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THE INFLUENCE OF LAND USE ON STREAM NUTRIENT LEVELS

Environmental Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Corvallis, Oregon 97330

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THE INFLUENCE OF LAND USE ON STREAM NUTRIENT LEVELS

By

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ABSTRACT

National Eutrophication Survey (NES) data for 473 non-point type drainage areas in the eastern United States were studied for relationships between drainage area characteristics (particularly land use) and nutrient levels in streams. Both the total and inorganic forms of phosphorus and nitrogen concentrations and loads in streams were considered.

The objectives were to: (1) investigate these relationships, as they were evidenced by the NES data and; (2) develop a means for estimating stream nutrient levels from knowledge of "macro" drainage area characteristics.

Mean nutrient levels were considerably higher in streams draining agricultural watersheds than in streams draining forested watersheds. The levels were generally proportional to the percentages of land in agriculture, or the combined percentages of agricultural and urban land use. Variations in nutrient loads (exports) in streams, associated with differences in land use categories, were not as pronounced as the variations in nutrient concentrations. This was apparently due, in large part, to differences in areal stream flow from different land use types.

Regression analyses of the combined percentages of agricultural and urban land uses against both the total and inorganic forms of phosphorus and nitrogen were performed. Equations for these analyses, together with maps illustrating the equations' residuals, offer a limited predictive capability and some accountability for regional characteristics.

ACKNOWLEDGEMENTS

This study would not have been possible without the volunteer manpower supplied by the National Guard of each state. The Guardsmen were responsible for collecting, preserving, and shipping the monthly samples from each designated stream site. Their contribution is sincerely appreciated.

Also gratefully acknowledged are the efforts of Mr. Robert R. Payne (Coordinator, National Eutrophication Survey, Washington, D.C.), who worked with each State water pollution control agency in initiating the survey, and Lt. Col. Louis R. Dworshak (Coordinator of Military Resources, Washington, D.C.), who arranged for the participation of the National Guard in each state.

Most of the data compilation (land use photo interpretation, drainage area and slope measurement, etc.) was accomplished by the following persons: June Fabryka, Madeline Hall, Thomas Jackson, Rose McCloud, Martha McCoy, Ted McDowell, Nola Murri, Michael Ness, James Sachet, and Leta Gay Snyder. Many of these individuals also assisted in graphics compilation and various aspects of basic research.

Dr. Don A. Pierce was primarily responsible for the construction of the prediction models. Both Dr. Pierce and Dr. Dale H. P. Boland provided assistance with computer programming and statistical data manipulation.

Many of the staff at the Corvallis Environmental Research Laboratory contributed input to this study through the logistic support, constructive suggestions, and technical editing. Especially deserving of recognition are Dr. Jack H. Gakstatter and Dr. Norbert A. Jaworski for their solid support and invaluable guidance.

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SECTION I

CONCLUSIONS

The analysis of drainage area characteristics and stream nutrient runoff data compiled for 473 non-point source-type drainage areas in the eastern United States indicate that:

1. Streams draining agricultural watersheds had, on the average, considerably higher nutrient concentrations than those draining forested watersheds. Nutrient concentrations were generally proportional to the percent of land in agriculture. Mean total phosphorus concentrations were nearly ten times greater in streams draining agricultural lands than in streams draining forested areas. The difference in mean total nitrogen concentrations was about five-fold.

2. In general, inorganic nitrogen made up a larger percentage of total nitrogen concentrations in streams with larger percentages of land in agriculture. The inorganic nitrogen component increased from about 27% in streams draining forested areas to over 75% in streams draining agricultural watersheds. The inorganic portion (orthophosphorus) of the total phosphorus component stayed roughly at the 40% level regardless of land use type.

3. Differences in nutrient loads in streams associated with different land use categories were not as pronounced as differences in nutrient concentrations. Mean total phosphorus export from agricultural lands was 3.7 times greater than that from forested lands; mean total nitrogen export was 2.2 times greater. Differences in magnitude between the relationships of concentration to land use and export to land use appear to be due mainly to differences in areal stream flow from different land use types, and to a lesser degree, to differences in the mean annual precipitation patterns and mean slope of study areas.

4. Relationships between nutrient levels in streams and "contributing" land use types (percent of drainage area in agricultural land plus the percent in urban land use [% agriculture plus % urban]) were found to be more significant than those considering only one land use type. Separate regression analyses of % agriculture plus % urban against both the total and inorganic forms of phosphorus and nitrogen concentrations were performed. Equations from these analyses offer a limited predictive capability. More complicated equations taking into consideration regional characteristics and/or drainage area characteristics other than land use, afforded only slightly better predictive capabilities over the simple equations.

5. Because of the effects of various aspects on the "flow" portion of the export computation, the most accurate method of predicting export values or stream loads appears to be by using the appropriate model for stream nutrient concentrations and then multiplying by flow.

6. Qualitative refinement of the simple prediction models for total phosphorus and total nitrogen concentrations are provided in maps of each model's residuals. These maps indicate where, in the eastern United States, nutrient concentrations can be expected to be greater, equal to, or less than those predicted by the models.

7. Surface soil pH appeared to have a significant effect on nutrient concentrations in streams, but because of the time and expense involved in procuring accurate surface soil pH data, no further analyses were accomplished.

8. Using a geological classification scheme based on origin and the National Eutrophication Survey nutrient runoff data, no clearly significant relationships were found between geology and phosphorus or nitrogen in streams. It is hypothesized that use of a rock-type classification system based on mineral composition, instead of origin, would reveal significant differences.

SECTION II

INTRODUCTION

HISTORY AND OBJECTIVES

The initial planning for the National Eutrophication Survey (NES) visualized a detailed watershed land use study for each of the approximately 750 lakes which was to be done parallel to the field sampling program. The idea stemmed from a desire to better understand the relationship between lake trophic state and watershed land use. It was hoped that the "fruits" of this effort would be the development of a quick, relatively accurate method of assessing nutrient loadings to lakes based on land use analysis of their watersheds.

The original concept pictured identification and mensuration of overall land use types through aerial photo and topographic map interpretation of the entire watershed of each lake included in the NES. For many reasons, including the unavailability of good photo and/or map coverage for many watersheds or parts of watersheds, the original concept was considerably modified. Presently, the project consists of a study of about 1,000 non-point type drainage areas, mostly within watersheds of lakes being studied by the NES.

As it is now envisioned, the basic objectives of the NES land use study are to investigate the relationships between "macro" drainage area characteristics (particularly general land use) and nutrient runoff in streams with an aim of developing a means for estimating nutrient (nitrogen and phosphorus) runoff based on land use and related geographic characteristics. The project is part of a massive stream and lake sampling program being conducted by NES and includes a large number of drainage areas covering a nationwide variety of climatic and geographic conditions. This affords a unique opportunity to look at the land use--nutrient loadings--eutrophication relationships on

a national scale, and to develop a system utilizing coefficients, or a range of coefficients, to reflect geographical or regional differences.

Because of its ties with the NES field sampling program, which is being accomplished in three phases, the NES land use study follows the same pattern. In the area in which tributary sampling began in the summer of 1972, 133 drainage areas were selected for land use analysis. In the NES study area where sampling was initiated in 1973, 340 drainage areas were selected; and in the remainder of the conterminous United States, where sampling began in 1974, 524 drainage areas were defined. Figure 1 illustrates the distribution of the individual study drainage areas, as well as the overall areas covered by each of the three phases.

Upon completion of data compilation for each of these phases, a report was to be written to present the data collected to date and to present some analyses of these data. This report, as well as providing an explanation of the overall project, presents the data compiled for the first two phases. National Eutrophication Survey Working Paper No. 25 (U.S. Environmental Protection Agency, 1974) presented data compiled through the first phase.

LITERATURE

Recently several extensive literature reviews have been published relating watershed characteristics to non-point source nitrogen and phosphorus concentrations and loads in streams (Uttormark, Chapin, and Green, 1974; Loehr, 1974; Dillon and Kirchner, 1975; and Dornbush, Anderson, and Harms, 1974). These reviews have gathered many of the investigations that, for the most part, have based their results on data collected from a small number of drainage areas within specific geographic regions. In attempting to develop systems for estimating nutrient runoff from land use based on coefficients developed entirely, or in part, from the literature, most reviewers have summarized their findings by presenting a range of values and, in some cases, midpoints

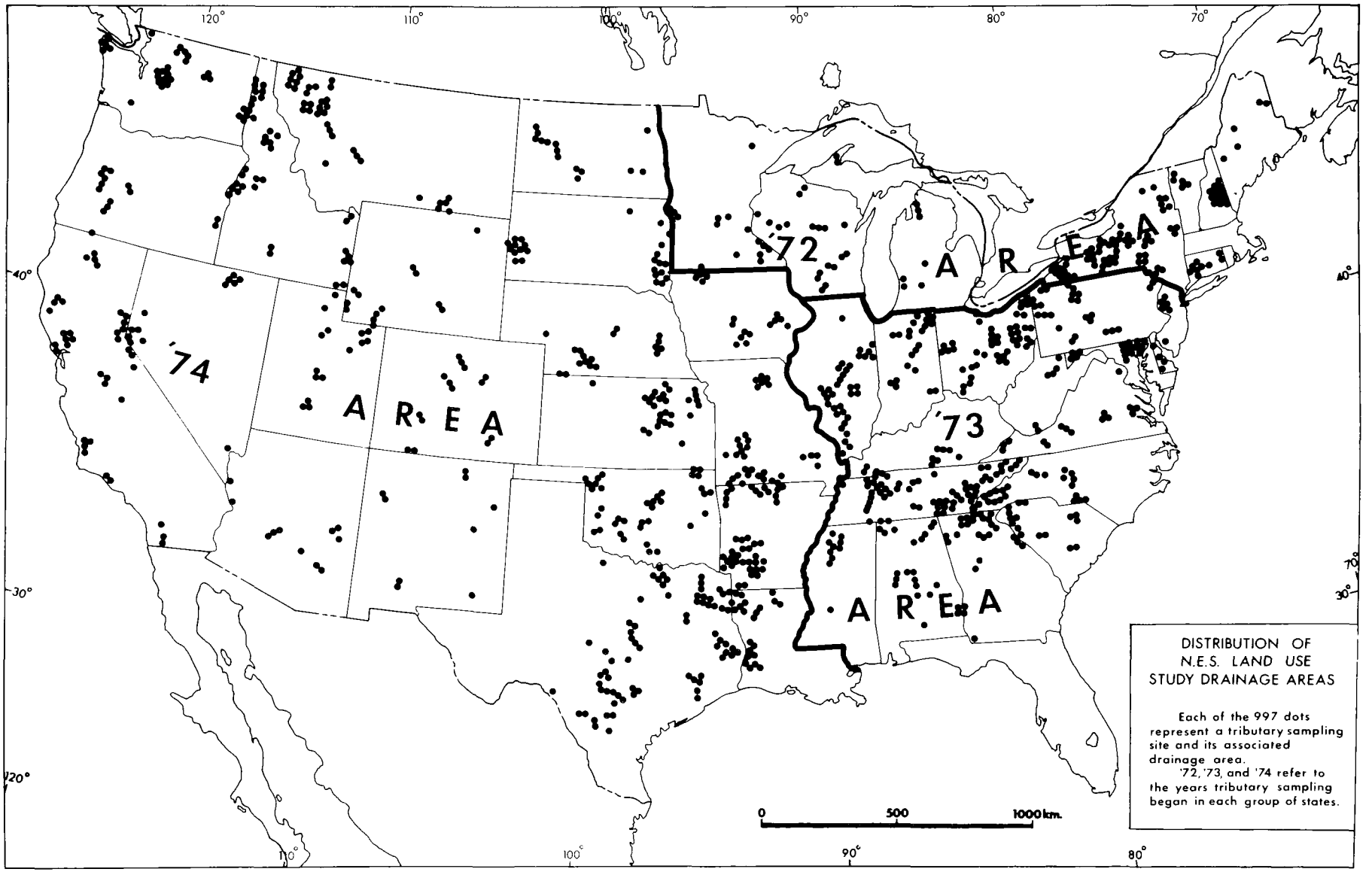


Figure 1. Distribution of individual NES land use study drainage areas.

or averages. Generally, these ranges are quite wide and the midpoints, or other indicators of central tendency, do not vary from one land use type to another as appreciably as one might expect.

It would seem that uniformity in procedure, which is largely lacking from one study (basic investigation) to another, would limit the validity of comparing the results of one with another, or using combined results to establish nutrient loading coefficients. More important, there is an insufficient quantity and an inadequate distribution of data points available from literature sources to study the regional aspects of nutrient runoff. An example of the latter point is shown later in this paper in the section dealing with the effects of geology on nutrients in streams.

STUDY AREA SELECTION CRITERIA

In general, criteria for selecting tributary sampling sites for their associated land use study drainage areas were:

A. Absence of identifiable point sources.

B. Availability of usable aerial photography (preferably in scales of from 1:40,000 to 1:80,000) and/or existing land use studies for identifying land use.

C. Availability of accurate topographic maps for drainage area delineation.

D. Sufficient relief for clear definition of drainage area limits and for surface runoff to be a significant factor.

E. Need to encompass a variety of geographic and climatic areas, and obtain, where possible, land use homogeneity within subdrainage areas.

A few exceptions to these criteria were necessary to accomodate study of particular types of areas. Within the 1973 study area, several heavily mined watersheds and several predominately urban watersheds (but without apparent industrial or municipal wastewater treatment facilities) have been included.

It should be noted that an overriding selection constraint was that tributary sampling sites for land use study drainage areas had to be

drawn from those already selected for support of NES lake reports, or had to be selected within a reasonable distance of NES study lake areas to accomodate sampling by the National Guard. At the time selections were being made of drainage areas within the 1972 study area, tributary sampling sites had already been selected and the actual field sampling was underway. Moreover, at that time, the major thrust of the Survey was on point source impact to lakes, particularly that due to municipal wastewater treatment plant discharges. Generally, only "problem" lakes had been selected for study and many of these were in watersheds having "problem" type land uses. Hence, it was somewhat difficult to find drainage areas without point sources; and obtain adequate coverage of all land use types.

At the time tributary sites were being selected for 1973 NES study area lakes, emphasis was still on point sources. However, tributary sampling had not yet begun in several of the 1973 area states which allowed an opportunity to choose additional sites where their inclusion was warranted by land use homogeneity and other factors suitable for land use and nutrient runoff analyses.

Selection of tributary sampling sites for land use study drainage areas in the 1974 area (west of the Mississippi) was made under more ideal conditions. By this time water research mandates had been revised by passage of Public Law 92-500. These revisions resulted in a broadening of Survey objectives to include assessment of relationships of non-point sources to lake nutrient levels. In addition, lake selection criteria were modified to no longer include just "problem" lakes, but lakes representative of a full range of water quality. This presented a better balance of lake watersheds and land use types as well as lake types. In several instances, where it was necessary to achieve a better geographic distribution of drainage areas or obtain a better balance of land use categories, sites were selected outside NES lake watersheds.

OVERALL STUDY AREA DESCRIPTION

The geographic area for which data are presented encompasses most of the United States east of the Mississippi River including Minnesota. All of Florida, some of the Gulf and Atlantic coasts and northwestern Minnesota were not included because of insufficient relief to allow accurate drainage area delineation and/or to enable surface runoff to be a significant factor. Although the overall study area does not exhibit the physiographic or climatic extremes found in the remainder of the conterminous United States west of the Mississippi River, there is considerable diversity. Landforms range from flat to rolling plains along the Atlantic and Gulf coasts and in the interior lake states, to hills, dissected plateaus and low mountains in the northeast-southwest trending Appalachian Highlands. Physical subdivisions are shown in Figure 2, and the general geology of the area is shown in Figure 3. The climate in the northern half of the area is humid continental and in the southern half, humid subtropical. The northern half is characterized by humid, warm to hot summers and cold winters; the southern half, hot humid summers and cool winters. Yearly temperature ranges are generally greater toward the interior. Most of the study area receives between 80 to 120 centimeters of precipitation per year (Figure 4). Extreme mean annual precipitation varies from less than 60 cm. in western Minnesota to over 160 cm. in parts of the Appalachians.

Figure 2. Physical subdivisions of the eastern United States. Adapted from U.S. Geological Survey (1970) and Hammond (1964).

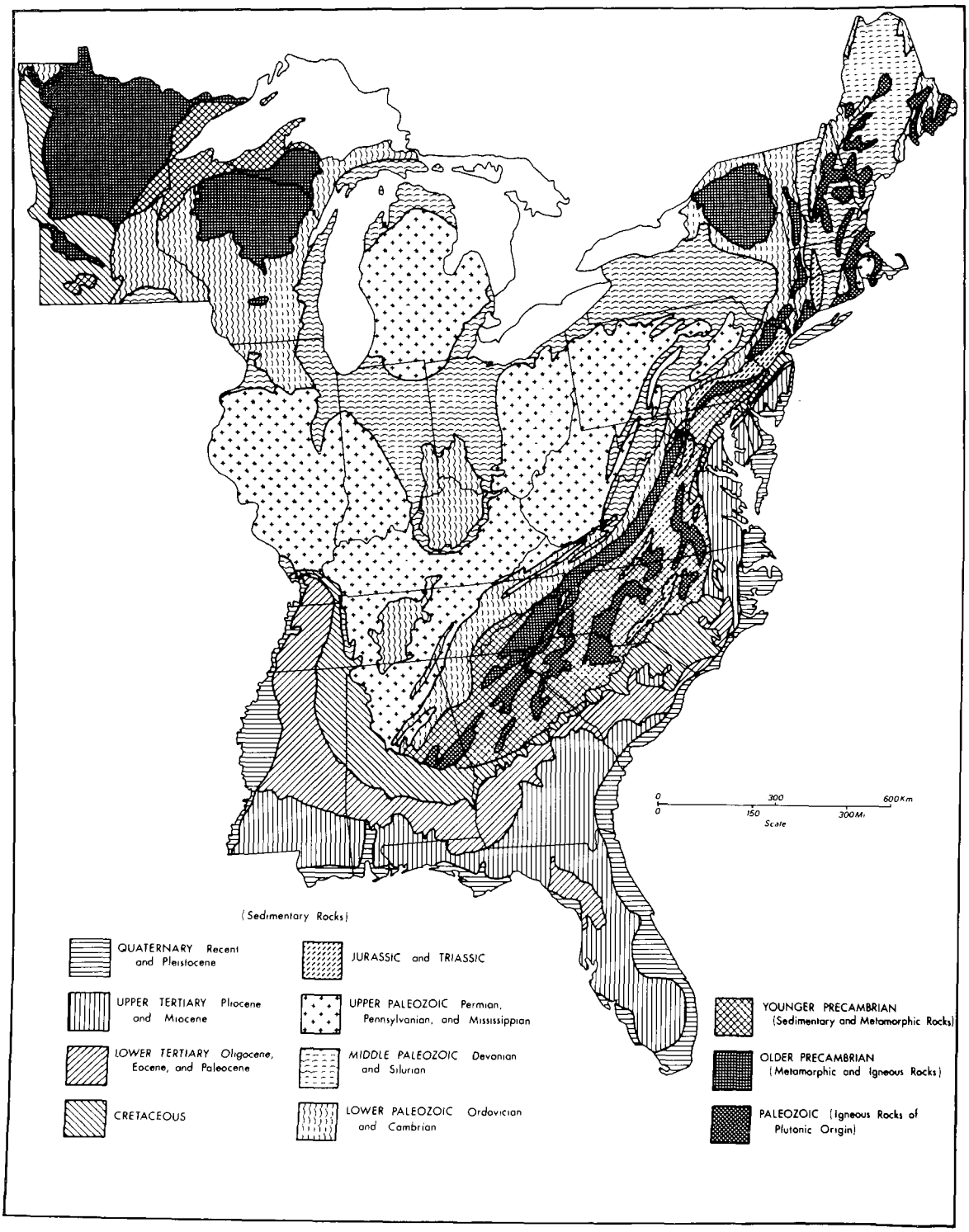


Figure 3. Geology of the eastern United States. Adapted from U.S. Geological Survey (1970).

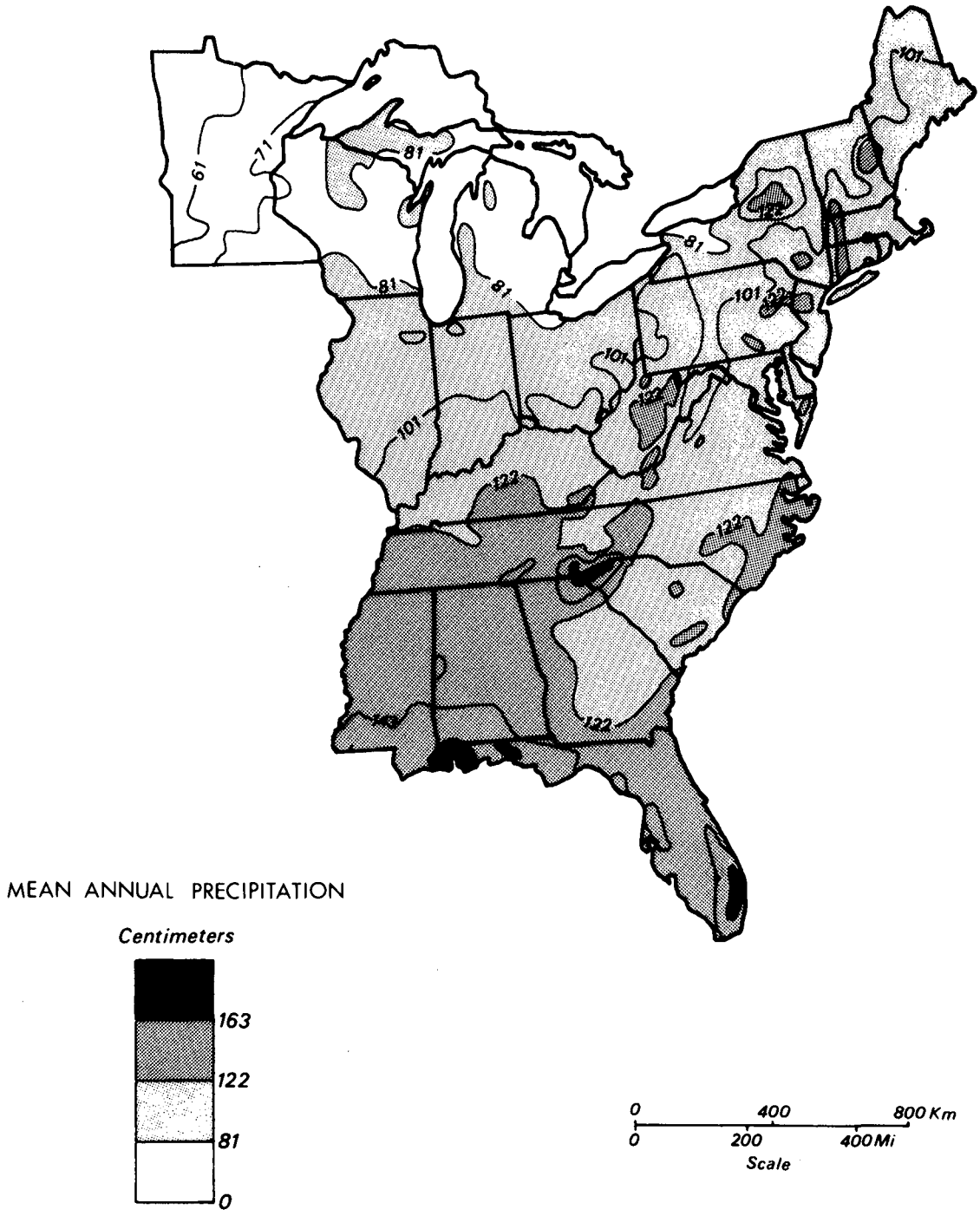


Figure 4. Mean annual precipitation in the eastern United States. Adapted from U.S. Geological Survey (1970).

SECTION III

DATA COLLECTION METHODS

DRAINAGE AREA MEASUREMENT AND LAND USE IDENTIFICATION

Following tributary site selection, individual drainage areas were delineated on U.S. Geological Survey (USGS) topographic maps and their areas determined by use of a compensating polar planimeter or an electronic planimeter. General land use identifications were made using late-date aerial photography and/or recent land use maps. Land use categories included: (1) forest, (2) cleared-unproductive, (3) agriculture, (4) urban, (5) wetland, and (6) other (including barren, extractive and open water). These types roughly correspond in level of classification to Level I of the recently developed USGS Land Use Classification System (U.S. Department of Interior, 1972).

LAND USE PERCENTAGE COMPUTATION

For each drainage area, percent coverage of each land use type was compiled by use of equidistant dot pattern overlays. The dot patterns were placed non-selectively over the USGS map overlays on which land use units had been outlined. To determine the land use percentage for a given drainage area, the number of dots that fell on each land use category was totaled; each total was multiplied by 100, and the resulting products were divided by the number of dots falling in the drainage area. Dot pattern densities varied from one drainage area to another depending on the overall size of the drainage area; generally, the larger the area the less dense the dot pattern. At least 400 dots per drainage area, but preferably less than 800 were needed for a valid determination of percent coverage.

ANIMAL UNIT DENSITY COMPUTATIONS

It is generally accepted that animal wastes are major contributors to the nitrogen and phosphorus in agricultural land runoff (Holt, Timmons, and Latterell, 1970; Holt, 1971; Robbins, Howells, and Kriz, 1971). Early in this study, it seemed some mechanism should be developed to analyze this aspect of agricultural runoff. Because of shifts in agricultural land use, particularly from season to season and year to year, it seemed impractical or impossible to accurately separate pasture from cropland. A more expeditious method was to determine overall animal densities (i.e., animal units per acre of subdrainage area).

For the most part, animal unit densities for each drainage area were computed from U.S. Census of Agriculture figures, other literature sources and personal communications (Johnson and Mountney, 1969; Miner and Willrich, 1970; Miner, 1971; Anonymous, 1972; Anonymous, 1973; Anonymous, 1974; Arscott, 1975; Harper, 1975; Hohenboken, 1975; and Miner, 1975). The quantities of total nitrogen and total phosphorus produced annually by common farm animals were also compiled from these sources (Table 1).

TABLE 1. ANIMAL NUTRIENT PRODUCTION (kgs/yr/animal)

	Total P	Total N
Cattle	17.60	57.49
Hogs	3.23	9.68
Sheep	1.47	10.06
Poultry		
Layers	0.16	0.42
Broilers	0.09	0.39
Turkeys	0.39	0.84

These data, together with Census of Agriculture figures by county, were used to compile animal unit densities per drainage area using the

following equation:

$$A_p = \left[\left(\frac{1}{A_c}\right)\left(\frac{D_a}{1}\right) \frac{C_a + (0.184 \cdot H) + (0.0084 \cdot S) + (0.0093 \cdot P_l) + (0.0011 \cdot P_b) + (0.0222 \cdot P_t)}{1} \right]$$

and

$$A_n = \left[\left(\frac{1}{A_c}\right)\left(\frac{D_a}{1}\right) \frac{C_a + (0.169 \cdot H) + (0.175 \cdot S) + (0.0073 \cdot P_l) + (0.0015 \cdot P_b) + (0.0147 \cdot P_t)}{1} \right]$$

where: A_p = Animal units per square kilometer for Total P;
A_n = Animal units per square kilometer for Total N;
A_c = Total agricultural land (by county) in square kilometers;
D_a = Percent of subdrainage area in agriculture;
C_a = Total cattle and calves (by county);
H = Total hogs and pigs (by county);
S = Total sheep and lambs (by county);
P_l = Total layers (by county);
P_b = Total broilers (by county); and
P_t = Total turkeys (by county).

For drainage areas located in more than one county, weighted unit densities were determined based on the amount of each drainage area's agricultural land in each county. The coefficients have been adjusted to reflect average animal weights relative to an average weight for cattle and calves (same sources as for Table 1). It should be noted that coefficients for poultry take into consideration average life spans and broods per year.

GEOLOGY IDENTIFICATION

Some recent works on non-point source nutrients in streams have given as much or more emphasis to the effects of geology than to the effects of land use (Dillon and Kirchner, 1975; Likens and Bormann,

1974; Thomas and Crutchfield, 1974). Using the paper by Dillon and Kirchner as a guide, the following general breakdown was used to classify NES study subdrainage areas:

1. Sedimentary rocks or deep alluvium (>61 meters) with some or all limestone.
2. Sedimentary rocks or deep alluvium (>61 meters) without any mapped limestone.
3. Igneous rocks of volcanic origin.
4. Metamorphic rocks.
5. Igneous rocks of plutonic origin.

Where drainage areas included two of the above classifications, combinations were shown with the predominant type first. Sources for these data were mostly state and federal government geologic maps of varying dates and scales; although most were of individual states at scales ranging from 1:250,000 to 1:500,000.

SLOPE COMPUTATIONS

For each drainage area mean slope was calculated using an equidistant dot pattern overlay. Less dense patterns were used for this work than were used for computing land use percentages. For this procedure, 40-80 dots per drainage area were used. The overlays were placed randomly over the topographic maps on which the drainage areas had been outlined. Then, using an appropriate slope indicator, the percent of slope for the points under each dot was calculated. The data were then totaled and divided by the total number of points falling in the drainage area. The slope indicators used were transparent templates indicating percent of slope from distances between map contours, adjusted for map scale and contour interval.

OTHER PROCEDURES

Explanations of the following procedures are given in NES Working Paper No. 1 (U.S. Environmental Protection Agency, 1974); and NES Working Paper No. 175 (U.S. Environmental Protection Agency, 1975):

1. Tributary sampling methods and handling.
2. Analytical methods (stream samples).
3. Nutrient loading estimates.
4. Stream flow estimates.

It should be noted that nutrient exports were computed using "normalized" flow data (adjusted for seasonality and sampling year) from the USGS and drainage area measurements as determined by NES. For a few tributary sampling sites, where the USGS had not provided flow estimates, they were calculated by NES from runoff patterns in adjacent, overlapping, or nearby areas for which USGS estimates were provided. Loadings for all drainage areas in this study were estimated according to the following equation:

$$\text{Annual Load} = (C)(F)(31{,}356)$$

where: C = Mean annual concentration in milligrams per liter, and
F = Mean normalized annual stream flow in cubic meters per second.

The factor 31,356 is used to adjust the concentration and flow data in order to obtain loads in kilograms per year. The annual loads were then divided by the area (in square kilometers) of their respective watershed.

SECTION IV

DISCUSSION OF RESULTS

This section discusses the analysis of land use, other drainage area characteristics, and stream nutrient runoff data compiled for drainage areas within the first two groups of states covered by the NES. The raw data are presented in Appendix A and the distribution of the 473 data points (comprising the 1972 and 1973 areas) are illustrated in Figure 1. Subsequent reports will present data on the 524 drainage areas west of the Mississippi River where tributary sampling is still in progress.

AREAL DISTRIBUTIONS OF DATA

After compiling the data presented in Appendix A, several types of these data were sorted into classes and plotted on maps of the eastern half of the United States using a graduated color scheme. It was theorized that this might aid in uncovering correlations, regional patterns, and (by comparison with maps of other "macro" aspects such as physiographic regions, geology, soils, and climate) possible covariants. Maps were compiled for total P concentrations, total N concentrations, total P export, total N export, % agriculture plus % urban, flow per unit area per year, and mean slope. Maps illustrating the most significant patterns are included in black and white as Figures 5 through 8.

The map (Figure 5) of various classes of percent of drainage area in agricultural land use plus the percent in urban land use (% agriculture + % urban) revealed what might be expected from a knowledge of general land use patterns in the eastern United States. High percentages of land in agricultural and urban uses were present in the midwest farming and

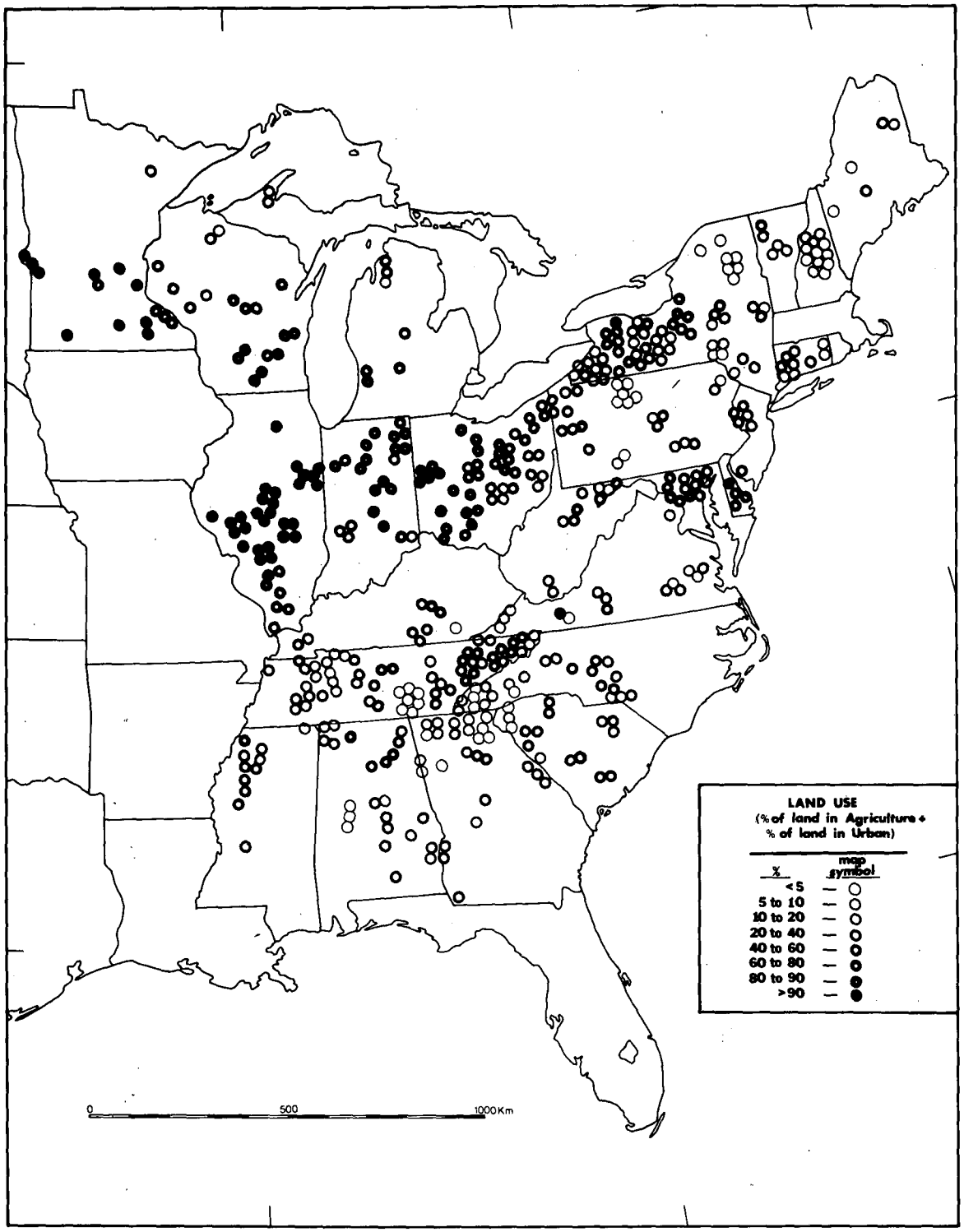


Figure 5. Areal distribution of percentages of land in agricultural and urban land use in study areas in the eastern United States.

manufacturing belt from the northwest corner of Pennsylvania through Ohio, Indiana, Illinois, and southern Wisconsin to southern Minnesota. Agricultural and urban land uses also predominated in Delaware and east-central Maryland, parts of the "ridge and valley" portion of the Appalachians, and patches of the "finger lakes" area of New York. Low percentages of these land use types were present in much of New England, northern Pennsylvania, and numerous places throughout the Appalachians and Southeast.

The map (Figure 6) illustrating the areal distribution of mean total phosphorus concentrations data uncovered a pattern roughly similar to that of the land use map, and hence a possible correlation. Comparison of the two maps (Figures 5 and 6) revealed several groups of drainage areas with notably lower phosphorus concentrations than might be expected from land use alone. These areas were in east-central Maryland, Pennsylvania, and parts of central and eastern Ohio and New York (particularly the finger lakes area).

The map (Figure 7) of total nitrogen concentrations, like that for total P, had a pattern similar to the map of land use. Some noteworthy differences were: (1) particularly high total nitrogen concentrations in the Midwest and middle Atlantic region, from Maryland and Delaware through New Jersey and southwestern Connecticut; and (2) very low values in the mixed farming areas of the central and southwestern Appalachians and remainder of the Southeast.

Examination of the areal distributions of both total P and total N export values revealed some similarities in pattern to that of land use, but far less than the likenesses between nutrient concentrations and land use. The distribution maps of slope and flow (discharge/unit area) values (Figure 8) were constructed to study the possible relationships of these factors to the differences in correlation between nutrient concentration and land use, and nutrient export and land use. Analyses of these data will follow in other sections of this paper.

