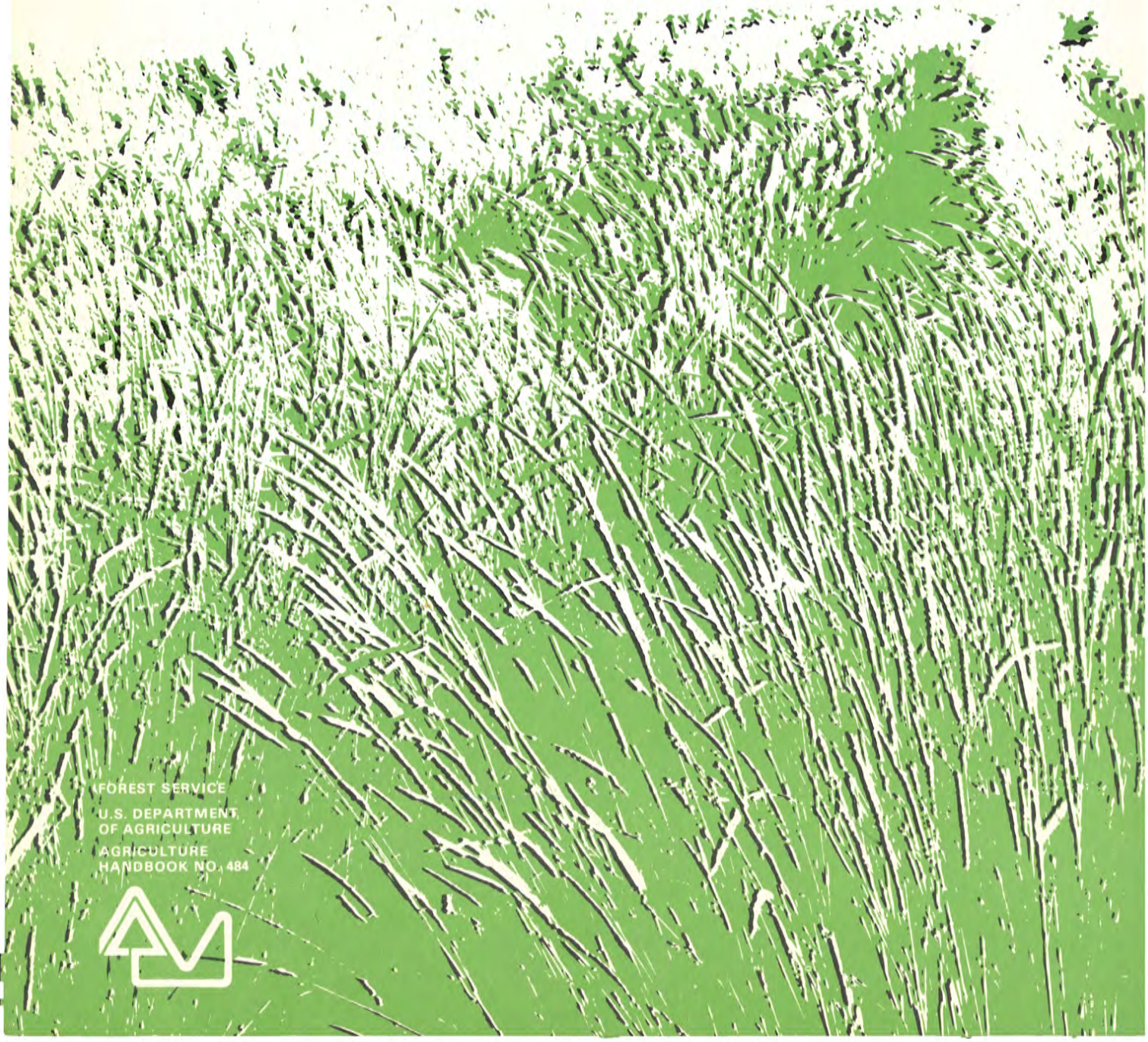
NATIONAL FOREST LANDSCAPE MANAGEMENT

VOLUME 2, CHAPTER 3

RANGE



FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURE HANDBOOK NO. 484

NATIONAL FOREST LANDSCAPE MANAGEMENT

VOLUME 2, CHAPTER 3

RANGE

FOREST SERVICE
U.S. DEPARTMENT
OF AGRICULTURE
MAY 1977

Foreword

Volume 1 National Forest Landscape Management, Volume 1, is a training document distributed throughout the National Forest System in April 1973. It is used as a basic text to illustrate the concepts, elements, and principles of our landscape management program. This program seeks to identify the visual characteristics of the landscape and analyze, in advance, the visual effects of resource management actions. Volume 1 was prepared by landscape architects, land management specialists, and research scientists from throughout the Forest Service over an extended period of time. It is available from the Superintendent of Documents, Washington, D.C., as Agriculture Handbook Number 434.

Volume 2 National Forest Landscape Management, Volume 2, will consist of several chapters (one of which you have before you), each dealing with the application of Volume 1 principles to a specific function or area of concern in the field of resource management. The effort to produce each chapter has been spearheaded by one Forest Service region, chosen for its experience and demonstrated expertise in the field, utilizing some contributions from other regions, research scientists, industry, and universities. These chapters will be published separately, as they are completed, for the purpose of prompt dissemination of what is, hopefully, very useful information.

When all chapters have been published and studied by all regions, and comments from other agencies and interested readers have been evaluated, we intend to revise and combine them into a single document—which will be Volume 2.

We hope you find this chapter thought provoking and useful. Comments and suggestions are always welcome.

John R. McGuire

JOHN R. McGUIRE
Chief

Issued July 1976

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price $1.70

25% discount allowed on orders of 100 or more to one address

Stock No. 001-000-03578-9

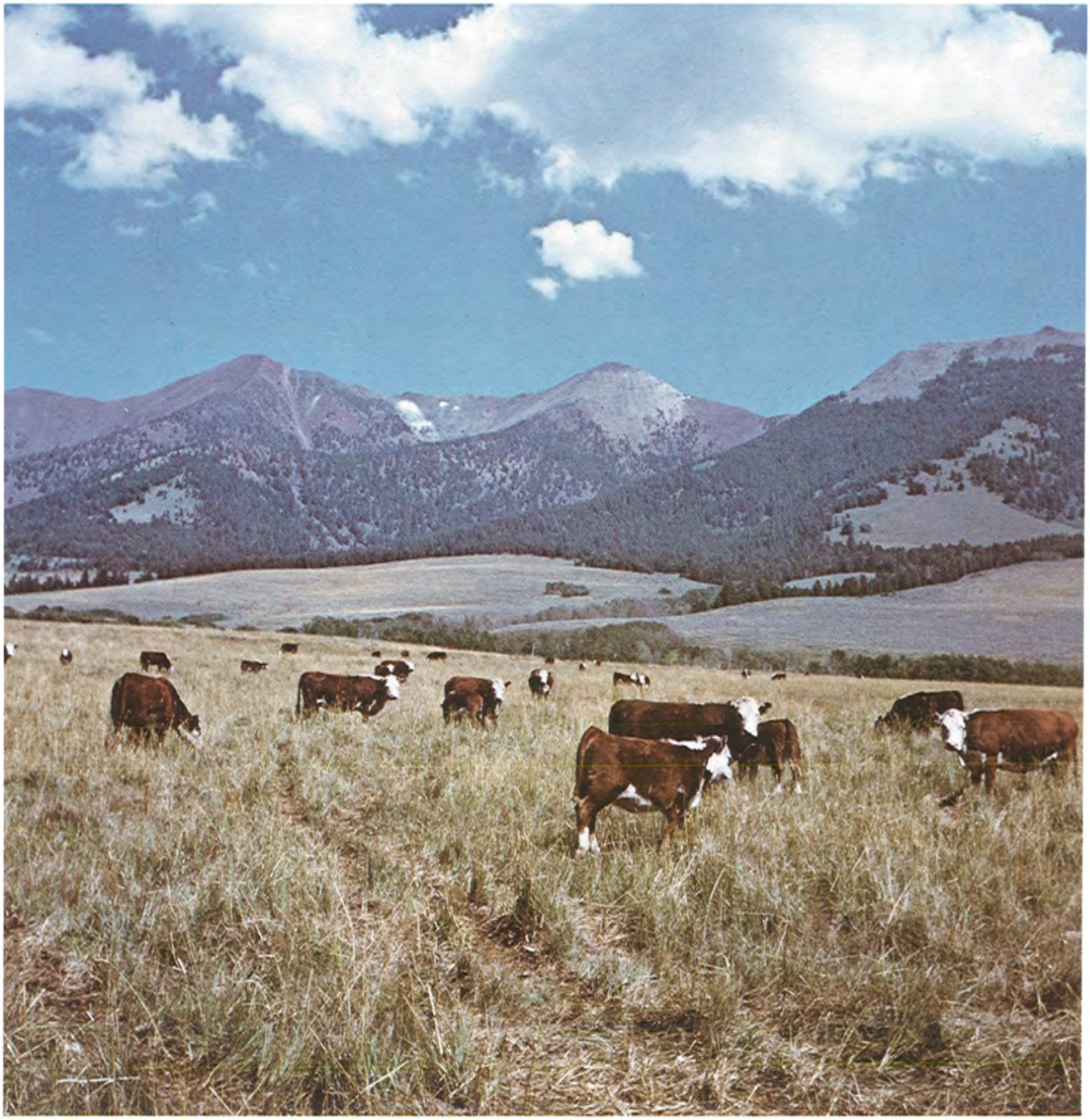
CONTENTS

	Page
OBJECTIVES	1
THE INVASION OF BRUSH	3
LANDSCAPE MANAGEMENT CONCEPTS	9
DOMINANCE ELEMENTS	15
BASIC PLANNING DATA	17
DESIGN GUIDELINES	21
VEGETATIVE CONTROL MEASURES	29
Mechanical treatment	30
Chemical treatment	35
Prescribed burning	35
RANGE STRUCTURES	37
Fences	38
Corrals and related structures	41
Water developments	42

The Range Management Chapter deals with the application of Landscape Management concepts and principles to the visual aspects of range resources management.

The objective of this chapter is to provide Landscape Management guidelines as applied to:

1. Range vegetation control
2. Range structures

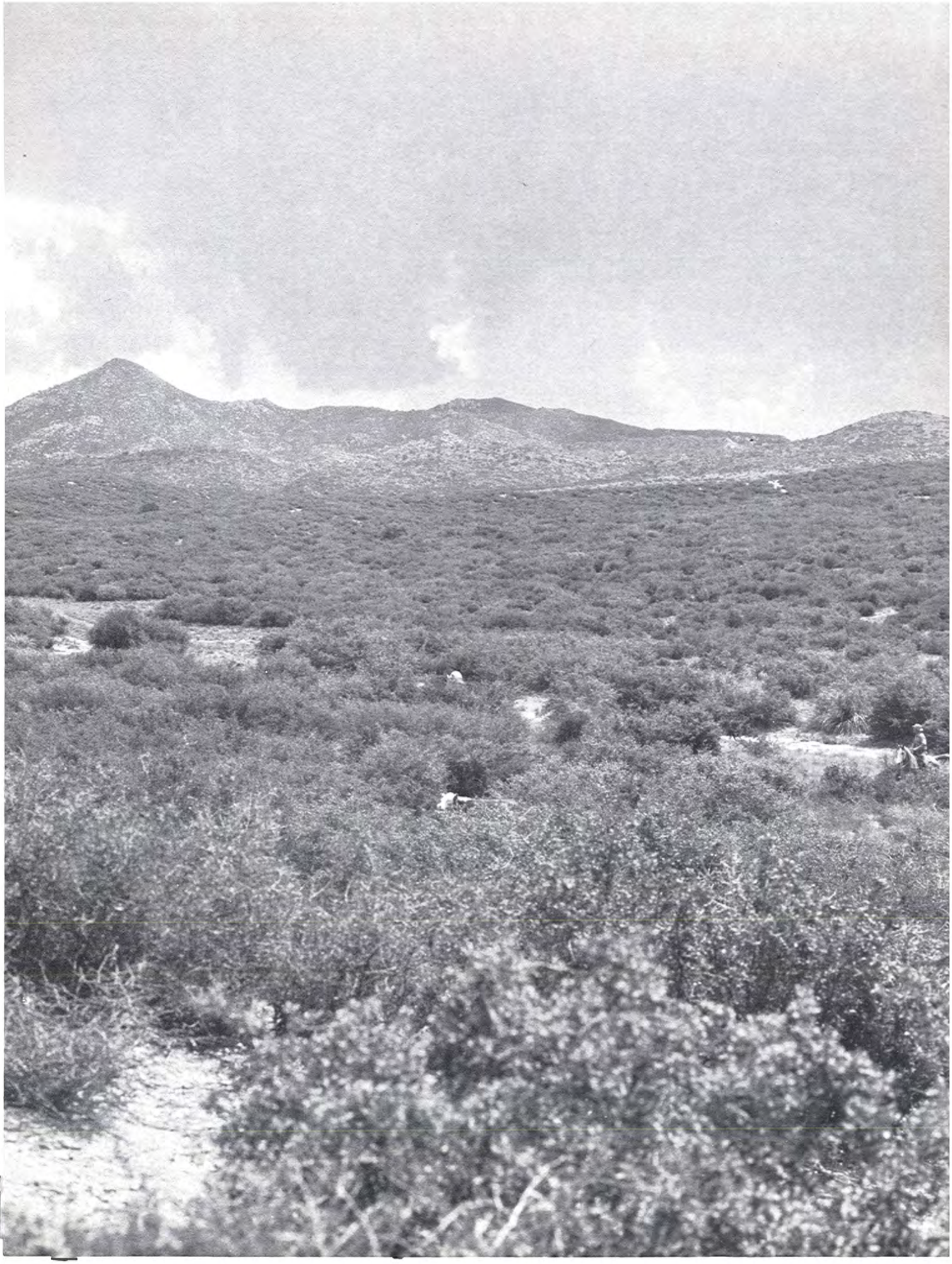


Objectives

The American people are concerned about the quality of their visual environment. Because of this concern, the *visual landscape* is now considered a basic resource, to be "treated as an essential part of and receive equal consideration with the other basic resources of the land." [1] At the same time, there is an increasing demand for goods and services produced on much of the same land. It has thus become necessary to both inventory our visual resources and provide measurable standards for their management.

