UNIVERSITY OF ILLINOIS

COLLEGE OF ENGINEERING

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BULLETIN 502

RECOMMENDATIONS FOR STABILIZATION OF ILLINOIS SOILS

by

Q. L. Robnett

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ABSTRACT

THIS REPORT PRESENTS RECOMMENDATIONS CONCERNING THE FEASIBILITY OF STABILIZING ILLINOIS SOILS AND MATERIALS FOR HIGHWAY USES WITH COMMON STABILIZING AGENTS (CEMENT, LIME, LIME-FLY ASH, BITUMEN, AND COMBINATIONS). PEDOLOGICAL SOIL MAPPING AND CLASSIFICATION CONCEPTS AND THE DISTRIBUTION AND NATURE OF SURFICIAL SOILS OF ILLINOIS ARE DISCUSSED. VARIOUS ASPECTS OF STABILIZATION TECHNOLOGY (OBJECTIVES OF STABILIZATION, TYPES, NATURE, AND TYPICAL CONTENT REQUIREMENTS OF STABILIZING AGENTS, AND CONSTRUCTION CONSIDERATIONS) ARE DISCUSSED AND PREVIOUSLY DEVELOPED STABILIZATION GUIDELINES AND CRITERIA ARE PRESENTED. THE PROCEDURE USED TO DEVELOP STABILIZER FEASIBILITY RATINGS FOR A SPECIFIC SOIL SERIES IS DESCRIBED.

STABILIZATION RECOMMENDATIONS ARE PRESENTED IN A TABULAR FORM FOR THE MAJOR SOIL SERIES OCCURRING IN ILLINOIS. IN ALL, FEASIBILITY RATINGS ARE PRESENTED FOR 77 PERCENT, AREAWISE, OF THE SURFICIAL DEPOSITS OF ILLINOIS.

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I. INTRODUCTION

There is an increasing demand for quality paving materials at all levels of the highway system (local, state, federal). These quality materials must economically provide desirable strength and durability characteristics. In certain areas of Illinois, quality natural materials meeting these requirements are not locally available and must be transported long distances at considerable cost. It is apparent that from the economic standpoint, it is desirable to utilize locally available materials to the greatest extent possible. In many instances, to obtain quality paving materials, the local materials must be modified by appropriate methods.

REPORT OBJECTIVE AND ORGANIZATION

The objective of this report is to present stabilization recommendations concerning the feasibility of stabilizing Illinois soils and materials for use in highway pavement construction.

The report objectives and organization are presented in Chapter 1. Chapter 2 contains a brief discussion of soil mapping concepts and terminology and a general discussion of the distribution and nature of surficial deposits in Illinois. Chapter 3 is devoted to a discussion of the various aspects of stabilization technology. In Chapter 4, the stabilization guidelines and criteria which were developed in another report (1)* are presented. Chapter 5 covers the development of the stabilization recommendations.

Appendix A contains a brief discussion of each of the 26 soil association areas in Illinois, a table which summarizes the nature and properties of the major soil series in each association area, and a table that presents the stabilization recommendations for the major soils that occur in each association area. A table of contents for Appendix A and an alphabetical index to the major soils included in this report are included at the beginning of Appendix A.

Appendix B contains a brief discussion of the major textural groups of Wisconsinan glacial till found in northeastern Illinois and stabilization recommendations for each.

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*Superscript numbers in parentheses refer to entries in References, Chapter VII.

II. SURFICIAL SOILS IN ILLINOIS

In order to utilize local and on-site highway construction materials to the greatest extent possible, an examination and inventory of the nature and areal distribution of the surficial materials of Illinois is required. Personnel of the Soil Conservation Service, United States Department of Agriculture, and the Department of Agronomy, University of Illinois, Urbana-Champaign, have done extensive work in the area of classification and mapping of the surficial soils in Illinois. Although much of their interpretative work is intended for use by people who are interested in agriculture, the criteria used to classify and map surficial soils are based on chemical and physical soil properties which are highly significant with respect to soil stabilization. Appropriate interpretation of soil maps, reports, and other information available from the Soil Conservation Service, the Department of Agronomy, and other sources can thus provide valuable information which will facilitate the establishment of stabilization of recommendations for the surficial materials of Illinois.

To more fully understand the basis of soil classification, soil mapping, and other available information, it is necessary to understand a number of basic pedologic concepts and terminology.

SOIL MAPPING CONCEPTS AND TERMINOLOGY

Pedology is the science which studies the nature, properties, formation, and behavior of the soils on the earth's surface. The classification system used by the pedologists is based on the premise that a soil's structure, form, and properties are controlled by the extent of chemical and physical weathering. A number of important environmental factors have been found to control the degree of weathering and thus the soil which develops.

Soil Forming Factors

Five factors which soil scientists recognize as being responsible for soil formation are:

(1) parent material
(2) relief
(3) native vegetation
(4) age
(5) climate

(a) Parent Material

Parent material constitutes the starting point in the soil genesis process. However, the relative influence of parent material diminishes as the amount of weathering increases. A number of parent materials are recognized in Illinois--loess, glacial till and outwash, alluvium, organic deposits, and bedrock residuum.

(b) Relief

Relief determines, for the most part, the position of the water table and the percentage of precipitation which enters and passes through a soil of a given texture. For example, more water will percolate downward through gently sloping medium-to fine-textured soils than will percolate through steeply sloping soils of the same texture. With the steeply sloping soils, a major part of the precipitation runs off carrying soil material with it which collects on the level and depressional soils or enters drainage ways. As the amount of water that percolates through a soil increases, the degree of soil weathering increases. Figure 1 illustrates the influence of relief on the internal drainage and water table level.

(c) Vegetation

Native vegetation determines to a large extent, the nature, amount, and distribution of organic matter in a soil. For the soils developed in Illinois, deciduous hardwood forests and prairie grasses have been the predominant types of vegetation. Soils developed under forest vegetation generally have a moderately low organic matter content confined to the upper few inches of the soil, Figure 2. Soils developed under prairie grass vegetation generally have a rather high organic matter content and substantial

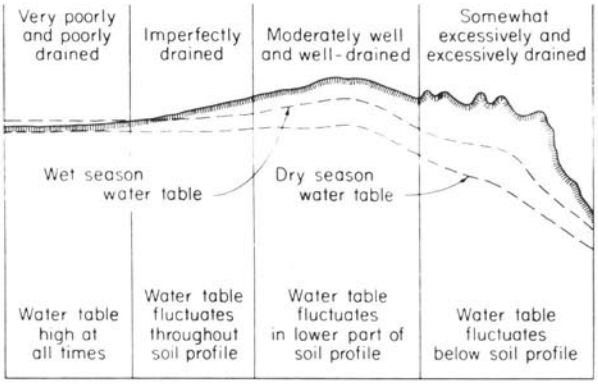


FIGURE 1. INFLUENCE OF RELIEF ON THE INTERNAL DRAINAGE, PRECIPITATION RUNOFF, AND WATER TABLE LEVEL (REDRAWN FROM REFERENCE 25).

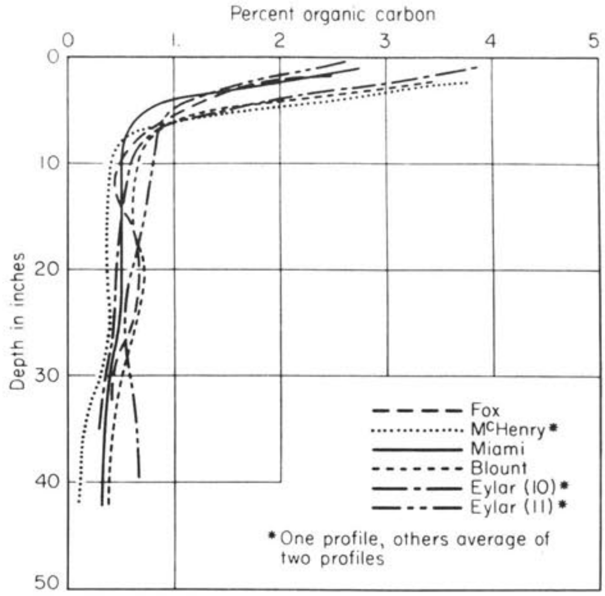


FIGURE 2. TYPICAL DISTRIBUTION OF ORGANIC CARBON WITH DEPTH IN A SOIL PROFILE DEVELOPED UNDER FOREST VEGETATION (REDRAWN FROM REFERENCE 4).

quantities of organic matter may be present in the soil profile to depths of 2 to 3 feet, Figure 3.

(d) Age

As the weathering processes continue, the influence of parent material becomes over-shadowed by other environmental factors. Distinct soil characteristics develop as the length of time to which various parent materials of Illinois have been exposed to weathering increases. The following is a list of parent materials of Illinois and their approximate ages.

Parent Material	Approximate Age (2), (3)
Alluvium	< 5,000 years
Loess (Peorian)	11,000-22,000
Wisconsinan till and outwash	13,000-60,000
Illinoian drift	225,000-330,000
Bedrock residuum	Varies

(e) Climate

The climate in which a soil develops has a great influence upon the rate and degree of weathering. The rate at which chemical and physical weathering takes place is related to the amount of moisture available, and the magnitude of temperatures and temperature variations. On a macroscopic scale, there is not a marked difference in climate amongst various areas of Illinois. Thus, climate has had a very limited influence on the soils developed in Illinois.

The Soil Profile

Weathering of a parent material brought about by various chemical and physical forces of the environment is most effective at the surface. The

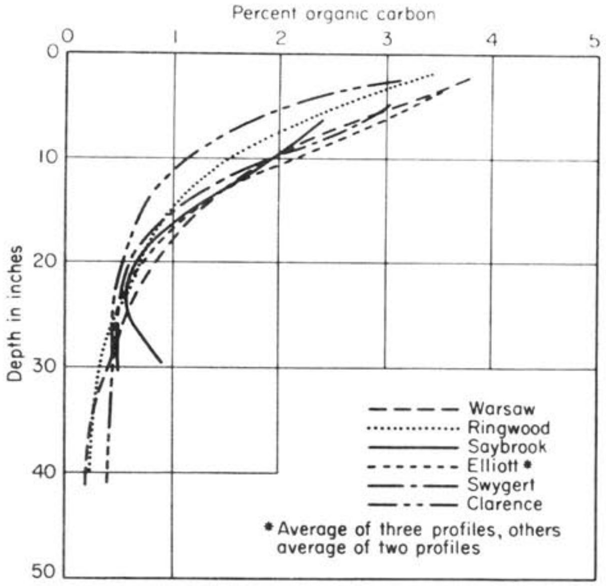


FIGURE 3. TYPICAL DISTRIBUTION OF ORGANIC CARBON WITH DEPTH IN A SOIL PROFILE DEVELOPED UNDER PRAIRIE GRASS VEGETATION (REDRAWN FROM REFERENCE 4).

relative degree of weathering decreases with increasing depth. Various layers or horizons are thus developed in a parent material as soil development progresses. These layers reflect different stages of alteration. A soil profile is a vertical cross-section which slices through the various horizons or layers.

(a) Horizons

In a typical soil profile, illustrated in Figure 4, three major horizons are recognized. The A horizon is the uppermost horizon and is the most weathered horizon in the profile. It is characteristically quite high in organic matter as evidenced by its typical dark brown to black color. The B horizon is located directly below the A horizon and is less weathered than A horizon. Materials (colloids and minerals) are leached from the A horizon and deposited in the B horizon. Thus, the clay content of the B horizon is generally greater than the A. However, the organic carbon content of the B horizon is more typically less than that of the A horizon. The color of the B horizon is typically a brownish color with reddish, yellowish, olive, and grayish shades predominant.

The C horizon is the layer where relatively unweathered parent material is encountered. Some slight alteration may have taken place, but from the engineering standpoint, the soil is not substantially different than the unweathered parent material.

Beneath the C horizon, a stratum of rock or layers of soil different than the parent material from which the

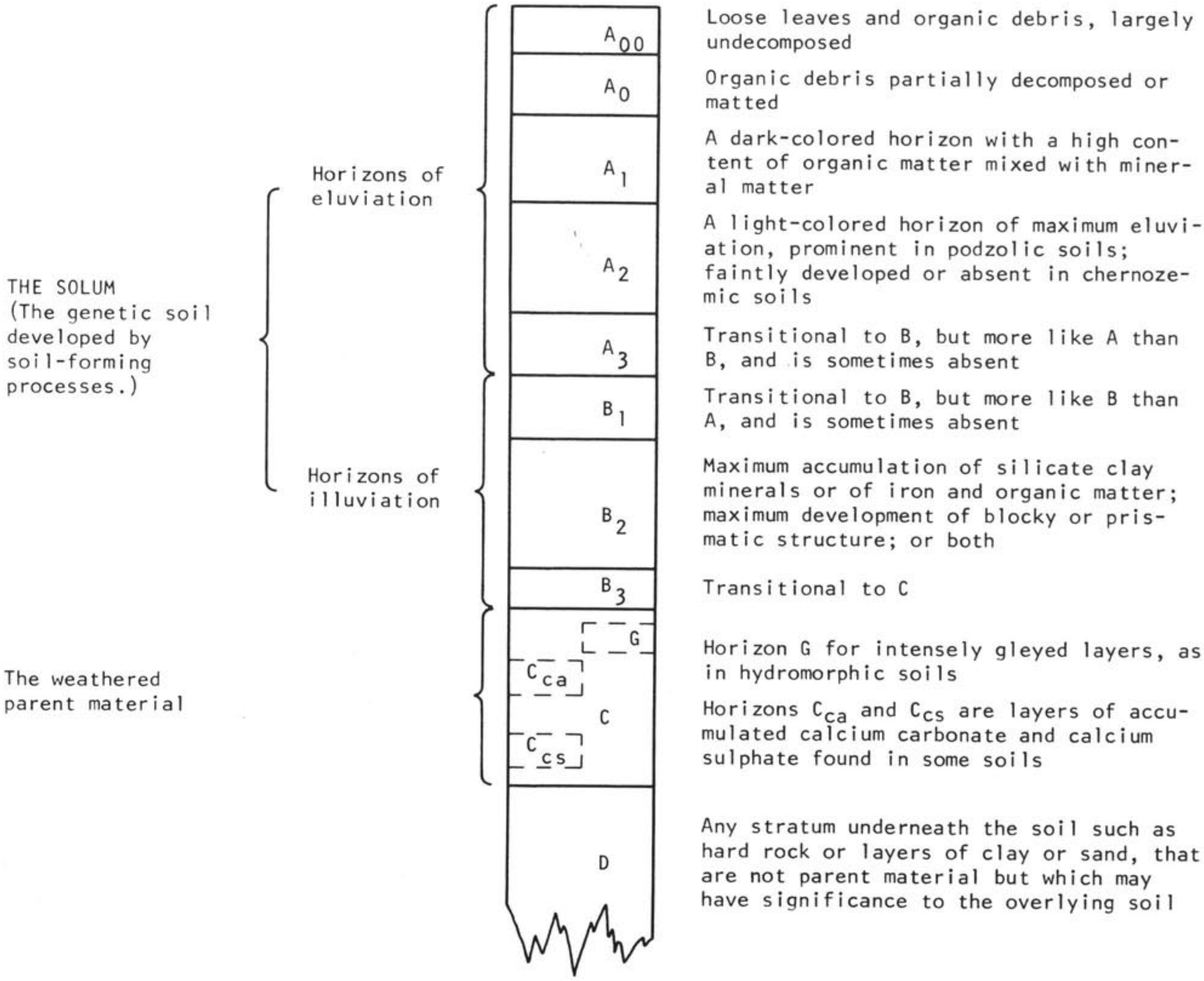


FIGURE 4. A TYPICAL PEDOLOGIC SOIL PROFILE SHOWING THE MAJOR HORIZONS (REDRAWN FROM REFERENCE 3).

soil has developed may be present. The nomenclature for describing this underlying material varies from agency to agency.

(b) Solum

The upper part of the soil profile consisting of the A and B horizons is the true soil which has been developed by the various soil forming processes and is often referred to as the solum.

Soil Classification and Mapping

The five soil forming factors are responsible for the soil which is developed. The relative degree of influence of each factor on soil development, however, depends upon the particular environment in which the soil has been exposed.

There are a number of profile characteristics which are a result of the soil forming factors and are commonly used by the pedologist to describe a soil profile:

(1) number, thickness, and relative arrangement of horizons in the profile
(2) organic matter content, usually reflected in the color of the horizon
(3) drainage class, as influenced by slope, permeability, and position of water table
(4) texture and structure of horizons
(5) chemical and mineralogical composition
(6) concretions and other special formations
(7) vegetation
(8) geology of the parent material

(a) Soil Type

Soil profiles which are similar with regard to all of the above characteristics, are grouped together and form a soil type. Thus, each soil type possesses a particular combination of profile characteristics which have resulted from the interaction of the soil forming factors. It should be realized, however, that surficial soils form a continuum on the earth's surface and that one soil type grades directly into the adjacent soil types. The boundary between two soil types is quite arbitrary and can only be delineated by establishing a particular set of profile characteristics for each.

(b) Soil Series

All soil types with profiles having the same characteristics except for the texture of the surface horizon, belong to the same soil series. Each soil series is given a proper name which is arbitrarily assigned based on some local feature in which it occurs such as a town, school, river, etc. By adding a modifying term (texture of the A horizon) to the soil series name, the name of a soil type results. In Illinois, the Soil Conservation Service and the Department of Agronomy assign a number to each soil type which has been defined and mapped. Typical examples of soil types for Illinois would be: 2 Cisne silt loam and 152 Drummer silty clay loam.

(c) Soil Catena

A soil catena is a group of soils of similar age and parent material that have developed under similar climate and vegetation, but differ in relief and/or drainage. Differences in various soil properties due to relief and natural drainage occur within small areas. This characteristic is used extensively in delineating soil types and in preparing soil maps.

A typical example of a soil catena in Illinois would be the Catlin-Flanagan-Drummer catena which occurs in areas where 3-5 feet of loess is found on calcareous loam to silty clay loam Wisconsinan till. Catlin is well to moderately well drained, Flanagan is imperfectly or somewhat poorly drained, and Drummer is poorly drained.

(d) Soil Association Area

In the pedologic system, soils are further grouped into soil association areas. A soil association area is a group of soils occurring together in a characteristic pattern (3). The grouping may consist of many soil types or only a few. It may include only similar soils or soils with quite different characteristics. As mapped in Illinois, a given soil association usually includes soil types developed from similar parent materials under similar vegetation conditions for approximately the same length of time (3).

AVAILABILITY OF SOIL MAPS AND SOIL INFORMATION FOR ILLINOIS

The Agricultural Experiment Station, University of Illinois and the Soil Conservation Service, United States Department of Agriculture have prepared county soil reports for most of the counties in Illinois.[a] Figure 5 illustrates the availability of these reports as of 1969 and the general usefulness of the various reports. Those county reports published after 1945 contain excellent soil type maps made from air photos at a scale of 1.5 to 4 inches per mile. Reports which were published from 1933-1945 also contain soil type maps of the soils in the county. Reports published prior to 1933 do not have maps based on modern soil type and number terminology and are thus of limited value to the engineer.

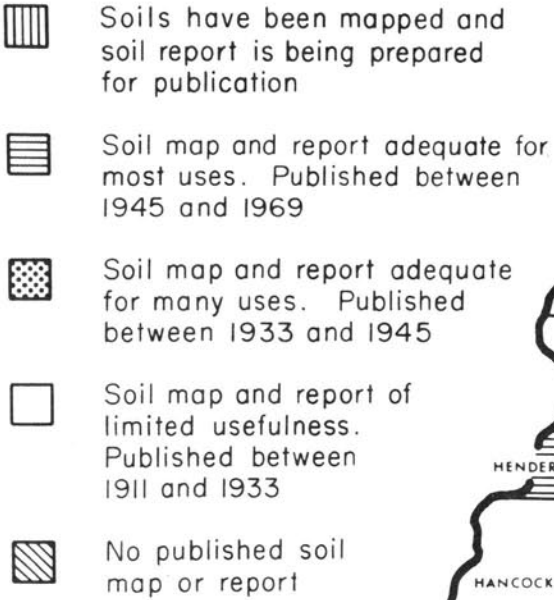
Agricultural Experiment Station Bulletin 665 (4)[a], "The Characteristics of Soils Associated with Glacial Tills in Northeastern Illinois," contains a great deal of pertinent information concerning the soils of northeastern Illinois. Included are typical gradation, plasticity, and chemical properties for these soils.

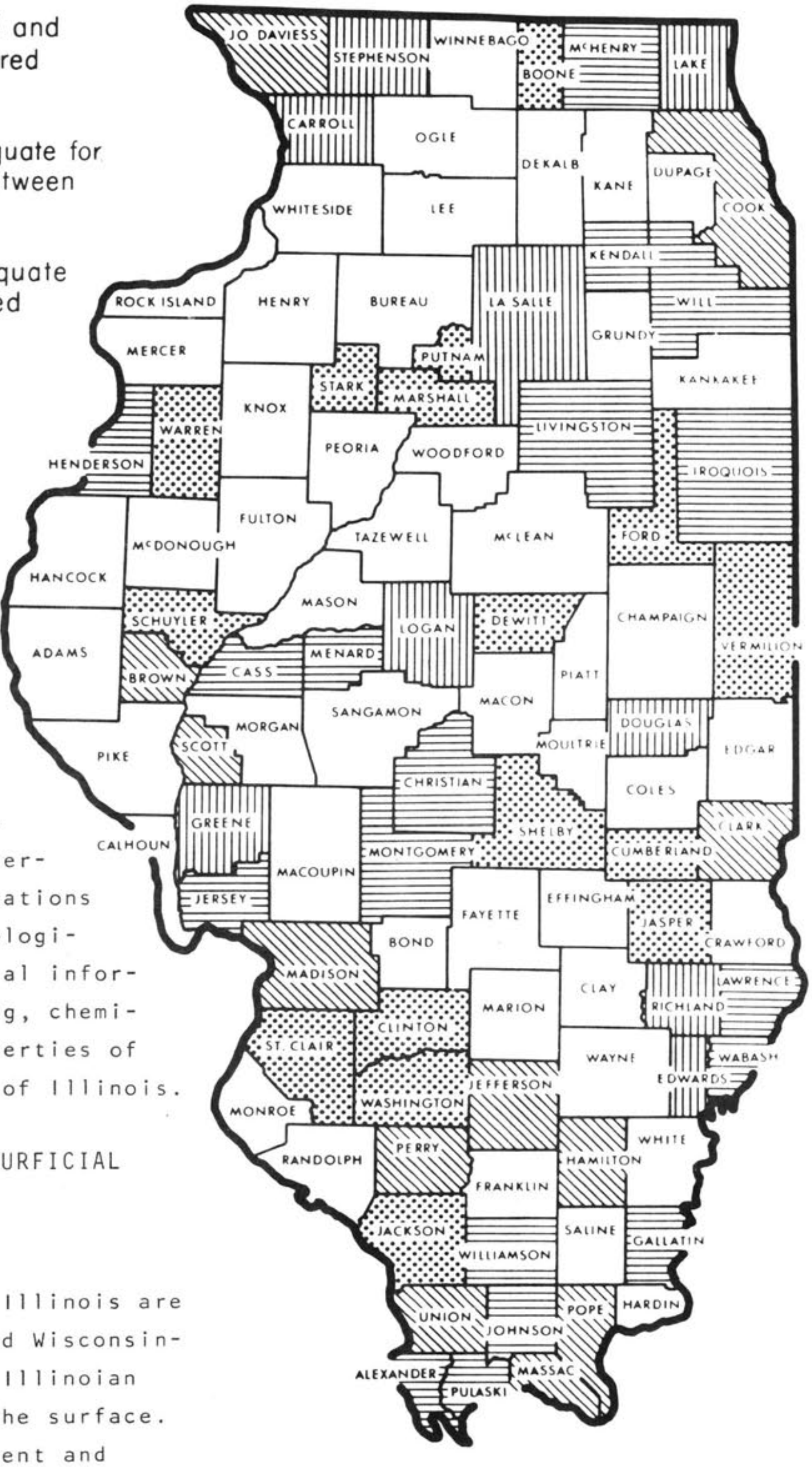
A soil association map is currently (1969) available[a] for the loess derived soils of northwestern Illinois. A soil report is presently being completed which will accompany the map.

A recent publication (5) (Bulletin 725, "Soils of Illinois")[a] contains a general discussion of the soils of Illinois. A description of the parent materials and the characteristics of the various soil association areas is included.

Presently, soil association maps are available or can be made available for all 102 Illinois counties[a]. These maps provide much valuable information concerning the distribution and areal extent of the various soils within a county.

[a] Available from: University of Illinois, Agronomy Department, Room N-405, Turner Hall, Urbana, Illinois, 61801.





Reference 3 (and the accompanying bibliography) available from the Engineering Experiment Station, University of Illinois, and publications available from the State Geological Survey provide substantial information concerning engineering, chemical, and other physical properties of the various surficial soils of Illinois.

DISTRIBUTION AND NATURE OF SURFICIAL DEPOSITS IN ILLINOIS

General

The surficial soils of Illinois are mainly derived from loess and Wisconsinan drift, but in some areas Illinoian till may be found close to the surface. Figure 6 illustrates the extent and distribution of the main parent materials in Illinois.

In northeastern Illinois, a thin, slightly weathered loess layer covers

FIGURE 5. AVAILABILITY AND GENERAL USEFULNESS OF THE COUNTY SOIL REPORTS FOR ILLINOIS AS OF 1969.

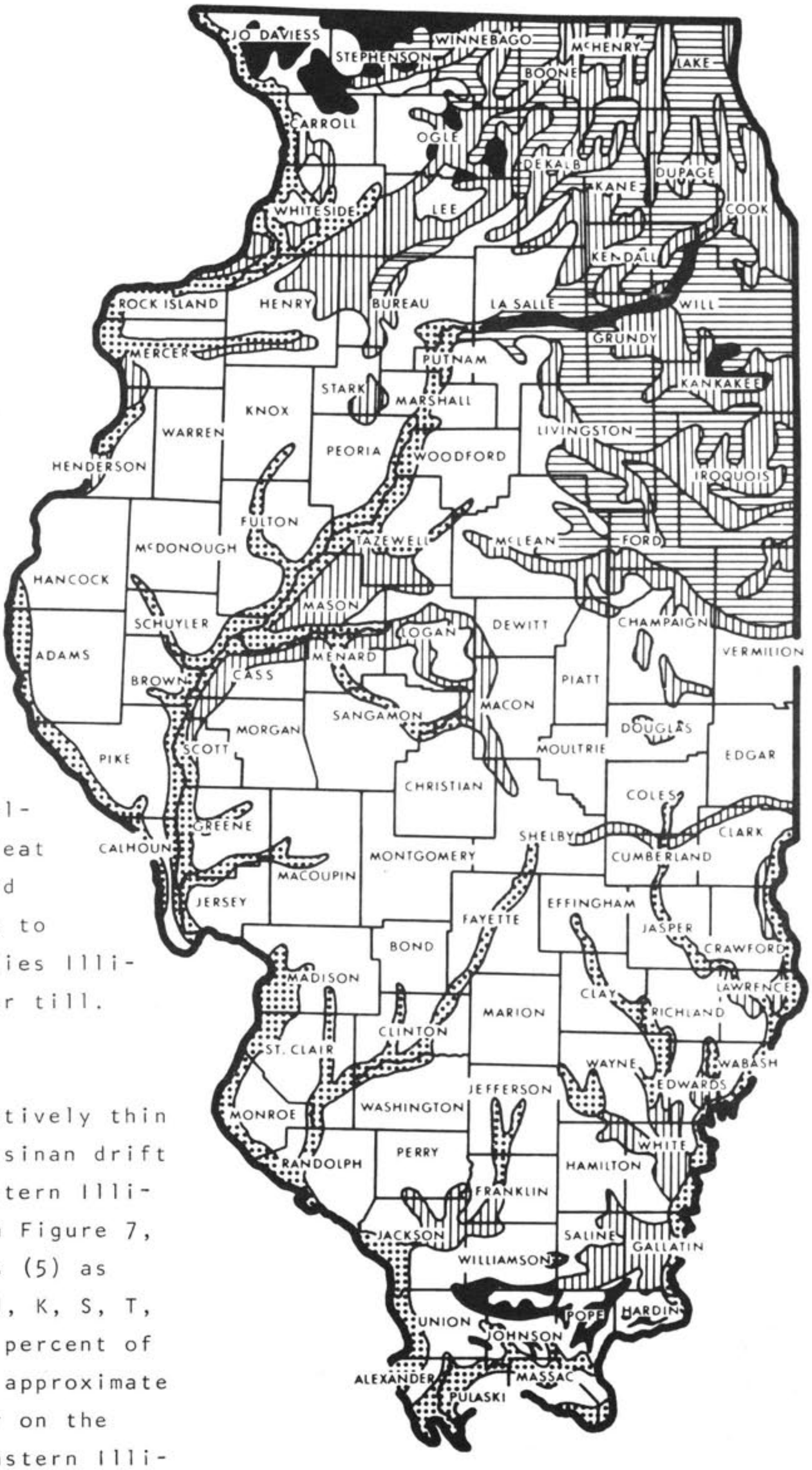


FIGURE 6. THE EXTENT OF THE SOIL PARENT MATERIALS IN ILLINOIS (REDRAWN FROM REFERENCE 27).

the Wisconsin drift. In south and south central Illinois, thin and extensively weathered loess overlies Illinoian till which is commonly weathered to a depth of 6 feet but often may be partially weathered to depths as great as 25 feet. In northwest and west central Illinois, thick to moderately thick loess overlies Illinoian or Wisconsinan drift or till.

Wisconsinan Drift

Soils derived from relatively thin loess over calcareous Wisconsinan drift are concentrated in northeastern Illinois. These soils (shown on Figure 7, General Soil Map of Illinois (5) as association areas G, H, I, J, K, S, T, U, and V) comprise about 13 percent of the state's land area. The approximate thickness of the loess cover on the Wisconsinan tills of northeastern Illinois may be determined by consulting Figure 8. Wascher, et al. (4) found that the major differentiating characteristics of these calcareous drifts was their texture which ranges from a loamy gravel as found in association areas G and S (coarse-textured outwash materials) to silty clay or clay as found in association areas K and V. The average grain size, liquid limit, and plasticity index for the various Wisconsinan glacial drift materials are shown in Table 1.

Calcareous Wisconsinan drift also underlies all of association areas B and M and those sections of association area A, north and east of the Shelbyville Moraine. In these association areas, however, the loess cover is thicker; 5 feet to greater than 20 feet in association area A and 3 feet to 5 feet in association areas B and M.

Loessial Soils

Loess, deposits of wind-blown silt, blankets most of Illinois. Approximately two-thirds of the surficial soils of Illinois are loess-derived. The occurrence of loess-derived soils is illustrated in Figure 7, by association areas A, B, C, D, E, F, L, M, N, O, P, Q, and R.

Studies by Smith (6) have shown a close relation between loess texture and thickness and the logarithm of the distance from the source area. The mean particle size and thickness of loess decrease with increasing distance from the loess bluffs bordering the source area. Figure 9, a map showing the general loess thicknesses for the state, illustrates this thinning trend. An examination of data presented by Thornburn (3) and Reference 7 indicates that as the distance from the loess bluffs increases, the liquid limit,

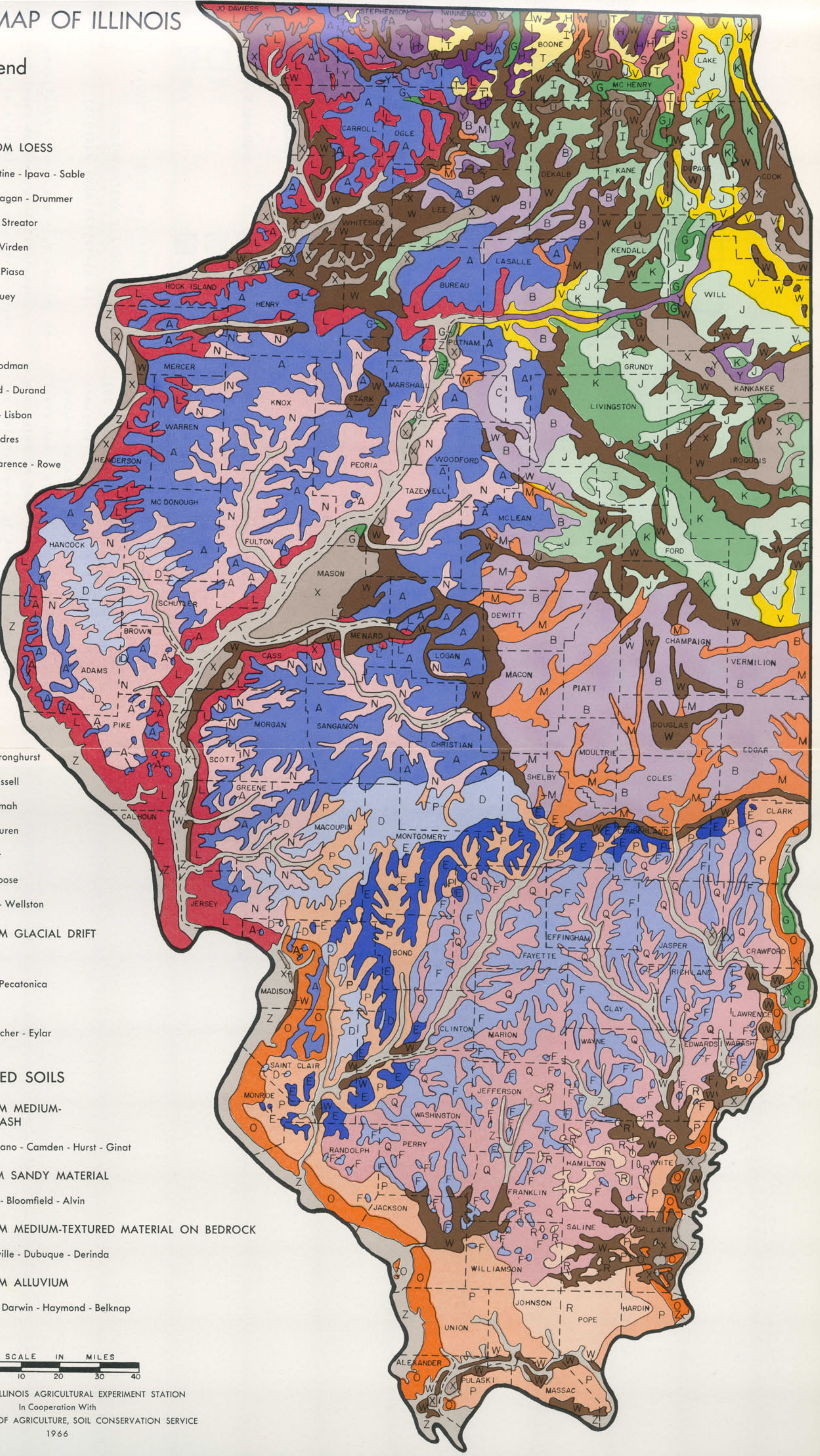
FIGURE 7. GENERAL SOIL MAP OF ILLINOIS.

