varied with the largest geologic unit being Precambrian Ruin Granite followed by Tertiary alluvium, Quaternary alluvium, Precambrian sedimentary rocks, Tertiary volcanic rocks, and other geologic members. The major non-renewable mineral resources are copper and associated minerals, gypsum and gypsic earths, silicates, limestone, diatomite, and uranium. Most of these minerals are refined within the district but are removed from the district and have little agricultural application with the exception of gypsic earths and potentially diatomite. At the present status the mining and related industries utilize 21,920 acres or 2.7% of the land within the district.

The second largest source of revenue within the district is livestock, agricultural, and agronomic related businesses.[1] There are 24 farm units and 50 ranch units that utilize 795,155 acres or 97% of the land resource. Much of the mining property previously discussed is used in conjunction with livestock grazing. Agronomic croplands, approximately 4,920 acres, produce varied commodities. Listed in respective order of acres planted these crops are: irrigated pasture, hay, small grains, grain sorghum, cotton, pecans, apples, citrus, and smaller amounts of other varied crops.

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[1]The classes are in compliance with Turley and Barr (1979).

Recreation and related services generate little revenue within the communities of the district even though the district land resources and physical improvements are exploited for their use. Revenues that are brought into the district by these related industries are generally in the form of salaries to technicians and employees who are on temporal assignment. Most type specific improvements, recreational and game habitat improvements, are made with monetary funds that are mainly generated from outside sources; while the majority of the beneficial land improvements, conservation, and restoration programs are achieved with monetary resources obtained from land resources within the district. The district tax base of private property and improvements, fees, and other fixed and variable expenditures produce substantial revenues for the communities in the district and various government agencies.

HISTORICAL REVIEW

It is necessary to have some understanding of historical use of lands within the district before valid considerations can be made of resource uses.

Col. H. C. Hooker stated in a letter to Griffiths (1901) that in 1870 the San Pedro River area had an abundance of sacaton, grama grasses, and underbrush of many kinds and that "...the riverbed was shallow and grassy...with a luxuriant growth of vegetation." Hooker indicates that by 1900 the forage production had been reduced by 50% over the previous twenty-five year period. Cattle numbers were also reduced by 50% for this same time period.

A letter from C. H. Bayless, Oracle, Arizona, to Griffiths (1901) stated that in 1880 "...grama grasses covered the country...(with) 'alfilaria' (Erodium cicutarium) furnishing limited but excellent pasture during spring and early summer." He indicates that the San Pedro River was a fertile valley in the 1880's but by the 1900's it had been overgrazed and became a "...sandy wasteland from bluff to bluff." He also states that average rainfall and environmental conditions had not changed and that the vegetational changes were a result of overgrazing and misuse. Forty thousand head of cattle were said to have grazed the region in 1880 whereas only 3,000 grazed by the 1900's.

In a 1904 bulletin, Griffiths described the rangelands between the Willow Springs Mountains (Black Mountain), Oracle, and Dudleyville as being grasslands with the dominant species being grama grasses. He also described "alfilerilla" (Erodium cicutarium) as an abundant and valuable forage species. Jojoba (Simmondsia chinensis) was considered a valuable browse species and was stated as being abundant in the Dudleyville area. Photos in this bulletin indicate rangelands near Dudleyville as being grasslands; in contrast this area is now classed as Upper Sonoran Desert Shrub by the Soil Conservation Service Major Land Resource Areas (MLRA) Site Descriptions.

Parr, et al. (1928) show that cattle numbers for Arizona and New Mexico peaked between 1890 and 1893 then declined until 1900 and again increased until 1922. Sheep and goat numbers were lowest between 1890 and 1893 then increased to the maximum of 6,750,000 in New Mexico and Arizona in 1903. A gradual decline in numbers of sheep and goats is then indicated until 1927.

The aforementioned indications of cattle numbers are in agreement with the approximate cattle numbers for the WNRCD given in Figure 1. No reliable information could be secured to atest to the number of Angora goats that utilized range resources in the district although the number was known to be considerable.

Long-time residents in the district indicate that severe droughts occurred between 1915 and 1921 and again between 1930 and 1941. Large numbers of livestock were lost during these periods. Weather records do not necessarily indicate

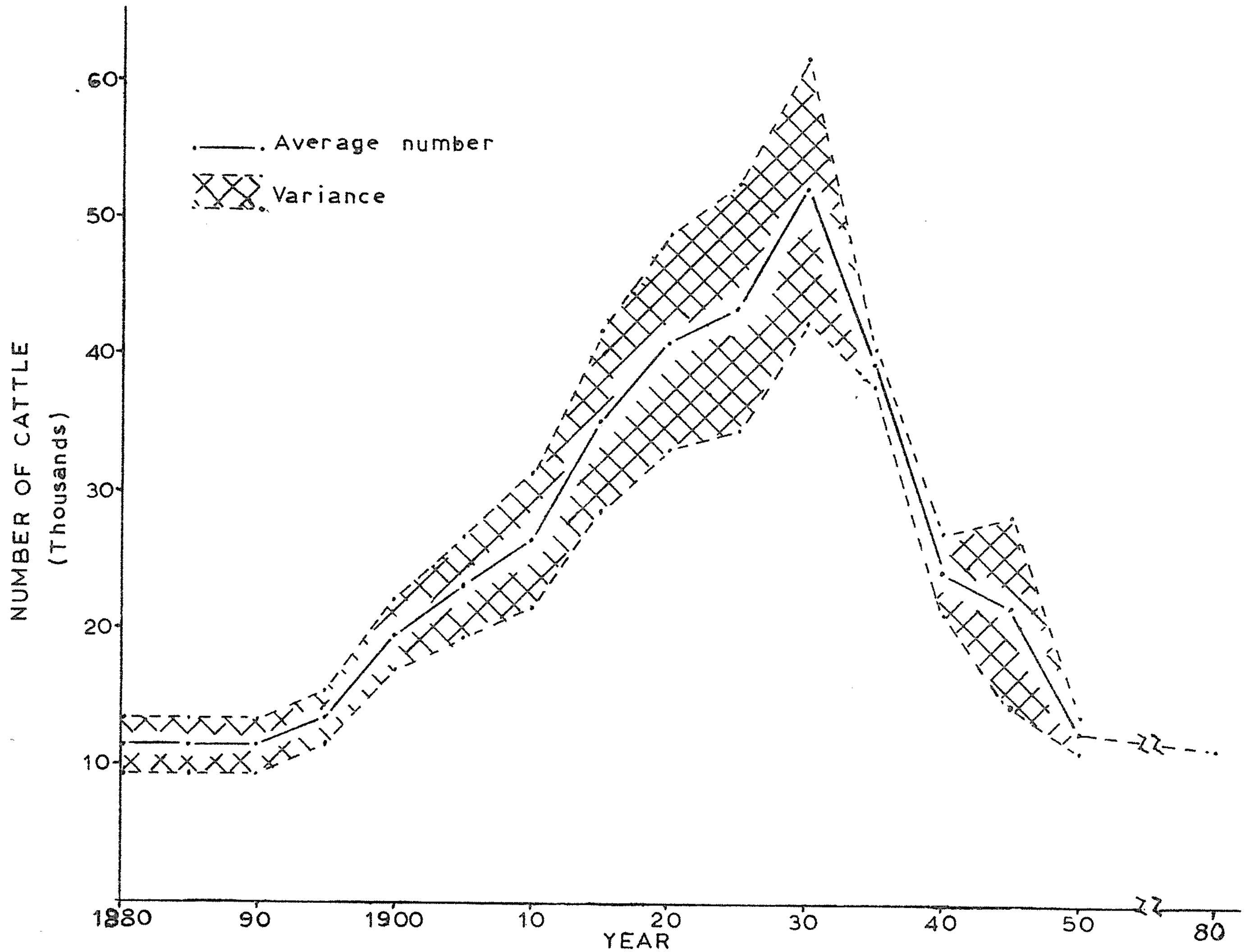

Figure 1. Cattle numbers in the Winkelman Natural Resource Conservation District through time (Meyer, 1972).

severe drought conditions for those time periods, but below normal seasonal rainfall did occur. This, along with the excessive livestock numbers, would have had a devastating effect on livestock numbers and range forage species.

