EXHIBIT TWO

BIOMETRICS NOTE

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Number 3 January 7, 1974

Sampling standards for judging stocking standards under the California Forest Practice Act of 1973

I'd like to address myself to the problem of deciding what proportion of the expandable plots (proposed under article 6, Standardized Stocking Sampling Procedures) must be stocked in order to declare that a logged area is legally regenerated under the Forest Practices Act of 1973.

After some discussion with CDF and industry foresters, I realized that previous stocking studies could not be used to determine the sampling standards because none of these studies had used the required legal definition of stocking. I therefore agreed to do a quick statistical analysis on data to be supplied by Jere Melo and Roger Kruger (one area) and CDF foresters (15 areas).

Using this data and several computer-generated populations; I did a computer simulation using the basal area and expandable plot sampling scheme as defined under the proposed regulation. From this I was able to determine for each area, the proportion of all possible sample plots that would be declared "stocked" under the sampling rule.

Using the subjective evaluations of the CDF and industry foresters who collected the field data, it was noted that areas that had as few as 60% of all possible plots stocked were consistently judged to be "stocked" or "marginally stocked". Areas in which less than 60% of all possible plots were stocked were judged to be "understocked". Actual counts showed all areas with 60% or better stocking were well over the 300 points per acre requirement.

At a meeting* held December 31 in Berkeley, results of the simulation study were reviewed by CDF and industry foresters. From looking at the plots of the countable trees, the individuals at the meeting concurred with the previously-made field judgements.

For your inspection, the plots made for several of the populations used in the simulation study are attached. On each plot, the area within which sample plots that are "stocked" are indicated by shading. The proportion of the area shaded then corresponds to the relative number of all possible plots that would be judged stocked under the proposed rule.

Prepared for the January 7, 1974 meeting of the State Board of Forestry, Sacramento.

Based upon this level of 60% of all possible plots stocked, Dave Sharpnack has prepared an analysis on the necessary sample size and proportion of stocked plots required for judging the area "stocked". Mr. Sharpnack will present this analysis following my presentation so I will not go into this here, except to say that I was party to, and I concur with, these findings.

In all area studied that had at least 60% of all possible plots stocked, the point count was well in excess of the required 300 points per acre. This supports the comments I made earlier that the point count was not nearly as restrictive as is the requirement that the points be "well-distributed". Thus if the samples show at least 60% of the plots stocked it is almost certain that the point count would be above the required 300 points, making a separate estimate of the total point count quite unnecessary.

As a last point, I would like to note that I am glad to see that the Act specifies that the "rules and regulations shall be continuously reviewed and may be revised". As we gain experience with the proposed sampling rule it is possible that certain revisions of both the methods and standards will be necessary. In order to further test the proposed sampling rule, I hope that individuals who question its adequacy in specific situations, will provide me with the necessary data for study. Then if I find that the sampling rule needs revision, I can propose a revision after testing it on the data that I now have.

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* Attending the meeting were:

