A COMPUTER ASSISTED RECHARGE EVALUATION OF A DRIFT-BEDROCK AQUIFER SYSTEM

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ABSTRACT

A COMPUTER ASSISTED RECHARGE EVALUATION OF A
DRIFT-BEDROCK AQUIFER SYSTEM

By

RICHARD J. MANDLE

A model is proposed for the systematic evaluation of the physical properties of a glacial drift-bedrock aquifer system. The study integrates geophysical, geologic, hydrologic, and soils data. The data was compiled in such a manner that approximations of the recharge potential of the aquifer system might be made as the study progresses.

A bedrock valley was located using drillers logs and further defined using gravity methods. A series of computer derived map overlays define subsurface physical characteristics such as: bedrock topography, bedrock lithology, drift lithology and thickness, and surface characteristics such as: infiltration capacity, soil drainage, surface gradient, location of water bofies, approximate depth to water table and location of urban areas. Combinations of the overlays indicate areas of potential recharge to the drift-bedrock system.

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A THESIS

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in partial fulfillment of the requirements
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Scope and Purpose of Study

The major objective of this study is to utilize existing data in a model that offers a rapid reconnaissance of the aquifer system, and is able to incorporate additional data as it becomes available. Data used in this study is readily available and adequate for conducting a preliminary study, A gravity survey was conducted to supplement existing data and to verify trends in the bedrock topography. The data was then combined in a manner similar to the method proposed by Tillman and others (1974).

The study area selected, Meridian Township, is located in the northwest quarter of Ingham County, which is in turn centrally located in Michigan's Lower Penninsula. The area was chosen because: 1) pressing water problems dictate that a new source of ground water be developed, or that existing sources be replenished, 2) it is easily accessible, and 3) Vanlier and others (1974) have shown that a buried stream valley exists in the eastern half of Meridian Township, running north-south under Lake Lansing. This valley is of hydrogeologic importance because ancient valleys generally contain sands and gravels which make good aquifers and are easily recharged. Political boundaries outline the study area because in developing a ground water resource, a governmental unit will work within its own political boundaries without regard for the ground water basin boundaries.

Areal Description

The study area lies in the south central portion of the Michigan Basin. The recent sediments consists primarily of unconsolidated glacial deposits of Wisconsinan age and Halocene alluvium. They overlie Pennsylvanian sandstone and shale lenses included in the Saginaw Formation, neither of which has any great areal extent (Mencenberg, 1967). The sandstones are of great thickness, up to 300 feet, in the Lansing Metropolitan area (Mencenberg, 1967), but they become interbedded with shales in the Meridian Township area.

Previous Studies

Visual means of depicting hydrogeologic conditions have been limited. The use of lithofacies maps has been discussed in detail by Krumbein and Sloss (1951) and Pettyjohn and Randich (1965). Modifications of lithofacies techniques were applied in a hydrogeologic study by Kazmann (1949). Lithofacies maps using overlays for hydrogeologic studies in glaciated areas was proposed by Pettyjohn and Randich (1966).

Lithofacies maps are a series of maps which show the lithologic variation in the study area. As applied to hydrogeologic studies, a series of transparent overlays depict the textural variation of the clastic sediments. Each of the overlays represents a unit thickness, which is determined by the complexity and thickness of the sedimentary section. A more complex section would require smaller units, or sampling intervals, to obtain a better description of the section. The number of units is limited by the transparency of the overlays and the number of shades of color perceivable. A section which is of great thickness or complexity cannot therefore be described without using a large sampling interval, and with a forfeiture of accuracy. The use of the digital computer eliminates this problem. Any number of matrices, each representing a unit thickness, can be stored and manipulated.

The matrix technique for hydrogeologic studies has not been attempted before, but has the distinct advantage over other techniques, such as that using acetate overlays as proposed by McHarg (1969), because the factors, levels, and weightings can be adjusted to manipulate the summation map to reflect more closely actual conditions where they are known,(for instance in the vicinity of a pumping well).

The use of subsurface lithofacies maps with surficial geologic data in a matrix form gives a complete physical description of the drift-bedrock aquifer system, that neither surface or basement maps provide in glaciated areas.

CHAPTER II

THE MATRIX STUDY

The technique of computer assisted data storage and manipulation of matrices for geologic evaluation in land use planning was proposed by Tillman and others (1974). Subsequent work was later done by Iverson (1974) and Tillman and others (1975).

The method involves computer-storage of different types of data pertinent to the study and manipulating it as a matrix. These matrix components are referred to as factors. Each factor is divided into different factor levels. Subjective factor levels are normalized with respect to the least desirable factor level, which is assigned a score of one. The most desirable factor level would have a score greater than one, depending on the number of factor levels. Factors are then assigned weightings which express the relative importance of that factor. Data is assigned to an appropriate factor level, multiplied by the weighting and results are summed for each data station. A composite map is drawn and contoured for the summation. High summations reflect optimal conditions. By altering the factors different properties of the physical system can be enhanced or depressed for different uses.

TABLE 1. Surface Factors.

Factors	Levels	Description
Infiltration Capacity*	1	Slow (.2-.8 in/hour)
	3	Moderate (.8-2.5 in/hour)
	4	Rapid (2.5-10.0 in/hour)
	5	Very Rapid (greater than 10.0 in/hour)
Surface Gradient*	1	6-12%
	3	2-6%
	5	0-2%
Depth to Water Table*	1	0-24 inches
	3	24-120 inches
	5	over 60 inches
Water Bodies#	1	Open Water
	3	Floodplains, intermittent streams
	5	No surface water
Natural Drainage*	1	Very poorly drained
	2	Poorly drained
	3	Somewhat poorly drained
	4	Moderately well drained
	5	Well drained
Urban Areas#	1	Within urban areas
	5	Outside urban areas

*Data derived from Schneider and Erickson (1972).
#Data derived from aerial photographs (US Soil Conservation Service).

Factors

Ten factors were chosen to describe the physical characteristics of the ground water system. The surface factors include: 1) infiltration capacity, 2) surface gradient, 3) depth to water table, 4) location of surface water bodies, 5) natural drainage, and 6) location of urban areas. These factors determine whether precipitation infiltrates or runs off the ground surface. The subsurface factors are: 7) drift permeability of the different intervals describing the glacial drift, 8) permeability of the drift-bedrock transition, 9) bedrock lithology, and 10) drift thickness. Each of these factors will be discussed and related to the hydrogeologic system.

Infiltration Capacity

Infiltration capacity is a measure of the capability of water to move through the soil. It had been previously emphasized that if rainfall intensity exceeded infiltration capacity, limited infiltration would occur, and overland flow would become the primary mode of water movement (Horton, 1945). Investigations have determined that infiltration is frequently not a limiting factor in well vegetated basins, if the basin as a whole is considered (Musgrave,1935),(Betson and Marius, 1969), and (Dickinson and Whitely, 1970). During an intense rainstorm, infiltration capacity will be exceeded, and local overland flow will occur. Water will also become ponded and stored on the surface until it eventually infiltrates into the soil. A rapid infiltration rate would be optimal for ground water recharge, since a slow infiltration rate would cause overland flow and evaporative loss of ponded waters. A high infiltration capacity receives a maximum factor score.

Surface Gradient

The surface gradient will help determine the rate of infiltration into the soil medium. A greater gradient will result in more runoff and less water infiltrating into the soil. Precipitation may enter the soil profile but will runoff as hillslope outflow or drainage (Troendle, 1970). Lower gradients will result in greater infiltration and less hillslope drainage and therefore receives the highest factor score.

Depth to Water Table and Location of Surface Water Bodies

The depth to water table and location of surface water bodies indicate groundwater discharge and recharge areas. Natural groundwater discharge areas refer to areas in which water leaves the groundwater flow system by means of stream baseflow, springs, seepage areas, and evapotranspiration (Freeze and Witherspoon, 1967). Water movement in the groundwater flowsystem is toward the water table in these areas. Recharge areas refer to areas in which water percolates to the water table and becomes part of the groundwater system (Freeze and Witherspoon, 1967). There groundwater moves downward from the water table.

The presence of surface water bodies and high water table will depict areas of discharge from the groundwater system. These areas will be given a low factor level score, because infiltration is reduced in discharging zones.

Although the data on depth to water table is not conclusive in regard to the actual position of the water table, the greatest depth to the water table will be used to indicate a groundwater recharge area. This along with the absence of surface water bodies will receive the highest factor level score.

Natural Drainage

The natural drainage of a soil is controlled by the depth to water table and the type of material making up the soil mass.

Natural Drainage as used in this study and defined by Schneider and Erickson (1972), is determined by the number of months during the year the water table is in contact with that part of the soil profile. This is determined by noting the color of the soil as viewed from aerial photographs and field observations. Because a poorly drained soil may represent a ground water discharge zone, it receives a low factor level score. Well drained soils may represent groundwater recharge areas. These soils are assigned to a high factor level.

TABLE 2. Subsurface Factors.

Factors	Level	Description		
Drift Permeability		%clay	%sand	%gravel
	1	100	0	0
	2	67	33	0
	3	67	0	33
	4	33	67	0
	5	33	0	67
	6	0	100	0
	7	0	67	33
	8	0	33	67
	9	0	0	100
Sands and gravels overlying sandstone	1	No		
	9	Yes		
Bedrock lithology	1	Shale		
	9	Sandstone		

Data derived from water well logs (Michigan Geological Survey). Drift thickness obtained from water well logs and the gravity survey, is used to determine the average drift permeability.

Subsurface Factors

The subsurface factors were derived entirely from water well logs and the gravity survey. Based on descriptions from the water well logs, the drift is seen to be composed mainly of four components: clay, sand, gravel, and till. The clay category contains clay and silt, and the till category contains undifferentiated materials. The sand and gravel categories contain sand and gravel.

Because of the overall complexity and thickness of the drift section, 25 foot sample intervals were chosen. Each 25 foot interval is evaluated based on the proportion of these components in that interval. The till category is arbitrarily divided equally between the clay and sand and gravel categories.

Different factor levels are assigned depending on these relative proportions (see Table 2).

Gravel and coarse sand deposits will have a permeability generally greater than 100 darcys. Sands have permeabilities ranging from 10 to 100 darcys, and clay-silt rich materials have a permeability less than 1 darcy and more commonly less than 0.1 (Davis and DeWeist, 1970). All will allow infiltration to occur. Intimate mixtures of clay and sand or gravel, or interlaminated clay and sand or gravel beds or lenses both allow infiltration. Infiltration is more likely to occur under a greater variety of hydraulic conditions through drift deposits of gravel. For this reason and because gravel deposits have a greater permeability, a factor level of 9 is assigned to these types of deposits. Deposits of clay are assigned a factor level of 1 because of their low permeability.

The bedrock consists of lenses of sandstone and shale. The sandstones are more permeable and will allow infiltration to occur more readily. Shales will allow infiltration to occur but only under limited hydraulic conditions. They have a lower permeability than sandstones and are assigned to a lower factor level.

Weightings

The different factors are assigned weightings relative to their importance in assessing the recharge potential of the drift-bedrock aquifer system. These weightings are arbitrary and are assigned by the hydrogeologist. The weightings are assigned on a relative scale, with three being assigned to the most important factor and one to the least important. Iverson (1974) found that optimal areas remained so regardless of the change in weightings. For this reason the hydrogeologist should place more emphasis on the assigning of factor levels and not on the weightings.

TABLE 3. Weightings

Surface factors		Weightings
Infiltration Capacity	(I)	3
Surface Gradient	(G)	1
Depth to Water Table	(T)	2
Location of Water Bodies	(B)	2
Natural Drainage	(D)	1
Location of Urban Areas	(U)	3
Subsurface factors*		
Drift Permeability	(P)	2

* Weightings were not assigned to: Areas in which sands and gravels overlie sandstone, Bedrock lithology, or Drift thickness.
The methods of combination involving these factors does not necessitate the use of weightings.

Method of Combination

The factors, as matrices, are combined to evaluate the recharge potential of the drift-bedrock aquifer system. The recharge potential of the drift aquifer is determined by a combination of the six surface factors and one subsurface factor. The surface factors are combined in the following manner to show, on the ground surface, areas of high infiltration capacity (SA):

$$SA = ((wxI)+(wxG)+(wxD)+(wxT)+(wxB)+(wxU))/6 \qquad (1)$$

where: w = weighting corresponding to each factor
I = Infiltration Capacity
G = Surface Gradient
T = Depth to Water Table
B = Location of Water Bodies
U = Location of Urban Areas

The purpose of dividing (SA) by six is only to reduce the magnitude of the resulting values and to make the factor (SA) easier to manipulate with respect to the subsurface factors. The factor (SA) is then multiplied by a weighting to normalize this factor relative to the subsurface factors.

Areas in which water table conditions (WT) are prevalent is then determined by combining areas of high infiltration capacity (SA) with permeable drift deposits (determined to be greater than a factor level of 5.0). The water table (WT) equation becomes:

$$WT = SA+P \qquad (2)$$

where: P = Drift Permeability (greater than 5.0)
SA = Infiltration Capacity (greater than 5.0)

All of the areas in which (P) and (SA) have values less than 5.0 are assigned a value of 0.0 before combination.

The recharge potential of the glacial drift is determined by the following equation:

$$RP = SA + WT + (wxP) \tag{3}$$

where: RP = Recharge potential of drift
P = Drift permeability
w = appropriate weighting for P
WT = Water table conditions

In order to evaluate the recharge potential of the bedrock aquifer, Equation (3) is revised to include areas in which permeable bedrock is overlain by permeable drift deposits (L).

$$RPB = RP + (wxL) \tag{4}$$

where: RPB = Recharge potential of the bedrock aquifer
L = Areas in which sands and gravels overlie sandstone

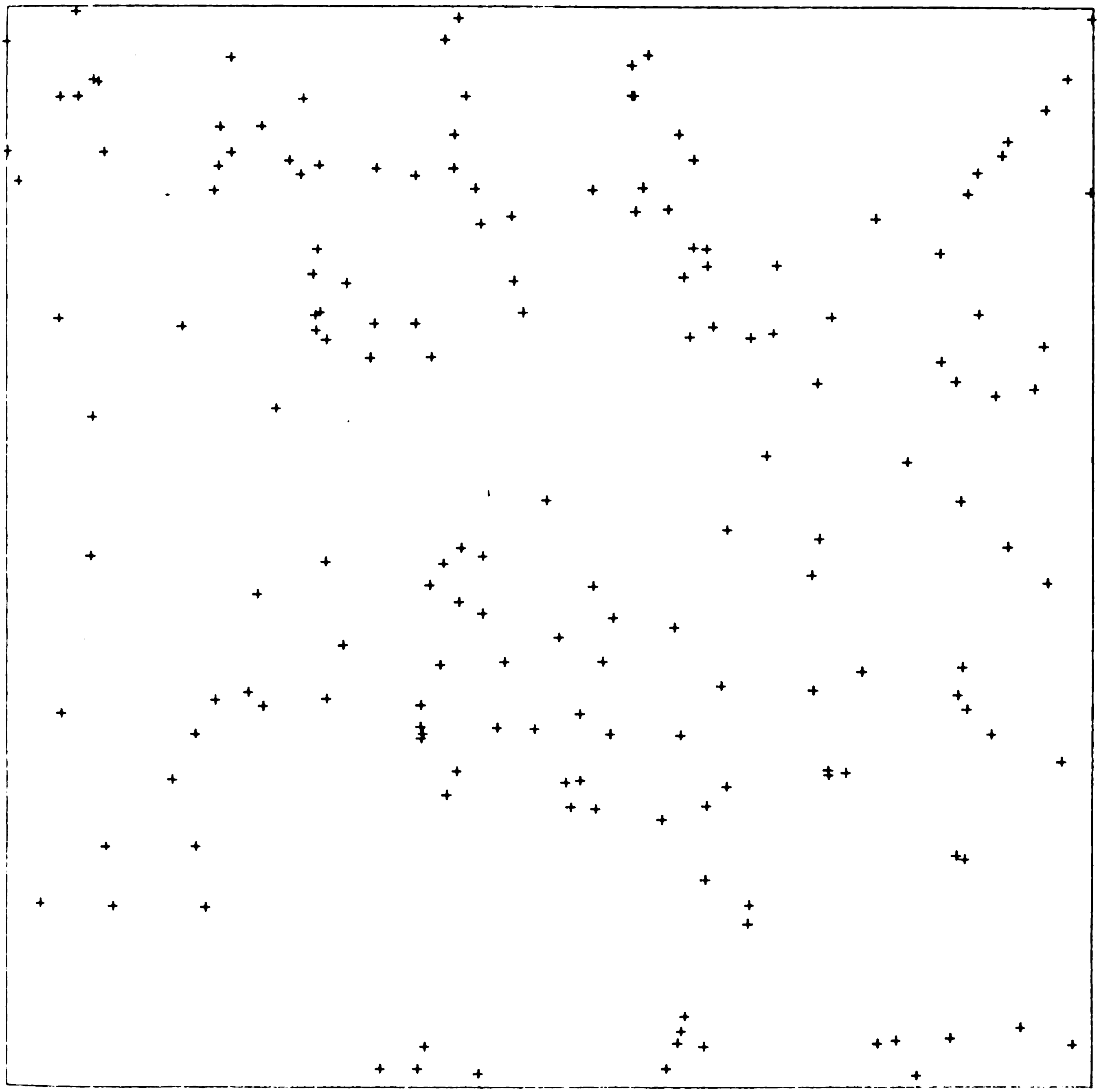
In Equation (4), sandstone is assigned a factor level of 9.0 and shale is assigned a factor level of 0.0 in determinin (L).

