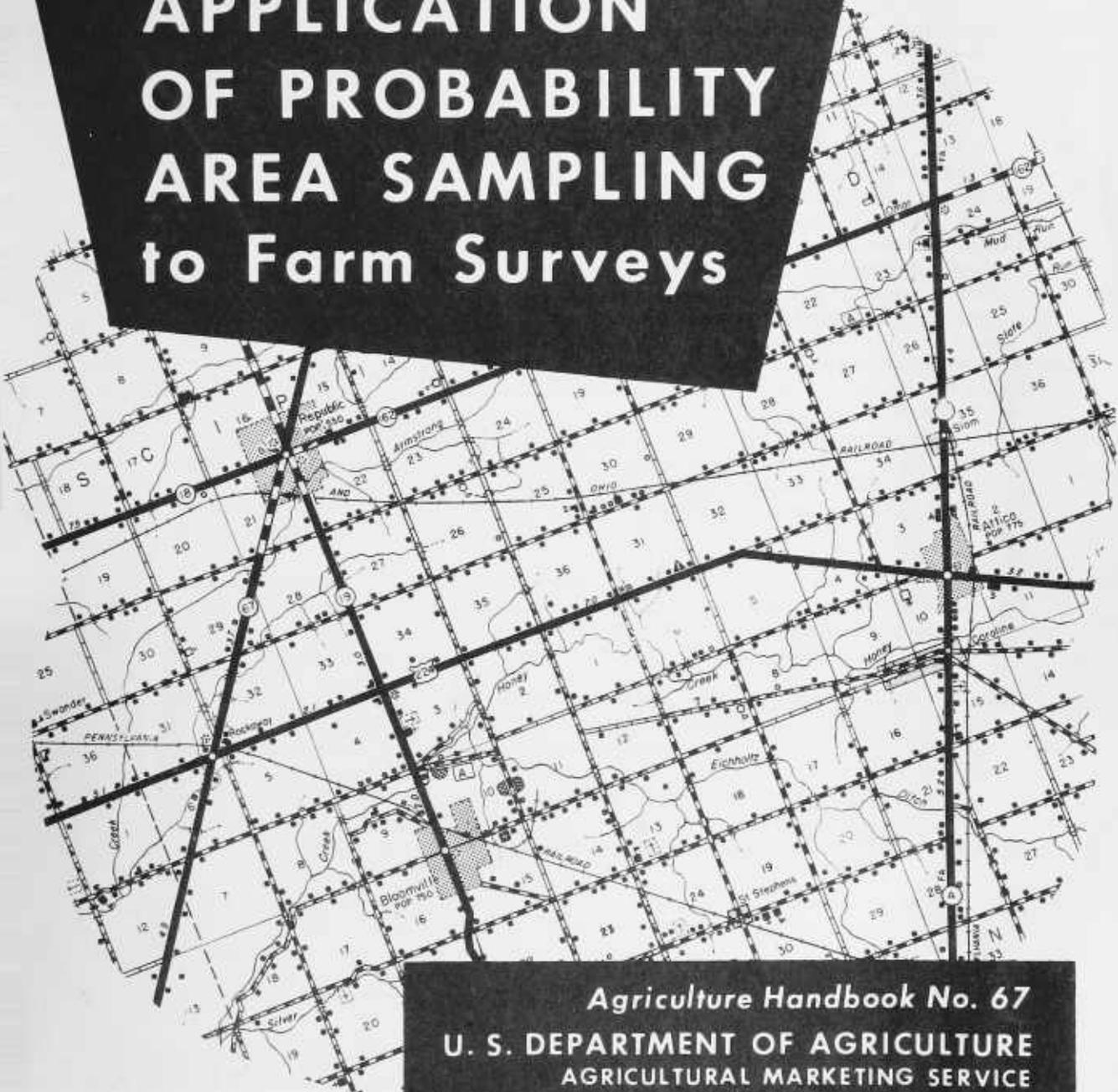




# APPLICATION OF PROBABILITY AREA SAMPLING to Farm Surveys



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# APPLICATION OF PROBABILITY AREA SAMPLING TO FARM SURVEYS

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## PROBABILITY AREA SAMPLING DEFINED

Area sampling and probability sampling are occasionally referred to synonymously; but an area sample is not necessarily a probability sample, and many probability samples are not area samples. Area sampling refers to the use of small areas of land as sampling units, whereas probability sampling pertains to the method of selecting sampling units. In probability sampling, each sampling unit in a defined statistical population has a known probability of selection. Thus, probability area sampling refers to a class of probability samples wherein areas are used as sampling units.

Briefly, the area method of sampling involves (1) subdividing the entire area within the limits of a defined population into small area segments (or sampling units) having identifiable boundaries and (2) selecting a sample of these segments. In the field, the interviewer must identify the boundaries of the sample segments and attempt to obtain the desired information for all farms (or whatever the units of observation might be) which qualify for the survey and are associated with the selected sample segments. Throughout this handbook, "sample segments" refer to the particular segments selected for a sample, whereas "segments" refer to segments of the population in general, irrespective of whether they are in a sample.

Rigorous application of the method of probability area sampling requires (1) adequate mapping material to define segments with decisive boundaries and (2) a set of rules for associating farms with segments in such a way that each farm in the defined population is associated with only one segment. The problem of identifying farms and associating them with segments is a subject for later discussion.

Many of the techniques found in recently published books on the theory and methods of sampling for surveys may be useful in designing area samples and in making estimates from the sample data. As these books present the theory for various sample designs, no direct attempt is made here to explain principles of sampling or sampling theory.

In writing this handbook, the authors were prompted by many inquiries concerning the actual operations of selecting and using area samples for farm surveys. We have endeavored to bring out important points that need attention in the application of probability area sampling and to relieve misapprehensions on other points that are of little consequence. We have also indicated how probability area sampling can be adapted to a number of special cases, thus emphasizing its flexibility and general utility. For a discussion of the merits of probability sampling and relevant material on the principles of sampling, the reader is referred to existing literature.<sup>2</sup>

Usually, applications of area sampling are made when a satisfactory list of farms in the population to be surveyed is not available. However, when a good list is available, it often provides a better basis for sampling than area sampling. But a word of caution on the use of lists is in order. A careful evaluation often reveals serious deficiencies in lists that are claimed to be satisfactory. They may be incomplete, and may contain duplications or

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<sup>1</sup> Mr. Reed was a member of the former Bureau of Agricultural Economics, and before the work became a part of the newly created Agricultural Marketing Service, he transferred to another Government agency.

<sup>2</sup> Cochran, W. G. Sampling Techniques. John Wiley and Sons, Inc., 1953; Deming, W. Edwards. Some Theory of Sampling. John Wiley and Sons, Inc., 1950; Hansen, Morris H., Hurwitz, William N., and Madow, William G. Sample Survey Methods and Theory. Vol. I. John Wiley and Sons, Inc., 1953; Yates, Frank, Sampling Methods for Censuses and Surveys. Charles Griffen and Company Limited, London; Hafner Publishing Company, New York, 1949.

other ambiguities attributable to the units on the list not corresponding to farms as defined for the survey. Also, interviewers might have difficulty locating the persons selected for the sample.

## BASIC MATERIALS FOR AREA SAMPLING

The preparation in 1944 of basic material<sup>3</sup> for area sampling had been preceded by research designed to find the best size and type of segment. Generally, small segments are statistically more efficient than large ones; but as the size is reduced, costs and problems of field enumeration increase. Furthermore, the requirement that segment boundaries be identifiable in the field places a lower limit on the size of segments that are of practical use. Studies<sup>4</sup> of the statistical efficiency of segments of different sizes, and limited information as to relative costs, indicated that for general-purpose farm surveys the segments should be as small and uniform as possible in the number of farms they contain. There was also reason to believe that travel-cost considerations make it inefficient to use segments of a size requiring more than one day's field work on a segment. However, with the materials described in the following paragraphs, one is not limited to use of segments of any particular size; in fact, the size of segment should be adapted to the objectives of the survey.

The first step in preparing the basic materials for area sampling was to assemble county highway maps for all counties in the United States. The county highway maps, available from State highway departments and commissions, showed in detail the locations of cities, towns, roads, railroads, rivers, and other topographical features. On these maps, the locations of farmsteads and of other dwellings outside the cities and towns were also indicated. Although correspondence between actual farms and indicated farmsteads is far from being one-to-one, particularly in some parts of the country, the information on the maps is useful for controlling the size of segment.

For illustration, the portion of a county map that covers two selected minor civil divisions in Seneca County, Ohio, is reproduced (fig. 1). The black lines and markings were part of the original map, whereas the red lines and markings represent additional work done on the county maps. Figure 1 was prepared for illustrative purposes only; it is not an exact replica of a part of the basic county work maps from which area samples may be selected. However, the basic work maps contain the same information except that no sample segments are shown.<sup>5</sup>

On the county maps, boundaries of minor civil divisions (political subdivisions as they existed in 1944) and all incorporated towns or cities were delineated, as were populated unincorporated places which had estimated populations of 100 or more and a density

<sup>3</sup>In 1944 the then Bureau of Agricultural Economics, the Bureau of the Census, and the Statistical Laboratory of Iowa State College cooperated on a project to develop a set of materials for the purposes of drawing a national sample to be used in connection with the 1945 Census of Agriculture and of providing a general basis for selection of area samples. An article on this project was published; Jessen, R. J. The Master Sample of Agriculture, Jour. Amer. Statis. Assoc. March, 1945.