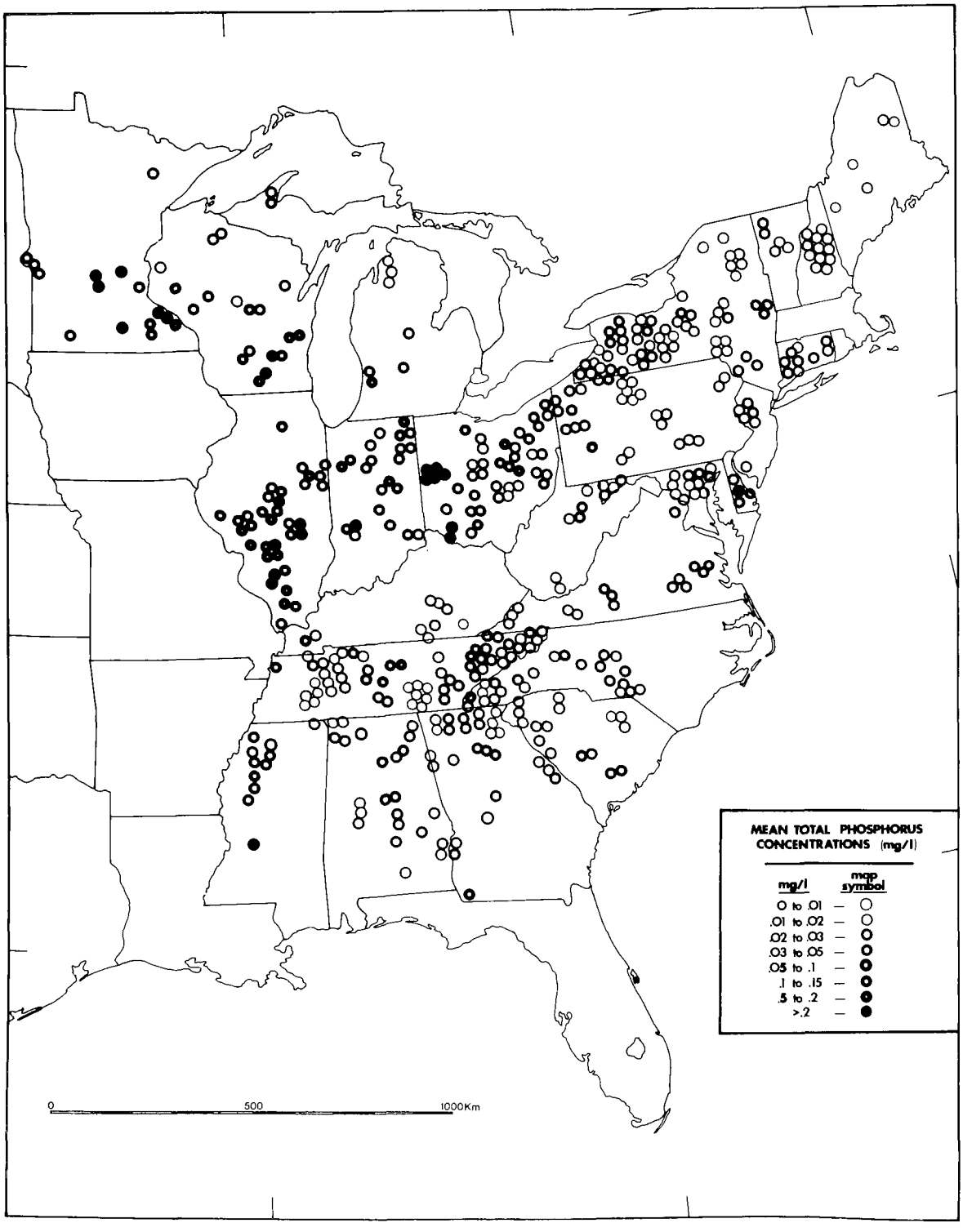


Figure 6. Areal distribution of mean total phosphorus concentrations in streams draining study areas in the eastern United States.

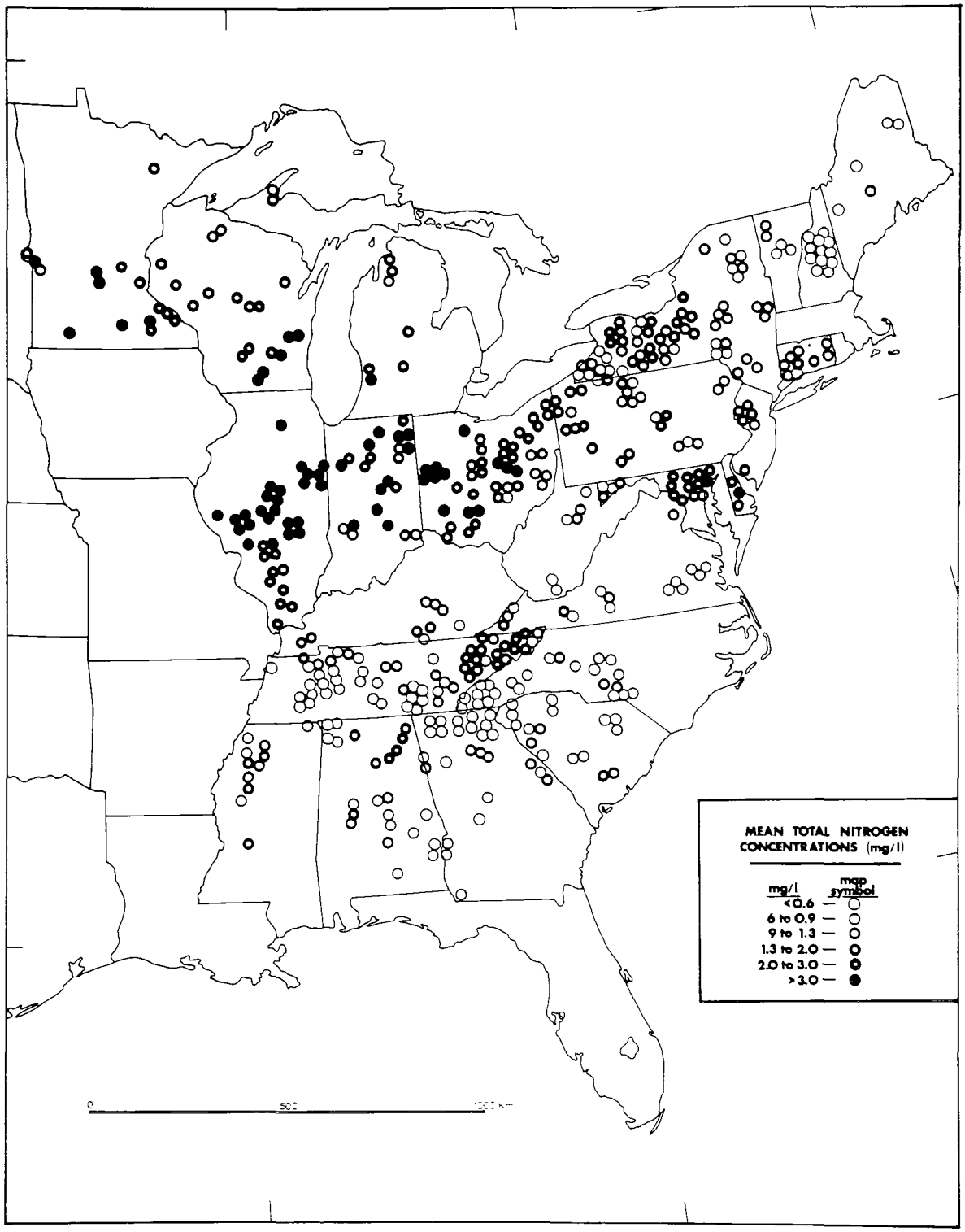


Figure 7. Areal distribution of mean total nitrogen concentrations in streams draining study areas in the eastern United States.

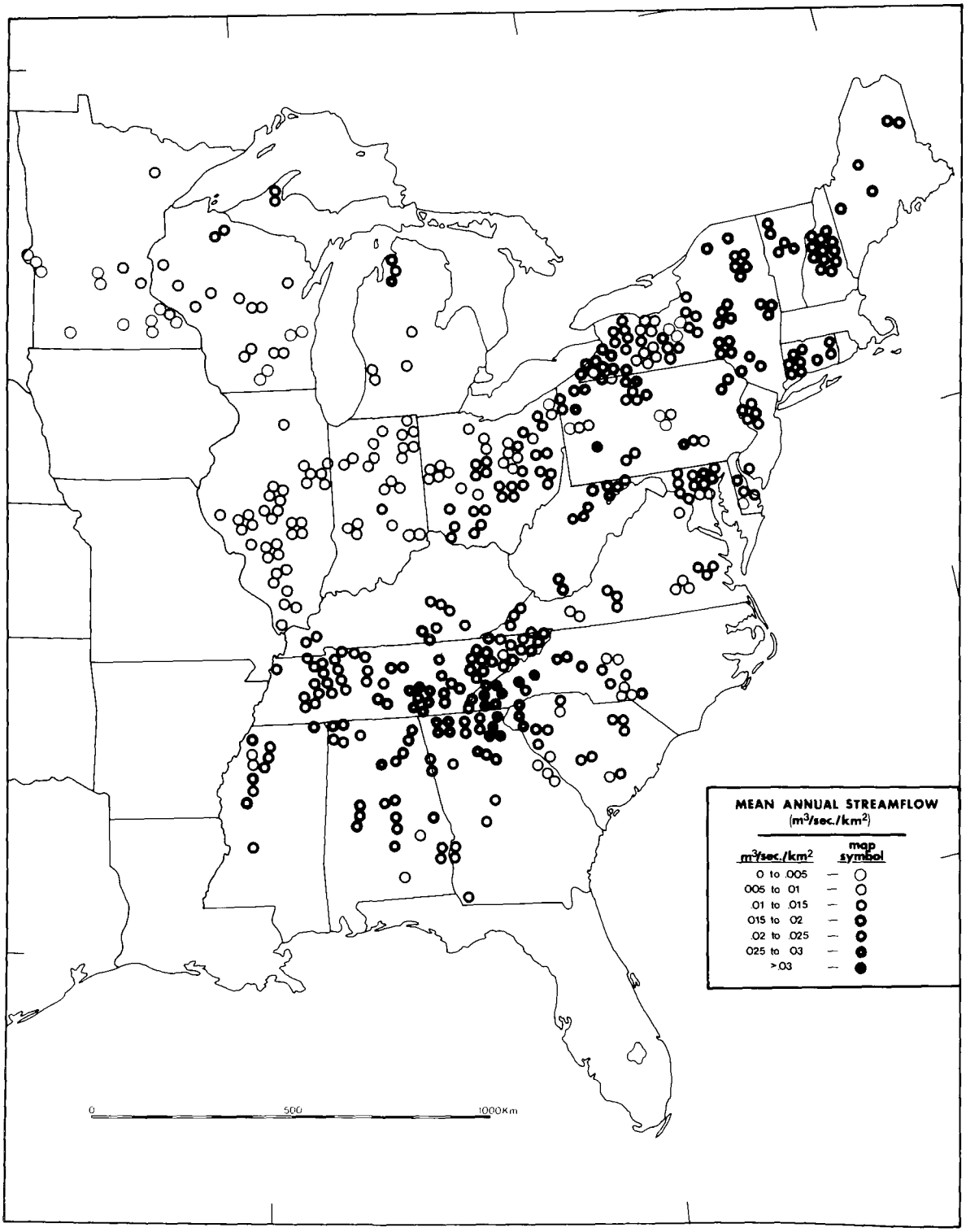


Figure 8. Distribution of mean annual areal flows in streams draining study areas in the eastern United States.

OVERALL LAND USE-NUTRIENT RUNOFF RELATIONSHIPS

Category Definitions

Individual drainage areas were assigned overall land use categories according to the following criteria:

1. Forest; other types negligible
   a. >75% forest (including forested wetland)
   b. <7% agriculture
   c. <2% urban
2. Mostly forest; other types present
   a. >50% forest
   b. not included in forest category
3. Mostly agriculture; other types present
   a. >50% agriculture
   b. not included in agriculture category
4. Agriculture; other types negligible
   a. >75% agriculture
   b. <7% urban
5. Urban
   >39% urban
6. Mixed; not included in any other category

General Analysis

The relationships between these overall land use categories and nutrient runoff are illustrated in Figures 9 through 12. It should be emphasized that these graphs contain mean annual nutrient stream values from the entire 24-state area and do not reflect regional relationships. For example, one should not conclude from Figure 9 that total phosphorus concentrations in streams draining "mostly agricultural" areas in Vermont and New York will average about 0.066.

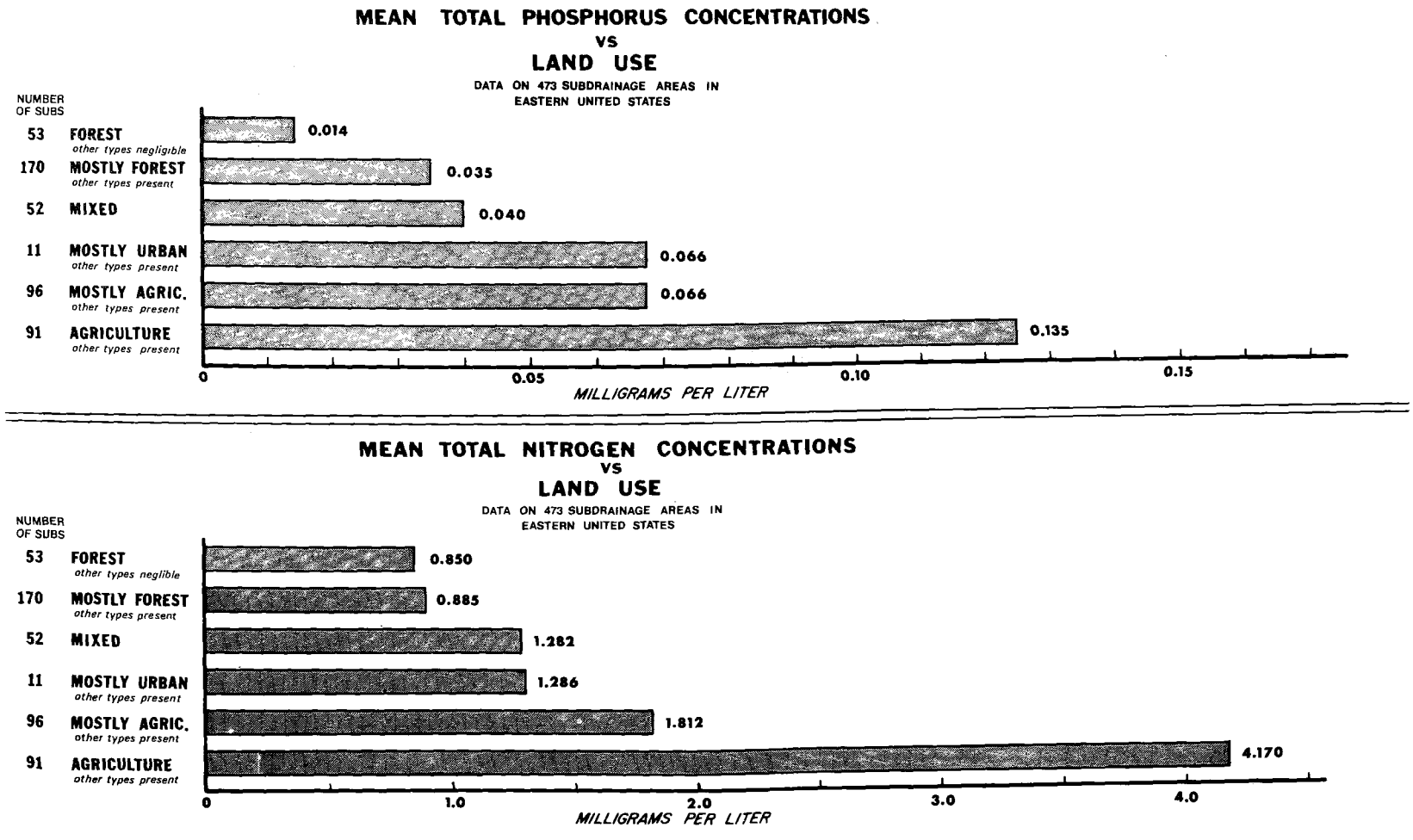


Figure 9. Relationships between general land use and total phosphorus and total nitrogen concentrations in streams.

From analysis of other values in the same geographical region, an average regional value would probably be somewhat smaller. By the same token, one would expect higher concentrations in streams draining "mostly agriculture" areas in the Corn Belt. Obviously, other interrelated factors such as agricultural practices, slope, soils, climate, etc., are important.

However, Figures 9 through 12 illustrate some significant overall relationships. Nutrient concentrations are significantly lower in streams draining forested areas than in streams draining areas that are used primarily for agricultural purposes. This is true for both nutrients but to a greater degree for total phosphorus than total nitrogen. Total phosphorus concentrations are roughly 10 times higher in streams draining predominantly agricultural watersheds than in streams draining forested watersheds. On the other hand, mean total nitrogen stream concentrations only show a difference of 5-fold from forested watersheds to agricultural watersheds. Interestingly, based on these mean concentration values, phosphorus would be expected to be limiting in surface waters draining either forest or agricultural areas. The total nitrogen to total phosphorus ratios are 60:1, 25:1, 32:1, 27:1 and 31:1 for "forest", "mostly forested", "mixed", "mostly agriculture" and "agriculture" areas, respectively. Generally phosphorus is the limiting nutrient as long as the N:P ratio exceeds 14:1 (Vollenweider, 1968). Also noteworthy is the fact that Figure 9 shows nearly the same mean values as did similar graphs prepared earlier for the 143 subdrainage areas covered by Working Paper No. 25 (U.S. Environmental Protection Agency, 1974).

Figure 10 shows the relationships of overall land use categories to mean concentrations of orthophosphorus and inorganic nitrogen. For orthophosphorus, the relationships appear about the same as those between total phosphorus and land use. Regardless of land use, mean orthophosphorus concentrations represented from 40% to 43% of the mean total phosphorus, except with predominantly urban drainage areas of which there were only 11.

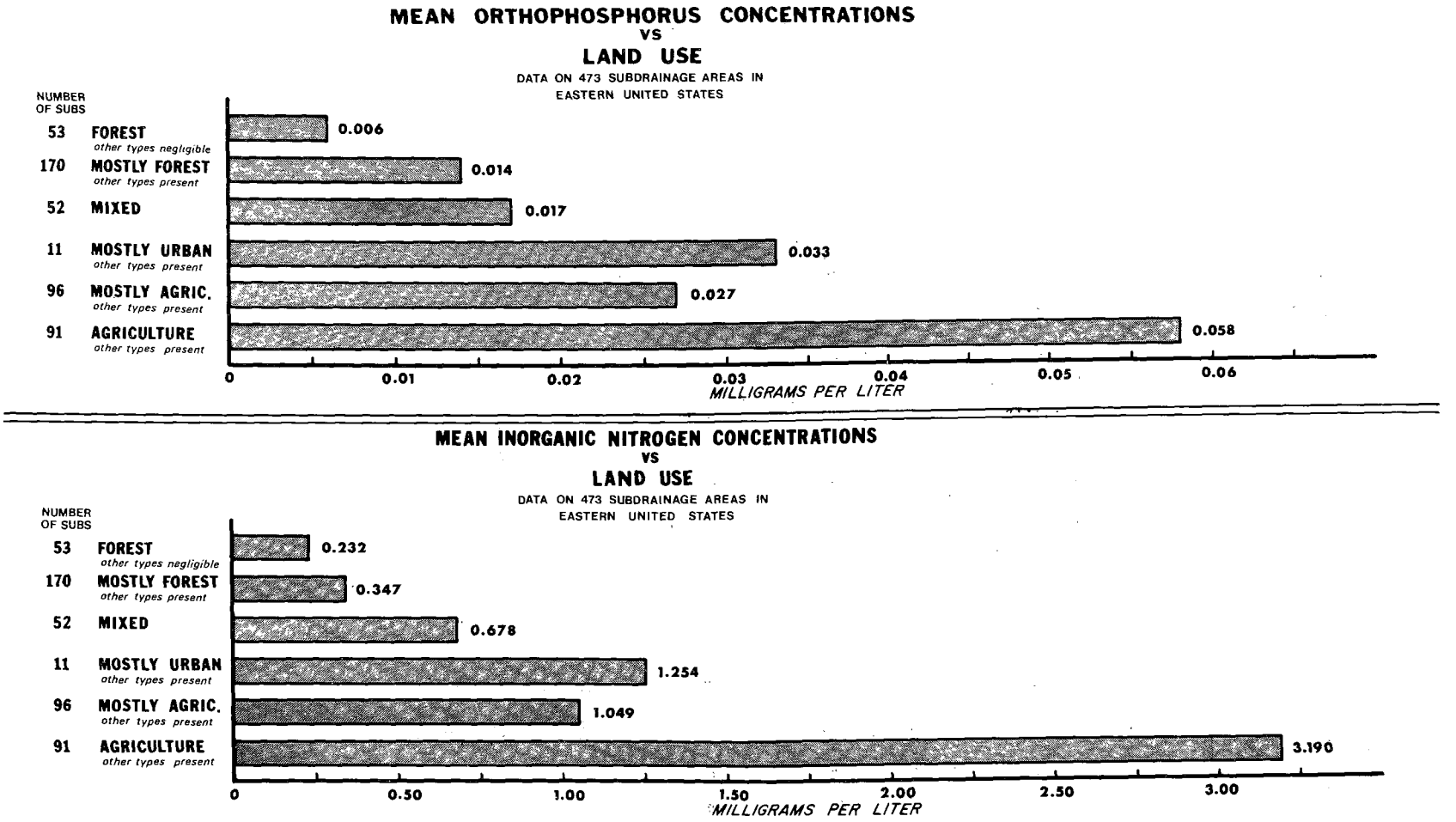


Figure 10. Relationships between general land use and orthophosphorus and inorganic nitrogen concentrations in streams.

By comparing Figure 9 with Figure 10, one can see that mean inorganic nitrogen concentrations represent an increasing percentage of mean total nitrogen concentrations with increased amounts of agricultural land use. The percentages are 27%, 39%, 53%, 57% and 76% for "forest", "mostly forest", "mixed", "mostly agriculture" and "agriculture" categories, respectively. This probably reflects the use of inorganic nitrogen fertilizers and the high water solubility of inorganic nitrogen compounds.

Mean inorganic nitrogen represented nearly 98% of the mean total nitrogen in the 11 "mostly urban" drainage areas. As mentioned earlier, no industrial or municipal waste treatment facilities or outfalls were known within these urban areas. However, the time and expense that would have been involved did not allow field checking. The data probably reflect effects of runoff from streets and lawns, and to some extent, the effects of septic tanks.

The nutrient loads per unit area of watershed for both forms of phosphorus and nitrogen are shown in Figures 11 and 12. These data indicate that the differences in export from different land use categories are considerably less pronounced than the differences in nutrient concentrations. Total phosphorus export was only 3.7 times greater from agricultural lands than from forested lands and total nitrogen export, only 2.2 times greater. Partial explanation of the difference in the relationships of concentrations to land use and export to land use apparently lies in the differences in stream flow (per unit area per year) between agricultural lands and forested lands. Regression analysis of flow (cubic meters per square kilometer per year) to the percent of subdrainage area in forest revealed a fairly good correlation ($r = 0.64$). This was probably due to greater slopes and thinner soils in the forested areas as opposed to the agricultural areas. The correlation coefficient between mean slope and the percent of drainage area in forest was 0.65 and the correlation coefficient for flow and the mean slope was 0.60. One would expect direct surface runoff to increase with increased slope, but

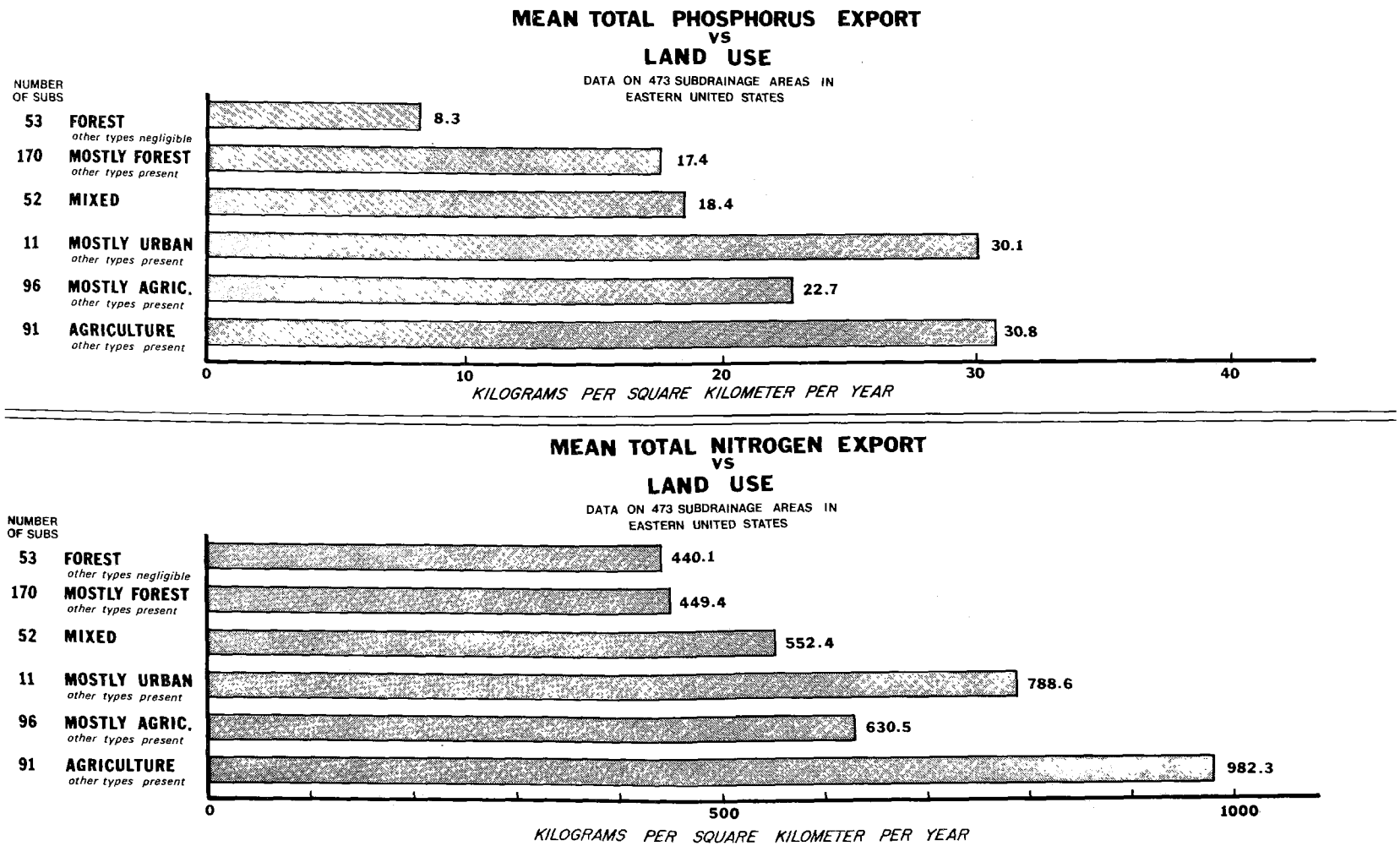
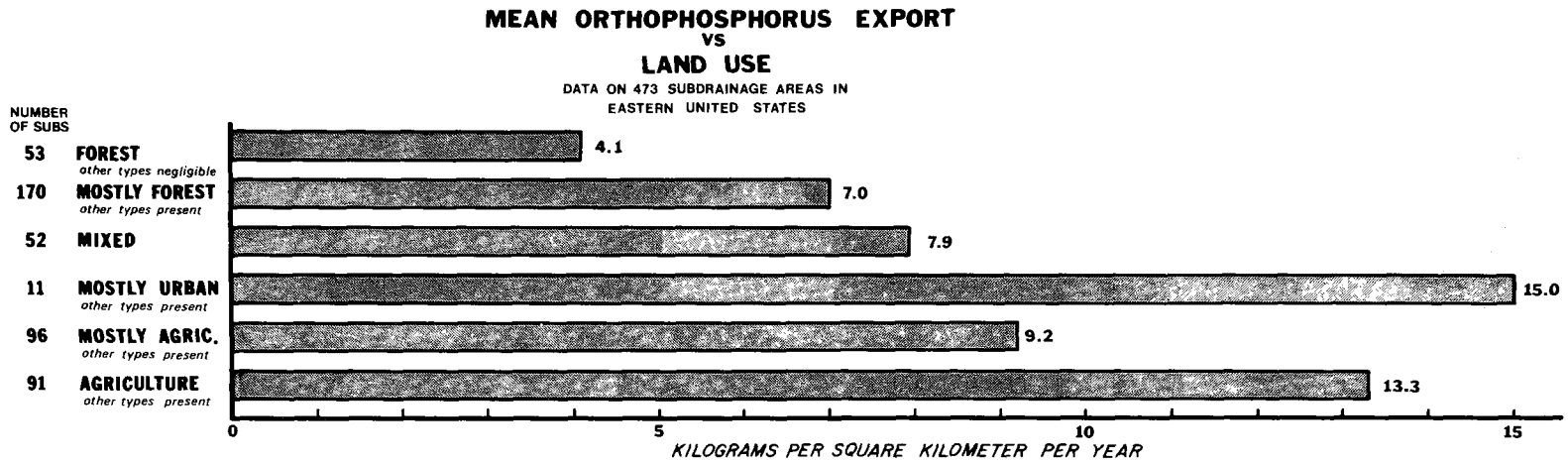


Figure 11. Relationships between general land use and stream exports of total phosphorus and total nitrogen.



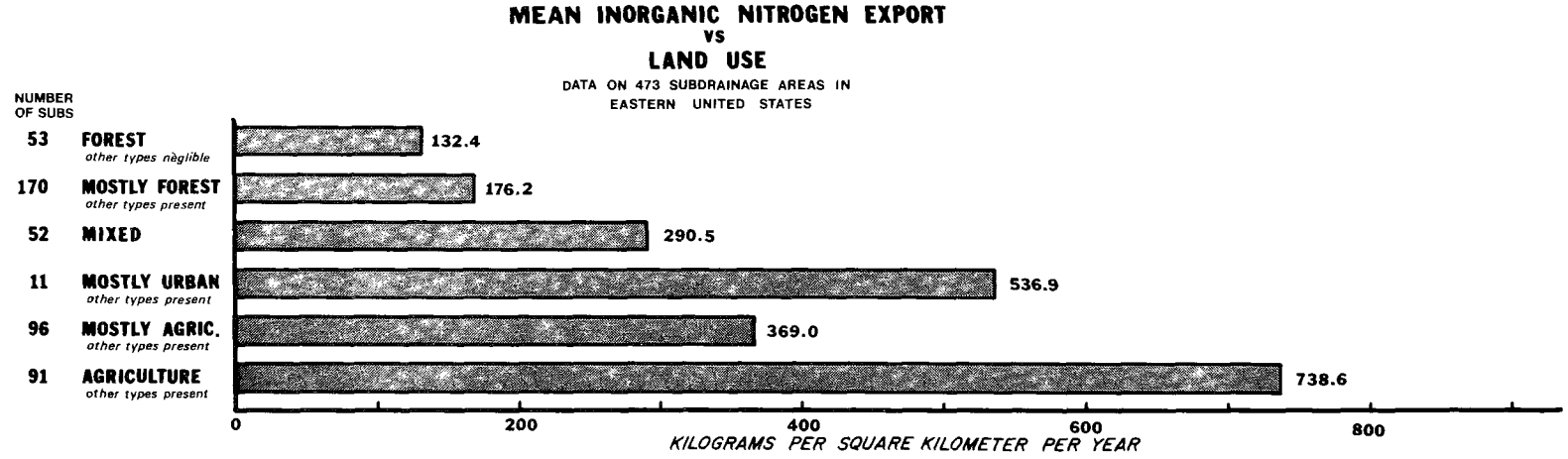


Figure 12. Relationships between general land use and stream exports of orthophosphorus and inorganic nitrogen.

not average annual stream discharge as was shown with these data; therefore, one or more covariants seem probable.

Some additional explanation of the difference between relationships of nutrient concentrations to land use and nutrient export to land use may be found in differences in mean annual precipitation patterns relative to study area locations. From analysis of study area locations, it appeared that most of the forested drainage areas were located in regions receiving slightly greater average annual precipitation amounts than regions where most of the agricultural watersheds were located. Greater annual precipitation amounts would help explain the greater flow values in forested study areas. However, the correlation between percent of subdrainage area in forest and mean annual precipitation was found to be statistically less significant ($r = 0.56$) than the correlation between slope and forest.

The data also indicate that urban land usage seems to have a pronounced effect on the amount of export. Again, the cause is probably increased flow rates, but in this case it was more likely because of greater areas of impervious surfaces.

For additional help in understanding the differences in the relationships between concentrations and land use, and export and land use, it is important to recognize that the drainage areas included in this study are not control plots. Rather, they are natural drainage areas which represent typical land use- and geographically-related characteristics in their respective areas. If one were studying control plots where slope, soil type, and climate conditions were similar from one plot to another, one would expect a significantly higher nutrient export rate (as well as a higher nutrient concentration) from plots in agricultural land use than from forested plots. Runoff as well would probably be somewhat greater from agricultural plots than from forested plots. Natural drainage areas, on the other hand, possess different topographic, soils, and climatic characteristics. These characteristics are important in determining land use in the first place. In general, flat to rolling terrain and rich soils, such as are found in southern Minnesota, lend

themselves to agricultural land use. Conversely, where the terrain is too mountainous or dissected or the soil too poor for agriculture to be economically feasible, such as in much of New England, forests are allowed to predominate.

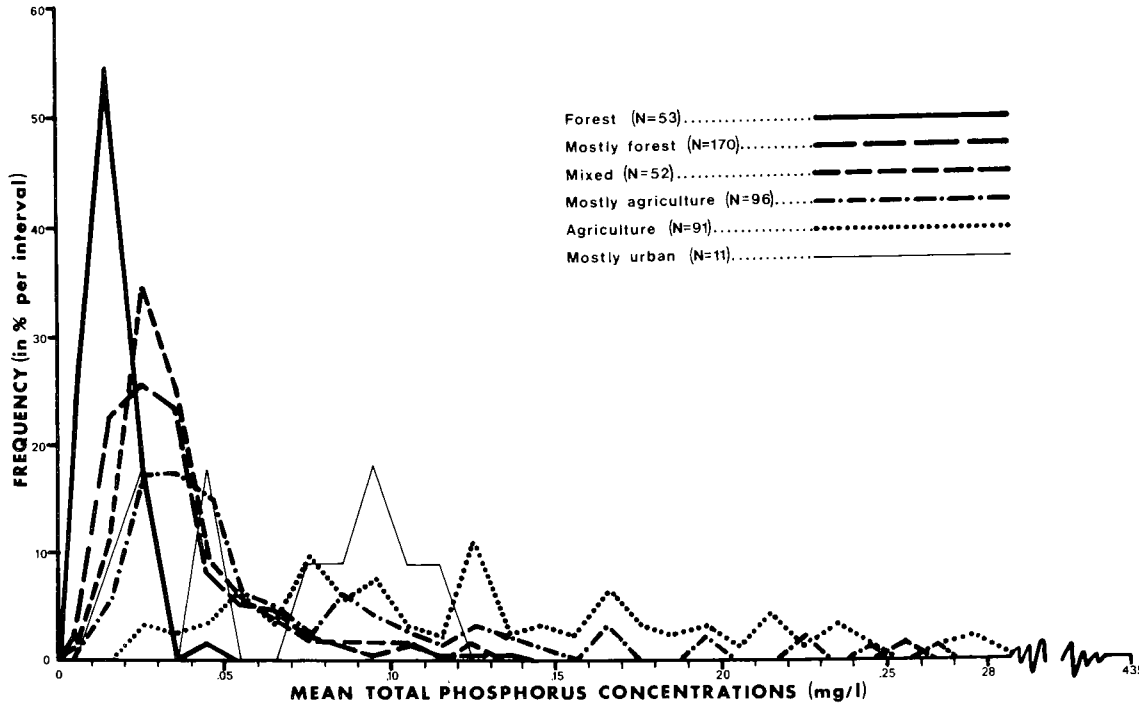
The fact that study subdrainage area sizes vary, and that those categorized as forest were considerably smaller than any other category, suggested that size might have a bearing on nutrient concentrations and/or stream flow. If either factor was related to size, then export would also be related. However, analysis of these data revealed no significant correlations.

The frequency polygons (Figures 13 through 16) illustrate how the nutrient concentration and export data were distributed for each land use type. Comparison of these polygons with Figures 9 through 12 show the data for forested drainage areas were grouped more tightly around the mean values than were data for agricultural drainage areas. The irregular data distributions for urban drainage areas are of questionable significance, mainly because of the small sample size.

Regionality

To refine the relationships of land use to nutrient runoff shown by the bar graphs and frequency polygons, a regional analysis is presented (Figures 18 through 21). Because the data appeared to be more closely related to land use than any other one "macro" element, it seemed a regional breakdown should be based on general land use and related geographical aspects that were instrumental in determining land usage. A modified breakdown of Austin's Land Resource Regions (1972) fits this description and the overall data distribution (Figure 17).

These graphs help explain where, within a given data distribution (in Figures 13 through 16), one is most likely to find concentration or export values based on regional location, but their use is limited. Where



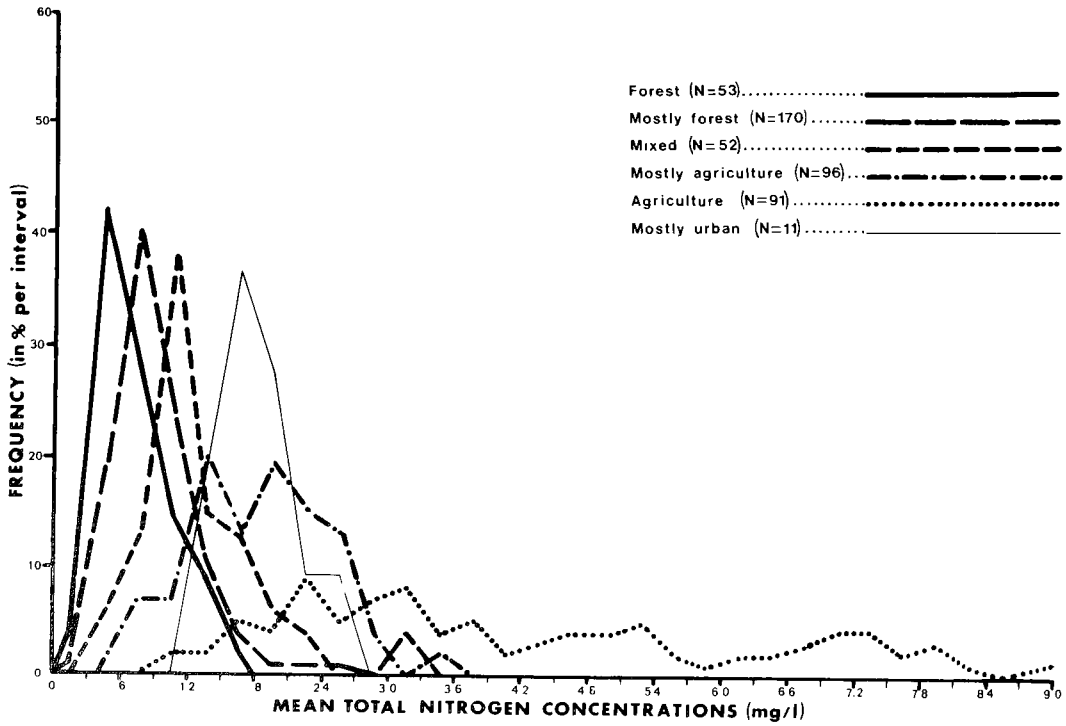
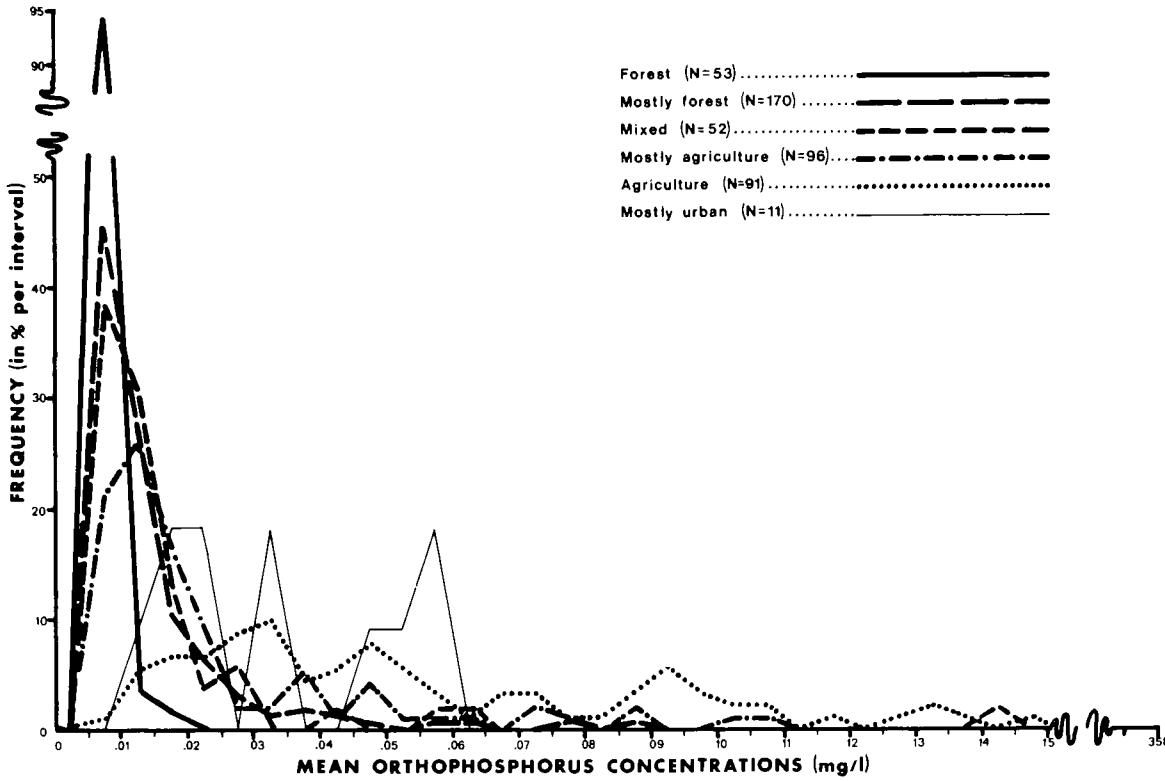


Figure 13. Frequency polygons of mean total phosphorus and mean total nitrogen concentrations in streams by overall land use category.