CHAPTER III

Sources of Data

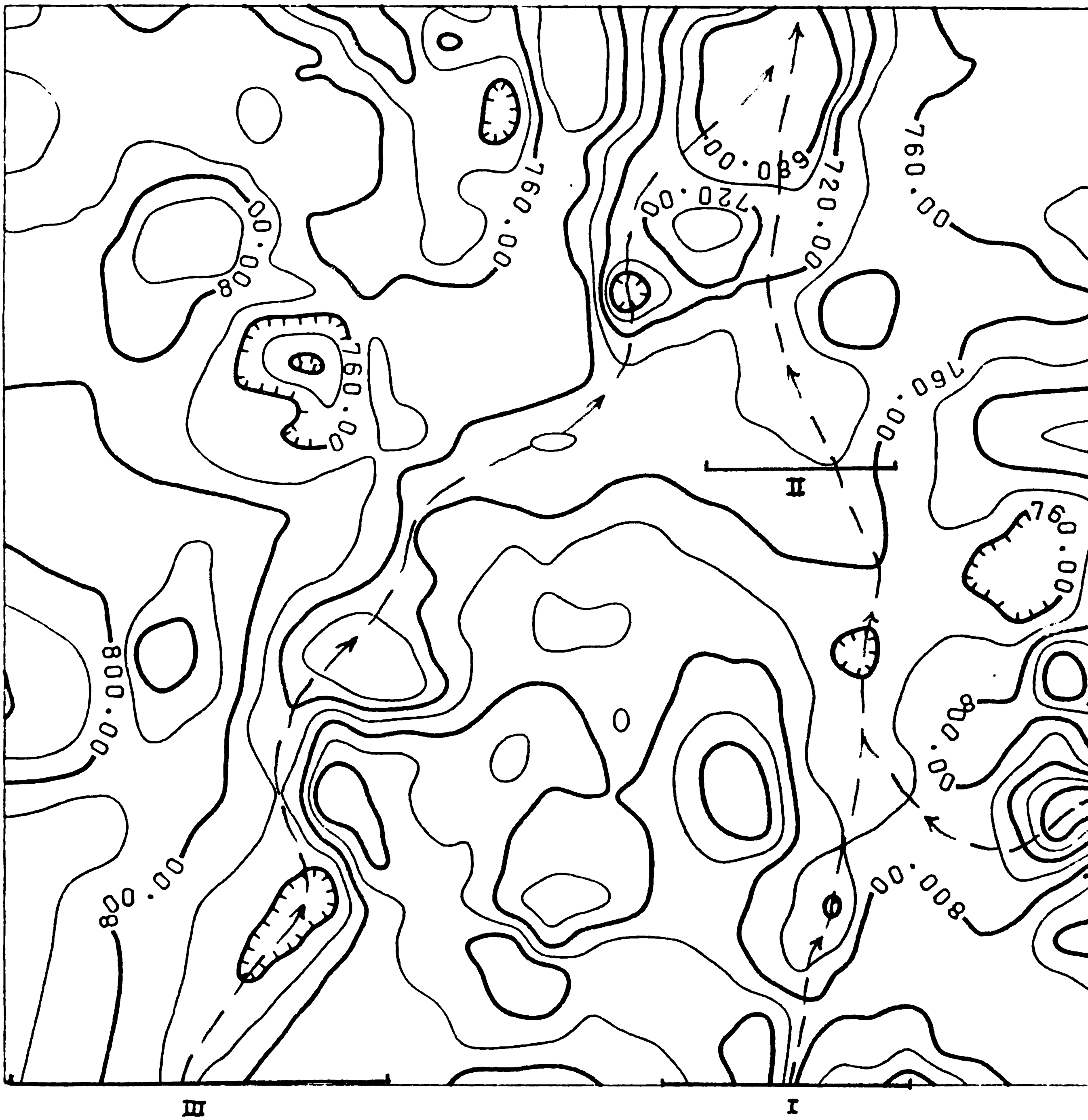
Aerial photographs, quadrangle topographic maps, and county soils maps (U.S. Soil Conservation Service), were used as data sources. All are easily obtainable sources of data. Data derived from these maps include: soil permeability, surface gradient, natural drainage, depth to water table, location of surface water bodies and the location of urban areas. The data derived from soil maps was compiled by Erickson and Schneider (1972).

Subsurface data was derived from water well logs. While it is recognized that these logs are not the best source of data, they are the only sources of subsurface data, and will have to be used with discretion. Over 500 well logs were examined and 182 were chosen based on what was considered a more complete lithologic description (see Fig. 1 and Appendix II). From these, lithologic variation in both the drift and the bedrock was determined. A gravity survey was conducted in areas of low well density and to verify trends in the first computer derived bedrock topographic map (Fig. 2).



WELL LOCATIONS

FIG. 1



BEDROCK TOPOGRAPHY

FIG. 2

CHAPTER IV

The Gravity Study

A preliminary bedrock topographic map of Meridian Township was computer derived from water well logs. Gravity traverses for further delineation of bedrock topography were laid out based on trends shown on this map and the low density of well data. Station intervals of 100 feet on four traverses were chosen. The four traverses contained 281 stations, and covered a linear distance of over 29,000 feet. Each station location was surveyed in, starting at benchmarks of known elevation. Multiple gravity readings were taken at each station location, and the average used in determining the gravity value at that location.

Gravity exploration was chosen because it is relatively quick and inexpensive, and it is easy to apply to actual field conditions. Methods proposed and refined by Reagan (1974) specifically apply to use in glaciated areas, and are used in this study. The only handicap in using gravity as an exploration method is that station elevations must be accurate, and relatively good well control is needed along a traverse (two or three wells) in order to accurately determine bedrock elevation.

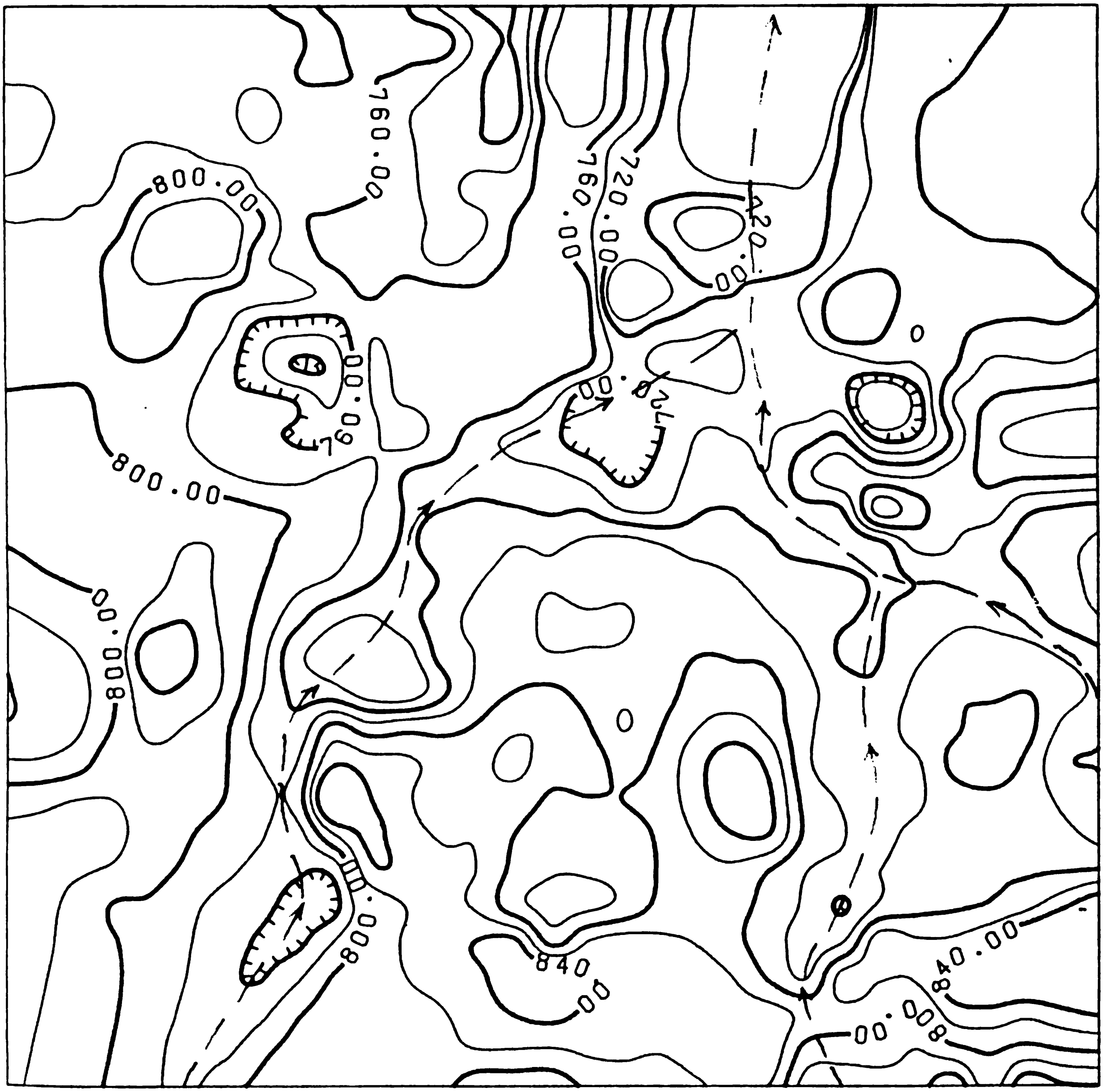
Data Reduction

The observed gravity readings are subjected to a series of corrections to produce a true relative value of the earth's gravitational field. These corrections are due to: 1) latitude differences, 2) elevation differences, 3) instrument drift, and 4) earth tides. The corrected gravity value is called the Bouguer Gravity Value. The Bouguer Gravity Anomaly was determined by reducing all values to some base level.

Interpretations

Upon plotting these values, there was found to be a linear increase in the Bouguer Gravity Anomaly, thought to be due to either a strong regional or an overcorrection for instrumental drift, which seems more probable. The linear trend was removed and the residuals retained. Elevations were determined using the interpolation technique. Readings were taken with the gravity meter at well locations where bedrock elevation is known. A polynomial regression curve was fit to the Bouguer Gravity Anomaly and known bedrock elevations to determine the relationship between them; bedrock elevations at other locations were determined from the curve.

The gravity determined bedrock elevations were added to the computer stored data and a more complete bedrock topographic map was obtained (Fig. 3). Drift thickness (Fig. 4) was calculated and with bedrock topography become data to be used in determining some physical parameters of the ground water system.



BEDROCK TOPOGRAPHY

FIG.3

DRIFT THICKNESS

FIG.4

CHAPTER V

Results

The various factors are combined according to equations (1),(2), (3), and (4), and represented on figures 5 through 11. In determining the potential recharge to the drift-bedrock aquifer, according to equation (4). One of the advantages to using this computerized matrix technique, is that the user is able to see the map being constructed as the study progresses. In order to determine areas of high recharge potential to glacial drift, figures 5,6 and 7 are combined as matrices, to form figure 10. Figures 5,6,7,8 and 9, are combined to determine areas of high potential recharge to the drift-bedrock aquifer, figure 11.

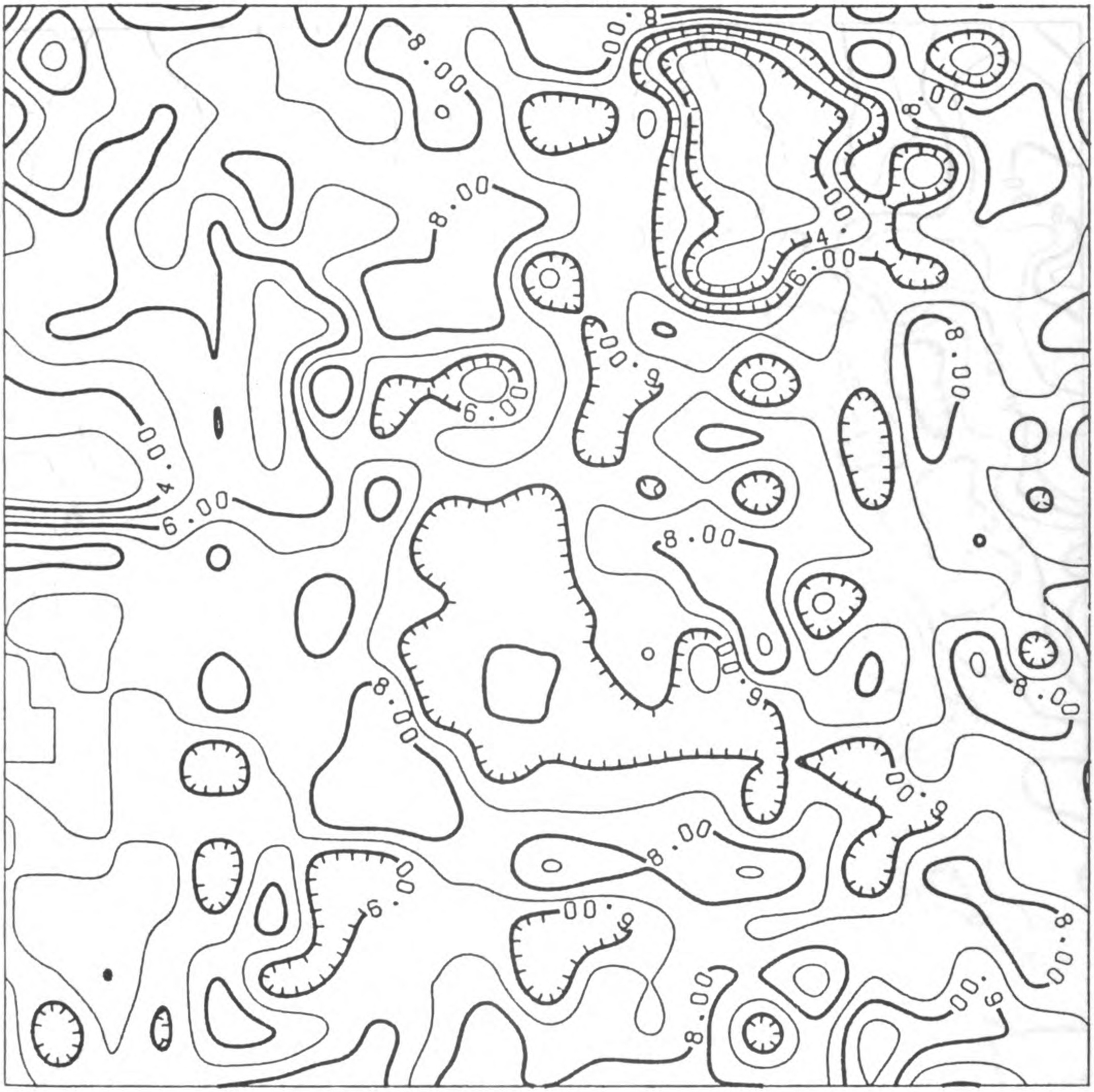
Located on figure 10 are sites having the highest recharge potential to the drift aquifer. The same sites are located on figure 11, with the exception of site 5, which is underlain by shale deposits.