In 1947 some revisions in the area sampling work maps were made primarily in the delineation of rural towns and villages. It is the work maps as they existed after revision that are described in this handbook.

<sup>4</sup>Jessen, R. J. Statistical Investigation of a Sample Survey for Obtaining Farm Facts. Iowa Agr. Expt. Sta. Research Bull., 304, 1952; Jessen, R. J. and Houseman, E. E. Statistical Investigations of Farm Surveys Taken in Iowa, Florida, and California. Iowa Agr. Expt. Sta. Research Bull. 329, 1944; Hendricks, W. A. The Relative Efficiencies of Groups of Farms as Sampling Units. Jour. Amer. Statis. Assoc., 39: 367-376. 1944; Finkner, A. L., Morgan, J. J., and Monroe, R. J. Methods of Estimating Farm Employment from Sample Data in North Carolina. N. C. Agr. Expt. Sta. Tech. Bull. 75. 1943.

<sup>5</sup>Copies of the work maps containing all of the information shown in figure 1, except for the sample segments that were selected for illustration, can be bought from the Bureau of the Census for the cost of reproduction, which is done photographically. The Agricultural Marketing Service has copies that can be loaned for short periods of time for official use. Reproductions of the listings of counting units (to be explained later) similar to table 2 are also available. This material covers all counties in the United States except for counties and parts of counties which were within metropolitan districts, as defined in the 1940 Census.

of more than about 100 persons in a square mile. For rural incorporated places the delineation was not necessarily coextensive with the corporate limits. The delineation frequently extended beyond the corporate limits for the purpose of including all of the populated area (relatively speaking) or to get a better boundary. But no part of the incorporated area was intentionally excluded in delineating these areas. However, for urban places the intention was to follow the corporate limits. If there was a "built up" area outside the city limits, it was delineated as an unincorporated place. On the illustrative map in figure 1, there are one incorporated place, New Riegel, and one unincorporated place, McCutchenville. The area remaining, after delineating the urban places and the incorporated and unincorporated rural places is called "open country."

As general information, estimates of the percentage distribution of the number of inhabitants and of the number of farms by urban places, rural places, and open country in 1940 are presented in table 1. The percentages for urban places were taken from census data, but the estimated percentages for rural places and open country are approximations because the primary basis for estimating the number of inhabitants and farms in most unincorporated places was information on the highway maps.

TABLE 1.--Estimated distribution for 1940 of total population and farms, by zones for the United States

Zone	Percentage distribution of number of	
	Inhabitants	Farms
	<i>Percent</i>	<i>Percent</i>
Urban places -----	56	1
Rural places -----	18	8
Open country -----	26	91
Total -----	100	100

### Open-country sampling

The delineation of areal units for sampling purposes in the open country was intended to serve the dual role of general-purpose sampling either for farms or farm and nonfarm households. Segments were desired that had as nearly equal numbers of farms as possible, but, as explained later, a secondary limiting rule was established to control the total number of dwellings in a segment. The only information available for controlling the number of farms in segments was the indicated farmsteads on the maps, and the number of farms by minor civil divisions from the 1940 Census.

Instead of immediately delineating segments of the size desired for sampling units, counts of the indicated farms and dwellings were made and recorded on the map for areas called counting units. These counting units were small areas of varying size bounded by roads, or other distinctive topographic features, and political divisions including minor civil divisions, city limits, and county lines (fig. 1). A counting unit contained a minimum of about 6 farms or 8 dwellings, a maximum of about 30 farms, and was not permitted to be in more than one political division. Some of the reasons for establishing counting units can best be explained after the procedure is developed.

Counts of the farmsteads and total dwellings indicated by the map were recorded on the map within the counting units as follows:

$$\frac{7 - 10}{19}$$

where the map indicated 7 farms and 10 total dwellings (including farmsteads) within counting-unit number 19, Counting units were identified by a serial number assigned in serpentine order within each minor civil division. Minor civil divisions were also identified by a serial number that was assigned by following a serpentine pattern within the county.

The counts recorded on the map in figure 1 may not always agree with the farms or dwellings indicated on the portion of the map that is reproduced, because some information is shown in the form of insets on the margins of the highway map. In counting unit 4 in minor civil division 17, for example, 5 farms are indicated on the map, but in an inset, not reproduced here, which covers part of this counting unit, 1 farm and 8 nonfarm dwellings are indicated. This adds to an indication of 6 farms and 14 dwellings as recorded on the map for this counting unit.

After the counting units had been delineated and counts of the indicated farms and dwellings had been made, a number of segments was assigned to each counting unit without actually dividing the counting units into segments. This was done by taking into consideration the availability of suitable boundaries for subdividing a counting unit into segments and completeness of the indicated number of farms on the map. Completeness was estimated by totaling, for a county, the counts from the maps of indicated farms and comparing the result with the number of farms enumerated in the 1940 Census of Agriculture. If, for example, the completeness for a county was only about 80 percent, then for each 80 indicated farms, we would expect to find about 100 census farms. Hence, that county would be allowed, other things equal, an average number of indicated farms per segment which would be about 80 percent of the average for a county with about as many indicated farms as census farms. This kept the average size of segment in terms of census farms approximately the same except for modifications from one broad area to another, depending upon the problem of subdividing the counting units into segments with identifiable boundaries.

The intentions were: (1) That the average size of segment, in terms of actual census farms should vary between 4 and 6 farms, depending upon the topographic features of the county, and (2) that the average segment should contain not more than 10 total dwellings. The intended average size, in terms of census farms, was lowest for counties within the territory covered by the Public Land Survey and where the roads and boundaries of tracts regularly followed section or half-section lines. Exceptions toward greater average size were made, especially in the mountainous areas of the eastern and western parts of the country, owing to the difficulty of defining small segments in terms of information shown on the map. As this procedure did not control segment size in terms of land area, the acreages in the segments varied widely. For the United States, the segments averaged about 2.5 square miles; but varied from 0.7 square miles in Indiana to 108 square miles in Nevada.

The number of segments assigned was recorded on the map by extending, within each counting unit, the entry illustrated above as follows:

$$\frac{7 - 10 - 2}{19}$$

where 2 is the number of segments assigned. A listing was then prepared for each county giving information as illustrated in table 2 for the two minor civil divisions shown in figure 1.

One question concerning the arrangement described above warrants some comment before proceeding with a description of the mechanics of selecting a sample of segments. In some areas boundaries of minor civil divisions are unsatisfactory as segment boundaries because of difficulties of identification in the field. In fact, some of them have the appearance of mere arbitrary lines drawn across the map. The primary reason for working with minor civil divisions was the fact that a sample was to be drawn from this material for use in connection with the 1945 Census of Agriculture. Farmers in the sample segments

were to be asked a number of questions in addition to the questions asked of all farmers. However, as tabulation of the information obtained from all farmers was to be made by minor civil divisions, it was important to avoid having any segments overlap minor civil division boundaries.

### Selecting a Sample of Segments

Now that the basic material has been described, How does one proceed to select a sample of segments in a simple case? Suppose that a 10-percent sample of all segments is to be selected. A convenient and common method is to take every 10th segment, after a random starting point between 1 and 10, using the column "Cumulative number of segments" (table 2). Because of the geographic order in which the counting units are listed, this procedure insures some geographic dispersion of the sample.

To describe the process in greater detail, a random number (for example, 3) is drawn which is equal to or less than the sampling interval (reciprocal of the sampling rate - 10 in this illustration) by using a table of random numbers. To designate the first sample segment, proceed down the column showing the cumulative number of segments to the number drawn or the next larger number. This will locate the counting unit from which the first segment is to be chosen. If it has been assigned only one segment the entire counting unit will be included in the sample. But if the counting unit has been assigned two or more segments, it is to be subdivided into as many segments as were originally assigned. One of these segments is then chosen at random to be included in the sample. Additional selections are made by successively adding the sampling interval to the randomly selected starting point, and repeating the process within each counting unit thus designated. In table 2, the counting units selected by starting with the 3rd segment and taking every 10th thereafter are designated.

As only those counting units chosen in this way actually require subdivision into segments, the task of dividing the entire county into segments has been avoided. This is of importance, particularly in areas with counting units which are difficult, if not impossible, to divide satisfactorily into segments without more detailed mapping or aerial photographs. Some methods of treating such counting units are discussed later in this handbook. The establishment of counting units also provides for some flexibility as to size of segments when designing samples for different purposes by permitting the assignment of a different number of segments to each of the original counting units.

In figure 1, lines dividing the selected counting units into segments are shown and the segment selected at random from each is also designated. The sample segments need not be marked on the work maps as they can be designated directly on copies of the highway maps for use in the field. Sample segments may also be outlined on aerial photographs for use in the field as an aid to accurate identification of segment boundaries and correct coverage of the farms that belong to each segment according to specified rules. (See section on farm identification.)

The procedure just described is not a process that gives a simple unrestricted random sample. But it does give an unbiased sample of segments in the sense that every segment has an equal chance of being selected. With reference to table 2, an unrestricted random sample of n segments could be selected by drawing n different numbers between 1 and 99, inclusive, from a table of random numbers. The counting units corresponding to these random numbers would then be identified on the map and divided into the assigned number of segments. The number of segments to be selected at random from a counting unit is equal to the number of random numbers--usually only one--that happen to fall in the counting unit.

Other modifications to adapt area sampling to special problems are indicated in a later section.

