ADDENDUM

LOWER KANAWHA RIVER BASIN
VOLUME III

1985

In April 1984, the Division of Water Resources, Municipal Permits Section developed a West Virginia Municipal Strategy in accordance with the National Municipal Policy adopted by the U. S. Environmental Protection Agency in January 1984. The objective of the National Municipal Policy is to bring noncomplying municipalities into compliance with Federal Clean Water Act guidelines by July 1, 1988. In implementing the state municipal strategy, municipalities were placed into one of seven general categories in order to develop a systematic approach to achieving compliance. The categories range from municipalities having treatment works with minor deficiencies (Category 1) to unsewered areas whose sewer needs are low priority (Category 7).

The Sewage Treatment Facilities measure of the Suggested Plan for water quality in this report was formulated from information compiled prior to the implementation of the West Virginia Municipal Strategy. Based on the FY 1984 Construction Grants Priority List and current funding trends, this plan measure identified $53.7 million in additional needs and recommended an acceleration of funding in the Basin from the $1.27 million per year average to about $3.35 million per year to install 19 sewage treatment facilities by the Year 2000. This additional funding was anticipated to satisfy sewage treatment needs in the Basin as identified by the 1984 Construction Grants Priority List.

In accordance with the new West Virginia Municipal Strategy, 13 of the 19 basin municipalities previously referred to have been allocated/awarded funding grants at a rate of 75 percent of the total project cost. One additional municipality (Point Pleasant) and two additional public service districts (Marlaing and Arborland) will be required to install secondary treatment facilities by July 1, 1988, with or without federal funding grants. The remaining three communities, including Glen White-Trap Hill, have been re-categorized as low priority.

During the current FY 1985, the program's emphasis has been realigned to focus upon treatment plants only, to achieve compliance for municipal waste water discharges. Gravity collection systems will no longer qualify for grants, and therefore, the program is essentially directed toward those municipalities having existing collection systems. In addition, municipalities eligible for grants will receive only 55 percent of the project cost compared to the 75 percent previously available. Beyond September 1985, the future of the Construction Grants Program is uncertain due to decreasing federal funds.

LOWER KANAWHA RIVER BASIN
Volume III

Problems, Concerns, Alternative Solutions,
and a Suggested Plan
1985

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PREFACE

Water and land resources are of fundamental importance to the economic, political, and social growth of the State of West Virginia. Increasing and shifting population, expanding industrial complex, and rapid change in agricultural and forestry create an urgent need for information about water and land resources and basic guidelines for future use, development, and management of those resources. Such information and guidelines can, to a considerable degree, help to facilitate optimum growth and development in the State. Careful planning for development, use, and protection of water and land resources can also help in achieving acceptable goals at the local, regional, State, and National level.

This comprehensive study of the Lower Kanawha River Basin, and the resulting report, will provide important information for use by local, regional, State, and Federal agencies and interested citizens of the area in water and land resource planning. Alternative solutions are developed and presented to insure choices acceptable to interested persons and entities. It also provides basic guidelines for plan implementation.

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

CHAPTER 2 - PROBLEMS, CONCERNS, AND OPPORTUNITIES (CONTINUED)

CHAPTER 3 - SUGGESTED PLAN

TABLE OF CONTENTS

Page

CHAPTER 3 - SUGGESTED PLAN (CONTINUED)

CHAPTER 4 - OPPORTUNITIES FOR IMPLEMENTATION

TABLE OF CONTENTS

Page

CHAPTER 5 - ALTERNATIVE PLANS

TABLE OF CONTENTS

Page

CHAPTER 5 - ALTERNATIVE PLANS (CONTINUED)

APPENDIX A - RESOURCES AND ECONOMY OF THE BASIN

TABLE OF CONTENTS

Page

APPENDIX A - RESOURCES AND ECONOMY OF THE BASIN (CONTINUED)

CHAPTER 1
INTRODUCTION

As the primary water planning agency within the State of West Virginia, the Division of Water Resources, of the Department of Natural Resources, is required by law to make studies and develop reports for all river basins in the State. The Director of the Department of Natural Resources determined that the Lower Kanawha River Basin was a high priority area. He initiated a comprehensive river basin study because of the need to evaluate the impacts of increased manufacturing, coal use, and urban development on water and related land resources and to formulate alternative solutions to existing and future problems.

AUTHORITY FOR THE STUDY

The West Virginia Department of Natural Resources, Division of Water Resources, has the authority under Chapter 20, Article 5, West Virginia Statutes, to conduct water resources studies and report results.

The United States Department of Agriculture provides assistance under provision of Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress as amended). This section authorizes the Secretary of Agriculture to cooperate with other Federal, State, and local agencies in surveys and investigations of watersheds, rivers, and other waterways to identify potential water resources developments and to develop coordinated programs.

DESCRIPTION OF THE STUDY AREA

The Lower Kanawha River Basin is located in southwestern West Virginia in the heart of the Appalachian Plateau Province, an area with extensive energy resources of coal, oil, gas, and timber. The study area contains 1,176,000 acres (1,838 square miles) and includes all lands drained by the Kanawha River from the confluence of the Elk River downstream to the confluence with the Ohio River at Point Pleasant. The area includes parts of Boone, Jackson, Kanawha, Lincoln, Logan, Mason, Putnam, Raleigh, and Roane Counties (see Figure 6 in Appendix A). Topography consists of rugged mountains separated by fairly level but narrow flood plains. Most level land occurs as bottom lands along the Kanawha River and its tributaries. Flood plain lands are highly developed for urban and industrial use, and continued industrial expansion is expected to occur down the Kanawha Valley to the Ohio River. Near the Ohio River, level land becomes more abundant as undissected upland or as remnants of the post glacial Teays Valley lakebed. This location is particularly attractive to the chemical industry which requires an abundant supply of energy, good water, rail or barge service, and land for expansion.

Basin streams include the Kanawha River main stem, the Coal River, Little Coal River, Pocatalico River, and many smaller tributaries, including Davis Creek, Tuppers Creek, Marsh Fork, Spruce Creek, and Clear Fork. There are a total of 27 separate subwatershed areas as defined in the West Virginia Soil and Water Conservation Needs Inventory.

OBJECTIVES AND NATURE OF THE STUDY

The primary purpose of this study is to improve or retain the quality of life in the Lower Kanawha River Basin by attaining the following objectives:

1. To enhance National Economic Development (NED) by increasing the value of the Nation's output of goods and services and improving national economic efficiency.

2. To enhance the quality of the environment (EQ) by management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

The goal of the study was to evaluate problems, establish objectives, present alternative solutions to problems, and recommend a plan for orderly development of the water and related land resources after giving full consideration to the environmental, economic, and other related impacts. Study effects were coordinated with all levels of government and others. As a result, local and regional economic development and environmental quality objectives are reflected in the Suggested Plan.

The first phase of this study was an inventory of existing water and land related resources. This was accomplished by field reconnaissance and collection of existing water and land related resource data. The information contained in the Kanawha River Comprehensive Basin Report published in June 1971 was analyzed, updated, and used in this study where applicable. Agricultural information was obtained from the 1967 West Virginia Conservation Needs Inventory and the 1979 West Virginia Agricultural Water Quality Management Plan, updated, and analyzed to determine the status of land treatment. Forest land information was obtained from the 1978 Forest Resources of West Virginia. The Regional Planning and Development Councils furnished some of the information that was used to project future population, income, and employment. Local planners analyzed resource problems and needs, and helped provide inventories of local resource data. Field studies were conducted to obtain technical information that was not previously available.

Alternative solutions to meet needs by the year 2000 were formulated. Various alternative plans were evaluated to determine their impacts on the Basin. The components of each alternative plan were discussed with county and State officials, the regional development councils, and others. The components judged to be economically and environmentally feasible, and acceptable to Basin residents, planners, and government officials, were included in the Suggested Plan. This plan provides the conceptual framework for future programs and projects that may improve the economic and environmental condition of the Basin. Implementation studies to determine detailed characteristics of each program or project in the Suggested Plan will be needed as a part of carrying out this plan.

SPONSORING AND COOPERATING AGENCIES

This was a cooperative study between the West Virginia Department of Natural Resources and the United States Department of Agriculture. The West Virginia Department of Natural Resources, Division of Water Resources; and the Soil Conservation Service, the Forest Service, and the Economic Research Service, of the United States Department of Agriculture, had joint responsibility for conducting the study. Federal contributing agencies included the United States Geological Survey, Farmers Home Administration, U.S. Army Corps of Engineers, and the United States Department of Interior's Fish and Wildlife Service. State contributing agencies included all Divisions of the Department of Natural Resources, the Department of Highways, Department of Health, Office of Economic and Community Development, the Cooperative Extension Service, and the Regional Planning and Development Councils.

RESPONSIBILITIES

Leadership responsibility was assigned for each major study concern prior to beginning the study. The Department of Natural Resources was responsible for municipal and industrial water supply and water quality, while the United States Department of Agriculture was responsible for flood prevention and erosion.

Study activities were guided and coordinated by the Coordinating Committee chaired jointly by the Director of the Department of Natural Resources and the State Conservationist of the Soil Conservation Service. Coordinating Committee membership included representatives from the Department of Natural Resources, the Soil Conservation Service, Forest Service, Economic Research Service, and the Department of Health.

An interagency work group was appointed to address each study concern. Members were selected with consideration for their agency's mission, responsibility, and expertise in a particular field. Each work group was given responsibility to inventory the resources base, define problems and needs, set objectives, and develop alternative plan elements to satisfy the needs.

PUBLIC INVOLVEMENT

A public involvement work group composed of representatives from the West Virginia Cooperative Extension Service, West Virginia Department of Highways, Department of Natural Resources, and the Soil Conservation Service developed and implemented a public involvement plan during the study.

USE OF THE STUDY

The conclusions, recommendations, and supporting data contained in this report provide the framework for natural resource policy formulation and more detailed studies. The greatest use of this report will be as a reference source to which specific problems, detailed investigations, and specific proposals can be compared. This information will be useful to Federal and State government, local governments, soil and water conservation districts, watershed associations, planning commissions, local groups, and individuals. It can be an aid in planning land use, developing budgets and setting priorities for expenditures of funds, and early acquisition for needed improvements.

CHAPTER 2
PROBLEMS, CONCERNS, AND OPPORTUNITIES

INTRODUCTION

The State of West Virginia and the US Department of Agriculture (USDA) mutually agreed to evaluate the following water and related land resource problems and concerns: a) flood damage, b) erosion and sedimentation, c) water quality, and d) water supply. It is the policy of the State to maintain reasonable standards of purity and quality of water, both surface and subsurface, consistent with the public health and public enjoyment thereof, and to provide its citizens with safe drinking water at reasonable cost. The USDA is committed to reducing erosion and sedimentation and minimizing flood damage losses in upstream watersheds. The policies of both the State and USDA are consistent with the agreed to problems and concerns. These problems and concerns were evaluated to reflect their relative magnitude, both in quantity and quality, and to determine their potential impact on the economy and the environment of the Lower Kanawha Basin. Base line conditions existing in 1982 were first determined, and then projected to the Year 2000 to reflect future conditions. Projections were based on a continuation of present trends without acceleration of existing programs or the development of new water and related land resource programs that would impact on the identified concerns. The following table presents a summary of the problems and concerns.

TABLE 1
SUMMARY OF PROBLEMS AND CONCERNS
(Present and Projected Conditions)
Lower Kanawha River Basin

Problems/ / Concerns	Unit	YEAR 1982	YEAR 2000
Annual Flood Damage:			
Lower Main Stem			
Residential	Dollars	2,908,100	5,540,700
Commercial	Dollars	1,700,000	3,239,000
Industrial	Dollars	1,249,000	2,379,600
Miscellaneous *	Dollars	927,600	1,767,300
Subtotal	Dollars	6,784,700	12,926,600
Rest of Basin			
Residential	Dollars	2,561,200	4,635,800
Commercial	Dollars	60,500	109,500
Agricultural	Dollars	40,700	73,700
Miscellaneous	Dollars	538,400	924,500
Subtotal	Dollars	3,200,800	5,743,500
Total Basin	Dollars	9,985,500	18,670,100
Erosion			
Abandoned Mines	Acres	10,000	9,460
	Tons/Ac/Yr	25.0	25.0
	Total Tons/Yr	250,000	236,500
Active Mines	Acres	43,340	46,980
	Tons/Ac/Yr	37.0	37.0
	Total Tons/Yr	1,603,580	1,738,260
Agricultural Land	Acres	169,110	160,220
	Tons/Ac/Yr	5.7	5.7
	Total Tons/Yr	963,930	913,250
Forest Land	Acres	871,820	863,700
	Tons/Ac/Yr	0.5	0.5
	Total Tons/Yr	435,910	431,850
Forest Roads	Acres	10,600	10,600
	Tons/Ac/Yr	2.9	2.9
	Total Tons/Yr	30,740	30,740
Urban Development	Acres	47,490	60,890
	Tons/Ac/Yr	2.4	2.4
	Total Tons/Yr	113,980	146,140
Miscellaneous Land **	Acres	9,780	10,140
	Tons/Ac/Yr	9.5	9.5
	Total Tons/Yr	92,910	96,330
Total Basin	Tons	3,491,050	3,593,070

Note: Price Base 1982. Damage projections are based upon expected future urban development.

TABLE 1 (Continued)
SUMMARY OF PROBLEMS AND CONCERNS
(Present and Projected Conditions)
Lower Kanawha River Basin

Problems/ / Concerns	Unit	YEAR 1982	YEAR 2000
Water Quality ***	Percent of		
Fecal Coliform	Streams		
Coal River	Affected	18.0	---------
Kanawha River		14.4	---------
Total Basin		12.4	---------
Mine Drainage	Percent of		
Heizer Creek	Streams		
Ph	Affected	20.7	---------
Fe		27.6	---------
Mn		10.3	---------
Sulfates		13.8	---------
Coal River			
pH		6.0	---------
Fe		6.6	---------
Mn		5.0	---------
Sulfates		8.8	---------
Total Basin			
pH		4.5	--------
Fe		4.5	--------
Mn		3.2	--------
Sulfates		5.5	--------
Chlorides	Percent of		
Pocatalico	Streams	8.6	--------
Total Basin	Affected	2.3	--------
Animal Wastes	Farms Needing		
Dairy Operations	Treatment	30	15
Swine Operations		16	8
Feedlots		11	5
Miscellaneous		4	2
Total Basin		61	30
Water Supply ****			
Inadequate Components:	Number		
Raw Water Source		7	4
Distribution Storage		1	0
Treatment Capacity		2	0
Treatment Quality		6	3
Transmission System		5	1
Other		4	3
Total Basin - Number of Complete Systems		9	6

* Includes damages to roads, railroads, bridges, utilities, and agricultural land.
** Includes oil and gas wells, dirt roads, streambanks, and agricultural land.
*** Based on a total of 692 sampling stations.
**** Each complete system contains components for raw water source, distribution storage, treatment capacity, water quality treatment, transmission system and other.

Source - Huntington District COE; SCS; and DNR.

FLOOD DAMAGE CONCERNS

Floodwater damages are a primary concern throughout the Basin. The mountainous topography, high gradient streams, narrow flood plains, and periods of high intensity rainfall combine to produce frequent damaging floods. The total 1982 average annual flood damages are estimated to be $9,985,500. By the Year 2000, average annual flood damages are projected to increase to $18,670,100. Damage projections are based upon expected future urban development.

