

Cooperative Soil Mapping Projects in Indiana

ROBERT D. MILES, Research Engineer, Joint Highway Research Project, Purdue University; and W. T. SPENCER, Soils Engineer, State Highway Department of Indiana

The Soils Section of the State Highway Department of Indiana uses agricultural soil maps, surficial and bed-rock geology maps, aerial photographs, and published literature to assist in preliminary engineering studies of soil along a proposed highway. In cooperation with the Joint Highway Research Project, Purdue University, special soil strip maps have been prepared, several county engineering soil maps have been and are being compiled, and special publications on use of agricultural soil maps by soils engineers have been developed.

A cooperative project between these highway agencies, the Bureau of Public Roads of the U.S. Department of Commerce, and the Soil Conservation Service of the U.S. Department of Agriculture has been initiated to develop and compile data on agricultural soil profiles within the various counties. These data will be used in an engineering section of the agricultural soil survey report, and will be used as supplementary data to the engineering soils maps.

This paper is a discussion of the applicability of the strip maps and area soil maps to highway planning and the development of field exploration programs in Indiana. The methods of map presentation are discussed.

● THE Soils Section of the State Highway Department of Indiana, in making recommendations for the design of a proposed highway, bases its decision on the analysis of soils information obtained by indirect and direct methods of exploration. The direct methods of soil sampling and laboratory analysis are standard and need not be discussed. They furnish criteria on engineering soil types and physical properties on which design recommendations are based.

The indirect methods, whereby actual contact is not made with the soil, involves the use of (a) published agricultural soil survey reports, (b) aerial photography, or (c) combinations of the two with additional information obtained from geological publications and maps.

To assist the engineer in evaluating these data contained in the published reports and portrayed on aerial photographs, cooperative soil mapping projects were developed at Purdue University by the Joint Highway Research Project.

These cooperative projects evolved from an early attempt to use published Agricultural Soil Survey Reports. This study resulted in the publication of an engineering soils manual in January 1943, on "The Formation, Distribution, and Engineering Characteristics of Soils," Bulletin 87, Purdue University. This manual which discusses the variables of parent material, topography and agricultural soil profile development, is used in conjunction with aerial photographs to make preliminary engineering soils maps. These preliminary engineering soils maps may be prepared for entire counties or for individual highway sections in the form of strip soils maps.

A new cooperative soil mapping project was established in July 1960. This new project involves the development of an engineering section in the Agricultural Soil Survey

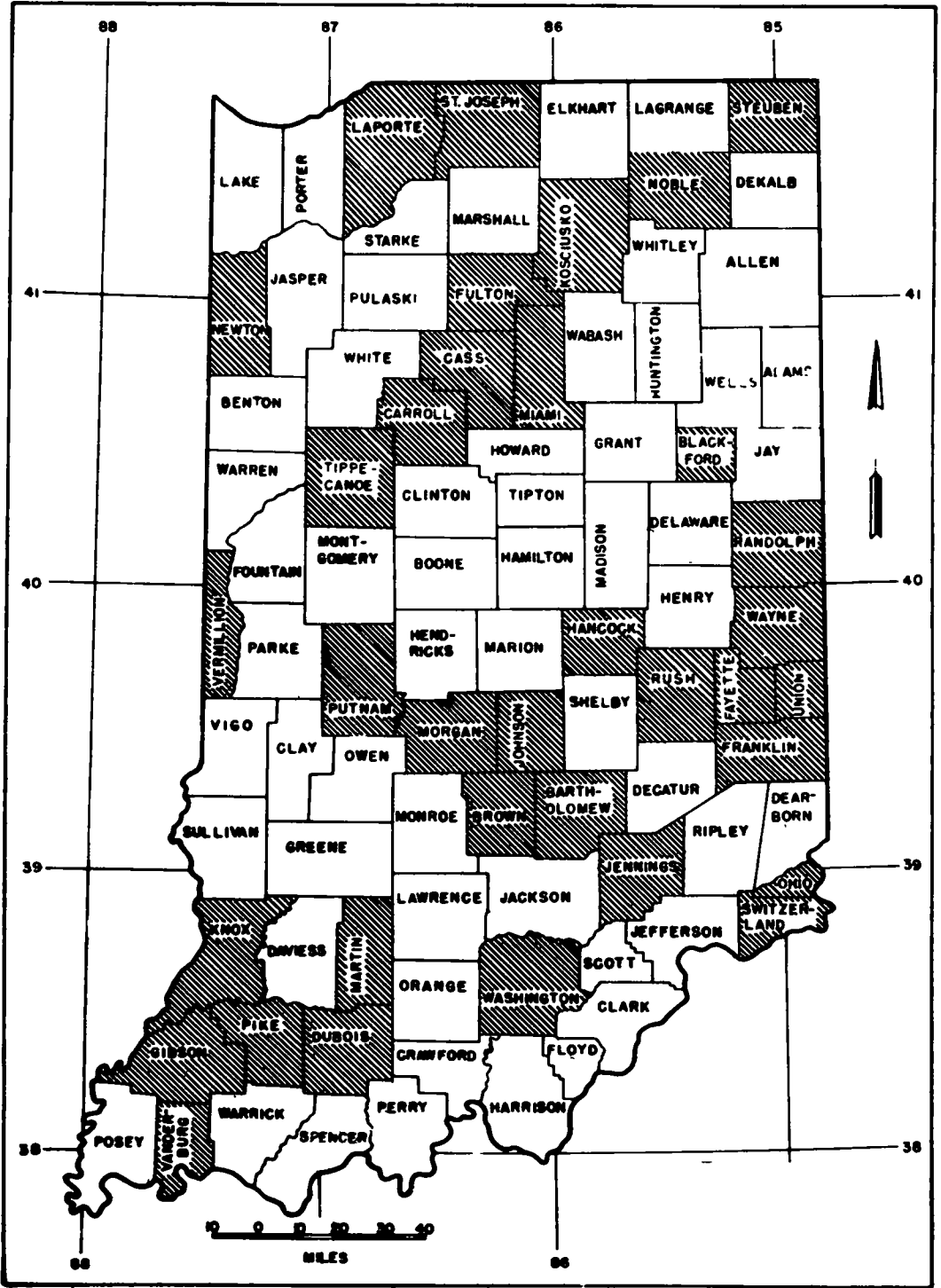


Figure 1. Agricultural soil surveys, 1925-1960.