TABLE 2.--Illustrative list of open country counting units and information on each

Minor civil division number	Counting unit number	Map indicated number of		Number of segments assigned	Cumulative number of segments assigned
		Farms	All dwellings		
16-----	1	17	19	4	<sup>1</sup> 4
	2	14	15	3	7
	3	6	6	1	8
	4	9	9	2	10
	5	7	7	2	12
	6	10	10	2	<sup>1</sup> 14
	7	8	8	2	16
	8	10	10	2	18
	9	6	6	1	19
	10	7	7	2	21
	11	15	28	3	<sup>1</sup> 24
	12	8	8	2	26
	13	6	6	1	27
	14	11	16	2	29
	15	12	13	3	32
	16	10	10	2	<sup>1</sup> 34
	17	10	10	2	36
	18	7	7	2	38
	19	7	10	2	40
	20	7	7	2	42
	21	10	21	2	<sup>1</sup> 44
	22	5	5	1	45
	23	13	13	3	48
	24	4	8	1	49
	25	8	8	2	51
17-----	1	9	9	2	<sup>1</sup> 53
	2	10	10	2	55
	3	12	12	3	58
	4	6	14	2	60
	5	6	6	1	61
	6	6	6	1	62
	7	6	6	1	<sup>1</sup> 63
	8	9	9	2	65
	9	8	8	2	67
	10	7	7	2	69
	11	11	11	3	72
	12	6	6	1	<sup>1</sup> 73
	13	7	7	2	75
	14	6	15	2	77
	15	11	11	3	80
	16	10	10	2	82
	17	7	7	2	<sup>1</sup> 84
	18	8	10	2	86
	19	10	10	2	88
	20	5	10	1	89
	21	5	15	2	91
	22	7	10	2	<sup>1</sup> 93
	23	7	7	2	95
	24	7	8	2	97
	25	10	10	2	99

<sup>1</sup> Counting units from which a sample segment is to be selected. The random starting number was 3 and the sampling interval was 10.

## Sampling in Non-open-country Territory

The procedure just described for drawing a sample in the open country can be applied to territory that is not in the open country. For purposes of sampling farms, each place can be regarded as the equivalent of a counting unit. Hence, the places can be listed and a number of segments assigned to each. But, owing to lack of detail on highway maps, the basis for assigning a number of segments to each place is less adequate than that used for the open country. The aim, however, is to assign a number of segments to each place so that the average number of farms per segment is about the same as in the open country.

The principles for dividing places into segments are the same as those for open country. Some county highway maps show considerable detail for small populated places by the use of insets, but others show practically no detail. Consequently, to get a satisfactory basis for segmenting places it is often advisable to supplement the county map with city maps or aerial photographs covering certain places.

Places can be listed in order of estimated number of inhabitants or by geographic location, a combination of the two, or by some other relevant factor. If the procedure for selecting segments is to take every nth segment down an accumulative total of the number of assigned segments, the order in which the places are listed might have some bearing on the efficiency of the sample. One might expect such a sample to be roughly equivalent to a stratified random sample where the criterion for stratification is the same as that used in ordering the places.

If a sample of all dwellings in non-open-country territory instead of farms is desired, appropriate modifications will be needed. Segments defined for farm sampling would be much too large. But further elaboration is out of place here, as the problems of sampling households in towns or cities lie outside the scope of this handbook.

### SOME GENERAL COMMENTS ON AREA SAMPLING

Theoretically, the method of probability area sampling, including expansion of the sample, can be applied in the absence of historical data or information obtained from lists, censuses, or other surveys; but successful application depends greatly upon the availability of accurate detailed maps. If, for example, a random sample of one-tenth of all segments covering some defined population is selected, the sample segments are expected<sup>6</sup> to contain one-tenth of all farms, one-tenth of the farms of any particular type, one-tenth of the land area, or one-tenth of any other elements that might be named, provided that each individual farm or element in the statistical population is associated with only one segment. Hence, if each segment selected for the sample is completely enumerated, one could multiply sample totals by 10 to get unbiased estimates--unbiased in the sense that the expected value would be equal to the result that would be obtained if the entire population were enumerated under exactly the same conditions. This could be done in the complete absence of any material or information other than the maps. But some pertinent information other than the maps is usually available and frequently used in the process of designing or expanding the sample. A full discussion of this point would encompass much of what is in a book or course on sampling for surveys. It is beyond the scope of this handbook.

Experience indicates that, if an area sample is to be self-sufficient and to provide accurate expansions, utmost care to insure complete and accurate coverage must be taken in canvassing the sample segments. This requires foreknowledge (obtained either through past experience or pretesting) of problems that might be encountered and prescribed methods for handling each. The Farm Identification Sheets in appendixes A and B have been used in actual surveys; they illustrate two different forms designed to aid in attaining the objective of complete and accurate identification of the farms that should be in the sample.

<sup>6</sup> "Expected" is used in a statistical sense. It refers to what happens on the average in repeated samples from the same population or to the average of all possible samples of a given size. Actually, under the popular or dictionary meaning of expected, we might expect that few if any samples would contain exactly one-tenth of the farms or of any other element, because of variability among segments.

Some readers may have the impression that area sampling is very expensive, or of doubtful practicability because it is too involved. On the contrary, some users have been impressed with its convenience and ease of application. Much depends upon what universe is to be sampled, what one hopes to accomplish, and the items of information under consideration, as these factors affect the complexity of the job to be done in the field. Also, some tend to overlook the fact that certain operating problems, such as those associated with the definition of a farm, are essentially independent of the method of sampling and exist regardless of whether a census or a sample is taken. The result is that a sampling procedure might be denounced because it is incorrectly associated with complexities that have little or no relation to the method of sampling.

With area sampling there is wide latitude in defining the statistical population to be sampled. Limits on the scope of the population might be partly governed by matters of economy or simplicity. For example, instead of defining the population to include all farm operators, it might be limited to farm operators living in the open country unless the impairment of the purpose of the survey is more serious than the gain from such a limitation. A determining factor, however, might be the need for getting data comparable with existing data.

### Effects of Map Inaccuracies

Correspondence between actual farms and dots on the map indicating farms is far from being one-to-one in some areas. When this is discovered by interviewers or others unfamiliar with the maps, the validity of the sample is sometimes questioned. Since the maps have defects, an inference is made that the sample must be defective. Assuming that identification of segment boundaries is not a problem, what is the effect of discrepancies between indicated farms and actual farms?

If a one-to-one correspondence actually existed, it would not be necessary to establish special rules for associating farms with sample segments as illustrated in the appendixes--farms in the sample would be the farms corresponding to dots on the map falling within the sample segments. (Incidentally, under this hypothetical assumption, area sampling would not be needed because one could get a sample of farms by selecting a sample of the dots indicating farms.) Hence, lack of correspondence means that rules need to be established which, in effect, will associate each farm in the specified statistical population as it exists at the time of the survey with one and only one segment.

With such a set of rules every farm has an equal chance of being in the sample provided every segment has an equal chance of being in the sample. In the field this means ignoring the dots indicating farms except for any value they might have for orientation. That is, one definitely should not go to a sample segment with the objective of finding one farm for each dot within the segment--the objective is to identify and get information from the farms associated with each sample segment according to the specified rules. Then, there is no bias attributable to failure of the map to indicate farms accurately and the only effect of such inaccuracies is on sampling error. The effect on sampling error emanates from the fact that size of segment, in terms of actual farms, is less variable when an accurate map is used to define the segments.

From the principles just indicated, the method of handling a number of situations should be clear. For example, suppose a dot is inaccurately located on the map and appears inside of a sample segment when the farmstead that it evidently corresponds to, is actually outside the segment. If an interviewer is careless about establishing segment boundaries, he might proceed as though the farm involved were in the sample segment because it is so indicated on the map. Ideally, an interviewer should use the indicated farms or other map culture only for purposes of general orientation and not as a means of establishing the exact location of a segment boundary.

Using only county highway maps it is impossible in some areas to delineate segments, with a high percentage of identifiable boundaries, that have as few as 4 to 6 farms. It appears that ambiguous boundaries, and hence uncertainty as to whether certain farms are in the sample, is likely to have a greater effect on expanded estimates (assuming the expansion is by the reciprocal of the sampling rate) than statistics such as averages per farm. In other words, one might expect that uncertainty as to whether to include a farm in the sample would influence the number of farms included in the sample to a greater degree than an average per farm. As a first approximation, the inclusion of too many or too few farms in the sample segments might be expected to affect proportionately any estimates expanded by the reciprocal of the sampling rate. Thus, the emphasis that is given to boundary problems may depend upon the survey objectives or the method to be used in expanding the sample.

Although, as indicated earlier, aerial photographs can be an effective aid in solving problems of getting identifiable boundaries, some alternatives are worth mentioning. One possibility is the use of larger segments, if feasible from the standpoint of statistical efficiency. Another procedure sometimes used is to divide counting units into segments only when segments having clearly identifiable boundaries can be delineated. From the counting units so divided, one segment is selected at random from each. The remaining counting units are not divided; but are marked on the field map in some distinguishing way for subsampling in the field according to specified procedures, the subsampling rate being  $1/n$  where  $n$  is the number of segments assigned to the counting unit. A rigorous job of subsampling a counting unit in the field would require listing all farms in it that qualify for the survey and applying the appropriate subsampling rate to the list. Less precise field subsampling might not be superior to forcing a division of counting units on the work maps, using imaginary boundaries if necessary, and approximating in the field, as well as possible, the somewhat artificial boundaries of the sample segments.