In their work of enriching the range resources of the Nation, Forest Service land managers frequently must take actions that significantly alter the landscape. Such actions vary from the addition of a fence to large-scale transformation of the vegetative cover.

[1] Landscape Management.
Forest Service Manual 2380.
U.S. Department of Agriculture.



The invasion of brush

To understand why range management activities are necessary, it is useful to recount the historical impact of the invasion of brush on grazing land in the United States.

Grazing of domestic livestock was introduced by the Spanish in the Southwest in the early 1600's. At that time, Jesuit missionaries stocked each mission with a herd of cattle in order to sustain the inhabitants and to teach the Indians the art of animal husbandry.

In the late 1800's, the cattle industry expanded rapidly. Government contracts encouraged beef production to supply military posts and Indian Reservations. New railroads made it possible to raise western beef for eastern markets. It was relatively easy for the cattle industry to attract investment capital:

> A great ballyhoo campaign waged by railroad prospectuses, livestock journals, and territorial legislatures trumpeted to an eager public that the West held easy riches and that grass was gold.[2]
>
> By 1883 the Governor of Arizona reported: Every running stream and permanent spring are settled upon; ranch houses built and adjacent ranges stocked.[3]

[2,3] James Rodney Hastings and Raymond M. Turner. The changing mile. Tucson, The University of Arizona Press, 1966.

1906—The arrow marks the leading edge of pinon-juniper vegetation. Scattered openings can be seen on the lower hillsides.

1955—Vegetative encroachment has progressed beyond the 1906 line and is now at the edge of the valley bottom.

1972—Pinon-juniper vegetation has progressed into the valley floor. The scattered openings, present on hillsides in 1955, are no longer evident.

The three photographs (opposite page) were taken near Young, Arizona, in 1906, 1955, and 1972. Note the progression of the pinon-juniper vegetation: encroachment on the hillsides, increased density, and, finally, complete coverage of hillsides.

In the late 1800's, however, the landscape began to change. Plants of low forage value (pinon pine, juniper, mesquite, sagebrush, chaparral, and others) began to invade the natural grasslands.

In 1903, David Griffiths of the Tucson, Arizona, Office of Farm Management, wrote:

> A close examination of the broad, gentle, grassy slopes between the arroyos in this vicinity reveals a . . . scattering of mesquite . . . in some of the more favorable localities . . . cannot tell whether this growth indicates that this shrub is spreading or not. The present condition . . . suggests this possibility.

After 7 more years of observation, he predicted that:

> Time is coming when those foothill grassy areas, which now have only an occasional small shrub, will be as shrubby as the deserts and lower foothills . . . if not more so.[4]

In a history of grazing on the Tonto National Forest, Ranger Fred Croxen contrasts the landscape of an earlier day with its condition in 1926:

> All the men interviewed stated that there was little brush in the country at the time stock was first brought in . . . it was possible to drive a wagon nearly anywhere one desired. The little that there was, was only on some of the mountains and some of the slopes . . . all the north slope of Mt. Ord was . . . Pine Bunchgrass country.
>
> Now, in 1926, this is one of the brushiest pieces of range on the Tonto as anyone will agree who has been unfortunate enough to have come in contact with it.[5]

In the October 1924 *Journal of Forestry*, Aldo Leopold noted that:

> One of the first things . . . a Forester hears when he begins to travel among the cowcamps of the Southern Arizona foothills is the story how the brush has "taken the Country." . . . A cowman will tell about how in the 1800's on a certain mesa he could see his cattle several miles, whereas now, on the same mesa, he cannot even find them in a day's hunt. The legend of brush encroachment must be taken seriously.

Scientists and laymen have ventured several hypotheses for the changes in vegetation. The most frequently stated causes are: (1) Overgrazing reduces the amount of fuel available to carry periodic fires that kill the young invading shrubs. (2) Overgrazing weakens the grass communities and leaves them open to invasion by shrubs. (3) Domestic livestock increases seed distribution. (4) A shift in climate favors the shrubby species.

Whatever the causes, by the beginning of the 1900's the changes in vegetation had reduced forage production, decreased suitable wildlife habitats for certain species, acceler-

[4] James Rodney Hastings and Raymond M. Turner, The changing mile, Tucson, The University of Arizona Press, 1966.

[5] Fred Croxen. History of Grazing on Tonto National Forest. (Paper)

Colorado—Sagebrush has invaded an area that once was productive grassland.

Nevada—This area now has a very limited carrying capacity for livestock because of the invasion of sagebrush.

Oregon—Livestock carrying capacity has been reduced by the advancement of undesirable vegetation.

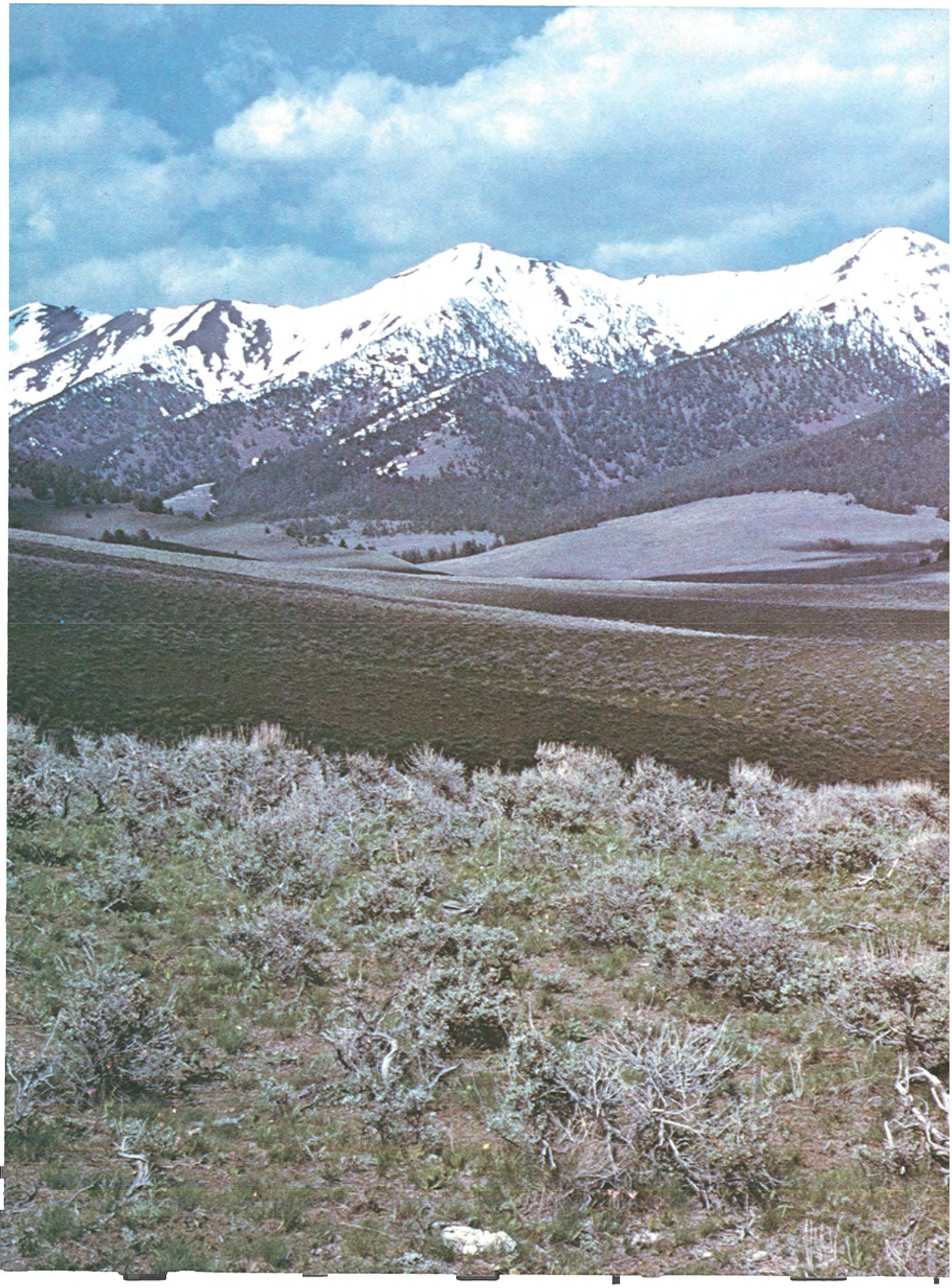
ated soil erosion, increased stream sediment, and degraded scenic values.

Aldo Leopold makes the following observation in *The Sand County Almanac:*

> The Southwest reverted through a series of more and more worthless grasses, shrubs, and weeds to a condition of unstable equilibrium. Each recession of plant types bred erosion. Each increment of erosion bred a further recession of plants. The result today is a progressive and mutual deterioration, not only of plants and soil but of the animal community subsisting therein.

The same changes in vegetation can be found in other parts of the Western United States.

Deterioration of the range made intensified management necessary to maintain or improve range productivity. Fencing and supplemental water became important range management tools.



Landscape management concepts

As described in Volume 1 of *National Forest Landscape Management*, three basic concepts should be considered in evaluating the visual impact of range management practices:

- *Characteristic landscape*—Regardless of the size or segment of the landscape being viewed, it has an identifiable character.
- *Variety*—Visual variety is desirable. Landscapes rich in variety are more likely to be appealing than monotonous ones.
- *Deviations*—Deviations from a characteristic landscape vary in degree of contrast and can usually be designed to achieve visually acceptable variety.

Characteristic landscape—This landscape is characterized by openness with little sense of boundary. Irregular vegetative patterns in the midground provide a design basis for modifying the extensive sage invasion.

Variety—Mountain meadows add variety to a landscape that otherwise would be a monotonous cover of trees. Any management activity that affects the tree cover should compliment the existing landscape.

Variety—The variety of vegetative patterns on the ridges provide the basis for design of the rehabilitated range in the foreground.

Variety—This landscape has been strongly influenced by agriculture use. The variety of vegetative patterns shown here can absorb many kinds of range management activities with minimal visual impact.

Deviations from the characteristic landscape vary in degree of contrast. As deviations, range structures and vegetative control work can add visually acceptable variety. Deviations often provide the only variety in a monotonous landscape.

