DEVELOPMENT OF AN INDOOR RADON INFORMATION SYSTEM FOR OHIO

AND

ITS APPLICATION IN THE STUDY OF THE GEOLOGY OF RADON IN OHIO

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Final Report
for a grant awarded by the
Ohio Air Quality Development Authority

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ABSTRACT

A computer database consisting of 50,626 indoor radon measurements in Ohio has been compiled from data supplied by government agencies, university researchers and commercial testing companies. It includes measurements from 1255 zip code areas and all 88 counties in the state. This database, herein referred to as the Indoor Radon Information System (IRIS), also contains information on building construction characteristics and remediation results from houses tested for radon, lung cancer mortality rates for Ohio counties, and geological characteristics of Ohio's zip code areas.

Two interactive software packages, IRISDAT and IRISMAP, have been developed for VAX mainframe computers and MS-DOS/IBM-compatible microcomputers, respectively. IRISDAT is used to edit and update the databases, and generate statistics files and summary reports. IRISMAP is used to produce maps of Ohio showing the variations in radon levels and geology across the state.

Of the 698 zip code areas in Ohio with five or more radon measurements, 64.9% have geometric mean radon concentrations below 4 picocuries per liter (pCi/l), 30.4% have concentrations between 4 and 8 pCi/l, and 4.7% have concentrations over 8 pCi/l. Seven counties in Ohio had geometric mean radon concentrations above 6 pCi/l: Licking, 11.5; Pickaway, 7.5; Knox and Harrison, 7.1; Franklin, 6.7; Carroll, 6.3; and Ross, 6.2.

The zip code areas with average indoor radon concentrations over 4 pCi/l are located primarily in central and western Ohio, with most of the rest in northeastern Ohio. Nearly all of these zip code areas are closely associated with glacial till deposits of Wisconsin age, with the majority occurring in the Scioto and Miami glacial lobes. The radon in houses and other buildings originates in the till from one or both of the following two sources: (1) uranium-rich Ohio Shale fragments that have been eroded from outcrops in central and western Ohio and incorporated into the till, and (2) concentrated uranium in calcareous soils developed on till derived from the underlying limestone and dolostone bedrock. Many zip code areas with high radon concentrations are also associated with glacial or alluvial sand and gravel deposits. It appears that it is the high permeability of these deposits, rather than their composition, that is responsible for elevated indoor levels.

The single geologic parameter that correlates best with the distribution of indoor radon is the soil uranium concentration as determined from aerial radiometric surveys. This parameter is an integration of the various near-surface, geological source effects. The correlation coefficient for the geometric mean radon concentration and the modal uranium concentration is 0.36 for the 698 zip code areas with five or more radon measurements. This correlation is weak but statistically significant.

ACKNOWLEDGEMENTS

This research was made possible by a $43,614 grant from the Ohio Air Quality Development Authority in Columbus, Ohio. To this organization and its director, Mark R. Shanahan, we wish to express our deepest thanks. We also gratefully acknowledge Thomas M. Berg, Director of the Division of Geological Survey (ODNR), who provided us with geological maps; and Alexander Ritchie, Jr., of the Division of Soil and Water Conservation (ODNR), who provided us with much useful information on Ohio's soils.

We are additionally indebted to our two graduate research assistants at the University of Toledo: Shushant Agarwal, in the Department of Civil Engineering, who assisted us in compiling the radon and other non-geologic databases; and John P. McKenna, in the Department of Geology, who compiled the geologic databases. To both of these excellent students we offer our thanks.

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INTRODUCTION

Statement of the Problem

Radon is a naturally occurring, radioactive gas that migrates into buildings from underlying uranium-bearing rocks, sediments and soils. It has by now been well established that long-term exposure to radon may cause lung cancer (EPA 1986, Nero et al. 1986). This gas is considered by the U.S. Environmental Protection Agency (EPA) to be the most serious environmental health hazard in the United States today. There is thus an urgent need to document the distribution of indoor radon levels within each state, and to make this information available to government officials, health experts and environmental researchers.

Many indoor radon measurements have been made in Ohio by the EPA, county and municiple health agencies, university researchers, and commercial testing companies. This information has either been published in obscure technical reports or still resides in the proprietory files of those who collected the data, and so is not readily available. Even if it had all been published in widely distributed sources, this body of information would still be of limited value as long as it remained fragmented. What is needed, and what we have done in this study, is to develop a comprehensive radon database for Ohio by combining and collating the available results of indoor radon measurements made in the state. This database, which we call the Indoor Radon Information System (IRIS), will not only reveal for the first time the true nature of the radon problem in Ohio, but it will also make it possible to discover the geologic controls on indoor radon levels.

Research Objectives

The specific objectives of the present research are as follows (note: the initials in parentheses indicate the areas of responsibility of each of the principal investigators):

1. Contact the government agencies, university researchers and commercial testing companies that have made large numbers of indoor radon measurements in Ohio and obtain copies of their data (AK).
2. Combine the radon data from the various sources in a computer database where all measurements are indexed by county and zip code (AK and AGH).
3. Generate additional computer databases for:
    a. building construction characteristics for houses included in the radon database (AK and AGH);
    b. building remediation results (i.e., before and after measurements) for houses included in the radon database (AK and AGH);
    c. lung cancer statistics for Ohio counties (AK and AGH); and
    d. geological characteristics of zip code areas in Ohio (JAH).
4. Develop computer software for the maintenance, manipulation and display of the various databases, including:
    a. a FORTRAN program for VAX mainframe computers that uses ASCII files and DATATRIEVE procedures to (i) maintain the non-geological databases, (ii) generate radon statistics

    data files for counties and zip codes, and (iii) print data summary reports (AGH); and

    b. a BASIC program for MS-DOS/IBM-compatible microcomputers that uses the geological and radon databases to generate state maps and summary tables (JAH).

5. Use the databases to investigate the relationship between indoor radon levels and local geology (JAH).
6. Prepare a comprehensive final report (JAH).

All of the above research objectives were achieved, and the results are described in the chapters which follow.

DATABASE STRUCTURE

An overview of the Indoor Radon Information System is provided in Figure 1. It can be seen in this figure that IRIS actually consists of two subsystems: one for VAX mainframe computers and the other for MS-DOS/IBM-compatible microcomputers.

IRISDAT and the Mainframe Subsystem

All data for indoor radon measurements and other nongeological parameters are stored in ASCII data files. IRISDAT, a compiled FORTRAN program, uses procedures written for DATATRIEVE to edit and update the data files, and also to generate radon summary reports for the Ohio's counties. DATATRIEVE is a commercially available database management software package that is used by the Ohio state government on its VAX mainframe computer in Columbus. The large size of the radon database requires the power and storage capacity of a mainframe computer. There is, however, a disadvantage to the mainframe subsystem: it is available only to those relatively few organizations with access to a VAX computer. To overcome this problem, a second subsystem was developed for microcomputers.

IRISMAP and the Microcomputer Subsystem

IRISMAP is a compiled BASIC program written for MS-DOS/IBM-compatible microcomputers. Its purpose is to generate maps of the state of Ohio showing the areal distribution of radon and the various geological parameters. It also produces radon and geology summary tables for zip code areas. The radon statistics files used by IRISMAP are generated by IRISDAT. The geology data files are not stored in IRISDAT because, unlike the radon and other nongeological files, they are relatively small and will require only minimal editing.

* * *

Copies of IRISMAP and IRISDAT (both of which include databases as well as programs) are available from:

Ohio Air Quality Development Authority
1901 LeVeque Tower
50 West Broad St.
Columbus, OH 43215
(614-224-3383 or 614-466-6825)

Users of this software will be required to pay a processing fee and also to sign a licensing agreement. It is anticipated that in the next few years there will be repeated improvements to IRISDAT and IRISMAP. The current versions are thus the first of many to come.

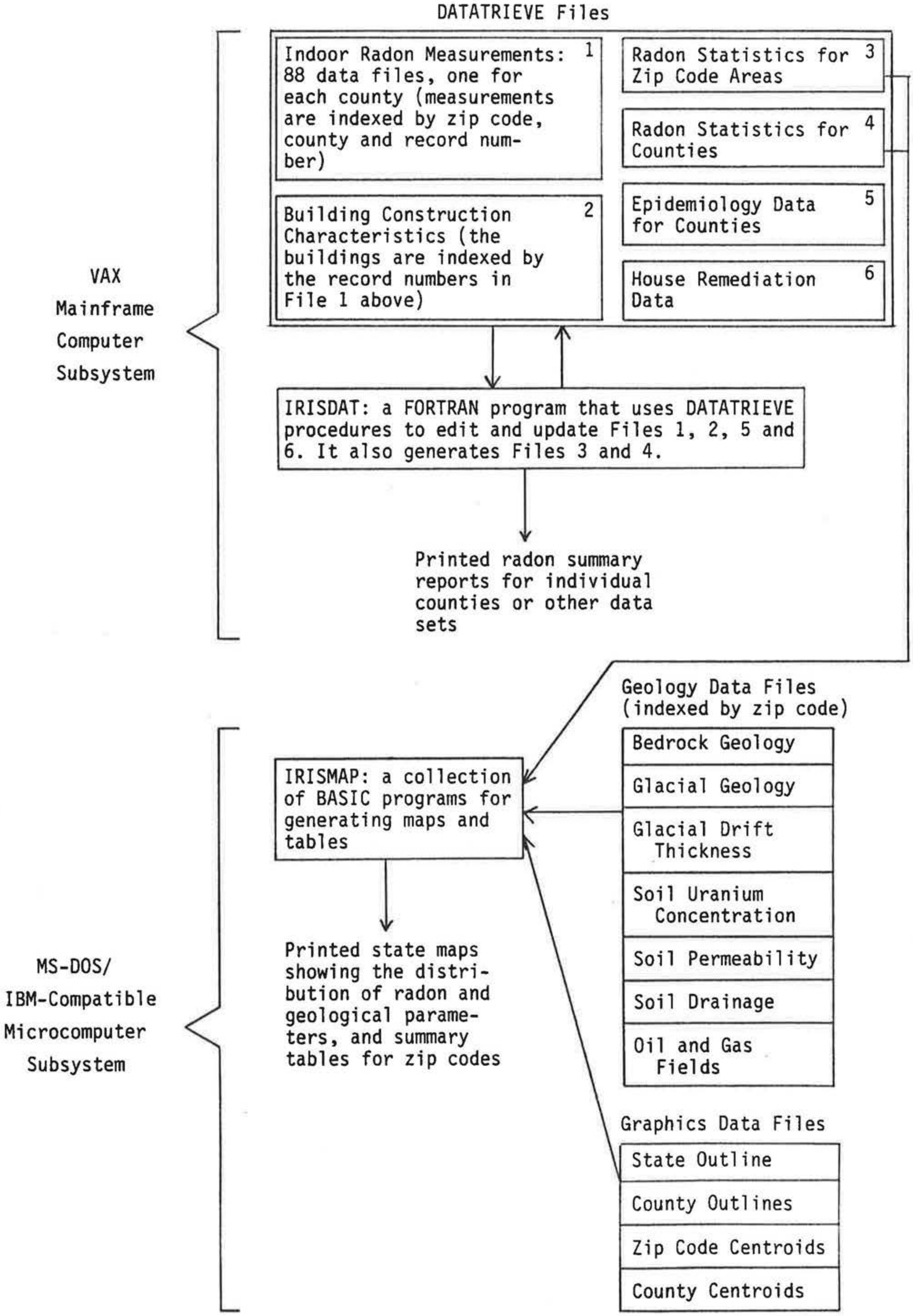

FIGURE 1 - An overview of the Indoor Radon Information System.

DATA COLLECTION

Indoor Radon Measurements

We contacted the government agencies, university researchers and commercial testing companies that have made indoor radon measurements in Ohio. Copies of their databases were requested, and in this way we were able to compile a unified database consisting of 50,626 measurements for 1220 zip code areas in Ohio (see Table 1 and Appendix 1 for information on the data sources). Although this is a gratifyingly large number there are still thousands more available from other, as of yet untapped, sources. The type of building tested was not always reported in the data sources, but our impression is that something over 95 percent of the measurements are for single family houses.

About 91 percent of the data was sent on floppy disks and so was transferred, without transcription errors, directly into ASCII data files. The remainder of the data was provided as printed tables. Most of these were read directly into ASCII files using a text scanner, which again allowed us to avoid transcription errors. Only data for about 3 percent of the measurements had to be typed into the database by hand. These data have been triple-checked for accuracy and so we believe they also are essentially error-free.

The radon data sets used in this study are quite diverse (Table 2). All included the zip code area for the tested buildings, and most also provided information on the type of room tested, type of radon detection devise used, and the time of year the test was conducted. Relatively few sources supplied information on the building construction characteristics, and this is unfortunate because some of these parameters may have a significant influence on indoor radon levels. Most sources did not identify the counties in which the tested buildings were located. It was therefore necessary to determine the county affiliations of these buildings using their zip codes as a guide. We were able to do this by referring to the zip code atlases published by Rand McNally (1988) and the U.S. Postal Service (1989) (see Appendix 3 for a tabulation of the county-zip code affiliations).

The radon data has been organized into 88 county files (see Table 3 for file format and content). Within these the individual measurements ("records") are referenced by zip code and a unique record number. The IRISDAT program makes it a simple matter to edit and update these files. The derivative data files containing the radon statistics for zip codes and counties are also easily regenerated after changes have been made to the radon database.

The following statistics have been calculated for radon measurements in all zip code areas and counties (DATATRIEVE files 3 and 4 in Figure 1): median, arithmetic mean, geometric mean, first quartile, third quartile, maximum, minimum, standard deviation and coefficient of variation. Calculation formulae and definitions for these statistics are given in Appendix 2, and the statistics themselves are compiled in Appendices 4 and 5 for the counties and zip codes, respectively. In computing these statistics, <u>every</u> radon measurement in a county or zip code was used without regard for building, room or detector type, or season.

The best measure of "average" for radon data is apparently the geometric mean. It is not adversely affected by extreme high concentrations as is the arithmetic mean, and unlike the median, which is based on just one or two central values, the geometric mean uses all of the available data in its calculation. In general, however, the geometric mean and median will have very similar values, and so the latter statistic may also be considered an acceptable measure of average for radon data. Because the distribution of radon data is usually heavily skewed towards the higher concentrations, the arithmetic mean is, in our opinion, an entirely inappropriate statistic. It is nevertheless included in the statistics files because it will still be of interest to some users of IRIS, especially those who are involved in health risk assessments.

The maximum and minimum radon concentrations are widely reported statistics. However, they are not as useful in radon studies as they might appear. The minimum is almost always equal to zero or a value close to it, and the maximum, because it is based on only a single measurement, may fluctuate wildly as new information is added to a data set. Also, nonrepresentative sampling (e.g., placing a detector in a sump pump well) may result in spuriously high concentrations being reported, and these will adversely affect the maximum. More stable and more meaningful measures of the distribution extremes are provided by the first and third quartiles. The latter statistic is especially useful as an alternative to the maximum for indicating the "common" upper range of a data distribution. The standard deviation and coefficient of variation, two common measures of dispersion, are included with the other statistics in the data files, but their usefulness in radon studies has not yet been demonstrated.

Building Construction Data

The information on building construction characteristics provided with some of the data sets (Table 2) was organized into one data file. Up to 23 different parameters are recorded for each building (Table 4). Although this information is currently available for only about 4000 buildings in the radon database, we feel it is important that the file be included in IRIS because with the addition of more data it will become a valuable reference resource.

Epidemiology Data

In the original research proposal for this study we suggested that it might be possible to establish a statistical correlation between lung cancer deaths and indoor radon levels in Ohio. To do this we needed, for each county, the number of deaths from lung cancer (per 100,000 residents) and the annual tobacco sales. The latter information is obviously necessary because most lung cancer cases are due to smoking. It was our thought that the health effects of radon might become evident if the lung cancer rate was standardized relative to the tobacco sales. Any excess deaths would then be attributable to radon inhalation.

The required epidemiological data on lung cancer deaths was readily obtained from the Ohio Department of Health. We were, however, unable to acquire information on tobacco sales. It is therefore not possible for us to investigate the role of radon in inducing lung cancer in Ohio. The epidemiology data has nevertheless been included in the IRIS database (DATATRIEVE file 5 in Figure 1). The tobacco sales data will eventually become available, and when it does, the epidemiology file will be useful to future researchers. Table 5 indicates the type of information contained within this file.

House Remediation Data

There seems to be very little house remediation data available for Ohio. We succeeded in acquiring only one small data set. This was provided by the U.S. EPA (1989) and consists of 32 houses from the Dayton area. We anticipate that more data of this kind will become available in the future, and when it does, it can be added to the house remediation file (DATATRIEVE file 6 in Figure 1; see Table 6 for file contents).

Geological Data

1. Zip Code Base Map

Because all the radon measurements in IRIS are referenced by zip code, it was necessary to develop a geological database that includes a detailed characterization of the geology in each zip code area. Such a database would permit a direct statistical comparison between the radon and geological data.

To reduce the geology of Ohio to the level of zip codes, it was first necessary to obtain a map of the zip code areas. The Rand McNally (1988) "Zip Code Atlas and Market Planner" provided us with the necessary maps. In this atlas the state of Ohio is divided into four sections, each represented by a geographic road map with a clear plastic overlay on which the zip code boundaries are drawn. The four overlays were photographically joined to make a single composite overlay which was then used as a base map for the geology (Figure 2).

A total of 1201 zip code areas are outlined on the base map in Figure 2. However, not all of the zip codes in use in Ohio are included. Only those with areas larger than about a square mile are shown. There are potentially 3000 different zip codes for Ohio (numbers 43000 through 45999) but most of these are not now in use. Of the 1255 zip codes represented in the radon database, only 1004 are shown on the base map, but of the 251 not shown, only 25 had 5 or more radon measurements. These 25 zip codes were added to the base map as dimensionless points, which seems reasonable given that all of them apparently occupy areas of less than one square mile. The final version of the base map therefore contained 1226 zip codes, 1029 of which also occur in the radon database. The centroids of these zip code areas are plotted in Figure 3.

2. Geological Maps

The geology of Ohio was taken from the six state maps listed in Table 7. These maps together provide information on most of the geological parameters that are likely to affect indoor radon levels:

(1) Bedrock and glacial geologic units (maps 1 and 2) are clearly of major importance because they represent the radon source materials. For example, the Devonian Ohio Shale and Pleistocene glacial sand and gravel deposits have been previously identified as problem materials (Harrell and Kumar 1988, 1989; Harrell et al. "in press"; Smith and Mapes 1989).

(2) Soil drainage and permeability may have a significant affect on radon migration. Neither of these parameters is actually used on map 5, but they have been inferred from the soil associations used on this map. Approximate, semi-quantitative estimates of permeability and drainage can be obtained for each association from the "Soil Interpretation Records" on file in the Division of Soil and Water Conservation, Ohio Department of

Natural Resources. Permeability, in this case, is a measure of the relative ease of fluid flow in the uppermost 4-6 feet of soil. Drainage largely reflects the topography in that soils in a hilly terrain tend to be well drained and soils in low, flat areas are poorly drained. It is expected that as soil permeability and drainage increase, there will be a corresponding increase in indoor radon (provided, of course, that there is a radon source material below). Higher permeabilities, as in the case of sandy soils, facilitate the escape of subsurface radon. Houses built on well drained soils tend to be located on hillsides and ridges where bedrock (which may be a radon source) is closer to the surface.

(3) Previous geological studies of radon in Ohio have indicated an ambiguous role for the thickness of glacial deposits (map 3) (Harrell and Kumar 1988, 1989; Harrell et al. "in press"; Khawaja et al. 1989; Smith and Mapes 1989). If the deposits do not produce radon themselves, then as they increase in thickness they will progressively reduce the amount of radon reaching the surface from an underlying bedrock source. If, on the hand, the deposit is the radon source, then its thickness is largely irrelevant. In many areas, of course, the glacial overburden may act as both a primary source of radon and a barrier to bedrock radon.

(4) Information on the distribution of oil and gas fields (map 6) was included in the database because earlier studies have shown that houses receiving natural gas from nearby bedrock storage or production reservoirs can have elevated indoor radon levels

(Mueller Associates et al. 1988, p. 34-39). The radon is picked up by the gas from the rocks making up the reservoir (normally sandstones or dolostones) and then released in the houses when the gas is burned.

(5) Map 4 provided us with information on the concentration of uranium in the upper several inches of soil. The data comes from an aerial radiometric survey, where the flight lines were flown in an east-west direction at an average spacing of 6 miles and with north-south tie lines spaced about 15 miles apart. It should be obvious from this that the uranium concentrations are very rough estimates which apply only to areas larger than 6 miles in diameter. Nevertheless, previous studies have shown that these surveys do tend to integrate the source effects of the surficial geology and so are helpful in "anticipating" indoor radon levels.

The zip code base map (Figure 2) was reproduced as an overlay (black zip code outlines on clear acetate) with the same scale as the geologic maps (1:500,000). The overlay was placed on top of each map, and the geologic parameters listed in Table 8 were evaluated for each zip code area. This data was then stored in computer files. For both the bedrock and glacial geology maps, up to five stratigraphic units were recognized in each zip code area, with each unit categorized according to its relative areal extend. Similarly for the oil and gas field map, up to four field types were recognized. For the other three maps, which contain quantitative information, the geology in each zip code area was summarized by three statistical measures: the modal ("most common"), maximum and minimum values.

3. Other maps

In order for IRISMAP to generate maps of Ohio showing the areal variations in radon and geology, it must use four graphics files for the (1) state outline, (2) county outlines, (3) zip code area centroids, and (4) county centroids. The first two files were created by electronically digitizing the county and state outlines on a map of Ohio using the Geology Department's Summagraphics Microgrid hardware. A mouse with a cross-hairs sight was moved along the outlines and the x,y (Cartesian) coordinates of consecutive, closely spaced points were automatically stored in a computer file. To create the third file, the zip code area outlines on the zip code base map were digitized as above and the geometric center of each area was calculated. In the same way, the county centroids in the fourth file were calculated from the county outlines.

TABLE 1:

DATA SETS USED IN THE RADON DATABASE[1]

Source[2]	Number of Measurements	Detector Type[3]	Measurement Period[4]
1. Airchek	18,030	CC	85-89
2. Ryan Nuclear Labs	13,192	CC	3/88-5/89
3. Terradex	5,544	AT	3/87-6/89
4. Radon Project	3,711	CC	4/86-6/88
5. Columbus Dept. of Health	3,545	CC	9/86-12/86
6. Cincinnati Dept. of Health	2,380	CC	3/89-7/89
7. U.S. EPA	1,748	CC,AT[5]	3/89-6/89
8. Youngstown State Univ.	714	AT	12/88-4/89
9. Ohio Univ.	440	CC	12/88-3/89
10. Teledyne Isotopes	427	CC	3/88-6/89
11. Radon Testing Corp. of America	378	CC	1/89-6/89
12. Univ. of Toledo	177	CC	12/87-2/88
13. City of Toledo	128	AT	8/86-3/89
14. Microbac Labs	121	CC	6/89-2/90
15. Scientific Analysis	74	CC	2/87-5/89
16. Radon Master	17	AT ?	12/88-6/89
	50,626		

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[1] Since the original database was compiled and the analyses discussed in this report were made, an additional 222 measurements were provided by the Lima Dept. of Health (197) and the Lake Co. Dept. of Health (25). The current number of measurements in the database is therefore now 50,848.

[2] See Appendix 1 for addresses and phone numbers.

[3] CC = charcoal canister detector, and AT = alpha track detector.

[4] Period during which the measurements were made (note that this is not the duration of the individual tests).

[5] The majority of measurements were made with charcoal canister detectors.

TABLE 2:

INFORMATION PROVIDED WITH THE RADON DATA SETS

Data Sets[1]: Parameters[2]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Type of building							X					X				
Room tested			X		X	X		X	X		X	X	X	X	X	X
Test date	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
House age	X				X				X			X				
Air exchange factor									X			X				
Penetration factor									X			X				
Temperature difference									X			X				
No. of occupants												X				
No. of smokers					X							X				
Type of cooking fuel												X				
Type of heating fuel					X							X				
Sump pump present?	X				X							X				
Crawl space present?	X				X							X				
Type of water supply?	X															
No. of floors	X				X				X			X				
Total floor area									X							

---

[1] See Table 1 or Appendix 1 for the data source corresponding to each numeric code.

[2] All data sets included radon concentration (in picocuries per liter) and zip code. Most also included county, but for those that did not, the county affiliation was determined for each zip code and added to the IRIS database. For the data sets with test dates, the season was determined (for test dates that fell within a single season) and added to the IRIS database.

TABLE 3:

CONTENTS OF THE RADON CONCENTRATION FILE

Record Format:

Record Number , zip code , Radon Conc. , Room Type , Detector Type , Season Tested

Numeric Codes Used in Records:

ROOM TYPE	
bedroom	1
kitchen	2
bath	3
recreation	4
storage	5
utility	6
basement	7
living/family	8
other	9
crawl space	10
dining	11
hall	12

SEASON TESTED	
fall (Sep - Nov)	1
winter (Dec - Feb)	2
spring (Mar - May)	3
summer (Jun - Aug)	4

NOTE: for missing information the code "-1" is entered.

DEVICE TYPE	
alpha track	1
charcoal canisters	2
scintillation counters	3
ionization chambers	4
positive barrier	5
2 filter method	6

TABLE 4:

CONTENTS OF THE BUILDING CONSTRUCTION FILE

	PARAMETERS	NUMERIC CODES*
1.	Record number	
2.	Zip Code	
3.	County	
4.	Type of Dwelling:	1=Single Family, 2=Double Family, 3=Commercial Bldg. 4=School, 5=Apartment, 6=Duplex
5.	Age of Building	
6.	Air Exchange Factor/Rate	
7.	Penetration Factor	
8.	Temperature Difference	
9.	No. of Occupants	
10.	No. of Smokers	
11.	Cooking Fuel:	1=Gas, 2=Electricity, 3=Other
12.	Heating Fuel:	1=Gas, 2=Electricity, 3=Solar, 4=Wood, 5=Oil, 6=Kerosene, 7=Other
13.	Fire Place:	1=Yes, 2=No
14.	Sump Pump:	1=Yes, 2=No
15.	Crawl Space:	1=Yes, 2=No
16.	Insulation:	1=Poor, 2=Moderate, 3=Good, 4=Excellent
17.	Water Supply:	1=Public, 2=Well Water, 3=Both
18.	Building Material:	1=Brick, 2=Concrete, 3=Stone, 4=Wood, 5=Flyash, 6=Plaster, 7=Other
19.	No. of Floors	
20.	Floor Area	
21.	Type of Floor:	1=Poured Concrete, 2=Stone or Dirt, 3=Other
22.	Type of Ventilation	1=Central Air Handling System, 2=Room Sized Unit Ventilators or Radiant Heat with Ventilation System, 3=Room Sized Unit Ventilators or Radiant Heat Without Ventilation System
23.	Domestic Water Radon Content (pCi/L)	
24.	House Location:	1=City, 2=Town, 3=Rural, 4=Farm, 5=Other

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*A code of "-1" is used to indicate missing information.

TABLE 5:

CONTENTS OF THE EPIDEMIOLOGY FILE

---

1. County
2. Population
3. Number of lung cancer deaths during 1979-1988
4. Adjusted lung cancer mortality (= number of lung cancer deaths per 100,000 people)

TABLE 6:

CONTENTS OF THE HOUSE REMEDIATION FILE

---

1. Radon concentration before mitigation (pCi/l)
2. Type of room tested
3. Radon concentration after mitigation (pCi/l)
4. Type of mitigation (one of the following numeric codes is entered):

Natural Ventilation	1
Forced Air Ventilation	2
Heat Recovery Ventilation	3
Wall Ventilation	4
Subslab Suction	5
Sealing of Cracks	6
Drain Tile Suction	7
House Pressurization	8
Barrier in Crawl Space	9
Carbon Adsorption	10
Treatment of Well Water	11

TABLE 7:

OHIO GEOLOGICAL MAPS*

1. Bedrock Geology

    Bownocker, J.A., 1947, Geologic Map of Ohio: Div. of Geological Survey, Ohio Dept. of Natural Resources

2. Glacial Geology

    Goldthwait, R.P., White, G.W. and Forsyth, J.L., 1967, Glacial Map of Ohio : U.S. Geological Survey, Misc. Investigations Map I-316.

3. Thickness of Glacial Deposits

    Soller, D.R., 1986, Preliminary Map Showing the Thickness of Glacial Deposits in Ohio: U.S. Geological Survey, Misc. Field Studies Map MF-1862.

4. Uranium Concentrations in Soils

    Duval, J.S., 1985, Aerial Radiometric Contour Maps of Ohio: U.S. Geological Survey, Geophysical Investigations Map GP-968.

5. Soil Permeability and Drainage

    Anonymous, 1973, Know Ohio's Soils: Div. of Soil and Water Conservation, Ohio Dept. of Natural Resources.

    Note: Soil permeability and drainage data were obtained from the Div. of Soil and Water Conservation's "Soil Interpretation Record" for each of the soil series shown on the map.

6. Oil and Gas Fields

    Debrasse, T.A. and Vohwinkel, J.C., 1974, Oil and Gas Fields of Ohio: Div. of Oil and Gas, Ohio Dept. of Natural Resources

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* All maps are published at a scale of 1:500,000.

TABLE 8:

GEOLOGICAL PARAMETERS

MAP I. BEDROCK GEOLOGY OF OHIO

code	Geologic Units Recognized
Pd	Permian Dunkard
Pm	Pennsylvanian Monongahela
Pc	Pennsylvanian Conemaugh
Ppa	Pennsylvanian Pottsville and Allegheny
Mwm	Mississippian Waverly and Maxville
Doo	Devonian Olentangy and Ohio
Dcd	Devonian Columbus and Delaware
DSm	Devonian-Silurian Monroe
Sn	Silurian Niagara
Sb	Silurian Brassfield
Or	Ordovician Richmond
Om	Ordovician Maysville
Oe	Ordovician Eden
Ot	Ordovician Trenton

Data Format in BR.DAT

```
zip code 1st unit  2nd unit  3rd unit  4th unit  5th unit
        ---------- decreasing areal extent ------------->
```

MAP II. GLACIAL GEOLOGY OF OHIO

code	Geologic Units Recognized
R	Recent alluvium
Wo	Wisconsin outwash
Wke	Wisconsin kames and eskers
Wl	Wisconsin lake deposits
Wgm	Wisconsin ground moraine
Wem	Wisconsin end moraine
Io	Illinoian outwash
Ik	Illinoian kames
Igm	Illinoian ground moraine
Iem	Illinoian end moraine
Il	Illinoian lake deposits
Kgm	Kansan ground moraine
NG	No glacial deposits

Data Format in GL.DAT

```
zip code 1st unit  2nd unit  3rd unit  4th unit  5th unit
        ----------- decreasing areal extent ----------->
```

TABLE 8 continued

MAP III. THICKNESS OF GLACIAL DEPOSITS IN OHIO

code	Thickness Classes	
0	no glacial deposits present	
1	<50 ft	
2	50-100 ft	Contours drawn at
3	100-200 ft	50, 100, 200 and
4	200-400 ft	400 feet.
5	>400 ft	

Data Format in TH.DAT

zip code modal thickness maximum thickness minimum thickness

MAP IV. SOIL URANIUM CONCENTRATIONS IN OHIO

code	Uranium Concentration Classes
1	<1.5 ppm
2	1.5-1.8 ppm
3	1.8-2.1 ppm
4	2.1-2.4 ppm
5	2.4-2.7 ppm
6	2.7-3.0 ppm
7	3.0-3.3 ppm
8	3.3-3.6 ppm
9	3.6-3.9 ppm
10	3.9-4.2 ppm
11	4.2-4.5 ppm
12	4.5-4.8 ppm
13	>4.8 ppm

Data Format in UR.DAT

zip code modal concentration maximum concentration minimum concentration

TABLE 8 continued

MAP V. SOIL PERMEABILITY AND DRAINAGE IN OHIO

code	Permeability Classes	inches/hour (flow)
VL	Very low	<0.06
L	Low	0.06-0.6
M	Moderate	0.6-2.0
H	High	2.0-20
VH	Very high	>20

code	Surface Drainage Classes
VP	Very poor
P	Poor
MW	Moderately well
W	Well

Note: the codes for modal permeability and drainage include + and - to further indicate relative magnitude (e.g., M- and P+).

Data Format in PD.DAT

zip code	modal permeability	maximum permeability	minimum permeability	modal drainage	maximum drainage	minimun drainage

MAP VI. OIL AND GAS FIELDS IN OHIO

code	Field Types
O	Oil
G	Gas (Production)
S	Gas (Storage)
N	No fields of any type

Data Format in GO.DAT

```
zip code  1st type  2nd type  3rd type  4th type
          ------- decreasing area extent ------>
```

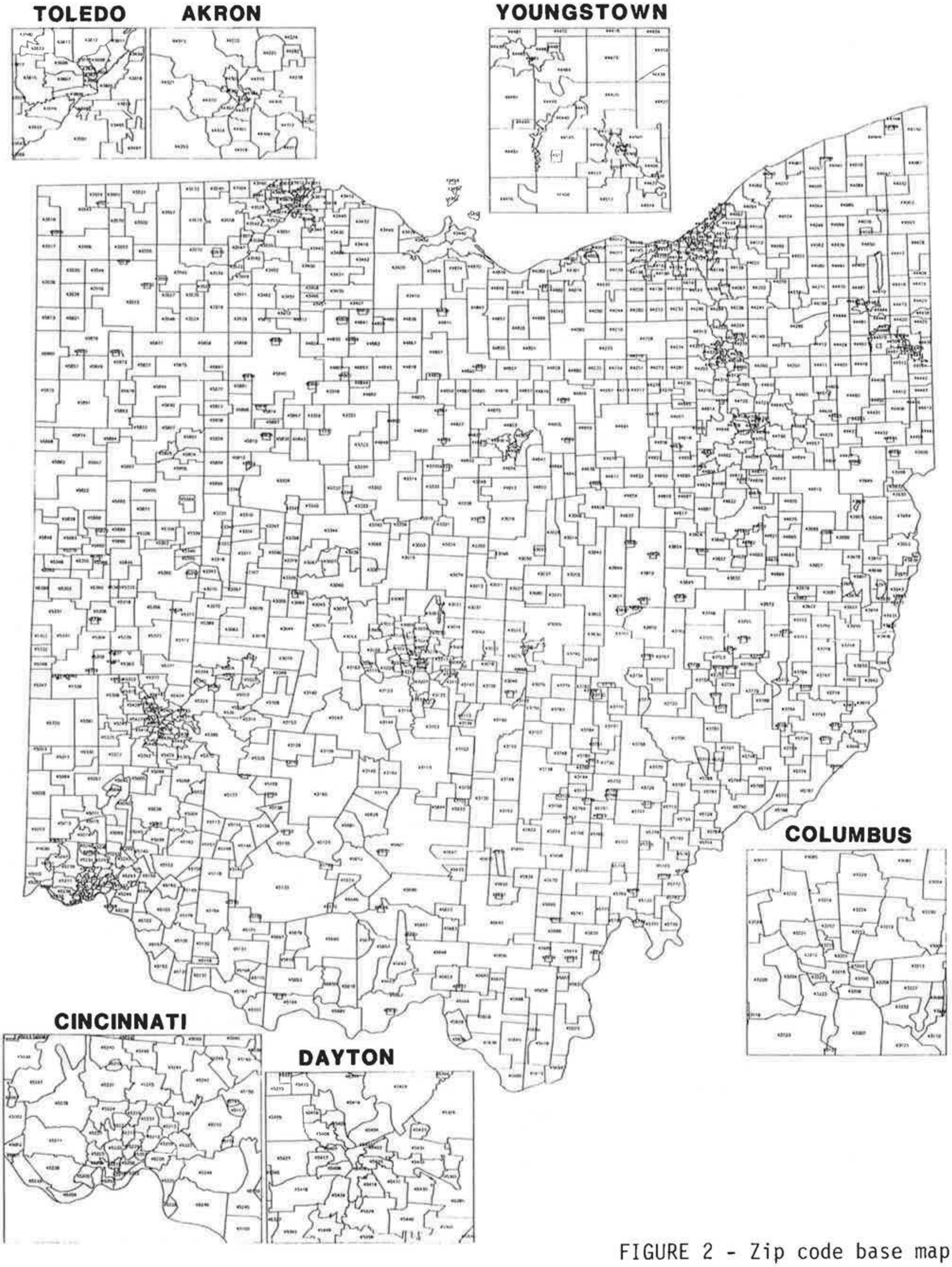


FIGURE 2 - Zip code base map.

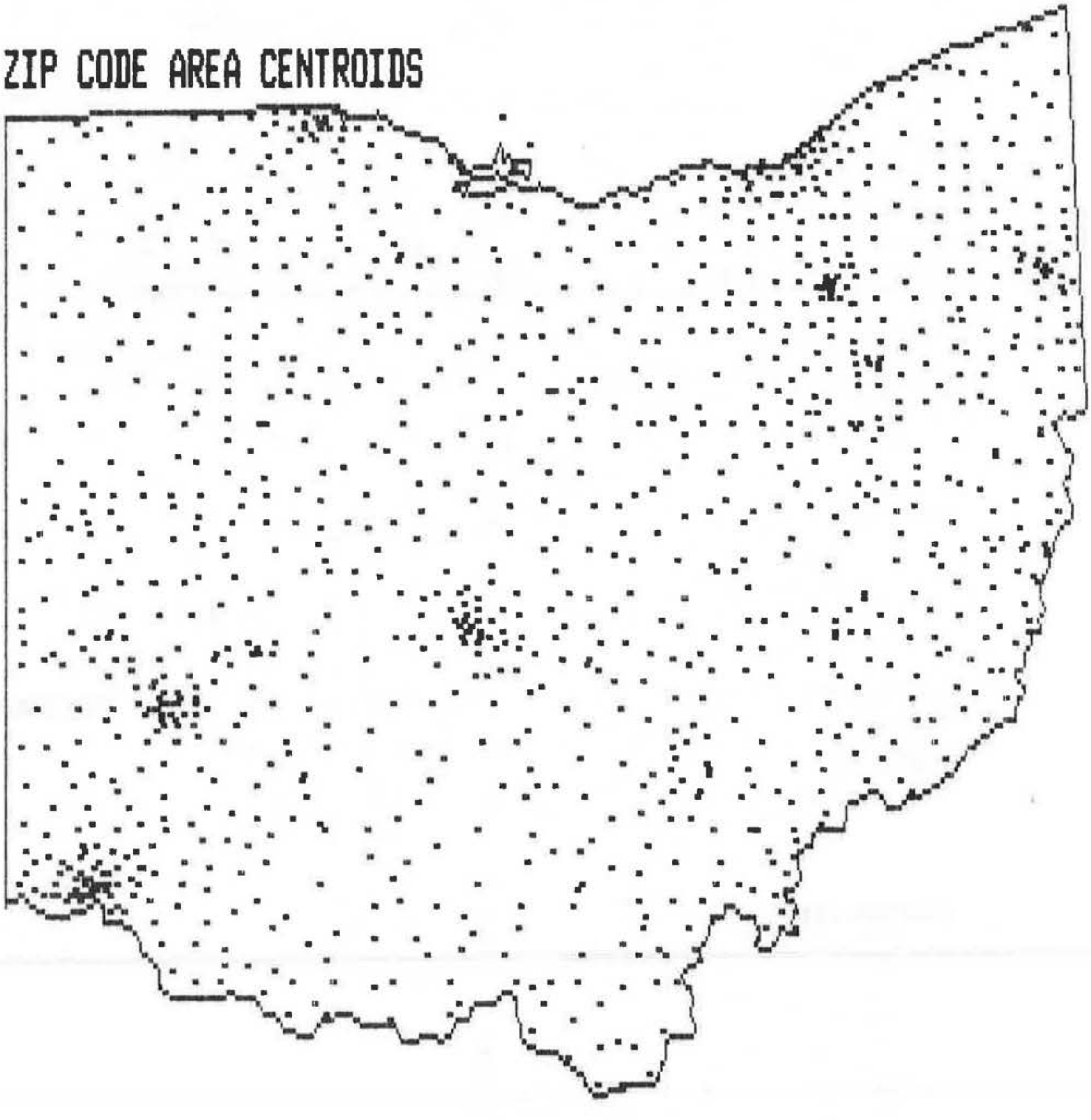


FIGURE 3 - Map of zip code centroids.

USING THE IRISDAT SOFTWARE

Introduction

IRISDAT is an interactive, FORTRAN-77 computer program that functions as a "Database Management Utility". It was developed on the University of Toledo's VAX 6420, but it should run on any VAX mainframe computer that has the DATATRIEVE (Version 1.0) software installed. DATATRIEVE (a product of Digital Equipment Corporation, Maynard, MA) is a commercially available, high-level language and report-writing utility that can be used to manipulate data very efficiently. IRISDAT uses the DATATRIEVE procedures to perform complicated database management tasks (e.g., sorting data, assembling data sets, and report writing). No other VAX software is required by IRISDAT. A menu that allows the user to select from a variety of options is displayed after execution of IRISDAT has begun. After a selection is made, all other information required by the program is obtained from prompts on the monitor display.

Program Modules

The program modules or selections available in the main menu of IRISDAT are shown in Figure 4. It is possible to opt for any of the modules without having first completed other tasks. This is possible because, after a selection is made, the system will prompt the user for information so that a collection of data can be assembled for use with the specific task. The following paragraphs describe each of the modules.

APPEND (#1 on the main menu) allows the user to add data to the database. Data can be entered using either of two methods. One can edit an ASCII file so that the data is in the proper format (see below for discussion of format) and then save the data in FILE1.DAT. The system queries if there is data stored in this file and then adds the data to the database. This method is very useful when large collections of data are to be added. The second way to append data is to allow the system to provide prompts for entering the data. This interactive manner is satisfactory when smaller data collections are to be appended or when data files are not available. When data is appended to the database, record numbers are assigned to the data automatically beginning with the highest record number in the database. It may be necessary to divide large data sets into smaller subsets when appending data to the database so that the run time does not become excessive.

After data is appended to the database, it is necessary to update the statistical files. Statistical files are maintained at all times so that statistics for each county and zip code area are available. Because it is intented that these files will contain statistics that include all data, it is necessary to ensure that the statistics are updated as the data is entered. Updating is therefore done automatically once the user indicates that no more data is to be entered. This operation may be very time consuming, requiring hours if a large amount of data is to be entered, but it does not require any additional user input.

Data that has been entered into the database and found to contain errors can be corrected using MODIFY (#2 on the main menu). It is not anticipated that large blocks of data will require modification.

Therefore data can only be modified by responding interactively to the program prompts. Data is modified by first specifying the county and record number of the data element. The data is then reentered so that the required corrections can be made and then saved back into the database.

It also necessary to update the statistical files once a data record has been modified. This is done after each modification. The statistical update can be more complicated than for APPEND because it is possible that the original zip code or county was erroneously specified. For these cases, the system must add the data to the corrected county file and then remove it from the county file where the error occurred. It must then update the statistics for the zip codes and counties involved.

IRISDAT maintains a record of all appends and modifications to the database. Information from the most recent session (e.g., comments, record number, date and user) is displayed. The user is then prompted to enter comments, the date and user identification for the current session. For APPEND, the system reads the maximum record number from the previous session and then numbers the new data record numbers beginning with the next number. Thus IRISDAT always assigns increasing record numbers to the database and the total number of data records is recorded. The information from APPEND and MODIFY is stored in files IRISAPP.TXT and IRISMOD.TXT, respectively.

The program module ESTABLISH (#3 on the main menu) is a convenient tool that enables the user to assemble data sets from the database. This is accomplished using DATATRIVE capabilities for forming collections of data. A collection of data is first formed by specifying the desired county or counties. It is also permissible to specify data files other than the county files. The collection is then edited by indicating specific information about the data that is to be contained in the collection. For example, one can request that the collection be limited to the records with a radon level greater than 8.0. The collection will then be reduced to such records and the data stored in FILE1.DAT.

Because data file FILE1.DAT is used by IRISDAT to serve many functions, it is necessary to erase or copy all the data in FILE1.DAT before establishing new collections. This is required because data is appended to FILE1.DAT rather than written over existing data. This enables the user to collect data over time from a number of counties or sources. It also enables the user to enter the data files individually in order to create collections. This may be necessary if the data from a number of files is too large for DATATRIEVE to work with efficiently.

Two modules, STATSZIP and STATSCNTY (#'s 4 and 5 on the main menu) are available to compute and display statistics for zip codes and counties, respectively. They are the same modules that were used to compute the statistics for the original database of 50,626 records (Appendices 4 and 5), and that are used to compute statistics on appended or modified files. The two modules are available to compute statistics for any county or zip code, or for new data sets created by the user and stored in FILE1.DAT. After a data file is selected, IRISDAT computes the 9 statistical parameters described in Appendix 2. If statistics are computed for an Ohio county or zip code, then the data is stored in files STATSZIP.DAT and STATSCNTY.DAT, respectively. If the data is from FILE1.DAT, the statistical data is stored in FILE2.DAT.

CONSTRUCT (#6 on the main menu) is a module that can be used to append to and display the building construction data that is stored in BLDCON.DAT. The data in this file includes the same record numbers that are used for the data records in the main database. Because it is desireable to maintain a correspondence between the data sets, users must first append data to the main database so that record numbers can be assigned to the data, and then the data should be entered into BLDCON.DAT using the same record numbers. This data file is appended by responding to DATATRIEVE prompts. A report can then be produced by using the DATATRIEVE report writing capability.

MITIGATE (#7 on the main menu) is a module that enables users to append to and display the building mitigation data that is stored in MITIG.DAT. The data in this file consists of radon readings taken before and after building alterations were made to reduce the radon level, plus other information. The file can be appended using the prompts displayed by the system. Reports are produced using DATATRIEVE capabilities.

Module EPIDEM (#8 on the main menu) was included in IRISDAT to write reports on county epidemiological data. Information related to lung cancer deaths has been stored in data file EPIDEM.DAT. Reports are produced using DATATRIEVE capabilities.

The purpose of module REPORT (#9 on the main menu) is to provide report-writing capabilities for the user. Reports that include a title page and other information can be generated by selecting a county or any other data file (e.g., FILE1.DAT). In the process of selecting a data file, REPORT uses the same routines that are used by module ESTABLISH to create collections of data sets. Therefore it is possible to assemble a data set using the REPORT module alone. REPORT then enables the user to further edit a data set by specifying another string of commands. This is particularly useful for further reducing a data collection or for sorting data sets by field (e.g., county, zip code or radon level). REPORT then sends the information either to a file or to the printer as specified by the user.

Individual data management sessions are completed by opting to end a session from the main menu (selection #10). After this selection is made, IRISDAT issues a command to DATATRIEVE to finish all on-going functions and then terminates the FORTRAN run. It is emphasized here that sessions with IRISDAT should never be terminated by hitting CONTROL C or by shutting off the terminal. This may result in loss of data in any of the data files that IRISDAT is writing to at the time of termination, including radon files and statistical files. It may be necessary to divide large data sets into smaller subsets when appending data to the database so that the run time does not become excessive.

A flow diagram for IRISDAT is shown in Figure 5. This figure illustrates how the various modules can be used consecutively to accomplish productive data management sessions. The solid lines between the modules (e.g., between APPEND or MODIFY) indicate results that occur automatically to maintain the database. The broken lines (e.g., between STATSZIP and STATSCNTY) indicate steps that can be followed by the user by successively making selections from the main menu.

Program User's Guide

The documentation that follows illustrates the prompts that are displayed for each module of IRISDAT. The actual displays produced by the program are given along with explanations and recommendations for program use. Details concerning the current and successive modules are also provided, as are examples illustrating input and output from module sessions. Examples of module reports are provided in Appendix 6.

1. Starting IRISDAT

In order to run IRISDAT, it is necessary to have a compiled version of IRISDAT (IRISDAT.EXE) and the software VAX DATATRIEVE resident in the system. If only the source program (IRISDAT.FOR) is available, IRISDAT must be compiled on the system, including linking with the DATATRIEVE libraries. The following commands can be used to obtain a compiled version of IRISDAT.

```
FORTRAN IRISDAT
LINK IRISDAT, DTR/OPT
```

Execution of IRISDAT begins by entering the following run command.

```
RUN IRISDAT
```

The program then displays the main menu shown in Figure 4 and the user can begin a session.

2. Module APPEND

The first prompt displayed when APPEND is selected is as follows.

```
HAVE YOU STORED DATA IN "FILE1.DAT" THAT
YOU WANT TO ENTER INTO THE OHIO IRIS?
Enter yes or no:  _
```

At this point the computer is waiting for a response (the underscore is used to indicate that a user response is required; it does not appear on the display however.) Any entry beginning with Y or y will be interperted as the affirmative. If yes is entered, then the program refrains from the next set of prompts. This is very useful if a data file has been obained from an external source and subsequently edited to comply with the format requirements of IRISDAT. The following section gives formatting information.

If a negative is given in the above response, then the user needs to input data interactively. The next prompt is:

```
YOU CAN ENTER DATA INTO "FILE1.DAT" OR INTO THE OHIO IRIS.
(NOTE: MAKE SURE THAT YOU HAVE THE CORRECT
DATA KEYS BEFORE ENTERING ANY DATA.)
TYPE YES TO ENTER DATA OR NO TO RETURN TO MAIN MENU.: _
```

The user must respond in the affirmative to proceed. The data keys that are referred to here are the numbered keys that are used for some of the information (e.g., the location of the radon reading, the type of device that was used, and the season of the year). These keys are provided by the report-writing module REPORT when a report is produced (see the third page of Appendix 6 for a list).

Data is entered interactively according to the following prompts.

```
Enter the ZIP CODE (I7).: _
Enter the COUNTY (A10).: _
Enter the RADON LEVEL (F6.1).: _
Enter the LOCATION (I4).: _
Enter the TYPE OF DEVICE (I6).: _
Enter the test SEASON (I6).: _
TYPE YES TO ENTER DATA OR NO TO RETURN TO MAIN MENU.: _
```

Data for the six data fields displayed above are entered interactively for each building tested. Data entry continues for additional buildings until the user's reply is something other than Y or y. These six fields plus the record number assigned to the data by IRISDAT combine to form one record in the database. The format required by IRISDAT for appending data files to the database is shown in parentheses above. A FORTRAN format statement written for the data would therefore be:

```
FORMAT (I9,I7,A10,F6.1,I4,I6,I6)
```

The first field in the data record (I9) is reserved for the record number.

After data is entered into the system, the user is given the option of storing it in data file FILE1.DAT, in the database or both. Data is stored in FILE1.DAT using the following prompts.

```
Do you want to store data in "FILE1.DAT"?
Enter yes or no: _
```

If the response is affirmative or if the user has previously requested that data stored in FILE1.DATA is to be entered into the database, then the next promp is given.

```
DO YOU WANT TO CALCULATE STATISTICS
FOR THE DATA IN "FILE1.DAT"?
Enter yes or no: _
```

After the statistics are computed, then the following prompt is given.

```
THE STATISTICS FOR "FILE1.DAT" ARE
STORED IN "FILE2.DAT".
```

Data can be stored in the database beginning with the following prompt.

```
Do you want to store the data in THE OHIO IRIS?
Enter yes or no: _
```

Before storing data in the database, IRISDAT determines the maximum record number in the database which has been stored in file IRISAPP.TXT along with the other information shown below on the most recent append session. IRISDAT then displays that information and returns with the following prompts.

```
Enter a notation of up to 20 characters.: _
Enter the current date (MM/DD/YY).: _
Enter your identity.: _
```

This information, along with the updated maximum record from the current session, is stored in the text file for the next session and the data is stored in the IRIS database.

The final prompt from APPEND is as follows.

```
Now that you have entered data into THE OHIO IRIS,
it is necessary to update the data in the statistical files
THIS MAY TAKE SOME TIME, SO PLEASE BE PATIENT !!!
```

The statistics for all zip codes and counties are computed and stored in STATSZIP.DAT and STATSCNTY.DAT. IRISDAT has been programmed so that the statistics are only computed once for each of the affected zip codes and counties. Still the time required for the computations may be substantial, especially if a large number of records have been added to the data base, or if the zip codes or counties already have a large number of records. Therefore it is recommended that the user only add data in small sets, or enter the data early in the day so they are present when the calculations are completed later in the day.