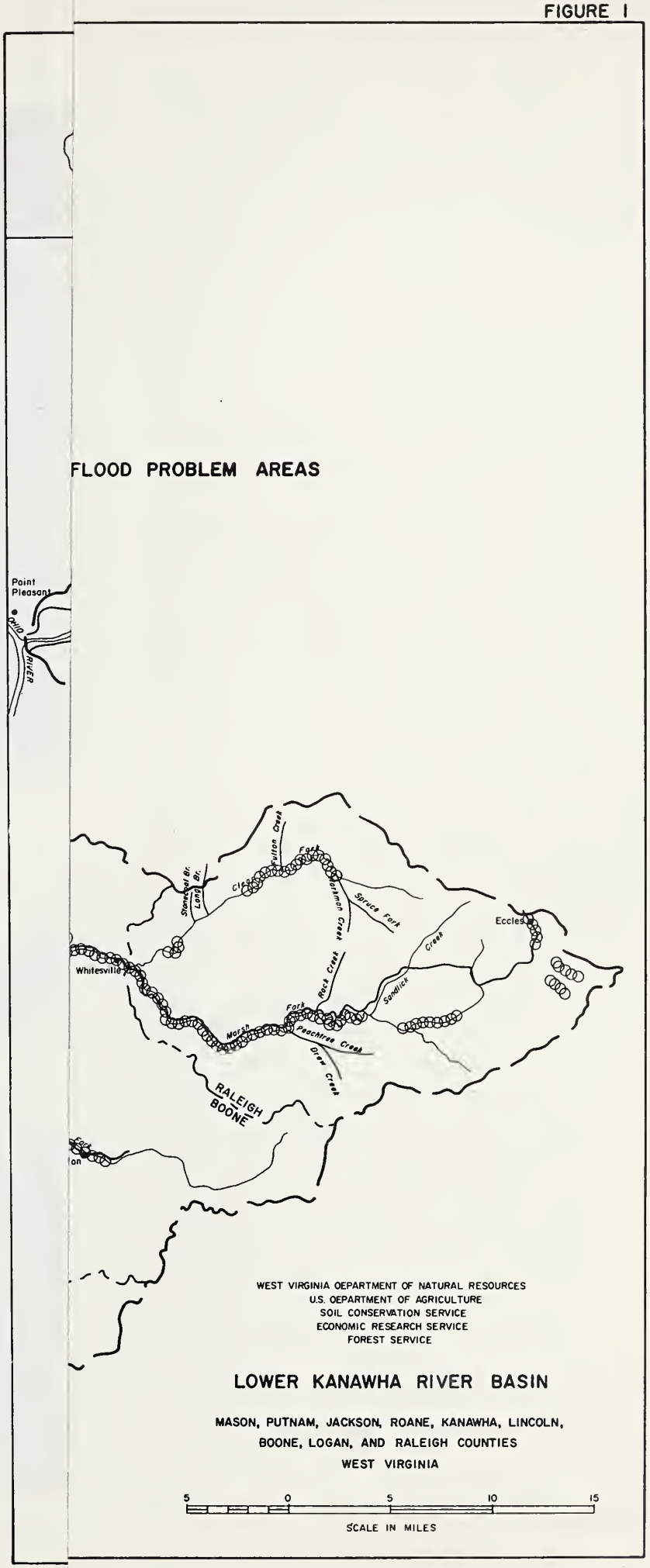
HISTORICAL FLOOD DAMAGE

The Lower Kanawha River Basin has a long history of damaging floods. Records indicate that major floods occurred in 1861, 1910, 1932, 1937, 1948, 1956, 1958, 1961, 1967, 1972, 1977 and 1980. Minor flooding occurs throughout the Basin every year, and in some locations several times a year (see Figure 1 and Pictures).

Flooding is attributable to both natural and manmade factors. The climate is conducive to the production of floods. The Basin is in the northern temperate zone and experiences the usual climatic variations in temperature and rainfall. Frontal air mass activity brings in both cold polar and humid tropical air masses. Frequent changes between the two types of air masses occur rapidly due to the passage of fronts, especially during late winter and early spring. Most flooding results from long duration rainfall associated with the tropical air masses falling on frozen ground, or on ground previously saturated by snow melt. However, occasional flooding occurs in the summer months from very high intensity rainfall from thunderstorms associated with the tropical air masses or from hurricanes moving inland from the east coast.

The rugged topography of the Basin lends itself to the rapid development of damaging floods. With the exception of the Kanawha River main stem, the major streams and their many tributaries flow in deep, narrow, sinuous valleys between steep ridges. In the headwater regions, especially of the Coal River, the terrain is mountainous and stream gradients are very steep. Most soils covering the steep mountain slopes are in Hydrologic Soil Group C. These soils have low permeability and produce high rates of runoff. Runoff from rain storms quickly runs down the mountain slopes building up high peak flows that spill over channel banks, inundating the narrow valleys. Many streams are already partially filled with sediment which reduces in-channel flow capacity causing more frequent out-of-bank flooding. Out-of-bank flow picks up debris, carrying it downstream until it clogs culverts and bridge openings, further increasing flood depths.

FIGURE 1

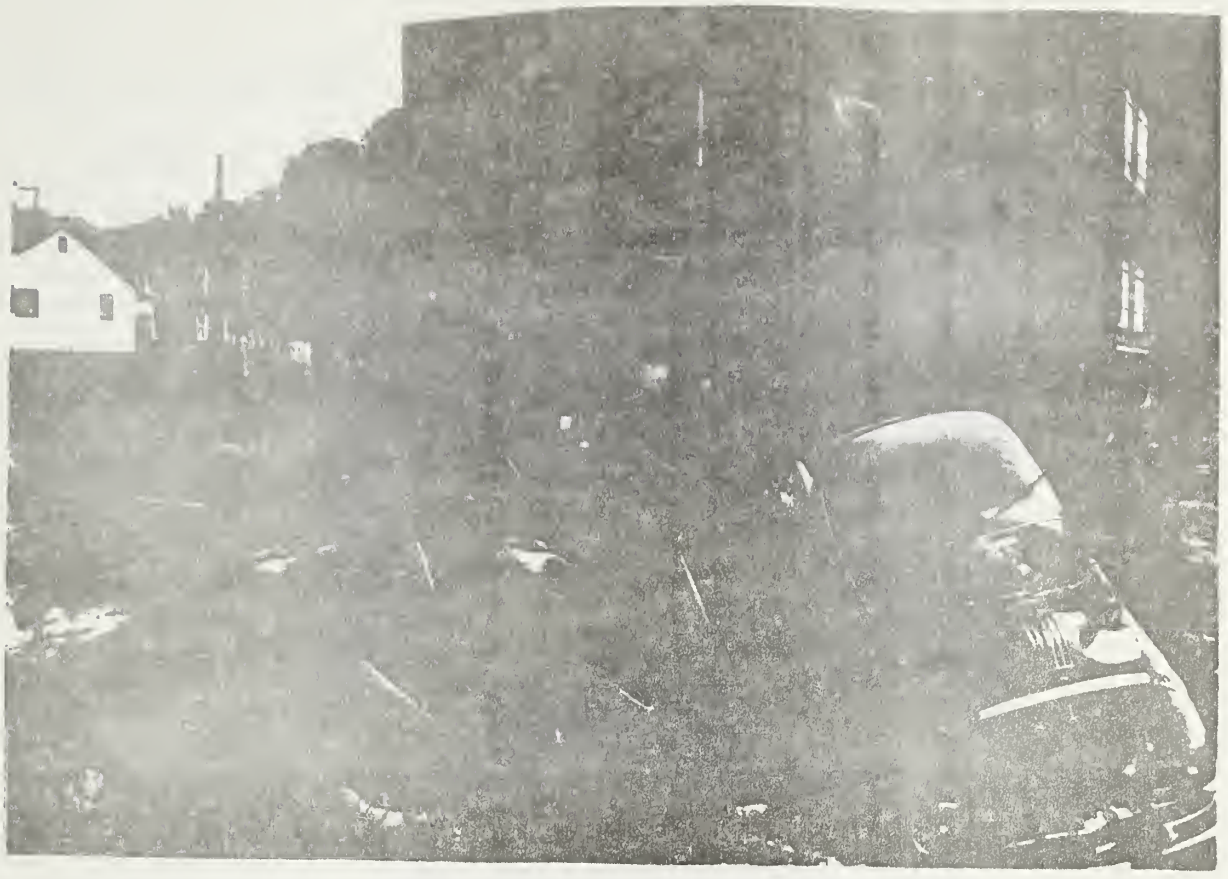

FLOOD PROBLEM AREAS
Point Pleasant
OHIO RIVER
Whitesville
Eccles
Stonecoal Br.
Long Br.
Clear
Fulton Creek
Fork
Workman Creek
Spruce Fork
Creek
Rock Creek
Sandlick
Fork
Marsh
Peachtree Creek
Drew Creek
RALEIGH
BOONE
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
5 0 5 10 15
SCALE IN MILES

WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE

LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN, BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES



JOL WAS OUT AFTER THE 1961 FLOOD ON KANAWHA TWOMILE CREEK IN CHARLESTON

"GONE WITH THE FLOOD" WAS PLAYING AT THE STATE THEATER IN POINT PLEASANT DURING THE 1948 FLOOD.

END OF THE ROAD AFTER THE 1973 FLOOD

THE TRAIN STOPPED HERE FOLLOWING THE 1969 FLOOD.

UPSTREAM FLOOD DAMAGES

Because of the rugged terrain, practically all development has occurred on or adjacent to the flood plains. The flood plains contain the towns and cities, most transportation facilities, utilities, and recreational areas. Outside of the towns and cities, ribbon-type development has occurred for miles up some of the narrow valleys. This type of development is especially vulnerable to frequent damaging floods resulting in high flood losses. Economic losses from upstream flood damage were estimated to be $3,200,800 annually in 1982, and projected to increase to $5,743,500 by the Year 2000. The estimated average annual flood damages are summarized by watershed in the following table. Damage projections are based upon expected future urban development.

TABLE 2

UPSTREAM AVERAGE ANNUAL FLOOD DAMAGES

(1982 Present Conditions)

LOWER KANAWHA RIVER BASIN

Major Drainage and Watershed	Type of Damage				
	Residential ($)	Commercial ($)	Agricultural ($)	Miscellaneous ($) *	Annual Damage ($)
Kanawha River Main Stem					
Blakes-Armour Creek	72,900	10,700	-	7,800	91,400
Davis Creek	196,300	10,800	2,900	114,300	324,300
Eighteenmile Creek	-	-	3,600	12,300	15,900
Kanawha Twomile Creek	62,100	7,500	-	41,000	110,600
Tupper Creek	11,300	-	-	3,800	15,100
Finney Branch	123,900	1,100	-	5,400	130,400
Teays Valley	-	-	5,100	2,000	7,100
Thirteenmile Creek	-	-	1,800	19,400	21,200
Pocatalico River	792,900	30,400	22,300	134,200	979,800
Subtotal	1,259,400	60,500	35,700	340,200	1,695,800
Big Coal Drainage					
Coal River	99,300	-	-	14,200	113,500
Clear Fork	59,100	-	300	19,400	78,800
Marsh Fork	249,800	-	-	57,200	307,000
Brier Creek	23,600	-	-	-	23,600
Subtotal	431,800		300	90,800	522,900
Little Coal Drainage					
Little Coal River	87,900	-	-	55,200	143,100
Spruce Fork	440,400	-	2,900	35,800	479,100
Pond Fork	341,700	-	1,800	16,400	359,900
Subtotal	870,000		4,700	107,400	982,100
TOTALS	2,561,200	60,500	40,700	538,400	3,200,800

* Miscellaneous includes roads, bridges, utilities, etc.

Source: SCS

Several towns and communities in the upstream portion of the Basin experience frequent flood damage. They include the Danville-Madison community complex, the Sylvester-Whitesville communities, and the communities of Greenview, Sharples, Van, Clinton, Fairdale, Shamrock Village, and Rock Branch. The following table summarizes flood damages in these communities.

TABLE 3
COMMUNITY FLOOD DAMAGES
Lower Kanawha River Basin

Community/ /Frequency	Number of Structures Damaged				Damage Losses $
	Residential	Commercial	Industrial	Miscellaneous *	
Danville-Madison					
2-year level	63	1	-	-	116,000
50-year level	485	63	2	25	9,342,000
100-year level	559	80	2	31	13,527,000
Greenview-Sharples					
2-year level	118	1	-	1	61,000
50-year level	442	25	-	15	5,010,000
100-year level	451	28	-	16	6,822,000
Sylvester-Whitesville					
2-year level	26	1	-	2	27,000
50-year level	253	9	2	4	1,215,000
100-year level	296	14	2	5	2,685,000
Van-Clinton					
2-year level	199	7	-	1	263,000
50-year level	602	24	-	28	6,545,000
100-year level	623	24	-	20	7,817,000
Fairdale	138	-	-	-	-
Shamrock Village					
100-year level	17	-	-	-	345,000
Rock Branch					
100-year level	25	3	-	1	188,900

*Miscellaneous includes roads, bridges, utilities, etc.
Source: U. S. Army Corps of Engineers, Huntington District and SCS.
Damages based on 1983 price levels.

MAIN STEM FLOOD DAMAGES

Flood damages along the Kanawha River main stem have been significantly reduced by construction of the Bluestone, Sutton, and Summersville dams; however, remaining damages on the Kanawha River flood plains are still a major source of economic losses. The major cities in the Basin are located on this wide flood plain including Charleston, St. Albans, Dunbar, Nitro, South Charleston, Winfield, and Pt. Pleasant. In addition, most of the major industry is located along the main stem. The valley is generally regarded by many as one of the major chemical centers of the world with large industrial plants such as Union Carbide, Monsanto, General Motors, Shell Oil, etc., located in the valley. With the high level of development along the Kanawha River, main stem flood damages are twice as high as upstream damages, amounting to $6,784,700 annually. This damage is projected to increase to $12,926,600 annually by the Year 2000. Projected damages and base upon expected future urban development. These damages are summarized in Table 1.

PROBLEMS ADDRESSED

A preliminary screening of the major flood problem areas was conducted to determine which problem areas had potential for project type solutions that should be addressed in this study. The screening process considered the magnitude of flood damages in 27 subwatersheds of the Basin along with the cost of potential solutions. Solutions analyzed included nonstructural solutions, structural solutions, and combinations of both nonstructural and structural solutions. The annual cost of the least costly solution was compared to the annual damage to determine a damage-cost ratio for each subwatershed. The damage-cost ratio is a measurement of the potential for project type action. Those subwatersheds that had a damage cost ratio of 0.9 or greater were determined to have potential for project type action.

Based upon the screening process the following flood problem areas had damage-cost ratios of 0.9 or greater and were addressed in this study; (1) Danville-Madison, (2) Greenview-Sharples, (3) Sylvester-Whitesville, (4) Van-Clinton, (5) Fairdale, (6) Shamrock Village, (7) and Rock Branch. Other subwatersheds were excluded from project type evaluations.