These sites are located using geologic criteria. Socio-economic constraints may be applied for further site evaluation

Site Evaluation

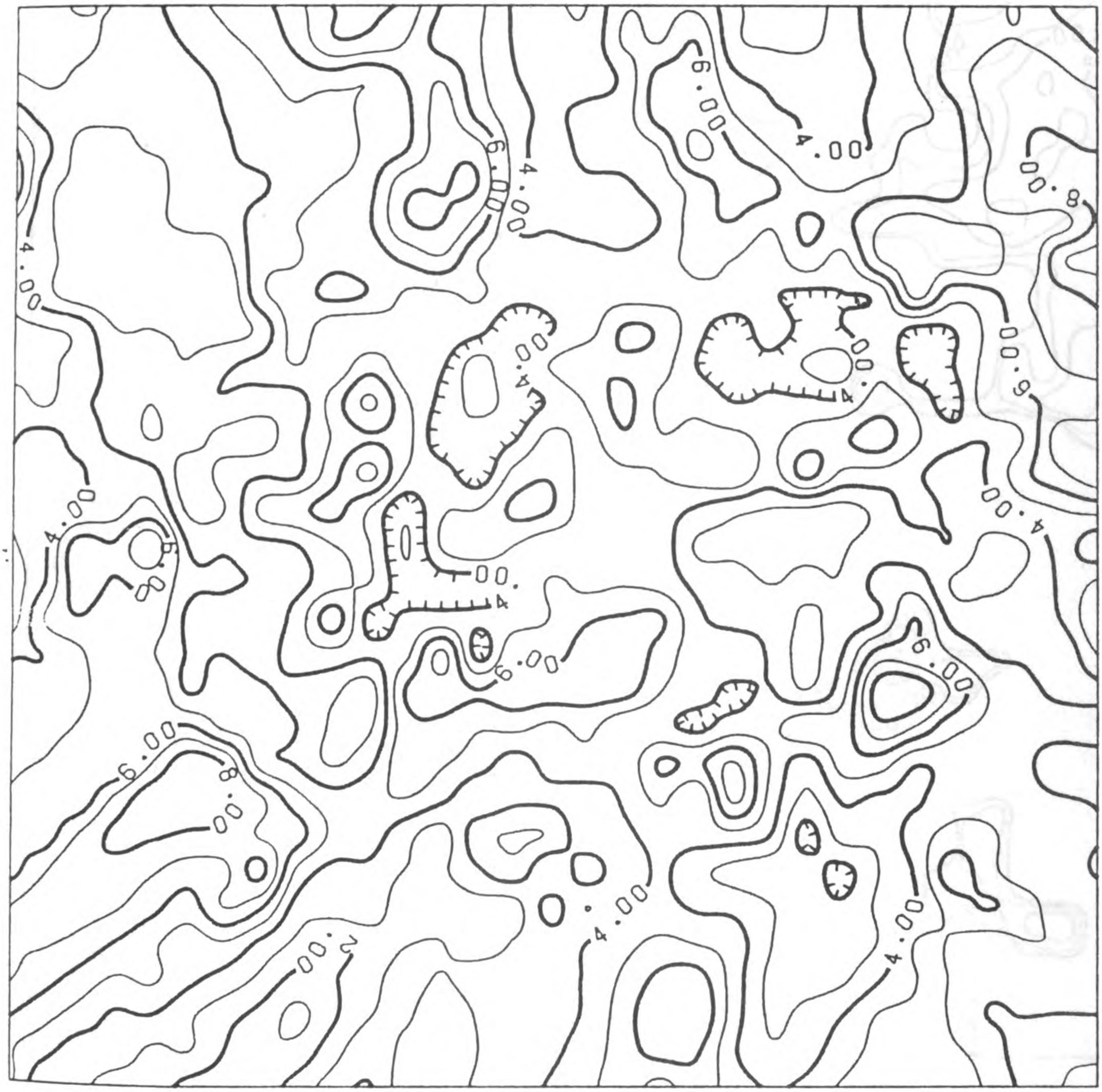
Site 1 is an abandoned gravel quarry located in section 9, east of Park Lake Road. This site has been also identified by local consultants (W.G. Keck and Associates) and the U.S.G.S. Water Resources Division as a potential recharge site. This site is presently not being developed.

Site 2 is also an abandoned gravel quarry located north of site 1



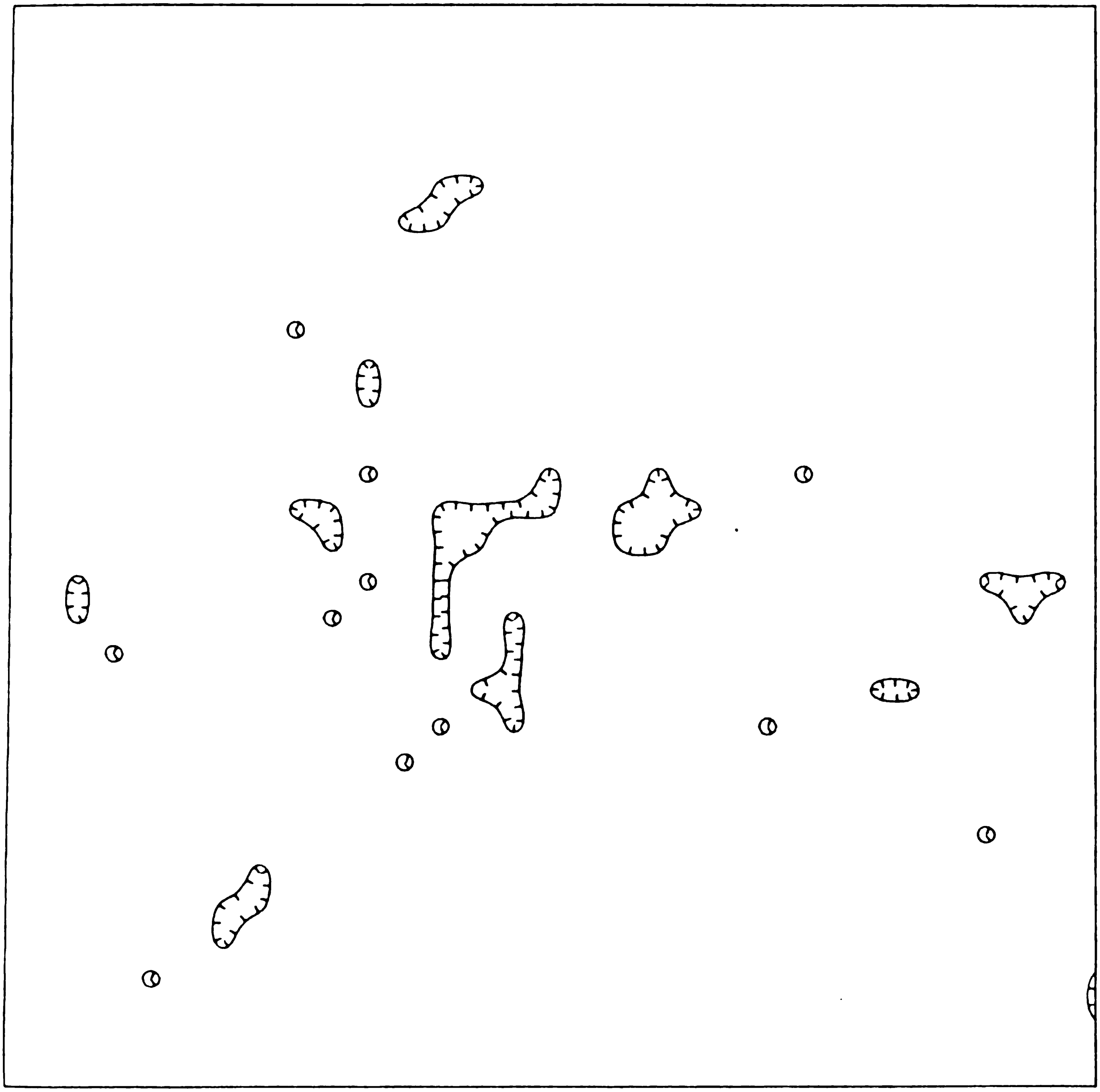
AREAS OF HIGH INFILTRATION CAPACITY

FIG. 5



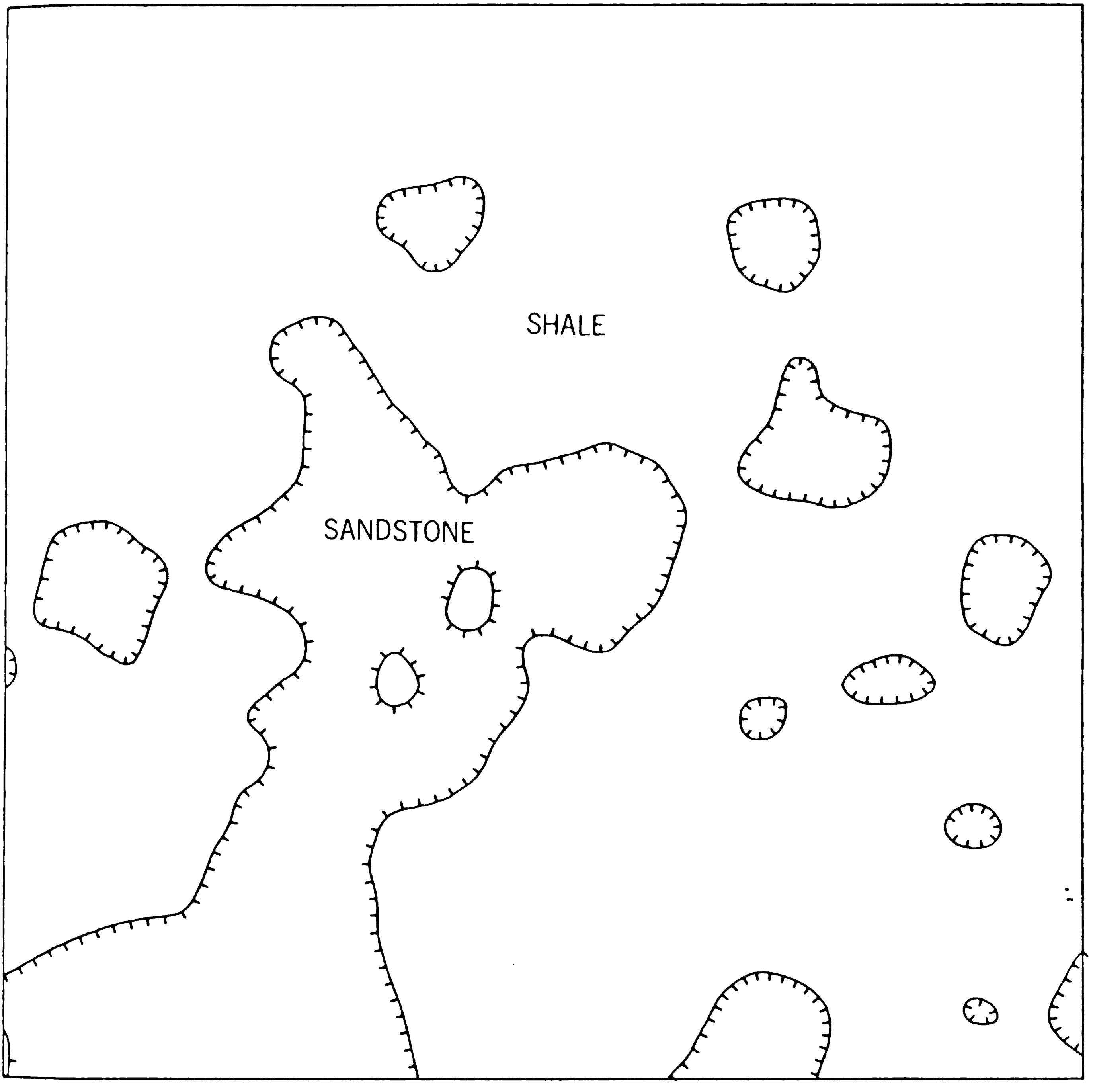
AVERAGE RELATIVE DRIFT PERMEABILITY

FIG.6



AREAS IN WHICH SANDSTONE IS OVERLAIN
BY SAND AND GRAVEL DEPOSITS

FIG. 8



BEDROCK LITHOLOGY

FIG. 9

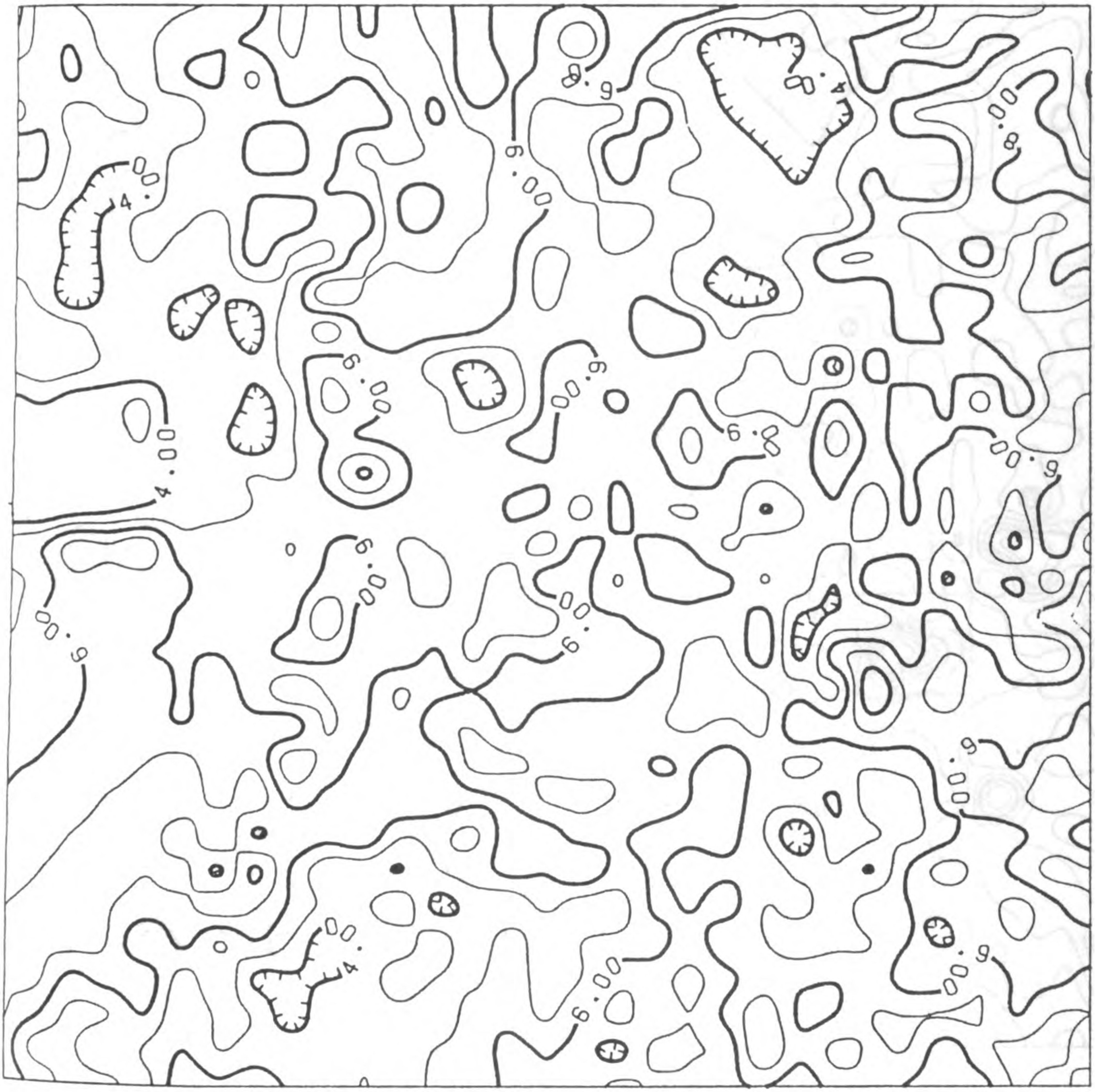
on highway M-78. This site appears to be the extension of an esker running south through site 1. This site is also not being developed. Both sites, if developed as recharge lagoons might also meet the recreational and aesthetic needs of the community, being located just east and north of the city of East Lansing.

