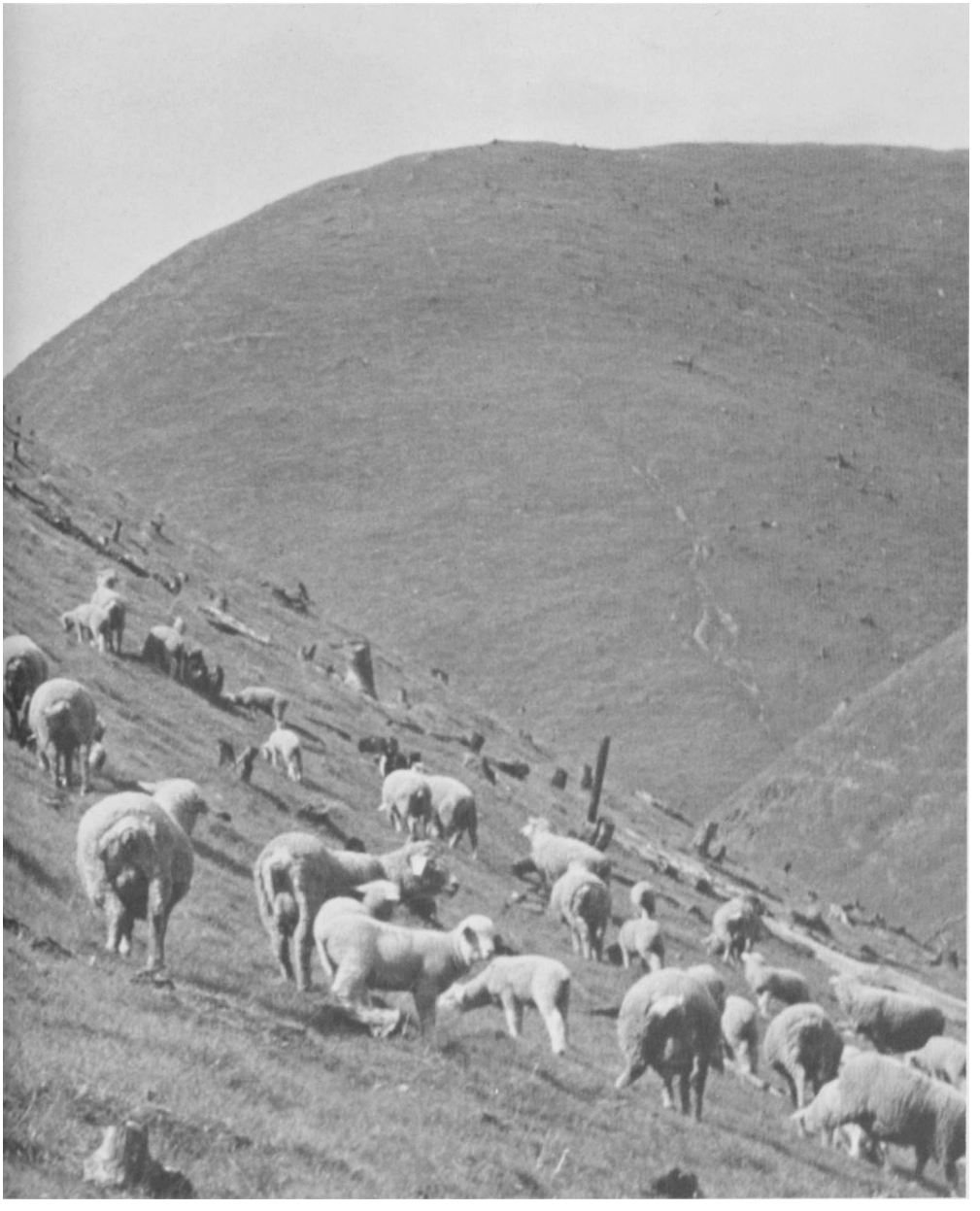
WATERSHED I

Watershed I, a 63-acre unit, is fenced as one grazing pasture. It ranges in elevation from 960 to 1,280 feet and receives an annual rainfall varying between 24 and 60 inches. Josephine soils, 3 to 4 feet deep, occupy about 60 percent of the watershed, with Los Gatos, Laughlin, and Livermore soils covering 30, 5, and 5 percent, respectively.

The topography is characterized by steep side-hills and narrow stream channels. The soil mantle developed from hard sandstone and shale on overlaying rock of the Franciscan formation. This formation consists of sandstones, shales, serpentine, and is very blocky and seamy with extensive fracturing and jointing. Generally, this area is typified by numerous slides and surface slumps. The configuration of the land features suggests a major fault with the possibility of cross faults that would result in subsurface water leakage out of the unit.



Objectives

In the treatment of this watershed unit, an attempt was made to measure water yield, erosion rates, and forage production. After a 4-year calibration period (1952-56), the conversion treatment was applied. This consisted of changing the original vegetation--44 acres of hardwood trees, 14 acres of brush, and 5 acres of grass--to a cover of grass and herbaceous vegetation. The change was made in summer of 1956 after the 1955-56 growing season and before the start of the 1956-57 growing season.