Livestock - cattle, goats, horses, and burros - traversed the district unimpeded in their movements, utilizing any available forage. There was no formal attempt to control livestock numbers or to instigate serious management programs with the exception of a federal program in the 1930's to purchase and destroy breeding herds in the district. This program met with limited success; only several thousand head at most were destroyed and buried along the San Pedro River Valley. In addition, large numbers of horses were gathered and shipped from the district by local ranching operators.

The Enlarged Homestead Act of 1909 and later the Stock-raising Homestead Act of 1916 encouraged exploitation of range resources by inferring that 640 acres were adequate to carry 50 head of cattle, Stoddart and Smith (1955). Note the resulting increase in cattle numbers between 1900 and 1930 shown in Figure 1. The devastating impact of overgrazing coupled with the depressed national economy brought about the sale of many homesteads and a subsequent reduction in live-stock numbers. The acquisition of these homesteads by local ranchers along with the allocation of lands by government agencies established many of the existing ranch units in the district. Fencing and establishment of ranch boundaries was essentially completed in the 1940's and 1950's.

The establishment of ranch units compounded the damage to range forage species because excess livestock was not removed. Transformation of rangelands from grasslands to desert shrub was essentially completed and persists to the present time. Serious attempts by ranchers to reestablish the grassland vegetation, whether by management or physical mechanical methods, have only met with limited success or failure.

York and Dick-Peddie (1969) suggest that historic excessive livestock grazing not only removed and damaged desirable forage species, but that it was also responsible for the introduction, spreading, and establishment of less desirable species such as mesquite (Prosopis juliflora). The establishment of a deep-rooted shrubby species such as mesquite is undesirable because such a species can manifest its own environment by its basic physiological characteristics, Simpson (1977).

Fenced exclosures[2] in the district reveal that vegetational changes in the rangelands occurred prior to the 1920's and 30's. The vegetational makeup of these exclosures is of very limited species composition. These monotypic communities vary in species makeup from exclosure to exclosure. An outstanding example is an area in Section (Sec.) 17, Township (T) 6S, Range (R) 18E where hairy grama (Bouteloua hirsuta) makes up about 90% of the composition and produces an estimated

[2]Exclosures are fenced parcels that exclude livestock from physical improvements or pastures which receive limited use.

95% of the total forage production. This information infers that livestock management (removal or manipulation) alone may not be adequate or desirable to achieve mixed communities of range forage plants, and may foster the establishment of similar monotypic communities. The sequencing of environmental conditions through time evidently favors a limited number of species through that particular time period, Jordan (1974). For example, one sequence of environmental and plant interactions may favor plains bristlegrass one year; whereas, plains lovegrass (Eragrostis intermedia) may be favored by a slight alteration in that sequence another year. Once a single species is established it maintains a closed community (if all other influences are held constant) because of the high probability of the dominant species seedlings becoming established, Connell and Slatyer (1977).

At the time of filing this report there are an estimated 11,450 head of cattle on rangelands and irrigated pastures within the district. The number does not include small "backyard cattle" and only reflects the number of cattle in commercial operations. It is of interest to note that this number is within the variance range of cattle numbers found on the district rangelands between 1880 and 1890, Figure 1.

RANCH UNITS

Prior to this field investigation less than 30% of the ranch and farm boundaries within the WNRCD was mapped. At that time only legal descriptions were used to define boundaries. It was the stated objective of this contract to develop individual ranch mapping units that could be used by the district for future management programs and decision-making tools. This objective was considered an integral part of the project. Information disclosed within these map units will provide the respective operators, field technicians, and the district board with base information for decision making within each operation. The basic mapping units are outlined on the enclosed map in the back of this report. Detailed information for each ranch and farm is included in the accompanying district property file.

It should be noted upon review of the map that the names of the ranch units may not reflect current names used for these ranch units. The logic behind using old or established names is that there is a greater than 10% turnover of ranch units within the district. By using old names on files it will be easier to keep track of information for each operation. The 10% turnover rate stated above is an inflated value because several ranches have changed ownership more than once within a year's time.

An important point should be kept in mind concerning the ranch units in the district; that is that most of these ranches have a slow rate of exchange compared to the average yearly 20% change in ownership within the state of Arizona, Stewart (1980) and Archibald (1980). Most ranches have been in the same ownership for fairly long periods of time with many being held within the same family for at least 25 to 50 years. This is a great advantage to the district in that it can draw upon these residents' long-term experience in operating under most all conditions.

DISTRICT LAND STATUS

The WNRCD is composed of 819,420 acres, most of which are used for livestock production and agronomic crops. Table 1 displays the number of acres and the distribution of lands to their respective management agencies.

Table 1. Land status of the Winkelman Natural Resource Conservation District with regard to specific management agencies.

Agent	Acres of Control	Total Acres	% Comp.
Private Ownership	187,815	187,815	22.9
State of Arizona	371,048	371,048	45.3
Bureau of Land Mgmt.		165,686	20.2
Safford District	121,250		(14.8)
Phoenix District	44,436		(5.4)
Forest Service		82,845	10.1
Coronado Forest	40,170		(4.9)
Tonto Forest	42,675		(5.2)
Primitive/Wilderness			
BLM/Forest Service	8,305	8,305	10.1
San Carlos Indian Res.	1,315	1,315	0.2
City or Townsites	1,709	1,709	0.2
Indian Family Trust	537	537	
Pinal County	160	160	
Total	819,420	819,420	

Land ownership and management programs are highly disseminated throughout the district. Private lands are greatly interdispersed with other lands. State of Arizona leased lands, which produce revenues for the state, form fairly contiguous blocks in many of the ranch units. Forest service lands are well blocked but apparently there is little continuity between allotments. Bureau of Land Management (BLM) lands are widely dispersed throughout the WNRCD with some differences in management philosophies between the Phoenix and Safford BLM districts.

The apparent charter of Forest Service land acquisition was based primarily on water resource yield values and visable forest stands. Little timber production other than salvage is evident within the district boundary. On forest lands, mineral resource exploration and development is becoming a potentially dominant monetary resource. Mineral resources are being explored in the Oracle Ridge area and in the JI Ranch and Pinal Mountain areas.

The distribution of BLM lands within the district is not purely random. There is a fairly strong correlation (r=-0.7[3], a conservative figure) between the occurrence of BLM lands and potentially exploitable mineral resources. (see Krieger). These non-renewable natural resources are non-metallic minerals, metallic minerals, and metallic fuels, listed in order of abundance. Seventy-seven percent of the BLM lands have apparent exploitable mineral resources while only 17% of the private lands and 7% of the state lands show evidence of potentially exploitable mineral resources. It must be considered that the mineral resources on private lands, exclusive of mineral patents, are controlled by the Department of Interior through BLM as are some of the state

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[3]The correlation coefficient r= -0.7 indicates that large areas of state and private lands are associated with small areas of mineral resources.

lands that have had minerals withheld. This information then suggests that priority for retention of ownership of BLM lands is based on the potential of generating revenues from a non-renewable resource, i.e. minerals, and with secondary regard to renewable resources, i.e. rangelands. The adage that BLM lands in the district are of poor quality and are not desired by the private or state sector is incorrect at best. Much of the BLM lands are comparable or better in range forage production than are the private or state lands. BLM's proposed acquisition of 21,485 acres of state and private lands in the WNRCD, BLM (undated), may not be pursuant to the goals of the WNRCD.

