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THE FUEL-BREAK SYSTEM FOR THE SAN DIMAS EXPERIMENTAL FOREST

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PACIFIC SOUTHWEST
FOREST AND RANGE
EXPERIMENT STATION
BERKELEY, CALIFORNIA

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

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Research policy and program formulation at the San Dimas Experimental Forest are guided by the following Advisory Committee:

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THE FUEL-BREAK SYSTEM

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Relatively few fires escape initial suppression effort in continuous brush on the steep mountain terrain of southern California, but those that escape often defy later fire-control action. The most intensive, coordinated ground and air attack may not control large fires until damage and fire-fighting costs are beyond tolerable limits. One approach to a solution of this problem lies in the modification of the fuel on key fire-control areas within expanses of heavy brush fuels. Much work has been started to break up the brushfields of southern California. With particular emphasis on areas critical to fire-control effort, the FUEL-BREAK program[1/] was organized in 1957 to apply this principle and work out improved methods. However, the first opportunity to plan and start work on a complete fuel-break system did not occur until the San Dimas Experimental Forest was burned over by wildfire in 1960. This report describes the system planned for the experimental forest.

Fuel-Break Objectives

Fuel-break systems aim at breaking extensive brushfields into small manageable units by converting brush to a new cover of low fuel volume on wide strips or blocks at strategic locations. These strips or blocks are called fuel-breaks, which will provide safer access for men and more effective use of highly developed fire-control techniques. Proper locations and adequate widths for the breaks are decided by experienced fire fighters.

The native brush on fuel-breaks is converted to a new plant cover that will protect the soil. This brush conversion process requires removal of all woody vegetation except occasional shrubs and trees left for esthetic or other reasons. The natural brush regrowth must be eliminated, which requires chemical spraying of sprouts and seedlings for a few years, and a new cover must be established as soon as possible. It should be made up of herbaceous plants, mainly grasses, unless other adapted species of lower flammability are found and techniques developed for establishing them. The objective is to have a new cover that is relatively stable and easily maintained over the years.

1/ The FUEL-BREAK program is conducted cooperatively by the California State Division of Forestry, the Los Angeles County Fire Department, and the U.S. Forest Service.

Besides aiding in fire control, fuel-breaks can help intensify management of brushland watersheds. They can be designed to include considerable acreage of sites from which increased water yield may be expected after brush removal; they can add to the amount of brushland "edge effect" and thus improve wildlife habitat; they can grow forage for use by deer and in some places by livestock; and they can open up and protect recreation values.[2]

Planning a complete fuel-break system for the future is advisable on each management unit even though the entire plan cannot be put into effect at once. An advance plan will assure best use of funds and manpower as they become available. It will make possible quick action if part or all of a unit is burned over by wildfire. Then quick action is essential. The brush can be eliminated on fuel-breaks after a hot burn at a fraction of the cost required to remove an unburned brush cover--provided that the work is started soon after the fire. And a complete plan will show the size of budget required to put brushland watersheds under more intensive management with better fire protection in the future.

The Problem Area

The San Gabriel Mountains, where the experimental forest is located, represent extremes in steep terrain and shallow soils. Wide-scale conversion of the native brush to a new vegetation cover is not advisable; it is hardly possible. On selected areas, however, conversion for specific purposes is both possible and advisable.

In a soil survey of the experimental forest, only about 10 percent of the acreage was mapped as having slopes under 55 percent in gradient and soils more than 2 feet deep. An additional 4 percent had slopes under 55 percent gradient with shallower, less productive soils.[3]

Bulldozers and other heavy ground equipment can be used on much of this 14 percent of the land to remove brush, to sow grass, and to spray chemicals on brush regrowth. Bulldozers also can be used on some of the narrow ridgetops and canyon bottoms not delineated by the survey. Including these areas, the total acreage workable with a bulldozer, and accessible without expensive trail construction, probably amounts to less than 15 percent of the experimental forest. This is the area on which brush conversion can be done efficiently and positively.