Woody plant treatment

Approximately 10,600 trees, ranging from a few inches to about 24 inches in diameter, were cut close to the ground with a chainsaw. The stumps were painted with 2,4-D amine to reduce sprouting.

Where the terrain was not too steep, the brush was crushed with a bulldozer by holding the blade approximately 6 inches above the ground so the soil would not be disturbed. Steep, brush-covered slopes were not treated.

Burning

By late summer the cut trees and crushed brush were dry and ready to burn. Area ignition--simultaneous ignition of many, closely spaced, small fires that support one another and cause intense, rapid burning--was used. All of the debris was consumed by the fire except for larger tree trunks, stumps, and some stems of standing brush. On the areas where the fallen trees were thick, a heavy accumulation of white ash resulted. On the brush and grass areas, a thinner black ash was deposited. The white ash provided an excellent seedbed.

Seeding

Two weeks after the burn, the area was seeded by aircraft to a mixture of grass and legumes. Per-acre seeding rates were hardinggrass, 4 pounds; smilo, 2 pounds; Palestine orchardgrass, 1/2 pound; Mt. Barker subclover, 1/2 pound; Tallarook subclover, 1/2 pound; crimson clover, 1 pound; and rose clover, 1 pound. Blando brome was seeded by hand on about 10 acres of steep brush slopes.

Within a month after the seeding about 1/2 inch of rain had fallen, starting germination of most of the seeded species. By the end of October, 3 inches had fallen, ensuring adequate moisture for germination and growing of all seeded species. Growing conditions were favorable for the initial period of growth and establishment. Seasonal rainfall was 29.4 inches, with no intense storms to initiate erosion of the soil and loss of plants.