TABLE 1

GRAIN SIZE DISTRIBUTION AND PLASTICITY OF THE SIX TEXTURE GROUPS OF CALCAREOUS GLACIAL TILL IN NORTHEASTERN ILLINOIS (FROM REFERENCE 4)

Texture Group	Average Percent				Average Values	
	Gravel > 2mm	Sand 2mm-50μ	Silt 50μ-2μ	Clay <2μ	Liquid Limit, %	Plasticity Index, %
Loamy gravel	62.5	30.9	4.8	1.5	NP	NP
Sandy loam	24.7	46.5	23.6	4.2	15.6	1.4
Loam and Silt loam	7.5	24.0	46.0	20.7	25.9	9.4
Silty clay loam	4.1	12.0	52.5	31.3	35.8	16.1
Silty clay	2.8	10.0	47.2	39.7	40.7	21.6
Clay	1.3	4.7	39.3	54.4	48.1	25.5

GENERAL SOIL MAP OF ILLINOIS



Legend

DARK-COLORED SOILS

DEVELOPED PRIMARILY FROM LOESS

- A Joy - Tama - Muscatine - Ipava - Sable
- B Sidell - Catlin - Flanagan - Drummer
- C Wenona - Rutland - Streator
- D Harrison - Herrick - Virden
- E Oconee - Cowden - Piasa
- F Hoyleton - Cisne - Huey

DEVELOPED PRIMARILY FROM GLACIAL DRIFT

- G Warsaw - Carmi - Rodman
- H Ringwood - Griswold - Durand
- I La Rose - Saybrook - Lisbon
- J Elliott - Ashkum - Andres
- K Swygert - Bryce - Clarence - Rowe

LIGHT-COLORED SOILS

DEVELOPED PRIMARILY FROM LOESS

- L Seaton - Fayette - Stronghurst
- M Birkbeck - Ward - Russell
- N Clary - Clinton - Keomah
- O Stookey - Alford - Muren
- P Hosmer - Stoy - Weir
- Q Ava - Bluford - Wynoose
- R Grantsburg - Robbs - Wellston

DEVELOPED PRIMARILY FROM GLACIAL DRIFT

- S Fox - Homer - Casco
- T Mc Henry - Lapeer - Pecatonica
- U Strawn - Miami
- V Morley - Blount - Beecher - Eylar

DARK- AND LIGHT-COLORED SOILS

DEVELOPED PRIMARILY FROM MEDIUM- AND FINE-TEXTURED OUTWASH

- W Littleton - Proctor - Plano - Camden - Hurst - Ginat

DEVELOPED PRIMARILY FROM SANDY MATERIAL

- X Hagener - Ridgeville - Bloomfield - Alvin

DEVELOPED PRIMARILY FROM MEDIUM-TEXTURED MATERIAL ON BEDROCK

- Y Channahon - Dodgeville - Dubuque - Derinda

DEVELOPED PRIMARILY FROM ALLUVIUM

- Z Lawson - Beaucoup - Darwin - Haymond - Belknap

SCALE IN MILES
0 10 20 30 40

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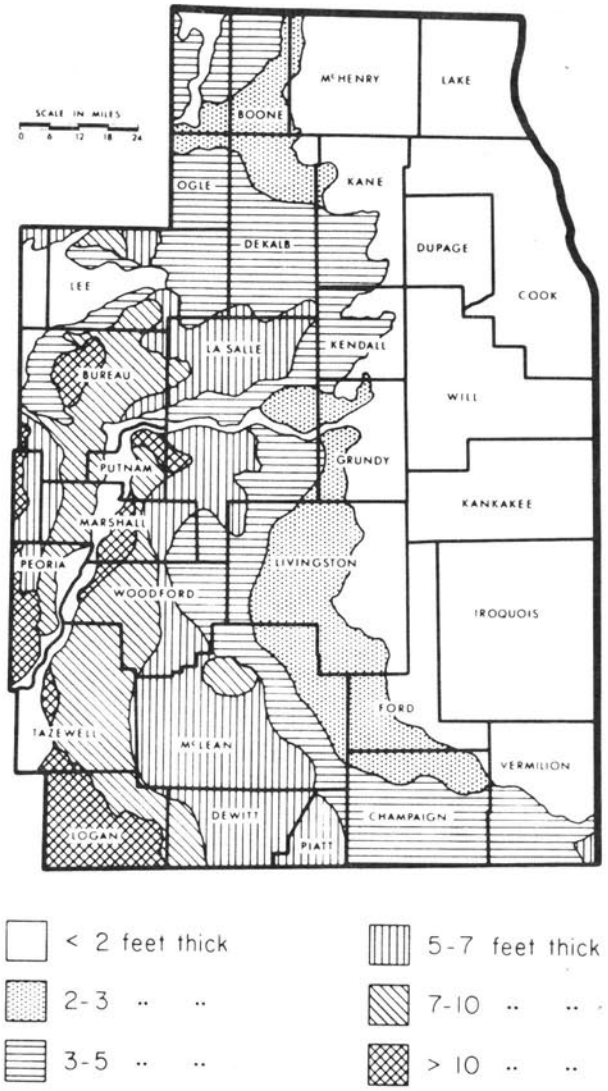


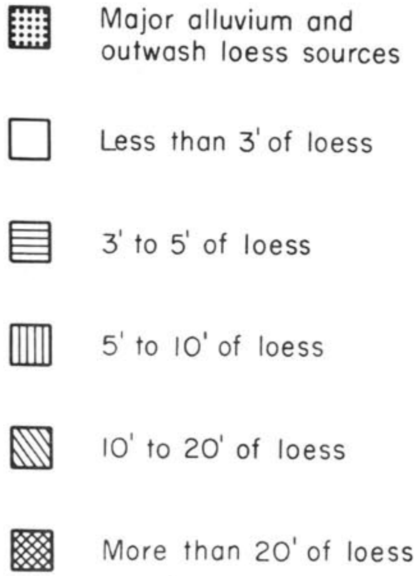
FIGURE 8. LOESS THICKNESS MAP FOR NORTHEASTERN ILLINOIS (REDRAWN FROM REFERENCE 4).

plasticity index, and clay content of the loess derived soils increase.

In a general sense, three types of loess deposits are present in the state; moderately thick (5 to 10 feet) to thick (10 to > 20 feet) loess on Wisconsinan drift, moderately thick to thick loess on Illinoian drift or bedrock, and thin loess (3 to 5 feet) on weathered Illinoian till.

In northwest and west central Illinois moderately thick to thick deposits of calcareous loess overlie Illinoian or Wisconsinan drift, depending on the location relative to the Shelbyville Moraine. These deposits are shown on Figure 7 as association areas A, L, and N. It has been found that a typical, moderately thick, unweathered loess from these areas contains 1 to 3 percent sand, 80 to 88 percent silt, and 10 to 18 percent clay (8) with plasticity indices ranging from 7 to 20 (3).

In southern Illinois a loess belt greater than 5 feet in thickness, designated association areas O, P, and R, borders the state along the Mississippi, Wabash, and Ohio Rivers. In these areas the loess overlies weathered Illinoian drift or bedrock. The loess in association area O is typically quite thick near the bluff line and thins with distance from the bluff. Fehrenbacher et al. (9) reported thicknesses near the bluff in southeastern and southern Illinois that exceeded 200 inches but the thickness rapidly decreased (less than 10 miles from the bluff Line) to 100 inches or less except for areas in Alexander, Pulaski, Union, and northwestern Massac County where the total loess depth exceeded 100 inches. Data presented in Reference 7 indicate that the parent loess of association areas O and P may be encountered at depths greater than about 30 to 40 inches and that the loess is texturally classified as silt loam which indicates that it is very similar to the moderately thick to



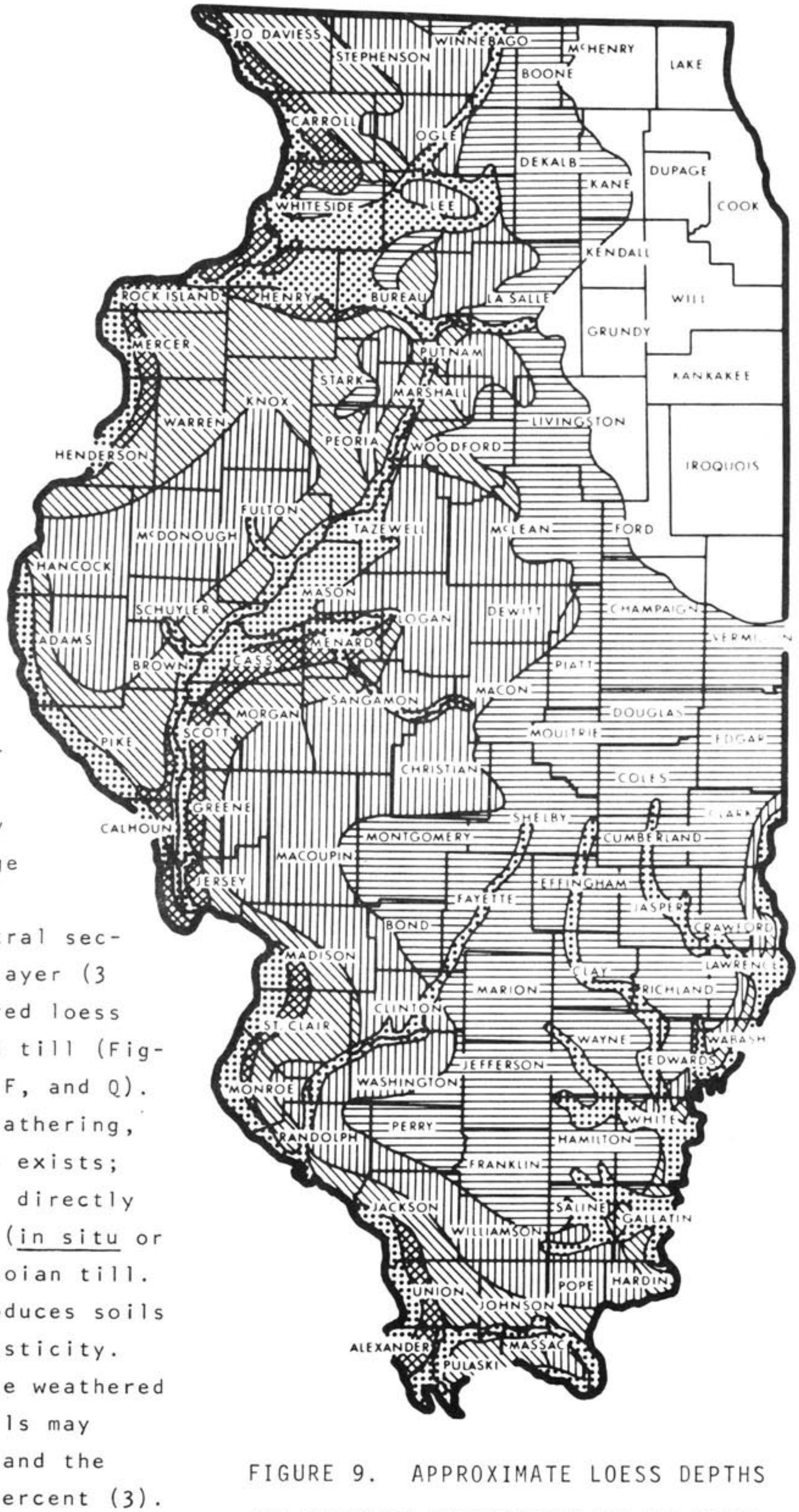


FIGURE 9. APPROXIMATE LOESS DEPTHS ON UNERODED TOPOGRAPHY IN ILLINOIS (REDRAWN FROM REFERENCE 5).

thick loess described earlier for northwest and west central Illinois. Limited data by Thornburn (3) indicate that the plasticity index of this loess may range from 10 to 20.

In south and south central sections of the state, a thin layer (3 to 5 feet) of highly weathered loess overlies weathered Illinoian till (Figure 7, association areas E, F, and Q). Due to the high degree of weathering, no C horizon of parent loess exists; rather, the B horizon grades directly into the weathering profile (in situ or accretion-gley) of the Illinoian till. The extensive weathering produces soils of high clay content and plasticity. The plasticity index of these weathered loess and Illinoian till soils may range from 20 to 25 percent and the clay content from 30 to 50 percent (3). Appreciable amounts of sodium have accumulated in some of these loess-

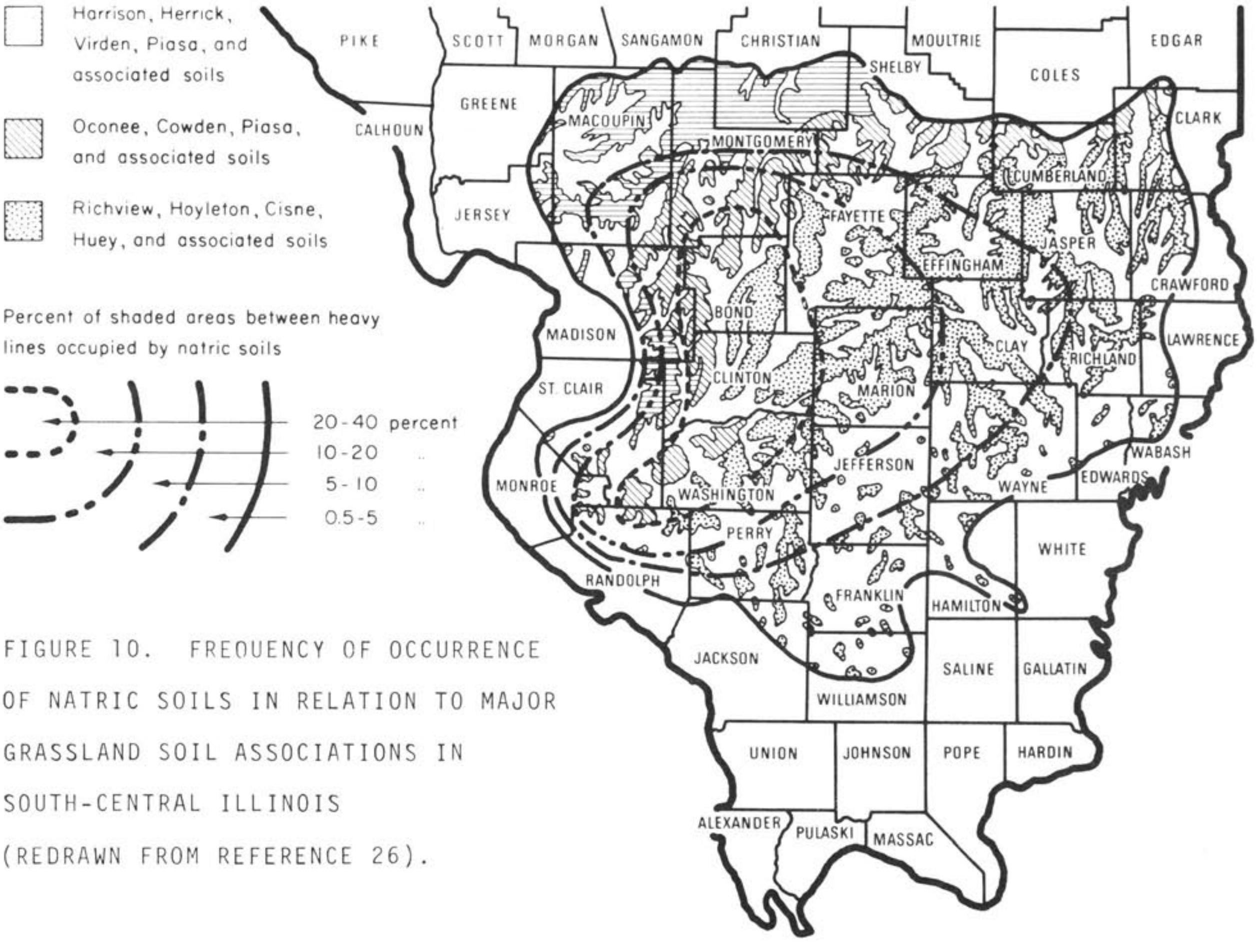


FIGURE 10. FREQUENCY OF OCCURRENCE OF NATRIC SOILS IN RELATION TO MAJOR GRASSLAND SOIL ASSOCIATIONS IN SOUTH-CENTRAL ILLINOIS (REDRAWN FROM REFERENCE 26).

derived soils, Figure 10, resulting in even higher plasticity. These so-called "slick" soils often comprise over 50 percent of the Cowden and Cisne association areas (E and F) (26).

Illinoian Till

Illinoian till underlies most of the loess derived soils of the state. In the southeast and south central sections of Illinois, a thin loess layer overlies weathered Illinoian till, whereas in west central and northwest Illinois, the overlying loess is much thicker, ranging from about 5 feet to 25 feet depending on the distance from the source area. The weathering profile in the Illinoian till is often referred to as the Sangamon Profile. Classification and nomenclature of the various Sangamon profiles are not well established, but Frye et al. (10) have divided these profiles into in situ and accretion-gley profiles. Essentially, the in situ well-drained profile is analogous to the B horizon of standard pedologic terminology while the poorly drained accretion-gley is an accumulation of fine-textured material characterized by an abundance of clay at the surface of the Sangamon Soil. The underlying Illinoian till is designated as the C zone and is equivalent to the C horizon of pedologic terminology.

Information pertaining to the texture and other important engineering properties of the Illinoian till and Sangamon profiles is rather limited. Thornburn (3) has texturally classified the Illinoian till as silt loam, silty clay loam, or clay loam. Recent work by the Illinois State Geological Survey (11) on four representative Illinoian till profiles indicated the following average grain size distribution: > 2mm (pebbles)--12 percent, 2mm to 0.062 mm (sand)--34 percent, 0.062 mm to 0.002 mm (silt)--36 percent, and < 0.002 mm (clay)--18 percent. Other information indicates that unweathered till commonly has a clay content range of 15 to 30 percent (10). Work by Frye et al. (10) shows that the weathered in situ profile generally contains 10 to 20 percent more clay than the unweathered till, while the accretion-gley profile contains an even higher percentage. Limited data by Thompson (12) indicate that the plasticity index of the unweathered till may range from 10 to 15 while that of the weathered material may vary from 15 to 20.

Sands

The sandy soils developed from Wisconsinan sandy outwash and wind-sorted materials of association area X comprise about 4 percent of the state's land area (5). This sandy A-2-4 or A-3 material is quite abundant in counties along the Wabash River, in counties of the Rock River area in northwestern Illinois, in counties along the southern half of the Illinois River, and in Kankakee, Iroquois, Will, and parts of Cook County. In some areas, a B horizon has developed while in others only a few inches of A horizon exists over the sand parent material. The plasticity of these sandy soils may range from nonplastic to slightly plastic and the clay content will typically be less than 10 percent (3).

Alluvium

Alluvium which is characteristically quite variable in physical (gradation, texture, plasticity, etc.) and chemical properties in both horizontal and vertical directions consists of the recent sediments deposited by streams on their flood plains. Alluvium is the principal parent material in association area Z and comprises about 7 percent of the state's land area (5). Deposits of alluvium are most extensive in southern Illinois because of the greater maturity of the streams.

These deposits range in texture from sands to clays although medium textured sediments predominate (5). Recent work (5) concerning the texture of the B and C horizons (subsoil and parent material) of the alluvial deposits of the state indicates that about 10 percent are silty clay to clay, about 25 percent are silty clay loam, and about 65 percent are silt loam to sand (13). In general, the finer-textured sediments are found in larger bottomlands along the Mississippi, Illinois, Wabash, and Ohio Rivers (5). Work by Thornburn (3) indicates that the plasticity indices may range from 25 to 80+ for the high clay content alluvium to NP to 10 for the extremely sandy materials.

III. STABILIZATION TECHNOLOGY

Effective and economical utilization of stabilization procedures requires that proper consideration be given to (1) stabilization objectives, (2) type, nature, and amount of stabilizer, (3) type and nature of materials to be treated, and (4) construction procedures.

OBJECTIVES OF STABILIZATION

A very important step in soil and/or aggregate stabilization is to establish the stabilization objective. In general, stabilization objectives can be grouped into three broad categories:

(a) Construction Expedient
(b) Subgrade Modification
(c) Strength and Durability Improvement

Construction Expedient

Vehicle mobility problems often arise during highway construction operations on medium-to fine-grained A-4, A-5, A-6, and A-7 soils which have high water contents and a high degree of saturation (quite often the case in the spring of the year). In many cases, problems of this nature can be greatly improved or alleviated with correct application of stabilization techniques.

Various stabilization techniques and procedures can be used to effect an immediate improvement in (a) resistance to deformation, (b) load-carrying capacity, and (c) shear strength. In essence, a "working-table" is created upon which construction operations become more efficient, effective, and economical.

Subgrade Modification

In most instances the subgrade of a pavement constructed in Illinois will consist of medium-to fine-grained A-4, A-5, A-6, or A-7 soils which are quite plastic, exhibit various degrees of swell and loss in strength, display high resilience, and in general, possess other undesirable characteristics at high water contents and high degrees of saturation.

Appropriate stabilization of these subgrade materials will result in:

(a) decreased plasticity (some soils may actually become nonplastic with the amounts of stabilizer normally used)
(b) reduced swell
(c) increased CBR, even though extensive cementing may not be obtained due to either a lack of "reactivity" (some soils do not display substantial strength gains when cement or lime is added) or the use of stabilizer quanti-

ties less than that required to effect substantial strength increases

(d) decreased resilience

(e) increased resistance to the detrimental effects of rainfall or moisture content fluctuations

(f) improved workability characteristics and ease of handling

Strength and Durability Improvement

In many cases, through appropriate application of stabilization techniques and procedures, soils and aggregates can be upgraded (increased strength and durability) to provide very economical paving materials of subbase and base course quality.

TYPES AND NATURE OF STABILIZERS

Numerous stabilizing agents are available for use in pavement construction. In general, stabilizing agents may be divided into two broad categories, based on stabilization mechanisms effected when the agents are incorporated into a soil or aggregate. Active stabilizers produce a chemical reaction with the soil or aggregate which in turn produces desirable changes in engineering characteristics of the soil or aggregate stabilizer system. A prime example of an active stabilizer is lime. When lime is added to medium- to fine-grained soils, reactions occur which produce decreased plasticity and swell, increased workability and CBR, and in some cases substantially increased strength.

Inert stabilizers do not react chemically with the soil or aggregate. Rather stabilization is obtained as a result of binding together and/or waterproofing the soil or aggregate with the inert stabilizer. An example of this type of stabilizer is bituminous materials.

Many other stabilizers display various combinations of active and inert characteristics. Cement and lime-fly ash may react chemically with the soil or aggregate to produce a number of desirable reactions (such as decreased plasticity, increased workability, etc.) but the main mechanism of stabilization provided by these stabilizing agents is the increased strength and durability produced by cementing agents that result from either the hydration of the portland cement or the pozzolanic reaction between the lime and fly ash.

TYPICAL STABILIZER CONTENT REQUIREMENTS

The amount of stabilizer required to adequately stabilize a soil or aggregate material depends on (1) stabilization objective, (2) type of stabilizer, and (3) chemical and physical properties of the soil or aggregate. A discussion of mixture design procedures may be found in the following references:

Stabilizing Agent	Reference
Cement	14
Lime	15
Bitumen	16, 17
Lime-Fly Ash	17, 18 and ASTM C593-66T

The following table presents typical ranges for stabilizer content requirements for the general types of soils and aggregates, and the various stabilizers.

Typical Stabilizer Content Requirements
Percentage on Dry Weight Basis

Stabilizer	Soil Type		
	Coarse-textured	Medium to moderately fine-textured	Fine-textured
Cement	3-11%	7-13%	9-16%
Lime	-	3-7%	3-7%
Bitumen	4-10%	4-8%	-
Lime-fly ash	10-30%[a]	15-30%[a]	-

[a] Percent lime and fly ash on a total weight basis.

TYPES OF SOIL OR AGGREGATE MATERIAL

The type of material to be stabilized has a tremendous effect upon the type of stabilizers that can be used and the construction procedures necessary to obtain proper pulverization, blending, compaction, and curing of the stabilized materials.

Essentially, materials can be grouped into three broad categories with respect to general engineering characteristics:

(1) coarse-textured materials
(2) medium- and moderately fine-textured materials
(3) fine-textured materials

Coarse-Textured Materials

This group of materials includes all of the granular crushed stones, gravels, and sands. Typical AASHO classification of these materials would be A-1, A-2, and A-3.

Medium- and Moderately Fine-Textured Materials

This group of materials includes the high silt content A-4, A-5, and low plasticity A-6 AASHO classified materials.

Fine-Textured Materials

This group of materials includes the high clay content, high plasticity A-6 and A-7 classified materials.

Coarse-textured material can be stabilized with a wide variety of admixtures and typically presents few problems in pulverization, blending, and compaction operations. The medium- and moderately fine-textured materials in general can be most readily stabilized with cement, lime, and combinations (lime-cement, lime-bitumen) although in some instances, lime-fly ash and bituminous stabilizers have been used. Proper pulverization and blending are more difficult to obtain with the medium- and moderately fine-textured materials than with the coarse-textured materials. Normally fine-textured materials can be stabilized most economically with lime. In some cases cement can be used although large amounts of cement are normally required. The pulverization and blending operations are extremely difficult with the fine-textured materials due to the high plasticity and clay content. The addition of lime however will decrease plasticity and increase workability thereby facilitating pulverization and mixing operations.

CONSTRUCTION OF STABILIZED MATERIALS

Proper field construction of stabilized materials is essential. Quality control must be exercised to insure the attainment of the desired design engineering properties and behavior. Improper construction of stabilized materials can lead to unnecessary and costly failures of otherwise properly designed pavements.

Pulverization

Pulverization is one of the most important steps in the stabilization process. Proper pulverization facilitates uniform distribution and mixing of the stabilizer(s) into the soil or aggregate. With coarse-textured soils, satisfactory pulverization is normally easily obtained. However, with medium to fine-textured soils, pulverization becomes more difficult. In general, the difficulty of obtaining satisfactory pulverization increases with increasing plasticity and clay content.

Proper pulverization of medium- to fine-grained soils normally exists when 60 to 80 percent of the mixture passes the No. 4 sieve; although, a lower degree of pulverization is often permitted in construction expedient or subgrade modification operations. With many fine-grained soils, this degree of pulverization is normally very difficult to achieve. However, if a small quantity of lime (1 to 4 percent) is added to the soil, pulverization is facilitated. A "mellowing" period of up to 48 hours or greater for the lime-soil mixture often is beneficial in obtaining additional pulverization.

A number of methods and types of equipment may be used to achieve pulverization in the field. One of the more popular methods is to use a "pulvi-mixer" which can be used to simultaneously pulverize the soil and blend it with the stabilizer. Other equipment such as motor graders, scarifiers, or discs may be used to achieve pulverization with medium to fine-textured soils.

Stabilizer Distribution

Another step in the stabilization process is the distribution of the stabilizer(s). In a number of road mix applications, stabilizer distribution may actually occur before the soil is pulverized. In other cases, it may be desirable to partially pulverize the soil before adding the stabilizer. Final pulverization and blending then occur simultaneously.

A number of techniques may be used to distribute stabilizers. Lime, cement, and lime-fly ash admixtures can be distributed by placing bags of the respective stabilizer(s) on the layer of material to be stabilized prior to or after initial pulverization. Various types of truck distributors may also be used including: bulk pneumatic and screw-auger tank truck spreaders, and dump trucks utilizing a spreader box. Lime can also be applied in a slurry form. Lime, cement, and lime-fly ash can be added directly into the mixing chamber in plant mix stabilization operations.

Bituminous materials can be either sprayed on to the soil or aggregate by a distributor truck (liquid bitumen-road mix operation) or applied directly into the chamber of a pug mill mixing operation (either plant or travel mix).

Blending the Materials

Proper mixing or blending of stabilizer(s) with the soil or aggregate is extremely important. In most cases, mixing must proceed until an intimate blending of the stabilizer(s) and the soil and/or aggregate has been accomplished. In isolated cases, such as the treatment of medium-textured soils with liquid bitunimous materials, it is desirable to manipulate the mixture only until a continuous bitumen-discontinuous soil matrix occurs (19).

A number of methods and types of equipment may be used to obtain mixing or blending. In plant mix operations, normally the soil or aggregate is processed in a pug mill. Typically both stabilizer and water are incorporated while the mixture is in the chamber of the pug mill.

In road mix stabilization, "pulvi-mixers," motor graders, discs, etc. can be used to achieve proper blending and mixing.

Water Requirements

The natural moisture content of surficial soils varies depending on the texture of the soil, time of year, weather, and position with respect to the water table. In most cases, an "optimum" moisture content must be maintained during compaction. With medium- to fine-grained soils, moisture contents substantially above optimum may be encountered during wet seasons of the year. Aeration of these soils may be required prior to compaction. During dry seasons, a substantial quantity of water may be required to bring the mixture to an optimum moisture content.

The moisture content of aggregates to be treated with bituminous materials normally must be quite low, on the order of 3 to 5 percent (16). The moisture content of medium- to moderately fine-textured soils should be in the "fluff point" range (19, 20) when liquid bituminous materials are used as stabilizers. Aeration of these mixtures prior to compaction to allow evaporation of hydrocarbon volatiles and/or water may be required in order that increased compacted stability is obtained (20).

Compaction Operations

With most stabilized mixtures, high compacted densities are essential in order to obtain high quality stabilized materials. Thus, it is essential that the stabilized mixtures be properly compacted in the field.

(a) Construction Expedient Applications

High density requirements are generally not imposed for applications of this nature because the stabilization objective can be satisfied at lower densities.

(b) Subgrade Modification, and Strength and Durability Improvement Applications

High density requirements must be obtained with these stabilized mixtures. Typical density requirements range from 90 to 95 percent of AASHO T-99 density (ASTM D-698) for subgrades and subbase materials to 95 to 100 percent

AASHO T-99 (ASTM D-698) for base course materials.

Curing

In general, there are three important variables which must be controlled in order to obtain proper curing of stabilized mixtures. These are temperature, time, and moisture regime. The required curing environment will vary depending on the stabilization objective and the particular stabilizing agent used. For example, the curing environment required for construction expedient applications can be substantially different than that required for subgrade modification or strength and durability improvement applications. Likewise the curing environment required for bitumen treated mixtures is much different than that required for mixtures treated with cement, lime, or lime-fly ash admixtures.

(a) Lime, Cement, and Lime-Fly Ash Treated Mixtures

The pozzolanic reactions or the hydration processes that occur when lime (with reactive soils), lime-fly ash or cement is added to a soil or aggregate-water mixture are time and temperature dependent. These reactions or processes are primarily responsible for the cementing agents that effect significant increases in strength. In order to insure that these reactions or processes continue, it is necessary that the temperature be greater than 40° F to 50° F. At temperatures less than 40° F to 50° F, the pozzolanic reactions and the hydration processes become essentially dormant while at temperatures above 40° F to 50° F the rate at which the reactions and processes proceed increases. Thus, for a given length of cure, increased temperatures normally produce higher mixture strengths.

Sufficient curing time at the prevailing environmental temperatures is essential so that high strength mixtures can be produced. Time and temperature effects during the curing phase are interdependent. Thus, both longer curing and higher temperatures will produce greater strength mixtures.

The retention of moisture during curing is essential since the pozzolanic reactions and the hydration processes require water. It has been found that the "optimum" compaction moisture content, if retained, will provide sufficient curing moisture.

Techniques that have been used to insure retention of moisture in the compacted mixture are periodic sprinkling with water, applying an asphaltic surface membrane, or immediate placement of an overlying pavement layer.

In applications where lime or cement are used to expedite construction or to modify the subgrade, time and temperature do not greatly affect the desired stabilization mechanisms as long as the temperature is above freezing. No additional cure is required after proper blending and the desired compaction have been obtained, since the desired stabilization reactions occur almost immediately.

(b) Bitumen Treated Mixtures

Hot mix plant mixtures require sufficient curing time after compaction to allow the mixtures to cool and gain stability. No further curing of these mixtures is required.

Mixtures treated with cutback asphalts may require a curing period after compaction to allow additional evaporation of hydrocarbon volatiles and water. Evaporation of these materials is required so that increased compacted stability is obtained. Thus, warm temperatures and dry weather must prevail to allow for proper curing of mixtures treated with cutbacks.

IV. STABILIZATION GUIDELINES AND CRITERIA

Stabilization guidelines and criteria have been developed to promote optimum utilization of common stabilizing agents (cement, lime, bitumen, lime-fly ash, and combinations) with Illinois soils to provide economical, quality paving materials.

The stabilization guidelines and criteria as established for use with Illinois soils and materials are as follows:

CEMENT STABILIZATION

1. Coarse-Grained Materials
   a. Included in this group of materials that may be treated with cement are crushed stones, gravels, and sands which are typically classified as A-1, A-2, and A-3 materials.
   b. A well-graded granular material is most desirable and should possess a floating aggregate matrix to promote adequate durability (21). To provide this matrix the following gradation is recommended:
      Minimum of 55 percent passing No. 4 sieve
      Minimum of 37 percent passing No. 10 sieve
      Minimum of 25 percent between No. 10 and No. 200 sieve
   c. Poorly graded sands may be used but in many cases some type of filler material should be added to improve the gradation. In many cases this will decrease the cement content required for adequate durability and produce a more workable mixture.
   d. Organic matter adversely affects cement hydration. A horizons and some B horizons (those associated with Brunizem soils) of typical Illinois soil profiles contain large amounts of organic matter and thus cement treatment of these materials may not be economically feasible. In fact, soils with organic matter contents greater than about 2 percent (about 1 percent organic carbon) should be considered questionable. However, the A and B horizons of granular soils of Illinois are generally quite thin and thus suitable material can be found at shallow depths.
2. Medium-, Moderately Fine-, and Fine-Grained Materials
   a. Medium- and moderately fine-grained materials can, in

some cases, be adequately stabilized with cement. The engineering properties of silty A-4, A-5, and low plasticity A-6 soils may be substantially improved upon the addition of cement.

b. The more clayey and highly plastic A-6 and A-7 fine-grained soils generally are difficult to stabilize with cement due to difficulty in pulverization of the soil and blending of the cement, and the high cement requirement for adequate stabilization.

c. Organic matter adversely affects cement hydration. The A horizon and some B horizons (those associated with Brunizem soils) of Illinois soil profiles typically contain large amounts of organic matter. Thus, cement treatment of such soils is generally not feasible. In fact all soils with an organic matter content greater than about 2 percent (about 1 percent organic carbon) should be considered as questionable.

d. Many unweathered soils treated with cement tend to display an increased compressive strength response as compared to weathered soils due to an additional lime-soil reaction. Often natural soil pH values of 7 to 8.3 (the exception in Illinois is the sodium "slick" solonetzic soils) indicate relatively unweathered soils. Also, in general, the plasticity and clay content of the relatively unweathered parent C horizon materials is less than the weathered B horizon. This indicates that soil from the C horizon of a profile may be much more desirable for treatment than either the A horizon (high degree of weathering and high organic matter content) or B horizon (high clay content and plasticity and possibly high organic matter content).

LIME STABILIZATION

1. Lime will react with all medium-, moderately fine-, and fine-grained soils to produce decreased plasticity, increased workability, reduced swell, and increased CBR.

2. With some soils (termed lime reactive)[a] an additional lime-soil pozzolanic reaction occurs which produces cementing products and results in a substantial strength increase.

   Following is a summary of the important factors which influence the degree of "lime-reactivity"[b] of a soil (12):

   a. A clay fraction is required although Thompson (12) found that Illinois soils with clay contents (< 2μ) as low as 7 percent may be reactive.

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[a] Lime reactive soils are those soils which display significant strength increase when treated with lime.

[b] Lime reactivity = compressive strength increase in excess of the strength of the natural soil.

b. Clay mineralogy influences reactivity. Generally, mixed layer and montmorillonitic clays are most reactive.

c. Typically, Illinois soils with high natural pH (> 7) are the most reactive and exhibit average compressive strength increases > 100 psi upon treatment with lime. It is believed that the better reactivity of the high pH soils is related to the degree of weathering. Generally, in Illinois, low pH soils are more highly weathered than high pH soils. However, in certain areas of southern Illinois, a number of the highly weathered soils display high natural pH due to an accumulation of sodium in the subsoil. These are commonly referred to as solonetzic soils (see following subheading g. for reactivity of these soils).

d. The natural drainage of B horizon materials is of prime importance as related to lime-reactivity. The natural drainage affects the relative degree of weathering and iron oxidation which the B horizon of a given parent material has undergone. In general, the poorer the natural drainage, the less the relative degree of weathering and oxidation. Thompson (12) found that, for Illinois materials, poorly drained soils display the best reactivity, and that in general, lime-reactivity decreases as natural drainage becomes better.

e. The horizon in the profile has an important influence on lime-reactivity. A horizon materials are typically not lime-reactive due to the presence of excessive organic matter and the high degree of weathering and oxidation (type of natural drainage). C horizon materials typically display lime-reactivities which are greater than 50 psi.

f. All calcareous loess and till soils of Illinois react very well with lime and generally display lime reactivities greater than 100 psi.

g. In Illinois, solonetzic "slick" soils are very lime reactive (22).

BITUMINOUS STABILIZATION

1. Coarse-Grained Material

   a. Included in the group of materials which may be treated are the A-1, A-2, and A-3 materials which produce "sand-, sand-gravel-, or aggregate-bitumen mixtures." Well-graded materials are most suited although poorly graded materials may be stabilized quite adequately but with slightly lower stability. Within a given soil type, the B horizon sands may be more desirable than the C horizon parent sands due to better gradation.

   b. A filler material often must

be added to poorly graded sands to improve the gradation thereby increasing the stability and reducing the air voids content. An angular filler material (such as pulverized limestone) may be more desirable and in some cases may produce higher stabilities; excellent and very economical filler material (coarse-textured loess) can be found close to the source of the poorly graded sands in many areas of Illinois.

c. The recommended gradation and Atterberg limits for coarse-grained materials suitable for treatment with bitumen are given in Table 2.

d. About 3 to 5 percent moisture is required in the aggregate

TABLE 2

ENGINEERING PROPERTIES OF MATERIALS SUITABLE FOR BITUMINOUS STABILIZATION

(FROM REFERENCE 23)

	% Passing Sieve		
Sieve Size	Sand-Bitumen	Soil-Bitumen	Sand-Gravel-Bitumen
1-1/2"			100
1"	100		
3/4"			60-100
No. 4	50-100	50-100	35-100
10	40-100		
40		35-100	13-50
100			8-35
200	5-12	good - 3-20 fair - 0-3 and 20-30 poor - > 30	0-12
Liquid Limit		good - < 20 fair - 20-30 poor - 30-40 Unusable - > 40	
Plasticity Index	< 10	good - < 5 fair - 5-9 poor - 9-15 Unusable - > 12-15	< 10

(a) Includes slight modifications later made by Herrin.

during mixing with either cutbacks or emulsions to promote the distribution and coating action of these materials (16). However, the moisture content is not as critical as it is with finger-grained materials.

e. Coarse-grained materials should be mixed until an "intimate" mixture between the bituminous materials and aggregate occurs.

f. The stability of a compacted mixture depends to a large extent on the gradation, temperature, and type of bituminous materials used. Granular materials treated with penetration grade asphalt (hot mix applications), in general, yield higher stabilities than granular materials treated with cutbacks or emulsions. The relative magnitute of stability with penetration grade asphalts, cutbacks, and emulsions depends to a large extent on the residue hardness but other factors such as distribution and coating action of the asphalt have important effects upon the strength.

g. When cutbacks and emulsions are used, a "drying" period must be allowed prior to compaction of the mixture. The drying period facilitates evaporation of the hydrocarbon volatiles and/or water present, thus increasing the viscosity of the bituminous binder and the stability of the mixture.

