

LAND CLASSIFICATION FOR RESIDENTIAL DEVELOPMENT

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ABSTRACT

LAND CLASSIFICATION FOR RESIDENTIAL DEVELOPMENT

by William G. Kweder

Metropolitan areas and individual communities all over the country are experiencing rapid urbanization into rural areas and the consequent problems of unplanned haphazard growth. Problems of water supply, sewage disposal, and storm drainage are but a few of a multitude of community development problems in practically every instance. These, however, are extremely important in relation to the provision of healthy, safe, and desirable residential environments. Those responsible for guiding or determining community development need to recognize the effects that natural physical characteristics of land have on residential development, and reflect this recognition through sound development policies and residential development controls.

This study has been undertaken to: 1) determine what information is available for, and useful in determining the effect of natural physical characteristics of land on the provision of adequate standards for urban residential water, sewer, and drainage utilities; 2) determine a method of classification of land utilizing available information applicable to residential development; and 3) develop minimum lot size requirement guides based on natural conditions and contemporary standards

for health and safety in relation to provision of adequate utilities -- particularly sewage disposal -- for each land classification.

An investigation was made of basic "natural conditions" exerted by geologic, topographic, soil and water table conditions on residential needs. It was found that characteristics of soil, as included in agricultural considerations for soil management practices, readily lends itself to interpretation for residential use evaluation and adaptation. Modern soil surveys include characteristics of drainage, topography, permeability, soil structure and other detailed evaluations for each soil type. Each soil series is assigned a code designation by the U.S. Soil Conservation Service, based on its characteristics. Soil types are mapped by code number and slope designation allowing for interpretation for agricultural or urban use considerations.

These categories utilize existing soil information and agricultural management requirements as a basis for urban residential considerations. Each soil series has been evaluated on this basis and assigned "penalty points" for each negative characteristic in relation to its affect on water supply and waste disposal systems for residential development. On this basis land may be classified with modern soil surveys. However, slight modifications are necessary in utilizing older soil surveys. Although older soil surveys are not completely adequate, they are

quite useful for community planning purposes and can be updated by soil scientists.

The six land classifications developed in this thesis readily lend themselves to the development of minimum lot size requirement guides in relation to the provision of none, some, or all facilities for water supply, waste disposal and drainage. Based on minimum health standards for urbanizing areas, local desires, and possible design variations, guidelines for community development policy determination and residential development standards may be developed to meet the specific needs of any particular community. When all factors affecting urban growth patterns are considered, the case for orderly development based on the provision of adequate public water supply, waste disposal and drainage systems is strengthened.

Zoning, subdivision and building regulations and health codes must be considered in relation to the problem of providing healthy, safe, and desirable residential environments. These additional regulatory factors are not covered in this thesis and may necessitate additional research of them, in relation to natural physical characteristics of land as they affect the provision of water supply, waste disposal and drainage, in order to coordinate them with the contents of this thesis. Much information in relation to this is available, but it requires further interpretation and adaptation by those responsible for community development. The contents of this thesis coupled

with the regulatory devices would go far in developing general development policies and guides that would be more realistically effective in producing sounder investments in urban residential developments of a healthy, safe, and desirable character.

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By

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INTRODUCTION

Franklin Thomas in his book "The Environmental Basis Of Society" said "advancing civilization is characterized by a diminishing importance of physical influences and an increasing importance of psychological and cultural factors". Although one may agree in many ways with this statement written in 1925, it behooves one to reflect on the many problems of living which characterize today's urban residential growth into previously rural areas. Builders, government officials, planners, and others are realizing that natural physical characteristics of land have not been accorded sufficient consideration in the development of modern residential subdivisions.

Families moving out of older established urban areas assume that services in recently urbanized rural areas will be equivalent to those enjoyed in their old environment. The adequacy of water supply, sewage disposal and storm drainage services is not readily discernable to the eager home buyer. He is told that adequate services exist, therefore he assumes that a septic tank sewage disposal system and/or well for individual water service are equal to the services offered by a municipality. As is too often the case, individual on-lot services are satisfactory for only a few years. Often, they break down and the homeowner is faced with both economic and health problems. Should the problem be too great for the individual to accomodate, he will eventually join with

neighbors, who most likely have the same condition, and make demands on the local government to rectify the situation.

To date, no adequate substitute for public water and sewer service in urban areas has been developed. Individual facilities are quite often satisfactory on farms and very low density developments, but in subdivisions the relatively short life and often the failure of individual systems usually means that government action and possibly aid are sought to solve the accumulated and collective problems. The Federal Housing Administration, U.S. Public Health Service, state and local health agencies, urban planners, and many other responsible officials and citizens have become alarmed over the present and potential health hazards that have been and are still being built into urbanizing areas. It is generally financially impossible to provide public water, sanitary sewer and storm sewer services to the present diffused, scattered and spotty pattern of urban development. Therefore, knowledge of land and its ability to support individual facilities or else the conditions under which to require public utility systems is needed in order to develop sound growth policies and residential development controls. Complete control of development through public ownership of all land is not an acceptable solution to the problem in this country, therefore existing legal instruments for development control need to be utilized more extensively and strengthened in order to

realize more soundly developed residential areas that will continue to be an asset to the community and the people who reside in them for many years to come.

Individuals and groups such as land-owners, developers, subdividers, builders, realtors, financiers, urban planners, government officials and agencies, chambers-of-commerce, and others are collectively responsible for encouraging or supervising sound residential development. In order to provide for sound residential development in a reasonably acceptable manner, these responsible people should understand those natural physical characteristics of land that affect and result in the standards for the provision of adequate individual or public water supply, sewage disposal, and storm drainage in urban residential areas. They need not be engineers, geologists, hydrologists, or soil scientists in order to understand land conditions, but they should enlist the aid of people in these fields and others and the knowledge that has been compiled by such people to further the policies of sound community development as the natural physical land characteristics affect it.

It is the purpose of this paper to determine as much as possible what information in relation to natural physical characteristics of land is available and to determine a method by which such data can be interpreted by those responsible for community development for their use in administering or constructing sound residential development policies. Included would be development controls or

guides for use in those urbanizing areas where a variable combination of public water, sanitary sewerage and storm drainage services are furnished, to be furnished or not furnished at all. From existing physical data it should be possible to develop a land classification scheme which categorizes various characteristics of land in relation to the variety of combinations of public or individual water supply, sewage disposal and storm drainage facilities. With such a scheme, further interpretation of existing health standards applied to variable conditions would lend support to the development and establishment of guides for minimum lot size requirements for each classification of land and the residential use of it.

CHAPTER I

NATURAL PHYSICAL CHARACTERISTICS OF LAND AFFECTING RESIDENTIAL DEVELOPMENT

In subdividing land for residential use the framework is established for a high degree of permanence of development due to the fact that the original design of an area will determine its character for an indefinite period of time. To make changes after the pattern is established is not only prohibitively expensive, but foolhardy and wasteful in the first place, therefore those responsible for sound community development should recognize the relationships of natural physical characteristics of land as they affect residential development. The most practical and economic way to meet development problems is to provide the necessary guides and controls over land use in order to promote more, if not the most, proper use of land to suit the needs of urban people and their many activities carried on in an urban or urbanizing community. Therefore, certain natural factors must be examined for their affect upon urban residential development.

For the purpose of this paper, four general areas of study were chosen for investigation. They are: 1) geology; 2) water table; 3) topography; and 4) soils. All of these subjects are interrelated and any one could form the basis of a study in itself. However, each should be considered in relation to the others in any investigation which examines man's use of land.

Research of these subjects in relation to urban residential development has shown that soil conditions are the primary area to be considered as a means for evaluating land in order to promote sound residential development policies and standards. Each of the other three subjects are somewhat secondary, but cannot be entirely omitted, as investigation has shown that they affect soil conditions and residential land use in various ways. Therefore, an examination of each of the four topics was necessary in order to point out what consideration should be given to each. Direct relationships that are observed in one geographic region may not be necessarily true in another. As in most planning considerations, variables are ever present and may influence any given approach by producing a variety of results.

Geology

It is not the intention of the author to examine the broad implications of geologic history, but rather to investigate this phenomena only in relation to those areas which exhibit primary influence on urban residential development.

In areas where rock formations are exposed, or close to the surface:

- 1) Location of public water and sewer lines or individual sewage disposal, water supply and drainage facilities may be seriously affected; and
- 2) Ledge rock, bedrock, etc. can seriously alter layout and design, not only of utilities, but all

man made improvements necessary for the urban use of land.

Southern Michigan has been affected by physical surface changes which places emphasis upon historic geology as related to glacial movement, mixing, and deposition of soils, rock, etc. Glacial action in this area has deposited an overburden that averages 300-400 feet in depth. Therefore, the major geologic considerations relative to residential development are confined mainly to water supply, sewage disposal, and storm drainage. Four areas of concern in this instance should be considered:

- 1) Most municipal water systems must be drilled to costly depths of 400'-600' to reach the water supply;
- 2) Ground water in glacial overburden is not usually desirable nor of sufficient quantity for municipal supply;
- 3) Individual private water systems tap ground water sources which in many areas are subject to contamination from polluted surface soil conditions resulting from improper waste disposal systems; and
- 4) Impermeable and poorly drained (including high water table) soils may require expensive drainage systems.

Of the four points, the first two are important for their indirect influence on residential development policies and standards. Deep drilling costs for municipal water supply increase at an increasing rate with depth

which eventually forces cities to pay more and more for water or seek supplemental supplies elsewhere. Paul R. Giroux of the U.S. Geological Survey (Ground Water Branch) feels, for instance, that the City of Lansing, due to a dropping water table and increasing demand, will be faced with such a dilemma in the near future. The City's policies may, as a result, change in regard to water service for new residential areas. If builders are faced with the prospect of having only poor quality ground water available in newer areas without public water available, it is conceivable that residential building construction might become undesirable and possibly cease in certain areas where adequate potable water supply is unobtainable.

The third and fourth points are important no matter what happens with municipal water sources. The close relationship of the four major natural physical factors in this chapter is apparent here. Topography and soils, as developed through geologic factors, can affect water conditions in such a way that man's misuse of the land can backfire on him. Therefore, in regard to geology it becomes obvious that surface conditions, as related to soils and the proper drainage of them, become more important in the development of policies and standards for residential development. This does not rule out the advisability of utilizing only partially available geologic information for general planning studies, although producing incomplete results; but, nevertheless something

is better than nothing at all.

Geologic information is ordinarily of a general nature due to the fact that geologists usually concern themselves with only the larger geographical areas. Therefore, detailed information for areas such as townships is not readily available. "General geologic maps can be utilized for interpreting ground conditions during a planning stage prior to site selection."¹

General surveys are often made for large projects such as reservoir location, industrial park sites, etc. To go further than this is not generally economically feasible for residential development because such studies only form a base upon which geologists, engineers, and other specialists may develop more detailed site analyses. As a result, detailed consideration of geology in the development of residential development policies and standards becomes secondary because of the general non-availability of adequate information. In addition, those responsible for community development will find that most information that is available is of a very general nature and does not deal with surface conditions to a great extent.

Water Table

Basically, there are two areas that should be considered in relation to this topic.

1. for an explanation of the use of geologic maps, see: U.S., Geological Survey, Interpreting Ground Conditions From Geologic Maps, Circular 46 (Washington: U.S. Government Printing Office, 1949), p.1.

1. Water table is directly related to geologic considerations for municipal water supply, sewage disposal plants, heavy construction, etc.
2. In relation to residential development, the upper water table (or ground water) becomes important in regard to individual water supply and individual sewage disposal systems, grading, and drainage.

Investigation shows that the first receives the greatest attention of geologists, hydrologists, and engineers; and much less attention is given to the second.

The Water Resources Division of the U.S. Geological Survey and state geological survey offices are primarily interested in sources of water supply for municipal systems. Knowledge derived from their studies indicates that these people are interested in large geographic regions. This is not conducive to interpretation for small areas in which those responsible for community development would wish to concern themselves by investigating the direct affect of water conditions on residential development. However, an understanding of water considerations where municipal water supply is not available will in many instances provide an insight to general development patterns. This phenomenon will be illustrated in Chapter IV - "The Battle Creek Area Study."

Water table conditions become very important to urban residential development considerations as an influence near the surface. This factor is directly related to soils and is also influenced by topography.

Topography

Topographic considerations have influenced man in his endeavors to utilize land throughout history. Today, modern earth moving equipment has made considerable inroads upon topographic influence, but the fact remains that completely changing the landscape configuration is not always desirable nor economically feasible. Due to economic influences the subdivider when forced to utilize hillside lands becomes more concerned with adapting development to slope conditions rather than making wholesale landscape changes. It is here that sound development policies and standards are necessary.

Consideration must be given to water supply, sewage disposal, drainage, lot size, and street layout and design in relation to slope. In general, steepness of slope may be categorized and rated in terms of residential development as follows:

1. Slopes up to 10% are not too serious.
2. Slopes between 10% and 15% require exceptional engineering practices.
3. Slopes over 15% are very serious and are expensive to develop, and drainage and erosion control become very important.

Topographic maps provide excellent references in regard to slope, drainage areas, and surface conditions. Although U.S. Geological Survey maps are quite large in scale (consequently small in presentation of detail),

they are extremely accurate, which allows for enlargement by reduction of scale without unduly distorting information. By enlarging U.S.G.S. maps, areas and intensity of slope may be readily measured.

The increasing use and availability of aerial photographic mapping by the U.S.G.S. has produced a basis for even more detailed analyses of the earth's surface.

Technicians can more accurately define boundaries of soil types, surface features, water conditions, etc., through aerial photo interpretation. Techniques such as this have allowed the soil scientist and others to make great progress in detailed analysis of land surfaces. As a result, contour lines are no longer placed separately upon soil maps, but rather slope conditions are now included as a characteristic of soil identification. This fact in itself therefore requires topography maps only for auxiliary use.

Soils

During conception of this study, it was felt that research would show that soils, geology, water table, and topography might be of equal importance in relation to residential development policies and standards. Investigation has shown that soil maps and studies are of utmost importance because they are made with full cognizance of geologic, water, and topographic factors. Although soil science has been concerned primarily with agriculture, the use of soil data when properly translated

to "urban adaptations" has become increasingly useful to planners, engineers, health agents and others in the past quarter century. Soil scientists, especially in urbanized areas, are now searching for methods by which to utilize this valuable information for urban types of land use as well as for the traditional agricultural uses. U.S. government soil scientists, where time allows, are permitted to conduct studies of non-agricultural soil projects, especially if applicable to urban development. Portions of this study have been made possible as a result of this policy through the help of U.S. Soil Conservation Service soil scientists here in Michigan.

The urban planner's interests in many ways parallel those of the soil scientist. The planner is very much interested in surface conditions for residential development. The soil scientist generally confines his studies to the upper 3-5½ feet of the land surface. He considers underlying material not only in relation to the development and use of soils, but also takes into account all other physical factors and the role that they have in relation to evaluation of existing soil conditions. When those responsible for community development consider the residential portions of it, they are interested in the same general area as the soil scientist, for it is within the upper level of the land surface that most problems of residential development occur.

In determining soil types there are considerations

utilized by the soil scientist which make agricultural classifications useful to those responsible for community development. By examining such characteristics as texture, color, slope and erosion, the soil scientist begins to collate factors which can be utilized in relation to residential development.

Of this group, the inclusion of slope characteristics in the numerical code of the U.S. Soil Conservation Service for field identification can be useful to all concerned in the determination of residential development policies and standards. Three factors are considered when judging slope. These are: 1) steepness; 2) length; and 3) type or pattern. The grouping of slope percentages as utilized in the U.S. Soil Conservation Service's Agricultural Classifications is presented in the following Table.

Table I: Slope Classification

<u>Slope Description</u>	<u>Percent of Slope</u>	<u>Field Code*</u>
Nearly level	0 - 2	A
Gently sloping	2 - 6	B
Moderately sloping	6 - 12	C
Strongly sloping	12 - 18	D
Steep	18 - 25	E
Very steep	Over 25	F

* Letters are preceded by numerical field code in mapping.

The National Cooperative Soil Survey has greatly

improved soil survey techniques and analyses of soils for various purposes over those of 30-40 years ago. Today, much more detailed information is available for each soil series and soil type. Included now are factors related to drainage conditions such as surface drainage, soil permeability, and internal drainage. Moisture conditions are rated as dry, moist, wet, or saturated. In addition, details on the relation of soil to water table and type location are available.

Each soil series now has not only a published general description but further information made available through a scientific analysis of its soil profile. All factors, including those stated in the preceding two paragraphs, can be utilized by those concerned with residential development in varying degree. The relationships and use of soil data for determining residential development policies and standards will be found in Chapters IV and V.

Summary and Conclusions

Geology, water table, and topography are all inter-related natural conditions affecting residential development. Studies presently available of each of these areas for comprehensive planning purposes leaves much to be desired because the usual studies of rock formations, water conditions, and terrain, because of their nature, encompass very large geographical areas and offer very general information. The result is that those responsible

for community development are generally limited to regional or broad area considerations in the application of such data to residential development. For more detailed information one will find that soil scientists in their particular studies have compiled a vast and useful store of general and detailed knowledge related to a better understanding of natural conditions and their effect on land classification for residential development.

Although soil science has dealt primarily with land and its capability to support agriculture, it is apparent that such knowledge of the natural characteristics of land is becoming available in greater detail or in a form that can be utilized by those responsible for community development. Both the soil scientist and those other individuals who are interested in surface conditions of the earth's crust should be more aware of the availability of this knowledge. It seems only natural that those responsible for community development should make better use of soil data for determining land use policies and design standards in classifying land for residential development under urbanizing conditions. While the information is available in the language of agriculture, it can be easily translated for use in community planning and development generally, and residential development specifically. This thesis is an effort to accomplish this translation.

CHAPTER II

PRESENT DESIGN STANDARDS FOR URBAN RESIDENTIAL DEVELOPMENT

The current trend in residential subdivision regulations being adopted by communities is to spell out standards of design and construction in greater detail. However, some factors lend themselves much more readily to uniform treatment than others. Various standards are defined for residential block size, lot size, water supply, grading, drainage, sewage disposal, street construction, etc. However, certain of these aspects of residential development have become increasingly important for they do not necessarily lend themselves to the same rigid standards in every case due to the influence of the variable natural physical characteristics of the land. In a survey of fringe area problems of 108 cities, done in 1949 by the International City Managers Association, it was found that nearly one-half of the cities had serious problems due to poor quality or the absence of drainage, sewers, or sanitation. In the study, water service problems ranked fourth and health problems seventh in a listing of the most serious and often reported problems.²

The most common method of dealing with problems related to natural physical characteristics of the land is to attempt to control the density of residential development by setting minimum lot sizes. Water supply and

2. J.C. Bollens, "Fringe Area Conditions And Relations", Public Management, XXXII (March 1950), pp. 51-52.

sewage disposal are most commonly handled in this manner. Storm drainage and development on slopes and floodplains should also be considered along with these two subjects because they are also directly affected by natural physical characteristics of the land. The interrelationship of these aspects of urban development is fairly obvious and should be recognized, but examination of the treatment of each of them, for example, in zoning and subdivision regulations, indicates that this is not usually the case. Zoning and subdivision regulations do not ordinarily state the qualifications used in arriving at the standards set forth, but it is obvious that many depend upon a "rule-of-thumb", based on experience, approach.

Design standards in zoning and subdivision regulations have been reflecting an increasing concern over problems in relation to the above mentioned aspects of urban development because established standards have not necessarily alleviated poor conditions or prevented increasing problems. Generally, while the "rule-of-thumb" approach is predominant, an effort is being made to overcome such shortcomings. Variations of a more scientifically planned approach that require site investigation are becoming increasingly popular. In order to evaluate these practices, an examination of zoning and subdivision regulations in regard to design standards was necessary.

Water Supply And Sewage Disposal In Relation To Developmental Regulations

In general, large minimum lot size requirements in

zoning ordinances have been defended on the grounds of safety, amenity, and sometimes health; but defense of large minimum lot size requirements in subdivision regulations has been usually dependent on health considerations. Often, variations are specified in an attempt to prevent certain development problems which result from the influence of highly localized natural physical factors. Very often, the local government not wishing to take on more administrative burdens or costly overhead ends up with the very problems it wished to avoid because of poor planning and development policies in the first place and the lack of sound development controls with proper administration, secondly. The most common source of trouble appears to be standards and policies for water supply and sewage disposal.

Some regulations in addition to requiring large minimum lot sizes where septic tanks are to be installed, require approval of the site by a health agency. In this case, the health officer is the final authority in determining whether or not a subdivision plat should be approved. Some even allow the health officer to raise the minimum lot size requirements. However, even with requirements for inspection, testing, etc., regulations do not usually specify standards by which the local developmental administrators or health officers may evaluate natural physical characteristics of the land that are often the cause of development problems. Many regulations of the past decade

require a standard of 20,000 square feet per lot when public water and sanitary sewers are not provided, and 10,000 square feet per lot when either one or the other is not available. When both public utilities are provided, smaller lot sizes are usually allowed.

The utilization of this "rule-of-thumb" standard is a reflection of statements made by the Committee on the Hygiene of Housing of the American Public Health Association. The following standard was meant to be used under good conditions (not defined):

- "a. When the public water supply is available but private sewage disposal systems are to be located on each lot, four dwellings or less per acre.
- "b. However, when a private water supply and private sewage disposal system are to be located on each lot, avoidance of contamination may require $\frac{1}{2}$ acre lots or larger."³

The Hamilton County, Ohio subdivision regulations of 1948 require a minimum lot area of 20,000 square feet where future sewer connections are not possible. Where sewers are constructed, but not yet being used and septic tanks must be used temporarily, the lot area minimum is reduced to 10,000 square feet. The regulations also state that when individual septic tanks are used, "a greater area and frontage may be required by the Planning Commission if, in the opinion of the County Engineer or County Health Commissioner, soil, topography or other conditions indicate

3. David C. Wiggin, Water Supply And Sewage Disposal At Realty Subdivisions, Connecticut Department of Health Bulletin No. 70, 3 (Hartford: March 1956), p.12.

the necessity therefor."

The subdivision regulations of Johnson City, Tennessee Region as amended in 1946, require a minimum lot size of 6,000 square feet, but in areas where public water is not reasonably accessible or not planned for in the near future, an alternate method of water supply may be allowed with approval of the county health office, but each lot in the subdivision must be at least 15,000 square feet. For sewage disposal the same approach and requirements are stated. However, no stipulation is made if both private facilities must be installed on a lot.

The Baltimore County subdivision regulations of 1949 provide for automatic disapproval of any subdivision which contains lots of less than 20,000 square feet if every lot is not connected to a public water main. It is also mandatory that the proposed type of sewage disposal shall be approved by the county health officer and the chief engineer of the county department of public works. Two standards are set forth for sewage service in relation to the geographic location of the subdivision.

When located outside the metropolitan district and facing the prospect of remaining permanently unsewered, each lot must be at least 20,000 square feet in area. Plats may be disapproved by the planning commission if the county health department feels that physical factors would tend to produce public health problems in connection with permanently unsewered occupancy.

When a plat is located inside the metropolitan district with public water supply available, two alternatives are offered: 1) arrangement for public sewer service; or 2) installation of individual disposal systems. The second alternative requires a minimum lot size of 10,000 square feet, but if the department of public works so rules, the minimum lot size is raised to 20,000 square feet. No qualifications are illustrated to support such action.

Even in more recent subdivision regulations the tendency to classify all land according to one standard prevails. Some standards are quite low while others have moved upward.

The Saginaw, Michigan subdivision regulations, passed in 1958, require a minimum lot width of 60 feet and minimum lot area of 6,000 square feet for any single family residence. No provisions are made for areas without public water service, but if sanitary sewers are not available, the 60 foot minimum lot frontage requirement is retained and the minimum lot area requirement is increased to 10,000 square feet. These requirements also apply to the townships (unless local zoning requires larger lots) which contain the City's fringe areas. It is quite evident that little, if any, consideration has been given to natural physical characteristics of the land in drawing up such standards.

More stringent requirements can be found in the Delaware County, Pennsylvania subdivision regulations of 1960.

Lots must have a minimum width of 125 feet at the building line and a minimum area of 30,000 square feet when water supply and sewage disposal are both provided by individual on-lot facilities. When only one of these services is provided by individual on-lot facilities, the minimums are reduced to 80 feet in width at the building line and 15,000 square feet in area. Again, no variations are mentioned.

Subdivision regulations are not the sole means by which lot dimensions for subdivisions are determined. State, county, and municipal health codes are often used to establish lot sizes in relation to water supply and sewage disposal. As noted above, some subdivision regulations require approval of plats by a health officer, but health codes are very similar to subdivision standards in their "rule-of-thumb" approach.⁴ Often, health codes have been the basis for setting up the standards in subdivision regulations. Rather than belabor the situation, suffice to say that most subdivision regulations and health codes are quite arbitrary in regard to the provision of water supply and sewage disposal.

