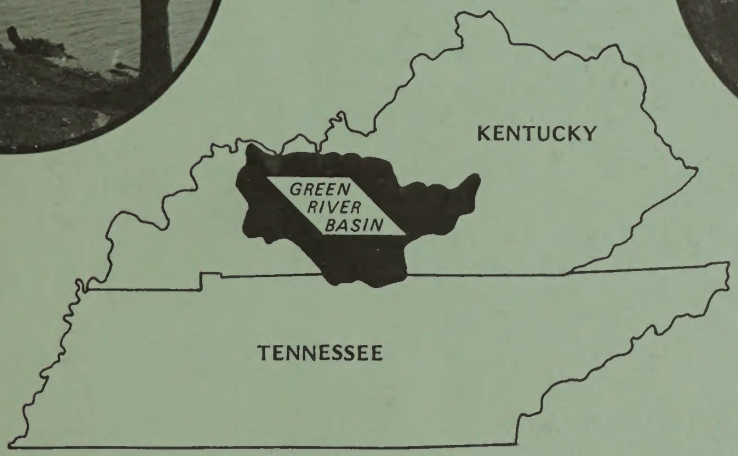
Report For
GREEN RIVER BASIN
KENTUCKY-TENNESSEE



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FOREST SERVICE
ECONOMIC RESEARCH SERVICE
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GREEN RIVER BASIN REPORT
ON
WATER, LAND AND RELATED RESOURCES

KENTUCKY AND TENNESSEE

Prepared by
USDA River Basin Planning Staff
Soil Conservation Service
Economic Research Service
Forest Service

In cooperation with
Commonwealth of Kentucky
Department for Natural Resources and Environmental Protection

Under direction of
USDA Field Advisory Committee
Lexington, Kentucky

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SUMMARY

This report presents the results of a comprehensive study of the water and related land resources in the Green River Basin in Kentucky and Tennessee. The study was requested by the Commonwealth of Kentucky to provide information for planning, developing, and utilizing the basin's water and related land resources. Authority for the Type IV river basin study is provided by Section 6 of the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended.

The study was conducted by the U.S. Department of Agriculture in cooperation with the Kentucky Department for Natural Resources and Environmental Protection. Since the study was initiated and substantially completed prior to implementation of the Water Resources Council's Principles and Standards, it partially complies with the requirements provided in these planning standards.

LOCATION AND DESCRIPTION

The 9,299-square mile basin encompasses all or portions of 31 west-central Kentucky counties and 3 in north-central Tennessee. The predominantly rural basin is composed of about 94 percent agricultural and forest land and 6 percent urban and water areas. It has a diversified economy, with manufacturing, agricultural, retail, and construction activities providing about 60 percent of the total employment. Population totaled about 670,000 in 1970 and is about equally divided between rural and urban.

OBJECTIVES, PROBLEMS, AND NEEDS

The study objective is to provide for orderly conservation, utilization, and management of the basin's water and land related resources. This objective contributes to the State's long-range goals of:

1. Promoting efficient planning, development, and use of natural resources;

2. Providing planning standards to minimize land use conflicts;

3. Encouraging the use of resources in accordance with their inherent capability; and

4. Expanding resource uses, particularly for recreational purposes.

Principal water and related land resource problems identified result largely from:

1. Erosion exceeding desirable limits on about 1,305,000 acres of agricultural land, 385,000 forest acres, and 43,700 acres of surface mined land. Other areas with erosion problems include 112,000 acres of gullies, 680 miles of streambanks, 1600 miles of roadbanks, and 9,800 acres affected by flood plain scour.

2. Sediment deposits which affect some 39,000 acres and contribute to swamping conditions on about 30,000 acres.

3. Flooding which causes over 3 million dollars of agricultural and nonagricultural damages annually.

4. Excess surface or subsurface water on 315,000 acres of agricultural land.

5. Pollution of water and land largely by excessive sediment, mine waste, untreated sewage, oil, and solid waste materials.

Most of the problems occur throughout the basin, except for those on surface-mined lands.

The resource problems generate need for planning and using wise conservation, development, and management measures. Major needs on the agricultural and forest lands are for conservation and management measures to reduce erosion, conserve productive base, and maintain and improve organic content and physical condition of the soil. Erosion reduction needs on gullies, streambanks, surface-mine, and other areas range from applying vegetative to structural measures or a combination. The need to reduce and prevent floodwater and sedimentation damages ranges from installing structural and vegetative measures to implementing zoning and flood plain management.

Based upon projections, water supply, recreation, food, and fiber needs will increase substantially by the years 2000 and 2020. The projected agricultural product needs can be met by utilizing the land resource base and by applying advanced technological and improved management methods. However, projections indicate that, even with improved management and additional plantings, the projected forest product needs will not be fully satisfied in the two time frames. The projected water supply and most of the recreational needs can be met by constructing facilities and transferring resources to these uses.

FINDINGS AND CONCLUSIONS

Significant potential exists in the basin for developing and utilizing water and related land resources to improve economic and environmental conditions. Some of the opportunities for decreasing the basic resource problems and improving the uses include:

1. Efficiently using the resource development programs and assistance provided by USDA and other federal and state agencies to plan and install water storage reservoirs, recreational developments, and other public facilities;

2. Applying needed conservation and management measures, using land according to its suitability, and utilizing technological and scientific developments to decrease agricultural land use problems and improve production;

3. Accelerating application of forest land treatment, tree planting, and other practices to increase timber production;

4. Making intensive use of existing programs and authorities and initiating new ones to reduce the quantity of sediment and related pollutants produced on surface mined, urban, and development lands; and

5. Providing guidelines and assistance in identifying and implementing ways to achieve more equitable allocation of resources among competing uses, minimize land use conflicts, and attain maximum resource use value.

The alternatives presented in this report to reduce water and related land resource problems and assist in meeting projected needs also contain provisions contributing to most of the above. These alternatives, the economic, environmental, and recommended, include a wide range of conservation, development, and management measures to promote resource development. While the summary table shows certain features and effects of the alternatives, the following discussion is limited to the recommended alternative.

The recommended alternative provides for applying conservation land treatment and management practices to reduce erosion and runoff on over one-half of the 1.3 million acres of cropland and pasture needing treatment. This would involve using the land according to its capabilities; shifting approximately 160,000 acres in the steeper land capability classes to permanent cover; and applying contouring, strip-cropping, and other land treatment measures. Minimum and no-till planting methods and the employment of improved management measures would also be used to decrease erosion. These measures would reduce erosion rates on agricultural lands from 7.6 tons per acre to 3.0 tons or less, resulting in a total reduction of about 3,000,000 tons annually.

Stabilization and reclamation measures proposed to reduce erosion, sedimentation, and related problems on 43,700 acres of previously surface-mined land and 127,850 acres projected to be mined by the year 2000 vary from shaping and leveling on most of the disturbed area to removing and stockpiling topsoil prior to extracting minerals. The overburden material and topsoil would then be returned to their approximate original position. Stabilization measures and methods of attaining them will vary, but, if properly implemented and maintained, the measures could reduce approximately 90 percent of the erosion, sediment, and related pollution problems occuring on surface-mined lands. Conservation and stabilization measures proposed to control erosion on gully, roadside, streambank, and nonagricultural lands vary from shaping, filling, and seeding severely eroded areas to vegetative plantings on lands with less severe problems. Potential effects of treatment measures on 1,280 miles of roadbanks and 540 miles of streambanks would decrease erosion from a high of 50 tons per acre to 5 tons or less, for about a 90-percent reduction. Similar reduction in erosion rates could be accomplished on gully and most of the urban lands.

Forestry management and treatment practices include planting trees on 253,510 acres of strip-mine, gully, and sheet erosion areas; 326,070 acres of spur roads and skid trails, and 122,400 acres of old fields and open areas, and providing management plans for 335,000 additional acres. These and other forestry measures would reduce gross erosion by 1,466,000 tons, sediment by 370,000 tons, and provide timber production to provide products to meet 81 percent of the projected needs for the year 2000.

Watershed projects identified for early action development include Upper Green River, Skaggs Creek, Trammel Fork, East Fork Deer Creek, and East Fork Indian Camp Creek. These five P.L. 566 watersheds provide for installing 16 single- or multiple-purpose structures, modifying 8 miles of channel, and accelerating the land treatment program to reduce about 45 percent of the average annual floodwater damages on 18,000 acres and four towns or communities. The additional water storage reservoirs proposed to be installed would reduce floodwater damages on an additional 34,000 acres.

This plan provides for local interests installing 35 multiple-purpose reservoirs for municipal, industrial, and recreational water storage. These reservoirs and 6 of the 11 multiple-purpose structures in the proposed P.L. 566 watershed projects would provide sufficient water to serve the equivalent of 690,000 people and meet the present and projected supply needs. Construction of 17,300 farm ponds would provide needed livestock water and could be used for fish and wildlife, recreation, flood prevention, and grade stabilization purposes.

The proposed 35 municipal, industrial, and recreational water storage reservoirs, the 11 multiple-purpose structures in the five P.L. 566 watershed projects, and the swimming pools expected to be installed would provide 2,475,000 additional water-based recreational visitor-days annually. These and the present supply of 6,800,000 will meet approximately 92 percent of the 10,100,000 total days projected to be needed by the year 2000. Also, these water storage reservoirs and stream management would provide about 812,000 annual fisherman-days. These and the present supply would meet 97 percent of estimated needs for the year 2000. Projected construction of

camping, picnicking, hiking, and related outdoor facilities adjacent to the multiple-purpose water storage reservoirs, coupled with the anticipated development of playgrounds, parks, and golf courses, would provide an additional 2,970,000 land-based recreational visitor-days. The 2,970,000 and the estimated present supply of 7,475,000 would meet 90 percent of the projected needs for the year 2000.

Projected agricultural production for the year 2000 would more than double that obtained in 1970. The increased production would require approximately 172,000 additional acres for soybeans, 118,000 for corn, and 28,000 acres small grain. The acreage needed for hay and pasture production would remain near the 1970 level. Specialty crops, including tobacco, fruit, and vegetables, would require a total of about 117,000 acres. The projected value of farm output under this alternative amounts to about $742 million, with cash farm income approaching $503 million. Estimated production costs amount to about $103 million and include labor, machinery. fertilizer, etc., but exclude land, taxes, and public costs. Annual employment would total about 13,000 including about 2,500 hired workers.

Projected timber production for the year 2000 would be from 1,928,200 acres, would amount to 66.8 million cubic feet, and would have a stumpage value approaching $14.8 million. During the installation period and through year 2000, the total estimated cost of forestry practices installed to increase timber growth and reduce erosion would approach $90 million.

Principal conclusions are that the basin has significant potential for applying conservation, development, and management measures to reduce the magnitude of the water, land, and related resource problems. The basin can satisfy its allocated share of the nations projected agricultural crop and livestock products for 2000 with the present level of production. The basin can also meet the projected municipal, industrial, agricultural, and recreational water supply needs by installing water storage reservoirs and farm ponds as identified in this report. Forestry products needs for the year 2000 cannot be met with the present acreage. Some of the programs and opportunities for meeting the needs and alleviating basic resource problems are shown in plate S-1.

Summary Comparison Between the Recommended Plan and Other Alternatives
Green River Basin

Accounts	Units	Economic Development[1]	Environmental Quality[1]	Recommended Plan[1]	Difference (Recommended Plan Minus Alternatives): Economic Development	Difference (Recommended Plan Minus Alternatives): Environmental Quality
1. Economic Development						
Beneficial Effects	Dollars	5,330,900	3,904,500	4,051,400	-1,279,500	146,900
Adverse Effects	Dollars	2,286,100	2,538,100	2,630,100	344,000	92,000
Net Beneficial Effects	Dollars	3,044,800	1,366,400	1,421,300	-1,623,500	54,900
II. Environmental Quality						
Beneficial & Adverse Effects						
A. Reduce erosion on:						
1. Agricultural land	Acres	500,000	1,000,000	500,000	0	-500,000
	(Tons)	(1.8 million)	(3.6 million)	(1.8 million)	0	(1.8 million)
2. Surface mine areas	Acres	171,550	171,550	171,550	0	0
	(Percent)	(45)	(70)	(70)	(-25)	(0)
3. Roadbanks	Miles	310	950	950	640	0
	(Percent)	(20)	(60)	(60)	(-40)	(0)
4. Streambanks	Miles	1.7 million	440	440	270	0
	(Percent)	(25)	(65)	(65)	(-40)	(0)
5. Forest land	Acres	0	162,000	112,000	112,000	-40,000
B. Provide additional (surface) water areas	Acres	5,000	7,250	6,200	1,200	-1,250
C. Improve stand and quality of timber and wildlife habitat	Acres	356,000	208,000	356,088	0	148,000
D. Affect wildlife habitat in reservoir areas	Acres	8,700	12,200	11,000	3,500	-1,200
E. Disturb environment by increasing recreational potential	V-days	1.5 million	2.8 million	2.8 million	1.3 million	0
III. Social Well-Being						
Beneficial and Adverse Effects						
A. Provide improved water supplies	No.people served	198,000	300,000	300,000	102,000	0
B. Reduce flooding	Acres	30,000	37,000	37,000	7,000	0
C. Provide recreational opportunities	No. V-days	1.5 million	2.8 million	2.8 million	1.3 million	0
D. Prevent future swamping and development of mosquito habitat	Acres	5,350	9,300	9,300	3,950	0
E. Provide additional employment opportunities	Man-years	380	164	381	1	217

1/ Compiled from study data. Beneficial and adverse effects are over and above those expected with the going program, which is without accelerated development.

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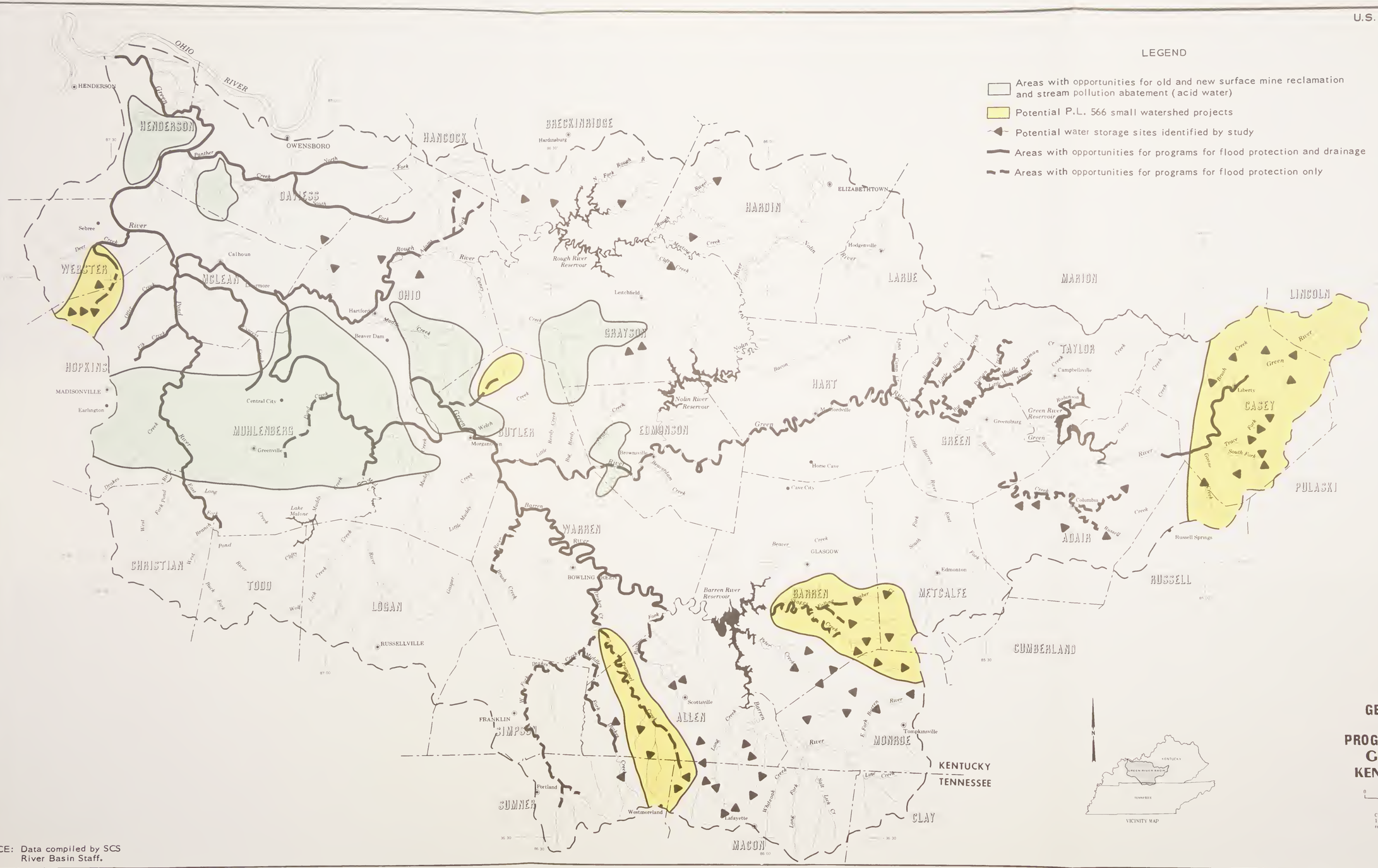


Plate S–1

GENERALIZED LOCATION OF PROGRAMS AND OPPORTUNITIES GREEN RIVER BASIN KENTUCKY AND TENNESSEE

APPROXIMATE SCALE - MILES

Compiled and reproduced at 1:250,000 (1 inch equals 4 miles) from 1:250,000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:700,500 (1 inch equals 11 miles).

SOURCE: Data compiled by SCS River Basin Staff.

USDA-SCS-FORT WORTH, TEX. 1975

AUGUST 1975 4–R–3510

REVISED MARCH 1975 4–R–3404 0

INTRODUCTION

This report presents the results of a comprehensive study of water, land, and related resource problems and needs in the Green River Basin of west-central Kentucky and north-central Tennessee. The Type IV river basin survey was sponsored by the Commonwealth of Kentucky.[1/] The study was made by the U.S. Department of Agriculture in cooperation with the Kentucky Department for Natural Resources and Environmental Protection.

The State expressed need for the study to assist decisionmakers in coordinating Federal and State agency programs; establishing project priorities; and appraising alternatives for alleviating basic resource problems, and meeting present and projected food and fiber needs. Special interest was expressed in inventorying the quantity and quality of resources available, assessing their productive potential, and identifying problems associated with resource development and use.

AUTHORITY

Authority for this study is section 6 of the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended. This act authorizes the Secretary of Agriculture to cooperate with other Federal, State, and local agencies in their investigations of watersheds, rivers, and other waterways to develop coordinated programs.

PARTICIPANTS

Principal USDA participants include the Soil Conservation Service, Economic Research Service, and Forest Service. Participation of these agencies was carried out in accordance with assigned responsibilities and coordinated through the Washington Advisory Committee and the Field Advisory Committee. The Field Advisory Committee, composed of a

1/ Hereinafter, the Commonwealth of Kentucky is referred to as "State."

chairman from the Soil Conservation Service and a member each from the Economic Research Service and Forest Service, provided guidance to the river basin planning staff. The Kentucky Department for Natural Resources and Environmental Protection coordinated and provided the major State inputs.

OBJECTIVES

The overall objective is to provide for orderly conservation, utilization, and management of water, land, and related resources, thereby improving environmental and economic conditions. This broad objective forms a framework for the State's long-range goals to (1) promote efficient planning, development, and use of natural resources; (2) provide planning standards to minimize land use conflicts; (3) encourage the use of resources in accordance with their inherent capability; and (4) expand resource uses, particularly for recreational purposes.

NATURE, SCOPE, AND INTENSITY

The study is designed to assess water, land, and related resource problems and needs; identify potentials for alleviating recognized problems; and appraise alternatives for meeting specified needs. To accomplish these, it was necessary that the investigations and analyses cover the total basin area in sufficient detail to:

1. Identify the physical and natural characteristics of the basin area; the quantity, quality, and availability of water and related land resources; the nature, distribution, and magnitude of major resource problems; and the needs resulting from identified problems.

2. Obtain data to reflect development and composition of the economy; identify the quantity and location of rural lands currently used for agricultural, forestry, recreational, and related activities; indicate future food, fiber, and recreational needs for selected target years; develop cost and response information for different farming systems; and depict conservation, management, and treatment needs and practices as related to land use, soil erosion, and sediment production.

3. Identify and evaluate alternative development potentials for alleviating resource problems and meeting projected agricultural, forestry, and recreational needs in light of the economic development and environmental quality objectives; and appraise the alternatives in terms of (a) quantity and quality of resources needed, (b) type, number, and relative cost of control measures or treatment practices, and (c) beneficial or adverse effects of each development alternative.

4. Prepare a report of study results.

This report will provide insights on resource availability, current uses, problems, and estimated quantity required to meet short- and long-range needs. It can be used by Federal, State, and local agencies to assist in planning for resource uses and identifying and locating potential water storage sites, recreational developments, and other improvements. The report should provide a useful reference for decisionmakers concerned with establishing land use policy plans, developing programs to minimize conflicts among competing resource uses, and setting priorities for allocating funds for resource development programs.

PROCEDURE, DATA, AND ACKNOWLEDGEMENTS

The planning team, composed of members from three USDA agencies, utilized an interdisciplinary approach in conducting the basin study. Each agency staff member had responsibility for specific technical phases within the study elements. This team, under the guidance of the Field Advisory Committee and in cooperation with State officials, organized the study into three major steps:

1. Conducting a reconnaissance of the area and contacting local and State people regarding problems and needs prior to finalizing the study plan and objectives;

2. Specifying and selecting study items, approaches, and analytical techniques; and

3. Performing investigations and analyses necessary to identify and appraise resource problems and needs, evaluate alternative development possibilities, and prepare the report.

The study recognizes the needs as expressed by local and State interests. To assure that these interests were adequately represented and the resource problems and needs were identified, the data were obtained by:

1. Contacting local and State officials having interests in the development and use of water and related land resources. This involved conducting meetings at the State level with different agency representatives to obtain information reflecting a cross section of interests and needs. At the local level, staff personnel and district conservationists held meetings, conducted interviews, and circulated questionnaires to ascertain problem and need information.

2. Developing and using data from (a) the Conservation Needs Inventory,[2/] supplemented with current data, to identify land use, production, and management problems and treatment needs; (b) soil surveys and USDA land capability classification[3/] to reflect use suitability, production potentials, management requirements, and limitations; (c) forest timber surveys for statistics on quantity, quality, and selected production and marketing information; and (d) economic related sources, including the U.S. Department of Commerce, Bureau of the Census, to identify selected economic and social characteristics of the basin.

3. Compiling and utilizing statistics from the Bureau of Economic Analysis, Economic Research Service, and related publications to indicate the future food, fiber, and recreational needs for the years of 2000 and 2020; estimate production and treatment practice costs; and project expected crop yields. Additional data were developed and obtained from other sources, including the U.S. Geological Survey, University of Kentucky, and Ohio River Basin (Type 1) Survey. These were used in identifying and assessing erosion, flooding, and sedimentation problems and evaluating alternative development possibilities. A field survey was made to provide data on hydrology, erosion, sedimentation, and wildlife habitat as related to forest land. Analytical techniques used to facilitate conducting the study included a linear programing model to evaluate the least costly resource development alternatives, a map information and display system to visually depict selected conditions, and a computerized program to assist in evaluating potential early action watershed projects.[4/]

2/ "Kentucky Soil and Water Conservation Needs Inventory"; Soil Conservation Service, U.S. Department of Agriculture, Lexington, Kentucky, 1970. "Tennessee Soil and Water Conservation Needs Inventory"; Soil Conservation Service, U.S. Department of Agriculture, Nashville, Tennessee, 1971.

3/ "Land Capability Classification"; Agriculture Handbook No. 210, Soil Conservation Service, U.S. Department of Agriculture, September 1966.

4/ This report contains only summary information; detailed material, mostly in the form of tables, appears in the appendix. Technical support material is available in state and regional offices of the cooperating agencies.

NATURAL RESOURCES

This chapter discusses the type and relative quantity of land, water, mineral, and associated natural resources in the basin and conditions influencing the distribution and use of the resources. The information is presented to facilitate understanding the nature and characteristics of the resource problems and needs discussed in subsequent chapters.

LOCATION AND DESCRIPTION

Green River Basin is located in west-central Kentucky and north-central Tennessee (plate II-1). It comprises a total drainage area of 9,229 square miles, with 8,821 in Kentucky and 408 in Tennessee.[1/] The basin is approximately 158 miles long, has an average width of about 58.5 miles, and encompasses all or portions of 31 Kentucky and three Tennessee counties (table II.1).

Green River, a tributary of the Ohio River, originates in Lincoln County about 50 miles south of Lexington, Kentucky. It flows in a southwesterly direction for about 30 miles to Dunnville in Casey County; thence westward for approximately 200 miles to its junction with Barren River at the Butler and Warren County boundary. The river then flows northwesterly for 150 miles to its confluence with the Ohio River.

1/ The term "basin," as used throughout the report, refers to the counties or portions within the hydrologic boundary.

Table II.1 - Area by State and County

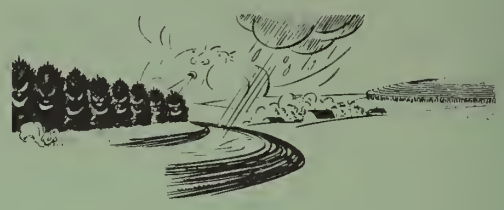
Green River Basin

State and County	County Area	Portion of County in Basin	
KENTUCKY			
Adair	251,520	226,400	90.0
Allen	232,960	232,960	100.0
Barren	311,040	311,040	100.0
Breckenridge	360,960	155,600	43.1
Butler	283,520	283,520	100.0
Casey	278,400	218,600	78.5
Christian	464,640	103,300	22.2
Daviess	295,680	242,400	81.9
Edmonson	194,560	194,560	100.0
Grayson	327,680	327,680	100.0
Green	180,480	180,480	100.0
Hancock	119,680	19,000	15.9
Hardin	394,240	255,800	64.9
Hart	272,000	272,000	100.0
Henderson	277,120	77,700	28.0
Hopkins	353,920	178,100	50.3
Larue	166,400	109,700	65.9
Lincoln	217,600	38,400	17.6
Logan	360,320	210,300	58.4
McLean	164,480	164,480	100.0
Metcalfe	189,440	165,100	87.2
Monroe	213,760	144,300	67.5
Muhlenberg	307,840	307,840	100.0
Ohio	381,440	381,440	100.0
Pulaski	418,560	600	0.1
Russell	152,320	42,800	28.1
Simpson	152,960	91,900	60.1
Taylor	181,760	181,760	100.0
Todd	240,640	88,100	36.6
Warren	349,440	349,440	100.0
Webster	216,960	90,200	41.6
Subtotal	8,312,320	5,645,500	67.9
TENNESSEE			
Clay	145,300	32,580	22.4
Macon	194,600	132,340	68.0
Sumner	341,800	96,140	28.1
Subtotal	681,700	261,060	38.3
TOTAL BASIN	8,994,020	5,906,560	65.7

Source: Soil and Water Conservation Needs Inventories, Kentucky 1970, Tennessee 1971; U.S. Department of Commerce 1969 Census of Agriculture; and U.S. Geological Survey. Areas are adjusted to include water.

During periods of normal flow, the Green River varies in width from a few feet in the upstream areas to an average of approximately one-third mile in the lower sections. The valley width, although irregular, ranges from less than one-half mile in the upper portion to over 3 miles in the western section.

Principal tributaries of the Green River are the Barren, Nolin, Pond, and Rough Rivers. Of these, Barren River, with about 1.2 million acres, has the largest drainage area. Pond River, with a drainage area about one-half that of the Barren, possesses the most flood plain area. Other tributaries with sizeable drainage areas are Panther and Russell Creeks and Mud River.



CLIMATE

The climate is temperate, with moderately cold winters and fairly warm summers. Each season is distinct, well defined, and marked with weather fronts associated with high or low pressure centers. Mean annual temperatures average 58° Fahrenheit with average monthly temperatures ranging from 35°F in January to 79°F in July. Although temperature extremes range from -25°F to 108°F, prolonged hot or cold periods are uncommon (table II.2).

Although varying, the growing season, which is defined as being between the last significant frost in the spring to the first one in the fall, averages 190 days. The last frost in the spring generally occurs around the middle of April, and the first frost in the the fall comes from the middle to the latter part of October.

Mean annual precipitation, as shown in plate II-2, ranges from 44 inches in the northwestern section of the basin to 52 inches in the southeastern portion. Precipitation is distributed fairly evenly throughout the year, with the largest amounts occurring in January and March and the smallest amounts in August, September, and October. Maximum annual precipitation of 68.6 inches was recorded at Campbellsville in 1967. Minimum annual rainfall recorded was 24.1 inches at Russellville in 1957.

Thunderstorms occur throughout the year, with the greatest number in the spring and summer months. About 50 storms of varying magnitude may be expected each year. Snowfall in the area is highly variable, with extremes ranging from less than 1 inch up to 50 inches annually. In normal years, about 8 to 12 inches may be expected. Wind velocities average about 5 to 10 miles an hour and are generally from a southerly or southwesterly direction. Higher velocities accompany storms, with tornadoes occasionally occurring in the basin.

U.S. DEPARTMENT OF AGRICULTURE

Plate II–1
HYDROLOGIC BASIN
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

SOURCE: Data compiled by SCS River Basin Planning Staff.

BASE MAP COMPILED FROM USGS NATIONAL BASE MAPS AND 1:500,000 STATE BASE MAP.

AUGUST 1975 4–R–35114

USDA-SCS-FORT WORTH, TEX 1975

MAY 1974 4-R-33970

PLATE II–2

MEAN ANNUAL PRECIPITATION
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

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APPROXIMATE SCALE

Compiled and reproduced at 1:250,000 (1 inch equals 4 miles) from 1:250,000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:889,630 (1 inch equals 14 miles).

SOURCE: U.S. Weather Bureau
Based on Period 1930-60.

USDA-SCS-FORT WORTH, TEX. 1975

AUGUST 1975 4–R–35125

REVISED MARCH 1975 4-R-34040

Table II.2 - Climatological Data from Selected Stations

Green River Basin

Station	Period of Record	Temperatures: Mean Monthly Jan.	Mean Monthly July	Mean Ann.	Record Extremes Low	Record Extremes High	Precipitation: Mean Monthly Min.	Mean Monthly Max.	Mean Annual	Record Extremes Min.	Record Extremes Max.
		-Degrees F-							-Inches-		
Bowling Green	1931-60	38.1	79.1	58.4	-20	108	0.04	27.70	48.29	35.60	63.73
Campbellsville	1945-68	36.4	76.2	56.9	-21	104	0.11	14.41	48.23	30.65	68.65
Glasgow	1954-68	34.6	76.4	56.7	-25	103	Trace	10.87	50.70	34.97	62.64
Greenville	1931-60	37.1	77.6	57.5	-18	107	0.30	19.22	47.21	33.73	66.63
Leitchfield	1931-60	37.0	77.7	57.4	-18	107	0.10	21.85	48.21	32.12	62.16
Madisonville	1931-60	37.7	79.0	58.4	-23	108	Trace	22.97	46.44	31.42	66.42
Owensboro	1931-60	35.8	78.4	57.2	-21	107	0.19	17.59	44.27	28.66	60.89
Russellville	1931-60	36.8	78.3	57.5	-18	107	0.12	18.57	48.03	24.10	67.53

Source: U.S. Department of Commerce, Climatography of the United States, Decennial Census - Kentucky Supplements.

PHYSIOGRAPHY AND GEOLOGY

PHYSIOGRAPHIC REGIONS

Four physiographic regions occur in the basin; namely, the Western Coal Fields, Pennyroyal, Knobs, and Alluvium (plate II-3). The Western Coal Fields Region, located in the western portion, comprises about one-third of the basin. This area is characterized as having gently rolling uplands with flood plains ranging up to 3 miles wide. The alluvial bottoms were formed during glacial periods when heavily silt-charged backwater, ponded water, and melting ice filled the valleys with glacial out-wash material. In some places, alluvial deposits are over 100 feet deep but may contain islands of bedrock.

The Pennyroyal Region covers most of the central and eastern sections of the basin. This region is divided into the eastern and western portions, with the latter being an area of undulating limestone uplands and moderately wide flood plains. Numerous karst areas and large solution caverns formed by subsurface drainage prevail in this region. The Eastern Pennyroyal was developed in the lower St. Louis and Warsaw limestone formations. While similar in many respects to the Western Pennyroyal, it has steeper sloping uplands and narrow ridges with some underground drainage and karst areas.

The remaining area of the basin is in the Knobs and the Alluvium Regions. The Knobs Region, located in the northeastern section of the basin, is a narrow belt characterized by conical hills. Most soils on sloping to steep uplands are shallow and when disturbed, are highly susceptible to erosion. The Alluvium Region occurs in a small area immediately north of Henderson, Kentucky. This region is characterized by broad and deep alluvial bottom lands which were formed by headwater flooding and glacial backwaters.

GEOLOGY

The entire basin lies on the western side of the Cincinnati anticline, resulting in underlying rock dipping generally west and northwestward. Sedimentary formations consist of limestones, cherty limestones, dolomites, sandstones, and shales. In some locations, residual soils are covered by old stream terrace deposits or, as in the northwest portion of the basin, have a loessal mantle over sandstone and shale residual soils. Numerous faults are found throughout the basin, with the majority being in the central and western sections. In the eastern section, a continuation of the Kentucky River fault zone is found along with several isolated series of faults. Two series of faults begin near Munfordville, Kentucky, and proceed west and northwest in ever increasing numbers, crisscrossing in a latticework fashion portions of Hopkins, Christian, Grayson, and McLean Counties.

Streams in the basin are dendritic, except in karst areas where water drains into sinks and underground caverns. Streams often flow on bedrock, have gravel deposits, and have channel banks with rock ledges. The streambanks are usually steep, fairly high, and vegetated. All major tributary streams are perennial, while most smaller ones are intermittent (plate II-4).

LAND RESOURCES AND USE

SOIL ASSOCIATIONS

A total of 16 soil associations are in the basin.[2/] Soil associations 7, 8, 13, 14, and 15 cover approximately two-thirds of the area (appendix table II.2). The largest is the Frondorf-Wellston Association (7) with over 1 million acres. This association is predominantly in the gently sloping to moderately steep uplands of the Western Coal Fields Physiographic Region. The Frondorf-Caneyville-Dekalb Association (8), with about 764,000 upland acres, is the dominant one in the Western Pennyroyal Physiographic Region. The Baxter-Bedford Association (14) is the largest one in the Eastern Pennyroyal Physiographic Region. This association covers about 750,000 acres and is mostly on sloping uplands and in depressional areas. The Garmon-Rockcastle-Frankstown (22) is the major association in the Knobs Physiographic Region. Plate II-5 is a map of general soil associations.

LAND CAPABILITY CLASSIFICATION

Land capability classification is a system used to show the suitability of soils for agricultural production.[3/] This system employs three basic categories for grouping soils; namely, capability class, subclass, and unit. The broadest category, capability class, is used for grouping soils into eight different classes according to limitations and risks which affect use. The risks of soil damage and limitations in use are progressively greater from class I through VIII. As shown in table II.3, approximately 28 percent of the agricultural and forestry acreage is in capability class II, 20 percent in class III, 20 percent in class VII, 14 percent in class IV, 12 percent in class VI, and 6 percent in class I.

Capability subclasses are used for grouping soils having similar limitations or hazards. The hazards or limitations recognized in the basin include erosion, wetness, and shallowness or stoniness. These hazards are identified by the letters "e," "w," and "s." Approximately 66 percent of the acreage in table II.3 is in the erosion "e" subclass, 15 percent in the shallowness "s" subclass, 13 percent in the wetness "w" subclass, and 6 percent has no significant limitations.

Capability units, the smallest subdivision, are groups within the subclass. These units are used to designate soil groups adapted to specific cultivated crops or pasture plants and require similar management practices. See appendix for additional data on land capability classes, soil association interpretations, and soil resource groups.

2/ A soil association includes a broad aggregation of soils grouped according to their relative positions and related characteristics. Even though each association is identified by two or three dominant soil series, it may include others which are less extensive.

3/ "Land Capability Classification"; Agriculture Handbook No. 210, Soil Conservation Service, U.S. Department of Agriculture, September 1966.

SOURCE: Data Compiled by USDA River Basin Staff

Plate II–3

PHYSIOGRAPHIC REGIONS GREEN RIVER BASIN KENTUCKY AND TENNESSEE

Compiled and reproduced at 1:250 000 (1 inch equals 4 miles) from 1:250 000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:700 500 (1 inch equals 11 miles)

AUGUST 1975 4–R–35116

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U.S. DEPARTMENT OF AGRICULTURE

Plate II–4

STREAMFLOW CLASSIFICATION

GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

0 5 10 15 20
APPROXIMATE SCALE MILES

Compiled and reproduced at 1 250 000 (1 inch equals 4 miles) from 1 250 000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1 700 500 (1 inch equals 11 miles)

SOURCE: Data compiled by SCS River Basin Planning Staff.

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U.S. DEPARTMENT OF AGRICULTURE

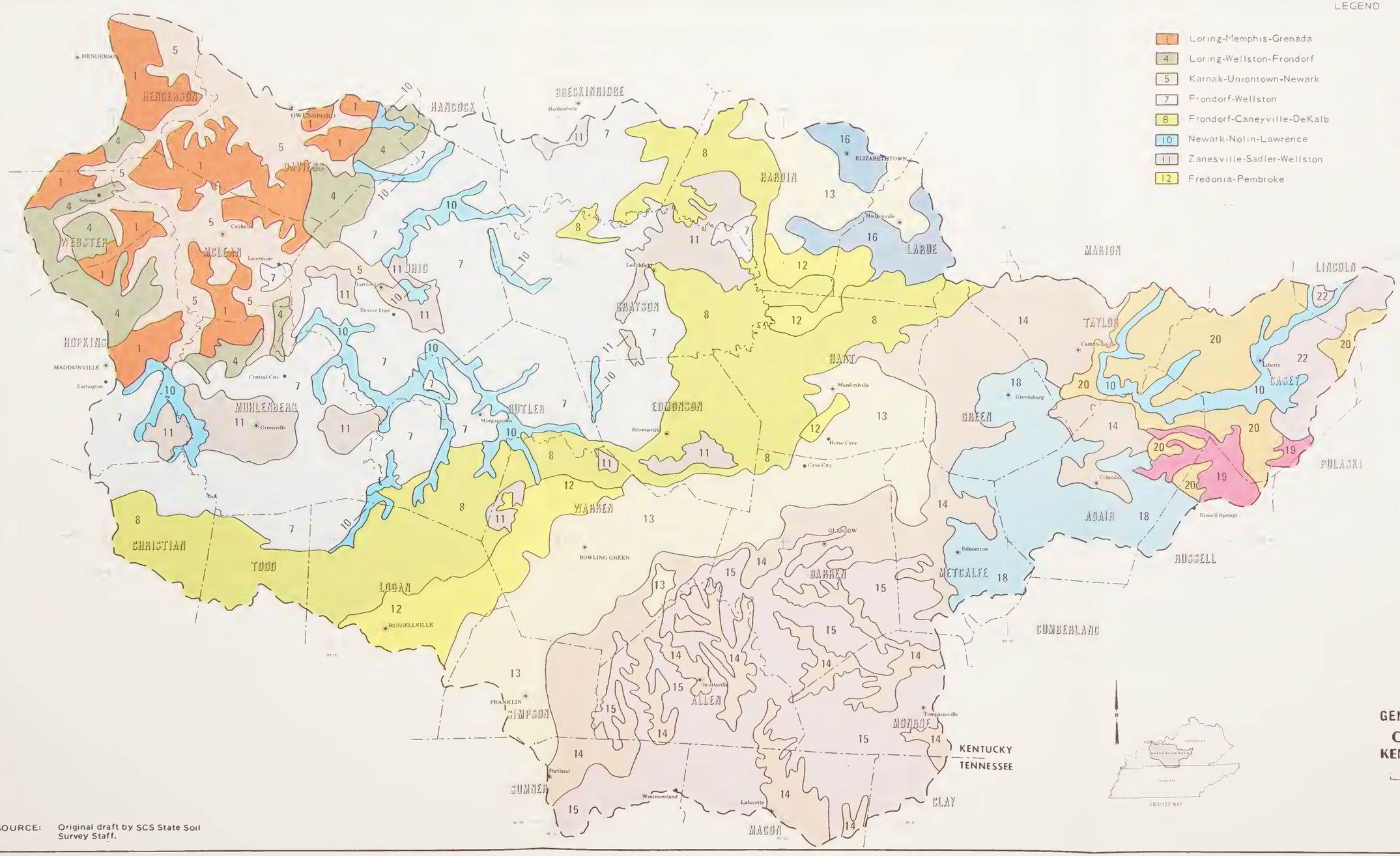

Plate II–5

GENERAL SOIL ASSOCIATIONS

GREEN RIVER BASIN

KENTUCKY AND TENNESSEE

APPROXIMATE SCALE: MILES

Compiled and reproduced at 1:250,000 (1 inch equals 4 miles) from 1:250,000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:500,000 (1 inch equals 8 miles).

SOURCE: Original draft by SCS State Soil Survey Staff.

AUGUST 1975 4–R–35109

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USDA-SCS-FORT WORTH, TEX. 1975

LAND USE

As shown in table II.3, about 94 percent of the 5,906,560-acre basin is agricultural and forest land, with only 6 percent being nonagricultural. Land use of the nonagricultural acreage consists of about 117,100 acres of federally owned land and water, 202,260 acres of urban built-up areas, and 27,200 acres of small water areas. Plate II-6 shows distribution of land use.

Land use in the 5,560,000-acre agricultural and forested area includes about 38 percent cropland, 20 percent pasture, 35 percent forest, and 7 percent other. By land capability class, approximately 84 percent of the cropland is on classes I, II, and III. All land classes are used for pasture production, with classes II, III, and IV accounting for almost three-fourths of the acreage. Approximately 42 percent of the forest acreage is on class VII land. The remaining forest acres are about equally distributed on class II, III, IV, and VI lands.

SOIL RESOURCE GROUPS

A grouping of land capability classes and subclasses was established to facilitate conducting this study. This involved placing basin soils having similar capabilities, yield characteristics, and management and treatment problems or needs into 22 soil resource groups (appendix table II.1). These groups were utilized to evaluate present and future production potentials of the basin's land resources.

Table II.3 - Land Use for Agricultural and Nonagricultural Areas
Green River Basin

Land Capability Class and Subclass and Use	Major Land Use and Acreage[1]					Percent
	Cropland	Pasture	Forest	Other[2]	Total	Total
I	226,000	38,900	51,800	15,200	331,900	5.62
IIe	767,400	254,900	107,300	77,600	1,207,200	20.44
s	22,300	10,900	11,800	2,000	47,000	.80
w	231,900	34,900	49,000	12,000	327,800	5.55
IIIe	323,900	250,000	181,000	43,800	798,700	13.52
s	700	100	800	100	1,700	.03
w	181,400	20,900	110,200	17,300	329,800	5.58
IVe	174,600	215,500	252,900	44,700	687,700	11.64
s	14,600	12,300	14,000	2,000	42,900	.73
w	11,600	2,600	9,900	1,500	25,600	.43
VIe	72,300	150,100	275,100	40,600	538,100	9.11
s	22,600	26,900	64,400	9,800	123,700	2.09
VIIe	18,200	56,500	320,800	61,800	457,300	7.74
s	19,000	55,000	500,500	62,800	637,300	10.79
w	--	--	100	--	100	--
VIIIs	--	500	2,400	300	3,200	.06
Subtotal	2,086,500	1,130,000	1,952,000	391,500	5,560,000	94.13
Federal Land and Water	--	--	63,200	53,900	117,100	1.98
Urban	--	--	--	202,260	202,260	3.43
Water	--	--	--	27,200[3]	27,200	0.46
Subtotal	--	--	63,200	283,360	346,560	5.87
Total Basin	2,086,500	1,130,000	2,015,200	674,860	5,906,560	100.00

1/ Compiled from Soil and Water Conservation Needs Inventories, Kentucky 1970, and Tennessee 1971, current water resource development bulletins published by the U.S. Army Corps of Engineers; and other Soil Conservation Service and Forest Service data.

2/ Includes farmsteads, farm roads, feedlots, ditchbanks, fence and hedge rows, miscellaneous farmlands, nonfarm residence, investment and industrial tracts, built-up areas smaller than 10 acres, gravel pits, and borrow areas.

3/ Includes water areas other than Corps of Engineers reservoirs.

WATER RESOURCES AND WATER QUALITY

Green River Basin, with a mean average annual precipitation of about 48 inches, normally has a sufficient supply of water. However, some areas have seasonal water supply shortages because of uneven distribution and subsequent low streamflows and decreased reservoir levels.

GROUND WATER

The occurrence of ground water in the basin is controlled or influenced by precipitation, topography, underlying soil-bedrock types, and alluvial deposits. Sandstones, cavernous limestones, and thick alluvial deposits of sand and gravel are regarded as the principal sources of ground water in the basin. As reflected by single vertical wells, ground water yields in areas underlain by sandstone and/or cavernous limestone are generally adequate for rural domestic and livestock requirements (plate II-7).

Springs in the Pennyroyal Region contribute substantial amounts to base flow during periods of low precipitation. While springs are found throughout the area, the greatest concentration is in the Pennyroyal Physiographic Region. Ground water from wells and springs provides supplies for 12 municipalities and at least four communities in the basin. These areas contain approximately 13 percent of the population served, or about 14 percent of the water used in the basin. Approximately 90 percent of the farm population depends on ground water sources for household supplies.

SURFACE WATER

Surface water obtained from reservoirs and streams provides most of the basin's municipal and industrial supplies. At present, central water supply systems serve approximately 200,000 people. Green River and its larger tributaries, Barren, Nolin, and Rough Rivers, are the major streams providing municipal water supplies.

Runoff from the Green River drainage area averages 18 inches annually. Because of variations in precipitation patterns, topography, geology, land use and related factors, annual water yields in some watersheds deviate 20 percent or more from the average. Data on water yields monitored by the U.S. Geological Survey, along with other information, are contained in appendix tables II.4 through 7.

WATER QUALITY

Surface water quality in the basin varies, depending largely upon local geologic conditions, streamflow characteristics, alterations in hydrologic cover, and quantity of waste water and effluent material discharged into streams and lakes. Smaller streams with vegetated drainage areas in the eastern and central basin are generally not polluted in contrast to those in strip-mined, urban, and intensive agricultural areas of the central and western part. Areas having the most noticeable inferior water quality include the coal mining section, the lower central and western corn- and soybean-producing belt, and below the towns and communities having inadequate sewage treatment facilities.

U. S. DEPARTMENT OF AGRICULTURE

PRESENT LAND USE MAP - 1975

GREEN RIVER BASIN

KENTUCKY AND TENNESSEE

DRAINAGE AREA 9229 SQ. MI.

PHYSICAL MAP LEGEND

- RIVER BASIN BOUNDARY
- STATE LINE
- COUNTY LINE
- GREEN RIVER
- TRIBUTARIES
- COUNTY SEAT
- U.S. CORPS OF ENGRS RESERVOIRS

LAND USE MAP LEGEND

Blank Area = Open Land (Crop and Pasture)

= Forest Land

SS = Surface Mined Land

= Urban Land

Approximate Scale 1:720,000

PLATE II-6

SOURCE: DATA COMPIED BY U.S.D.A. RIVER BASIN STAFF.

(Computer Generated Map - Every 2 characters represents 85.33 ac.)

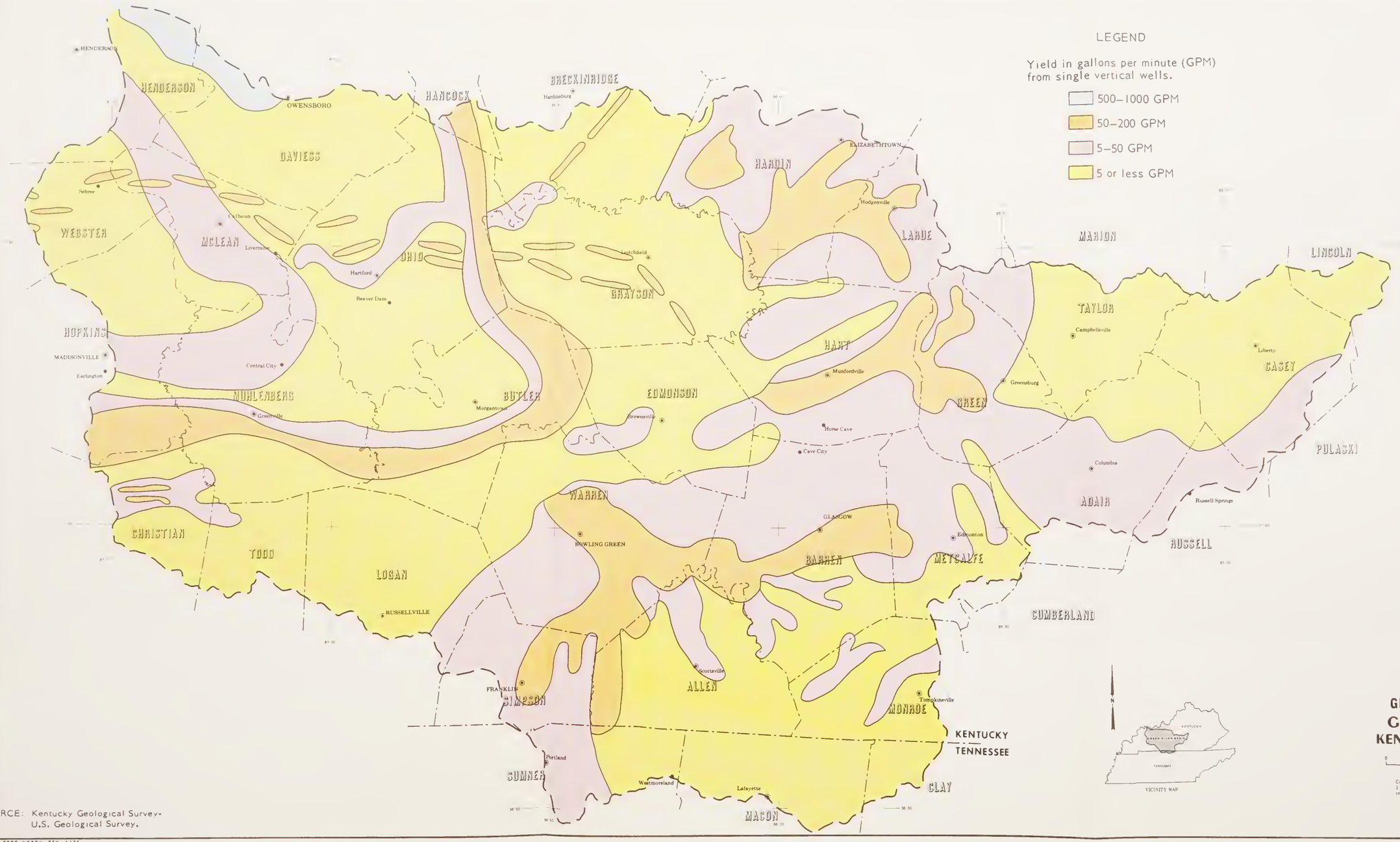

Plate II–7

GROUNDWATER SOURCES
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

0 5 10 15 20
APPROXIMATE SCALE - MILES

Compiled and reproduced at 1 250,000 (1 inch equals 4 miles) from 1 250 000 USGS Topographic Map and 1974 State Road Map Also reproduced at 1 700,500 (1 inch equals 11 miles)

SOURCE: Kentucky Geological Survey-
U.S. Geological Survey.

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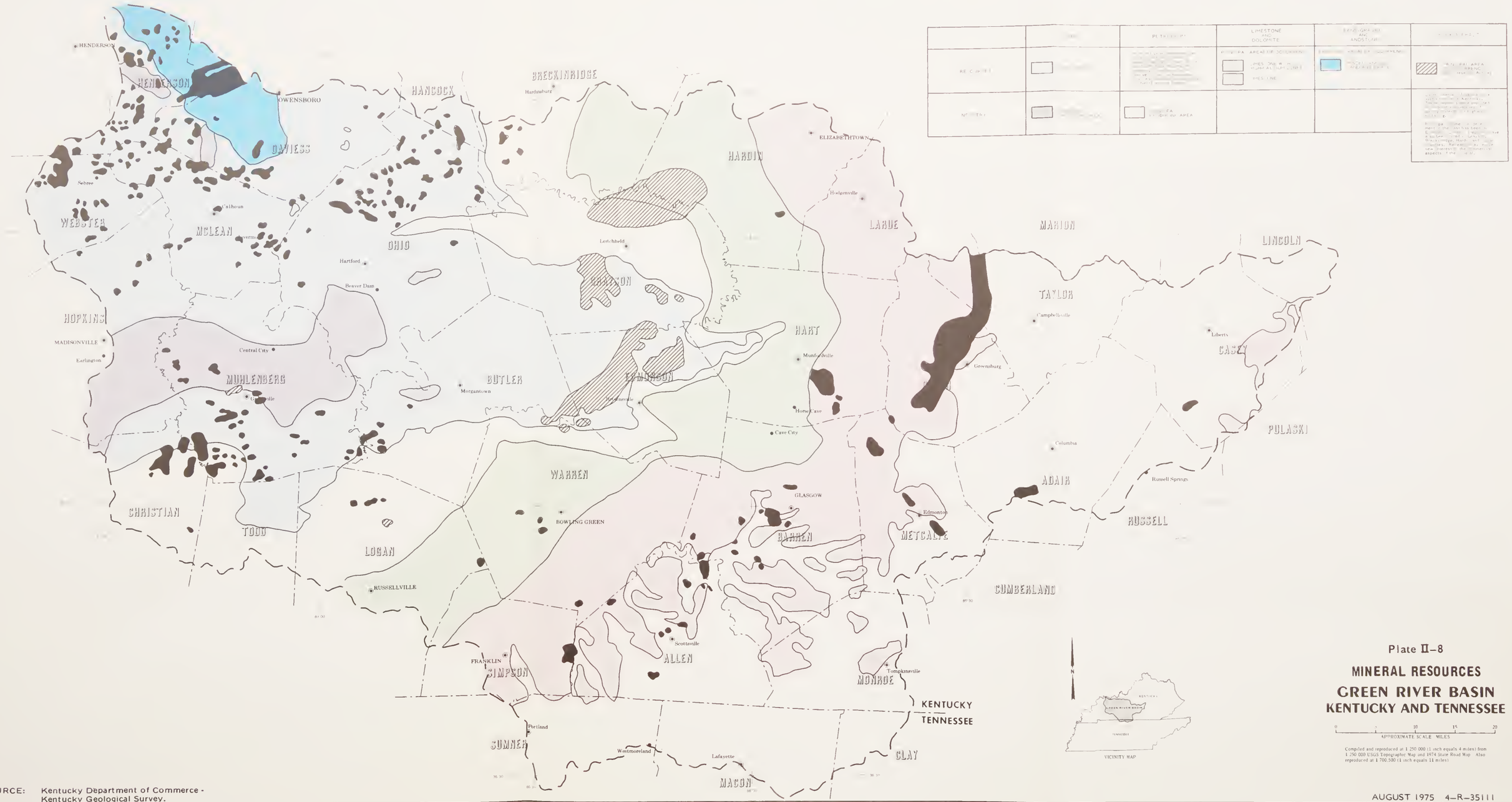

Plate II–8

MINERAL RESOURCES
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

APPROXIMATE SCALE MILES

Compiled and reproduced at 1 250 000 (1 inch equals 4 miles) from 1 250 000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1 700 500 (1 inch equals 11 miles).

SOURCE: Kentucky Department of Commerce - Kentucky Geological Survey.

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MINERALS

Minerals are an important natural resource in the basin, with coal presently being the most important economically. Other minerals currently produced include limestone, gas and oil, sand and gravel, asphalt rock, clay, and dimension stone (plate II-8). These resources are utilized primarily for fuels and construction materials.

COAL

The production of coal is highly important to the economy of the basin and the State. In 1973, for example, Kentucky produced about 127 million tons having an estimated total value in excess of $2.2 billion. As shown in table II.4, approximately one-third of the State's coal is produced in the basin area, contributing a gross of over $700 million to the local economy.

Table II.4 - Coal Production by County and Type of Mining, 1973

Green River Basin

County	Coal Mining Methods		
	Surface	Underground	Total
	----------Tons----------		
Butler	68,500	5,800	74,300
Christian	171,200	--	171,200
Daviess	977,300	--	977,300
Edmondson	95,900	--	95,900
Henderson	--	524,200	524,200
Hopkins	2,433,600	2,889,800	5,323,400
McLean	1,309,300	--	1,309,300
Muhlenberg	19,116,100	5,021,900	24,138,000
Ohio	5,299,200	2,225,600	7,524,800
Totals	29,471,100	10,667,300	40,138,400
Percent of Totals	73	27	100

Source: Annual Report of the Department of Mines and Minerals for Kentucky, 1973.

The basin study indicates that about 169,000 acres of surface mineable coal exist. As shown in plate II-9, the acreage is concentrated in the counties of Muhlenberg, Ohio, Hopkins, Grayson, Butler, and Daviess. Of the estimated mineable acreage underlain by coal, approximately 35 percent is crop and

pastureland, 35 percent forest land, 29 percent previously surface-mined areas, and one percent urban land. About two-thirds of the land has 13 to 30 percent slopes, with the remaining having slopes less than 13 percent.

Approximately 93 percent of the 40,138,400 tons of coal produced in the basin in 1973 was mined in three counties, with Muhlenberg accounting for 60 percent, Ohio 19, and Hopkins 13. Other coal-producing counties include Butler, McLean, Daviess, Henderson, Christian, and Edmondson. Surface mining operations were performed on about 8,000 acres to produce about 70 percent of the 40,138,400 tons, while underground and auger mining accounted for the remaining 27 percent. Strip mining operations on the 8,000 acres represent a 400 percent increase over the 1955 level of 2,000 acres and 33 percent over 1971.4/

4/ As used in this report, coal mining methods refer to the operations used to extract coal commercially. In simple terms, surface mining involves mechanically removing earthen materials above coal seams prior to extracting the coal. Subsurface mining involves constructing underground tunnels and work areas to permit extracting and removal of coal.

OIL AND GAS

Production of oil and gas in the basin is from approximately 20 different formations distributed stratigraphically between rocks of Ordovician and Pennsylvanian Ages. While only a limited volume is marketed, gas has been present with oil in many fields either in solution or as gas.

The bulk of commercial petroleum is in the Western Coal Fields Physiographic Region (plate II-8). Most production is from shallow wells drilled in Mississippian Age strata of sandstone and limestone. Except for a very few deep holes, the older sedimentary strata remain practically untested in the lower half of the basin. Oil production from the basin has declined from about 4.3 million barrels in 1969 to about 2.7 million barrels in 1973. Appendix table II.8 shows oil production by counties for selected years.

ROCK ASPHALT

Oil-impregnated rocks, commonly referred to as rock asphalt, are known to occur at shallow depths in nine central counties in the basin, with Hardin, Grayson, Hart, Edmonson, Butler, and Warren Counties accounting for most of the reserves (plate II-8). These and other reserves amount to about 500 million tons and are in beds 15 to 30 feet thick and under about 15 feet of overburden. Most oil-impregnated rocks are principally sandstones of the Pennsylvanian and Mississippian Ages with the former being the better producer. Bituminous contents range from 10 to 15 gallons per ton.

OIL SHALE

As traditionally defined, oil shale is a very fine-grained sedimentary rock containing sufficient organic matter (hydrocarbons) to produce oil when properly processed. To be classed as an oil shale, rocks must be capable of yielding 10 gallons or more per ton. Chattanooga shale, which yields as much as 21 gallons of oil and 3,000 cubic feet of low BTU gas per ton, is the dominant one in the basin. This shale outcrops at scattered locations in the upstream basin area or is present in most of the subsurface at relatively shallow depths beneath overlying strata. As it progresses from east to west in the basin, the shale becomes deeper and thicker. In the outcrop area, its thickness generally ranges from 30 to 45 feet. Even though Chattanooga shale has potential for a low grade source of oil and hydrocarbon gas, it is not presently commercially competitive with the high grade oil shales yielding 25 to 65 gallons per ton.

LIMESTONE ROCK

Limestone rock having physical properties suitable for construction and commercial lime is present in large quantities, either as outcrops or at shallow depths in the Mississippian Age strata that underlies the upper portion of the basin (plate II-8).