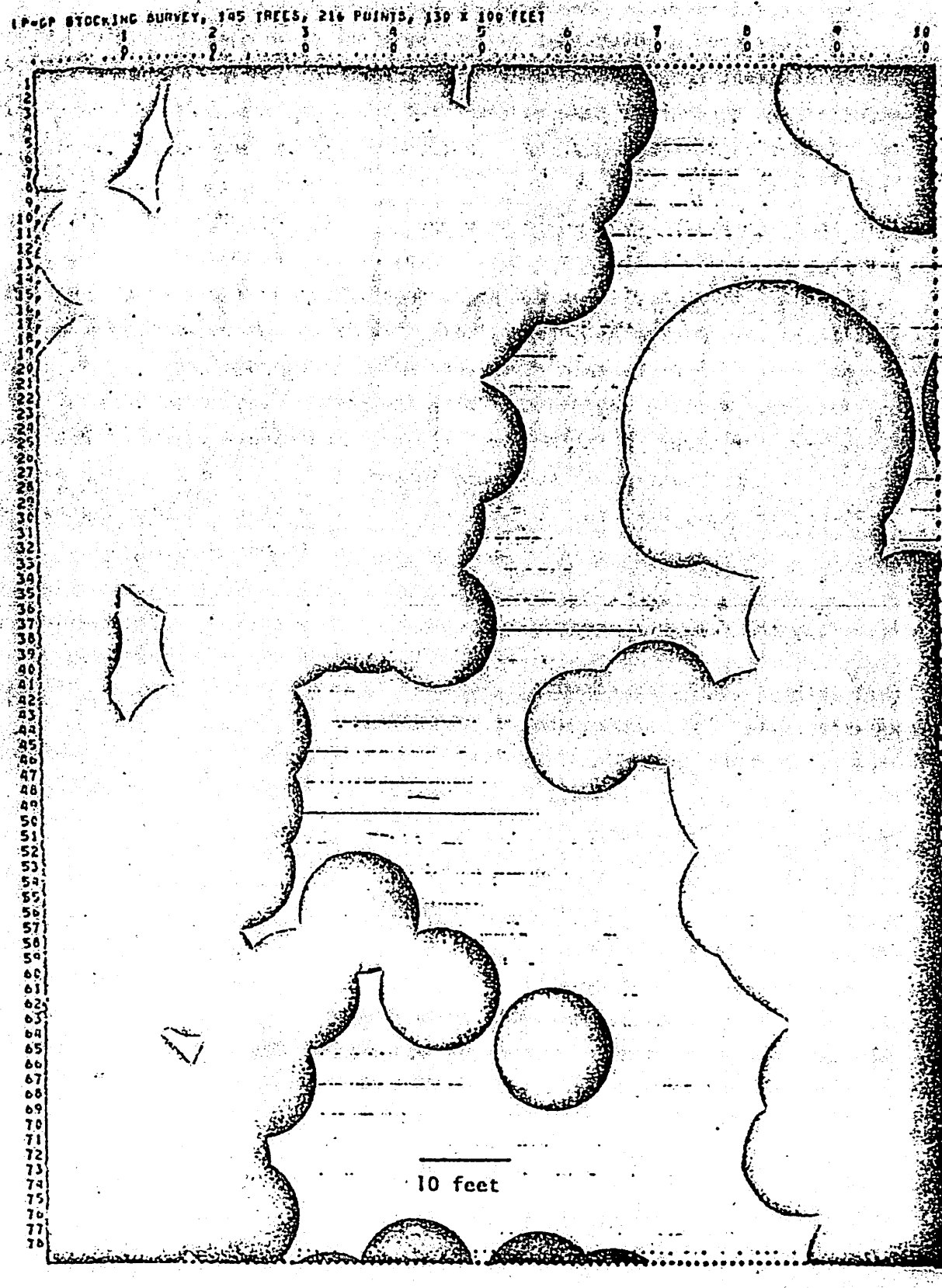
Earl Sechrist, CDF, Sacramento
Brian Barrett, CDF, Sacramento
Dave Burns, CDF, Auburn
Fred Landenberger, California Forest Protective Association, Sacramento
Jere Melo, Georgia Pacific, Ft. Bragg
Dave Sharpnack, U.S. Forest Service, Berkeley
Lee Wensel, Univeristy of California, Berkeley
Jack Sweeley, Masonite Corp., Ukiah
Roger Kruger, Louisiana Pacific
Marshall Palley, consultant to CFPA, Grass Valley
Bob Latham, Hammon, Jensen, Wallen and Associates, Oakland

LP-GP Stocking Survey (AA)

