THE NATION'S WATER RESOURCES 1975-2000

Volume 4: Ohio Region

Second National Water Assessment by the U.S. Water Resources Council

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December 1978

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Stock Number 052-045-00063-1

Foreword

The Water Resources Planning Act of 1965 (Public Law 89-80) directs the U.S. Water Resources Council to maintain a continuing study of the Nation's water and related land resources and to prepare periodic assessments to determine the adequacy of these resources to meet present and future water requirements. In 1968, the Water Resources Council reported the results of its initial assessment. The Second National Water Assessment, a decade later, provides a comprehensive nationally consistent data base for the water resources of the United States. The results of the Second National Water Assessment were obtained by extensive coordination and collaboration in three phases.

Phase I: Nationwide Analysis

The Council member agencies researched, analyzed, and prepared estimates of current and projected water requirements and problems and the implications of the estimates for the future.

Phase II: Specific Problem Analysis

Regional sponsors, one for each of the 21 water resources regions, surveyed and analyzed State and regional viewpoints about (1) current and future water problems, (2) conflicts that may arise in meeting State and regional objectives, and (3) problems and conflicts needing resolution.

Phase III: National Problem Analysis

The Council conducted this final phase in three steps: (1) An evaluation of phases I and II, (2) an analysis that identified and evaluated the Nation's most serious water resources problems, and (3) the preparation of a final report entitled "The Nation's Water Resources--1975-2000."

The final report of the Second National Water Assessment consists of four separate volumes as described below. These volumes can assist Federal, State, local, and other program managers, the Administration, and the Congress in establishing and implementing water resources policies and programs.

Volume 1, Summary, gives an overview of the Nation's water supply, water use, and critical water problems for "1975," 1985, and 2000 and summarizes significant concerns.

Volume 2, Water Quantity, Quality, and Related Land Considerations, consists of one publication with five parts:

Part I, "Introduction," outlines the origin of the Second National Water Assessment, states its purpose and scope, explains the numerous documents that are part of the assessment, and ident-

ifies the individuals and agencies that contributed to the assessment.

II, "Water-Management Problem Profiles," identifies ten general water problem issues and their implications and potential consequences.

Part III, "Water Uses," focuses on the national perspectives regarding existing ("1975") and projected (1985 and 2000) requirements for water to meet offstream, instream, and flow-management needs. State-regional and Federal perspectives are compared.

Part IV, "Water Supply and Water Quality Considerations," analyzes the adequacy of fresh-water supplies (ground and surface) to meet existing and future requirements. It contains a national water budget; quantifies surface- and ground-water supplies, reservoir storage, and transfers of water within and between subregions; describes regional requirements and compares them to supplies; evaluates water quality conditions; and discusses the legal and institutional aspects of water allocation.

Part V, "Synopses of the Water Resources Regions," covers existing conditions and future requirements for each of the 21 water resources regions. Within each regional synopsis is a discussion of functional and location-specific water-related problems; regional recommendations regarding planning, research, data, and institutional aspects of solving regional water-related problems; a problem-issue matrix; and a comparative-analysis table.

Volume 3, Analytical Data, describes the methods and procedures used to collect, analyze, and describe the data used in the assessment. National summary data are included with explanatory notes. Volume 3 is supplemented by five separately published appendixes that contain data for the regions and subregions:

Appendix I, Social, Economic, and Environmental Data, contains the socioeconomic baseline ("1975") and growth projections (1985 and 2000) on which the water-supply and water-use projections are based. This appendix presents two sets of data. One set, the National Future, represents the Federal viewpoint; the other set, the State-Regional Future, represents the regional sponsor and/or State viewpoint.

Appendix II, Annual Water Supply and Use Analysis, contains baseline water-supply data and baseline and projected water withdrawal and water-consumption data used for the assessment. Also included are a water adequacy analysis, a natural flow analysis, and a critical-month analysis.

Appendix III, Monthly Water Supply and Use Analysis, contains monthly details of the water-supply, water-withdawal, and water-

consumption data contained in Appendix II and includes an analysis of monthly water adequacy.

Appendix IV, Dry-Year Conditions Water Supply and Use Analysis, contains both annual and monthly baseline and projected water-withdrawal and water-consumption data for dry conditions. Also, a dry conditions water-adequacy analysis is included.

Appendix V, Streamflow Conditions, contains detailed background information on the derivation of the baseline streamflow information. A description of streamflow gages used, correction factors applied, periods of record, and extreme flows of record, are given for each subregion. Also included is the State-Regional Future estimate of average streamflow conditions.

Volume 4, Water Resources Regional Reports, consists of separately published reports for each of the 21 regions. Synopses of these reports are given in Volume 2, Part V.

For compiling and analyzing water resources data, the Nation has been divided into 21 major water resources regions and further subdivided into 106 subregions. Eighteen of the regions are within the conterminous United States; the other three are Alaska, Hawaii, and the Caribbean area.

The 21 water resources regions are hydrologic areas that have either the drainage area of a major river, such as the Missouri Region, or the combined drainage areas of a series of rivers, such as the South Atlantic-Gulf Region, which includes a number of southeastern States that have rivers draining directly into the Atlantic Ocean and the Gulf of Mexico.

The 106 subregions, which are smaller drainage areas, were used exclusively in the Second National Water Assessment as basic data-collection units. Subregion data point up problems that are primarily basinwide in nature. Data aggregated from the subregions portray both regional and national conditions, and also show the wide contrasts in both regional and national water sources and uses.

The Second National Water Assessment and its data base constitute a major step in the identification and definition of water resources problems by the many State, regional, and Federal institutions involved. However, much of the information in this assessment is general and broad in scope; thus, its application should be viewed in that context, particularly in the area of water quality. Further, the information reflects areas of deficiencies in availability and reliability of data. For these reasons, State, regional, and Federal planners should view the information as indicative, and not the only source to be considered. When policy decisions are to be made, the effects at State, regional, and local levels should be carefully considered.

In a national study it is difficult to reflect completely the regional variations within the national aggregation. For example, several regional

reviewers did not agree with the national projections made for their regions. These disagreements can be largely attributed either to different assumptions by the regional reviewers or to lack of representation of the national data at the regional level. Therefore, any regional or State resources-management planning effort should consider the State-regional reports developed during phase II and summarized in Volume 4 as well as the nationally consistent data base and the other information presented in this assessment.

Additional years of information and experience show that considerable change has occurred since the first assessment was prepared in 1968. The population has not grown at the rate anticipated, and the projections of future water requirements for this second assessment are considerably lower than those made for the first assessment. Also, greater awareness of environmental values, water quality, ground-water overdraft, limitations of available water supplies, and energy concerns are having a dramatic effect on water-resources management. Conservation, reuse, recycling, and weather modification are considerations toward making better use of, or expanding, available supplies.

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Description

The Ohio Region (Figure 5-1), embracing a total area of 160,056 square miles,[1] lies in the middle eastern portion of the United States. The river supplies the largest volume of flow of the six Mississippi tributary drainage patterns, and, of these, the Ohio River Basin is exceeded in land area only by the Missouri River drainage basin. The area, about 300 miles wide and 550 miles long, is bounded on the north by the Great Lakes Basin, on the east by the divide of the Appalachian Mountains, on the south by the Tennessee River Basin, and on the west by tributary drainage areas of the Upper Mississippi River. The area represents about 5 percent of the total land area of the 48 contiguous States and nearly 20 percent of the area east of the Mississippi River. It includes portions of Pennsylvania (9.6 percent of the region), West Virginia (12.6 percent), Virginia (2.5 percent), North Carolina (0.5 percent), Ohio (18.2 percent), Kentucky (23.3 percent), Tennessee (6.9 percent), Indiana (17.9 percent), Illinois (7.0 percent), Maryland (0.3 percent), and New York (1.2 percent).

The Ohio River, the region's primary river, is formed by the confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania, and is joined by major downstream tributaries. It flows 981 rivermiles in a southwesterly direction and joins the Mississippi River at Cairo, Illinois. The river bounds Ohio, Indiana, and Illinois (north bank) and West Virginia and Kentucky (south bank). The area has about 170 major man-made reservoirs, many more small impoundments, and a few natural lakes. The total water surface of about 1 million acres is about 1 percent of the regional area.

Geology

The Ohio Region lies in four major physiographic divisions: (1) the Valley and Ridge Province, a mountainous area to the east; (2) the Appalachian Plateau, which lies to the west of the Valley and Ridge Province; (3) the Interior Low Plateau, which lies south of the Ohio River and west of the Appalachian Plateau; and (4) the Central Lowland, a nearly level glaciated till plain which includes virtually all of the region north and west of the Ohio River below Portsmouth, Ohio.

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[1] This is the sum of the areas of counties used to approximate the hydrologic area of the region. Land use and other socioeconomic data are related to this area. The drainage area within the hydrologic boundary is 162,660 square miles.

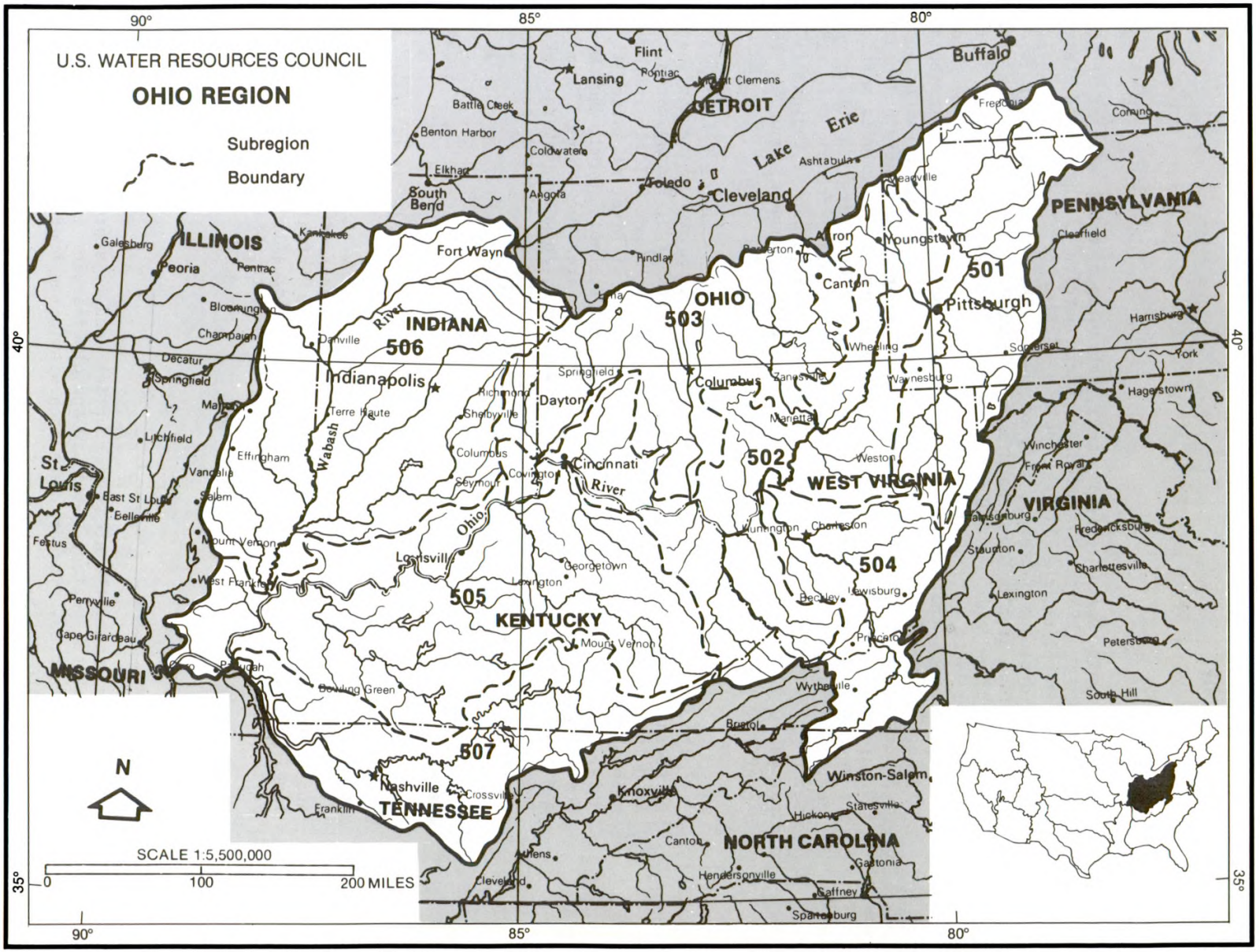


Figure 5-1. Region Map

Rock formations are nearly all sedimentary, chiefly sandstone, limestone, and shale, and range in age from only a few million years old for the Tertiary deposits at the Ohio River mouth to over 500 million years old for the Precambrian igneous and metamorphic structures at the eastern basin boundary. Most of the region has Paleozoic bedrock formations with strata of all systems of that era. From the beginning (except possibly during continental glacial periods), the rock formations have controlled the physical features of the region. Characteristics of the rocks were instrumental in forming the topographic relief and drainage patterns. Historically, these have been controlling elements in transportation routes, in economic development, and, consequently, in water resource development of the region.