Adherence To Rule-Of-Thumb Standards

Many sanitation experts feel that the 20,000 square foot lot size standard does not meet the needs of planning

4. for a complete analysis see: Planning Advisory Service, Minimum Requirements For Lot And Building Size, No.37 (Chicago: American Society of Planning Officials, 1952) pp. 9-10.

commissions in accepting subdivision plats. It is felt that soil and site characteristics should determine the basis for lot size requirements. Certain natural physical characteristics of the land may make individual water supply and septic tank systems incompatible on the same lot, even with a 20,000 square foot minimum size. Topography and soil permeability are extremely important considerations in such situations, and are recognized in some form in most lot area standards. Even in areas where large lots are the rule, one may find tremendous problems of sanitation. Such conditions as contaminated water supplies, septic tank effluent visible on land surfaces, clogged septic tank leach fields, and other unsanitary and/or nuisance conditions are often found in subdivisions that were guided in their layout and design by "rule-of-thumb" lot size standards.

Eventually, local government is forced to alleviate such conditions by the installation of public water service and a public sewer system. This may involve a cost of two to three times as much as it would have cost in the initial subdivision. To place water and sewer lines in already built-up areas is economically wasteful to government and to those residents who already have invested in individual facilities in the purchase price of their homes and land. It has been estimated, by Sanford Farness, former director of the Lansing Tri-County Regional Planning Commission, that home buyers in the

Lansing area invested about \$5,000,000 in individual sewage disposal systems between 1950-1959. Such a tremendous investment for facilities that should be considered only as a temporary measure seems extremely wasteful.

Units of government that do not offer public water and/or sewer services find to their dismay that to begin such services after a community is substantially built-up places a tremendous burden upon their finances. An example of such a situation exists at the present time in Shrewsbury, Massachusetts.

The town until the end of World War II was an upper middle class suburb adjacent to the city of Worcester. Development problems were not apparent because development had proceeded very slowly on a lot by lot basis. Some foresighted people had advised, during the 1930's, that the town take advantage of a Federal government offer to install a municipal sewer plant and service system. Due to conservatism and an attitude of "yankee independence", the offer was flatly rejected.

Immediately after World War II, the town began to receive the brunt of residential overspill from the city. Although zoning by-laws and subdivision regulations were instituted and improved in the last ten years, the "rule-of-thumb standards" adhered to nullified sound residential development policies. Today, the town is faced with a staggering financial burden trying to provide schools,

police protection, etc. for its trebled population. In addition, the town must add a \$3,000,000 debt in order to provide one small phase of a necessary comprehensive sewer system. Had the town recognized the influence of natural physical factors on development, it is conceivable that a sewer system encompassing the whole town might not be necessary now or in the near future.

Situations such as that illustrated are not uncommon in our expanding metropolitan areas. Many communities did not take advantage of the opportunity to protect themselves in the past and too many still do not go far enough to prevent repetition of similar mistakes in newly developing areas. Recognition of natural physical characteristics of the land as they influence residential development is necessary in order to guide sound residential development.

Slope As A Factor In Residential Development

Topography has always been a determining factor in man's treatment or use of the land. Level or nearly level lands have usually been of primary concern for development by residential builders. Only when the prime land has been built up or the price of available level lands ridiculously inflated⁵ has the builder been forced

5. for an excellent analysis of this problem see: "How To Get Better Land For Less And How To Use Good Land Better, House and Home, XVIII, no.2 (August 1960) 97-164s.

to the hills. Little has been written on slope development although subdivision regulations usually contain grading regulations in one form or another. These usually do not reflect any great concern for naturally steep slopes, unless steep slopes predominate in an area such as Pittsburgh and California.

Several planning agencies in California have been working on the consideration of slope as a factor in residential development. Los Angeles County has been the scene of many landslides and floods as the result of the failure to recognize natural topography in relation to residential development. Geologic hazards such as a land slide, soil slump, ground subsidence, rock failure, mud avalanche, and similar conditions are more prevalent in hilly areas like Los Angeles County. However, most, if not all of these hazards are possible in many parts of the country.⁶

The Tiburon Peninsula in Marin County, California was classified by percent of slope in preparing one aspect of the county master plan. It was found that land lying in the 0-10 percent range of natural ground slope was almost completely built up, which forced the conclusion that policies in regard to slope development had to be determined. As a result, two policies were adopted:

6. for a comprehensive discussion of this subject, see: Planning Advisory Service, Hillside Development No.126 (Chicago: American Society of Planning Officials, 1959), pp. 22-25.

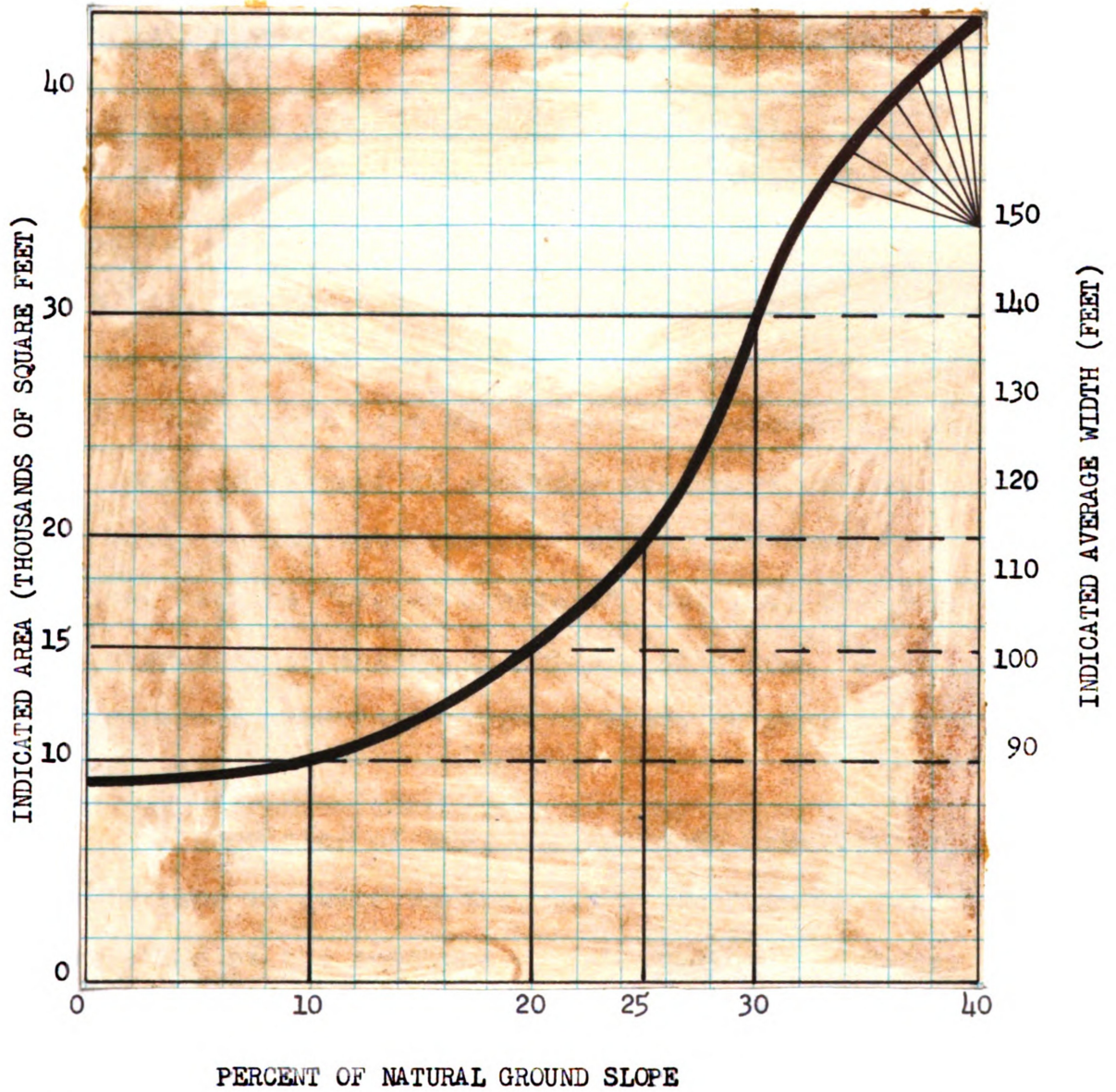
1) a policy for undeveloped land which sets the basic minimum of 9,000 square feet of lot area when slopes are up to ten percent; and 2) a policy for certain areas designated in the master plan, where the pattern of small lots is already set, therefore, a minimum lot size of 7,500 square feet is considered adequate on slopes up to ten percent. These policies are presented in written and graphic form.⁷ The graphic scale for undeveloped land is presented in Plate I. The result of this approach is that more flexibility in subdivision regulations is possible and physical factors are recognized as variables which should not be treated in a static manner.

Steep slopes usually require larger lots for residential construction because of the need for more grading than one would have on level land. An important consideration at this point is the affect that grading may have in regard to the provision of water supply and sewage disposal. In regard to individual on-site handling of these matters, the fact that grading can nullify the results of percolation tests is an important fact that should be considered. If this is the case, then it seems logical that subsoil conditions must be considered.

If public sewer and water are to be provided in a subdivision, grades and grading become very important from service and economic points of view. Problems of

7. Marin County, California, Planning Commission, Tiburon Peninsula (Master Plan), I (San Rafael: 1956), 49.

Table I: Slope Policy



EXAMPLE: For a lot whose natural ground slope is 25%, the indicated area is 20,000 square feet and the indicated average width is 115 feet.

Applies to upland area of the unincorporated portion of the main Tiburon Peninsula, California.

Source: Marin County(Calif.)Planning Commission, Tiburon Peninsula Master Plan I, San Rafael, 1956, p. 27.

pumping, distribution patterns, etc. are all brought about by physical factors. These factors must be considered in setting up standards for water supply, sewage disposal, slope development, and storm drainage.

Storm Drainage And Flood Plain Development

The addition of buildings and paved areas, such as streets, sidewalks, driveways, patios, etc., to former open land increases the run-off and places a tremendous burden upon normal natural drainage capacities of the land. The result, too often creates tremendous problems for local government if adequate drainways are not planned and built during subdivision. Often, ordinances and regulations require "proper drainage", but fail to spell out the standards necessary to achieve this end. Slope and soils become important areas of study to prevent erosion and flooding.

The provision of adequate drainage, through subdivision regulations is quite varied, but often much is left to the discretion of the subdivider. The Saginaw, Michigan subdivision regulations of 1960 require only temporary drainage before houses are built. No provision under "permanent improvements" is made for drainage other than an implication that combined sanitary and storm sewers may be provided through a five year covenant for installation of permanent improvements. If sanitary sewers are not planned for a street by the city, no requirements are made for storm drainage.

The Oakland, California subdivision regulations (supported by various city ordinances) state that the "minimum improvements for hillside lands shall be: grading, drainage, and drainage structures necessary to the use and the proper drainage of the streets, roads, highways or ways, and other properties necessary for public health and safety...(p.242b)". No standards are stated in regard to what proper drainage consists of, or should be based upon.

The Delaware County, Pennsylvania subdivision regulations of 1960, though still quite general in approach to the problem of drainage, does attempt to point out future capacities of drainways. The regulations state simply, why and where drainage will be provided, what must be considered, and what must be avoided. Subdivisions with and without buildings are considered individually. Where subdivision is carried out with no intent to build immediately, the subdivider must make provision for potential runoff from adjacent property as though it were built-up land. However, the reviewing agency must determine what is adequate -- a requirement that also depends upon interpretation.

Unfortunately, the majority of regulations do not state definite standards. This approach may be satisfactory where a planning commission has a working arrangement and agreements on standards with an engineer, but the community with only a lay commission and no engineering

aid is very likely to suffer as a result of a lack of understanding of the land.

Subdivisions are often the scene of flood damage as a result of inadequate drainage systems and/or building in areas subject to flood. Not only has this practice proved dangerous, but the problem is increasing with increased subdivision activity.⁸

California witnessed a great deal of damage in fourteen counties due to floods in the years 1950 and 1951-52. Most heavily damaged were subdivisions on flood plains where levees broke and/or tides were high. Subsequent investigation showed that drainage facilities were inadequate, proper safeguards were not undertaken, and a general lack of subdivision control were the causes of problems.⁹ Most of the areas damaged were recent subdivisions. Such a situation points out the need to recognize that changing the land for urban habitation disrupts the natural physical capacities of the land to handle the elements. Homebuyers and many developers are ignorant of factors such as these, therefore, it becomes the duty of local government to require protective measures in the form of policies and standards that will produce sound residential development.

8. G.F. Whyte et al. Changes In Urban Occupance of Flood Plains in the United States (Chicago: Chicago University Press, 1958), 235.
9. California, Senate Journal, Subdivision Control In California - Report To The Senate Finance Committee (reprint) by D.D. Watson (Sacramento: March 11, 1953) pp. 21-40.

Flood plain zoning and waterway easements have been utilized to a great extent in recent years, but a great deal of research needs to be done in these areas. Many communities do not have adequate flood data upon which to base delineation of areas for the purpose of protecting property owners. Soil studies offer a key to the location of flood plain boundaries whereas topographic considerations can be valuable only if flood records and maps have been compiled over a great number of years. In addition, flood records and other data are not usually available except for major waterways and major tributaries. As a result, most communities find that it is extremely difficult to determine the area of flood plains. Soil maps can be of tremendous help in such an endeavor, but soil scientists suspect that flood plains are increasing in size due to increased urbanization. Only limited information has been compiled to date by which to determine to what extent this is true.

Summary and Conclusions

The requirements of water supply, sewage disposal, drainage, slope development, and floodplain development are directly related to the natural physical characteristics of land and should be recognized in this context. Regulations concerning water supply and sewage disposal that require minimum lot size requirements for individual provision of these utilities adhere pretty much to the

Public Health Association "Standard" set up a number of years ago. Requirements for percolation tests, approval of health officers, etc., have become more prevalent in the past decade, but standards remain far from optimum.

Slope development is rapidly becoming an important consideration in subdivision control, but at present is quite localized. However, with an increasing movement from built-up level lands to hilly land, one may expect increasing concern in this area in the future.

Storm drainage and floodplain development, although they have plagued man through history, have been practically ignored in some localities. With increasing incidence of storm damage, more definite policies and standards are needed.

All five areas of concern are related to natural physical characteristics of land, but the recognition of this fact is at best only superficial. Therefore, in order to develop sound standards and policies for subdivision design, a more comprehensive approach is necessary.

CHAPTER III

RECENT RECOGNITION OF NATURAL PHYSICAL CHARACTERISTICS OF LAND AS AN INFLUENCE ON URBAN RESIDENTIAL AND OTHER URBAN DEVELOPMENTS

In the past few years many organizations and government agencies have become greatly concerned over inadequate residential design standards in subdivision and other regulations. As a result, considerable research has been undertaken, directly and indirectly, in attempting to determine what natural physical factors should be considered in determining urban land use policies and standards of design. Subdivision regulations attempt to recognize certain natural physical characteristics of areas, but for the most part rely upon a very general approach. Researchers have attempted to evaluate and relate individual factors, but results in most cases tend to point out problems rather than provide solutions to the problems. Some rather pertinent studies are summarized and evaluated in this section.

Macomb County, Michigan

A rather brief report was recently published by the Macomb County Planning Commission,¹⁰ which recognizes the importance of soil conditions as they affect urban development and agriculture. Recognition of the problem facing planners today is aptly stated in the following quotation:

10. Macomb County, Michigan Planning Commission, Drainage Characteristics of Generalized Soil Type Areas In Macomb County, (April 1960), 9.

"Knowledge of the topographic and drainage characteristics of land can be of tremendous aid to the farmer, land developer, builder, planner and prospective purchasers of real estate. This knowledge is essential to the successful realization of the objectives pursued by these people in the use of land.

"Such knowledge becomes doubly essential in an area such as Macomb County. The majority of our area is relatively flat and the slightest obstruction to the drainage pattern can mean widespread flooding. Our soils resulted from glacial action, and subsequent interaction of the elements have created a heterogeneous mixture of soils with differing characteristics. Some of these soils can accomodate urban uses without substantial improvements, while others require extensive improvements."¹¹

In this study, soils of the county were classified in a very general fashion. Eight classifications or "areas" were devised and a ninth considered all flood-plains. These groupings were based on soil series, topographic considerations, and water table; then related to urban uses and farming. The result of this approach was an evaluation of each "area". For example, "Area 2" as it appears in the report is quoted below.

"Area 2

Character of Land
Surface:

Gently to steeply rolling sandy area with low wet areas along drainage ways.

Soils:

The soil series are generally Fox and Oshtemo with occassional muck and peat deposits. Some of the wet areas have unstable sands.

Urban Uses:

The higher, well-drained areas are adaptable for building sites with septic tank systems. The low areas are generally unuseable due to high water table and unstable soil conditions.

Farming:

Moderate to low productivity."¹²

11. Ibid. p.1

12. Ibid. p.9

Although this report classifies soils to some degree, it appears to be of limited value. The mapped generalized areas showing the classifications are of tremendous size and at a scale which makes the information useful in only a general fashion. A great deal of refinement is needed in order to point out the local problem areas and those characteristics of soils which create problems. Careful consideration of these facts becomes necessary in order to determine land use policies for urban development.

U.S. Government

In August 1959 the Federal Housing Administration published a detailed report of interest to planners, engineers, builders, etc. The report¹³ deals for the most part with soil bearing capacities and provides an excellent foundation for a comprehensive method of stating engineering data on the behavior of soils with respect to foundations, streets, and other structural, mechanical, and site engineering considerations. For this purpose, soils were combined into four major groups and a total of fifteen subgroups.

Domestic sewage disposal ratings and soil permeability classifications were overgeneralized, although other factors were rated in a detailed fashion. These two areas were limited to a three-point system which, in essence, amount to ratings of good, fair, or poor. Perhaps this

13. Federal Housing Administration, Engineering Soil Classifications For Residential Developments (Washington: U.S. Government Printing Office, 1959), 107.

reflects the attitude of the authors who felt that one may use any soil for most things, through adequate design, except for sewage disposal.

It is unfortunate that further attention was not afforded soil permeability and sewage disposal in view of the fact that so many related characteristics were considered in great detail. The foundation for further research is evident, but this particular study has not been carried through in such a way that the urban planner might make maximum use of the results.

Akron, Ohio

The first major regional study by the Akron Tri-County Regional Planning Commission was published in March 1958.

The study¹⁴ was undertaken to point out regional land features of significance for preparing a regional comprehensive plan. Land features were generalized in order to point out areas that would not be suitable for large urban developments due to rough terrain, marsh or lake areas, floodplains, organic soils, and similar problem producing characteristics.

The report points out that studies of soils were of primary concern in order to determine what soils are capable of handling septic tanks with leach fields, as commonly used for individual homes. Research of records

14. Akron (Ohio) Tri-County Regional Planning Commission, Physical Geography of the Tri-County Area (1958), 51.

had shown that nearly 26,000 septic tank systems were installed in the region between 1949 and 1957.¹⁵ In addition, the study points out that many systems were being installed in small lots on clay soils, and in many cases individual water supplies had to be obtained in the same small area. Needless to say, health and nuisance problems were increasing.

Soil types of the region were classified into four general groups, based on drainage characteristics, and rated as follows:

Group I - Very well drained soils.

Group II - Moderately well drained soils.

Group III- Poorly drained soils.

Group IV - Very poorly drained soils.

Consideration was given to geology, topography, vegetation, etc., and the effect that historical transition had played over the years. The results were summarized graphically by producing a regional map which shows the four soil groups, slopes of 10% or more, organic soils, and swamps and floodplains.

There is no doubt that the results of this study would prove useful for generalized regional or large areal considerations, but because of this generalized approach and mapping, the results would not be of great value in township or local use. However, it is conceivable that this study could provide an excellent foundation

upon which more detailed examinations could be made of areas in the region in order to determine sound land use policies and subdivision design standards.

Baltimore, Maryland

A comprehensive study undertaken by a special committee of the Baltimore Regional Planning Council has resulted in some very controversial proposals as a means of preventing additional regional sewage problems. This special study¹⁶ came about because of increasing problems of sewage nuisance, health hazards, water pollution, and economic hardship associated with increasing use of individual sewage disposal systems in the Baltimore region. It is significant that this study was concerned only with residential development.

In general, it may be stated that the study committee did not feel that septic tanks should be used except for a short interim period until public sewer facilities could be provided. Two paragraphs from this report illustrate the committee's thinking in regard to individual sewage disposal systems.

"The individual sewage disposal system as a device for sewage disposal in a community is considered to offer definite limitations in performance. In addition, there is considerable evidence that more critical attention than has heretofore been provided must be given to the design and construction of all such individual systems, prior to approval of these installations. It must be

16. Baltimore Regional Planning Council Committee, Sewage Problems Connected With Land Development, Technical Bulletin No.1 (Baltimore: Maryland State Planning Commission, 1958), 21.

realized by both the approving agencies and the public at large that an individual sewage disposal system under present conditions cannot be expected to have a useful life of much more than five years. Even when ideal soil conditions exist, the useful life of such a system is frequently limited by excessive loading and lack of adequate maintenance.

"Except in isolated locations involving small developments or separate large lots, individual sewage disposal systems are generally unsatisfactory from a community service standpoint. The useful life of a tile field or seepage pit is so limited that extensive areas must be available for rebuilding or relocating facilities to obtain useful service after failure of the original facilities."¹⁷

Various proposals were made in regard to future policies to be adopted within the region. In addition to proposals for implementing the sewer master plan, it was proposed that peripheral time bands be established around Baltimore for development control. These bands supplemented with special policies would greatly determine the extent of development until areas could be serviced by public sewers. The proposed policy would discourage all subdivisions or groups of subdivisions containing 50 or more dwelling units unless they are in the five-year peripheral time band.

Should a large subdivision (50 dwelling units or more) be contemplated outside of this band, then stringent requirements for a community sewage system and disposal plant would be made. For smaller subdivisions the preceding would also hold or large lots of one acre would be required with special standards for house location, leach fields, septic tanks, etc.; provided, it could be proved

17. Ibid. p.9

that soils were suitable for temporary use as an efficient dispersal agent. In areas where no possibility of sewer service does or will exist, then the preceding requirements would hold or no subdividing would be allowed.

Although the report does not present an analysis of the reasons for the proposals presented, it appears that characteristics of soils have been recognized for their influence on urban residential use. In some ways the proposals appear to be quite arbitrary, but intensive study of the report indicates the feeling that rule-of-thumb standards do not provide adequate protection to the community. It is evident that investigation was carried to a point where a broad classification could be developed upon which stringent regulations would be devised in order to promote sound development policies and standards. However, much is left to local investigation under a regional policy of arbitrary control.

Lansing, Michigan

Another study¹⁸ which recognized the need to control urban sprawl was published by the Lansing Tri-County Regional Planning Commission. This study, based upon the relationships between functional areas, service areas, and natural resources, points out the impracticality and practicality of servicing uncontrolled urban sprawl and compact development, respectively. The two possibilities of growth and service within the same area are examined

18. Lansing (Michigan) Tri-County Planning Commission, Functional Organization of the Lansing Tri-County Region (1959), 49.

and illustrated in one aspect of the published report. It is pointed out that under the compact approach all urban development is serviced by public utilities which requires (in this case) 500% less sanitary sewers and 800% less storm drainage.¹⁹

Although this study does not examine all natural physical factors in detail, it does point out the need for recognizing and coordinating development in relation to influences generated by natural physical characteristics of land. Regional rather than local consideration was given to stream pollution, water supply, sewage disposal, drainage, and many other urban considerations as well as rural agricultural. Significantly, the study points out that regional needs must be met by coordinating local policies and standards in order to attain regional continuity in all urban-rural endeavors.

The Lansing report does offer pertinent insights to those factors which must be considered along with physical conditions in order to achieve sound physical development. By pointing out the lack of coordination in the region, it appears logical that certain factors must be examined in relation to regional as well as local needs. Some of these factors would directly concern or be indirectly influenced by natural physical characteristics of land.

Hartford, Connecticut

Hartford County, Connecticut has witnessed heavy

19. Ibid. p.18

urban growth for many years by virtue of the fact that it lies within the eastern seaboard megalopolis. The U.S. Soil Conservation Service offices, having experienced a lessening demand for agricultural information as a result of the decline in agriculture throughout New England, began to turn their attention to the utilization of soils information for nonagricultural endeavors.

The study of soils in the New England area is well advanced due to early establishment of soil science in this area. With the decline of agriculture, many soil scientists began working with planning agencies, local governments, and others on specific problems of urban development. Of significant note is a publication done on soils in Hartford County this past year, which analyzes each soil series in the county in regard to site considerations.²⁰

The information from detailed analyses is tabulated as "Site ratings and limitations of soil series as possible sites for urban development."²¹ Each soil series was assigned to one of the following five "type" groupings: 1) upland till soils; 2) terrace soils; 3) glaciolacustrine terrace soils; 4) alluvial soils; or 5) miscellaneous land types. In addition, each soil series was rated from

20. David E. Hill and Arthur E. Shearin, Soils and Urban Development In Hartford County, Agricultural Experiment Station Circular No.209 (New Haven: 1960), 8.

21. Ibid. pp.6-8

excellent to very poor for general site rating, drainage limitations (slight, moderate or severe) and "other limitations". The latter category breaks down into consideration of slow infiltration rate, frequent flooding, bedrock near surface, stony or very stony phases, and slope phases more than 15%.