On the remaining acreage the brush conversion job would have to be done with hand labor and by aerial applications of seed and chemical. Aerial sowing may be fairly cheap but it produces erratic results. Aerial

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2/ Bentley, Jay R. Fitting brush conversion to San Gabriel watersheds. U.S. Forest Serv. Pacific Southwest Forest and Range Expt. Sta. Misc. Paper 61. 8 pp., illus.

3/ Bentley, J. R. *Op. cit.*

spraying is economical and ordinarily is effective. However, the final cleanup of brush sprouts must be done by hand labor, which is a costly operation on inaccessible steep terrain.

Thus accessibility to men and equipment is a major factor determining which areas are selected for brush conversion. Most of the acreage is accessible only by long and arduous foot travel, which makes the job expensive. Fortunately, the areas most readily worked by equipment or on foot are also the areas most accessible for fire fighting, and they are at strategic locations where wide breaks in the brushfields are most needed.

Fire-Control Access

A fire-control access map (fig. 1) was prepared from data which had been obtained in a pre-attack survey of the area. These data included locations of all fire-control roads, the existing or potential tractorways and hand line locations, and other essential information.[4/] The access map served as a guide in locating fuel-breaks on the most accessible and strategic ridges and roads. Also, it showed the areas most readily worked by equipment and those where manual work would be required.

In general, access over the experimental forest is good. A complete network of roads encircles it, and a road extends along the ridge separating its two main drainages. The upper part of the experimental forest is accessible by county highway and the lower part by several other roads. The major canyon bottoms have roads into them.

Access by all-wheel-drive vehicles is planned along some main ridges and in the drainage bottom at a critical location below headquarters. Tractor ramps give access to the strategic ridgetops.

This fire control access map, along with maps showing the most favorable sites for brush removal to improve water yield and other resources,[5/] was used in planning the brush conversion job.

Primary Fuel-Breaks

A system of primary fuel-breaks (fig. 2) was first laid out to represent the minimum system considered essential for aiding in control of large fires. These breaks are along the prominent ridges bordering two major drainages and on lateral ridges across the "front country" near the southern boundary of the experimental forest. Primary breaks also were laid out to break one major drainage into three large areas. The objective of the primary breaks is to exclude a large fire from, or confine it to, relatively large units of a few thousand acres each.

4/ U.S. Forest Service. Pre-attack planning and construction for forest fire suppression. U.S. Dept. Agr. Forest Serv. 66 pp., illus. 1959.

5/ Bentley, Jay R. op. cit., figs. 1 and 2.