Topography

The topography of the Ohio Region varies from flat and rolling plains to rugged mountains. This topography is reflected in the general land use pattern of the basin as shown in Figure 5-2. The highest point is Mount Rogers, elevation 5,720 feet above mean sea level, on the basin divide in southwestern Virginia; the lowest point is at the mouth of the Ohio River at Cairo, Illinois, at an elevation of about 310 feet. The veins of relief of the Ohio River Basin are made up of three major drainage systems, the upper tributaries, the southern tributaries, and the northern tributaries.

The eastern portion of the region, from southwestern New York to North Carolina, is dominated by the rugged terrain of the Appalachian Mountains and Plateau. The ridges are sharp, the slopes steep, and the valleys narrow. The streams, in their upper reaches, flow parallel to the ridges, then generally turn to cut through the ridges, and flow normally in their lower sections to the Ohio River. Because of the rugged terrain, most transportation routes and economic developments are located in narrow valleys.

West of the Appalachians and south of the Ohio River, Kentucky and Tennessee have considerable mountainous and local relief. Most of the streams are incised in deep canyons and narrow valleys throughout these states. However, central and western Kentucky have rolling plains and hills suitable for agriculture. The streamflow in the headwaters is generally west, turning north in the lower reaches to join the Ohio River.

North of the Ohio River, broad valleys and minor relief extend westward from the Appalachian Mountain Plateau. This area includes most of the basin area in New York, northwestern Pennsylvania, central and southwestern Ohio, central Indiana, and southeastern Illinois. The topography of the area was formed by glaciation. The glaciated area extends from beyond the northern boundary of the basin to slightly beyond the Ohio River from Maysville, to Louisville, Kentucky. The remainder of the glaciated area in Indiana and Illinois extends to within 10 to 100 miles of the Ohio River. In all, 75 percent of the region north of the Ohio River, representing about 35 percent of the total study area, is of minor relief. North of the Ohio River, the streams flow south and enter the Ohio River normal to its general course. Nearly all of the few natural lakes of the region are located in the glaciated areas north of the Ohio River.

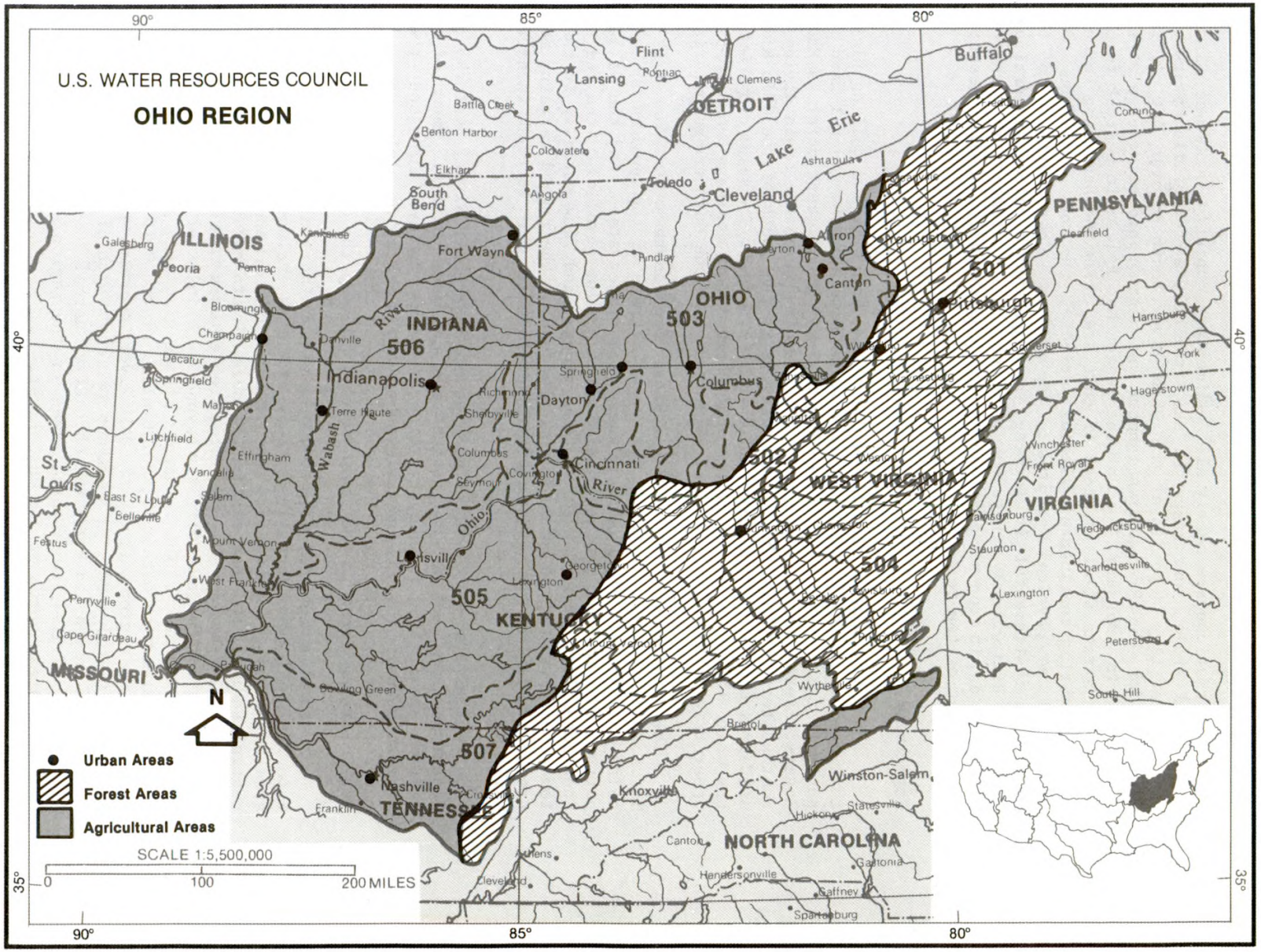


Figure 5-2. Present Land Use

Climate

The climate of the Ohio Region is temperate with blending seasons. Eastward passage of cyclonic storms causes changes in weather, considerable rainfall, snowfall, and humidity, and moderate cloudiness and wind. Several tornadoes occur within the region each year, and hurricanes occasionally occur in the southern and eastern portions of the region.

Rainfall is moderately high, ranging from 36 to 56 inches per year, with 40 to 46 inches predominating. Summers are moderately warm and humid, providing a favorable growing season for at least one harvest. In the southern and western portions of the region, the growing season between killing frosts lasts about 200 days, from April through October. In the northern and extreme northeastern portions, the season lasts about 120 days. July, the warmest month, has an average temperature varying from 70° to 80° F from northeast to southwest. Temperatures rise over 90° F during several days each year, and extreme temperatures range from about 100 to 110° F.

Winters range from moderately cold in the southwest to severe in the extreme northeast. January is the coldest month, with average temperatures ranging from 26° to 40° F from the most northern to the most southern parts of the region. Several days of subzero temperatures can be expected each winter. During extremely cold periods in the north and northeast portions of the region, it is often 10° to 20° warmer in the southwest and southern portions of the region.

People and the Resources

Estimates and projections of the population, economy, land and water resources, and their parameters were made as explained previously. The data for the regions and subregions are referred to as the National Future (NF). In this report the State-Regional Future (SRF) is the same as the NF.

Population

In 1975 the Ohio Region contained 21.2 million people, about 10 percent of the Nation's population. They produce 12.5 percent of the national income. The population is concentrated in the northern portion of the region. Its greatest density is in Allegheny County, Pennsylvania, which contains the Pittsburgh metropolitan area at the head of the Ohio River. Other large population centers on the Ohio River are Wheeling and Huntington, West Virginia; Ashland, Kentucky; Cincinnati, Ohio; and Louisville, Kentucky. Evansville and Indianapolis, Indiana; and Dayton, Columbus, and Youngstown, Ohio, are major centers north of the Ohio River. South of the river, Charleston, West Virginia; Lexington and Frankfort, Kentucky; and Nashville, Tennessee, are important centers of population growth and economic activity. The mountainous areas of these States are sparsely settled. By the year 2000, the regional population is expected to reach 24.8 million, about 9 percent of the Nation's population.

Wide environmental differences affecting employment also prevail within the region. The contrasts and variations in economic conditions result from urbanization. Natural resources and transportation influence the pattern.

Nationally important steel working centers are located at Johnstown and Pittsburgh, Pennsylvania; Youngstown, and Middletown, Ohio; Ashland, Kentucky; and Wheeling, West Virginia. Industrial centers in Cincinnati, Louisville, Indianapolis, and Nashville are of national significance in fabricated metals, machinery, hardwood forest products, and chemicals. A major chemical manufacturing complex is located in Charleston, West Virginia.

About 60 percent of the region's population lives in urban areas, and 40 percent in rural areas. Fewer than 10 percent of the people live on farms. Pittsburgh, Pennsylvania, accounts for about one-eighth of the population and is a major contributor in the expanding regional economy. The major economic pursuits are manufacturing of primary metals and machinery. Pittsburgh and other cities bordering navigable waterways account for over one-third of the region's total economic output.

Almost half of the region lies in Appalachia, which extends from New York to central Alabama and northern Mississippi. Except in the cities, the well-being of the people in Appalachia has been substandard. A majority of the inhabitants live in rural areas. In some counties, as many as 75

percent of the people at one time were in the poverty class. Inadequate income, education, and living standards were prevelant in much of the rural areas until the energy crisis of 1973 to 1974. Many of the people were unskilled in trades, and their educational levels were low, but these are improving rapidly. High and sustained rates of unemployment prevailed, and considerable net outmigration occurred because of the continuing decline in occupational opportunities. Many of the social problems stemmed from mechanization in the coal-mining industry.

However, population trends in coal producing counties have reversed, and the population is now increasing. Coal mining has expanded rapidly. Local people have been trained to operate the machinery. Unemployment is in line with State averages; wage rates have increased spectacularly; and economies are booming. Although many aged and disabled persons live on transfer payments, coal sections of Appalachia are rapidly turning around.

Economy

About 8.3 million people were employed in 1975. During that year total personal income, measured in 1975 dollars, was $119.4 billion, or about $5,645 per person, almost $600 less than the national average. Total employment in the Ohio Region constituted 39 percent of its inhabitants and over 9 percent of the Nation's total labor force in 1975.

Major earnings were from manufacturing, which constituted almost 34 percent of the total. The "Other" category in Table 5-1 was 61 percent of the total. Agriculture amounted to 2.6 percent of the total. About one-sixth of the manufacturing earnings were from the chemical and allied products industries; about 9.5 percent of the earnings came from food and kindred products industries. The remaining 74.5 percent of the manufacturing earnings was spread over many categories. Total earnings and per capita income are expected to more than double by the year 2000. Employment is expected to increase by over 2.5 million people by the year 2000. All categories are projected to have increased earnings by the year 2000. The largest single increase is expected in chemical and allied products, which are projected to increase by 2.75 times. The "Other" category is projected to increase by 2.58 times.

Table 5-1.--Ohio Region earnings--1975, 1985, 2000
(million 1975 dollars)

Earnings sector	1975	1985	2000
Manufacturing	32,025	44,877	69,438
Agriculture	2,494	2,433	2,800
Mining	2,486	2,623	3,367
Other	57,987	86,411	149,587
Total	94,992	136,344	225,192

Natural Resources

About 49 percent of the total surface area of the region is used for cropland, pasture and range, and other agricultural purposes. Forested areas, in the north and mideast comprise about 42 percent of the surface area. In the Pennsylvania, Ohio, West Virginia, Virginia, Tennessee, Indiana, Kentucky, and Illinois portions of the Ohio Region, there are vast bituminous coal reserves along some small associated pockets of oil and natural gas. The region contains about 70 percent of the Nation's bituminous reserves, 30 percent of the Nation's total coal reserves (which include lignite), and 14 percent of the known world coal reserves.

Table 5-2 shows the 1975 distribution of land use. A major change in land use patterns projected between now and 2000 is a reduction of approximately 1 million acres in the forest lands and an increase of approximately 10 million acres of urban buildup.

Table 5-2.--Ohio Region surface area and 1975 land use

Surface area or land-use type	1,000 acres	Percentage of total surface area
Surface area		
Total	102,436	100.0
Water	943	0.9
Land	101,493	99.1
Land use		
Cropland	32,877	32.1
Pasture and range	13,995	13.7
Forest and woodland	43,143	42.1
Other agriculture	3,011	2.9
Urban	3,351	3.3
Other	5,116	5.0

Agriculture

Agricultural earnings presently contribute about 2.6 percent of the total regional earnings, and about 50 percent of the 101.5 million acres of land is used for agricultural purposes.

Cropland accounts for about 32.9 billion acres or 32 percent of the total land area. About 24.8 million acres, representing 75 percent of the total cropland acreage, is harvested cropland. By the year 2000, cropland is expected to increase only slightly (less than 1 percent), but harvested cropland is projected to increase by about 25 percent. Irrigated farmland is not extensive and accounts for less than one percent of total cropland (see Table 5-3). Indirectly, agriculture makes a much greater contribution to the economy since large quantities of machinery, fertilizer, petroleum, and other industrial products are used in the production, marketing, and processing of food and fiber. Employment in

these industries is related to agriculture. The number of farms in the basin continues to decline as a result of mechanization and consolidation of smaller units into larger operations and the attraction of farmers to other jobs. The decreases have been most significant in the less productive farming areas. The major food crops are corn, soybeans, dry-field beans, potatoes and hay; over half of all crops produced in the region are feed crops (corn, oats, and barley). Hay is a major crop. In 1959, 24 percent of the cropland was used for hay.