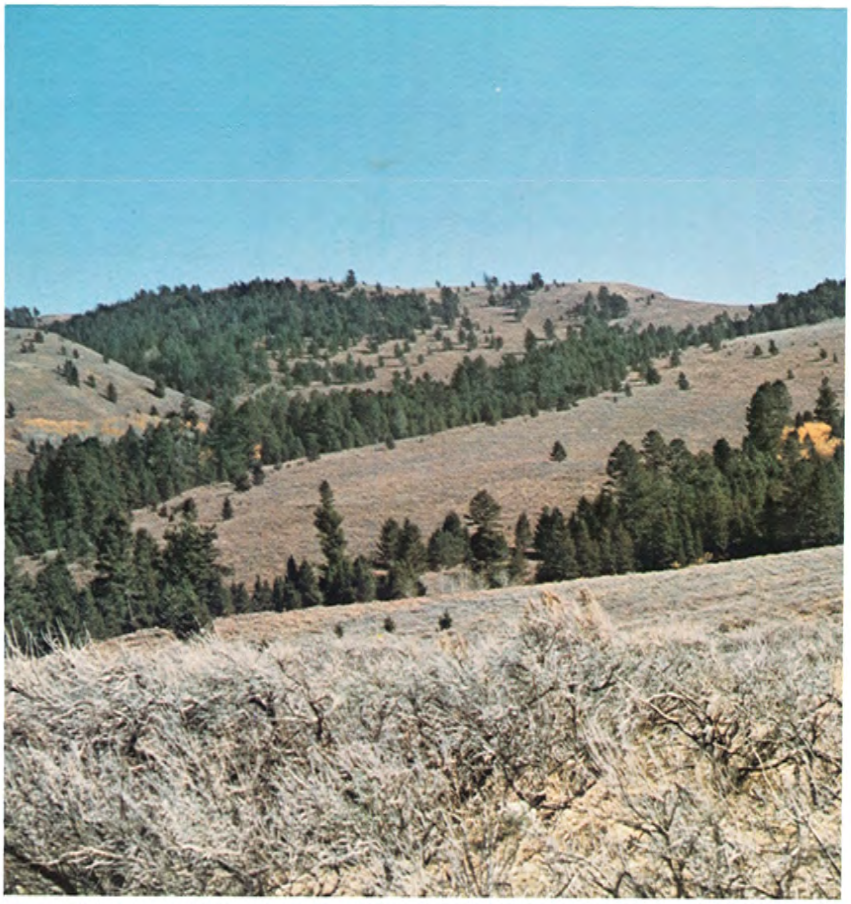
Deviation—Through careful siting this windmill has become a minor deviation that adds variety to the characteristic landscape. If the structural surfaces were nonreflective and the color similar to the background, the windmill would be nearly invisible.

Deviation—Vegetative control activities on soils best suited for grassland create a deviation that adds variety to an otherwise monotonous cover of brush.

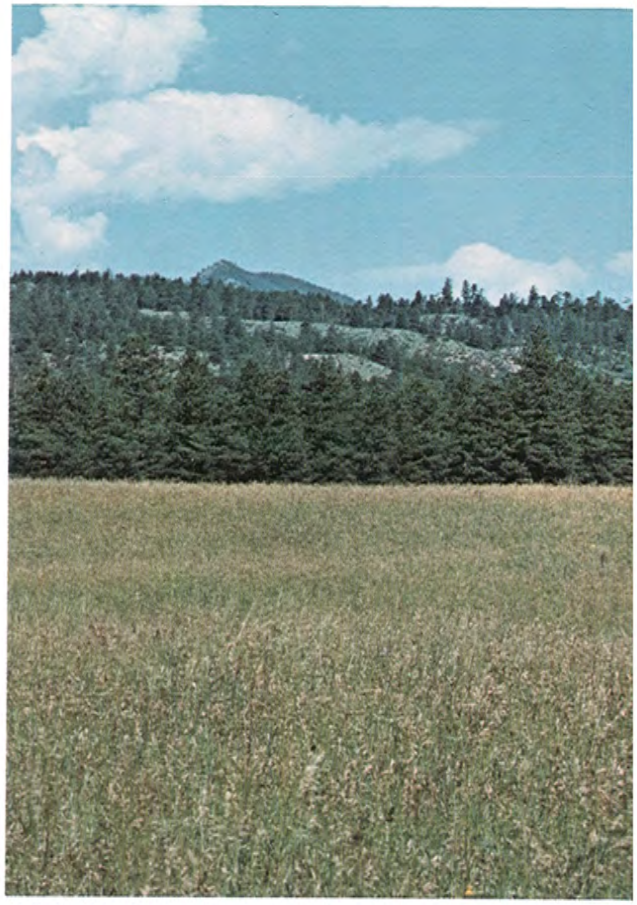
To avoid becoming a negative deviation, vegetative control projects should be designed in relation to the total area visible from key observation points.

For example, the vegetative control project pictured at the left appears to complement the surrounding landscape in form, line, color, and texture.

However, when this same area is viewed within an average human visual cone of 100° (see below), an observer sees that the project stops abruptly along a relatively straight-line boundary. From this perspective, the vegetative control project becomes a negative deviation.

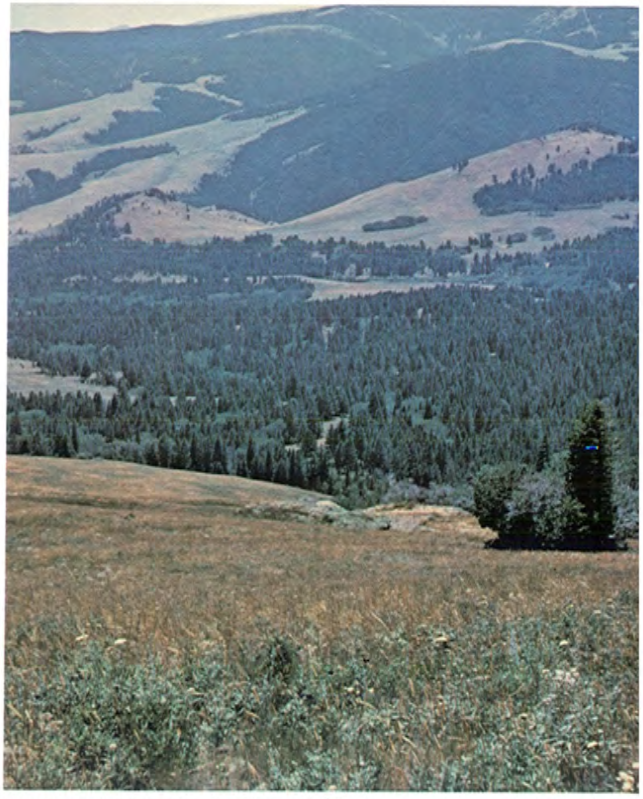


*The **form** of the mountains with their foothills and vegetative patterns dominates this landscape.*



***Color** dominates this landscape. **Texture** exerts a secondary degree of visual influence.*

*The **line** created by the change of vegetative types dominates this landscape.*

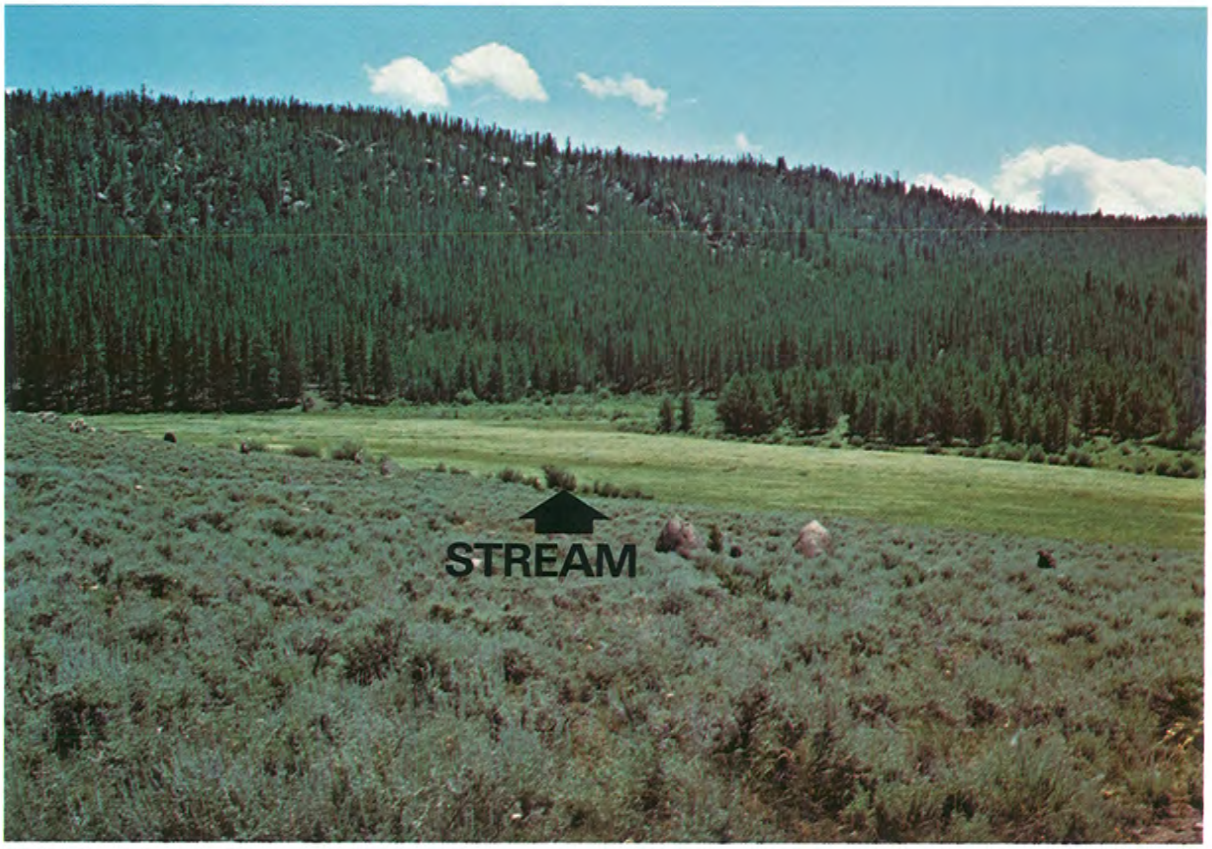


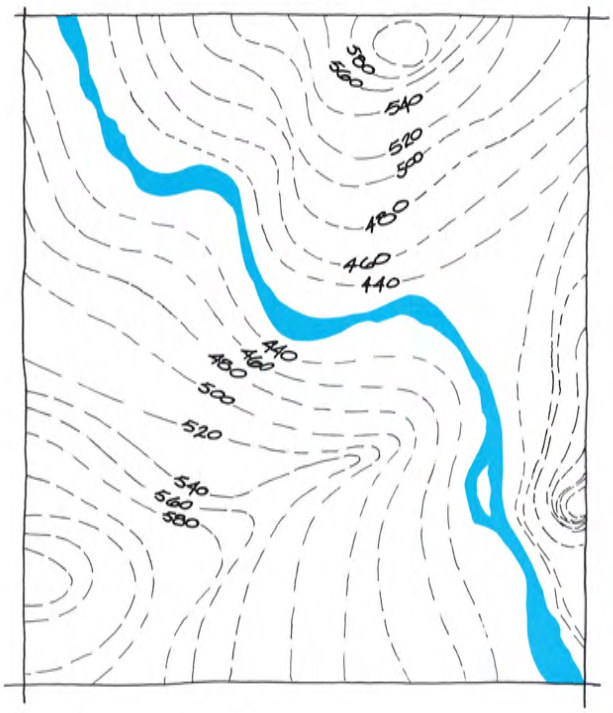
***Texture** and **color** dominate this landscape.*

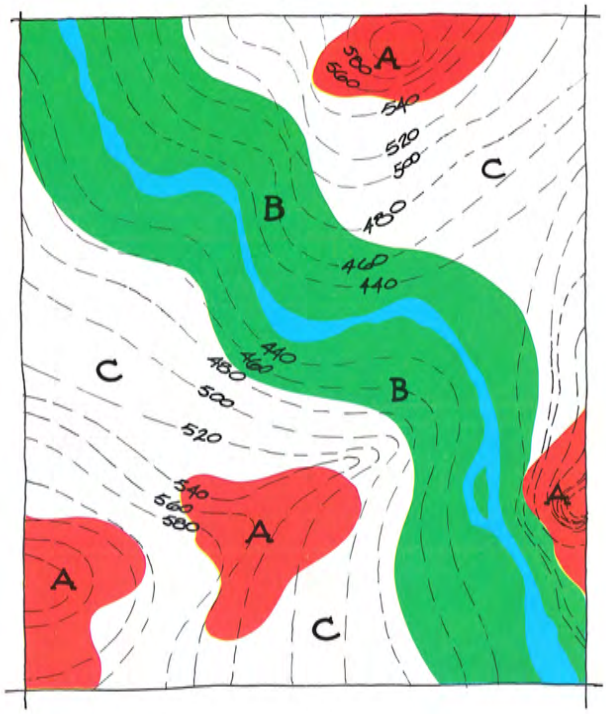
Dominance elements

Dominance elements (form, line, color, and texture) provide important tools in analyzing the existing landscape and the potential visual impact of a vegetative control project or range structure.

