Use of Soils Maps in Operation and Planning of County Highway Activities

FRANK K. EVANS, Engineer-Superintendent,
Ingham County Road Commission, Mason, Michigan

● INGHAM COUNTY, located in the south central part of Michigan, is 553 sq mi ir area, and is considered to be one of the southern Michigan industrial ccunties. However, approximately 75 percent of the area is typical farming country encountered in any of the so-called rural counties of the state. The geology of the county is typical of the glacial area of the United States. The relief as a whole is smooth or generally rolling although a few sections of the county are choppy and comparatively hilly. The secondary topographic features are typical of the old glacial drainage valleys in this area and are composed of moraines, till plains and drainage basins. The climate is fairly cold in the winter with rather mild summers. The annual precipitation is about 30 in. with a yearly snowfall of approximately 48 in. The spring break-up or thawing period normally begins about February 15 and extends until April 15 or slightly later.

The county highway system, exclusive of the state trunk lines which are maintained by the County Road Commission, is composed of 1,155 miles of roads and streets, 357 miles are classified as county primary highways, and 798 miles are made up of local roads and streets.

There are 25 well-defined soil types within the county ranging from sand gravels through loamy series to heavy clays and muck in the swampy black ground farming area. A very high percentage of these soils are not desirable for the construction of good road grades unless they are given proper corrective measures. Mineral soils comprise about 85 percent of the total land area and the ramaining 15 percent of the soils are organic in nature.

SOIL GROUPS, PERCENT	
Organic soils	15.3
Alluvial soils	2.0
Poorly drained sand	8.8
Imperfect poorly drained clays	30.1
Well drained clay	12.6
Well drained loamy and sandy soils	25.9
Well drained very sandy soil	5.3

The redeeming feature of local highway construction is the availability of numerous sand and gravel deposits in the eskers and moraines which provide excellent subbase and base materials.

A great many county road departments in the United States are in the same situation as Ingham County which cannot afford a technical staff of adequate size to give complete and proper study to numerous problems of an engineering nature. Much work must be based on rational designs, convenient rules of thumb, and horsesense; however, certain aids are available which provide guidance and help in the maintenance and construction of roads. The Michigan Agricultural Experiment Station in cooperation with the United States Department of Agriculture during the early 1930's conducted a rather

detailed soil survey of this county and published the results of the survey together with a soils map adequate to provide considerable detailed information. This map and the report are used extensively as a reference in solving construction and maintenance problems. In addition to this soils map, the county has been covered by an aerial survey which provided stereo pairs of aerial photographs covering the entire county. These aerial photographs provide a great deal of topographic information. The Michigan State Highway Department's "Field Manual of Soil Engineering" has also been helpful.

The entire engineering and supervisory staff—in fact, the entire organization—is fairly familiar with the soil types to be encountered and is aware of the many advantages of better road construction that can be obtained by the proper use of local resources.

When a road is to be reconstructed, soils maps are consulted and conferences held between the engineers, the maintenance foreman, and the construction superintendent. The soil conditions are reviewed both as shown on the maps and as observed in the field. As a result of these conferences information is pooled, and adequate grades and road bases can be constructe with greater efficiency and a saving of tax dollars. From the soils maps, the type of soils and their characteristics are checked off and then the maintenance men indicate localized trouble spots and road sections which are inadequate for normal use. Because of climatic conditions (an annual thaw or break-up period of a 2- to 3- month duration) road failure due to natural soils conditions is of great importance. Road grades are checked for frost heaves and weak sections caused by poor soils. In severe cases natural soils normally are under-cut and wasted, backfilled with a free-draining sandy soil; or the grades are raised with sand or sand-gravel to provide a subbase. The extensive corrective measures that most of the state highway departments undertake in this section of the country are not feasible because of financial limitations. The work accomplished during the last 8 or 10 years has made such a vast improvement on the over-all condition of the roads that ordinary citizens are apparently satisfied with the approach to providing better roads.

A 3-mi section of road was recently up-graded or reconstructed from a local gravel road to a medium type bituminous surfaced highway. During normal springs, serious difficulties had been encountered throughout the entire area. On the south mile of this section, there were five types of soils; three of these types (Miami loam, Conover, and Brookston) are loams and clays with imperfect drainage characteristics. These soils extended over 80 percent of the south mile. A 12-in sand-gravel subbase was placed on the earth grade, and the regular 6-in. gravel base was constructed there on. Then a 2-in. bituminous aggregate surfacing was placed on the new base

In this one 3-mi section of highway, eleven different types of soils were encountered ranging from muck and sand to imperfectly drained clays and wet loams. In the middle mile approximately 1,900 ft received an insulator course of 6-in. of sand-gravel as a subbase, and on the north mile the base depth was increased to 8 in. of gravel, thus obtaining a satisfactory standard. The new 22-ft blacktop on a 28-ft grade has gone through two spring break-up periods and no surface failures of any kind have been noted. This road is an important cross-county route, carrying light to moderate trucking and a variable vehicular traffic of 800 to 1,200 cars per day. Reasonable maintenance costs are anticipated for the 15-yr estimated life of the light bituminous aggregate surface.