Production of livestock and livestock products is distributed more widely than the production of crops. Corn, soybeans, and cattle are major agriculture products in the western portion of the region, while dairy and poultry products dominate agricultural production in the eastern areas. Tobacco is a major cash crop, particularly in Kentucky, Virginia, and Tennessee.

Forest products are a major element in the region's agricultural output. Over 42 percent of the region is forestland, which lies predominately in the Appalachian plateau. Over 90 percent of the forestland is classified as commercial, that is land producing or capable of producing crops of industrial wood which has not been withdrawn from timber utilization.

Table 5-3.--Projected changes in cropland and irrigated farmland in the Ohio Region--1975, 1985, 2000
(1,000 acres)

Land category	1975	1985	2000
Total cropland----------	32,877	32,977	33,020
Cropland harvested----------	24,802	30,260	30,996
Irrigated farmland----------	57	76	102

Energy

In 1975 the total fossil-fueled electric generation was about 299,000 gigawatt-hours (gWh) for the Ohio Region. In 1975 there was no electric generation by nuclear-fueled plants. By the year 2000, the total electric generation is projected to be about 1,050,000 gWh as shown in Table 5-4. About 50 percent of this is projected to be from nuclear-fueled power plants.

The Energy Research and Development Administration has projected energy generation based on the assumption that synthetic fuels can be developed and become a part of the regional energy structure. If such a development occurs, the energy generation by nuclear plants could be reduced significantly.

Table 5-4.--Ohio Region electric power generation--1975, 1985, 2000
(gigawatt-hours)

Fuel source	1975	1985	2000
Fossil----------	299,003	424,389	521,651
Nuclear----------	0	75,361	527,353
Conventional hydropower----	5,455	5,844	7,696
Total generation	304,458	505,594	1,056,700

The Ohio Region's coal production in 1973 was approximately 455,151,000 short tons; by the year 2000 this is expected to exceed 900 million tons. The region's extensive coal resources, combined with the relative abundance of adequate water supplies, make the Ohio Region a prime candidate for increased energy-related development. Careful planning is needed in the operation of the producing mines and the development of the reserves so as not to harm the water-related land resources while helping meet the increased demand for coal production. Petroleum, natural gas, and natural gas liquids are also found in the region, but coal and its expected development will have the greatest impact on the region's environment and economy.

Navigation

The Ohio River from Pittsburgh to the Mississipi River has been channelized for freight transport by a system of locks and dams. The lower Allegheny, Monongahela, Kanawha, Green, and Cumberland Rivers also have been improved for barge navigation (Figure 5-3).

The Ohio River is a key element of the Nation's inland waterways system. The inland waterways carry about one-sixth of the domestic cargo in the United States, mostly by long-distance movement of bulk commodities. Coal, petroleum, grain, construction aggregates, and miscellaneous materials move down the Ohio River. Coal, chemicals, construction aggregates, petroleum, and other miscellaneous commodities move upriver.

According to State-regional sources, the Ohio River navigation system carried over 170 million tons of freight in 1975, well over one-half of the domestic intercity tonnage of the region. This is projected to increase to 276 million tons* by the year 2000. Improved channels, locks, and terminal facilities will be needed to accommodate this traffic. The authorized modernization of the Ohio River navigation system involves 43 of the 49 low-lift dams which have 600-foot locks. These will be replaced by 14 high-lift dams, which have 1200-foot locks. This work was begun in 1955; it includes Smithland Dam, which is scheduled for completion in 1980. Gallipolis and three dams near Pittsburgh on the Upper Ohio have 600-foot locks. Increasing traffic will cause problems there and at the two remaining low-lift dams near the mouth of the Ohio which have 1200-foot temporary locks.

* Ohio River Basin Comprehensive Survey, Appendix L, Navigation, p. 67.

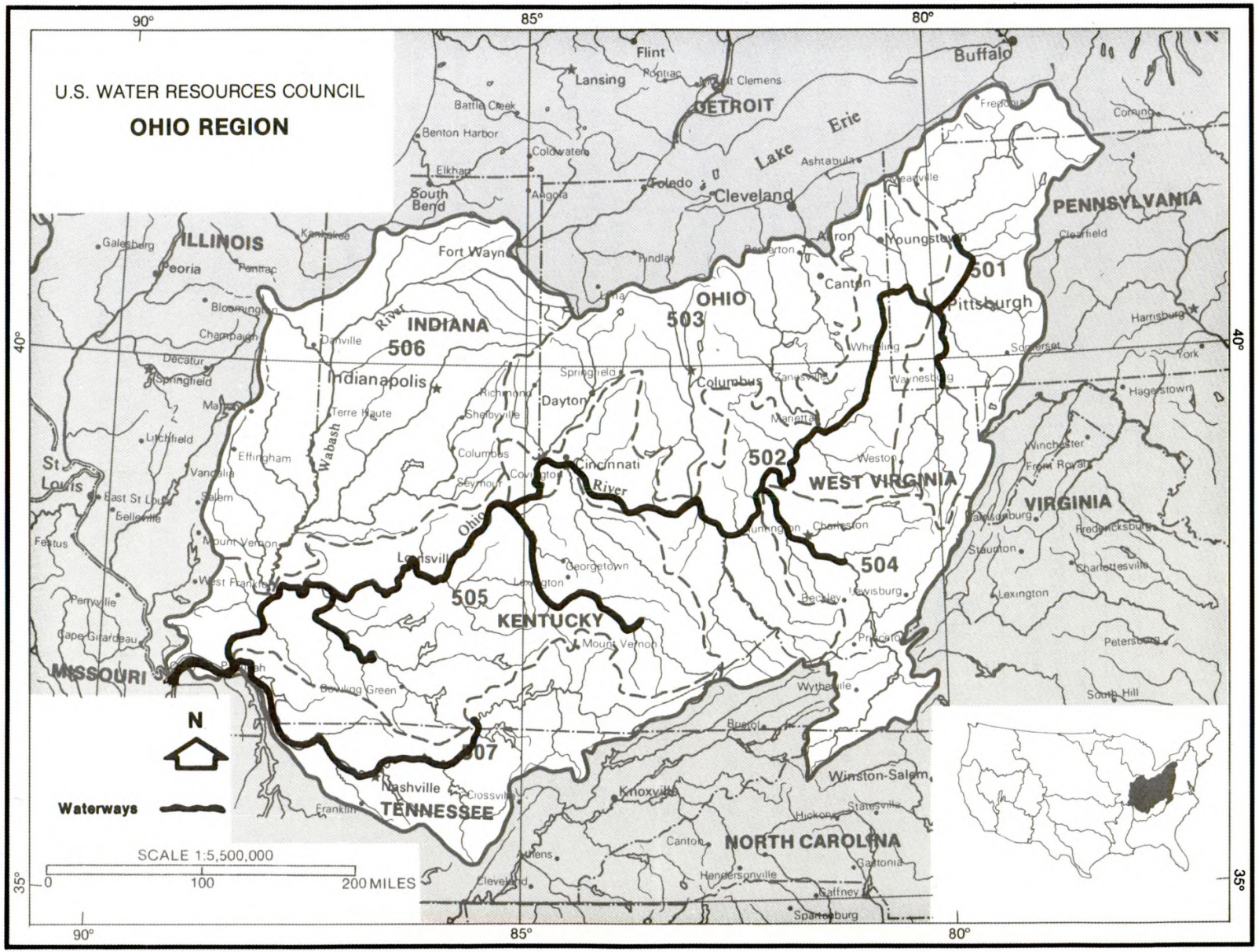


Figure 5-3. Navigation System

Environment

Increasing numbers of people are seeking open spaces for outdoor recreation. The enthusiasm for boating, camping, hiking, fishing, and picnicking is having substantial impact on the outdoor environment.

Higher living standards, including a shortened workweek, are resulting in a greater public awareness and interest in aesthetics, heritage, and culture as related to land and water resources. The needs and problems relating to outdoor recreation and enjoyment of unique cultural, aesthetic, and historical features prevail throughout the region. Most individuals and social groups and all levels of government are concerned. Figure 5-4 indicates the locations of parks, forests, wildlife refuges, scenic streams, etc.

Water

The data collected and projected in this report on the region's water are for the purpose of assessing the water situation and current and potential problems related to water and its uses.

Surface Flows

Water available in streams varies considerably, both seasonally and geographically, throughout the year because of differences in precipitation and runoff. About 50 percent of the streamflow usually occurs in January through April. In the spring and summer, the evapotranspiration rises, runoff decreases, and streamflows begin to decline. Where ground-water seepage is deficient, many small streams go dry in the summer and fall. Lowest streamflows generally occur in September and October, but streams may also be low through November and December. Even in some larger tributaries, streamflow at times is insufficient to maintain adequate water quality or assure a dependable water supply. Of the total precipitation, over 60 percent is lost to the atmosphere; 17.3 inches (average equivalent depth over the drainage area) flow to the Ohio River.

Figure 5-5, supplied by State-regional sources, illustrates average and low flows in the Ohio River. The streamflow at the outflow point is estimated by the National Future to be about 178,000 mgd.

Ground Water

Moderate to plentiful ground-water supplies are available throughout most of glacial till areas and the alluvial valleys in other portions of the region. The unconsolidated deposits to the north of the Ohio River contain large ground-water storage reservoirs in buried flow channels formed by preglacial drainage systems. For the most part, ground-water reserves of the glacial till and the small area of the Gulf Coastal Plain in the lower portion of the Ohio River Basin are plentiful and adequate except for