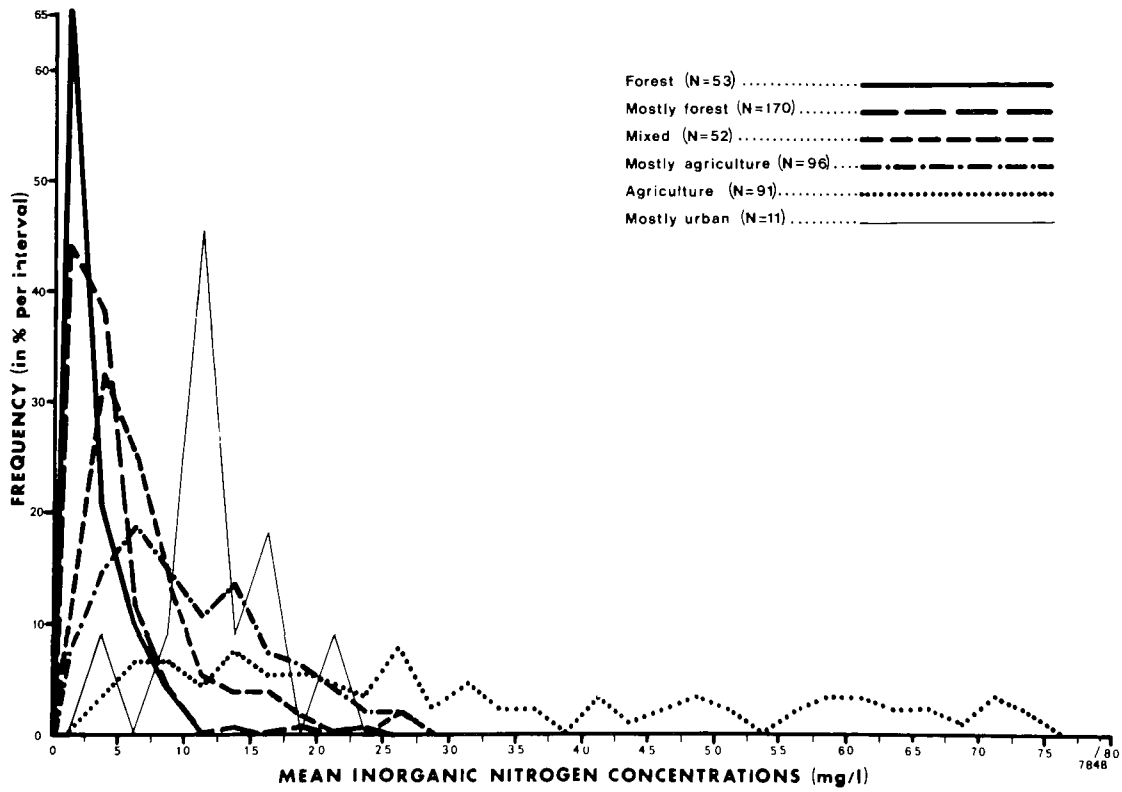
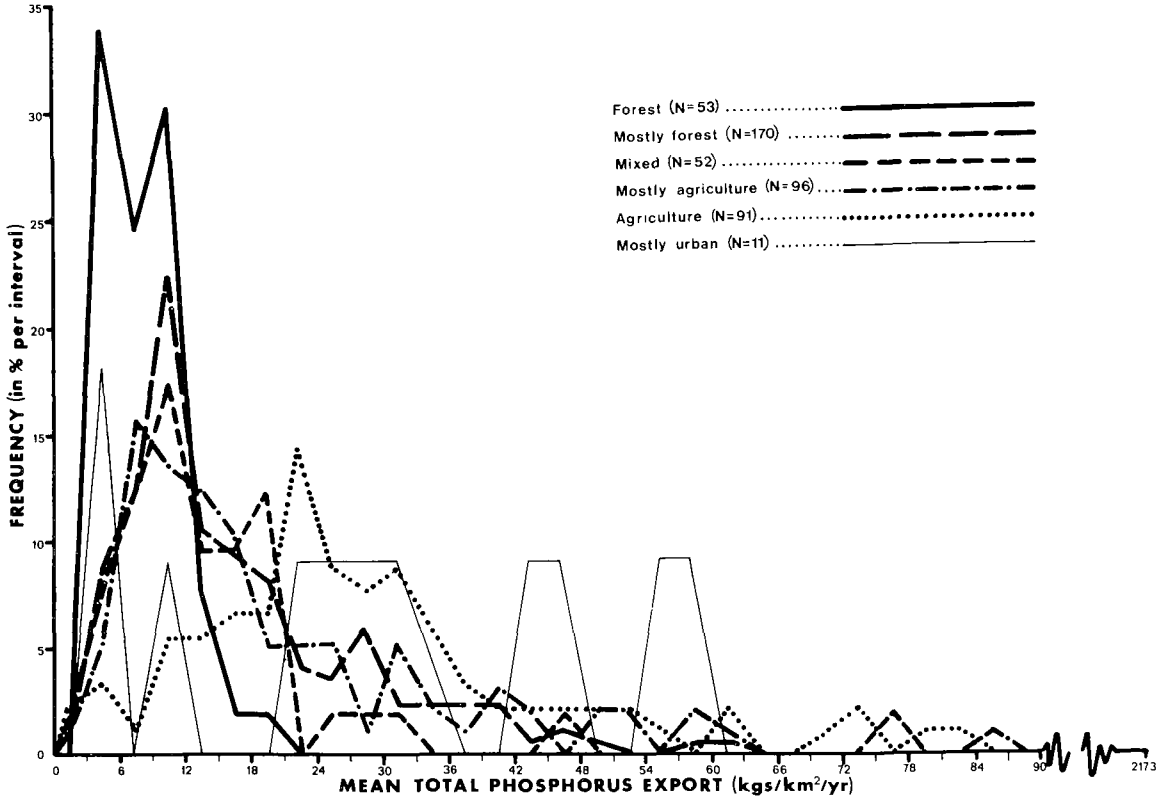


Figure 14. Frequency polygons of mean orthophosphorus and mean inorganic nitrogen concentrations in streams by overall land use category.



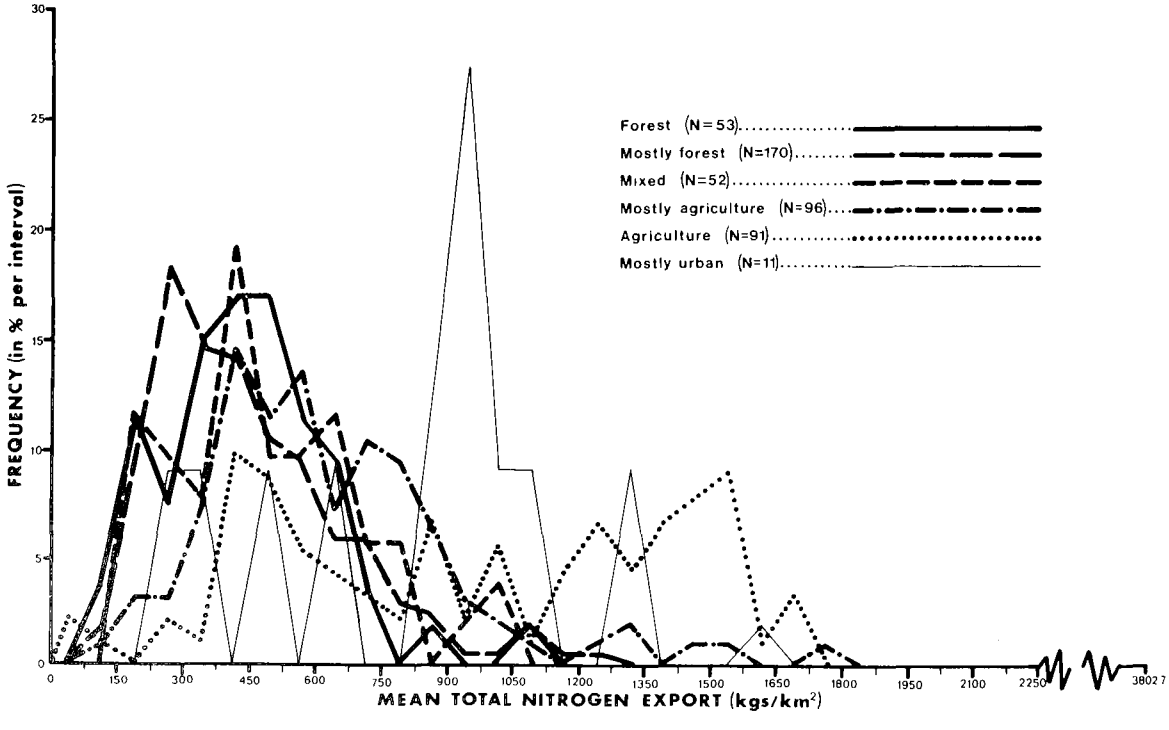


Figure 15. Frequency polygons of mean total phosphorus and mean total nitrogen stream exports by overall land use category.

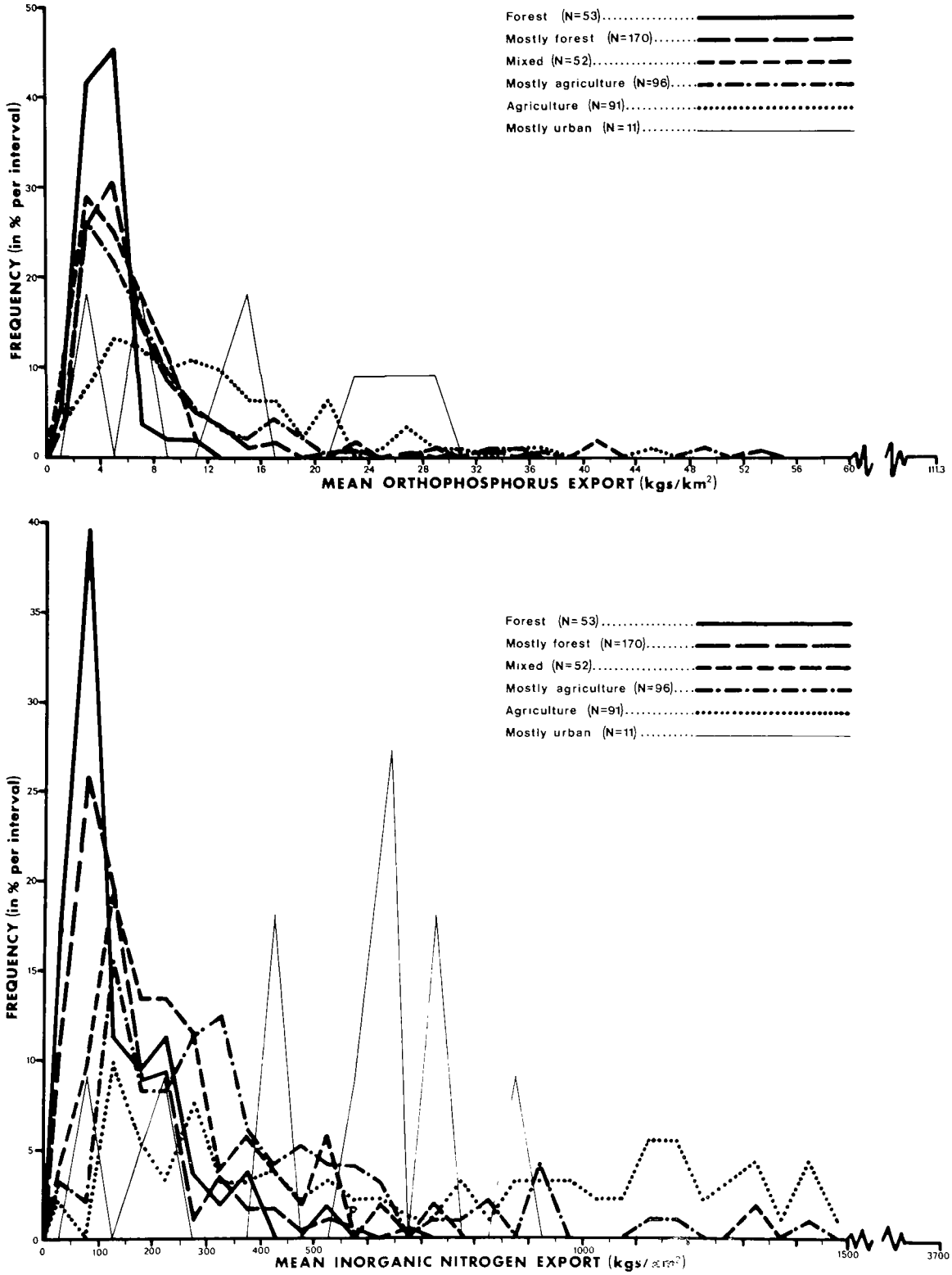


Figure 16. Frequency polygons of mean orthophosphorus and mean inorganic nitrogen stream exports.

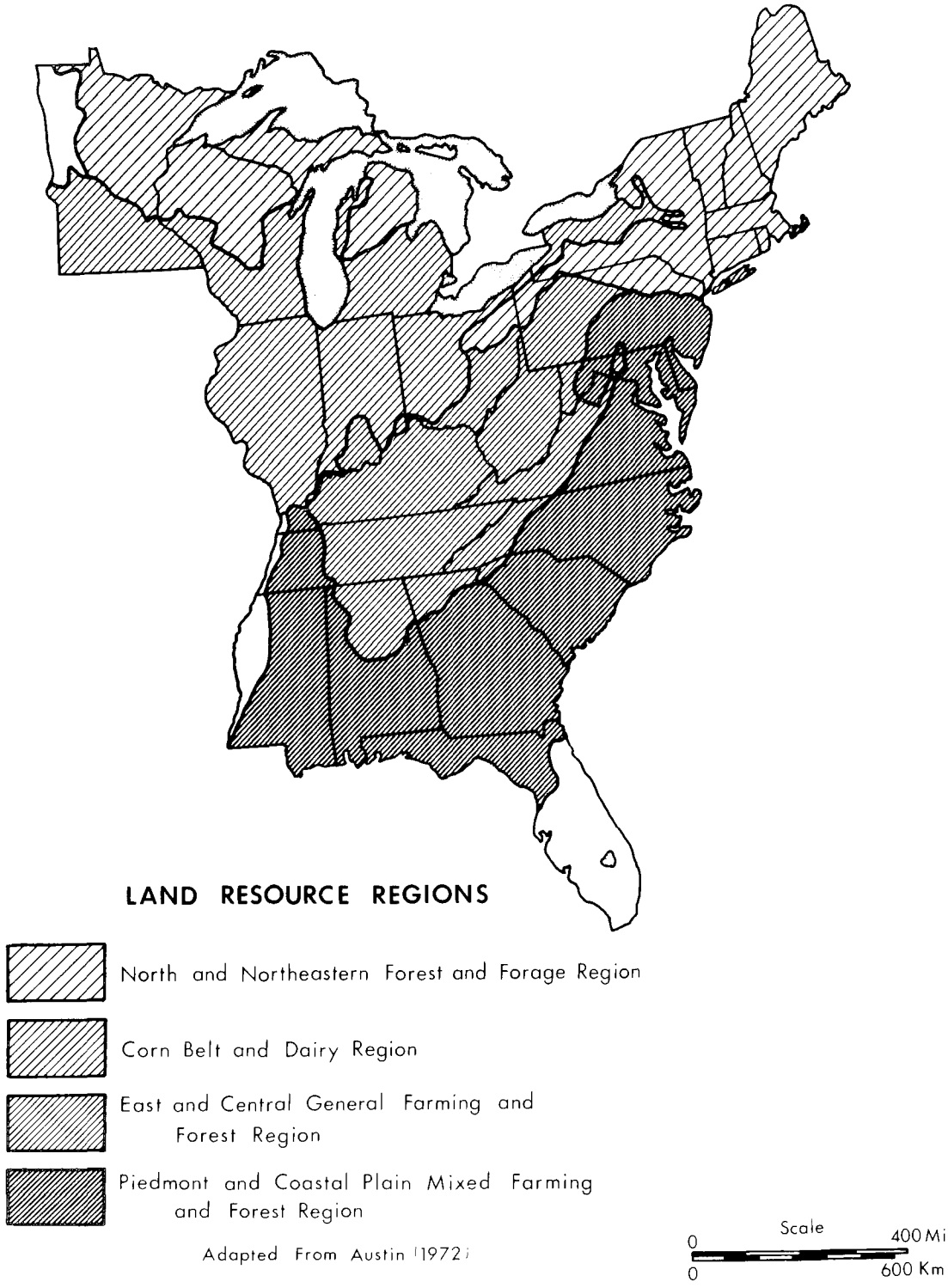


Figure 17. Land resource regions in the eastern United States. Adapted from Austin (1972).

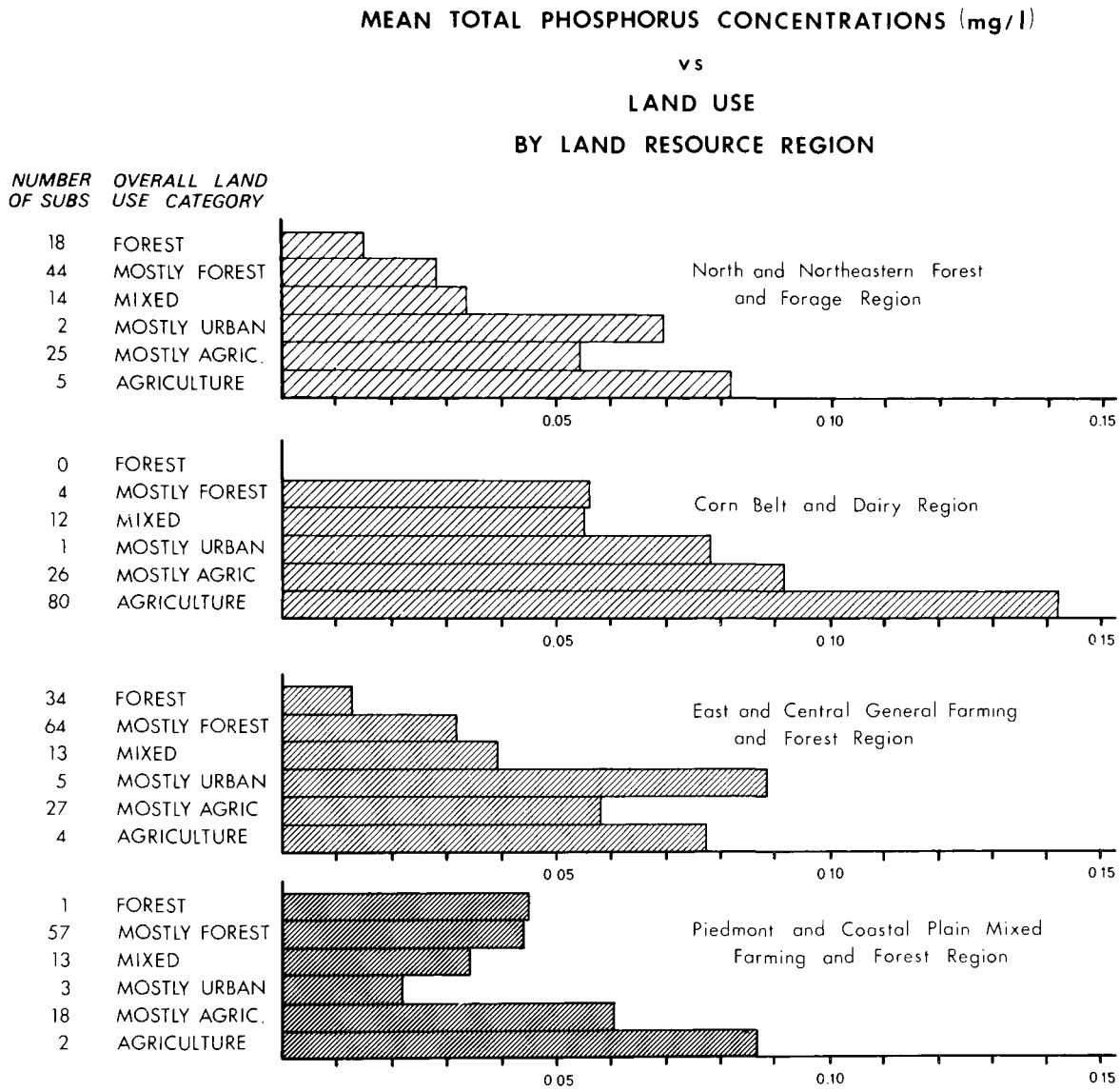


Figure 18. Regional relationships between general land use and total phosphorus concentrations in streams.

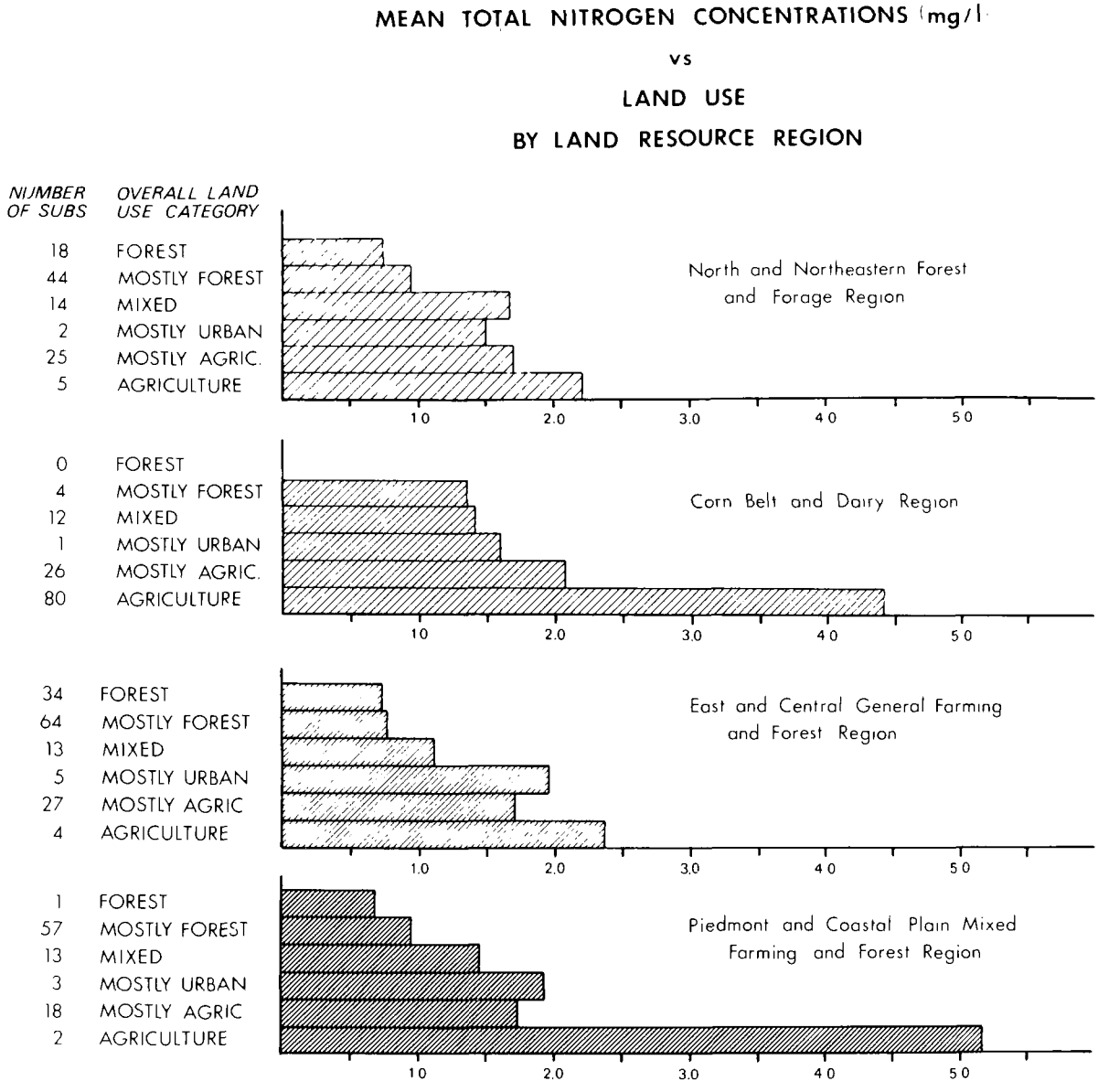


Figure 19. Regional relationships between general land use and total nitrogen concentrations in streams.

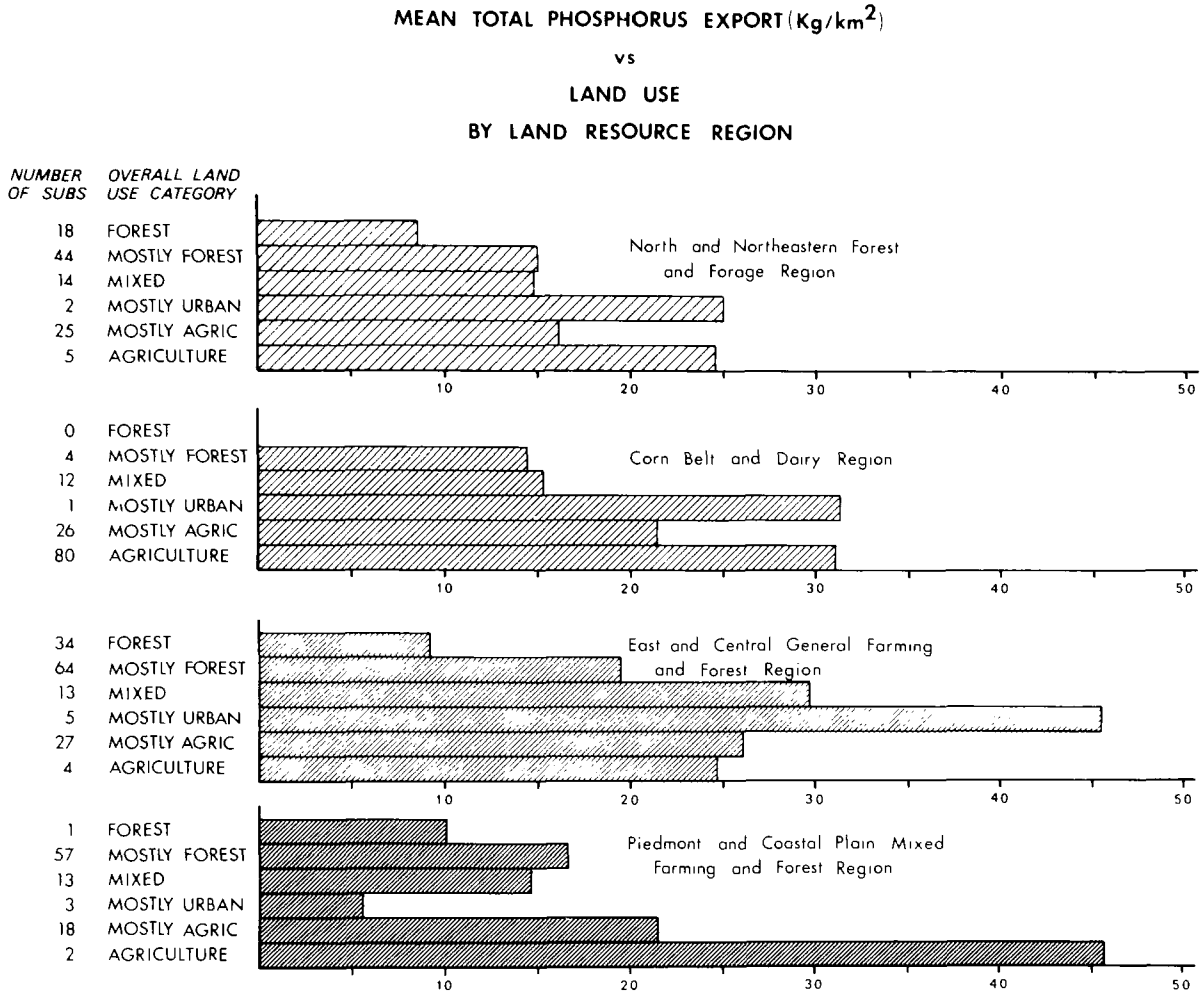


Figure 20. Regional relationships between general land use and stream export of total phosphorus.

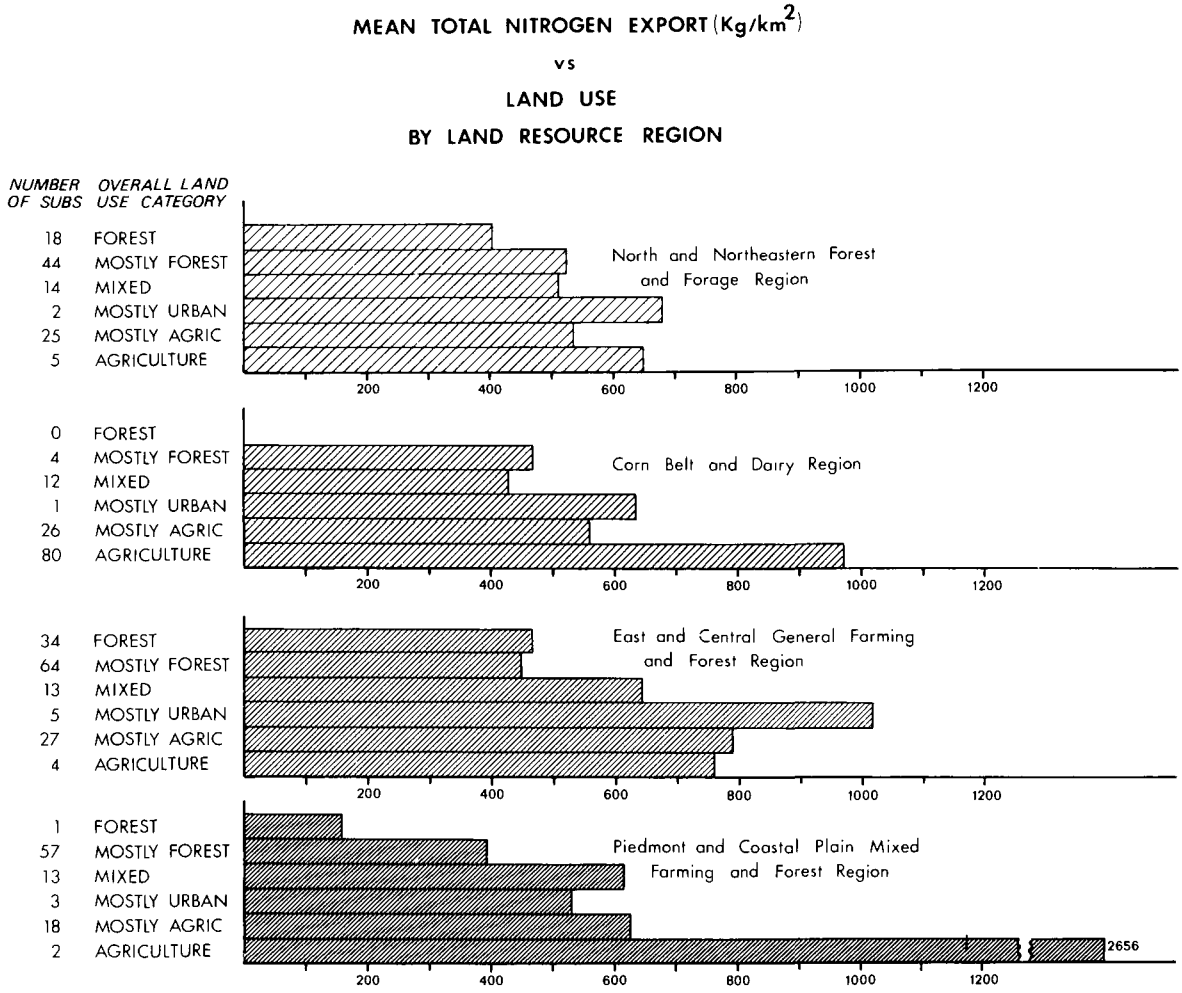


Figure 21. Regional relationships between general land use and stream export of total nitrogen.

sample sizes for a particular land use category are small, the concentration or export values for that category are of questionable use. For example, it is not safe to assume that, based on data for two drainage areas, streams draining "agriculture" areas in the Piedmont and Coastal Plain Mixed Farming Region (P.C. Region) are going to have generally higher total nitrogen concentrations than streams in the Corn Belt and Dairy Region (C.D. Region). As a matter of fact, from looking at the data for "mostly agriculture" areas, where the sample size was fairly large for both regions, one would probably estimate total nitrogen concentrations to be slightly lower in the P.C. Region than the C.D. Region. Also, because of the "room" within these overall land use categories (e.g. drainage areas categorized "forest" may contain from 75 to 100 percent forest and 0 to 6.9 percent agriculture), where sample sizes are small on either end of the overall land use category "scale" for a given Land Resource Region, the amount of that land use type within those few drainage areas can be expected to be smaller than it would be with a region where sample sizes are larger on the same end of the "scale".

INDIVIDUAL RELATIONSHIPS AND PREDICTION CAPABILITY

"Contributing" Land Use Types and Stream Nutrients

Figures 22 through 27 illustrate the relationships between land uses generally considered nutrient contributing (% agriculture plus % urban) and nutrients in streams. Several ways of looking at the effects of land use on nutrient concentrations or loads in streams were investigated. In general, nutrient loads increased with increased percentages in agricultural land usage, and decreased percentages in forested land. Little to no correlation was found between nutrient levels and percent of land in either cleared-unproductive, urban or wetland. This was expected because of the probable masking effects by agriculture and forest.

Since increased or decreased percentages of all general land use types appeared to have some effect on nutrient levels, a land use ratio of "contributing" (agriculture + urban) over "non-contributing" (forest + cleared-unproductive + wetland) types was investigated for its utility as a single factor including all land use types. Generally, relationships between these ratios and nutrient levels in streams were found to be more significant than those considering only one land use type. It was then determined that use of just the numerator (% agriculture plus % urban) from the ratio provided more easily understood land use values and eliminated the graphing problems encountered by working with values to infinity.

Use of "% agriculture plus % urban" to relate effects of land use on nutrient levels in streams appears to be appropriate where agriculture and/or forest comprise the predominant type(s). These two land use categories comprise the bulk of the land use data gathered for this study, but also constitute by far the predominant land use in the eastern half of the United States. The use of "% agriculture plus % urban" even seems to compensate for minor amounts of the other general land use types. However, its use is probably unsatisfactory for predicting or estimating nutrient concentrations or loads for areas where either urban, cleared-unproductive, or wetland land use types predominate; particularly where urban predominates. Insufficient data have been collected for these types.

"Contributing" Land Use Types and Nutrient Concentrations

Figure 22 shows the relation between mean total phosphorus concentrations in streams and "% agriculture plus % urban". The equation for the regression line shown in Figure 22 is:

$$\text{Log}_{10}\,(\text{PCONC}) = -1.831 + 0.0093\,(\%\ \text{agric.} + \%\ \text{urban}) \qquad (1)$$

The correlation coefficient for this relationship is 0.73. The utility of the equation for predictions is illustrated in Table 2.