Report. The cooperating agencies are the Bureau of Public Roads of the U.S. Department of Commerce, the Soil Conservation Service of the U.S. Department of Agriculture, the State Highway Department of Indiana, and the Joint Highway Research Project of Purdue University. The engineering section will be based on soil test data of the important pedological soils in a county.

It is the purpose of this paper to discuss the applicability of the various types of maps to highway engineering and the development of field exploration programs.

COUNTY AGRICULTURAL SOIL SURVEY REPORTS

County agricultural soil survey reports and maps prepared under the soils mapping program of the U.S. Department of Agriculture have been published in Indiana since about 1900. The early reports and maps developed prior to about 1925 are of little value to the engineer except as a reconnaissance-type soil survey. Current soil mapping techniques have shown that care must be exercised in evaluating the pedological soil types shown in these early reports.

The reports and maps published since about 1925 are suitable for interpretation into engineering terms and to locate engineering soil problem areas. The soil mapping scheme used presently by the Soil Conservation Service was essentially standardized about that time. Figure 1 shows those county soil surveys presently being used in preliminary soil studies for highway engineering purposes.

The interpretation of these maps and reports in Indiana is facilitated by the use of information published in the engineering soils manual on "The Formation, Distribution and Engineering Characteristics of Soils." This manual includes an engineering summary of 146 major pedological soil profiles as mapped in Indiana by the agricultural soil scientists. The soil profiles are correlated with engineering test data to include physical soil properties and highway performance data in relation to subgrade, embankment and foundation conditions. The pedological soil names as such are not used in Indiana highway mapping projects; however, they are used for evaluation and comparison of soil textural changes and profile development that might influence design.

The engineering soils manual published in January 1943 was prepared by personnel of the Joint Highway Research Project for the State Highway Department of Indiana. Although it contains only the pedological soil profile information that had been accumulated up to the year of publication, it continues to be of great value in assessing soils on even the most recently published soil survey reports. Numerous new soil series, types, and phases have been added by the Soil Conservation Service since the publication of the manual; therefore, it is necessary to correlate the new soil series and their parent material types with those published in the engineering soils manual. This may be done by reference to the report section of the agricultural soil survey and determining the slope and parent material class for the new soil series and comparing this with a similar series in the engineering soils manual. Valuable information may be obtained by reference to the tentative and adopted soil series descriptions that are published by the National Cooperative Soil Survey, U.S. Department of Agriculture.

To further enhance the value of the agricultural soil survey report to the engineer, an engineering section is needed to complement the information presented. To accomplish this, the Joint Highway Research Project, the Bureau of Public Roads, the Soil Conservation Service and the Indiana State Highway Department have entered into a cooperative agreement. The purpose of the project is to provide engineering test data on the important soil series that occur within a county. These engineering test data will assist in developing an engineering section to be included in all future agricultural soil survey reports.

The preparation of the engineering soils section as it is being developed in Indiana is primarily the responsibility of the agricultural engineer, Soil Conservation Service, with advice and review by the highway engineer. The soil samples of the major pedological soil series within a county will be collected by field personnel of the Soil Conservation Service. The samples with complete field notes including location on an aerial photograph will be forwarded to the Joint Highway Research Project for testing.

Engineering tests will be performed by the Joint Highway Research Project on all

soil samples from the various soil horizons. The data for the preparation of a table on physical constants will be supplied to the Bureau of Public Roads for transmittal to the Soil Conservation Service for inclusion in the report. The summary of the soil test data will include the pedological soil type, soil horizon sampled and depth, parent material type, soil textural description, mechanical analysis, liquid limit, plasticity index, AASHO standard density and optimum moisture content, CBR values, and both the AASHO and Unified soil classification. Appropriate explanatory notes will be included in the report section to explain the table and its use. A summary table to explain both the AASHO system of soil classification and the Unified system of soil classification will be included.

As a part of the engineering section of the agricultural soil survey report, information will be presented in tabular form on all the soil series and types mapped within the county. Estimates will be made of the physical properties or characteristics within the soil profile that may affect the design or the application of treatment measures for engineering structures. Qualitative or quantitative data will be presented on such items as: seasonally high water table; soil permeability; shrink-swell potential; susceptibility to frost action; erosion potential; internal and external drainage conditions; landslide potential; suitability of soil material as a pavement subgrade, road fill, source of topdressing, source of sand and/or gravel; and other soil data that may affect highway design and construction.

The new agricultural soil survey reports with engineering sections developed by the Soil Conservation Service will contain soil maps prepared on an airphoto base map. The engineering soil test data combined with the land-use information shown on the airphoto mosaics will make these maps and reports of inestimable value in preliminary studies of highways or any other civil engineering project.