EROSION & SEDIMENT CONCERNS

This section addresses the problems and concerns of erosion rates and sediment yields in the Lower Kanawha River Basin (See Figure 2). Erosion can be divided into two categories according to the conditions under which it occurs. The first category is natural (geologic) erosion which has been occurring at variable rates, depending upon climatic, topographical, biological, and lithological conditions since the area was first uplifted. Geologic erosion is extremely slow and is an important process in soil formation. The underlying rock is

attacked by air and water causing fragments to be detached, decomposed and/or dissolved. This process is termed weathering. In general, a rough equilibrium is reached in natural environments between geologic erosion and soil formation. The second category is accelerated erosion which is caused primarily by the activities of man. Deforestation, cultivation, and destruction of vegetation accelerates erosion. Accelerated erosion takes place when erosion occurs at a rate greater than the natural (geologic) rate.

Both categories of erosion can be divided into two types: 1) sheet and rill and 2) gully. Sheet and rill erosion is the removal of soil by the forces of raindrop impact and overland runoff. Although it occurs on all land surfaces, sheet and rill erosion is particularly active on denuded soils of moderate slope where the water is not concentrated in well defined channels but consists of overland flow. The numerous small, but visible rills caused by the overland flow may, with time, develop into gully erosion.

Gully erosion consists of the removal of soil and rock by a concentrated flow of water. Concentrated flow permits a more local attack upon the soil and rock. Gully erosion may include: streambank erosion, streambed degradation, roadbank erosion as well as the other sources previously mentioned.

These classifications are helpful in estimating the rate of erosion. They also aid in determining the relative importance of the sediment source in the basin. The seven major sources of accelerated erosion and sedimentation present in the Basin are: (1) coal mine lands and roads, (2) roadbanks, (3) oil and gas well sites and roads, (4) construction sites, (5) forest roads and associated forestry operations, (6) agricultural lands, and (7) streambanks.

Sediment can greatly alter the aquatic system of a stream. By reducing the volume and flow of a channel, silt accumulations can promote and accelerate eutrophication. High sediment loads can cover riverbeds, destroy or reduce the diversity of benthic organisms, and reduce the survival rate of fish eggs. This alters the ecosystem and also results in a loss of fishing opportunities.

Silt flocculates planktonic algae and carries it to the bottom to die. This allows aerobic bacteria to attack it, reducing oxygen concentration in the water. A decrease of algae and aquatic plants can also be attributed to a decrease in light penetration due to sediment. This disturbs the aquatic food chain, resulting in a decrease in primary producers.

Silt absorbs oil precipitates, nutrients, and pesticides. This sediment remains a source of pollution since agitation of the bottom or chemical changes can release the pollutants.

FIGURE 2

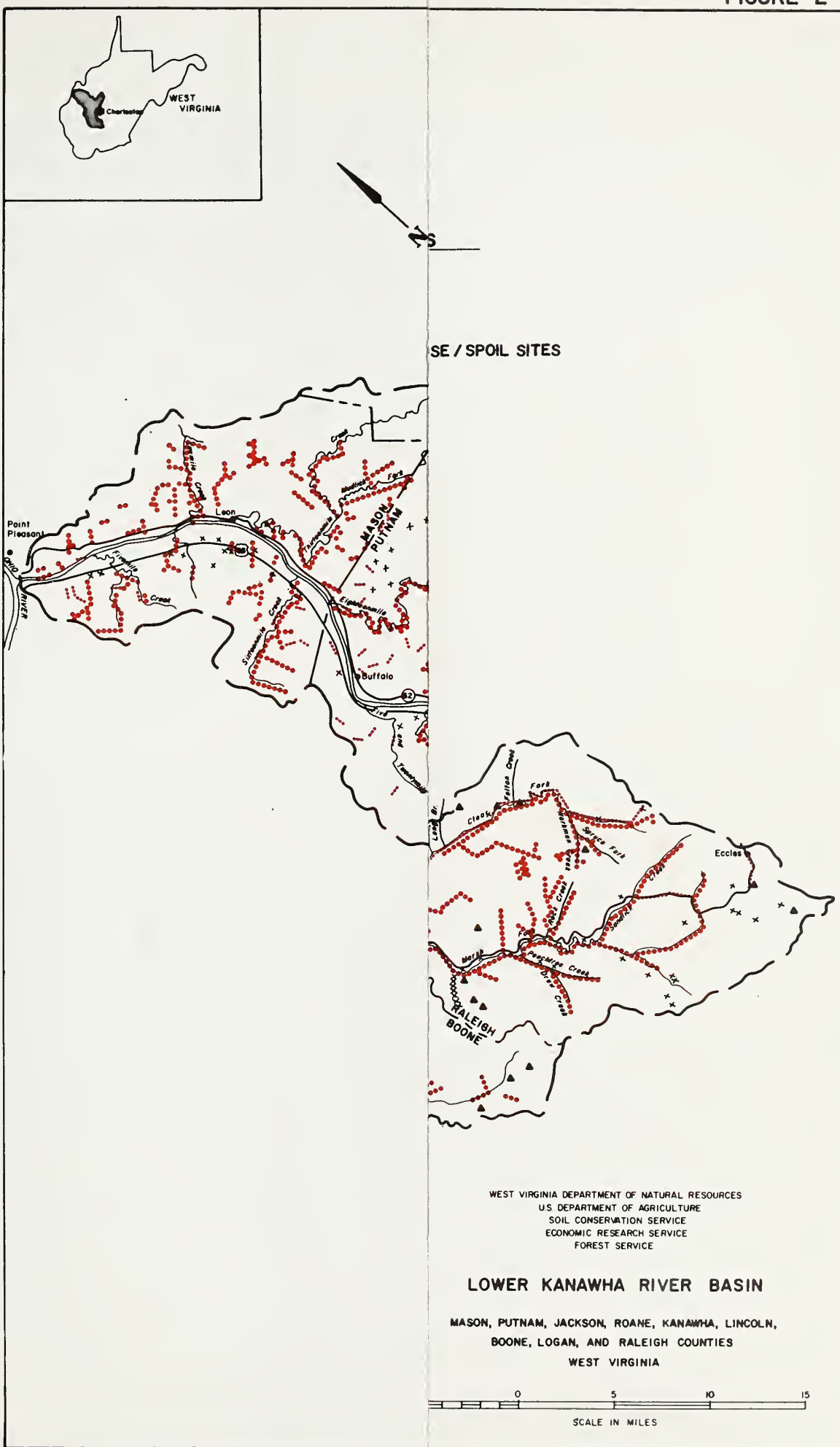
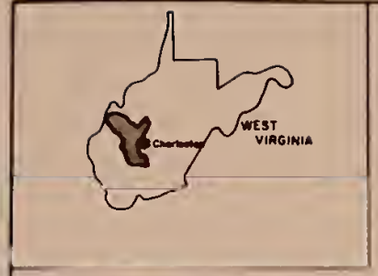

WEST VIRGINIA
Charleston
N
SE / SPOIL SITES
Point Pleasant
OHIO
RIVER
Leon
MASON
PUTNAM
Buffalo
Eccles
RALEIGH
BOONE
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
0
5
10
15
SCALE IN MILES

FIGURE 2



N

SEVERELY ERODING AREAS

- ROADBANKS
- STREAMBANKS
- CONSTRUCTION SITES
- MAJOR COAL MINE REFUSE / SPOIL SITES

Walton
ROANE
Sissonville
JACKSON
KANAWHA
Pocatalico
Liberty
Leon
Point Pleasant
MASON
PUTNAM
Confidence
Winfield
Buffalo
CHARLESTON
South Charleston
Dunbar
Nitro
Saint Albans
KANAWHA
BOONE
LINCOLN
Hurricane
TEAYS VALLEY
Racine
Whitesville
Eccles
RALEIGH
BOONE
Madison
Wharton
BOONE
LOGAN
Sharples

WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE

LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES

Sediment alters fish species composition. Sediment laden waters usually are not suitable habitat for game fish of high recreational value, leaving rough fish of less sporting value. The growth rate of fish may also be reduced by high sediment loads.

Timber harvesting operations temporarily disrupt terrestrial plant and animal communities. Unmanaged and unsupervised logging operations can cause a major increase in soil erosion. Mining activities also alter the terrestrial ecosystem and contribute sediment to Basin waterways. Continuous erosion associated with livestock grazing can deteriorate the site to a level where normal plant and animal communities are virtually nonexistent, resulting in annual weeds and exposed soil. Regardless of the source, a heavy sediment delivery into a waterway during spawning seasons can be especially damaging to aquatic life. In addition to effects on the aquatic and terrestrial environment, sediment laden, turbid waters are aesthetically displeasing.

MINED LANDS AND ACCESS ROADS

Both surface mining and deep mining of coal occurs in the Basin. Surface mining accounts for the vast majority of erosion and sedimentation problems associated with mining operations. The main reason for erosion and sedimentation problems can be attributed to the method of surface mining employed, which is contour or "strip" mining. Contour "strip" mines have a long, narrow, linear geometry and therefore provide more spoil area draining directly into the watershed.

About 53,340 acres of active and inactive surface and deep mines are present in the Basin. All of the active and inactive strip mines, since August 3, 1977, are sufficiently bonded and required by law to be reclaimed in lieu of forfeiture of the bond. Mines, before August 3, 1977, that were not required to be reclaimed and were left in an unreclaimed state, are termed "abandoned mines". These abandoned strip mines are continually eroding and producing sediment, and are a great concern in the Basin. The average erosion rate for the Basin is 250,000 tons per year on the approximately 10,000 acres of abandoned mine lands.

Abandoned mine lands were classified as having high, medium, or low threats to health, safety, and general welfare. The following criteria were considered for the priority classifications of each area:

1. Subsidence within, or adjacent to, a residential or public area.
2. Slides or slide prone areas caused by mining in a residential or public area.
3. Mine fires or burning refuse caused by mining in a residential or public area.
4. Open shafts or tunnels caused by mining in a residential or public area.
5. Hazardous waste impoundments upstream of residential or public area.
6. Mine drainage into public or private water supplies.
7. Serious flooding of residential or commercial properties caused by past mining.
8. Hazardous highwalls adjacent to populated areas.
9. Hazardous water-filled pits adjacent to populated areas.
10. Loss of water supply as a result of mining.
11. Illegal garbage or trash dumps on mined areas adjacent to populated areas.
12. Vermin or insect vectors caused by past mining.
13. Blowing mine waste dust.
14. Loss of agricultural productivity caused by past mining.
15. Impairment of natural visual resources as a result of past mining.
16. Destruction or impairment of fish or wildlife habitat by erosion, sedimentation, flooding, toxic seepage or drainage, as a result of past mining.

Each area was reviewed and assigned one of the following priorities:

PRIORITY 1 - Protection of public health, safety, general welfare and property. This priority is assigned to extremely dangerous situations that present a clear, evident and predictable threat to life and property.

These are situations that a rational person would not want to be exposed to because of the substantial expectation of peril to life and/or property. Priority 1 situations are usually located within, or in close proximity to, populated areas where the risk of danger is extreme and the frequency of exposure or the number of people exposed is high.

PRIORITY 2 - Protection of public health, safety, and general welfare. This priority is assigned to situations that are hazardous to human health, safety, and general welfare, but the danger to life and property is not as clear or evident as for Priority 1 situations. There is not an immediate danger to life or property. Priority 2 situations usually exist in sparsely populated areas or where the frequency of exposure is less than Priority 1 situations. Presently, 217 acres of Priority 1 and 2 have been inventoried in the Basin. [3]

PRIORITY 3 - Restoration of the environment and beneficial use. This priority applies to situations that are degrading the quality of the environment and preventing beneficial use of the area. Priority 3 situations present little or no risk to human health or safety, but adversely affect the quality of the environment as a result of the past mining activity. Preference is given to those Priority 3 situations that have offsite benefits.

The inventory of abandoned mine lands is incomplete, but it was assumed that the majority of the uninventoried acreage would be classified as Priority 3.

Because of the various areas of activities associated with a mine, overall erosion rates are difficult to determine; however, the erosion rate should be less on regulated, active mines than on the unregulated, abandoned mines. Potential sediment sources include areas that have been cleared and grubbed, roads, spoil piles, refuse piles, areas of active mining, and areas being reclaimed. Actively mined lands are protected by Federal and State laws, regulations and agencies. Sedimentation control devices are required by law during all phases of a mining operation.

Surface mining operations can produce significant modifications in the hydrologic equilibrium, especially if several operations are conducted concurrently within the same watershed. The overall increase in the rate of runoff from mine sites may accelerate erosion within the undisturbed areas of the watershed.

The two most significant modifications that affect the receiving streams are increases in the rates and the total volume of surface runoff. These modifications together with an accompanying increase in sedimentation adversely affect the stability of the stream. A chain reaction of downcutting of the bottom of the channel and under cutting and sloughing of streambanks can be triggered. This situation could contribute sediment long after mining operations have ceased.

ROADBANK EROSION

Roadbank erosion results from sheet, rill and gully erosion of roadbanks and side drainage ditches. The maintenance of roads and side ditches, use of salt in winter and other associated problems, reduces the vegetative cover and allows for accelerated erosion. Gully erosion of both cut and fill roadbanks is a very common problem in the Basin. This type of erosion often leads to slump-slide failures of not only the banks, but also of the roads themselves. Many of the roads of the Basin are unimproved secondary roads. These roads are subjected to the same erosional forces as the ditches and roadbanks and can be the source of major erosion and sedimentation. Primary and secondary roadbanks are responsible for 53,750 tons of erosion each year.

OIL AND GAS WELL SITES

Erosion from oil and gas well sites and associated access roads is recognized as a major problem. With the increased demand for domestically produced energy sources a dramatic increase in exploration and development of oil and gas resources has occurred in the Basin. A 50% increase in well permits granted occurred in the Basin between 1982 (211 permits) and 1983 (326 permits). This increase in exploration and development is having a major impact on soil and water resources and associated forest land resources of the Basin.

There is no official estimate of the amount of land that is affected by the oil and gas industry nor its impact on water quality. The West Virginia Department of Natural Resources has estimated that the annual soil loss on some oil and gas well access roads is 600+ tons/acre.

The reason for such a high tonnage is that on the average, 1/3 of the access roads are on a 15% grade or steeper. Overall, the average well site has a sediment loss well below the average sediment loss for access roads.

The West Virginia Department of Mines, Office of Oil and Gas, has developed sediment and erosion control regulations. The regulations require that a reclamation plan be developed for each well site and be reviewed by the Soil Conservation District prior to the issuance of a drilling permit. This procedure has brought about improvement that has reduced the erosion rate. However, it must be noted that the rate of erosion may vary greatly on these sites during the development, drilling, and reclamation stages. The current regulations have improved reclamation of new sites; however, hundreds of old sites are present in the Basin. These older sites may be eroding and degrading the adjacent land and water.

There is a need for a comprehensive evaluation of conditions that exist at both old and new well sites to determine the amount of erosion as well as associated water quality and other problems that affect our soil, water, and related resources.

URBAN DEVELOPMENT

Each year more and more acres are being converted from agricultural and forest lands into urban use. This converted land provides sites for new houses, shopping centers, schools, industrial parks and highways which are needed by the growing population of the Basin.

This converted land is also the source of much of the sediment that pollutes streams, rivers and lakes. Studies have shown that erosion on land being converted to highways, houses, shopping centers, etc., is about 10 times greater than on land in cultivated row crops; 200 times greater than on land in pasture; and 2,000 times greater than land in timber. [4]

Much of the erosion occurs during the construction period. However, areas below a construction site may erode more after construction is completed because of the rapid runoff from impervious pavement, parking lots, or compacted soil.