3. Module MODIFY

This module has been included in IRISDAT so that data that has been entered into the database and found to contain errors can be corrected. The user should make every effort to ensure that the data is correct before storing it. Data can be reviewed for accuracy by first storing it in FILE1.DAT as described previously. Data in the database is modified one record at a time by reentering the six data fields (note that the seventh data field, the record number, cannot be modified because record numbers are computed by the system and should not require correction).

MODIFY begins with the following prompts.

```
YOU CAN MODIFY DATA IN THE OHIO IRIS FOR A PARTICULAR
RECORD BY SPECIFYING THE COUNTY AND RECORD NUMBER.
TYPE YES TO MODIFY DATA OR NO TO RETURN TO MAIN MENU.: _
```

The user then selects the data record to be modified by responding to the following prompts.

```
ENTER THE NAME OF THE COUNTY.: _
ENTER THE RECORD NUMBER.: _
```

IRISDAT uses this information to read all the data in the specified data record. The data are then displayed for the user and the user is prompted to continue.

```
THE INFORMATION FOR THE DATA RECORD IS AS FOLLOWS:
[All seven fields from the data record are displayed here.]
IS THIS THE RECORD THAT YOU WANT TO MODIFY?
ENTER YES OR NO.: _
```

If the response is not affirmative, then the system returns to the prompt given above, and queries whether the user wants to modify data or return to the main menu.

Before modifying data in the data record, IRISDAT refers to an archival file, IRISMOD.TXT, that contains records of previous data modification sessions. Information from the most recent modification is displayed as follows.

```
INFORMATION ON THE OHIO INDOOR RADON INFORMATION SYSTEM:
[Information displayed here.]
```

Information about the current modification is then entered using the following prompts.

```
Enter a notation of up to 20 characters.: _
Enter the current date (MM/DD/YY).: _
Enter your identity.: _
```

The data is then modified by reentering data using the following prompts.

```
Enter the ZIP CODE (I7).: _
Enter the COUNTY (A10).: _
Enter the RADON LEVEL (F6.1).: _
Enter the LOCATION (I4).: _
Enter the TYPE OF DEVICE (I6).: _
Enter the test SEASON (I6).: _
```

Data should be entered using the formats given in parentheses. MODIFY displays the following instructions after the entries have been completed.

```
Now that you have modified data in the OHIO IRIS,
it is necessary to update the data in the statistical files.
THIS MAY TAKE SOME TIME, SO PLEASE BE PATIENT !!!
```

These computations should not require a large amount of time because only one record is modified at a time. Whenever a county name is modified, it is necessary to remove the data record from the data file of the incorrect county and to store the corrected data in the correct county file. MODIFY then updates the statistics for the affected zip codes and counties, and stores them in files STATSZIP.DAT and STATSCNTY.DAT. The user is then returned to the initial prompt in MODIFY to determine if more records are to be modified or if the system is to return to the main menu.

4. Module ESTABLISH

ESTABLISH enables the user to assemble a data collection using data from different files for later use with IRISDAT. The user is first guided in selecting a data file with the following prompt.

```
YOU CAN SPECIFY ANY COUNTY BY SELECTING THE COUNTY NAME.
DO YOU WISH TO SEE THE LIST OF OHIO COUNTIES?
ENTER YES OR NO: _
```

If the response is affirmative, a display of the 88 Ohio counties is provided.

The system then begins the process of creating a user-specified data collection. The first set of prompts is as follows.

```
ENTER THE NUMBER OF COUNTIES YOU WANT TO USE: _
```

The following sequence of queries is repeated for each of the counties specified.

```
ENTER THE NAME OF THE COUNTY YOU WANT TO USE: _
```

Here an Ohio county can be specified or FILE1 can be entered if data has been prepared and stored in FILE1.DAT. Next the user is prompted with:

```
YOU CAN NOW SELECT PARTICULAR ZIP CODES FROM THE COUNTY
OR YOU CAN USE ALL THE ZIP CODES IN THE COUNTY.
ENTER YES TO SELECT ZIP CODES OR NO TO USE ALL ZIP CODES: _
```

The following steps are necessary if an affirmative response is entered for the above prompt.

```
DO YOU WISH TO SEE THE LIST OF ZIP CODE NUMBERS?
```

ENTER YES OR NO: _

If the answer is affirmative:

LIST OF ZIP CODES FOR [Name displayed here] COUNTY.

COUNTY   ZIP

[List displayed here]

ENTER THE NUMBER OF ZIP CODES YOU WANT TO USE: _

ENTER THE ZIP CODE: _

The collection is formed using all the data records from the specified zip codes and counties.

The next step in the procedure is to provide additional specifications to limit the data records in the collection. The user is first prompted with the following query.

DO YOU WANT TO USE ALL THE RECORDS
IN THE COLLECTION? _

The following information is then displayed if the answer is negative.

The collection will be formed based on your particular specifications. Enter your choices according to the following examples.

REC (field) GT (Boolean) 100 (value).

RADL (field) GT (Boolean) 4.0 (value).

The following fields can be selected.

RECORD_NUMBER or REC (for short),
ZIP_CODE or ZIP,
COUNTY,
RADON_LEV or RADL,
ROOM_LOC or LOC,
TEST_DEV or DEV,
TEST_SEASON or SEAS.

```
Enter the FIELD (REC, ZIP, RADL or etc.).: _
Enter the BOOLEAN (EQ, GT, GE, LT, BT, CONTAINING): _
Enter the VALUE (non-numeric values must be in quotes):
```

The above information is offered as a guide. Users may need to consult references on the VAX DATATRIEVE software for additional information. Users should be careful when entering the above selections because the data collection will be limited by the specifications. If data records are removed from the collection inadvertantly, it then becomes necessary to return to the main menu and start the whole process (module ESTABLISH) over again.

The user may need to repeat the specifications a number of times in order to selectively create data collections. This is done by replying affirmatively to the following prompt.

```
Would you like to establish a sub-collection
from the current collection? _
```

This returns the user to the previous prompt. When the data collection is complete, ESTABLISH displays the following information and then returns to the main menu.

```
THIS COLLECTION IS NOW BEING STORED ON "FILE1.DAT".
```

It was anticipated that users might want to create collections consisting of a large number of records. However, this might severly slow down the processing of the data or might exceed the capabilities of DATATRIEVE. Therefore all data is appended to FILE1.DAT rather than written over data in the data file. Thus the user can opt for ESTABLISH repetitively in order to produce a large collection of data stored in FILE1.DAT. It is, however, necessary to remove all previous data from FILE1.DAT before beginning a collection.

5. Modules STATSZIP and STATSCNTY

Modules STATSZIP and STATSCNTY are very similar and so will be discussed together. The purpose of the two modules is to compute and display statistics for selected zip codes or counties, or for a data collection stored in FILE1.DAT. The modules use the same FORTRAN routines that are used to update the statistical files STATSZIP.DAT and STATSCNTY.DAT. The modules also make use of the routines that display county names and zip codes.

Both of the modules begin by asking if the user wants to see a list of the counties. The process is the same as described previously for module ESTABLISH. The following prompt is then displayed.

```
ENTER THE NAME OF THE COUNTY REQUIRING STATISTICS: _
```

The user can enter any Ohio county name, or FILE1 if data in FILE1.DAT is to be used. If FILE1 is specified, then the following prompt is displayed.

```
DOES FILE1.DAT CONTAIN DATA
FROM JUST ONE COUNTY?
Enter yes if just one county._
```

If an affirmative response is given, the user receives the following prompt.

```
Enter the name of the county._
```

Statistics are then computed for module STATSCNTY.

For STATSZIP it is necessary to identify a zip code. Thus the user is queried as in module ESTABLISH. A list of zip codes is provided upon request and then the following prompt is given.

```
ENTER THE ZIP CODE REQUIRING STATISTICS: _
```

Statistics are then computed for module STATSZIP.

Both modules store the statistical data in FILE2.DAT by appending to the file. It is therefore necessary to erase or copy data in FILE2.DAT before beginning a new data collection. The modules then access DATATRIEVE in order to print out the statistical data with appropriate headings. To store this data or to get a hardcopy, DATATRIEVE provides the following prompt.

```
Enter a device or file name. _
```

The system then returns to the main menu. The modules can thus be used to prepare reports for any of the zip codes or counties, or for any other collection of data.

6. Module CONSTRUCT

The purpose of CONSTRUCT is to append and display the building construction data. This module uses a simplified DATATRIEVE procedure to store data rather than FORTRAN programming because there are no statistics to be calculated from the data. It was necessary to use FORTRAN for modules APPEND and MODIFY because the computed statistics needed to be updated. The user first has the option to append the data and then is given the option to create a report from the data.

Data is appended to data file BLDCON.DAT beginning with the following display.

```
DO YOU WANT TO ENTER DATA INTO THE BUILDING
CONSTRUCTION FILE?
Enter yes to enter data. _
```

If an affirmative response is given, then the following information is displayed.

```
DATA CAN BE ENTERED INTO THE BUILDING CONSTRUCTION
FILE (BLDCON.DAT) USING THE SCREEN PROMPTS.
```

```
TO ENTER DATA FIRST NOTE THE NUMBER IN PARENTHESES.
THE NUMBER DENOTES THE WIDTH OF EACH FIELD.
IN ORDER TO BE CONSISTENT WITH OTHER DATA IN THE FILE,
IT IS NECESSARY TO PLACE BLANKS IN FRONT OF ALL DATA
EXCEPT FOR COUNTY.
THUS A FIELD FIVE CHARACTERS WIDE AND WITH A SINGLE
DIGIT RESPONSE WOULD BE ENTERED 'bbbb#'.
NOTE: MULTIPLE ENTRY RESPONSES CAN BE USED
      WHEREVER THEY APPLY.
      ENTER -1 WHERE RESPONSE IS UNKNOWN
```

The information displayed above provides general instructions on entering data. Specifically, it is necessary to place blanks (using the space bar) at the beginning of all fields, except for COUNTY, so that all the data is right justified. Thus it is important to note the field width given in parentheses at the prompts to determine the number of required blanks. This enables IRISDAT to store and display all the data in the same columns so that better looking reports can be produced. This is also required because DATATRIEVE is used to store the data as ASCII characters and because DATATRIEVE is used to produce reports. The prompts described below should enable the user to input data without much difficulty.

Data entry begins with the following prompts.

```
Enter record number (7): _
Enter zip code (7): _
Enter county name (10) (Do not use blanks.): _
```

These three records do not require explanation by the system. The record numbers should correspond to those in the database. This will require using module APPEND to add the records to the database before entering data using CONSTRUCT. Five digit zip codes are used. The user is reminded not to place blanks before the county name.

Some of the remaining records require single digit codes to represent the information. The required codes are displayed prior to the data entry prompts as follows.

```
1 = SINGLE FAMILY        2 = DOUBLE FAMILY
3 = COMMERCIAL BLDG.     4 = SCHOOL
5 = APARTMENT            6 = DUPLEX


Enter type of building (6): _
Enter age of building in years (5): _
Enter air exchange rate (4): _
Enter penetration factor (4): _
Enter temperature difference (4): _
Enter number of occupants (4): _
Enter number of smokers (4): _
1 = GAS   2 = ELECTRICITY   3 = OTHER
Enter cooking fuel (4): _
1 = GAS     2 = ELECTICITY   3 = SOLAR
4 = WOOD   5 = OIL   6 = KEROSENE   7 = OTHER
Enter heating fuel (7): _
Enter fireplace: 1 = YES, 2 = NO (4): _
Enter sump pump: 1 = YES, 2 = NO (4): _
Enter crawl space: 1 = YES, 2 = NO (4): _
1 = POOR   2 = MODERATE
3 = GOOD   4 = EXCELLENT
Enter insulation (4): _
1 = PUBLIC   2 = WELL WATER   3 = BOTH
```

```
Enter water supply (4): _
1 = BRICK   2 = CONCRETE   3 = STONE
4 = WOOD    5 = FLYASH     6 = PLASTER
7 = OTHER
Enter building material (4): _
Enter number of floors including basement (8): _
Enter floor area in square feet (7): _
1 = POURED CONCRETE   2 = STONE OR DIRT FLOOR
3 = OTHER
Enter type of basement floor (4): _
1 = CENTRAL AIR HANDLING SYSTEM
2 = ROOM SIZE UNIT OR RADIANT HEAT WITH VENTILATION
3 = ROOM SIZE UNIT OR RADIANT HEAT WITHOUT VENTILATION
Enter type of ventilation (4): _
Enter domestic water radon level in pCi/l (4): _
1 = CITY   2 = TOWN   3 = RURAL
4 = FARM   5 = OTHER
Enter house location (4): _
```

The information for the single digit codes is not displayed until the prior entry is completed, thus avoiding confusion.

After entering information for each record, the system allows the user to continue adding records or proceed to the next step. Each record consists of the 24 fields listed above (from RECORD NUMBER to HOUSE LOCATION). The prompt to add another record is:

```
Enter Y if storing more records, N if not: _
```

If "Y" is entered, then the user is prompted to enter the RECORD NUMBER and the 23 other data fields. The following prompt is provided if "N" is entered.

```
THE BUILDING CONSTRUCTION DATA HAS BEEN
ENTERED INTO FILE BLDCON.DAT.
```

A report can be obtained from all or part of file BLDCON.DAT in the following manner. The users first is prompted with the following display.

```
DO YOU WANT TO PRINT OUT RECORDS IN THE BUILDING
CONSTRUCTION FILE?
Enter yes to print records. _
```

If an affirmative response is given, then the user is prompted to continue by writing an expression to create a collection of data.

```
YOU CAN EDIT YOUR REPORT BY ENTERING AN EXPRESSION SUCH AS
RECORD _ NUMBER (REC) BETWEEN 2 AND 200
OR ENTER REC GE 1 TO DISPLAY ALL RECORDS.
YOUR ENTRY? _
```

Expressions can be entered for any of the fields in BLDCON.DAT. Because there are 24 fields in the file, the system does not provide all of them in the information given above. A listing of all 24 fields is given below, where the shorter names in parentheses can be used.

1. RECORD_NUMBER (REC)
2. ZIP_CODE (ZIP)
3. COUNTY
4. TYPE_OF_BLDG (TBLDG)
5. AGE_OF_BLDG (ABLDG)
6. AIR_EXCH_RATE (AER)
7. PENE_FACT (PFACT)
8. TEMP_DIFF (TDIFF)
9. NUM_OF_OCC (NOCC)
10. NUM_OF_SMOK (NSMOK)
11. COOK_FUEL (COOK)

12. HEAT_FUEL (HEAT)
13. FIRE_PLACE (FIRE)
14. SUMP_PUMP (SUMP)
15. CRAWL_SPACE (CRAWL)
16. INSUL_ATION (INSUL)
17. WATER_SUPP (WATER)
18. BLDG_MAT (BMAT)
19. NUM_OF_FLRS (FLOORS)
20. FLOOR_AREA (AREA)
21. TYPE_OF_FLOOR (TFLR)
22. TYPE_OF_VENT (VENT)
23. WATER_RADON_LEVEL (WRADL)
24. HOUSE_LOC (LOC)

Report-writing for the building construction module ends with the following displays.

```
Enter device or the first file name. _
Enter device or the second file name. _
YOU HAVE CREATED A COLLECTION OF RECORDS FROM THE
BUILDING CONSTRUCTION FILE.
FOR A COPY, PRINT OUT YOUR FILES.
```

The output from this module is too wide to be printed on one sheet of paper. Therefore two files are input and a report is obtained by placing the output from each file side by side. The first file is the left-hand side of the report and the second is the right-hand side. Do not input the same name or else the right-hand side will be written over the left-hand side.

7. Module MITIGATE

Module MITIGATE allows the user to append and print out the data from the building mitigation file. This module is very similar to the CONSTRUCT module. The user is prompted to append data to file MITIGAT.DAT using the following displays.

```
DO YOU WANT TO ENTER DATA INTO THE BUILDING MITIGATION FILE?
Enter yes to enter data. _
```

If an affirmative reply is entered, then instructions similar to module CONSTRUCT are displayed informing the user to place blanks in front of all data to completely fill each data field.

The data entry is completed using the following prompts.

```
Enter radon level before mitigation in pCi/l (8) _
1 = BEDROOM       2 = KITCHEN      3 = BATHROOM
4 = REC. ROOM     5 = STORAGE      6 = UTILITY
7 = BASEMENT      8 = LIV./FAM.    9 = OTHER
10 = CRAWL SPACE  11 = DINING      12 = HALL
13 = 1'ST FLR.    14 = 2'ND FLR.
Enter location of test (4) _
Enter radon level after mitigation in pCi/l (8) _
1 = NATURAL VENTILATION         2 = FORCED AIR VENTILATION
3 = HEAT RECOVERY VENTILATION   4 = WALL VENTILATION
5 = SUBSLAB SUCTION             6 = SEALING OF CRACKS
7 = DRAIN TILE SUCTION          8 = HOUSE PRESSURIZATION
9 = OTHER
Enter type of mitigation (4) _
```

The above prompts are for the four fields in MITIG.DAT. The field widths are given in parentheses. The required single digit codes are provided as shown above the prompts. Data entry is completed with the following prompts.

```
Enter Y if storing more records, N if not. _
THE BUILDING MITIGATION DATA HAS BEEN
ENTERED INTO FILE MITIG.DAT.
```

A report is obtained from module MITIGATE using the following prompts.

```
DO YOU WANT TO PRINT OUT RECORDS IN THE BUILDING
MITIGATION FILE?
Enter yes to print records. _
YOU CAN EDIT YOUR REPORT BY ENTERING AN EXPRESSION SUCH AS:
PRE_RADON_LEVEL (PRE) BETWEEN 2 AND 200
ROOM_LOC (LOC) EQ 3
POST_RADON_LEVEL (POST) GT 5
TYPE_OF_MITIG (TMITIG) EQ 3
OR ENTER PRE GE 0 TO DISPLAY ALL RECORDS
YOUR ENTRY ? _
```

The editing information given above is used to create a collection which is then printed out using the following prompts.

```
Enter device or the file name _
YOU HAVE CREATED A COLLECTIN OF RECORDS FROM THE
BUILDING MITIGATION FILE.
FOR A COPY, PRINT OUT YOUR FILE.
```

A complete report is then printed using the information specified above.

8. Module EPIDEMIOLOGY

This module was included so that users can print out information in data file EPIDEM.DAT which contains statistics on lung cancer deaths by county. The following prompts are provided to request a report and to prepare a collection.

```
DO YOU WANT TO PRINT OUT RECORDS IN THE
EPIDEMIOLOGY FILE?
Enter yes to print records. _
YOU CAN EDIT YOUR REPORT BY ENTERING AN EXPRESSION SUCH AS:
COUNTY EQ "FRANKLIN"
POPULATION (POP) GT 100000
LUNG_CANCER_DEATHS (DEATHS) GT 100
ADJUSTED_LUNG_CANCER DEATHS (ADJUST) BETWEEN 100 AND 200
OR ENTER POP GE 0 TO DISPLAY ALL RECORDS
YOUR ENTRY? _
```

The following prompts are then displayed to complete the report.

```
Enter device or file name. _
YOU HAVE CREATED A COLLECTION OF RECORDS
FROM THE EPIDEMIOLOGY FILE.
FOR A COPY, PRINT OUT YOUR FILE.
```

The report includes a title page and the four fields listed above. The data file on epdemiology EPIDEM.DAT can be modified or appended using a system editor.

9. Module REPORT

Module REPORT makes use of the report-writing capabilities of DATATRIEVE. Reports produced using this module have a title page followed by a page containing the radon data keys. Subsequent pages contain the data from the specified data file with field headings. Statistical parameters computed using DATATRIEVE functions are provided at the end of the report.

Module REPORT is used to write reports from statistical and radon concentration files. The following prompt is used to determine the type of file to be reported.

```
DO YOU WANT TO WRITE A REPORT FOR
STATISTICAL FILES (STATSZIP OR STATSCNTY)
OR RADON CONCENTRATION FILES?
Enter yes for statistical files or
no for radon concentration files. _
```

For an affimative response, the system then queries whether the data contains statistics by zip codes or by counties.

```
DO YOU WANT STATISTICS BY ZIP CODES OR
BY COUNTIES?
Enter yes for zip codes or no for counties.
```

It is necessary to indicate whether the statistics are by zip code or county in order for DATATRIEVE to print out the data fields. If it is indicated that a report is to be written using radon concentration files then users can select either an Ohio county or FILE1.DAT.

After the data file is determined, REPORT then provides the following prompts to allow the user to specify how the data is to appear in the report.

```
YOU CAN EDIT YOUR REPORT BY ENTERING AN EXPRESSION SUCH AS:
RECORD_NUMBER (rec) between 1 AND 100
ZIP_CODE  (ZIP) (EQ 43611
COUNTY = "ADAMS"
RADON_LEVEL (RADL) GT 5.0
ROOM_LOC (LOC) EQ 6
TEST_DEV (DEV) EQ 1
```

```
TEST_SEASON (SEAS) BT 1 AND 3
OR ENTER REC GE 1 TO DISPLAY ALL RECORDS
YOUR ENTRY?_
```

This step performs nearly the same function as the data collection process described for ESTABLISH. That is, REPORT is programmed so that data collections can be edited (data records eliminated) using a command such as those in the above examples.

The above entry procedure can also used to take existing data records in a data file and arrange them in a specified order using the SORTED BY command. The following example can be used to take all the data records in a data file and sort them out by county and zip code.

```
REC GE 1 SORTED BY COUNTY, ZIP
```

The data in the report will first be sorted by county, and then the records in each county will be sorted by zip code.

DATATRIEVE displays the following prompt in order to provide a copy of a report.

```
Enter device or file name. _
```

This can include any file name except an Ohio county. If an extension is not supplied, then DATATRIEVE automatically attaches a LIS extension. The report-writing session is completed with the following instructions provided by REPORT.

```
YOUR REPORT IS COMPLETE.  TO GET A COPY OF YOUR
REPORT, PRINT OUT YOUR FILE.
DO YOU WISH TO WRITE A REPORT FOR ANOTHER COUNTY?
ENTER YES OR NO: _
```

If a positive answer is entered, then the program returns to the beginning of REPORT. Otherwise the system returns to the main menu.

```
              THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)
                                  MENU

 1. APPEND DATA TO THE DATABASE.
 2. MODIFY DATA IN THE DATABASE.
 3. ESTABLISH A COLLECTION OF RECORDS FROM THE OHIO IRIS.
 4. COMPUTE INDOOR RADON STATISTICS FOR OHIO ZIP CODES.
 5. COMPUTE INDOOR RADON STATISTICS FOR OHIO COUNTIES.
 6. ADD OR PRINT RECORDS IN THE BUILDING CONSTRUCTION FILE.
 7. ADD OR PRINT RECORDS IN THE BUILDING MITIGATION FILE.
 8. PRINT RECORDS IN THE EPIDEMIOLOGY FILE.
 9. WRITE A REPORT FOR DIFFERENT COUNTIES.
10. END THIS SESSION.


ENTER THE NUMBER OF THE SELECTION
YOU WISH TO PERFORM:
```

FIGURE 4. - Main Menu for IRISDAT

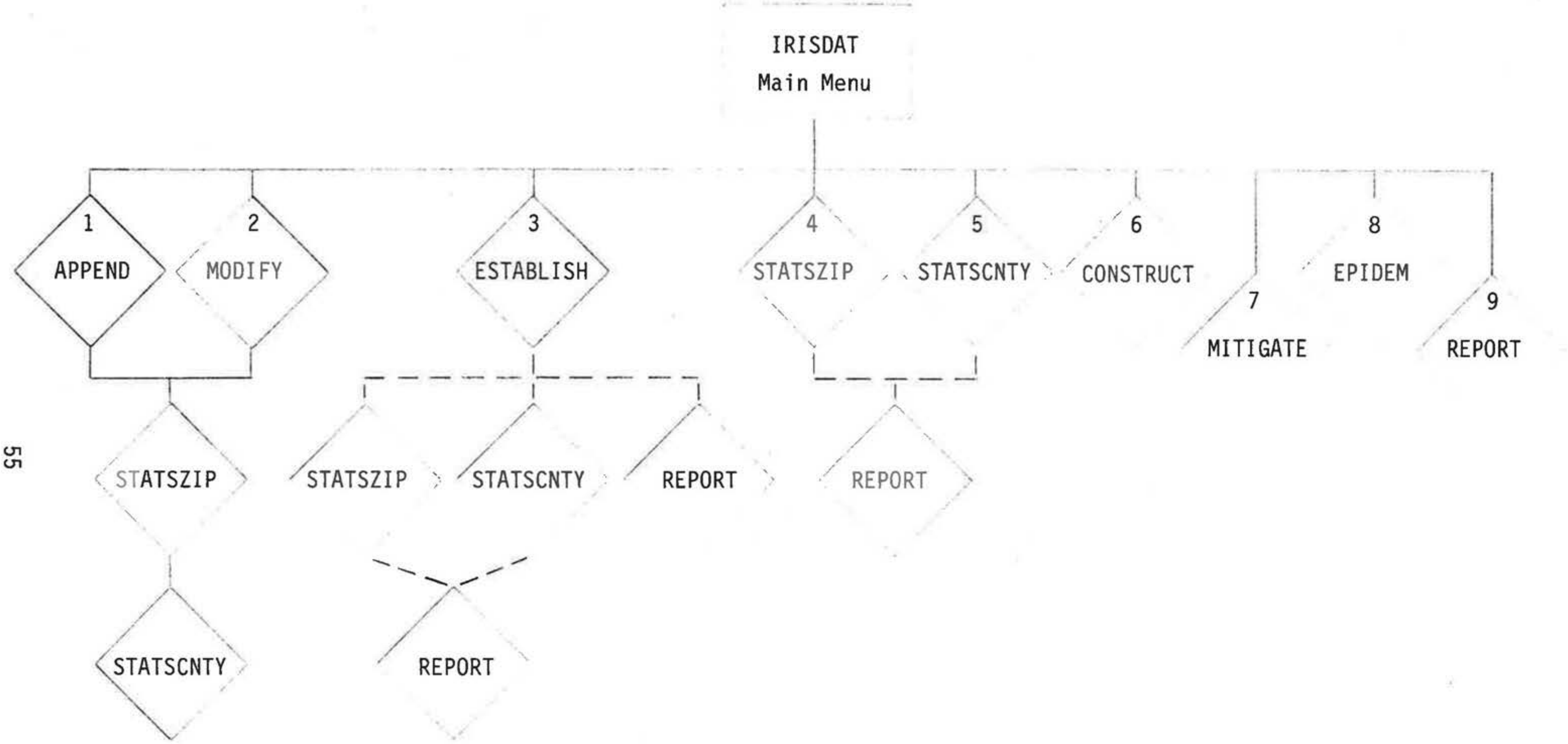


FIGURE 5 - Flow diagram for IRISDAT.

USING THE IRISMAP SOFTWARE

Introduction

IRISMAP is not one program, but rather is a collection of several interacting programs (Table 9) that are written in Microsoft GW-BASIC (also known as BASICA) and compiled using the Microsoft QUICK-BASIC compiler (Version 4.0). The numerous data files used by IRISMAP (and also listed in Table 9) are stored in an ASCII format.

IRISMAP requires an IBM-compatible microcomputer with at least 256 K internal (RAM) memory and MS-DOS software (Version 3.0 or higher). A math coprocessor and hard disk are recommended to speed up program execution but these are not essential. IRISMAP can be run from a single 3.5 inch floppy disk. The graphic displays require only a monochrome monitor but will, of course, also work on a color monitor. A dot-matrix printer will be necessary if printouts of the displayed maps and tables are desired.

Examples of geologic and radon concentration maps generated by IRISMAP are provided in Appendix 7 and in the next chapter (Figures 12-13, 15-19 and 22), respectively.

Program User's Guide

1. Getting Started

The drive containing the IRISMAP software (i.e., the programs and data files listed in Table 9) must be designated the "active" drive. This can be either a 3.5 inch floppy disk drive or a hard drive. If the latter, be sure you have specified the subdirectory in which the software resides. Type "IRISMAP" to initiate the title display. Next, press any key to display the main menu (Figure 6). Enter the number of the desired option and press either the RETURN or ENTER key (in what follows it should be understood by the reader that one of these keys is always pressed after information has been entered from the keyboard).

2. All Map Options

At some point prior to displaying a requested map, the program will prompt the user to specify whether they want just the state outline or all the county outlines displayed. Later, when a map is being plotted on the monitor, a message will appear in the lower right corner of the screen indicating what percentage of the plot has been completed up to that time. Upon completion of the plot, another message will briefly appear in the same corner of the screen. It will inform the user that they can press the "SHIFT + PRTSC (Print Screen)" keys to obtain a copy of the map from the dot-matrix printer. If any other key is pressed, the map is erased from the display and a prompt gives the user the option of returning to the IRISMAP main menu, to DOS or to the map option previously selected from the main menu.

3. The Bedrock Geology, Glacial Geology, and Oil and Gas Field Map Options

Whenever any of these options are selected from the IRISMAP main menu, a new menu will be displayed in which the plottable bedrock stratigraphic units, glacial deposit types, or oil and gas field types are listed (Figure 7). A first prompt asks the user how many parameters are to be plotted in the map. Succeeding prompts request the numeric codes for each of the parameters desired.

As discussed in an earlier section and also shown in Table 7, up to 4 oil and gas field types, and up to 5 bedrock units or glacial deposit types are listed in the data files for each zip code. Moreover, these are listed in order of decreasing areal extent. The data at all levels of areal extent are available for plotting. The user will thus be prompted to enter the "search level" for the geologic parameters to be plotted. For example, if "Doo" was selected for a bedrock geology map and a search level of 3 was specificied, a point would be plotted for all zip codes for which Doo occurred as the first, second or third most extensive unit.

4. The Glacial Deposit Thickness, Surficial Uranimum, and Soil Permeability and Drainage Map Options

The option menus for each of these map types are given in Figures 8 and 9. The user is prompted to select only one option from a given menu. One of three statistics can be selected (modal, maximum and minimum value for a zip code) for each of three types of maps. On one of these, zip code centroids are plotted as solid circles that are roughly proportional to the value of the selected statistic. A second map plots uniformly sized points for all zip codes that have values for the selected statistic larger than a user-specified (prompted) value. The last map is similar to the second except that it plots zip code centroids when the value of the statistic falls between two user-specified limits.

5. The County and Zip Code Radon Map Options

The prompts and options for the radon maps differ from those just described in Section 4 in only two respects. First, different statistics are available: median, arithmetic mean, geometric mean, third quartile and maximum (see Figure 10). Second, and this applies only to the zip code radon maps, the user is prompted to specify the minimum acceptable number of measurements for a zip code. Any zip codes with less than this number of measurements will not be plotted on the map. We have set the program default at 5 because we consider this to be the absolute minimum number of observations for reliable estimates of the statistics. It could, however, be reasonably argued that 10 or perhaps 20 would be a better minimum. It is the user who decides but it should be kept in mind that the number of zip codes plotted decreases as the minimum acceptable number of measurements increases.

As stated earlier, only 1029 of the 1255 zip codes included in the radon database are represented on the zip code base map (Figures 2 and 3) and, hence, are plottable. However, all of those excluded from the base map have fewer than 5 measurements and so, if the minimum recommended above is followed, would not be plotted in any event.

6. The Geologic and Radon Data Summary Option

In this last option in the IRISMAP main menu, the user receives only one prompt and that is for a zip code number. The program then displays three tables that list all the geologic and radon data available in the IRIS database for the selected zip code (see Figure 11 for an example of the output). The display will pause indefinitely between each table. Press "SHIFT + PRTSC" to generate a printed copy, or press any other key to continue to the next table. After the last table has been erased from the screen, the user is given the option of returning to the IRISMAP main menu or DOS, or to produce summary tables for another zip code.

Summary tables can be produced for any zip code in the radon database. However, if the zip code does not appear on the zip code base map, then there will be no geological data displayed (i.e., Tables 1 and 2 in Figure 11 will not be generated).

7. Additional Instructions

If at any time you wish to abort one of the IRISMAP programs, you may do so by pressing the CONTROL and BREAK keys simultaneously. This will return you to DOS.

All of the programs can be run independently of the main menu. Rather than initiating a session by typing "IRISMAP" and then selecting a menu option, you may instead type the name of the program that executes the option. For example, you can type "CBR" to generate a bedrock geology map (see Table 9 for the names of the other programs).

TABLE 9:

PROGRAMS AND DATA FILES IN IRISMAP

QUICK BASIC-Compiled GW-BASIC Programs

IRISMAP.EXE	Generates the main menu from which the system options (i.e., other programs) are selected
CBR.EXE	Generates bedrock geology maps
CGL.EXE	Generates glacial geology maps
CTH.EXE	Generates glacial drift thickness maps
CUR.EXE	Generates soil uranium concentration maps
CSP.EXE	Generates soil permeability maps
CSD.EXE	Generates soil drainage maps
CGO.EXE	Generates oil and gas field maps
CZRN.EXE	Generates radon concentration maps using zip code statistics
CCRN.EXE	Generates radon concentration maps using county statistics
CSUM.EXE	Generates geology and radon summary tables for zip codes

ASCII Data Files

1. Geology

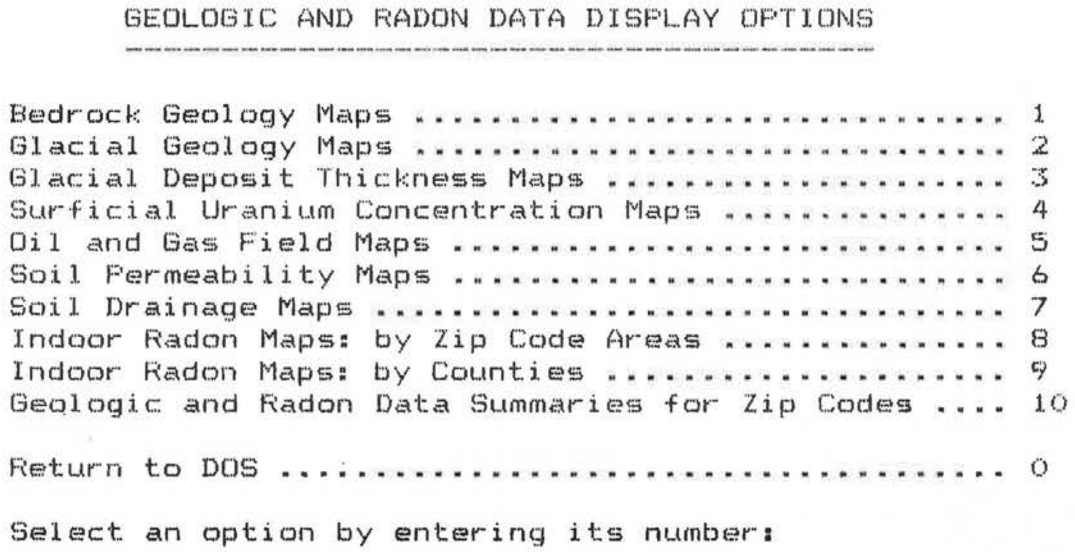
BR.DAT	Bedrock geology
GL.DAT	Glacial geology
TH.DAT	Glacial drift thickness
UR.DAT	Soil uranium
PD.DAT	Soil permeability and drainage
GO.DAT	Oil and gas fields

2. Radon

ZRN.DAT	Radon summary statistics for zip codes
CRN.DAT	Radon summary statistics for counties

3. Graphics

STATE.OUT	Digitized state outline
COUNTY.OUT	Digitized county outlines
ZIP.CEN	Zip code centroids
COUNTY.CEN	County centroids



```
        GEOLOGIC AND RADON DATA DISPLAY OPTIONS
        ---------------------------------------

Bedrock Geology Maps ............................... 1
Glacial Geology Maps ............................... 2
Glacial Deposit Thickness Maps ..................... 3
Surficial Uranium Concentration Maps ............... 4
Oil and Gas Field Maps ............................. 5
Soil Permeability Maps ............................. 6
Soil Drainage Maps ................................. 7
Indoor Radon Maps: by Zip Code Areas ............... 8
Indoor Radon Maps: by Counties ..................... 9
Geologic and Radon Data Summaries for Zip Codes .... 10

Return to DOS ...................................... 0

Select an option by entering its number:
```

FIGURE 6 - Main menu for IRISMAP.

```
BEDROCK GEOLOGY DATA SET

----------------  FORMATIONS  --------------------- CODES --- LITHOLOGIES -----

Permian Dunkard Fm: Pd............................   1   ......(Sh>Ss>>Lmst>Coal)
Pennsylvanian Monongahela Fm: Pm .................   2   ......(Sh>Ss>Lmst>>Coal)
Pennsylvanian Conemaugh Fm: Pc ...................   3   .....(Sh>>Ss>Lmst>>Coal)
Pennsylvanian Pottsville - Allegheny Fm: Ppa .....   4   ......(Sh=Ss>>Coal=Lmst)
Mississippian Waverly - Maxville Fm: Mwm .........   5   ...(Congl & Ss>Sh>>Lmst)
Devonian Olentangy - Ohio Fm: Doo ................   6   ...................(Sh)
Devonian Columbus - Delaware Fm: Dcd .............   7   ........(Lmst>>Dolst>Sh)
Devonian/Silurian Monroe Fm: DSm..................   8   ................(Dolst)
Silurian Niagara Fm: Sn ..........................   9   ............(Dolst>>Sh)
Silurian Brassfield Fm: Sb .......................  10   ...........(Lmst=Sh>Ss)
Ordovician Richmond Fm: Or .......................  11   ..............(Sh=Lmst)
Ordovician Maysville Fm: Om ......................  12   ..............(Sh=Lmst)
Ordovician Eden Fm: Oe ...........................  13   ..............(Sh>Lmst)
Ordovician Trenton Fm: Ot ........................  14   .....(Lmst=Dolst>>Sh>Ss)
```

```
GLACIAL GEOLOGY DATA SET

----- SURFICIAL DEPOSITS ---------- CODE ---------  TEXTURE -------------

Recent alluvium: R ....................  1   ...................Silt and sand
Wisconsin outwash: Wo .................  2   ..................Sand and gravel
Wisconsin kames and eskers: Wke .......  3   ..................Sand and gravel
Wisconsin lake sediments: Wl ..........  4   ...........Clay, silt & fine sand
Wisconsin ground moraine: Wgm .........  5   .Till (clay-silt > sand > gravel)
Wisconsin end moraine: Wem ............  6   .................Till (as above)
Illinoian outwash: Io .................  7   ..................Sand and gravel
Illinoian kame: Ik ....................  8   ..................Sand and gravel
Ilinoian ground moraine: Igm ..........  9   .................Till (as above)
Illinoian end moraine: Iem ............ 10   .................Till ( as above)
Illinoian lake sediments: Il .......... 11   ...........Clay, silt & fine sand
Kansan ground moraine: Kgm ............ 12   .................Till (as above)
Nonglaciated terrain: NG .............. 13
```

```
OIL AND GAS FIELDS DATA SET

-------  FIELDS  ---------          -- CODE --

Oil (production): O ....................   1
Natural Gas (production): G ...........   2
Natural Gas (storage): S................   3
No fields of any type: N ..............   4
```

FIGURE 7 - Menus for the bedrock geology, glacial geology, and oil and gas field options of IRISMAP.

```
SURFICIAL URANIUM CONCENTRATION DATA SET

   -------------- OPTIONS -------------------     -- CODES --

A. Plot solid circles with areas proportional
   to the concentration. Use:
     Modal concentration ............................  1
     Maximum concentration ..........................  2
     Minimum concentration ..........................  3
B. Plot dots of uniform size to indicate areas
   with a concentration greater than a specified
   limit. Use:
     Modal concentration ............................  4
     Maximum concentration ..........................  5
     Minimum concentration ..........................  6
C. Plot dots of uniform size to indicate areas with
   a concentration between two specified limits.
   Use:
     Modal concentration ............................  7
     Maximum concentration ..........................  8
     Minimum concentration ..........................  9
```

```
GLACIAL DEPOSIT THICKNESS DATA SET

   -------------- OPTIONS -------------------     -- CODES --

A. Plot solid circles with areas proportional
   to the thickness. Use:
     Modal thickness ................................  1
     Maximum thickness ..............................  2
     Minimum thickness ..............................  3
B. Plot dots of uniform size to indicate areas
   with a thickness greater than a specified
   limit. Use:
     Modal thickness ................................  4
     Maximum thickness ..............................  5
     Minimum thickness ..............................  6
C. Plot dots of uniform size to indicate areas
   with a thickness between two specified limits.
   Use:
     Modal thickness ................................  7
     Maximum thickness ..............................  8
     Minimum thickness ..............................  9
```

FIGURE 8 - Menus for the surficial uranium and glacial deposit thickness options of IRISMAP.

```
SOIL PERMEABILITY DATA SET

     --------------  OPTIONS  -------------------    -- CODES --

A. Plot solid circles with areas proportional
   to the permeability. Use:
     Modal permeability ..............................  1
     Maximum permeability ............................  2
     Minimum permeability ............................  3
B. Plot dots of uniform size to indicate areas
   with a permeability greater than a specified
   limit. Use:
     Modal permeability ..............................  4
     Maximum permeability ............................  5
     Minimum permeability ............................  6
C. Plot dots of uniform size to indicate areas
   with a permeability between two specified limits.
   Use:
     Modal permeability ..............................  7
     Maximum permeability ............................  8
     Minimum permeability ............................  9
```

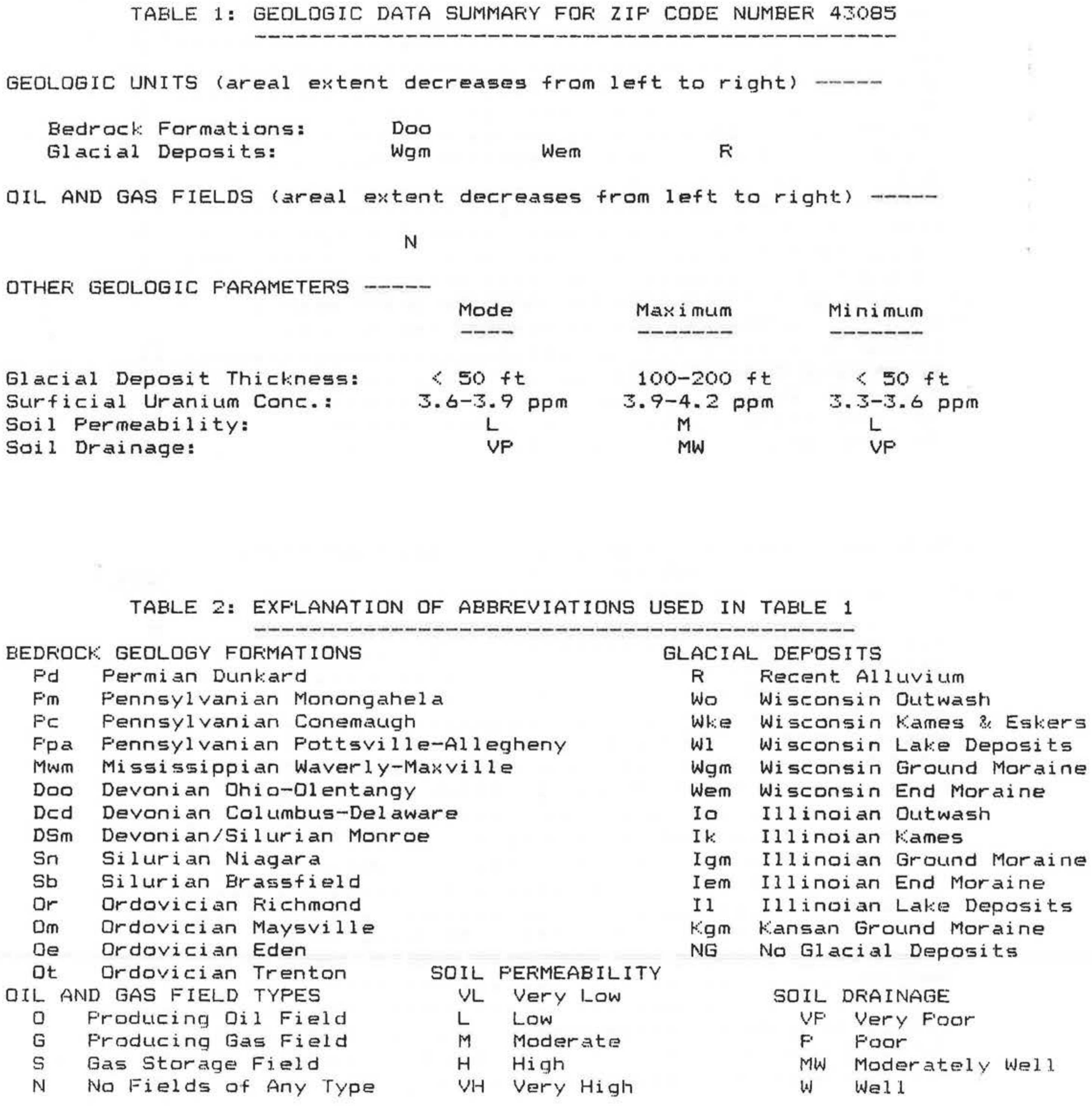
```
SOIL DRAINAGE DATA SET

     --------------  OPTIONS  -------------------    -- CODES --

A. Plot solid circles with areas proportional
   to the amount of drainage. Use:
     Modal drainage ..................................  1
     Maximum drainage ................................  2
     Minimum drainage ................................  3
B. Plot dots of uniform size to indicate areas
   with an amount of drainage greater than a
   specified limit. Use:
     Modal drainage ..................................  4
     Maximum drainage ................................  5
     Minimum drainage ................................  6
C. Plot dots of uniform size to indicate areas
   with an amount of drainage between two specified
   limits. Use:
     Modal drainage ..................................  7
     Maximum drainage ................................  8
     Minimum drainage ................................  9
```

FIGURE 9 - Menus for the soil permeability and drainage options of IRISMAP.

```
INDOOR RADON CONCENTRATION DATA SET: ZIP CODE STATISTICS
   ------------------------ OPTIONS ---------------------------   --- CODES ---
A. Plot solid circles with areas proportional to the
   concentration. Use:
     Median ............................................   1
     Arithmetic Mean ...................................   2
     Geometric Mean ....................................   3
     Third Quartile ....................................   4
     Maximum Value .....................................   5
B. Plot dots of uniform size to indicate areas with a
   concentration greater than a specified limit. Use:
     Median ............................................   6
     Arithmetic Mean ...................................   7
     Geometric Mean ....................................   8
     Third Quartile ....................................   9
     Maximum Value .....................................  10
C. Plot dots of uniform size to indicate areas with a
   concentration between two specified limits. Use:
     Median ............................................  11
     Arithmetic Mean ...................................  12
     Geometric Mean ....................................  13
     Third Quartile ....................................  14
     Maximum Value .....................................  15
```

```
INDOOR RADON CONCENTRATION DATA SET: COUNTY STATISTICS
   ------------------------ OPTIONS ---------------------------   --- CODES ---
A. Plot solid circles with areas proportional to the
   concentration. Use:
     Median ............................................   1
     Arithmetic Mean ...................................   2
     Geometric Mean ....................................   3
     Third Quartile ....................................   4
     Maximum Value .....................................   5
B. Plot dots of uniform size to indicate areas with a
   concentration greater than a specified limit. Use:
     Median ............................................   6
     Arithmetic Mean ...................................   7
     Geometric Mean ....................................   8
     Third Quartile ....................................   9
     Maximum Value .....................................  10
C. Plot dots of uniform size to indicate areas with a
   concentration between two specified limits. Use:
     Median ............................................  11
     Arithmetic Mean ...................................  12
     Geometric Mean ....................................  13
     Third Quartile ....................................  14
     Maximum Value .....................................  15
```

FIGURE 10 - Menus for the zip code and county statistics options of IRISMAP.



```
          TABLE 1: GEOLOGIC DATA SUMMARY FOR ZIP CODE NUMBER 43085
                   -------------------------------------------

GEOLOGIC UNITS (areal extent decreases from left to right) -----

   Bedrock Formations:       Doo
   Glacial Deposits:         Wgm        Wem         R

OIL AND GAS FIELDS (areal extent decreases from left to right) -----

                             N

OTHER GEOLOGIC PARAMETERS -----
                                Mode         Maximum       Minimum
                                ----         -------       -------

Glacial Deposit Thickness:     < 50 ft      100-200 ft      < 50 ft
Surficial Uranium Conc.:     3.6-3.9 ppm   3.9-4.2 ppm   3.3-3.6 ppm
Soil Permeability:                L             M             L
Soil Drainage:                    VP            MW            VP



          TABLE 2: EXPLANATION OF ABBREVIATIONS USED IN TABLE 1
                   ----------------------------------------
BEDROCK GEOLOGY FORMATIONS                        GLACIAL DEPOSITS
  Pd   Permian Dunkard                              R    Recent Alluvium
  Pm   Pennsylvanian Monongahela                    Wo   Wisconsin Outwash
  Pc   Pennsylvanian Conemaugh                      Wke  Wisconsin Kames & Eskers
  Ppa  Pennsylvanian Pottsville-Allegheny           Wl   Wisconsin Lake Deposits
  Mwm  Mississippian Waverly-Maxville               Wgm  Wisconsin Ground Moraine
  Doo  Devonian Ohio-Olentangy                      Wem  Wisconsin End Moraine
  Dcd  Devonian Columbus-Delaware                   Io   Illinoian Outwash
  DSm  Devonian/Silurian Monroe                     Ik   Illinoian Kames
  Sn   Silurian Niagara                             Igm  Illinoian Ground Moraine
  Sb   Silurian Brassfield                          Iem  Illinoian End Moraine
  Or   Ordovician Richmond                          Il   Illinoian Lake Deposits
  Om   Ordovician Maysville                         Kgm  Kansan Ground Moraine
  Oe   Ordovician Eden                              NG   No Glacial Deposits
  Ot   Ordovician Trenton           SOIL PERMEABILITY
OIL AND GAS FIELD TYPES              VL  Very Low              SOIL DRAINAGE
  O  Producing Oil Field             L   Low                     VP  Very Poor
  G  Producing Gas Field             M   Moderate                P   Poor
  S  Gas Storage Field               H   High                    MW  Moderately Well
  N  No Fields of Any Type           VH  Very High               W   Well
```

FIGURE 11 - Output from the zip code data summary option of IRISMAP.

FIGURE 11 cont'd

TABLE 3: INDOOR RADON DATA SUMMARY FOR ZIP CODE NUMBER 43085

Number of Radon Measurements	1317
MEDIAN Radon Concentration (Second Quartile)	9.5 pCi/l
ARITHMETIC MEAN Radon Concentration	13.70486 pCi/l
GEOMETRIC MEAN Radon Concentration	8.441251 pCi/l
FIRST QUARTILE Radon Concentration	4.7 pCi/l
THIRD QUARTILE Radon Concentration	18.075 pCi/l
MINIMUM Radon Concentration	0 pCi/l
MAXIMUM Radon Concentration	369.9 pCi/l
Radon Concentration STANDARD DEVIATION	18.3087 pCi/l
Radon Concentration COEFFICIENT OF VARIATION	133.5927 %

DISTRIBUTION OF INDOOR RADON IN OHIO

Zip Code Areas

Figures 12-13 and 15-19 show the distribution of indoor radon levels across Ohio as represented by various statistical measures. We believe the map of geometric mean concentrations (Figures 12 and 13) provides the most meaningful illustration of this distribution.

One problem in interpreting these maps is that the number of measurements available for each zip code area is extremely variable. As can be seen in Figure 20, the vast majority of the indoor radon testing has been confined to the state's urban areas: i.e., the greater Akron, Canton, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Toledo and Youngstown areas. The implication of this is that we still may not have an accurate picture of the true nature of the radon distribution in rural Ohio. A comparison of Figures 3 and 12, for example, reveals that there are numerous, sizable gaps in the radon database's coverage. It is our hope, of course, that these gaps will eventually be filled if the database is updated in the years to come. We believe, however, that the database is sufficiently comprehensive now to permit a sound geological interpretation of the radon distribution (see the next chapter).

Figure 12 should be fairly reassuring to Ohioians. Relatively few zip code areas have a geometric mean radon concentration above 8 pCi/l (Figure 21; see also Figure 25). Most of the problem areas are confined to the central and western parts of the state. There are good geologic reasons for this as will become apparent later. We do not expect this overall pattern to change significantly as new information is added to the database.