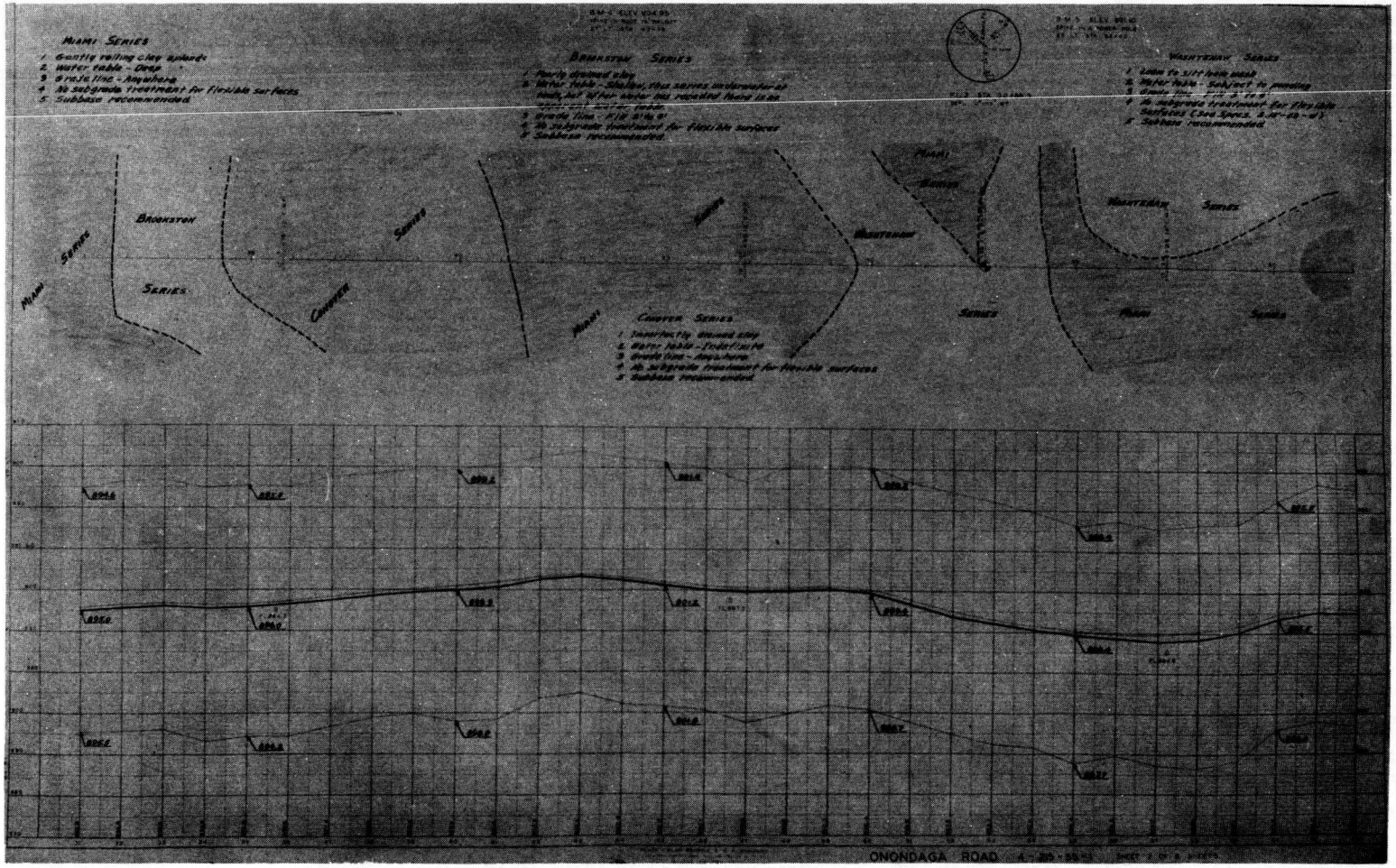

Figure 1. Use of soil map on county road plans, Ingham County, Michigan.

Figure 2. Typical muck excavation and backfill with selected material.

The county soils map and aerial photographs were used to make a survey and map on which are shown the various potential locations for sand and gravel deposits available in each of the 16 townships. Township maps were prepared to a scale of 1 in. equals 2,000 ft, and the limits of some four different mineral soils which produce sand and sand gravel for road work were outlined. The data from the county soils map was checked against the aerial photographs which clearly showed the well drained areas. The use of the aerial photographs also showed many old pits and locations which had not been worked in recent years. These complete records of the deposits are of great assistance in planning the road program and construction activities. In addition to these visual aids, the resistivity methods of soil survey are occasionally used—combined with actual borings in order to determine more accurately the amount of material available in certain deposits. The resistivity surveys are usually carried on by consultants.