SAND AND GRAVEL

Although sand and gravel are not commercially exploited for aggregate use on a large scale, they provide a good source of aggregate materials. The most important sources of natural sand and gravel are the major stream channels and highly weathered or weakley cemented sandstones and conglomerates at or near the surface.

Silica sand, even though not currently utilized commercially, is common in the western portion of the basin. The deposits are present in the sandstone strata of Pennsylvanian and Upper Mississippian Ages.

DIMENSION STONE

This natural building stone, which may be selected and cut to specified or indicated shapes and sizes, is quarried from sandstone and limestone. Logan and Warren Counties were once prominent in production of dimension stone. Since substitutes are now used, dimension stone production has virtually ceased.

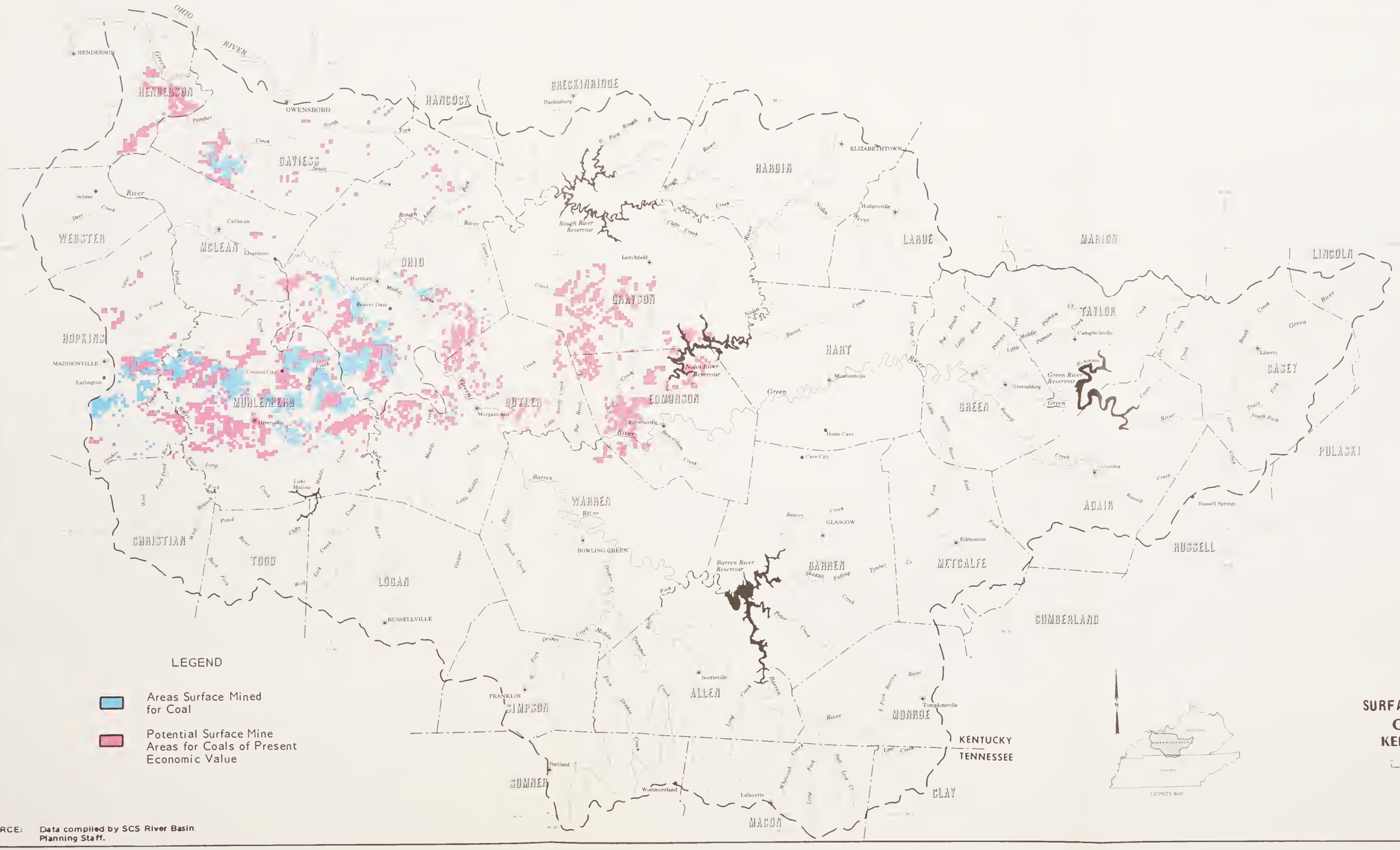


Plate II–9
SURFACE COAL MINING RESOURCES
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

SOURCE: Data compiled by SCS River Basin Planning Staff.

AUGUST 1975 4–R–35130

REVISED MARCH 1975 4–R–34040

FOREST LAND

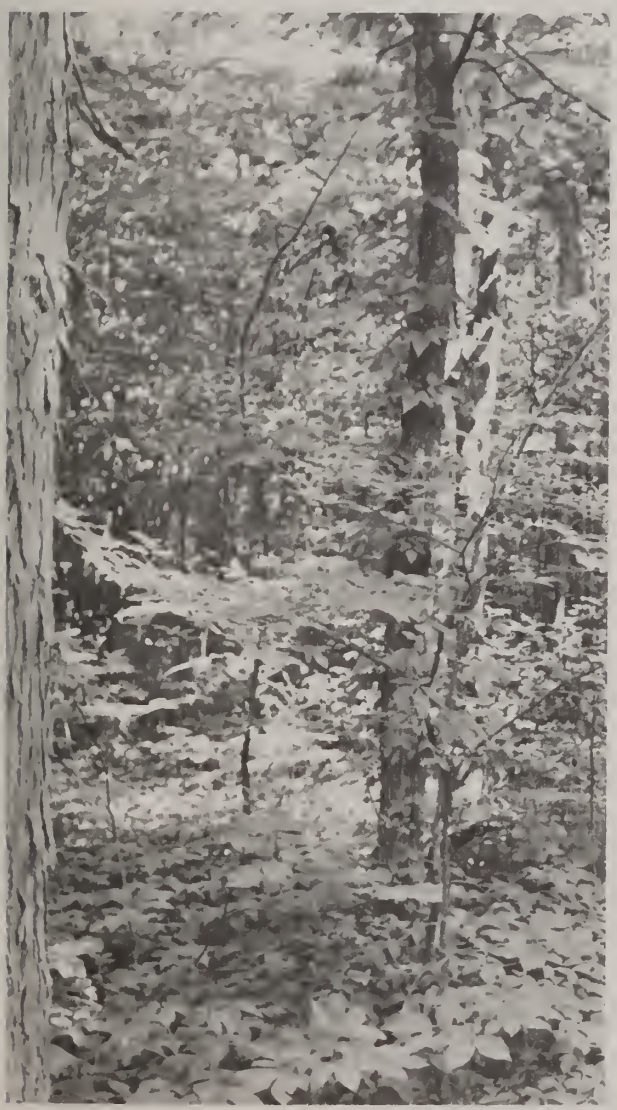
Forest land encompasses 2,015,150 acres or 34 percent of the basin. Commercial forest capable of producing industrial wood occupies 1,965,800 acres. Much of the forest land also serves as wildlife habitat and is often used for recreation. About 98 percent of commercial forest land is privately owned. There are nine forest types within the basin. Oak-hickory is the major type and covers 40 percent of the forest area. The next largest type is the central mixed hardwoods which cover 34 percent of the forest area. The oak-gum-cypress and elm-ash-cottonwood types occupy 11 percent of the area and are along the bottom areas of the Green River and its tributaries. Over 46 percent of the commercial forest land is in sawtimber stand size; 25 percent in poletimber; 28 percent in seedling and sapling; and the remainder is nonstocked. Forest stocking is a classification based on the percentage of area occupied by merchantable or potentially merchantable trees. Stocking in the basin was found to be

38 percent well stocked, 50 percent medium, 11 percent poor, and 1 percent nonstocked.

The timber resource available from the commercial forest land consists of 1.3 billion cubic feet of growing stock, including 4.2 billion board feet for sawtimber volume.5/ Ninety-seven percent of these volumes is in hardwood species. The average volume of standing timber is 670 cubic feet per acre for growing stock, including 2,150 board feet per acre for sawtimber.

Net annual growth of growing stock is 62.7 billion cubic feet. Approximately 60 percent of this is in the sawtimber class and 40 percent in the poletimber class. The average net annual growth is about 32 cubic feet per acre. The net annual growth for sawtimber is 290.7 million board feet, or an average yield of 148 board feet per acre.

The remaining forest land is classified as noncommercial and consists of areas that are used for recreation, have a historical value, or are sites too poor to produce industrial timber. Almost 98 percent of the noncommercial forest is found in the Mammoth Cave National Park. The remaining is in Lake Malone, Rough River Dam, Green River Lake, and Barren River Lake State Parks; the Abraham Lincoln Birthplace, a national historic site; and Old Mulky Meeting House State Shrine. Additional information on the forest resource is contained in appendix tables II-9 through 14.



5/ Growing stock volume - net volume in cubic feet of live sawtimber and poletimber trees from stump to a minimum 4-inch top of central stem or to the point where the central stem breaks into limbs. Sawtimber volume - net volume of the sawlog portion of live sawtimber trees in board feet scaled using the International 1/4-inch rule. Net annual growth - annual change in volume of sound wood in live sawtimber and poletimber trees resulting from natural causes.

FISH AND WILDLIFE

Vertebrate fauna of Kentucky consist of approximately 320 species of birds, 35 species of mammals, 99 species of reptiles and amphibians, and 190 species of fishes. Although distribution of some of these species within the State is limited, probably 75 percent or more of them can be found in the Green River Basin either as residents or seasonal visitors.

The distribution of these divers kinds of fish and wildlife throughout the basin depends, of course, upon the distribution of their respective habitats. Terrestrial species have available about 5.9 million acres of habitat of which about 35 percent is cropland, 19 percent pastureland, 34 percent forest land, and 12 percent urban, water and other lands. Openland species such as the bobwhite quail, mourning dove, and cottontail rabbit are found mostly in the more intensively farmed areas, especially in Barren, McLean, Christian, Daviess, Henderson, Todd, Simpson, Hardin, and Webster Counties. Forest species, particularly the white-tailed deer and gray squirrel, are concentrated mainly in woodland areas of Butler, Edmonson, Muhlenberg, Ohio, Hancock, Hopkins, Monroe, and Casey Counties in Kentucky, and Macon, Clay, and Sumner Counties in Tennessee. Most of the resident and transient waterfowl habitat is provided by the four U.S. Army Corps of Engineers water impoundments, and by some 80,000 acres of overflow forest land along Green River and its major tributaries.

Habitat for aquatic wildlife and fishes in the basin is provided by (1) 87 principal streams, with a total length of about 1,600 miles and a total surface area of approximately 18,000 acres; (2) 4 large Corps of Engineers water impoundments that have a total surface area of 29,100 acres; (3) about 100 small lakes whose total surface area is about 3,800 acres; and (4) almost 10,000 farm ponds with a combined surface area of approximately 5,300 acres. Plate II-10 shows the significant fishing streams.

Sport fishing and hunting are the main uses now being made of the fish and wildlife resources of the area. However, interest in bird watching, wildlife photography, and nature study in general is growing rapidly. The commercial fishing industry is insignificant as is commercial furbearer trapping, although some new interest in trapping has been stimulated by recent increases in fur prices.

The more important game birds and mammals are the bobwhite quail, mourning dove, cottontail rabbit, gray squirrel, raccoon, and white-tailed deer. Thirty-one species of ducks and geese are known to visit the basin, but only 18 are considered common transients or winter residents. Even these are not attracted to the area in sufficient numbers for waterfowl to be considered a major component of the basin's wildlife resources. Mink and muskrat are the furbearers most sought by trappers.

Principal game and pan fish found in the streams, lakes, and ponds of the basin are largemouth bass, smallmouth bass, rock bass, Kentucky bass, white bass, croppie, walleye, muskellunge, bluegill, and channel catfish (appendix table II.16). Rainbow trout are stocked in some streams for put-and-take fishing. Rough fish are the backbone of the commercial fishing industry. Various species of catfish, buffalo, and carp are the usual kinds taken, but sometimes drum compose a substantial portion of the catch.

Other fish and wildlife resources of the basin of special interest to bird watchers, scientists, and nature study enthusiasts are those considered rare or endangered. A preliminary list of such species recently developed by the Kentucky Academy of Science is shown in appendix table II.15. This list contains seven mammals, two fishes, three birds, two salamanders and frogs, one lizard, and six snakes.

Plate II–10

STREAM FISHERY CLASSIFICATION
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

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SOURCE: Data compiled by SCS River Basin Staff.

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ARCHEOLOGICAL AND HISTORICAL ITEMS

Several items having archeological and historical value or interest are in the basin area. Properties listed in the National Register of Historic Places include the:

1. Old Courthouse located on the public square at Greensburg, in Green County;

2. Maria Moore House at 801 State Street, Bowling Green, in Warren County;

3. Riverview (Hobson House) on Main Street in Bowling Green, Warren County; and

4. Birthplace of Abraham Lincoln, located 3 miles south of Hodgenville, in Larue County.

Indian Knoll, near Paradise Ferry Landing on Green River in Ohio County, has been designated a national historic landmark by the Secretary of the Interior.

The "Survey of Historic Sites in Kentucky," compiled by the Kentucky Heritage Commission, recognizes 191 sites as having historical, archeological, architectural, or geological significance, in the basin. Of these, 67 are noted as architectural examples, 5 as archaic or geologic formations, 5 as having national historical significance, 28 as having state historical significance, and 86 as having local interest. Examples of the above include Mammoth Cave National Park in Edmonson County, Lincoln Heritage House in Hardin County, and the Old Mulkey Meeting House in Monroe County (appendix table 11.17).

WILD AND SCENIC RIVERS

A 26-mile section of Green River, beginning at the northeast boundary of the Mammoth Cave National Park and extending to the the southwest boundary, is the only wild and scenic river in the basin. This river section, which was designated by the Kentucky Legislature in 1974, has narrow flood plains, moderately steep banks with overhanging vegetation, and is bounded by forested hills.

QUALITY OF ENVIRONMENT

The quality of environment in the basin is dependent upon conservation, development, and productive use of water, land, and related resources so that all residents may enjoy quality (1) of the natural resource base for substantial use; (2) in the environment to provide attractive, convenient, and satisfying places to live, work, and play; and (3) in the standard of living based on community improvement and adequate income. Factors reflecting the environmental quality of the basin are:

Climate - As a general rule, climatic conditions are favorable, with average monthly temperatures ranging from 35°F in January to 79°F in July. Annual rainfall is about 48 inches, and snow averages from 8 to 12 inches per year.

Water - Although distribution and quality problems exist, the supply of water is generally adequate for domestic, industrial, and agricultural use. Water quality ranges from good in some basin portions to very poor in others. The largest concentrated area having poor quality is the Western Coal Fields Physiographic Region where water is polluted by sediment and acid drainage from surface and underground coal mines. Ground water quality is generally acceptable for most uses, although it may contain undesirable amounts of iron.

Air - The basin, being mostly rural and not containing any large metropolitan areas or large industrial developments, has few air quality problems. However, some air pollution results from small manufacturing plants, electrical power generating plants, garbage and waste disposals, uncontrolled burning of trash, and automobile exhaust emissions.

Land - The 5,906,560-acre basin is predominantly rural, interspersed with several small- to medium-sized towns and communities. Agriculture accounts for 94 percent of the land use, of which about 38 percent is used for crops, 20 percent pasture, 35 percent forest, and 7 percent other. Urban,

ECONOMIC DEVELOPMENT

Economic development, as traditionally identified, is reflected by the increase in the quantity of goods and services produced and the contributions these make toward satisfying needs. While the rate varies by regions and specific areas, it is the intent of this chapter to present data to depict economic development and growth for the basin area. The data are designed to identify (1) the general characteristics of the economy; (2) certain health, religious, and educational institutions; (3) major agricultural, industrial, and commercial activities; and (4) important social and economic conditions prevailing in the basin. Statistical data have been compiled to reflect present conditions, indicate changes occurring and the rate, and provide a prospectus of the future.

An area consisting of 29 counties in Kentucky was selected to represent the basin for the purpose of preparing the economic section. This area referred to as the "study area," was further divided into multicounty subareas. These subareas were delineated by grouping counties having similar geographic, economic, and related characteristics. The use of complete counties and the subsequent grouping of the counties into subareas facilitated using published data from secondary sources which are not generally available for hydrologic boundaries.1/ The counties and subareas which are shown in plate III-1 are listed in appendix table III.1.

The study area, with approximately 7.7 million acres, covers over 30 percent of the State's 25.5 million acres. Over 90 percent of the area is agriculture and forest land. This is slightly more than the State's

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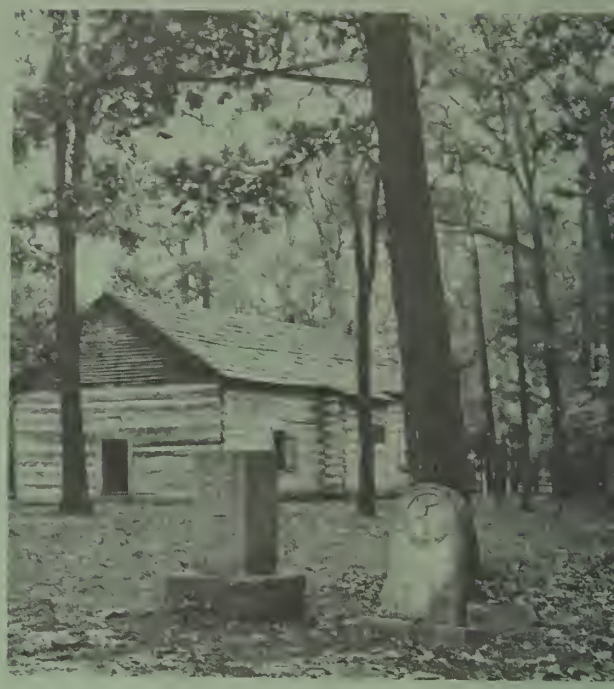
1/ Principal sources of data utilized include the Census of Population, Census of Agriculture, and various national and State publications.

average, and the mix between cropland, pasture, and forest land is quite different. Approximately 55 percent of the study area is used for cropland and pasture as compared to 46 percent for the State. Forests comprise about 36 percent of the land area as compared with 43 percent for the State. The urban and built up areas of the study area constitute a smaller portion of the total than these do for the State.

HISTORY

Settlement of the basin began about two centuries ago in 1775. Most of the early settlers were from North Carolina, Pennsylvania, and Virginia. The North Carolina and Virginia settlers entered Kentucky and the basin via the Cumberland Gap, the route traveled by Daniel Boone and a hunting party in 1769. Pennsylvania emigrants came down and across the Ohio River. The settlement rate, while initially slow, increased as the westward movement gained momentum in the latter part of the 1700's. By the turn of the century the population had increased rapidly, and settlements were distributed throughout the basin.

During the first half of the nineteenth century, forested and grassed lands were converted to agricultural uses, small manufacturing and trade enterprises were established, the railroad system was started, and population centers were developed. Major efforts were directed toward clearing forest lands in the eastern and western basin section and converting wild grasslands in the central section for crop and livestock production. Principal crops produced were corn, wheat, hemp, hay, and vegetables. Early trading involved fur, farm products, and lumber. Early manufacturing and processing establishments were principally clothing, furniture, and farm produce.



Until the Civil War, agriculture, small scale manufacturing, trade, and commercial activities were actively developing. Even though Kentucky was neutral during the war, many of its citizens became members of the Union and Confederate forces. Abraham Lincoln, U.S. President during the Civil War and Chief Commander of the Union forces, was born in the basin at Hodgenville, Kentucky. Jefferson Davis, president of the Confederacy, was from Fairview which is adjacent to the basin in Todd County, Kentucky.

Although development was interrupted, the basin was not as extensively damaged as some other Kentucky areas or southern states. After the war, development of agriculture, industry, and commerce continued. Growth, however, was hampered by depressed economic conditions that prevailed during the latter part of the nineteenth and early twentieth centuries. As the basin recovered, agriculture, small wood, textile, and metal industries became more important to the economy. Coal mining further stimulated the economy and accelerated development of the railroads.

Even though agriculture, forestry, and mining are still important economic enterprises, the basin has become more industrially oriented and diversified since World War II. The most notable growth has been in metal, rubber, plastic, textile, and related manufacturing enterprises in the basin's community centers. These developments have been paralleled by improved highways, schools, churches, and other institutions. The expanded economy has provided needed employment, including many specialized jobs.

U.S. DEPARTMENT OF AGRICULTURE

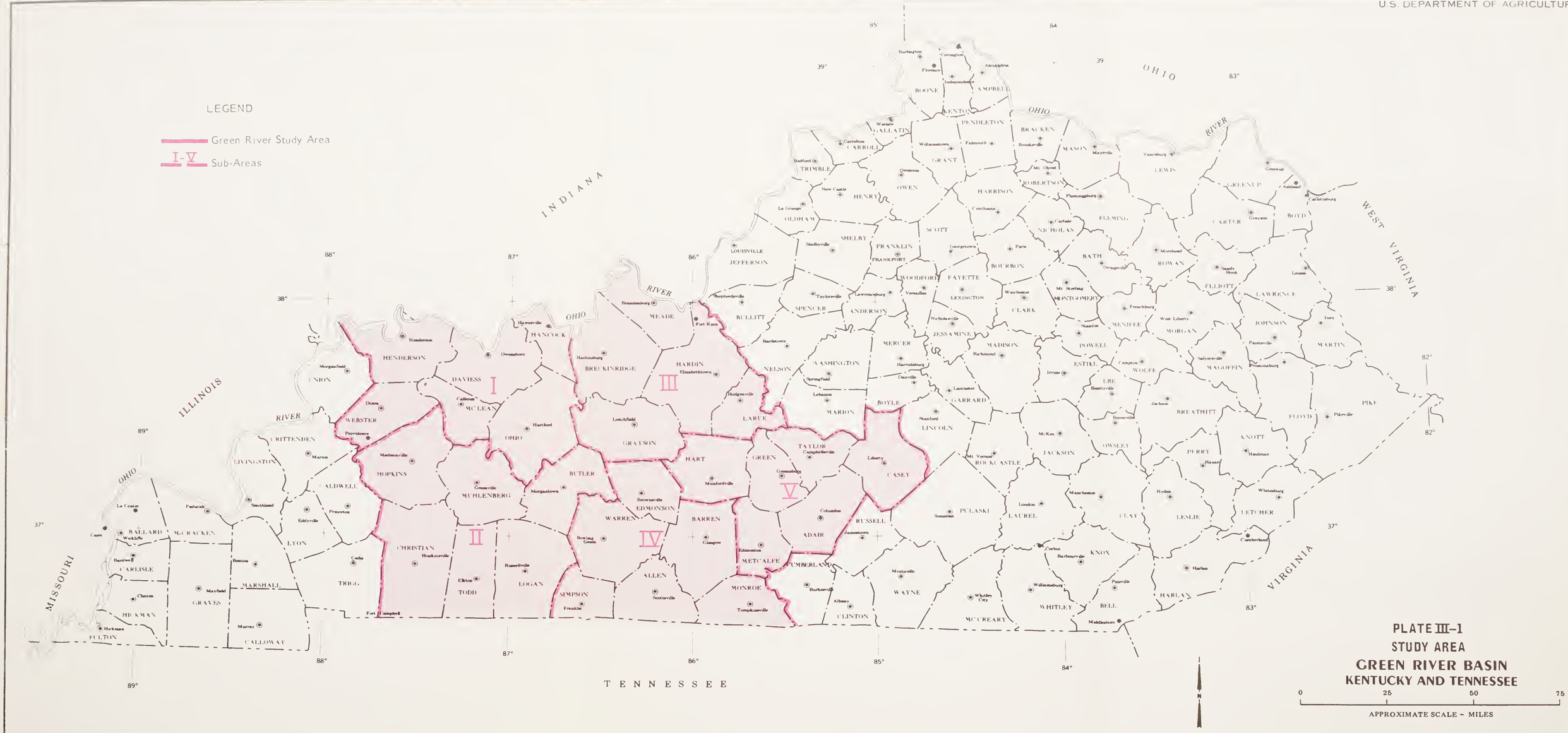


PLATE III–1
STUDY AREA
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

0 25 50 75
APPROXIMATE SCALE – MILES

SOURCE: Data Compiled by USDA River Basin Staff

BASE MAP COMPILED FROM USGS NATIONAL BASE MAPS AND 1:500,000 STATE BASE MAP.

SEPTEMBER 1975 4-R-35127

USDA-SCS-FORT WORTH, TEX 1975

MAY 1974 4-R-33970

ECONOMIC ACTIVITY AND INDICATORS

POPULATION

In 1970, population of the 29-county study area totaled about 670,000. Of the total, approximately one-half is concentrated in Daviess, Hardin, Warren, Christian, Hopkins, and Henderson Counties. Population ranges from 79,500 in Daviess County to 7,100 in Hancock County. Principal population centers are Owensboro with 50,300; Bowling Green with 36,300; and Fort Knox with 31,800. Approximately 42 percent of the population is urban, and the remaining 58 percent is rural farm and nonfarm. Appendix table III.2 shows current and projected population for the 29 counties.

Population in the area increased from about 506,000 in 1890 to the 1970 level of 670,000. The population increased in each 10-year period except for the decline in 1910 to 1920 and 1920 to 1930. This loss resulted from residents seeking employment in populated centers outside the area and the State. Since 1930, modest population gains have occurred in each decade.

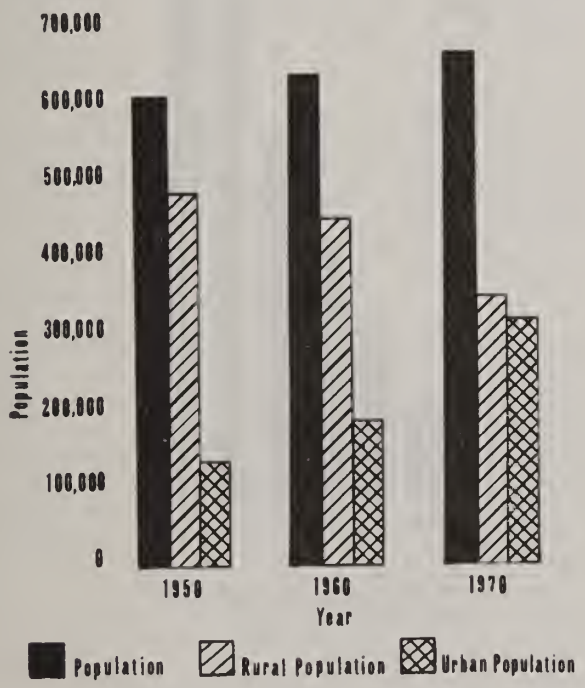


Figure III-1 Total Urban and Rural population 1950, 1960, and 1970.

EMPLOYMENT

The study area has shared in previous national economic expansion, and indications are that it will continue to do so in the future. However, not all sectors of the economy have shared equally in the expansion. Employment, an important economic indicator totaled about 187,000 in 1970. This was approximately a 14 percent increase over the 1960 level of 164,000. Table III.1 shows the employment by industry for 1970 and percent change from 1960 to 1970.

In 1970, the civilian labor force in the study area totaled over 228,000, a 13.5 percent increase over the 1960 level. As the labor force increased, unemployment decreased from 5.5 percent in 1960 to 4.7 percent in 1970. These statistics compare favorably with those of the State and the Nation.

Table III.1 - Employment by Industry for 1970 with Percent Change (1960 - 1970)

Green River Study Area

Employment Sectors	1970	Percent Change 1960 to 1970
Agriculture, forestry, and fisheries	25,567	-44.4
Mining	7,342	-16.1
Construction	16,328	36.7
Manufacturing	55,452	69.0
Railroad	940	16.7
Trucking and warehousing	2,607	6.4
Other transportation	1,562	11.5
Communication	1,865	40.2
Utilities and sanitation	4,856	63.8
Wholesale trade	5,398	37.4
Food and dairy stores	5,313	1.5
Eating and drinking places	5,367	21.9
Other retail	22,408	24.5
Finance, insurance, and real estate	5,721	48.9
Business and repair service	4,444	20.4
Private household	4,081	-40.6
Other personal service	7,179	38.8
Entertainment and recreation	1,036	5.8
Welfare, religious, and nonprofit	2,413	29.4
Legal, engineering, and other prof.	2,990	6.4
Public administration	9,373	34.5

Source: Census of Population, Bureau of the Census.

The study area has, like the rest of the country, undergone a change in the type of employment. The professional, managerial, and service opportunities have increased while employment in agriculture and the lower skilled occupations has decreased (table III.2).

Table III.2 - Employment by Occupations for 1970 with Percent Change (1960 to 1970)

Green River Study Area

Major Occupation	1970	Percent Change 1960 to 1970
Professional and technical	20,272	47.8
Managers and administrators	14,413	12.5
Sales workers	12,440	2.2
Clerical	4,211	109.8
Craftsmen and foremen	31,897	53.8
Operative	52,015	41.6
Laborer (nonfarm)	10,534	26.7
Farmers and farm managers	18,429	-45.9
Farm laborers	6,307	-43.6
Service workers	22,024	73.0
Private household workers	4,040	-34.9

Source: Census of Population, Bureau of the Census.

INCOME

Personal and family incomes in the study area, although improving, are lower than in the State and Nation. In 1970, the $2,225 average per capita income was $212 below the State average of $2,437. The average family income of $7,720 for the same year was $840 less than the $8,560 State average and $1,870 below the $9,590 national figure. The number of families with incomes below the poverty level is about double the national average of 10.7 percent.

The median income for women compares more favorably to that of the State and Nation than does income received by men. In 1970, the $3,265 median income received by women was only 3 and 18 percent below that of the State and Nation, respectively. The $5,570

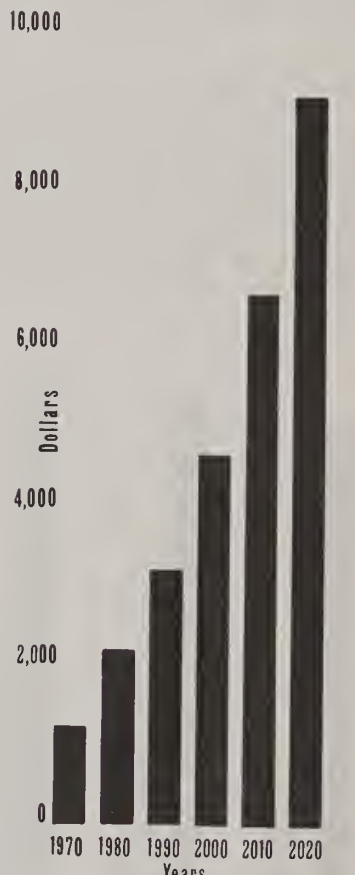


Figure III-2 Present and Projected per capita incomes from 1970 to 2020, Green River, Basin

Table III.3 - Median Earnings by Occupation for 1970

Green River Study Area

Occupation	Study Area	Kentucky
Professionals and managers	$8,571	$9,387
Craftsmen and foremen	6,384	7,278
Operatives	5,421	5,994
Laborers except farm	3,872	4,081
Farmers and farm managers	3,450	3,390
Farm laborers	1,852	2,120

Source: Census of Population, Bureau of the Census.

median income for men was 13 percent below the median for Kentucky and 31 percent under the United States. Except for farmers and farm managers, the median income by occupational classes in the study area is below the State (table III.3).

Although the median income of workers in the study area is below that of the State and Nation, it increased over 100 percent from 1960 to 1970. Median income for the State increased 85 percent and the nation 67 percent. Projections indicate that incomes will continue to increase, but at a slower rate than for the 1960-1970 period. By the year 2020, per capita incomes are projected to increase by about 450 percent over the 1970 level (figure III.2).

As shown in figure III.1, the population is gradually changing from rural to urban. In 1950, only 21 percent of the population was urban, 35 percent rural nonfarm, and 44 percent rural. By 1970, the urban population comprised 42 percent of the total, with another 6 percent residing in places with populations from 1,000 to 2,500.

The shift from rural to urban is expected to continue as the area's population increases. Total population in the 29-county area is projected to increase by about 72 percent over the 1970 level during next one-half century (appendix table III.2). The major increase is projected to occur in Daviess, Hardin, Warren, and Christian Counties.

URBAN CENTERS

The study area contains 48 cities or towns with populations of 1,000 or more. Of these, 36 have populations ranging from 1,000 to 5,000; eight with populations in the 5,000 to 20,000 range; and four with populations exceeding 20,000. Fort Knox, a military installation near Elizabethtown, Kentucky, has a population exceeding 37,000. Twenty-nine of the towns or cities are county seats and serve as the centers of economic activity for the study area counties.

Owensboro, with a population exceeding 50,000, is the largest city in the study area. It is the fourth largest city in Kentucky and is the hub of commercial activity for Daviess and four surrounding Kentucky counties. Most of the employment is provided by manufacturing, trade and services, government, and agriculture.

Bowling Green, county seat of Warren County and with a population exceeding 36,000, is the second largest city in the study area. This south-central Kentucky city is the commercial center for Warren and six surrounding counties. Industrial employment in this area has doubled since 1959, with major growth in machinery and metal products; industrial equipment; apparel; lumber and furniture; and chemicals and rubber.

The other cities in the study area with populations exceeding 20,000 are Henderson and Hopkinsville. Henderson, the seat of Henderson County, had a population of 22,976 in 1970. This represents a 36 percent increase over the 1960 level, making Henderson the fastest growing major city in the study area. Most of the employment is provided by manufacturing, trade and services, and agriculture. Hopkinsville, with a 1970 population of 21,250, is located in Christian County, an intensive agricultural area. Employment in this southwestern Kentucky city is provided largely by trade and services, government, manufacturing, and agriculturally related activities. Important industries in the other study area cities and towns include manufacturing of metal, apparel, plastic, wood, and related products.

TRANSPORTATION AND COMMUNICATION

Transportation facilities are generally adequate throughout the area (Plate III-2). Interstate 65, a major highway artery with interchanges at key towns and intersecting highways, traverses the area from north to south. The Western Kentucky Parkway, which intersects Interstate 65 and the Blue Grass Parkway at Elizabethtown, crosses the area in a southwest to northwest direction. Green River Parkway extends in a southerly direction from Owensboro to Interstate 65 below Bowling Green. The recently completed Cumberland Parkway extends in an easterly direction from the vicinity of Glasgow to Somerset. The Pennyrile Parkway, located in the western section of the study area, extends in a north to south direction. All large population centers in the area are connected by or located close to the major highway system. Other highways in the area include U.S. 31, 62, 68, and 431; and State Highways 65, 70, and 80.

Commercial passenger and freight service in the area is provided by bus, truck, railroad, air, and water. Bus transportation is available in about 90 percent of the area. Truck freight service, which is available in all of the area, is provided locally or by units in adjacent towns. The Louisville-Nashville railroad provides both passenger and freight service to the major population areas. It and the Illinois Central railroad have numerous lines and facilities in the coal mining area. Approximately one-half of the counties in the study area have local airport facilities, but only Owensboro has commercial air service. Commercial passenger and scheduled air freight services are available nearby at Nashville, Tennessee, and Louisville and Lexington, Kentucky. Green River, the major navigable stream in the area, provides water transportation to the southwestern and western counties. Counties along the Indiana border have access to the Ohio River.

Communication facilities and services in the area include and are provided by radio, television, telephone, press, and mail delivery. The area is served by 22 local radio stations and others in adjacent towns or cities. All counties have television available either by cable or regular transmission. Telephone service is provided in the area, mostly through regional cooperatives. Each county has a local daily, biweekly, or weekly newspaper. Daily newspapers from Louisville and Lexington, Kentucky, Nashville, Tennessee, and Evansville, Indiana are distributed in the area. Rural and urban postal service is provided throughout the area.

INSTITUTIONAL AND SOCIAL STRUCTURE

The study area, having been settled over 150 years ago, is socially well established. Religious and social organizations have grown to become important parts of the study area's total environment. Approximately 680 churches representing most major Christian denominations are in the area, and each county has several denominations represented.

All counties have fraternal and social organizations or clubs such as the Rotary, Lions, Kiwanis, Chamber of Commerce, Jaycees, Veterans of Foreign Wars, American Legion, and Sportsman's. Other industrially oriented organizations flourish in urban areas and agriculturally oriented clubs, such as the Farm Bureau, are common in the less populated rural areas. These clubs and organizations actively promote development of community and county activities.

Medical facilities have recently increased and are continuing to expand. The study area has 29 hospitals with approximately 3,800 beds, or roughly one bed for every 175 persons. The Owensboro-Daviess County

Plate III–2

MAJOR HIGHWAY NETWORK

GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

APPROXIMATE SCALE MILES

Compiled and reproduced at 1:1 200 000, 1 inch equals 19.4 miles)

SOURCE: Data Compiled by USDA River Basin Staff

NOVEMBER 1975 4-R-35124

USDA-SCS-FORT WORTH, TEX. 1975

Hospital with approximately 850 beds is the largest. There are also 89 nursing units or extended care facilities with an additional 4,800 beds. All counties have public health departments. The area has about 450 physicians or an average of one for every 1,500 persons.

Educational facilities are being improved and expanded. Historically, the educational level has been below that of the State, but the gap has narrowed significantly in recent years. In 1970 the median educational level was about 10 years, with 39 percent of the adult population having completed 12 or more years of formal education, as compared to 27.5 percent in 1960. Total enrollment increases have lagged behind the State's averages. In 1970, parochial schools had approximately 5 percent of the elementary and 3.5 percent of the high school enrollments.

Western Kentucky University, located at Bowling Green, is the only college offering graduate degrees. The university provides a joint doctoral program with the University of Kentucky and George Peabody College. Three colleges offering 4-year programs and an additional four offering 2-year associate programs are also in the study area.

Financial institutions, including banks and savings and loan associations, are in most of the area's population centers. In 1970, area banks had approximately $838 million in assets and $740 million in deposits. The savings and loan associations had $376 million in assets with $334 million in deposits.

Other factors important to the area's social conditions include the quality and quantity of public services and facilities provided by the State, county, and city; the type and number of recreational parks, libraries, and related community or civic centers available; and the planning, zoning, development, legal, and associated assistance programs provided. These vary throughout the area, with the preponderance being available or carried out in the larger population centers. In many local areas, efforts are being made to provide services and facilities to improve the social environment. Some resources may be limited, but many are available or can be developed to attain the desired improved conditions.

AGRICULTURE AND RELATED ACTIVITY

Agriculture as an industry, although declining in terms of number employed and farm operators, continues to expand and remains an important segment of the area's economy. Between 1959 and 1969, the values of agriculture products sold increased 54 percent, from $171.6 million to $264.3 million. In addition, the value of business added by activities associated with processing, storing, distributing, and marketing farm products in 1969 is estimated at $600 million. Farm production expenses for machinery, fuel, feed, fertilizer, and other items exceeded $200 million. The business generated by processing and marketing agricultural products and by farm purchases of production items, while accruing to people within and outside the area, depicts agriculture's contribution to the economy.

The structure of agriculture, which is reflected by the size, number, and composition of farms, has changed in recent years. The changes have been influenced greatly by the high level of economic development, especially the pressures exerted by the continued increase in demand and price of labor and related resources in the nonfarm sectors of the economy. Largely in response to the economic forces outside the agricultural sector and because of the low level of farm prices, farmers have adopted a wide array of improved technological and management methods. Most of the technological improvements are output-increasing and labor-saving but require larger capital investments for machinery, buildings, and purchased inputs. To decrease the impacts of the increased production costs, it is necessary to reduce unit costs through increasing volume and enlarging operations. As a result, the change has been toward fewer and larger farms, a trend which is expected to continue.

Although changing to larger and more specialized operations, most of the farms in the area are medium-sized family operated units. From 1959 to 1969, farm size increased from an average of 120.3 acres to 128.6 acres. The value of land and building increased $15,567 during the 10-year period. Land in farms decreased by about 2.1 percent, and the number of farms by 8.2 percent in the 10-year span. These and other statistics presented depict the average and total for the area but do not reflect the diversity of enterprises or range in scale of operations within the area. Appendix tables III.3 and III.4 along with the following discussion provide additional information by county and subarea.

As previously indicated, the study area was divided into five subareas. Plate III.1, in the first part of this chapter, shows the subareas and counties. Subarea I, which is in the northwest section of the area, contains

over 7,000 farms. Average size ranges from 118 acres in Hancock County to 223 acres in Henderson County. Most of the farms are family operated and many are highly specialized. Corn and soybeans are the principal cash crops and beef the dominant type of livestock. The largest farms are in subarea II. This subarea has over 7,600 farms, ranging in size from averages of 153 to 197 acres. Major crops are corn, soybeans, wheat, and hay. Livestock is primarily beef with some hogs. This area and subarea I are the most intensive agricultural sections in the study area. Farms in subarea III average 132 acres in size and are predominantly family owned and operated grain and livestock operations. Most of the livestock is beef with some hog and dairy enterprises. Corn, soybeans and tobacco are the principal crops. In subarea IV, the farms average 103 acres in size and most are family operated. The majority of the farms have diversified operations consisting of either beef or dairy cattle and feed grains and tobacco. Subarea V has the largest number of farms, 11,600, with an average size of 104 acres. This subarea has the least amount of cropland per farm but has the most diversified enterprises. Principal crops are tobacco, corn, and hay, with some small grains, soybeans, and vegetables produced. Since beef is the major livestock, pasture is an important land use.

MAJOR CROP ENTERPRISES

Corn, soybeans, tobacco, and hay are the major crops produced in the area. Although the acreage used for corn production declined from 767,000 acres in 1959 to 443,000 acres in 1969, it accounted for over 25 percent of the total land used for crops. From 1959 to 1969, the acreage of soybeans increased by 50 percent and production by 85 percent. Acreage used for wheat decreased slightly, but production increased by 23 percent in the 10-year period. Both acreage and production decreased for other small grains. Tobacco acreage declined substantially from 1959 to 1969, with a small decline in volume produced. The area produced about 25 percent of the tobacco produced in Kentucky.

Acreage and production of hay and silage crops for feed purposes have increased in response to an expanded livestock industry. The acreage of corn for silage increased rapidly at the expense of corn for grain. In 1959 there were 43.7 acres of corn for grain to each acre of corn for silage. The ratio in 1969 was only 13.5 acres for grain to each acre of corn for silage. Besides these primary crops, the study area also produces some vegetables, grass, and hay seed. The acreage and production of major crops are shown in tables III.4 and III.5.

Table III.4 - Acreage of Crops Harvested in Selected Years

Green River Study Area

Crop	Years		
	1959	1964	1969
	------Thousands------		
Corn for grain	767.2	513.2	442.9
Corn for silage	10.7	22.7	32.8
Soybeans	124.7	156.3	185.5
Wheat	99.6	90.2	90.0
Oats	28.2	16.0	11.9
Barley	42.7	27.0	22.7
Alfalfa hay	66.9	102.2	50.8
Clover and timothy hay	123.2	146.5	208.6
Other hay	50.0	68.7	111.2
Tobacco	63.9	64.2	36.4

Source: U.S. Census of Agriculture.

Table III.5 - Crop Production for Selected Years

Green River Study Area

Crop	Years		
	1959		
	-------Thousands--------		
Corn for grain (bushels)	33,166	28,122	33,069
Corn for silage (tons)	177	292	476
Soybeans (bushels)	2,743	3,424	5,056
Wheat (bushels)	2,581	2,946	3,164
Oats (bushels)	949	683	633
Barley (bushels)	1,266	1,059	1,175
Alfalfa hay (tons)	157	258	129
Clover and timothy hay (tons)	181	201	379
Other hay (tons)	60	86	180
Tobacco (pounds)	95,610	125,068	84,820

Source: U.S. Census of Agriculture.

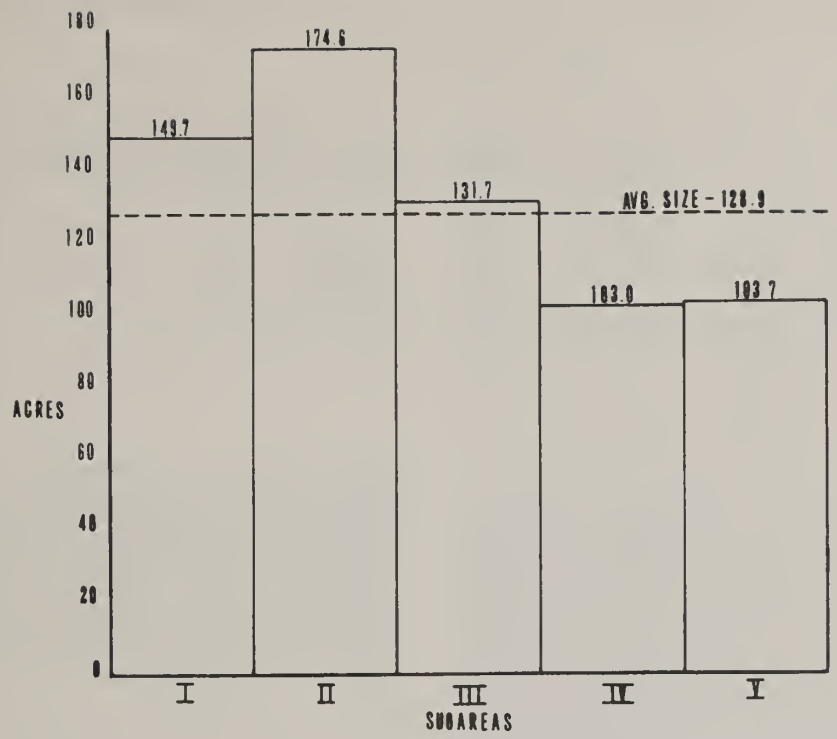


FIGURE III-3 AVERAGE FARM SIZE BY SUBAREAS AND TOTAL AREA

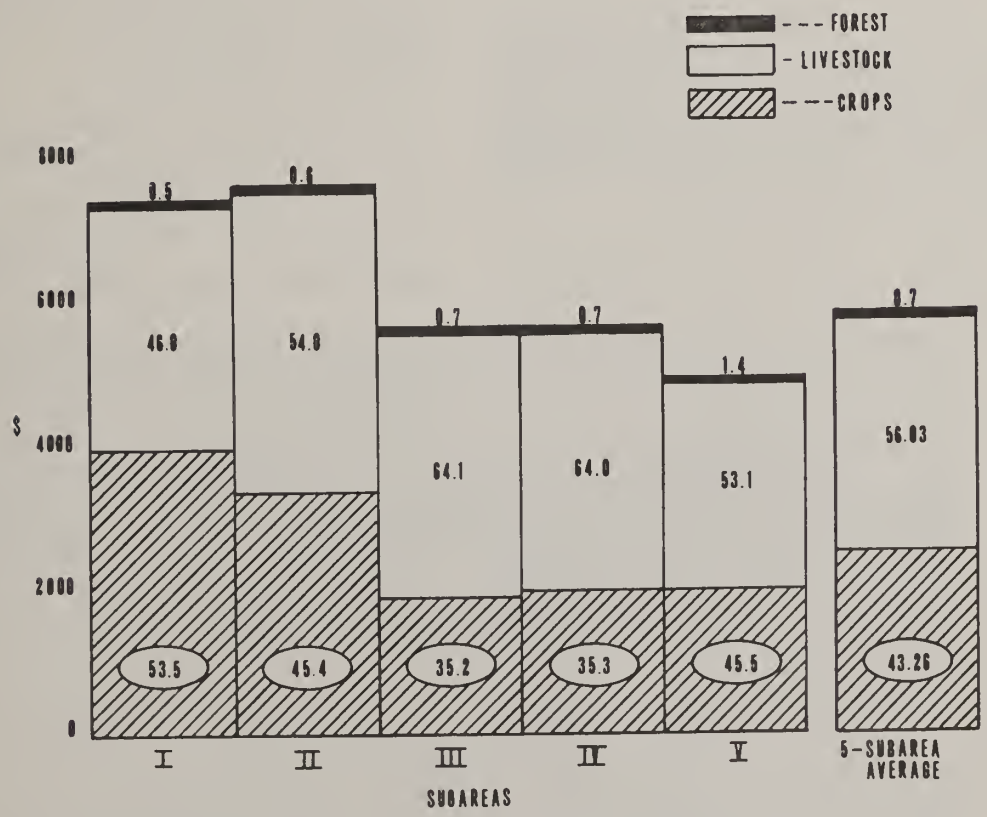


FIGURE III-4 MARKET VALUE OF ALL AGRICULTURAL PRODUCTS SOLD

Table III.6 - Numbers of Livestock on Hand and Sold for Selected Years

Green River Study Area

Livestock	1959		1964		1969	
	(No.1/)	(% 2/)	(No.1/)	(% 2/)	(No.1/)	(% 2/)
Cattle and calves	349.3	35.1	432.7	39.2	441.5	35.0
Hogs and pigs	752.0	42.4	766.5	46.7	862.0	44.2
Broiler & meat chickens	5,832.2	42.7	3,690.4	33.6	2,038.3	40.5
Milk cows on hand	165.0	35.4	149.2	40.7	101.4	35.9

Source: U.S. Census of Agriculture.

1/ Number in thousands.
2/ Percent of Kentucky's totals.

MAJOR LIVESTOCK ENTERPRISES

In 1969, 56 percent of all study area farm sales came from livestock and livestock products. Cattle and hog production are both expanding at a rate faster than that for the State. Dairy production is declining at the same rate as the State, while poultry production is declining faster. Table III.6 shows the number of animals sold and milk cows on hand in the study area in 1959, 1964, and 1969.

FARM NUMBERS AND SIZE

The number of farms in the study area decreased 8 percent from 48,025 in 1959 to 44,098 in 1969, while land in farms decreased 2 percent from 5.8 million acres to 5.7 million acres. Since the State experienced a larger decrease, the study areas' proportion of the total number of farms and acreage increased from 33 to 36 percent.

Two trends in farm size are appearing. A trend toward larger farms for economic advantages and toward hobby size farms of less than 10 acres. The absolute number of farms over 260 acres has increased while the total number of farms has declined. This change is due to an effort to increase the size of farming operations to gain efficiency. The number of hobby class farms of less than 10 acres has increased 16 percent. This results primarily from more people establishing country retirement homes. Table III.7 shows the percentage of farms in each size class for the census years of 1959 and 1969.

Value of sales is another measure of farm size. In general, all farms with over $2,500 in sales are classed as commercial. However, if an operator was under 65 years of age, has less than 100 days of off-farm work, and has sales over $50, his farm is considered commercial (table III.8).

Table III.7 - Percentages of Farms by Size for Selected Years

Green River Study Area

Farm Size	Years	
	1959	1969
	----Percent---	
Less than 10 acres	8.0	10.0
10 to 50 acres	21.1	19.9
50 to 100 acres	26.9	25.6
100 to 180 acres	25.1	23.9
180 to 260 acres	9.7	9.6
260 to 500 acres	7.2	8.0
500 to 1,000 acres	1.7	2.4
Over 1,000 acres	0.3	0.6

Source: U.S. Census of Agriculture.

Table III.8 - Number of Farms by Type for Selected Years

Green River Study Area

Type of Farms	Years		
	1959	1964	1969
	--------Number--------		
Commercial (Class I-V)	29,624	30,085	27,856
Commercial (Class VI)	18,401	14,479	16,242
Part-time	61	56	67
Part retirement	39	44	33

Source: U.S. Census of Agriculture

Commercial farms are divided into six economic classes ranging from class I with sales over $40,000 to class VI with sales of $50 to $2,500 (table III.9). From 1959 to 1969, the number of farms with sales of $5,000 and over increased. The number of study area farms with sales over $40,000 increased by nearly 500 percent as compared to a 400 percent increase for the State and only a 200 percent for the Nation. Farms with sales of less than $5,000 decreased in numbers.

Table III.9 - Distribution of Farms by Economic Classes

Green River Study Area

Value of Sales	Years 1959	1964	1969
	-------Percent--------		
$40,000 or more	0.5	1.0	2.6
$20,000 to $40,000	2.5	3.0	6.3
$10,000 to $20,000	7.5	9.7	13.1
$ 5,000 to $10,000	19.8	24.0	26.0
$ 50 to $ 2,500	29.8	27.6	20.0

Source: U.S. Census of Agriculture.

VALUE OF FARM PRODUCTION

The value of farm products sold from area farms was $264.3 million in 1969 (table III.10). This represented over one-third of the total value of farm products sold in Kentucky. The increase in value of products sold from 1959 to 1969 was 54 percent as compared with 48 percent for the State and about 41 percent for the Nation.

Table III.10 - Value of Farm Products Sold

Green River Study Area

Products	Years 1959	1964	1969
	---------$1,000----------		
All farm products sold	171,675	205,221	264,315
All crops sold	80,933	110,629	114,334
All livestock and livestock products	90,742	94,443	148,081

Source: U.S. Census of Agriculture.

Crop sales in 1969 accounted for about 43 percent of gross farm income, livestock product sales amounted to nearly 56 percent, and forestry products one percent. The study area's livestock sales are composed of 4 percent from poultry and products, 22 percent dairy products, and 74 percent farm animals sold for slaughter and feeding purposes.

Additional farm income is derived from nursery, fruit, nut, and vegetable sales. Approximately 26 percent of the State's fruit and nuts and 14 percent of the State's vegetables come from the study area. Forty-three percent of the State's farm forestry products comes from the study area.

OFF-FARM EMPLOYMENT

Off-farm employment by operators has increased rapidly. The number of operators reporting 100 days or more off-farm employment increased 52 percent from 1959 to 1969 as compared to 30 percent for the State. Forty percent of all operators work off the farm 100 days or more each year. This is equivalent to the national average but is less than the State's figure of 42 percent. The percent of operators reporting any off-farm work was approximately 55 percent for the study area, the same as the State and the Nation.

CAPITAL INVESTMENT

Capital investments have increased significantly since 1959, largely from added farm improvements and inflation. The average value of land and buildings per farm in the study area increased from $13,437 in 1959 to

Table III.11 - Value of Land and Buildings Per Farm and Percent Change from 1959 to 1969

Green River Study Area

	Years			Percent Change
	1959	1964	1969	1959 To 1969
Study area	$13,437	$20,135	$28,999	116
Kentucky	15,269	22,235	32,309	112
United States	33,175	50,646	75,725	128

Source: U.S. Census of Agriculture

almost $29,000 in 1969. The increase, however, was less than the national average (table III.11).

Converting the investment to a per-acre figure shows a different picture. The 1969 per-acre value of land and buildings was $225 as compared with $200 for the Nation, and values in the study area are increasing rapidly (table III.12).

Table III.12 - Value of Land and Buildings Per Acre and Percent Changes From 1959 To 1969

Green River Study Area

	Years			Percent Change
	1959	1964	1969	1959 To 1969
Study area	$111	$159	$225	103
Kentucky	135	182	252	87
United States	115	152	200	74

Source: U.S. Census of Agriculture.

FOREST RESOURCES AND RELATED ECONOMIC ACTIVITIES

EXTENT AND NATURE OF THE RESOURCES2/

There are approximately 2.9 million acres of forest land in the study area. Ninety-seven percent of the area's forests is hardwood. Commercial forest land, which does or can produce crops of industrial wood and is not withdrawn from timber utilization by statute or administrative regulations, makes up almost 98 percent of the forest land in the study area. The remaining two percent is noncommercial forest land. This is unproductive forest land incapable of yielding crops of industrial wood and productive forest land withdrawn from commercial timber use through statute or administrative regulations. The bulk of the noncommercial forest, reserved from timber cutting, is found in Mammoth Cave National Park. Other noncommercial areas are in the Pennyrile Forest, Lake Malone, John James Audubon, Rough River Dam, Green River Lake, and the Barren River Lake State Parks.

The commercial forest area has increased about 5 percent, from 2,725,100 to 2,849,400 acres since 1949, with gains occurring over the entire study area. The greatest gain, 16 percent, was in the 6 counties in subarea I Much of the increase in forest area has resulted from abandoned sub-marginal fields and pastures becoming re-stocked with tree cover. Counties in the central part of the study area are more heavily forested than those to the north and south where the land surface is more level and better suited to agriculture.

The pattern of forest land ownership has not changed significantly since 1949, although acreages of commercial forest land in both public and private ownership have increased. About 96 percent of the commercial forest is privately owned, and the remainder is on lands in Fort Knox, Fort Campbell, Corps of Engineers projects and the Pennyrile State Forest (table III.13).

Almost 75 percent of the commercial forest is either oak-hickory or central mixed hardwood types. Elm-ash-cottonwood and red cedar-hardwood comprise nine percent and seven percent of the commercial forest, respectively. Red cedar-hardwood is commonly associated with dry sites. Although a small acreage, nearly one-half of the State's

Table III.13 - Area of Commercial Forest Land by Ownership Class, 1967

Green River Study Area

Ownership Class	Commercial Forest Land	
	1,000 Acres	Percent
Public	97.7	3.4
Forest industry	28.8	1.0
Farmer and miscellaneous	2,722.9	95.6
All ownership	2,849.4	100.0

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

2/ Forest acreage and volumes were obtained by updating, to the base year of 1967, an inventory of the timber resources in Kentucky that was collected in 1963.

oak-gum-cypress forests is in the study area along the bottom lands of the Green and Ohio Rivers.

Over 46 percent of the commercial forest area is in sawtimber stand size; poletimber accounts for 25 percent; seedlings and saplings 28 percent; with the remaining being nonstocked. These nonstocked areas contain some volume, but less than 10 percent of the growing space is effectively utilized by growing stock. The study area has almost 1.1 million acres, or 38 percent of the forest, that are 70 percent or more stocked with growing-stock trees. Another 1.4 million acres or 50 percent are building toward well stocked stands. Additional information about forest land acreage is listed by subareas in appendix tables III.5 through III.8.

FOREST VOLUME, GROWTH, AND REMOVALS

The 1967 timber inventory shows 1.9 billion cubic feet of wood classified as growing stock (table III.14). Almost 60 percent of the growing-stock volume is in sawtimber. A typical forest acre has about 670 cubic feet of growing stock of which 60 percent, or 2,150 board feet, is sawtimber. The total net volume of sawtimber is 6.1 billion board feet. Approximately 95 percent of the timber inventory, growing stock and sawtimber, is under the farmer-miscellaneous ownership class.

The net annual growth for growing stock was 3.9 million cubic feet of softwood and 87.0 million cubic feet of hardwood. The growth for all species averaged 31.9 cubic feet per acre per year, a 4.8-percent yield. This represents a weighted average of the softwood growth rate of 6.9 percent and a hardwood rate of 4.7 percent. The net annual growth for sawtimber was 18.5 million board feet of softwood and 402.8 million board feet of hardwood. The combined average growth per acre was 148 board feet.

The timber removal from the growing stock was 34.9 million cubic feet and from sawtimber was 206.9 million board feet (table III.15). Not all of the growing-stock removal was utilized for products. Just over 2 percent or 723,000 cubic feet of it was left in the forest as logging residue. Over 65 percent of the total growing-stock removals was for saw logs, approximately 20 percent went for fuelwood, and 13 percent to the remaining products. Even though timber growth is lower than it might be, it still exceeded the cut. A comparison of growth and removals shows that growing-stock volume is increasing almost three percent and sawtimber volume almost four percent annually.

Additional volume data by subarea are listed in appendix tables III.9 through III.13.

Table III.14 - Volume of Growing Stock and Sawtimber on Commercial Forest Land by Tree-size Class, 1967

Green River Study Area

Tree-size Classes	Growing Stock (Million Cubic Feet)			Sawtimber (Million Board Feet)		
	Total	Softwood	Hardwood	Total	Softwood	Hardwood
Poletimber	762.6	21.6	741.0	-	-	-
Sawtimber	1,143.9	34.3	1,109.6	6,131.6	208.1	5,923.5
All classes	1,906.5	55.9	1,850.6	6,131.6	208.1	5,923.5

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Table III.15 - Timber Removals from Growing Stock and Sawtimber on Commercial Forest Land by Item and Species Group, 1967

Green River Study Area

Item	Growing Stock			Sawtimber		
	Species	Softwood	Hardwood	Species	Softwood	Hardwood
	- Thousand Cubic Feet -			- Thousand Board Feet -		
Roundwood products:						
Industrial:						
Saw logs	22,764	1,411	21,353	153,794	7,107	146,687
Cooperage logs	1,280	0	1,280	8,158	0	8,158
Mine timbers	1,061	69	992	2,128	137	1,991
Posts	760	262	498	573	72	501
Other	1,593	14	1,579	1,000	42	958
Domestic fuelwood	6,691	0	6,691	13,472	0	13,472
All products	34,149	1,756	32,393	179,125	7,358	171,767
Logging residue	723	94	629	27,809	175	27,634
Total removals	34,872	1,850	33,022	206,934	7,533	199,401

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

UTILIZATION: KIND, VOLUME, AND VALUE OF OUTPUT

Timber industries have a significant role in the study area's economy. In 1969, the total timber removals from the growing stock were approximately 39.1 million cubic feet (table III.16). This is a 12-percent increase over the 1976 timber removals. Roundwood products accounted for 38.3 million cubic feet, with the remaining timber removed going to logging residue. Industrial roundwood products harvested totaled 32.6 million cubic feet. Saw logs comprised 64 percent; cooperage, mine timbers, pulpwood, posts, and other 21 percent; with fuelwood amounting to 15 percent of the total roundwood production. Hardwoods made up 95 percent of the total production.