2. Medium-, Moderately Fine-, and Fine-Grained Materials

a. Included in this group of materials which may be treated are A-4, A-5 and low plasticity A-6 materials, which when treated are often called "soil-bitumen" mixtures.

b. In general, the more plastic finer-grained soils usually can not be treated with bitumen due to problems of pulverization, blending, and lack of adequate soaked strength. Herrin (23), Table 2, indicates that all A-4, A-5, A-6, and A-7 materials are classified as poor to unusable as to their suitability for treatment. However, the silty A-4, A-5 and low plasticity A-6 soils may in some cases be adequately stabilized with cutback and emulsified asphalt materials.

c. Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. Frequent rejuvenation of this surface is normally required to provide a satisfactory level of serviceability.

d. Generally, only cold mix type stabilization is considered with finer-grained materials.

e. With the finer-grained materials, the moisture content during mixing is quite critical. Herrin (20) indicates that the ideal moisture content during mixing is the "fluff point" moisture which produces maximum bulking of the soil and may range from 8.5 to 18+ percent depending on the soil type. It may not be convenient in the field to control the moisture content to this extent. However, sufficient moisture must be present to promote distribution of the bituminous material.

f. Little or no strength is imparted to the finer-grained materials by the addition of bitumen and the resulting soaked compressive strength can be expected to range from 20 to 39 psi, which indicates that a certain degree of waterproofing is provided by the bituminous materials.

g. Mixing of the finer-grained materials should proceed until a "continuous asphalt-discontinuous soil matrix" is formed. The length of mixing time required to produce this matrix varies with the soil, grade and type of cutback or emulsion, and moisture content of the mixture.

h. A drying period prior to compaction is required with bitumen-treated fine-grained soils to evaporate hydrocarbon volatiles and/or water so as to increase stability. The Asphalt Institute recommends that drying proceed until only 50 percent of the original hydrocarbon volatiles remain and less than 2 percent moisture is left in the mixture (2 to 5 percent for emulsions) (16).

LIME-FLY ASH STABILIZATION

1. Coarse-Grained Materials

   a. Included in the group of materials which may be treated with lime-fly ash are the A-1, A-2, and A-3 materials.

   b. Well-graded materials are desirable but materials of more uniform gradation are suitable because the fly ash acts as a filler material.

   c. The literature recommends that these materials should have 100 percent passing the 2 inch sieve and an optimum amount of fines ranging from 4 to 6 percent passing the No. 200 sieve (23).

   d. In general, it has been found that the coarser-textured materials are the most suitable for treatment with lime-fly ash.

   e. Organic matter adversely affects the lime-fly ash reaction. A horizons and some B horizons (those associated with Brunizem soils) of Illinois soil profiles typically contain large amounts of organic matter and thus lime-fly ash treatment of these materials may not be feasible. However, the A and B horizons of granular soils of Illinois are generally quite thin and thus, suitable material can be found at very shallow depths.

2. Medium-, Moderately Fine-, and Fine-Grained Materials
   a. Included in this group of materials which may be treated are A-4, A-5, and low plasticity A-6 soils.
   b. In many cases, these materials may give similar strengths with lime alone--especially if the materials are "lime-reactive."
   c. Problems arise in pulverization and blending processes with the highly plastic, high clay content A-6 and A-7 varieties of fine-grained materials.
   d. Organic matter adversely affects the lime-fly ash reaction. The A horizon and some B horizons (those associated with Brunizem soils) of Illinois soil profiles typically contain substantial amounts of organic matter, and thus, treatment of many of these medium- to fine-grained materials may not be feasible due to the organic matter.

COMBINATION STABILIZATION

1. Included in this group of materials which may be treated are those A-6, A-7, and possibly some of the A-4 and A-5 materials which can not be effectively or economically stabilized with ordinary techniques because of limited strength gains upon addition of cement or lime, because they often require high cement contents to effectively stabilize them, and/or because they can not be adequately blended with bituminous materials.
2. The purpose of using a combination stabilization approach (pretreatment of the soil with lime) is to reduce plasticity, increase workability, and thus increase the ease of pulverization of the soil. These altered properties greatly increase the ability to blend either cement or bitumen with the lime-soil mixture to provide increased strength and durability.

V. DEVELOPMENT OF STABILIZATION RECOMMENDATIONS FOR ILLINOIS SOILS

INTRODUCTION

There are in excess of 300 soil series mapped in the State of Illinois. In order to systematically develop stabilization recommendations for the soils and materials of Illinois, it is necessary to place the soils into meaningful groupings. As indicated in Chapter 2, the soil association grouping provides a meaningful grouping in that it is based on chemical and physical soil characteristics which are of major concern with respect to soil stabilization.

As mapped in Illinois, a given soil association area usually includes soil types (or series) developed from similar parent materials under similar vegetation conditions for approximately the same length of time. The soils of Illinois have been grouped into 26 association areas (5), Figure 7. Table 3 contains a description of the parent materials, soil series, and drainage classification for the soil series found in each soil association area.

Many soil series have only minor areal occurrence and consequently only major soil series were considered in this report. It was found that the major soil series included in this report represent, areawise, approximately 77 percent of the state. Stabilization recommendations for those soil series not included in Appendix A can be readily determined by appropriate application of stabilization technology, Chapter 2, and the stabilization guidelines and criteria, Chapter 4.

PROCEDURE USED IN THE DEVELOPMENT OF STABILIZATION RECOMMENDATIONS

In the development of the stabilization recommendations, the characteristics of the major soils in each association area were briefly discussed and the following soil characteristics and properties were summarized as shown in Appendix A:

(1) Areal extent of each major soil series in the association area
(2) dominant slope and internal drainage
(3) a brief soil profile and site description
(4) horizon thicknesses for a typical profile of the soil series
(5) typical USDA and AASHO soil classification for the materials of the soil profile
(6) percent material passing the No. 4 and No. 200 sieve and percent clay (< 2μ) sized

TABLE 3

SOIL SERIES IN ILLINOIS GROUPED BY SOIL ASSOCIATION ACCORDING TO PARENT MATERIAL, SURFACE COLOR, DEGREE OF PROFILE DEVELOPMENT, AND NATURAL DRAINAGE (FROM REF. 5)

Area on general soil map	Parent material[2]	Surface color[2]	Degree of development[2]
A	Loess >4-5 ft. thick, noncalc. >3 1/2 ft.	Dark	Weak
		Dark	Moderate
		Dark	Mod.-mod. strong
B	Loess 3-5 ft. thick on calc. loam-sicl. till	Dark	Mod.-mod. strong
	Loess 1-3 ft. thick on cl. till, noncalc. >3 1/2 ft.	Dark	Moderate
C	Loess 3-5 ft. thick on calc. sic.-c. till or drift	Dark	Mod. strong
D	Loess 5-7 ft. thick on weathered Illinoian till	Dark	Mod. strong
E	Loess 4-6 ft. thick on weathered Illinoian till	Mod. dark	Strong
F	Loess 2 1/2-4 ft. thick on weathered Illinoian till	Mod. dark	Strong-very strong
G	Med. tex. mat. 2-3 1/2 ft. thick on calc. gravel	Dark	Moderate
	Med. tex. mat. 2-3 1/2 ft. thick on noncalc. gravel	Dark	Mod.-weak
H	Loess 2 1/2-5 ft. thick on noncalc. cl.-scl. till	Dark	Moderate
	Loess 1 1/2-3 ft. thick on noncalc. cl.-scl. till to 4 ft.	Dark	Moderate
	Loess 1-3 ft. thick on sl. till, calc. <4 ft.	Dark	Moderate
	Loess <1 ft. thick on sl. till, calc. <3 1/2 ft.	Dark	Moderate
I	Loess 1 1/2-3 ft. thick on loam till, calc. by 2-3 1/2 ft.	Dark	Moderate
	Loess <1 1/2 ft. thick on loam till, calc. by 2-3 1/2 ft.	Dark	Moderate
J	Med. tex. mat. 2-4 ft. thick on calc. sicl. till	Dark	Moderate
	Med. tex. mat. <2 ft. thick on sicl. till, calc. at 1 1/2-3 ft.	Dark	Moderate
	Sandy mat. 1 1/2-3 1/2 ft. thick on sicl., calc. by <3 1/2 ft.	Dark	Mod.-weak
K	Med. tex. mat. 2-4 ft. thick on calc. sic. drift	Dark	Moderate
	Med. tex. mat. (inc. loess) <2 ft. thick on sic. drift, calc. at <3 ft.	Dark	Mod. strong
	Med. tex. mat. (inc. loess) <2 ft. thick on c. drift, calc. at <3 ft.	Dark	Mod.-strong
L	Loess >5 ft. thick, calc. at 2 1/2-4 ft.	Light	Moderate
	Loess >4-5 ft. thick, noncalc. >3 1/2 ft.(Same as A above.)	Mod. dark	Weak
		Light	Weak
		Mod. dark	Moderate
		Light	Moderate
M	Loess 3-5 ft. thick on calc. loam-sicl. till(Same as B above.)	Mod. dark	Mod. strong
		Light	Mod. strong
	Loess 1-3 ft. thick on cl. till, noncalc. >3 1/2 ft.(Same as B above.)	Mod. dark	Moderate
		Light	Moderate
N	Loess >4-5 ft. thick, noncalc. >3 ft.(Same as A above.)	Mod. dark	Mod. strong
		Light	Mod. strong
O	Loess >5 ft. thick, calc. at 2 1/2-4 ft.	Light	Moderate
	Loess >5 ft. thick, noncalc. >3 1/2 ft.	Light	Moderate
P	Loess 4-10 ft. thick on Illinoian drift or >7 ft. thick on residuum	Light	Strong
Q	Loess 1 1/2-4 ft. thick on Illinoian drift	Light	Strong-very strong
	Loess <1 1/2 ft. thick on Illinoian drift	Light	Mod.-strong
R	Loess 3 1/2-7 ft. thick on bedrock residuum	Light	Strong-very strong
	Loess 1 1/2-3 1/2 ft. thick on bedrock residuum	Light	Mod.-strong
S	Med. tex. mat. 2-3 1/2 ft. thick on calc. gravel	Light	Moderate
T	Loess 2 1/2-5 ft. thick on noncalc. cl.-scl. till(Same as H above.)	Mod. dark	Moderate
		Light	Moderate
	Loess 1 1/2-3 ft. thick on noncalc. cl.-scl. till to 4 ft.(Same as H above.)	Mod. dark	Moderate
		Light	Moderate

[1] Correlated and important uncorrelated soils in Illinois.

[2] Abbreviations and symbols used in tables are as follows: < = less than; > = greater than; c. = clay; calc. = calcareous; cl. = clay loam; f. = fine; fs. = fine sand; fsl. = fine sandy loam; ft. = feet; g. = gravel; gcl. = gravelly clay loam; gl. = gravelly loam; hv. = heavy; inc. = including; l. = loam; lfs. = loamy fine sand; ls. = loamy sand; mat. = material; med. = medium; mod. = moderate; noncalc. = noncalcareous; s. = sand; scl. = sandy clay loam; si. = silt; sic. = silty clay; sicl. = silty clay loam; sil. = silty loam; sl. = sandy loam; slt. = slightly; and tex. = texture.

[3] "Somewhat poor" may also be used for this soil drainage class.

[4] Associated soils often occur in the field with those soils shown on the same lines, but usually differ in one or more characteristics. Some soils shown in a given area are also listed as associated soils in other areas.

Natural internal drainage class				Associated soil type numbers[4]
Well	Moderately well	Imperfect[3]	Poor	
Port Byron 277	Joy 275			272, 276, 562, 564
	Tama 36	Muscatine 41	Sable 68	34, 44, 45, 47, 67, 244, 272, 660
	Bolivia 246	Ipava 43	Sable 68	34, 44, 45, 47, 67, 244, 249, 470
	Catlin 171	Flanagan 154	Drummer 152	67, 153, 330
Sidell 55	Dana 56	Raub 481	Drummer 152	330
	Wenona 388	Rutland 375	Streator 435	91, 235, 330
Douglas 128	Harrison 127	Herrick 46	Virden 47, 50	138, 250, 251, 252, 256, 259, 474
	O'Fallon 114	Oconee 113	Cowden 112	48, 120, 138, 250, 474, 581, 584
	Richview 4	Hoyleton 3	Cisne 2	48, 120, 167, 218, 287, 581, 584
Warsaw 290		Kane 343	Will 329	93, 197, 313, 318
Carmi 285, 286		Omaha 289	Abington 300	79, 155, 305, 253
Ogle 412				
Durand 416				
	Ringwood 297			191, 197
Griswold 363				
	Saybrook 145	Lisbon 59		152
LaRose 60, Parr 221	Corwin 495	Odell 490	Pella 153	152, 204
	Symerton 294	Andres 293	Reddick 594	97, 100, 103, 210
	Varna 223	Elliott 146	Ashkum 232	330
	Rankin 157	Wesley 141		
	Mona 448	Mokena 295		
		Swygert 91	Bryce 235	42, 229, 238
		Clarence 147	Rowe 230	42, 229
Sylvan 19	Iona 307	Reesville 723	Whitson 116	30, 35, 271
Mt. Carroll 268	Fall 263			
Seaton 274	Decorra 273			30, 271, 281, 282, 563, 565
	Downs 386	Atterberry 61		
Fayette 280	Rozetta 279	Stronghurst 278	Traer 633	30, 35, 271
		Sunbury 234		
	Birkbeck 233	Sabina 236	Ward 207	
Mellott 497	Wingate 348	Toronto 353		
Russell 322	Xenia 291	Fincastle 496		
	Sicily 258	Clarksdale 257		
Clary 283	Clinton 18	Keomah 17	Rushville 16	6, 7, 8, 119, 264, 470, 660
Sylvan 19	Iona 307	Reesville 723	Whitson 116	30, 35, 271
Alford 308	Muren 453	Iva 454		35, 216, 271
	Hosmer 214	Stoy 164	Weir 165	8, 15, 215, 583, 585
	Ava 14	Bluford 13	Wynoose 12	15, 109, 337, 583, 585
	Hickory 8	Blair 5		264
	Grantsburg 301	Robbs 335		
	Zanesville 340			339, 425
Fox 327		Homer 326		93, 253, 313, 323, 325, 342, 364
Myrtle 414				
Flagg 419				
	Argyle 227	Beaver 225		
	Pecatonica 21			

TABLE 3 (Continued)

Area on general soil map	Parent material[2]	Surface color[2]	Degree of development[2]
T Continued	Loess 1-3 ft. on sl. till, calc. <4 ft.(Same as H above.)	Light	Moderate
	Loess <1 ft. thick on sl. till, calc. <3 1/2 ft.(Same as H above.)	Light	Moderate
	Loess <1 1/2 ft. thick on noncalc. cl.-scl. till to 3 1/2 ft.	Light	Moderate
U	Loess 1 1/2-3 ft. thick on loam till, calc. by 2-3 1/2 ft.(Same as I above.)	Mod. dark	Moderate
		Light	Moderate
	Loess <1 1/2 ft. thick on loam till, calc. by 2-3 1/2 ft.(Same as I above.)	Mod. dark	Moderate
		Light	Moderate
V	Med. tex. mat. <2 ft. thick on sicl. till, calc. at 1 1/2-3 ft.(Same as J above.)	Mod. dark	Moderate
		Light	Moderate
	Med. tex. mat. <2 ft. thick on sic.-c. drift, calc. at 1 1/2-3 ft.	Mod. dark	Mod. strong
		Light	Mod.-strong
W	Loess 3-5 ft. thick on noncalc. med. tex. outwash or sl. till to 5 ft.	Dark	Moderate
		Mod. dark	Moderate
		Light	Moderate
	Loess <3 ft. thick on med. tex. outwash to 5 ft., noncalc. to 3 1/2 ft.	Dark	Moderate
		Mod. dark	Moderate
		Light	Moderate
	Silty wash >5 ft. thick	Dark	Weak
		Light	Weak
	Silty mat. >4 ft. thick, calc. at 2-3 1/2 ft.	Dark	Moderate
		Mod. dark	Moderate
		Light	Moderate
	Med. tex. mat. <2 ft. thick on noncalc. sic.-c. >3 1/2 ft. thick	Dark	Moderate
		Light	Mod. strong
	Med. tex. mat. <1 1/2 ft. thick on sic.-c., calc. at 2-3 1/2 ft.	Light	Moderate
	Med. tex. mat. <1 1/2 ft. thick on sicl. calc. at 2 1/2-4 ft.	Dark	Moderate
		Light	Moderate
	Med. tex. mat. 3-5 ft. thick on loamy mat.	Light	Moderate
	Med. tex. mat. 3 1/2-5 ft. thick on sand or fine sand	Dark	Moderate
	Med. tex. mat. or loess 2-3 1/2 ft. thick on sand or fine sand	Dark	Moderate
		Light	Moderate
X	Sand, fine sand, loamy sand, or loamy fine sand >5 ft. thick	Dark	None to 5 ft.
		Light	None to 5 ft.
		Dark	Weak at 3-5 ft.
		Light	Weak at 3-5 ft.
	Sandy loam and fine sandy loam 1 1/2-3 ft. thick on sand, fine sand, loamy sand, or loamy fine sand at 3-5 ft.	Dark	Weak
		Light	Weak
		Dark	Moderate
		Light	Moderate
Y	Med. tex. mat. <1 ft. thick on limestone	Dark	None-weak
	Med. tex. mat. 1-2 1/2 ft. thick on limestone	Dark	Weak-mod.
		Light	Weak-mod.
	Med. tex. mat. 2 1/2-4 ft. thick on limestone	Dark	Moderate
	Loess 1-2 1/2 ft. thick on <1 ft. of limestone residuum on limestone at 1 1/2-3 ft.	Dark	Moderate
		Light	Moderate
	Loess 2 1/2-4 ft. thick on <1 ft. of limestone residuum on limestone at 3-5 ft.	Dark	Moderate
		Light	Moderate

[1]Correlated and important uncorrelated soils in Illinois.

[2]Abbreviations and symbols used in tables are as follows: < = less than; > = greater than; c. = clay; calc. = calcareous; cl. = clay loam; f. = fine; fs. = fine sand; fsl. = fine sandy loam; ft. = feet; g. = gravel; gcl. = gravelly clay loam; gl. = gravelly loam; hv. = heavy; inc. = including; l. = loam; lfs. = loamy fine sand; ls. = loamy sand; mat. = material; med. = medium; mod. = moderate; noncalc. = noncalcareous; s. = sand; scl. = sandy clay loam; si. = silt; sic. = silty clay; sicl. = silty clay loam; sil. = silty loam; sl. = sandy loam; slt. = slightly; and tex. = texture.

[3]"Somewhat poor" may also be used for this soil drainage class.

[4]Associated soils often occur in the field with those soils shown on the same lines, but usually differ in one or more characteristics. Some soils shown in a given area are also listed as associated soils in other areas.

Natural internal drainage class: Well	Moderately well	Imperfect[3]	Poor	Associated soil type numbers[4]
	McHenry 310			292, 296, 299, 364
Lapeer 361				25, 292, 296, 364
Westville 22				25
		Herbert 62		
Dodge 24				
Octagon 656	Montmorenci 57	Otterbein 617		
Miami 27	Celina 616			25, 205, 224
	Markham 531	Beecher 298		210, 324
	Morley 194	Blount 23		
		Frankfort 320		
	St. Clair 560	Eylar 228 (Nappanee)		241
	Plano 199	Elburn 198	Drummer 152	191, 197, 206
	Batavia 105	Virgil 104		
	St. Charles 243	Kendall 242		
Alexis 80	Proctor 148	Brenton 149		67, 136, 152, 206
	Harvard 344	Millbrook 219		346
	Camden 134	Starks 132	Sexton 208	137
	Worthen 37	Littleton 81		39
	Drury 75			732
		Harco 484		
		Marissa 176	Patton 142	
	Uniontown 482	Reesville 723		
		Denrock 262	Perrot 568	110, 261, 576
	Colp 122	Hurst 338	Okaw 84	26
	Markland 467	McGary 173		465
	Gilmer 341	Martinton 189	Milford 69	
		DelRey 192		
Wheeling 463	Sciotoville 462	Weinbach 461	Ginat 460	469
		LaHogue 102	Selma 125	130, 188, 265
	Pilot 159			
	Thebes 212	Tamms 211		
Hagener 88		Watseka 49	Maumee 89	
Plainfield 54, 90			Kilbourne 203	270
Ade 98				
Bloomfield 53				31
	Dickinson 87	Hoopeston 172, 237	Gilford 201	266
	Lamont 175			332
	Onarga 150, 190	Ridgeville 151, 156	Pittwood 130	101, 187, 200, 202, 359, 673
	Alvin 131, 144	Roby 184, 185	Ruark 178	101. 187, 200
			Romeo 316	
	Channahon 315		Joliet 314	
	Ritchey 311			
		Plattville 220	Millsdale 317	
Dodgeville 40				
Dubuque 29				413, 471, 511
Ashdale 411				
Palsgrove 429				

TABLE 3 (Continued)

Area on general soil map	Parent material[2]	Surface color[2]	Degree of development[2]
Y Continued	Loess and noncalc. cl. drift 2 1/2-4 ft. thick on limestone	Dark	Moderate
		Light	Moderate
	Med. tex. mat. <1 ft. thick on shale residuum or shale	Light	Weak-mod.
	Loess 1-2 1/2 ft. thick on shale residuum or shale	Dark	Moderate
		Light	Moderate
	Loess 2 1/2-4 ft. thick on shale residuum or shale	Dark	Moderate
		Light	Moderate
	Sl. and fsl. <1 ft. thick on Sandstone	Mod. dark	None
	Sandy mat. 1-3 1/2 ft. thick on Sandstone	Dark	Weak-mod.
		Light	Weak-mod.
Z	Calcareous sandy loam to sand or fine sand	Light	None
	Calcareous medium textured sediments	Dark	Weak
		Mod. dark	None
		Light	None
	Slightly acid-neutral sl.-fsl. 2-3 ft. thick on sand	Dark	None-weak
	Slightly acid-neutral med. tex. mat. 1-2 1/2 ft. thick on sand	Dark	Weak
	Slt. acid-neutral mod. f.-f. tex. mat. 1-2 1/2 ft. thick on sand	Dark	Weak
	Slt. acid-neutral med.-mod. f. tex. mat. 2 1/2-4 ft. thick on sand	Dark	Weak
	Slightly acid-neutral med. tex. mat. 1 1/2-3 1/2 ft. thick on dark fine tex. soil	Dark	Weak
		Light	None
	Slightly acid-neutral med. tex. mat. >4 ft. thick	Dark	Weak
		Light	None-weak
	Slightly acid-neutral mod.-fine tex. mat. >4 ft. thick	Dark	Weak
		Light	Weak
	Slightly acid-neutral fine tex. mat. >4 ft. thick	Dark	Weak
		Mod. dark	Weak
		Light	Weak
	Acid med. tex. mat. >4 ft. thick	Light	None-weak
	Acid mod. fine tex. mat. >4 ft. thick	Light	Weak
	Acid mod. f. tex. mat. 2-3 1/2 ft. thick on fine tex. mat.	Light	Weak
	Acid fine tex. mat. >4 ft. thick	Light	Weak

[1]Correlated and important uncorrelated soils in Illinois.

[2]Abbreviations and symbols used in tables are as follows: < = less than; > = greater than; c. = clay; calc. = calcareous; cl. = clay loam; f. = fine; fs. = fine sand; fsl. = fine sandy loam; ft. = feet; g. = gravel; gcl. = gravelly clay loam; gl. = gravelly loam; hv. = heavy; inc. = including; l. = loam; lfs. = loamy fine sand; ls. = loamy sand; mat. = material; med. = medium; mod. = moderate; noncalc. = noncalcareous; s. = sand; scl. = sandy clay loam; si. = silt; sic. = silty clay; sicl. = silty clay loam; sil. = silty loam; sl. = sandy loam; slt. = slightly; and tex. = texture.

[3]"Somewhat poor" may also be used for this soil drainage class.

[4]Associated soils often occur in the field with those soils shown on the same lines, but usually differ in one or more characteristics. Some soils shown in a given area are also listed as associated soils in other areas.

Natural internal drainage class				Associated soil
Well	Moderately well	Imperfect[3]	Poor	type numbers[4]
Hitt 506				
Woodbine 410				
	Gosport 551			
	Schapville 418			
	Derinda 417			309, 549
Keltner 546		Loran 572		
Eleroy 547				
Bullard 389				
Hesch 390				
Boone 397				
Sarpy 92				
DuPage 321		Millington 82		400
	Dorchester 239, 578			
	Jules 28			
Landes 304				
Ware 456				
	Riley 452	Bowdre 589		
		Newart 161	Gorham 162	248, 590
		Radford 74		
Arenzville 78		Dupo 180		415
Huntsville 77		Lawson 451	Otter 76	
Haymond 331		Wakeland 333	Birds 334	475
Allison 306		Tice 284	Beaucoup 70, 124	107, 302
			Petrolia 288	
			Wabash 83	
			Darwin 71	
			Karnak 426	
Sharon 72		Belknap 382	Bonnie 108	427
			Piopolis 420	
			Cape 422	
			Jacob 85	

material of the soil in the various horizons of the profile

(7) typical pH for the materials

(8) average depth in the profile to which high (> 2% organic carbon), medium 1-2% organic carbon), and low (> 1% organic carbon) quantities of organic carbon are normally encountered

By analyzing the above properties and characteristics, applying the stabilization guidelines and criteria presented in Chapter 4, and giving appropriate consideration to the various aspects of stabilization technology, Chapter 2, it was possible to develop stabilization recommendations as shown in Appendix A for the major soils of each soil association area.

RATING SYSTEM USED IN RECOMMENDATIONS

Recommendations concerning stabilization of a particular soil carry either a 1, 2, or 3 rating. A "1" rating indicates that the stabilizing agent should quite suitably and adequately provide stabilization if proper construction practice is used. A "2" rating indicates a questionable rating because the stabilizing agent may provide adequate stabilization, but in certain cases adequate stabilization can not be obtained. A "3" rating indicates that in most cases, the particular stabilizing agent will not provide the degree of stabilization desired.

DISCUSSION OF PRESENTATION OF STABILIZATION RECOMMENDATIONS

Stabilization recommendations for the major soils in each soil association area are presented in Appendix A. An alphabetical index to the major soils included in this report is also included at the beginning of Appendix A. Appendix B contains stabilization recommendations for the major textural groups of Wisconsinan glacial till. Recommendations are presented concerning the feasibility of using cement, lime, bitumen, lime-fly ash and combination stabilizing agents for stabilization (either to expedite construction, modify the subgrade, or to improve strength and durability) of the material in the A, B, and C horizons (including unweathered Wisconsinan glacial till) of each major soil series.

VI. SUMMARY

Stabilization recommendations for the major soils and materials occurring in Illinois have been developed and are presented in Appendices A and B.

In developing these stabilization recommendations, extensive use has been made of pedological soil mapping concepts used by the Department of Agronomy, University of Illinois and the Soil Conservation Service, U. S. Department of Agriculture. Soil association areas were used to combine the soils into groups with similar characteristics. Although recommendations have not been presented for all soils within each soil association area, by utilizing the guidelines and criteria which were developed for the soils of Illinois (Chapter 4) and by appropriate consideration of stabilization technology (Chapter 3), stabilization recommendations can be readily determined for other soils.

The information which can be obtained from this report is meant to facilitate the selection of a stabilizing agent or agents to be used in various highway construction applications. However, additional factors must be considered in order to obtain quality stabilized materials meeting job requirements for a particular stabilization objective. Appropriate mixture design procedures must be used to determine the quantity of stabilizing agent or agents which must be used to satisfy the job requirements of the particular application. Economic considerations, in many cases, may be very important and will often be used in final selection of a stabilizing agent. And finally, proper construction techniques and control must be used to insure that a quality product is obtained in the field.

VII. APPENDIX A

Presented in this appendix for the major soils occurring in the soil associations in Illinois as shown on Figure 7 are:

(1) A brief discussion of the soils in each soil association
(2) A tabular summary of the nature and properties of the major soils in each soil association
(3) Stabilization recommendations for the major soils of each soil association

TABLE OF CONTENTS FOR APPENDIX A

ALPHABETICAL INDEX TO THE MAJOR SOILS IN THIS REPORT

Soil Series Name and Number	Found in Soil Association Areas	Page
Parr 221	I	93
Pecatonica 21	T	167
Pella 153	I	93
Piasa 474	E	69
Piopolis 420	Z	211
Plainfield 54	X	195
Plano 199	W	185
Port Byron 277	A	45
Proctor 148	W	185
Radford 74	Z	211
Raub 481	B	51
Reesville 723	L,O	111, 137
Richview 4	F	75
Ridgeville 151	X	195
Ringwood 297	H	87
Robbs 335	R	155
Roby 184	X	195
Rodman 93	G	81
Rowe 230	K	105
Rozetta 279	L	111
Rushville 16	N	131
Russell 322	M	121
Rutland 375	C	57
Sabina 236	M	121
Sable 68	A	45
Saybrook 145	I	93
Seaton 274	L	111
Selma 125	W	185
Sicily 258	N	131
Sidell 55	B	51
St. Clair 560	V	179

Soil Series Name and Number	Found in Soil Association Areas	Page
Starks 132	W	185
Stoy 164	P	143
Strawn 224	U	173
Streator 435	C	57
Stronghurst 278	L	111
Sunbury 234	M	121
Sylvan 19	L,O	111, 137
Symerton 294	J	99
Swygert 91	K	105
Tama 36	A	45
Thorp 206	W	185
Tice 284	Z	211
Toronto 353	M	121
Traer 633	L	111
Varna 223	J	99
Virden 47,50	D	63
Wabash 83	Z	211
Wakeland 333	Z	211
Ward 207	M	121
Warsaw 290	G	81
Weir 165	P	143
Wenona 388	C	57
Westville 22	T	167
Will 329	G	81
Wingate 348	M	121
Woodbine 410	Y	205
Wynoose 12	Q	149
Xenia 291	M	121
Zanesville 340	R	155

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SOIL ASSOCIATION A

Soil association area A occurs in the northwestern and west-central parts of Illinois, Figure 7, and occupies about 4,761,000 acres or 13.2 percent of the state. A more detailed soil association map of northwestern Illinois is available [a]. The soils in this association have developed under grass vegetation from moderately thick to thick (5 to 20 feet) loess. The thickness of the loess layer decreases from the northwest to the southeast in this association area.

The major soil series of association area A are listed in Table 1-A. Tama, Port Byron, Joy, and Bolivia are found on the well and moderately well drained positions of the soil catena; Muscatine and Ipava soils occur on the imperfectly drained positions; and Sable is found on the poorly drained positions of the catena.

Typically, association area A soils have rather thick, highly organic A horizons. As noted in Table 1-A, the organic carbon content is generally greater than 2 percent to a depth of 14 to 16 inches and is less than 1 percent below 22 to 26 inches. The A horizon materials typically display a silt loam texture and are designated as A-6 soils. The B horizon materials are typically classified as silty clay loam in texture and are designated A-6 to A-7 soils while the C horizon material (parent loess) is typically classified as silt loam with an A-4 or A-6 designation depending on the plasticity.

Available information, summarized in Table 1-A, indicates that the plasticity index ranges from 10-35, 16-35, and 7-30 respectively for the A, B, and C horizons. The clay content ranges from 20-35, 20-35, and 15-25 percent for the respective horizons. Typical unweathered loess of association area A contains 1-3 percent sand, 80-88 percent silt, and 10-18 percent clay (8) with plasticity indices ranging from 7-20 percent (3).

Stabilization recommendations for the materials found in association area A are summarized in Table 2-A.

(a) Available from: University of Illinois, Agronomy Department, Room N-405 Turner Hall, Urbana, Illinois 61801

TABLE 1-A
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION A

Percent Area of State 13.2 Parent Material: Loess > 4 - 5 feet thick, noncalcareous at > 3-1/2 feet.

Total Acreage 4,761,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
246 Bolivia	1.0 (3177)	2-6 (MW)	About 1 ft. of silt loam on 3 ft. of silty clay loam underlain by silt loam. Moderately well drained, gently to moderately sloping soils formed in loess generally 6 to 8 ft. thick on glacial drift.
43 Ipava	1.9 (5941)	1-3 (Imp)	About 1-1/2 ft of silt loam on 1-1/2 to 2 ft of silty clay loam underlain by silt loam (loess). Somewhat poorly drained, level to gently sloping soils formed from deep deposits of loess. Seasonal water tables above 3 ft.
275 Joy	0.08 (253)	1-3 (MW)	About 1 to 1-1/2 ft. of silt loam on 2 ft. of silt loam underlain by silt loam (loess). Moderately well-drained, level to moderately sloping soils formed from deep deposits of loess.
41 Muscatine	2.4 (8015)	1-3 (Imp)	About 1 ft. of silt loam on about 2-1/2 ft. of silty clay loam & underlain by silt loam (loess). Somewhat poorly drained level to sloping soils on loess (over 60 in. thick) covered drift or bedrock. Seasonal watertable above 3 ft.
277 Port Byron	0.12 (405)	3-10 (W)	About 1 ft.of silt loam on 2 to 2-1/2 ft. of heavy silt loam and underlain by silt loam (loess). Well drained, sloping soils on loess (over 60 in. thick) covered till or bedrock uplands.
68 Sable	1.0 (3474)	0-1 (P)	About 1-1/2 ft. of organic silty clay loam on about 1-1/2 to 2 ft. of silty clay loam and underlain by silt loam (loess). Poorly drained, level soils on loess (over 60 in. thick) covered glacial drift or bedrock. Seasonal water table at or near the surface.
36 Tama	3.5 (11420)	3-7 (W-MW)	About 1 ft. of silt loam on about 2-1/2 ft. of silty clay loam and underlain by silt loam (loess). Well-drained, sloping soils on loess (> 60 in.thick) covered glacial till or bedrock uplands.

(1) From Reference 13

(2) From Reference 7

TABLE 1-A (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve						Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA(2) Textural	AASHO (2)	No. 4	No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	> 2%	1-2%	< 1%
0-14	Silt Loam	A-6 or A-7	100	95-100	20-30	30-50	10-25	5.1-6.0			
14-50	Silty Clay Loam	A-7 or A-6	100	95-100	30-40	40-60	20-30	5.6-6.5	0-16	16-26	26-60
50-60	Silt Loam	A-4, A-6	100	95-100	15-25	30-45	7-20	5.6-6.5			
0-18	Silt Loam	A-6 or A-7	100	95-100	20-30	30-50	10-25	5.6-6.5			
18-40	Silty Clay Loam	A-7	100	95-100	30-40	50-60	20-30	5.6-6.5	0-14	14-22	22-60
40-60	Silt Loam	A-4, A-6	100	95-100	15-25	30-45	7-20	6.6-8.4			
0-16	Silt Loam	A-6	100	95-100	15-25	30-50	10-25	5.6-6.5			
16-40	Silt Loam	A-6	100	95-100	20-30	40-55	20-30	5.6-6.5	0-14	14-23	23-60
40-60	Silt Loam	A-4, A-6	100	95-100	15-25	30-45	7-20	6.6-7.8			
0-16	Silt Loam	A-7	100	95-100	20-30	40-60	15-25	5.6-6.5			
16-42	Silty Clay Loam	A-7	100	95-100	25-35	45-55	20-35	5.6-6.5	0-16	16-24	24-60
42-60	Silt Loam	A-4, A-6	100	95-100	15-25	25-50	4-25	6.6-7.8			
0-12	Silt Loam	A-6	100	95-100	15-25	30-50	10-25	5.6-6.5			
12-42	Silt Loam	A-6	100	95-100	20-30	40-55	20-30	5.6-6.5	0-16	16-22	22-60
42-60	Silt Loam	A-4, A-6	100	95-100	15-25	30-45	7-20	6.6-7.8			
0-16	Silty Clay Loam	A-7	100	95-100	25-35	40-65	13-35	6.1-7.3			
16-36	Silty Clay Loam	A-6 or A-7	100	95-100	25-35	40-55	20-35	6.1-7.3	0-14	14-20	20-60
36-60	Silt Loam	A-4, A-6	100	95-100	15-25	30-50	10-30	6.6-7.8			
0-12	Silt Loam	A-7 or A-6	100	95-100	20-30	30-60	10-25	5.6-6.5			
12-42	Silty Clay Loam	A-7 or A-6	100	95-100	25-35	38-65	16-35	5.6-6.5	0-16	16-22	22-60
42-60	Silt Loam	A-4, A-6	100	95-100	15-25	25-45	7-23	6.6-7.8			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-A
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION A

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
246 Bolivia	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
43 Ipava	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
275 Joy	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
41 Muscatine	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
277 Port Byron	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
68 Sable	A	2	1	3	3	3	2	1	2(a)	2	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
36 Tama	A	2	1	3	3	3	2	1	2(a)	2	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature survey.