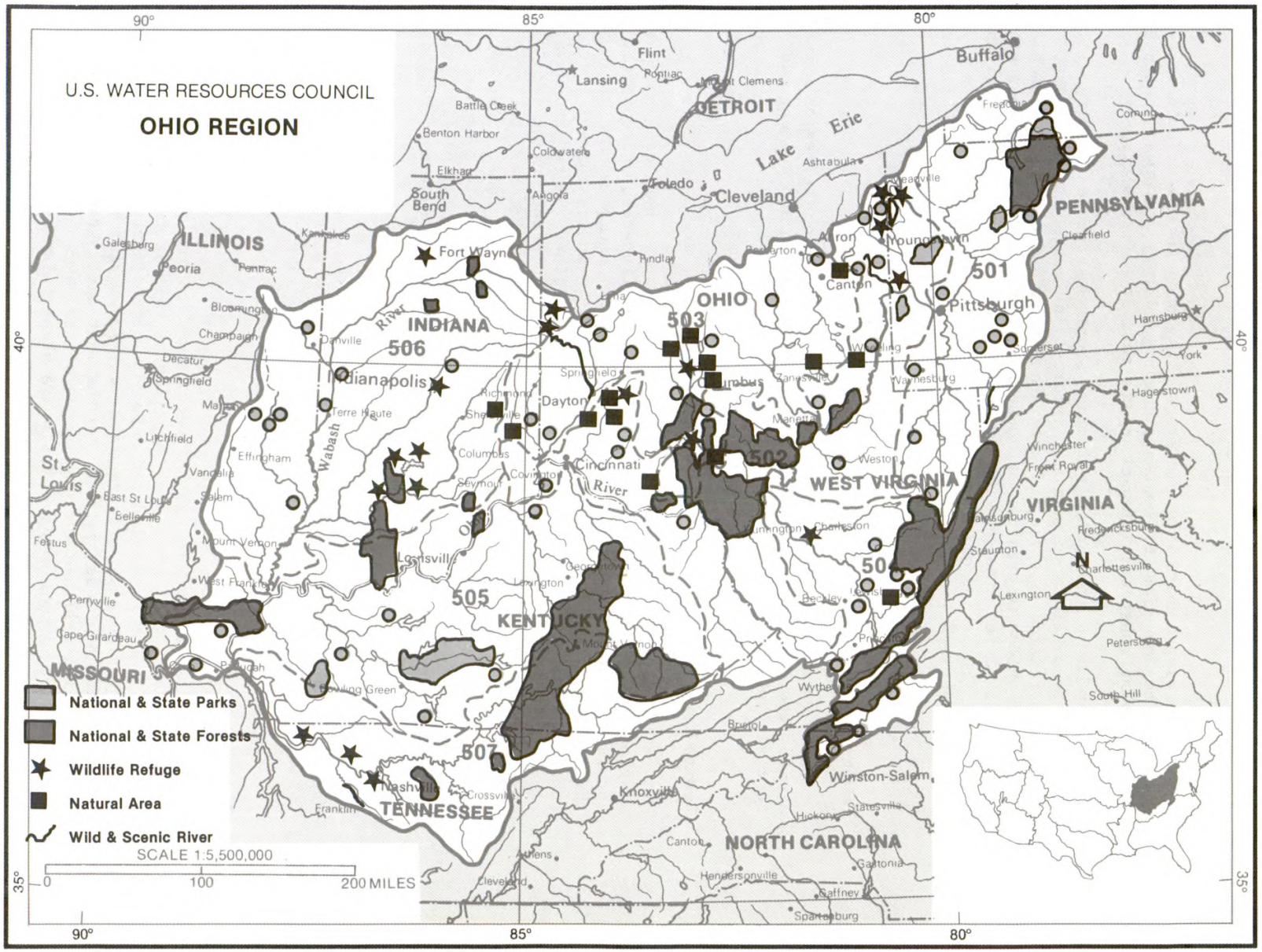
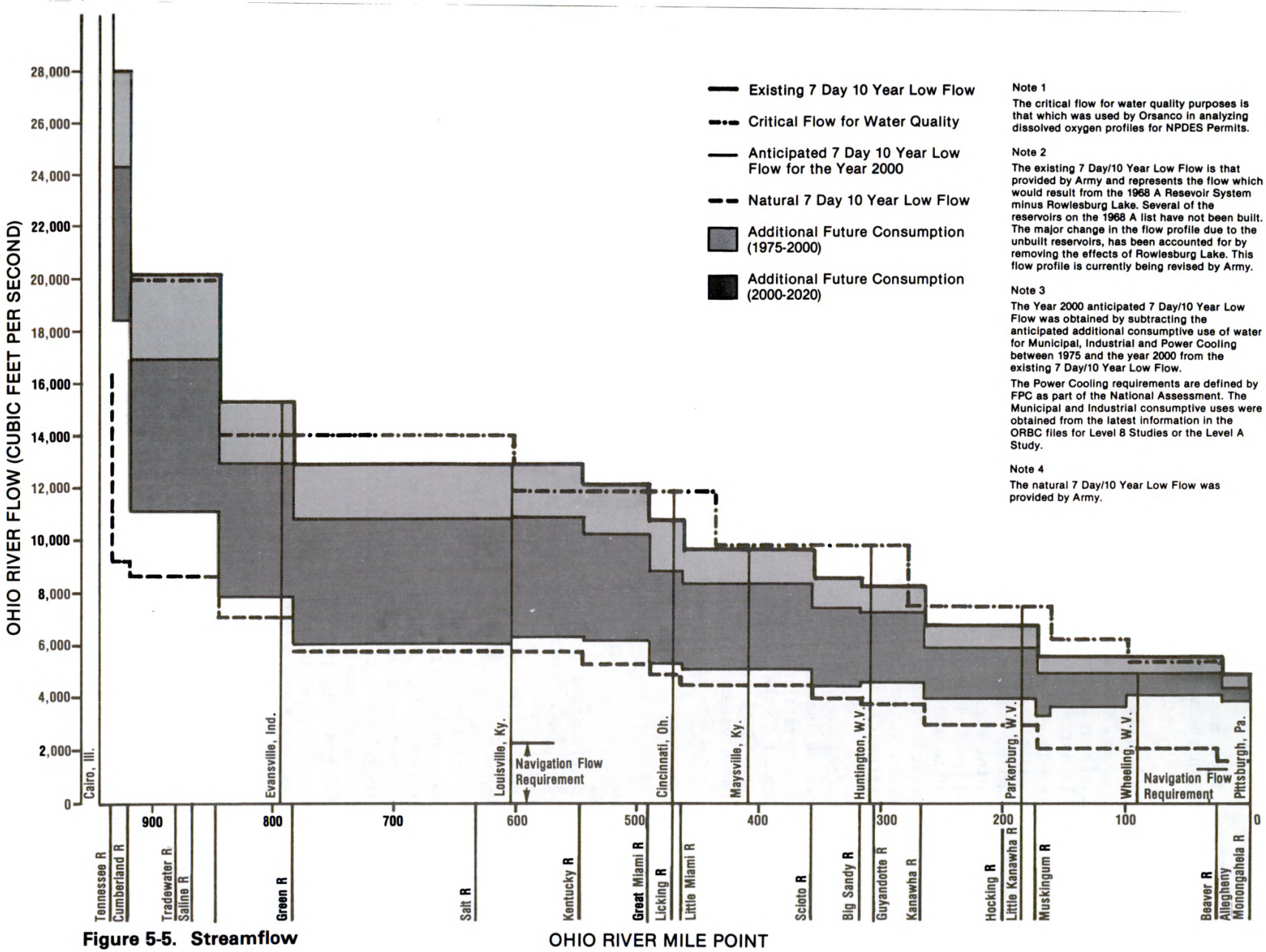


Figure 5-4. Environmental Resources



Note 1

The critical flow for water quality purposes is that which was used by Orsanco in analyzing dissolved oxygen profiles for NPDES Permits.

Note 2

The existing 7 Day/10 Year Low Flow is that provided by Army and represents the flow which would result from the 1968 A Resevoir System minus Rowlesburg Lake. Several of the reservoirs on the 1968 A list have not been built. The major change in the flow profile due to the unbuilt reservoirs, has been accounted for by removing the effects of Rowlesburg Lake. This flow profile is currently being revised by Army.

Note 3

The Year 2000 anticipated 7 Day/10 Year Low Flow was obtained by subtracting the anticipated additional consumptive use of water for Municipal, Industrial and Power Cooling between 1975 and the year 2000 from the existing 7 Day/10 Year Low Flow.

The Power Cooling requirements are defined by FPC as part of the National Assessment. The Municipal and Industrial consumptive uses were obtained from the latest information in the ORBC files for Level B Studies or the Level A Study.

Note 4

The natural 7 Day/10 Year Low Flow was provided by Army.

Figure 5-5. Streamflow

the large municipal and industrial water needs. The permeable sand and gravel deposits in the valleys of the drainage system, although somewhat limited in size, are sources of high yield.

Bedrock formations underlying the region vary greatly in their hydrologic characteristics. Mississippian sandstone aquifers in the northwestern part of the Allegheny Basin are capable of high yields. Ordovician and Mississippian limestones in Kentucky and West Virginia are sources of numerous springs and well supplies. Although the sources are widespread, they are only capable of serving moderate needs. Bedrock formations of shale and siltstones, such as flank both sides of the Ohio River between Wheeling, and Point Pleasant, West Virginia, yield little water. Supply is also meager where bedrock lies near the surface in the glaciated area of Indiana and Ohio and in the nonglaciated areas of Kentucky where the Ordovician formations of the Cincinnati arch form the surface. The location and yield of ground water in bedrock and unconsolidated materials in the region is illustrated in Figure 5-6.

During a year of average precipitation, over a million gallons of water fall on each acre of land in the Ohio Region. Most of the precipitation is lost to evapotranspiration or runoff to streams. The remaining moisture filters slowly down into the ground to replenish the ground-water supplies. The annual withdrawal of ground water in the region in 1975 was 1,843 mgd. No change in ground water withdrawal by the year 2000 has been projected, but it appears that there will be no increase in withdrawals of ground water as such.

Water Withdrawals

Total water withdrawn from surface streams and ground water in 1975 averaged about 34.9 bgd. Manufacturing and steam-electric withdrawals made up 91.3 percent of the total; while domestic, commercial, and institutional accounted for only 6.7 percent of the total (See Figure 5-7).

Large quantities of water are required for manufacturing and electric generation because the water is used only once. Future water withdrawals for these and other industrial uses are projected at a much lower level than actual in-plant water requirements. These projections are based on assumptions of major recycling of the water once it is withdrawn for use. On this basis, total water withdrawals are projected to decrease by 18.0 bgd by the year 2000 to 16.9 bgd (Figure 5-7). By the year 2000, manufacturing is projected to account for a smaller proportion (about 14 percent) of total withdrawals. Domestic use shows a corresponding increase in importance.

Water Consumption

While withdrawals are being reduced, the amount of water consumed is projected to increase from 1.8 bgd to 4.3 bgd in the year 2000. Water consumed is not returned to the streams. Manufacturing and steam electric plants account for over 63 percent of the 1975 water consumption. The

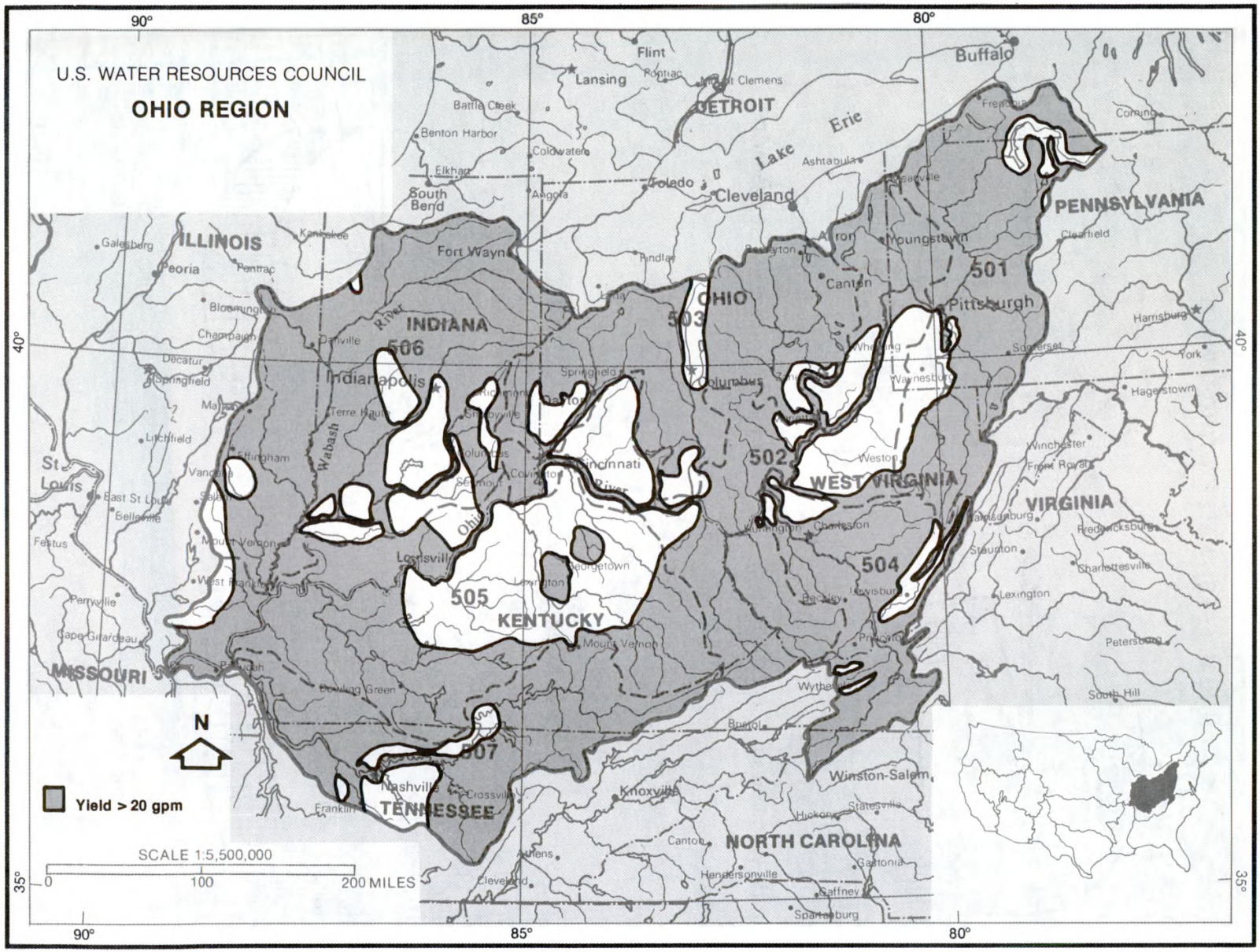
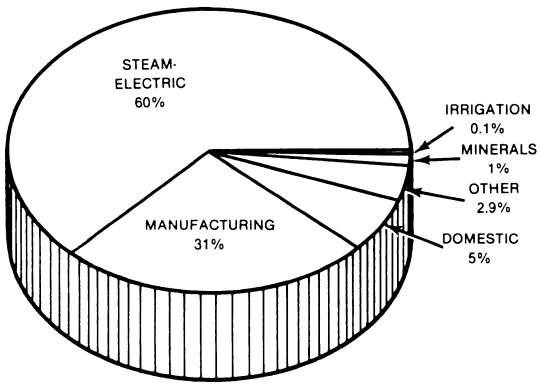
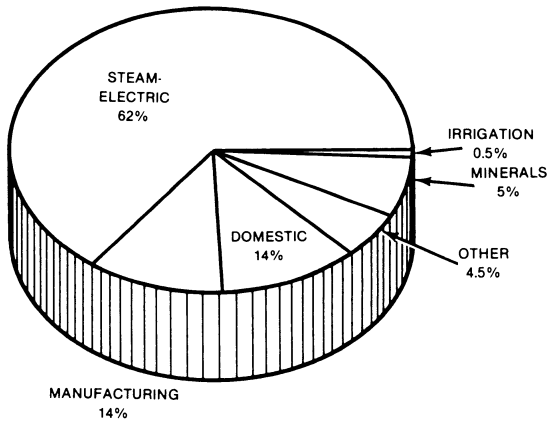


Figure 5-6. Major Aquifers

ANNUAL FRESHWATER WITHDRAWALS

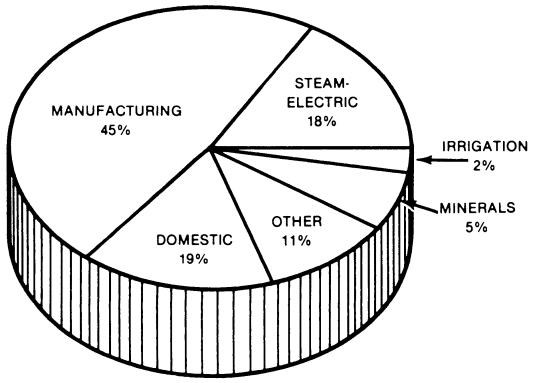


1975
Total Withdrawals — 34,934 MGD

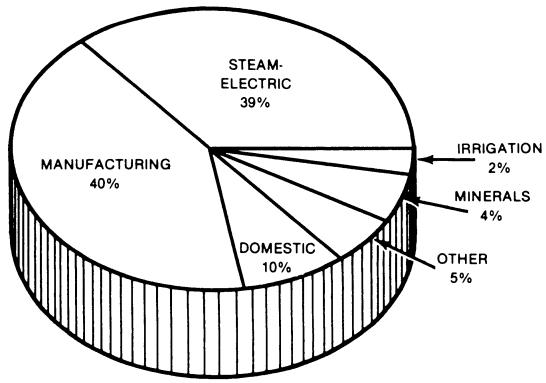


2000
Total Withdrawals — 16,925 MGD

ANNUAL FRESHWATER CONSUMPTION



1975
Total Consumption — 1,798 MGD



2000
Total Consumption — 4,332 MGD

Figure 5-7. Withdrawals and Consumption

major increase in water consumption is expected for steam electric generation with an increase of 1.4 bgd by the year 2000. This is an estimated 39 percent of total consumption in the year 2000 as compared to a little over 18 percent in 1975 (Figures 5-7).