Although accurate identification of segment boundaries is important, in some circumstances interviewers might waste considerable time in trying to establish segment boundaries. Suppose, for example, that part of a boundary as shown on the map is an unimproved road but the interviewer finds that this road is nonexistent. A rough approximation to the location of this imaginary road might be adequate to establish with practical certainty that a more exact approximation would not give a different result in terms of the houses or farms to be included in the sample. In other words, we are concerned with boundaries only if a decision about what farms (or other units) to include in the sample is involved; but the need for giving the interviewer rigorous, yet practical, instructions should not be overlooked.

### Unimportant Segments

Some sample segments may appear to yield nothing useful, especially if the survey is oriented toward a certain type of farm or subject. This problem occurs when it is impossible to define the population geographically, excluding all land not used for agricultural purposes or territory otherwise irrelevant. A sample segment might fall in a military reservation or in an area inundated as the result of construction of a dam. A segment might, for example, extend several miles from a road into mountains or other uninhabited areas. Hence, some sample segments may look ridiculous when the background or basis for the sampling is not understood. Irrelevant territory should not be included in the universe if there is a sound basis for excluding it. An effort to exclude irrelevant territory, to such an extent that only a very few, if any, maverick segments would appear in the sample, would require either (1) arbitrary elimination in the office, without knowing definitely what was being discarded, or (2) extensive field work prior to selection of the sample.

Both of these alternatives are undesirable. The easiest solution, and the one usually followed, is to include all land area in the population, except for areas larger than perhaps several square miles which can be eliminated in the office as definitely of no use for

purposes of the survey. All land in the population thus defined is then included in the segments and given a chance of being in the sample. Much less work is spent on any sample segments that fall in an airport, military reservation, wasteland, etc., than would be required to delete all such territory in the population prior to selection of the sample. The latter job cannot be done satisfactorily (at least not completely) in the office. If a segment is found to be under water, for example, that should not be a matter of great concern. It does not contribute any direct information to the survey and a substitute is not required. However, it is counted as a "zero" if the sample is expanded by multiplying an average per segment in the sample by the number of segments in the population.

The discussion in the two previous paragraphs was mainly with reference to completely irrelevant territory. Usually there are other areas where the subject of the survey is relatively unimportant, perhaps because only a relatively small proportion of all farms qualify for the survey. If such areas are included in the population, a major part of the survey effort might be spent on a small or unimportant part of the population unless appropriate action is taken. Assuming that the unimportant areas can be identified, one of three alternatives can be chosen: (1) Eliminate such areas from the population and recognize that fact when interpreting the data, (2) include such marginal areas in the population and sample at the same rate used for the more important areas, or (3) include these areas in the population but form a stratum consisting of relatively unimportant areas and sample this stratum at a relatively low sampling rate. Each case should be judged on its own merits, as no single alternative is best for all situations.

### ADAPTATION TO SPECIAL CASES

Several schemes can be used in adapting probability area sampling to particular problems. In fact, knowledge in the whole field of sampling theory and methods might be brought to bear on a problem. However, the discussion is limited to the more common cases that we have encountered.

#### Size of Segment

A problem may call for the use of a segment of a size different from that illustrated in table 2. For example, for a survey of new construction of farm buildings and major repairs during a year, larger segments are desirable. Because of the small proportion of all farms having any new construction or major repairs, there would be less than two questionnaires to administer in most of the segments. To select larger segments, one can proceed from the material illustrated in figure 1 and table 2 with much less effort than developing a new work map. The first step would be to combine counting units with adjacent ones as necessary to establish a set of counting units that are all at least as large as the desired size of segment. A new number of segments is then assigned to the redefined counting units and the sampling proceeds as already described.

Sometimes, however, a survey may be focused on an item found on only 20 percent of all farms in the area to be surveyed but distributed geographically so that it is found primarily in some segments and not in others, rather than being distributed more or less uniformly among all segments. As a matter of the statistical efficiency of segments of different sizes (considering size in terms of all farms), this situation differs from the one on new construction of farm buildings and use of a larger segment might not be appropriate.

A sample of segments that are half the size as defined on the work maps is easily selected. If the sampling rate is  $1/n$ , simple use  $n/2$  as an interval for selecting counting units (last column, table 2). Then, divide each counting unit selected into twice the assigned number of segments and select one at random.

An additional example on how segments have been adapted or redefined for special surveys is worth citing. For a farm-management study conducted a few years ago, the population was defined as farms with 10 or more dairy cows in an area of several counties.

The number of such farms in each minor civil division was known from a previous census. As the proportion of all farms that qualified for the survey varied widely among the minor civil divisions, the segments that had been established for general use were not well suited to this situation. For purposes of sampling, a minor civil division was used as the equivalent of a counting unit. A number of segments was assigned to each minor civil division, aiming at an average of about four dairy farms per segment. Otherwise, the sampling followed the methods described earlier.

### Establishing the Sampling Rate

Frequently we find an inadequate basis for setting a sampling rate that will yield within, for example, about 5 percent of the desired number of completed questionnaires. This occurs when the size of the universe is unknown and the best judgment of it might be in error by a large amount. Another factor is uncertainty about the rate of nonresponse. If a pretest of the survey is made, it might be used to help establish a sampling rate by ascertaining the proportion of farms that are eligible in a small sample of segments.

For many surveys, particularly local surveys covering less than a few counties, it is feasible to arrange the sample in parts and cover as many parts as necessary to get approximately the desired number of schedules. Suppose, for example, one is reasonably certain that a sampling rate of 3 percent will not yield more, and that 5 percent will not yield less, than the desired number. Two possible ways of coping with this situation are suggested:

1. A 3-percent probability sample could be selected and designated on field maps. After the field force has done enough work to establish the number of sample segments that will be required, an additional probability sample can be drawn of sufficient size to yield approximately the desired number of schedules. The supplemental sample is marked on another set of field maps and sent to the interviewers. If properly handled, no technical problems of sample bias or design need arise owing to the fact that the sample was drawn in two parts.

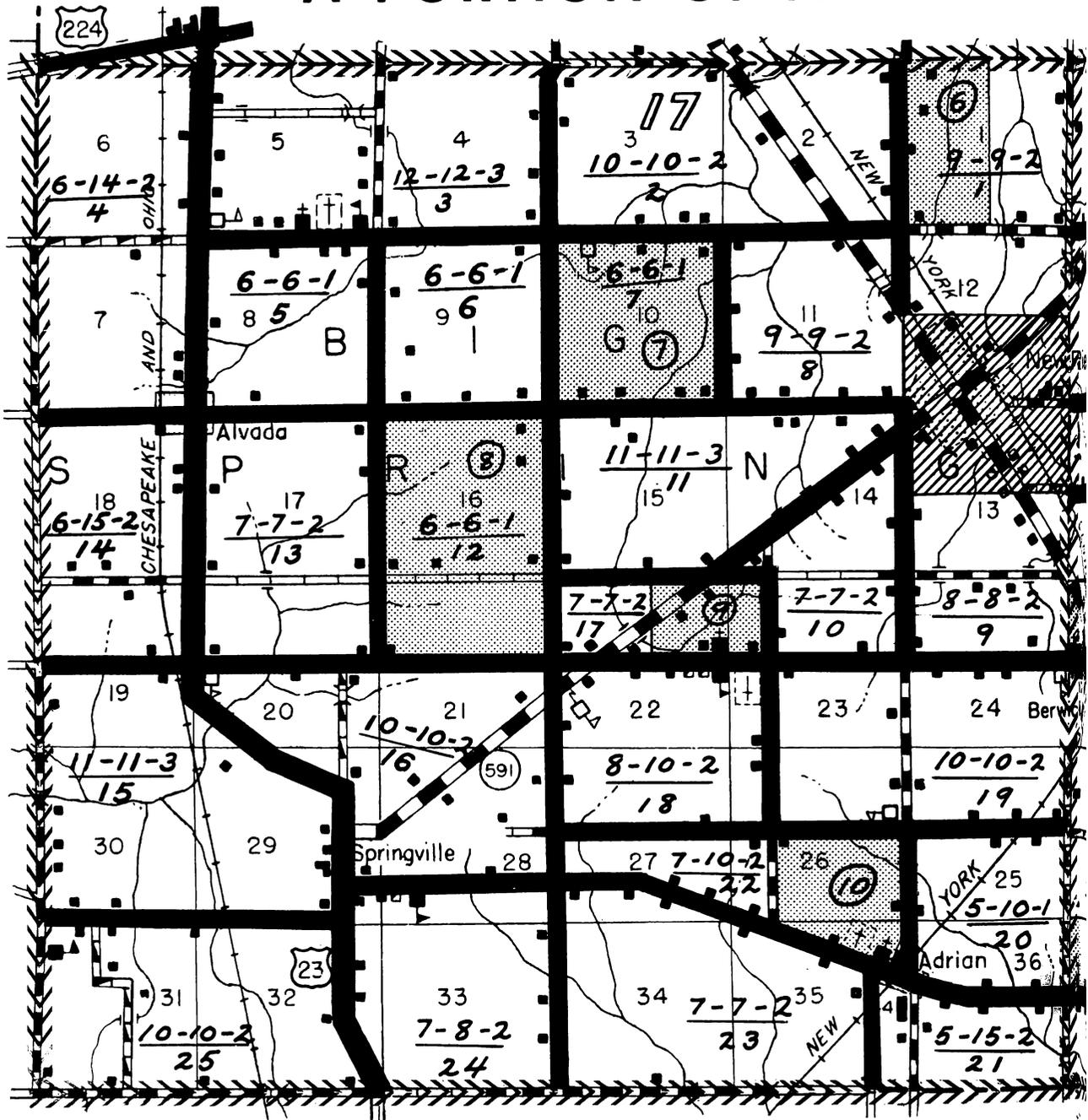
2. A 5-percent sample could be drawn with three-fifths of the sample segments designated in red and two-fifths in green. The segments would be designated as to color when selected, in the process of proceeding down the column of accumulated number of segments (table 2), by following a systematic arrangement such as: R, G, R, G, R: R, G, R, G, R: R, G, etc., giving the desired 3 to 2 proportion. The segments designated as red are marked in red on a field map and numbered serially in any order. The remaining sample segments are delineated in green and assigned serial numbers at random. The field procedure is to enumerate all red segments first in any convenient order, but the green segments would be enumerated in the order as numbered. Field work is terminated upon completion of the sample segment which yields the predetermined number of schedules<sup>7</sup>. As an alternative, before completion of the work on the red segments, the person in charge of field work might estimate the number of green segments needed, for example 10, and assign that number to the interviewers. As the green segments were assigned serial numbers at random he would select green segments numbered 1 through 10. Field work would be terminated upon completion of the 10 green segments. The alternative might have some economy in terms of travel.

