THE GEOGRAPHY OF FRAGIPAN SOILS IN THE EASTERN UNITED STATES

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(ABSTRACT)

The *Soil Taxonomy* definition for the brittle, compact subsoil horizons known as fragipans is vague and processes responsible for fragipan formation are poorly understood. Ambiguities in the fragipan definition have resulted in a lack of consistency in the interpretation of fragipan characteristics. These ambiguities may be attributed to difficulties encountered in establishing a precise definition broad enough to encompass the wide range of fragipan soils known to occur. This study approaches the problems of defining and identifying fragipans from a geographic perspective; emphasizing distribution of fragipan soils in the United States, and interpretation of fragipan characteristics across this range. A series of maps based on data gathered from county soil surveys are presented to estimate the areal distribution of fragipan soils in the United States and explore the regional variability of several fragipan characteristics. This study demonstrates that a "universal" definition of fragipans may not be realistic.

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TABLE OF CONTENTS

ABSTRACT ii

ACKNOWLEDGEMENTS iii

LIST OF FIGURES v

LIST OF TABLES vi

Chapters

I. INTRODUCTION 1

II. EFFECTS OF FRAGIPANS 4

III. THE *SOIL TAXONOMY* DEFINITION OF FRAGIPAN. 8

IV. TAXONOMY AND CLASSIFICATION 11

V. FRAGIPAN "BRITTLENESS" 13

VI. FRAGIPAN GENESIS 16

VII. PROBLEMS WITH MAPPING FRAGIPAN SOILS 36

VIII. AREAL DISTRIBUTION OF FRAGIPAN SOILS 43

IX. REGIONAL VARIABILITY OF FRAGIPAN CHARACTERISTICS . . . 63

X. CONCLUSIONS 85

LITERATURE CITED 87

Appendix

A. FRAGIPAN SOILS DATA BASE 91

VITA 207

LIST OF FIGURES

Figure Page

1. Areal Distribution of Fragipan "Genesis Theories" 33
2. County Soil Surveys Published Between 1900 - 1966 37
3. County Soil Surveys Published Between 1967 - 1991 38
4. Areas Never Surveyed at County-Level 39
5. Areas Lacking Modern County-Level Surveys (post-1966) 40
6. Fragipan Soils of the Northwest 45
7. Areal Distribution of Fragipan Soils in the Eastern United States 46
8. Areal Distribution of Soils Recently Reclassified as Non-Fragipan 52
9. Areal Distribution of Fragipan Soils Classified as Alfisols 64
10. Areal Distribution of Fragipan Soils Classified as Ultisols 65
11. Areal Distribution of Fragipan Soils Classified as Inceptisols 66
12. Areal Distribution of Fragipan Soils Classified as Spodosols 67
13. Areal Distribution of Fragipan Soils Formed in Loess 69
14. Areal Distribution of Fragipan Soils Formed in Colluvium 70
15. Areal Distribution of Fragipan Soils Formed in Alluvium 71
16. Areal Distribution of Fragipan Soils Formed in Marine Sediment 72
17. Areal Distribution of Fragipan Soils Formed in Weathered Bedrock 73
18. Areal Distribution of Fragipan Soils Formed in Glacial Till 74
19. Fragipan Soils in the Fine-Silty Particle Size Class 77
20. Fragipan Soils in the Fine-Loamy Particle Size Class 78
21. Fragipan Soils in the Coarse-Loamy Particle Size Class 79
22. Fragipan Soils in the Coarse-Silty Particle Size Class 80
23. Soils with Depth to Fragipan less than 18 Inches 84
24. Soils with Depth to Fragipan greater than 32 Inches 85

LIST OF TABLES

Table Page

1. Synoptic Review of Fragipan Genesis Research in the Eastern United States 32
2. Fragipan Genesis Theories: Bonding Agents Compared to Parent Materials 34
3. Fragipan Soils Data Base Contents 42
4. Fragipan Soils of the Northwest 44
5. "Top 10" Fragipan Counties in the Eastern United States 48
6. "Top 15" Most Extensive Fragipan Soil Series 50
7. Affects of Recent Reclassification of Fragipan Soils in the Eastern United States 51
8. Modern Survey Fragipan Acreage Compared to Witty & Knox Estimates 54
9. Lindbo & Veneman Estimates Compared to Modern Survey/Witty & Knox Estimates .. 55
10. Modern Survey/Reclassified Fragipan Acreage Estimates Compared to Smith & Daniels Estimates 57
11. Franzmeier Estimates Compared to Modern Survey/Witty & Knox Estimates 59
12. Hudnall & Williams Estimates Compared to Modern Survey/Witty & Knox Estimates . 60
13. Fragipan Soil Orders in the Eastern United States 68
14. Parent Materials of Fragipan Soils in the Eastern United States 75
15. Particle Size Class of Fragipan Soils in the Eastern United States 81

I. INTRODUCTION

In 1946, Guy D. Smith coined the term "fragipan" to describe the brittle, compact subsoil horizons previously designated as silt-pans, silica hardpans, or simply hardpans. Today, these soil horizons are still referred to as fragipans, but their definition is vague and their genesis remains obscure. A fragipan (from L. *fragilis*, brittle, and pan; meaning brittle pan) can be defined as:

> A loamy, brittle subsurface horizon low in porosity and organic matter and low in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.[1]

The brittleness of the fragipan layer makes one suspect a cementing material, but if cementation exists it must be weak, for the material slakes in water (Birkeland, 1984, p.135). While characteristics such as porosity and organic matter content can be easily tested in the laboratory, it is much more difficult to determine "brittleness." The above definition includes ambiguous, general statements like; "...a fragipan *appears* cemented..." and "...it *tends* to rupture suddenly..." Such problems of definition led the authors of *Soil Taxonomy* (Soil Survey Staff, 1975) to admit that:

> There is no known laboratory procedure for identifying a sample of fragipan. Identification is primarily a field problem. A combination of clues must be used because there is no single unique property of fragipans. (p.44)

This statement is followed by seven paragraphs of "clues" that are intended as criteria for field identification of fragipans.

Ambiguities in the fragipan definition have resulted in a lack of consistency in interpretation of fragipan characteristics (as described in the literature and published soil surveys). These ambiguities may be attributed to difficulties encountered in establishing a precise definition broad enough to encompass the wide range of fragipan soils known to occur.

The purpose of this study is to approach the problems of defining and identifying fragipans from a geographic perspective; emphasizing distribution of fragipan soils in the United States, and interpretation of

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[1] from the Soil Survey of Ashley County, Arkansas (published in 1979), used here as an example of a "typical" definition for fragipans.

fragipan characteristics across this range. An historical perspective will be utilized to show that the criteria used to categorize and define fragipans have changed significantly over time. It is the intent of this study to demonstrate that inconsistencies inherent in the current concept of fragipan are the result of the use of "working definitions" in specific regions, rather than the establishment of a definition that adequately characterizes fragipans across their entire range.

The relevant previous work on this subject, including the treatise by Grossman and Carlisle (1969), will be discussed and challenged or expounded upon, as appropriate. Specific attention will be given to the recent collection of articles issued in Fragipans: Their Occurrence, Classification, and Genesis (Soil Sci. Soc. Amer. Spec. Pub. No. 24, 1989); the follow-up publication to the symposium at the 1987 Annual Meeting of the Soil Science Society of America (held December 1, 1987). This collection includes several papers on the regional distribution of fragipans in the United States, as well as a first attempt at estimating their worldwide distribution. The need for revisiting the issues of fragipan definition, classification, distribution, and genesis is best summarized by Witty and Knox (1989, p.1) who state that, "In spite of the large number of theses, special studies, and papers about fragipans, the concept does not seem to be well understood." Witty and Knox point out that Guy D. Smith, who coined the term more than 40 years ago, recently characterized the existing fragipan definition as "completely inadequate." As a result, the consistency of the definition of fragipans across both space and time (1949, 1969, 1990) warrants investigation.

The substantial literature regarding the obscure genesis of fragipans, which undoubtedly contributes to its ambiguous definition and difficulties in field identification, will also be discussed in an attempt to utilize the geographical perspective to shed new light on this long and frequently debated subject.

This study does not provide an unequivocal definition of fragipans or explain their genesis; instead, it simply introduces the use of the geographical perspective as a tool that could assist in developing a better understanding of this poorly defined soil characteristic. A series of maps based on data gathered from county soil surveys are presented to estimate the areal distribution of fragipan soils in the United States and explore

the regional variability of several fragipan characteristics (parent material, classification, topographic position). This study will demonstrate that a "universal" definition of fragipans may not be realistic.

II. EFFECTS OF FRAGIPANS

From a soil management perspective, fragipans are the most significant subsoil horizon in the eastern United States, limiting both agricultural and urban uses of soils. These significant effects are summarized below to emphasize the importance of proper identification and classification of fragipans.

The effects that shallow, well-expressed fragipans can have on plant growth and drainage have long been recognized in widely separated regions. In studying soils in the Ozark Region, Krusekopf (1942, p. 436) found that: "The roots of forest trees and other vegetation do not penetrate the hardpan..." (of Lebanon silt loam, now classified as Typic Fragiudalfs). Krusekopf also found that these fragipan soils are less than ideal agricultural soils:

> The high acidity of the subsoil horizons is unfavorable to most plants. . . soils with a hardpan are of low productivity and have a low capacity to respond to fertilizer treatment. (p. 436)

In describing "siltpan" soils in West Virginia, Smith et al. (1946) concurred with Krusekopf's opinion:

> . . . poor structure, low water reserves, low organic matter, and extreme erodibility of the upper profile combine with low mineral fertility to restrict the use of soils with strong siltpan development (which included the Cookport, Monongahela, and Pickaway Series, now classified as Aquic Fragiudults, Typic Fragiudults, and Aquic Fragiudalfs, respectively). (p. 316)

The dramatic effect fragipans can have on root growth is exemplified by the findings of Winters and Simonson (1951) in their study of fragipan soils in western Tennessee:

> Well-developed fragipan layers seem to be impervious to nearly all kinds of plant roots. The authors have observed sweet clover and servicea (*Lespedeza cuneata*) roots which penetrated only to the top of the fragipan layer . . . (at which point) the roots turned sideways and extended laterally. (p. 41)

Root-restricting characteristics of fragipans indicate that the depth to the top of the fragipan layer, as well as its thickness or "expression," have important implications for use of these soils. The mechanical impedance of roots by fragipans can effectively stunt the growth of plants, while impeded drainage can cause extended periods of wetness immediately above the impermeable fragipan, creating conditions that may allow the development of root fungi or may lengthen time needed for seed germination.

Deleterious effects of shallow fragipans are exacerbated by erosion, which effectively bring fragipans closer to the surface. Unfortunately, many extensive fragipan soils are highly erodible. Two prominent examples are the Grenada (Glossic Fragiudalfs) and Loring (Typic Fragiudalfs) Series which are widespread in the southcentral United States, ranging from Louisiana to Kentucky. Effects of deep fragipans are less obvious. Grossman and Carlisle (1969, p. 264) noted that, for most plants, the fragipan influence diminished rapidly at depths greater than 50 cm. Likewise, thin or weakly expressed fragipans may not significantly affect plant growth.

Comer and Zimmermann (1969) found that shallow, well-expressed fragipans in northern Vermont not only stunt growth and restrict root penetration of plants, but actually exhibit some control over the types of vegetation which has developed on these soils:

> The forest that grows on fragipan soils is shallow-rooted (0 to 18 inches) as few roots penetrated the pan. Deep-rooted vegetation, likely to dry out as much as five or six feet of soil, generally grows only in the (nonfragipan) soils of the Calais and Colrain Series. (p. 105)

The primary intent of the Comer and Zimmermann study was to determine effects of fragipans on watershed hydrology. They found that:

> ...the low base flow in Morill Brook (which has a watershed controlling 8.4 square miles) is due to the widespread occurrence in the basin of fragipan soils (comprising 44% of the soils of the basin) that prevent deep infiltration, and retain water in the surficial horizons. In Pope Brook basin (drainage area of 3.2 square miles, 22% fragipan soils) the soils are deeper, have greater storage capacity, and are surficially well-drained. The higher base flow of Pope Brook is due to drainage of water from these (nonfragipan) soils. (p. 107)

As demonstrated by the above examples, fragipans need to be considered in soil management. Grossman and Carlisle (1969, p. 263) noted that "Improving the plant nutrient status of soils has become increasingly feasible. One result has been to increase the relative importance of a physical limitation such as presence of a fragipan." Several studies have been able to show that intensive soil management can minimize the detrimental effects fragipans have on agriculture. Bradford and Blanchar (1977) utilized a wheel-trencher, conveyor belt, and front-end-loader to "modify" fragipan soils in a series of experimental

plots (comprised primarily of the Hobson Series, Typic Fragiudalfs) located in Dent County, Missouri. Their results were compelling:

> Within unmodified areas (control plots), sorghum yields averaged 1,841 kg/Ha. Deep trenching without chemical or physical additives increased yields to 4,322 kg/Ha. Mixing lime, fertilizer, and sawdust with the soil material within the trenches increased grain sorghum yields to 5,987 kg/Ha. (p. 127)

The most important factor contributing to the dramatic increase in yields was attributed to "...the decreased density and strength of the fragipan layer, which allowed roots and water to penetrate the soil profile..." To placate critics who asserted that profile modification was a short-term solution, Bradford and Blanchar (1977, p. 127) also re-excavated the Hobson Series identification pit dug 16 years earlier by the Soil Conservation Service and found "...no signs of soil density or strength reformation..."

Blanchar et al. (1978, p. 440) concentrated on analyzing root growth in the fragipan layer of the Hobson soil. Their results indicated that high bulk density and low pH produced a combined effect to restrict root growth. By increasing soil pH from 4 to 5, they found that root growth in the fragipan increased substantially, but had no measurable effect on fragipan density or consistence.

The study by Bradford and Blanchar (1980, p. 374) was a continuation of the previous work discussed above. Over a 3-year period, they found that sorghum grain yields were increased by 50% due to the mixing process alone and by 150% when lime and sawdust were added prior to mixing. The cumulative conclusion of these studies indicated that breaking up the fragipan in these soils increased water storage, enhanced water movement through the soil profile, and allowed root penetration which combined to improve the probability of higher crop yields. While fragipan soil profile modification appears to be an effective means of improving soil productivity, these studies were performed on small experimental plots, using only one type of fragipan soil, in one location. The cost of this mixing process far exceeds the benefit resulting from increased yields, especially when there is no evidence that the increased yields found in Missouri would transfer equally well to the fragipan soils of other regions.

Fragipans have significant effects on non-agricultural uses of soils as well. Fragipan soils may be unsuitable for many urban land uses due to poor drainage or increased freeze-thaw effects. The deleterious

effects of shallow, well-expressed fragipans on roads is exemplified in Evansville, Indiana, where roads built on the Hosmer soil (Typic Fragiudalfs) exhibit much poorer general condition than roads built on similar non-fragipan soils (Soil Survey of Vanderburgh County, Indiana, 1980 and personal observations).

Strong, well-expressed fragipans can significantly increase excavation costs for foundations, drainage ditches, tile lines, and septic systems. Huddleston and Olson (1967, p. 408) found that the installation of pervious seepage beds for septic systems may be necessary in slowly permeable fragipan soils subject to prolonged wet periods. Grossman and Carlisle (1969, p. 265) recognized the significance of fragipans for urban planning, especially given the suburban sprawl which encroached upon ridges and hillsides in heavily populated areas of the eastern United States. This urban sprawl has made the recognition of fragipans a vital component of urban planning.

In addition to their adverse effects on agricultural and urban uses of soils, the presence of fragipans may significantly impair the ability of hydrologists to predict soil-water flow. Dabney and Selim (1987, p. 3) point out that soil-water flow modelers commonly assume that the soil is homogeneous. While some researchers have attempted to improve the reality of their models by assuming that the soil consists of several layers (usually corresponding with genetic soil horizons), each of these layers is considered to be homogeneous and isotropic. According to Dabney and Selim, these models rarely attempt to incorporate the possibility of anisotropy within individual layers, since this would make the models excessively complex. In measuring the hydraulic conductivity of Olivier silt loam (Aquic Fragiudalfs) in Baton Rouge, Louisiana, Dabney and Selim found that conductivity values in the fragipan horizon were three times greater in vertical than in horizontal directions. This anisotropy was attributed to the primarily vertical orientation of flow-restrictive zones in the fragipan.

To further familiarize the reader with the characteristics of fragipans, the following section provides the full definition and pertinent discussion from *Soil Taxonomy*.

III. THE *SOIL TAXONOMY* DEFINITION OF FRAGIPAN

Soil Taxonomy defines a fragipan as:

> A loamy or uncommonly a sandy subsurface horizon that may but does not necessarily underlie a cambic, spodic, or albic horizon. It has a very low content of organic matter, has high bulk density relative to the horizons above it, and is seemingly cemented when dry, having then hard or very hard consistence. When moist, a fragipan has moderate or weak brittleness, which is the tendency for a ped or clod to rupture suddenly when pressure is applied rather than to undergo slow deformation. A dry fragment slakes or fractures when placed in water. A fragipan is usually mottled, is slowly or very slowly permeable to water, and has few or many bleached, roughly vertical planes that are faces of coarse or very coarse polyhedrons or prisms...Most commonly, a fragipan has an abrupt or clear upper boundary at a depth of 33 to 100 cm below the original surface. Thickness ranges from about 15 to 200 cm, and ordinarily the lower boundary is gradual or diffuse. A fragipan is virtually free of roots except along the bleached prism faces. It should be noted that the bleached materials are not brittle when moist, although, if clayey, they may be hard when dry. Clay skins may be patchy or discontinuous both on the faces and in the interiors of the prisms. All observations on thin sections that have been reported in the literature indicate bodies of oriented clay within the fragipan, although the volume of the bodies varies widely. Some fragipans have moderate to strong, thick platy or lenticular structure within the large prisms. In others, the structure within the prisms is more nearly coarse blocky than platy. There are varying transitions between platy and blocky structure. In some fragipans, the prisms have no secondary structure. (p. 42)

The *Soil Taxonomy* definition for duripans (L. *durus* , hard, plus pan; meaning hardpan) is provided below, both to differentiate these indurated subsoil horizons from fragipans and to provide an example of a more concise and well understood definition:

> The duripan is a subsurface horizon that is cemented by silica to the degree that fragments from the air-dry horizon do not slake during prolonged soaking in water or HCl. Duripans vary in the degree of cementation by silica and, in addition, they commonly contain accessory cements, chiefly iron oxides and calcium carbonate. As a consequence, duripans vary in appearance, but all of them have very firm or extremely firm moist consistence and they are always brittle, even after prolonged wetting. (p. 41)

By comparing the duripan definition to the one given for fragipan, the qualitative and vague criteria of the fragipan definition become apparent. The chemical cementation and irreversible induration of duripans clearly separates them from fragipans. While fragipans are confined to humid regions, duripans are most commonly found in arid or droughty regions. As a result, there is little opportunity for confusion in differentiating between these two impermeable subsoil horizons.

To fully understand the *Soil Taxonomy* concept, the six factors offered as "evidence" for considering fragipans to be genetic soil horizons are provided below.

1. The fragipan, within its range of occurrence, is roughly parallel to the soil surface.

2. The upper boundary of most fragipans is about 40 to 80 cm below the surface if the soil is not eroded...The extreme range in depth from the surface in the soils that have not been eroded or buried seems to be from about 25 to 150 cm. This would be a remarkable accident if the fragipans were not soil horizons.

3. The pans occur in alluvium, in loess, in residuum from bedrock[2], in glacial till, and in solifluction materials. The common features of the parent materials are a loamy texture, a low carbonate content or no carbonates, and an appreciable content of silt or very fine sand.

4. The pans underlie a variety of horizons--spodic, argillic, cambic, or albic horizons. In all instances the morphology of the fragipans may be very similar; however, the fragipans are not known to occur in materials that are calcareous, nor do they underlie a ca, cs, or sa horizon, however weakly developed these horizons may be. If the fragipans are not soil horizons, the failure to find them under ca, cs, or sa horizons would be another remarkable accident. Fragipans form only in soils in which water moves through the soil to the groundwater below. They are at depths which rarely freeze.

5. If a soil has an A'2 and a B't horizon, the fragipan may be lower in the lower argillic horizon or even in the eluvial horizon that separates the two B horizons. Thus, it occurs in otherwise eluvial or illuvial horizons. In an uneroded soil, however, it always occurs below an eluvial horizon and therefore is subject to the accumulation of substances from some horizon above.

6. The vegetation has been forest, either conifers or deciduous hardwoods. (from *Soil Taxonomy*, p. 42-43)

Soil Taxonomy's seven "field clues," which need to be used to identify fragipans since there is "no unique property of fragipans," are as follows.

1. Position is important. A fragipan lies below an eluvial horizon unless the soil has been truncated, but it is not necessarily immediately below. If the soil has been truncated, the pan can be traced upslope until it lies under an eluvial horizon.

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2 While *Soil Taxonomy* acknowledgfes the presence of fragipans in soils formed in residuum from bedrock, it is likely that th majority of these soils formed in colluvial material which was mistaken for bedrock weathered in place (discussed in detail in Section IX).

2. If there is an argillic or a cambic horizon above a fragipan, there is commonly an A'2 horizon between the fragipan and the overlying horizon. The A'2 horizon is marked by uncoated grains of sand and silt. This horizon seems related to water that either stands above the pan or moves laterally along its surface.

3. If the pan is not saturated for long periods, some or all pedons normally have bleached vertical streaks that form a roughly polygonal pattern on a horizontal plane. The bleached streaks are bounded by strong brown or reddish brown streaks where iron or manganese have accumulated. If the pan is saturated for long periods or if the texture is sandy, the polygonal color pattern may be absent.

4. If the moisture content is near the wilting point, the matrix between the streaks is very firm. If it is near field capacity, the matrix is brittle. The brittle matrix should constitute 60% or more of the volume of some subhorizon.

5. Fine feeder roots are virtually absent in the brittle parts of the fragipan. If brittleness is so weakly expressed that fine feeder roots are present throughout the horizon, the horizon should not be considered a fragipan. It should be noted, however, that some trees have tap roots that extend through a well-expressed fragipan, but this is the exception rather than the rule. It is characteristic of fragipans that few or many roots may be present in the bleached vertical streaks and that few or no fine roots are present in the brittle matrix between the bleached streaks. The fine roots should not be present at intervals of <10 cm except within bleached vertical streaks, and the mean horizontal dimensions of the brittle matrix should be at least 10 cm.

6. Texture of the fine-earth fraction of a fragipan is finer than fine sand, and the percentage of clay is generally <35; in most soils appreciable less. The texture normally is loamy.

7. An air-dry fragment about the size of a fist slakes or fractures when placed in water. (from *Soil Taxonomy*, p. 44)

The problems inherent in the definition, genetic factors, and "field clues" given for fragipans in *Soil Taxonomy* have been criticized by Witty and Knox (1989) who state that:

> When the definition of the fragipan, which could more appropriately be called a description of common properties, is compared with the field clues, numerous uncertainties remain. In contrast to most other definitions in *Soil Taxonomy*, few specific limits are given for the fragipan, and there are several inconsistencies between the two lists concerning limits. More specific limits are given in the field clues than in the definition, but five of the clues are conditioned by words ("should," "commonly," "normally," and "generally") that imply that the indicated limits are not mandatory. (p. 3)

The following section describes the "building blocks" on which the *Soil Taxonomy* was built to help the reader more fully understand the complexities involved in fragipan classification.

IV. TAXONOMY AND CLASSIFICATION

The obscure genesis and ambiguous definition of fragipans is puzzling since they are such common characteristics of soils in the eastern United States; especially when considering the detrimental effects fragipans can have on agricultural and urban uses of soil. Ironically, it may be the commonness of fragipans which perpetuates these ambiguities since the difficulties fragipans pose for soil management facilitates the need for a functional, practical concept of fragipan which is not necessarily conducive to taxonomy.

The lack of consistency in defining and identifying fragipans cannot be attributed to soil classification; instead it is a problem of taxonomy. The authors of *Soil Taxonomy*, in explaining their rationale for the hierarchy of soil classes, state that:

> Taxonomy is a narrower term than classification. Classification includes taxonomy, but it also includes classifications for specific practical purposes, such as limitations of soils for use to support foundations of buildings. Taxonomy is the part of classification that is concerned primarily with relationships. Classifications are contrivances made by men to suit their purposes. (p. 7)

Fragipans have been classified according to *specific practical purposes* to the point where the term is often used colloquially in different regions to describe hardpans in the same manner that tractor-compacted soil layers are referred to as "plowpans."

Defining soil characteristics according to how they effect the use of the soil seems logical since the primary intent of *Soil Taxonomy* is to support the production of soil surveys; which in turn are produced to assist in soil management. However, the loose application of the term fragipan spawned by classification according to "practical purpose," rather than specific, quantifiable diagnostic characteristics, threatens the integrity of the taxonomic building blocks of the *Seventh Approximation.*

In developing *Soil Taxonomy*, the Soil Survey Staff established eight desired attributes of taxonomy, the first of which states that:

> The definition of each taxon should carry as nearly as possible the same meaning to each user. We must not say that the soils of a taxon have a high organic-matter content because what is considered high in one place may be considered low in another. Rather, we must specify the amounts as measured by specific methods for specific parts

> of the soil. Only by such definitions can competent pedologists with diverse backgrounds arrive at the same classification of the same kind of soil. (p. 8)

In short, consistency may be considered the most basic requirement of taxonomy. Another of the "desired attributes", which is particularly significant as applied to fragipans, states that:

> The taxa should be concepts of real bodies of soils that are known to occupy geographic areas. We are concerned with mapping real bodies of soil, and a classification related to these real bodies facilitates this mapping. So, we should take the soils as they are and find a way to classify them. (p. 8)

By combining the intent of these two attributes, it is clear that a consistent definition for fragipans, which can be applied to soils across their geographic range, is necessary if *Soil Taxonomy* is to be successfully applied.

The following Section discusses fragipan "brittleness" in detail to provide the reader with a thorough understanding of the primary characteristic used by pedologists to identify fragipans.

V. FRAGIPAN "BRITTLENESS"

While there is no unique defining property for fragipans, brittleness is widely recognized as their single most important feature. Qualitative descriptions for fragipans abound, some of which predate the use of the term. Winters (1942, p. 438) described "silica hardpans" in Tennessee as having "brittle consistence" which, when crushed, "behaves like a dry cracker, crumbling suddenly into a friable mass that displays very little cohesion or plasticity." Winters also noted difficulties in identifying these pan horizons when soil moisture content was high and found "great variation" in the degree of "hardness" or cementation in comparing the hardpans of the different physiographic regions of Tennessee, thus identifying the need for quantifying the inherently qualitative characteristic of "brittleness." In describing fragipan soils in Kentucky, Bailey (1964) concurred with Winters' concerns over fragipan identification, stating that:

> When wet the pans tended to lose their consistency contrast and become sticky, a reflection of the generally finer texture. The consistency contrast returns as moisture content decreases. In field identification, using an auger, this has led to some failure of pan identification when the investigator relied to heavily on consistence as an identification tool. (p. 683)

Grossman and Bartelli (1957) investigated the "human element" in estimating the variability in soil consistence measurements by employing a hand dynamometer to test the ability of 20 soil scientists to differentiate between the consistence classes defined in the *Soil Survey Manual* (U.S.D.A. Handbook 18, 1951). Since the consistence classes are described by "subjective," "adjectival" phrases, Grossman and Bartelli expected that, "...among field personnel, the working tactile concept of the boundaries between consistence classes should be highly variable." As expected, a "high degree of variability" between individuals was found; however, each participant displayed a "high degree of consistency upon repetition in separating between the same consistence classes." (p. 661) As a result, Grossman and Bartelli concluded that the participants were "...practiced at making these qualitative determinations; but that their individual judgement does not necessarily coincide with that of others." While the skills of the study participants is

notable, Grossman and Bartelli's findings are clearly contradictory with the "first attribute" of taxonomy ["...each taxon should carry as nearly as possible the same meaning to each user..." (*Soil Taxonomy*, p.8)].

Several subsequent studies made attempts to provide quantitative methods for determining brittleness and soil consistence. Grossman et al. (1959, p. 67) used the "drop shatter" technique (which consists of dropping soil clods and measuring how the soil shatters, as the name implies) to assess the resistance to fracture of the soil horizons of Hosmer silt loam (Typic Fragiudalfs). Their results indicated a progressive increase in resistance to fracture from the surface of the soil down to the loessial parent material. When dry soil clods were used, weakly altered loess of the C_1 horizon was more resistant than the fragipan. However, when moist soil was used, the C_1 horizon was less resistant to rupture than the fragipan. They concluded that:

> ...the results would suggest that somewhat weathered loess may express a greater degree of reversible induration than a fragipan. This, in turn, suggests that reversible induration may be a property inherent in the nature of loessial parent materials and is not specific to the fragipan developed therein. (p. 68)

In addition to describing soil consistence, Grossman et al. expose the complex and poorly understood relationship of fragipan horizons to the parent material from which they are derived. To add to the confusion, the uniqueness of fragipan characteristics has spawned the use of such seemingly contradictory terms as "reversible induration" [Buol et al. (1980, p. 274) went so far as to refer to the elusive fragipan bonding agent as the "invisible, reversible cement."].

In exploring the relationships between rigidity and particle size distribution, Grossman and Cline (1957, p. 322) found that (among 24 fragipan horizons in New York) rigidity was highly correlated with percent total clay. Two decades later, Hallmark and Smeck (1979, p. 200) established a method for identifying fragipan soil using a jury-rigged testing apparatus, complete with balance beam and water bucket, to determine the "horizon average rupture strength" (HARS) of three Aeric Fragiaqualfs and an Aeric Ochraqualf. They found that the rupture values abruptly increased in the fragipan as compared to overlying horizons and decreased with depth in the lower B3 and C horizons. While Hallmark and Smeck suggested

that their HARS technique could provide a "useful tool for objectively identifying fragipans," their approach has not been adopted.

As the search for an objective method for defining fragipans continued, a study of mechanical impedance of a fragipan soil in Baton Rouge, Louisiana demonstrated why quantitative criteria for defining fragipan characteristics have been so elusive: Selim at al. (1987, p. 452) used a cone penetrometer to measure the *in situ* variability of mechanical impedance with soil depth along an 80 m transect of Olivier silt loam (Aquic Fragiudalfs). After taking mechanical impedance measurements at 0.3 m spacing, their results indicated "no obvious patterns" along the 80 m transect. They concluded that:

> ...the random occurrence of gray seams and brittle brown areas in the fragipan horizons significantly contributed to the lack of observed spatial variability. (p. 442)

While their conclusion can not be applied universally without extensive replication of their methods across several regions, their results indicate that some fragipan characteristics simply do not lend themselves to quantification.

The lack of a definitive quantitative method for identifying fragipans should not; however, preclude fragipans from being classified as genetic soil horizons, even though it obviously complicates the criteria on which that classification should be based. Virtually all of the research on fragipans either directly or indirectly raises the issue of their obscure genesis. Because it holds important consequences for fragipan classification, definition, identification, and, ultimately, their areal distribution, a review of this research follows.

VI. FRAGIPAN GENESIS

Many researchers have searched for the elusive bonding agent or process responsible for fragipan formation. While numerous hypotheses have surfaced through the years, no definitive cause for fragipan formation has been agreed upon. The most effective approach for deciphering the literature on this complex issue is, arguably, to address significant papers on fragipan genesis chronologically. This allows us to see how the various schools of thought on the subject have evolved over time, some gaining adherents, others falling from favor. This approach should also demonstrate whether these hypotheses have considered geographical variation.

The earliest material implicated as the fragipan bonding agent - which incidentally, still has many proponents today - was Silica dioxide (SiO_2) . Marbut (1935) suggested that the hardpan in the Leonardtown Series (now classified as Typic Fragiaquults) in the Washington D.C. area was cemented with SiO_2. Winters (1942), who suggested designating these horizons as "silica hardpans," was the first to present a hypothesis for explaining fragipan genesis. While his term was rejected in favor of Smith's "fragipan," Winters' description of the role of SiO_2 in the development of these hardpans in Tennessee was compelling:

> The manner in which silica accumulates in the pan may be as follows. Soluble SiO_2 would result from silicate hydrolysis during the moist period of the year. Restricted drainage would retard or prevent the leaching of the SiO_2 except from the upper horizons. Invariably, during the late summer, surface evaporation and moisture withdrawal by vegetation result in extremely dry conditions throughout the entire soil profile. At such a time any SiO_2 in solution would not only be precipitated, but much of it would be dehydrated and form a coating on the soil grains much as it does in beakers when used for SiO_2 dehydration. In the absence of disruptive forces of shrinking and swelling, adjacent soil grains, over a period of years, would gradually become cemented and so be held together. (p. 439)

While Winters did not elaborate on the amount of time necessary for fragipan formation, he did indicate that silica hardpans were not found in very recent alluvium and colluvium and were "less pronounced" in moderately young deposits than in soils on older parent material.

In describing parent materials, Winters stated that:

> The geologic origin of the parent material seems of much less consequence to pan formation than its physical properties. (p. 439)

Contrary to Winters' findings, Krusekopf (1942, p. 435) stated that the formation of the hardpans found in soils in the Ozark Mountains (southern Missouri) were "...attributed to the character of the parent rocks and their decomposition under certain topographic conditions." Krusekopf does agree with Marbut and Winters that SiO_2 acts as the cementing agent. According to Krusekopf, SiO_2 accumulates *in situ* as a result of the disintegration and decomposition of the parent material.

The role of silica in fragipan bonding was questioned by Nikiforoff et al. (1948) who, like Marbut, studied the Leonardtown Series in two Maryland counties (Prince Georges and Montgomery) adjacent to Washington D. C. (where Marbut had performed his study). The data they gathered, in the most detailed mineralogical, physical, and micromorphological study of fragipans to date, "...tended to rule out any cementation of this hardpan, and especially cementation by silica" (p. 149). The SiO_2 maximum noted by Marbut was attributed to the sand content of the hardpan layer. Nikiforoff et al. proposed that the hardpan was not of genetic origin, citing close-packing of particles during deposition prior to soil development. Nikiforoff et al.'s findings are significant in two ways: first, their rejection of silica as the bonding agent resulted in the virtual disappearance of that hypothesis (although it would regain proponents in the 1970's and 1980's, as described below); and second, they were the first to question whether these hardpans were of pedogenic (vs. geogenic) origin (which later became a significant issue in soil classification).

Fitzpatrick (1956), in examination of soils of Britain and northern Europe, proposed that periglacial conditions were prerequisite for fragipan formation, and suggested that the fragipan is simply a "fossilized permafrost layer." Fitzpatrick asserted that fragipans are "...always found in an area which is known or thought to have had a periglacial climate during and/or after the last glaciation" (p. 249). While this statement may have been correct for the indurated soil horizons in northern Europe, periglacial origin does not satisfactorily explain the presence of fragipans in the southern United States and other areas where

periglacial effects were limited or non-existent. Although Fitzpatrick's explanation for fragipan genesis clearly cannot be applied universally, it is a thorough documentation of the "periglacial effects" hypothesis:

> At first, summer thawing would take place to a considerable depth. Succeeding tundra conditions, with the accompanying vegetation and litter, would provide insulation which would cause a steady reduction in the depth of thawing. The reduction in depth of thawing would take place slowly, allowing the gradual but steady rise in the permafrost table. This gradual upward movement of the permafrost table would produce a marked development of alternating laminae of clear ice and soil which would account for the well-developed laminar structure of the indurated layer, especially at its upper surface. The presence of a continuous vegetative cover would also tend to cause the depth of thawing to be fairly uniform in any one given locality. This would account for the constant depth in the soil of the upper surface of the indurated layer. (p. 253)

Fitzpatrick's hypothesis was proposed for soils found in Spitsbergen, Norway (now called Svalbard), an island in the Arctic Ocean at approximately 77 degrees north latitude. In addition to demonstrating the extreme range of fragipan development, Fitzpatrick's conclusions show how authors in widely different areas were reaching conclusions which satisfactorily explained the presence of the fragipan in their specific location; however, few efforts were made at tying these findings together to provide an explanation which could be universally applied.

Knox (1957, p. 329-330) proposed that illite was responsible for a major part of the strength and rigidity of fragipans in New York soils. In one of the earliest laboratory-oriented, micromorphological studies on fragipans, Knox used X-ray diffraction to identify the fine material in the clay flows and bridges of the fragipan. Knox also employed chemical treatments of fragipan material in an attempt to remove or destroy possible bonding agents. While Knox attributes a major portion of fragipan strength in the Albia (now classified as Aeric Fragiaqualfs), Rockaway (Typic Fragiudults), and Wurtsboro (Typic Fragiochrepts) soils to illite, he noted a contributory effect of colloidal silica to the strength of the Rockaway fragipan.

Interstitial clay filling in spaces between uniformly deposited silty loess was implicated as the process responsible for fragipan formation in northwest Oregon by Whittig et al. (1957, p. 231). Laboratory analyses of the Cascade (now classified as Typic Fragiumbrepts) and Powell (Typic Fragiochrepts) soils indicated a high content of soluble SiO_2 and Al_2O_3; however, the authors did

not mention the role of these materials in fragipan genesis and development. The authors also noted that, ". . . these soils consist largely of loess overlying older, more weathered soils"; however, the significance of this "weathering discontinuity" was not speculated upon.

In investigating the relationships between rigidity and particle size distribution in fragipan soils in New York, Grossman and Cline (1957, p. 322) found that rigidity was highly correlated with percent total clay. While they concluded that clay was a "principle bonding agent," which was consistent with the hypothesis advanced by Knox (1957), Grossman and Cline's study did not reveal any "special role" for ultra-fine clay (as was suspected by Knox).

In studying the Hosmer soil (now classified as Typic Fragiudalfs) in southern Indiana, Anderson and White (1958, p. 454) concluded that soil particles of the fragipan are weakly cemented by iron oxides. While qualitative tests indicated a "slight accumulation of soluble silica" in the upper part of the fragipan which raised the "possibility of cementation by silica," Anderson and White did not speculate to what extent the presence of this silica might contribute to the fragipan bonding. Grossman et al. (1959, III, p. 75) reached similar conclusions after studying the micromorphology of Hosmer silt loam slightly to the west in Illinois, finding that sesquioxides[3] were "important bonding agents."

Yassoglou and Whiteside (1960) offered the following four step process, which occurs after leaching of carbonates and acidification of the profile, for describing fragipan genesis in Michigan soils:

1. Removal of part of the clay and preferentially of the expanding clay;
2. Contraction (caused by the load of overlying material, pressure of tap roots, wetting and drying, and freeze-thaw effects) following the removal of soluble materials and clay, which results in close packing of sand grains;
3. Following contraction and close packing of skeletal elements, the matrix substances undergo rearrangement (creating conditions conducive for clay bridging between sand and silt grains);
4. During the course of soil development, aluminum is released from the decomposing minerals possibly adding to the induration of the pan. (p. 405-406)

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[3] *Soil Taxonomy* defines "sesquioxides" as compounds of iron and aluminum.

Yassoglou and Whiteside did not expand upon the role of aluminum in fragipan bonding, asserting that the mechanical processes of contraction and close packing of soil particles are largely responsible for fragipan genesis. Fitzpatrick's (1956, p. 406) assertion that frost action is essential to fragipan development was refuted by Yassoglou and Whiteside, who point to fragipans in areas where soils do not freeze (e.g., sea level in Greece). Rather than implicating a specific factor responsible for fragipan formation, Yassoglou and Whiteside concluded that fragipans, "...occur wherever the mechanical composition, mineralogical components, and the close packing of the coarse soil particles (sand and silt grains) are favorable."

The conclusions reached by Jha and Cline (1963), in their micromorphological study of fragipan soils in New York, concurred with Yassoglou and Whiteside in disputing the claims of those who considered periglacial effects or compaction by glacial ice as necessities to fragipan formation. They stated that:

> The existence of strongly expressed fragipans far from glaciated regions, as in the lower Mississippi Valley and on the Gulf Coast Plain, demonstrates that not all can be attributed to such causes. Within the glaciated part of the northeastern United States, however, the literature has not presented a case in which these factors can be excluded as potential contributors. (p. 339)

This statement by Jha and Cline represents an important change in perspective in seeking an explanation for fragipan formation: the possibility that more than one factor could be responsible for their existence. An even more significant perspective change is the realization that different factors may be responsible for fragipan development in different regions. Jha and Cline proceeded to demonstrate that factors considered to be "essential" to fragipan formation could not explain the presence of a fragipan in the following case of a New York soil formed in lacustrine deposits:

> The fact that the parent material is a lake deposit that must have been under water until glacial ice had receded at least 190 miles to the northeast eliminates compaction by ice as a contributing factor...Under these circumstances, the site was probably not subject to permafrost at any time since deglaciation. Thus, this study argues strongly against permafrost and related periglacial phenomena as essential to fragipan development... (p. 343)

Jha and Cline's attempts to identify potential chemical bonding agents in fragipans were "fruitless." Instead, they found that:

> ...the genesis of fragipans has involved primarily physical phenomena related to the development of close packing and to organization and orientation of clays in intergrain spaces as the medium through which binding must be transmitted. (p. 344)

Hutcheson and Bailey (1964) performed laboratory analyses on four fragipan soils in Kentucky which were derived from a heterogeneous mix of limestone, shale, siltstone, and sandstone. They concluded that:

> High concentrations of silt and/or sand in the pan horizons of Bedford (now classified as Typic Fragiudults), Dickson (Glossic Fragiudults), Mercer (Typic Fragiudalfs), and Tilsit (Typic Fragiudults) soils representing a wide range of parent materials along with relatively high levels of clay lead one to visualize pan horizons as brick and mortar structures, i.e., silt particles acting as bricks held in a dense mass by clay mortar. Formation of tightly packed interstitial masses of clay connecting silt particles would be promoted and preserved by upward and downward movement of the water table during normal moisture variations. (p. 685)

Hutcheson and Bailey's hypothesis, sometimes referred to as the "brick and mortar" theory, requires only the mechanical and mineralogical composition conducive to fragipan formation (as suggested by Yassoglou and Whiteside), plus the movement of water through the soil with some regularity. While Hutcheson and Bailey do not indicate what "normal moisture variations" are, it can be assumed, given the areal distribution of fragipans in the United States (Section VIII), that it generally coincides with Thornthwaite's P-E index of 64 (Hudnall and Williams, 1989, p. 45) which separates the udic and ustic moisture regimes as used at the suborder level of *Soil Taxonomy*. As the literature on this topic accumulates, it is apparent that the emphasis must, by necessity, shift away from the search for a definitive bonding agent or process responsible for fragipan formation, towards an approach which considers a number of contributing factors, some of which may or may not apply in certain geographic areas, as the criteria for explaining fragipan genesis.

Ray (1967) continued the attack on the periglacial effects hypothesis, stating that:

> ...there is no necessity to attribute them (fragipans) to a former periglacial climate in areas embarrassingly far separated from all other evidence of a rigorous frost climate during the development of the profiles of weathering in post-glacial time. (p. D226)

Ray attributed the development of fragipans in the Grenada (now classified as Glossic Fragiudalfs), Calloway (Glossaquic Fragiudalfs), Loring (Typic Fragiudalfs), and Henry (Typic Fragiaqualfs) soils formed in the Peorian loess of western Kentucky to the alternate wetting and drying of the loess during profile development.

The significance of soil moisture conditions is furthered by Nettleton et al. (1968b) in their micromorphological study of fragipans on the North Carolina Coastal Plain:

> Removal of bases and irons from the lower solum through alternate wetting and drying is a necessary first step (to fragipan formation). Next, clay is translocated downward to form the B'2t (bisequal argillic) horizon. Silt and sand, no longer protected by clay, can then slake or slump into place or into voids and channels, increasing the bulk density and packing density of the horizon. Amorphous materials (possibly weathering products of feldspars) and the soil matrix are bound together by hydrogen bonds to produce fragipan brittleness. (p. 587)

Laboratory analyses of the same North Carolina fragipan soils (which were not identified) by Nettleton et al. (1968a, p. 581) indicated that the strongest fragipan horizons had the least amount of clay. By plotting the clay and silt distributions of the fragipan soils studied, the clay minima always occurred in the fragipan while the clay maxima occurred below the pan. This study also attempted to determine the relationship of parent material to fragipan formation. Of the two geomorphic surfaces studied, the Sunderland surface was comprised of soils largely derived from feldspathic materials, while the soils formed on the Wicomico surface were mostly derived from quartz-rich materials. Since fragipan formation was much more common on the Sunderland surface, the authors hypothesized that "...weathering products of feldspars are needed in whatever produces the apparent cementation..." After testing their hypothesis, they determined that "Alumina or silica, or both, probably are required to produce the apparent cementation of fragipans..." which led them to conclude that materials with an abundance of "feldspathic sediments" (the suggested source of alumina and silica) may enhance fragipan formation. One possibility which is not raised by the authors is that it could be the coarser texture and lesser uniformity of soil particle size of the quartz-rich sediments which makes them less conducive to fragipan formation.

In their treatise on fragipan soils of the eastern United States, Grossman and Carlisle (1969, p. 256) endorsed silicate clay as the bonding agent, citing the work by Jha and Cline (1963), Knox (1957), and others who had shown that dispersing agents for clay disaggregated the fragipans among soils studied more completely than treatments designed to remove silica, hydrous iron oxides, or hydroxy aluminum compounds. They also noted the contributions of close packing of sand and silt to the effectiveness of clay as a bonding agent.

Results of chemical analyses performed on a fragipan soil derived from glacial till in the Appalachian Highlands of Quebec by C. De Kimpe (1970, p. 317) indicated that the firmness of the pan was not necessarily related to the presence of illite, as suggested by Knox (1957). De Kimpe noted that, while periglacial effects alone may not be able to account for all fragipans, the action of glacial ice pressure should not be discounted. De Kimpe's study did not reveal any evidence to implicate a bonding agent.

Lozet and Herbillon's (1971) mineralogical, chemical and physical analyses of fragipan soils in Condroz, Belgium exemplifies the frustrations involved in attempting to explain fragipan genesis:

> Like other soil scientists who have worked on this problem, we do not succeed in putting clearly in evidence the chemical nature of the cement which should bind the particles in the pan horizon: the higher content in easily soluble silica in this horizon seems actually more closely related to the nature of their clay fractions than to the presence of a real cement. (p. 340)

While they failed to discover the elusive bonding agent, Lozet and Herbillon's conclusions reinforced Grossman and Carlisle's conviction that silica is not the answer. Lacking a definitive chemical bonding agent, Lozet and Herbillon concluded that fragipans in the Condroz are simply "compacted layers," which formed through a process they called "fragipan catastrophic development," which was described as follows:

> If, under climatic conditions cold enough to allow the presence of a perennially frozen ground, a succession of thawing and freezing occurs every year at about the same depth in the soil material, the intermediate soil layer will be taken every cold season between the jaws of a vice: the lower jaw being perennially frozen ground and the upper one, the seasonally frozen subsoil. (p. 340)

While Lozet and Herbillon do not preclude "incremental" fragipan formation, they consider the above scenario the most likely explanation for the presence of fragipans found in Condroz.

In continuing their study of fragipan soils in the Appalachian Highlands of Ontario, De Kimpe et al.(1972) tested the "illite-orientation" hypothesis of Knox (1957) and found that, in the profile studied:

> ...micas represented 86% of the bedrock and decreased to about 80% in the fragipan. The typical oriented structure of the slates (which the glacial till parent material was largely derived from), associated with the high bulk density of the deposit...favored this (Knox's) hypothesis. (p. 147)

In addition to concurring with Knox, De Kimpe et al. noted that the glacial till parent material had strongly influenced pan genesis.

The results of the Wang et al. (1974, p. 169) study of the micromorphology of two fragipan soils of Nova Scotia indicated that "clay bridges" were primarily responsible for the brittleness of the fragipan material. Interpretations of several scanning electron micrographs (SEMs) of the fragipan material revealed clay bridges linking coarser particles, while SEMs of similar nonfragipan soil material showed that clay tended to form films or bands, instead of bridges. While their results do not explain how these clay bridges form, the findings of Wang et al. represent the first time these clay bridges, which had been suspected by Knox and others several years earlier as the cause of fragipan brittleness, had been observed by SEM, or any other means.

The results of Harlan et al. (1977) marked the first study to champion silica as the primary bonding agent since Krusekopf (1946). They proposed the following explanation for the formation of fragipan soils (Cincinnati silt loam [Typic Fragiudalfs] and Tilsit silt loam [Typic Fragiudult]) in southwestern Indiana:

> The fine-textured paleosol, or the sandy loess, or both, retard downward water movement causing a wet zone in the profile. Silica moves down the profile in solution and accumulates with soil water in the wet zone. If this wet zone is within rooting depth of trees, the zone also becomes seasonally dry, causing silica to concentrate and to precipitate. This precipitate binds soil particles together to form the fragipan. Possibly silica coprecipitates with aluminum hydrous oxides on clays to form an aluminosilicate binding agent. (p. 103)

In addition to reviving silica as a potential bonding agent, Harlan et al. emphasize the influence of trees in fragipan genesis. They found that in thick loess where the "wet zone" is below the rooting depth of trees

(and as a result does not undergo the seasonal drying necessary for precipitation of silica) fragipans are not present.

To investigate the chemical and mineralogical properties of of the Cincinnati catena (Cincinnati, Typic Fragiudalf; Rossmoyne, Aquic Fragiudalf; Avonburg, Aeric Fragiaqualf; and Clermont, Typic Ochraqualf) in southern Indiana, Steinhardt and Franzmeier (1979 p. 1013) performed Citrate-bicarbonate-dithionite (CBD) extractions (of SiO_2, Fe_2O_3, Al_2O_3, and MnO_2) and vacuum extractions. The results of the vacuum extraction suggested that Fe and Al were not critical bonding agents in the fragipan because the fragipan matrix was unaffected by their extraction. While Steinhardt and Franzmeier acknowledged that clay may be a significant component of the fragipan, they determined that it was probably not the critical binding agent. Instead, their data pointed to silica as the critical binding agent, with clay acting as an "important auxiliary" in the fragipan matrix.

Hallmark and Smeck (1979, p. 145-147) performed pyrophosphate, oxalate, and HCl-acetylacetone extractions for Al, Fe, and Si on five soils with fragipans (Aeric Fragiaqualfs and an Aeric Fragiudalf) and two similar soils without fragipans (Aeric Ochraqualfs) from northeastern Ohio to evaluate the role of amorphous components in effecting bonding between soil particles of fragipans. Laboratory results provided evidence which suggested that amorphous precipitants would be concentrated at contact points between soil particles which, upon dessication and further polymerization, resulted in bonding between these particles which imparts strength to the fragipan and is probably the source of fragipan brittleness. Hallmark and Smeck qualify their findings with the following:

> Although bonding between particles in the fragipan of soils in northeastern Ohio is due to an amorphous phase, it remains unclear whether all fragipans, especially those in other geographical areas, exhibit this phenomena. Further research in soils with fragipans of other regions may show that all fragipans contain an amorphous phase which imparts strength and is responsible for the brittle character of these horizons. (p. 150)

With this statement, Hallmark and Smeck acknowledge an obvious shortcoming of laboratory analysis of individual soils: such studies are not capable of providing a universal mechanism for explaining fragipan formation without innumerable replication of methods.

Micromorphological analyses of several soils with fragipans from the British Isles by Payton (1980) revealed that:

> Most medium-textured fragipans and indurated layers examined in this study have bridges of fine material between skeleton grains, including clay bridges ranging from meniscus-like features and illuvial bridges several microns across and probably comparable to those originally described by Knox (1957), to domain-like bridges of much smaller dimension similar to those detected by Wang et al. (1974). In any one pan horizon, all forms of bridges...may be present; although a single type is usually predominant, and some areas may lack bridge development. (p. 330)

While Payton clearly refrains from endorsing a particular type, clay bridges are implicated as the primary bonding agents in fragipans

Steinhardt et al. (1982, p. 656) performed sodium-CBD extractions on two fragipan soils (Cincinnati, Typic Fragiaqualf and Avonburg, Aeric Fragiaqualf) and one non-fragipan soil (Alford, Typic Hapludults) from southern Indiana to evaluate the role of silica in fragipan formation. Their results indicated that Si was a critical part of the fragipan, because the subsurface maximum of Si found in the fragipan soils was absent in the non-fragipan soil tested. While this study was limited to small-scale laboratory testing, it continued the resurgence of silica as a potential explanation for fragipan formation.

Norton et al. (1983) studied the micromorphology of Hosmer silt loam (Typic Fragiudults, assumed to be from southern Indiana or Illinois) using Optical Transmission Microscopy (OTM) and SEM analyses. Their results indicated that:

> ...small features forming bridges between silt grains could be seen in the fragipan...These features always contained a large Si peak with smaller peaks for Al, K, and Fe...The high Si content of the bridges was a characteristic feature; however the Al content was somewhat variable. The variability may be due to differing amounts of exchangeable Al associated with clay, or to Al-interlayering of clay minerals; however...both Si and Al probably occur in the structure of a poorly crystallized hydrous oxide occurring in the bridges. It is possible that these bridges are the source of brittleness in the fragipan. (p. 63)

The primary intent of the Norton et al. study was to evaluate the usefulness of the coupled use of OTM and SEM analyses, not fragipan genesis *per se*. Regardless of their motives, their results continued the resurgence of the "silica bonding" theory of fragipan genesis.

In their continuing study of a fragipan soil (Arago Series, Typic Fragiorthods) formed in glacial till of the Appalachian Highlands of Quebec, De Kimpe et al. (1983) revisited the potential role of silica and sesquioxides in fragipan formation. Prompted by a modification to CBD extraction methods (noted above) and the report of Steinhardt et al. (1982), De Kimpe et al. performed their own CBD extraction and found that:

> In the Arago profile, there is no evidence that a highly siliceous material is the major factor causing induration in the fragipan. Contrary to what was reported in loess-derived soils (Steinhardt, 1982), there is no significant increase of extractable Si in the fragipan and the silica-to-clay ratio remains constant throughout the profile. The oxide fraction amounts to 3.70% in the fragipan, contains more Fe_2O_3 than SiO_2, and probably contributes to the induration; however, it does not explain the slaking in water. High clay content and formation of clay bridges (Wang et al., 1974) remain other possible factors for the brittleness and slaking of the northern Appalachian fragipans. (p. 840)

While the findings of De Kimpe et al. appears to remove silica from consideration as *the* bonding agent, they do not offer any definitive alternative either; the mystery seems to persist.

Norton et al. (1984, p. 1365), continuing their investigation into the role of silica bonding in fragipans, added solutions containing Fe, Al, and Si to nonfragipan loess from east-central Ohio. Their results demonstrated that the adding of Si or Al compounds to acid nonfragipan loessial material could increase rupture strength. Their study also included sodium-CBD extractions performed on Hosmer silt loam (Typic Fragiudalfs), from which they concluded that hydrous aluminosilicate appears to form bridges at the contact points of skeletal grains in the presence of varying amounts of clay.

Karathanasis (1987) concluded that:

> Thermodynamic relationships between extracted amorphous soil constituents, crystalline soil minerals, and compositions of contacting solutions support the hypothesis of a highly siliceous amorphous aluminosilicate binding agent in those fragipan horizons of western Kentucky that have solutions undersaturated with amorphous SiO_2. (p. 824)

In their review of fragipans in the northeastern United States, Lindbo and Venemen (1989), put

their search for an explanation for fragipan formation into perspective:

> Even after 40 years of fragipan research, the exact mode of its formation is still unclear. It may be possible that several different processes produce a similar end product, the fragipan. Understanding the genesis of fragipans is critical to an understanding of its inherent properties and to the development of appropriate diagnostic taxonomic criteria. (p. 26)

Lindbo and Veneman endorse the notion that "several processes" may be responsible for fragipan formation by noting that illuviated clay may be responsible for the brittleness of glaciated fragipans, while silica cementation may be the dominant cause of of brittleness in nonglaciated areas. They also note the influence of desiccation on pan formation, adding the possibility that the polygonal network of some fragipans formed in glacial till could be attributed to desiccation in addition to ice wedging (which has been considered by many to be the "classic" cause).

Smeck et al. (1989) investigated the role of weathering discontinuities in the formation of fragipans in Ohio. Their results conclusively show that fragipans commonly form in close proximity to weathering discontinuities, which are described as follows:

> A weathering discontinuity can form either as a weathering front in a uniform deposit due to decreasing weathering intensity with depth or due to the shallow burial of a preexisting soil by unweathered material. In the former situation, it is speculated that leachates containing acid-weathering products, hydrous oxides of Si and Al, released in the intensely weathered upper solum move down to the weathering front and are precipitated to form the bonding agent in the fragipan. In the other situation, it is speculated that leachates from a relatively unweathered surficial mantle move down into a preexisting soil containing hydrous oxides that are precipitated by components in the leachate. The position of the weathered and unweathered zones are just reversed in the two situations, but the results is the same. (p. 109-110)

Smeck et al.'s findings are very significant in that they allow the possibility of two completely different processes to result in the same end product - the fragipan. This led them to conclude that clay bridging, amorphous bonding, and close-packing may all be involved in the development of well-expressed fragipans, while in less-expressed fragipans the influence of these three mechanisms may "vary considerably." While they lean towards the amorphous phase hypothesis as the most plausible candidate for a "principle" bonding agent, Smeck et al. refrained from implicating a specific agent; rather, they suggested the role of a weathering discontinuity as the source of precipitation of the elusive bonding agent.

While the findings of Bryant (1989, p. 145-146) did not downplay the significance of chemical bonding in fragipan development, his results emphasized the importance of close-packing and frequency of grain-to-grain contacts in the soil matrix to facilitate fragipan development. Bryant proposed a process, which he called "physical ripening," that is responsible for the development of physical characteristics of the soil matrix conducive to fragipan formation. This physical ripening process entails the initial dessication of a wet soil mass (necessary to produce the high bulk density, close-packing of soil grains, and coarse prismatic structure associated with fragipans), followed by subsequent wetting and drying cycles, which allow for little alteration of soil structure and skeletal grain arrangements of these subsurface horizons. Physical ripening can occur following drainage of a water deposited sediment, deposition of a melt-out till deposit, congeliturbation, soliflucation, wet-mass colluviation, and melting of a permafrost. Bryant suggested that the fragipans formed in loess deposits in the lower Mississippi Valley can be attributed to self-weight collapse of a wetted sediment and subsequent physical ripening.

While it is important to note that Bryant does not suggest that physical ripening eliminates the need for chemical bonding in fragipans, he considers the physical ripening process to be a more significant factor as applied to soil classification (discussed in Section VII).