Instream Uses

Many stream uses do not require actual removal of water from its bed. Principal among these uses are recreation, navigation, fish and wildlife, waste disposal, and hydroelectric power. These purposes do require minimum levels of water quantity and quality. In fact, a stream must provide minimum flows in order to sustain the habitat of its aquatic life forms. The U.S. Fish and Wildlife Service has prepared judgmental estimates of monthly flows sufficient to support aquatic habitats and outdoor recreation. According to these estimates, the instream flow approximation for the Ohio Region is 160,520 mgd. SRF sources consider this flow requirement excessive.

Comparative Analysis

Table 5-5 presents the NF estimates of streamflows and water use in the Ohio Region. The Ohio Region has adopted the NF as its SRF for these water data categories. Therefore, the NF and SRF values for withdrawals, consumption, and streamflow estimates are in agreement for the Ohio Region. The Ohio River Basin Commission decided to accept the NF data for use in the National Assessment, not because there was agreement with the numbers themselves, but because they could not be separated into any meaningful disaggregation for use at the regional level.

Table 5-5.--Socioeconomic and volumetric data summary: the Ohio Region

Category	1975		1985		2000	
	NF	SRF[a]	NF	SRF[a]	NF	SRF[a]
SOCIOECONOMIC DATA (1000)						
Total population	21,158	21,158	22,722	22,722	24,791	24,791
Total employment	8,313	8,313	9,429	9,429	10,838	10,838
VOLUMETRIC DATA (mgd)						
-Base conditions-						
Total streamflow	180,111	NE	180,111	NE	180,111	NE
Streamflow at outflow point(s)	178,000	178,000	176,937	NE	174,674	NE
Fresh-water withdrawals	34,934	34,934	27,838	27,838	16,925	16,925
Agriculture	160	160	195	195	230	230
Steam electric	21,022	21,022	21,008	21,008	10,574	10,574
Manufacturing	10,881	10,881	3,323	3,323	2,341	2,341
Domestic	1,842	1,842	2,068	2,068	2,343	2,343
Commercial	495	495	529	529	571	571
Minerals	493	493	662	662	808	808
Public lands	5	5	8	8	12	12
Fish hatcheries	36	36	45	45	46	46
Other	0	0	0	0	0	0
Fresh-water consumption	1,798	1,798	2,527	2,527	4,332	4,332
Agriculture	150	150	180	180	213	213
Steam electric	324	324	656	656	1,692	1,692
Manufacturing	817	817	1,095	1,095	1,757	1,757
Domestic	349	349	389	389	424	424
Commercial	62	62	67	67	74	74
Minerals	91	91	132	132	160	160
Public lands	5	5	8	8	12	12
Fish hatcheries	0	0	0	0	0	0
Other	0	0	0	0	0	0
Ground-water withdrawals	1,843	1,843	NE	NE	NE	NE
Evaporation	0	0	0	0	0	0
Instream approximation						
Fish and wildlife	160,520	160,520	160,520	160,520	160,520	160,520

NE - Not estimated.

[a] The Ohio River Basin Commission accepted the National Future as the State-Regional Future for use in the national assessment because of the lack of regional data on a subregion basis.

Problems

Even though the overall water supply and use situation is excellent in the Ohio Region, many water-related problems need attention. These problems affect the lives of the people in the region environmentally as well as economically.

Water Quality

At this time surface-water quality is a major problem throughout the region. The major causes of poor water quality are acid mine drainage, domestic sewage, industrial pollution, and erosion and sedimentation.

Acid Mine Drainage

Of the water quality problems in the region, acid mine drainage is the most significant. The States in the region have programs to prevent present and future coal mining operations from creating additional problems, but a major problem still exists from past development of the coal resources. The cost to reclaim the total land area used for strip mining has been estimated at approximately $2.6 billion, and it would cost another $350 to $450 million to prevent recurring acid drainage from abandoned deep mines.

Acid mine drainage affects five major functions in the region: industrial water uses, municipal water uses, navigation, recreation, and instream flow to serve other purposes. Industries such as primary metal and chemicals that use water with acid mine drainage pollution must provide additional treatment of that water and/or increase maintenance of plant equipment. The costs to produce their products is correspondingly increased.

Municipalities have to soften or neutralize the water in many areas to make it drinkable. In some cases alternative sources for water supply had to be developed. The life span of transportation equipment on some navigable waterways (barges, towboats, locks, dams) is reduced by mine drainage pollution. Recreation is affected by acidity which prevents human contact and causes fish and aquatic life kills. Acid mine drainage also adversely affects point-source pollution control programs.

Domestic Sewage

Localized domestic sewage problems throughout the region affect the streams and the fish and wildlife. Louisville, Cincinnati, and Columbus have such problems, mostly during low-flow conditions. In these areas, coliform, ammonia, and nitrate levels in and below the stream reach can in many cases be attributed to municipal discharge.

A high biochemical oxygen demand (BOD) reduces the oxygen in the water, which seriously affects fish and other aquatic life. The domestic sewage problems in these localized areas are expected to be corrected by projects

made possible through Public Law 92-500.

Industrial Pollution

Industrial discharges high in BOD, heavy metals, organic and chemical contaminants, process water discharges, and other toxic substances occur in the industrial areas. With the projected reuse of water, much less process water is expected to be discharged into streams by the year 2000; and compliance with Public Law 92-500 should resolve the other industrial water pollution problems.

Erosion and Sedimentation

With increased demand for coal, growing urban centers, and the present extent of agriculture, erosion and sedimentation will be a continuing problem throughout the region. Other significnat contributions to erosion or sedimentation include streambank erosion and suspended solids discharged by industry. Sedimentation makes dredging necessary to maintain the region's navigable waterways at the authorized depth.

A situation from which problems might arise is the increased consumptive use of water by a growing number of electric generating facilities in the region beyond the year 2000. The reduced 7-day/10-year low flow anticipated by the year 2000 due to the increased consumption will not have a significant impact on water quality or fish and wildlife on the Ohio River mainstem. Other streams have not yet had the impact determined.

Flooding

Flooding affects cities and rural areas throughout the region. The region as a whole experiences average annual flood damages of $186 million. The Wabash River subbasin suffers the most damages with $49 million annually. Continuing programs of flood control, land treatment, flood-plain information studies, and flood-forecast points are being carried out to reduce the annual flood loss.

Water Quantity

Except for a few localized areas, there appears to be an abundance of water resources (ground and surface) available to meet the many demands in the region. The existing problems are usually related to the local distribution system, except for a few rural areas where quantity problems exist. During low-flow conditions, some stream reaches do not have sufficient flow to maintain an optimum fish and wildlife habitat. In some of these areas where reservoirs are available, low-flow augmentation is used to help correct the problem. The growth of the region will require additional electric generating facilities, which will consume more water and thus create the possibility of quantity problems on some tributaries.

Navigation

More than half of the Ohio Region intercity freight moves on inland waterways. The continued economic development of the region depends to a significant degree upon water transportation and the elimination of bottlenecks in the navigation system. Of immediate concern is the improvement of inadequate facilities at the Gallipolis Locks and Dam.

Water Surface Recreation

Water surface available for recreation is considered to be in short supply for most of the region, with major deficits occurring in and around the large metropolitan areas. Many of the backwater surface areas along the Ohio River lack public access because of the lack of Federal authority for land acquisition and the inability of local interests to share the cost.

River Management

Pervading all individual problems in problem areas along the Ohio River corridor are institutional and physical management difficulties. The various interests impacting on the rivers have different objectives and desires and affect the rivers in different ways. Navigation requires dredging and locks and dams. Recreation requires access, quality environment, and health and safety measures. Fishermen require access, high quality habitat, fish, and the time and quiet to pursue them. Travelers and inhabitants deserve an opportunity to view the river and to have attractive riverscapes to enjoy. Industries require land and water for transportation, processing, and cooling. Cities need the water for domestic and commercial use, fire-fighting, park maintenance, and street cleaning. Many of these uses impact on the streams, the water quality, and the environment. Compromises and controls must be developed.

A major step toward the management of this important river system was taken with the establishment of the Ohio River Basin Commission in 1971. This commission is made up of Federal and State representatives with a chairman appointed by the President. The commission, working with the Federal and State agencies, local governments, and the public, is involved in and has instituted study programs, including a Comprehensive Coordinated Joint Plan to develop a management plan for the optimum use of the water and related land resources in the Ohio River Basin. The commission is studying the Ohio River main stem from Pittsburgh to Cairo, Illinois, a distance of 981 miles.

There are many obstacles to the preparation of a management strategy suitable to all interests. Although the commission has the responsibility to plan and coordinate, it must rely upon individual agencies and units of government to implement plans and programs. Many of these agencies and units of government operate under narrow authorities and have limited funds. Only extensive collaboration among many individuals and interests can bring about the wise management of the river system.

Individual Problem Areas

The Ohio River Basin Commission has identified specific areas with urgent problems concerning water and related land resources. The problems have been described and evaluated for each area. These problem areas require immediate attention:

Subregion	Drainage or Geographical Areas
501	Allegheny River Basin
502	Mahoning River Basin
502	Upper Ohio River Main Stem Basin
501	Monongahela River Basin
503	Muskingum River Basin
504	New River Basin
504	Kanawha River Main Stem
502	Big Sandy-Guyandotte River Basins
502	Middle Ohio River Main Stem
503	Scioto River Basin
503	Great Miami River Basin
505	Licking River Basin
505	Kentucky River Basin
506	Wabash River Basin
505	Lower Ohio River Main Stem
505	Tradewater River Basin
505	Green River Basin
507	Cumberland River Basin
Regionwide	Mine Drainage - Ohio River Basin
Regionwide	Non-Point Source Pollution
Regionwide	Energy

Figure 5-8a shows the location of these areas. Table 5-8b illustrates types of problems found in each problem area. Summary sheets describing each area, its problems, and their effects follow the map.

Problem Area : Allegheny River Basin

Description

The Allegheny River Basin is a rugged and heavily forested area in New York and Pennsylvania, which has a drainage area of 11,747 square miles.

Most of the manufacturing is in the Pittsburgh Metropolitan Area and includes steel mills, metal fabricating plants, and manufacturers of machinery and motor vehicles. In the upland area, oil, gas, and coal are being extracted. Agricultural production also contributes to the basin's economy.