All four dominance elements are usually present in a landscape but exert different degrees of visual influence. The elements are described as *dominance* elements to emphasize the importance of looking at both the landscape and the proposed management practices to determine their basic visual composition and the relative strengths of each.







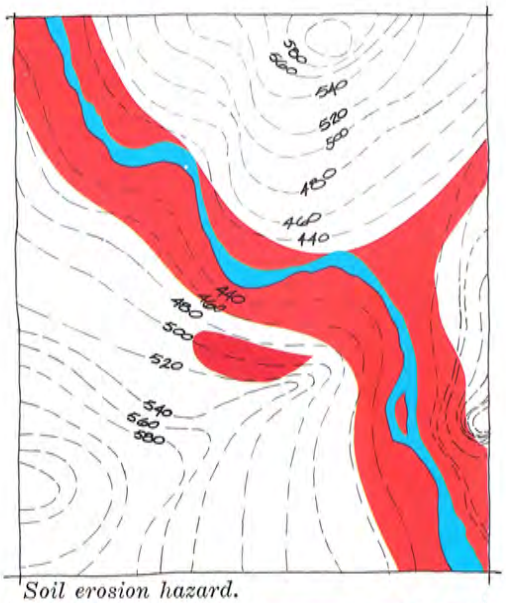
The plan view (bottom) represents the same landscape shown in the oblique photograph (top).

Soil types.

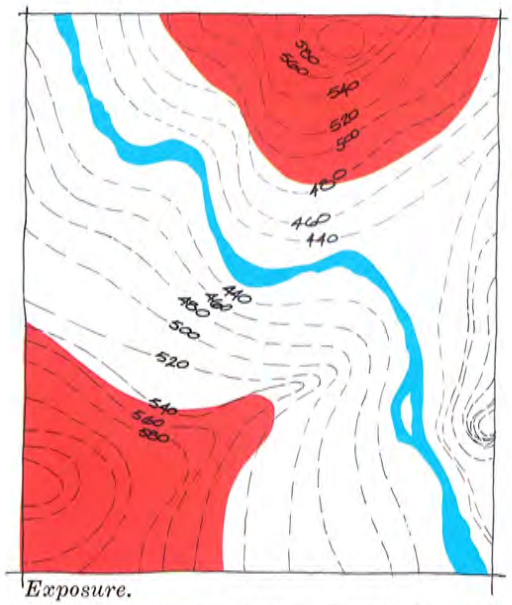
Basic planning data

When a land manager first observes grassland deterioration and encroachment of undesirable plant species, he must consider restoring the area's productivity. In his consideration, he collects natural resource data such as:

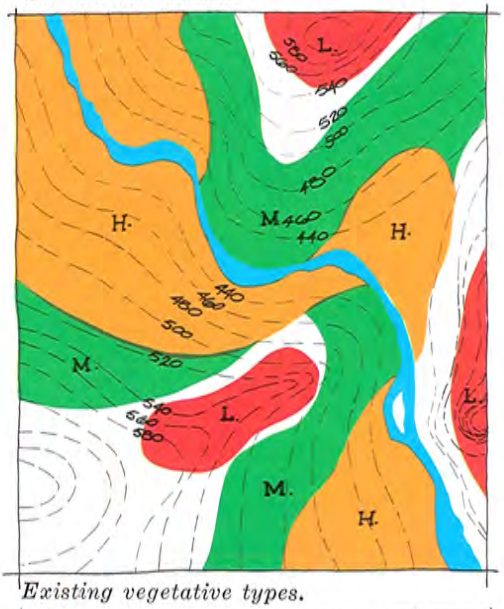
- Topography (slope analysis, erosion hazard)
- Soil types (capability and suitability for grazing)
- Exposure
- Existing vegetative types
- Wildlife
- Cultural and archeological



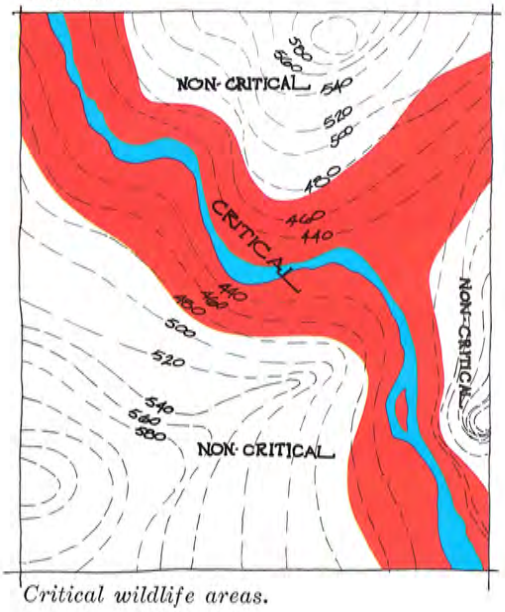
Soil erosion hazard.



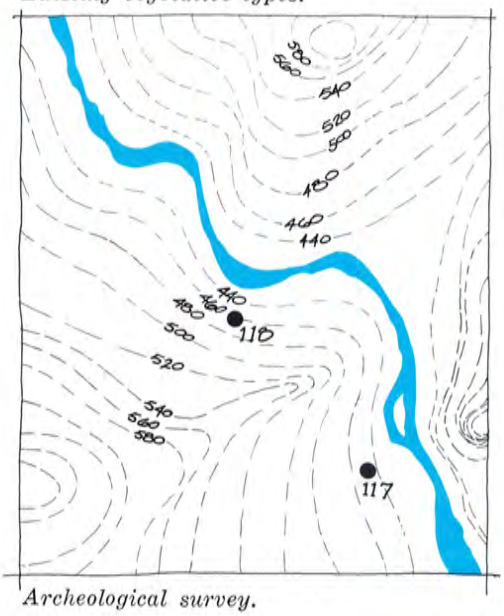
Exposure.



Existing vegetative types.



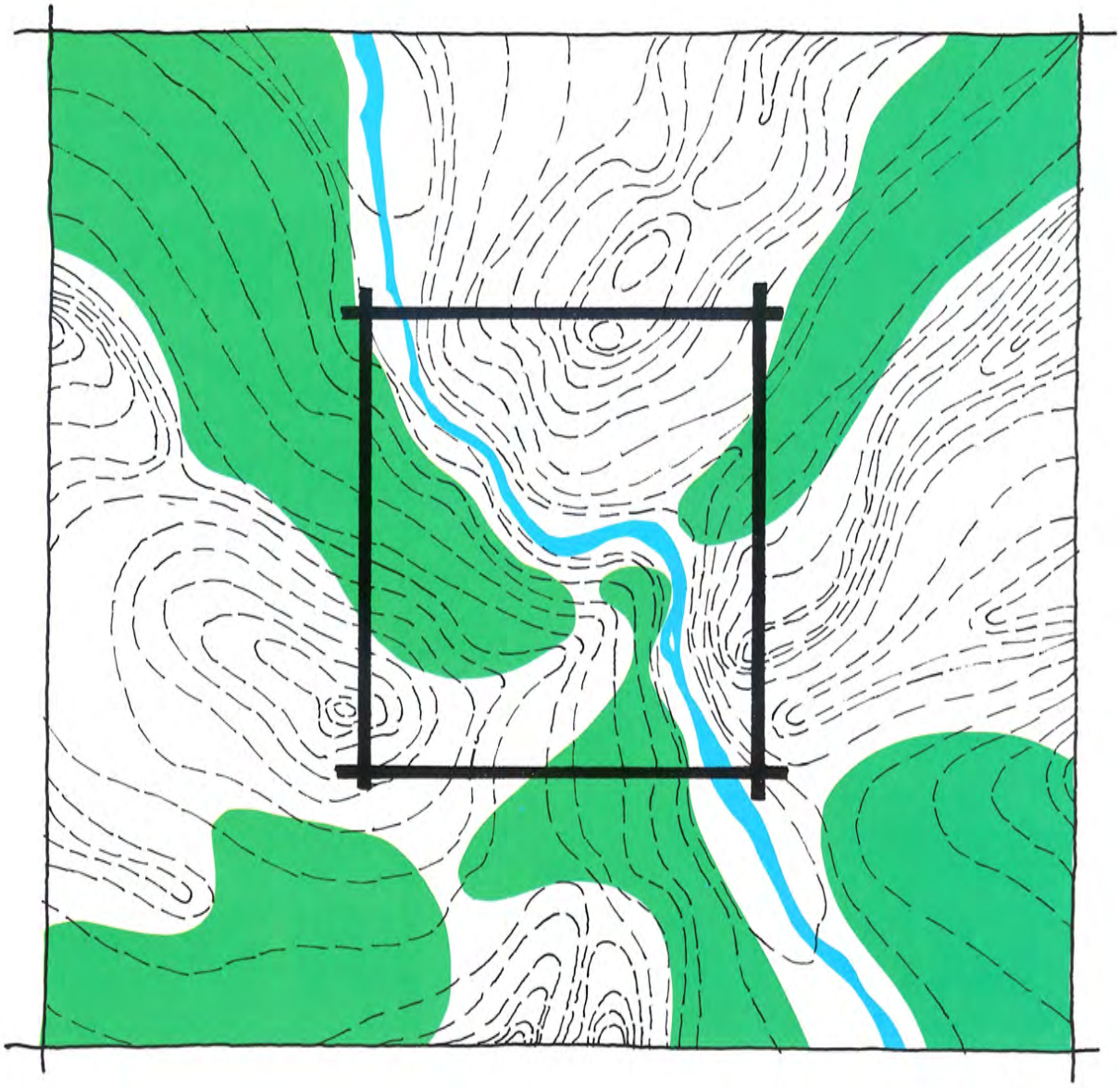
Critical wildlife areas.



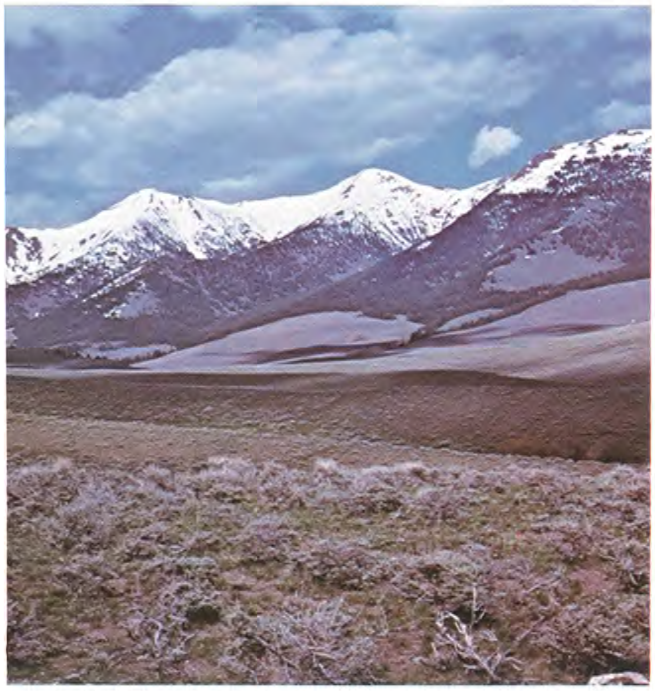
Archeological survey.

The combined data is then evaluated by an interdisciplinary team to identify suitable grazing sites and to determine the kind and extent of vegetative control work needed. Soils information is probably the most important factor in selecting vegetative treatment patterns.

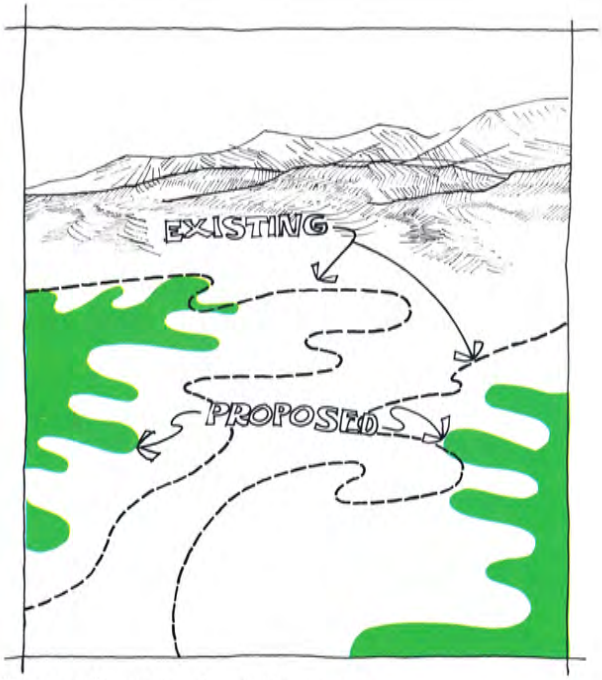
Each type of natural resource data thus collected is plotted as an overlay to a single map of the area (opposite page).