A requirement that call-backs be made on respondents not at home might add a complication but the above plans can still be operated successfully, particularly if one is willing to accept some variation, from the desired number, in the actual number of schedules.

---

<sup>7</sup> This termination procedure presents a very minor problem because a large segment is more likely to be the terminating segment than a small one. It appears that a correction for this would seldom, if ever, be worth making.

# A PORTION OF A WORK MAP

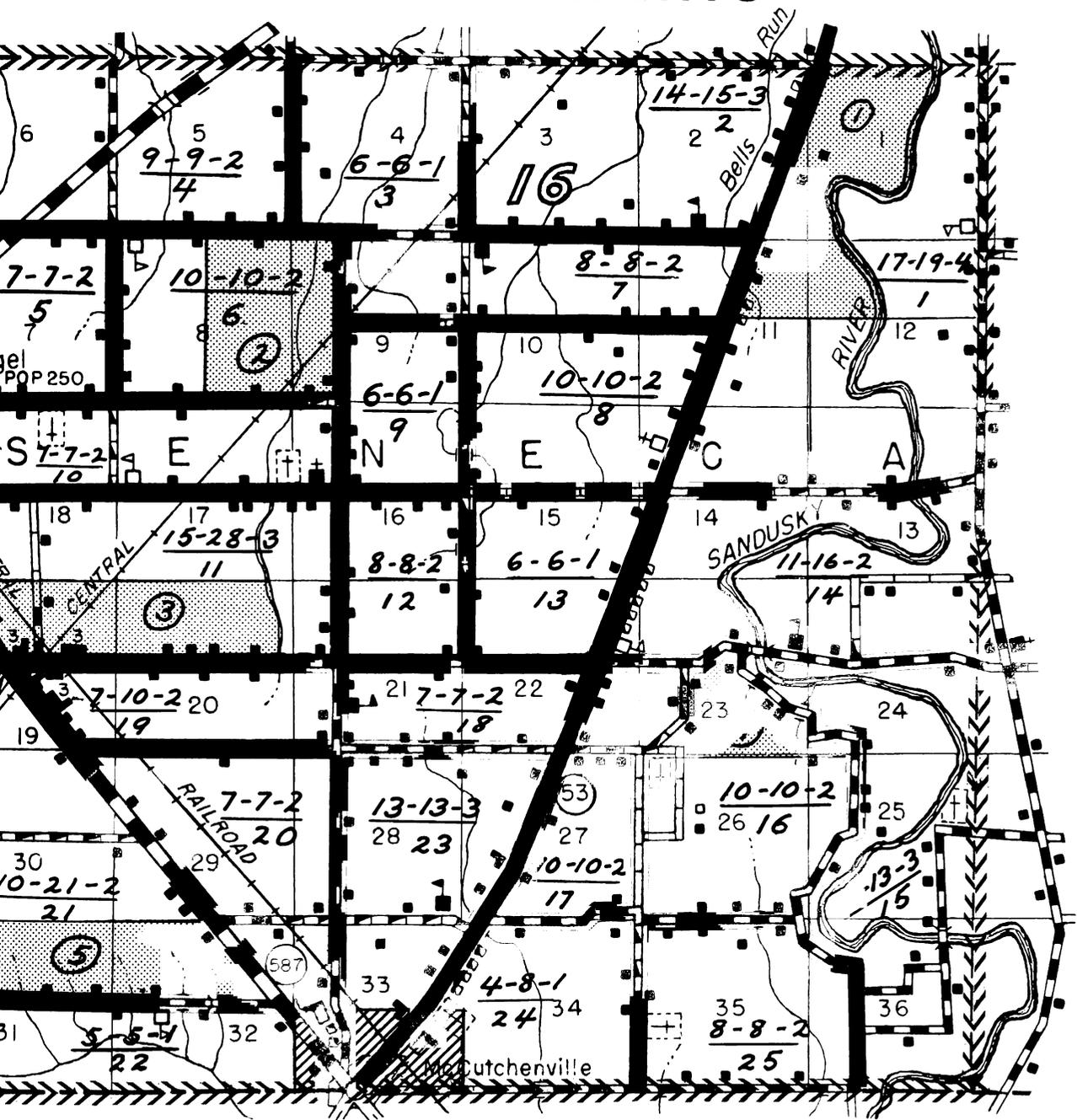


- Farm
- ▣ Nonfarm dwelling
- 4 Group of dwellings
- ▨ Rural place
- >>>> Minor Civil Division boundary
- 17 Minor Civil Division number
- Segment boundary
- ③ Sample segment
- ▬ Counting unit boundary

U. S. DEPARTMENT OF AGRICULTURE

SCALE: 1"=1/2 MI.

# MAP FOR AREA SAMPLING



ry  
and its serial number  
boundary

Indicated number of farms  
Indicated number of dwellings, farm plus nonfarm  
6-6-1 --- Number of segments assigned the counting unit  
6 --- Serial number of the counting unit

1 MILE

AGRICULTURAL MARKETING SERVICE

## Sampling for Comparisons Among Groups

Another problem of frequent occurrence appears when the objectives of the study are to make comparisons among two or more groups. For this purpose, approximately an equal sized sample from each group might be desired instead of proportionate representation. Sampling rates are often varied by geographic areas to get approximately equal-sized samples from areas to be compared. When comparisons among two or more groups interspersed in the same area are desired the problem is more complicated. Two alternatives are indicated assuming, for simplicity, that only two groups are to be compared. The extension of these procedures to more than two groups should be clear.

1. Suppose we wish to compare owner-operated farms (including part owners) with renter-operated farms. Assume, for purposes of illustration, that about two-thirds of the operators in the area to be studied are owners and about one-third are renters, and that a sample of approximately 100 owners and 100 renters is wanted. If an area sample large enough to give the required number of renters is selected, the problem is one of deciding upon some scheme for dropping out half of the owners in the selected sample segments. Probably the simplest objective scheme, but not necessarily the best, is to divide the sample of segments into two equivalent subsamples, or to have selected two equal-sized samples initially. For half of the segments, schedules are taken for both owners and renters; on the other half only renters are interviewed. For the second half it might be desirable to use larger sample segments (larger in terms of all farms) because of the density of renters. Fewer segments would then be in the second half than in the first.

2. An alternative method is to design a form which the interviewers can use for keeping a tally of owners and renters as they are reached. A schedule would be taken with every other owner contacted. Theoretically, this scheme should give a better sample of owners, but there is more possibility that interviewers would subjectively select the one out of two owners to be interviewed.

### FARM IDENTIFICATION

It is good practice to design a form to aid interviewers in going through the steps of identifying farms in each sample segment and to provide them with a uniform system of keeping a record of contacts and farms on which call-backs should be made. The form, which is referred to as a farm identification sheet, may also contain any screening questions needed to determine which farms qualify for the survey. One such form is used for each sample segment.

Farm identification sheets and accompanying instructions that were used in two actual surveys are reproduced in appendixes A and B. Appendix A was used from a local survey in southern Alabama to estimate farm labor requirements in the production of potatoes and sweet corn. In this survey the farm operator's residence was the reference point to determine whether the farm was in the sample. This approach requires a one-to-one correspondence between farms and operators; hence, an operator of a farm must be uniquely defined. Appendix B presents, with minor modifications, certain instructions and forms that were used in a nationwide farm survey conducted by the then Bureau of Agricultural Economics in April 1948. In this survey the "farm headquarters" was used as a reference point for determining whether a farm should be included in the sample.

The survey referred to in appendix A involved identification of farm operators living within the sample segments. There are two main problems with this approach: The first is how to get complete coverage of farm operators living in sample segments that have a high proportion of nonfarm dwellings, because it is impractical to visit all dwellings in town or city blocks in search of farm operators. Second, if all farms are to have equal chances of being in the sample a one-to-one correspondence between farms and operators is needed. Therefore, special rules were devised to cover farm operatorships involving more than one person so that, by definition a farm has only one operator. Then, a farm

is in the sample if its operator is in a sample segment. Incidentally, for this survey a list of large growers was developed so they could be sampled at a heavier rate--an important step to take for the reduction of sampling error.

In the national farm survey (appendix B) all farms that were in, or partly in, each sample segment were to be identified. The farm headquarters of each farm was then determined for the purpose of deciding whether the farm was in the sample. This approach was developed primarily because of the problem of getting complete coverage of farms that have nonresident operators. But, even though the farms that have nonresident operators are completely identified, we still have the problem of finding and interviewing the operators.