It is important to once again point out that the radon statistics were calculated from all of the available data for the zip code areas. Consequently, measurements for different building and room types, and for different times of the year have been combined. Most of the measurements have been made by the residents themselves, and it is quite likely that the EPA sampling protocol was not always followed. The reported radon levels may not, therefore, be truly representative of the buildings or rooms tested. The majority of measurements are for the lowest level of single family houses with the test dates spread throughout the year. This means that the averages computed in this study and displayed in Figures 12-13 and 15-16 may be taken as rough estimates of the upper limit of year-round average radon concentrations in the living areas of houses.

A comparison of the distribution of maximum radon concentration (Figures 18 and 19) with the distribution of numbers of measurements (Figure 20) reveals a strong similarity between these two maps. Higher maxima seem to be associated with areas with large numbers of measurements. We believe this to be a sampling artifact. If enough sampling is done in an area, it seems inevitable that at least one spuriously high concentration will be reported as a result of some kind of sampling error. This sampling effect may also have slightly affected the arithmetic mean, which is also sensitive to extreme high values. It is, of course, hard to know whether a large number of measurements in an area is more a result of a large population or a response to a serious radon problem. In many cases it is clearly both.

Counties

The geometric mean (GM) radon concentrations for Ohio counties are shown in Figure 22. This map is broadly similar to that in Figure 12. The average concentration is relatively low (<8 pCi/l) in all of the counties except one: Licking County (see also Appendix 4 for county radon statistics). The GM for Licking is 11.5 pCi/l based on 946 measurements. This is significantly higher than the next highest county average of 7.5 pCi/l (N = 384) for nearby Pickaway County. Franklin County (GM = 6.7 pCi/l and N = 10,020) previously held the dubious distinction of being the radon hot spot of the state. The other counties with geometric mean radon concentrations above 4 pCi/l (the EPA's "action level") are: Knox, 7.1; Harrison, 7.1; Carroll, 6.3; Ross, 6.2; Fairfield, 6.0; Hocking, 5.9; Delaware, 5.9; Champaign, 5.7; Marion, 5.4; Miami, 5.4; Crawford, 5.2; Madison, 5.1; Pike, 5.1; Muskingum, 5.0; Coshocton, 4.9; Darke, 4.9; Morrow, 4.9; Huron, 4.6; Preble, 4.6; Logan, 4.5; Wayne, 4.5; Richland, 4.5; Tuscarawas, 4.4; Greene, 4.4; Ashland, 4.3; Auglaize, 4.3; Mercer, 4.2; Shelby, 4.2; Holmes, 4.3; Van Wert, 4.0.

A breakdown of the radon distribution within counties is provided in Appendix 8. Appendix 3 lists the zip codes in each county and this, in conjunction with Appendix 5, can be used to obtain the radon statistics for county zip codes.

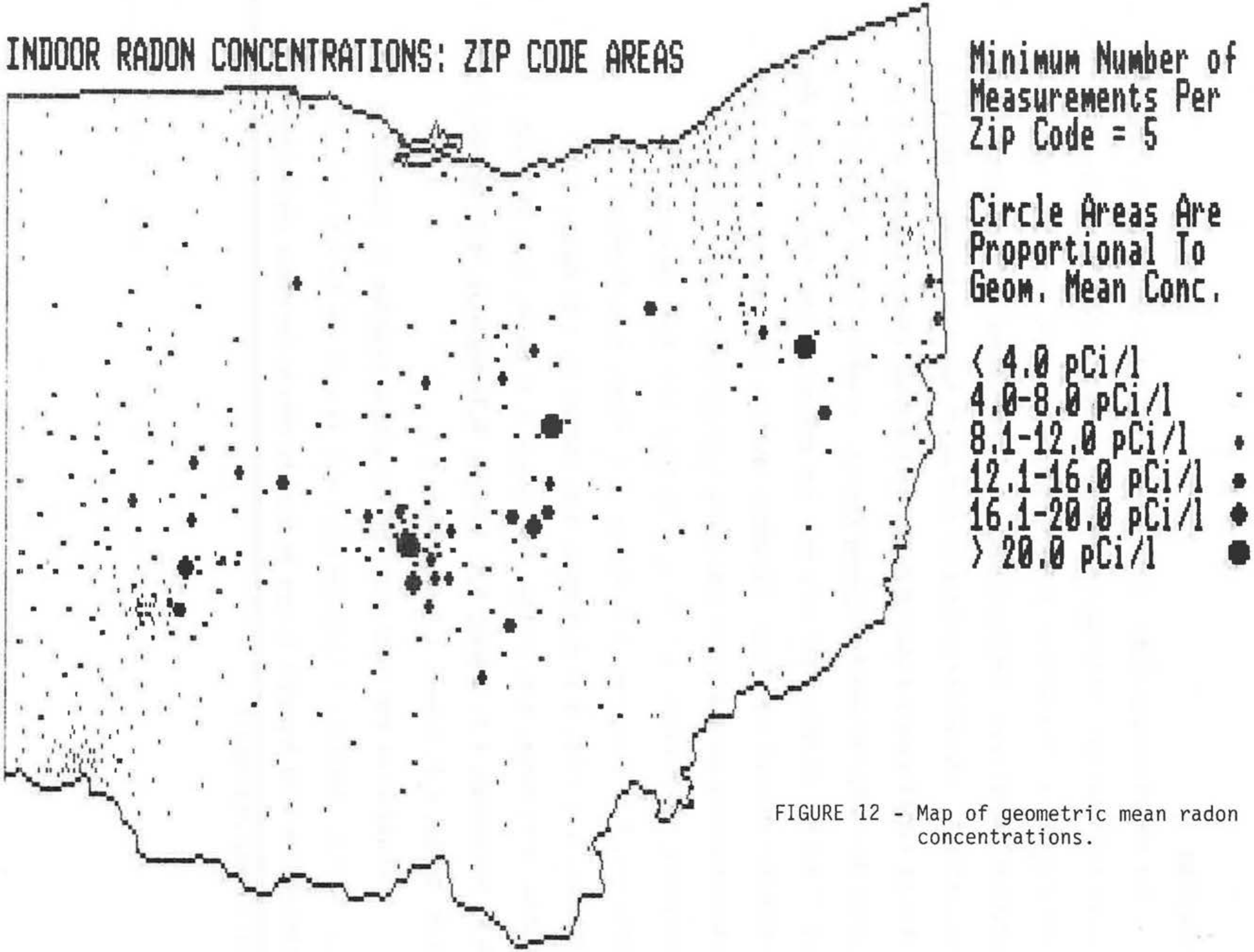


FIGURE 12 - Map of geometric mean radon concentrations.

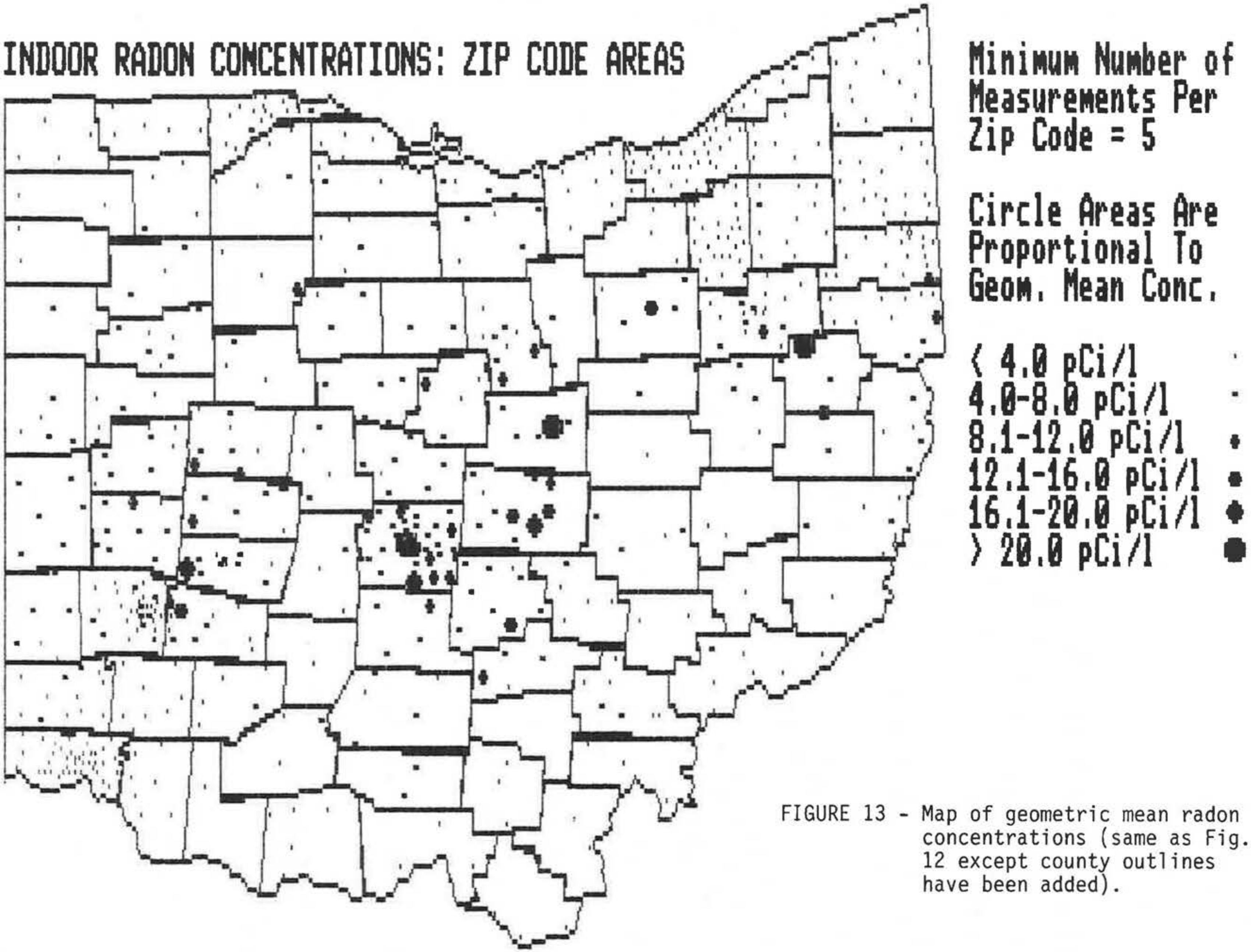


FIGURE 13 - Map of geometric mean radon concentrations (same as Fig. 12 except county outlines have been added).

FIGURE 14 - Map of Ohio counties.

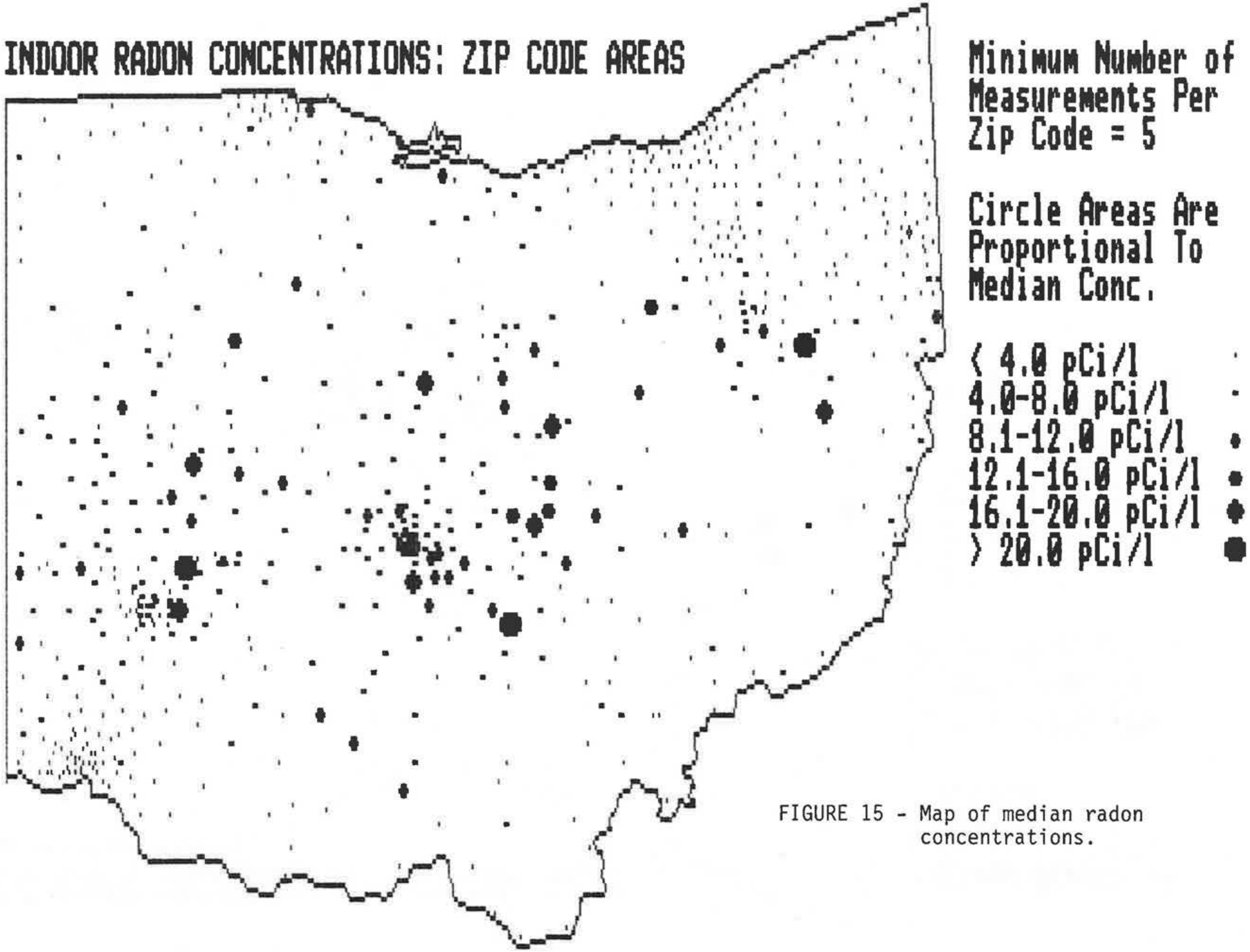


FIGURE 15 - Map of median radon concentrations.

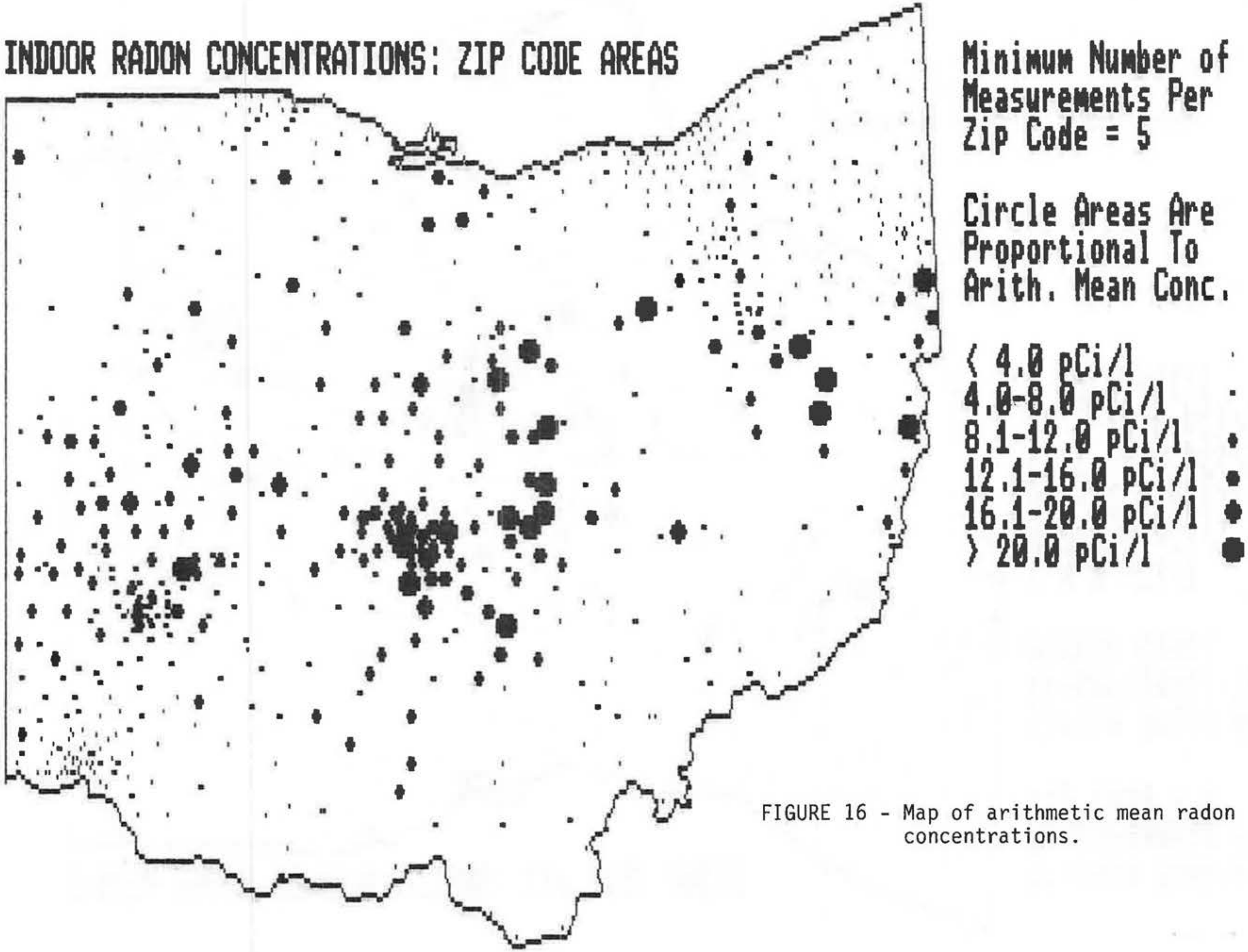


FIGURE 16 - Map of arithmetic mean radon concentrations.

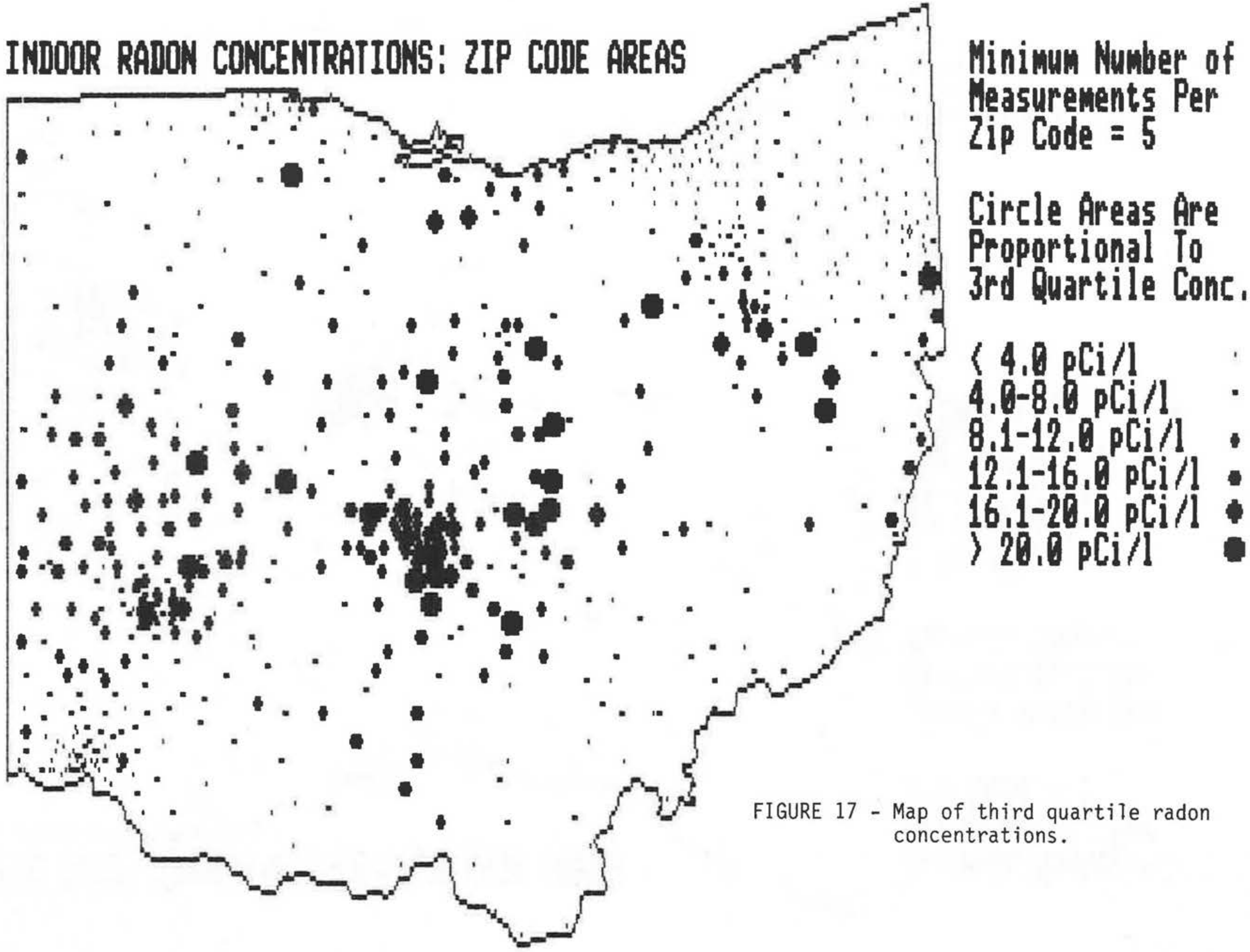


FIGURE 17 - Map of third quartile radon concentrations.

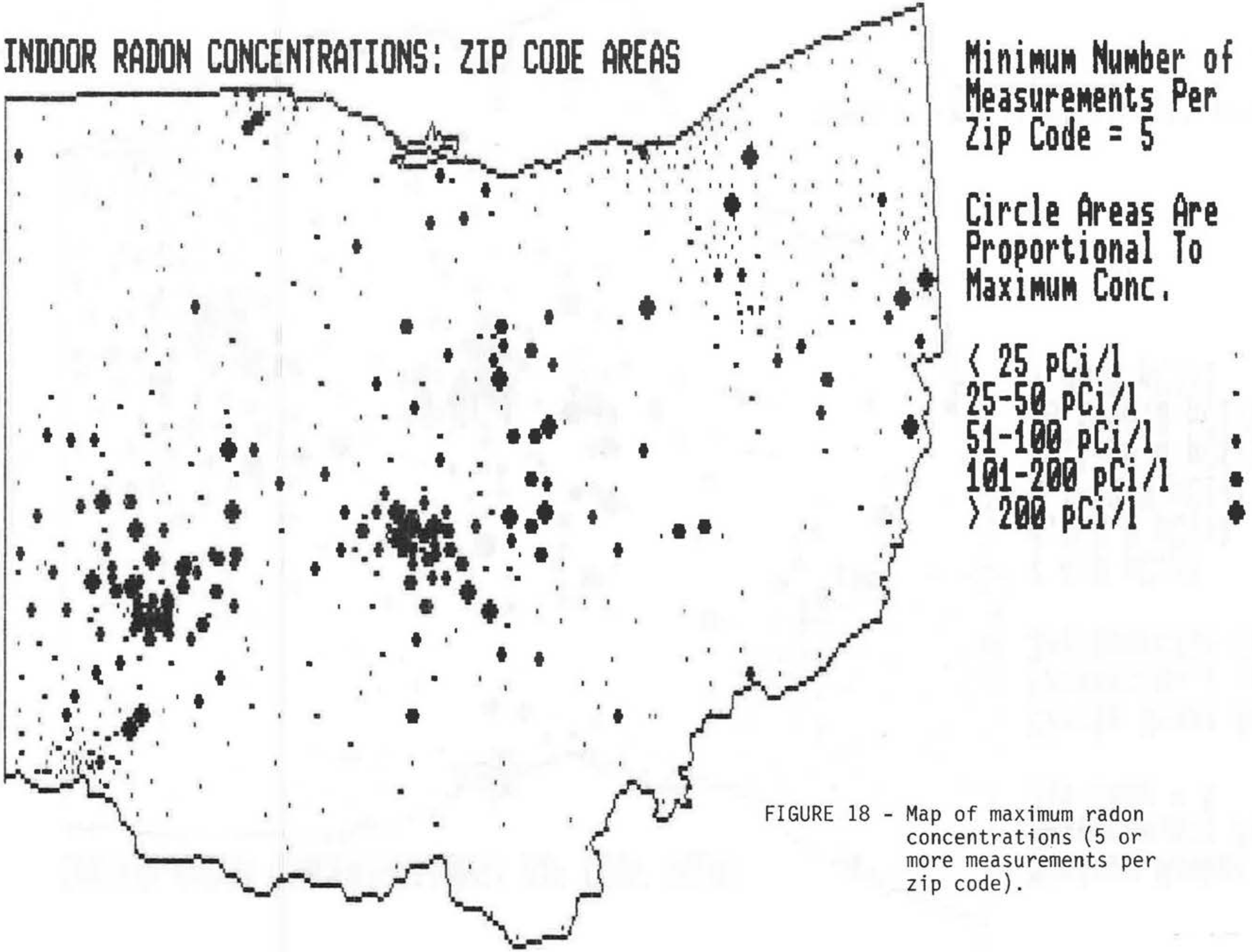


FIGURE 18 - Map of maximum radon concentrations (5 or more measurements per zip code).

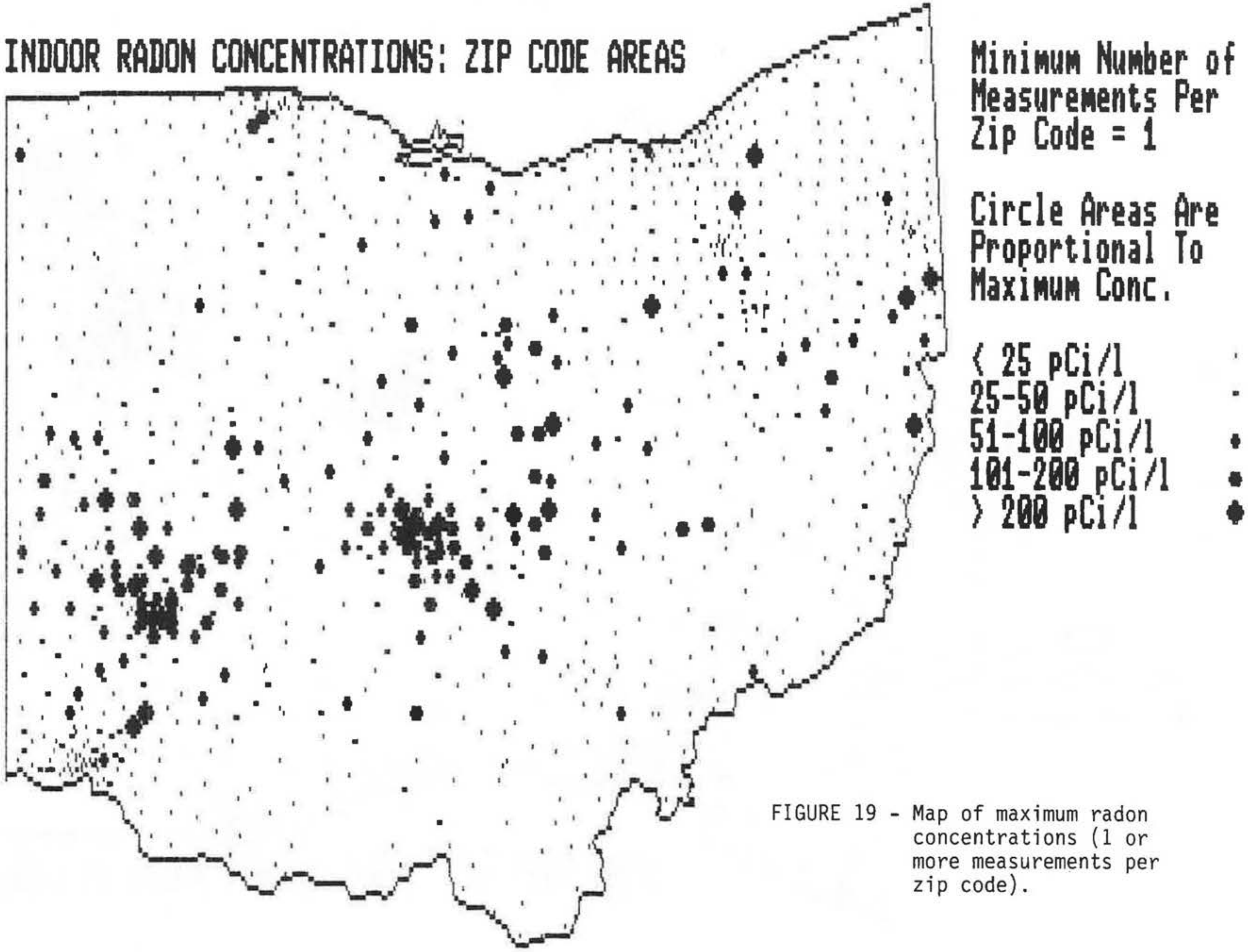


FIGURE 19 - Map of maximum radon concentrations (1 or more measurements per zip code).

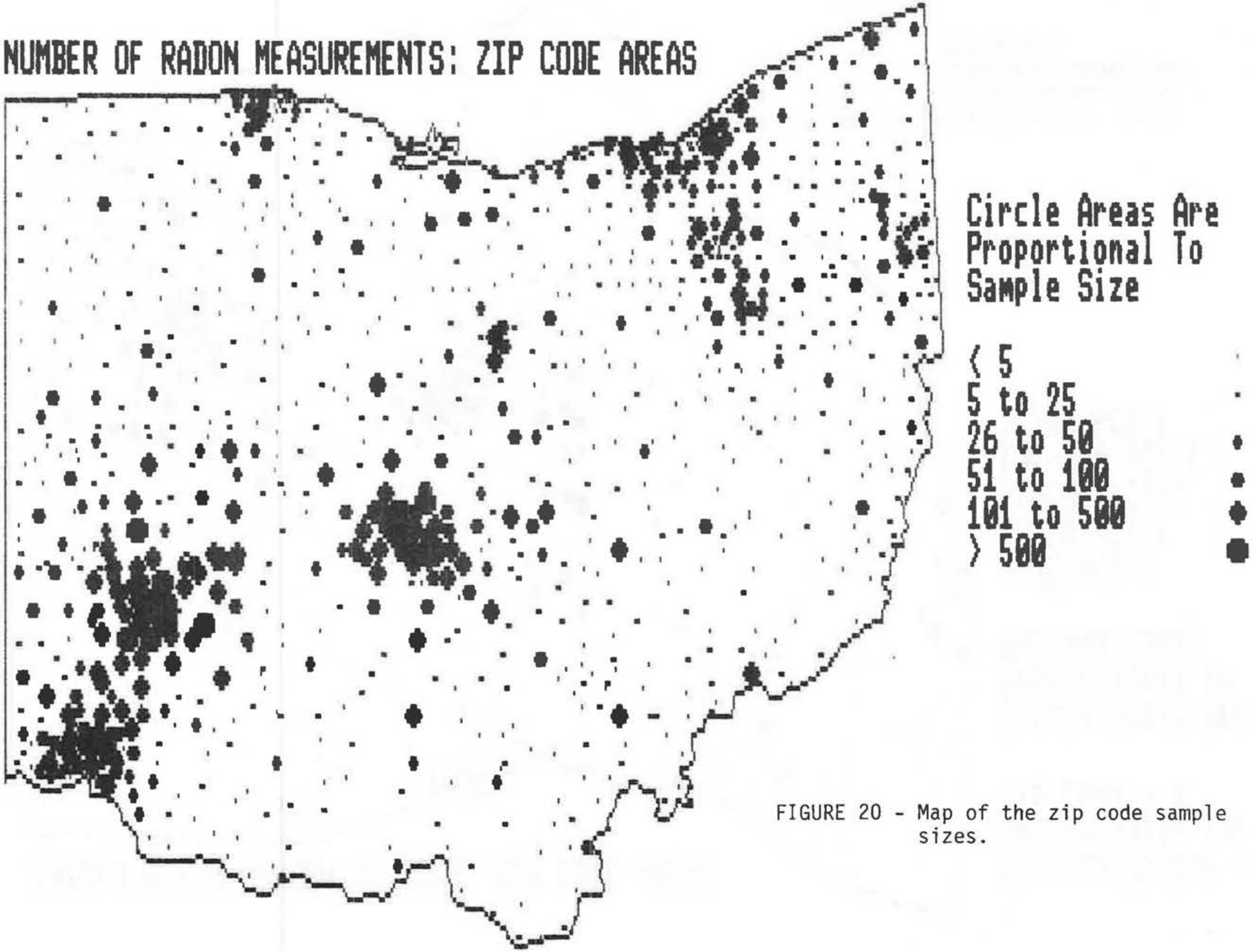


FIGURE 20 - Map of the zip code sample sizes.

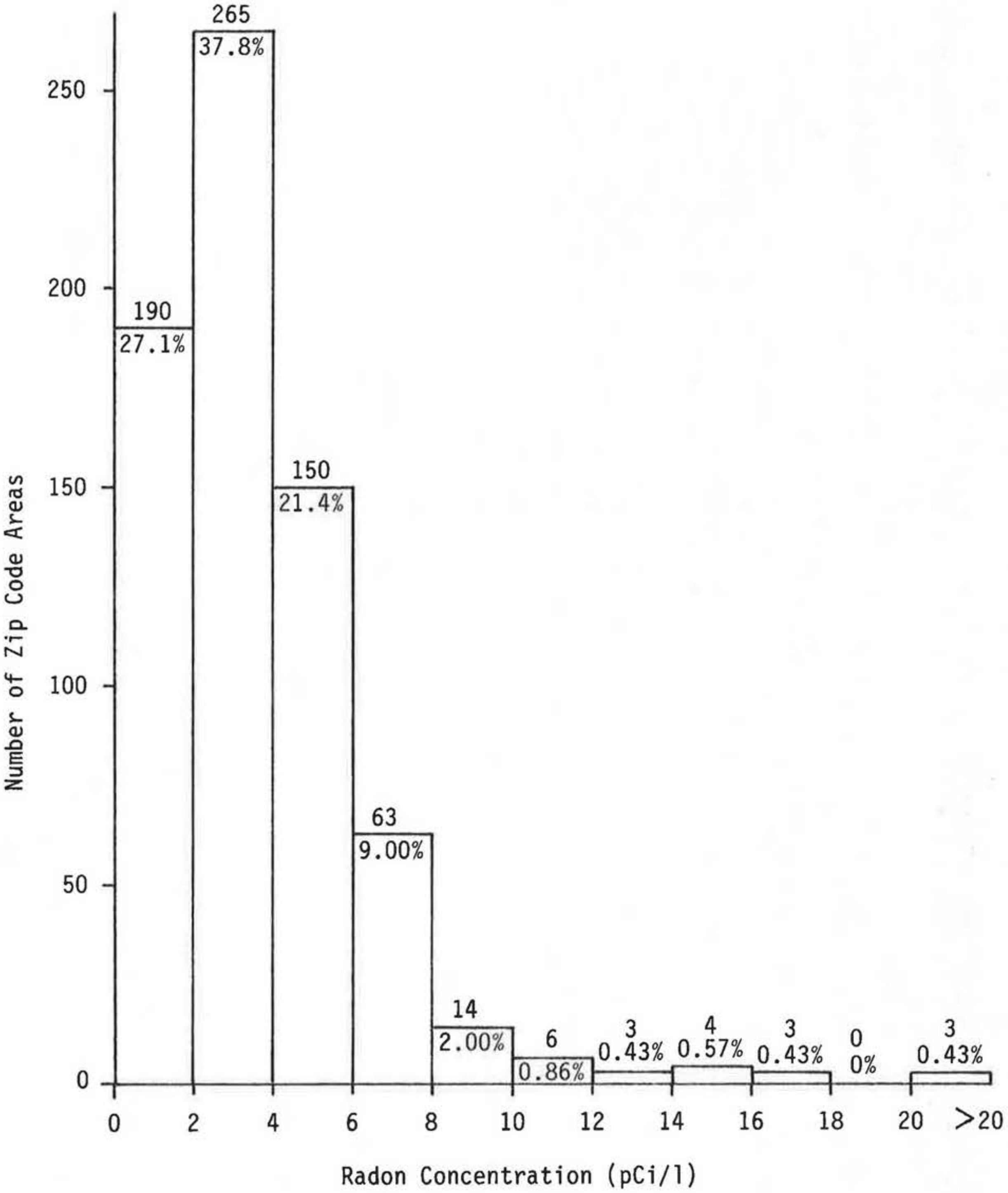


FIGURE 21 - Frequency distribution of geometric mean radon concentrations for zip code areas.

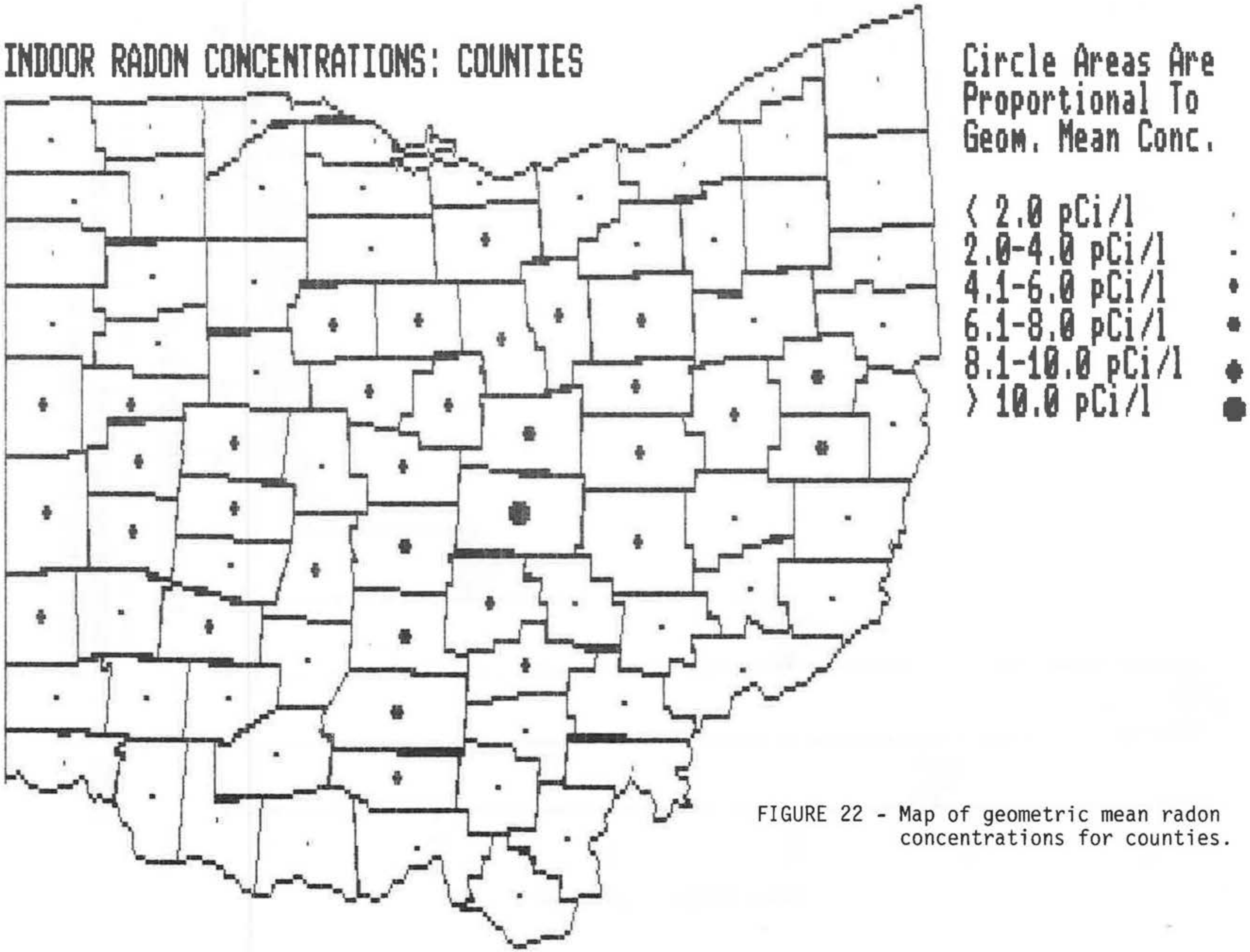


FIGURE 22 - Map of geometric mean radon concentrations for counties.

GEOLOGIC CONTROLS ON INDOOR RADON IN OHIO

Introduction

Indoor radon is fundamentally a geologic problem. The gas is derived from the radioactive decay of uranium which occurs in some rocks, sediments and soils beneath buildings. The permeability of these materials is also important because it determines how much of the gas survives the upward migration to the surface. The concentration of indoor radon is therefore primarily controlled by the underlying geology. The physical characteristics of the buildings are normally of secondary importance. They serve only to modulate the indoor radon levels.

The IRIS database provides a unique opportunity to explore the cause-and-effect relationship between radon and geology. Because both radon and geologic data are available for each zip code area, it should be possible to identify the main geologic controls on radon production. It is important to point out, however, that the database has some limitations when used in this way. It is to be expected that for some zip codes the average geological characteristics do not adequately describe the conditions where the majority of the radon measurements were made. This is most likely to be the case when few measurements have been made or when most of the population, and so perhaps also most of the measurements, are concentrated in a small part of the zip code area. Another problem with small sample sizes is that the radon measurements may not be representative of the buildings in the zip code area.

Although geological interpretations may not always be reliable for individual zip codes, when all of these areas are taken together, a clear picture of the relationship between geology and radon emerges. In the discussion that follows, our interpretations are based on data for the 698 zip code areas that occur in both the radon and geological parts of the IRIS database, and that also have 5 or more measurements. While these zip codes account for only a little more than half of the total number of zip codes in the radon database, they do come from all parts of the state and so adequately represent the distribution of radon in Ohio.

Interpretive Overview

Figures 23 and 24 illustrate the relationships between bedrock and glacial geology, and the distribution of indoor radon across Ohio. From these maps it is immediately apparent that the vast majority of geometric mean radon concentrations above 4 pCi/l are associated with Wisconsin-age glacial deposits (primarily till), especially those of the Miami and Scioto Lobes. A similar finding has been made for the glaciated portion of Illinois (Hudson and Nelson 1989 and personal communication). In the Scioto Lobe, where most of the highest levels occur, the underlying bedrock is the Devonian Ohio Shale (Doo) and Mississippian conglomerates, sandstones and shales of the Waverly-Maxville Group (Mwm) (see Tables 8 and 10 for additional information on these and other units). In the Miami Lobe, where many of the other high radon levels in the state occur, the bedrock consists of various Devonian, Silurian and Ordovician limestone and dolostone units. Of the 698 zip code areas represented on the maps in

Figures 23 and 24, 33 have geometric mean radon concentrations of 8 pCi/l or higher. We consider these areas to be the radon "hot spots" in the state. They are identified by zip code in Figure 25, and their geological and other characteristics are summarized in Table 11.

The association of radon with the Ohio Shale comes as no surprise because this unit is well known to be a potent radon producer (Harrell and Kumar 1988, 1989; Harrell et al. "in press"). However, the high radon levels above the other bedrock units was unexpected because none of them, with one exception, are known to be uraniferous. The lone exception is the Mississippian Sunbury Shale which is an organic black shale like the Ohio, but this unit is generally less than 50 feet thick and so has a negligible outcrop area. The close association between glacial till and radon was also unexpected because these generally fine-grained sediments are of low permeability and, hence, were thought to be incapable of transmitting radon from the source materials either within the till or below in the bedrock. The clear conclusion to be drawn from these results is that the Wisconsin glacial deposits are the primary source of radon in Ohio. What remains to be determined is why?

Composition of Glacial Deposits

Glacial till (i.e., ground and terminal moraine deposits; Wgm, Wem, Igm and Iem in Table 8) is a poorly sorted and generally unstratified mixture of clay (clasts <0.004 mm), silt (0.004-0.062 mm), sand (0.062-2.000 mm) and gravel (>2.000 mm). Glacial outwash (Wo, Io), kames and eskers (Wke, Ik), and the related Recent alluvial deposits (R) consist largely of sand and gravel. Of particular interest in radon studies are the amount and composition of the sand and gravel clasts. When these clasts are abundant, the permeability of the deposit will be high, and when the clasts are uraniferous, the deposit will be a source of radon.

Almost nothing is known about the composition of the sand fraction in glacial and related deposits. Not much more is known about the composition of the gravel fraction, but "pebble counts" from numerous till and outwash localities throughout western Ohio indicate what is probably a general rule: Canadian-derived granite and gneiss clasts almost always account for less than 20% of the total clasts and usually account for less than 10%, with the remainder of the clasts derived from Ohio bedrock (Kempton 1956, Kempton and Goldthwait 1959, Goldthwait 1969, Rosengreen 1974; Oldfield 1977; Quinn and Goldthwait 1979 and 1985, Goldthwait et al. 1981, and Strobel and Faure 1987). Most of the bedrock clasts were probably carried by glaciers and streams no further than several tens of miles from their point of origin. The so-called "boulder belts" in southwest Ohio are an exception to the compositional tendencies just described. In these deposits the Canadian granite and gneiss consistently account for over 75% of the boulders (i.e., gravel clasts over 25.6 cm in diameter) with the remainder coming from the local bedrock. These boulders occur only on or very near the surface as scattered, noncontiguous clasts in fine-grained till. They do not form gravel deposits.

The present authors (Harrell and Kumar 1988) and others (e.g., Smith and Mapes 1989) have previously suggested that the Canadian granite and gneiss clasts may be the primary source of radon in glacial till, and especially in glacial and alluvial sand and gravel deposits. The pebble counts seem to indicate that these clasts are not abundant enough to constitute a significant source of radon. Indeed, we do not even know that these particular rock types are uraniferous. Many granites and gneisses in the world are uraniferous, but certainly not all of them are.

We may conclude from the relative paucity of Canadian clasts that if the glacial deposits are acting as a radon source, then the radon must be coming from clasts derived from the local bedrock.

The Ohio Shale as a Source of Radon

We would like to offer the following hypothesis to explain most of the geometric mean radon concentrations above 4 pCi/l in the Miami and Scioto Lobes (see Figures 23 and 24):

> First, the radon comes from source materials in the upper few tens of feet of the glacial and alluvial deposits.
>
> Second, the radon source materials in these deposits are fragments of Ohio Shale (gravel through clay size clasts) that were eroded by glaciers from the outcrop of this formation (i.e., the north-south belt running down the center of Ohio, the Bellefontaine outlier in west-central Ohio, and the belt in the northwest corner of the state), and carried by the ice over the adjacent areas and deposited.

This interpretation is supported by the directions of ice movement shown in Figure 26. These directions are inferred from the striation azimuths shown on the Glacial Map of Ohio (Goldthwait et al. 1967) and by assuming that the end moraines, also shown on this map, are oriented approximately normal to the direction of ice movement.

The uranium and radon contents of the Ohio Shale in its outcrop areas were reported in Harrell and Kumar (1988) and Harrell et al. ("in press"). The north-south belt and especially the Bellefontaine area were shown to be highly uraniferous (Figure 27). Our conclusion that the outcrop belt in the northwest corner of the state was not a radon producer was based on rock samples collected at only one locality, and so may be incorrect. There is essentially no data on how much of the Ohio Shale has been incorporated into the glacial and alluvial sediment of central and western Ohio. Oldfield (1977) encountered the Ohio Shale in pebble counts of till in Preble and Butler counties, and Gooding (1973) reported that pebbles of Ohio Shale are often found in the Wisconsin tills of eastern Indiana (the westward continuation of the Miami Lobe). All of these gravel clasts were presumably derived from the Ohio Shale outcrop in northwest Ohio and northeast Indiana (note: the Ohio Shale in Indiana is referred to as the Antrim Shale). The pebble counts may actually underestimate the abundance of Ohio Shale in glacial deposits. This rock is soft, and so is easily eroded and abraded. Its fragments may thus largely exist as clay- and silt-size particles.

Figure 26 would seem to suggest that the high radon concentrations near the glacial boundary in northeast Ohio are perhaps also due to Ohio Shale fragments being brought down from the outcrops along the lake to the north. Although undoubtedly such fragments were brought down in abundance, they could not be a significant radon source. The low levels of uranium in this outcrop have been previously documented (e.g., Figure 27), and are further confirmed by the IRIS database which shows no high radon levels in the area of the outcrop.

If our hypothesis that the Ohio Shale is largely responsible for the high radon levels in central and western Ohio is incorrect, then other sources of radon must be found. This represents a serious problem for the area underlain by the Mississippian Waverly-Maxville Group (Mwm in Figure 23). The conglomerates, sandstones and shales that comprise most of this stratigraphic interval are not known to contain uranium in amounts greater than the crustal average (2-3 ppm according to Dyck 1978). The only exception to this is the previously mentioned black Sunbury Shale which cannot be a significant source of radon because it has a negligible outcrop area. It must, however, be admitted that no one has yet investigated the possibility of uranium enrichment in these rocks, and so until uranium analyses are made we cannot be certain that these rocks are not radon producers. In the case of the carbonate rocks that underlie most of the state west of the Ohio Shale's north-south outcrop belt, there are viable alternative hypotheses to explain the elevated radon levels: soil development on calcareous glacial deposits, and silicification of carbonate rocks.

Calcareous Soil as a Source of Radon

The glacial deposits in western Ohio are enriched in limestone and dolostone clasts derived from the underlying bedrock (units Dcd, DSm, Sn, Sb, Or, Om, Oe and Ot in Figure 23, and Tables 8 and 10). This is true for the outwash, kame and esker sands and gravels as well as for the morainal tills. During weathering the carbonate fraction in these deposits is easily dissolved and the insoluble residues (largely clay) are concentrated, and as a result soils are rapidly developed. In advanced stages of development, these soils have a reddish color and are called "terra rossa" or red earth. Less mature soils are more typical of Ohio and these we will hereafter refer to as "calcareous soils".

Limestones and dolostones typically contain less than 3 ppm uranium (Haglund 1972 and Dyck 1978). However, soils developed on such rocks would have much higher uranium levels because the insoluble residue, of which uranium is a part, becomes concentrated. Calcareous soils, and terra rossas especially, can thus be potent radon sources.

Soils formed repeatedly in western Ohio during the interglacial periods of the last Ice Age. The Sangamon Interglacial between the Illinoian and Wisconsin advances is especially well known as a period of deep weathering. With each new advance of the glaciers these soils were eroded and incorporated into the next-formed till. At several localities in western Ohio remnants of these ancient, buried soils ("paleosols") can still be seen. According to Quinn and Goldthwait (1985, p. 13) these soils "typically exhibit (1) distinctive red-brown color, (2) clay enrichment, and (3) ghosts of former calcareous material. In some cases, leached reddish pods of paleosol are incorporated into the overlying till." Paleosols are almost non-existent in the Erie and Killbuck Lobes, but occurrences become more common to the south, especially in the southern parts of the Miami and Scioto Lobes (Michael Angle, Ohio Geological Survey, personal communication).

Calcareous soils have also formed on the present day land surface in western Ohio (Forsyth 1965). These soils, where developed on the Wisconsin tills, show a decrease in the depth of leaching and an increase in clay content from south to north. The northward increase in clay may be related to the presence of fine-grained lacustrine sediments in the vicinity of Lake Erie, or may be due, as suggested by Gooding (1973), to increasing proximity to the Ohio Shale outcrop. The southward increase in soil depth results from longer exposure of these areas following the northward retreat of the glaciers.

Soil development in western Ohio, with the concomitant concentration of uranium, does explain the observed radon distribution. Higher radon levels to the south are consistent with the greater development of both modern soils and paleosols in this region. Uranium enrichment may also have occurred in the Wisconsin tills if a significant portion of these deposits was derived from the glacial erosion of earlier soils. Soils have developed, of course, in all parts of Ohio, but those in the western part of the state are quite different because they are derived from calcareous glacial sediment which in turn was largely derived from the carbonate bedrock. Although this bedrock may well have the low uranium concentrations typical of most limestones and dolostones, it is because carbonate rocks are so easily dissolved that the soils developed on them are likely to have more uranium than the soils developed on other less soluble rock types elsewhere in the state.