145 trees 0.30 acres

216 points 724 points per acre

70.8% of 4,000 plots stocked under proposed rule

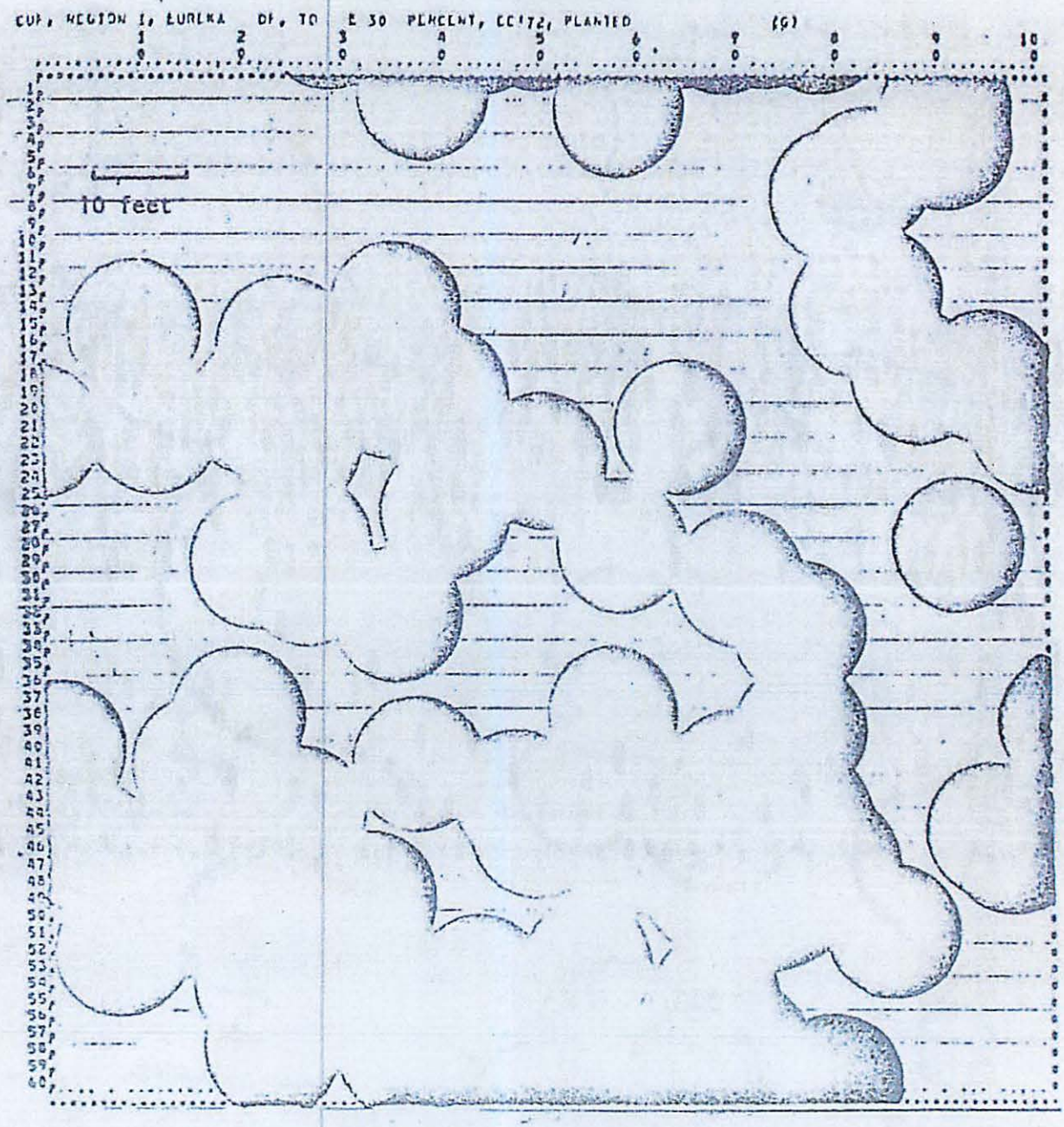


CDF, Region I, Eureka (G)