As engineering test data is accumulated on the major pedological soil series in the State of Indiana, it is contemplated that a new engineering soils manual will be prepared to replace Bulletin 87 that is currently out-of-print. The general format of the previous engineering soil manual will be followed, but important new pedological soil series and test data will be included. A manual of this type will be of great value to all highway engineers.

COUNTY ENGINEERING SOIL MAPS AND REPORTS

County engineering soil maps and reports prepared by the use of aerial photographs have been developed for the Indiana State Highway Department by the Joint Highway Research Project. These maps serve a need in those counties for which agricultural soil surveys are not available. In some cases, the engineering soils map has been or is being prepared for a county that has an existing agricultural soil survey. In such cases both the soil survey and the aerial photographs are used to prepare the engineering soils map. This procedure is used in an attempt to expedite the development of the county engineering soils mapping program. It will be used extensively in conjunction with the new agricultural soil surveys that contain engineering test data. Figure 2 shows the 31 county engineering soils maps that have been completed as of December 1960. Four more are in various stages of completion. The present rate of production is about two per year.

An example of a published county engineering soils map is shown in Figure 3. Selective sampling of major soil profiles and parent material areas are conducted in conjunction with the mapping program. Laboratory soil tests are performed on these samples. A summary table of soil tests is presented as a part of the map. These data (reproduced as Table 1) show the range of engineering soil types that may be expected in the county; however, no attempt is made to sample in the quantity needed to develop pavement designs.

The standard system of line symbols used in the county engineering soils mapping program is shown in Figure 4. Persons familiar with this symbol system will recognize that it is an attempt to show parent material-landform conditions, topographic conditions, soil drainage conditions, and soil textural conditions of the parent material. Only line symbols are used, and problems naturally arise in such a mapping system.