Figure 1

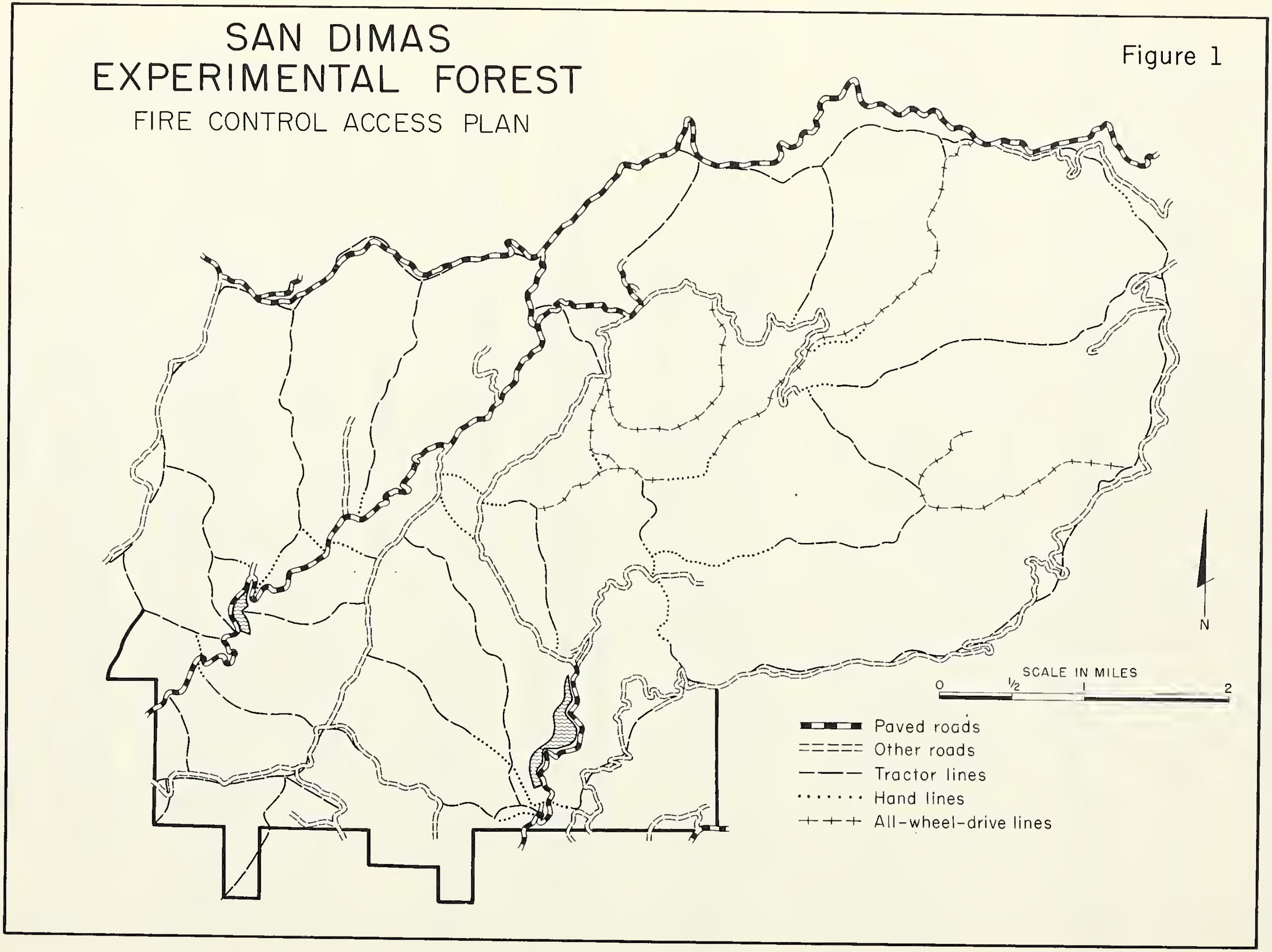