The stumpage value of the 1969 products was approximately $6,698,000. Sawlogs accounted for 89 percent of the total value with cooperage logs being the next largest by producing over 8 percent of the total value.

A total of 167 primary wood-using plants were in operation during 1967 (table III.17). Included in this number were 128 sawmills, 1 pulpmill, 8 cooperage mills, 10 handle and furniture blank mills, and 20 timber product concentration yards. These yards bring products such as pulpwood, poles, logs, and posts together for resale. Only one pulpmill, located along the Ohio River in Hancock County, is in the study area. The supply for

Table III.16 - Timber Removals from Growing Stock on Commercial Forest Land by Item and Species Group, 1969

Green River Study Area

Item	All Species	Softwood	Hardwood
	- Thousand Cubic Feet -		
Roundwood products:			
Industrial:			
Saw logs	24,675	1,481	23,194
Pulpwood	680	0	680
Veneer logs	0	0	0
Cooperage logs	1,154	0	1,154
Mine timbers	1,423	100	1,323
Posts	268	260	8
Poles	0	0	0
Other	4,415	44	4,371
Domestic fuelwood	5,667	0	5,667
All products	38,282	1,885	36,397
Logging residue	847	110	737
Total removals	39,129	1,995	37,134

Source: Updated from primary Wood-Product Industries of Kentucky - 1969. USDA, Forest Service Resource Bulletin NE-25, 1972.

Table III.17 - Primary Wood-Using Industries, 1963 and 1967

Green River Study Area

Year	Total	Sawmills	Cooperage	Furniture and Handle	Pulpmill	Timber Yards
1963	207	190	11	5	0	1
1967	167	128	8	10	1	20

Source: Kentucky Forests - U.S. Forest Service Resource Bulletin CS-6 and CS-9, March 1966; and Primary Wood Industries of Kentucky 1967 - A Utilization Summary and Directory by C. J. Lohr.

this mill comes from the 5-county area around Hancock County. Approximately 42 percent of the wood-using plants were located in the eastern part of the study area in subarea V. This area accounted for 38 percent of the sawmills and 59 percent of the other mills and timber product concentration yards.

Since 1963, the study area has had a 20-percent reduction in the total number of primary wood-using plants (table III.17). The number of sawmills was reduced 28 percent. The reduction of sawmills took place in every subarea with a range of 18 percent in subarea II to 44 percent in subarea I. Cooperage plants also decreased 27 percent. However, the furniture and handle-blank plants and the timber concentration yards went from 6 to 30 in numbers, a 400-percent increase. Appendix tables III.14 and III.15 list the 1963 and 1967 primary wood-using industries by subarea.

FOREST EMPLOYMENT AND INCOME

Employment in timber-based manufacturing industries is presented in three groups; namely, forest management, lumber and wood products, and paper and allied products.

Forest management employment involves protecting and managing forest lands for the production of timber and related products. The lumber and wood products industry employs the needed labor and management in cutting timber and pulpwood and operating merchant sawmills, lath mills, shingle mills, cooperage stock mills, planning mills, plywood mills, veneer mills, and factories producing finished articles made from wood. Paper and allied products employment includes labor and management involved in the manufacturing of pulp, paper, paperboard, and paper products.

Forest-related employment in 1965 totaled 3,922 employees with an annual income of $15,900,000 (table III.18). The lumber and wood products group had the largest number of employees and the greatest total income. The income per employee averaged over $4,050 with the paper and allied products group having an average employee income of $5,875.

By 1970, the forest employment accounted for almost two percent of the total employment in the study area. During the period 1965-70, there was an increase of 4 percent in forest employment with a 24-percent increase in annual income (table III.18). Over the

Table III.18 - Employment and Income in Forest Management and Industry for Selected Years

Green River Basin

Year	Forest Management		Lumber and Wood Products		Pulp, Paper, and Allied Products	
	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)
1965	571	2,861	2,458	7,806	893	5,246
1970	652	4,024	2,471	8,717	962	6,958
1980	814	6,350	2,500	11,321	1,200	11,509
2000	1,213	15,527	2,600	17,091	1,500	22,451
2020	1,513	31,672	2,500	24,951	1,400	35,887

Source: USDA, Forest Service.

Table III.19 - Recreational Facilities and Use
Corps of Engineers Reservoirs, 1969

Green River Basin

Reservoir	Reservoir Acess Area	Public Boat Launching Lane	Picnic Areas	Swimming Areas	Tent or Trailer Spaces	Guest Rental Units	Original Camps	Visitor-Days
Rough River	13	26	7	1	215	68	1	1,162,500
Nolin	17	24	4	0	131	17	0	346,500
Barren	8	22	15	0	174	0	0	875,200
Green	7	27	0	4	0	0	0	509,400

Source: Recreation - Civil Works Project Brochure, Corps of Engineers, Dept. of the Army.

past years, agricultural employment has declined; whereas, forest management employment has increased 14 percent since 1965.

Future forest employment is expected to increase through the year 2000.

Additional data on forest employment and income by subareas are listed in appendix tables III.16 through III.20.

OUTDOOR RECREATION

Approximately 96,000 acres of land and 35,000 acres of water are used for recreational purposes in the area.3/ Major recreational areas are the Mammoth Cave National Park; four U.S. Army, Corps of Engineers developments; and about 11,000 acres of parks, playgrounds, and outdoor recreational acres.

The Mammoth Cave National Park occupies approximately 51,000 acres and offers the world's longest network of cavern corridors, 144 miles in length. Hotel and cottage accommodations and an improved 145-site campground and picnic area are available. There are guided and self-guided scenic trails that lead through the dense forest and along the Green River bluffs.

3/ The land area includes acreage used predominately for recreational purposes. It excludes undeveloped rural lands which may be used for hunting, horseback riding, and similar outdoor recreation. The water areas exclude streams and small farm ponds. In addition to recreation, the water may be used for flood control, municipal and industrial supplies, and other uses.

Table III.20 - Existing Recreational Facilities and Use, 1970

Green River Basin

Activity	Facilities 1/ (No.)	Land or Water Area (Acres)	Units 2/ (No.)	Visitor-Days
Camping	48	900	2,350	530,000
Picnicking	146	1,200	3,450	1,800,000
Golf courses	29	1,800	320	1,200,000
Tennis	73	60	140	435,000
Bicycling	2	N.A.	16	2,500,000
Hiking	29	64	135	760,000
Horseback riding	20	N.A.	100	550,000
Other outdoor games 3/	85	260	140	2,200,000
Water sports		35,000 4/		6,800,000 5/
Fishing				1,800,000
Hunting				3,200,000

Source: Comprehensive Outdoor Recreation Plan for Kentucky, prepared by Spindletop Research, Inc., Lexington, Kentucky, and primary data.

1/ Includes number of facilities providing recreational activities.
2/ Includes number of tables, camping pads, trail miles, etc.
3/ Includes baseball, basketball, and similar outdoor playground facilities.
4/ Reflects area used for boating, skiing, swimming, and related water sports.
5/ Excludes fishing but includes swimming, skiing, power boating, sailing, and canoeing, with swimming accounting for approximately 70 percent of the total.

The four Corps of Engineers developments provide 29,000 acres of water and 34,000 acres of land adjacent to this water. All of this area has recreational potential. In 1969, the attendance at the four reservoir areas was nearly 2.9 million visitor-days (table III.19).

Other recreational opportunities exist on 2,600 acres of water in completed Public Law 566 watershed developments and about 3,400 acres of water in state, county, city, and privately owned developments.

The area contains opportunities for a wide range of activities, including camping, picnicking, hicking, horseback riding, bicycling, golf, tennis, other outdoor games, hunting, fishing, boating, swimming, water skiing, and other water sports (table III.20).

Areas available for hunting and fishing and the supply of game and fish are considered adequate to meet current needs. The hunting potential is estimated to exceed 3.2 million hunter-days. Important game species are the bobwhite quail, morning dove, cottontail rabbit, gray squirrel, raccoon, and white-tail deer. The sport fishing potential exceeds 1.8 million fisherman-days, and species include largemouth bass, smallmouth bass, rock bass, Kentucky bass, white bass, croppie, walleye, muskellunge, bluegill, channel catfish, buffalo, and carp.

RESOURCE PROBLEMS AND NEEDS

This chapter identifies the major resource problems, needs emanating from the problems, and projected food, fiber, and recreational needs for the years 2000 and 2020. The type and distribution of problems and needs are emphasized and reflect, where applicable, the scope and magnitude of economic losses or degraded environmental values.1/

PROBLEMS

The most widespread water and related land-based problem in the basin is erosion. Erosion exceeding acceptable limits occurs on about 1,305,000 acres of agricultural lands, 1,600 miles of roadbanks, and 385,000 acres of forest land (table IV.1). Flooding, the next most widespread problem, affects some 516,000 acres. Sediment deposition affects about 39,000 acres of bottom land and contributes to swamping problems. Impaired drainage prevails on 315,500 acres. Other pollution and related environmental problems are caused by acid mine drainage, agricultural pesticides, untreated sewage, garbage, and waste materials.

1/ To facilitate identifying the location, distribution, and magnitude of problems and needs, they are presented by physiographic region, hydrologic area, economic subarea, or county. See chapters II and III for a description of these areas.

Table IV.1 - Summary of Major Water and Related Land Resource Problems

Green River Basin

Item	Unit	Quantity
Erosion		
Agricultural	Acres	1,305,000
Gully	Acres	112,000
Streambank	Miles	680
Roadbank	Miles	1,600
Forest	Acres	385,000
Flood plain scour	Acres	9,800
Coal mine areas	Acres	43,700
Flooding		
Agricultural	Acres	515,190
Urban	Acres	1,490
Impaired Drainage	Acres	315,500
Excessive Sediment		
Infertile deposition	Acres	39,000
Swamping	Acres	30,000

Source: Data obtained from study inventories and investigations.

EROSION

Slight to moderately severe erosion problems occur throughout the basin. Sheet and gully are the principal types of soil erosion. Some rill, landslide, and waterfall erosion occur when prolonged or high intensity rainfall causes high-stage floods and saturated soil conditions. Some natural erosion occurs, but erosion accelerated by man's activities causes the most damage.

Sheet erosion is most prevalent on sloping uplands having fine textured, silt loam soils. These soils, which occupy almost 50 percent of the basin, cover approximately two-thirds of the Eastern and Western Pennyroyal Physiographic Regions and one-third of the Western Coal Field Physiographic Region. At one time, the silt loam soils in these regions were estimated to have average depths of 8 inches. Over the years, however, surface soils have been removed by sheet erosion from about one-fourth of the area, leaving silty clay or clayey subsoils exposed.

Some erosion occurs on most cropland with about 60 percent of the basin's 2.1 million acres having annual rates in excess of acceptable limits. (Because of the shallowness of most upland soils and other conditions, annual erosion rates exceeding 3 to 5 tons per acre are generally regarded in Kentucky as exceeding acceptable limits.) This acreage, with an average rate of about 7.6 tons per acre, has a gross erosion of 9,774,000 tons annually. Some of the erosion occurs on other acreage, but the dominant portion is on the acreage classified in the land classification system as having an erosion "e" hazard. Appendix table IV.1 shows the annual erosion rates on cropland needing treatment.

About two-thirds of the basin's area is classed as upland erosive "e" soils. This includes 1,356,500 acres of cropland, of which about 57 percent is capability class and subclass IIe land, 24 percent is IIIe, 13 percent is IVe, and the remaining 6 percent is mostly VIe (table IV.2).

Table IV.2 - Land Use of Upland Soils Having Erosion Limitations

Green River Basin

Land Capability Class and Subclass	Land Use				
	Cropland	Pasture	Forest	Other[1/]	Total
IIe	767,400	254,900	107,300	77,600	1,207,200
IIIe	323,900	250,000	181,000	43,800	798,700
IVe	174,600	215,500	253,000	44,700	687,800
VIe	72,300	150,100	275,100	40,600	538,100
VIIe	18,300	56,500	320,800	61,800	457,400
Total	1,356,500	927,000	1,137,200	268,500	3,689,200

Source: Data compiled from Soil and Water Conservation Needs Inventories for Kentucky 1970, Tennessee 1971.

1/ Other includes road, farmstead, idle, and other rural lands.

Pastureland, when properly managed and maintained, has little erosion. However, approximately 250,000 acres in the basin have some erosion problem. Annual erosion rates on this acreage vary, with gently sloping uplands averaging about 0.5 ton or less per acre; moderately sloping uplands with 8 percent and greater slopes about 1.6 tons per acre; and steeper areas around 5.0 tons per acre. Most of the excessive erosion problems on pastureland result from inadequate grass cover, overgrazing, improper fertilization, lack of weed and brush control, and related management practices.

Gully erosion is localized and not as widespread as sheet erosion. The most extensive gully erosion is in the Western Coal Field Physiographic Region, particularly in the wind deposited loess soils and on the steeper sandstone-shale uplands. Gullies are more prominent on idle land, forest lands, strip mining areas, and unimproved pasturelands. A total of about 112,000 acres are affected by gully erosion. About 57 percent of this acreage is in the Western Coal Field Physiographic Region, and the remaining 43 percent is in the other three physiographic regions. Counties most seriously affected by gully erosion are Muhlenberg, Breckinridge, Green, Larue, Taylor, Hardin, and Hart.

Flood plain scour is prevalent in valleys susceptible to high velocity overbank flows. Although the area varies, an average of about 9,800 acres are affected to some extent annually. Flood plain scour results from floodwaters dislodging and removing surface soils on cultivated, inadequately vegetated, and disturbed lands. Most of the scour erosion damages occur on upstream tributaries located in the rolling to steep sections of the Pennyroyal Physiographic Region, and some in the eastern part of the Western Coal Field Physiographic Region. Flood plains most damaged by scour erosion occur in the Barren River tributaries of Trammel, Skaggs, Peter, and Drakes Creeks. Green, Warren, Christian, Barren, and Allen Counties are most seriously affected.

Streambank erosion, like flood plain scour, results from high velocity floodflow. Streambank erosion consists primarily of degrading and eroding of the channel banks, especially on the narrow, entrenched, and meandering streams. Freezing and thawing, along with livestock use, contribute to the degrading and slipping problems on streambanks. Simpson Christian, Warren, Monroe, Metcalfe, and Barren Counties in Kentucky and Macon and Sumner in Tennessee have the most extensive streambank erosion.

Rill and landslide erosion are comparatively minor. Rill erosion is confined to those sections in the western basin area having intense rainfall on sloping croplands. Landslide erosion results from floods undercutting toe slopes and slippage of saturated soils on steep, sloping areas. This occurs mostly in the western portion of the basin and on steep forested and disturbed lands during early spring when soils are saturated.

Table IV.3 - Estimated Average Annual Gross Erosion by Condition on Forest Land, 1972

Green River Basin

Condition	Forest Land Acres	Gross Erosion Rate Tons/Ac/Yr	Gross Erosion Tons/Yr	Gross Erosion Percent
Natural	2,015,150	0.6	1,289,700	37.2
Disturbed				
Logging	151,140	3.4	518,400	15.0
Skid trails	22,170	31.7	702,300	20.3
Spur roads	40,300	4.3	171,300	4.9
Fire	32,240	3.0	97,000	2.8
Grazing	201,510	3.4	687,100	19.8
Total or Average		1.7	3,465,800	100.0

Source: Forest Service, U.S. Department of Agriculture.

Field studies indicate that the 2,015,150 acres of forest land are experiencing 3,465,800 tons of erosion annually, or an average rate of 1.7 tons per acre (table IV.3). Erosion rates range from 0.6 tons for undisturbed areas to 31.7 tons per acre annually from skid trails. Of all the forestry related activities, logging, skid trails, and grazing produce about 88 percent of the accelerated erosion.

Skid trails occupy about 1 percent of the forest area, but produce over 20 percent of the total gross erosion on forest land. Grazing produces almost 20 percent of this total. Damage from grazing is evident on 201,500 basin acres. The average annual rate of erosion from such areas is over 3 tons per acre with an estimated sediment yield of 0.5 ton per acre.

Logging, which is defined as the "felling and removing of trees," produced 15 percent of the total forest land erosion. The erosion rate on logging areas is about 3.4 tons per acre per year. Spur roads and areas burned by fire, with annual erosion rates of 4.25 and 3.01 tons, produced about 8 percent of the forest land total gross erosion.

The degree of gross erosion was determined by establishing the relative amount of disturbance caused by logging, fire, skid trails, etc., in each soil association. Appendix table IV.2 shows the degree of erosion caused by each area of disturbance. The Garmon-Talbott-Baxter and the Trimble-Garmon-Mountview (12-30 percent slope) soil associations erode severely when disturbed. Skid trails, spur roads, and grazing cause severe problems in over 50 percent of the soil associations. Eighty-five percent of the severe erosion, 5 tons per acre or greater, is within soil associations 12 through 23 located in the southern and eastern portions of the basin (plate II-5).

Erosion on nonagricultural lands occurs mainly on public road and railroad, surface mine, commercial, industrial, and residential areas. Approximately 1,600 miles of roadbanks are affected to some degree by erosion. While distributed throughout the basin, roadbank erosion is more prevalent in Simpson, Barren, Warren, Christian, and Green Counties. The problems result primarily from runoff on unstabilized sloping banks, inadequately protected drainage ditches, and discharge of drainage water on adjacent lands. Excessive erosion occurs on both the newly and previously strip-mined areas in the lower Western Coal Field Physiographic Region, especially in Muhlenberg and Hopkins Counties. Erosion rates on nonagricultural lands vary widely, with the larger amounts being on the newly disturbed and unstabilized surface-mined, developed, and road areas. Annual erosion rates on many of these areas exceed 50 tons per acre.

Primary damage resulting from erosion is the loss of the soil resource. When expressed in reduced crop yields, the productivity loss from severe erosion on agricultural land ranges up to 10 percent, from moderate erosion about 5 percent, and from slight erosion about 2 percent. The erosion increases the loss of artificially added plant nutrients, decreases water infiltration rates, accelerates runoff, increases management problems, restricts land use alternatives, and often increases production costs.

FLOODWATER

The watershed project inventory sections of the 1970-1971 Soil and Water Conservation Needs Inventories for Kentucky and Tennessee show a total of 109 delineated watersheds having 250,000 acres or less in the basin. Of the 109 watersheds, 59 watersheds covering 3,257,000 acres drain into the Green River and its smaller tributaries. Barren River subbasin, with 24 watersheds, 18 of which are in Kentucky and 6 in Tennessee, covers 1,446,560 acres. Rough River subbasin has 17 watersheds covering 692,000 acres, and Pond River subbasin has 9 with 511,000 acres.

Approximately nine percent of the basin is subject to floodwater and sediment damage. The area subject to damage includes about 515,190 acres of rural land and 1,490 acres in urban areas. Of the 516,680 acres, about 300,000 are on Green River and its smaller tributaries, with the remaining 216,680 acres in the three subbasins of Pond, Barren, and Rough Rivers (plate IV-1).

Floodwater problems result primarily from overbank streamflows and overland runoff caused by high intensity rains occurring when antecedent soil moisture is high. Floods that inundate larger land areas occur more frequently during the winter and spring months. These floods are usually more damaging to rural farm improvements and to some urban residential or industrial developments. Floods occurring during the cropping season are usually high intensity localized rains which inundate smaller areas. These normally cause more serious crop and pasture damages, disrupt agricultural operations and use of flood plains, and frequently occur too late in the growing season for recovery by followup farming operations.

Floods in the steeper, sloping portions of the upper sections of the Green, Barren, and Rough Rivers generally have high velocity flows. These floods usually are of a shorter duration but normally cause heavy damage to agricultural improvements, and public roads and bridges. Floods occurring on the comparatively wide and level bottom lands of the middle and lower portions of the Green and Pond Rivers normally have less velocity and remain on the land for longer periods. Long duration flooding and accumulation in low areas cause heavy damage to crops, but damage to improvements is generally less than with higher velocity flows.

Flooding frequency in the basin is rather high, particularly on unprotected tributaries in the middle and lower sections. At least one and often two and three floods occur annually. Stream gage data collected at the Woodbury, Kentucky station show that 11 damaging floods occurred on the Green River during the period 1955 to 1962. The maximum flood of record in the basin occurred in January and February 1937, inundating essentially all the flood plain for up to 25 days. Other major floods occurred in 1913, 1945, 1952, 1962, and 1969.

Floodwater damages to crops and pastures include delayed plantings, replantings, extensive plant injuries, production input losses, obnoxious weed infestations, additional tillage operations, and delayed harvests.

These reduce crop yields, increase production costs, and sometimes result in complete crop loss. In addition, prolonged flooding during the spring makes certain flood plain areas on the lower Green, Pond, and Rough Rivers inaccessible for extended periods. Delays in land preparation and planting cause many operators to produce lower value crops requiring a shorter growing season, or not produce crops on the affected land.

Noncrop floodwater damages occur to land, agricultural improvements, transportation facilities, and urban properties. Land damages result from floodwaters causing excessive erosion, flood plain scour, and sediment deposition. Agricultural improvement damages are to homesteads, outbuildings, fences, roads, machinery, and stored crops. With the exception of fence and farm roads, these damages are caused by high-stage floods in the central and western flood plain areas. Even low-stage floods cause widespread farm fence and road damage. Damage to transportation facilities includes scouring, degrading, or destruction of road fills, banks, surfaces, culverts, ditches, and bridges. Similar damages also occur to railroads paralleling and crossing the major streams.

As shown in table IV.4, 48 basin towns or communities have problems caused by flooding, drainage, or a combination. Of these, 8 are flooded by Green River; 2 by the Green River and adjacent streams; 23 by upstream tributaries; 7 by a combination of local drainage and tributary overflows; and 8 by local drainage. Towns or communities subject to frequent flooding in Kentucky include Slaughters in Webster County; Russellville in Logan; Campbellsville in Taylor; Mortons Gap in Hopkins; and Hodgenville in Larue. In Tennessee, Red Boiling Springs in Macon is the most extensively damaged. The major residential, commercial, and light industrial damage results from flooding of first flood household furnishings, basements, retail merchandise, garages, yards, and industrial machinery and equipment.2/

Floodwaters cause indirect damages, even though the property involved was not flooded. Examples are traffic disruptions resulting from inundated roads and bridges; delays in persons arriving to work, school, or place of business; loss in potential sales and income; and personal inconveniences. Most indirect damages result from the large, infrequent floods.

Floodwater damages in the basin are estimated to average $3,496,000 annually. This includes $1,913,000 to crops and pastures; $231,000 to other agricultural improvements; $192,000 to flood plain lands from sediment deposition and scour; $52,000 from obnoxious weed infestation and debris; $507,000 from road, bridge, and culvert damage; $249,000 to residential, industrial, and commercial properties; and $352,000 from indirect damages. Approximately 58 percent of the annual damages is estimated to occur on Green River and its smaller tributaries, 24 percent in the Pond River area, 11 percent on Barren, and 7 percent on Rough (table IV.5).

SEDIMENT

Primary sediment sources are surface-mined areas, roadbanks, streambanks, gullies, agricultural cropland, forests, construction, and development areas. Excessive sediment yields causes channel filling, swamping, infertile deposits on flood plains, and stream pollution. Sediment deposition also decreases the storage capacity of the basin's water supply reservoirs, flood control structures, recreational lakes, and farm ponds.

The largest concentrated area with extensive sedimentation is in the coal mining section of the Western Coal Field Physiographic Region, especially in Muhlenberg, Hopkins, and Ohio Counties. Approximately 68,000 acres have been surface mined for coal

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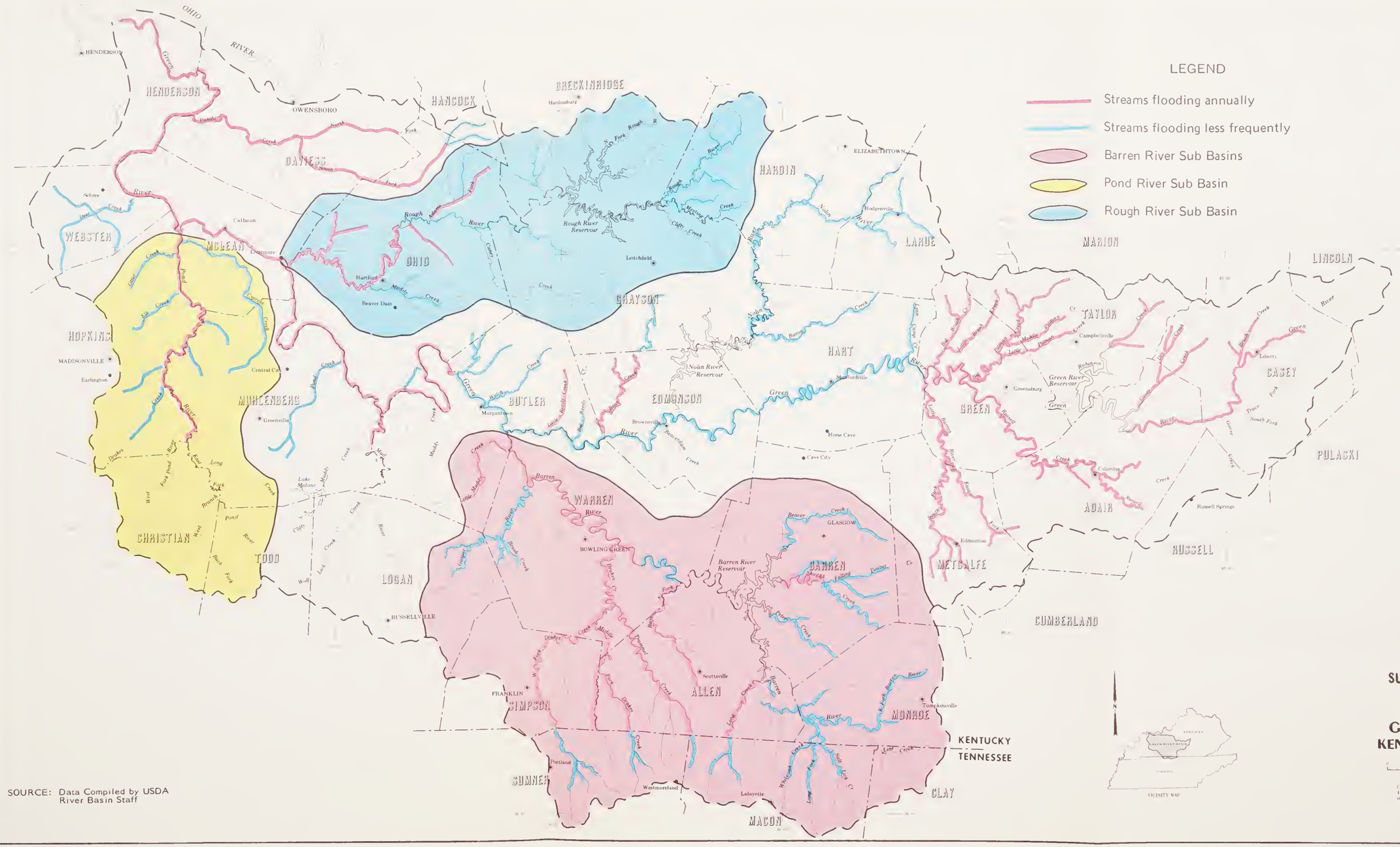
2/ Flooding problems in Elizabethtown in Hardin County and Caneyville in Grayson County have been virtually eliminated by installation of watershed projects in the counties. The recently approved Public Law 566 projects in Larue County, Kentucky, and Macon County, Tennessee, will reduce flooding problems in Hodgenville and Red Boiling Springs, respectively. The Corps of Engineers' development on the Green, Barren, and Rough Rivers, has reduced most of the significant damages in downstream urban areas.



SOURCE: Data Compiled by USDA River Basin Staff

Plate IV–1

SUB BASINS DELINEATIONS AND FLOOD PRONE AREAS GREEN RIVER BASIN KENTUCKY AND TENNESSEE

APPROXIMATE SCALE - MILES

Compiled and reproduced at 1:250,000 (1 inch equals 4 miles) from 1:250,000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:500,500 (1 inch equals 11 miles)

VICINITY MAP

NOVEMBER 1975 4-R-35119

USDA-SCS-FORT WORTH, TEX. 1975

REVISED MARCH 1975 4-R-34040

Table IV.4 - Towns or Communities with Excess Water Problems[1/]

Green River Basin

County	Town or Community	Source of Flooding	County	Town or Community	Source of Flooding
Kentucky					
Allen	Scottsville	Local drainage	Hardin	Elizabethtown	Valley Creek
Barren	Glasgow	Beaver Creek and tributaries	Hart	Bonnieville	Bacon Creek
			Logan	Auburn	Black Lick Creek
Butler	Rochester	Green River		Lewisburg	Alum Creek
	Woodbury	Green River		Russellville	Town Branch
Casey	Clementsville	Woods Creek	McLean	Calhoun	Green River
	Dunnville	Green River		Livermore	Green River
	Gilpin	South Fork Creek		Runsey	Green River
	Liberty	Green River			
	Middleburg	Green River	Muhlenberg	Central City	Local drainage and Little Cypress Creek
	Yosemite	Knob Lick Creek			
				Greenville	Local drainage and Caney Creek
Daviess	Curdsville	Green R. and Panther Creek			
	Pettit	Local drainage			
	Philpot	Local drainage	Ohio	Beaver Dam	Local drainage
	Stanley	Fulkerson Creek		McHenry	Local drainage
	Utica	Local drainage			
			Simpson	Franklin	Local drainage
Grayson	Caneyville	Caney Creek			
	Leitchfield	Bear Creek	Taylor	Campbellsville	Buckhorn Creek and local drainage
Warren	Bowling Green	Barren River and local drainage	Larue	Hodgenville	North Fork Nolin River
Webster	Sebree	McElroy Creek and local drainage	Tennessee		
	Slaughters	East Fork Deer Creek	Clay	Clementsville	Line Creek
				Hermitage Springs	Line Creek
Hopkins	Ashbyburg	Unnamed creek			
	Jewell City	Green, Pond Rivers	Macon	Red Boiling Springs	Salt Lick Creek
	Madisonville	Local drainage			
	Mortons Gap	Flat Creek and tributaries	Sumner	Westmoreland	Local drainage and Little Trammel Creek
	Nortonville	Pleasant Creek		Adolphus-Sugar	Little Trammel Creek
	White Plains	Unnamed creek		Grove & Pleasant Grove	Little Trammel Creek

Source: U.S. Department of Housing and Urban Development, Type 21, Flood Insurance Study, July 1973, and primary data.

1/ Includes overflows from rivers or streams which result from excessive runoff, debris blockades, and inadequate drainage systems.

Table IV.5 - Estimated Average Annual Flood Water and Sediment Damages

Green River Basin

Green River and its Subbasins	Major Damages[1]							
	Crop and Pasture	Road and Bridge	Other Agri-cultural	Sediment and Erosion	Urban	Other[2]	Total Indirect	Damages
	Dollars							
Green River[3]	1,073,000	303,000	142,000	97,000	193,000	28,000	208,000	2,044,000
Rough River	133,000	35,000	17,000	10,000	6,000	4,000	23,000	228,000
Barren River	195,000	77,000	31,000	23,000	16,000	6,000	39,000	387,000
Pond River	512,000	92,000	41,000	62,000	34,000	14,000	82,000	837,000
Total	1,913,000	507,000	231,000	192,000	249,000	52,000	352,000	3,496,000

1/ Estimated damage data obtained from watershed investigations conducted during this study, installed or authorized P.L. 566 watersheds, and Soil and Water Conservation Needs Inventories for Kentucky, 1970 and Tennessee, 1971.
2/ Includes obnoxious weed infestations and debris removal from fields, etc.
3/ Includes Green River and its smaller tributaries.

in these and other basin counties. Presently, about 2,000 acres per year are being surface mined. Newly mined areas are critical sediment producing sources and remain so until stabilized. Total sediment from newly stripped areas has been estimated at about 32,600 tons per square mile annually. In addition to sediment from the newly disturbed areas, runoff and erosion are still producing sediment from old abandoned "orphan" surface-mined lands. Although some of the surface-mined acreage has been stabilized, it is estimated that about 43,700 acres are still producing sediment. The annual estimated sediment yield from the coal mining area is over 8.8 million tons.

The major portion of the basin's 1,600 miles of eroding roadbanks and the 680 miles of streambanks contributes to the sedimentation problems. The most significant roadbank erosion occurs in the middle and eastern portion of the Pennyroyal Physiographic Region, particularly the Barren and Nolin River areas. Roadbanks are estimated to contribute about 49,000 tons of sediment annually to the basin's streams and reservoirs.

Sediment is produced from most land used for crop production, construction, and development purposes. The most significant producing cropland areas are in the western Kentucky counties of Christian, Logan, McLean, Daviess, Ohio, and Todd. Construction and development activities are widespread, with the preponderance being near larger population centers.

The total sediment yield from the basin's forest land is estimated to be 265,250 tons per year, or an average annual rate of 0.132 tons per acre. Grazing, skid trails, and spur roads are the major sediment producers. Grazed forest land produces the largest amount of sediment, 39 percent of the total, while spur roads have the greatest delivery ratio,[3/] over 37 percent (table IV.6).

Major sedimentation damages occurring in the basin are infertile deposition, channel filling, swamping, and pollution. Sediment deposition damages are to flood plain lands and growing crops. Crop damage results from sediment laden floodwaters depositing silts or clays on crop leaves and grasses. Land damage is from deposition of coarser and infertile sand and gravel. Approximately 39,000 acres in the basin are affected annually to some degree by infertile deposition. Damages from infertile deposition and flood plain scour were evaluated under floodwater problems and amount to about $192,000 annually.

Swamping, a serious problem in the Western Coal Field Physiographic Region, results from runoff waters transporting and depositing sediment on bottom lands and in stream channels. The accumulated deposits have retarded natural runoff and drainage on bottoms and in streams, causing swamping on some 30,000 acres in 17 basin counties. The problems are compounded in the Western Coal Fields Region by runoff and seepage of chemically polluted waters. These acid laden waters, some with a pH below 3.0, have rendered some streams and areas unsuitable for wildlife or other uses. Studies indicate that, with the recent increase in strip-mining operations, bottom land swamping is also increasing. Currently, swamping is affecting from 500 to 1,000 additional acres each year.

Another problem, attributable largely to swamping, is the high mosquito population in the western portion of the basin. The primary

3/ Delivery Ratio - the percent of erosion that reaches the nearest stream channel.

Table IV.6 - Estimated Sediment Yield by Condition on Forest Land, 1972

Green River Basin

Condition	Forest Area	Sediment Yield and Delivery: Average Annual Rate	Total	Percent of Total	Average Delivery Ratio
	Ac.	Tons/Ac.	Tons/Yr.	%	%
Natural	2,015,150	0.003	6,050	2.3	0.5
Disturbed					
Logging	151,140	0.069	10,430	3.9	2.0
Skid trails	22,170	3.533	78,330	29.5	11.2
Spur roads	40,300	1.582	63,750	24.0	37.2
Fire	32,240	0.103	3,320	1.3	3.4
Grazing	201,510	0.513	103,370	39.0	15.4
Total or Average		0.132	265,250	100.0	7.7

Source: Forest Service, U.S. Department of Agriculture.

problem is caused by salt marsh mosquitoes, which are not a native to the area, but have adapted to the favorable habitat formed by the sediment and chemically polluted waters in the swamped areas. Because of large population and migratory range, the salt marsh mosquitoes have a serious impact on the health, comfort, and general welfare of rural and urban residents of the area. Heavy mosquito infestations even restrict the use of land resources for agricultural, industrial, and recreational activities.

Table IV.7 - Total Acreage of Class IIw, IIIw, and IVw Land

Green River Basin

Land Use	Land Capability Class and Subclass: IIw	IIIw	IVw	Total
	Acres			
Cropland	231,900	181,300	11,600	424,800
Pasture	34,900	20,900	2,600	58,400
Forest	49,000	110,200	9,900	169,100
Other	12,000	17,300	1,500	30,800
Total	327,800	329,700	25,600	683,100

Source: Soil and Water Conservation Needs Inventories, Kentucky, 1970 and Tennessee, 1971.

IMPAIRED DRAINAGE

Excess surface and/or subsurface water often interfere with utilization of land for crop production. Drainage problems are caused by several factors, including composition, slope, and characteristics of the soil which retard the rate of surface runoff or the infiltration of water in the soil. Ponded surface water, high water tables, and saturated soils are indications of impaired drainage.

Excess surface or internal water affects management and use of agricultural lands by limiting the choice of crops to those tolerant to wet conditions; retarding plant growth; delaying land preparation and planting operations; preventing performance of timely cultivations; and restricting fall harvesting to dry periods. These limitations reduce crop yields and increase production costs, thus decreasing returns.

Table IV.8 - Acreage with Drainage Problems

Green River Basin

Land Use	Soil Resource Group	Subarea I	II	III	IV	V	Total
		Acres					
Cropland							
	1	800	5,700	2,200	100	400	9,200
	6	600	100	1,700	4,000	1,000	7,400
	7	101,100	47,000	6,100	3,700	7,700	165,600
	8	39,400	18,800	1,100	--	3,000	62,300
	9	20,300	10,200	2,200	6,400	6,800	45,900
	16	4,300	1,300	--	--	300	5,900
Subtotal		166,500	83,100	13,300	14,200	19,200	296,300
Pasture 1/		5,100	2,500	3,000	4,600	4,000	19,200
Total		171,600	85,600	16,300	18,800	23,200	315,500
Percent		54	27	6	6	7	100

Source: Soil and Water Conservation Needs Inventories for Kentucky, 1970 and Tennessee, 1971.

1/ Includes total drainage problems for all soil resource groups.

A dominant limitation of the wetland class in the land classification system is excess water or impaired drainage. As shown in table IV.7, the basin contains 683,100 acres of wet "w" soils. Approximately 62 percent of the wetland is used for crops, 9 percent for pasture, 25 percent for forest, and the remaining 4 percent is other.

Approximately 315,500 acres of the wetland are identified as having impaired drainage problems. The drainage problems occur on 296,300 acres of cropland and 19,200 acres of pasture (table IV.8).

Approximately three-fourths of the drainage problems are in the Western Coal Fields Physiographic Region (plate IV-2). More specifically, about 55 percent of the drainage problems are in the western Kentucky counties of Daviess, Henderson, McLean, Ohio, and Webster subarea 1 (plate III-1). Most of the acreage is on the comparatively wide and level valleys of the lower Green, Pond, and Rough Rivers.

WATER

Water supply problems exist throughout the basin, even though the average annual rainfall and runoff are about 48 and 18 inches, respectively. The problems mostly involve seasonal supply shortages, inadequate local sources, inferior quality, and inadequate facilities for storage, treatment, or distribution. As a result, several rural and urban areas have seasonal or annual shortages of quality water for domestic, industrial, or agricultural use.

About two-thirds of the municipal, industrial, and domestic water supplies are obtained from streams; the remaining one-third comes from storage reservoirs, springs, and wells. The quality is generally satisfactory except for the sources which are polluted by sewage, sediment, chemicals, and related effluents. During periods of normal flow, supplies obtained from streams are adequate,

but acute supply problems occur during prolonged dry periods. Towns such as Liberty and Columbia which obtain their supplies directly from Green River experience seasonal supply problems. Towns depending upon upstream tributaries, wells, or springs also have supply problems. The counties or areas with present or projected supply shortages are shown in table IV.13 in the needs section of this chapter.

Rural water supplies are obtained from water districts, wells, springs, and cisterns. There are 25 rural water districts in the basin. Of these, 19 purchase treated water from municipal water treatment plants and the other 6 districts operate their own water treatment facilities. These rural and the other urban water districts supply treated water to about 51 percent of the basin homes and most of the industrial users. While these districts have helped alleviate the quantity and quality problems, many areas still have inadequate supply sources and inferior quality of water.

Agricultural water is supplied largely by farm ponds, streams, wells, and springs. As a general rule, the area has ample livestock water. In some areas, shortages occur because of inaccessibility to streams, inadequate underground supplies, insufficient farm pond storage, or unsuitable terrain and conditions for development of ponds. The most significant use of irrigation water is for tobacco. The 1969 Census of Agriculture shows that about 5,500 acres of tobacco and 3,500 acres of corn were irrigated in that year. The main problem with irrigation water is the lack of dependable and accessible sources.

FOREST

The hydrologic condition of the forest land in the basin depends upon the vegetative cover types, soil types, and the use and treatment of the forest.4/ The hydrologic condition class of upland forest cover is 2 percent very good, 9 percent good, 13 percent fair, 7 percent poor, and 69 percent very poor. Over 75 percent of the upland forest is in a poor or very poor condition class. These conditions have resulted from poor management, overgrazing, overcutting, wildfires, and the different forest and soil types. Under the present forest condition, runoff is accelerated and the annual gross erosion is 3,465,800 tons with an estimated sediment production of 265,250 tons.

Forest grazing is one of the most detrimental practices to forest reproduction and timber production. It damages watersheds through soil compaction, loss of soil, and increased runoff by leaving only a small amount of grass residue to protect the surface. Damage from grazing is evident on 201,500 acres and constitutes a primary source of accelerated erosion and sediment.

4/ The hydrologic condition on forest land is defined as that condition of a watershed area which reflects its ability to influence the quantity and quality of runoff into streams.

U.S. DEPARTMENT OF AGRICULTURE

LEGEND

Counties or partial counties with impaired drainage

- More than 50,000 acres
- 10,000 to 50,000 acres
- 1,000 to 10,000 acres
- Less than 1,000 acres

Plate IV–2

IMPAIRED DRAINAGE LOCATION
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

APPROXIMATE SCALE - MILES

Compiled and reproduced at 1:250,000 (1 inch equals 4 miles) from 1:250,000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:700,500 (1 inch equals 11 miles).

SOURCE: Data Compiled by USDA River Basin Staff

NOVEMBER 1975 4-R-35122

USDA-SCS-FORT WORTH, TEX. 1975

REVISED MARCH 1975 4-R-36040

Fire has traditionally been destructive to forest land throughout the basin. All the counties in the basin were under fire protection by 1961. The fire protection goal, expressed in terms of maximum tolerable burned acreage, is set at 0.20 percent of the forest land. District records show that debris burning has caused 45 to 55 percent of all fires. Burning sedgegrass for pasture, incendiarism, and machine use accounts for the remainder. For the 5-year period, 1964 to 1968, the average annual burn was 6,450 acres or 0.23 percent of the protected area in the basin. The average annual burn in 1971-72 was only 3,240 acres or 0.12 percent of the protected area. A significant problem in the western portion of the basin is the lack of interest in fire protection by large coal companies who own vast areas that they plan to strip mine.

POLLUTION

For this report pollution problems are regarded to exist when water, land, air, and related resources are degraded to such a degree as to affect their use for present and projected purposes. Most of the water and land in the basin are to some extent polluted. Air pollution is not regarded as a major problem even though the quality is affected by automobile emission, uncontrolled fires, dust, and emission from small manufacturing plants.

Major pollutants of the basin's streams are sediment, acid mine drainage, agricultural pesticides, solid waste, industrial waste, sewage, oil, and animal waste. The most common stream pollutant is suspended sediment, a product of runoff and erosion. Sediment pollution, which is reflected by excessive turbidity and concentration of suspended solids, is common on most streams during periods of high flows. Approximately 17,963,000 tons of sediment enter the Green River stream system each year. In the Western Coal Field Physiographic Region, the sedimentation problems are further compounded by chemical pollution. For example, some streams in the coal fields have a pH as low as 2.5, with most being in the range of 3.5 to 4. It is estimated that about 178 miles of stream are affected (plate IV-3).

Agricultural fertilizers, herbicides, and pesticides used in crop production are potential polluting agents. Many of these chemicals become attached and are carried by sediment particles while others are water soluble. Data in the 1969 Census of Agriculture show that basin farmers applied 252,000 tons of commercial fertilizers on about 1,044,000 acres; used 431,000 tons of lime on approximately 195,000 acres; and utilized chemical dusts or sprays to control weeds, grasses, brush, insects, or diseases on about 500,000 acres. Even though no known major problem has resulted, excessive nutrient levels from these materials or chemicals have

been reported to alter the ecological system, stimulate algae bloom, and cause offensive odor in some reservoirs and streams in the western section of the basin.

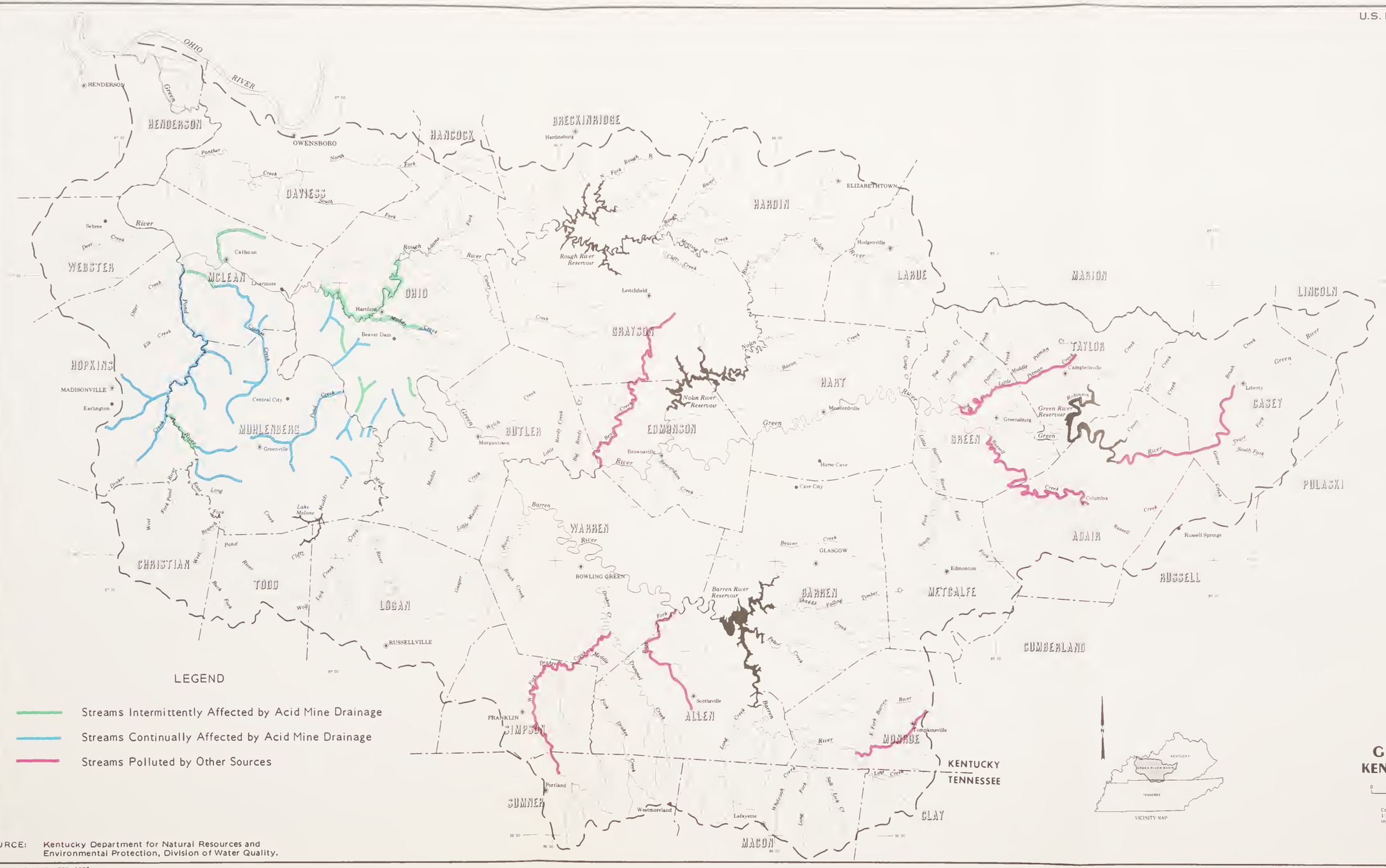
Solid waste disposal along roadsides and in rural areas and streams is a pollution problem. Although industrial waste is not of major importance, it has caused periodic problems in West Fork Drakes Creek below Franklin, Kentucky, and Little Pitman Creek below Campbellsville.

Animal waste in the area is estimated to be about 42,500 tons per day, or about 16 million tons per year. The problems caused by animal waste are largely from feedlots and some dairy operations. When excessive, animal waste disposed into streams or on land degrades environmental conditions.

Pollution problems from sewage disposal occur in several towns and communities and from rural homesteads. Problems occur primarily where septic tank systems or outdoor facilities are used on impermeable, saturated, and shallow soils or have insufficient drainage fields. Problems are being magnified by the increased usage of water provided to rural areas by the water districts. Most larger towns or municipalities have primary and secondary treatment facilities, but in some cases they are of insufficient capacity and improperly operated.

RECREATION

The problems associated with land- and water-based outdoor recreational facilities and areas are quantity and quality. Outdoor recreational facilities are sufficient except for a shortage of picnic areas, playgrounds, golf courses, and trail areas. Hunting areas and game population are adequate, but fishing areas only satisfy current demand. The quality of recreational water and, to an extent, the land area is affected by many of the aforementioned pollutants, especially sediment, waste materials, sewage, and related effluents.



SOURCE: Kentucky Department for Natural Resources and Environmental Protection, Division of Water Quality.

Plate IV–3

STREAM POLLUTION
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

0 5 10 15 20
APPROXIMATE SCALE - MILES

Compiled and reproduced at 1 250 000 (1 inch equals 4 miles) from 1:250 000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1 700,500 (1 inch equals 11 miles)

AUGUST 1975 4–R–35123
REVISED MARCH 1975 4–R–34040

USDA-SCS-FORT WORTH, TEX. 1975

NEEDS

The basin's problems require wise conservation, development, utilization, and management of the basin's water and related land resources. The need to reduce the resource-based problems is magnified by the increased competition for resources, projected demand for food, fiber, and related products, and the recent interest in improving environmental conditions. While the nature and intensity of the needs to reduce the resource problems will change with economic conditions, this section identifies the major conservation, management, and related needs emanating from the resource oriented problems. It also provides information on the present and projected fish, wildlife, and principal outdoor recreational needs and the basin's allocated share of the projected food and fiber needs for 2000 and 2020.5/

5/ To avoid ambiguities associated with the term "needs," it is used here to reflect the needs arising from existing conditions, problems, desires, or lack of adequate quantity or quality.

CONSERVATION AND MANAGEMENT NEEDS

Major conservation and management needs on the 1,286,000 cropland acres are to reduce erosion to keep soil losses within acceptable limits, conserve productive base, and maintain and improve organic content and physical condition of the soil. As shown in table IV.9, cropland conservation and management needs range from including sod in rotation system to strip-cropping or terracing, depending upon the magnitude of the problem.

Table IV.9 - Estimated
Cropland Conservation-Management Needs

Green River Basin

Conservation-Management Needs	Acres
Residue management	221,000
Sod in rotation	178,000
Contouring	227,000
Strip-crop or terrace	596,000
Conversion to cover	160,000

Source: Data developed from Soil and Water Conservation Needs Inventories for Kentucky, 1970 and Tennessee, 1971.

In some cases, a combination of practices is required to satisfactorily reduce erosion and improve the cropping system.

Pasture acreage also requires conservation, management, and improvement measures to obtain, protect, and improve vegetative cover. These measures are needed on about 700,000 acres, of which approximately 19,200 have additional needs for erosion control measures. Table IV.10 depicts the type of measures and the acreage having specific needs.

Table IV.10 - Estimated
Pasture Conservation-Management Needs

Green River Basin

Conservation-Management Needs	Acres
Protection only	103,000
Improvement only	341,000
Brush control and improvement	21,000
Re-establishment of vegetative cover	206,000
Re-establishment of vegetative cover with brush control	134,000
Change in land use (pasture to forest)	53,000

Source: Data developed from Soil and Water Conservation Needs Inventories for Kentucky, 1970 and Tennessee, 1971.

Forest land treatment is needed to reduce erosion from critical areas, to increase timber production, and to improve hydrologic conditions of upland forest soils. Management plans are needed on approximately 80 percent of the forest land (table IV.11).

Tree planting is needed on about 70 percent of the strip mine areas and 40 percent of the gully areas. There are 90,550 acres of classes VIe and VIIe cropland, and 31,650 acres of classes VIe and VIIe pasture that should be converted to forest cover. Within the logged areas, there are spur roads and skid trails that need treatment. There is a need to remove or fence out cattle from the 201,500 acres of upland forest that are presently being grazed.

There are 328,200 acres of open land and old fields that should be planted to trees. These include 40,600 acres of classes VIs and VIIs cropland and pasture, and 31,700 acres of classes VIe and VIIe pasture. Timber stand improvement will include 988,000 acres for hardwood release and 195,500 acres for an improvement cut.

The present fire protection organization is considered adequate for normal fire occurrances. There is a need to accelerate the

present fire prevention and educational program through newspaper articles, radio spots, school visits, literature distribution, house-to-house contacts, and talks before various clubs and groups. Fire protection needs to be stimulated and improved in the coal field areas in the western part of the basin.

Table IV.11 - Forest Management Needs

Green River Basin

Needs	Acres
Forest management plans	1,600,000
Critical area stabilization	
Strip mine	30,600
Gullied areas	45,100
Sheet erosion areas	122,200
Spur roads	40,300
Skid trails	22,200
Grazing control	201,500
Tree planting	
Open	72,300
Old fields	255,900
Timber stand improvement	
Hardwood release	988,000
Improvement cut	195,500

Source: Forest Service, U.S. Department of Agriculture.

Other areas needing conservation, management, and stabilization measures to decrease runoff and erosion include about 112,000 acres of gullies; some 680 miles of streambanks; around 1,600 miles of roadbanks; approximately 43,700 acres of surface mine lands; and several hundred acres of disturbed or unprotected residential, commercial, and industrial areas. These needs range from management to vegetative and/or structural measures or a combination. Needs on streambanks range from fencing to prevent livestock access to streams to shaping and riprapping banks. Similarly, the needs on roadbanks vary from vegetative plantings to installing concrete lined waterways. The needs on surface-mined lands vary widely from applying additional stabilization measures on previously disturbed areas to modifying surface mining operations to facilitate stockpiling topsoil for subsequent distribution on the replaced overburden material. Other than filling, leveling, and seeding of severe gully areas, the primary need is for sediment retaining basins and vegetative plantings.

FLOODWATER DAMAGE REDUCTION

Of the 516,680 flood plain acres subject to floodwater damage, approximately 185,000 acres receive some flood control from the installed U.S. Army Corps of Engineers, P.L. 566, and privately installed structural or channel improvement measures. Even though much of the protected acreage is subject to flooding by a large storm, protection normally is provided from floods equivalent to a 3-year cropping frequency. Flooding on about 332,000 flood plain acres is unaffected by installed works of improvement. Approximately 40 percent of the 332,000 acres is in narrow upstream areas, floods infrequently, or does not have suitable areas for installing works of improvement for flood control. As a result, approximately 195,000 acres show a need or offer potential for flood control development (table IV.12).

The major flood control needs in urban and rural areas are to retard and remove excess runoff. In rural areas, the need is to decrease damage to crops, pastures, agricultural improvements, and public transportation facilities. In urban areas, the need is to reduce property damages in 48 towns or communities having flooding and/or local drainage problems.

Table IV.12 - Estimated Area Subject to Flooding and Offering Potential for Protection[1/]

Green River Basin

Green River and its Subbasins	Total Area Subject to Flooding		Area Without Protection		Area w/Potential for Protection	
	Agricultural	Urban	Agricultural	Urban	Agricultural	Urban
	Acres					
Green River	297,300	700	184,200	580	107,000	400
Barren River	55,290	390	40,730	270	25,200	200
Rough River	45,900	100	84,000	60	6,600	25
Pond River	116,700	300	23,000	200	56,800	100
Total	515,190	1,490	331,930	1,110	195,600	725

1/ Data obtained from Watershed Investigations, authorized P.L. 566 watersheds, U.S. Army Corps of Engineers publications, and Soil and Water Conservation Needs Inventories for Kentucky, 1970, and Tennessee, 1971.

SEDIMENT REDUCTION

Although reduced erosion and flooding would significantly decrease sedimentation damages, additional control and corrective measures are needed. The most apparent needs are (a) land leveling, shaping, sediment retention basins, and other measures to retain excessive sediment from critical areas such as surface mining; and (b) measures such as channel improvement and drainage to reduce swamped areas and mosquito habitat.

Reduced sediment production would decrease the downstream damages which result from channel filling; swamping; infertile deposits on flood plains; stream pollution; and reduction in the storage capacity of water supply reservoirs, flood control structures, recreational lakes, and farm ponds.

DRAINAGE IMPROVEMENT

Approximately 315,500 acres need drainage improvement measures to be more responsive to agricultural production. The major need is for subsurface (tile) systems, land smoothing, leveling, grading, and installing mains and laterals. Sod waterways and open field ditches are the lesser needs identified. Land smoothing, leveling, and grading are used to achieve both surface and subsurface

Table IV.13 - Counties, Municipalities, and Communities with Current Capacity and Projected Water Supply Needs for 1990

Green River Basin

State and County	Communities or Municipality	Projected Year of Shortage	Present Capacity	Projected Needs[1/]
			- Gallons/day -	
Kentucky:				
Adair	Columbia	1975	225,000	400,000
Allen	Scottsville	1975	600,000	1,200,000
Breckinridge	Hardinsburg	1975	120,000	2,500,000
Casey	Liberty[2/]	1975	360,000	500,000
Daviess	Whitesville	1975	65,000	125,000
Hardin	Elizabethtown	1990	5,500,000	9,500,000
Hopkins	Madisonville	1980	4,000,000	6,000,000
Lincoln	Stanford	1975	350,000	800,000
Logan	Auburn	1975	112,000	313,000
	Lewisburg	1990	73,000	141,000
	Olmstead	1975	--	100,000
	Bucksville	1975	--	100,000
Metcalfe	Edmonton	1990	90,000	186,000
Ohio	Rockport	1990	66,000	100,000
	Hartford	1975	360,000	660,000
Russell	Jamestown[3/]	1975	260,000	730,000
Simpson	Franklin	1975	1,640,000	2,780,000
Taylor	Mannsville	1975	--	100,000
Tennessee:				
Macon	Lafayette	1975	250,000	450,000
Sumner	Portland	1975	250,000	450,000
	Westmoreland	1975	150,000	280,000

Source: Data obtained from Kentucky Framework Water Plan published in 1971; Area Development District Water and Sewer Plans; and primary (inventory) data.

1/ Total projected needs for year 1990, including present sources.

2/ Three communities - Dunnville, Middleburg, and Yosemite - are recommended to be serviced by Liberty.

3/ Includes Russell Springs' demands.

drainage; sod waterways and open ditches are for surface drainage; and tile is for subsurface drainage. Most acreage needs a combination of drainage measures (appendix table IV.3).

WATER SUPPLY

A total of 16 basin counties now or will in the immediate future need additional municipal, industrial, or domestic water supplies (table IV.13). Of these, 14 counties have been identified as needing new or expanded water districts in the next 10-15 years to serve about 70,000 rural people. A need exists for upstream storage or another form of streamflow augmentation to supplement existing supplies.

Agricultural water supplies are adequate, except during prolonged dry periods and in specific locations. In the future, additional farm ponds, spring development, wells, and small upstream reservoirs will be required to provide water for the anticipated increase in livestock.

RECREATION

The current supply of major outdoor recreational facilities and areas in the basin is adequate to satisfy most of the present needs, except for golf courses to provide 90 additional holes; picnicking areas to provide some 500 tables; about 275 more acres of playgrounds; and 3,000 more acres of water for swimming, boating, skiing, and other water-based recreational activities. Most of these needs are in the counties of Henderson, Daviess, Ohio, McLean, and Webster. Because of the four Corps of Engineer impoundments, other water areas, and related land-based developments, the other counties do not have significant needs for additional outdoor recreational facilities. However, there are several individual communities in these counties that need water areas for swimming, boating, and fishing.