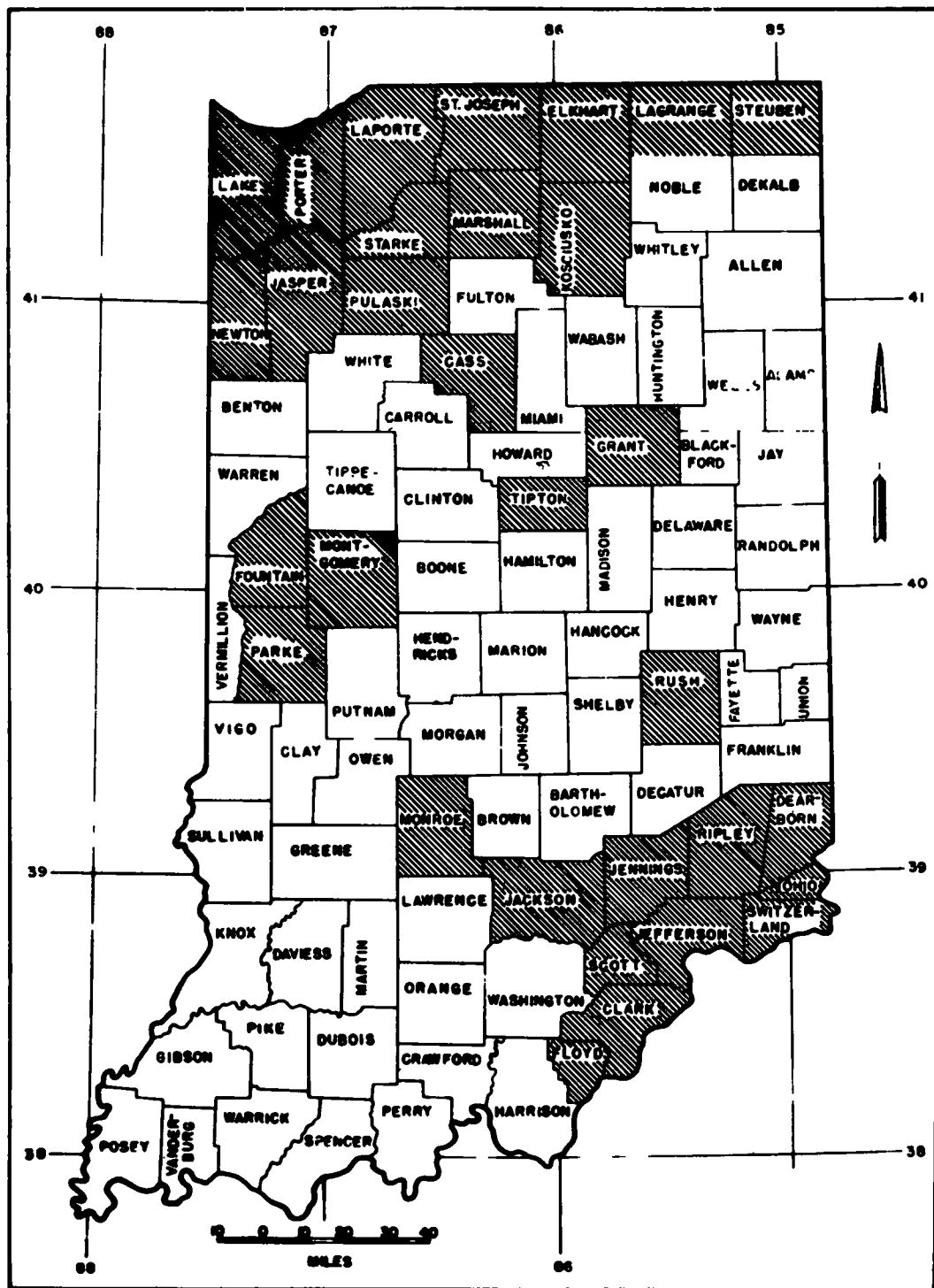


TABLE I

LABORATORY SOIL TEST DATA

SITE	HORIZON	DEPTH IN FT.	GRAIN SIZE DISTRIBUTION				LIQUID LIMIT	PLASTIC INDEX	LAB. COMPACTION (AASHTO T99)		C. B. R.	MOISTURE CONTENT OF C. B. R. TEST	UNIFIED CLASSIFICATION	AASHTO CLASSIFICATION
			GRAVEL % ON #10	COARSE SAND % #10 - #60	FINE SAND % #60 - #200	SILT & CLAY % LESS #200			O.M.C	MAX DRY WEIGHT				
1	B	1/2 - 2	3.7	9.6	11.9	74.8	29.1	12.1	14.8	112.6	4.6 ⁴	15.2	CL	A-6 (16)
	B	2 - 5	2.4	19.1	22.7	55.8	33.5	14.4	16.5	110.4	4.9 ⁴	14.3	CL	A-6 (6)
	C	5 -	5.1	19.3	23.2	52.4	27.9	10.7	12.7	117.9	6.7 ⁴	12.0	CL	A-6 (4)
2	B	1/2 - 3	1.5	6.6	7.3	84.6	36.8	19.9	16.6	109.5	10.0 ³	16.4	CL	A-6 (16)
	C	3 - 6	3.9	26.2	23.5	46.4	23.0	8.0	12.5	118.2	8.9 ⁴	11.9	SC	A-4 (2)
3	B	1/2 - 1 1/2	11.4	11.5	14.7	62.4	44.7	26.6	19.1	107.0	3.4 ⁴	20.2	CL	A-7-6 (7)
	C	4 - 6	3.0	24.4	37.9	34.7	NP	NP	8.6	130.0	13.6 ³	9.8	SM	A-2-4
4	B	1/2 - 3	11.5	36.7	29.1	22.7	25.7	12.8	15.0	114.9			SC	A-2-6
	C	3 - 6	41.6	51.7	5.5	1.2	NP	NP	1.8	124.6	37.5 ²	0.84	SP	A-1-b
5	C	2 1/2 - 3 1/2	6.9	24.4	37.9	40.5	18.8	5.2	10.9	124.0			SM-SC	A-4 (1)
6	B	1 1/2 - 2 1/2	9.2	35.0	28.4	27.4	30.4	11.6	12.3	119.0	15.0 ³	12.6	SC	A-2-6
	C	2 1/2 - 3 1/2	34.0	47.4	7.7	10.9	NP	NP	9.0	144.8	21.2 ²	7.6	SW-SM	A-1-b
7	B	1 1/2 - 2 1/2	5.2	20.6	31.6	42.6	19.2	6.9	11.2	125.6	7.1 ²	11.8	SM-SC	A-4 (2)
	C	2 1/2 - 3 1/2	62.6	27.3	6.7	3.4	NP	NP	12.0	119.2	55.0 ³	11.2	GP	A-1-a
8	B	1 1/2 - 2 1/2	0.6	27.3	48.4	23.7	18.4	3.2	12.0	119.2	12.0 ³	12.5	SM	A-2-4
	C	2 1/2 - 3 1/2	4.5	17.5	19.4	58.6	27.5	13.9	13.2	117.0			CL	A-6 (7)
9	B	1 1/2 - 2 1/2	4.8	19.0	33.1	43.1	25.3	8.5	14.7	117.2	5.1 ⁸	14.0	SC	A-4 (2)

	J	2 1/2 - 3 1/2	2.0	20.1	27.0	49.0	18.3	6.0	9.7	129.0	7.6 ³	9.7	SM-SC	A-4(3)
10	B	1 1/2 - 2 1/2	4.8	14.6	25.6	55.0	27.4	10.3	16.0	112.2	3.4 ⁴	18.9	CL	A-4(4)
	C	2 1/2 - 3 1/2	6.7	16.1	28.2	49.0	25.6	12.1	12.0	124.0	7.5 ⁵	13.0	SC	A-6(3)
11	B	1 1/2 - 2 1/2	1.4	24.5	44.7	29.4	NP	NP	10.2	119.6	20.0 ¹	9.4	SM	A-2-4
	C	2 1/2 - 3 1/2	0	35.2	57.8	7.0	NP	NP	11.0	114.0	21.8 ³	11.5	SP-SM	A-3
12	B	2 - 4	9.4	19.5	24.9	46.2	23.6	5.8	12.3	118.4	9.8 ⁴	12.2	SM-SC	A-4(2)
	C	6	9.2	27.1	27.3	36.4	15.2	3.0	8.6	126.1	4.8 ⁴	9.7	SM	A-4
13	B	1 1/2	25.4	38.9	17.1	18.6	24.9	11.3	13.6	122.1	8.8 ³	13.2	SC	A-2-6
	C	1 1/2 - 3	53.2	35.5	5.6	5.7	NP	NP	9.6	131.0	24.8	9.0	GW-GM	A-1-0
14	B	1 1/2 - 4	0	28.1	58.4	13.5	NP	NP	10.1	113.3	26.6 ¹	9.2	SM	A-2-4
	C	4 - 6	0	29.5	62.8	7.7	NP	NP	11.2	115.2	37.4 ³	10.6	SP-SM	A-3
15	B	1 1/2 - 3	25.4	22.1	21.8	30.7	32.4	16.5	14.8	113.2			SC	A-2-6(1)
	C	4 - 6	31.8	47.2	12.8	8.2	NP	NP	12.1	122.2	8.0 ⁴	11.5	SW-SM	A-3
16	B	2 - 4	6.1	17.7	30.4	45.8	26.4	13.1	12.4	115.1	8.6 ⁴	12.8	SC	A-6(3)
	C	4 - 6	5.5	17.0	28.6	48.9	15.7	2.0	8.5	128.2	22.4 ²	8.5	SM	A-4(3)
17	B	1 - 7	1.1	21.2	47.3	30.4	NP	NP	8.6	114.0	6.2 ³	8.7	SM	A-2-4
	C	7 - 10	6.4	18.3	29.2	46.1	22.6	7.6	13.0	116.4	10.5 ³	11.6	SC	A-4(2)
18	B	1 - 3	2.2	22.7	48.9	26.2	21.9	7.5	12.2	119.7	5.3 ⁴	11.7	SC	A-2-4
	C	4 - 6	6.4	23.5	37.1	32.0	NP	NP	8.5	129.0	17.3 ³	8.6	SM	A-2-4