The dispersion of private lands is selective and dependent upon resources available to livestock or agronomic production or proximity to community centers. This great interdispersion of land ownership confounds any attempt by district ranchers to develop basic management programs. The lack of consistency in land management policies and regulations between different land agencies fosters confusion and counterproductive results rather than agreeable steps to achieve true land management goals.

LAND RESOURCE AREAS

The land resource areas and subresource areas within the WNRCD are idealistically illustrated in Figure 2. The acreages of the subresource areas are displayed in Table 2. The delineation of these map units is in compliance with information set forth by the United States Department of Agriculture Soil Conservation Service (SCS) Major Land Resource Areas (MLRA) and Subresource Areas Map (1978) and by the SCS Range Site Description sheets.

Table 2. Acreages of land subresource areas in the Winkelman Natural Resource Conservation District.

Id. Code	Subresource Area Name	Acreage	% of District
D39-1	Mogollon Plateau Coniferous Forest	5,865	0.7
D39-3	Mogollon Mixed Woodland-Grassland	740	
D39-4	Ariz. Interior Chaparral-Grassland	77,080	9.4
D40-1	Upper Sonoran Desert Shrub	263,500	32.2
D41-1	Mexican Oak-Pine Woodland and Oak Savannah	56,420	6.9
D41-3	Chihuahuan Semidesert Grass-land	415,815	50.7
	Total	819,420	

The MLRA range site descriptions do not fit particularly well for the WNRCD. In general the site descriptions are

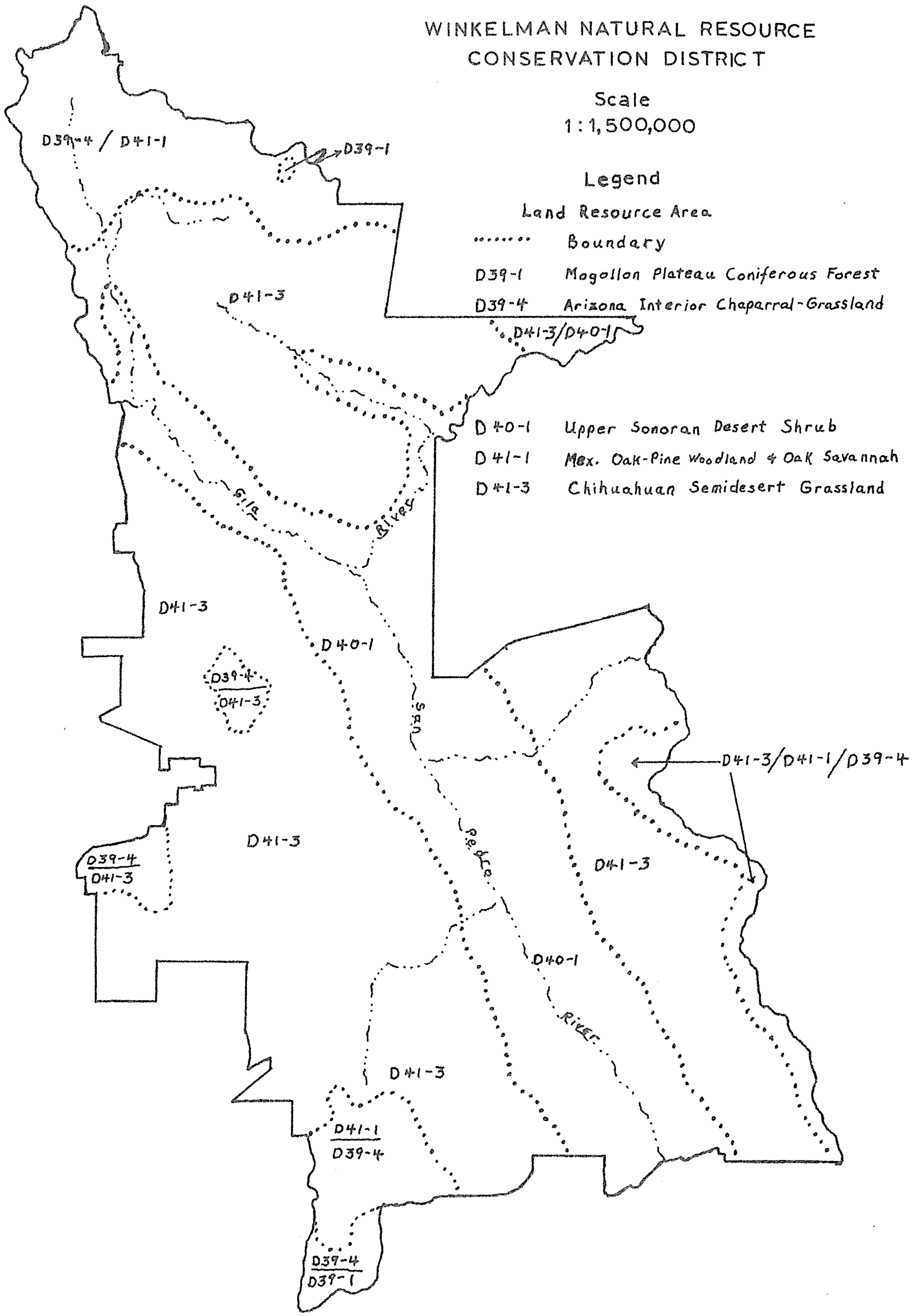

Figure 2. Land subresource areas in the Winkelman Natural Resource Conservation District.

usually deficient in their descriptive characteristics. The major inconsistencies are rainfall and species listings.

The Mogollon Plateau Coniferous MLRA occurs primarily in the Santa Catalina Mountains on the Canada Del Oro allotment. Similar small acreages of this subresource area are found in the Pinal Mountain portion of the district. Little livestock utilization occurs in this subresource area due to topographical inaccessability.

The WNRCD contains only a small amount of Mogollon Mixed Woodland-Grassland. The value of delineation of this subresource area is questionable. It is found only in the northern part of the Lyons Fork Allotment on top of the Pinal Mountains which receives in excess of 25 inches average annual rainfall. Most of this area is used by livestock when adequate water is available at the higher elevations.

Arizona Interior Chaparral-Grassland MLRA is widely dispersed and varied in vegetational makeup throughout the WNRCD. There is good conformity between the MLRA description sheet and the actual physical plant communities in the northern part of the district. However nonconformities increase between the MLRA description sheets and actual vegetational populations the farther south one travels within the district. This nonconformity can be better understood if the uniqueness of the area is considered. The absence of many of the species constituents is not unlike the species nonconformities that exist within the other MLRA site descriptions. The occurrence of chaparral species associations in the west central portion of the WMRCD must be considered as Arizona Interior Chaparral-Grassland for they are historic, they form closed communities, they are fire persistent, and they are not greatly modified in composition by normal habitat alterations. The southern and western populations conform better to the Coronado Chaparral classification given in the Arizona Interagency Range Technical Subcommittee Bulletin A-58 (1973). There is also a difference in the livestock utilization within these two distinct populations. Many species that make up the chaparral in the northern regions are seldom utilized whereas most species in the southerly chaparral communities are periodically utilized.