Considering all of the technical and operating difficulties involved, neither can be definitely recommended over the other. The first (appendix A) has more appeal from the standpoint of field operations. It should be adequate for many surveys, particularly in areas which have practically no nonresident operators. The second approach (appendix B) was used for a nationwide survey and hence had to embrace a wide variety of situations.

## APPENDIX A

Reproduced in this appendix is part of the instructions to interviewers who were employed for a survey of labor requirements in the production of potatoes and sweet corn in Baldwin County, Ala. Information was to be obtained just prior to the 1953 crop season from every farm operator who lived in the sample segments and expected to grow Irish potatoes or sweet corn for sale. Each operator in the sample was to report for his entire farm regardless of the location of his farmland with respect to segment boundaries. General instructions to interviewers on canvassing the sample segments were as follows:

An attempt should be made to contact all farm operators living within the boundaries of the sample segments, regardless of whether their farms are in a segment or not. The names of all farm operators living in each sample segment should be listed on the Farm Identification Sheet, page 17, even though they are not growing either potatoes or sweet corn. It is important that the first name or initials as well as the last name of each of these farm operators be listed, as these names will be checked against some lists we are using to obtain other information.

In a segment containing a residential section, all dwellings which appear to be farm dwellings should be visited and sufficient inquiries made to determine whether any other operators of farms live within the residential portion of the segment. These latter inquiries may be made of anyone who can give the information.

The following section, with minor modifications, is a reproduction of the instructions to interviewers pertaining to the farm identification sheet. Note the provisions on the farm identification sheet that were designed to avoid giving farms operated by a partnership a double chance of being in the sample when the partners do not live in the same segment. There was also a provision, not discussed herein, for ascertaining the number of acres of potatoes being produced within the sample segments by anyone living outside the county.

### Filling Out the Farm Identification Sheet

The chief purposes of this sheet are:

1. To obtain a clear record of all farm operators living in each segment.
2. To determine if the sample farm is eligible for an interview (that is, growing potatoes or sweet corn and the senior partner, if a partnership, lives in the segment).
3. To provide a convenient record of the action taken with regard to each farm operator living in the segment.
4. To determine how many acres of potatoes are being grown in each segment by someone who does not live in Baldwin County.

One farm identification sheet should be used for each segment. If there are not enough lines on one sheet to list all of the farm operators in one segment, use a second sheet, clearly identifying it, and write "continued" at the bottom of the first sheet. Fill in the segment number (as shown on your map) and your name in the space at the top of the sheet.

One line should be used for each farm operator living in the segment. A diagram (see illustration, page 18) of the segment is to be drawn on the back of the first page of the farm identification sheet. To help the supervisor orient the diagram, indicate the direction north by N. Draw a little square  to indicate the approximate location of each farm operator's residence on the diagram and assign to each a number. (Drawing in other obvious landmarks will also be helpful.) Enter this number in the first column, under "Residence Number," on the front of the farm identification sheet. When you learn the operator's name, fill that in on the same line. Remember to use first name or initials as well as last name. The next three columns are questions which ordinarily will be asked of the operator if he is available, but may be asked of another responsible member of the family. If no member of the family is available, these questions may be asked of a neighbor.

For a farm operator who is growing potatoes or sweet corn ("Yes" in column 2) and is the senior partner (if operating as a partnership--"No" to column 3, or "Yes" to column 4), an entry is required in column 5. This entry will not be made until after the interview is completed or until you are satisfied that an interview is not obtainable. In such cases, explain as follows:

- a. 3 calls made--if you have made 3 visits and could not find the farmer at home.
- b. Out of area--if you have learned that the farmer is out of the county and will not return before the end of the survey.
- c. Refused--if the farmer refused to be interviewed

When you have completed a segment, enter the total number of schedules completed in the lower right hand corner. This number should equal the total number of "Yes" answers in column 5.

UNITED STATES DEPARTMENT OF AGRICULTURE  
Bureau of Agricultural Economics

Budget Bureau No. 40-5321.1  
Approval Expires 6/30/53

UNITED STATES DEPARTMENT OF LABOR  
Bureau of Employment Security

SEASONAL LABOR REQUIREMENTS, 1953

Baldwin County, Alabama

Form I

Farm Identification

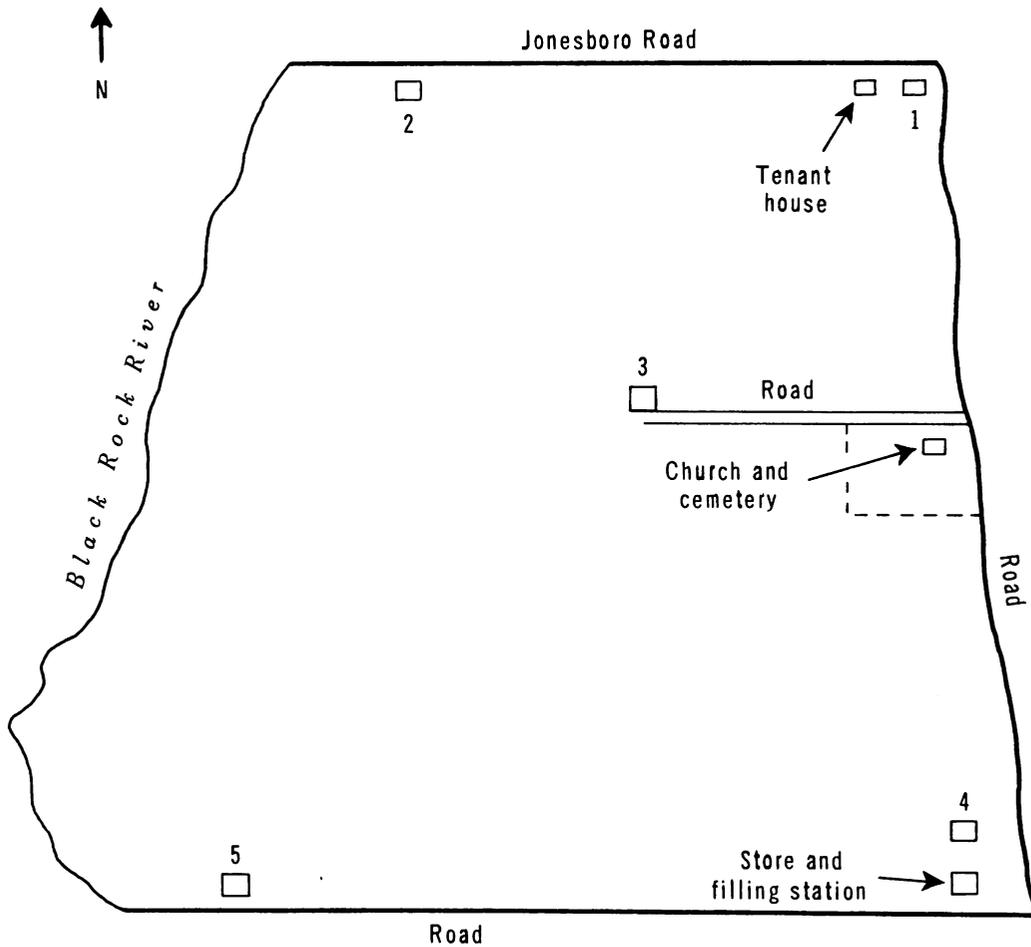
Segment No. 318

Interviewer Joe Doakes

Residence Number	Farm operator		2 Do you expect to grow any Irish potatoes or sweet corn for sale this year? YES or NO (If NO, conclude the interview)	3 If YES to 2, Are you operating a farm in partnership with anyone? YES or NO (If NO, proceed with the questionnaire)	4 If YES to 3, Are you the senior partner? (If YES, proceed with the questionnaire.) (If NO, conclude the interview)	5 If NO to 3 or YES to 4, Was a questionnaire completed? (If NO, explain)
	1 Name					
1	John Smith	No				
2	R. L. Brown	Yes	No			Yes
3	H. G. Jones	Yes	Yes		No	
4	Thomas L. Andrews	Yes	Yes		Yes	Yes
5	Frank J. Edwards	No				

Total number of Schedules completed 2

# SKETCH OF A SAMPLE SEGMENT NUMBER 318



## APPENDIX B

In the past the "farm headquarters" has been used as a reference point for most nationwide surveys. There has been considerable emphasis in such surveys on getting complete and accurate identification of all farms that should be in the sample. One such survey was conducted by the then Bureau of Agricultural Economics in September 1948 to obtain information on farm employment and wages.

The instructions below are taken from the interviewers' instruction manual with some deletion and modification. In these instructions four types of reference points were for farms having nonresident operators. Perhaps the headquarters for farms with nonresident operators should have been defined in terms of a single kind of reference point, for example, the northwest corner, instead of multiple reference points. Experience with alternatives has not been sufficient for deciding upon a best definition. The idea underlying the definition used in the labor survey was to exhaust the use of the more tangible points before resorting to the main entrance or northwest corner. If the northwest corner were used as the only reference point for nonresident operators, it would need to be carefully defined and illustrated. However, in the definition of headquarters given here, the northwest corner would be used so infrequently that it seemed unwise to burden the field force with a definition which would cover farms of any configuration.

Some question might also be raised about the need for identifying and recording all of the nonfarm tracts within the sample segments, as provided in the instructions below. This is also an unresolved issue, but it is clear that getting complete and accurate farm identification requires major attention and thoroughness.