G.B.R. NOTATION

- ¹ WITH SURCHARGE OF 10 LBS
- ² WITH SURCHARGE OF 15 LBS.
- ³ WITH SURCHARGE OF 20 LBS
- ⁴ WITH SURCHARGE OF 25 LBS
- ⁵ WITH SURCHARGE OF 30 LBS.

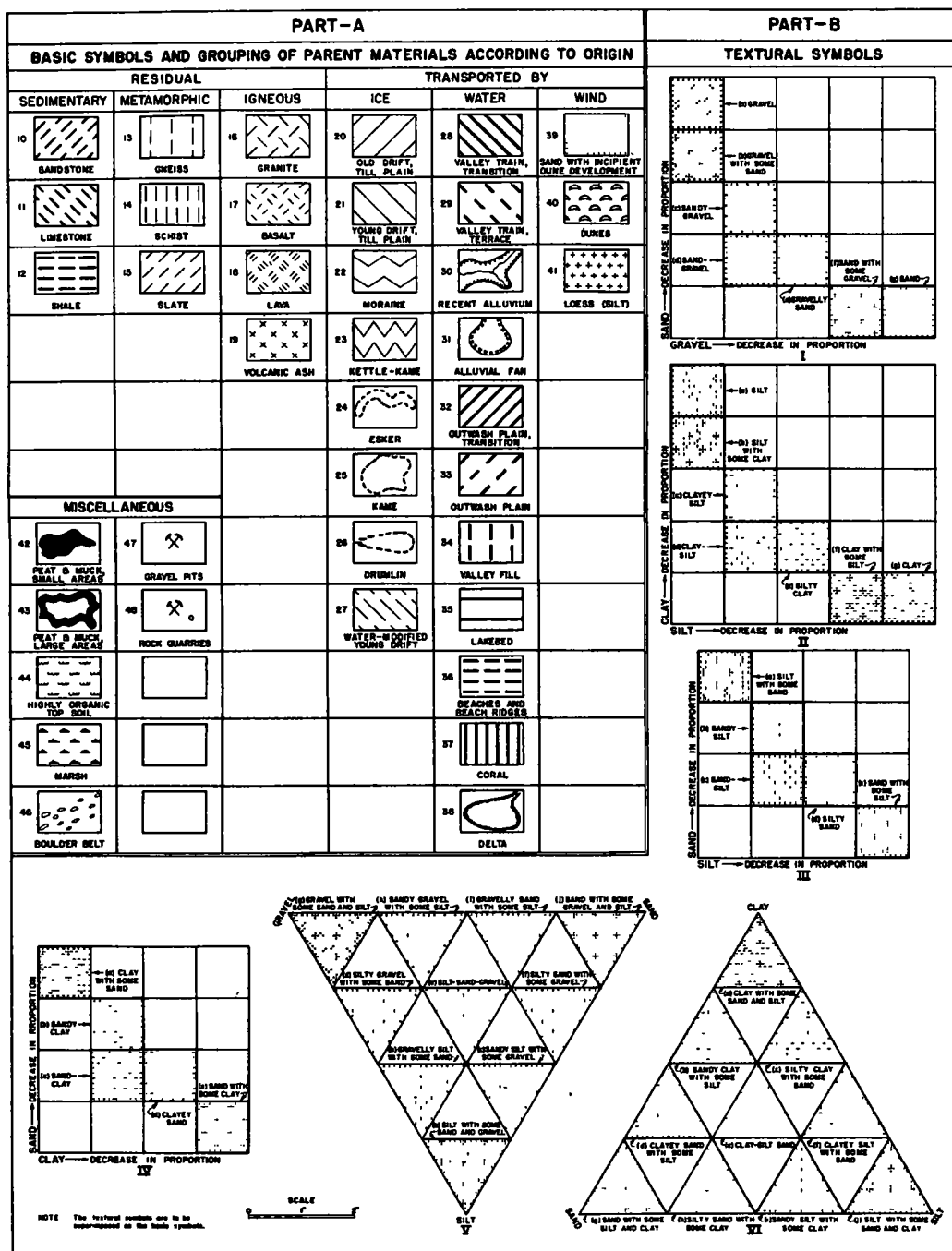


Figure 4. System of symbols for engineering soil-materials mapping.

HIGHWAY SOIL STRIP MAPS

The Joint Highway Research Project has prepared special soil strip maps from aerial photographs. The purpose of these maps was to provide the Soils Section of the State

Highway Department of Indiana with advanced information on soil types and drainage conditions along proposed routes. The maps serve as a guide for the planning of any detailed investigation that may appear advisable.

Two types of strip maps have been prepared. One type is a line drawing showing the distribution of engineering soil materials as inferred, using aerial photographs.