A table incorporating these natural physical characteristics was constructed so that a check could be assigned to the proper column for each soil series. For example, Wethersfield soil series, an upland till soil, has a site rating of fair to poor. Limitations are a slow infiltration rate, very stony, and slopes of more than 15%.

A table such as that cited along with soil maps and other planning information could provide a valuable basis for developing planning policies. Further refinement of the factors presented could very well provide a foundation for subdivision regulations. The purpose of constructing such a table was to inform planning and zoning commissions of the limitations imposed on urban development by characteristics of various soils. Hartford County is fortunate to have a great store of basic knowledge about its soils that has been accumulated by two generations of soil scientists. This information is being made readily available for planning considerations in the area and might serve very well to illustrate future possibilities in other parts of the country.

Stark County, Ohio

The Stark County Regional Planning Commission, as a part of their comprehensive inventory studies, has compiled a great deal of information on the physical geology²² of their planning region. The study was undertaken in order to determine what physical resources or limitations would affect long range plans for facilities, improvements, and development potentials; what problems might develop and where such problems could be expected. The physical geography of the region is considered as a planning dimension; one of nine dimensions that will be considered for its influence on the County's future planning program.

This study investigated geology in terms of bedrock, mineral resources, glaciation, drainage characteristics, and the economic importance of sand and gravel deposits. The purpose of the detailed examination appears to be economically oriented for future utilization of resources rather than physical planning considerations. Half of the report is devoted to these considerations.

Physical characteristics of surface features were studied in relation to problems of erosion, flooding, and the economic use of organic soils, swamps, and floodplains. Again, the economic consideration appeared to be of primary concern. Although economic significance was placed upon

22. Stark County (Ohio) Regional Planning Commission, Physical Geography. A Planning Dimension - (Canton: 1960), 97.

these physical characteristics, the physical problems in relation to urban development and agricultural land use were recognized. As a direct result, the role of soil conditions and associated relationships were noted for their influence on future planning.

The soils of the county were grouped into five predominant areas in order to simplify and facilitate an understanding of associated relationships. The purpose was not to guide the planner, developer, or farmer, but to develop a guide in which to fit detailed studies.²³ The result of this approach was threefold:

- 1) major physical barriers to development (organic soils, slopes over 10%, and potential flood areas) were mapped;
- 2) predominant soil areas were mapped; and
- 3) it was determined that an accelerated program of detailed soil mapping is greatly needed.

An attempt was made to relate selected characteristics of soils with the mapping of predominant soil areas. Characteristics such as bearing capacity, bedrock location, agricultural productivity, possible sources of gravel and adaptability to septic tanks were tabulated in a generalized fashion in table form. These characteristics were in turn related to soil groups. This method does provide something of a general framework on which to focus more detailed studies but there is little if any correlation between soils assigned to each group. Perhaps, this is

23. Ibid. p.78

due to the fact that soil information in this particular area is very sparse. Apparently, this is the reason for such an approach.

An Earlier Approach

In 1951 Robert Hoover²⁴ undertook a study of the relation of soils and other natural physical factors and their affect on residential development. He wished to point out that those responsible for community development, due to a general lack of concern, had been very slow in recognizing the important problems of sanitation in rural and suburban subdivisions.

Mr. Hoover recognized soil characteristics, topography, utility systems, and existing property subdivision as fundamental factors that should be considered in relation to sanitation. On this basis he developed standards for lot sizes in different areas where public water or public sewers were not available. Natural physical characteristics of soils and topography, as they affect the requirements of utilities, were of primary concern. The result of the study offers some interesting standards with variations due to influences, both natural and man-made. This is best illustrated by examining Mr. Hoover's results as reproduced in Table 2.

This table, though carried out in considerable detail,

24. Robert C. Hoover, "Land Planning For Sanitary Drainage and Water Supply in Suburban and Open Country Subdivisions", Journal of the American Institute of Planners, XVII, No.1 (Winter, 1951) 29-37.

Table 2: Suggested Scale of Minimum Lot Size Requirements

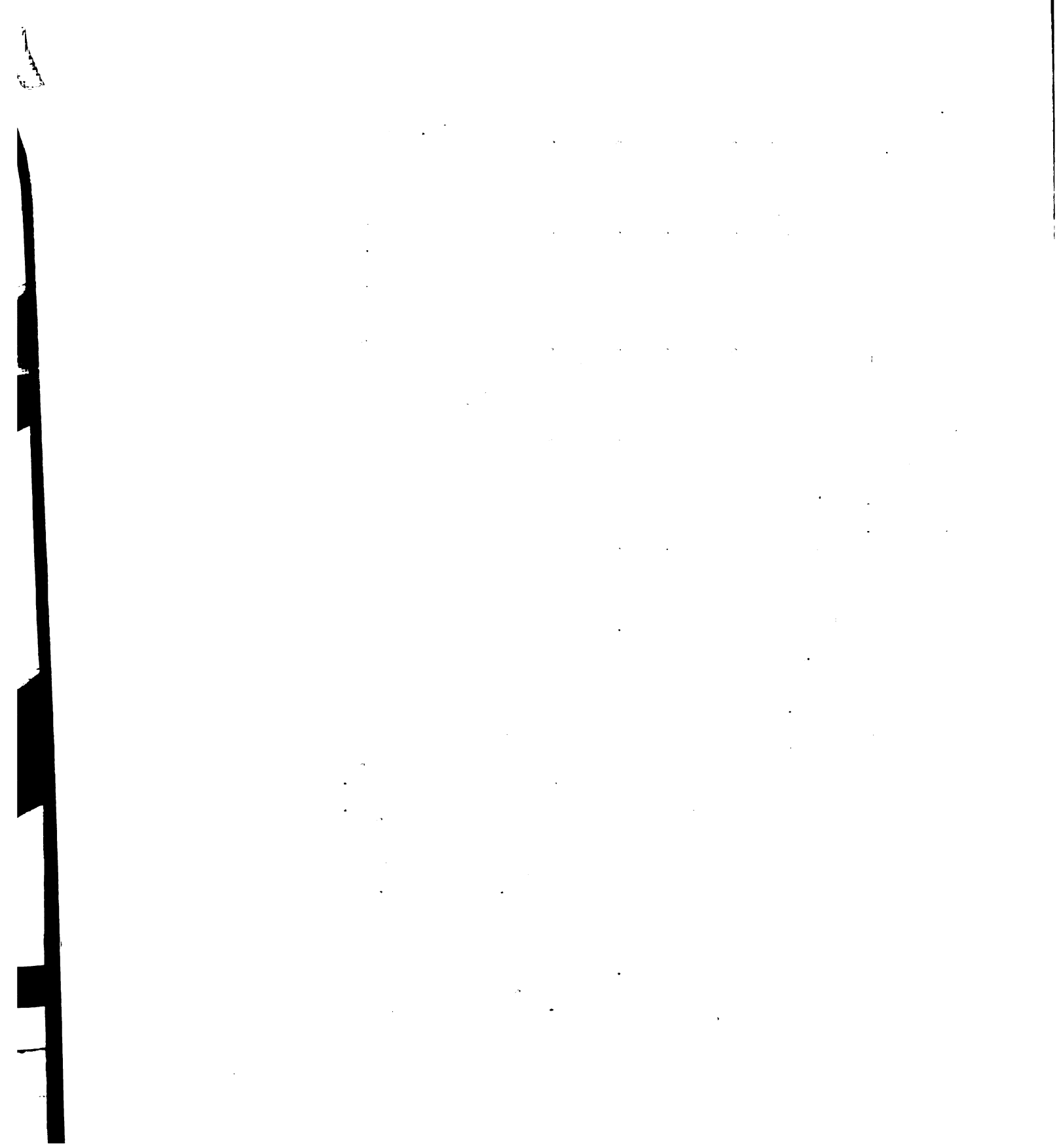
Soil type	Required facilities (family of 4a)	Area of sewerage system in sq.ft.		Minimum lot sizes (in square ft.)	
		Grade	6%+	Grade: 0-5%	
				Type of water service	Type of water service
		0-5%		Public	Private
Clean coarse sand or gravel.	60' tile & 2' trench, or a 40 sq. ft. cesspool	120	210	5,000	20,000
				6,000	20,000
Fine sand or light loam.	80' tile & 2' trench	190	350	6,000	20,000
				8,000	20,000
Fine sand with some clay or loam	120' tile & 2½' trench	780	1,200	8,000	20,000
				12,000	20,000
Clay with some sand or gravel.	320' tile & 3' trench	3,150	4,700	10,000	20,000
				15,000 ^b	20,000 ^b
Heavy clay, shallow bedrock or impervious layer.	Subsurface sand filter discharging to a flowing stream; or a public sewer			15,000 ^b	20,000 ^b
Flooded, swampy or with a high water table.	Considerable filling and public sewerage			15,000 ^b	20,000 ^b

(Lot size not directly related to sanitary requirements since both public sewer and public water connection is assumed to be provided.)

^aAssumes that there will be approximately 50 gallons of sewage produced for each person in the family.

^bAssuming that a subsurface sand filter is employed and that no public sewer connection is available.

Source: Robert C. Hoover, "Land Planning For Sanitary Drainage and Water Supply in Suburban and Open Country Subdivisions", Journal of the American Institute of Planners, XVII, No. 1, (Winter, 1951) p.36.



is still quite general in the treatment of soils. In addition, it appears that Mr. Hoover has decided that a rule-of-thumb maximum is necessary, because in no case do lot size recommendations exceed 20,000 square feet. The figures presented for individual sewage volume per person and leaching requirements are far too low to meet the needs of present suburbanites. However, the basis for further research in this area is apparent. Unknowingly, the author of this paper has followed some of the same reasoning as Mr. Hoover. However, as will be seen in the next section, the results are not the same.

Summary and Conclusions

Various studies of natural physical characteristics of land have been undertaken in the last few years. The majority of studies have been concerned with large land areas by county or regional agencies. Due to such a large-scale approach, the tendency to generalize or even to overgeneralize has made the results useable mainly as a framework for further detailed studies. As yet, little has been done to break down soil characteristics in greater detail so that they might be evaluated for urban use.

Mr. Hoover did attempt to devise a table for septic tank use evaluation some years ago, but due to certain assumptions and methods used, it is not valid today. The Federal Housing Agency produced voluminous tables on soil characteristics as related to man's use of land for

structures, roads, etc., but practically neglected soil permeability as a characteristic of soil which must be considered wherever public water and/or public sewers are not available.

Generally, the studies cited in this section do point out that soil characteristics are important for agricultural land use and urban land use. Many of these reports state concern over good agricultural land being urbanized and do wish to guide urban development. Certain factors are obvious, but classification of soils has proved to be generalized. For policy development and construction of regulations, this might prove disastrous. More detailed studies are necessary in order to proceed in the development of a long range program, but methods of utilizing existing data have not been fully developed.

Problems of flood control, erosion, septic tank hazards and other detrimental aspects of urbanization have pressed urban planners to recognize these physical problems of urbanization in rural and urban fringe areas. A great deal of information is available, but not always in such form that it may lend itself to easy usage by those responsible for community development. The problem, though recognized, has not yet been solved.

CHAPTER IV

THE BATTLE CREEK AREA STUDY

The Battle Creek area, for purposes of this paper, is made up of the cities of Battle Creek and Springfield, Michigan and the four townships surrounding them -- Bedford, Pennfield, Battle Creek and Emmett (all in Calhoun County, Michigan). This area is typical of those areas that make up the fringe around a growing city in that urbanization of rural areas is proceeding at a rapid rate. Consequently, various agencies and individuals have become concerned about the direction of development. The tendency of subdivision developments to leapfrog about the countryside has resulted in typical suburban problems of water supply, sewage disposal, increasing taxes, special assessments, and service costs and many other problems inherent in modern suburban development.

Water Supply

The City of Battle Creek is located on glacial overburden which requires deep drilled wells in order to supply the municipal water system. At a depth of approximately 400 feet, the City has tapped the Saginaw Aquifer (water strata) which is composed of permeable sandstone. The City can be assured of a continual water supply for many years. However, this aquifer traverses only the northern and eastern portions of the city which is the southwestern termination of this cross-state geologic formation. The result is that no immediately available

municipal water source is possible in a westerly or southerly direction from Battle Creek.

Domestic wells in the latter directions have often been abandoned due to the unsuitability of the water supply that is found in the glacial till. In a way, this might be considered an advantage for the City because through the installation of water systems to serve these areas, better control of development seems possible. To the north and east of the City, urban growth has continued but individual water supplies are not always palatable. It appears that the logical approach would be for the City to capitalize on this physical factor and encourage a better type of urban development by guiding growth through the provision of extensions to a public water supply system.

Agricultural Considerations

The four townships around Battle Creek have a large number of productive farms which add substantially to the economic base of the area. A great deal of the land in this area is made up of Class I, II, or III agricultural soils, which as classified by the U.S. Department of Agriculture, is among the nation's most productive farmland. The eight agricultural capability classifications of land are presented in Appendix A.

Competition between farmer and urban developer for good land is not new, but urban sprawl often results from this competition and can be and often is detrimental in many ways to both the farming and urban development

operations. Land in agricultural use is often considered by developers as prime land for residential subdivision. In many cases this is true, but too often good agricultural land is not good land for residential subdivisions when individual wells and/or sewage disposal systems must be placed on the same lot. This is very evident in the Battle Creek Area Townships where ten soil series are in the category of good agricultural lands while only one of these soil series has a very good percolation rate and one has a moderate percolation rate.

It has been suggested by agricultural authorities that subdivision of the nation's best soils should be limited when the aggregate area is economically important and feasible in an agricultural sense. The state of California, which produces a large amount of foods, is comprised of about 100 million acres of land with only 12.4 million acres rated in classes I, II, or III.²⁵ A great deal of the other 87.6 million acres could be utilized for urban development.

Another argument that lends itself to the application of this principle in the Battle Creek area is the fact that mixed agricultural and residential land use results in very costly services, utilities, etc.

25. U.S. Department of Agriculture, Talks On Rural Zoning, Agricultural Research Service (Washington: U.S. Government Printing Office, January 1960) p.63.

Nationally, farmlands are being eliminated at the rate of 400,000 acres per year²⁶ while patterns of urban growth leave unbuilt-upon land spotted throughout the city fringe.²⁷ There are some who argue that the loss of farmland is not serious, but farmers will continue to farm their land until they are forced to cease operations. Class I farmland accounts for only 10% of this country's total cropland, and only 3.8% of total land, but it produces 20% of our food supplies. About one-half of our class I land is located around our cities. Even with present food surpluses "it is economic nonsense to retire (and destroy) the most productive, rather than the marginal land... Yet the farmer has no choice but to sell when sprawl entraps him."²⁸

The Community Planning Association of Canada in its pamphlet entitled "Sprawl (1957)" aptly summed up the case against the evils of this development for urban and agricultural consideration. They described this phenomenon as having four evil effects: 1) sprawl produces badly served communities; 2) it is costly to all concerned; 3) it destroys productive farmland prematurely; and 4) it ensures that eventual development of the areas affected

26. M.M. Gaffney, "Urban Expansion - Will It Ever Stop?", Land - 1958 Yearbook of Agriculture (Washington: U.S. Government Printing Office, 1958), 503-522.

27. House and Home, op.cit., pp. 106-113.

28. "The City's Threat to Open Land", Architectural Forum, CVIII (January, 1958) 87-90, 166.

will be difficult and inefficient.

Mapping of the Townships

The author, while engaged in preliminary planning studies of Calhoun County for the Institute For Community Development and Services, became concerned with and delved into some of the problems of the areas's urbanization. It was learned that preliminary research had been done in certain physical characteristics of the land in the area, therefore arrangements were made to complete the mapping of soils for the four township area in order to utilize this information for further study. It was felt that detailed soil information could provide the framework upon which to develop a land classification system for those areas which were receiving or about to receive the bulk of urbanization.

The four townships were mapped on acetate by Mr. Glenn Bedell, of the U.S. Soil Conservation Service regional office in Jackson, Michigan, at a scale of four inches to the mile by employing four sources of data. These sources were:

- 1) The U.S. Department of Agriculture's "Soil Survey of Calhoun County, Michigan", published in 1919, was used to supply basic information.
- 2) Aerial photographs were used to obtain more accuracy in determining physical features and soil series boundaries.
- 3) Soils information from farms cooperating with the

U.S. Soil Conservation Service program were utilized.

- 4) Finally, the information was "spot" field checked from various vantage points and information checked in the field for those areas in which the Calhoun County Health Department had made percolation tests.

During the process of delineating soil boundaries on the overlays, Mr. Bedell redesignated all soil categories according to the National Cooperative Soil Survey soil identifications practices. The author was then able to take this information from the overlays and compile it as base soil maps that could be used for either agricultural or urban considerations. These maps have been photographically reproduced for inclusion in this paper at a scale of one inch to the mile and are illustrated as Plates II, III, IV, and V.

Each base map has been titled "Generalized Soil Map" due to the fact that it is impossible to survey every square foot of ground in a short period of time in order to produce a completely accurate map. The end result produced in this case is much more refined than the 1919 soil surveys and definitely more usable. However, it should be kept in mind that those forces that are building up, changing, or destroying the soil are not uniform over large areas of the earth's surface with the result that soils show a corresponding lack of uniformity. Definite

characteristics of the soil in a region are the result of a particular combination of conditions. These characteristics can be identified and categorized in order to identify a soil type of a particular series.

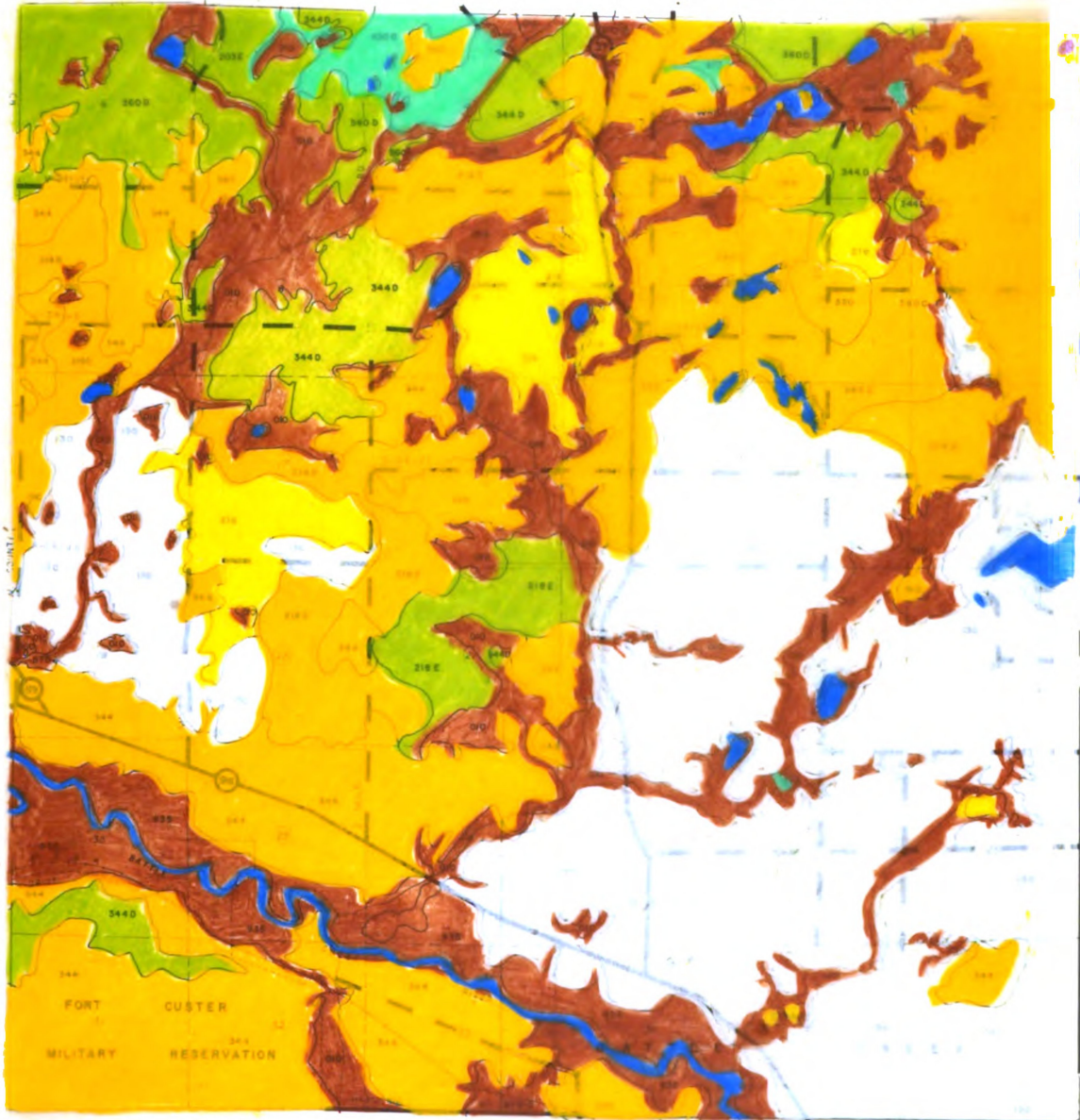
Subdivision activity is proceeding in many areas where the suitability of soils to handle septic tank effluent is questionable. Many soil scientists and others have been working on the possibility of developing a scheme of land classification which would utilize the knowledge of natural characteristics of soils for determining some limitations on the use of land for residential development.

Originally, Mr. Bedell developed a basic classification of six categories of soils which formed the foundation for further research. The author, after consultation with various individuals at Michigan State University, local and state health agencies, and others too numerous to mention, decided that a systematic method could be devised which would utilize Mr. Bedell's six basic categories as the end result in classifications of areas. This method is further explained in the following chapter.

Information on the Battle Creek Area townships as illustrated by Plates II, III, IV, and V are supplemented by Table 4. These plates show soil type boundaries with each soil type indicated by a code number according to the U.S. Soil Conservation Service's master code designation for soils in Michigan.