( ) See designated comment on following page

TABLE 2-A (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION B

Soil association area B occurs in east-central and north-central Illinois, Figure 7, and occupies about 2,621,000 acres or 7.2 percent of the state. The soils in this area have developed under grass vegetation from either 3-5 feet of loess on loam to silty clay loam Wisconsinan glacial till or 1-3 feet of loess on clay loam Wisconsinan glacial till. The loess of area B is slightly finer-textured than loess of association area A. The nature of underlying Wisconsinan tills is discussed in Chapter 2 and Appendix B.

The major soil series of association area B are listed in Table 1-B. Sidell, Catlin, and Dana occur on the higher, well, well-moderately well, and moderately well drained positions of the soil catena; Flanagan and Raub on the imperfectly drained positions; and Drummer on the poorly drained positions. Drummer soils may also be found in association areas L and W.

Thick, highly organic A horizons are typical of the soils in area B. As noted in Table 1-B, the organic carbon content is generally greater than 2 percent to a depth of 12 to 16 inches and is less than 1 percent at depths greater than 20 to 24 inches. These soils typically display a silt loam texture in the A horizon with the exception of the A horizon of Drummer which displays a silty clay loam texture. The AASHO designation for the A horizon materials is typically A-6 to A-7. The B horizon of association area B soils is typically silty clay loam in texture and is designated as a more plastic A-6 or A-7 material. The texture of the C horizon material of the area B soils depends on the loess thickness since in many areas the loess is quite thin and the weathering profile extends into the underlying Wisconsinan till. If the C horizon is present in loess it will be loam in texture while if the C horizon is present in the glacial till a loam, clay loam, or silty clay loam texture may be expected. The C horizon materials typically classify as A-4 or A-6 depending on the plasticity.

Available information, summarized in Table 1-B, indicates that the average plasticity index for the A horizon and B horizon materials of the well to imperfectly drained soils ranges from 16-36 and the clay content ranges from 24-41 percent. The A and B horizons of the poorly drained soils display plasticity indices and clay contents ranging from 16-36 and 28-53 percent respectively. The plasticity index and clay content of the C horizon typically range from 11-30 and 10-25 percent respectively.

Stabilization recommendations for association area B materials are summarized in Table 2-B.

TABLE 1-B

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION B

Percent Area of State 7.2

Total 2,613,000

Parent Material: (a) Loess 3 - 5 feet thick on calcareous loam to silty clay loam till or
(b) Loess 1 - 3 feet thick on clay loam till, (noncalcareous > 3-1/2).

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
171 Catlin (a)	1.15 (3771)	3-7 (W-MW)	About 1 foot of silt loam on 2 feet of silty clay loam underlain by silt loam grading to calcareous loam glacial till. Well drained, nearly level to strongly sloping soils formed from about 3-5 feet of loess over calcareous loam glacial till.
56 Dana (b)	0.16 (515)	3-7 (MW)	About 1 foot of silt loam on 2-1/2 to 3 feet of silty clay loam underlain by non-calcareous clay loam glacial till which becomes calcareous below 4 feet. Moderately well drained, nearly level soils formed from 2-4 feet of loess over glacial till.
152 Drummer (a&b)	6.06 (19911)	0-1 (P)	About 1-1/2 feet of silty clay loam on about 1-1/2 feet of silty clay loam and underlain by silt loam, loam or sandy loam glacial drift. Poorly drained, level soils on loess (40-60 inches thick) covered till plains and moraines or stream terraces and outwash plains. Seasonal water tables at or near the surface.
154 Flanagan (a)	3.31 (10867)	1-3 (Imp.)	About 1 foot of silt loam on 2 to 3 feet of silty clay loam and underlain by loam to silt loam till. Somewhat poorly drained level to sloping soils on loess (40 to 50 inches thick) covered till plains and moraines. Seasonal water tables above 3 feet.
481 Raub (b)	0.14 (458)	1-3 (Imp.)	About 1 to 1-1/2 feet of silt loam on 2 feet of silty clay loam on 1 to 2 feet of clay loam underlain by calcareous loam glacial till. Somewhat poorly drained, nearly level to gently sloping soils formed in about 1 1/2 to 3 feet of loess on glacial till plains. Seasonal water tables are within 3 feet of the surface.
55 Sidell (b)	0.07 (237)	6-12 (W)	About 1 foot of silt loam on 1 to 1-1/2 feet of silt clay loam on 1-1/2 to 2 feet of clay loam underlain by loam glacial till. Well drained, gently sloping to moderately steep soils formed in 2 to 3 feet of loess on glacial till plains and moraines.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-B (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-12	Silt Loam	A-6 or A-7	100	95-100	15-25	30-50	10-25	5.6-6.5			
12-42	Silty Clay Loam	A-6 or A-7	100	95-100	30-40	35-58	15-30	5.6-6.5	0-16	16-22	22-60
42-60	Silt Loam to Loam	A-4 or A-6	95-100	55-75	15-25	30-55	11-20	7.4-8.4 (calc.)			
0-14	Silt Loam	A-6 or A-7	100	95-100	15-25	30-55	10-25	5.6-6.5			
14-50	Silty Clay Loam to Clay Loam	A-6 or A-7	100	60-90	30-40	35-55	15-35	5.6-6.0	0-16	16-22	22-60
50-60	Loam to Silt Loam	A-4 or A-6	95-100	55-85	15-25	25-50	11-20	7.4-8.4 (calc.)			
0-16	Silty Clay Loam	A-7	95-100	85-100	30-40	35-65	15-33	6.6-7.3			
16-36	Silty Clay Loam	A-7 or A-6	95-100	85-100	30-40	30-55	12-34	6.6-7.3	0-16	16-24	24-60
36-60	Silt Loam, Loam or Sandy Loam	A-2,A-4 or A-6	90-100	30-75	10-25	NP-50	NP-30	6.6-7.3			
0-14	Silt Loam	A-6 or A-7	100	95-100	15-25	30-60	15-29	5.6-6.5			
14-44	Silty Clay Loam	A-6 or A-7	100	95-100	35-45	42-60	16-35	5.6-6.5	0-12	12-20	20-60
44-60	Loam, Silt Loam or Silty Clay Loam	A-6 or A-4	95-100	55-75	15-25	30-55	11-30	7.4-8.4 (calc)			
0-14	Silt Loam	A-6 or A-7	100	85-95	15-25	--	--	5.6-6.5			
14-50	Silty Clay Loam to Clay Loam	A-6 or A-7	100	65-95	35-45	--	--	5.6-6.5	0-12	12-20	20-60
50-60	Loam to Silt Loam	A-4 or A-6	100	60-70	15-25	35-50	11-20	7.4-8.4 (calc.)			
0-14	Silt Loam	A-6 or A-7	100	95-100	15-25	30-55	10-25	5.6-6.5			
14-50	Silty Clay loam to Clay Loam	A-6 or A-7	100	60-90	30-40	35-55	15-35	5.6-6.0	0-16	16-22	22-60
50-60	Loam to Silt Loam	A-4 or A-6	100	55-85	15-25	25-50	11-20	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-B

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION B

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
171 Catlin	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
56 Dana	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	*
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
152 Drummer	A	2	1	3	3	3	2	1	$3^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
154 Flanagan	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
481 Raub	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
55 Sidell	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page.

TABLE 2-B (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION C

Soil association area C occurs in north-central Illinois, Figure 7, and occupies about 116,000 acres or 0.3 percent of the state. The soils of this area have developed under grass vegetation from 3-5 feet of loess underlain by silty clay to clay textured Wisconsinan glacial till. Further discussion of Wisconsinan glacial tills can be found in Chapter 2 and Appendix B.

The major soils series of this association area are Rutland, Streator, and Wenona. Minor inclusions of Bryce and Swygert soils may also be found in this association area. Wenona is found on the moderately well drained positions of the soil catena; Rutland on the imperfectly drained positions; and Streator on the poorly drained positions.

Rather thick, highly organic A horizons are typical of these soils. Materials in the A horizons of this area typically classify as silt loams or silty clay loams with an A-6 or A-7 AASHO designation. The B horizon materials contain more clay and are texturally classed as silty clay loam with a typical AASHO classification of A-6 or A-7. Depending on the thickness of the loess cover, the C horizon may be developed in either loam textured loess or Wisconsinan silty clay to clay glacial till. The AASHO designation of these two materials will be either A-4 to A-6 or A-6 to A-7.

Available information, summarized in Table 1-C, indicates that the plasticity index typically ranges from 20-35 for the C horizon. Clay contents for the A, B, and C horizons typically range from 25-40, 30-45, and 40-60 percent respectively. The C horizon typically displays properties similar to the parent loess described for association area A or of the fine-silty clay or clay-textured Wisconsinan till described in Chapter 2 and Appendix B depending on which parent material is encountered.

Stabilization recommendations for association area C materials are summarized in Table 2-C.

TABLE 1-C
PROPERTIES OF MAJOR SOILS IN SOILS ASSOCIATION C

Percent Area of State 0.3 Parent Material: Loess 3 - 5 feet thick on calcareous silty clay - clay till or drift.

Total Acreage 116,000

MAJOR SOIL SERIES, Number and Name	Percentage [(1)] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site [(2)] Description
375 Rutland	0.13 (442)	1-3 (Imp.)	About 1 foot of silt loam on 2 feet of silty clay loam on less than 1 foot of silt loam and underlain by calcareous silty clay to clay glacial till. Some what poorly drained, nearly level to moderately sloping soils formed in 2 to 5 ft. of loess on glacial till plains. seasonal water tables within 3 feet of the surface.
435 Streator	0.05 (166)	0-1 (P)	About 1 to 1-1/2 feet of silty clay loam on 2 feet of silty clay loam underlain by calcareous silty clay glacial till. Poorly drained, level to depressional soils formed in 3 to 5 feet of loess on calcareous glacial till plains. Seasonal water tables are at or near the surface.
388 Wenona	0.03 (88)	3-7 (MW)	About 1 foot of silt loam on 1 to 2 feet of clay loam underlain by calcareous silty clay to clay glacial till. Well drained, gently sloping to strongly sloping soils formed from 2-1/2 to 5 feet of loess on heavy glacial till plains. In some places there is a foot or so of silt loam just above the glacial till.

(1) From Reference 13

(2) From Reference 7

TABLE 1-C (Continued)

Depth From Surface, Inches	Soil Classification		Percent Passing Sieve (2)		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-12	Silt Loam	A-6 or A-7	95-100	90-100	25-30	--	--	5.6-6.5			
12-42	Silty Clay Loam	A-6 or A-7	95-100	85-100	35-45	--	--	5.6-6.5	0-12	12-20	20-60
42-60	Silty Clay to Clay	A-7	95-100	90-100	40-60	40-50	20-35	7.4-8.4 (calc)			
0-16	Silty Clay Loam	A-7	100	95-100	30-40	--	--	5.6-6.5			
16-40	Silty Clay Loam	A-7	100	95-100	35-45	--	--	5.6-6.5	0-14	14-24	24-60
40-60	Silty Clay	A-7	95-100	85-100	40-60	40-50	20-35	7.4-8.4 (calc)			
0-12	Silt Loam	A-6 or A-7	100	95-100	25-30	--	--	5.6-6.5			
12-30	Silty Clay Loam	A-6 or A-7	95-100	60-70	30-40	--	--	5.6-6.5	0-16	16-22	22-60
30-60	Silty Clay to Clay	A-7	95-100	70-80	40-60	40-50	20-35	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-C

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION C

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
375 Rutland	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	*
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	*
435 Streator	A	2	1	3	3	3	2	1	3[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	*
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	*
388 Wenona	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	*
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page.

TABLE 2-C (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION D

Soil association area D occurs in southwestern and western Illinois, Figure 7, and occupies 960,000 acres or about 2.7 percent of the state. These soils have developed under grass vegetation from 5-7 feet of loess on weathered Illinoian glacial drift.

The major soil series of this area are listed in Table 1-D. Douglas and Harrison occur on the well and moderately-well drained positions of the soil catena; Herrick is found on the imperfectly drained positions; and Virden occupies the poorly drained positions of the catena.

As indicated in Table 1-D, the organic carbon content is generally greater than 2 percent to a depth of about 10 inches and is less than 1 percent at depths greater than 11 to 20 inches. A silt loam textured A horizon with an AASHO designation of A-4 to A-6 is typical of these soils although the A horizon of Virden soils is generally more plastic and classifies as A-6 or A-7. Texturally, the B horizon classifies as a silty clay loam and has an A-6 or A-7 AASHO designation. The C horizons of association area D soils are usually developed in parent loess although at depths greater than 5-7 feet, weathered Illinoian drift will be encountered. The C horizon parent loess classifies texturally as silt loam and is generally of A-4 or A-6 AASHO designation.

The available information, summarized in Table 1-D, indicates that the plasticity indices and clay content of the A and B horizon can be expected to range from 10-20 and 20-25 percent respectively for the A horizon and 30-40 and 25-45 percent respectively for the B horizon. The C horizon typically ranges 15-35 and 15-25 percent respectively for the plasticity indices and clay content.

Stabilization recommendations for association area D materials are summarized in Table 2-D.

TABLE 1-D
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION D

Percent Area of State 2.7 Parent Material: Loess 5 to 7 feet thick on weathered Illinoian till.

Total Acreage 960,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
128 Douglas	0.05 (175)	4-12 (W)	About 1 foot of silt loam on 2 feet of silty clay loam underlain by silt loam. Well drained, nearly level to moderately steep soils formed from 4 to 8 feet of loess over glacial till.
127 Harrison	0.40 (1322)	3-7 (MW)	About 1 foot of silt loam on 3 feet of silty clay loam underlain by silt loam to silty clay loam glacial till. Moderately well drained, nearly level to moderately sloping soils formed from 3-5 ft. of loess on glacial till plains. Seasonal water tables above 3 feet in some places.
46 Herrick	1.40 (4591)	1-3 (Imp.)	About 1 foot of silt loam on 2 to 2-1/2 feet of heavy silty clay loam and underlain by silt loam (loess). Somewhat poorly drained, level soils on loess (60-90 inches thick) covered till plains. Seasonal water tables are above 3 feet.
47 Virden	0.14 (455)	0-2 (P)	About 1-1/2 feet of silt loam on 1-1/2 to 2 feet of silty clay loam underlain by silt loam (loess). Poorly drained, level to slightly depressional soils formed in deep loess. Seasonal water tables are at or near the surface.
50 Virden	0.47 (1564)	0-1 (P)	About 1-1/2 feet of silty clay loam high in organic matter on 2 to 2-1/2 feet of silty clay loam underlain by silt loam (loess). Clay loam may be encountered below 50 inches. Poorly drained, level soils on loess (45-70 inches thick) covered till plains. Seasonal water table near surface.

(1) From Reference 13

(2) From Reference 7

TABLE 1-D (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ), %	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-14	Silt Loam	A-4 or A-6	100	95-100	15-25	30-45	5-20	5.6-6.5			
14-40	Silty Clay Loam	A-6 or A-7	100	95-100	25-35	25-65	9-40	5.1-6.0		0-11	11-60
40-60	Silt Loam	A-6 or A-4	100	95-100	15-25	35-50	15-30	5.6-6.5			
0-12	Silt Loam	A-4 or A-6	100	95-100	15-25	33-55	9-26	5.6-6.5			
12-46	Silty Clay Loam	A-7	100	95-100	30-40	32-75	10-55	5.6-6.0	0-10	10-20	20-60
46-60	Silt Loam	A-6 or A-4	100	95-100	15-25	35-55	15-35	5.6-6.5			
0-14	Silt Loam	A-4 or A-6	100	95-100	15-25	30-40	10-20	5.1-6.0			
14-40	Silty Clay Loam	A-7	100	95-100	35-45	50-70	30-40	5.1-6.0	0-9	9-16	16-60
40-60	Silt Loam	A-6	100	95-100	15-25	35-45	15-30	5.6-6.5			
0-20	Silt Loam	A-6 or A-7	100	95-100	20-30	43-64	12-34	6.1-7.3			
20-40	Silty Clay Loam	A-6	100	95-100	30-40	34-60	15-40	6.1-7.3	0-10	10-16	16-60
40-60	Silt Loam	A-4 or A-6	100	95-100	15-25	25-55	15-35	6.6-7.8			
0-16	Silt Loam	A-7	100	95-100	30-40	37-64	12-34	6.1-7.3			
16-44	Silty Clay Loam	A-6 or A-7	100	95-100	30-40	34-60	15-40	6.1-7.3	0-10	10-16	16-60
44-60	Silt Loam	A-6	100	95-100	15-25	35-55	15-35	6.6-7.8			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-D
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION D

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
128 Douglas	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆
127 Harrison	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆
46 Herrick	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆
47 Virden	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆
50 Virden	A	2	1	3	3	3	2	1	3(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page.

TABLE 2-D (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION E

Soil association area E occurs in south-central and southwestern Illinois, Figure 7, and occupies 671,000 acres or about 1.9 percent of the state. These soils have developed under grass vegetation from 4-6 feet of loess on weathered Illinoian glacial drift.

The major soil series occurring in this area are listed in Table 1-E. O'Fallon and Oconee soils are found on the moderately well and imperfectly drained positions of the soil catena and Cowden occupies the poorly drained position.

Association area E may contain small inclusions of natric soils, which are characterized by a high sodium content in the subsoil, but which more commonly occur in association area F. In association area E, the predominant natric soils are Piasa, Tamalco, and Walshville. The distribution and occurence of natric soils in Illinois is illustrated in Figure 10.

Association area E soils are characterized by lower carbon contents and thinner A horizons compared to association areas A, B, C, and D. As indicated in Table 1-E, the organic carbon content of the A horizon can only be considered as moderate. In general, the organic carbon content is greater than 1 percent to a depth of 8 to 20 inches and less than 1 percent at greater depths. Texturally the materials in the A horizon of association area E classify as silt loam with an A-4 to A-6 AASHO designation. Silty clay loam to silty clay texture and an A-6 or A-7 AASHO designation are typical of the B horizon materials while the texture of the C horizon is typically silt loam with an A-6 AASHO designation.

Available information, summarized in Table 1-E, indicates that the plasticity index will typically range 5-10, 30-35, and 7-30 percent for the A, B, and C horizon materials respectively; and the clay content of these horizons will typically range 15-25, 30-45, 20-40 percent respectively. In some cases the C horizon will be present in the underlying weathered Illinoian drift.

Stabilization recommendations for association area E materials are summarized in Table 2-E.

TABLE 1-E
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION E

Percent Area of State 1.9 Parent Material: Loess 4 - 6 feet thick on weathered Illinoian till.

Total Acreage 671,000

MAJOR SOIL SERIES, Number and Name	Percentage[1] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site[2] Description
112 Cowden	0.86 (2851)	1-3 (P)	About 1 foot of silt loam on 2 to 2-1/2 feet of silty clay loam to silty clay and underlain by silt loam (loess). Poorly drained, level to sloping soils on loess (50-60" thick) covered till plains. Seasonal water table at or near the surface.
113 Oconee	0.53 (1742)	2-7 (Imp.)	About 1 foot of silt loam on 3 to 4 ft. of silty clay loam on silt loam (loess) underlain by glacial till below about 5 ft. Somewhat poorly drained, level to moderately sloping soils formed from 4 to 5 ft. of loess on glacial till plains. Seasonal water tables are above 3 feet.
114 O'Fallon	0.01 (40)	4-8 (MW)	About 1 foot of silt loam on 1-1/2 feet of silty clay loam on 1 to 2 feet of very firm silty clay loam on silt loam (loess). Glacial till occurs at 5 feet or above. Moderately well drained, gently to moderately sloping soils formed from 3 to 5 ft. of loess on glacial till plains.
474 Piasa	0.21 (677)	0-2 (P)	About 1/2 to 1 ft. of silt loam on 2 ft. of silty clay loam to silty clay and underlain by silt loam (loess). Poorly drained, nearly level soils formed in 4 to 5 ft. of loess on glacial till plains. Material below the surface has more than 15 percent saturation with exchangeable sodium. Seasonal water tables are at or near the surface. "Slicks" or "Scalds".

[1] From Reference 13

[2] From Reference 7

TABLE 1-E (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-14	Silt Loam	A-4 or A-6	100	95-100	15-25	30-40	5-10	5.6-6.5			
14-40	Silty Clay loam to Silty Clay	A-7	100	95-100	35-45	50-60	30-40	5.6-6.5		0-20	20-60
40-60	Silt Loam	A-6	100	95-100	20-30	30-50	7-30	5.6-7.3			
0-14	Silt Loam	A-4 or A-6	100	95-100	15-25	30-45	5-20	5.6-6.5			
14-48	Silty Clay Loam to silty clay	A-7	100	95-100	35-45	40-60	20-40	5.1-6.0		0-16	16-60
48-60	Silt Loam	A-6	100	95-100	20-30	20-60	5-40	6.1-7.3			
0-14	Silt Loam	A-4 or A-6	100	95-100	15-25	--	--	5.6-6.0			
14-50	Silty Clay Loam	A-6 or A-7	100	95-100	30-40	--	--	4.5-6.0		0-16	16-60
50-60	Silt Loam	A-6 or A-4	100	95-100	20-30	--	--	5.6-7.3			
0-10	Silt Loam	A-6 or A-7	100	95-100	15-25	35-45	15-20	6.1-7.3			
10-36	Silty Clay loam to Silty Clay	A-7	100	95-100	35-45	50-65	30-40	7.4-9.0		0-8	8-60
36-60	Silt Loam	A-7	100	95-100	20-30	40-50	5-30	7.4-9.0			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-E

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION E

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
112 Cowden	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆
113 Oconee	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆
114 O'Fallon	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	2	2	☆
474 Piasa	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-E (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION F

Association area F soils occur on uplands in south-central and southern Illinois, Figure 7, and occupy 1,798,000 acres or about 5 percent of the state. The soils of this association are more highly weathered than those of association A through E. As a result, thicker A and B horizons are encountered compared to the soils of association A through E. These soils have developed under grass vegetation from 2 1/2 to 4 feet of loess on weathered Illinoian glacial drift.

A number of the soils of association area F include areas of natric soils which are characterized by a high sodium content in the subsoil and which may in some cases occupy more than 50 percent of the area of Cisne soils. The predominant natric soil in association area F is Huey. The distribution and occurrence of natric soils in Illinois are illustrated in Figure 10.

The major soil series occurring in association area F are listed in Table 1-F. Cisne and Huey soils occupy the poorly drained positions of the soil catena and Hoyleton and Richview, the imperfectly and moderately well drained positions respectively.

The organic carbon content of the soils of this association area is quite low. As indicated in Table 1-F, the organic carbon content is greater than 1 percent to a depth of about 8 inches and less than 1 percent at greater depths. Texturally the A horizon typically classifies as silt loam with an A-4 AASHO designation. Silty clay loam to silty clay texture and an A-6 or A-7 designation is typical of the B horizon materials while the C horizon materials is typically silt loam to silty clay loam in texture and is designated A-4, A-6, or A-7.

Available information, summarized in Table 1-F,indicates that the plasticity index typically ranges from 5-10, 25-55, and 10-35 for the materials of the A, B, and C horizons respectively (more highly plastic B horizons are typical of the natric soils); the clay contents typically range from 15-30, 40-55, and 20-40 percent for the same respective horizons.

Stabilization recommendations for association area F materials are summarized in Table 2-F.

TABLE 1-F

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION F

Percent Area of State 5.0 Parent Material: Loess 2-1/2 to 4 feet thick on weathered Illinoian till.

Total Acreage 1,798,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
2 Cisne	2.97 (9776)	0-2 (P)	About 1-1/2 ft. of silt loam on 1-1/2 to 2 ft. of heavy silty clay loam and underlain by gritty silty clay loam till, poorly drained level soils on loess (20-50" thick) covered till plains. Seasonal water tables at or near the surface.
3 Hoyleton	1.33 (4376)	1-4 (Imp.)	About 1 ft.of silt loam on 1-1/2 to 2 ft. of heavy silty clay loam underlain by gritty silty clay loam. Somewhat poorly drained, level to sloping soils on loess (20-50" thick) covered till plains. Seasonal water table above 3 ft.
120 Huey	0.23 (767)	0-2 (P)	About 1 ft. of silt loam on about 2 ft. of silty clay loam to silty clay and underlain by gritty silty clay loam till. Poorly drained, level to sloping soils on till plains. Seasonal water tables at or near the surface. Material below the surface layer has more than 15 percent saturation with exchangeable sodium.
4 Richview	0.04 (126)	3-7 (MW)	About 1 ft. of silt loam on 2 ft. of silty clay loam underlain by silt loam. Moderately well drained, gently to moderately sloping soils formed in 2 to 4 ft. of loess on glacial till.

(1) From Reference 13

(2) From Reference 7

TABLE 1-F (Continued)

Depth From Surface, Inches	Soil Classification: USDA [(2)] Textural	Soil Classification: AASHO [(2)]	Percent [(2)] Passing Sieve: No. 4	Percent [(2)] Passing Sieve: No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH [(2)]	Organic Carbon [(3)] Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-18	Silt loam	A-4 or A-6	100	95-100	10-20	25-30	5-10	4.5-5.0			
18-40	Silty clay loam to silty clay	A-7	100	90-95	35-45	50-60	25-39	4.5-5.0		0-8	8-60
40-60	Silty clay loam	A-6 or A-7	100	80-95	25-35	30-50	10-25	5.1-6.0			
0-16	Silt loam	A-4 or A-6	100	95-100	10-20	25-35	5-10	4.5-5.0			
16-40	Silty clay loam	A-6 or A-7	100	90-100	35-45	55-75	25-45	4.5-5.5		0-8	8-60
40-60	Silty clay loam	A-6 or A-7	100	80-95	25-35	30-55	15-35	5.1-7.3			
0-12	Silt loam	A-4	100	95-100	10-20	25-35	5-10	5.6-6.5			
12-36	Silty clay loam to silty clay	A-6	100	90-100	30-40	50-80	30-55	7.9-9.0		0-8	8-60
36-60	Silty clay loam	A-6	100	80-95	25-35	30-55	15-35	7.9-9.0			
0-12	Silt loam	A-4 or A-6	100	95-100	10-20	25-35	5-15	5.6-6.5			
12-36	Silty clay loam	A-6 or A-7	100	90-100	30-40	35-60	15-35	5.1-5.5		0-8	8-60
36-60	Silt loam	A-4 or A-6	100	80-95	25-35	20-60	10-40	5.6-6.5			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-F
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION F

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
2 Cisne	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	1	3	3	*
	C	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	1	3	3	*
3 Hoyleton	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	2 (d)	3	3	*
	C	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	1	3	3	*
120 Huey	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	1	3	3	*
	C	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	1	3	3	*
4 Richview	A	2	1	3	3	3	2	1	2 (a)	3	2	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	2 (d)	3	3	*
	C	2	1	3	3	3	1 (b)	1	3	3	3	1	1	3	3	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on next page.

TABLE 2-F (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive"soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION G

Soil association area G occurs in the northeastern part of the state and in the upper regions of both the Illinois and Wabash river valleys, Figure 7. Although occupying only 224,000 acres or about 0.6 percent of the state, these soils typically provide a good source of gravel at depths greater than about 2 to 3 1/2 feet. The soils of this association have developed under grass vegetation from thin medium-textured material on coarse textured Wisconsinan glacial till or outwash.

The major soil series found in this area are listed in Table 1-G. Warsaw and Carmi appear on the well-drained positions of the soil catena; Kane and Omaha on the imperfectly drained positions, and Will and Abington on the poorly drained positions.

Characteristically these soils have a thick and highly organic A horizon. As indicated in Table 1-G, the organic carbon content is normally greater than 2 percent to a depth of 11-16 inches (exception--Carmi which has 1-2 percent organic carbon to a depth of about 17 inches) and less than 1 percent at depths typically greater than 16-24 inches.

Texturally, the A horizon is quite variable, ranging from loam to silty clay loam. The AASHO designation for the A horizon materials is typically A-4, A-6, or A-7. The B horizon texture reflects the influence of the underlying gravel and is quite variable depending on location and type of material in which the B was developed. Clay loam to gravelly clay or silty clay is typical however, with an AASHO designation of A-6 or A-7. Parent gravel (C horizon) will typically be encountered at 2 to 3-1/2 feet. Stratified sands and gravels which have an AASHO designation of A-1 or A-2 are the typical materials encountered.

Available information, summarized in Table 1-G, indicates that the expected plasticity index typically ranges from 5-20, 15-30, and NP-15 percent for the A, B, and C horizons. The information summarized in Table 1-G also indicates that the clay content typically ranges from 15-30, 30-40, 0-25 percent for these same respective horizons.

Stabilization recommendations for association area G materials are summarized in Table 2-G.

TABLE 1-G
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION G

Percent Area of State 0.6

Total Acreage 224,000

Parent Material: (a) Medium textured material 2 to 3-1/2 feet thick on calcareous gravel or
(b) Medium textured material 2 to 3-1/2 thick on noncalcareous gravel.

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
300 Abington (b)	0.01 (30)	0-1 (P)	About 1-1/2 feet of clay loam on about 1-1/2 feet of clay loam to gravelly loam underlain by loose, calcareous gravel and sand. Poorly drained, depressional and level soils on outwash plains and terraces.
285 Carmi (b) & 286 Carmi	0.12 (379)	1-5 (W)	About 1-1/2 feet of loam to sandy loam on 1-1/2 feet of clay loam to gravelly clay loam underlain by loose gravel and sand. Well to moderately well drained, nearly level soils on low-lying terraces.
343 Kane (a)	0.02 (82)	1-3 (Imp.)	About 1 foot of silt loam on 1-1/2 to 2 feet of silty clay loam or clay loam and underlain by gravel and sand. Somewhat poorly drained, level to gently sloping soils formed in medium or moderately fine textured outwash material over calcareous stratified loose gravel and sand.
289 Omaha (b)	0.02 (71)	0-2 (Imp.)	About 1-1/2 to 2 feet of loam on 1 to 2 feet of clay loam to gravelly clay loam and underlain by gravel and sand. Somewhat poorly drained, nearly level soils on low-lying terraces. Seasonal water tables are within 3 feet of the surface.
93 Rodman (a)	0.04 (146)	7-25 (W)	About 1 foot of gravelly loam underlain by calcareous and stratified loose gravel and sand. Somewhat excessively drained, moderately sloping to very steep gravelly soils of outwash plains, moraines and valley trains.
290 Warsaw (a)	0.11 (368)	1-8 (W)	About 1 foot of silt loam on 1 to 1-1/2 feet of silty clay loam to clay loam and underlain by stratified gravel and sand. Well drained, level to sloping soils on stream terraces and outwash plains.
329 Will (a)	0.03 (87)	0-1 (P)	About 2 to 3 feet of silty clay loam underlain by stratified gravel and sand. Very poorly drained, level to depressional soils formed in medium or moderately fine-textured material over calcareous, stratified gravel and sand. Seasonal water tables are at or near the surface.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material.

TABLE 1-G (Continued)

Depth From Surface, Inches	Soil Classification USDA(2) Textural	AASHO(2)	Percent (2) Passing Sieve No. 4	No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (2) Content, Avg. Depths of Occurrence, Inches > 2%	1-2%	< 1%
0-20	Clay Loam	A-6	100	90-100	25-35	--	--	6.6-7.3			
20-36	Clay Loam to Gravelly Loam	A-6	80-100	55-80	25-35	--	--	6.6-7.3	0-16	16-24	24-60
36-60	Gravel and Sand	A-1	40-80	0-10	0-10	NP-35	NP-15	7.4-8.4 (calc)			
0-20	Loam to Sandy Loam	A-4	90-100	25-70	15-25	--	--	5.6-6.0			
20-36	Clay Loam to Gravelly Clay Loam	A-6	80-100	55-80	25-35	--	--	5.6-6.0		0-17	17-60
36-60	Gravel and Sand	A-1	40-80	0-10	0-10	NP-35	NP-15	5.1-6.5			
0-10	Silt Loam	A-6 or A-7	100	80-95	15-25	20-65	5-30	5.6-6.5			
10-30	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	30-40	25-60	11-30	6.0-7.3	0-11	11-16	16-50
30-60	Gravel and Sand Stratified	A-1, A-2, or A-3	40-100	0-15	0-10	NP-35	NP-15	7.4-8.4 (calc)			
0-20	Loam	A-4	90-100	35-70	15-25	--	--	5.6-6.5			
20-36	Clay Loam to Gravelly Clay Loam	A-6	80-100	55-80	25-35	--	--	5.6-6.5	0-11	11-16	16-50
36-60	Gravel and Sand	A-1	40-80	0-10	0-10	NP-35	NP-15	6.1-6.5			
0-12	Gravelly Loam	A-2 or A-4	70-80	30-60	5-15	20-55	5-25	7.4-7.8			
12-60	Stratified Loose Gravel and Sand	A-1	50-80	0-10	0-5	NP-55	NP-20	7.4-8.4 (calc)	0-11	11-18	18-50
0-14	Silt Loam	A-6 or A-7	100	80-95	15-25	20-52	5-20	5.6-6.5			
14-30	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	30-40	30-55	12-30	5.6-6.5	0-11	11-16	16-50
30-60	Stratified Gravel and Sand	A-1	40-80	0-10	0-10	NP-45	NP-22	7.4-8.4 (calc)			
0-18	Silty Clay Loam	A-6 or A-7	100	80-95	25-35	20-70	NP-30	6.1-6.5			
18-30	Silty Clay Loam	A-6 or A-7	95-100	60-90	25-35	35-69	20-40	6.6-7.3	0-12	12-20	20-45
30-60	Stratified Gravel and Sand	A-1	40-80	0-10	0-10	NP-68	NP-38	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-G

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION G

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
300 Abington	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
285 & 286 Carmi	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
343 Kane	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
289 Omaha	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
290 Warsaw	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
329 Will	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
93 Rodman	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

NA = Not Applicable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-G (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials **may** provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION H

Soil association area H occurs in northern Illinois, Figure 7, and occupies about 152,000 acres or 0.4 percent of the state. These soils have developed under grass vegetation from 1-5 feet of loess over sandy loam or clay loam to sandy clay loam Wisconsinan glacial till. Further discussion of Wisconsinan glacial tills may be found in Chapter 2 and Appendix B.

The major soil series occurring in this association are listed in Table 1-H. Durand, Griswold, and Ogle appear on the well drained positions of the soil catena and Ringwood on the well to moderately well drained positions.

The organic carbon content of A horizon of these soils is in general, moderately high to high. As indicated by the information in Table 1-H, the organic carbon content is typically greater than 2 percent to a depth of about 8 inches, and less than 1 percent at depths greater than about 15 to 16 inches.

In general, the A horizon materials in this association have a silt loam texture and an A-6 or A-7 AASHO designation. The B horizon materials normally display a silty clay loam to clay loam texture and an A-6 or A-7 AASHO designation. The texture of the C horizon may be either clay loam to sandy clay loam (Durands and Ogle soils) or sandy loam (Griswold and Ringwood soils). The AASHO designation for these materials is typically A-6 or A-7 for Durands and Ogle soils and A-2 or A-4 for Griswold and Ringwood soils.

Available information, summarized in Table 1-H, indicates that the plasticity index ranges from 5-15, 15-25, and NP-10 for the A, B, and C horizon materials of the Griswold and Ringwood soils. The clay content of the respective horizons for these two soils typically ranges from 15-30, 20-35, 15-20 for the A, B, and C horizon materials. Clay contents for these two soils typically range from 15-25, 25-40, and 20-40 percent for the same respective horizons.

Stabilization recommendations for association area H materials are summarized in Table 2-H.

TABLE 1-H
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION H

Parent Material: (a) Loess 2-1/2 to 5 feet thick on noncalcareous clay loam to sandy clay loam till or
(b) Loess 1-1/2 to 3 feet thick on noncalcareous clay loam to sandy clay loam till to 4 feet or
(c) Loess 1 - 3 feet thick on sandy loam till, calcareous < 4 feet or
(d) Loess < 1 feet thick on sandy loam till, calcareous < 3-1/2 feet.