Karathanasis (1989) studied the solution chemistry of fragipans in Kentucky. Despite the volume of laboratory-oriented studies on fragipans, none had concentrated on describing them thermodynamically. Karathanasis asserted that since fragipans are some of the "least-changing" soil horizons over time, the development of thermodynamic relationships describing solution-mineral interactions in fragipan and overlying nonfragipan horizons should be useful in the identification of mineral weathering trends typifying a fragipan pedogenic environment. Karathanasis' results support the hypothesis of Si acting as the bonding agent; he found that:

> Thermodynamic relationships between extracted amorphous soil constituents, crystalline soil minerals and composition of interstitial solutions suggested that the binding agent in fragipans may be a highly siliceous amorphous aluminosilicate material...This unified hypothesis can explain cementation in all fragipans. (p. 137)

The findings of Franzmeier et al. (1989), in their study of fragipan soils of the midwestern United States, concurred with the opinion of Karathanasis indicating that the silica bonding hypotheses has come full circle:

> These (recent) studies all suggest that silica plays a key role in the formation of fragipans, as Winters suggested 45 years earlier. Now, however, more data and observations are available to substantiate this theory. (p. 89)

Franzmeier et al. describe the silica bonding in fragipan genesis as follows:

> In the process of fragipan formation, silicate minerals weather in upper horizons and release their weathering products to the soil solution. In the winter and early spring, Si-rich solutions leach downward and become perched over the less permeable material. During the summer, trees remove water preferentially to the silicic acid in solution, and the remaining solution is concentrated in the small pores. As water is removed from these pores, silica precipitates and forms bonds with M-O groups, where O is oxygen and M may be Al, Fe, Mg or Si, on the surfaces of particles around these pores. This bond can bridge between mineral grains. The first bonding is molecular in scale, but with time it can grow large enough to be seen with a scanning electron microscope or even with a light microscope. This bridging is responsible for the hardness and brittleness of the fragipan. (p. 69)

The essential role of trees in this formation process, is cited as a possible explanation for why fragipans do not usually occur in soils developed primarily under prairie vegetation. This relationship will be explored further in Section IX below.

In addition to returning the silica bonding theory as the leading candidate for explaining fragipan genesis, Franzmeier et al. (1989) also noted the significance of time and interpretation of fragipan features in their review of fragipan literature:

> The concepts of how fragipans formed and how they are defined both changed with time. Moreover, these concepts are interrelated. One decides if a certain horizon is a fragipan partly based on his or her ideas about how the soil formed, and, conversely, one must have in mind what a fragipan is before he or she attempts to explain how it formed. (p. 71)

Franzmeier et al.'s point is well taken: in the course of reviewing 50-plus years of research on fragipan genesis there is no way of determining whether each individuals' view of fragipans is compatible with the view of others across both space and time. In their study of fragipans in Belgium, Lozet and Herbillon (1971) performed a "synoptic review" of fragipan literature, categorizing research into the various "schools of thought" on the origin of physical characteristics, nature of cementing agents, and clay mineralogy of

fragipans. The following is intended as an update to their review, summarizing the literature described above. This review, however, will emphasize the regional distribution of the various "genesis theories."

The "evolution" of fragipan genesis theories in the eastern United States over the years is succinctly summarized by Table 1. After the early years, a paradigm shift away from "silica as bonding agent" ushered in a time of uncertainty over fragipan genesis. In the 1960's, a theory simply referred to here as "close-packing" gained adherents. This period was followed by a return to silica and, more generally, "amorphous materials," as most likely bonding agents. Recently, a consensus that "synergistic" roles for several bonding agents (silica and amorphous materials being prominent components) seems to have been established. All theories aside, the most striking feature displayed in Table 1 is the relatively limited number of fragipan soil series studied. While several works are listed as studying "many" soil series, most of these studies are regionally based and do not include detailed analysis of particular soil series' characteristics. As a result, the "great genesis debate" appears to have considered only a relatively small number of fragipan soils.

Figure 1 shows the specific geographical regions these fragipan genesis studies examined.[4] The areal pattern of the "genesis theories" demonstrates the preponderance of silica and amorphous bonding agents noted in the loessial regions adjacent to the Ohio and Mississippi Rivers, while "clay" is confined to the glacial till areas of New York. "Close-packing" does not seem to follow any geographical pattern, which seems logical since "brittleness" and "compaction" seem to be the only truly universal characteristics of fragipans.

Table 2 relates parent materials of the soils studied to the several genesis theories. The. dominance of amorphous materials and silica as bonding agents for loessial soils, as shown in Figure 1, is again apparent. While these loessial fragipan soils account for approximately 30% of all fragipan soils surveyed (details below in Section IX), they are the object of study for 11 of the 20 works displayed here.

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[4] All maps in this study were generated using MapMaker 4.0, a software program designed for use on Apple Macintosh computers.

Table 1. Synoptic Review of Fragipan Genesis Research in the Eastern United States

Author(s)	Year	Principal Formation Process	Map Category	Location of Study	Soil(s) Studied	Primary Parent Material
Marbut	1935	silica	silica	Washington D. C.	Leonardtown	acid silt (marine sediment)
Krusekopf	1942	silica	silica	southern Missouri	Lebanon	loess(1)
Winters	1942	silica	silica	western Tennessee	many	mostly loess
Nikiforoff et al.	1948	close-packing	close-packing	central Maryland	Leonardtown	marine sediment
Grossman and Cline	1957	clay	clay	central New York	many	glacial till
Knox	1957	illite	clay	southeastern New York	Albia, Rockaway, Wurtsboro	glacial till
Anderson and White	1958	iron oxide	amorphous	southern Indiana	Hosmer	loess
Grossman et al.	1959	sesquioxides	amorphous	southern Illinois	Hosmer	loess
Yassoglou & Whiteside	1960	close-packing	close-packing	northcentral Michigan	McBride	glacial till
Jha and Cline	1963	close-packing/orient. of clay	close-packing	western New York	Williamson	glacial till
Hutcheson & Bailey	1964	"brick and mortar"	close-packing	western Kentucky	Bedford, Mercer, Tilsit(2)	mostly weathered bedrock(3)
Ray	1967	alternate wetting and drying	close-packing	western Kentucky	Grenada, Calloway, Loring, Henry	loess
Nettleton et al.	1968	amorphous materials	amorphous	eastern North Carolina	not identified	marine sediment
Grossman & Carlisle	1969	silicate clay	N/A	eastern United States	many	many
Harlan et al.	1977	aluminosilicate	amorphous	southwestern Indiana	Cinncinati, Tilsit	loess
Hallmark & Smeck	1979	amorphous phase	amorphous	northeastern Ohio	not identified	glacial till
Steinhardt & Franzmeier	1979	silica	silica	southern Indiana	Rossmoyne, Avonburg, Clermont	loess or loess over till
Norton et al.	1983	silica	silica	east-central Ohio	Hosmer	loess
Norton et al.	1984	aluminosilicate bridging	amorphous	east-central Ohio	Hosmer	loess
Karathanasis	1987	amorphous aluminosilcate	amorphous	western Kentucky	Grenada, Loring, Calloway, Sadler	loess or loess over bedrock
Bryant	1989	physical ripening	close-packing	eastern United States	many	many
Franzmeier et al.	1989	silica	N/A	midwestern U.S.	many	many
Karathanasis	1989	silica	silica	west/central Kentucky	many	loess or loess over bedrock
Lindbo & Veneman	1989	multiple causes	N/A	northeastern U.S.	many	mostly glacial till
Smeck et al.	1989	hydrous oxides of Si and Al	amorphous	Ohio	many	many

(1) While Krusekopf describes parent materials in the study area as "weathered chert," current interpretations for the Lebanon Series identify its parent material as loess.

(2) Categorizing the parent material of the soils in this study as "weathered bedrock" is questionable given interpretations for these series in recent soil surveys (mostly loess).

(3) These soils were most likely formed in colluvial material rather than weathered bedrock.

Figure 1. Areal Distribution of Fragipan "Genesis Theories"

Table 2. Fragipan Genesis Theories: Bonding Agents Compared to Parent Materials

Principle Formation Process	Glacial Till	Loess	Marine Sediment	Weathered Bedrock	Totals
Silica		5	1		6
Close-Packing	2	1	1	1	5
Clay	2				2
Amorphous Materials	1	5	1		7
Totals:	5	11	3	1	20

The disproportionately large number of studies on loessial fragipans may be attributed to their status as the "classical" fragipan. On the other hand, soils formed in colluvial and alluvial sediments account for at least 20% of all fragipan soils and yet none of these soils are represented by these genesis studies.

It is clear that continued research is necessary to further define fragipan genesis. The recent shift away from declaring a single, universal fragipan bonding agent appears to be well under way. Utilizing the geographical perspective, it may be possible to bridge some of the differences that were unwittingly created by insensitivity to areal patterns. The following sections address problems associated with mapping fragipans, complexities arising from re-classification, and attempts at areally displaying detailed maps of fragipan soils and their characteristics. This information is presented in the spirit of availing the insights of the geographical perspective to ongoing fragipan research.

VII. PROBLEMS WITH MAPPING FRAGIPAN SOILS

The study by Grossman and Carlisle (1969, p. 244) contained a map of fragipan soils of the eastern United States. While this map was a good first attempt at displaying the areal distribution of fragipans, it was a highly generalized shaded area map that did not attempt to delineate areas of high or low fragipan concentration. The map was simply a generalization of the Soil Conservation Service's (SCS) "General Soils Map of the United States," (contained in *The National Atlas of the United States of America*, 1968, p. 86) with very little modification. The findings of Gersmehl (1977, p. 421) question the accuracy of that SCS map at the soil order level, and yet Grossman and Carlisle used it as a data base to map a characteristic at the great group level. The limited accuracy and detail of both Grossman and Carlisle's map and the National Atlas map does not lie with their compilers; instead, as Gersmehl points out, the maps had to be drawn ". . . before the data base gave the cartographer a fighting chance to be accurate." Figure 2 presents the level of completion of county soil surveys in the eastern United States as of 1966, while Figure 3 shows counties surveyed between 1967-1991 (as derived from the "List of Published Soil Surveys 1990," SCS, revised February 1991). Comparison of these maps shows how greatly improved the data base for mapping a great group level characteristic is today. Even with improved survey coverage, a surprising number of eastern U.S. counties, primarily those areas where the land has limited agricultural value (such as the far north, Appalachia, and southern wetland areas), have yet to be surveyed at the county level, as shown in Figure 4. Figure 5 combines the areas depicted in Figures 2 and 4 to demonstrate that "modern" county-level soil survey coverage of the eastern United States still leaves much to be desired. It is clearly apparent that, despite improvements in county survey coverage in the two decades since the Grossman and Carlisle map was published, significant cartographic problems associated with mapping fragipans at this scale remain.

The study area displayed in Figures 2 through 5, as defined by the occurrence of fragipan soils, is comprised of all of the states east of the Mississippi River, states adjacent to the Mississippi's "west bank" (Minnesota, Iowa, Missouri, Arkansas, and Louisiana), and the extreme eastern portions of Texas,

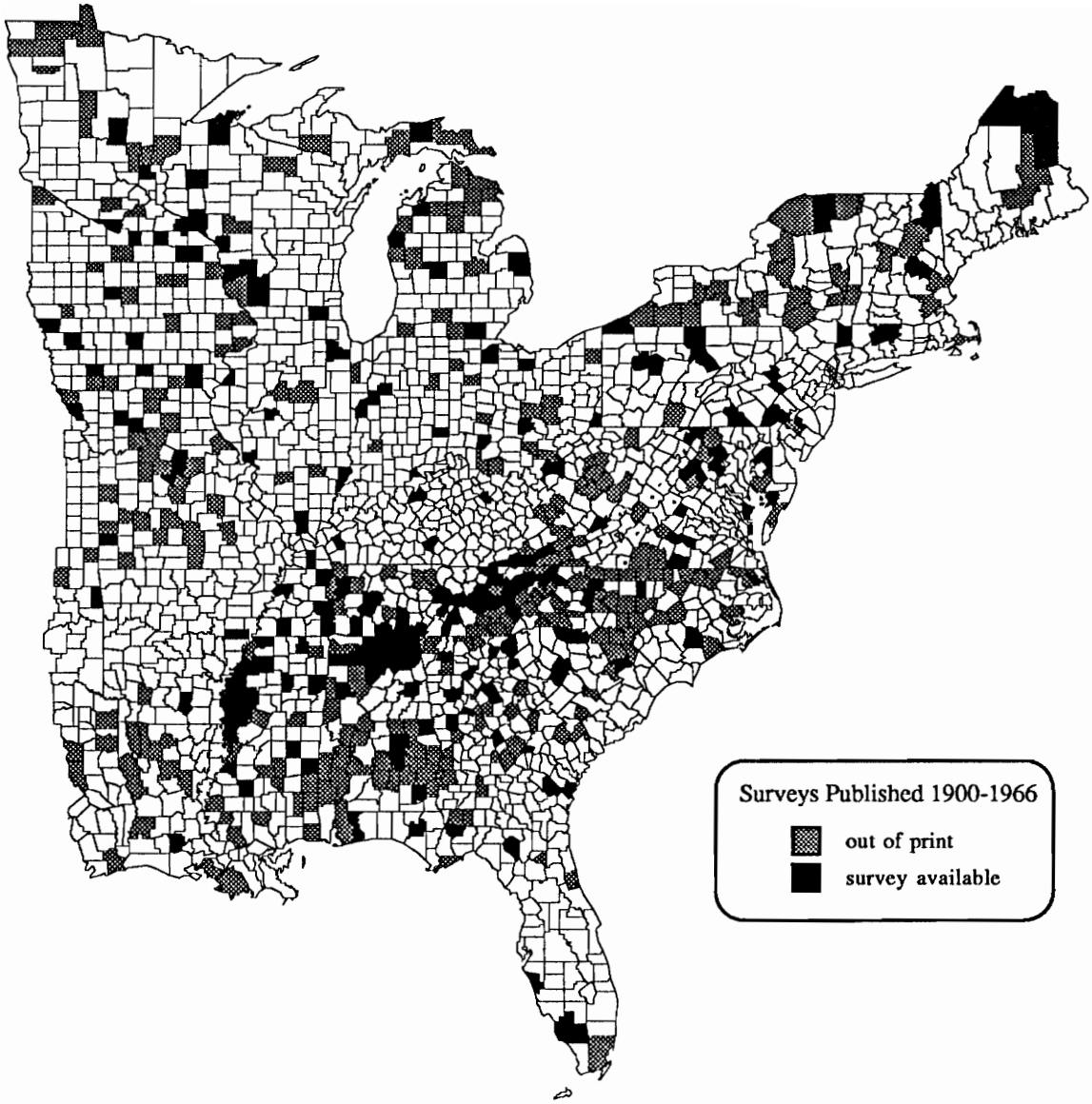

Figure 2. County Soil Surveys Published Between 1900-1966

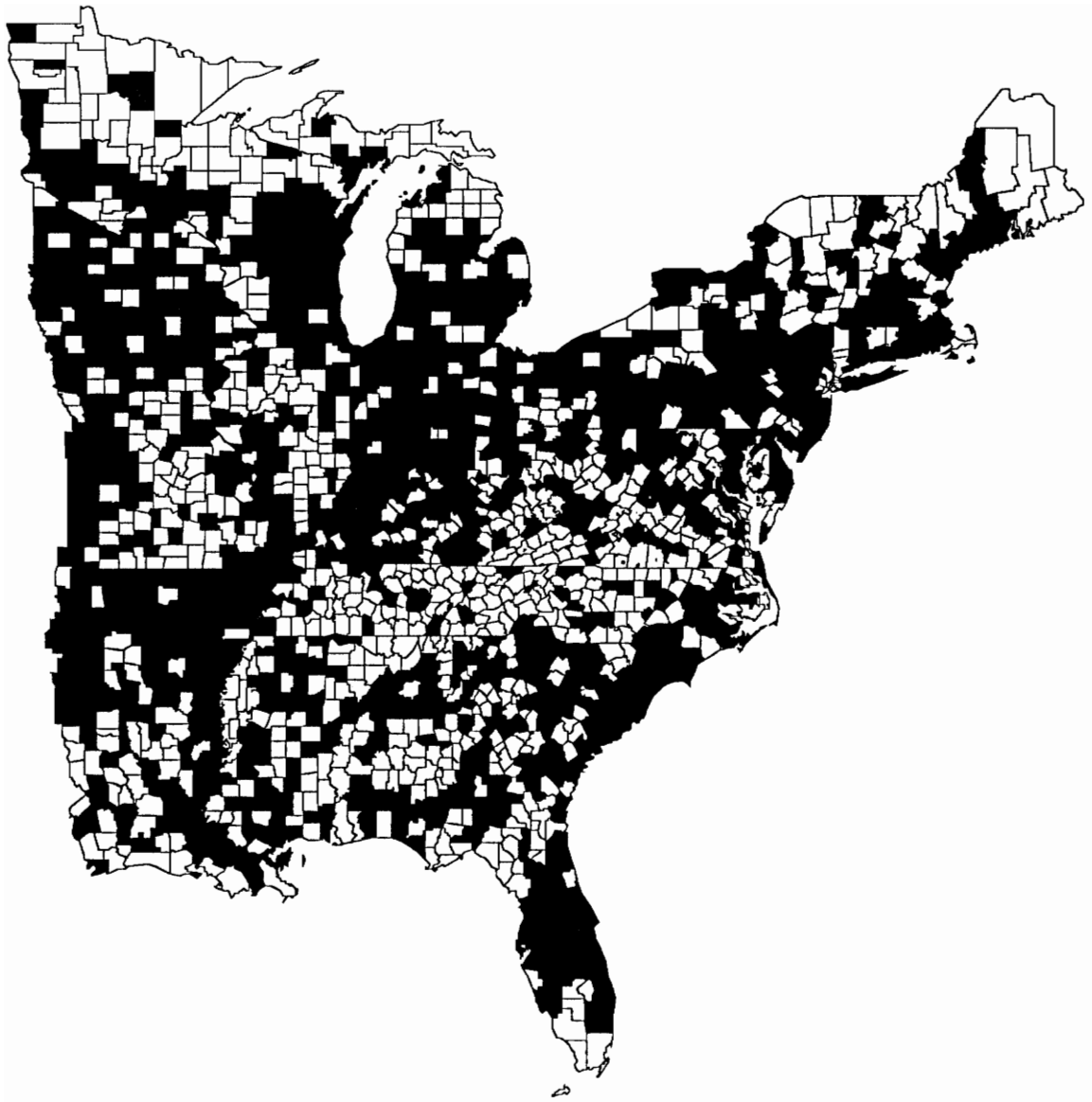

Figure 3. County Soil Surveys Published Between 1967-1991

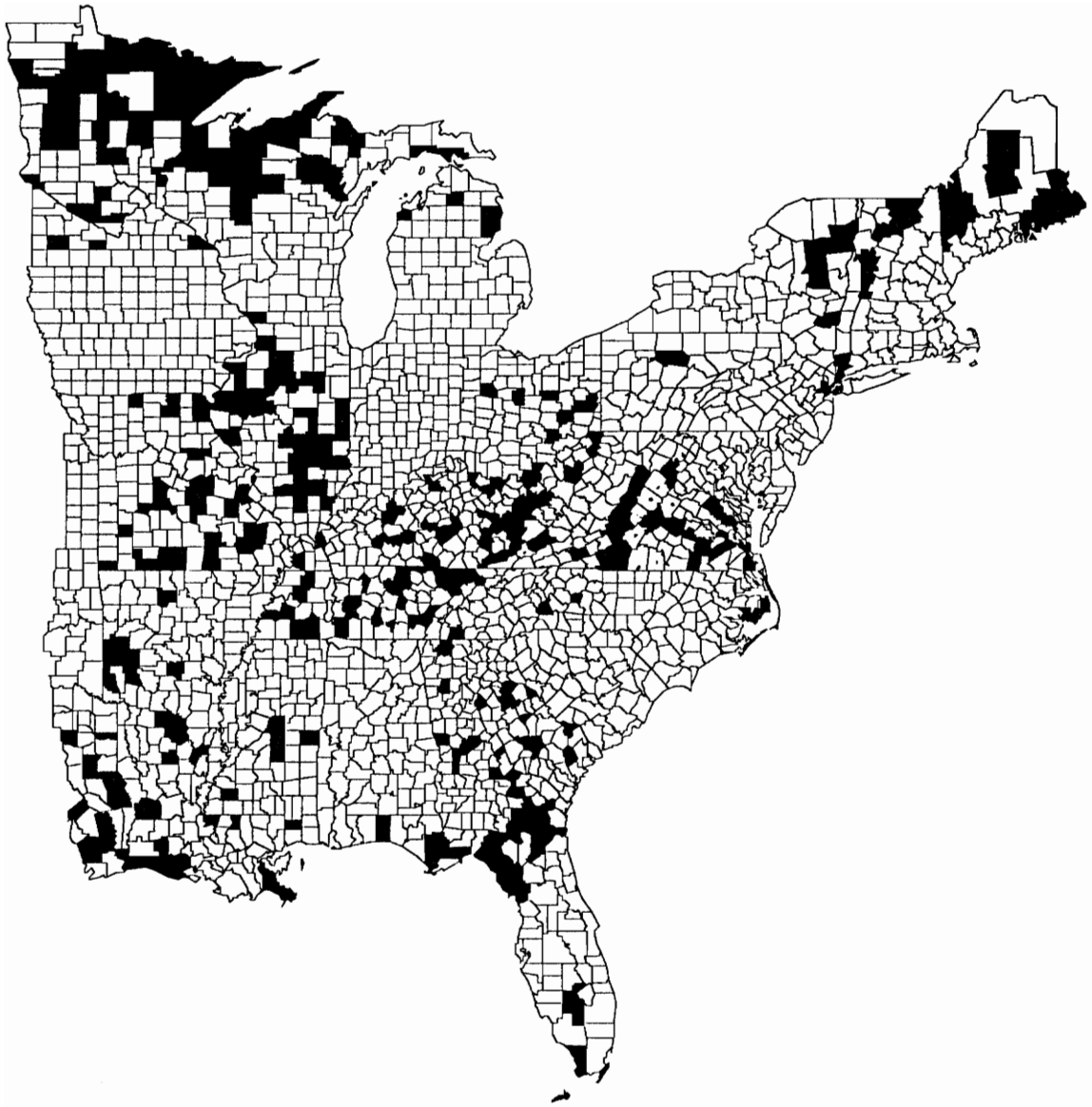

Figure 4. Areas Never Surveyed at County-Level

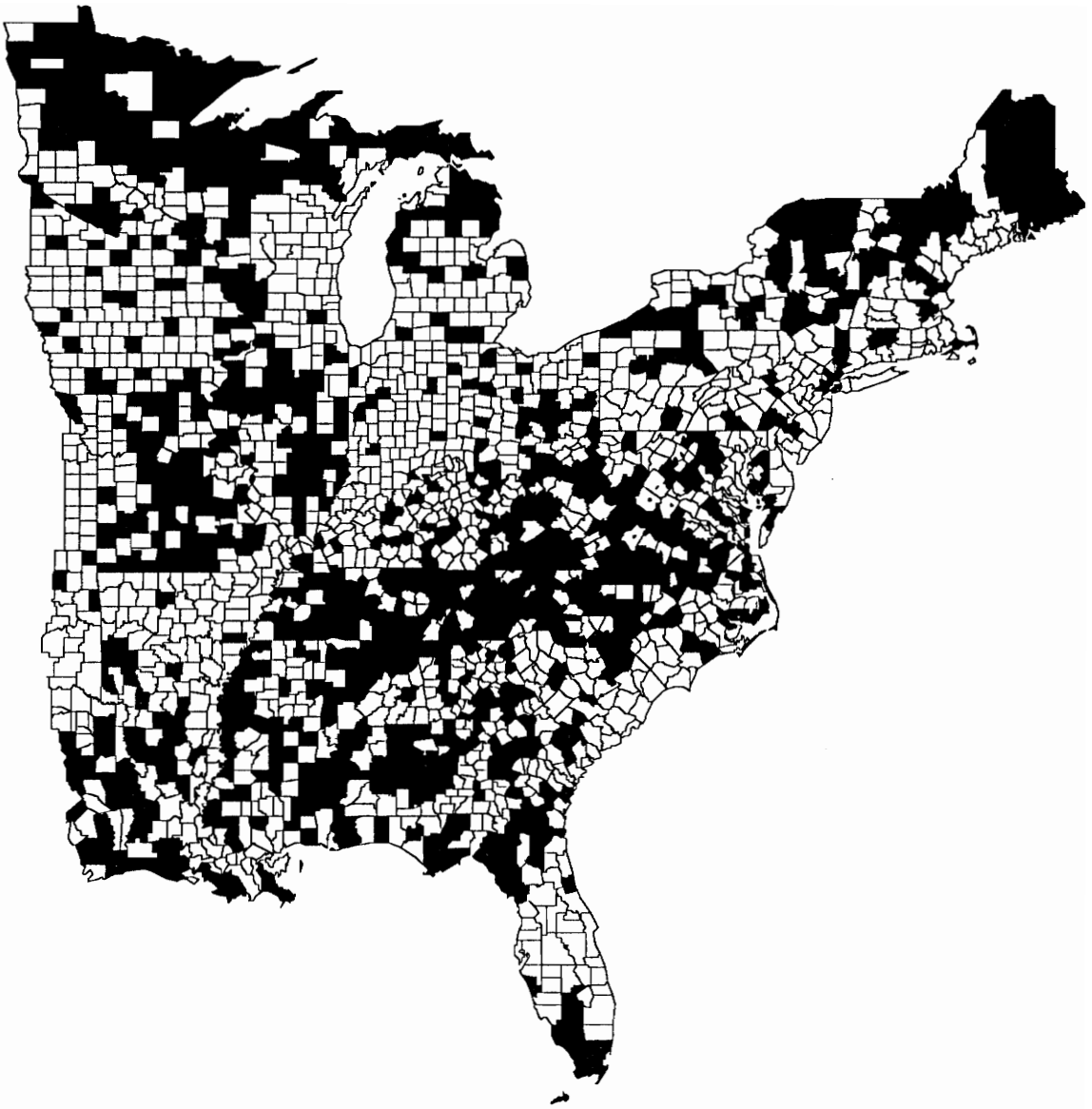

Figure 5. Areas Lacking Modern County-Level Surveys (post-1966)

Oklahoma, and Kansas (fragipan soils are also located in the northwestern states of Washington, Oregon, and Idaho, as described in Section VIII below). This eastern U.S. study area encompasses 2120 counties out of which 1257 have "modern" surveys (those published after 1966), 503 have surveys published between 1902 and 1966 (of which 205 are out of print), and 360 have never been surveyed at the county level.

Fragipan soils data was collected through review of "modern" SCS county soil surveys.[5]. Review of all modern surveys (as derived from the "List of Published Soil Surveys 1990," SCS, revised February 1991[6]) available in various government repositories (University of Minnesota, Minneapolis; Virginia Tech; University of Georgia at Athens) resulted in establishing a county-based[7] data set of fragipan soil series information. In addition to collecting information regarding the areal extent of fragipan soil series in each county where they occur, several other soil characteristics were also cataloged. Table 3 describes the contents of the data base.[8] A summary printout of the Fragipan Soils Data Base is included as Appendix A. Among the information collected, soil classification, family, and parent material type are particularly significant in the context of this study (as discussed in Section IX below).

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[5] Most surveys published after 1966 utilize the *Soil Taxonomy* classification scheme which recognizes fragipans at the Great Group level. As a result, this was determined to be an appropriate date to define a "modern" survey. In fact, only one exception was noted while reviewing surveys which included fragipan soils: Queen Anne County, Maryland, which was published in 1966, but utilized *Soil Taxonomy's* classification scheme.

[6] The data base also includes the following surveys published after the SCS list of surveys went to print: Huntington and Warren, Indiana; Traverse, Minnesota; Dallas and Iron, Missouri; Rockland, New York; Bertie, North Carolina; Noble, Ohio; and Juneau, Wisconsin. Overall, the data base can be considered current, based on what was available on the shelf in the Virginia Tech repository, through June 4, 1991.

[7] Many soil surveys encompass two and sometimes three counties. Due to the size of the data base and the area covered by this study, fragipan acreage for these areas were simply divided in half (or thirds) to represent acreages for individual counties (since map units are counties).

[8] Created in FileMaker II a software package by Claris for use on Apple Macintosh computers.

Table 3. Fragipan Soils Data Base Contents

(EXAMPLE)

SURVEY NAME	KANAWAH	
STATE	WV	
SURVEY PUBLISHED	1981	*these dates are extracted from the "about this survey" section of each survey*
SURVEY FIELDWORK	1975	
SURVEY CONDITIONS	1976	
SURVEY APPROVAL	1976	
SURVEY AREA [sq. mi.]	908	
SURVEY AREA [acres]	581120	
SERIES NAME	LAIDIG	*a record is established for each soil series identified*
TAXONOMY	TYPIC FRAGIUDULTS	*taken from the "series classification" table in each survey*
SUBGROUP	TYPIC	*broken down by classification components to simplify data base searches*
SUBORDER	UDIC	
ORDER	ULTISOLS	
% OF SURVEY	1.6	*as extracted from the "areal extent of soils" table in each survey "% of survey" multiplied by "survey area [acres]"*
SERIES ACREAGE	9297.92	
PARTICLE SIZE CLASS	FINE-LOAMY	*taken from the "series classification" table in each survey*
MINERALOGY CLASS	MIXED	
SOIL TEMP. CLASS	MESIC	
PARENT MATERIAL	COLLUVIUM DERIVED FROM SANDSTONE, SILTSTONE, AND SHALE	*parent material description taken verbatim from series description in each survey*
P.M. CLASS	COLLUVIUM	*parent material description interpreted into discrete classes*
PHYSIOGRAPHY	MAJOR STREAM TERRACES, HEADS OF DRAINAGEWAYS, AND BASES OF STEEP SLOPES	*topographical description taken verbatim from series description in each survey*
PHYS. CLASS	TERRACES - FOOT SLOPES	*physiographic description interpreted into discrete classes*
DRAINAGE: SOIL	4	*drainage "class" taken from series description in each survey: 1=very poor, 2=poor, 3=somewhat poor, 4=moderately well, 5=well, 6=somewhat excessive, 7=excessive*
PERM: SOIL	n/a	*permeability "class" taken from series description in each survey: 1=very slow, 2=poor 3=moderately slow, 4=moderate, 5=moderately rapid, 6=rapid, 7=very rapid*
PERM: UPPER	4	*permeability "classes" taken from series description for soils which differentiate between "upper" and "lower" soil permeability*
PERM: LOWER	2	
DEPTH: UPPER RANGE	32	*depth to fragipan range as taken from soil series descriptions*
DEPTH: LOWER RANGE	50	
DEPTH: AVERAGE	41	*average of upper and lower ranges*
DEPTH TO FRAG T.P.	45	*specific depth to top of fragipan, end of fragipan, and width of fragipan as extracted from soil series "Typical Pedon" description*
END OF FRAG T.P.	82	
WIDTH OF T.P. FRAG	37	
END OF SOLUM T.P.	82	*depth to end of solum given by typical pedon*
TRUE FRAG?	YES	*"yes" indicates that series is currently recognized as fragipan - "no" identifies series previously considered to have fragipans which have been reclassifed*

VIII. AREAL DISTRIBUTION OF FRAGIPANS

The Pacific Northwest includes a small percentage of fragipan soils as shown by Table 4, which displays all of the modern surveys with fragipan soils in this area. Wide-spread deposits of homogeneous, fine-textured alluvial and loessial sediments have resulted in somewhat substantial concentrations (nearly 20% of some counties) of fragipan soils in a few areas of the northwest as displayed in Figure 6.[9] While modern survey coverage in this region is relatively poor, the portions of the region likely to contain fragipans (i.e., humid/forested areas with relatively fine soil texture) are fairly well mapped. Of the areas in the northwest currently lacking modern surveys, only the areas adjacent to Benewah and Latah Counties, Idaho are likely to contain a significant percentage of fragipan soils. The Helmer and Santa series found in Benewah and Latah Counties are most interesting since they receive less than 28 inches of precipitation per year - less than any other fragipan series known to occur [the Santa series is the only fragipan series encountered in modern surveys in the "Xeric" (dry summer) suborder]. The arid (Aridisols), droughty, (Ustic suborder), and Mediterranean (Xeric suborder) climates of the west are apparently responsible for the overall lack of fragipans in the western United States. From this relationship, water movement through the soil (or landscape processes associated with humid regions) at least some time through the year must be a prerequisite to fragipan formation.

Figure 7 shows the areal distribution of fragipan soils in the eastern United States for counties with modern (post-1966) soil surveys. The gray shading shows the counties which lack modern surveys (as shown in Figure 5). Despite major gaps in survey coverage, major concentrations of fragipan soils in New

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[9] The limitations of MapMaker 4.0 software for generating dot maps are revealed by Figure 6. Unlike hand-drafted dot maps, maps generated in MapMaker do not allow the compiler to specify where dot values should be placed within the specified areal units. For instance, the western half of a county adjacent to the east bank of a major river may be comprised almost entirely of alluvium, while the eastern half may include soils formed exclusively in loess. If the soils formed in loess all contain fragipans, while the alluvial soils do not, the cartographer would scatter dots representing the entire counties fragipan percentage in the eastern half of the county. While MapMaker does not allow this selective dot placement within individual counties, the maps of the eastern United States on the following pages are at such a small scale and include so many areal units (2078 counties) that this shortcoming is virtually insignificant. The advantages of MapMaker, especially its capability to convert massive quantities of data directly from spread sheets or data bases into areal information, far exceed its cartographic limitations.

Table 4. Fragipan Soils of the Northwest

SURVEY NAME: BENEWAH		STATE: ID	AREA [sq. mi.] 642	AREA [acres] 410880	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
HELMER	ANDIC FRAGIOCHREPT	LOESS		12.4	50949.12
SANTA	TYPIC FRAGIOCHREPTS	LOESS		5.8	23831.04
			TOTALS:	18.2	74780.16
SURVEY NAME: LATAH		STATE: ID	AREA [sq. mi.] 753	AREA [acres] 481920	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
HELMER	ANDIC FRAGIOCHREPTS	LOESS		3.4	16385.28
SANTA	OCHREPTIC FRAGIXERALFS	LOESS		13.3	64095.36
			TOTALS:	16.7	80480.64
SURVEY NAME: CLACKAMAS		STATE: OR	AREA [sq. mi.] 1003	AREA [acres] 641920	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
CASCADE	TYPIC FRAGIUMBREPTS	LOESS		2.5	16048
CORNELIUS	MOLLIC FRAGIXERALFS	LOESS		0.6	3851.52
DELENA	HUMIC FRAGIAQUEPTS	ALLUVIUM		0.5	3209.6
HUBERLY	TYPIC FRAGIAQUEPTS	GLACIAL TILL		0.3	1925.76
KINTON	TYPIC FRAGIOCHREPTS	GLACIAL TILL		0.4	2567.68
POWELL	TYPIC FRAGIOCHREPTS	ALLUVIUM		1.0	6419.2
			TOTALS:	5.3	34021.76
SURVEY NAME: COLUMBIA		STATE: OR	AREA [sq. mi.] 651	AREA [acres] 416640	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
CASCADE	TYPIC FRAGIUMBREPTS	LOESS		0.6	2499.84
CORNELIUS	MOLLIC FRAGIXERALFS	LOESS		1.4	5832.96
DELENA	HUMIC FRAGIAQUEPTS	LOESS		0.3	1249.92
GLOHM	TYPIC FRAGIOCHREPTS	ALLUVIUM		2.4	9999.36
GOBLE	ANDIC FRAGIUMBREPTS	LOESS		12.2	50830.08
			TOTALS:	16.9	70412.16
SURVEY NAME: HOOD RIVER AREA (NE PART)		STATE: OR	AREA [sq. mi.] 185	AREA [acres] 118400	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
WYEAST	AERIC FRAGIAQUEPTS	GLACIAL TILL		1.2	1420.8
			TOTALS:	1.2	1420.8
SURVEY NAME: MULTNOMAH		STATE: OR	AREA [sq. mi.] 423	AREA [acres] 270720	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
CASCADE	TYPIC FRAGIUMBREPTS	LOESS		9.6	25989.12
DELENA	HUMIC FRAGIAQUEPTS	LOESS		0.2	541.44
GOBLE	ANDIC FRAGIUMBREPTS	LOESS		6.6	17867.52
POWELL	TYPIC FRAGIOCHREPTS	ALLUVIUM		2.6	7038.72
			TOTALS:	19.0	51436.8
SURVEY NAME: WASHINGTON		STATE: OR	AREA [sq. mi.] 716	AREA [acres] 458240	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
CASCADE	TYPIC FRAGIUMBREPTS	LOESS		2.5	11456
DELENA	HUMIC FRAGIAQUEPTS	ALLUVIUM		0.4	1832.96
GOBLE	ANDIC FRAGIUMBREPTS	ALLUVIUM		1.8	8248.32
HUBERLY	TYPIC FRAGIAQUEPTS	ALLUVIUM		0.6	2749.44
KINTON	TYPIC FRAGIOCHREPTS	ALLUVIUM		3.6	16496.64
			TOTALS:	8.9	40783.36
SURVEY NAME: CLARK		STATE: WA	AREA [sq. mi.] 630	AREA [acres] 403200	
SERIES NAME	CLASSIFICATION	PARENT MATERIAL		%	ACRES
DOLLAR	TYPIC FRAGIUMBREPTS	ALLUVIUM		2.7	10886.4
POWELL	TYPIC FRAGIOCHREPTS	ALLUVIUM		1.3	5241.6
			TOTALS:	4.0	16128

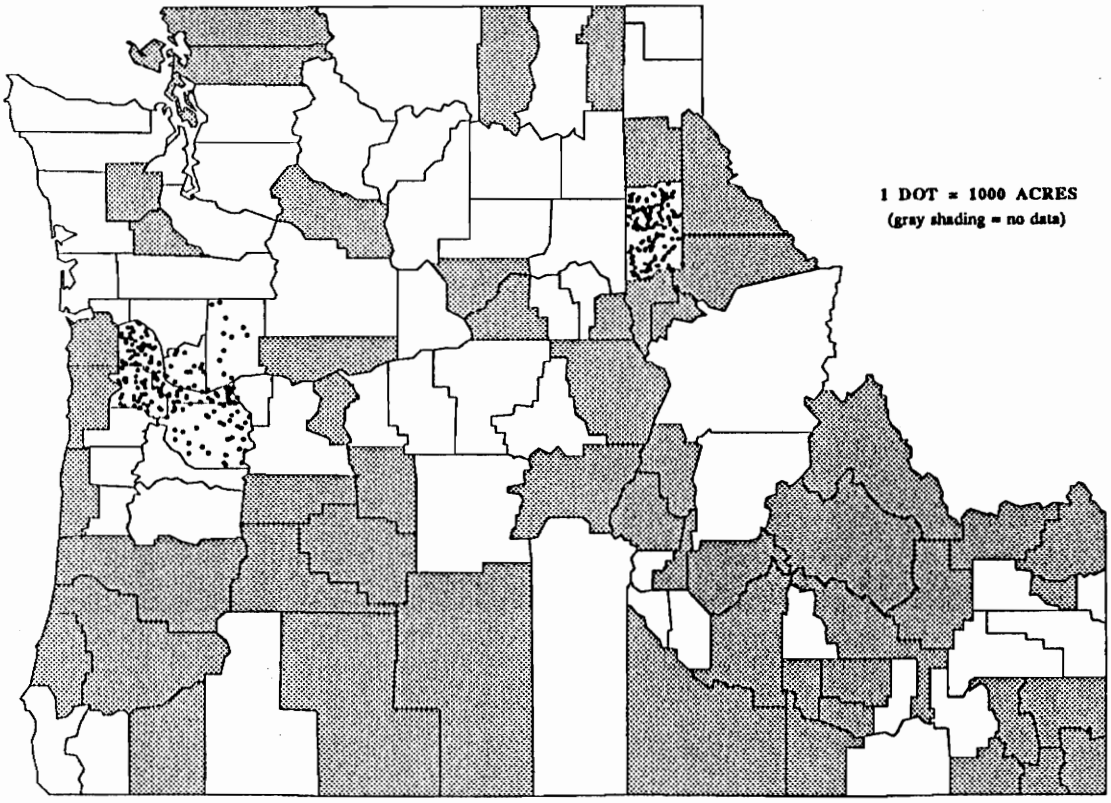

Figure 6. Fragipan Soils of the Northwest

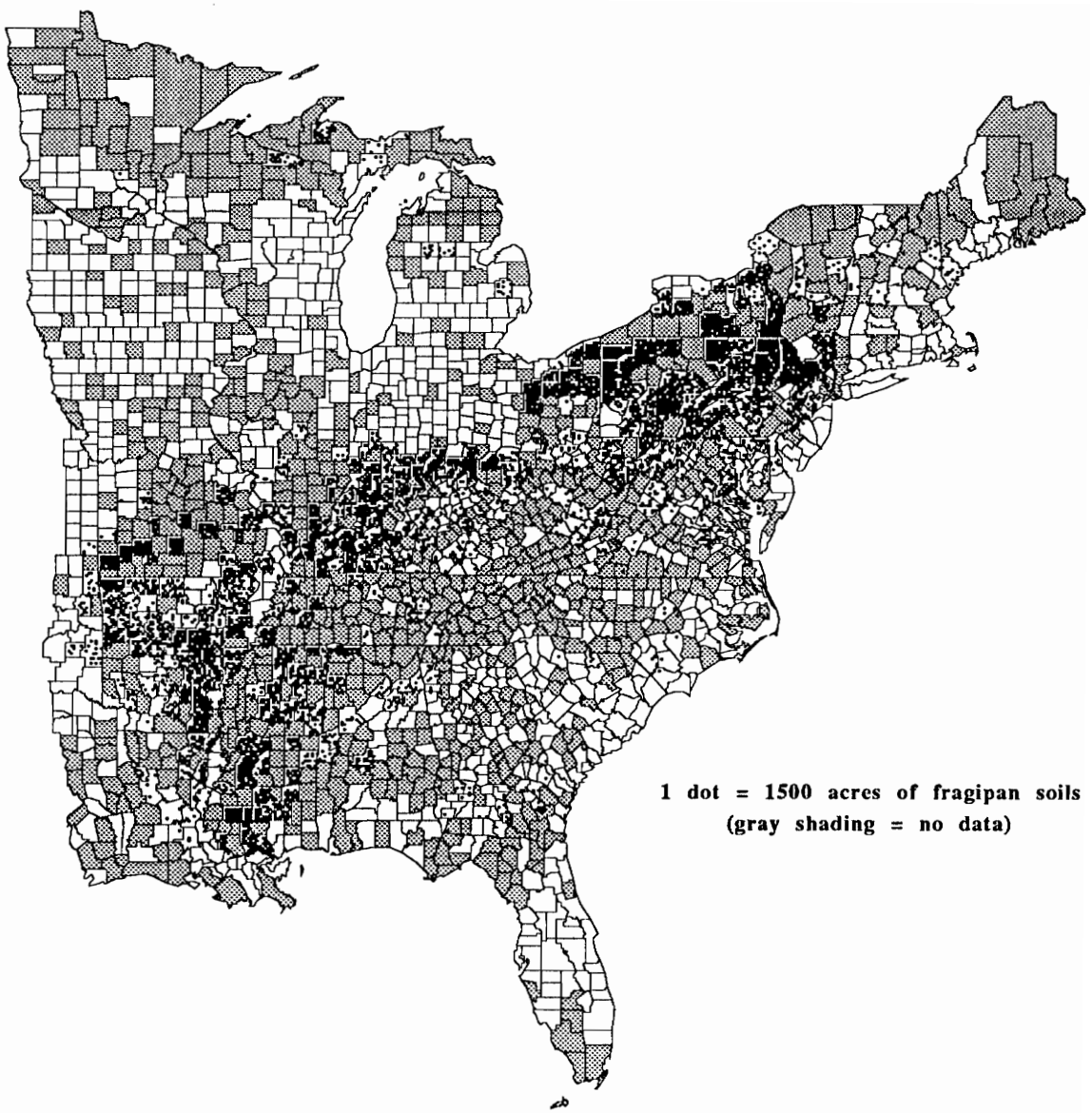

Figure 7. Areal Distribution of Fragipan Soils in the Eastern United States

York, Pennsylvania, and eastern Ohio and along the Mississippi and Ohio Rivers in Kentucky, Indiana, Illinois, Missouri, Arkansas, and Mississippi are clearly apparent. Current gaps in survey coverage, which are likely to result in significant increases in fragipan acreage when surveys are completed, include Tennessee, Mississippi, Kentucky, southern Missouri, eastern Ohio, and portions of New York and Pennsylvania.

Aside from those found in the Pacific Northwest, fragipans are not found west of the 95th parallel. Another factor, strongly related to precipitation, which appears to have a strong effect on fragipan development is vegetation. The "prairie line" as shown in Grossman and Carlisle's (1969) map provides an almost impenetrable boundary to fragipans (though a few fragipan series in Missouri and other areas along the western fringe of the range of fragipans may have formed under prairie vegetation). Fragipan soils form primarily under forest. While the Grand Prairie of central and northern Illinois receives enough precipitation for fragipan formation, no fragipans are found there. Prairie vegetation apparently limits fragipan development, perhaps due to high pH which can effect soil formation processes. Grossman and Carlisle (1969) found that fragipans do not occur in highly calcareous glacial tills (high pH) of New York, but do occur in adjacent areas of non-calcareous till. Likewise, fragipans are generally not found in areas with shallow limestone parent materials such as "Bluegrass" region of Kentucky. High pH may be a direct limiting factor on fragipan formation by effecting cementation processes, or it may act indirectly by creating an environment very conducive to soil micro-organisms like earthworms which can effectively churn up the subsoil, possibly disrupting the formation of a fragipan layer.

Despite limiting factors, over 29 million acres of fragipan soils have been identified in 526 counties possessing post-1966 soil surveys. Another 731 counties surveyed after 1966 in the study area are identified as having no fragipan soils. The remaining 863 counties in the study area do not have modern surveys available. The ten counties (with modern surveys) with the most fragipan soils (by acreage) is shown in Table 5. Not surprisingly, the "top ten" is comprised of five counties in Pennsylvania, four in New York, and one in Ohio. To demonstrate the large area and extensive range covered by individual soil

Table 5. "Top 10" Fragipan Counties in the Eastern United States

	County	State	% of County with Fragipans	Fragipan Acreage
1.	Steuben	NY	49.4	445153
2.	Crawford	PA	65.1	421640
3.	Susquehanna	PA	67.2	359547
4.	Tioga	PA	44.8	328581
5.	Oswego	NY	52.8	327107
6.	Mercer	PA	74.2	323393
7.	Wayne	PA	67.9	323213
8.	Ashtabula	OH	71.3	321706
9.	Chenango	NY	52.9	307412
10.	Broome	NY	66.3	301267

series in the study area, Table 6 lists 15 fragipan soil series which exceed a half-million acres as derived from modern surveys.

A significant factor affecting the areal distribution of fragipan soils unrelated to survey coverage or physical limiting factors is the changing interpretations and classification of fragipan soil series which has occurred in recent years. These recent reclassifications of soils formerly classified as fragipan soils has affected 124 counties (of the 1257 with post-1966 surveys) in the eastern United States. Of these, 61 counties have had all fragipan soil series previously identified reclassified as non-fragipans. At least 73 soil series found in post-1966 soil surveys (as derived from a listing of fragipan series extracted from the "SCS Soil Classification File," personal communications with Harvey Terpstra, Statistical Laboratory, Iowa State University, February, 1989 and January 1991) have been reclassified as non-fragipan soils. Table 7 displays the effects of this re-classification on each state in the study area (the acreage figures given are limited to modern survey areas). Figure 8 graphically displays the effects of this re-classification: glacial till areas of the northeast and the southeastern coastal plain are the most significantly impacted regions in the study area. In the northeast, the brittle and impermeable soil layers have been largely attributed to inherent characteristics of the compact basal till parent material rather than the result of any pedogenic process. While in the case of the coastal plain soils, plinthite and compact marine clay layers have frequently been confused with the existence of "true" fragipans. The resulting 12% reduction in total fragipan acreage of counties with modern surveys reiterates the significance of the impact of these re-classifications on the areal distribution of fragipans.

An alternative to the modern survey data set used in this study to quantify the areal extent of fragipan soils is the Map Unit User File (MUUF) compiled for SCS by Iowa State University. Fragipan acreage estimates by Witty and Knox (1989) utilized this data source. Conversations with Harvey Terpstra, the data base "administrator" for SCS at Iowa State University's Statistical Laboratory, indicate that the MUUF file is comprised of soil survey information compiled by state soil scientists across the United States (information from pre-1967 soil surveys, new surveys which have been completed but are not yet published,

Table 6. "Top 15" Most Extensive Fragipan Soil Series

County	Series Acreage	*Soil Taxonomy* Classification	Range of Occurrence
1. Loring	1,656,534	Typic Fragiudalfs	AR, KY, LA, MO, MS, TN
2. Volusia	1,118,083	Aeric Fragiaquepts	NY, PA
3. Mardin	1,106,718	Typic Fragiochrepts	NY, PA
4. Providence	963,009	Typic Fragiudalfs	AR, LA, MS, TN
5. Grenada	945,433	Glossic Fragiudalfs	AR, KY, LA, MS, TN
6. Zanesville	922,009	Typic Fragiudalfs	IL, IN, KY, OH
7. Savannah	894,947	Typic Fragiudults	AL, AR, LA, MS, VA
8. Ernest	778,295	Aquic Fragiudults	MD, OH, PA, VA, WV
9. Calloway	724,126	Glossaquic Fragiudalfs	AR, KY, LA, MS, TN
10. Leadvale	699,480	Typic Fragiudults	AL, AR, TN
11. Hosmer	692,111	Typic Fragiudalfs	IL, IN, KY
12. Laidig	682,811	Typic Fragiudults	MD, OH, PA, VA, WV
13. Cookport	656,776	Aquic Fragiudults	MD, PA, WV
14. Ora	612,988	Typic Fragiudults	AL, AR, LA, MS
15. Wellsboro	504,988	Typic Fragiochrepts	NY, PA

Table 7. Affects of Recent Reclassification of Fragipan Soils in the Eastern United States

State	Fragipan Counties Effected	Fragipan Counties Eliminated	"As Surveyed" Fragipan Acreage	Fragipan Acreage Eliminated	Fragipan Acreage Remaining	% Reduction due to Re-Classification
Alabama	3	1	534344	99401	434943	19%
Arkansas	1	0	4233936	23078	4210858	1%
Connecticut	6	6	609314	609314	0	100%
Delaware	0	0	9789	0	9789	0%
Florida	0	0	0	0	0	0%
Georgia	19	10	328781	191577	137204	58%
Illinois	11	1	873616	97373	776243	11%
Indiana	2	0	1864143	3070	1861073	<0.5%
Iowa	0	0	0	0	0	0%
Kansas (east)	0	0	10230	0	10230	0%
Kentucky	0	0	2051073	0	2051073	0%
Louisiana	0	0	715930	0	715930	0%
Maine	9	8	954360	930790	23570	98%
Maryland	0	0	460338	0	460338	0%
Massachussetts	6	5	428078	426333	1745	100%
Michigan	1	0	236687	14502	222185	6%
Minnesota	4	3	226112	223310	2802	99%
Mississippi	9	2	2962609	98513	2864096	3%
Missouri	0	0	1984784	0	1984784	0%
New Hampshire	5	4	324108	304985	19123	94%
New Jersey	3	0	439062	21742	417320	5%
New York	4	1	2806156	101248	2704908	4%
North Carolina	1	1	32292	1826	30466	6%
Ohio	2	0	2077829	18718	2059111	1%
Oklahoma (east)	0	0	117651	0	117651	0%
Pennsylvania	7	0	6753995	19398	6734597	<0.5%
Rhode Island	5	5	168600	168600	0	100%
South Carolina	17	13	398533	381262	17271	96%
Tennessee	0	0	638830	0	638830	0%
Texas (east)	0	0	0	0	0	0%
Vermont	4	1	360269	340697	19572	95%
Virginia	5	0	248468	11716	236752	5%
West Virginia	0	0	715563	0	715563	0%
Wisconsin	0	0	54674	0	54674	0%
TOTALS:	124	61	33620154	4087453	29532701	12%

(Data collected from SCS soil surveys published 1967-1989)

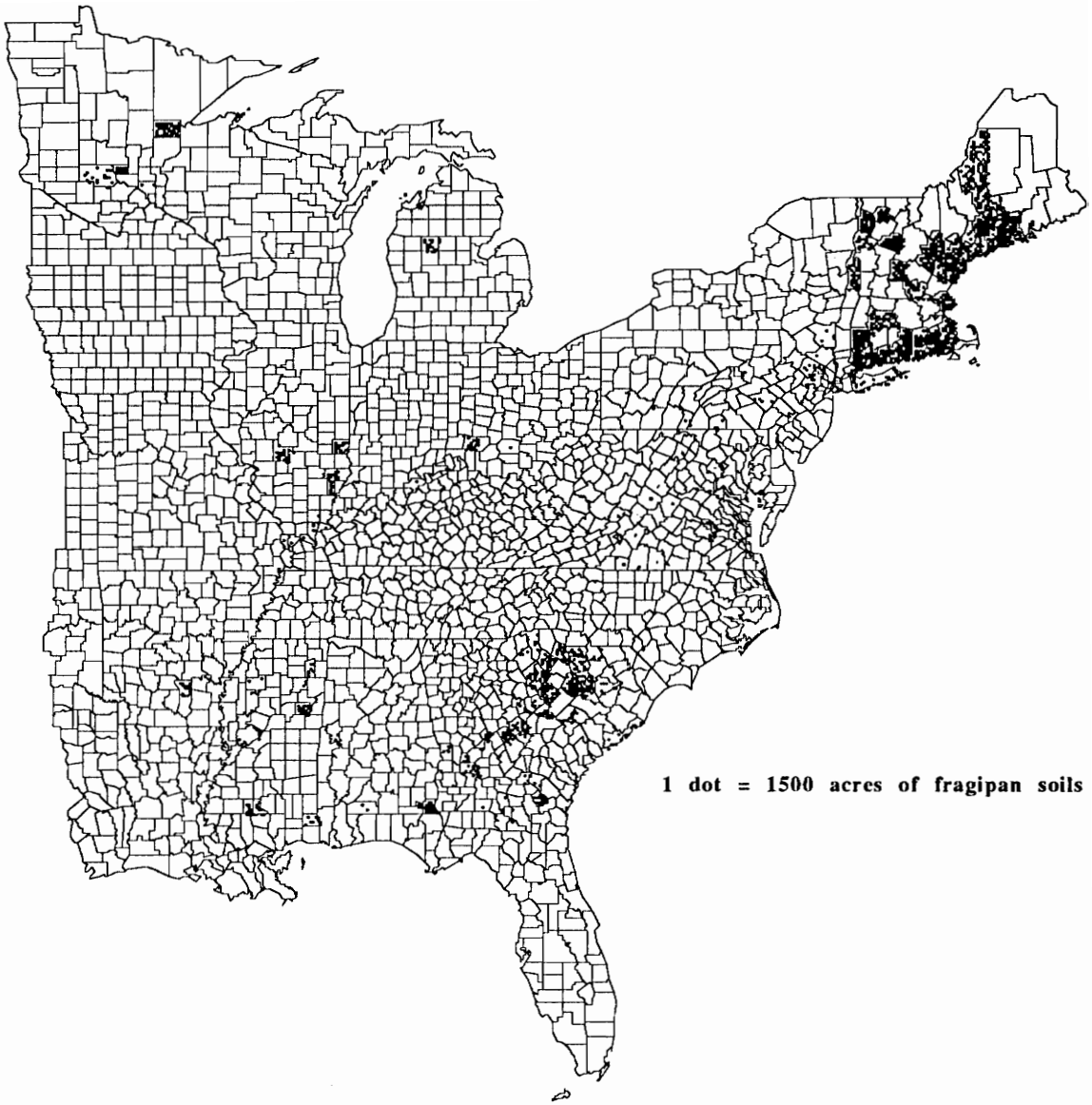

Figure 8. Areal Distribution of Soils Recently Reclassified as Non-Fragipan

and other regional and state level soil surveys is included in this data base as correlated by SCS personnel). As a result, the information contained in the MUUF may be more extensive, but does not necessarily coincide with information contained in the post-1966 surveys available on the shelves of government repositories.

Table 8 provides a comparison of modern survey fragipan acreage to the estimates extracted from MUUF data by Witty and Knox. As testament to the larger areal coverage of MUUF data, the Witty and Knox estimates identify approximately 4.5 million more acres of fragipan soils. A prime example of information contained in the MUUF which is currently unavailable from the modern survey data base is found in Texas. No fragipan soils were encountered in Texas by review of modern surveys, while the MUUF data cited by Witty and Knox estimates nearly 75,000 acres of fragipan soils in Texas. Review of the SCS Soil Classification file identifies at least two soil series (Cart and Erno) which are found in Texas.

For a surprising number of states, more fragipan soils are identified by the modern survey data base than the MUUF estimates proposed by Witty and Knox. Illinois and West Virginia are two excellent examples of apparent under-estimates by the MUUF data file. According to Witty and Knox (1989), MUUF record coverage of Illinois is 80% complete, while West Virginia is listed as 65% complete. Both of these figures are well above the percentage of area with modern surveys. Since the information source for soil series reclassified as non-fragipan (the SCS Soil Classification File) was the same for each data set, it is difficult to determine the cause of this contradictory relationship.

Based on information displayed in Table 9, the explanation for the apparent error in fragipan acreage given for West Virginia may be explained. Estimates by Lindbo and Veneman (1989) for the northeastern states, apparently extracted from the same MUUF data base, greatly exceed areal estimates by Witty and Knox for the same states. For West Virginia, Lindbo and Veneman exceed the Witty and Knox estimates by over 500,000 acres. Combining the values given for New York and Pennsylvania, Lindbo and Veneman's estimate is nearly six million acres greater than Witty and Knox (and over eight million acres more than the modern survey estimate).