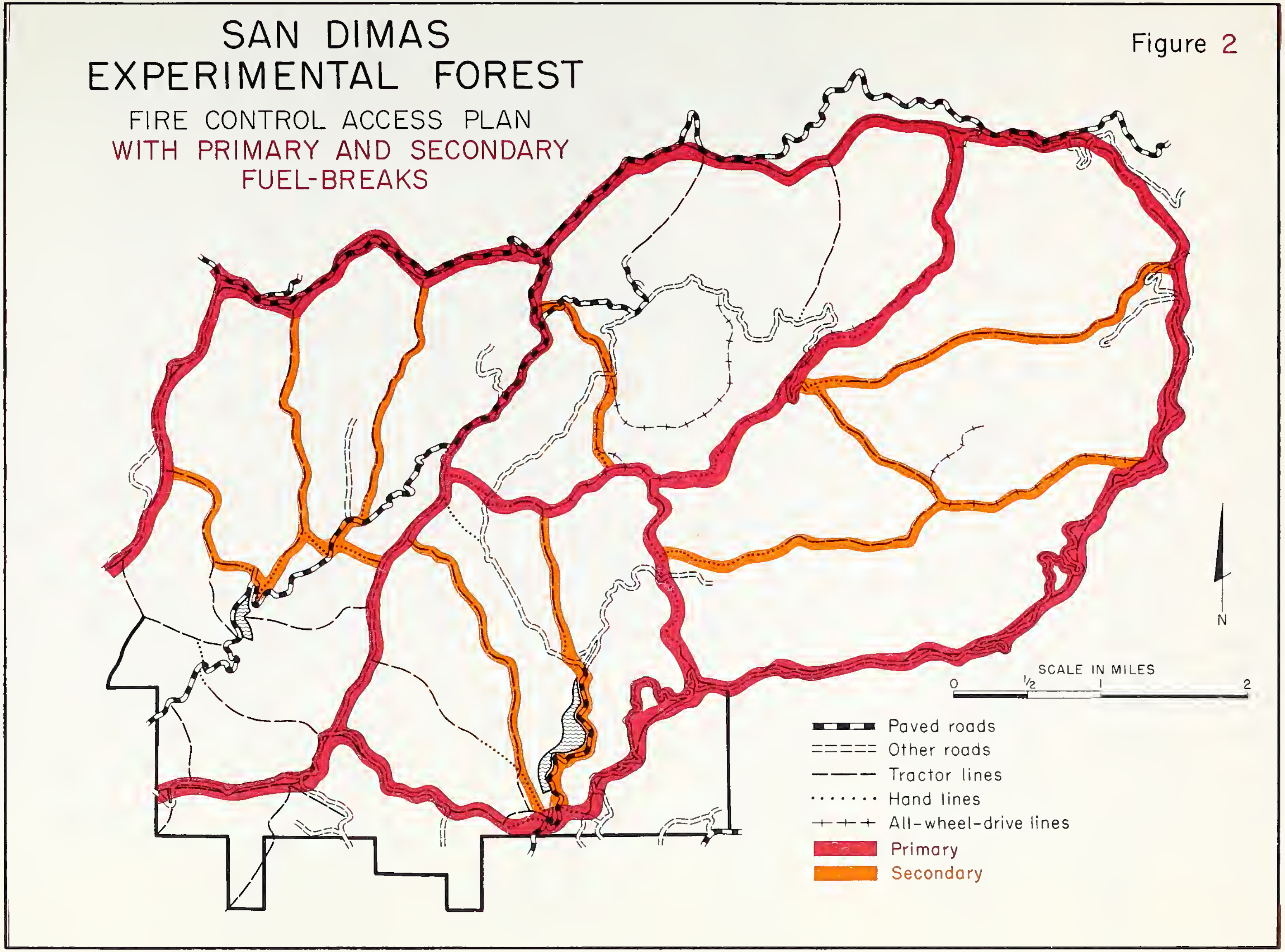