Site 3 is located on the southern half of Michigan State University, off Bennett and Hagadorn Roads. This site is located in the Michigan State University well field. A recharge reservoir located here could recharge the shrinking ground water reserves and serve the recreational needs of the university community.

Site 4 deserves further consideration because it is located above a buried bedrock valley. Although this area has not been developed hydrogeologically, increasing future water needs dictate that this area be evaluated as a potential glacial drift aquifer and possibly developed at some time in the future. This area could also serve as a catchment for storm runoff. The recent flooding (April 1975), emphasized the need for this type of runoff control.

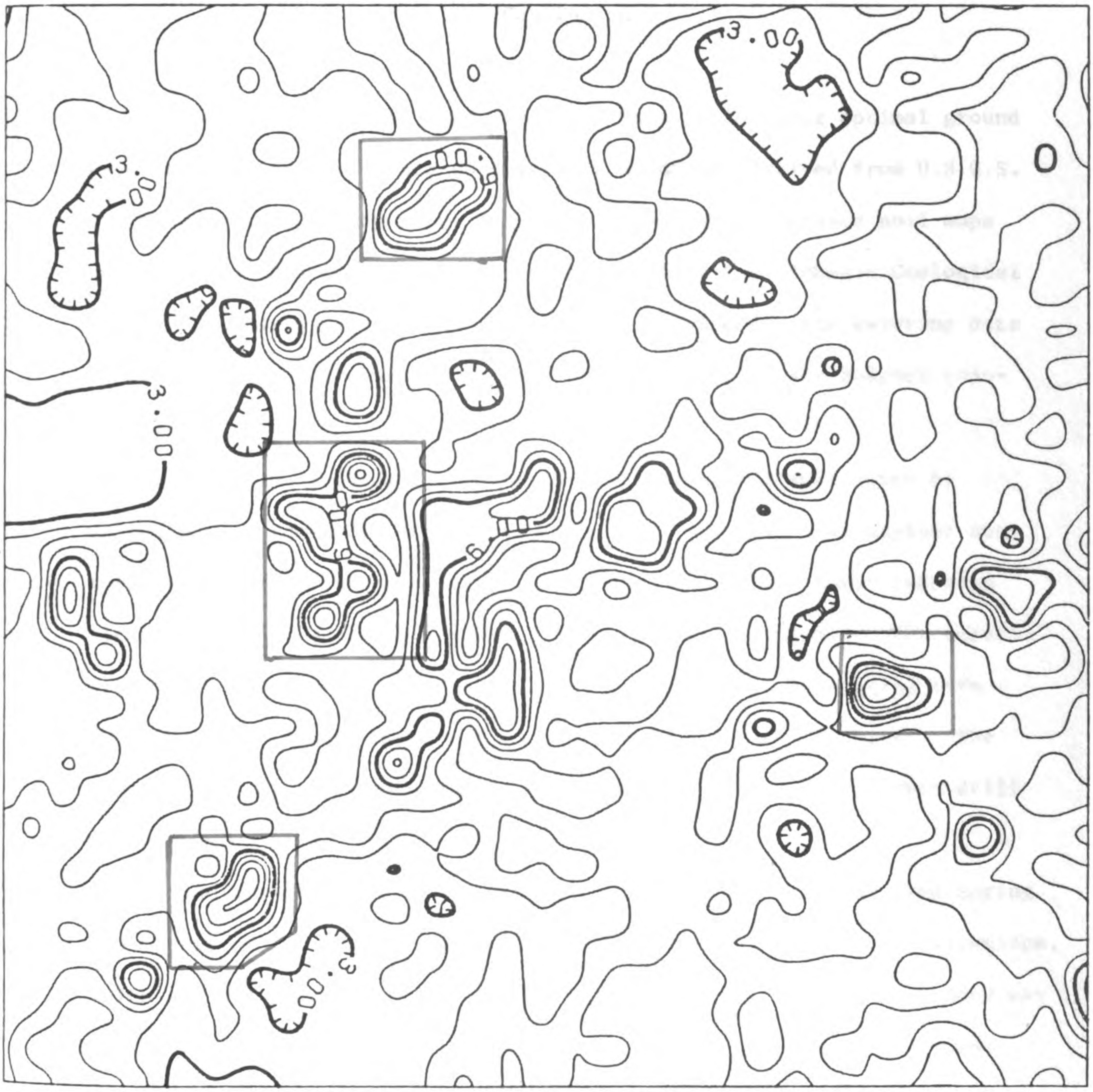
Site 5, east of Lake Lansing might also be developed as runoff catchment site or as a ground water recharge reservoir for recharge of a potential glacial drift aquifer. The drift is over 120 feet thick in this area, allowing for ample storage volume, and the site is underlain by shale which acts as the bottom boundary for the drift aquifer.

Each of these sites has the potential for development as storm runoff catchments or ground water recharge sites. Sites 1 and 2 serving East Lansing. Site 3 developed for Michigan State University. Site 4 for eastern Meridian Township, and site 5 for the Haslett-Lake Lansing area.



AREAS OF HIGH POTENTIAL RECHARGE TO DRIFT

FIG. 10



RELATIVE RECHARGE POTENTIAL

FIG.11

Conclusion

The model proposed uses available data in locating optimal ground water recharge sites. Data used in this study was derived from U.S.G.S. quandrangle topographic maps, U.S. Soil Conservation Service soil maps and aerial photographs, and water well logs from the Michigan Geological Survey. A gravity survey was conducted to supplement this existing data in areas of low well density and the verify trends in the bedrock topographic map.

Using the technique of matrix addition and multiplication by weightings, a summation map is produced and contoured. The highest summations represent the most optimal locations for ground water recharge sites. Five different sites were located using this method. The selection of site 1 concurs with the evaluation by a local consulting firm (W.G. Keck and Assoc. and the U.S.G.S. Water Resources Division). The confirmation of the remaining sites should be accomplished be test drilling and percolation tests.

The advantage of this technique is that changes can be made during the course of the study by simply adjusting factors, levels and weightings, which are all a matter of simple programming changes. Additional data may be incorporated and stored as matrices, to be manipulated when needed. Approximations may be made as the study progresses, without the manual construction of new maps.

Although not used for hydrogeologic purposes in the past, this study has demonstrated the applicability of this computer matrix technique to reconnaissance hydrogeologic investigations. The selection of sites should not be considered absolute but rather as a first approximation. Further on-site evaluation becomes necessary in order to offer definite solutions to the problem at hand.

Recommendations for Further Study

Since the proposed model admittedly, is of use only in reconnaissance studies further on-site evaluation is required. This would encompass test drilling for sampling the drift material and the location of observation wells. A pump test well could be used to determine the hydraulic response of the glacial drift and bedrock aquifer. The flow paths of recharging water can then be determined and hopefully the model is verified. By changing weightings, thus changing the emphasis of different factors, the model might be made to fit the known hydraulic characteristics of the aquifer. This might be a method of arriving at the appropriate weightings for the different factors.

The proposed model might also be used for regional evaluation of the aquifer potential of a particular formation. In order to do this, some ranges of permeabilities must be known.

APPENDIX I

THE GRAVITY SURVEY

APPENDIX I

THE GRAVITY SURVEY

Theory

In the presence of some massive object, any other object will experience an attractive force, directly proportional to the product of their masses, and inversely proportional to the distance between them, or;

$$G=\lambda m'm/ r^2$$

where: G = gravitational force of attraction
λ = gravitational constant
m'= massive object
m = attracted object
r = distance between their centers of mass

The gravitational force of attraction per unit mass produced by an object of mass M, at a distance r, is:

$$G=\lambda M/ r^2$$

When measuring the gravitational attraction of the earth, this equation is used, where M is the mass of the earth, and r is the radius of the earth. The attractive force of the earth on the test mass is then measured.

Data Reductions

The observed gravity readings are subjected to a series of corrections to produce a relative value of the earth's gravitational field. These corrections are due to: 1) latitude differences, 2) elevation differences, 3) instrument drift, and 4) earth tides. The corrected gravity value is called the Bouguer Gravity Value. The Bouguer Gravity Value can be calculated using the following expression:

$$Gbgv = g_o + g_l + g_{fa} + g_m + g_t$$

where: Gbgv= Bouguer Gravity Value
g_o= observed gravity value
g_l= latitude correction
g_{fa}= free air correction
g_m= Bouguer mass correction
g_t= terrain correction

All corrections are applied as outlined in any applied geophysics textbook, except earth tides corrections. These are outlined in Reagan (1974).

Earth Tides Correction

Due to the gravitational attraction of the moon and sun on the solid and liquid mass of the earth, a bulging takes place. These are the tides. Earth tides is the bulging of the solid mass of the earth in response to this attraction. This phenomenon fluctuates diurnally and semidiurnally due to the change in postion of the earth with respect to the sun and moon. Conventionally this drift is incorporated into one correction along with instrumental drift. This correction is determined by frequent measurements at some base station. The method used by Reagan (1974) and in this study involves a theoretical determination of the earth tides.

RESULTS

All corrections were applied to the observed gravity values measured along the traverses. A density of 2.10 gm/cm^3 was used for the glacial drift. This value was obtained from a range of values published in the literature. Bedrock elevations were related to residual anomaly values by linear interpolation. The results are listed in the following tables.

REDUCTION OF GRAVITY DATA

JOLLY ROAD - I

LATITUDE OF REFERENCE STATION = 41.7 DEGREES

ASSUMED ROCK DENSITY = 2.10 GRAMS PER CUBIC CENTIMETER

STATION NUMBER	READING	TIME	ELEVATION	BOUGUER VALUE	EARTH TIDES	BOUGUER ANOMALY
1	[illegible]	[illegible]	[illegible]	4114.843	.0820	-.075
2	[illegible]	[illegible]	[illegible]	4114.855	.0820	-.052
3	[illegible]	[illegible]	[illegible]	4114.881	.0830	-.038
4	[illegible]	[illegible]	[illegible]	4114.923	.0830	.008
5	[illegible]	[illegible]	[illegible]	4115.073	.0830	.112
6	[illegible]	[illegible]	[illegible]	4115.083	.0830	.152
7	[illegible]	[illegible]	[illegible]	4115.097	.0830	.177
8	[illegible]	[illegible]	[illegible]	4115.233	.0820	.312
9	[illegible]	[illegible]	[illegible]	4115.321	.0810	.401
10	[illegible]	[illegible]	[illegible]	4115.248	.0810	.327
11	[illegible]	[illegible]	[illegible]	4115.288	.0790	.359
12	[illegible]	[illegible]	[illegible]	4115.357	.0780	.439
13	[illegible]	[illegible]	[illegible]	4115.359	.0750	.443
14	[illegible]	[illegible]	[illegible]	4115.405	.0720	.491
15	[illegible]	[illegible]	[illegible]	4115.513	.0710	.601
16	[illegible]	[illegible]	[illegible]	4115.507	.0700	.595
17	[illegible]	[illegible]	[illegible]	4115.480	.0690	.560
18	[illegible]	[illegible]	[illegible]	4115.463	.0680	.552
19	[illegible]	[illegible]	[illegible]	4115.584	.0660	.575
21	[illegible]	[illegible]	[illegible]	4115.567	.0460	.575
22	[illegible]	[illegible]	[illegible]	4115.565	.0440	.675
23	[illegible]	[illegible]	[illegible]	4115.558	.0420	.670
24	[illegible]	[illegible]	[illegible]	4115.757	.0390	.868
25	[illegible]	[illegible]	[illegible]	4115.797	.0360	.905
26	[illegible]	[illegible]	[illegible]	4115.829	.0340	.948
27	[illegible]	[illegible]	[illegible]	4115.893	.0320	1.007
28	[illegible]	[illegible]	[illegible]	4115.929	.0300	1.045
29	[illegible]	[illegible]	[illegible]	4115.995	.0270	1.113
30	[illegible]	[illegible]	[illegible]	4115.017	.0250	1.130
31	[illegible]	[illegible]	[illegible]	4115.959	.0230	1.091
32	[illegible]	[illegible]	[illegible]	4115.055	.0190	1.180
33	[illegible]	[illegible]	[illegible]	4115.032	.0160	1.150
34	[illegible]	[illegible]	[illegible]	4115.030	.0120	1.152
35	[illegible]	[illegible]	[illegible]	4115.025	.0090	1.159
36	[illegible]	[illegible]	[illegible]	4115.091	.0060	1.217
37	[illegible]	[illegible]	[illegible]	4115.081	.0040	1.218
38	[illegible]	[illegible]	[illegible]	4115.012	.0010	1.157
39	[illegible]	[illegible]	[illegible]	4115.057	-.0020	1.201
40	[illegible]	[illegible]	[illegible]	4115.099	-.0090	1.243
41	[illegible]	[illegible]	[illegible]	4115.211	-.0130	1.364
42	[illegible]	[illegible]	[illegible]	4115.240	-.0150	1.395
43	[illegible]	[illegible]	[illegible]	4115.377	-.0150	1.533
44	[illegible]	[illegible]	[illegible]	4115.295	-.0200	1.455
45	[illegible]	[illegible]	[illegible]	4115.389	-.0220	1.549
46	[illegible]	[illegible]	[illegible]	4115.394	-.0250	1.547
47	[illegible]	[illegible]	[illegible]	4115.624	.0610	1.729
48	[illegible]	[illegible]	[illegible]	4115.598	.0570	1.726