GENERALIZED SOIL MAP

BEDFORD TOWNSHIP CALHOUN COUNTY, MICHIGAN



LAND CLASSIFICATION*

- | | | | |
|---|---|---|-------|
|  | 1 |  | 5 |
|  | 2 |  | 6 |
|  | 3 |  | water |
|  | 4 | * use with Table 4 | |



COOPERATING AGENCIES:

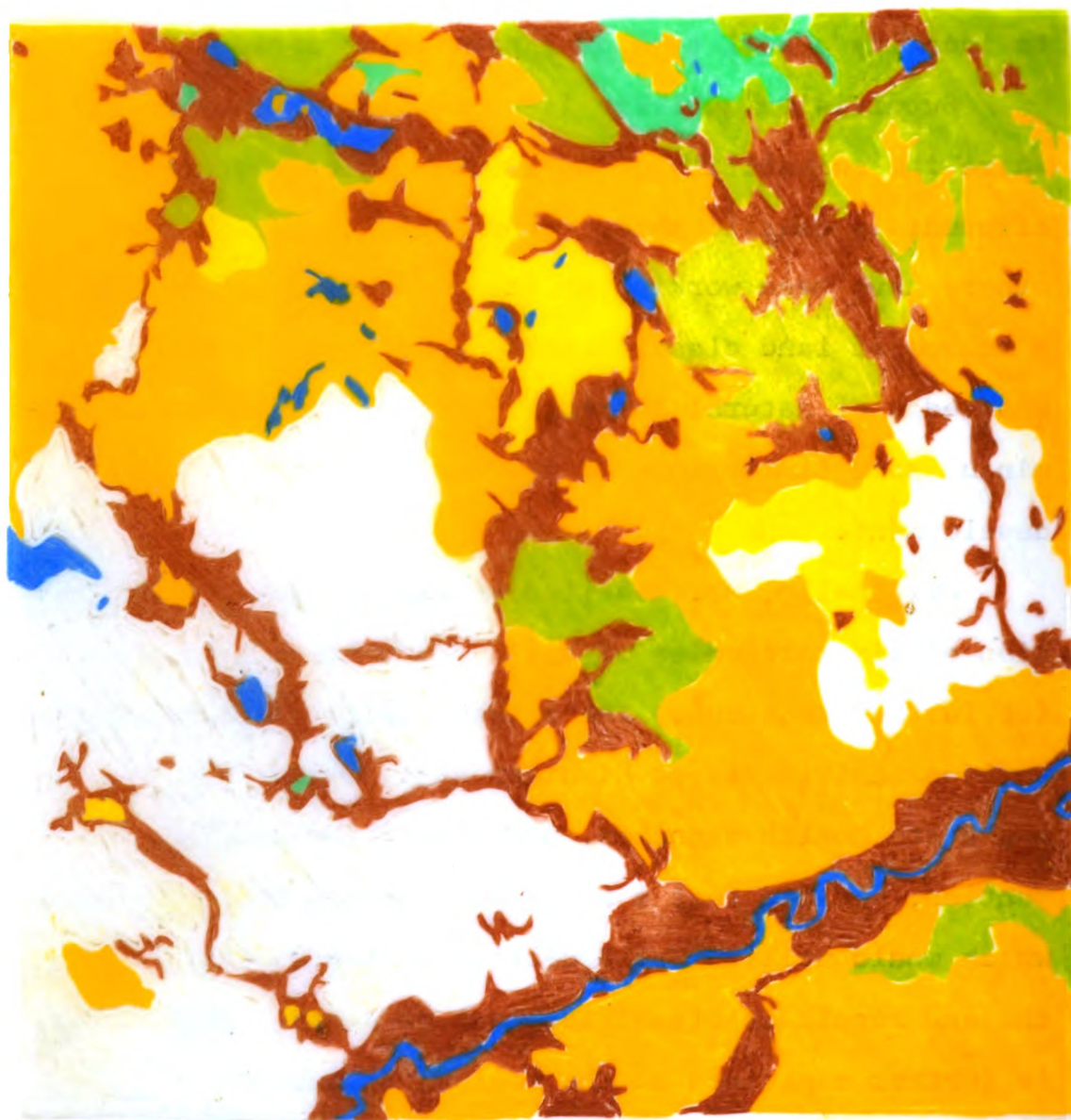
SOIL CONSERVATION SERVICE, U.S. DEPT. OF AGRICULTURE

Field work by Glenn Bedell, Area Soil Scientist
CALHOUN COUNTY COOPERATIVE EXTENSION SERVICE
CALHOUN COUNTY HEALTH DEPARTMENT
INSTITUTE FOR COMMUNITY DEVELOPMENT,
MICHIGAN STATE UNIVERSITY

PREPARED BY:

William G. Kwaeder

October, 1960



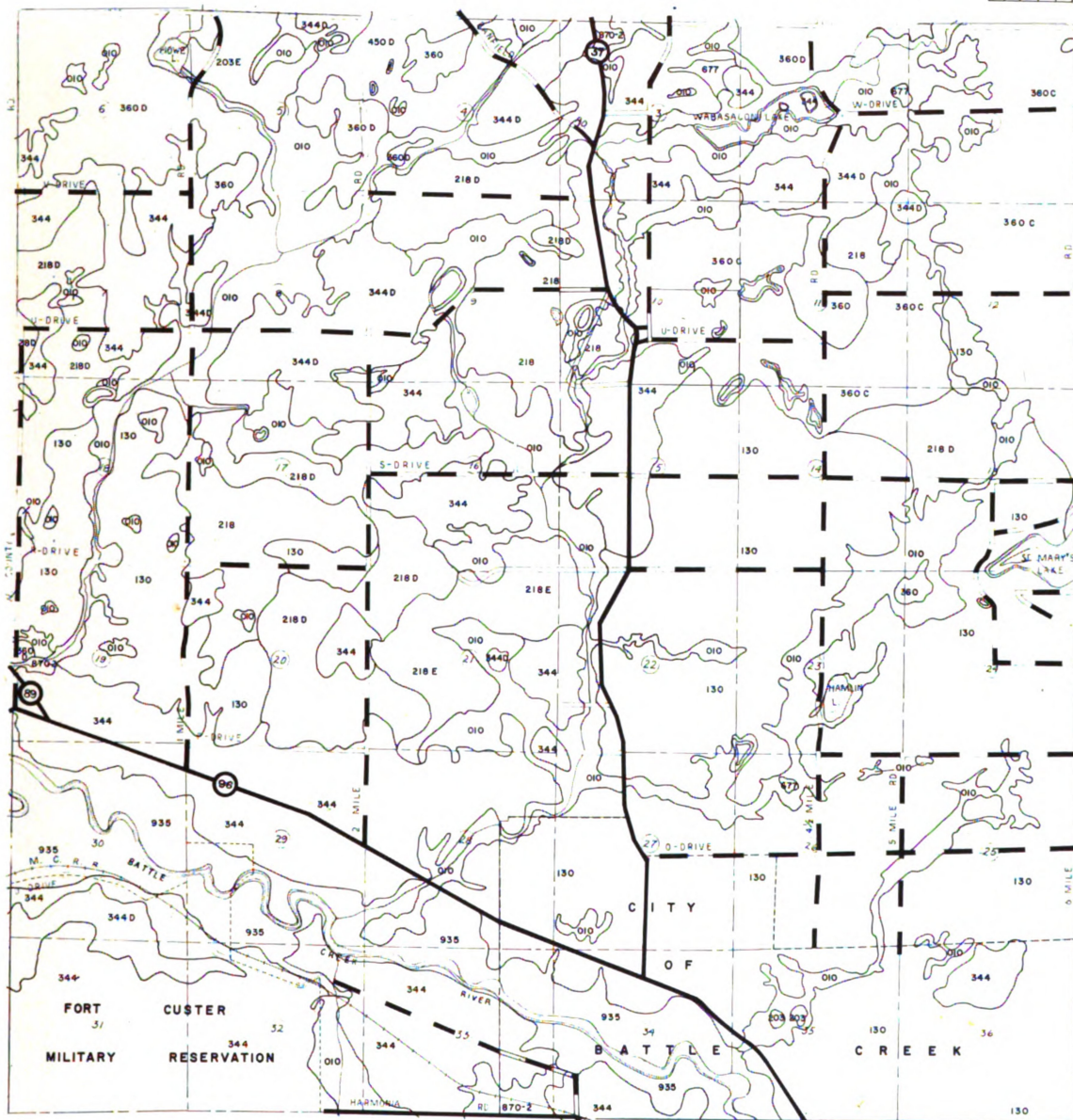
**LAND
CLASSIFICATION***

1		2	
2		3	
3		4	
4		5	
5		6	
6		7	

* use with Table 4

GENERALIZED SOIL MAP

BEDFORD TOWNSHIP CALHOUN COUNTY, MICHIGAN



COOPERATING AGENCIES:

SOIL CONSERVATION SERVICE, U.S. DEPT. OF AGRICULTURE
Field work by Glenn Bedell, Area Soil Scientist
CALHOUN COUNTY COOPERATIVE EXTENSION SERVICE
CALHOUN COUNTY HEALTH DEPARTMENT
INSTITUTE FOR COMMUNITY DEVELOPMENT,
MICHIGAN STATE UNIVERSITY

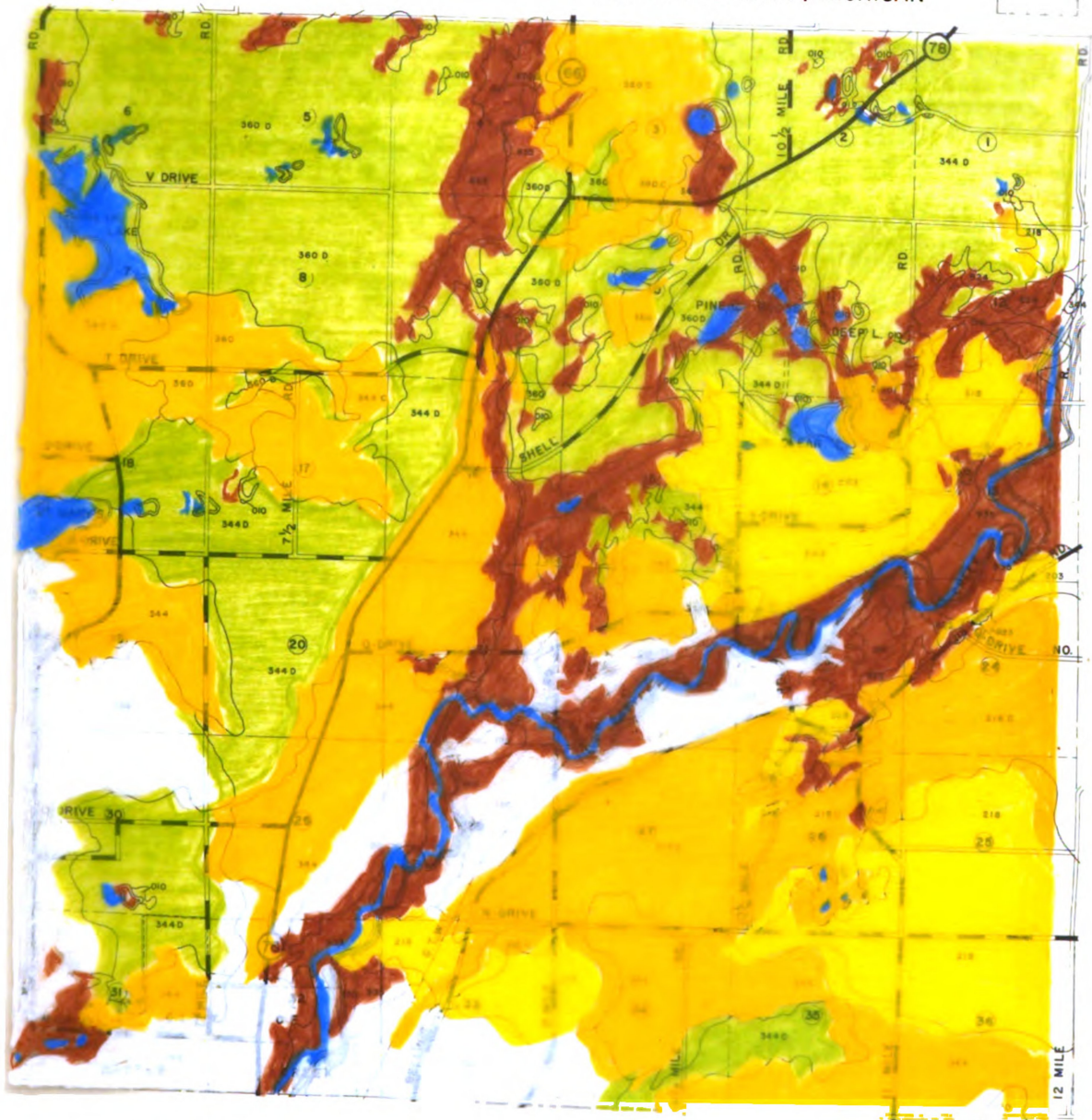
PREPARED BY:

William G. Kwader

October 1960

GENERALIZED SOIL MAP

PENNFIELD TOWNSHIP
CALHOUN COUNTY, MICHIGAN



LAND CLASSIFICATION*

- | | | | |
|--|---|--------------------|-------|
| | 1 | | 5 |
| | 2 | | 6 |
| | 3 | | water |
| | 4 | * use with Table 4 | |



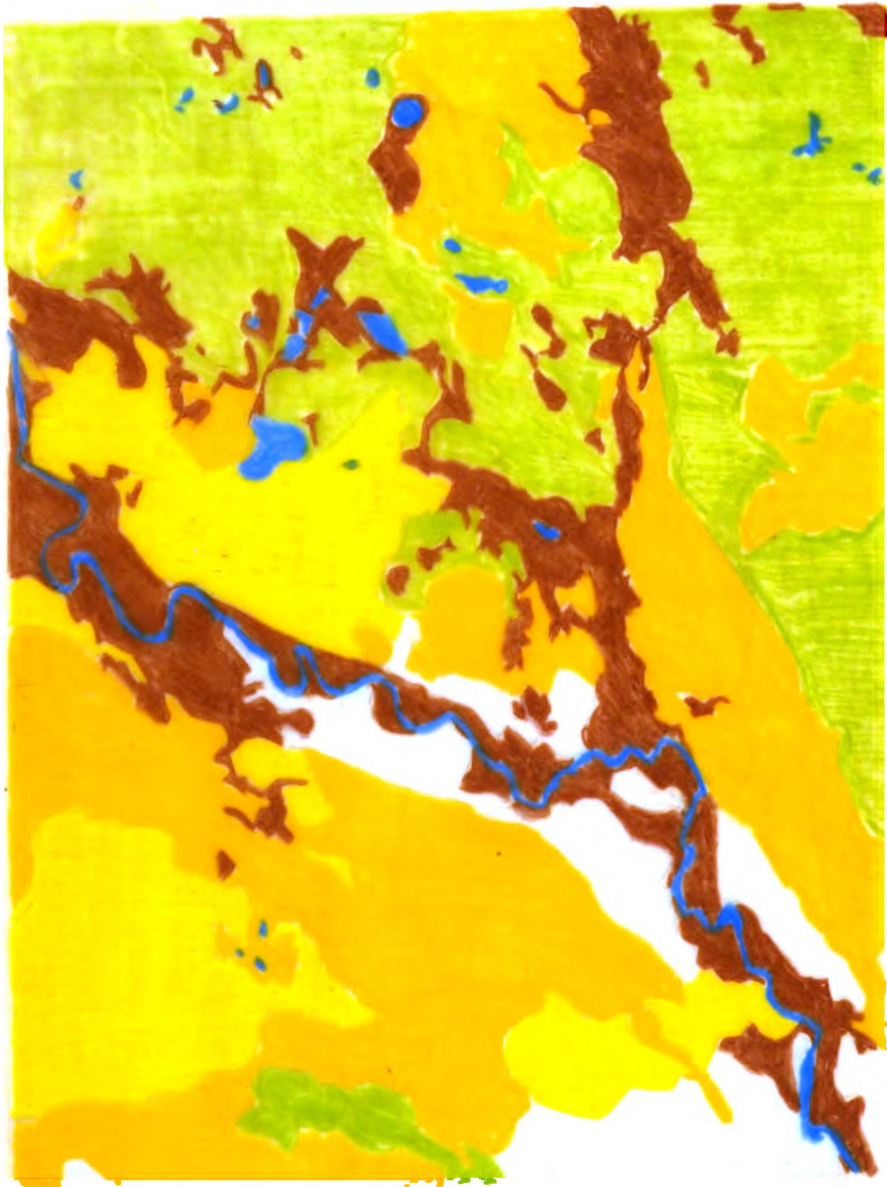
COOPERATING AGENCIES:

SOIL CONSERVATION SERVICE, U.S. DEPT. OF AGRICULTURE
Field work by Glenn Bedell, Area Soil Scientist
CALHOUN COUNTY COOPERATIVE EXTENSION SERVICE
CALHOUN COUNTY HEALTH DEPARTMENT
INSTITUTE FOR COMMUNITY DEVELOPMENT,
MICHIGAN STATE UNIVERSITY

PREPARED BY
William G. Kuebler

October 1960

PLATE III



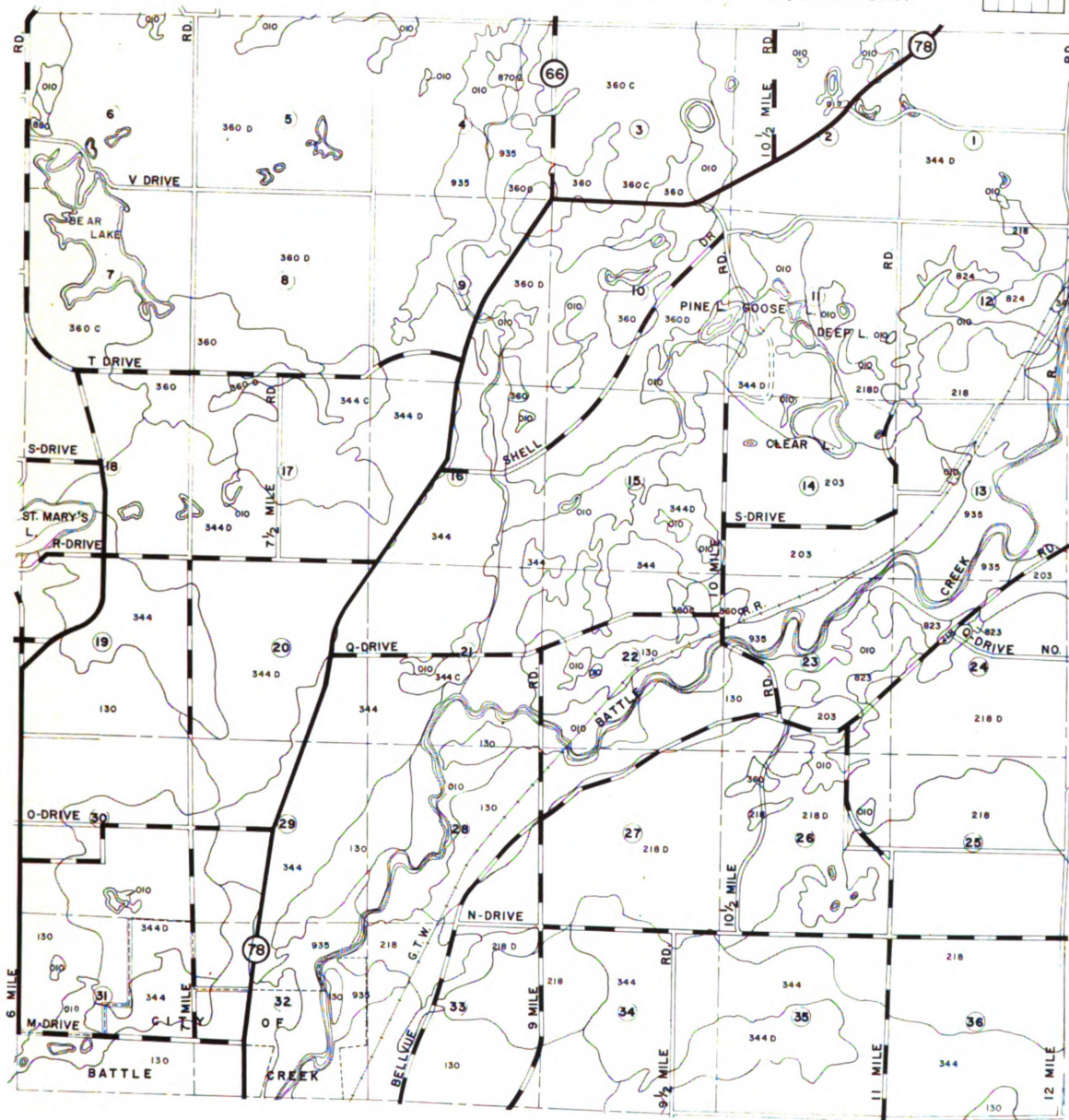
LAND CLASSIFICATION *

- | | | | |
|---|--|-------|--|
| 1 | | 2 | |
| 3 | | 6 | |
| 4 | | water | |

* use with Table 4

GENERALIZED SOIL MAP

PENNFIELD TOWNSHIP CALHOUN COUNTY, MICHIGAN



COOPERATING AGENCIES:

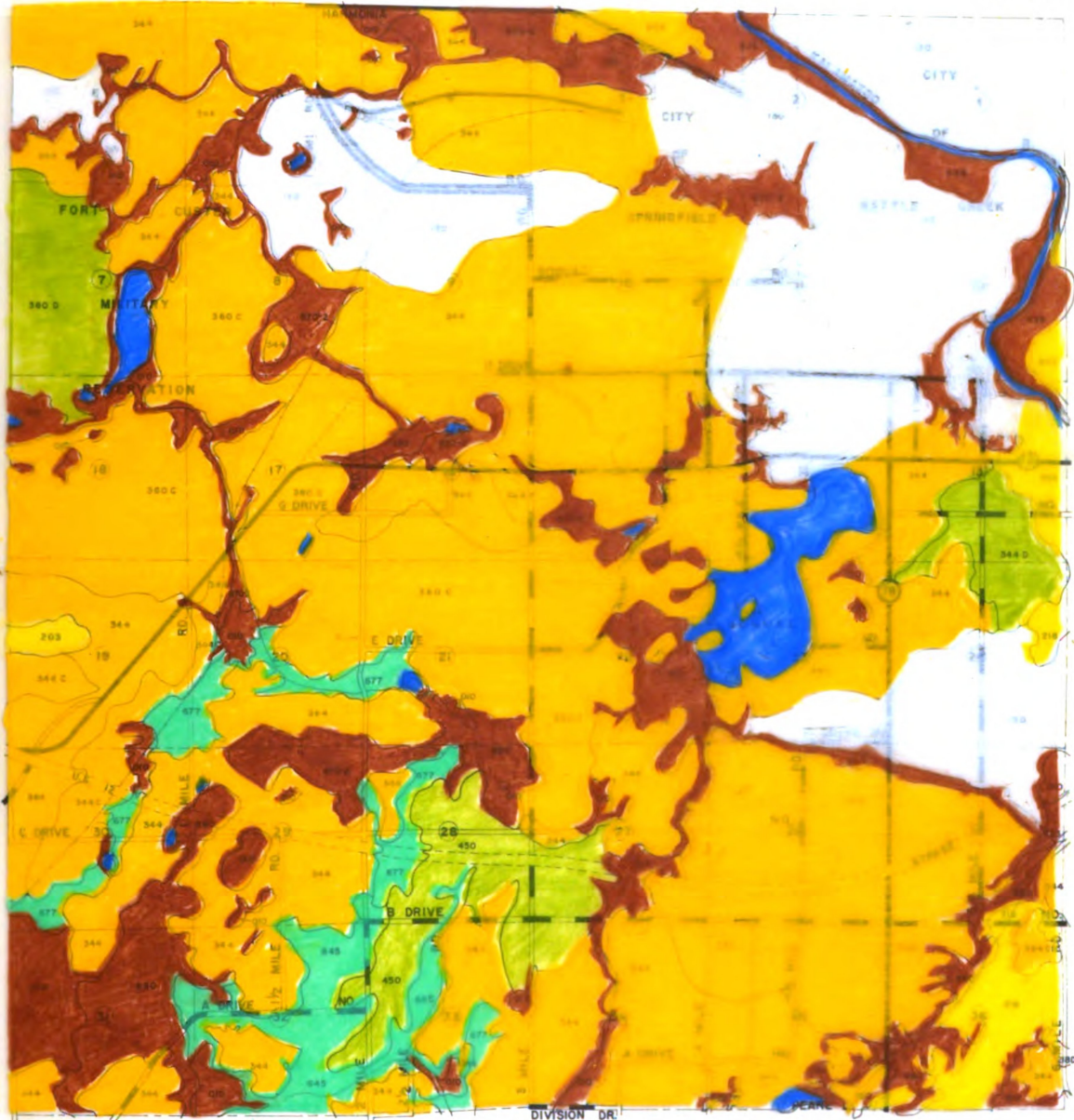
SOIL CONSERVATION SERVICE, U.S. DEPT. OF AGRICULTURE
Field work by Glenn Bedell, Area Soil Scientist
CALHOUN COUNTY COOPERATIVE EXTENSION SERVICE
CALHOUN COUNTY HEALTH DEPARTMENT
INSTITUTE FOR COMMUNITY DEVELOPMENT,
MICHIGAN STATE UNIVERSITY

PREPARED BY:
William G. Kweder

October 1960

GENERALIZED SOIL MAP

BATTLE CREEK TOWNSHIP CALHOUN COUNTY, MICHIGAN



LAND CLASSIFICATION *

- | | | | |
|---|---|---|-------|
|  | 1 |  | 5 |
|  | 2 |  | 6 |
|  | 3 |  | water |
|  | 4 | *use with Table 4 | |



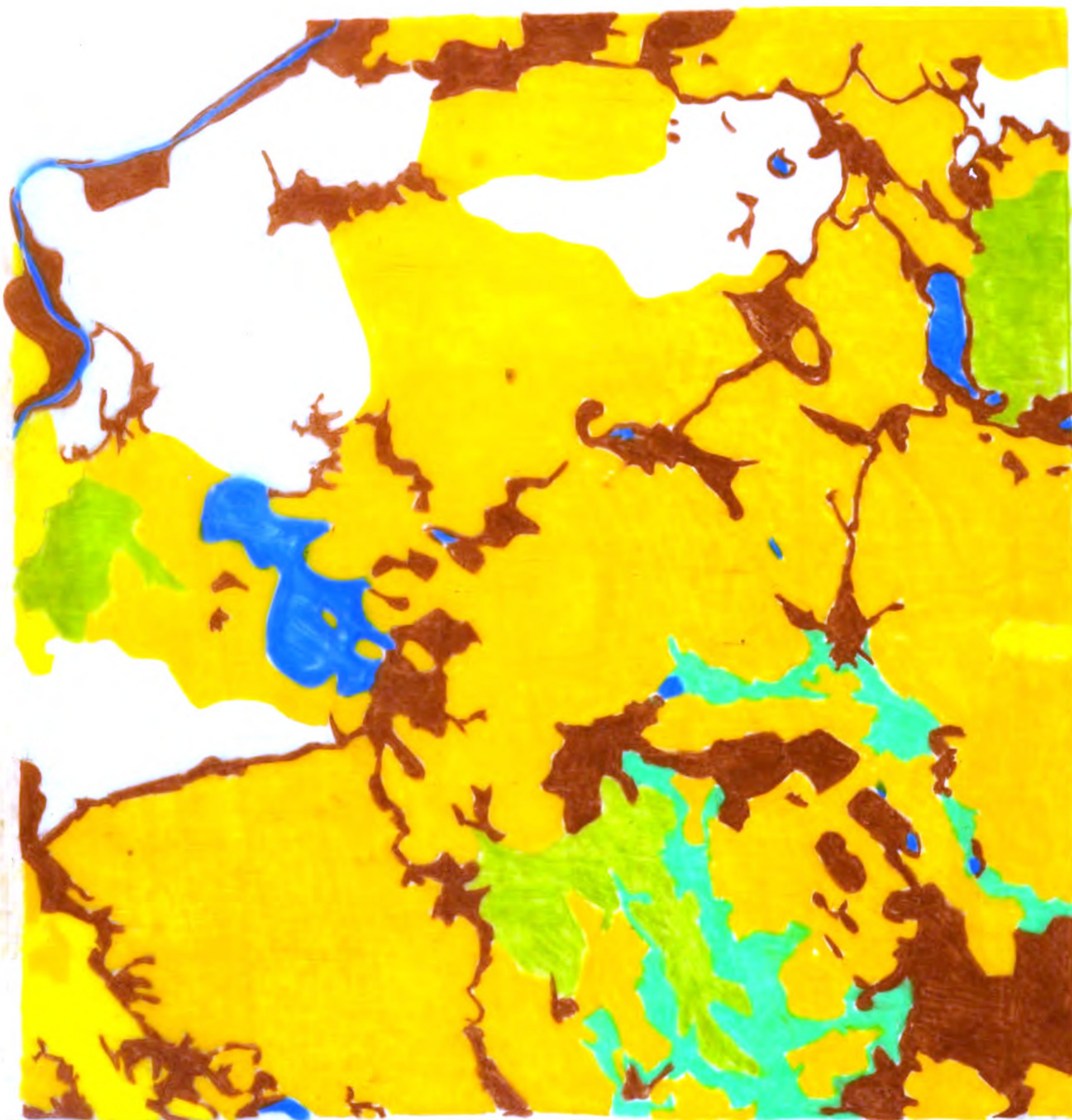
COOPERATING AGENCIES:

SOIL CONSERVATION SERVICE, U.S. DEPT. OF AGRICULTURE
Field work by Glenn Bedell, Area Soil Scientist
CALHOUN COUNTY COOPERATIVE EXTENSION SERVICE
CALHOUN COUNTY HEALTH DEPARTMENT
INSTITUTE FOR COMMUNITY DEVELOPMENT,
MICHIGAN STATE UNIVERSITY

PREPARED BY
William G. Kuender

October 1960

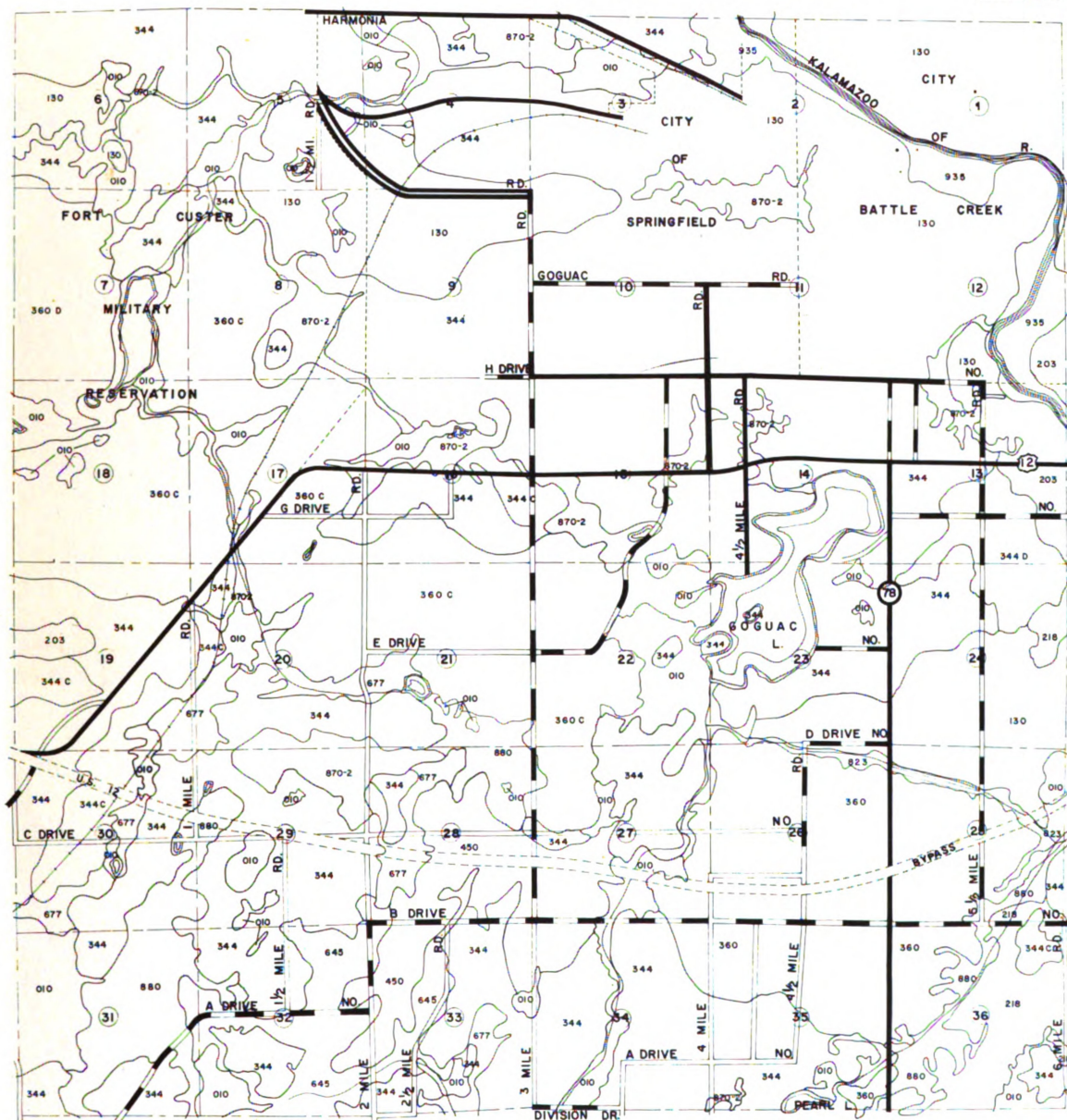
PLATE IV



LAND CLASSIFICATION *

1		2	
5		6	
3		water	
4			

* use with Table 2

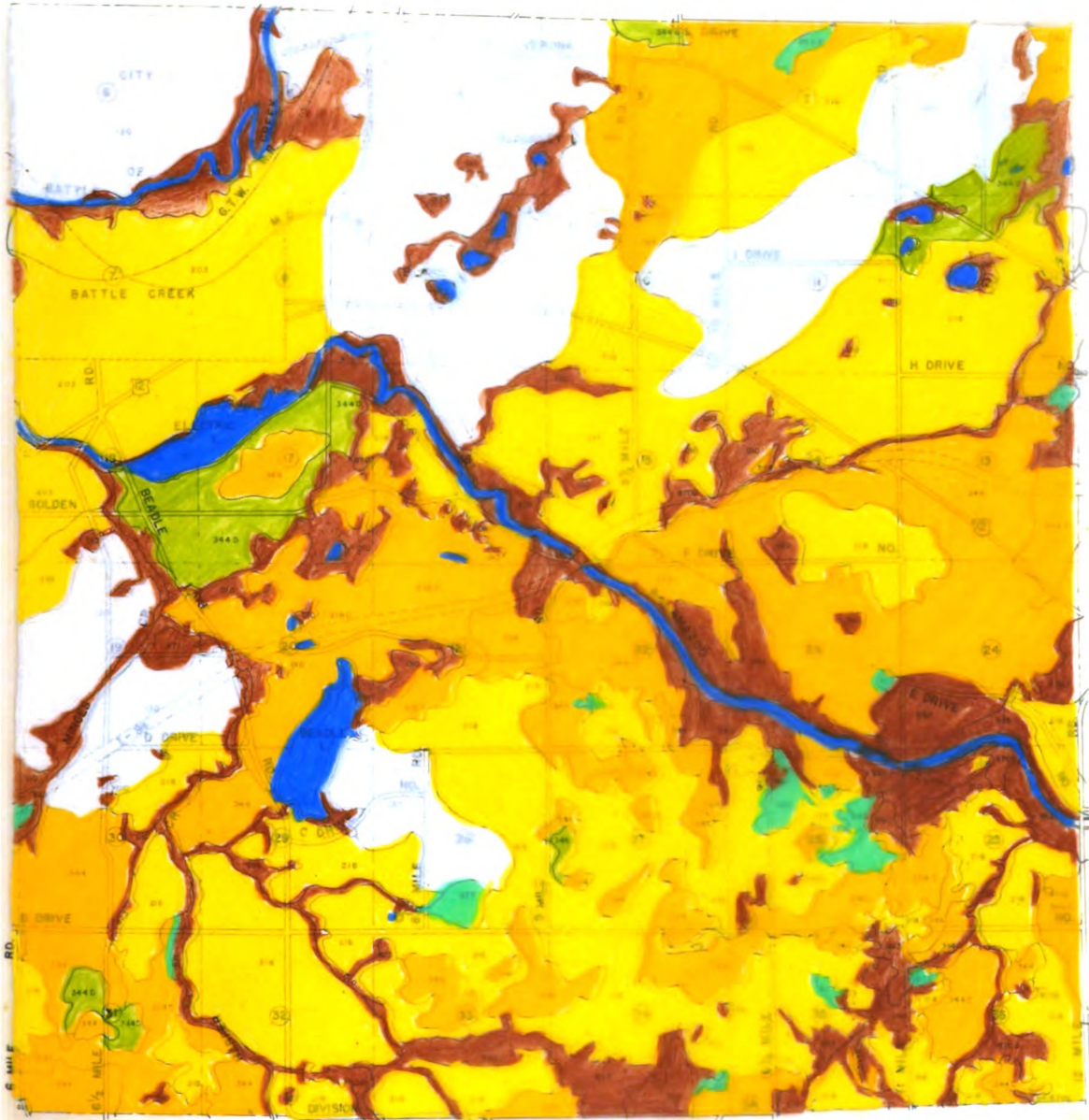


PREPARED BY:
William G. Kweder

PLATE IV

EMMETT TOWNSHIP
CALHOUN COUNTY, MICHIGAN

GENERALIZED SOIL MAP



LAND CLASSIFICATION *

- | | | | |
|--|---|--------------------|-------|
| | 1 | | 5 |
| | 2 | | 6 |
| | 3 | | water |
| | 4 | * use with Table 4 | |



COOPERATING AGENCIES:

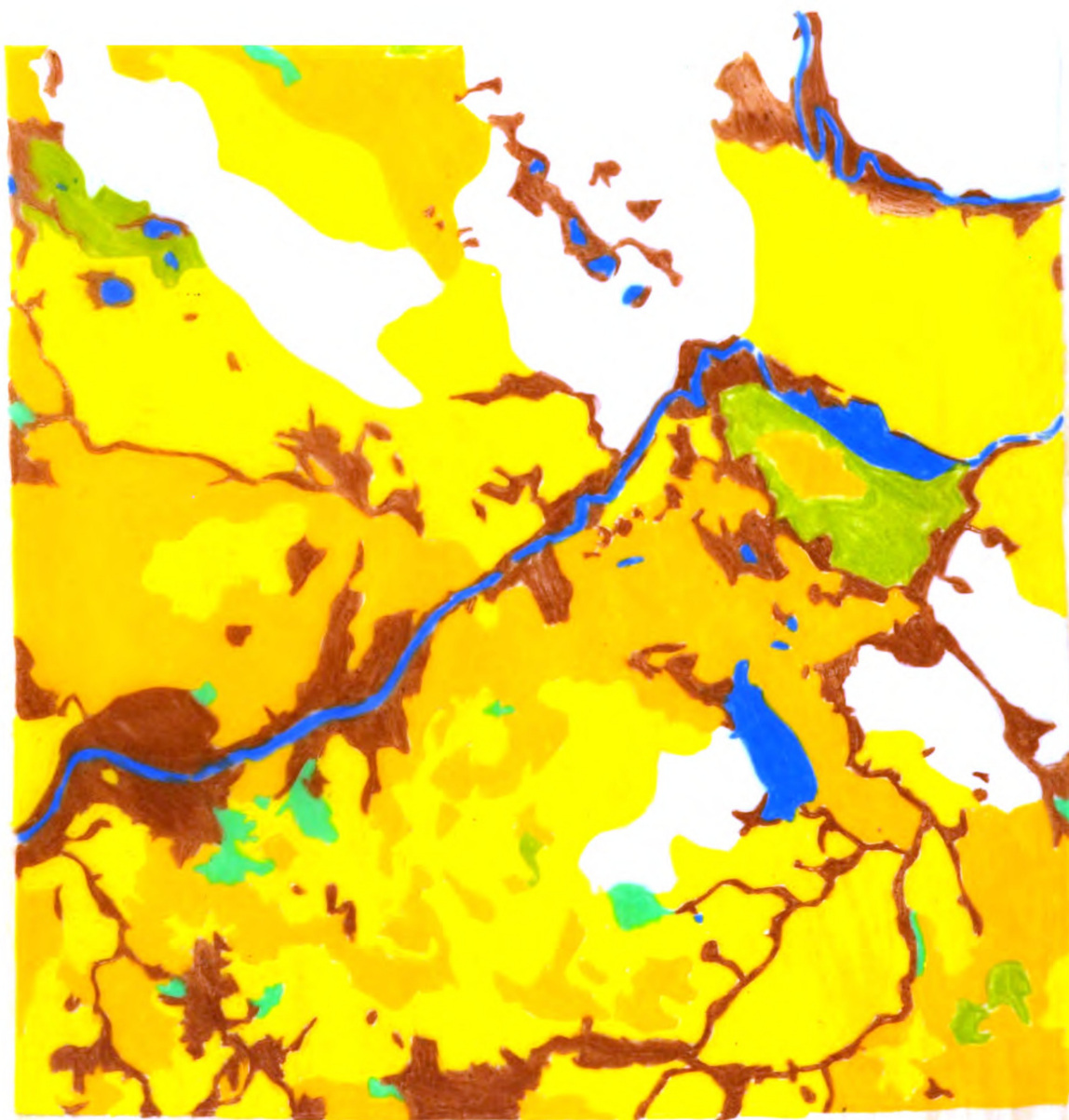
SOIL CONSERVATION SERVICE, U.S. DEPT. OF AGRICULTURE
Field work by Glenn Bedell, Area Soil Scientist
CALHOUN COUNTY COOPERATIVE EXTENSION SERVICE
CALHOUN COUNTY HEALTH DEPARTMENT
INSTITUTE FOR COMMUNITY DEVELOPMENT,
MICHIGAN STATE UNIVERSITY

PREPARED BY

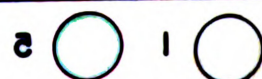
William G. Kweder

October 1960

PLATE V



LAND CLASSIFICATION *

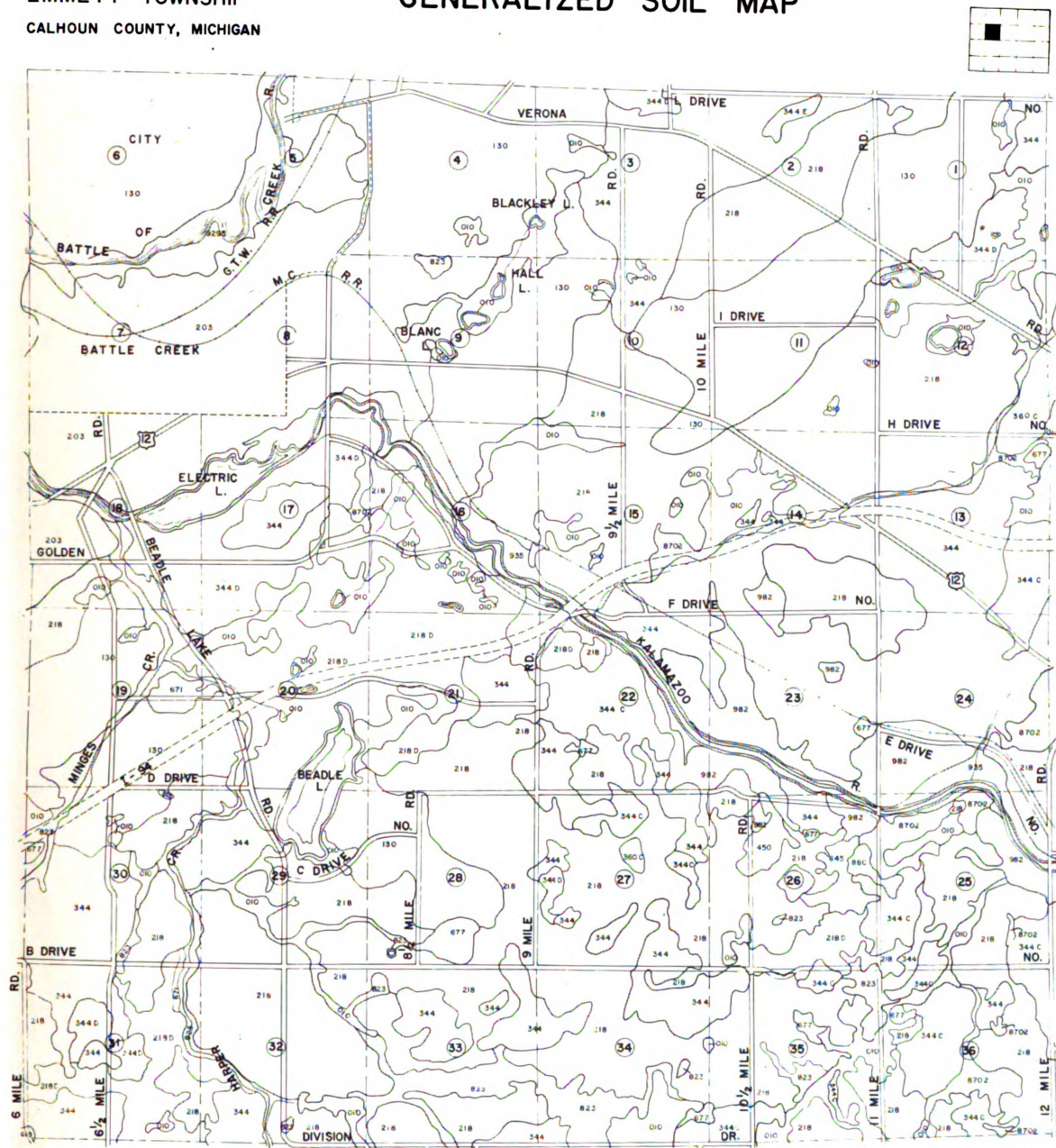


water

* use with table

EMMETT TOWNSHIP
CALHOUN COUNTY, MICHIGAN

GENERALIZED SOIL MAP



COOPERATING AGENCIES:

SOIL CONSERVATION SERVICE, U.S. DEPT. OF AGRICULTURE

Field work by Glenn Bedell, Area Soil Scientist

CALHOUN COUNTY COOPERATIVE EXTENSION SERVICE

CALHOUN COUNTY HEALTH DEPARTMENT

INSTITUTE FOR COMMUNITY DEVELOPMENT,

MICHIGAN STATE UNIVERSITY

PREPARED BY:

William G. Kweder

October 1960

Overlays have been utilized in this paper in order to illustrate the grouping of various types of soils according to similar characteristics as they appear on the base maps. These groupings as indicated by six colors are indicative of the rating of soil for urban residential use according to the procedure set forth in the following chapter. As a result, these maps and overlays can be utilized as a basic planning tool. With the use of this system, land use information and other data, it is conceivable that the Battle Creek Area townships and, in similar fashion, other local governments may better control urbanization of urbanizing areas through their inclusion in sound planning policies and development controls.

Denotation of Slope

In the older soil series maps, contour lines were often employed, but due to new techniques this is no longer true. Slope and location (lowland, terrace, etc.) are considered as characteristics of soils but slope identification is now employed in field coding during the compilation of modern soil maps. In addition to the digital code, a letter designation (upper case) is used to denote intensity of slope. The standard designation was previously stated in Table 1. These designations were originally conceived for agricultural use but again, they easily lend themselves to urban planning considerations. Slopes up to twelve percent are not usually

considered as detrimental to residential development although very flat land creates problems for drainage facilities and sewer lines which must depend upon gravity to produce natural flow. At the other end of the scale some caution becomes necessary due to installation of facilities and utilities which require proper gradients for satisfactory performance. However, this situation has not faced the urbanizing area surrounding Battle Creek because the city and its environs are in a relatively flat area where slopes do not exceed six percent.

Slopes exceeding twelve percent (fifteen percent is sometimes used) often create barriers to development; or if they are built upon, serious consequences may result if proper land development precautions are not taken. Development costs rise rapidly when slopes exceed ten percent and provision of public sewer and water is often not economically feasible. Investigation of the Battle Creek area showed that there are considerable areas of steep slopes out from the city, but development on these slopes, to date, has not been of an urban nature.

Subdivision On Floodplains and Poorly Drained Soils

The City of Battle Creek, for the most part, is on relatively well drained soils except for two large floodplains associated with the Battle Creek and Kalamazoo Rivers. It is also interesting to note that the well drained soils also happen to be very poor agricultural land. However, building upon the floodplains in the city

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has created flood problems which have only recently been alleviated at considerable cost through public expenditures -- primarily by the U.S. Corps of Engineers. Because of periodic flooding of urban facilities, the channel of the Battle Creek River had to be straightened and deepened. Had building not been allowed on the floodplain, much of the grief and the recent expense could have been avoided.

Current residential growth patterns appear to point out that officials and citizens in the area have not learned a lesson. Land use maps of 1959²⁹ bear shocking evidence of new subdivision activity on the floodplains of minor streams as well as on the floodplain of the Battle Creek River. This is especially true in Bedford Township. Ignorance of natural physical characteristics of land could very likely be the reason for lack of control in the area. However, ignorance of nature will not prevent the destruction of property and the expense of putting right what should not have been in the first place.

These very same areas are not all served by public sewers and in some, water must be obtained through individual wells. Drainage conditions are not always poor in floodplains, but in the case of Bedford Township,

29. Basic planning studies of Calhoun County, Michigan are presently being prepared by the Institute For Community Development and Services at Michigan State University, East Lansing, Michigan.

some subdivisions are traversed by organic soils. This latter consideration is very serious from a health standpoint for it is just about impossible to have a well and septic tank disposal system on a house lot of less than several acres, particularly where organic conditions are paramount. Even then, it is difficult to obtain potable water.

Summary and Conclusions

The Battle Creek Area Study sharply illuminated the need for a method of classifying land not only to guide sound residential development, but also to protect good agricultural land. This investigation lent itself to the development of the classification scheme (explained in the next chapter) because it is an area in Michigan that is witnessing rapid urbanization of rural areas and has many of the problems that are plaguing city fringe areas all over the nation. Natural physical characteristics of land in the area had not been investigated for the purpose of determining growth policies and/or residential development controls.

The information that has been compiled and the land classification maps have not been made available to officials in the Battle Creek area as yet, but it is the humble opinion of the author that they should prove useful in helping to achieve better patterns and standards in future development.

CHAPTER V

CLASSIFICATION OF LAND FOR RESIDENTIAL DEVELOPMENT AND LOT SIZE REQUIREMENTS

Natural characteristics of soils are considered by soil scientists for their relation to agricultural use of land, but analyses of these characteristics are also useful in consideration of land for urban residential development. Such characteristics as slope (explained previously), erosion, color, and texture are all important in judging land. Detailed analyses of color and texture are made through field and laboratory examination while erosion is based upon field observation. Of importance to those responsible for community development is the fact that these analyses are correlated in code form and written form for all soil series which may be obtained from U.S. Soil Conservation Service offices. Each soil series has been assigned a name and master field code designation.

A Method of Classifying Land For Residential Development

With the above information one may refer to Soil Conservation Service listings in order to obtain agricultural capability classifications. This procedure allows one to readily identify the best agricultural lands in relation to urban development, but more information is desirable if such land is to be used for urban subdivision. However, each soil series is rated for soil management purposes which offers a key to urban residential considerations.

The Departments of Soil Science and Horticulture at Michigan State University have compiled tables³⁰ of fertilizer recommendations for soil series in Michigan. It is within the framework of these tables that soil series have been converted, by the author, to urban residential land use considerations.

Soil management groups are based upon natural physical characteristics of soil to a depth of 3 to 5.5 feet. They are subdivided into management units on the basis of slope, degree of erosion, surface texture, or stoniness and may be regrouped into Land Capability Classes, Subclasses, or Units. The grouping of soil series into urban residential classes is accomplished by utilizing the coding system of agricultural considerations by a simple mathematical weighting process applied to the characteristics.

Table 3 illustrates texture, natural drainage, and surface color. The agricultural classification number indicates relative coarseness of the mineral materials from which the soils were formed; from 0 for the finest texture or clays, to 5 for the coarsest texture or sands. A small letter following the numbers or capital letters denotes natural drainage under which the soil developed: "a" for well drained, light colored; "b" for imperfectly

30. Departments of Soil Science and Horticulture, Michigan State University, Fertilizer Recommendations For Michigan Crops, Cooperative Extension Service Bulletin E-159 (East Lansing: June 1959), pp. 43-48.

Table 3: Soil Management Group Identification Chart

Texture of the upper 3 feet of the soil profile	Natural drainage and surface color		
	Well drained light colored a	Imperfectly drained moderately dark colored b	Poorly drained dark colored c
0 Clays (over 55%)			0c*
1 Clay and silty clays	1a*	1b*	1c*
2 Clay loams or loams	2a*	2b*	2c*
3 Sandy loams	3a*	3b*	3c*
4 Loamy sands or sands with some finer textured layers	4a*	4b*	4c*
5 Sands	5a*	5b*	5c*
G Gravelly or stony	Ga*	Gc*	Gc*
R Rocky	Ra*	Rc*	Rc*

* Soil management group designations.