POLLUTION ABATEMENT

The most apparent pollution abatement needs in the basin are for:

1. Application of additional land use planning, development, and management to decrease the volume of sediment produced as a result of runoff and erosion;

2. Appropriate measures and methods to decrease the volume of chemically polluted water entering streams from the coal mining area;

3. Development and use of appropriately distributed solid waste collection and disposal facilities;

4. Improved and additional sewage disposal systems;

5. Construction of animal waste disposal systems on farms having feed lots or large dairy operations; and

6. Reduction in the customary practices of burning trash, discharging industrial waste, discarding unusable automobiles and other debris, and similar activities that contribute to land, water, and air pollution.

Except for the need to decrease mining pollution damages in the Western Coal Fields Physiographic Region, most of the other needs are distributed throughout the basin.

Table IV.14 - Current Recreational Activity Use with Projected 2000 and 2020 Needs[1/]

Green River Basin

Item	1970	2000	2020
	Visitor-Days		
Camping	530,000	890,000	1,100,000
Picnicking	1,800,000	2,300,000	2,650,000
Golfing	1,200,000	2,200,000	2,900,000
Tennis	435,000	677,000	830,000
Hiking	760,000	920,000	1,030,000
Horseback riding	550,000	700,000	800,000
Outdoor games	2,200,000	3,900,000	5,100,000
Water sports[2/]	6,900,000	10,100,000	12,000,000

Source: Comprehensive Outdoor Recreation Plan for Kentucky, prepared by Spindletop Research, Inc., Lexington, Kentucky and primary data.

1/ Projections for 2000 based on anticipated population growth, income, and related factors. The 2020 projections were extrapolated from 2000.

2/ Excludes fishing but includes swimming, skiing, power boating, sailing, and canoeing, with swimming accounting for approximately 70 percent of total.

Based upon anticipated population growth, improved income, increased leisure time, and related factors, future recreational activities are expected to increase significantly (table IV.14). Of the activities analyzed, the most significant increase in land-based activities is expected in golf and outdoor games. By 2000, participation in land-based recreational activities is expected to increase from the present level of 7.5 million visitor-days to almost 12 million. By 2020, the participation is expected to reach nearly 14 million. Participation in water-based sports is projected to increase from 6.8 million to over 10 million by 2000 and 12 million by 2020. Other recreational activities not requiring significant additional land and water such as sightseeing, bird watching, and walking for pleasure, are expected to increase.

Table IV.15 shows the number of present outdoor recreational facility units and land along with the estimated additional number to meet 2000 and 2020 projected needs. Approximately 6,000 acres of land and 9,000 acres of additional water will be needed to meet the 2000 projected needs.

Table IV.15 - Present Outdoor Recreational Units and Land Area and the Additional Units and Area Needed to Meet 2000 and 2020 Projected Needs

Green River Basin

Activity	Unit	1970		2000		2020	
		No.	Area (Ac.)	No.	Area (Ac.)	No.	Area (Ac.)
Camping	Sites	2,350	900	500	300	840	600
Picnicking	Tables	3,450	1,200	1,020	400	1,500	500
Golf	Holes	320	1,800	550	4,200	735	6,000
Tennis	Courts	140	60	13	5	20	10
Hiking	Miles	135	65	170	170	280	280
Outdoor playground areas[1/]		140	260	--	400	--	700
Other[2/]	Acres	--	--	--	500	--	1,000
Water sports[3/]	Acres	--	35,000	--	9,000	--	10,000

Source: Comprehensive Outdoor Recreation Plan for Kentucky prepared by Spindletop Research, Inc., Lexington, Kentucky and primary data.

1/ Includes outdoor playground areas for baseball, softball, basketball, etc.

2/ Other includes acreage for small parks and facilities.

3/ Reflects area projected to be needed for boating, swimming, fishing, and related water sports.

FISH AND WILDLIFE

The supply of sport fishing currently satisfies demand. However, unless more fish can be produced, the current supply will not meet the expected demand in 1980 and beyond (table IV.16).

Table IV.16 - Estimated Potential Supply of and Demand for Sport Fishing 1980, 2000, and 2020[1/]

Green River Basin

Year	Estimated Supply Without Development[2/]	Estimated Demand	Estimated Deficit
	Fisherman-Days		
1980	1,858,000	2,211,000	353,000
2000	1,858,000	2,753,000	895,000
2020	1,858,000	3,465,000	1,607,000

Source: Information developed from inventories on fish and wildlife and from secondary data.

1/ Based on present ratio of fisherman success and participation.

2/ Estimated supply without development refers to the level of sport fishing that the existing waters will support under current levels of management.

To meet the needs for additional sport fishing, it will require more intensive management of existing waters, rehabilitation of streams that are not now producing at their optimum because of pollution, and development of new water areas. The need for additional fishing water was one of the major components which comprised the total projected recreational water needs for 2000 and 2020 (appendix tables IV.4 and IV.5).

The analysis of the supply and demand for hunting indicates a surplus of hunting opportunity now and in the future (table IV.17). Appendix table IV.6 shows supply and demand data by county.

Table IV.17 includes the supply of just four species, namely: bobwhite quail, cottontail rabbit, gray squirrel, and white-tailed deer. The heavily hunted mourning dove, ducks, and geese were not included in the analysis because they are migratory and their production and harvest are not limited to the basin. Hence, the estimate of hunting opportunity is conservative rather than liberal.

This analysis of hunting opportunity does not mean there are sufficient deer or squirrel in the basin to assure all hunters a legal limit on every trip. Rather, it means that the existing habitat has the potential for producing enough game animals to assure hunters enough success to keep them participating in the sport.

Table IV.17 - Estimated Potential Supply of and Demand for Hunting in 1980, 2000, and 2020[1/]

Green River Basin

Year	Estimated Supply Without Development	Estimated Demand	Estimated Surplus
	Hunter-Days		
1980	3,220,000	999,000	2,221,000
2000	3,220,000	1,244,000	1,976,000
2020	3,220,000	1,566,000	1,654,000

Source: Information developed from fish and wildlife inventories and secondary data.

1/ Based on present rate of hunter success.

PROJECTED FOOD AND FIBER NEEDS

Projected national requirements of food and fiber were prepared by the Office of Business Economics and the Economic Research Service (OBERS). National demands for agricultural production were based upon three categories of utilization: domestic food use, domestic nonfood use, and net foreign trade. The projected requirements for agricultural products were determined through consideration of the major forces which influence demand such as population, per capita income, consumer tastes, industrial uses, livestock feeding efficiencies, imports, and exports. The appraisal of future conditions relies heavily on historical trends and relationships, and an increase in national population to the target time period.6/

The baseline levels of projections for the basin were developed from the OBERS data. The projection requirements were prepared by computing a 1959 through 1969 study area share of the Ohio Region and extrapolating this share to the target time period. Livestock and livestock product feed requirements were translated into crop needs with projected rations and are included in the crop items. The requirements for feed grains were computed nationally and allocated to regions on the basis of historical acreages and trends in shares. Hence, historical relationships of import/export relationships between feed grain production and the local livestock industry are implicit in the projections. Because of the difficulty of harvesting pasture, other than by grazing, and because of the high cost of transporting bulky hays and silages, the roughage need shown was computed as a function of regional livestock projection needs. The historical mix among roughage types was projected to continue.

The projected timber demands indicate levels of consumption that might be expected in the future if all the stated and implicit assumptions influencing demand and supply were realized. Use of historical data assumes continuation of trends similar to those that have prevailed in the past. It was assumed that future price trends for competing

6/ Further details of the national system are contained in "1972 OBERS Projections, Regional Economic Activity in the U.S.," U.S. Water Resource Council, September 1972.

Table IV.18 - Projected Food, Fiber, and Timber Needs for 2000 and 2020 Under Two OBERS Projection Series

Green River Basin

Item	Unit	OBERS Projection Series and Year			
		Series C		Series E'	
		2000	2020	2000	2020
		Thousands			
Food-Fiber					
Corn grain	bu.	45,500	54,900	51,500	57,300
Corn silage	ton	1,500	1,500	1,400	1,700
Wheat	bu.	3,400	3,800	3,760	4,100
Feed grain					
Oat & barley	bu.	1,100	1,100	1,200	1,200
Soybeans	bu.	12,700	16,300	19,500	24,100
Hay	ton	1,000	1,200	940	950
Pasture	a.u.d.1/	158,200	218,200	148,300	175,600
Beef	lb.	474,000	668,000	452,500	543,000
Pork	lb.	260,600	352,700	245,700	296,300
Milk	lb.	869,400	1,101,700	783,500	871,400
Eggs	doz.	4,500	2,500	3,900	1,850
Poultry	lb.	22,100	30,800	20,950	24,300
Tobacco	lb.	157,700	181,900	143,500	181,500
Timber Products					
Veneer	cu.ft.	15,300	16,700	11,000	13,000
Saw logs	cu.ft.	54,900	58,900	39,800	45,900
Pulpwood	cu.ft.	9,000	15,900	6,500	12,400
Other	cu.ft.	2,800	4,800	2,000	3,700

Source: Information developed from Office of Business and Economic Research Service data and study data.

1/ A.U.D. refers to animal unit days.

materials, and that future "price inducted" substitution between competing materials and timber products would be limited. Implicit are the further assumptions that adequate stumpage supplies will be available throughout the projection period to supply the projected needs for timber products; and that technological progress in the forest industries will keep pace with that in industries producing competing materials.

Table IV.18 shows the quantity of food, fiber, and timber products required to meet the projected baseline needs for the basin for the years 2000 and 2020. The projected product needs in the table are for two series of OBERS projections, Series C and E'. The major difference between the two projection series is the assumption about national birth rates. The birth rate under the C series is assumed to be 2,777 births per 1,000 women. Under the E' series, the birth rate is assumed to be 2,100 per 1,000 women. In addition, the E' projection series reflect the recent trends in export activities. Since the C projection series are used for the baseline, the E' series are shown for comparison purposes.

As compared to the projected agricultural product needs under the C projection series, the E' series requires a larger supply of corn, soybeans, and small grain and a smaller quantity of livestock products. Approximately 1,029,000 acres would be needed for corn, soybean, small grain, and specialty crop production under the E' projection series for the year 2000. This is 27 percent more than the 811,000 acres projected to be needed for production of these crops under the C projection series. Hay, and pasture production under the E' series would require 1,252,000 acres; 82,000 less than the 1,354,000 acres needed for production of these under the C series. The present agricultural acreage and the productive capacity are more than sufficient to meet the production requirements under both of the OBERS projection series (table IV.19).7/

Table IV.19 - Estimated Crop Acreage Required to Meet the Projected Agricultural Production Needs Under OBERS Series C and E' Projections for 2000

Green River Basin

Item	OBERS Projection Series and Acreage	
	Series C	Series E'
	-------Thousands-------	
Corn	317.6	343.3
Silage	62.9	51.9
Wheat	77.3	87.6
Soybeans	217.9	410.5
Oats & Barley	18.0	19.1
Hay	205.5	195.8
Cropland Pasture	312.8	293.1
Speciality Crops	117.0	117.0
Idle Cropland	692.0	502.7
Subtotal Cropland	2,021.0	2,021.0
Permanent Pasture	835.7	783.1
Idle Pasture	332.1	384.7
Subtotal Pasture	1,167.8	1,167.8
Total Basin	3,188.8	3,188.8

Source: Compiled from study data.

7/ Appendix table IV.6 contains data on present and projected crop yields used in accessing and evaluating the agricultural production potential of the basin.

EXISTING RESOURCE PROJECTS AND PROGRAMS

This chapter is concerned with identifying existing programs and projects having an important influence on the conservation, development, and management of water, land, and related resources in the basin. It also identifies the federal, state, or local agency or group having authority and administrative responsibility for the resource programs or projects. The programs or projects are presented relative to type, location, and purpose.

U.S. DEPARTMENT OF AGRICULTURE

U.S. Department of Agriculture agencies having major administrative responsibility for water and related land resource conservation development and management programs include the Soil Conservation Service, Agricultural Stabilization and Conservation Service, Farmers Home Administration, and Forest Service. Other USDA agencies, such as the Extension Service, Economic Research Service, and Statistical Reporting Service, also provide educational and informational assistance.

SOIL CONSERVATION SERVICE

Under authority of Public Law 46 of the 74th Congress, as amended, the Soil Conservation Service provides assistance to owners, operators, and other land users in planning, applying, and maintaining water and land resource conservation program measures. Assistance provided by the Service to cooperating landowners or operators is through local conservation district programs.

All 34-basin counties have active conservation districts. Highlights of the district activities show that 47 percent of all landowners or operators in the basin are cooperators with the local districts; 71 percent of the cooperators have conservation plans covering one-third of the total basin area; and 43 percent of the land is adequately treated. Detailed accomplishments made by landowners or operators in applying conservation management treatment measures are shown in table V.1.

The Soil Conservation Service under authority of Public Law 83-566, as amended, provides technical and financial assistance to state and local organizations. This assistance is for watershed protection, flood prevention, fish and wildlife enhancement, public recreation, irrigation, and drainage. Financial loan assistance is also available for providing municipal and industrial water supplies. To date, 12 Kentucky and two Tennessee watershed projects in the basin have been planned and approved for operation (plate V-1). Two of these, North Fork Nolin River in Kentucky and Red Boiling Springs in Tennessee, were approved for installation in July 1974. The remaining 12 projects are either installed or are in the process of being installed (table V.2).

The following provides information on the completed, partially installed, and approved watershed projects:

Big Reedy Watershed - a completed project, is in Butler, Grayson, and Edmonson Counties, Kentucky. Major problems in the 26,390-acre watershed included upland sheet erosion and severe floodwater damage to crops, pasture, and farm improvements. This project provided for applying land treatment on 5,210 acres, installing two floodwater retarding structures, and modifying 19 miles of channel. Total estimated project cost was $968,000, with $708,000 being federal funds, and $260,000 local funds. The ratio of estimated average annual benefits of $59,487 to estimated average annual cost of $31,490 is 1.9 to 1.0.

Table V.1 - Applied Conservation Management-Treatment Measures

Green River Basin

Conservation Treatment-Management Measures	Unit	Amount[1/]
Establishing commercial recreational enterprises	number	137
Conservation cropping systems	acres	933,000
Contour farming	acres	220,300
Critical area planting	acres	51,000
Crop residue management	acres	591,000
Diversions	feet	5,196,000
Ponds	number	41,100
Grade stabilization structures	number	200
Grassed waterways or outlets	acres	34,100
Irrigation storage reservoirs	number	650
Irrigation systems	number	535
Minimum tillage	acres	433,000
Drainage, mains, and laterals	feet	9,425,000
Drainage, surface	feet	2,557,000
Drainage, subsurface	feet	20,244,000
Open channels	feet	901,000
Pasture and hayland planting	acres	1,298,000
Pipeline, livestock water	feet	4,019,000
Recreation area improvement	acres	4,300
Spring development	number	3,200
Strip cropping	acres	17,300
Terraces, gradient	feet	10,108,000
Tree planting	acres	96,200
Wildlife upland habitat management	acres	32,600
Land adequately treated	acres	3,049,000

Source: Soil Conservation Service Program Data.
1/ County totals as of June 30, 1970.

U.S. DEPARTMENT OF AGRICULTURE

LEGEND

P.L. 566 PROJECTS

1. W.F. Pond River W/S
2. E.F. Pond River W/S
3. Mud River W/S
4. Big Muddy Creek W/S
5. Caney Creek W/S
6. Short Creek W/S
7. Big Reedy Creek W/S 1/
8. Red Boiling Springs W/S
9. Valley Creek W/S
10. N.F. Nolin River W/S
11. Line Creek W/S 1/
12. Mill Creek W/S

P.L. 46 (PILOT) PROJECTS

A. N.F. Rough River W/S 1/

B. Upper Green River W/S 1/

1/ Completed Projects

VICINITY MAP

Plate V–1
WATERSHED PROJECT STATUS
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

APPROXIMATE SCALE MILES

Compiled and reproduced at 1:250,000 (1 inch equals 4 miles) from 1:250,000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:700,500 (1 inch equals 11 miles)

SOURCE: Compiled from SCS Data

NOVEMBER 1975 4-R-35121

USDA-SCS-FORT WORTH, TEX. 1975

REVISED MARCH 1975 4-R-34040

Table V.2 - Status of P.L. 566 and P.L. 46 Watershed Project Measures[1/]

Green River Basin

Watershed Name	Drainage Area	Measures: Planned Str.	Planned Chan.	Installed Str.	Installed Chan.	Storage Capacity (Structures): Sediment	Floodwater	Other	Total
	(Sq.Mi.)	(No.)	(Mi.)	(No.)	(Mi.)	Acre Feet			
KENTUCKY									
Big Muddy	33.41	5	18.0	4	--	1,014.8	7,548.0	--	8,562.8
Big Reedy	11.07	2	19.0	2	19	199.0	1,424.0	--	1,623.0
Caney Creek	46.85	10	20.0	9	2	1,591.0	7,261.0	236.0	9.088.0
East Fork Pond River	98.18	18	41.0	16	27	2,412.7	15,816.1	527.0	18,755.8
Mud River	132.78	26	16.0	22	16	2,721.6	21,085.6	18,785.0	42.592.0
Mill Creek	7.26	1	--	1	--	568.0	1,612.0	1,180.0	3,360.0
North Fork Nolin River	24.55	4	--	--	--	1,180.0	6,324.0	1,411.0	8,915.0
North Fork Rough River[2/]	5.52	2	--	2	--	94.0	920.0	--	1,014.0
Short Creek	5.01	3	5.0	2	--	174.0	659.0	--	833.0
Upper Green[2/]	3.86	5	12.0	5	12	84.0	630.0	--	714.0
Valley Creek	20.45	4	--	4	--	881.0	4,701.0	1,600.0	7,182.0
West Fork Pond River	31.93	9	25.0	7	--	1,087.0	4,673.0	--	5,760.0
TENNESSEE									
Line Creek	4.43	1	--	1	--	106.0	1,109.0	--	1,215.0
Red Boiling Springs	15.08	5	--	--	--	529.0	1,437.0	--	1,937.0
Total	440.38	95	156.0	75	76	12,642.1	75,199.7	23,739.0	111,551.8

Source: Status Report for Small Watersheds in Kentucky, July 1974.

1/ Includes completed, partially completed, and recently approved watershed projects.

2/ Pilot (P.L. 46) watershed projects.

Big Muddy Creek Watershed - in Butler and Logan County, Kentucky, is complete except for installing one floodwater retarding structure and the planned channel modifications. Problems identified in the 65,140-acre watershed were excessive sediment from upland erosion; floodwater damages to crops, pasture, roads, bridges, and other fixed improvements; and a low level of agricultural use because of high flood risks. To reduce the problems, the project provided for applying land treatment practices on 17,420 acres, installing five floodwater retarding structures, and improving 18.5 miles of channel. Total estimated project cost is $2,094,000 with $1,316,000 being the federal share and $778,000 the local share. The annual ratio of benefits $86,990 to costs $62,400 is 1.4 and 1.0.

Caney Creek Watershed - in Grayson, Butler, and Ohio Counties, Kentucky, is complete except for two floodwater retarding structures and 18 miles of channel modification. Problems identified in the 97,310-acre drainage area included excessive erosion on uplands; sediment deposition; floodwater damages to crops, pasture, other agricultural items, and urban properties in Caneyville; low intensity flood plain land use; inadequate water supply for Caneyville; and insufficient water oriented recreational facilities in the area. The plan included accelerating the existing land treatment program on 25,400 acres; installing nine floodwater retarding structures and multiple-purpose structure for flood, recreation, and municipal water storage; and 20 miles of channel modification. Estimated cost for these will involve $7,910,000 of federal funds and $1,659,000 of local funds, making the total $9,659,000.

East Fork Pond River Watershed - with a 139,700-acre drainage area, is in Muhlenberg, Christian, and Todd Counties, Kentucky. Major needs identified were to reduce upland erosion problems and floodwater damages to agricultural crops and fixed improvements in the 10,940-acre flood plain. Project measures planned provided

for accelerating a land treatment program on about 35,000 acres, installing 18 floodwater retarding structures, and improving 41 miles of channel. Total estimated cost is $6,158,000, with 66 percent from federal sources and 34 percent local. The ratio of average annual benefits of $166,020 to average annual cost of $131,907 is 1.3 to 1.0. The project is complete, except for two remaining floodwater retarding structures and 18 miles of channel modification which are scheduled for completion in 1976.

Line Creek Watershed - with a drainage area of 40,330 acres, includes 8,736 in Monroe County, Kentucky, and 31,594 in Macon and Clay Counties, Tennessee. Principal problems included upland erosion; floodwater damages to crops, pasture, roads, bridges, and other fixed improvements; and scour and sediment deposition in the flood plain area. This project, completed in 1970, included applying land treatment measures on 1,200 acres and installing one floodwater retarding structure. Total project cost was shown as $514,047, of which $285,888 was federal funds and $228,159 was local.

Mud River Watershed - in Butler, Logan, Muhlenberg, and Todd Counties, Kentucky, encompasses a 240,033-acre drainage area. This watershed had need for land treatment measures on 54,000 acres to reduce upland erosion and improve hydrologic conditions; 26 floodwater retarding structures, and 16 miles of channel improvement to reduce flooding frequency on about 14,000 acres of agricultural land; and four multiple-purpose structures to provide municipal and industrial water supplies for Russellville and Lewisburg and a public fishing development for the area. All improvements have been made except four single-purpose structures which are scheduled for completion in 1977. Total estimated project cost is $7,032,700, of which 42 percent is from federal sources and 58 percent local. The ratio of annual benefits of $35,287 to average annual cost of $26,145 is 1.3 to 1.0.

Short Creek Watershed - is located in Grayson County, Kentucky and is 24,300 acres in size. It had floodwater problems on 730 acres of agricultural land, sheet erosion on uplands, and infertile sediment deposition on bottom lands. Project measures planned include 4,740 acres of land treatment, three floodwater retarding structures, and about 4.5 miles of channel modification. All measures have been applied other than one floodwater retarding structure and the channel, which are expected to be completed by 1976. Estimated total project cost is $1,874,700, with 69 percent being borne locally and the remaining by federal cost. The ratio of estimated average annual benefits of $15,844 to estimated average annual cost of $15,727 is 1.0 to 1.0.

Valley Creek Watershed - a completed 58,000-acre project, is in Hardin County, Kentucky. Landowners in this area were experiencing upland erosion problems and floodwater damages to 880 acres of crops and pasture, and severe urban property damage in Elizabethtown. This area had an inadequate supply of municipal and industrial water, and needed water oriented recreational development. Watershed program measures provided to meet the identified needs were land treatment and management practices on 9,860 acres; three floodwater retarding structures; and one multiple-purpose structure having flood, recreational, and municipal water storage. Adjacent land-based recreational facilities were also provided. Estimated cost for the above items is $3,024,300, of which $1,407,300 is federal and $1,617,000 is local. The ratio of average annual benefits of $75,165 to average annual cost of $39,000 is 1.9 to 1.0.

West Fork Pond River Watershed - a 52,900-acre watershed, is in Christian and Hopkins Counties, Kentucky. Improvement measures planned to reduce upland erosion and floodwater problems include applying treatment practices on 18,300 acres, constructing nine floodwater retarding structures, and modifying 25 miles of channel. These measures are estimated to cost $1,852,000, with 39 percent being a local cost and 61 percent federal. On an average annual basis, the $67,201 benefits and the $49,475 costs give a 1.4:1.0 benefit-cost ratio. All land treatment has been applied and seven of the nine floodwater retarding structures have been installed. Remaining structural measures are estimated to be installed by 1978.

Mill Creek Watershed - located in Monroe County, Kentucky, comprises 21,179 acres. Major needs were to decrease upland erosion problems, reduce floodwater damages on 460 acres, provide an adequate water supply for the city of Tompkinsville, and make available a water-based recreational development for the area. This project, which is scheduled for completion in 1975, consists of accelerating an existing land treatment program on 7,182 acres and installing one flood retention, recreational, and municipal water storage structure. This plan also provides for installation of adjacent recreational facilities. Estimated cost for the above is $877,000, which will be cost shared by local and federal sources at 66 to 34 percent, respectively. It will provide $34,470 average annual benefits and have an average annual cost of $23,045 for a ratio of benefits to cost of 1.5:1.0.

Plate V-1 shows the installed or partially completed watersheds, the recently authorized projects, and the pilot watershed projects. The two watershed projects recently approved for installation are:

North Fork Nolin River Watershed - with a 34,610-acre drainage area, is in Larue County, Kentucky. This area experiences erosion and floodwater damages to crops, pasture, other agricultural items, public roads, bridges, and urban properties. The area also has municipal and industrial water supply shortages and needs recreational water. The proposed project includes applying land treatment practices on 12,790 acres and installing two floodwater retarding structures. It also provides for two multiple-purpose structures, one providing 1,000 acre-feet for municipal water and the other having a 98-acre recreational lake. Estimated project cost is $1,979,011, of which $1,050,980 will be a federal fund and $928,031 local. The ratio of estimated average annual benefits of $143,015 to estimated average annual cost of $91,225 is 1.6:1.0.

Red Boiling Springs Watershed - located in Macon and Clay Counties, Tennessee, encompasses 9,650 acres. Major problems identified include flooding of urban and rural properties, upland erosion, and downstream sedimentation damages. Planned project provides for applying conservation measures on 2,450 acres and constructing five floodwater retarding structures.

Estimated total cost for these improvement measures is $1,951,800, of which $1,479,000 is federal and the remaining $472,800 is local cost. When average annual project benefits are compared to the average annual cost, the benefit-cost ratio is 1.6 to 1.0.

Two watersheds in the basin were planned and installed under authority provided by Public Law 46, 74th Congress, and the watershed protection items in the Agricultural Appropriation Bill of 1954. These laws established the basis for providing financial and technical assistance to plan and install local "Pilot" watershed protection projects. The two in the basin are:

Upper Green River Watershed - with a 24,275-acre drainage area, is located in the upper section of the basin in Lincoln and Casey Counties, Kentucky. Major problems were flooding, upland erosion, bottom land scouring, and sediment deposition. This pilot project was completed in 1959 and has five floodwater retarding structures and 12 miles of channel modification. Stabilization measures were applied to 3 miles of roadbanks and 1,532 acres of critically eroded areas. Land treatment measures were applied to some 3,000 acres. The project cost is $618,000, with the local share being $234,000 and federal share $384,000.

North Fork Rough River Watershed - located in Breckinridge County, Kentucky, has a drainage area of 25,568 acres. Problems identified were upland erosion, flooding, flood plain scour, and sediment deposition. Completed in 1960, this pilot project has two floodwater retarding structures and 10 miles of subwatershed waterway improvement. In addition to applying land treatment practices on some 870 acres, stabilization measures were applied to 6,000 acres classed as critical areas and on 10 miles of highway rights-of-way. These measures cost $696,000, with the local share being 43 percent of the funds and the remaining 57 percent federal.

Section 102 of the Food and Agriculture Act of 1962, Public Law 87-703, as amended, provides the Soil Conservation Service with authority to assist local people in planning and carrying out Resource Conservation and Development Projects. The locally initiated and sponsored projects are designed to promote orderly conservation, improvement, development, and wise use of natural resources. Portions of three Resource Conservation and Development Projects are in the basin (plate V-2). These and the measures installed or under installation include:

Tradewater River Area Project - includes six western Kentucky counties, with a portion of three - Christian, Hopkins, and

Webster - being in the basin. All major installed measures are in Hopkins County and include (a) the Kenneth Roberts measure which involved installing a drainage system to remove excess water on 560 acres of agricultural land; (b) the Sebree Springs measure which included improving 2,580 linear feet of channel to provide flood protection to properties in Sebree Springs; and (c) the Narge Creek flood prevention and agricultural water management measure involves improving about 6.3 miles of channel and applying land treatment practices to reduce flooding, erosion, and drainage problems.

Cumberland-Green Lakes Project - a south-central Kentucky RC&D project, developed in 1973, covers a 10-county area. All of the basin counties of Green and Taylor and parts of Adair, Russell, and Casey are in the project area.

Hull-York Lakeland Project - organized in 1964, this north-central Tennessee RC&D project encompasses 11 counties. Portions of two counties, Clay and Macon, are in the basin area. Several measures have been planned and applied, including land treatment and stabilization practices on eroded roadbanks and critical areas, and installing local flood prevention and drainage structures.

SOURCE: Data Compiled by USDA River Basin Staff

Plate V-2

LOCATION OF RESOURCE CONSERVATION AND DEVELOPMENT PROJECTS

GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

0 5 10 15 20
APPROXIMATE SCALE MILES

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The assistance provided by the Soil Conservation Service under the aforementioned programs or projects has been instrumental in enabling landowners and/or operators to apply conservation practices to maintain and improve environmental conditions. Applied project or program measures making the more noticeably contributions include those alleviating erosion, flooding, and related resource problems; improving landscape; enhancing aesthetic appearance; increasing recreational opportunities; and improving fish and wildlife habitat. With respect to fish and wildlife habitat improvement, the Service, in cooperation with other federal and state agencies, has assisted landowners in constructing about 10,000 farm ponds. These ponds, many of which are stocked with different fish species, have an estimated sport fishing capacity of 370,000 fisherman-days. The 65 completed single or multiple-purpose watershed structures in the basin contain sufficient water to provide over 100,000 fisherman-days. In addition, the Service cooperated with the Kentucky Department of Fish and Wildlife and Mud River Watershed Conservancy District in developing Lake Malone, a public water-based recreational development.

FARMERS HOME ADMINISTRATION

This U.S. Department of Agriculture agency provides credit and technical management assistance to rural people, public agencies, and nonprofit organizations to facilitate conservation, development, and utilization of water and related land resources. Some of these include:

(1) Water and waste disposal loans for constructing community water, sanitary sewer, and solid waste disposal systems;

(2) Farm ownership loans to qualified persons for purchasing land, refinancing debts, constructing or repairing buildings,

improving farmland, developing water facilities, and establishing farm-based business enterprises to supplement farming incomes;

(3) Irrigation and drainage loans for developing community irrigation, drainage, and related soil and water use programs;

(4) Recreation enterprise loans for developing onfarm recreational facilities;

(5) Soil and water conservation loans for financing land and water development measures, forestation, drainage of farmland, irrigation, pasture improvement, and related land and water use adjustments; and

(6) Resource conservation and development loans for measures contributing to conservation, development, and improvement of natural resources and economic conditions.

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

The major function of this agency is administering certain production adjustment, resource protection, and related farm income stabilization programs. Some of the commodity or resource programs affecting water and related land resources include:

(1) The Cropland Adjustment Program, which provides cost-share assistance for shifting cropland to protective conservation uses under long-term agreements. Emphasis was given to the development of hunting and fishing areas through conservation practices designed to foster wildlife. Approximately 450 agreements were in effect beginning in 1972 in those counties partially or totally within the basin;

(2) The Agricultural Conservation, Rural Environmental Assistance, and Rural Environmental Conservation Programs, which provide cost-sharing assistance to land operators in applying resource conservation and environmental improvement practices; and

(3) The Production Adjustment, Conservation Reserve, Crop Conservation, and Commodity Disposal and Inventory Operation Programs to assist in stabilizing farm prices and income, regulate commodity production, and conserve natural resources.

FOREST SERVICE

The primary responsibility of this USDA agency is administering National Forest programs and providing assistance through cooperative programs to state agencies responsible for the protection, management, and development of state, local, and privately owned forest lands. There is no National Forest land in the basin. The Forest Service, through several state-federal cooperative programs, provides services and assistance to landowners through the Kentucky Department of Natural Resources and Environmental Protection, Division of Forestry, and the Tennessee Department of Conservation, Division of Forestry. Some of these programs and their principal features are:

(1) The Clarke-McNary Act of June 7, 1924. Section 2 of this act, Cooperative Forest Fire Control (CM-2), provides for protection of forest resources from fire on private and nonfederal public forest lands and certain nonforested watersheds. The fire protection is provided by the State forestry agency and its cooperators. Section 4, Cooperative Production and Distribution of Forest Tree Planting Stock (CM-4), provides authority to assist states with needed tree planting and other forestation programs on private and nonfederal public lands to help assure an adequate future supply of industrial wood. The State forestry agency provides tree planting stock at moderate prices. Under this act, the Federal cost share cannot exceed the net expenditures by a state in any fiscal year. The State Forester is responsible for administration of this program in cooperation with the U.S. Forest Service.

(2) The Forest Pest Control Act of June 25, 1947. As implied by name, this act is to reduce to tolerable levels losses caused by forest insects and diseases, other than blister rust, on private and public forest lands. The U.S. Forest Service administers the program in cooperation with the states or with other Federal agencies. The assistance provided is for (a) leadership to prevent, detect, evaluate, and suppress forest insect and disease outbreaks; (b) aid to develop and conduct cooperative pest and disease control programs; and (c) cost-sharing for cooperative control of pests and diseases on state and private forest lands. The act also empowered the Secretary of Agriculture to provide cost-share assistance on federal land. The federal cost-sharing is approximately 25 percent and may not exceed 33-1/3 percent without the Secretary's approval. The remainder of the cost is borne by the states and private cooperators.

(3) The Granger-Thye Act of April 24, 1950. This act provides financial assistance for the erection of buildings, lookout towers, and other structures on privately and publicly owned land.

(4) The Cooperative Forest Management Act of August 25, 1950. Major purpose of this act is to improve the management of small woodlands and the operation of small processors of primary forest products. Technical assistance and advice is provided woodland owners and processors of primary forest products by the State forestry agency. Federal funds expended cannot exceed the State's share in any fiscal year. The State Forester is responsible for administering this program in cooperation with the U.S. Forest Service.

(5) The Watershed Protection and Flood Prevention Act of 1954 (P.L. 566). This law provides authority to assist local organizations to plan and install forestry measures for watershed protection and flood prevention on nonfederal land, and plan and install such measures on national forest land. Soil Conservation Service is the USDA agency responsible for administration of the act. The U.S. Forest Service, in cooperation with State Foresters, is responsible for the forestry phases, including developing plans, furnishing technical and management assistance, and supervising the installation of recommended forestry measures.

(6) The Bankhead-Jones Farm Tenant Act, Title III, as amended by the Food and Agriculture Act of 1962, Title I, sec. 102, provides the Forest Service with authority to assist state foresters in Resource Conservation and Development Projects.

The purpose is to plan and carry out programs of land conservation in areas where the current conservation activities plus the use of new authorities will provide additional economic opportunities.

(7) The Land and Water Conservation Fund Act (P.L. 88-578) of January 1, 1965. The purposes of this act are to preserve, develop, and assure accessibility to all citizens the quality and quantity of outdoor recreation resources as may be available and are necessary and desirable for individual active participation in such recreation. Funds are provided for assisting states in planning, acquiring, and developing needed land and water areas and recreational facilities and for federal acquisition and development of certain lands and other areas for recreational purposes.

(8) The Agriculture and Consumer Protection Act of 1973. This is authorized as a Rural Environmental Conservation Program to provide cost-sharing for soil and water conservation, pollution abatement, timber production, and other purposes. Forestry practices were under two distinct programs, namely the Rural Environmental Assistance Program (REAP) and the Forestry Incentive Program (FIP). REAP is available in all counties and provides cost-share assistance for a wide range of conservation practices, including those to improve timber production. The FIP program is available only in designated counties which have significant potential for increasing timber production.

Other programs that assist in the development of forestry resources do so through providing for the purchase of forest land, forest research, additional economic opportunities, improved land use, rural renewal, rural area development, and others. Some of these programs are under: (a) Weeks Law of 1911; (b) McSweeney-McNary Act of 1938; (c) Soil Conservation Act of 1935; (d) Agricultural Act of 1956, Title IV; and (e) McIntire-Stennis Act of 1962.

COOPERATIVE EXTENSION SERVICE

The Extension Service is the educational arm of the U.S. Department of Agriculture in cooperation with the land grants to colleges and universities. Federal, State, and county levels of government assist in financing, planning, and carrying out information and educational programs. County agents and individual specialists work with various agencies and groups in providing the public with information relating to agricultural programs.

APPALACHIAN REGIONAL DEVELOPMENT ACT OF 1965
(Section 203 of PL 89-4)

The purpose of the Act is "to assist the region in meeting its special problems, to promote its economic development, and to establish a framework for joint Federal and State efforts toward providing the basic facilities essential to its growth and attacking its common problems and meeting its common needs on a coordinated and concerted basis."

Section 203 provides for the control and prevention of erosion and sediment damages, and promotion of conservation and development of soil throughout the region. It provides for long-term agreements of up to 10 years and cost-sharing in the cost of carrying out planned land uses and conservation treatments.

Responsibilities for carrying out this section are, in general, assigned to four USDA agencies. These are Agricultural Stabilization and Conservation Service, Soil Conservation Service, Forest Service, and Farmers Home Administration.

This program involves portions of seven counties in the extreme eastern portion of the basin. They are Lincoln, Casey, Adair, Russell, and Monroe in Kentucky, and Clay and Macon in Tennessee.

U.S. DEPARTMENT OF DEFENSE

U.S. ARMY CORPS OF ENGINEERS

The Corps of Engineers have major responsibilities for programs and projects that affect the development, management, and utilization of the basin's water and related land resources (plate V-3). Some of the major activities in the basin include:

(1) The navigation project on the Green River. This system originally consisted of eight locks and dams to provide 5.5 feet of navigable water from the confluence of the Green and Ohio Rivers to Mammoth Cave, a distance of 198 miles. The navigable system also included 30 miles on the Barren River, 29 miles on the Rough, and 8 miles on the Nolin. In the 1950's the system was modified to provide 103 miles of 9-foot deep navigable water on the Green River. This is the only section currently used, as the remaining areas are no longer maintained for navigation purposes.

(2) Four completed multiple-purpose water resource development projects (table V.3). These developments which provide storage for flood prevention, municipal and industrial water, recreation, and/or streamflow augmentation, include:

(a) Barren River Reservoir - completed in 1964, is in the south-central Kentucky counties of Allen, Barren, and Monroe, and has a drainage area of 940 square miles. The earthfill structure is located on the Barren River about 10 miles east of Scottsville, Kentucky. Total reservoir storage capacity is 815,000 acre-feet, with 749,680 being for flood control and 66,100 for permanent minimum pool. Water storage is regulated to maintain a 10,000-acre recreation pool in the summer and a minimum pool of 4,320 acres in winter months. It also provides 1,050 acre-feet of municipal water supply to Glasgow and Scottsville.

(b) Green River Reservoir - completed in 1969, is in Taylor, Adair, and Casey Counties. It has a drainage area of 682 square miles. The reservoir storage capacity is 723,200 acre-feet, with 98,100 acre-feet for minimum pool, 64,000 for water quality improvement, and 560,600 for flood control. The summer pool surface area is 8,200 acres.

(c) Nolin River Reservoir - with a 703-square mile drainage area, was completed in 1963. The dam is located in Edmonson County, Kentucky, about 7.8 miles above the confluence of Nolin and Green Rivers. The reservoir is located in Edmonson, Grayson and Hart Counties and has a total storage capacity of 609,000 acre-feet, with 545,000 being for flood control and 63,000 for minimum pool. The summer pool is maintained to have a surface area of 5,800 acres and minimum (winter) pool of 2,890.

(d) Rough River Reservoir - located in Breckinridge, Hardin, and Grayson Counties, was completed in 1959. The

Table V.3 - Major Water Resource Impoundments - U.S. Army Corps of Engineers Developments

Green River Basin

Water Resource Impoundment	Drainage Area	Minimum Pool Elevation	Minimum Pool Surface Area	Minimum Pool Total Storage	Summer Pool Elevation	Summer Pool Surface Area	Summer Pool Total Storage	Flood Pool Elevation	Flood Pool Surface Area	Flood Pool Storage
	(Sq.Mi.)	(Ft.)	(Ac.)	(Ac.Ft.)	(Ft.)	(Ac.)	(Ac.Ft.)	(Ft.)	(Ac.)	(Ac.Ft.)
Green River Reservoir	682	653	5,070	98,100	675	8,200	244,100	713	19,100	723,200
Nolin River Reservoir	703	490	2,890	64,000	515	5,800	234,000	560	14,530	609,000
Rough River Reservoir	454	470	2,180	29,800	495	5,100	120,000	524	10,260	334,380
Barren River Reservoir	940	525	4,320	66,100	552	10,000	237,000	590	20,150	815,000

Source: Project maps and data sheets covering authorized projects - Volume 2, Revised June 1972 by U.S. Army, Corps of Engineers, Louisville District, Kentucky.

flood control and recreational reservoir has a drainage area of 454 square miles. It has a minimum pool of 2,180 surface acres and a summer pool of 5,100. Total storage capacity is 334,380 acre-feet, with 304,580 being for flood control, 29,800 for minimum pool, and 20,170 for water supply to Leitchfield, Kentucky.

(3) Two local flood control projects in the western portion of the basin. One included 9 miles of channel improvement on Barnett Creek in Ohio County, and the other involved clearing and removing vegetation from 64 miles of Rough River channel banks in McLean and Ohio Counties. These projects were completed in 1961.

(4) Four additional projects completed under special authorizations in the basin. These include:

(a) Clearing and snagging 45.6 miles of channel area on Panther Creek in Ohio County;

(b) Clearing and snagging on 18.4 miles of Cypress Creek channel area in McLean and Muhlenberg Counties;

(c) Removing debris from 2 miles of Rough River channel at the Falls of the Rough; and

(d) Shaping and riprapping a caving bank on 4 miles of Rough River in Ohio County.

The four Corps of Engineers multiple-purpose developments have boat docks, ramps, and related facilities for water sport activities. Rough and Barren Rivers have land-based public recreational developments. Water capacity in the four structures is sufficient to provide over 800,000 annual fisherman-days. Plate V-3 shows the location of U.S. Army Corps of Engineers developments.

Photo Courtesy of U.S. Army Corps of Engineers

SOURCE: Kentucky Water Resource Developments by U. S. Army Corps of Engineers, 1975

Plate V–3

WATER RESOURCE DEVELOPMENT OF THE U.S. ARMY CORPS OF ENGINEERS

GREEN RIVER BASIN

KENTUCKY AND TENNESSEE

APPROXIMATE SCALE MILES

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Photo Courtesy National Park Service

U.S. DEPARTMENT OF THE INTERIOR

Principal U.S. Department of Interior agencies or services having active water and related land resource projects or programs in the basin are the National Park Service, Fish and Wildlife Service, and Bureau of Outdoor Recreation.

NATIONAL PARK SERVICE

The National Park Service operates and maintains the Mammoth Cave National Park and Abraham Lincoln Birthplace National Historic Site. The 51,000-acre Mammoth Cave National Park, located in portions of Hart, Barren, and Edmonson Counties, was designated as a National Park in 1941. It has many natural attractions, highlighted by the 360-foot deep Mammoth Cave with its crystal formations and underground rivers. The park provides facilities and services to accommodate visitors, including guided tours, lodging, restaurants, gift shops, camping, hiking, picnicking, and fishing.

Abraham Lincoln Birthplace National Historic Site is located south of Hodgenville in Larue County. The site includes 100 acres of the original Thomas Lincoln farm, a granite memorial which houses the log cabin where Abraham Lincoln was born, and a visitor center containing exhibits of the Lincoln family. Picnic facilities are also provided at the site.

FISH AND WILDLIFE SERVICE

The Fish and Wildlife Service conducts research and provides grants, services, and assistance to states and other agencies to perpetuate the enhancement of fish and wildlife resources. In this basin, this agency cooperates with the Kentucky and Tennessee departments in carrying out fish and wildlife conservation and management programs.

BUREAU OF OUTDOOR RECREATION

The bureau provides assistance to states in assessing needs, identifying outdoor recreational opportunities, and planning and developing additional projects. This agency also provides land and water conservation fund grants to states and appropriate political subdivisions for outdoor recreational planning, land acquisition, and facility development.

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

The Department of Housing and Urban Development has administrative responsibility for programs through which loans, grants, or insurance are provided to state and local governments and individuals. Assistance provided by HUD may be for planning, developing, constructing, preserving, or restoring rural and urban properties, areas, or sites.

U.S. ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency is the prime regulatory, research, and educational agency of the Federal Government having responsibility for protecting and improving the environment. This agency has wide responsibilities, including researching, developing, and enforcing standards for emissions and effluents; evaluating and registering pesticides; controlling toxic and poisonous substances; and developing new methodology in pollution control. The agency works with other public and private agencies or groups on matters concerning the environment.

U.S. WATER RESOURCES COUNCIL

The U.S. Water Resources Council is an independent executive agency of the Federal Government. It is composed of the Secretaries of the Interior; Agriculture; the Army; Transportation; Health, Education, and Welfare; and Chairman of the Federal Power Commission. The council which solicits participation from other interested agencies and departments, encourages conservation, development, and utilization of water, land, and related resources on a comprehensive and coordinated basis by federal, state, and local governments, and private enterprises.

STATE AGENCIES AND PROGRAMS

The commonwealth of Kentucky and the State of Tennessee sponsor and administer several projects and programs influencing water and related land resources.

AREA DEVELOPMENT DISTRICTS

These districts were formed to assist cities, counties, and regions in comprehensive planning and development activities. Of the 15 area development districts in Kentucky, parts of six are in basin area. These include the Pennyrile, Green River, Barren River, Lincoln Trail, Blue Grass, and Lake Cumberland Development Districts (plate V-4).

KENTUCKY DEPARTMENT OF FISH AND WILDLIFE RESOURCES

Major activities of this department include conducting inventories and investigations to facilitate identifying fish and wildlife populations; evaluating habitat conditions; managing state and other publicly owned or controlled lands and waters for fish and wildlife production; introducing new species to the State lands or waters; and stocking suitable lands and waters with native species. The department also performs analyses and studies on water quality in lakes and streams, fish and wildlife specie life histories, and the effectiveness of management techniques. The department owns and manages four lakes in the basin which include Spurlington Lake (33 acres) in Taylor County,

Shanty Hollow Lake (106 acres) in Warren County, Lake Malone (692 acres) in Muhlenberg County, and Washburn Lake (26 acres) in Ohio County.

TENNESSEE WILDLIFE RESOURCE AGENCY

Tennessee Wildlife Resource Agency conducts activities similar to those of the Kentucky Department of Fish and Wildlife Resources. In the basin, the major activities of the commission involve conducting an extensive wildlife management program and enforcing game and fish laws.

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Major activities of this department are designed to conserve natural resources and protect environmental conditions, and are carried out by:

Division of Forestry - The major responsibility of this division is providing services and carrying out programs to protect, conserve, and maintain the forest resources in the State. The division has three districts in the basin, including the Green District headquartered at Madisonville, the Central District at Elizabethtown, and the South-Central District at Campbellsville. District staff personnel assist forest landowners with: tree planting, timber stand improvement, timber marking, and others; developing management plans; preventing and suppressing wild forest fires; and utilizing and marketing of timber products.

During the last 10 years, 4,838 forest management plans have been made on approximately 387,000 acres, almost 42 million board feet of timber was marked, and trees were planted on 29,650 acres in the basin.

Division of Water - This division is concerned primarily with assisting local groups and agencies with planning and installing measures to control or reduce sediment, pollution, and related water problems. It provides assistance to agencies and groups interested in developing municipal and industrial or recreational water supplies in the basin.

Division of Conservation - This division provides assistance to the basin's 31 conservation districts. It works closely with the Soil Conservation Service and watershed conservancy districts in planning watershed developments and conservation practices.

Division of Reclamation - The development and application of land use management plans to reduce sediment, runoff, and pollution

LEGEND

——— Area Development District Boundaries

SOURCE. Data Compiled by USDA
River Basin Staff

Plate V-4

KENTUCKY
AREA DEVELOPMENT DISTRICTS
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

0 5 10 15 20
APPROXIMATE SCALE MILES

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DEVELOPMENT POTENTIALS AND ALTERNATIVE PLANS

The first section of this chapter identifies the development and adjustment potentials for alleviating water, land, and related resource problems. The second section presents (a) the on-going program which is formulated to indicate what future conditions may be without planned resource development and (b) two of the alternative resource development plans which emphasize improving economic and environmental conditions.

DEVELOPMENT AND ADJUSTMENT POTENTIALS

The development and adjustment potentials are practices and measures which offer opportunities for reducing the previously identified land- and water-based problems and satisfying projected needs. In addition to those presented, other broad resource adjustments will also be required to insure that the problems will not continue. These adjustments include recombining and reallocating resources within and between agricultural and nonagricultural interests to attain maximum use value, promote economic growth, and minimize adverse environmental impact.

AGRICULTURAL LAND AVAILABILITY AND POTENTIALS

Sufficient agricultural land is available to permit a wide range of land use adjustments and to meet the basins allocated share of projected production needs. Considerable land use adjustments are anticipated during the next one-half century, culminating in a projected net decrease of about 97,000 acres of rural agricultural lands. Even though adequate land exists, acreage suitable for intensive agricultural use is not evenly distributed in the basin. Likewise, certain areas in the basin are more suitable for urban, recreational, and other development. Thus, potential and need exist for land use changes and adjustments to obtain more efficient allocation of resources among competing agricultural and nonagricultural interests.

Potentials for alleviating current land resource problems and preventing their recurrence in the future are:

1. Land use planning and appropriate plan implementation to determine and encourage resource adjustments needed between agricultural and nonagricultural interests.

2. Farm enlargements, reorganizations, and similar changes to provide for more efficient resource use.

3. Shifts in enterprises or crops to permit using land resources according to inherent capabilities.

4. Conservation land treatment and management systems to assure a continuing resource base.

The first, land use planning and implementation, would involve comprehensive area-wide plans for minimizing environmental and economic land use conflicts and providing a framework for best using water, land, and related resources.

Farm adjustment potentials are for reorganization, enlargement, and enterprise shifts to facilitate using land according to its suitability; increasing productivity; and decreasing per unit costs, resulting in improved incomes. On many small basin farms, particularly those in the eastern and south-central sections, potential exists for enlargement of farm size to permit incorporating longer rotations in cropping systems, and spreading labor and machinery costs over more acres. Enlargement might be accomplished by merger, through purchases, leases or rentals. On some others, the potential is for shifting to specialty crop enterprises to more fully use available resources. Opportunities exist on most farms to increase efficiency of resource uses through converting idle and under utilized lands to more productive purposes, improving productivity of existing crop land, and utilizing more intensive crop and/or livestock enterprises. Where farms are of insufficient size or unsuitable for farming operations, the most favorable potential may be to transfer part or all of the land, labor, and related resources to recreation or other non farm uses.

FOREST LAND AVAILABILITY AND POTENTIALS

The 2,015,150 acres of forest are insufficient to produce enough products to meet projected needs for the year 2000. Some of the deficit could be met by planting trees on 109,550 cropland acres; 84,900 pasture acres; 45,000 gullied acres; 30,600 strip-mined acres; and about two-thirds of the 128,000 acres projected to be surface mined by 2000. The Class VI and VII crop and pasture lands have limited production potential due to erosion, shallowness, stoniness, low moisture holding capacity, or low fertility. Likewise, the strip-mine and gullied acreage is unsuitable for crop production but can be used for limited timber production and wildlife habitat. Conversions of these lands to forest and the present forest acres could, with a high level of management, produce approximately 87 percent of the forest products projected to be needed by the year 2000 (appendix table VI.2).

Potential for timber production, recreation, and wildlife development is high, but much of the basins forest has been affected by grazing, stripmining, overcutting, burning, and generally mismanaged. Approximately 80 percent of the forest land is in need of management plans to recommend and schedule forestry practices such as tree planting of critical, open, and old field areas. Timber stand improvement measures needed include the conversion to more favorable tree species, release and thinnings to put desirable tree species into the best productive condition, and an improvement cut to remove merchantable timber and provide growing room for the remaining trees. Implementation would be accomplished by landowners with the Divisions of Forestry of the Kentucky Department for Natural Resources and Environmental Protection, and the Tennessee Department of Conservation providing technical assistance. Potential exists for installing forestry land treatment and management for protecting the soil from erosion; reducing storm runoff; increasing timber growth; and enhancing wildlife, recreational, and aesthetic values.

Potential site productivity of the forest varies because of differences in soil fertility, moisture, slope, and aspect. Potential forest growth is divided into four classes. (table VI.1). A description and identification of important soil types for each soil resource group are listed in appendix table II.1.

Only 3 percent of the commercial forest land is in site productivity class which is capable of producing 120 cubic feet or more, and 9 percent in the 85 to 119 cubic foot productivity class.[1/] Nearly three-fourths of the total forest is in the 50 to 84 cubic foot class. Timber production efforts should be concentrated on these 3 productivity classes. The 0 to 49 cubic foot class provides limited response to timber management activities but is important for recreation, wildlife, or other nontimber uses.

Under full forest stocking and with proper forest management, the potential timber production could average 65 cubic feet per acre. This average could not be realized until the year 2050 or later. Using the potential growth of 65 cubic feet per acre, the present forest land of 2,015,150 acres plus the potential land available for conversion to forest could produce an average annual growth of about 149 million cubic feet.

1/ Site productivity class - A classification of forest land in terms of potential annual growth in cubic feet per acre of fully stocked stands.

Table VI.1 - Commercial Forest Land by Site Productivity Classes and Soil Resource Groups, 1969

Green River Basin

Site Productivity Classes (Cu.Ft./Ac./Yr.)	Soil Resource Groups	Commercial Forest Land (1,000 Acres)	(Percent)
120 or more	1-5-14	66,300	3.3
85 - 119	7-8-9-16	183,800	9.1
50 - 84	2-3-4-6-10 11-12-13-13 15-17-18-19	1,433,700	71.1
0 - 49	21-22	331,350	16.5
All Classes		2,015,150	100.0

Source: Forest Service, U.S. Department of Agriculture.

POTENTIAL FOOD AND FIBER PRODUCTION

Significant potential exists for increasing food and fiber production in the basin. If agricultural resources were used more intensively, basic land use problems alleviated, and needed conservation and management practices applied, food and fiber production by the year 2000 could increase as shown in table VI.2. This table shows the 1970 level of food and fiber production and that projected for the year 2000 under two alternative conditions. The first condition, which is referred to as the going program, indicates the quantity of food and fiber that could be produced by the year 2000 without accelerating existing or initiating new water and related land resource development activities.2/ The second was developed to indicate the level of production that could be attained by using the land more intensively and with accelerated water and related land resource developments.

The additional agricultural production projected for the year 2000 would require expanding crop acreage by about 40 percent over the 1970 level. Minor land use shifts would occur between crop and/or pasture acreage, but the total acreage is the same for both alternative conditions. Thus, the difference in productive output for the two conditions results primarily from more intensive land use and increased yields made possible through application of conservation, management, and development measures. The additional production obtained by using the land more intensively could be used domestically or for exports to reduce the world food problem.

2/ A more detailed discussion of the going program is presented in the second part of this chapter.

POTENTIAL FOR ALLEVIATING PROBLEMS

Erosion Reduction Potential

Conservation land treatment and management measures are fundamental requirements for decreasing problems caused by excessive erosion, runoff, and improper land use. The greatest potential for decreasing erosion and runoff on the 1,286,000 cropland acres needing treatment and preventing similar problems on other acreage is (1) using the land according to its capabilities; (2) shifting approximately 160,000 acres in the steeper land capability classes to permanent cover, particularly Class IV, VI, and VIII lands; and (3) applying conservation land treatment and management measures. Execellent opportunities exist for farmers to decrease cropland erosion by adopting new scientific and technologic advancements, like minimum and no-till planting practices, and by employing improved management measures such as seeding cover crops on land customarily left unprotected after harvesting crops.

The most obvious potential for improving pasture cover, minimizing land abuse, and decreasing erosion include stand improvement, fertilization, weed control, and proper livestock rotation. Approximately 84,900 acres of pasture in the steeper land areas should be shifted to trees.

The most significant factor in reducing erosion and sediment production on forest land is the condition and type of vegetative cover. Treatment can improve the hydrologic condition of forest soils by developing a protective cover and absorbent forest floor of porous humus under a protective layer of litter. The improved hydrologic condition retards runoff, thereby reducing soil erosion and sediment losses.

Table VI.2 - Present and Potential Food and Fiber Production

Green River Basin

Item	Unit	1970	2000 Going Program	2000 More Intensive Use
			Thousands	
Agricultural				
Corn	Bu.	26,000	59,800	63,600
Silage	Tons	370	1,980	2,600
Wheat	Bu.	2,500	4,490	4,480
Soybeans	Bu.	4,500	16,650	16,200
Barley and oats	Bu.	1,400	1,530	1,500
Hay	Tons	530	1,240	1,430
Cropland pasture	A.u.d.	50,000	90,000	101,500
Permanent pasture	A.u.d.	80,000	131,000	130,800
Forestry				
Timber products	Cu.ft.	26,400	54,800	71,900

Source: U.S. Department of Agriculture Census, 1969 and study data.

During timber harvest operations, erosion can be reduced by locating spur roads and skid trails on the contour and avoiding steep slopes. After completion of the timber operation, roads and trails should be water-barred to prevent concentration of large water flows, and then seeded, mulched, and fertilized to provide a temporary grass cover. Cattle should be excluded from forest land by fencing and management.

Potential prevails throughout the basin for applying conservation land treatment and management measures to control erosion on gully, roadside, streambank, and nonagricultural land. These measures vary from shaping and filling severely eroded gully areas to vegetative plantings on road and streambanks. In many areas, management practices, such as eliminating machinery and equipment crossing or preventing cattle from having access to gully or streambank areas, are sufficient. On severely affected areas, structural and vegetative measures are required.

Floodwater Damage Prevention Potential

The potential for preventing or reducing floodwater damages in the basin is through applying land treatment, structural, or nonstructural measures or a combination of these measures. Structural measures may include floodwater retarding structures, dikes, levees, channel improvements, and flood proofing, either singly or in combination. Nonstructural measures applicable are flood alarm systems, flood insurance programs, and flood plain zoning.

Structural sites are available for development of P.L. 566 upstream watershed projects for flood protection, except in the karst area of the south-central portion of the basin and in the wide bottomlands of the northwest portion. Five projects identified as having potential and need for early action development include Upper Green River, Skaggs Creek, Trammel Fork, East Fork Deer Creek, and East Fork Indian Camp (plate VI-1). These watersheds

Table VI.3 - Physical Data for Potentially Feasible P.L. 566 Watersheds

Green River Basin

Watershed and Identification Number	Drainage Area	Str. Prop.	D. A. Cont.	Storage			Surface Area		Chan. Imp.
				Sediment	Floodwater	Beneficial	Normal Pool	Flood-Pool	
	(Sq.Mi.)	(No.)	(%)	Acre-Feet					(Mi.)
Upper Green River (16-1)	322.1	4	38	3,615	23,880	4,130	740	2,365	-
Skaggs Creek (16A-9)	80.6	3	39	1,665	5,035	1,065	790	1,310	-
Trammel Fork (16A-18)	134.5	4	21	1,970	4,770	2,970	350	620	
E.F. Deer Creek (16-34)	47.5	4	30	1,205	2,695	8,990	910	1,110	8
E.F. Indian Camp (16-23)	26.7	1	21	50	1,050	0	75	140	-
Total	611.4	16	149	8,505	37,420	17,155	2,865	7,210	8

Source: Data obtained from watershed investigations conducted during survey.

have a combined drainage area of 611 square miles and provide for installing 16 flood control structures, modifying 8 miles of channel, and accelerating land treatment program (table VI.3). The benefits and costs of the five projects, which provide flood protection to about 18,000 acres of land and four towns or communities are shown in table VI.4.

Flood insurance programs and flood plain zoning systems offer potential for preventing floodwater damages in some upstream communities identified in Chapter IV. Flood alarm systems to provide advance warning and the projected flood stages, particularly for communities located adjacent to Green River, would permit evacuation of the area ahead of floods.

Potential for reducing floodwater damages by projects installed for purposes other than flood protection is significant, although not usually recognized. For example, most structures installed for municipal, fish and wildlife, agricultural, or recreational water supplies provide some flood protection. The water supply and recreational structures, if installed to meet anticipated needs for the next 50 years, would reduce floodwater damages on approximately 20,000 acres. Land treatment measures and critical area stabilization practices expected to be installed to decrease runoff during this period would also decrease flooding problems.

Table VI.4 - Summary of Average Annual Benefits and Costs for Potential P.L. 566 Watersheds

Green River Basin

Watershed and Identification Number	Average Annual Benefits 1/						Average Annual Cost	Benefit Cost Ratio
	Flood Prevention		Recreation					
	Damage Reduct.	Land Enhancement	F & W	Water Supply	Other 1/	Total		
Upper Green River (16-1)	39,000	51,500	30,000	15,000	47,000	182,500	170,000	1.07:1
E.F. Indian Camp Creek (16-23)	10,700	2,000	--	--	5,000	17,700	12,700	1.39:1
E.F. Deer Creek (16-34)	14,000	17,000	40,000	70,000	28,000	169,000	148,500	1.14:1
Skaggs Creek (16A-9)	17,500	7,500	43,500	--	8,000	76,500	72,300	1.06:1
Trammel Fork (16A-12)	20,000	9,500	17,000	17,500	7,200	71,300	75,600	.94:1
Total	101,200	87,500	130,500	102,500	95,200	516,900	479,100	1.08:1

Source: Data obtained from watershed investigations conducted during survey.
1/ Other includes indirect, secondary and, where applicable, redevelopment benefits.