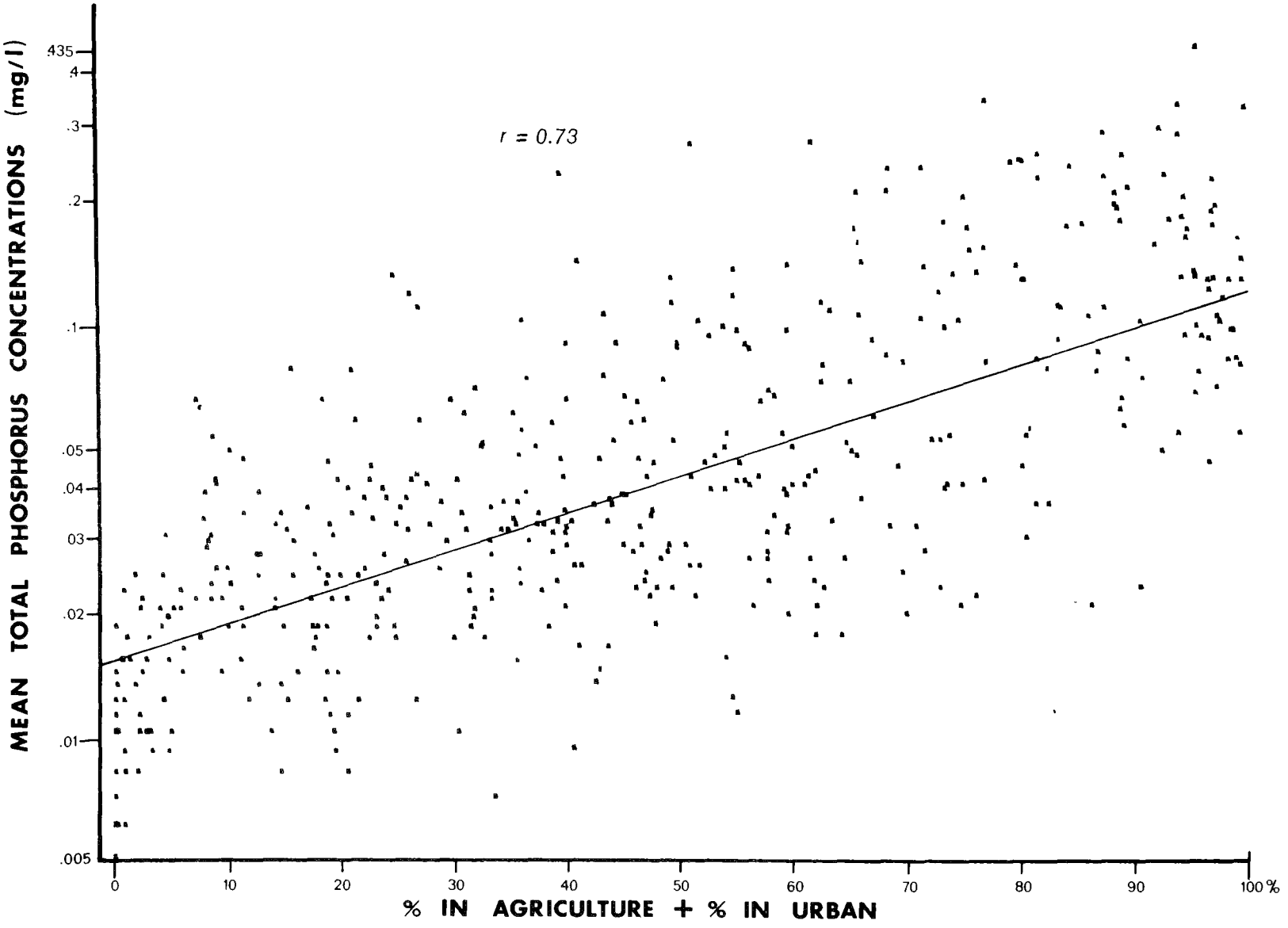


Figure 22. Scattergram of "contributing" land use types related to phosphorus concentrations in streams.

TABLE 2. PREDICTED MEAN TOTAL PHOSPHORUS CONCENTRATIONS (mg/l)

% Ag + % Urb	Avg. PCONC	67% Limits	95% Limits
0	0.015	0.008-0.027	0.004-0.050
25	0.025	0.014-0.046	0.007-0.086
50	0.043	0.023-0.079	0.013-0.146
75	0.074	0.040-0.135	0.022-0.249
100	0.126	0.068-0.231	0.037-0.427

For example, for streams draining areas with a combined agriculture plus urban land use percentage of 25%, mean total phosphorus concentrations average 0.025 mg/l. However, because of the variation around this prediction, there is only a 67% probability that the true value will fall in the range 0.014 to 0.046 mg/l, and there is a 95% confidence that the value will be within the wider range of 0.007 to 0.086 mg/l.

The next most complex model makes a correction in the sense that streams in the Corn Belt and Dairy Land Resource Region (region B) have somewhat higher mean total phosphorus concentrations than one would predict from data for the other Land Resource regions (regions A, C and D) only. Equations for this model are:

$$\text{Log}_{10}\,(\text{PCONC}) = -1.805 + 0.0081\ (\%\ \text{agric.} + \%\ \text{urban}) \qquad (2)$$

for region B and

$$\text{Log}_{10}\,(\text{PCONC}) = -1.676 + 0.0081\ (\%\ \text{agric.} + \%\ \text{urban}) \qquad (3)$$

for regions A, C and D.

This model explains that for drainage areas having similar combined agriculture plus urban land use percentages, streams in region B will have predicted phosphorus concentrations about 37% higher than those in regions A, C and D.

However, the root mean square deviation using this model is only 0.26 as compared to 0.27 for the first model (1), which means it is not appreciably better for prediction. In other words, although the model does predict somewhat different average phosphorus concentrations because of some regional characteristics, the unexplained variation around this prediction is so great that the change is really not significant. Differences in predicted values using the two models are shown in Table 3.

TABLE 3. PREDICTED MEAN TOTAL PHOSPHORUS CONCENTRATIONS (mg/l) FOR SIMPLE AND REGIONAL MODELS

	Simple Model	Regional Model	
% Ag + % Urb	Avg. PCONC	Avg. PCONC in Region B	Avg. PCONC in Regions A, C and D
0	0.015	0.021	0.016
25	0.025	0.034	0.025
50	0.043	0.054	0.040
75	0.074	0.085	0.063
100	0.126	0.136	0.101

Finally, a model which incorporates every variable on file in this study (listed in Appendix A) that has a statistically significant effect, adjusted for other related variables on file, is the following:

$$\text{Log}_{10}\,(\text{PCONC}) = -2.576 - 0.0046\ \text{slope} + 0.0021\ \text{precip.} + 0.129\ \text{pH} + 0.0071\ (\%\ \text{agric.} + \%\ \text{urban}) \qquad (4)$$

The correlation coefficient for this model is 0.75 and the root mean square deviation is 0.255 meaning that again, predictions using this model are not appreciably better than those derived from the simple model. Inclusion of this model is primarily to show the effect of the statistically significant variables used, holding everything else constant. It

is notable that inclusion of the surface soil pH value makes it unnecessary to fit a different model for region B. Also interesting is the fact that after adjusting for "% agriculture plus % urban", the effect of animal unit density is not statistically significant for total phosphorus concentrations. Animal unit density had a significant effect on total phosphorus concentrations for the data (on 143 drainage areas) collected for Working Paper No. 25 (Environmental Protection Agency, 1974). This may have been due to the fact that most of the agricultural areas included in the Working Paper No. 25 data set were dairy oriented. With the present data set (473 subdrainage areas) it is probable that other agricultural characteristics have masked the effects of animal unit densities.

Figure 23 shows the relationship between mean total nitrogen concentrations and "% agriculture plus % urban". The equation for the regression line shown in Figure 23 is:

$$\text{Log}_{10}\,(\text{NCONC}) = -0.278 + 0.0088\,(\%\ \text{agric.} + \%\ \text{urban}) \qquad (5)$$

The correlation is stronger (r = 0.83) than that shown for phosphorus concentrations (Figure 22), and there is noticeably less variation around the regression. Thus, the model does a little better in predicting than did the simple model for phosphorus. The utility of this equation for predicting mean total nitrogen concentrations is shown in Table 4.

TABLE 4. PREDICTED MEAN TOTAL NITROGEN CONCENTRATIONS (mg/l)

% Ag + % Urb	Avg. NCONC	67% Limits	95% Limits
0	0.53	0.35-0.80	0.24-1.19
25	0.87	0.58-1.31	0.39-1.96
50	1.45	0.97-2.18	0.64-3.26
75	2.41	1.61-3.62	1.07-5.42
100	4.00	2.67-6.00	1.78-9.00

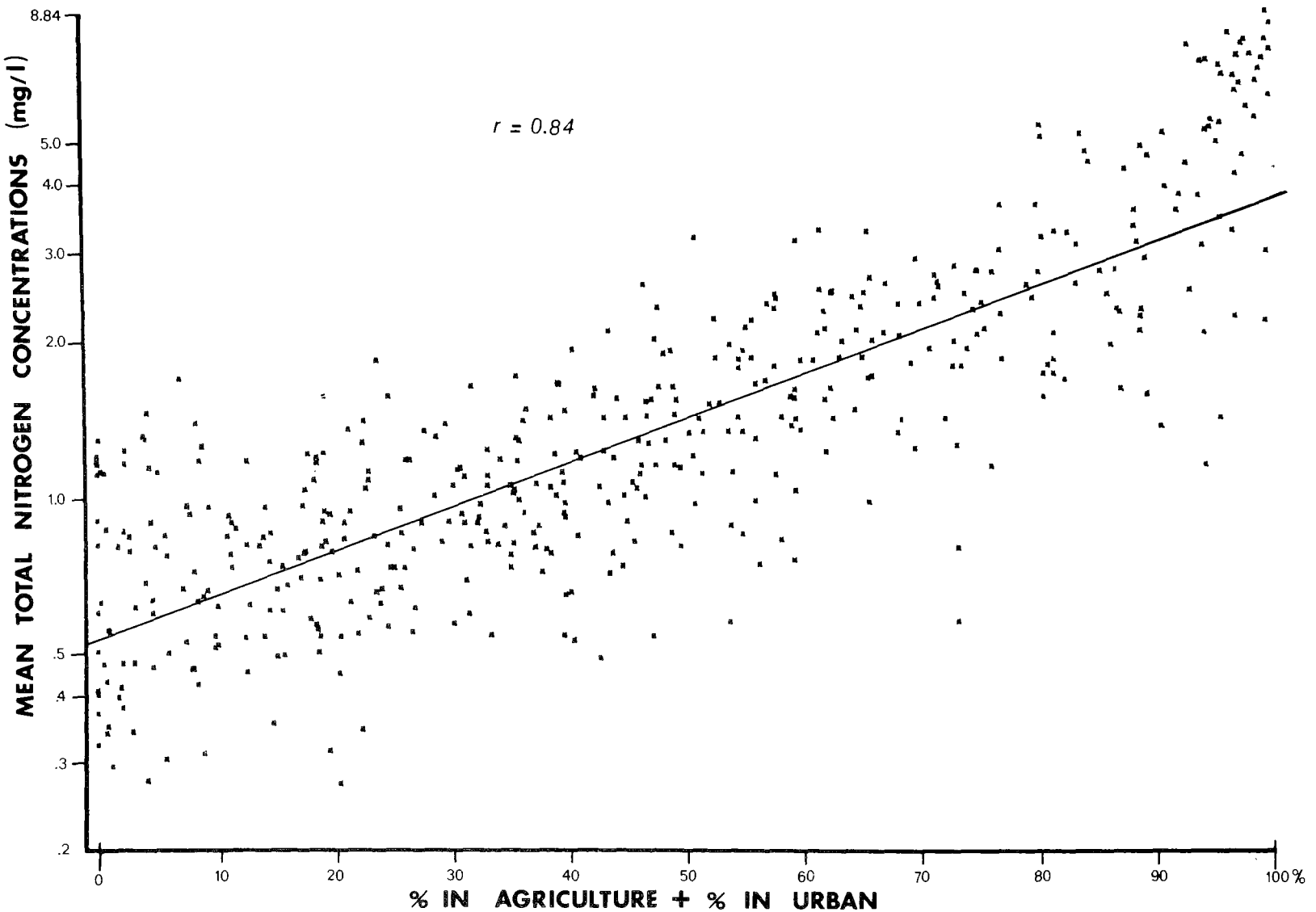


Figure 23. Scattergram of "contributing" land use types related to nitrogen concentrations in streams.

The next most complex model, as was the case with phosphorus, fits one regression line for region B and another for regions A, C and D. However, the two equations for predicting total nitrogen concentrations not only have different intercepts, but different slopes as well. One partial explanation is that the effect of "% agriculture + % urban" on nitrogen concentrations is not linear over a very wide range.

The equations for the regional model are:

$$\text{Log}_{10}\ (\text{NCONC}) = -0.331 + 0.0101\ (\%\ \text{agric.} + \%\ \text{urban}) \qquad (6)$$

for region B and

$$\text{Log}_{10}\ (\text{NCONC}) = -0.236 + 0.0071\ (\%\ \text{agric.} + \%\ \text{urban}) \qquad (7)$$

for regions A, C and D.

This regional model, like that for total phosphorus concentrations, does not give appreciably better predictions than the simple model, due to the large amount of unexplained variation. The root mean square deviation for the regional model is 0.17 as compared to 0.19 for the simple model. Differences in predicted values using the two models are shown in Table 5.

TABLE 5. PREDICTED MEAN TOTAL NITROGEN CONCENTRATIONS (mg/l) FOR SIMPLE AND REGIONAL MODELS

	Simple Model	Regional Model	
% Ag + % Urb	Avg. NCONC	Avg. NCONC in Region B	Avg. NCONC in Regions A, C & D
0	0.53		0.58
25	0.87	0.83	0.87
50	1.45	1.49	1.32
75	2.41	2.67	1.98
100	4.00	4.77	2.98

A third model using all variables on file which are statistically significant, adjusted for other related variables on file, is the following:

$$\text{Log}_{10}\ (\text{NCONC}) = 0.237 - 0.0018\ (\%\ \text{Forest}) - 0.002\ \text{slope} - 0.0018\ \text{precip.} - 0.0012\ \text{animal unit density} + 0.0013\ (\%\ \text{agric.} + \%\ \text{urban}) + 0.000055\ (\%\ \text{agric.} + \%\ \text{urban})^2 \quad (8)$$

This model has a root mean square deviation of about the same as the previous two models (0.17) and a correlation coefficient of 0.84, indicating it is not significantly better for predictive purposes than the simple model. It does show, however, which variables have statistically significant effects when other variables are held constant. It is interesting to note that animal unit density has a significant effect on mean total nitrogen concentrations[1].

Figures 24 and 25 show the relationships between "% agriculture plus % urban" and both mean orthophosphorus concentrations and mean inorganic nitrogen concentrations. The equation for the regression line shown in Figure 24 is:

$$\text{Log}_{10}\ (\text{OPCONC}) = -2.208 + 0.0089\ (\%\ \text{agric.} + \%\ \text{urban}) \quad (9)$$

The equation for the regression line shown in Figure 25 is:

$$\text{Log}_{10}\ (\text{INCONC}) = -0.873 + 0.0136\ (\%\ \text{agric.} + \%\ \text{urban}) \quad (10)$$

The correlation coefficients ($r = 0.70$ for OPCONC and % agric. + % urban, and 0.82 for INCONC and % agric. + % urban) for these relationships are a little lower than similar relationships for total phosphorus and total nitrogen shown in Figures 22 and 23.

1 Data from the three drainage areas with extremely high animal unit densities were <u>not</u> used to fit the above model. In these three cases, county figures were apparently not appropriate and gave distorted animal unit density values.

"Contributing" Land Use Types and Nutrient Export

Figures 26 through 27 illustrate the relationships between nutrient export and "% agriculture plus % urban". These figures show less significant relationships between nutrient export and "contributing" land use than were shown between nutrient concentrations and "contributing" land use. From an earlier analysis of overall land use and nutrient runoff, lower correlations (r = 0.41 between total P export and "% agric. + % urban", 0.36 between orthophosphorus export and "% agric. + % urban", 0.46 between total nitrogen export and "% agric. + % urban", and 0.61 for inorganic nitrogen export and "% agric. + % urban") were to be expected. Because of the covariants mentioned earlier, and other effects on the "flow" portion of the export computation, a more accurate method of predicting export values (or stream loads) would be to use the appropriate model for concentration prediction and then multiply by flow. Stream flow data are available for most of the United States from the U.S. Geological Survey. For drainage areas where flow data are not available, good estimates can be made for USGS flow records on overlapping, adjacent, or nearby areas, together with some general knowledge of the topographic and climatic characteristics of the particular area.

Regionality

Figures 28 and 29 illustrate the regional aspects of the two simple models [(1) and (5)] for predicting nutrient concentrations in streams from combined percentages of agricultural and urban existing land use. These maps offer some qualitative refinement of the models by revealing, on the basis of data gathered for this study, geographical areas where nutrient concentrations can be expected to be greater, much the same as, or less than those predicted by the models.

The data in Figure 28 illustrate some fairly obvious regional patterns. They indicate that phosphorus concentrations in streams are generally

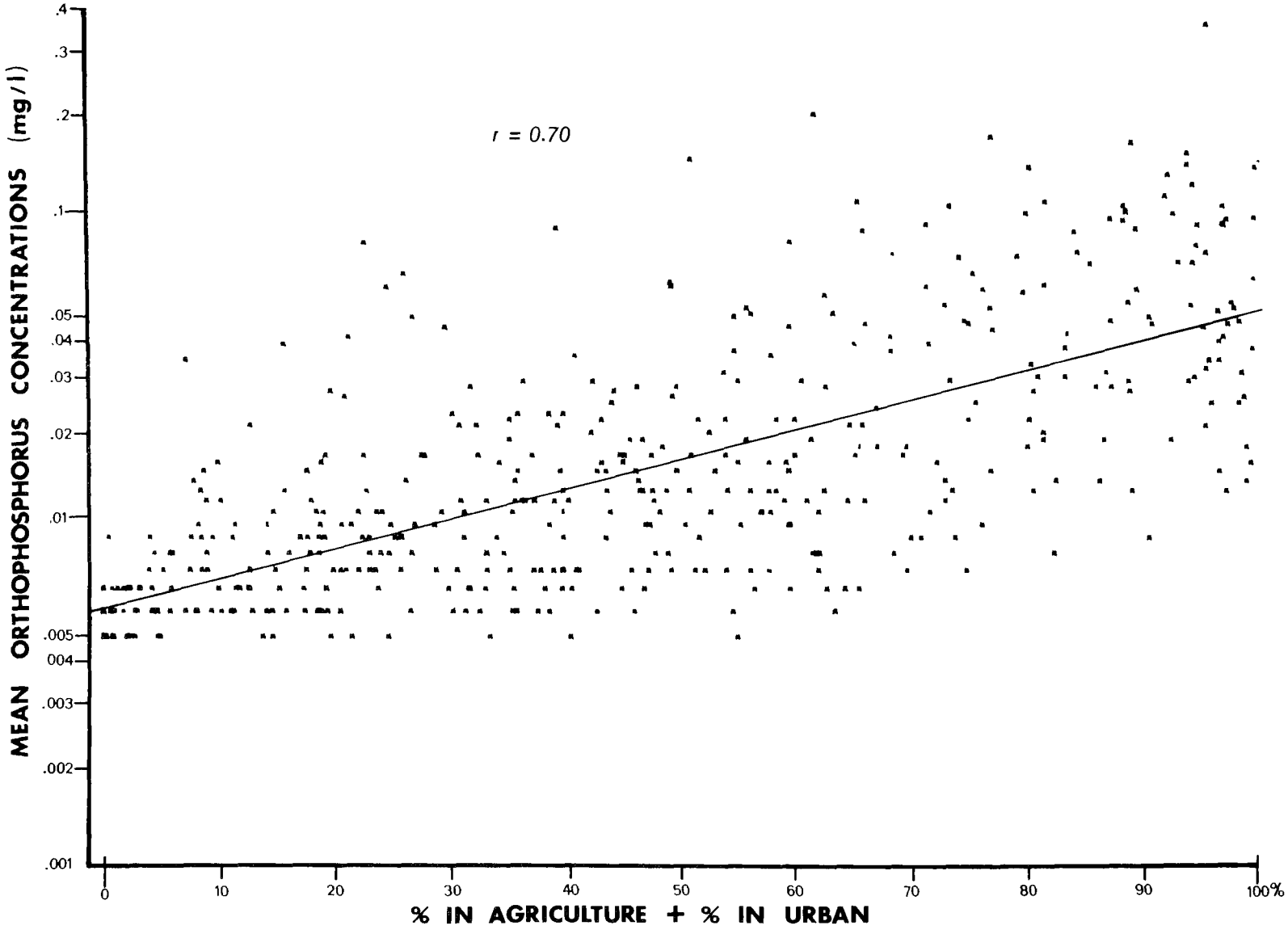


Figure 24. Scattergram of "contributing" land use types related to orthophosphorus concentrations in streams.

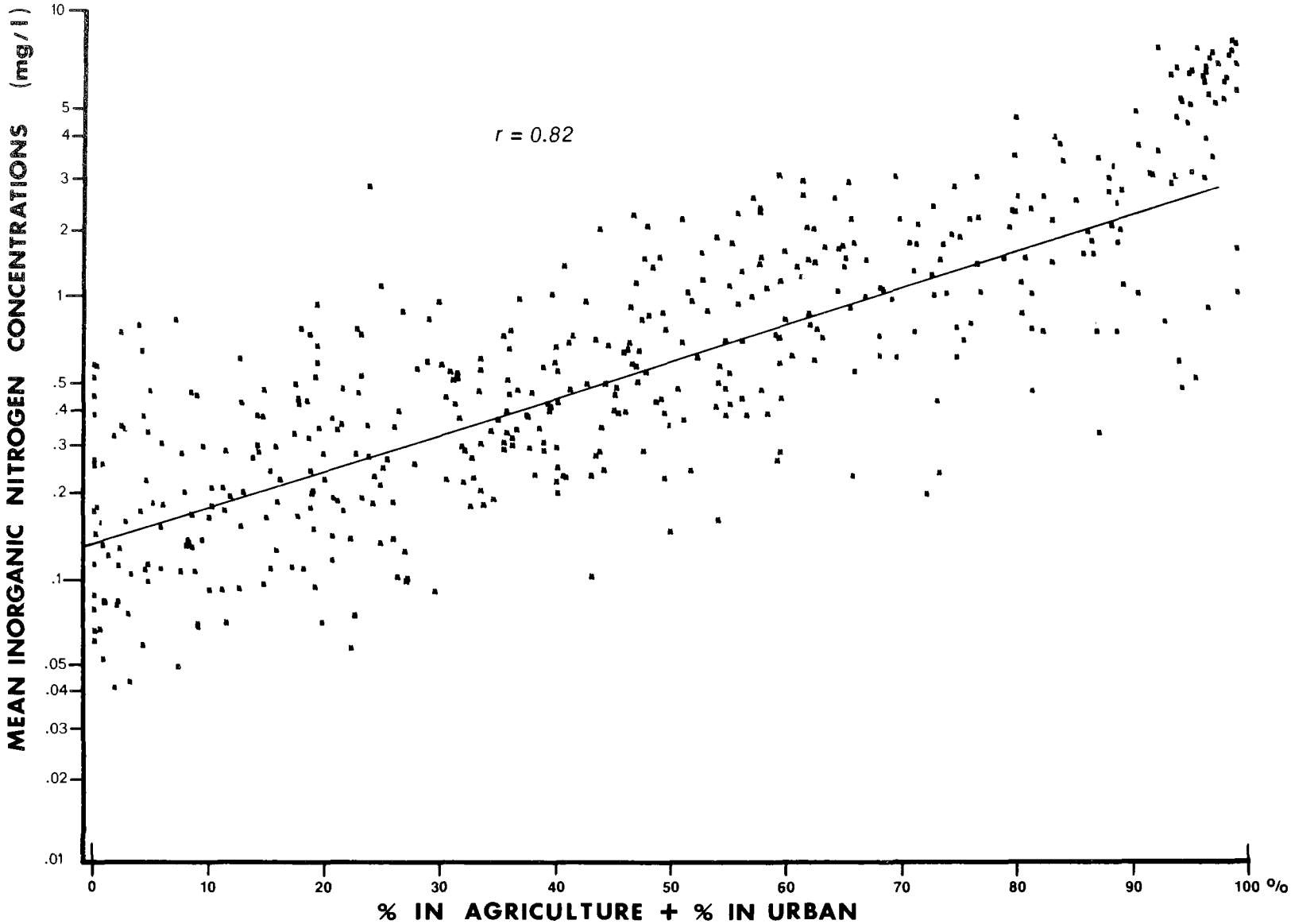
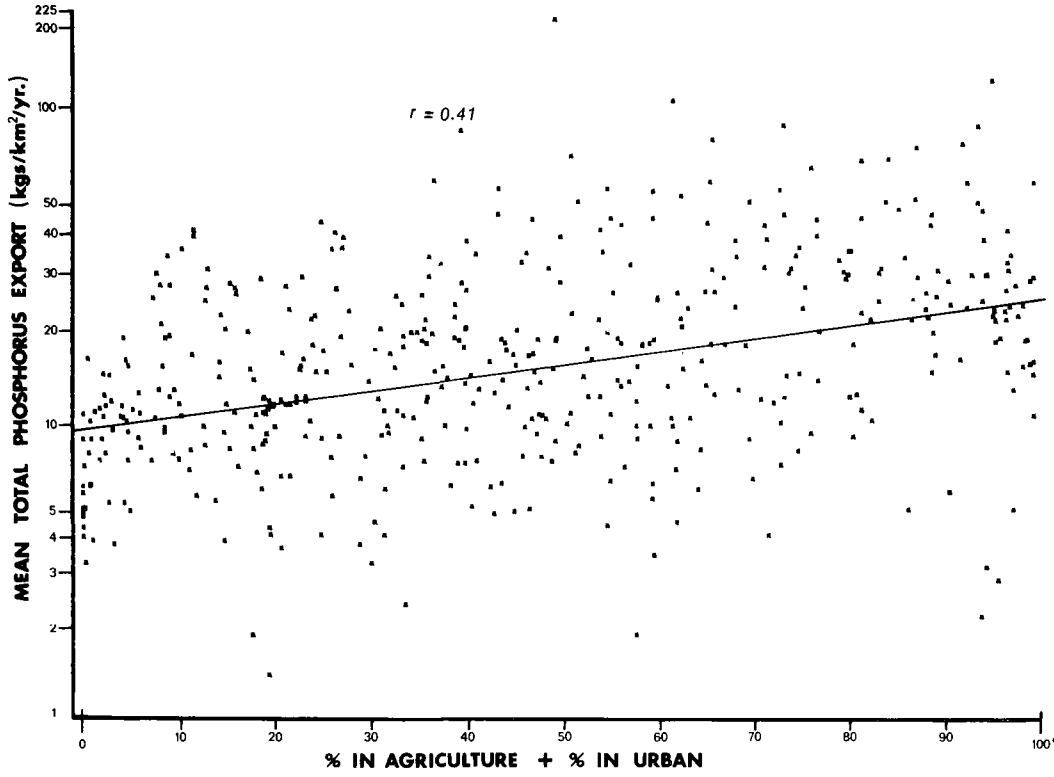


Figure 25. Scattergram of "contributing" land use types related to inorganic nitrogen concentrations in streams.



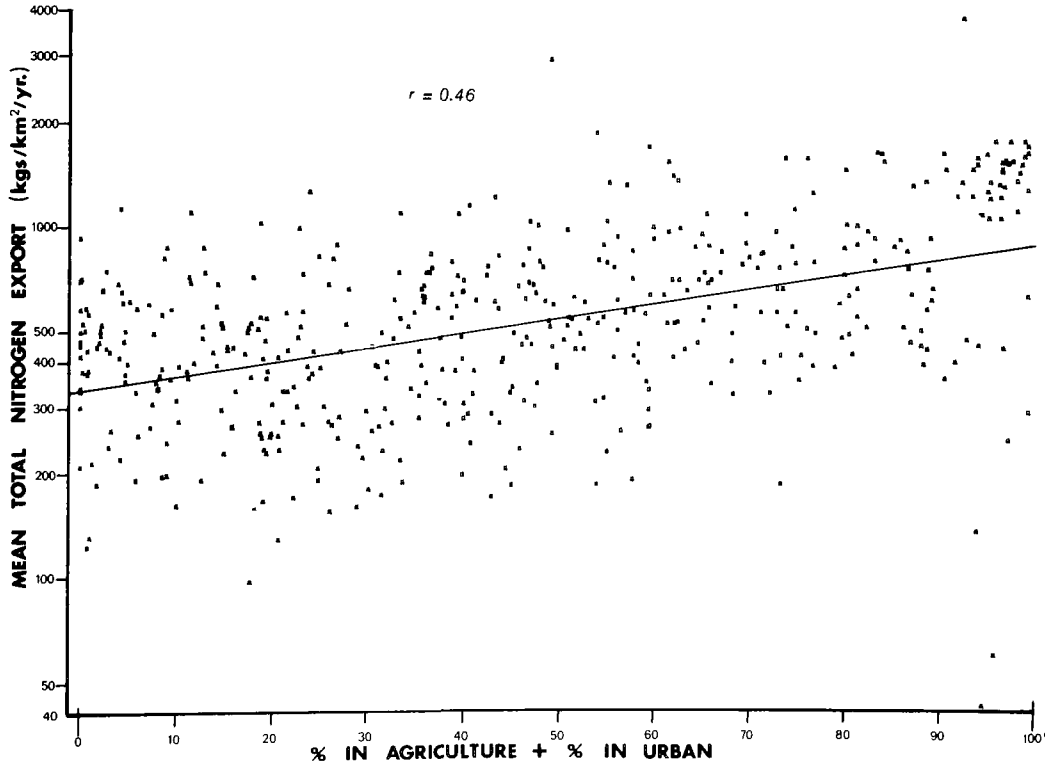
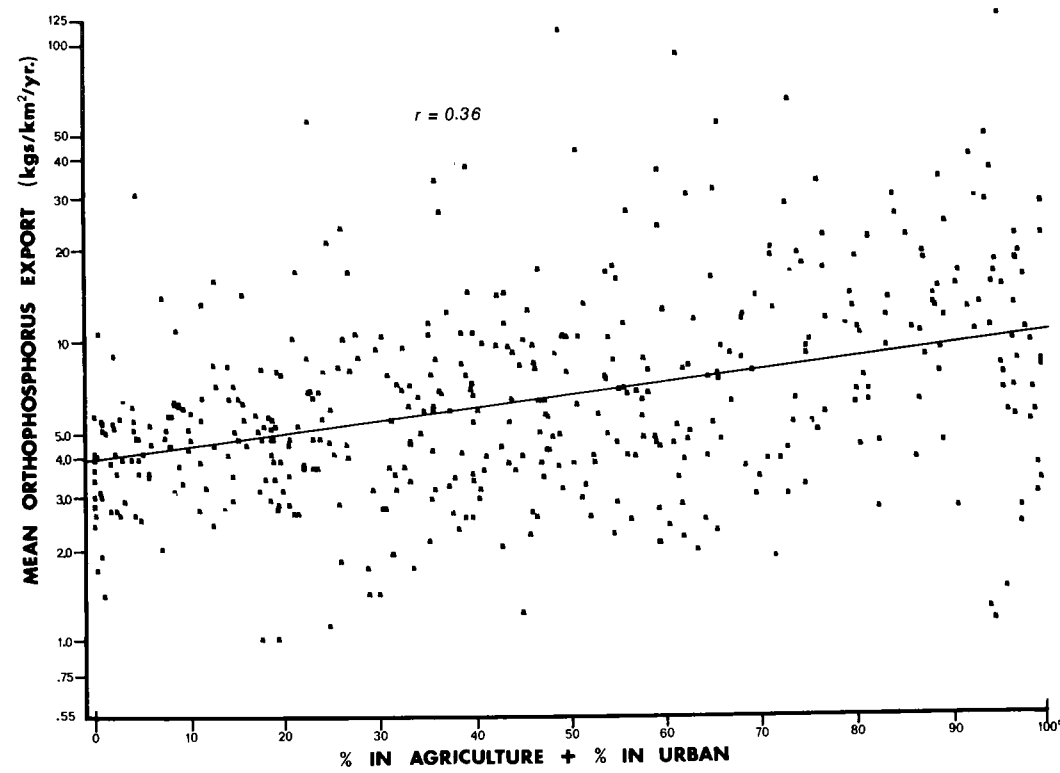


Figure 26. Scattergram of "contributing" land use types related to stream exports of total phosphorus and total nitrogen.



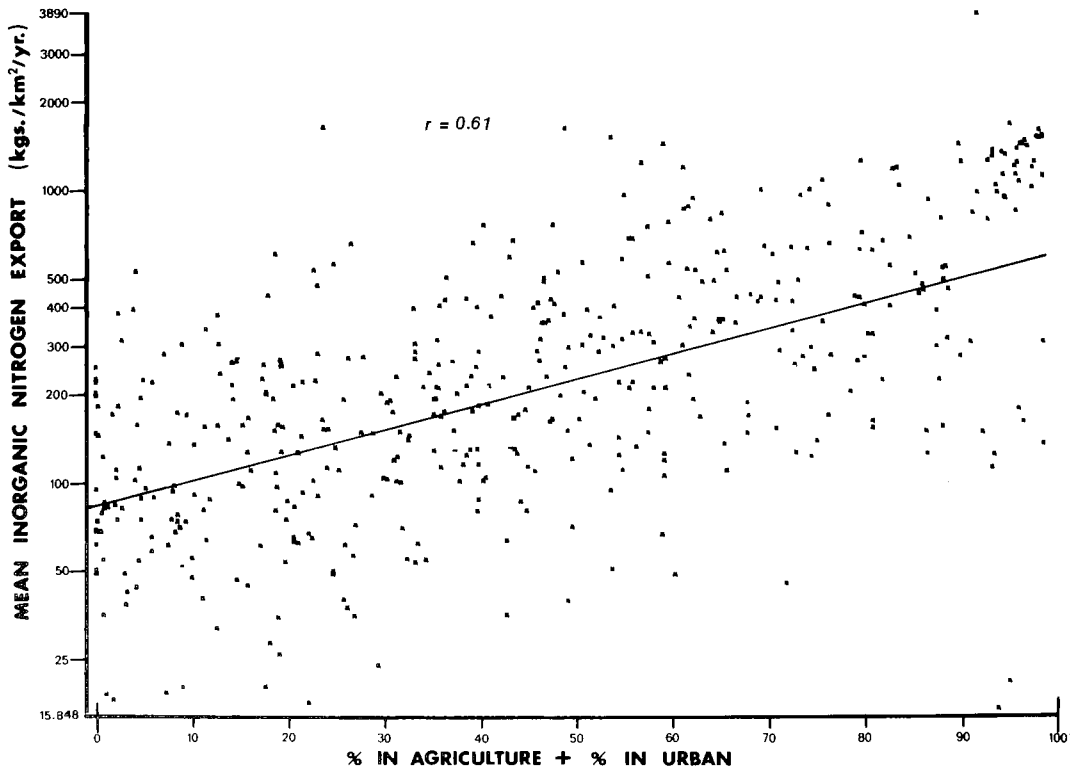


Figure 27. Scattergram of "contributing" land use types related to stream exports of orthophosphorus and inorganic nitrogen.

higher than those predicted by the prediction model in a region extending from eastern Ohio through central and southern Indiana to southern Illinois. This region may extend around through the western tips of Kentucky and Tennessee into Mississippi, north-central Alabama and parts of northern Georgia. Another area where phosphorus concentrations are generally higher than those predicted by the model comprises much of Wisconsin and south-central and southeastern Minnesota. Still another "high" area may exist in a region extending from west-central Virginia through eastern Virginia and into central Delaware, but large gaps in data points make definition of this area difficult to support. A very large region where phosphorus concentrations are nearly the same as, or lower than, those predicted by the model includes most of the Northeast from West Virginia, Maryland, and Pennsylvania through Maine, with the exception of the area centered on southeastern New York and Connecticut. Other smaller areas where phosphorus concentrations are mostly lower than those predicted, are central Illinois, central Ohio, west-central Tennessee, and a small region extending from south-central Kentucky to the northwestern tip of Georgia.

The regional patterns were even more evident for total nitrogen (Figure 29) than they were for total phosphorus (Figure 28). Interestingly though, the regional patterns illustrated by residuals of the nitrogen prediction model show little to no resemblance to those of the phosphorus model. It is also noteworthy that, neither map reveals patterns that appear to have any clear correlation with map units of the macro-aspects (such as physiographic regions, climatic characteristics, soil types, and geology), that one might expect to affect the regional patterns of the residuals.

Figure 29 reveals two major areas where the data show nitrogen concentrations in streams to be near or above those predicted by the model. The first area is centered on eastern Pennsylvania, New Jersey and southeastern New York and includes much of Delaware, east-central Maryland, central Pennsylvania, northeastern New York and Connecticut. The second area extends from southeastern Wisconsin, through central

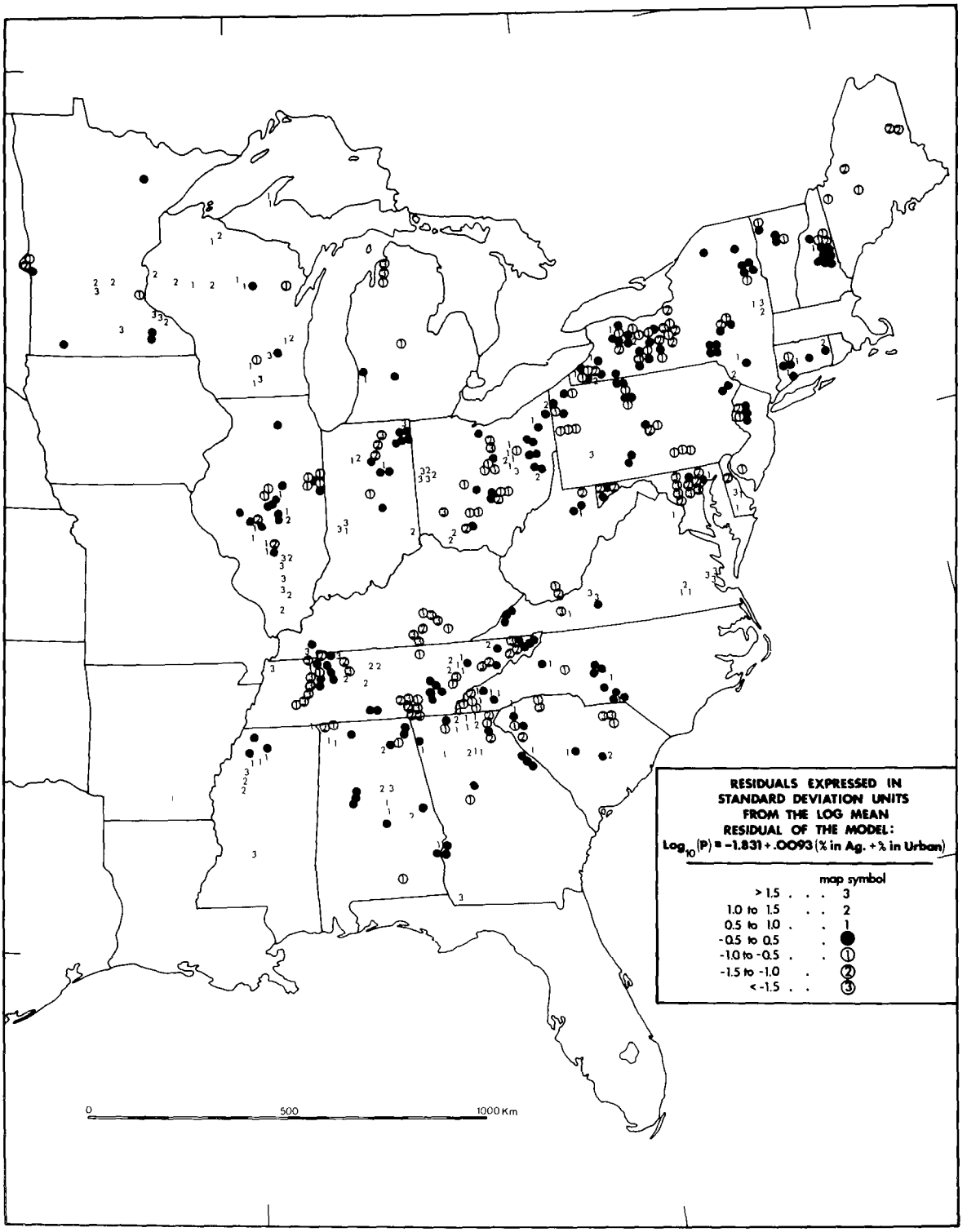


Figure 28. Areal distribution of residuals from a prediction model for total phosphorus concentrations in streams studied in the eastern United States.