Chert as a Source of Radon

In Figure 23 it can be seen that there are numerous high radon levels above or very near the outcrop of the Devonian Columbus and Delaware limestones (Dcd). In our earlier study (Harrell and Kumar 1988, Harrell et al. "in press") we observed that indoor radon levels tended to be higher in houses built above these limestones than in those built above the Ohio Shale immediately to the east. In research currently in progress at the University of Toledo we have also observed similar differences in radon levels in ground water pumped from the limestone and black shale. Our measurements of airborne radon in one of the underground limestone caverns in the Columbus-Delaware outcrop yielded concentrations of 262 and 353 pCi/l.

It seems clear that the high radon levels associated with this limestone cannot be entirely attributed to Ohio Shale clasts in the overlying glacial deposits or to soil development. We have previously suggested that the limestones stratigraphically below the Ohio Shale (see able 10) may have been enriched in uranium leached from this formation by downward circulating ground waters. This same mechanism was advocated by Hand and Banikowski (1988) for a similar black shale/limestone sequence in New York. In central Ohio, as in New York, the current limestone outcrop was originally overlain by black shale that has since eroded back. Although we still think this is a viable hypothesis for the Columbus and Delaware limestones, we would like to suggest a new interpretation: uranium enrichment in chert.

While attempting to obtain information on the uranium concentration in the carbonate bedrock of western Ohio, an endeavor in which we were ultimately unsuccessful, we came across some intriguing data. It was provided to us by Nancy Hasenmueller of the Indiana Geological Survey. Analyses for the Mississippian St. Genevieve Limestone showed that the arithmetic mean uranium concentrations for the various lithologies were as follows: limestone, 3.65 ppm; dolomitic limestone, 4.83 ppm; dolostone, 4.35 ppm; shale, 4.26 ppm; and chert, 10.3 ppm. It appears that the chert has been enriched in uranium by some diagenetic process. This finding is perhaps significant because the Columbus and Delaware limestones have more chert than most carbonate units in Ohio (see Hatfield 1975 for a discussion of silicification in these rocks). In many areas the underlying Devonian Detroit River Formation (the upper part of the Devonian-Silurian Monroe Group, DSm, in Figure 23 and Table 10) is also similarly siliceous. The radon may come directly from chert in the bedrock, or from chert clasts that have been incorporated into the overlying till.

Although there is no direct evidence for uranium enrichment in the Columbus-Delaware cherts, the possibility must be considered. It will be recalled from the previous chapter that Licking County has the highest average radon level (11.5 pCi/l) of any county in the state. It is perhaps not a coincidence that the main radon hot spot in this county, zip code 43056 with 16.0 pCi/l (see Figure 25 and Table 11), includes within its area the historically famous Flint Ridge, where chert in the Pennsylvanian Allegheny Formation is locally developed and occurs in abundance at the surface.

Sand and Gravel Deposits as Conduits for Radon

One of the conventional wisdoms in radon studies is that higher indoor radon levels tend to be associated with sand and gravel deposits. Such an association has already been documented for parts of Ohio (e.g., Smith and Mapes 1989, Kwawaja et al. 1989). It may be that in some instances the sand and gravel clasts are the source of radon, but more often it seems that the deposit serves as a conduit for radon coming from bedrock or other sources below. The high permeability of sand and gravel deposits greatly facilitates the upward migration of radon to the surface. It may be that potent radon sources are not needed when buildings are located above these types of deposits: a greater proportion of the small amount of radon produced by uranium-poor source materials will survive the trip to the surface than would be the case for other types of surficial deposits with lower permeabilities.

Of the 698 zip codes represented in Figures 23 and 24, the following percentages, for different geometric mean radon concentration ranges (in pCi/l), have sand and gravel deposits (Wo, Wke, Io, Ik and R) as the first and/or second most areally extensive glacial units:

$\mathrm{Rn} > 8$	45.5%	(the radon "hot spots")
$4 < \mathrm{Rn} < 8$	29.1%	
$\mathrm{Rn} < 4$	22.8%	

Areas of abundant glacial and alluvial sand and gravel are shown in Figure 24. It is clear that there are many high radon levels directly associated with, and perhaps largely attributable to, these deposits. We conclude from this that sand and gravel deposits help to elevate indoor radon concentrations by (1) making it possible for radon to reach the surface from materials that would not ordinarily be considered radon sources, (2) containing uranium-bearing rock fragments, and (3) serving as a conduit for radon derived from uranium-rich source materials. In our opinion, it is the latter situation that accounts for most of the associations between sand and gravel deposits and high radon levels in Ohio.

Other Geological Factors

No consistent or credible relationships were observed between indoor radon levels and (1) the thickness of glacial deposits, (2) the location of oil and gas fields, (3) soil drainage, and (4) soil permeability. With the exception of soil permeability, these results did not surprise us. Our assignment of permeabilities to soil associations apparently did not yield useful data. The assignments were, at best, only rough approximations and, in any event, they pertained only to the upper 4 to 6 feet of soil.

Statistical Analyses

The geological data in the IRIS database does not lend itself well to quantitative statistical analyses. As can be seen in Table 8, the geological parameters are all either qualitative or semi-quantitative. Some of these parameters can, however, be converted to a fully numerical form and so can be used in statistical calculations (see the footnote in Table 12). In this way it was possible to perform correlation and regression analyses (Tables 12 and 13). It must be kept in mind though that because these parameters are not truly quantitative, no tests of statistical significance can be made. It follows then that the stated significance levels in Tables 12 and 13 are of questionable validity. The statistical analyses were nevertheless performed because there was no other way to quantify the strength of the relationship between radon and geology.

Bivariate linear correlation coefficients (Table 12) show that radon has its strongest association with soil uranium (r = 0.36). Although weak, the correlation is clearly statistically significant. The relationship between radon and uranium is further illustrated in Figures 28 and 29. The geological parameter with the next strongest association with radon was the presence/absence of sand and gravel deposits (r = 0.16). This result, of course, is to be expected given the findings discussed earlier for these deposits. The other correlations with radon in Table 12 are too small to be considered meaningful. The high significance levels for most of these correlations is due more to the large number of paired observations used in the calculations (n = 698) than to any inherent strength of association.

Multivariate stepwise regression analyses were also performed (Table 13). As would be expected, given the bivariate correlations, uranium and sand/gravel were included in all three models. The multiple correlations for these models is only marginally better that the linear correlation between radon and uranium, and the percentage of the total variation in indoor radon levels explained by the models is woefully small. These models are therefore not useful for predicting radon concentration.

Closing Remarks

Aerial radiometric uranium concentrations, like those depicted in Figure 28, are an integration of the various near-surface, geological source effects. Although soil uranium works better than any other single geological parameter for predicting indoor radon levels, it cannot be considered a good predictive tool. The geologic controls on indoor radon are sufficiently complex and poorly understood that we are still a long ways from being able to predict indoor radon levels. We have nevertheless been able to shed considerable light on the geology of radon in Ohio. Even if we cannot predict radon levels, we can now, at least, explain them.

TABLE 10:
GEOLOGICAL SECTION FOR OHIO BEDROCK*

PERMIAN SYSTEM

Dunkard

Green	(Sh>Ss>>Lmst>Coal)
Washington	(Ss>Sh>>Lmst>Coal)

PENNSYLVANIAN SYSTEM

Monongahela	(Sh>Ss>Lmst>>Coal)
Conemaugh	(Sh>>Ss>Lmst>>Coal)

Pottsville & Allegheny

Allegheny	(Sh=Ss>>Lmst=Coal)
Pottsville	(Sh=Ss>>Lmst=Coal)

MISSISSIPPIAN SYSTEM

Waverly & Maxville

Maxville	(Lmst>>Sh)
Logan	(Ss & Congl>>Sh)
Cuyahoga	(Ss & Congl>Sh)
Sunbury	(black Sh)
Berea	(Ss>>Sh)
Bedford	(Sh)

DEVONIAN SYSTEM

Ohio & Olentangy

Ohio	(black Sh)
Olentangy	(Sh>Lmst)

Columbus & Delaware

Delaware	(Lmst>>Sh)
Marcellus	(black Sh)
Columbus	(Lmst=Dolst)

DEVONIAN & SILURIAN SYSTEMS

Monroe

Detroit River Group (Devonian)

Lucas	(Dolst)
Amherstburg	(Dolst)
Oriskany	(Ss)

Bass Island Group (Silurian)

Raisin River	(Dolst)
Put-in-Bay	(Dolst)
Tymochtee	(Dolst)
Greenfield	(Dolst)

TABLE 10 continued

SILURIAN SYSTEM

Niagara

Guelph	(Dolst)
Cedarville	(Dolst)
Springfield	(Dolst)
Euphemia	(Dolst)
Alger	(Sh>Dolst)
Dayton	(Dolst)

Brassfield

Brassfield	(Lmst>Sh)
Clinton	(Ss)
Elkhorn	(Sh)

ORDOVICIAN SYSTEM

Richmond

Whitewater	(Sh=Lmst)
Liberty	(Sh>Lmst)
Waynesville	(Sh=Lmst)
Arnheim	(Sh=Lmst)

Maysville

McMillan	(Sh=Lmst)
Fairview	(Sh=Lmst)

Eden

Latonia	(Sh=Lmst)
Fulton	(Sh>>Lmst)

Trenton

Trenton/Point Pleasant	(Lmst=Dolst)
Black River	(Lmst=Dolst)
Glenwood	(Dolst>Sh)
St. Peter	(Ss)
Lower Magnesian	(Dolst>Ss)

CAMBRIAN SYSTEM

Mt. Simon	(Ss>Dolst)

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* Listed below each system are the names of the groups or formations (in bold script) used in the "Geologic Map of Ohio" (Bownocker 1947, Ohio Geological Survey) and also by IRISMAP, and below each of the bold names are the names and lithologies of the stratigraphically equivalent formations or stages given in the "Generalized Geologic Section of Rocks in Ohio" (Information Circular 4, Ohio Geological Survey). The abbreviations used for lithologies are as follows: Congl = conglomerate, Ss = sandstone, Sh = shale, Lmst = limestone, and Dolst = dolostone. The relative abundances of the lithologies are also given.

TABLE 11: GEOLOGICAL CHARACTERISTICS OF RADON HOT SPOTS[1]

Zip Code	County	Geometric Mean Conc. (pCi/l)	Number of Measurements	Geologic Units[2]		Glacial Deposit Thickness[3]	Soil Properties[4]		
				Bedrock	Glacial		Uranium	Permeability	Drainage
I. Central Ohio - West Group									
43216	Franklin	29.2	19	Doo	Wgm	50-100	3.0-3.3	M/M	W/W
43137	Franklin	16.4	6	Doo	R,Wgm,Wo	50-400	3.0-3.6	L-VH/M	VP-W/W
43232	Franklin	10.5	295	Doo,Mwm	Wgm,R	50-200	3.6-4.5	L-VH/M	VP-W/W
43002	Franklin	10.4	8	Doo	Wgm	50-200	3.3-3.6	L-M/M-	VP-P/VP
43125	Franklin	9.3	64	Doo,Mwm	Wgm,R,Wke	50-400	3.3-4.2	L-VH/M-	VP-W/VP
43103	Pickaway	9.3	89	Doo,Mwm	Wgm,Wo,Wke,R	50-400	2.7-3.9	L-VH/L	VP-W/W
43320	Morrow	9.2	5	Doo	Wgm,Wem	50-100	3.0-3.3	L-M/L	VP-W/P
43085	Franklin	8.4	1317	Doo	Wgm,Wem,R	50-200	3.3-4.2	L-M/L	VP-MW/VP
II. Central Ohio - East Group									
43028	Knox	22.6	7	Mwm	Igm,Wo,Io,Iem	0-200	2.4-3.0	L-H/M-	MW-W/W
43056	Licking	16.0	55	Mwm	Wem,Wgm	0-400	2.4-3.0	L-VH/M	VP-W/W
44677	Wayne	15.2	9	Mwm	Wgm,R	50-400	2.1-2.4	L-M/L+	P-W/MW
43023	Licking	14.7	269	Mwm	Wgm,Wo,R	50-400	2.4-3.0	L-M/L	P-W/MW
43155	Fairfield	13.8	5	Mwm	Igm,NG,R,Wo	0-200	1.5-2.4	L-VH/M+	MW-W/W
43055	Licking	13.8	409	Mwm,Ppa	Igm,Wgm,NG,Wo,Ik	0-400	2.1-3.0	L-VH/M+	VP-W/W
44813	Richland	10.7	22	Mwm	Igm,Wem,Wgm,Wo,Iem	0-200	1.8-3.0	L-H/L+	VP-W/MW
43004	Franklin	10.2	54	Mwm	Wgm,Wem	50-200	3.6-4.5	L-M/L	VP-MW/P
43071	Licking	9.7	9	Mwm,Ppa	Igm,Wgm,R,Wo	0-400	2.4-2.7	L-H/M+	P-W/W
44843	Richland	9.3	8	Mwm	Wem,Wgm,Wke,Igm,R	50-200	1.8-2.7	L-H/L+	P-W/MW
43110	Franklin	8.8	107	Mwm,Doo	Wgm,R,Wke	50-400	3.3-4.2	L-VH/M-	VP-W/VP
43135	Hocking	8.1	6	Mwm	NG,Igm,Wem	0-50	1.5-2.7	L-H/M+	MW-W/W
III. Northeastern Ohio									
44644	Carroll	25.5	5	Pc,Ppa	NG,Wo	0	1.8-2.7	L-H/M-	MW-W/W
43988	Harrison	15.9	8	Pc	NG	0	1.8-2.4	L-H/M+	MW-W/W
44443	Mahoning	11.2	13	Ppa	Wgm,Wem,Wo	50-200	1.8-2.4	L-M/L+	P-W/MW
44441	Columbiana	10.8	12	Pc,Ppa	Igm,Wo,NG,Wgm	0-50	1.8-2.4	L-H/M-	P-W/W
44707	Stark	8.7	10	Ppa	Igm,Wo,Wgm	50-200	2.1-2.7	L-H/H-	P-W/W
IV. West-Central Ohio - North Group									
43060	Champaign	12.4	7	DSm	Wem,Wgm	50-200	3.3-3.6	L-M/L+	VP-W/VP
45890	Hancock	10.0	6	Sn	Wgm	0-50	2.4-2.7	L-M/L+	VP-P/P
43343	Logan	8.9	10	Sn,DSm	Wgm,Wem	100-400	2.7-3.6	L-H/M-	VP-W/VP
43359	Miami	8.8	27	Sn	R	0-50	2.4-2.7	M/M	W/W
45389	Champaign	8.6	5	Sn/DSm	Wgm,Wem	50-400	2.4-3.6	L-M/L+	VP-MW/P
43357	Logan	8.1	30	DSm,Sn,Doo,Dcd	Wem,Wo,Wgm,Wke	50-400	2.4-3.6	L-H/L+	VP-W/W
V. West Central Ohio - South Group									
45341	Clark	17.5	73	Or	Wo,R,Wke	50-400	2.4-3.3	M-VH/M	W/W
45301	Green	15.3	5	Or	Wo,R	100-400	1.8-2.4	L-M/L+	MW-W/W

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[1] Hot spots are defined as zip code areas with geometric mean radon concentrations greater than 8.0 pCi/l.

[2] Both bedrock and glacial units are listed from left to right in order of decreasing areal extent. See Table 8 for definition of unit codes.

[3] The thickness range is given in feet.

[4] Uranium concentrations are in parts per million. Ranges (min-max) are given for all three properties. For permeability and drainage the mode is also given to the right of the slash.

TABLE 12: BIVARIATE LINEAR CORRELATIONS BETWEEN RADON AND THE GEOLOGIC PARAMETERS*

	Rn	**U**	**P**	**D**	**T**
U	0.36 99%	——			
P	0.10 99%	-0.25 99%	——		
D	0.07 93%	-0.22 99%	0.32 99%	——	
T	0.12 99%	0.13 99%	0.02 40%	-0.31 99%	——
SG	0.16 99%	-0.07 94%	0.21 99%	0.25 99%	0.11 99%

*The following variables for 698 zip code areas with 5 or more radon measurements were used in the calculations: **Rn** = geometric mean indoor radon concentration (pCi/l), **U** = modal soil uranium concentration (ppm), **P** - modal soil permeability, **D** = modal soil drainage, **T** = modal thickness of glacial deposits, and **SG** = occurrence (=1) or absence (=0) of Wo, Wke, Io, Ike and/or R as one or both of the two most areally existence glacial/alluvial sand and gravel units (see Table 8 for definitions of the unit codes). The numeric codes listed in Table 8 for thickness and uranium were used in the calculations. The semi-quantitative alphabetic codes for permability and drainage in Table 8 were converted to numbers for use in the calculations: e.g., for permeability, VL- = 1, VL = 2, VL+ = 3,..., VH+ = 15; and for drainage, VP- = 1,..., W+ = 12. Below each product-moment correlation coefficient is the statistical significance level.

TABLE 13: RESULTS OF STEPWISE REGRESSION ANALYSES FOR RADON VS THE GEOLOGIC PARAMETERS[1,2]

Prediction Equation	Correlation Coefficient	Variance Explained	Method[3]	Model (Rn *vs*)
1. $Rn = -1.956 + 0.238 \cdot P + 0.103 \cdot D + 0.607 \cdot U + 0.243 \cdot T + 0.770 \cdot SG$	0.447	20.0%	FS	P,D,U,T,SG
2. $Rn = 0.611 + 0.088 \cdot U \cdot P - 0.196 \cdot P \cdot SG + 0.242 \cdot D \cdot SG = 0.058 \cdot U \cdot T$	0.465	21.7%	FS	$P, P^2 \cdot D, D^2, U, U^2, T, T^2, SG, SG^2, P \cdot D, P \cdot U, P \cdot T, P \cdot SG, D \cdot U, D \cdot T, D \cdot SG, U \cdot T, U \cdot SG, T \cdot SG$
3. $Rn = 1.415 - 0.896 \cdot T = 0.155 \cdot T^2 + 0.070 \cdot U \cdot P + 0.111 \cdot D \cdot SG + 0.199 \cdot U \cdot T$	0.468	21.9	BS	Same as #2 above

[1] All regression analyses are based on the average parameter values for the 698 zip code areas with 5 or more radon measurements. The value of the F statistics for adding or removing predictor variables from a model was 4.00 which corresponds to a significance level of 95 percent.

[2] The radon and geological parameters used are those previously defined in the footnote to Table 11.

[3] Equation 1 as derived from a linear multivariate model, and equations 2 and 3 were derived from full quadratic multivariate models.

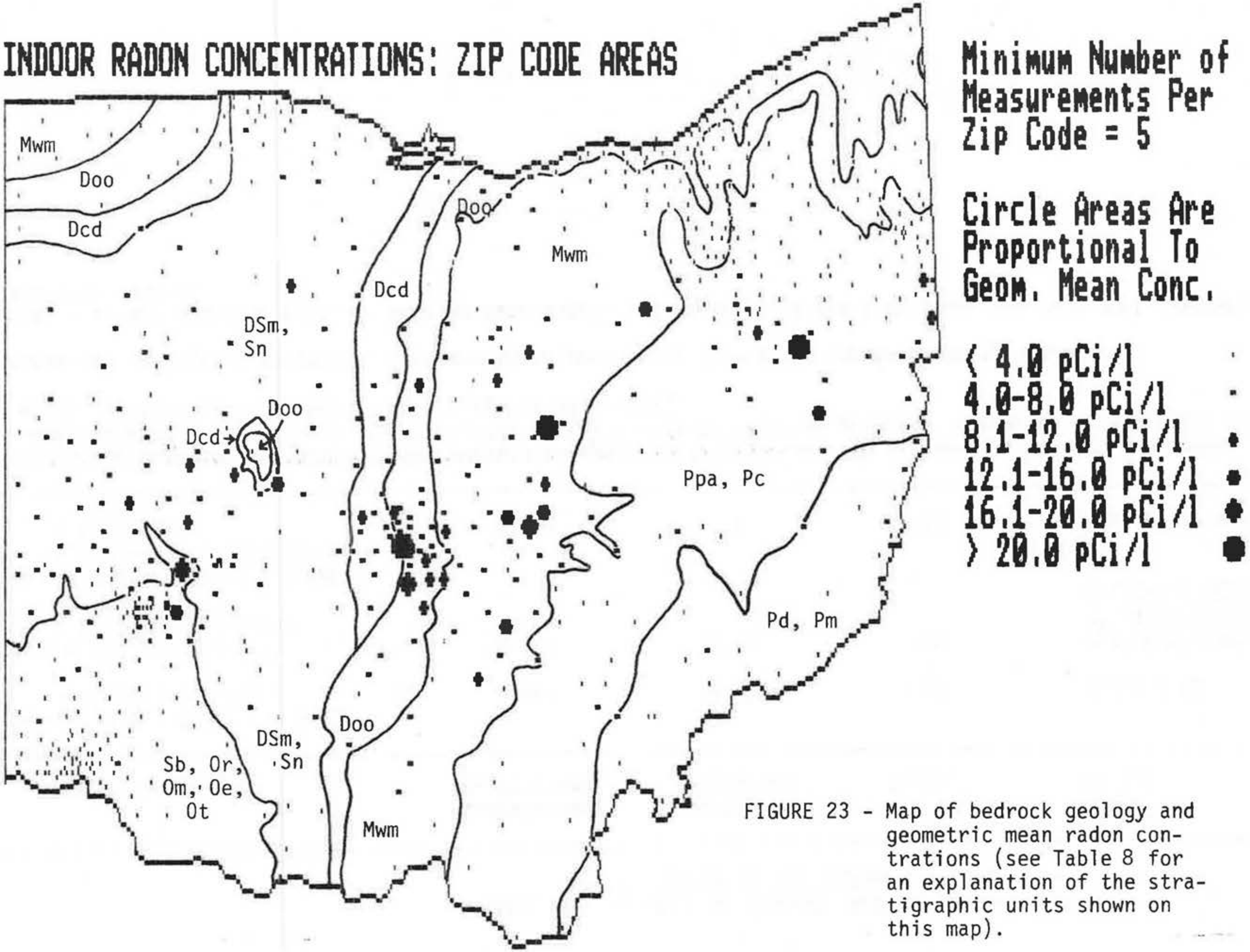

FIGURE 23 - Map of bedrock geology and geometric mean radon contrations (see Table 8 for an explanation of the stratigraphic units shown on this map).

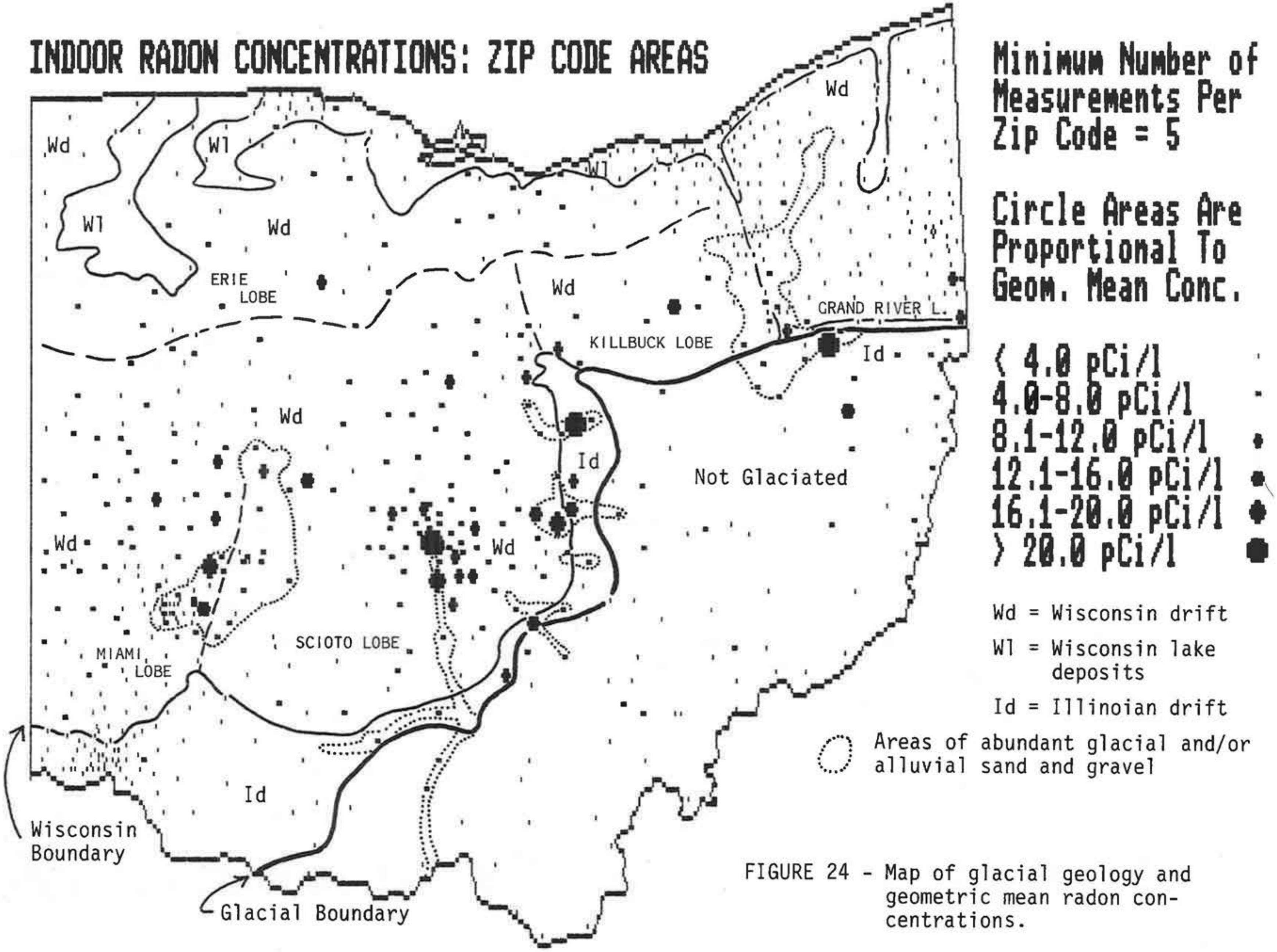

FIGURE 24 - Map of glacial geology and geometric mean radon concentrations.

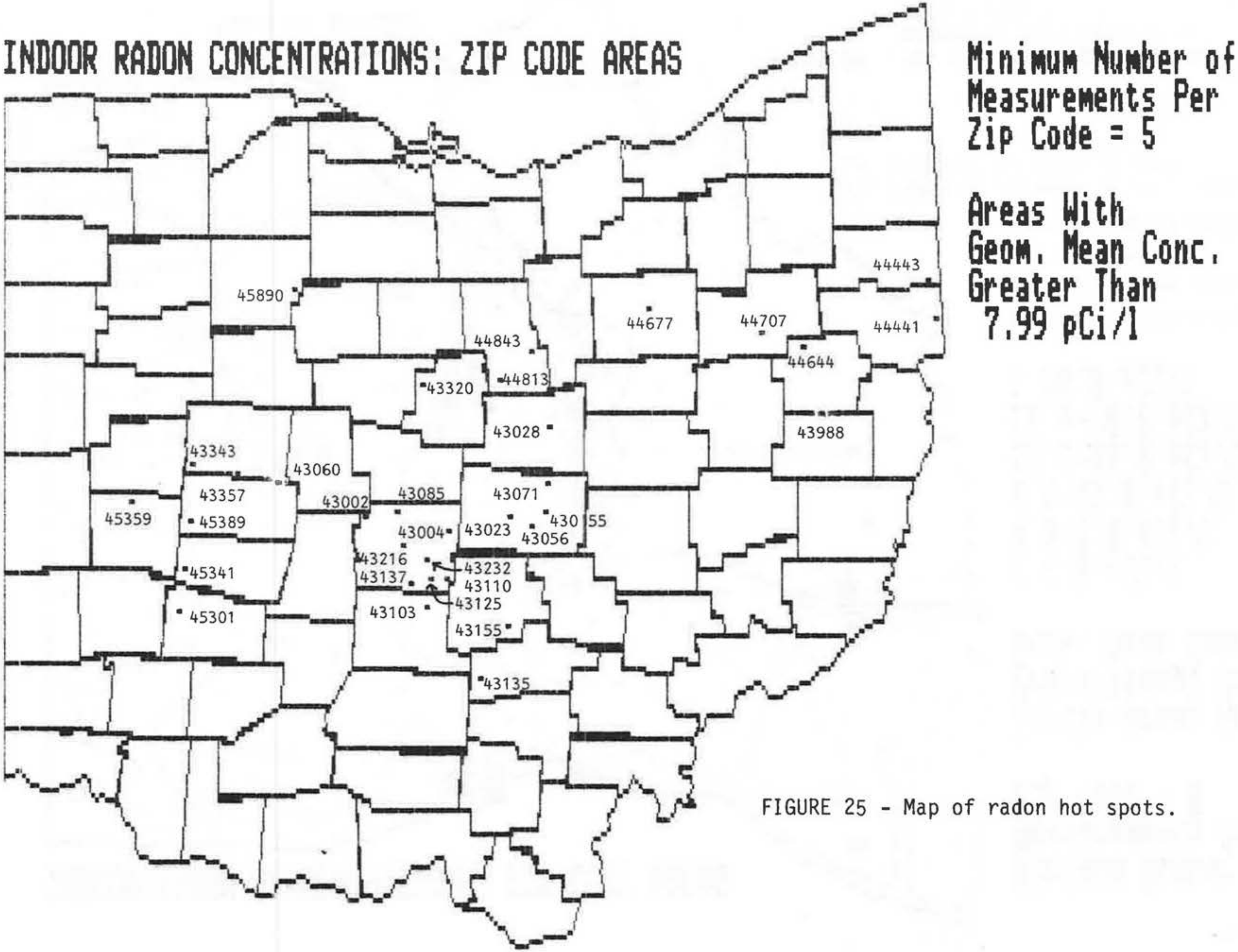

FIGURE 25 - Map of radon hot spots.

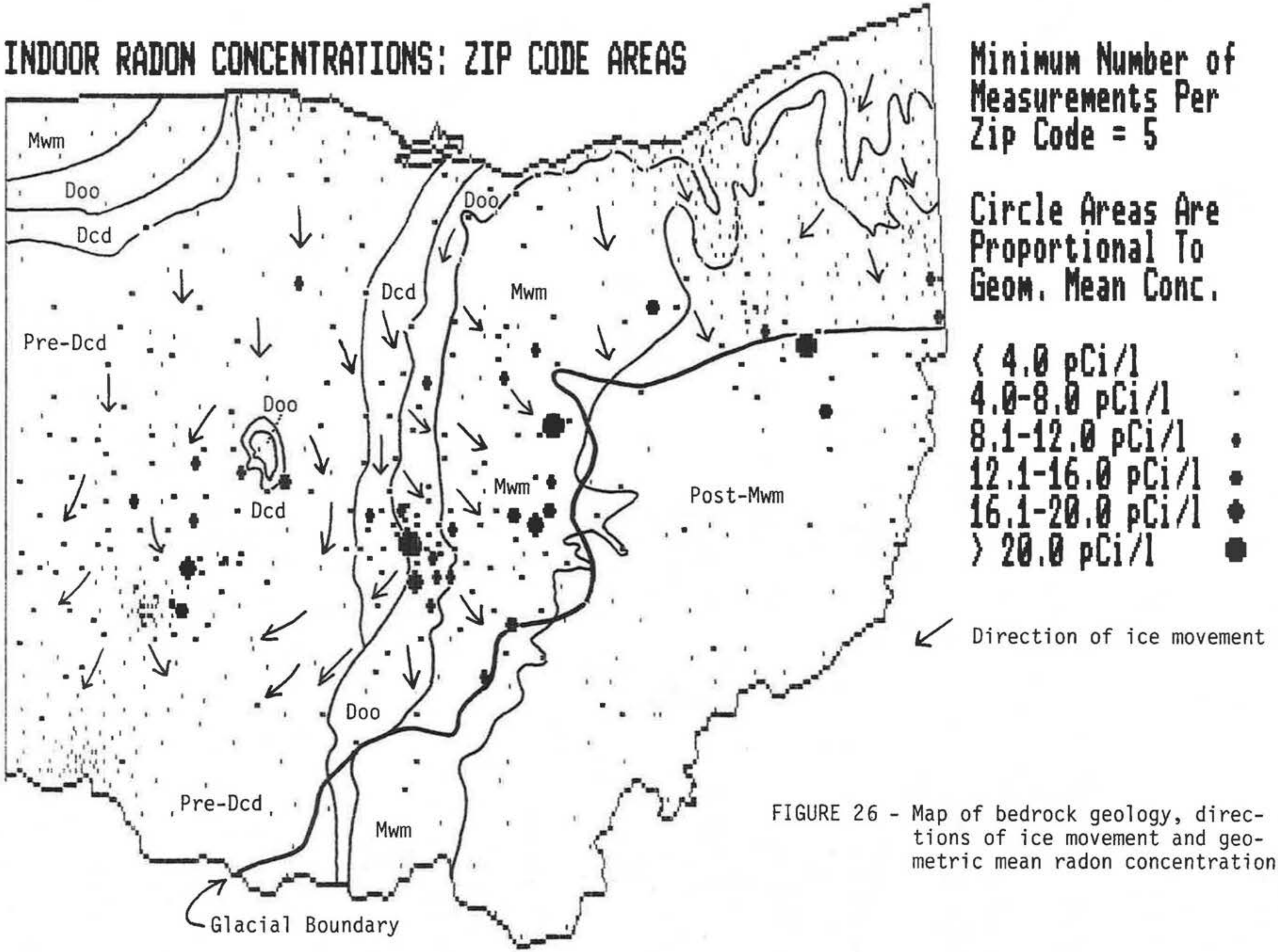

FIGURE 26 - Map of bedrock geology, directions of ice movement and geometric mean radon concentrations.

FIGURE 27 - Summary of the radon survey results from Harrell and Kumar (1988) for the Ohio Shale. From top to bottom, the values reported in each box are as follows: mean radon concentration in Ohio Shale samples, median radon concentration in houses, and percent of houses with concentrations above 4 pCi/l. Indoor radon measurements were made in basements during the winter months.

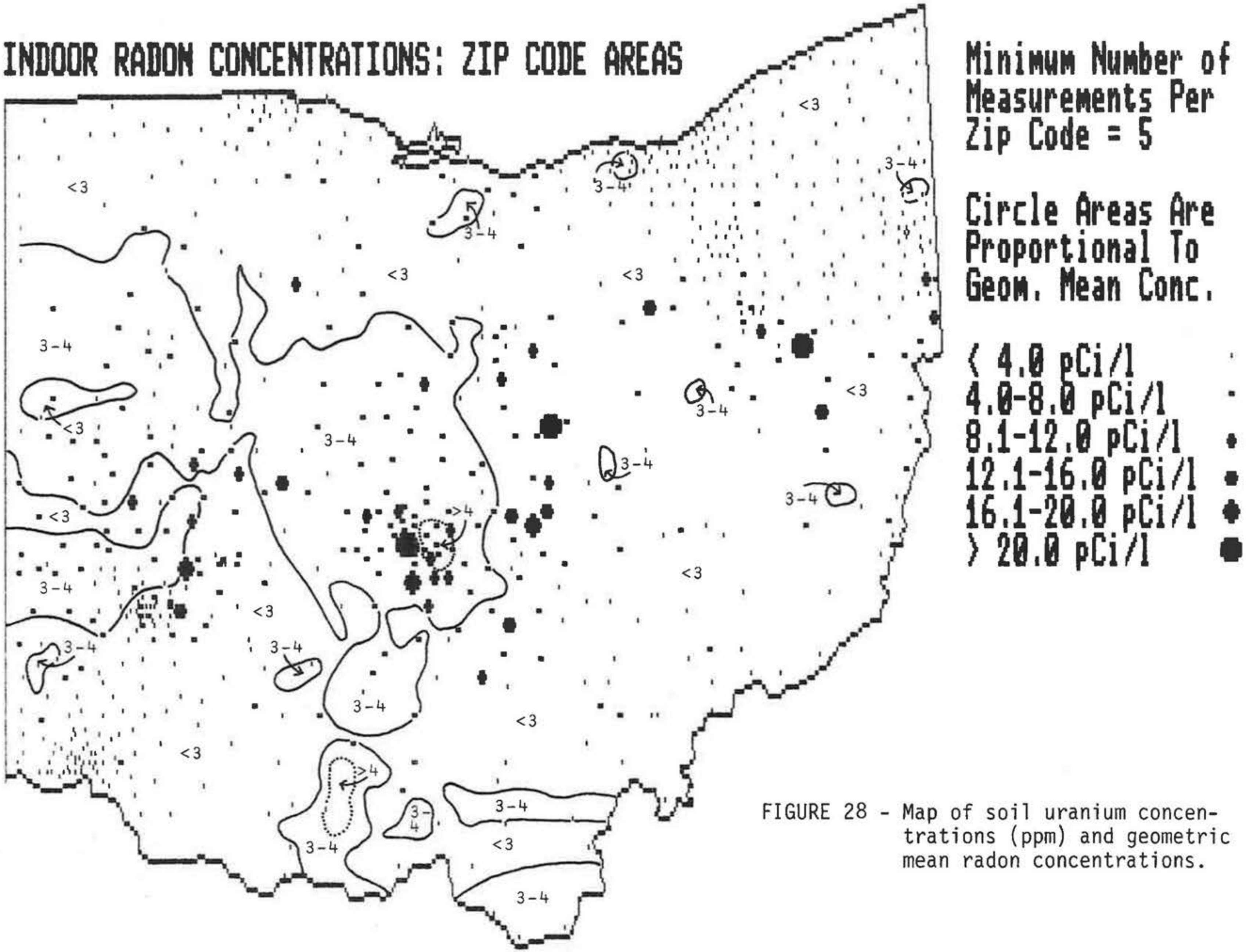

FIGURE 28 - Map of soil uranium concentrations (ppm) and geometric mean radon concentrations.

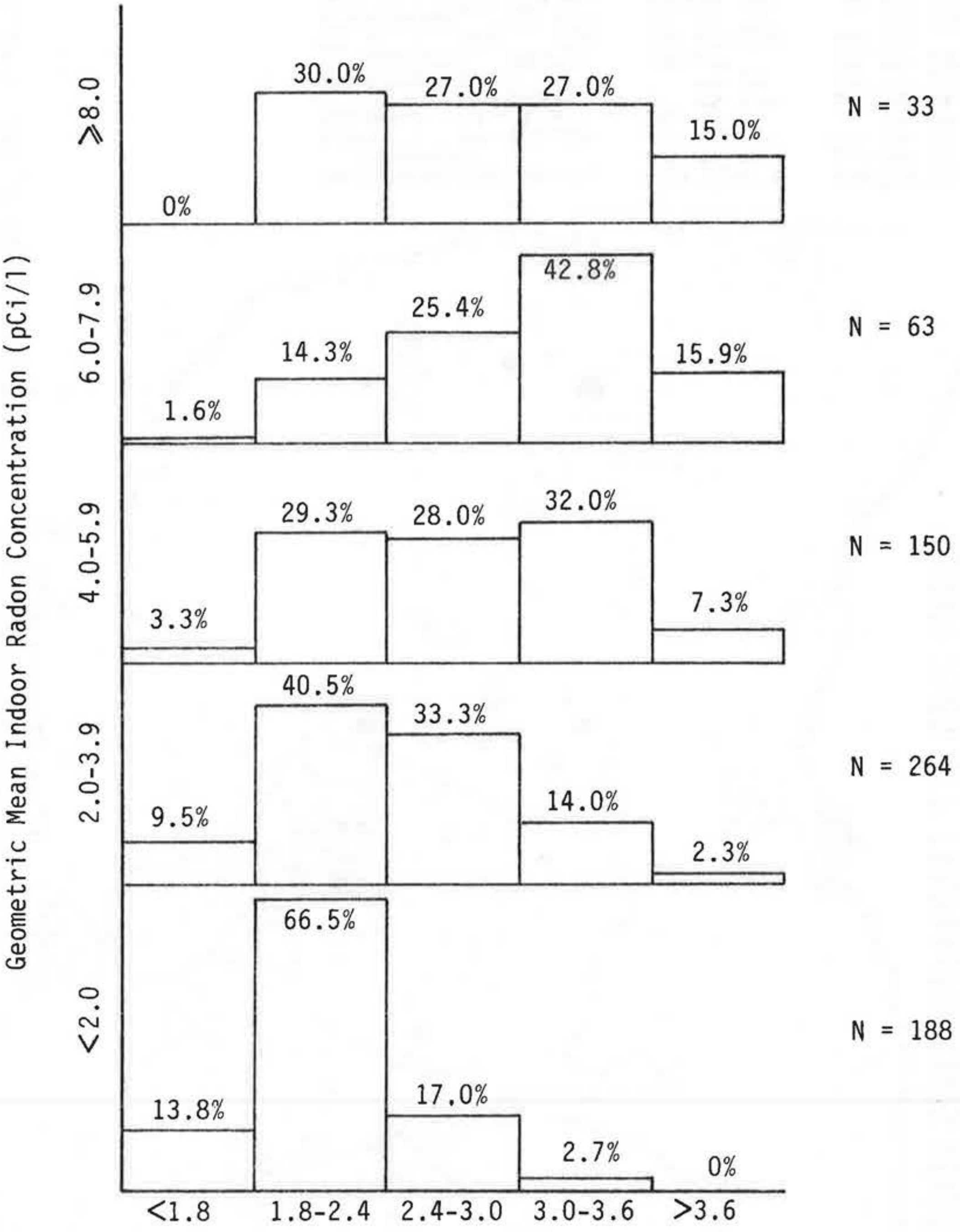

FIGURE 29 - Histograms of soil uranium concentration for different ranges of indoor radon concentration (N = number of zip code areas).

CONCLUSIONS

1. A computer database consisting of 50,626 individual indoor radon measurements in Ohio has been compiled from data provided by government agencies, university researchers and commercial testing companies. The database includes measurements from 1255 zip code areas and all 88 counties in Ohio.

2. Subsidiary computer databases have also been compiled for:
    a. building construction characteristics for houses included in the radon database (data currently exists for only about 4000 houses);
    b. building remediation results (before and after radon measurements) for houses included in the radon database (data currently exists for only 32 houses);
    c. lung cancer mortality rates for Ohio counties; and
    d. geological characteristics of Ohio zip code areas, including bedrock geology, glacial geology, thickness of glacial deposits, uranium concentration in soils, soil permeability and drainage, and occurrence of oil and gas fields.

3. Interactive software (IRISDAT) was developed for VAX mainframe computers to (i) update and edit the radon and other nongeological

databases, (ii) generate radon statistics data files for counties and zip code areas, and (iii) produce printed data summary reports for counties and other data sets. The IRISDAT program is written in FORTRAN-77 and makes use of the data management procedures available in VAX DATATRIEVE, a commercially available, high-level language and report-writing utility.

4. A second interactive computer software package (IRISMAP) was developed for MS-DOS/IBM-compatible microcomputers to (i) generate maps of Ohio showing the statewide variation of indoor radon and the geological parameters, and (ii) produce data summary tables for zip code areas. The IRISMAP program is written in GW-BASIC.

5. Thirty-three counties in Ohio have geometric mean radon concentrations above 4 pCi/l. Seven of these counties have average concentrations above 6 pCi/l: Licking, 11.5; Pickaway, 7.5; Knox, 7.1; Harrison, 7.1; Franklin, 6.7; Carroll, 6.3; and Ross, 6.2.

6. Of the 698 zip code areas in Ohio with five or more radon measurements, 35.1% have geometric mean radon concentrations above 4 pCi/l (30.4% have concentrations between 4 and 8 pCi/l, and 4.7% have concentrations over 8 pCi/l).

7. The zip code areas with average indoor radon concentrations over 4 pCi/l are located primarily in central and western Ohio, with most of the rest in northeastern Ohio. Nearly all of these zip code areas are closely associated with Wisconsin-age glacial till, with the majority occurring in the Scioto and Miami lobes. The radon in houses and other buildings appears to originate in the till from one

or both of the following two sources: (i) uraniferous Ohio Shale fragments that have been eroded from outcrops in central and western Ohio, and (ii) concentrated uranium in calcareous soils developed on tills derived from the underlying, non-uraniferous limestone and dolostone bedrock.

8. Many zip code areas with high radon concentrations are also associated with glacial or alluvial sand and gravel deposits. It appears that the high permeabilities of these deposits, rather than their compositions, are responsible for some elevated indoor radon levels. The sand and gravel facilitates the escape of radon gas to the surface from buried radon source materials.

9. There is evidence suggesting that chert in some of the bedrock carbonate units, most notably the Devonian Columbus and Delaware limestones, is enriched in uranium. Clasts of this chert in the overlying till may be a source of radon.

10. No relationships were observed between indoor radon levels and (i) the thickness of glacial deposits, (ii) the location of oil and gas fields, and (iii) soil drainage and permeability.

11. The single geologic parameter that correlates best with the distribution of indoor radon is the soil uranium concentration as determined from aerial radiometric surveys. The product-moment correlation coefficient for the geometric mean radon concentration

and the modal uranium concentration is 0.36 for the 698 zip code areas with five or more radon measurements. This correlation is weak but statistically significant. The second highest correlation between radon and a geologic parameter is 0.16 for the geometric mean radon concentration and the presence/absence of glacial/alluvial sand and gravel deposits.

RECOMMENDATIONS

1. Currently existing indoor radon data that has not been included in the IRIS database should be identified, acquired and then added to the database.

2. The radon database should be updated at least once a year to incorporate data generated since the last update. In order to do this, communication must be maintained with the government agencies, university researchers and commercial testing companies that are doing radon testing in Ohio. The geologic databases should also be periodically revised as errors are discovered or new information becomes available.

3. The radon database should be expanded to include separate data files for schools, commercial buildings and other nonresidential structures.

4. The IRISDAT and IRISMAP software should be periodically reviewed and, where possible, improvements should be made.

5. A statewide indoor radon testing program should be initiated to obtain data for those zip code areas in Ohio that are either not represented in the radon database, or currently have too few measurements (<50?). This program could perhaps be best implemented

by the county health agencies with guidance and coordination from the Ohio Department of Health. This Department should also target those zip code areas with elevated indoor radon levels for public education on remediation strategies available to homeowners. This information can be dessiminated through press releases to local newspapers and radio and television stations, or through enclosures with public utility bills.

6. The geological conclusions in this study are largely speculative. Additional field work is needed to either confirm or refute them. Specifically, investigations should be conducted to determine (i) the amount of Ohio Shale incorporated into Wisconsin tills in central and western Ohio; (ii) the uranium contents of the carbonate bedrock, in central and western Ohio, and the soils developed on these rocks and the overlying tills; and (iii) the uranium content of chert in the Devonian Columbus and Delaware limestones, and other siliceous carbonate units.

7. The best way to determine the exact manner in which geology controls indoor radon levels is to measure the various geological parameters for the ground beneath each tested building. Research that would generate this type of data should be encouraged, especially when it targets the zip code areas or counties where elevated radon levels are common. Such research should also include a careful analysis of the building construction characteristics and the role they play in modulating indoor radon levels.

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APPENDIX 1

Radon Data Sources

Sources of Data for the Radon Database

1. Airchek, Inc.
   543 King Rd.
   P.O. Box 2000
   Arden, NC 28704
   (704) 684-0893

2. Ryan Nuclear Labs, Inc.
   P.O. Box 88
   West Jefferson, OH 43162
   (614) 879-7735

3. Terradex Inc.
   3 Science Rd.
   Glenwood, IL 60425-1586
   (312) 755-7911

4. Radon Project, Inc.
   P.O. Box 90069
   Pittsburgh, PA 15224
   (412) 687-3393

5. Columbus Dept. of Health
   181 Washington Blvd.
   Columbus, OH 43215
   (614) 645-7634

6. Dept. of Health
   City of Cincinnati
   3101 Burnet Ave.
   Cincinnati, OH 45229-3098
   (513) 352-3177

7. U.S. Environmental Protection Agency
   Office of Radiation
   Research Triangle Park, NC 27711
   (919) 541-4112
   Note: the data was forwarded through the Ohio EPA offices.

8. Dr. Ikram U. Khawaja
   Dept. of Geology
   Youngstown State University
   Youngstown, OH 44555
   (216) 742-3612

9. Dr. Geoffrey W. Smith
   Dept. of Geological Sciences
   Ohio University
   Athens, OH 45701
   (614) 593-1101

10. Teledyne Isotopes, Inc.
Environmental Analysis Dept.
50 Van Buren Ave.
Westwood, NJ 07675
(201) 664-7070

11. Radon Testing Corporation of America
12 West Main St.
Elmsford, NY 10523
(914) 347-5010

12. Dr. James A. Harrell
Dept. of Geology
University of Toledo
Toledo, OH 43606-3390
(419) 537-2193

13. Environmental Services
City of Toledo
26 Main St.
Toledo, OH 43605
(419) 693-0350

14. Microbac Labs, Inc.
2411 W. 26th St.
Erie, PA 16506
(814) 833-4790

15. Scientific Analysis, Inc.
6012 East Shirley Ln.
Montgomery, AL 36117
(205) 271-0643

16. Radon Master, Inc.
P.O. Box 606
Hudson, OH 44236
(216) 656-1990

<u>Sources of Recently Acquired Data</u>

17. Dept. of Health
City of Lima
405 E. Market St.
P.O. Box 1503
Lima, OH 45802
(419) 228-4457

18. Dept. of Health
Lake County
105 Main St.
P.O. Box 490
Painsville, OH 44077
(216) 357-2543

Source of EPA Mitigation Data

19. U.S. Environmental Protection Agency
Indoor Air Branch
Air and Energy Laboratory
Research Triangle, NC 27711
(919) 541-4112

(Data published in EPA 1989)

Source of Epidemiology Data

20. Ohio Dept. of Health
P.O. Box 118
Columbus, OH 43266
(614) 644-7814

APPENDIX 2

Formulae and Definitions for Statistics

A. Measures of Central Tendency

1. MEDIAN (MD) = that value of radon concentration which divides a distribution so that equal numbers of values are larger and smaller. The median is also known as the second quartile (i.e., the value corresponding to the 50th percentile of the distribution of radon measurements). If the nuber of measurements (n) is odd for a given zip code area or county, then the median is the central value after the measurements have been arranged in order of increasing magnitude. If n is given then the median is the arithmetic mean of the two central values.

2. ARITHMETIC MEAN:

$$AM = \frac{\sum_{i=1}^{n} X_i}{n}$$

where X_i is an individual radon measurement, n is the total number of measurements in a zip code area or county and $\sum$ denotes summation

3. GEOMETRIC MEAN:

$$GM = \sqrt[n]{\prod_{i=1}^{n} X_i} = e^{\left(\frac{\sum_{i=1}^{n} \ln X_i}{n}\right)}$$

where X_i and n are as previously defined, $\prod$ denotes consecutive multiplication, ln is the natural logarithm and e is the Napierian constant with a value of 2.7118282

Note: Zero values for X_i are not allowed. All such values in the radon database were therefore changed to 0.1, the minimum detectable level of radon.

B. Measures of Peripheral Tendency

4. FIRST QUARTILE (Q1) = that value of radon concentration which divides a distribution so that 25 percent of the values are smaller and the rest are larger (i.e., it is the value corresponding to the 25th percentile of a distribution).

If n equals 100 and the measurements have been arranged in order of increasing magnitude, then Q1 would be the 25th value. For other values of n, Q1 must be calculated by linearly interpolating between the two closest percentiles. For example, if n = 17, then the two percentiles closest to 25 for the rank ordered measurements are 23.53 for the 4th measurement (X_4; i.e., 25.53 = [4/17]*100) and 29.41 for the 5th measurement (X_5). The first quartile would then be calculated as follows:

$$Q1 = X_4 + = [25 - 23.53] \bullet \left[\frac{X_5 - X_4}{29.41 - 23.53}\right]$$

THIRD QUARTILE (Q3) = that value of radon concentration which divides a distribution so that 75 percent of the values are smaller and the rest are larger (i.e., it is the value corresponding to the 75th percentile of a distribution).

The calculation of Q3 follows the same linear interpolation procedure described above for Q1. The only difference, of course, is that Q3 must be calculatd from the two percentiles closest to 75.

6. MAXIMUM (Max) = the single largest radon concentration for a zip code or county.

7. MINIMUM (Min) = the single smallest radon concentration for a zip code or county.

C. Measures of Dispersion

8. STANDARD DEVIATION:

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (X_i - AM)^2}{n - 1}}$$

where all symbols are as previously defined.