Source: Michigan State University Cooperative Extension Service, "Fertilizer Recommendations for Michigan Crops", Extension Bul. E-159, Ju 59, p.44.

Table 4: Classification of Battle Creek Area Soil Series For
Agricultural and Urban Residential Use

Soil no.	Soil series	Soil series mngmt. group	Dominant land use capability class (1)	Primary rating for urban res. use(2)	Final rating for urban res. use(3)
010	Organic soil*	Mc	III	6	6
130	Plainfield	5.0a	VII	1	1
203	Coloma	4a	IV	2	2
218	Oshtemo	4a	III	2	2
218D	Oshtemo (Hilly)	4a	IV	2	3
218E	Oshtemo (Steep)	4a	VI	2	4
344	Fox	3a	II	3	3
344C	Fox (Rolling)	3a	III	3	3
344D	Fox (Hilly)	3a	IV	3	4
344E	Fox (Steep)	3a	VI	3	5
360	Hillside	3a	II	3	3
360C	Hillside (Rolling)	3a	III	3	3
360D	Hillside (Hilly)	3a	IV	3	4
450	Miami	2a	II	4	4
450D	Miami (Hilly)	2a	IV	4	5
645	Conover	2b	I	5	5
671	Brady	4b	III	3	5
677	Matherton	3b	II	4	5
823	Gilford	4c	III	4	6
8702	Sebewa	3c	II	5	6
880	Brookston	2c	I	6	6
935	Genessee	3a-L	IV	6	6
982	Parma	3/Ra	III	6	6

* includes Carlisle, Houghton, and Tanas Soil Series.

- (1) Soils series are grouped into Land Capability Classes according to degree of limitations in use, and general suitability for agricultural use as defined in Appendix A. Class I soils have few limitations in use and limitations increase with class.
- (2) An arabic number is used for primary urban residential use rating. Drainage factors in relation to use for septic tank systems received primary consideration in this grouping.
- (3) An arabic number is used for final urban residential use rating. In addition to (2), slope factors and predominance of dense materials such as loam or organic matter determine the final rating.

drained, moderately dark colored; and "c" for poorly drained, dark colored. These factors become important considerations in determining a soil's suitability for septic tank effluent dispersal, storm drainage and the provision of individual wells for domestic water supply. This classification of soil series is illustrated in the table classifying Battle Creek Area soils (Table 4).

Methodology Employed

Using characteristics of texture and drainage characteristics an "urban weighting system" is applied. Urban weights are for the six numerical designations used in soil management groupings and are obtained by reversing the numerical order that applies to texture. The lower case letters denoting drainage characteristics are weighted as: "a" = 1; "b" = 2; and "c" = 3. By combining these two urban weights a primary soil series classification for urban residential use may be obtained. These weighting factors are illustrated in Tables 5 and 6.

Table 5: Conversion Factors for Urban Residential Use Rating

Management group capital letter or number designation	urban weight	texture of the upper 3 feet of the soil profile
0	5	clays (over 55%)
1	4	clay and silty clay
2	3	clay loams or loams
3	2	sandy loams
4	1	loamy sands or sands with some finer textured materials
5	0	sands
G	0	Gravelly or stony
R	3	Rocky

Table 6: Drainage Weighting

Management group lower case letter designation	Urban weight	Description
a	1	well drained
b	2	imperfectly drained
c	3	poorly drained

Where soils are made up of one material over another, a fractional symbol is used. The capital letter or number above the line refers to the upper layer, while the lower letter or number refers to the lower layer. For example, 5/1 refers to sands over clay and silty clays.

Possible combinations of Michigan soil series are presented in Table 7. These are obtained by simply adding the urban weights which correspond to the series characteristics as listed in Table 3. The resulting number indicates a soil series relative position on the "Primary Rating For Urban Residential Use" scale such as in Table 4.

Table 7: Possible Primary Ratings for Urban Residential Use

Mngmt.group designation	Primary rating	Mngmt.group designation	Primary rating	Mngmt.group designation	Primary rating
---		---		0c	6
1a	5	1b	6	1c	6
2a	4	2b	5	2c	6
3a	3	3b	4	3c	5
4a	2	4b	3	4c	4
5a	1	5b	2	5c	3
Ga	1	Gc	3	Gc	3
Ra	3	Rc	5	Rc	5

Table 8 illustrates the urban weighting to be assigned a soil series which has certain important characteristics coded in the soil management group designation. These characteristics are indicated by a letter following a dash. For example, Algansee soil series is denoted as 4c-L. The "L" designates this series as a lowland soil, subject to flood. Factors such as these are given penalties in rating the soil for residential development.

Table 8: Urban Weighting For Seriously Detrimental Soil Characteristics

Management group letter designation following a dash	Urban weight	Description
M	6	Muck
L	6	Lowland soils - subject to flood
f	5	fragipan - compact, imper- meable layer in soil profile
h	5	subsoils are hardened and cemented

Slope considerations must be included as a final additional influence. Only slopes over 12% are included as a serious factor which will be given an urban weight. The slope classification as given in Table 9 is used for this purpose and the relative weights are given.

Table 9: Slope Rating For Urban Residential Use

<u>Slope designations</u>	<u>Urban weight</u>	<u>% of slope</u>
C	1	12-18
D	2	18-25
E	3	over 25

Summary Of Soil Classification Methodology

The use of soil management groups as rated for each soil series lends itself to urban weighting for each characteristic of soils as listed in Tables 5, 6, and 8. In addition to texture, drainage, and seriously detrimental soil characteristics, slope factor weights should be included (Table 9). By totalling all the assigned weights for a particular soil series a "Final Rating For Urban Residential Use" will be obtained. The ratings will range from 1 to 6 denoting excellent to not suitable, respectively. In a few cases, penalty points may be greater than six, but this is due to a combination of numerous detrimental characteristics. This in no way affects the scale, for these particular cases automatically revert to a rating of 6.

The soil rating scale is presented below (Table 10) as it would relate to percolation rates and the suitability of the soil for individual sewage disposal systems. Although this is the primary consideration, the addition of detrimental factors would have the same effect as lowering of percolation rates in determining sewage disposal area needs.

Table 10: Soil Rating For Urban Residential Use

<u>Numerical designation</u>	<u>Description of group</u>
1	Soils are generally acceptable for individual sewage disposal systems. Very good percolation rate.*
2	Soils are generally acceptable for individual sewage disposal systems. Have a good percolation rate.
3	Soils have a clay loam layer 10 to 30 inches thick that frequently create problems in individual sewage disposal systems. Other soil horizons have varying percolation rates.
4	Soils need careful examination and percolation tests to determine their suitability for individual sewage disposal systems.
5	Soils are frequently not acceptable, but careful examination may locate acceptable areas.
6	Soils generally not acceptable for individual disposal systems. Includes organic soils, soils subject to flooding, high water table, or poorly drained mineral soils.

* Percolation rate: Time required for water to fall one inch in minutes, see Public Health Service Publication No. 526, "Manual of Septic Tank Practice", Table 1, p6.

Soil ratings for all soil series in Michigan have been determined by the author. These ratings have been accomplished by rating each soil series by the method presented in this section, for its soil management group designation. However, slope characteristics are not included, therefore, this consideration should be made where applicable. These soil ratings may be found in Appendix B.

Some Considerations of Minimum Lot Size Requirements

Careful consideration must be given to natural physical

characteristics of land in determining minimum lot sizes for subdivisions where individual water supply systems and individual sewage disposal systems are to be used. There is no perfect method for accomplishing such a feat as evidence of present lot size ranges indicate. If proper consideration was given to land during the determination of control devices, it is very likely that better residential land use would result. This is especially true where minimum lot sizes must be determined that will accomodate individual sewage disposal systems.

Public or community sewers and treatment plants are the most satisfactory method of disposing of sanitary waste. This is true not only from the standpoint of health, but also in relation to economics. When consideration is given to the life period of the house in relation to the means of sewage disposal utilized, it is apparent that public sewer connections are less costly.³¹

After World War II the construction of homes outside of public water and sewer service areas began to increase. Subdivision building has increased at such a rate that public agencies have not been able to provide the services demanded. This uncontrolled growth has resulted in a great dependence on individual sewage disposal systems and individual wells for water supply, although the latter has not been as serious as the former.

31. Housing and Home Finance Agency (Division of Housing Research), Septic Tank Soil Absorption Systems For Dwellings, (Washington: U.S. Government Printing Office, 1954), p.1.

The septic tank soil absorption system of sewage disposal has been widely used for suburban dwellings. This system was originally designed for the farm but has been adopted for urban use. The fallacy of urban use of such a method is that on a farm, should the system break down, the farmer has sufficient land in which to duplicate the system; whereas in a subdivision it is unlikely that the homeowner can duplicate his system in another area of his lot. The subdivision dweller, at best, can invest a tremendous amount of money in removal of several thousand cubic feet of saturated soil in order to replace it with a more permeable material. Even then, the homeowner cannot be guaranteed a satisfactory system.

The septic tank soil absorption system of sewage disposal is considered by many sanitary engineers, public health officials, planners, and others to offer only a temporary method of sewage disposal. The Ohio Department of Health strongly supports this philosophy, but states that where public sewers are not available, lot sizes must be large enough to accomodate such a system yet not so large that provision of public sewers at a later date will be economically unfeasible.³² This consideration creates a dilemma for those responsible for community development.

In attempting to guide sound residential development, those responsible for community development must rely upon

32. Ohio Department of Health, Control of Sanitation in Unincorporated Areas (Cleveland: 1958), p.30.

three legal tools to guarantee proper lot sizes or to prevent sanitary waste disposal problems in a subdivision. Zoning, subdivision regulations, and health codes may be based, in part, upon natural physical characteristics of land. In this way, minimum lot sizes may be required.

Various public agencies constantly concern themselves with problems of individual water supply and individual sewage disposal. Standards for well location, protection of water supply, well construction, treatment of water, etc. have been devised over the years. By the same token, these same agencies have also devised standards for individual sewage disposal systems which consider protection of water supply, septic tank and leach field construction, location, etc.

The author, for purposes of this paper, has relied mainly upon the standards of the: 1) U.S. Public Health Service; 2) Housing and Home Finance Agency; and 3) Michigan Department of Health. The standards of these agencies are quite similar and have been utilized as a guide for evaluating lot size needs in relation to the author's six land classifications.

Certain design criteria have been used to determine lot size minimums although variations by local agencies could conceivably alter the final results. Factors such as minimum lot widths and depths, front, side, and rear yard requirements, and other desired residential design factors could substantially affect the minimum lot areas

suggested by the author in Table 11. However, certain minimums related to location of individual facilities should be recognized as standards adhered to by most health agencies. The minimum distance of the septic tank from a house should be 8 feet. The distribution field should not be within: 10 feet of a house or property line; 25 feet of a stream or water body; or 100 feet of a well. A well should not be within 50 feet of a property line and the ground must slope away from the well toward possible sources of contamination.

Determination Of Minimum Lot Sizes For Six Land Classifications

Table 11 has been constructed with the preceding influences in mind. Square foot requirements of leaching areas and disposal trench length requirements are based upon accepted standards. These have been evaluated according to requirements of disposal field design, recognizing factors of soil permeability, lateral lengths, distance between laterals, and minimum distances to lot lines. The results of this approach are summarized under minimum disposal area (column 4).

Recognizing the influence of design requirements of local regulations and assuming a minimum lot width of 70 feet with yard requirements of 25 feet front and 10 foot sides; minimum lot sizes have been calculated for homes with public water supply and individual sewage disposal systems (column 5). Local desires for yard

Table 11: Minimum Lot Size Requirements For Land Classification

Land classification number	Standard sewage absorption minimum (a)	Minimum sewage dis- posal area in sq. ft.	Minimum lot sizes for individual sewage disposal in sq. ft.		
			With public water supply	With individual water supply Range	With individual water supply Average
	Sq. ft. area	Trench in ft. (b)			
1	225	150	7,000	17,500 - 21,500	19,500
2	450	300	8,000	18,700 - 29,200	23,950
3	750	500	11,000	21,100 - 31,500	26,300
4	900	600	17,500	28,400 - 38,900	33,650
5	1,500	1,000	22,000	32,760 - 43,260	38,010
6(d)	NS	NS	NS	NS	NS

(a) Based on two bedroom requirements (250 gals/day/bedroom) in undisturbed soil.

(b) Assuming use of clay tile drain in crushed rock trench 18 inches wide.

(c) Sewage disposal area doubled due to possible failure dictated by natural physical characteristics of land class.

(d) Not suitable for urban residential development. Application of engineering measures might make certain areas suitable for large estate type developments.

requirements, lot width, house design, etc. could substantially change these area requirements, but it is more than likely that lot sizes would increase rather than decrease because of the limited flexibility possible in disposal field location and design.

For houses without public water and sewer, severe limitations are necessary. All previous factors of sewage disposal location and design were considered, plus possible arrangements of both facilities on the same lot. Due to the location of a well on the lot (and assuming all neighboring wells similarly located) a bare minimum lot width of 100 feet is necessary. Assuming some variation in subdivision arrangements of individual facilities, it is apparent that lot widths might vary from 100-170 feet or more. However, the 170 foot figure has been used in conjunction with the 100 foot figure in order to obtain a reasonable lot area range. These ranges are given for lots without public water or public sewer services (column 6). In addition, each range was averaged (column 7) only as a means of determining a reasonably safe guide for lot size requirements of properties in relation to land classifications and having neither public sewer or public water services.

Summary and Conclusions

The method of land classification explained in this section is based on natural physical characteristics of land. Soil information as compiled by soil scientists,

recognizes the important considerations of geologic-geographic influences. From such considerations it is possible to classify land into major categories which may be used as an aid in developing sound development policies and urban residential development controls.

Soil information for agricultural application offers a multitude of basic information which can be very useful to those responsible for community development. By utilizing the soil scientist's soil management system, it is possible to convert the information quite readily to ratings for urban residential use. Although there are possible exceptions, it may be stated that any combination of natural physical characteristics of land will lend itself to the six point classification system devised.

Minimum lot size requirements may be determined for areas in relation to the need for individual water supply and/or individual sewage disposal. The land classification system, during its development, was designed as a means to determine minimum lot size requirements in this regard. The result is that lot size requirements are presented in table form for the various classifications of land. They are meant to be used only as a guide due to local desires, design considerations, special problem areas, and other variables. Therefore, reasonable lot size requirements based upon design considerations and natural physical factors for safe water supply and sanitary sewage disposal provisions do provide a basis for zoning and/or subdivision regulations.

CHAPTER VI

MERIDIAN TOWNSHIP - A CASE STUDY

The development of the land classification system and minimum lot size requirements tables in this paper were originally designed in regard to information derived in the Battle Creek Area Study. The information for this area was compiled by modern techniques utilizing existing soil maps, aerial photographs, health department tests, "cooperating farm" information, and actual field work by a soil scientist. Therefore, in order to show that older studies for an area could be converted to the same classification and rating system, a case study appeared mandatory.

Meridian Township, Michigan was chosen to illustrate the possible approach that a planner might follow in any given area. The illustration of this case study will further support the contention of the author that existing data on natural physical characteristics of land can be utilized as a means to the provision of sound development policies and sound residential development controls. Data that is useful to the urban planner exists in many forms, but often such data is by-passed due to the lack of a means of interpreting the information for its planning implications.

Meridian Township was chosen as a test case for various reasons. The more important ones are: 1) the township is experiencing rapid urbanization of rural areas;

2) modern soil maps are not available for the area; and
3) a new zoning ordinance and subdivision regulations were in the process of being prepared in conjunction with a master plan. The latter point is very important for these legal tools have been completed and are now in effect controlling the use of land. Of major concern to the author are the minimum residential lot size requirements that now exist for each zoning district. It is the intention of the author, due to the findings of this study, to make an analysis of minimum residential lot size requirements required by the Meridian Township Zoning Ordinance. Therefore, the goals of this section are twofold: 1) to show that soils may be classified for urban residential use and minimum lot sizes can be developed from this information - for any area; and 2) to determine whether or not there is a need for further reflection on development policies and standards for residential lot sizes in Meridian Township.

Physical Information Available

As with most communities, the only soil maps that are currently available are those published (with text) for counties 35-45 years ago. Meridian Township is covered by the Ingham County Soil Survey of 1919, done by the Bureau of Soils of the U.S. Department of Agriculture. These surveys were originally intended for agricultural use only. However, this does not rule out their usefulness today, to those responsible for community development.

Land forms and soils do not change rapidly, therefore, great use may be made of the surveys. The major purpose of the new studies of soils by the U.S. Soil Conservation Service is to utilize new techniques for greater accuracy in determining soil series boundaries, minor changes in physical features and to make soil studies more useable. Better coding systems through the National Cooperative Soil Survey make information in one state more readily useable in another state.

Slope information is not included as a characteristic of soil series in the older soil surveys, therefore this information had to be compiled by the author from U.S. Geologic Maps of Meridian Township. Actually, slope considerations affect very little area within the township and these occur in isolated instances. In general, those areas with slopes over twelve percent will not be considered for development for some time due to the plentiful supply of more level land throughout the township. Nevertheless, the consideration of serious slope conditions must be taken into account in the development controls.

The availability of soil and slope information for Meridian Township lends itself to easy interpretation for urban residential use considerations in accordance with the procedure developed for this paper. However, a comparison between the Battle Creek Area and Meridian Township is warranted at this point. Although soil considerations for agricultural capability should be considered in many communities, Meridian Township does not

necessarily fall into this category. Agricultural activity as a major economic consideration degenerated before the township witnessed any great urbanizing influences. Therefore, even though the township has islands of Southern Michigan's best agricultural soil (Conover Loam), intensive agriculture is not conducive to competition with other areas that have great acreages of excellent soils. To consider these islands of good agricultural soils for farming would only create barriers to orderly community growth. It might be desirable to consider some of these areas for open space use should they fit into the comprehensive development plan of the township.

In regard to geologic conditions in Meridian Township, this area, like the Battle Creek Area, has very much the same history and relationships to surface formations. Public water systems in the Lansing area all tap the Saginaw aquifer. The basic difference between this area and Battle Creek is that Lansing's area's water table has been receding for many years, which may influence development policies due to the high cost of municipal water supplies resulting from deep drilling or future distant surface supply. Ground water in many areas of Meridian Township is not palatable and in many areas subject to surface contamination due to soil conditions. This is typical for an area with a glacial overburden of 300-400 feet which, of course, will affect development patterns

in relation to the provision of safe palatable water for household use.

Land Classification For Meridian Township

Table 12 has been compiled according to the methodology explained previously for land classification. Each soil series name (column 2) follows its field code number (column 1) according to the new state soil mapping legend of Michigan (1960). Soil management groupings (column 3)³³ were determined and urban classifications assigned (column 4) with inclusion of slope considerations where applicable. Finally, agricultural capability classes were listed (column 5) only to indicate the contrast between desirable land use for certain soils.

Plate VI shows the twenty four different soils found in this township. In addition, eight variations for hilly or steep topography have raised the total to thirty two. This is an unusually large number of categories for so small an area. For purposes of reduction for this paper, the only identification for each area is a soil series code number. Each soil may be readily identified and analyzed by referring to Table 12 and the appendices. In this way, specific areas may be analyzed in terms of agriculture or urban residential desirability.

To further expedite easy identification of urban

33. Depts. of Soil Science and Horticulture, op.cit.

Table 12: Classification of Soils In Meridian Township
For Agricultural and Urban Residential Use

Soil no.	Soil name (1)	Soil series mngmt. group	Urban residential use class	Dominant land use capability class
010	Carlisle Muck	Mc	6	III
011	Rifle Peat	Mc-b	6	III
030	Houghton Muck	Mc	6	III
070	Kerston Muck	Mc-L	6	IV
080	Greenwood Peat	Mc	6	VIII
130	Plainfield L.S.	5.0a	1	VII
203	Coloma L.S.	4a	2	IV
203E	Coloma L.S.(steep)	4a	4	VII
218	Oshtemo L.S.	4a	2	III
218D	Oshtemo L.S.(hilly)	4a	3	VI
242	Ottawa L.F.S.	5/2a	4	IV
248	Berrien L.S.	5/2a	4	IV
253	Boyer L.S.(2)	4a	3	III
253D	Boyer L.S.(hilly)	4a	4	VI
253E	Boyer L.S.(steep)	4a	5	VII
344	Fox S.L.	3a	3	II
344E	Fox S.L.(steep)	3a	5	VI
345	Fox Loam	3a	3	II
360	Hillsdale S.L.	3a	3	II
360D	Hillsdale S.L.(steep)	3a	4	IV
450	Miami Loam	2a	4	II
645	Conover Loam	2b	5	I
672	Brady S.L.	4b	3	III
672E	Brady S.L.(steep)	4b	5	VII
816	Granby S.L.(3)	5c	5	IV
842	Maumee Loam (3)	5c	5	II
880	Brookston Loam	2c	6	I
920	Warsaw Loam (4)	3c-L	6	II
930	Griffin Loam	3c-L	6	II
935	Genessee F.S.L.	3a-L	6	II
960	Wallkill Loam	3c-L	6	II
960D	Wallkill Loam(hilly)	3c-L	6	IV

(1) abbreviations used: L.S.= Loamy Sand;
L.F.S.= Loamy Fine Sand;
S.L.= Sandy Loam;
F.S.L.= Fine Sandy Loam.

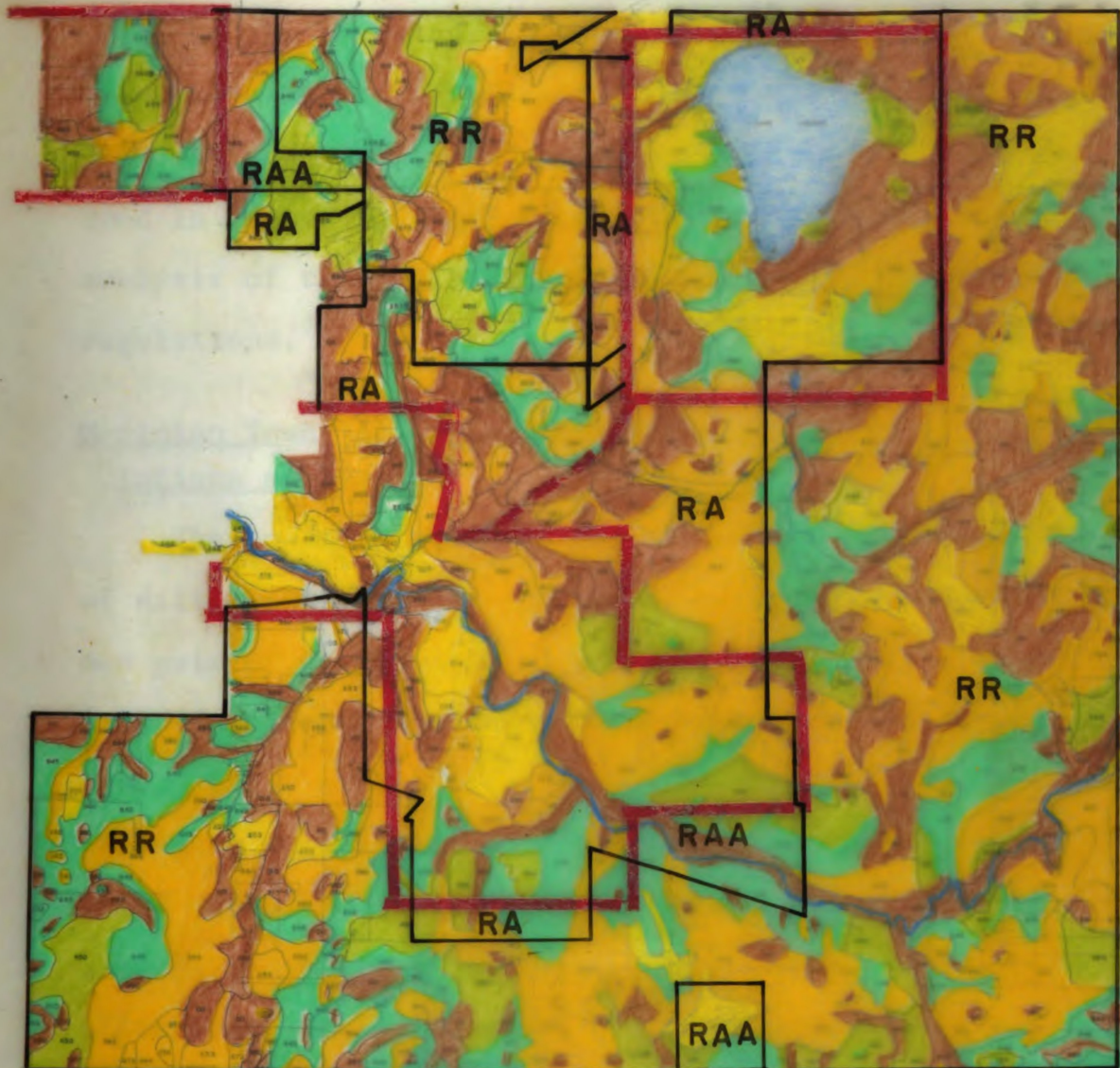
(2) formerly Bellafontaine Loamy Sand.