Table 8. Modern Survey Fragipan Acreage Compared to Witty & Knox Estimates

State	Modern Survey (1) Fragipan Acreage	Witty&Knox (2) Acreage Estimates	Witty&Knox Acreage minus Modern Survey	Witty&Knox Acreage as % of Modern Survey Acreage
Alabama	436790	1078083	641293	247%
Arkansas	3901676	4233030	331354	108%
Connecticut	0	0	0	
Delaware	9789	8893	-896	91%
Florida	0	5188	5188	0%
Georgia	138443	51631	-86812	37%
Illinois	817502	424909	-392593	52%
Indiana	1861073	2130226	269153	114%
Iowa	0	0	0	
Kansas (east)	10230	9882	-348	97%
Kentucky	2051073	2366890	315817	115%
Louisiana	715930	831537	115607	116%
Maine	23570	11364	-12206	48%
Maryland	460338	410086	-50252	89%
Massachussetts	1745	19763	18018	1133%
Michigan	222185	410086	187901	185%
Minnesota	2802	31374	28572	1120%
Mississippi	2864096	3859012	994916	135%
Missouri	1948675	1960015	11340	101%
New Hampshire	19123	2470	-16653	13%
New Jersey	417320	478516	61196	115%
New York	2704908	3811086	1106178	141%
North Carolina	30466	43726	13260	144%
Ohio	2059111	2410369	351258	117%
Oklahoma (east)	117651	205290	87639	174%
Pennsylvania	6734597	6612767	-121830	98%
Rhode Island	0	0	0	
South Carolina	17271	21740	4469	126%
Tennessee	638830	1383177	744347	217%
Texas (east)	0	73865	73865	
Vermont	19572	124014	104442	634%
Virginia	236756	245558	8802	104%
West Virginia	715564	365866	-349698	51%
Wisconsin	54674	69171	14497	127%
TOTALS:	29231760	33689586	4457826	115%

(1) Data collected from SCS soil surveys published 1967-1989

(2) Data collected from the MUUF data base (Ames, IA, August 1987)

Table 9. Lindbo & Veneman Estimates Compared to Modern Survey/Witty & Knox Estimates

State	Modern Survey (1) Fragipan Acreage	Lindbo&Veneman (2) Acreage Estimates	Witty & Knox (3) Acreage Estimates	Lindbo&Veneman Estimates Minus Modern Survey Acreage	Witty & Knox Estimates Minus Lindbo&Veneman
Connecticut	0	0	0	0	0
Delaware	9789	9633	8893	-156	-740
Maine	23570	13462	11364	-10109	-2098
Maryland	460338	589219	410086	128881	-179133
Massachussetts	1745	20131	19763	18386	-368
New Hampshire	19123	2470	2470	-16653	0
New Jersey	417320	500175	478516	82855	-21659
New York	2704908	7446680	3811086	4741772	-3635594
Pennsylvania	6734597	8846058	6612767	2111461	-2233291
Rhode Island	0	0	0	0	0
Vermont	19572	125600	124014	106028	-1586
Virginia	236756	900315	245558	663559	-654757
West Virginia	715564	912912	365866	197348	-547046
TOTALS:	11343282	19366653	12090383	8023371	-7276270

(1) Data collected from SCS soil surveys published 1967-1989
(2) Based on information supplied by MUUF data (K. Langlois 1988, personal communication)
(3) Data collected from the MUUF data base (Ames, IA, August 1987)

Lindbo and Veneman estimate that overall, fragipan soils account for approximately 13% of total soils of their study area. This figure is somewhat misleading when compared to Figure 7. While the overall percentage may indeed be close to 13%, the dot map provides much more information than a simple percentage figure for such a large area. While the reader can extrapolate the much higher concentrations of fragipan soils in New York and Pennsylvania from acreage figures displayed in the table, the dot density map is clearly a more effective means of communicating areal information.

Smith and Daniels (1989) utilized yet another information source for estimating fragipan acreage in the southeastern coastal plain. Correlated acreages of soils by state and Major Land Resource Area (MLRA) provided by the SCS South National Technical Center (Fort Worth, TX, 1988) provided the basis for their study (Table 10). The Smith and Daniels estimates for fragipan acreage in Alabama more than double the modern survey estimate for that state. This would seem to indicate that, since the state has relatively poor survey coverage, the information source utilized attempts to correlate soil types for the entire area. In this instance, the estimate given seems reasonable when compared to the (fragmented) pattern of high fragipan concentration in western Alabama apparent in Figure 7. Alabama's southern neighbor, the panhandle of Florida, has no fragipan soils identified in modern surveys; however, the Smith and Daniels estimates indicate that at least 5,000 acres of fragipan soils exist in Florida. The most unusual relationship between the modern survey data base and Smith and Daniels' estimates is found in Georgia. While Smith and Daniels identify less than 7,000 acres, the modern survey data base identifies almost 140,000 acres. The Irvington series (Plinthic Fragiudults; identified as one of the coastal plain fragipans by Smith and Daniels) accounts for all of the fragipan acreage found in modern Georgia soil surveys in the coastal plain region. Since this difference cannot be attributed to reclassification, an error in the data used by Smith and Daniels or an error in identifying the Irvington series in Georgia counties has occurred. As mentioned above, reclassification has had a significant impact on the areal distribution of fragipan soils in the southeastern United States. While fragipan acreage extracted from modern surveys was reduced by over 300,000 acres for the southeastern coastal plain, Smith and Daniels estimate this reduction due to re-classification at more than 900,000 acres.

Table 10. Modern Survey/Reclassified Fragipan Acreage Estimates Compared to Smith & Daniels Estimates

State	Modern (1) Survey Fragipan Acreage	Smith and Daniels (2) Acreage Estimates	Smith and Daniels Acreage minus Modern Survey Acreage	Smith and Daniels (2) Re-classified Acreage Estimate	Modern (3) Survey Re-classified Acreage Estimate	Re-classified Smith and Daniels minus re-classifed Modern Survey Acreage Estimate
Alabama	436790	355680	-81110	86697	96547	-9850
Florida	0	5434	5434	8645	0	8645
Georgia	138443	6916	-131527	574522	38364	536158
South Carolina	17271	7163	-10108	366301	173654	192647
North Carolina	30466	25688	-4778	197106	1826	195280
Virginia	236756	68419	-168337	1976	11416	-9440
TOTALS:	859726	469300	-390426	1235247	321807	913440

(1) Data collected from SCS soil surveys published 1967-1989
(2) Based on correlated acreages of soils by state and Major Land Resource Area (1988, SCS South National Technical Center, Fort Worth, TX)
(3) As derived from SCS Soils Classification File (SCS, Ames, IA, February 1989)

Modern survey coverage in this region is very poor, which may explain the dramatic difference in the two estimates. The effects of re-classification of fragipan soils found on the coastal plain, while obviously more pronounced in the Smith and Daniels estimates, dramatically re-draws the map of fragipan soils for the southeastern United States.

Franzmeier et al. (1989) utilized data from the Midwest National Technical Center of SCS (Lincoln, NE; Kentucky data provided by state soil scientist Gene E. Kelley, Lexington) to describe fragipan soils of the midwestern United States. Table 11 compares their estimates to those offered by Witty and Knox and the modern survey data base. Overall, Franzmeier et al.'s figures undercut the modern survey estimates for this region by over 200,000 acres, while undercutting the Witty and Knox estimates by more than one million acres. A closer look at these figures reveals that Franzmeier et al.'s estimates are significantly higher than the modern survey figures for Kentucky and Michigan. This difference is most likely due to the poor modern survey coverage in these two states. Franzmeier et al.'s estimates for Ohio; on the other hand, fall significantly short of the modern survey estimates, despite a need for improved modern survey coverage in eastern Ohio (an area of significant fragipan occurrence as established by existing surveys). The most likely explanation for this seemingly contradictory relationship is that re-classifications or errors in series identification have resulted in significant adjustments to the fragipan acreage estimates. Franzmeier et al. do not provide any figures indicating how complete survey coverage is for the midwestern states listed, further complicating comparisons of their data to that from other sources. With this in mind, comparisons to Witty and Knox's figures show dramatic differences in estimates for Illinois, Missouri, and Ohio. Witty and Knox's figures far exceed the Franzmeier et al. estimates for Missouri and Ohio, while a significantly lower figure is offered by Witty and Knox for Illinois.

In their analysis of fragipan soils in the southcentral United States, Hudnall and Williams (1989) utilized the MUUF database. Comparisons of their acreage estimates to the modern survey and Witty and Knox acreage estimates are shown by Table 12. The Hudnall and Williams fragipan soil estimates exceed the modern survey estimates by more than 2.5 million acres, while exceeding the Witty and Knox estimate

Table 11. Franzmeier Estimates Compared to Modern Survey/Witty & Knox Estimates

State	Modern (1) Survey Fragipan Acreage	Franzmeier (2) Acreage Estimates	Witty&Knox (3) Acreage Estimates	Franzmeier Acreage minus Modern Survey	Witty&Knox Acreage Acreage minus Franzmeier Acreage
Illinois	817502	718770	424909	-98732	-293861
Indiana	1861073	1741350	2130226	-119723	388876
Kansas (east)	10230	9880	9882	-350	2
Kentucky	2051073	2435420	2366890	384347	-68530
Michigan	222185	496470	410086	274285	-86384
Minnesota	2802	32110	31374	29308	-736
Missouri	1948675	1588210	1960015	-360465	371805
Ohio	2059111	1756170	2410369	-302941	654199
Wisconsin	54674	27170	69171	-27504	42001
TOTALS:	9027325	8805550	9812922	-221775	1007372

(1) Data collected from SCS soil surveys published 1967-1989
(2) Kentucky data from G. E. Kelley (SCS, Lexington); all other data from G. J. Post (SCS Midwest National Technical Center, Lincoln, NE)
(3) Data collected from the MUUF data base (Ames, IA, August 1987)

Table 12. Hudnall & Williams Estimates Compared to Modern Survey/Witty & Knox Estimates

State	Modern Survey (1) Fragipan Acreage Estimates	Hudnall&Williams (2) Fragipan Acreage Estimates	Witty & Knox (3) Fragipan Acreage Estimates	Hudnall&Williams Acreage minus Modern Survey Acreage Estimates	Witty & Knox Acreage minus Hudnall&Williams Acreage Estimates
Arkansas	3901676	4322500	4233030	420824	-89470
Louisiana	715930	889200	831537	173270	-57663
Mississippi	2864096	4001400	3859012	1137304	-142388
Oklahoma (east)	117651	197600	205290	79949	7690
Tennessee	638830	1407900	1383177	769070	-24723
Texas (east)	0	49400	73865	49400	24465
TOTALS:	8238183	10868000	10585911	2629817	-282089

(1) Data collected from SCS soil surveys published 1967-1989
(2) Data collected from the MUUF data base (no details given)
(3) Data collected from the MUUF data base (Ames, IA, August 1987)

by almost 300,000 acres. It is unclear whether the difference between the Hudnall and Williams figures and the Witty and Knox figures are attributed to correlations made by these authors or due to accessing the MUUF data base at different times. Entry of data into MUUF is an ongoing process, therefore the acreage figures for fragipan soils included in the data base are always changing.

Hudnall and Williams provide dot density maps of each study area, specifically identifying counties which have not been correlated and are not included in their study (despite the fact that these counties may contain fragipan soils). This more readily accommodates comparisons of the modern survey data base to their MUUF-based data. For Arkansas, Hudnall and Williams identify 16 counties scattered throughout the state which lack data, but when compared to modern survey data only 13 counties lack data. Hudnall and Williams identify a few counties as having "less than 3000 hectares" of fragipan soils, but do not indicate any counties which lack fragipans entirely. Modern survey data, on the other hand, identifies six counties (three in the southwestern corner of the state and three along the Mississippi River) where no fragipan soils occur. This inconsistency in the two data sets indicates that either these modern surveys with no fragipans are erroneous, or the data correlated in MUUF is incorrect.

In summary, it is clear that significant differences exist between various data sources attempting to estimate the extent and distribution of fragipan soils in the United States. As a result, comparisons between these various studies are difficult (this is especially ironic since all of the articles displayed in the tables above were published together). The differences between MUUF and other data sources, when compared to the modern survey data presented here, questions the accuracy of such information sources. County-based data extracted from individual surveys offers the advantages of direct use in the real world and the availability of information (such as parent material, topographic position, depth, width, and range of the fragipan layer) not currently available in MUUF or other data sources. The MUUF data base has great potential to eliminate the arduous and monotonous task of searching through soil surveys to gather information. However, as with any data base, its outputs are only as good as the information entered into it. In addition, the system must be configured in a way that accommodates system users. It is clear that efforts to organize

and improve geographic soils information are just beginning. To promote improvements in our understanding of soils geography, such improvements are a necessity.

Currently, the modern survey data base presented here is an accurate reflection of the "as surveyed" data for fragipans in the eastern United States. Of course, all of the error associated with individual surveys (regional bias, mapping inaccuracies, etc.) is embodied by this data. However, part of geography is dedicated to overcoming the limitations of imperfect data to analyze spatial patterns. The following section analyzes the regional variability of fragipan characteristics in an attempt to utilize the geographical perspective to improve our understanding of fragipans.

IX. REGIONAL VARIABILITY OF FRAGIPAN CHARACTERISTICS

The simple dot maps displayed on the following pages attempt to isolate the areal distribution of specific fragipan soil characteristics. The extensive gaps in modern survey coverage must be considered when viewing these maps (gray shading denotes "no data" counties - those which lack post-1966 surveys). As survey coverage improves, a higher degree of accuracy in analyzing spatial patterns will be possible. However, the current data is considered adequate for making generalized conclusions with a reasonable level of confidence. This study does not make any attempts at interpolating the likely occurrence of fragipans in counties lacking data, since the emphasis has been placed on identifying the *actual* occurrence of fragipan soils, rather than surmising their *estimated* occurrence.

Figures 9 through 12 show the areal distribution of the four soil orders in which fragipans are recognized at the Great Group level. Alfisols (Figure 9) dominate the areas along the Mississippi and Ohio Rivers, while Ultisols (Figure 10) are common in Arkansas and Mississippi away from the river influence and in the remainder of the southeast (this pattern is difficult to discern given the low percentage of fragipan soils in this region). Pennsylvania also has a significant number of fragipan soils classified as Ultisols. Fragipan soils classified as Inceptisols (Figure 11) are tightly grouped in northeastern Pennsylvania and New York. Spodosols, of which fragipans were once considered to be so common as to be part of their defining criteria, are now limited to just a few counties in the far north (Figure 12) as a result of recent re-classification. Table 13 shows the breakdown of fragipan soil orders by state. Nearly half of all fragipan soils are classified as Alfisols, over one third are Ultisols and the remainder are Inceptisols (17%) and Spodosols (2%).

It is difficult to interpret the patterns of fragipan soil orders without considering parent material as shown in Figures 13 through 18. The deep penetration of Alfisols into the southcentral coincides with the preponderance of loessial soils [which comprise 31% of all fragipan soils (Table 14)] as shown in Figure 13. Fragipan soils formed in colluvium (Figure 14), which account for 14% of fragipan soils, are widespread in

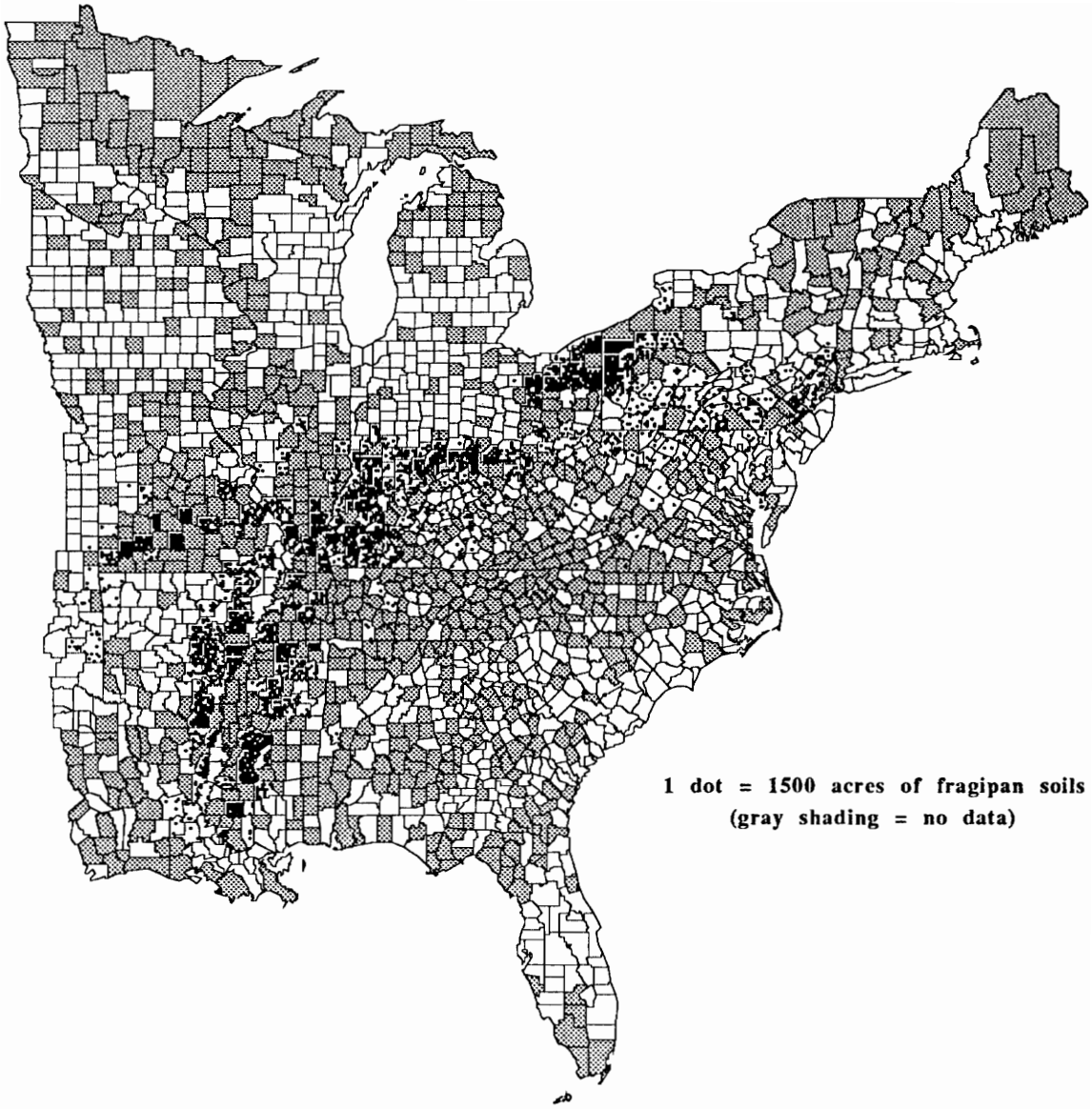

Figure 9. Areal Distribution of Fragipan Soils Classified as Alfisols

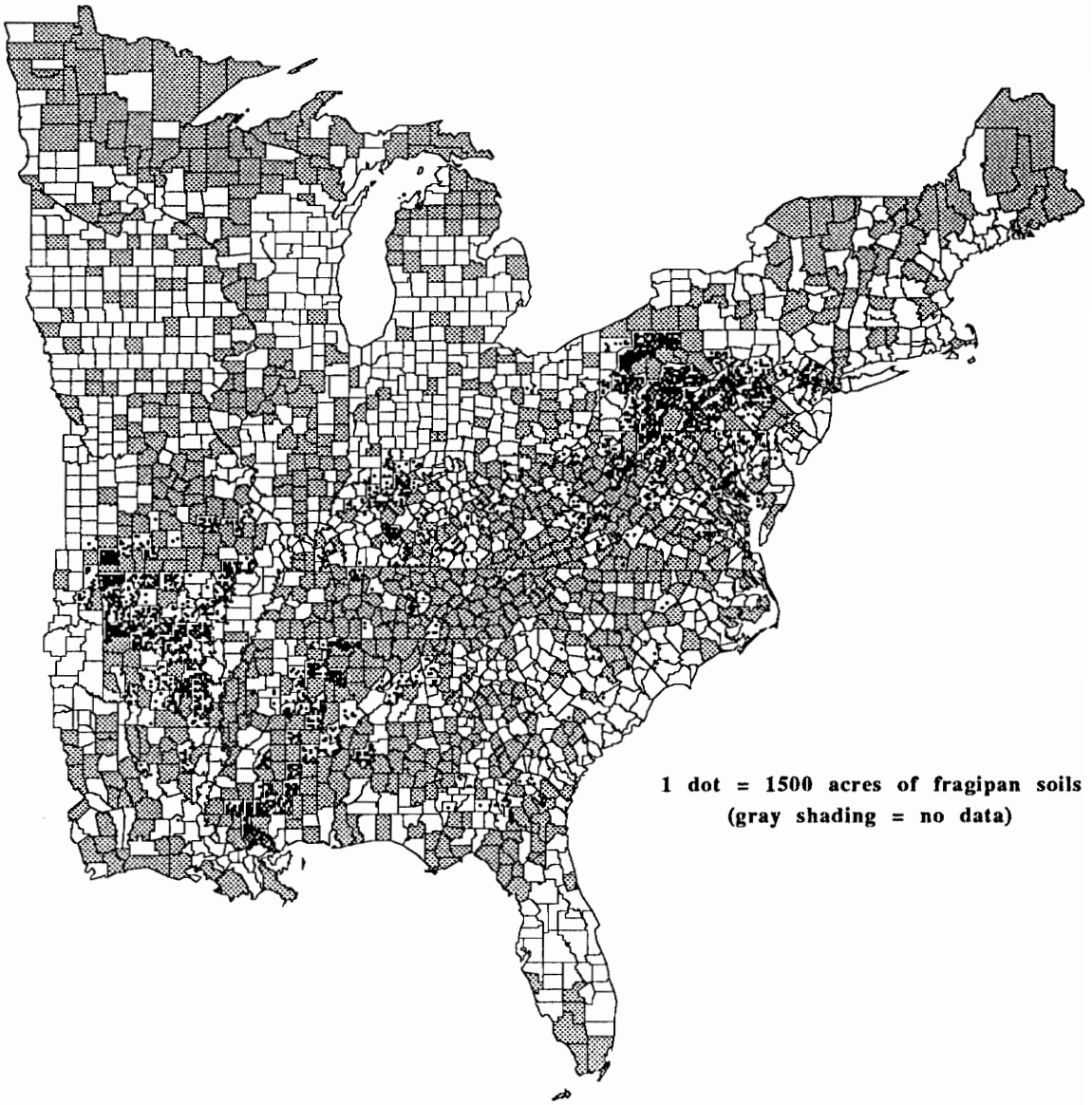

Figure 10. Areal Distribution of Fragipan Soils Classified as Ultisols

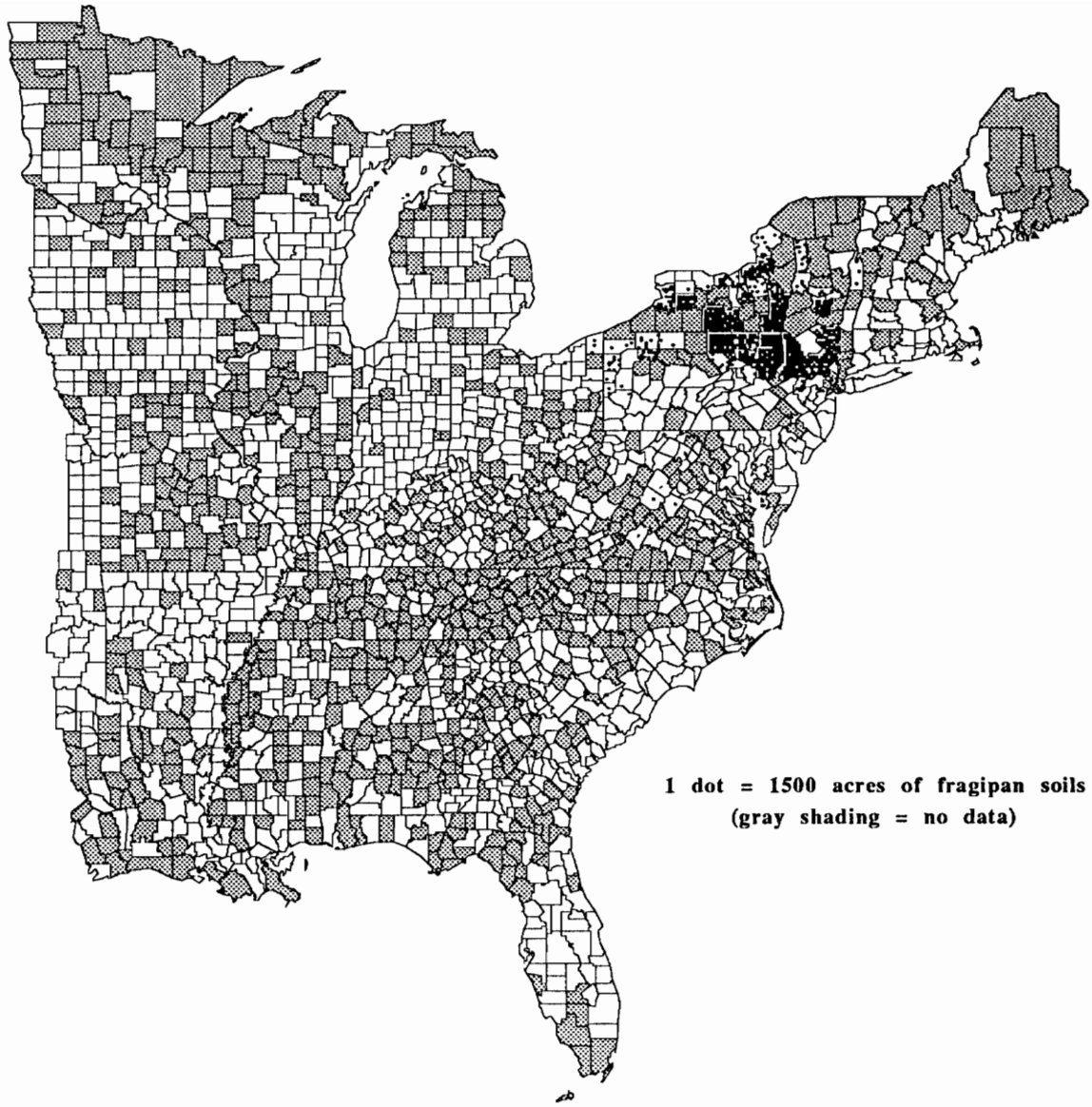

Figure 11. Areal Distribution of Fragipan Soils Classified as Inceptisols

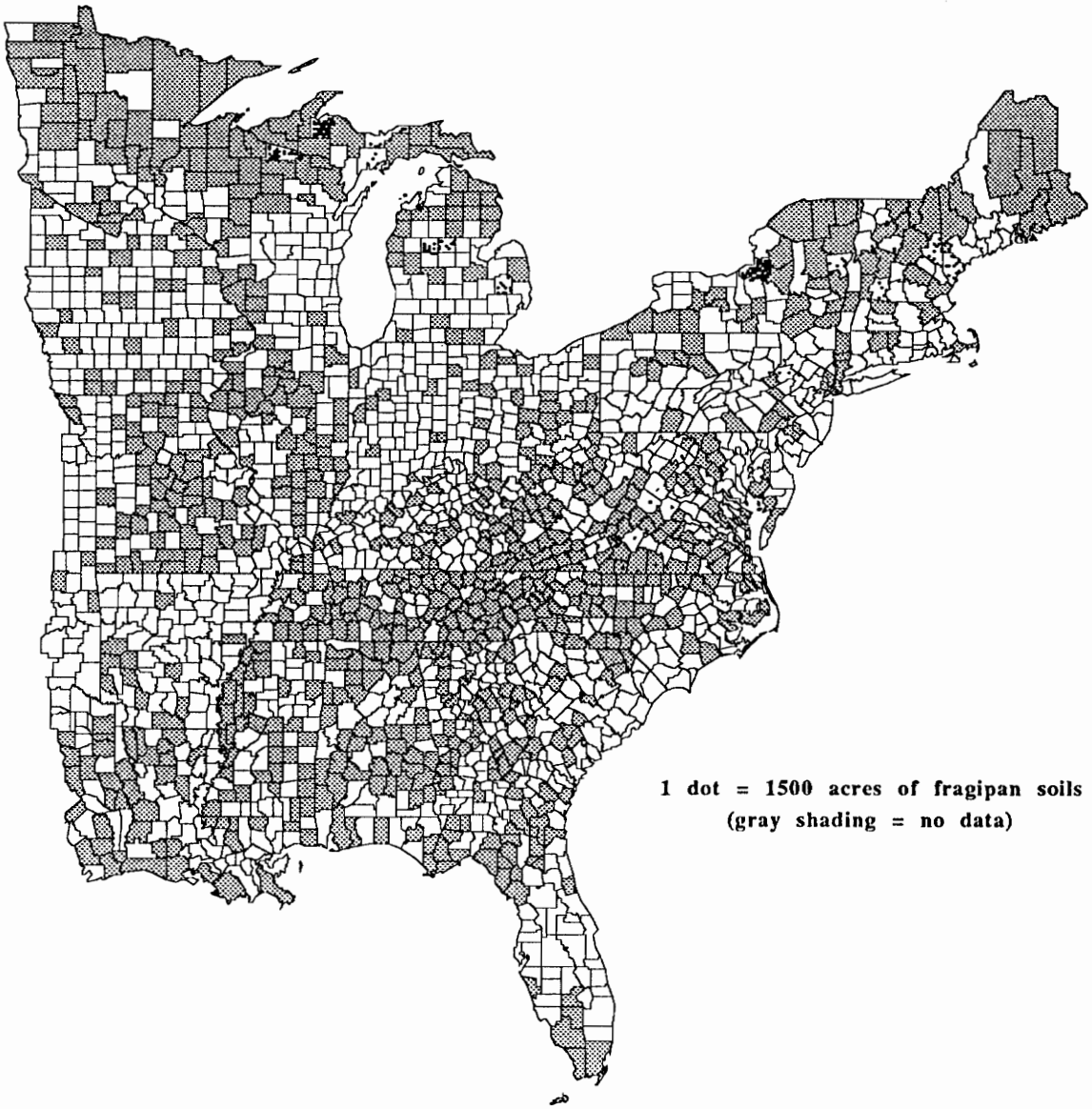

Figure 12. Areal Distribution of Fragipan Soils Classified as Spodosols

Table 13. Fragipan Soil Orders in the Eastern United States

State	Alfisols	Ultisols	Inceptisols	Spodosols	TOTALS
Alabama	4077	432713	0	0	436790
Arkansas	1605252	2296446	0	0	3901698
Connecticut	0	0	0	0	0
Delaware	5034	4755	0	0	9789
Florida	0	0	0	0	0
Georgia	0	138441	0	0	138441
Illinois	802292	17417	0	0	819709
Indiana	1538905	324378	0	0	1863283
Iowa	0	0	0	0	0
Kansas	758	9472	0	0	10230
Kentucky	1725644	323829	0	0	2049473
Louisiana	389672	326259	0	0	715931
Maine	0	0	0	23570	23570
Maryland	29120	431217	0	0	460337
Massachussetts	0	1745	0	0	1745
Michigan	0	0	0	222186	222186
Minnesota	2802	0	0	0	2802
Mississippi	1763334	1100773	0	0	2864107
Missouri	1453208	494928	0	0	1948136
New Hampshire	0	0	0	19123	19123
New Jersey	108606	176216	132498	0	417320
New York	89569	0	2431395	184387	2705351
North Carolina	0	30466	0	0	30466
Ohio	2005684	48450	5414	0	2059548
Oklahoma	59283	58369	0	0	117652
Pennsylvania	1612481	2832923	2278310	5475	6729189
Rhode Island	0	0	0	0	0
South Carolina	0	17279	0	0	17279
Tennessee	495939	138889	0	0	634828
Texas	0	0	0	0	0
Vermont	0	0	0	19572	19572
Virginia	4796	231957	0	0	236753
West Virginia	118675	596869	0	0	715544
Wisconsin	0	0	0	54674	54674
TOTALS	13815131	10033791	4847617	528987	29225526
as % of total	47%	34%	17%	2%	

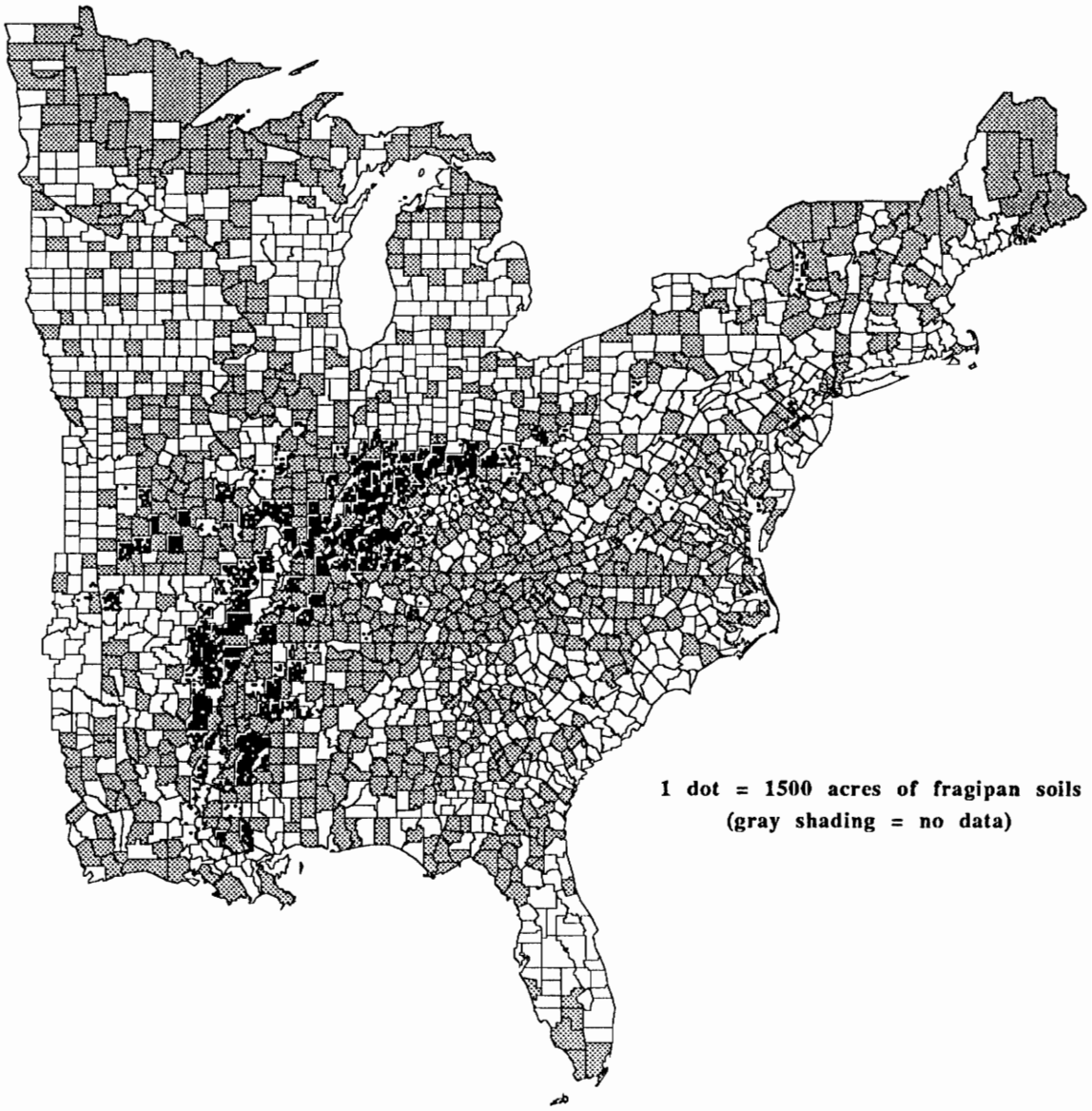

Figure 13. Areal Distribution of Fragipan Soils Formed in Loess

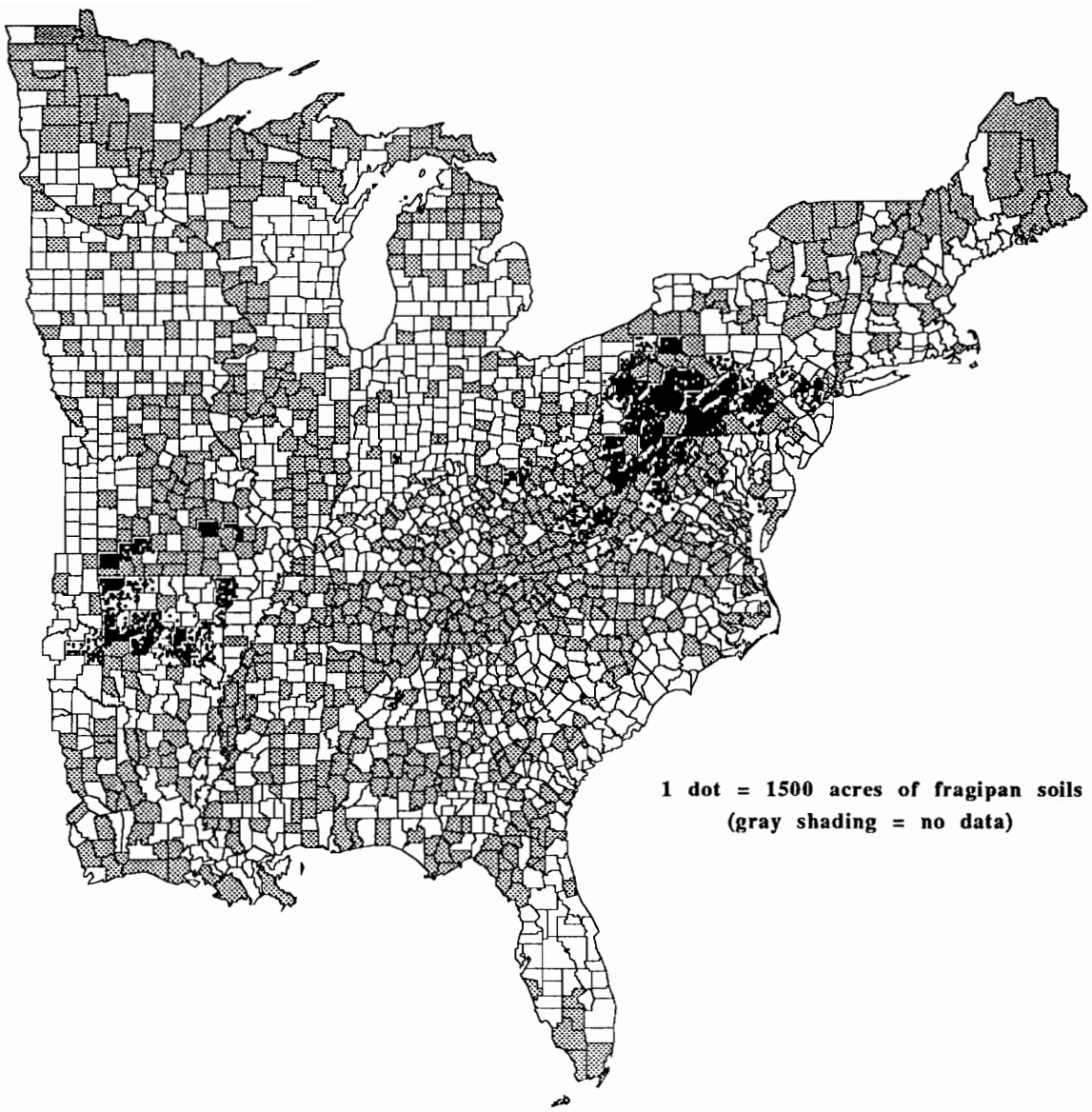

Figure 14. Areal Distribution of Fragipan Soils Formed in Colluvium

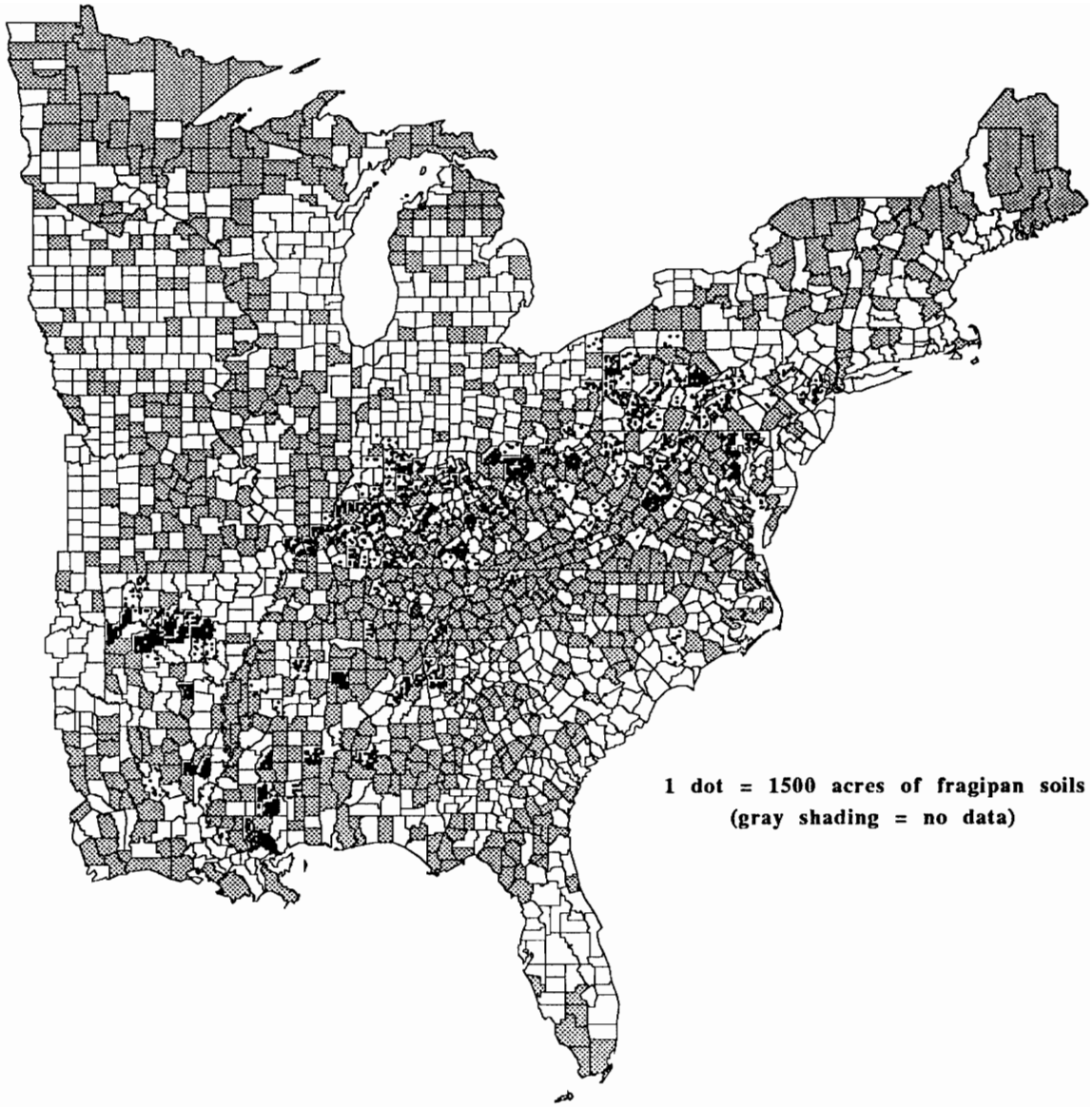

Figure 15. Areal Distribution of Fragipan Soils Formed in Alluvium

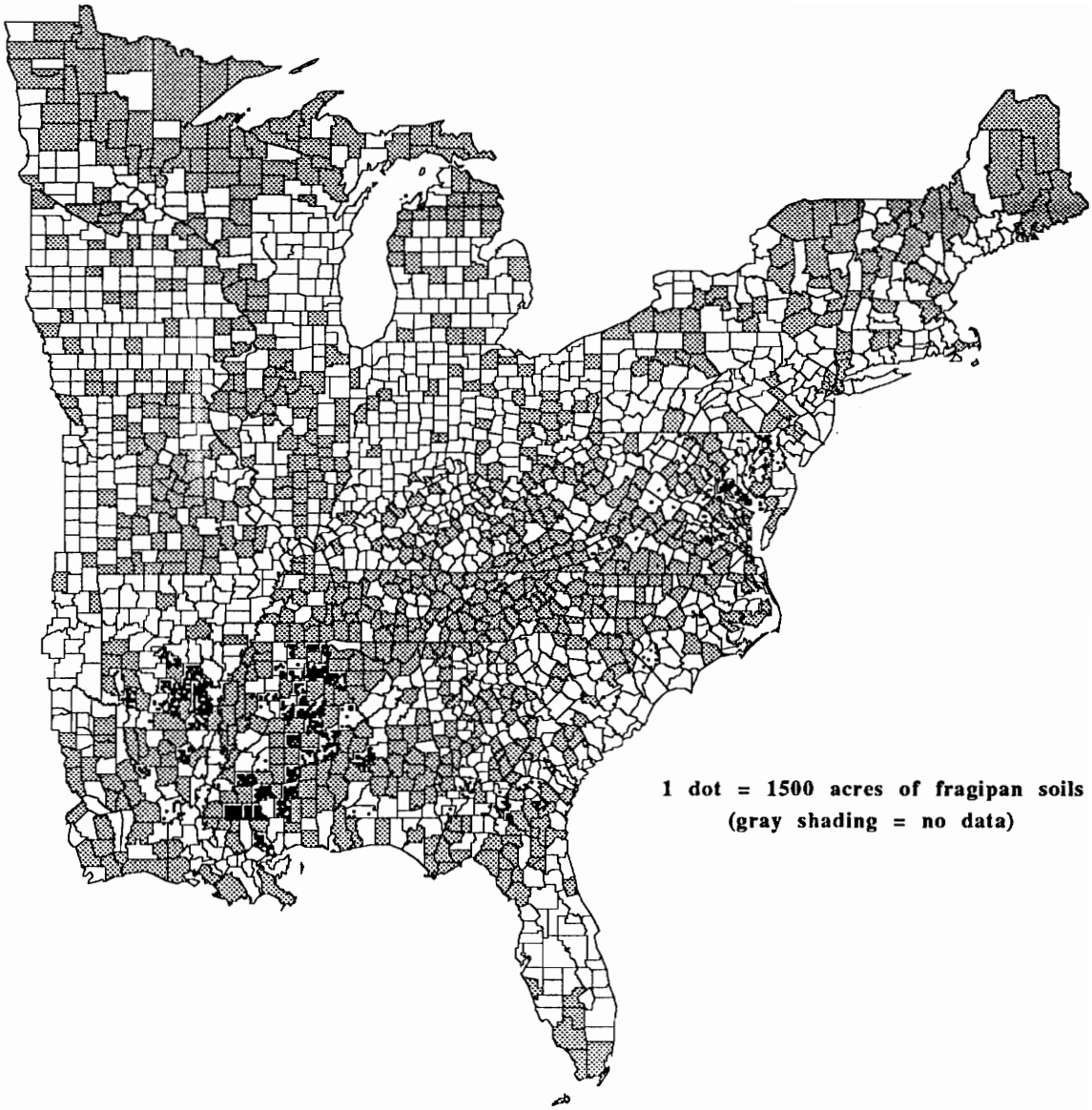

Figure 16. Areal Distribution of Fragipan Soils Formed in Marine Sediment

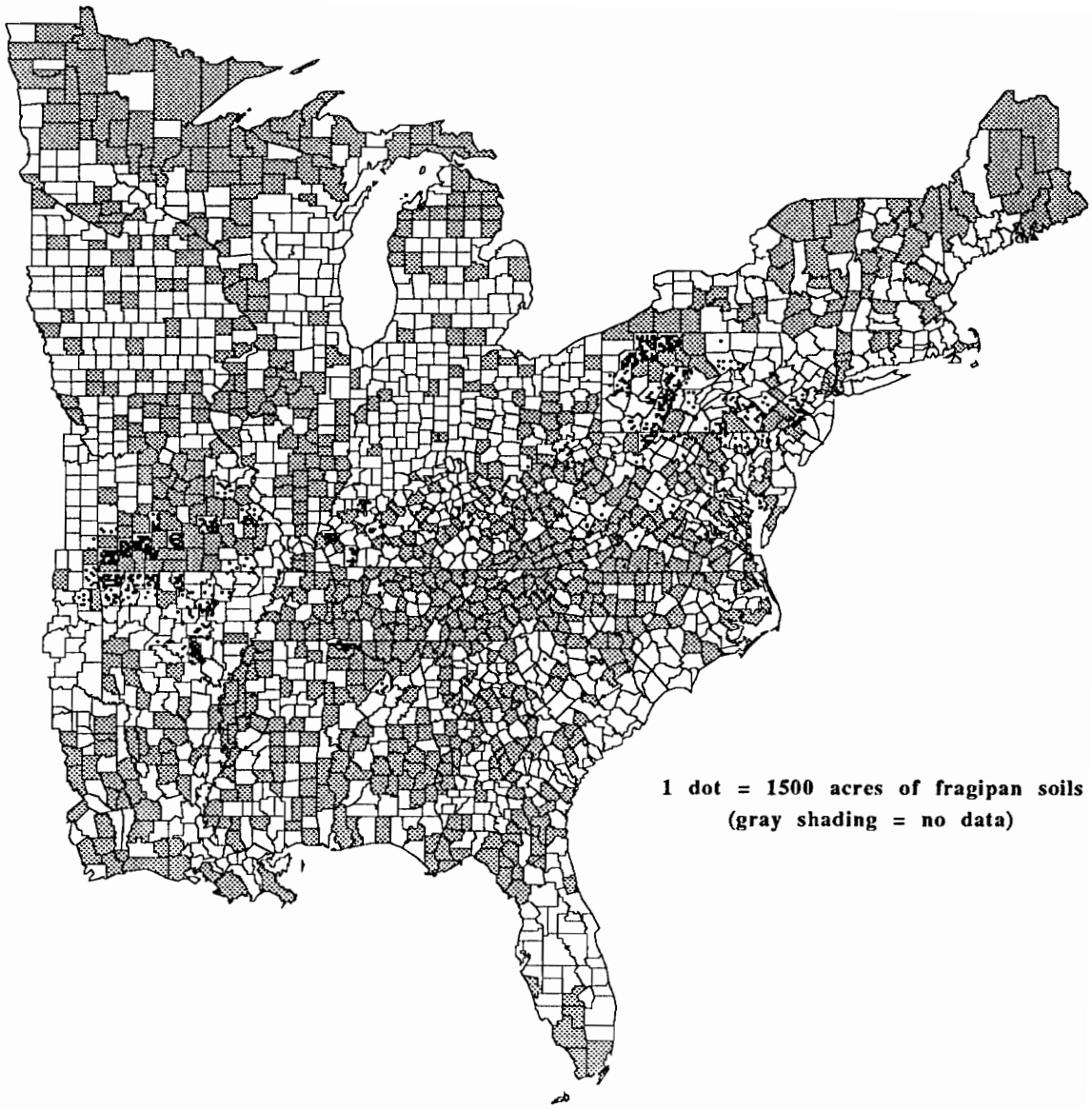

Figure 17. Areal Distribution of Fragipan Soils Formed in Weathered Bedrock

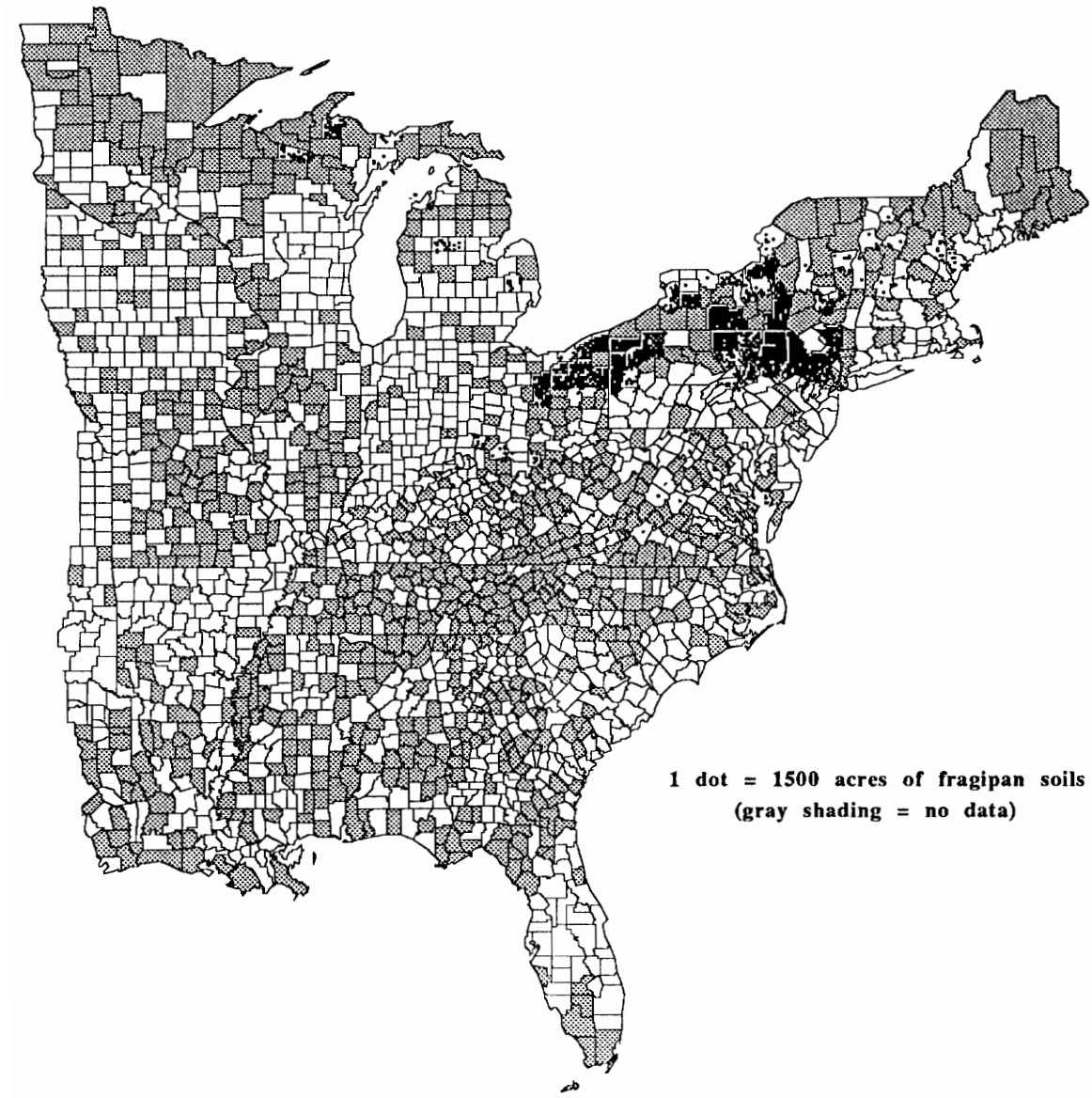

Figure 18. Areal Distribution of Fragipan Soils Formed in Glacial Till

Table 14. Parent Materials of Fragipan Soils in the Eastern United States

State	Loess	Colluvium	Alluvium	Marine Sediment	Weathered Bedrock	Glacial Till	TOTALS
Alabama	0	14336	91008	186577	139549	0	431470
Arkansas	1654483	876802	383301	448204	541681	0	3904471
Connecticut	0	0	0	0	0	0	0
Delaware	0	0	0	5873	3916	0	9789
Florida	0	0	0	0	0	0	0
Georgia	0	0	24872	113569	0	0	138441
Illinois	776672	0	47557	0	0	0	824229
Indiana	1671595	7078	149017	0	41258	0	1868948
Iowa	0	0	0	0	0	0	0
Kansas	0	0	0	0	10230	0	10230
Kentucky	1547406	6195	301145	0	192547	0	2047293
Louisiana	388366	0	224137	96159	0	0	708662
Maine	0	0	0	0	0	23570	23570
Maryland	0	87832	72089	192357	108060	0	460338
Massachussetts	0	0	0	0	0	1745	1745
Michigan	0	0	0	0	0	222185	222185
Minnesota	0	0	0	0	0	2802	2802
Mississippi	1154135	0	150218	1437966	0	0	2742319
Missouri	734538	396718	0	0	706267	0	1837523
New Hampshire	0	0	0	0	0	19123	19123
New Jersey	0	87411	13137	0	19754	273076	393378
New York	34147	0	1832	0	0	2668922	2704901
North Carolina	0	0	3554	19171	0	0	22725
Ohio	478847	37389	124535	0	16729	1449370	2106870
Oklahoma	7532	51751	0	0	58368	0	117651
Pennsylvania	68401	1903210	184412	0	906479	3671260	6733762
Rhode Island	0	0	0	0	0	0	0
South Carolina	0	0	0	4413	12858	0	17271
Tennessee	530791	7024	45156	0	3583	0	586554
Texas	0	0	0	0	0	0	0
Vermont	0	0	0	0	0	19572	19572
Virginia	0	79559	52220	64780	40194	0	236753
West Virginia	0	578931	80647	0	52518	3468	715564
Wisconsin	0	0	0	0	0	54674	54674
TOTALS	9046913	4134236	1948837	2569069	2853991	8409767	28962813
as % of total	31%	14%	7%	9%	10%	29%	

the highland areas of Pennsylvania and West Virginia and Arkansas and Missouri. No significant areal pattern can be discerned from the distribution of fragipan soils formed in alluvium (Figure 15, 7% of total fragipan soils). Since alluvial soil forming processes occur throughout humid regions, this lack of pattern is not surprising. Fragipan soils formed in marine sediment (9% of fragipan soils), are confined to the coastal plain areas as shown in Figure 16.

Soils formed in weathered bedrock or residuum (Figure 17, 10% of fragipan soils) are unique among fragipan soil parent materials since they are the only soils which form *in situ*. This soil formation process would not allow the "physical ripening" process as described by Bryant (1989) to assist in fragipan formation. The evidence for the accumulation of sediment as a necessity for fragipan formation in soils appears to be increasingly formidable. The fragipan soils shown in Figure 17 may be a key to unlocking the significance of Bryant's physical ripening process. The pattern displayed by these soils formed from weathered bedrock seems to correspond very well with the pattern of colluvial fragipan soils (Figure 14). It is very likely that the soils categorized as forming from "weathered bedrock" may actually have formed in colluvial (or alluvial) material which was not recognized by the survey authors.

Fragipan soils formed in glacial till (which, despite reductions due to re-classification, still account for 29% of all fragipan soils) dominate the far north in the expected pattern as shown in Figure 18.