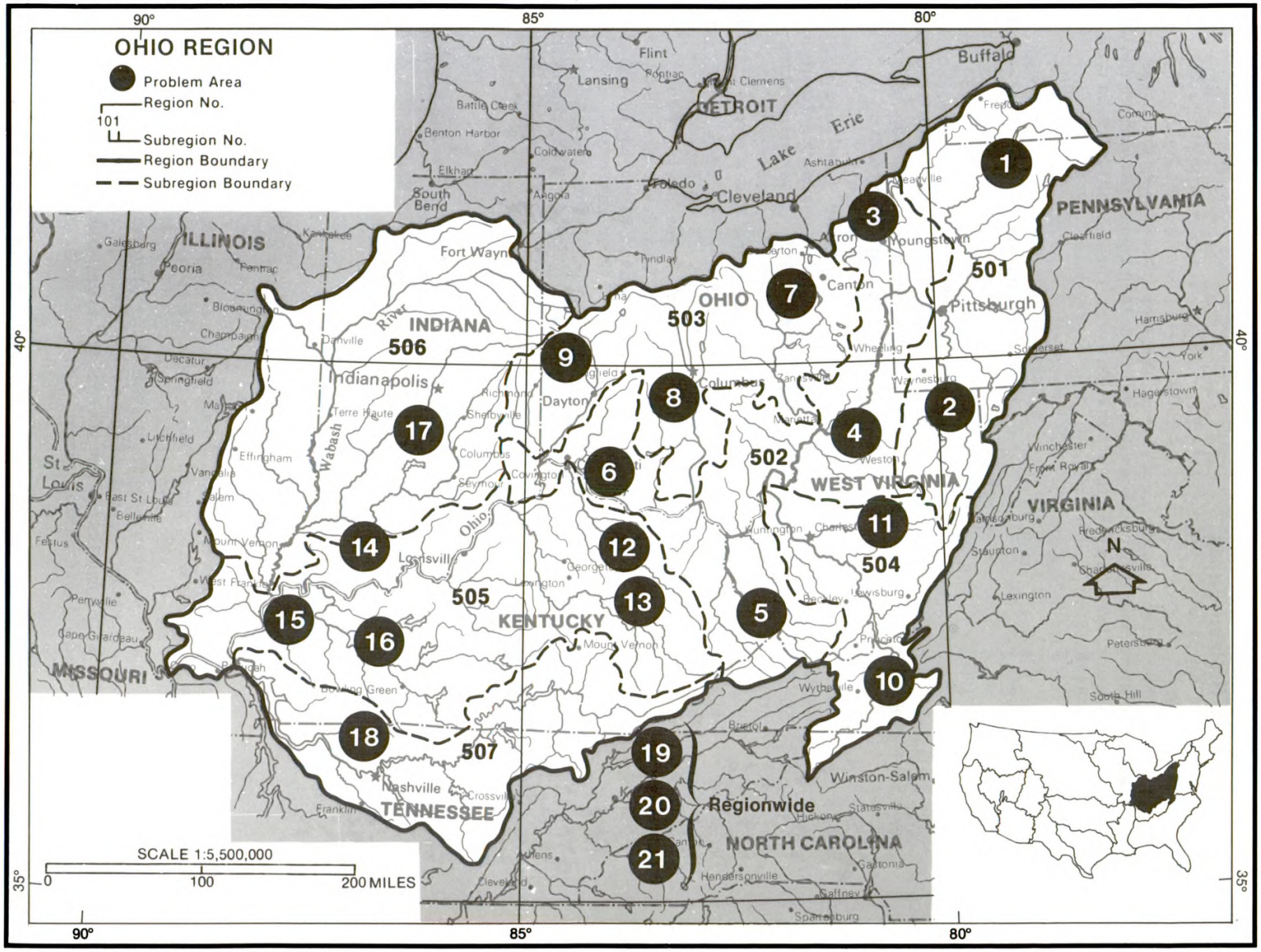


Figure 5-8a. Problem Map

OHIO REGION (5)

PROBLEM MATRIX

Problem area		Problem issues O= Identified by Federal Agency Representatives X= Identified by State-Regional Representative													
		Water quantity				Water quality				Related lands					
No. on map	Name	Fresh surface	Ground	Marine and estuarine	Surface/depth	Fresh surface	Ground	Marine and estuarine	Surface/depth	Flooding	Drainage	Erosion and sedimentation	Dredge and fill	Water related use conflicts	Other
Subregion 501	Ohio Headwaters					O						O			O
Area 1	Allegheny River Basin	X				X				X				X	
2	Monongahela River Basin	X			X	X				X				X	
Subregion 502	Upper Ohio-Big Sandy					O				O		O			O
Area 3	Mahoning River Basin	X				X				X	X				
4	Upper Ohio River Main Stem					X	X			X		X			
5	Big Sandy-Guyandotte River Basins					X						X			
6	Middle Ohio River Main Stem		X			X				X		X			
Subregion 503	Muskingum-Scioto-Maimi					O				O		O			O
Area 7	Muskingum River Basin	X			X	X	X			X	X				
8	Scioto River Basin	X	X		X	X									
9	Great Miami River Basin				X	X	X			X	X				
Subregion 504	Kanawha					O				O		O			O
Area 10	New River Basin	X				X				X	X	X			
11	Kanawha River Main Stem	X				X				X	X	X		X	
Subregion 505	Kentucky-Licking-Green-Ohio					O				O		O			O
Area 12	Licking River Basin	X			X	X				X					
13	Kentucky River Basin	X	X		X	X				X			X		
14	Lower Ohio River Main Stem	X			X	X				X	X	X			
15	Tradewater River Basin	X				X					X			X	
16	Green River Basin	X				X	X			X	X	X			
Subregion 506	Wabash					O						O			O
Area 17	Wabash River Basin	X			X	X				X	X	X		X	
Subregion 507	Cumberland					O						O			O
Area 18	Cumberland River Basin	X	X			X	X			X					
19	Ohio River Basin: Regionwide Mine Drainage	X				X	X					X			
20	Ohio Region: Non-Point Source Pollution	X			X	X						X			
21	Ohio Region: Energy														

Figure 5-8b. Problem Matrix

Water Issues

Domestic sewage, industrial wastes, and acid mine drainage affect the basin's surface-water quality. The Ohio River Basin Commission has recommended construction of 144 new pollution treatment plants and 61 modifications to existing plants to alleviate this problem. In most locations in the Allegheny Basin, water shortages occur only during low-flow periods. Recently, the Pennsylvania Department of Environmental Resources adopted the 7-day/10-year low flow as the minimum amount necessary for stream management to preserve aquatic life. Consumptive water users requesting new or increased withdrawals will be required to provide make-up water from storage when this low flow is reached. The ongoing Level B study in the New York State portion of the Allegheny Basin is investigating major problems and their solutions relating to flood damages, water quality, Lake Chantauqua, and other significant matters.

Related Land Issues

The Allegheny River Basin has about $25 million in annual flood damages, with 90 percent of the damages in urban areas and almost 76 percent occurring in the lower portions of the basin. Four million acres of abandoned strip mines require treatment to reduce erosion and sediment loads affecting fish and wildlife and carrying capacity. With its abundance of natural areas and streams and an increased potential for mineral extraction, the basin needs management practices that will bring these competing land uses into balance.

Problem Area : Mahoning River Basin

Description

The Mahoning River Basin, located in the northeast corner of Ohio, has a drainage area of 1,133 square miles and includes portions of Ashtabula, Columbiana, Lawrence, Mahoning, Portage, Stark, and Trumbull Counties. Its major tributaries are West Branch, Eagle Creek, Mosquito Creek, Meander Creek, and Mill Creek. The basin is characterized by gently rolling terrain, although there are some steep slopes in Mahoning and Trumbull Counties, primarily along the main stem. About 40 percent of the land area is cropland and pasture; 25 percent is forested. The heaviest urbanized area is in Mahoning County where more than 40 percent of the land is devoted to urban uses.

Water Issues

Industrial waste discharges, municipal sewage, mine drainage, and nonpoint sources are the primary cause of the basin's serious water quality problems. Mahoning County has the most serious acid mine drainage problems, and the lower 27 miles of the Mahoning River have severe industrial pollution. Ground-water supplies appear to be adequate to meet current and projected demands in the basin. There are some water supply problems,

but these are primarily limited to facility or distribution problems. There is a significant need for water- and land-based recreation in the Mahoning River Basin; the heaviest demand is in Mahoning and Trumbull Counties.

Related Land Issues

Flood damage abatement projects have reduced natural annual flood damages from $21,800,000 (1975 dollars) to $2,178,000, a reduction of about 90 percent, although localized flood problems still exist.

Problem Area : Upper Ohio Main Stem Basin

Description

The Upper Ohio Main Stem Basin is located in Ohio, Pennsylvania, and West Virginia and has a drainage area of 12,180 square miles (excluding the Mahoning River). The topography is primarily hilly to rugged. Nearly 50 percent of the basin is forested. The heaviest forested area is located in the south and southwestern portions of the basin. About 20 percent of the area is cropland, about 15 percent is pasture, and 10 percent is urban.

Water Issues

The water quality problems are attributed to industrial wastes, domestic sewage, mine drainage, and nonpoint sources. The Ohio River Basin Commission has recommended construction of 14 new waste treatment systems and 154 modifications to existing systems. No serious municipal or industrial water supply source problems have been identified to date in the Upper Ohio River Main Stem Basin, although the water demand for electric production or gasification or liquefaction of coal have not been assessed.

Related Land Issues

Existing and underway projects have reduced annual flood damages to $28,053,900, of which $15,330,000 worth of damage occurs along the Upper Ohio River Main Stem and the remaining occurs in its tributaries. An additional 70,000 acres of water will be required by the year 2020 to meet projected fish and boating demands. Additional camping facilities are needed now and in the future.

Problem Area : Monongahela River Basin

Description

The Monongahela River, located in the Appalachian Plateau, has a drainage area of 7,384 square miles. The terrain is rugged, and valleys are

deep and narrow. Most of the agriculture, manufacturing, mining, and urban and industrial centers are located in the western half of the basin. Forested lands are more concentrated in the eastern half. Much coal mining has occurred in the basin, and coal extraction continues to be important. Industries are concentrated along the main stem of the Monongahela River, with most of the steel industry located in the lower reach.

Water Issues

Pollution from domestic sewage, industrial wastes, and acid mine drainage has a serious effect on the use of the basin's streams for recreation and fish and wildlife. The U.S. Environmental Protection Agency's inventory of National Pollution Discharge Elimination System shows 48 major point sources of industrial pollution in the basin. Of the water quality problems, acid mine drainage is the most serious. A recommendation has been made to undertake corrective works at an estimated cost of $34 million for 154 sites which discharge 75 percent of the acidity from abandoned mines. The Ohio River Basin Commission's Comprehensive Coordinated Joint Plan recommends construction of 120 new municipal treatment systems and 43 modifications to existing systems.

Pittsburgh, McKeesport, Monongahela, and Somerset, Pennsylvania, have projected water supply source problems that need to be corrected. Rehabilitation of the existing navigation system will be necessary to handle projected river traffic increases. A recommendation has been made for eventual replacement of locks and dams 2, 3, 4, 7, and 8 when required. Immediate rehabilitation of existing locks and dams 3 and 4 has been suggested because of their deterioration. Large deficits of surface acres for boating, swimming, fishing, and related activities are projected. The Pittsburgh area has the greatest need for surface water for these activities.

Related Land Issues

Current average annual flood damage in the Monongahela River Basin is approximately $9.1 million in Maryland and Pennsylvania. Approximately 90 percent of the damage is in urban areas.

Problem Area : Muskingum River Basin

Description

The Muskingum River Basin, located in eastern Ohio, has a drainage area of 8,050 square miles. The basin includes almost 20 percent of the land area of the State and covers all or part of 27 counties. The eastern and southern portions of the Muskingum Basin are largely rolling and rugged terrain. Much of the land is forested. The remainder is relatively flat, except land adjacent to the Muskingum River and its tributary valleys.

Approximately one-half of the land in the basin is used for agriculture, mainly cropland and pasture. About one-sixth is used for urban development and other purposes.

Water Issues

Domestic sewage, industrial wastes (chlorides), mine drainage, and nonpoint sources contribute to the basin's water quality problems. The Ohio River Basin Commission's Comprehensive Coordinated Joint Plan recommends nine modifications to municipal waste treatment facilities and construction of 46 new plants. The northeast Ohio four-county area (Stark, Summit, Wayne, and Portage Counties), Cleveland, and the Muskingum River Basin are funded for 208 water quality planning studies.

There are no serious water supply problems reported or projected in the Muskingum River Basin. In certain areas of the southwest portion of the basin, the ground-water yield is low, and other sources are required to meet the needs.

Problem Area : New River Basin

Description

The Kanawha River and its tributaries form the largest northwardly flowing drainage system located entirely in the United States. The basin drains 12,300 square miles extending generally south to north from the Blue Ridge Parkway at Blowing Rock, North Carolina, to the Ohio River at Point Pleasant, West Virginia, and east to west from the West Virginia highlands in the heart of the Monongehela National Forest to the coal fields of Logan County, West Virginia. About 8,450 square miles are in West Virginia, 3,080 in Virginia, and 700 in North Carolina.

The New River Basin makes up 54 percent of the Kanawha River Basin. The New River is formed by the junction of the north and south branch of the New River in northern Tennessee. It flows in a northeastern direction through Virginia, then in a northwestern direction through West Virginia to the Kanawha River.

Water Issues

Of 43 industrial point sources, 18 in Virginia are not in compliance with Federal water quality standards. Twelve modifications to municipal treatment facilities and two new plants are recommended. Surface- and ground-water supplies have good potential for development in the basin. The Kanawha River Basin Comprehensive Study has identified 11 communities that will have water supply problems by 1980. The Virginia portion of the basin requires additional boating and fishing areas; the North Carolina portion has a surplus. With the basin's excellent potential for outdoor recreation, these needs should be met.

Related Land Issues

Flood damages to agriculture and forest areas are small. The majority of the damages occur in residential and commercial areas. The total annual residual flood damages are $14 million in the Kanawha and New River basins, according to a report by the Ohio River Basin Commission in July 1977. Completed projects are directly responsible for preventing $22 million additional flood damages annually.