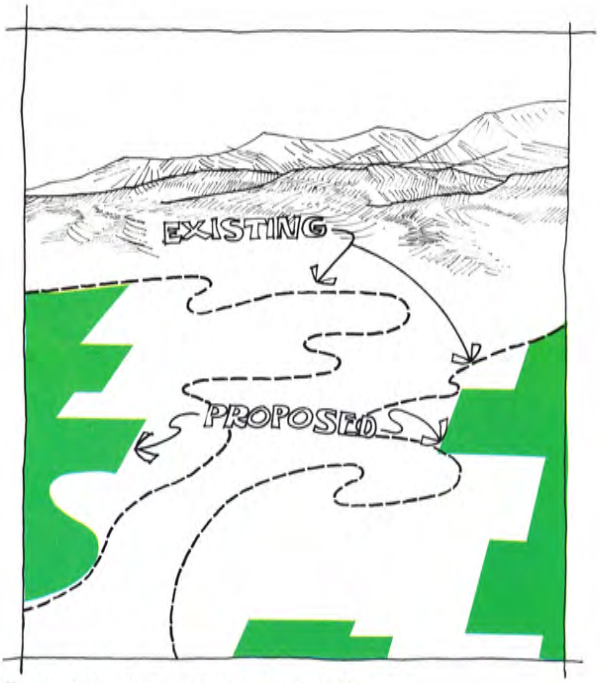
The composite overlay identifies the areas best suited for productive grassland.



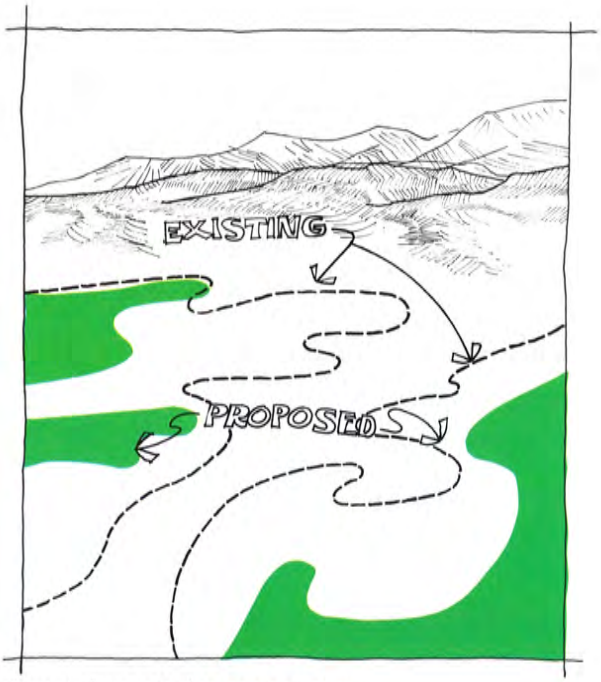
Existing vegetative openings are irregular in form; the boundary between grassland and the invading brush is curvilinear.



Extremely intricate patterns are incompatible with this landscape.



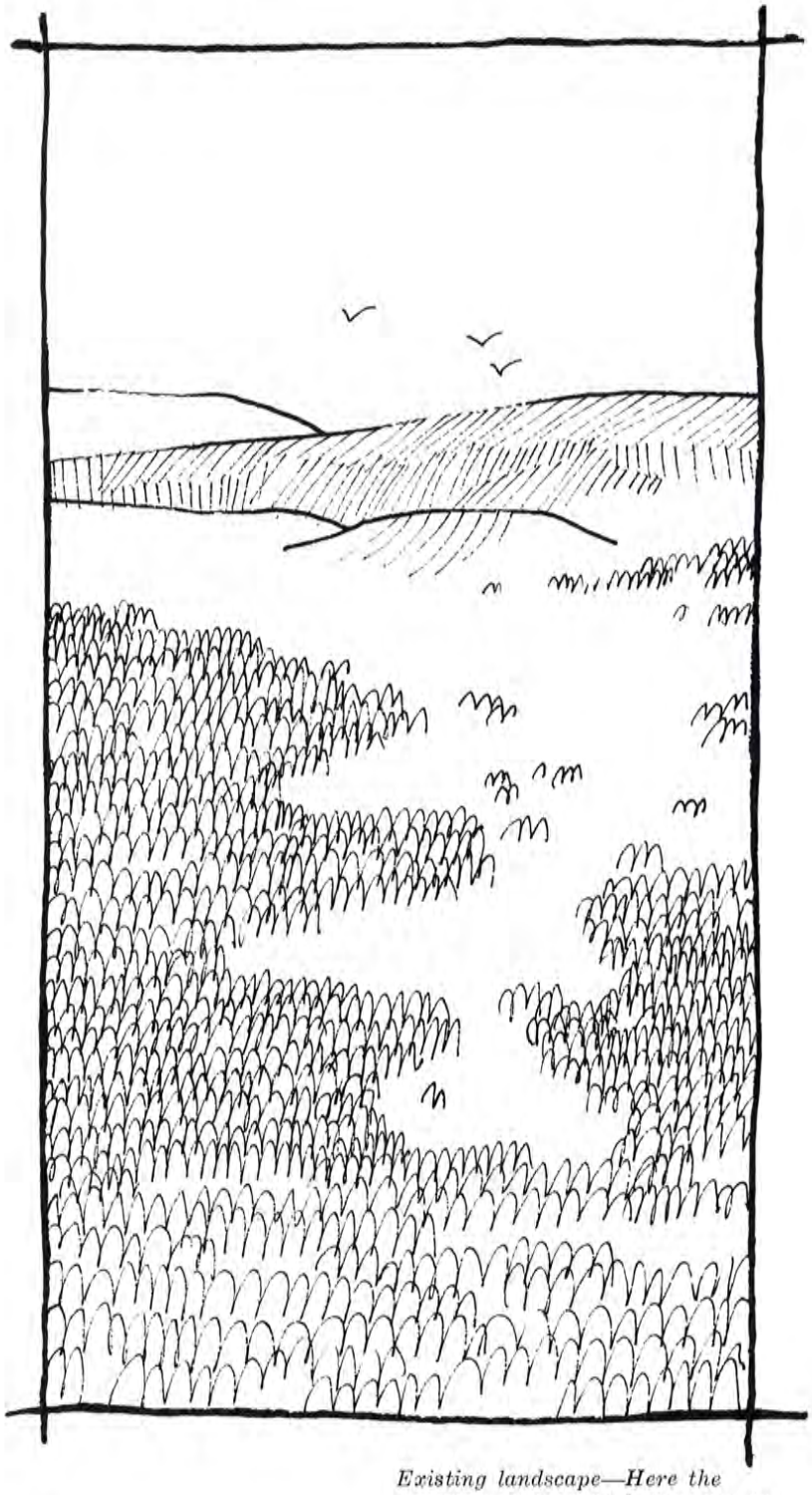
Geometric patterns are generally negative deviations in a rangeland setting.



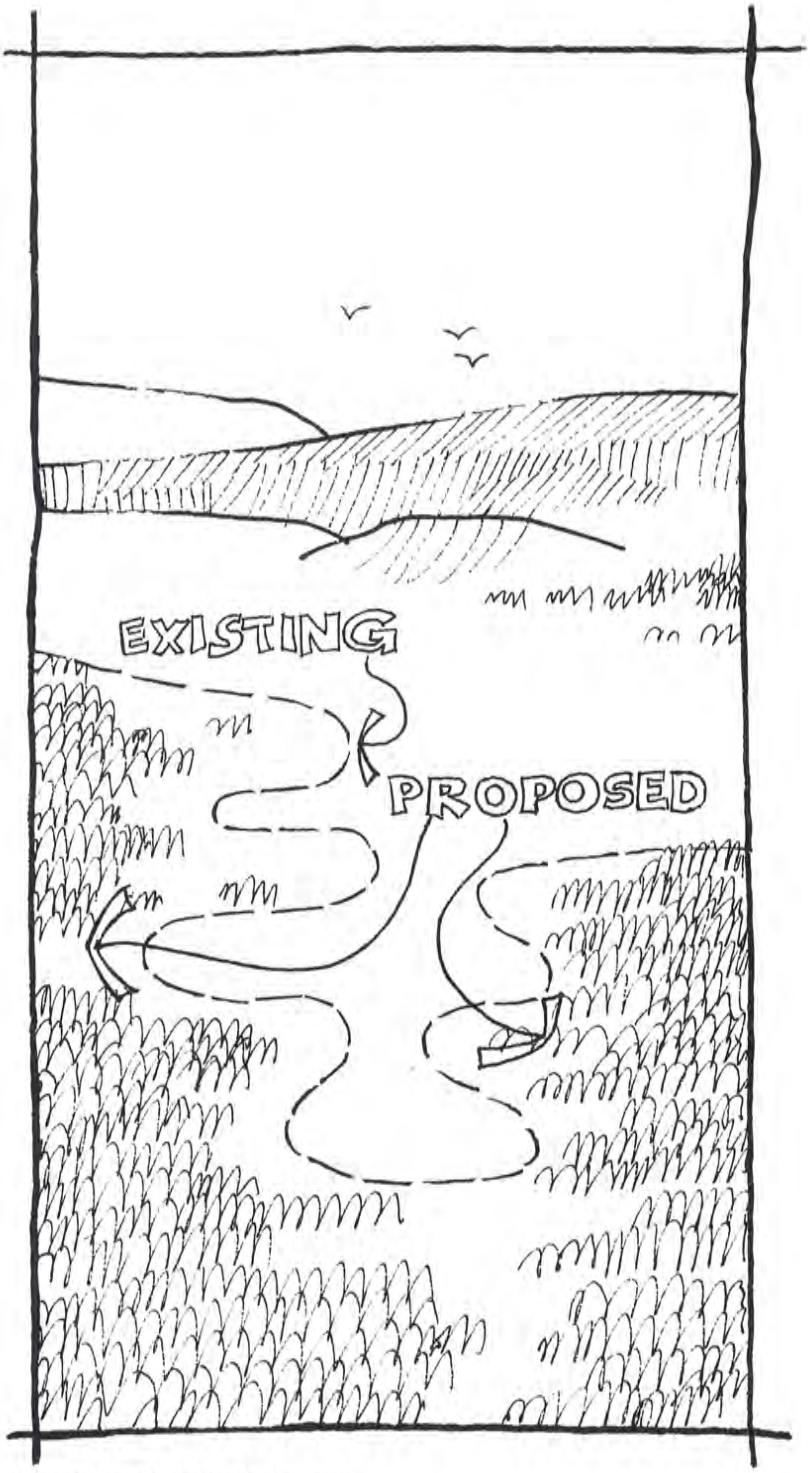
Proposed vegetative control complements the forms in this landscape.

Design guidelines

To plan and design the appearance of a vegetative control project in a general forest zone, it is necessary to analyze the landscape in detail. The existing visual patterns (form, line, color, and texture) of vegetation and landforms provide the basis for designing vegetative control projects.



Existing landscape—Here the irregular groups of larger vegetation provide a transition from open grass to dense brush.



Proposed vegetative control project —Note that this project has been designed to reflect the character of the existing landscape.

The strong line contrast created by a sharp boundary between grassland and untreated brush or trees can be reduced by creating a transition zone of vegetation that varies in size and density. Such a transition is accomplished by "feathering" the edge of untreated vegetation to create irregular vegetative patterns. The feathering begins with open grassland, progresses to scattered brush or trees, and gradually reaches the density of the untreated vegetation.

Wildlife requirements directly affect the planning and design of a vegetative control project. A wildlife biologist or range ecologist can provide the wildlife information necessary for control projects.

Basic wildlife requirements include untreated areas in draws and ravines, along permanent watercourses, and around stock tanks and springs. Untreated areas for wildlife escape routes between water and food and between shelter sources are also important. Escape routes should be linked to other untreated areas. Wildlife and livestock cover should be provided by leaving untreated areas on northeasterly exposures. If the site is to be used as a winter range, untreated areas should have a southern exposure.

Brush piles created by vegetative control projects can be used as wildlife cover if adequate cover is not available nearby. Since wildlife requirements vary, the number and size of brush piles should be suited to the particular area.