Figures 19 through 22 map "particle size" classes of fragipan soils (also shown by Table 15). Witty and Knox (1989) estimated that 35.1% of fragipan soils are in the fine-silty class, 32.1% are fine-loamy. 21.0% are coarse-loamy, and the remainder are in an assortment of other classes. The percentage of fragipan soils in the fine-silty class as established by the modern survey data base is 41%, as distributed in Figure 19. These soils are closely associated with the loessial soils shown by Figure 13. The fine-loamy class accounts for 36% of fragipan soils in modern surveys as distributed in Figure 20. These are dominant in areas outside of the loessial influence. Coarse-loamy soils, as shown by Figure 21 (13% of total fragipan soils), are closely related to the glacial material formed Inceptisols and fragipan soils formed in marine sediment. Coarse-Silty soils, as shown by Figure 22, account for less than 4% of modern survey fragipans,

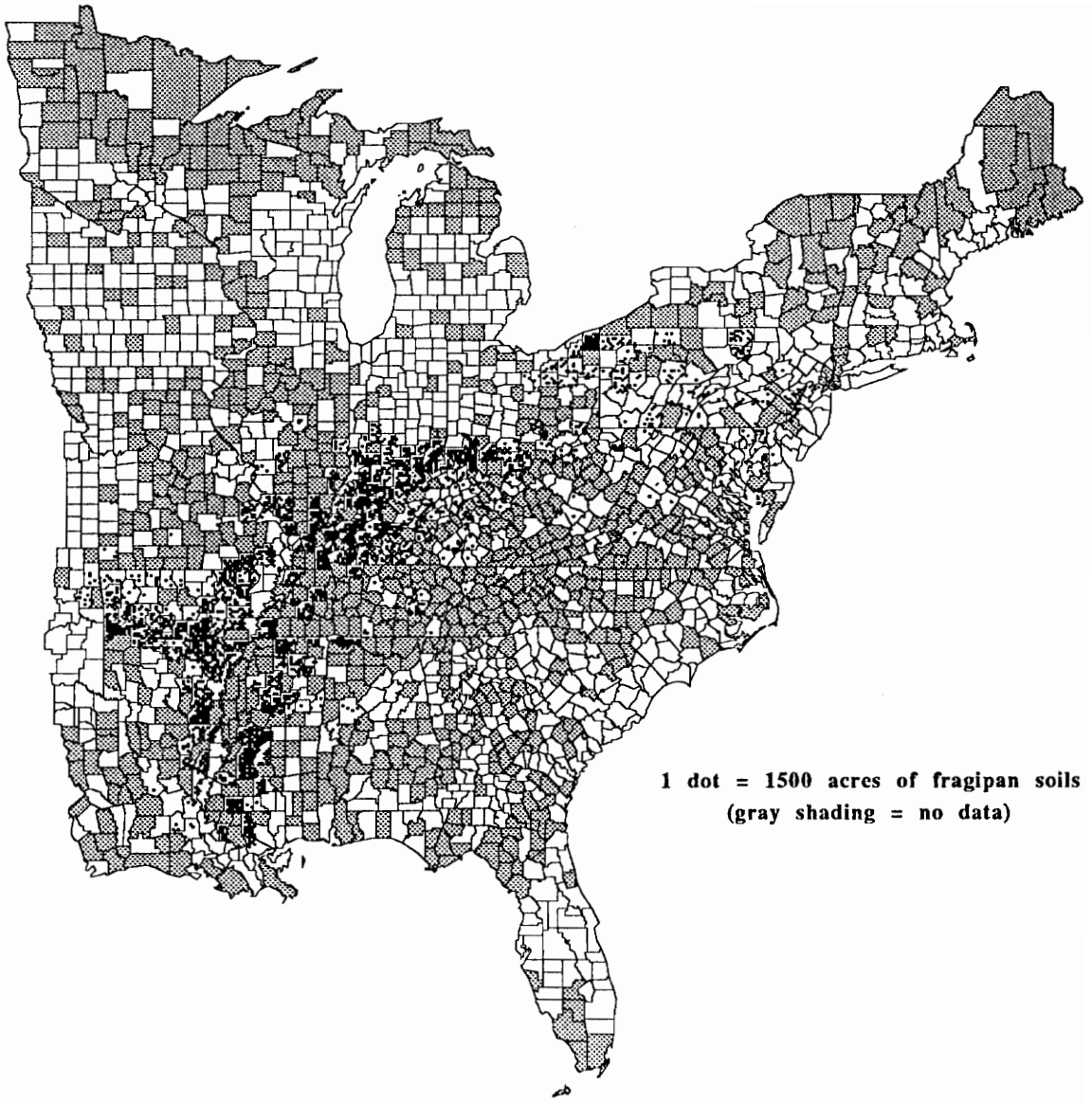

Figure 19. Fragipan Soils in the Fine-Silty Particle Size Class

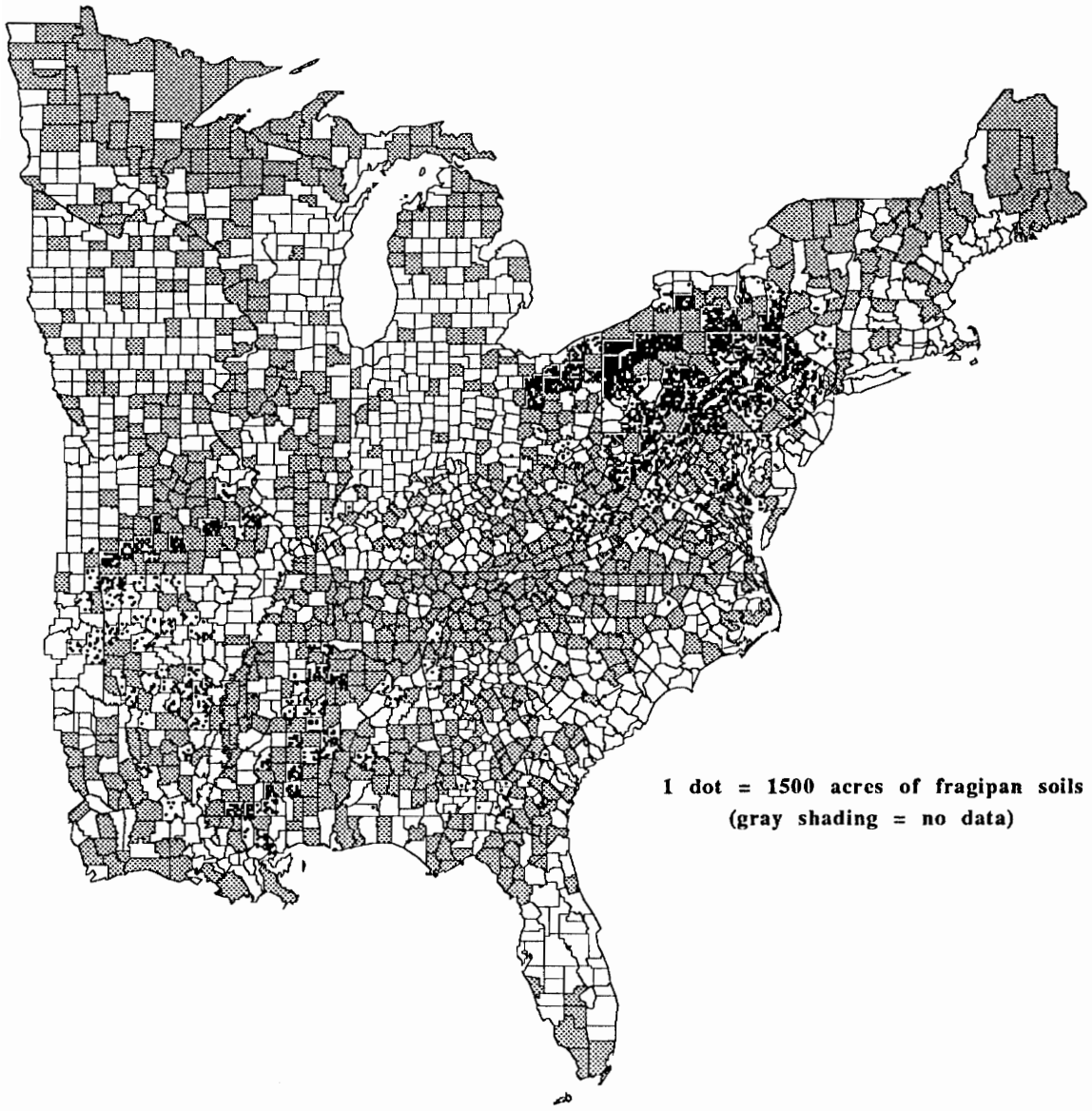

Figure 20. Fragipan Soils in the Fine-Loamy Particle Size Class

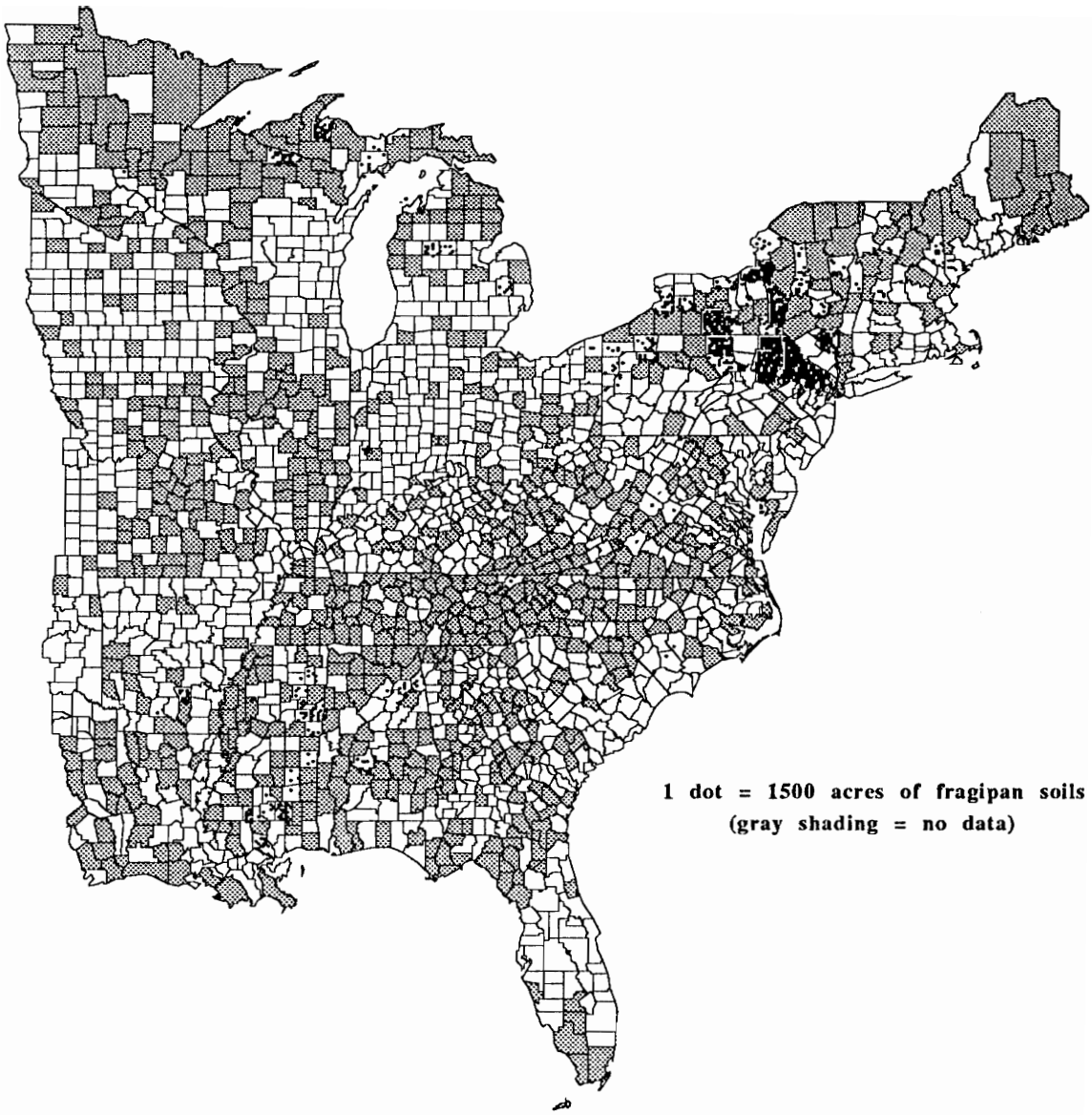

Figure 21. Fragipan Soils in the Coarse-Loamy Particle Size Class

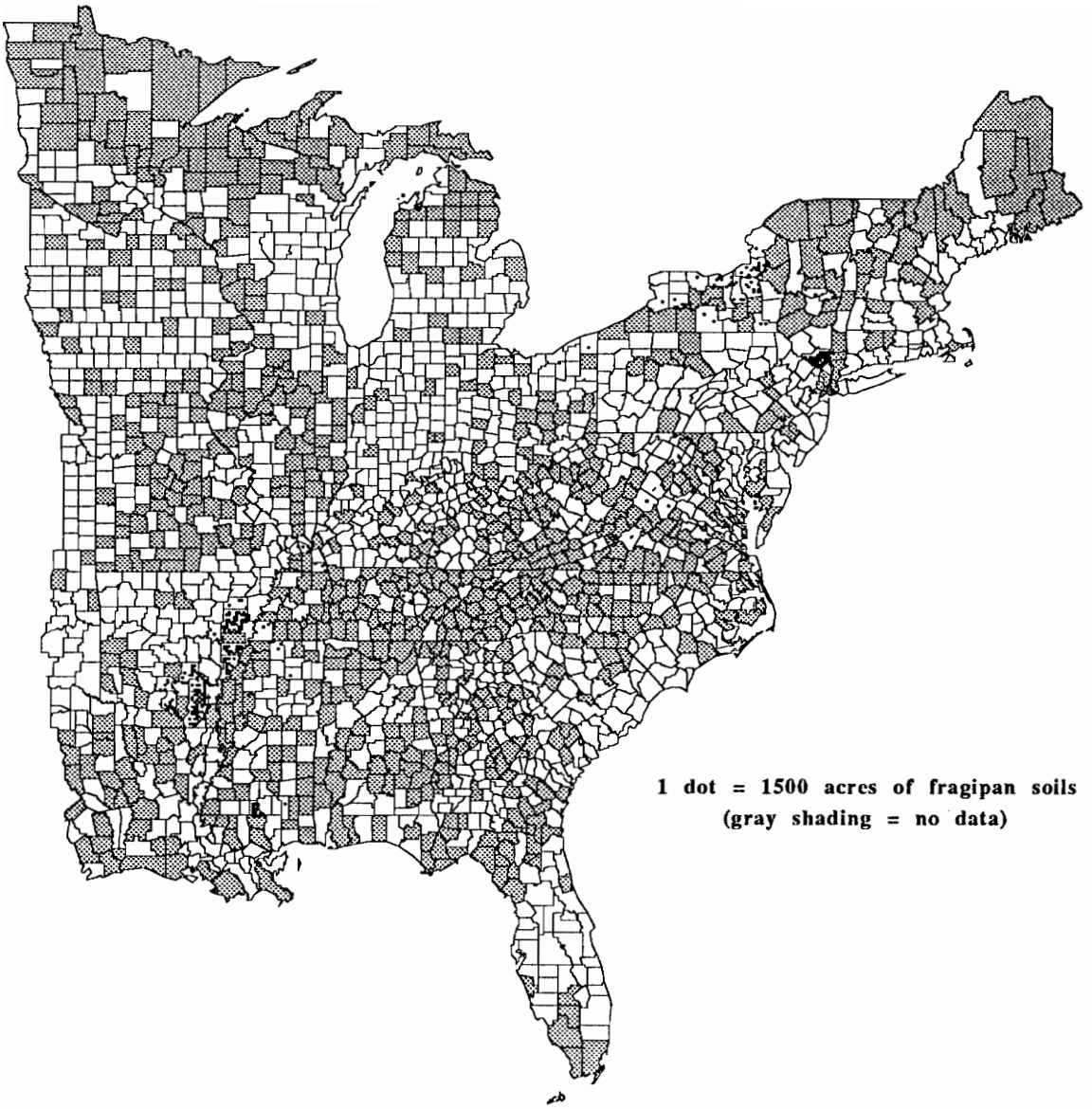

Figure 22. Fragipan Soils in the Coarse-Silty Particle Size Class

Table 15. Particle Size Class of Fragipan Soils in the Eastern United States

State	Fine-Silty	Fine-Loamy	Coarse-Loamy	Other	TOTALS
Alabama	136107	239281	54210	7192	436790
Arkansas	2476449	547081	28344	849802	3901676
Connecticut	0	0	0	0	0
Delaware	6712	3077	0	0	9789
Florida	0	0	0	0	0
Georgia	2512	125682	0	10249	138443
Illinois	763066	11623	0	42813	817502
Indiana	1812545	9383	19336	19809	1861073
Iowa	0	0	0	0	0
Kansas	0	2652	0	7578	10230
Kentucky	1978203	27886	0	44984	2051073
Louisiana	542189	134035	39706	0	715930
Maine	0	0	23570	0	23570
Maryland	73591	386747	0	0	460338
Massachussetts	0	1745	0	0	1745
Michigan	0	0	201970	20215	222185
Minnesota	0	0	2802	0	2802
Mississippi	1781665	756684	233050	92697	2864096
Missouri	313306	592162	0	1043207	1948675
New Hampshire	0	0	19123	0	19123
New Jersey	42058	147310	227952	0	417320
New York	0	987700	1276788	440420	2704908
North Carolina	0	7741	12709	10016	30466
Ohio	1046569	902006	2256	108280	2059111
Oklahoma	27300	90351	0	0	117651
Pennsylvania	414735	4772111	1393732	154019	6734597
Rhode Island	0	0	0	0	0
South Carolina	0	2536	0	14735	17271
Tennessee	599554	13611	5393	20272	638830
Texas	0	0	0	0	0
Vermont	0	0	19572	0	19572
Virginia	5932	224915	1792	4117	236756
West Virginia	52464	663100	0	0	715564
Wisconsin	0	0	54674	0	54674
TOTALS	12074957	10649419	3616979	2890405	29231760
as % of total	41%	36%	12%	10%	

significantly undercutting the Witty and Knox estimates. The areal distribution of soil particle size classes may provide insight into the ongoing debate regarding the role of uniform, fine textured sediments as a necessity to fragipan formation.

Figure 23 maps the areal distribution of soils where the depth to the top of the fragipan layers is less than 18 inches (as determined from the "typical pedon" description of each series provided in each survey). The only significant pattern discernable is the dominance of shallow fragipans coinciding with the pattern of fragipan Inceptisols as shown in Figure 11. The effects of erosion in the widespread occurrence of loessial fragipan soils in the southcentral states is not represented as well as one might expect (this lack of pattern may be an artifact of "typical pedons" versus "real world" soil erosion). Figure 24 maps soils where the depth to the top of the fragipan layer exceeds 32 inches. Concentrations of "deep" fragipans in central and eastern Pennsylvania and along the loessial areas of the Ohio and Mississippi Rivers are apparent; however, it is hard to differentiate between a "pattern" and the overall high concentration of fragipans (regardless of depth) in these areas.

Attempts to map the topographic position (taken from soil series descriptions in each soil survey) of fragipans on a national scale failed to reveal any significant geographical patterns. However, high concentrations of fragipan soils formed in "depressions" were noted in glacial till areas, while soils described as forming on "terraces" were dominant in the loessial regions along major rivers. The qualitative nature of the descriptors used in various surveys make any conclusions that bridge regions very questionable. For instance, the definitions for "toe" or "foot" slopes are likely to vary greatly depending on the relief in a given region (For example, consider the Front Range of Colorado as compared to the Flint Hills of Kansas). While the topographical position of fragipan soils is not conducive to mapping at this scale, its importance in studying fragipan genesis should not be dismissed.

More detailed analysis of the areal patterns of fragipan characteristics may provide insights and explanations to many unanswered questions about fragipans. The initial attempts provided here are offered as a mechanism to merge "traditional" soil science with geography.

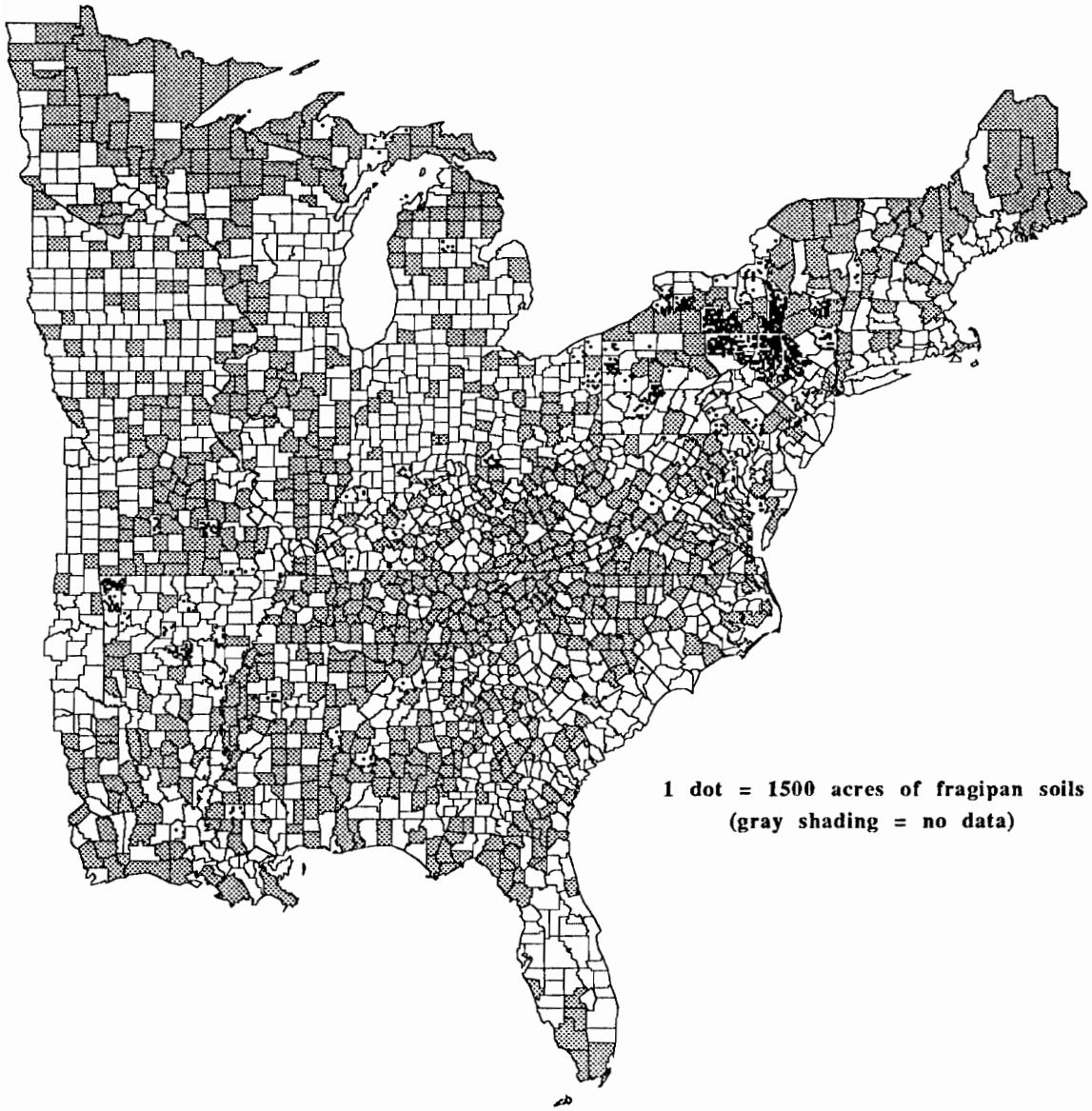

Figure 23. Soils with Depth to Fragipan less than 18 Inches

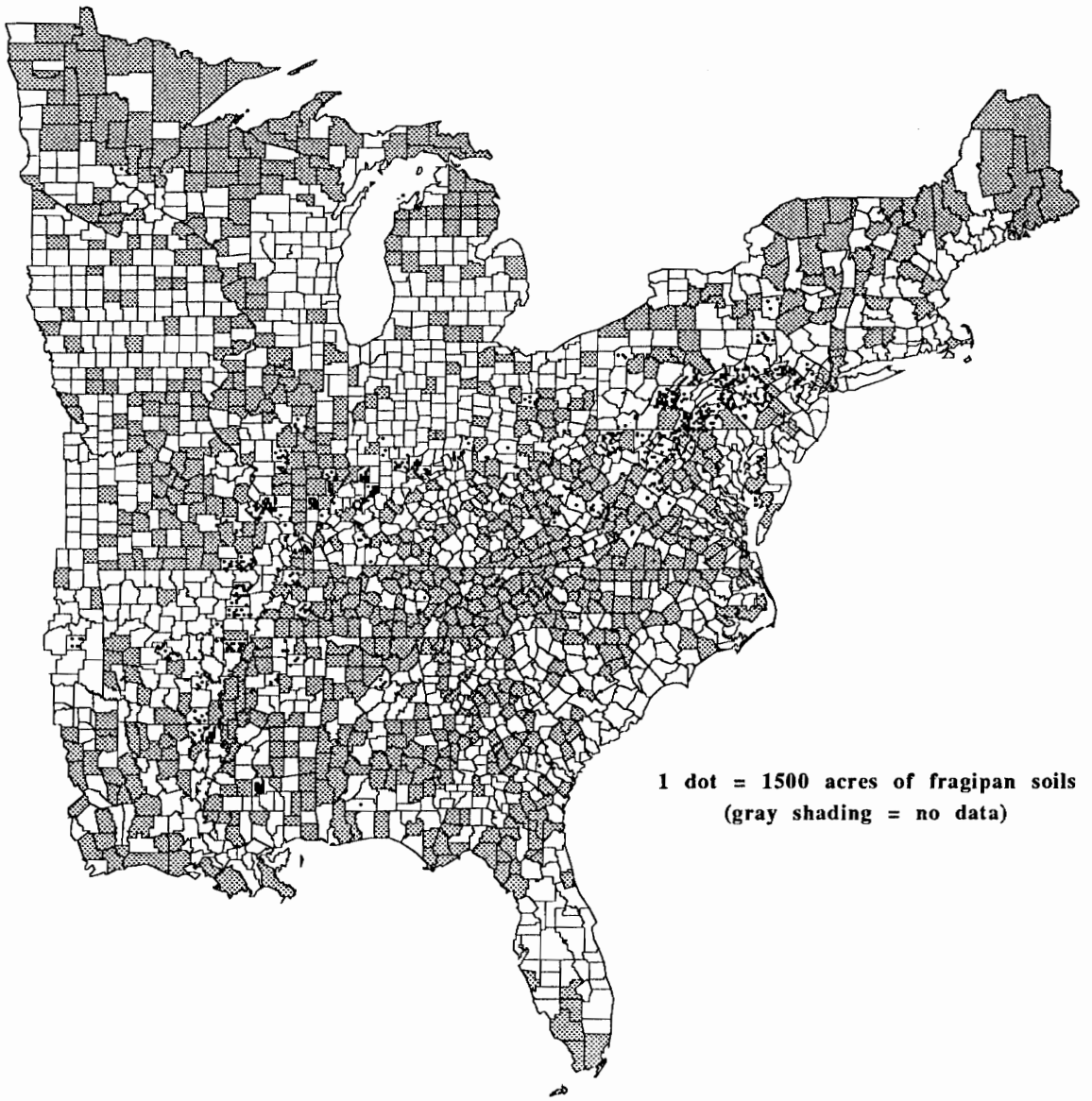

Figure 24. Soils with Depth to Fragipan greater than 32 Inches

X. CONCLUSIONS

The geographical perspective complements "traditional" soil science methodologies used in studying fragipans. While geography can provide insights not traditionally utilized by many soil scientists, it is clear that significant improvements in geographical soils information (soil survey coverage, MUUF data file coverage, accuracy, accessibility) are needed to more fully utilize this geographical perspective (the contradictions found by comparing various fragipan acreage estimates described earlier reiterates this point). Changing interpretations of fragipans and other soil characteristics require continual updates of soil survey information to ensure accurate mapping and understanding of soils information. The dramatic impact of reclassification of many soils formerly recognized as having fragipans clearly makes this point. As noted by Smith and Daniels (1989) in the southeast and Lindbo and Veneman (1989) in the northeast, the fact that these soils cannot meet all of the criteria necessary for consideration as a fragipan should not preclude the ability of the farmer, engineer, or soil scientist to identify a soil which limits root growth and impedes water flow. Witty and Knox (1989, p. 8)) suggest revising the current fragipan definition "To promote more universal recognition of an important limitation for the use of soils..." It is clear that such a revision is necessary based on the findings of this study.

Finally, regarding fragipan genesis, Smeck and Ciolkosz [in their summary of the papers presented in "Fragipans: Their Occurrence, Classification, and Genesis" (Soil Sci. Soc. Amer. Spec. Pub. No. 24, 1989)] state that:

> It seems reasonable to conclude that all three mechanisms suggested (physical ripening, clay bridging, and bonding by an amorphous component) are involved in fragipan formation. The dominant mechanism may vary from pedon to pedon giving rise to the variety of fragipans that have been described and studied. Undoubtedly all three mechanisms play a role in the development of the best expressed fragipans. Furthermore the evidence for the existence of an amorphous Si-rich aluminosilicate bonding agent in fragipans is becoming conclusive. (p. 153)

After reviewing fragipan genesis literature utilizing a geographic perspective, I strongly concur with this view . Efforts to bring soil scientists together to address problems associated with fragipan genesis and definition has created an emphasis on regional variability of fragipan characteristics never fully realized before. Historical review of fragipan genesis literature indicates that the search for a "universal" genesis theory to explain fragipan formation yielded many contradictions when compared to other areas. The recent acceptance of a "synergistic" view of fragipan genesis may be largely attributed to the incorporation of geographical perspective into fragipan genesis research. While the geographical perspective is not a panacea for addressing unsolved problems, it is an important tool which deserves consideration in fragipan soils research, as well as soils research in general.

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APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: BLOUNT | STATE: AL | AREA [sq. mi.]: 640 | AREA [acres]: 409600 | PUB. DATE: 1980 | FIELD DATE: 1966-1973 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: 5.6% | ACREAGE: 22937.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LEADVALE	TYPIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	THERMIC	NONE GIVEN	4		4	3	20	36	28	24	52	28	60	0.9	3686.40
STEMLEY	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4		4	2	17	32	25	18	40	22	65	0.5	2048.00
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	NONE GIVEN	3		4	2	20	36	28	21	75	54	75	0.1	409.60
WYNNVILLE	GLOSSIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4		4	2	18	36	27	33	48	15	72	4.1	16793.60

SURVEY NAME: CHEROKEE | STATE: AL | AREA [sq. mi.]: 548 | AREA [acres]: 350720 | PUB. DATE: 1978 | FIELD DATE: 1968-1972 | COND. DATE: 1972 | APPROV. DATE: 1973 | SURVEY AREA: 4.5% | ACREAGE: 15782.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BOMAR	TYPIC FRAGIUDULTS	CLAYEY	MIXED	THERMIC	ALLUVIUM	4		2	2	19	40	30	33	73	40	100	1.0	3507.20
CLOUDLAND	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4		4	2	18	28	23	26	36	10	72	2.4	8417.28
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2	2			20	36	28	20	43	23	60	0.2	701.44
STEMLEY	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4		4	2	17	36	27	17	33	16	65	0.9	3156.48

SURVEY NAME: DALLAS | STATE: AL | AREA [sq. mi.]: 976 | AREA [acres]: 624320 | PUB. DATE: 1979 | FIELD DATE: 1969-1977 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: 13.0% | ACREAGE: 81161.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MASHULAVILLE	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	2						17	74	57	90	3.8	23724.16
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3						29	72	43	72	9.2	57437.44

SURVEY NAME: ESCAMBIA | STATE: AL | AREA [sq. mi.]: 962 | AREA [acres]: 615680 | PUB. DATE: 1975 | FIELD DATE: 1969 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: 0.6% | ACREAGE: 3694.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	2	22	34	28	33	65	32	65	0.6	3694.08

SURVEY NAME: ETOWAH | STATE: AL | AREA [sq. mi.]: 555 | AREA [acres]: 355200 | PUB. DATE: 1978 | FIELD DATE: 1972-1976 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: 4.9% | ACREAGE: 17404.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CLOUDLAND	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	2	4						21	62	41	62	2.4	8524.80
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2	4			17	30	24	21	60	39	60	0.5	1776.00
STEMLEY	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	2	4			15	35	25	16	60	44	60	1.2	4262.40

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

WYNNVILLE	GLOSSIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	3	4						21	49	28	64	0.8	2841.60

SURVEY NAME: GREENE	STATE: AL	AREA [sq. mi.]: 637	AREA [acres]: 407680	PUB. DATE: 1971	FIELD DATE: 1960-1966	SURVEY AREA: % 8.1	ACREAGE 33022.08
				COND. DATE: 1966	APPROV. DATE: 1967		

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
DULAC	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	4							19	72	53	72	1.0	4076.80
MASHULAVILLE	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	2							15	80	65	80	1.0	4076.80
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT					20	30	25	26	72	46	72	1.7	6930.56
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT					20	30	25	23	72	49	72	4.4	17937.92

SURVEY NAME: LAUDERDALE	STATE: AL	AREA [sq. mi.]: 688	AREA [acres]: 440320	PUB. DATE: 1977	FIELD DATE: 1963-1973	SURVEY AREA: % 25.8	ACREAGE 113602.56
				COND. DATE: 1973	APPROV. DATE: 1973		

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
DICKSON	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4		4	2	24	30	27	25	44	19	72	24.3	106997.76
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	2	1			20	30	25	23	54	31	54	1.5	6604.80

SURVEY NAME: MARION	STATE: AL	AREA [sq. mi.]: 743	AREA [acres]: 475520	PUB. DATE: 1979	FIELD DATE: 1969-1976	SURVEY AREA: % 17.4	ACREAGE 82740.48
				COND. DATE: 1976	APPROV. DATE: 1976		

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	2			20	36	28	24	48	24	72	10.8	51356.16
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4		4	3				20	66	46	66	6.6	31384.32

SURVEY NAME: ST. CLAIR	STATE: AL	AREA [sq. mi.]: 640	AREA [acres]: 409600	PUB. DATE: 1985	FIELD DATE: 1982	SURVEY AREA: % 5.2	ACREAGE 21299.20
				COND. DATE: 1982	APPROV. DATE: 1983		

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	2			20	35	28	25	62	37	62	1.7	6963.20
WAX	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	2			25	35	30	25	62	37	62	3.5	14336.00

SURVEY NAME: SUMTER	STATE: AL	AREA [sq. mi.]: 907	AREA [acres]: 580480	PUB. DATE: 1989	FIELD DATE: 1985	SURVEY AREA: % 5.1	ACREAGE 29604.48
				COND. DATE: 1885	APPROV. DATE: 1985		

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3			16	30	23	18	65	47	65	5.1	29604.48

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: TUSCALOOSA | STATE: AL | AREA [sq. mi.]: 1349 | AREA [acres]: 863360 | PUB. DATE: 1981 | FIELD DATE: 1971-1979 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 1.8 | ACREAGE 15540.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SHATTA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4						21	60	39	60	1.8	15540.48

SURVEY NAME: ARKANSAS | STATE: AR | AREA [sq. mi.]: 1042 | AREA [acres]: 666880 | PUB. DATE: 1972 | FIELD DATE: 1956-1966 | COND. DATE: 1966 | APPROV. DATE: 1968 | SURVEY AREA: % 15.9 | ACREAGE 106033.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2						14	50	36	72	1.2	8002.56
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2						20	72	52	72	13.4	89361.92
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	5	3			20	30	25	21	42	21	72	1.3	8669.44

SURVEY NAME: ASHLEY | STATE: AR | AREA [sq. mi.]: 928 | AREA [acres]: 593920 | PUB. DATE: 1979 | FIELD DATE: 1971-1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 43.4 | ACREAGE 257761.28

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			18	40	29	32	72	40	72	3.1	18411.52
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			14	38	26	25	72	47	72	16.9	100372.48
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			17	30	24	26	72	46	72	11.3	67112.96
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	2			18	36	27	24	47	23	72	4.7	27914.24
PHEBA	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	3	3			14	30	22	28	72	44	72	3.0	17817.60
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			18	38	28	30	72	42	72	0.5	2969.60
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3			16	38	27	24	59	35	72	3.9	23162.88

SURVEY NAME: BAXTER & MARION | STATE: AR | AREA [sq. mi.]: 1215 | AREA [acres]: 777600 | PUB. DATE: 1983 | FIELD DATE: 1973-1978 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 10.4 | ACREAGE 80870.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2			16	30	23	24	44	20	72	0.9	6998.40
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			14	24	19	22	44	22	72	8.5	66096.00
SIDON	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	2			20	36	28	21	44	23	60	0.2	1555.20
TONTI	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			15	24	20	19	32	13	72	0.8	6220.80

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SURVEY NAME: BENTON | STATE: AR | AREA [sq. mi.]: 851 | AREA [acres]: 544640 | PUB. DATE: 1981 | FIELD DATE: 1972-1976 | COND. DATE: 1977 | APPROV. DATE: 1973 | SURVEY AREA: % 45.7 | ACREAGE 248900.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	2			18	26	22	22	40	18	68	0.2	1089.28
CAPTINA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			17	25	21	21	48	27	58	10.3	56097.92
JAY	MOLLIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	COLLUVIUM	4	2			18	28	23	22	54	32	62	2.1	11437.44
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	1			18	28	23	22	56	34	72	0.4	2178.56
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			14	24	19	17	30	13	50	24.4	132892.16
TONTI	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			15	24	20	19	42	23	42	8.3	45205.12

SURVEY NAME: BOONE | STATE: AR | AREA [sq. mi.]: 586 | AREA [acres]: 375040 | PUB. DATE: 1981 | FIELD DATE: 1972-1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 20.5 | ACREAGE 76883.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	2			36	50	43	43	72	29	72	1.8	6750.72
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	2			16	28	22	20	40	20	45	1.5	5625.60
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	2			16	30	23	21	50	29	50	1.5	5625.60
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			14	22	18	18	36	18	72	15.7	58881.28

SURVEY NAME: CALHOUN & DALLAS | STATE: AR | AREA [sq. mi.]: 632 | AREA [acres]: 404480 | PUB. DATE: 1980 | FIELD DATE: 1972-1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 17.9 | ACREAGE 72401.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
PHEBA	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	3	3			14	30	22	29	72	43	72	8.8	35594.24
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4			22	38	30	27	59	32	72	9.1	36807.68

SURVEY NAME: CARROLL | STATE: AR | AREA [sq. mi.]: 634 | AREA [acres]: 405760 | PUB. DATE: 1984 | FIELD DATE: 1981 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 13.1 | ACREAGE 53154.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	2			20	35	28	24	72	48	72	1.6	6492.16
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	2			16	28	22	26	52	26	72	2.9	11767.04
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			14	22	18	21	35	14	72	8.6	34895.36

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CLARK & HOT SPRING | STATE: AR | AREA [sq. mi.]: 1505 | AREA [acres]: 963200 | PUB. DATE: 1987 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA %: 2.9 | ACREAGE: 27932.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3			18	42	30	29	72	43	72	0.4	3852.80
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4			16	38	27	25	72	47	72	2.4	23116.80
SHERMORE	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	3			20	40	30	20	49	29	73	0.1	963.20

SURVEY NAME: CLAY | STATE: AR | AREA [sq. mi.]: 639 | AREA [acres]: 408960 | PUB. DATE: 1978 | FIELD DATE: 1971-1974 | COND. DATE: 1974 | APPROV. DATE: 1975 | SURVEY AREA %: 8.4 | ACREAGE: 34352.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			22	32	27	27	52	25	72	8.4	34352.64

SURVEY NAME: CLEBURNE & VAN BUREN | STATE: AR | AREA [sq. mi.]: 1316 | AREA [acres]: 842240 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA %: 3.9 | ACREAGE: 32847.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	2			20	32	26	23	72	49	72	0.7	5895.68
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2	2			20	36	28	27	72	45	72	0.2	1684.48
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	2			16	38	27	23	39	16	51	0.9	7580.16
SIDON	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	2			20	36	28	24	39	15	50	1.8	15160.32
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2			20	36	28	23	57	34	72	0.3	2526.72

SURVEY NAME: CLEVELAND | STATE: AR | AREA [sq. mi.]: 601 | AREA [acres]: 384640 | PUB. DATE: 1968 | FIELD DATE: 1960-1963 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA %: 23.0 | ACREAGE: 88467.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HATCHIE	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3				18	30	24	22	60	38	60	0.1	384.64
PHEBA	AQUEPTIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	3				18	36	27	20	32	12	60	6.8	26155.52
PRENTISS	TYPIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4				18	36	27	26	48	22	62	7.0	26924.80
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4				18	36	27	28	50	22	62	9.1	35002.24

SURVEY NAME: COLUMBIA | STATE: AR | AREA [sq. mi.]: 767 | AREA [acres]: 490880 | PUB. DATE: 1985 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA %: 0.6 | ACREAGE: 2945.28

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3			18	42	30	19	55	36	72	0.6	2945.28

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CONWAY | **STATE: AR** | AREA [sq. mi.]: 569 | AREA [acres]: 364160 | PUB. DATE: 1980 | FIELD DATE: 1972-1976 | COND. DATE: 1976 | APPROV. DATE: 1977 | SURVEY AREA %: 18.8 | SURVEY ACREAGE: 68462.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4			20	35	28	20	46	26	78	2.9	10560.64
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	2	2						17	47	30	84	2.7	9832.32
LEADVALE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			16	38	27	22	40	18	70	10.4	37872.64
TAFT	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	36	28	27	67	40	85	2.8	10196.48

SURVEY NAME: CRAIGHEAD | **STATE: AR** | AREA [sq. mi.]: 569 | AREA [acres]: 364160 | PUB. DATE: 1980 | FIELD DATE: 1972-1976 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA %: 16.9 | SURVEY ACREAGE: 61543.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			16	36	26	28	66	38	72	3.7	13473.92
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			20	30	25	23	62	39	72	1.4	5098.24
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	2						32	49	17	84	3.4	12381.44
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			22	32	27	28	72	44	72	8.4	30589.44

SURVEY NAME: CRAWFORD | **STATE: AR** | AREA [sq. mi.]: 596 | AREA [acres]: 381440 | PUB. DATE: 1979 | FIELD DATE: 1970-1974 | COND. DATE: 1976 | APPROV. DATE: 1975 | SURVEY AREA %: 9.5 | SURVEY ACREAGE: 36236.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	3			16	38	27	28	56	28	77	9.5	36236.80

SURVEY NAME: CROSS | **STATE: AR** | AREA [sq. mi.]: 626 | AREA [acres]: 400640 | PUB. DATE: 1968 | FIELD DATE: 1958-1963 | COND. DATE: 1963 | APPROV. DATE: 1966 | SURVEY AREA %: 35.1 | SURVEY ACREAGE: 140624.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			15	22	19	20	50	30	60	10.6	42467.84
GRENADA	OCHREPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			22	30	26	25	54	29	82	1.0	4006.40
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	1			25	36	31	31	52	21	52	17.5	70112.00
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4			24	36	30	30	48	18	48	6.0	24038.40

SURVEY NAME: DREW | **STATE: AR** | AREA [sq. mi.]: 836 | AREA [acres]: 535040 | PUB. DATE: 1976 | FIELD DATE: 1965-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA %: 39.4 | SURVEY ACREAGE: 210805.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2						28	72	44	72	7.2	38522.88

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2				26	72	46	72	12.4	66344.96
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	SILICEOUS	THERMIC	LOESS	2	2				29	54	25	72	9.2	49223.68
PHEBA	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	3	3	18	32	25	30	60	30	72	5.3	28357.12
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3	18	36	27	24	65	41	72	5.3	28357.12

SURVEY NAME: FAULKNER | STATE: AR | AREA [sq. mi.]: 641 | AREA [acres]: 410240 | PUB. DATE: 1979 | FIELD DATE: 1970-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 30.7 | ACREAGE 125943.68

							PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	3		16	38	27	26	64	38	73	20.8	85329.92
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	1		20	36	28	24	42	18	76	9.9	40613.76

SURVEY NAME: FRANKLIN | STATE: AR | AREA [sq. mi.]: 623 | AREA [acres]: 398720 | PUB. DATE: 1971 | FIELD DATE: 1960-1965 | COND. DATE: 1965 | APPROV. DATE: 1967 | SURVEY AREA: % 11.0 | ACREAGE 43859.20

							PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2	1		12	20	16	17	52	35	72	0.7	2791.04
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	2		18	26	22	22	72	50	72	7.5	29904.00
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	COLLUVIUM	4	2		24	36	30	23	60	37	60	0.8	3189.76
TAFT	AQUEPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3			14	23	19	15	58	43	58	2.0	7974.40

SURVEY NAME: FULTON & IZARD | STATE: AR | AREA [sq. mi.]: 1188 | AREA [acres]: 760320 | PUB. DATE: 1984 | FIELD DATE: 1973-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 0.5 | ACREAGE 3801.60

							PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2		16	30	23	20	46	26	72	0.5	3801.60

SURVEY NAME: GARLAND | STATE: AR | AREA [sq. mi.]: 734 | AREA [acres]: 469760 | PUB. DATE: 1989 | FIELD DATE: 1985 | COND. DATE: 1985 | APPROV. DATE: 1986 | SURVEY AREA: % 0.3 | ACREAGE 1409.28

							PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	2		16	38	27	29	48	19	72	0.3	1409.28

SURVEY NAME: GREENE | STATE: AR | AREA [sq. mi.]: 579 | AREA [acres]: 370560 | PUB. DATE: 1969 | FIELD DATE: 1958-64 | COND. DATE: 1965 | APPROV. DATE: 1966 | SURVEY AREA: % 17.6 | ACREAGE 65218.56

							PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3			16	22	19	19	41	22	84	4.3	15934.08
FREELAND	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4			20	26	23	24	43	19	84	0.3	1111.68

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		20	36	28	33	45	12	84	13.0	48172.80		

SURVEY NAME: HEMPSTEAD | STATE: AR | AREA [sq. mi.]: 726 | AREA [acres]: 464640 | PUB. DATE: 1979 | FIELD DATE: 1969-1974 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 8.7 | ACREAGE 40423.68

		FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION						SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3		20	40	30	28	72	44	72	2.7	12545.28
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3		20	38	29	25	72	47	72	6.0	27878.40

SURVEY NAME: HOWARD | STATE: AR | AREA [sq. mi.]: 600 | AREA [acres]: 384000 | PUB. DATE: 1975 | FIELD DATE: 1964-1968 | COND. DATE: 1968 | APPROV. DATE: 1970 | SURVEY AREA: % 2.1 | ACREAGE 8064.00

		FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION						SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	2					24	72	48	72	0.6	2304.00
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3					35	58	23	72	1.5	5760.00

SURVEY NAME: INDEPENDENCE | STATE: AR | AREA [sq. mi.]: 760 | AREA [acres]: 486400 | PUB. DATE: 1982 | FIELD DATE: 1975-1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 13.5 | ACREAGE 65664.00

		FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION						SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2		18	30	24	24	62	38	72	2.2	10700.80
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3		22	35	29	25	72	47	72	4.8	23347.20
SIDON	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	2		20	36	28	24	38	14	45	6.4	31129.60
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	3	2		20	36	28	22	46	24	72	0.1	486.40

SURVEY NAME: JACKSON | STATE: AR | AREA [sq. mi.]: 629 | AREA [acres]: 402560 | PUB. DATE: 1974 | FIELD DATE: 1964-1969 | COND. DATE: 1970 | APPROV. DATE: 1971 | SURVEY AREA: % 4.6 | ACREAGE 18517.76

		FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION						SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	3		20	30	25	24	60	36	60	4.6	18517.76

SURVEY NAME: JEFFERSON & LINCOLN | STATE: AR | AREA [sq. mi.]: 1435 | AREA [acres]: 918400 | PUB. DATE: 1980 | FIELD DATE: 1968-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 20.0 | ACREAGE 183680.00

		FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION						SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2		14	38	26	37	75	38	75	2.6	23878.40
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3		16	30	23	29	72	43	72	2.3	21123.20
HENRY	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	2		18	36	27	28	52	24	72	1.1	10102.40
PHEBA	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3		14	30	22	29	72	43	72	7.0	64288.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4				24	59	35	72	7.0	64288.00

SURVEY NAME: JOHNSON | STATE: AR | AREA [sq. mi.]: 680 | AREA [acres]: 435200 | PUB. DATE: 1977 | FIELD DATE: 1967-1972 | COND. DATE: 1972 | APPROV. DATE: 1973 | SURVEY AREA: % 7.5 | ACREAGE 32640.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	2		18	30	24	20	59	39	70	2.1	9139.20
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	2	2		20	30	25	22	72	50	72	0.7	3046.40
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	3		20	39	30	23	72	49	72	3.7	16102.40
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2		18	26	22	23	72	49	72	1.0	4352.00

SURVEY NAME: LAWRENCE | STATE: AR | AREA [sq. mi.]: 590 | AREA [acres]: 377600 | PUB. DATE: 1978 | FIELD DATE: 1964-1972 | COND. DATE: 1973 | APPROV. DATE: 1975 | SURVEY AREA: % 10.3 | ACREAGE 38892.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	2					20	40	20	72	7.2	27187.20
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3		18	26	22	19	72	53	72	1.8	6796.80
TONTI	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2					20	55	35	55	1.3	4908.80

SURVEY NAME: LEE | STATE: AR | AREA [sq. mi.]: 608 | AREA [acres]: 389120 | PUB. DATE: 1977 | FIELD DATE: 1967-1973 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 40.5 | ACREAGE 157593.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2					23	57	34	74	10.7	41635.84
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2					21	60	39	60	3.4	13230.08
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	2					32	63	31	76	16.5	64204.80
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3		24	32	28	26	52	26	80	9.9	38522.88

SURVEY NAME: LOGAN | STATE: AR | AREA [sq. mi.]: 732 | AREA [acres]: 468480 | PUB. DATE: 1980 | FIELD DATE: 1968-1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 30.1 | ACREAGE 141012.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	2		20	35	28	30	58	28	72	1.3	6090.24
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	2	2		20	35	28	24	72	48	72	0.5	2342.40
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2		16	38	27	23	42	19	60	24.4	114309.12
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	3			20	30	25	21	49	28	72	3.9	18270.72

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: LONOKE & PRAIRIE | STATE: AR | AREA [sq. mi.]: 1482 | AREA [acres]: 948480 | PUB. DATE: 1981 | FIELD DATE: 1975-1979 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA: % 25.3 | ACREAGE 239965.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			16	32	24	26	60	34	72	7.8	73981.44
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2			18	36	27	28	72	44	72	2.6	24660.48
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			22	30	26	26	58	32	72	14.2	134684.16
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	36	28	32	72	40	72	0.7	6639.36

SURVEY NAME: MADISON | STATE: AR | AREA [sq. mi.]: 837 | AREA [acres]: 535680 | PUB. DATE: 1986 | FIELD DATE: 1981 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: % 5.2 | ACREAGE 27855.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	MESIC	ALLUVIUM	4	2			17	25	21	20	52	32	72	0.5	2678.40
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1						22	34	12	72	0.3	1607.04
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2			17	26	22	19	47	28	78	1.1	5892.48
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			15	22	19	18	31	13	71	2.1	11249.28
TONTI	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			15	24	20	20	34	14	72	1.2	6428.16

SURVEY NAME: MONROE | STATE: AR | AREA [sq. mi.]: 607 | AREA [acres]: 388480 | PUB. DATE: 1978 | FIELD DATE: 1967-1972 | COND. DATE: 1972 | APPROV. DATE: 1974 | SURVEY AREA: % 7.8 | ACREAGE 30301.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			16	33	25	25	72	47	72	0.8	3107.84
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			22	36	29	22	58	36	72	6.6	25639.68
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			22	30	26	26	43	17	72	0.4	1553.92

SURVEY NAME: NEWTON | STATE: AR | AREA [sq. mi.]: 823 | AREA [acres]: 526720 | PUB. DATE: 1988 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 0.9 | ACREAGE 4740.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	2			20	36	28	25	47	22	54	0.2	1053.44
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			14	24	19	19	41	22	72	0.7	3687.04

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: OUACHITA | STATE: AR | AREA [sq. mi.]: 739 | AREA [acres]: 472960 | PUB. DATE: 1973 | FIELD DATE: 1962-1968 | COND. DATE: 1968 | APPROV. DATE: 1969 | SURVEY AREA: % 1.9 | ACREAGE 8986.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3						23	63	40	63	1.4	6621.44
MASHULAVILLE	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	2	2						25	46	21	60	0.3	1418.88
PHEBA	AQUEPTIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	3	3						24	72	48	72	0.2	945.92

SURVEY NAME: PERRY | STATE: AR | AREA [sq. mi.]: 561 | AREA [acres]: 359040 | PUB. DATE: 1982 | FIELD DATE: 1976-1979 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA: % 10.4 | ACREAGE 37340.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4		4	2	20	25	23	29	67	38	94	0.5	1795.20
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	2	2			20	40	30	21	72	51	72	3.8	13643.52
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	3						23	37	14	54	5.1	18311.04
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	36	28	22	60	38	76	1.0	3590.40

SURVEY NAME: PHILLIPS | STATE: AR | AREA [sq. mi.]: 728 | AREA [acres]: 465920 | PUB. DATE: 1974 | FIELD DATE: 1965-1970 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA: % 22.5 | ACREAGE 104832.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2						27	54	27	72	5.7	26557.44
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2						28	72	44	72	2.7	12579.84
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	2						25	49	24	74	7.8	36341.76
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			24	32	28	26	52	26	72	6.3	29352.96

SURVEY NAME: POINSETT | STATE: AR | AREA [sq. mi.]: 762 | AREA [acres]: 487680 | PUB. DATE: 1977 | FIELD DATE: 1966-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 22.3 | ACREAGE 108752.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			20	36	28	32	68	36	83	4.2	20482.56
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2						27	67	40	83	0.9	4389.12
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	2						28	45	17	72	15.0	73152.00
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			24	32	28	26	75	49	75	2.2	10728.96

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: POPE | **STATE: AR** | AREA [sq. mi.]: 822 | AREA [acres]: 526080 | PUB. DATE: 1981 | FIELD DATE: 1970-1978 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA %: 9.1 | ACREAGE: 47873.28

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIAQUULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	2			20	35	28	24	64	40	76	1.4	7365.12
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2	2			20	35	28	23	60	37	74	0.8	4208.64
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2			16	38	27	24	56	32	72	5.7	29986.56
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	30	25	25	56	31	72	1.2	6312.96

SURVEY NAME: PULASKI | **STATE: AR** | AREA [sq. mi.]: 765 | AREA [acres]: 489600 | PUB. DATE: 1975 | FIELD DATE: 1966-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA %: 11.9 | ACREAGE: 58262.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	2	2			15	30	23	16	46	30	72	3.2	15667.20
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	3			16	33	25	16	72	56	72	8.7	42595.20

SURVEY NAME: RANDOLPH | **STATE: AR** | AREA [sq. mi.]: 647 | AREA [acres]: 414080 | PUB. DATE: 1980 | FIELD DATE: 1972-1975 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA %: 16.5 | ACREAGE: 68323.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	2			16	30	23	20	58	38	72	12.0	49689.60
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			22	35	29	24	72	48	72	4.5	18633.60

SURVEY NAME: SALINE | **STATE: AR** | AREA [sq. mi.]: 728 | AREA [acres]: 465920 | PUB. DATE: 1979 | FIELD DATE: 1971-1975 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA %: 7.0 | ACREAGE: 32614.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4		3	2				27	49	22	60	1.0	4659.20
SAVANNAH	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	3				32	72	40	72	6.0	27955.20

SURVEY NAME: SEBASTIAN | **STATE: AR** | AREA [sq. mi.]: 537 | AREA [acres]: 343680 | PUB. DATE: 1975 | FIELD DATE: 1964-1970 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA %: 38.1 | ACREAGE: 130942.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	2			20	30	25	25	72	47	72	5.0	17184.00
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2			18	30	24	25	72	47	72	24.9	85576.32
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	30	25	26	59	33	72	8.2	28181.76

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: SHARP | STATE: AR | AREA [sq. mi.]: 607 | AREA [acres]: 388480 | PUB. DATE: 1984 | FIELD DATE: 1981 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA %: 1.8 | ACREAGE: 6992.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2						24	72	48	72	1.8	6992.64

SURVEY NAME: STONE | STATE: AR | AREA [sq. mi.]: 608 | AREA [acres]: 389120 | PUB. DATE: 1983 | FIELD DATE: 1975-1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA %: 2.0 | ACREAGE: 7782.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			14	24	19	15	38	23	78	2.0	7782.40

SURVEY NAME: WASHINGTON | STATE: AR | AREA [sq. mi.]: 963 | AREA [acres]: 616320 | PUB. DATE: 1969 | FIELD DATE: 1958-1964 | COND. DATE: 1968 | APPROV. DATE: 1966 | SURVEY AREA %: 18.2 | ACREAGE: 112170.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						20	54	34	60	5.7	35130.24
JAY	MOLLIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	5	2						25	72	47	72	0.8	4930.56
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	2			18	28	23	23	72	49	72	2.1	12942.72
NIXA	OCHREPTIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	5	1			14	24	19	16	32	16	40	6.2	38211.84
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	COLLUVIUM	4	2						22	70	48	70	3.4	20954.88

SURVEY NAME: WHITE | STATE: AR | AREA [sq. mi.]: 1041 | AREA [acres]: 666240 | PUB. DATE: 1981 | FIELD DATE: 1974-1979 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA %: 27.6 | ACREAGE: 183882.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			24	38	31	29	72	43	72	5.9	39308.16
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	2	2			20	36	28	24	72	48	72	0.9	5996.16
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	2			20	36	28	24	47	23	72	9.7	64625.28
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4	3			24	35	30	26	72	46	72	5.8	38641.92
SIDON	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4	2			24	36	30	25	41	16	55	3.1	20653.44
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	3	2			20	30	25	20	72	52	72	2.2	14657.28

SURVEY NAME: WOODRUFF | STATE: AR | AREA [sq. mi.]: 593 | AREA [acres]: 379520 | PUB. DATE: 1968 | FIELD DATE: 1956-1963 | COND. DATE: 1963 | APPROV. DATE: 1966 | SURVEY AREA %: 7.9 | ACREAGE: 29982.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			15	22	19	16	39	23	52	4.9	18596.48

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
GRENADA	OCHREPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				18	30	24	23	45	22	52	1.5	5692.80
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2	2			28	40	34	38	66	28	72	1.5	5692.80

SURVEY NAME: YELL | STATE: AR | AREA [sq. mi.]: 950 | AREA [acres]: 608000 | PUB. DATE: 1988 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA %: 21.9 | ACREAGE: 133152.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	2			20	35	28	26	60	34	72	4.5	27360.00
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2	2			20	40	30	22	72	50	72	5.2	31616.00
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2			16	30	23	25	51	26	72	8.7	52896.00
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	30	25	26	60	34	72	3.5	21280.00

SURVEY NAME: WASHINGTON | STATE: DC | AREA [sq. mi.]: 69 | AREA [acres]: 44160 | PUB. DATE: 1976 | FIELD DATE: 1974-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA %: 1.2 | ACREAGE: 529.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4				20	24	22	21	45	24	60	1.0	441.60
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4				18	24	21	18	41	23	60	0.2	88.32

SURVEY NAME: NEW CASTLE | STATE: DE | AREA [sq. mi.]: 437 | AREA [acres]: 279680 | PUB. DATE: 1970 | FIELD DATE: 1943-1965 | COND. DATE: 1965 | APPROV. DATE: 1966 | SURVEY AREA %: 3.5 | ACREAGE: 9788.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALDINO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4	3						19	36	17	48	1.5	4195.20
BUTLERTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4	2			30	38	34	38	52	14	60	0.6	1678.08
CALVERT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	2	2						18	30	12	48	0.3	839.04
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2						38	48	10	54	1.1	3076.48

SURVEY NAME: APPLING & JEFF DAVIS | STATE: GA | AREA [sq. mi.]: 843 | AREA [acres]: 539520 | PUB. DATE: 1975 | FIELD DATE: 1963-1968 | COND. DATE: 1968 | APPROV. DATE: 1969 | SURVEY AREA %: 1.9 | ACREAGE: 10250.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULT	NONE GIVEN OR	NONE GIVEN	NONE	MARINE SEDIMENT					25	35	30	26	60	34	60	1.9	10250.88