9. COEFFICIENT OF VARIATION:

$$CV = \frac{SD}{AM} \cdot 100$$

Note that CV is a "relative standard deviation" where SD is expressed as a percentage of AM.

APPENDIX 3

Zip Code Areas in Ohio Counties

ZIP	COUNTY
45105	ADAMS
45144	ADAMS
45616	ADAMS
45618	ADAMS
45650	ADAMS
45660	ADAMS
45679	ADAMS
45684	ADAMS
45693	ADAMS
45697	ADAMS
45801	ALLEN
45802	ALLEN
45804	ALLEN
45805	ALLEN
45806	ALLEN
45807	ALLEN
45808	ALLEN
45809	ALLEN
45817	ALLEN
45819	ALLEN
45833	ALLEN
45850	ALLEN
45854	ALLEN
44007	ASHLAND
44805	ASHLAND
44838	ASHLAND
44840	ASHLAND
44842	ASHLAND
44848	ASHLAND
44859	ASHLAND
44864	ASHLAND
44866	ASHLAND
44874	ASHLAND
44880	ASHLAND
44003	ASHTABULA
44004	ASHTABULA
44010	ASHTABULA
44030	ASHTABULA
44032	ASHTABULA
44041	ASHTABULA
44047	ASHTABULA
44048	ASHTABULA
44066	ASHTABULA
44068	ASHTABULA
44076	ASHTABULA
44082	ASHTABULA
44084	ASHTABULA
44085	ASHTABULA
44088	ASHTABULA
44093	ASHTABULA
44099	ASHTABULA
45700	ATHENS
45701	ATHENS
45710	ATHENS
45711	ATHENS
45716	ATHENS
45717	ATHENS
45719	ATHENS
45723	ATHENS
45732	ATHENS
45735	ATHENS
45739	ATHENS
45740	ATHENS
45761	ATHENS
45764	ATHENS
45766	ATHENS
45777	ATHENS
45778	ATHENS
45780	ATHENS
45781	ATHENS
45782	ATHENS
45865	AUGLAIZE
45869	AUGLAIZE
45871	AUGLAIZE
45884	AUGLAIZE
45885	AUGLAIZE
45887	AUGLAIZE
45895	AUGLAIZE
45896	AUGLAIZE
43713	BELMONT
43718	BELMONT
43719	BELMONT
43759	BELMONT
43902	BELMONT
43905	BELMONT
43906	BELMONT
43912	BELMONT
43916	BELMONT
43927	BELMONT
43933	BELMONT
43935	BELMONT
43942	BELMONT
43947	BELMONT
43950	BELMONT
43971	BELMONT
43977	BELMONT
45101	BROWN
45115	BROWN
45118	BROWN
45119	BROWN
45121	BROWN
45130	BROWN
45131	BROWN
45154	BROWN
45167	BROWN
45168	BROWN
45171	BROWN
45011	BUTLER
45013	BUTLER
45014	BUTLER
45015	BUTLER
45042	BUTLER
45044	BUTLER
45050	BUTLER
45053	BUTLER
45056	BUTLER
45061	BUTLER
45062	BUTLER
45063	BUTLER
45064	BUTLER
45067	BUTLER
45069	BUTLER
44427	CARROLL
44607	CARROLL
44615	CARROLL
44620	CARROLL
44639	CARROLL
44643	CARROLL
44644	CARROLL
44651	CARROLL
44657	CARROLL
44675	CARROLL
43009	CHAMPAIGN
43010	CHAMPAIGN
43044	CHAMPAIGN
43047	CHAMPAIGN
43060	CHAMPAIGN
43072	CHAMPAIGN
43078	CHAMPAIGN
43083	CHAMPAIGN
43084	CHAMPAIGN
43357	CHAMPAIGN
45323	CHAMPAIGN
45341	CHAMPAIGN
45344	CHAMPAIGN
45389	CHAMPAIGN
45502	CHAMPAIGN
45503	CHAMPAIGN
45505	CHAMPAIGN
45506	CHAMPAIGN
45319	CLARK
45349	CLARK
45368	CLARK
45369	CLARK
45372	CLARK
45501	CLARK
45504	CLARK
45102	CLERMONT
45103	CLERMONT
45106	CLERMONT
45120	CLERMONT
45122	CLERMONT
45140	CLERMONT
45150	CLERMONT
45153	CLERMONT
45157	CLERMONT
45160	CLERMONT
45176	CLERMONT
45104	CLINTON
45107	CLINTON
45113	CLINTON
45114	CLINTON
45138	CLINTON
45146	CLINTON
45148	CLINTON
45159	CLINTON
45166	CLINTON
45169	CLINTON
45177	CLINTON
43920	COLUMBIANA
43945	COLUMBIANA
43968	COLUMBIANA
44408	COLUMBIANA
44413	COLUMBIANA

44415	COLUMBIANA
44423	COLUMBIANA
44431	COLUMBIANA
44432	COLUMBIANA
44441	COLUMBIANA
44445	COLUMBIANA
44455	COLUMBIANA
44460	COLUMBIANA
44490	COLUMBIANA
44493	COLUMBIANA
44625	COLUMBIANA
44634	COLUMBIANA
44665	COLUMBIANA
43811	COSHOCTON
43812	COSHOCTON
43821	COSHOCTON
43824	COSHOCTON
43828	COSHOCTON
43843	COSHOCTON
43844	COSHOCTON
43845	COSHOCTON
44820	CRAWFORD
44825	CRAWFORD
44827	CRAWFORD
44833	CRAWFORD
44854	CRAWFORD
44856	CRAWFORD
44860	CRAWFORD
44881	CRAWFORD
44887	CRAWFORD
44017	CUYAHOGA
44040	CUYAHOGA
44070	CUYAHOGA
44100	CUYAHOGA
44101	CUYAHOGA
44102	CUYAHOGA
44103	CUYAHOGA
44104	CUYAHOGA
44105	CUYAHOGA
44106	CUYAHOGA
44107	CUYAHOGA
44108	CUYAHOGA
44109	CUYAHOGA
44110	CUYAHOGA
44111	CUYAHOGA
44112	CUYAHOGA
44113	CUYAHOGA
44114	CUYAHOGA
44115	CUYAHOGA
44116	CUYAHOGA
44117	CUYAHOGA
44117	CUYAHOGA
44118	CUYAHOGA
44119	CUYAHOGA
44120	CUYAHOGA
44121	CUYAHOGA
44122	CUYAHOGA
44123	CUYAHOGA
44124	CUYAHOGA
44125	CUYAHOGA
44126	CUYAHOGA
44127	CUYAHOGA
44128	CUYAHOGA
44129	CUYAHOGA
44130	CUYAHOGA
44131	CUYAHOGA
44132	CUYAHOGA
44133	CUYAHOGA
44134	CUYAHOGA
44135	CUYAHOGA
44136	CUYAHOGA
44137	CUYAHOGA
44138	CUYAHOGA
44139	CUYAHOGA
44140	CUYAHOGA
44141	CUYAHOGA
44142	CUYAHOGA
44143	CUYAHOGA
44144	CUYAHOGA
44145	CUYAHOGA
44146	CUYAHOGA
44147	CUYAHOGA
44150	CUYAHOGA
44151	CUYAHOGA
44190	CUYAHOGA
45303	DARKE
45304	DARKE
45308	DARKE
45328	DARKE
45329	DARKE
45331	DARKE
45332	DARKE
45346	DARKE
45348	DARKE
45350	DARKE
45351	DARKE
45352	DARKE
45358	DARKE
45362	DARKE
45380	DARKE
45388	DARKE
45536	DARKE
43512	DEFIANCE
43526	DEFIANCE
43556	DEFIANCE
43003	DELAWARE
43015	DELAWARE
43021	DELAWARE
43032	DELAWARE
43035	DELAWARE
43061	DELAWARE
43065	DELAWARE
43066	DELAWARE
43074	DELAWARE
43438	ERIE
44816	ERIE
44824	ERIE
44847	ERIE
44870	ERIE
44890	ERIE
43046	FAIRFIELD
43076	FAIRFEILD
43102	FAIRFIELD
43105	FAIRFIELD
43107	FAIRFEILD
43112	FAIRFIELD
43130	FAIRFIELD
43136	FAIRFIELD
43148	FAIRFIELD
43150	FAIRFIELD
43154	FAIRFIELD
43155	FAIRFIELD
43157	FAIRFIELD
43106	FAYETTE
43128	FAYETTE
43142	FAYETTE
43160	FAYETTE
17268	FRANKLIN
43002	FRANKLIN
43004	FRANKLIN
43017	FRANKLIN
43026	FRANKLIN
43054	FRANKLIN
43068	FRANKLIN
43081	FRANKLIN
43085	FRANKLIN
43109	FRANKLIN
43110	FRANKLIN
43119	FRANKLIN
43123	FRANKLIN
43125	FRANKLIN
43126	FRANKLIN
43137	FRANKLIN
43147	FRANKLIN
43201	FRANKLIN
43202	FRANKLIN
43203	FRANKLIN
43204	FRANKLIN
43205	FRANKLIN
43206	FRANKLIN
43207	FRANKLIN
43209	FRANKLIN
43210	FRANKLIN
43211	FRANKLIN
43212	FRANKLIN
43213	FRANKLIN
43214	FRANKLIN
43215	FRANKLIN
43216	FRANKLIN
43217	FRANKLIN
43219	FRANKLIN
43220	FRANKLIN
43221	FRANKLIN
43222	FRANKLIN
43223	FRANKLIN
43224	FRANKLIN
43225	FRANKLIN
43226	FRANKLIN
43227	FRANKLIN
43228	FRANKLIN
43229	FRANKLIN
43230	FRANKLIN
43231	FRANKLIN
43232	FRANKLIN
43234	FRANKLIN
43235	FRANKLIN

43239	FRANKLIN
43243	FRANKLIN
43264	FRANKLIN
43269	FRANKLIN
43985	FRANKLIN
43502	FULTON
43515	FULTON
43521	FULTON
43533	FULTON
43540	FULTON
43553	FULTON
43558	FULTON
43567	FULTON
45611	GALLIA
45614	GALLIA
45620	GALLIA
45623	GALLIA
45631	GALLIA
45643	GALLIA
45655	GALLIA
45658	GALLIA
45674	GALLIA
45685	GALLIA
45686	GALLIA
44021	GEAUGA
44022	GEAUGA
44024	GEAUGA
44026	GEAUGA
44027	GEAUGA
44046	GEAUGA
44062	GEAUGA
44064	GEAUGA
44065	GEAUGA
44072	GEAUGA
44080	GEAUGA
44086	GEAUGA
45301	GREENE
45305	GREENE
45307	GREENE
45314	GREENE
45316	GREENE
45324	GREENE
45335	GREENE
45370	GREENE
45384	GREENE
45385	GREENE
45387	GREENE
47933	GREENE
43722	GUERNSEY
43723	GUERNSEY
43725	GUERNSEY
43729	GUERNSEY
43732	GUERNSEY
43736	GUERNSEY
43749	GUERNSEY
43750	GUERNSEY
43755	GUERNSEY
43768	GUERNSEY
43772	GUERNSEY
43773	GUERNSEY
43778	GUERNSEY
43780	GUERNSEY
43973	GUERNSEY
45001	HAMILTON
45002	HAMILTON
45022	HAMILTON
45030	HAMILTON
45033	HAMILTON
45041	HAMILTON
45052	HAMILTON
45174	HAMILTON
45201	HAMILTON
45202	HAMILTON
45203	HAMILTON
45204	HAMILTON
45205	HAMILTON
45206	HAMILTON
45207	HAMILTON
45208	HAMILTON
45209	HAMILTON
45210	HAMILTON
45211	HAMILTON
45212	HAMILTON
45213	HAMILTON
45214	HAMILTON
45215	HAMILTON
45216	HAMILTON
45217	HAMILTON
45218	HAMILTON
45219	HAMILTON
45220	HAMILTON
45223	HAMILTON
45224	HAMILTON
45225	HAMILTON
45226	HAMILTON
45227	HAMILTON
45228	HAMILTON
45229	HAMILTON
45230	HAMILTON
45231	HAMILTON
45232	HAMILTON
45233	HAMILTON
45234	HAMILTON
45235	HAMILTON
45236	HAMILTON
45237	HAMILTON
45238	HAMILTON
45239	HAMILTON
45240	HAMILTON
45241	HAMILTON
45242	HAMILTON
45243	HAMILTON
45244	HAMILTON
45245	HAMILTON
45246	HAMILTON
45247	HAMILTON
45248	HAMILTON
45249	HAMILTON
45251	HAMILTON
45252	HAMILTON
45255	HAMILTON
45264	HAMILTON
45265	HAMILTON
45274	HAMILTON
45291	HAMILTON
45917	HAMILTON
45942	HAMILTON
47001	HAMILTON
47006	HAMILTON
47025	HAMILTON
47032	HAMILTON
47042	HAMILTON
47050	HAMILTON
47060	HAMILTON
47096	HAMILTON
47203	HAMILTON
48169	HAMILTON
44804	HANCOCK
45814	HANCOCK
45839	HANCOCK
45840	HANCOCK
45841	HANCOCK
45858	HANCOCK
45867	HANCOCK
45868	HANCOCK
45881	HANCOCK
45889	HANCOCK
45890	HANCOCK
45897	HANCOCK
43326	HARDIN
43340	HARDIN
45810	HARDIN
45812	HARDIN
45836	HARDIN
45843	HARDIN
45859	HARDIN
43901	HARRISON
43907	HARRISON
43974	HARRISON
43976	HARRISON
43979	HARRISON
43983	HARRISON
43986	HARRISON
43988	HARRISON
43989	HARRISON
44693	HARRISON
44695	HARRISON
44699	HARRISON
43510	HENRY
43516	HENRY
43523	HENRY
43524	HENRY
43527	HENRY
43532	HENRY
43534	HENRY
43535	HENRY
43545	HENRY
43548	HENRY
43550	HENRY
43555	HENRY
45110	HIGHLAND
45123	HIGHLAND
45132	HIGHLAND
45133	HIGHLAND
45135	HIGHLAND
45142	HIGHLAND

45155	HIGHLAND
45165	HIGHLAND
43111	HOCKING
43127	HOCKING
43135	HOCKING
43138	HOCKING
43149	HOCKING
43152	HOCKING
43158	HOCKING
44610	HOLMES
44611	HOLMES
44617	HOLMES
44628	HOLMES
44633	HOLMES
44637	HOLMES
44638	HOLMES
44654	HOLMES
44660	HOLMES
44681	HOLMES
44687	HOLMES
44690	HOLMES
44089	HURON
44811	HURON
44814	HURON
44826	HURON
44837	HURON
44839	HURON
44846	HURON
44851	HURON
44855	HURON
44857	HURON
44889	HURON
45621	JACKSON
45640	JACKSON
45656	JACKSON
45656	JACKSON
45692	JACKSON
43903	JEFFERSON
43908	JEFFERSON
43910	JEFFERSON
43913	JEFFERSON
43917	JEFFERSON
43921	JEFFERSON
43926	JEFFERSON
43930	JEFFERSON
43932	JEFFERSON
43938	JEFFERSON
43939	JEFFERSON
43943	JEFFERSON
43944	JEFFERSON
43948	JEFFERSON
43952	JEFFERSON
43963	JEFFERSON
43964	JEFFERSON
43005	KNOX
43014	KNOX
43019	KNOX
43022	KNOX
43028	KNOX
43050	KNOX
44045	LAKE
44057	LAKE
44060	LAKE
44061	LAKE
44077	LAKE
44081	LAKE
44092	LAKE
44094	LAKE
44095	LAKE
45619	LAWRENCE
45638	LAWRENCE
45645	LAWRENCE
45659	LAWRENCE
45669	LAWRENCE
45678	LAWRENCE
45680	LAWRENCE
45682	LAWRENCE
45688	LAWRENCE
45696	LAWRENCE
47421	LAWRENCE
43001	LICKING
43008	LICKING
43011	LICKING
43013	LICKING
43018	LICKING
43023	LICKING
43025	LICKING
43031	LICKING
43033	LICKING
43055	LICKING
43056	LICKING
43062	LICKING
43071	LICKING
43080	LICKING
43310	LOGAN
43311	LOGAN
43318	LOGAN
43319	LOGAN
43324	LOGAN
43331	LOGAN
43333	LOGAN
43336	LOGAN
43343	LOGAN
43345	LOGAN
43347	LOGAN
43348	LOGAN
43358	LOGAN
43360	LOGAN
44001	LORAIN
44011	LORAIN
44012	LORAIN
44028	LORAIN
44035	LORAIN
44036	LORAIN
44038	LORAIN
44039	LORAIN
44044	LORAIN
44049	LORAIN
44050	LORAIN
44052	LORAIN
44053	LORAIN
44054	LORAIN
44055	LORAIN
44074	LORAIN
44090	LORAIN
43412	LUCAS
43434	LUCAS
43504	LUCAS
43528	LUCAS
43537	LUCAS
43542	LUCAS
43560	LUCAS
43566	LUCAS
43571	LUCAS
43601	LUCAS
43602	LUCAS
43604	LUCAS
43605	LUCAS
43606	LUCAS
43607	LUCAS
43608	LUCAS
43609	LUCAS
43611	LUCAS
43612	LUCAS
43613	LUCAS
43614	LUCAS
43615	LUCAS
43616	LUCAS
43617	LUCAS
43618	LUCAS
43620	LUCAS
43623	LUCAS
43650	LUCAS
43652	LUCAS
43655	LUCAS
43662	LUCAS
43694	LUCAS
43697	LUCAS
43699	LUCAS
43064	MADISON
43140	MADISON
43143	MADISON
43151	MADISON
43153	MADISON
43162	MADISON
44401	MAHONING
44405	MAHONING
44405	MAHONING
44406	MAHONING
44416	MAHONING
44422	MAHONING
44429	MAHONING
44436	MAHONING
44442	MAHONING
44443	MAHONING
44449	MAHONING
44451	MAHONING
44452	MAHONING
44454	MAHONING
44471	MAHONING
44501	MAHONING
44502	MAHONING
44503	MAHONING
44504	MAHONING
44505	MAHONING
44507	MAHONING

44509	MAHONING
44511	MAHONING
44512	MAHONING
44513	MAHONING
44514	MAHONING
44515	MAHONING
44516	MAHONING
44519	MAHONING
44572	MAHONING
44609	MAHONING
44672	MAHONING
43302	MARION
43304	MARION
43305	MARION
43314	MARION
43322	MARION
43332	MARION
43335	MARION
43337	MARION
43341	MARION
43342	MARION
43356	MARION
44212	MEDINA
44215	MEDINA
44233	MEDINA
44251	MEDINA
44253	MEDINA
44254	MEDINA
44256	MEDINA
44258	MEDINA
44273	MEDINA
44274	MEDINA
44275	MEDINA
44280	MEDINA
44281	MEDINA
44302	MEDINA
44307	MEDINA
44311	MEDINA
44323	MEDINA
44349	MEDINA
45720	MEIGS
45738	MEIGS
45741	MEIGS
45743	MEIGS
45760	MEIGS
45769	MEIGS
45770	MEIGS
45771	MEIGS
45772	MEIGS
45775	MEIGS
45776	MEIGS
45779	MEIGS
45783	MEIGS
45310	MERCER
45822	MERCER
45826	MERCER
45828	MERCER
45846	MERCER
45860	MERCER
45862	MERCER
45866	MERCER
45882	MERCER
45883	MERCER
45312	MIAMI
45317	MIAMI
45318	MIAMI
45326	MIAMI
45337	MIAMI
45339	MIAMI
45356	MIAMI
45359	MIAMI
45361	MIAMI
45371	MIAMI
45373	MIAMI
45383	MIAMI
43716	MONROE
43747	MONROE
43789	MONROE
43793	MONROE
43915	MONROE
43931	MONROE
43946	MONROE
45529	MONROE
45309	MONTGOMERY
45315	MONTGOMERY
45322	MONTGOMERY
45325	MONTGOMERY
45327	MONTGOMERY
45342	MONTGOMERY
45345	MONTGOMERY
45354	MONTGOMERY
45377	MONTGOMERY
45401	MONTGOMERY
45402	MONTGOMERY
45403	MONTGOMERY
45404	MONTGOMERY
45404	MONTGOMERY
45405	MONTGOMERY
45406	MONTGOMERY
45407	MONTGOMERY
45408	MONTGOMERY
45409	MONTGOMERY
45410	MONTGOMERY
45413	MONTGOMERY
45414	MONTGOMERY
45415	MONTGOMERY
45416	MONTGOMERY
45417	MONTGOMERY
45418	MONTGOMERY
45419	MONTGOMERY
45420	MONTGOMERY
45421	MONTGOMERY
45422	MONTGOMERY
45423	MONTGOMERY
45424	MONTGOMERY
45426	MONTGOMERY
45427	MONTGOMERY
45428	MONTGOMERY
45429	MONTGOMERY
45430	MONTGOMERY
45431	MONTGOMERY
45432	MONTGOMERY
45433	MONTGOMERY
45434	MONTGOMERY
45435	MONTGOMERY
45437	MONTGOMERY
45439	MONTGOMERY
45440	MONTGOMERY
45441	MONTGOMERY
45446	MONTGOMERY
45448	MONTGOMERY
45449	MONTGOMERY
45450	MONTGOMERY
45451	MONTGOMERY
45453	MONTGOMERY
45454	MONTGOMERY
45456	MONTGOMERY
45458	MONTGOMERY
45459	MONTGOMERY
45482	MONTGOMERY
45490	MONTGOMERY
43728	MORGAN
43756	MORGAN
43758	MORGAN
43770	MORGAN
43787	MORGAN
45715	MORGAN
43315	MORROW
43317	MORROW
43320	MORROW
43321	MORROW
43334	MORROW
43338	MORROW
43349	MORROW
43350	MORROW
43914	MORROW
43701	MUSKINGUM
43702	MUSKINGUM
43720	MUSKINGUM
43727	MUSKINGUM
43734	MUSKINGUM
43735	MUSKINGUM
43738	MUSKINGUM
43746	MUSKINGUM
43762	MUSKINGUM
43767	MUSKINGUM
43771	MUSKINGUM
43777	MUSKINGUM
43785	MUSKINGUM
43791	MUSKINGUM
43802	MUSKINGUM
43822	MUSKINGUM
43830	MUSKINGUM
43830	MUSKINGUM
43711	NOBLE
43717	NOBLE
43724	NOBLE
43779	NOBLE
43781	NOBLE
43788	NOBLE
45727	NOBLE
43416	OTTAWA
43430	OTTAWA
43432	OTTAWA
43433	OTTAWA
43440	OTTAWA

43445	OTTAWA
43449	OTTAWA
43452	OTTAWA
43468	OTTAWA
45813	PAULDING
45821	PAULDING
45849	PAULDING
45851	PAULDING
45861	PAULDING
45873	PAULDING
45879	PAULDING
45880	PAULDING
43730	PERRY
43731	PERRY
43739	PERRY
43743	PERRY
43748	PERRY
43760	PERRY
43761	PERRY
43764	PERRY
43766	PERRY
43782	PERRY
43783	PERRY
43103	PICKAWAY
43113	PICKAWAY
43116	PICKAWAY
43117	PICKAWAY
43120	PICKAWAY
43145	PICKAWAY
43146	PICKAWAY
43156	PICKAWAY
43164	PICKAWAY
45613	PIKE
45624	PIKE
45661	PIKE
45683	PIKE
45690	PIKE
44201	PORTAGE
44202	PORTAGE
44231	PORTAGE
44234	PORTAGE
44235	PORTAGE
44240	PORTAGE
44241	PORTAGE
44255	PORTAGE
44260	PORTAGE
44265	PORTAGE
44266	PORTAGE
44272	PORTAGE
44288	PORTAGE
44411	PORTAGE
44412	PORTAGE
45003	PREBLE
45070	PREBLE
45311	PREBLE
45320	PREBLE
45321	PREBLE
45330	PREBLE
45338	PREBLE
45347	PREBLE
45378	PREBLE
45381	PREBLE
45382	PREBLE
45827	PUTNAM
45830	PUTNAM
45831	PUTNAM
45844	PUTNAM
45847	PUTNAM
45848	PUTNAM
45853	PUTNAM
45856	PUTNAM
45875	PUTNAM
45876	PUTNAM
45877	PUTNAM
45893	PUTNAM
44813	RICHLAND
44822	RICHLAND
44843	RICHLAND
44875	RICHLAND
44878	RICHLAND
44901	RICHLAND
44902	RICHLAND
44903	RICHLAND
44904	RICHLAND
44905	RICHLAND
44906	RICHLAND
44907	RICHLAND
43101	ROSS
43115	ROSS
45601	ROSS
45612	ROSS
45617	ROSS
45628	ROSS
45633	ROSS
45644	ROSS
45647	ROSS
45673	ROSS
45681	ROSS
43407	SANDUSKY
43410	SANDUSKY
43420	SANDUSKY
43431	SANDUSKY
43435	SANDUSKY
43442	SANDUSKY
43464	SANDUSKY
43469	SANDUSKY
45629	SCIOTO
45636	SCIOTO
45648	SCIOTO
45652	SCIOTO
45653	SCIOTO
45662	SCIOTO
45671	SCIOTO
45694	SCIOTO
44802	SENECA
44807	SENECA
44809	SENECA
44815	SENECA
44818	SENECA
44823	SENECA
44828	SENECA
44829	SENECA
44830	SENECA
44836	SENECA
44841	SENECA
44845	SENECA
44853	SENECA
44861	SENECA
44867	SENECA
44883	SENECA
45302	SHELBY
45306	SHELBY
45333	SHELBY
45334	SHELBY
45336	SHELBY
45340	SHELBY
45360	SHELBY
45363	SHELBY
45365	SHELBY
45845	SHELBY
44601	STARK
44608	STARK
44614	STARK
44626	STARK
44632	STARK
44635	STARK
44640	STARK
44641	STARK
44646	STARK
44657	STARK
44662	STARK
44666	STARK
44669	STARK
44685	STARK
44686	STARK
44688	STARK
44689	STARK
44701	STARK
44702	STARK
44703	STARK
44704	STARK
44705	STARK
44706	STARK
44707	STARK
44708	STARK
44709	STARK
44710	STARK
44711	STARK
44714	STARK
44718	STARK
44720	STARK
44721	STARK
44728	STARK
44730	STARK
44742	STARK
44751	STARK
44865	STARK
44056	SUMMIT
44067	SUMMIT
44087	SUMMIT
44167	SUMMIT
44203	SUMMIT
44205	SUMMIT
44210	SUMMIT
44212	SUMMIT
44216	SUMMIT

44221	SUMMIT
44223	SUMMIT
44224	SUMMIT
44236	SUMMIT
44250	SUMMIT
44262	SUMMIT
44264	SUMMIT
44278	SUMMIT
44286	SUMMIT
44301	SUMMIT
44303	SUMMIT
44304	SUMMIT
44305	SUMMIT
44306	SUMMIT
44308	SUMMIT
44310	SUMMIT
44311	SUMMIT
44312	SUMMIT
44313	SUMMIT
44314	SUMMIT
44316	SUMMIT
44319	SUMMIT
44320	SUMMIT
44321	SUMMIT
44322	SUMMIT
44324	SUMMIT
44341	SUMMIT
44402	TRUMBULL
44403	TRUMBULL
44404	TRUMBULL
44410	TRUMBULL
44417	TRUMBULL
44418	TRUMBULL
44418	TRUMBULL
44420	TRUMBULL
44424	TRUMBULL
44425	TRUMBULL
44428	TRUMBULL
44430	TRUMBULL
44437	TRUMBULL
44438	TRUMBULL
44439	TRUMBULL
44440	TRUMBULL
44444	TRUMBULL
44446	TRUMBULL
44450	TRUMBULL
44453	TRUMBULL
44470	TRUMBULL
44473	TRUMBULL
44481	TRUMBULL
44483	TRUMBULL
44484	TRUMBULL
44485	TRUMBULL
44491	TRUMBULL
44506	TRUMBULL
44508	TRUMBULL
44510	TRUMBULL
43832	TUSCARAWAS
43837	TUSCARAWAS
44612	TUSCARAWAS
44621	TUSCARAWAS
44622	TUSCARAWAS
44624	TUSCARAWAS
44656	TUSCARAWAS
44656	TUSCARAWAS
44663	TUSCARAWAS
44680	TUSCARAWAS
44682	TUSCARAWAS
44683	TUSCARAWAS
43029	UNION
43040	UNION
43045	UNION
43067	UNION
43344	UNION
43020	UNKNOWN
43042	UNKNOWN
43051	UNKNOWN
43052	UNKNOWN
43069	UNKNOWN
43132	UNKNOWN
43173	UNKNOWN
43188	UNKNOWN
43327	UNKNOWN
43328	UNKNOWN
43376	UNKNOWN
43745	UNKNOWN
43820	UNKNOWN
44005	UNKNOWN
44018	UNKNOWN
44058	UNKNOWN
44247	UNKNOWN
44296	UNKNOWN
44466	UNKNOWN
44648	UNKNOWN
44806	UNKNOWN
44835	UNKNOWN
44879	UNKNOWN
44908	UNKNOWN
44911	UNKNOWN
44927	UNKNOWN
44945	UNKNOWN
44989	UNKNOWN
45026	UNKNOWN
45037	UNKNOWN
45045	UNKNOWN
45046	UNKNOWN
45049	UNKNOWN
45059	UNKNOWN
45072	UNKNOWN
45085	UNKNOWN
45129	UNKNOWN
45139	UNKNOWN
45374	UNKNOWN
45375	UNKNOWN
45390	UNKNOWN
45509	UNKNOWN
45515	UNKNOWN
45522	UNKNOWN
45571	UNKNOWN
45592	UNKNOWN
45737	UNKNOWN
45785	UNKNOWN
45800	UNKNOWN
45892	UNKNOWN
45832	VANWERT
45863	VANWERT
45874	VANWERT
45891	VANWERT
45894	VANWERT
45898	VANWERT
45634	VINTON
45651	VINTON
45654	VINTON
45670	VINTON
45672	VINTON
45695	VINTON
45698	VINTON
45005	WARREN
45032	WARREN
45034	WARREN
45036	WARREN
45039	WARREN
45040	WARREN
45054	WARREN
45065	WARREN
45066	WARREN
45068	WARREN
45152	WARREN
45162	WARREN
45172	WASHINGTON
45712	WASHINGTON
45713	WASHINGTON
45714	WASHINGTON
45724	WASHINGTON
45729	WASHINGTON
45742	WASHINGTON
45744	WASHINGTON
45745	WASHINGTON
45746	WASHINGTON
45750	WASHINGTON
45767	WASHINGTON
45768	WASHINGTON
45773	WASHINGTON
45774	WASHINGTON
45784	WASHINGTON
45786	WASHINGTON
45787	WASHINGTON
45788	WASHINGTON
44214	WAYNE
44217	WAYNE
44230	WAYNE
44270	WAYNE
44276	WAYNE
44287	WAYNE
44606	WAYNE
44618	WAYNE
44627	WAYNE
44636	WAYNE
44645	WAYNE
44667	WAYNE
44676	WAYNE
44677	WAYNE
44691	WAYNE
43501	WILLIAMS
43505	WILLIAMS

43506	WILLIAMS
43517	WILLIAMS
43518	WILLIAMS
43531	WILLIAMS
43543	WILLIAMS
43554	WILLIAMS
43557	WILLIAMS
43570	WILLIAMS
43402	WOOD
43406	WOOD
43413	WOOD
43437	WOOD
43443	WOOD
43447	WOOD
43450	WOOD
43451	WOOD
43457	WOOD
43460	WOOD
43462	WOOD
43465	WOOD
43466	WOOD
43511	WOOD
43522	WOOD
43525	WOOD
43529	WOOD
43551	WOOD
43569	WOOD
43619	WOOD
44817	WOOD
45872	WOOD
43316	WYANDOT
43330	WYANDOT
43351	WYANDOT
43359	WYANDOT
44844	WYANDOT
44849	WYANDOT
44882	WYANDOT

APPENDIX 4

Radon Statistics for Counties

ABBREVIATIONS USED

No. = number of radon measurements

Radon Concentration Statistics (in pCi/l except CV which is %)

MD = median

GM = geometric mean

AM = arithmetic mean

Q1 = first quartile

Q3 = third quartile

Min = minimum

Max = maximum

SD = standard deviation

CV = coefficient of variation

COUNTY	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
ADAMS	41	2.1	1.8	2.8	1.2	3.3	0.1	14.7	2.9	102.1
ALLEN	153	4.4	3.9	6.3	2.2	7.6	0.1	62.6	7.4	117.3
ASHLAND	86	4.0	4.3	7.9	2.3	7.1	0.6	79.6	12.8	162.3
ASHTABULA	414	1.0	1.0	1.7	0.5	1.8	0.1	28.3	2.7	155.1
ATHENS	505	4.6	3.8	5.4	2.4	7.1	0.1	82.1	5.8	107.6
AUGLAIZE	147	4.6	4.3	7.8	2.6	10.1	0.1	64.5	9.3	118.8
BELMONT	111	2.8	3.2	5.3	1.6	6.6	0.1	33.9	6.1	115.6
BROWN	21	1.9	1.5	2.7	0.5	2.4	0.1	18.3	3.9	143.4
BUTLER	1347	3.2	3.1	5.2	1.6	6.6	0.1	70.3	6.0	116.4
CARROLL	107	5.0	6.3	19.9	2.6	14.9	0.1	189.0	38.2	192.2
CHAMPAIGN	1399	6.1	5.7	10.9	3.1	11.8	0.1	750.1	31.0	285.0
CLARK	275	3.9	3.6	5.8	2.1	6.8	0.1	73.0	7.0	121.4
CLERMONT	396	2.8	2.8	5.5	1.5	5.4	0.1	470.8	24.0	432.5
CLINTON	308	3.2	3.0	5.4	1.6	5.9	0.1	55.6	7.9	146.5
COLUMBIANA	301	3.0	3.2	6.6	1.6	6.4	0.1	234.2	15.9	241.1
COSHOCTON	46	4.4	4.9	9.3	2.2	11.9	0.1	60.5	12.3	132.0
CRAWFORD	84	5.7	5.2	11.0	2.8	11.6	0.1	163.0	20.4	185.4
CUYAHOGA	2036	1.4	1.3	2.2	0.7	2.5	0.1	74.5	3.3	151.1
DARKE	273	6.0	4.9	10.1	2.3	11.4	0.1	125.0	14.3	141.4
DEFIANCE	61	2.6	2.6	3.6	1.7	4.3	0.1	13.1	3.0	84.4
DELAWARE	642	6.1	5.9	8.7	3.5	10.4	0.1	95.5	9.0	103.3
ERIE	197	3.7	3.7	7.4	1.7	8.2	0.1	80.3	11.6	155.7
FAIRFIELD	539	6.8	6.0	12.0	3.0	12.2	0.1	340.5	25.4	212.1
FAYETTE	38	4.3	3.2	5.3	1.9	7.1	0.1	38.3	6.3	118.0
FRANKLIN	10020	7.0	6.7	10.9	3.8	12.7	0.1	1333.9	19.1	176.1
FULTON	64	1.9	1.8	2.9	0.8	3.3	0.1	13.1	3.2	108.9
GALLIA	72	2.7	2.1	3.0	1.1	3.7	0.2	10.6	2.4	79.7
GEAUGA	261	1.6	1.6	5.6	0.9	2.9	0.1	733.8	45.4	813.2
GREENE	2172	4.9	4.4	7.6	2.4	9.0	0.1	163.0	10.7	139.7
GUERNSEY	74	2.7	2.8	5.9	1.3	5.1	0.3	108.1	13.0	218.5
HAMILTON	3057	2.0	1.9	3.1	1.0	3.8	0.1	52.5	3.8	124.3
HANCOCK	96	3.5	3.4	6.0	1.5	7.3	0.1	39.1	7.5	124.8
HARDIN	39	3.7	3.2	5.5	1.6	8.4	0.1	26.2	5.2	93.3
HARRISON	29	6.0	7.1	13.5	2.8	16.5	0.7	60.7	16.2	120.2
HENRY	41	2.7	1.8	2.8	0.9	4.1	0.1	7.8	2.0	70.6
HIGHLAND	69	2.9	2.8	4.5	1.4	5.9	0.1	31.0	4.8	106.8
HOCKING	99	6.7	5.9	10.1	3.1	11.5	0.1	99.5	13.8	136.7
HOLMES	20	4.3	4.1	7.8	1.1	8.8	0.6	50.5	11.0	141.1
HURON	246	4.8	4.6	8.4	2.5	10.1	0.1	99.3	11.6	137.3
JACKSON	54	2.0	2.1	3.8	1.1	4.9	0.2	21.3	4.6	121.7
JEFFERSON	108	3.3	3.8	23.8	1.9	8.3	0.1	1927.6	185.0	777.3
KNOX	170	6.8	7.1	13.4	3.0	15.4	0.1	212.4	23.0	170.7
LAKE	343	1.4	1.3	2.7	0.7	2.7	0.1	31.2	4.2	158.3
LAWRENCE	50	1.9	2.0	2.9	1.2	3.2	0.2	16.3	3.1	104.3
LICKING	946	11.8	11.5	26.0	5.2	26.5	0.1	559.0	48.8	188.1
LOGAN	255	5.0	4.5	9.1	2.3	9.1	0.1	319.2	22.0	242.4
LORAIN	318	2.7	2.6	4.4	1.4	5.7	0.1	28.0	4.7	106.5
LUCAS	805	2.2	2.1	3.9	1.2	4.0	0.1	125.5	8.0	203.8
MADISON	166	5.7	5.1	10.3	2.5	10.7	0.1	70.4	13.9	135.4
MAHONING	552	1.8	1.8	3.2	1.0	3.0	0.1	207.0	11.4	354.9

COUNTY	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
MARION	255	5.9	5.4	8.4	3.2	10.6	0.1	60.8	8.4	100.3
MEDINA	168	2.3	2.7	4.3	1.5	4.3	0.4	42.3	6.4	148.1
MEIGS	28	2.0	1.6	2.2	1.0	3.2	0.2	6.4	1.5	67.3
MERCER	183	4.6	4.2	6.9	2.1	8.3	0.1	56.1	8.1	115.8
MIAMI	1746	5.6	5.4	9.0	2.9	10.3	0.1	252.0	13.8	153.0
MONROE	18	3.8	3.6	6.0	1.8	5.8	0.7	39.3	8.8	145.8
MONTGOMERY	11611	3.6	3.3	6.0	1.7	7.0	0.1	1267.8	15.8	263.8
MORGAN	29	3.4	3.3	5.2	1.8	5.8	0.1	27.0	5.7	108.8
MORROW	60	5.4	4.9	8.8	2.4	10.4	0.1	54.8	10.3	117.2
MUSKINGUM	185	5.2	5.0	8.6	2.6	9.2	0.4	129.0	13.0	151.4
NOBLE	12	3.1	3.0	3.5	1.7	4.6	1.1	8.7	2.0	58.3
OTTAWA	74	2.0	1.9	3.6	1.0	3.9	0.1	26.7	4.8	132.5
PAULDING	23	2.3	1.6	2.7	0.6	3.3	0.1	9.5	2.5	92.2
PERRY	39	2.4	2.9	4.4	1.6	5.3	0.6	19.4	4.8	107.2
PICKAWAY	384	7.4	7.5	12.0	3.8	14.8	0.1	102.5	13.1	109.7
PIKE	59	7.4	5.1	9.1	2.3	13.4	0.1	43.3	8.3	91.7
PORTAGE	210	1.8	1.8	3.1	0.9	3.9	0.1	35.4	3.8	122.2
PREBLE	274	5.1	4.6	8.6	2.2	10.2	0.1	90.3	10.5	122.6
PUTNAM	31	4.5	3.9	5.6	1.9	7.8	0.1	20.2	4.4	77.8
RICHLAND	635	4.6	4.5	9.1	2.4	9.3	0.1	274.0	18.6	205.5
ROSS	425	7.3	6.2	11.4	3.0	13.4	0.1	123.0	13.6	119.2
SANDUSKY	62	4.0	3.5	4.8	2.5	5.7	0.1	26.8	4.1	85.8
SCIOTO	67	2.3	2.4	3.8	1.3	3.6	0.4	29.5	4.8	127.4
SENECA	157	5.2	3.7	6.7	2.1	8.4	0.1	59.8	7.2	107.8
SHELBY	216	5.4	4.2	6.9	2.1	8.9	0.1	48.6	7.6	108.8
STARK	773	3.5	3.4	5.6	1.8	6.6	0.1	68.7	6.7	120.4
SUMMIT	817	2.3	2.3	4.4	1.3	4.4	0.1	319.0	13.3	301.9
TRUMBULL	408	1.6	1.5	2.2	0.9	2.5	0.1	71.7	4.0	176.2
TUSCARAWAS	68	5.0	4.4	7.5	2.3	9.6	0.1	32.2	7.4	99.9
UNION	140	2.4	2.8	5.3	1.5	5.8	0.1	61.5	7.4	141.1
VAN WERT	46	4.4	4.0	6.0	2.2	6.5	0.5	24.5	5.8	96.7
VINTON	9	3.0	2.7	3.7	1.6	3.4	0.9	13.5	3.8	102.9
WARREN	983	3.3	3.1	5.4	1.6	6.2	0.1	219.0	9.4	174.8
WASHINGTON	260	2.9	3.0	5.2	1.6	5.0	0.1	91.9	9.3	177.9
WAYNE	100	3.8	4.5	11.2	1.8	9.9	0.2	259.0	27.6	246.1
WILLIAMS	34	2.6	2.5	5.2	1.2	3.9	0.4	67.8	11.6	222.9
WOOD	216	2.8	2.8	4.5	1.6	5.2	0.1	43.1	5.5	121.6
WYANDOT	41	3.8	4.2	7.2	2.5	7.6	0.1	44.2	8.8	122.3

APPENDIX 5

Radon Statistics for Zip Code Areas

ABBREVIATIONS USED

ZIP = zip code number (arranged in order of increasing magnitude)

No. = number of radon measurements

<u>Radon Concentration Statistics</u> (in pCi/l except CV which is %)

MD = median

GM = geometric mean

AM = arithmetic mean

Q1 = first quartile

Q3 = third quartile

Min = minimum

Max = maximum

SD = standard deviation

CV = coefficient of variation

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43001	8	5.7	5.7	7.8	2.6	6.0	2.1	25.0	7.6	97.6
43002	8	11.0	10.4	15.2	4.2	21.2	3.2	40.0	13.4	87.8
43003	6	4.3	4.5	6.8	1.9	6.7	1.7	21.4	7.5	110.2
43004	54	6.7	10.2	21.6	4.5	16.7	1.3	120.0	29.5	136.9
43005	2	9.7	8.7	9.7	5.4	9.7	5.4	14.0	6.1	62.7
43008	5	2.4	3.2	4.6	1.3	5.0	1.0	11.5	4.3	93.7
43009	6	7.2	6.2	6.6	4.1	7.7	2.9	9.1	2.2	33.7
43011	17	5.8	6.5	8.8	3.8	11.5	0.8	28.8	7.3	82.1
43013	6	2.6	4.1	7.6	1.5	9.3	1.4	22.2	8.9	117.6
43014	6	5.2	5.3	6.3	2.8	8.0	2.6	11.8	3.8	61.1
43015	200	7.5	6.6	9.0	4.2	11.3	0.3	46.5	7.1	78.6
43017	823	7.9	8.0	12.7	4.3	14.9	0.0	95.4	14.1	110.7
43018	2	15.6	14.9	15.6	11.2	15.6	11.2	19.9	6.2	39.6
43019	35	8.3	7.4	9.6	4.7	15.1	1.5	23.6	6.5	67.8
43020	2	23.1	12.4	23.1	3.6	23.1	3.6	42.5	27.5	119.3
43021	79	6.2	5.8	7.7	4.1	9.9	0.0	28.5	5.7	73.8
43022	36	6.1	6.8	13.0	2.8	13.3	0.5	121.1	20.9	160.9
43023	269	13.8	14.7	35.5	5.9	31.3	0.2	543.5	64.0	180.5
43025	22	5.3	6.8	12.4	3.0	10.8	1.2	57.0	15.6	126.0
43026	351	7.6	6.7	11.0	3.9	13.4	0.0	117.6	12.8	116.2
43028	7	19.0	22.6	49.0	6.9	37.5	5.1	212.4	74.3	151.5
43029	2	6.3	5.8	6.3	3.9	6.3	3.9	8.6	3.3	53.2
43031	42	4.4	4.0	6.2	2.3	7.3	0.0	49.9	8.4	134.3
43032	1	4.8	4.8	4.8	4.8	4.8	4.8	4.8	0.0	0.0
43033	1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	0.0	0.0
43035	1	10.4	10.4	10.4	10.4	10.4	10.4	10.4	0.0	0.0
43040	111	2.2	2.5	4.8	1.5	4.9	0.0	61.5	7.5	155.0
43042	1	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0.0	0.0
43044	21	4.7	3.5	8.0	1.5	9.5	0.0	41.5	10.2	126.9
43045	6	5.2	4.4	7.0	1.6	8.7	0.5	16.6	6.1	87.1
43046	22	3.7	3.4	5.2	1.7	4.2	0.9	29.0	6.4	123.1
43047	1	15.3	15.3	15.3	15.3	15.3	15.3	15.3	0.0	0.0
43050	84	6.3	6.6	12.9	2.9	16.0	0.0	124.7	18.8	146.2
43051	1	8.5	8.5	8.5	8.5	8.5	8.5	8.5	0.0	0.0
43052	1	19.2	19.2	19.2	19.2	19.2	19.2	19.2	0.0	0.0
43054	70	5.2	5.5	8.5	3.4	8.2	0.5	56.9	11.0	129.1
43055	409	15.3	13.8	28.2	6.2	30.4	0.0	559.0	49.5	175.8
43056	55	18.3	16.0	24.3	7.9	33.2	0.9	114.7	22.4	92.1
43060	7	9.7	12.4	19.2	5.6	20.2	3.3	62.7	20.9	108.8
43061	13	5.5	4.6	6.1	2.0	7.8	1.0	17.6	4.5	73.0
43062	87	6.1	5.7	9.9	2.7	11.0	0.0	83.5	14.5	145.9
43064	70	5.0	5.5	11.3	2.2	12.7	0.5	70.4	15.6	137.1
43065	287	5.4	5.6	8.4	3.2	9.7	0.0	95.5	9.5	113.4
43066	2	51.7	51.6	51.7	49.3	51.7	49.3	54.1	3.4	6.6
43067	5	2.5	2.9	3.6	1.7	2.9	1.5	8.9	3.0	83.7
43068	282	6.0	5.5	9.0	3.4	9.8	0.0	180.5	13.9	155.5
43069	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
43071	9	14.5	9.7	24.8	3.4	32.7	0.1	78.4	26.0	104.5
43072	55	4.2	4.3	7.5	2.2	8.8	0.0	43.2	9.2	123.7
43074	53	4.8	5.6	9.7	2.6	9.0	0.8	64.1	12.9	132.4

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43076	28	5.7	4.5	13.1	1.4	10.1	0.2	161.1	30.0	229.7
43078	159	5.3	4.8	9.2	2.7	10.4	0.0	265.3	21.7	236.3
43080	14	5.2	6.1	15.1	2.1	13.5	1.7	119.3	30.6	202.9
43081	780	6.2	5.5	8.0	3.4	9.9	0.0	90.6	8.2	101.8
43084	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
43085	1317	9.5	8.4	13.7	4.7	18.1	0.0	369.9	18.3	133.6
43102	7	4.9	5.9	7.1	3.2	7.3	3.0	15.0	5.0	70.5
43103	89	11.5	9.3	17.4	4.2	23.2	0.0	102.5	19.5	112.3
43105	49	5.5	5.1	7.3	2.6	7.6	1.0	37.2	7.0	97.0
43106	3	1.8	1.0	2.3	0.1	2.6	0.1	5.0	2.5	108.2
43107	10	6.8	5.0	7.6	1.5	9.5	0.8	21.3	6.3	83.2
43109	4	6.7	7.5	9.3	3.4	6.8	3.4	20.5	7.6	81.6
43110	107	9.7	8.8	13.7	5.1	17.5	0.0	73.6	12.3	90.1
43111	1	21.2	21.2	21.2	21.2	21.2	21.2	21.2	0.0	0.0
43112	72	7.1	6.7	14.2	3.2	14.2	0.0	238.5	29.5	207.2
43113	204	7.7	7.8	11.5	4.3	14.3	0.5	61.5	10.7	92.9
43115	5	5.9	7.0	8.3	3.7	10.6	3.7	16.1	5.6	66.5
43117	4	5.8	5.1	5.7	2.5	6.9	2.5	8.6	2.7	46.7
43119	55	7.3	7.2	9.6	4.4	14.6	0.7	29.7	6.8	70.8
43120	3	3.5	3.1	3.2	2.5	3.5	2.5	3.5	0.6	18.2
43123	281	5.9	5.3	7.7	3.2	9.7	0.0	47.0	7.0	91.5
43125	64	10.5	9.3	15.3	5.2	21.1	0.0	61.6	13.8	89.9
43126	2	11.9	9.8	11.9	5.2	11.9	5.2	18.5	9.4	79.4
43127	1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0
43128	3	2.7	2.2	3.6	0.5	3.9	0.5	7.5	3.6	100.4
43130	325	8.2	6.5	12.9	3.3	13.0	0.0	340.5	27.8	215.9
43132	1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	0.0	0.0
43135	6	7.8	8.1	9.7	4.7	9.0	3.0	23.2	7.0	72.2
43136	3	14.9	11.0	14.2	3.8	17.1	3.8	23.8	10.0	70.7
43137	6	19.0	16.4	32.8	3.7	39.3	3.0	100.5	37.8	115.2
43138	63	7.3	5.9	9.5	3.4	11.0	0.0	99.5	13.1	137.5
43140	39	5.0	3.8	10.9	1.3	9.6	0.0	68.6	16.8	154.0
43142	1	9.6	9.6	9.6	9.6	9.6	9.6	9.6	0.0	0.0
43143	14	5.0	3.2	5.0	1.4	6.0	0.0	13.1	3.8	76.5
43146	77	4.9	5.5	7.7	2.9	10.8	0.5	41.3	7.0	89.9
43147	354	8.3	7.8	11.4	4.3	14.3	0.0	110.1	11.2	98.4
43148	11	5.6	4.3	8.7	2.8	7.4	0.0	45.7	12.5	144.1
43149	22	6.5	7.3	13.3	2.8	15.6	0.8	85.9	18.2	137.1
43151	3	6.5	3.8	5.3	1.0	7.0	1.0	8.4	3.8	72.5
43152	5	2.0	1.4	3.3	0.3	3.0	0.1	10.2	4.0	122.4
43153	4	6.7	6.8	7.3	4.8	8.6	4.8	10.9	3.0	41.3
43154	7	2.1	2.7	5.4	0.9	6.4	0.3	19.1	6.5	122.1
43155	5	21.9	13.8	21.5	3.5	33.5	2.8	40.2	17.4	80.8
43158	1	7.5	7.5	7.5	7.5	7.5	7.5	7.5	0.0	0.0
43160	31	4.5	3.7	5.6	2.1	7.0	0.5	38.3	6.7	119.4
43162	36	7.2	7.4	10.3	4.5	10.7	1.1	54.4	10.2	99.5
43164	7	5.6	6.6	11.5	2.5	10.5	2.3	45.8	15.5	134.4
43173	1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.0	0.0
43188	2	3.9	3.0	3.9	1.5	3.9	1.5	6.2	3.3	86.3
43201	116	7.3	6.8	10.6	3.6	11.1	0.1	53.8	10.8	102.0
43202	154	6.0	5.5	8.7	3.2	9.8	0.0	152.9	13.5	155.9