Percent Area of State 0.4

Total Acreage 152,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
416 Durand (b)	0.07 (230)	1-10 (W)	About 1 ft. of silt loam on 2 to 3 ft. of silty clay loam or clay loam underlain by calcareous sandy loam drift. Well drained, gently sloping to steep soils formed from 1 to 3 ft. of loess on sandy loam glacial drift containing some stones.
363 Griswold (d)	0.07 (243)	2-10 (W)	About 1 ft. of silt loam or loam on 1 to 1-1/2 ft. of clay loam underlain by calcareous sandy loam glacial till containing some stones. Well drained, moderately to strongly sloping soils on till plains.
412 Ogle (a)	0.09 (307)	4-10 (W)	About 1 ft. of silt loam on 2 to 2-1/2 ft. of silty clay loam and underlain by clay loam glacial till. Well drained, gently sloping to moderately steep soils formed in 2-1/2 to 4 ft. of loess on glacial drift.
297 Ringwood (c)	0.07 (237)	2-7 (W-MW)	About 1 ft. of silt loam on 1 to 2 ft. of silty clay loam to sandy clay loam, underlain by calcareous sandy loam glacial till. Well to moderately well drained, gently to strongly sloping soils formed from 1 to 3 ft. of loess on glacial till plains and moraines.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-H (Continued)

Depth From Surface, Inches	Soil Classification: USDA (2) Textural	Soil Classification: AASHO (2)	Percent (2) Passing Sieve: No. 4	Percent (2) Passing Sieve: No. 200	(3) Clay Fraction (< 2μ), %	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-12	Silt loam	A-6 or A-7	100	90-100	15-25	--	--	5.6-6.5			
12-36	Silty clay loam to clay loam	A-6 or A-7	100	60-70	30-40	--	--	4.5-5.5	0-8	8-15	15-48
36-40	Sandy loam to loam	A-4 or A-6	85-95	35-60	10-20	NP-30	NP-20	5.5-6.5			
0-10	Silt loam or loam	A-4	100	70-90	10-20	30-50	10-20	5.6-6.5			
10-32	Clay loam	A-6 or A-7	95-100	60-90	25-35	25-55	15-25	5.6-6.5	0-8	8-16	16-45
32-60	Sandy loam	A-2 or A-4	85-95	30-45	5-15	NP-20	NP-10	7.4-8.4 (Calc)			
0-12	Silt loam	A-4 or A-6	100	90-100	15-25	--	--	5.1-6.5			
12-40	Silty clay loam	A-6 or A-7	100	90-100	25-35	--	--	5.1-6.5	0-8	8-16	16-60
40-60	Clay loam	A-6 or A-7	95-100	80-100	10-20	NP-30	NP-20	6.6-7.3			
0-12	Silt loam	A-4 or A-6	100	70-90	10-20	30-50	10-20	5.6-6.5			
12-36	Silty clay loam to sandy clay loam	A-6 or A-7	95-100	40-80	25-35	25-55	10-25	5.6-6.5	0-8	8-15	15-48
36-60	Sandy loam	A-2 or A-4	85-95	30-45	5-15	NP-20	NP-10	7.4-8.4 (Calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various soil reports.

TABLE 2-H

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION H

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
416 Durand	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	2	2	2	☆
363 Griswold	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
412 Ogle	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	☆
297 Ringwood	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

NA = Not Applicable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page.

TABLE 2-H (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION I

Soils of association area I occur in northeastern Illinois, Figure 7, and occupy 892,000 acres or 2.5 percent of the state. These soils have developed under grass vegetation from thin loess (< 3 feet) on Wisconsinan loam textured glacial till.

The major soil series found in this association area are listed in Table 1-I La Rose and Parr occur on the well drained positions of the soil catena, Saybrook on the well-moderately well drained positions, Corwin on the moderately well drained positions, Lisbon and Odell on the imperfectly drained positions, and Pella on the poorly drained positions.

Moderately thick, moderately organic A horizons are characteristic of the soils of association area I. As indicated in Table 1-I, the organic carbon content of the soils is generally greater than 2 percent to a depth of 8-16 inches and is less than 1 percent at depths greater than 14-28 inches.

The A horizon material of association area I soils is typically silt loam to loam in texture although poorly drained Pella is slightly finer textured having a silty clay loam texture. The typical AASHO designation of the A horizon materials is A-4 or A-6 with the exception of Pella which is A-7 or A-6. The B horizon materials are normally silty clay loam to clay loam in texture and have an AASHO designation of A-6 or A-7. At depths greater than about 3 feet, loam to silty loam Wisconsinan glacial till is typically encountered which has an A-4 or A-6 AASHO designation. Further discussion of Wisconsinan glacial tills may be found in Chapter 2 and Appendix B.

Available information, summarized in Table 1-I, indicates that the plasticity index for the A, B, and C horizons of these soils ranges from 15-25, 15-35, 5-20 respectively. The clay content for these respective horizons typically ranges from 20-35, 25-45, and 15-40 percent.

Stabilization recommendations for association area I soils are summarized in Table 2-I.

TABLE 1-I
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION I

Percent Area of State 2.5

Total Acreage 892,000

Parent Material: (a) Loess 1-1/2 to 3 feet thick on loam till, calcareous by 2 to 3-1/2 feet or
(b) Loess < 1-1/2 feet thick on loam till, calcareous by 2 to 3-1/2 feet.

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site Description (2)
495 Corwin (b)	0.09 (291)	3-10 (MW)	About 1 foot of loam on 1 foot of clay loam underlain by calcareous loam. Moderately well drained, nearly level to moderately steep soils formed from calcareous loam glacial drift containing some small stones.
60 LaRose (b)	0.22 (720)	7-15 (W)	About 1/2 to 1 foot of silt loam on 1 foot of clay loam underlain by loam glacial till. Well drained, gently sloping to steep soils formed from calcareous loam glacial till. Stones are common below 2 feet or so.
59 Lisbon (a)	0.35 (1152)	1-3 (Imp.)	About 1 foot of silt loam on 2 feet of silty clay loam to clay loam underlain by loam to silt loam glacial till. Somewhat poorly drained, level to gently sloping soils formed from 1 to 3 feet of loess on calcareous glacial till plains and moraines. Seasonal water tables above 3 feet.
490 Odell (b)	0.08 (258)	1-5 (Imp.)	About 1 foot of loam on 1 to 2-1/2 feet of clay loam underlain by calcareous loam to silt loam. Somewhat poorly drained, nearly level to gently sloping soils formed from calcareous loam or silt loam glacial drift. Seasonal water tables are within 3 feet of the surface.
221 Parr (b)	0.03 (97)	5-12 (W)	About 1 foot of silt loam on 2 feet of silty clay loam underlain by calcareous loam glacial till. Well drained, gently to moderately sloping soils on glacial till plains and moraines.
153 Pella (b)	0.29 (940)	0-1 (P)	About 2 to 4 feet of silty clay loam underlain by stratified sandy loam, loam and silt loam. Thin strata of sand, gravelly loam and clay loam occur in some places. Poorly drained, level to depressional soils formed from glacial outwash deposits. Seasonal water tables are at or near the surface.
145 Saybrook (a)	1.30 (4269)	2-7 (W-MW)	About 1 foot of silt loam on about 1-1/2 feet of silty clay loam to clay loam and underlain by loam to silt loam till. Well drained, sloping soils on till plains and moraines.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-I (Continued)

Depth From Surface, Inches	Soil Classification: USDA (2) Textural	Soil Classification: AASHO (2)	Percent (2) Passing Sieve: No. 4	Percent (2) Passing Sieve: No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-12	Loam	A-4 or A-6	100	80-100	15-25	--	--	5.6-6.5			
12-30	Clay Loam	A-6 or A-7	95-100	55-75	30-40	--	--	5.6-6.5	0-12	12-20	20-60
30-60	Loam to Silt Loam	A-4 or A-6	90-100	55-75	15-25	20-40	10-20	7.4-8.4 (calc)			
0-10	Silt Loam or Loam	A-6 or A-4	100	80-100	15-25	30-55	13-25	6.1-6.5			
10-20	Clay Loam	A-6 or A-7	95-100	55-75	25-35	30-50	12-30	5.6-6.5	0-8	8-14	14-45
20-60	Loam to Silt Loam	A-4 or A-6	90-100	55-75	15-25	25-40	10-20	7.4-8.4 (calc)			
0-14	Silt Loam	A-6 or A-7	100	80-100	20-30	40-55	15-30	5.6-6.5			
14-34	Silty Clay Loam to Clay Loam	A-7 or A-6	95-100	70-95	25-35	30-60	12-35	5.6-6.5	0-12	12-20	20-60
34-60	Loam to Silt Loam	A-6 or A-4	95-100	55-75	15-25	20-45	5-25	7.4-8.4 (calc)			
0-12	Silt Loam or Loam	A-4 or A-6	100	80-100	20-30	--	--	5.6-6.5			
12-30	Clay Loam	A-6 or A-7	95-100	55-75	25-35	--	--	5.6-6.5	0-12	12-20	20-60
30-60	Loam to Silt Loam	A-4 or A-6	90-100	55-75	15-25	20-40	10-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	100	85-95	15-25	--	--	5.6-6.5			
12-34	Silty Clay Loam to Clay Loam	A-6	100	60-90	25-35	--	--	5.1-6.5	0-8	8-14	14-45
34-60	Loam to Silt Loam	A-4 or A-6	95-100	60-70	15-25	20-40	10-20	7.4-8.4 (calc)			
0-24	Silty Clay Loam	A-7 or A-6	100	80-100	25-35	--	--	6.6-7.3			
24-36	Silty Clay Loam	A-6 or A-7	100	80-95	25-35	--	--	7.4-8.4	0-16	16-20	20-45
36-60	Sandy Loam, Loam or Silt Loam	A-2 or A-4	95-100	25-60	15-25	20-40	10-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-6 or A-7	100	80-100	20-30	40-60	15-25	5.6-6.5			
12-32	Silty Clay Loam to Clay Loam	A-7 or A-6	95-100	70-95	25-35	30-55	10-30	5.6-6.5	0-11	11-28	28-50
32-60	Loam to Silt Loam	A-6 or A-4	95-100	55-75	15-25	20-46	10-25	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-I
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION I

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers: Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
495 Corwin	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	1	1	3	3	3	1	1	2	2	☆
60 La Rose	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	1	1	3	3	3	1	1	2	2	☆
59 Lisbon	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	1	1	3	3	3	1	1	2	2	☆
490 O'dell	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	1	1	3	3	3	1	1	2	2	☆
221 Parr	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	1	1	3	3	3	1	1	2	2	☆
153 Pella	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	★
	C	2	1	3	3	3	1	1	3	3	3	1	$2^{(d)}$	1	1	☆
145 Saybrock	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	1	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-I (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION J

Soils of association area J occur in northeastern Illinois, Figure 7, and occupy 1,328,000 acres or about 3.7 percent of the state. These soils have developed under grass vegetation from thin loess (1-1/2 to 4 feet) on silty clay loam Wisconsinan glacial till.

The major soil series occurring in this association area are listed in Table 1-J. Symerton and Varna occur on well to moderately well drained positions of the soil catena; Andres and Elliott are found on the imperfectly drained positions, and Ashkum occupies the poorly drained positions.

Moderately thick, moderately organic A horizons are characteristic of association area J soils. As indicated in Table 1-J, the organic carbon content is generally greater than 2 percent to a depth ranging from 8-12 inches and less than 1 percent at depths greater than 14-28 inches.

The texture of the material in the A horizon of these soils varies from silt loam to silty clay loam. The AASHO designation of the materials in this horizon are typically A-6 or A-7. B horizon materials are typically silty clay loam to clay loam in texture and have an A-7 or A-6 AASHO designation. At depths greater than about 2-4 feet, unweathered A-6 or A-7 Wisconsinan silty clay loam glacial till is typically encountered. Further discussion of Wisconsinan glacial tills may be formed in Chapter 2 and Appendix B.

Available information summarized in Table 1-J, indicates that the plasticity index for the materials of A, B, and C horizons typically ranges from 10-30, 15-35, and 11-20 respectively. The clay content for the materials of these same respective horizons will typically range from 20-40, 25-50, and 21-40 percent.

Stabilization recommendations for the materials of soil association area J are summarized in Table 2-J.

TABLE 1-J
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION J

Percent Area of State 3.7

Total Acreage 1,328,000

Parent Material: (a) Medium textured material 2 - 4 feet thick on calcareous silty clay loam till or
(b) Medium textured material < 2 feet thick on silty clay loam till, calcareous at 1-1/2 to 3 feet.

MAJOR SOIL SERIES, Number and Name	Percentage[1] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site[2] Description
293 Andres (a)	0.53 (1741)	1-3 (Imp.)	About 1-1/2 ft. of silt loam on 1-1/2 ft. of clay loam underlain with a thin strata of loam or sandy loam over calcareous glacial till. Somewhat poorly drained, nearly level soils formed from 24 to 60 in. of loamy glacial outwash over calcareous till. Seasonal water table above 3 feet.
232 Ashkum (b)	0.65 (2133)	0-1 (P)	About 1 ft. of silty clay loam on about 1-1/2 ft. of silty clay loam and underlain by silty clay loam till. Poorly drained, level soils on till plains and moraines. Seasonal water table at or near the surface.
146 Elliott (b)	1.11 (3640)	1-3 (Imp.)	About 1 ft. of silt loam on about 1-1/2 ft. of silty clay loam to light silty clay and underlain by silty clay loam till. Somewhat poorly drained, sloping soils on till plains and moraines. Seasonal water tables above 3 ft.
294 Symerton (a)	0.23 (747)	2-8 (W-MW)	About 1 ft. of silt loam on 1 to 2-1/2 ft. of clay loam underlain by calcareous silty clay loam glacial till. Moderately well to well drained, gently to moderately sloping soils formed in 2 to 5 ft. of loamy glacial outwash over glacial till.
223 Varna (b)	0.33 (1097)	3-10 (W-MW)	About 1 ft. of silt loam on 1 ft. of silty clay loam underlain by calcareous silty clay loam glacial till. Well drained, gently sloping to strongly sloping soils formed in 2 ft. or less of loess on calcareous glacial till. Small stones occur in the glacial till.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-J (Continued)

Depth From Surface, Inches	Soil Classification USDA Textural (2)	AASHO (2)	Percent (2) Passing Sieve No. 4	No. 200	Clay Fraction (3) (< 2μ), %	Liquid Limit (4) %	Plasticity Index, (4) %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches > 2%	1-2%	< 1%
0-18	Silt loam	A-6 or A-7	95-100	75-90	20-30	35-55	13-25	5.6-6.5			
18-36	Clay loam	A-7 or A-6	95-100	55-85	30-40	35-55	16-33	5.6-6.5	0-11	11-17	17-45
36-60	Silty clay loam	A-6 or A-7	95-100	80-90	25-35	30-48	11-27	7.4-8.4 (Calc)			
0-14	Silty clay loam	A-7	95-100	95-100	30-40	40-70	15-30	6.6-7.3			
14-30	Silty clay loam	A-7	95-100	85-100	30-40	30-60	12-35	6.6-7.3	0-12	12-18	18-60
30-60	Silty clay loam	A-6 or A-7	95-100	85-100	25-35	32-55	13-30	7.4-8.4 (Calc.)			
0-12	Silt loam	A-6 or A-7	95-100	90-100	20-30	35-55	11-32	5.6-6.5			
12-30	Silty clay loam to light silty clay	A-7	95-100	85-100	35-45	30-55	10-35	5.6-6.5	0-11	11-17	17-45
30-60	Silty clay loam	A-6 or A-7	95-100	85-100	25-35	30-48	10-36	7.4-8.4 (Calc.)			
0-14	Silt loam	A-6 or A-7	95-100	75-95	20-30	35-55	10-25	5.6-6.5			
14-36	Clay loam	A-7 or A-6	95-100	55-85	30-40	27-55	10-35	5.6-6.5	0-8	8-16	16-60
36-60	Silty clay loam	A-6 or A-7	95-100	80-90	25-35	30-45	11-20	7.4-8.4 (calc.)			
0-12	Silt loam	A-6 or A-7	100	80-95	15-25	35-55	10-28	5.6-6.5			
12-24	Silty clay loam to silty clay	A-7 or A-6	95-100	80-95	30-40	30-55	14-35	5.6-6.5	0-8	8-16	16-45
24-60	Silty clay loam	A-6 or A-7	95-100	80-95	25-35	30-52	11-31	7.4-8.4 (calc.)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-J

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION J

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
293 Andres	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
232 Ashkum	A	2	1	3	3	3	2	1	3(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
146 Elliott	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
294 Symerton	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
223 Varna	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

*Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-J (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime as been assigned a "1" rating and cement a "2" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION K

Soils of association area K occur in northeastern Illinois, Figure 7, and occupy 776,000 acres or about 2.2 percent of the state. Soils of this association area have developed under grass vegetation from less than 3 feet of medium textured materials (generally loess) on silty clay to clay Wisconsinan glacial till.

The major soil series occurring in this area are listed in Table 1-K. Mona occurs on the well-moderately well drained positions of the soil catena; Clarence, Mokena, and Swygert are found on the imperfectly drained positions; and Bryce and Rowe occupy the poorly drained positions.

Moderately thick, organic A horizons are characteristic of the soils of association area K. As indicated in Table 1-K, the organic carbon content is typically greater than 2 percent to a detph of 8-11 inches and less than 1 percent at depths greater than 12-23 inches.

The material of the A horizon of these soils is typically silt loam, silty clay loam, or clay loam in texture and displays an A-6 or A-7 AASHO designation. The texture of the B horizon materials is typically silty clay loam, clay loam, or clay with an AASHO designation of generally A-7 although some A-6 material may be encountered. At depths greater than about 3 feet, clay loam to clay Wisconsinan glacial till will be encountered. The AASHO designation of this till is generally A-7. Further discussion of Wisconsinan glacial tills can be found in Chapter 2 and Appendix B.

Available information, summarized in Table 1-K, indicates that the plasticity index typically ranges from 15-30, 25-40, 20-40 for the A, B, and C horizon materials respectively. The clay content ($< 2\mu$) for the materials of these respective horizons typically ranges from 30-50, 40-70, and 25-75 percent.

Stabilization recommendations for association area K materials are summarized in Table 2-K.

TABLE 1-K
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION K

Parent Material: (a) Medium textured material 2 - 4 feet thick on calcareous silty clay drift or
(b) Medium textured material (including loess) < 2 feet thick on silty clay or
(c) Medium textured material (including loess) < 2 feet thick on clay drift, calcareous at < 3 feet.

Percent Area of State 2.2

Total Acreage 776,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
235 Bryce (b)	0.51 (1662)	0-2 (P)	About 1 foot of silty clay loam to silty clay on 2 feet of silty clay underlain by silty clay glacial till. Poorly drained, level or depressional soils formed in calcareous silty clay till or lakebed sediments. Seasonal water tables at or near the surface.
147 Clarence (c)	0.16 (535)	1-6 (Imp.)	About 1 foot of silty clay loam on about 1-1/2 feet of clay and underlain by clay till or lakebed deposits. Somewhat poorly drained, sloping soils on till plains and moraines on glacial lakebeds. Seasonal water tables above 3 feet.
295 Mokena (a)	0.36 (1201)	1-3 (Imp.)	About 1 foot of silt loam on 1 to 2 feet of silty clay loam to clay loam on a foot or less of loam to sandy loam underlain by silty clay to clay. Somewhat poorly drained, nearly level soils formed from 2 to 5 feet of outwash over calcareous silty clay to clay glacial till or lake-bed sediments. Seasonal water tables above 3 feet.
448 Mona (a)	0.04 (130)	2-5 (W-MW)	About 1 foot of silt loam on 1 to 2 feet of clay loam less than 1 foot of loam to sandy loam underlain by calcareous silty clay to clay. Moderately well to well drained, gently to moderately sloping soils formed from 2 to 5 feet of outwashover calcareous silty clay to clay till or lakebed sediments.
230 Rowe (c)	0 11 (359)	0-3 (P)	About 1/2 to 1 foot of silty clay over 1-1/2 feet of silty clay to clay and underlain by silty clay. Very poorly drained, level to depressional soils formed in fine textured glacial drift and glacial lake deposits. Seasonal water tables are at the surface or ponded.
91 Swygert (b)	0.61 (2011)	1-6 (Imp.)	About 1 foot of silty clay loam on heavy silty clay and underlain by silty clay till. Somewhat poorly drained, sloping soils on till plains and moraines. Seasonal water table above 3 feet.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-K (Continued)

Depth From Surface, Inches	Soil Classification USDA (2) Textural	AASHO (2)	Percent (2) Passing Sieve No. 4	No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches > 2%	1-2%	< 1%
0-12	Silty Clay Loam to Silty Clay	A-7	100	90-100	40-50	35-65	20-30	5.6-6.5			
12-34	Silty Clay	A-7	100	90-100	45-55	32-63	25-40	5.6-6.5	0-10	10-15	15-60
34-60	Silty Clay Till	A-7 or A-6	95-100	85-100	40-50	30-70	13-44	7.4-8.4 (calc)			
0-10	Silty Clay Loam	A-6 or A-7	95-100	90-100	30-40	30-60	14-30	5.6-6.5			
10-30	Clay	A-7	95-100	85-100	50-70	45-70	25-38	5.6-6.5	0-8	8-12	12-45
30-60	Clay	A-7	95-100	85-100	45-70	40-70	20-44	7.4-8.4 (calc)			
0-14	Silt Loam	A-6 or A-7	100	80-95	20-30	31-55	10-25	6.1-6.5			
14-36	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	30-40	35-55	16-33	6.1-6.5	0-10	10-15	15-60
36-60	Silty Clay to Clay	A-7	95-100	70-95	40-65	33-50	14-30	7.4-8.4 (calc)			
0-14	Silt Loam	A-6 or A-7	100	80-95	20-30	--	--	6.1-6.5			
14-36	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-80	30-40	--	--	6.1-6.5	0-11	11-23	23-45
36-60	Silty Clay to Clay	A-7	95-100	70-95	40-65	35-50	15-30	7.4-8.4 (calc)			
0-7	Silty Clay	A-7	100	95-100	40-55	45-60	15-32	6.1-7.3			
7-26	Silty Clay or Clay	A-7	100	95-100	50-70	40-65	21-40	6.1-7.3	0-8	8-15	15-60
26-60	Silty Clay	A-7	100	95-100	45-70	38-58	20-37	7.4-8.4 (calc)			
0-12	Silty Clay Loam	A-6 or A-7	95-100	90-100	25-35	45-55	15-25	5.6-6.5			
12-30	Silty Clay	A-7	95-100	85-100	45-55	40-60	20-40	5.6-6.5	0-11	11-23	23-45
30-60	Silty Clay	A-7	95-100	85-100	40-50	30-55	15-35	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-K

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION K

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
235 Bryce	A	2	1	3	3	3	2	1	$3^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*
147 Clarence	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	*
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*
295 Mokena	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	*
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*
448 Mona	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	*
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*
230 Rowe	A	2	1	3	3	3	2	1	$3^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*
91 Swygert	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	*
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-K (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION L

Soils of association area L occur in northwestern and western Illinois, Figure 7, and occupy 2,094,000 acres or about 5.8 percent of the state. A more detailed soil association map of northwestern Illinois is available [a]. Soils of this association area have developed under forest or mixed prairie and forest vegetation from thick loess.

The major soil series found in this area are listed in Table 1-L. Fayette, Mt. Carroll, Seaton, and Sylvan occur on the well drained positions of the soil catena; Downs on the moderately well to well drained positions; Fall, Iona, and Rozetta on the moderately well drained positions; Atterberry, Reesville, and Stronghurst on the imperfectly drained positions; and Traer on the poorly drained positions.

Thin to moderately thin, moderately organic A horizons are characteristic of the soils of this association area. As indicated in Table 1-L, the organic carbon content typically ranges from 1-2 percent to a depth of 8 to 16 inches and is less than 1 percent at depths greater than this.

The texture of the A horizon material is typically silt loam. An A-4 or A-6 AASHO classification can generally be expected from these surface materials. The B horizon materials typically display a silty clay loam texture although an occassional silt loam or silty clay texture may be encountered. The AASHO classification of these materials is generally A-6 or A-7. The C horizon (parent loess) is typically silt loam in texture and has an A-4 or A-6 AASHO classification.

Available information, summarized in Table 1-L, indicates that the plasticity index may range from 5-12, 8-25, and 5-20 respectively for the A, B, C, horizons, and the clay content from 10-25, 20-40, and 10-25 percent for the A, B, and C horizon materials respectively.

Stabilization recommendations for association area K materials are summarized in Table 2-L.

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[a] Available from: University of Illinois, Agronomy Department, Room N-405, Turner Hall, Urbana, Illinois 61801.

TABLE 1-L

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION L

Percent Area of State 5.8

Total Acreage 2,094,000

Parent Material: (a) Loess > 5 feet thick, calcareous at 2-1/2 to 4 feet.
(b) Loess > 4 - 5 feet thick, noncalcareous » 3-1/2 feet.

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
61 Atterberry (b)	0.36 (1167)	0-3 (Imp.)	About 1-1/2 ft. of silt loam on 2 to 3 ft. of silty clay loam underlain by silt loam (loess). Somewhat poorly drained, level to gently sloping soils formed from more than 5 ft. of loess. Seasonal water tables within 3 ft. of the surface.
386 Downs (b)	0.84 (151)	3-7 (W-MW)	About 1 ft. of silt loam on about 2-1/2 ft. of silty clay loam and underlain by silt loam (loess). Well drained sloping soils on loess (over 60 in. thick) covered glacial drift or bedrock uplands.
263 Fall (b)	0.03 (98)	1-3 (MW)	About 1 to 1-1/2 ft. of silt loam on 2 ft. of heavy silt loam underlain by silt loam. Moderately well drained nearly level to gently sloping soils formed from 5 ft. or more of loess on glacial till plains.
280 Fayette (b)	2.27 (7462)	3-12 (W)	About 1 ft. of silt loam on about 2-1/2 ft. of silty clay loam and underlain by silt loam (loess). Well drained, sloping soils on loess (over 60 in. thick) covered glacial drift or bedrock uplands.
307 Iona (a)	0.02 (59)	3-7 (MW)	Aeolian deposits on upland and terrace positions. Silty and moderately coarse materials. Some variable textured layers below 60 in., underlain with coarse sandy materials Moderately well drained.
268 Mt. Carroll (b)	0.03 (103)	2-7 (W)	About 1 ft. of silt loam on 3 ft. of heavy silt loam underlain by silt loam (loess). Well drained, gently to strongly sloping soils formed from deep loess, generally on upland ridges and knolls.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-L (Continued)

Depth From Surface, Inches	Soil Classification USDA (2) Textural	AASHO (2)	Percent (2) Passing Sieve No. 4	No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches > 2%	1-2%	< 1%
0-14	Silt loam	A-4 or A-6	100	95-100	15-25	--	--	5.6-6.5			
14-40	Silty clay loam	A-7 or A-6	100	95-100	30-40	--	--	5.6-6.5		0-16	16-60
40-60	Silt Loam	A-6	100	95-100	15-25	25-40	5-20	6.6-7.3			
0-12	Silt loam	A-4 or A-6	100	95-100	15-25	--	--	5.6-6.5			
12-42	Silty clay loam	A-6 or A-7	100	95-100	30-40	--	--	5.6-6.5		0-16	16-60
42-60	Silt loam	A-4 or A-6	100	95-100	15-25	25-40	5-20	6.6-7.8			
0-16	Silt loam	A-4 or A-6	100	95-100	10-20	25-40	5-12	5.6-6.5			
16-40	Heavy silt loam	A-6	100	95-100	20-30	30-50	8-25	5.6-6.5		0-16	16-60
40-60	Silt loam	A-4 or A-6	100	95-100	10-20	25-40	5-20	5.6-6.5			
0-10	Silt loam	A-4 or A-6	100	95-100	15-25	25-40	5-10	5.6-6.5			
10-42	Silty clay loam	A-7 or A-6	100	95-100	25-35	40-50	15-30	5.6-6.5		0-8	8-60
42-60	Silt loam	A-4 or A-6	100	95-100	15-25	25-40	5-20	6.6-7.8			
0-12	Silt loam	A-4	100	85-95	15-25	--	--	5.1-6.0			
12-36	Silty clay loam	A-6 or A-7	100	80-90	25-35	--	--	5.1-6.0		0-8	8-60
36-60	Silt loam	A-6 or A-4	100	85-95	15-25	25-40	5-20	6.6-7.8			
0-18	Silt loam	A-4 or A-6	100	95-100	10-20	25-40	5-12	5.6-6.5			
18-48	Heavy silt loam	A-6 or A-4	100	95-100	20-30	30-50	8-25	5.6-6.5		0-16	16-60
48-60	Silt loam	A-4 or A-6	100	95-100	10-20	25-40	5-20	6.6-7.3			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 1-L (Continued)
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION L

Parent Material: (a) Loess > 5 feet thick, calcareous at 2-1/2 to 4 feet.
(b) Loess > 4 - 5 feet thick, noncalcareous > 3-1/2 feet.

MAJOR SOIL SERIES, Number and Name	Peneentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
723 Reesville (a)	0.004 (13)	1-3 (Imp.)	About 1 ft. of silt loam (when uneroded) on about 1-1/2 ft of silty clay loam, underlain by at least 3 ft. of silt loam which has properties of loess. Nearly level to gently sloping, somewhat poorly drained, terrace areas. Depth to seasonal water table is 3 to 5 ft.
279 Rozetta (b)	0.66 (2169)	2-12 (MW)	About 1 ft. of silt loam on 2 to 3 ft. of silty clay loam underlain by silt loam (loess). Moderately well drained, nearly level to strongly sloping soils formed in 5 ft. or more of loess on glacial drift or bedrock uplands.
274 Seaton (b)	0.32 (762)	3-15 (W)	About 1 ft. of silt loam on 2 to 2-1/2 ft. of heavy silt loam and underlain by silt loam (loess). Well drained, sloping soils on loess (over 60 in. thick) covered till or bedrock uplands.
278 Stronghurst (b)	0.15 (494)	1-3 (Imp.)	About 1 ft. of silt loam on 2 ft. of silty clay loam underlain by silt loam (loess). Somewhat poorly drained, level to gently sloping soils formed in deep loess on glacial till plains. Seasonal water tables are within 3 ft. of the surface.
19 Sylvan (a)	0.41 (1355)	7-18 (W)	About 1 ft. of silt loam on 2 ft. of silty clay loam underlain by silt loam (loess). Well drained, moderately steep to very steep soils formed in deep loess.
633 Traer (b)	0.01 (29)	0-1 (P)	About 1 ft. of silt loam on 3 ft. of silty clay loam to silty clay underlain by silt loam (loess). Poorly drained level to depressional soils formed in deep loess. Seasonal water tables are at or near the surface. Commonly appear as "gray spots" within a field.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-L (Continued)

Depth From Surface, Inches	Soil Classification USDA (2) Textural	Soil Classification AASHO (2)	Percent (2) Passing Sieve No. 4	Percent (2) Passing Sieve No. 200	Clay Fraction (3) (< 2μ),%	(4) Liquid Limit %	(4) Plasticity Index, %	Natural Soil (2) pH	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches > 2%	1-2%	< 1%
0-8	Silt loam	A-4	100	95-100	15-25	--	--	5.6-6.5			
8-29	Silty clay loam	A-6 or A-7	100	95-100	25-35	--	--	6.1-7.3		0-8	8-60
29-60	Silt loam	A-6 or A-4	100	90-100	15-25	25-40	5-20	7.4-8.4 (calc)			
0-12	Silt loam	A-4 or A-6	100	95-100	15-25	25-40	8-12	5.6-6.5			
12-36	Silty clay loam	A-7 or A-6	100	95-100	25-35	30-50	8-18	5.6-6.5		0-8	8-60
36-60	Silt loam	A-4 or A-6	100	95-100	15-25	25-40	5-20	6.6-7.8			
0-12	Silt loam	A-4 or A-6	100	95-100	10-20	--	--	5.6-6.5			
12-42	Silt loam	A-6	100	95-100	20-30	--	--	5.6-6.5		0-8	8-60
42-60	Silt loam	A-4 or A-6	100	95-100	10-20	25-40	5-20	6.6-7.8			
0-12	Silt loam	A-4 or A-6	100	95-100	15-25	25-40	5-12	5.1-6.5			
12-36	Silty clay loam	A-7 or A-6	100	95-100	25-35	30-55	11-25	5.1-6.0		0-8	8-60
36-60	Silt loam	A-6	100	95-100	15-25	25-40	5-20	6.6-7.8			
0-12	Silt loam	A-4	100	95-100	10-20	--	--	5.6-6.5			
12-36	Sily clay loam	A-6 or A-7	100	95-100	25-35	--	--	5.6-6.5		0-8	8-60
36-60	Silt loam	A-4 or A-6	100	95-100	15-25	25-40	5-20	6.6-7.8			
0-10	Silt loam	A-4 or A-6	100	95-100	15-25	--	--	5.1-6.5			
10-46	Silty clay loam to silty clay	A-7	100	95-100	30-40	--	--	4.5-5.5		0-8	8-60
46-60	Silt loam	A-6	100	95-100	15-25	25-40	5-20	6.1-7.3			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-L

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION L

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
61 Atterberry	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
386 Downs	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
263 Fall	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
280 Fayette	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
307 Iona	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	★
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
268 Mt. Carroll	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-L (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

TABLE 2-L (Continued)

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION L

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
723 Reesville	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	2 (d)	3	3	*
	C	2	1	3	3	3	1 (b)	1	3	3	3	1	1	2	2	*
279 Rozetta	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	2 (d)	3	3	*
	C	2	1	3	3	3	1 (b)	1	3	3	3	1	1	2	2	*
274 Seaton	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	2 (d)	3	3	*
	C	2	1	3	3	3	1 (b)	1	3	3	3	1	1	2	2	*
278 Stronghurst	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	2 (d)	3	3	*
	C	2	1	3	3	3	1 (b)	1	3	3	3	1	1	2	2	*
19 Sylvan	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	2 (d)	3	3	*
	C	2	1	3	3	3	1 (b)	1	3	3	3	1	1	2	2	*
633 Traer	A	2	1	3	3	3	2	1	2 (a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2 (b)	1	3	3	3	1 (c)	1	3	3	*
	C	2	1	3	3	3	1 (b)	1	3	3	3	1	1	2	2	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-L (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION M

Soils of association area M occur on uplands mainly in east central Illinois with a few small areas in the north-central part of the state, Figure 7, and occupy 859,000 acres or 2.4 percent of the state. Soils of this association area have developed under forest or mixed prairie and forest vegetation from 3-5 feet of loess on loam to silty clay loam Wisconsinan glacial till.

The major soil series occurring in this area are listed in Table 1-M. Mellott and Russell occur on the well drained positions of the soil catena; Birkbeck on the moderately well to well drained positions; Wingate and Xenia on the moderately well drained positions; Fincastle, Sabina, Sunbury, and Toronto on the imperfectly drained positions; and Ward on the poorly drained positions.

Thin to moderately thin and moderately organic A horizons are characteristic of the soils of association area M. As indicated in Table 1-M, the organic carbon content is typically 1-2 percent to a depth of about 8-16 inches and is less than 1 percent at depths greater than this.

The material of the A horizon is typically silt loam in texture and has an AASHO designation of A-4 or A-6. The texture of the material in the B horizon is normally silty clay loam to silty clay with an AASHO designation of A-6 or A-7. The C horizon (in either loess or Wisconsinan loam to silty clay loam or clay loam till) typically displays a loam, silt loam, or silty clay loam texture and an A-4 or A-6 AASHO designation. At depths greater than about 36-60 inches Wisconsinan loam to silty clay loam or clay loam glacial till will be encountered. Further discussion of Wisconsinan glacial tills can be found in Chapter 2 and Appendix B.

Available information, summarized in Table 1-M, indicates that the plasticity index typically ranges from NP-25, 11-30, and 5-20 respectively for the A, B, and C horizons and the clay content commonly ranges from 15-25, 30-45, and 13-35 percent for the A, B, and C horizons.

Stabilization recommendations for association area M materials are summarized in Table 2-M.

TABLE 1-M

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION M

Percent Area of State 2.4

Total Acreage 859,000

Parent Material: (a) Loess 3 - 5 feet thick on calcareous loam to silty clay loam till or
(b) Loess 1 - 3 feet thick on clay loam till, noncalcareous > 3-1/2 feet.