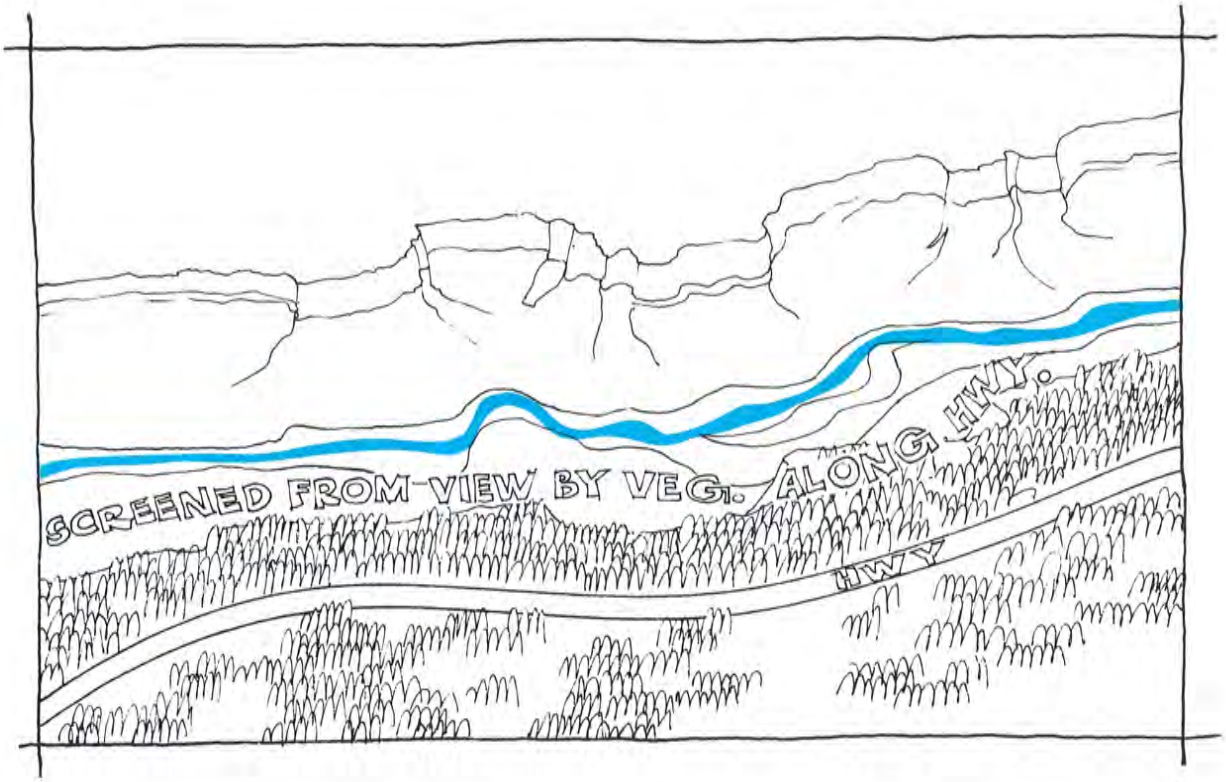
In general, brush piles should be randomly spaced and irregular in size and shape. For maximum wildlife value, the piles should contain an abundance of fine branches. The piles should be uncompacted and be no wider than 20 feet. Smaller piles often fail to provide adequate cover. Larger piles may become negative deviations in range landscapes.

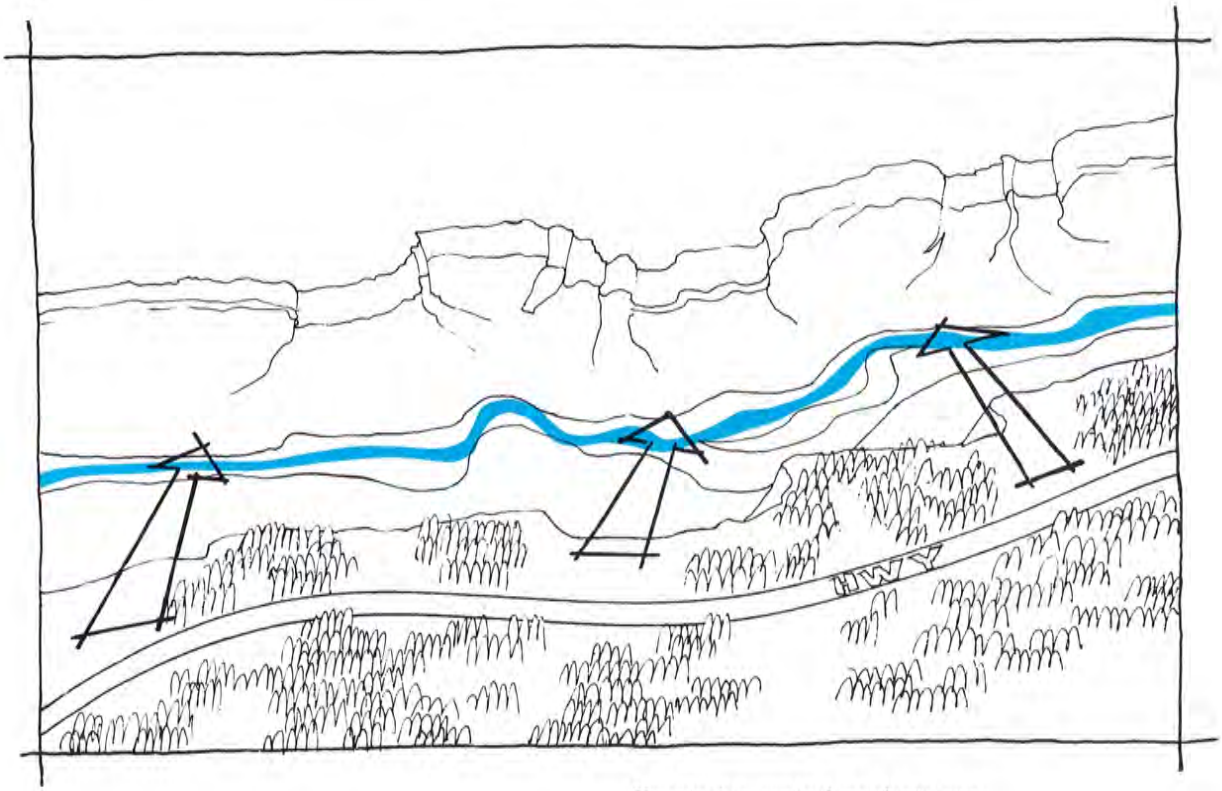
Brush not needed for wildlife cover should be removed from the site. Root wads left after the brush is burned should be buried or removed from visible foreground areas. If the piles cannot be removed, the shape of the piles should complement the landscape. Windrows or individual piles forming a continuous line should generally be avoided.

Treatment of areas densely covered with brush can result in large amounts of site debris. In esthetically sensitive areas, the visual impact of root wads and other large debris can be minimized by burning and burying or removing the residue from the site.

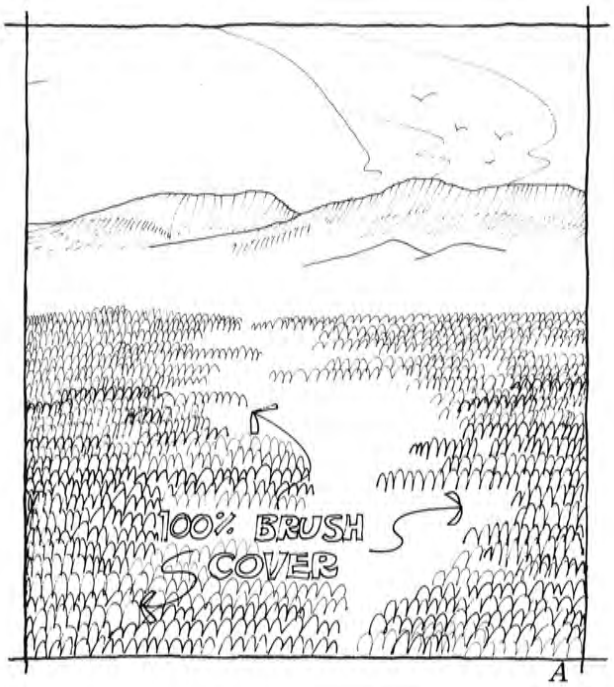
Chopping or crushing minimizes The visual impact of brush piles

The visual impact of brush piles can be reduced by forming randomly spaced piles of irregular size and shape.

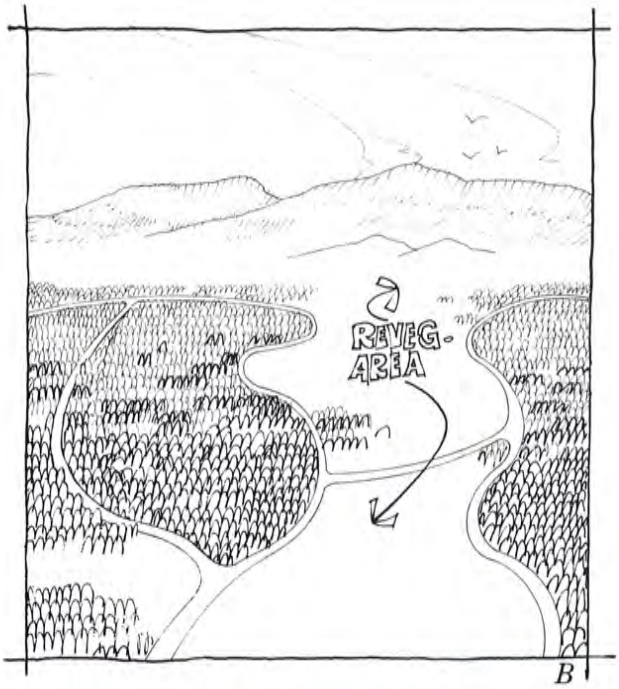




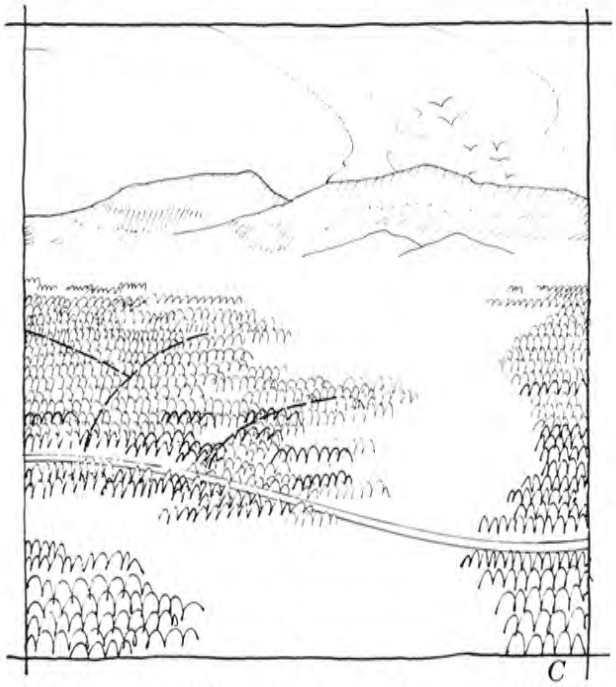
Vegetative control projects can enhance variety by featuring existing landforms, water, wildlife, or vegetation.



A



B



C

D

Access roads, necessary to accomplish vegetation control, can have a significant visual impact. The roads create major contrasts in color and texture. Line deviations are also evident, particularly when the road forms a boundary around vegetative control projects.

A. The visual impact of the roads associated with a vegetative control project for this site must be carefully assessed.

B. Roads that follow the perimeter of a vegetation control project usually create an undesirable line deviation.

C. The visual impact of roads needed for vegetation control can be minimized by reducing the number and extent of roads. Topography and vegetation can also be used to reduce the visual contrasts.

D. Treated areas should flow up to and across roads and trails. The narrow leave strips that flank this road are visually undesirable.

New Mexico—This vegetative control project rehabilitated the areas best suited for grassland.

New Mexico—This reseeded area had been invaded by pinon-juniper.

Utah—Reseeding of this formerly depleted range resulted in a 12-fold increase in grazing capacity.

Idaho—Sagebrush was removed from this area. After reseeding and a year of no grazing, productive rangeland was restored. The pattern of hardwood and evergreen on the midground ridge shows how manmade patterns can complement the landscape.

Vegetative control measures

Several alternative treatment methods can be used to control vegetation. The method chosen depends on the characteristics of the site (such as size and density of vegetation, topography, soil conditions, and requirements for reseeding). The three general categories of treatment methods are:

- Mechanical treatment
- Chemical treatment
- Prescribed burning

The purpose of all treatment methods is to remove undesirable vegetation. Examples of vegetative control projects are shown on the facing page.