Improvements in earthmoving equipment have made reshaping of the land easier and have brought steeper and rougher land into use. Also, the trend toward large subdivisions and developments have left larger cleared and graded areas exposed to rainfall and potential erosion for longer periods. Because of these factors, an ever increasing amount of land is undergoing development each year and erosion and sedimentation is becoming a more serious problem in the Basin. Presently there are 47,490 acres of urban, commercial, and industrial lands in the Basin of which approximately 3,200 acres are currently construction sites. The average erosion rate on the 47,490 is 3.7 tons per acre. However, when the 3,200 acres of current construction with its erosion rate of approximately 20 tons/acre is subtracted, the overall erosion rate drops to 2.4 tons/acre. Approximately 64,000 tons are eroding from current construction sites annually.

The rapid commercial and residential development which has occurred in the Teays Valley Watershed in the last 15-years has created severe erosion and sedimentation problems. Two water supply reservoirs are experiencing severe sediment damage due to disturbance of soil during construction activity. A third reservoir in the watershed, Lake Washington, is filling with sediment from sheet erosion, roadbank erosion, and streambank erosion.

The following paragraphs on sedimentation and erosion in the Teays Valley describe site specific problems encountered as a result of an increase in construction.

Teays Valley Water Supply Reservoir - Sedimentation of the Teays Valley Water Supply Reservoir is largely due to construction and building site development which has occurred in its drainage area. It is estimated that 33 percent of the reservoir's total volume (21,102,300 gallons or 104,209 cubic yards) has been depleted by sediment since 1963, when the dam was constructed. A settling basin above the reservoir is completely full of sediment.

Hurricane Water Supply Reservoir - This reservoir is also experiencing excessive sedimentation due to the urbanization of the watershed. Sewer line construction was a critical sediment source for 1-1/2 years. Approximately 134 acres of farmland were converted to commercial or residential land uses in the period 1968 to 1980. At present, approximately 30 acres are disturbed in the 3,333-acre watershed. Approximately 25 to 50 percent of the total volume of the reservoir has been depleted by sediment.

Lake Washington - The original lake had a surface pool area of 60 acres. It is estimated that the volume of the lake has been depleted by 67 percent, and the surface area of the pool is now approximately 45 acres. Large islands have formed in the lake and are supporting vegetation. Trees are growing on sediment bars lining the banks of the lake where boats were once moored. Recent informal sediment surveys indicated depths of water of 1.5 feet where in 1964, water was 5 feet deep.

The drainage area which feeds the lake is approximately 8,466 acres in size. Many hillsides have been cleared and are sources of sheet erosion. Soils of the uplands are the Gilpin - Upshur complex. The Upshur component of this complex has a severe erosion hazard. In addition to sheet erosion on areas of poor cover, numerous unpaved county and private roads exist in the drainage area. These are critical sediment sources. Severe erosion is occurring on unvegetated roadbanks along some of these roads as well as along some paved roads, including State Route 60, which roughly parallels Hurricane Creek for its entire length up the valley. Large gullies exist on some roadbanks. Although some streambank erosion is occurring, it does not appear to contribute as much sediment as sheet and roadbank erosion, or erosion of unpaved roads.

Sedimentation of the Hurricane and Teays Valley reservoirs will continue as development in the watershed continues. The population of the Teays Valley area, comprised of Teays and Scott Districts, increased from 8,649 in 1970 to 13,467 in 1980, or nearly 56 percent. Similar increases are expected in the future. It was predicted that urban, commercial, and industrial land in the watershed would increase from 2,000 acres in 1979 to 5,000 acres in the Year 2000. Approximately 300 acres of this development has already taken place.

FOREST ROADS

The major source of forest land erosion and sediment is 10,600 acres of the private road system. Soil erosion on the forest road system generally occurs on sections of roads that are located in or near a streambed, constructed on an excessive grade, or constructed with a poor drainage system or no drainage system at all. Approximately 30% of these roads are producing nearly all of the sediment originating from forest land.

Improperly designed and located forest roads and ditches often serve as a collector and conduit for the delivery of eroded materials from a hillside directly into a watercourse. Forest access roads and ditches are responsible for producing 30,740 tons of sediment annually.

FOREST GRAZING

Grazed forest land is a minor source of soil erosion and sediment. When livestock continually use forest land, their hooves compact the soil, and destroy the litter and humus layers, thus making the soil less permeable. This action increases water runoff and consequently, sheet and rill erosion. Approximately 7,500 acres of forest land are subject to grazing. This amount is expected to remain constant to the Year 2000. Grazed forest lands are responsible for 15,000 tons of sediment per year.

TIMBER HARVESTING

The harvesting of trees for wood products is a continuous operation within the area. While trees can be harvested without causing stream sedimentation, poorly planned, unsupervised harvesting operations are currently being utilized in several places throughout the area. Current tree harvesting methods are responsible for producing 2,000 tons of sediment per year.

Table 4 is a summary of the present and future erosion rates without the benefit of remedial projects.

Table 4
EROSION RATES AND TOTAL EROSION
Lower Kanawha River Basin

Land Use	Present Condition			Future w/o Project Condition		
	Area (Acres)	Erosion Rate (Tons/Acre/Year)	Total Erosion (Tons/Year)	Area (Acres)	Erosion Rate (Tons/Acre/Year)	Total Erosion (Tons/Year)
Forest Land	871,820	0.5	435,910	863,700	0.5	431,850
Forest Roads	10,600	2.9	30,740	10,600	2.9	30,740
Abandoned Mine Lands	10,000	25.0	250,000	9,460	25.0	236,500
Active Mine Lands	43,340	37.0	1,603,580	46,980	37.0	1,738,260
Urban Development	47,490	2.4	113,980	60,890	2.4	146,140
Agricultural Lands	169,110	5.7	963,930	160,220	5.7	913,250
Miscellaneous Lands *	9,780	9.5	92,910	10,140	9.5	96,330
Noncontributing **	13,890	-	-	14,040	-	-
Total Basin	1,176,030	-	3,491,050	1,176,030	-	3,593,070

* Streambank, roadbanks, oil gas well sites, dirt roads, etc.
** Lakes, wetlands, rivers, etc.

Source - SCS and FS

STREAMBANK EROSION

Streambank erosion is the lateral recession of channel banks due to the movement of soil particles by high velocity flows. Streambank erosion and streambed degradation are affected primarily by the bank materials and the resistance of the channel bottom to the character and direction of flow. Removal of the natural vegetation from streambanks increases erosion. The presence of coarse bed material, that a stream cannot pick up during reduced flows, results in an attack on the streambanks by the flowing water.

Streambank erosion is a natural process and occurs even on streams and rivers that tend to maintain a long term constant width, such as the Kanawha. On these streams, bank erosion is offset by less obvious deposition and accretion. Streambed erosion is not a significant long term sediment source because the material subject to this type of erosion is limited in both extent and volume. Compared with other potential sources of sediment in the Lower Kanawha Basin, streambank and streambed erosion is usually minor and therefore, will not be discussed any further in this Basin study.

PROBLEMS ADDRESSED

The problems that are addressed in the following chapters of this report were initially screened by an interdisciplinary planning team of specialists to determine if their magnitude was sufficient to require project type action as a solution.

The screening process involved a field reconnaissance of the Basin, an evaluation of available data on sediment sources in the Basin, and input from members of the Erosion and Sediment Work Group and SCS District Conservationists.

During the field reconnaissance a number of sediment sources were observed. These included abandoned mine refuse piles, oil and gas well sites, construction sites, eroding streambanks, surface mined areas and forestry operations.

Available data on sediment sources which were evaluated and screened included reports on severely eroding agricultural land, land disturbed by surface mining, and abandoned mine lands. In addition, the seven SCS District Conservationists in the Basin provided data on streambank and roadbank erosion and acreage being disturbed by construction.

Members of the Erosion and Sediment Work Group included representatives of the USDA's Forest Service, the WV Department of Highways, and the WV Department of Natural Resources: Divisions of Reclamation, Wildlife Resources, and Water Resources. This group provided input on areas of oil and gas development, construction sites, and on watersheds affected by surface and deep mining.

WATER SUPPLY CONCERNS

DOMESTIC AND AGRICULTURAL

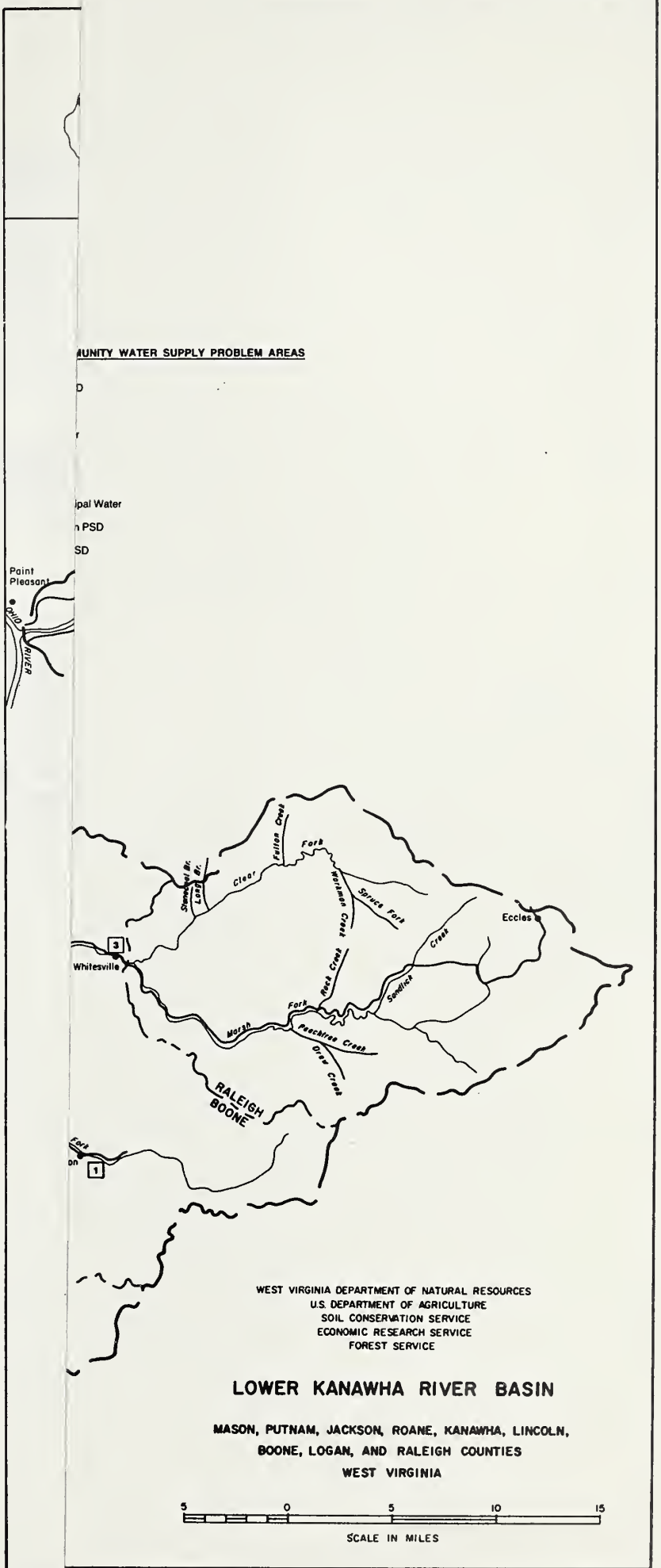
Domestic water needs for a high proportion of the Basin population which lives in the intensively developed Kanawha Valley, are adequately met by commercial and public water suppliers. Most rural residents, however, have traditionally self-supplied their water needs for both domestic and agricultural uses from a wide range of water sources. It is estimated that water from wells used solely, or in combination with a pond, creek or spring, comprised about 50 percent of the rural water sources. Public water systems provide the primary source of water for about 41 percent of the rural residents.

It is estimated that 22 percent of the rural residents experience a shortage of water for domestic and, or, agricultural uses. Water shortages for household uses are most common and affect about 14 percent of the population. Water shortages for dairy operations and irrigation activities collectively affected about 13 percent of the population. About 10 percent of the water shortages are caused by sources that are temporarily or permanently dry. For about 9 percent a source of water was lacking. (See Figure 4).

Some rural water supply problems have been caused by activities associated with mineral production and competition from larger users. Exploitation of energy producing resources has altered local water tables and contaminated water supplies in the Kanawha coal fields and Pocatalico subbasin. On a potentially larger scale, the competition for water between established rural users and new residents in rural subdivisions and municipalities looms as the major water supply problem, particularly in Putnam County, the most rapidly developing county in the Basin.

For an increasing proportion of the Basin population, water for domestic uses, has, and will be supplied by public water systems. Data for the sources of water supplied to housing units indicate a change from the traditional self-supplied sources to system supplied water. As recently as 1980, 70-percent of all units built during the previous decade had system supplied water (Table 5). This trend, common to the subdivision pattern of construction and growth, will continue and intensify the dual burdens of greater distribution and supply capability on existing public water systems and their sources of water.

FIGURE 4


UNITY WATER SUPPLY PROBLEM AREAS
D
ipal Water
n PSD
SD
Point Pleasant
OHIO RIVER
Whitesville
3
1
Eccles
Fork
Clear
Spruce Fork
Workman Creek
Rock Creek
Sandlick Creek
Marsh Fork
Peachtree Creek
Drew Creek
RALEIGH
BOONE
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FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
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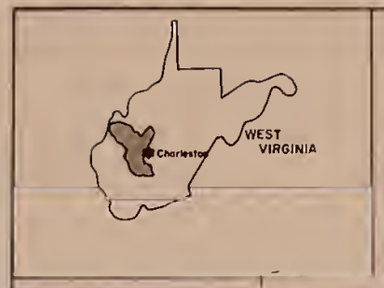
WEST VIRGINIA
5 0 5 10 15
SCALE IN MILES

FIGURE 4



COMMUNITY WATER SUPPLY PROBLEM AREAS

1. South Boone PSD
2. Keith Water
3. Whitesville Water
4. Leon Water
5. Buffalo Water
6. Hurricane Municipal Water
7. Lake Washington PSD
8. South Putnam PSD
9. Winfield Water

WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
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FOREST SERVICE

LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES

Table 5
NUMBER OF HOUSING UNITS AND SOURCES OF WATER, 1970 AND 1980
Lower Kanawha River Basin, West Virginia

Category	1970	1980	Percentage Change
Number of housing units	160,121	197,871	+ 24
Sources of water			
public or private system	116,330	147,526	+ 27
well	37,649	43,750	+ 16
other	6,076	5,775	- 5

SOURCES: U.S. Census of Housing, 1970, 1980," General Housing Characteristics" and "Detailed Housing Characteristics," West Virginia, U.S. Department of Commerce, Bureau of the Census.

In 1982, an estimated eight public water systems had marginally adequate treatment and distribution capabilities due mainly to inadequate physical plants. Widespread interruptions of service can be expected as seven public systems have had problems maintaining adequate water supplies from existing sources due to a combination of factors which include natural and manmade deterioration, dry weather and withdrawals above regenerative capacity (Table 6).