MAJOR SOIL SERIES, Number and Name	Percentage[1] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site[2] Description
233 Birkbeck (a)	0.44 (1447)	2-8 (W-MW)	About 1 foot of silt loam on 2 to 3 feet of silty clay loam and underlain by loam to silt loam till. Well drained, sloping soils on loess (40-50 inches thick) covered till plains and moraines.
496 Fincastle (b)	0.12 (394)	1-3 (Imp.)	About 1 foot of silt loam on 3 feet of silty clay loam to clay loam underlain by loam glacial till. Somewhat poorly drained, nearly level to gently sloping soils formed from 1-1/2 to 3 feet of loess on calcareous loam glacial till. Seasonal water tables within 3 feet of the surface.
497 Mellott (b)	0.02 (74)	3-7 (W)	About 1 foot of silt loam on 2-1/2 to 3 feet of silty clay loam to clay loam underlain by calcareous loam glacial till. Well drained, gently sloping to steep soils formed from about 3 to 4 feet of loess on glacial till plains and moraines.
322 Russell (b)	0.21 (678)	3-8 (W)	About 1 foot of silt loam on 2-1/2 to 3-1/2 feet of silty clay loam to clay loam and underlain by loam to silt loam till. Well drained, sloping soils on till plains and moraines.
236 Sabina (a)	0.24 (806)	1-3 (Imp.)	About 1 foot of silt loam on 2-1/2 feet of silty clay loam underlain by loam to silt loam glacial till. Somewhat poorly drained, nearly level to gently sloping soils on loess (3 to 5 feet thick) covered glacial till plains and moraines. Seasonal water tables are within 3 feet of the surface.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-M (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		Clay Fraction (3) (< 2μ),%	Liquid (4) Limit, %	Plasticity (4) Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-12	Silt Loam	A-4 or A-6	100	95-100	15-25	20-40	5-15	5.6-6.5			
12-42	Silty Clay Loam	A-7 or A-6	100	95-100	30-40	30-50	12-25	5.6-6.5		0-16	16-60
42-60	Loam to Silt Loam	A-4 or A-6	95-100	55-75	20-35	35-45	5-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	95-100	70-90	15-25	--	--	5.1-6.0			
12-48	Silty Clay Loam to Clay Loam	A-6	95-100	60-85	30-40	--	--	5.1-6.0		0-10	10-60
48-60	Loam to Silt Loam	A-4 or A-6	90-100	50-80	15-25	--	10-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	100	95-100	15-25	--	--	5.1-6.0			
12-44	Silty Clay Loam to Clay Loam	A-6	95-100	70-95	30-40	--	--	5.1-6.0		0-16	16-60
44-60	Loam to Silt Loam	A-4 or A-6	95-100	55-75	15-25	--	10-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	100	80-100	15-25	NP-50	NP-25	5.1-6.0			
12-48	Silty Clay Loam to Clay Loam	A-6	95-100	70-95	30-40	30-50	15-30	5.1-6.0		0-8	8-60
48-60	Loam to Silt Loam	A-4 or A-6	95-100	55-75	15-25	25-35	10-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-6	100	95-100	15-25	--	--	5.6-6.5			
12-42	Silty Clay Loam	A-7 or A-6	100	95-100	30-40	--	--	5.6-6.5		0-8	8-60
42-60	Loam, Silt Loam or Silty Clay Loam	A-4 or A-6	95-100	55-75	20-35	--	5-20	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 1-M (Continued)

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION M

Parent Material: (a) Loess 3 - 5 feet thick on calcareous loam to silty clay loam till or
(b) Loess 1 - 3 feet thick on clay loam till, noncalcareous > 3-1/2 feet.

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
234 Sunbury (a)	0.11 (355)	1-3 (Imp.)	About 1 foot of silt loam on 2 to 3 feet of silty clay loam underlain by loam or silt loam calcareous glacial till. Somewhat poorly drained, level to gently sloping soils formed in 3 to 5 feet of loess on calcareous glacial till plains. Seasonal water tables are within 3 feet of the surface.
353 Toronto (b)	0.04 (118)	0-2 (Imp.)	About 1 foot of silt loam on 2 feet of silty clay loam on 2 feet of clay loam and underlain by calcareous loam glacial till. Somewhat poorly drained, level to moderately sloping soils formed on loess covered glacial till plains. Seasonal water tables within 3 feet of surface.
207 Ward (a)	0.02 (64)	0-1 (P)	About 1 to 2 feet of silt loam on 1-1/2 to 2-1/2 feet of silty clay loam to silty clay and underlain by calcareous loam to silt loam glacial till. Poorly drained, level to depressional soils formed from 3 to 5 feet of loess on glacial till plains. Seasonal water tables are at or near the surface.
348 Wingate (b)	0.03 (87)	1-4 (MW)	About 1 foot of silt loam on 2 to 5 feet of silty clay loam to clay loam underlain by calcareous loam glacial till. Moderately well drained, gently to strongly sloping soils formed in 1-1/2 to 3 feet of loess on glacial till plains.
291 Xenia (b)	0.17 (558)	2-4 (MW)	About 1 foot of silt loam on 2 feet of silty clay loam on 1 foot of clay loam and underlain by calcareous loam glacial till. Moderately well drained, gently to strongly sloping soils formed from 1-1/2 to 3 feet of loess and glacial till.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-M (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-14	Silt Loam	A-6	100	95-100	15-25	--	--	5.6-6.5			
14-42	Silty Clay Loam	A-7 or A-6	100	95-100	30-40	--	--	5.6-6.5		0-16	16-60
42-60	Loam, Silt Loam or Silty Clay Loam	A-6 or A-4	95-100	55-75	20-35	--	5-20	7.4-8.4 (calc)			
0-14	Silt Loam	A-4 or A-6	100	85-95	15-25	NP-50	NP-25	5.6-6.0			
14-50	Silty Clay Loam to Clay Loam	A-6	100	65-95	30-40	30-50	15-30	5.1-6.0		0-8	8-60
50-60	Loam to Silt Loam	A-4 or A-6	100	60-70	15-25	25-35	10-20	7.4-8.4 (calc)			
0-18	Silt Loam	A-6	100	95-100	15-25	--	--	5.6-6.5			
18-40	Silty Clay Loam to Silty Clay	A-6 or A-7	100	95-100	35-45	--	--	5.6-6.5		0-8	8-60
40-60	Loam to Silt Loam	A-4 or A-6	95-100	55-75	15-30	--	5-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	100	85-95	15-25	NP-50	NP-25	5.1-6.0			
12-48	Silty Clay Loam to Clay Loam	A-6	100	60-90	30-40	30-50	15-30	5.1-6.5		0-16	16-60
48-60	Loam to Silt Loam	A-4 or A-6	95-100	60-70	15-25	25-35	10-20	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	100	85-95	15-25	NP-50	NP-25	5.1-6.0			
12-48	Silty Clay Loam to Clay Loam	A-6	100	60-85	30-40	30-50	15-30	5.1-6.0		0-8	8-60
48-60	Loam to Silt Loam	A-4 or A-6	95-100	50-80	15-25	25-35	10-20	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-M
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION M

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
234 Sunbury	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
353 Toronto	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
207 Ward	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
348 Wingate	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆
291 Xenia	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-M (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

TABLE 2-M (Continued)
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION M

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
233 Birkbeck	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
496 Fincastle	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
497 Mellott	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
322 Russell	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
236 Sabina	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-M (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION N

Soils of association area N occur on nearly level to very steep upland areas in northwest-central, west-central, and southwest-central Illinois, Figure 7, and occupy 2,888,000 acres or about 8 percent of the state. Soils of this association area have developed under forest or mixed prairie and forest vegetation from greater than 4-5 feet of loess on either Wisconsinan or Illinoian glacial till or drift.

The major soil series occurring in this area are listed in Table 1-N. Clary occurs on the well drained positions of the soil catena; Sicily on the moderately well to well drained positions; Clinton on the moderately well drained position; Clarksdale and Keomah on the imperfectly drained positions; and Rushville on the poorly drained positions.

Thin to moderately thin A horizons with low to moderate organic carbon contents are characteristic of the soils in association area N. As indicated in Table 1-N, the organic carbon content is typically no greater than 1-2 percent to a depth of about 8-16 inches and is less than 1 percent at depths greater than this.

The A horizon material of these soils is typically silt loam in texture and has an A-6 AASHO designation. The texture of the B horizon material is commonly silty clay loam with an AASHO designation of A-6 or A-7. The C horizon (parent loess) normally displays a silt loam texture and an A-6 or A-4 AASHO designation.

Available information, summarized in Table 1-N, indicates that the plasticity index typically ranges from 11-15, 11-20, and 11-25 respectively for the A, B, and C horizons and the clay content ordinarily ranges from 15-25, 30-45, and 15-25 percent for these respective horizons.

Stabilization recommendations for association area N materials are summarized in Table 2-N.

TABLE 1-N
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION N

Percent Area of State 8.0 Parent Material: Loess > 4 - 5 feet thick, noncalcareous > 3 ft.

Total Acreage 2,888,000

MAJOR SOIL SERIES, Number and Name	Percentage[(1)] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site[(2)] Description
257 Clarksdale	0.66 (2184)	0-2 (Imp.)	About 1 foot of silt loam on 2 feet of silty clay loam underlain by silt loam. Somewhat poorly drained, level to gently sloping soils formed in deep loess. Seasonal water tables above 3 feet.
283 Clary	0.51 (1674)	4-15 (W)	About 1 foot of silt loam on 2 to 2-1/2 feet of silty clay loam underlain by silt loam. Well drained, nearly level to steep soils formed in deep loess.
18 Clinton	1.76 (5751)	3-10 (MW)	About 1 foot of silt loam on 2 to 2-1/2 feet of heavy silty clay loam and underlain by silt loam (loess). Moderately well drained sloping soils on loess (more than 60 inches thick) covered till plains.
17 Keomah	0.81 (2670)	1-4 (Imp.)	About 1 foot of silt loam on 3 feet of silty clay loam underlain by silt loam (loess). Somewhat poorly drained, level to gently sloping soils formed from deep loess. Seasonal water tables within 3 feet of the surface.
16 Rushville	0.08 (245)	0-1 (P)	About 1 to 1-1/2 feet of silt loam on 2 feet of heavy clay loam to light silty clay and underlain by silt loam (loess). Poorly drained, level to depressional soils formed in 5 feet or more of loess on glacial till plains. Seasonal water tables are at or near the surface.
258 Sicily	0.74 (2416)	2-7 (W-MW)	One foot of silt loam or about 2-1/2 feet of silty clay loam and underlain by silt loam (loess). Well drained, sloping soils on loess covered glacial till or bedrock uplands.

(1) From Reference 13

(2) From Reference 7

TABLE 1-N (Continued)

Depth From Surface, Inches	Soil Classification		Percent[2] Passing Sieve						Organic Carbon[3] Content, Avg. Depths of Occurrence, Inches		
	USDA[2] Textural	AASHO[2]	No. 4	No. 200	Clay Fraction[3] (< 2μ),%	Liquid Limit[4] %	Plasticity Index[4], %	Natural Soil pH[2]	> 2%	1-2%	< 1%
0-14	Silt Loam	A-6	100	95-100	15-25	--	--	5.6-6.5			
14-45	Silty Clay Loam	A-6 or A-7	100	95-100	35-45	--	--	5.6-6.5		0-16	16-60
45-60	Silt Loam	A-6 or A-4	100	95-100	15-25	--	11-25	6.6-7.8			
0-12	Silt Loam	A-6	100	95-100	15-25	--	--	5.1-6.5			
12-42	Silty Clay Loam	A-6 or A-7	100	95-100	30-40	--	--	5.6-6.5		0-8	8-60
42-60	Silt Loam	A-6 or A-4	100	95-100	15-25	--	11-25	6.6-7.8			
0-12	Silt Loam	A-6	100	95-100	15-25	30-40	11-15	5.1-6.5			
12-42	Silty Clay Loam	A-6 or A-7	100	95-100	30-40	35-45	11-20	5.1-6.5		0-8	8-60
42-60	Silt Loam	A-6 or A-4	100	95-100	15-25	25-50	11-30	6.6-7.8			
0-12	Silt Loam	A-6	100	95-100	15-25	--	--	5.1-6.5			
12-48	Silty Clay Loam	A-6 or A-7	100	95-100	35-45	--	--	5.1-6.5		0-8	8-70
48-60	Silt Loam	A-6 or A-4	100	95-100	15-25	--	--	6.6-7.8		0-8	
0-16	Silt Loam	A-4 or A-6	100	95-100	15-25	--	--	5.1-6.5			
16-40	Silty Clay Loam to Silty Clay	A-7	100	95-100	35-45	--	--	5.1-6.5		0-8	8-60
40-60	Silt Loam	A-6 or A-4	100	95-100	15-25	45-50	11-25	6.6-7.8			
0-12	Silty Loam	A-6	100	95-100	15-25	--	--	5.6-6.5			
12-46	Silty Clay Loam	A-6 or A-7	100	95-100	30-40	--	--	5.6-6.5		0-16	16-60
46-60	Silt Loam to Silty Clay Loam	A-6 or A-4	100	90-95	15-25	--	11-25	6.6-7.8			

[2] From Reference 7

[3] Data supplied by Department of Agronomy, University of Illinois.

[4] Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-N

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION N

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
257 Clarksdale	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
283 Clary	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
18 Clinton	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
17 Keomah	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
16 Rushville	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
258 Sicily	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆

C = Cement
L - Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-N (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION O

Soil association area O occurs on nearly level to very steep uplands in southwestern, southeastern, and southern Illinois, Figure 7, and occupies 650,000 or about 1.8 percent of the state. The soils of this association have developed under forest or mixed prairie and forest vegetation from thick loess (> 5 feet).

The major soil series occuring in this association area are listed in Table 1-O. Alford and Sylvan occur on the well drained positions of the soil catena; Iona and Moren are found on the moderately well drained positions; and Iva and Reesville occupy the imperfectly drained positions.

Thin A horizons with a low organic carbon content are characteristic of the soils of this association area. As indicated in Table 1-O, the organic carbon content is typically not greater than 1-2 percent to a depth of 8 inches and is less than 1 percent at depths greater than 8 inches.

The materials of the A, B, and C horizons respectively are typically silt loam, silty clay loam, and silt loam in texture. The AASHO designation of the materials in the respective horizons is: A horizon, A-4 or A-6; B horizon, A-6 or A-7; and C horizon, A-6 or A-4.

Available information, summarized in Table 1-O, indicates that the plasticity index normally ranges from NP-10, 10-25, and 10-25 respectively for the A, B, and C horizons and the clay content typically ranges from 10-25, 25-35, and 15-25 percent for these respective horizons.

Stabilization recommendations for association area O materials are summarized in Table 2-O.

TABLE 1-0

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION 0

Percent Area of State 1.8

Total Acreage 650,000

Parent Material: (a) Loess > 5 feet thick, calcareous at 2-1/2 to 4 feet or
(b) Loess > 5 feet thick, noncalcareous > 3-1/2 feet

MAJOR SOIL SERIES, Number and Name	Percentage [1] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site [2] Description
308 Alford (b)	0.92 (3030)	3-12 (W)	1 foot of silt loam over 2-1/2 feet of silty clay loam, underlain by 2 to 30 feet of silt loam resting on bedrock. Well drained, sloping soils on loess covered uplands.
307 Iona (a)	0.02 (59)	3-7 (MW)	Aeolian deposits on upland and terrace positions. Silty and moderately coarse materials. Some variable textured layers below 60 inches, underlain with coarse sandy materials. Moderately well drained.
454 Iva (b)	0.04 (126)	0-2 (Imp.)	About 1 foot of silt loam on 3 to 4 feet of silty clay loam and underlain by silt loam loess. Somewhat poorly drained, nearly level to gently sloping soils formed in loess 6 to 10 feet or more thick. Seasonal water tables are within 3 feet of the surface. Loess covered upland areas.
453 Muren (b)	0.24 (799)	2-7 (MW)	About 1 foot of silt loam on 2 to 2-1/2 feet of silty clay loam and underlain by silt loam (loess) 5 to 20 feet thick over bedrock. Moderately well drained, moderately sloping to very steep soils formed in loess.
723 Reesville (a)	0.004 (13)	1-3 (Imp.)	About 1 foot of silt loam (when uneroded) or about 1-1/2 feet of silty clay loam underlain by at least 3 feet of silt loam which has properties of loess. Nearly level to gently sloping, somewhat poorly drained, terrace areas. Depth to season water table is 3 to 5 feet.
19 Sylvan (a)	0.65 (2152)	7-18 (W)	About 1 foot of silt loam on 2 feet of silty clay loam underlain by silt loam (loess). Well drained, moderately steep to very steep soils formed in deep loess.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-0 (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-10	Silt Loam	A-4	100	95-100	15-25	20-30	NP-10	6.1-7.3			
10-42	Silty Clay Loam	A-6 or A-7	100	95-100	25-35	35-45	10-25	5.1-6.5		0-8	8-60
42-60	Silt Loam	A-6 or A-4	100	95-100	15-25	30-45	10-25	4.5-5.0			
0-12	Silt Loam	A-4	100	85-95	15-25	--	--	5.1-6.0			
12-36	Silty Clay Loam	A-6 or A-7	100	80-90	25-35	--	--	5.1-6.0		0-8	8-60
36-60	Silt Loam	A-6 or A-4	100	85-95	15-25	25-40	10-25	6.6-7.8			
0-12	Silt Loam	A-4 or A-6	100	90-100	15-25	--	--	5.6-6.5			
12-50	Silty Clay Loam	A-6 or A-7	100	90-100	25-35	--	--	5.1-6.0		0-8	8-60
50-60	Silt Loam	A-6 or A-4	100	90-100	15-25	25-40	10-25	5.6-6.0			
0-10	Silt Loam	A-4 or A-6	100	95-100	15-25	--	--	5.6-6.5			
10-37	Silty Clay Loam	A-6 or A-7	100	95-100	25-35	--	--	5.1-6.0		0-8	8-70
37-60	Silt Loam	A-6 or A-4	100	95-100	15-25	25-40	10-25	5.6-6.0			
0-8	Silt Loam	A-4	100	95-100	15-25	--	--	5.6-6.5			
8-29	Silty Clay Loam	A-6 or A-7	100	95-100	25-35	--	--	6.1-7.3		0-8	8-60
29-60	Silt Loam	A-6 or A-4	100	90-100	15-25	25-40	10-25	7.4-8.4 (calc)			
0-12	Silt Loam	A-4	100	95-100	10-20	--	--	5.6-6.5			
12-36	Silty Clay Loam	A-6 or A-7	100	95-100	25-35	--	--	5.6-6.5		0-8	8-60
36-60	Silt Loam	A-4 or A-6	100	95-100	15-25	25-40	10-25	6.6-7.8			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-0
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION O

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
308 Alford	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	☆
	C	2	1	3	3	3	1[b]	1	3	3	3	1	2[d]	2	2	☆
307 Iona	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	☆
	C	2	1	3	3	3	1[b]	1	3	3	3	1	2[d]	2	2	☆
454 Iva	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	☆
	C	2	1	3	3	3	1[b]	1	3	3	3	1	2[d]	2	2	☆
453 Muren	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	☆
	C	2	1	3	3	3	1[b]	1	3	3	3	1	2[d]	2	2	☆
723 Reesville	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	☆
	C	2	1	3	3	3	1[b]	1	3	3	3	1	1	2	2	☆
19 Sylvan	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	3	3	☆
	C	2	1	3	3	3	1[b]	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-0 (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION P

Soil association area P occurs in southwestern, southeastern and southern Illinois and occupies 2,137,000 acres or about 5.9 percent of the state. The soils of this association have developed under forest vegetation from either 4 to 10 feet of loess on Illinoian glacial drift or greater than 7 feet of loess on bedrock.

The major soil series occurring in this association area are listed in Table 1-P. Hosmer occurs on the moderately well drained positions of the soil catena; Stoy occupies the imperfectly drained positions; and Weir is found on the poorly drained positions.

The organic carbon content of the moderately thick A horizons is generally no greater than 1-2 percent to a depth of 8 inches and less than 1 percent at depths greater than 8 inches.

The A horizon material of the soils of this association is typically silt loam in texture and has an A-4 or A-6 AASHO designation. The B horizon material is ordinarily silty clay loam in texture with an A-6 or A-7 AASHO designation. The typically A-4 or A-6 C horizon material (parent loess) has a silt loam texture. At depths below 7 to 10 feet, either Illinois glacial drift or bedrock will be encountered.

Available information, summarized in Table 1-P, indicates that the plasticity index typically ranges from NP-10, 10-30, and 10-20 respectively for the A, B, and C horizonsand the clay content commonly ranges from 10-20, 25-40, and 15-25 percent for the respective horizons.

Stabilization recommendations for association area N materials are summarized in Table 2-P.

TABLE 1-P
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION P

Percent Area of State 5.9

Total Acreage 2,137,000

Parent Material: Loess 4 to 10 feet thick on Illinoian drift or > 7 feet thick on residuum.

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
214 Hosmer	1.90 (6260)	3-10 (MW)	About 1 ft. of silt loam on 1 to 1-1/2 ft. of silty clay loam on a 2 to 3 ft. silt loam to silty clay loam fragipan and underlain by silt loam (loess). Well drained, sloping soils on loess (more than 50 in. thick) covered till plains.
164 Stoy	0.86 (2836)	1-4 (Imp.)	About 1 ft. of silt loam on about 2 ft of silty clay loam and underlain by silt loam (loess). Somewhat poorly drained, level to sloping soils on loess (more than 50 in. thick) covered till plains. Seasonal water table above 3 ft.
165 Weir	0.28 (910)	0-2 (P)	About 1-1/2 ft. of silt loam on about 2 ft. of heavy silty clay loam and underlain by silt loam (loess). Poorly drained, level soils on loess (more than 50 in. thick) covered till plains. Seasonal water table at or near the surface.

(1) From Reference 13

(2) From Reference 7

TABLE 1-P (Continued)

Depth From Surface, Inches	Soil Classification: USDA Textural (2)	Soil Classification: AASHO (2)	Percent Passing Sieve (2): No. 4	Percent Passing Sieve (2): No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-10	Silt loam	A-4 or A-6	100	95-100	10-20	25-35	NP-10	5.1-6.0			
10-30	Silty clay loam	A-6 or A-7	100	95-100	25-35	35-50	10-30	4.5-5.5		0-8	8-60
30-50	Silty loam to silty clay loam	A-6 or A-7	100	95-100				4.5-5.5			
50-60	Silt loam	A-4 or A-6	100	90-100	5-25	25-40	10-20	5.1-6.0			
0-12	Silt loam	A-6 or A-4	100	95-100	10-20	--	--	5.1-6.0			
12-36	Silty clay loam	A-7	100	95-100	30-40	--	--	5.1-5.5		0-8	8-60
36-60	Silt loam	A-6 or A-4	100	90-100	15-25	25-40	10-20	5.1-6.0			
0-16	Silt loam	A-6	100	95-100	10-20	--	--	5.1-6.0			
16-36	Silty clay loam	A-7	100	95-100	30-40	--	--	4.5-5.5		0-8	8-60
36-60	Silt loam	A-6 or A-4	100	90-100	15-25	25-40	10-20	6.1-6.5			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-P

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION P

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
214 Hosmer	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	2	2	*
164 Stoy	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	2	2	*
165 Weir	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-P (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high-- on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION Q

Soil association area Q occurs in south-central and southern Illinois on nearly level to steep uplands, Figure 7, and occupies a total of 2,989,000 acres or about 8.3 percent of the state. The soils of this association area have developed under forest vegetation from 1-1/2 to 4 feet of loess on Illinoian glacial drift.

The major soil series occurring in this area are listed in Table 1-Q. Hickory occurs on the moderately well to well drained positions of the soil catena; Blair and Bluford on the imperfectly drained positions; and Wynoose is found on the poorly drained positions.

Moderately thick A horizons with moderately low organic carbon contents are characteristic of the soils of this association area. As indicated by the data presented in Table 1-Q, the organic carbon content is generally 1 to 2 percent to a depth of 8 inches and less than 1 percent at greater depths.

The material in the A horizon of these soils is typically silt loam in texture and has an A-4 or A-6 AASHO designation. The texture of the B horizon material is commonly silty clay loam, clay loam, or silty clay with an A-6 or A-7 AASHO designation. The texture of the C horizon (located in lower part of loess or upper Illinoian till) may be quite variable including loam, silty clay loam and clay loam textures. The AASHO designation is typically A-4, A-6, or A-7.

Available information, summarized in Table 1-Q, indicates that the plasticity index typically ranges from 5-15, 15-40, and 10-25 for the A, B, and C horizons and the clay content ordinarily ranges from 10-20, 25-45, and 10-35 percent respectively.

Stabilization recommendations for association area Q materials are summarized in Table 2-Q.

TABLE 1-Q

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION Q

Percent Area of State 8.3 Parent Material: (a) Loess 1-1/2 to 4 feet thick on Illinoian drift or
(b) Loess < 1-1/2 feet thick on Illinoian drift.

Total Acreage 2,989,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
14 Ava (a)	1.12 (3691)	3-7 (MW)	About 1 foot of silt loam on about 3 feet of firm silty clay loam underlain by firm clay loam glacial till. Moderately well drained, gently sloping to moderately steep soils formed in 2 to 4 feet of loess on glacial till.
5 Blair (b)	1.27 (4184)	4-12 (Imp.)	About 1 foot of silt loam on 2 to 3 feet of gritty silty clay loam to clay loam on clay loam glacial till. Somewhat poorly drained, moderately to strongly sloping soils formed from a thin layer of loess on glacial till. Seasonal water tables within 3 feet of surface.
13 Bluford (a)	2.37 (7786)	1-4 (Imp.)	About 1-1/2 feet of silt loam on 1-1/2 to 2 feet of heavy silty clay loam and underlain by gritty silty clay loam till. Somewhat poorly drained, level to sloping soils on loess (20 to 50" thick) covered till plains. Seasonal water table above 3 feet.
8 Hickory (b)	3.68 (12083)	15-30 (W-MW)	About 1 foot of loam on about 2 to 2-1/2 feet of silty clay loam to clay loam and underlain by loam till. Well drained, sloping soils in valleys cut into glacial till plains.
12 Wynoose (a)	0.98 (3205)	0-2 (P)	About 1-1/2 feet of silt loam on 1-1/2 to 2 feet of light silty clay and underlain by gritty silty clay loam till. Poorly drained, level soils on loess (20 to 50 inches thick) covered till plains. Seasonal water table at or near the surface.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-Q (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil (2) pH	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-10	Silt Loam	A-4 or A-6	100	95-100	10-20	--	--	5.1-6.0			
10-24	Light Silty Clay Loam	A-6	100	95-100		--	--	5.1-5.5			
24-40	Silty Clay Loam	A-6	100	90-100	30-40	--	--	5.1-5.5		0-8	8-60
40-60	Clay Loam to Silty Clay Loam	A-6 or A-4	100	80-95	20-35	20-40	10-25	5.1-6.0			
0-10	Silt Loam	A-4 or A-6	95-100	65-100	10-20	--	--	5.1-6.0			
10-40	Gritty Silty Clay loam to clay loam	A-6 or A-7	95-100	60-85	30-40	--	--	4.5-5.5		0-8	8-60
40-60	Clay Loam	A-6 or A-7	90-100	60-75	20-35	20-40	10-25	5.1-5.5			
0-16	Silt Loam	A-4 or A-6	100	95-100	10-20	30-40	5-10	5.1-6.0			
16-40	Silty Clay Loam	A-6 or A-7	100	90-100	35-45	45-55	20-25	4.5-5.5		0-8	8-60
40-60	Silty Clay Loam to Clay Loam	A-4 or A-6	100	80-95	25-35	20-40	10-25	4.1-6.0			
0-10	Loam	A-4 or A-6	95-100	50-80	10-20	20-30	5-10	4.5-5.5			
10-40	Clay Loam to Silty Clay Loam	A-6	95-100	55-85	25-35	30-50	15-30	4.5-5.5		0-8	8-60
40-60	Loam	A-4 or A-6	95-100	50-80	10-20	20-35	10-25	5.6-7.8			
0-16	Silt Loam	A-4	100	95-100	10-20	20-35	3-15	4.5-6.0			
16-48	Silty Clay	A-7 or A-6	100	90-100	35-50	40-60	15-40	4.5-5.5		0-8	8-60
48-60	Silty Clay Loam	A-6	100	80-95	25-35	35-45	10-25	5.1-6.0			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-Q
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION Q

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
14 Ava	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	2	2	☆
5 Blair	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	3(e)	3(e)	☆
13 Bluford	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	2	2	☆
8 Hickory	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
12 Wynoose	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Stability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-Q (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

(e) A "3" rating has been assigned as the stabilization recommendation for bituminous and lime-fly ash due to the fine-grained A-6 and A-7 nature of the C horizon material. Note that the C horizon of the other major soils of this association area are A-4 and A-6.

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SOIL ASSOCIATION R

Soil association area R occurs in southern Illinois, Figure 7, and occupies 451,000 acres or about 1.2 percent of the state. The soils of this association have developed under forest vegetation from either 1-1/2 to 3-1/2 feet or 3-1/2 to 7 feet of loess on bedrock.

The major soil series occurring in this association area are listed in Table 1-R. Zanesville occurs on the well to moderately well drained positions of the soil catena; Grantsburg occupies the moderately well drained positions; and Robbs is found on the imperfectly drained positions.

As indicated by Table 1-R, the organic carbon content of the A horizons in the association are generally less than 1 to 2 percent to a depth of 8 inches and less than 1 percent at depths greater than this.

The A horizon material is generally silt loam in texture with an A-4 AASHO designation. A texture of silty clay loam and an A-6 AASHO designation are typical of the B horizon materials. The C horizon may vary in texture depending on the thickness of loess and/or the type of underlying bedrock. However, in general, silty clay loam and silt loam textures are typical with an A-4 and A-6 AASHO designations.

Available information, summarized in Table 1-R, indicates that the plasticity index typically ranges from 10-20, 10-20, and 5-10 respectively for the A, B, and C horizons and the clay content ordinarily ranges from 10-20, 25-40, and 10-30 percent respectively.

Stabilization recommendations for association area R materials are summarized in Table 2-R.

TABLE 1-R

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION R

Parent Material: (a) Loess 3-1/2 to 7 feet thick on bedrock residuum or
(b) Loess 1-1/2 to 3-1/2 feet thick on bedrock residuum.

Percent Area of State 1.2

Total Acreage 451,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
301 Grantsburg (a)	0.50 (1656)	2-10 (MW)	About 1 foot of silt loam on 1-1/2 feet of silty clay loam over 3 to 4 feet of compacted silty clay loam to silt loam (fragipan) underlain by silt loam. Moderately well drained, gently sloping to moderately steep soils formed in 3-1/2 to 7 feet of loess over sandstone and shale bedrock.
335 Robbs (a)	0.04 (119)	0-2 (Imp.)	About 1-1/2 feet of silt loam on 2 feet of silty clay loam on gritty silt loam to loam. Somewhat poorly drained soils formed in 5 to 10 feet of loess over bedrock or residuum.
340 Zanesville (b)	0.31 (1030)	7-18 (W-MW)	About 1 foot of silt loam on about 1 foot of silty clay loam over a fragipan, which is a silty loam's underlain by sandstone bedrock at a depth of 3 to 6 feet. Moderately well drained, moderately sloping to moderately steep upland areas.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material.

TABLE 1-R (Continued)

Depth From Surface, Inches	Soil Classification USDA (2) Textural	AASHO (2)	Percent (2) Passing Sieve No. 4	No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches > 2%	1-2%	< 1%
0-12	Silt Loam	A-4	100	95-100	10-20	30-40	10-20	5.1-6.0			
12-30	Silty Clay Loam	A-6	100	95-100	25-35	30-40	10-20	4.5-5.5		0-8	8-60
30-60	Silty Clay Loam to Silt Loam	A-6 or A-4	100	90-100	20-30	20-30	5-10	4.5-6.0			
0-16	Silt Loam	A-4	100	95-100	10-20	--	--	5.1-6.0			
16-47	Silty Clay Loam	A-6	100	95-100	30-40	--	--	4.5-5.5		0-8	8-60
47-60	Gritty Silt Loam to Loam	A-4 or A-6	100	60-90	20-30	--	--	4.5-5.5			
0-12	Silt Loam	A-4	100	95-100	10-20	--	--	5.0-6.0			
12-26	Silty Clay Loam	A-6	100	95-100	25-35	--	--	4.6-5.5		0-8	8-70
26-56	Silt Loam to Loam	A-4	100	90-100	10-25			4.5-5.5			
56-60	Sandstone and Shale bedrock	--	--	--		--	--				

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-R
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION R

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
301 Grantsburg	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	$2^{(d)}$	2	2	☆
335 Robbs	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	$2^{(d)}$	2	2	☆
340 Zanesville	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	$2^{(d)}$	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-R (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION S

Soil association area S occurs in northern Illinois on stream terraces and upland areas, Figure 7. Soils of this association occupy 101,000 acres or about 0.3 percent of the state. These soils have developed under forest vegetation from 2 to 3-1/2 feet of medium textured material on calcareous gravel.

The major soil series occurring in this association area are listed in Table 1-S. Casco and Fox both occupy the well drained positions of the soil catena and Homer occupies the imperfectly drained positions.

The organic carbon content of these soils is, in general, moderately low in the upper part of the profile. As indicated in Table 1-S, the organic carbon content is no greater than 1 to 2 percent to a depth of 8 inches and is less than 1 percent at depths greater than 8 inches.

The material of the A horizon of these soils ordinarily classifies as loam or silt loam in texture with an A-4 or A-6 AASHO designation. The texture of the B horizon material is typically silty clay loam, clay loam, or sandy clay loam and the AASHO designation is generally A-6 or A-7. Calcareous gravel and sand (coarse-textured Wisconsinan glacial till or outwash) with an AASHO designation of A-1 are normally encountered at depths greater than about 2 to 3-1/2 feet.

Available in formation, summarized in Table 1-S indicates that the plasticity index typically ranges from NP-30, 10-35, NP-30 for the respective A, B, and C horizons and the clay content normally ranges from 10-25, 20-35 and 5-10 percent for these respective horizons.

Stabilization recommendations for association area S materials are summarized in Table 2-S.

TABLE 1-S
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION S

Percent Area of State 0.3 Parent Material: Medium textured material 2 to 3-1/2 feet thick on calcareous gravel.

Total Acreage 101,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
323 Casco	0.074 (243)	4-15 (W)	About 1 foot of loam or silt loam on 1 foot of clay loam or gravelly clay loam underlain by stratified calcareous gravel and sand. Well drained, moderately sloping to steep soils formed on kames, terraces, and outwash plains.
327 Fox	0.06 (202)	1-8 (W)	About 1 foot of silt loam to loam on 1 to 2-1/2 feet of silty clay loam to sandy clay loam and underlain by stratified gravel and sand. Well drained, level to sloping soils on kames, stream terraces, and outwash plains.
326 Homer		0-2 (Imp.)	Outwash plains, terraces and moraines. Silty and loamy materials underlain with stratified sand and gravel at 24 to 42 inches. Somewhat poorly drained.

(1) From Reference 13

(2) From Reference 7

TABLE 1-S (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ), %	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-10	Loam or Silt Loam	A-4 or A-6	100	55-90	10-20	NP-30	NP-15	6.1-6.5			
10-20	Clay Loam to Gravelly Clay Loam	A-6	85-100	55-85	20-30	25-55	10-30	6.1-7.3		0-8	8-60
20-60	Stratified Gravel and Sand	A-1	40-90	0-10	5-10	NP	NP	7.4-8.4 (calc)			
0-12	Silt Loam to Loam	A-4 or A-6	100	55-90	15-25	20-55	3-30	5.6-6.5			
12-30	Silty Clay Loam to Sandy Clay Loam	A-6 or A-7	95-100	45-90	25-35	30-60	10-35	5.6-6.5		0-8	8-60
30-60	Stratified Gravel and Sand	A-1	40-80	0-10	5-10	NP-50	NP-30	7.4-8.4 (calc)			
0-10	Loam or Silt Loam	A-4 or A-6	100	85-95	15-25	25-35	4-8	6.5-6.5			
10-36	Clay Loam to Sandy Clay Loam	A-6 or A-7	100	80-90	25-35	35-45	15-25	5.1-6.0		0-8	8-50
36-60	Stratified Sand and Gravel	A-1	40-80	0-10	5-10	NP-45	NP-25	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-S

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION S

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers															
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement					
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
323 Casco	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
327 Fox	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
326 Homer	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

NA = Not Applicable

( ) See designated comments on following page

TABLE 2-S (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do not display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION T

Soil association area T occurs on uplands in northern Illinois and occupies 209,000 or about 0.6 percent of the state. The soils of this association area have developed under forest or mixed forest and grass vegetation from thin loess over permeable Wisconsinan clay loam, sandy clay loam, or sandy loam glacial till.

The major soil series occurring in this association area are listed in Table 1-T. Lapeer, Myrtle, and Westville occupy the well drained positions of the soil catena and Argyle, McHenry, and Pecatonica are found on the moderately well to well drained positions.

The organic carbon content of these soils is typically moderately low in the upper part of the profile. As indicated by the data presented in Table 1-T, the organic carbon content is typically no greater than 1 to 2 percent to a depth of 8-16 inches and is less than 1 percent at greater depths.

The A horizon material of these soils normally classifies as loam or silt loam in texture with an AASHO designation of A-4 or A-6. The textural classification of the B horizon material is typically silty clay loam to clay loam with a A-6 or A-7 AASHO designation. Generally, the texture of the C horizon is clay loam, sandy clay loam, or sandy loam. The AASHO designation of these materials is either A-2 to A-4 or A-6 to A-7.