SURVEY NAME: BEN HILL & IRWIN | STATE: GA | AREA [sq. mi.]: 627 | AREA [acres]: 401280 | PUB. DATE: 1969 | FIELD DATE: 1963-1964 | COND. DATE: 1965 | APPROV. DATE: 1969 | SURVEY AREA %: 1.8 | ACREAGE: 7223.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC OCHREPTIC	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4			20	34	27					1.8	7223.04

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: BERRIEN & LANIER | STATE: GA | AREA [sq. mi.]: 645 | AREA [acres]: 412800 | PUB. DATE: 1973 | FIELD DATE: 1964-1966 | COND. DATE: 1967 | APPROV. DATE: 1973 | SURVEY AREA %: 8.0 | ACREAGE: 33024.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3			23	36	30					8.0	33024.00

SURVEY NAME: CANDLER, EVANS & TATTNALL | STATE: GA | AREA [sq. mi.]: 927 | AREA [acres]: 593280 | PUB. DATE: 1980 | FIELD DATE: 1965-1975 | COND. DATE: 1976 | APPROV. DATE: | SURVEY AREA %: 1.2 | ACREAGE: 7119.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULT	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4							34	-34			1.2	7119.36

SURVEY NAME: CHATOOGA, FLOYD & POLK | STATE: GA | AREA [sq. mi.]: 1143 | AREA [acres]: 731520 | PUB. DATE: 1978 | FIELD DATE: 1968-1973 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA %: 3.4 | ACREAGE: 24871.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WAX	TYPIC FRAGIUDULT	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	2						30	60	30	60	3.4	24871.68

SURVEY NAME: COLQUITT & COOK | STATE: GA | AREA [sq. mi.]: 796 | AREA [acres]: 509440 | PUB. DATE: 1975 | FIELD DATE: 1968-1969 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA %: 1.8 | ACREAGE: 9169.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULT	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	2			24	27	26	24	60	36	60	1.8	9169.92

SURVEY NAME: DOUGHERTY | STATE: GA | AREA [sq. mi.]: 326 | AREA [acres]: 208640 | PUB. DATE: 1968 | FIELD DATE: 1960-1963 | COND. DATE: 1964 | APPROV. DATE: 1965 | SURVEY AREA %: 1.7 | ACREAGE: 3546.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC OCHREPTIC	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3						23	54	31	54	1.7	3546.88

SURVEY NAME: LEE & TERRELL | STATE: GA | AREA [sq. mi.]: 684 | AREA [acres]: 437760 | PUB. DATE: 1978 | FIELD DATE: 1968-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA %: 2.3 | ACREAGE: 10068.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	2	18	32	25	20	57	37	67	2.3	10068.48

SURVEY NAME: MILLER & SEMINOLE | STATE: GA | AREA [sq. mi.]: 533 | AREA [acres]: 341120 | PUB. DATE: 1976 | FIELD DATE: 1966-1970 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA %: 1.8 | ACREAGE: 6140.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	2	22	32	27	29	44	15	62	1.8	6140.16

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: PIERCE | STATE: GA | AREA [sq. mi.]: 342 | AREA [acres]: 218880 | PUB. DATE: 1968 | FIELD DATE: 1960-1964 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 11.2 | ACREAGE 24514.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC OCHREPTIC	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4				20	36	28	26	33	7	60	11.2	24514.56

SURVEY NAME: SCHLEY & SUMTER | STATE: GA | AREA [sq. mi.]: 654 | AREA [acres]: 418560 | PUB. DATE: 1974 | FIELD DATE: 1965-1968 | COND. DATE: 1968 | APPROV. DATE: 1969 | SURVEY AREA: % 0.6 | ACREAGE 2511.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRVINGTON	PLINTHIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	2		14	34	24	22	41	19	60	0.6	2511.36

SURVEY NAME: BENEWAH | STATE: ID | AREA [sq. mi.]: 642 | AREA [acres]: 410880 | PUB. DATE: 1980 | FIELD DATE: 1962-1974 | COND. DATE: 1974 | APPROV. DATE: 1975 | SURVEY AREA: % 18.2 | ACREAGE 74780.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HELMER	ANDIC FRAGIOCHREPT	MEDIAL	NONE GIVEN	FRIGID	LOESS	4	1			15	33	24	19	60	41	60	12.4	50949.12
SANTA	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	FRIGID	LOESS	4	1			22	36	29	34	60	26	60	5.8	23831.04

SURVEY NAME: LATAH | STATE: ID | AREA [sq. mi.]: 753 | AREA [acres]: 481920 | PUB. DATE: 1981 | FIELD DATE: 1965-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 16.7 | ACREAGE 80480.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HELMER	ANDIC FRAGIOCHREPTS	MEDIAL	NONE GIVEN	FRIGID	LOESS	4	1						27	57	30	60	3.4	16385.28
SANTA	OCHREPTIC FRAGIXERALFS	COARSE-SILTY	MIXED	FRIGID	LOESS	4	1			20	36	28	26	60	34	60	13.3	64095.36

SURVEY NAME: BOND | STATE: IL | AREA [sq. mi.]: 383 | AREA [acres]: 245120 | PUB. DATE: 1983 | FIELD DATE: 1975-1979 | COND. DATE: 1980 | APPROV. DATE: 1981 | SURVEY AREA: % 5.6 | ACREAGE 13726.72

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	1		25	38	32	38	51	13	60	2.4	5882.88
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	1		20	40	30	32	49	17	60	3.2	7843.84

SURVEY NAME: CLARK | STATE: IL | AREA [sq. mi.]: 505 | AREA [acres]: 323200 | PUB. DATE: 1979 | FIELD DATE: 1966-1973 | COND. DATE: 1973 | APPROV. DATE: 1974 | SURVEY AREA: % 5.6 | ACREAGE 18099.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4				24	32	28	26	60	34	60	4.1	13251.20
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4				24	50	37	26	60	34	60	1.5	4848.00

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SURVEY NAME: EDWARDS & RICHLAND | STATE: IL | AREA [sq. mi.]: 589 | AREA [acres]: 376960 | PUB. DATE: 1972 | FIELD DATE: 1956-1965 | COND. DATE: 1965 | APPROV. DATE: 1967 | SURVEY AREA: % 13.4 | ACREAGE 50512.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			24	36	30	34	44	10	60	7.8	29402.88
GRANTSBURG	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	22	30	26	25	60	35	60	1.7	6408.32
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	40	32	38	44	6	68	2.2	8293.12
ROBBS	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	2						40	60	20	100	0.5	1884.80
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4							30	45	15	45	1.2	4523.52

SURVEY NAME: GALLATIN | STATE: IL | AREA [sq. mi.]: 327 | AREA [acres]: 209280 | PUB. DATE: 1969 | FIELD DATE: 1955-1964 | COND. DATE: 1964 | APPROV. DATE: 1966 | SURVEY AREA: % 9.6 | ACREAGE 20090.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		3	1				25	60	35	60	0.8	1674.24
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		3	2				30	30	0	79	6.8	14231.04
SCIOTOVILLE	AQUEPTIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	ALLUVIUM	4		4	3				34	41	7	52	1.1	2302.08
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	MESIC	LOESS	4		4	1				26	37	11	37	0.9	1883.52

SURVEY NAME: HAMILTON | STATE: IL | AREA [sq. mi.]: 435 | AREA [acres]: 278400 | PUB. DATE: 1986 | FIELD DATE: 1981 | COND. DATE: 1981 | APPROV. DATE: 1982 | SURVEY AREA: % 27.7 | ACREAGE 77116.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		3	1				40	60	20	60	16.3	45379.20
GRANTSBURG	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		3	1	24	40	32	38	68	30	68	6.4	17817.60
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	30	25	18	52	34	70	5.0	13920.00

SURVEY NAME: JACKSON | STATE: IL | AREA [sq. mi.]: 605 | AREA [acres]: 387200 | PUB. DATE: 1979 | FIELD DATE: 1969-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 17.5 | ACREAGE 67760.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		3	1	24	40	32	39	68	29	68	1.0	3872.00
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	24	36	30	25	67	42	67	16.5	63888.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: MACON | STATE: IL | AREA [sq. mi.]: 864 | AREA [acres]: 552960 | PUB. DATE: 1990 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1986 | SURVEY AREA: 2.6% | ACREAGE: 14376.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	36	48	42	42	50	8	60	2.6	14376.96

SURVEY NAME: MADISON | STATE: IL | AREA [sq. mi.]: 745 | AREA [acres]: 476800 | PUB. DATE: 1986 | FIELD DATE: 1981 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: 1.0% | ACREAGE: 4768.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	25	36	31	30	53	23	60	1.0	4768.00

SURVEY NAME: MONTGOMERY | STATE: IL | AREA [sq. mi.]: 706 | AREA [acres]: 451840 | PUB. DATE: 1969 | FIELD DATE: 1958-1963 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: 4.8% | ACREAGE: 21688.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						41	68	27	68	4.8	21688.32

SURVEY NAME: PERRY | STATE: IL | AREA [sq. mi.]: 443 | AREA [acres]: 283520 | PUB. DATE: 1988 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: | SURVEY AREA: 10.9% | ACREAGE: 30903.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		3	1	28	45	37					4.3	12191.36
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	20	40	30					6.6	18712.32

SURVEY NAME: POPE, HARDIN & MASSAC | STATE: IL | AREA [sq. mi.]: 809 | AREA [acres]: 517760 | PUB. DATE: 1975 | FIELD DATE: 1971 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA: 48.6% | ACREAGE: 251631.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1				22	48	26	73	1.3	6730.88
GINAT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2		2	1				34	49	15	71	2.0	10355.20
GRANTSBURG	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		2	1	24	30	27	24	61	37	71	16.2	83877.12
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			24	36	30	31	57	26	72	15.8	81806.08
LAX	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2						20	52	32	63	1.7	8801.92
ROBBS	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	2			24	31	28	29	44	15	65	0.1	517.76
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3						24	42	18	72	1.8	9319.68
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						36	45	9	72	1.7	8801.92
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			19	27	23	22	48	26	60	8.0	41420.80

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: PULASKI & ALEXANDER — STATE: IL — AREA [sq. mi.]: 452 — AREA [acres]: 289280 — PUB. DATE: 1968 — FIELD DATE: 1957-1963 — COND. DATE: 1965 — APPROV. DATE: 1964 — SURVEY AREA %: 14.8 — ACREAGE: 42813.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
GINAT	TYPIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	ALLUVIUM	2	2						35	47	12	51	2.5	7232.00
HOSMER	TYPIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	LOESS	4		3	2	20	36	28	31	60	29	60	9.0	26035.20
SCIOTOVILLE	TYPIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	ALLUVIUM	4	3						25		-25		1.6	4628.48
WEINBACH	AERIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	ALLUVIUM	3	2						30		-30		1.7	4917.76

SURVEY NAME: RANDOLPH — STATE: IL — AREA [sq. mi.]: 604 — AREA [acres]: 386560 — PUB. DATE: 1988 — FIELD DATE: 1982 — COND. DATE: 1982 — APPROV. DATE: 1983 — SURVEY AREA %: 13.4 — ACREAGE: 51799.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	25	40	33	33	50	17	60	13.4	51799.04

SURVEY NAME: SALINE — STATE: IL — AREA [sq. mi.]: 383 — AREA [acres]: 245120 — PUB. DATE: 1978 — FIELD DATE: 1960-1973 — COND. DATE: 1973 — APPROV. DATE: 1974 — SURVEY AREA %: 31.1 — ACREAGE: 76232.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	18	30	24	22	51	29	61	13.9	34071.68
GRANTSBURG	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	18	30	24	26	61	35	72	3.2	7843.84
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	36	30	28	49	21	62	10.0	24512.00
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	36	30	26	42	16	70	4.0	9804.80

SURVEY NAME: UNION — STATE: IL — AREA [sq. mi.]: 424 — AREA [acres]: 271360 — PUB. DATE: 1979 — FIELD DATE: 1971-1975 — COND. DATE: 1975 — APPROV. DATE: 1976 — SURVEY AREA %: 28.0 — ACREAGE: 75980.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	25	36	31	28	73	45	73	25.6	69468.16
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	3	23	32	28	32	65	33	65	2.4	6512.64

SURVEY NAME: BARTHOLOMEW — STATE: IN — AREA [sq. mi.]: 402 — AREA [acres]: 257280 — PUB. DATE: 1976 — FIELD DATE: 1967-1971 — COND. DATE: 1972 — APPROV. DATE: 1972 — SURVEY AREA %: 16.4 — ACREAGE: 42193.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			24	32	28	27	63	36	130	3.7	9519.36
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3			1	24	32	28	32	65	33	96	0.5	1286.40
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5			1	20	32	26	27	62	35	140	7.1	18266.88

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

DUBOIS	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3		1	23	35	29	27	66	39	150	0.7	1800.96
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		1	20	32	26	24	48	24	120	0.9	2315.52
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		1	24	32	28	25	58	33	130	2.7	6946.56
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5		1	24	36	30	26	57	31	72	0.8	2058.24

SURVEY NAME: BROWN | STATE: IN | AREA [sq. mi.]: 316 | AREA [acres]: 202240 | PUB. DATE: 1990 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1985 | SURVEY AREA: % 9.3 | ACREAGE 18808.32

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3		4	1	21	30	26	23	52	29	80	0.1	202.24
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	1	24	36	30	24	58	34	80	0.8	1617.92
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	20	36	28	26	52	26	80	3.2	6471.68
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1	20	30	25	22	41	19	60	2.7	5460.48
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	30	25	22	56	34	80	1.0	2022.40
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2				30	52	22	64	1.5	3033.60

SURVEY NAME: CLARK & FLOYD | STATE: IN | AREA [sq. mi.]: 533 | AREA [acres]: 341120 | PUB. DATE: 1974 | FIELD DATE: 1963-1967 | COND. DATE: 1967 | APPROV. DATE: 1968 | SURVEY AREA: % 28.6 | ACREAGE 97560.32

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3				22	30	26	24	64	40	76	4.2	14327.04
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			22	30	26	22	67	45	75	2.2	7504.64
BEDFORD	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			18	30	24	25	41	16	70	1.9	6481.28
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			18	30	24	22	45	23	76	5.2	17738.24
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			18	30	24	29	60	31	90	1.8	6140.16
JENNINGS	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			18	30	24	27	50	23	60	4.1	13985.92
JOHNSBURG	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			22	30	26	23	45	22	62	0.5	1705.60
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	25	63	38	70	0.8	2728.96
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			18	30	24	24	58	34	96	1.6	5457.92
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			22	30	26	28	55	27	65	0.4	1364.48
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			18	30	24	26	40	14	52	5.9	20126.08

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CLAY | STATE: IN | AREA [sq. mi.]: 364 | AREA [acres]: 232960 | PUB. DATE: 1982 | FIELD DATE: 1973-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 14.1 | ACREAGE 32847.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVA	TYPIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	LOESS	4	1			20	36	28	22	58	36	80	8.3	19335.68
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			24	36	30	21	56	35	80	5.8	13511.68

SURVEY NAME: CRAWFORD | STATE: IN | AREA [sq. mi.]: 312 | AREA [acres]: 199680 | PUB. DATE: 1975 | FIELD DATE: 1964-1969 | COND. DATE: 1969 | APPROV. DATE: 1970 | SURVEY AREA: % 21.5 | ACREAGE 42931.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			24	36	30	27	72	45	87	0.2	399.36
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			18	36	27	24	72	48	90	1.0	1996.80
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			18	36	27	31	76	45	82	0.2	399.36
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			18	36	27	29	46	17	57	8.9	17771.52
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1			20	30	25	24	44	20	76	11.2	22364.16

SURVEY NAME: DAVIESS | STATE: IN | AREA [sq. mi.]: 433 | AREA [acres]: 277120 | PUB. DATE: 1974 | FIELD DATE: 1965-1969 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 32.6 | ACREAGE 90341.12

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3			1				25	39	14	112	0.2	554.24
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1			15	30	23	25	58	33	110	8.6	23832.32
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1			14	36	25	33	62	29	100	21.0	58195.20
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			26	34	30	31	54	23	60	2.8	7759.36

SURVEY NAME: DEARBORN & OHIO | STATE: IN | AREA [sq. mi.]: 393 | AREA [acres]: 251520 | PUB. DATE: 1981 | FIELD DATE: 1973-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 24.3 | ACREAGE 61119.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3			1	24	36	30	26	72	46	80	2.9	7294.08
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3			1	24	36	30	28	58	30	60	0.1	251.52
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5			1	18	36	27	29	50	21	80	6.2	15594.24
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2	22	30	26	23	66	43	80	4.7	11821.44
WEISBURG	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	1	12	36	24	24	39	15	80	10.4	26158.08

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: DECATUR | STATE: IN | AREA [sq. mi.]: 370 | AREA [acres]: 236800 | PUB. DATE: 1983 | FIELD DATE: 1976-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA %: 17.3 | ACREAGE: 40966.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3			1	23	36	30	27	76	49	80	7.1	16812.80
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	18	38	28	26	60	34	80	5.2	12313.60
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	30	25	21	72	51	80	5.0	11840.00

SURVEY NAME: DUBOIS | STATE: IN | AREA [sq. mi.]: 433 | AREA [acres]: 277120 | PUB. DATE: 1980 | FIELD DATE: 1973-1977 | COND. DATE: 1977 | APPROV. DATE: 1978 | SURVEY AREA %: 35.1 | ACREAGE: 97269.12

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			24	36	30	30	50	20	60	0.4	1108.48
DUBOIS	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			20	36	28	30	58	28	80	1.9	5265.28
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			20	36	28	22	62	40	62	0.1	277.12
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			22	36	29	23	44	21	80	5.1	14133.12
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			24	36	30	25	44	19	70	1.3	3602.56
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	28	24	25	46	21	72	8.0	22169.60
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			24	32	28	32	47	15	79	18.3	50712.96

SURVEY NAME: FRANKLIN | STATE: IN | AREA [sq. mi.]: 391 | AREA [acres]: 250240 | PUB. DATE: 1989 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA %: 22.1 | ACREAGE: 55303.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3		4	1	21	28	25	21	75	54	80	5.2	13012.48
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	18	33	26	24	70	46	80	11.8	29528.32
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	18	40	29	21	65	44	80	4.9	12261.76
WEISBURG	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	20	34	27	23	39	16	62	0.2	500.48

SURVEY NAME: GIBSON | STATE: IN | AREA [sq. mi.]: 499 | AREA [acres]: 319360 | PUB. DATE: 1989 | FIELD DATE: 1984 | COND. DATE: 1985 | APPROV. DATE: 1986 | SURVEY AREA %: 15.4 | ACREAGE: 49181.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
GUDGEL	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	10	14	12	12	29	17	60	1.4	4471.04
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	20	30	25	23	80	57	80	14.0	44710.40

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: GREENE | **STATE: IN** | **AREA [sq. mi.]: 546** | **AREA [acres]: 349440** | **PUB. DATE: 1988** | **FIELD DATE: 1983** | **COND. DATE: 1983** | **APPROV. DATE: 1984** | **SURVEY AREA: 27.7 %** | **ACREAGE 96794.88**

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	30	25	29	53	24	80	9.2	32148.48
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1						27	52	25	60	0.2	698.88
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	18	30	24	22	46	24	80	6.7	23412.48
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			24	30	27	24	43	19	60	0.6	2096.64
SHAKAMAK	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	1						28	57	29	80	2.8	9784.32
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						23	46	23	60	8.2	28654.08

SURVEY NAME: HARRISON | **STATE: IN** | **AREA [sq. mi.]: 479** | **AREA [acres]: 306560** | **PUB. DATE: 1975** | **FIELD DATE: 1964-1968** | **COND. DATE: 1969** | **APPROV. DATE: 1969** | **SURVEY AREA: 8.4 %** | **ACREAGE 25751.04**

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			24	36	30	28	60	32	96	1.7	5211.52
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			18	30	24	25	40	15	76	3.6	11036.16
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			18	30	24	22	38	16	93	0.1	306.56
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			18	36	27	31	49	18	84	0.4	1226.24
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	1			18	30	24	23	46	23	96	0.4	1226.24
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			18	30	24	25	46	21	66	1.2	3678.72
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			18	30	24	23	59	36	92	0.4	1226.24
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5	1			18	30	24	29	50	21	65	0.6	1839.36

SURVEY NAME: JACKSON | **STATE: IN** | **AREA [sq. mi.]: 514** | **AREA [acres]: 328960** | **PUB. DATE: 1990** | **FIELD DATE: 1983** | **COND. DATE: 1984** | **APPROV. DATE: 1984** | **SURVEY AREA: 23.0 %** | **ACREAGE 75660.80**

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	2			24	36	30	36	77	41	85	0.5	1644.80
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			30	36	33	35	73	38	80	0.4	1315.84
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1				25	37	12	80	0.9	2960.64
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	18	38	28	23	61	38	80	3.0	9868.80
DUBOIS	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3		4	1				34	80	46	90	7.0	23027.20
HAUBSTADT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1	16	36	26	17	67	50	88	4.7	15461.12
MEDORA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1	20	36	28	21	45	24	80	0.8	2631.68

OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1						20	58	38	80	2.1	6908.16
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1	24	36	30	30	58	28	80	0.3	986.88
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			18	38	28	33	65	32	80	1.9	6250.24
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2				31	58	27	64	1.4	4605.44

SURVEY NAME: JEFFERSON | STATE: IN | AREA [sq. mi.]: 366 | AREA [acres]: 234240 | PUB. DATE: 1985 | FIELD DATE: 1979 | COND. DATE: 1980 | APPROV. DATE: 1982 | SURVEY AREA: % 34.5 | ACREAGE 80812.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1						30	57	27	80	11.0	25766.40
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2						33	56	23	80	12.1	28343.04
JENNINGS	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			15	30	23	27	51	24	68	1.4	3279.36
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	1						26	42	16	72	0.9	2108.16
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	1						25	57	32	60	0.5	1171.20
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						25	47	22	80	8.6	20144.64

SURVEY NAME: JENNINGS | STATE: IN | AREA [sq. mi.]: 377 | AREA [acres]: 241280 | PUB. DATE: 1976 | FIELD DATE: 1967-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 44.4 | ACREAGE 107128.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3			1	20	36	28	35	71	36	81	15.2	36674.56
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3			1	20	36	28	25	60	35	60	1.4	3377.92
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5			1	20	30	25	27	52	25	72	13.0	31366.40
JENNINGS	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5			1	20	30	25	23	60	37	60	3.7	8927.36
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			1	20	36	28	24	47	23	72	1.2	2895.36
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			1	20	30	25	30	60	30	80	9.9	23886.72

SURVEY NAME: KNOX | STATE: IN | AREA [sq. mi.]: 517 | AREA [acres]: 330880 | PUB. DATE: 1981 | FIELD DATE: 1973-1978 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 5.0 | ACREAGE 16544.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1						30	64	34	80	5.0	16544.00

SURVEY NAME: LAWRENCE | STATE: IN | AREA [sq. mi.]: 459 | AREA [acres]: 293760 | PUB. DATE: 1985 | FIELD DATE: 1978-1981 | COND. DATE: 1981 | APPROV. DATE: 1982 | SURVEY AREA: % 8.8 | ACREAGE 25850.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	2		4	1	24	36	30	24	67	43	80	0.8	2350.08

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	1	20	36	28	21	39	18	80	5.5	16156.80
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	1	20	40	30	28	54	26	80	1.8	5287.68
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	4	1	24	36	30	31	53	22	80	0.7	2056.32

SURVEY NAME: MARTIN | STATE: IN | AREA [sq. mi.]: 340 | AREA [acres]: 217600 | PUB. DATE: 1988 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA %: 14.9 | ACREAGE: 32422.40

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	1				24	53	29	80	0.5	1088.00
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2				23	80	57	80	0.1	217.60
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	23	27	25	26	55	29	80	1.6	3481.60
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3		4	2				23	42	19	70	0.4	870.40
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2				30	44	14	60	12.3	26764.80

SURVEY NAME: MONROE | STATE: IN | AREA [sq. mi.]: 412 | AREA [acres]: 263680 | PUB. DATE: 1981 | FIELD DATE: 1972-1977 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA %: 7.8 | ACREAGE: 20567.04

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	1	24	36	30	29	47	18	60	0.6	1582.08
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	20	36	28	20	28	8	80	2.9	7646.72
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	23	36	30	23	63	40	72	0.8	2109.44
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1	24	36	30	32	54	22	60	1.0	2636.80
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	18	28	23	26	48	22	58	1.8	4746.24
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	23	32	28	28	39	11	60	0.7	1845.76

SURVEY NAME: MORGAN | STATE: IN | AREA [sq. mi.]: 406 | AREA [acres]: 259840 | PUB. DATE: 1981 | FIELD DATE: 1974-1978 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA %: 8.3 | ACREAGE: 21566.72

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	1						29	62	33	80	3.0	7795.20
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1						26	57	31	76	0.4	1039.36
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1				27	49	22	80	0.2	519.68
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	20	40	30	23	47	24	80	3.5	9094.40
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1				21	56	35	60	0.1	259.84
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2				34	54	20	56	1.1	2858.24

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ORANGE | **STATE: IN** | AREA [sq. mi.]: 405 | AREA [acres]: 259200 | PUB. DATE: 1984 | FIELD DATE: 1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 10.7 | ACREAGE 27734.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	1	24	36	30	25	44	19	60	0.2	518.40
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	20	36	28	29	65	36	80	4.0	10368.00
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1	20	36	28	20	43	23	60	0.5	1296.00
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	24	36	30	25	43	18	60	6.0	15552.00

SURVEY NAME: PERRY | **STATE: IN** | AREA [sq. mi.]: 384 | AREA [acres]: 245760 | PUB. DATE: 1969 | FIELD DATE: 1956-1963 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: % 21.7 | ACREAGE 53329.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						32	60	28	82	0.5	1228.80
GINAT	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	2			18	30	24	23	38	15	80	0.1	245.76
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3	2						22	36	14	66	0.7	1720.32
PEKIN	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2						26	58	32	72	0.6	1474.56
SCIOTOVILLE	AQUEPTIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	26	60	34	100	0.6	1474.56
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			18	30	24	26	65	39	90	1.5	3686.40
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			18	30	24	23	40	17	65	0.8	1966.08
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5	2						31	58	27	64	16.9	41533.44

SURVEY NAME: PIKE | **STATE: IN** | AREA [sq. mi.]: 341 | AREA [acres]: 218240 | PUB. DATE: 1987 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1983 | SURVEY AREA: % 33.4 | ACREAGE 72892.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1						27	39	12	60	0.1	218.24
DUBOIS	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			24	36	30	31	55	24	70	1.3	2837.12
HAUBSTADT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						27	40	13	80	2.6	5674.24
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	1	20	36	28	31	63	32	80	12.7	27716.48
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1						11	46	35	70	3.7	8074.88
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	5		4	1	27	33	30	29	56	27	60	0.5	1091.20
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	32	26	21	50	29	65	12.5	27280.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: POSEY | **STATE: IN** | AREA [sq. mi.]: 414 | AREA [acres]: 264960 | PUB. DATE: 1979 | FIELD DATE: 1972-1977 | COND. DATE: 1975 | APPROV. DATE: 1977 | SURVEY AREA: % 6.1 | ACREAGE 16162.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
GINAT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	1			20	26	23	25	48	23	60	2.2	5829.12
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1			25	36	31	33	80	47	80	1.3	3444.48
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			24	32	28	30	58	28	80	0.2	529.92
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			20	30	25	20	45	25	60	2.4	6359.04

SURVEY NAME: PUTNAM | **STATE: IN** | AREA [sq. mi.]: 490 | AREA [acres]: 313600 | PUB. DATE: 1981 | FIELD DATE: 1975-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 8.4 | ACREAGE 26342.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			1				22	50	28	80	6.3	19756.80
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1						28	59	31	70	0.1	313.60
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2				29	54	25	80	2.0	6272.00

SURVEY NAME: RIPLEY | **STATE: IN** | AREA [sq. mi.]: 461 | AREA [acres]: 295040 | PUB. DATE: 1985 | FIELD DATE: 1981 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 43.8 | ACREAGE 129227.52

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			21	36	29	27	80	53	80	9.0	26553.60
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1						25	36	11	80	4.6	13571.84
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			18	38	28	25	65	40	80	16.1	47501.44
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	38	29	23	68	45	80	0.2	590.08
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			18	38	28	28	80	52	80	13.9	41010.56

SURVEY NAME: SPENCER | **STATE: IN** | AREA [sq. mi.]: 396 | AREA [acres]: 253440 | PUB. DATE: 1973 | FIELD DATE: 1964-1966 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: % 36.5 | ACREAGE 92505.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	NONE GIVEN	3	1						28	64	36	124	0.9	2280.96
GINAT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	1						18	50	32	100	1.3	3294.72
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1			24	30	27	25	83	58	83	6.8	17233.92
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			20	30	25	22	48	26	91	0.2	506.88
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1						26	44	18	85	0.4	1013.76
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4			1	20	36	28	31	60	29	120	1.1	2787.84

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		1	20	30	25	23	48	25	90	3.2	8110.08
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1					22	66	44	88	6.6	16727.04
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5		1	20	30	25	24	57	33	57	16.0	40550.40

SURVEY NAME: SULLIVAN | STATE: IN | AREA [sq. mi.]: 457 | AREA [acres]: 292480 | PUB. DATE: 1971 | FIELD DATE: 1958-1962 | COND. DATE: 1967 | APPROV. DATE: 1966 | SURVEY AREA: % 17.5 | ACREAGE 51184.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2		22	34	28	22	55	33	100	8.1	23690.88
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2		26	32	29	29	51	22	140	9.4	27493.12

SURVEY NAME: SWITZERLAND | STATE: IN | AREA [sq. mi.]: 224 | AREA [acres]: 143360 | PUB. DATE: 1987 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 25.4 | ACREAGE 36413.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1		24	36	30	17	70	53	80	3.0	4300.80
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2		24	38	31	27	64	37	88	9.6	13762.56
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1		24	36	30	22	43	21	60	0.3	430.08
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2		24	36	30	22	60	38	80	3.5	5017.60
WEISBURG	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	4	1	24	36	30	28	56	28	80	9.0	12902.40

SURVEY NAME: VANDERBURGH | STATE: IN | AREA [sq. mi.]: 241 | AREA [acres]: 154240 | PUB. DATE: 1976 | FIELD DATE: 1969-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 35.0 | ACREAGE 53984.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1		24	30	27	27	53	26	60	0.7	1079.68
GINAT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	1		18	26	22	23	52	29	75	0.7	1079.68
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1					29	68	39	73	22.3	34395.52
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	1		20	28	24	23	52	29	60	2.2	3393.28
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1		18	26	22	23	46	23	65	4.2	6478.08
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	5	1		23	30	27	26	50	24	60	4.9	7557.76

SURVEY NAME: WARRICK | STATE: IN | AREA [sq. mi.]: 391 | AREA [acres]: 250240 | PUB. DATE: 1979 | FIELD DATE: 1971-1975 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 40.7 | ACREAGE 101847.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2		24	36	30	29	55	26	79	1.3	3253.12
HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1		25	36	31	30	65	35	65	20.8	52049.92

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			18	30	24	30	58	28	80	0.4	1000.96
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			18	30	24	21	48	27	66	0.1	250.24
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			20	32	26	24	55	31	80	0.2	500.48
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			18	28	23	24	33	9	80	1.9	4754.56
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			18	30	24	25	52	27	80	0.2	500.48
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	5	2			23	32	28	32	52	20	70	15.8	39537.92

SURVEY NAME: WASHINGTON | STATE: IN | AREA [sq. mi.]: 517 | AREA [acres]: 330880 | PUB. DATE: 1988 | FIELD DATE: 1978-1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 20.5 | ACREAGE 67830.40

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			21	28	25	23	46	23	80	0.1	330.88
BARTLE	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			24	34	29	24	50	26	60	1.0	3308.80
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			24	28	26	24	51	27	80	13.6	44999.68
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	18	28	23	24	50	26	80	1.1	3639.68
DUBOIS	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3		4	2	18	24	21	22	46	24	80	0.3	992.64
HAUBSTADT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	24	22	24	40	16	80	0.2	661.76
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	1			18	28	23	22	48	26	80	0.2	661.76
PEKIN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1	24	28	26	27	44	17	60	1.9	6286.72
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	26	23	24	54	30	80	0.1	330.88
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	28	24	20	48	28	56	2.0	6617.60

SURVEY NAME: CHEROKEE | STATE: KS | AREA [sq. mi.]: 592 | AREA [acres]: 378880 | PUB. DATE: 1985 | FIELD DATE: 1980-1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 2.7 | ACREAGE 10229.76

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
GERALD	UMBRIC FRAGIAQUALFS	FINE	MIXED	MESIC	WEATHERED BEDROCK	3		4	1				22	42	20	60	0.2	757.76
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1						18	28	10	60	1.8	6819.84
TONTI	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2						19	28	9	60	0.7	2652.16

SURVEY NAME: ALLEN | STATE: KY | AREA [sq. mi.]: 351 | AREA [acres]: 224640 | PUB. DATE: 1989 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1986 | SURVEY AREA: % 10.1 | ACREAGE 22688.64

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1			25	30	28	27	56	29	72	9.5	21340.80
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	MESIC	ALLUVIUM	4	2			16	30	23	28	42	14	60	0.3	673.92

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
TAFT	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	36	28	25	55	30	65	0.3	673.92

SURVEY NAME: ANDERSON & FRANKLIN | STATE: KY | AREA [sq. mi.]: 500 | AREA [acres]: 320000 | PUB. DATE: 1985 | FIELD DATE: | COND. DATE: | APPROV. DATE: | SURVEY AREA: % 3.9 | ACREAGE 1600.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LAWRENCE	???	NONE GIVEN OR	NONE GIVEN	NONE	???												0.5	1600.00
NICHOLSON	???	NONE GIVEN OR	NONE GIVEN	NONE	???												1.9	0.00
OTWELL	???	NONE GIVEN OR	NONE GIVEN	NONE	???												1.5	0.00

SURVEY NAME: BALLARD & MCCRACKEN | STATE: KY | AREA [sq. mi.]: 509 | AREA [acres]: 325760 | PUB. DATE: 1976 | FIELD DATE: 1967-1971 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA: % 53.6 | ACREAGE 174607.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2					26	50	24	70	9.8	31924.48
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2		18	28	23	25	50	25	67	25.4	82743.04
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	ALLUVIUM	2	4	2		12	26	19	18	70	52	70	6.3	20522.88
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3		26	36	31	34	46	12	60	12.1	39416.96

SURVEY NAME: BARREN | STATE: KY | AREA [sq. mi.]: 486 | AREA [acres]: 311040 | PUB. DATE: 1969 | FIELD DATE: 1959-1966 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: % 14.1 | ACREAGE 43856.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
DICKSON	OCHREPTIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	2		24	30	27	28	36	8	72	8.6	26749.44
SANGO	OCHREPTIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	LOESS	4	4	2		20	26	23	23	46	23	46	1.9	5909.76
TAFT	AQUEPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	4	2		12	19	16	16	42	26	42	1.5	4665.60
TARKLIN	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	MESIC	ALLUVIUM	4	4	2		20	28	24	23	45	22	53	1.8	5598.72
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	2		24	30	27	28	46	18	46	0.3	933.12

SURVEY NAME: BOONE, CAMPBELL, & KENTON | STATE: KY | AREA [sq. mi.]: 563 | AREA [acres]: 360320 | PUB. DATE: 1973 | FIELD DATE: 1965-1967 | COND. DATE: 1968 | APPROV. DATE: 1968 | SURVEY AREA: % 24.3 | ACREAGE 87557.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3			2	21	32	27	24	36	12	50	0.6	2161.92
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			2	18	22	20	20	50	30	50	0.9	3242.88
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3				14	18	16	17	50	33	50	0.2	720.64
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	30	25	26	36	10	50	10.1	36392.32
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2				12	16	14	13	36	23	50	0.2	720.64

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		2		18	22	20	21	52	31	60	12.3	44319.36

SURVEY NAME: BOURBON & NICHOLAS | STATE: KY | AREA [sq. mi.]: 504 | AREA [acres]: 322560 | PUB. DATE: 1982 | FIELD DATE: 1968-1977 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 0.7 | ACREAGE 2257.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						29	48	19	66	0.1	322.56
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						24	44	20	80	0.5	1612.80
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			18	30	24	27	50	23	74	0.1	322.56

SURVEY NAME: BOYD & GREENUP | STATE: KY | AREA [sq. mi.]: 510 | AREA [acres]: 326400 | PUB. DATE: 1979 | FIELD DATE: 1969-1974 | COND. DATE: 1974 | APPROV. DATE: 1975 | SURVEY AREA: % 2.0 | ACREAGE 6528.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	4		2	24	30	27	30	51	21	65	0.5	1632.00
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			2	20	30	25	25	56	31	74	0.5	1632.00
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	4		1	20	28	24	25	58	33	72	0.8	2611.20
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3			1	18	28	23	24	50	26	70	0.2	652.80

SURVEY NAME: BOYLE & MERCER | STATE: KY | AREA [sq. mi.]: 439 | AREA [acres]: 280960 | PUB. DATE: 1983 | FIELD DATE: 1974-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 1.2 | ACREAGE 3371.52

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	19	28	9	78	0.6	1685.76
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2						23	44	21	60	0.6	1685.76

SURVEY NAME: BULLITT & SPENCER | STATE: KY | AREA [sq. mi.]: 492 | AREA [acres]: 314880 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 10.0 | ACREAGE 31488.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3			2				20	48	28	64	1.9	5982.72
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2				24	42	18	72	2.7	8501.76
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			1				26	42	16	62	2.7	8501.76
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	4		2				31	40	9	63	2.7	8501.76

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CALLOWAY & MARSHALL | **STATE: KY** | AREA [sq. mi.]: 687 | AREA [acres]: 439680 | PUB. DATE: 1973 | FIELD DATE: 1962-1966 | COND. DATE: 1967 | APPROV. DATE: 1968 | SURVEY AREA: % 46.7 | ACREAGE 205330.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2	13	25	19	18	50	32	50	8.2	36053.76
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	20	26	23	22	60	38	60	23.4	102885.12
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2		4	2	15	39	27	26	50	24	50	2.1	9233.28
LAX	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4		4	2	18	30	24	22	33	11	50	7.9	34734.72
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	24	35	30	29	50	21	50	5.1	22423.68

SURVEY NAME: CARROLL, GALLATIN, & OWEN | **STATE: KY** | AREA [sq. mi.]: 581 | AREA [acres]: 371840 | PUB. DATE: 1975 | FIELD DATE: 1968-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 6.8 | ACREAGE 25285.12

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	3			2				25	50	25	75	0.7	2602.88
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	20	28	24	24	36	12	60	3.8	14129.92
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	4		4	2	18	26	22	21	46	25	63	1.9	7064.96
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	2	2						18	46	28	60	0.4	1487.36

SURVEY NAME: CARTER | **STATE: KY** | AREA [sq. mi.]: 397 | AREA [acres]: 254080 | PUB. DATE: 1983 | FIELD DATE: 1974-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 1.2 | ACREAGE 3048.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	ALLUVIUM	4		4	2				28	48	20	62	0.5	1270.40
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	WEATHERED BEDROCK	4		4	1				24	50	26	65	0.7	1778.56

SURVEY NAME: CHRISTIAN | **STATE: KY** | AREA [sq. mi.]: 725 | AREA [acres]: 464000 | PUB. DATE: 1980 | FIELD DATE: 1966-1974 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 24.1 | ACREAGE 111824.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						26	44	18	60	1.3	6032.00
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			16	30	23	23	42	19	70	5.4	25056.00
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	2						16	66	50	66	1.0	4640.00
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2	18	32	25	24	56	32	74	5.0	23200.00
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4			2				26	40	14	68	11.4	52896.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CRITTENDEN | **STATE: KY** | AREA [sq. mi.]: 360 | AREA [acres]: 230400 | PUB. DATE: 1988 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 47.8 | ACREAGE 110131.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			18	36	27	29	60	31	60	0.2	460.80
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			20	30	25	25	46	21	70	2.7	6220.80
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	20	35	28	29	63	34	78	14.7	33868.80
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			16	30	23	20	59	39	78	4.9	11289.60
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1						26	54	28	80	1.7	3916.80
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			20	30	25	22	40	18	60	0.7	1612.80
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2			20	30	25	22	38	16	58	22.9	52761.60

SURVEY NAME: DAVIESS & HANCOCK | **STATE: KY** | AREA [sq. mi.]: 649 | AREA [acres]: 415360 | PUB. DATE: 1974 | FIELD DATE: 1965-1969 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA: % 27.6 | ACREAGE 114639.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2				27	50	23	50	0.9	3738.24
GINAT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2			2	15	30	23	20	40	20	52	1.8	7476.48
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	20	30	25	22	36	14	50	3.5	14537.60
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2				30	54	24	60	15.7	65211.52
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2				26	40	14	60	1.9	7891.84
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2				27	52	25	60	0.1	415.36
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	2				24	40	16	50	1.4	5815.04
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3		4	2	22	32	27	26	60	34	60	2.3	9553.28

SURVEY NAME: ESTILL & LEE | **STATE: KY** | AREA [sq. mi.]: 470 | AREA [acres]: 300800 | PUB. DATE: 1974 | FIELD DATE: 1958-1968 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 1.0 | ACREAGE 3008.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4				18	26	22	22	42	20	54	0.8	2406.40
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4			2	18	25	22	23	42	19	51	0.2	601.60

SURVEY NAME: FAYETTE | **STATE: KY** | AREA [sq. mi.]: 280 | AREA [acres]: 179200 | PUB. DATE: 1968 | FIELD DATE: 1962-1964 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 5.5 | ACREAGE 9856.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4				18	26	22	21	40	19	54	0.6	1075.20

LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3		2	15	24	20	20	33	13	48	0.3	537.60
MERCER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4			15	26	21	21	38	17	48	4.3	7705.60
RUSSELLVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	4	2	28	36	32	33	48	15	62	0.3	537.60

SURVEY NAME: GRANT & PENDLETON | STATE: KY | AREA [sq. mi.]: 528 | AREA [acres]: 337920 | PUB. DATE: 1980 | FIELD DATE: 1973-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA %: 5.4 | ACREAGE: 18247.68

NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		2	20	30	25	26	38	12	65	3.5	11827.20
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		2	18	32	25	23	48	25	65	1.8	6082.56
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2		2	18	30	24	25	50	25	65	0.1	337.92

SURVEY NAME: GRAYSON | STATE: KY | AREA [sq. mi.]: 514 | AREA [acres]: 328960 | PUB. DATE: 1972 | FIELD DATE: 1962-1966 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA %: 32.2 | ACREAGE: 105925.12

CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		2	18	26	22	24	49	25	49	0.1	328.96
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3		2	11	18	15	12	36	24	50	1.3	4276.48
MERCER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		2	17	25	21	23	34	11	52	0.5	1644.80
SADLER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		2	18	26	22	24	48	24	94	11.3	37172.48
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4			24	32	28	28	45	17	60	19.0	62502.40

SURVEY NAME: GREEN & TAYLOR | STATE: KY | AREA [sq. mi.]: 566 | AREA [acres]: 362240 | PUB. DATE: 1982 | FIELD DATE: 1972-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA %: 5.6 | ACREAGE: 20285.44

DICKSON	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4		2	24	30	27	26	38	12	65	2.6	9418.24
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		2	24	30	27	28	96	68	96	1.1	3984.64
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1		20	30	25	20	56	36	75	1.0	3622.40
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	3	2		20	36	28	24	60	36	60	0.8	2897.92
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	2		16	24	20	20	64	44	64	0.1	362.24

SURVEY NAME: HARDIN & LARUE | STATE: KY | AREA [sq. mi.]: 876 | AREA [acres]: 560640 | PUB. DATE: 1979 | FIELD DATE: 1967-1974 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA %: 12.0 | ACREAGE: 67276.80

GATTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	4	2	20	30	25	22	42	20	65	1.7	9530.88
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2					17	44	27	64	1.1	6167.04

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NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	21	28	25	23	41	18	86	5.0	28032.00
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	21	28	25	26	42	16	64	1.2	6727.68
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	2			15	25	20	16	45	29	66	0.2	1121.28
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2				28	51	23	64	2.8	15697.92

SURVEY NAME: HARRISON | STATE: KY | AREA [sq. mi.]: 308 | AREA [acres]: 197120 | PUB. DATE: 1968 | FIELD DATE: 1961-1964 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 1.1 | ACREAGE 2168.32

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4				14	24	19	20	37	17	50	0.6	1182.72
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3				14	18	16	16	29	13	48	0.2	394.24
MERCER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4				18	26	22	23	42	19	48	0.3	591.36

SURVEY NAME: HOPKINS | STATE: KY | AREA [sq. mi.]: 553 | AREA [acres]: 353920 | PUB. DATE: 1977 | FIELD DATE: 1966-1973 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 37.2 | ACREAGE 131658.24

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2	20	30	25	27	60	33	60	2.6	9201.92
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	20	32	26	29	60	31	60	4.3	15218.56
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	24	35	30	28	45	17	60	8.2	29021.44
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	20	32	26	20	48	28	65	0.2	707.84
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	18	28	23	24	41	17	60	2.8	9909.76
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	2	18	30	24	21	53	32	71	0.4	1415.68
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	32	28	31	39	8	68	18.7	66183.04

SURVEY NAME: JESSAMINE & WOODFORD | STATE: KY | AREA [sq. mi.]: 371 | AREA [acres]: 237440 | PUB. DATE: 1983 | FIELD DATE: 1971-1976 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 0.2 | ACREAGE 474.88

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3	2						18	43	25	75	0.2	474.88

SURVEY NAME: KNOX | STATE: KY | AREA [sq. mi.]: 388 | AREA [acres]: 248320 | PUB. DATE: 1988 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 0.1 | ACREAGE 248.32

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CLARKRANGE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2				26	50	24	72	0.1	248.32

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: LAUREL & ROCKCASTLE | **STATE: KY** | AREA [sq. mi.]: 756 | AREA [acres]: 483840 | PUB. DATE: 1981 | FIELD DATE: 1968-1972 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: 1.2 % | ACREAGE 5806.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4			1	20	30	25	23	45	22	65	0.4	1935.36
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2			20	28	24	23	43	20	43	0.8	3870.72

SURVEY NAME: LOGAN | **STATE: KY** | AREA [sq. mi.]: 563 | AREA [acres]: 360320 | PUB. DATE: 1975 | FIELD DATE: 1966-1970 | COND. DATE: 1970 | APPROV. DATE: 1972 | SURVEY AREA: 15.2 % | ACREAGE 54768.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3			1	18	26	22	20	56	36	56	0.3	1080.96
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3			2	18	30	24	22	52	30	52	0.8	2882.56
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2	20	30	25	25	42	17	42	2.1	7566.72
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	2	1			16	34	25	32	50	18	50	0.4	1441.28
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	18	28	23	23	48	25	78	3.6	12971.52
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	25	32	29	28	37	9	72	8.0	28825.60

SURVEY NAME: LYON & TRIGG | **STATE: KY** | AREA [sq. mi.]: 654 | AREA [acres]: 418560 | PUB. DATE: 1981 | FIELD DATE: 1972-1978 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: 15.0 % | ACREAGE 62784.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	2	2						23	43	20	60	0.3	1255.68
LAX	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4		4	2	18	35	27	24	49	25	72	4.5	18835.20
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	30	25	27	55	28	70	8.8	36833.28
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	1				22	38	16	60	0.3	1255.68
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	2	2			15	30	23	26	48	22	62	0.3	1255.68
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	18	26	22	26	42	16	60	0.3	1255.68
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	23	32	28	29	42	13	65	0.5	2092.80

SURVEY NAME: MADISON | **STATE: KY** | AREA [sq. mi.]: 446 | AREA [acres]: 285440 | PUB. DATE: 1973 | FIELD DATE: 1964-1967 | COND. DATE: 1967 | APPROV. DATE: 1968 | SURVEY AREA: 16.1 % | ACREAGE 45955.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	14	24	19	20	48	28	48	1.8	5137.92
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3	2			14	24	19	18	40	22	48	4.1	11703.04
MERCER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4				18	26	22	22	42	20	60	6.6	18839.04

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			20	48	28	48	0.5	1427.20
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		2		29	47	18	52	1.9	5423.36
ROBERTSVILLE	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	2				18	27	9	48	1.2	3425.28

SURVEY NAME: MASON | STATE: KY | AREA [sq. mi.]: 246 | AREA [acres]: 157440 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 4.5 | ACREAGE 7084.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2	18	30	24	21	43	22	73	4.2	6612.48
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1			18	30	24	20	57	37	94	0.3	472.32

SURVEY NAME: MCCREARY & WHITLEY | STATE: KY | AREA [sq. mi.]: 636 | AREA [acres]: 407040 | PUB. DATE: 1970 | FIELD DATE: 1962-1964 | COND. DATE: 1964 | APPROV. DATE: 1963 | SURVEY AREA: % 0.8 | ACREAGE 3256.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4				18	26	22	24	42	18	42	0.2	814.08
ROBERTSVILLE	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	2			10	22	16	11	42	31	42	0.2	814.08
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2			18	28	23	19	28	9	64	0.3	1221.12
TYLER	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3			2	10	20	15	15	32	17	42	0.1	407.04

SURVEY NAME: MCLEAN & MUHLENBERG | STATE: KY | AREA [sq. mi.]: 736 | AREA [acres]: 471040 | PUB. DATE: 1980 | FIELD DATE: 1969-1976 | COND. DATE: 1975 | APPROV. DATE: 1976 | SURVEY AREA: % 30.0 | ACREAGE 141312.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			16	30	23	24	65	41	65	1.1	5181.44
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	18	30	24	28	60	32	60	4.7	22138.88
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4			24	35	30	33	50	17	64	7.2	33914.88
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	18	36	27	27	45	18	60	0.7	3297.28
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	32	26	25	45	20	60	4.6	21667.84
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			16	30	23	26	56	30	70	0.5	2355.20
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	32	28	30	50	20	70	11.2	52756.48

SURVEY NAME: MENIFEE, ROWAN, & NORTHWEST MORGAN | STATE: KY | AREA [sq. mi.]: 538 | AREA [acres]: 344320 | PUB. DATE: 1974 | FIELD DATE: 1966-1969 | COND. DATE: 1974 | APPROV. DATE: 1971 | SURVEY AREA: % 4.4 | ACREAGE 15150.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			15	25	20	15	55	40	75	0.6	2065.92
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	1			20	26	23	21	48	27	65	0.1	344.32

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

MULLINS	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3	1		15	24	20	16	48	32	60	0.1	344.32
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2		18	28	23	24	56	32	65	3.6	12395.52

SURVEY NAME: MONROE | STATE: KY | AREA [sq. mi.]: 334 | AREA [acres]: 213760 | PUB. DATE: 1982 | FIELD DATE: 1967-1972 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA %: 5.0 | ACREAGE: 10688.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	1						26	38	12	61	4.0	8550.40
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						25	62	37	62	0.7	1496.32
TARKLIN	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	MESIC	ALLUVIUM	4	2						24	60	36	60	0.3	641.28

SURVEY NAME: MONTGOMERY | STATE: KY | AREA [sq. mi.]: 204 | AREA [acres]: 130560 | PUB. DATE: 1986 | FIELD DATE: 1978-1982 | COND. DATE: 1982 | APPROV. DATE: 1983 | SURVEY AREA %: 10.9 | ACREAGE: 14231.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2	16	30	23	27	49	22	60	1.9	2480.64
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			2	18	32	25	18	48	30	65	1.3	1697.28
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2			2	15	30	23	28	60	32	60	0.5	652.80
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			2	18	28	23	23	41	18	63	5.4	7050.24
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3			2	15	30	23	24	67	43	80	1.8	2350.08

SURVEY NAME: NELSON | STATE: KY | AREA [sq. mi.]: 437 | AREA [acres]: 279680 | PUB. DATE: 1971 | FIELD DATE: 1962-1966 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA %: 10.1 | ACREAGE: 28247.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	18	26	22	23	37	14	90	2.4	6712.32
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	18	26	22	23	37	14	90	2.3	6432.64
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	32	28	30	36	6	52	2.2	6152.96
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	1			12	20	16	28	40	12	54	0.8	2237.44
RUSSELLVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2				24	43	19	56	0.6	1678.08
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2				25	34	9	40	1.4	3915.52
ZANESVILLE	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	26	32	29	28	39	11	54	0.4	1118.72

SURVEY NAME: OHIO | STATE: KY | AREA [sq. mi.]: 606 | AREA [acres]: 387840 | PUB. DATE: 1987 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA %: 22.5 | ACREAGE: 87264.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			16	30	23	24	65	41	65	0.2	775.68

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

HOSMER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	3			24	33	29	30	70	40	70	2.2	8532.48
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	20	32	26	24	40	16	60	0.5	1939.20
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2	20	32	26	26	45	19	60	4.1	15901.44
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			20	30	25	22	40	18	60	0.5	1939.20
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	32	26	30	40	10	65	15.0	58176.00

SURVEY NAME: OLDHAM | STATE: KY | AREA [sq. mi.]: 184 | AREA [acres]: 117760 | PUB. DATE: 1977 | FIELD DATE: 1969-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 15.4 | ACREAGE 18135.04

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	3			2				22	38	16	63	0.9	1059.84
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2				27	36	9	58	13.1	15426.56
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			1				24	33	9	62	0.9	1059.84
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3							23	39	16	54	0.5	588.80

SURVEY NAME: PULASKI | STATE: KY | AREA [sq. mi.]: 653 | AREA [acres]: 417920 | PUB. DATE: 1974 | FIELD DATE: 1961-1969 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 8.7 | ACREAGE 36359.04

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4			2	20	30	25	24	59	35	65	4.8	20060.16
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			20	32	26	22	58	36	65	2.7	11283.84
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			20	30	25	27	54	27	65	0.1	417.92
ROBERTSVILLE	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	2			15	30	23	18	62	44	65	0.7	2925.44
TARKLIN	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	2						23	50	27	50	0.4	1671.68

SURVEY NAME: RUSSELL | STATE: KY | AREA [sq. mi.]: 238 | AREA [acres]: 152320 | PUB. DATE: 1982 | FIELD DATE: 1974-1978 | COND. DATE: 1979 | APPROV. DATE: 1978 | SURVEY AREA: % 6.3 | ACREAGE 9596.16

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
SANGO	GLOSSIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4			2	20	34	27	26	62	36	94	5.2	7920.64
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2			20	36	28	31	60	29	60	1.1	1675.52

SURVEY NAME: SCOTT | STATE: KY | AREA [sq. mi.]: 284 | AREA [acres]: 181760 | PUB. DATE: 1977 | FIELD DATE: 1972-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA: % 2.0 | ACREAGE 3635.20

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	16	30	23	21	34	13	60	2.0	3635.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: SHELBY | **STATE: KY** | AREA [sq. mi.]: 383 | AREA [acres]: 245120 | PUB. DATE: 1980 | FIELD DATE: 1975-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 0.4 | ACREAGE 980.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		1					25	44	19	61	0.4	980.48

SURVEY NAME: SIMPSON | **STATE: KY** | AREA [sq. mi.]: 236 | AREA [acres]: 151040 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 11.3 | ACREAGE 17067.52

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						17	44	27	62	3.1	4682.24
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						28	37	9	62	6.1	9213.44
ROBERTSVILLE	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	1			15	30	23	21	54	33	62	2.1	3171.84

SURVEY NAME: TODD | **STATE: KY** | AREA [sq. mi.]: 337 | AREA [acres]: 215680 | PUB. DATE: 1987 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 22.6 | ACREAGE 48743.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1						22	46	24	60	0.9	1941.12
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		1					25	52	27	60	1.6	3450.88
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		2		20	30	25	24	42	18	60	6.0	12940.80
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	3		2		18	32	25	26	44	18	60	8.8	18979.84
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		2		20	32	26	26	43	17	60	5.3	11431.04

SURVEY NAME: UNION & WEBSTER | **STATE: KY** | AREA [sq. mi.]: 679 | AREA [acres]: 434560 | PUB. DATE: 1981 | FIELD DATE: 1970-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 20.4 | ACREAGE 88650.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			18	30	24	21	61	40	61	0.8	3476.48
GRENADA	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			20	30	25	24	60	36	60	3.4	14775.04
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			24	35	30	31	50	19	60	7.8	33895.68
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2			18	28	23	23	45	22	60	1.1	4780.16
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			20	30	25	20	49	29	63	0.6	2607.36
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	32	28	30	47	17	69	6.7	29115.52

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: WARREN | **STATE: KY** | AREA [sq. mi.]: 546 | AREA [acres]: 349440 | PUB. DATE: 1981 | FIELD DATE: 1973-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: 11.4% | ACREAGE: 39836.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						18	60	42	60	1.4	4892.16
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	30	27	25	37	12	62	2.9	10133.76
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	2						18	40	22	70	0.4	1397.76
SADLER	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4			2	18	32	25	26	56	30	65	1.0	3494.40
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			23	32	28	23	45	22	56	5.7	19918.08

SURVEY NAME: WASHINGTON | **STATE: KY** | AREA [sq. mi.]: 301 | AREA [acres]: 192640 | PUB. DATE: 1986 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: 2.9% | ACREAGE: 5586.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						21	39	18	64	0.4	770.56
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2						23	51	28	62	1.9	3660.16
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	1						28	54	26	89	0.6	1155.84

SURVEY NAME: WAYNE | **STATE: KY** | AREA [sq. mi.]: 446 | AREA [acres]: 285440 | PUB. DATE: 1990 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1985 | SURVEY AREA: 0.9% | ACREAGE: 2568.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DICKSON	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4		4	1	24	36	30	26	44	18	60	0.6	1712.64
LAWRENCE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			20	32	26	26	60	34	60	0.3	856.32

SURVEY NAME: ASCENSION | **STATE: LA** | AREA [sq. mi.]: 300 | AREA [acres]: 192000 | PUB. DATE: 1976 | FIELD DATE: 1970-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA: 4.4% | ACREAGE: 8448.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
OLIVIER	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			18	32	25	18	61	43	61	4.4	8448.00

SURVEY NAME: AVOYELLES | **STATE: LA** | AREA [sq. mi.]: 850 | AREA [acres]: 544000 | PUB. DATE: 1986 | FIELD DATE: 1976-1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: 1.3% | ACREAGE: 7072.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4			22	35	29	25	61	36	61	1.3	7072.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CALDWELL | **STATE: LA** | AREA [sq. mi.]: 548 | AREA [acres]: 350720 | PUB. DATE: 1990 | FIELD DATE: 1986 | COND. DATE: 1986 | APPROV. DATE: 1986 | SURVEY AREA: % 9.7 | ACREAGE 34019.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
PRENTISS	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	4			20	32	26	24	64	40	84	0.2	701.44
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	4	3			18	38	28	24	54	30	72	1.5	5260.80
SAVANNAH	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	3			16	38	27	29	72	43	72	8.0	28057.60

SURVEY NAME: CATAHOULA | **STATE: LA** | AREA [sq. mi.]: 751 | AREA [acres]: 480640 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 3.5 | ACREAGE 16822.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			18	36	27	24	60	36	60	2.3	11054.72
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4			24	35	30	30	52	22	60	0.3	1441.92
NECESSITY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			20	37	29	27	58	31	80	0.1	480.64
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			20	35	28	25	43	18	60	0.8	3845.12