The method of vegetative control selected is based on the characteristics of the particular site.

Discing is best suited for low-growing sagebrush. Visual impact is minimized by the orderly appearance of the plowed field.

This productive grassland was made possible through the vegetative control of invading sagebrush.

MECHANICAL TREATMENT

The first category includes discing, root-plowing, pushing, chopping, crushing, and chaining or railing. The visual effects of each method vary with the type, size, and density of vegetation.

Discing or plowing is used primarily for sagebrush control. Usually pulled by a crawler tractor, the discs cut, lift, and invert the vegetation and scarify the soil in preparation for planting. Because of the overall dimensions of the disc or plow, and the short turning radius of the crawler tractor, a variety of sizes and shapes of treatment and leave areas is possible.

The visual impact of site debris depends on the size and density of vegetation and the degree of cleanup or debris removal prescribed. Since sagebrush is generally only 3 to 5 feet high and has small, twiggy branches, the visual impact of the treatment area is minimal unless the brush is windrowed or piled in high, geometric forms.

Rootplowing is generally used for the control of chaparral and mesquite. The rootplow is a V-shaped, 4- to 6-foot horizontal blade attached to a crawler tractor. The tractor pulls the rootplow across the treatment area at a depth of 8 to 16 inches below the surface. Roots systems are severed and lifted to the surface. The plants are disposed of or removed from the site.

Because of the short turning radius of the crawler tractor, rootplowing can be used to create a variety of treatment and leave areas. The blade, which travels below ground surface, gives the soil the appearance of a plowed field. Assuming immediate reseeding and establishment of range grasses, this treatment can create visually acceptable variety in most National Forest landscapes.

Pushing is used for the control of large mesquite and pinon-juniper. A crawler tractor with a dozer blade and usually a push bar uproots the plants. The uprooted plants are removed, disposed of, or piled for wildlife cover.

The crawler tractor is highly maneuverable and can be used to create treatment and leave areas in a wide variety of sizes and shapes. Because large plants (often 10 to more than 20 feet high) are normally treated by this method, the plant debris left onsite can create a deviation that does not borrow the form, line, color, or texture of most National Forest landscapes.

Chopping or brush cutting is used to control small pinon-juniper, chaparral, and sagebrush. Cutting blades mounted on drums are pulled across the treatment area by a crawler tractor. These units have a short turning radius and can create treatment areas in a variety of sizes and shapes.

Two factors minimize the visual impact of this method of treatment:

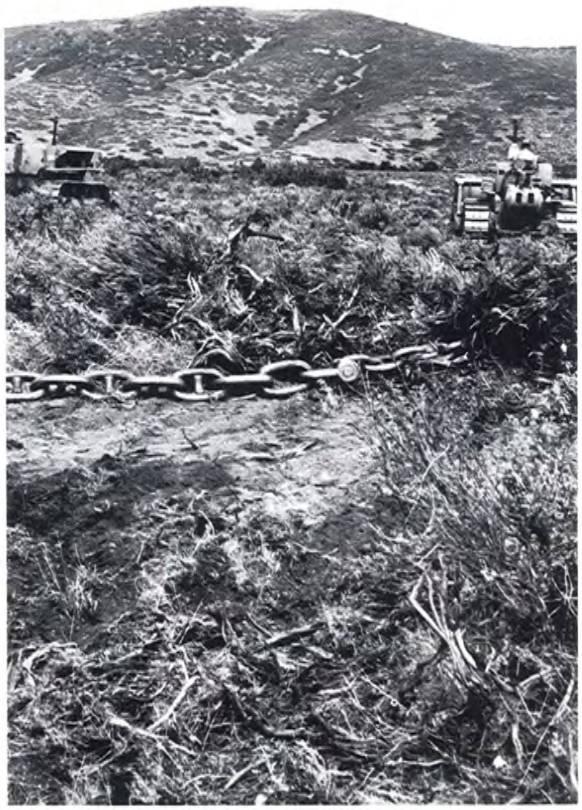
- The plants treated are small and create minimal onsite debris.
- The drum and blades force the plant down to ground surface and chop the plant into small pieces. Changes in form, line, color, and texture are visible only on foreground viewing areas.

Crushing is generally used to control large pinon-juniper and chaparral. Chopping blades mounted on drums serve as the wheels of a large, self-propelled unit. A push bar is usually mounted on front.

The visual impact of an area treated by a tree crusher is often great since the size of vegetation is generally large (small to medium tree-size). Treated and untreated areas contrast sharply in form, line, color, and texture.

The tree crusher and chopper units have similar maneuverability and both leave small, chopped pieces of vegetation on the ground. Since large pieces of the chopped vegetation can be used for firewood, local inhabitants tend to promptly and thoroughly clean up material that would otherwise have to be removed or disposed of onsite.

Removal of fuelwood can significantly reduce the visual impact of a vegetative control project.



Chaining, cabling, and railing are used to control mesquite, pinon-juniper, chaparral and sagebrush. The ends of large anchor chains, cable, or linked railroad rails are attached to the back of two crawler tractors. The tractors, moving in the same direction about 200 to 300 feet apart, drag the chain across the area to be treated, thus uprooting the invading plants. The uprooted plants are then removed or disposed of onsite.

The resulting visual impact is similar to that of a push-treatment area. However, there is one major difference in the appearance of treated areas. The shape of treated areas is determined by the length of chain or rail between tractors (since the distance between tractors determines the turning radius of the chain/tractor units). Therefore, the variety in size and shape of leave areas that can be created by chaining is generally limited.

CHEMICAL TREATMENT

A variety of chemicals can be used to control vegetation. The chemicals are delivered by aircraft or ground-spray units or both. The visual results are defoliated brush or trees or both, depending on site conditions.

The degree of visual impact depends on the size and extent of the treated vegetation. For example, if the treated brush does not dominate more than half of the area and is the same size or smaller than the surrounding grass, the visual impact is minimal. But if larger brush dominates half the treated site, the result is a deviation that does not barrow the form, line, color, or texture of most National Forests or National Grasslands.

The analogies apply to the treatment of small tree-size vegetation. The degree of visual impact depends on the density and extent of treated vegetation.

The result of chemical treatment is a productive grassland that retains a minimum of invading brush. Because undesirable species are selectively removed and ground cover remains relatively undisturbed, the overall visual impact is significantly reduced.

PRESCRIBED BURNING

Individual plant burning is used where plant densities are sparse and each plant must be treated.

Broadcast burning is used where the understory is thick enough to carry a fire and where groups of plants can be burned.

The visual impact is like that of chemically treated areas. The degree of impact varies with the density and size of the burned vegetation. Dead, fire-blackened trunks and branches are the visual remnants.

The visual impact of blackened brush can be reduced by rapid seeding of the site and reestablishment of existing grasses. Once established, the grassland adds visually acceptable variety to the landscape.

Range structures

Range structures are a major part of successful range management programs. Fencing provides distribution and control of grazing animals. Water developments provide a needed source of water in semiarid range country. Properly located and well maintained range improvements are becoming increasingly important due to expanding public needs and a greater diversity of use of our National Grasslands.

Ranching is a part of our cultural heritage, and range structures have become accepted as necessary parts of the characteristic landscapes. Range structures can be grouped into three categories: fences, corrals and related structures, and water developments.

Barbed wire fence.

FENCES

A variety of fences are available to fit the needs of a site. The selection of a fence depends on:

- Kind and class of livestock
- Topography
- Development and distribution of water
- Vegetative type
- Season of use
- Cost and availability.

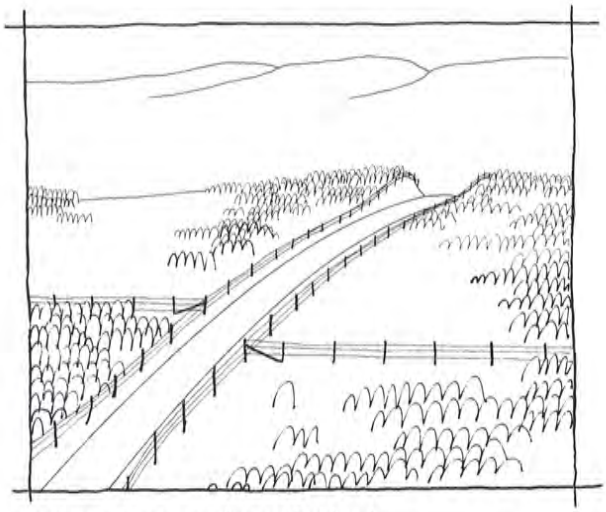
No single type of fence will fit all conditions.

The basic types of fences are shown on this page.

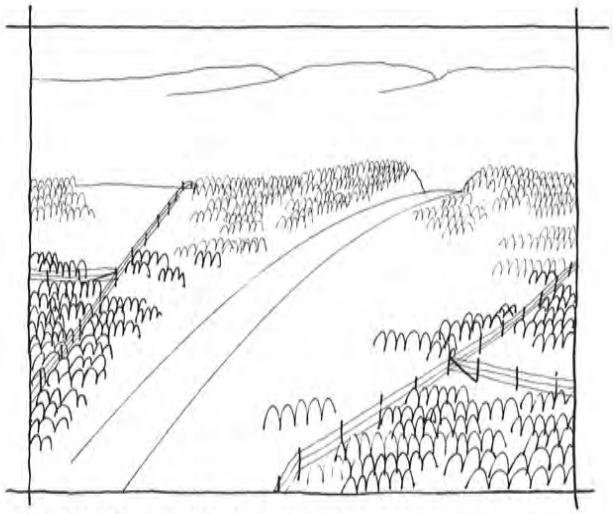
Post and log fence.

Electric fence.

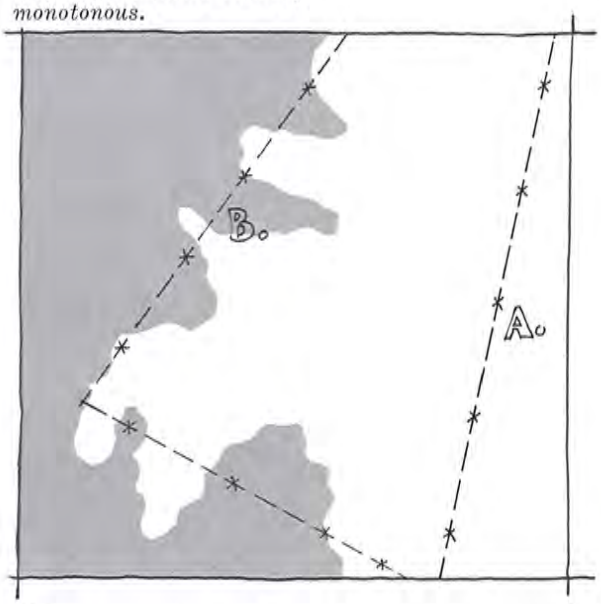
Woven wire fence.

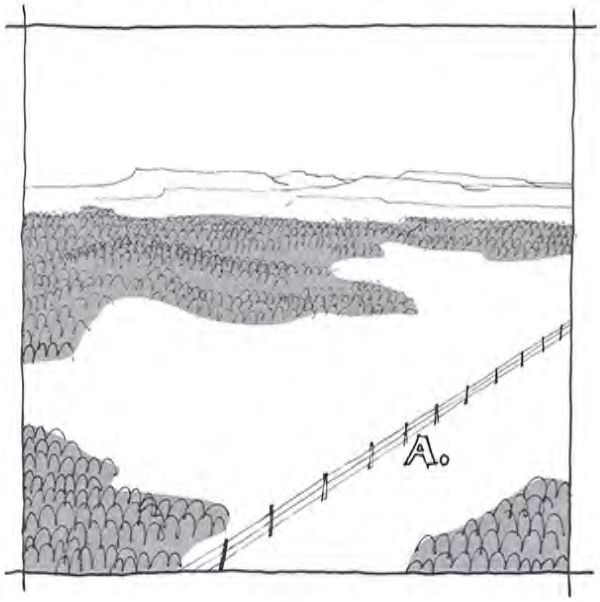


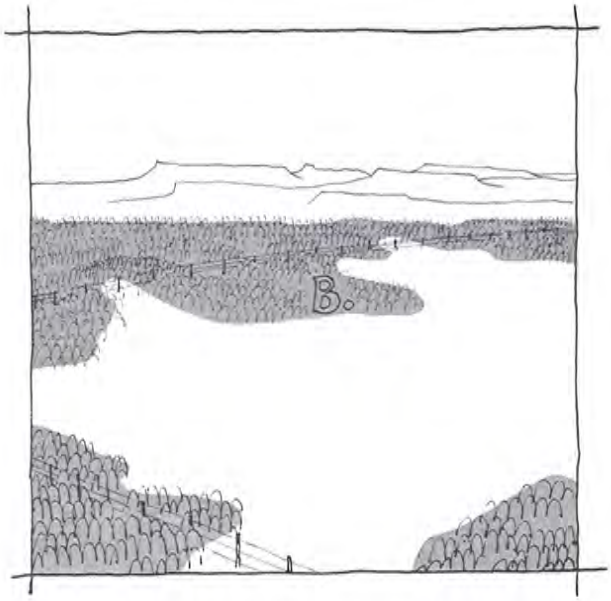
If fence lines continuously dominate the view from a road, the landscape becomes visually monotonous.