REDUCTION OF GRAVITY DATA

TIHART ROAD - II

LATITUDE OF REFERENCE STATION = 41.[illegible] DEGREES

ASSUMED ROCK DENSITY = 2.[illegible] GRAMS PER CUBIC CENTIMETER

STATION NUMBER	READING	TIME	ELEVATION	BOUGUER VALUE	EARTH TIDES	BOUGUER ANOMALY
2	[illegible]	10.10	[illegible]	4107.465	.0800	-.069
3	[illegible]	[illegible]	[illegible]	4107.448	.0790	-.085
4	[illegible]	[illegible]	887.79	4107.447	.0770	-.094
5	[illegible]	[illegible]	[illegible]	4107.404	.0740	-.124
6	[illegible]	[illegible]	[illegible]	4107.331	.0700	-.194
7	[illegible]	[illegible]	[illegible]	4107.387	.0690	-.138
8	[illegible]	[illegible]	[illegible]	4107.232	.0660	-.289
9	[illegible]	11.10	[illegible]	4107.261	.0620	-.257
10	[illegible]	[illegible]	[illegible]	4107.194	.0570	-.320
11	[illegible]	[illegible]	[illegible]	4107.184	.0550	-.320
12	[illegible]	[illegible]	[illegible]	4107.094	.0520	-.426
13	[illegible]	[illegible]	[illegible]	4106.987	.0500	-.521
14	[illegible]	[illegible]	875.17	4106.914	.0480	-.532
15	[illegible]	[illegible]	[illegible]	4106.931	.0460	-.514
16	[illegible]	[illegible]	[illegible]	4106.901	.0420	-.500
17	[illegible]	[illegible]	[illegible]	4106.791	.0410	-.719
18	[illegible]	[illegible]	967.99	4106.739	-.0110	-.714
19	[illegible]	[illegible]	[illegible]	4106.729	-.0130	-.724
20	[illegible]	[illegible]	[illegible]	4106.612	-.0160	-.837
21	[illegible]	[illegible]	[illegible]	4106.537	-.0170	-.911
22	[illegible]	[illegible]	[illegible]	4106.534	-.0190	-.924
24	[illegible]	[illegible]	[illegible]	4106.491	-.0230	-.953
25	[illegible]	[illegible]	[illegible]	4106.427	-.0240	-1.026
26	[illegible]	[illegible]	[illegible]	4106.383	-.0260	-1.069
27	[illegible]	[illegible]	[illegible]	4106.398	-.0300	-1.052
28	[illegible]	[illegible]	[illegible]	4106.283	-.0310	-1.159
29	[illegible]	[illegible]	[illegible]	4106.215	-.0330	-1.230
31	[illegible]	[illegible]	[illegible]	4106.055	-.0360	-1.398
32	[illegible]	[illegible]	[illegible]	4106.025	-.0380	-1.415
33	[illegible]	[illegible]	[illegible]	4106.119	-.0400	-1.321
34	[illegible]	[illegible]	[illegible]	4106.083	.0150	-1.396
35	[illegible]	[illegible]	[illegible]	4106.075	.0130	-1.440
36	[illegible]	[illegible]	[illegible]	4106.022	.0110	-1.452
37	[illegible]	[illegible]	[illegible]	4105.961	.0100	-1.513
38	[illegible]	[illegible]	[illegible]	4105.928	.0080	-1.544
39	[illegible]	[illegible]	[illegible]	4105.790	.0060	-1.581
40	[illegible]	[illegible]	[illegible]	4105.722	.0040	-1.746
41	[illegible]	[illegible]	[illegible]	4105.615	.0020	-1.851
42	[illegible]	[illegible]	[illegible]	4105.617	.0000	-1.849
43	[illegible]	[illegible]	[illegible]	4105.613	-.0010	-1.853
44	[illegible]	[illegible]	[illegible]	4105.535	-.0020	-1.899
45	[illegible]	[illegible]	[illegible]	4105.559	-.0040	-1.923
46	[illegible]	[illegible]	[illegible]	4105.462	-.0050	-2.110
47	[illegible]	[illegible]	[illegible]	4105.497	-.0070	-1.377
48	[illegible]	[illegible]	[illegible]	4105.385	-.0080	-2.084

49	3924.[illegible]	[illegible]	857.10	4115.655	.0550	1.766
50	3923.7[illegible]	11.10	867.98	4115.804	.0520	1.916
51	3923.2[illegible]	11.20	877.12	4115.894	.0510	2.007
52	3923.1[illegible]	11.30	874.44	4115.878	.0490	1.993
53	3923.7[illegible]	11.50	868.56	4115.909	.0460	2.026
54	3923.9[illegible]	11.70	867.57	4115.923	.0430	2.043
55	3924.1[illegible]	11.80	858.95	4115.825	.0410	1.945
56	3924.1[illegible]	11.90	856.49	4116.720	.0320	1.847
57	3924.2[illegible]	12.00	855.63	4116.767	.0320	1.894
58	3924.3[illegible]	12.10	855.51	4116.864	.0320	1.990
59	3924.3[illegible]	12.20	855.66	4116.874	.0320	2.000
60	3924.3[illegible]	12.30	856.63	4116.943	.0320	2.068
61	3924.4[illegible]	12.40	857.05	4117.069	.0320	2.195
62	3924.4[illegible]	12.50	856.60	4117.042	.0320	2.157
63	3924.4[illegible]	12.60	857.89	4117.128	.0320	2.253
64	3924.7[illegible]	12.70	860.56	4117.204	.0330	2.327
65	3924.2[illegible]	12.80	863.23	4117.265	.0330	2.388
66	3924.10	12.90	865.57	4117.331	.0330	2.454
67	3923.9[illegible]	12.90	868.92	4117.241	.0340	2.363
68	3923.5[illegible]	13.00	872.99	4117.200	.0340	2.322
69	3923.3[illegible]	13.10	875.41	4117.153	.0350	2.273
70	3923.7[illegible]	13.20	875.49	4117.225	.0360	2.345
71	3923.2[illegible]	13.30	878.33	4117.244	.0370	2.362
72	3923.[illegible]	13.40	880.37	4117.212	.0370	2.329
73	3922.90	13.40	882.65	4117.220	.0380	2.336
74	3922.9[illegible]	13.60	887.22	4117.258	.0400	2.372
75	3923.0[illegible]	13.70	882.77	4117.333	.0410	2.446
75	3923.[illegible]	13.70	887.19	4117.369	.0420	2.481
78	3923.5[illegible]	13.80	871.93	4117.234	.0420	2.345
79	3923.9[illegible]	13.90	869.50	4117.385	.0440	2.494
80	3924.1[illegible]	14.00	871.25	4117.399	.0450	2.397

REDUCTION OF GRAVITY DATA

SANDHILL ROAD - III

LATITUDE OF REFERENCE STATION = 41.7 DEGREES

ASSUMED ROCK DENSITY = 2.10 GRAMS PER CUBICE CENTIMETER

STATION NUMBER	READING	TIME	ELEVATION	BOUGEUR VALUE	EARTH TIDES	BOUGEUR ANOMALY
2	3901.80	10.20	860.06	4093.328	.0820	-.072
3	3901.90	10.30	859.80	4093.416	.0800	.017
4	3902.00	10.40	859.80	4093.521	.0790	.123
5	3902.10	10.50	859.85	4093.629	.0780	.232
6	3902.10	10.60	860.02	4093.640	.0770	.244
7	3902.00	10.70	859.64	4093.510	.0750	.115
8	3902.00	10.80	859.55	4093.504	.0740	.110
9	3902.00	11.00	859.69	4093.513	.0710	.122
10	3902.00	11.20	859.78	4093.519	.0690	.129
11	3902.00	11.30	859.99	4093.533	.0670	.145
12	3902.20	12.80	857.71	4093.590	.0450	.219
13	3902.30	12.90	854.47	4093.477	.0440	.107
14	3902.50	13.00	851.60	4093.494	.0430	.125
15	3902.70	13.10	850.51	4093.631	.0420	.262
16	3902.70	13.20	849.42	4093.557	.0410	.189
17	3902.80	13.20	848.78	4093.619	.0400	.252
18	3902.80	13.30	849.40	4093.661	.0390	.295
19	3902.90	13.50	849.75	4093.789	.0370	.424
20	3902.90	13.60	849.58	4093.778	.0360	.414
21	3903.00	13.80	850.95	4093.976	.0340	.613
22	3902.90	13.90	852.81	4093.995	.0330	.633
23	3902.70	14.00	855.28	4093.951	.0320	.590
24	3902.60	14.10	856.76	4093.946	.0310	.575
25	3902.70	14.20	856.13	4094.009	.0300	.638
26	3902.80	14.30	854.45	4094.000	.0300	.630
27	3903.00	14.40	853.53	4094.149	.0290	.779
28	3903.00	14.50	853.29	4094.132	.0280	.763
29	3903.10	14.70	853.30	4094.238	.0280	.868
30	3903.00	15.20	853.94	4094.176	.0270	.806
31	3902.90	15.30	855.71	4094.190	.0270	.820
32	3902.80	15.40	858.69	4094.286	.0270	.915
33	3902.50	15.50	853.40	4094.288	.0280	.916
34	3902.20	15.60	858.55	4094.320	.0280	.947
35	3901.90	15.70	872.50	4094.270	.0290	.896
36	3901.90	15.80	874.41	4094.399	.0290	1.024
37	3901.70	15.90	875.83	4094.284	.0300	.909
38	3901.80	16.00	877.28	4094.486	.0300	1.111
39	3901.70	16.10	878.86	4094.488	.0320	1.110
40	3901.60	16.20	880.83	4094.515	.0330	1.136
41	3901.60	9.60	882.99	4094.661	.0850	1.259
42	3901.70	9.70	885.04	4094.903	.0850	1.502
43	3901.50	9.90	886.12	4094.765	.0850	1.364
44	3901.50	10.00	886.18	4094.770	.0850	1.368
45	3901.50	10.20	886.63	4094.800	.0840	1.399
46	3901.50	10.40	887.55	4094.862	.0830	1.461
47	3901.50	10.50	889.28	4094.979	.0820	1.578
48	3901.30	10.60	892.43	4094.981	.0800	1.581

49	3901.10	10.70	895.36	4095.001	.0800	1.602
50	3900.80	10.80	900.14	4094.974	.0790	1.576
51	3900.60	10.90	903.85	4095.014	.0790	1.616
52	3900.50	11.00	905.01	4094.987	.0770	1.590
53	3900.70	11.10	902.34	4095.017	.0760	1.621
54	3900.90	11.20	898.55	4094.972	.0740	1.577
55	3901.10	11.30	895.63	4094.986	.0730	1.592
56	3901.40	11.40	895.43	4095.287	.0710	1.895
57	3901.50	12.80	891.39	4095.121	.0490	1.746
58	3901.80	12.90	886.30	4095.228	.0480	1.854
59	3903.00	13.00	886.50	4096.366	.0460	2.994
60	3902.00	13.10	885.92	4095.278	.0440	1.907
61	3902.10	13.20	885.94	4095.384	.0420	2.015
62	3902.00	13.30	885.94	4095.279	.0400	1.912
63	3902.00	13.40	885.29	4095.235	.0390	1.869
64	3902.00	13.50	884.32	4095.170	.0370	1.805
65	3902.20	13.60	883.86	4095.349	.0350	1.986
66	3902.20	13.70	883.46	4095.322	.0340	1.960
67	3902.20	13.30	883.11	4095.298	.0330	1.937
68	3902.30	13.90	882.94	4095.392	.0310	2.032
69	3902.40	14.10	882.81	4095.488	.0290	2.119
70	3902.30	14.20	882.96	4095.393	.0270	2.026
71	3902.40	14.30	882.76	4095.485	.0260	2.118
72	3902.60	14.40	882.50	4095.677	.0250	2.312
73	3902.50	14.50	882.21	4095.553	.0230	2.189
74	3902.60	14.70	882.55	4095.681	.0220	2.317
75	3902.60	14.80	883.67	4095.756	.0210	2.393
76	3902.50	14.90	885.06	4095.745	.0200	2.382
77	3902.60	14.90	885.75	4095.896	.0190	2.535
78	3902.50	15.00	886.34	4095.831	.0180	2.470
79	3902.60	15.10	887.02	4095.981	.0180	2.620
80	3902.50	15.20	887.76	4095.926	.0170	2.566
81	3902.50	15.30	888.11	4095.950	.0170	2.589
82	3902.70	15.40	889.79	4096.273	.0160	2.913
83	3902.70	9.80	890.66	4096.331	.0740	2.940
84	3902.60	9.90	891.02	4096.250	.0750	2.358
85	3902.70	10.00	891.30	4096.374	.0750	2.982
86	3902.80	10.20	891.28	4096.478	.0760	3.084
87	3902.90	10.30	890.38	4096.522	.0770	3.127
88	3902.80	10.50	889.02	4096.326	.0770	2.930
89	3902.90	10.60	888.12	4096.370	.0770	2.974
90	3903.00	10.70	887.56	4096.438	.0770	3.041
92	3903.10	10.80	886.42	4096.466	.0770	3.069
93	3903.20	11.00	886.36	4096.567	.0770	3.169
94	3903.20	11.10	886.16	4096.553	.0770	3.156
95	3903.30	11.20	885.45	4096.611	.0770	3.213
96	3903.30	11.30	884.94	4096.576	.0760	3.178
97	3903.30	11.50	885.49	4096.613	.0760	3.215
98	3903.30	11.60	885.97	4096.645	.0760	3.247
99	3903.30	11.70	887.32	4096.736	.0750	3.339
100	3903.20	13.10	889.33	4096.767	.0650	3.375
101	3903.30	13.20	891.22	4096.999	.0640	3.608
102	3903.10	13.30	892.27	4096.859	.0630	3.469
103	3903.10	13.40	892.87	4096.900	.0620	3.510
104	3903.10	13.50	892.87	4096.900	.0610	3.511
105	3903.20	13.60	892.74	4096.996	.0600	3.608
106	3903.20	13.70	892.53	4096.982	.0590	3.594
107	3903.30	13.80	892.30	4097.071	.0570	3.686
108	3903.30	13.90	891.94	4097.047	.0560	3.662
109	3903.50	14.00	891.94	4097.257	.0540	3.874
110	3903.50	14.10	890.37	4097.151	.0520	3.760

111	3903.50	14.20	889.57	4097.104	.0510	3.713
112	3903.60	14.30	889.38	4097.190	.0500	3.799
113	3903.70	14.40	889.07	4097.274	.0480	3.885
115	3903.60	14.50	889.23	4097.180	.0470	3.792
116	3903.60	14.60	889.33	4097.186	.0450	3.800
117	3903.60	14.70	889.48	4097.196	.0440	3.811
118	3903.60	14.80	890.00	4097.231	.0420	3.848
119	3903.60	14.90	890.70	4097.279	.0400	3.896
120	3903.70	15.10	891.60	4097.444	.0380	4.063
121	3903.70	15.20	892.36	4097.495	.0360	4.116
122	3903.70	15.30	893.20	4097.552	.0350	4.173
123	3903.70	15.40	893.88	4097.597	.0330	4.221
124	3903.80	15.50	894.45	4097.741	.0310	4.366
125	3903.80	15.60	895.12	4097.786	.0290	4.412
126	3903.70	16.00	896.02	4097.741	.0220	4.374
127	3903.60	16.50	896.59	4097.675	.0140	4.314
128	3903.50	16.60	897.64	4097.640	.0120	4.281
129	3903.50	15.60	898.67	4097.710	.0100	4.352
130	3903.50	16.70	899.86	4097.790	.0090	4.433
131	3903.50	16.80	900.83	4097.855	.0070	4.500
132	3903.50	16.90	902.06	4097.938	.0060	4.583