The Upper Sonoran Desert Shrub class in the WMRCD fits the site description sheet except for rainfall. The association of species is probably maintained within the district by a complex set of environmental and physical interactions. Historical information indicates that these communities have invaded from "island communities" and have become entrenched in what would otherwise be classed, at least in part, as Chihuahuan Semidesert Grasslands. It is evident from field investigation within this land resource area that suppression of fire, for example, has allowed much of the potential forage production to be locked up in low forage value species. The actual average annual rainfall is much greater than that used to define this land resource. It is conceivable to transform 50% of the Upper Sonoran Desert Shrub class to Chihuahuan Semi-desert Grasslands if more progressive approaches are taken on clayland extensions and bottomlands.

Mexican Oak-Pine Woodland and Oak Savannah occurs most commonly at elevations above 4,200 feet (120 m). This land resource area conforms fairly well with the description sheets although there are species absent in the district that are considered dominant in this type site location description.

The Chihuahuan Semidesert Grassland MLRA makes up the majority of the WNRCD. These grasslands have similarities with the MLRA description sheets; but again there are many species missing that are included in the description sheets.

Due to the uniqueness of the physical and environmental conditions and their interactions within the WNRCD it would be unwise to extrapolate information from previously documented materials. This portion of Arizona cannot be justly compared with other parts of Arizona or the Southwest. This district has two distinct growing seasons, late fall to spring and summer to early fall. Forty-five percent of the long-term average rainfall comes in the winter months while 55% occurs in the summer growing period. Winter storms which originate in the Pacific Ocean are usually of low intensity and of several-days duration. Summer rains originating in the Gulf of Mexico are usually of high intensity and short duration. These conditions provide for the establishment of warm and cool season plant communities that may have certain similarities with plant communities elsewhere in the state; but management programs for outside areas may not be adaptive or even desirable for those within the district.

RANGELAND IMPROVEMENTS

Rangeland improvement requirements are given in Table 3 and in Appendix 3. There is a degree of overlapping of acreages needing treatment within the improvement categories.

Table 3. Rangeland improvement requirements in the Winkelman Natural Resource Conservation District.

Type Improvement	Acreage Needing Treatment
Noxious Range Plant Control	637,367
Mechanical and Seed	155,262
Fire and Seed	324,348
Fire only	101,250
Range Fair to Good	83,410
Treatment Impractical	210,593

Any range improvement program requires some type of energy investment, whether it be fossil fuel or energy entrapped within the range resource itself. Any increase in range forage production (a higher energy yield) requires an equal unit investment of energy above existing production levels, Slatyer (1974). The increase in cost of fossil fuels will dictate the use of alternatives, mainly fire, for this energy investment. Chemical use may, in many instances, be the most cost-effective method; but, because of many inherent problems associated with their use, it is suggested that they be used for specific cases but not excluded from range improvement programs.

The need for noxious range plant control is a dominating characteristic throughout the district. Control of some forbs and half shrubs may not be economically desirable; their impact must be determined on an individual site basis and the particular situation. For example, Chumo (1970) found that removal of burroweed (Haplopappus tenuisectus) did not significantly increase perennial grass production but did increase herbage production of annuals. Deep-rooted undesirable shrubby species i.e. mesquite, whitethorn (Acacia constricta), and similar species are invading and becoming dominant in much of the district. This is alarmingly evident on much of the district rangelands that can be classed in fair to good condition and have been rested from livestock utilization. The morphological characters and physiological tolerances of these plant species enable them to utilize water resources in the upper surface soil horizons as well as deeper sources, Simpson (1977). With the depletion of subsurface moisture, their ability to actively compete with desirable species for surface soil horizon moisture enables them to manifest and modify their environment at the expense of the desirable species. For these undesirable species, control is mandatory and urgent. Subsurface soil moisture integrity must be reestablished before any rangeland improvement or seeding program can be considered successful.

Mechanical Control and Seeding

Many of the ranchers within the district have carried on individual programs to improve their rangeland resources through mechanical or hand grubbing means. Approximately 65,000 acres have been treated with few desired results and all treatments will have to be reinstituted. Some of these programs will be renewed.

One program of hand grubbing and chopping was implemented in the southern part of the district, Sec. 2, T 10S, R 18E, at an elevation of 3,200 feet. Approximately 4 to 5 years ago, 60 to 80 acres were treated on a clayland extension that sloped to the west. Paloverde (*Cercidium microphylum*), cacti (mostly *Opuntia fulgida*), mesquite, whitethorn, and other minor species were removed by grubbing with no follow-up seeding program. Rothrock grama (*Bouteloua rothrockii*) is the major forage species present. Other species in the area are sideoats (*Bouteloua curtipendula*), Arizona cottontop (*Trichachne californica*), bush muhly (*Muhlenbergia porteri*), and Plains bristlegrass (*Setaria macrostachya*). There is an outstanding contrast between the treated and untreated areas. However, paloverde and mesquite are again becoming established. Although this method appears to be an effective means of controlling root-sprouting species like paloverde, the expense of such projects would be prohibitive for any large scale program.

Bulldozing of individual undesirable species has been used for rangeland improvement throughout the district. Areas in the upper Dripping Springs Valley on the Bar Flag and Hagen Ranches have received extensive dozing and windrowing of mesquite and catclaw (Acacia gregii). Completion dates for this treatment were not verified. There was no apparent follow-up program, neither reseeding nor diesel fuel treatment, and much of the treated area is resprouting and being reinvaded by catclaw. This program may have been more effective if seedings of an adaptive grass species had been applied. In the Black Mountain area of the district individual dozing of catclaw gave good results. This area was later burned by a wildfire in 1979 and many of the young catclaw were damaged. Again, no follow-up program was applied, consequently, the area produces mostly annual species. Individual dozing of whitethorn in the Black Mountain/Antelope Peak area met with limited success. Whitethorn seedlings have become established in the treated area within the first summer. However on these treated plots the vigor and forage production of shrubby buckwheat (Eriogonum wrightii), jojoba, and sideoats grama have greatly increased although follow-up programs must be carried on to forestall the invasion of undesirable species.

The most extensively used method of controlling undesirable range species has been cabling or chaining. The largest area in the district treated by this method is on the Willow Springs Ranch. This program was implemented for a number of years (1960's and 70's) but no reliable dates could be secured as to its timing. Good to excellent results were achieved on mesquite and catclaw. Native grass species, mainly Aristida sp., rothrock grama, and sand dropseed (Sporobolus cryptandrus), have increased in the area although the main forage production is still annual species. However, when comparing treated and untreated areas, there is a dramatic increase in Haplopappus sp. and Opuntia sp. There is a need for a follow-up program of fire and seeding to secure greater usable forage production. Cabling at lower elevations in Sec. 27, 29, 32, and 33, T 7S, R 15E was not effective on whitethorn, paloverde, and other lower elevation species. The soils in these areas have coarse surface textures and rapid infiltration rates and require other treatment considerations.

In 1969 approximately 1,077 acres of rangelands in Sec. 9 and 10, T 6S, R 13E on the XT Ranch were chained, intermittently root-plowed, and seeded. This program was applied on Ustallic Haplargid, Typic Haplargid, and Torriorthent soils at 3,400 feet elevation. The project was carried on under the management and direction of the SCS. A mixture of lehmann lovegrass (Eragrostis lehmanniana)and blue panicgrass (Panicum antidotale) was used for the seeding program. A fairly good stand was received by the following year (1970); however, in the 1980 review of the area there were no observed plants or seedlings of the seeded species. In general, the treated range in this pasture is in worse condition as far as forage production than is the adjacent rangeland.

In 1971 a cooperative project between the XT Ranch, the SCS, and the University of Arizona Ag. Engineering Department was conducted in Sec. 10 and 15, T 6S, R 14E on the XT Ranch. This program consisted of contour pitting and seeding of Lehman lovegrass and boer lovegrass (Eragrostis chloromelas). The 1980 review reveals that lehmann lovegrass remains only in the bottom of the pits and that there are relatively few seedlings while the boer lovegrass has spread outside of the treatment area and many young seedlings are growing. However, again, it is questionable whether the program has improved range forage production to any extent.