The most impressive single topographic feature of the Kanawha Basin is the New River Gorge. This segment of the New River follows a narrow, deeply-trenched, irregular and tortuous course, interrupted by small falls and rapids, from the vicinity of Hinton to the vicinity of Montgomery, a distance of about 70 miles. Current developments on the New River involve the Blue Ridge Project and recent congressional action to designate the New River as a national wild and scenic river. In January 1975, the Appalachian Power Company received a license from the FPC for a pumped storage project (Blue Ridge) on the New River. This project was planned to have a total installed capacity of 1,800 MW and involved two dams that would have inundated 14,200 acres in North Carolina and 27,900 acres in Virginia. The United States Congress, on September 9, 1976, included a 26.5-mile section of the New River and the South Fork of the New River in the National Wild and Scenic Rivers System. This action eliminates the Blue Ridge Project because much of it was to be located at the scenic section of the New River. North Carolina has also designated the same 26.5-mile reach of the New and South Fork of the New as a scenic river area and has included it in the North Carolina Natural and Scenic Rivers System. As a result, the Blue Ridge Project has been deleted from the Ohio River Basin Commission's Plan.

Problem Area : Kanawha River Main Stem

(From Bluestone Reservoir to the Mouth)

Description

The Kanawha River and its tributaries form the largest northwardly flowing drainage system located entirely in the United States. The basin drains 12,300 square miles extending generally south to north from the Blue Ridge Parkway at Blowing Rock, North Carolina, to the Ohio River at Point Pleasant, West Virginia, and east to west from the West Virginia highlands in the heart of the Monongahela National Forest to the coal fields of Logan County, West Virginia. About 8,450 square miles are in West Virginia, 3,080 in Virginia, and 770 in North Carolina.

The Kanawha River is formed by the junction of the New and Gauley Rivers in southern West Virginia. It flows 97 miles in a northwestern direction and enters the Ohio River at Point Pleasant, West Virginia, 266 miles downstream from Pittsburgh, Pennsylvania.

Water Issues

Domestic sewage, industrial wastes, coal mining drainage, oil production wastes, erosion, sedimentation, possible pesticides, and other agricultural chemicals contribute to the water quality problems in the Kanawha River. According to the ORSANCO compliance status inventory, there are 129 industrial plants in West Virginia. Twenty-five of the total fail to meet Federal or State regulations; 10 have not made satisfactory progress. Further, there are 78 municipal point sources of pollution, of which 39 are not in compliance and 1.5 have not made satisfactory progress, according to the ORSANCO compliance status inventory dated June 30, 1975.

Even though surface water accounts for 80 percent of the water used in the basin, ground water has a great potential for development. Although water supply is generally abundant, there are local deficiencies often caused by poor quality.

The basin has excellent potential for outdoor water-based recreation. The West Virginia State Comprehensive Outdoor Recreation Plan shows a need for 6,420 additional boating acres, but no additional acreage is needed for fishing. The Kanawha River is improved for navigation 90.6 miles from the mouth with three locks and dams. Projections show a need for improvement of the navigation system.

Related Land Issues

Of the total annual flood damage ($4,565,000), residential properties have the most damage (54 percent), with transportation next. Agricultural damage is relatively small in comparison with all flood damages.

Problem Area : Big Sandy-Guyandotte River Basins

Description

Situated in the south-central portion of the Ohio River Basin, the Big Sandy and Guyandotte River Basins contain 5,929 square miles, approximately 4 percent of the Ohio Region. The basins are located in western Virginia and West Virginia and eastern Kentucky. The topography is rolling to rugged with many hills and valleys generally covered by forests and pastureland. The very narrow valleys are rather densely populated. The Big Sandy and Guyandotte Basins are divided into three major hydrologic areas: Big Sandy/Levisa Fork, Tug Fork, and the Guyandotte River.

Water Issues

The basins have adequate dry weather flows to supply the municipal demand. The only problems are of quality and/or distribution. Water quality problems result from a lack of municipal treatment in moderately densely

populated rural areas. The Ohio River Basin Commission's Comprehensive Coordinated Joint Plan recommends 36 modifications and new treatment facilities to alleviate these problems. Solid waste disposal, sedimentation, and siltation also cause water quality problems in the basins.

Related Land Issues

More fishing and boating acres are needed in the region, and lake projects now under construction will not meet the needs. Existing flood control systems of seven major reservoirs, one watershed project, and six local flood protection projects have reduced the annual flood damages in the basins to $6.9 million. The Big Sandy-Guyandotte River Basins had an installed electrical generating capacity of 1,097 MW in 1974. In the future the basins will depend upon an expansion of existing facilities and on facilities in adjoining areas.

Problem Area : Middle Ohio River Main Stem

Description

The Middle Ohio River Basin is located in portions of Indiana, Kentucky, Ohio, and West Virginia and has a drainage area of 9,050 square miles. This basin lies in three physiographic provinces: the Central Lowlands and the Interior Low Plateaus (eastern half) and the Appalachian Plateau (western half). The eastern portion is generally a broad plateau modified by irregular and morained hills and deposits of glacial drift and cut by valleys of glacial origin now occupied by the Ohio River, Little Miami River, and Mill Creek. To the west, the unglaciated Appalachian Plateau is characterized by rough, hilly terrain. Tributary valleys are generally narrow except for a few principal streams which flow through wide valleys of preglacial origin. Existing land use is 8.3 percent urban, 45.0 percent forest, 26.4 percent cropland, 15.8 percent pasture, and 4.4 percent other.

Water Issues

Urban runoff, sewage overflow, nonpoint sources, and acid mine drainage are the main quality problems. The Ohio River Basin Commission's Comprehensive Joint Plan has recommended construction of four new waste treatment systems and 59 modifications to existing systems. There are no major municipal or industrial water supply problems in the Middle Ohio River Main Stem.

Related Land Issues

Current annual flood damages in the Basin are $24 million. The draft Ohio Main Stem Level B Study recommendations for implementation reduce the annual damages to $17 million. Another 16 projects are recommended

for study which would further reduce flood damages.

The draft Ohio Main Stem Level B Study estimates that an additional 154,100 acres of water-related recreation acreage will be needed by 1990. With the consensus of the Ohio Main Stem Level B Recreation Work Group that few new reservoirs will be constructed in the near future, not all acreage demand will be met.

Problem Area : Scioto River Basin

Description

The Scioto River Basin, situated in the northcentral portion of the Ohio Basin, contains 6,510 square miles, or nearly 4 percent of the Ohio Basin. It is located entirely within the State of Ohio. The northern part of the subregion is a glacial plain that extends southward through rolling terrain; the extreme southern part of the subregion is rugged unglaciated plateau.

Water Issues

Because of low summer flows and a large population center located in Columbus, the largest water quality problem area is the reach near and below Columbus. Twelve of the 68 municipal treatment plants in the basin are to be modified in the next 5 years, and 37 new plants are to be built in that time.

Of the 87 municipal water supply systems in the Basin, 42 are not adequate to meet the needs of their communities; only 19 of these systems require additional supply sources.

There is an existing and projected deficit of surface water acres for boating in the basin, while a surplus of acres for fishing and land-based hunting and sports, camping, picknicking, and hiking exist and are projected for the future.

Related Land Issues

According to the Ohio River Basin Commission, the Scioto River Basin has an average annual flood damage of $4 million. The U.S. Department of Agriculture and the Corps of Engineers have proposed and recommended flood control projects to help reduce flood damage. There are three utility generating plants in the basin, two steam-electric and one gas turbine. In 1974, the two steam-electric units had an average withdrawal of 126.5 cfs and an average consumption of 4 cfs.

Problem Area : Great Miami River Basin

Description

Located in the north-central portion of the Ohio River Basin, the

Great Miami River and Little Miami River Basins contain 5,400 square miles and 1,760 square miles, respectively. Together they cover about 4.4 percent of the Ohio Region. The Great Miami Basin includes portions of southwestern Ohio and southeastern Indiana, while the Little Miami is entirely in southwestern Ohio. The topography in the upper and middle portions of the basins is level to gently rolling plains interrupted by broad valleys of the larger streams. In the southern reaches of the basins, the topography changes to rolling and hilly as the rivers approach the Ohio River.

Water Issues

Organic wasteloads from municipal treatment plants and paper mills, industrial pollution, and thermal pollution are the major water quality problems in the basin. By 1980, 49 individual and 11 consolidated regional plants are expected to be in operation.

The basin has ample ground-water supplies. The most common problem is water quality. In the northern part of the basin, where water is drawn from the river, taste and odor are a problem.

The demand for recreation in Indiana is expected to be met by Brookville Reservoir; the demand in Ohio is by residents traveling outside the basin, except for canoeing, since there is an excess supply in Ohio.

Related Land Issues

Completed and underway projects will reduce annual flood damages $10.7 million; however, annual flood damages are still estimated to be $5.4 million.

Problem Area : Licking River Basin

Description

The Licking River Basin is located in the south-central portion of the Ohio River Basin and contains 3,760 square miles. It lies entirely within the State of Kentucky and has a topography that varies from the rolling Bluegrass area in the south-central part to the rugged Appalachian Mountains in the southwest.

Water Issues

The water quality management plan for the Licking River Basin divides the basin into 40 segments. Eleven of these were classified as "effluent limited." The remainder were classified as "water quality limited." The management plan has placed two segments of the Licking River into a high priority class. They are Strodes Creek from Stone Creek to its

headwaters and Hinkston Creek. The Comprehensive Coordinated Joint Plan recommends construction of 24 new municipal waste treatment facilities and 12 modifications to existing facilities.

The low flow of the streams in the area creates some problems for municipal and industrial water supply. Ground water in the basin is generally high in hardness and iron concentrations and thus requires treatment for public water supplies.

Problem Area : Kentucky River Basin

Description

The Kentucky River Basin is located in the south-central portion of the Ohio River Basin and contains 6,790 square miles. It lies entirely within the State of Kentucky and has a topography that varies from the rolling Bluegrass area in the north to the rugged Appalachian Mountains in the southeast. The two major hydrologic divisions of the Kentucky River Basin are the upper Kentucky River and the lower Kentucky River.

Water Issues

Municipal, industrial, mining drainage, and indiscriminate disposal of solid waste are major contributors to Kentucky River pollution. There are 40 new waste treatment plants planned and 23 modifications to existing plants.

There are 46 completed and underway water supply projects in the Kentucky River Basin, most of which utilize surface water. Surface storage is necessary because of the low flow of the streams in the basin. Whitesburg has a supply problem because of lack of sufficient surface storage.

The Kentucky River Basin is provided with manmade lakes and other resources for water-oriented recreation.

Related Land Issues

In 1980, the projected annual flood damages for the basin will be $2,810,000. Hazard, Kentucky, has only a small degree of protection from Carr Fork Dam and experiences severe flooding.

There are six completed and two planned electric power projects in the basin. Two undesignated plants are planned.

Problem Area : Wabash River Basin

Description

The Wabash River Basin, located in Ohio, Indiana, and Illinois, has a

drainage area of 33,100 square miles. Except for the rugged, hilly section in the south, it is essentially a broad prairie plain. Cropland comprises 64 percent of the basin, and forests 15 percent.

Water Issues

Water quality problems arise from domestic sewage, industrial wastes, mine drainage, natural gas and oil production, and nonpoint sources. The Comprehensive Coordinated Joint Plant recommends 156 new plants and 193 modifications to waste treatment facilities.

Twenty-three communities in the Wabash Basin are projected to have water supply source problems by 1980. Another potential supply problem is that of electric power generation. The construction of coal conversion facilities in the basin would pose a serious consumptive use problem.

Illionis indicates that local recreation day use is a major need in the basin. The demand for recreation acres is projected to increase by 13,600 acres for land and 839,100 acres for water from 1968 to 2020.

Related Land Issues

Current average annual flood damage in the basin is approximately $39 million a year. Most of the damage occurs in the agricultural section.

The electric energy requirements of the basin are estimated to increase by 47.9 billion kWh annually by 1980. Studies are needed to ascertain the effects of increased energy productions.

Problem Area : Lower Ohio River Basin Stem

Description

The Lower Ohio River Main Stem has a drainage area of about 11,510 square miles, including portions of Illinois, Indiana, and Kentucky. The basin consists of generally rolling hills sloping down to the wetlands and flood plain of the Ohio River. In portions of the basin, particularly just below Louisville, the hills are quite steep and rugged. Cropland and pasture account for about 55 percent of the total area, while another 30 percent is forested.

Water Issues

Water quality problems arise from domestic sewage, industrial wastes, mine drainage, and nonpoint sources. In the area of municipal sewage treatment, the Comprehensive Coordinated Joint Plan recommends construction of seven new wastewater treatment systems and 27 modifications to existing systems.

The Lower Ohio Main Stem has abundant surface- and ground-water supplies except for Shepherdsville, and Hardinsburg, Kentucky. Sources for these cities are questionable in quantity for the present, but recommended alternatives would correct this problem. Marion in Crittendon County may have to run an unusually long line to obtain water from either the Cumberland or the Ohio Rivers. The current supply of surface water for water-based recreation is projected to just meet existing demand for 25 years.

Related Land Issues

Since it is located at the lower end of a major river system, the Lower Ohio River Main Stem experiences substantial flood losses each year. The current annual flood damage is $21 million.