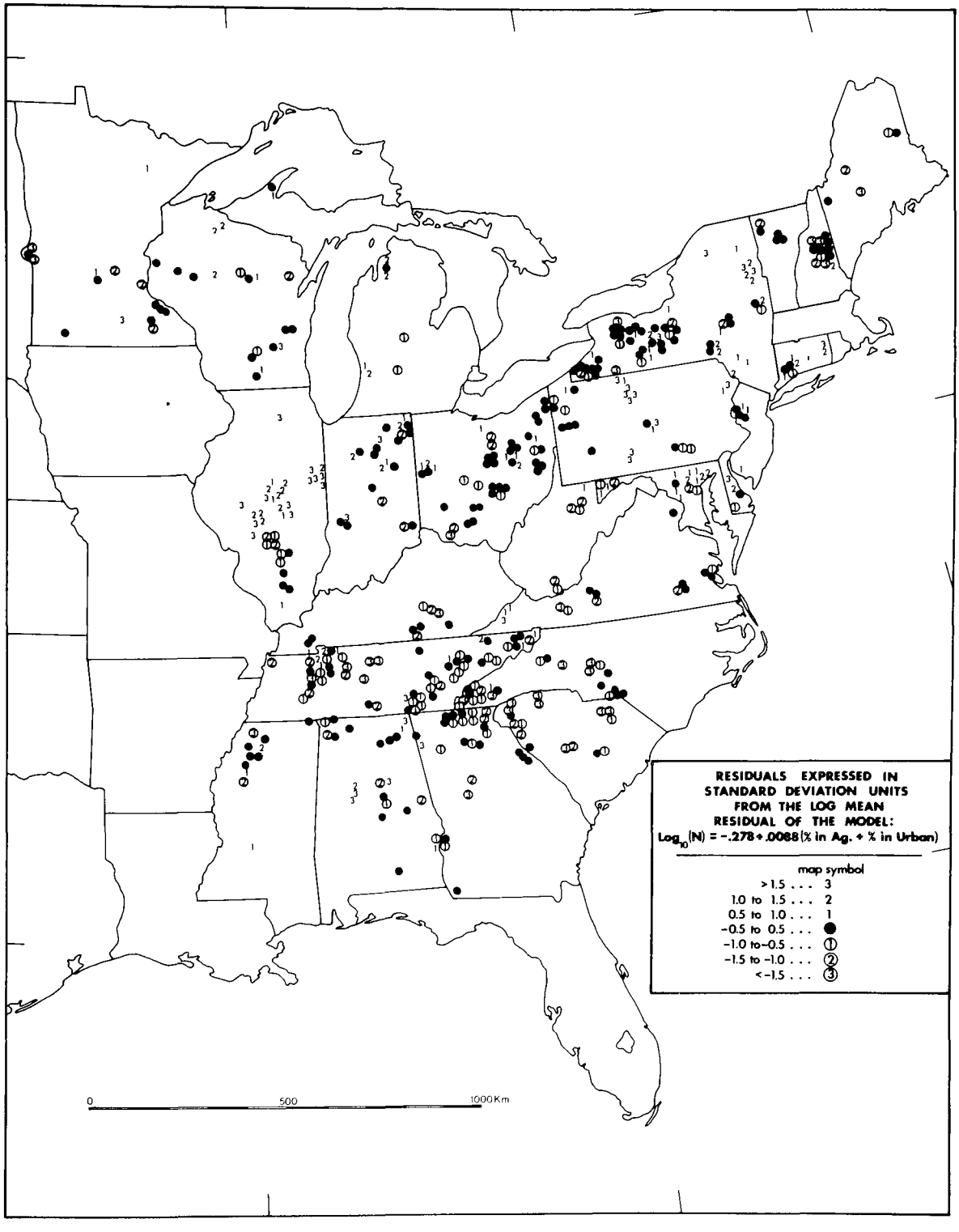


Figure 29. Areal distribution of residuals from a prediction model for total nitrogen concentrations in streams studied in the eastern United States.

Illinois, south-western Michigan, north-central Indiana and west-central Ohio. Data on the central and eastern Illinois part of the latter region show nitrogen concentrations in streams in that area to average much higher than would be predicted from the model. Data on Figure 29 also suggest that throughout most of the Appalachian highlands, and adjacent parts of the Piedmont, southern Illinois, southern Indiana and southern Ohio, nitrogen concentrations in streams can be expected to be near or below what one would predict from the model. Another area of lower nitrogen concentrations consists of the extreme northeastern New England states of Vermont, New Hampshire and Maine.

Although the models presented illustrate a significant increase in the predictability of nutrient concentrations in streams through the use of land use parameters, rather than simply using mean values of data points regardless of land use parameters, the models only indicate correlations found between existing land use patterns and nutrient concentrations in streams. It does not necessarily follow that the models can be used to predict changes in concentrations with associated changes in land use. However, gross predictions of this nature may be aided by analysis of the raw data (Appendix A) together with some of the individual relationships and regional patterns which have been illustrated

Nutrient Runoff--Soils Relationships

The preliminary analysis of the relationships between soils and nutrient concentrations in streams, discussed in Working Paper No. 25, indicated significant correlations between pH characteristics in soils and nutrient concentrations in streams. Generally, concentrations were found to be considerably higher in streams draining areas with soil orders characteristically high in bases, than in streams draining areas with mostly acid-type soils. Efforts were therefore made to include consideration of surface soil pH in the analysis of results in this follow up study. It was found that even a good approximation of mean

surface soil pH for each of the 473 drainage areas was not available except through time-consuming work with numerous large-scale maps from widely scattered sources and contact with local soils scientists. The time and expense ruled this approach out, at least for the present.

Considering time and expense, the best available source was a collection of estimates of surface soil pH ranges for map units appearing on the National Atlas soils map (Smith, 1975; and U.S. Geological Survey, 1970). Each drainage area was identified with a midpoint of the pH range for the soils map unit predominant within it. This system left much to be desired for the actual surface soil pH values probably varied considerably with land use within the area covered by a given soils map unit. For instance, for a given soils map unit in central South Carolina, the surface soil pH is probably a great deal higher in the active cropland areas than in the parts where pine forests predominate. Even with these limitations, which if anything would have a "diluting" effect on the pH to stream nutrient concentration correlations, there appear to be sufficiently significant correlations to warrant a more detailed examination of the relationship. The correlation coefficients for the relationships between surface soil pH and mean nutrient concentrations in streams were as follows:

pH and Total Phosphorus, $r = 0.58$
pH and Orthophosphorus, $r = 0.57$
pH and Total Nitrogen, $r = 0.61$
pH and Inorganic Nitrogen, $r = 0.55$

Nutrient Runoff--Geology Relationships

Discussions of water quality differences from one lake watershed to another, particularly with respect to nitrogen and phosphorus loads and concentrations, often include some mention of geological effects. However, little data are available on the specific effects of geology

on nutrients in either lakes or streams. One of the few articles written on the subject (Dillon and Kirchner, 1975) has suggested a strong effect of geology on phosphorus loads in streams. It was the strength of Dillon and Kirchner's conclusions, together with the suitability of their system to NES non-point source study data, that motivated the inclusion of geology as a macro-aspect to be considered in this paper.

Tables 6 and 7, from Dillon and Kirchner, illustrate the results of their findings.

TABLE 6. RANGES AND MEAN VALUES FOR EXPORT OF TOTAL PHOSPHORUS FROM 31 SOUTHERN ONTARIO WATERSHEDS ($kg/km^2/yr$)

	Geological Classification	
Land Use	Igneous	Sedimentary
Forest		
Range	2.5-7.7	6.7-14.5
Mean	4.8	10.7
Forest + Pasture		
Range	8.1-16.0	20.5-37.0
Mean	11.7	28.8

TABLE 7. RANGES AND MEAN VALUES FOR EXPORT OF TOTAL PHOSPHORUS FROM 43 WATERSHEDS. VALUES INCLUDE DATA GIVEN IN TABLE 6 AND ADDITIONAL DATA FROM THE LITERATURE ($kg/km^2/yr$)

	Geological Classification	
Land Use	Igneous	Sedimentary
Forest		
Range	0.7-8.8	6.7-18.3
Mean	4.7	11.7
Forest + Pasture		
Range	5.9-16.0	11.1-13.0
Mean	10.2	23.3

These data indicate a strong effect of the sedimentary geology classification on phosphorus loads in streams. Generally their mean values for sedimentary watersheds were between 2 1/4 and 2 1/2 times greater than those from igneous watersheds. It should be noted that the igneous watersheds shown in Tables 6 and 7 are of plutonic origin. Additional data from the literature led Dillon and Kirchner to conclude that one would expect phosphorus loads in streams draining igneous watersheds of volcanic origin to be 15 times greater than in streams draining igneous watersheds of plutonic origin.

Table 8 was prepared to illustrate the possible effects of geology on nutrient concentrations and loads in streams with respect to data collected by the NES on 473 non-point source-type drainage areas in the eastern United States. The drainage areas were identified according to the geological classification outlined earlier in this paper. The numbers shown after the classification provide a coding scheme for handling combinations. The data were grouped by overall land use category to hold land use as constant as possible. Data were not presented for drainage areas in mixed, mostly urban, and mostly agriculture categories because of the greater variability of land use within these categories.

Generally, data in Table 8 indicate that given this classification scheme and the NES data, there is no apparent significant effect of geology on either phosphorus or nitrogen loads in streams. The same appears true for phosphorus and nitrogen concentrations. Although there was a paucity of purely igneous watersheds, there were many where igneous rocks were present, or even represented the predominant type; enough it was felt, to see an effect of this classification if existent. By looking at the "mostly forested" data set, which contains the largest number of predominantly igneous-plutonic watersheds, one can see little difference in mean total phosphorus concentration or export values between sedimentary watersheds and igneous-plutonic watersheds. Interestingly, although the mean total phosphorus export

TABLE 8. GEOLOGIC CLASSIFICATION AND MEAN VALUES FOR STREAM NUTRIENT CONCENTRATIONS AND EXPORTS FROM 223 SUBDRAINAGE AREAS IN THE EASTERN UNITED STATES. DATA GROUPED BY OVERALL LAND USE CATEGORY

Land Use	Geologic Classification and Grouping Code(s)	Number of Subdrainage Areas	Concentrations (mg/l)				Export (kg/km^2/yr)			
			T-P	O-P	T-N	I-N	T-P	O-P	T-N	I-N
Forest		53								
	Sedimentary; some or all limestone (10)	19	.011	.006	.860	.287	6.4	3.6	498.7	159.6
	Sedimentary; without limestone (20)	11	.014	.007	.766	.337	9.0	4.5	467.6	192.2
	Sedimentary; all (10 & 20)	30	.012	.006	.825	.306	7.4	3.9	487.3	171.5
	Predominantly sedimentary (10, 14, & 20)	31	.012	.006	.818	.301	7.3	3.9	482.3	169.1
	Igneous; volcanic origin (30)	0	-	-	-	-	-	-	-	-
	Metamorphic (40)	16	.017	.007	.520	.103	10.3	4.6	337.4	65.2
	Igneous; plutonic origin (50)	0	-	-	-	-	-	-	-	-
	Igneous and metamorphic (40 & 45)	18	.017	.007	.533	.119	10.3	4.6	342.1	74.6
	Predominantly igneous and metamorphic (40, 41, 42, & 45)	22	.016	.007	.625	.135	9.7	4.3	380.7	80.7
Mostly Forest		170								
	Sedimentary; some or all limestone (10)	55	.037	.015	1.056	.488	16.3	6.3	472.1	233.2
	Sedimentary; without limestone (20)	48	.035	.014	.817	.288	18.0	6.9	441.8	161.2
	Sedimentary; all (10 & 20)	103	.036	.014	.945	.395	17.1	6.6	458.0	194.3
	Predominantly sedimentary (10, 14, 20, 23, 24, & 25)	118	.036	.014	.930	.374	17.1	6.5	456.5	186.7
	Igneous; volcanic origin (30)	0	-	-	-	-	-	-	-	-
	Igneous; volcanic origin (present but not dominant, 23 & 43)	4	.038	.018	.975	.328	13.1	6.2	332.2	115.5
	Metamorphic (40)	32	.035	.014	.762	.277	20.7	8.2	452.0	166.0
	Igneous; plutonic origin (50)	1	.026	.010	.951	.138	7.4	2.8	269.5	39.1
	Predominantly igneous; plutonic origin (50, 52, & 54)	6	.032	.013	1.049	.317	13.6	9.1	476.2	134.6
	Igneous and metamorphic (40, 43, 45, 50, & 54)	40	.036	.014	.798	.269	19.2	8.2	427.7	149.8
	Predominantly igneous and metamorphic (40, 41, 42, 43, 45, 50, 52, & 54)	52	.035	.014	.827	.284	18.2	8.1	433.1	152.3
Agriculture		91								
	Sedimentary; some or all limestone (10)	80	.136	.059	4.315	3.296	30.5	12.4	996.8	748.3
	Sedimentary; without limestone (20)	11	.123	.055	3.497	2.335	23.6	10.3	865.4	660.1
	Sedimentary; all (10 & 20)	91	.135	.058	4.225	3.190	29.7	12.2	982.3	738.6

Abbreviations:
T-P = Total Phosphorus
O-P = Orthophosphorus
T-N = Total Nitrogen
I-N = Inorganic Nitrogen

value was about 25% greater for sedimentary watersheds than for igneous-plutonic watersheds, the mean orthophosphorus export value was about 27% less. Analysis of the remaining data revealed no significant differences in orthophosphorus to total phosphorus relationships with different geological classifications.

It was difficult to study these data for the possible effects of igneous rocks of volcanic origin (as compared with igneous rocks of plutonic origin) on stream nutrient concentrations or loads. No drainage areas in either the "forest" or "mostly forest" data sets were classified as completely or predominantly igneous-volcanic. However, there were four drainage areas in one data set where igneous rocks of volcanic origin were present but not predominant. Comparison of these data with those of other geological classifications revealed relatively insignificant differences.

It should be emphasized that the above analysis does not suggest that geology has no effect on nutrient concentrations or loads in streams. It does point out that no clearly significant effects are apparent using this type of classification and the NES data. That the NES data did not support the conclusions in Dillon and Kirchner's paper regarding phosphorus export may lie in the method of classification.

Perhaps a more appropriate classification scheme should be based on the mineral composition of the rocks rather than being based entirely or primarily on origin. A simplified version of such a scheme might have just two groups or classes--a class containing rocks generally considered as being high in phosphorus content and a class containing rocks having very little phosphorus. Rocks included in the first, or "high phosphorus", group would be the gabbros, diorites, and basalts, or rocks largely composed of ferromagnesian minerals and containing considerable apatite (Taylor, 1975; and Goldschmidt, 1958, pp. 454-459). Apatite is the mineral containing nearly all of the phosphorus in igneous rocks (Rankama and Sahuma, 1950, pp. 584-586). Common rocks in the "low phosphorus" group would be granite, syenite, granodiorite, rhyolite and andesite; or rocks

largely made up of aluminosilicate minerals and containing little to no apatite. Apparently all of the southern Ontario watersheds classified igneous by Dillon and Kirchner contained "low phosphorus" rocks. Metamorphic rocks might be fit into one of the above groups depending on the type or types of rocks metamorphosed.

Although this scheme represents a better breakdown of igneous and some metamorphic rocks for studying the effects of general rock types on phosphorus in streams, it may present difficulties. For many parts of the United States, geologic maps with the level of detail necessary to accomplish this breakdown, may be lacking or difficult to obtain.

SECTION V

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SECTION VI

APPENDIX

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM)[1]	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM)[5]
ALABAMA														
GANTT RESERVOIR														
0103B1	40	21.26	74.5	.6	24.9	0	0	0	M. FOR.	U06-01	4.5	8.8	147	.0073
GUNTERSVILLE RESERVOIR														
0104A1	30	53.92	52.2	3.4	43.5	0	0	.9	M. FOR.	U05-01	4.5	11.0	137	.0261
0104E1	30	78.55	34.9	2.5	61.8	.5	0	.3	M. AGRIC	U05-01	4.5	5.9	137	.0201
0104G1	30	55.06	24.4	1.1	74.3	0	0	.2	M. AGRIC	U05-01	4.5	3.6	132	.0195
0104J1	30	127.74	42.8	1.6	55.4	.1	0	.1	M. AGRIC	U05-01	4.5	4.7	132	.0192
0104L1	30	22.17	60.0	1.3	24.0	0	0	14.7	M. FOR.	U05-01	4.5	9.3	132	.0208
HOLT LOCK AND DAM														
0105B1	30	5.44	93.8	1.4	2.4	0	0	2.4	FOREST	I08-06	5.0	16.2	135	.0162
0105C1	30	3.11	92.5	3.5	1.0	3.0	0	0	FOREST	I08-06	5.0	29.8	135	.0162
0105D1	30	29.86	85.0	1.0	0	0	0	14.0	FOREST	I08-06	5.0	21.9	135	.0162
LAY LAKE														
0106C1	30	22.07	74.7	1.5	23.8	0	0	0	M. FOR.	U06-11	4.5	6.6	140	.0175
0106D1	30	45.38	69.0	2.6	27.7	.1	0	.6	M. FOR.	U06-11	4.5	10.3	140	.0189
MARTIN LAKE														
0107C1	40	40.71	73.3	6.0	19.5	1.1	0	.1	M. FOR.	U05-03	4.5	9.2	135	.0176
0107H1	40	43.36	79.1	1.3	19.1	0	0	.5	FOREST	U05-03	4.5	7.3	135	.0075
MITCHELL LAKE														
0108B1	40	26.94	63.2	.7	35.7	0	.3	.1	M. FOR.	U05-04	4.5	9.0	142	.0201
PICKWICK LAKE														
0109C1	34	174.80	64.8	9.0	24.6	.9	0	.7	M. FOR.	U06-11	4.5	13.0	127	.0131
0109D1	34	134.32	74.8	4.1	20.7	.1	0	.3	M. FOR.	U06-11	4.5	16.7	127	.0135
0109K1	40	42.48	76.6	4.2	19.1	0	0	.1	M. FOR.	U06-11	4.5	15.8	127	.0244
0109M1	40	173.63	80.2	3.5	16.2	0	0	.1	M. FOR.	U06-11	4.5	18.2	127	.0160
0109Q1	40	111.63	80.4	11.3	8.3	0	0	0	M. FOR.	U04-01	4.5	19.5	132	.0164
W. F. GEORGE RESERVOIR														
0111B1	40	31.44	84.6	2.3	11.2	0	.9	1.0	M. FOR.	U05-03	4.5	8.2	135	.0145
0111C1	40	117.85	81.6	5.3	12.6	0	.3	.2	M. FOR.	U05-03	4.5	9.0	135	.0115
0111J1	40	25.74	72.9	5.6	19.8	.2	1.5	0	M. FOR.	U06-01	4.5	10.1	132	.0126
0111M1	40	32.50	58.0	3.9	37.5	0	.4	.2	M. FOR.	U06-01	4.5	7.9	135	.0126
WEISS LAKE														
0112C1	40	26.42	89.2	1.4	9.4	0	0	0	M. FOR.	U06-11	4.5	20.4	132	.0170
0112E1	40	23.65	50.3	45.2	4.5	0	0	0	M. FOR.	U06-11	4.5	7.5	132	.0165
WILSON LAKE														
0114F1	30	7.30	25.7	8.1	66.1	0	0	.1	M. AGRIC	U06-01	4.5	3.6	127	.0141
LAKE PURDY														
0115B1	30	8.44	89.8	1.3	8.8	0	0	.1	M. FOR.	I08-06	5.0	19.8	140	.0214
0115C1	30	3.99	72.5	0	26.9	.3	0	.3	M. FOR.	I08-06	5.0	12.1	140	.0214

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
ALABAMA												
GANTT RESERVOIR												
0103B1	1	SED W/O L	23.0	23.1	.018	.005	.805	.215	4.1	1.1	184.0	49.2
GUNTERSVILLE RESERVOIR												
0104A1	4	SED	65.8	68.0	.072	.017	1.433	.688	59.0	13.9	1175.0	564.1
0104E1	1	SED	93.4	102.3	.042	.012	2.129	1.318	26.5	7.6	1342.8	831.3
0104G1	1	SED	115.2	125.6	.051	.010	2.492	1.497	30.8	6.0	1504.3	903.7
0104J1	1	SED	57.2	60.9	.044	.011	2.145	1.511	26.4	6.6	1284.7	905.0
0104L1	2	SED	18.6	19.3	.027	.007	1.865	2.405	17.6	4.6	1213.4	1564.7
HOLT LOCK AND DAM												
0105B1	1	SED W/O L	2.0	2.0	.021	.007	1.235	.736	10.9	3.6	640.7	381.8
0105C1	1	SED W/O L	.8	.9	.020	.008	1.314	.774	10.1	4.0	662.4	390.2
0105D1	2	SED W/O L	0	0	.012	.006	.897	.508	5.9	3.0	442.7	250.7
LAY LAKE												
0106C1	1	SED/MET	39.7	39.3	.039	.012	.650	.270	21.6	6.6	360.2	149.6
0106D1	1	SED/MET	46.3	45.8	.040	.018	.892	.253	22.9	10.3	511.6	145.1
MARTIN LAKE												
0107C1	1	MET	24.6	24.7	.021	.008	.450	.116	11.5	4.4	246.1	63.4
0107H1	1	MET	25.5	27.3	.045	.017	.691	.150	10.4	3.9	159.9	34.7
MITCHELL LAKE												
0108B1	1	MET/SWOL	33.4	33.8	.032	.012	1.021	.327	20.1	7.5	641.7	205.5
PICKWICK LAKE												
0109C1	1	SED	19.2	18.4	.035	.010	.729	.264	14.4	4.1	299.5	108.4
0109D1	1	SED	13.0	12.9	.039	.011	.531	.193	16.5	4.6	224.4	81.5
0109K1	4	SED W/O L	12.8	12.6	.011	.006	.532	.205	8.4	4.6	408.4	157.4
0109M1	4	SED W/O L	11.5	11.4	.014	.009	.674	.225	6.9	4.4	331.1	110.5
0109Q1	1	SED	5.2	5.0	.029	.011	.711	.134	14.9	5.6	364.2	68.6
W. F. GEORGE RESERVOIR												
0111B1	1	SED W/O L	10.2	10.0	.015	.006	.840	.091	6.7	2.7	377.0	40.8
0111C1	1	SED W/O L	11.4	11.2	.027	.007	.527	.092	9.4	2.4	183.7	32.1
0111J1	1	SED W/O L	13.0	12.9	.024	.008	.779	.224	9.4	3.1	303.7	87.3
0111M1	1	SED W/O L	24.6	24.4	.032	.008	.797	.373	12.7	3.2	315.3	147.5
WEISS LAKE												
0112C1	1	SED W/O L	10.8	10.5	.014	.006	.655	.137	7.6	3.3	357.6	74.8
0112E1	1	SED W/O L	4.4	4.4	.030	.009	1.137	.107	15.5	4.7	587.9	55.3
WILSON LAKE												
0114F1	1	SED	41.4	41.1	.046	.019	1.713	.893	17.8	7.3	662.2	345.2
LAKE PURDY												
0115B1	1	SWOL/MET	14.7	14.5	.052	.016	1.177	.106	34.8	10.7	787.1	70.9
0115C1	1	SWOL/MET	44.9	44.5	.057	.011	.605	.100	40.3	7.8	427.9	70.7

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA[1] (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
CONNECTICUT														
ASPINOOK POND														
0901C1	10	2.33	87.4	3.1	7.7	1.3	.3	.2	M. FOR.	S04-04	4.5	6.6	97	.0209
0901F1	10	22.74	82.5	3.8	8.8	.7	3.7	.5	M. FOR.	S04-04	4.5	7.2	97	.0188
HANOVER POND														
0905B1	10	12.85	46.5	11.3	.3	39.4	1.6	.9	M. URBAN	S04-08	4.5	11.4	94	.0198
LAKE ZOAR														
0910B1	10	1.71	72.5	13.2	14.3	0	0	0	M. FOR.	S04-04	4.5	16.0	97	.0211
0910C1	10	24.81	74.3	9.7	6.2	8.2	.9	.7	M. FOR.	S04-04	4.5	12.0	94	.0197
0910D1	10	4.82	40.8	17.5	39.1	1.1	1.5	0	MIXED	S04-04	4.5	12.8	91	.0207
0910F1	10	2.98	69.2	7.2	13.6	9.6	0	.4	M. FOR.	S04-04	4.5	15.1	89	.0210
0910G1	10	12.02	68.7	7.3	22.5	.4	.2	.9	M. FOR.	S04-04	4.5	11.8	91	.0202
0910H1	10	12.28	40.2	17.7	11.9	28.1	1.8	.3	MIXED	S04-04	4.5	11.0	91	.0186
DELAWARE														
KILLEN POND														
1002A2	40	37.40	36.0	1.8	61.0	.8	.4	0	M. AGRIC	U01-04	5.5	1.3	117	.0147
1002B1	40	2.28	23.4	0	76.6	0	0	0	AGRIC	U05-05	4.5	1.2	117	.0148
SILVER LAKE														
1008B1	40	5.02	6.1	.5	92.1	.9	0	.4	AGRIC	U05-05	4.5	1.9	114	.0166
WILLIAMS POND														
1009C1	40	4.01	29.0	10.1	59.4	1.5	0	0	M. AGRIC	U05-05	4.5	.6	117	.0017
GEORGIA														
ALLATOONA RES.														
1301F1	30	46.54	96.2	1.8	1.8	0	0	.2	FOREST	U05-06	4.5	20.0	132	.0141
CHATUGE														
1303A1	30	15.44	91.3	.5	8.2	0	0	0	M. FOR.	U05-04	4.5	42.4	152	.0234
1303C1	30	23.34	89.5	2.4	8.1	0	0	0	M. FOR.	U05-04	4.5	43.4	163	.0232
CLARK HILL RES														
1304C1	40	31.13	80.4	9.3	10.1	0	0	.2	M. FOR.	U05-03	4.5	7.7	117	.0093
1304F1	40	71.92	70.3	3.8	25.2	.7	0	0	M. FOR.	U05-01	4.5	9.0	117	.0089
1304J1	40	43.38	67.9	2.5	29.5	0	0	.1	M. FOR.	U05-01	4.5	6.9	117	.0082
1304K1	40	25.64	62.4	2.7	33.8	.8	0	.3	M. FOR.	U05-01	4.5	8.3	117	.0082
JACKSON LAKE														
1309A1	40	188.84	59.3	2.1	37.6	.6	.1	.3	M. FOR.	U05-03	4.5	6.3	119	.0139
SIDNEY LANIER LAKE														
1310C1	40	63.56	61.5	1.8	36.6	.1	0	0	M. FOR.	U05-03	4.5	15.4	152	.0274
1310D1	40	53.54	53.4	.5	45.6	.3	.1	.1	M. FOR.	U05-03	4.5	12.3	157	.0194
1310E1	40	43.15	51.5	2.0	45.0	1.4	0	.1	M. FOR.	U05-01	4.5	14.2	163	.0194

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
CONNECTICUT												
ASPINOOK POND												
0901C1	4	MET	17.2	16.4	.041	.009	1.256	.440	27.6	6.1	845.1	296.1
0901F1	3	MET	19.6	18.8	.021	.010	.959	.291	12.4	5.9	565.5	171.6
HANOVER POND												
0905B1	3	SWOL/IG-V	.3	.3	.045	.022	1.664	.995	28.5	14.0	1055.7	631.3
LAKE ZOAR												
0910B1	1	MET	13.7	13.5	.021	.011	.532	.295	15.4	8.1	390.2	216.4
0910C1	3	MET	5.9	5.8	.032	.009	.956	.279	22.2	6.3	664.5	193.9
0910D1	1	MET	37.4	36.8	.031	.008	.978	.416	20.2	5.2	636.2	270.6
0910F1	3	MET	15.2	14.6	.018	.010	1.126	.721	11.4	6.3	710.9	455.2
0910G1	4	MET	25.1	24.2	.044	.079	1.416	.758	29.8	53.6	960.4	514.1
0910H1	3	MET	11.4	11.2	.034	.012	1.069	.653	20.0	7.0	627.8	383.5
DELAWARE												
KILLEN POND												
1002A2	1	SED W/O L	16.3	17.2	.261	.192	3.322	2.523	16.0	85.3	1476.1	1121.1
1002B1	1	SED W/O L	20.5	21.6	.126	.057	2.743	1.836	69.3	31.4	1508.9	1010.0
SILVER LAKE												
1008B1	1	SED W/O L	26.9	26.5	.047	.020	7.610	7.406	23.5	10.0	3802.7	3700.8
WILLIAMS POND												
1009C1	1	SED W/O L	85.2	109.0	.083	.030	1.382	.601	6.5	2.3	108.1	47.0
GEORGIA												
ALLATOONA RES.												
1301F1	4	MET	1.9	2.2	.024	.006	.401	.041	10.7	2.7	178.3	18.2
CHATUGE												
1303A1	4	MET	17.0	15.2	.028	.006	.458	.136	20.5	4.4	334.8	99.4
1303C1	4	MET	16.8	15.1	.038	.006	.458	.130	27.6	4.4	332.3	94.3
CLARK HILL RES												
1304C1	1	MET	2.1	2.1	.025	.017	.532	.164	7.3	5.0	155.4	47.9
1304F1	1	IGNEOUS-P	32.3	31.4	.026	.010	.951	.138	7.4	2.8	269.5	39.1
1304J1	1	MET/IG-P	39.9	37.6	.029	.012	.818	.090	7.5	3.1	212.9	23.4
1304K1	1	MET	46.9	43.6	.036	.017	1.189	.191	10.1	4.8	334.4	53.7
JACKSON LAKE												
1309A1	1	MET/IG-P	30.2	29.9	.032	.008	.711	.232	13.7	3.4	304.6	99.4
SIDNEY LANIER LAKE												
1310C1	1	MET	204.8	222.3	.072	.030	.931	.465	62.9	26.2	812.9	406.0
1310D1	1	MET	233.5	261.9	.055	.020	1.072	.626	33.5	12.2	652.9	381.3
1310E1	1	MET	230.4	258.4	.062	.016	1.295	.679	36.0	9.3	752.8	394.7

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA[1] (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
GEORGIA														
NOTTELY RES.														
1311C1	30	71.77	73.9	1.9	24.2	0	0	0	M. FOR.	U05-06	4.5	17.8	135	.0192
1311D1	30	29.84	82.0	.8	17.2	0	0	0	M. FOR.	U05-04	4.5	27.4	135	.0176
SEMINOLE LAKE														
1312D1	40	55.43	67.7	4.0	27.1	0	.6	.6	M. FOR.	U06-01	4.5	4.7	132	.0112
BLUE RIDGE LAKE														
1316A1	30	9.40	85.9	2.7	11.4	0	0	0	M. FOR.	U05-06	4.5	31.1	132	.0287
1316C1	30	36.36	83.4	1.3	15.3	0	0	0	M. FOR.	U05-06	4.5	25.6	132	.0285
1316D1	30	10.23	86.0	2.5	11.5	0	0	0	M. FOR.	U05-06	4.5	20.8	132	.0292
1316E1	30	16.96	96.0	.8	3.2	0	0	0	FOREST	U05-06	4.5	35.5	132	.0289
BURTON LAKE														
1318B1	30	16.14	98.0	0	2.0	0	0	0	FOREST	U05-03	4.5	34.3	165	.0340
1318C1	30	20.33	99.4	0	.6	0	0	0	FOREST	U05-06	4.5	38.0	165	.0330
1318D1	30	17.25	99.2	0	.8	0	0	0	FOREST	U05-03	4.5	39.9	165	.0332
1318E1	30	14.71	99.1	0	.9	0	0	0	FOREST	U05-06	4.5	36.6	165	.0332
HIGH FALLS POND														
1319B1	40	99.30	54.9	3.5	40.7	.2	.2	.5	M. FOR.	U05-01	4.5	6.8	122	.0141
ILLINOIS														
CARLYLE RESERVOIR														
1706D1	20	134.89	14.9	3.0	80.5	1.5	0	.1	AGRIC	A01-03	6.3	1.5	104	.0063
1706E1	20	223.41	29.0	4.5	66.2	.2	0	.1	M. AGRIC	A01-03	6.3	2.3	102	.0064
1706H1	20	59.39	9.9	2.5	86.8	.8	0	0	AGRIC	A01-03	6.3	1.5	102	.0062
CRAB ORCHARD LAKE														
1712C1	20	43.90	39.3	7.0	52.6	.3	0	.8	M. AGRIC	A06-07	6.0	8.3	117	.0061
LAKE DECATUR														
1714B1	20	20.90	.5	2.0	97.4	.1	0	0	AGRIC	M06-06	6.0	2.2	94	.0061
1714C1	20	109.06	3.6	1.2	93.8	1.2	0	.2	AGRIC	M06-06	6.0	1.7	94	.0063
1714E1	20	53.54	0	.9	99.1	0	0	0	AGRIC	M06-06	6.0	.5	94	.0062
1714F1	20	45.56	0	1.1	98.9	0	0	0	AGRIC	M06-06	6.0	.6	94	.0062
1714G1	20	26.37	2.0	2.8	93.9	1.2	0	.1	AGRIC	M06-06	6.0	1.5	94	.0061
1714H1	20	57.06	.6	2.3	97.1	0	0	0	AGRIC	M06-06	6.0	1.7	94	.0062
1714J1	20	21.63	1.4	2.8	95.8	0	0	0	AGRIC	M06-06	6.0	1.6	94	.0061
LAKE LOU YEAGER														
1726C1	20	51.13	1.4	1.1	97.3	0	0	.2	AGRIC	M06-06	6.0	.7	91	.0061
REND LAKE														
1735B1	20	229.14	27.8	3.4	68.0	.6	0	.2	M. AGRIC	A01-03	6.3	3.7	107	.0064
1735F1	20	130.82	20.8	3.2	76.0	0	0	0	AGRIC	A01-03	6.3	2.6	107	.0061

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
GEORGIA												
NOTTELY RES.												
1311C1	1	MET	41.4	38.5	.037	.009	.619	.185	22.1	5.4	370.5	110.7
1311D1	4	MET	38.5	35.0	.035	.010	.759	.110	19.5	5.6	422.7	61.3
SEMINOLE LAKE												
1312D1	1	SED W/O L	16.5	20.5	.106	.047	.794	.098	37.2	16.5	278.5	34.4
BLUE RIDGE LAKE												
1316A1	1	MET	13.5	13.1	.018	.006	.769	.174	16.2	5.4	692.6	156.7
1316C1	1	MET	18.1	17.6	.031	.007	.487	.108	28.1	6.3	441.0	97.8
1316D1	1	MET	13.6	13.2	.046	.007	.729	.070	42.3	6.4	670.3	64.4
1316E1	4	MET	9.8	11.4	.010	.007	.470	.043	9.1	6.3	425.8	39.0
BURTON LAKE												
1318B1	1	MET	3.3	3.8	.008	.005	.422	.080	8.5	5.3	450.9	85.5
1318C1	1	MET	1.0	1.1	.015	.010	.466	.066	15.7	10.5	488.7	69.2
1318D1	1	MET	1.3	1.5	.009	.005	.342	.052	9.7	5.4	366.8	55.8
1318E1	1	MET	1.5	1.7	.008	.005	.353	.082	8.5	5.3	376.2	87.4
HIGH FALLS POND												
1319B1	1	MET	38.7	38.6	.025	.007	.522	.227	11.2	3.1	234.1	101.8
ILLINOIS												
CARLYLE RESERVOIR												
1706D1	1	SED	27.7	27.3	.243	.105	2.095	.750	47.4	20.5	857.0	146.4
1706E1	1	SED	21.7	21.4	.134	.045	1.720	.529	26.7	9.0	342.8	105.4
1706H1	1	SED	29.1	28.7	.273	.093	2.305	.734	54.4	18.2	450.3	143.4
CRAB ORCHARD LAKE												
1712C1	1	SED	28.8	28.4	.089	.021	2.236	1.395	17.2	4.0	431.2	269.0
LAKE DECATUR												
1714B1	1	SED	12.3	12.2	.122	.041	6.399	5.093	23.8	8.0	1248.0	993.3
1714C1	1	SED	11.9	11.7	.153	.078	5.292	4.897	30.4	15.5	1049.8	971.5
1714E1	1	SED	12.5	12.4	.092	.032	6.848	5.832	18.3	6.4	1363.6	1161.3
1714F1	1	SED	15.6	15.4	.078	.026	5.510	4.920	15.0	5.0	1061.8	948.1
1714G1	1	SED	13.4	13.2	.160	.089	5.453	4.809	30.4	16.9	1037.4	914.9
1714H1	1	SED	15.4	15.1	.115	.035	6.227	5.645	21.5	6.5	1163.4	1054.7
1714J1	1	SED	12.1	12.0	.127	.044	6.955	6.051	22.1	7.7	1209.9	1052.6
LAKE LOU YEAGER												
1726C1	1	SED	38.9	38.1	.177	.090	7.265	6.066	33.6	17.1	1381.1	1153.2
REND LAKE												
1735B1	1	SED	25.4	24.9	.198	.041	2.390	.710	39.6	8.2	477.5	141.8
1735F1	1	SED	29.0	28.4	.143	.026	2.138	.685	27.6	5.0	413.3	132.4