Other boer lovegrass seedings have been made throughout the Crozier Peak area. In most of the seedings boer lovegrass has remained and reproduced to varying degrees.

Another area rancher disked and seeded 40 acres of Ustallic Haplargid soils in Sec. 24 and 26, T 6S, R 14E in 1969. This seeding trial involved 34 species of native and introduced range grass species and shrubs (See Appendix 4). There was a fair germination and seedling establishment of most of the native grass species and no results for the shrubby species. However, most established grass plants were dead by the second year after planting and no significant reproduction from these established plants was noticed. The native species were not present on the seeded area at the time of review. The inclusion of cool season plants afforded the opportunity to investigate the feasibility of utilizing fall, winter, and spring moisture for perennial grass production. Very scattered crested wheatgrass (Agropyron desertorum) plants and one russian wildrye (Elymus junceus) plant were found but the other species were absent. Boer lovegrass remains in some of the seeded area but constitutes only a small amount of the forage production. Lehmann lovegrass was seeded at 2 pounds of seed per acre. Fairly good germination and seedling emergence was received. However seedling establishment was poor with surviving plants being about three feet (1 m) apart the following year. The established plants displayed good influorescence the following summers but no new seedlings were ever observed. By 1980 no lehmann lovegrass was found on the seeded area.

The Campstool Ranch reseeding project that was mentioned in the SCS file has not been reviewed because sufficient time has not lapsed to truly evaluate its response and potential. (For the Campstool seeded species see Appendix 4.)

The 155,260 acres classed as needing mechanical treatment and seeding (Appendix 3) only include lands with slopes and soils that will remain stable when mechanically disturbed. Considered in this determination were surface and subsurface soil textural classes, stoniness, degree of slope, present vegetational composition and etc.

Fire and Seed

Long-time residents of the district state that fires were responsible for the suppression of undesirable species. Between the 1910's and 1930's there was a sufficient reduction in fuel sources, grasses, forbs, and half-shrubs, to reduce the effects of burning which allowed the invasion of undesirable species. At the present time controlled burning appears to be a good means of managing undesirable species whenever natural fuel is available. Claveron (1967) found that 86% of the mesquite with basal diameters of 2 in. (5 cm) or less were damaged by fire and 32% were completely killed. About 3% of the mesquite with basal diameters over 2 in. (5 cm) were killed. The basal areas of perennial grass species were not significantly damaged by burning, nor did burning increase soil erosion, Moreno (1968).

The use of fire for range improvement may be restrictive to other than chaparral vegetational type until competitive, adaptable, desirable species are found or developed. Old burns in the Pinal Mountain (1950's) and Black Mountain (1968) part of the WNRCD did not remove the chaparral species. Chaparral is commonly classified as a fire type, although it flourishes despite fire, Humphrey (1962). Some chaparral species (Arctostaphyles sp., Ceanothus sp., and Rhus sp.) produce large quantities of hard-coated seeds that tend to lie dormant in the soil until fire cracks the seed coat and promotes germination, Daubenmire (1967).

Burning in MLRA Upper Sonoran Desert Shrub can effectively change the vegetational aspect. A 1972 fire in Sec. 8 and 9, T 7S, R 15E removed approximately 95% of the paloverde, 70% of the mesquite, and varying amounts of other shrubby species. Sand dropseed, spike dropseed (Sporobolus contractus), rothrock grama, sideoats grama, and similar species are strongly evident in the burned area, although the greatest amount of forage production is produced by annual species.

A 1979 wildfire in Sec. 4, T 5S, R 14E gave a 100% kill of jojoba, 90% kill of paloverde and creosotebush (Larria divaricata), and 80% kill of whitethorn. This burned area is now mainly annual species with some threeawns (Aristida sp.).

Extensive acreages of Chihuahuan Semidesert Grassland have been burned throughout the WNRCD. Many wildfires have burned and reburned the Dripping Springs Mountain range. Much of this rangeland is in fair condition with a good composition of perennial species. A six thousand plus wildfire in 1979 in the Black Mountain area killed most of the Opuntia species. An estimated 20% of the mesquite and less than 5% of the catclaw was killed. Compared to pre-fire vegetation, ragweed (Franseria confertiflora) has become more abundant. The density of snakeweed (Gutierrezia sp.) greatly increases on burned areas in the Chihuahuan Semidesert Grassland.

It appears that timing of burning is critical and should be based on the response of key species that are present on the proposed burn area. For example, if the aforementioned fire in Sec. 4, T 5S, R 14E had occurred other than during the major growing season for jojoba, better results may have been obtained.

Seeding after fire in the WNRCD has received very limited attention. Since ashes provide a good seedbed for adaptive range forage species, seeding after fire should be included in future management programs.

Seeding

Several factors appear to be causative to seeding failures within the district. One is that not enough consideration has been given to the potential competition from annual species that can more efficiently utilize soil moisture and are more efficient in photo entrapment. The two distinct growing periods in the WNRCD produce two different crops of annual species that will complicate seeding programs.

Furthermore, at present there are no proven adaptive species, exclusive of boer lovegrass, available for seeding throughout the district. More information must be developed about adaptive species availability. These species then need to be researched and used on the district rangelands.

Another major causative factor is that not enough importance is given to rainfall when conducting seeding trials within the district. Tapia (1970) found that lehmann lovegrass appeared very susceptible to physiological drought while arizona cottontop and plains bristlegrass were not markedly affected. The soil moisture environment around the seed and its speed of germination governs the success of seedlings. Van Haveren (1974) found that soil water recharge by rainfall appears to be independent of various physical factors such as grazing, and that patterns in soil water recharge are dependent on form and intensity of precipitation and upon seasonal evapotransporation. Therefore, to assure optimum soil moisture conditions at the time of seeding, rainfall should be given prime consideration. Rainfall probabilities of two locations within the WNRCD are given in

Table 4 to illustrate some factors that should be considered. Appendix 5 gives the probabilities of having a 0.10 inch or greater rainfall event on any given day throughout the year. For example, this data indicates that on August 2, there is an 18% chance of having rainfall, a 16% chance of the following day (Aug. 3) having no rainfall, but a 25% chance of the following day (Aug. 3) having rainfall.

Livestock Management Programs

Fifty percent of the WNRCD ranchers have never initiated any formal rotational grazing programs (i.e. deferred, rest, etc.). The greatest percentage of these operations are small ranches that operate on limited revenues and most do not have adequate livestock facilities for such a program at the present time.

Approximately 23% of the WNRCD ranchers currently have some type of rotation grazing system incorporated into their range programs. Over 80% of those ranches have large acreages (in comparison to their total acreages) of federal lands. On most of these ranches mandatory compliance with federal policy requires the incorporation of some grazing system.

Twenty-seven percent of the ranches in the WNRCD have voluntarily experimented with some type of rotational grazing system; but they have terminated the programs because they felt that more damage was incurred to the rangeland than was incurred under yearlong programs that maintained sensible livestock numbers. It was stated that several factors were causative to the failure of their programs. One was that

Table 4. Probability of sequences of wet and dry years in the WNRCD.