70 trees 0.23 acres

72 points 313 points per acre

64.9% of 4,000 plots stocked under proposed rule

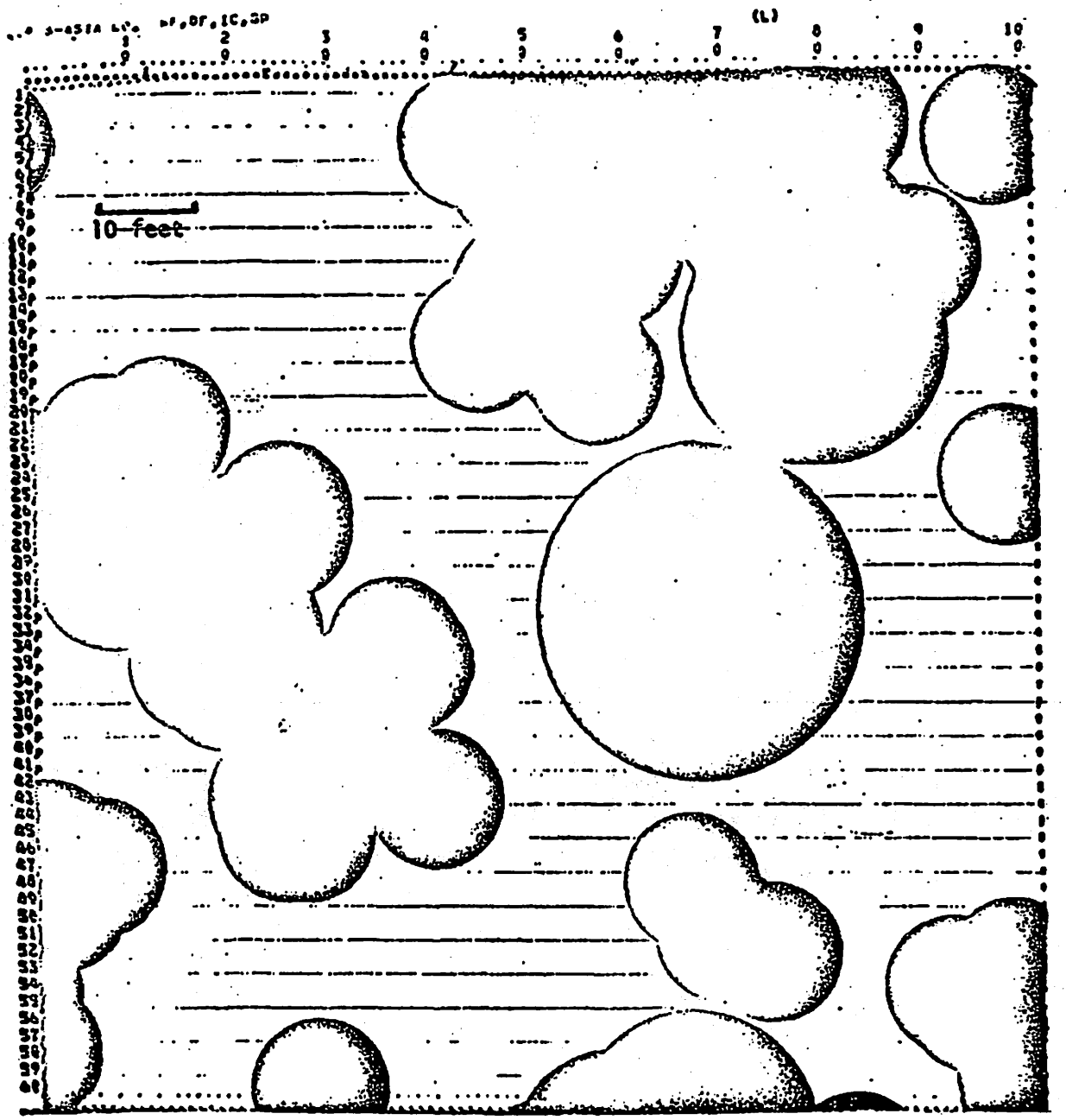


CDF, Shasta Co. (L)