As a result of using this approach during the past ten years (particularly since 1951 when the financial structure was materially improved)

real progress in providing the people with better roads at a lower cost is being made. Savings in surface repair costs are providing additional highway services, such as road signing, pavement marking, roadside mowing and brush control, and more extensive winter maintenance which results in a more satisfied tax-payer group.

In Michigan, in accordance with state law, counties must report annually to the people and the legislature as to the condition and adequacy

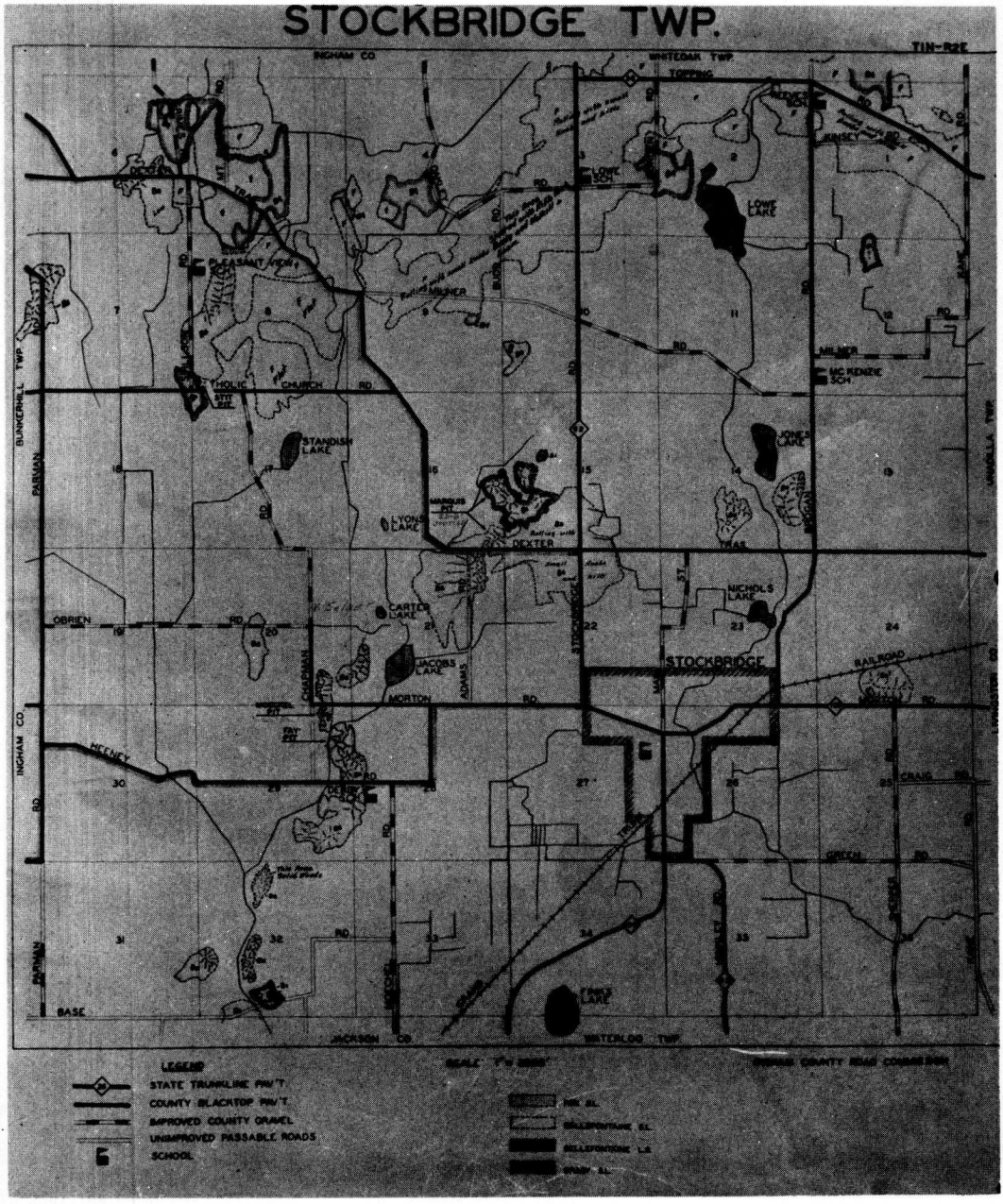

Figure 3. Use of soil map to locate gravel deposits.

of each mile of road. The Ingham County report for the year ending December 31, 1951 showed a county arterial system of 333 miles of which 30 percent was inadequate; and a county local road system of 785 miles of which 40 percent was inadequate. However, the county report of December 31, 1955 showed a county primary system of 362 miles with only 15 percent inadequate, and a county local road system of 793 miles with only 28 percent inadequate. A summary of costs for maintenance of road surfaces shows that over the 4-yr period from 1952 to 1956, during which time price indexes indicate that the cost of labor, materials and equipment has increased about 15 percent, the average per mile cost on routine surface maintenance has decreased as follows: (a) primary bituminous surfaces—1951 cost per mile $266.00, 1955 cost per mile $158.00; and (b) local road surfaces—1951 cost per mile $158.00, 1955 cost per mile $127.00.