	Pinal Ranch			Central WNRCD		
	Events			Events		
	Yearly	Summer	Winter	Yearly	Summer	Winter
Mean Rainfall	24.75"	10.27"	14.48"	16.11"	8.81"	7.30"
Yrs. of continuous records	68	68	68	30	30	30
Standard deviation	±8.07	-	-	±4.58	-	-
	Percent			Percent		
Probability of any one event having above average rainfall	45.6	47.1	45.6	36.6	40.0	33.3
Probability of the 2nd event being above average given the first event above average	23.5	17.6	23.5	13.3	13.3	10.0
Probability of the 3rd event being above average given the 2nd event above average	5.9	7.4	7.4	3.3	3.3	3.3
Probability of the 4th event being above average given the 3rd event above average	1.5	1.5	1.5	0	0	0

acclimated livestock, most of which represent many years of intensive breeding to achieve the ranchers' livestock quality goals, have developed home range territories and tend to destroy pasture land by overgrazing and trampling along fences nearest their home range. Few of these operators would be willing to replace their developed herds with non-acclimated cattle. There cannot be economic justification for total replacement of resident herds: new cattle would not be familiar with native forage species; livestock will be lost from poisonous plants and stress-induced diseases; the feed conversion efficiency of the new livestock may not be known; and there would be a discrepancy in revenues generated from the sale of the resident herd versus the cost of the replacement herd.

In addition, ranchers mentioned that most rotation systems were not flexible enough to take advantage of peak forage palatability periods (mainly of annual species) and much of the actual range forage production was not harvested.

A third commonly mentioned failure was that economic losses from total revenue jeopardized the financial structure within the ranch unit. Monetary losses were commonly incurred from reduction in calf crop and animal weights and in an increase in variable costs.

Considering the capital and time investment by WNRCD ranchers to develop established breeding herds, any attempt to establish a range "cureall" rotation system may be counterproductive. Instead, more progressive steps must be made toward livestock with greater forage conversion efficiency, therefore assuring the production of more pounds of beef while using less forage. We cannot optimize range moisture or plant photo conversion efficiency; we can only capitalize on animal efficiency in harvesting in situ rangeland energy resources and try to ensure sustained production of out rangelands.

PHYSICAL IMPROVEMENTS

The physical improvements placed upon the WNRCD rangelands are summarized in Appendix 6. Almost all ranches in the district have at least two pastures, exclusive of traps, of varying sizes. The 1,240 miles of fences does not account for all ranch or pasture boundaries for many of the ranches use natural geographical features in conjunction with fences. Approximately five miles of the 65 miles of proposed fencing is to be completed by the BLM. The cost of construction per mile was estimated by a local fencing contractor at about $1,400.00 for materials and $2,500.00 for labor, a total of $19,500.00. But since BLM plans to transport materials to the construction site via helicopter, the total cost for constructing this five miles of fence would far exceed that estimate. Economically, the grazing fees from the 2.5 head per section allotments where the fences are to be constructed will not provide sufficient return on investment. This makes the investment for the fencing questionable considering that these ranch units have been operating under present conditions for many years.

The water resource improvements, both developed and planned, are basically adequate as they now stand, but the construction of many more earthen dams (dirt tanks) would have a great long-term beneficial impact for water users both within the district and downstream from the district. The benefits from such impoundments would include flood control for downstream communities, infiltration basins for recharging ground water, and increase in water quality by impounding silts and sediments. Perennial and ephemeral springs (exclusive of the Gila and San Pedro rivers and Aravaipa, Mescal, Mineral, and Dripping Springs creeks) produce high water yields throughout the district yet only 35% of the springs are developed. However, more spring developments are being considered by ranchers within the district.

OTHER RESOURCES AND CONSIDERATIONS

Recreational resources and facilities in the WMRCD are summarized in Appendix 7.

Recreation

At present there are approximately 15,930 acres of primitive, wilderness, and scenic areas within the district boundaries with approximately 17,420 acres more under consideration by BLM for wilderness value. Including the lands still under consideration, the result is that about 4% of the district lands are specified for recreational use. Yet, most of the remaining 779,230 acres of district livestock rangelands are used for unsupervised recreation. Recreationalists are free to traverse the district lands without assumption of responsibility or liability. Owners of private properties and improvements must assume all liabilities with little legal recourse, Church (1979). Arizona Revised Statutes: 13-712 defines recreational trespass yet, to date, Arizona has no liability limits.

Wildlife

Wildlife habitat resources and facilities within the district are given in Appendix 8. Wildlife is under the management policies of the Arizona Game and Fish Commission (AGFC). All other agency management programs must be subservient to AGFC management goals because the AGFC manage all non-migratory wildlife in accordance to regulations and policies of the State of Arizona and through expressed philosophies of the citizens of Arizona. Wildlife upon private lands should be managed in coordination with land owners' management goals.

Included in this report are acreages that are historic antelope (<u>Antilocapra americana</u>)and bighorn sheep (<u>Ovis sp.</u>) habitat. The inclusion of these figures does not imply that reestablishment of antelope or bighorn in the district is desirable. The intent is only to document that antelope and bighorn were a part of the ecosystem. Habitat may be available for them; but, until the citizens of Arizona express the desire for establishing these herds and are willing to support the cost of their management and protection from illegal removal, their ecological niche will remain empty, Russell (1964). Withdrawal of grazing by livestock alone will not secure them. Until every citizen decides for himself that these animals are ecologically worthwhile and will generate significant capital resources for the state, the success of such a project is doubtful.

The Mississippi Kite (<u>Ictinia misisippiensis</u>) is included in this report because of its uniqueness. One rancher holds most of the kite's nesting habitat as private property. His management program and philosophies are complimentary to the kite's nesting habits. However, urban encrouchment and habitat destruction near the nesting area should be recognized by the WNRCD before government agencies become involved.

Environmental Quality

One of the major factors affecting the WNRCD lands is air quality. Smelter smoke is of major concern. The oxide fraction of smelter smoke may have the greatest potential impact on district rangelands. The gaseous forms of these oxides appear to have pronounced effect on rangeland vegetation. For example, in the smoke belt along the township line between T 4S and T 5S, R 14E, paloverde is extensively damaged. While jojoba plants are robust in growth, their palatability is questionable for they are not heavily utilized in this area which has limited other forage.

The non-metallic oxides (ie. sulfur dioxide) can oxidize and hydrate to form acids when atmospheric moisture is available. These acids then precipitate as acid rains which have become more prevalent in the last several years, Lewis and Grant (1980). The resulting decrease in soil pH has varying effects on the soil and plant communities, Cronan and Schofield (1979). Meyer (1973) found that soil pH had a significant effect on the distribution of two phenotypes of burroweed. He states that germination was rapid at pH values between 4.0 and 4.5. Weaver (1964) states that germination of alfombrilla (*Drymaria arenarioides*) and inkweed (*Drymaria pachyphylla*) are highest in soils ranging from pH 4 to pH 6. The effects of pH on other range plants is not fully documented; but the indication is that periodic alteration of soil pH can govern the establishment or the existence of range plants, whether desirable or undesirable.

Soil pH also affects the availability of soil nutrients to plants. For example, at a pH between 5 and 7, phosphorus is available for plant uptake; but at a higher or lower pH, phosphorus is fixed (unavailable). Potassium is leached from the root environment when soil pH is more than about 5, Black (1968). Some of the district soils contain calcium carbonates that will buffer the effects of acid rains but, at present, long-term effects cannot be predicted.

Another environmental consideration within the district is water quality. Urban effluent has the potential to lower ground water quality along the major stream and river valleys. Chemical spills and releases from mining operations can release heavy metals into surface and ground water tables. These contaminants (especially uranium) can have long lasting impact upon the water quality and agricultural production within the district.

Soil Survey

The general soils map of Pinal County, Arizona, Adams (1972), is unsuitable for specific land resource planning projects. A more intensive soil survey must be made on 780,300 acres of the WNRCD range and farmlands. The exclusion of 39,120 acres from the total 819,420 acres accounts for city and townsites and mining properties.