(3) high water table.

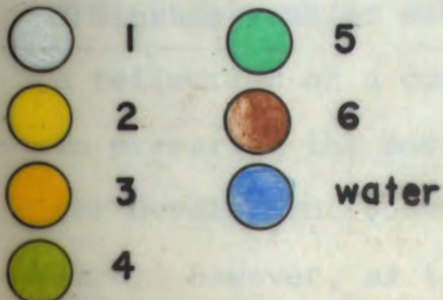
(4) formerly Washtenaw Loam.

MERIDIAN TOWNSHIP

GENERALIZED SOIL MAP



LAND CLASSIFICATIONS*



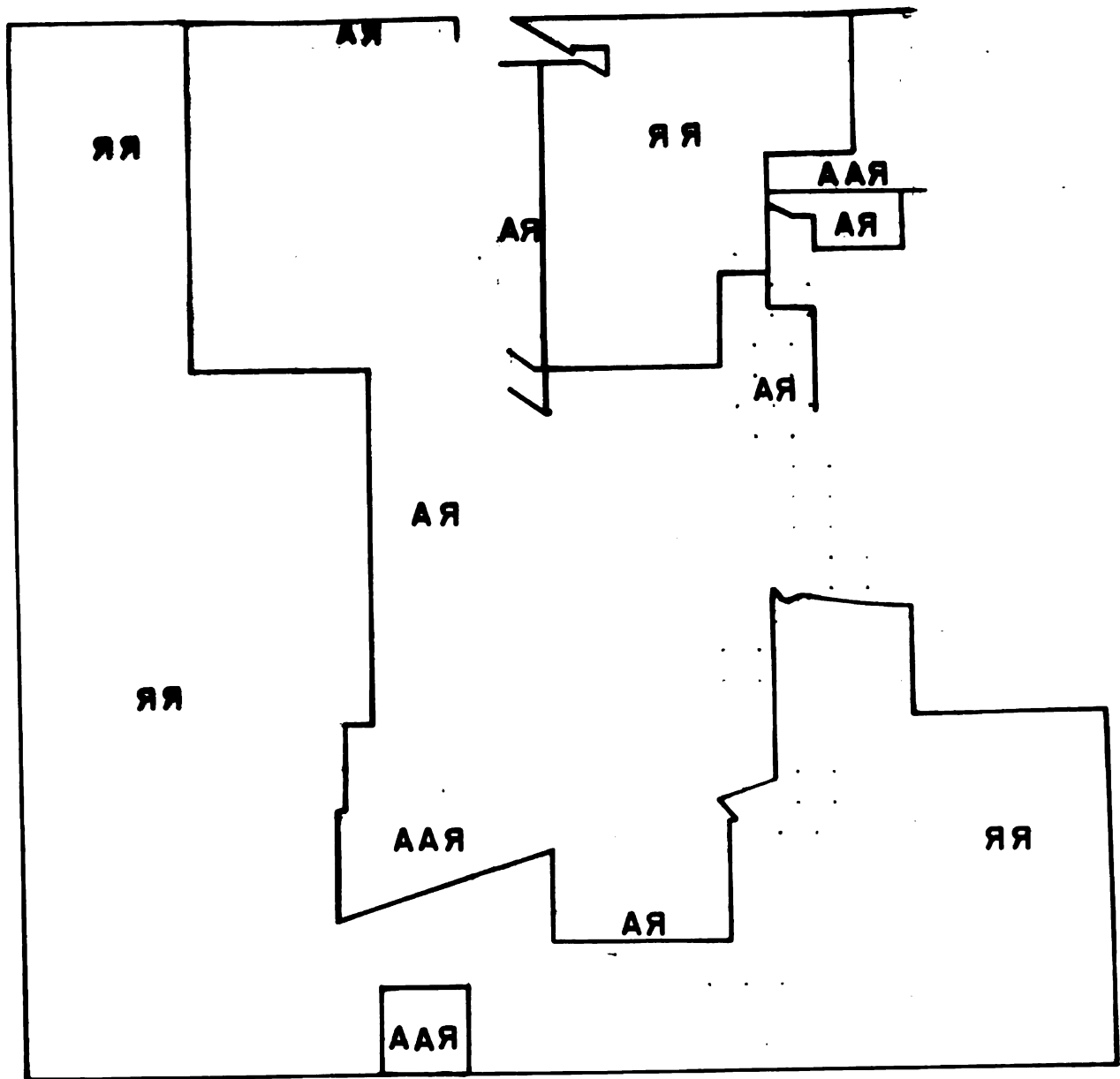
SINGLE-FAMILY ZONING (Outside proposed sewer areas)

Zone	Min. Lot Size in sq. ft.
RR	40,000
RAA	15,000
RA	10,000

 PROPOSED SEWERED AREAS

PLATE VI

* USE WITH TABLE 12

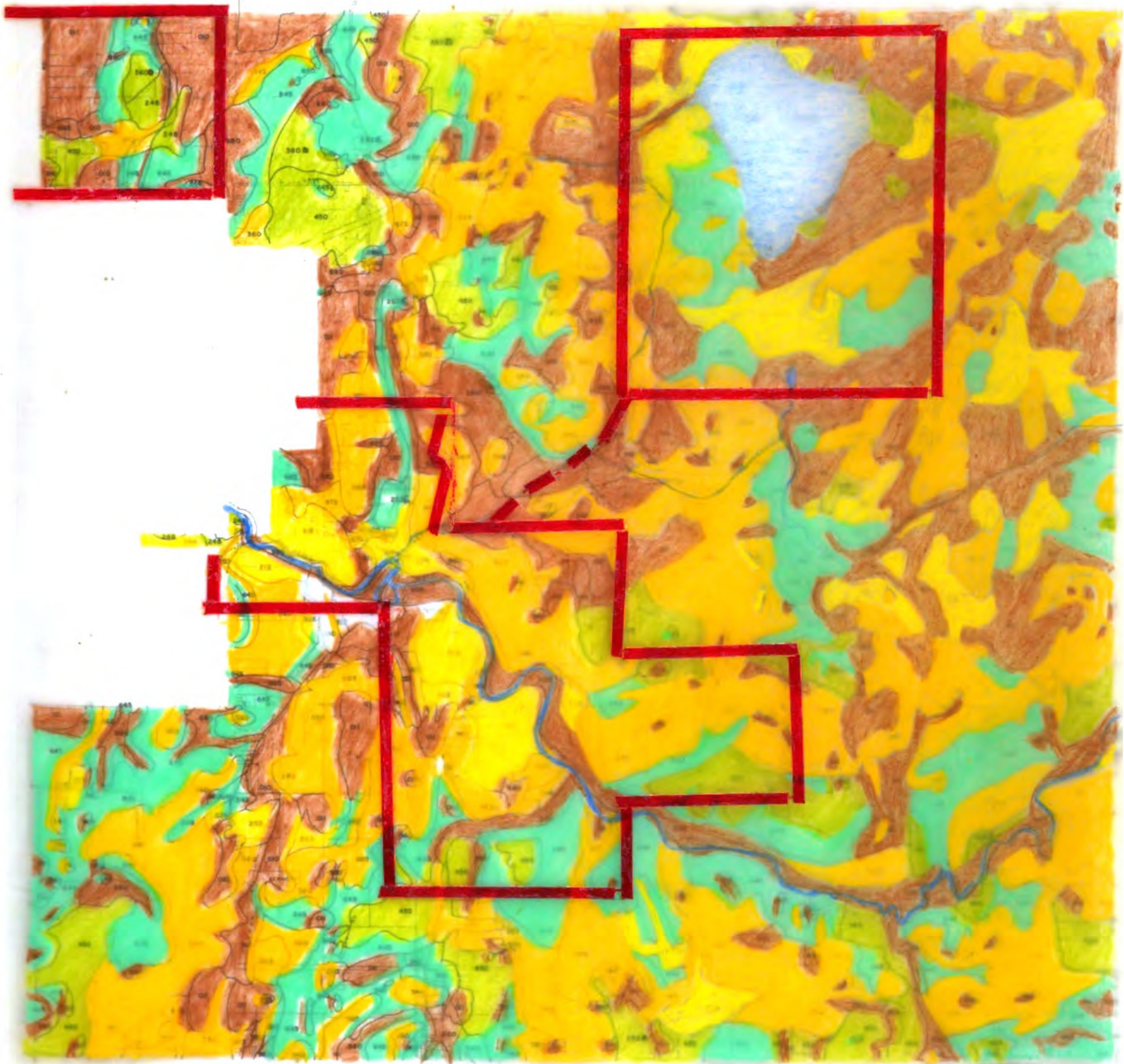


SINGLE-FAMILY ZONING (Outside
proposed sewer areas)

<u>Min. Lot Size in sq. ft.</u>	<u>Zone</u>
40,000	RR
15,000	RAA
10,000	RA

MERIDIAN TOWN

GENERALIZED



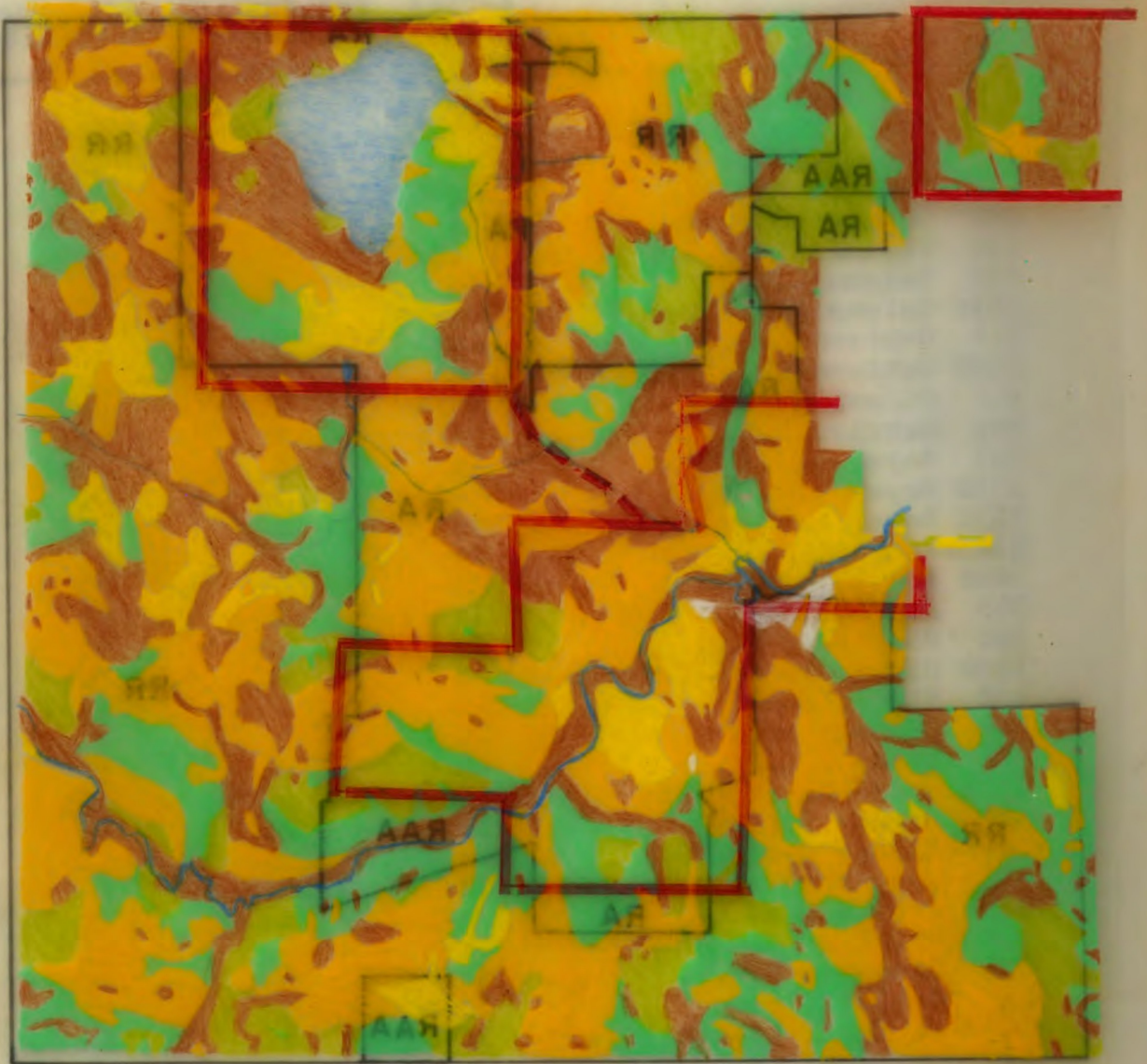
LAND CLASSIFICATIONS*

	1		5
	2		6
	3		water
	4		

 PROPOSED SEWERED AREAS

PLATE VI

* USE WITH TABLE 12



LAND CLASSIFICATIONS*

1	2	3	4
2	3	4	
water			

PROPOSED SEWERED AREAS

* USE WITH TABLE 12

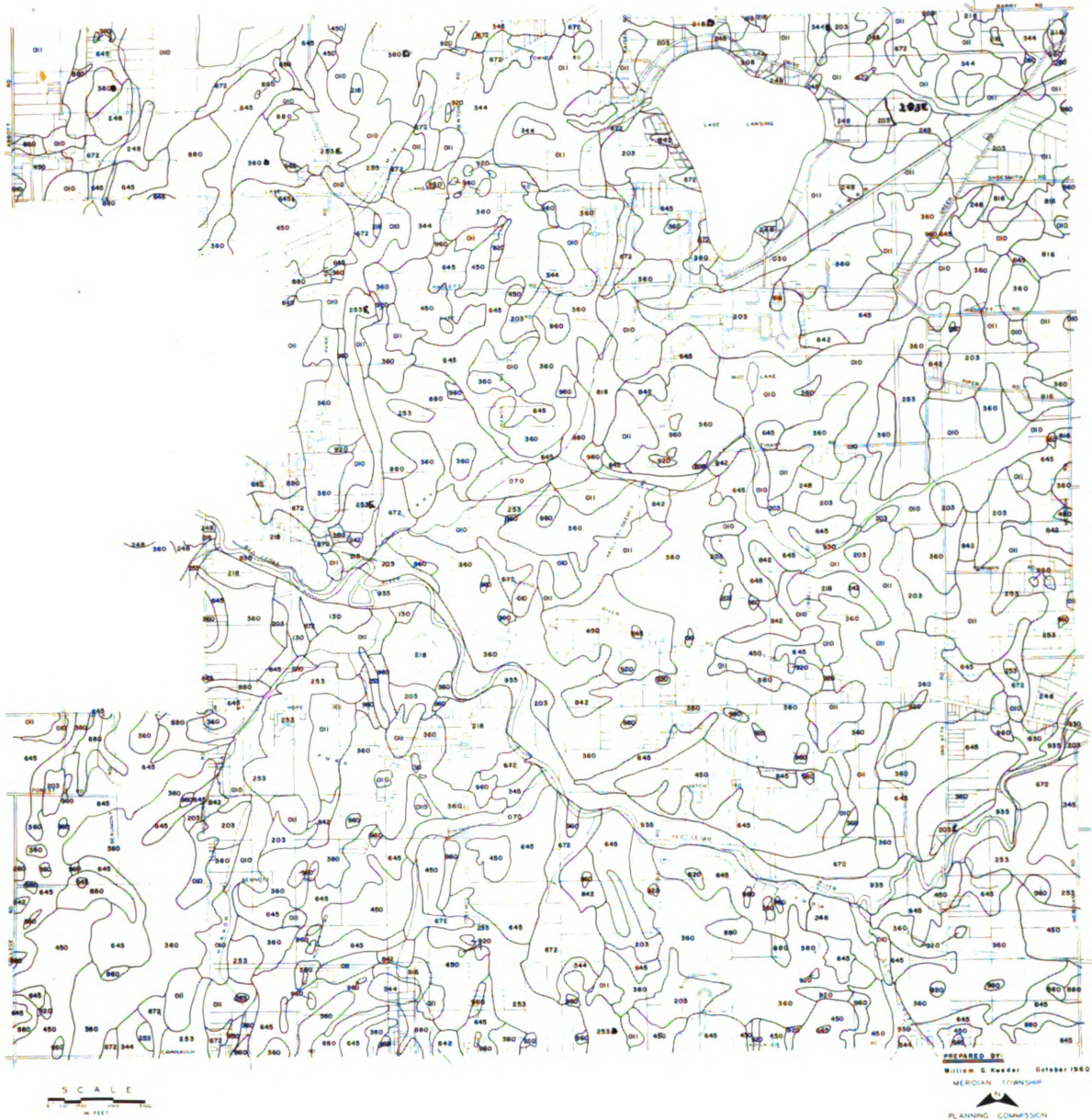
SINGLE-FAMILY ZONING(Outside
proposed sewer areas)

Zone	Min. Lot Size in sq. ft.
RR	40,000
RAA	15,000
RA	10,000

-87d-

MERIDIAN TOWNSHIP

GENERALIZED SOIL MAP



residential considerations, a map overlay has been prepared showing the six land classifications applicable to various areas in the township. Also, on the same overlay, future "planned" (by the township) sewerred areas are outlined. Implications of future development will be further examined in regard to these considerations as part of the analysis of the new zoning ordinance and subdivision regulations.

Meridian Township Zoning Ordinance and Subdivision Regulations of 1960

The township planning commission after several years of diligent effort has succeeded in creating an entirely new pair of development controls that reflects the policies of the comprehensive development plan for the township. Great effort was expended in the process of providing such a plan in order to guide development in a sound manner. However, the author in analyzing certain aspects of the legal tools prepared for implementation of the township's goals, does not wish to deride, but only to offer constructive criticism for further consideration.

Minimum lot sizes, in part, as expressed in zoning ordinances and/or subdivision regulations, are usually a reflection of a community's comprehensive master plan. In preparing the master plan which provides the basis for development controls, many factors must be considered. However, as is too often the case, those responsible

for community development do not place enough emphasis on natural physical characteristics of land which will affect future development patterns, conditions, etc. The planning commission in Meridian Township has not overlooked this serious consideration and have realized the seriousness of soil conditions in their community.

The zoning ordinance lists four single-family residence districts and lot size requirements that are subject³⁴ to investigation in this study. Section 4.2.1. of the ordinance states that several single-family residential districts with various lot size requirements are necessary to satisfy "a range of preference relative to the character and size of individual properties...". Of significance is the explanation immediately following, that recognizes limitations in respect to the lack of municipal water and sewerage service.

"In consideration of the excessive cost of extending water and sewerage service to all areas of the Township, the establishment of a zoning district in which spacious lots are required makes it reasonably possible to obtain a continuous supply of safe, potable water on the immediate property and to treat sewage by septic tank followed by the disposal of the effluent on the same property."

The section further states that the "RR One-family Rural Residential District" will serve those areas presently without water and sewer service and those

34. Meridian Township (Michigan) Planning Commission, Zoning Ordinance (Meridian Charter Township: October 4, 1960).

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which are not expected to have such services for some time to come. This district is of a semi-rural character and provides for minimum requirements of 200 feet lot-front width and 40,000 square feet of area. Unfortunately, it is highly questionable whether certain soils in this district can accomodate urban development with or without public water and sewerage services. A third overlay showing only the single family residential zoning districts outside of the "proposed sewerred areas" has been prepared for use with Plate VI. In addition, Table 13 lists the four single family residential districts with their minimum lot width and lot area requirements.

Table 13: Meridian Township Required Lot Sizes

Section of zoning ordinance	Zoning map designation	Min. width of lot in ft. at street line	Minimum area of lot in sq. ft.
4.2	RR ⁽¹⁾	200	40,000
4.3	RAA	90	15,000
4.4	RA	80	10,000
4.5	RB	70	8,000

(1) district with no sewerage and water service and not expected to have such services for some time to come.

Section IV.D.1. of the township's 1960 subdivision regulations makes provision for minimum lot sizes by referring to the zoning ordinance. However, the regulations (II.B.) do require certain procedures which are intended to require sound residential development. The

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township engineer must comment upon required preliminary plans for storm drainage, water service and sewerage service if feasible or required under the subdivision regulations. Also, the Ingham County Health Department must comment on the relation of the subdivision to existing storm drains or the need for additional drains plus the "suitability of the land for plat development from the standpoint of sewage disposal, water resources and supply" and other health factors.

A measure of protection is afforded here and the planning commission also reserves the right to require subdivision sewer system if feasible (section V.D.7.). If either connection to a public system or provision of a subdivision system is not feasible, then individual septic tank disposal systems are allowed in accordance with the county sanitary code. Provision of water is treated as either public supply or individual well supply. If individual wells are employed, then these too are subject to the county health code.

"Ingham County Sanitary Code"

This code is concerned primarily with sanitary disposal of waste whether publicly operated or private. In addition to construction, materials, types of systems, and location, the code spells out minimum absorption areas for subsurface disposal systems. This section of the code has been reproduced as Table 14. It should be noted that the minimum absorption area is based upon

three bedrooms

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three bedrooms whereas Table 11 is based on two bedrooms.

In comparing the two area requirements presented in this paper, in Tables 11 and 14 there is some similarity in the best drained and the poorest drained soils, but for the remainder there is little correlation between the two tables. For ease of comparison, the minimum lot sizes indicated by the two tables are compared in Table 15. Minimum lot sizes for Ingham County in relation to the provision of individual lot facilities have been calculated in the same manner as those in Table 11.

Planning For Future Residential Development In Meridian Township

Various factors in the township should be considered in future residential proposals. Although the township zoning ordinance and subdivision regulations have been well written, full protection for sound residential development is questionable. Even though the county health codes do provide some guarantee of sound future residential development in the township, it is also apparent that the zoning ordinance and subdivision regulations could be strengthened in regard to the provision of individual sewage disposal.

Present sewerage service area plans will service less than one-half of the township. When these areas are serviced, individual sewage disposal considerations should no longer affect lot size requirements. However, these areas do contain a great deal of poorly drained

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Table 14: Ingham County Disposal Area Requirements*

"2-5.406 AREA-- Subsurface disposal systems shall comply with the following minimum trench bottom absorption areas:

Soil	Perc.test time per 1" drop	Min. absorption area per single family residence 3 bedrooms or less
Coarse Sand or Gravel	Less than 5 min.	300 sq.ft.
Sand	5-10 min.	450 sq.ft.
Loam	11-20 min.	600 sq.ft.
Sandy Clay or Clay Loam	21-30 min.	750 sq.ft.
Clay	30-45 min.	900 sq.ft.
Heavy Clay	Over 45 min.	Not suitable-- minimum filter bed area: 400 sq.ft.

In heavy clay soils where the drop in water level is over 45 minutes per inch by standard percolation test or where ground water or an impervious hardpan is found less than 4' from the ground surface, a filter bed underdrained to an approved outlet, or some other drainage device approved by the health officer shall be used, or the permit denied. Drainage for systems to serve other than single family residences of three bedrooms or less shall be prescribed by the health officer. Subsurface disposal systems shall contain at least one (1) lineal foot of tile for every three (3) feet of trench width. Trench excavations exceeding 36" in width at the bottom shall be considered tile beds and shall require 50% more trench bottom absorption area than required for single line trench. (As amended February 27, 1958 -- In effect May 3, 1958)."

* Source: Ingham Co., Mich., "Ingham County Sanitary Code", November 14, 1953 as amended.

Table 15: Individual Sewage Disposal Requirements Compared

Land	Min. absorption area in	Min. lot size in sq. ft. with public water supply and indiv. sewage disposal	Aver. min. lot size in sq. ft. with private water supply and indiv. sewage disposal
------	----------------------------	--	---

Table 15: Individual Sewage Disposal Requirements Compared

Land classi- fication	Min. absorption area in sq. ft.	Min. lot size in sq.ft.with public water supply and indiv. sewage disposal	Aver.min.lot size in sq.ft. with private water supply and indiv. sewage disposal	Calculated for	
				Table 11	Ingham Co.
1	225	300		7,000	7,300
2	450	450		8,000	8,000
3	750	600		11,000	9,200
4	900	750		17,500	11,000
5	1500	900		22,000	17,500
6	NS	400 sq.ft. filter bed		NS	individual site calculations
				NS	individual site calculations
				19,500	20,500
				23,950	23,950
				26,300	25,000
				33,650	26,300
				38,010	33,650

Note: Table 11 based on 2 bedrooms.

Table 14 based on 3 bedrooms.

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soils which may be hazardous for building purposes. Organic soils such as muck and peat would appear to be unlikely candidates for house lots. Perhaps, where extensive areas of such soil or similar soils exist, provided the application of engineering measures would not be feasible, it might be more feasible to zone the land for very large lots or some form of open use. A logical candidate for such action may be found on both sides of the section line separating section #5 and section #6.

Another factor that should not be overlooked in the proposed sewerred areas is the time element involved in which septic tank systems must be utilized on a temporary basis until public service can be provided. There are certain areas which would require extensive leaching areas to accomodate individual sewage disposal systems which should raise minimum lot size requirements. Here the planning commission should exercise its mandate to require subdivision sewer systems. This might be handled in the manner suggested in the Baltimore Study.³⁵ If such systems are not feasible, then lot area requirements may have to be raised or permission to subdivide refused.