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43203	8	4.5	4.2	7.4	3.0	6.7	0.3	28.1	8.7	118.1
43204	172	5.0	4.9	7.0	3.0	9.7	0.0	30.2	5.9	83.5
43205	25	4.7	4.4	7.3	2.0	7.8	0.4	40.1	8.6	117.8
43206	89	5.4	5.2	6.8	3.3	8.4	0.5	28.2	5.1	75.7
43207	115	7.6	7.4	11.2	4.2	13.3	0.4	88.8	12.7	113.3
43209	429	6.2	5.9	8.4	3.6	10.8	0.0	48.7	7.6	91.0
43210	15	3.0	3.2	5.8	1.3	4.0	1.0	30.7	8.1	139.1
43211	54	4.7	3.9	6.0	3.1	7.6	0.0	25.9	5.2	85.5
43212	188	4.8	4.8	8.5	2.8	8.1	0.1	178.2	17.3	203.3
43213	276	7.5	6.7	11.6	3.2	13.8	0.0	79.6	13.1	113.2
43214	474	7.3	6.6	10.3	3.7	12.6	0.0	73.3	10.2	99.7
43215	69	4.9	4.5	7.4	2.4	9.1	0.0	37.3	7.7	105.1
43216	19	27.9	29.2	53.1	19.7	50.3	1.1	232.0	62.1	117.0
43217	2	6.2	6.1	6.2	5.9	6.2	5.9	6.4	0.4	5.7
43218	3	5.9	6.1	6.6	3.8	7.0	3.8	10.1	3.2	48.6
43219	67	6.9	7.6	13.7	3.9	13.3	0.4	112.2	20.5	149.4
43220	580	6.4	6.1	8.5	3.7	11.1	0.0	47.4	7.2	85.0
43221	490	6.3	6.1	8.8	3.7	10.4	0.0	142.6	10.5	119.3
43222	9	7.2	5.2	7.3	3.0	9.1	0.4	16.4	4.9	66.1
43223	52	5.3	4.6	6.7	2.6	8.7	0.0	25.4	5.4	80.2
43224	187	6.2	5.9	14.5	3.7	9.3	0.0	1333.9	97.2	668.8
43225	1	5.6	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0
43226	3	7.6	6.1	7.9	2.1	9.2	2.1	14.0	6.0	75.4
43227	180	8.6	7.7	10.5	4.7	13.4	0.0	76.7	9.0	86.0
43228	197	5.8	5.4	8.6	3.1	10.1	0.0	73.5	9.7	112.6
43229	410	7.0	6.2	9.1	3.7	11.7	0.0	102.8	8.7	95.1
43230	294	7.8	7.8	14.6	3.8	16.7	0.0	417.7	28.1	192.3
43231	65	7.0	6.3	9.1	3.5	11.0	0.3	46.0	8.5	93.4
43232	295	11.2	10.5	16.4	5.9	22.5	0.1	142.8	16.6	100.9
43234	2	8.3	8.3	8.3	8.2	8.3	8.2	8.4	0.1	1.7
43235	417	8.0	7.4	11.5	4.4	13.6	0.0	108.3	12.2	106.5
43239	2	26.9	15.9	26.9	5.2	26.9	5.2	48.6	30.7	114.1
43243	1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.0	0.0
43254	1	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.0	0.0
43264	1	2.9	2.9	2.9	2.9	2.9	2.9	2.9	0.0	0.0
43269	1	9.9	9.9	9.9	9.9	9.9	9.9	9.9	0.0	0.0
43284	1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	0.0	0.0
43285	2	2.3	2.1	2.3	1.4	2.3	1.4	3.1	1.2	53.4
43302	199	5.7	5.3	8.2	3.1	10.7	0.0	55.2	8.1	97.7
43304	1	7.0	7.0	7.0	7.0	7.0	7.0	7.0	0.0	0.0
43305	2	35.5	24.9	35.5	10.2	35.5	10.2	60.8	35.8	100.8
43306	1	6.8	6.8	6.8	6.8	6.8	6.8	6.8	0.0	0.0
43310	9	4.2	6.3	9.3	2.6	12.5	2.3	29.8	9.1	98.2
43311	142	5.7	5.3	10.4	2.4	9.8	0.0	319.2	27.5	264.1
43313	3	3.1	3.2	3.2	2.9	3.3	2.9	3.7	0.4	12.9
43314	14	7.5	5.8	7.8	3.5	11.8	0.7	16.7	5.1	65.3
43315	16	5.3	5.5	9.1	2.4	6.9	1.4	54.8	13.0	143.1
43316	9	2.8	2.8	3.5	1.4	4.9	0.8	7.6	2.4	68.1
43318	29	5.0	4.7	5.9	3.5	7.0	0.8	18.9	4.2	70.6
43319	4	1.8	1.5	1.7	0.8	2.2	0.8	2.5	0.8	46.3
43320	5	16.3	9.2	16.3	1.9	25.2	1.4	32.4	14.1	86.4

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43321	3	9.9	9.6	10.2	6.2	11.1	6.2	14.6	4.2	41.1
43322	2	5.2	4.4	5.2	2.5	5.2	2.5	7.8	3.7	72.8
43324	9	2.0	2.9	7.2	1.2	4.8	0.2	34.1	11.0	153.0
43326	22	4.3	2.7	5.1	1.4	8.3	0.0	13.5	3.9	77.2
43327	1	2.6	2.6	2.6	2.6	2.6	2.6	2.6	0.0	0.0
43328	2	4.2	4.2	4.2	3.9	4.2	3.9	4.5	0.4	10.1
43330	1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	0.0	0.0
43331	7	2.3	2.0	3.0	0.7	3.3	0.5	8.7	2.9	98.3
43332	6	6.4	7.7	11.0	3.6	11.8	2.3	30.3	10.5	95.7
43333	4	7.5	4.0	7.5	0.3	7.5	0.3	14.6	5.8	78.1
43334	13	6.6	7.4	11.7	3.3	11.4	1.1	35.4	11.6	98.6
43335	1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	0.0	0.0
43336	2	3.5	3.4	3.5	3.1	3.5	3.1	3.8	0.5	14.3
43337	3	2.2	1.8	2.1	0.8	2.5	0.8	3.2	1.2	58.3
43338	17	3.3	2.9	5.0	2.2	6.1	0.0	23.2	5.3	104.9
43340	3	1.1	1.6	1.9	1.1	1.7	1.1	3.6	1.4	74.7
43341	3	4.6	4.8	4.9	4.2	4.9	4.2	5.8	0.8	17.1
43342	16	6.9	5.3	8.1	2.5	7.9	0.6	21.3	6.7	82.3
43343	10	17.8	8.9	18.2	1.8	31.5	0.8	38.8	15.9	87.4
43344	16	2.6	4.1	7.9	1.3	10.8	0.8	24.2	8.4	107.0
43345	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0
43347	3	2.5	1.7	2.0	0.8	2.5	0.8	2.6	1.0	51.4
43348	4	3.3	2.3	4.1	0.7	5.8	0.7	9.1	4.1	101.2
43349	5	2.1	2.5	4.1	1.0	2.7	0.7	12.9	5.0	122.4
43350	1	10.7	10.7	10.7	10.7	10.7	10.7	10.7	0.0	0.0
43351	19	4.9	5.5	10.1	3.3	11.9	0.0	44.2	11.4	113.2
43356	7	7.4	6.5	9.0	2.8	8.1	2.4	28.8	9.1	101.0
43357	30	8.9	8.1	13.5	3.4	18.3	1.1	42.9	13.2	97.6
43358	4	1.7	1.8	2.0	1.0	1.9	1.0	3.8	1.2	61.2
43359	4	2.6	2.9	4.3	1.1	3.6	1.1	10.8	4.5	104.8
43360	27	3.2	3.5	9.0	1.7	6.1	0.4	90.2	19.4	216.2
43376	1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0.0	0.0
43402	59	2.4	2.6	4.1	1.4	4.6	0.5	43.1	6.0	144.9
43406	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
43407	1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	0.0	0.0
43410	4	5.6	5.6	6.0	3.1	5.9	3.1	9.8	2.8	46.3
43412	1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0
43413	1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0
43416	5	3.2	3.0	5.2	1.1	3.4	1.1	17.2	6.8	129.9
43420	41	4.0	3.9	5.1	2.7	6.3	0.4	26.8	4.3	85.6
43430	7	2.0	2.8	3.8	1.3	5.2	0.9	10.2	3.3	87.2
43431	5	4.2	5.3	6.6	3.2	4.7	2.9	17.0	5.9	88.7
43432	5	1.0	1.2	1.3	0.9	1.2	0.8	2.6	0.7	55.3
43434	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0
43435	4	1.5	1.5	1.5	1.3	1.6	1.3	1.8	0.2	14.5
43437	2	2.6	1.0	2.6	0.2	2.6	0.2	4.9	3.3	130.3
43438	1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
43440	10	2.3	2.5	5.4	1.3	6.7	0.0	19.5	6.3	117.5
43443	1	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0.0	0.0
43445	2	2.0	0.6	2.0	0.0	2.0	0.0	3.9	2.8	141.4
43447	4	1.6	1.3	1.6	0.5	2.1	0.5	2.6	1.0	60.3

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43449	17	1.3	1.7	2.8	0.7	4.0	0.4	10.2	2.8	100.7
43450	5	3.6	5.1	13.3	0.9	21.4	0.5	33.0	15.5	116.6
43451	1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0
43452	27	2.0	1.7	3.8	1.0	3.2	0.0	26.7	5.8	151.9
43457	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0
43460	4	5.5	5.7	8.6	1.6	5.8	1.6	21.7	8.9	104.3
43462	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
43464	1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0
43465	8	3.2	3.4	4.6	1.6	5.1	1.0	10.7	3.8	82.5
43466	1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0	0.0
43468	1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0
43469	6	2.6	1.7	3.2	0.5	4.1	0.0	7.3	2.8	87.5
43501	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0
43502	15	3.3	3.1	3.9	1.9	4.9	0.8	11.9	2.8	71.5
43504	2	8.6	5.4	8.6	1.9	8.6	1.9	15.2	9.4	110.0
43505	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
43506	12	2.7	2.5	3.7	1.8	3.0	0.6	16.4	4.2	114.7
43512	53	2.6	2.8	3.7	1.7	4.4	0.4	13.1	3.1	83.7
43515	8	2.9	2.0	2.9	0.5	3.8	0.5	6.9	2.2	76.1
43516	5	2.7	2.2	2.8	1.0	2.8	0.7	6.1	2.0	72.6
43517	6	4.0	3.9	15.2	0.5	9.5	0.4	67.8	26.3	173.2
43518	1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0
43521	5	2.7	2.4	4.2	0.8	3.2	0.6	12.9	5.0	120.5
43522	5	3.1	2.7	2.9	1.7	3.3	1.4	4.4	1.1	38.1
43524	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43526	5	3.8	1.9	3.3	0.7	4.4	0.0	5.3	2.1	63.2
43527	3	3.6	2.9	4.1	0.9	4.7	0.9	7.8	3.5	84.8
43528	18	2.0	2.2	3.5	1.2	4.0	0.0	14.7	3.7	105.4
43532	7	0.6	0.5	0.7	0.1	1.0	0.0	1.6	0.6	82.5
43533	1	7.4	7.4	7.4	7.4	7.4	7.4	7.4	0.0	0.0
43534	3	3.6	3.3	3.6	1.9	4.0	1.9	5.3	1.7	47.2
43535	1	5.8	5.8	5.8	5.8	5.8	5.8	5.8	0.0	0.0
43537	67	4.8	4.3	7.8	2.9	6.9	0.2	125.5	16.1	205.8
43540	4	0.8	0.5	0.8	0.0	1.2	0.0	1.5	0.7	95.2
43542	4	2.5	1.8	2.3	0.5	2.7	0.5	3.7	1.3	58.1
43543	5	2.6	2.1	2.2	1.2	2.8	1.0	3.0	0.9	38.5
43545	16	2.9	2.1	2.8	1.6	3.8	0.1	5.5	1.6	56.1
43548	5	4.3	4.5	4.5	3.5	4.9	3.3	5.8	1.0	20.9
43551	97	3.0	3.2	4.5	2.0	5.5	0.0	26.0	4.4	97.1
43553	2	1.7	1.6	1.7	1.5	1.7	1.5	1.8	0.2	12.9
43554	1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0
43556	3	0.9	0.9	1.2	0.4	1.2	0.4	2.2	0.9	79.6
43557	2	4.4	3.9	4.4	2.5	4.4	2.5	6.2	2.6	60.1
43558	19	1.0	1.0	1.6	0.5	1.5	0.2	11.8	2.6	155.6
43560	79	1.8	1.9	3.1	1.2	2.8	0.1	43.1	5.7	181.6
43566	29	3.4	2.6	4.3	1.6	5.8	0.0	13.0	3.5	81.6
43567	10	2.0	2.5	4.0	1.8	2.9	0.3	13.1	4.3	109.8
43569	2	0.4	0.3	0.4	0.2	0.4	0.2	0.6	0.3	70.7
43570	5	1.1	1.9	2.5	1.0	3.7	0.9	5.0	2.0	81.2
43571	8	1.0	0.6	0.8	0.2	1.1	0.0	1.6	0.6	70.0
43602	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43604	2	0.5	0.3	0.5	0.0	0.5	0.0	1.0	0.7	141.4
43605	23	2.0	2.0	2.8	0.9	3.4	0.3	10.3	2.4	84.8
43606	70	1.7	1.7	2.6	1.0	2.9	0.0	17.8	3.0	112.4
43607	17	2.9	2.5	3.5	1.8	3.6	0.3	15.8	3.5	99.4
43608	9	3.7	2.5	3.6	1.7	4.8	0.0	6.5	2.1	57.0
43609	21	2.0	2.0	3.8	0.9	3.1	0.3	26.2	6.0	156.0
43611	29	4.9	4.4	6.9	2.3	9.3	0.0	24.4	6.1	88.1
43612	37	1.7	1.7	2.1	1.0	2.9	0.3	8.7	1.6	73.6
43613	55	1.4	1.3	1.9	0.9	2.2	0.0	13.6	2.1	109.9
43614	116	3.2	3.4	6.6	1.9	5.7	0.0	103.9	13.6	206.8
43615	82	1.6	1.4	2.1	0.9	2.9	0.0	7.5	1.7	79.5
43616	26	3.8	3.4	5.0	2.0	6.3	0.0	25.9	5.1	101.3
43617	31	1.7	1.4	1.6	1.2	2.1	0.3	3.1	0.8	47.4
43618	11	8.1	5.3	6.6	3.4	9.1	0.9	10.8	3.5	53.5
43619	20	2.8	1.9	4.2	0.7	3.9	0.0	18.7	4.8	115.0
43620	2	1.0	0.8	1.0	0.4	1.0	0.4	1.6	0.8	84.9
43623	50	1.5	1.5	2.8	1.0	2.3	0.0	50.8	7.1	251.3
43650	1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0
43652	1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	0.0	0.0
43655	1	27.9	27.9	27.9	27.9	27.9	27.9	27.9	0.0	0.0
43662	1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.0	0.0
43694	1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0
43697	1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0
43699	7	0.2	0.2	0.3	0.1	0.2	0.0	1.0	0.3	123.5
43701	121	5.0	4.5	6.6	2.6	8.3	0.5	53.3	7.2	108.5
43702	1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	0.0	0.0
43713	10	4.8	4.0	5.9	1.3	9.0	0.9	13.4	4.6	78.3
43716	1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	0.0	0.0
43718	4	1.3	1.2	3.9	0.0	1.5	0.0	13.0	6.1	157.8
43720	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
43723	7	2.2	1.9	2.6	1.1	3.7	0.3	4.8	1.8	67.9
43724	11	3.2	3.2	3.7	2.2	4.6	1.1	8.7	2.0	55.3
43725	55	2.9	3.2	6.7	1.3	6.5	0.4	108.1	14.7	219.4
43727	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
43728	1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0
43730	2	2.7	1.7	2.7	0.6	2.7	0.6	4.8	3.0	110.0
43731	7	2.3	2.2	2.6	1.5	2.8	0.6	4.9	1.4	55.6
43732	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0
43734	1	13.9	13.9	13.9	13.9	13.9	13.9	13.9	0.0	0.0
43735	2	8.1	6.0	8.1	2.6	8.1	2.6	13.7	7.8	96.3
43739	6	9.6	8.0	10.1	3.8	13.9	2.4	19.4	6.6	66.0
43745	1	17.0	17.0	17.0	17.0	17.0	17.0	17.0	0.0	0.0
43746	3	5.0	6.1	11.2	1.7	10.5	1.7	27.0	13.8	122.4
43747	1	5.6	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0
43748	5	1.4	1.8	3.2	0.9	1.6	0.8	11.1	4.4	138.4
43749	1	23.9	23.9	23.9	23.9	23.9	23.9	23.9	0.0	0.0
43750	2	6.5	5.9	6.5	3.8	6.5	3.8	9.1	3.7	58.1
43755	2	1.9	1.2	1.9	0.4	1.9	0.4	3.4	2.1	111.6
43756	11	3.6	2.6	3.6	2.1	4.6	0.0	6.6	2.0	55.8
43758	7	3.2	3.4	4.6	1.4	5.6	1.0	11.6	3.8	82.5
43759	3	2.6	2.5	2.5	2.4	2.6	2.4	2.6	0.1	4.6

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43760	1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.0	0.0
43762	19	8.6	7.9	16.5	3.6	10.3	0.6	129.0	29.0	175.5
43764	9	2.9	2.8	3.6	1.4	5.3	0.8	7.7	2.5	68.5
43766	3	1.6	1.6	1.6	1.3	1.7	1.3	1.9	0.3	18.7
43767	6	3.2	3.6	4.7	1.7	6.0	1.2	9.8	3.6	77.5
43768	2	2.0	2.0	2.0	1.9	2.0	1.9	2.1	0.1	7.1
43772	2	2.6	1.2	2.6	0.3	2.6	0.3	4.9	3.3	125.1
43773	2	1.4	1.1	1.4	0.6	1.4	0.6	2.1	1.1	78.6
43779	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
43783	6	3.0	3.6	5.6	1.6	4.3	1.0	18.8	6.6	119.3
43787	6	2.8	3.6	6.3	1.3	7.2	0.8	18.3	7.1	111.7
43789	1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.0	0.0
43793	8	2.6	2.1	2.6	0.8	3.1	0.7	4.4	1.4	56.8
43802	1	6.9	6.9	6.9	6.9	6.9	6.9	6.9	0.0	0.0
43811	3	1.2	1.7	4.2	0.4	3.6	0.4	11.0	5.9	140.5
43812	28	3.6	4.0	7.6	2.0	10.9	0.0	56.9	11.1	144.8
43820	1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0
43821	5	7.8	7.3	8.0	4.4	8.4	4.2	14.6	4.1	51.4
43822	9	2.0	3.0	4.2	1.5	3.9	1.4	13.3	4.2	99.2
43824	1	4.4	4.4	4.4	4.4	4.4	4.4	4.4	0.0	0.0
43828	1	8.8	8.8	8.8	8.8	8.8	8.8	8.8	0.0	0.0
43830	20	10.6	7.9	15.7	2.2	18.8	0.4	64.1	17.6	112.2
43832	3	0.6	1.1	4.1	0.2	3.3	0.2	11.5	6.4	156.4
43837	1	9.4	9.4	9.4	9.4	9.4	9.4	9.4	0.0	0.0
43843	1	60.5	60.5	60.5	60.5	60.5	60.5	60.5	0.0	0.0
43844	4	17.2	10.2	15.6	1.4	19.8	1.4	26.8	10.7	68.7
43845	3	8.5	7.7	8.3	4.4	9.4	4.4	12.1	3.9	46.2
43901	1	8.0	8.0	8.0	8.0	8.0	8.0	8.0	0.0	0.0
43902	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
43903	2	6.2	5.3	6.2	3.1	6.2	3.1	9.2	4.3	70.1
43905	1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.0	0.0
43906	8	6.7	6.1	9.8	1.8	12.5	1.7	33.9	10.7	108.6
43907	11	3.5	5.4	9.3	2.6	7.0	1.5	39.5	12.0	129.4
43908	2	2.0	1.9	2.0	1.9	2.0	1.9	2.0	0.1	3.6
43910	7	2.0	2.0	2.3	1.4	2.0	0.9	5.7	1.6	67.1
43912	3	5.3	6.4	10.3	2.1	9.8	2.1	23.4	11.5	111.9
43913	2	1.6	1.5	1.6	1.5	1.6	1.5	1.6	0.1	4.6
43915	3	8.2	12.7	18.0	6.4	16.0	6.4	39.3	18.5	103.0
43917	1	19.4	19.4	19.4	19.4	19.4	19.4	19.4	0.0	0.0
43920	63	6.2	5.1	9.8	2.1	11.4	0.0	58.1	11.2	114.6
43921	1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0
43926	1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0
43930	1	39.0	39.0	39.0	39.0	39.0	39.0	39.0	0.0	0.0
43932	2	23.6	19.6	23.6	10.5	23.6	10.5	36.7	18.5	78.5
43933	1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0
43935	15	2.2	2.5	3.2	1.5	4.0	0.9	9.4	2.5	78.2
43938	8	5.4	4.5	7.6	1.7	8.3	0.5	21.4	7.3	96.1
43942	5	2.3	2.4	3.4	1.1	2.6	0.7	9.1	3.3	96.3
43943	14	6.8	4.9	8.7	1.8	14.6	0.3	22.8	7.7	88.4
43944	2	6.8	6.3	6.8	4.4	6.8	4.4	9.1	3.3	49.2
43945	11	3.8	4.1	5.9	1.6	6.6	1.4	18.2	5.6	94.3

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
43946	1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0
43947	7	2.8	3.2	5.0	1.7	4.4	0.6	16.8	5.5	111.8
43948	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
43950	53	3.2	3.3	5.4	1.6	7.0	0.1	33.3	6.2	114.9
43952	49	3.2	3.5	44.1	1.4	6.9	0.0	1927.6	274.7	622.9
43963	3	3.1	3.3	3.6	2.1	3.7	2.1	5.6	1.8	50.1
43964	12	3.6	4.1	4.7	2.5	4.8	2.0	9.8	2.6	56.4
43968	13	3.7	4.1	5.5	2.1	6.9	0.8	14.6	4.2	76.4
43974	1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.0	0.0
43976	1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.0	0.0
43983	1	10.4	10.4	10.4	10.4	10.4	10.4	10.4	0.0	0.0
43985	1	5.9	5.9	5.9	5.9	5.9	5.9	5.9	0.0	0.0
43986	2	5.3	4.7	5.3	2.9	5.3	2.9	7.7	3.4	64.0
43988	8	17.8	15.9	25.9	4.8	39.9	1.7	60.7	22.0	85.2
44001	32	3.1	3.7	6.6	1.9	8.1	0.0	28.0	7.2	109.4
44003	27	1.0	0.9	1.1	0.6	1.4	0.2	2.7	0.7	63.3
44004	103	0.9	1.0	1.6	0.6	1.5	0.0	13.5	2.3	141.4
44005	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
44007	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
44010	10	1.8	1.4	1.9	0.6	2.2	0.4	4.5	1.4	76.5
44011	16	3.4	2.4	4.1	0.9	5.3	0.0	11.7	3.5	87.0
44012	66	5.1	4.0	6.2	2.3	9.0	0.0	24.0	5.1	82.3
44017	20	2.1	1.6	2.4	1.0	2.5	0.0	11.6	2.4	102.9
44018	1	9.3	9.3	9.3	9.3	9.3	9.3	9.3	0.0	0.0
44020	1	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0.0	0.0
44021	6	1.4	1.4	1.5	1.2	1.4	1.1	2.3	0.4	29.8
44022	115	1.6	1.8	9.2	0.9	3.2	0.1	733.8	68.3	743.1
44024	33	1.7	2.1	3.4	1.1	4.4	0.0	19.6	3.9	113.4
44026	59	1.7	1.3	2.1	0.7	2.2	0.0	22.8	3.2	151.8
44027	2	2.0	1.7	2.0	0.9	2.0	0.9	3.1	1.6	77.8
44028	6	2.6	2.5	2.6	2.0	2.9	1.4	3.4	0.7	27.0
44030	50	1.7	1.6	3.2	0.6	3.5	0.1	27.4	4.6	143.5
44032	10	0.9	0.8	1.1	0.4	1.2	0.3	3.9	1.0	92.6
44035	61	1.7	2.1	3.5	1.0	4.3	0.0	21.4	4.4	124.0
44036	3	4.4	3.0	3.5	1.3	4.5	1.3	4.7	1.9	54.3
44038	1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
44039	19	2.6	2.6	4.1	1.0	5.2	0.5	14.9	4.0	99.4
44040	24	1.4	1.3	1.5	0.9	1.7	0.3	3.2	0.8	54.7
44041	45	0.7	0.8	1.6	0.4	2.0	0.0	11.9	2.2	140.9
44044	13	1.7	1.9	2.2	1.4	2.3	0.7	5.9	1.3	60.7
44045	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
44046	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44047	54	0.9	0.8	1.0	0.6	1.3	0.0	3.0	0.6	64.5
44048	8	1.9	1.4	1.7	0.4	2.2	0.4	3.4	1.0	61.0
44049	1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0
44050	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
44052	35	2.8	2.2	4.5	1.2	5.7	0.0	20.2	5.1	113.0
44053	18	2.4	2.2	3.6	1.1	4.5	0.2	15.3	3.7	102.3
44054	7	2.3	1.8	3.3	0.8	3.5	0.0	10.4	3.4	103.0
44055	16	1.5	1.9	3.2	0.9	5.5	0.2	9.1	3.0	94.7
44056	12	1.4	1.3	1.7	0.6	1.9	0.4	4.1	1.3	76.4

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44057	13	1.1	1.0	2.7	0.2	3.1	0.0	12.1	3.6	132.4
44058	1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0
44060	100	1.4	1.1	1.9	0.5	2.4	0.0	18.0	2.5	131.3
44061	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
44062	10	0.8	0.7	1.2	0.3	1.4	0.2	4.5	1.3	112.8
44064	2	1.9	1.1	1.9	0.4	1.9	0.4	3.3	2.1	110.8
44065	6	2.5	2.4	5.0	0.6	5.4	0.4	16.5	6.2	124.5
44067	27	1.3	1.1	2.1	0.6	2.2	0.0	14.5	2.8	136.9
44068	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
44070	101	2.3	2.1	3.8	1.2	4.3	0.0	35.9	5.4	143.7
44072	22	1.6	1.6	3.0	0.7	3.0	0.2	20.2	4.3	142.2
44074	12	3.1	2.6	3.7	1.9	4.9	0.0	8.5	2.5	67.0
44076	28	1.2	1.0	1.5	0.5	1.4	0.3	9.3	1.7	117.4
44077	87	1.7	1.8	3.8	0.9	3.5	0.0	31.2	5.8	154.6
44080	1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0
44081	12	3.3	4.4	7.3	1.9	11.1	1.1	22.6	7.6	104.2
44082	15	1.0	1.2	1.9	0.5	2.1	0.3	8.4	2.2	115.3
44084	15	1.1	1.1	1.3	0.8	1.4	0.3	3.0	0.7	57.4
44085	23	1.2	1.2	1.6	0.7	1.8	0.3	6.7	1.4	85.9
44086	4	3.1	3.4	8.6	0.9	5.1	0.9	27.5	12.7	147.6
44087	11	1.1	1.1	1.6	0.6	1.8	0.0	5.1	1.4	92.2
44088	1	28.3	28.3	28.3	28.3	28.3	28.3	28.3	0.0	0.0
44089	37	5.9	4.3	6.8	2.4	10.1	0.0	28.0	5.7	83.2
44090	9	2.5	1.5	2.0	0.9	2.9	0.0	3.5	1.2	59.1
44092	25	1.2	1.0	1.3	0.5	1.7	0.0	3.3	1.1	77.9
44093	10	1.2	1.5	2.2	0.8	2.7	0.3	8.5	2.4	108.5
44094	102	1.2	1.2	2.4	0.7	2.3	0.0	20.6	3.6	151.3
44095	2	0.7	0.6	0.7	0.5	0.7	0.5	0.8	0.2	32.6
44099	14	0.8	0.8	1.0	0.4	1.1	0.3	3.0	0.9	87.0
44100	1	5.4	5.4	5.4	5.4	5.4	5.4	5.4	0.0	0.0
44101	2	2.7	2.2	2.7	1.2	2.7	1.2	4.1	2.1	77.4
44102	27	2.5	2.6	3.1	1.5	3.7	0.9	13.3	2.4	78.5
44103	5	2.2	2.2	2.6	1.2	2.2	1.0	6.1	2.0	75.6
44104	1	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.0	0.0
44105	15	1.4	1.3	2.6	0.4	3.1	0.0	13.7	3.5	134.0
44106	19	1.2	1.0	1.7	0.6	2.1	0.1	6.7	1.7	97.5
44107	70	0.9	0.8	1.3	0.5	1.4	0.0	7.4	1.4	106.4
44108	9	1.4	1.1	1.3	0.7	1.5	0.4	2.1	0.6	45.8
44109	34	1.2	1.0	1.6	0.6	1.5	0.1	8.0	1.7	107.2
44110	10	1.2	1.0	1.1	0.5	1.3	0.4	2.7	0.7	58.9
44111	50	1.0	0.9	1.7	0.5	2.0	0.0	7.8	1.8	108.5
44112	8	0.5	0.6	1.2	0.2	0.8	0.0	6.2	2.1	165.7
44113	18	1.9	1.2	2.1	0.6	2.6	0.0	10.3	2.3	108.6
44114	12	0.6	0.4	0.6	0.1	0.8	0.0	1.4	0.4	76.6
44115	3	1.8	3.5	5.9	1.6	4.9	1.6	14.3	7.3	123.3
44116	62	1.3	1.1	1.6	0.6	2.2	0.0	9.3	1.5	95.1
44117	17	1.1	1.3	1.8	0.7	2.0	0.4	6.3	1.8	98.9
44118	134	1.0	0.9	2.1	0.5	1.6	0.0	24.3	4.2	193.5
44119	16	1.2	1.3	2.3	0.7	1.6	0.4	17.1	4.0	174.1
44120	42	0.7	0.6	1.2	0.3	1.3	0.0	9.0	1.8	146.0
44121	72	1.1	1.0	1.7	0.6	1.7	0.0	18.1	2.5	146.3

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44122	111	1.1	0.9	1.3	0.7	1.5	0.0	8.9	1.2	93.1
44123	21	0.5	0.6	0.8	0.3	1.1	0.0	3.2	0.8	90.3
44124	84	1.2	1.1	1.4	0.7	1.6	0.1	8.7	1.1	78.9
44125	27	0.9	0.9	1.4	0.5	2.2	0.0	4.9	1.2	87.8
44126	30	1.4	1.6	4.1	1.1	2.2	0.4	74.5	13.3	324.6
44127	3	2.5	2.5	2.5	2.4	2.5	2.4	2.6	0.1	4.0
44128	11	0.5	0.5	0.7	0.4	0.6	0.0	2.2	0.6	89.0
44129	47	0.9	0.9	1.2	0.5	1.4	0.0	3.9	0.9	78.0
44130	98	1.2	1.2	2.0	0.7	2.4	0.0	11.5	2.2	111.7
44131	42	2.1	2.0	3.7	1.1	3.4	0.0	48.2	7.4	198.7
44132	14	0.9	0.9	1.9	0.5	1.3	0.2	14.8	3.8	197.5
44133	42	1.8	1.7	2.7	0.9	3.5	0.1	11.8	2.5	91.9
44134	58	1.2	1.1	1.8	0.8	1.9	0.0	23.1	3.0	169.5
44135	23	0.8	0.8	1.3	0.5	1.8	0.0	3.8	1.2	88.8
44136	115	2.1	1.8	2.3	1.2	3.0	0.0	8.8	1.5	66.8
44137	25	1.0	0.9	1.2	0.5	1.5	0.2	4.3	0.9	74.7
44138	28	2.5	2.4	3.0	1.4	3.8	0.6	10.6	2.2	72.7
44139	49	1.7	1.6	2.2	1.0	2.3	0.0	7.5	1.7	80.6
44140	84	3.0	2.6	4.0	1.5	5.6	0.0	24.1	3.7	94.0
44141	42	1.9	2.1	2.9	1.4	2.7	0.3	14.5	3.0	103.5
44142	29	1.0	0.8	1.2	0.5	1.4	0.0	5.4	1.1	92.8
44143	58	1.7	1.6	2.2	0.9	2.8	0.0	7.1	1.6	74.6
44144	17	1.2	0.9	1.4	0.3	1.9	0.2	4.3	1.1	82.1
44145	136	2.5	2.4	3.4	1.5	4.1	0.0	15.0	2.9	86.4
44146	40	1.2	1.1	1.9	0.5	1.8	0.0	10.5	2.3	124.2
44147	26	1.3	1.4	2.2	0.8	2.1	0.4	19.6	3.7	164.6
44150	1	3.7	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0
44151	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44167	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44190	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
44201	6	1.2	1.0	1.7	0.3	2.5	0.2	3.6	1.5	91.4
44202	37	1.2	1.2	2.0	0.5	2.7	0.0	10.6	2.2	108.2
44203	55	3.4	2.4	4.1	1.2	5.4	0.0	15.8	3.7	90.2
44205	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44209	1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0	0.0
44210	5	3.3	2.7	3.3	1.4	3.8	0.7	5.0	1.6	48.8
44211	1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.0	0.0
44212	31	1.9	1.9	2.3	1.3	2.6	0.8	11.8	2.0	85.1
44214	2	3.3	3.2	3.3	2.7	3.3	2.7	3.8	0.8	23.9
44215	1	4.5	4.5	4.5	4.5	4.5	4.5	4.5	0.0	0.0
44216	17	3.5	3.5	4.2	1.8	6.0	1.3	9.4	2.6	61.6
44217	1	19.2	19.2	19.2	19.2	19.2	19.2	19.2	0.0	0.0
44221	41	1.9	1.7	2.3	0.9	3.5	0.0	6.9	1.9	79.2
44223	26	1.7	1.7	2.1	1.2	2.4	0.5	5.6	1.3	62.8
44224	61	1.9	2.1	2.9	1.2	3.9	0.0	14.6	2.7	92.2
44230	10	7.1	5.7	8.5	2.0	11.0	1.0	24.1	7.3	85.9
44231	10	1.5	1.6	3.1	0.7	2.0	0.4	14.1	4.3	139.3
44233	15	1.8	2.0	2.4	1.3	3.8	0.8	4.2	1.3	55.1
44234	5	1.5	1.4	1.6	0.7	1.6	0.5	2.8	0.8	52.6
44235	2	2.6	1.9	2.6	0.8	2.6	0.8	4.4	2.5	97.9
44236	80	2.2	2.4	10.4	1.2	3.5	0.0	319.0	39.6	382.0

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44240	56	2.9	2.7	4.0	1.3	4.8	0.2	15.9	3.6	90.9
44241	6	7.1	5.1	6.3	2.0	8.4	1.5	9.8	3.5	56.6
44247	1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	0.0	0.0
44249	1	20.6	20.6	20.6	20.6	20.6	20.6	20.6	0.0	0.0
44250	1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0
44251	4	3.0	3.3	3.9	2.0	3.9	2.0	7.6	2.6	68.1
44253	3	3.2	3.7	3.9	2.6	3.9	2.6	6.0	1.8	46.1
44254	2	10.8	7.9	10.8	3.5	10.8	3.5	18.0	10.3	95.4
44255	11	1.7	2.6	4.8	0.8	7.4	0.5	16.8	5.2	107.5
44256	72	2.6	3.0	4.5	1.7	5.6	0.6	36.1	5.4	121.2
44258	2	11.4	11.1	11.4	9.1	11.4	9.1	13.6	3.2	28.0
44260	18	3.4	2.4	5.0	1.2	4.9	0.0	35.4	7.9	157.6
44262	13	3.4	3.3	4.0	1.6	5.9	1.1	8.4	2.4	60.1
44264	1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0
44265	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44266	31	1.3	1.3	2.0	0.6	2.4	0.2	9.1	2.2	106.1
44270	3	0.6	0.6	0.9	0.2	0.9	0.2	1.9	0.9	98.8
44272	11	1.3	1.6	2.8	0.8	4.4	0.1	8.1	2.7	95.5
44273	4	22.4	9.6	22.3	2.0	42.3	2.0	42.3	23.2	104.1
44274	1	2.6	2.6	2.6	2.6	2.6	2.6	2.6	0.0	0.0
44275	1	10.2	10.2	10.2	10.2	10.2	10.2	10.2	0.0	0.0
44276	1	2.6	2.6	2.6	2.6	2.6	2.6	2.6	0.0	0.0
44278	33	2.0	1.6	2.2	0.8	2.8	0.1	6.6	1.6	72.7
44280	4	4.7	6.4	11.9	2.2	5.9	2.2	36.1	16.2	135.8
44281	20	2.0	1.9	2.5	1.1	3.0	0.5	7.7	1.9	75.9
44286	20	2.4	2.3	2.6	1.4	3.2	1.2	5.7	1.2	45.0
44287	5	2.6	2.4	2.7	1.4	3.4	1.0	3.6	1.1	40.1
44288	5	2.1	1.5	1.7	0.7	2.3	0.7	2.7	0.9	53.0
44296	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0
44301	19	1.6	1.9	2.4	1.2	3.4	0.5	5.9	1.6	65.8
44302	3	1.3	1.2	1.2	1.0	1.3	1.0	1.4	0.2	16.9
44303	16	2.5	2.2	2.6	1.2	3.2	0.9	6.1	1.6	60.7
44304	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44305	21	2.5	2.7	4.0	1.3	4.3	0.6	12.4	3.6	91.6
44306	13	3.1	3.1	4.6	1.3	6.5	0.5	11.7	3.7	80.8
44307	1	4.4	4.4	4.4	4.4	4.4	4.4	4.4	0.0	0.0
44308	1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	0.0	0.0
44310	26	3.5	3.5	5.1	2.5	6.0	0.0	20.8	4.6	89.4
44311	2	2.6	1.4	2.6	0.4	2.6	0.4	4.7	3.0	119.2
44312	43	4.0	3.4	4.5	2.2	5.8	0.7	13.7	3.4	74.0
44313	129	2.3	2.5	4.0	1.6	4.5	0.0	30.7	4.7	116.5
44314	11	2.1	1.6	2.2	1.0	3.5	0.0	4.6	1.5	65.5
44316	1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0.0	0.0
44319	65	3.1	3.4	6.1	1.7	9.2	0.0	77.3	10.0	164.9
44320	30	2.4	1.9	3.3	0.9	5.3	0.0	11.8	3.1	93.4
44321	32	2.5	3.3	7.1	1.2	12.2	0.0	26.7	8.1	113.9
44322	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
44323	1	12.6	12.6	12.6	12.6	12.6	12.6	12.6	0.0	0.0
44324	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
44341	1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0
44349	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44401	11	1.7	2.0	2.3	1.3	3.0	0.9	4.9	1.3	54.0
44402	10	2.6	3.1	4.0	1.8	3.4	1.4	11.0	3.6	88.4
44403	16	1.7	1.8	2.5	0.9	2.8	0.5	11.0	2.5	100.8
44404	7	2.1	1.7	2.6	0.7	2.6	0.3	8.5	2.8	104.9
44405	10	1.6	1.5	3.0	0.5	2.5	0.3	16.9	5.0	163.6
44406	65	2.0	1.9	2.4	1.2	3.2	0.4	14.1	2.1	84.5
44408	32	2.9	3.3	11.3	1.6	3.8	0.5	234.2	40.9	361.3
44410	43	2.0	1.8	2.5	1.3	2.8	0.0	9.6	2.1	81.6
44411	3	1.2	1.7	3.0	0.6	2.7	0.6	7.1	3.6	121.1
44412	8	1.3	1.4	1.7	0.8	1.8	0.7	5.0	1.4	82.1
44413	14	1.7	1.5	1.8	0.9	2.0	0.6	3.9	0.9	52.9
44416	2	1.8	1.7	1.8	1.6	1.8	1.6	1.9	0.2	12.1
44417	11	1.3	1.2	1.5	0.7	2.0	0.3	3.1	1.0	68.1
44418	4	2.2	1.5	2.0	0.4	3.3	0.4	3.3	1.5	74.1
44420	25	1.4	1.2	1.8	0.8	2.2	0.0	6.8	1.6	85.3
44422	2	1.1	0.8	1.1	0.4	1.1	0.4	1.7	0.9	87.5
44423	10	4.2	3.5	6.8	2.6	5.8	0.0	32.7	9.3	136.2
44424	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0
44425	46	1.5	1.6	2.2	1.1	2.4	0.3	11.0	2.1	98.4
44427	4	9.9	10.6	21.7	2.2	13.0	2.2	64.6	29.0	133.8
44428	16	1.2	1.6	2.4	1.1	2.4	0.3	10.7	2.8	113.0
44429	4	1.5	1.3	2.0	0.3	1.5	0.3	4.9	2.0	98.4
44430	4	0.6	0.4	0.6	0.1	0.7	0.1	1.3	0.5	82.0
44431	20	3.3	3.0	3.9	1.6	3.9	1.1	15.3	3.3	85.5
44432	38	3.0	2.6	5.7	1.8	4.7	0.0	92.2	14.6	255.7
44436	10	3.1	2.8	4.1	1.6	4.4	0.5	15.8	4.4	106.1
44437	4	1.8	0.9	1.4	0.0	2.0	0.0	2.1	1.0	68.4
44438	16	1.9	1.8	2.3	1.5	2.9	0.1	5.5	1.5	62.3
44439	2	1.1	1.1	1.1	0.9	1.1	0.9	1.3	0.3	25.7
44440	8	1.5	1.3	1.8	0.6	2.5	0.4	4.5	1.4	78.8
44441	12	11.5	10.8	13.3	8.8	13.0	2.4	31.6	8.9	66.7
44442	8	2.1	2.5	3.1	1.3	4.0	1.0	8.2	2.4	76.3
44443	13	5.1	11.2	41.8	2.7	68.8	1.7	207.0	64.1	153.4
44444	23	1.8	1.4	2.0	0.8	2.6	0.0	5.9	1.6	77.7
44445	7	3.0	2.4	3.0	1.3	4.0	0.5	5.3	1.7	55.7
44446	27	1.5	1.2	2.1	0.7	2.1	0.0	12.8	2.7	125.5
44449	5	1.7	0.9	1.4	0.3	1.7	0.3	2.9	1.1	79.8
44450	4	1.3	1.1	1.5	0.4	2.1	0.4	3.1	1.3	85.7
44451	18	1.7	1.4	1.8	0.8	2.2	0.4	5.4	1.3	71.8
44452	16	2.9	2.4	3.0	1.5	4.0	0.3	7.3	1.8	59.4
44453	1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0
44454	7	4.8	4.5	7.4	1.6	7.0	1.1	26.8	8.9	120.1
44455	2	2.7	1.7	2.7	0.6	2.7	0.6	4.7	2.9	109.4
44460	63	2.2	2.3	3.5	1.2	3.2	0.4	28.9	4.5	128.2
44465	1	8.2	8.2	8.2	8.2	8.2	8.2	8.2	0.0	0.0
44466	1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0	0.0
44470	7	1.6	1.3	1.4	1.0	1.6	0.4	1.8	0.5	34.9
44471	13	1.7	1.3	1.7	0.8	2.0	0.3	4.7	1.1	68.1
44473	8	1.8	1.7	2.3	1.3	2.5	0.3	6.4	1.8	79.8
44481	22	1.0	1.0	1.9	0.5	1.4	0.0	11.1	2.8	147.2
44483	33	1.0	1.2	1.4	0.7	1.8	0.2	4.7	1.0	69.0

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44484	51	2.0	1.8	3.5	0.9	2.7	0.1	71.7	9.8	281.4
44485	10	1.6	1.0	1.5	0.2	2.1	0.2	3.2	1.1	75.4
44491	5	1.8	1.7	1.8	1.1	2.3	1.0	2.5	0.7	36.2
44493	2	2.9	2.8	2.9	2.3	2.9	2.3	3.5	0.8	29.3
44501	8	1.8	1.8	2.3	0.8	2.1	0.6	4.9	1.7	73.0
44502	6	1.6	0.9	2.5	0.0	1.8	0.0	9.9	3.7	149.7
44503	6	3.4	3.4	3.4	3.2	3.5	3.0	3.9	0.3	8.6
44504	7	1.3	1.2	1.3	0.9	1.6	0.6	2.0	0.5	36.9
44505	34	2.0	1.8	2.4	1.0	3.1	0.0	7.4	1.8	75.8
44506	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0
44507	5	0.8	1.0	1.2	0.6	1.2	0.5	2.4	0.8	64.7
44508	2	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
44509	12	1.8	1.5	2.0	0.8	2.6	0.3	5.1	1.4	69.7
44510	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
44511	41	1.4	1.4	1.9	0.9	2.4	0.0	6.9	1.6	84.4
44512	110	2.0	1.9	2.3	1.2	2.9	0.4	7.7	1.4	61.2
44513	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44514	68	1.5	1.5	2.1	0.9	2.7	0.0	8.9	1.8	84.9
44515	50	1.5	1.6	2.0	1.1	2.4	0.5	7.5	1.5	74.4
44516	1	2.6	2.6	2.6	2.6	2.6	2.6	2.6	0.0	0.0
44519	1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0
44572	2	4.4	2.0	4.4	0.5	4.4	0.5	8.3	5.5	125.4
44575	2	3.8	3.7	3.8	3.4	3.8	3.4	4.1	0.5	13.2
44601	68	1.4	1.3	2.0	0.7	2.0	0.0	16.3	2.3	117.2
44606	3	0.8	1.3	1.7	0.7	1.5	0.7	3.7	1.7	98.3
44607	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
44608	1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
44609	11	1.1	1.1	1.4	0.6	1.7	0.3	3.7	1.0	74.1
44611	1	4.4	4.4	4.4	4.4	4.4	4.4	4.4	0.0	0.0
44612	12	5.6	5.1	7.9	2.3	10.7	1.0	28.3	7.7	97.1
44614	34	3.8	3.9	4.7	2.8	6.2	0.7	16.1	2.9	62.1
44615	50	4.3	5.7	28.2	1.9	19.0	0.0	189.0	51.4	182.5
44617	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
44618	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44620	2	3.9	3.9	3.9	3.5	3.9	3.5	4.3	0.6	14.5
44621	3	3.4	3.1	3.2	2.1	3.6	2.1	4.2	1.1	32.8
44622	16	5.5	4.6	6.0	2.7	7.5	0.5	18.1	4.2	70.0
44624	1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	0.0	0.0
44625	7	1.8	2.2	6.0	1.0	2.0	0.7	32.6	11.8	197.4
44626	4	8.1	6.6	8.8	1.9	11.0	1.9	17.0	6.6	75.8
44628	3	2.0	1.9	2.1	1.1	2.3	1.1	3.2	1.1	50.2
44632	35	1.5	1.6	2.3	0.9	3.1	0.1	11.5	2.4	101.3
44633	1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0
44634	7	1.7	2.2	3.5	1.0	3.5	0.7	10.2	3.7	106.9
44635	1	68.7	68.7	68.7	68.7	68.7	68.7	68.7	0.0	0.0
44637	4	4.5	3.9	15.0	0.6	8.1	0.6	50.5	23.9	159.1
44638	3	4.1	5.3	6.3	3.1	6.0	3.1	11.8	4.8	75.2
44639	2	8.0	7.9	8.0	7.9	8.0	7.9	8.0	0.1	0.9
44640	2	1.7	1.6	1.7	1.2	1.7	1.2	2.1	0.6	38.6
44641	24	2.8	2.3	2.9	1.5	3.8	0.2	9.2	1.9	64.4
44643	30	6.0	6.7	12.4	3.8	11.2	1.1	95.7	20.9	168.5

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44644	5	24.0	25.5	29.0	13.8	31.4	11.1	54.5	16.4	56.4
44645	4	3.7	4.5	8.3	1.5	5.3	1.5	24.2	10.7	129.9
44646	69	2.8	2.7	4.7	1.5	4.8	0.0	29.3	5.8	124.0
44648	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44651	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0
44654	6	8.6	5.4	7.3	2.0	9.4	0.9	12.6	4.4	60.8
44656	3	3.8	3.8	4.1	2.3	4.4	2.3	6.1	1.9	47.1
44657	12	5.3	5.9	7.6	3.5	7.1	1.8	21.9	6.1	80.1
44662	32	9.4	7.3	12.3	2.2	18.9	1.4	37.0	10.9	88.9
44663	21	7.4	5.8	9.1	2.2	11.0	0.6	30.5	8.4	91.5
44666	3	5.8	4.0	4.6	1.9	5.9	1.9	6.0	2.3	50.6
44667	9	5.7	5.7	7.2	4.2	6.1	1.6	22.8	6.1	85.0
44669	1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.0	0.0
44672	5	0.9	1.0	1.1	0.6	1.3	0.5	1.8	0.5	47.8
44676	2	2.6	2.4	2.6	1.6	2.6	1.6	3.6	1.4	54.4
44677	9	14.1	15.2	46.1	3.5	42.6	2.2	259.0	81.9	177.5
44680	2	18.4	17.3	18.4	12.2	18.4	12.2	24.5	8.7	47.4
44681	1	15.9	15.9	15.9	15.9	15.9	15.9	15.9	0.0	0.0
44682	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44683	5	3.5	2.6	8.4	0.4	4.6	0.2	32.2	13.4	160.5
44685	53	4.6	5.1	9.1	2.1	10.2	0.6	61.1	12.3	135.1
44686	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
44688	12	3.3	3.5	4.3	2.2	4.1	1.3	11.8	3.1	73.8
44691	50	3.8	4.5	9.3	1.7	10.3	0.6	48.7	12.6	134.5
44695	1	33.0	33.0	33.0	33.0	33.0	33.0	33.0	0.0	0.0
44699	3	4.9	3.2	5.2	0.7	6.2	0.7	9.9	4.6	89.1
44701	1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	0.0	0.0
44702	2	3.1	2.7	3.1	1.7	3.1	1.7	4.4	1.9	62.6
44703	9	3.1	3.0	3.4	1.9	3.8	1.5	7.5	1.8	53.9
44704	2	4.5	3.7	4.5	2.0	4.5	2.0	7.0	3.5	78.6
44705	30	3.8	3.1	5.1	2.4	5.1	0.0	25.1	5.4	105.7
44706	22	4.0	3.4	5.3	1.7	6.0	0.0	23.3	5.4	101.7
44707	10	8.8	8.7	13.1	5.9	17.2	0.6	33.8	10.7	81.6
44708	54	4.0	3.6	5.3	1.9	7.4	0.0	25.0	4.5	85.5
44709	57	5.1	4.3	6.0	1.9	8.8	0.5	27.1	5.0	82.1
44710	11	6.7	4.4	6.2	2.1	9.1	0.8	13.4	4.3	70.3
44711	1	6.4	6.4	6.4	6.4	6.4	6.4	6.4	0.0	0.0
44714	30	3.4	3.1	4.4	2.0	5.5	0.0	12.4	3.2	74.3
44718	35	5.6	5.8	7.7	3.3	8.8	1.1	21.0	5.9	76.9
44720	119	3.8	3.7	5.7	2.2	7.4	0.0	35.3	5.6	96.9
44721	38	3.7	3.4	4.4	2.3	5.7	0.6	16.4	3.3	75.2
44728	1	5.5	5.5	5.5	5.5	5.5	5.5	5.5	0.0	0.0
44730	5	3.1	4.4	7.1	2.0	4.4	1.6	23.0	8.9	125.7
44742	1	6.4	6.4	6.4	6.4	6.4	6.4	6.4	0.0	0.0
44751	1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	0.0	0.0
44802	3	8.2	9.6	10.6	6.1	10.6	6.1	17.6	6.1	57.6
44804	2	2.3	2.0	2.3	1.2	2.3	1.2	3.4	1.6	67.6
44805	59	4.1	4.1	7.0	2.3	6.9	0.6	67.3	10.5	149.6
44806	1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.0	0.0
44807	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
44811	53	7.1	7.0	14.3	3.6	17.9	0.0	99.3	18.3	127.7