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA[1] (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
ILLINOIS														
SHELBYVILLE RESERVOIR														
1739B1	20	28.21	3.7	.4	95.9	0	0	0	AGRIC	M06-06	6.0	1.1	97	.0061
1739C1	20	40.64	3.0	1.0	96.0	0	0	0	AGRIC	M06-06	6.0	.9	97	.0062
1739G1	20	144.39	1.9	.8	97.2	.1	0	0	AGRIC	M06-06	6.0	.7	97	.0064
1739H1	20	119.30	4.6	1.2	93.3	.9	0	0	AGRIC	M06-06	6.0	1.1	99	.0063
SPRINGFIELD LAKE														
1742B1	20	60.74	1.1	.4	98.4	0	0	.1	AGRIC	M06-06	6.0	1.1	91	.0063
VERMILION RESERVOIR														
1748A3	20	98.52	.2	.2	97.6	1.7	.1	.2	AGRIC	M06-06	6.0	1.2	94	.0063
1748B1	20	13.49	3.3	.2	96.5	0	0	0	AGRIC	A07-17	6.3	1.6	97	.0061
1748C1	20	24.29	.2	.2	99.6	0	0	0	AGRIC	M06-06	6.0	1.6	94	.0061
1748E1	20	29.73	.1	.3	99.6	0	0	0	AGRIC	M06-06	6.0	1.2	94	.0062
1748F1	20	43.90	.1	0	99.9	0	0	0	AGRIC	A07-17	6.3	1.4	97	.0059
1748G1	20	35.41	1.4	.7	97.2	.7	0	0	AGRIC	M06-06	6.0	1.6	94	.0061
SANGCHRIS LAKE														
1753B1	20	36.23	2.8	.2	97.0	0	0	0	AGRIC	M06-06	6.0	.8	91	.0061
1753C1	20	12.61	0	0	100.0	0	0	0	AGRIC	M06-06	6.0	.2	91	.0060
1753D1	20	17.38	.1	1.0	98.9	0	0	0	AGRIC	M06-06	6.0	.4	91	.0061
1753E1	20	32.17	1.8	.5	97.6	0	0	.1	AGRIC	M06-06	6.0	.5	91	.0061
HOLIDAY LAKE														
1754A2	20	138.15	3.9	1.4	93.9	.8	0	0	AGRIC	M06-06	6.0	1.4	86	.0061
RACCOON LAKE														
1762A2	20	90.86	22.0	2.0	75.2	.2	.1	.5	AGRIC	A01-03	6.3	3.0	104	.0063
LAKE VANDALIA														
1764A2	20	11.47	2.6	0	97.4	0	0	0	AGRIC	A01-03	6.3	.9	97	.0060
1764B1	20	10.54	6.5	0	93.5	0	0	0	AGRIC	A01-03	6.3	1.8	97	.0060
1764C1	20	4.53	5.2	0	94.8	0	0	0	AGRIC	A01-03	6.3	1.2	97	.0059
1764D1	20	3.16	0	0	100.0	0	0	0	AGRIC	A01-03	6.3	1.4	97	.0059
INDIANA														
CATARACT LAKE														
1805D1	20	3.55	54.8	4.1	41.1	0	0	0	M. FOR.	A06-06	6.0	10.0	107	.0093
1805E1	20	6.42	39.0	9.2	51.1	0	0	.7	MIXED	A06-06	6.0	7.1	107	.0093
1805E2	20	15.67	44.3	6.1	47.9	0	1.1	.6	MIXED	A06-06	6.0	16.3	107	.0093
GEIST RESERVOIR														
1811D1	20	23.88	6.6	1.1	91.1	0	0	1.2	AGRIC	A07-04	6.3	3.0	91	.0094
MISSISSINEWA RESERVOIR														
1827C1	20	7.59	4.9	0	93.7	.9	.5	0	AGRIC	A07-04	6.3	1.6	94	.0093
1827D1	20	25.62	15.5	.3	83.6	.2	.4	0	AGRIC	A07-04	6.3	3.4	94	.0093
1827F1	20	18.36	1.9	0	98.1	0	0	0	AGRIC	A07-04	6.3	1.5	94	.0094

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	GEOLOGY	ANIMAL DENSITY 7 (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
ILLINOIS												
SHELBYVILLE RESERVOIR												
1739B1	1	SED	27.2	26.7	.123	.074	5.370	4.694	23.2	14.0	1014.7	887.0
1739C1	1	SED	23.4	22.9	.094	.033	6.660	6.157	18.1	6.4	1284.6	1226.5
1739G1	1	SED	15.8	15.3	.211	.102	7.269	6.359	42.6	20.6	1468.1	1284.3
1739H1	1	SED	18.1	17.6	.270	.136	7.082	5.961	53.2	26.8	1396.0	1175.1
SPRINGFIELD LAKE												
1742B1	1	SED	29.5	28.8	.110	.050	7.332	6.533	22.1	10.1	1476.2	1315.3
VERMILION RESERVOIR												
1748A3	1	SED	19.9	19.6	.092	.027	7.186	7.011	18.4	5.4	1440.9	1405.8
1748B1	1	SED	17.4	17.2	.089	.026	8.025	7.444	18.6	5.4	1678.8	1557.2
1748C1	1	SED	17.9	17.8	.079	.015	7.827	7.247	15.3	2.9	1515.6	1403.3
1748E1	1	SED	17.9	17.8	.153	.019	8.842	7.848	29.0	3.6	1678.6	1489.9
1748F1	1	SED	18.0	17.8	.076	.017	8.394	7.630	14.1	3.2	1558.8	1416.9
1748G1	1	SED	17.5	17.3	.067	.014	7.809	7.177	12.5	2.6	1452.1	1334.6
SANGCHRIS LAKE												
1753B1	1	SED	17.8	17.4	.121	.049	6.624	5.915	23.0	9.3	1261.2	1126.2
1753C1	1	SED	18.3	17.9	.052	.038	6.109	5.229	10.3	7.6	1215.2	1040.2
1753D1	1	SED	18.1	17.7	.121	.046	6.510	5.607	24.0	9.1	1291.9	1112.7
1753E1	1	SED	26.0	25.5	.182	.093	7.641	6.876	35.5	18.1	1489.5	1340.4
HOLIDAY LAKE												
1754A2	1	SED	66.0	67.0	.123	.051	7.141	6.292	24.8	10.3	1442.5	1271.0
RACCOON LAKE												
1762A2	1	SED	26.5	26.1	.191	.045	2.775	.599	37.6	8.9	545.9	117.8
LAKE VANDALIA												
1764A2	1	SED	31.9	31.5	.164	.089	2.260	.888	31.4	17.0	432.5	169.9
1764B1	1	SED	30.6	30.2	.169	.069	2.550	.791	30.2	12.3	455.2	141.2
1764C1	1	SED	31.0	30.6	.191	.069	2.108	.575	39.7	14.3	437.7	119.4
1764D1	1	SED	32.7	30.3	.313	.133	3.042	1.444	62.1	26.4	603.7	286.7
INDIANA												
CATARACT LAKE												
1805D1	1	SED	29.8	29.2	.135	.036	1.222	.675	35.8	9.5	323.8	178.9
1805E1	1	SED	37.0	36.3	.259	.142	3.215	1.834	75.9	41.6	942.1	537.4
1805E2	1	SED	34.7	34.0	.044	.014	1.155	.532	13.2	4.2	346.7	159.7
GEIST RESERVOIR												
1811D1	1	SED	35.1	34.6	.096	.047	5.143	4.424	29.0	14.2	1553.2	1336.1
MISSISSINEWA RESERVOIR												
1827C1	1	SED	55.1	53.2	.172	.118	5.226	4.210	49.7	34.1	1511.3	1217.5
1827D1	1	SED	35.1	33.8	.105	.038	2.616	1.295	30.8	11.2	768.4	380.4
1827F1	1	SED	44.8	43.5	.096	.052	5.781	4.730	27.9	15.1	1678.4	1373.3

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM)[1]	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM)[5]
INDIANA														
MORSE RESERVOIR														
1829B1	20	48.02	8.5	.1	90.4	.9	0	.1	AGRIC	A07-04	6.3	2.1	91	.0111
WAWASEE LAKE														
1836C1	20	4.53	16.5	1.9	80.7	0	.9	0	AGRIC	A07-01	6.3	1.9	91	.0092
WINONA LAKE														
1840B1	20	29.81	11.9	.4	87.1	.2	.2	.2	AGRIC	A07-01	6.3	2.4	94	.0094
1840C1	20	9.27	8.2	.8	89.7	0	.5	.8	AGRIC	A07-01	6.3	2.8	94	.0093
MAXINKUCEE LAKE														
1843B1	20	3.81	9.1	6.4	84.5	0	0	0	AGRIC	A07-05	6.3	4.7	94	.0093
1843C1	20	5.10	18.6	6.2	72.0	0	3.2	0	M. AGRIC	A07-05	6.3	5.0	94	.0093
OLIVER LAKE														
1847B1	20	5.52	12.1	4.0	83.1	0	.8	0	AGRIC	A07-01	6.3	2.4	89	.0092
VERSAILLES LAKE														
1850B1	20	15.46	25.4	43.4	31.2	0	0	0	MIXED	A06-02	5.8	3.9	104	.0093
1850D1	20	11.58	21.0	10.0	68.4	.2	0	.4	M. AGRIC	A06-02	5.8	3.9	104	.0093
PIGEON LAKE														
1855A2	20	33.20	15.0	3.0	81.9	0	0	.1	AGRIC	A07-05	6.3	2.4	89	.0094
1855B1	20	8.18	10.4	5.6	84.0	0	0	0	AGRIC	A07-05	6.3	2.1	89	.0093
MARSH LAKE														
1856B1	20	5.52	15.1	15.7	65.7	0	3.5	0	M. AGRIC	A07-05	6.3	6.0	89	.0093
HAMILTON LAKE														
1857B1	20	21.89	15.6	.6	83.8	0	0	0	AGRIC	A07-04	6.3	3.4	89	.0093
1857C1	20	2.15	17.0	.1	82.9	0	0	0	AGRIC	A07-05	6.3	6.0	89	.0091
1857D1	20	1.81	25.7	14.9	59.4	0	0	0	M. AGRIC	A07-04	6.3	8.1	89	.0092
KENTUCKY														
LAKE CUMBERLAND														
2101C1	30	12.61	46.2	6.2	47.6	0	0	0	MIXED	U05-07	4.5	17.8	132	.0132
2101H1	30	39.63	47.1	1.8	50.8	.3	0	0	M. AGRIC	U06-06	4.5	14.9	127	.0134
2101J1	30	40.38	35.4	1.8	62.5	0	0	.3	M. AGRIC	U06-06	4.5	13.6	127	.0134
2101K1	30	58.43	20.3	3.0	75.8	.8	0	.1	AGRIC	U06-06	4.5	10.1	127	.0134
2101S1	30	46.36	89.1	6.6	2.8	.5	0	1.0	FOREST	U05-07	4.5	22.6	122	.0134
DALE HOLLOW RESERVOIR														
2102B1	30	12.92	41.0	4.7	54.3	0	0	0	M. AGRIC	U05-07	4.5	16.0	127	.0182
2102C1	30	30.46	39.9	4.7	55.2	.1	0	.1	M. AGRIC	U05-07	4.5	17.2	132	.0182
2102F1	30	23.39	78.6	6.0	15.4	0	0	0	M. FOR.	I08-06	5.0	25.6	137	.0208
KENTUCKY LAKE														
2104C1	40	76.59	40.2	4.8	55.0	0	0	0	M. AGRIC	A07-14	5.8	7.6	122	.0146
2104D1	43	8.96	52.4	11.4	35.6	.3	0	.3	M. FOR.	U06-03	4.5	11.0	122	.0146
2104E1	43	138.44	54.5	2.5	42.7	0	.1	.2	M. FOR.	U06-03	4.5	8.4	122	.0146
2104F1	30	32.92	64.3	8.7	27.0	0	0	0	M. FOR.	U06-03	4.5	10.9	122	.0146
2104K1	34	9.61	82.5	2.8	14.7	0	0	0	M. FOR.	U06-03	4.5	14.8	127	.0146
2104L1	34	38.18	76.2	4.0	19.6	0	.1	.1	M. FOR.	U06-03	4.5	16.0	127	.0146
2104M1	34	19.43	66.7	2.5	30.5	0	0	.3	M. FOR.	U06-03	4.5	11.8	127	.0146
2104N1	40	13.99	57.2	10.1	29.9	2.1	0	.7	M. FOR.	U06-03	4.5	8.1	127	.0146
2104V1	30	37.58	74.6	2.2	22.9	.3	0	0	M. FOR.	U06-06	4.5	17.5	132	.0146
2104W1	30	55.04	77.5	3.6	18.6	.2	0	.1	M. FOR.	U06-06	4.5	17.8	132	.0146
2104X1	30	48.02	86.1	2.0	11.9	0	0	0	M. FOR.	U06-06	4.5	19.4	132	.0146
2104Y1	30	59.83	79.1	2.1	18.7	.1	0	0	M. FOR.	U06-06	4.5	17.4	130	.0146
2104Z1	34	19.71	76.1	3.2	20.7	0	0	0	M. FOR.	U06-03	4.5	10.6	127	.0146

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	FLAG 6	GEOLOGY 7	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
INDIANA												
MORSE RESERVOIR												
1829B1	1	SED	43.7	42.8	.070	.045	4.029	3.356	24.2	15.6	1394.3	1161.4
WAWASEE LAKE												
1836C1	1	SED	49.2	48.7	.043	.023	5.048	4.241	11.9	6.4	1397.7	1174.2
WINONA LAKE												
1840B1	1	SED	65.7	62.5	.073	.020	2.781	1.527	21.5	5.9	819.1	449.7
1840C1	1	SED	67.7	64.4	.054	.014	2.928	1.687	16.4	4.3	891.4	513.6
MAXINKUCEE LAKE												
1843B1	1	SED	46.1	45.1	.163	.085	4.731	3.373	53.6	28.0	1557.4	1110.4
1843C1	1	SED	41.5	40.7	.130	.039	2.630	1.489	40.0	12.0	808.5	457.7
OLIVER LAKE												
1847B1	1	SED	80.4	77.5	.035	.015	3.285	2.221	9.9	4.3	933.0	630.8
VERSAILLES LAKE												
1850B1	1	SED	21.1	20.7	.031	.013	.927	.413	8.8	3.7	263.2	117.3
1850D1	1	SED	46.4	45.3	.080	.037	1.336	.603	23.8	11.0	397.9	179.6
PIGEON LAKE												
1855A2	1	SED	47.7	47.9	.078	.020	3.301	1.991	22.8	5.9	966.5	582.9
1855B1	1	SED	48.9	49.1	.104	.042	5.098	3.597	31.9	12.9	1563.4	1103.1
MARSH LAKE												
1856B1	1	SED	38.3	38.4	.161	.105	2.509	1.328	45.7	29.8	712.6	337.2
HAMILTON LAKE												
1857B1	1	SED	48.8	49.0	.087	.031	3.109	1.820	24.9	8.9	890.7	521.4
1857C1	1	SED	48.3	48.5	.074	.009	1.700	.736	21.6	2.6	495.9	214.7
1857D1	1	SED	34.6	34.7	.052	.013	1.567	.713	18.0	4.5	542.9	247.0
KENTUCKY												
LAKE CUMBERLAND												
2101C1	4	SED	46.7	46.4	.021	.008	1.554	.811	8.9	3.4	656.9	342.8
2101H1	1	SED	47.9	47.7	.025	.014	1.205	.676	10.5	5.9	505.3	283.5
2101J1	1	SED	61.6	61.2	.020	.009	1.223	.779	8.4	3.8	512.8	326.7
2101K1	1	SED	74.7	74.3	.021	.011	1.150	.786	9.0	4.7	493.7	337.4
2101S1	1	SED	2.3	2.5	.009	.007	.607	.103	3.8	2.9	254.5	43.2
DALE HOLLOW RESERVOIR												
2102B1	1	SED	53.2	52.9	.015	.008	.881	.485	8.7	4.7	513.2	282.5
2102C1	1	SED	50.6	50.3	.011	.005	1.342	.527	6.2	2.8	759.8	298.4
2102F1	1	SED	19.0	20.9	.012	.007	.658	.241	7.9	4.6	432.2	158.3
KENTUCKY LAKE												
2104C1	1	SED	30.9	30.6	.129	.037	1.865	.461	59.2	17.0	855.2	211.4
2104D1	1	SED	20.0	19.8	.025	.013	1.304	.448	11.4	5.9	593.2	203.8
2104E1	1	SED	24.9	24.6	.013	.030	1.630	.483	5.9	13.7	745.8	221.0
2104F1	4	SED W/O L	16.1	15.9	.042	.009	.544	.124	18.8	4.0	243.5	55.5
2104K1	1	SED W/O L	9.6	9.4	.008	.006	.598	.096	3.9	2.9	292.7	47.0
2104L1	1	SED W/O L	12.8	12.6	.009	.006	.818	.337	4.1	2.8	376.2	155.0
2104M1	1	SED W/O L	19.9	19.6	.010	.006	.565	.224	4.5	2.7	255.3	101.2
2104N1	1	SED W/O L	19.5	19.2	.020	.007	.800	.218	9.0	3.1	358.6	97.7
2104V1	1	SED	19.6	19.5	.019	.008	.580	.193	8.7	3.7	266.2	88.6
2104W1	1	SED	12.6	12.4	.018	.009	.551	.177	8.2	4.1	251.1	80.7
2104X1	1	SED	7.3	7.2	.012	.007	.869	.195	5.5	3.2	397.2	89.1
2104Y1	1	SED	11.5	11.3	.023	.010	1.173	.239	10.5	4.6	534.8	109.0
2104Z1	1	SED W/O L	13.5	13.3	.008	.006	.271	.142	3.7	2.8	125.0	65.5

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM) [1]	LAND USE PERCENTAGES FOR	CL [2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT [3]	PH [4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM) [5]
MAINE														
MATTAWAMKEAG LAKE														
2308B1	10	65.01	82.4	2.2	13.8	.1	1.5	0	M. FOR.	S04-03	4.5	5.5	102	.0169
2308C3	10	56.88	73.5	2.1	21.5	.2	1.8	.9	M. FOR.	S04-03	4.5	5.9	102	.0169
MOOSEHEAD LAKE														
2309K1	10	18.75	97.3	0	0	0	0	2.7	FOREST	S04-04	4.5	15.6	102	.0204
RANGELEY LAKE														
2310B1	10	39.08	99.3	0	0	0	0	.7	FOREST	S04-04	4.5	12.0	102	.0174
SEBASTICOOK LAKE														
2312F1	10	53.02	54.6	7.2	32.9	0	3.6	1.7	M. FOR.	S04-04	4.5	3.0	99	.0196
MARYLAND														
DEEP CREEK LAKE														
2402B1	30	31.93	67.2	3.1	18.7	0	9.5	1.5	M. FOR.	I08-04	5.5	5.5	122	.0153
2402C1	30	7.20	86.0	6.0	6.0	0	2.0	0	FOREST	I08-06	5.0	16.3	122	.0241
2402D1	30	9.32	30.3	.7	69.0	0	0	0	M. AGRIC	I08-06	5.0	9.5	122	.0130
2402E1	30	5.23	45.3	.5	54.2	0	0	0	M. AGRIC	I08-06	5.0	11.2	122	.0290
LIBERTY RESERVOIR														
2403B1	40	18.10	35.1	2.9	60.6	1.3	0	.1	M. AGRIC	U05-05	4.5	10.5	112	.0115
2403C1	40	73.45	31.3	3.9	63.3	1.4	0	.1	M. AGRIC	U05-05	4.5	13.1	112	.0109
2403D1	40	16.06	20.8	3.3	74.2	1.1	0	.6	M. AGRIC	U05-05	4.5	7.7	112	.0126
2403E1	40	37.48	25.3	4.3	63.5	6.6	0	.3	M. AGRIC	U05-05	4.5	9.0	112	.0115
LOCH RAVEN RESERVOIR														
2408B1	40	53.90	39.9	15.0	26.6	17.3	0	1.2	MIXED	U05-05	4.5	7.5	114	.0119
2408C1	40	150.82	35.2	8.7	54.3	1.8	0	0	M. AGRIC	U05-05	4.5	11.2	112	.0107
2408D1	40	10.57	43.2	8.8	39.4	8.6	0	0	MIXED	U05-05	4.5	11.2	112	.0135
2408E1	40	8.60	34.1	6.0	15.3	44.6	0	0	M. URBAN	U05-05	4.5	12.8	112	.0063
2408F1	40	7.95	33.1	7.1	37.6	22.2	0	0	MIXED	U05-05	4.5	12.2	112	.0161
2408G1	40	4.14	33.0	9.6	53.4	4.0	0	0	M. AGRIC	U05-05	4.5	11.1	112	.0158
2408H1	40	2.67	12.5	29.5	0	58.0	0	0	M. URBAN	U05-05	4.5	9.6	114	.0114
2408J1	40	3.76	5.0	8.1	0	86.9	0	0	M. URBAN	U05-05	4.5	7.1	114	.0086
MICHIGAN														
LAKE CHARLEVOIX														
2617B1	20	29.09	52.9	6.0	40.7	0	.4	0	M. FOR.	S04-07	5.0	11.2	76	.0175
2617D1	12	44.88	40.6	3.2	54.3	.6	.6	.7	M. AGRIC	S04-07	5.0	8.6	76	.0117
2617E1	12	202.15	73.4	7.1	18.6	.2	.5	.2	M. FOR.	S04-07	5.0	11.2	76	.0264
MACATAWA LAKE														
2648A3	20	171.30	4.8	5.9	88.0	1.2	0	.1	AGRIC	S04-06	5.5	1.8	84	.0085
2648B1	20	39.73	9.5	21.3	55.7	7.3	5.8	.4	M. AGRIC	S04-06	5.5	1.1	84	.0085

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
MAINE												
MATTAWAMKEAG LAKE												
2308B1	1	SED/MET	1.5	1.5	.010	.005	.803	.267	5.3	2.7	426.0	141.7
2308C3	1	SED/MET	21.5	22.9	.012	.005	.624	.173	6.4	2.6	330.2	91.6
MOOSEHEAD LAKE												
2309K1	1	MET	0	0	.008	.006	.325	.112	5.0	3.7	201.1	69.3
RANGELEY LAKE												
2310B1	1	SED/MET	0	0	.010	.005	.590	.172	5.6	2.8	331.4	96.6
SEBASTICOOK LAKE												
2312F1	1	SED	36.4	38.8	.017	.006	.966	.227	10.6	3.7	599.9	141.0
MARYLAND												
DEEP CREEK LAKE												
2402B1	1	SED	19.0	19.1	.012	.006	.559	.314	5.8	2.9	269.0	151.1
2402C1	1	SED	6.1	6.1	.014	.007	.764	.300	10.4	5.2	565.6	222.1
2402D1	1	SED	70.2	70.6	.031	.009	1.414	1.036	12.5	3.6	570.9	418.3
2402E1	1	SED	55.2	55.5	.048	.018	1.984	1.588	43.2	16.2	1784.2	1428.1
LIBERTY RESERVOIR												
2403B1	1	MET	52.3	51.2	.026	.009	2.551	2.235	9.5	3.3	928.1	813.1
2403C1	1	MET	54.6	53.5	.017	.007	2.463	2.193	5.8	2.4	841.2	749.0
2403D1	1	MET	64.0	62.7	.020	.008	2.765	2.406	7.8	3.1	1079.7	939.5
2403E1	1	MET	54.8	53.6	.024	.008	2.908	2.609	8.6	2.9	1046.1	938.6
LOCH RAVEN RESERVOIR												
2408B1	3	MET	18.1	17.9	.016	.010	2.115	1.700	6.1	3.8	799.8	642.8
2408C1	1	MET	36.8	36.5	.040	.020	2.214	1.927	13.4	6.7	741.1	645.0
2408D1	1	MET	26.7	26.5	.018	.013	2.349	1.742	7.5	5.4	975.6	723.5
2408E1	3	MET	10.4	10.3	.019	.011	1.424	1.106	3.5	2.0	259.6	201.6
2408F1	3	MET	25.5	25.3	.092	.044	3.175	2.630	47.2	22.6	1627.9	1348.5
2408G1	1	MET	36.2	35.9	.062	.012	2.385	2.190	32.9	6.4	1264.5	1161.1
2408H1	3	MET	0	0	.027	.017	2.342	2.022	9.5	6.0	825.1	712.4
2408J1	3	MET	0	0	.020	.015	1.981	1.662	5.0	3.8	495.6	415.8
MICHIGAN												
LAKE CHARLEVOIX												
2617B1	1	SED	25.8	25.7	.009	.005	1.947	1.266	5.1	2.9	1112.3	723.2
2617D1	1	SED	33.6	33.5	.012	.006	1.436	.372	4.4	2.2	531.7	137.7
2617E1	4	SED	8.7	8.5	.014	.006	1.199	.722	11.6	5.0	993.1	598.0
MACATAWA LAKE												
2648A3	1	SED W/O L	66.6	64.3	.167	.052	4.845	2.808	44.6	13.9	1294.8	750.4
2648B1	3	SED W/O L	45.0	43.3	.076	.029	2.534	1.295	20.4	7.8	680.0	347.5

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION[1]	AREA (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
MICHIGAN														
PORTAGE LAKE														
2669G1	10	42.97	58.6	2.4	38.9	0	0	.1	M. FOR.	S04-04	4.5	4.7	91	.0130
2669H1	10	57.55	61.8	6.9	27.9	2.6	.1	.7	M. FOR.	S04-04	4.5	5.9	91	.0130
THORNAPPLE LAKE														
2683B1	20	144.83	19.2	1.0	77.2	.3	1.6	.7	AGRIC	A07-04	6.3	1.9	76	.0079
CRYSTAL LAKE														
2694B1	20	7.49	26.4	14.1	58.5	1.0	0	0	M. AGRIC	A07-04	6.3	3.1	76	.0083
MINNESOTA														
BIG STONE LAKE														
2709D1	20	35.02	2.6	2.3	95.0	0	0	.1	AGRIC	M05-04	7.2	2.0	53	.0011
2709E1	20	15.07	3.9	1.6	94.5	0	0	0	AGRIC	M05-04	7.2	2.0	53	.0012
2709F1	20	62.19	1.8	2.0	96.2	0	0	0	AGRIC	M05-04	7.2	1.3	53	.0012
BUFFALO LAKE														
2713C1	20	6.19	9.4	0	74.1	15.2	1.3	0	M. AGRIC	M05-01	6.5	1.5	74	.0063
COKATO LAKE														
2719B2	20	51.90	4.8	.1	75.0	2.3	15.2	2.6	AGRIC	A07-06	6.3	3.1	69	.0041
2719C1	20	9.82	5.1	0	89.8	0	5.1	0	AGRIC	A07-06	6.3	4.0	69	.0036
HERON LAKE														
2739H1	20	6.24	1.0	1.1	97.8	0	0	.1	AGRIC	M07-06	6.3	1.2	64	.0020
MASHKENODE LAKE														
2756B1	10	17.28	41.4	14.7	1.2	27.8	1.1	13.8	MIXED	A04-01	5.5	4.5	71	.0056
UPPER SAKATAH LAKE														
2777B1	20	88.34	6.2	1.1	79.9	.7	11.5	.6	AGRIC	A07-06	6.3	5.2	76	.0031
LAKE PEPIN														
27A4H1	20	176.79	19.1	1.2	79.6	0	.1	0	AGRIC	A07-17	6.3	9.3	74	.0046
27A4J1	20	64.39	26.8	4.5	68.7	0	0	0	M. AGRIC	A07-17	6.3	12.0	74	.0050
27A4K1	20	44.91	19.9	4.2	73.8	2.0	0	.1	M. AGRIC	A07-17	6.3	12.4	76	.0046
ZUMBRO LAKE														
27A5F1	20	.49	0	0	76.2	23.8	0	0	AGRIC	M06-07	6.0	6.7	74	.0041
27A5G1	20	78.30	7.7	0	92.3	0	0	0	AGRIC	M06-07	6.0	5.9	74	.0036
LAKE ST. CROIX														
27A7C1	20	15.07	13.4	4.8	81.5	0	0	.3	AGRIC	M05-01	6.5	6.9	74	.0074
MISSISSIPPI														
ARKABUTLA RESERVOIR														
2801G1	40	83.14	20.2	5.4	70.9	2.9	0	.6	M. AGRIC	A07-09	6.0	5.5	132	.0166
ENID LAKE														
2802B1	40	32.14	58.1	1.3	40.1	0	0	.5	M. FOR.	A07-09	6.0	9.8	132	.0145
2802D1	40	34.60	55.3	1.2	43.5	0	0	0	M. FOR.	A07-09	6.0	11.8	132	.0153

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
MICHIGAN												
PORTAGE LAKE												
2669G1	1	SED W/O L	15.3	15.3	.056	.024	1.437	.282	24.1	10.3	618.7	121.4
2669H1	3	SWOL/IG-V	11.0	10.9	.041	.024	1.056	.435	17.2	10.1	443.0	182.5
THORNAPPLE LAKE												
2683B1	1	SED	42.7	43.1	.077	.043	1.863	1.017	19.7	11.0	475.9	259.8
CRYSTAL LAKE												
2694B1	1	SED	19.8	19.8	.038	.017	1.382	.257	9.5	4.3	347.1	64.6
MINNESOTA												
BIG STONE LAKE												
2709D1	1	SED W/O L	29.0	29.0	.089	.031	1.159	.460	3.2	1.1	41.5	16.5
2709E1	1	SED W/O L	28.8	28.0	.052	.030	3.106	2.589	2.2	1.2	129.3	107.7
2709F1	1	SED W/O L	29.4	29.3	.073	.035	1.431	.504	2.9	1.4	57.7	20.3
BUFFALO LAKE												
2713C1	3	SED W/O L	59.3	58.9	.240	.158	2.119	.731	48.6	32.0	429.4	148.1
COKATO LAKE												
2719B2	1	SED W/O L	60.0	59.6	.326	.165	3.033	1.275	41.4	20.9	384.8	161.8
2719C1	1	SED W/O L	71.8	71.4	.202	.087	4.626	2.312	25.8	11.1	590.8	295.3
HERON LAKE												
2739H1	1	SED W/O L	52.0	51.9	.099	.045	4.676	3.059	5.0	2.3	235.0	153.7
MASHKENODE LAKE												
2756B1	2	MET/SED	.6	.6	.036	.008	1.313	.823	6.3	1.4	230.6	144.5
UPPER SAKATAH LAKE												
2777B1	1	SED	40.3	39.5	.233	.134	5.320	3.080	30.6	17.6	698.7	404.5
LAKE PEPIN												
27A4H1	1	SED	62.2	61.6	.231	.072	2.586	1.329	34.0	10.6	380.7	195.6
27A4J1	1	SED	63.5	63.5	.224	.073	2.059	1.044	34.9	11.4	320.9	162.7
27A4K1	1	SED	73.5	73.7	.161	.064	2.391	1.584	23.6	9.4	350.6	232.2
ZUMBRO LAKE												
27A5F1	1	SED	66.8	65.9	.121	.062	2.219	1.007	15.5	7.9	284.0	128.9
27A5G1	1	SED	75.6	74.9	.147	.109	3.651	2.646	15.9	11.8	394.8	286.1
LAKE ST. CROIX												
27A7C1	1	SED	60.5	60.4	.053	.031	1.812	1.341	12.1	7.1	414.7	306.9
MISSISSIPPI												
ARKABUTLA RESERVOIR												
2801G1	1	SED	52.0	51.9	.093	.030	.794	.232	48.4	15.6	413.2	120.7
ENID LAKE												
2802B1	1	SED	31.1	31.1	.086	.014	1.478	.245	39.4	6.4	677.7	112.3
2802D1	1	SED	26.6	26.6	.101	.023	1.235	.270	48.5	11.0	593.2	129.7

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM) [1]	LAND USE PERCENTAGES [2] FOR	CL	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS [3] MAP UNIT	PH [4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW [5] (CMS/SQ KM)
MISSISSIPPI														
ROSS BARNETT RESERVOIR														
2804C1	40	183.79	59.8	.7	39.5	0	0	0	M. FOR.	A07-09	6.0	2.3	127	.0134
SARDIS LAKE														
2805C1	40	8.91	62.7	10.5	26.1	0	0	.7	M. FOR.	A07-09	6.0	6.6	132	.0055
2805E1	40	69.00	50.7	11.6	37.7	0	0	0	M. FOR.	A07-09	6.0	8.4	132	.0140
2805F1	40	31.31	56.8	6.7	35.5	.4	0	.6	M. FOR.	A07-09	6.0	6.8	132	.0122
2805H1	40	27.38	45.8	5.0	48.8	0	0	.4	MIXED	A07-09	6.0	10.4	132	.0146
2805J1	40	23.98	51.8	1.7	45.3	0	0	1.2	M. FOR.	A07-09	6.0	10.4	132	.0072
GRENADA LAKE														
2806F1	40	56.62	49.0	.9	50.0	0	.1	0	M. AGRIC	A07-06	6.0	3.6	132	.0152
NEW HAMPSHIRE														
LAKE WINNIPESAUKEE														
3303A1	10	17.09	87.3	2.3	7.5	.1	2.5	.3	M. FOR.	S04-04	4.5	8.4	109	.0193
3303D1	10	.73	74.2	3.2	16.1	6.5	0	0	M. FOR.	S04-04	4.5	15.1	114	.0192
3303E1	10	6.14	77.1	4.9	7.8	.8	7.4	2.0	M. FOR.	S04-05	4.5	11.7	114	.0193
3303F1	10	3.06	80.0	5.0	15.0	0	0	0	M. FOR.	S04-04	4.5	11.4	114	.0193
3303J1	10	7.02	82.8	4.4	12.4	.4	0	0	M. FOR.	S04-04	4.5	12.4	114	.0193
3303K1	10	18.36	93.5	1.0	4.8	0	0	.7	FOREST	S04-04	4.5	18.1	114	.0193
3303L1	10	40.51	91.5	1.6	2.5	1.6	2.1	.7	FOREST	S04-04	4.5	12.6	112	.0193
3303N1	10	8.65	79.4	7.2	8.3	1.8	3.3	0	M. FOR.	S04-04	4.5	5.7	109	.0193
3303U1	10	23.00	95.0	.2	.9	.1	2.5	1.3	FOREST	S04-04	4.5	14.9	107	.0193
3303V1	10	8.96	94.9	1.1	2.3	0	0	1.7	FOREST	S04-04	4.5	12.7	107	.0193
3303X1	10	7.56	96.3	.7	3.0	0	0	0	FOREST	S04-05	4.5	16.5	109	.0193
3303Y1	10	9.84	91.3	2.9	5.8	0	0	0	FOREST	S04-04	4.5	17.4	107	.0193
NEW JERSEY														
SPRUCE RUN RESERVOIR														
3420A2	40	40.32	48.2	8.9	40.4	2.2	0	.3	MIXED	U05-05	4.5	5.6	122	.0142
3420B1	40	30.35	46.2	6.0	46.5	.5	0	.8	MIXED	U05-05	4.5	11.2	122	.0137
3420C1	40	7.38	46.7	5.1	48.2	0	0	0	MIXED	U05-05	4.5	12.9	122	.0151
3420D1	40	6.37	57.9	10.6	30.3	1.2	0	0	M. FOR.	U05-05	4.5	14.8	122	.0141
3420E1	40	4.61	69.2	2.7	28.1	0	0	0	M. FOR.	U05-05	4.5	15.4	122	.0151
UNION LAKE														
3422B1	40	38.95	49.5	1.5	45.1	3.4	.1	.4	MIXED	U05-11	4.5	1.5	112	.0123
NEW YORK														
CANADIAGUA LAKE														
3604A3	20	14.56	22.0	3.3	73.4	0	1.3	0	M. AGRIC	A07-01	6.3	3.6	84	.0064
3604C1	21	12.07	56.4	13.7	29.9	0	0	0	M. FOR.	A07-01	6.3	12.8	84	.0063
3604D1	20	3.34	40.0	28.5	31.5	0	0	0	MIXED	A07-01	6.3	15.3	84	.0059
3604E1	20	16.24	50.0	19.8	29.0	1.2	0	0	M. FOR.	A07-01	6.3	13.4	84	.0064
3604H1	10	114.48	68.9	9.6	18.2	1.2	1.8	.3	M. FOR.	I10-04	5.0	17.1	81	.0113

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	FLAG 6	GEOLOGY	ANIMAL DENSITY 7 (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
MISSISSIPPI												
ROSS BARNETT RESERVOIR												
2804C1	1	SED	64.2	69.5	.219	.088	1.672	.405	91.9	36.9	701.7	170.0
SARDIS LAKE												
2805C1	1	SED	15.3	15.3	.031	.010	.850	.344	5.5	1.8	149.6	60.5
2805E1	1	SED	25.0	24.9	.034	.013	1.059	.288	15.0	5.7	466.8	127.0
2805F1	1	SED	26.2	26.5	.047	.015	1.732	.645	17.9	5.7	659.1	245.5
2805H1	1	SED	36.1	36.5	.070	.019	1.288	.419	32.1	8.7	590.0	191.9
2805J1	1	SED	33.5	33.8	.064	.017	1.433	.470	15.1	4.0	337.3	110.6
GRENADA LAKE												
2806F1	1	SED	38.8	38.7	.086	.016	.801	.144	41.0	7.6	381.5	68.6
NEW HAMPSHIRE												
LAKE WINNIPESAUKEE												
3303A1	1	MET	6.7	6.4	.017	.008	.517	.106	10.0	4.7	303.5	62.2
3303D1	1	MET	13.4	12.9	.017	.010	.348	.074	14.6	8.6	299.0	63.6
3303E1	1	MET	6.5	6.2	.030	.010	.622	.129	18.4	6.1	381.1	79.1
3303F1	1	MET	12.5	12.0	.018	.008	.358	.164	11.1	4.9	220.1	100.3
3303J1	1	MET	11.0	10.6	.013	.007	.807	.599	8.1	4.4	504.6	374.6
3303K1	1	MET/IG-P	4.3	4.1	.015	.006	.589	.329	9.0	3.6	352.1	196.7
3303L1	1	MET/IG-P	2.2	2.1	.018	.010	.676	.172	10.9	6.0	408.1	103.8
3303N1	1	MET	7.4	7.1	.018	.007	.504	.091	11.1	4.3	310.6	56.1
3303U1	1	MET	.8	.7	.017	.006	.544	.082	3.9	1.4	126.1	19.0
3303V1	1	MET	1.9	1.8	.020	.007	.855	.127	11.9	4.2	508.7	75.6
3303X1	1	MET	2.5	2.4	.017	.006	.343	.075	11.3	4.0	227.6	49.8
3303Y1	1	MET	4.8	4.6	.020	.006	.304	.109	12.1	3.6	184.1	66.0
NEW JERSEY												
SPRUCE RUN RESERVOIR												
3420A2	1	MET/SWOL	32.9	31.2	.035	.021	1.582	.939	15.5	9.3	701.3	416.2
3420B1	1	MET/SWOL	37.9	35.9	.023	.014	1.541	1.101	10.0	6.1	668.7	477.7
3420C1	1	MET/SWOL	39.3	37.2	.022	.009	1.638	.839	10.3	4.2	765.5	392.1
3420D1	1	MET/SWOL	24.7	23.4	.024	.012	1.098	.506	10.6	5.3	486.4	224.2
3420E1	1	MET/SWOL	22.9	21.7	.032	.018	1.350	.550	15.2	8.6	642.8	261.9
UNION LAKE												
3422B1	1	SED W/O L	17.8	15.4	.026	.012	1.909	1.249	10.0	4.6	737.7	500.0
NEW YORK												
CANADIAGUA LAKE												
3604A3	1	SED	34.2	34.3	.050	.015	2.826	2.036	9.7	2.9	547.7	394.6
3604C1	1	SED	12.2	12.2	.064	.044	1.392	.949	13.3	9.1	289.3	197.2
3604D1	1	SED	14.7	14.7	.022	.010	.890	.528	4.1	1.9	167.1	99.1
3604E1	4	SED	13.6	13.6	.017	.007	.896	.572	3.3	1.4	173.0	101.8
3604H1	4	SED	8.5	8.5	.030	.007	.941	.662	11.4	2.7	358.3	252.0