U.S. DEPARTMENT OF AGRICULTURE

LEGEND

1. East Fork Deer Creek
2. East Fork Indian Camp Creek
3. Trammel Fork
4. Skaggs Creek
5. Upper Green River

VICINITY MAP

SOURCE: Data compiled by SCS River Basin Planning Staff.

Plate VI–1

POTENTIAL P.L. 566 PROJECTS
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

APPROXIMATE SCALE - MILES

Compiled and reproduced at 1:250,000 (1 inch equals 4 miles) from 1:100,000 USGS Topographic Map and 1974 State Road Map. Also reproduced at 1:700,500 (1 inch equals 11 miles).

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USDA-SCS-FORT WORTH, TEX. 1975

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Sediment Damages Reduction Potential

Application of conservation land treatment and management measures to reduce erosion on agricultural and nonagricultural lands will significantly reduce sedimentation problems throughout the basin. Potential prevails for installing conservation and stabilization measures to reduce sediment produced by run-off on surface mine areas, gullies, road-banks, streambanks, and newly disturbed development lands.

Surface mining activities in the western portion of the basin cause the most severe localized sedimentation problems. Studies show that approximately 64 percent of the surface-mined lands are still contributing to the sedimentation problems. Moreover, projections indicate that, in the next 50 years, some 168,000 more basin acres will likely be surface mined.

The potential for satisfactorily reclaiming and stabilizing previously stripped lands is not as great as for lands projected to be mined in the future. Treatment potentials on previously surface mined land are for additional tree plantings and grass seedings, with shaping and smoothing of some land prior to establishing vegetation. For lands to be surface mined, the greatest potential for decreasing sedimentation problems appears to be modification of current surface mining practices.

Instead of indicating that changes in current surface mining methods are in order, the following depicts the nature of efforts and activities needed to decrease sedimentation damages to water, land and related resources. On lands to be surface mined, it appears that potential prevails for:

1. Removing and stockpiling topsoil prior to removing other overburden material.

2. Extracting minerals and then replacing the overburden material and topsoil to their approximate original position.

3. Constructing debris basin and other structural measures to reduce offsite damages during the mining and stabilization process.

4. Shaping and leveling disturbed lands to approach the original slopes and grades.

5. Establishing vegetative cover on the carefully prepared seedbed. (Attaining vegetative cover will require carefully selecting plants, properly preparing seedbeds, applying recommended plant nutrients, and mulching to keep nutrients and seed in place during establishment periods.)

Similar to potentials for decreasing sedimentation problems from surface mined areas, a wide range of potentials exist for installing land and grade stabilization measures on gullies and other disturbed lands. Structural measures installed may include chutes, drop spillways, sediment basins, inter-farm diversions, and waterways. Vegetative planting may include both grasses and tree plantings to provide a quick and permanent cover. Implementation of management measures to decrease disturbance of the gully, stream, and sediment producing areas are also effective in decreasing the problems.

Drainage Improvement Potential

An excellent potential exists for farmers to install surface and/or subsurface drainage measures to remove excess water from agricultural lands. As earlier identified, some 315,500 acres need drainage improvement measures to increase production potential and decrease management problems. The greatest potential for reducing these problems is installing and maintaining subsurface tile systems, open drainage ditches, sod waterways, and similar measures as identified in appendix table IV.3 of Chapter IV. Land leveling and grading, while used to facilitate land use, would assist in alleviating drainage problems.

Water Supply Potential

Potential for installing upstream reservoirs and impoundments to obtain additional water supplies is good in most of the basin. However, suitable sites are limited in part of the south-central portion which is underlain by cavernous limestone and in the flatlands of the northwestern portion. Sites having adequate storage characteristics are found in all subbasins, but most of those identified for this report are in the Upper Green, Barren, and Rough Rivers (appendix table VI.5). Additional sites were not identified or studied in areas which have approved P.L. 566 watershed projects or other supply sources that would meet projected needs. As shown by plate VI-2, the studied areas include Rough and Upper Barren River subbasins, along with other upstream areas, which drain directly into the Green River.

Functional purposes studied for the potential upstream impoundments include rural, municipal, and industrial supplies; fish, wildlife, and recreational water; water quality control; and agricultural supplies. Rather than attempting to identify the purposes to be served by each site, the data in appendix table VI.5 are to assist decision makers in selecting the appropriate alternative to meet identified needs. In upstream drainage areas, the storage reservoirs could be developed with controlled release rates to improve stream flow characteristics and provide more dependable supplies of agricultural, recreational, and rural or municipal water.

The potential water storage in upstream reservoir is estimated at 449,000 acre-feet. This storage includes about 121,000 acre-feet for flood prevention, approximately 25,000 acre-feet for sediment, and 303,000 acre-feet for other uses. It should be noted that, in considering potential water storage sites, attention must be given to development and relocation costs, mean annual water yields, evaporation and seepage losses, and other factors affecting site utilization.

In addition to the larger upstream reservoirs identified, potential exists for constructing onfarm impoundments for livestock water, fish and wildlife, recreation, flood prevention, and grade stabilization purposes. Other than identifying the potential for development of onfarm impoundments, no attempt was made to locate, identify the number, or estimate the storage available in the potential sites. In the area affected by surface mining, for example, potential exists for construction of about 290 debris basins to reduce present and future offsite damages resulting from mining operations.

Groundwater development potential is somewhat limited, as yields are less than 50 gallons per minute on approximately 80 percent of the basin. Yields range from 50 to 1000 gallons per minute in the remaining area, with the highest yields being in the alluvial flood plains near the junction of the Green and Ohio Rivers. Significant potential exists for developing groundwater supplies in the latter areas, but the developments may be slow in occurring because of the abundance of surface water. Consideration should be given to using groundwater to supplement surface supplies in these areas, particularly where the development potential for upstream reservoirs is limited.

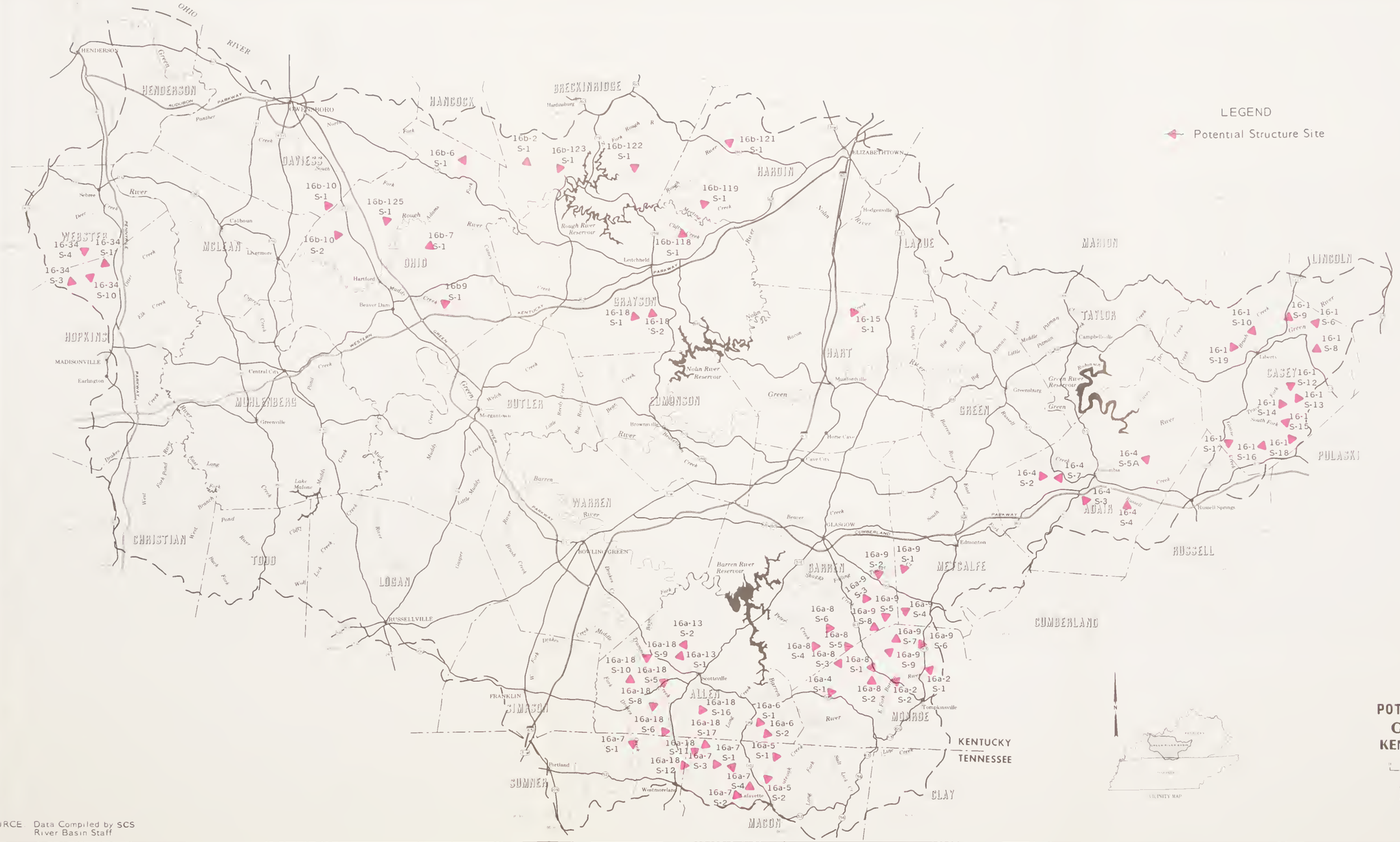

Plate VI–2
POTENTIAL STRUCTURE SITES
GREEN RIVER BASIN
KENTUCKY AND TENNESSEE

APPROXIMATE SCALE - MILES

Compiled and reproduced at 1:250,000. 1 inch equals 4 miles from 1:250,000 USGS Topographic Map and FHWA State Road Map. Also reproduced at 1:500,000. 1 inch equals 11 miles.

SOURCE Data Compiled by SCS River Basin Staff

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Recreational Development Potential

Potential exists for development of outdoor recreational facilities and areas needed to satisfy present and projected needs. The recreational facility or area needs may be fulfilled through acquiring land needed for constructing playground facilities; converting unused rural or urban lands to recreational areas; developing additional water and water-based facilities; and encouraging individuals to transfer land and related resources to recreational uses. In the surface mining area, potential exist for developing and using the "orphan lands" for hiking trails, horseback riding, hunting, bicycling, golfing, and similar recreational activities. Opportunities for increasing fish resources to satisfy projected needs are through developing additional water areas and intensively managing existing waters. The latter would require rehabilitation of streams and reservoirs that are adversely affected by pollution. Addition of new water areas could be attained through the development of appropriately distributed lakes to support fish populations. Potential for developing additional hunting areas and wildlife habitat are through acquiring lands, encouraging land owners to improve habitat, and managing existing areas to support larger game populations.

Pollution Abatement Potential

Opportunities exist throughout the basin for individual and group effort to prevent and reduce pollution. Some opportunities for pollution abatement include decreasing the quantity of debris and solid waste material deposited along roadsides, in streams, and on rural lands; preventing discharge of excessive sewage, animal waste, and industrial effluents into streams; applying erosion control and sediment reduction measures on lands susceptible to erosion; and reducing the practice of burning debris and waste materials that contribute to air pollution. Major efforts required to reduce air, water, and land pollution will involve installing improved sewage disposal systems, modifying manufacturing practices to prevent discharging effluents into streams, and making other agricultural and nonagricultural changes to minimize pollution. Most of the other efforts will only require individuals and groups to discontinue disposing waste products in streams or on rural lands and curtailing similar practices which contribute to pollution.

RESOURCE DEVELOPMENT ALTERNATIVES

The State's goal is for economic development and improvement of the environment so that citizens can enjoy a better quality of life. These interests are included in the economic development and the environmental quality alternatives presented in this section. Major features expected to be accomplished under the two alternatives and the going program, which is used to indicate what may be expected without planned resource development, are summarized in table VI.5.

GOING PROGRAM

The going program is formulated to indicate what conditions might be by the year 2000 in the absence of new or accelerated programs to deal with water, land, and related resource problems. It is used as a base from which the two alternative plans in this chapter and the selected plan in chapter VII are evaluated. Projected conditions were developed using historical data to establish trends, with adjustments for technological and scientific advances.

Land Uses, Shifts, and Projections

Major land use shifts anticipated under the going program by the year 2000 are from rural agricultural land to nonagricultural uses. Urban areas are expected to increase by about 46,000 acres and water areas about 14,000 acres. Cropland is expected to decrease by some 65,000 acres and idle and other land by 61,000 acres. Small increases are anticipated in pasture acreage. Forest land is projected to increase by about 29,000 acres. Similar land use shifts, except for forest acreage, are projected for the year 2020. Forestry acreage in the year 2020 is expected to decrease by about 2,300 from the projected 2000 level. The total projected land use shifts would decrease rural agricultural lands by 60,000 acres by the year 2000 and 97,000 acres by the year 2020 (table VI.6).

Surface mining activities are expected to require about 130,000 acres of rural crop, pasture, forest, and idle lands. Since most of this acreage is projected to be reclaimed or restored to pasture and forest uses, the mined acreage will not result in a loss of rural agricultural lands.

Projections indicate that a diversified agriculture is expected to continue in the immediate future, even though shifts are anticipated toward a higher degree of specialization. Farm enlargements, reorganizations, and enterprise shifts are anticipated to facilitate applying advanced production techniques and increasing crop and livestock output. Corn, soybeans, and tobacco are expected to remain the major crops, with beef continuing as the dominant type of livestock. The level of forestry management is projected to continue at the present rate, with adoption of scientific and technologic advancements. Land treatment practices and the rate of application are projected to be similar to the present, with additional emphasis in urban and critical erosion areas.

Table VI.5 - Summary of Project or Program Measures Projected to be Accomplished by the Year 2000[1/]

Green River Basin

Item	Unit	Going Program Total	Economic Development Total	Economic Development Accelerated[2/]	Environmental Quality Total	Environmental Quality Accelerated[2/]
1. Channel modification	Mi.	110[3/]	118	8	118	8
2. Debris basins	No.	90	220	130	290	200
3. Drainage	Ac.	47,000	144,000	97,000	47,000	-
4. Floodwater retarding structures (P.L.566)	No.	12[3/]	17	5	17	5
Surface area	Ac.	370	1,160	790	1,160	790
Land area	Ac.	1,100	4,130	3,030	4,130	3,030
5. Multiple-Purpose reservoirs (P.L.566)	No.	4[3/]	15	11	15	11
Surface area	Ac.	280	3,185	2,905	3,185	2,905
Land area	Ac.	600	4,000	3,400	4,000	3,400
6. Multiple-Purpose reservoirs (Others)	No.	19	29	10	35	16
Surface area	Ac.	1,600	2,522	922	3,760	2,160
7. Farm ponds	No.	13,900	17,300	3,400	29,900	16,000
Surface area	Ac.	4,060	5,200	1,140	6,280	2,220
8. Roadbank erosion treatment	Mi.	330	640	310	1,280	950
9. Streambank erosion treatment	Mi.	100	270	170	540	440
10. Fish pond management	Ac.	1,170	7,060	5,890	11,100	9,930
11. Livestock waste disposal systems	No.	30	220	190	314	284
12. Strip mine stabilization (new)	Ac.	127,850	127,850	-	127,850	-
13. Strip mine stabilization (old)	Ac.	43,700	43,700	-	43,700	-
14. Forest management	Ac.	737,000	1,072,000	335,000	1,072,000	335,000
15. Tree planting						
a. Critical strip mine	Ac.	95,830	106,270	10,440	119,310	23,480
b. Gully areas	Ac.	6,000	24,200	18,200	24,200	18,200
c. Open areas and old fields	Ac.	58,800	122,400	63,600	101,800	43,000
d. Sheet erosion areas	Ac.	-	110,000	110,000	110,000	110,000
16. Spur road and skid trail stabilization	Ac.	308,690	326,070	17,380	319,030	10,340
17. Timber stand improvement						
a. Hardwood release	Ac.	5,000	325,000	320,000	119,000	114,000
b. Improvement cutting	Ac.	53,000	89,000	36,000	89,000	36,000
18. Grazing control	Ac.	28,000	80,600	52,600	120,900	92,900
19. Land stabilization measures						
a. Strip cropping and terraces[4/]	Ac.	89,400	260,320	170,920	536,400	447,000
b. Crop residue management[4/]	Ac.	33,150	89,820	56,670	198,900	165,750
c. Contouring[4/]	Ac.	34,050	95,340	61,290	204,300	170,250
d. Conversion to permanent cover	Ac.	24,000	67,200	43,200	144,000	120,000
e. Pasture improvement	Ac.	51,150	143,220	92,070	306,900	255,750
f. Reestablishment of vegetative cover	Ac.	30,900	86,520	55,620	185,400	154,500
g. Gully stabilization	Ac.	10,000	20,600	10,600	54,800	44,800

1/ Compiled from study data.
2/ Accelerated includes the quantity over and above that of the going program.
3/ These are unconstructed measures in authorized P.L. 566 projects and are considered in place in economic studies of this report.
4/ Minimum and no-till cropping systems are often used with or instead of the above.

Table VI.6 - Present and Projected Land Use (Going Program)

Green River Basin

Major Land Use	Present Conditions	Projected Years 2000	2020
Agricultural			
Cropland	2,086,530	2,021,630	1,992,930
Pasture	1,129,990	1,167,810	1,170,500
Forest	1,951,950	1,981,080	1,978,820
Other	391,530	330,080	320,550
Subtotal	5,560,000	5,500,000	5,462,800
Nonagricultural			
Federal land and water	117,100	117,100	117,100
Urban	202,260	248,160	281,160
Water	27,200	41,300	45,500
Subtotal	346,560	406,560	443,760
Total	5,906,560	5,906,560	5,906,560

1/ Compiled from Soil and Water Conservation Needs Inventories for Kentucky, 1970, and Tennessee, 1971; Current Water Resource Development Bulletins published by the U.S. Army Corps of Engineers; and other Soil Conservation Service and Forest Service data. Projected land use estimates were developed from study data.

2/ Includes farmsteads, farm roads, feed lots, ditch banks, fence and hedge rows, miscellaneous farmlands, nonfarm residences, investment and industrial tracts, built-up areas smaller than 10 acres, gravel pits, and borrow areas.

3/ Includes 88,000 acres of Federal land, of which 63,200 acres are forest.

4/ Includes water areas other than Corps of Engineers Reservoirs.

In nonagricultural areas, projections indicate that industrial and commercial activities will continue to expand. The most significant increases are expected in mining, manufacturing, construction, wholesale and retail, utility, and service related activities. Major manufacturing and related industrial developments are expected to occur in or near the larger population centers of Owensboro, Bowling Green, Madisonville, and Elizabethtown. These, along with Hopkinsville and Glasgow in Kentucky and the Westmoreland area in Tennessee, are projected to have substantial gains in population, housing, and employment. These projected activities will require converting about 46,000 acres of agricultural and forest land to urban uses.

Program Components

Principal program or project measures expected to be accomplished under the going programs by the year 2000 include:

1. Applying conservation land treatment and management measures to adequately treat about 200,000 acres of agricultural land;

2. Installing 12 floodwater retarding structures, four multiple-purpose structures, and 110 miles of channel included in the P.L. 566 watershed projects authorized for installation;

3. Stabilizing about 43,700 acres of previously surface-mined land and 127,850 acres projected to be mined by the year 2000;

4. Improving forestry management on 737,000 acres and planting trees on approximately 58,800 acres of open areas;

5. Installing 19 multiple-purpose water storage reservoirs by local and state interests for municipal, industrial, and recreational use; and

6. Constructing some 14,000 farm ponds for agricultural and recreational water.

Additional accomplishments are expected to result from federal and state agencies providing assistance and information to landowners, developers, and other resource users.

Impacts

The following identifies some of the impacts expected to result from the above measures and others included in table VI.5.

Erosion and sediment - Application of conservation land treatment and management measures under the going program would result in about 200,000 net acres being adequately treated by the year 2000. These measures would reduce cropland erosion from 7.6 tons per acre to 3.0 tons or less, giving a gross reduction in excess of 900,000 tons annually. Conservation treatment and stabilization measures expected to be applied would reduce approximately 20 percent of the erosion on 43,700 acres of surface mined land and 127,850 acres projected to be mined by 2000. These measures would, through decreasing erosion and sediment, reduce infertile overwash on about 7,000 acres and decrease swamping and development of potential mosquito habitat on some 4,000 acres. Erosion and sediment problems would be decreased on 330 miles of roadbank and 100 streambank miles by applying conservation treatment practices.

Forest conservation treatment and management practices expected to be accomplished by the year 2000 includes: (1) Forest management plans on 737,000 acres of private forest land; (2) Tree planting on 58,800 acres of old fields; (3) Tree planting for critical area stabilization on 95,830 acres strip mined areas and 6,000 acres of gullied areas; (4) Timber stand improvement to include 5,000 acres of hardwood release and improvement cutting (timber marking) on 53,000 acres; (5) Grazing exclusing from 28,000 acres; and (6) Erosion control on 308,690 acres of spur roads and skid trails. These practices, primarily those applied to spur roads and skid trails, would reduce erosion from 4,407,000 tons to 3,053,100 and sediment yields from 370,020 tons to 136,780 (appendix table VI.8). This reduction, with planned practices of cattle exclusion, would meet the requirements of the Federal Water Pollution Control Act of 1972.

Floodwater - Projected construction of 19 multiple-purpose reservoirs, dikes, and channels by local, state, and private concerns will reduce flooding frequency on about 22,000 acres. Some communities are expected to implement flood insurance, flood plain zoning, and flood warning programs which would further prevent floodwater damages. The authorized but unconstructed P.L. 566 watershed project measures were, for the purpose of this study, considered in place. Damages projected to be reduced by these projects were deducted from the damages identified in Chapter IV.

Drainage - Surface and/or subsurface drainage measures are expected to be installed on about 47,000 acres. The measures will provide for improved land management and crop yields.

Water supplies - It is anticipated that basin citizens will install 19 multiple purpose reservoirs, principally for municipal, industrial, and recreational water. These reservoirs will provide municipal, industrial, and rural water which would meet about 60 percent of the additional projected needs for the year 2000. The additional supply would be sufficient for a population equivalent to about 375,000. In addition, about 14,000 ponds are projected to be constructed to provide agricultural livestock and irrigation water.

Recreation:

1. Water-based - The present water areas will meet approximately two-thirds of the 10,100,000 annual water-based recreational days projected to be needed by the year 2000. Projected installation of the 19 multiple-reservoirs, swimming pools, and related facilities by local groups and private individuals under the going program by the year 2000 will provide an estimated 1,320,000 additional visitor-days. The present supply of 6,800,000 and the additional 1,320,000 will meet approximately 80 percent of the total water-based recreational needs for the year 2000.

2. Land-based - Present land-based recreational facilities will provide about 64 percent of the 11,600,000 annual visitor-days projected to be needed by the year 2000. The additional playgrounds, golf courses, camp sites, picnic areas, and related land-based recreational facilities will provide an additional 1,700,000 visitor-days. The 9,200,000 visitor-days will meet almost 80 percent of the projected needs for the year 2000.

3. Fish and Wildlife - The current supply of some 1,858,000 annual fisherman-days provided by existing waters will meet about 67 percent of the total days projected to be needed by the year 2000. The water in the 19 multiple-purpose reservoirs, 14,000 farm ponds, and other small private lakes projected to be installed by area residents will provide some 228,500 additional fisherman-days. These additional fisherman-days and the present supply of 1,858,000 will meet about 77 percent of the total projected

to be needed by the year 2000. The 1,244,000 hunter-days estimated to be needed by the year 2000 can be met under existing programs. However, stabilization of the 127,850 acres projected to be surface mined by the year 2000 and application of conservation measures on other lands will provide additional wildlife habitat.

Agricultural Production - The basin has good agriculture potential. Projected agricultural production under the going program for 2000 is shown in table VI.7.

Table VI.7 - Present and Projected Agricultural Production Under Going Program

Green River Basin

Item	Unit	Production and Year 1970	2000
		---Thousands---	
Corn	Bu.	26,000	59,800
Silage	Tons	370	1,980
Wheat	Bu.	2,500	4,490
Soybeans	Bu.	4,500	16,650
Barley and oats	Bu.	1,400	1,530
Hay	Tons	530	1,240
Cropland and pasture	A.u.d.	50,000	90,000
Permanent pasture	A.u.d.	80,000	131,000

Source: U.S. Census of Agriculture, 1969, and study data.

This production would require all the acres available for agriculture be used with the exception of some acres idled due to institutional or transitional requirements (table VI.8).

The value of gross agricultural output using current normalized prices would be $728 million in the year 2000. This includes the value of all livestock feed, plowed down crops, and production withheld for seed purposes or personal consumption. It does not include specialty crops, subsidy or support payments from governmental agencies, or imputed income for rents. Expressed in present dollars, the value would be $502 million of gross farm income.

Cost associated with this level of production would be over $102.7 million in private farm costs not including land charges, management fees, costs of marketing the agricultural products, and public costs of maintaining agricultural programs at their current levels.

The projected level of agricultural employment in the year 2000 could amount to about 13,000. A comparable projection by OBERS is 13,500 workers, which includes additional agricultural service employees not included in the employment projected from production needs. Hired agricultural employment is expected to be about 2500 by the year 2000. Rural farm population is estimated to be about 60 to 70 thousand in the year 2000 and rural families should range between 15 and 20 thousand.

Table VI.8 - Projected Crop and Pasture Acreage Under Going Program for 2000

Green River Basin

Item	Acres Required
	---Thousands--
Corn	409.9
Silage	80.8
Wheat	107.8
Soybeans	330.3
Barley and oats	23.8
Hay	257.8
Cropland pasture	588.8
Specialty crops	117.0
Idle cropland	104.8
Total cropland	2,021.0
Permanent pasture	1,107.3
Idle pasture	60.5
Total pasture	1,167.8
Total Basin	3,188.8

Source: U.S. Census of Agriculture, 1969, and study data.

Forestry Production - Total forest land in the year 2000 is projected to be 2,044,280 acres. This includes 101,830 acres of gully and strip mine planted to trees and excludes 72,700 acres to be cleared. About 92 percent, or 1,890,770 acres would be available for timber production. Production would be about 54.8 million cubic feet, including 3 percent veneer; 42 percent saw logs; 28 percent pulpwood; and 27 percent other.

Average timber growth in the year 2000 is estimated at 34.2 cubic feet per acre, with a product yield of 29.1 cubic feet per acre (appendix table VI.2). The estimated production of 54.8 million cubic feet will satisfy about 67 percent of the total projected needs. The need for pulpwood and "other products" would be met, while the need for veneer and saw logs would not be satisfied (appendix table VI.4). An additional 927,000 acres of forest land would be required to meet the product need of 82.0 million cubic feet in the year 2000 (table VI.7). Even with these additional acres, the need for veneer and saw logs would not be satisfied. In the year 2000, the stumpage value of forestry products would be about $7.3 million. Projected employment of 2,665 man-years providing an income of about $22.8 million would result from managing and protecting the forest resources and in forestry related industries, such as logging, sawmills, planner mills, cooperage mills, and wood furniture plants.

Estimated cost of installing forestry practices to increase timber growth and reduce erosion would be about $65.5 million with an additional technical assistance cost of $1.9 million (appendix table VI.9). These forestry practices would provide employment of 2,605 man-years with an income of $28.0 million. A summary of the forest land impacts that would occur under this plan are shown in appendix table VI.10.

ECONOMIC DEVELOPMENT ALTERNATIVE

The economic development alternative emphasizes accelerating existing programs and initiating new programs to alleviate present and projected water, land, and related resource problems and to assist in meeting projected needs. This alternative also includes provisions for enhancing economic, social, and environmental conditions.

Land Uses, Shifts, and Projections

Major land use shifts expected with implementation of the economic development alternative for the years 2000 and 2020 are shown in table VI.9. The land use shifts expected are similar to those anticipated under the going program and include decreases of about 63,000 and 102,000 acres or rural agricultural land by the years 2000 and 2020, respectively. Decreases are projected for crop, pasture, and other lands and increases for forest, urban, and water acreages.

Projected agricultural and nonagricultural changes, as identified under the going program, are expected with this alternative. However, implementation of the development alternative would require more intensive use of conservation, management, and other improvement measures to improve productivity of land, labor, and related agricultural resources.

3/ The proposed measures and investments included in this alternative contribute toward economic growth by providing for improved management, development, and utilization of resources. These improvements, which provide for more intensive and multiple resource uses, permit increasing the quantity of goods and services produced, and often with fewer resources. The increased resource productivity, in turn, permits the transfer of marginal agricultural lands or areas susceptible to damage by erosion or related factors to less intensive uses. Since transferring resources to less intensive uses as well as investments in certain erosion control and some other conservation-management measures seldom contribute to maximum economic development in the short run, these provisions can be questioned from an economic viewpoint. In the long run, however, resource-use shifts, and particularly investments in conservation measures, are necessary to preserve the productive capacity of land for the future and to prevent expensive restoration costs at later periods. Thus, if the long run view is taken, the transfer of resources to less intensive use and the investment in conservation measures are important considerations for attaining future economic development.

Table VI.9 - Present and Projected Land Use
(Economic Development Alternative)

Green River Basin

Major Land Use	Present Condition[1/]	Project Years 2000	2020
Agricultural			
Cropland	2,086,530	1,921,130	1,891,430
Pasture	1,129,990	1,079,370	1,077,940
Forest	1,951,950	2,183,620	2,203,680
Other[2/]	391,530	312,780	284,750
Subtotal	5,560,000	5,496,900	5,457,800
Nonagricultural			
Federal land and water[3/]	117,100	117,100	117,100
Urban	202,260	248,160	281,160
Water[4/]	27,200	44,400	50,500
Subtotal	346,560	409,660	448,760
Total	5,906,560	5,906,560	5,906,560

1/ Compiled from 1970 Soil and Water Conservation Needs Inventories for Kentucky and Tennessee: Current Water Resource Development Bulletins published by the U.S. Army Corps of Engineers; and other Soil Conservation Service and Forest Service data. Projected land use estimates developed from study data.
2/ Includes farmsteads, farm roads, feed lots, ditch banks, fence and hedge rows, miscellaneous farmlands, nonfarm residences, investment and industrial tracts, built-up areas smaller than 10 acres, gravel pits, and borrow areas.
3/ Includes 88,000 acres of Federal land, of which 63,200 acres are forest.
4/ Includes water areas other than Corps of Engineers reservoirs.

Program Components

Major components projected to be accomplished by the year 2000 under the economic development alternative include:

1. Planning and installing the works of improvement included in the five potential P.L. 566 watershed projects identified in this study;

2. Applying conservation land treatment and management measures to adequately treat about 700,000 acres of crop and pasture;

3. Installing surface and/or subsurface drainage measures on 144,000 agricultural acres;

4. Applying stabilization or reclamation measures on 43,700 acres of previously surface mined land, 127,850 acres of land projected to be mined by the year 2000, and over 900 miles of stream and/or road banks;

5. Improving forestry management on 1,072,000 acres;

6. Constructing 29 multiple-purpose storage reservoirs by local and state interests to provide water for municipal, industrial, and recreational use;

7. Installing over 17,000 farm ponds for agricultural water; and

8. Developing 220 livestock waste disposal systems, installing 220 debris basins, and applying related pollution control measures to improve water quality and enhance environmental conditions.

Other measures included under this alternative are in table VI.6.

Impacts

The following presents some of the major impacts projected to result from implementing the economic resource development alternative. Display VI.1 through VI.3 in the appendix of this chapter contain more detailed data on the beneficial and adverse effects of the alternative.

Erosion and Sediment - Application of conservation land treatment and management

measures on about 700,000 total acres of agricultural lands would reduce annual erosion rates from 7.6 tons per acre to 3.0 tons or less, resulting in a total reduction of some 3,000,000 tons. The application of land treatment and stabilization measures on 43,700 acres of previously surface mined land and the 127,850 acres projected to be mined by the year 2000 would decrease erosion on these lands by about 65 percent. This would increase the value of surface mined lands, reduce infertile overwash on about 21,000 acres, and alleviate swamping approximately 11,000 acres.

Application of intensive land stabilization practices on 270 miles of streambank and 640 miles of roadbank would reduce erosion from a high of 50 tons per acre annually to an acceptable level of 5 tons or less. Grazing control, better logging methods, and treatment of spur roads and skid trails would reduce erosion of forest land by about 1.3 million tons per year, or 30 percent of gross erosion. Sediment yields would be reduced by 257,000 tons per year, or a reduction of 69 percent of the total (appendix table VI.8).

Floodwater - Installation of five floodwater retarding structures, 11 multiple-purpose structures, and modification of 8 miles of channel included in the five P.L. 566 watershed projects would reduce almost 45 percent of the average damages accruing on 18,000 acres and to four communities. Installation of 29 multiple-purpose water reservoirs by local people for municipal, industrial, and recreational water would decrease flooding problems on about 34,000 acres or 12,000 acres more than the going program.

Drainage - Application of drainage practices on 144,000 acres would increase the productive capability of the basin, and accordingly increase income and employment. This would increase the total value of agricultural output over the going program by approximately $2.6 million annually and gross farm income by about $1.5 million, while creating nearly 50 man-years of employment.

Recreation:

1. Water-based - The existing water areas, coupled with the basin residents installing the proposed 29 water storage structures, 11 P.L. 566 multiple-purpose reservoirs, and public swimming pools, would provide about 1,947,000 recreational visitor days. These, and the present supply of 6,800,000, would meet about 87 percent of the 10,100,000 total visitor-days projected to be needed by the year 2000.

2. Land-based - Projected construction of golfing, playground, camping, picnicking, and related outdoor recreational facilities would provide some 2,310,000 visitor days. The 2,310,000, together with the present supply of 7,475,000, would meet about 84 percent of the estimated 11,600,000 visitor-days projected to be needed by the year 2000.

3. Fish and Wildlife - The 29 water storage reservoirs, 15 P.L. 566 structures, some 17,000 farm ponds, and improved stream management would provide opportunity for about 662,000 fisherman-days. These, and the current supply of 1,858,000 days, would meet about 92 percent of the 2,753,000 total fisherman-days expected to be needed by the year 2000. Projected hunting day needs for the year 2000 can be satisfied under each of the alternatives studied.

Water Supply - This alternative provides for local people installing 29 multiple-purpose reservoirs and six P.L. 566 multiple-purpose structures to meet municipal, industrial, recreational, and rural needs. These would meet about 90 percent of projected needs and provide adequate water for the equivalent of 573,000 people. Agricultural water supplies would be increased by constructing over 17,000 farm ponds.

Pollution - Sediment production and damages would be reduced by about 75 percent through agricultural conservation and management practice applications; strip-mine, critical area, gully, road, and streambank stabilizations; and land use conversions. These measures would also decrease problems caused by runoff transporting pesticides and related pollutants to streams and water areas. Water pollution could be further reduced by local people installing sewage and waste disposal facilities. Installation of 220 animal waste disposal systems would sufficiently control problems caused by livestock waste.

Agricultural Production - Increased production is anticipated in higher value crops with implementation of the economic development alternative. This production would result in higher cash farm income, but gross value of farm output would be less than that under the going program. The decrease in the gross value of farm output results from less land in capability classes VI, VII, and VIII being used for pasture production to support livestock. Projected production under this alternative for the year 2000 is illustrated in table VI.10.

Table VI.10 Present and Projected Agricultural Production Under Economic Development Alternative

Green River Basin

Item	Unit	Production and Year	
		1970	2000
		---Thousands----	
Corn	Bu.	26,000	61,100
Silage	Tons	370	2,030
Wheat	Bu.	2,500	4,570
Soybeans	Bu.	4,500	16,900
Barley and oats	Bu.	1,400	1,590
Hay	Tons	530	1,240
Cropland pasture	A.u.d.	50,000	76,200
Permanent pasture	A.u.d.	80,000	122,700

Source: U.S. Census of Agriculture, 1969, and study data.

The acreage used in production of these crops is essentially the same as the going program except less land will be available for roughage production. The increase in production of other crops comes from greater yield on adequately treated land. Table VI.11 illustrates the land requirements for production under the economic alternative.

The gross value of farm output under the economic development alternative would decrease six million dollars when compared to the $728 million obtained under the going program. This decreased value results from shifting agricultural land to nonagricultural uses. Cash from income realized under this alternative would amount to about $504 million, a two million dollar increase over the going program. This increase results from production of higher value crops such as wheat, soybeans, and corn.

Farm costs necessary to attain this level of production amount to about $103 million, or $300,000 more than the going program. Public costs, which include the average annual cost of technical assistance and federal cost sharing, increase about $250,000 above the going program. The implied agricultural employment from this level of production would be approximately 12,700 employees. Farm population is projected to be in the 60,000 to 70,000 range and includes from 15,000 to 20,000 farm families.

Table VI.11 - Projected Crop and Pasture Acreage Under Economic Development Alternative for Year 2000

Green River Basin

Item	Acres Required
	--Thousands---
Corn	409.9
Silage	80.8
Wheat	107.8
Soybeans	330.3
Barley and oats	23.8
Hay	257.8
Cropland pasture	488.9
Specialty crops	117.0
Idle cropland	104.8
Total cropland	1,921.1
Permanent pasture	1,023.7
Idle pasture	55.7
Total pasture	1,079.4
Total basin	3,000.5

Source: U.S. Census of Agriculture, 1969, and study data.

Forest Production - Forest land, under the economic development alternative, is projected to be almost 2,247,000 acres by the year 2000 (appendix table VI.1). Clearing forest land for surface mining and urban areas would be the same as the going program (68,700 acres), but recreational and municipal water would take an additional 5,200 acres. Forest land used for recreation and wildlife areas is expected to increase by about 1,000 acres over the present 66,950 acres managed for these uses. Tree planting is projected on 305,570 acres of strip mine, gully, sheet erosion, and open areas. The net increase in forest land would amount to 231,670 acres.

Proposed programs under this alternative provide for increasing the level of forestry management. Application of improved management practices would increase annual timber growth to 41.8 cubic feet per acre, with a product yield of 35.5 cubic feet per acre by the year 2000 (appendix table VI.2).

Timber production would be from 1,926,240 acres by the year 2000. Approximately 15 percent of the reclaimed strip mine and gully areas and 25 percent of the reforested open areas would provide some timber production by the year 2000.

The 1,926,240 acres available for timber production would produce 66.8 million cubic feet in the year 2000. This production would be composed of 5 percent veneer, 78 percent saw logs, 10 percent pulpwood, and 7 percent other. These products would have a stumpage value of approximately $14.8 million. Under this alternative, the forest industry would increase and greater employment would occur in managing and protecting the forest land. Annual employment for the year 2000 would amount to 3,235 man-years, with an estimated annual income of $27.7 million.

The forestry practices that would be accomplished during the installation period under this alternative would cost an estimated $92.4 million (appendix table VI.9). This includes a $4.3 million technical assistance cost to carry out these practices. Installation of the forestry practices would provide 5,024 total man-years of employment, with a total income of $38.4 million. Forest land impacts occurring under this alternative and the going programs are shown in appendix table VI.11.

Expansion of strip mining, urban, and water areas would require 73,900 acres now classed as forest land. Another 1,000 acres of forest would be developed for recreational use. The resultant average annual timber growth forgone would be 2.8 million cubic feet, with a value of $165,000 annually.

ENVIRONMENTAL QUALITY ALTERNATIVE

This alternative emphasizes the development and use of water, land, and related resources to enhance environmental conditions, alleviate resource problems, and meet projected needs.

Land Uses, Shifts, and Projections

Major land use shifts projected under this development alternative would reduce crop, pasture, and other rural agricultural land about 310,000 acres by the year 2000 and approximately 382,000 acres by 2020 (table VI.12). Urban and water acreage would increase about the same as for the going program and economic development alternative. The enterprise shifts and projections would be similar to those for the economic development alternative. The enterprise shifts and projections would be similar to those for the economic development alternative, except more emphasis would be on improving the environment.

The total forest acreage, after clearing and planting, would be 2,258,360 acres by the year 2000 (appendix table VI.1). This includes 58,700 acres projected to be cleared for strip mining, 10,000 acres for urban expansion, and 6,700 acres for water impoundments. An additional 1,100 acres of forest land would be used for recreation, making a total of 67,450 forest acres available for recreation and wildlife uses. Land that would be put back into trees (strip mine, gullied, sheet erosion, and open areas) would total 318,610 acres. The net gain over the present forest acres would be 243,210 acres, or a 12 percent increase.

Table VI.12 - Present and Projected Land Use
(Environmental Quality Alternative)

Green River Basin

Major Land Use	Present Conditions[1]	Projected Years 2000	2020
Agricultural			
Cropland	2,086,530	1,920,030	1,885,930
Pasture	1,129,990	1,065,230	1,055,830
Forest	1,951,950	2,195,160	2,213,490
Other[2]	391,530	312,880	284,050
Subtotal	5,560,000	5,493,300	5,439,300
Nonagricultural			
Federal land and water[3]	117,100	117,100	117,100
Urban	202,260	248,160	281,160
Water[4]	27,200	48,000	69,000
Subtotal	346,560	413,260	467,260
Total	5,906,560	5,906,560	5,906,560

1/ Compiled from 1970 Soil and Water Conservation Needs Inventories for Kentucky and Tennessee; Current Water Resource Development Bulletins published by the U.S. Army Corps of Engineers; and other Soil Conservation Service and Forest Service data. Projected land use estimates developed from study data.

2/ Includes farmsteads, farm roads, feed lots, ditch banks, fence and hedge rows, miscellaneous farmlands, nonfarm residences, investment and industrial tracts, built-up areas smaller than 10 acres, gravel pits, and borrow areas.

3/ Includes 88,000 acres of Federal land of which 63,200 acres are forest.

4/ Includes water areas other than Corps of Engineers reservoirs.

Program Components

Major components of this alternative which differ from those of the going program and economic development alternative provide for:

1. Increasing the application of conservation land treatment and management measures to adequately treat a total of about 1,200,000 agricultural acres;

2. Intensifying the application of land treatment and stabilization measures to reduce erosion, sediment, and pollution on lands currently surface mined or projected to be mined by the year 2000 and other eroding areas; and

3. Accelerating the construction and development of farm ponds, livestock waste disposal systems, and multiple-purpose reservoirs to improve recreation and related environmental values. See table VI.6 for other features of this alternative.

Impacts

Major impacts of the environmental quality alternative are presented here, with the beneficial and adverse effects summarized in displays VI.4 through 7 included in the appendix.

Erosion and Sediment - This alternative provides for applying conservation and management measures on a total of almost 1,200,000 acres of agricultural land by the year 2000. Application of these measures on land needing treatment would reduce erosion rates to an acceptable level on approximately 90 percent of the agricultural land. Total reduction in erosion on this land would be in excess of 5,500,000 tons. In addition, these measures would significantly reduce sediment and resultant pollution problems.

Land treatment and stabilization programs which would need to be accelerated or intensified to enhance environmental quality, include a more complete reclamation program on surface mined areas. This program would require: (a) placing overburden soils in

their original profile, with the top-soils spread evenly on the surface; (b) establishing vegetation of trees and/or grass by adding the proper nutrients for quick vegetation; (c) mulching to reduce erosion during establishment periods; and (d) constructing 290 debris basins to further reduce offsite damages during the establishment period. Care should be taken when selecting plants which will also enhance wildlife habitat. Application of these measures are estimated to reduce approximately 90 percent of the erosion and sediment damages on 43,700 acres previously surface mined and 127,850 acres projected to be mined by the year 2000. The value of the reclaimed surface mined areas could approach the value of most surrounding non-mined rural lands. Downstream or offsite damages resulting from infertile overwash and swamping would be reduced on 45,000 total acres. Application of land treatment and stabilization measures on 1,280 miles of roadbanks and 540 miles of streambanks would reduce erosion on these areas by approximately 90 percent.

Forest management practices projected for this alternative are listed in appendix table VI.3. These practices include tree planting on critical areas, old fields, and open areas. Stand improvement, through hardwood release and improvement cuts, would be accomplished on 208,000 acres. Cattle would be restricted from 120,900 forest acres. Forest improvement plans would be prepared for 1,072,000 acres of forest land. These plans would stress the environmental aspects rather than timber production. Due to more consideration of the forest environment under the various forest practices, the amount of timber growth and product yield would be only slightly greater than under the going program (appendix table VI.2). Smaller and more selected areas for tree planting and hardwood release would be done. Timber cutting would not be permitted on recreation and wildlife areas. Only 15 percent of the reforested strip mined and gullied areas and 25 percent of the planted open areas would provide timber products during the evaluation period.

This alternative calls for more critical area stabilization, a smaller annual logged area with fewer spur roads and skid trails, and greater emphasis on cattle exclusion. The forest land under this plan would produce gross erosion of 2,891,400 tons per year and a sediment yield of 91,150 tons, a reduction of 141,700 and 45,630 tons, respectively from the going program (appendix table VI.8).

Floodwater - Agricultural crop, pasture, and improvement damages would be reduced by installing five P.L. 566 watershed projects, 35 multiple-purpose water storage reservoirs, and 29,900 farm ponds. These measures would, through decreasing flooding frequency, reduce damages on about 59,000 acres and four communities.

Drainage - This alternative does not provide for accelerating the installation of drainage measures above the 47,000 acre level included under the going program.

Recreation:

1. Water-based - An additional 2,475,000 annual visitor days will be provided by local people installing the proposed 35 multiple-purpose reservoirs, P.L. 566 watershed structures, swimming pools, and related recreational facilities. The 2,475,000 visitor days and the present supply of 6,800,000 will meet approximately 92 percent of the 10,100,000 total visitor days projected to be needed by the year 2000.

2. Land-based - The projected construction of playground, golfing, camping, picnicking, and other land-based recreational facilities by basin residents will provide an additional 2,970,000 annual visitor days. These additional 2,970,000 visitor days and the present supply of 7,475,000 would meet about 90 percent of the 11,600,000 projected to be needed by 2000.

3. Fish and Wildlife - The water projected to be provided in the 35 multiple-purpose reservoirs, P.L. 566 project measures, 29,900 farm ponds, and other small private lakes projected to be installed by area residents will provide some 786,500 additional fisherman-days. Improved management of streams and farm ponds will provide 37,400 more fisherman-days. These, coupled with the present supply of 1,858,000 annual visitor days, will meet about 97 percent of the 2,753,000 estimated to be needed by the year 2000. The estimated needs of 1,244,000 annual hunter days for the year 2000 can be satisfied by each of the alternatives evaluated.

Water Supplies - The proposed installation of 35 multiple-purpose reservoirs and six P.L. 566 multiple-purpose structures by local people would meet the estimated additional water supply needs for the year 2000. These multiple-purpose municipal, industrial, and recreational water storage reservoirs would provide sufficient water to supply the equivalent of about 675,000 people. The additional agriculture water supply needs would be satisfied by constructing over 29,000 farm ponds. These structures will also provide additional fish and wildlife water.

Pollution - A major purpose of the conservation and stabilization measures under this alternative is to reduce erosion, sediment, pesticide, and related pollution problems. These measures, if applied, would reduce erosion rates to a tolerable level on approximately 80 percent of the basin. A reduction in erosion and sediment would likewise reduce stream pollution, infertile deposition, and related pollutants. The provision for constructing over 300 livestock waste disposal systems would adequately control pollution

from that source. Installation and improvement of facilities to properly dispose sewage, solid waste, and industrial effluents would substantially alleviate pollution from these sources. Local people could, through cooperating with appropriate governments, curtail activities contributing to air and water pollution. These efforts, coupled with the structural and vegetative measures proposed, could significantly enhance environmental conditions.

Agricultural Production - Agricultural production obtained under the environmental quality alternative would have lower cash value and higher public and private costs than under the going program or economic development alternative. This results primarily from an increase in acreage of pasture, cover, and roughage crops produced; cropping systems and rotations used; and related conservation and management measures applied to reduce erosion, sediment, and environmental pollution problems. Potential production under this alternative is displayed in table VI.13.

An important goal under the environmental quality alternative is to reduce erosion on agricultural land to 3 tons or less per acre. To accomplish this, it would require different land uses, crop mixtures, and crop rotations than under the going program or economic development alternative. Cultivatable crops, or those which do not protect the land from damaging erosion, would need to be produced on less erosive soils. Close growing crops, such as small grains and hay, would need to be grown on land more susceptible to erosion.

Table VI.13 - Present and Projected Agriculture Production Under Environmental Quality Alternative

Green River Basin

Item	Units	Production and Year 1970	2000
		-thousands-	
Corn	Bu.	26,000	58,030
Silage	Ton	390	1,930
Wheat	Bu.	2,500	4,340
Soybeans	Bu.	4,500	16,310
Barley & oats	Bu.	1,400	1,490
Hay	Ton	530	1,190
Cropland pasture	A.u.d.	50,000	86,950
Permanent pasture	A.u.d.	80,000	130,200

Source: U.S. Census of Agriculture, 1969, and study data.

These and other constraints, which affect the use of land and other productive resources, often prevents attaining the most profitable or economically efficient agricultural output. As shown in tables VI.13 and 14, the environmental constraints included for this alternative have reduced both the acreage and output of corn and other higher value crops.

The gross value of farm output under this alternative is projected to amount to about $720 million. Cash farm income would be under $500 million. The lower value of farm production and farm income would result from using land and other productive resources to minimize environmental problems. From an economic viewpoint, the environmental quality alternative is not the most feasible in the short run. In the long run, however, the alternative could be the most feasible as it prevents land voiding and lesser forms of depletion, thereby ensuring the maintenance of a productive base.

Costs associated with this alternative would be considerably higher than for the economic development alternative or the going program. Private production costs approach $112 million annually due primarily to increased costs for rotations and changes in tillage practices. The public costs, primarily technical assistance, would increase by $400 thousand above the economic development alternative. This would not include regulation enforcement costs if the 3 ton gross erosion constraint were envoked as a legal requirement. The implied employment in the year 2000 would be approximately 12.8 thousand people under this alternative. This implies a hired work force greater than the economic alternative but lower than the going program. Both farm population and farm families would remain in the same general ranges of 60 to 70 thousand people and 15 to 20 thousand families, respectively.

Table VI.14 - Projected Crop and Pasture Acreage Under Environmental Quality Alternative for Year 2000

Green River Basin

Item	Acres Required -thousands-
Corn	398.0
Silage	68.4
Wheat	85.9
Soybeans	287.0
Barley & oats	22.6
Hay	242.4
Cropland pasture	581.0
Specialty crops	117.0
Idle	117.0
Total cropland	1,919.3
Permanent pasture	999.9
Idle pasture	65.3
Total pasture	1,065.2
Total Basin	2,984.5

Source: U.S. Census of Agriculture, 1970, and Study Data.

Forestry Production - The projected timber supply from 1,926,600 forest acres for the year 2000 would amount to 59.1 million cubic feet. This supply would satisfy 72 percent of the projected timber needs for that year, leaving an unsatisfied need of 22.9 million cubic feet (appendix table VI.4). As in the economic alternative, only the "other" timber products needs would be exceeded. To meet the unsatisfied need, it would require that 685,000 additional acres of forest land be used for production. Production from this additional forest acreage would meet the saw log, pulpwood, and "other" timber product needs, but not veneer.

The total forest land is projected to amount to 2,258,360 acres by the year 2000. This includes 318,610 acres projected to be planted to trees. Of the total 2,258,360 acres, only 85 percent would produce harvestable timber. Production by the year 2000 would amount to 59.1 million cubic feet and have a stumpage value of approximately $13.1 million. Projected employment for that year would be 2,853 man-years, with an income of $24.4 million.

The forestry practices to be accomplished by the year 2000 would cost an estimated $84.4 million and another $3.5 million in technical assistance to carry out the practices. Employment generated by the installation of these practices would be 4,549 man-years, with an income valued at $35.2 million.

Implementation of this alternative would emphasize improving the forest environment rather than increasing timber production. Forest clearing for strip mines and urban expansion would be the same as for the going program and economic alternative. Water would occupy 6,700 acres now in forest land and an additional 1,100 acres of forest would be developed for recreation. Potential annual timber growth of 2.6 million cubic feet valued at $150,000 would be foregone. Appendix table VI.12 is a summary of the forest land impacts.

SYSTEM OF ACCOUNTS DISPLAY

The system of accounts is used to provide a display of the beneficial and adverse effects of the economic development and environmental quality alternatives. The effects are displayed in three accounts: economic development; environmental quality; and social well-being. Economic development beneficial effects accrue from increased production of goods and services and improvements in economic efficiency. Adverse effects reflected in this account include the value of resources required to achieve the benefits. Beneficial and adverse effects in this account are expressed in quantative values. Beneficial effects in the environmental quality account accrue from specific components of the plan which result from management, preservation, or enhancement features of the alternatives. Adverse effects include resources forgone to obtain benefits and other plan consequences which degrade or diminish the quality of the environment. In the social well-being account, beneficial effects include contributions made by the alternative toward improving employment, income, and related factors affecting social conditions. Adverse effects reflect the adverse consequences of the alternative or loss in employment or income and degrading of social conditions. Because of their nature, most of the benefits and adverse effects in the environmental quality and social well-being accounts are expressed qualitatively rather than quantitatively. Displays VI.1 through VI.3 in the appendix show the beneficial and adverse effects of the economic development alternative. Displays VI.4 through VI.6, which are also in the appendix, show the effects of the environmental quality alternative.

RECOMMENDED ALTERNATIVE

This chapter presents the alternative recommended to promote conservation, development, and utilization of the basin's resources. The alternative includes measures ranging from accelerating land treatment practices to reduce erosion to constructing multiple-purpose reservoirs for municipal and related water supplies. It is structured to be responsive to the desires expressed by the State during early study stages and reflects many components contained in the two alternatives presented in the previous chapter.

LAND USES, SHIFTS, AND PROJECTIONS

Sufficient land is available to permit shifts and adjustments needed for implementing the resource development alternative. Land use shifts projected under the proposed alternative would decrease rural agricultural lands about 63,000 acres by the year 2000 and over 102,000 acres by 2020 (table VII.1). The projected shifts would decrease cropland about 165,000 acres, pastureland approximately 63,600 acres, and idle and other rural lands about 79,000 acres. Forest land is expected to increase about 245,000 acres, urban approximately 46,000 acres, and water areas about 17,000 acres. Similar land use shifts are projected for the year 2020.

Surface mining activities are projected to affect about 130,000 of rural agriculture and forest land by the year 2000. The accelerated mining activities are expected to be accompanied by an increase in reclamation and restoration programs. The measures applied

Table VII.1 - Present and Projected Land Use
for Recommended Alternative

Green River Basin

Major Land Use	Present Conditions[1]	Projected Years 2000	2020
Agricultural			
Cropland	2,086,530	1,921,130	1,891,430
Pasture	1,129,990	1,066,330	1,061,130
Forest	1,951,950	2,196,660	2,220,490
Other[2]	391,530	312,780	284,750
Subtotal	5,560,000	5,496,900	5,457,800
Nonagricultural			
Urban	202,260	248,160	281,160
Water[3]	27,200	44,400	50,500
Federal land and water[4]	117,100	117,100	117,100
Subtotal	346,560	409,660	448,760
Total	5,906,560	5,906,560	5,906,560

1/ Compiled from 1970 Soil and Water Conservation Needs Inventories for Kentucky and Tennessee: Current Water Resource Development Bulletins published by the U.S. Army Corps of Engineers; and other Soil Conservation Service and Forest Service data. Projected land use estimates developed from study data.

2/ Includes farmsteads, farm roads, feed lots, ditch banks, fence and hedge rows, miscellaneous farmlands, nonfarm residences, investment and industrial tracts, built-up areas smaller than 10 acres, gravel pits, and borrow areas.

3/ Includes water areas other than Corps of Engineers reservoirs.

4/ Includes 88,000 acres federal land, of which 63,200 are forest.

under the intensified reclamation programs are projected to return most of the disturbed land to timber, pasture, and limited crop production.

Projections indicate that the shifts toward larger, more mechanized, and more capital oriented farming units will continue through the year 2000. Corn, soybeans, and tobacco are expected to remain the major crops and beef the principal type of livestock. In producing these crops, farmers are expected to continue adopting new and improved methods to increase yields, reduce costs, and attain more efficient output. However, the rate of applying new techniques and scientific advancements is expected to be influenced greatly by the growing concern for improved environmental conditions. The environmental constraints could substantially increase the need for land use planning and management to minimize the conflicts between and within agricultural and nonagricultural interests.

Forest land management is projected to be accelerated and will provide for adopting scientific and technologic improvements. Application of improved management measures would be applied to the present forest areas and to lands projected to be converted to forests. Additional emphasis would also be given to applying land treatment practices to reduce problems on nonagricultural and forest lands.

Industrial and commercial activities are projected to increase by the year 2000. The most significant increase is expected in mining, manufacturing, construction, wholesale and retail, utility, and service related activities. Most major developments are expected to occur in or near the larger population centers of Owensboro, Bowling Green, Madisonville, and Elizabethtown. These projected activities will require converting about 46,000 acres of agricultural and forest land to urban uses.

PROGRAM COMPONENTS

Principal components projected to be installed under the recommended alternative include:

1. Applying conservation land treatment, stabilization, or management measures on about 700,000 acres of agricultural lands, 1,280 miles of roadbanks, 540 miles of streambanks, and 43,700 acres of previously surface-mined land and 127,850 projected to be mined by 2000;

2. Planting trees or applying forestry management measures on over 1,000,000 acres;

3. Installing the five P.L. 566 watershed projects;

4. Constructing 35 multiple-purpose water storage reservoirs for municipal, industrial, and recreational water;

5. Installing 17,300 farm ponds to provide agricultural water;

6. Developing water- and land-based outdoor recreational facilities and areas; and

7. Installing 220 livestock waste disposal systems, needed sewage treatment plants, and other facilities to reduce pollution.

These and other proposed measures for this alternative are included in table VII.2.

IMPACTS

Some of the project measures and estimated impacts of the recommended plan are presented here. Most of the impacts described are in terms of the total which includes those accruing to the going program and the recommended plan. This permits identifying the relative scale of development that would occur with implementation of the recommended plan by the year 2000. The impacts accruing specifically to the recommended plan are summarized in table VII.5 and the displays at the end of this chapter.

EROSION AND SEDIMENT

The recommended alternative provides for applying conservation land treatment and management practices to reduce erosion and runoff on over one-half of the 1.3 million cropland and pasture acres needing treatment. This would be accomplished by using the land according to its capabilities; shifting approximately 160,000 acres in the steeper land capability classes to permanent cover; and applying conservation and management

measures identified in table VII.2. New practices such as minimum and no-till planting methods and the employment of improved management measures would also decrease erosion. Application of the land treatment and management measures would reduce erosion rates on agricultural lands from 7.6 tons per acre to 3.0 tons or less, resulting in a total reduction of about 3,000,000 tons annually.

Recommended practices to improve pasture cover conditions, minimize land abuse, and decrease erosion include stand improvement, fertilization, weed control, and proper livestock rotation. In addition to the conservation and management practices, approximately 85,000 acres of pasture in the steeper land areas would be shifted to trees. These and similar measures would improve pasture production and decrease erosion problems on some 19,000 acres.