PARENT MATERIAL		NATURE OF PROFILE	SLOPE		CLASSIFICATION		RECENT ALLUVIAL SOILS AND SPECIALS
			S	L	O	P	
AREA	CLASS		55% 10%	16% 4%	4% 0%	DEPRESSIONS	
WISCONSIN DRIFT	I	SILTY-CLAYS	MIAMI KENNEBETH	MIAMI PARR RUSSELL CARRINGTON	CORWIN DANA	BROOKSTON CLYDE	GENESSEE EEL WAYLAND
	II	POROUS SUBSTRATA (SANDS AND GRAVELS)	BELLEFONTAINE ROOMAN	BELLEFONTAINE	DELPHI HARTMAN WAUKESHA MILL CREEK TRACY WEA	PAULDING	GENESSEE EEL WAYLAND
	III	SANDS	PLAINFIELD BRIDGEMAN	PLAINFIELD COLONA HILLSDALE METEER ALLEDALE	PLAINFIELD CALUMET OSHTENO BUCKNER METEER ALLEDALE	NEWTON MAINE DILLON DE NOTTE	GENESSEE EEL WAYLAND
	IV	SHALLOW SOILS ON BEDROCK	FARMINGTON LORDSTOWN	FARMINGTON LORDSTOWN SULTON	MILTON HARTMAN	RANDOLPH	GENESSEE EEL WAYLAND
LACUSTRINE	I	DERIVED FROM WISCONSIN DRIFT		LUCAS	LUCAS	FULTON	TOLEDO BOND
	II	DERIVED FROM ILLINOIAN DRIFT (SILT AND SILTY-CLAY)	BARBRIDGE	BARBRIDGE OTWELL	HAUBSTADT ELKINSVILLE PEKIN WHEELING MARKLAND ELK BUCKNER	DUBOIS ROBINSON BARTLE PEOGA ZIPP MONTGOMERY SHARREY VINCENNES	HUNTINGTON LINDSIDE POPE FIELD AITKINS STERDAL
ILLINOIAN TILL	III	SILTS AND SILTY-CLAYS	PARKE	CINCINNATI GISSON PARKE	GIBSON ROSSMOYNE PARKE	ROSSMOYNE AYONBURG CORY	BLANCHESTER
	IV	SHALLOW SOILS ON BEDROCK		BRADFORD JENNINGS	CANA WHITCOMB		
WINDBLOWN AND LOESS-LIKE	V	SANDS		PRINCETON OAKTOWN	ELKINSVILLE		STABER
	VI	SILTS	PIKE	PIKE PRINCETON ALFORD HOSMER	PIKE KORA BURER KASSON	OWENSVILLE AYRESHIRE IVA COE	STABER
RESIDUAL	VII	LIMESTONES	CORYDON	ORLEANS FREDERICK HAGERSTOWN BLOOMINGTON	BEDFORD LAWRENCE	GUTHRIE	HUNTINGTON
	VIII	STRATIFIED LIMESTONES AND SHALES	FAIRMOUNT	SWITZERLAND	ALLENSVILLE LAWRENCE	GUTHRIE	
	IX	SANDSTONES AND SHALES	MUSKINGUM	ZANESVILLE WELLSTON	TILSIT	LICKDALE	STERDAL

† LESS GRANULAR PARENT MATERIAL THAN OTHER SOILS IN BOX.
NOTE:—SEE INDIVIDUAL PLATES FOR DETAILED SOIL PROFILES.

Figure 5. Pedological soils and their relationship to parent materials and topography.

Typical soil profiles as shown in Figure 5 and as obtained from the engineering soils manual previously mentioned, provide a guide to the three-dimensional development of soils within the region mapped. The profiles are intended to indicate either uniform soil development where extensive sampling is not required, complex soil development that requires detailed field sampling and the probable depth of organic soils that may require removal. An example of this type of map for use in preliminary surveys is illustrated in Figure 6. The maps are prepared at a scale of 3 in. = 1 mi or larger. They are prepared by direct tracing of the aerial photographs, and are symbolized in the standard manner as used by the Joint Highway Research Project (Fig. 4).

The second type of strip map that has been prepared consists of a plan showing soil borders with the actual aerial photographs serving as the base map. It is produced by photographic reproduction of annotated aerial photographs. It may be prepared at the scale of the photographs or it may be enlarged two to four diameters. A difficulty that has been encountered in the enlarging process has been that the smooth borders drawn

on the aerial photographs are irregular and much larger than needed on enlargement (Fig. 7).

The soil strip map prepared with the aerial photographic base is much preferred over the line drawing. It should be prepared at the largest scale possible, and if en-