Problem Area : Tradewater River Basin

Description

The Tradewater River Basin is located in western Kentucky and has a drainage area of 1,000 square miles, including portions of Caldwell, Christian, Crittenden, Hopkins, Union, and Webster Counties. The area is characterized by broad plains used for cropland to the north and forested hills to the south. About 50 percent of the total land acreage is used for crops or pasture, and another 40 percent is forested.

Water Issues

Water quality problems in the Tradewater River Basin result mainly from acid mine drainage, municipal sewage, and nonpoint sources. Acid mine drainage is most severe in Buffalo, Caney, and Clear Creeks. To correct the municipal sewage problem, six new municipal treatment facilities and one modification of an existing facility have been recommended.

The only potential water supply problem identified in the basin is at Madisonville, Kentucky. A solution has already been recommended. No need for water-oriented recreation facilities is expected. The need for related land development for recreation has not been assessed.

Related Land Issues

Average annual flood damage totals $1 million, 75 percent is damage to crops. No urban areas experience severe flood damage. The breeding of mosquitoes in a swampy area in the Clear Creek section and acid mine drainage upstream of this area create serious problems for humans and livestock.

Problem Area : Green River Basin

Description

The Green River Basin includes all or part of 22 counties in west-central

Kentucky and three counties in northern Tennessee. It has a drainage area of approximately 9,230 square miles. Its major subbasins are the Barren River, the Green River above the Barren River, the Rough River, and the Green River below the Barren River, excluding the Rough River. The topography varies from the rugged hills in the eastern part of the subregion, to the deep valleys and caverns in the central section, and the swamps and wide flood plain of the western or downstream section.

Water Issues

Water quality problems arise from municipal, industrial, agricultural, and mining wastes. For municipal treatment, the Comprehensive Coordinated Joint Plan recommends construction of seven new municipal facilities and modifications to 29 existing facilities in the next 5 years. The plan also recommends 15 sanitary sewer evaluation studies.

The quantity of water supplies in some areas is affected in relation to quality problems created by coal mining and oil well drilling. Columbia, Kentucky, has a potential municipal shortage, and there is a ground-water shortage at Sebree, Kentucky. The Ohio River Basin Commission recommends three USDA watershed projects for implementation and three for study. These would provide 36 water storage impoundments.

The Green River Basin has a surplus of water-based recreation through the year 1990. The greatest surplus is in sailing acres.

Related Land Issues

The average annual flood damage for the basin is approximately $10.6 million, 60 percent of which is to agricultural lands. Existing flood control structures realize $6.7 million average annual flood control benefits. Erosion and sedimentation create problems in the upper Green and tributaries of the lower Green and Rough Rivers.

Problem Area : Cumberland River Basin

Description

The Cumberland River originates in southeastern Kentucky, flows southwest through northern Tennessee and then proceeds northwest through western Kentucky, eventually meeting the Ohio River near Smithland, Kentucky. The drainage area contains 17,914 square miles in rolling to rugged terrain.

Water Issues

Domestic sewage, industrial wastes, mine drainage, thermal discharges from power plants, and nonpoint sources contribute to the water quality problems. The Comprehensive Coordinated Joint Plan recommends the con-

struction of 22 new wastewater treatment plants and modifications to 80 existing municipal facilities.

Five areas in Kentucky have been identified as having existing water supply problems; Tennessee has some potential water supply problem areas. Present navigation capabilities are projected to meet demands to the year 2020. Future recreation demands, as a result of population growth within the basin, are expected to increase, creating a deficit in recreation supply areas by 1980.

Related Land Issues

The average annual flood damage in the Cumberland River Basin is more than $12 million. Over half of the damage occurs in urban areas. Nashville has the most damage. The upper reaches of the Cumberland in Kentucky also suffer heavily.

There are 13 completed electric generating facilities in the basin, and an additional nuclear plant is being built.

Problem Area : Mine Drainage — Ohio River Basin

All States in the Ohio River Basin have programs to assure that present and future coal mining operations will not create additional problems. To assure the success of these programs, the acid mine drainage problems from past coal mine operations must be brought under control. The cost of surface reclamation for coal mining is high. The U.S. Bureau of Mining, Eastern Field Operations Center (Bitler and Evans), completed a study showing that reclamation would cost $8,168 per acre. Using this cost for the total acreage of surface mines in the Ohio River Basin, the total cost to reclaim this land would be near $8 billion.

Industrial Water Users

Of the industrial groups affected, primary metals would realize the greatest savings from pollution abatement, followed by the chemicals industry. The subbasin to receive the most benefit would be the Kanawha River Basin.

Municipal Water Users

Some municipalities have had to develop alternative sources of water supplies because mine drainage has affected the quality of ground and surface water. Clarion County, Pennsylvania, has a serious problem with mine drainage pollution of ground water, which therefore must be treated before the public can use it. The Clarion River is so polluted that it cannot be considered a viable alternative as a drinking water source.

Navigaton

It has been estimated that the useful life of towboats and barges is

reduced from 40 to 25 years because of mine drainage. Water quantity for navigation and domestic uses is reduced because of poor runoff conditions of the strip mining operations.

Recreation

In many areas the low pH prevents the existence of aquatic life and prevents recreation use of the water. Erosion and sedimentation from strip mine areas lower the expected life of lakes used for water-based recreation.

Problem Area : Nonpoint Source Pollution

There are four basic sources of nonpoint source pollution in the Ohio Basin: runoff farmland and forestland; runoff from abandoned and active mines; runoff from the urban areas; and streambank erosion. The United States Army's National Strip Mine Study, 1976, indicates that 9,900 miles of streams in the Ohio Basin are affected by mine drainage. According to the National Assessment of Streambank Erosion, 1969, a total of 25,900 bank miles have erosion problems in the basin.

The extent to which agricultural and streambank erosion create water quality problems has not yet been determined for the tributaries, but it has been determined not to be a problem on the Ohio River. The acid water from coal mines reduces the effectiveness of the point source water quality control program and increases the cost for water supply, locks and dams, and industrial facilities along the streams.

Problem Area : Energy

Electric energy generation in the Ohio River Basin is anticipated to increase from about 304,000 gWh in 1975 to 1,056,700 gWh in 2000. The number of facilities for steam electric generation is expected to go from 103 existing plants to 123 by the year 2000. Consumptive use of water by the steam-electric plants will increase from 324 mgd in 1975 to 1,692 mgd in 2000. Additional consumptive use with coal gasification and liquefaction is anticipated through the year 2000. There is adequate water in the streams of the Ohio Region to support this level of consumptive use. It has been determined that the reduced 7-day/10-year low flow anticipated in the year 2000 because of electric generation and municipal and industrial uses will not have a significant impact on water quality or fish and wildlife along the Ohio River.

The Ohio Region is not anticipated to export any significant amounts of electrical energy through the year 2000; rather, it will continue to support its own needs.

Summary

The Ohio Region's quality and diversity of land and water resources allows for the expansion of the economy area as well as the improvement of environmental quality. Water quality, erosion, sedimentation, flooding, land use conflicts, instream flow inadequacies in some areas, and local supply problems in the region require improved management practices and possible structural solutions.

The region has a varied topography from flat agricultural lands to rugged mountain areas. Its temperate climate with ample rainfall allows for an adequate growing season from April and May to September and October. Natural resources include farmland, forestland, geologic formations, petroleum, natural gas, water, coal, other minerals, and fish and wildlife.

The population is mostly concentrated in urban areas. Only 10 percent of the people live on farms. The economy is growing, with total earnings expected to more than double from 1975 to the year 2000. The population of the region is expected to grow, but at a lower rate than the rest of the country.

Many rivers and streams course through the region, most of which are tributaries of the Ohio River. The Ohio acts as a navigation route, a source of water for municipalities and industries, and as a recreation facility. Ground water is a valuable resource in the region, but in many areas it has not been developed to its potential for water supply. Rivers, lakes, natural areas, historic areas, and other recreation facilities supply the people of the region with excellent opportunities for outdoor recreation, but in many areas a deficit is projected for the future.

Surface and ground water withdrawn in the region have many uses, the largest being for steam electric generation, followed by manufacturing. In 1975, approximately 5.1 percent of the water withdrawn was consumed. It is projected that, by the year 2000, the consumption of water withdrawn will be almost 26 percent. Withdrawals are projected to decrease by almost 52 percent by the year 2000 because industries and cities will reuse water withdrawn from rivers and streams as a result of restrictions on discharge waters. Overall, the region has an excellent potential water supply that should enable its residents to overcome any supply problems.

In most places, the water quality problems throughout the region are industrial wastes, domestic sewage, acid mine drainage, and agricultural runoff. The greatest problems occur in metropolitan areas and downstream of these areas, except for acid mine drainage and agricultural runoff. Implementation of the recommendations contained in the Ohio River Basin Commission's Comprehensive Coordinated Joint Plan would alleviate many of the problems throughout the region.

Flood damage is a major problem throughout the region with most of the damages centered in urban areas. Floods cause much damage to industrial and residential property, farmland, and transportation facilities located in flood plains.

Conclusions and Recommendations

The conclusions and recommendations listed below are consistent with the Comprehensive Coordinated Joint Plan for the Ohio Region as it now exists and with the regional assessment based on that plan.

Federal Role

The region's most severe water resources problem is pollution of streams and lakes by highly acid drainage waters from abandoned mines and heavy sediment loads from active or recently mined areas. The entire Nation benefited from the ready availability of low-cost energy provided by the coal resources of the Ohio Region in the past, particularly during the two world wars. The waters of the Monongahela River are already so polluted, primarily from dissolved solids, that further development in the Monongahela Valley is seriously impaired. This has had severe adverse impacts on employment and family income in an area which has been depresed because of other reasons for many years. The Ohio River Basin Commission recommended a program to abate pollution from abandoned mines. State members of the commission worked closely with Congress in developing the legislation to meet this need. Ultimately, Congress passed the Surface Mining Control and Reclamation Act of 1977. This act did much to strengthen the requirements for pollution abatement from active mines which discharge directly into surface waters. Assuming successful implementation of the act, the significant remaining problem to be addressed by the commission is ground-water pollution from mines.

Pollution of the region's streams by nonpoint sources, including sedimentation from farmland and mines, is and will continue to be a severe problem. Although these problems are presently being addressed by existing Federal and State programs, the problem is so pervasive and so technically complex and presents such potential interstate legal and institutional problems that it should be addressed on a regional basis with strong Federal input.

While overall water supply sources are adequate, numerous communities are experiencing water shortages. In most cases, however, the solutions to these localized problems are best left to the State and local governments.

The serious navigation bottleneck at Gallipolis requires urgent relief through prompt construction of authorized locks and dams at that location. In spite of the many flood control works that have been constructed in the past four decades, it is estimated that over a quarter of a billion dollars in annual residual flood damages still occurs in the basin. All communities within the region are being encouraged to establish flood-plain-management programs and to take advantage of existing Federal flood insurance programs. There is a need for further Federal participation in better delineation of flood plains and specific local flood protection measures.

The State members of the Ohio River Basin Commission, a Federal/State entity, have reaffirmed that the commission's continued activities are

highly desirable. It is important that the Federal Government agencies continue to participate actively in the commission to insure its effectiveness. The Ohio River Basin Commission serves as the mechanism through which all water-related entities within the basin are able to work in partnership to achieve the coordination essential for carrying out the many interrelated activities of the Federal, State, and local agencies and other interest groups.

Planning

Since the commission has developed a regional plan, it should direct its major attention in the future toward special studies of critical importance to the region. Such studies on acid mine drainage, power plant siting, environmental corridors, and water-borne transportation will be made as needed to fill information gaps in the regional plan or to examine more detailed alternatives. During the development of a regional plan, the commission identified a serious lack of information on the need for natural areas, wild and scenic rivers, wildlife preserves, nongame management programs, and unique natural systems. Furthermore, it identified the lack of concrete proposals for programs to meet such needs. It is therefore recommended that a special environmental study be conducted to address the identification and preservation or enhancement of the region's environmental assets.

Data and Research

The following research and data needs have been identified: study of fresh water management and regulation in the Allegheny Basin; study of the effects of hydrogen sulfide on reproduction of fish in acid mine waters; development of a unified regional recreation data program (a cooperative program with the States, proposed by the Bureau of Outdoor Recreation, Department of the Interior); and a fishery resource inventory and classification program for the Pennsylvania portion of the Ohio Region.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1979—O-306-616

ACKNOWLEDGMENTS

The Second National Water Assessment program, including the technical data input and the final report, was the responsibility of the U.S. Water Resources Council's National Programs and Assessment Task Group. Participants in the Group included technical representatives from the Federal member agencies, Regional Sponsors, Regional Study Directors, numerous State agencies, Council staff, and others as listed on the facing cover.

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THE NATION'S WATER RESOURCES — 1975-2000

Volume 4: Ohio Region

Authorization

The United States Water Resources Council was established by the Water Resources Planning Act of 1965 (Public Law 89-80).
The purpose of the Council is to encourage the conservation, development, and utilization of water and related land resources on a comprehensive and coordinated basis by the Federal government, States, localities, and private enterprises with the cooperation of all affected Federal agencies, States, local government, individual corporations, business enterprises, and others concerned.