An intensive reclamation and stabilization program is recommended to reduce erosion,

Table VII.2 - Summary of Project or Program Measures Projected to be Accomplished by the Year 2000[1/]

Green River Basin

Item	Unit	Going Program	Recommended Alternative: Total Amount	Recommended Alternative: Accelerated[2/]
1. Channel modification	Mi.	110[3/]	118	8
2. Debris basins	No.	90	290	200
3. Drainage	Ac.	47,000	47,000	0
4. Floodwater retarding structure (P.L. 566)	No.	12[3/]	17	5
Surface area	Ac.	370	660	290
Land area	Ac.	1,100	3,290	3,190
5. Multiple-Purpose reservoir (P.L. 566)	No.	4[3/]	15	11
Surface area	Ac.	280	2,855	2,575
Land area	Ac.	1,100	3,440	2,840
6. Multiple-Purpose reservoir (Others)	No.	19	35	16
Surface area	Ac.	1,600	3,760	2,160
7. Farm ponds	No.	13,900	17,300	3,400
Surface area	Ac.	4,060	5,200	1,140
8. Roadbank erosion treatment	Mi.	330	1,280	950
9. Streambank erosion treatment	Mi.	100	540	440
10. Fish pond management	Ac.	1,170	7,060	5,890
11. Livestock waste disposal system	No.	30	220	190
12. Strip mine stabilization (new)	Ac.	127,850	127,850	0
13. Strip mine stabilization (old)	Ac.	43,700	43,700	0
14. Forest management	Ac.	737,000	1,072,000	335,000
15. Tree planting				
a. Critical strip mine	Ac.	95,830	119,310	23,480
b. Gully areas	Ac.	6,000	24,200	18,200
c. Open areas and old fields	Ac.	58,800	122,400	63,600
d. Sheet erosion areas	Ac.	0	110,000	110,000
16. Spur roads and skid trails stabilization	Ac.	308,690	326,070	17,380
17. Timber stand improvement				
a. Hardwood release	Ac.	5,000	325,000	320,000
b. Improvement cutting	Ac.	53,000	89,000	36,000
18. Grazing control	Ac.	28,000	120,900	92,900
19. Land stabilization measures				
a. Strip cropping and terraces[4/]	Ac.	89,400	260,320	170,920
b. Crop residue management[4/]	Ac.	33,150	89,820	56,670
c. Contouring[4/]	Ac.	34,050	95,340	61,290
d. Conversion to permanent cover	Ac.	24,000	67,200	43,200
e. Pasture improvement	Ac.	51,150	143,220	92,070
f. Reestablishment of vegetative cover	Ac.	30,900	86,520	55,620
g. Gully stabilization	Ac.	10,000	54,800	44,800

1/ Compiled from study data.
2/ Accelerated includes the quantity over and above that of the going program.
3/ These are unconstructed measures in authorized P.L. 566 projects and are considered in place in economic studies of this report.
4/ Minimum and no-till cropping systems are often used with or instead of the above.

sedimentation, and related problems on 43,700 acres of previously surface-mined land and 127,850 acres projected to be mined by the year 2000. Treatment recommended on land presently mined includes shaping and leveling on most of the disturbed area; installing debris basins to retain sediment produced from erosion; and establishing trees or grass on all areas except those suitable for intensive pasture or limited crop production. Programs needed on land to be mined in the future would involve (a) removing and stockpiling topsoil prior to removing other overburden material; (b) extracting minerals and then replacing the overburden material and topsoil to their approximate original position; (c) constructing debris basins and structural measures to reduce offsite damages during the mining and stabilization process; (d) shaping and leveling disturbed lands to approach the original slopes and grades; and (e) establishing vegetative cover on the carefully prepared seedbed. The stabilization measures and methods of attaining them will vary, but major accomplishments could be realized through utilizing existing state and federal programs.

Significant effects could be realized from an intensive reclamation program. If properly implemented and maintained, the measures could reduce approximately 90 percent of the erosion, sediment, and related pollution problems occurring on surface-mined lands. Through reducing these problems, the measures would improve water quality in streams, enhance fish and wildlife habitat, and improve aesthetic and environmental conditions. The value of the restored land could approach that of much of the surrounding rural land. Stabilization measures applied on the disturbed surface-mined land areas and treatment of agricultural and other eroding lands would decrease infertile deposition on approximately 34,500 acres and prevent swamping and the development of potential mosquito habitat on 13,300 acres. Most of the mined land could, when restored, be used for timber, pasture, and limited crop production, or for recreational developments. However, the intensive reclamation program would, through alleviating swamping conditions, alter wildlife habitat provided in the affected area.

Conservation and stabilization measures to be applied to control erosion on gully, roadside, streambank, and nonagricultural lands vary from shaping, filling, and seeding severely eroded areas to vegetative plantings on less severe lands. Drop spillways, chutes, sediment basins, diversions, vegetated or concrete lined waterways, and rip-rapping are some of the practices recommended to decrease erosion and sedimentation problems. Management measures, such as eliminating machinery and equipment crossings or preventing cattle from having access to gully or streambank areas, are also features of the plan.

Potential effects of applying intensive treatment measures on 1,280 miles of roadbanks and 540 miles of streambanks would decrease erosion from a high of 50 tons per acre to 5 tons or less, for about a 90-percent reduction. Similar reduction in erosion rates could be accomplished on gully and most of the urban lands.

The forestry management and treatment practices as included in appendix table VII.1 stress applying improvement of timber production and environmental conditions on 1,072,000 acres. The practices include planting trees on 253,510 acres of strip-mine, gully, and sheet erosion areas; 326,070 acres of spur roads and skid trails, and 122,400 acres of old fields and open areas. Cattle grazing would be prevented on 120,900 forest acres. Stand improvement, through hardwood release and improvement cuts, would be accomplished on 414,000 acres.

The average annual timber growth under the increased level of management planned is estimated at 41.8 cubic feet per acre (appendix table VII.2). Timber product yield would amount to about 35.5 cubic feet per acre by the year 2000. All timber production would be from 1,928,200 acres, except for the production obtained on 15 percent of the reclaimed strip-mine and gully areas and 25 percent of the reforested open areas. These areas could provide some timber production by the year 2000. Timber would not be harvested from forests used for recreation and wildlife areas.

The projected timber supply would amount to about 66.8 million cubic feet by the year 2000. This supply would satisfy 81 percent of the total projected timber needs for that year, leaving an unsatisfied need of 15.2 million cubic feet (appendix table VII.3). The "other" timber product needs would be met, but additional timber production would be required from about 382,000 acres to satisfy the needs for saw log, pulpwood, and veneer products.

Application of forest last treatment and management practices would reduce gross annual erosion by 1,466,000 tons, or 33 percent of the total. The practices would reduce about 75 percent of the estimated 370,020 tons of sediment produced on forest lands. These reductions would be accomplished largely by controlling livestock grazing, improving logging methods, reducing the number of spur roads and trails, and applying other forest land treatment practices. Appendix table VII.4 shows the estimated amount of erosion and sediment with and without treatment practices.

Photo Courtesy Kentucky Division of Forestry

FLOODWATER

This alternative provides for installing structural or nonstructural measures singularly or in combination to prevent or reduce floodwater damages. Planned structural measures include single-purpose floodwater retarding structures, multiple-purpose structures, channel modifications, flood proofing, or a combination thereof. Nonstructural measures recommended along the main stem of the Green River and in several upstream towns or communities are flood alarm systems, flood insurance programs, and flood plain zoning.

Five P.L. 566 watershed projects have been identified for early action development. These include Upper Green River, Skaggs Creek, Trammel Fork, East Fork Deer Creek, and East Fork Indian Camp Creek. The five watersheds have a combined drainage area of 611 square miles and provide for installing 16 single- or multiple-purpose structures, modifying 8 miles of channel, and accelerating the land treatment program. These measures would reduce about 45 percent of the average annual floodwater damages on 18,000 acres and four towns or communities.

The recommended alternative also provides for installing 35 multiple-purpose water reservoirs by local, state, and private interests. These municipal, industrial, and recreational water storage structures, along with the proposed 17,300 farm ponds, would reduce the flooding frequency on about 34,000 acres. Nonstructural measures, including flood insurance programs, flood proofing, flood plain zoning, and flood alarm systems, are recommended to prevent or reduce floodwater damages in some of the upstream communities identified in Chapter IV.

DRAINAGE

The recommended plan does not provide for accelerating the installation of onfarm drainage measures above the 47,000-acre level included under the going program and the environmental quality alternative. Most of onfarm drainage projected to be accomplished under this plan will include both surface and subsurface measures. While waterways, diversions, and other surface measures are expected to be used, most of the drainage is expected to be tile drainage and land leveling.

RECREATION:

1. Water-based - This plan provides for local interests installing 35 municipal, industrial, and recreational water storage reservoirs. It also provides for installing 11 multiple-purpose structures included in the five P.L. 566 watershed projects. These water storage structures and the swimming pools expected to be installed would provide 2,475,000 additional visitor-days annually. The additional visitor-days and the present supply of 6,800,000 will meet approximately 92 percent of the 10,100,000 total days projected to be needed by the year 2000.

2. Land-based - Projections indicate that 11,600,000 outdoor recreational visitor-days will be needed by the year 2000. The projected construction of camping, picnicking, hiking, and related outdoor facilities adjacent to the multiple-purpose water storage reservoirs, coupled with the anticipated development of playgrounds, parks, and golf courses, would provide an additional 2,970,000 visitor-days. The 2,970,000 and the estimated present supply

of 7,475,000 would meet 90 percent of the total projected to be needed by the year 2000.

3. Fish and Wildlife - A total of 2,753,000 annual fisherman-days are estimated to be needed by the year 2000. At present, about 1,858,000 days are provided by existing waters. Construction of the 35 multiple-purpose reservoirs, 16 P.L. 566 watershed structures, and 17,300 farm ponds are estimated to provide about 775,000 additional fisherman-days. Improved management of streams and existing farm ponds would provide an estimated 37,400 more fisherman-days. The additional 812,000 fisherman-days and the present supply of 1,858,000 annual days would meet almost 97 percent of the total needed for 2000. The projected 1,244,000 annual hunter-days projected to be needed by the year 2000 can be met under the recommended plan.

WATER SUPPLY

An important segment of this study was to identify possible ways of obtaining municipal and industrial water to augment present supplies or provide additional water for future uses. The possibilities for obtaining adequate supplies vary by location and are influenced by factors such as water yields, development costs, quantity needed, and distance of supply from consumption area. While adequate in the western section of the basin,

water supplies from springs, wells, and streams are insufficient to provide most other areas with a dependable quantity, especially, during summer months. As a result, the most favorable option is developing surface storage reservoirs to provide additional supplies to the towns dispersed throughout the area.

The average annual rainfall of 48 inches and the runoff of 18 inches would, when stored, be sufficient to provide additional water needed. Suitable sites are also available in most of the basin for development of water storage reservoirs. Because of the potential for development of surface storage structures, this plan provides for local interests installing 35 multiple-purpose reservoirs and six included in the proposed P.L. 566 watershed projects. These multiple-purpose municipal, industrial, and recreational water storage reservoirs would provide sufficient quantities to serve the equivalent of 690,000 people. Supplies from these reservoirs would meet the present and projected needs of the towns or communities identified in table IV.13 in Chapter IV of this report.

Proposals are for the construction of 17,300 farm ponds by the year 2000. The farm ponds would be primarily for livestock water, but could also be used for fish and wildlife, recreation, flood prevention, and grade stabilization purposes. Although potential prevails, the plan does not provide for groundwater development over and above that expected under the going program.

POLLUTION ABATEMENT

Conservation land treatment and management measures applied to reduce erosion and decrease sediment production throughout the basin will decrease downstream sediment pollution problems. Application of the treatment measures on present and projected surface-mine lands would alleviate much of the pollution from this source. In addition, the recommendations are for appropriate action to further decrease pollution by encouraging basin residents to discontinue discarding debris and solid waste materials along roadsides, in streams, and on rural lands; decrease discharging of excessive sewage, animal waste, and industrial effluents into streams; and reduce the practice of burning debris and waste materials that contribute to air pollution.

Installation of 220 animal waste disposal systems to handle, store, and treat will minimize the offsite damages from this source. The constructed water storage reservoirs and applied land stabilization practices would also reduce downstream pollution through reducing floodwater and sedimentation problems.

AGRICULTURAL PRODUCTION

The level of production projected for this alternative for the year 2000 greatly exceeds that obtained in 1970. When compared to 1970, the projected production of soybeans under this alternative would increase by about 375 percent; corn by 230 percent; corn silage by 540 percent; wheat by 180 percent; and other small grains by about 110 percent. Hay production would be 1.8 times more than the 1970 level and pasture about 1.5 times greater (table VII.3).

Although a substantial part of projected production under this alternative would result from improved yields, additional crop production acreage would be needed. The increased crop production for the year 2000 would require approximately 172,000 additional acres for soybeans, 118,000 for corn, and 28,000 for small grain. Except for the increase in acreage of cropland used in rotation for pasture, the acreage needed for hay and pasture production would remain near the 1970 level. Specialty crops, including tobacco, fruit, and vegetables, would require a total of about 117,000 acres. Table VII.4 shows the

Table VII.3 - Present and Projected Agricultural Production Under the Recommended Alternative

Green River Basin

Item	Units	Production and Year 1970	2000
		----Thousands-----	
Corn	Bu.	26,000	60,270
Silage	Ton	370	2,000
Wheat	Bu.	2,500	4,520
Soybeans	Bu.	4,500	16,835
Barley and oats	Bu.	1,400	1,560
Hay	Ton	530	1,235
Pasture	A.u.d.	80,000	197,505

Source: Compiled from study data.

estimated acreage needed for agricultural production under this alternative.

Total value of farm output under this alternative amounts to about $742 million. Cash farm income would approach the $503 million level. Estimated production costs amount to about $103 million. These costs include labor, machinery, fertilizer, etc., but exclude land, taxes, and public costs. Annual employment would amount to about 13,000, with hired workers totaling about 2,500.

Table VII.4 - Crop and Pasture Acreage Required for the Year 2000 Under Recommended Alternative

Green River Basin

Item	Acres Required
	---thousands---
Corn	408.6
Silage	75.5
Wheat	100.4
Soybeans	314.7
Barley and oats	23.4
Hay	254.8
Cropland pasture	515.0
Specialty crops	117.0
Idle cropland	111.7
Total cropland	1,921.1
Permanent pasture	1,015.0
Idle pasture	51.3
Total pasture	1,066.3
Total basin	2,987.4

Source: Compiled from study data.

TIMBER PRODUCTION

Projections under this alternative show a reduction in forest land due to strip mining, urban expansion, and water impoundments of 73,900 acres by the year 2000. Another 1,000 acres of forest would be developed for recreational use. These areas would not be available for timber growth, and the production value forgone would amount to almost 2.8 million cubic feet per year, with an annual value of $165,000.

Tree planting would be accomplished on 318,610 acres. With anticipated losses to other uses, this would amount to a net increase of 244,700 acres. The total forest would be 2,259,860 acres, but only 1,928,200 acres would be available for timber production. Projected production from the available forest acres would amount to 66.8 million cubic feet in the year 2000, with a stumpage value of approximately $14.8 million. Under this alternative, forest industry would increase and greater employment would occur in managing and protecting the forest land. Projected employment for the year 2000 would be 3,235 man-years with an income of $27.7 million.

During the installation period through the year 2000, the total estimated cost of forestry practices installed to increase timber growth and reduce erosion would be $90.6 million (appendix table VII.5). The technical assistance to carry out these practices would cost $4.3 million. These forestry practices would provide 5,217 man-years of employment with an income of $39.7 million. The total forestry impacts occurring under this alternative and the impacts over the going program are shown in appendix table VII.6.

Table VII.5 summarizes the major beneficial and adverse effects expected to accrue from implementating the recommended plan. The effects are displayed into three accounts: Economic development, environmental quality, and social well-being. To identify the accomplishments expected with the recommended plan, the effects in table VII.5 are over and above those expected under the going program. In addition, this table shows some of the plan elements and opportunities for implementing specific segments or obtaining assistance thereon.

CAPABILITY OF PLAN TO MEET NEEDS

The recommended plan was formulated to meet specific needs and assist in alleviating identified water and related land resource problems. It consists mostly of elements included in the economic development and environmental quality alternatives. The elements included in the recommended and the alternative plans were designed to advance

Table VII.5 - Summary of Recommended Plan Effects and Program Opportunities
Green River Basin

Plan Elements	Amount	Unit	RECOMMENDED PLAN EFFECTS: Economic Development Account[2/] Beneficial Effects (Dollars)	Economic Development Account[2/] Adverse Effects (Dollars)	Environmental Quality Account: Beneficial and Adverse Effects	Social Well-Being Account: Beneficial and Adverse Effects
Land Treatment and Stabilization						
Agricultural land	500,000	Ac.				
Surface mine areas						
1. present	43,700	Ac.				
2. projected	127,850	Ac.				
Roadbanks	950	Mi.				
Streambanks	440	Mi.				
Forest land	17,380	Ac.				
Structural Measures						
Floodwater retarding structures (P.L. 566)	5	No.				
Channel modification	8	Mi.				
Multiple-purpose reservoirs (P.L. 566)	11	No.				
Multiple-purpose reservoirs (others)	16	No.				
Farm ponds	3,400	No.				
Livestock waste disposal systems	190	No.				
Debris basins	200	No.				
Improved Management						
Forest management plans	335,000	Ac.				
Timber stand improvement	356,000	Ac.				
Grazing control	92,900	Ac.				
			Flood Prevention	(296,000)	(282,400)	
			Water Supply	(401,000)	(365,200)	
			Fish and Wildlife	(435,000)	(287,000)	
			Recreation - Land-based	(928,000)	(760,000)	
			Recreation - Water-based	(866,000)	(635,000)	
			Wages - Salaries	(733,100)	(248,000)	
			Indirect - Incidental	(392,300)	(52,500)	
			Total Benefits	(4,051,400)	Total Cost (2,630,100)	
			Net Benefits	(1,421,300)		
					Natural Beauty - Reduce erosion on 500,000 acres of agricultural land; 171,550 surface-mined land; 950 miles of roadbanks; 440 miles of streambanks; and 18,200 acres of gully areas. - Provide 6,200 additional acres of water. - Utilize about 11,000 acres for lakes, flood pools and dam sites. - Disturb environment by providing opportunity for 2.8 million annual visitor-days. Quality of land, Water, and Air - Decrease erosion and sediment to reduce soil loss and deposits on bottom lands and in streams. - Provide improved water supplies to urban and rural residents. - Improve potential for development of manufacturing and related businesses. Biological - Provide 6,200 additional acres of water for fish habitat. - Reduce stream pollution by applying land treatment measures.	Biological (Continued) - Alter wildlife habitat on 11,000 acres in reservoir areas. Resource Commitment - Commit 11,000 acres for reservoir areas. - Commit capital and labor to implement plan. Health and Safety - Reduce flooding on 37,000 acres and four communities. - Reduce swamping, pollution, and mosquito habitat on 11,000 acres. - Provide improved municipal water supplies to about 300,000 people. - Permit about 276,000 acres to remain subject to flooding. Recreation - Provide opportunities for 2.8 million recreational visitor-days. Employment - Provide an estimated 381 man-years of employment. Other - Maintain and preserve a productive resource base.

Table VII.5 - Summary of Recommended Plan Effects and Program Opportunities (Continued)
Green River Basin

PROGRAM OPPORTUNITIES	
U.S. Department of Agriculture	Other Programs
Land Treatment, Management, and Stabilization	**Land Treatment, Management, and Stabilization**
SCS, through P.L. 46 program, applies treatment on 500,000 agricultural acres and on some of the 171,550 surface mine acres.	Kentucky's Department for Natural Resources and Environmental Protection, through its mine operators and local people, applies needed structural and vegetative treatment measures. Conservation districts assist local owners to carry out land treatment programs.
State and private forest programs accelerate treatment and management on over 1,000,000 acres.	**Water Storage Reservoirs**
ASCS provides incentive to apply conservation pasture and crop improvement practices.	Local governmental units ascertain state and federal assistance to install 16 multiple-purpose water storage reservoirs.
U.S. Forest Service assists in developing management plans.	**Other**
Water Storage Reservoirs	U.S. Department of Housing and Urban Development, in cooperation with other federal agencies, provides nonstructural assistance to towns with flooding problems.
Install five P.L. 566 projects with five floodwater retarding structures, 11 multiple-purpose structures, and 8 miles of channel for floodwater reduction and water storage.	U.S. Army Corps of Engineers investigates flooding problems on main stream of the Green and major tributaries.
RCD investigates local flooding problems.	Bureau of Sports Fisheries, in cooperation with state agencies, accelerates stream management improvement efforts.
Farmers Home Administration provides financial assistance for developing urban and rural water supplies.	Environmental Protection Agency assists the state in performing water quality studies and monitoring systems.
ASCS provides financial and SCS technical assistance for installing 3,400 farm ponds.	State and local agencies utilize existing authorities and assistance from federal agencies to install waste disposal systems (sewage, debris, and garbage); implement land use planning; and install public recreational and service facilities.
Other	
Federal Extension Service provides assistance to improve agricultural production.	

1/ Beneficial and adverse effects are over and above those expected with the going program.
2/ Excludes benefits and costs of applying land treatment measures.

the objectives of economic development and improvement of environmental quality and to be responsive to the interests of State and local people.

Selection of the recommended plan involved comparing features of the alternative plans and considering the ability of plan elements to satisfy component needs and fulfill requirements of the stated objectives. Foremost among the considerations was accessing the contributions of the alternative plans and the effectiveness of plan elements in meeting component needs in light of objectives, preferences, and constraints. Since both of the major alternatives--the economic development and environmental quality--contained elements which better satisfied component needs, trade-offs were required between the two. In addition, the ability of the basin to meet its allocated shares of projected food product needs resulted in decreasing the quantity of drainage and related structural measures to increase agricultural production. This and other priorities influenced the selection of elements which are included in the recommended plan and which contribute toward improving environmental conditions and preserving the productive base. As a consequence, the monetarial benefits realized in the recommended plan are more than the environmental quality alternative but considerably less than the economic development.

The ability of the recommended and alternative plans to satisfy component needs is shown in table VII.6. This table shows the major component needs under each objective. The needs include the total amount projected to be needed by the year 2000. Except for food and fiber, the quantity provided or remaining for the other components is over and above that provided by the going program. Appendix table VII.7 includes the quantity projected to be provided by the going program.

Table VII.6 - Capability of Recommended and Alternative Plans to Satisfy Component Needs
Green River Basin

Objectives			Alternative Plans - Component Needs Provided and Remaining 1/						
Component Needs			Economic Development			Environmental Quality		Recommended Plan	
	Description	Unit	Quantity	Provides	Remaining	Provides	Remaining	Provides	Remaining
ED	1. Food-Fiber Production								
	Major Agricultural Products								
	Corn-Grain	Bu. (1000)	45,500	61,100	0	58,030	0	60,270	0
	Soybeans	Bu. (1000)	12,700	16,900	0	16,310	0	16,835	0
	Small grains	Bu. (1000)	4,500	6,160	0	5,830	0	6,080	0
	Hay	Ton (1000)	1,000	1,240	0	1,190	0	1,235	0
	Pasture	A.u.d. (1000)	158,200	198,900	0	217,150	0	197,500	0
	Major Forest Products								
	Veneer	Cu. ft. (1000)	15,300	3,200	12,100	2,800	12,500	3,200	12,100
	Saw logs	Cu. ft. (1000)	54,900	52,200	2,700	46,200	8,700	52,200	2,700
	Pulpwood	Cu. ft. (1000)	9,000	6,800	2,200	6,000	3,000	6,800	2,200
	Other	Cu. ft. (1000)	2,800	4,600	0	4,100	0	4,600	0
	2. Floodwater Drainage Reduction	Acres (1000)	332	30	280	37	273	34	276
	3. Agricultural Water Management (Drainage)	Acres (1000)	315.5	97	171.5	268.5	268.5	0	268.5
	4. Water Supply								
	Domestic (people served)	Number (1000)	625	198	52	300	0	300	0
	Agricultural (farm ponds)	Number (1000)	29.9	3.4	12.6	16	0	3.4	12.6
	5. Forest Management Plans	Acres (1000)	1,600	1,072	528	1,078	528	1,072	528
EQ	1. Erosion Reduction								
	Agricultural land	Acres (1000)	1,305	500	605	1,000	105	500	605
	Surface mine areas (1000) 2/	Acres (1000)	173.7	171.5	0	171.5	0	171.5	0
		(Percent)		(45)	(55)	(90)	(10)	(90)	(10)
	Roadbanks	Miles	1,600	310	960	950	320	950	320
	Streambanks	Miles	680	170	410	440	140	440	140
	Forest land 3/	Acres (1000)	385	17.3	59	10.3	66	17.3	59
	2. Sediment Reduction								
	Infertile deposition	Acres (1000)	39	14	18	23	9	23	9
	Swamping	Acres (1000)	30	7	19	11	15	11	15
	3. Recreation (Outdoor) 4/								
	Water-based	Vis.-days (1000)	10,100	627	1,353	1,155	825	1,155	825
	Land-based	Vis.-days (1000)	11,600	578	1,815	1,238	1,155	1,238	1,155
	Fish	Fish.-days (1000)	2,753	296.1	233	458	71.1	446	83.1
	4.Livestock Waste Disp. System	Number	300	190	80	280	0	290	80

1/ Developed from study data. Except for food and fiber, the quantity shown includes the amount provided by the going program.
2/ All distrubed surface mine lands would receive some treatment for erosion under each alternative, but the application rate and intensity would vary. The percentage shown reflects the reduction in erosion under each alternative.
3/ The forest acreage consists primarily of areas affected by skid trails and logging roads.
4/ The projected hunter-day needs for the year 2000 can be met under each of the alternatives evaluated.

Table VII.7 - Display of Recommended Alternative
Economic Development Account

Components	Effects (Dollars)[1]	Components	Effects (Dollars)[1]
Beneficial effects:[2]		Adverse effects:[2]	
I. Value of increased output of goods and services to users		I. Value of resources required to achieve outputs	
A. Flood prevention		A. Flood prevention cost	270,000
1. Damage reduction	165,800	O&M	12,400
2. Land enhancement	130,200		
B. Impaired drainage	0	B. Impaired drainage cost	0
		O&M	0
C. Water supply		C. Water supply cost	
1. Urban (M&I)	341,000	1. M&I Water	290,000
2. Agricultural	60,000	O&M	18,200
		2. Agricultural water	51,000
		O&M	6,000
D. Recreation		D. Recreation cost	
1. Fish & wildlife	435,000	1. Fish & wildlife	244,000
2. Water-based	866,000	O&M	43,000
3. Land-based	928,000	2. Water-based	545,000
		O&M	90,000
		3. Land-based	630,000
		O&M	130,000
E. Additional wages and salaries accruing to region from implementation of plan through		E. Wages and salaries lost to region from implementation of plan through	
1. Utilization of hired labor		1. Reduction of hired labor used in	
a. Farm sectors	106,000[3]	a. Farm sectors	248,000[4]
b. Forest sectors	194,100	b. Forest sectors	0
c. Recreation sectors	223,000	c. Recreation sectors	0
d. Water supply	88,000	d. Water supply	0
2. Project O&M	122,000	2. Project O&M	0
Total	3,659,100		2,577,600
Net	1,081,500		
II. Value of output resulting from external economics		II. Losses in output from external diseconomies	
A. Indirect and incidental activities		A. Indirect and incidental activities associated with project development	
1. Flood prevention	57,300	1. Flood prevent on	6,500
2. Impaired drainage	0	2. Impaired drainage	0
3. Water supplies	112,000	3. Water supplies	17,000
4. Recreation		4. Recreation	
a. Fish & wildlife	43,000	a. Fish & wildlife	5,000
b. Water-based	87,000	b. Water-based	11,000
c. Land-based	93,000	c. Land-based	13,000
Total	392,300		52,500
Net	339,800		

Table VII.7 - Display of Recommended Alternative (Continued)
Economic Development Account

Components	Effects (Dollars)[1]	Components	Effects (Dollars)[1]
Beneficial effects:[2]		Adverse effects:[2]	
III. Employment (No. Man-Years)		III. Employment (No. Man-Years)	
A. Increase in number and type of jobs		A. Decrease in number and type of jobs	
1. Agricultural	52	1. Agricultural	55
2. Forestry	290	2. Forestry	0
3. Recreation	55	3. Recreation	5
4. Water resource projects	30	4. Water resource projects	8
5. Project O&M	22	5. Project O&M	0
Total	449		68
Net	381		
IV. Other[5]			

1/ Average annual basis and authorization rate is 5.625 percent.
2/ The beneficial and adverse effects are over and above those expected under the going program which is without any new or accelerated water or land resource developments. The identified effects exclude benefits, costs, and employment gains or losses accreditable to land treatment, stabilization, and reclamation measures proposed for this alternative.
3/ Includes wages and salaries projected to accrue primarily to suppliers of farm production items and to businesses involved in processing and marketing agricultural produce.
4/ Includes a reduction in wages and salaries of hired farm workers displaced.
5/ Other includes the increased average annual benefits and costs resulting from projected application of land treatment measures and the value and cost of the increased output accreditable to improved production methods applied under this alternative. The estimated average annual land treatment benefits and costs include:
   a. Agricultural land treatment benefits of $1,680,000 and costs of $400,000;
   b. Benefits of $2,613,000 and costs of $3,810,000 for reclaiming, stabilizing, and treating present and projected strip-mined lands; and
   c. Benefits of $562,000 and costs of $474,000 for stabilizing roadbanks, streambanks, gullies, and other critical areas not included in the above agricultural and strip-mined lands and in forest areas.

The increased timber production value resulting from application of forestry land treatment, stabilization, and management measures amounts to about $7,500,000 and costs to about $1,300,000. The improved production efficiencies projected under this alternative would increase annual farm income by about $1,000,000, with a $200,000 increase in production costs.

Table VII.8 - Display of Recommended Alternative
Environmental Quality Account

Components	Measure of Effects
Benefits and Adverse Effects	
A. Areas of Natural Beauty	1. Accelerate the application of conservation land treatment and management measures to enhance appearance on approximately 500,000 additional acres of farmland.
	2. Increase the application of land stabilization and reclamation measures to improve the quality of vegetation on 43,700 acres of surface-mined land and 127,850 acres projected to be surface mined by the year 2000.
	3. Construct water storage reservoirs and farm ponds to make available an additional 6,200 acres of water in the area.
	4. Stabilize an additional 950 miles of roadbanks and 440 miles of streambanks.
	5. Revegetate and control erosion on 18,200 acres affected by gullies.
	6. Require 11,000 additional acres of cropland, pastureland, and forest land for reservoir and farm pond areas.
	7. Disturb the tranquility of a rural environment by providing for an additional 2.8 million recreational visitor-days.
B. Quality consideration of water, land, and air resources	1. Decrease the rate of erosion from an average of 7.6 tons per acre to 3.0 tons or less on approximately 500,000 additional acres of agricultural land.
	2. Reduce erosion by about 70 percent above the going program on 43,700 acres of surface-mined land and 127,850 acres projected to be mined by the year 2000.
	3. Reduce the frequency of flooding on an additional 34,000 acres.
	4. Decrease infertile deposition on approximately 23,000 acres.
	5. Reduce total erosion on forest lands by about 112,700 tons, or 4 percent.
	6. Reduce total sediment yield from forest lands by 44,610 tons per year, or 33 percent.
	7. Provide additional water supplies to serve the equivalent of approximately 300,000 people.
	8. Construct an additional 3,400 farm ponds for agricultural water.
	9. Convert approximately 1,700 acres of agricultural and forest lands to recreational use.
	10. Convert an additional 153,000 acres of old fields and open areas to forest land to reduce erosion.
	11. Improve timber stand on 335,000 acres of forest land.

Table VII.8 - Display of Recommended Alternative (Continued)
Environmental Quality Account

Components		Measure of Effects
Benefits and Adverse Effects		
B. Continued	12.	Control grazing on 92,900 acres of forest land.
	13.	Plant trees on 18,200 acres affected by gullies.
	14.	Install 190 additional waste disposal systems to reduce pollution.
	15.	Increase the potential for accelerated development of urban, industrial, and commercial activities.
C. Biological resources and selected ecosystems	1.	Make available about 6,200 additional acres of water available for fish and wildlife use.
	2.	Restore and improve wildlife habitat on 43,700 acres of surface-mined land and 127,850 acres projected to be mined by the year 2000.
	3.	Reduce the quantity of sediment, pesticides, and related pollutants entering streams.
	4.	Improve wildlife habitat on 440 miles of streambanks and 950 miles of roadbanks.
	5.	Improve wildlife habitat on 17,380 acres of logging spur roads and skid trails.
	6.	Affect wildlife habitat on 11,000 acres needed for reservoirs and disturb biological systems by modifying 8 miles of stream channel.
D. Irreversible or irretrievable commitments	1.	Convert about 11,000 acres of agricultural and forest lands to water areas.
	2.	Require commitment of capital and labor resources to implement this alternative.

Table VII.9 - Display of Recommended Alternative
Social Well-Being Account

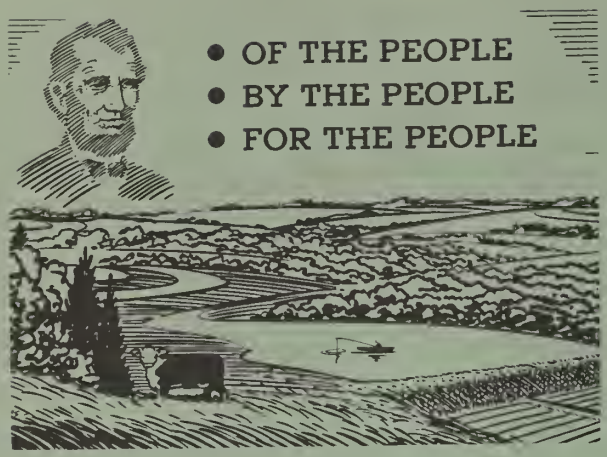
Components		Measure of Effects
Benefits and Adverse Effects		
A.	Life, health, and safety	1. Make available an improved quality of municipal and industrial water to serve the equivalent of 300,000 people.
		2. Reduce flooding frequency on approximately 34,000 additional acres of agricultural land and four communities.
		3. Prevent future swamping and development of mosquito habitat on 9,300 acres of bottom land.
		4. Reduce acid water problems in streams or reservoirs caused by erosion and drainage on present and projected surface-mined lands.
		5. Decrease pollution caused by runoff transporting and depositing sediment, pesticides, and related pollutants in streams and on lands.
		6. Permit 276,000 acres to remain subject to flooding.
B.	Recreational and wildlife development	1. Provide opportunities for 2.8 million visitor-days of recreation, including 458,000 fisherman-days.
		2. Provide an additional 175,100 acres of upland forest game habitat.
		3. Affect fish, wildlife, or waterfowl habitat by modifying 8 miles of channel, requiring 11,000 acres for reservoirs, and affecting swamping on 11,000 acres.
C.	Employment opportunities	1. Provide an estimated 381 additional man-years of employment annually.
		2. Provide opportunities for an increase in business activity from the additional water supplies, recreational facilities, and land reclamation measures.
D.	Other	1. Provide basis for utilizing agricultural land more in accordance with its inherent capability.
		2. Maintain and conserve the productive base to provide a wider range of future resource uses.

COORDINATION AND PROGRAMS FOR FUTURE DEVELOPMENT

COORDINATION AND IMPLEMENTATION

Implementation of programs for development and use of the basin's water, land, and related resources should be coordinated by community, city, county, area, state, and federal entities. The Kentucky Department for Natural Resources and Environmental Protection and the Tennessee Department of Conservation are expected to assume primary responsibility for coordinating and implementing this plan. Local people's acceptance and support of the plan is a must, and can be cultivated by keeping them well informed and actively participating in the decisionmaking process.

State and local entities of government, with or without grants, loans, and cost-sharing from appropriate federal agencies have primary responsibility for implementing many of the identified development proposals. These entities may install beneficial water storage reservoirs, sewage treatment facilities, water treatment and distribution systems, solid waste collection and disposal facilities and other proposals of this plan. Assistance in installing the major proposed development may be obtained under programs administered by the U.S. Department of Agriculture, the U.S. Army Corps of Engineers, and other federal agencies. Assistance provided by the U.S. Department of Agriculture to plan and install a locally sponsored watershed project to provide watershed protection, flood prevention, municipal, rural and industrial water supply, recreation, and fish and wildlife water storage, is an example of a major development with federal assistance.



OTHER PROGRAMS

Several local and state groups and federal agencies have programs or are conducting studies associated with water, land, and related resources. To prevent duplication and obtain efficient use of resources, there is need for further coordination of the agency and departmental programs and studies. The U.S. Department of Housing and Urban Development is evaluating community flooding problems in cooperation with other federal agencies, mainly the Soil Conservation Service, U.S. Geological Survey, and U.S. Army Corps of Engineers. These evaluations will provide communities with information on frequency and extent of flooding for the purpose of determining flood insurance rates. HUD is also contracting with private firms to provide data on communities with flooding problems.

The U.S. Corps of Engineers has investigations underway to determine the feasibility of additional navigation on the Green River and its main tributaries. The Corps is also investigating several small flood control projects, local protection projects, and special projects in the basin area.

The U.S. Department of the Interior operates the Mammoth Cave National Park and the Lincoln Birthplace National Historic Shrine, involving some 53,000 acres. The portion of the Green River that flows through the Mammoth Cave National Park is designated a wild and scenic river.

The Bureau of Sport Fisheries and Wildlife cooperates with other agencies and state governments in perpetuating and enhancing fish and wildlife resources.

The Kentucky Division of Water with assistance from the Environmental Protection Agency, (EPA), is conducting a water quality study for the State. It is also in the process of setting up a state water quality monitoring system with assistance from EPA. An interagency strategy team is coordinating the establishment of the monitoring system.

The primary state and local agencies having responsibility for water, land, and related resources projects include the Kentucky Department for Natural Resources and Environmental Protection, Tennessee Department of Conservation, Kentucky Department of Fish and Wildlife Resources, Tennessee Game and Fish Commission, Area Development Districts, Soil Conservation Districts, and Watershed Conservancy Districts.

Photo Courtesy Kentucky Division of Forestry

MODIFICATION OF EXISTING PROGRAMS

Several existing programs are operated to assist landowners in applying conservation land treatment and management practices. Changing technology and public interest are causing some of these programs to become outdated. In many instances with the changing resource situation they are not flexible enough to efficiently provide for what the legislation intended. These programs should be reviewed and updated to increase their effectiveness, and existing legislation should be fully utilized to provide needed assistance. Provisions of the Rural Development Act of 1972, including assistance on municipal and industrial water supplies and waste disposal systems; conservation and proper utilization of the land; and long term conservation agreements are needed. Provisions of the Water Resources Planning Act of 1974 for non-structural measures for flood damage prevention would provide much needed flexibility in dealing with the basins flood problems and should ultimately result in saving tax revenues.

NEW PROGRAMS

New programs are needed to promote conservation, development, and utilization of resources in the basin. The programs should contain features to:

1. Prevent preempting of potential reservoir sites identified in this and other studies.

2. Develop and implement a state land use plan. This plan should be based on properly interpreted resource data, contain provisions for continuously monitoring land use changes, respect private property rights and provide incentives to assist basin landowners in using land within its capabilities.

3. Provide appropriate legislative authority for reclaiming existing and future strip mine land and other critical areas. Intensive reclamation and stabilization programs are needed to minimize the off-site effect of sediment, acid water,

etc., and to restore land to a usable form.

4. Assist county and city governments plan, install, and finance solid waste collection and disposal systems.

OPPORTUNITIES

Alternative opportunities for promoting the conservation, development and utilization of resources include:

1. Zoning and land use management - County governments in the basin have authority for zoning and regulating land use to protect public and private investments. This authority is derived from the constitutional powers to protect the public health safety, and general welfare. Encouraging more extensive use of this authority would assist in attaining more efficient use of water, land and related resources. Additional planning is needed to provide designers and developers with information to adequately safeguard the basin's water and land resources. The Soil Conservation Service and other groups have resource information which is necessary to provide the basis for land use planning. An example is the physical suitability of soils for construction of subdivisions, sanitary disposal systems, drainage characteristics, and other information about the capability of soils for both agricultural and nonagricultural use.

2. Economic Development - The basin, even though making impressive progress in recent years, has significant potential for further development and resource use. For the basin to attain accelerated economic growth and improve its competitive position, it will be necessary to direct programs, efforts, investments, and resources to areas providing employment opportunities and yielding the greatest economic returns. The potential growth areas are not always evident but normally include fast growing industries having products with strong and relatively stable demands. While subject to regional, national, and international economic conditions, currently attractive nonagricultural areas include minerals, fuels, utilities and personal services. In agricultural areas, there is potential for making farm reorganizations, enlargements, and related adjustments to increase production efficiency and improve resource uses. Paralleling these are needs to expand markets for agricultural products and to improve, consolidate, and modernize processing, transportation, and distribution facilities. Implementation of proposals in this plan to alleviate resource problems, conserve productive base, and assist in meeting projected needs, will contribute to overall economic growth of the basin.

3. Recreation and Fish and Wildlife - The demand for outdoor recreation, hunting, and fishing areas and facilities is increasing. Since very little of this basin is public land, private lands offer the greatest potential to meeting these needs. However, landowners must be willing to improve wildlife habitat, develop recreational facilities, and provide access. The development and operation costs could be partially offset by user fees, but cost sharing assistance along with a tax incentive would likely be required for land so used. Potential exists for developing and using strip mined lands in the Western portion of the basin for public recreation and hunting areas. Other potential uses include golf courses, race tracks, and wildlife management areas.

4. Environmental Quality Control - In times of natural landscape use and modification, the challenge is one of achieving balanced development with planning and protection of our resources. The objective should be the identification, preservation, and protection of the outstanding values and insuring development in harmony with the environment.

This plan with the inspiration of future leaders and the needed cooperation from the public and all levels of government will provide a means of protecting the basins resources. The citizens of the basin can then enjoy a high quality of life and provide their share of products to feed and support the world.

APPENDIX TABLES

OF

GREEN RIVER BASIN REPORT

Appendix Table II.1 - Soil Resource Groups and Selected Characteristics of Each - Green River Basin

Soil Resource Groups	Description and Identification	Land Capability Units Number	Land Capability Units Acreage
SRG 1:	Well drained alluvial and upland soils, 0 to 4 percent slopes.	I - 1	244,314
		I - 2	52,448
		I - 3	35,187
	Important Soil Types:	IIs - 3	5,680
	Huntington silt loam		
	Nolin silt loam	Subtotal	337,629
	Cuba silt loam		
	Lindside silt loam		
	Maury silt loam		
	Pembroke silt loam		
SRG 2:	Well drained upland soils, 2 to 12 percent slopes.	IIe - 1	433,066
		IIe - 2	159,359
		IIe - 8	4,829
	Important Soil Types:	IIe - 9	16,902
	Crider silt loam	IIIe - 1	127,795
	Cumberland silt loam	IIIe - 2	329,870
	Maury silt loam	IIIe - 7	71,086
	Pembroke silt loam		
	Lowell silt loam	Subtotal	1,142,907
	Christian silt loam		
	Wellston silt loam		
SRG 3:	Moderately well drained upland soils with fragipan, 2 to 12 percent slopes.	IIe - 6	107,446
		IIe - 7	144,872
		IIe - 10	251,111
	Important Soil Types:	IIIe - 9	11,182
	Bedford silt loam	IIIe - 8	10,383
	Captina silt loam	IIIe - 15	7,188
	Mercer silt loam	IVe - 16	6,189
	Sango silt loam		
	Loring silt loam	Subtotal	538,371
	Zanesville silt loam		
	Tilsit silt loam		
	Dickson cherty silt loam		
SRG 4:	Well drained upland soils, 2 to 12 percent slopes.	IIe - 3	2,415
		IIe - 4	12,073
		IIe - 5	15,694
	Important Soil Types:	IIe - 11	49,498
	Mountview silt loam	IIs - 2	141
	Baxter cherty silt loam	IIIe - 3	43,131
	Beasley silt loam	IIIe - 4	41,533
	Cumberland cherty silt loam	IIIe - 5	3,195
	McAfee silt loam	IIIe - 6	127,795
	Faywood silt loam	IIIe - 10	12,779
	Frankstown silt loam		
		Subtotal	308,254
SRG 5:	Well drained gravelly, alluvial soils, 0 to 4 percent slopes.	IIs - 1	38,073
		IIs - 5	3,051
	Important Soil Types:	Subtotal	41,124
	Huntington gravelly silt loam		
	Pope gravelly fine sandy loam		
	Huntington, shallow		

(Continued)

Appendix Table II.1 - Soil Resource Groups and Selected Characteristics of Each - Green River Basin (cont.)

Soil Resource Group	Description and Identification	Land Capability Units Number	Land Capability Units Acreage
SRG 6:	Moderately well drained upland soils with fragipan, 0 to 2 percent slopes.	IIw - 1	24,912
		IIw - 2	18,029
	Important Soil Types:	Subtotal	42,941
	Bedford silt loam		
	Captina silt loam		
	Tilsit silt loam		
	Monongahela fine sandy loam		
	Nicholson silt loam		
SRG 7:	Somewhat poorly drained alluvial soils on flood plains and stream terraces, 0 to 4 percent slopes.	IIw - 3	656
		IIw - 4	277,641
		IIw - 5	5,572
		IIw - 6	983
	Important Soil Types:		
	Newark silt loam	Subtotal	284,852
	Stendal fine sandy loam		
	Falaya silt loam		
	Dekoven silt loam		
SRG 8:	Poorly drained clayey and loamy alluvial soils, 0 to 2 percent slopes.	IIIw - 2	3,627
		IIIw - 4	3,957
		IIIw - 5	101,896
		IIIw - 6	34,955
	Important Soil Types:	IIIw - 7	16,818
	Alligator silty clay loam		
	Sharkey silty clay loam	Subtotal	161,253
	Dunning silty clay loam		
	Zipp silty clay		
	Melvin silt loam		
	Atkins loam		
	Sharkey clay		
SRG 9:	Somewhat poorly drained upland soils with fragipan, 0 to 4 percent slopes.	IIIw - 1	148,392
		IIIw - 3	20,115
	Important Soil Types:	Subtotal	168,507
	Johnsburg silt loam		
	Lawrence silt loam		
	McGary silt loam		
	Taft silt loam		
SRG 10:	Dominantly well drained upland soils, 12 to 20 percent slopes.	IVe - 1	13,067
		IVe - 2	9,628
		IVe - 3	201,502
	Important Soil Types:	IVe - 4	127,227
	Cumberland silt loam	IVe - 5	1,375
	Jefferson gravelly loam		
	Baxter cherty silt loam	Subtotal	352,799
	Beasley silt loam		
	Eden silt clay loam		
	Wellston silt loam		

(Continued)

Appendix Table II.1 - Soil Resource Groups and Selected Characteristics of Each - Green River Basin (cont.)

Soil Resource Group	Description and Identification	Land Capability Units Number	Land Capability Units Acreage
SRG 11:	Well drained, dominantly clayey soils, with restricted rooting depth, 2 to 12 percent slopes.	IVe - 6	69,459
		IVe - 8	24,070
		Subtotal	93,529
	Important Soil Types: Caneyville silt loam, McAfee silt loam, Faywood silt loam, Needmore silt loam		
SRG 12:	Well drained, clayey soils, 2 to 6 percent slopes.	IIIe - 11	1,597
		IIIe - 12	5,591
		IIIe - 13	799
	Important Soil Types:	IIIe - 14	4,792
	Cumberland silty clay loam, Markland silt loam, Talbott silt loam, Salvisa silt loam	IVe - 15	688
		Subtotal	13,467
SRG 13:	Well drained, severely eroded upland soils, 6 to 12 percent slopes.	IVe - 9	47,452
		IVe - 10	8,253
		IVe - 11	105,220
	Important Soil Types:	IVe - 12	688
	Baxter cherty silty clay loam, Lowell silty clay loam, Crider silty clay loam, Cumberland silty clay, Maury silty clay loam, Nicholson silty clay, Zanesville silty clay	IVe - 13	2,751
		IVe - 14	70,147
		Subtotal	234,511
SRG 14:	Well drained sandy alluvial soils, 0 to 6 percent slopes.	IIIs - 1	1,728
		Subtotal	1,728
	Important Soil Types: Bruno loamy fine sand		
SRG 15:	Somewhat excessive drained very cherty or gravelly upland soils, 0 to 12 percent slopes.	IVs - 1	987
		IVs - 2	41,907
		Subtotal	42,894
	Important Soil Types: Bodine cherty silt loam		
SRG 16:	Poorly drained upland and terrace soils with fragipan, 0 to 2 percent slopes.	IVw - 1	25,608
		Subtotal	25,608
	Important Soil Types: Robertsville silt loam		

(Continued)

Appendix Table II.1 - Soil Resource Groups and Selected Characteristics of Each - Green River Basin (cont.)

Soil Resource Group	Description and Identification	Land Capability Units Number	Land Capability Units Acreage
SRG 17:	Well drained upland soils, dominantly 20 to 30 percent slopes.	VIe - 1	151,760
		VIe - 5	3,229
		VIe - 7	21,526
	Important Soil Types:		
	Baxter cherty silt loam	Subtotal	176,515
	Culleoka silt loam		
	Eden silty clay loam		
	Fairmount flaggy silty clay loam		
	Shelocta gravelly silt loam		
	Jefferson gravelly loam		
	Wellston silty clay		
	Jefferson silty clay		
SRG 18:	Well drained, severely eroded upland soils, 12 to 30 percent slopes.	VIe - 2	91,487
		VIe - 3	200,733
		VIe - 4	27,446
	Important Soil Types:	VIe - 6	32,828
	Eden clay	VIe - 9	9,149
	Baxter cherty silty clay loam	VIs - 2	11,503
	Beasley silty clay loam	VIs - 4	247
	Faywood silty clay loam	VIs - 5	7,668
	Fairmount flaggy clay		
	Corydon very rocky silty clay loam	Subtotal	104,267
	Captina silty clay		
	Mercer silty clay		
	Gilpin silty clay		
	Otway clay		
SRG 19:	Very rocky, cherty, shaly, or stony upland soils, 6 to 20 percent slopes.	VIs - 1	68,398
		VIs - 3	35,869
	Important Soil Types:	Subtotal	104,267
	Caneyville very rocky silty clay loam		
	McAfee very rocky silt loam		
	Colyder shaly silt loam		
	Bodine cherty silt loam		
SRG 20:	Well drained upland soils, 30 to 60 percent slopes.	VIIe - 1	123,478
		VIIe - 3	93,294
		VIIs - 1	140,834
	Important Soil Types:	VIIs - 2	74,559
	Culleoka silt loam	VIIs - 4	1,912
	Eden silty clay loam		
	Colyer shaly silt loam	Subtotal	434,077
	Bodine cherty silt loam		
	Muskingum stony silt loam		
	Fairmount very rocky silt clay loam		
	Shelocta gravelly silt loam		
	Jefferson gravelly loam		

(Continued)

Appendix Table II.1 - Soil Resource Groups and Selected Characteristics of Each - Green River Basin (cont.)

Soil Resource Group	Description and Identification	Land Capability Units Number	Land Capability Units Acreage
SRG 21:	Well drained, severely eroded or extremely rocky upland soils, dominantly 12 to 50 percent slopes.	VIIe - 2 VIIs - 3 VIIs - 5	217,687 393,188 26,765
	Important Soil Types: Fairmount flaggy clay Muskingum stony silt loam Otway clay loam Shrouts silty clay loam Garmon shaly silt loam Rockcastle clay Colyer shaly silty clay	Subtotal	637,640
SRG 22:	Disturbed surface strip-mine areas, mine spoils, severely gullied areas, rock outcrop, swamp areas, and unclassified acreage.		36,066
		Subtotal	36,066
		Total	5,560,000

Source: Developed from Soil Conservation Service Soil Surveys and study data.

Appendix Table II.2 - Soil Associations and Acreage
Green River Basin

Soil Association and Number	Approximate Acreage	Characteristics			
		Slope	Drainage	Texture	Parent Material
1. Loring-Memphis-Grenada	253,000	Level to sloping	Moderately well to well	Loamy, some with fragipan	Formed in thick loess
4. Loring-Wellston-Frondorf	152,000	Gently sloping to steep	Well	Loamy	Formed in loess over sandstone residuum
5. Karnak-Uniontown-Newark	320,000	Nearly level	Poorly	Clayey and loamy	Formed in Alluvium
7. Frondorf-Wellston	1,034,000	Mostly steep	Well	Loamy	Formed in siltstone residuum and loess
8. Frondorf-Caneyville-DeKalb	764,000	Mostly steep	Well	Loamy and clayey	Formed in siltstone, limestone, or sandstone residuums.
10. Newark-Nolin-Lawrence	195,000	Nearly level	Poorly to well	Loamy	Formed in Alluvium
11. Zanesville-Sadler-Wellston	219,000	Nearly level to gently sloping	Well to somewhat poorly	Loamy, most with fragipan	Formed from siltstone & sandstone residuum
12. Fredonia-Pembroke	175,000	Moderately steep to gently sloping	Well	Clayey, some are shallow	Formed in limestone residuum and loess
13. Pembroke-Crider-Cumberland	492,000	Nearly level to sloping	Well	Loamy	Formed in thin loess over limestone residuum
14. Baxter-Bedford	750,000	Gently sloping to steep	Well	Clayey, and loamy	Formed in limestone residuum and loess
15. Trimble-Garmon-Mountview	460,000	Steep	Well	Loamy, some are shallow	Formed in limestone and shale residuum
16. Crider-Bedford-Baxter	132,000	Nearly level to steep	Well	Loamy and clayey	Formed in loess and limestone residuum
18. Garmon-Talbott-Baxter	213,000	Sloping to steep	Well	Loamy and clayey	Formed in shale or limestone residuum
19. Bedford-Lawrence	31,000	Nearly level	Moderately well to poorly	Loamy with fragipan	Formed in loess or limestone residuum
20. Frankstown-Bedford-Christian	248,000	Sloping to steep	Moderately to well	Loamy and clayey	Formed from limestone and shale residuum
22. Garmon-Rockcastle-Frankstown	109,000	Sloping to steep	Well	Loamy and clayey, some are shallow	Formed in a residuum limestones and shale or clay shales

Source: Soil Conservation Service, Soil Surveys.

Appendix Table II.3 - Soil Association Interpretations

Green River Basin

Soil Ass. No.	Major Soils	Flood Hazard	Suit. for Agric.	Prod. Pot. for Tree Gr.[1]	W/L Hab. Suit.[2] Open land	W/L Hab. Suit.[2] Wood-land	W/L Hab. Suit.[2] Wet-land	Outdoor Recreation Limitations[3] Play-ground	Outdoor Recreation Limitations[3] Camp Areas	Outdoor Recreation Limitations[3] Picnic	Outdoor Recreation Limitations[3] Trails	Hyd. Soil Group
1	Loring	None	IIe IIIe IVe VIe	85	Well	Well	Well	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	C
	Memphis	None	I,IIe IIIe IVe VIIe	90	Fair	Fair	Very Poor	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	C
	Grenada	None	IIe IIIe IVe	85	Well	Fair	Poorly	Mod.	Mod.	Slight	Slight	C
4	Loring	None	IIe IIIe IVe VIe	85	Well	Well	Poorly	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	C
	Wellston	None	IIe IIIe IVe VIe	90	Poorly	Fair	Very Poor	Severe (slope)	Severe (slope)	Severe (slope)	Severe (slope)	B
	Gilpin	None	IIs IIe IIIe IVe VIe	90	Poorly	Fair	Very Poor	Severe (slope)	Severe (slope)	Mod. (slope)	Slight (slope)	B
5	Alligator	Freq.	IIIw IVw	80	Fair	Fair	Fair	Severe (wet-floods)	Severe (wet-floods)	Severe (wet-floods)	Severe (wet-floods)	D
	Unionton	Occas.	I,IIe IIIe IVe	70	Fair	Fair	Very Poor	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
	Newark	Freq.	IIw	95	Fair	Fair	Fair	Severe (wet-floods)	Severe (wet-floods)	Mod. (wet-floods)	Mod. (wet-floods)	C
7	Gilpin	None	IIs IIe IIIe IVe VIe VIIe	90	Poorly	Fair	Very Poor	Severe (slope)	Severe (slope)	Mod. (slope)	Slight (slope)	B
	Wellston	None	IIe IIIe IVe VIe	90	Fair	Fair	Very Poor	Severe (slope)	Severe (slope)	Severe (slope)	Mod. (slope)	B

(Continued)

Appendix Table II.3 - Soil Association Interpretations (cont.)

Green River Basin

Soil Ass. No.	Major Soils	Flood Hazard	Suit. for Agric.	Prod. for Tree Gr.[1]	W/L Hab. Suit.[2] Open land	W/L Hab. Suit.[2] Wood-land	W/L Hab. Suit.[2] Wet-land	Outdoor Recreation Limitations[3] Play-ground	Camp Areas	Picnic	Trails	Hyd. Soil Group
8	Gilpin	None	IIs IIe IIIe IVe VIe VIIe	90	Poorly	Fair	Very Poor	Severe (slope)	Severe (slope)	Severe (slope)	Mod. (slope)	B
	Caney-ville	None	IVe,VIe	65	Fair	Fair	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Slight	C
	Dekalb	None	IIs,IIe IIIe IVe VIe VIIe	66	Fair	Fair	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Slight	B
10	Newark	Occas.	I,IIw	85	Well	Well	Fair	Severe (floods)	Severe (floods)	Severe (floods)	Mod. (floods)	C
	Nolin	Occas.	I,IIw IIIw	95	Well	Well	Poorly	Severe (floods-wet)	Severe (floods)	Severe (floods)	Mod. (floods)	B
	Law-rence	Occas.	IIIw	80	Well	Well	Fair	Severe (floods-wet)	Severe (floods-wet)	Severe (floods-wet)	Mod. (floods-wet)	C
11	Zanes-ville	None	II IIIe IVe VIe	65	Fair	Fair	Poorly	Severe (slope)	Mod. (slope)	Mod. (slope)	Slight	C
	Sadler	None	IIw IIe IIIe	70	Well	Well	Poorly	Mod. (slope)	Mod. (slope)	Slight	Slight	C
	Wells-ton	None	IIe IIIe IVe VIe	90	Fair	Fair	Poorly	Severe (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
12	Fre-donia	None	IIe IIIe IVe VIe	70	Fair	Well	Poorly	Severe (slope-rock)	Severe (slope)	Severe (slope)	Severe (slope)	C
	Pem-broke	None	I IIe IIIe IVe	90	Fair	Fair	Poorly	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B

(Continued)

Appendix Table II.3 - Soil Association Interpretations (cont.)

Green River Basin

Soil Ass. No.	Major Soils	Flood Hazard	Suit. for Agric.	Prod. Pot. for Tree Gr.[1]	W/L Hab. Suit.[2] Open land	Wood-land	Wet-land	Outdoor Recreation Limitations[3] Play-ground	Camp Areas	Picnic	Trails	Hyd. Soil Group
13	Garmon	None	IIe IIIe IVe VIe	90	Fair	Fair	Poorly	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
	Crider	None	IIe IIIe IVe VIe	90	Fair	Fair	Poorly	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
	Cumberland	None	IIe IIIe IVe VIe	70	Well	Well	Very Poor	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
14	Baxter	None	IIe IIIe IVe VIe	93	Well	Well	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
	Bedford	None	IIw IIe IIIe IVe	80	Well	Well	Poorly	Mod. (wet)	Mod. (wet)	Mod. (wet)	Mod. (wet)	C
15	Trimble	None	IIe IIIe IVe VIe	80	Well	Well	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
18	Garmon	None	IIe IIIe IVe VIe	61	Well	Well	Very Poor	Severe (slope)	Severe (slope)	Severe (slope)	Severe (slope)	C
	Talbott	None	IIIe IVe VIe	65	Well	Well	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Slight	D
	Baxter	None	IIe IIIe IVe VIe	65	Well	Well	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	B
19	Bedford	None	IIw IIe IIIe IVe	80	Well	Well	Poorly	Mod. (wet)	Mod. (wet)	Mod. (wet)	Mod. (wet)	C
	Lawrence	Occas.	IIIw	80	Well	Well	Fair	Severe (flood)	Severe (flood)	Severe (flood)	Severe (flood)	C

(Continued)

Appendix Table II.3 - Soil Association Interpretations (cont.)