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44813	22	8.3	10.7	31.0	5.0	13.7	1.5	274.0	63.4	204.7
44814	10	4.7	4.0	7.0	1.9	9.5	0.3	21.7	6.7	96.9
44815	3	4.4	5.9	7.4	3.3	6.9	3.3	14.5	6.2	83.4
44816	5	3.2	3.8	4.5	2.6	3.3	2.5	11.0	3.6	79.9
44817	1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.0	0.0
44818	4	1.0	0.7	1.0	0.0	1.2	0.0	2.1	0.9	85.2
44820	25	4.3	4.5	13.7	1.6	9.9	0.0	163.0	32.1	233.9
44822	4	5.7	5.0	6.7	1.5	7.2	1.5	13.7	5.2	78.9
44824	18	8.3	7.2	12.3	3.2	12.3	0.7	80.3	17.8	145.1
44826	3	5.5	6.0	7.0	3.2	7.2	3.2	12.2	4.7	67.1
44827	10	6.1	4.7	6.6	2.1	8.7	0.7	14.6	4.8	72.0
44828	1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0
44830	34	3.3	2.3	4.7	1.3	6.1	0.0	25.5	5.3	110.9
44833	44	6.9	6.4	11.4	3.4	12.0	0.3	77.1	14.3	126.0
44834	1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0
44835	1	13.3	13.3	13.3	13.3	13.3	13.3	13.3	0.0	0.0
44836	2	3.2	2.3	3.2	1.0	3.2	1.0	5.4	3.1	97.2
44837	2	7.7	5.3	7.7	2.1	7.7	2.1	13.2	7.8	102.6
44838	1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0
44839	37	4.2	4.1	6.4	2.1	9.4	0.0	24.7	5.7	89.3
44840	1	42.7	42.7	42.7	42.7	42.7	42.7	42.7	0.0	0.0
44842	2	2.7	2.5	2.7	1.7	2.7	1.7	3.7	1.4	52.4
44843	8	10.1	9.3	48.1	1.3	23.6	0.0	179.0	73.8	153.5
44844	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0
44846	18	6.9	5.3	10.5	2.5	9.5	0.0	81.6	18.1	173.0
44847	55	7.1	7.7	13.2	3.7	16.2	0.8	74.4	16.0	120.9
44848	2	8.9	8.6	8.9	6.8	8.9	6.8	10.9	2.9	32.8
44849	2	11.7	8.0	11.7	3.2	11.7	3.2	20.2	12.0	102.7
44851	9	7.4	5.6	6.6	2.9	8.9	2.5	12.3	3.7	56.6
44853	5	1.7	2.4	4.0	0.8	4.3	0.6	10.9	4.2	106.7
44854	2	1.3	0.7	1.3	0.2	1.3	0.2	2.3	1.5	118.8
44855	2	6.0	5.5	6.0	3.7	6.0	3.7	8.2	3.2	53.5
44857	69	3.7	3.4	6.2	2.0	6.3	0.0	48.0	7.9	127.5
44859	2	5.3	4.3	5.3	2.3	5.3	2.3	8.2	4.2	79.5
44860	1	7.3	7.3	7.3	7.3	7.3	7.3	7.3	0.0	0.0
44861	1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0
44864	13	6.0	6.6	13.3	2.8	9.1	1.9	79.6	21.5	161.9
44865	1	5.0	5.0	5.0	5.0	5.0	5.0	5.0	0.0	0.0
44866	2	1.8	1.8	1.8	1.5	1.8	1.5	2.1	0.4	23.6
44867	3	6.0	5.9	5.9	4.8	6.3	4.8	7.0	1.1	18.6
44870	104	2.7	2.4	4.4	1.0	4.9	0.0	37.4	5.8	132.4
44875	28	4.0	3.4	4.7	2.5	5.0	0.0	21.7	4.1	86.2
44878	4	7.4	6.3	8.3	1.9	9.8	1.9	16.6	6.4	76.9
44879	1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0	0.0
44880	3	3.2	2.2	2.7	0.9	3.4	0.9	3.9	1.6	58.9
44882	5	3.8	4.5	5.1	2.5	6.7	2.3	8.7	2.9	56.1
44883	100	6.8	4.7	7.8	2.8	9.8	0.0	59.8	8.0	102.9
44887	2	2.4	2.3	2.4	1.8	2.4	1.8	2.9	0.8	33.1
44889	5	4.4	5.8	7.0	3.2	8.8	3.1	13.7	4.7	68.2
44890	14	2.2	2.2	2.6	1.4	3.4	0.9	5.6	1.4	55.7
44901	24	1.4	1.3	3.4	0.6	2.1	0.0	41.4	8.2	245.8

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
44902	3	1.5	1.8	1.9	1.5	1.8	1.5	2.7	0.7	36.5
44903	81	4.1	4.5	9.0	2.5	8.2	0.0	150.4	18.1	200.6
44904	232	5.7	5.8	9.8	3.1	11.7	0.0	89.4	11.4	115.5
44905	21	5.7	3.4	5.7	1.4	8.4	0.0	16.6	4.6	81.1
44906	118	4.4	4.0	6.1	2.2	7.8	0.0	44.0	6.0	99.4
44907	90	3.4	3.5	6.3	2.0	6.8	0.0	64.9	10.0	157.7
44908	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
44911	1	8.6	8.6	8.6	8.6	8.6	8.6	8.6	0.0	0.0
44927	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
44939	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
44941	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
44945	1	9.0	9.0	9.0	9.0	9.0	9.0	9.0	0.0	0.0
44989	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0
45000	13	4.7	3.6	5.5	1.5	9.4	0.5	12.1	4.0	73.7
45001	4	3.1	3.0	3.0	2.3	3.5	2.3	3.6	0.6	20.8
45002	22	1.6	2.1	4.4	1.0	5.4	0.0	28.0	6.3	144.0
45003	6	9.3	7.3	8.3	3.5	10.4	3.1	14.0	4.2	50.5
45005	315	4.1	3.9	7.2	2.0	8.8	0.0	66.1	8.8	122.1
45011	72	2.4	2.8	5.0	1.2	5.5	0.4	70.3	8.8	176.6
45013	179	2.2	2.3	4.0	1.2	4.5	0.1	43.0	5.6	138.7
45014	188	3.9	3.5	6.0	1.9	8.0	0.0	61.1	7.3	121.4
45015	30	3.1	4.0	5.9	2.2	7.0	0.6	22.5	5.7	95.9
45022	1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
45026	1	5.4	5.4	5.4	5.4	5.4	5.4	5.4	0.0	0.0
45030	26	5.8	4.0	8.7	1.4	11.4	0.0	34.8	9.4	108.0
45033	2	2.5	2.0	2.5	1.0	2.5	1.0	4.0	2.1	84.9
45034	3	1.8	1.5	1.8	0.7	2.1	0.7	2.9	1.1	61.1
45036	174	2.9	2.7	4.2	1.4	5.2	0.1	29.2	4.5	107.0
45037	1	3.4	3.4	3.4	3.4	3.4	3.4	3.4	0.0	0.0
45039	80	3.1	3.1	7.0	1.7	5.0	0.4	219.0	24.9	356.3
45040	111	2.5	2.1	2.9	1.2	3.8	0.0	12.9	2.4	82.1
45041	1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0	0.0
45042	260	4.4	4.0	6.2	2.1	8.6	0.0	33.0	5.8	93.4
45044	205	3.5	3.3	5.2	1.8	6.6	0.0	50.2	5.5	105.0
45045	1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	0.0	0.0
45046	1	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.0	0.0
45049	1	3.4	3.4	3.4	3.4	3.4	3.4	3.4	0.0	0.0
45050	26	2.6	2.4	3.5	1.3	5.5	0.0	8.8	2.6	73.6
45052	8	2.4	1.9	2.8	0.8	2.9	0.4	9.4	2.9	102.2
45053	6	0.9	1.0	2.6	0.3	1.6	0.1	11.0	4.2	161.7
45054	7	2.3	2.0	3.7	0.9	6.0	0.0	8.6	3.3	87.8
45056	70	2.4	2.0	4.6	1.1	4.4	0.0	43.0	7.0	153.5
45059	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
45061	5	4.6	5.4	7.1	3.0	4.8	2.7	19.4	6.9	97.5
45062	6	7.0	6.4	7.8	2.9	11.2	2.6	13.8	5.0	63.9
45063	3	3.3	3.8	4.0	2.9	3.9	2.9	5.7	1.5	38.2
45064	8	3.5	3.5	10.0	0.6	8.8	0.5	30.9	13.2	133.1
45065	4	4.9	4.8	6.7	2.1	7.5	2.1	14.8	6.0	89.4
45066	136	3.5	3.1	4.7	1.8	5.4	0.0	37.6	5.4	113.9
45067	41	6.1	4.8	7.8	2.7	10.6	0.0	20.8	5.8	75.4
45068	108	3.6	3.3	5.0	1.9	6.5	0.4	31.3	5.2	104.9

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45069	248	2.9	2.6	3.9	1.3	4.9	0.0	20.4	3.7	97.0
45070	2	2.0	1.9	2.0	1.7	2.0	1.7	2.2	0.4	18.1
45072	1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.0	0.0
45081	2	3.7	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0
45085	1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	0.0	0.0
45101	2	4.9	4.4	4.9	2.8	4.9	2.8	6.9	2.9	59.8
45102	32	3.0	3.0	4.3	1.5	5.8	0.5	10.7	3.3	77.9
45103	35	2.6	2.6	3.8	1.6	5.0	0.2	15.2	3.4	89.9
45105	3	1.4	1.5	1.5	1.3	1.5	1.3	1.9	0.3	21.0
45106	16	2.8	2.3	3.5	0.7	4.3	0.3	12.8	3.3	92.9
45107	36	2.7	2.1	3.2	1.1	5.2	0.0	9.3	2.5	78.8
45111	2	3.3	3.2	3.3	2.6	3.3	2.6	3.9	0.9	28.3
45113	19	2.5	3.4	8.1	1.1	6.6	0.6	54.2	13.1	161.2
45118	2	0.2	0.2	0.2	0.0	0.2	0.0	0.3	0.2	141.4
45120	2	3.2	1.7	3.2	0.5	3.2	0.5	5.9	3.8	119.3
45121	4	1.5	1.2	1.4	0.5	1.8	0.5	2.1	0.7	52.2
45122	11	2.2	2.0	2.9	1.1	2.9	0.5	11.8	3.2	108.7
45123	9	8.1	7.2	9.4	4.2	8.5	2.7	31.0	8.6	92.2
45129	1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0.0	0.0
45130	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
45132	3	3.2	4.6	5.2	3.2	4.7	3.2	9.2	3.5	66.6
45133	41	2.0	2.1	3.2	1.3	4.0	0.0	13.0	3.0	94.1
45135	5	3.1	3.1	5.4	0.9	5.8	0.8	15.4	6.0	111.0
45138	3	26.5	24.8	27.4	13.7	30.4	13.7	42.1	14.2	51.8
45139	2	3.4	0.8	3.4	0.0	3.4	0.0	6.7	4.7	141.4
45140	193	3.3	3.3	7.6	1.6	6.4	0.0	470.8	34.1	451.1
45142	9	4.2	2.5	3.6	0.9	5.5	0.5	7.2	2.6	72.1
45144	5	3.5	3.0	4.5	1.1	3.7	0.6	12.0	4.4	97.1
45146	3	2.5	2.7	14.3	0.2	12.0	0.2	40.3	22.5	157.1
45148	4	2.4	2.4	3.2	0.8	2.4	0.8	7.1	2.7	85.8
45150	71	2.7	2.7	3.8	1.8	5.0	0.0	15.2	3.2	85.1
45152	40	2.6	2.4	4.0	1.5	4.3	0.0	16.8	3.8	95.6
45153	3	0.9	1.0	1.2	0.6	1.2	0.6	2.0	0.7	63.2
45154	7	1.9	2.4	4.3	1.3	2.5	0.5	18.3	6.3	146.4
45155	1	6.5	6.5	6.5	6.5	6.5	6.5	6.5	0.0	0.0
45157	27	1.8	1.8	3.3	0.9	3.7	0.1	22.7	4.7	141.6
45159	20	4.8	4.2	8.0	1.9	8.6	0.0	30.9	8.6	108.1
45160	3	1.2	1.2	1.2	1.0	1.3	1.0	1.4	0.2	16.7
45162	4	2.4	1.3	2.8	0.2	4.2	0.2	6.4	3.0	106.1
45165	1	14.3	14.3	14.3	14.3	14.3	14.3	14.3	0.0	0.0
45166	1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0
45167	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
45168	2	2.2	2.1	2.2	1.8	2.2	1.8	2.5	0.5	23.0
45169	17	2.8	3.0	4.2	1.9	5.0	0.4	12.0	3.6	85.0
45170	1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	0.0	0.0
45171	2	3.3	3.0	3.3	2.0	3.3	2.0	4.5	1.8	54.4
45172	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
45174	27	5.3	5.8	7.6	3.7	8.6	1.0	34.2	6.7	88.3
45176	3	1.5	1.6	2.4	0.5	2.5	0.5	5.3	2.5	104.1
45177	205	3.2	3.0	5.0	1.8	5.9	0.0	55.6	7.3	144.6
45201	1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45202	13	2.5	2.1	3.1	0.9	3.2	0.5	9.7	3.0	96.1
45203	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45204	7	1.1	1.1	2.2	0.4	2.2	0.0	8.6	2.9	130.4
45205	32	1.3	1.6	2.2	0.9	2.8	0.4	7.5	1.7	80.3
45206	24	2.0	1.6	3.4	0.6	4.6	0.0	12.4	3.7	108.0
45207	4	0.8	0.8	0.8	0.5	0.9	0.5	1.3	0.3	40.2
45208	111	2.2	2.1	3.5	1.1	3.8	0.0	35.4	4.4	127.0
45209	23	2.3	2.0	2.4	1.1	3.1	0.5	6.6	1.5	62.9
45210	4	2.7	1.3	2.5	0.0	3.1	0.0	4.7	2.0	78.5
45211	108	1.4	1.5	2.6	0.9	2.6	0.0	19.6	3.2	126.3
45212	41	1.3	1.3	1.9	0.7	2.2	0.1	9.2	1.7	93.0
45213	42	3.1	3.0	4.8	1.8	5.4	0.6	49.5	7.6	157.3
45214	12	2.3	1.7	2.7	0.5	4.2	0.0	6.5	2.2	81.0
45215	148	2.1	2.1	3.1	1.2	4.4	0.0	13.2	2.7	85.8
45216	26	3.2	2.4	3.8	1.0	4.6	0.0	14.7	3.7	96.7
45217	15	1.6	1.5	2.0	0.7	2.8	0.5	5.1	1.5	75.8
45218	16	1.2	1.0	1.5	0.5	2.0	0.1	3.8	1.2	81.1
45219	19	3.0	2.3	4.1	0.8	5.2	0.0	18.7	4.4	108.0
45220	30	2.1	2.0	2.9	0.9	3.2	0.5	9.7	2.8	96.3
45223	28	2.0	1.5	2.5	0.7	3.4	0.0	8.8	2.4	95.6
45224	88	2.1	1.8	2.6	1.0	3.2	0.0	12.0	2.3	88.3
45225	6	1.2	1.3	2.0	0.5	2.1	0.5	5.9	2.1	105.6
45226	18	1.7	1.8	2.2	1.1	3.2	0.7	5.1	1.4	63.2
45227	49	2.7	2.8	4.4	1.8	4.2	0.5	52.5	7.5	171.5
45228	2	5.3	4.2	5.3	2.1	5.3	2.1	8.4	4.5	84.9
45229	17	1.7	1.8	3.1	0.7	3.4	0.5	19.2	4.4	143.8
45230	148	2.0	2.0	3.0	1.1	3.4	0.0	27.0	3.5	117.0
45231	320	1.8	1.7	2.8	0.9	3.2	0.0	40.0	3.5	128.0
45232	7	1.8	2.3	3.4	0.9	4.9	0.5	8.7	3.0	86.3
45233	41	2.3	2.4	3.9	1.1	4.3	0.6	26.7	4.8	122.3
45234	2	2.1	2.1	2.1	1.8	2.1	1.8	2.4	0.4	20.2
45235	2	2.9	0.8	2.9	0.0	2.9	0.0	5.7	4.0	141.4
45236	135	1.8	1.7	2.4	1.0	3.3	0.1	11.4	2.1	86.4
45237	55	2.3	1.9	2.8	1.0	3.8	0.0	11.0	2.3	83.1
45238	124	1.3	1.3	2.2	0.6	2.7	0.0	38.2	3.8	169.2
45239	93	1.3	1.4	2.0	0.8	2.6	0.0	8.3	1.8	91.2
45240	87	1.5	1.4	1.9	0.8	2.3	0.0	8.7	1.6	83.6
45241	168	2.4	2.2	3.5	1.0	4.6	0.0	26.8	3.6	102.1
45242	191	2.4	2.1	3.1	1.2	4.1	0.0	25.7	3.2	104.0
45243	108	2.4	2.2	3.1	1.2	3.7	0.0	26.5	3.5	112.3
45244	90	2.9	2.7	4.1	1.5	5.2	0.0	17.8	3.7	90.1
45245	37	3.0	2.3	3.0	1.3	3.9	0.5	8.0	2.0	67.0
45246	65	2.6	2.2	3.5	1.0	4.1	0.0	23.5	4.1	114.9
45247	76	1.4	1.5	2.3	0.9	2.5	0.0	10.8	2.3	101.9
45248	66	1.4	1.7	2.9	0.9	2.6	0.4	27.0	4.5	153.8
45249	84	2.9	2.9	4.0	1.7	4.9	0.0	27.2	3.8	96.7
45251	48	1.8	2.1	4.2	1.0	3.7	0.5	45.5	7.7	183.5
45252	11	1.1	1.1	1.4	1.0	1.7	0.0	2.9	0.9	61.6
45255	93	2.0	1.9	2.9	1.0	3.8	0.0	15.6	2.6	90.7
45264	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0
45265	1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45274	1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	0.0	0.0
45280	1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	0.0	0.0
45291	1	4.2	4.2	4.2	4.2	4.2	4.2	4.2	0.0	0.0
45300	1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0
45301	5	17.8	15.3	15.8	10.7	17.9	8.8	17.9	3.9	25.0
45302	7	5.4	5.2	8.0	2.3	6.3	1.7	29.2	9.6	119.7
45303	4	7.8	9.8	35.6	2.0	12.6	2.0	125.0	59.8	167.8
45304	48	6.2	5.7	9.6	2.7	13.0	0.0	49.0	9.8	101.4
45305	207	4.5	4.6	7.2	2.7	8.7	0.0	79.5	9.2	128.5
45306	8	2.9	3.2	5.5	0.9	8.3	0.8	18.3	6.0	109.8
45307	6	3.3	3.6	4.0	2.5	3.4	2.5	8.8	2.4	60.6
45308	28	5.5	6.3	11.8	2.7	11.4	1.2	71.0	17.0	144.3
45309	267	4.0	3.6	11.6	1.8	8.0	0.0	1267.8	77.7	668.8
45310	1	3.4	3.4	3.4	3.4	3.4	3.4	3.4	0.0	0.0
45311	25	3.7	3.0	5.6	1.4	7.1	0.4	41.5	8.2	144.9
45312	26	5.9	6.3	10.6	3.9	12.2	0.0	59.2	12.3	116.7
45314	65	3.5	3.1	7.5	1.6	7.6	0.0	97.7	16.6	221.6
45315	73	3.9	3.9	6.7	2.2	7.2	0.0	67.3	8.9	133.3
45316	2	5.6	4.1	5.6	1.8	5.6	1.8	9.3	5.3	95.6
45317	10	8.6	7.0	8.7	3.3	11.8	2.1	17.6	5.5	63.2
45318	45	6.2	5.4	12.9	2.5	8.5	0.0	252.0	37.3	289.0
45319	5	3.3	5.9	8.8	3.3	6.5	3.3	26.6	10.1	114.7
45320	94	4.5	4.1	8.2	1.6	9.5	0.1	54.5	9.9	120.2
45321	9	3.5	4.4	6.3	2.9	5.2	1.2	23.3	6.8	107.9
45322	389	3.8	3.5	6.1	1.8	8.1	0.0	59.4	7.0	114.8
45323	152	6.6	6.2	10.5	3.1	12.4	0.0	67.1	11.7	112.0
45324	466	4.0	3.8	7.2	1.8	8.9	0.0	163.0	10.5	147.1
45325	44	5.6	5.4	7.8	2.7	9.0	0.5	27.7	7.0	89.5
45326	17	6.0	3.9	7.2	3.5	10.0	0.0	20.1	6.1	84.2
45327	135	4.9	4.8	8.6	2.4	9.2	0.3	86.1	12.3	143.2
45328	2	1.8	1.5	1.8	0.8	1.8	0.8	2.7	1.3	76.8
45329	2	3.0	2.6	3.0	1.5	3.0	1.5	4.5	2.1	70.7
45330	2	1.8	1.6	1.8	1.0	1.8	1.0	2.6	1.1	62.9
45331	99	6.4	4.4	10.1	2.3	11.0	0.0	81.7	13.7	135.9
45332	2	8.8	8.8	8.8	8.6	8.8	8.6	9.0	0.3	3.2
45333	10	4.5	5.6	9.2	2.9	8.8	1.3	36.0	10.9	118.6
45334	7	1.5	1.7	2.9	0.7	1.8	0.7	11.6	3.9	136.3
45335	65	3.4	2.6	4.6	1.6	5.6	0.0	21.2	4.5	97.4
45336	2	2.2	1.5	2.2	0.6	2.2	0.6	3.8	2.3	102.9
45337	22	6.4	5.9	7.7	2.9	12.2	1.7	18.1	5.5	71.1
45338	63	6.5	6.0	10.4	3.3	12.2	0.0	57.0	11.2	107.7
45339	26	5.5	5.5	8.9	3.6	8.4	0.5	38.7	9.9	111.3
45340	8	2.1	3.1	5.4	1.5	9.3	0.5	13.1	5.5	101.5
45341	73	23.0	17.5	42.3	10.5	31.5	0.0	750.0	120.6	285.2
45342	511	2.6	2.5	4.3	1.4	5.6	0.0	41.1	5.0	116.8
45344	191	7.0	6.5	11.9	3.0	13.7	0.0	150.0	16.8	141.2
45345	98	4.7	4.0	6.2	1.9	7.1	0.0	40.1	6.5	104.9
45346	17	4.5	5.0	11.7	1.7	10.8	0.4	62.3	16.9	144.9
45347	28	8.8	5.9	9.8	2.3	10.1	0.6	44.4	9.9	100.9
45348	1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0
45349	4	4.9	4.6	4.7	3.2	5.1	3.2	5.8	1.1	23.5

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45350	2	1.5	1.3	1.5	0.8	1.5	0.8	2.2	1.0	66.0
45351	1	38.2	38.2	38.2	38.2	38.2	38.2	38.2	0.0	0.0
45352	1	10.8	10.8	10.8	10.8	10.8	10.8	10.8	0.0	0.0
45354	19	1.4	0.9	3.2	0.0	3.0	0.0	18.3	5.0	153.6
45356	267	5.9	5.7	9.0	3.5	10.4	0.0	92.8	10.8	119.7
45358	1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
45359	27	6.2	8.8	18.6	4.5	16.4	0.8	105.0	29.4	158.0
45361	2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	0.0	0.0
45362	2	3.5	3.3	3.5	2.3	3.5	2.3	4.6	1.6	47.1
45363	10	4.2	3.7	4.8	1.9	7.0	1.2	9.3	3.3	68.5
45365	144	5.7	4.4	7.3	2.3	9.0	0.0	48.2	7.3	100.8
45368	19	5.3	4.8	5.9	2.1	7.7	1.1	13.3	3.5	58.8
45369	18	4.0	3.7	5.4	1.7	6.1	0.7	20.6	5.0	93.8
45370	202	4.7	4.6	7.5	2.8	8.9	0.0	89.0	9.3	123.9
45371	377	4.3	4.4	8.1	2.5	8.1	0.0	204.0	14.3	178.0
45372	4	18.5	17.8	20.6	7.9	19.0	7.9	37.5	12.3	60.0
45373	814	5.9	5.7	9.0	2.9	10.8	0.0	223.0	12.0	133.0
45374	1	9.2	9.2	9.2	9.2	9.2	9.2	9.2	0.0	0.0
45375	2	9.4	9.4	9.4	9.4	9.4	9.4	9.4	0.0	0.0
45376	2	14.0	14.0	14.0	14.0	14.0	14.0	14.0	0.0	0.0
45377	333	3.4	2.9	4.6	1.4	6.5	0.0	40.8	4.3	93.6
45378	5	9.6	6.6	8.3	2.8	9.6	1.4	13.8	4.6	55.0
45380	58	6.2	4.8	8.6	2.2	10.9	0.0	41.6	9.7	112.5
45381	35	5.2	4.4	9.4	3.0	10.5	0.0	90.3	15.1	161.2
45382	5	3.0	2.5	5.6	0.8	6.0	0.0	15.0	5.8	103.8
45383	112	5.2	5.1	9.0	2.7	10.4	0.0	62.9	11.1	123.1
45384	21	2.4	2.3	4.7	0.9	3.9	0.6	26.9	7.6	161.5
45385	981	5.4	4.9	8.3	2.7	9.5	0.0	142.0	11.1	134.1
45387	150	4.6	4.3	7.3	2.4	10.1	0.0	111.9	10.7	146.3
45388	4	7.2	6.1	8.1	1.7	8.7	1.7	16.2	6.1	76.3
45389	5	10.6	8.6	11.4	3.7	13.9	1.4	19.4	6.7	58.6
45390	7	6.1	5.1	6.9	2.1	8.7	1.3	14.3	5.2	74.7
45401	18	1.0	1.0	2.4	0.4	2.3	0.0	15.6	3.7	154.9
45402	56	4.1	2.8	5.0	1.4	6.9	0.0	27.7	5.2	103.4
45403	167	4.0	3.7	5.8	2.0	7.2	0.0	65.0	7.1	121.6
45404	88	7.0	7.0	9.4	4.7	9.5	0.2	48.2	8.2	87.0
45405	380	4.2	3.7	6.0	1.9	7.9	0.0	49.6	6.1	100.9
45406	287	2.7	2.5	3.9	1.3	5.3	0.0	32.9	4.0	102.1
45407	35	4.9	5.0	8.8	2.4	8.4	0.8	71.0	12.7	144.1
45408	42	5.5	5.3	12.8	1.8	12.5	0.5	191.0	29.5	230.9
45409	244	5.2	4.5	7.0	2.4	9.2	0.0	39.9	6.5	93.0
45410	268	2.6	2.6	3.7	1.5	4.8	0.0	22.3	3.2	86.9
45413	4	5.7	5.6	6.4	2.7	5.7	2.7	11.4	3.6	57.0
45414	494	4.5	4.0	7.1	1.9	8.4	0.0	75.6	8.7	123.7
45415	467	4.6	4.4	8.2	2.5	8.7	0.0	416.3	21.0	255.1
45416	133	2.6	2.9	5.8	1.3	6.2	0.0	61.2	9.3	159.7
45417	46	3.2	2.5	3.6	2.0	5.1	0.0	10.5	2.5	69.1
45418	51	3.3	3.2	4.9	1.9	5.6	0.0	21.5	5.1	103.1
45419	722	3.6	3.6	6.4	1.9	7.4	0.0	220.0	13.3	209.6
45420	764	3.3	3.0	4.8	1.8	5.9	0.0	76.5	6.1	125.8
45421	2	1.9	1.8	1.9	1.5	1.9	1.5	2.2	0.5	26.8

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45422	1	10.9	10.9	10.9	10.9	10.9	10.9	10.9	0.0	0.0
45423	3	0.6	0.9	1.8	0.3	1.6	0.3	4.5	2.3	130.2
45424	583	3.0	3.1	5.3	1.6	6.6	0.0	46.9	6.5	121.8
45426	322	2.9	2.9	5.7	1.5	5.9	0.0	161.0	14.3	249.1
45427	62	3.1	2.7	4.0	1.8	5.0	0.1	18.6	3.5	86.8
45428	18	1.5	1.1	1.8	0.6	2.8	0.0	4.2	1.3	76.5
45429	1229	3.4	3.2	5.6	1.8	6.2	0.0	440.7	14.5	257.8
45430	204	4.3	3.8	6.5	1.8	8.6	0.0	70.5	7.7	118.5
45431	393	4.6	4.4	6.7	2.4	8.4	0.0	117.0	8.5	126.7
45432	383	4.9	4.2	6.6	2.2	8.8	0.0	117.0	7.7	117.1
45433	11	2.6	2.2	7.3	0.6	4.1	0.0	49.0	14.2	193.9
45434	1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0
45435	4	7.1	5.8	7.3	2.2	10.5	2.2	12.9	5.2	70.7
45437	2	7.5	6.0	7.5	3.1	7.5	3.1	11.8	6.2	82.6
45439	111	5.7	5.6	9.7	3.1	12.1	0.0	56.1	9.4	97.6
45440	723	3.1	2.9	5.0	1.8	5.6	0.0	359.0	14.3	282.9
45441	2	12.8	12.7	12.8	12.0	12.8	12.0	13.5	1.1	8.3
45446	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
45448	13	1.1	1.2	1.8	0.7	1.2	0.5	6.1	2.0	108.7
45449	260	2.9	2.7	5.6	1.3	7.0	0.0	51.6	7.4	132.0
45450	2	5.9	5.6	5.9	3.9	5.9	3.9	7.9	2.8	47.9
45451	1	11.9	11.9	11.9	11.9	11.9	11.9	11.9	0.0	0.0
45453	1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	0.0	0.0
45454	2	2.8	2.7	2.8	2.1	2.8	2.1	3.4	0.9	33.4
45456	2	10.4	9.2	10.4	5.7	10.4	5.7	15.0	6.6	63.5
45458	80	2.3	2.4	4.3	1.4	5.1	0.0	35.5	5.6	130.2
45459	1057	3.2	3.1	5.9	1.5	6.8	0.0	153.0	9.6	163.8
45469	4	2.4	2.0	2.2	0.9	2.5	0.9	3.0	0.9	41.4
45482	1	20.4	20.4	20.4	20.4	20.4	20.4	20.4	0.0	0.0
45490	2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
45500	1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0
45501	17	4.5	3.4	5.3	1.7	8.5	0.0	11.5	3.9	72.9
45502	185	6.1	5.2	9.2	3.0	11.5	0.0	57.3	10.0	109.2
45503	290	5.6	5.0	7.6	3.0	9.7	0.0	106.0	8.5	112.8
45504	208	3.6	3.4	5.5	2.1	6.3	0.0	73.0	7.2	131.2
45505	133	5.5	5.2	7.5	3.4	9.4	0.0	61.3	7.6	101.8
45506	90	4.8	5.0	7.6	2.8	10.0	0.3	47.1	8.1	106.7
45509	1	15.8	15.8	15.8	15.8	15.8	15.8	15.8	0.0	0.0
45515	1	15.9	15.9	15.9	15.9	15.9	15.9	15.9	0.0	0.0
45522	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
45529	1	11.6	11.6	11.6	11.6	11.6	11.6	11.6	0.0	0.0
45536	1	9.7	9.7	9.7	9.7	9.7	9.7	9.7	0.0	0.0
45540	1	3.4	3.4	3.4	3.4	3.4	3.4	3.4	0.0	0.0
45558	2	3.4	1.6	3.4	0.4	3.4	0.4	6.4	4.2	124.8
45571	1	4.4	4.4	4.4	4.4	4.4	4.4	4.4	0.0	0.0
45592	1	12.0	12.0	12.0	12.0	12.0	12.0	12.0	0.0	0.0
45601	380	7.5	6.4	11.7	3.3	13.6	0.0	123.0	14.0	118.9
45611	1	4.5	4.5	4.5	4.5	4.5	4.5	4.5	0.0	0.0
45612	12	9.9	5.7	10.5	1.2	13.4	0.7	28.4	9.7	92.6
45613	2	0.7	0.3	0.7	0.1	0.7	0.1	1.2	0.8	119.7
45614	5	3.6	3.0	4.6	0.9	5.9	0.6	10.6	4.1	88.2

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45619	4	1.8	1.9	1.9	1.5	1.9	1.5	2.5	0.4	22.7
45620	2	3.6	3.6	3.6	3.1	3.6	3.1	4.1	0.7	19.6
45621	2	5.5	2.0	5.5	0.4	5.5	0.4	10.5	7.1	131.0
45623	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
45628	12	5.0	3.3	5.8	1.9	6.7	0.1	18.0	5.1	88.5
45629	2	0.6	0.6	0.6	0.4	0.6	0.4	0.8	0.3	47.1
45631	53	2.7	2.2	3.0	1.1	3.6	0.2	9.2	2.3	75.8
45633	1	15.9	15.9	15.9	15.9	15.9	15.9	15.9	0.0	0.0
45634	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0
45636	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
45638	22	2.2	2.2	3.6	1.3	3.3	0.3	16.3	4.0	112.6
45640	30	2.3	2.1	3.4	1.1	4.0	0.2	20.3	3.9	113.0
45644	12	2.8	3.6	6.0	1.9	7.6	0.6	27.7	7.4	123.7
45645	2	1.3	1.2	1.3	0.7	1.3	0.7	1.9	0.8	65.3
45646	3	17.2	10.3	14.2	2.8	18.5	2.8	22.6	10.2	72.1
45647	2	6.6	5.1	6.6	2.4	6.6	2.4	10.8	5.9	90.0
45648	10	2.4	3.5	7.7	1.2	9.9	0.8	29.5	10.0	130.0
45651	4	3.4	3.4	3.4	3.0	3.5	3.0	3.9	0.4	11.5
45652	3	1.3	1.7	2.3	0.8	2.2	0.8	4.7	2.1	93.6
45653	3	1.1	1.2	1.2	1.1	1.2	1.1	1.3	0.1	9.9
45655	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
45656	8	4.4	3.8	5.4	1.6	6.4	1.2	12.4	4.4	81.7
45658	3	3.7	2.5	3.8	0.6	4.5	0.6	7.0	3.2	85.0
45660	10	2.8	3.3	4.3	1.9	4.2	1.4	14.7	4.0	93.8
45661	14	8.6	6.3	11.8	2.2	13.9	0.7	43.3	12.3	104.7
45662	41	2.6	2.9	3.6	1.8	4.0	1.0	16.1	3.0	82.6
45669	12	2.2	2.0	2.8	0.9	3.7	0.4	7.1	2.2	80.4
45670	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
45672	3	1.9	3.7	5.8	1.9	4.8	1.9	13.5	6.7	116.1
45674	2	1.8	1.7	1.8	1.2	1.8	1.2	2.3	0.8	44.4
45679	6	3.0	2.6	3.2	1.4	3.7	0.7	6.7	2.0	63.3
45680	9	2.1	2.1	2.8	0.9	3.1	0.7	6.8	2.2	78.8
45681	1	52.9	52.9	52.9	52.9	52.9	52.9	52.9	0.0	0.0
45686	4	1.3	1.1	1.3	0.5	1.5	0.5	2.0	0.6	49.8
45690	43	7.4	5.4	8.6	2.6	13.4	0.2	23.8	6.6	76.1
45692	14	1.2	1.5	3.5	0.8	1.5	0.3	21.3	6.1	175.5
45693	7	0.7	0.8	1.6	0.2	2.2	0.1	4.8	1.7	110.0
45694	7	1.2	1.6	2.4	0.8	1.8	0.8	8.3	2.7	114.2
45697	10	1.7	1.2	1.6	0.6	2.2	0.0	3.7	1.1	68.3
45700	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45701	420	5.0	4.3	5.8	2.8	7.5	0.0	82.1	6.1	105.3
45708	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
45710	9	2.0	1.8	2.4	0.7	3.4	0.4	5.2	1.8	75.1
45711	4	1.3	1.3	1.7	0.6	1.3	0.6	3.5	1.3	77.1
45712	2	2.4	1.9	2.4	1.0	2.4	1.0	3.7	1.9	81.2
45714	21	3.1	2.8	3.8	2.0	4.1	0.3	16.7	3.4	90.5
45715	4	5.5	6.5	10.0	2.2	6.0	2.2	27.0	11.4	114.0
45716	2	0.6	0.3	0.6	0.1	0.6	0.1	1.1	0.7	117.9
45717	1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0
45719	1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0
45723	2	1.0	0.7	1.0	0.3	1.0	0.3	1.6	0.9	96.8

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45724	1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
45729	8	2.3	3.5	5.4	1.7	5.0	1.7	21.0	6.6	122.7
45732	14	3.3	2.4	3.7	1.2	6.4	0.1	7.9	2.7	74.8
45735	5	1.8	1.7	1.9	0.9	2.1	0.9	3.8	1.2	60.5
45737	1	5.6	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0
45740	3	4.4	2.7	3.3	1.0	4.4	1.0	4.5	2.0	60.4
45741	1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0.0	0.0
45742	3	2.2	2.4	3.2	1.0	3.3	1.0	6.4	2.8	88.6
45744	5	2.5	2.6	2.7	2.0	3.0	2.0	3.8	0.8	29.2
45745	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
45746	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0
45750	190	3.1	3.2	5.7	1.6	5.4	0.3	91.9	10.6	184.2
45760	4	2.1	1.7	2.2	0.7	3.2	0.7	4.0	1.6	73.1
45761	8	1.1	1.0	3.2	0.0	2.8	0.0	15.5	5.2	162.6
45764	16	3.7	3.9	4.6	2.6	6.3	0.9	9.0	2.6	55.9
45766	4	1.1	1.1	1.1	0.8	1.1	0.8	1.4	0.2	23.3
45767	5	1.0	0.9	1.2	0.4	1.0	0.3	2.9	1.0	87.6
45768	4	3.5	2.8	3.3	1.1	4.8	1.1	5.3	2.0	61.5
45769	11	2.2	1.5	2.0	0.6	2.6	0.3	4.2	1.2	61.6
45770	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
45771	5	1.9	2.1	2.3	1.2	2.9	1.0	3.4	1.0	44.9
45772	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0
45773	5	4.6	3.0	3.5	1.3	4.7	1.1	5.1	1.8	52.8
45775	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
45776	3	3.5	1.6	3.4	0.2	4.2	0.2	6.4	3.1	92.1
45778	6	2.8	2.6	3.8	1.1	4.7	0.7	9.4	3.3	87.7
45779	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
45780	9	4.2	4.4	5.5	2.4	5.6	1.7	16.1	4.4	81.4
45784	4	6.1	5.6	7.1	2.1	8.4	2.1	14.2	5.4	76.0
45785	1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0
45786	7	4.0	4.1	6.7	2.3	7.4	0.4	19.6	6.5	96.7
45788	2	1.9	1.8	1.9	1.6	1.9	1.6	2.1	0.4	19.1
45800	1	17.5	17.5	17.5	17.5	17.5	17.5	17.5	0.0	0.0
45801	18	3.2	3.4	5.5	1.4	6.3	0.4	19.2	5.5	100.0
45802	2	2.8	2.2	2.8	1.1	2.8	1.1	4.5	2.4	85.9
45804	16	3.9	4.1	6.4	1.5	6.5	1.1	24.7	6.6	104.4
45805	61	4.6	4.1	5.7	2.3	7.3	0.0	23.5	4.8	85.0
45806	16	7.2	3.4	8.7	0.8	8.8	0.0	38.1	10.6	122.7
45807	21	3.0	3.1	4.7	1.1	7.1	0.4	17.5	4.3	92.0
45809	2	6.2	4.6	6.2	2.1	6.2	2.1	10.2	5.7	93.1
45810	5	12.1	6.2	11.0	1.3	13.2	0.9	26.2	10.2	92.6
45812	5	3.7	3.9	4.3	2.4	4.2	2.2	8.3	2.4	54.9
45813	12	2.9	2.9	3.5	1.6	4.7	1.0	7.6	2.1	60.4
45814	1	9.6	9.6	9.6	9.6	9.6	9.6	9.6	0.0	0.0
45817	6	4.2	5.1	13.3	1.8	5.4	1.4	62.6	24.2	181.4
45819	1	21.5	21.5	21.5	21.5	21.5	21.5	21.5	0.0	0.0
45821	1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0
45822	100	4.7	4.3	6.6	2.3	9.1	0.2	31.6	6.5	98.4
45828	26	4.1	3.8	5.3	1.9	6.5	0.7	17.6	4.7	88.8
45830	3	3.6	3.3	4.0	1.5	4.4	1.5	6.8	2.7	67.3
45831	3	5.8	6.2	7.1	3.4	7.4	3.4	12.1	4.5	63.3

ZIP	No.	MD	GM	AM	Q1	Q3	Min	Max	SD	CV
45832	1	11.3	11.3	11.3	11.3	11.3	11.3	11.3	0.0	0.0
45833	10	7.0	6.7	7.7	4.8	8.3	2.5	18.5	4.3	56.5
45836	1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	0.0	0.0
45839	1	2.9	2.9	2.9	2.9	2.9	2.9	2.9	0.0	0.0
45840	68	3.4	3.3	5.5	1.5	5.9	0.0	39.1	7.0	125.9
45843	3	3.6	4.7	5.7	2.7	5.4	2.7	10.7	4.4	77.3
45844	5	7.4	4.5	8.1	1.0	10.0	1.0	20.2	8.0	98.2
45845	19	5.1	4.9	7.5	2.3	7.0	1.5	48.6	10.4	138.9
45846	19	4.6	3.7	5.8	1.5	6.6	0.9	20.4	5.9	102.4
45848	1	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0.0	0.0
45849	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
45851	1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0
45853	2	8.0	7.8	8.0	6.4	8.0	6.4	9.6	2.3	28.3
45856	8	3.7	4.1	5.3	1.7	7.9	1.7	11.2	3.9	73.0
45858	10	2.2	2.4	4.1	0.9	3.4	0.7	14.7	4.7	116.8
45860	12	7.0	7.5	13.8	2.1	14.9	1.4	56.1	16.6	120.8
45861	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
45862	3	2.5	2.3	5.3	0.4	5.1	0.4	12.9	6.7	127.1
45863	2	3.1	3.1	3.1	2.6	3.1	2.6	3.6	0.7	22.8
45865	28	5.7	5.0	11.7	2.7	13.8	0.1	64.5	15.3	131.4
45867	2	6.4	1.6	6.4	0.2	6.4	0.2	12.5	8.7	137.0
45868	3	4.2	3.3	4.2	1.2	5.0	1.2	7.3	3.1	72.1
45869	19	3.9	3.7	5.1	2.6	7.6	0.4	11.3	3.6	70.2
45871	20	11.5	7.9	13.1	4.4	17.2	0.0	38.9	11.1	84.3
45872	2	12.4	12.4	12.4	11.5	12.4	11.5	13.3	1.3	10.3
45873	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0
45874	3	5.4	3.3	4.5	0.9	5.9	0.9	7.3	3.3	72.5
45875	6	3.2	2.1	4.0	0.9	6.0	0.0	8.1	3.3	83.3
45876	1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.0	0.0
45877	1	5.3	5.3	5.3	5.3	5.3	5.3	5.3	0.0	0.0
45879	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
45880	5	0.6	1.1	2.5	0.4	1.4	0.3	9.5	3.9	154.6
45881	1	7.8	7.8	7.8	7.8	7.8	7.8	7.8	0.0	0.0
45882	3	4.1	4.1	4.4	2.8	4.6	2.8	6.2	1.7	39.3
45883	18	6.2	4.8	9.2	2.7	8.5	0.0	53.0	12.1	130.8
45885	32	4.1	3.4	5.4	1.8	5.4	0.1	18.4	5.0	92.7
45887	6	7.6	6.0	7.8	2.7	10.6	1.1	14.3	5.0	63.5
45889	2	17.3	4.9	17.3	0.7	17.3	0.7	33.8	23.4	135.7
45890	6	9.8	10.0	12.8	4.8	11.6	4.4	34.7	11.2	87.4
45891	35	4.1	4.1	6.3	2.2	6.4	0.5	24.5	6.4	101.1
45892	1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
45893	1	7.8	7.8	7.8	7.8	7.8	7.8	7.8	0.0	0.0
45894	2	6.0	5.9	6.0	4.9	6.0	4.9	7.1	1.6	25.9
45895	40	4.7	3.7	5.9	2.6	7.0	0.0	34.2	5.8	98.5
45896	2	4.6	1.0	4.6	0.0	4.6	0.0	9.1	6.4	141.4
45898	3	2.2	2.9	3.5	1.8	3.3	1.8	6.4	2.5	73.5
45917	1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0
45942	1	39.9	39.9	39.9	39.9	39.9	39.9	39.9	0.0	0.0

APPENDIX 6

Sample Reports from IRISDAT

THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)

INDOOR RADON CONCENTRATION DATA

28-Aug-1990

THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)

INDOOR RADON CONCENTRATION FILE

KEY USED FOR RADON CONCENTRATION FILE

ROOM LOCATION

1 = BEDROOM
2 = KITCHEN
3 = BATH
4 = RECR.
5 = STORAGE
6 = UTILITY
7 = BASEMENT
8 = LIV./FAM
9 = OTHER
10 = CRAWL SPACE
11 = DINING
12 = HALL
13 = 1'ST FL
14 = 2'ND FL

DEVICE USED

1 = ALPHA TRACK
2 = CHARCOAL CANIST.
3 = SCINTILL. COUNTER
4 = IONIZATION CHAMBERS
5 = POSITIVE BARRIER
6 = TWO-FILTER METHOD

TEST SEASON

1 = SEP-NOV
2 = DEC-FEB
3 = MAR-MAY
4 = JUN-AUG

MISSING DATA FOR ANY FIELD = (-1)

INDOOR RADON CONCENTRATION DATA

28-Aug-1990
Page 1

RECORD NUMBER	ZIP CODE	COUNTY	RADON LEVEL PCIL	ROOM LOCA	TEST DEVICE	TEST SEASON
12341	43001	LICKING	25.0	-1	-1	3
13004	43001	LICKING	2.1	-1	-1	3
14529	43001	LICKING	11.8	-1	-1	3
16595	43001	LICKING	2.6	-1	-1	4
16596	43001	LICKING	6.0	-1	-1	4
20621	43001	LICKING	5.6	-1	-1	1
20622	43001	LICKING	5.7	-1	-1	1
32582	43001	LICKING	3.4	-1	-1	-1
2548	43008	LICKING	1.0	1	2	3
12347	43008	LICKING	2.4	-1	-1	3
15939	43008	LICKING	5.8	-1	-1	4
18208	43008	LICKING	11.5	-1	-1	1
26038	43008	LICKING	2.1	9	1	2
2845	43011	LICKING	3.1	8	2	3
3061	43011	LICKING	5.8	7	2	3
3968	43011	LICKING	10.2	7	2	3
8236	43011	LICKING	6.6	-1	-1	-1
12348	43011	LICKING	7.5	-1	-1	3
14533	43011	LICKING	19.1	-1	-1	3
15560	43011	LICKING	28.8	-1	-1	4
18209	43011	LICKING	17.6	-1	-1	1
18210	43011	LICKING	4.8	-1	-1	1
20625	43011	LICKING	4.9	-1	-1	1
22409	43011	LICKING	.8	-1	-1	2
23271	43011	LICKING	3.3	-1	-1	2
23272	43011	LICKING	3.4	-1	-1	2
26040	43011	LICKING	4.9	8	1	2
26041	43011	LICKING	4.9	7	2	1
26042	43011	LICKING	11.9	7	1	1
26043	43011	LICKING	12.8	7	2	1
12349	43013	LICKING	22.2	-1	-1	3
13007	43013	LICKING	1.5	-1	-1	3
20626	43013	LICKING	15.3	-1	-1	1
26044	43013	LICKING	1.4	8	1	1
26045	43013	LICKING	1.9	1	1	1
26046	43013	LICKING	3.3	7	1	1
15275	43018	LICKING	19.9	-1	-1	3
16352	43018	LICKING	11.2	-1	-1	4

NUMBER OF RECORDS	38
MEAN RADON LEVEL	8.2131
MIN RADON LEVEL	0.8
MAX RADON LEVEL	28.8
STANDARD DEVIATION	7.2454

THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)

BUILDING CONSTRUCTION DATA

28-Aug-1990

THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)

BUILDING CONSTRUCTION FILE

KEY USED FOR BUILDING CONSTRUCION FILE

TYPE OF BUILDING

1 = SINGLE FAMILY 2 = DOUBLE FAMILY 3 = COMMERCIAL BLDG.
4 = SCHOOL 5 = APPARTMENT 6 = DUPLEX

COOKING FUEL

1 = GAS 2 = ELECTRICITY 3 = OTHER

HEATING FUEL

1 = GAS 2 = ELECTRICITY 3 = SOLAR 4 = WOOD
5 = OIL 6 = KEROSENE 7 = OTHER

INSULATION

1 = POOR 2 = MODERATE 3 = GOOD 4 = EXCELLENT

WATER SUPPLY

1 = PUBLIC 2 = WELL WATER 3 = BOTH

BUILDING MATERIAL

1 = BRICK 2 = CONCRETE 3 = STONE 4 = WOOD
5 = FLYASH 6 = PLASTER 7 = OTHER

TYPE OF BASEMENT FLOOR

1 = POURED CONCRETE 2 = STONE OR DIRT 3 = OTHER

TYPE OF VENTILATION

1 = CENTRAL AIR HANDLING SYSTEM
2 = ROOM SIZE UNIT OR RADIANT HEAT WITH VENTILATION
3 = ROOM SIZE UNIT OR RADIANT HEAT WITHOUT VENTILATION

HOUSE LOCATION

1 = CITY 2 = TOWN 3 = RURAL 4 = FARM 5 = OTHER

MISSING DATA FOR ANY FIELD = (-1)

BUILDING CONSTRUCTION DATA

RECORD NUM	ZIP CODE	COUNTY	TYPE OF BLDG	AGE OF BLDG	AIR EXCH RATE	PENE FACT	TEMP DIFF	NUM OF OCC	NUM OF SMOK	COOK FUEL
31705	44107	CUYAHOGA	-1	65	21	1	36	2	2	-1
31706	44111	CUYAHOGA	-1	36	23	1	39	5	1	-1
31707	44116	CUYAHOGA	-1	32	18	2	33	1	1	-1
31708	44111	CUYAHOGA	-1	32	21	1	36	4	2	-1
31709	44145	CUYAHOGA	-1	35	20	2	32	2	0	-1
31710	44140	CUYAHOGA	-1	17	14	2	33	2	1	-1
31711	44116	CUYAHOGA	-1	33	17	2	35	3	0	-1
31712	44107	CUYAHOGA	-1	65	18	2	33	1	1	-1
31713	44107	CUYAHOGA	-1	74	22	1	33	2	0	-1
31714	44140	CUYAHOGA	-1	29	19	2	32	2	0	-1
31715	44111	CUYAHOGA	-1	30	22	1	36	3	1	-1
31716	44145	CUYAHOGA	-1	12	21	2	32	6	0	-1

HEAT FUEL	FIRE PLACE	SUMP PUMP	CRAWL SPACE	INSUL ATION	WATER SUPP	BLDG MAT	NUM OF FLRS	FLOOR AREA	TYPE OF FLR	TYPE OF VENT	WATER RADON LEVEL	HOUSE LOC
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
2	-1	1	3	-1	-1	-1	-1	-1	-1	-1	-1	-1

THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)

BUILDING MITIGATION DATA

28-Aug-1990

THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)

BUILDING MITIGATION FILE

KEY USED FOR BUILDING MITIGATION FILE

LOCATION OF TEST

1 = BEDROOM 2 = KITCHEN 3 = BATHROOM
4 = REC. ROOM 5 = STORAGE 6 = UTILITY
7 = BASEMENT 8 = LIV./FAM. 9 = OTHER
10 = CRAWL SPACE 11 = DINING 12 = HALL
13 = 1'ST FLR. 14 = 2'ND FLR.