Available information, summarized in Table 1-T, indicates that the plasticity index typically ranges from NP-15, 10-30, and NP-30 respectively for the A, B, and C horizons and the clay content commonly ranges from 10-25, 25-40, and 5-20 percent for the respective horizons.

Stabilization recommendations for association area T materials are summarized in Table 2-T.

TABLE 1-T

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION T

Parent Material: (a) Loess 2-1/2 to 5 feet thick on noncalcareous clay loam to sandy clay loam till or
(b) Loess 1-1/2 to 3 feet thick on noncalcareous clay loam to sandy clay loam till to 4 feet or
(c) Loess 1 to 3 feet on sandy loam till, calcareous < 4 feet or
(d) Loess < 1 feet thick on sandy loam till, calcareous < 3-1/2 feet or
(e) Loess < 1-1/2 feet thick on noncalcareous clay loam to sandy clay loam till to 3-1/2 feet

Percent Area of State 0.6

Total Acreage 209,000

MAJOR SOIL SERIES, Number and Name	Percentage [1] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site [2] Description
227 Argyle (b)	0.03 (112)	2-7 (W-MW)	About 1 to 1-1/2 feet of silt loam on about 2-1/2 feet of silty clay loam or clay loam underlain with calcareous sandy loam drift. Small stones are common below 4 feet. Well drained, sloping to moderately steep soils formed in loess (20 to 40 inches thick) on glacial till plains.
361 Lapeer (d)	0.11 (366)	5-12 (W)	About 1 foot of loam on 1 to 2 feet of clay loam underlain by sandy loam. Well drained, strongly sloping to steep soils formed from calcareous sandy loam glacial till. Gravel and cobbles are common below 30 inches or so.
310 McHenry (c)	0.05 (168)	1-6 (W-MW)	About 1 foot of silt loam on about 1-1/2 feet of silty clay loam to clay loam and underlain by sandy loam glacial till. Well drained, sloping soils on till plains and moraines.
414 Myrtle (a)	0.07 (220)	2-8 (W)	About 1 foot of silt loam on 2 to 2-1/2 feet of silty clay loam and underlain by clay loam glacial till. Well drained, gently sloping to strongly sloping soils formed in 2-1/2 to 4 feet of loess on glacial drift.
21 Pecatonica (b)	0.23 (760)	2-7 (W-MW)	About 1 foot of silt loam on 3 to 4 feet of silty clay loam to clay loam and underlain by sandy loam till. Well drained, sloping soils on till plains and moraines.
22 Westville (e)	0.09 (297)	4-12 (W)	About 1/2 to 1 foot of silt loam on 2 to 3 feet of clay loam underlain by calcareous loam to sandy loam glacial drift. Well drained, gently sloping to moderately steep soils formed from very thin loess over glacial drift.

[1] From Reference 13

[2] From Reference 7

( ) See designated parent material.

TABLE 1-T (Continued)

Depth From Surface, Inches	Soil Classification		Percent [2] Passing Sieve		[3] Clay Fraction (< 2μ),%	[4] Liquid Limit, %	[4] Plasticity Index, %	Natural Soil pH (2)	Organic Carbon [3] Content, Avg. Depths of Occurrence, Inches		
	USDA [2] Textural	AASHO [2]	No. 4	No. 200					> 2%	1-2%	< 1%
0-18	Silt Loam	A-6 or A-4	100	80-95	15-25	--	--	5.6-6.5			
18-48	Silty Clay Loam to Clay Loam	A-6 or A-7	100	60-80	30-40	--	--	5.6-6.5		0-16	16-60
48-60	Sandy Loam	A-2 or A-4	85-100	30-80	10-20	--	NP-30	5.6-6.5			
0-12	Loam	A-4	95-100	50-80	10-20	NP-45	NP-15	5.6-6.5			
12-30	Clay Loam	A-6 or A-7	95-100	55-80	25-35	35-50	15-25	5.6-6.5		0-8	8-60
30-60	Sandy Loam	A-2 or A-4	85-100	25-55	5-15	NP-20	NP-10	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	100	70-90	10-20	NP-45	NP-7	5.6-6.5			
12-34	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	25-35	35-50	10-30	5.6-6.5		0-8	8-45
34-60	Sandy Loam	A-2 or A-4	85-100	30-45	5-15	NP-20	NP-5	7.4-8.4 (calc)			
0-10	Silt Loam	A-4 or A-6	100	90-100	15-25	--	--	5.1-6.5			
10-40	Silty Clay Loam	A-6 or A-7	100	90-100	25-35	--	--	5.1-6.5		0-16	16-60
40-60	Clay Loam	A-6 or A-7	95-100	80-100	10-20	--	11-30	6.6-7.3			
0-12	Silt Loam	A-6 or A-4	100	70-90	15-25	--	--	5.6-6.5			
12-48	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	30-40	--	--	5.6-6.5		0-8	8-60
48-60	Sandy Loam	A-2 or A-4	85-95	30-45	10-20	--	11-30	7.4-8.4 (calc)			
0-10	Silt Loam	A-4 or A-6	100	90-100	15-25	--	--	5.1-6.0			
10-36	Clay Loam to Silty Clay Loam	A-6	95-100	60-70	25-35	--	--	5.1-6.0		0-8	8-60
36-60	Loam to Sandy Loam	A-4 or A-6	95-100	35-60	10-20	--	11-30	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-T
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION T

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
227 Argyle	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
361 Lapeer	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
310 McHenry	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
414 Myrtle	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	1	3	3	☆
21 Pecatonica	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
22 Westville	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	☆
	C	2	1	3	3	3	$1^{(b)}$	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

NA = Not Applicable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-T (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION U

Soils of association area U occur primarily in northeastern Illinois, Figure 7, and occupy 90,000 acres or about 0.2 percent of the state. The soils in this association have developed under forest or mixed grass and prairie vegetation from less than 3 feet of loess on loam textured Wisconsinan glacial till. Further discussion of Wisconsinan glacial tills may be found in Chapter 2 and Appendix B.

The major soil series occurring in this association are listed in Table 1-U. Dodge, Miami, and Strawn occupy the well drained positions of the soil catena; Montmorenci is found on the moderately well drained positions; and Herbert occupies the imperfectly drained positions.

As indicated by the data presented in Table 1-U, the organic carbon content of these soils is generally no greater than 1 to 2 percent to a depth of 8-16 inches and is less than 1 percent at greater depths.

Typically the soils have a loam or silt loam textured A horizon with an A-4 or A-6 AASHO designation. The texture of the B horizon is normally silty clay loam or clay loam and the AASHO designation is typically A-6 or A-7. The parent C horizon material generally has a silt loam or loam texture and an A-4 or A-6 AASHO desingation.

Available information, summarized in Table 1-U, indicates that plasticity index typically ranges from NP-25, 10-30, and 5-22 respectively for the A, B, and C horizons and the clay content commonly ranges from 15-25, 25-35, and 15-25 percent for the respective horizons.

Stabilization recommendations for association area U materials are summarized in Table 2-U.

TABLE 1-U

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION U

Percent Area of State 0.2

Total Acreage 90,000

Parent Material: (a) Loess 1-1/2 to 3 feet thick on loam till, calcareous by 2 to 3-1/2 feet.
(b) or Loess < 1-1/2 feet thick on loam till, calcareous by 2 to 3-1/2 feet.

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
24 Dodge (a)	0.39 (1286)	1-10 (W)	About 1 ft. of silt loam on about 2 ft. of silty clay loam and underlain by calcareous loam till. Well drained, gently sloping to strongly sloping soils formed in 1-1/2 to 3 ft. of loess on glacial till plains.
62 Herbert (a)	0.03 (93)	0-2 (Imp.)	About 1 ft. of silt loam on 1 to 2 ft. of silty clay loam underlain by loam or silt loam glacial till. Somewhat poorly drained, nearly level to gently sloping soils formed from 1 to 3 ft. of loess over calcareous glacial till. Seasonal water tables above 3 ft.
27 Miami (b)	0.11 (365)	2-10 (W)	About 1 ft. of loam on 2 ft. of silty clay loam to clay loam underlain by calcareous loam glacial till. Well drained, gently sloping to steep soils on till plains and moraines.
57 Montmorenci (b)	0.09 (304)	1-4 (MW)	About 1 ft. of silt loam on 2 ft. of silty clay loam to clay loam underlain by calcareous loam glacial till. Moderately well drained, level to moderately steep soils formed on glacial till plains and moraines.
224 Strawn (b)	0.493 (1620)	5-15 (W)	About 1 ft. of silt loam on 1 ft. of clay loam underlain by calcareous loam glacial till. Well drained, moderately sloping to very steep soils on glacial till plains. The glacial till contains some small stones.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material.

TABLE 1-U (Continued)

Depth From Surface, Inches	Soil Classification: USDA (2) Textural	Soil Classification: AASHO (2)	Percent (2) Passing Sieve: No. 4	Percent (2) Passing Sieve: No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-8	Silt loam	A-4 or A-6	100	70-90	15-25	--	--	5.6-6.5		0-8	8-50
8-30	Silty clay loam	A-6 or A-7	95-100	60-80	25-35	--	--	5.6-6.5			
30-60	Loam	A-4	95-100	50-80	15-25	--	10-20	7.4-8.4 (calc)			
0-14	Silt loam	A-4 or A-6	100	90-100	15-25	NP-50	NP-25	5.6-6.5		0-16	16-55
14-30	Silty clay loam	A-6 or A-7	95-100	90-100	25-35	30-50	15-20	5.6-6.5			
30-60	Loam or silt loam	A-4 or A-6	95-100	50-80	15-25	25-35	10-20	7.4-8.4 (calc)			
0-12	Loam or silt loam	A-6 or A-4	100	55-80	15-25	NP-50	NP-20	5.6-6.5		0-8	8-42
12-36	Silty clay loam to clay loam	A-6 or A-7	95-100	60-80	25-35	30-50	10-30	5.6-6.5			
36-60	Loam to silt loam	A-6 or A-4	95-100	50-80	15-25	20-40	5-22	7.4-8.4 (calc)			
0-12	Silt loam	A-6 or A-4	100	85-95	15-25	NP-50	NP-25	5.6-6.0		0-16	16-60
12-36	Silty clay loam to clay loam	A-6 or A-7	100	70-95	25-35	30-50	15-30	5.6-6.5			
36-60	Loam to silt loam	A-6 or A-4	95-100	55-80	15-25	25-35	10-20	7.4-8.4 (calc)			
0-12	Silt loam	A-4 or A-6	100	80-100	15-25	NP-50	NP-25	5.6-6.5		0-16	16-45
12-20	Clay loam	A-6 or A-7	95-100	70-95	25-35	26-50	10-30	5.6-6.5			
20-60	Loam to silt loam	A-4 or A-6	95-100	55-75	15-25	25-35	10-20	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois,

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-U
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION U

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
24 Dodge	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
62 Herbert	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
27 Miami	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
57 Montmorenci	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆
224 Strawn	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-U (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increases strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION V

Soil association V occurs in northwestern Illinois, Figure 7, and occupies 657,000 acres or about 1.8 percent of the state. The soils of this association have developed under forest or mixed forest and prairie vegetation from less than 2 feet of medium textured material on silty clay loam or silty clay to clay textured Wisconsinan glacial till. Further discussion of Wisconsinan glacial tills may be found in Chapter 2 and Appendix B.

The major soil series occurring in this area are listed in Table 1-V. Markham and Morley occupy the moderately well to well drained positions of the soil catena; St. Clair occupies the moderately well drained positions; and Beecher, Blount, Eylar, and Frankfort are found on the imperfectly drained positions.

The organic carbon content of these soils is, in general, moderately low in the upper part of the profile. As indicated by the data presented in Table 1-V, the organic carbon content is typically no greater than 1 to 2 percent to a depth of 8-16 inches and is less than 1 percent at depths greater than this.

The A horizon material is typically silt loam to silty clay loam in texture and has an AASHO designation of A-4, A-6 or in some cases A-7. The texture of the B horizon is generally silty clay, clay, or silty clay loam and the AASHO designation is typically A-7 or A-6. The parent C horizon material generally will display a texture of silty clay loam or silty clay to clay and an AASHO designation of A-6 or A-7.

Available information, summarized in Table 1-V, indicates that the plasticity index typically ranges from NP-20, 10-35, and 11-30 for the A, B, and C horizons respectively and the clay content commonly ranges from 15-25, 35-70, and 25-70 percent for the respective horizons.

Stabilization recommendations for association area V materials are summarized in Table 2-V.

TABLE 1-V
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION V

Percent Area of State 1.8

Total Acreage 657,000

Parent Material: (a) Medium textured material < 2 feet thick on silt clay loam till, calcareous at 1-1/2 to 3 feet or
(b) Medium textured material < 2 feet thick on silty clay - clay drift, calcareous at 1-1/2 to 3 ft.

MAJOR SOIL SERIES, Number and Name	Percentage Area of State (100's of Acres) (1)	Dominant Slope % (Drainage)	Brief Soil Profile and Site Description (2)
298 Beecher (a)	0.25 (813)	1-6 (Imp.)	About 1-1/2 ft. of silt loam to silty clay loam on 1-1/2 ft. of silty clay underlain by calcareous silty clay loam glacial till. Somewhat poorly drained, mostly gently sloping soils formed from a thin layer of loess or outwash over glacial till. Seasonal water tables above 3 ft.
23 Blount (a)	0.12 (395)	1-5 (Imp.)	About 1 ft. of silt loam on about 1-1/2 ft. of light silty clay and underlain by silty clay loam till. Somewhat poorly drained, sloping soils on till plains and moraines. Seasonal water tables above 3 ft.
228 Eylar (b) (Nappanee)	0.09 (300)	0-6 (Imp.)	About 1 ft. or less of silt loam on 1 to 1-1/2 ft. of silty clay to clay and underlain by silty clay or clay glacial till or lakebed deposits. Somewhat poorly drained, sloping soils on till plains and moraines or glacial lakebeds. Seasonal water tables are above 3 ft.
320 Frankfort (b)	0.16 (520)	1-10 (Imp.)	About 1 ft. of silt loam or silty clay loam on 2 ft. of silty clay underlain by silty clay to clay glacial till. Somewhat poorly drained, nearly level to moderately sloping soils formed from calcareous, dense, silty clay to clay glacial till or lakebed sediments. Seasonal water tables within 3 ft. of the surface.
531 Markham (a)	0.08 (269)	3-8 (W-MW)	About 1 ft. of silt loam on 1-1/2 to 2 ft. of silty clay to silty clay loam and underlain by calcareous silty clay loam glacial till. Well to moderately well drained, nearly level to strongly sloping soils formed from silty deposits over glacial till.
194 Morley (a)	0.31 (1011)	4-12 (W-MW)	About 1 ft. of silt loam on about 1-1/2 ft. of light silty clay underlain by silty clay loam glacial till. Well drained, sloping soils on till plains and moraines.
560 St. Clair (b)	---	3-15 (MW)	About 1 ft. of silt loam on 1-1/2 to 2 ft. of silty clay to clay and underlain by silty clay or clay glacial till or lakebed material. Well to moderately well drained, strongly sloping to moderately steep soils on till plains and moraines or in glacial lakebeds.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material.

TABLE 1-V (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-18	Silt loam to silty clay loam	A-6 or A-4	95-100	90-100	15-25	NP-47	NP-15	5.1-6.0			
18-34	Silty clay	A-7	95-100	80-100	35-45	35-60	15-30	5.6-6.5		0-16	16-45
34-60	Silty clay loam	A-6 or A-7	95-100	80-100	25-35	30-40	11-20	7.4-8.4 (calc)			
0-10	Silt loam	A-6 or A-4	95-100	90-100	15-25	25-50	6-15	5.6-6.5			
10-30	Silty clay		95-100	85-100	40-50	35-55	10-35	5.6-6.5		0-8	8-42
30-60	Silty clay loam	A-6 or A-7	95-100	85-100	25-35	30-44	11-20	7.4-8.4 (calc)			
0-10	Silt loam	A-6	95-100	90-100	15-25	25-60	5-30	5.6-6.5			
10-24	Silty clay to clay	A-7	95-100	85-100	45-70	30-55	10-35	5.6-6.5		0-8	8-42
24-60	Silty clay to clay	A-7	95-100	85-100	35-70	30-57	11-35	7.4-8.4 (calc)			
0-12	Silt loam or silty clay loam	A-6 or A-7	95-100	90-100	15-25	35-50	10-20	6.1-6.5			
12-36	Silty clay	A-7	95-100	85-100	45-70	30-57	10-30	6.1-6.5		0-14	14-45
36-60	Silty clay to clay	A-7	95-100	85-100	35-70	26-50	10-30	7.4-7.8 (calc)			
0-10	Silt loam	A-6 or A-4	95-100	90-100	15-25	--	--	5.6-6.5			
10-30	Silty clay to silty clay loam	A-7	95-100	85-100	40-50	--	--	5.6-6.5		0-16	16-45
30-60	Silty clay loam	A-6 or A-7	95-100	85-100	25-35	30-40	11-20	7.4-8.4 (calc)			
0-10	Silt loam	A-6 or A-4	95-100	90-100	15-25	25-45	5-15	5.6-6.5			
10-30	Silty clay	A-7 or A-6	95-100	85-100	40-50	30-50	10-27	5.6-6.5		0-8	8-45
30-60	Silty clay loam	A-6 or A-7	95-100	85-100	25-35	30-40	11-20	7.4-8.4 (calc)			
0-10	Silt loam	A-6 or A-4	95-100	90-100	15-25	--	--	5.6-6.5			
10-30	Silty clay to clay	A-7	95-100	85-100	40-65	--	--	5.6-6.5		0-8	8-50
30-60	Silty clay to clay	A-7	95-100	85-100	35-70	30-50	15-30	7.4-8.4 (calc)			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-V

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION V

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers: Construction Expedient C	L	B	F	COMB	Subgrade Modification C	L	B	F	COMB	Strength and Durability Improvement C	L	B	F	COMB
298 Beecher	A	2	1	3	3	3	2	1	2[(a)]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	2[(d)]	3	3	*
	C	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*
23 Blount	A	2	1	3	3	3	2	1	2[(a)]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	2[(d)]	3	3	*
	C	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*
228 Eylar (Nappanee)	A	2	1	3	3	3	2	1	2[(a)]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	2[(d)]	3	3	*
	C	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*
320 Frankfort	A	2	1	3	3	3	2	1	2[(a)]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	2[(d)]	3	3	*
	C	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*
531 Markham	A	2	1	3	3	3	2	1	2[(a)]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	2[(d)]	3	3	*
	C	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*
194 Morley	A	2	1	3	3	3	2	1	2[(a)]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	2[(d)]	3	3	*
	C	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*
560 St. Clair	A	2	1	3	3	3	2	1	2[(a)]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*
	C	2	1	3	3	3	2[(b)]	1	3	3	3	1[(c)]	1	3	3	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-V (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION W

Soil association area W occurs in scattered areas throughout the state but is most extensive in northern and central Illinois. Soils of association area W occupy 4,382,000 or about 12.1 percent of the state. These soils have developed from medium and moderately-fine textured water deposited materials although a layer of loess may be present on the surface in some areas. A source of gravel and sand can be found in the subsoil and substratum (B and C horizon) of a number of these materials.

The soils of association area W can be grouped according to variation in kind, texture, and thickness of parent materials. In Table 1-W, the major soils of the association are footnoted to indicate the particular grouping into which each falls. It should be noted that the major soils of association area W included in Table 1-W represent 5 of the 10 groupings as designated in Reference 5.

The major soil series occurring in this association are listed in Table 1-W. Alexis occupies the well drained positions of the soil catena; Camden and Plano occur on the moderately well to well drained positions; Brenton, Elburn, Hurst, LaHogue, Littleton, and Starks are found on the imperfectly drained positions; and Drummer, Ginat, Harpster, Selma, and Thorp occupy the poorly drained positions.

The total organic carbon content may vary from high to low in the upper part of the soil profile. However, for the majority of the soils presented in Table 1-W, the organic carbon content is typically greater than 2 percent to depths from 10-16 inches and less than 1 percent at depths greater than 15-40 inches (Camden, Ginat, Hurst, and Starks are not as high in organic carbon having no greater than 1 and 2 percent to a depth of 8-16 inches and less than 1 percent at greater depths).

The texture of the A horizon is typically loam, silt loam, silty clay, or clay loam in texture. The B horizon typically displays a silty clay loam, silty clay, or clay loam texture, while the texture of the C horizon depends on the texture of the parent material.

The AASHO designation of A horizon materials is typically A-4 to A-6 or A-6 to A-7; the B horizon texture is normally A-6 or A-7; and the designation for the C horizon varies depending on the parent material but in general, is A-2-4, A-4, or A-6.

Typical Atterberg limits and clay contents for these materials vary greatly but generally can be estimated by consulting the typical ranges as presented in Table 1-W.

Stabilization recommendations for association area W materials are summarized in Table 2-W.

TABLE 1-W

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION W

Parent Material:
(a) Loess 3 - 5 feet thick on noncalcareous medium textured outwash or sandy loam till to 5 feet or
(b) Loess < 3 feet thick on medium textured outwash to 5 feet noncalcareous to 3-1/2 feet or
(c) Medium textured material < 2 feet thick on noncalcareous silty clay to clay > 3-1/2 feet thick or
(d) Medium textured material 3 to 5 feet thick on loamy material or
(e) Medium textured material 3-1/2 to 5 feet thick on sand or fine sand.
(f) Silty wash > 5 feet thick.

Percent Area of State 12.1

Total Acreage 4,382,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
80 Alexis (b)	0.19 (631)	3-7 (W)	About 1 foot of silt loam on 2 feet of silty clay loam underlain by stratified loam, silt loam and sandy loam. Well drained, sloping soils formed on outwash plains or terraces.
149 Brenton (b)	0.98 (3228)	0-2 (Imp.)	About 1 foot of silt loam on about 2-1/2 feet of silty clay loam to clay loam and underlain by stratified loam, silt loam and sandy loam. Somewhat poorly drained, level to sloping soils on stream terraces and outwash plains. Seasonal water tables above 3 feet.
134 Camden (b)	0.56 (1847)	1-7 (W-MW)	About 1 foot of silt loam on about 2-1/2 feet of silty clay loam to clay loam and underlain by stratified loam, silt loam and sandy loam. Well drained, level to steep soils on stream terraces and outwash plains.
152 Drummer (a)	6.06 (19911)	0-1 (P)	About 1-1/2 feet of silty clay loam on about 1-1/2 feet of silty clay loam and underlain by silt loam, loam or sandy loam glacial drift. Poorly drained, level soils on loess (40-60 inches thick) covered till plains and moraines or stream terraces and outwash plains. Seasonal water tables at or near the surface.
198 Elburn (a)	0.74 (2449)	0-2 (Imp.)	About 1 foot of silt loam on 2 feet of silty clay loam on 1 foot of silt loam grading to loam to sandy loam. Somewhat poorly drained, nearly level soils formed from 3 to 5 feet of loess on calcareous glacial till or outwash. Seasonal water tables above 3 feet.
460 Ginat (d)	0.07 (228)	0-1 (P)	1-1/2 feet of silt loam over 2-1/2 feet of silty clay loam to silty clay, underlain by silt loam or stratified river sediments. Poorly drained, nearly level soils on low stream terraces. Seasonal water tables are at or near the surface.
67 Harpster (b)	0.47 (1533)	0-1 (P)	About 1-1/2 feet of loam, silt loam, or silty clay loam on 1-1/2 feet of loam or silty clay loam to clay loam underlain by loam to silt clay loam glacial drift. Poorly drained, depressional to nearly level soils formed from 2 to 3 feet of calcareous loess or outwash over calcareous glacial till. Snail shells common. Seasonal water tables at or near the surface.
338 Hurst (c)	0.11 (372)	1-4 (Imp.)	1 foot of silt loam over 3 to 6 feet of silty clay to silty clay loam, underlain by stratified river sediments. Somewhat poorly drained, level to gently sloping soils of low-lying stream terraces. Seasonal water tables within 3 feet of surface.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-W (Continued)

Depth From Surface, Inches	Soil Classification: USDA (2) Textural	Soil Classification: AASHO (2)	Percent (2) Passing Sieve: No. 4	Percent (2) Passing Sieve: No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-14	Silt Loam	A-6 or A-7	100	55-90	15-25	28-53	NP-23	5.6-6.5			
14-36	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	35-45	16-52	4-30	5.6-6.5	0-10	10-21	21-60
36-60	Stratified Loam, Silt Loam and Sandy Loam	A-2, A-4, or A-6	45-100	25-100	5-20	NP-50	NP-29	6.1-7.3			
0-14	Silt Loam	A-6 or A-7	100	80-95	20-30	30-56	7-20	5.6-6.5			
14-44	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	30-40	30-65	10-40	5.6-6.5	0-11	11-16	16-60
44-60	Stratified Loam, silt loam and sandy loam	A-2, A-4, or A-6	90-100	30-80	15 30	NP-55	NP-30	7.4-8.4 (calc)			
0-10	Silt Loam	A-6 or A-4	100	80-95	15-25	NP-40	NP-15	5.6-6.5			
10-44	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	30-40	12-55	NP-35	5.6-6.5		0-8	8-60
44-60	Stratified Loam, Silt Loam and Sandy Loam	A-2, A-4, or A-6	90-100	30-80	15-30	NP-48	NP-38	6.6-8.4 (calc)			
0-16	Silty Clay Loam	A-7	95-100	85-100	30-40	35-65	15-33	6.6-7.3			
16-36	Silty Clay Loam	A-7 or A-6	95-100	85-100	30-40	33-57	12-34	6.6-7.3	0-16	16-24	24-60
36-60	Loam or Sandy Loam	A-2 or A-4	90-100	30-75	10-25	NP-50	NP-33	6.6-7.3			
0-14	Silt Loam	A-6	100	90-100	15-25	30-50	10-20	5.6-6.5			
14-50	Silty Clay Loam to Heavy Silt Loam	A-6 or A-7	100	95-100	30-40	30-55	15-25	5.6-6.5	0-12	12-18	18-80
50-60	Loam to Sandy Loam	A-4 or A-2	90-100	25-60	15-25	NP-20	NP-10	7.4-8.4 (calc)			
0-17	Silt Loam	A-4 or A-6	100	85-100	10-20	--	--	5.1-6.0			
17-35	Silty Clay Loam to Silty Clay	A-7 or A-6	100	85-100	30-45	--	--	5.1-6.0		0-8	8-60
35-60	Silty Clay Loam	A-6	100	85-100	20-35	--	11-20	5.1-6.0			
0-16	Loam, Silt Loam, or Silty Clay Loam	A-7	95-100	70-100	15-25	20-70	14-36	7.4-8.4			
16-34	Loam or Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	-100	25-40	26-67	9-40	7.4-8.4	0-10	10-15	15-60
34-60	Sandy Loam, Loam, Silt Loam, Silty Clay Loam	A-2, A-4, or A-6	95-100	30-100	5-20	NP-51	NP-31	7.4-8.4 (calc)			
0-12	Silt Loam	A-4 or A-6	100	85-100	10-20	--	--	5.1-6.0			
12-40	Silty Clay	A-7	100	80-100	40-60	--	--	4.5-5.5		0-16	16-60
40-60	Silty Clay to Silty Clay Loam	A-7	100	80-100	35-50	--	11-20	4.5-5.5			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 1-W (Continued)
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION W

Percent Area of State 12.1

Total Acreage 4,382,000

Parent Material:
(a) Loess 3 - 5 feet thick on noncalcareous medium textured outwash or sandy loam till to 5 feet or
(b) Loess < 3 feet thick on medium textured outwash to 5 feet noncalcareous to 3-1/2 feet or
(c) Medium textured material < 2 feet thick on noncalcareous silty clay to clay > 3-1/2 feet thick or
(d) Medium textured material 3 to 5 feet thick on loamy material or
(e) Medium textured material 3-1/2 to 5 feet thick on sand or fine sand
(f) Silty wash > 5 feet thick.

MAJOR SOIL SERIES, Number and Name	Percentage [(1)] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site [(2)] Description
102 LaHogue (e)	0.27 (891)	0-2 (Imp.)	About 1 foot of silt loam on 1 to 2 feet of clay loam underlain by stratified loamy and sandy material. Somewhat poorly drained, nearly level to gently sloping soils formed from loamy glacial outwash. In some places, there is loose sand within 5 feet. Seasonal water tables within 3 feet of the surface.
81 Littleton (f)	0.17 (568)	0-2 (Imp.)	About 1 to 2 feet of silt loam on 1 to 2 feet of heavy silt loam underlain by silt loam. Somewhat poorly drained, level to gently sloping soils on terraces, alluvial fans and outwash plains. Seasonal water tables are within 3 feet of the surface.
199 Plano (a)	0.54 (1778)	1-4 (W-MW)	About 1 to 1-1/2 feet of silt loam on 2 to 3 feet of silty clay loam on 1/2 to 1 foot of silt loam and underlain by sandy loam glacial till (calc.). Moderately well to well drained, nearly level to moderately sloping soils formed from 2-1/2 to 5 feet of loess on glacial till plains or outwash area.
148 Proctor (b)	0.60 (1981)	1-4 (MW)	About 1 foot of silt loam on 2 to 3 feet of silty clay loam to clay loam underlain by stratified sandy loam, loam and silt loam. Moderately well drained, nearly level to strongly sloping soils on stream terraces and outwash plains.
125 Selma (e)	0.23 (760)	0-1 (P)	About 1 to 1-1/2 feet of loam on 1 to 2 feet of clay loam underlain by sandy loam or loam. Poorly drained, level to depressional soils formed in loamy glacial outwash. In some places, loose sand may be present within 5 feet of the surface. Seasonal water tables are at or near the surface.
132 Starks (b)	0.23 (749)	0-2 (Imp.)	About 1 foot of silt loam on 2 to 3 feet of silty clay loam underlain by stratified sandy and silty material. Somewhat poorly drained, level to gently sloping soils formed on stream terraces and outwash plains. In some places, gravel is within 5 feet of the surface. Seasonal water tables within 3 feet of surface.
206 Thorp (d)	0.25 (829)	0-2 (P)	About 1-1/2 foot of silt loam on 1 to 2 feet of clay loam to silty clay loam underlain by sandy loam to silty clay loam. Poorly drained, level or depressional soils formed from glacial drift. Seasonal water tables at or near the surface.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material

TABLE 1-W (Continued)

Depth From Surface, Inches	Soil Classification: USDA Textural	Soil Classification: AASHO	Percent Passing Sieve: No. 4	Percent Passing Sieve: No. 200	Clay Fraction (< 2μ), %	Liquid Limit, %	Plasticity Index, %	Natural Soil pH	Organic Carbon Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-14	Loam	A-4 or A-6	100	50-80	10-20	NP-30	NP-15	6.1-7.3			
14-30	Clay Loam	A-6 or A-7	90-100	55-85	20-30	25-45	8-20	6.1-7.3	0-10	10-21	21-60
30-60	Stratified Loamy Sand to Sandy Clay Loam	A-2, A-4, or A-6	85-100	10-55	5-20	NP	NP	6.6-7.3			
0-20	Silt Loam	A-6 or A-7	100	95-100	15-25	30-50	12-24	5.6-6.5			
20-40	Heavy Silt Loam	A-6 or A-7	100	95-100	20-30			5.6-6.5	0-16	16-40	40-60
40-60	Silt Loam	A-4 or A-6	95-100	65-80	15-25	19-48	5-24	6.1-7.3			
0-16	Silt Loam	A-6 or A-4	100	95-100	15-25	--	--	5.6-6.5			
16-50	Silty Clay Loam or Heavy Silt Loam	A-6	100	95-100	30-40	--	--	5.6-6.5	0-12	12-18	18-80
50-60	Loam to Sandy Loam	A-4 or A-2	90-100	25-60	15-25	--	NP-33	7.4-8.4 (calc)			
0-12	Silt Loam	A-6 or A-7	100	80-95	15-25	NP-60	NP-28	5.6-6.5			
12-42	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	25-35	22-48	7-25	5.6-6.5	0-10	10-21	21-80
42-60	Stratified Sandy Loam, Loam and Silt Loam	A-2, A-4, or A-6	90-100	30-80	15-30	20-41	3-24	6.1-7.3			
0-16	Loam	A-4 or A-6	100	60-80	20-30	20-60	10-25	6.6-7.3			
16-36	Clay Loam	A-6 or A-7	100	55-85	25-35	22-60	5-35	7.4-7.8	0-16	16-24	24-60
36-60	Sandy Loam or Loam	A-2 or A-4	100	25-70	5-20	NP-44	NP-25	7.4-7.8			
0-14	Silt Loam	A-6 or A-4	100	80-95	15-25	NP-40	NP-15	5.6-6.5			
14-40	Silty Clay Loam to Clay Loam	A-6 or A-7	95-100	60-90	30-40	23-55	4-35	5.1-5.5		0-8	8-60
40-60	Stratified Loam, Silt Loam and Sandy Loam	A-2, A-4, or A-6	90-100	30-80	15-30	NP-41	NP-23	6.6-7.3			
0-18	Silt Loam	A-6 or A-7	95-100	80-90	15-25	NP-54	NP-24	5.1-6.0			
18-40	Silty Clay Loam	A-6 or A-7	95-100	75-90	35-45	27-60	10-35	5.6-6.0	0-16	16-24	24-60
40-60	Sandy Loam to Silty Clay Loam	A-2, A-6, or A-7	90-100	25-90	15-30	NP-50	NP-30	6.6-7.3			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-W

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION W

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
80 Alexis	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
149 Brenton	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
134 Camden	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
152 Drummer	A	2	1	3	3	3	2	1	3(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
198 Elburn	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
460 Ginat	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
	C	2	1	3	3	3	1(b)	1	3	3	3	1	1	2	2	3
67 Harpster	A	2	1	3	3	3	2	1	3(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	*
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
338 Hurst	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-W (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

(e) As indicated in the soil properties table, the C horizons of Association Area W soils are of variable texture ranging from A-2, A-4, A-6 to A-7. Due to this great range in texture, it is difficult to assign stabilization recommendation.

Coarse-Grained C Horizons

For the low clay content, low plasticity A-2 and A-4 C horizon materials, stabilization is generally not needed to expedite construction or to modify the subgrade and thus, a "not applicable" (NA) rating was assigned. For coarser C horizon materials, cement, bituminous, and lime-fly ash should have a "1" rating and combination stabilization should have a "3" rating under strength and durability improvement application.

Finer-Grained C Horizons

For the finer-grained C horizon materials (the A-4, A-6, or A-7 soils) cement and lime should have a "2" and a "1" rating respectively for construction expedient applications. Under subgrade modification applications, cement should have a "1" rating if the soils are A-4 or low plasticity A-6 and a "2" rating if the soils are higher plasticity A-6 or A-7. Lime should have a "1" rating for all the finer-grained soils. Under strength and durability improvement applications, cement should have a "1" rating (see comment C above) and lime should have a "2" rating. For the A-4 to low plasticity A-6 soils, bituminous and lime-fly ash have been assigned a "2" rating but for high plasticity A-6 to A-7 soils, these ratings should be "3". The rating for combination stabilizers should be the * which indicates possible use.

TABLE 2-W (Continued)

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION W

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
102 LaHogue	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2	3	3	☆
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
81 Littleton	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	2	2	☆
199 Plano	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
148 Proctor	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	☆
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
125 Selma	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
132 Starks	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)
206 Thorp	A	2	1	3	3	3	2	1	2(a)	3	3	2	3	3	3	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	1	3	3	☆
	C	(e)	(e)	3	3	3	(e)	(e)	3	3	3	(e)	(e)	(e)	(e)	(e)

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-W (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

(e) As indicated in the soil properties table, the C horizons of Association Area W soils are of variable texture ranging from A-2, A-4, A-6 to A-7. Due to this great range in texture, it is difficult to assign stabilization recommendation.

Coarse-Grained C Horizons

For the low clay content, low plasticity A-2 and A-4 C horizon materials, stabilization is generally not needed to expedite construction or to modify the subgrade and thus, a "not applicable" (NA) rating was assigned. For coarser C horizon materials, cement, bituminous, and lime-fly ash should have a "1" rating and combination stabilization should have a "3" rating under strength and durability improvement application.

Finer-Grained C Horizons

For the finer-grained C horizon materials (the A-4, A-6, or A-7 soils) cement and lime should have a "2" and a "1" rating respectively for construction expedient applications. Under subgrade modification applications, cement should have a "1" rating if the soils are A-4 or low plasticity A-6 and a "2" rating if the soils are higher plasticity A-6 or A-7. Lime should have a "1" rating for all the finer-grained soils. Under strength and durability improvement applications, cement should have a "1" rating (see comment C above) and lime should have a "2" rating. For the A-4 to low plasticity A-6 soils, bituminous and lime-fly ash have been assigned a "2" rating but for high plasticity A-6 to A-7 soils, these ratings should be "3". The rating for combination stabilizers should be the * which indicates possible use.