Table 6
COMMUNITY WATER SYSTEMS WITH PROBLEMS
Lower Kanawha River Basin

NEEDS / COMMUNITY SYSTEMS	Inadequate Raw Water Source	Inadequate Distribution Storage	Inadequate Treatment Capacity	Inadequate Treatment Process/Deficient Water Quality	Inadequate Transmission System	Other
South Boone PSD	X (E)		X (E)	X (E)	X (E)	X 1 (E
Keith Water		X (E)		X (E)		X 2
Whitesville			X (E)		X (E)	
Leon Water	X (E)			X (E)		
Buffalo Water	X (E)			X	X(E)	
Hurricane	X				X	X 3
South Putnam PSD	X					
Winfield Water	X			X	X (E)	
Lake Washington PSD	X			X		X 3

X - Denotes problems/needs in a particular category.
(E) - Problems are or anticipated to be addressed through existing programs.
1 - System needs upgrading/renovation.
2 - Need new distribution system.
3 - Reservoir silted in/needs to be cleaned out to increase storage.

Source - West Virginia Department of Health.

Keith Water System

The Keith water system is a small community system supplied by an individual well with a wooden storage tank. Health problems associated with the Keith water system are a result of poor operation, such as failure to fill the chlorinator. Other problems result from high iron concentration and leaky pipes.

Whitesville Water System

Whitesville obtains its raw water source from the Big Coal River. The distribution system is in reasonably good shape and is not a high priority. The major problem at Whitesville is the dilapidated treatment plant and the need to expand the service around Whitesville.

Leon Water System

Leon obtains water from one well and a treatment plant. The well produces water extremely high in iron and some manganese. The treatment plant is not big enough to adequately treat the high levels of iron. The well capacity is also limited; however, treatment limitations are the main priority.

Buffalo Water System

The primary supply source is a small stream (Cross Creek). Stream supplies are sufficient most of the year, but during low flows, the supply is supplemented from a well. The supplemental water supply from the well is high in iron. The treatment plant is probably sufficiently large at present; however, it will probably not handle any expansion and is not setup to handle the treatment of iron. Therefore, the water quality decreases when supplies are drawn from the well source.

Winfield Water System

Winfield obtains its water from a surface impoundment. Problems associated with an inadequate water supply, similar to those at Winfield, also exist for Hurricane and South Putnam. In addition, there is a manganese problem during periods of low water as the manganese is suspended in the lower levels.

Lake Washington PSD

The source of raw water for the Lake Washington PSD is an impoundment that is highly polluted with sediment. Quality problems similar to the three previously mentioned systems exist for the Lake Washington PSD; in addition, drought periods pull water levels down resulting in manganese problems. Domestic pollution enters the impoundment from neighboring houses as a result of malfunctioning septic systems which leach and/or drain into the lake.

Also, the stability of the dam has been questioned in the event of a 100-year storm. The spillway may not be large enough to handle the excessive runoff. Break away splashboards have been installed, but no other modifications to the reservoir are expected for another 5-10 years.

Hurricane Water System

An impoundment provides the primary supply source. The impoundment is sometimes recharged from two or three wells. Additional water is purchased from South Putnam PSD.

The primary problem is a reduced storage capacity resulting from sediment deposition. The treatment plant produces good water but needs to be upgraded.

South Putnam PSD

The supply source is an impoundment supplemented by water purchased from the West Virginia Water Company. The impoundment is too small to fulfill South Putnam's own needs, yet water from this source is currently being sold to Hurricane and Winfield. The impoundment is subject to contamination from diesel fuel spills from the nearby railroad and nearby I-64 Truck Stop. The truck stop has treatment ponds that drain into a stream that feeds the reservoir.

South Boone PSD

The South Boone Public Service District provides water supply service to two large areas of Boone County. The system actually consists of two or three smaller sub-systems that were originally old coal company systems that were turned over to the public agency. The primary problem with this system is that it is old and poorly maintained. The water source also contains high concentrations of iron, manganese, hydrogen sulfides, and sporadic bacterial contamination.

PROBLEMS ADDRESSED

In the nine communities experiencing water supply problems about 60 percent of the documented problems are being, or are anticipated to be, addressed through existing funding assistance programs such as FmHA. Those problems, denoted by subscript (E) in Table 6 for each respective water system, are assumed to be resolved through the existing programs and consequently represent the conditions for the future without plan. These include all the documented problems for the South Boone PSD, Whitesville, and Leon water systems. In addition, the inadequate supply source at Buffalo, inadequate distribution storage at Keith, inadequate treatment process at Keith, and needs for expanded distribution at Buffalo, Hurricane and Winfield, are assumed to be resolved through existing programs.

Those water system problems not expected to be addressed through existing programs represent the remaining needs. These needs involve the development of new or additional supply sources, upgrading treatment processes or facilities, and the replacement of existing distribution systems. They include the problems associated with the water systems in Keith, Buffalo, Hurricane, South Putnam, Winfield, and Lake Washington.

In addition to the above problems, many small community systems financed years ago by the Farmers Home Administration (FmHA) have reached or have exceeded their design life without completing payments to the lending institutions. It is anticipated that some of these community systems will experience failures due to wornout treatment plants. Increased funding levels may be necessary to replace the plants or provide portable water systems during emergency periods.

An underlying factor of water supply problems has been the increased demand for domestic water due to the growing number of new housing units which typically have more water using appliances. Per capita water needs for rural domestic users were projected to rise to 100 gallons per day from the estimated current level of about 85 gallons per day. For urban domestic users, the projected per capita use was expected to rise to 125 gallons per day from the estimated current level of 100 gallons per day. By the year 2000, the projected total daily water withdrawal for domestic uses will be about 38 million gallons per day.

In addition to greater quantities of water being used, the pattern of water demand has changed. Greater reliance on system supplied water has concentrated the withdrawals of existing water resources, rendering them less reliable and inadequate. Extensive groundwater reserves, in the past, were more than adequate for the wells relied upon as the primarily water source by the dispersed rural population. Adequate surface and groundwater reserves exist basinwide; however, the recharge rates for many local water sources are, or will be, inadequate to match the rise in demand. New water sources, with the capacities to serve the growing water needs of expanding public water systems, are needed.

Water used for manufacturing activities accounts for the largest category of daily water withdrawals; 129 mgd, of which 27 mgd are consumed. All but three percent of these totals are associated with manufacturing activities in the Charleston metropolitan area where surface water withdrawals from the Kanawha River are the primary sources of water. Due primarily to the high incidence of water reuse and recycling by the chemical industry, no large increases in water quantities used by manufacturing are expected.

Power production requires extensive water for cooling and evaporation. Recent estimates for the John Amos Power Plant in the Basin indicate a maximum intake capacity, or withdrawal of 194 mgd and an average daily consumption use of 42 mgd. No sharp rise in the amount of water used for power production is anticipated.

Comparisons of current water uses (Table 7) to the average flow of the Kanawha River at Charleston, West Virginia, indicate a substantial surplus of water under varying conditions. If the total consumption and evaporative use is compared to the daily average flow equaled or exceeded 90 percent of the time, the surplus is 1,632 mgd. The surplus which would result from the same level of usage drawn from the 7-day - 50-year low flow would be about 372 mgd. Because of this surplus and the apparent lack of problems associated with manufacturing and industrial uses, these uses were not addressed in this report.

Table 7
CONSUMPTIVE AND EVAPORATIVE WATER USE
Lower Kanawha River Basin, West Virginia

Major Uses	Water Withdrawal (mgd.)	Consumptive and Evaporation Water Use * (mgd.)	Flow Rates of the Kanawha River at Charleston
Rural domestic **	11	11	:Daily Average Flow
Rural agricultural	1	1	:equalled or exceeded
Urban domestic ***	27	27	:90% of the time, 1,740 mgd
Manufacturing	129	27	:7-day 50 year low
Power	194	42	:flow, 480 mgd.
Total	362	108	

* Data from Kanawha River Basin Comprehensive Study, Vol. I, Main Report, Pages 3-11.
** Data are for the total population within the hydrologic boundaries of the Basin, except for Putnam and Kanawha Counties
*** Data for Putnam and Kanawha Counties only.
Source - USDA, Economic Research Service.

The previous comparisons assumed that all water needs could be met from surface supplied water from the mainstem Kanawha River. And this is, and will be, the situation for the larger users of water in the Basin. However, many water needs, particularly for domestic uses, are supplied by local water sources. These points are too far away from the vast surface water reserves of the mainstem for the River to be used economically. In many parts of the Basin, surface and groundwater reserves have been, and will be, adequate to meet the local needs. Exceptions are the communities with rapidly growing populations and marginally adequate water service caused by the changed nature of demand, and inadequate distribution systems stemming from less than optimum facilities and water reserves.

WATER QUALITY CONCERN

Various water quality problems exist throughout the Basin. These problems are associated with sedimentation, domestic pollution (sewage), mine drainage, industrial discharges, chlorides, dissolved oxygen, and domesticated animal wastes. Water quality problems were identified by comparing existing parameters and indicators of water quality to standards of allowable water quality set by the State of West Virginia. Whenever existing parameters failed to meet the State standards for that parameter a problem (violation) was determined to exist. Major water quality problems were determined to exist when tests consistently indicated a high frequency of water quality sampling stations exceeded State standards.

Water quality data were collected from August 1981 through May 1982 for the Lower Kanawha River Basin Study.

Water quality samples were taken from 692 sampling stations located near the mouth of each named stream in the Basin. Unnamed streams were also sampled where activities such as construction, mining, or oil and gas drilling were obvious, or if the stream had visible water quality problems.

Temperature, dissolved oxygen, pH, and conductivity parameters were recorded for each sample site from hydrolab readings. Readings of conductivity (greater than 350 micro-ohms) and pH (less than 6.0 or greater than 9.0) along with visible factors (such as iron precipitation) were used to determine if samples for laboratory analysis were to be collected. Laboratory analysis included testing for iron, manganese, aluminum, nitrates, sulfates, and chlorides. In addition, watersheds with human inhabitants were also tested for fecal coliform bacteria using millipore coli-counters.

Once data collection was complete, Table 8 was prepared showing the numbers of sampling stations and types of violations of State standards for each watershed/segment. This represents the types and relative magnitude of the violations observed (Reference Lower Kanawha River Basin 303(e) Report).

Table 8
Summary of Water Quality Data
(Present Condition)
Lower Kanawha River Basin

Segment Name (No. Sites Sampled)	Major Pollutants	No. (%) With Violations Per Segment	Percentage of Sites in Violation of West Virginia Stream Quality Standards								
			Nitrates	Sulfates	Mn	Fe	Al	pH	DO	Coliform	Chlorides
Kanawha River (160)	Fecal Coliform	54 (33.8)	0 (0)	2 (1.2)	1 (0.6)	2 (1.2)	0 (0)	0 (0)	38 (23.8)*	23 (14.4)*	0 (0)
Heizer Creek (29)	Abandoned Mine Drainage	9 (31.0)	0 (0)	4 (13.8)	3 (10.3)	8 (27.6)*	0 (0)	6 (20.7)*	0 (0)	1 (3.4)	0 (0)
Pocatalico River (186)	Chlorides - Fecal Coliform	42 (22.6)	0 (0)	4 (2.2)	2 (1.1)	0 (0)	0 (0)	6 (3.2)	1 (0.5)	15 (8.1)*	16 (8.6)*
Coal River (28)	Fecal Coliform	14 (50.0)	0 (0)	0 (0)	0 (0)	1 (3.6)	0 (0)	0 (0)	3 (10.7)	11 (39.3)*	0 (0)
Little Coal River (41)	Fecal Coliform, Mine Drainage	27 (65.8)	0 (0)	3 (7.3)	5 (12.2)	8 (19.5)*	0 (0)	0 (0)	5 (12.2)	12 (29.3)*	0 (0)
Big Coal River (63)	Fecal Coliform, Mine Drainage	20 (31.7)	1 (1.6)	7 (11.1)*	1 (1.6)	3 (4.8)	0 (0)	1 (1.6)	0 (0)	10 (15.9)*	0 (0)
Marsh Fork (62)	Mine Drainage	15 (24.2)	0 (0)	8 (12.9)*	4 (6.4)	5 (8.1)	10 (16.1)*	6 (9.7)	0 (0)	3 (4.8)	0 (0)
Clear Fork (29)	Mine Drainage	9 (31.0)	0 (0)	6 (20.7)*	4 (13.8)	1 (3.4)	0 (0)	7 (24.1)*	0 (0)	1 (3.4)	0 (0)
Spruce Fork (47)	Fecal Coliform, Mine Drainage	13 (27.6)	0 (0)	2 (4.2)	1 (2.1)	3 (6.4)	1 (2.1)	3 (6.4)	0 (0)	1 (17.0)*	0 (0)
Pond Fork (47)		6 (12.8)	0 (0)	2 (4.2)	1 (2.1)	0 (0)	0 (0)	2 (4.2)	0 (0)	2 (4.2)	0 (0)
TOTAL (692)		209 (30.2)	1 (0.1)	38 (5.5)	22 (3.2)	31 (4.5)	11 (1.6)	31 (4.5)	47 (6.8)	86 (12.4)*	16 (2.3)

*High frequency of violations.
Source - W.Va. Department of Natural Resources, Water Resources Division.

SEDIMENTATION

Sedimentation, the most prominent water quality problem in the Basin, is discussed in the Erosion and Sedimentation Concerns Section of this report.

DOMESTIC POLLUTION (SEWAGE)

Eighty-six of the water quality sampling stations tested for fecal coliform, which is used as an indicator of domestic sewage, were in violation of State standards. Coliform counts ranged up to 84,000 colonies per 100 milliliters. Anything over 200 colonies per 100 milliliters is a violation of State standards.

Approximately 12.4 percent of all sampling stations exceeded State coliform standards. The highest incidence of violations (39.3%) occurred in the Coal River from the mouth to the confluence of Little Coal and Big Coal Rivers. The Little Coal River had the next highest incidence at 29.3% followed by Spruce Fork - 17.0%; Big Coal River - 15.9%; and tributaries to the main Kanawha River at 14.4%.

This indicates a relatively widespread problem in the Basin with the highest incidence within the Coal River Subbasin. This problem appears to be the result of inadequate sewage treatment at the many small communities in this Subbasin.

According the the EPA Construction Grants Priority List published in 1984 by the West Virginia DNR Division of Water Resources, West Virginia DNR, for 1984, there were 23 community areas in need of sewage treatment projects in the Basin. Four of these, Nitro, Sissonsville, St. Albans, and South Putnam, are presently under construction. It is probable that two more, Danville and Glen White - Trap Hill, may be funded in the near future; however, it may be years before the others reach full funding approval. This is based on the fact that over the past ten years only seven projects, totaling 12.7 million dollars have been completed in the Basin. This is an average of 0.7 projects per year at an annual expenditure of 1.27 million dollars. At this rate it would require between 30 and 40 years to complete the 19 projects not yet under construction. It is apparent that a need exists to accelerate funding and the rate of installing sewage treatment facilities throughout the Basin. (See Addendum)

MINE DRAINAGE

Water quality problems associated with mine drainage are most prevalent on Heizer Creek, and most of the major streams in the Coal River Subbasin (See Figure 3). Parameters used as an indication of mine drainage pollution include pH, iron (Fe), manganese (Mn), and sulfates.