103 trees 0.23 acres

118 points 513 points per acre

54.8% of 4,000 plots stocked under proposed rule

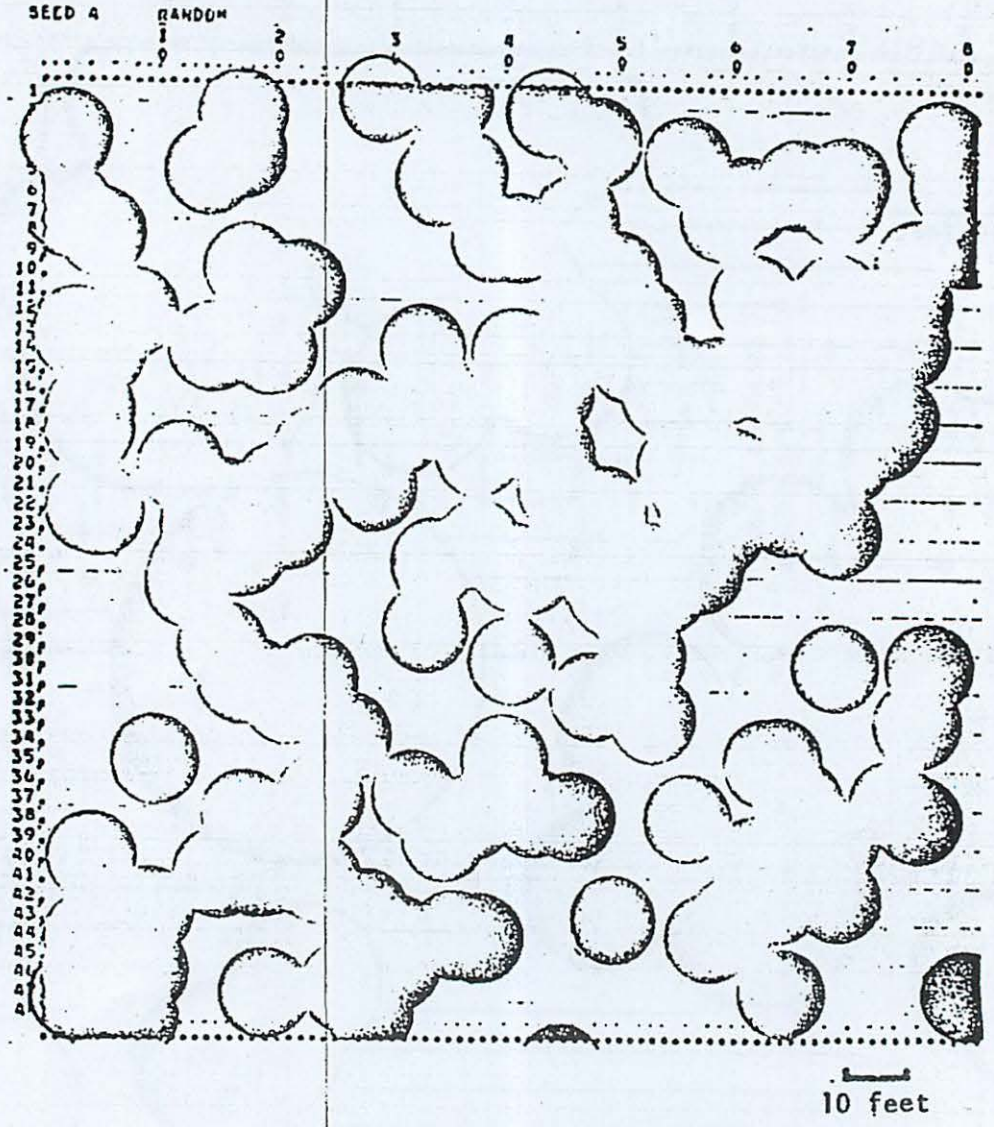


Computer generated population - Random (0)

166 trees 0.55 acres

166 points 300 points per acre*

61.5% of 4,000 plots stocked under proposed rule



* Area scaled to obtain exactly 300 points per acre.

