WATER PRODUCTION FROM FOREST LANDS OF NEW MEXICO

By

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There seems to be a great deal of misunderstanding regarding water production in the Southwest. We appreciate this opportunity to discuss the situation before your seminar and only hope that we can contribute something in a small way.

The discussion will be directed along three main lines:

1. The situation of forested areas--particularly national forests.
2. The water supply reaching the national forests--precipitation.
3. Water production and its relation to influencing factors.

Multiple use of National Forests is a guiding principle in managing these federally-owned lands. Although the production of usable water is by far the highest service of these watershed lands in the State, there are other resources such as timber, grazing, wildlife and recreation which, if properly managed, can be concurrently maintained without material loss of water or long-term values.

The six National Forests which are wholly or partially within New Mexico are the Carson, Santa Fe, Cibola, Lincoln, Gila and Apache. Parts of the latter two are in Arizona. Within the exterior boundaries of these units in New Mexico are about 9,800,000 acres of land. Approximately 8,600,000 acres of this total are federally owned and this constitutes 11% of the State's area. Additionally there are 740,900 acres of federal land in the so-called L. U. units and other categories recently transferred to the administration of the U. S. Forest Service. Prior to transfer, most of these lands were managed by the Soil Conservation Service. Purchased during the dust bowl days of the thirties for purposes of protection and rehabilitation, these lands contain very small areas of true forest type, and probably will not be added to the National Forests. They are of only moderate importance from the standpoint of water yield and will be given little attention in this discussion.

The high mountains and foothill areas of New Mexico are generally

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occupied by National Forests. The fact that precipitation increases with elevation explains this location. Forests occur only on the mountain ranges because precipitation is sufficient there to support them; on the remainder of the State's area, precipitation is not ample. It therefore follows, logically, that these same National Forests are the highest water yielding parts of the State. The terrain is rugged and these lands are primarily noteworthy as watersheds.

It is difficult to estimate the value or even the quantity of the water which comes from National Forest watersheds. For instance--what is the value of water for irrigation? For municipal use? Economists will disagree and even the answers of the experts have holes in them. Certainly the value is considerably above the price paid by the farmer which is the cost of distribution only. A look around the State shows us quickly that every important agricultural area is tied in economically with one or more mountain watersheds which is the source of its water supply. Most of these source areas are on National Forests.

Irrigation in the Rio Grande Valley derives most of its water from the Rio Grande National Forest in Colorado and the Carson, Santa Fe, Cibola and Gila National Forests in New Mexico. In the Pecos Valley, an important headwater supply originates on the Santa Fe National Forest, and is the mainstay of Pecos River flow. Along the western divide of this watershed the Lincoln National Forest contributes supplies from above Roswell to below Carlsbad. The main recharge areas for pump irrigation (formerly partially artesian) in this part of the valley receive water from the Lincoln National Forest. Gila Valley irrigation water has its source on the Gila National Forest and much of the surface flow of the Gila River passes across the State line into Arizona, augmented by flows from the Apache National Forest. San Juan Valley irrigation water comes from national forests in Colorado and to a minor extent from the Carson National Forest in New Mexico. Eagle Nest Reservoir in the north on the Cimarron and the Bluewater Reservoir in the western part of the State are dependent partially on national forest watersheds. Water for pumping in the Mimbres Valley originates on the Gila National Forest.

Explanation of the foregoing relationships lies simply in the fact that the mountain ranges of the State are the areas where higher amounts of precipitation fall. Here also, temperatures are lower with consequently less evaporation, and the growing season is short, thus limiting transpiration.

Cognizant of the need to stay clear of the subjects to be handled by other speakers, some discussion of precipitation is necessary here. Elementary as it may appear, it must be borne in mind that the State's water resources and to a large extent their economic

importance are entirely dependent, at the present time at least, on the natural precipitation which occurs.