SURVEY NAME: EAST BATON ROUGE | **STATE: LA** | AREA [sq. mi.]: 457 | AREA [acres]: 292480 | PUB. DATE: 1968 | FIELD DATE: 1959-1964 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 27.8 | ACREAGE 81309.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
FREELAND	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	4	2						24	49	25	49	0.9	2632.32
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2				22	52	30	52	5.1	14916.48
OLIVIER	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2						22	64	42	64	20.9	61128.32
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2						22	74	52	74	0.9	2632.32

SURVEY NAME: EVANGELINE | **STATE: LA** | AREA [sq. mi.]: 668 | AREA [acres]: 427520 | PUB. DATE: 1974 | FIELD DATE: 1964-1968 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 1.7 | ACREAGE 7267.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	4			3				23	60	37	60	0.1	427.52
OLIVIER	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	3			2				12	45	33	65	1.2	5130.24
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	NONE GIVEN	4			3				34	85	51	100	0.4	1710.08

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: FRANKLIN | **STATE: LA** | AREA [sq. mi.]: 648 | AREA [acres]: 414720 | PUB. DATE: 1981 | FIELD DATE: 1975-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA %: 28.1 | ACREAGE: 116536.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			14	35	25					7.8	32348.16
GIGGER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	4	2			18	35	27					8.3	34421.76
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	4		4	3	22	35	29					8.3	34421.76
NECESSITY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	3	2			20	37	29					3.7	15344.64

SURVEY NAME: MOREHOUSE | **STATE: LA** | AREA [sq. mi.]: 808 | AREA [acres]: 517120 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1980 | APPROV. DATE: 1981 | SURVEY AREA %: 9.8 | ACREAGE: 50677.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUSHEY	TYPIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4	2			24	40	32	35	65	30	65	4.9	25338.88
DEBUTE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			20	40	30	27	70	43	90	1.6	8273.92
LIRUSE	TYPIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4	2			18	36	27	27	60	33	70	3.3	17064.96

SURVEY NAME: NATCHITOCHES | **STATE: LA** | AREA [sq. mi.]: 1303 | AREA [acres]: 833920 | PUB. DATE: 1990 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1985 | SURVEY AREA %: 0.7 | ACREAGE: 5837.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SHATTA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4	2			20	36	28	32	70	38	70	0.7	5837.44

SURVEY NAME: OUACHITA | **STATE: LA** | AREA [sq. mi.]: 643 | AREA [acres]: 411520 | PUB. DATE: 1974 | FIELD DATE: 1964-1968 | COND. DATE: 1968 | APPROV. DATE: 1968 | SURVEY AREA %: 8.2 | ACREAGE: 33744.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	4			28	42	35	40	60	20	60	2.9	11934.08
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	2						25	54	29	54	2.9	11934.08
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	2			18	40	29	22	62	40	62	2.4	9876.48

SURVEY NAME: RAPIDES | **STATE: LA** | AREA [sq. mi.]: 1362 | AREA [acres]: 871680 | PUB. DATE: 1980 | FIELD DATE: 1965-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA %: 1.3 | ACREAGE: 11331.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LIRUSE	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	2						20	42	22	60	1.3	11331.84

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: RED RIVER | **STATE: LA** | AREA [sq. mi.]: 395 | AREA [acres]: 252800 | PUB. DATE: 1980 | FIELD DATE: 1966-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: 4.5% | ACREAGE: 11376.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SHATTA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	2			20	36	28	30	70	40	70	4.5	11376.00

SURVEY NAME: ST. LANDRY | **STATE: LA** | AREA [sq. mi.]: 933 | AREA [acres]: 597120 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: 0.9% | ACREAGE: 5374.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			22	35	29	30	60	30	60	0.9	5374.08

SURVEY NAME: ST. TAMMANY | **STATE: LA** | AREA [sq. mi.]: 1128 | AREA [acres]: 721920 | PUB. DATE: 1990 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: 16.4% | ACREAGE: 118394.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4				20	32	26	25	62	37	62	5.5	39705.60
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	3			16	38	27	29	60	31	60	10.9	78689.28

SURVEY NAME: TANGIAPAHOA | **STATE: LA** | AREA [sq. mi.]: 838 | AREA [acres]: 536320 | PUB. DATE: 1990 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1985 | SURVEY AREA: 27.6% | ACREAGE: 148024.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
FLUKER	GLOSSIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3		4	2	18	40	29	31	70	39	70	1.8	9653.76
PRENTISS	GLOSSIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4		4	3	20	32	26	26	65	39	65	0.1	536.32
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	2			16	38	27	25	61	36	61	1.6	8581.12
TANGI	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4		4	1	18	38	28	25	65	40	65	14.9	79911.68
TOULA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4		4	2	18	38	28	19	48	29	65	9.2	49341.44

SURVEY NAME: WEST CARROLL | **STATE: LA** | AREA [sq. mi.]: 356 | AREA [acres]: 227840 | PUB. DATE: 1977 | FIELD DATE: 1972-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: 26.2% | ACREAGE: 59694.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			14	35	25	27	70	43	70	0.2	455.68
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2				33	64	31	64	26.0	59238.40

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: FRANKLIN | STATE: MO | AREA [sq. mi.]: 930 | AREA [acres]: 595200 | PUB. DATE: 1989 | FIELD DATE: 1985 | COND. DATE: 1985 | APPROV. DATE: 1985 | SURVEY AREA: % 19.1 | ACREAGE 113683.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
HOBSON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2	20	26	23	22	60	38	60	5.2	30950.40
UNION	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	4	2	26	32	29	30	51	21	60	13.9	82732.80

SURVEY NAME: IRON | STATE: MO | AREA [sq. mi.]: 552 | AREA [acres]: 353280 | PUB. DATE: 1991 | FIELD DATE: 1987 | COND. DATE: 1987 | APPROV. DATE: 1987 | SURVEY AREA: % 27.1 | ACREAGE 95738.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DELASSUS	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3	1	25	36	31	29	65	36	65	1.6	5652.48
KILLARNEY	TYPIC FRAGIUDULTS	LOAMY-SKELETAL	MIXED	MESIC	COLLUVIUM	4	4	1				36	80	44	80	8.2	28968.96
LEBANON	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	3	1	22	30	26	25	45	20	60	2.5	8832.00
VIRATON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	3	1	20	32	26	31	59	28	71	1.0	3532.80
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	COLLUVIUM	4	4	2	20	32	26	31	59	28	71	13.8	48752.64

SURVEY NAME: NEWTON | STATE: MO | AREA [sq. mi.]: 629 | AREA [acres]: 402560 | PUB. DATE: 1989 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: % 65.0 | ACREAGE 261664.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BADO	TYPIC FRAGIAQUALFS	FINE	MIXED	MESIC	COLLUVIUM	2	2	1	20	32	26	29	48	19	60	0.6	2415.36
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	MESIC	COLLUVIUM	4	4	2	18	27	23	24	54	30	60	1.1	4428.16
CRELDON	MOLLIC FRAGIUDALFS	FINE	MIXED	MESIC	COLLUVIUM	4	3	1	18	27	23	26	41	15	60	4.6	18517.76
GERALD	UMBRIC FRAGIAQUALFS	FINE	MIXED	MESIC	COLLUVIUM	3	4	1	20	30	25	28	48	20	60	4.5	18115.20
HOBERG	MOLLIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	4	1	18	27	23	24	46	22	60	6.6	26568.96
KENNO	MOLLIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	1	18	27	23	23	34	11	60	4.7	18920.32
NEEDLEYE	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	3	1	18	27	23	27	48	21	60	0.3	1207.68
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	3	1	18	27	23	26	36	10	60	30.3	121975.68
TONTI	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	1	18	27	23	25	44	19	60	12.3	49514.88

SURVEY NAME: HAMPDEN, CENTRAL PART | STATE: MA | AREA [sq. mi.]: 303 | AREA [acres]: 193920 | PUB. DATE: 1978 | FIELD DATE: 1960-1973 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 0.9 | ACREAGE 1745.28

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	3	18	30	24	19	60	41	60	0.9	1745.28

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ALLEGANY | **STATE: MD** | AREA [sq. mi.]: 428 | AREA [acres]: 273920 | PUB. DATE: 1977 | FIELD DATE: 1941-1966 | COND. DATE: 1966 | APPROV. DATE: 1968 | SURVEY AREA: % 12.8 | ACREAGE 35061.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		2					15	40	25	50	0.5	1369.60
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		2					25	60	35	60	3.1	8491.52
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		2					35	40	5	40	3.2	8765.44
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3							24	60	36	60	1.6	4382.72
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		2					38	78	40	78	1.8	4930.56
LANDISBURG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		2					22	44	22	44	0.6	1643.52
LOYSVILLE	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2		1					24	36	12	56	0.1	273.92
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5							31	40	9	60	0.7	1917.44
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		2					28	62	34	72	0.6	1643.52
NOLO	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2		1					23	60	37	60	0.4	1095.68
ROBERTSVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2		1					28	60	32	60	0.1	273.92
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						29	54	25	54	0.1	273.92

SURVEY NAME: ANNE ARUNDEL | **STATE: MD** | AREA [sq. mi.]: 417 | AREA [acres]: 266880 | PUB. DATE: 1973 | FIELD DATE: 1948-1967 | COND. DATE: 1968 | APPROV. DATE: 1968 | SURVEY AREA: % 1.3 | ACREAGE 3469.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4	2						26	40	14	60	0.2	533.76
BUTLERTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4							33	42	9	60	1.1	2935.68

SURVEY NAME: BALTIMORE CITY | **STATE: MD** | AREA [sq. mi.]: 610 | AREA [acres]: 390400 | PUB. DATE: 1976 | FIELD DATE: 1940-1969 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA: % 6.1 | ACREAGE 23814.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALDINO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2						17	37	20	60	0.8	3123.20
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4		2		20	32	26	28	43	15	60	1.3	5075.20
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4				20	30	25	21	44	23	60	0.3	1171.20
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	3						26	47	21	72	3.6	14054.40
LEONARDTOWN	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	2		1		28	44	36	21	58	37	74	0.1	390.40

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CALVERT | **STATE: MD** | AREA [sq. mi.]: 219 | AREA [acres]: 140160 | PUB. DATE: 1971 | FIELD DATE: 1948-1965 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA: % 1.1 | ACREAGE 1541.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4	2						23	50	27	50	0.4	560.64
BUTLERTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4	2			30	40	35	31	60	29	60	0.7	981.12

SURVEY NAME: CARROLL | **STATE: MD** | AREA [sq. mi.]: 453 | AREA [acres]: 289920 | PUB. DATE: 1969 | FIELD DATE: 1944-1964 | COND. DATE: 1966 | APPROV. DATE: 1965 | SURVEY AREA: % 5.6 | ACREAGE 16235.52

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ABBOTTSTOWN	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2						23	48	25	48	1.1	3189.12
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2						24	48	24	60	3.7	10727.04
RARITAN	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3							22	35	13	50	0.2	579.84
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4							20	30	10	48	0.6	1739.52

SURVEY NAME: CECIL | **STATE: MD** | AREA [sq. mi.]: 352 | AREA [acres]: 225280 | PUB. DATE: 1973 | FIELD DATE: 1945-1966 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA: % 16.1 | ACREAGE 36270.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALDINO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4							21	55	34	60	1.0	2252.80
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4		1					21	46	25	60	3.6	8110.08
BUTLERTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4							28	59	31	64	6.6	14868.48
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4							22	40	18	55	4.4	9912.32
LEONARDTOWN	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	2		1					17	39	22	50	0.5	1126.40

SURVEY NAME: CHARLES | **STATE: MD** | AREA [sq. mi.]: 458 | AREA [acres]: 293120 | PUB. DATE: 1974 | FIELD DATE: 1941-1969 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA: % 29.5 | ACREAGE 86470.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4	2			20	32	26	28	54	26	72	24.5	71814.40
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	2			18	28	23	23	60	37	60	3.2	9379.84
LEONARDTOWN	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	2							16	40	24	72	1.8	5276.16

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: GARRETT | **STATE: MD** | AREA [sq. mi.]: 662 | AREA [acres]: 423680 | PUB. DATE: 1974 | FIELD DATE: 1944-1968 | COND. DATE: 1969 | APPROV. DATE: 1970 | SURVEY AREA: % 28.6 | ACREAGE 121172.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3						18	44	26	60	2.2	9320.96
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2						24	38	14	60	2.2	9320.96
BENKERTON	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2							30	50	20	50	2.2	9320.96
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		2					24	38	14	38	12.9	54654.72
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3						30	60	30	60	7.0	29657.60
LADIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5							32	76	44	76	0.4	1694.72
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3						33	44	11	60	1.3	5507.84
NOLO	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2						25	53	28	53	0.4	1694.72

SURVEY NAME: HARFORD | **STATE: MD** | AREA [sq. mi.]: 378 | AREA [acres]: 241920 | PUB. DATE: 1975 | FIELD DATE: 1940-1970 | COND. DATE: 1973 | APPROV. DATE: 1971 | SURVEY AREA: % 8.9 | ACREAGE 21530.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALDINO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2						24	36	12	49	3.0	7257.60
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4	2			20	34	27	27	42	15	60	1.4	3386.88
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3	3			15	30	23	15	28	13	60	4.3	10402.56
LEONARDTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	2	2						16	45	29	60	0.2	483.84

SURVEY NAME: HOWARD | **STATE: MD** | AREA [sq. mi.]: 250 | AREA [acres]: 160000 | PUB. DATE: 1968 | FIELD DATE: 1945-1962 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 6.8 | ACREAGE 10880.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALDINO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		1					22	36	14	60	0.2	320.00
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2						22	39	17	54	1.8	2880.00
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4							17	37	20	50	4.5	7200.00
LEONARDTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	2	2						18	34	16	44	0.3	480.00

SURVEY NAME: KENT | **STATE: MD** | AREA [sq. mi.]: 281 | AREA [acres]: 179840 | PUB. DATE: 1982 | FIELD DATE: 1976-1978 | COND. DATE: 1978 | APPROV. DATE: 1979 | SURVEY AREA: % 3.0 | ACREAGE 5395.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUTLERTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4	3			30	38	34	31	65	34	75	3.0	5395.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: PRINCE GEORGES | **STATE: MD** | AREA [sq. mi.]: 485 | AREA [acres]: 310400 | PUB. DATE: 1967 | FIELD DATE: 1941-1963 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 12.0 | ACREAGE 37248.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4							25	50	25	72	10.0	31040.00
BUTLERTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4							32	45	13	72	0.1	310.40
LEONARDTOWN	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2							12	49	37	70	1.9	5897.60

SURVEY NAME: QUEEN ANNES | **STATE: MD** | AREA [sq. mi.]: 373 | AREA [acres]: 238720 | PUB. DATE: 1966 | FIELD DATE: 1942-1961 | COND. DATE: 1964 | APPROV. DATE: 1964 | SURVEY AREA: % 4.7 | ACREAGE 11219.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUTLERTOWN	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	4							34	49	15	60	4.7	11219.84

SURVEY NAME: ST. MARY'S | **STATE: MD** | AREA [sq. mi.]: 367 | AREA [acres]: 234880 | PUB. DATE: 1978 | FIELD DATE: 1941-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 21.3 | ACREAGE 50029.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BELTSVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	MARINE SEDIMENT	4			1	20	32	26	24	42	18	73	19.1	44862.08
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4		2	1				25	55	30	60	2.1	4932.48
LEONARDTOWN	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	MARINE SEDIMENT	2		2	1	21	30	26	21	45	24	60	0.1	234.88

SURVEY NAME: YORK | **STATE: ME** | AREA [sq. mi.]: 1023 | AREA [acres]: 654720 | PUB. DATE: 1982 | FIELD DATE: 1966-1977 | COND. DATE: 1977 | APPROV. DATE: 1978 | SURVEY AREA: % 3.6 | ACREAGE 23569.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WESTBURY	TYPIC FRAGIAQUODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	3				13	24	19	23	60	37	60	3.6	23569.92

SURVEY NAME: ALGER (DELTA & HIAWATHA N. F.) | **STATE: MI** | AREA [sq. mi.]: 1000 | AREA [acres]: 640000 | PUB. DATE: 1977 | FIELD DATE: 1958-1967 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA: % 2.3 | ACREAGE 14720.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MUNISING	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4		4	2	15	20	18	16	46	30	60	2.3	14720.00

SURVEY NAME: BARAGA | **STATE: MI** | AREA [sq. mi.]: 929 | AREA [acres]: 594560 | PUB. DATE: 1988 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1984 | SURVEY AREA: % 22.8 | ACREAGE 135559.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CHAMPION	TYPIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4		4	2				21	53	32	60	8.5	50537.60
KALLIO	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4		4	2	12	22	17	16	34	18	60	1.0	5945.60

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

MUNISING	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	4	2	15	24	20	21	48	27	80	5.6	33295.36
NET	TYPIC FRAGIAQUODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	4	2				23	39	16	60	3.0	17836.80
SKANEE	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	3	4	2	15	24	20	18	30	12	60	1.3	7729.28
YALMER	ALFIC FRAGIORTHODS	SANDY	MIXED	FRIGID	GLACIAL TILL	4	6	2	20	40	30	23	39	16	70	3.4	20215.04

SURVEY NAME: CLARE | STATE: MI | AREA [sq. mi.]: 576 | AREA [acres]: 368640 | PUB. DATE: 1979 | FIELD DATE: 1967-1976 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 3.1 | ACREAGE 11427.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCBRIDE	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	5	2				15	38	23	60	3.1	11427.84

SURVEY NAME: DELTA & HIAWATHA NATL FOREST | STATE: MI | AREA [sq. mi.]: 1000 | AREA [acres]: 640000 | PUB. DATE: 1977 | FIELD DATE: 1958-1967 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA: % 1.7 | ACREAGE 10880.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SKANEE	ALFIC FRAGIAQUODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	3	4	2				14	33	19	60	0.3	1920.00
STEUBEN	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	4	2	17	26	22	19	38	19	60	1.4	8960.00

SURVEY NAME: LAPEER | STATE: MI | AREA [sq. mi.]: 659 | AREA [acres]: 421760 | PUB. DATE: 1972 | FIELD DATE: 1954-1962 | COND. DATE: 1962 | APPROV. DATE: 1966 | SURVEY AREA: % 5.5 | ACREAGE 23196.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCBRIDE	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	4					23	30	7	60	5.5	23196.80

SURVEY NAME: OSCEOLA | STATE: MI | AREA [sq. mi.]: 581 | AREA [acres]: 371840 | PUB. DATE: 1969 | FIELD DATE: 1952-1959 | COND. DATE: 1959 | APPROV. DATE: 1966 | SURVEY AREA: % 7.1 | ACREAGE 26400.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCBRIDE	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	5	4	3								7.1	26400.64

SURVEY NAME: BENTON | STATE: MN | AREA [sq. mi.]: 398 | AREA [acres]: 254720 | PUB. DATE: 1977 | FIELD DATE: 1958-1969 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA: % 1.1 | ACREAGE 2801.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
PAGET	AQUIC FRAGIBORALFS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	3			20	30	25	23	64	41	64	1.1	2801.92

SURVEY NAME: BARTON | STATE: MO | AREA [sq. mi.]: 594 | AREA [acres]: 380160 | PUB. DATE: 1974 | FIELD DATE: 1965-1968 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 2.9 | ACREAGE 11024.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CRELDON	MOLLIC FRAGIUDALFS	FINE	MIXED	MESIC	WEATHERED BEDROCK	4	4	2	18	36	27	28	45	17	60	2.0	7603.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

KENNO	MOLLIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	6	2	18	36	27	27	42	15	72	0.9	3421.44

SURVEY NAME: BENTON | STATE: MO | AREA [sq. mi.]: 752 | AREA [acres]: 481280 | PUB. DATE: 1989 | FIELD DATE: 1985 | COND. DATE: 1985 | APPROV. DATE: 1985 | SURVEY AREA: 6.2% | ACREAGE: 29839.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CREDON	MOLLIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	3	1	18	36	27	26	33	7	60	2.1	10106.88
UNION	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	4	2	26	36	31	27	42	15	60	4.1	19732.48

SURVEY NAME: BUTLER & PART OF RIPLEY | STATE: MO | AREA [sq. mi.]: 1355 | AREA [acres]: 867200 | PUB. DATE: 1983 | FIELD DATE: 1966-1981 | COND. DATE: 1980 | APPROV. DATE: 1981 | SURVEY AREA: 21.7% | ACREAGE: 188182.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	NONE GIVEN	4	4	2	16	30	23	25	57	32	60	12.8	111001.60
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		3	26	35	31	33	60	27	60	7.3	63305.60
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2	15	20	18	17	28	11	60	1.6	13875.20

SURVEY NAME: CHRISTIAN | STATE: MO | AREA [sq. mi.]: 564 | AREA [acres]: 360960 | PUB. DATE: 1985 | FIELD DATE: 1977-1981 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: 20.0% | ACREAGE: 72192.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	4	2				27	46	19	63	0.8	2887.68
CREDON	MOLLIC FRAGIUDALFS	FINE	MIXED	MESIC	WEATHERED BEDROCK	4	4	2				24	44	20	61	0.4	1443.84
NEWDLEYE	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		2				29	60	31	70	0.8	2887.68
TONTI	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	4	2	15	24	20	22	40	18	62	9.7	35013.12
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2				23	31	8	60	8.3	29959.68

SURVEY NAME: DALLAS | STATE: MO | AREA [sq. mi.]: 543 | AREA [acres]: 347520 | PUB. DATE: 1991 | FIELD DATE: 1986 | COND. DATE: 1986 | APPROV. DATE: 1986 | SURVEY AREA: 37.1% | ACREAGE: 128929.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BADO	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	2	2	1	23	35	29	26	49	23	66	0.2	695.04
CELT	AQUIC FRAGIUDULTS	CLAYEY	MIXED	MESIC	LOESS	2	4	1	20	30	25	24	40	16	60	1.1	3822.72
GERALD	UMBRIC FRAGIAQUALFS	FINE	MIXED	MESIC	LOESS	4	4	2	20	40	30	27	38	11	60	0.6	2085.12
HOBERG	MOLLIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	LOESS	4	4	2	19	26	23	24	48	24	60	2.7	9383.04
HOBSON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2	20	27	24	26	49	23	60	2.2	7645.44
KENNO	MOLLIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2	20	30	25	28	44	16	60	1.0	3475.20
LEBANON	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	4	2	18	24	21	21	39	18	60	5.8	20156.16

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VIRATON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	LOESS	4	4	1	16	33	25	26	54	28	60	14.4	50042.88
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2	15	25	20	15	33	18	60	9.1	31624.32

SURVEY NAME: DENT | STATE: MO | AREA [sq. mi.]: 756 | AREA [acres]: 483840 | PUB. DATE: 1971 | FIELD DATE: 1958-1963 | COND. DATE: 1963 | APPROV. DATE: 1966 | SURVEY AREA %: 37.2 | ACREAGE: 179988.48

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BADO	TYPIC FRAGIAQUALFS	FINE	MIXED	MESIC	LOESS	2				25	36	31	29	48	19	66	0.1	483.84
HERSON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2					20	42	22	60	21.0	101606.40
LEBANON	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	4	2	12	20	16		24	31	7	54	1.0	4838.40
NEA	OCHREPTIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	5	2					17	33	16	58	14.0	67737.60
VIRATON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	4	2	15	22	19		18	36	18	58	1.1	5322.24

SURVEY NAME: GREENE & LAWRENCE | STATE: MO | AREA [sq. mi.]: 1296 | AREA [acres]: 829440 | PUB. DATE: 1982 | FIELD DATE: | COND. DATE: | APPROV. DATE: | SURVEY AREA %: 47.6 | ACREAGE: 394813.44

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BADO	TYPIC FRAGIAQUALFS	FINE	MIXED	MESIC	WEATHERED BEDROCK	2	1			18	40	29	28	51	23	76	0.3	2488.32
CHELDON	MOLLIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	4	2		18	36	27	24	36	12	67	6.5	53913.60
GERALD	UMBRIC FRAGIAQUALFS	FINE	MIXED	MESIC	LOESS	3	1			18	40	29	24	44	20	72	0.8	6635.52
HOBERG	MOLLIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	LOESS	4	4	2		16	36	26	22	47	25	72	4.8	39813.12
KENO	MOLLIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	5	2		18	36	27	30	45	15	72	5.8	48107.52
NEEDLEYE	AQUIC FRAGIUDULTS	FINE	MIXED	MESIC	WEATHERED BEDROCK	4	2			18	36	27	29	38	9	72	2.6	21565.44
NEA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	1			14	24	19	18	41	23	72	1.7	14100.48
VIRATON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	4	2		16	36	26	22	34	12	72	9.9	82114.56
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2		15	29	22	21	56	35	72	15.2	126074.88

SURVEY NAME: HENRY | STATE: MO | AREA [sq. mi.]: 737 | AREA [acres]: 471680 | PUB. DATE: 1976 | FIELD DATE: 1959-1962 | COND. DATE: 1969 | APPROV. DATE: 1966 | SURVEY AREA %: 0.3 | ACREAGE: 1415.04

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CHELDON	MOLLIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	2			18	36	27	29	37	8	62	0.3	1415.04

SURVEY NAME: MARK TWAIN NATL FOREST AREA | STATE: MO | AREA [sq. mi.]: 728 | AREA [acres]: 465920 | PUB. DATE: 1975 | FIELD DATE: 1967-1970 | COND. DATE: 1970 | APPROV. DATE: 1971 | SURVEY AREA %: 16.7 | ACREAGE: 77808.64

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	4	2		17	30	24	28	60	32	60	14.7	68490.24

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

VIRATON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	4	2	15	30	23	20	60	40	60	0.4	1863.68
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	LOESS	4	4	2	15	22	19	17	38	21	60	1.6	7454.72

SURVEY NAME: PULASKI | STATE: MO | AREA [sq. mi.]: 550 | AREA [acres]: 352000 | PUB. DATE: 1989 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 28.6 | ACREAGE 100672.00

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LEBANON	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	4	2	20	24	22	21	39	18	72	14.0	49280.00
PLATO	AQUIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	3	3	1	25	36	31	29	46	17	62	1.2	4224.00
VIRATON	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	4	2	16	33	25	24	48	24	60	13.4	47168.00

SURVEY NAME: ST. FRANCOIS | STATE: MO | AREA [sq. mi.]: 457 | AREA [acres]: 292480 | PUB. DATE: 1981 | FIELD DATE: 174-1978 | COND. DATE: 1978 | APPROV. DATE: 1979 | SURVEY AREA: % 28.2 | ACREAGE 82479.36

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
DELASSUS	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	1			24	36	30	31	61	30	61	6.8	19888.64
HILDEBRECHT	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			24	40	32	28	53	25	80	9.2	26908.16
JONCA	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	LOESS	4	2			28	37	33	30	48	18	68	4.9	14331.52
LEBANON	TYPIC FRAGIUDALFS	FINE	MIXED	MESIC	LOESS	4	2			18	27	23	23	61	38	72	2.0	5849.60
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			24	39	32	25	39	14	64	3.1	9066.88
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	2			20	29	25	22	37	15	60	2.2	6434.56

SURVEY NAME: STE. GENEVIEVE | STATE: MO | AREA [sq. mi.]: 511 | AREA [acres]: 327040 | PUB. DATE: 1985 | FIELD DATE: 1981 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 12.9 | ACREAGE 42188.16

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
HILDEBRECHT	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	2	25	40	33	38	59	21	75	3.7	12100.48
JONCA	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	LOESS	4	4	2	30	38	34	32	52	20	62	6.3	20603.52
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	2	25	30	28	25	51	26	68	0.4	1308.16
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	4	2	24	29	27	27	66	39	66	2.5	8176.00

SURVEY NAME: STODDARD | STATE: MO | AREA [sq. mi.]: 837 | AREA [acres]: 535680 | PUB. DATE: 1985 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: % 13.7 | ACREAGE 73388.16

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	3			20	32	26	28	52	24	72	13.7	73388.16

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: WRIGHT | STATE: MO | AREA [sq. mi.]: 684 | AREA [acres]: 437760 | PUB. DATE: 1981 | FIELD DATE: 1968-1978 | COND. DATE: 1978 | APPROV. DATE: 1979 | SURVEY AREA: % 39.4 | ACREAGE 172477.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BADO	TYPIC FRAGIAQUALFS	FINE	MIXED	MESIC	LOESS	2	1			18	40	29	32	65	33	65	0.5	2188.80
NEEDLEYE	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2						27	42	15	60	1.1	4815.36
VIRATON	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	LOESS	4	2			16	35	26	20	37	17	60	20.6	90178.56
WILDERNESS	TYPIC FRAGIUDALFS	LOAMY-SKELETAL	SILICEOUS	MESIC	WEATHERED BEDROCK	4	2			15	29	22	23	29	6	60	17.2	75294.72

SURVEY NAME: ALCORN | STATE: MS | AREA [sq. mi.]: 405 | AREA [acres]: 259200 | PUB. DATE: 1971 | FIELD DATE: 1959-1966 | COND. DATE: 1966 | APPROV. DATE: 1967 | SURVEY AREA: % 30.0 | ACREAGE 77760.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2				22	55	33	55	1.5	3888.00
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	NONE GIVEN	2			2				20	55	35	55	0.8	2073.60
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4			2				18	45	27	65	8.6	22291.20
PADEN	OCHREPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4		4	2	15	25	20	22	65	43	65	4.3	11145.60
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4		4	2				26	46	20	66	14.8	38361.60

SURVEY NAME: AMITE | STATE: MS | AREA [sq. mi.]: 729 | AREA [acres]: 466560 | PUB. DATE: 1976 | FIELD DATE: 1965-1970 | COND. DATE: 1970 | APPROV. DATE: 1971 | SURVEY AREA: % 51.9 | ACREAGE 242144.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	3				16	60	44	60	2.4	11197.44
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4		4	3	20	32	26	23	68	45	68	10.4	48522.24
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4		4	3				22	70	48	70	39.1	182424.96

SURVEY NAME: BENTON | STATE: MS | AREA [sq. mi.]: 412 | AREA [acres]: 263680 | PUB. DATE: 1977 | FIELD DATE: 1968-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 15.7 | ACREAGE 41397.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2	15	36	26	26	52	26	52	1.4	3691.52
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2				24	67	43	67	1.2	3164.16
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3				25	62	37	62	1.6	4218.88
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4		4	3	18	30	24	22	80	58	80	11.5	30323.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: CARROLL | STATE: MS | AREA [sq. mi.]: 638 | AREA [acres]: 408320 | PUB. DATE: 1990 | FIELD DATE: 1985 | COND. DATE: 1985 | APPROV. DATE: 1985 | SURVEY AREA: % 18.4 | ACREAGE 75130.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DULAC	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4				16	26	21	17	30	13	65	0.6	2449.92
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4							25	70	45	70	1.3	5308.16
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				20	35	28	24	48	24	65	10.0	40832.00
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				18	38	28	21	42	21	65	6.5	26540.80

SURVEY NAME: CHICASAW | STATE: MS | AREA [sq. mi.]: 506 | AREA [acres]: 323840 | PUB. DATE: 1974 | FIELD DATE: 1960-1968 | COND. DATE: 1969 | APPROV. DATE: 1970 | SURVEY AREA: % 10.5 | ACREAGE 34003.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MASHULAVILLE	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	2	4	2					19	58	39	58	0.6	1943.04
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3					27	54	27	54	6.5	21049.60
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3					30	60	30	60	3.4	11010.56

SURVEY NAME: CHOCTAW | STATE: MS | AREA [sq. mi.]: 417 | AREA [acres]: 266880 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: % 19.6 | ACREAGE 52308.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2		18	35	27	20	60	40	60	0.9	2401.92
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		18	30	24	22	50	28	60	12.8	34160.64
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3		18	30	24	19	60	41	60	5.3	14144.64
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		16	32	24	22	60	38	60	0.6	1601.28

SURVEY NAME: CLAY | STATE: MS | AREA [sq. mi.]: 414 | AREA [acres]: 264960 | PUB. DATE: 1976 | FIELD DATE: 1969-1973 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 20.1 | ACREAGE 53256.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		20	36	28	26	56	30	56	10.3	27290.88
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		20	28	24	26	60	34	60	9.8	25966.08

SURVEY NAME: COPIAH | STATE: MS | AREA [sq. mi.]: 781 | AREA [acres]: 499840 | PUB. DATE: 1984 | FIELD DATE: 1970-1980 | COND. DATE: 1980 | APPROV. DATE: 1979 | SURVEY AREA: % 32.1 | ACREAGE 160448.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	2		18	24	21	18	64	46	64	1.6	7997.44

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2	18	28	23	20	64	44	64	0.8	3998.72
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	2				27	64	37	64	0.1	499.84
LAX	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	2	18	30	24	25	64	39	64	0.2	999.68
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3	22	30	26	23	68	45	68	11.7	58481.28
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3	18	28	23	25	70	45	70	17.7	88471.68

SURVEY NAME: FORREST | STATE: MS | AREA [sq. mi.]: 469 | AREA [acres]: 300160 | PUB. DATE: 1979 | FIELD DATE: 1969-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 9.8 | ACREAGE 29415.68

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
PHEBA	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	3		4	3				21	60	39	60	0.3	900.48
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	3				27	60	33	60	9.5	28515.20

SURVEY NAME: GRENADA | STATE: MS | AREA [sq. mi.]: 433 | AREA [acres]: 277120 | PUB. DATE: 1967 | FIELD DATE: 1957-1964 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 19.1 | ACREAGE 52929.92

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3							16	45	29	60	3.0	8313.60
DULAC	TYPIC FRAGIUDULTS	FINE	MIXED	THERMIC	MARINE SEDIMENT	4		4	2				18	36	18	60	1.8	4988.16
GRENADA	OCHREPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	18	30	24	22	60	38	60	4.1	11361.92
HENRY	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	THERMIC	LOESS	2	2			4	16	10	4	60	56	60	0.6	1662.72
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	5		4	2	24	36	30	29	60	31	60	3.6	9976.32
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	5		4	2	18	32	25	24	32	8	60	6.0	16627.20

SURVEY NAME: HINDS | STATE: MS | AREA [sq. mi.]: 877 | AREA [acres]: 561280 | PUB. DATE: 1979 | FIELD DATE: 1970-1976 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 39.6 | ACREAGE 222266.88

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BYRAM	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	18	30	24	23	51	28	90	2.4	13470.72
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2	15	33	24	20	65	45	65	2.3	12909.44
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	20	34	27	23	70	47	70	2.7	15154.56
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	22	35	29	27	56	29	80	23.5	131900.80
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	18	34	26	24	57	33	64	8.7	48831.36

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ITAWAMBA | STATE: MS | AREA [sq. mi.]: 541 | AREA [acres]: 346240 | PUB. DATE: 1979 | FIELD DATE: 1959-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 11.2 | ACREAGE 38778.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		18	30	24	22	56	34	56	6.0	20774.40
PHEBA	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	MARINE SEDIMENT	3	4	3		14	24	19	21	80	59	80	0.6	2077.44
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		16	30	23	25	65	40	65	4.6	15927.04

SURVEY NAME: JASPER | STATE: MS | AREA [sq. mi.]: 683 | AREA [acres]: 437120 | PUB. DATE: 1979 | FIELD DATE: 1968-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA: % 13.5 | ACREAGE 59011.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3					28	70	42	70	5.7	24915.84
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		20	32	26	25	60	35	60	1.4	6119.68
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		16	38	27	30	50	20	50	6.4	27975.68

SURVEY NAME: JEFFERSON | STATE: MS | AREA [sq. mi.]: 520 | AREA [acres]: 332800 | PUB. DATE: 1980 | FIELD DATE: 1968-1975 | COND. DATE: 1975 | APPROV. DATE: 1976 | SURVEY AREA: % 8.5 | ACREAGE 28288.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3					27	60	33	60	7.2	23961.60
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3					30	66	36	70	1.3	4326.40

SURVEY NAME: JEFFERSON DAVIS | STATE: MS | AREA [sq. mi.]: 414 | AREA [acres]: 264960 | PUB. DATE: 1976 | FIELD DATE: 1965-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA: % 23.2 | ACREAGE 61470.72

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3					26	64	38	79	14.6	38684.16
PADEN	GLOSSIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	2					18	80	62	80	0.7	1854.72
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4	3		20	32	26	25	86	61	86	0.9	2384.64
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	4	4	3					25	70	45	70	2.4	6359.04
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		16	28	22	22	65	43	70	4.6	12188.16

SURVEY NAME: JONES | STATE: MS | AREA [sq. mi.]: 706 | AREA [acres]: 451840 | PUB. DATE: 1986 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 16.4 | ACREAGE 74101.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4	3					26	64	38	64	1.4	6325.76

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	18	37	28	21	62	41	62	15.0	67776.00

SURVEY NAME: LAFAYETTE | STATE: MS | AREA [sq. mi.]: 639 | AREA [acres]: 408960 | PUB. DATE: 1981 | FIELD DATE: 1975-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 6.4 | ACREAGE 26173.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2				21	65	44	65	0.3	1226.88
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	2				24	65	41	65	1.0	4089.60
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3				24	65	41	65	1.7	6952.32
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3				23	65	42	65	3.4	13904.64

SURVEY NAME: LAMAR | STATE: MS | AREA [sq. mi.]: 500 | AREA [acres]: 320000 | PUB. DATE: 1975 | FIELD DATE: 1965-1969 | COND. DATE: 1971 | APPROV. DATE: 1969 | SURVEY AREA: % 11.4 | ACREAGE 36480.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
MASHULAVILLE	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	2	2						16	61	45	61	1.2	3840.00
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	22	32	27	27	65	38	65	10.2	32640.00

SURVEY NAME: LAUDERDALE | STATE: MS | AREA [sq. mi.]: 721 | AREA [acres]: 461440 | PUB. DATE: 1983 | FIELD DATE: 1972-1979 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 9.1 | ACREAGE 41991.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	18	42	30	23	65	42	65	5.2	23994.88
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4	3				27	60	33	60	1.4	6460.16
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4	3	18	36	27	25	65	40	65	2.5	11536.00

SURVEY NAME: LAWRENCE | STATE: MS | AREA [sq. mi.]: 433 | AREA [acres]: 277120 | PUB. DATE: 1978 | FIELD DATE: 1965-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA: % 23.8 | ACREAGE 65954.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
PADEN	GLOSSIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	4	4	2	18	30	24	18	85	67	85	5.4	14964.48
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3	18	36	27	32	58	26	74	18.4	50990.08

SURVEY NAME: LEE | STATE: MS | AREA [sq. mi.]: 455 | AREA [acres]: 291200 | PUB. DATE: 1973 | FIELD DATE: 1960-1967 | COND. DATE: 1968 | APPROV. DATE: 1968 | SURVEY AREA: % 20.9 | ACREAGE 60860.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3				19	50	31	50	10.0	29120.00
PRENTISS	OCHREPTIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	14	26	20	18	48	30	48	4.3	12521.60

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3				18	50	32	50	5.8	16889.60
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	17	28	23	23	60	37	60	0.8	2329.60

SURVEY NAME: LOWNDES | STATE: MS | AREA [sq. mi.]: 508 | AREA [acres]: 325120 | PUB. DATE: 1979 | FIELD DATE: 1968-1976 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 17.5 | ACREAGE 56896.00

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
PADEN	GLOSSIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	2		18	26	22	19	70	51	70	1.7	5527.04
PHEBA	GLOSSAQUIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	LOESS	3	4	3		16	29	23	26	70	44	70	0.3	975.36
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		19	26	23	26	73	47	73	7.2	23408.64
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		18	28	23	21	75	54	75	8.3	26984.96

SURVEY NAME: MADISON | STATE: MS | AREA [sq. mi.]: 751 | AREA [acres]: 480640 | PUB. DATE: 1984 | FIELD DATE: 1970-1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 48.2 | ACREAGE 231668.48

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2		18	30	24	27	62	35	62	0.2	961.28
BYRAM	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3		18	30	24	20	44	24	72	3.9	18744.96
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2		14	38	26	30	60	30	60	2.5	12016.00
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	2					25	70	45	70	3.1	14899.84
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3		22	35	29	30	52	22	70	22.3	107182.72
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3		18	38	28	22	52	30	70	16.2	77863.68

SURVEY NAME: MARION | STATE: MS | AREA [sq. mi.]: 550 | AREA [acres]: 352000 | PUB. DATE: 1985 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: % 13.0 | ACREAGE 45760.00

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4	3					25	65	40	65	2.0	7040.00
SAVANNAH	GLOSSIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4	3		16	38	27	26	70	44	70	11.0	38720.00

SURVEY NAME: MARSHALL | STATE: MS | AREA [sq. mi.]: 693 | AREA [acres]: 443520 | PUB. DATE: 1972 | FIELD DATE: 1959-1968 | COND. DATE: 1968 | APPROV. DATE: 1968 | SURVEY AREA: % 31.5 | ACREAGE 139708.80

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	3	4	2					22	54	32	54	2.1	9313.92
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	4	4	2					33	80	47	80	1.5	6652.80
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	NONE GIVEN	2	2						22	56	34	80	0.8	3548.16
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	4	4	2					26	80	54	80	20.6	91365.12

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	4						26	60	34	60	6.5	28828.80

SURVEY NAME: MONTGOMERY	STATE: MS	AREA [sq. mi.]: 403	AREA [acres]: 257920	PUB. DATE: 1975	FIELD DATE: 1959-1970	SURVEY AREA: % 28.0	ACREAGE 72217.60
				COND. DATE: 1971	APPROV. DATE: 1971		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2		18	26	22	22	60	38	60	1.2	3095.04
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2		20	30	25	30	60	30	60	1.9	4900.48
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3		22	32	27	27	48	21	60	1.5	3868.80
MASHULAVILLE	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	2	2					27	50	23	50	0.6	1547.52
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3		18	32	25	29	57	28	65	22.8	58805.76

SURVEY NAME: NESHOBA	STATE: MS	AREA [sq. mi.]: 568	AREA [acres]: 363520	PUB. DATE: 1981	FIELD DATE: 1971-1978	SURVEY AREA: % 13.9	ACREAGE 50529.28
				COND. DATE: 1979	APPROV. DATE: 1979		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	18	42	30	23	60	37	60	11.8	42895.36
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3	18	38	28	24	60	36	60	0.1	363.52
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3				23	65	42	65	2.0	7270.40

SURVEY NAME: NOXUBEE	STATE: MS	AREA [sq. mi.]: 695	AREA [acres]: 444800	PUB. DATE: 1986	FIELD DATE: 1982	SURVEY AREA: % 7.9	ACREAGE 35139.20
				COND. DATE: 1982	APPROV. DATE: 1983		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	20	27	24	27	64	37	64	2.9	12899.20
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	16	36	26	20	70	50	70	5.0	22240.00

SURVEY NAME: OKTIBBEHA	STATE: MS	AREA [sq. mi.]: 454	AREA [acres]: 290560	PUB. DATE: 1973	FIELD DATE: 1959-1967	SURVEY AREA: % 12.2	ACREAGE 35448.32
				COND. DATE: 1967	APPROV. DATE: 1968		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
PRENTISS	OCHREPTIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	19	30	25	23	60	37	60	5.1	14818.56
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	3	16	27	22	21	45	24	60	2.7	7845.12
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3	18	28	23	22	60	38	60	4.4	12784.64

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SURVEY NAME: PIKE | STATE: MS | AREA [sq. mi.]: 410 | AREA [acres]: 262400 | PUB. DATE: 1968 | FIELD DATE: 1958-1963 | COND. DATE: 1964 | APPROV. DATE: 1964 | SURVEY AREA: % 41.4 | ACREAGE 108633.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4				22	28	25	24	52	28	52	27.4	71897.60
PADEN	OCHREPTIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4				16	20	18	18	54	36	54	0.4	1049.60
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4				20	24	22	23	54	31	54	1.8	4723.20
SAVANNAH	TYPIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4				16	20	18	19	89	70	89	11.8	30963.20

SURVEY NAME: PONTOTOC | STATE: MS | AREA [sq. mi.]: 501 | AREA [acres]: 320640 | PUB. DATE: 1973 | FIELD DATE: 1958-1969 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 17.5 | ACREAGE 56112.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	15	26	21	24	60	36	60	1.5	4809.60
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	ALLUVIUM	2	2						19	70	51	70	0.4	1282.56
MASHULAVILLE	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	2	2			18	24	21	23	62	39	62	0.4	1282.56
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	3			18	25	22	22	63	41	63	4.2	13466.88
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	3			16	30	23	19	60	41	60	11.0	35270.40

SURVEY NAME: RANKIN | STATE: MS | AREA [sq. mi.]: 776 | AREA [acres]: 496640 | PUB. DATE: 1987 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 20.5 | ACREAGE 101811.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	3	18	34	26	22	65	43	65	0.6	2979.84
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	18	36	27	24	65	41	65	10.1	50160.64
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4		4	3	16	38	27	28	65	37	65	9.8	48670.72

SURVEY NAME: TALLAHATCHIE | STATE: MS | AREA [sq. mi.]: 644 | AREA [acres]: 412160 | PUB. DATE: 1970 | FIELD DATE: 1959-1965 | COND. DATE: 1965 | APPROV. DATE: 1966 | SURVEY AREA: % 2.9 | ACREAGE 11952.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	3				24	60	36	60	0.2	824.32
GRENADA	OCHREPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2				26	60	34	60	0.7	2885.12
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3				25	60	35	60	2.0	8243.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: TISHOMINGO | STATE: MS | AREA [sq. mi.]: 436 | AREA [acres]: 279040 | PUB. DATE: 1983 | FIELD DATE: 1972-1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA %: 9.7 | ACREAGE: 27066.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		18	34	26	25	47	22	70	5.3	14789.12
PADEN	GLOSSIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	4	4	2		18	24	21	20	40	20	70	0.3	837.12
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		18	28	23	20	60	40	60	4.1	11440.64

SURVEY NAME: UNION | STATE: MS | AREA [sq. mi.]: 422 | AREA [acres]: 270080 | PUB. DATE: 1979 | FIELD DATE: 1965-1974 | COND. DATE: 1974 | APPROV. DATE: 1975 | SURVEY AREA %: 13.0 | ACREAGE: 35110.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	ALLUVIUM	3	4	2		15	37	26	35	60	25	60	2.1	5671.68
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		20	25	23	22	52	30	64	0.6	1620.48
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3		18	31	25	18	62	44	62	10.3	27818.24

SURVEY NAME: WALTHALL | STATE: MS | AREA [sq. mi.]: 403 | AREA [acres]: 257920 | PUB. DATE: 1968 | FIELD DATE: 1959-1965 | COND. DATE: 1963 | APPROV. DATE: 1965 | SURVEY AREA %: 34.2 | ACREAGE: 88208.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ORA	TYPIC FRAGIUDULTS	COARSE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	3				20	29	25	25	40	15	60	29.1	75054.72
PHEBA	AQUEPTIC FRAGIUDULTS	COARSE-SILTY	MIXED	THERMIC	MARINE SEDIMENT	3				15	20	18	16	38	22	50	0.7	1805.44
PRENTISS	TYPIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4				19	24	22	23	40	17	54	1.2	3095.04
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	NONE GIVEN	4				18	30	24	19	60	41	60	1.6	4126.72
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4				18	27	23	23	65	42	65	1.6	4126.72

SURVEY NAME: WEBSTER | STATE: MS | AREA [sq. mi.]: 416 | AREA [acres]: 266240 | PUB. DATE: 1978 | FIELD DATE: 1967-1974 | COND. DATE: 1975 | APPROV. DATE: 1974 | SURVEY AREA %: 15.4 | ACREAGE: 41000.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUDE	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	4	2		18	35	27	16	72	56	72	2.2	5857.28
ORA	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3		18	30	24	21	48	27	60	2.5	6656.00
PRENTISS	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	4	3					29	60	31	60	0.1	266.24
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	4	3		18	32	25	22	60	38	60	10.6	28221.44

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: YALOBUSHA | STATE: MS | AREA [sq. mi.]: 504 | AREA [acres]: 322560 | PUB. DATE: 1978 | FIELD DATE: 1965-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 19.9 | ACREAGE 64189.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			16	24	20	18	70	52	70	1.1	3548.16
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	20	34	27	36	52	16	52	2.6	8386.56
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	22	32	27	31	65	34	65	7.2	23224.32
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3	18	38	28	19	54	35	80	9.0	29030.40

SURVEY NAME: YAZOO | STATE: MS | AREA [sq. mi.]: 938 | AREA [acres]: 600320 | PUB. DATE: 1975 | FIELD DATE: 1969 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 21.4 | ACREAGE 128468.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2				23	52	29	52	2.5	15008.00
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2				22	55	33	55	1.7	10205.44
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	3				26	60	34	60	17.2	103255.04

SURVEY NAME: BLADEN | STATE: NC | AREA [sq. mi.]: 888 | AREA [acres]: 568320 | PUB. DATE: 1990 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 0.3 | ACREAGE 1704.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
TOISNOT	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	2	2			20	40	30	21	31	10	62	0.3	1704.96

SURVEY NAME: CUMBERLAND & HOKE | STATE: NC | AREA [sq. mi.]: 1042 | AREA [acres]: 666880 | PUB. DATE: 1984 | FIELD DATE: 1971-1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 0.5 | ACREAGE 3334.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCCOLL	TYPIC FRAGIAQUULTS	CLAYEY	KAOLINITIC	THERMIC	MARINE SEDIMENT	2	2			12	36	24	26	43	17	72	0.5	3334.40

SURVEY NAME: ROBESON | STATE: NC | AREA [sq. mi.]: 949 | AREA [acres]: 607360 | PUB. DATE: 1978 | FIELD DATE: 1966-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA: % 1.9 | ACREAGE 11539.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCCOLL	TYPIC FRAGIAQUULTS	CLAYEY	KAOLINITIC	THERMIC	MARINE SEDIMENT	2	2						18	51	33	64	1.5	9110.40
TOISNOT	TYPIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	2	2			20	42	31	28	45	17	90	0.4	2429.44

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: SAMPSON | STATE: NC | AREA [sq. mi.]: 963 | AREA [acres]: 616320 | PUB. DATE: 1985 | FIELD DATE: 1981 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 0.3 | ACREAGE 1848.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
TOISNOT	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	2				20	40	30	30	50	20	85	0.3	1848.96

SURVEY NAME: WAKE | STATE: NC | AREA [sq. mi.]: 864 | AREA [acres]: 552960 | PUB. DATE: 1970 | FIELD DATE: 1957-1965 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: % 1.4 | ACREAGE 7741.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	NONE GIVEN	3	3										1.4	7741.44

SURVEY NAME: WILSON | STATE: NC | AREA [sq. mi.]: 373 | AREA [acres]: 238720 | PUB. DATE: 1983 | FIELD DATE: 1974-1979 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA: % 1.8 | ACREAGE 4296.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
TOISNOT	TYPIC FRAGIAQUULTS	COARSE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	2		4	2	10	48	29	25	56	31	67	1.8	4296.96

SURVEY NAME: CARROLL | STATE: NH | AREA [sq. mi.]: 996 | AREA [acres]: 637440 | PUB. DATE: 1977 | FIELD DATE: 1956-1972 | COND. DATE: 1972 | APPROV. DATE: 1973 | SURVEY AREA: % 3.0 | ACREAGE 19123.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MILLIS	ENTIC FRAGIORTHODS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	3	18	36	27	22	46	24	46	3.0	19123.20

SURVEY NAME: HUNTERDON | STATE: NJ | AREA [sq. mi.]: 435 | AREA [acres]: 278400 | PUB. DATE: 1974 | FIELD DATE: 1962-1967 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA: % 19.0 | ACREAGE 52896.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ABBOTTSTOWN	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3		4	2	15	30	23	16	42	26	42	2.0	5568.00
ANNANDALE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	2	25	36	31	35	43	8	60	1.4	3897.60
CALIFON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	25	36	31	35	43	8	60	1.1	3062.40
CHALFONT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	NONE GIVEN	3		4	2	15	30	23	26	42	16	50	8.6	23942.40
COKESBURY	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2			20	30	25	28	40	12	60	1.0	2784.00
CROTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	2		4	2	15	20	18	18	48	30	48	2.0	5568.00
LAWRENCEVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		4	3	25	35	30	28	40	12	55	0.8	2227.20
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	26	40	33	31	38	7	60	0.3	835.20
RARITAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3	3			20	30	25	24	44	20	60	1.0	2784.00
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	3	24	36	30	26	46	20	46	0.6	1670.40

TURBOTVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3			20	30	25	28	42	14	60	0.2	556.80

SURVEY NAME: MERCER | STATE: NJ | AREA [sq. mi.]: 228 | AREA [acres]: 145920 | PUB. DATE: 1972 | FIELD DATE: 1950-1965 | COND. DATE: 1965 | APPROV. DATE: 1967 | SURVEY AREA: % 5.8 | ACREAGE 8463.36

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ABBOTTSTOWN	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		3	2								1.3	1896.96
CHALFONT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	2			16	28	22	18	43	25	43	1.1	1605.12
DOYLESTOWN	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2		4	2								1.6	2334.72
LAWRENCEVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4		4	3				30	60	30	60	0.8	1167.36
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	3								1.0	1459.20

SURVEY NAME: MIDDLESEX | STATE: NJ | AREA [sq. mi.]: 318 | AREA [acres]: 203520 | PUB. DATE: 1987 | FIELD DATE: 1978 | COND. DATE: 1977 | APPROV. DATE: 1979 | SURVEY AREA: % 4.4 | ACREAGE 8954.88

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BOONTON	TYPIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				33	40	7	60	1.3	2645.76
CHALFONT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	2			15	30	23	26	50	24	60	0.4	814.08
HALEDON	AQUIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2				16	22	6	60	2.7	5495.04

SURVEY NAME: MORRIS | STATE: NJ | AREA [sq. mi.]: 468 | AREA [acres]: 299520 | PUB. DATE: 1976 | FIELD DATE: 1964-1968 | COND. DATE: 1968 | APPROV. DATE: 1971 | SURVEY AREA: % 32.7 | ACREAGE 97943.04

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ANNANDALE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	24	36	30	32	44	12	108	2.2	6589.44
BARTLEY	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	24	36	30	32	42	10	88	1.3	3893.76
BOONTON	TYPIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			20	30	25	30	45	15	60	1.0	2995.20
CALIFON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	20	30	25	23	57	34	100	4.5	13478.40
COKESBURY	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			20	30	25	23	35	12	60	3.5	10483.20
HALEDON	AQUIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	16	30	23	18	46	28	64	0.3	898.56
HIBERNIA	AQUIC FRAGIUDULTS	COARSE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	18	30	24	20	46	26	60	3.5	10483.20
ROCKAWAY	TYPIC FRAGIUDULTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	18	30	24	20	40	20	60	15.0	44928.00
TURBOTVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3		4	2	20	36	28	20	36	16	96	1.4	4193.28

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: PASSAIC | STATE: NJ | AREA [sq. mi.]: 200 | AREA [acres]: 128000 | PUB. DATE: 1975 | FIELD DATE: 1967-1969 | COND. DATE: 1969 | APPROV. DATE: 1972 | SURVEY AREA: % 39.5 | ACREAGE 50560.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BOONTON	TYPIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	24	36	30	30	60	30	60	1.8	2304.00
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	30	23	24	38	14	60	0.2	256.00
HALEDON	AQUIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	24	36	30	30	72	42	72	1.9	2432.00
HIBERNIA	AQUIC FRAGIUDULTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		5	2	18	30	24	25	36	11	72	4.8	6144.00
NORWICH	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			18	24	21	18	45	27	60	1.6	2048.00
ROCKAWAY	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	30	24	22	56	34	72	19.0	24320.00
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	24	21	23	60	37	60	8.9	11392.00
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	18	24	21	22	60	38	60	1.3	1664.00

SURVEY NAME: SOMERSET | STATE: NJ | AREA [sq. mi.]: 275 | AREA [acres]: 176000 | PUB. DATE: 1976 | FIELD DATE: 1957-1968 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA: % 10.6 | ACREAGE 18656.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ABBOTTSTOWN	AERIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3	2			15	25	20	19	35	16	48	0.8	1408.00
AMWELL	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2						21	36	15	60	2.4	4224.00
CHALFONT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	2			15	22	19	15	40	25	46	2.1	3696.00
CROTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2		4	2	15	20	18	19	33	14	42	1.1	1936.00
LAWRENCEVILLE	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	3			25	35	30	31	48	17	48	0.4	704.00
MECKESVILLE	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL								26	45	19	50	1.1	1936.00
RARITAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3	3			20	30	25	25	44	19	44	2.7	4752.00

SURVEY NAME: SUSSEX | STATE: NJ | AREA [sq. mi.]: 536 | AREA [acres]: 343040 | PUB. DATE: 1975 | FIELD DATE: 1950-1970 | COND. DATE: 1970 | APPROV. DATE: 1972 | SURVEY AREA: % 33.3 | ACREAGE 114232.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBIA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	12	20	16	24	60	36	60	1.9	6517.76
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	26	34	30	28	48	20	60	4.4	15093.76
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			3	24	30	27	24	36	12	60	0.6	2058.24
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2		3	2	15	24	20	21	60	39	60	0.9	3087.36
HIBERNIA	AQUIC FRAGIUDULTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	20	30	25	20	72	52	72	1.9	6517.76
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	16	26	21	26	60	34	60	3.0	10291.20

NORWICH	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	2			15	20	18	24	38	14	60	5.0	17152.00
ROCKAWAY	TYPIC FRAGIUDULTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		5	2	20	30	25	30	65	35	65	10.6	36362.24
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	3	24	36	30	30	60	30	60	1.8	6174.72
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	3	24	36	30	32	48	16	60	0.8	2744.32
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	3	17	24	21	20	72	52	72	2.4	8232.96

SURVEY NAME: WARREN | STATE: NJ | AREA [sq. mi.]: 361 | AREA [acres]: 231040 | PUB. DATE: 1979 | FIELD DATE: 1973-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 28.4 | ACREAGE 65615.36

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ANNANDALE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	2	24	36	30	24	52	28	60	5.9	13631.36
BARTLEY	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		3	2	20	36	28	30	52	22	65	4.3	9934.72
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	26	36	31	34	72	38	72	6.4	14786.56
CALIPON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	30	25	22	48	26	66	2.5	5776.00
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1		4	2	10	20	15	18	65	47	65	1.9	4389.76
COKESBURY	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2		3	2	26	38	32					0.9	2079.36
ROCKAWAY	TYPIC FRAGIUDULTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	1	24	30	27	30	65	35	65	0.4	924.16
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	24	36	30	24	70	46	70	3.7	8548.48
VENANGO	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	1	15	24	20	20	60	40	60	1.1	2541.44
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	17	24	21	18	70	52	70	1.3	3003.52

SURVEY NAME: BROOME | STATE: NY | AREA [sq. mi.]: 710 | AREA [acres]: 454400 | PUB. DATE: 1971 | FIELD DATE: 1958-1964 | COND. DATE: 1967 | APPROV. DATE: 1966 | SURVEY AREA: % 66.3 | ACREAGE 301267.20