The most significant mine drainage problem is on Heizer Creek. Acid conditions violated the State standard (pH 6.0 - 9.0) at almost 21 percent of the sites tested. In addition, iron concentrations

FIGURE 3

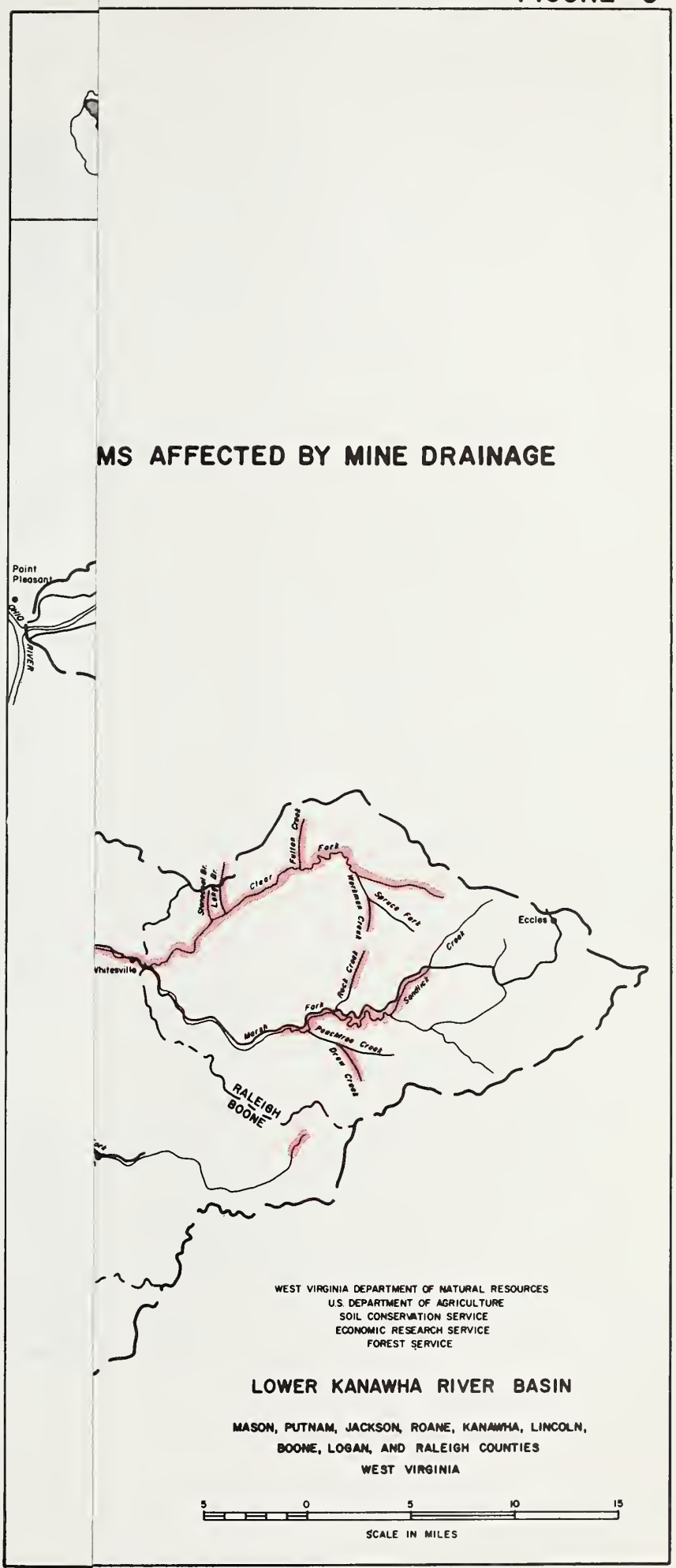
MS AFFECTED BY MINE DRAINAGE
Point Pleasant
OHIO RIVER
Clear Fork
Fulton Creek
Spruce Fork
Eccles
Whitesville
Marsh Fork
Peachtree Creek
Drew Creek
RALEIGH
BOONE
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
5 0 5 10 15
SCALE IN MILES

FIGURE 3

STREAMS AFFECTED BY MINE DRAINAGE

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ECONOMIC RESEARCH SERVICE
FOREST SERVICE

LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES

violated the State standard for iron (> 1.0 mg/l) in 27.6 percent of the samples taken. The incidence of violation for manganese was 10.3 percent and sulfates were excessive at 13.8 percent of the sites tested. The source of mine drainage in Heizer Creek and its major tributary of Manila Creek is from abandoned, deep, and surface mines. Nearly all of these mine lands are classified as priority III sites under the AML Program. Because they do not constitute an imminent danger to health or property, and have not been proven to be affecting groundwater supplies, these areas are not prime candidates for reclamation. One priority I site and five priority II sites have been identified through the AML Program for this area. The priority one site is a one acre project to correct portal drainage that is causing a slide. Of the five priority II sites identified, three involve slides (27 acres), one involves a spoil area (29 acres), and one involves portal drainage (1 acre). While these projects may alleviate some mine drainage problems locally, the overall affects with regard to water quality improvement in the Basin will be minimal.

The Coal River subbasin is one of the major coal producing areas of West Virginia. Coal mining has been ongoing for over a century. Coal has been, and is still being, removed by both surface and deep mines. It is likely that much of the mine drainage pollution originates from some of the older mines; however, negligence on the part of existing mine operators in operating treatment facilities and in noncompliance with permits, is also responsible for some mine drainage pollution. According to a report published by the U.S. General Accounting Office, problems with permit noncompliance is widespread throughout the Nation. The Environmental Protection Agency (EPA) is concerned that if the permit program continues to exhibit its present high noncompliance rates, dischargers may lose further incentives to operate treatment facilities in accordance with permits, knowing that little or no effective enforcement will occur. This report indicates that a need exists to encourage cooperation between State agencies responsible for mining activities in an effort to bring about better enforcement of the existing permit system.

INDUSTRIAL DISCHARGES

Toxic organic discharges, primarily from chemical and plastic manufacturers, are mainly found along the Kanawha River mainstem. The Ohio River Valley Water Sanitation Commission (ORSANCO) is the primary toxic waste discharge sampling and testing agency. Tests results obtained by ORSANCO over the past several years indicate a significant decline in organic pollution in the Kanawha River. Improvement in water quality, as related to toxic wastes, is further verified by W.Va. Department of Natural Resource's fishery population studies that show both increased fish species diversity as well as greater total populations. Fish tissue samples tested for toxics have indicated a lack of these substances.

With the National Pollution Discharge Elimination System (NPDES) recently assumed by the State, and in conjunction with the Clean Water Act administered by EPA, it is probable that the decreasing trend in toxic wastes will continue. Therefore, the present toxic waste control system appears to be adequate at this time. No further consideration of toxic wastes will be considered in this report.

CHLORIDES

Chlorides presently appear to be the major pollutant in the Pocatalico River drainage area with violations exceeding State standards (100 mg/l) in 16 out of 186 sampling stations, 8.6 percent. All of these violations, ranging up to 2010 mg/l, occur within a 6 to 7 mile radius of Walton, which adds to the significance of the problem.

Historical water quality data indicates that high chloride concentrations have been a long standing problem in the Walton area. The release of highly concentrated salt brines in association with early gas and oil drilling activities were thought to be the cause of this problem. However, data collected between 1975 and 1982 at Lanham, West Virginia, were inconclusive in showing that gas and oil drilling activities were responsible for chloride pollution in the Pocatalico River at Walton.

A need exists to collect additional water quality data that can be used to determine the source of chloride pollution.

DISSOLVED OXYGEN

Insufficient dissolved oxygen (< 5.0 mg/l) was found to be a problem in tributary streams in the lower portion of the Kanawha River, primarily in Mason and Putnam Counties. Tests indicated an incidence of violations in approximately 23.8 percent of the samples. It would appear that most of the streams affected flow through flat agricultural land and may be related to agricultural activities. A study is currently underway to determine the cause of this problem. No further discussion of dissolved oxygen as a pollution indicator will be considered during this Study.

ANIMAL WASTES

Farm animal waste pollution, although of local concern, is not considered to be a major problem throughout the Basin. The West Virginia Agricultural Water Quality Management Plan indicates that there are approximately 16 dairy operations, 22 swine operations, 30 feedlots, and 4 miscellaneous farm operations that contribute significant amounts of animal waste pollution to local streams. The majority of these operations are located along the Kanawha River in Mason or Putnam Counties. Although the local streams initially receiving wastes from these operations are often highly polluted, once this pollution reaches the Kanawha River it is diluted and disseminated into the river water in relatively safe concentrations.

If the diminishing trend in agricultural production continues, this concern would not appear to become worse in the future; however, a need exists to minimize existing pollution caused by animal wastes in local streams.

PROBLEMS ADDRESSED

Several water quality problems were addressed during this study. Those problems included areas of poor water quality caused by the discharge of untreated or poorly treated domestic wastes into the Basin's streams; areas where drainage from mines causes a deterioration of water quality; areas of high chloride concentrations in the Pocatalico River Subbasin; and localized stream pollution from animal wastes. These problems are considered to be more severe in respect to water quality and will be explored in depth to determine if potential solutions exist.

The other pollution problems of industrial discharges of toxic wastes and a lack of dissolved oxygen in tributaries to the Kanawha River in Mason and Putnam Counties have not been addressed to the point of exploring solutions. Industrial discharges were omitted from consideration because this type of pollution is decreasing in the Kanawha River and seems to be well under control by existing State and Federal laws. The problems associated with insufficient dissolved oxygen was dropped from further consideration because a study dealing specifically with this problem is currently underway, and any further study under this project would be a duplication of effort.

OTHER CONCERNS

Several other concerns were given a cursory evaluation during this study. However, they were not studied in detail because they were incorporated in the concerns that were studied in detail; they were isolated concerns and not Basinwide in scope; or there was insufficient public concern to deal with them as major problems.

LAND USE CONCERNS

Unregulated land use changes contribute to the many land and water resource problems of the Basin. Commercial and residential expansion has accounted for much of the changed land use. Pressures to develop more land are expected to mount as the population growth and physical expansion of suburban and rural areas continues. This trend is most apparent in Putnam County, where subdivisions are being created at a rapid rate to provide homes for Charleston and Huntington commuters. Residential and commercial construction in the Basin has created new sources of erosion and sedimentation, and placed increased demand on water distribution systems and sewage facilities. Surface mining, especially in the Coal River drainage, has also accounted for accelerated erosion and sedimentation, as large areas of forest land are being converted to mined land.

Institutional innovations for the objective management of land and its uses are urgently needed in the Basin. However, in spite of the many problems brought about by the extensive land use changes that have occurred, many residents oppose land use control or zoning, as they perceive such controls as an infringement on their rights.

RECREATION CONCERNS

A major concern associated with recreation is the maintenance and further development of the existing recreational opportunities that occur in the Basin. Evaluation of the Basin's outdoor resources indicates that a market exists for recreation and tourism. Although development of this market has occurred, the potential has not been fully realized. Facilities available in the Basin offer a wide range of activities and services; however, recreation supply has not caught up with demand. According to information contained in the State-Wide Comprehensive Outdoor Recreation Plan,[5] recreation opportunities in Planning and Development Region 3, are not sufficient to meet current demand. This region consists of Putnam, Kanawha, Clay, and Boone Counties, which includes the bulk of the Basin. Need exists for increasing high density use areas at the local level, new acquisition and development of community recreation resources, and renovation and revitalization of existing developments. Deficiencies occur in several recreation activities, including the number of developed campgrounds, regulation golf courses, and swimming pools. As the demand for recreation facilities increases, overuse of recreational areas is becoming an increasing problem. Heavy use results in soil compaction, destruction of vegetation, and disruption of the outdoor experience. The lack of local and State monies to develop and operate recreational facilities is perhaps the basis for recreation shortcomings.

FISH AND WILDLIFE CONCERNS

Loss of fish and wildlife habitat is a concern in the Basin. Many streams have reduced fishery capability because of pollution. The principal sources of pollution effecting the fishery resource are heavy metals and sediment from coal mining operations, chemical waste from heavy industries, and bacterial contamination from malfunctioning or nonexisting sewage treatment systems. Access to most of the streams, rivers, and impoundments is controlled by private landowners. As sources of pollution are abated, increased use of waterways for fishing and other recreation will occur, and the problem of public access will increase.

Due to diverse habitat conditions, the Basin is rich in both game and nongame species; however, habitat loss for these species is a significant problem. Wetland and riparian habitats, the most productive habitats, are being lost at an alarming rate. Pressure to drain wetlands and clear vegetation for development is intense. Access

to wildlife resources for hunting and nonconsumptive uses is largely controlled by private owners. Expansion of WV DNR Wildlife Division management activities is hampered by insufficient funds and manpower.

SOLID WASTE CONCERNS

Much solid waste in the Basin is disposed of in streams, over steep banks along roadsides, on former strip mine or sawmill sites, on abandoned roads, and on many other environmentally unacceptable sites. Nearly all dumps are found in rural areas because urban areas are usually serviced by some type of organized disposal system. In addition to being aesthetically offensive, solid waste often pollutes surface and groundwater with leachate. Land for sanitary landfills is difficult to obtain due to public opposition.

REFERENCES

1. Controlling Erosion on Construction Sites, United States Department of Agriculture - Soil Conservation Service, Bulletin #47.

2. National Rural Abandoned Mine Program Manual, United States Department of Agriculture - Soil Conservation Service, December, 1979.

3. Abandoned Mine Inventory - Priority 1 & 2, West Virginia Department of Natural Resources, Mine Reclamation Division.

4. Controlling Erosion on Construction Sites, United States Department of Agriculture, Soil Conservation Service, Bulletin #347, December, 1970, page 4.

5. Statewide Comprehensive Outdoor Recreation Plan, Governors Office of Economic and Community Development, Chapter IV.

CHAPTER 3
SUGGESTED PLAN

INTRODUCTION

Four alternative plans that would solve or minimize the problems discussed in Chapter 2 were analyzed during this study. These plans are discussed in Chapter 5 and include: 1) A no project alternative, 2) National Economic Development (NED) alternative, 3) Environmental Quality (EQ) alternative, and 4) Combination alternative that considers both national economic development and environmental quality.

The State of West Virginia suggests that Alternative No. 4 be adopted by local planners and residents for further consideration in solving, or reducing, identified land and water resource problems. The USDA concurs with this suggestion. This plan consists of a reasonable blend of economic development measures and environmental quality measures that would impact on major project concerns, if implemented. It was selected from the alternatives described in Chapter 5 under the direction of the Field Advisory Committee after considerable consultation with planning specialists from all levels of government. The primary reason for suggesting implementation of this plan is its ability to deal with both the economic and environmental concerns of the Basin at costs considered reasonable over the implementation period. Based upon professional judgment and public opinion, measures in the Suggested Plan best meet the needs of the Basin.

Prior to the implementation of any measures in the Suggested Plan, detailed planning studies and designs to determine specific types and sizes, costs, and economic feasibilities will be needed. Federal and State planners can provide assistance for additional studies of specific measures at the request of local governments. The Suggested Plan establishes the framework for the necessary Federal, State, and local cooperation needed to bring about better management of the Basin resources through the implementation of this plan.

Costs and benefits were estimated using a 1982 price base, unless noted otherwise. These costs and benefits can be updated by using the U. S. Department of Commerce's Construction Cost Composite. Using this index, the 1982 prices should be multiplied by a factor of 1.09 to estimate 1985 costs.