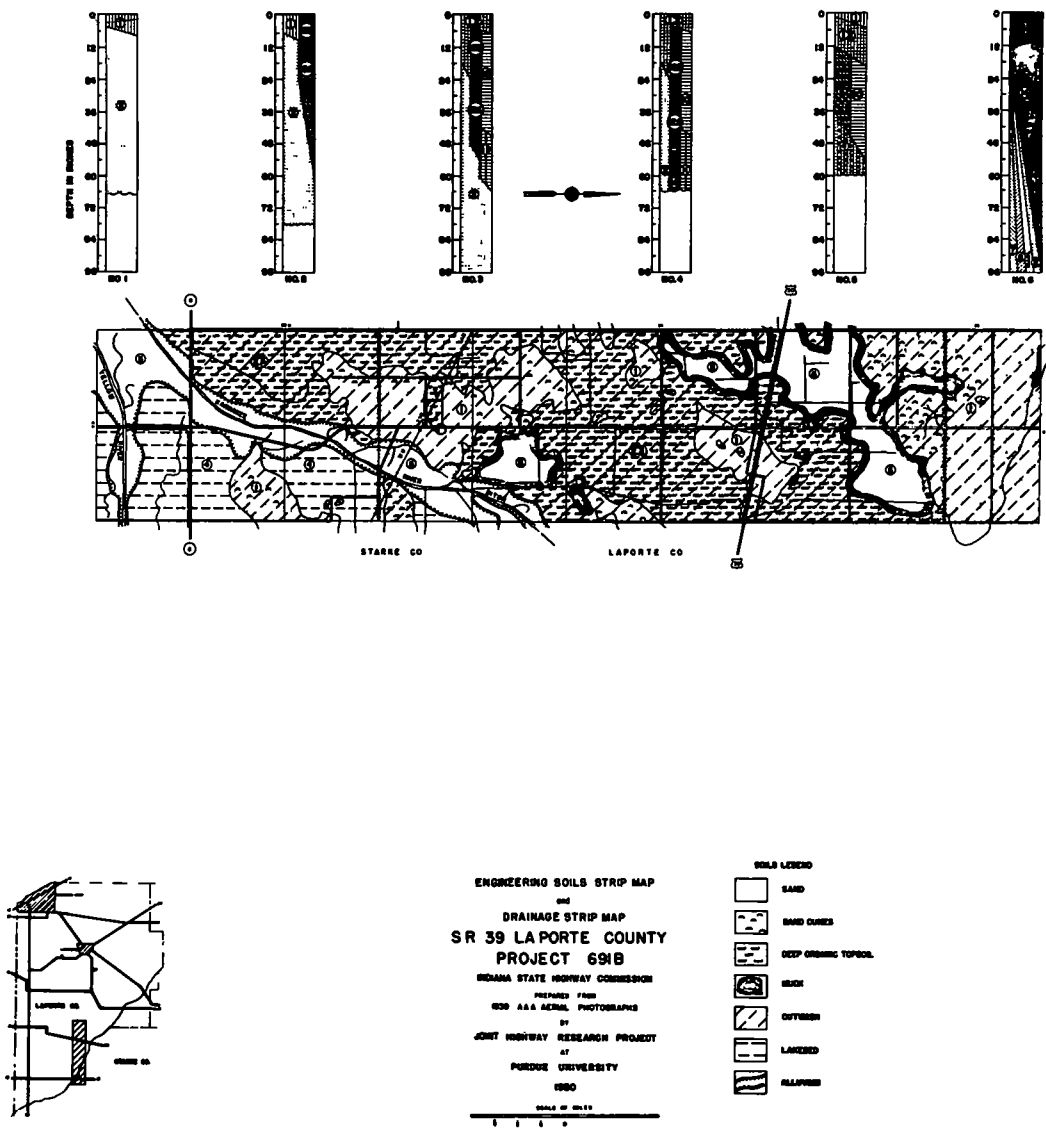


Figure 6. Engineering soils strip map prepared from aerial photographs by direct tracing.

largement is desired, the aerial photographic stereopairs should be enlarged prior to annotation. A written report should accompany each map, or the qualitative description of the soils may be typed and attached to the photo base so that it will reproduce as a part of the strip map.

The soil strip maps shown in Figures 6 and 7 illustrate primarily a region of glacial-fluvial outwash plains with low sand dunes and broad muck basins. The regional extent of the soil materials can be readily outlined on the airphotos, and good correla-

tion can be obtained with typical engineering soil profiles contained in the engineering soils manual on the basis of topographic position and photo tonality. A field inspection of the project by the soils section confirmed the accuracy of the information supplied by the written report and the strip maps. Since the low, flat terrain dictated a high level profile and deep special side ditches, the only problem that needed special attention was limited to the profiling of the muck and organic sand deposits. The organic sands were found not to be objectionable, but the removal of the muck areas was incor-



AIRPHOTO MOSAIC
NORTHERN SECTION
S.R. 39
LAPORTE COUNTY

Scale 1" = 3 mi

→ N

Figure 7. Engineering soils strip map prepared by photographic reproduction.

porated in the construction project. The limits of removal were defined by field surveys.

Figure 8 illustrates an engineering soils strip map along two highway sections that were programmed for reconstruction. The soils strip map was made from aerial photographs, and a soil survey was conducted in the field to verify the accuracy of the map. The field survey also served to define the limits of the peat and organic deposits so that the soils section could determine the type and extent of treatment required.

The engineering soils strip map shows symbolically that the area consists of a sand plain, scattered sand dunes, an organic sand plain underlain with sand, and muck depressions and channels. The soil profiles illustrated were taken directly from the engineering soils manual by reference to Figure 5, using topography and parent materials as the variables in the airphoto study. It was expected that the sand deposits would be classified as either A-3 or A-2. The organic deposits were expected to be of variable depth with some exceeding 8 ft.

The field inspection confirmed the accuracy of the map and report, and verified its use as a source of information in preliminary studies. Only limited testing seemed advisable. Table 2 is a summary of the tests performed on field samples secured along the alignment of State Road 10.