Green River Basin

Soil Ass. No.	Major Soils	Flood Hazard	Suit. for Agric.	Prod. Pot. for Tree Gr.[1]	W/L Hab. Suit.[2] Open land	W/L Hab. Suit.[2] Wood-land	W/L Hab. Suit.[2] Wet-land	Outdoor Recreation Limitations[3] Play-ground	Outdoor Recreation Limitations[3] Camp Areas	Outdoor Recreation Limitations[3] Picnic	Outdoor Recreation Limitations[3] Trails	Hyd. Soil Group
20	Frankstown	None	IIe IIIe IVe VIe	79	Well	Well	Poorly	Severe (slope)	Mod. (slope)	Mod. (slope)	Slight	B
	Bedford	None	IIw IIe IIIe IVe VIe	80	Well	Well	Poorly	Mod. (wet)	Mod. (wet)	Mod. (wet)	Mod. (wet)	C
	Christian	None	IIe IIIe IVe VIe	73	Fair	Fair	Very Poor	Mod. (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	C
22	Garmon	None	IIe IIIe IVe VIe	61	Well	Well	Very Poor	Severe (slope)	Severe (slope)	Severe (slope)	Severe (slope)	C
	Rockcastle	None	VIe VIIe	58	Poorly	Fair	Very Poor	Severe (slope)	Severe (slope)	Severe (slope)	Severe (slope)	B
	Frankstown	None	IIIe IVe VIe	79	Well	Well	Very	Severe (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	D
23	Lowell	None	IIe IIIe IVe VIe	70	Well	Well	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	C
	Shelbyville	None	IIw IIe IIIe IVe	80	Well	Well	Very Poor	Mod. (wet)	Mod. (wet)	Slight	Slight	B
	Fairmount	None	IIe IIIe IVe	55	Fair	Well	Very Poor	Severe (slope)	Mod. (slope)	Mod. (slope)	Mod. (slope)	D

1/ Site index based on native hardwoods.
2/ Suitability based on a rating of 1 - well suited, 2 - fairly well suited, 3 - poorly suited, and 4 - very poorly suited
3/ The word in parenthesis indicates the dominant limitations

Appendix Table II.4 - Average Annual Water Yield for Continuous Record Gaging Stations

Green River Basin

Station No.	Station Name	Drainage Area[1] (sq.mi.)	Length of Record[2] (years)	Average Discharge (cfs)	Average Water Yield (in./yr.)
03 3045.00	McGills Creek near McKinney	2.14	20	2.58	16.37
03 3050.00	Green River near McKinney	22.4	20	29.6	17.94
03 3065.00	Green River at Greensburg	736	32	1,073[3]	19.80[3]
03 3070.00	Russell Creek near Columbia	188 (15)	32	269	19.43
03 3071.00	Russell Creek near Gresham	265 (19)	7	401	20.55
03 3075.00	South Fork Little Barren River at Edmonton	18.3	30	26.2	19.44
03 3085.00	Green River at Munfordville	1,673 (180)	45	2,565[3]	20.82[3]
03 3095.00	McDougal Creek near Hodgenville	5.34	18	7	17.83
03 3100.00	North Fork Nolin River at Hodgenville	36.4 (0.8)	30	45.9[4]	17.12[4]
03 3103.00	Nolin River at White Mills	357 (120)	12	426	16.20
03 3104.00	Bacon Creek near Priceville	85.4 (31)	12	50.2	7.98
03 3115.00	Green River at Brownsville	2,762 (690)	40	4,066[5]	19.99[5]
03 3120.00	Bear Creek near Leitchfield	30.8	22	42.7	18.83
03 3130.00	Barren River near Finney	940 (77)	20	1,374	19.85
03 3135.00	West Bays Fork at Scottsville	7.47	21	10.7	19.45
03 3140.00	Drakes Creek near Alvaton	478 (120)	32	688	19.55
03 3145.00	Barren River at Bowling Green	1,848 (490)	33	2,389[6]	17.56[6]
03 3155.00	Green River at Lock 4, at Woodbury	5,403 (1,360)	34	7,664[7]	19.26[7]
03 3160.00	Mud River near Lewisburg	90.5 (9)	32	150	22.51
03 3165.00	Green River at Paradise	6,182 (1,380)	22	8,600[7]	18.89[7]
03 3175.00	North Fork Rough River near Westview	42.0 (19)	17	35	11.32
03 3182.00	Rock Lick Creek near Glen Dean	20.1	15	24.9	16.82
03 3185.00	Rough River at Falls of Rough	504 (110)	23	698[8]	18.81[8]
03 3188.00	Caney Creek near Horse Branch	124	15	153	16.76
03 3190.00	Rough River near Dundee	757 (120)	32	949[8]	17.02[8]
03 3200.00	Green River at Lock 2, at Calhoun	7,564 (1,540)	41	10,570[9]	18.98[9]
03 3205.00	East Fork Pond River near Apex	194	31	256	17.92

Source: U.S. Geological Survey. 1973. Water Resources Data for Kentucky Part 1: Surface Water Records. Water Resources Records, 1971. Louisville, Kentucky.

1/ Numbers in parentheses give the square miles of the drainage area which does not contribute directly to surface runoff.

2/ This length of record includes the 1971 water year.

3/ Flow regulated by Green River Lake beginning February 1969.

4/ Approximately 0.1 cfs daily diversion by Hodgenville.

5/ Flow regulated by Green and Nolin River Lakes beginning March 1963.

6/ Flow regulated by Barren River Lake beginning March 1964.

7/ Flow regulated by Green, Nolin and Barren River Lakes beginning March 1963.

8/ Flow regulated by Rough River Lake beginning October 1959.

9/ Flow regulated by Green, Nolin, Barren and Rough River Lakes beginning October 1959.

Appendix Table II.5 - Observed Extreme Discharges for Continuous Record Gaging Stations[1/]

Green River Basin

Station No.	Station Name	Maximum Observed		Minimum Observed	
		Discharge (cfs)	Gage Height (ft.)	Discharge (cfs)	Gage Height (ft.)
03 3045.00	McGills Creek near McKinney	1,340	6.31	0	--
03 3050.00	Green River near McKinney	12,700	9.16	0	--
03 3065.00	Green River at Greensburg	60,600	37.17	0.4	--
03 3070.00	Russell Creek near Columbia	16,700	24.34	0.4	--
03 3071.00	Russell Creek near Gresham	13,500	26.05[2/]	5.2	--
03 3075.00	South Fork Little Barren River at Edmonton	2,970	10.00	0	--
03 3085.00	Green River at Munfordville	76,800	57.72	39	2.2
03 3095.00	McDougal Creek near Hodgenville	2,890	7.04	0	--
03 3100.00	North Fork Nolin River at Hodgenville	9,380	15.72	0	--
03 3103.00	Nolin River at White Mills	19,400	34.86	31	1.52
03 3104.00	Bacon Creek near Priceville	2,400	14.01	4.4	--
03 3115.00	Green River at Lock 6, at Brownsville	120,000	44.94	120	--
03 3120.00	Bear Creek near Leitchfield	8,070	21.33	0	--
03 3130.00	Barren River near Finney	78,000	110.6	20	--
03 3135.00	West Bays Fork at Scottsville	7,050	8.34	0	--
03 3140.00	Drakes Creek near Alvaton	96,400	40.43	9	2.79
03 3145.00	Barren River at Bowling Green	85,000	49.55	44	4.03
03 3155.00	Green River at Lock 4, at Woodbury	205,000	43.1	200	--
03 3160.00	Mud River near Lewisburg	12,200	22.53	0	--
03 3165.00	Green River at Paradise	107,000	40.46	250	--
03 3175.00	North Fork Rough River near Westview	3,890	20.12	0	--
03 3182.00	Rock Lick Creek near Glen Dean	8,720	18.36	0	--
03 3185.00	Rough River at Falls of Rough	12,400[3/]	28.87	6	--
03 3188.00	Caney Creek near Horse Branch	10,000	14.43	0	--
03 3190.00	Rough River near Dundee	20,000	28.97	8.1	2.92
03 3200.00	Green River at Lock 2, at Calhoun	208,000	42.4	280	--
03 3205.00	East Fork Pond River near Apex	21,800	20.70	0	--

Source: U.S. Geological Survey. 1973. Water Resources Data for Kentucky, Part 1: Surface Water Records. Water Resources Records, 1971. Louisville, Kentucky.

1/ Drainage area and length of record for each station are given in appendix table II.4.
2/ Flood of March 27, 1962 reached a stage of about 32 feet, according to information from local residents.
3/ From floodmarks, floods of January 12, 1913, 1915, March 1935, and January 25, 1937 reached stages of 28.96, 28.93, 29.31 and 34.06, respectively.

Appendix Table II.6 - Low Flood Characteristics for Selected Stream Gaging Stations

Green River Basin

Station No.	Station Name	7-day, 10-yr., low-flow, cfs	Drainage area, sq. mi.	Station type[1/]
03 3045.00	McGills Creek near McKinney	0	2.14	C
03 3050.00	Green River near McKinney	0	22.4	C
03 3055.00	Green River near Mount Salem	0	36.3	P
03 3070.00	Russell Creek near Columbia	1.6	188	C
03 3071.00	Russell Creek near Gresham	2.1	265	CP
03 3072.95	Big Pitman Creek near Summersville	0.3	126	P
03 3075.00	South Fork Little Barren River at Edmonton	0	18.3	C
03 3091.00	Wet Prong Buffalo Creek near Mammoth Cave	0.8	2.26	P
03 3095.00	McDougal Creek near Hodgenville	0	5.34	C
03 3100.00	North Fork Nolin River at Hodgenville	0	36.4	CR
03 3103.00	Nolin River at White Mills	34	357	C
03 3104.00	Bacon Creek near Priceville	5.2	85.4	C
03 3106.00	Dog Creek near Mammoth Cave	1.1	8.12	P
03 3111.00	Bylew Creek near Mammoth Cave	0.4	5.16	P
03 3120.00	Bear Creek near Leitchfield	0	30.8	C
03 3121.00	Bear Creek near Roundhill	0.5	137	P
03 3135.00	West Bays Fork at Scottsville	0	7.47	C
03 3137.00	West Fork Drakes Creek near Franklin	2.2	110	CP
03 3139.00	Trammel Creek near Scottsville	4.5	93.4	P
03 3140.00	Drakes Creek near Alvaton	16	478	C
03 3153.00	Gasper River at Hadley	1.0	190	P
03 3160.00	Mud River near Lewisburg	0	90.5	C
03 3162.00	Wolf Lick Creek near Lewisburg	0	116	P
03 3175.00	North Fork Rough River near Westview	0.1	42.0	C
03 3182.00	Rock Lick Creek near Glen Dean	0	20.1	C
03 3188.00	Caney Creek near Horse Branch	0	124	C
03 3205.00	East Fork Pond River near Apex	0	194	C
03 3213.50	South Fork Panther Creek near Whitesville	0	58.2	CP
03 3213.70	South Fork Panther Creek near Masonville	0	109	P
03 3214.10	North Fork Panther Creek near Masonville	0	88.3	P

Source: These data were developed by Dick Swisshelm, USGS, Louisville, Kentucky, for release in a forthcoming report. Until such report is released, data are preliminary and subject to revision.

1/ P - Partial-record gaging station.
C - Continuous-record gaging station.
CP - Short-term continuous-record gaging station analyzed as a partial record gaging station.
R - Regulation is significant.

Appendix Table II.7 - Probabilities That Monthly Precipitation (Inches) Will Be Less Than Amounts Listed

Green River Basin

% PROBABILITY	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	1.1	0.8	2.2	2.0	0.9	1.0	1.4	1.2	0.4	0.9	1.3	1.4
10	1.6	1.2	2.7	2.1	1.3	1.4	1.8	1.6	0.7	1.1	1.6	1.9
20	2.5	1.8	3.2	2.5	1.8	2.1	2.4	2.1	1.1	1.4	2.1	2.5
50	4.8	3.5	5.0	3.9	3.3	3.7	3.9	3.3	2.5	2.3	3.3	3.9
80	8.4	6.2	7.0	5.3	5.6	6.2	5.9	5.0	4.6	3.5	5.0	6.0
90	10.9	8.1	8.3	6.4	7.1	8.0	7.2	6.2	6.2	4.1	6.0	7.2
95	13.3	9.8	9.5	7.1	8.5	9.6	8.4	7.1	7.7	4.8	7.0	8.3
YEARS OF RECORD	30	30	30	30	30	30	30	30	30	30	30	30

Source: Dependability of Monthly Precipitation in Kentucky
Progress Report 182
University of Kentucky: Agricultural Experiment Station,
Lexington, Ky., by Doyle Cook, Clyde B. Lee, and Allen B. Elam, Jr.

Appendix Table II.8 - Oil Production by County for Selected Years

Green River Basin

County	Year				
	1969	1970	1971	1972	1973
			-Barrels-		
Adair	7,545	275,930	330,750	293,334	197,648
Allen	61,850	47,398	39,123	36,073	38,535
Barren	11,413	10,106	12,343	11,186	9,322
Breckinridge	5,248	5,648	7,766	7,766	8,295
Butler	62,124	54,290	47,008	59,827	47,839
Casey	12,698	11,872	7,325	5,274	3,951
Christian	40,233	38,735	38,293	33,737	31,792
Daviess	997,693	786,376	720,236	584,490	525,590
Edmonson	449	428	510	368	773
Green	112,019	71,042	62,950	44,604	32,206
Hancock	11,990	11,426	11,341	10,230	11,020
Hart	16,670	15,390	15,455	13,171	8,900
Henderson	555,931	477,206	397,706	328,492	287,812
Hopkins	427,640	396,358	414,692	354,246	280,000
Logan	746	1,496	741	391	235
McLean	686,140	584,665	551,354	558,665	480,670
Metcalfe	81,638	74,030	62,142	26,385	12,832
Monroe	15,447	15,006	12,536	10,955	5,772
Muhlenberg	405,689	346,307	300,467	253,187	194,295
Ohio	467,421	385,412	328,608	276,390	224,577
Russell	158	45	49	356	362
Simpson	2,303	6,744	7,074	6,033	5,802
Taylor	43	255	78	--	--
Todd	55	--	389	453	895
Warren	23,770	22,364	20,380	21,919	22,370
Webster	367,382	281,785	270,452	298,728	251,427
Totals	4,374,285	3,920,314	3,659,768	3,236,160	2,682,920

Source: Annual Reports, Kentucky Department of Mines and Minerals, 1969-1975 adjusted to hydrologic boundary of basin and includes only Kentucky counties.

Appendix Table II.9 - Area of Land and Forest

Green River Basin[1/]

Land Class	Area (Acres)
Forest:	
Commercial	1,965,800
Noncommercial	49,350
Total	2,015,150
Non-forest:	
Agricultural	3,608,050
Other[2/]	283,360
Total	3,891,410
All land	5,906,590

Source: 1970 Soil and Water Conservation Needs Inventories for Kentucky and Tennessee and study data by U.S. Forest Service.

1/ Reflects 1969 as base year.
2/ Includes urban water, and other federal land.

Appendix Table II.10 - Area of Commercial Forest Land by Ownership for 1969

Green River Basin[1/]

Ownership Class	Commercial Forest Land	
	Acres (000)	Percent
Public	15.0	0.8
Forest industry	19.5	1.0
Farmer and miscellaneous private	1,931.3	100.0
All ownership	1,965.8	100.0

Source: Derived from study data by U.S. Forest Service

1/ Reflects 1969 as base year.

Appendix Table II.11 - Area of Commercial Forest Land by Forest Type

Green River Basin[1/]

Type	Commercial Forest Land
	Acres (000)
Southern pine	23.6
Redcedar-hardwood	139.6
Oak-pine	21.6
White oak	57.0
Oak-hickory	790.3
Central mixed hardwoods	666.4
Maple-beech	45.2
Oak-gum-cypress	43.2
Elm-oak-cottonwood	178.9
All types	1,965.8

Source: Derived from the 1963 inventory of the timber resources of Kentucky.

1/ Reflects 1969 as base year.

Appendix Table II.12 - Area of Commercial Forest Land by Stand Size

Green River Basin[1/]

Stand-size class	Commercial Forest Land
	Acres (000)
Sawtimber	908.2
Poletimber	479.6
Seedling-sapling	554.4
Non-stocked	23.6
All classes	1,965.8

Source: Derived from the 1963 inventory of the timber resources of Kentucky

1/ Reflects 1969 as base year.

Appendix Table II.13 - Area of Commercial Forest Land by Stocking Class

Green River Basin[1/]

Stocking Class	Commercial Forest Land Acres (000)
Well	752.9
Medium	979.0
Poor	210.3
Non-stock	23.6
All classes	1,965.8

Source: Derived from the 1963 inventory of the timber resources of Kentucky.

1/ Reflects 1969 as base year.

Appendix Table II.14 - Volume and Growth of Growing Stock and Sawtimber on Commercial Forest Land by Softwood and Hardwood.

Green River Basin[1/]

	Volume	Growth
	Million Cu.Ft.	Thousand Cu.Ft.
Growing stock		
Softwood	38.5	2,660
Hardwood	1,276.8	60,010
Total	1,315.3	62,670
	Million Bd.Ft.	Thousand Bd.Ft.
Sawtimber		
Softwood	143.5	12,770
Hardwood	4,086.7	277,900
Total	4,230.2	290,670

Source: Derived from the 1963 inventory of the timber resources of Kentucky.

1/ Reflects 1969 as base year.

Appendix Table II.15 - Rare or Endangered Animals in Kentucky[1/]

Green River Basin

Type	Name: Scientific	Name: Common
Mammals	Sorex longirostris	Bachman's shrew
	Myotis austroriparius	Southeastern bat
	Myotis grisescens	Gray bat
	Plecotus townsendii	Townsend's big-eared bat
	Myotis sodalis	Indiana bat
	Peromyscus maniculatus numiterrae	Cloudland deermouse
	Canis latrans	Coyote
Birds	Aquila chrysaetos	Golden eagle
	Haliaeetus alascanus	Northern bald eagle
	Pandion haliaetus	Osprey
Fish	Etheostoma tippecanoe	Tippecanoe darter
	Percina macrocephala	Longhead darter
Salamanders and Frogs	Siren intermedia	Western lesser siren
	Hemidactylium scutatum	Four-toed salamander
Lizards	Ophisaurus attendautus	Slender glass lizard
Snakes	Masticophis flagellum flagellum	Eastern coachwhip
	Elaphe guttata guttata	Corn snake
	Pituophis melanoleucus melanoleucus	Northern pine snake
	Lampropeltis calligaster calligaster	Prairie kingsnake
	Cemophora coccinae	Scarlet snake
	Tantilla coronata coronata	Southeastern crowned snake

1/ Includes rare and endangered species of fish and wildlife as contained in KRS 150.025.

Appendix Table II.16 - Stream Fishing Resources
Green River Basin

Stream	Miles	largemouth bass	smallmouth bass	rock bass	Kentucky bass	bluegill and other sunfish	croppie	trout	catfish	walleye and sauger	muskellunge	sucker	carp	white perch	buffalo	white bass
Upper Green River	52.05	x	x	x	x	x	x		x	x	x	x	x			
Green River	153.21	x	x	x	x	x	x		x	x	x	x	x	x	x	
Green River (Barren to Rough)	77.46	x	x		x	x	x		x		x		x	x	x	
Green River (Rough to Ohio)	71.21	x	x			x	x		x		x		xx	x	x	x
Nolin River	37.50	x	x	x	x	x	x		x		x	x	x	x		x
Barren River	113.48	x	x	x		x	x		x	x	x	x	x		x	
Rough River	90.87		x	x		x			x			x	x		x	x
Knoblick Creek	3.82		x	x		x						x				
Carpenters Creek	6.51		x	x		x						x				
Brush Creek	7.12		x	x		x						x				
Trace Fork	5.83		x	x		x						x				
South Fork	7.31		x	x		x			x			x				
Goose Creek	10.07		x	x		x		x								
Casey Creek	15.99	x	x	x		x			x			x				
Dry Creek	10.23	x	x	x		x			x			x				
Pettys Fork	6.14	x	x	x		x						x				
Big Creek	3.71											x				
Russell Creek	59.28	x	x	x		x			x			x				
Robinson Creek	13.45		x	x		x			x				x			
Middle Pittman Creek	5.15	x	x	x								x				
Big Pittman Creek	31.97	x	x	x		x						x	x			
Big Brush Creek	17.95	x	x	x	x			x								
Little Brush Creek	9.39	x	x	x	x											
Sulphur Creek	10.31	x	x	x		x		x				x				
Little Barren River	20.83	x	x	x		x										
Barren Run	5.45		x	x		x						x				
Walters Creek	2.39		x	x		x						x				
McDougal Creek	4.32		x	x		x						x				
N. F. Nolin River	9.39		x	x		x			x			x				
Castleman Creek	2.50		x	x		x						x				
S. F. Nolin River	6.36															
E. F. Barren River	20.30		x	x	x	x						x				
S. F. Barren River	29.77		x	x	x	x						x				
Beaver Creek	24.92	x	x	x	x	x	x					x	x			
Falling Timber Creek	7.08	x	x	x	x	x	x		x			x	x			
Skaggs Creek	34.13	x	x	x	x	x	x		x			x	x			
Peter Creek	12.23	x	x	x	x	x	x		x			x				
Lynn Camp Creek	8.41	x						x	x							
Bacon Creek	27.58	x	x	x		x	x									
Roundstone Creek	9.70							x								
Rough Creek	20.03	x	x	x	x	x		x	x							x
Linders Creek	7.73			x					x			x	x			
Little Meeting Creek	4.55			x					x			x	x			
Big Meeting Creek	14.92			x			x		x			x	x			
N. F. Rough River	4.77		x	x		x			x			x	x		x	x
Rock Lick Creek	3.07		x	x		x	x		x			x	x		x	x
Clifty Creek	4.13			x		x			x							x
Peter Cove Creek	2.35	x	x			x	x		x							
Little Clifty Creek	2.31	x			x		x		x							x
Spring Fork Creek	3.48	x		x		x			x			x				
Caney Creek	34.77	x				x			x			x				

Appendix Table II.16 - Stream Fishing Resources (continued)
Green River Basin

Stream	Miles	largemouth bass	smallmouth bass	rock bass	Kentucky bass	bluegill and other sunfish	croppie	trout	catfish	walleye and sauger	muskellunge	sucker	carp	white perch	buffalo	white bass
Bear Creek	41.97	x	x	x		x		x	x			x	x			
Rock Creek	4.70	x	x			x		x	x							
Beaverdam Creek	12.95	x		x	x	x						x	x			
Alexander Creek	3.64					x	x						x			
Little Beaverdam Creek	1.67	x			x	x	x						x			
Middle Fork	6.25	x	x	x		x			x			x				
Trammel Creek	30.19	x	x	x		x			x			x				
Drakes Creek	2.35	x	x	x			x		x	x	x	x	x			
Clear Fork	6.29		x	x		x	x					x				
Gasper River	27.05	x	x			x			x			x	x			
Mill Creek	2.84	x	x		x	x			x			x	x		x	x
East Fork	15.53	x	x		x	x			x			x	x		x	x
Line Creek	15.98	x	x		x	x			x			x	x		x	x
Salt Lick Creek	12.52	x	x		x	x		x	x			x	x			x
Long Fork	12.82	x	x		x	x			x			x	x			x
White Oak Creek	10.26	x	x		x	x			x			x	x			x
Puncheon Creek	8.10	x	x	x		x		x				x	x			x
Long Creek	14.47	x	x	x		x						x	x			x
Bays Fork	15.19	x		x		x						x	x			
Sulphur Fork	6.48	x	x	x	x	x			x			x	x			
Lick Creek	14.62	x		x		x		x	x				x	x	x	
West Fork Drakes Creek	34.16	x	x		x	x	x					x	x			x
Sinking Creek	4.43								x							
Sharps Branch	3.45											x				
Indian Camp Creek	10.83	x	x			x			x				x	x		
Panther Creek	5.07	x				x	x		x				x		x	
Big Muddy Creek	15.11		x		x		x		x		x					
Little Muddy Creek	15.11					x			x				x			
Mud River	63.14	x	x		x	x	x		x							
Race Creek	.98					x	x		x					x	x	
Cash Creek	5.53					x	x							x		
Richland Ditch	4.73					x							x	x	x	
Pond River	13.71	x		x		x			x							
W. F. Pond River	6.29	x		x		x			x							
Little Trace Creek	3.75	x		x		x										x
Trace Creek	.48	x		x		x										x
Hungry Creek	2.27	x	x	x												
Big Trammel Creek	3.86	x	x	x												
Total	1606.00															

Source: Soil Conservation Service primary data.

Appendix Table II.17 - Significant Archeological, Geological, and Historical Sites[1/]

Green River Basin

Sites	Location	Description
Cypress Creek Villages	Todd County, Ky.	Archeological dwelling sites of early Indians.
Salts Caves	Edmonson County, Ky.	Mammoth Cave National Park - dwelling site within cave complex occupied by group of hunters and gatherers; one of the best preserved mummies in southeastern United States was found here.
Page Site	Logan County, Ky.	Mississippian - series of mounds containing crematoria, ossuaries, tombs, stone box graves, and walls constructed of stones.
The Cliffs	Todd County, Ky.	Formation of high limestone cliffs extending east and west across Todd County.
Pilot Rock	Todd County, Ky.	Located near Christian County line; massive boulder on top of knob used as guide since Indian occupation of the area.
Fort Hartford	Ohio County, Ky.	Site of Civil War, Fort Hartford.
Fort Craig	Hart County, Ky.	Civil War earthen fort built by the Union Army in 1862.
Clark House	Russellville, Ky.	Constructed in 1820; in November 1861, the Confererate Sovereignty Convention met here, passed an act of secession declaring Kentucky a Confederate state, establishing Bowling Green as the capitol, and elected George W. Johnson as provisional governor.
Battle of Green River or Tebbs Bend Site	Campbellsville, Ky.	Site of 1863 Union victory over John Hunt Morgan.
Lincoln Heritage House	Elizabethtown, Ky.	Ca. 1780-90, originally owned by Hardin Thomas, remodelled about 1805 with help of Thomas Lincoln, father of Abraham Lincoln; lost remaining link with Lincoln family in Hardin County.

Source: Kentucky Heritage Commission, Survey of Historic Sites in Kentucky, 1971.

1/ The 28 properties that are of statewide significance include seven former governors' homes, two old iron furnaces, three stage inns, a building that housed the first Bank of Kentucky, the largest sassafras tree in Kentucky, and several late 18th century churches.

Appendix Table III.1 - Area of Counties,
Green River Study Area

Subarea and County:	Total Land in County[1/]
	Acres
Subarea I	1,455,360
Daviess	295,680
Hancock	119,680
Henderson	277,120
McLean	164,480
Ohio	381,440
Webster	216,960
Subarea II	2,010,880
Butler	283,520
Christian	464,640
Hopkins	353,920
Logan	360,320
Muhlenberg	307,840
Todd	240,640
Subarea III	1,444,480
Breckinridge	360,960
Grayson	327,680
Hardin	394,240
Larue	166,400
Meade	195,200
Subarea IV	1,260,160
Allen	232,960
Barren	311,040
Monroe	213,760
Simpson	152,960
Warren	349,440
Subarea V	1,548,160
Adair	251,520
Casey	274,400
Edmonson	194,560
Green	180,480
Hart	272,000
Metcalfe	189,440
Taylor	181,760
Total	7,719,040

Source: Kentucky Soil and Water Conservation Needs Inventory 1970.

1/ Does not include large water areas (40 acres or greater).

Appendix Table III.2 - Population, Current and
Projected for 1970-2020

Green River Basin Study Area

County	Year 1970	1980	2000	2020
	Number			
Adair	13,037	12,115	10,046	7,646
Allen	12,598	12,652	12,950	13,156
Barren	28,677	29,284	30,142	32,278
Breckinridge	14,789	16,159	21,083	27,779
Butler	9,723	10,590	13,218	16,883
Casey	12,930	12,644	11,730	10,430
Christian	56,224	65,359	91,352	130,688
Daviess	79,486	91,009	125,333	168,828
Edmonson	8,751	9,869	13,066	16,961
Grayson	16,445	17,929	22,817	29,483
Green	10,350	10,056	9,092	7,817
Hancock	7,080	8,731	14,091	22,482
Hardin	78,421	89,450	110,980	136,365
Hart	13,980	14,677	16,814	19,264
Henderson	36,031	39,778	49,751	61,712
Hopkins	38,167	39,483	45,277	51,717
Larue	10,672	11,720	15,127	19,197
Logan	21,793	24,467	33,259	45,689
McLean	9,062	9,173	9,456	9,724
Meade	18,796	19,517	19,794	16,941
Metcalfe	8,177	7,973	8,043	8,099
Monroe	11,462	11,475	10,951	9,942
Muhlenberg	22,537	28,506	31,104	34,139

(Continued)

Appendix Table III.2 - Population, Current and Projected for 1970-2020 (continued)

Green River Basin Study Area

County	Year			
	1970	1980	2000	2020
	Number			
Ohio	18,790	19,379	21,892	24,911
Simpson	13,054	14,648	19,516	26,423
Taylor	17,138	18,291	20,792	22,661
Todd	10,823	10,768	10,867	11,377
Warren	57,432	70,317	105,955	152,311
Webster	13,282	13,684	15,948	19,284
Total	669,707	739,703	920,446	1,154,187

Source: 1970 Census of Population, U.S. Department of Census, Bureau of Census and Kentucky Population Projections for 1975-2020, prepared for Commonwealth of Kentucky by Spindletop Research, Inc., Lexington, Kentucky.

Appendix Table III.3 - Selected Farm Characteristics

Green River Study Area

Subarea and County	County Area (Acres)	Land in Farms (Acres)	Percent Land in Farms	Number of Farms	Average Farm Size (Acres)
I.					
Daviess	295,680	249,731	84.5	1,971	126.7
Hancock	119,680	84,407	70.5	715	118.0
Henderson	277,120	239,306	86.3	1,073	223.0
McLean	164,480	131,981	80.2	863	152.9
Ohio	381,440	188,265	49.4	1,539	122.3
Webster	216,960	157,202	72.5	861	182.5
Subtotal	1,455,360	1,050,892	72.2	7,022	149.7
II.					
Butler	283,520	174,578	61.6	1,007	173.3
Christian	464,640	344,116	74.1	1,868	184.2
Hopkins	353,920	170,456	82.8	890	191.5
Logan	360,320	304,103	84.4	1,957	155.3
Muhlenburg	307,840	130,360	42.4	852	153.0
Todd	240,640	208,362	86.7	1,055	197.4
Subtotal	2,010,880	1,331,975	66.2	7,629	174.6
III.					
Breckinridge	360,960	310,404	87.5	1,828	169.8
Grayson	327,680	240,519	75.8	1,992	120.7
Hardin	394,240	253,967	64.4	2,150	118.1
Larue	166,400	137,761	82.8	1,220	112.9
Meade	195,200	132,255	67.7	971	136.2
Subtotal	1,444,480	1,074,906	74.4	8,161	131.7

(Continued)

Appendix Table III.3 - Selected Farm Characteristics (continued)

Green River Study Area

Subarea and County	County Area (Acres)	Land in Farms (Acres)	Percent Land in Farms	Number of Farms	Average Farm Size (Acres)
IV.					
Allen	232,960	174,547	77.7	1,652	105.6
Barren	311,040	227,524	92.7	3,092	89.7
Monroe	213,760	169,880	79.5	1,444	117.6
Simpson	152,960	135,121	88.4	995	135.8
Warren	349,440	290,065	83.0	2,502	115.9
Subtotal	1,260,160	997,137	79.1	9,685	103.0
V.					
Adair	251,520	196,934	83.2	2,186	90
Casey	274,400	208,224	74.8	1,868	111.4
Edmonson	194,560	104,269	54.7	951	109.6
Green	180,480	157,015	87.0	1,607	97.7
Hart	272,000	218,649	81.3	2,022	108.1
Metcalfe	189,440	164,933	87.1	1,493	110.4
Taylor	181,760	152,561	86.1	1,474	103.5
Subtotal	1,544,160	1,202,585	77.7	11,601	103.7
TOTAL	7,715,040	5,657,495	73.29	44,098	128.29

Source: 1969 U.S. Census of Agriculture.

Appendix Table III.4 - Market Value of All Agricultural Products Sold

Green River Study Area

Subarea and County	Crops	Forest	Livestock	Total	Average Per Farm
	dollars				
I.					
Daviess	9,502,924	58,324	7,714,592	17,275,840	8,765
Hancock	1,627,064	16,905	1,381,554	3,025,523	4,231
Henderson	7,591,581	63,069	6,591,525	14,246,175	13,276
McLean	3,686,107	34,817	2,293,936	6,014,860	6,969
Ohio	2,616,741	50,265	2,678,171	5,345,177	3,473
Webster	3,172,108	20,819	3,597,792	6,790,719	7,887
Subtotal	28,196,525	244,199	24,257,570	52,698,294	7,505
II. Butler	1,259,037	66,338	2,281,712	3,607,087	3,582
Christian	9,198,466	95,932	9,569,315	18,863,713	10,098
Hopkins	3,133,929	47,862	3,045,908	6,227,699	6,997
Logan	6,313,101	58,719	8,527,576	14,899,396	7,613
Muhlenburg	1,764,413	83,188	2,995,647	4,843,248	5,684
Todd	5,002,618	34,368	5,298,140	10,355,126	9,796
Subtotal	26,671,564	386,407	31,718,298	58,776,269	7,704
III.					
Breckinridge	5,036,734	70,971	5,634,991	10,742,696	5,876
Grayson	2,676,117	55,656	5,624,469	8,356,242	4,194
Hardin	3,694,302	82,860	8,231,388	12,008,550	5,585
Larue	2,610,225	20,542	4,492,541	7,573,308	6,207
Meade	1,570,278	39,607	3,934,086	5,543,971	5,709
Subtotal	15,587,656	269,636	28,367,475	44,224,767	5,419

(Continued)

Appendix Table III.4 - Market Value of All Agricultural Products Sold (continued)

Green River Study Area

Subarea and County	Crops	Forest	Livestock	Total	Average Per Farm
			dollars		
IV.					
Allen	2,025,410	87,631	4,087,862	6,200,903	3,753
Barren	7,659,114	92,724	9,897,334	17,649,172	5,708
Monroe	1,970,408	86,983	3,994,133	6,051,524	4,190
Simpson	3,553,609	34,504	6,260,673	9,848,786	9,898
Warren	4,340,357	47,814	11,201,890	15,590,061	6,231
Subtotal	19,548,898	349,656	35,441,892	55,340,446	5,714
V.					
Adair	3,000,591	109,099	5,106,897	8,216,587	3,758
Casey	3,566,062	96,851	3,235,591	6,898,504	3,692
Edmonson	1,206,445	81,795	2,056,413	3,344,653	3,516
Green	4,105,795	83,492	4,624,608	8,813,895	5,484
Hart	5,459,155	54,264	5,330,918	10,844,337	5,363
Metcalfe	3,395,182	112,846	3,343,876	6,851,904	4,589
Taylor	3,606,178	62,167	4,597,466	8,265,811	5,607
Subtotal	24,339,408	600,154	28,295,769	53,235,691	4,589
TOTAL	114,344,051	1,850,412	148,081,004	264,275,467	5,992

Source: 1969 U.S. Census of Agriculture.

Appendix Table III.5 - Area of Land and Forest by Subarea
Green River Study Area, 1967.

Subarea	Land Area	Forest Land		
		Commercial	Noncommercial[1/]	Total
		- acres -		
I	1,455.4	494.2	3.2	497.4
II	2,010.9	740.5	7.4	747.9
III	1,444.5	565.7	3.8	569.5
IV	1,260.1	376.7	3.6	380.3
V	1,548.1	672.3	50.3	722.6
Total	7,719.0	2,849.4	68.3	2,917.7

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.6 - Area of Commercial Forest Land by Forest Type and Subarea
Green River Study Area, 1967

Subarea	Southern Pine	Redcedar Hardwood	Oak-Pine	White Oak	Oak-Hickory	Central Hardwood	Maple Beech	Oak-Gum Cypress	Elm Ash Cottonwood	All Types
					- acres -					
I	4,900	27,700	4,100	10,200	175,500	162,300	11,500	24,700	73,300	494,200
II	3,900	49,200	4,000	21,300	303,000	229,200	18,200	23,300	88,400	740,500
III	10,600	53,100	9,900	18,100	226,000	209,800	11,700	-	26,500	565,700
IV	4,600	24,400	3,900	11,300	155,400	117,900	10,700	11,300	37,200	376,700
V	10,400	49,100	10,600	21,200	283,900	245,100	14,500	2,900	34,600	672,300
Total	34,400	203,500	32,500	82,100	1,143,800	964,300	66,600	62,200	260,000	2,849,400

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.7 - Area of Commercial Forest Land by Stand Size and Subarea, Green River Study Area, 1967

Sub-Area	All Stands	Sawtimber	Poletimber	Seedlings and Saplings	Non Stocked
			- 1,000 acres -		
I	494.2	221.0	121.3	142.6	9.3
II	740.5	358.3	176.3	197.1	8.8
III	565.7	253.0	134.3	174.7	3.7
IV	376.7	181.3	90.6	98.7	6.1
V	672.3	304.2	172.0	191.0	5.1
Total	2,849.4	1,317.8	694.5	804.1	33.0

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.8 - Area of Commercial Forest Land by Stocking Class and Subarea, Green River Study Area, 1967

Sub-Area	All Classes Percent	70 Percent or More	40 to 69 Percent	10 to 39 Percent	Less than 10 Percent
			- 1,000 acres -		
I	494.2	189.2	246.2	49.5	9.3
II	740.5	283.5	368.9	79.3	8.8
III	565.7	216.6	281.8	63.6	3.7
IV	376.7	144.2	187.7	38.7	6.1
V	672.3	257.4	335.0	74.8	5.1
Total	2,849.4	1,090.9	1,419.6	305.9	33.0

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.9 - Volume of Growing Stock on Commercial Forest Land by Species Group and Subarea, Green River Study Area, 1967

	Softwood			Hardwood			All Species		
Subarea	Total	Pole-timber	Sawtimber	Total	Pole-timber	Sawtimber	Total	Pole-timber	Sawtimber
				- thousand cubic feet -					
I	6,560	1,990	4,570	329,300	129,030	200,270	335,860	131,020	204,840
II	7,450	3,070	4,380	518,290	202,620	315,670	525,740	205,690	320,050
III	17,750	7,200	10,550	331,800	136,390	195,410	349,550	143,590	205,960
IV	5,490	1,740	3,750	258,510	102,540	155,970	264,000	104,280	159,720
V	18,650	7,600	11,050	412,700	170,420	242,280	431,350	178,020	253,330
Total	55,900	21,600	34,300	1,850,600	741,000	1,109,600	1,906,500	762,600	1,143,900

Source: Updated from the 1963 inventory of the timber resource of Kentucky.

Appendix Table III.10 - Volume of Sawtimber on Commercial Forest Land by Species Group and Subarea, Green River Study Area, 1967

Subarea	Softwood	Hardwood	All Species
	- thousand board feet -		
I	31,190	1,078,300	1,109,490
II	25,030	1,701,240	1,726,270
III	62,160	1,025,880	1,088,040
IV	30,000	931,600	961,600
V	59,720	1,186,480	1,246,200
Total	208,100	5,923,500	6,131,600

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.11 - Volume of Growing Stock on Commercial Forest Land by Ownership Class and Subarea, Green River Study Area, 1967

Subarea	Other Public	Forest Industry	Farmer & Miscellaneous	All Ownership
	- thousand cubic feet -			
I	4,330	1,820	329,710	335,860
II	1,000	2,260	522,480	525,740
III	37,700	5,490	306,360	349,550
IV	500	1,190	262,310	264,000
V	39,610	6,180	385,560	431,350
Total	83,140	16,940	1,806,420	1,906,500

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.12 - Volume of Sawtimber on Commercial Forest Land by Ownership Class and Subarea, Green River Study Area, 1967

Subarea	Other Public	Forest Industry	Farmer & Miscellaneous	All Ownership
	- thousand board feet -			
I	9,940	6,150	1,093,400	1,109,490
II	3,380	7,440	1,715,450	1,726,270
III	79,530	18,850	989,660	1,088,040
IV	1,840	4,330	955,430	961,600
V	79,550	19,520	1,147,130	1,246,200
Total	174,240	56,290	5,901,070	6,131,600

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.13 - Net Annual Growth of Growing Stock and Sawtimber on Commercial Forest Land by Species Group and Subarea, Green River Study Area, 1967

Subarea	Growing Stock: All Species	Growing Stock: Softwood	Growing Stock: Hardwood	Sawtimber: All Species	Sawtimber: Softwood	Sawtimber: Hardwood
	- thousand cubic feet -			- thousand board feet -		
I	15,240	380	14,860	72,970	1,590	71,380
II	23,490	460	23,030	113,710	1,740	111,970
III	18,150	1,370	16,780	79,290	6,930	72,360
IV	11,970	290	11,680	57,080	1,130	55,950
V	22,000	1,360	20,640	98,270	7,130	91,140
Total	90,850	3,860	86,990	421,320	18,520	402,800

Source: Updated from the 1963 inventory of the timber resources of Kentucky.

Appendix Table III.14 - Primary Wood-using Industries, 1963
Green River Study Area

Subarea	Total	Sawmills	Cooperage	Furniture and Handle	Pulpmill	Timber Yards
			- number -			
I	27	25	2	-	-	-
II	27	22	2	1	-	1
III	47	44	3	-	-	-
IV	29	27	1	1	-	-
V	78	72	3	3	-	-
Total	207	190	11	5	-	1

Source: Kentucky Forests - U.S. Forest Service Resource Bulletin CS-6 and CS-9, March 1966.

Appendix Table III.15 - Primary Wood-using Industries, 1967
Green River Study Area

Subarea	Total	Sawmills	Cooperage	Furniture and Handle	Pulpmill	Timber Yards
			- number -			
I	16	14	1	-	1	-
II	22	18	1	-	-	3
III	30	28	1	-	-	1
IV	28	20	1	1	-	6
V	71	48	4	9	-	10
Total	167	128	8	10	1	20

Source: Primary Wood Industries of Kentucky 1967 - A Utilization Summary and Directory by C. J. Lohr.

Appendix Table III.16 - Employment and Income in Forest Management and Industry
Green River Study Area, 1965

Subarea	Forest Management		Lumber and Wood Products		Pulp, Paper and Allied Products	
	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)
I	99	495	441	1,449	170	853
II	148	746	806	2,637	0	0
III	113	565	94	294	0	0
IV	76	380	747	2,317	723	4,393
V	135	675	370	1,107	0	0
Total	571	2,861	2,458	7,806	893	5,246

Source: U.S. Forest Service

Appendix Table III.17 - Employment and Income in Forest Management and Industry Green River Study Area, 1970

Subarea	Forest Management		Lumber and Wood Products		Pulp, Paper and Allied Products	
	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)
I	113	697	460	1,514	180	1,192
II	169	1,046	804	2,989	0	0
III	129	798	96	333	0	0
IV	87	534	731	2,626	782	5,766
V	154	949	380	1,255	0	0
Total	652	4,024	2,471	8,717	962	6,958

Source: U.S. Forest Service.

Appendix Table III.18 - Potential Employment and Income in Forest Management and Industry - Green River Study Area, 1980

Subarea	Forest Management		Lumber and Wood Products		Pulp, Paper and Allied Products	
	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)
I	141	1,100	500	2,421	200	1,871
II	211	1,646	800	3,693	100	1,126
III	162	1,264	100	412	0	0
IV	108	842	700	3,245	900	8,512
V	192	1,498	400	1,550	0	0
Total	814	6,350	2,500	11,321	1,200	11,509

Source: U.S. Forest Service

Appendix Table III.19 - Potential Employment and Income in Forest Management and Industry - Green River Study Area, 2000

Subarea	Forest Management		Lumber and Wood Products		Pulp, Paper and Allied Products	
	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)
I	210	2,688	600	3,845	300	4,383
II	315	4,032	800	5,494	200	3,070
III	241	3,085	100	613	0	0
IV	161	2,061	700	4,828	900	13,461
V	286	3,661	400	2,311	100	1,537
Total	1,213	15,527	2,600	17,091	1,500	22,451

Source: U.S. Forest Service.

Appendix Table III.20 - Potential Employment and Income in Forest Management and Industry - Green River Study Area, 2020

Subarea	Forest Management		Lumber and Wood Products		Pulp, Paper and Allied Products	
	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)	Employees (No.)	Income ($1,000)
I	262	5,476	400	3,571	300	7,338
II	393	8,214	800	8,871	200	5,336
III	301	6,291	100	990	0	0
IV	200	4,180	800	7,796	800	20,545
V	357	7,461	400	3,723	100	2,668
Total	1,513	31,622	2,500	24,951	1,400	35,887

Source: U.S. Forest Service.

Appendix Table IV.1 - Estimated Annual Erosion Rates on Cropland Needing Treatment by Soil Resource Group and Land Capability Class

Green River Basin

Soil Resource Group and Land Capability Class[1]	Annual Erosion Rates for Cropland With Erosion Problems and Needing Treatment[2]				
	Residue Management: (Annual Cover)	Sod in Rotation	Contouring	Strip-cropping and/or Terracing	Converting to Permanent Cover
	-Tons/Acre-				
SRG-2					
IIe	4.9	15.2	6.0	6.0	15.2
IIIe	6.8	6.0	6.0	7.2	6.0
SRG-3					
IIe	3.7	9.9	4.5	4.5	9.9
IIIe	3.6	4.8	4.8	6.0	6.0
SRG-4, 5 and 12					
IIe	3.5	12.9	5.1	5.1	12.9
IIIe	3.0	5.1	3.9	5.1	5.1
IIIe	3.6	4.8	4.8	4.8	4.8
SRG-10,11 and 13					
IVe	6.0	4.5	3.6	4.5	4.5
IVe	4.0	4.5	4.0	4.5	4.5
IVe	4.2	4.8	4.2	4.8	4.8
SRG-14 and 15					
IIIs and IVs	4.2	4.5	4.5	5.1	5.1

Source: Data developed from primary and secondary sources.

1/ Soil loss per acre on Class VIe averages about 20 tons per acre.

2/ Reflects the quantity of erosion on cropland needing one or more of the five treatment practices. The rates were determined by applying "soil loss equation" to the dominant cropping system used in each subarea for each soil resource group or land capability class.

Appendix Table IV.2 - Degree of Erosion by General Soil Association and Disturbance on Forest Land, 1972.

Green River Basin

Soil Association and Number	Forest Land Acres	Slope Percent	Logging[1]	Skid Trail[2]	Spur Roads[1]	Fire[1]	Grazing[1]
1. Loring-Memphis-Grenada	34,047	0-12	S	S	S	S	S
	18,771	12-30	M	M	S	S	S
4. Loring-Wellston-Gilpin	26,963	0-12	S	S	S	M	S
	40,189	12-30	S	Sev.	Sev.	M	S
5. Alligator-Uniontown-Newark	91,561	0-12	S	S	S	S	S
7. Gilpin-Wellston	57,255	0-12	S	M	M	S	Sev.
	460,539	12-30	M	M	M	S	Sev.
8. Gilpin-Caneyville-Dekalb	53,754	0-12	M	M	M	S	S
	336,207	12-30	M	M	M	S	S
	1,620	30 +	M	Sev.	M	S	Sev.

(Continued)

Appendix Table IV.2 - Degree of Erosion by General Soil Association and Disturbance on Forest Land, 1972. (continued)

Green River Basin

Soil Association and Number	Forest Land Acres	Slope Percent	Logging[1/]	Skid Trail[2/]	Spur Roads[1/]	Fire[1/]	Grazing[1/]
10. Newark-Nolin-Lawrence	64,674	0-12	S	S	S	S	S
11. Zanesville-Sadler-Wellston	46,928	0-12	S	M	Sev.	M	S
12. Fredonia-Pembroke	25,512	0-12	S	M	Sev.	S	Sev.
	51,794	12-30	M	M	Sev.	M	Sev.
13. Pembroke-Crider-Cumberland	22,355	0-12	S	M	Sev.	S	Sev.
	7,422	12-30	M	M	Sev.	M	Sev.
14. Baxter-Bedford	81,828	0-12	S	M	M	S	M
	47,185	12-30	S	Sev.	Sev.	M	M
15. Trimble-Garmon-Mountview	61,010	0-12	S	M	M	S	S
	111,698	12-30	Sev.	Sev.	Sev.	Sev.	Sev.
16. Crider-Bedford-Baxter	11,946	0-12	S	M	M	S	M
	3,498	12-30	S	Sev.	Sev.	M	M
18. Garmon-Talbott-Baxter	34,901	0-12	Sev.	Sev.	Sev.	Sev.	Sev.
	78,164	12-30	Sev.	Sev.	Sev.	Sev.	Sev.
	2,304	30 +	Sev.	Sev.	Sev.	Sev.	Sev.
19. Bedford-Lawrence	7,337	0-12	S	S	S	S	M
20. Frankstown-Bedford-Christian	39,508	0-12	S	S	S	S	M
	101,801	12-30	M	Sev.	S	S	Sev.
	3,071	30 +	M	Sev.	S	S	Sev.
22. Garmon-Rockcastle-Frankstown	8,533	0-12	S	S	S	S	M
	64,426	12-30	M	M	M	S	M
	16,810	30 +	M	Sev.	M	S	Sev.

Source: Forest Service, U.S. Department of Agriculture.

1/ Degree of Erosion - Slight (S) 0-2.9 tons per acre; Moderate (M) 3.0-4.9 tons per acre; Severe (Sev.) 5.0 + tons per acre.

2/ Degree of Erosion - Slight (S) 0-2.9 tons per acre; Moderate (M) 3.0-29.9 tons per acre; Severe (Sev.) 30.0 + tons per acre.

Appendix Table IV.3 - Summary of Estimated Drainage Needs by Type, Subarea, and Soil Resource Group.

Green River Basin

Drainage Measure	Soil Resource Group	Subareas I	II	III	IV	V	Total Basin
	No.				-Acres-		
Sod Waterways							
	1	235	1,760	840	30	115	2,980
	6	165	45	495	615	300	1,620
	7	24,190	12,190	1,440	480	1,900	40,200
	8	13,300	4,890	270	-	740	19,200
	9	5,830	3,190	610	1,000	2,020	12,650
	16	820	275	-	-	55	1,150
Total		44,540	22,350	3,655	2,125	5,130	77,800
Land Smoothing[1/]	1	650	4,500	1,400	80	200	6,830
	6	-	-	100	-	70	170
	7	48,000	23,000	1,400	900	1,800	75,100
	8	13,000	4,000	400	-	800	18,200
	9	-	-	-	-	-	-
	16	-	-	-	-	-	-
Total		61,650	31,500	3,300	980	2,870	100,300
Tile Drainage							
	6	50	10	150	190	100	500
	7	72,080	36,500	4,320	1,430	5,670	120,000
	8	35,000	12,800	820	-	2,380	51,000
	9	1,970	995	285	310	940	4,500
	16	-	-	-	-	-	-
Total		109,100	50,305	5,575	1,930	9,090	176,000
Main and Laterals							
	1	-	-	-	-	-	-
	6	195	45	385	640	235	1,500
	7	45,270	22,700	1,790	890	2,350	73,000
	8	24,660	9,100	330	-	910	35,000
	9	4,370	2,475	550	775	1,830	10,000
	16	730	215	-	-	55	1,000
Total		75,225	34,535	3,055	2,305	5,380	120,500
Open Field Ditches							
	1	-	-	-	-	-	-
	6	300	90	1,000	1,200	600	3,190
	7	500	5,800	600	200	900	8,000
	8	9,500	3,400	100	-	300	13,300
	9	12,000	6,500	1,500	2,000	5,000	27,000
	16	3,000	1,000	-	-	200	4,200
Total		25,300	16,790	3,200	3,400	7,000	55,690

Source: Data developed from primary and secondary sources.

1/ This includes grading, leveling and smoothing to facilitate removal of excess water.

Appendix Table IV.4 - Streams or Portions of Streams Affected by Pollution and Type of Pollutant

Green River Basin

Stream[1/]	Type of Pollutant
Sulphur Creek	Sediment
Big Pitman Creek	Industrial effluent; oil well wastes
Green River	Municipal sewage; oil well wastes
North Fork Nolin River	Municipal sewage
South Fork Nolin River	Municipal sewage
South Fork	Municipal sewage; industrial effluent
Valley Creek	Municipal sewage
Barren River	Industrial effluent
Bays Fork	Oil well wastes
West Fork Drakes Creek	Municipal sewage; industrial effluent
Pond River	Mine drainage
Barnett Creek	Oil well wastes
West Fork Pond River	Mine drainage

Source: Data developed from fish and wildlife inventories and from secondary sources.

1/ Includes streams or portion thereof which are affected by pollution to an extent to impair their suitability and use for fish.

Appendix Table IV.5 - Estimated Potential Supply of and Demand for Sport Fishing by County for Specified Years.

Green River Basin

County[1/]	Supply 1974	Demand 1980	Demand 2000	Demand 2020
	-Fisherman-days-			
Adair	128,864	35,978	29,828	22,710
Allen	152,674	39,051	39,970	40,597
Barren	273,331	86,953	89,502	95,838
Breckinridge	81,807	46,714	60,949	80,313
Butler	116,426	31,443	39,256	50,126
Casey	10,783	36,554	33,907	30,152
Christian	16,256	191,505	267,673	382,943
Daviess	48,638	256,005	352,555	474,910
Edmonson	81,078	28,911	38,288	49,703
Grayson	149,444	51,825	65,977	85,239
Green	36,776	29,862	26,992	23,203
Hancock	915	25,921	41,839	66,756
Hardin	15,112	272,855	338,200	415,557
Hart	91,485	43,009	49,278	56,445
Henderson	54,180	114,998	143,843	178,409
Hopkins	13,147	118,313	134,449	153,558
Larue	6,607	33,888	43,741	55,494
Lincoln	1,220	50,875	58,706	67,895
Logan	24,128	73,603	100,050	137,455
McLean	67,753	27,586	28,453	29,250
Metcalfe	10,996	23,678	23,884	24,054
Monroe	18,380	34,075	32,512	29,522
Muhlenberg	110,892	85,766	93,578	102,700
Ohio	15,948	58,296	65,857	74,944
Russell	1,577	32,955	38,730	46,628
Simpson	8,698	43,486	57,940	78,460

(Continued)

Appendix Table IV.5 - Estimated Potential Supply of and Demand for Sport Fishing by County for Specified Years. (continued)

Green River Basin

County 1/	Supply 1974	Demand 1980	Demand 2000	Demand 2020
	-Fisherman-days-			
Taylor	138,271	54,307	61,729	67,283
Todd	8,050	31,968	32,275	33,787
Warren	103,135	208,781	314,609	452,248
Webster	28,988	41,702	48,599	58,775
Clay (Tenn.)	4,063	2/	2/	2/
Macon (Tenn.)	10,279	2/	2/	2/
Sumner (Tenn.)	28,059	2/	2/	2/
Total	1,854,203	2,210,863	2,753,169	3,464,954

Source: Data developed from fish and wildlife inventories and from secondary sources.

1/ Includes only the portion of the county in the basin.
2/ Not available.

Appendix Table IV.6 - Estimated Potential Supply of and Demand for Hunting by County for Specified Years.

Green River Basin

County1/	Supply 1974	Demand 1980	Demand 2000	Demand 2020
	-Hunter days-			
Adair	118,734	16,264	13,483	10,267
Allen	123,335	17,648	18,070	18,360
Barren	111,967	39,303	40,463	43,323
Breckinridge	155,336	21,114	27,559	36,311
Butler	128,188	14,208	17,740	22,656
Casey	116,188	16,528	15,328	13,628
Christian	152,344	86,579	121,005	173,106
Daviess	105,698	115,720	159,373	214,689
Edmonson	78,449	13,075	17,305	22,472
Grayson	184,791	23,434	29,826	38,525
Green	76,166	13,496	12,205	10,491
Hancock	57,761	11,717	18,913	30,182
Hardin	126,440	123,352	152,888	187,855
Hart	158,596	19,441	22,274	25,516
Henderson	79,993	51,982	65,017	80,648
Hopkins	140,801	53,484	60,773	69,419
Larue	63,944	15,315	19,770	25,095
Lincoln	93,926	22,999	26,531	30,696
Logan	151,555	33,280	45,234	62,131
McLean	60,086	12,468	12,864	13,220
Metcalfe	85,212	10,702	10,794	10,874
Monroe	103,848	15,407	14,696	13,351
Muhlenberg	137,228	38,762	42,295	46,420
Ohio	173,311	26,360	29,774	33,873
Russell	57,316	14,893	17,503	21,075

(Continued)

Appendix Table IV.6 - Estimated Potential Supply of and Demand for Hunting by County for Specified Years. (continued)

Green River Basin

County[1/]	Supply 1974	Demand 1980	Demand 2000	Demand 2020
		-Hunter days-		
Simpson	65,585	19,664	26,189	35,467
Taylor	51,122	24,554	27,902	30,419
Todd	84,713	14,458	14,590	15,276
Warren	105,056	94,382	142,212	204,435
Webster	72,310	18,847	21,971	26,571
Clay (Tenn.)	2/	2/	2/	2/
Macon (Tenn.)	2/	2/	2/	2/
Sumner (Tenn.)	2/	2/	2/	2/
Total	3,219,999	999,437	1,244,547	1,566,351

Source: Data developed from fish and wildlife inventories and from secondary sources.

1/ Includes only the portion of the county in the basin.
2/ Not available.