PLAN MEASURES

The Suggested Plan consists of measures that will help alleviate the major Basin concerns of flood prevention, erosion and sedimentation, water supply, and water quality.

FLOOD PREVENTION

Flood prevention measures included in the Suggested Plan (See FIGURE 5) are identical to the flood prevention measures included in Alternative Plan 4 described in Chapter 5 of this report. These measures consist of (1) Upper Rocky Fork Channel Work; (2) Marsh Fork Channel Work; (3) Danville-Madison Channel Rehabilitation; (4) Greenview-Sharples Channel Rehabilitation; (5) Sylvester-Whitesville Channel Rehabilitation; (6) Van-Clinton Channel Rehabilitation; (7) Rock Branch Nonstructural Plan; (8) Flood Plain Management Studies; and (9) National Flood Insurance Studies. These measures are described in greater detail below.

Upper Rocky Fork Channel Work

The Upper Rocky Fork channel work flood prevention measure would be located in Shamrock Village, a small residential community immediately southeast of Cross Lanes, in Kanawha County.

The planned work consists of clearing and snagging debris and sediment from 2,410 feet of Rocky Fork and 180 feet of Howard Fork to reduce flood damages in Shamrock Village. Approximately 1.5 feet of sediment along with numerous trees, stumps, and logs would be removed from the channel area. (See following sketch).

The work is estimated to cost $159,400. This cost includes $92,200 for construction, $13,800 for engineering, $26,800 for project administration, and $26,600 for real property rights. Amortization of this cost at the interest rate of 8-3/8 percent over the 100-year design life yields an average annual cost of $14,700, including an O, M. & R cost of $1,300. Average annual benefits of $15,700 would be generated by the work producing a benefit to cost ratio of 1.1 to 1.0.

Marsh Fork Channel Work

The Marsh Fork channel work flood prevention measure is located at Fairdale, West Virginia, near the center of Raleigh County approximately 13 miles west of Beckley.

The most cost effective measure in this area would appear to consist of clearing and grubbing approximately 13,000 feet of the Marsh Fork channel through Fairdale. This work would consist of removing sediment, debris, and vegetation that impedes flood flows from the immediate channel area. Material removed would be properly disposed of in accordance with State law and stabilized with a good stand of vegetation.

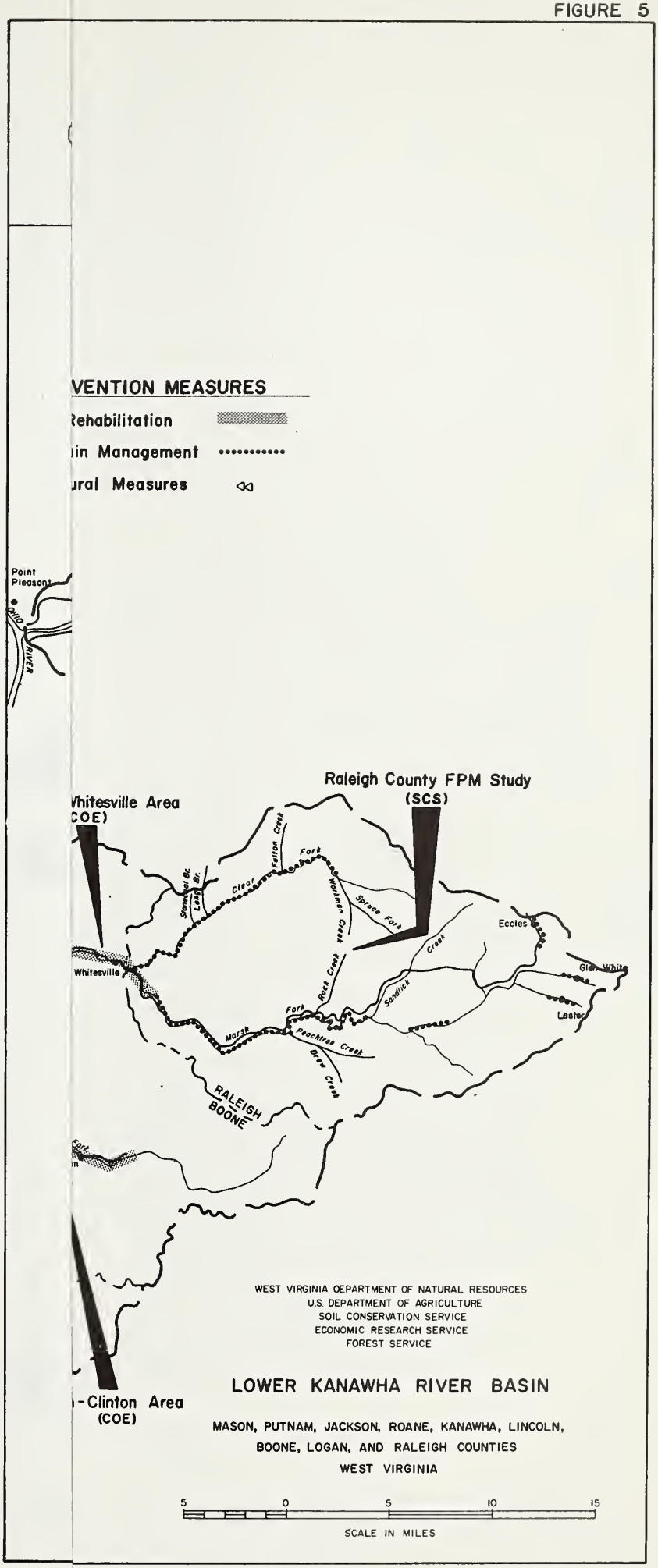
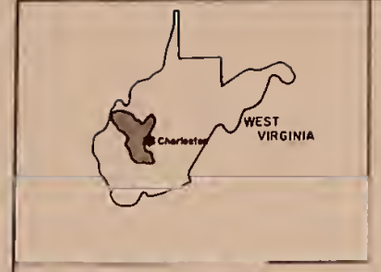

VENTION MEASURES
Rehabilitation
in Management
ural Measures
Point Pleasant
OHIO RIVER
Raleigh County FPM Study
(SCS)
Whitesville Area
(COE)
Fulton Creek
Fork
Workman Creek
Spruce Fork
Clear
Stewart Br.
Laurel Br.
Eccles
Creek
Whitesville
Rock Creek
Sandlick
Fork
Marsh
Peachtree Creek
Drew Creek
RALEIGH
BOONE
Glen White
Lester
-Clinton Area
(COE)
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
5 0 5 10 15
SCALE IN MILES

FIGURE 5



N

ROANE
JACKSON
KANAWHA
MASON
PUTNAM
LINCOLN
BOONE
LOGAN
RALEIGH

Walton
Liberty
Sissonville
Pocatalico
Point Pleasant
Leon
Confidence
Winfield
Buffalo
Nitro
Saint Albans
Dunbar
CHARLESTON
South Charleston
Hurricane
Racine
Whitesville
Madison
Horton
Sharples
Eccles
Glen White
Lester

Shamrock Village Area (SCS)

Hack Branch Area (SCS)

Danville-Madisan Area (COE)

Greenview-Sharples Area (COE)

Sylvester-Whitesville Area (COE)

Raleigh County FPM Study (SCS)

Van-Clintan Area (COE)

FLOOD PREVENTION MEASURES

- Channel Rehabilitation
- Flood Plain Management
- Nonstructural Measures

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U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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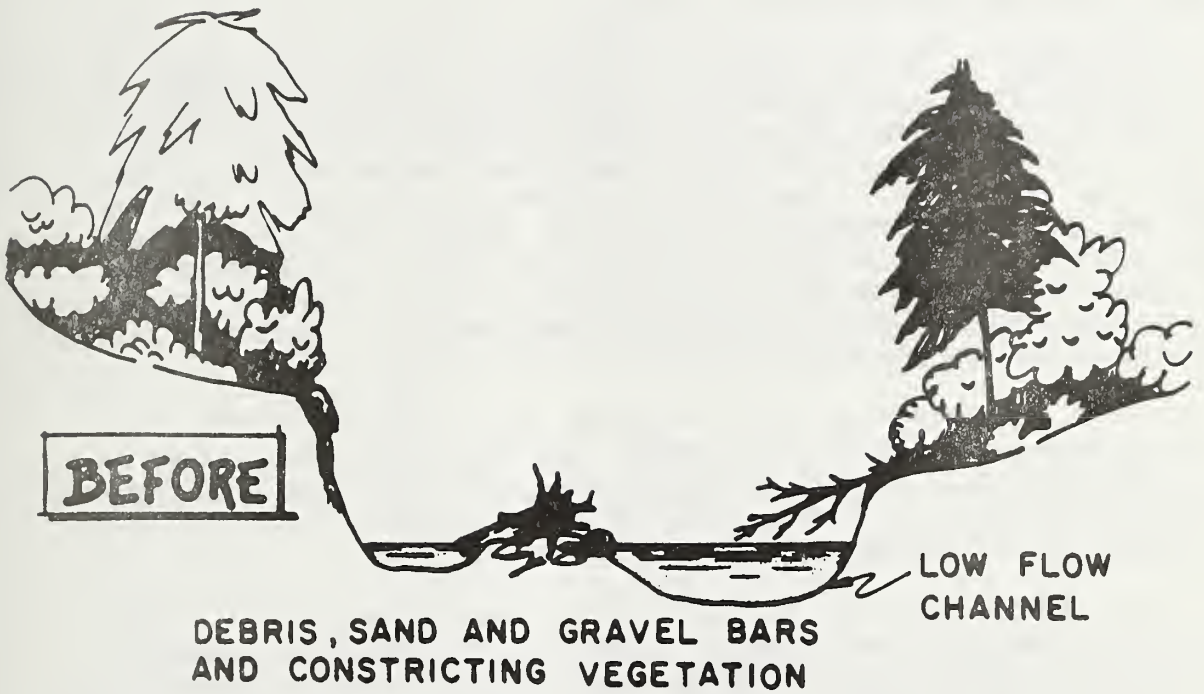
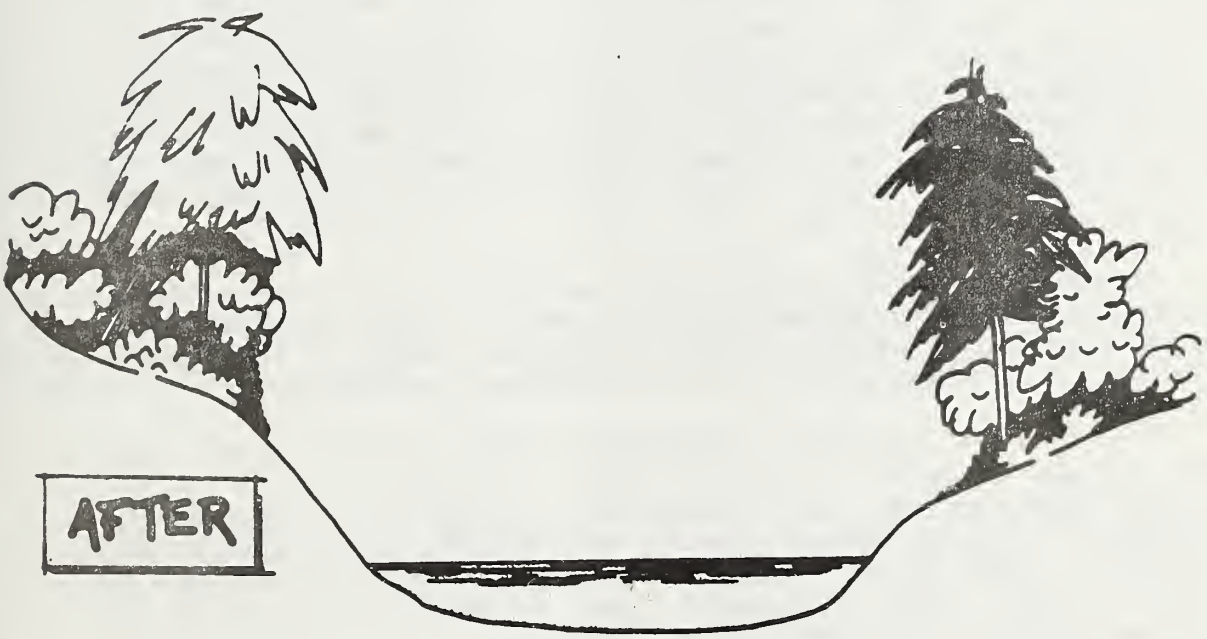
LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES





Sketch of Clearing and Snagging

Preliminary estimates indicate that the work would cost approximately $160,700. This cost includes $124,800 for construction costs, $16,200 for engineering and design, $8,700 for supervision and administration, and $11,000 for real property rights-of-way. Annual costs, including an O, M, & R cost of $3,000, are about $16,500. Benefits attributable to this work average approximately $226,200 annually, producing a benefit to cost ratio of better than 15 to 1.

Danville-Madison Channel Rehabilitation

The Danville-Madison channel rehabilitation measure is located in the Boone County cities of Danville and Madison. The major purpose of this work is to protect these cities from frequently occurring floods. The work would begin on the Little Coal River approximately 2 miles downstream from Danville and extend upstream about 4.3 miles, through Madison to the confluence of Pond Fork and Spruce Fork, then up Pond Fork about 6.5 miles and Spruce Fork about 2.2 miles. The communities of South Madison, Price Hill, Foch, Uneeda, and Quinland are located within the project limits on Pond Fork, and Washington Heights and a portion of Madison are within the Spruce Fork reach.

Channel rehabilitation, consisting of channel shaping and restoration along Little Coal River and Pond Fork and selective clearing and removal of debris, snags, logs, and trash from within the channel and along the banks of Spruce Fork, appears to be the best method of protecting the Danville-Madison area.

The channel shaping and restoration measures along Little Coal River and Pond Fork would consist primarily of removing a number of sand and gravel bars, most of which appear as islands during periods of low flow. Approximately 144,000 cubic yards of sand and gravel material would be removed along Little Coal River and 153,000 cubic yards along Pond Fork. Excavation within the stream channel would be relatively shallow. Selective clearing and pruning of some vegetation on 113 acres would be accomplished including 37 acres along Little Coal River, 60 acres along Pond Fork, and about 16 acres along Spruce Fork. Approximately 58 acres of the vegetation is along the east bank with the remainder along the west bank. Stone (riprap) would be placed along about 6,900 linear feet of the project for bank stability.

The project would require the acquisition of rights-of-way easements on 316 acres of which about 30 acres would be disposal area. Acquisition of land in-fee, relocations, modifications of structures, utilities, or transportation facilities would not be required.

This work is estimated to cost approximately $2,746,600. This cost includes $2,080,800 for construction, $416,200 for engineering and project administration, and $249,600 for real property rights-of-way easements. Average annual costs are $255,100. Average annual benefits, resulting from reducing flood damages at 251 residences, 11 businesses, and other structures, are estimated to be $257,500 producing a 1.0 to 1.0 benefit to cost ratio.

Greenview-Sharples Channel Rehabilitation

This measure is located on the Little Coal River between the communities of Greenview and Sharples in Boone and Logan Counties. Other communities along this reach of stream that this measure would protect are Ramage, Secoal, Jeffrey, Ottawa, Clothier, Coal Valley, Mifflin, and Debra.

The most cost effective method of providing interim flood protection for this area includes selective clearing and removal of debris, snags, logs, and trash within the channel and along the banks of Spruce Fork and the removal of major bars. The project would begin a short distance downstream from Greenview and extend upstream to a point above Sharples, a total distance of about 10.4 miles.