TYPE OF MITIGATION

1 = NATURAL VENTILATION
2 = FORCED AIR VENTILATION
3 = HEAT RECOVERY VENTILATION
4 = WALL VENTILATION
5 = SUBSLAB SUCTION
6 = SEALING OF CRACKS
7 = DRAIN TILE SUCTION
8 = HOUSE PRESSURIZATION
9 = OTHER

MISSING DATA FOR ANY FIELD = (-1)

BUILDING MITIGATION DATA

28-Aug-1990

PRE RADON LEVEL	ROOM LOC	POST RADON LEVEL	TYPE OF MITIG
35.8	7	0.5	5
10.9	7	2.6	5
27.0	7	1.2	5
14.3	7	0.5	5
18.2	7	1.5	5
9.2	7	1.2	5
83.4	7	4.0	5
17.9	8	4.6	2
14.7	8	12.8	2
29.6	8	14.5	2
20.2	8	1.3	5
17.9	8	0.5	5
14.7	8	0.8	5
29.6	8	0.9	5
14.4	8	9.1	1
14.4	8	4.4	2
25.8	10	10.7	1
25.8	10	23.8	2
17.7	8	6.8	1
17.7	8	4.8	2
34.1	10	15.1	1
34.1	10	17.6	2
5.0	8	2.7	1
5.0	8	0.8	2
31.1	10	4.2	1
31.1	10	26.1	2
18.2	8	2.9	1
18.2	8	1.3	2
43.9	10	3.8	1
43.9	10	21.9	2
27.0	7	10.2	6
5.8	7	4.4	6

THE OHIO INDOOR RADON INFORMATION SYSTEM (IRIS)

EPIDEMIOLOGY DATA

28-Aug-1990

EPIDEMIOLOGY DATA

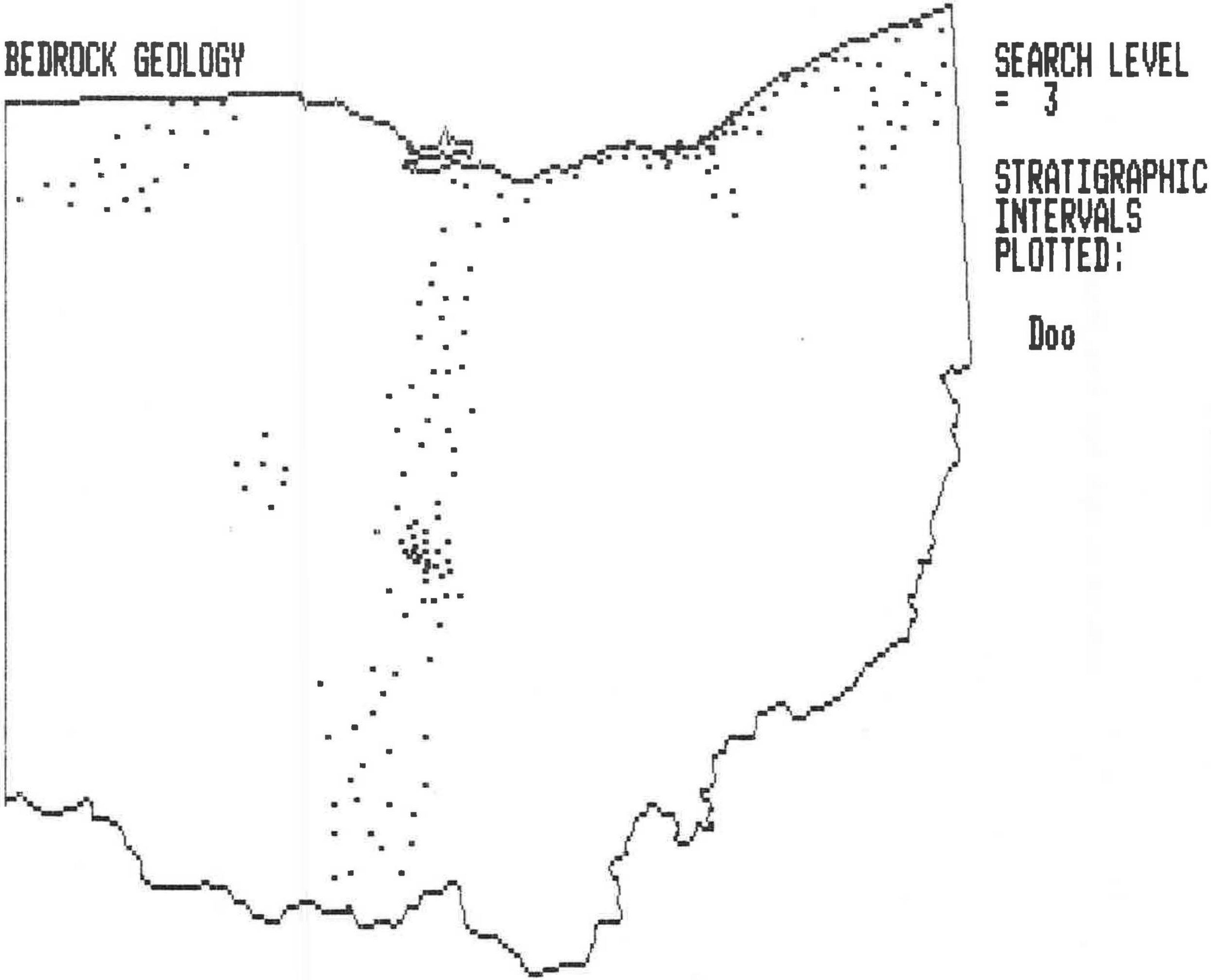
COUNTY	POPULATION	LUNG CANCER DEATHS	ADJUSTED LUNG CANCER DEATHS
OHIO	10752000	54575	49.23
ADAMS	24700	117	43.97
ALLEN	110500	550	47.73
ASHLAND	46300	203	41.03
ASHTABULA	101200	477	41.73
ATHENS	57600	236	50.16
AUGLAIZE	43700	197	42.58
BELMONT	78200	465	45.32
BROWN	34700	185	54.20
BUTLER	271500	1247	53.98
CARROLL	26800	116	44.99
CHAMPAIGN	33900	152	42.45
CLARK	147400	804	50.38
CLERMONT	140600	638	63.05
CLINTON	34800	157	42.74
COLUMBIANA	110100	569	45.44
COSHOCTON	35900	151	36.43
CRAWFORD	49000	251	45.55
CUYAHOGA	1445400	8340	47.63
DARKE	54000	223	36.79
DEFIANCE	39200	131	38.16
DELAWARE	59000	199	42.12
ERIE	77100	342	41.68
FAIRFIELD	97400	406	44.95
FAYETTE	27700	148	48.87
FRANKLIN	907000	4159	55.59
FULTON	38800	106	29.11
GALLIA	29800	133	42.38
GEAUGA	75500	241	38.02
GREENE	130200	459	44.79
GUERNSEY	40200	222	45.80
HAMILTON	865100	5241	56.63
HANCOCK	65900	267	40.49
HARDIN	31700	165	50.53
HARRISON	16400	110	50.11
HENRY	28500	105	35.12
HIGHLAND	34600	189	45.80
HOCKING	24700	131	49.17
HOLMES	30000	62	23.65
HURON	55100	224	42.37
JACKSON	30000	162	47.04
JEFFERSON	85700	566	51.61
KNOX	47600	223	42.69
LAKE	212500	940	48.23
LAWRENCE	62200	342	50.22
LICKING	125400	611	51.13
LOGAN	40200	213	46.23
LORAIN	270600	1138	46.92
LUCAS	462100	2533	52.19

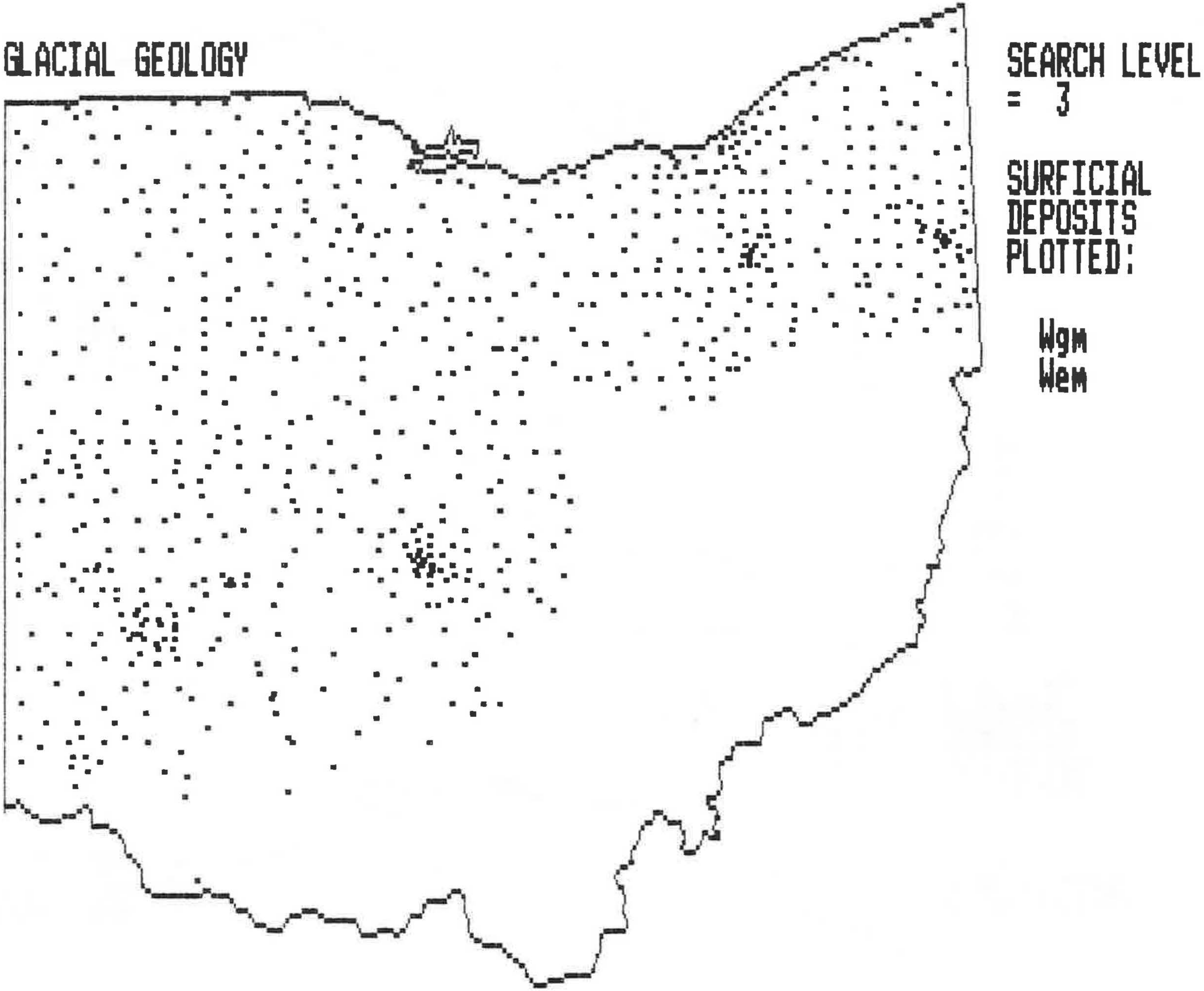
COUNTY	POPULATION	LUNG CANCER DEATHS	ADJUSTED LUNG CANCER DEATHS
MADISON	34800	145	47.04
MAHONING	276600	1464	43.19
MARION	65300	324	49.80
MEDINA	116900	332	37.83
MEIGS	23900	128	47.04
MERCER	39000	127	32.90
MIAMI	89600	422	45.50
MONROE	16200	59	31.36
MONTGOMERY	566300	2957	52.03
MORGAN	14200	75	45.78
MORROW	27000	108	43.13
MUSKINGUM	84100	510	56.81
NOBLE	11500	49	35.59
OTTAWA	39900	182	39.51
PAULDING	20900	97	50.19
PERRY	31800	175	55.25
PICKAWAY	44700	204	51.66
PIKE	25000	17	45.85
PORTAGE	137000	475	46.36
PREBLE	39300	188	47.46
PUTNAM	33400	118	37.43
RICHLAND	128800	574	43.58
ROSS	67300	279	40.88
SANDUSKY	62200	240	38.53
SCIOTO	82300	489	50.34
SENECA	61600	269	43.31
SHELBY	44000	181	44.12
STARK	373500	1831	45.23
SUMMIT	507800	2621	46.66
TRUMBULL	233500	1109	43.51
TUSCARAWAS	85500	406	40.99
UNION	31100	103	35.63
VANWERT	30000	124	35.48
VINTON	11400	64	50.60
WARREN	104500	392	49.59
WASHINGTON	64200	295	44.29
WAYNE	101200	312	35.21
WILLIAMS	36800	134	34.94
WOOD	110300	352	39.89
WYANDOT	22600	103	39.68

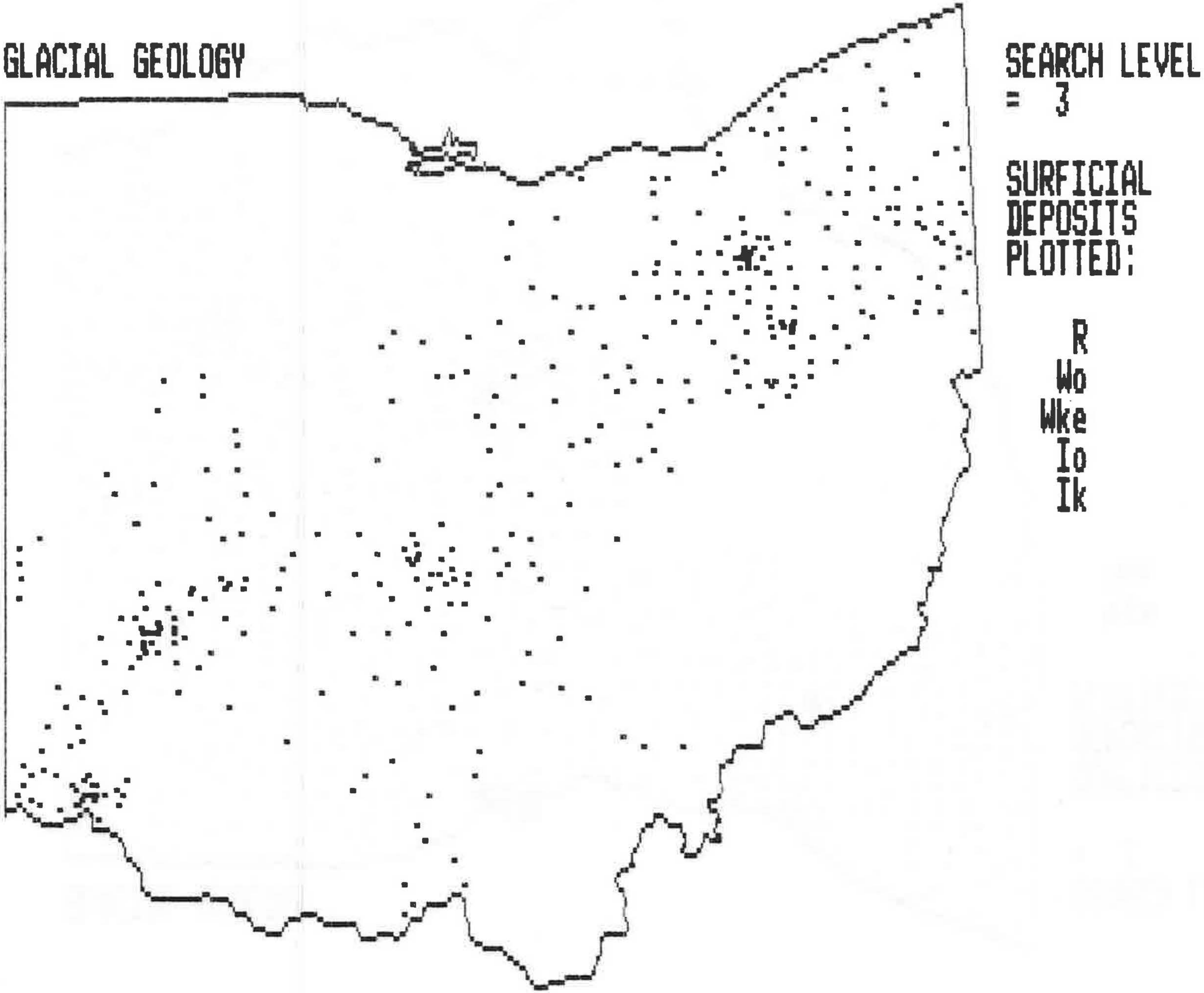
NOTE: ADJUSTED LUNG CANCER DEATHS ARE THE AGE ADJUSTED LUNG CANCER DEATHS PER 100,000 PERSONS.

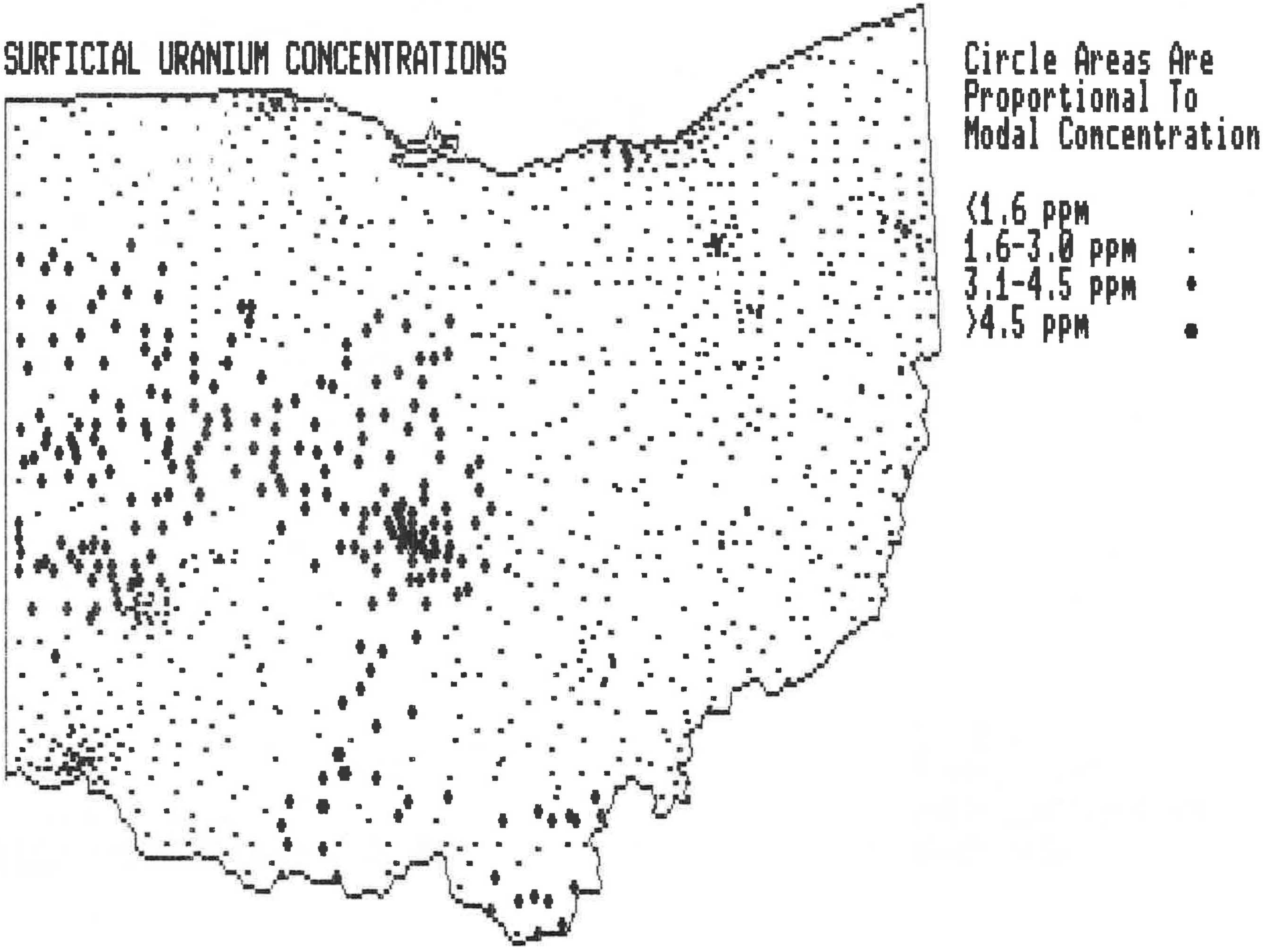
APPENDIX 7

Selected Geologic Maps from IRISMAP

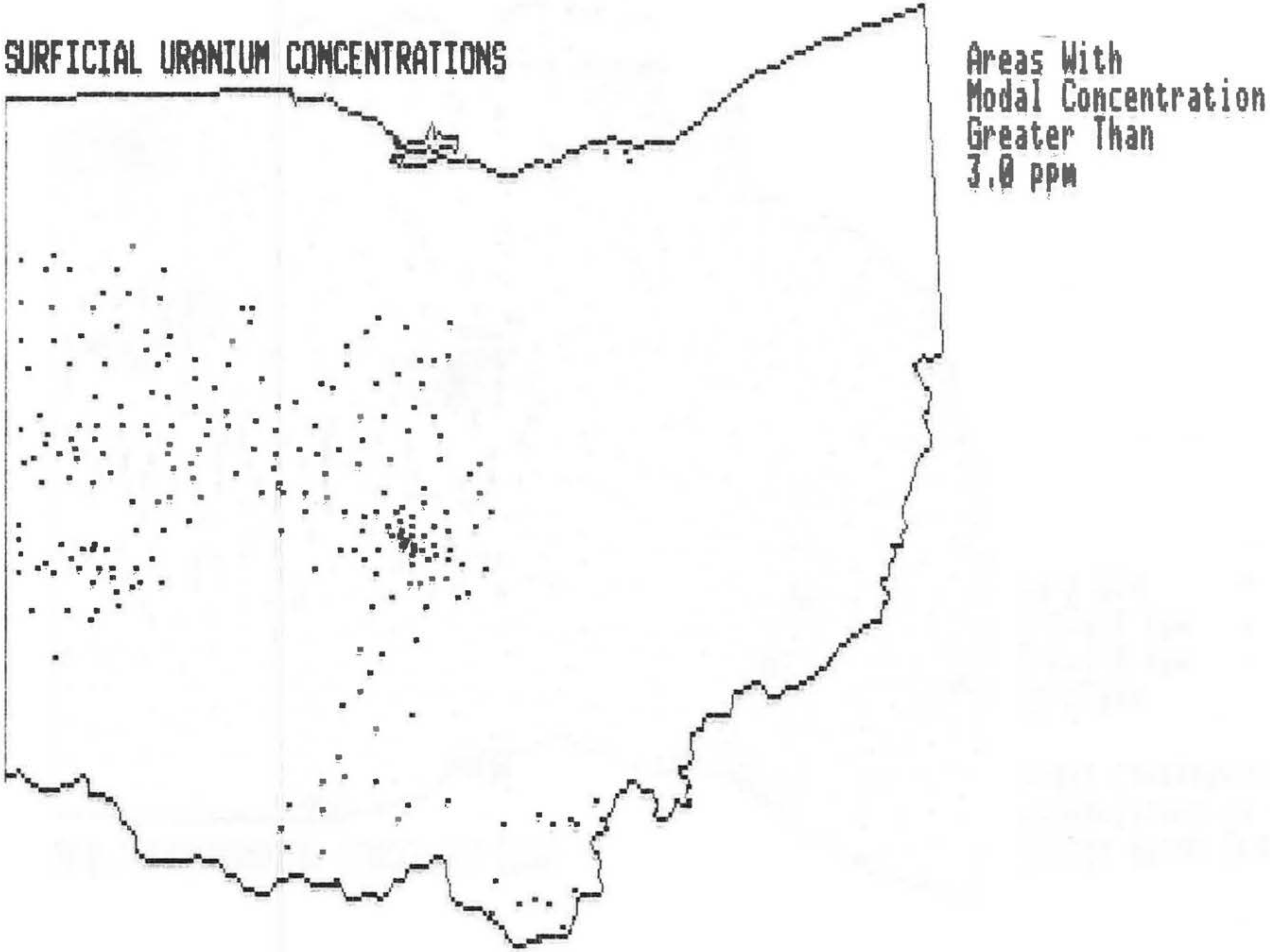

BEDROCK GEOLOGY
SEARCH LEVEL = 3
STRATIGRAPHIC INTERVALS PLOTTED:
Doo

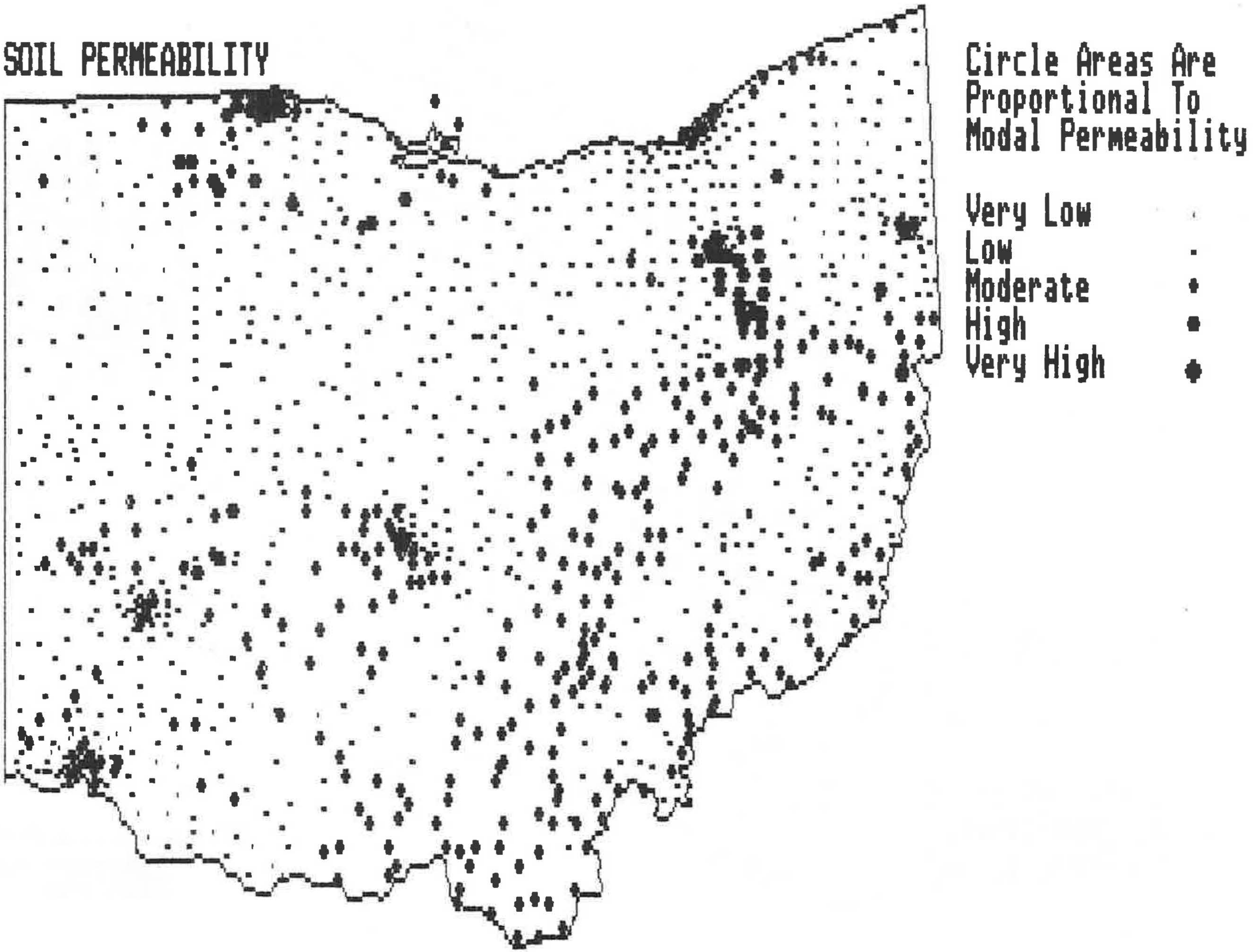

GLACIAL GEOLOGY
SEARCH LEVEL = 3
SURFICIAL DEPOSITS PLOTTED:
Wgm
Wem

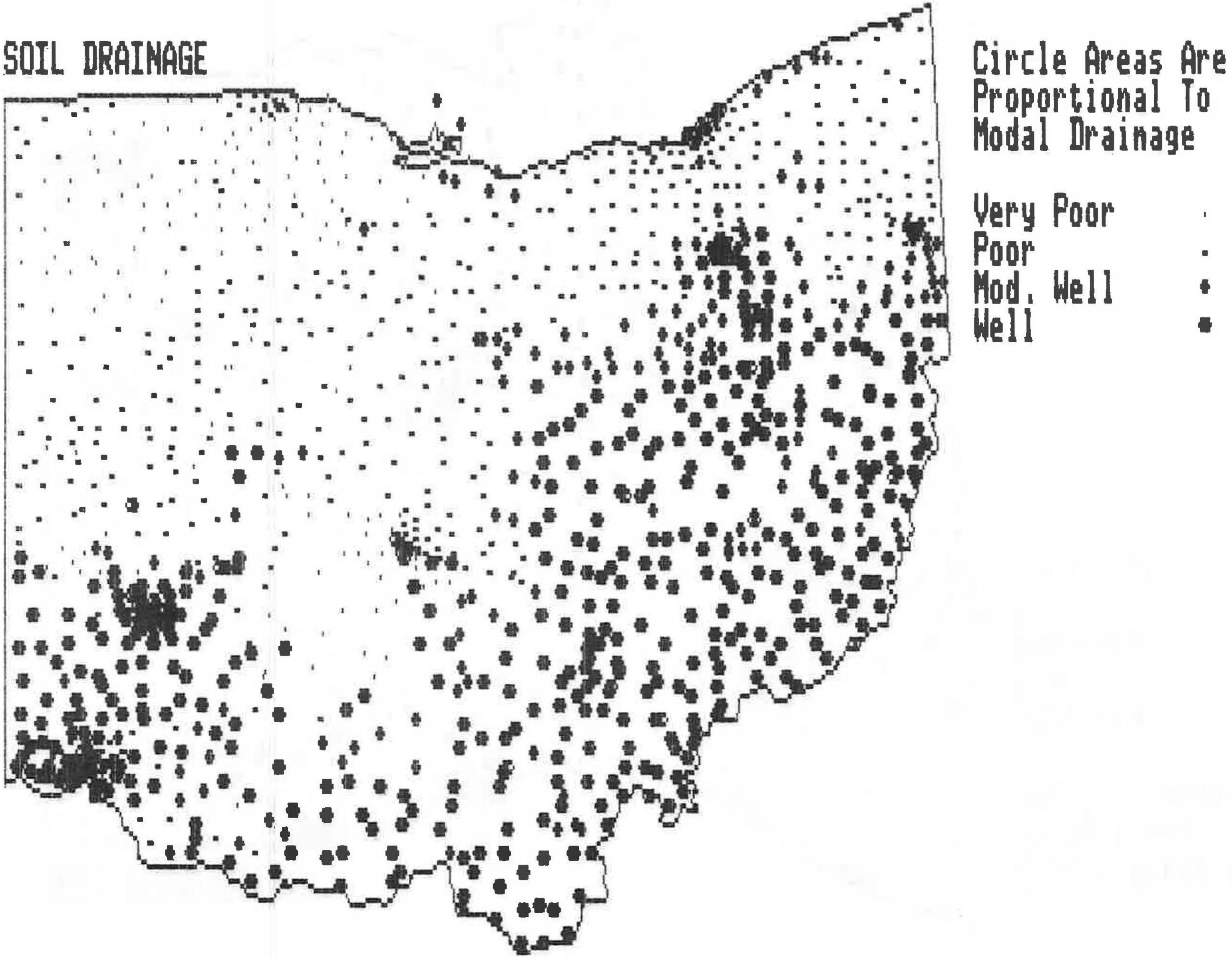

GLACIAL GEOLOGY
SEARCH LEVEL
= 3
SURFICIAL
DEPOSITS
PLOTTED:
R
Wo
Wke
Io
Ik

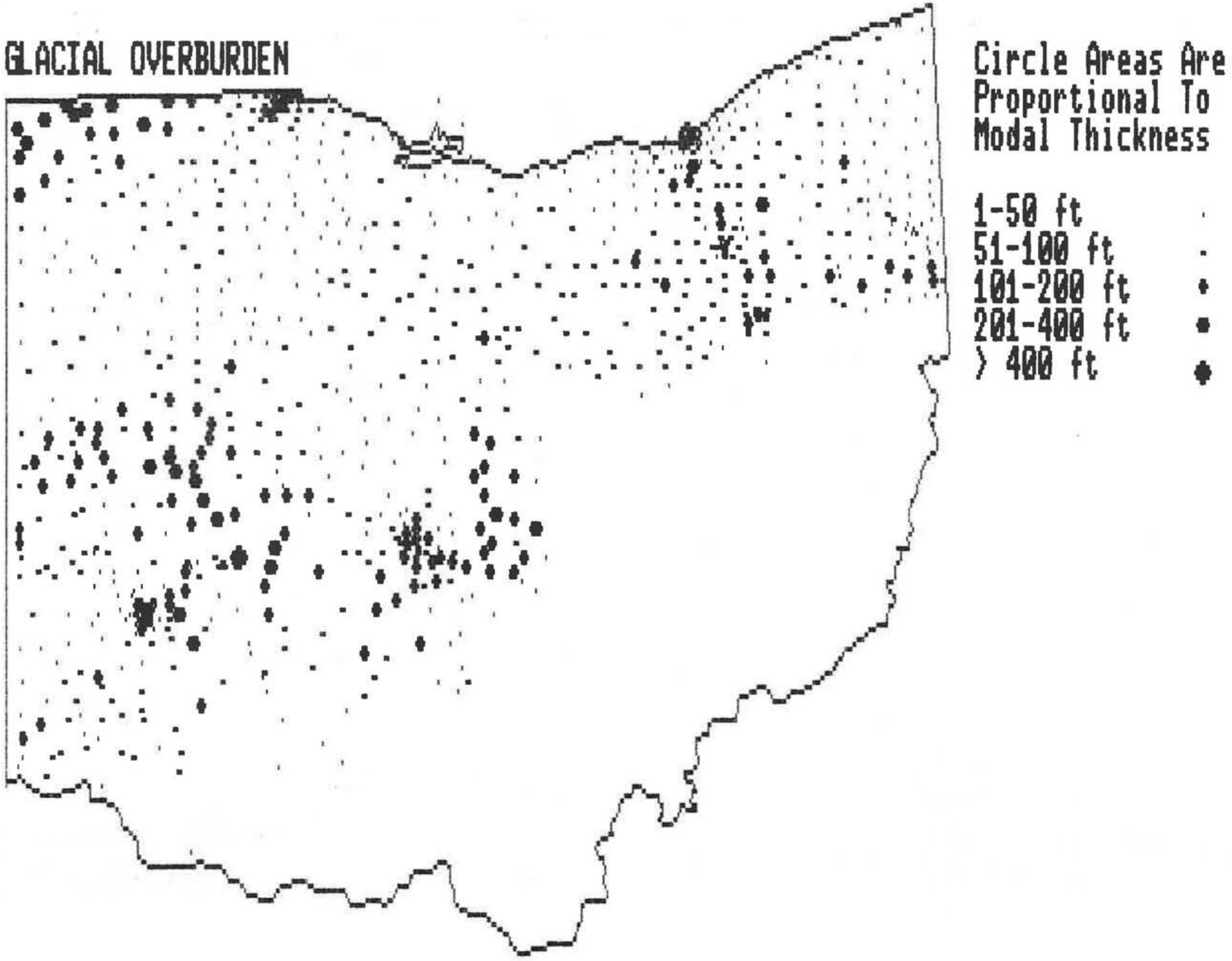


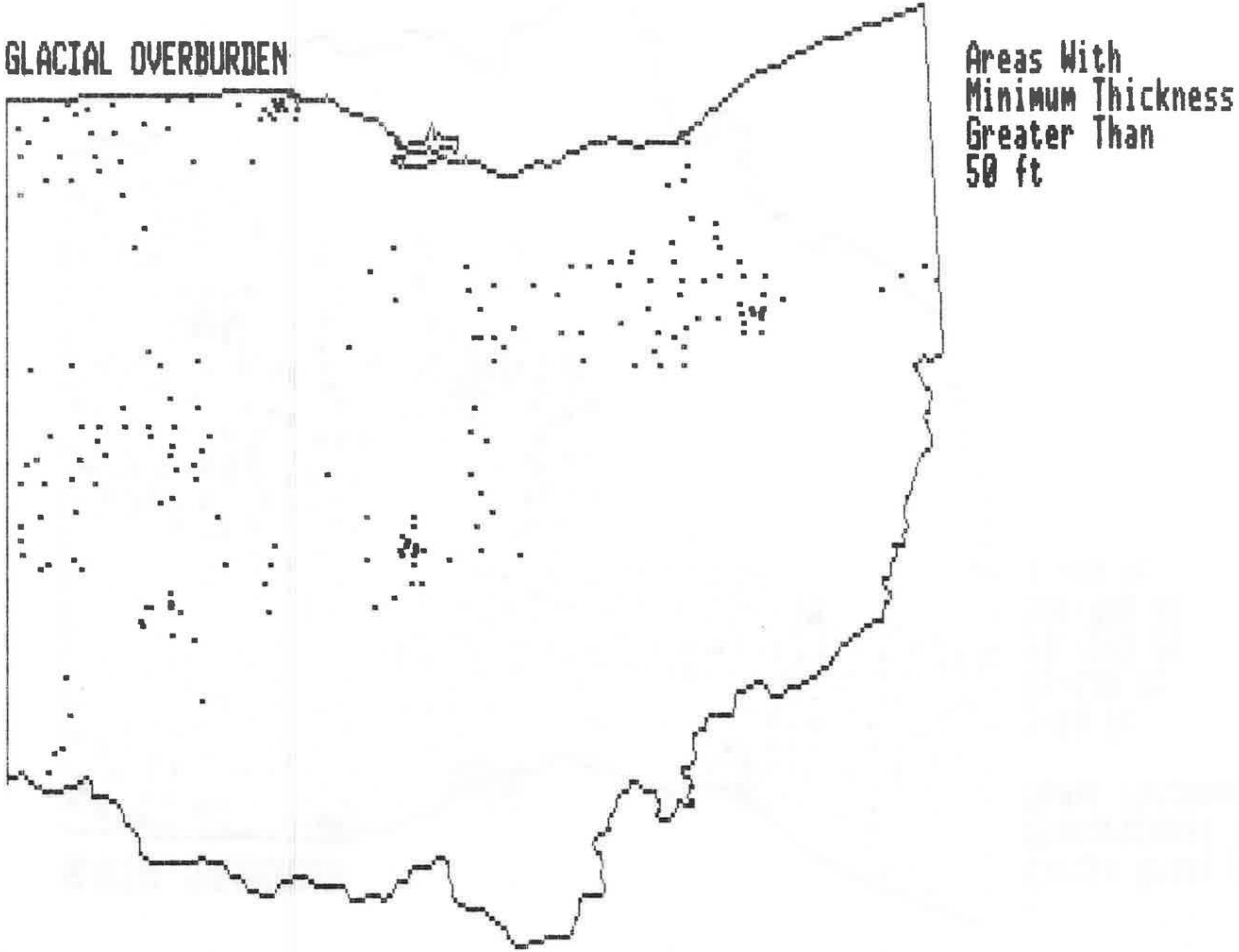
SURFICIAL URANIUM CONCENTRATIONS


SURFICIAL URANIUM CONCENTRATIONS
Areas With
Modal Concentration
Greater Than
3.0 ppm


SOIL PERMEABILITY
Circle Areas Are
Proportional To
Modal Permeability
Very Low ·
Low .
Moderate •
High ●
Very High ⬤


SOIL DRAINAGE
Circle Areas Are Proportional To Modal Drainage
Very Poor
Poor
Mod. Well
Well

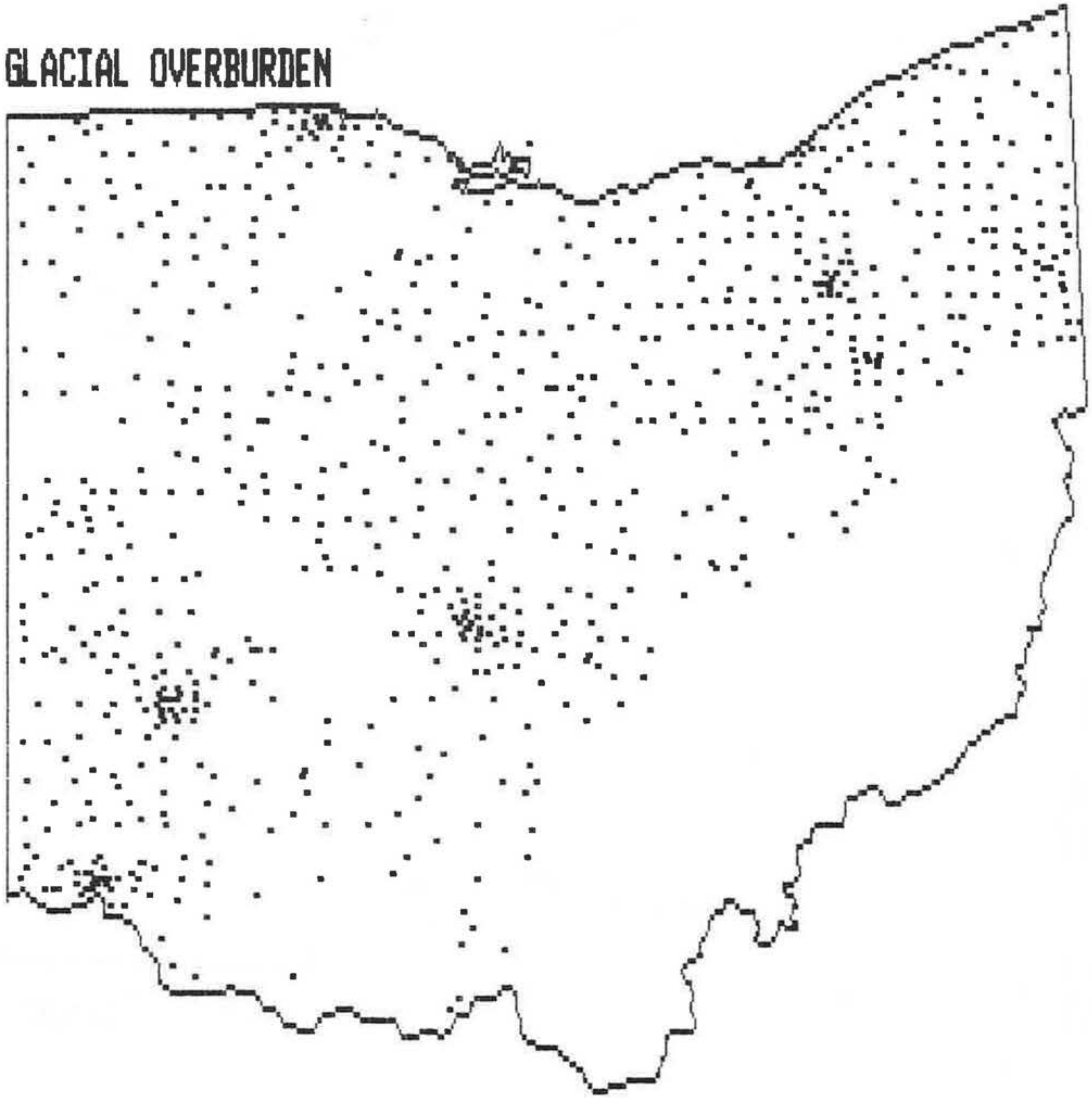

GLACIAL OVERBURDEN
Circle Areas Are Proportional To Modal Thickness
1-50 ft
51-100 ft
101-200 ft
201-400 ft
> 400 ft



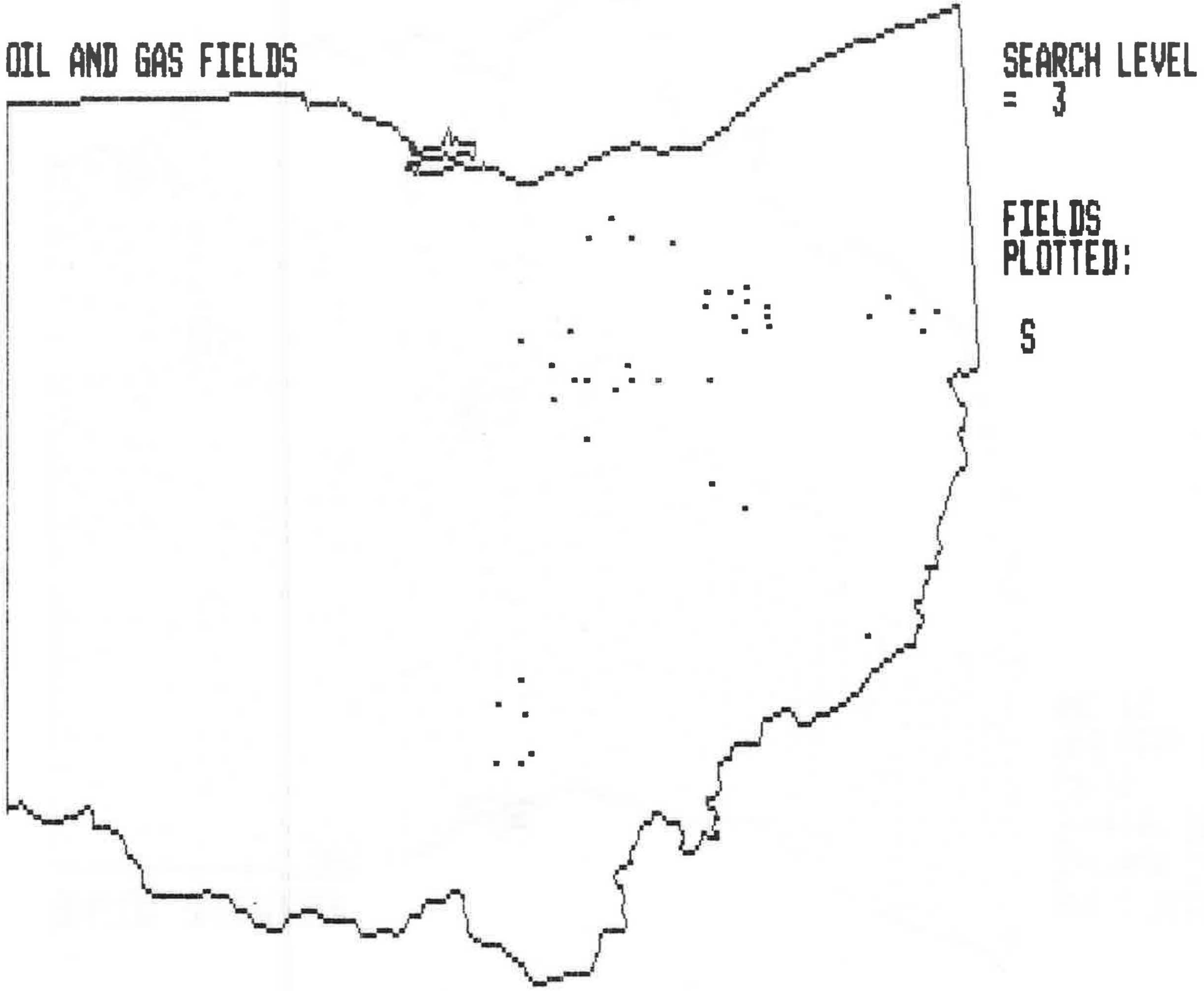
GLACIAL OVERBURDEN

Areas With
Minimum Thickness
Greater Than
50 ft

GLACIAL OVERBURDEN



Areas With
Maximum Thickness
Greater Than
50 ft
And Less Than
401 ft


OIL AND GAS FIELDS
SEARCH LEVEL
= 3
FIELDS
PLOTTED:
S

APPENDIX 8

Distribution of Radon Concentrations
Within Counties

DISTRIBUTION OF RADON CONCENTRATIONS WITHIN AND AMONG COUNTIES

	RADON CONCENTRATIONS (pCi/l)				
COUNTY	0-4	4-20	20-200	>200	COUNT
ADAMS	85.4	14.6	0.0	0.0	41
ALLEN	46.4	49.0	4.6	0.0	152
ASHLAND	51.2	40.7	8.1	0.0	86
ASHTABULA	92.8	6.8	0.5	0.0	414
ATHENS	46.3	52.9	0.8	0.0	505
AUGLAIZE	42.2	49.7	8.2	0.0	147
BELMONT	62.2	33.3	4.5	0.0	111
BROWN	85.7	14.3	0.0	0.0	21
BUTLER	57.2	40.2	2.6	0.0	1347
CARROL	35.5	44.9	19.6	0.0	107
CHAMPAIGN	34.8	53.1	11.9	0.2	1399
CLARK	52.0	44.7	3.3	0.0	275
CLERMONT	65.2	32.8	1.8	0.3	396
CLINTON	60.1	35.4	4.5	0.0	308
COLUMBIANA	63.5	30.2	6.0	0.3	301
COSHOCTON	41.3	52.2	6.5	0.0	46
CRAWFORD	38.1	52.4	9.5	0.0	84
CUYAHOGA	88.5	11.1	0.4	0.0	2036
DARKE	37.4	50.2	12.5	0.0	273
DEFIANCE	73.8	26.2	0.0	0.0	61
DELAWARE	30.1	62.5	7.5	0.0	642
ERIE	52.8	40.1	7.1	0.0	197
FAIRFIELD	33.2	52.9	13.2	0.7	539
FAYETTE	47.4	50.0	2.6	0.0	38
FRANKLIN	26.7	60.9	12.3	0.0	10020
FULTON	79.7	20.3	0.0	0.0	64
GALLIA	75.0	25.0	0.0	0.0	72
GEAUGA	82.4	15.7	1.5	0.4	261
GREENE	43.3	50.5	6.2	0.0	2172
GUERNSEY	59.5	36.5	4.1	0.0	74
HAMILTON	77.3	21.9	0.8	0.0	3057
HANCOCK	52.1	42.7	5.2	0.0	96
HARDIN	51.3	46.2	2.6	0.0	39
HARRISON	37.9	41.4	20.7	0.0	29
HENRY	73.2	26.8	0.0	0.0	41
HIGHLAND	59.4	39.1	1.4	0.0	69
HOCKING	29.3	60.6	10.1	0.0	99
HOLMES	45.0	50.0	5.0	0.0	20
HURON	43.5	48.0	8.5	0.0	246
JACKSON	72.2	24.1	3.7	0.0	54
JEFFERSON	57.4	38.0	3.7	0.9	108
KNOX	31.8	52.9	14.7	0.6	170
LAKE	86.9	11.4	1.7	0.0	343
LAWRENCE	82.0	18.0	0.0	0.0	50
LICKING	19.1	48.5	30.9	1.5	946
LOGAN	45.5	45.5	8.6	0.4	255
LORAIN	61.9	35.8	2.2	0.0	318
LUCAS	76.0	21.9	2.1	0.0	805
MADISON	38.0	50.0	12.0	0.0	166
MAHONING	86.2	12.9	0.7	0.2	552
MARION	31.4	61.2	7.5	0.0	255
MEDINA	72.6	24.4	3.0	0.0	168
MEIGS	92.9	7.1	0.0	0.0	28

MERCER	43.2	51.4	5.5	0.0	183
MIAMI	36.0	55.4	8.4	0.2	1746
MONROE	55.6	38.9	5.6	0.0	18
MONTGOMERY	55.0	41.3	3.7	0.1	11611
MORGAN	58.6	37.9	3.4	0.0	29
MORROW	41.7	46.7	11.7	0.0	60
MUSKINGUM	41.6	50.8	7.6	0.0	185
NOBLE	66.7	33.3	0.0	0.0	12
OTTAWA	75.7	23.0	1.4	0.0	74
PAULDING	78.3	21.7	0.0	0.0	23
PERRY	61.5	38.5	0.0	0.0	39
PICKAWAY	26.6	56.0	17.4	0.0	384
PIKE	35.6	54.2	10.2	0.0	59
PORTAGE	76.2	23.3	0.5	0.0	210
PREBLE	41.2	48.2	10.6	0.0	274
PUTNAM	48.4	48.4	3.2	0.0	31
RICHLAND	44.9	46.8	8.2	0.2	635
ROSS	30.8	52.2	16.9	0.0	425
SANDUSKY	52.4	46.0	1.6	0.0	62
SCIOTO	76.1	22.4	1.5	0.0	67
SENECA	42.7	54.1	3.2	0.0	157
SHELBY	43.5	50.9	5.6	0.0	216
STARK	56.4	39.3	4.3	0.0	773
SUMMIT	73.1	25.2	1.6	0.1	816
TRUMBULL	90.2	9.6	0.2	0.0	408
TUSCARAWAS	42.6	48.5	8.8	0.0	68
UNION	67.1	30.0	2.9	0.0	140
VAN WERT	47.8	45.7	6.5	0.0	46
VINTON	88.9	11.1	0.0	0.0	9
WARREN	59.4	37.2	3.3	0.1	983
WASHINGTON	65.8	31.2	3.1	0.0	260
WAYNE	51.0	35.0	13.0	1.0	100
WILLIAMS	76.5	20.6	2.9	0.0	34
WOOD	66.7	30.6	2.8	0.0	216
WYANDOT	56.1	34.1	9.8	0.0	41