Watersheds may be rated in importance approximately in accordance with the amount of precipitation which they receive. Generally, but not always, those which receive the most water from the skies produce the most yield. Water which leaves an area in surface or underground channels and which is later available for use may be considered as the yield. The water production from a watershed may be likened to a farm crop. It is an annual "crop", much large some years than others. Its value is somewhat dependent on the use to which it is put, on its quality and on the season and nature of its flow from the watershed.

Records of precipitation and stream gaging have been wholly inadequate to provide much basis for establishing the relationship between water received and water produced by our mountain watersheds. Even less do they provide data for establishing trends in this relationship as over the years man's use of the watersheds causes changes in the vegetative cover. Research is providing some information which is very helpful in understanding the principles involved, but it is meager and usually applies to small areas and findings require many years of time.

The Branch of Administration of the Forest Service has attempted to extract some facts regarding water yield, using available records, which would contribute to our knowledge of the performance of the watersheds being administered. As a result of these studies, a typical average curve was obtained which applies roughly to many mountain watersheds of northern New Mexico. Like most averages, however, it probably does not apply without adjustment to any particular watershed or year.

The curve shows relationship between annual precipitation and local water production from areas of moderate size seldom in excess of 300 square miles. This is not the same as water productinn reaching Elephant Butte Reservoir or other downstream points, from a small upstream area. Points on the curve are tabulated as follows:

Tabulation Illustrating Precipitation--Water Production Relationship On Basis of Annual Averages

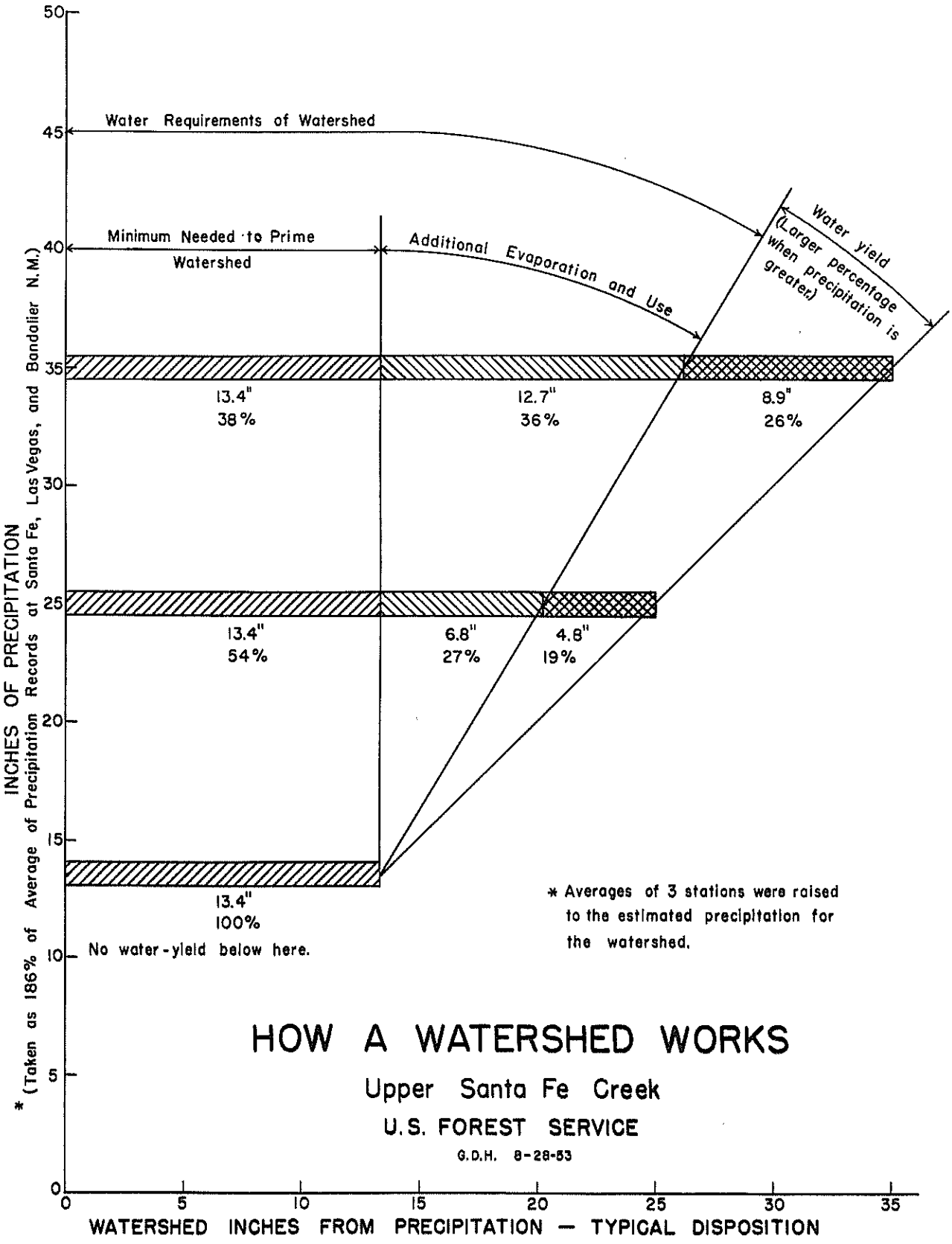
Precipitation In Inches	Water Production In Inches	Water Production In Ac. Ft. per Sq.Mi.	Water Production In % of Precipitation
10	0.1	5	1
15	0.5	25	3
20	1.6	83	8
25	3.7	195	15
30	6.3	335	21
35	9.3	500	27
40	12.8	685	32