REDUCTION OF GRAVITY DATA

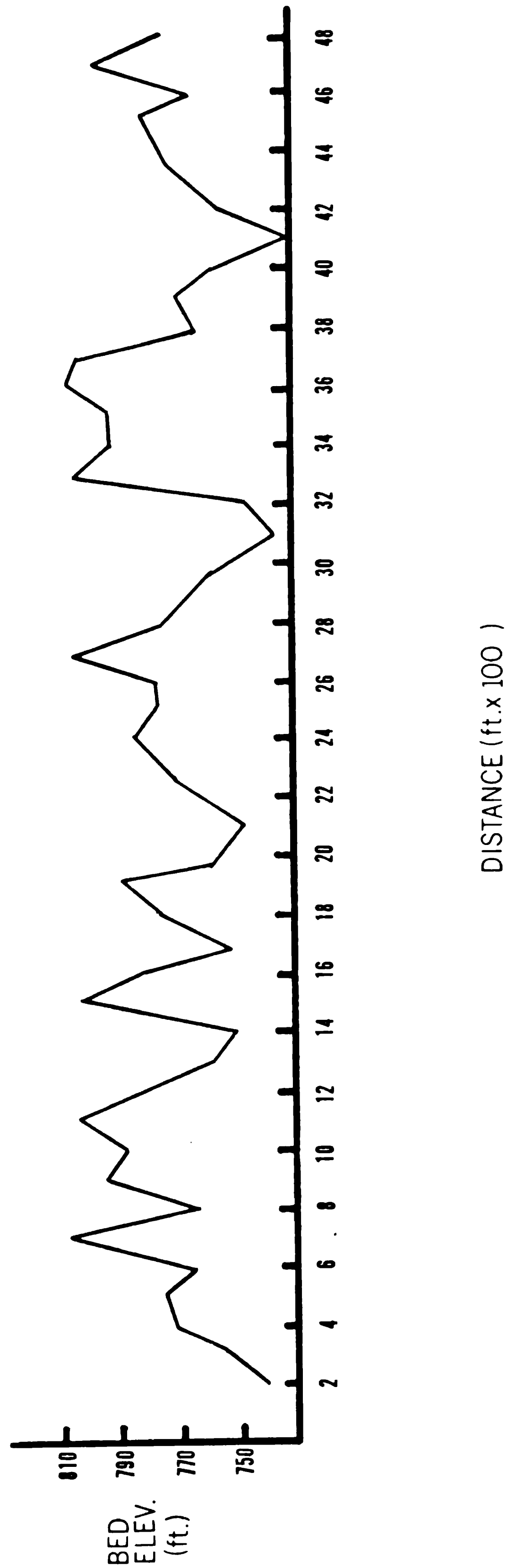
MERIDIAN ROAD - IV

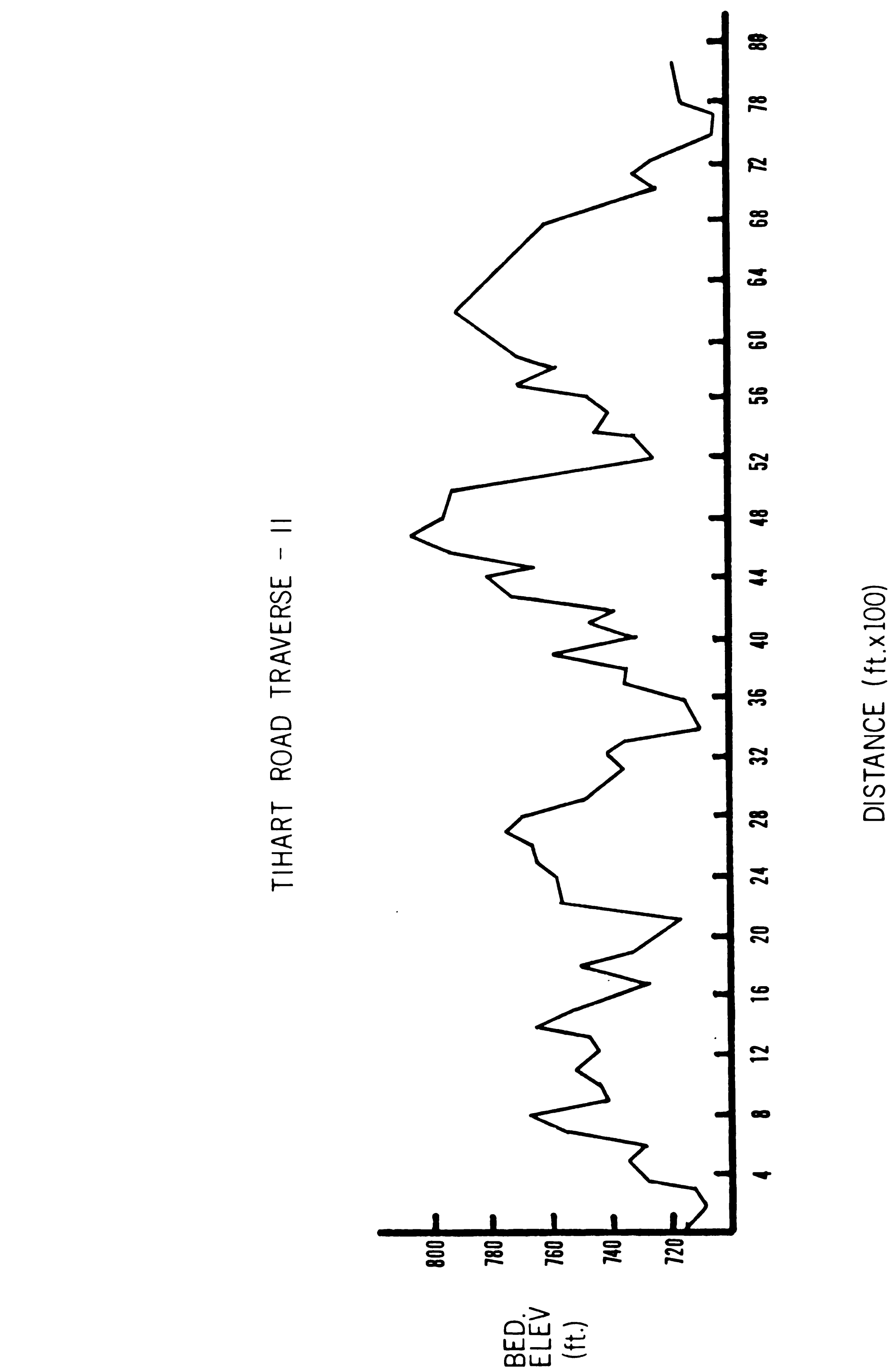
LATITUDE OF REFERENCE STATION = 41.7 DEGREES

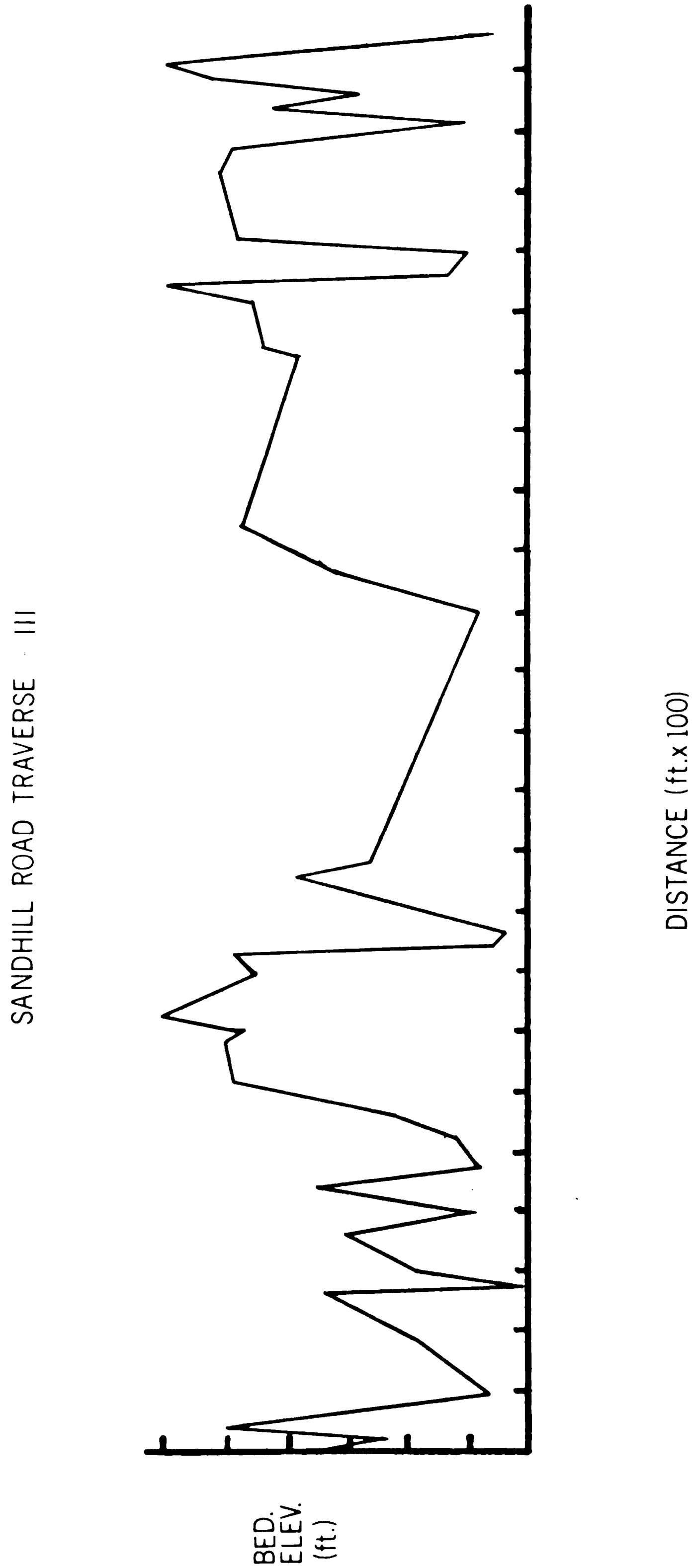
ASSUMED ROCK DENSITY = 2.10 GRAMS PER CUBICE CENTIMETER

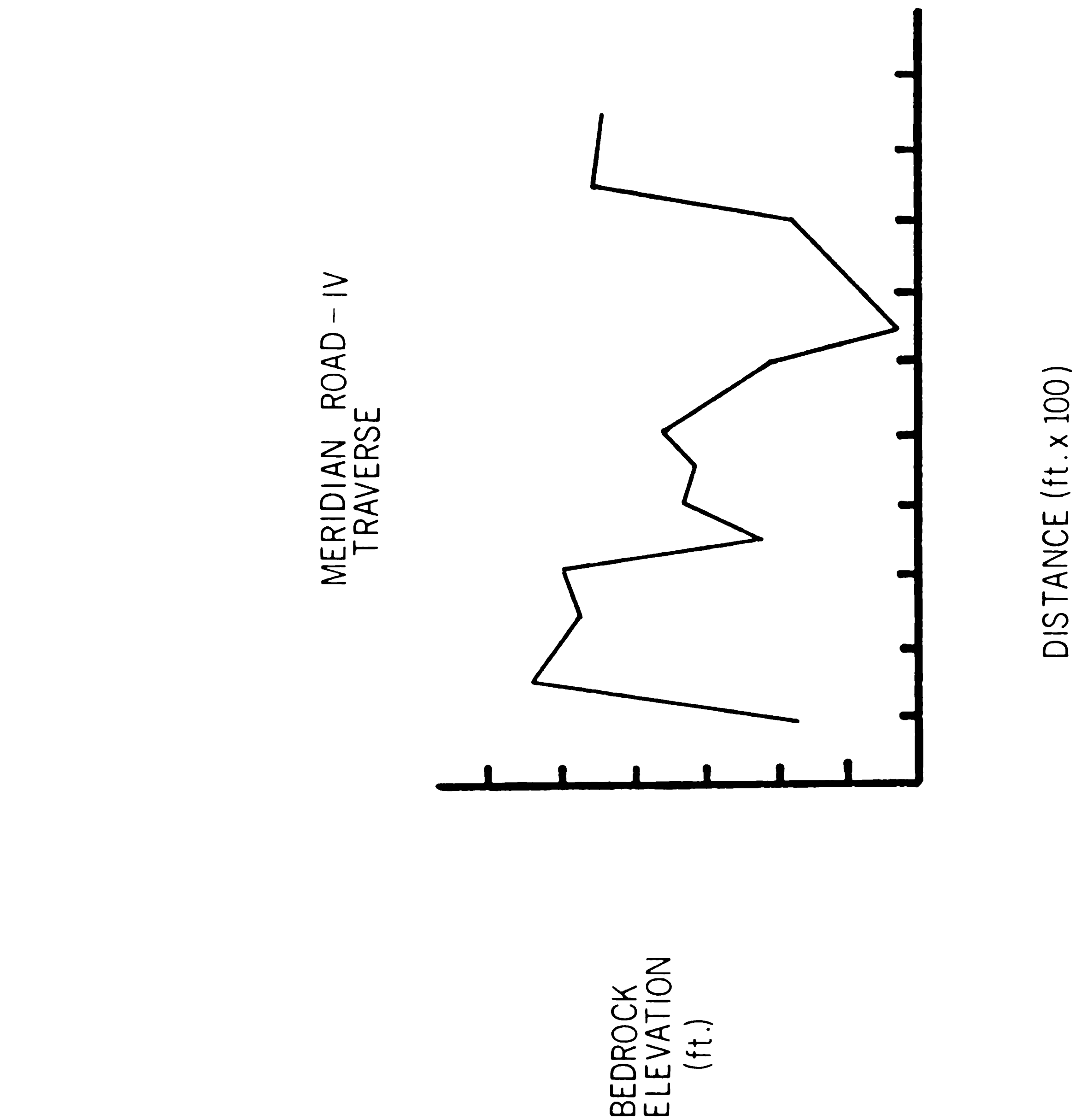
STATION NUMBER	READING	TIME	ELEVATION	BOUGEUR VALUE	EARTH TIDES	BOUGEUR ANOMALY
1	3919.70	10.80	859.36	4112.150	.0750	-.071
2	3919.60	10.80	870.76	4112.081	.0750	-.140
3	3919.70	10.90	870.74	4112.160	.0740	-.060
4	3919.90	11.00	869.04	4112.232	.0730	.012
5	3920.10	11.10	866.26	4112.230	.0710	.012
6	3920.30	11.20	864.10	4112.270	.0700	.053
7	3920.40	11.20	863.00	4112.277	.0690	.061
8	3920.50	11.30	862.57	4112.329	.0680	.114
9	3920.60	11.30	861.57	4112.367	.0670	.152
10	3920.70	11.40	861.02	4112.410	.0660	.197
11	3920.80	11.50	860.27	4112.440	.0650	.228
12	3920.90	11.50	859.51	4112.470	.0630	.259
13	3921.00	11.60	858.60	4112.489	.0620	.279
15	3921.20	11.70	858.47	4112.642	.0600	.433
16	3921.20	11.70	858.53	4112.622	.0590	.414
17	3921.30	11.90	858.35	4112.690	.0560	.485
18	3921.40	11.90	858.10	4112.754	.0550	.550
19	3921.40	12.00	858.63	4112.765	.0540	.562
20	3921.50	12.10	859.15	4112.881	.0510	.680

JOLLY ROAD TRAVERSE - I




TIHART ROAD TRAVERSE - II
BED. ELEV (ft.)
800
780
760
740
720
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
DISTANCE (ft.x100)


SANDHILL ROAD TRAVERSE - III
DISTANCE (ft.x100)
BED.
ELEV.
(ft.)


MERIDIAN ROAD – IV
TRAVERSE
DISTANCE (ft. x 100)
BEDROCK
ELEVATION
(ft.)

APPENDIX II

WELL LOGS

WATER WELL LOGS

The water well logs were obtained from the Michigan Geological Survey. The logs listed were chosen from over 500 logs based on what was thought to be a more complete geologic description. The logs are listed in a code that was used for easire manipulation and storage on the computer. An example of a coded well log is as follows:

42696.875032807.6875		4	1	
20101	0.0	4.0	21.0	0.0
	0.0	25.0	0.0	0.0
	5.0	3.0	12.0	5.0
	8.0	0.0	8.5	8.5

The numbers 42696.8750 and 32807.6875 are the Cartesian coordinates of the well location, with the origin one mile south of the southwest corner of the township. 1000 coordinate units roughly correspond to 1000 feet. The number 4 refers to the number of 25 foot intervals making up the glacial drift section. All locations cannot be divided evenly into 25 foot intervals and for this reason rounding off to the nearest interval occurs. The number 1 refers to the fact that the bedrock at that location is shale, 2 refers to sandstone bedrock. 20101 is the well number. 2 refers to Meridian Township (I used some wells outside the township for deriving the bedrock topographic maps), 01 is the section number, and 01 is the well number in that section. The first of the four columns is the approximate number of feet of clay in the 25 foot interval. The second, third, and fourth columns correspond to till, sand, and gravel. So that, in the first 25 foot interval there is 0.0 feet of clay, 4.0 feet of till, 21.0 feet of sand and 0.0 feet of gravel. In this case the drift was approximately 100 feet thick, this is the reason for the four lines of values.