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SOIL ASSOCIATION X

Soil association area X occurs in six predominant areas in Illinois, Figure 7, and occupies 1,238,000 acres or about 3.4 percent of the state. The six areas are the lower Rock and Green river basins and the upper Mississippi valley in northwestern Illinois, the glacial Lake Chicago area in Cook County, the Kankakee and Iroquois river basins, the Mississippi river basin in Mercer and Henderson Counties, the Illinois river valley in central Illinois (mainly in Mason and Cass Counties), and along the lower Wabash river valley south from Crawford County. Association area X is an excellent source of sand.

The soils of this association are extremely sandy in texture and have various degrees of profile development. Some soils have only a thin A horizon with no B horizon while others have quite thick A and B horizons.

The major soil series occurring in this area are listed in Table 1-X. Ade, Bloomfield, Hagener, and Plainfield soils occur on the well drained positions of the soil catena; Alvin, Dickinson, Lamont, and Onarga occupy the moderately well to well drained position; and Hoopeston, Ridgeville, and Roby are found on the imperfectly drained positions.

The thickness and organic carbon content of the A horizon may vary greatly with these sandy soils. However, in general, Dickinson, Onarga, and Ridgeville have greater than 2 percent organic carbon to a depth of 8-10 inches and possess less than 1 percent at depths greater than about 15-20 inches. Ade, Alvin, Hagener, Hoopeston, Lamont, and Roby have organic carbon contents of no greater than 1-2 percent to a depth of 8-20 inches and possess less than 1 percent organic carbon at greater depths. Bloomfield and Plainfield have less than 1 percent organic carbon at all depths of the profile.

The texture of the A horizon of these soils is typically very sandy, ranging from fine sandy loam to sand; the texture of the B horizon typically ranges from loam, clay loam, or sandy clay loam to sandy loam; the texture of the C horizon typically ranges from sandy loam to sand in texture.

The AASHO soil designation for these sandy soils is generally A-2 and A-3 or A-4 in all horizons although occassionally the B horizon materials may rate an A-6 or A-7 designation.

Available information, summarized in Table 1-X, indicates that these materials are generally nonplastic although plasticity indices up to 15-20 may be encountered. The clay content of these sandy materials is generally quite low with typical ranges being from 5-15, 5-25, and 0-10 percent for the A, B, and C horizons respectively.

Stabilization recommendations for association area X sandy materials are summarized in Table 2-X.

TABLE 1-X
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION X

Percent Area of State 3.4

Total Acreage 1,238,000

Parent Material: (a) Sand, fine sand, loamy sand, or loamy fine sand > 5 feet thick or
(b) Sandy loam and fine sandy loam 1-1/2 to 3 feet thick on sand, fine sand, loamy sand, or loamy fine sand at 3 to 5 feet.

MAJOR SOIL SERIES, Number and Name	Percentage [(1)] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site [(2)] Description
98 Ade (a)	0.17 (558)	2-10 (W)	About 1-1/2 to 2 ft. of loamy fine sand on fine sand with occasional thin layers of sandy loam or sandy clay loam. Well drained, sloping soils formed in sandy wind or water deposited material.
131 Alvin (b)	0.22 (715)	2-7 (W-MW)	1 to 2 ft. of fine sandy loam over 1-1/2 ft. of sandy clay loam, underlain by loamy fine sand and other stratified river sediments. Well drained to moderately well drained level to sloping soils on stream terraces.
53 Bloomfield (a)	0.20 (649)	2-12 (W)	About 3 ft. of fine sand underlain by fine sand having bands of sandy loam to sandy clay loam. Well drained, sloping soils on or near outwash plains or stream terraces.
87 Dickinson (b)	0.42 (1373)	1-7 (W-MW)	About 1 ft. of sandy loam on 1-1/2 ft of loam to sandy clay loam underlain by loose loamy sand that contains layers of fine gravel or sand. Well drained, nearly level to sloping soils formed from very sandy wind and water deposited material.
88 Hagener (a)	0.18 (609)	1-7 (W)	About 1 ft. of loamy sand over sand. Well drained, level to sloping soils on or near outwash plains or stream terraces.
172 Hoopeston (b)	0.18 (601)	0-2 (Imp.)	About 1 ft. of sandy loam or fine sandy loam on a thin layer (less than 1 ft.) of loam to sandy clay loam underlain by loamy fine sand to sand. Somewhat poorly drained, nearly level soils formed from sandy glacial outwash. Seasonal water tables above 3 ft.

[(1)] From Reference 13

[(2)] From Reference 7

( ) See designated parent material.

TABLE 1-X (Continued)

Depth From Surface, Inches	Soil Classification: USDA Textural (2)	Soil Classification: AASHO (2)	Percent (2) Passing Sieve: No. 4	Percent (2) Passing Sieve: No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-24	Loamy fine sand	A-2	100	15-45	5-15	--	--	5.6-6.5		0-8	8-60
24-60	Fine Sand	A-2 or A-3	100	0-35	0-5	NP	NP	5.6-6.5			
0-18	Fine sandy loam	A-2 or A-4	100	30-60	5-15	NP-30	NP-10	5.1-5.5			
18-36	Sandy clay loam	A-4 or A-6	100	40-65	15-25	NP-38	NP-18	5.1-5.5		0-8	8-60
36-60	Sand to loamy sand	A-3 or A-2	100	0-20	5-10	NP-36	NP-18	5.6-6.5			
0-42	Fine sand	A-3 or A-2	100	5-20	5-15	NP	NP	5.6-6.5			0-60
42-60	Fine sand with bands of sandy loam to sandy loam	A-2 or A-3	100	10-30	0-5			5.6-6.5			
0-14	Sandy loam	A-2 or A-4	95-100	25-40	5-15	--	--	5.6-6.5			
14-30	Loam to sandy clay loam	A-2 or A-4	95-100	25-65	10-20	--	--	5.6-6.5	0-8	8-15	15-60
30-60	Loamy sand with fine gravel or sand	A-2 or A-3	55-75	0-20	5-10	NP	NP	6.1-7.3			
0-14	Loamy sand	A-2	100	15-25	5-10	NP	NP	5.6-6.5			
14-24	Sand	A-3	100	0-10	5-10	NP	NP	5.6-6.5		0-20	20-110
24-60	Sand	A-3	100	0-10	0-5	NP	NP	5.6-6.5			
0-20	Sandy loam	A-2 or A-4	100	30-50	5-15	--	--	6.1-7.3			
20-30	Sandy loam to sandy clay loam	A-4 or A-6	100	40-70	10-20	--	--	6.1-7.3		0-8	8-60
30-60	Loamy fine sand to sand	A-2 or A-3	100	0-20	5-10	--	--	6.1-6.5			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 1-X (Continued)
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION X

Parent Material: (a) Sand, fine sand, loamy sand, or loamy fine sand > 5 feet thick or
(b) Sandy loam and fine sandy loam 1-1/2 to 3 feet thick on sand, fine sand, loamy sand, or loamy fine sand at 3 to 5 feet

Percent Area of State 3.4

Total Acreage 1,238,000

MAJOR SOIL SERIES, Number and Name	Percentage Area of State (100's of Acres) (1)	Dominant Slope % (Drainage)	Brief Soil Profile and Site Description (2)
175 Lamont (b)	0.11 (370)	1-7 (W-MW)	About 1 ft. of fine sandy loam to loamy fine sand on 2 to 3 ft. of sandy loam to loam and underlain by loamy fine sand to sand. Well to somewhat excessively drained, nearly level to moderately steep soils formed in sandy glacial outwash material.
190 Onarga (b)	0.14 (472)	1-7 (W-MW)	About 1 ft. of sandy loam on 1 to 2 1/2 ft. of clay loam to sandy clay loam and underlain by sand to fine sand. Well drained, level to sloping soils on stream terraces and outwash plains.
54 Plainfield (a)	0.21 (676)	2-15 (W)	5 ft. or more of wind or water deposited sand occurring as ridges or dunes in glacial outwash areas. Slopes range from nearly level to steep. Drainage is excessive. The sand fraction is dominantly quartz.
151 Ridgeville (b)	0.17 (551)	1-3 (Imp.)	About 1 to 1 1/2 ft. of sandy loam to fine sandy loam on 1 to 2 ft. of sandy clay loam to clay loam underlain by sandy loam to loamy fine sand. Moderately well drained, level to gently sloping soils formed from deep, sandy glacial outwash.
184 Roby (b)	0.13 (418)	1-3 (Imp.)	About 1 to 1 1/2 ft of fine sandy loam on 1 1/2 to 2 ft. of sandy clay loam and underlain by loamy sand. Somewhat poorly drained, level to moderately sloping soils formed in sandy glacial outwash. Seasonal water tables are within 3 ft. of the surface.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material.

TABLE 1-X (Continued)

Depth From Surface, Inches	Soil Classification: USDA (2) Textural	Soil Classification: AASHO (2)	Percent Passing Sieve (2): No. 4	Percent Passing Sieve (2): No. 200	Clay Fraction (3) (< 2μ), %	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-14	Fine sandy loam to loamy fine sand	A-2 or A-4	100	25-40	5-15	--	--	5.1-6.0			
14-30	Sandy loam to loam	A-2 or A-4	95-100	25-55	10-20	--	--	5.1-6.0		0-8	8-60
30-60	Loamy fine sand to sand	A-2 or A-3	95-100	5-20	5-10	--	--	5.1-6.5			
0-14	Fine sandy loam	A-2 or A-4	100	30-60	5-15	NP-36	NP-10	5.6-6.5			
14-30	Sandy clay loam to clay loam	A-6	100	40-70	15-25	NP-33	NP-15	5.6-6.5	0-10	10-20	20-60
30-60	Loamy fine sand to fine sand	A-2 or A-3	100	0-20	5-10	NP-30	NP-15	5.6-6.5			
0-60	Sand	A-3	100	0-5	0-5	NP	NP	5.1-6.5			0-60
0-14	Sandy loam or fine sandy loam	A-4 or A-2	100	30-60	5-10	NP-35	NP-15	5.6-6.5			
14-36	Sandy clay loam to clay loam	A-6	100	40-70	15-25	NP-43	NP-20	5.6-6.5	0-10	10-20	20-60
36-60	Sandy loam to loamy fine sand	A-2 or A-4	100	25-45	5-10	NP-40	NP-20	5.6-6.5			
0-16	Fine sandy loam	A-2 or A-4	100	25-60	5-15	--	--	5.6-6.5			
16-36	Sandy clay loam	A-6 or A-7	100	35-55	15-25	--	--	5.6-6.5		0-8	8-60
36-60	Loamy sand	A-2	100	15-35	5-10	--	--	5.6-6.5			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-X
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION X

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
98 Ade	A	NA	NA	NA	NA	NA	NA	NA	2(a)	NA	NA	2	3	1	2	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
131 Alvin	A	2	2	3	3	3	2	2	2(a)	3	3	2	3	2	2	3
	B	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	1	1	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
53 Bloomfield	A	NA	NA	NA	NA	NA	NA	NA	2(a)	NA	NA	2	3	1	2	3
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
87 Dickinson	A	2	2	3	3	3	2	2	2(a)	3	3	2	3	1	2	3
	B	2	2	3	3	3	1(b)	1	3	3	3	1	3	1	1	3
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
88 Hagner	A	NA	NA	NA	NA	NA	NA	NA	2(a)	NA	NA	2	3	1	2	3
	B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
172 Hoopeston	A	2	2	3	3	3	2	2	2(a)	3	3	2	3	1	2	3
	B	2	1	3	3	3	1(b)	1	3	3	3	1	2(d)	2	2	☆
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

NA = Not Applicable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-X (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 B horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

TABLE 2-X (Continued)
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION X

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
175 Lamont	A	2	3	3	3	3	2	2	2(a)	3	3	2	3	1	2	3
	B	2	2	3	3	3	1(b)	1	3	3	3	1	3	1	1	3
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
190 Onarga	A	2	3	3	3	3	2	2	2(a)	3	3	2	3	1	2	3
	B	2	2	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	2	2	*
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
54 Plainfield	A-C	NA	NA	NA	NA	NA	NA	NA	2(a)	NA	NA	1	3	1	1	3
151 Ridgeville	A	2	2	3	3	3	2	2	2(a)	3	3	2	3	1	2	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	2	2	*
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
184 Roby	A	2	2	3	3	3	2	2	2(a)	3	3	2	3	1	2	3
	B	2	1	3	3	3	2(b)	1	3	3	3	1(c)	2(d)	3	3	*
	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

NA = Not Applicable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page.

TABLE 2-X (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 B horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION Y

Soil association area Y occurs in northwestern Illinois, along the Des Plaines River valley east of LaSalle, and along the Kankakee River in Kankakee county, Figure 7. It occupies 541,000 acres of 1.5 percent of the state. The soils have developed from thin to moderately thick loess or medium-textured drift on limestone, shale, or sandstone.

The major soil series occurring in this association area are listed in Table 1-Y. Ashdale, Dubuque, Hitt, Palsgrove, and Woodbine occur on the well drained positions of the soil catena and Eleroy is found on the well to moderately well drained positions.

The thickness and organic carbon content of the A horizon of these soils vary from thick and highly organic (Ashdale) to moderately thick with moderate organic carbon content (Eleroy and Palsgrove), Table 1-Y. Typically, the organic carbon content is greater than 1 percent to a depth of 8-22 inches and less than 1 percent at greater depths.

A loam or silt loam texture is typical of the A horizon while silty clay loam, clay loam, or clay textures are found in the B horizon. No C horizon has developed in most of the soils due to the presence of the underlying bedrock. In some areas, a plastic clayey residuum may be present on top of the bedrock.

The AASHO designation of the A horizon materials is commonly A-4, A-6, or A-7 and is commonly A-6 or A-7 for the B horizon materials.

Available information, summarized in Table 1-Y indicates that the plasticity index typically ranges from 6-12 and 11-25 respectively for the A and B horizons. Typical clay contents for these horizons are 15-25 and 25-70 percent respectively. A thin residuum may be present directly on top of the bedrock. Residuum on the limestone typically displays substantially higher Atterberg limits and clay contents than the B horizon.

Stabilization recommendations for soil association area Y materials are summarized in Table 2-Y.

TABLE 1-Y
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION Y

Parent Material: (a) Loess 1 to 2-1/2 feet thick on < 1 ft. of limestone residuum on limestone at 1-1/2 to 3 feet or
(b) Loess 2-1/2 to 4 feet thick on < 1 feet of limestone residuum on limestone at 3-5 feet or
(c) Loess and noncalc. clay loam drift 2-1/2 to 4 feet thick on limestone or
(d) Medium textured materials < 1 feet thick on shale residuum or shale or
(e) Loess 2-1/2 to 4 feet thick on shale residuum or shale.

Percent Area of State 1.5

Total Acreage 541,000

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
411 Ashdale (b)	0.11 (346)	2-7 (W)	About 1 foot of silt loam on 2 feet of silty clay loam over 1/2 foot of clay. Well drained, sloping soils in loess (30 to 45 inches thick) over limestone bedrock.
29 Dubuque (a)	0.30 (971)	7-15 (W)	About 1 foot of silt loam on about 1 foot of silty clay loam and underlain by clay limestone residuum and limestone bedrock. Well drained, sloping soils or loess (15 to 30 inches thick) covered limestone in unglaciated uplands.
547 Eleroy (e)	0.08 (272)	4-10 (W-MW)	About 1 foot of silt loam on 2 to 3 feet of silty clay loam underlain by shale bedrock interbedded with thin layers of limestone or sandstone. Well drained, gently sloping to steep soils formed from 2 to 4 feet of loess over bedrock.
506 Hitt (c)	0.09 (293)	7-12 (W)	About 1 foot of silt loam or loam on 1-1/2 feet of silty clay loam or clay loam over limestone bedrock. Moderately well drained, gently sloping to steep soils formed from silty or loamy material over limestone bedrock in upland areas. Rock fragments are common just above the bedrock.
429 Palsgrove (b)	0.27 (877)	5-15 (W)	About 1 foot of silt loam on 1-1/2 to 3-1/2 feet of silty clay loam on 1 foot or less of silty clay to clay underlain by limestone bedrock. Well drained, gently sloping to steep soils formed from 2 to 4 ft. of loess on limestone bedrock in upland areas. Limestone fragments are common in the clayey residuum just above the bedrock.
410 Woodbine (c)	0.09 (295)	5-15 (W)	About 1 foot of silt loam on 1-1/2 to 3 feet of silty clay loam to clay loam on 1 foot or less of silty clay to clay underlain by limestone bedrock. Well drained, gently sloping to moderately steep soils formed in 2 to 4 feet of loess and/or glacial till over limestone bedrock.

(1) From Reference 13

(2) From Reference 7

( ) See designated partent material.

TABLE 1-Y (Continued)

Depth From Surface, Inches	Soil Classification USDA (2) Textural	Soil Classification AASHO (2)	Percent (2) Passing Sieve No. 4	Percent (2) Passing Sieve No. 200	(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches > 2%	1-2%	< 1%
0-14	Silt Loam	A-6 or A-7	100	95-100	15-25	--	--	5.6-6.5			
14-34	Silty Clay Loam	A-7	100	95-100	25-35	--	--	5.6-6.5			
34-40	Clay	A-7	90-100	85-95	55-70	--	--	5.6-6.5	0-16	16-22	22-50
40-49	Soft Limestone	--	--	--		--	--	Calcareous			
49-60	Hard Limestone	--	--	--		--	--	Calcareous			
0-10	Silt Loam	A-4 or A-6	100	95-100	15-25	25-35	6-12	5.6-6.5			
10-24	Silty Clay Loam	A-6 or A-7	100	95-100	25-35			5.6-6.5			
24-36	Clay	A-7	90-100	85-95	55-70	30-45	11-25	5.6-6.5		0-8	8-50
36-60	Limestone Bedrock	--	--	--		50-70	35-45	Calcareous			
0-10	Silt Loam	A-4 or A-6	100	90-100	15-25	--	--	5.1-6.5			
10-40	Silty Clay Loam	A-6 or A-7	100	90-100	30-45	--	--	5.1-6.5		0-8	8-60
40-60	Shale Bedrock	--	--	--		--	--				
0-12	Silt Loam or Loam	A-6 or A-7	100	70-90	15-25	--	--	5.6-6.5			
12-40	Silty Clay Loam to Clay Loam	A-6 or A-7	90-100	60-80	25-35	--	--	5.6-6.5		0-16	16-40
40-60	Limestone Bedrock	--	--	--		--	--				
0-10	Silt Loam	A-4 or A-6	100	95-100	15-25	--	--	5.6-6.5			
10-40	Silty Clay Loam	A-6 or A-7	100	95-100	25-35	--	--	5.1-5.5			
40-50	Silty Clay to Clay	A-7	90-100	80-90	55-70	--	--	5.1-6.5		0-8	8-50
50-60	Limestone Bedrock	--	--	--		--	--	7.4-8.4 (calc)			
0-10	Silt Loam	A-6 or A-7	100	95-100	15-25	--	--	5.6-6.5			
10-30	Silty Clay Loam to Clay Loam	A-6 or A-7	100	95-100	25-35	--	--	5.1-5.5			
30-40	Silty Clay to Clay	A-7	90-100	85-95	55-70	--	--	5.1-6.5	0-16	16-22	22-50
40-60	Limestone Bedrock	--	--	--		--	--	--			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublsihed research in Deparment of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-Y

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION Y

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
411 Ashdale	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
29 Dubuque	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
547 Eleroy	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
	Shale Bedrock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
506 Hitt	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
	Limestone Bedrock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
429 Palsgrove	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
410 Woodbine	A	2	1	3	3	3	2	1	$2^{(a)}$	3	3	2	3	3	3	3
	B	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	
	C	2	1	3	3	3	$2^{(b)}$	1	3	3	3	$1^{(c)}$	$2^{(d)}$	3	3	

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comments on following page.

TABLE 2-Y (Continued)
COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for the A horizon materials.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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SOIL ASSOCIATION Z

The soils of association area Z occur in bottomlands throughout the state, Figure 7, and occupy 2,519,000 acres or about 7 percent of the state. These alluvial soils are the most variable of any soils found in the state. They are much more wide spread than indicated by Figure 7 and may be found as minor inclusions in every other association area of the state. The texture of many of these soils is extremely erratic in both horizontal and vertical directions and may vary from sand to clay within short distances. Others are predominately uniform in texture from the surface to great depths.

The predominant soil series of this association area are listed in Table 1-Z. Haymond and Huntsville occur on the moderately well to well drained positions of the soil catena; Belknap, Lawson, Radford, Tice, and Wakeland occupy the imperfectly drained positions; and Beaucoup, Bonnie, Darwin, Piopolis, and Wabash are found on the poorly drained positions.

There are three general groups of these bottomland soils based on their natural pH. These three groups consist of calcareous soils, slightly acid to neutral soils, and acid soils. The acid soils group is normally found in southern Illinois while the other two groups occur throughout the state.

The organic carbon content of these soils varies greatly from soil to soil. As indicated in Table 1-Z, Darwin, Huntsville, Lawson, Tice, and Wabash soils have rather highly organic (greater than 2 percent organic carbon) surfaces to a depth of 8-30 inches; Beaucoup, Haymond, Piopolis, Radford, and Wakeland have moderately organic (1 to 2 percent organic carbon) surfaces to a depth of 8-40 inches; and Belknap and Bonnie have an organic carbon content of less than 1 percent at all depths in the profile.

Most of the A horizons of these soils have a silt loam texture although an occasional silty clay loam or silty clay texture may be encountered. Typically, no B horizon is present in these soils--rather there exists an A horizon which grades directly into the alluvium parent material (C horizon). Recent work (5,13) on the texture of the parent material, indicates that about 10 percent of association area Z soils display a silty clay to clay texture; about 25 percent display a silty clay loam texture; and about 65 percent have a silt loam to sand texture. In general, the finer textured sediments are found in the larger bottomlands along the Mississippi and Wabash Rivers in southern Illinois.

The AASHO designation of the A horizon is typically A-4 or A-6 with the silt clay loam and silty clay textured soils rating an A-6 or A-7 designation. The designation for the underlying alluvial material typically ranges from A-4, A-6, to A-7 depending upon the texture and specific parent material encountered.

As indicated by the information summarized in Table 1-Z, the Atterberg limits may vary from nonplastic to very plastic depending upon the specific alluvial material encountered. Likewise, the clay content for these soils will vary greatly depending upon the parent material encountered. For example, Belknap is typically nonplastic and quite low in clay while Darwin is one of the most plastic and high clay content soils in the state.

Stabilization recommendations for association area Z materials are summarized in Table 2-Z.

TABLE 1-Z

PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION Z

Parent Material:
(a) Slightly acid-neutral medium textured material 1-1/2 to 3-1/2 feet thick on dark fine textured soil or
(b) Slightly acid-neutral medium textured material > feet thick or
(c) Slightly acid-neutral moderate-fine textured material > 4 feet or
(d) Slightly acid-neutral fine textured material > 4 feet thick or
(e) Acid medium textured material > 4 feet thick or
(f) Acid moderate fine textured materials > 4 feet thick.

Percent Area of State 7.0

Total Acreage 2,519,000

MAJOR SOIL SERIES, Number and Name	Percentage [(1)] Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site [(2)] Description
70 Beaucoup (c)	0.80 (2630)	0-1 (P)	About 1 foot of silty clay loam on 2 to 3 feet of silty clay loam to silty clay and underlain by stratified silt loam, silty clay loam, and clay loam. Poorly drained level soils on stream floodplains or low stream terraces. Seasonal water tables at or near the surface. Subject to overflow.
382 Belknap (e)	1.56 (5144)	0-2 (Imp.)	Silt loam to at least 3 feet depth, underlain by stratified river sediments or silty stream sediments. Somewhat poorly drained, level soils subject to flooding. Seasonal water tables are within 3 feet of the surface.
108 Bonnie (e)	0.95 (3120)	0-1 (P)	Silt loam to at least 3 feet depth, usually underlain by several feet of silt loam to silty clay alluvium. Poorly drained, level soils subjected to flooding.
71 Darwin (d)	0.35 (1137)	0-1 (P)	About 1 foot of silty clay underlain by silty clay to clay. Poorly drained, level soils on stream flood plains or low stream terraces. Seasonal water tables at or near the surface. Subject to overflow.
331 Haymond (b)	0.23 (760)	0-2 (W-MW)	About 2 feet of silt loam underlain by silt loam having strata of loam. Well drained, level soils on stream floodplains. Subject to infrequent overflow.
77 Huntsville (b)	0.36 (1172)	0-2 (W-MW)	About 2 to 3 feet of silt loam or loam underlain by stratified silt loam and loam with occasional thin strata of sand, fine gravel or clay loam. Well drained, level bottomland soils subject to flooding.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material.

TABLE 1-Z (Continued)

Depth From Surface, Inches	Soil Classification: USDA Textural (2)	Soil Classification: AASHO (2)	Percent (2) Passing Sieve: No. 4	Percent (2) Passing Sieve: No. 200	(3) Clay Fraction (< 2μ), %	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH (2)	Organic Carbon (3) Content, Avg. Depths of Occurrence, Inches: > 2%	1-2%	< 1%
0-14	Silty Clay Loam	A-6 or A-7	100	95-100	30-40	50-90	35-60	6.1-7.3			
14-42	Silty Clay Loam	A-7	100	90-100	30-40	50-95	35-60	6.1-7.3		0-14	14-60
42-60	Stratified Silt Loam, Silty Clay Loam, and Clay Loam	A-7	100	65-95	30-40	50-100+	25-80+	6.1-7.3			
0-60	Silt Loam	A-4	100	70-95	15-25	NP-30	NP-8	5.1-6.0			0-60
0-60	Silt Loam	A-4 or A-6	100	90-100	15-25	25-45	10-25	5.1-6.0			0-70
0-12	Silty Clay	A-7	100	-100	45-60	60-100	35-75	6.1-6.5	0-8	8-20	20-60
12-60	Silty Clay to Clay	A-7	100	-100	45-60	50-80	25-60	6.1-7.3			
0-24	Silt Loam	A-4 A-6	100	80-100	15-25	--	--	5.6-6.5		0-8	8-55
24-60	Silt Loam	A-4 or A-6	100	65-100	15-25	--	--	6.1-7.8			
0-30	Silt Loam	A-6 or A-4	100	45-100	15-25	20-65	3-28	6.1-7.3	0-30	30-50	50-60
30-60	Stratified Silt Loam and Loam	A-6 or A-4	95-100	55-95	15-25	NP-43	NP-21	6.1-7.3			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 1-Z (Continued)
PROPERTIES OF MAJOR SOILS IN SOIL ASSOCIATION Z

Parent Material:
(a) Slightly acid-neutral medium textured material 1-1/2 - 3-1/2 feet thick on dark fine textured soil or
(b) Slightly acid-neutral medium textured material > feet thick or
(c) Slightly acid-neutral moderate-fine textured material > 4 feet or
(d) Slightly acid-neutral fine textured material > 4 feet thick or
(e) Acid medium textured material > 4 feet thick or
(f) Acid moderate fine textured materials > 4 feet thick.

MAJOR SOIL SERIES, Number and Name	Percentage (1) Area of State (100's of Acres)	Dominant Slope % (Drainage)	Brief Soil Profile and Site (2) Description
451 Lawson (b)	2.09 (6862)	0-1 (Imp.)	About 2 to 3 feet of silt loam underlain by stratified silt loam and loam. Somewhat poorly drained, level soils on stream flood plains. Seasonal water tables above 3 feet. Subject to overflow.
420 Piopolis (f)	0.26 (872)	0-1 (P)	Silty clay loam to at least 3-1/2 feet depth, underlain by silty clay or stratified river sediments. Poorly and very poorly drained, nearly level soils subject to flooding. Seasonal water tables at or near the surface. Some areas are ponded.
74 Radford (a)	0.37 (1223)	0-2 (Imp.)	About 2 to 3 feet of silt loam on silty clay loam. Somewhat poorly drained, nearly level bottomland soils subject to overflow. Seasonal water tables are within 3 feet of the surface.
284 Tice (c)	0.28 (916)	0-2 (Imp.)	Over 5 feet of silty clay loam. Somewhat poorly drained, level soils on stream flood plains. Seasonal water table above 3 feet. Subject to flooding.
83 Wabash (d)	0.21 (704)	0-1 (P)	About 1-1/2 feet of silty clay and underlain by silty clay to clay. Poorly drained, level soils on stream flood plains. Seasonal water table at or near the surface. Subject to stream overflow.
333 Wakeland (b)	0.73 (2405)	0-1 (Imp.)	About 3 feet of silt loam underlain by stratified loam, silt loam and sandy loam. Depth to bedrock usually greater than 5 feet. Somewhat poorly drained, nearly level bottomland areas. Depth to seasonal high water table 0-3 feet. Subject to flooding.

(1) From Reference 13

(2) From Reference 7

( ) See designated parent material.

TABLE 1-Z (Continued)

Depth From Surface, Inches	Soil Classification		Percent (2) Passing Sieve		(3) Clay Fraction (< 2μ),%	(4) Liquid Limit, %	(4) Plasticity Index, %	Natural Soil pH(2)	Organic Carbon(3) Content, Avg. Depths of Occurrence, Inches		
	USDA (2) Textural	AASHO (2)	No. 4	No. 200					> 2%	1-2%	< 1%
0-30	Silt Loam	A-4 or A-6	100	85-100	20-30	--	--	6.1-7.3	0-20	20-50	50-60
30-60	Stratified Silt Loam and Loam	A-6 or A-4	95-100	55-95	20-30	--	--	6.1-7.3			
0-60	Silty Clay Loam	A-6	100	95-100	30-40	45-55	28-35	5.1-6.0		0-30	30-60
0-30	Silt Loam	A-4 or A-6	95-100	80-100	15-25	--	--	6.5-7.3		0-40	40-60
30-60	Silty Clay Loam	A-6 or A-7	95-100	80-100	25-35	--	--	6.5-7.3			
0-30	Silty Clay Loam	A-6 or A-7	100	95-100	25-40	--	--	6.1-7.3	0-20	20-30	30-70
30-60	Silty Clay Loam	A-6 or A-7	100	80-100	25-40	--	--	6.1-7.3			
0-18	Silty Clay	A-7	100	95-100	40-60	--	--	6.1-7.3	0-20	20-30	30-70
18-60	Silty Clay to Clay	A-7	100	90-100	40-70	--	--	6.1-7.3			
0-35	Silt Loam	A-4	100	80-100	15-25	--	--	6.1-7.3		0-8	8-55
35-60	Stratified Loam, Silt Loam and Sandy Loam	A-2 or A-4	100	30-80	15-25	--	--	6.1-7.3			

(2) From Reference 7

(3) Data supplied by Department of Agronomy, University of Illinois.

(4) Data from engineering publications, unpublished research in Department of Civil Engineering, University of Illinois, and various other soil reports.

TABLE 2-Z
STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION Z

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
70 Beaucoup	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	B	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	☆
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	☆
382 Belknap	A-C	2	1	3	3	3	2	1	2[a]	3	3	1	2[d]	2	2	☆
108 Bonnie	A-C	2	1	3	3	3	2	1	2[a]	3	3	1	1	2	2	☆
71 Darwin	A	2	1	3	3	3	2	1	3[a]	3	3	2	1	3	3	☆
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	2[b]	1	3	3	3	2	1	3	3	☆
331 Haymond	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	☆
77 Huntsville	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	1[b]	1	3	3	3	1	2[d]	2	2	☆

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-Z (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

TABLE 2-Z (Continued)

STABILIZATION RECOMMENDATIONS FOR MAJOR SOILS OF SOIL ASSOCIATION Z

MAJOR SOIL SERIES Number and Name	Horizon	Stabilization Objectives and Recommended Stabilizers														
		Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
		C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
451 Lawson	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	2[d]	2	3	☆
420 Piopolis	A-C	2	1	3	3	3	2	1	2[a]	3	3	2	2[d]	3	3	☆
74 Radford	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	☆
284 Tice	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	☆
83 Wabash	A	2	1	3	3	3	2	1	3[a]	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	3	3	☆
333 Wakeland	A	2	1	3	3	3	2	1	2[a]	3	3	2	3	3	3	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	2	1	3	3	3	2[b]	1	3	3	3	1[c]	1	1	1	☆

C = Cement
L = Lime
B = Bituminous
F = Lime-Fly Ash
COMB = Combinations

1, 2, 3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

☆ Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

( ) See designated comment on following page

TABLE 2-Z (Continued)

COMMENTS

(a) Experience with oiled earth roads in Illinois has indicated that in some cases, periodic treatment of organic A horizon materials with cutback bituminous materials may provide a satisfactory pavement surface layer for low traffic volume roads. For this reason, a "2" rating was assigned as the bituminous recommendation for all A horizon materials except those that are the very high clay content and plasticity A-7 materials. Treatment of these A-7 materials will not provide a satisfactory pavement surface layer, and thus, a "3" rating was assigned.

(b) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured A-6 and A-7 B and C horizon materials. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For A-4 and low plasticity A-6 C horizon materials, cement also has a "1" rating.

(c) Cement can be used to obtain increased strength and durability with fine-grained A-6 and A-7 soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

(d) Lime treatment of "reactive" fine-grained soils will effect substantial strength increases. A "1" rating has been assigned as the stabilization recommendation for lime where "reactive" soils are encountered. However, many soils are not "reactive" but do display slight to moderate strength increases when treated with lime. Under certain service conditions, the lower strength lime-treated soils may be satisfactory. Thus, for those fine-grained soils which display limited reactivity a "2" feasibility rating has been assigned with the supposition that under certain service conditions, this rating can be changed to a "1".

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VIII. APPENDIX B

Presented in this appendix for the major textural groups of Wisconsinan glacial till found in northeastern Illinois are:

(1) A brief discussion of the till textural groups

(2) Stabilization recommendations for the six major textural groups of the Wisconsinan glacial till.

WISCONSINAN GLACIAL TILL

The soils of northeastern Illinois have developed primarily from thin loess on glacial drift and outwash. These soils, illustrated by association areas G, H, I, J, K, S, T, U, and V, Figure 7, comprise about 13 percent of the state's land area. The typical thickness of the loess cover on the Wisconsinan drift may be determined by consulting Figure 8.

Wascher, et al. (4), found that the major differentiating characteristic of these calcareous drifts is their texture which ranges from a loamy gravel as found in association areas G and S (coarse-textured outwash materials) to silty clay or clay as found in association areas K and V.

Bulletin 665 (4), "Characteristics of Soils Associated with Glacial Tills in Northeastern Illinois," a publication available[a] from the University of Illinois, contains a rather complete discussion of the origin, areal distribution, texture, and engineering properties of the six major textural groups of Wisconsinan glacial drift.

The areal distribution of the different textured tills of northern Illinois is illustrated on a large foldout map available with Bulletin 665. The average grain size distribution and Atterberg limits for the six materials are summarized in Table 1.

Stabilization recommendations for the various tills are summarized in the following table.

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[a]Available from: University of Illinois, Agronomy Department, Room N-405, Turner Hall, Urbana, Illinois 61801.

STABILIZATION RECOMMENDATIONS FOR THE SIX TEXTURAL GROUPS OF WISCONSINAN GLACIAL TILL

Wisconsinan Till Textural Group	Stabilization Objectives and Recommended Stabilizers														
	Construction Expedient					Subgrade Modification					Strength and Durability Improvement				
	C	L	B	F	COMB	C	L	B	F	COMB	C	L	B	F	COMB
Loamy Gravel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
Sandy Loam	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	3	1	1	3
Loam and Silt Loam	2	1	3	3	3	1(a)	1	3	3	3	1	1	2	2	*
Silty Clay Loam	2	1	3	3	3	1(a)	1	3	3	3	1	1	2	2	*
Silty Clay	2	1	3	3	3	2(a)	1	3	3	3	1(b)	1	3	3	*
Clay	2	1	3	3	3	2(a)	1	3	3	3	1(b)	1	3	3	*

C = Cement
L = Lime
B = Bitumen
F = Lime-Fly Ash
COMB = Combinations

1,2,3, = Stabilizer Suitability Rating
where: 1 = Suitable
2 = Questionable
3 = Not Suitable

NA = Not Applicable

( ) See designated comments on following page.

* Indicates that combination stabilization (lime-cement and/or lime-bitumen) may be a suitable method of beneficiation. However, this recommendation is based on a very limited amount of laboratory results and the respective literature surveys.

STABILIZATION RECOMMENDATIONS FOR WISCONSINAN GLACIAL TILL (Continued)
COMMENTS

(a) Both cement and lime feasibly can be used in subgrade modification applications with the finer-textured Wisconsinan tills. However, lime will prove more effective and efficient than cement in most cases. Consequently, lime has been assigned a "1" rating and cement a "2" rating. For medium textured Wisconsinan tills, cement also has a "1" rating.

(b) Cement can be used to obtain increased strength and durability with fine-grained soils and thus, a "1" rating has been assigned to these materials. However, the cement content required to obtain adequate durability for these materials (PCA criteria) may be quite high--on the order of 9-16 percent (by soil dry weight).

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