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		3	2				18	41	23	48	0.1	454.40
CANASERAGA	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4			2				23	60	37	60	0.7	3180.80
CATTARAUGUS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5			2				28	52	24	52	3.0	13632.00
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2			2				12	36	24	48	0.2	908.80
CULVERS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			2	18	24	21	20	91	71	91	1.3	5907.20
DALTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3			2				20	60	40	60	0.4	1817.60
MARDIN	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			2				18	70	52	70	23.2	105420.80
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3			2	12	18	15	15	85	70	85	1.7	7724.80
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3			2				17	64	47	64	35.5	161312.00

WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		2	15	20	18	27	38	11	45	0.2	908.80

SURVEY NAME: CAYUGA | STATE: NY | AREA [sq. mi.]: 699 | AREA [acres]: 447360 | PUB. DATE: 1971 | FIELD DATE: 1945-1964 | COND. DATE: 1964 | APPROV. DATE: 1964 | SURVEY AREA: % 18.6 | ACREAGE 83208.96

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ELLERY	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2						10	48	38	48	0.1	447.36
ERIE	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			12	18	15	13	48	35	48	2.8	12526.08
IRA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			12	24	18	21	48	27	48	1.5	6710.40
LANGFORD	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			15	24	20	18	54	36	62	10.0	44736.00
SCRIBA	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2						13	48	35	54	0.5	2236.80
SODUS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		3	2	15	24	20	20	53	33	85	2.1	9394.56
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		3	2				19	36	17	48	1.6	7157.76

SURVEY NAME: CHEMUNG | STATE: NY | AREA [sq. mi.]: 412 | AREA [acres]: 263680 | PUB. DATE: 1973 | FIELD DATE: 1957-1968 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 42.5 | ACREAGE 112064.00

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2						18	40	22	50	2.2	5800.96
MARDIN	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			15	25	20	18	42	24	72	10.8	28477.44
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2						17	48	31	60	28.9	76203.52
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2						13	50	37	65	0.4	1054.72
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2						21	50	29	72	0.2	527.36

SURVEY NAME: CHENANGO | STATE: NY | AREA [sq. mi.]: 908 | AREA [acres]: 581120 | PUB. DATE: 1985 | FIELD DATE: | COND. DATE: | APPROV. DATE: | SURVEY AREA: % 52.9 | ACREAGE 307412.48

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	1	26	36	31	29	52	23	60	5.0	29056.00
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1		4	1	8	20	14	15	60	45	60	1.6	9297.92
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	17	36	27	33	60	27	60	2.2	12784.64
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	1	14	26	20	16	46	30	60	21.5	124940.80
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	1	10	20	15	15	63	48	63	3.6	20920.32
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	1	10	20	15	15	48	33	60	15.5	90073.60
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	26	21	18	58	40	66	3.5	20339.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ERIE | STATE: NY | AREA [sq. mi.]: 1028 | AREA [acres]: 657920 | PUB. DATE: 1986 | FIELD DATE: 1967-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 14.8 | ACREAGE 97372.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2		4	1	8	20	14	13	36	23	60	0.4	2631.68
ERIE	AERIC FRAGIAQUALFS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	1	10	24	17	14	40	26	60	2.0	13158.40
LANGFORD	AQUEPTIC FRAGIUDALFS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	1	15	24	20	18	42	24	60	1.8	11842.56
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	1	14	26	20	16	50	34	60	4.9	32238.08
MARILLA	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	1	15	25	20	18	42	24	60	1.1	7237.12
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	1	10	20	15	15	50	35	60	4.3	28290.56
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4	2						18	45	27	60	0.3	1973.76

SURVEY NAME: GENESEE | STATE: NY | AREA [sq. mi.]: 501 | AREA [acres]: 320640 | PUB. DATE: 1969 | FIELD DATE: 1951-1963 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 0.7 | ACREAGE 2244.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MARILLA	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	24	21	24	62	38	62	0.7	2244.48

SURVEY NAME: HERKIMER, SOUTHERN PART | STATE: NY | AREA [sq. mi.]: 1442 | AREA [acres]: 922880 | PUB. DATE: 1975 | FIELD DATE: 1960-1968 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA: % 3.9 | ACREAGE 35992.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BROADALBIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	LOESS	5		4	2	18	36	27	18	34	16	52	3.0	27686.40
MOSHERVILLE	AQUIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	LOESS	3			2				21	40	19	50	0.7	6460.16
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4			2				27	40	13	50	0.2	1845.76

SURVEY NAME: JEFFERSON | STATE: NY | AREA [sq. mi.]: 1253 | AREA [acres]: 801920 | PUB. DATE: 1989 | FIELD DATE: 1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 2.1 | ACREAGE 16840.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4				17	24	21	17	41	24	62	0.2	1603.84
PINCKNEY	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4				20	30	25	22	64	42	72	1.5	12028.80
SODUS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5				15	24	20	22	52	30	60	0.2	1603.84
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	ALLUVIUM	4				15	24	20	18	42	24	60	0.2	1603.84

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: MADISON | STATE: NY | AREA [sq. mi.]: 661 | AREA [acres]: 423040 | PUB. DATE: 1981 | FIELD DATE: 1965-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA %: 24.6 | ACREAGE: 104067.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	26	36	31	30	55	25	55	5.4	22844.16
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2		4	2	10	15	13	14	42	28	58	0.9	3807.36
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	14	25	20	16	42	26	60	12.9	54572.16
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	10	20	15	13	42	29	60	5.4	22844.16

SURVEY NAME: MONROE | STATE: NY | AREA [sq. mi.]: 673 | AREA [acres]: 430720 | PUB. DATE: 1973 | FIELD DATE: 1955-1966 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA %: 0.3 | ACREAGE: 1292.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRA	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	24	21	18	41	23	51	0.1	430.72
SODUS	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	5		4	2	18	24	21	19	40	21	60	0.2	861.44

SURVEY NAME: MONTGOMERY & SCHENECTADY | STATE: NY | AREA [sq. mi.]: 618 | AREA [acres]: 395520 | PUB. DATE: 1978 | FIELD DATE: 1966-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA %: 4.4 | ACREAGE: 17402.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BROADALBIN	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	36	27	20	47	27	52	0.6	2373.12
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	27	23	27	47	20	55	0.2	791.04
MOSHERVILLE	AQUIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	2	16	26	21	18	39	21	60	0.6	2373.12
SCRIBA	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	2	10	18	14	15	43	28	54	3.0	11865.60

SURVEY NAME: NASSAU | STATE: NY | AREA [sq. mi.]: 300 | AREA [acres]: 192000 | PUB. DATE: 1987 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA %: 0.1 | ACREAGE: 192.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	2				24	42	18	60	0.1	192.00

SURVEY NAME: ONONDAGA | STATE: NY | AREA [sq. mi.]: 793 | AREA [acres]: 507520 | PUB. DATE: 1977 | FIELD DATE: 1945-1971 | COND. DATE: 1972 | APPROV. DATE: 1973 | SURVEY AREA %: 3.6 | ACREAGE: 18270.72

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	24	20	21	58	37	72	1.7	8627.84
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	10	16	13	15	46	31	53	0.5	2537.60
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		3	2	15	24	20	22	45	23	60	1.4	7105.28

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ORANGE | STATE: NY | AREA [sq. mi.]: 829 | AREA [acres]: 530560 | PUB. DATE: 1981 | FIELD DATE: 1971-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: 43.4% | ACREAGE: 230263.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	5		4	1	26	40	33	29	53	24	53	2.7	14325.12
ERIE	AERIC FRAGIAQUALFS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	1	14	25	20	20	60	40	60	9.6	50933.76
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	1	10	24	17	18	54	36	70	21.7	115131.52
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	25	35	30	31	62	31	62	9.1	48280.96
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	2	18	25	22	23	60	37	60	0.3	1591.68

SURVEY NAME: OSWEGO | STATE: NY | AREA [sq. mi.]: 968 | AREA [acres]: 619520 | PUB. DATE: 1981 | FIELD DATE: 1965-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA: 52.8% | ACREAGE: 327106.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AMBOY	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	5		4	3	20	30	25	21	51	30	60	2.0	12390.40
DANNEMORA	TYPIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	2		4	2	13	18	16	27	40	13	60	0.9	5575.68
EMPEYVILLE	AQUIC FRAGIORTHODS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	16	21	19	17	44	27	60	1.2	7434.24
IRA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	13	22	18	20	40	20	50	8.5	52659.20
SCRIBA	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	12	15	14	14	36	22	50	5.4	33454.08
SODUS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	15	24	20	20	51	31	60	4.4	27258.88
WESTBURY	TYPIC FRAGIAQUODS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	17	22	20	20	41	21	50	3.7	22922.24
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	17	24	21	20	44	24	50	4.3	26639.36
WORTH	TYPIC FRAGIORTHODS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	20	30	25	27	48	21	62	22.4	138772.48

SURVEY NAME: ROCKLAND | STATE: NY | AREA [sq. mi.]: 178 | AREA [acres]: 113920 | PUB. DATE: 1990 | FIELD DATE: 1986 | COND. DATE: 1986 | APPROV. DATE: 1986 | SURVEY AREA: 0.2% | ACREAGE: 227.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	2	12	20	16	14	40	26	60	0.2	227.84

SURVEY NAME: SCHOHARIE | STATE: NY | AREA [sq. mi.]: 625 | AREA [acres]: 400000 | PUB. DATE: 1969 | FIELD DATE: 1940-1964 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: 24.5% | ACREAGE: 98000.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CATTARAUGUS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5				20	36	28	24	60	36	60	0.3	1200.00
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2							15	30	15	30	1.5	6000.00
CULVERS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4				16	24	20	20	72	52	72	2.3	9200.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

ERIE	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3			15	21	18	18	40	22	60	5.3	21200.00
LANGFORD	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4						20	42	22	42	0.5	2000.00
MARDIN	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			18	30	24	22	60	38	60	5.3	21200.00
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3						15	60	45	60	0.9	3600.00
NORWICH	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3						13	42	29	42	1.5	6000.00
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3			10	18	14	15	48	33	48	6.9	27600.00

SURVEY NAME: SCHUYLER | STATE: NY | AREA [sq. mi.]: 331 | AREA [acres]: 211840 | PUB. DATE: 1979 | FIELD DATE: 1971-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 43.7 | ACREAGE 92574.08

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	2	26	40	33	27	52	25	60	3.1	6567.04
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	4	2				15	42	27	42	1.0	2118.40
ERIE	AERIC FRAGIAQUALFS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	2	10	16	13	15	45	30	55	5.4	11439.36
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2	14	26	20	21	51	30	69	18.1	38343.04
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	1				13	48	35	60	16.1	34106.24

SURVEY NAME: STEUBEN | STATE: NY | AREA [sq. mi.]: 1408 | AREA [acres]: 901120 | PUB. DATE: 1978 | FIELD DATE: 1958-1971 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 49.4 | ACREAGE 445153.28

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	2	26	36	31	31	41	10	60	3.7	33341.44
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2	15	30	23	24	36	12	60	0.3	2703.36
CANASERAGA	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4	4	2				28	62	34	62	0.2	1802.24
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	4	1				13	40	27	64	0.8	7208.96
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	2	18	36	27	27	60	33	60	0.5	4505.60
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2	14	23	19	19	60	41	60	21.0	189235.20
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	1	10	20	15	15	60	45	60	1.1	9912.32
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	1	10	20	15	15	46	31	60	21.0	189235.20
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3	4	2				12	38	26	62	0.1	901.12
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			15	20	18	18	60	42	60	0.7	6307.84

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ULSTER | STATE: NY | AREA [sq. mi.]: 1143 | AREA [acres]: 731520 | PUB. DATE: 1979 | FIELD DATE: 1968-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA: % 23.4 | ACREAGE 171175.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	2	26	38	32	28	65	37	65	5.8	42428.16
CAMBRIDGE	AQUEPTIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	1				23	64	41	64	0.3	2194.56
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	2	17	36	27	17	49	32	80	3.4	24871.68
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2	14	26	20	21	46	25	56	1.8	13167.36
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	2	12	22	17	13	65	52	80	1.0	7315.20
SCRIBA	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	2	12	18	15	13	50	37	50	0.9	6583.68
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	2	20	36	28	29	60	31	60	3.5	25603.20
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	2	15	20	18	19	58	39	70	1.3	9509.76
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2	15	25	20	21	50	29	50	5.2	38039.04
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2	15	24	20	26	42	16	52	0.2	1463.04

SURVEY NAME: WARREN | STATE: NY | AREA [sq. mi.]: 883 | AREA [acres]: 565120 | PUB. DATE: 1989 | FIELD DATE: 1981 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 2.7 | ACREAGE 15258.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
STOWE	ENTIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	5	4	2	16	33	25	30	60	30	60	2.7	15258.24

SURVEY NAME: WASHINGTON | STATE: NY | AREA [sq. mi.]: 837 | AREA [acres]: 535680 | PUB. DATE: 1975 | FIELD DATE: 1959-1971 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 1.4 | ACREAGE 7499.52

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SCRIBA	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	2	12	18	15	12	64	52	64	1.1	5892.48
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3	4	2	15	24	20	17	48	31	90	0.3	1607.04

SURVEY NAME: WAYNE | STATE: NY | AREA [sq. mi.]: 607 | AREA [acres]: 388480 | PUB. DATE: 1978 | FIELD DATE: 1944-1972 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 12.5 | ACREAGE 48560.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
IRA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2	18	26	22	21	44	23	60	3.3	12819.84
SODUS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	2	18	30	24	28	45	17	56	2.7	10488.96
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3	4	2	12	24	18	15	34	19	58	1.2	4661.76
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4	4	2	15	24	20	20	48	28	60	5.3	20589.44

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: WYOMING | STATE: NY | AREA [sq. mi.]: 598 | AREA [acres]: 382720 | PUB. DATE: 1974 | FIELD DATE: 1963-1968 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA %: 44.8 | ACREAGE: 171458.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	18	34	26	29	46	17	58	7.5	28704.00
CANASERAGA	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	1	18	36	27	26	52	26	52	1.2	4592.64
DALTON	AERIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	2				18	56	38	70	1.2	4592.64
ELLERY	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2		4	1	10	18	14	15	50	35	60	2.7	10333.44
ERIE	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	1	10	16	13	15	45	30	60	9.6	36741.12
LANGFORD	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	24	20	20	48	28	55	8.4	32148.48
MARDIN	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	1	14	24	19	16	60	44	70	7.1	27173.12
MARILLA	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	25	20	18	42	24	60	0.8	3061.76
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	15	20	18	19	58	39	70	5.4	20666.88
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	2				14	46	32	60	0.1	382.72
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	1				17	41	24	50	0.8	3061.76

SURVEY NAME: ASHLAND | STATE: OH | AREA [sq. mi.]: 424 | AREA [acres]: 271360 | PUB. DATE: 1980 | FIELD DATE: 1970-1975 | COND. DATE: 0 | APPROV. DATE: 1976 | SURVEY AREA %: 36.5 | ACREAGE: 99046.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	30	23	21	35	14	60	9.1	24693.76
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	18	30	24	23	38	15	60	1.5	4070.40
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	36	27	20	36	16	60	7.3	19809.28
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3		4	2	18	28	23	23	42	19	72	2.1	5698.56
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	3	24	36	30	27	50	23	60	16.5	44774.40

SURVEY NAME: ASHTABULA | STATE: OH | AREA [sq. mi.]: 705 | AREA [acres]: 451200 | PUB. DATE: 1973 | FIELD DATE: 1953-1964 | COND. DATE: 1964 | APPROV. DATE: 1967 | SURVEY AREA %: 71.3 | ACREAGE: 321705.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BRACEVILLE	TYPIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			18	30	24	21	34	13	100	0.5	2256.00
CAMBRIDGE	OCHREPTIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	1			18	26	22	24	50	26	70	1.7	7670.40
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	1			18	24	21	22	40	18	60	3.0	13536.00
PIERPONT	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	4	2			18	30	24	21	48	27	60	1.0	4512.00
PLATEA	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	1			15	26	21	22	41	19	60	30.8	138969.60

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SHEFFIELD	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	2			15	26	21	22	41	19	60	30.1	135811.20
VENANGO	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1		16	24	20	21	46	25	75	3.5	15792.00
WALLINGTON	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	3	1		15	30	23	17	50	33	70	0.5	2256.00
WILLIAMSON	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	ALLUVIUM	4	1		15	24	20	22	52	30	70	0.2	902.40

SURVEY NAME: ATHENS | STATE: OH | AREA [sq. mi.]: 504 | AREA [acres]: 322560 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA %: 4.0 | ACREAGE: 12902.40

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
DOLES	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2						25	52	27	60	0.2	645.12
OMULGA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	23	43	20	60	3.3	10644.48
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	22	32	27	27	52	25	60	0.5	1612.80

SURVEY NAME: BUTLER | STATE: OH | AREA [sq. mi.]: 471 | AREA [acres]: 301440 | PUB. DATE: 1980 | FIELD DATE: 1969-1975 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA %: 0.4 | ACREAGE: 1205.76

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	2			18	30	24	28	50	22	74	0.2	602.88
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			18	30	24	24	50	26	75	0.2	602.88

SURVEY NAME: CLERMONT | STATE: OH | AREA [sq. mi.]: 459 | AREA [acres]: 293760 | PUB. DATE: 1972 | FIELD DATE: 1964-1969 | COND. DATE: 1969 | APPROV. DATE: 1969 | SURVEY AREA %: 53.7 | ACREAGE: 157749.12

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1						26	45	19	85	17.1	50232.96
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	3	18	36	27	19	36	17	80	11.6	34076.16
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			18	30	24	18	39	21	130	25.0	73440.00

SURVEY NAME: COLUMBIANA | STATE: OH | AREA [sq. mi.]: 535 | AREA [acres]: 342400 | PUB. DATE: 1968 | FIELD DATE: 1942-1960 | COND. DATE: 1960 | APPROV. DATE: 1965 | SURVEY AREA %: 30.7 | ACREAGE: 105116.80

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANFIELD	AQUIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	4							19	38	19	70	10.0	34240.00
ERNEST	AQUIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	COLLUVIUM	4							23	48	25	108	0.3	1027.20
FRENCHTOWN	TYPIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	2							21	34	13	58	0.5	1712.00
GRESHAM	AERIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3							22	60	38	196	0.1	342.40
LAIDIG	TYPIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	COLLUVIUM	5							32	51	19	60	0.2	684.80
MONONGAHELA	TYPIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	ALLUVIUM	4							25	56	31	71	1.9	6505.60

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

RAINSBORO	TYPIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	4						24	43	19	71	0.5	1712.00
RAVENNA	AERIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3						15	48	33	96	2.0	6848.00
RITTMAN	AQUIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	4						22	49	27	78	0.9	3081.60
TITUSVILLE	AQUIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	4						19	47	28	230	1.8	6163.20
TYLER	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	ALLUVIUM	3						16	73	57	126	0.2	684.80
WADSWORTH	AERIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3						18	41	23	72	0.3	1027.20
WOOSTER	TYPIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	5						19	44	25	56	12.0	41088.00

SURVEY NAME: CRAWFORD | STATE: OH | AREA [sq. mi.]: 404 | AREA [acres]: 258560 | PUB. DATE: 1979 | FIELD DATE: 1969-1974 | COND. DATE: 1974 | APPROV. DATE: 1975 | SURVEY AREA: % 0.5 | ACREAGE 1292.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WADSWORTH	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1			18	28	23	24	36	12	64	0.5	1292.80

SURVEY NAME: CUYAHOGA | STATE: OH | AREA [sq. mi.]: 456 | AREA [acres]: 291840 | PUB. DATE: 1981 | FIELD DATE: 1973-1977 | COND. DATE: 1977 | APPROV. DATE: 1978 | SURVEY AREA: % 3.8 | ACREAGE 11089.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
RITTMAN	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	4	4	2					22	44	22	60	1.1	3210.24
WADSWORTH	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	3	1		18	28	23	25	40	15	60	2.7	7879.68

SURVEY NAME: GEAUGA | STATE: OH | AREA [sq. mi.]: 407 | AREA [acres]: 260480 | PUB. DATE: 1982 | FIELD DATE: 1965-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 33.4 | ACREAGE 87000.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2					25	48	23	78	5.5	14326.40
PLATEA	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	3	1					17	34	17	60	3.8	9898.24
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	4	2					31	43	12	60	1.9	4949.12
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	4	2		18	36	27	25	44	19	60	9.0	23443.20
SHEFFIELD	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	2	3	1					20	40	20	60	1.4	3646.72
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	4	2					19	41	22	60	11.7	30476.16
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		3					20	34	14	60	0.1	260.48

SURVEY NAME: HAMILTON | STATE: OH | AREA [sq. mi.]: 413 | AREA [acres]: 264320 | PUB. DATE: 1982 | FIELD DATE: 1975-1979 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA: % 29.3 | ACREAGE 77445.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	3	1		25	40	33	33	66	33	131	4.2	11101.44

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	4	1	22	36	29	25	53	28	85	0.9	2378.88
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5	4	2	20	38	29	30	46	16	86	3.7	9779.84
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	2	18	30	24	26	49	23	92	20.5	54185.60

SURVEY NAME: HIGHLAND | STATE: OH | AREA [sq. mi.]: 549 | AREA [acres]: 351360 | PUB. DATE: 1977 | FIELD DATE: 1963-1969 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 34.6 | ACREAGE 121570.56

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	1			22	32	27	31	39	8	124	9.6	33730.56
BOSTON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	5	3			18	30	24	18	32	14	58	3.5	12297.60
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	5	3			18	38	28	35	52	17	115	1.3	4567.68
DUBOIS	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	THERMIC	GLACIAL TILL	3	1			20	35	28	31	59	28	131	0.6	2108.16
HAUBSTADT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	GLACIAL TILL	4			2	16	36	26	18	53	35	110	5.4	18973.44
JOHNSBURG	AQUIC FRAGIUDULTS	FINE-SILTY	MIXED	THERMIC	WEATHERED BEDROCK	3	1			18	34	26	28	45	17	60	0.1	351.36
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			20	30	25	24	42	18	74	0.6	2108.16
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			18	30	24	17	56	39	97	13.5	47433.60

SURVEY NAME: JACKSON | STATE: OH | AREA [sq. mi.]: 419 | AREA [acres]: 268160 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 12.4 | ACREAGE 33251.84

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
DOLES	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	2						35	60	25	71	1.6	4290.56
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	24	36	30	31	62	31	70	0.9	2413.44
OMULGA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2				27	49	22	85	9.3	24938.88
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2				29	58	29	60	0.6	1608.96

SURVEY NAME: KNOX | STATE: OH | AREA [sq. mi.]: 531 | AREA [acres]: 339840 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 22.5 | ACREAGE 76464.00

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	28	23	25	42	17	60	1.0	3398.40
GRESHAM	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		3	2	24	35	30	33	52	19	73	0.3	1019.52
HOMEWOOD	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	20	36	28	29	67	38	80	11.7	39761.28
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	36	27	27	40	13	70	1.7	5777.28
TITUSVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	26	22	21	46	25	60	4.6	15632.64
WADSWORTH	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		3	1	18	28	23	20	39	19	60	0.5	1699.20

WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3		24	36	30	32	44	12	60	2.7	9175.68

SURVEY NAME: LAKE | STATE: OH | AREA [sq. mi.]: 231 | AREA [acres]: 147840 | PUB. DATE: 1979 | FIELD DATE: 1967-1973 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 14.8 | ACREAGE 21880.32

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
PIERPONT	AQUEPTIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			1	18	30	24	24	40	16	60	4.3	6357.12
PLATEA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3			1				26	43	17	60	10.5	15523.20

SURVEY NAME: MAHONING | STATE: OH | AREA [sq. mi.]: 419 | AREA [acres]: 268160 | PUB. DATE: 1971 | FIELD DATE: 1958-1964 | COND. DATE: 1965 | APPROV. DATE: 1966 | SURVEY AREA: % 32.6 | ACREAGE 87420.16

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3						20	50	30	124	11.6	31106.56
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	1			18	24	21	19	46	27	132	1.9	5095.04
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			15	24	20	21	44	23	64	4.6	12335.36
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			1	15	28	22	20	50	30	70	6.0	16089.60
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3				14	28	21	16	35	19	60	5.8	15553.28
WOOSTER	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5				10	36	23	23	36	13	108	2.7	7240.32

SURVEY NAME: MEDINA | STATE: OH | AREA [sq. mi.]: 425 | AREA [acres]: 272000 | PUB. DATE: 1977 | FIELD DATE: 1966-1972 | COND. DATE: 1972 | APPROV. DATE: 1974 | SURVEY AREA: % 21.3 | ACREAGE 57936.00

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	28	23	22	42	20	70	4.4	11968.00
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	26	32	29	30	57	27	68	1.1	2992.00
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			2	20	32	26	26	40	14	60	8.6	23392.00
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3			2	20	28	24	21	52	31	80	4.4	11968.00
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	3	24	34	29	31	42	11	75	2.8	7616.00

SURVEY NAME: MONROE | STATE: OH | AREA [sq. mi.]: 455 | AREA [acres]: 291200 | PUB. DATE: 1974 | FIELD DATE: 1960-1966 | COND. DATE: 1966 | APPROV. DATE: 1970 | SURVEY AREA: % 6.0 | ACREAGE 17472.00

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	10	30	20	21	57	36	94	0.4	1164.80
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	15	24	20	30	55	25	84	0.1	291.20
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	NONE GIVEN	4		4	2	12	40	26	25	40	15	55	5.5	16016.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: NOBLE | STATE: OH | AREA [sq. mi.]: 398 | AREA [acres]: 254720 | PUB. DATE: 1990 | FIELD DATE: 1986 | COND. DATE: 1986 | APPROV. DATE: 1986 | SURVEY AREA: % 2.6 | ACREAGE 6622.72

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
OMULGA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	20	36	28	34	48	14	68	1.1	2801.92
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	32	26	25	47	22	58	1.5	3820.80

SURVEY NAME: PERRY | STATE: OH | AREA [sq. mi.]: 410 | AREA [acres]: 262400 | PUB. DATE: 1988 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 16.5 | ACREAGE 43296.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	1	24	32	28	31	56	25	80	11.3	29651.20
HOMEWOOD	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	LOESS	4		4	2				18	46	28	80	2.4	6297.60
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	24	32	28	27	47	20	80	2.8	7347.20

SURVEY NAME: PIKE | STATE: OH | AREA [sq. mi.]: 443 | AREA [acres]: 283520 | PUB. DATE: 1990 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 11.3 | ACREAGE 32037.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DOLES	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			20	30	25	24	58	34	69	0.6	1701.12
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	36	28	22	42	20	72	0.2	567.04
OMULGA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	24	36	30	27	53	26	70	7.2	20413.44
OTWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	1	24	36	30	27	50	23	80	0.5	1417.60
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	18	28	23	27	51	24	58	2.8	7938.56

SURVEY NAME: PORTAGE | STATE: OH | AREA [sq. mi.]: 495 | AREA [acres]: 316800 | PUB. DATE: 1978 | FIELD DATE: 1965-1972 | COND. DATE: 1972 | APPROV. DATE: 1973 | SURVEY AREA: % 21.7 | ACREAGE 68745.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2				22	46	24	82	6.6	20908.80
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2						30	48	18	80	1.3	4118.40
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2				27	41	14	60	4.8	15206.40
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			2				26	47	21	70	0.8	2534.40
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	4			2	24	28	26	28	50	22	68	5.3	16790.40
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	3	20	30	25	23	43	20	60	2.9	9187.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: RICHLAND | STATE: OH | AREA [sq. mi.]: 497 | AREA [acres]: 318080 | PUB. DATE: 1975 | FIELD DATE: 1966-1970 | COND. DATE: 1970 | APPROV. DATE: 1971 | SURVEY AREA: % 32.1 | ACREAGE 102103.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3			2	15	28	22	22	45	23	60	7.7	24492.16
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2			1	13	24	19	22	40	18	60	0.2	636.16
HANOVER	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3			20	28	24	22	72	50	76	1.9	6043.52
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			18	24	21	23	50	27	60	0.9	2862.72
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			2	12	24	18	18	42	24	60	7.0	22265.60
TITUSVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	3	18	26	22	21	45	24	81	0.9	2862.72
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3			1	16	28	22	20	38	18	60	1.7	5407.36
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3			20	30	25	24	40	16	60	11.8	37533.44

SURVEY NAME: ROSS | STATE: OH | AREA [sq. mi.]: 687 | AREA [acres]: 439680 | PUB. DATE: 1967 | FIELD DATE: 1952-1959 | COND. DATE: 1959 | APPROV. DATE: 1965 | SURVEY AREA: % 5.5 | ACREAGE 24182.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	1			24	36	30	32	54	22	76	0.5	2198.40
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			18	30	24	24	63	39	63	0.3	1319.04
RAINSBORO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	3			20	26	23	26	48	22	102	1.2	5276.16
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	2			20	32	26	27	38	11	120	3.3	14509.44
TYLER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			15	30	23	18	59	41	59	0.2	879.36

SURVEY NAME: SCIOTO | STATE: OH | AREA [sq. mi.]: 608 | AREA [acres]: 389120 | PUB. DATE: 1989 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 16.3 | ACREAGE 63426.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DOLES	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			20	30	25	38	53	15	62	0.4	1556.48
DOLES	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	2			20	30	25	24	58	34	69	0.4	1556.48
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	22	28	25	24	60	36	60	0.3	1167.36
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	36	28	22	42	20	72	0.3	1167.36
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	18	30	24	18	57	39	70	1.3	5058.56
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4		4	2	18	30	24	18	57	39	70	1.3	5058.56
OMULGA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4		4	2	18	36	27	30	43	13	85	2.1	8171.52
OMULGA	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4		4	2	24	36	30	27	53	26	70	5.0	19456.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	4	2	24	38	31	34	59	25	69	0.6	2334.72
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	4	2	24	38	31	34	59	25	69	0.6	2334.72
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	2	22	38	30	24	47	23	60	0.8	3112.96
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4	4	2	22	28	25	24	47	23	60	0.7	2723.84
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	4	1	24	36	30	29	51	22	70	1.8	7004.16
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	4	1	24	36	30	29	51	22	70	0.7	2723.84

SURVEY NAME: STARK | STATE: OH | AREA [sq. mi.]: 573 | AREA [acres]: 366720 | PUB. DATE: 1971 | FIELD DATE: 1962-1965 | COND. DATE: 1965 | APPROV. DATE: 1967 | SURVEY AREA: % 35.5 | ACREAGE 130185.60

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	3	15	30	23	25	55	30	62	16.8	61608.96
GINAT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	2	3						26	36	10	60	0.6	2200.32
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3			3				23	43	20	60	6.7	24570.24
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			2	18	30	24	22	41	19	78	0.5	1833.60
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3			2	18	26	22	20	31	11	48	1.5	5500.80
WEINBACH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	2			18	30	24	19	30	11	60	1.6	5867.52
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4			20	36	28	21	40	19	50	7.8	28604.16

SURVEY NAME: SUMMIT | STATE: OH | AREA [sq. mi.]: 413 | AREA [acres]: 264320 | PUB. DATE: 1974 | FIELD DATE: 1964-1968 | COND. DATE: 1968 | APPROV. DATE: 1969 | SURVEY AREA: % 30.5 | ACREAGE 80617.60

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	20	29	25	20	44	24	79	13.0	34361.60
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			23	32	28	32	62	30	71	0.1	264.32
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	21	26	24	23	51	28	90	2.3	6079.36
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4			2	20	26	23	20	46	26	66	6.9	18238.08
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3			2	20	26	23	23	44	21	80	3.0	7929.60
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4			24	30	27	30	54	24	70	5.2	13744.64

SURVEY NAME: TUSCARAWAS | STATE: OH | AREA [sq. mi.]: 569 | AREA [acres]: 364160 | PUB. DATE: 1986 | FIELD DATE: 1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 0.8 | ACREAGE 2913.28

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	30	23	17	60	43	60	0.1	364.16
WEINBACH	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	1				27	41	14	60	0.7	2549.12

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: WARREN | STATE: OH | AREA [sq. mi.]: 408 | AREA [acres]: 261120 | PUB. DATE: 1973 | FIELD DATE: 1957-1963 | COND. DATE: 1963 | APPROV. DATE: 1968 | SURVEY AREA: % 21.6 | ACREAGE 56401.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AVONBURG	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3			2	20	32	26	24	35	11	104	6.8	17756.16
CINCINNATI	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	5			3				36	45	9	100	1.5	3916.80
ROSSMOYNE	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	3				27	39	12	92	13.3	34728.96

SURVEY NAME: WASHINGTON | STATE: OH | AREA [sq. mi.]: 641 | AREA [acres]: 410240 | PUB. DATE: 1977 | FIELD DATE: 1966-1971 | COND. DATE: 1971 | APPROV. DATE: 1972 | SURVEY AREA: % 3.6 | ACREAGE 14768.64

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ZANESVILLE	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	5		4	2	24	32	28	28	58	30	77	3.6	14768.64

SURVEY NAME: WAYNE | STATE: OH | AREA [sq. mi.]: 561 | AREA [acres]: 359040 | PUB. DATE: 1984 | FIELD DATE: 1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 39.9 | ACREAGE 143256.96

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	30	23	26	55	29	72	19.8	71089.92
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3		4	2	14	30	22	18	45	27	90	4.5	16156.80
RITTMAN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	18	32	25	28	42	14	60	7.1	25491.84
WADSWORTH	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3		3	1	18	30	24	28	43	15	60	4.0	14361.60
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3			20	36	28	27	58	31	60	4.5	16156.80

SURVEY NAME: CHEROKEE & DELAWARE | STATE: OK | AREA [sq. mi.]: 1471 | AREA [acres]: 941440 | PUB. DATE: 1970 | FIELD DATE: 1958-1966 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA: % 7.0 | ACREAGE 65900.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	5	3			20	40	30	27	50	23	50	2.1	19770.24
JAY	MOLLIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2				24	70	46	70	0.8	7531.52
LOCUST	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	5		4	2				22	30	8	42	4.1	38599.04

SURVEY NAME: LATIMER | STATE: OK | AREA [sq. mi.]: 737 | AREA [acres]: 471680 | PUB. DATE: 1981 | FIELD DATE: 1972-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 2.6 | ACREAGE 12263.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SHERMORE	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	4	3						36	80	44	80	2.6	12263.68

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: LEFLORE | STATE: OK | AREA [sq. mi.]: 1582 | AREA [acres]: 1012480 | PUB. DATE: 1983 | FIELD DATE: 1965-1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 3.9 | ACREAGE 39486.72

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SHERMORE	TYPIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	THERMIC	COLLUVIUM	5	3						31	80	49	80	3.9	39486.72

SURVEY NAME: CLACKAMAS | STATE: OR | AREA [sq. mi.]: 1003 | AREA [acres]: 641920 | PUB. DATE: 1985 | FIELD DATE: 1981 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: % 5.3 | ACREAGE 34021.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CASCADE	TYPIC FRAGIUMBREPTS	FINE-SILTY	MIXED	MESIC	LOESS	3		4	2	20	30	25	21	60	39	60	2.5	16048.00
CORNELIUS	MOLLIC FRAGIXER ALPS	FINE-SILTY	MIXED	MESIC	LOESS	5		4	2	30	40	35	34	60	26	60	0.6	3851.52
DELENA	HUMIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2		4	1	20	30	25	25	60	35	60	0.5	3209.60
HUBERLY	TYPIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	2	2			20	30	25	24	60	36	60	0.3	1925.76
KINTON	TYPIC FRAGIOCHREPTS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	4		4	2	30	40	35	35	65	30	65	0.4	2567.68
POWELL	TYPIC FRAGIOCHREPTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		4	2	15	24	20	15	60	45	60	1.0	6419.20

SURVEY NAME: COLUMBIA | STATE: OR | AREA [sq. mi.]: 651 | AREA [acres]: 416640 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 16.9 | ACREAGE 70412.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CASCADE	TYPIC FRAGIUMBREPTS	FINE-LOAMY	MIXED	MESIC	LOESS	3		4	2	20	30	25	24	60	36	60	0.6	2499.84
CORNELIUS	MOLLIC FRAGIXER ALPS	FINE-LOAMY	MIXED	MESIC	LOESS	4		4	2	30	40	35	38	60	22	60	1.4	5832.96
DELENA	HUMIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	LOESS	2		4	1	20	30	25	23	60	37	60	0.3	1249.92
GLOHM	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	20	40	30	36	60	24	60	2.4	9999.36
GOBLE	ANDIC FRAGIUMBREPTS	MEDIAL	NONE GIVEN	FRIGID	LOESS	4		4	2	30	45	38	38	60	22	60	12.2	50830.08

SURVEY NAME: HOOD RIVER AREA (NE PART) | STATE: OR | AREA [sq. mi.]: 185 | AREA [acres]: 118400 | PUB. DATE: 1981 | FIELD DATE: 1974 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA: % 1.2 | ACREAGE 1420.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WYEAST	AERIC FRAGIAQUEPTS	COARSE-SILTY	MIXED	MESIC	GLACIAL TILL	4	2			20	36	28	28	52	24	52	1.2	1420.80

SURVEY NAME: MULTNOMAH | STATE: OR | AREA [sq. mi.]: 423 | AREA [acres]: 270720 | PUB. DATE: 1983 | FIELD DATE: 1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 19.0 | ACREAGE 51436.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CASCADE	TYPIC FRAGIUMBREPTS	FINE-SILTY	MIXED	MESIC	LOESS	3	2			20	30	25	27	60	33	60	9.6	25989.12

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DELENA	HUMIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	LOESS	2	1			20	30	25	23	60	37	60	0.2	541.44
GOBLE	ANDIC FRAGIUMBREPTS	MEDIAL	NONE GIVEN	MESIC	LOESS	4		4	2	30	48	39	37	60	23	60	6.6	17867.52
POWELL	TYPIC FRAGIOCHREPTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			20	30	25	16	69	53	69	2.6	7038.72

SURVEY NAME: WASHINGTON STATE: OR AREA [sq. mi.]: 716 AREA [acres]: 458240 PUB. DATE: 1982 FIELD DATE: 1975 COND. DATE: 1975 APPROV. DATE: 1976 SURVEY AREA: % 8.9 ACREAGE 40783.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CASCADE	TYPIC FRAGIUMBREPTS	FINE-SILTY	MIXED	MESIC	LOESS	3	1						27	50	23	50	2.5	11456.00
DELENA	HUMIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	1			20	30	25	22	50	28	50	0.4	1832.96
GOBLE	ANDIC FRAGIUMBREPTS	MEDIAL	NONE GIVEN	MESIC	ALLUVIUM	4		4	2	30	45	38	33	60	27	60	1.8	8248.32
HUBERLY	TYPIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	2	2			20	30	25	25	42	17	42	0.6	2749.44
KINTON	TYPIC FRAGIOCHREPTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2			30	40	35	30	60	30	60	3.6	16496.64

SURVEY NAME: ADAMS STATE: PA AREA [sq. mi.]: 526 AREA [acres]: 336640 PUB. DATE: 1967 FIELD DATE: 1948-1961 COND. DATE: 1962 APPROV. DATE: 1965 SURVEY AREA: % 22.2 ACREAGE 74734.08

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ABBOTTSTOWN	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3							16	25	9	36	7.0	23564.80
BUCHANAN	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4							37	44	7	44	0.6	2019.84
CROTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2							18	36	18	55	5.4	18178.56
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			23	40	32	23	40	17	40	0.3	1009.92
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	THERMIC	COLLUVIUM	2							16	45	29	45	0.1	336.64
LAMINGTON	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2							16	31	15	60	0.3	1009.92
LAWRENCE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3							34	42	8	70	1.1	3703.04
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4							27	40	13	46	6.1	20535.04
ROHRENSVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3							21	56	35	56	1.3	4376.32

SURVEY NAME: ALLEGHENY STATE: PA AREA [sq. mi.]: 727 AREA [acres]: 465280 PUB. DATE: 1981 FIELD DATE: 1964-1972 COND. DATE: 1972 APPROV. DATE: 1973 SURVEY AREA: % 4.7 ACREAGE 21868.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BRINKERTON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			20	30	25	24	44	20	60	0.1	465.28
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	30	25	28	44	16	60	0.6	2791.68
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	30	25	28	60	32	72	2.5	11632.00
RAINSBORO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4	2			20	30	25	26	60	34	65	1.5	6979.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ARMSTRONG | STATE: PA | AREA [sq. mi.]: 656 | AREA [acres]: 419840 | PUB. DATE: 1977 | FIELD DATE: 1965-1970 | COND. DATE: 1971 | APPROV. DATE: 1970 | SURVEY AREA: % 15.5 | ACREAGE 65075.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			20	28	24	24	50	26	74	12.8	53739.52
RAINSBORO	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	3			22	34	28	28	60	32	70	2.7	11335.68

SURVEY NAME: BEAVER & LAWRENCE | STATE: PA | AREA [sq. mi.]: 814 | AREA [acres]: 520960 | PUB. DATE: 1982 | FIELD DATE: 1967-1977 | COND. DATE: 1977 | APPROV. DATE: 1978 | SURVEY AREA: % 34.9 | ACREAGE 181815.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			15	30	23	20	38	18	60	0.4	2083.84
BRINKERTON	TYPIC FRAGIOCHREPTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			15	30	23	29	50	21	60	0.7	3646.72
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			15	30	23	21	50	29	60	12.6	65640.96
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			20	30	25	24	44	20	60	1.7	8856.32
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	1			16	32	24	18	44	26	60	2.3	11982.08
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	23	48	25	60	1.5	7814.40
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			14	30	22	20	60	40	62	11.0	57305.60
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			15	24	20	18	44	26	60	0.1	520.96
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2			18	28	23	21	39	18	60	1.5	7814.40
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			15	24	20	24	48	24	60	0.7	3646.72
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3			18	36	27	22	59	37	72	2.4	12503.04

SURVEY NAME: BERKS | STATE: PA | AREA [sq. mi.]: 864 | AREA [acres]: 552960 | PUB. DATE: 1981 | FIELD DATE: 1947-1964 | COND. DATE: 1970 | APPROV. DATE: 1965 | SURVEY AREA: % 9.5 | ACREAGE 52531.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			20	30	25	23	53	30	53	0.3	1658.88
BRINKERTON	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2						18	31	13	38	1.5	8294.40
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2						26	60	34	60	0.6	3317.76
COMLY	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2						27	41	14	50	1.1	6082.56
CROTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2						30	40	10	40	0.7	3870.72
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4							20	40	20	60	0.6	3317.76
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3						38	55	17	55	3.8	21012.48
LAMINGTON	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	2	2						18	48	30	52	0.1	552.96

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

RARITAN	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2				23	43	20	46	0.2	1105.92
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2				21	44	23	66	0.4	2211.84
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2	13	24	19					0.2	1105.92

SURVEY NAME: BLAIR | STATE: PA | AREA [sq. mi.]: 530 | AREA [acres]: 339200 | PUB. DATE: 1981 | FIELD DATE: 1968-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 33.6 | ACREAGE 113971.20

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3			22	32	27	22	60	38	60	1.1	3731.20
ANDOVER	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			18	26	22	18	50	32	60	0.5	1696.00
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			19	30	25	21	40	19	60	1.9	6444.80
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	21	46	25	60	4.9	16620.80
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	20	50	30	60	1.3	4409.60
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			22	30	26	27	48	21	60	1.1	3731.20
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			32	48	40	32	71	39	71	16.2	54950.40
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			26	48	37	29	60	31	60	5.7	19334.40
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			20	30	25	20	54	34	86	0.6	2035.20
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			20	24	22	20	48	28	62	0.3	1017.60

SURVEY NAME: BRADFORD & SULLIVAN | STATE: PA | AREA [sq. mi.]: 635 | AREA [acres]: 406400 | PUB. DATE: 1986 | FIELD DATE: 1963-1978 | COND. DATE: 1978 | APPROV. DATE: 1979 | SURVEY AREA: % 56.2 | ACREAGE 228396.80

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BRACEVILLE	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			15	30	23	22	37	15	60	0.2	812.80
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	1	1			14	20	17	18	51	33	60	1.8	7315.20
MARDIN	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	1			14	26	20	20	57	37	60	5.8	23571.20
MORRIS	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			13	22	18	16	52	36	60	14.5	58928.00
NORWICH	TYPIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	1	1			12	24	18	20	53	33	60	0.8	3251.20
REXFORD	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			15	24	20	18	42	24	60	0.6	2438.40
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	2			10	20	15	14	50	36	60	20.4	82905.60
WELLSBORO	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			15	26	21	20	52	32	60	12.1	49174.40

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: BUCKS & PHILADELPHIA | STATE: PA | AREA [sq. mi.]: 743 | AREA [acres]: 475520 | PUB. DATE: 1975 | FIELD DATE: 1963-1970 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA: % 27.7 | ACREAGE 131719.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ABBOTTSTOWN	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	15	27			3	2	3	15	42	27	46	7.3	34712.96
CHALFONT	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	3	2			15	25	20	21	57	36	70	1.3	6181.76
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			20	36	28	32	62	30	62	0.2	951.04
DOYLESTOWN	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	LOESS	2	2			15	25	20	20	53	33	53	7.4	35188.48
LAWRENCEVILLE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	LOESS	4	3			24	32	28	25	47	22	87	2.9	13790.08
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	3			24	36	30	24	50	26	60	4.0	19020.80
TOWHEE	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2	20	30	28	63	46					4.1	19496.32
URBANA	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2			16	25	21	18	50	32	50	0.5	2377.60

SURVEY NAME: BUTLER | STATE: PA | AREA [sq. mi.]: 794 | AREA [acres]: 508160 | PUB. DATE: 1989 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 30.7 | ACREAGE 156005.12

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2		4	2	16	28	22	21	42	21	62	1.5	7622.40
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	30	23	17	33	16	72	0.6	3048.96
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2		4	2	15	30	23	20	48	28	60	4.2	21342.72
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	36	28	29	60	31	64	7.4	37603.84
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2	16	27	22	24	39	15	60	4.9	24899.84
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	36	28	23	55	32	60	4.6	23375.36
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2		4	2	16	32	24	17	65	48	65	0.7	3557.12
GRESHAM	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	15	26	21	21	75	54	75	2.3	11687.68
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	18	30	24	20	40	20	60	0.3	1524.48
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2	18	28	23	25	55	30	60	2.0	10163.20
TITUSVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	16	28	22	23	60	37	60	2.2	11179.52

SURVEY NAME: CAMBRIA | STATE: PA | AREA [sq. mi.]: 695 | AREA [acres]: 444800 | PUB. DATE: 1985 | FIELD DATE: 1967-1976 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 43.5 | ACREAGE 193488.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	3			18	32	25	31	50	19	80	0.3	1334.40
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2			15	30	23	28	60	32	60	5.5	24464.00

COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2	16	27	22	26	40	14	60	12.4	55155.20
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3	20	30	25	26	41	15	61	12.3	54710.40
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3	30	50	40	36	65	29	65	12.0	53376.00
NOLO	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2	16	30	23	19	50	31	60	1.0	4448.00

SURVEY NAME: CENTRE | STATE: PA | AREA [sq. mi.]: 1115 | AREA [acres]: 713600 | PUB. DATE: 1981 | FIELD DATE: 1965-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 20.2 | ACREAGE 144147.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			20	32	26	27	60	33	60	0.8	5708.80
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			18	28	23	23	60	37	60	4.7	33539.20
BRINKERTON	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			15	30	23	21	44	23	62	1.0	7136.00
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	27	47	20	60	5.0	35680.00
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			24	36	30	35	48	13	63	0.3	2140.80
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	30	25	26	51	25	80	0.7	4995.20
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	5	3			30	45	38	40	74	34	74	6.8	48524.80
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			25	36	31	28	54	26	80	0.7	4995.20
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			18	30	24	29	60	31	60	0.1	713.60
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	2			15	24	20	16	44	28	60	0.1	713.60

SURVEY NAME: CLEARFIELD | STATE: PA | AREA [sq. mi.]: 1144 | AREA [acres]: 732160 | PUB. DATE: 1988 | FIELD DATE: 1981 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA: % 24.2 | ACREAGE 177182.72

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2				18	30	24	28	47	19	62	2.1	15375.36
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4				16	27	22	22	40	18	49	9.7	71019.52
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4				20	36	28	24	48	24	60	11.0	80537.60
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4				18	30	24	25	64	39	64	0.6	4392.96
NOLO	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2				16	30	23	17	55	38	55	0.5	3660.80
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3				15	24	20	20	61	41	61	0.3	2196.48

SURVEY NAME: COLUMBIA | STATE: PA | AREA [sq. mi.]: 484 | AREA [acres]: 309760 | PUB. DATE: 1967 | FIELD DATE: 1950-1961 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 14.5 | ACREAGE 44915.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3	3						19	40	21	60	1.5	4646.40

ALVIRA	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3	2					29	45	16	50	1.0	3097.60
BUCHANAN	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	COLLUVIUM	3	3	20	36	28		32	38	6	42	0.7	2168.32
CANFIELD	AQUIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3	2					27	33	6	50	0.7	2168.32
LACKAWANNA	TYPIC FRAGIOCHREPTS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	4	2					44	51	7	51	2.6	8053.76
LAIDIG	TYPIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	5	3									0.9	2787.84
LAWRENCEVILLE	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	LOESS	4	2					35	55	20	66	0.4	1239.04
MORRIS	AERIC FRAGIAQUEPTS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	2	2					18	38	20	38	0.2	619.52
RAVENNA	AERIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3	2					29	42	13	42	0.4	1239.04
SHELMADINE	TYPIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	2	2					32	42	10	50	2.2	6814.72
WATSON	TYPIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	4	2					24	52	28	60	2.1	6504.96
WELLSBORO	TYPIC FRAGIOCHREPTS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	3	2					31	63	32	63	0.2	619.52
WOOSTER	TYPIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	GLACIAL TILL	5	2					40	47	7	62	1.6	4956.16

SURVEY NAME: CRAWFORD | STATE: PA | AREA [sq. mi.]: 1012 | AREA [acres]: 647680 | PUB. DATE: 1979 | FIELD DATE: 1962-1972 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 65.1 | ACREAGE 421639.68

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	25	74	49	74	1.3	8419.84
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3			18	26	22	22	33	11	54	1.3	8419.84
CAMBRIDGE	OCHREPTIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	1						24	50	26	50	12.5	80960.00
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2						20	56	36	74	12.3	79664.64
HANOVER	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3						25	71	46	71	2.1	13601.28
PLATEA	AERIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	1						17	60	43	60	1.6	10362.88
SHEFFIELD	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	2	1						24	40	16	54	4.3	27850.24
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2						22	45	23	56	0.2	1295.36
VENANGO	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1						20	50	30	68	29.5	191065.60

SURVEY NAME: CUMBERLAND & PERRY | STATE: PA | AREA [sq. mi.]: 1108 | AREA [acres]: 709120 | PUB. DATE: 1986 | FIELD DATE: 1979 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 15.4 | ACREAGE 109204.48

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3			18	32	25	24	45	21	62	1.1	7800.32
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			16	28	22	18	42	24	60	1.1	7800.32
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			15	28	22	16	44	28	62	1.3	9218.56

BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2			20	36	28	27	44	17	60	3.8	26946.56
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	23	44	21	60	0.9	6382.08
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	3			15	30	23	21	43	22	60	0.6	4254.72
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	50	40	32	60	28	60	3.6	25528.32
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			25	48	37	31	54	23	60	1.0	7091.20
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	21	46	25	62	1.4	9927.68
PENLAW	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3	2			15	30	23	21	49	28	60	0.3	2127.36
RARITAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			20	30	25	29	48	19	65	0.1	709.12
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			15	24	20	21	62	41	68	0.2	1418.24

SURVEY NAME: DAUPHIN | STATE: PA | AREA [sq. mi.]: 520 | AREA [acres]: 332800 | PUB. DATE: 1972 | FIELD DATE: 1960-1965 | COND. DATE: 1965 | APPROV. DATE: 1967 | SURVEY AREA: % 14.6 | ACREAGE 48588.80

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3						17	58	41	58	0.6	1996.80
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2			14	20	17	14	42	28	46	0.4	1331.20
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2						30	40	10	47	1.0	3328.00
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			15	30	23	15	46	31	50	0.7	2329.60
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM			20	34	48		24					0.1	332.80
COMLY	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3						23	44	21	52	0.7	2329.60
CROTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	2	2			15	25	20	18	42	24	42	0.3	998.40
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	5	3			30	42	36	42	60	18	60	10.4	34611.20
LAWRENCEVILLE	AQUIC FRAGIUDALFS	COARSE-SILTY	MIXED	MESIC	LOESS	4	3						25	34	9	72	0.2	665.60
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	3						33	50	17	50	0.2	665.60

SURVEY NAME: FAYETTE | STATE: PA | AREA [sq. mi.]: 794 | AREA [acres]: 508160 | PUB. DATE: 1973 | FIELD DATE: 1957-1967 | COND. DATE: 1968 | APPROV. DATE: 1968 | SURVEY AREA: % 14.5 | ACREAGE 73683.20

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	3			24	32	28	27	50	23	50	0.6	3048.96
ANDOVER	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2						25	88	63	88	1.0	5081.60
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			20	30	25	29	50	21	50	0.6	3048.96
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2						27	42	15	42	0.6	3048.96
CLARKSBURG	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2						37	56	19	66	1.9	9655.04

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2		18	26	22	25	42	17	49	1.6	8130.56
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3		20	30	25	23	40	17	48	6.1	30997.76
MONONGAHELA	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3		18	26	22	19	44	25	80	1.4	7114.24
THORNDALE	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	2	2		18	30	24	26	41	15	48	0.5	2540.80
TYLER	TYPIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	3	2					31	54	23	60	0.2	1016.32

SURVEY NAME: FRANKLIN STATE: PA AREA [sq. mi.]: 754 AREA [acres]: 482560 PUB. DATE: 1975 FIELD DATE: 1959-1970 COND. DATE: 1970 APPROV. DATE: 1971 SURVEY AREA: % 18.7 ACREAGE 90238.72

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			18	28	23	19	46	27	58	1.2	5790.72
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2						18	46	28	50	1.6	7720.96
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2			20	36	28	20	43	23	50	2.3	11098.88
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	32	48	16	60	2.0	9651.20
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	3						20	39	19	54	0.2	965.12
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3						36	60	24	60	9.2	44395.52
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3						36	65	29	65	1.2	5790.72
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	22	55	33	66	0.4	1930.24
PENLAW	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2						23	50	27	61	0.3	1447.68
TYLER	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3	2			15	34	25	30	50	20	65	0.3	1447.68

SURVEY NAME: FULTON STATE: PA AREA [sq. mi.]: 435 AREA [acres]: 278400 PUB. DATE: 1969 FIELD DATE: NONE GIVEN COND. DATE: 1966 APPROV. DATE: 1966 SURVEY AREA: % 24.3 ACREAGE 67651.20

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				22	40	18	50	1.2	3340.80
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2						17	24	7	42	1.0	2784.00
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2						21	44	23	44	1.0	2784.00
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2				24	48	24	48	2.7	7516.80
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3		4	2				19	40	21	43	0.8	2227.20
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2				26	40	14	44	0.3	835.20
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	3				44	60	16	70	16.8	46771.20
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	3				22	40	18	40	0.5	1392.00

SURVEY NAME: HUNTINGTON | STATE: PA | AREA [sq. mi.]: 895 | AREA [acres]: 572800 | PUB. DATE: 1978 | FIELD DATE: 1964-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA: % 23.0 | ACREAGE 131744.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	3			20	32	26	24	45	21	62	1.3	7446.40
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			16	26	21	18	48	30	60	1.9	10883.20
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			18	30	24	25	41	16	60	1.6	9164.80
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2			22	32	27	29	49	20	60	7.0	40096.00
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2						27	41	14	62	0.5	2864.00
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2						23	60	37	60	1.5	8592.00
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	42	36	30	78	48	78	6.1	34940.80
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	5	3			30	40	35	40	72	32	72	2.1	12028.80
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	28	48	20	60	0.5	2864.00
RARITAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3						21	43	22	73	0.3	1718.40
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	2			15	24	20	18	66	48	66	0.2	1145.60

SURVEY NAME: INDIANA | STATE: PA | AREA [sq. mi.]: 831 | AREA [acres]: 531840 | PUB. DATE: 1968 | FIELD DATE: 1965 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 20.4 | ACREAGE 108495.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BRINKERTON	TYPIC FRAGIAQUALFS	NONE GIVEN OR	NONE GIVEN	NONE	COLLUVIUM	2	2						17	26	9	60	1.5	7977.60
CLARKSBURG	AQUIC FRAGIUDALFS	NONE GIVEN OR	NONE GIVEN	NONE	COLLUVIUM	3	2						25	48	23	48	0.1	531.84
COOKPORT	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	WEATHERED BEDROCK	3	3						21	39	18	48	2.9	15423.36
ERNEST	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	COLLUVIUM	3	3						17	26	9	52	14.2	75521.28
MONONGAHELA	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	ALLUVIUM	4							25	34	9	44	1.5	7977.60
NOLO	AQUIC FRAGIUDULTS	NONE GIVEN OR	NONE GIVEN	NONE	WEATHERED BEDROCK	3	2						17	40	23	40	0.2	1063.68

SURVEY NAME: JUANITA & MIFFIN | STATE: PA | AREA [sq. mi.]: 820 | AREA [acres]: 524800 | PUB. DATE: 1981 | FIELD DATE: 1967-1974 | COND. DATE: 1974 | APPROV. DATE: 1975 | SURVEY AREA: % 25.7 | ACREAGE 134873.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	25	60	35	60	0.2	1049.60
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			16	28	22	18	50	32	60	3.0	15744.00
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			15	30	23	16	45	29	65	2.4	12595.20
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	21	60	39	60	5.5	28864.00

ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			20	30	25	24	40	16	60	1.6	8396.80
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	50	40	30	65	35	65	10.7	56153.60
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	28	56	28	70	1.2	6297.60
PENLAW	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	3	2			15	30	23	30	45	15	69	0.3	1574.40
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			15	24	20	21	46	25	60	0.6	3148.80
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	32	25	28	60	32	60	0.2	1049.60

SURVEY NAME: LACKAWANNA & WYOMING | STATE: PA | AREA [sq. mi.]: 850 | AREA [acres]: 544000 | PUB. DATE: 1982 | FIELD DATE: 1967-1975 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 55.0 | ACREAGE 299200.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	26	40	33	30	60	30	60	3.2	17408.00
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	30	24	19	37	18	72	0.2	1088.00
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			12	20	16	18	52	34	65	2.6	14144.00
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	20	35	28	20	50	30	60	7.2	39168.00
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			15	26	21	20	60	40	60	6.1	33184.00
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			12	20	16	15	65	50	65	10.5	57120.00
NORWICH	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	2			10	18	14	12	48	36	65	2.6	14144.00
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			15	24	20	21	40	19	60	0.2	1088.00
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			22	36	29	24	56	32	65	2.0	10880.00
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			12	20	16	12	60	48	60	7.7	41888.00
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			15	26	21	23	60	37	60	11.6	63104.00
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			17	28	23	21	60	39	60	1.1	5984.00