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION[1]	AREA (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM)[5]
NEW YORK														
CANNONSVILLE RESERVOIR														
3605B1	10	11.29	88.6	5.3	6.1	0	0	0	FOREST	I10-01	5.5	20.7	109	.0162
3605D1	10	32.01	77.6	3.1	18.8	.5	0	0	M. FOR.	I10-01	5.5	14.9	109	.0162
3605E1	10	51.52	66.2	15.5	17.8	.3	.2	0	M. FOR.	I10-01	5.5	16.0	109	.0182
3605F1	10	3.11	100.0	0	0	0	0	0	FOREST	I10-01	5.5	26.0	109	.0191
CARRY FALLS RESERVOIR														
3606B1	10	4.92	41.3	0	0	0	56.6	2.1	FOREST	S04-05	4.5	4.5	97	.0190
CASSADAGA LAKE														
3607B1	10	.75	62.8	3.9	33.3	0	0	0	M. FOR.	I10-03	5.0	10.8	97	.0177
3607C1	10	1.27	76.4	18.6	5.0	0	0	0	FOREST	A07-15	6.0	14.6	97	.0176
CAYUGA LAKE														
3608G2	21	6.81	20.6	27.8	51.6	0	0	0	M. AGRIC	A07-01	6.3	4.0	86	.0117
3608H1	20	22.02	27.9	23.1	45.8	.5	2.7	0	MIXED	A07-01	6.3	3.1	86	.0135
3608M1	20	6.16	21.1	6.3	72.1	0	.5	0	M. AGRIC	A07-01	6.3	2.9	86	.0049
3608P2	20	6.29	11.9	7.0	80.6	.5	0	0	AGRIC	A07-01	6.3	5.5	89	.0119
3608Q1	20	37.30	22.9	4.0	71.0	.3	1.8	0	M. AGRIC	A07-01	6.3	3.2	89	.0116
CHAUTAUQUA														
3610B1	12	27.97	47.7	6.4	38.2	1.2	6.4	.1	MIXED	A07-15	6.0	6.6	107	.0184
3610C1	10	60.66	66.8	14.7	14.6	.2	3.4	.3	M. FOR.	I10-03	5.0	8.9	107	.0188
3610D1	10	24.94	45.9	4.4	45.8	.2	3.5	.2	MIXED	I10-03	5.0	7.9	107	.0091
3610E1	10	75.73	56.8	6.6	31.6	2.7	2.1	.2	M. FOR.	I10-03	5.0	6.9	107	.0185
3610F1	10	4.12	35.9	10.0	6.3	47.8	0	0	M. URBAN	I10-03	5.0	5.8	107	.0084
3610H1	10	15.44	53.5	11.6	34.4	.5	0	0	M. FOR.	I10-03	5.0	8.3	107	.0190
3610J1	10	31.73	62.9	13.5	19.9	.8	2.7	.2	M. FOR.	I10-03	5.0	8.3	107	.0188
3610K1	10	35.77	57.4	5.0	35.8	.3	1.5	0	M. FOR.	I10-03	5.0	7.4	107	.0181
GOODYEAR LAKE														
3613B1	10	29.50	51.9	1.6	40.4	1.1	5.0	0	M. FOR.	I10-04	5.0	11.4	102	.0161
3613C1	10	5.67	41.3	1.5	56.4	0	.8	0	M. AGRIC	I10-04	5.0	8.9	102	.0163
3613D1	10	10.23	74.4	5.9	17.6	0	2.1	0	M. FOR.	I10-04	5.0	11.4	102	.0162
3613E1	10	32.58	58.3	5.0	32.4	1.1	3.1	.1	M. FOR.	I10-04	5.0	11.3	102	.0160
LAKE HUNTINGTON														
3615A1	10	.44	77.4	6.4	0	12.9	3.3	0	M. FOR.	I10-01	5.5	6.4	114	.0153
KEUKA LAKE														
3617B1	10	3.37	39.9	13.6	38.1	8.4	0	0	MIXED	I10-04	5.0	10.5	86	.0082
3617C1	10	5.96	28.7	8.3	62.4	0	.6	0	M. AGRIC	I10-04	5.0	6.7	86	.0081
3617D1	21	89.72	41.2	20.4	35.3	.2	2.1	.8	MIXED	A07-01	6.3	9.0	86	.0080
3617F1	21	8.21	27.3	22.6	48.4	.8	.9	0	MIXED	A07-01	6.3	4.7	86	.0081
3617H1	10	4.12	26.0	26.1	47.8	0	.1	0	MIXED	I10-04	5.0	7.5	86	.0083

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
NEW YORK												
CANNONSVILLE RESERVOIR												
3605B1	1	SED W/O L	6.2	6.2	.016	.009	.492	.181	8.0	4.5	246.0	90.5
3605D1	1	SED W/O L	19.2	19.2	.021	.010	.899	.515	10.7	5.1	457.9	262.3
3605E1	4	SED W/O L	18.2	18.2	.018	.009	1.216	.759	10.3	5.1	695.7	434.2
3605F1	1	SED W/O L	0	0	.014	.007	.803	.378	8.5	4.2	485.8	228.7
CARRY FALLS RESERVOIR												
3606B1	1	MET/SWOL	0	0	.018	.006	1.171	.260	10.3	3.4	671.7	149.1
CASSADAGA LAKE												
3607B1	1	SED W/O L	3.3	3.3	.029	.007	.856	.457	24.2	5.9	715.8	382.1
3607C1	1	SED W/O L	15.9	15.9	.010	.005	.799	.458	4.9	2.5	394.5	226.2
CAYUGA LAKE												
3608G2	1	SED W/O L	25.0	31.8	.021	.008	1.428	1.017	7.7	2.9	526.0	374.6
3608H1	1	SED W/O L	16.4	16.4	.022	.006	1.039	.635	9.4	2.6	443.9	271.3
3608M1	1	SED W/O L	55.9	55.2	.027	.012	2.579	1.765	4.1	1.8	393.8	269.5
3608P2	1	SED W/O L	48.1	47.5	.051	.028	1.745	1.101	17.8	9.8	608.9	384.2
3608Q1	1	SED W/O L	42.4	41.8	.031	.010	1.943	1.512	11.7	3.8	735.0	572.0
CHAUTAUQUA												
3610B1	3	SED W/O L	32.8	32.7	.032	.013	1.006	.390	18.3	7.4	575.2	223.0
3610C1	4	SED W/O L	12.5	12.5	.034	.012	.853	.460	19.9	7.0	498.2	268.7
3610D1	4	SED W/O L	39.3	39.2	.027	.008	.816	.384	7.5	2.2	225.7	106.2
3610E1	3	SED W/O L	27.1	27.0	.031	.010	.807	.330	19.4	6.3	504.5	206.3
3610F1	3	SED W/O L	5.4	5.4	.094	.032	1.340	.399	21.5	7.3	305.9	91.1
3610H1	4	SED W/O L	29.5	29.4	.031	.009	.878	.365	19.5	5.7	552.8	229.8
3610J1	4	SED W/O L	17.1	17.0	.011	.006	.706	.366	6.4	3.5	411.6	214.4
3610K1	4	SED W/O L	30.7	30.6	.023	.006	1.180	.751	11.9	3.1	610.3	388.4
GOODYEAR LAKE												
3613B1	4	SED W/O L	37.5	37.2	.025	.008	1.191	.715	12.5	4.0	595.0	357.2
3613C1	4	SED W/O L	52.3	51.9	.026	.008	.982	.427	12.9	4.0	488.8	212.5
3613D1	1	SED W/O L	16.3	16.2	.018	.006	.960	.482	9.4	3.1	500.2	251.2
3613E1	4	SED W/O L	30.0	29.8	.035	.009	1.058	.542	17.5	4.5	529.5	271.3
LAKE HUNTINGTON												
3615A1	3	SED W/O L	0	0	.038	.022	1.178	.416	27.1	15.7	839.5	296.5
KEUKA LAKE												
3617B1	3	SED	21.2	21.4	.045	.029	1.108	.905	12.6	8.1	309.3	252.6
3617C1	1	SED	31.1	31.3	.017	.008	1.551	.851	4.5	2.1	408.0	223.9
3617D1	1	SED	14.4	14.4	.033	.008	1.058	.715	8.6	2.1	277.3	187.4
3617F1	1	SED	19.8	19.8	.027	.014	1.939	1.345	7.2	3.7	518.4	359.6
3617H1	1	SED	26.6	26.9	.034	.018	2.044	1.338	10.4	5.5	622.2	407.3

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM) [1]	LAND USE PERCENTAGES [2] FOR	CL	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS [3] MAP UNIT	PH [4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM) [5]
NEW YORK														
OTTER LAKE														
3625B1	20	1.06	18.9	13.5	62.2	0	5.4	0	M. AGRIC	I10-02	5.0	7.9	91	.0137
ROUND LAKE														
3630A1	10	7.54	87.8	3.8	1.8	5.9	.7	0	M. FOR.	I10-02	5.0	7.6	104	.0158
3630B1	10	2.28	44.5	3.7	51.8	0	0	0	M. AGRIC	I10-02	5.0	4.7	104	.0158
3630C1	10	44.60	34.5	25.3	26.9	5.8	5.0	2.5	MIXED	I10-02	5.0	4.6	104	.0158
SCHROON LAKE														
3634D1	10	25.07	89.1	1.6	0	4.6	2.4	2.3	M. FOR.	S04-05	4.5	12.9	97	.0163
3634D2	10	21.57	93.7	0	0	.7	2.8	2.8	FOREST	S04-05	4.5	13.9	97	.0163
3634E1	10	5.70	94.0	2.4	0	.8	0	2.8	FOREST	S04-05	4.5	12.2	97	.0163
3634F1	10	5.98	92.3	0	0	2.8	3.7	1.2	FOREST	S04-05	4.5	17.6	99	.0163
3634G1	10	61.77	88.8	1.1	0	.2	6.6	3.3	FOREST	S04-05	4.5	11.4	99	.0163
SENECA LAKE														
3635D1	10	37.87	43.0	22.1	32.9	.6	.9	.5	MIXED	I10-04	5.0	16.4	81	.0148
3635F2	10	64.59	42.5	34.2	21.6	.1	1.5	.1	MIXED	A07-01	6.3	9.1	84	.0147
3635G1	10	13.52	55.7	24.5	19.0	.4	0	.4	M. FOR.	A07-01	6.3	6.3	81	.0042
3635H1	20	14.27	40.6	32.6	22.5	2.5	1.2	.6	MIXED	A07-01	6.3	4.4	84	.0157
3635L1	20	24.50	20.3	50.8	24.7	4.2	0	0	MIXED	A07-01	6.3	2.4	81	.0049
3635M1	10	33.05	58.8	13.0	22.0	1.7	4.0	.5	M. FOR.	A07-01	6.3	12.2	81	.0148
SWAN LAKE														
3636A1	10	17.02	60.5	8.7	21.6	4.9	4.0	.3	M. FOR.	I10-01	5.5	12.6	114	.0214
SWINGING BRIDGE RES.														
3637H1	10	27.35	51.0	25.1	7.4	15.6	.5	.4	M. FOR.	I10-01	5.5	12.2	114	.0154
CONESUS LAKE														
3639A1	20	4.84	25.0	9.6	65.4	0	0	0	M. AGRIC	A07-01	6.3	4.3	79	.0120
3639B1	20	6.76	25.2	25.2	47.5	2.1	0	0	MIXED	A07-01	6.3	6.2	79	.0120
3639C1	20	6.11	23.8	6.5	69.7	0	0	0	M. AGRIC	A07-01	6.3	6.0	79	.0121
3639D2	20	.78	6.7	3.3	43.3	46.7	0	0	M. URBAN	A07-01	6.3	5.0	79	.0122
3639F1	20	7.61	15.4	9.5	71.4	.3	3.4	0	M. AGRIC	A07-01	6.3	3.1	79	.0120
3639H1	20	18.08	39.6	10.4	48.4	1.1	.4	.1	MIXED	A07-01	6.3	9.3	79	.0122
LOWER ST. REGIS														
3640A1	10	1.71	92.7	0	0	1.8	5.5	0	FOREST	S04-05	4.5	5.8	97	.0182
ALLEGHENY RES (PENN)														
3641C1	30	73.53	50.0	1.8	47.4	.3	.5	0	M. FOR.	I10-04	5.0	10.6	112	.0181
3641H1	30	10.93	93.0	2.7	4.3	0	0	0	FOREST	I10-04	5.0	17.4	114	.0248
3641J1	30	53.51	96.0	1.2	2.3	.5	0	0	FOREST	I08-02	5.0	18.8	114	.0293
3641K1	30	30.23	99.1	.9	0	0	0	0	FOREST	I08-02	5.0	18.5	114	.0147
3641L1	30	51.67	98.3	1.7	0	0	0	0	FOREST	I08-02	5.0	16.8	117	.0122
3641M1	30	55.40	95.1	4.6	0	.3	0	0	FOREST	I08-02	5.0	14.1	117	.0105
3641N1	30	115.41	93.8	3.8	1.3	1.1	0	0	FOREST	I08-02	5.0	17.6	117	.0173

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
NEW YORK												
OTTER LAKE												
3625B1	1	SED	37.1	36.6	.023	.009	2.302	1.724	6.8	2.7	681.0	510.0
ROUND LAKE												
3630A1	3	SED W/O L	1.2	1.2	.061	.010	.963	.275	30.4	5.0	480.6	137.2
3630B1	4	SED W/O L	35.8	35.6	.097	.023	1.111	.237	53.4	12.7	611.2	130.4
3630C1	1	SED W/O L	18.6	18.5	.050	.018	.912	.266	25.7	9.2	468.1	136.5
SCHROON LAKE												
3634D1	3	MET/SWOL	0	0	.019	.006	.890	.222	9.7	30.8	456.4	113.8
3634D2	1	MET	0	0	.015	.006	1.110	.157	7.6	3.1	564.8	79.9
3634E1	1	MET/SED	0	0	.012	.006	.864	.251	5.9	3.0	427.8	124.3
3634F1	1	MET/SED	0	0	.010	.005	.832	.159	5.2	2.6	436.3	83.4
3634G1	1	MET/SED	0	0	.013	.005	1.293	.143	6.9	2.6	682.6	75.5
SENECA LAKE												
3635D1	1	SED	19.5	19.8	.021	.009	1.106	.593	10.3	4.4	540.3	289.7
3635F2	1	SED	8.8	8.8	.024	.011	.937	.468	11.1	5.1	432.1	215.8
3635G1	1	SED	11.3	11.4	.010	.007	1.582	.923	1.4	1.0	220.1	128.4
3635H1	3	SED	9.2	9.2	.017	.009	1.575	1.069	8.6	4.5	796.0	540.3
3635L1	3	SED	8.9	8.8	.025	.011	1.007	.579	3.8	1.7	154.7	88.9
3635M1	3	SED	13.1	13.2	.021	.008	.837	.347	9.8	3.7	389.1	161.3
SWAN LAKE												
3636A1	3	SED W/O L	54.0	46.6	.041	.015	1.183	.389	27.2	9.9	784.6	258.0
SWINGING BRIDGE RES.												
3637H1	3	SED W/O L	18.5	16.0	.033	.014	1.044	.452	15.9	6.7	502.7	217.6
CONESUS LAKE												
3639A1	1	SED	34.5	35.0	.069	.039	2.349	1.487	26.8	15.2	913.1	578.0
3639B1	1	SED	25.0	25.4	.050	.027	1.554	.751	18.6	10.0	576.7	278.7
3639C1	1	SED	36.7	37.3	.043	.018	1.827	.956	17.7	7.4	750.1	394.5
3639D2	3	SED	22.8	23.1	.078	.057	1.588	1.077	31.4	22.9	638.4	433.0
3639F1	1	SED	37.6	38.2	.098	.058	2.448	1.205	32.3	19.1	806.9	397.2
3639H1	1	SED	25.5	25.9	.022	.008	1.153	.382	8.4	3.1	439.9	145.7
LOWER ST. REGIS												
3640A1	1	MET	0	0	.013	.007	.798	.315	7.2	3.9	439.0	173.3
ALLEGHENY RES (PENN)												
3641C1	1	SED W/O L	45.8	45.8	.033	.011	.531	.280	18.4	6.1	296.6	156.4
3641H1	1	SED	7.1	7.1	.012	.006	1.303	.628	10.0	5.0	1084.0	522.5
3641J1	1	SED	1.7	1.7	.015	.006	.783	.336	13.8	5.5	720.4	309.1
3641K1	1	SED	0	0	.010	.006	1.198	.437	4.7	2.8	559.2	204.0
3641L1	1	SED	0	0	.011	.006	1.153	.564	4.3	2.4	454.8	222.5
3641M1	1	SED	0	0	.010	.005	1.115	.554	3.3	1.7	372.3	185.0
3641N1	1	SED	.9	1.0	.014	.005	1.164	.341	7.6	2.7	632.5	185.3

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA[1] (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
NORTH CAROLINA														
BADIN LAKE														
3701B1	40	23.05	77.3	.8	21.2	0	0	.7	M. FOR.	U05-03	4.5	8.8	114	.0103
BLEWETT FALL LAKE														
3702B1	40	36.67	80.5	1.0	18.2	0	0	.3	M. FOR.	U05-01	4.5	6.8	112	.0085
3702C1	40	32.56	72.4	8.3	19.2	0	0	.1	M. FOR.	U05-01	4.5	5.4	117	.0078
3702G1	40	16.24	54.9	1.6	43.1	0	0	.4	M. FOR.	U05-01	4.5	3.6	112	.0085
3702H1	40	77.52	76.1	.6	21.7	.5	0	1.1	M. FOR.	U05-01	4.5	8.1	122	.0150
FONTANA LAKE														
3704C1	30	81.61	87.0	0	13.0	0	0	0	M. FOR.	U05-06	4.5	43.8	142	.0377
3704E1	30	29.03	98.3	0	1.3	0	0	.4	FOREST	U05-06	4.5	46.5	142	.0225
3704F1	30	24.04	88.2	.3	11.5	0	0	0	M. FOR.	U05-06	4.5	38.0	142	.0377
HIGH ROCK LAKE														
3706B1	40	39.03	65.3	.8	32.4	1.1	0	.4	M. FOR.	U05-03	4.5	6.4	114	.0083
3706D1	40	33.64	41.6	2.6	54.7	.6	0	.5	M. AGRIC	U06-05	4.5	7.9	114	.0082
3706G1	40	40.12	42.7	1.9	52.6	1.6	0	1.2	M. AGRIC	U06-05	4.5	5.7	114	.0100
HIWASSEE LAKE														
3707B1	30	65.50	78.8	1.4	19.8	0	0	0	M. FOR.	U05-13	4.5	35.9	152	.0242
3707C1	30	14.01	88.7	.9	10.3	0	0	.1	M. FOR.	U05-06	4.5	21.3	142	.0241
LOOKOUT SHOALS LAKE														
3710B1	40	13.39	40.7	.5	58.7	0	0	.1	M. AGRIC	U05-03	4.5	8.9	119	.0167
RHODHISS LAKE														
3715G1	40	15.80	63.8	0	35.4	.8	0	0	M. FOR.	U05-03	4.5	12.0	127	.0174
3715H1	40	19.79	73.8	1.8	22.7	1.7	0	0	M. FOR.	U05-03	4.5	10.9	127	.0209
SANTEETLAH LAKE														
3716A2	30	144.88	83.4	.5	15.0	1.0	0	.1	M. FOR.	U05-13	4.5	39.1	157	.0289
3716B1	30	9.71	73.0	.8	26.0	0	0	.2	M. FOR.	U05-13	4.5	40.7	142	.0324
3716C1	30	19.22	85.3	1.9	12.7	0	0	.1	M. FOR.	U05-13	4.5	39.8	142	.0324
3716D1	30	110.62	97.3	.6	2.1	0	0	0	FOREST	U05-13	4.5	39.2	147	.0413
3716E1	30	35.66	97.3	.5	2.2	0	0	0	FOREST	U05-13	4.5	42.6	152	.0322
3716F1	30	72.88	99.5	.2	.3	0	0	0	FOREST	U05-13	4.5	39.9	165	.0263
LAKE TILLERY														
3717C1	40	29.50	55.1	.2	43.5	.8	0	.4	M. FOR.	U05-03	4.5	9.4	114	.0106
OHIO														
BEACH CITY RESERVOIR														
3901C1	10	44.21	13.3	.7	84.0	1.9	0	.1	AGRIC	I08-04	5.5	5.2	102	.0097
3901D1	13	83.89	15.4	2.7	80.2	.4	0	1.3	AGRIC	I08-04	5.5	6.6	102	.0096
3901E1	13	8.96	30.3	2.8	63.8	0	0	3.1	M. AGRIC	I08-04	5.5	11.4	102	.0100
3901F1	31	34.50	29.0	1.9	65.9	.3	0	2.9	M. AGRIC	I08-04	5.5	14.3	102	.0099
3901G1	30	15.51	16.1	3.6	76.3	1.0	0	3.0	AGRIC	I08-04	5.5	12.3	102	.0099
3901H1	30	31.03	17.0	1.5	79.5	1.4	0	.6	AGRIC	I08-04	5.5	11.4	102	.0097
3901K1	30	70.42	21.6	4.3	65.6	.3	0	8.2	M. AGRIC	I08-04	5.5	16.1	102	.0101

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
NORTH CAROLINA												
BADIN LAKE												
3701B1	1	MET/IG-V	19.4	20.1	.034	.008	.830	.188	11.1	2.6	271.0	61.4
BLEWETT FALL LAKE												
3702B1	1	SWOL/IG-P	20.1	17.6	.025	.013	.575	.108	6.6	3.4	152.4	28.6
3702C1	1	SWOL/IG-P	21.2	18.6	.032	.012	.803	.093	8.9	3.4	224.3	26.0
3702G1	4	SED W/O L	68.8	82.2	.045	.016	1.048	.230	12.2	4.3	283.3	62.2
3702H1	1	SWOL/IG-P	32.4	35.7	.025	.008	.716	.138	11.9	3.8	341.7	65.9
FONTANA LAKE												
3704C1	1	SWOL/MET	13.1	12.9	.027	.006	.612	.202	31.5	7.0	714.8	235.9
3704E1	1	SED W/O L	1.0	1.0	.015	.007	.293	.120	10.5	4.9	205.7	84.2
3704F1	1	SED W/O L	8.6	8.6	.034	.011	.893	.283	40.4	13.1	1059.9	335.9
HIGH ROCK LAKE												
3706B1	1	MET/IG-V	24.6	24.4	.027	.013	.817	.204	6.9	3.3	210.0	52.4
3706D1	1	IGNEOUS-P	41.6	41.2	.040	.017	.844	.408	10.4	4.4	220.3	106.5
3706G1	1	IGNEOUS-P	39.8	39.7	.038	.023	.566	.158	11.9	7.2	176.9	49.4
HIWASSEE LAKE												
3707B1	1	SED W/O L	30.7	28.1	.014	.005	.316	.070	10.9	3.9	245.1	54.3
3707C1	1	SED W/O L	16.0	14.6	.048	.006	.510	.179	36.5	4.6	388.1	136.2
LOOKOUT SHOALS LAKE												
3710B1	1	MET	52.4	51.4	.033	.014	.824	.376	17.8	7.5	443.8	202.5
RHODHISS LAKE												
3715G1	1	IG-P/MET	54.8	59.4	.054	.016	1.294	.295	30.0	33.3	719.0	163.9
3715H1	1	SED W/O L	35.2	38.1	.022	.012	.659	.230	14.3	7.8	428.1	149.4
SANTEETLAH LAKE												
3716A2	1	SED W/O L	11.2	11.2	.029	.006	.490	.186	26.0	5.4	439.0	166.7
3716B1	1	SED W/O L	19.4	19.4	.037	.008	.663	.187	37.0	8.0	663.7	187.2
3716C1	1	SED W/O L	9.5	9.5	.024	.008	.452	.154	24.7	8.2	464.6	158.3
3716D1	1	SED W/O L	1.6	1.6	.011	.007	.384	.083	14.0	8.9	489.8	105.9
3716E1	1	SED W/O L	1.6	1.6	.010	.005	.469	.111	10.1	5.1	474.3	112.2
3716F1	1	SED W/O L	.2	.2	.006	.005	.619	.177	5.0	4.1	511.3	146.2
LAKE TILLERY												
3717C1	1	MET/IG-V	45.8	44.5	.050	.026	1.190	.487	17.0	8.8	404.8	165.6
OHIO												
BEACH CITY RESERVOIR												
3901C1	1	SED	79.1	77.6	.165	.068	2.771	2.130	50.3	20.7	845.1	649.6
3901D1	1	SED	86.9	85.3	.121	.019	2.751	1.949	36.6	5.8	832.9	590.1
3901E1	1	SED	50.5	50.5	.032	.006	2.011	1.465	10.1	1.9	633.4	461.4
3901F1	1	SED	76.1	74.7	.100	.022	2.671	1.833	31.8	7.0	849.7	583.1
3901G1	1	SED	88.1	86.5	.145	.050	3.714	2.596	46.9	16.2	1201.4	839.7
3901H1	1	SED	91.7	90.1	.121	.034	3.225	2.213	36.7	10.3	977.7	670.9
3901K1	2	SED	55.6	55.7	.197	.007	3.304	2.492	62.3	2.2	1044.5	787.8

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM) [1]	LAND USE PERCENTAGES FOR	CL [2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT [3]	PH [4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM) [5]
OHIO														
CHARLES MILL RESERVOIR														
3905B1	10	19.76	18.4	0	79.8	1.3	0	.5	AGRIC	A06-09	6.0	5.3	89	.0095
3905C1	10	42.17	16.6	.9	81.3	.7	.2	.3	AGRIC	A06-09	6.0	2.9	89	.0094
DEER CREEK RESERVOIR														
3906B1	20	31.57	3.0	.8	96.0	0	0	.2	AGRIC	A07-04	6.3	1.3	99	.0100
3906C1	20	15.41	2.3	.6	97.1	0	0	0	AGRIC	A07-04	6.3	.1	99	.0100
DILLON RESERVOIR														
3908B1	30	11.86	35.9	13.3	50.8	0	0	0	M. AGRIC	I08-04	5.5	15.6	102	.0107
3908C1	30	9.14	46.6	14.1	39.3	0	0	0	MIXED	I08-04	5.5	15.7	99	.0105
3908E1	20	12.71	38.3	8.4	52.4	.9	0	0	M. AGRIC	A07-04	6.3	11.5	99	.0106
3908F1	20	50.30	33.0	9.5	57.3	0	0	.2	M. AGRIC	A07-04	6.3	15.0	102	.0104
3908G1	30	40.46	50.9	10.5	38.5	0	0	.1	M. FOR.	I08-04	5.5	14.7	102	.0104
LAKE GRANT														
3912A1	20	52.89	15.9	1.9	82.0	0	0	.2	AGRIC	A06-03	6.0	.8	109	.0108
3912B1	20	5.00	11.2	.8	86.6	1.2	0	.2	AGRIC	A06-03	6.0	1.4	107	.0110
HOOVER RESERVOIR														
3914C1	20	32.30	11.3	.9	87.0	.4	0	.4	AGRIC	A07-04	6.3	.7	97	.0099
MOSQUITO CREEK RESERVOIR														
3921A1	10	47.63	30.9	5.4	62.8	0	.2	.7	M. AGRIC	A07-15	6.3	1.5	99	.0102
3921B1	10	9.17	25.9	5.8	67.4	0	.5	.4	M. AGRIC	A07-15	6.3	2.2	99	.0102
PLEASANT HILL LAKE														
3924B1	10	28.36	29.0	6.0	64.3	.7	0	0	M. AGRIC	A06-09	6.0	9.3	91	.0101
3924C1	10	31.03	35.4	12.6	51.3	.7	0	0	M. AGRIC	A06-09	6.0	15.3	91	.0102
3924D1	10	16.08	29.8	8.9	60.1	1.2	0	0	M. AGRIC	I08-04	5.5	11.6	91	.0103
3924E1	20	21.52	28.0	5.6	66.2	.2	0	0	M. AGRIC	I08-04	5.5	12.5	91	.0105
GRAND LAKE OF ST. MARYS														
3927B1	20	18.60	6.0	.9	93.0	0	0	.1	AGRIC	A07-04	6.3	1.0	94	.0096
3927C1	20	45.84	5.5	.4	92.3	1.8	0	0	AGRIC	A07-04	6.3	1.6	94	.0096
3927D1	20	47.22	6.7	.4	92.4	.2	0	.3	AGRIC	A07-04	6.3	1.8	94	.0096
3927F1	20	8.62	15.2	0	84.8	0	0	0	AGRIC	A07-04	6.3	2.5	94	.0097
3927G1	20	12.10	4.4	0	95.0	.6	0	0	AGRIC	A07-04	6.3	1.2	94	.0097
ATWOOD RESERVOIR														
3928B1	30	15.20	38.7	20.6	40.2	0	0	.5	MIXED	I08-04	5.5	18.0	91	.0105
3928C1	30	20.98	38.5	8.2	52.7	.3	0	.3	M. AGRIC	I08-04	5.5	13.0	91	.0104
BERLIN RESERVOIR														
3929B1	10	47.14	25.8	4.4	67.5	0	.7	1.6	M. AGRIC	A06-09	6.0	4.6	91	.0096
3929F1	10	18.93	39.1	4.2	52.1	.4	.1	4.1	M. AGRIC	A06-09	6.0	1.7	91	.0100
HOLIDAY LAKE														
3930C1	20	6.55	11.7	0	87.5	.4	0	.4	AGRIC	A07-04	6.3	4.0	89	.0097

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	GEOLOGY	7 ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
OHIO												
CHARLES MILL RESERVOIR												
3905B1	1	SED	58.2	59.1	.029	.014	1.574	.850	8.7	4.2	474.6	256.3
3905C1	1	SED	38.5	39.3	.035	.021	1.747	1.000	10.7	6.4	532.6	304.9
DEER CREEK RESERVOIR												
3906B1	1	SED	34.1	50.8	.065	.022	3.532	2.684	21.3	7.2	1157.7	879.7
3906C1	1	SED	51.8	51.2	.088	.040	3.328	2.585	26.9	12.2	1015.8	789.0
DILLON RESERVOIR												
3908B1	1	SED	41.1	43.0	.028	.011	1.336	.462	9.6	3.8	459.2	158.8
3908C1	1	SED	31.8	33.2	.023	.008	1.220	.412	7.1	2.5	376.7	127.2
3908E1	1	SED	31.5	32.5	.046	.016	1.525	.868	15.9	5.5	526.7	299.8
3908F1	1	SED	34.4	35.6	.041	.012	1.687	.972	13.3	3.9	546.8	315.1
3908G1	1	SED	25.8	26.8	.018	.007	.794	.337	6.0	2.3	264.6	112.3
LAKE GRANT												
3912A1	1	SED	41.4	41.2	.213	.059	1.858	.452	73.2	20.3	638.9	155.4
3912B1	1	SED	43.7	43.5	.215	.046	1.632	.319	80.9	17.3	614.1	120.0
HOOVER RESERVOIR												
3914C1	1	SED	42.6	44.3	.081	.032	2.338	1.377	25.2	9.9	726.3	427.8
MOSQUITO CREEK RESERVOIR												
3921A1	1	SED	41.1	41.1	.069	.014	1.632	.583	21.8	4.4	515.7	184.2
3921B1	1	SED	43.9	43.9	.087	.025	2.088	.975	29.7	8.5	714.0	333.4
PLEASANT HILL LAKE												
3924B1	1	SED	30.4	31.1	.049	.022	2.118	1.449	15.7	7.1	679.1	464.6
3924C1	1	SED	24.3	24.8	.025	.010	1.340	.945	8.1	3.2	433.3	305.6
3924D1	1	SED	28.4	29.1	.039	.013	1.849	1.240	12.9	4.3	612.9	411.1
3924E1	1	SED	31.3	32.0	.036	.013	2.023	1.510	12.1	4.4	678.0	506.0
GRAND LAKE OF ST. MARYS												
3927B1	1	SED	62.4	57.6	.216	.097	4.476	3.196	61.9	27.8	1282.8	915.9
3927C1	1	SED	69.6	62.6	.318	.148	3.896	2.466	95.7	44.5	1172.6	742.2
3927D1	1	SED	69.7	62.7	.278	.127	3.915	2.617	83.1	37.9	1169.9	782.0
3927F1	1	SED	49.8	47.5	.226	.074	4.504	2.965	74.0	24.2	1474.5	970.7
3927G1	1	SED	71.6	64.5	.435	.358	4.954	4.038	135.3	111.3	1540.5	1255.7
ATWOOD RESERVOIR												
3928B1	1	SED	26.6	26.9	.028	.010	.916	.537	9.2	3.3	302.3	177.2
3928C1	1	SED	34.9	35.2	.038	.012	1.870	1.117	11.9	3.8	586.9	350.6
BERLIN RESERVOIR												
3929B1	1	SED	49.4	47.7	.057	.019	2.608	1.312	17.8	5.9	815.3	410.2
3929F1	2	SED	36.8	35.4	.044	.008	1.518	.593	13.8	2.5	477.7	186.6
HOLIDAY LAKE												
3930C1	1	SED	22.1	23.1	.104	.029	4.377	3.027	29.9	8.3	1257.2	869.4

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION[1]	AREA (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
OHIO														
O"SHAUGHNESSY RESERVOIR														
3931C1	20	27.40	10.0	0	89.2	.3	0	.5	AGRIC	A07-04	6.3	1.3	94	.0097
ROCKY FORK CREEK														
3932B1	20	86.14	19.2	5.4	73.6	1.8	0	0	M. AGRIC	A06-03	6.0	8.3	112	.0116
3932C1	20	15.15	11.8	1.7	86.0	.5	0	0	AGRIC	A06-03	6.0	4.0	107	.0115
LAKE SHAWNEE														
3933A2	20	21.24	2.4	.3	94.6	2.6	0	.1	AGRIC	A07-04	6.3	1.4	94	.0105
TAPPAN RESERVOIR														
3934A1	30	53.82	35.5	8.9	30.7	.2	0	24.7	MIXED	I08-04	5.5	24.3	99	.0107
3934B1	30	23.13	30.9	9.2	30.4	.7	0	28.8	MIXED	I08-04	5.5	19.5	99	.0107
3934D1	30	8.96	47.3	5.4	47.3	0	0	0	MIXED	I08-04	5.5	22.8	99	.0107
PENNSYLVANIA														
BLANCHARD RESERVOIR														
4201B1	40	29.79	51.2	.2	46.6	.2	0	1.8	M. FOR.	I08-05	5.0	21.6	102	.0057
4201C1	40	42.79	40.1	1.0	57.6	.4	0	.9	M. AGRIC	A08-01	5.3	15.0	102	.0023
4201D1	30	12.90	82.1	0	17.7	0	0	.2	M. FOR.	I08-05	5.0	23.7	102	.0038
CONNEAUT LAKE														
4204D1	10	2.25	42.3	3.0	54.0	.4	0	.3	M. AGRIC	I10-03	5.0	6.1	102	.0232
PYMATUNING RESERVOIR														
4213B1	10	14.71	32.3	1.8	65.2	.4	0	.3	M. AGRIC	I10-03	5.0	3.7	94	.0087
4213C1	10	9.89	50.0	3.8	43.5	1.1	.7	.9	M. FOR.	I10-03	5.0	2.0	94	.0044
4213F1	10	39.70	42.1	1.1	56.4	0	.1	.3	M. AGRIC	I10-03	5.0	2.4	97	.0147
4213H1	10	17.33	38.6	3.0	57.6	.4	0	.4	M. AGRIC	I10-03	5.0	2.7	97	.0123
SHENANGO RESERVOIR														
4216F1	10	7.67	33.1	5.2	61.7	0	0	0	M. AGRIC	I10-03	5.0	7.2	102	.0073
4216G1	10	22.79	30.4	9.7	57.5	2.2	0	.2	M. AGRIC	I10-03	5.0	5.7	99	.0054
4216H1	10	9.48	26.7	13.6	58.1	1.6	0	0	M. AGRIC	I10-03	5.0	4.2	97	.0049
BEAVER RUN RESERVOIR														
4219B1	30	7.10	48.3	2.3	48.0	1.4	0	0	MIXED	U05-02	4.5	9.9	102	.0569
LAKE CANADOTHA														
4221B1	10	8.03	48.6	12.0	36.6	0	2.8	0	MIXED	I10-03	5.0	7.5	107	.0159
4221C1	10	7.28	43.3	9.5	47.2	0	0	0	MIXED	I10-03	5.0	4.9	107	.0207
INDIAN LAKE														
4223C1	30	8.73	92.3	0	1.4	3.0	2.1	1.2	FOREST	I08-05	5.0	8.8	112	.0137
4223D1	30	19.30	88.1	0	3.4	3.8	3.4	1.3	FOREST	I08-05	5.0	8.3	112	.0111
CONEWAGO LAKE (PINCHOT)														
4226A1	40	21.21	64.5	1.9	33.0	.5	0	.1	M. FOR.	U05-05	4.5	12.3	99	.0272
4226B1	40	3.55	51.5	3.3	45.2	0	0	0	M. FOR.	U05-05	4.5	7.9	99	.0067
4226C1	40	6.55	56.7	5.4	37.9	0	0	0	M. FOR.	U05-05	4.5	13.0	97	.0140