Appendix Table IV.7A - Estimated Corn Yields by Soil Resource Groups for Present and Projected Conditions[1/]
Green River Basin

SRG's	PRESENT YIELD: With Adeq. Treat.	PRESENT YIELD: WITHOUT Erosion Treat.	PRESENT YIELD: WITHOUT Flood Control	PRESENT YIELD: WITHOUT Drainage Measures	PRESENT YIELD: WITHOUT Flood & Drainage	PROJECTED YIELD: With Adeq. Treat.	PROJECTED YIELD: WITHOUT Erosion Treat.	PROJECTED YIELD: WITHOUT Flood Control	PROJECTED YIELD: WITHOUT Drainage Measures	PROJECTED YIELD: WITHOUT Flood & Drainage
	(Bushels)					(Bushels)				
1	115.0	0.0	108.0	110.0	103.0	182.0	0.0	166.0	166.0	150.0
2	100.0	95.0	0.0	0.0	0.0	158.0	150.0	0.0	0.0	0.0
3	90.0	85.0	0.0	0.0	0.0	142.0	134.0	0.0	0.0	0.0
4	90.0	85.0	0.0	0.0	0.0	142.0	134.0	0.0	0.0	0.0
5	100.0	0.0	90.0	0.0	0.0	158.0	0.0	142.0	0.0	0.0
6	90.0	0.0	0.0	75.0	0.0	142.0	0.0	0.0	118.0	0.0
7	100.0	0.0	90.0	80.0	70.0	158.0	0.0	142.0	142.0	111.0
8	88.0	0.0	80.0	68.0	60.0	139.0	0.0	126.0	126.0	95.0
9	70.0	0.0	0.0	50.0	0.0	111.0	0.0	0.0	79.0	0.0
10	75.0	72.5	0.0	0.0	0.0	118.0	115.0	0.0	0.0	0.0
11	70.0	67.5	0.0	0.0	0.0	111.0	107.0	0.0	0.0	0.0
12	70.0	67.5	0.0	0.0	0.0	111.0	107.0	0.0	0.0	0.0
13	65.0	62.5	0.0	0.0	0.0	103.0	99.0	0.0	0.0	0.0
14	65.0	0.0	55.0	0.0	0.0	103.0	0.0	87.0	0.0	0.0
15	65.0	62.5	0.0	0.0	0.0	103.0	99.0	0.0	0.0	0.0
16	55.0	0.0	0.0	0.0	0.0	87.0	0.0	0.0	0.0	0.0
17	0.0	55.0	0.0	0.0	0.0	0.0	87.0	0.0	0.0	0.0
18	0.0	55.0	0.0	0.0	0.0	0.0	87.0	0.0	0.0	0.0
19	0.0	55.0	0.0	0.0	0.0	0.0	87.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table IV.7B - Estimated Corn (Silage) Yields by Soil Resource Groups for Present and Projected Conditions[1/]
Green River Basin

SRG's	PRESENT YIELD: With Adeq. Treat.	PRESENT YIELD: WITHOUT Erosion Treat.	PRESENT YIELD: WITHOUT Flood Control	PRESENT YIELD: WITHOUT Drainage Measures	PRESENT YIELD: WITHOUT Flood & Drainage	PROJECTED YIELD: With Adeq. Treat.	PROJECTED YIELD: WITHOUT Erosion Treat.	PROJECTED YIELD: WITHOUT Flood Control	PROJECTED YIELD: WITHOUT Drainage Measures	PROJECTED YIELD: WITHOUT Flood & Drainage
	(Tons)					(Tons)				
1	23.0	0.0	21.0	21.0	19.0	36.4	0.0	33.2	33.2	30.0
2	20.0	19.0	0.0	0.0	0.0	31.6	30.0	0.0	0.0	0.0
3	18.0	17.0	0.0	0.0	0.0	28.4	26.8	0.0	0.0	0.0
4	18.0	17.0	0.0	0.0	0.0	28.4	26.8	0.0	0.0	0.0
5	20.0	0.0	18.0	0.0	0.0	31.6	0.0	28.4	0.0	0.0
6	18.0	0.0	0.0	15.0	0.0	28.4	0.0	0.0	23.6	0.0
7	20.0	0.0	18.0	18.0	14.0	31.6	0.0	28.4	28.4	22.2
8	17.6	0.0	16.0	16.0	12.0	27.8	0.0	25.2	25.2	19.0
9	14.0	0.0	0.0	10.0	0.0	22.2	0.0	0.0	15.8	0.0
10	15.0	14.5	0.0	0.0	0.0	23.6	23.0	0.0	0.0	0.0
11	14.0	13.5	0.0	0.0	0.0	22.2	21.4	0.0	0.0	0.0
12	14.0	13.5	0.0	0.0	0.0	22.2	21.4	0.0	0.0	0.0
13	13.0	12.5	0.0	0.0	0.0	20.6	19.8	0.0	0.0	0.0
14	13.0	0.0	11.0	0.0	0.0	20.6	0.0	17.4	0.0	0.0
15	13.0	12.5	0.0	0.0	0.0	20.6	19.8	0.0	0.0	0.0
16	11.0	0.0	0.0	0.0	0.0	17.4	0.0	0.0	0.0	0.0
17	0.0	11.0	0.0	0.0	0.0	0.0	17.4	0.0	0.0	0.0
18	0.0	11.0	0.0	0.0	0.0	0.0	17.4	0.0	0.0	0.0
19	0.0	11.0	0.0	0.0	0.0	0.0	17.4	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table IV.7C - Estimated Wheat Yields by Soil Resource Groups for Present and Projected Conditions[1/] Green River Basin

SRG's	PRESENT YIELD: With Adeq. Treat.	PRESENT YIELD: WITHOUT Erosion Treat.	PRESENT YIELD: WITHOUT Flood Control	PRESENT YIELD: WITHOUT Drainage Measures	PRESENT YIELD: WITHOUT Flood & Drainage	PROJECTED YIELD: With Adeq. Treat.	PROJECTED YIELD: WITHOUT Erosion Treat.	PROJECTED YIELD: WITHOUT Flood Control	PROJECTED YIELD: WITHOUT Drainage Measures	PROJECTED YIELD: WITHOUT Flood & Drainage
	(Bushels)					(Bushels)				
1	45.0	0.0	42.0	42.0	38.0	76.0	0.0	71.0	71.0	64.0
2	42.0	40.0	0.0	0.0	0.0	71.0	67.0	0.0	0.0	0.0
3	37.0	35.0	0.0	0.0	0.0	62.0	59.0	0.0	0.0	0.0
4	37.0	35.0	0.0	0.0	0.0	62.0	59.0	0.0	0.0	0.0
5	42.0	0.0	38.0	0.0	0.0	71.0	0.0	64.0	0.0	0.0
6	30.0	0.0	0.0	25.0	0.0	50.0	0.0	0.0	42.0	0.0
7	27.0	0.0	27.0	27.0	20.0	45.0	0.0	45.0	45.0	34.0
8	27.0	0.0	22.0	22.0	15.0	45.0	0.0	37.0	37.0	25.0
9	25.0	0.0	0.0	17.0	0.0	42.0	0.0	0.0	29.0	0.0
10	26.0	25.0	0.0	0.0	0.0	44.0	42.0	0.0	0.0	0.0
11	27.0	26.0	0.0	0.0	0.0	45.0	44.0	0.0	0.0	0.0
12	27.0	26.0	0.0	0.0	0.0	45.0	44.0	0.0	0.0	0.0
13	23.0	22.0	0.0	0.0	0.0	39.0	37.0	0.0	0.0	0.0
14	25.0	0.0	17.0	0.0	0.0	42.0	0.0	29.0	0.0	0.0
15	23.0	22.0	0.0	0.0	0.0	39.0	37.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table IV.7D - Estimated Soybeans Yields by Soil Resource Groups for Present and Projected Conditions[1/] Green River Basin

SRG's	PRESENT YIELD: With Adeq. Treat.	PRESENT YIELD: WITHOUT Erosion Treat.	PRESENT YIELD: WITHOUT Flood Control	PRESENT YIELD: WITHOUT Drainage Measures	PRESENT YIELD: WITHOUT Flood & Drainage	PROJECTED YIELD: With Adeq. Treat.	PROJECTED YIELD: WITHOUT Erosion Treat.	PROJECTED YIELD: WITHOUT Flood Control	PROJECTED YIELD: WITHOUT Drainage Measures	PROJECTED YIELD: WITHOUT Flood & Drainage
	(Bushels)					(Bushels)				
1	40.0	0.0	36.0	36.0	32.0	63.0	0.0	57.0	57.0	51.0
2	38.0	36.0	0.0	0.0	0.0	60.0	57.0	0.0	0.0	0.0
3	34.0	32.0	0.0	0.0	0.0	54.0	51.0	0.0	0.0	0.0
4	34.0	32.0	0.0	0.0	0.0	54.0	51.0	0.0	0.0	0.0
5	38.0	0.0	32.0	0.0	0.0	60.0	0.0	51.0	0.0	0.0
6	32.0	0.0	0.0	26.0	0.0	51.0	0.0	0.0	41.0	0.0
7	35.0	0.0	27.0	27.0	22.0	55.0	0.0	43.0	43.0	35.0
8	35.0	0.0	25.0	25.0	20.0	55.0	0.0	39.0	39.0	32.0
9	28.0	0.0	0.0	20.0	0.0	44.0	0.0	0.0	32.0	0.0
10	25.0	24.0	0.0	0.0	0.0	39.0	38.0	0.0	0.0	0.0
11	25.0	24.0	0.0	0.0	0.0	39.0	38.0	0.0	0.0	0.0
12	24.0	25.0	0.0	0.0	0.0	38.0	39.0	0.0	0.0	0.0
13	21.0	20.0	0.0	0.0	0.0	33.0	32.0	0.0	0.0	0.0
14	20.0	0.0	15.0	0.0	0.0	32.0	0.0	24.0	0.0	0.0
15	21.0	20.0	0.0	0.0	0.0	33.0	32.0	0.0	0.0	0.0
16	25.0	0.0	0.0	17.0	0.0	39.0	0.0	0.0	27.0	0.0
17	0.0	25.0	0.0	0.0	0.0	0.0	39.0	0.0	0.0	0.0
18	0.0	25.0	0.0	0.0	0.0	0.0	39.0	0.0	0.0	0.0
19	0.0	25.0	0.0	0.0	0.0	0.0	39.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table IV.7E - Estimated Oats Yields by Soil Resource Groups for Present and Projected Conditions[1/] Green River Basin

SRG's	PRESENT YIELD: With Adeq. Treat.	PRESENT YIELD: WITHOUT Erosion Treat.	Flood Control	Drainage Measures	Flood & Drainage	PROJECTED YIELD: With Adeq. Treat.	PROJECTED YIELD: WITHOUT Erosion Treat.	Flood Control	Drainage Measures	Flood & Drainage
	(Bushels)					(Bushels)				
1	64.0	0.0	55.0	55.0	49.0	108.0	0.0	92.0	2.0	82.0
2	58.0	56.0	0.0	0.0	0.0	97.0	94.0	0.0	0.0	0.0
3	52.0	50.0	0.0	0.0	0.0	87.0	84.0	0.0	0.0	0.0
4	55.0	52.0	0.0	0.0	0.0	92.0	87.0	0.0	0.0	0.0
5	58.0	0.0	48.0	0.0	0.0	97.0	0.0	81.0	0.0	0.0
6	51.0	0.0	0.0	42.0	0.0	86.0	0.0	0.0	0.0	0.0
7	52.0	0.0	41.0	41.0	39.0	87.0	0.0	69.0	69.0	66.0
8	48.0	0.0	38.0	38.0	30.0	81.0	0.0	64.0	64.0	50.0
9	44.0	0.0	0.0	33.0	0.0	74.0	0.0	0.0	55.0	0.0
10	45.0	43.0	0.0	0.0	0.0	76.0	72.0	0.0	0.0	0.0
11	45.0	43.0	0.0	0.0	0.0	76.0	72.0	0.0	0.0	0.0
12	47.0	45.0	0.0	0.0	0.0	79.0	76.0	0.0	0.0	0.0
13	45.0	43.0	0.0	0 0	0.0	76.0	72.0	0.0	0.0	0.0
14	45.0	0.0	36.0	0.0	0.0	76.0	0.0	60.0	0.0	0.0
15	41.0	40.0	0.0	0.0	0.0	69.0	67.0	0.0	0.0	0.0
16	30.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0
17	0.0	30.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
18	0.0	30.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
19	0.0	30.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table IV.7F - Estimated Hay Yields by Soil Resource Groups for Present and Projected Conditions[1/] Green River Basin

SRG's	PRESENT YIELD: With Adeq. Treat.	PRESENT YIELD: WITHOUT Erosion Treat.	Flood Control	Drainage Measures	Flood & Drainage	PROJECTED YIELD: With Adeq. Treat.	PROJECTED YIELD: WITHOUT Erosion Treat.	Flood Control	Drainage Measures	Flood & Drainage
	(Tons)					(Tons)				
1	3.7	0.0	3.3	3.3	3.0	5.7	0.0	5.1	5.1	4.6
2	3.3	3.3	0.0	0.0	0.0	5.2	5.2	0.0	0.0	0.0
3	2.9	2.9	0.0	0.0	0.0	4.5	4.5	0.0	0.0	0.0
4	2.5	2.5	0.0	0.0	0.0	3.8	3.8	0.0	0.0	0.0
5	3.1	0.0	2.6	0.0	0.0	4.8	0.0	4.0	0.0	0.0
6	2.4	0.0	0.0	1.5	0.0	3.7	0.0	0.0	2.3	0.0
7	2.0	0.0	1.6	1.6	1.3	3.0	0.0	2.5	2.5	2.0
8	1.3	0.0	1.0	1.0	.7	2.0	0.0	1.5	1.5	1.0
9	1.5	0.0	0.0	1.2	0.0	2.3	0.0	0.0	1.8	0.0
10	2.1	2.1	0.0	0.0	0.0	3.2	3.2	0.0	0.0	0.0
11	2.1	2.1	0.0	0.0	0.0	3.2	3.2	0.0	0.0	0.0
12	2.0	2.0	0.0	0.0	0.0	3.1	3.1	0.0	0.0	0.0
13	1.8	1.8	0.0	0.0	0.0	2.8	2.8	0.0	0.0	0.0
14	1.5	0.0	1.2	0.0	0.0	2.3	0.0	1.9	0.0	0.0
15	2.9	2.9	0.0	1.2	0.0	4.5	4.5	0.0	1.9	0.0
16	1.2	0.0	0.0	.8	0.0	1.8	0.0	0.0	1.2	0.0
17	0.0	1.2	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0
18	0.0	1.2	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0
19	0.0	1.2	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table IV.7G - Estimated Cropland Pasture Yields by Soil Resource Groups for Present and Projected Conditions[1/]
Green River Basin

SRG's	PRESENT YIELD: With Adeq. Treat.	PRESENT YIELD: WITHOUT Erosion Treat.	PRESENT YIELD: WITHOUT Flood Control	PRESENT YIELD: WITHOUT Drainage Measures	PRESENT YIELD: WITHOUT Flood & Drainage	PROJECTED YIELD: With Adeq. Treat.	PROJECTED YIELD: WITHOUT Erosion Treat.	PROJECTED YIELD: WITHOUT Flood Control	PROJECTED YIELD: WITHOUT Drainage Measures	PROJECTED YIELD: WITHOUT Flood & Drainage
	(A.U.D.)					(A.U.D.)				
1	212.0	0.0	189.8	189.8	169.9	325.0	0.0	291.0	291.0	262.0
2	190.9	190.9	0.0	0.0	0.0	296.0	296.0	0.0	0.0	0.0
3	164.7	164.7	0.0	0.0	0.0	257.0	257.0	0.0	0.0	0.0
4	141.4	141.4	0.0	0.0	217.0	217.0	217.0	0.0	0.0	0.0
5	176.7	0.0	148.2	0.0	0.0	274.0	0.0	228.0	0.0	0.0
6	138.5	0.0	0.0	83.8	0.0	211.0	0.0	0.0	0.0	0.0
7	111.2	0.0	94.0	94.0	74.1	171.0	0.0	143.0	143.0	114.0
8	73.5	0.0	57.0	57.0	37.6	114.0	0.0	86.0	86.0	57.0
9	85.5	0.0	0.0	68.4	0.0	131.0	0.0	0.0	103.0	0.0
10	118.6	118.6	0.0	0.0	0.0	182.0	182.0	0.0	0.0	0.0
11	118.6	118.6	0.0	0.0	0.0	182.0	182.0	0.0	0.0	0.0
12	116.3	116.3	0.0	0.0	0.0	177.0	177.0	0.0	0.0	0.0
13	103.2	103.2	0.0	0.0	0.0	160.0	160.0	0.0	0.0	0.0
14	86.6	0.0	70.1	0.0	0.0	131.0	0.0	108.0	0.0	0.0
15	164.7	164.7	0.0	70.1	0.0	257.0	257.0	0.0	108.0	0.0
16	68.4	0.0	0.0	45.6	0.0	103.0	0.0	0.0	68.0	0.0
17	0.0	68.4	0.0	0.0	0.0	0.0	103.0	0.0	0.0	0.0
18	0.0	68.4	0.0	0.0	0.0	0.0	103.0	0.0	0.0	0.0
19	0.0	68.4	0.0	0.0	0.0	0.0	103.0	0.0	0.0	0.0
20	0.0	68.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	68.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table IV.7H - Estimated Permanent Pasture Yields by Soil Resource Groups for Present Conditions[1/]
Green River Basin

Soil Resource Groups[2/]	With Adequate Treatment	WITHOUT: Flood Control	WITHOUT: Drainage Measures	WITHOUT: Flood & Drainage	Conservation Treatment Nos.[3/] 2	3	4	5	6
1	230.	210.	210.	190.	190.	147.	137.	105.	95.
2	210.	0.	0.	0.	190.	147.	137.	105.	95.
3	200.	0.	0.	0.	180.	140.	130.	100.	90.
4	200.	0.	0.	0.	180.	140.	130.	100.	90.
5	200.	180.	0.	0.	180.	140.	130.	100.	90.
6	190.	0.	170.	0.	170.	133.	124	95.	85.
7	195.	180.	180.	162.	162.	126.	117.	90.	80.
8	185.	165.	165.	150.	150.	115.	107.	82.	75.
9	165.	0.	150.	0.	150.	115.	107.	82.	75.
10	150.	0.	0.	0.	135.	105.	98.	75.	70.
11	175.	0.	0.	0.	158.	122.	114.	88.	80.
12	150.	0.	0.	0.	135.	105.	98.	75.	70.
13	130.	0.	0.	0.	117.	90.	85.	65.	60.
14	115.	105.	0.	0.	105.	80.	75.	58.	50.
15	115.	0.	0.	0.	105.	80.	75.	58.	50.
16	160.	0.	145.	0.	145.	112.	105.	80.	70.
17	150.	0.	0.	0.	135.	105.	98.	75.	70.
18	115.	0.	0.	0.	105.	80.	75.	58.	50.
19	115.	0.	0.	0.	105.	80.	75.	58.	50.
20	115.	0.	0.	0.	105.	80.	75.	58.	50.
21	115.	0.	0.	0.	105.	80.	75.	58.	50.

Appendix Table IV.7I - Estimated Permanent Pasture Yields by Soil Resource Groups for Projected Conditions[1/] Green River Basin

Soil Resource Groups[2/]	With Adequate Treatment	WITHOUT							
		Flood Control	Drainage Measures	Flood & Drainage	Conservation Treatment Nos.[3/] 2	3	4	5	6
1	354.	323.	323.	296.	293.	226.	211.	162.	146.
2	323.	0.	0.	0.	293.	226.	211.	162.	146.
3	308.	0.	0.	0.	277.	216.	200.	154.	139.
4	308.	0.	0.	0.	277.	216.	200.	154.	139.
5	308.	277.	0.	0.	277.	216.	200.	154.	139.
6	293.	0.	262.	0.	262.	205.	191.	146.	131.
7	300.	277.	277.	249.	249.	194	180.	139.	123.
8	285.	254.	254.	231.	231.	177.	165.	126.	115.
9	254.	0.	231.	0.	231.	177.	165.	126.	115.
10	231.	0.	0.	0.	208.	162.	151.	115.	108.
11	269.	0.	0.	0.	243.	188.	176.	136.	123.
12	231.	0.	0.	0.	208.	162.	151.	115.	108.
13	200.	0.	0.	0.	180.	139.	131.	100.	92.
14	177.	162.	0.	0.	162.	123.	115.	89.	77.
15	177.	0.	0.	0.	162.	123.	115.	89.	77.
16	246.	0.	223.	0.	223.	172.	162.	123.	108.
17	231.	0.	0.	0.	208.	162.	151.	115.	108.
18	177.	0.	0.	0.	162.	123.	115.	89.	77.
19	177.	0.	0.	0.	162.	123.	115.	89.	77.
20.	177.	0.	0.	0.	162.	123.	115.	89.	77.
21	177	0.	0.	0.	162.	123.	115.	89.	77.

Source: Compiled from data in the Soil and Water Conservation Needs Inventories for Kentucky (1970) and Tennessee (1971); Kentucky Agricultural Statistics, Kentucky Crop and Livestock Reporting Service, Louisville, Kentucky; Production Potentials for Kentucky Agriculture, University of Kentucky Cooperative Extension Service, Lexington, Kentucky; and other information on yields from Soil Conservation Service files and University of Kentucky records.

1/ The estimated yields are completed to represent present (1973) and projected (2000) conditions and are for (a) land adequately treated for soil and water conservation, and (b) land needing treatment measures to reduce erosion; floodwater and/or drainage problems.

2/ Refer to Appendix Tables II.1 for data on the soil resource groups.

3/ Conservation treatment practice number TN-2 refers to pastureland needing protection from overgrazing; TN-3 refers to pastureland needing improvement of plant cover; TN-4 refers to pastureland needing brush control and improvement of plant cover; TN-5 refers to pastureland needing re-establishment of vegetative cover; and TN-6 refers to pastureland needing re-establishment of vegetative cover with brush control.

Appendix Table VI.1 - Present Forest Land and Projected Acreage Available with the Various Plans, Year 2000

Green River Basin

Present and Projected Forest Land	Forest Acreage for Studied Alternatives		
	Going Program	Economic	Environmental
	Acres		
Forest Acreage - 1970	2,015,150	2,015,150	2,015,150
Clearing for:			
Strip mine	58,700	58,700	58,700
Urban	10,000	10,000	10,000
Water[1/]	4,000	5,200	6,700
Planting for:			
Strip mine areas	95,830	106,270	119,310
Gullied areas	6,000	24,200	24,200
Sheet erosion areas	0	110,000	110,000
Open areas	0	65,100	65,100
Forest Acreage - 2000	2,044,280	2,246,820	2,258,360
Forest land used for:			
Recreation and wildlife areas	66,950	67,350	67,450
Timber production[2/]	1,890,770	1,926,240	1,926,600

Source: U.S. Forest Service.

1/ Includes recreation and municipal water.
2/ Total forest 2000 minus recreation and wildlife areas and 85 percent of the strip mine and gullied areas.

Appendix Table VI.2 - Annual Timber Growth and Product Yield Under Studied Alternatives for Selected Years.

Green River Basin

Year	Annual Growth and Product Yield for Studied Alternatives					
	Going Program[1/]		Economic[2/]		Environmental[2/]	
	Annual Growth	Product[3/] Yield	Annual Growth	Product[3/] Yield	Annual Growth	Product[3/] Yield
	Cubic Feet Per Acre					
1980	32.7	20.2	36.9	22.9	33.5	20.8
2000	34.2	29.1	41.8	35.5	36.9	31.4
2020	36.0	34.2	47.7	45.3	41.8	39.7

Source: U.S. Forest Service.

1/ Current level of management.
2/ High level of management.
3/ Product yield - the growth available for products is a percentage of the net annual growth: 1980 - 70%; 2000 - 85%; 2020 - 95%.

Appendix Table VI.3 - Forest Management Plans or Practices for Studied Alternatives, Year 2000

Green River Basin

Forestry management plans or practices	Forestry acreage for studied development alternatives		
	Going Program	Economic	Environmental
	----------Acres----------		
Forest management plans	737,000	1,072,000	1,072,000
Critical area stabilization			
Strip mine	95,830	106,270	119,310
Gullied and sheet erosion areas	6,000	134,200	134,200
Logging roads and skid trails	308,690	326,070	319,030
Grazing control	28,000	80,600	120,900
Tree planting	58,800	122,400	101,800
Timber stand improvement			
Hardwood release	5,000	325,000	119,000
Improvement cut	53,000	89,000	89,000

Source: U.S. Forest Service.

1/ Tree plantings are old fields and other open areas.

Appendix Table VI.4 - Timber Product Demand, Supply and Need, under the Going Program and Economic and Environmental Alternative, Year 2000.

Green River Basin

	Timber product	Demand 1/	Supply	Need	
				Satisfied	Unsatisfied
		----------Million Cubic Feet----------			
Going program	Veneer	15.3	1.5	-	13.8
	Saw logs	54.9	23.2	-	31.7
	Pulpwood	9.0	15.4	6.4	-
	Other	2.8	14.7	11.9	-
Total		82.0	54.8	18.3	45.5
Total unsatisfied need					27.2
Economic	Veneer	15.3	3.2	-	12.1
	Saw logs	54.9	52.2	-	2.7
	Pulpwood	9.0	6.8	-	2.2
	Other	2.8	4.6	1.8	-
Total		82.0	66.8	1.8	17.0
Total unsatisfied need					15.2
Environmental	Veneer	15.3	2.8	-	12.5
	Saw logs	54.9	46.2	-	8.7
	Pulpwood	9.0	6.0	-	3.0
	Other	2.8	4.1	1.3	-
Total		82.0	59.1	1.3	24.2
Total unsatisfied need					22.9

Source: U.S. Forest Service

1/ OBERS Table 4.9

Appendix Table VI.5 - Potential Water Reservoir Sites to Meet Projected Needs

Green River Basin

Delineated Watershed Identification			Drainage Area	Storage Capacity (Acre Feet)				Water Surface Area (Acres)		Cost[2] (Dollars)	
CNI Number	Site No.	Name	(Sq.Mi.)	Sediment	Beneficial[1]	Flood-water	Total	Permanent	Flood-water	Per Acre Ft. Storage	Per Acre Surface Area
16-1	6	Upper Green River	63.77	1,714	58,534	12,418	72,666	2,008	2,572	34	988
	7	Upper Green River	13.73	376	9,519	2,663	12,558	412	501	81	8,489
	8	Upper Green River	10.91	293	6,369	2,114	8,736	268	354	229	7,480
	9	Upper Green River	22.19	543	15,384	4,861	20,758	752	969	94	2,606
	10	Upper Green River	23.56	625	16,335	3,935	20,895	620	770	80	2,570
	11	Upper Green River	6.72	180	4,660	1,190	6,030	200	250	110	3,340
	12	Upper Green River	1.64	45	1,135	250	1,430	50	60	200	5,760
	13	Upper Green River	3.83	90	1,945	700	2,735	100	135	160	4,250
	14	Upper Green River	8.35	225	5,790	1,275	7,290	260	310	105	2,960
	15	Upper Green River	7.49	200	4,095	1,330	5,625	220	300	100	2,530
	16	Upper Green River	3.26	90	2,260	450	2,800	130	155	350	7,400
	17	Upper Green River	40.63	1,075	12,065	6,885	20,025	650	920	60	1,730
	18	Upper Green River	4.75	125	3,295	680	4,100	190	220	150	3,215
	19	Upper Green River	5.81	155	3,975	1,055	5,185	160	200	120	3,930
16-15	1	Bacon Creek	27.62	705	3,270	4,420	8,395	350	710	90	2,120
16-18	1	Bear Creek	6.40	425	4,780	1,240	6,445	180	220	65	2,300
	2	Bear Creek	17.38	1,160	12,980	3,360	17,500	630	760	45	1,230
16A-2	1	E. Fork Barren R.	9.04	385	5,785	1,990	8,160	300	385	55	1,450
	2	E. Fork Barren R.	24.64	1,050	6,570	5,435	13,055	440	680	60	1,815
16A-4	1	Indian Creek	18.34	980	3,910	4,050	8,940	275	415	45	1,430
16A-5	1	Puncheon Creek	12.68	540	4,060	2,550	7,160	230	310	60	1,850
	2	Puncheon Creek	3.85	165	2,875	755	3,795	125	155	105	3,080
16A-6	1	Hungry Creek	5.40	290	3,165	1,060	4,515	125	150	80	3,000
	2	Pinchqut Creek	4.61	245	1,970	935	3,150	70	85	80	3,630
16A-7	1	Long Creek	5.82	250	1,800	1,140	3,190	80	115	110	4,210
	2	Long Creek	4.20	180	3,320	810	4,310	120	140	65	2,250
	3	Long Creek	5.77	245	2,604	1,130	3,980	90	125	80	3,450
	4	Long Creek	2.67	115	1,400	520	2,035	60	75	150	5,430
16A-8	1	Peter Creek	8.18	285	2,650	1,315	4,250	180	265	165	3,900
	2	Peter Creek	1.95	95	980	310	1,385	60	75	255	6,060
	3	Peter Creek	15.90	490	2,860	2,580	5,930	230	410	100	2,580
	4	Peter Creek	33.59	1,000	8,730	5,410	15,140	570	910	60	1,500
	5	Peter Creek	4.16	200	2,460	560	3,220	160	190	110	2,270
	6	Peter Creek	2.46	120	1,705	390	2,215	110	140	165	3,450

Appendix Table VI.5 - Potential Water Reservoir Sites to Meet Projected Needs (cont.)

Green River Basin

Delineated Watershed Identification			Drainage Area	Storage Capacity (Acre Feet)				Water Surface Area (Acres)		Cost 2/ (Dollars)	
CNI Number	Site No.	Name	(Sq.Mi.)	Sediment	Beneficial 1/	Flood-water	Total	Permanent	Flood-water	Per Acre Ft. Storage	Per Acre Surface Area
16A-9	1	Skaggs Creek	3.51	170	2,435	560	3,165	130	150	75	1,800
	2	Skaggs Creek	8.18	395	1,310	5,670	7,375	300	350	75	1,815
	3	Skaggs Creek	11.78	565	8,170	1,885	10,620	535	635	75	1,500
	4	Skaggs Creek	6.02	290	2,560	965	3,815	205	295	150	2,830
	6	Skaggs Creek	6.93	335	1,110	1,110	2,555	100	155	132	3,400
	8	Skaggs Creek	10.91	295	6,330	2,115	8,740	785	1,085	55	1,310
	10	Skaggs Creek	2.94	140	2,040	470	2,650	120	140	110	2,330
16A-13	1	Bays Fork	17.48	1,025	3,050	4,040	8,115	1,245	1,650	30	400
	2	Bays Fork	21.08	1,125	4,500	4,230	9,855	300	430	30	1,040
16A-17	1	M. F. Drakes Creek	14.61	780	8,570	2,930	12,230	420	500	50	1,430
16A-18	2	Trammel Fork	1.51	145	1,045	175	1,365	50	60	205	5,400
	11	Trammel Fork	11.77	745	8,160	2,095	11,000	320	415	80	2,680
	12	Trammel Fork	1.28	125	890	220	1,235	55	70	220	5,080
	16	Trammel Fork	5.40	435	970	755	2,160	90	145	140	3,335
	17	Trammel Fork	1.72	165	1,190	205	1,560	60	65	165	4,590
16B-2	1	Rock Lick Creek	19.68	840	3,150	3,825	7,815	250	400	115	3,660
16B-6	1	Adams Fork	2.96	180	1,580	570	2,330	105	140	115	2,590
16B-7	1	Halls Creek	3.39	270	2,530	660	3,460	165	210	75	1,615
16B-9	1	Muddy Creek	3.64	290	2,720	705	3,715	215	250	50	915
16B-10	1	Barnetts Creek	2.34	125	1,420	480	2,025	180	220	95	1,045
	2	Barnetts Creek	5.31	285	2,550	1,025	3,860	275	350	55	750
16B-118	1	Little Clifty Creek	2.81	190	1,800	545	2,535	90	105	75	2,100
16B-119	1	Hoover Creek	8.27	550	5,260	1,610	7,420	235	295	55	1,700
16B-121	1	Mays Run	12.13	520	3,235	2,710	6,465	335	550	95	1,820
16B-122	1	Clear Prong	4.37	185	1,630	850	4,165	100	150	85	2,210
16B-123	1	Long Lick	3.77	160	430	740	1,330	65	115	100	2,200
16B-125	1	Wolf Pen	1.40	85	1,045	270	1,400	90	100	115	1,790

Source: Soil Conservation Service.

1/ Recommended maximum storage for beneficial uses such as municipal, industrial and rural water supplies, recreation, water quality, irrigation, etc.

2/ Price base 1970.

Appendix Table VI.6 - Projected Forest Employment and Income for Studied Alternative Developments for Year 2000

Green River Basin

Source of Forest Employment	Unit	Projected Employment Under Alternatives		
		Going Program	Economic	Environmental
Land treatment practices and technical assistance				
a. Number	man-years	2,605	5,024	4,549
b. Income	million dollars	28.0	38.4	35.2
Forest management, protection, and industries				
a. Number	man-years	2,665	3,235	2,853
b. Income	million dollars	22.8	27.7	24.4
Total				
a. Number	man-years	5,270	8,259	7,402
b. Income	million dollars	50.8	66.1	59.6

Source: U.S. Forest Service.

Appendix Table VI.7 - Additional Forest Land Needed to Satisfy Timber Production Needs for Studied Alternatives Year 2000

Green River Basin

Development Alternative	Additional Forest Land Needed
	-Acres-
Going program	927,000
Economic	384,000
Environmental	685,000

Appendix Table VI.8 - Estimated Average Annual Gross Erosion and Sediment Yield by Conditions for Studied Alternatives, Year 2000

Green River Basin

Forest Condition and Problem	Erosion or Sediment Production for Studied Alternatives			
	Going Program		Economic	Environmental
	Without Treatment	With Treatment[2/]	With Treatment[2/]	With Treatment[2/]
	-Tons per year-			
Erosion				
Natural	1,308,300	1,308,300	1,437,600	1,445,400
Disturbed[1/]	3,098,700	1,744,800	1,631,200	1,446,000
Total	4,407,000	3,053,100	3,068,800	2,891,400
Sediment				
Natural	6,130	6,130	6,740	6,780
Disturbed[1/]	363,890	130,650	106,040	84,370
Total	370,020	136,780	112,780	91,150

1/ Includes logging areas, skid trails, spur roads, and grazing.
2/ Treatment of skid trails, spur roads, and grazing expected to be done under the Federal Water Pollution Control Act Amendments of 1972.

Appendix Table VI.9 - Estimated Forestry Practice Cost for Studied Development Alternatives, Year 2000

Green River Basin

Forestry	Forestry Practice Cost for Studied Alternatives		
	Going Program	Economic	Environmental
	Million dollars[2/]		
Tree planting			
Strip mines	13.9	15.4	17.3
Gullied areas	1.9	10.9	10.9
Other (old fields)	1.2	2.4	2.0
Timber stand improvement	0.2	7.6	2.8
Grazing exclusion[1/]	0.5	1.4	2.0
Logging roads and skid trails[1/]	47.8	50.4	49.4
Technical assistance	1.9	4.3	3.5
Total	67.4	92.4	87.9

1/ Treatment under the Federal Water Pollution Control Act Amendments of 1972.
2/ Price base 1970.

Appendix Table VI.10 - Forestry Impacts - Going Program

Green River Basin

	Unit	Total Impacts
Impacts for the period 1970 to 2000		
Forest land cleared for:		
Strip mine	Acres	58,700
Urban	Acres	10,000
Water	Acres	4,000
Forest land development for:		
Recreation areas	Acres	600
Timber growth foregone -		
Forest land cleared and	Cubic feet	2,400,000
recreation areas	Dollars	140,000
Tree planting for:		
Strip mine	Acres	95,830
Gullied	Acres	6,000
Sheet erosion areas	Acres	0
Open areas	Acres	0
Old fields	Acres	58,800
Forest employment & income for:		
Forest practices installation	Man-years	2,605
and technical assistance	Dollars	28,000,000
Impacts for the year 2000		
Timber production for:		
Products from 1,890,770 acres	Cubic feet	54,800,000
of commercial forest land	Dollars	7,300,000
Forest management, protection,	Man-years	2,665
and industry	Dollars	22,800,000
Forest land with treatment -		
Gross erosion reduction	Tons/Yr	1,353,900 1/
	Percent	31
Sediment	Tons/Yr	233,240 1/
	Percent	63

Source: U.S. Forest Service.

1/ Difference between no treatment and with treatment - going program, see Appendix table VI-7.

Appendix Table VI.11 - Forestry Impacts - Economic Development Alternative

Green River Basin

	Unit	Total Impacts	Accelerated Impacts
Impacts for the period 1970 to 2000			
Forest land cleared for:			
Strip mine	Acres	58,700	0
Urban	Acres	10,000	0
Water	Acres	5,200	1,200
Forest land development for:			
Recreation areas	Acres	1,000	400
Timber growth foregone -			
Forest land cleared and	Cubic feet	2,750,000	350,000
recreation areas	Dollars	165,000	25,000
Tree planting for:			
Strip mine	Acres	106,270	10,440
Gullied	Acres	24,200	12,200
Sheet erosion areas	Acres	110,000	110,000
Open areas	Acres	65,100	64,100
Old fields	Acres	57,300	500 2/
Forest employment & income for:			
Forest practices installation	Man-years	5,024	2,419
and technical assistance	Dollars	38,400,000	10,400,000
Impacts for the year 2000			
Timber production for:			
Products from 1,926,240 acres	Cubic feet	66,800,000	12,000,000
of commercial forest land	Dollars	14,800,000	7,500,000
Forest management, protection,	Man-years	3,235	570
and industry	Dollars	27,700,000	4,900,000
Forest land with treatment -			
Gross erosion reduction	Tons/Yr	1,338,200 1/	15,700 2/ 3/
	Percent	30	0.5 2/
Sediment	Tons/Yr	257,240 1/	24,000 3/
	Percent	69	18

Source: U.S. Forest Service.

1/ Difference between no treatment - going program and with treatment - economic development, see Appendix table VI-7.

2/ Less than going program.

3/ Difference between with treatment - going program and with treatment - economic development, see Appendix table VI-7.

Appendix Table VI.12 - Forestry Impacts - Environmental Development Alternative

Green River Basin

	Unit	Total Impacts	Accelerated Impacts
Impacts for the period 1970 to 2000			
Forest land cleared for:			
Strip mine	Acres	58,700	0
Urban	Acres	10,000	0
Water	Acres	6,700	2,700
Forest land development for:			
Recreation areas	Acres	1,100	500
Timber growth foregone -			
Forest land cleared and	Cubic feet	2,600,000	200,000
recreation areas	Dollars	156,000	16,000
Tree planting for:			
Strip mine	Acres	119,310	23,480
Gullied	Acres	24,200	18,200
Sheet erosion areas	Acres	110,000	110,000
Open areas	Acres	65,100	65,100
Old fields	Acres	36,700	22,100 2/
Forest employment & income for:			
Forest practices installation	Man-years	4,549	1,944
and technical assistance	Dollars	35,200,000	7,200,000
Impacts for the year 2000			
Timber production for:			
Products from 1,926,600 acres	Cubic feet	59,100,000	4,300,000
of commercial forest land	Dollars	13,100,000	5,800,000
Forest management, protection,	Man-years	2,853	183
and industry	Dollars	24,400,000	1,600,000
Forest land with treatment -			
Gross erosion reduction	Tons/Yr	1,495,600 1/	141,700 3/
	Percent	34	5
Sediment	Tons/Yr	278,870 1/	45,630 3/
	Percent	75	33

Source: U.S. Forest Service

1/ Difference between no treatment - going program and with treatment - environmental development, see Appendix table VI-7.

2/ Less than going program.

3/ Difference between with treatment - going program and with treatment - environmental development, see Appendix table VI-7.

Appendix Table VI.13 - Display of Economic Development Alternative
Economic Development Account

Components	Effects (Dollars)[1]
Beneficial effects:[2]	
I. Value of increased output of goods and services to users	
A. Flood prevention	
1. Damage reduction	144,800
2. Land enhancement	111,900
B. Impaired drainage	2,565,000
C. Water supply	
1. Urban (M&I)	254,450
2. Agricultural	60,000
D. Recreation	
1. Fish & wildlife	287,500
2. Water-based	470,000
3. Land-based	433,500
E. Additional wages and salaries accruing to region from implementation of plan through	
1. Utilization of hired labor	
a. Farm sectors	153,300[3]
b. Forest sectors	194,100
c. Recreation sectors	119,000
d. Water supply	166,500
2. Project O&M	84,000
Total	4,944,100
Net	2,708,000
II. Value of output resulting from external economies	
A. Indirect and incidental activities	
1. Flood prevention	51,300
2. Impaired drainage	128,000
3. Water supplies	87,50
4. Recreation	
a. Fish and wildlife	29,000
b. Water-based	47,000
c. Land-based	44,000
Total	386,800
Net	336,800

Components	Effects (Dollars)[1]
Adverse effects:[2]	
I. Value of resources required to achieve outputs	
A. Flood prevention cost	243,200
O&M	10,200
B. Impaired drainage cost	455,200
O&M	17,000
C. Water supply cost	
1. M&I water	210,000
O&M	11,500
2. Agricultural water	51,000
O&M	6,000
D. Recreation	
1. Fish & wildlife	162,000
O&M	27,000
2. Water-based	297,000
O&M	48,000
3. Land-based	306,000
O&M	32,000
E. Wages and salaries lost to region from implementation of plan through	
1. Reduction of hired labor used in	
a. Farm sectors	360,000[4]
b. Forest sectors	0
c. Recreation	0
d. Water supply	0
2. Project O&M	0
	2,236,100
II. Losses in output from external diseconomies	
A. Indirect and incidental activities associated with project development	
1. Flood prevention	4,000
2. Impaired drainage	11,000
3. Water supplies	14,000
4. Recreation	
a. Fish and Wildlife	4,000
b. Water-based	9,000
c. Land-based	8,000
	50,000

Appendix Table VI.13 - Display of Economic Development Alternative (Continued)
Economic Development Account

Components	Effects (Dollars)[1/]	Components	Effects (Dollars)[1/]
Beneficial effects:		Adverse effects:	
III. Employment (No. Man-Years)		III. Employment (No. Man-Years)	
A. Increase in number and type of jobs		A. Decrease in number and type of jobs	
1. Agricultural	56	1. Agricultural	60
2. Forestry	290	2. Forestry	0
3. Recreation	45	3. Recreation	3
4. Water resource projects	24	4. Water resource projects	7
5. Project O&M	15	5. Project O&M	0
Total	430		70
Net	360		
IV. Other[5/]			

1/ Average annual basis and amortization rate is 5.625 percent.

2/ The average annual beneficial and adverse effects are over and above those expected under the going program which is without any new or accelerated water or land resource developments. The identified effects exclude benefits, costs, and employment gains or losses accreditable to the land treatment, stabilization, and reclamation measures proposed for this alternative.

3/ Includes wages and salaries projected to accrue primarily to suppliers of farm production items and to businesses involved in processing and marketing agricultural produce.

4/ Includes a reduction in wages and salaries of hired farm workers displaced by improved efficiencies in agricultural production.

5/ Other includes the increased average annual benefits and costs resulting from projected application of land treatment measures and the value and cost of the increased output accreditable to improved production methods applied under this alternative. The estimated average annual land treatment benefits and costs include:

a. Agricultural land treatment benefits of $1,680,000 and costs of $400,000;
b. Benefits of $1,281,000 and costs of $2,436,000 for reclaiming, stabilizing, and treating present and projected strip-mined lands; and
c. Benefits of $251,000 and costs of $208,000 for stabilizing roadbanks, streambanks, gullies, and other critical areas not included in the above agricultural and strip-mined lands and in forest areas.

The increased timber production value resulting from application of forestry land treatment, stabilization, and management measures amount to about $7,500,000 and costs to about $1,300,000. The total value of agricultural production under this alternative would be less than that under the going program but improved production efficiencies would increase annual farm income by about $2,000,000, with a $300,000 increase in production costs.

Appendix Table VI.14 - Display of Economic Development Alternative

Components	Measure of Effects
Benefits and Adverse Effects	
A. Areas of natural beauty	1. Intensify the application of land treatment and reclamation measures to improve appearance of 43,700 acres of surface-mined land and 127,850 acres projected to be mined by the year 2000.
	2. Install water storage reservoirs to provide for about 5,000 additional acres of water in the area.
	3. Establish vegetation on an additional 310 miles of eroding roadbanks and 170 miles of streambanks.
	4. Establish vegetation on 18,200 acres affected by gullies.
	5. Require 8,700 additional acres of agricultural and forest land for reservoir and pond areas.
	6. Disturb the tranquility of a rural environment by providing for 1.5 million additional recreational visitor-days.
B. Quality consideration of water, land, and air resources	1. Reduce the per acre rate of erosion from an average 7.6 to 3.0 tons or less on about 500,000 acres of agricultural land.
	2. Decrease erosion by approximately 45 percent above the going program to improve the quality of 43,700 acres of surface-mined land and 127,850 acres projected to be mined by the year 2000.
	3. Reduce flooding frequency on an additional 30,000 acres.
	4. Decrease infertile deposition on approximately 14,000 acres.
	5. Decrease total erosion on forest lands by about 0.5 percent or 15,700 tons per year.
	6. Reduce total sediment yield on forest lands by about 18 percent.
	7. Provide additional water supplies to serve the equivalent of 198,000 people.
	8. Provide agricultural drainage on an additional 97,000 acres.
	9. Construct an additional 3,400 farm ponds for agricultural water.
	10. Convert approximately 1,700 acres of agricultural and forest land to recreational use.
	11. Convert 173,600 acres of old fields and open areas to forest land, thereby reducing erosion.
	12. Improve timber stand on an additional 356,000 acres of forest land.

Appendix Table VI.14 - Display of Economic
Development Alternative (Continued)
Environmental Quality Account

Components		Measure of Effects
Benefits and Adverse Effects		
B. Continued	13.	Control livestock grazing on 52,600 acres of forest land.
	14.	Install 190 additional livestock waste disposal systems to reduce pollution.
C. Biological resources and selected ecosystems	1.	Provide about 5,000 additional acres of water for fish and wildlife use.
	2.	Establish or improve vegetation on 43,700 acres of surface-mined land and 127,850 acres projected to be surface mined by the year 2000, thereby improving wildlife habitat.
	3.	Improve wildlife habitat by establishing vegetation on an additional 170 miles of streambanks and 310 miles of roadbanks.
	4.	Reduce the quantity of sediment, pesticides, and related pollutants entering streams.
	5.	Provide an additional 400 acres of forest lands for recreation and wildlife uses.
	6.	Revegetate 17,380 acres of abandoned spur roads and skid trails in forest areas and improve wildlife habitat.
	7.	Disturb biological ecosystems by modifying 8 miles of stream channel.
D. Irreversible or irretrievable commitment of resources	1.	Require about 8,700 additional acres included in farm ponds and reservoir areas.
	2.	Require commitment of capital and labor resources to implement this alternative.

Appendix Table VI.15 - Display of
Economic Development
Social Well-Being Account

Components	Measure of Effects
Benefits and Adverse Effects	
A. Life, health and safety	1. Provide an improved quality of water to serve the equivalent of 198,000 people.
	2. Reduce the flooding frequency on approximately 30,000 additional acres of agricultural land in four communities.
	3. Prevent swamping and development of mosquito habitat on about 7,000 acres.
	4. Decrease pollution caused by runoff transporting and depositing sediment, pesticides, and related pollutants in streams and on lands.
	5. Decrease acid water problems caused by runoff and drainage on present and projected surface-mined lands.
	6. Continue flooding on 280,000 acres of flood-prone lands.
B. Recreational and wildlife development	1. Reduce potential waterfowl habitat by preventing swamping on some 7,000 acres.
	2. Establish and improve vegetation on 175,000 acres to improve upland game habitat.
	3. Provide opportunity for about 1.5 million additional recreational visitor-days, including 296,000 fisherman-days.
	4. Provide opportunities for 296,000 additional fisherman-days by constructing additional reservoirs and improving management of existing ponds and streams.
C. Employment opportunities	1. Provide for increased efficiencies in agricultural production by increasing productivity of labor, land, and related resources to reduce the number of farm workers required by about 300 and increase farm income by about $2,000,000.
	2. Provide about 360 additional man-years of employment annually.
	3. Provide opportunities for increased business to an additional million recreational visitors, resulting in added employment as well as sales.
D. Other	1. Provide basis for utilizing agricultural land more in accordance with its inherent capability.

Appendix Table VI.16 - Display of
Environmental Quality Alternative
Economic Development Account

Components	Effects (Dollars)[1]	Components	Effects (Dollars)[1]
Beneficial effects:[2]		Adverse effects:[2]	
I. Value of increased output of goods and services to users		I. Value of resources required to achieve outputs	
A. Flood prevention		A. Flood prevention cost	270,000
1. Damage reduction	165,800	O&M	12,400
2. Land enhancement	130,200		
B. Impaired drainage	0	B. Impaired drainage cost	0
		O&M	0
C. Water supply		C. Water supply cost	
1. Urban (M&I)	341,000	1. M&I water	290,000
2. Agricultural	117,000	O&M	18,200
		2. Agricultural water	99,000
		O&M	12,000
D. Recreation		D. Recreation cost	
1. Fish & wildlife	435,000	1. Fish & wildlife	244,000
2. Water-based	866,000	O&M	43,000
3. Land-based	928,000	2. Water-based	545,000
		O&M	90,000
		3. Land-based	630,000
		O&M	130,000
E. Additional wages and salaries accruing to region from implementation of plan through		E. Wages and salaries lost to region from implementation of plan through	
1. Utilization of hired labor		1. Reduction of hired labor used in	
a. Farm sectors	18,200[3]	a. Farm sectors	102,000[4]
b. Forest sectors	73,000	b. Forest sectors	0
c. Recreation sectors	223,000	c. Recreation sectors	
d. Water supply	91,000	d. Water supply	0
2. Project O&M	122,000	2. Project O&M	0
Total	3,510,200		2,485,600
Net	1,024,600		
II. Value of output resulting from external economics		II. Losses in output from external diseconomies	
A. Indirect and incidental activities		A. Indirect and incidental activities associated with project development	
1. Flood prevention	57,300	1. Flood prevention	6,500
2. Impaired drainage	0	2. Impaired drainage	0
3. Water supplies	114,000	3. Water supplies	17,000
4. Recreation		4. Recreation	
a. Fish & wildlife	43,000	a. Fish & wildlife	5,000
b. Water-based	87,000	b. Water-based	11,000
c. Land-based	93,000	c. Land-based	13,000
Total	394,300		52,500
Net	341,800		

Appendix Table VI.16 - Display of Environmental Quality Alternative (Continued)
Economic Development Account

Components	Effects (Dollars)[1]	Components	Effects (Dollars)[1]
Beneficial effects:[2]		Adverse effects:[2]	
III. Employment (No. Man-Years)		III. Employment (No. Man-Years)	
A. Increase in number and type of jobs		A. Decrease in number and type of jobs	
1. Agricultural	56	1. Agricultural	47
2. Forestry	65	2. Forestry	0
3. Recreation	55	3. Recreation	5
4. Water resource projects	30	4. Water resource projects	8
5. Project O&M	22	5. Project O&M	0
Total	188		60
Net	430		
IV. Other[5]			

1/ Average annual basis and authorization rate is 5.625 percent.
2/ The beneficial and adverse effects are over and above those expected under the going program which is without any new or accelerated water or land resource developments. The identified effects exclude benefits, costs, and employment gains or losses accreditable to land treatment, stabilization, and reclamation measures proposed for this alternative.
3/ Includes wages and salaries projected to accrue primarily to suppliers of farm production items and to businesses involved in processing and marketing agricultural produce.
4/ Includes a reduction in wages and salaries of hired farm workers displaced.
5/ Other includes the increased average annual benefits and costs resulting from projected application of land treatment measures and the value and cost of the increased output accreditable to improved production methods applied under this alternative. The estimated average annual land treatment benefits and costs include:
a. Agricultural land treatment benefits of $3,300,000 and costs of $1,000,000
b. Benefits of $2,613,000 and costs of $3,810,000 for reclaiming, stabilizing, and treating present and projected strip-mined lands; and
c. Benefits of $583,000 and costs of $491,000 for stabilizing roadbanks, streambanks, gullies, and other critical areas not included in the above agricultural and strip-mined lands and in forest areas.
The increased timber production value resulting from application of forestry land treatment, stabilization, and management measures amounts to about $5,800,000 and costs to about $1,100,000. The value of efficiencies gained by employing improved production technology would be more than offset by the loss incurred from using land and related resources to minimize environmental problems. Hence, the total value of agricultural production would be less and production costs more than those under the going program and the economic development alternative.

Appendix Table VI.17 - Display of
Environmental Quality Alternative
Environmental Quality Account

Components	Measure of Effects
Benefits and Adverse Effects	
A. Areas of natural beauty	1. Intensify the application of land treatment and reclamation measures to improve the quality of vegetation on 43,700 acres of surface-mined land and 127,850 acres projected to be surface mined by the year 2000.
	2. Install reservoirs and farm ponds to make available an additional 7,250 acres of water.
	3. Establish vegetation on an additional 950 miles of roadbanks and 440 miles of streambanks.
	4. Revegetate and control erosion on 18,200 acres affected by gullies.
	5. Require about 12,200 additional acres of cropland, pastureland, and forest land for reservoir and pond areas.
	6. Disturb the tranquility of a rural environment by providing for an additional 2.8 million recreational visitor-days.
B. Quality consideration of water, land, and air resources	1. Reduce the per acre rate of erosion from an average of 7.6 to 3.0 tons or less on approximately 1,000,000 additional acres of agricultural land.
	2. Decrease erosion by about 70 percent above the going program on 43,700 acres of surface-mined land and 127,850 acres projected to be mined by the year 2000.
	3. Reduce flooding frequency on an additional 37,000 acres.
	4. Decrease infertile deposition on approximately 23,000 acres.
	5. Reduce total erosion on forest lands by about 141,700 tons, or almost 5 percent.
	6. Reduce total sediment yield from forest lands by 45,630 tons per year, or 33 percent.
	7. Provide additional water supplies to serve the equivalent of approximately 300,000 people.
	8. Construct an additional 16,000 farm ponds for agricultural water.
	9. Convert approximately 2,300 acres of agricultural and forest lands to recreational use.
	10. Convert an additional 153,000 acres of old fields and open areas to forest land to reduce erosion.
	11. Improve the qualities of 335,000 acres of forest land.
	12. Reduce grazing damages on 92,900 acres of forest land.
	13. Revegetate 18,200 acres affected by gullies.
	14. Install 190 additional livestock waste disposal systems to reduce pollution.

Appendix Table VI.17 - Display of Environmental Quality Alternative (Continued)
Environmental Quality Account

Components	Measure of Effects
Benefits and Adverse Effects	
C. Biological resource and selected ecosystems	1. Make available about 7,250 additional acres of water for fish and wildlife use.
	2. Restore and improve wildlife habitat on 43,700 acres of surface-mined land and 127,850 acres projected to be mined by the year 2000.
	3. Reduce the quantity of sediment, pesticides, and related pollutants entering streams.
	4. Improve wildlife habitat on 440 miles of streambanks and 950 miles of roadbanks.
	5. Improve wildlife habitat on 10,340 acres of logging spur roads and skid trails.
	6. Disturb biological systems by modifying 8 miles of stream channel.
D. Irreversible or irretrievable commitments	1. Convert about 12,200 additional acres of agricultural and forest lands to water areas.
	2. Require commitment of capital and labor resources to implement this alternative.

Appendix Table VI.18 - Display of
Environmental Quality Alternative
Social Well-Being Account

Components		Measure of Effects
Benefits and Adverse Effects		
A. Life, health and safety	1.	Provide an improved quality of water to serve the equivalent of 300,000 people.
	2.	Reduce the flooding frequency on approximately 37,000 acres of agricultural land and four communities.
	3.	Prevent future swamping and development of mosquito habitat on about 11,000 acres.
	4.	Reduce acid water problems in streams or reservoirs caused by erosion and drainage on present and projected surface-mined lands.
	5.	Continue to flood 273,000 acres of flood-prone lands.
B. Recreational and wildlife development	1.	Provide on additional 175,100 acres of upland forest game habitat.
	2.	Provide opportunities for 2.8 million visitor-days of recreation, including 458,000 fisherman-days.
	3.	Reduce potential waterfowl habitat by decreasing swamping on 11,000 acres.
C. Employment opportunities	1.	Provide about 154 additional man-years of employment annually.
	2.	Provide opportunities for an increase in business activity from the additional water supplies, recreational facilities, and land reclamation measures.
D. Other	1.	Provide basis for utilizing agricultural land more in accordance with its inherent capability.
	2.	Maintain and conserve the productive base to provide a wider range of future resource uses.

Appendix Table VII.1 - Forest Management Plans or Practices for the Going Program and Recommended Alternative, Year 2000

Green River Basin

Forest Management Plans or Practices[1/]	Forestry Acreage	
	Going Program	Recommended
	-Acres-	
Forest management plans	737,000	1,072,000
Critical area stabilization		
Strip mine	95,830	119,310
Gullied and sheet erosion areas	6,000	134,200
Spur roads and skid trails	308,690	326,070
Grazing control	28,000	120,900
Tree planting[2/]	58,800	122,400
Timber stand improvement		
Hardware release	5,000	325,000
Improvement cut	53,000	89,000

1/ Source: U.S. Forest Service
2/ Old fields and other open areas.

Appendix Table VII.2 - Present and Projected Annual Timber Growth and Product Yield Under the Going Program and Recommended Alternative for Years 1980, 2000, and 2020

Green River Basin

Year	Going Program[1/]		Recommended[2/]	
	Annual Growth	Product Yield[3/]	Annual Growth	Product Yield[3/]
	-Cubic Feet Per Acre-			
1980	32.7	20.2	36.9	22.9
2000	34.2	29.1	41.8	35.5
2020	36.0	34.2	47.7	45.3

Source: U.S. Forest Service

1/ Current level of management.
2/ High level of management.
3/ Product yield - the growth available for products is a percentage of the net annual growth: 1980-62%, 2000-85%, 2020-95%.

Appendix Table VII.3 - Timber Product Demand, Supply, and Need Under the Going Program and Recommended Alternative, Year 2000

Green River Basin

Alternative	Timber Product	Demand	Supply	Need Satisfied	Need Unsatisfied
		-Million Cubic Feet-			
Going Program	Veneer	15.3	1.5	-	13.8
	Saw logs	54.9	23.2	-	31.7
	Pulpwood	9.0	15.4	6.4	-
	Other	2.8	14.7	11.9	-
Total		82.0	54.8	18.3	45.5
Total unsatisfied need					27.2
Recommended	Veneer	15.3	3.2	-	12.1
	Saw logs	54.9	52.2	-	2.7
	Pulpwood	9.0	6.8	-	2.2
	Other	2.8	4.6	1.8	-
Total		82.0	66.8	1.8	17.0
Total unsatisfied need					15.2

Source: U.S. Forest Service

Appendix Table VII.4 - Estimated Average Gross Erosion and Sediment Yield by Conditions for the Going Program and Recommended Alternative, Year 2000

Green River Basin

Forest Conditions	Going Program		Recommened Plan
	No Treatment	With Treatment 1/	With Treatment 1/
	-Tons-		
Gross Erosion			
Natural	1,308,300	1,308,300	1,446,300
Disturbed 2/	3,098,700	1,744,800	1,494,100
Total	4,407,000	3,053,100	2,940,400
Sediment Yield			
Natural	6,130	6,130	6,780
Disturbed 2/	363,890	130,650	85,390
Total	370,020	136,780	92,170

Source: U.S. Forest Service

1/ Treatment of spur roads, skid trails, and grazing expected to be done under the Federal Water Pollution Control Act Amendments of 1972.
2/ Includes logging areas, spur roads, skid trails, and grazing.

Appendix Table VII.5 - Estimated Forestry Practices Cost for the Going Program and Recommended Alternative, Year 2000[1]/

Green River Basin

Forest Practices	Going Program	Recommended
	-Million Dollars-	
Tree planting		
Strip mines	13.9	17.3
Gullied and sheet erosion areas	1.9	10.9
Other (old fields and open areas)	1.2	2.4
Timber stand improvement	0.2	7.6
Grazing control 2/	0.5	2.0
Spur roads and skid trails 2/	47.8	50.4
Technical assistance	1.9	4.3
Total	67.4	94.9

Source: U.S. Forest Service
1/ Price base 1970.
2/ Treatment under the Federal Water Pollution Control Act amendments of 1972.

Appendix Table VII.6 - Forestry Impacts for the Recommended Alternative

Green River Basin

	Unit	Total Impact	Accelerated Impacts
Impacts for the period 1970 to 2000			
Forest land cleared for:			
Strip mine	Acres	58,700	0
Urban	Acres	10,000	0
Water	Acres	5,200	1,200
Forest land development for:			
Recreation Areas	Acres	1,000	400
Timber growth foregone:			
Forest land cleared and	Cubic Feet	2,750,000	350,000
recreation areas	Dollars	165,000	25,000
Tree planting for:			
Strip mine	Acres	119,310	23,480
Gullied	Acres	24,200	18,200
Sheet erosion areas	Acres	110,000	110,000
Open areas	Acres	57,300	1,500[2]/
Forest employment & income for:			
Forest practices installation	Man-years	5,217	2,612
and technical assistance	Dollars	39,700,000	11,700,000

(Continued)

Appendix Table VII.6 - Forestry Impacts - Recommended Alternative (continued)

Green River Basin

	Unit	Total Impact	Accelerated Impacts
Impacts for the year 2000			
Timber production for:			
Products from 1,928,200 acres of commercial forest land	Cubic feet	66,600,000	12,000,000
	Dollars	14,800,000	7,500,000
Forest management, protection, and industry	Man-years	3,235	570
	Dollars	27,700,000	4,900,000
Forest land with treatment - Gross erosion reduction	Tons/Yr	1,466,600 1/	112,700 3/
	Percent	33	4
Sediment reduction	Tons/Yr	277,850 1/	44,610
	Percent	75	33

Source: U.S. Forest Service

1/ Difference between no treatment-going program and with treatment-recommended development, see Appendix Table VI.8.

2/ Less than Going Program.

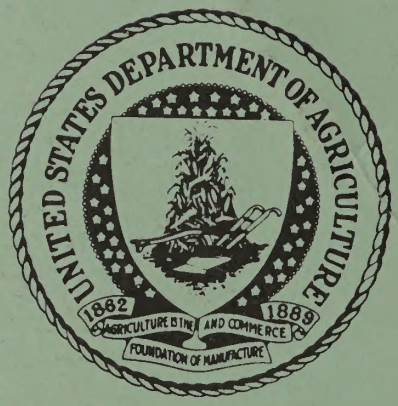
3/ Difference between with treatment-going program and with treatment-recommended development, see Appendix Table VI.8.

Appendix Table VII.7 - Quantity of Component Needs Projected to be Provided by the Going Program, Year 2000[1/]

Green River Basin

Objective	Component Needs: Description	Unit	Quantity	Component Needs Provided	Component Needs Remaining
EQ	1. Food-Fiber Production				
	Major Agricultural Products				
	Corn-grain	Bushels (1000)	45,500	59,800	0
	Soybeans	Bushels (1000)	12,700	16,650	0
	Small grains	Bushels (1000)	4,500	6,020	0
	Hay	Tons (1000)	1,000	1,240	0
	Pasture	A.u.d. (1000)	158,200	221,000	0
	Major Forest Products				
	Veneer	Cubic feet (1000)	15,300	1,500	13,800
	Saw logs	Cubic feet (1000)	54,900	23,200	31,700
	Pulpwood	Cubic feet (1000)	9,000	15,400	0
	Other	Cubic feet (1000)	2,800	14,700	0
	2. Floodwater Damage Reduction	Acres (1000)	332	22	310
	3. Agricultural Water Mgt. (Drainage)	Acres (1000)	315.5	47	268.5
	4. Water Supply				
	Comestic (people served)	Number (1000)	625	375	250
	Agricultural (farm ponds)	Number (1000)	29.9	13.9	16
	5. Forest Management Plans	Acres (1000)	1,600	737	863
EQ	1. Erosion Reduction				
	Agricultural land	Acres (1000)	1,305	200	1,105
	Surface-mined areas[2/]	Acres (1000)	173.7	171.5	171.5
		(Percent)		(20)	(80)
	Roadbanks	Miles	1,600	330	1,270
	Streambanks	Miles	680	100	580
	Forest land	Acres (1000)	385	308.7	76.3
	2. Sediment Reduction				
	Infertile deposition	Acres (1000)	39	7	32
	Swamping	Acres (1000)	30	4	26
	3. Recreation (Outdoor)				
	Water-based	Visitor-days (1000)	10,100	1,320	1,980
	Land-based	Visitor-days (1000)	11,600	1,732	2,393
	Fish	Fisher.-days (1000)	2,753	365.9	529.1
	Hunting	Hunter-days (1000)	1,244	1,244	0
	4. Livestock Waste Disposal Systems	Number	300	30	270

1/ Compiled from study data.
2/ The percent reflects the quantity of disturbed surface-mined land that would be adequately treated.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