SURVEY NAME: LANCASTER | STATE: PA | AREA [sq. mi.]: 946 | AREA [acres]: 605440 | PUB. DATE: 1985 | FIELD DATE: 1981 | COND. DATE: 1982 | APPROV. DATE: 1982 | SURVEY AREA: % 6.4 | ACREAGE 38748.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ABBOTTSTOWN	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2			15	30	23	24	35	11	60	0.4	2421.76
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	36	28	22	52	30	60	2.0	12108.80
GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	3	15	30	23	15	38	23	62	2.8	16952.32
PENLAW	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	3		4	1	15	30	23	29	55	26	60	0.2	1210.88
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	3	20	36	28	33	58	25	58	1.0	6054.40

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: LEBANON | STATE: PA | AREA [sq. mi.]: 363 | AREA [acres]: 232320 | PUB. DATE: 1981 | FIELD DATE: 1967-1974 | COND. DATE: 1977 | APPROV. DATE: 1976 | SURVEY AREA: % 16.7 | ACREAGE 38797.44

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ABBOTTSTOWN	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2			15	30	23	20	42	22	60	0.4	929.28
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			15	30	23	26	62	36	62	1.7	3949.44
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2			20	36	28	23	60	37	60	1.4	3252.48
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			20	36	28	22	38	16	81	3.7	8595.84
COMLY	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3		4	3	20	35	28	32	61	29	61	2.3	5343.36
LADIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	3	30	50	40	31	80	49	80	6.4	14868.48
READINGTON	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	3			20	36	28	32	45	13	60	0.4	929.28
THORNDALE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	2	2			20	36	28	36	60	24	60	0.4	929.28

SURVEY NAME: LUZERNE | STATE: PA | AREA [sq. mi.]: 886 | AREA [acres]: 567040 | PUB. DATE: 1981 | FIELD DATE: 1966-1973 | COND. DATE: 1973 | APPROV. DATE: 1974 | SURVEY AREA: % 43.3 | ACREAGE 245528.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	22	60	38	60	0.2	1134.08
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			26	40	33	29	60	31	60	0.8	4536.32
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3			18	30	24	30	55	25	60	0.9	5103.36
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			20	30	25	20	60	40	60	1.1	6237.44
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1			15	20	18	20	45	25	60	3.1	17578.24
KEDRON	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			20	32	26	22	60	38	60	1.0	5670.40
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			17	36	27	17	60	43	60	8.5	48198.40
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			16	26	21	19	50	31	64	2.9	16444.16
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3			28	36	32	35	60	25	60	2.2	12474.88
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			13	22	18	16	60	44	60	4.5	25516.80
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			15	24	20	18	37	19	60	0.6	3402.24
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			18	30	24	20	60	40	60	0.3	1701.12
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1			10	20	15	20	60	40	60	1.5	8505.60
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	26	22	22	72	50	72	13.4	75983.36
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			17	28	23	22	60	38	60	2.3	13041.92

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: LYCOMING | STATE: PA | AREA [sq. mi.]: 1222 | AREA [acres]: 782080 | PUB. DATE: 1986 | FIELD DATE: 1980 | COND. DATE: 1981 | APPROV. DATE: 1981 | SURVEY AREA %: 15.3 | ACREAGE: 119658.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	3			18	30	24	20	52	32	64	0.6	4692.48
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	23	46	23	60	1.0	7820.80
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	20	42	22	85	0.6	4692.48
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			22	36	29	36	50	14	60	0.3	2346.24
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			16	27	22	22	39	17	48	1.8	14077.44
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			20	34	27	28	44	16	68	2.2	17205.76
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	50	40	30	65	35	65	2.3	17987.84
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			10	22	16	19	60	41	60	1.1	8602.88
NOLO	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2			16	30	23	16	42	26	51	0.2	1564.16
NORWICH	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1			12	24	18	13	48	35	62	0.2	1564.16
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			18	30	24	20	42	22	60	0.5	3910.40
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			24	36	30	30	60	30	60	0.3	2346.24
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			20	30	25	26	52	26	64	1.4	10949.12
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	26	22	24	48	24	64	2.0	15641.60
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			17	28	23	19	60	41	60	0.8	6256.64

SURVEY NAME: MCKEAN | STATE: PA | AREA [sq. mi.]: 997 | AREA [acres]: 638080 | PUB. DATE: 1987 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA %: 42.5 | ACREAGE: 271184.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3			18	30	24	19	48	29	70	5.0	31904.00
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	15	30	23	18	37	19	63	0.2	1276.16
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4		4	2	16	28	22	20	44	24	60	2.0	12761.60
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	20	36	28	26	43	17	83	15.2	96988.16
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2	16	27	22	21	39	18	45	19.8	126339.84
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	3	25	40	33	24	51	27	66	0.2	1276.16
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	ALLUVIUM	2		4	2	15	24	20	18	39	21	60	0.1	638.08

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: MERCER | STATE: PA | AREA [sq. mi.]: 681 | AREA [acres]: 435840 | PUB. DATE: 1971 | FIELD DATE: 1961-1966 | COND. DATE: 1966 | APPROV. DATE: 1967 | SURVEY AREA: % 74.2 | ACREAGE 323393.28

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			20	32	26	25	36	11	50	3.6	15690.24
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			14	30	22	25	71	46	89	15.0	65376.00
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			15	25	20	16	49	33	70	17.0	74092.80
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	18	55	37	70	38.6	168234.24

SURVEY NAME: MONROE | STATE: PA | AREA [sq. mi.]: 611 | AREA [acres]: 391040 | PUB. DATE: 1981 | FIELD DATE: 1966-1974 | COND. DATE: 1974 | APPROV. DATE: 1975 | SURVEY AREA: % 52.1 | ACREAGE 203731.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	25	21	17	41	24	60	0.3	1173.12
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	26	40	33	26	68	42	79	0.7	2737.28
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			18	30	24	21	36	15	60	0.7	2737.28
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	20	32	26	29	55	26	65	1.1	4301.44
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	1			12	20	16	19	60	41	60	2.5	9776.00
EMPEYVILLE	AQUIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	3	2			14	22	18	22	60	38	60	1.4	5474.56
KEDRON	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			20	32	26	24	60	36	60	0.7	2737.28
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5		4	2	24	36	30	33	75	42	75	7.3	28545.92
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	50	40	31	60	29	60	0.7	2737.28
LAWRENCEVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			24	36	30	25	60	35	60	0.2	782.08
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			14	26	20	24	70	46	110	1.2	4692.48
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3			26	40	33	32	60	28	60	1.9	7429.76
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1			10	20	15	15	60	45	60	4.1	16032.64
NORWICH	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1			10	22	16	16	42	26	60	2.5	9776.00
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	ALLUVIUM	3	2			15	20	18	16	36	20	60	0.5	1955.20
SHEFFIELD	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	2	1			15	26	21	19	38	19	66	0.4	1564.16
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			18	26	22	20	48	28	60	0.3	1173.12
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			24	36	30	34	60	26	60	4.8	18769.92
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1			10	20	15	16	60	44	60	7.1	27763.84
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	32	25	23	60	37	60	0.3	1173.12

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	24	21	23	60	37	60	7.3	28545.92
WORTH	TYPIC FRAGIORTHODS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	36	27	30	60	30	60	0.9	3519.36
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	28	23	27	60	33	60	5.2	20334.08

SURVEY NAME: MONTOUR | STATE: PA | AREA [sq. mi.]: 131 | AREA [acres]: 83840 | PUB. DATE: 1985 | FIELD DATE: 1975-1979 | COND. DATE: 1980 | APPROV. DATE: 1979 | SURVEY AREA: % 22.9 | ACREAGE 19199.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3			18	32	25	30	60	30	60	0.1	83.84
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	20	62	42	62	7.4	6204.16
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	20	60	40	60	1.3	1089.92
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	50	40	33	65	32	65	1.1	922.24
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	48	39	36	60	24	60	0.3	251.52
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	23	48	25	63	1.9	1592.96
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			18	30	24	29	51	22	61	2.0	1676.80
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	32	25	27	45	18	61	8.8	7377.92

SURVEY NAME: NORTHUMBERLAND | STATE: PA | AREA [sq. mi.]: 470 | AREA [acres]: 300800 | PUB. DATE: 1985 | FIELD DATE: 1977 | COND. DATE: 1980 | APPROV. DATE: 1979 | SURVEY AREA: % 17.6 | ACREAGE 52940.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3			18	32	25	30	60	30	60	0.6	1804.80
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	20	62	42	62	2.9	8723.20
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	20	60	40	60	1.1	3308.80
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	50	40	33	65	32	65	6.6	19852.80
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3			30	48	39	36	60	24	60	1.3	3910.40
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			18	30	24	23	48	25	63	0.5	1504.00
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			18	30	24	29	51	22	61	1.2	3609.60
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	32	25	27	45	18	61	3.4	10227.20

SURVEY NAME: PIKE | STATE: PA | AREA [sq. mi.]: 545 | AREA [acres]: 348800 | PUB. DATE: 1969 | FIELD DATE: 1961-1964 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: % 57.1 | ACREAGE 199164.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			25	35	30	30	42	12	48	0.3	1046.40
CATTARAUGUS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2						24	72	48	72	7.6	26508.80

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

CULVERS	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2	15	24	20	15	72	57	72	10.6	36972.80
MARDIN	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2	15	30	23	20	80	60	80	13.6	47436.80
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2	10	18	14	15	60	45	60	3.4	11859.20
NORWICH	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1				15	42	27	42	1.3	4534.40
SWARTSWOOD	TYPIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	4	24	36	30	21	58	37	58	8.2	28601.60
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2	10	20	15	14	42	28	42	5.3	18486.40
WURTSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2	15	24	20	20	56	36	56	6.8	23718.40

SURVEY NAME: SCHUYLKILL STATE: PA AREA [sq. mi.]: 784 AREA [acres]: 501760 PUB. DATE: 1982 FIELD DATE: 1956-1976 COND. DATE: 1976 APPROV. DATE: 1977

SURVEY AREA:	%	ACREAGE
	24.4	122429.44

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2		16	28	22	20	70	50	70	0.5	2508.80
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2		16	28	22	20	46	26	62	1.0	5017.60
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2		20	36	28	29	54	25	72	7.0	35123.20
KEDRON	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2		20	32	26	27	58	31	80	3.1	15554.56
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3		30	50	40	42	74	32	74	3.6	18063.36
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3		25	48	37	31	70	39	96	6.9	34621.44
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2		18	30	24	19	46	27	60	0.8	4014.08
WATSON	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2		18	32	25	28	60	32	60	1.5	7526.40

SURVEY NAME: SNYDER STATE: PA AREA [sq. mi.]: 329 AREA [acres]: 210560 PUB. DATE: 1985 FIELD DATE: 1971 COND. DATE: 1980 APPROV. DATE: 1979

SURVEY AREA:	%	ACREAGE
	19.5	41059.20

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3		18	32	25	30	60	30	60	0.3	631.68
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2		16	28	22	20	62	42	62	2.7	5685.12
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2		20	36	28	20	60	40	60	3.2	6737.92
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3		30	50	40	33	65	32	65	6.5	13686.40
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3		30	48	39	36	60	24	60	0.4	842.24
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2		18	30	24	23	48	25	63	1.3	2737.28
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2		18	30	24	29	51	22	61	2.8	5895.68
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2		18	32	25	27	45	18	61	2.3	4842.88

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: SOMERSET | STATE: PA | AREA [sq. mi.]: 1085 | AREA [acres]: 694400 | PUB. DATE: 1983 | FIELD DATE: 1968-1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 19.6 | ACREAGE 136102.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3			18	28	23	18	54	36	65	1.0	6944.00
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			16	26	21	24	46	22	60	3.3	22915.20
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	3			18	26	22	22	40	18	62	5.1	35414.40
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			25	30	28	28	48	20	60	7.8	54163.20
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			20	30	25	22	55	33	63	0.2	1388.80
NOLO	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	2	2			18	30	24	29	55	26	55	2.0	13888.00
TYLER	AERIC FRAGIAQUULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3	1			18	24	21	24	52	28	60	0.2	1388.80

SURVEY NAME: SUSQUEHANNA | STATE: PA | AREA [sq. mi.]: 836 | AREA [acres]: 535040 | PUB. DATE: 1973 | FIELD DATE: 1958-1967 | COND. DATE: 1967 | APPROV. DATE: 1968 | SURVEY AREA: % 67.2 | ACREAGE 359546.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2						32	50	18	50	4.6	24611.84
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2						12	41	29	50	0.5	2675.20
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5							20	38	18	50	4.0	21401.60
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			18	30	24	20	50	30	50	13.8	73835.52
MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			10	20	15	17	50	33	50	13.8	73835.52
NORWICH	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1			10	25	18	25	50	25	50	0.5	2675.20
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			10	18	14	13	60	47	60	16.2	86676.48
WELLSBORO	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3			18	30	24	21	52	31	52	13.8	73835.52

SURVEY NAME: TIOGA | STATE: PA | AREA [sq. mi.]: 1146 | AREA [acres]: 733440 | PUB. DATE: 1981 | FIELD DATE: 1958-1972 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 44.8 | ACREAGE 328581.12

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BATH	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			26	36	31	31	43	12	60	2.4	17602.56
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3			20	30	25	24	34	10	60	0.2	1466.88
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	1						12	40	28	58	1.5	11001.60
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2						22	36	14	48	0.2	1466.88
LACKAWANNA	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	2			24	36	30	30	44	14	68	0.3	2200.32
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			14	26	20	24	58	34	75	8.7	63809.28

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

MORRIS	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2		12	22	17	20	48	28	56	5.9	43272.96
NORWICH	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1		10	24	17	22	36	14	58	0.3	2200.32
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2		15	24	20	17	38	21	60	0.3	2200.32
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1		12	20	16	15	56	41	56	20.9	153288.96
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2		16	26	21	20	50	30	60	4.1	30071.04

SURVEY NAME: UNION | STATE: PA | AREA [sq. mi.]: 319 | AREA [acres]: 204160 | PUB. DATE: 1985 | FIELD DATE: 1975-1979 | COND. DATE: 1980 | APPROV. DATE: 1979 | SURVEY AREA: % 28.8 | ACREAGE 58798.08

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	3		18	32	25	30	60	30	60	0.8	1633.28
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2		16	28	22	20	62	42	62	1.8	3674.88
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2		20	36	28	20	60	40	60	6.7	13678.72
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3		30	50	40	33	65	32	65	7.9	16128.64
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	3		30	50	40	33	65	32	65	5.9	12045.44
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	5	3		30	48	39	36	60	24	60	0.9	1837.44
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2		18	30	24	29	51	22	61	3.1	6328.96
WATSON	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2		18	32	25	27	45	18	61	1.7	3470.72

SURVEY NAME: VENANGO | STATE: PA | AREA [sq. mi.]: 675 | AREA [acres]: 432000 | PUB. DATE: 1975 | FIELD DATE: 1964-1970 | COND. DATE: 1970 | APPROV. DATE: 1971 | SURVEY AREA: % 67.3 | ACREAGE 290736.00

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2		16	28	22	21	60	39	60	9.2	39744.00
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2		16	28	22	23	41	18	63	2.5	10800.00
CANFIELD	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2		16	28	22	22	47	25	62	6.7	28944.00
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2		16	27	22	20	38	18	60	20.2	87264.00
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3		20	30	25	23	46	23	60	1.8	7776.00
FRENCHTOWN	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2		15	24	20	19	44	25	60	1.8	7776.00
HANOVER	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3		17	26	22	20	60	40	60	21.7	93744.00
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2		18	30	24	26	53	27	72	0.6	2592.00
RAVENNA	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2		16	30	23	24	60	36	60	1.6	6912.00
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	ALLUVIUM	2	2	18	24	23	24	40	60	20		0.3	1296.00
TYLER	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3	2		15	24	20	19	42	23	60	0.1	432.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

WOOSTER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	5	3			30	40	35	36	47	11	60	0.8	3456.00

SURVEY NAME: WARREN & FOREST | STATE: PA | AREA [sq. mi.]: 1341 | AREA [acres]: 858240 | PUB. DATE: 1985 | FIELD DATE: 1960-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA %: 45.3 | ACREAGE: 388782.72

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALVIRA	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			16	28	22	21	60	39	60	5.4	46344.96
BRACEVILLE	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			15	30	23	19	35	16	60	0.6	5149.44
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	2			16	28	22	28	44	16	60	1.2	10298.88
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	1			8	20	14	16	40	24	60	0.5	4291.20
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			16	27	22	24	40	16	60	16.5	141609.60
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			20	30	25	29	42	13	60	1.5	12873.60
HANOVER	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3			16	30	23	27	60	33	60	4.5	38620.80
MARDIN	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	1			14	26	20	21	64	43	64	4.4	37762.56
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			15	24	20	24	36	12	60	0.8	6865.92
SHELMADINE	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			18	30	24	26	42	16	60	1.2	10298.88
VENANGO	AERIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	2			14	28	21	19	46	27	62	7.0	60076.80
WOOSTER	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	5	3			18	36	27	27	42	15	60	1.7	14590.08

SURVEY NAME: WAYNE | STATE: PA | AREA [sq. mi.]: 744 | AREA [acres]: 476160 | PUB. DATE: 1985 | FIELD DATE: 1967-1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA %: 67.9 | ACREAGE: 323312.64

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CHIPPEWA	TYPIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1			8	20	14	10	40	30	60	1.8	8570.88
MARDIN	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4		4	2	14	26	20	22	49	27	63	9.8	46663.68
MORRIS	AERIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1			10	22	16	14	50	36	60	17.7	84280.32
NORWICH	TYPIC FRAGIOCHREPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	1	1			10	24	17	12	38	26	60	1.8	8570.88
REXFORD	AERIC FRAGIAQUEPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	2	2			15	24	20	18	42	24	60	0.1	476.16
SWARTSWOOD	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	2			20	36	28	28	60	32	70	7.4	35235.84
VOLUSIA	AERIC FRAGIAQUEPTS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	3	1			12	20	16	12	45	33	60	7.6	36188.16
WELLSBORO	TYPIC FRAGIOCHREPTS	COARSE-LOAMY	MIXED	MESIC	GLACIAL TILL	15	26			20	50	35					21.7	103326.72

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: WESTMORELAND | STATE: PA | AREA [sq. mi.]: 1040 | AREA [acres]: 665600 | PUB. DATE: 1968 | FIELD DATE: 1957-1962 | COND. DATE: 1965 | APPROV. DATE: 1965 | SURVEY AREA: % 15.3 | ACREAGE 101836.80

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2						24	42	18	48	0.3	1996.80
CLARKSBURG	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2						16	53	37	65	2.4	15974.40
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3						29	60	31	60	9.8	65228.80
MONONGAHELA	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3			18	36	27	24	49	25	55	2.8	18636.80

SURVEY NAME: BARNWELL | STATE: SC | AREA [sq. mi.]: 347 | AREA [acres]: 222080 | PUB. DATE: 1977 | FIELD DATE: 1967-1972 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 0.6 | ACREAGE 1332.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCCOLL	TYPIC FRAGIAQUULTS	CLAYEY	KAOLINITIC	THERMIC	MARINE SEDIMENT								20	30	10	60	0.6	1332.48

SURVEY NAME: CLARENDON | STATE: SC | AREA [sq. mi.]: 599 | AREA [acres]: 383360 | PUB. DATE: 1976 | FIELD DATE: 1965-1970 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 0.6 | ACREAGE 2300.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCCOLL	TYPIC FRAGIAQUULTS	CLAYEY	KAOLINITIC	THERMIC	MARINE SEDIMENT	2	2			28	36	32	28	58	30	72	0.6	2300.16

SURVEY NAME: DILLON | STATE: SC | AREA [sq. mi.]: 406 | AREA [acres]: 259840 | PUB. DATE: 1978 | FIELD DATE: 1973-1975 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA: % 0.3 | ACREAGE 779.52

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
MCCOLL	TYPIC FRAGIUDULTS	CLAYEY	KAOLINITIC	THERMIC	MARINE SEDIMENT	2	2			12	28	20	14	40	26	80	0.3	779.52

SURVEY NAME: LANCASTER | STATE: SC | AREA [sq. mi.]: 504 | AREA [acres]: 322560 | PUB. DATE: 1973 | FIELD DATE: 1955-1966 | COND. DATE: 1966 | APPROV. DATE: 1967 | SURVEY AREA: % 3.5 | ACREAGE 11289.60

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	3	2						36	55	19	55	0.3	967.68
GILLS	AQUIC FRAGIUDULTS	CLAYEY	MIXED	THERMIC	WEATHERED BEDROCK	3	2						31	52	21	52	3.2	10321.92

SURVEY NAME: LAURENS & UNION | STATE: SC | AREA [sq. mi.]: 1225 | AREA [acres]: 784000 | PUB. DATE: 1975 | FIELD DATE: 1961-1969 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA: % 0.2 | ACREAGE 1568.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	3	2			20	35	28	22	44	22	50	0.2	1568.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ANDERSON | STATE: TN | AREA [sq. mi.]: 335 | AREA [acres]: 214400 | PUB. DATE: 1981 | FIELD DATE: 1973-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 1.0 | ACREAGE 2144.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4				16	38	27	27	42	15	50	0.5	1072.00
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4				18	28	23	22	38	16	62	0.5	1072.00

SURVEY NAME: CARROLL | STATE: TN | AREA [sq. mi.]: 596 | AREA [acres]: 381440 | PUB. DATE: 1984 | FIELD DATE: 1973-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 19.7 | ACREAGE 75143.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3				15	32	24	26	40	14	60	1.4	5340.16
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4							26	60	34	60	5.3	20216.32
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				20	35	28	26	62	36	62	2.3	8773.12
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				18	38	28	22	34	12	60	10.7	40814.08

SURVEY NAME: CROCKETT | STATE: TN | AREA [sq. mi.]: 269 | AREA [acres]: 172160 | PUB. DATE: 1988 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1985 | SURVEY AREA: % 50.3 | ACREAGE 86596.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3	2			18	38	28	27	65	38	65	0.7	1205.12
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			17	32	25	25	62	37	62	26.5	45622.40
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4	2			16	35	26	30	65	35	65	23.1	39768.96

SURVEY NAME: DAVIDSON | STATE: TN | AREA [sq. mi.]: 509 | AREA [acres]: 325760 | PUB. DATE: 1981 | FIELD DATE: 1970-1977 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: % 2.2 | ACREAGE 7166.72

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BYLER	TYPIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4							24	44	20	65	1.0	3257.60
DICKSON	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4				24	36	30	30	44	14	65	0.7	2280.32
STEMLEY	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	4				18	32	25	20	46	26	65	0.4	1303.04
TAFT	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	3				20	36	28	22	43	21	61	0.1	325.76

SURVEY NAME: DEKALB | STATE: TN | AREA [sq. mi.]: 276 | AREA [acres]: 176640 | PUB. DATE: 1972 | FIELD DATE: 1964-1967 | COND. DATE: 1967 | APPROV. DATE: 1967 | SURVEY AREA: % 14.1 | ACREAGE 24906.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DICKSON	OCHREPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	NONE GIVEN	4				20	34	27	27	38	11	60	10.6	18723.84

GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	NONE GIVEN	2			20	40	30	30	60	30	60	1.3	2296.32
SANGO	OCHREPTIC FRAGIUDULTS	COARSE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4						34	60	26	60	1.3	2296.32
TAFT	AQUEPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	NONE GIVEN	3			24	40	32	32	63	31	63	0.3	529.92
TARKLIN	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4						17	32	15	50	0.6	1059.84

SURVEY NAME: GILES | STATE: TN | AREA [sq. mi.]: 619 | AREA [acres]: 396160 | PUB. DATE: 1968 | FIELD DATE: 1961-1964 | COND. DATE: 1964 | APPROV. DATE: 1966 | SURVEY AREA: % 2.3 | ACREAGE 9111.68

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
DICKSON	OCHREPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4				16	32	24	27	40	13	50	0.6	2376.96
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	2				18	30	24	22	40	18	40	0.1	396.16
MERCER	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	4				18	30	24	24	50	26	50	1.4	5546.24
TAFT	AQUEPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	3				18	30	24	24	48	24	60	0.2	792.32

SURVEY NAME: HAMILTON | STATE: TN | AREA [sq. mi.]: 587 | AREA [acres]: 375680 | PUB. DATE: 1982 | FIELD DATE: 1972-1978 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 2.9 | ACREAGE 10894.72

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	2	2			30	40	35	30	60	30	60	0.2	751.36
ROANE	GLOSSIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4				15	40	28	20	60	40	60	2.6	9767.68
WOODMONT	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3				20	36	28	20	60	40	60	0.1	375.68

SURVEY NAME: HAWKINS & HANCOCK | STATE: TN | AREA [sq. mi.]: 710 | AREA [acres]: 454400 | PUB. DATE: 1979 | FIELD DATE: 1966-1972 | COND. DATE: 1972 | APPROV. DATE: 1973 | SURVEY AREA: % 2.0 | ACREAGE 9088.00

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CLOUDLAND	GLOSSIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4		4	2	22	35	29	26	50	24	65	0.9	4089.60
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2	2			20	35	28	25	65	40	65	0.1	454.40
LEADVALE	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	COLLUVIUM	4	2						24	48	24	63	0.7	3180.80
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3	2						25	52	27	60	0.3	1363.20

SURVEY NAME: LAUDERDALE | STATE: TN | AREA [sq. mi.]: 477 | AREA [acres]: 305280 | PUB. DATE: 1990 | FIELD DATE: 1983 | COND. DATE: 1983 | APPROV. DATE: 1983 | SURVEY AREA: % 8.7 | ACREAGE 26559.36

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3		4	2	22	30	26	27	62	35	62	0.8	2442.24
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	17	34	26	20	60	40	60	2.1	6410.88
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4		4	2	20	30	25	24	62	38	62	5.8	17706.24

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: MADISON | STATE: TN | AREA [sq. mi.]: 560 | AREA [acres]: 358400 | PUB. DATE: 1978 | FIELD DATE: 1966-1973 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA: % 20.1 | ACREAGE 72038.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3				18	30	24	26	45	19	72	2.8	10035.20
DULAC	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				16	30	23	23	37	14	72	2.0	7168.00
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				18	36	27	29	63	34	72	6.2	22220.80
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2				18	37	28	19	50	31	72	2.2	7884.80
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				22	37	30	35	47	12	72	5.7	20428.80
PROVIDENCE	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				18	36	27	30	45	15	72	1.2	4300.80

SURVEY NAME: MEIGS | STATE: TN | AREA [sq. mi.]: 191 | AREA [acres]: 122240 | PUB. DATE: 1974 | FIELD DATE: 1962-1967 | COND. DATE: 1968 | APPROV. DATE: 1968 | SURVEY AREA: % 1.4 | ACREAGE 1711.36

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
TARKLIN	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	2						24	48	24	60	1.4	1711.36

SURVEY NAME: MONTGOMERY | STATE: TN | AREA [sq. mi.]: 539 | AREA [acres]: 344960 | PUB. DATE: 1975 | FIELD DATE: 1966-1970 | COND. DATE: 1971 | APPROV. DATE: 1971 | SURVEY AREA: % 11.2 | ACREAGE 38635.52

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BEDFORD	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	LOESS	4		4	2	20	32	26	24	32	8	60	0.4	1379.84
DICKSON	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	NONE GIVEN	4	3			18	36	27	24	45	21	60	6.9	23802.24
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	2	2			18	30	24	23	65	42	65	1.5	5174.40
LAX	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4		4	2	18	35	27	24	39	15	63	1.0	3449.60
TAFT	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	3	2			20	30	25	21	42	21	65	1.4	4829.44

SURVEY NAME: OBION | STATE: TN | AREA [sq. mi.]: 550 | AREA [acres]: 352000 | PUB. DATE: 1973 | FIELD DATE: 1963-1966 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: % 25.4 | ACREAGE 89408.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	GLOSSAQUIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	2				18	26	22	27	45	18	72	4.2	14784.00
GRENADA	GLOSSIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				14	34	24	24	48	24	72	13.9	48928.00
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				16	36	26	32	46	14	72	7.3	25696.00

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: RUTHERFORD | STATE: TN | AREA [sq. mi.]: 630 | AREA [acres]: 403200 | PUB. DATE: 1977 | FIELD DATE: 1964-1972 | COND. DATE: 1972 | APPROV. DATE: 1973 | SURVEY AREA: % 1.2 | ACREAGE 4838.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALMAVILLE	TYPIC FRAGIAQUALFS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	2				20	36	28	25	72	47	72	0.2	806.40
BYLER	TYPIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4				18	34	26	25	46	21	65	0.7	2822.40
WOODMONT	GLOSSIC FRAGIUDALFS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3				20	36	28	23	62	39	62	0.3	1209.60

SURVEY NAME: SHELBY | STATE: TN | AREA [sq. mi.]: 751 | AREA [acres]: 480640 | PUB. DATE: 1970 | FIELD DATE: 1961-1965 | COND. DATE: 1966 | APPROV. DATE: 1966 | SURVEY AREA: % 27.5 | ACREAGE 132176.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALLOWAY	AQUEPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	3				15	25	20	21	50	29	60	3.2	15380.48
GRENADA	OCHREPTIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				15	30	23	22	40	18	60	17.1	82189.44
HENRY	TYPIC FRAGIAQUALFS	COARSE-SILTY	MIXED	THERMIC	LOESS	2							20	50	30	90	2.1	10093.44
LORING	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	THERMIC	LOESS	4				12	30	21	28	50	22	60	5.1	24512.64

SURVEY NAME: WARREN | STATE: TN | AREA [sq. mi.]: 450 | AREA [acres]: 288000 | PUB. DATE: 1967 | FIELD DATE: 1961-1963 | COND. DATE: 1963 | APPROV. DATE: 1965 | SURVEY AREA: % 13.7 | ACREAGE 39456.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CAPTINA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4							24	45	21	60	1.9	5472.00
DICKSON	OCHREPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	4				20	30	25	26	40	14	60	7.6	21888.00
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	2				18	32	25	24	56	32	56	1.9	5472.00
LAWRENCE	AQUEPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	3				20	25	23	21	46	25	46	1.5	4320.00
SANGO	AQUEPTIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	ALLUVIUM	4				18	30	24	20	35	15	70	0.8	2304.00

SURVEY NAME: WHITE & VAN BUREN | STATE: TN | AREA [sq. mi.]: 636 | AREA [acres]: 407040 | PUB. DATE: 1981 | FIELD DATE: 1966-1973 | COND. DATE: 1974 | APPROV. DATE: 1974 | SURVEY AREA: % 2.2 | ACREAGE 8954.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DICKSON	GLOSSIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	NONE GIVEN	4	3			20	32	26	28	38	10	60	0.9	3663.36
GUTHRIE	TYPIC FRAGIAQUULTS	FINE-SILTY	SILICEOUS	THERMIC	LOESS	2	2			20	35	28	30	65	35	65	0.5	2035.20
TAFT	GLOSSAQUIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	THERMIC	NONE GIVEN	3	2			20	30	25	32	63	31	63	0.6	2442.24
TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	NONE GIVEN	4		4	2	18	28	23	24	56	32	62	0.2	814.08

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: ALBERMALE | STATE: VA | AREA [sq. mi.]: 741 | AREA [acres]: 474240 | PUB. DATE: 1985 | FIELD DATE: 1981 | COND. DATE: 1980 | APPROV. DATE: 1981 | SURVEY AREA: 0.2% | ACREAGE: 948.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BELVOIR	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2			16	30	23	19	28	9	72	0.2	948.48

SURVEY NAME: AUGUSTA | STATE: VA | AREA [sq. mi.]: 986 | AREA [acres]: 631040 | PUB. DATE: 1979 | FIELD DATE: 1963-1968 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA: 5.5% | ACREAGE: 34707.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	3		4	2	16	24	20	20	44	24	60	1.8	11358.72
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			22	28	25	26	42	16	60	0.1	631.04
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	20	30	25	29	53	24	62	3.3	20824.32
NIXA	GLOSSIC FRAGIUDULTS	LOAMY-SKELETAL	SILICEOUS	MESIC	COLLUVIUM	4	1						14	34	20	64	0.3	1893.12

SURVEY NAME: BEDFORD | STATE: VA | AREA [sq. mi.]: 764 | AREA [acres]: 488960 | PUB. DATE: 1989 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1985 | SURVEY AREA: 0.2% | ACREAGE: 977.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	2	30	50	40	36	61	25	72	0.2	977.92

SURVEY NAME: CHARLOTTE | STATE: VA | AREA [sq. mi.]: 467 | AREA [acres]: 298880 | PUB. DATE: 1974 | FIELD DATE: 1963-1968 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA: 0.2% | ACREAGE: 597.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2			25	40	33	32	44	12	52	0.2	597.76

SURVEY NAME: CHESTERFIELD | STATE: VA | AREA [sq. mi.]: 469 | AREA [acres]: 300160 | PUB. DATE: 1978 | FIELD DATE: 1961-1967 | COND. DATE: 1967 | APPROV. DATE: 1974 | SURVEY AREA: 9.9% | ACREAGE: 29715.84

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4		4	1	18	34	26	22	44	22	72	5.0	15008.00
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	3		4	2	24	40	32	21	52	31	73	4.9	14707.84

SURVEY NAME: CLARKE | STATE: VA | AREA [sq. mi.]: 174 | AREA [acres]: 111360 | PUB. DATE: 1982 | FIELD DATE: 1966-1970 | COND. DATE: 1970 | APPROV. DATE: 1980 | SURVEY AREA: 5.0% | ACREAGE: 5568.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	3	30	50	40	32	60	28	60	2.5	2784.00
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	18	30	24	21	60	39	60	1.6	1781.76

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	2		20	30	25	23	36	13	60	0.9	1002.24

SURVEY NAME: FREDERICK | STATE: VA | AREA [sq. mi.]: 436 | AREA [acres]: 279040 | PUB. DATE: 1987 | FIELD DATE: 1981 | COND. DATE: 1982 | APPROV. DATE: 1983 | SURVEY AREA %: 6.1 | SURVEY ACREAGE: 17021.44

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	20	30	25	26	46	20	60	1.4	3906.56
LADIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	30	50	40	36	60	24	60	4.4	12277.76
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	17	24	21	20	31	11	43	0.1	279.04
NICHOLSON	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4		4	2	16	30	23	18	26	8	74	0.2	558.08

SURVEY NAME: GOOCHLAND | STATE: VA | AREA [sq. mi.]: 295 | AREA [acres]: 188800 | PUB. DATE: 1980 | FIELD DATE: 1968-1975 | COND. DATE: 1977 | APPROV. DATE: 1976 | SURVEY AREA %: 1.2 | SURVEY ACREAGE: 2265.60

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	2			18	36	27	28	52	24	82	0.2	377.60
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	COLLUVIUM		3	2		18	35	27	21	44	23	64	1.0	1888.00

SURVEY NAME: GREENE | STATE: VA | AREA [sq. mi.]: 153 | AREA [acres]: 97920 | PUB. DATE: 1986 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1983 | SURVEY AREA %: 1.0 | SURVEY ACREAGE: 979.20

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BELVOIR	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	16	30	23	28	38	10	63	1.0	979.20

SURVEY NAME: HANOVER | STATE: VA | AREA [sq. mi.]: 471 | AREA [acres]: 301440 | PUB. DATE: 1980 | FIELD DATE: 1967-1975 | COND. DATE: 1975 | APPROV. DATE: 1976 | SURVEY AREA %: 3.9 | SURVEY ACREAGE: 11756.16

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4		4	2				24	68	44	76	2.4	7234.56
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	ALLUVIUM	3		4	2				24	60	36	60	1.5	4521.60

SURVEY NAME: HENRICO | STATE: VA | AREA [sq. mi.]: 229 | AREA [acres]: 146560 | PUB. DATE: 1975 | FIELD DATE: 1961-1970 | COND. DATE: 1970 | APPROV. DATE: 1973 | SURVEY AREA %: 8.7 | SURVEY ACREAGE: 12750.72

		FAMILY				SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4		4	1	18	30	24	18	31	13	109	2.7	3957.12
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	3		4	2	25	40	33	30	54	24	54	6.0	8793.60

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SURVEY NAME: LOUISA | STATE: VA | AREA [sq. mi.]: 514 | AREA [acres]: 328960 | PUB. DATE: 1976 | FIELD DATE: 1965-1970 | COND. DATE: 1970 | APPROV. DATE: 1971 | SURVEY AREA: 1.1 % | ACREAGE: 3618.56

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	3	2			25	36	31	28	50	22	62	1.0	3289.60
YORK	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	4	3			23	33	28	26	32	6	45	0.1	328.96

SURVEY NAME: MADISON | STATE: VA | AREA [sq. mi.]: 327 | AREA [acres]: 209280 | PUB. DATE: 1975 | FIELD DATE: 1960-1965 | COND. DATE: 1967 | APPROV. DATE: 1965 | SURVEY AREA: 0.6 % | ACREAGE: 1255.68

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALVERTON	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		2					24	44	20	62	0.1	209.28
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	COLLUVIUM	3		1					26	42	16	60	0.2	418.56
TREGO	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		2					22	36	14	72	0.3	627.84

SURVEY NAME: MONTGOMERY | STATE: VA | AREA [sq. mi.]: 300 | AREA [acres]: 192000 | PUB. DATE: 1985 | FIELD DATE: 1956-1961 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: 2.0 % | ACREAGE: 3840.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			20	36	28	26	50	24	72	2.0	3840.00

SURVEY NAME: ORANGE | STATE: VA | AREA [sq. mi.]: 354 | AREA [acres]: 226560 | PUB. DATE: 1971 | FIELD DATE: 1959-1964 | COND. DATE: 1964 | APPROV. DATE: 1966 | SURVEY AREA: 0.8 % | ACREAGE: 1812.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALVERTON	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3		4	2				23	31	8	58	0.3	679.68
YORK	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	5		5	3	20	33	27	25	40	15	80	0.5	1132.80

SURVEY NAME: PRINCE GEORGE | STATE: VA | AREA [sq. mi.]: 200 | AREA [acres]: 128000 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: 1.0 % | ACREAGE: 1280.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BURROWSVILLE	TYPIC FRAGIUDULTS	COARSE-LOAMY	MIXED	THERMIC	MARINE SEDIMENT	4	2			20	32	26	25	38	13	70	1.0	1280.00

SURVEY NAME: PRINCE WILLIAM | STATE: VA | AREA [sq. mi.]: 316 | AREA [acres]: 202240 | PUB. DATE: 1989 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: 7.2 % | ACREAGE: 14561.28

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
AIRMONT	TYPIC FRAGIUDULTS	LOAMY-SKELETAL	MIXED	MESIC	COLLUVIUM	4		5	2	16	40	28	27	45	18	65	1.1	2224.64
CALVERTON	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	1	10	30	20	19	29	10	65	1.0	2022.40

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

GLENVILLE	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2	15	30	23	22	32	10	72	0.3	606.72
HOADLY	AQUIC FRAGIUDALFS	FINE-LOAMY	SILICEOUS	MESIC	COLLUVIUM	4	4	1				29	41	12	72	1.6	3235.84
NEABSCO	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	MESIC	MARINE SEDIMENT	4	4	1	14	30	22	17	36	19	72	3.2	6471.68

SURVEY NAME: PULASKI | STATE: VA | AREA [sq. mi.]: 297 | AREA [acres]: 190080 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: 2.3 % | ACREAGE: 4371.84

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-SILTY	SILICEOUS	MESIC	MARINE SEDIMENT	3	2						23	46	23	60	2.3	4371.84

SURVEY NAME: RICHMOND | STATE: VA | AREA [sq. mi.]: 192 | AREA [acres]: 122880 | PUB. DATE: 1982 | FIELD DATE: 1975-1979 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA: 3.9 % | ACREAGE: 4792.32

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4	3			18	26	22	20	60	40	70	3.9	4792.32

SURVEY NAME: ROCKINGHAM | STATE: VA | AREA [sq. mi.]: 800 | AREA [acres]: 512000 | PUB. DATE: 1982 | FIELD DATE: 1970-1976 | COND. DATE: 1976 | APPROV. DATE: 1980 | SURVEY AREA: 9.9 % | ACREAGE: 50688.00

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3		4	2	21	24	23	21	42	21	60	1.6	8192.00
BURKETOWN	TYPIC FRAGIUDULTS	COARSE-LOAMY	SILICEOUS	MESIC	ALLUVIUM	4		4	2	18	36	27	24	44	20	60	0.1	512.00
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			30	50	40	41	60	19	60	6.3	32256.00
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	20	30	25	24	33	9	60	1.9	9728.00

SURVEY NAME: SPOTSYLVANIA | STATE: VA | AREA [sq. mi.]: 450 | AREA [acres]: 288000 | PUB. DATE: 1985 | FIELD DATE: 1977 | COND. DATE: 1978 | APPROV. DATE: 1980 | SURVEY AREA: 5.2 % | ACREAGE: 14976.00

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
COLFAX	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	THERMIC	WEATHERED BEDROCK	3	2			16	30	23	18	25	7	67	2.0	5760.00
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	2	16	28	22	22	39	17	79	3.2	9216.00

SURVEY NAME: STAFFORD & KING GEORGE | STATE: VA | AREA [sq. mi.]: 449 | AREA [acres]: 287360 | PUB. DATE: 1974 | FIELD DATE: 1963-1968 | COND. DATE: 1970 | APPROV. DATE: 1970 | SURVEY AREA: 4.8 % | ACREAGE: 13793.28

						SOIL	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BOURNE	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	MARINE SEDIMENT	4		4	1	18	24	21	22	52	30	102	4.2	12069.12
COLFAX	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	WEATHERED BEDROCK	3		4	2				27	54	27	92	0.6	1724.16

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: WARREN | STATE: VA | AREA [sq. mi.]: 219 | AREA [acres]: 140160 | PUB. DATE: 1984 | FIELD DATE: 1973-1978 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA: % 1.9 | ACREAGE 2663.04

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	4	2	20	24	22	20	60	40	60	0.9	1261.44
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	4	2	20	30	25	24	53	29	60	1.0	1401.60

SURVEY NAME: WESTMORELAND | STATE: VA | AREA [sq. mi.]: 236 | AREA [acres]: 151040 | PUB. DATE: 1981 | FIELD DATE: 1973-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 1.2 | ACREAGE 1812.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
SAVANNAH	TYPIC FRAGIUDULTS	FINE-LOAMY	SILICEOUS	THERMIC	ALLUVIUM	4	4	2	19	35	27					1.2	1812.48

SURVEY NAME: ADDISON | STATE: VT | AREA [sq. mi.]: 785 | AREA [acres]: 502400 | PUB. DATE: 1971 | FIELD DATE: 1941-1964 | COND. DATE: 1964 | APPROV. DATE: 1967 | SURVEY AREA: % 0.5 | ACREAGE 2512.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CALAIS	TYPIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	5							18	25	7	25	0.5	2512.00

SURVEY NAME: LAMOILLE | STATE: VT | AREA [sq. mi.]: 474 | AREA [acres]: 303360 | PUB. DATE: 1981 | FIELD DATE: 1971-1978 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 0.8 | ACREAGE 2426.88

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
POTSDAM	TYPIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	4	2					23	48	25	70	0.8	2426.88

SURVEY NAME: ORANGE | STATE: VT | AREA [sq. mi.]: 690 | AREA [acres]: 441600 | PUB. DATE: 1978 | FIELD DATE: 1967-1974 | COND. DATE: 1975 | APPROV. DATE: 1975 | SURVEY AREA: % 0.9 | ACREAGE 3974.40

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
STOWE	ENTIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	6	2					21	60	39	60	0.9	3974.40

SURVEY NAME: WINDHAM | STATE: VT | AREA [sq. mi.]: 793 | AREA [acres]: 507520 | PUB. DATE: 1987 | FIELD DATE: 1982 | COND. DATE: 1982 | APPROV. DATE: 1983 | SURVEY AREA: % 2.1 | ACREAGE 10657.92

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
WESTBURY	TYPIC FRAGIAQUODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	3											2.1	10657.92

SURVEY NAME: CLARK | STATE: WA | AREA [sq. mi.]: 630 | AREA [acres]: 403200 | PUB. DATE: 1972 | FIELD DATE: 1950-1960 | COND. DATE: 1960 | APPROV. DATE: 1970 | SURVEY AREA: % 4.0 | ACREAGE 16128.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
DOLLAR	TYPIC FRAGIUMBREPTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	4	1	24	42	33	32	60	28	60	2.7	10886.40

POWELL	TYPIC FRAGIOCHREPTS	COARSE-SILTY	MIXED	MESIC	ALLUVIUM	4	2		23	36	30	23	45	22	63	1.3	5241.60	

SURVEY NAME: VILAS	STATE: WI	AREA [sq. mi.]: 1017	AREA [acres]: 650880	PUB. DATE: 1988	FIELD DATE: 1984	SURVEY AREA: % 8.4	ACREAGE 54673.92
				COND. DATE: 1984	APPROV. DATE: 1984		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CHAMPION	TYPIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	2		16	24	20	18	39	21	60	5.6	36449.28
GOGEBIC	ALFIC FRAGIORTHODS	COARSE-LOAMY	MIXED	FRIGID	GLACIAL TILL	4	2		20	35	28	22	32	10	60	2.8	18224.64

SURVEY NAME: BARBOUR	STATE: WV	AREA [sq. mi.]: 336	AREA [acres]: 215040	PUB. DATE: 1968	FIELD DATE: 1945-1964	SURVEY AREA: % 10.9	ACREAGE 23439.36
				COND. DATE: 1964	APPROV. DATE: 1965		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2		18	30	24	20	42	22	42	0.3	645.12
CLARKSBURG	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2		18	30	24	27	40	13	46	0.5	1075.20
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	5			16	24	20	24	42	18	42	0.8	1720.32
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4			20	24	22	22	47	25	57	9.1	19568.64
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4			20	28	24	23	38	15	45	0.2	430.08

SURVEY NAME: BROOKE, HANCOCK, & OHIO	STATE: WV	AREA [sq. mi.]: 278	AREA [acres]: 177920	PUB. DATE: 1974	FIELD DATE: 1964-1968	SURVEY AREA: % 4.2	ACREAGE 7472.64
				COND. DATE: 1968	APPROV. DATE: 1969		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3		20	30	25	25	47	22	54	1.4	2490.88
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3		20	28	24	26	60	34	60	1.7	3024.64
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3		18	28	23	21	52	31	52	1.1	1957.12

SURVEY NAME: CABELL	STATE: WV	AREA [sq. mi.]: 285	AREA [acres]: 182400	PUB. DATE: 1989	FIELD DATE: 1984	SURVEY AREA: % 0.9	ACREAGE 1641.60
				COND. DATE: 1984	APPROV. DATE: 1984		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4						23	56	33	65	0.9	1641.60

SURVEY NAME: FAYETTE & RALEIGH	STATE: WV	AREA [sq. mi.]: 1263	AREA [acres]: 808320	PUB. DATE: 1975	FIELD DATE: 1961-1966	SURVEY AREA: % 4.6	ACREAGE 37182.72
				COND. DATE: 1966	APPROV. DATE: 1969		

		FAMILY				SOIL	PERMEABILITY		FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION				PARENT MATERIAL	DRAIN.	SOIL	UPPER LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	4	2		20	26	23	25	47	22	54	0.2	1616.64
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4 2	18	26	22	20	38	18	42	0.3	2424.96

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2	20	28	24	27	47	20	55	3.7	29907.84
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	4	2	34	40	37	38	62	24	70	0.3	2424.96
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	4	3	18	24	21	28	56	28	56	0.1	808.32

SURVEY NAME: GRANT & HARDY | STATE: WV | AREA [sq. mi.]: 1063 | AREA [acres]: 680320 | PUB. DATE: 1989 | FIELD DATE: 1979 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 13.4 | ACREAGE 91162.88

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2				20	46	26	60	3.5	23811.20	
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2				24	53	29	60	1.5	10204.80	
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2				26	39	13	60	2.1	14286.72	
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2				36	61	25	72	4.3	29253.76	
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	4	2				20	42	22	60	2.0	13606.40	

SURVEY NAME: GREENBRIER | STATE: WV | AREA [sq. mi.]: 1026 | AREA [acres]: 656640 | PUB. DATE: 1972 | FIELD DATE: 1942-1965 | COND. DATE: 1965 | APPROV. DATE: 1967 | SURVEY AREA: % 9.8 | ACREAGE 64350.72

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			24	30	27	26	38	12	50	0.2	1313.28
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			20	28	24	27	38	11	50	0.1	656.64
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			22	28	25	25	38	13	54	0.1	656.64
CLARKSBURG	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			24	28	26	25	55	30	55	0.1	656.64
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4	2			22	26	24	25	36	11	40	0.3	1969.92
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	3			20	28	24	26	50	24	50	3.1	20355.84
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			35	45	40	39	60	21	60	5.2	34145.28
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	4	2		25	30	28	27	57	30	65	0.6	3939.84
PICKAWAY	AQUIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	4	2		22	28	25	25	61	36	61	0.1	656.64

SURVEY NAME: HAMPSHIRE, MINERAL, & MORGAN | STATE: WV | AREA [sq. mi.]: 1202 | AREA [acres]: 769280 | PUB. DATE: 1978 | FIELD DATE: 1960-1970 | COND. DATE: 1972 | APPROV. DATE: 1972 | SURVEY AREA: % 10.6 | ACREAGE 81543.68

							PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	3		18	30	24	21	50	29	55	0.2	1538.56
ANDOVER	TYPIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	3	2		20	28	24	22	42	20	54	0.2	1538.56
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	COLLUVIUM	2	3	2		16	20	18	21	45	24	50	0.2	1538.56
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2		20	30	25	26	52	26	52	2.7	20770.56

CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	2	20	34	27	29	52	23	52	0.9	6923.52
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	4	3	36	50	43	28	46	18	46	1.2	9231.36
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	4	3	30	44	37	36	62	26	62	3.2	24616.96
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	4	3	20	30	25	26	50	24	50	2.0	15385.60

SURVEY NAME: HARRISON & TAYLOR | STATE: WV | AREA [sq. mi.]: 592 | AREA [acres]: 378880 | PUB. DATE: 1980 | FIELD DATE: 1962-1972 | COND. DATE: 1973 | APPROV. DATE: 1973 | SURVEY AREA %: 12.7 | ACREAGE: 48117.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	24	36	30	32	52	20	52	6.6	25006.08
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	3	18	27	23	26	38	12	46	0.4	1515.52
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	3	20	30	25	28	53	25	53	3.9	14776.32
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	18	30	24	26	56	30	61	1.8	6819.84

SURVEY NAME: JEFFERSON | STATE: WV | AREA [sq. mi.]: 150 | AREA [acres]: 96000 | PUB. DATE: 1973 | FIELD DATE: 1962-1967 | COND. DATE: 1967 | APPROV. DATE: 1968 | SURVEY AREA %: 2.8 | ACREAGE: 2688.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	3	30	45	38	36	50	14	50	2.7	2592.00
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	3	20	27	24	26	50	24	50	0.1	96.00

SURVEY NAME: KANAWAH | STATE: WV | AREA [sq. mi.]: 908 | AREA [acres]: 581120 | PUB. DATE: 1981 | FIELD DATE: 1967-1975 | COND. DATE: 1976 | APPROV. DATE: 1976 | SURVEY AREA %: 3.5 | ACREAGE: 20339.20

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		5	3	32	50	41	45	82	37	82	1.6	9297.92
LAIDIG	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	0	4	2	32	50	41	45	82	37	82	1.6	9297.92
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	18	30	24	26	50	24	60	0.3	1743.36

SURVEY NAME: MARION & MONONGAHELA | STATE: WV | AREA [sq. mi.]: 679 | AREA [acres]: 434560 | PUB. DATE: 1982 | FIELD DATE: 1972-1976 | COND. DATE: 1977 | APPROV. DATE: 1977 | SURVEY AREA %: 13.3 | ACREAGE: 57796.48

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				21	60	39	68	2.1	9125.76
CLARKSBURG	TYPIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				34	61	27	80	8.1	35199.36
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				22	55	33	64	1.6	6952.96
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2				22	61	39	65	1.2	5214.72
TILSIT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2				21	42	21	56	0.3	1303.68

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

SURVEY NAME: MERCER & SUMMERS | STATE: WV | AREA [sq. mi.]: 781 | AREA [acres]: 499840 | PUB. DATE: 1984 | FIELD DATE: 1971-1979 | COND. DATE: 1979 | APPROV. DATE: 1979 | SURVEY AREA: % 7.4 | ACREAGE 36988.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	30	25	26	47	21	60	0.9	4498.56
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2	20	30	25	24	38	14	60	2.8	13995.52
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	18	30	24	21	60	39	60	0.8	3998.72
TILSIT	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2	18	28	23	24	51	27	51	2.9	14495.36

SURVEY NAME: PLEASANTS & TYLER | STATE: WV | AREA [sq. mi.]: 392 | AREA [acres]: 250880 | PUB. DATE: 1989 | FIELD DATE: 1984 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 1.4 | ACREAGE 3512.32

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
GIWELL	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	4		2	1	24	36	30	27	65	38	65	1.4	3512.32

SURVEY NAME: PUTNAM | STATE: WV | AREA [sq. mi.]: 300 | AREA [acres]: 192000 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1980 | APPROV. DATE: 1981 | SURVEY AREA: % 1.5 | ACREAGE 2880.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2				25	60	35	72	1.0	1920.00
TILSIT	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4		4	2				24	49	25	62	0.3	576.00
TYLER	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	ALLUVIUM	3		3	1				24	52	28	60	0.2	384.00

SURVEY NAME: RANDOLPH | STATE: WV | AREA [sq. mi.]: 1036 | AREA [acres]: 663040 | PUB. DATE: 1982 | FIELD DATE: 1969-1977 | COND. DATE: 1978 | APPROV. DATE: 1978 | SURVEY AREA: % 15.0 | ACREAGE 99456.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
BRINKERTON	AERIC FRAGIAQUULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	3	2			20	30	25	27	42	15	60	1.0	6630.40
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	3				26	60	34	72	5.7	37793.28
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	3				24	54	30	74	5.5	36467.20
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5		4	2				29	48	19	60	2.2	14586.88
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2				22	52	30	60	0.6	3978.24

SURVEY NAME: RITCHIE | STATE: WV | AREA [sq. mi.]: 452 | AREA [acres]: 289280 | PUB. DATE: 1986 | FIELD DATE: 1979 | COND. DATE: 1979 | APPROV. DATE: 1980 | SURVEY AREA: % 2.9 | ACREAGE 8389.12

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY			FRAGIPAN DEPTH			TYPICAL PEDON				AREA	
							SOIL	UPPER	LOWER	UPPER	LOWER	RANGE	TOP	END	WIDTH	SOLUM	%	ACRES
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	2			20	28	24	24	48	24	60	1.5	4339.20

APPENDIX A: FRAGIPAN SOILS DATABASE (soil series information gathered from U.S.D.A. County Soil Surveys published 1967-1991)

TILSIT	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2		20	28	24	22	41	19	46	1.4	4049.92

SURVEY NAME: TUCKER | STATE: WV | AREA [sq. mi.]: 527 | AREA [acres]: 337280 | PUB. DATE: 1967 | FIELD DATE: 1959-1964 | COND. DATE: 1964 | APPROV. DATE: 1965 | SURVEY AREA: % 13.3 | ACREAGE 44858.24

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
ALBRIGHTS	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2			18	30	24	28	38	10	38	0.3	1011.84
BRINKERTON	TYPIC FRAGIAQUALFS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	2	2			13	26	20	26	53	27	88	3.5	11804.80
COOKPORT	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	4				18	25	22	21	37	16	37	0.8	2698.24
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4	2						23	74	51	74	4.0	13491.20
MECKESVILLE	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	5	2										2.1	7082.88
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	2			18	24	21	20	36	16	36	0.3	1011.84
NOLO	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	WEATHERED BEDROCK	3	2						21	23	2	23	2.3	7757.44

SURVEY NAME: UPSHUR | STATE: WV | AREA [sq. mi.]: 500 | AREA [acres]: 320000 | PUB. DATE: 1985 | FIELD DATE: 1980 | COND. DATE: 1980 | APPROV. DATE: 1980 | SURVEY AREA: % 19.9 | ACREAGE 63680.00

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				30	52	22	60	7.4	23680.00
ERNEST	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				29	49	20	60	12.2	39040.00
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2				26	44	18	60	0.3	960.00

SURVEY NAME: WOOD & WIRT | STATE: WV | AREA [sq. mi.]: 602 | AREA [acres]: 385280 | PUB. DATE: 1970 | FIELD DATE: 1957-1964 | COND. DATE: 1964 | APPROV. DATE: 1966 | SURVEY AREA: % 6.7 | ACREAGE 25813.76

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
GINAT	TYPIC FRAGIAQUALFS	FINE-SILTY	MIXED	MESIC	GLACIAL TILL	2	2						25	52	27	60	0.1	385.28
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4	3						19	35	16	52	3.2	12328.96
SCIOTOVILLE	AQUIC FRAGIUDALFS	FINE-LOAMY	MIXED	MESIC	GLACIAL TILL	4	3						22	32	10	60	0.2	770.56
TILSIT	TYPIC FRAGIUDALFS	FINE-SILTY	MIXED	MESIC	WEATHERED BEDROCK	4	3			18	26	22	24	34	10	60	3.2	12328.96

SURVEY NAME: WYOMING | STATE: WV | AREA [sq. mi.]: 504 | AREA [acres]: 322560 | PUB. DATE: 1988 | FIELD DATE: 1983 | COND. DATE: 1984 | APPROV. DATE: 1984 | SURVEY AREA: % 1.1 | ACREAGE 3548.16

SERIES NAME	CLASSIFICATION	FAMILY			PARENT MATERIAL	SOIL DRAIN.	PERMEABILITY SOIL	PERMEABILITY UPPER	PERMEABILITY LOWER	FRAGIPAN DEPTH UPPER	FRAGIPAN DEPTH LOWER	FRAGIPAN DEPTH RANGE	TYPICAL PEDON TOP	TYPICAL PEDON END	TYPICAL PEDON WIDTH	TYPICAL PEDON SOLUM	AREA %	AREA ACRES
BUCHANAN	AQUIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	COLLUVIUM	4		4	2				35	59	24	65	1.0	3225.60
MONONGAHELA	TYPIC FRAGIUDULTS	FINE-LOAMY	MIXED	MESIC	ALLUVIUM	4		4	2	20	30	25	27	51	24	65	0.1	322.56

VITA

Born in Minneapolis in 1964, the author resided in Minnesota until completing a B.S. in Geography at the University of Minnesota in 1986. After completing coursework for the M.S. program in Geography at Virginia Polytechnic Institute and State University in June 1987, the author moved to the Washington D.C. area to pursue a career in environmental consulting (primarily hazardous waste management and environmental auditing). Four years, four job assignments, four states, and seven residences later, the author has managed to complete this M.S. thesis. Currently residing in Richland, Washington, employed by Westinghouse Hanford Company (the operating contractor for the Department of Energy weapons complex currently undergoing massive environmental restoration) the author explores the vastly different geography of the Pacific Northwest region in a less-than academic fashion at every opportunity (backpacking and fishing).