On the Farm Identification Sheet, page 20, and in the instructions below, the reader will find reference to a check sheet. The check sheet was a short form to be completed, if possible, for farms when the operator could not be contacted within a specified number of calls. The purpose of the check sheet was to provide a minimum of information on characteristics of the "no-interview" farms as an aid in appraising the possible extent of any biases due to nonresponse.

In addition to the county highway maps on which the sample segments were delineated, the interviewers were given aerial photographs covering most sample segments. The segments were also delineated on the photographs. For the remaining sample segments, sketches in the form of outlines of segment boundaries were provided. After a description of these materials and instructions on outlining farm or tract boundaries came the following instructions for completing the Farm Identification Sheet (see page 20) and ascertaining farm headquarters:

### Fill out Farm Identification Sheet (Form 1)

The third step is to fill out a Farm Identification Sheet (Form 1) for each sample segment. The operators of all farms having headquarters within the boundaries of the sample segments are in the sample and the Farm Identification Sheet is used to determine which farm operators are to be interviewed. This sheet has three chief purposes:

- (a) To obtain a clear, legible, accurate record of all tracts of land in the segments.
- (b) To determine what is the farm headquarters and whether the headquarters is inside the segment.
- (c) To provide a convenient record of the action taken with regard to each tract in the segment.

A separate Farm Identification Sheet is to be used for each sample segment. Fill in the information asked for at the top of the sheet; State, County, the Segment Number, and your Name.

The aerial photograph or sketch is to be used in conjunction with the Farm Identification Sheet. One line on the Farm Identification Sheet is to be used for each farm or nonfarm tract of land, any part of which is in the segment. If a farm consists of 2 or more tracts that do not join each other, make only one line entry on the Farm Identification Sheet as they all were given the same number on the photograph or sketch. If you run out of lines, attach another sheet and repeat the information needed across the top, labeling the second sheet "Sheet 2".

SEPTEMBER 1948  
FARM EMPLOYMENT AND WAGES SURVEY

FORM 1  
FARM IDENTIFICATION

State Kansas County Polk Segment Number 7 Interviewer John Doe

1. Tract number on photo or sketch	2. Is this tract that is inside the segment: (a) part of a farm (b) an entire farm (c) an idle farm (d) non-farm land or place? IF PART OF A FARM OR AN ENTIRE FARM, SKIP TO QUESTION 4.	IF NONFARM LAND: 3. What kind of nonfarm land is this tract?	4. Who operates this farm? (NAME)	5. What place on this farm is the headquarters? ENTER FIRST THAT APPLIES: (a) Oper. residence (b) Most val. dwelling (c) Most val. building (d) Main entrance (e) Northwest corner	6. Is the farm headquarters inside this segment? (YES or NO)	IF "YES" TO QUESTION 6: 7. What action was taken? (a) Schedule (b) Check sheet
1	Nonfarm land	Church and cemetery				
2	Entire farm		J. M. White	Oper. residence	Yes	Schedule
3	Nonfarm land	Store and residence				
4	Part of a farm		Black	Oper. residence	No	
5	Nonfarm land	Timber land				
6	Part of a farm		R. C. Williams	Most val. dwelling	Yes	Schedule
7	Entire farm		Moore	Most val. building	Yes	Schedule
8	Part of a farm		S. Harlan	Oper. residence	No	
9	Entire farm		L. Todd	Main entrance	Yes	Check sheet
10	Part of a farm		M. Stilwell	Northwest corner	Yes	x
11	Part of a farm		P. Roberts	Oper. residence	No	
12	Entire farm		T. Judd	Oper. residence	Yes	Schedule
13	Idle farm					

Number of sample farms ("YES" to question 6) 6 Number of schedules completed 4

x Check sheet completed and sent to State supervisor. Mr. Stilwell lives in Topeka.

**Column 1.** --Enter the number you have assigned to the farm or tract on the photograph or sketch. Be sure to account for all tracts of land as you have numbered them on the photograph or sketch.

**Column 2.** --The purpose of the question in column 2 is to separate the tracts in a segment that are farms or parts of farms from nonfarm land in the segments. In order to do this a "farm" must be defined.

(The instructions included at this point about two pages on definition of a farm that are not reproduced here. The definition, with the exception of minor details, was the same as that used in the 1945 Census of Agriculture.)

One entry is to be made in column 2 for each farm or tract outlined on the photograph or sketch:

- (a) Part of a farm--if the tract of land as outlined on the photograph or sketch is cropland, pasture, orchards, buildings, woods or wasteland which belongs to a farm but the tract as outlined is not an entire farm, enter "part of a farm", and skip to column 4.
- (b) An entire farm--if the tract as outlined on the photograph or sketch is all of the land in a farm and there is no land in this farm other than this tract, enter "entire farm" and skip to column 4.
- (c) An idle farm--if the tract of land outlined on the photograph or sketch is an idle farm or part of an idle farm, write in "idle farm". An idle farm is one with no agricultural operations in 1948. If the entry is "idle farm" make no further entry for that tract.
- (d) Nonfarm land or place--nonfarm land is any tract that is not part of a farm and will not be used for agricultural operations at any time in 1948. If the tract outlined is not farm land of any kind enter "nonfarm" and then answer the question in column 3.

**Column 3.** --Write in this column the kind of nonfarm land in this tract. Examples are cemeteries, golf courses, building lots, forest land not used for pasture or other agricultural operations. After the question in column 3 is answered, make no further entry for nonfarm land. Column 3 should be left blank if the tract is part of a farm, an entire farm, or an idle farm.

**Column 4.** --Enter the name of the person who is now operating the farm. In many cases the last name will be sufficient identification here since the full name is to be put on the face sheet of the schedule for those farms which qualify as sample farms. In the case of partnerships enter the name of the partnership.

**Column 5.**--Since an interview is to be obtained for all farms having headquarters inside the sample segments, the next step is to determine what is the farm headquarters. It is important to have one place on every farm which is used to determine whether or not the farm is to be interviewed. This place we refer to as the farm "headquarters." All farms with headquarters inside the segment are to be interviewed regardless of whether or not all of the land in the farm lies inside the boundaries of the segment. Many farms will have land partly inside and partly outside the segment but only those farms with headquarters inside the segments are to be interviewed. Remember that all the land operated by one person or partnership is one farm.

#### DETERMINATION OF FARM HEADQUARTERS

The following rules are to be used in determining the headquarters of farms in the new segments:

Rule a. If the farm operator lives on his farm, his residence is the farm headquarters. The operator is considered as living on his farm if his residence is on the farm, bordering on the farm, or just across the road from his farm. If his residence is not on, bordering on or just across the road from his farm, he is considered as living on his farm only if he conducts agricultural operations at his place of residence which would qualify it as a farm. This refers mainly to operators living in town who are raising some chickens or performing other agricultural operations at their residence in town. If the place of residence can be classified as a farm, the residence is the headquarters of the entire farm, including both town and country tracts. In the case of partnership use the residence of the oldest member of the partnership to determine farm headquarters.

If the farm operator does not live on this farm, the following rules apply:

Rule b. If there is one dwelling on the farm, whether occupied or unoccupied, that dwelling is the farm headquarters.

Rule b-1. If there are two or more dwellings on the farm the dwelling of greatest value is the headquarters.

Rule c. If there is no dwelling on the farm but there is a building on the farm, this building is the farm headquarters.

Rule c-1. If there are two or more buildings, the building of greatest value is the headquarters.

Rule d. If there are no dwellings and no buildings on the farm, the main entrance is the headquarters. The main entrance is the point where the farm operator usually turns off the public road, private road, trail, or path onto the farm he operates.

Rule d-1. If a farm with no buildings is composed of two or more separate tracts of land, the headquarters of the farm is the main entrance to the tract of land of greatest value.

Rule e. If there are no dwellings and no buildings on the farm and the main entrance cannot be determined, the northwest corner of the farm is regarded as the headquarters. The "northwest corner" is defined as the point farthest north, except when the most northern point lies on an east-west parallel. In this case the "northwest corner" is the point farthest north which lies farthest to the west along the east-west parallel.

Select the first of these rules which applies and when you have determined what place is the headquarters write it in column 5.

In the South remember that when a multiple unit is partly inside and partly outside the segment, the headquarters of each separate farm or sub-unit is determined without regard to the others.

Column 6. --After the headquarters has been determined, it is necessary to decide whether the place which is the headquarters is inside the segment. If the entire farm is inside the segment, the headquarters would, of course, be inside also. If only part of the farm is in the segment it may require some careful study to determine whether the headquarters is inside or outside the boundaries of the segment. Enter "Yes" in column 6 if the headquarters is within the segment boundaries; enter "No" if the headquarters is outside the segment.

If "Yes" is entered in column 6 an interview should be obtained for that farm. If "No" is entered do not get an interview.

When you have completed the identification of farms in the segment, enter the total number of "yes" entries in column 6 in the blank at the bottom of column 6.

Column 7. --All farms having "yes" in column 6 (headquarters inside the segment) are sample farms and are to be accounted for with an entry in column 7. When an interview has been obtained and a schedule filled out, enter "schedule" in column 7. If a schedule cannot be obtained after three visits, fill out a check sheet for the farm and enter "check sheet" in column 6. When each farm with headquarters inside the segment has been accounted for with either a schedule or a check sheet, enter the total number of schedules completed in this segment in the blank at the bottom of column 7.

The accuracy and value of this survey is dependent on the care exercised by you in determining the proper farms to be interviewed and obtaining schedules for such farms and no others. To aid you in becoming familiar with the job of identifying a segment, determining the boundaries of farms and tracts in a segment, and determining farm headquarters, we have drawn an illustration of a segment and have illustrated the rules for determining farm headquarters (p. 23). A careful study of these examples will aid in determining what farms are to be interviewed.