42696.875032807.6875		4	1	
20101	0.0	4.0	21.0	0.0
	0.0	25.0	0.0	0.
	5.0	3.0	12.0	5.0
	8.0	0.0	8.5	8.5
41351.375030109.8984		4	1	
20102	0.0	0.0	25.0	0.0
	0.0	0.0	25.0	0.0
	0.0	10.0	15.0	0.0
	0.0	10.0	7.5	7.5
41987.062531039.3594		4	1	
20103	3.0	0.0	17.0	5.0
	0.0	0.0	7.5	17.5
	0.0	2.0	0.0	23.0
	0.0	25.0	0.0	0.0
40235.437529168.5000		4	1	
20104	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	8.0	0.0	8.5	8.5
39359.765628243.0859		4	1	
20105	25.0	0.0	0.0	0.0
	5.0	0.0	20.0	0.0
	15.0	0.0	0.0	10.0
	15.0	0.0	10.0	0.0
40068.390628751.2500		4	1	
20106	0.0	10.0	15.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	20.0	0.0	5.0
29231.578131413.5937		4	1	
20301	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	20.0	2.5	2.5
	0.0	0.0	12.5	12.5
29716.539131705.4844		5	1	
20302	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
31044.648428602.7422		6	1	
20303	19.0	6.0	0.0	0.0
	22.0	0.0	0.0	3.0
	20.0	0.0	5.0	0.0
	5.0	0.0	20.0	0.0
	22.0	0.0	3.0	0.0
	0.0	14.0	5.5	5.5
30617.125029350.0391		7	1	
20304	0.0	0.0	25.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
29236.460930513.3750		4	1	
20305	3.0	13.0	9.0	0.0
	0.0	25.0	0.0	0.0
	0.0	13.0	12.0	0.0
	0.0	17.0	8.0	0.0

29296.453130512.3672		4	1	
20306	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	20.0	5.0	0.0
	0.0	0.0	12.5	12.5
23763.421932165.5156		4	1	
20401	25.0	0.0	0.0	0.0
	15.0	0.0	0.0	10.0
	14.0	0.0	11.0	0.0
	13.0	5.0	7.0	0.0
24019.585928360.6797		6	1	
20402	0.0	17.0	8.0	0.0
	22.0	3.0	0.0	0.0
	25.0	0.0	0.0	0.0
	20.0	0.0	0.0	5.0
	0.0	0.0	0.0	25.0
	0.0	0.0	0.0	25.0
24375.468730495.0000		6	2	
20403	25.0	0.0	0.0	0.0
	25.0	0.0	0.0	0.0
	10.0	15.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
21759.226628358.6328		4	1	
20404	22.0	0.0	3.0	0.0
	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	9.0	0.0	8.0	8.0
22895.710928139.5078		5	2	
20405	0.0	0.0	7.0	18.0
	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
24036.039129340.5312		5	1	
20406	15.0	10.0	0.0	0.0
	8.0	17.0	0.0	0.0
	0.0	25.0	0.0	0.0
	12.0	13.0	0.0	0.0
	0.0	15.0	0.0	10.0
24154.125032799.0312		6	1	
20407	17.0	8.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	17.0	5.0	3.0
	0.0	2.0	23.0	0.0
	0.0	0.0	12.0	13.0
	0.0	0.0	0.0	25.0
18399.523429595.2109		3	2	
20501	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	15.0	10.0	0.0
19613.460930414.9453		4	1	
20502	5.0	20.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	4.0	15.0	6.0
	0.0	10.0	7.5	7.5
19202.953128601.5781		5	1	
20504	22.0	3.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	18.0	0.0	7.0

	0.0	00.0	0.0	25.0
	25.0	0.0	0.0	0.0
19535.851628175.9375		5	1	
20505	25.0	0.0	0.0	0.0
	25.0	0.0	0.0	0.0
	6.0	0.0	19.0	0.0
	15.0	0.0	10.0	0.0
	25.0	0.0	0.0	0.0
17139.882828436.1953		4	1	
20706	12.0	0.0	13.0	0.0
	0.0	20.0	5.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
17506.546928830.0937		4	1	
20507	00.0	0.0	12.5	12.5
	0.0	0.0	0.0	25.0
	0.0	0.0	0.0	25.0
	0.0	25.0	0.0	0.0
17179.023429575.7109		3	1	
20508	0.0	20.0	5.0	0.0
	0.0	10.0	15.0	0.0
	0.0	10.0	15.0	0.0
17493.570331630.7109		4	1	
20509	25.0	0.0	0.0	0.0
	23.0	0.0	2.0	0.0
	0.0	0.0	17.5	7.5
	15.0	0.0	5.0	5.0
12935.710932987.4219		4	2	
20601	25.0	0.0	0.0	0.0
	15.0	10.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
10780.906232123.4922		3	1	
20602	25.0	0.0	0.0	0.0
	22.0	0.0	3.0	0.0
	25.0	0.0	0.0	0.0
13786.066428832.5625		3	1	
20603	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
12493.457030474.5078		3	1	
20604	25.0	0.0	0.0	0.0
	20.0	0.0	0.0	5.0
	0.0	0.0	12.5	12.5
13013.718730485.7812		4	2	
20605	25.0	0.0	0.0	0.0
	15.0	0.0	5.0	5.0
	0.0	25.0	0.0	5.0
	0.0	25.0	0.0	0.0
10826.484428882.2734		3	1	
20606	6.0	0.0	19.0	0.0
	0.0	0.0	25.0	0.0
	17.0	0.0	8.0	0.0
13621.019530915.6328		4	1	
20607	0.0	25.0	0.0	19.0
	16.0	3.0	6.0	0.0
	10.0	15.0	0.0	0.0
	0.0	25.0	0.0	0.0
13462.050830978.3047		3	1	
20608	12.0	0.0	13.0	0.0
	0.0	0.0	25.0	0.0

	0.0	7.0	18.0	0.0
12463.293023914.0781		3	2	
20701	25.0	0.0	0.0	0.0
	15.0	10.0	0.0	0.0
	2.0	23.0	0.0	0.0
11191.652327996.0156		3	1	
20702	9.0	3.0	13.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
16079.765623673.3281		2	1	
20703	25.0	0.0	0.0	0.0
	25.0	0.0	0.0	0.0
19998.539123567.5156		6	1	
20801	14.0	0.0	11.0	0.0
	00.0	0.0	19.0	6.0
	0.0	0.0	12.5	12.5
	0.0	0.0	12.5	12.5
	0.0	15.0	5.0	5.0
	15.0	10.0	0.0	0.0
19966.265624028.1250		2	1	
20802	10.0	10.0	0.0	5.0
	5.0	20.0	0.0	0.0
17007.812527718.3203		3	1	
20803	0.0	10.0	15.0	0.0
	17.0	8.0	0.0	0.0
	20.0	5.0	0.0	0.0
20038.835925967.1719		4	1	
20804	0.0	25.0	0.0	0.0
	5.0	5.0	7.5	7.5
	0.0	20.0	5.0	0.0
	0.0	25.0	0.0	0.0
19906.429725229.2969		4	1	
20805	0.0	25.0	0.0	0.0
	0.0	8.0	8.5	8.5
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
20107.585924105.7578		3	1	
20806	13.0	12.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
20882.250024972.8672		4	1	
20807	0.0	8.0	8.5	8.5
	0.0	0.0	12.5	12.5
	14.0	0.0	5.0	6.0
	0.0	0.0	0.0	25.0
20294.125023302.5078		6	1	
20808	0.0	0.0	25.0	0.0
	0.0	0.0	5.0	20.0
	0.0	15.0	0.0	10.0
	0.0	22.0	3.0	0.0
	0.0	15.0	5.0	5.0
	14.0	11.0	0.0	0.0
24649.750027770.0078		4	1	
20901	0.0	25.0	0.0	0.0
	0.0	25.0	0.0	0.0
	0.0	0.0	25.0	0.0
	0.0	15.0	10.0	0.0
22902.484423778.7891		3	1	
20902	25.0	0.0	0.0	0.0
	9.0	0.0	0.0	16.0
	14.0	5.0	0.0	6.0