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
OHIO												
O"SHAUGHNESSY RESERVOIR												
3931C1	1	SED	37.9	38.9	.063	.028	2.331	1.513	19.5	8.7	720.2	467.5
ROCKY FORK CREEK												
3932B1	1	SED	49.3	48.8	.039	.023	2.080	.756	14.2	8.4	757.1	275.2
3932C1	1	SED	57.6	57.0	.099	.029	2.500	1.388	34.8	10.2	879.6	488.4
LAKE SHAWNEE												
3933A2	1	SED	71.7	71.3	.044	.016	4.292	3.540	14.3	5.2	1394.0	1149.7
TAPPAN RESERVOIR												
3934A1	2	SED	23.0	24.9	.034	.008	1.134	.540	11.7	2.7	389.8	185.6
3934B1	2	SED	22.8	24.6	.059	.022	1.143	.502	20.0	7.5	387.4	170.1
3934D1	1	SED	35.4	38.3	.041	.011	1.273	.633	14.3	3.8	445.5	221.5
PENNSYLVANIA												
BLANCHARD RESERVOIR												
4201B1	1	SED	34.5	34.4	.028	.014	2.605	1.895	5.0	2.5	466.1	339.1
4201C1	1	SED	42.6	42.5	.026	.008	2.501	1.946	1.9	.6	183.3	142.6
4201D1	1	SED	13.1	13.1	.016	.008	.776	.166	1.9	1.0	94.3	20.2
CONNEAUT LAKE												
4204D1	1	SED	47.5	47.4	.052	.014	1.115	.553	36.2	9.8	776.9	385.3
PYMATUNING RESERVOIR												
4213B1	1	SED	42.8	42.8	.047	.018	1.872	1.239	13.0	5.0	518.7	343.3
4213C1	1	SED	28.6	28.6	.086	.028	1.558	.660	10.9	3.6	197.6	83.7
4213F1	1	SED	49.6	49.6	.039	.014	1.302	.681	17.9	6.4	596.4	312.0
4213H1	1	SED	50.7	50.6	.030	.014	1.798	1.272	11.4	5.3	683.2	483.3
SHENANGO RESERVOIR												
4216F1	1	SED	50.0	50.0	.041	.020	2.092	1.143	10.1	4.9	513.1	280.4
4216G1	1	SED	46.6	46.6	.030	.011	1.619	.568	5.4	2.0	289.6	101.6
4216H1	1	SED	47.0	47.0	.037	.016	1.559	.696	6.1	2.6	257.8	115.1
BEAVER RUN RESERVOIR												
4219B1	1	SED	36.4	36.5	.123	.060	1.644	.864	217.3	106.0	2904.2	1526.3
LAKE CANADOTHA												
4221B1	1	SED	28.8	28.8	.038	.013	1.416	.336	19.3	6.6	718.8	170.6
4221C1	1	SED	38.6	38.5	.024	.007	1.443	.492	16.5	4.8	994.4	339.1
INDIAN LAKE												
4223C1	1	SED	1.2	1.2	.012	.006	1.460	.370	5.2	2.6	629.3	159.5
4223D1	1	SED	2.8	2.8	.021	.006	1.705	.810	7.2	2.0	581.7	276.4
CONEWAGO LAKE (PINCHOT)												
4226A1	1	IG-P/SWOL	25.0	24.5	.022	.008	1.238	.299	18.9	6.9	1061.5	256.4
4226B1	1	IG-P/SWOL	34.2	33.6	.028	.007	1.006	.442	4.9	1.2	177.7	78.1
4226C1	1	IG-P/SWOL	28.7	28.2	.022	.006	.881	.453	9.5	2.6	379.6	195.2

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM) [1]	LAND USE PERCENTAGES FOR	CL [2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT [3]	PH [4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM) [5]
PENNSYLVANIA														
LAKE WALLENPAUPACK														
4229C1	10	10.08	90.0	3.4	5.2	0	0	1.4	FOREST	I10-04	5.0	12.3	109	.0162
4229D1	10	3.65	63.8	3.2	23.2	0	0	9.8	M. FOR.	I10-04	5.0	10.3	112	.0169
SOUTH CAROLINA														
HARTWELL RES														
4505B1	40	76.82	59.0	1.0	40.0	0	0	0	M. FOR.	U05-03	4.5	8.5	132	.0139
4505F1	30	26.21	45.1	5.6	48.6	.7	0	0	MIXED	U05-03	4.5	11.8	137	.0168
MARION LAKE														
4506F1	40	25.15	40.3	.6	58.6	0	.2	.3	M. AGRIC	U01-02	4.5	3.3	112	.0086
4506J1	40	55.24	47.0	2.3	48.0	2.0	.7	0	MIXED	U06-05	4.5	1.9	112	.0108
MURRAY LAKE														
4507B1	40	18.44	51.3	3.0	44.4	.7	0	.6	M. FOR.	U06-10	4.5	5.8	119	.0142
4507C1	40	46.10	57.9	.5	39.4	.7	0	1.5	M. FOR.	U06-10	4.5	4.7	122	.0142
ROBINSON LAKE														
4508C1	40	16.71	30.3	33.0	33.7	0	2.6	.4	MIXED	U06-10	4.5	4.8	122	.0105
4508D1	40	21.19	31.8	23.9	43.1	0	.6	.6	MIXED	U06-10	4.5	4.5	122	.0104
4508F1	40	25.18	41.0	26.2	31.6	0	1.0	.2	MIXED	U06-10	4.5	4.2	119	.0103
KEOWEE LAKE														
4513E1	30	77.78	94.6	.6	3.9	.3	0	.6	FOREST	U05-06	4.5	18.7	188	.0245
4513F1	34	19.99	90.0	.5	9.0	0	.1	.4	M. FOR.	U05-06	4.5	23.8	152	.0242
4513G1	30	30.64	95.1	0	4.8	0	0	.1	FOREST	U05-06	4.5	26.0	173	.0244
SECESSION LAKE														
4514E1	40	8.39	39.3	2.3	58.1	0	0	.3	M. AGRIC	U05-03	4.5	6.3	122	.0125
WILLIAM C. BOWEN LAKE														
4516B1	40	11.50	49.5	9.5	39.3	.7	0	1.0	MIXED	U05-03	4.5	8.5	137	.0110
4516C1	40	9.12	40.2	2.7	55.3	1.5	0	.3	M. AGRIC	U05-03	4.5	9.4	127	.0099
TENNESSEE														
BARKLEY LAKE														
4701F1	30	44.68	78.3	3.4	17.8	0	.2	.3	M. FOR.	U06-06	4.5	16.2	119	.0145
4701G1	30	105.44	54.4	27.0	18.3	.2	0	.1	M. FOR.	U06-06	4.5	12.8	122	.0146
4701J1	30	49.68	48.9	9.7	40.4	.8	0	.2	MIXED	U06-06	4.5	15.7	122	.0140
4701N1	30	28.13	53.8	5.4	40.3	.3	0	.2	M. FOR.	U06-06	4.5	18.7	122	.0140
4701P1	30	431.03	58.0	6.0	35.2	.3	.1	.4	M. FOR.	U06-06	4.5	16.4	122	.0140
4701R1	30	29.09	87.0	2.7	10.0	.3	0	0	M. FOR.	U06-06	4.5	20.3	127	.0140
4701S1	30	30.04	82.2	1.6	15.8	.1	.2	.1	M. FOR.	U06-06	4.5	16.1	130	.0140
4701T1	30	23.41	90.5	.7	8.6	0	0	.2	M. FOR.	U06-06	4.5	19.0	130	.0140
4701U1	30	25.95	79.4	.8	19.4	0	0	.4	M. FOR.	U06-06	4.5	16.2	127	.0140

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
PENNSYLVANIA												
LAKE WALLENPAUPACK												
4229C1	1	SED W/O L	5.7	5.5	.020	.008	1.117	.184	10.6	4.2	590.7	97.3
4229D1	2	SED W/O L	25.4	24.5	.023	.009	1.081	.521	11.9	4.6	557.2	268.5
SOUTH CAROLINA												
HARTWELL RES												
4505B1	1	MET	30.4	30.1	.030	.008	.933	.290	13.1	3.5	407.5	126.7
4505F1	1	MET	52.5	51.0	.028	.009	.852	.425	14.7	4.7	501.1	237.9
MARION LAKE												
4506F1	1	SED W/O L	15.0	14.4	.064	.023	1.432	1.051	17.6	6.3	392.8	288.3
4506J1	1	SED W/O L	17.0	16.2	.084	.029	1.137	.344	28.6	9.9	387.2	117.2
MURRAY LAKE												
4507B1	1	MET/SWOL	36.7	38.7	.037	.018	.733	.388	16.4	8.0	324.1	171.5
4507C1	1	MET/SWOL	32.6	34.4	.063	.024	.641	.200	27.0	10.3	274.7	85.7
ROBINSON LAKE												
4508C1	1	SED W/O L	26.5	21.8	.007	.005	.537	.181	2.4	1.7	181.4	61.1
4508D1	1	SED W/O L	33.8	27.9	.014	.006	.481	.101	4.8	2.0	163.7	34.4
4508F1	1	SED W/O L	24.8	20.5	.018	.006	.688	.369	5.8	1.9	222.8	119.5
KEOWEE LAKE												
4513E1	1	MET	4.1	4.0	.024	.007	.275	.058	18.5	5.4	211.7	44.7
4513F1	1	MET	9.7	9.5	.025	.008	.312	.069	18.8	6.0	234.9	52.0
4513G1	1	MET	5.2	5.0	.019	.006	.628	.098	14.8	4.7	488.4	76.2
SECESSION LAKE												
4514E1	1	MET	44.2	43.8	.023	.012	1.104	.459	8.6	4.5	412.6	171.5
WILLIAM C. BOWEN LAKE												
4516B1	1	MET	25.8	25.6	.020	.007	.535	.220	7.1	2.5	189.6	78.0
4516C1	1	MET	36.2	36.0	.020	.007	.736	.371	6.9	2.4	253.0	127.6
TENNESSEE												
BARKLEY LAKE												
4701F1	1	SED	11.7	11.6	.017	.010	.782	.433	7.9	4.6	362.2	200.6
4701G1	4	SED	11.8	11.6	.064	.012	1.084	.422	29.3	5.5	496.4	193.3
4701J1	1	SED	24.8	24.4	.016	.008	.837	.464	7.2	3.6	375.1	208.0
4701N1	4	SED	32.3	32.0	.032	.013	.650	.228	13.9	5.7	282.6	99.1
4701P1	1	SED	30.1	29.9	.059	.023	.725	.285	26.1	10.2	320.1	125.8
4701R1	1	SED	6.1	6.1	.023	.013	.610	.208	10.2	5.7	269.6	91.9
4701S1	1	SED	9.7	9.6	.024	.014	.598	.291	10.5	6.1	262.2	127.6
4701T1	1	SED	5.3	5.2	.021	.014	.426	.168	9.3	6.2	188.3	74.3
4701U1	1	SED	11.9	11.7	.010	.018	1.225	.576	4.3	7.8	532.3	250.6

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION	AREA (SQ KM) [1]	LAND USE PERCENTAGES [2] FOR	CL	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS [3] MAP UNIT	PH [4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW (CMS/SQ KM) [5]
TENNESSEE														
BOONE RESERVOIR														
4704B1	30	33.54	18.2	7.4	72.7	1.4	0	.3	M. AGRIC	U05-12	4.5	15.5	112	.0112
4704C1	30	7.49	18.5	3.8	68.6	8.8	0	.3	M. AGRIC	U05-12	4.5	10.2	112	.0112
4704G1	30	8.60	18.5	6.4	73.7	1.4	0	0	M. AGRIC	U05-12	4.5	15.3	112	.0112
4704H1	30	5.70	17.7	11.8	63.0	7.5	0	0	M. AGRIC	U05-12	4.5	14.4	112	.0112
4704J1	30	42.14	56.4	6.4	36.3	.5	0	.4	M. FOR.	U05-12	4.5	34.9	112	.0158
4704K1	30	17.90	79.9	1.2	18.9	0	0	0	M. FOR.	U05-12	4.5	45.2	112	.0158
4704L1	30	31.00	78.8	3.4	17.8	0	0	0	M. FOR.	U05-12	4.5	41.7	112	.0158
CHEROKEE LAKE														
4707B1	30	49.91	49.4	10.7	38.8	1.1	0	0	MIXED	I08-06	5.0	29.2	114	.0134
4707C1	30	13.13	65.7	12.8	21.5	0	0	0	M. FOR.	U05-13	4.5	42.6	122	.0130
CHICKAMAUGA LAKE														
4708D1	30	72.21	49.9	3.3	46.7	0	0	.1	MIXED	U06-11	4.5	12.2	142	.0166
4708E1	30	35.04	51.5	3.1	45.4	0	0	0	M. FOR.	U06-11	4.5	12.4	142	.0171
4708K1	30	41.70	43.8	4.4	51.2	0	0	.6	M. AGRIC	U05-13	4.5	13.4	132	.0176
4708M1	30	57.16	61.3	3.2	33.8	1.7	0	0	M. FOR.	U06-11	4.5	15.0	132	.0177
4708R1	30	44.96	55.4	5.5	38.7	.2	0	.2	M. FOR.	I08-06	5.0	16.2	122	.0234
DOUGLAS LAKE														
4711B1	30	78.50	30.0	2.0	64.6	.3	0	3.1	M. AGRIC	U06-11	4.5	16.4	112	.0097
4711D1	30	44.50	50.8	4.9	43.6	.2	.1	.4	M. FOR.	I09-01	7.0	30.0	112	.0184
4711K1	30	3.94	25.6	.5	66.7	6.7	0	.5	M. AGRIC	U06-11	4.5	15.1	112	.0100
FT. LOUDOUN LAKE														
4712C1	30	48.90	15.1	11.2	16.3	57.0	0	.4	M. URBAN	I08-06	5.0	10.3	137	.0166
4712E1	30	42.71	16.8	20.4	6.5	56.3	0	0	M. URBAN	I08-06	5.0	10.2	142	.0166
4712F1	30	24.97	11.3	33.2	0	55.3	0	.2	M. URBAN	I08-06	5.0	10.3	142	.0166
4712H1	30	29.14	35.4	4.0	58.5	1.8	0	.3	M. AGRIC	U05-13	4.5	12.3	127	.0211
4712J1	30	26.44	30.7	5.8	61.2	1.9	0	.4	M. AGRIC	U05-13	4.5	9.9	127	.0157
4712L1	30	49.11	57.1	5.2	35.0	2.4	0	.3	M. FOR.	U05-13	4.5	18.0	122	.0214
4712P1	30	7.54	29.2	13.8	0	56.4	0	.6	M. URBAN	U05-13	4.5	13.1	132	.0166
4712Q1	30	6.63	27.2	11.5	0	60.2	0	1.1	M. URBAN	U05-13	4.5	13.8	132	.0166
NICKAJACK RESERVOIR														
4717E1	30	59.03	92.1	.5	4.7	0	0	2.7	FOREST	I08-06	5.0	19.6	132	.0252
4717M1	30	10.49	99.8	.2	0	0	0	0	FOREST	I08-06	5.0	25.4	127	.0257
4717N1	30	4.69	99.8	.2	0	0	0	0	FOREST	I08-06	5.0	23.7	124	.0253
4717P1	30	3.39	10.0	0	0	0	0	0	FOREST	I08-06	5.0	28.5	124	.0253
4717Q1	30	3.89	99.2	.7	0	0	0	.1	FOREST	I08-06	5.0	24.3	124	.0252
4717R1	30	2.38	99.9	.1	0	0	0	0	FOREST	I08-06	5.0	25.8	124	.0271
4717T1	30	42.37	97.2	1.0	.9	0	0	.9	FOREST	I08-06	5.0	19.3	124	.0315

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
TENNESSEE												
BOONE RESERVOIR												
4704B1	1	SED	78.4	77.8	.039	.014	1.802	1.315	13.9	5.0	640.2	467.2
4704C1	3	SED	73.9	73.4	.040	.016	2.274	1.852	13.4	5.4	761.6	620.3
4704G1	1	SED	64.3	64.1	.097	.046	2.315	1.631	35.4	16.8	844.1	594.7
4704H1	3	SED	55.0	54.8	.019	.010	2.378	1.845	6.3	3.3	784.9	609.0
4704J1	1	SED	31.5	31.5	.029	.013	1.486	.967	14.5	6.5	740.8	482.1
4704K1	1	SED	16.5	16.4	.024	.011	.494	.199	11.8	5.4	242.3	97.6
4704L1	1	SED	15.5	15.5	.027	.016	1.037	.411	13.4	7.9	514.0	203.7
CHEROKEE LAKE												
4707B1	4	SED	31.7	31.7	.041	.016	1.115	.573	17.3	6.7	469.3	241.2
4707C1	4	SED W/O L	17.6	17.5	.057	.041	1.363	.350	23.1	16.6	553.4	142.1
CHICKAMAUGA LAKE												
4708D1	1	SED	52.9	52.1	.031	.015	1.152	.571	16.2	7.8	600.3	297.5
4708E1	1	SED	50.1	51.0	.037	.018	.896	.381	19.9	9.7	481.1	204.6
4708K1	1	SED	53.1	53.2	.041	.018	.971	.358	22.5	9.9	533.0	196.5
4708M1	4	SED	30.5	31.3	.033	.020	.771	.302	18.3	11.1	427.2	167.3
4708R1	4	SED	35.9	35.5	.030	.011	1.050	.557	22.0	8.1	768.9	407.9
DOUGLAS LAKE												
4711B1	1	SED	75.6	75.0	.026	.013	1.482	1.028	7.9	3.9	449.9	312.1
4711D1	1	SED W/O L	38.4	39.1	.032	.016	.978	.279	18.5	9.2	565.1	161.2
4711K1	3	SED	69.8	69.2	.022	.013	2.013	.988	7.0	4.1	640.8	314.5
FT. LOUDOUN LAKE												
4712C1	3	SED	15.6	15.4	.113	.051	1.797	1.157	58.7	26.5	933.4	600.9
4712E1	3	SED	6.2	6.2	.107	.055	2.508	1.699	55.8	28.7	1307.3	885.6
4712F1	3	SED	0	0	.092	.030	1.930	1.072	47.4	15.4	993.7	551.9
4712H1	1	SED	66.3	65.9	.039	.018	1.350	.815	25.6	11.8	886.1	535.0
4712J1	1	SED	69.4	68.9	.022	.007	1.420	.753	14.7	4.7	952.0	504.8
4712L1	1	SED	33.5	33.1	.049	.018	.851	.375	32.9	12.1	570.5	251.4
4712P1	3	SED	0	0	.083	.048	1.668	1.197	44.9	25.9	901.8	647.1
4712Q1	3	SED	0	0	.048	.023	1.842	1.413	25.0	12.0	958.3	735.1
NICKAJACK RESERVOIR												
4717E1	1	SED	4.6	4.9	.009	.005	.461	.112	7.2	4.0	367.3	89.2
4717M1	1	SED	0	0	.007	.007	1.107	.249	5.6	5.6	893.4	201.0
4717N1	1	SED	0	0	.006	.005	.407	.087	4.8	4.0	326.5	69.8
4717P1	1	SED	0	0	.006	.005	.495	.060	5.0	4.2	412.1	49.9
4717Q1	1	SED	0	0	.006	.005	.415	.078	4.8	4.0	334.5	62.9
4717R1	1	SED	0	0	.005	.005	.374	.065	4.0	4.0	295.6	51.4
4717T1	1	SED	.1	.1	.006	.005	.546	.083	6.0	5.0	545.5	82.9

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION[1]	AREA (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
TENNESSEE														
OLD HICKORY LAKE														
4720C1	30	36.88	28.5	4.3	65.6	.6	0	1.0	M. AGRIC	A08-02	5.3	13.9	124	.0185
4720F1	30	79.41	20.3	5.9	73.2	.5	0	.1	M. AGRIC	A08-02	5.3	5.4	124	.0185
PERCY PRIEST RESERVOIR														
4723F1	30	28.59	35.4	2.4	59.4	.4	0	2.4	M. AGRIC	A08-02	5.3	7.9	119	.0141
TIMS FORD RESERVOIR														
4724E1	30	8.55	48.7	7.1	44.2	0	0	0	MIXED	U05-10	4.5	10.6	137	.0163
4724F1	30	21.37	67.5	7.3	24.8	.3	0	.1	M. FOR.	U05-10	4.5	11.0	137	.0170
REELFOOT LAKE														
4727C1	40	21.86	63.8	9.6	24.8	0	0	1.8	M. FOR.	A07-09	6.0	22.7	122	.0113
VERMONT														
ARROWHEAD MOUNTAIN LAKE														
501021	10	22.07	37.1	3.0	59.1	.8	0	0	M. AGRIC	S04-04	4.5	7.6	84	.0190
501031	10	236.21	53.3	9.6	32.8	3.0	1.3	0	M. FOR.	S04-04	4.5	16.7	84	.0190
WATERBURY RESERVOIR														
501131	10	5.41	79.5	3.0	17.5	0	0	0	M. FOR.	S04-04	4.5	18.9	99	.0220
501141	10	23.05	84.6	.7	13.0	1.7	0	0	M. FOR.	S04-04	4.5	23.3	99	.0220
501151	10	66.59	81.3	3.5	13.5	.7	1.0	0	M. FOR.	S04-04	4.5	18.1	99	.0220
VIRGINIA														
CLAYTOR LAKE														
5103B1	30	48.02	97.8	.8	.6	.2	0	.6	FOREST	U05-12	4.5	31.9	102	.0087
5103E1	30	43.80	3.9	3.0	90.8	.4	0	1.9	AGRIC	U05-12	4.5	17.7	102	.0082
JOHN W FLANNAGAN RES.														
5105D1	30	20.95	66.7	12.8	7.2	1.4	0	11.9	M. FOR.	I08-06	5.0	36.7	117	.0128
5105E1	30	8.83	83.6	5.1	11.3	0	0	0	M. FOR.	I08-06	5.0	34.8	117	.0124
5105F1	30	7.25	88.3	5.9	5.8	0	0	0	FOREST	I08-06	5.0	31.5	117	.0126
OCCOQUAN RESERVOIR														
5108D1	40	13.91	69.5	9.9	19.6	.3	0	.7	M. FOR.	U05-03	4.5	9.7	102	.0086
SMITH MOUNTAIN RESERVOIR														
5110E1	30	27.07	69.8	8.4	20.4	.7	0	.7	M. FOR.	U05-04	4.5	24.1	109	.0111
5110F1	30	68.58	57.6	5.5	35.8	.4	0	.7	M. FOR.	U05-03	4.5	20.8	109	.0110
5110G1	30	11.73	50.2	5.4	43.0	1.0	0	.4	M. FOR.	U05-03	4.5	16.4	109	.0114
LAKE CHESDIN														
5111B1	40	25.87	63.2	3.2	32.5	.1	0	1.0	M. FOR.	U05-03	4.5	5.4	112	.0096
5111C1	40	152.32	70.4	6.4	22.1	.1	.4	.6	M. FOR.	U05-03	4.5	5.3	112	.0097
5111E1	40	52.97	83.5	6.4	8.6	.5	.2	.8	M. FOR.	U05-03	4.5	6.0	112	.0093

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
TENNESSEE												
OLD HICKORY LAKE												
4720C1	1	SED	63.5	63.5	.149	.086	.975	.226	86.1	49.7	563.7	130.7
4720F1	1	SED	70.9	70.8	.166	.102	1.260	.416	96.4	59.2	731.4	241.5
PERCY PRIEST RESERVOIR												
4723F1	1	SED	65.7	65.6	.132	.079	.753	.277	57.9	34.7	330.3	121.5
TIMS FORD RESERVOIR												
4724E1	1	SED	53.1	52.7	.035	.012	.774	.239	18.0	6.2	397.4	122.7
4724F1	1	SED	29.8	29.6	.032	.011	.729	.245	16.9	5.8	385.1	129.4
REELFOOT LAKE												
4727C1	1	SED W/O L	12.8	12.6	.127	.058	.556	.134	45.5	20.8	199.4	48.1
VERMONT												
ARROWHEAD MOUNTAIN LAKE												
501021	1	SWOL/MET	61.8	61.7	.031	.007	1.029	.426	18.5	4.2	614.0	254.2
501031	1	MET/SED	35.3	35.2	.036	.007	1.034	.499	21.5	4.2	616.3	297.4
WATERBURY RESERVOIR												
501131	1	SED/MET	17.9	17.8	.021	.007	.697	.324	14.6	4.9	484.8	225.3
501141	1	SED/MET	13.3	13.2	.013	.005	.745	.373	9.0	3.5	516.9	258.8
501151	1	SED/MET	13.8	13.7	.020	.006	.835	.375	13.7	4.1	574.0	257.8
VIRGINIA												
CLAYTOR LAKE												
5103B1	4	SED	.7	.7	.022	.007	.433	.131	6.0	1.9	118.8	35.9
5103E1	1	SED	109.3	113.2	.022	.010	1.374	.996	5.7	2.6	354.1	256.7
JOHN W FLANNAGAN RES.												
5105D1	2	SED	3.8	3.8	.023	.008	1.400	.450	9.0	3.1	544.8	175.1
5105E1	1	SED	6.0	6.0	.020	.010	.917	.209	7.8	3.9	358.2	81.6
5105F1	1	SED	3.1	3.1	.022	.009	.842	.152	8.6	3.5	327.7	59.2
OCCOQUAN RESERVOIR												
5108D1	1	IG-P/MET	15.8	15.8	.041	.028	.924	.277	11.1	7.6	250.0	74.9
SMITH MOUNTAIN RESERVOIR												
5110E1	1	MET	22.1	22.0	.075	.027	.893	.336	27.8	10.0	331.0	124.5
5110F1	1	MET	38.7	38.6	.099	.024	.990	.313	34.9	8.4	348.5	110.2
5110G1	1	MET	46.5	46.4	.036	.014	.710	.339	13.5	5.2	265.7	126.9
LAKE CHESDIN												
5111B1	1	MET	19.7	19.2	.049	.022	.889	.179	14.8	6.7	269.4	54.2
5111C1	1	MET/SWOL	14.2	14.0	.037	.012	.540	.057	11.3	3.7	164.5	17.4
5111E1	1	MET/SWOL	8.8	8.7	.040	.013	.640	.068	11.8	3.8	189.4	20.1

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION[1]	AREA (SQ KM)	LAND USE PERCENTAGES FOR	CL[2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT[3]	PH[4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW[5] (CMS/SQ KM)
VIRGINIA														
CHICKAHOMINY LAKE														
5112B1	40	4.77	86.0	6.7	7.3	0	0	0	M. FOR.	U06-05	4.5	8.2	112	.0109
5112C1	40	17.53	81.9	2.2	15.8	.1	0	0	M. FOR.	U06-05	4.5	6.7	112	.0110
5112D1	40	14.66	65.6	7.8	26.3	0	0	.3	M. FOR.	U06-05	4.5	9.3	112	.0113
WEST VIRGINIA														
BLUESTONE RESERVOIR														
5401E1	30	45.95	66.2	1.9	31.9	0	0	0	M. FOR.	U05-12	4.5	29.9	97	.0158
5401F1	30	31.83	61.1	3.2	35.7	0	0	0	M. FOR.	U05-12	4.5	28.1	97	.0153
LAKE LYNN														
5402C1	30	6.03	72.0	1.1	23.4	3.4	0	.1	M. FOR.	I08-04	5.5	15.8	112	.0240
TYGART RESERVOIR														
5404C1	30	1.50	52.2	0	47.0	0	0	.8	M. FOR.	I08-04	5.5	19.4	117	.0237
5404D1	30	9.04	26.9	2.9	62.3	7.8	0	.1	M. AGRIC	I08-04	5.5	13.6	117	.0223
5404H1	30	23.23	48.4	5.8	38.9	0	1.9	5.0	MIXED	I08-04	5.5	23.1	117	.0221
WISCONSIN														
BUTTERNUT LAKE														
5509A3	10	57.73	46.7	7.4	8.0	0	37.2	.7	MIXED	S04-04	4.4	3.5	84	.0120
5509B1	10	20.54	35.3	10.2	22.7	0	31.8	0	MIXED	S04-04	4.5	4.0	84	.0118
EAU CLAIRE LAKE														
5515C1	12	76.12	59.1	6.5	32.1	0	2.3	0	M. FOR.	A07-12	6.3	3.0	79	.0077
KEGONSA LAKE														
5520C1	20	15.05	6.3	7.2	80.3	0	6.0	.2	AGRIC	A07-11	6.3	4.5	81	.0039
5520D1	20	6.55	8.5	2.3	88.7	0	0	.5	AGRIC	A07-11	6.3	5.7	81	.0039
SHAWANO LAKE														
5539C1	20	38.85	9.4	.8	72.5	.2	14.0	3.1	M. AGRIC	S04-04	4.5	2.0	76	.0072
TAINTER LAKE														
5546B1	20	45.92	36.3	2.8	49.5	0	10.9	.5	MIXED	A07-02	6.3	8.8	74	.0054
WAPOGASSET LAKE														
5550C1	10	8.91	16.5	6.0	55.0	0	22.5	0	M. AGRIC	A07-12	6.3	3.7	71	.0056
WAUSAU LAKE														
5551C3	10	34.19	20.5	4.6	72.4	2.1	0	.4	M. AGRIC	A07-12	6.3	2.6	81	.0082
LAKE WINNEBAGO														
5554B1	20	44.34	7.5	2.6	83.7	5.0	1.2	0	AGRIC	A07-10	6.3	4.7	76	.0039
5554C1	20	51.02	5.4	3.4	82.9	6.1	1.1	1.1	AGRIC	A07-10	6.3	3.4	76	.0040
WISCONSIN LAKE														
5555D2	10	25.72	9.7	.9	88.4	1.0	0	0	AGRIC	E12-02	6.5	5.1	76	.0076
5555E2	20	87.31	15.0	1.4	78.4	1.7	3.5	0	AGRIC	A07-11	6.3	7.8	76	.0076

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

UBDRAINAGE AREAS TORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
IRGINIA												
CHICKAHOMINY LAKE												
5112B1	1	SED W/O L	2.0	2.0	.064	.035	.660	.049	25.2	13.8	260.3	19.3
5112C1	1	SED W/O L	4.3	4.2	.076	.039	.730	.126	27.2	14.0	261.2	45.1
5112D1	1	SED W/O L	9.0	8.7	.115	.064	.727	.101	41.8	23.3	264.3	36.7
EST VIRGINIA												
BLUESTONE RESERVOIR												
5401E1	1	SED	27.7	28.0	.019	.007	.589	.291	9.5	3.5	293.4	145.0
5401F1	1	SED	30.2	30.3	.015	.006	.810	.389	7.2	2.9	391.0	187.8
LAKE LYNN												
5402C1	1	SED	18.4	19.0	.012	.006	1.186	.868	8.7	4.4	863.4	631.9
TYGART RESERVOIR												
5404C1	1	SED	43.9	44.5	.056	.020	1.003	.557	46.8	16.7	838.7	465.7
5404D1	3	SED	58.2	59.0	.077	.019	1.241	.593	53.4	13.2	860.9	411.4
5404H1	2	SED	27.3	27.5	.027	.006	.774	.301	18.6	4.1	532.8	207.2
WISCONSIN												
BUTTERNUT LAKE												
5509A3	1	IGNEOUS-P	5.5	5.5	.033	.015	.928	.203	12.4	5.6	347.8	76.1
5509B1	1	IGNEOUS-P	15.6	15.6	.041	.018	1.282	.274	15.0	6.6	469.7	100.4
EAU CLAIRE LAKE												
5515C1	1	SWOL/IG-P	26.4	26.5	.068	.029	1.650	.282	16.5	7.0	401.0	68.5
KEGONSA LAKE												
5520C1	1	SED	81.6	80.8	.235	.097	3.704	1.973	29.4	12.1	463.0	246.6
5520D1	1	SED	90.2	89.2	.184	.092	3.378	2.563	26.4	13.2	485.1	368.1
SHAWANO LAKE												
5539C1	1	SED	70.5	70.3	.050	.017	1.426	.194	11.3	3.8	322.3	43.8
TAINTER LAKE												
5546B1	1	SED W/O L	43.5	43.4	.107	.058	1.454	.225	18.3	9.9	248.2	38.4
WAPOGASSET LAKE												
5550C1	1	SED W/O L	58.9	57.0	.111	.047	1.783	.684	19.5	8.3	313.7	120.4
WAUSAU LAKE												
5551C3	3	IG-P/SWOL	73.3	73.1	.125	.071	1.949	.999	32.1	18.2	500.5	256.5
LAKE WINNEBAGO												
5554B1	1	SED	13.4	13.1	.195	.102	3.645	2.301	23.4	12.3	438.2	276.6
5554C1	3	SED	13.2	13.0	.179	.098	3.150	1.737	22.0	12.0	387.2	213.5
WISCONSIN LAKE												
5555D2	1	SED	82.9	82.9	.059	.030	2.259	2.084	14.4	7.3	555.8	508.1
5555E2	3	SED	77.9	77.3	.131	.056	2.444	1.726	31.1	13.3	579.3	409.1

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	REGION [1]	AREA (SQ KM)	LAND USE PERCENTAGES FOR	CL [2]	AG	URB	WET	OTHER	OVERALL LAND USE CATEGORY	SOILS MAP UNIT [3]	PH [4]	MEAN SLOPE (%)	AVE ANN PRECIP (CM)	FLOW [5] (CMS/SQ KM)
WISCONSIN														
LAKE WISSOTA														
5556D1	10	143.20	37.7	4.5	56.1	0	1.7	0	M. AGRIC	A07-12	6.3	3.4	79	.0070
BIG EAU PLEINE RES														
5565B1	10	183.09	31.8	4.4	63.0	.6	0	.2	M. AGRIC	A07-12	6.3	2.8	79	.0073
5565C1	10	59.34	34.7	4.7	58.2	0	0	2.4	M. AGRIC	A07-12	6.3	4.0	79	.0072
BEAVERDAM LAKE														
5577C2	20	60.97	10.0	6.1	71.7	0	12.2	0	M. AGRIC	A07-11	6.3	2.8	76	.0064
5577E2	20	4.30	0	0	99.1	.9	0	0	AGRIC	A07-11	6.3	1.4	76	.0069

SUMMARY OF LAND USE PARAMETERS BY SUBDRAINAGE AREAS

SUBDRAINAGE AREAS STORET NO.	6 FLAG	7 GEOLOGY	ANIMAL DENSITY (AN UNITS/SQ KM) TOT P	TOT N	MEAN CONCENTRATIONS (MG/L) TOT P	ORTHO P	TOT N	INORG N	EXPORT (KG/SQ KM) TOT P	ORTHO P	TOT N	INORG N
WISCONSIN												
LAKE WISSOTA												
5556D1	1	SED W/O L	52.5	52.4	.085	.050	1.872	.921	18.6	10.9	409.9	201.7
BIG EAU PLEINE RES												
5565B1	1	IGNEOUS-P	63.8	63.6	.102	.048	1.866	.700	23.5	11.0	429.5	161.1
5565C1	1	IGNEOUS-P	58.9	58.8	.066	.036	2.453	1.352	15.0	8.2	557.4	307.2
BEAVERDAM LAKE												
5577C2	1	SED	67.5	67.5	.224	.089	2.723	.735	44.9	17.9	546.2	147.4
5577E2	1	SED	100.0	99.1	.136	.094	7.449	6.510	29.8	20.6	1629.6	1424.1

******** FOOTNOTES ********

1. REGION
   10....N. AND N.E. FORAGE AND FOREST REGION
   20....CORN BELT AND DAIRY REGION
   30....E. AND CENTRAL GENERAL FARMING AND FOREST REGION
   40....PIEDMONT AND COASTAL PLAIN MIXED FARMING AND FOREST REGION
   NOTE --- WHERE DRAINAGE AREAS COVER PARTS OF TWO REGIONS, THE FIRST NUMBER IDENTIFIES THE REGION HAVING THE MOST EXTENSIVE COVERAGE, AND THE SECOND NUMBER IDENTIFIES THE REGION WITH LEAST EXTENT

   AFTER AUSTIN (1972)

2. CL.....CLEARED UNPRODUCTIVE

3. U. S. GEOLOGICAL SURVEY (1970)

4. FROM UNPUBLISHED ESTIMATES BY GUY D. SMITH (1975)

5. CMS/SQ MI.....CUBIC METERS/SECOND/SQUARE KILOMETER

6. FLAG
   1....NO PROBABLE POINT SOURCE EVIDENT
   2....NO PROBABLE POINT SOURCE EVIDENT, BUT INFLUENCE FROM STRIP MINING
   3....NO PROBABLE POINT SOURCE EVIDENT, BUT URBAN INFLUENCE
   4....NO PROBABLE POINT SOURCE EVIDENT, BUT AGRICULTURAL CONCENTRATION NEAR SAMPLING SITE

7. GEOLOGY
   SED....SEDIMENTARY ROCKS (OR DEEP ALLUVIUM) INCLUDING LIMESTONE
   SED W/O L OR SWOL....SEDIMENTARY ROCKS (OR DEEP ALLUVIUM) NOT INCLUDING LIMESTONE
   IG-V....IGNEOUS ROCKS OF VOLCANIC ORIGIN
   MET....METAMORPHIC ROCKS
   IGNEOUS-P OR IG-P....IGNEOUS ROCKS OF PLUTONIC ORIGIN
   NOTE --- WHERE COMBINATIONS EXIST THE PREDOMINANT TYPE IS SHOWN FIRST

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/3-76-014	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE The Influence of Land Use on Stream Nutrient Levels		5. REPORT DATE
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) James M. Omernik		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Eutrophication Survey Branch, Corvallis Environmental Research Laboratory, Environmental Protection Agency, 200 S. W. 35th St., Corvallis, Oregon 97330		10. PROGRAM ELEMENT NO. 1BA029
		11. CONTRACT/GRANT NO.
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15. SUPPLEMENTARY NOTES

16. ABSTRACT

National Eutrophication Survey (NES) data for 473 non-point type drainage areas in the eastern United States were studied for relationships between drainage area characteristics (particularly land use) and nutrient levels in streams. Both the total and inorganic forms of phosphorus and nitrogen concentrations and loads in streams were considered.

The objectives were to (1) investigate these relationships, as they were evidenced by the NES data and (2) develop a means for estimating stream nutrient levels from knowledge of "macro" drainage area characteristics.

Mean nutrient levels were considerably higher in streams draining agricultural watersheds than in streams draining forested watersheds. The levels were generally proportional to percentages of land in agriculture, or the combined percentages of agricultural and urban land use. Variations in nutrient loads (exports) in streams, associated with differences in land use categories, were not as pronounced as the variations in nutrient concentrations. This was apparently due, in large part, to differences in areal stream flow from different land use types.

Regression analysis of the combined percentages of agricultural and urban land uses against both the total and inorganic forms of phosphorus were performed. E Equations for these analyses, together with maps illustrating the equations residuals offer a limited predictive capability and some accountability for regional characteristics.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Land Use*	Eutrophication	Non-Point source	02A
Nutrients*	Stream Flow	Nutrients	02E
Watersheds*	Animal Unit Density		04A
Phosphorus*	Soils		04C
Nitrogen*	Geology		05A
Loadings	Eastern U.S.		05C
Concentrations			05G

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