DISCUSSION AND CONCLUSIONS

Livestock grazing and farming are the largest renewable natural resource revenue producers in the WNRCD. The land resource users within the district have developed programs that are based upon physical diversities within their individual operations. As a whole, the area operators have striven to implement management programs that will improve the land resources with which they have to work. Most ranchers attempt to adjust livestock numbers in accordance to the anticipated environmental conditions. All ranchers have fairly well developed livestock facilities and most have expressed a desire to incorporate rangeland improvement programs when such programs become economically feasible and philosophically acceptable. A major restraint appears to be lack of public social acceptance in range improvement programs.

The extremely excessive livestock numbers that existed between the late 1880's and the 1940's, which was encouraged and promoted by the national interest in developing western rangelands, had pronounced impact upon the formation and distribution of present day vegetation within the WNRCD. The exclusion or management of livestock grazing alone cannot reverse that impact or achieve the desired mixed species composition rangelands that are considered most desirable for livestock production and wildlife habitat. Once a monospecies plant community is established, it maintains a well defined advantage over other potential invading species. Historic use dictates the present conditions and the course the district must take to obtain future range management goals.

The majority of the ranchers in the district have well developed livestock facilities, physical improvements, and livestock programs; however some recommendations are offered.

First and foremost, all operators within the district should function as a unit and must be impressed with the necessity to initiate management programs before they become mandatory. It is the WNRCD responsibility to organize and inform (i.e. thru newsletter or personal communication) all within the district, member or not, of anything pertaining to their operation. It is essential that each operator have an understanding of the management program procedures and terminology used by any agency involved in their business.

Using all tools and means, the district and its ranchers must take a more assertive role in future policies concerning any "good range management programs" that are developed by the various management agencies. These programs are inevitably forthcoming. Therefore district ranchers must initiate a systematic program to monitor their range conditions, forage production and utilization, and other pertinent range data. The WNRCD should take a more positive role in aiding its ranchers in acquiring this data, whether it is collected by the individual rancher or in conjunction with an outside employee or district representative. All records should be retained in private ranch files and it is imperative that a copy be maintained in a "neutral" file (i.e. the WNRCD). It should be remembered that if agencies are used, they are likely to follow their designated philosophies and doctrines which may not allow their technician to function in alignment with their charter mandates to avoid jeopardizing their existence.

The WNRCD should strive to develop "management plans" for each ranch within the district; this will enable district ranchers to have a "filing of intent" and to have a more positive involvement in any extraneous management decisions involving their ranch operations.

Confounding factors exist that will affect the development of any grazing system, i.e. rotation or deferred. If a system is to be developed, it cannot necessarily be based upon currently existing facilities. The required physical improvements must be made before the system can be instigated.

The WNRCD must cooperate and aid in the development of physical range improvement projects and distribute more information about the feasibility of such programs. No range improvement project should be viewed as "experimental" but as an attempt to resolve a major rangeland problem.

There is an urgent need to encourage the control of non-productive deep-rooted noxious species whether by mechanical means or by use of control burning, thus establishing sub-surface soil moisture integrity so as to benefit shallower-rooted desirable forage species and down-slope water users.

More control burn programs should be instigated. Fire is the cheapest tool available for range improvement and has been an historic part of the WNRCD rangeland ecology.

The review of seedings in the WNRCD indicates that at present no truly long-term adaptive species (exclusive of boer lovegrass) is available. There is a need to select and/or develop adaptive species that can be used on the district rangelands and that maintain sustained yields for long periods of time through its varying climatic conditions. Seedings must be made in accordance with optimum climatic conditions.

More consideration should be given to water resource improvement. With the current emphasis on authoritarian control of resources, large quantities of water that could be beneficially utilized go unused. More long-term beneficial earthen dams could be constructed to hasten an increase in quantity and quality of ground water supply and more spring developments should be made.

Any change in land status within the WNRCD should be reviewed. The loss of private and state lands will have pronounced impact on the revenues generated within the district and may not be pursuant to its goals. The district must insist upon clarification of present management authority by the different agencies on individual ranch units and of improprieties in disputes and in deviations in policies. The district ranchers should have equitable representation in matters concerning their operations.

There can be no separation of "rights" from rangeland resources. All rights (i.e. water, trespass) must remain inherent with ownership of private property. Also, the question of liability on private property and private improvements should be resolved.

The economic stability of the WNRCD and of our nation is dependent upon wise and prudent use of its resources. Livestock grazing is the only efficient method of harvesting the renewable energy resources that are entrapped in range forage. The WNRCD must assure the continual productivity of its rangeland resources. The district can accomplish its goal "...to foster and assist in programs that will ensure sustained yields of all natural resources..." by the unification of its ranchers and farmers. It is important to take a more progressive position in decisions affecting its producers. Data collected in this project can serve as a foundation for the development of a knowledgeable course that the WNRCD can take in its expostulation of whatsoever may involve its resources.

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Appendix 1. Definitions of acronyms used in text.

AGF	Arizona Game and Fish
ASCS	Agricultural Stabilization and Conservation Service
BLM	Bureau of Land Management
FS	Forest Service
LO	Land owner or lessee
MLRA	Major Land Resource Area
SCS	Soil Conservation Service
State(S)	State of Arizona
WNRCD	Winkelman Natural Resource Conservation District

Appendix 2. Land usage within the WNRCD.

Item	Units	Total needs	Accomplished	Remaining to be done	Involved
Industrial use	Ac	14,410	12,650	1,760	Related industry
Industrial support facility (rail, etc.)	Ac	3,660	3,660	-0-	User
Mining (surface use)	Ac	5,610	5,610	-0-[a]	Mining company
Livestock grazing	Ac	790,340	790,340	-0-	LO
Agronomic	Ac	4,915	4,915	-0-[b]	LO
Urban	Ac	20,410	18,650	1,760[c]	City & development

a. Future development is dependent upon demand for particular minerals.
b. Lands with agronomic potential were not included.
c. Depends upon future economic status within the WNRCD.

Appendix 3. Rangeland improvements in the WNRCD.

Item	Unit	Total Need	Complete	To Be Done	Agency Involved
Noxious Range Plant Control	Ac	637,367	0	637,367	LO SCS ASCS BLM FS
Mechanical and Seed	Ac	155,262	0	155,262	LO SCS ASCS BLM FS
Fire and Seed	Ac	324,348	0	324,348	LO SCS ASCS BLM FS
Fire Only	Ac	101,250	0	101,250	LO SCS BLM FS
Range Fair-Good[a] (Adequate Treat.)	Ac	795,155	83,410	711,745	LO SCS BLM FS
Soil Erosion					
a. Erosion cont.	Ac	66,820	0	66,820	LO SCS BLM FS
b. Revegetate	Ac	66,820 &above	0	66,820 &above	LO SCS BLM FS

(a) Indicates that much of the Upper Sonoran Desert Shrub and other MLRA have greater usable forage production than may otherwise be implied in current philosophies.

Appendix 4. Species used in seeding trials in the WNRCD.