It is not difficult to understand, with this relationship existing, the much greater importance of watersheds receiving higher precipitation than the average. The Weather Bureau gives, with qualifications, the average for New Mexico as slightly less than 14 inches per year. At the lower elevations on National Forests precipitation may be as low as 11 or 12 inches. It ranges from that amount up to about 18 inches throughout the grassland-wooded belt. Above this is usually a belt of ponderosa pine receiving from 18 or 19 up to about 28 inches; then a spruce-fir belt extends from there to the top rate which may be 40 to 50 inches, the latter occurring only on a very small part of the Sangre de Cristo Mountains on the Carson National Forest.

The tabulation also illustrates what happens to one particular watershed as precipitation varies from year to year. For example, where 25 inches of water is normal, a drop to 20 inches during a few years of drought may cut the water production in half; twenty per cent decline in rainfall producing fifty per cent decline in water production.

From the study which was made of the relationships prevalent in Santa Fe Canyon, the chart titled "How A Watershed Works" was prepared. Its main use has been in getting the idea over to our own Forest Service personnel. It is attached here.

The chart was based on precipitation data at three stations surrounding Santa Fe Canyon as there were no records on the immediate area (see chart). These average data were uniformly adjusted upward to the approximate actual amounts falling on the area. The adjustment makes it more realistic and has no effect on the correlation between precipitation and streamflow. Actual streamflow records were used. The data extended over a period of 27 years.



HOW A WATERSHED WORKS

Upper Santa Fe Creek

U.S. FOREST SERVICE

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Note that the first block of precipitation--13.4 inches--is required to wet or "prime" the watershed before water production starts to be of importance. Precipitation in excess of this amount makes more water available for evaporation, plant use, and for water yield.

As precipitation (and number of storms) increases, the opportunity for evaporation from vegetation, litter, and soil surface also increases, and transpiration occurs in larger amounts. However, water production occurs and continues to build up with added precipitation.

The amount required for "priming" the watershed will vary by watersheds; soil types; vegetative cover; amount, pattern and nature of precipitation; and other factors. It will also vary from year to year because of varying residual soil moisture.

The chart is intended to illustrate general principles of watershed performance. Important points are that water yield for a period of drought cannot be compared directly with that for a period of ample precipitation; neither can water yield be expected to be a constant percentage of precipitation year by year.