SAN DIMAS
EXPERIMENTAL FOREST
FIRE CONTROL ACCESS PLAN
N
SCALE IN MILES
0
1/2
1
2
Paved roads
Other roads
Tractor lines
Hand lines
All-wheel-drive lines

Figure 2


SAN DIMAS
EXPERIMENTAL FOREST
FIRE CONTROL ACCESS PLAN
WITH PRIMARY AND SECONDARY
FUEL-BREAKS
N
SCALE IN MILES
0
½
1
2
Paved roads
Other roads
Tractor lines
Hand lines
All-wheel-drive lines
Primary
Secondary

The primary breaks have a minimum width of about 400 feet. Portions are wider at the most critical saddles and down ridge points or other steep slopes where the breaks cross canyon bottoms. Breaks also are widened in many places to include a fire-control road located below the ridgetop.

For the time being, portions of certain breaks have to be made narrower than 400 feet to avoid undue disturbance of small experimental watersheds. These breaks can be widened after the experiments have been completed.

The primary system includes about 32 miles of wide breaks. Total area within the breaks is about 1,535 acres. Of this, about 1,135 acres are within the boundaries of the experimental forest, making up nearly 7 percent of its 17,000-acre total area. The additional 400 acres are around the periphery in adjoining drainages.

Secondary Fuel-Breaks

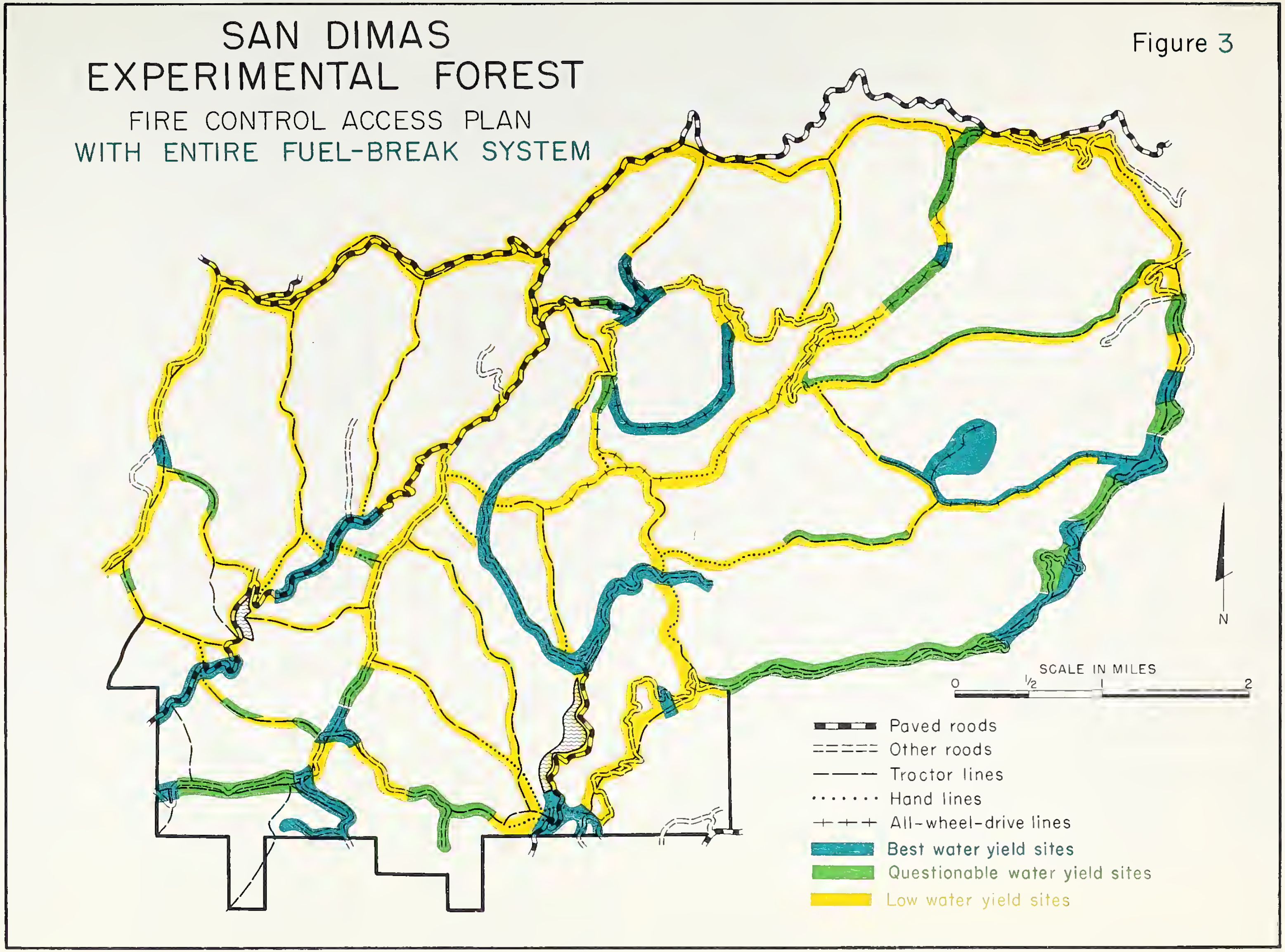
Secondary breaks were located around the main sub-drainages (fig. 2) to break the experimental forest into smaller units, mostly less than 1,000 acres in area. The minimum width of break on sharp ridges is 200 feet, a 100-foot strip on each side. The width is greater in key saddles and at the mouths of the lateral drainages.

The system of secondary fuel-breaks totals a little more than 17 miles, and includes 402 acres. This small additional acreage of breaks adds greatly to the possibilities of confining fires to relatively small acreage. Building of both primary and secondary breaks appears highly desirable under all conditions on San Gabriel watersheds. Combined, the primary and secondary breaks cover 1,537 acres within the experimental forest, or 9 percent of its total acreage.