Scientific Name	Common Name	Type or Source
Grasses		
Agropyron desertorum	Crested wheatgrass	Noran[1]
Bouteloua chondrosioides	Sprucetop grama	Native source[1]
Bouteloua curtipendula	Sideoats grama	Native source[1]
" "	" "	El Reno[2]
" "	" "	Premier[2]
" "	" "	Coronado[2]
" "	" "	Vaughn[1,2]
" "	" "	Tucson[2]
" "	" "	PMT-478[2]
" "	" "	PMT-328[2]
Bouteloua eriopoda	Black grama	Native[1]
" "	" "	Jornada[1]
" "	" "	Sonoran[2]
Bouteloua gracilis	Blue grama	Sonoita[1]
" "	" "	New Mexico[1]
Bouteloua hirsuta	Hairy grama	Native[1]
Bouteloua rothrockii	Rothrock grama	Native[1]
Elymus junceus	Russian wildrye	ARS Ft. Collins[1]
Eragrostis atherstonei	Atherstone lovegrass	P-15608[2,3]
Eragrostis chromalis	Boer lovegrass	Commercial[1,2,3]
" "	" "	A-84[1,2]
Eragrostis curvula	Weeping lovegrass	Commercial[1,3]
Eragrostis intermidia	Plains lovegrass	Native[1]
" "	" "	Commercial[2]
Eragrostis lehmanniana	Lehmann lovegrass	Commercial[1,2,3]
" "	" "	A-68[2]
Eragrostis pelefera	Mason sandhill lovegrass[2]	
Eragrostis superba	Wilman lovegrass	Palar[1,2,3]
Koeleria cristata	Junegrass	Native[1]
Leptochloa dubia	Green sprangletop	Native[1]
" "	" "	A-14254[2]
Oryzopsis hymenoides	Indian ricegrass	Cameron[1]
" "	" "	Paloma[2]
Panicum antidotale	Blue panicgrass	Commercial[1,3]
" "	" "	ARS[2]
" "	" "	A-130[2]
" "	" "	P-15630[2]
Panicum colorada	Kleingrass[2]	
Panicum hallii	Halls panicgrass	Native[1]
Panicum maximum	Guinea grass	PMC plantings[1]
Panicum obtusum	Vinemesquite	Native[1]
" "	"	A-11711[2]
Pennisetum ciliaris	Buffelgrass	Commercial[2]

Appendix 4. Continued

Setaria macrostachya	Plains bristlegrass	Native[1]
" "	" "	Commercial[2]
Sporobolus airoides	Alkali sacaton	PMT 326[2]
Sporobolus contractus	Spike dropseed	Native[1]
Sporobolus cryptandrus	Sand dropseed	Native[1]
" "	" "	A-16352[2]
Sporobolus flexuosus	Mesa dropseed	New Mexico[1]
Sporobolus wrightii	Sacaton	Native[1]
Stipa speciosa	Desert needlegrass	Native[1]
Trichachne californica	Arizona cottontop	Native[1]
" "	" "	A-16514[2]
Trichloris crinata	Two flowered trichloris	PMT-12[2]

Forbs and Shrubs

Atriplex canescens	Four wing saltbrush	Native[1]
Ceanothus greggii	Desert ceanothus	Native[1]
Menodora scabra	Twinberry[2]	
Simmondsia chinensis	Jojoba	Native[1]
Semsia calva	Bush sunflower[2]	

[1] 1969 seeded species study trial Sections 20, 26, T 6S, R 14E

[2] July 1-15, 1976 species study seedings (Campstool Ranch file).

[3] Major species used for seedings throughout the district.

Appendix 5. Probability of sequences of wet and dry days in the WNRCD (after Heermann, 1971). Probability (p) is expressed as percent. Wet = greater or equal to 0.10 inch of rainfall.
p(dry)=1-p(wet) p(dry/dry)=1-p(wet/dry)
p(dry/wet)=1-p(wet/wet)

Period begins	p(wet)	p(wet/dry)	p(wet/wet)
Mar 1	11	9	19
15	7	5	26
29	4	3	19
Apr 12	3	2	20
26	5	4	19
May 10	7	2	7
24	1	1	1
June 7	2	2	1
21	3	3	20
July 5	9	8	17
19	14	16	19
Aug 2	18	16	25
16	12	12	19
30	9	7	30
Sep 13	8	7	25
27	6	5	22
Oct 11	5	4	25
25	7	6	19
Nov 8	5	5	13
22	7	5	27
Dec 6	9	8	25
20	11	8	27
Jan 3	10	8	25
17	7	6	13
31	7	6	24
Feb 14	8	6	32

Appendix 6. Physical improvements on WNRCD rangelands.

Item	Unit	Total Need	Complete	To Be Done	Agency Involved
1. Grazing pastures	No.	288	265	23	LO SCS ASCS BLM FS
2. Fencing	Mi.	1,305	1,240	65	LO SCS ASCS BLM FS
3. Livestock water developments					
a. Catchment basins	No.	6	2	4	LO SCS ASCS BLM
b. Earthen/cement dams (tanks)	No.	503	376	127	LO SCS ASCS BLM FS
c. Haul waters	No.	13	12	1	LO
d. Storage tanks steel/cement	No.	343	276	67	LO SCS ASCS BLM FS
e. Springs	No.	486	170	316	LO SCS ASCS BLM FS
f. Pipelines	Mi.	186	133	53	LO SCS ASCS BLM FS
g. Water troughs	No.	845	510	335	LO SCS ASCS BLM FS
h. Wells	No.	252	229	23	LO SCS ASCS BLM FS
4. Livestock corrals	No.	319	303	16	LO
5. Private roads and trails	Mi.	921	911	10	LO

Appendix 6. Continued

Item	Unit	Total Need	Complete	To Be Done	Agency Involved
6. Flooding					
a. Channel Stabilization	Lin. ft.	143,457	44,420	99,037	I.O
b. Channel Clearance	Lin. ft.	91,892	39,600	52,292	I.O
c. Diversion dams and dikes	Lin. ft.	2,640	0	2,640	I.O

Appendix 7. Recreational sites and facilities within the WNRCD.

Facility	Unit	Total Need	Complete	Proposed	Agency Involved
Recreational					
a. Land recreational needs (P/W included)	Ac.	33,348	15,928	17,420	FS BLM STATE
b. Improved picnic areas	No.	9	9	0	FS BLM LO
c. Parks	Ac.	1,320	1,320	0	FS
	No.	4	4	0	FS STATE CITY
d. Hiking trails	No.	6	6	0	FS BLM
Historic Sites	No.	15	15	0	FS BLM STATE LO
Archaeological Sites	No.	17	17	0[a]	FS BLM STATE LO
Scenic Areas	Ac.	10,316	10,316	0[b]	FS BLM STATE LO

[a] This value is only for major sites and does not include numerous small sites.

[b] Includes such as Aravaina, Galiuro Mts., Oak Flat, Pinal Mts., Santa Catalina, and etc.

Appendix 8. Wildlife habitat and facilities in the WNRCD.

Item	Unit	Total Need	Complete	Potential or Historic	Agency Involved
Wildlife facilities (trick tanks or catchments)	No.	6	6		AGF
Wildlife habitat					
Upland gamebirds	Ac.	819,420	819,420	0	LO AGF
a. Bandtail pigeon	Ac.	86,077	86,077	0	LO FS AGF
b. Mearns quail	Ac.	61,809	32,220	29,589	LO FS AGF
Mule deer	Ac.	757,276	757,276	0	LO FS BLM AGF
Whitetail deer	Ac.	164,500	164,500	0	LO FS BLM AGF
Antelope	Ac.	152,800	0	152,800	
Javelina	Ac.	768,820	768,820	0	LO FS BLM AGF
Bighorn sheep	Ac.	111,035	10,095	100,940[a]	LO FS BLM AGF
Mississippi kite	Ac.	1,600	960	840[b]	LO AGF

[a] Although this acreage represents habitat that may be suitable for bighorn, the feasibility of establishing them there is questionable for the existing herd has not propagated and expanded its habitat to any extent.

[b] This is the only known present habitat for the Mississippi kite in Arizona and its habitat is being degraded by human activity and unsuccessful manipulation of the San Pedro River.