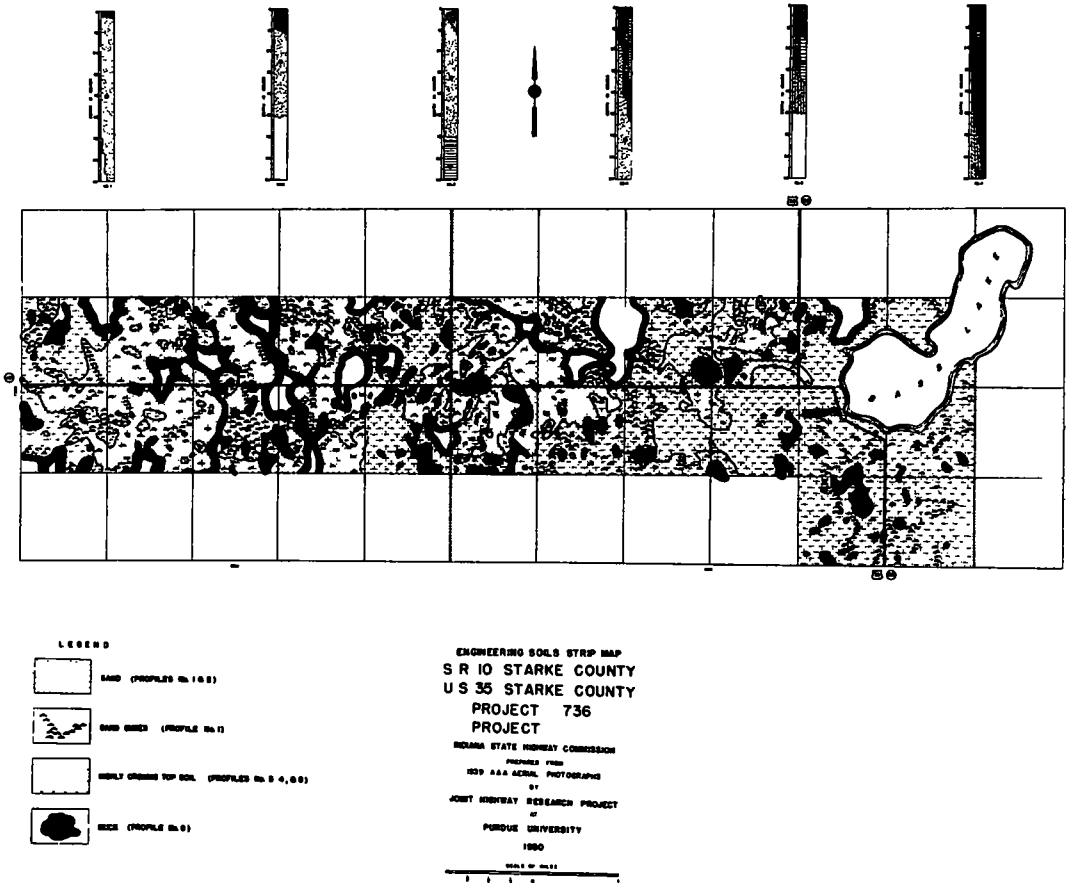


Figure 8. Engineering soils strip map along two highway sections programmed for reconstruction.

TABLE 2
 SUMMARY OF SOIL TESTS, SR 10

Test Location Sta. Offset	Depth (ft)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL	PI	Loss on Ignition (%)	Texture	Laboratory Classification
380 10' Rt	0.0- 1.5	2	85	7	6	22	3	5	Sand	A-2 (0)
405 15' Rt	0.0- 4.5	0	94	4	2	19	NP	-	Sand	A-3 (0)
411 45' Rt	0.0- 2.6	0	79	-	21	97	2	40	Org. sandy loam	A-8 (Peat)
467 5' Rt	0.0- 7.7	0	71	-	29	99	8	73	Org. sandy loam	A-8 (Peat)
561 15' Rt	0.0- 4.0	0	91	5	4	17	NP	-	Sand	A-3 (0)
580 30' Rt	0.0- 0.7	0	83	12	5	33	2	7	Sand	A-2 (0)
635 10' Lt	9.5-11.8	-	-	-	-	48	8	6	Marl	Marl
636 11' Lt	1.5- 4.5	-	-	-	-	83	3	35	Peat	A-8 (Peat)
	4.5-13.0	-	-	-	-	62	NP	32	Peat	A-8 (Peat)
636 40' Lt	0.0- 2.8	-	-	-	-	155	12	67	Peat	A-8 (Peat)
	2.8-10.8	-	-	-	-	172	9	77	Peat	A-8 (Peat)
723 25' Lt	0.0- 2.0	0	87	6	7	19	2	3	Sand	A-2 (0)
730 26' Rt	1.2- 3.0	0	85	4	11	17	1	-	Sand	A-2 (0)

Information obtained from the airphoto study and, of course, from the field study dictated a high level grade line with a deep side ditch. Construction of the project con-

firmed the accuracy of the information obtained from the written report, strip maps, and field soil survey.

SUMMARY

The cooperative soil mapping projects discussed are valuable in preliminary studies. The agricultural soil survey maps properly evaluated, the county engineering soils map, and the individual engineering soil strip maps with typical soil profiles are highly adaptable to highway planning, design and construction. The consistency or variability of soils to be encountered in cuts can be determined for establishing the pavement grades and types of treatment to be used. Locations of possible sources of granular materials for project uses can be indicated. Areas for special borrow, where materials are needed for embankment construction and not available within the right-of-way, can be selected.

The system of soil mapping symbols is suitable for uniform mapping practices of counties and small-scale strip maps. Even these symbols require "interpretation," and typical soil profiles are needed to complete the soils information. The soil profiles as contained in the engineering soils manual for Indiana are suitable for preliminary studies.

The ideal soil strip map should be prepared by using large-scale aerial photographs or enlargements as the base map with annotations to show soil areas and soil profiles. To determine the applicability of this type of map, it is anticipated that a cooperative soil strip mapping project will be developed using contact prints at a scale of 200 ft per inch and enlargements at 50 ft per inch. This scale should provide the detail for a master soil plan along proposed routes.