Areas outside of the proposed sewerage service areas, as mentioned previously, contain large areas which are not desirable for urban residential development. Those

35. Baltimore Regional Planning Council Committee, op.cit., pp. 4-8.

areas which fall into the author's classification 5 might be satisfactory with the present minimum lot size requirements if they do not have public water and sewerage service. However, those that are in classification 6 are highly questionable even with 40,000 square foot lots. These areas should be seriously considered as reserve or estate areas, rather than semi-urban residential. Even in the future, with urban services there are soil conditions which may prohibit urban development of a large amount of acreage.

In regard to the areas outside of the proposed sewerage service areas, there is another very important consideration that should not be overlooked. There are some areas that need not be zoned quite so rigidly. Soils such as Coloma Loamy Sand can support a well and septic tank system on a one-half acre lot. This observation is made only to point out the variation in conditions within one zoned area and has no reference to the master planning principals which established the zone. But factors such as this do warrant consideration.

A final consideration that should not be overlooked is that of slope. As mentioned earlier, Meridian Township does not have a great amount of area in slopes greater than twelve percent. Although these areas are not large they may be found in various locations within the township boundaries. Actually, they may serve as future barriers to development. Where the steeper slopes

are within proposed sewerage service areas, the installation of public water and sewer lines may not be feasible. In that case, larger lots will be needed to handle the inherent problems of provision of individual water supply and individual sewage disposal systems on the same lot. The same problems will be found in the present rural residential (zoned) districts.

Recommendations and Conclusions

Meridian Township has an excellent existing legal framework in which to mold the growth of the community with sound policies. However, the township should not place as much emphasis on the county health codes (which require lower standards than more recent codes) in order to guarantee healthy environments, but should, after thorough considerations of existing natural physical characteristics of land, incorporate stronger guarantees for sound residential development into their legal tools.

The present subdivision regulations do not allow building on floodplains. Therefore, it seems logical and reasonable to prevent the building of homes on land that is not suited to urban development. By classifying such lands under an estate or open space zone, potential purchasers who often do not understand site considerations would be protected. By the same token, the township would be protecting itself from the burden of providing public utilities to these areas at a later date and attempting to abate problems, nuisances, or

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blighted areas that should not have been allowed to develop in the first place.

A possible approach to the provision of minimum lot sizes would be to state what is considered desirable in certain districts, including estate or open space districts in the zoning ordinance after a review of conditions in the township. These new districts and regulations should be set up so that restrictions on lot size, due to known natural physical characteristics of the land, will compliment the subdivision regulations. Minimum lot size requirements in the subdivision regulations based upon soil types and slope would allow for a reduction in minimum lot size requirements, but not less than the zoning district requires, upon proof by the subdivider that smaller lots would be satisfactory for urban residential use. In this way the township would not have to determine in advance what size residential lots must be for every parcel of land. Actually, the planning commission would do this in a general fashion from generalized soil maps, but every acre of land cannot be readily examined, therefore more generalized requirements subject to change would provide a vehicle for sound development.

The new legal tools in effect in Meridian Township are far superior than those recently discarded and are quite superior to most township laws. However, a critical analysis and adjustment is warranted in view of natural

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physical characteristics of land in this township. This area has a greater variety of problem-producing soils than most communities which will make the adjustment of the zoning ordinances (and zoning map) and subdivision regulations no easy task. The township is experiencing rapid urbanization, therefore the sooner this is done, the better.

A large amount of information is available for this township which has helped the Meridian Township Planning Commission to determine their present policies of controlled urban development. The 40,000 square foot minimum lot size requirement for areas outside the proposed sewerage service areas is reasonable in view of the tremendous soil problems existing in these areas. However, adjustment to conditions that are even more serious than anticipated by this foresighted commission is warranted. A variation of lot size requirements may be warranted if this variation would serve the anticipated goals set forth in the township's comprehensive development plan.

Additional information might be obtained through modern soil mapping techniques and testing of the various soils in the township in line with their proposed use. This would require the services of personnel trained in sanitary engineering, and soil science. However, what information is available will serve as a framework for developing sound residential areas in Meridian Township.

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CHAPTER VII

CONCLUSIONS

This thesis was originally conceived to point out the need for those responsible for community development to recognize the affect of natural physical characteristics of land on urban residential development in urbanizing areas. Factors such as soils, water table, topography, and geology are all interrelated, therefore all exert varying influence on certain aspects of community development. However, the need to obtain, interpret, and apply available information to development policies and urban residential development controls required further investigation.

It was found that information compiled by soil scientists readily lends itself to considerations for the provision of water supply, sewerage service, and storm drainage facilities in urbanizing areas. These three utilities, whether public or private individual systems, are affected by surface conditions of the land. The information compiled by soil scientists and others has ordinarily been devoted to the field of agriculture, but investigation for agricultural use in most instances evaluates many land characteristics that also affect urban residential development. The relationship of soils to geology, topography, and water conditions are recognized, therefore a means of interpreting these factors in relation to urban residential development

was needed. Interpretation of agricultural soil management requirements produced a scale of evaluation in relation to the provision of individual water supply and individual sewage disposal systems for urban residential use.

Individual water supply and individual sewage disposal systems are not the most desirable methods of providing potable water and sanitary sewer services to urban residences. However, due to the expansion of urban residential development into areas without public services or too distant from existing public facilities to make connections feasible, those responsible for community development must consider two alternatives: 1) to allow urban residential development only where such services can be provided by public or community systems; and 2) to allow urban residential development beyond the reach of such services with sound development policies and development controls. A combination of the two approaches may be feasible as long as full recognition is given natural physical characteristics of land as they affect urban residential development.

A system of land classification which utilizes existing physical data in respect to the provision of residential sanitary services is feasible for urban planning consideration. Available data in various forms can be analysed and interpreted by those responsible for community development to form a basis for sound land

planning. Existing soil and slope data offer a wealth of information in relation to the needs of urban residential use. The six land classifications developed from soil and slope data in this paper point out the need for urban management practices applicable to various soil series in relation to their natural characteristics. Natural physical characteristics of land are prone to changes brought about by nature or man. Many interrelationships of physical influences exist from area to area, therefore careful consideration must be given to those influences which play greater or lesser roles in a given locale. However, the land classification system as presented can serve as a guide for the development of urban residential development policies and design standards.

Individual lot size requirements may be generally determined for each classification of land, but a need exists for more detailed field studies of soil types in relation to urban planning considerations. This is especially true for soils that are rated in classes 5 and 6. Existing soil maps, due to human limitations, do not necessarily show the detail that is desirable for urban analyses. The role of the soil scientist and sanitary engineer in relation to community development is evident. Therefore, more reliance on these people for guidance in determining development policies and urban residential development controls is warranted.

Those responsible for community development should recognize the implications of soil conditions which make urban residential development undesirable. Large areas of land that are highly prized for agricultural use and can compete effectively with other agricultural areas should be seriously considered as permanent or at least as semi-permanent open space. Quite often, good agricultural land is not necessarily well suited to urban residential development.

The older soil surveys do not necessarily indicate agricultural capabilities of soils due to the fact that slope information is not included as a characteristic of each soil. Therefore, it becomes quite difficult to denote which land is best suited for agriculture. For this purpose the aid of a soil scientist must be sought and the contributions of agriculture to the economic base of an area must be considered. However, modern soil surveys such as those utilized in this paper for the Battle Creek area, lend themselves to interpretation by those responsible for community development. In this case, slope conditions are included as a characteristic of each soil and help to determine its agricultural capability.

Due to physical limitations, the U.S. Soil Conservation Service will be unable to provide modern soil maps for large areas of the country for many years. Although modern soil information supplied by new techniques is

very desirable for community planning purposes, those responsible for community development in many cases must rely on older available data. Therefore, these people should make maximum use of available data and request the aid of the U.S. Soil Conservation Service to help pinpoint problem areas. With such an arrangement, a system of land classification which recognizes the influences of all natural physical characteristics of land in relation to urban residential development policies and controls is quite feasible.

There is a definite need for more research that would examine the effect of slope on residential development. Many fine residential areas have been built on hillsides, but it is difficult for those responsible for community development to determine what restrictions should be applied to those areas that cannot be served with public sanitary services. Although southern Michigan is not faced with difficult slope conditions, many urban areas throughout the country may be faced with various hazards through development of certain slopes. How serious these hazards might be remains a question that has not yet been resolved.

Although storm drainage systems, as a consideration of urban residential development, have been cited in this paper, they too have a great dependence on natural physical characteristics of land. The subject must be considered by those responsible for community development,

but due to two considerations, treatment within the scope of this paper has been necessarily superficial. It is the opinion of the author that: 1) the analysis of storm drainage conditions is a highly technical engineering consideration which is rapidly producing grave problems for many communities due to a lack of research in relation to urban land use; and 2) modern engineering techniques are being utilized to combat problems of surface runoff. Consideration of these factors is beyond the range of the author's abilities, therefore superficial treatment is warranted.

In communities undergoing urbanizing influences, various factors must be considered, evaluated, and coordinated in relation to urban residential development. It is the responsibility of various local officials to determine what the best course of action may be for the community as a whole. It must be determined who shall provide the high capitalization cost of urban services in relation to the individual dwelling; the subdivider who passes the cost on to the homebuyer in the purchase price of the home, or the community which requires distribution of the cost to all taxpayers when future improvements must be made.

When capital costs are placed on the original purchase price of a home, they are included in a 20-30 year mortgage which the homebuyer considers as part of the cost of his home; but when capital costs must be

distributed through the tax program, a community is kept in constant turmoil over increasing tax rates. By providing necessary utilities in subdivisions during construction, original costs are held to a minimum and the community is not saddled with future tax burdens to alleviate conditions that should not have been allowed to materialize in the first place.

Such a procedure is possible only if sound development policies and development controls are instituted by those officials who are responsible for community development. These people and others in a nonofficial capacity must recognize the influence of natural physical characteristics of land and their affect on urban residential development. As land use changes from rural to urban use, the transition period must be marked by sound policies of capitalization by requiring necessary improvements to provide sound residential areas that will remain an asset rather than a burden to the entire community for years to come. This is possible only if those responsible for community development recognize their true responsibilities in regard to urban residential development.

Planned orderly growth must replace our present urban sprawl by requiring urban standards in all areas subject to urbanization. By requiring large lots in areas without public water and sanitary services and/or smaller lots with community facilities or "dead"

facilities, then it is conceivable that urban growth patterns can be controlled by encouraging building closer to central areas due to high land development costs in outlying areas. Such policies may be readily defended through recognition of natural physical characteristics of land in relation to the provision of healthy urban residential environments.

The methods of utilizing available information as set forth in this thesis may serve as a guide for further investigation of the affect of natural physical characteristics of land on urban residential development policies and standards. However, it is conceivable that the utilization of this data may help to determine further courses of action, but it must be realized that more detailed research is needed in relation to this data. In any given locality considerable research may be necessary due to special problems associated with soils, slope, bedrock conditions, etc. Therefore, the material presented in this thesis should serve as a framework within which a locality's special problems may determine modifications in the application of this data and/or point out the need for specific research in this respect. Such information can help to prevent repetition of various problems of residential development that are influenced by natural physical characteristics of land and today are plaguing those responsible for sound community development.

APPENDIX A

AGRICULTURAL LAND CAPABILITY CLASSES

"Best suited for cropland

Class I--This is very good productive farm land that can be cultivated safely with ordinary good farming methods. It will grow all locally adapted crops. It is nearly level, easy to till and not droughty. It holds water well and has good natural fertility. It is practically free from hazards. Erosion is not a problem and the soil is easily drained. It can be maintained with ordinary good farming practices such as crop rotations, fertilizer, and lime when needed.

Class II--This is good land that can be cultivated safely if simple measures are taken to overcome some particular handicap such as erosion or low organic matter. It may be steep enough so that runoff water carries soil. It may tend to be a little droughty. Some Class II land may be a little wet and require drainage. Usually the drainage is easily installed, but maintaining the drainage system may present some problems. Water may move slowly through the soil. Any of these conditions either limits the use of the land or requires special attention to such conservation practices as contouring, protective cover crops, application of organic matter, and simple water management.

Class III--This is moderately good land. Most crops grow well, but the soil needs a lot of protection and care. Its use is more limited than Class II because of one or more particular physical features.

Several kinds of land fit in Class III. Some is so steep that it requires intensive erosion control measures when used for row crops. Poor drainage may place it into Class III if the necessary drainage is hard to maintain. Droughty land may also be included since it is apt to suffer from wind erosion. These problems must be overcome or combatted year after year if the land is used for field crops.

Class IV--This land may grow an occasional row crop with very careful management. Row crops should not be grown more often than once in five or six years.

Class IV land is often too steep or irregular and badly eroded to cultivate. Or it may be too dry for dependable crop production.

Class IV land may be wet, making it very hard to install and maintain drainage. It should be used mainly for hay and small grain crops.

"Best suited for permanent vegetation

Class V--This land is nearly level and not subject to erosion, but it isn't suited for cultivation because of permanent wetness or stoniness. Drainage of this class is not practical because of cost or no outlet. There is little limitation to its use for pasture or forestry.

Class VI--Land in this class is best adapted to growing grass or trees. Its use for grazing is somewhat limited by steep or very irregular slopes, shallow soils, stoniness, dry condition, or excessive wetness. There is little limitation for forestry and recreation.

Class VII--This land is best suited for forestry recreation, though some Class VII fields can be grazed with careful management. Limitations to grazing include steep slopes, droughtiness, and severe past erosion. It may be necessary to scalp spots rather than plow furrows before you plant trees.

Class VIII--This land is not suited for cultivation, pasture or woods. Leatherleaf bogs and rock outcrop areas are typical of this class in Michigan.³⁶

36. Cooperative Extension Service, A Guide for Land Judging in Michigan, Michigan State University Extension Bulletin #326 (East Lansing: Revised June 1960), pp. 18-20.

APPENDIX B

PRIMARY LAND CLASSIFICATIONS FOR MICHIGAN SOILS

Soil series	Soil man- age- ment group ⁽¹⁾	Pri- mary soil class (2)	Soil series	Soil man- age- ment group ⁽¹⁾	Pri- mary soil class (2)
Abscota.....	4a-L	6	Brimley.....	3b	4
Adolph.....	3c	5	Bronson.....	4a	2
Adrian.....	M/4c	6	Brookston.....	2c	6
Ahmeek.....	3a	3	Bruce.....	3c	5
Alcona.....	3a	3	Brule.....	3c-L	6
Algansee.....	4c-L	6	Burleigh.....	4c	4
Alger.....	3a	3	Burt.....	3/Rc	6
Allendale.....	4/1b	6	Butternut.....	2c	6
Allouez.....	Ga	1			
Alpena.....	Ga	1	Cadmus.....	3/2a	4
Amasa.....	3a	3	Cain.....	M/mc	6
Angelica.....	2c	6	Capac.....	2b	5
Antrim.....	4a	2	Carbondale....	Mc	6
Arenac.....	5/2b	5	Carlisle.....	Mc	6
Au Gres.....	5b	2	Casco.....	4a	2
Au Train.....	5a-h	3	Celina.....	2a	4
			Ceresco.....	3c-L	6
Bach.....	3c	5	Champion.....	3a	3
Bannister.....	4/2c	5	Channing.....	5b-h	5
Baraga.....	Ga	1	Charity.....	1c	6
Barker.....	2a	4	Chatham.....	3a	3
Bark River....	2a	4	Cheneaux.....	4b	3
Barry.....	3c	5	Chesaning.....	4/2b	5
Belding.....	3/2b	5	Cohoctah.....	3c-L	6
Bellefontaine.	3a	3	Coldwater.....	3b	4
Bentley.....	4a	2	Coloma.....	4a	2
Bergland.....	1c	6	Colwood.....	3c	5
Berrien.....	5/2a	4	Conover.....	2b	5
Berville.....	3/2c	6	Constantine...	4a	2
Bibon.....	5/2a	4	Coral.....	3b	4
Blount.....	2b	5	Coventry.....	3a	3
Blue Lake.....	4a	2	Crosby.....	2b	5
Bohemian.....	2a	4	Croswell.....	5.0a	1
Bono.....	1c	6	Crystal Falls.	Ra	4
Bowers.....	2b	5			
Boyer.....	4a	2	Danby.....	2c-L	6
Brady.....	4b	3	Dawson.....	Mc	6
Brant.....	4/2a	4	Deer Park.....	5.3a	1
Breckenridge..	3/2c	6	Deford.....	4c	4
Brevort.....	4/2c	6	Detour.....	Gc	3
Bridgman.....	5.3a	1	Diana.....	Gc	3

(1) Modifying symbols used after a dash in soil management groups.

(2) Weight assignments for class designation do not include consideration of slope or high water table.

APPENDIX B -- Continued

PRIMARY LAND CLASSIFICATIONS FOR MICHIGAN SOILS					
Soil series	Soil man- age- ment group	Pri- mary soil class (1) (2)	Soil series	Soil man- age- ment group	Pri- mary soil class (1) (2)
Dighton.....	2a	4	Greenwood.....	Mc	6
Dillon.....	5c	3	Griffin.....	3c-L	6
Dowagiac.....	3a	3	Guelph.....	2a	4
Dresden.....	3a	3			
Dryden.....	3a	3	Hagener.....	5.0a	1
Duel.....	4/Ra	4	Hartwick.....	5.0a	1
			Hessel.....	Gc	3
East Lake.....	5.0a	1	Hettinger.....	2c	6
Eastport.....	5.3a	1	Hiawatha.....	5.0a	1
Ebay.....	M/mc	6	Hibbing.....	2a	4
Echo.....	5.0a	1	Hillsdale.....	3a	3
Edmore.....	4c	4	Hodunk.....	3a	3
Edwards.....	M/mc	6	Houghton.....	Mc	6
Eel.....	3a-L	6	Hoytville.....	1c	6
Elmdale.....	3a	3	Huron.....	1a	5
Elo.....	2a	4			
Emmert.....	Ga	1	Ingalls.....	4b	3
Emmet.....	3a	3	Ionia.....	3a	3
Ensley.....	3c	5	Iosco.....	4/2b	5
Epoufette.....	4c	4	Iron River....	3a	5
Essexville....	4/2c	6	Isabella.....	2a	4
Ewen.....	3a-L	6			
			Jeddo.....	2c	6
Fabius.....	4b	3	Johnswood.....	Ga	1
Fox.....	3a	3			
Freesoil.....	3a	3	Kalamazoo.....	3a	3
Froberg.....	1a	5	Kalkaska.....	5.0a	1
Fulton.....	1b	6	Karlin.....	4a	2
			Kawkawlin.....	2b	5
Gaastra.....	3b	4	Kendallville..	3/2a	4
Gagetown.....	2a	4	Kent.....	1a	5
Gay.....	3c	5	Kerston.....	Mc-L	6
Genesee.....	3a-L	6	Keweenaw.....	4a	2
Gilchrist.....	4a	2	Kibbie.....	3b	4
Gilford.....	4c	4	Kinross.....	5c	3
Gladwin.....	4b	3	Kiva.....	4a	2
Glendora.....	4c-L	6	Kokomo.....	2c	6
Gogebic.....	3a	5			
Granby.....	5c	3	Lacota.....	3c	5
Graycalm.....	5.0a	1	Lake Linden...	2a	4
Grayling.....	5.7a	1	Landes.....	3a-L	6

(1) Modifying symbols used after a dash in soil management groups.

(2) Weight assignments for class designation do not include consideration of slope or high water table.

APPENDIX B -- Continued

PRIMARY LAND CLASSIFICATIONS FOR MICHIGAN SOILS

Soil series	Soil man- age- ment group	Pri- mary soil class (1)(2)	Soil series	Soil man- age- ment group	Pri- mary soil class (1)(2)
Lapeer.....	3a	3	Nester.....	2a	4
Lease.....	M/1c	6	Newaygo.....	3a	3
Leelanau.....	4a	2	Newton.....	3a	3
Lenawee.....	2c	6	Nunica.....	2a	4
Linwood.....	M/3c	5			
Locke.....	3b	4	Oakville.....	5.0a	1
London.....	2b	5	Ockley.....	2a	4
Longlois.....	2a	4	Ocqueoc.....	4a	2
Longrie.....	3/Ra	4	Ogden.....	M/1c	6
Lorenzo.....	4a	2	Ogemaw.....	5b-h	5
Lupton.....	Mc	6	Ogontz.....	3/2c	6
			Omega.....	5.7a	1
Mackinac.....	2b	5	Onaway.....	2a	4
Macomb.....	3/2b	5	Onota.....	3/Ra	4
Mancelona.....	4a	2	Ontonagon.....	1a	5
Manistee.....	4/2a	4	Oshtemo.....	4a	2
Marenisco.....	4a	2	Otisco.....	4b	3
Markey.....	M/4c	4	Ottawa.....	5/2a	4
Marlette.....	2a	4	Ottokee.....	5.0a	1
Matherton.....	3b	4			
Maumee.....	5c	3	Palms.....	M/3c	5
McBride.....	3a	3	Palo.....	3b	4
McGregor.....	3b	4	Parkhill.....	2c	6
Melita.....	5/2a	4	Parma.....	3/Ra	4
Menominee.....	4/2a	4	Paulding.....	Oc	6
Metamora.....	3/2b	5	Pelkie.....	3c-L	6
Metea.....	3/2a	4	Pence.....	4a	2
Miami.....	2a	4	Perrin.....	4a	2
Mink.....	M/mc	6	Perth.....	1b	6
Montcalm.....	4a	2	Peshekee.....	Ra	4
Moran.....	3/Ra	4	Pewamo.....	2c	6
Morley.....	2a	4	Pickford.....	1c	6
Morocco.....	5b	2	Pinconning....	4/1c	6
Moye.....	4b	3	Plainfield....	5.0a	1
Munising.....	3a	5	Pleine.....	3c	5
Munuscong.....	3/1c	6	Posen.....	3a	3
Mussey.....	4c	4			
			Randville.....	4a	2
Nappanee.....	1b	6	Richter.....	3b	4
Negaunee.....	3/Ra	4	Rifle.....	Mc-b	6
Nekoosa.....	5.0a	1	Rimer.....	3/1b	6

(1) Modifying symbols used after a dash in soil management groups.

(2) Weight assignments for class designation do not include consideration of slope or high water table.

APPENDIX B -- Continued

PRIMARY LAND CLASSIFICATIONS FOR MICHIGAN SOILS

Soil series	Soil man- age- ment group	Pri- mary soil class (1)(2)	Soil series	Soil man- age- ment group	Pri- mary soil class (1)(2)
Rodman.....	Ga	1	Tappan.....	2c	6
Rollin.....	M/mc	6	Tawas.....	M/4c	6
Ronald.....	3c	5	Tedrow.....	5b	2
Roscommon.....	5c	3	Thackery.....	2a	4
Roselawn.....	5.3a	1	Thomas.....	2c	6
Rousseau.....	4a	2	Tobico.....	5c	3
Rubicon.....	5.3a	1	Toledo.....	1c	6
Rudyard.....	1b	6	Tolfree.....	2c	6
Ruse.....	3/Rc	6	Tonkey.....	3c	5
			Traunik.....	5b	2
Saganing.....	4c	4	Traverse.....	3b	4
Sanilac.....	3b	4	Trenary.....	2a	4
Saranac.....	2c-L	6	Trout Lake....	5b-h	5
Satago.....	3/Rc	6	Tula.....	3b	4
Sauble.....	5.3a	1	Tuscola.....	2a	4
Saugatuck.....	5b-h	5	Twining.....	2b	5
Saverine.....	3/2b	5	Tyre.....	4/Rb	5
Sebewa.....	3c	5			
Selkirk.....	1b	6	Ubly.....	3/2a	4
Seward.....	3/2a	4			
Shelldrake....	5.3a	1	Vilas.....	5.3a	1
Shoals.....	3c-L	6	Volinia.....	3a	3
Sigma.....	4b	3			
Sims.....	2c	6	Wainola.....	4b	3
Sisson.....	2a	4	Waiska.....	Ga	1
Skanee.....	3b	4	Wakefield.....	2a	5
Sleeth.....	2b	5	Wallace.....	5a-h	5
Sloan.....	3c-L	6	Wallkill.....	3c-L	6
Spalding.....	Mc-a	6	Warners.....	M/mc	6
Spartan.....	5.0a	1	Warsaw.....	3a	3
Spinks.....	4a	2	Wasepi.....	4b	3
Stambaugh.....	3a	3	Washtenaw.....	3c-L	6
St. Clair.....	1a	5	Watton.....	2a	4
St. Ignace....	Ra	4	Wauseon.....	3/1c	6
Strong's.....	5.0a	1	Wea.....	2a	4
Summerville...	Ra	4	Weare.....	5.0a	1
Sumner.....	4a	2	Westland.....	2c	6
Sunfield.....	3a	3	Whittemore....	2c	6
Superior.....	1a	5	Willette.....	M/1c	6
			Winegars.....	4b	3
Tahquamenon...	Mc	6	Wisner.....	2c	6

(1) Modifying symbols used after a dash in soil management groups.

(2) Weight assignments for class designation do not include consideration of slope or high water table.

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