EXHIBIT THREE

BIOMETRICS NOTE

Lee C. Wensel, School of Forestry and Conservation, University of California, Berkeley, California 94720

Number 4 January 7, 1975

Determining the necessary proportion of stocked sample plots under the Forest Practices Act of 1973

Based upon the study reported in the previous note,[1/] it was determined that an area would be judged "stocked" under the Forest Practices Act if 60 percent or more of "all possible" sample plots were stocked.[2/] This then defines what is meant by the term "adequately distributed" in the Act, with empirical studies showing that with this level of stocking the stands will almost certainly contain more than the 300 points per acre required by law.[3/] This makes a separate assessment of the number of points per acre quite unnecessary.

The purpose of this note is to establish the reasoning behind the decision to require a minimum sample size of 40 locations with at least 55% of these plots being stocked before the area is judged to be stocked.

For the sake of this discussion, let us define p to be the actual proportion of all possible samples that are stocked using the expandable plot concept explained in the regulations. We want to accept the area as being stocked if p is greater than or equal to 0.60 and reject the area if p is less than 0.60.

In practice, a sample of n locations (at least 40 here) are selected and if at least k of them are stocked the area is accepted as being stocked. The problem of determining n and k, the sample size and the number of these samples that must be stocked, boils down to a balancing act between the probability of unnecessary planting (type 1 error) and the probability of failing to detect conditions where the area is understocked (type 2 error).

1/ Wensel, Lee C. 1975. Sampling standards for judging stocking standards under the California Forest Practices Act of 1973. Biometrics Note Number 3, January 7, 1975. Printed by the author.

2/ The actual procedures used to determine if an individual plot is stocked are given under Article 6 of the California Administrative Code, Title 14, Subchapter 4.1, Chapter 2, Division 2.

3/ Points are assigned by tree size class as follows: one point for trees less than 4 inches DBH, three points for trees from 4 to 12 inches DBH, and six points for trees over 12 inches DBH, where DBH refers to the diameter at breast height (4-1/2 feet from the ground).

Using the binomial probability distribution and a sample size of 40 plots, the probability of these two types of error are given below for various values of k. [4/]

Number of plots out of 40 that must be stocked	Probability of error when actual p is:					
	.70	.65	.60	.55	.50	.45
20	*	.02	.07	.79	.56	.32
21	*	.03	.13	.68	.44	.21
22	.01	.07	.21	.56	.32	.13
23	.03	.12	.31	.44	.21	.08
24	.06	.20	.44	.32	.13	.04
25	.11	.31	.56	.21	.08	.02
(* less than .005)	Probability of unnecessary planting			Probability of failing to detect understocked stands		

It should be noted that the actual probabilities of error are only large when the area being examined has stocking approaching the 60 percent level. Since very little is lost in accepting areas where p is slightly under 0.60, the large probabilities of failing to reject the area is of little consequence. The probability of type 2 error cited in the regulation is thus based upon an actual p of 0.50.

Increasing the required proportion of stocked plots decreases the probability of accepting understocked areas but it also increases the probability of unnecessary planting. The minimum standard of 22 out of 40 plots being stocked yields an acceptable compromise between the two types of error (as judged by the individuals listed in the previous note). Such a compromise could not be agreed upon using smaller sample sizes, making 40 the minimum sample size allowed. The smaller probabilities of error for larger sample sizes are given in the regulation for those instances where more than the minimum number of samples is used.

[4/] Probabilities computed by Dave Sharpnak, U.S. Forest Service, Berkeley.