The visual impact of a fence line can be screened by natural landforms and vegetation.



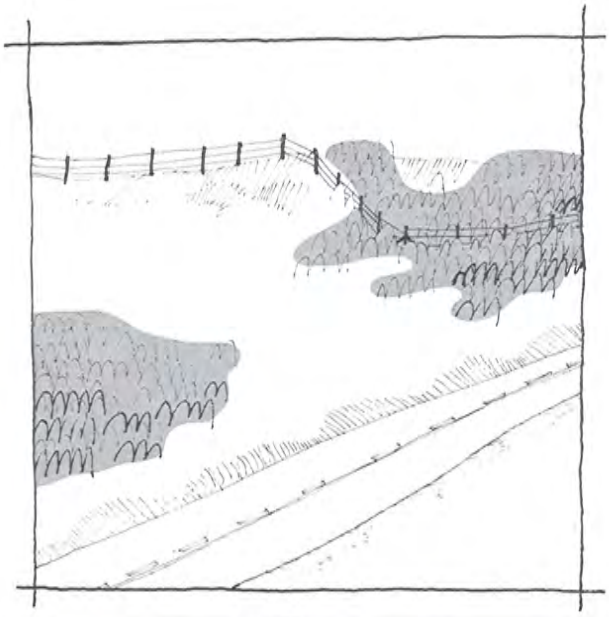




The visual impact of a fence line is minimized by selecting a form, line, color, and texture that blends with the landscape. The fence selected must also meet range management objectives.

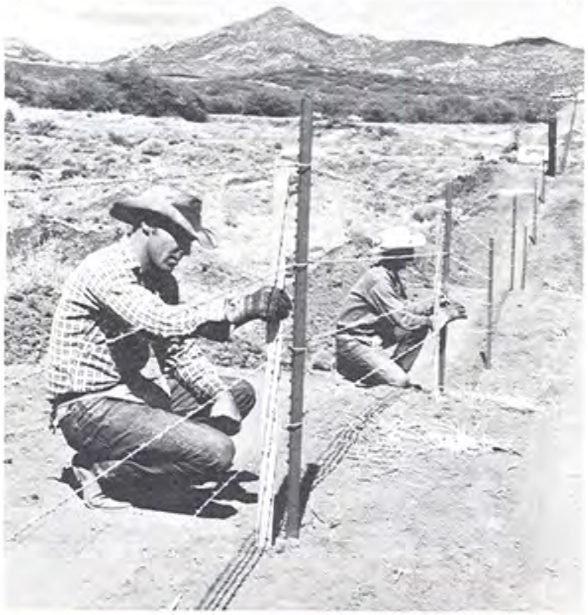
The most critical locations of fences are in the foreground and midground views along major travel routes and in vegetative openings. The visual impact of fence lines can be reduced by minimizing the amount of fencing within view of a road.

If a fence line crosses vegetative openings, the visual impact can be reduced by limiting the open space crossed. Fences should be placed slightly inside the vegetation that surrounds the opening.



Fence lines silhouetted against the sky have a stronger visual impact than those viewed against a vegetative background.

To reduce color deviations, disturbance of soil and vegetative cover should be held to the minimum.

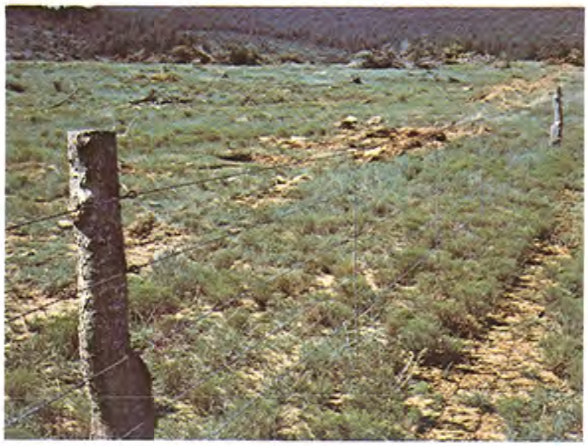


A fence line located part way up a slope viewed against a landform and vegetative background, creates less visual impact than one silhouetted against the sky.

Soil disturbance and the clearing of vegetation for fence construction may cause undesirable deviations in color and texture. The degree of contrast varies with the form and extent of clearing and soil disturbance.

If clearing is necessary, color and texture deviation can be reduced by minimizing clearing and by creating irregular or feathered clearing edges. Clearing methods that do not disturb the soil create less color contrast than methods that expose mineral soil. Brushcutters or rolling choppers are effective because they chop the brush and leave it on the ground as a mulch.

Color and texture contrasts can also be minimized by using nonreflective wire and posts that blend with the landscape.



Since it requires fewer posts, a suspension fence generally has less visual impact.

This fence complements the form, line, color, and texture of the surrounding landscape.

CORRALS AND RELATED STRUCTURES

This category includes all structures used to handle or work livestock. Properly constructed handling structures are becoming important due, in part, to decreasing reliance on horses and a shortage of manpower.

The design and location of these structures depend on the type of livestock operation, the number of existing structures, the sales procedures of the locality, and the general preferences of the operator. A complete set of guidelines is beyond the scope of this publication because of the variety of structures and the variations of each structure. There are, however, several facts to be considered before construction.

Because corrals are used only a few times a year, economic constraints have given rise to the use of structural designs and materials that often contrast with the form, line, color, or texture of the landscape. Therefore, careful siting is very important in minimizing the visual impact. Existing landforms and vegetation can be used for partial or total screening of views from most observation points.

Visual impact can be reduced by using materials that have textures and colors that blend with the landscape.

This corral loading area has been sited to take advantage of the natural screening provided by landforms and vegetation.

WATER DEVELOPMENTS

The location, amount, and reliability of water are often the limiting factors in developing a range management system. Water for livestock must be dependable, available at the right time of the year, of sufficient quantity, and properly located to contribute to good livestock management. There are a variety of structures that meet water requirements, including reservoirs, spring or seep developments, wells, trick tanks, storage tanks, pumps, pipelines, and drinking troughs.

Resevoirs often add visual variety to monotonous landscapes. To minimize the visual impact caused by soil and vegetation disturbance, areas that require excavation or fill can be designed to blend with the form, line, color, and texture of the landscape.

The visual impact of above-ground water developments can be minimized by using vegetation or landforms as screens and by keeping vegetation removal and soil disturbance to the minimum. An alternative method is to place as much of the structure as possible at or below ground level.

Horizontal wells usually create the least visual impact of any water development since landforms and vegetation remain relatively undisturbed.

Selected references

Arnold, Joseph F., Donald A. Jameson, and Elbert H. Reid.
1964. The pinyon-juniper type of Arizona: effects of grazing, fire, and tree control. USDA For. Serv., Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Baldwin, J.J.
1968. Chaparral conversion on the Tonto National Forest. Annu. Tall Timbers Fire Ecol. Conf. Proc.

Bentley, Jay R.
1967. Conversion of chaparral areas to grassland: techniques used in California. USDA For. Serv., Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Crowe, Sylvia
1966. Forestry in the landscape. For. Comm. Bull. No. 18. London: Her Majesty's Stationery Office.

Croxen, Fred W.
1926. History of grazing on Tonto National Forest. (Paper) [Presented at the Tonto Grazing Conf., Phoenix, Ariz., unn. publ.]

Entwistle, Robert
1970. A place for visual quality in the range resources. (Paper) [Presented at Amer. Soc. Range Manage. meet., Idaho Falls, Idaho.]

Hastings, James Rodney, and Raymond M. Turner.
1966. The changing mile. Tucson: The University of Arizona Press.

Johnson, Thomas N., Jr.
1962. One-seed juniper invasion of northern Arizona grassland. Ecol. Monogr. 32.

Lamb, Samuel H., and Rex Piper
1971. Game range improvements in New Mexico. (Paper) [Prepared for the N.M. Interagency Range Comm.] USDA Agric. Res. Serv., Las Cruces, N.M.

Leopold, Aldo
1924. Grass, brush, timber, and fire in southern Arizona. J. For., Vol. 22, No. 6, Oct. 1924.
1949. A sand county almanac. New York: Oxford University Press.

Litton, R. Burton, Jr.
1968. Forest landscape descriptions and inventories: a basis for land planning and design. USDA For. Ser., Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Parker, Kenneth W.
1945. Juniper comes to the grassland. Amer. Cattle Prod. 27(6).

Pollock, James W., and Jack L. Reveal.
1972. Landscape management guidelines: brushland fuelbreak design. USDA For. Serv., Cleveland Natl. For., San Diego, Calif.

U.S. Department of Agriculture Forest Service.
1963. Timber management. USDA For. Serv., Pac. Northwest Reg. (R-6). For. Serv. Man., Reg 6 Suppl. No. 68, Title 2400.
1970. Chaparral vegetation type. USDA For. Serv., Southwestern Reg. (R-3).
1970. Nonstructural range improvements handbook. USDA For. Serv., Southwestern Reg. (R-3), Amend. No. 1, FSH 2209.23R.
1970. Timber management. USDA For. Serv., Calif. Reg. (R-5). For. Serv. Man., Reg. 5 Suppl. No. 91, Title 2400.
1971. Guideline for vegetative manipulation projects. USDA For. Serv., Prescott Natl. For., Prescott, Ariz.
1971. Fuelbreaks planning treatments. USDA For. Serv., Calif. Reg. (R-5).
1971. Landscape treatment wildlife habitats. USDA For. Serv., Calif. Reg. (R-5).
1971. Utilities placement treatment. USDA For. Serv., Calif. Reg. (R-5).
1972. Structural range improvements handbook. USDA Forest Serv., Southwestern Reg. (R-3), FSH 2209.22 R3.
1972. Landscape management in pinyon-juniper control. USDA For. Serv., Southwestern Reg. (R-3).
1972. Range programs. USDA For. Serv., Sitgreaves Natl. For., Holbrook, Ariz.
1972. The visual management system. USDA For. Serv., Vol. 3, Chap. 1.
1973. National forest landscape management. USDA For. Serv., Vol. 1. Washington, D.C.
1973. Visual resource management guides: visual quality standard determination and application. USDA For. Serv., Calif. Reg. (R-5).
1973. Final environmental statement: vegetation control with herbicides in the state of Arizona. USDA For. Serv., Southwestern Reg. (R-3).
1973. Final environmental statement: a proposal for vegetation control by mechanical treatment in the state of Arizona. USDA For. Serv., Southwestern Reg. (R-3).
1974. National forest landscape management. USDA For. Serv., Vol. 2, Chap. 1, Washington, D.C.

U.S. Department of the Interior and U.S. Department of Agriculture
1970. Environmental criteria for electric transmission systems. Washington, D.C.

Williamson, Robert M. and W. F. Currier
1971. Applied landscape management in plant control. J. Range Manage., Vol. 24, No. 1, Jan. 1971.

OTHER PUBLICATIONS IN THIS SERIES

United States Department of Agriculture, Forest Service.

1973. National Forest Landscape Management. Vol. 1. U.S. Dep. Agric., Agric. Handbook 434, 77 p., illus. U.S. Government Printing Office, Washington.

———

1974. National Forest Landscape Management. Vol. 2, ch. 1 (The visual management system). U.S. Dep. Agric., Agric. Handbook 462, 47 p., illus. U.S. Government Printing Office, Washington.

———

1975. National Forest Landscape Management Vol. 2, ch. 2 (Utilities). U.S. Dep. Agric., Agric. Handbook 478, 147 p., illus. U.S. Government Printing Office, Washington.

———

1977. National Forest Landscape Management. Vol. 2, ch. 4 (Roads). U.S. Dep. Agric., Agric. Handbook 483, 62 P., illus. U.S. Government Printing Office, Washington.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1976 O—579—420