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24812.265626727.1328       5      1
20903         20.0       5.0          0.0         0.0
               0.0      25.0          0.0         0.0
              15.0       0.0          0.0        10.0
               5.0       0.0         20.0         0.0
              20.0       5.0          0.0         0.0
21585.210922760.7578       3      1
20904          5.0      20.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
23365.960922790.8672       3      1
20905          5.0      15.0          5.0         0.0
               0.0      20.0          0.0         5.0
               0.0      25.0          0.0         0.0
25716.171926951.9766       4      1
20906         16.0       9.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
21702.320323778.9297       3      2
20907          8.0      17.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
25784.257825050.5703       3      1
20908          5.0      20.0          0.0         0.0
               5.0      20.0          0.0         0.0
              25.0       0.0          0.0         0.0
26048.437524106.0000       4      1
20909          7.0      18.0          0.0         0.0
               6.0      19.0          0.0         0.0
               0.0      23.0          2.0         0.0
              10.0      15.0          0.0         0.0
31452.187525475.4687       6      2
21001         25.0       0.0          0.0         0.0
              15.0       0.0          0.0        10.0
              25.0       0.0          0.0         0.0
              25.0       0.0          0.0         0.0
              17.0       0.0          4.0         4.0
              11.0       0.0         14.0         0.0
31041.312526022.4453       4      1
21002          0.0      20.0          5.0         0.0
               0.0       0.0         12.5        12.5
               0.0       0.0         12.5        12.5
              10.0       0.0          7.5         7.5
28089.609427732.2500       4      1
21004          4.0      21.0          0.0         0.0
               0.0      20.0          5.0         0.0
               0.0      15.0         10.0         0.0
               0.0      25.0          0.0         0.0
31420.585925976.0625       5      1
21005         16.0       0.0          4.5         4.5
              14.0       0.0          5.5         5.5
              23.0       0.0          0.0         2.0
              25.0       0.0          0.0         0.0
              11.0      14.0          0.0         0.0
30766.570325146.9297       6      2
21008         18.0       0.0          7.0         0.0
               0.0      16.0          9.0         0.0
               0.0       4.0         21.0         0.0
               0.0       0.0         25.0         0.0
              11.0       0.0         14.0         0.0
              25.0       0.0          0.0         0.0
29339.023427091.1797       6      2
21006          5.0      20.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      16.0          9.0         0.0
               0.0       8.0         17.0         0.0
               1.0       4.0         10.0        10.0
               0.0       5.0         10.0        10.0
30936.992223383.8281       5      1
21007          0.0      25.0          0.0         0.0
              18.0       7.0          0.0         0.0
               0.0      10.0         10.0         5.0
               0.0       5.0         10.0        10.0
               6.0      19.0          0.0         0.0
29550.742227787.7109       6      1
21009          0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
              10.0      15.0          0.0         0.0
              20.0       5.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
30300.218727155.0391       6      2
21010          0.0      12.0         13.0         0.0
               0.0       0.0         17.0         8.0
              10.0       0.0          0.0        15.0
               0.0       0.0          0.0        25.0
               0.0       0.0          0.0        25.0
               2.0       0.0          0.0        23.0
31621.929723672.3594       4      1
21011          0.0      15.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0      25.0          0.0         0.0
33379.000023482.8359       6      1
21101         25.0       0.0          0.0         0.0
              15.0      10.0          0.0         0.0
               0.0      25.0          0.0         0.0
               0.0       9.0          0.0        16.0
               0.0       1.0          0.0        24.0
               0.0      25.0          0.0         0.0
```

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32716.734423353.9297     5        1
21102       25.0        0.0          0.0         0.0
            20.0        0.0          0.0         5.0
            25.0        0.0          0.0         0.0
            25.0        0.0          0.0         0.0
            10.0       15.0          0.0         0.0
36376.343726872.9766     5        1
21103        0.0        0.0         25.0         0.0
             0.0        0.0         17.0         8.0
             0.0        0.0         12.5        12.5
            15.0        0.0          5.0         5.0
            11.0        0.0          7.0         7.0
33472.906225501.5312     6        1
21104       25.0        0.0          0.0         0.0
            20.0        0.0          5.0         0.0
             0.0        0.0         12.5        12.5
            25.0        0.0          0.0         0.0
            25.0        0.0          0.0         0.0
            25.0        0.0          0.0         0.0
35087.484423974.2187     4        2
21105       20.0        0.0          5.0         0.0
             0.0        0.0         25.0         0.0
             0.0        5.0         20.0         0.0
             0.0       25.0          0.0         0.0
42650.890627687.7422     4        1
21201        0.0       10.0          7.5         7.5
             0.0       20.0          2.5         2.5
             0.0       10.0         15.0         0.0
             0.0       25.0          0.0         0.0
41293.843723109.8828     4        1
21202       25.0        0.0          0.0         0.0
            25.0        0.0          0.0         0.0
            13.0        0.0          0.0        12.0
            25.0        0.0          0.0         0.0
39069.390627627.8594     4        1
21203        0.0       22.0          3.0         0.0
             0.0        0.0         25.0         0.0
             0.0        0.0         10.0        15.0
            16.0        0.0          0.0         9.0
39389.562524061.9922     4        1
21204       18.0        0.0          3.5         3.5
            15.0        0.0          5.0         5.0
             5.0        0.0         10.0        10.0
             5.0        0.0         10.0        10.0
38259.625025861.2187     5        1
21205        0.0       25.0          0.0         0.0
             0.0       25.0          0.0         0.0
             0.0       25.0          0.0         0.0
            10.0       15.0          0.0         0.0
            16.0        0.0          9.0         0.0
38285.875022660.3203     5        1
21206        0.0        0.0         12.5        12.5
             0.0        0.0         12.5        12.5
             0.0       25.0          0.0         0.0
             0.0       25.0          0.0         0.0
             0.0       25.0          0.0         0.0
41032.734421854.0781     3        1
21301        4.0        0.0         20.0         0.0
             0.0        0.0         12.5        12.5
             5.0        0.0         10.0        10.0
38876.609418529.8281     4        1
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21302            0.0        25.0         0.0         0.0
                 0.0         5.0         0.0        20.0
                 0.0        25.0         0.0         0.0
                10.0        15.0         0.0         0.0
38716.062522073.0234        3       1
21303            0.0         0.0        20.0         5.0
                 0.0         0.0        12.5        12.5
                25.0         0.0         0.0         0.0
39889.187521653.2578        3       1
21304            4.0         0.0        21.0         0.0
                 0.0         0.0        12.5        12.5
                 5.0         0.0        10.0        10.0
37315.968719696.1953        4       1
21401            0.0         6.0        19.0         0.0
                 0.0        25.0         0.0         0.0
                10.0        15.0         0.0         0.0
                25.0         0.0         0.0         0.0
34674.625022020.8672        5       1
21402           20.0         0.0         5.0         0.0
                10.0         0.0        15.0         0.0
                25.0         0.0         0.0         0.0
                 5.0         0.0        10.0        10.0
                 0.0         0.0        12.5        12.5
33178.234419865.6953        4       1
21403           10.0         0.0        15.0         0.0
                 0.0        19.0         0.0         6.0
                 0.0         4.0         0.0        21.0
                 0.0         0.0         0.0        25.0
34737.375017419.1719        5       1
21404           20.0         0.0         5.0         0.0
                10.0         0.0        15.0         0.0
                25.0         0.0         0.0         0.0
                 5.0         0.0        10.0        10.0
                 0.0         0.0        12.5        12.5
32041.453117684.4766        4       1
21501            0.0        25.0         0.0         0.0
                 0.0         5.0        20.0         0.0
                 0.0         0.0        25.0         0.0
                 5.0        20.0         0.0         0.0
26755.289118553.3594        4       2
21601           16.0         7.0         0.0         2.0
                 0.0        25.0         0.0         0.0
                 0.0        25.0         0.0         0.0
                 0.0        25.0         0.0         0.0
18819.742221266.9766        3       1
21701            6.0        14.0         5.0         0.0
                 0.0         6.0        19.0         0.0
                 0.0        25.0         0.0         0.0
13434.457020997.3672        3       1
21801            0.0         0.0        25.0         0.0
                 0.0         0.0        25.0         0.0
                15.0         0.0         5.0         5.0
13405.609416897.2734        3       1
21902           16.0         0.0         4.5         4.5
                 0.0        14.0         4.0         7.0
                18.0         7.0         0.0         0.0
20315.781212680.6562        4       2
22001            0.0        18.0         3.5         3.5
                 0.0        12.0         6.5         6.5
                 0.0         5.0        10.0        10.0
                 0.0        25.0         0.0         0.0
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18452.015612471.9258    4     2
22002        8.0       0.0         17.0        0.0
            10.0       0.0         15.0        0.0
            10.0       0.0         15.0        0.0
            10.0       0.0         15.0        0.0
17054.898412655.4102    2     1
22003        5.0      20.0          0.0        0.0
            25.0       0.0          0.0        0.0
18018.789112879.2578    3     1
22004       14.0       9.0          2.0        0.0
            18.0       7.0          0.0        0.0
             3.0       9.0          0.0        0.0
20283.960916741.7656    3     1
22005       15.0       4.0          0.0        6.0
             0.0      15.0          0.0       10.0
             4.0       0.0          0.0       15.0
20802.578114272.7148    5     2
22006        0.0      10.0         15.0        0.0
             0.0      25.0          0.0        0.0
             0.0      25.0          0.0        0.0
             0.0      25.0          0.0        0.0
             0.0      15.0          0.0        0.0
18287.453115775.1484    2     1
22007        0.0      25.0          0.0        0.0
             0.0       5.0         20.0        0.0
25514.859413773.5156    3     2
22101       20.0       0.0          5.0        0.0
            19.0       6.0          0.0        0.0
             0.0       2.0          7.0        4.0
23073.031212494.3359    5     1
22102       10.0       0.0         15.0        0.0
            20.0       0.0          5.0        0.0
            10.0       0.0          0.0       15.0
             0.0       0.0          0.0       25.0
             0.0       0.0          0.0       25.0
23332.789116050.4766    4     2
22103       13.0       0.0          9.5        2.5
             4.0       0.0         10.5       10.5
             0.0       0.0          0.0       25.0
             0.0       0.0         12.0        1.0
24878.796915204.3984    3     1
22104       20.0       0.0          5.0        0.0
             0.0      20.0          5.0        0.0
             0.0      12.0          0.0        0.0
23723.476616684.0078    3     1
22105       10.0       5.0          5.0        5.0
             0.0      23.0          1.0        1.0
             0.0       0.0         10.0       10.0
24184.593715556.1016    3     2
22106        4.0      21.0          0.0        0.0
            25.0       0.0          0.0        0.0
            19.0       0.0          3.0        0.0
23633.109413685.0977    3     2
22107       20.0       0.0          5.0        0.0
             0.0       0.0         25.0        0.0
             0.0       0.0         23.0        0.0
24887.351616904.4922    3     2
22108        0.0      25.0          0.0        0.0
             0.0      10.0         15.0        0.0
             0.0       5.0          5.0        0.0
24251.460917155.2031    4     2

22109        5.0       0.0         13.5        6.5
             0.0       0.0          2.5       22.5
             0.0       0.0          0.0       25.0
             6.0       0.0          0.0        3.0
27107.398414506.8789    4     2
22201       25.0       0.0          0.0        0.0
            25.0       0.0          0.0        0.0
             0.0       0.0         15.5        9.5
             0.0       0.0         20.0        0.0
30492.068714810.0703    3     1
22202       14.0       0.0          5.5        5.5
            25.0       0.0          0.0        0.0
            17.0       0.0          0.0        0.0
28395.453113785.1484    4     2
22203       20.0       5.0          0.0        0.0
             0.0      25.0          0.0        0.0
             0.0      25.0          0.0        0.0
             0.0       7.0          0.0        0.0
31863.882813066.8086    3     1
22204       15.0       0.0         10.0        0.0
             0.0      10.0         15.0        0.0
             0.0      15.0          0.0       10.0
28112.781216010.2070    3     2
22205       12.0       0.0         13.0        0.0
             7.0       0.0         15.0        3.0
             0.0       0.0          0.0       10.0
27729.351612236.1133    2     2
22206        0.0      25.0          0.0        0.0
            13.0      12.0          0.0        0.0
28697.242215080.2617    4     1
22207       25.0       0.0          0.0        0.0
            10.0      15.0          0.0        0.0
             0.0      23.0          0.0        2.0
            15.0       0.0          0.0        0.0
34562.156212941.4844    4     1
22301        0.0       0.0         25.0        0.0
             6.0       0.0         19.0        0.0
            14.0       0.0         11.0        0.0
            22.0       0.0          0.0        0.0
34519.265616342.6836    3     1
22302        7.0      18.0          0.0        0.0
             0.0      25.0          0.0        0.0
             0.0      25.0          0.0        0.0
35991.703113497.5625    4     2
22303        0.0       0.0         12.5       12.5
             0.0       0.0         12.5       12.5
             0.0       0.0         12.5       12.5
             0.0       9.0          8.0        8.0
40254.234417186.5078    5     1
22401       25.0       0.0          0.0        0.0
            25.0       0.0          0.0        0.0
            10.0      15.0          0.0        0.0
             0.0      25.0          0.0        0.0
             0.0      10.0          0.0        0.0
38934.312513628.1680    4     1
22402       16.0       0.0          4.5        4.5
             0.0       0.0         12.5       12.5
             0.0       0.0         12.5       12.5
             0.0       0.0          9.5        9.5
39073.468712385.6523    5     1
22404       12.0       0.0         13.0        0.0
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	0.0	0.0		25.0	0.0
	0.0	0.0		17.5	7.5
	4.0	0.0		10.5	10.5
	13.0	0.0		0.0	0.0
42723.0781	8163.7812	4	1		
22405	6.0	0.0		19.0	0.0
	25.0	0.0		0.0	0.0
	2.0	0.0		0.0	23.0
	0.0	0.0		0.0	10.0
38760.6250	8050.2988	4	1		
22502	25.0	0.0		0.0	0.0
	15.0	0.0		10.0	0.0
	0.0	15.0		10.0	0.0
	0.0	25.0		0.0	0.0
39781.2656	11653.6641	3	1		
22503	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	0.0	0.0		20.0	0.0
38998.9062	7946.2832	3	1		
22504	0.0	0.0		25.0	0.0
	7.0	15.0		3.0	0.0
	0.0	15.0		0.0	0.0
41827.8594	10839.1836	4	1		
22505	0.0	0.0		0.0	25.0
	0.0	14.0		0.0	11.0
	0.0	0.0		0.0	25.0
	0.0	0.0		0.0	23.0
35002.4687	10573.7539	5	1		
22601	8.0	0.0		17.0	0.0
	0.0	0.0		25.0	0.0
	0.0	0.0		25.0	0.0
	1.0	0.0		24.0	0.0
	16.0	0.0		0.0	0.0
35521.3906	10505.0312	5	1		
22602	10.0	0.0		7.5	7.5
	0.0	10.0		7.5	7.5
	0.0	15.0		5.0	5.0
	0.0	10.0		7.5	7.5
	0.0	0.0		5.0	0.0
35020.1094	10433.4375	4	1		
22603	0.0	25.0		0.0	0.0
	0.0	25.0		0.0	0.0
	0.0	25.0		0.0	0.0
	6.0	15.0		0.0	0.0
30679.2031	11606.4961	3	2		
22701	20.0	0.0		5.0	0.0
	0.0	0.0		25.0	0.0
	0.0	0.0		15.0	5.0
27315.1562	10202.7852	2	2		
22702	20.0	0.0		5.0	0.0
	0.0	5.0		20.0	0.0
31407.5547	7333.6641	2	1		
22703	5.0	6.0		14.0	0.0
	9.0	0.0		0.0	5.0
32033.8281	10083.5352	2	2		
22704	12.0	0.0		6.5	6.5
	0.0	0.0		0.0	7.0
27736.4453	10275.7227	2	2		
22705	0.0	2.0		23.0	0.0
	0.0	22.0		0.0	0.0
31444.1562	9513.3555	2	1		
22706	10.0	0.0		15.0	0.0
	0.0	20.0		5.0	0.0
27463.0469	9480.1992	2	2		
22707	0.0	2.0		23.0	0.0
	0.0	22.0		0.0	0.0
28182.2734	9428.1172	2	1		
22708	2.0	23.0		0.0	0.0
	0.0	10.0		10.0	5.0
28619.4922	11641.0820	4	2		
22709	0.0	0.0		25.0	0.0
	0.0	0.0		25.0	0.0
	0.0	20.0		5.0	0.0
	0.0	15.0		0.0	0.0
30137.2891	9115.2422	3	1		
22710	13.0	12.0		0.0	0.0
	1.0	24.0		0.0	0.0
	8.0	0.0		0.0	0.0
23138.9219	11653.1094	3	2		
22801	6.0	6.0		6.5	6.5
	8.0	4.0		0.0	13.0
	0.0	0.0		0.0	10.0
23828.5937	9841.2773	3	1		
22802	11.0	14.0		0.0	0.0
	0.0	25.0		0.0	0.0
	0.0	4.0		9.0	0.0
26401.8125	11798.3437	2	2		
22803	6.0	0.0		19.0	0.0
	0.0	0.0		6.0	0.0
23062.2891	11854.4219	2	2		
22804	16.0	1.0		4.0	4.0
	0.0	20.0		0.0	0.0
23076.5703	11514.1406	2	2		
22805	11.0	0.0		7.0	7.0
	5.0	10.0		0.0	0.0
25302.3047	11836.8086	2	2		
22806	5.0	0.0		10.0	10.0
	0.0	0.0		5.0	0.0
24120.3125	10536.4727	2	2		
22807	7.0	5.0		10.0	3.0
	0.0	0.0		18.0	0.0
16477.8516	11644.9609	3	2		
22901	0.0	25.0		0.0	0.0
	0.0	12.0		13.0	0.0
	5.0	0.0		0.0	0.0
16482.0937	8324.4180	3	2		
22902	0.0	0.0		12.5	12.5
	0.0	10.0		5.0	10.0
	0.0	0.0		0.0	13.0
15795.1055	10296.2305	2	2		
23001	25.0	0.0		0.0	0.0
	21.0	0.0		0.0	0.0
13861.4570	8308.4219	3	2		
23002	25.0	0.0		0.0	0.0
	15.0	0.0		10.0	0.0
	15.0	0.0		0.0	0.0
14072.2070	6564.6348	3	2		
23101	14.0	11.0		0.0	0.0
	0.0	25.0		0.0	0.0
	0.0	25.0		0.0	0.0
11913.1836	6640.9004	2	2		
23102	7.0	18.0		0.0	0.0

	3.0	22.0		0.0	0.0
16772.1562	6539.2969	4	1		
23201	9.0	0.0		16.0	0.0
	0.0	0.0		12.5	12.5
	0.0	8.0		4.5	12.5
	0.0	4.0		0.0	0.0
24750.4297	1604.6392	4	1		
23301	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	5.0	10.0		0.0	0.0
21872.5078	1752.9834	3	1		
23302	24.0	1.0		0.0	0.0
	0.0	25.0		0.0	0.0
	0.0	10.0		0.0	0.0
22972.6953	1754.5103	3	2		
23303	15.0	0.0		10.0	0.0
	0.0	0.0		25.0	0.0
	15.0	0.0		0.0	0.0
23183.7500	2411.0586	3	1		
23304	9.0	16.0		0.0	0.0
	12.0	13.0		0.0	0.0
	0.0	9.0		0.0	0.0
30586.7266	2526.7715	4	1		
23401	19.0	0.0		6.0	0.0
	5.0	0.0		20.0	0.0
	15.0	0.0		10.0	0.0
	20.0	0.0		0.0	0.0
30692.4219	2865.0439	4	1		
23402	0.0	0.0		25.0	0.0
	0.0	24.0		1.0	0.0
	0.0	25.0		0.0	0.0
	0.0	25.0		0.0	0.0
31364.9453	2413.6875	4	1		
23403	20.0	0.0		5.0	0.0
	0.0	0.0		25.0	0.0
	0.0	25.0		0.0	0.0
	0.0	10.0		0.0	0.0
30799.8047	3303.3027	4	1		
23404	0.0	6.0		19.0	0.0
	16.0	9.0		0.0	0.0
	2.0	15.0		8.0	0.0
	13.0	10.0		2.0	0.0
30253.6719	1752.2544	5	1		
23405	6.0	0.0		19.0	0.0
	8.0	0.0		17.0	0.0
	25.0	0.0		0.0	0.0
	9.0	16.0		0.0	0.0
	7.0	18.0		0.0	0.0
32646.2266	6052.6875	3	1		
23501	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
37008.8437	2598.9473	3	1		
23502	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
32695.2812	6591.9375	3	1		
23503	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	10.0	0.0		0.0	0.0
36467.2344	2508.0273	3	1		
23504	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	20.0	0.0		0.0	0.0
42167.4375	2472.3105	3	1		
23602	25.0	0.0		0.0	0.0
	25.0	0.0		0.0	0.0
	5.0	15.0		0.0	0.0
37611.2969	1548.6831	4	1		
23603	24.0	0.0		1.0	0.0
	0.0	0.0		14.0	6.0
	0.0	23.0		2.0	0.0
	0.0	0.0		0.0	18.0
40655.7187	2977.7656	4	1		
23604	25.0	0.0		0.0	0.0
	9.0	16.0		0.0	0.0
	12.0	13.0		0.0	0.0
	13.0	0.0		0.0	0.0

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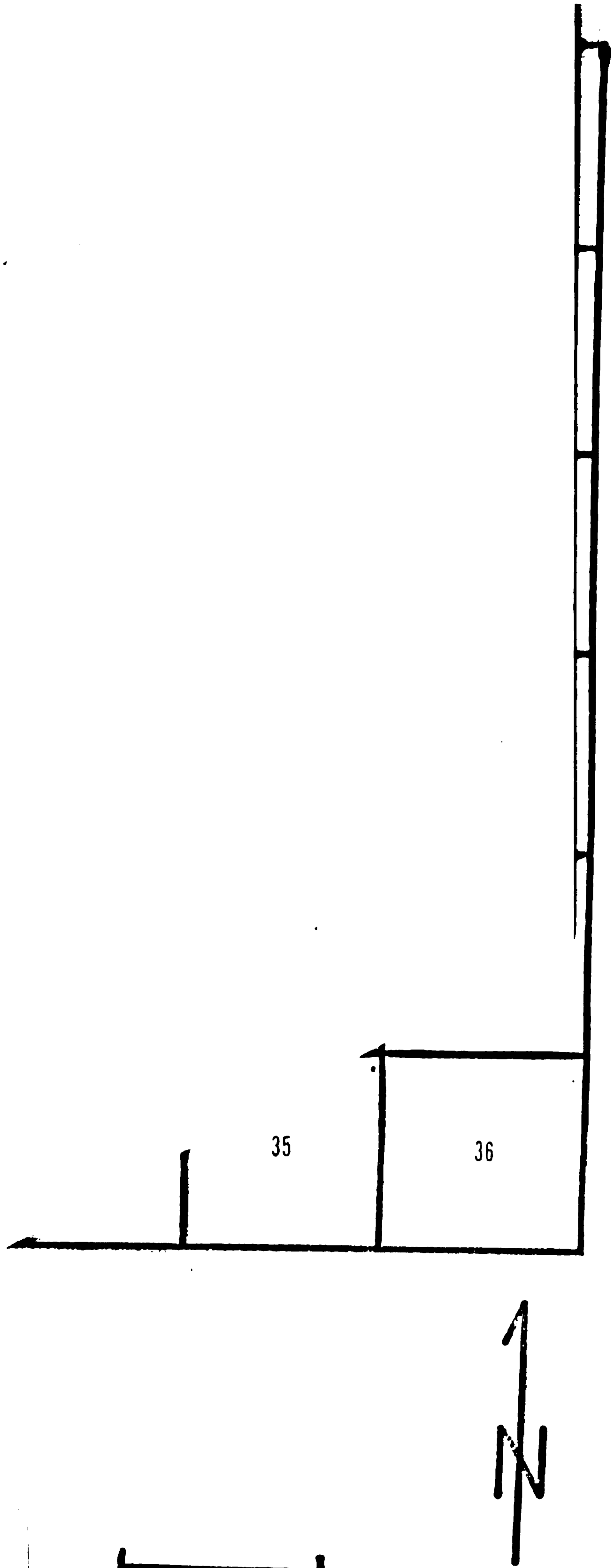

MERIDIAN TWP.
MICH.

SCALE : 1.16" = 1 mile

Pocket has: 1 Transparency Overlay