The Entire Model System

In addition to the primary and secondary breaks the fuel-break system for the experimental forest includes other fuel-breaks needed for special purposes. With these additions, the plan fits brush conversion into all aspects of intensive brushland management. The plan visualizes a changed vegetation pattern for the future, which should promote much better fire control than would be possible if brush is allowed to regrow over all of the area. Special-purpose breaks added to the system include:

> Wide breaks were located along roads in major canyon bottoms where "special-use" dwellings are situated. Hazardous woody fuel will be removed behind and between the dwellings, but sufficient trees will be left to maintain esthetic values.
>
> Breaks extending 100 feet on each side of the road were located along all fire-control roads not included within primary and secondary breaks. Specimen trees or shrubs will


SAN DIMAS
EXPERIMENTAL FOREST
FIRE CONTROL ACCESS PLAN
WITH ENTIRE FUEL-BREAK SYSTEM
Figure 3
N
SCALE IN MILES
0
½
1
2
Paved roods
Other roods
Troctor lines
Hand lines
All-wheel-drive lines
Best water yield sites
Questionable water yield sites
Low water yield sites

be left, where possible, to make the landscape more pleasing. These breaks will allow safer use of the roads and serve as fire-control lines under some fire conditions where the road itself is not an adequate break.

Areas of special value were marked for protection by removing fuel-hazards within them and by building wide breaks around them. Such areas are the headquarters, plantation sites, a grove of large ponderosa pine trees. Other natural groves of native trees may be included if desired.

Wide breaks were located in a few canyon bottoms of strategic importance to provide safe access into them.

Breaks 200 feet in width were located on some of the short ridges that connect other fuel-breaks. This makes possible breaking out many small units with a minimum of fuel-break construction.

The entire system includes 74 miles of breaks. A total of 2,405 acres are within the experimental forest, adding up to 14 percent of its total area. The system breaks up the experimental forest in such a way that the breaks can aid in both initial attack and in control of fires which escape initial action. But benefits from this extensive job of brush conversion will not be limited to fire control.

For example, the fuel-break system includes a total of some 600 acres in canyon bottoms and on other sites with deep soils; here an increase in water yield can be expected from replacing brush with grass (fig. 3). Additional areas totaling about 400 acres have medium-depth soils--typically 2 to 3 feet deep with spots of deeper soil--from which some increase in water yield may occur. On the remaining acreage of shallower soils little effect on water yield is expected from changing brush to grass.

The fuel-break system may not represent the ultimate brush conversion endeavor on San Gabriel watersheds. Modifications in the plan undoubtedly will be made as more knowledge is gained on the place of brush conversion in wildland resource management, and after more experience in the use of fuel-breaks in controlling fires. Research now underway may show that more extensive removal of brush from slopes with medium depth and deep soil can be recommended for increasing water yield. Clearing of such areas, which usually are located on north exposures, can connect canyon bottoms and ridgetop fuel-breaks in a manner that will break the brushfields into quite small units.

Economic justification for fuel-break systems probably will be judged mainly by the extent to which they reduce the damage caused by large fires and the cost of controlling such fires. Reduction in the flood and erosion hazard created on recently burned watersheds will continue to be the primary management problem in the San Gabriel Mountains.

Because these watersheds are perched directly above highly developed urban and industrial areas, the potential flood damage after fire is estimated at hundreds of dollars for each acre that is burned over. As urban development moves into watershed areas, life and property add new dimensions to the damage potential.

Bentley, Jay R., and White, Verdie E.
1961. The fuel-break system for the San Dimas Experimental forest. U.S. Forest Serv. Pacific Southwest Forest and Range Expt. Sta. Misc. Paper 63. 9 pp., illus.

Fuel-breaks 200 to 400 feet wide were laid out after a wildfire to break future brushfields into small units as an aid in confining fires. Native brush on fuel-breaks is being converted to an herbaceous ground cover with a very open stand of trees or shrubs. About 74 miles of breaks on strategic ridges, along roads, in some canyon bottoms, and around areas of special value total 2,400 acres, or 14 percent of the experimental forest. Conversion of cover may lead to increased water yield from 600 to 1,000 acres of the breaks.

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