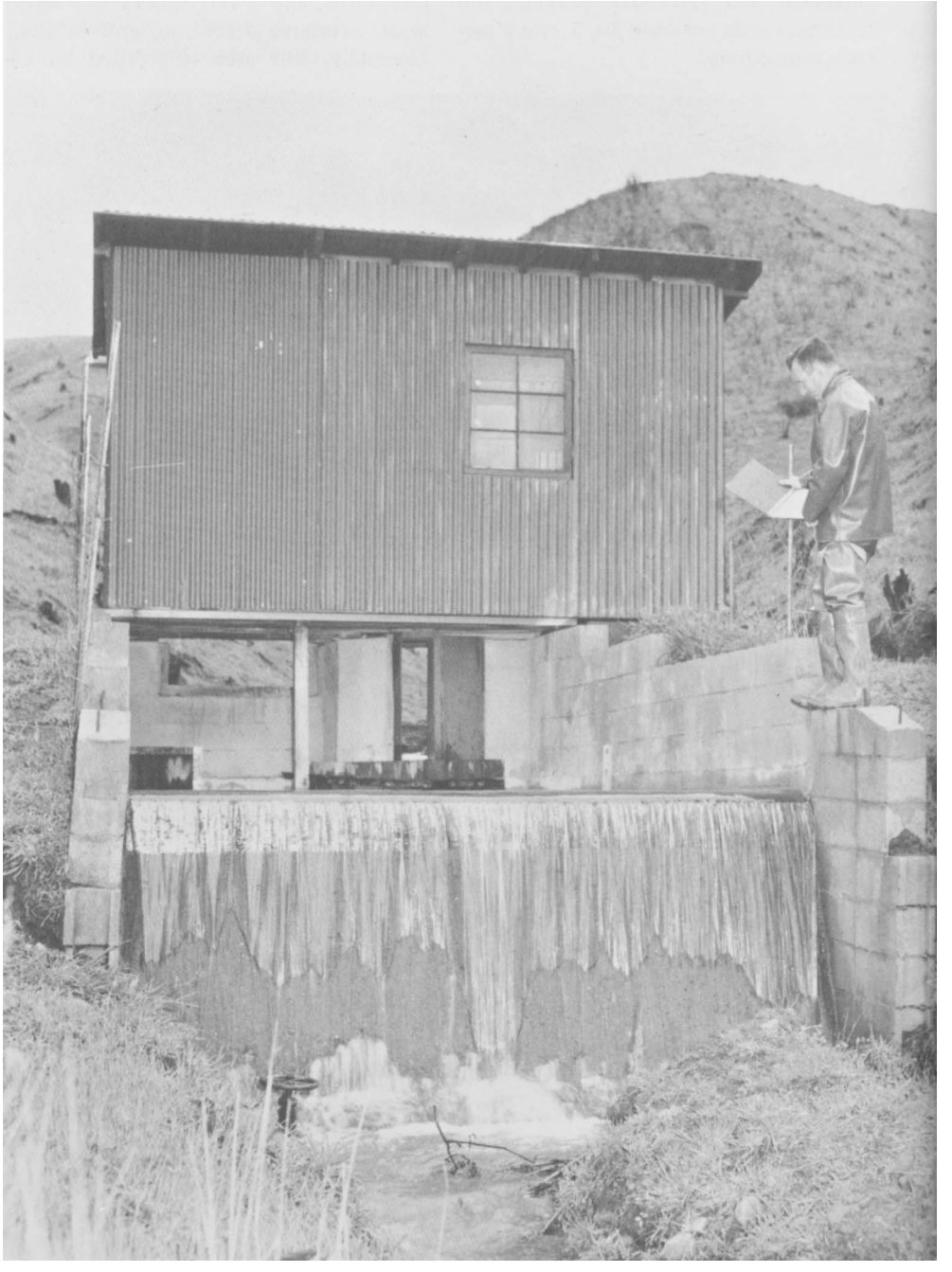
Sprout control

During the first spring after the burn, the area previously in brush was sprayed with 2,4-D amine mixed with water and 1 percent diesel oil. Rate of application was 4 pounds of 2,4-D amine per 100 gallons of water per acre. The material was applied by backpack sprayer to the basal sprouts of the brush plants. Plants missed or still sprouting after the earlier treatment were sprayed a year later.

One year after the burn, tree sprouts were cut with an axe and the sprouting surface sprayed with a mixture containing esters of 2,4-D and 2,4,5-T in diesel oil. The two chemical treatments, combined with grazing and competition from seeded species, eliminated any further need for chemical sprout control.

Livestock use

Before changes were initiated, the watershed had only about 5 acres of grass and supported an estimated 70 sheep-days per acre. Following seeding, sheep were not grazed in the area until the majority of the planted grasses and legumes had matured and shattered their seed in late July; thus the 1957 grazing use was low. Deferring grazing until the herbaceous vegetation was mature and dry helped shatter and distribute the seed and encouraged browsing on the green woody species. In the 10 years following the burning and seeding (1957-66), grazing use averaged approximately 276 sheep-days per acre. The post-treatment grazing varied from 112 sheep-days per acre in the year following treatment to 615 sheep-days per acre in 1965. Fertilizers, applied by aircraft, included phosphorus in 1958 and 1963 and phosphorus and sulfur in 1965.



Stream-flow measurements are an important part of the watershed studies.

Water and soil

A water-measuring weir and a basin to collect the stream soil load were installed in the canyon where all surface water leaving the area could be measured.

The water measurements have been inconclusive, due principally to the underlying fractured rock formation, which causes much of the flow to run subsurface where it cannot be measured by the channel weir. This is most pronounced during low discharge where the channel flow does not reach the measuring structure. Well drillings indicate, however, that subsurface flow is close to the surface during much of the year.

The change of vegetation from trees and brush to herbaceous ground cover has resulted in very little erosion disturbance. Because this watershed's subsurface structure is porous, the surplus moisture is not retained in the soil mantle; thus, soils do not become saturated with water, and soil movement is minimized. Likewise, the increase in available water is not expressed as visible stream flow. A good stand of forage species has been maintained in the area by applying phosphorus and sulfur when nutrient needs were indicated. This has resulted in a high rate of productivity for livestock use, maximizing the production efficiency of this grazing land while minimizing soil disturbance.

WATERSHED II

Watershed II is a 210-acre drainage basin that has a west-facing orientation and drains directly into the Russian River. Elevations range from 600 to 1,300 feet. The pre-treatment vegetation consisted of approximately 13 acres of grass; 49 acres of mixed grass and deciduous oak trees; 125 acres of black oak, live oak, blue oak, and madrone; and 23 acres of brush, principally chamise and chaparral. The soils consisted of eight series: 28 percent Sutherland-Laughlin complex, 1 percent Sutherland, 4 percent Laughlin, 46 percent Josephine, 8 percent Yorkville, 3 percent Los Gatos, 9 percent Maymen, 1 percent Montara. The soils, several feet thick, are over sandstone and shale rock of the Franciscan formation. The formations are typical of coastal mountain ranges--extremely shattered and jointed, with intrusions of basic rock and interlaced with faults.

In the lower part of the watershed, near the gauging station, sediments of varying depths are present adjacent to the channel, which appears to be oriented along a fault line. The sediments are well consolidated and have low permeability.

The study on this area began in 1952 when the watershed was fenced as a unit, and a weir and settling basin were installed for measuring runoff and erosion. Other instruments to measure precipitation, soil moisture, and ground water levels also were installed.

Objectives

The vegetative change in this watershed was gradual compared with the rapid change in Watershed I. The management program involved three phases: pre-treatment monitoring, or calibration (September 1952 to December 1959); chemical treatment of trees, seeding, burning, and reseeding (December 1959 to September 1965); post-treatment monitoring (September 1965 to present).

Vegetative treatment

The trees were killed by placing 2,4-D amine in surface cuts around the base of the trees. Deciduous trees treated in December and January, for the most part, did not come into leaf in the spring; however, those treated later did leaf out but lost most of their leaves before September. The evergreen trees--live oak and madrone--gradually lost their leaves and were bare within a year following the treatment. Many of the smaller limbs fell