#1. This is a tract of about five acres on which is located a church and cemetery. This, of course, is nonfarm land and the entries on the Farm Identification Sheet (Form 1) are;

1. 1
2. nonfarm land
3. church and cemetery
- 4 to 7. (no entry)

#2. This is a 120-acre farm all of which lies inside the segment. The farm operator, John M. White, lives on his farm and should be interviewed. The questions on Form 1 should be answered as follows;

1. 2
2. entire farm
3. (no entry)
4. J. M. White
5. Operator residence
6. Yes
7. schedule

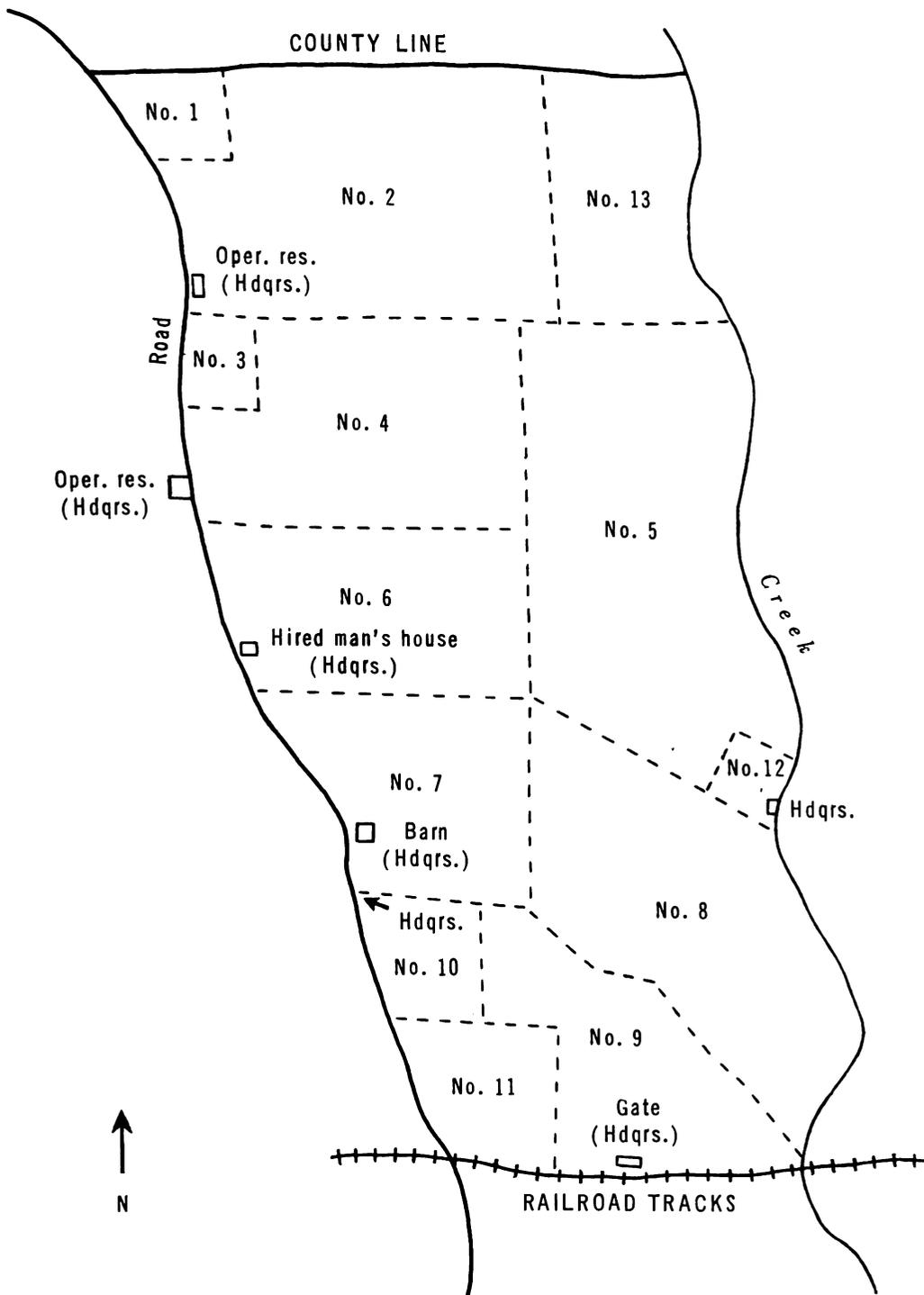
#3. This is a tract of about 4 acres on which there is a combination filling station and country store and a house occupied by the proprietor and his family. Inquiry reveals that there are no agricultural operations performed on this place so it is not a farm and no schedule is obtained. The entries on Form 1 are as follows;

1. 3
2. nonfarm land
3. store and residence
- 4 to 7. (no entry)

#4. This is a tract of about 100 acres which is operated by Henry Black whose residence is across the road on about 2 acres of land. According to the rule, Mr. Black's residence is considered as being on his farm but as it is outside the segment no interview is to be obtained. The entries on Form 1 are;

1. 4
2. part of a farm
3. (no entry)
4. H. Black

# DIAGRAM OF SAMPLE SEGMENT



5. operator's residence
6. no
7. (no entry)

#5. This is a tract of woodland owned by the Tyson Coal Co. and is not used for pasture or other agricultural purposes. At one time there was a small coal mine on this tract but it has closed down and the land is being held presumably for the future value of the timber. Entries on Form 1 are:

1. 5
2. nonfarm land
3. timber land
- 4 to 7. (no entry)

#6. This tract is part of a farm operated by a Mr. R. C. Williams who lives in town where he does not carry on any agricultural operations. He has a hired man living in a dwelling on the tract inside the segment. There is additional land across the road that is part of the farm and on it is an old house of little value. Mr. Williams should be interviewed. Entries on Form 1 are:

1. 6
2. part of a farm
3. (no entry)
4. R. C. Williams
5. most valuable dwelling
6. yes
7. schedule

#7. This place consists of about 20 acres, has a fenced-in pasture and a few acres of cropland and a small barn. The operator, Mr. William Moore, is a barber who lives in a town 2 miles away where he does not carry on any farming operations. Each night and morning he comes to his farm and milks the cows and occasionally he spends a day cultivating his crops. He should be interviewed. The entries on Form 1 are:

1. 7
2. entire farm
3. (no entry)
4. Wm. Moore
5. most valuable building
6. yes
7. schedule

#8. This tract consisting of several different fields is part of a farm the rest of which is across the creek. Mr. Sam Harlan is the operator and he lives on his farm but on land outside the segment. The entries on Form 1 are:

1. 8
2. part of a farm
3. (no entry)
4. S. Harlan
5. operator's residence
6. no
7. (no entry)

#9. This place is a farm on which there are no buildings of any kind. The operator, Larry Todd, lives in a rather large nearby city where he does not carry on any agricultural operations. His farm is entirely in wheat and he comes there only when necessary. The main entrance is a gate on the south side of the farm near the railroad tracks. The entries on Form 1 are:

1. 9
2. entire farm
3. (no entry)
4. L. Todd
5. main entrance
6. yes
7. check sheet

NOTE: (3 visits were made to Mr. Todd's place of residence in the city to obtain an interview but he was out of town and not available, consequently a check sheet was made out for this farm.)

#10. This tract is part of a large farm the rest of which lies to the south and west outside the segment. Practically all of the land in the farm is in grain and there are no buildings on it and no main entrance. The operator, Max Stilwell, is a business man who

lives in a city 500 miles away. A study of a sketch of the farm indicates that the northwest corner of the entire farm is located in the segment. Entries on Form 1 are;

1. 10
2. part of a farm
3. (no entry)
4. M. Stilwell
5. northwest corner
6. yes
7. ("schedule" written in by the State supervisor since the interview was obtained by another interviewer who worked in the county where Mr. Stilwell lives.)

#11. This tract is operated by Mr. Paul Roberts who lives in a town 2 miles away where he has a large lot, perhaps three-fourths of an acre, on which he has a cow, about 100 chickens, and a vegetable garden. As he produced \$250 or more of agricultural products in 1948 at his place of residence this 3/4 acre is considered part of his farm and Mr. Roberts is considered as living on his farm. His residence is therefore the farm headquarters and since it is outside the segment an interview is not to be obtained. Entries on Form 1 are;

1. 11
2. part of a farm
3. (no entry)
4. P. Roberts
5. operator's residence
6. no
7. (no entry)

#12. On checking his work on determination of farms and tracts in the segment the interviewer discovered that he had overlooked the fact that there was an old house occupied by Thomas Judd and his family on a corner of the Tyson Coal Co. property (#5). Investigation revealed that this man uses the house, a shed, and about 4 acres of land for which he paid no rent. He has an old horse, a cow, and a few chickens. As he has over 3 acres of land and carries on some agricultural operations the place comes under the definition of a farm. Since the operator lives on his farm and his residence is inside the segment a schedule is obtained. Entries on Form 1 are;

1. 12
2. entire farm
3. (no entry)
4. T. Judd
5. operator's residence
6. yes
7. schedule

#13. This tract is part of an idle farm the rest of which lies outside the segment. The interviewer thought that Mr. White's farm (#2) extended all the way to the creek and that this tract was part of his farm but careful inquiry revealed that it was a separate tract belonging to Mr. Hansen's place which is not being farmed this year because he is ill and not able to do any work. Entries on Form 1 are;

1. 13
2. idle farm
- 3 to 7. (no entry)