Within the project limits, clearing and pruning vegetation would be accomplished on 20.9 acres along the west bank, 26.4 acres on the east bank, and 2.8 acres on islands. Growth on the streambanks is from moderate to dense, and fairly uniform throughout the reach. Approximately 45,000 cubic yards of sand and gravel material would be excavated from the channel.

In the area between Ottawa and Clothier, where trout are stocked for migration into Spruce-Laurel Fork, more stringent and selective clearing and pruning practices would be employed. Prior to initiation of construction, a representative of the Department of Natural Resources would mark vegetation to be left in place.

The project would require easement acquisition of 100 acres of rights-of-way easements along the streambanks and 5 acres for the disposal area. No relocations or modifications of structures, utilities, or transportation facilities would be required.

The Greenview-Sharples channel rehabilitation work is estimated to cost approximately $447,200. About $327,100 is for construction activities needed to install the measure; $64,800 for engineering and project administration, and $55,300 for real property rights-of-way easements. Average annual costs are $54,100.

The measure would protect approximately 285 residences, 12 businesses, and several other structures, including transportation facilities to some degree. Average annual benefits attributable to protecting these structures are estimated to be $76,000 resulting in a benefit to cost ratio of 1.4 to 1.0.

Sylvester-Whitesville Channel Rehabilitation

This measure is located in the communities of Sylvester, Elk Run Junction, Janie, and Whitesville along the Big Coal River in Boone County, and Pettus and Eunice along Marsh Fork in Raleigh County.

The best means of providing interim flood protection for this area includes selective clearing and removal of debris, snags and logs, and trash within the channel and along the banks of Big Coal River and Marsh Fork, with selective removal of islands in the channel at

Sylvester. The project would begin downstream from Sylvester and extend upstream about 4.4 miles to the mouth of Marsh Fork through Elk Run Junction, Janie, and Whitesville, and thence up Marsh Fork past Pettus and Eunice, a distance of about 2 miles.

Within the project limits on Big Coal River, some vegetation would be cleared and pruned on 20 acres on the west bank and 17 acres on the east bank, and about one acre of major bars would be cleared. Approximately 22,000 cubic yards of sand and gravel material would be excavated from the channel. The Marsh Fork reach would involve some clearing and pruning on 22 acres of streambank. The bank areas to be affected are about equally divided along both banks.

The project would require the acquisition of 93 acres of rights-of-way easements along the streambank and about 2 acres for disposal areas. Acquisition of land in-fee will not be required. Further, no relocations or modifications of structures, utilities, or transportation facilities would be required.

Estimated costs of installing the Sylvester-Whitesville channel rehabilitation work is $368,900. This cost includes $245,700 for construction, $49,100 for engineering and project administration, and $74,000 for real property rights-of-way easements. Total annual costs are $41,100, including $10,200 annually for O, M, & R.

Average annual benefits of $33,700 would result from protecting 107 residences, 4 businesses, 1 industry and several other facilities. Comparing benefits to costs produces a ratio of only 0.8 to 1.0; however, this fails to include additional flood plain development that has occurred in recent years. If new developments had been included, the current benefit to cost ratio would be nearly 1.0 to 1.0.

Van-Clinton Rehabilitation

The Van-Clinton rehabilitation measure is located in the communities of Van, West Junction, Bob White, Cazy, Kohlsaat, Marthatown, Birn, Wharton, Pondes, Barrett, and Clinton scattered along the flood plain of Pond Fork of the Little Coal River upstream of Madison in Boone County.

The channel rehabilitation measure selected as the best means of providing interim flood protection for these communities consists of channel shaping and restoration. The potential work would begin just downstream from the community of West Junction and extend upstream to a point just above Clinton, a total distance of about 11.3 miles.

The principal channel shaping and restoration work consists of removing sand and gravel bars, and islands from the stream channel in conjunction with minor removal of debris, snags, logs, and trash and selective clearing. Selective clearing and pruning of some vegetation would be accomplished on 17 acres on the west bank, 20 acres on the east bank, and 6 acres on islands would be cleared. Frequently, only

one or the other bank would be affected. Approximately 216,000 cubic yards of material would be excavated from the channel.

The project would require the acquisition of 189 acres of rights-of-way easements of which about 22 acres would be for disposal area. Acquisition of land in-fee will not be required. Further, no relocations or modifications of structures, utilities, or transportation facilities would be required. Stone (riprap) will be selectively placed along approximately 3,400 linear feet of the project for bank stability.

Total installation cost of this measure is estimated to be $1,725,900. This cost includes $1,316,200 for construction, $260,600 for engineering and administration, and $149,100 for real property rights-of-way easements. Average annual costs are estimated to be $167,200, including an O, M. & R annual cost of $22,600.

Benefits to this measure would accrue from reducing flood damages presently occurring to approximately 447 residences, 13 businesses, and other structures including highways. Total average annual benefits are estimated to be $159,500, and do not include additional benefits from recent developments. These developments would increase total benefits by more than $165,800 annually and raise the benefits part of the ratio to over 1.0.

Rock Branch Nonstructural Plan

The community of Rock Branch is located immediately upstream where Rock Branch crosses under State Highway 62 approximately 1.5 miles west of Nitro in Putnam County.

This measure would consist of nonstructural methods to protect nine buildings on the Rock Branch flood plain. Three mobile homes would be relocated to flood free areas in the general vicinity. Two frame houses would be raised about 1.5 feet. A garage and two car washes would be modified slightly to allow them to flood with minimal damage, and the Exxon Service Station would be allowed to flood with damageable items placed above flood depths.

The estimated cost of this plan is $93,100. This cost includes $70,000 for construction; $3,700 for engineering; $15,400 for project administration; and $4,000 for real property easements. Annual costs are estimated at $13,200, including O, M, & R.

Average annual benefits attributable to protecting the nine structures are estimated at $17,300 resulting in a benefit to cost ratio of 1.3 to 1.0.

Flood Plain Management Studies

This measure would consist of developing flood plain management studies for approximately 112.3 miles of flood plains in Boone, Lincoln, and Logan Counties. These flood plains consist of ribbon-like

development that renders justification of other flood prevention measures essentially impossible. The studies would result in reports that present detailed hydraulic data and management options that could be used by local governments to better manage flood plain areas.

The cost of preparing these studies is estimated to be $650,000. Monetary benefits attributable to flood plain management studies were not evaluated.

National Flood Insurance Studies

This measure would develop detailed hydraulic data for use by the Federal Emergency Management Agency in converting the incorporated cities of Danville, Madison, Sylvester, and Whitesville to the regular phase of the flood insurance program.

The total development cost for the detailed hydraulic data was estimated at $236,600. Monetary benefits attributable to participation in the regular phase of the flood insurance program were not evaluated.

EROSION

Erosion control measures consist of accelerating the reclamation of abandoned coal mine lands, stabilization of critically eroding roadbanks, protecting construction sites during urban development, and applying erosion control practices on forest access roads and grazed forest land.

Abandoned Coal Mine Lands

This measure consists of reclaiming 3,100 acres of abandoned coal mines, mainly Priority I, II, and III.

Reclamation would consist of the following:

1. The backfilling of portals, tunnels, and excavated areas with adequate suitable material to prevent human entry and eliminate or significantly reduce toxic acid mine drainage.

2. Extinguish burning refuse piles.

3. Level, grade and compact refuse and spoil materials to blend with the surrounding contours in order to eliminate highwalls, pits and gullys.

4. Install drains, culverts, sediment and debris basins in order to divert and control runoff and to minimize erosion on the reclaimed lands.

5. The addition of topsoil and other additives to insure proper plant growing medium.

6. Establish the proper vegetation to achieve desired land use.

Technical assistance would be provided by the Soil Conservation Service and by the West Virginia Department of Natural Resources. These agencies would provide the technical assistance to insure proper location, planning and design in addition to supervising and inspecting the installation of structural measures.

Roadbank Stabilization

Roadbank stabilization measures would be applied to approximately 800 acres of primary and secondary roadbanks. These measures would consist of the following:

1. The backsloping and grading of the roadbank to a stable slope.

2. Implementation of seeding, fertilizing and mulching of the slopes to establish vegetation.

The WV DOH, SCS, and Soil Conservation Districts would provide assistance necessary to insure proper installation, treatment and maintenance.

Construction Sites

Land which is cleared prior to construction is a source of excessive erosion and sedimentation. Under the suggested plan, the SCS; FS; and WV DNR, Division of Water Resources would assist State and county governments in the formulation, drafting and passage of erosion and sedimentation control regulations. Erosion control measures would be applied to approximately 3,200 acres of annual construction in the Basin. Actual installation costs of structural control measures would be the responsibility of the contractor, developer and landowner. Consultive technical assistance would be provided under Public Law 46 by Soil Conservation Districts and other State agencies already established to insure proper implementation and installation of control measures. Control measures should include:

1. Installation of diversion ditches, sediment and debris basins, and culverts, to control surface water during and after construction.

2. Temporary seeding of areas that will be dormant for extended periods (topsoil stockpiles, spoil piles, etc.).

3. Developing large tracts in small workable units on which construction can be completed rapidly so that large areas are not exposed for extended periods of time.

Forest Land Access Roads and Livestock Grazing

The planned forest land treatment work will reduce the erosion rate on 2,122 miles of forest land access roads and on 6,600 acres of forest land grazing. The planned treatment would be applied on critically eroding areas of Kanawha, Mason, and Putnam Counties. USDA Forest Service and WV Department of Natural Resources would provide the technical assistance necessary to insure proper location, implementation, installation and maintenance treatment.

WATER SUPPLY

Water Supply measures included in the Suggested Plan are the same water supply measures included in Alternative Plan 4, Chapter 5. These measures include (1) Keith Water System; (2) Buffalo Water System; (3) Hurricane Water System; (4) South Putnam PSD System; (5) Winfield Water System; (6) Lake Washington PSD System; (7) Portable Water Treatment Plant; (8) Groundwater Protection Strategy; and (9) Water Use Conservation Measures. These measures are described in detail below:

Keith Water System

This plan suggests that a local distribution system be installed in the community of Keith to replace the existing leaky system and that this measure be included on the West Virginia Department of Health priority listing for funds to complete the system.

Installing the distribution system is estimated to cost $200,000. This includes costs for construction, rights-of-way, engineering, and contract administration. Operation, maintenance, and replacement costs are expected to be about $5,500 annually.

Buffalo Water System

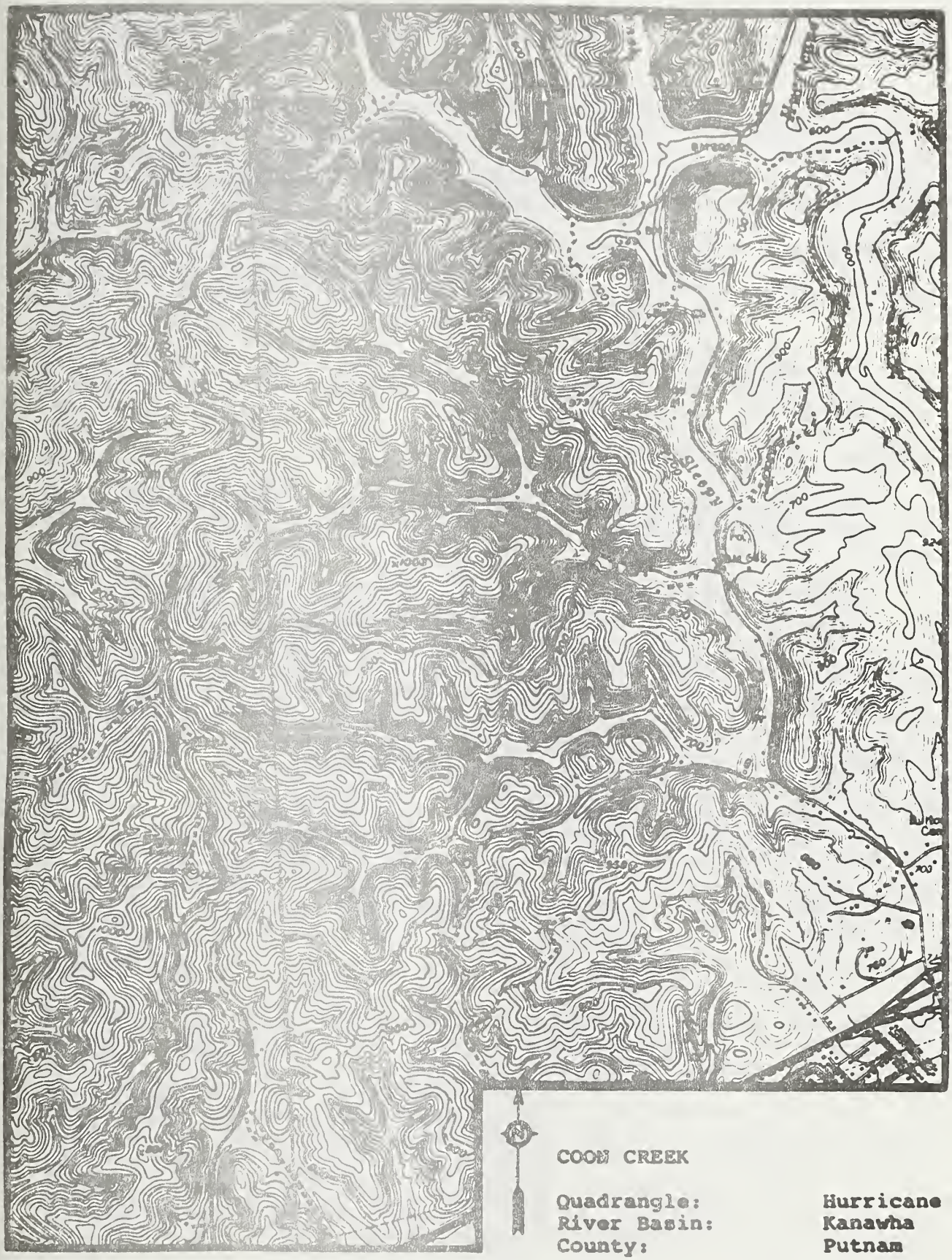
The suggested measure for the Buffalo Water System is to renovate the existing treatment plant to improve its operating efficiency, increase capacity, and provide capability to remove high concentrations of iron from the water source.

Renovation of the treatment plant is expected to cost $75,000, including costs for construction, rights-of-way, and engineering and contract administration. Operation, maintenance, and replacement costs are expected to be about $2,900 annually.

Hurricane Water System

The Hurricane Water System is primarily in need of additional storage capacity. Suggested measures planned to satisfy that need include a new impoundment structure, a transmission line (and a pump station) from the impoundment to the treatment plant, and removing sediment deposits from the existing impoundment.

Impoundment Site Number 12 (Appendix D, unattached) could be evaluated to provide increased capacity for the Hurricane Water System. This site was identified during the Impoundment Site Survey. It is located on Coon Creek at Latitude 38° 26' 26" W and Longitude 82° 02' 14" W, approximately three miles upstream from the Hurricane water treatment plant (See Map 1). The dam could be designed to store 850 acre feet (277 million gallons) of water supply storage at a height of 70 feet. This would create a reservoir of 60 surface acres and provide a year round draft rate of approximately four million gallons per day.[2]



Map 1 - COON CREEK MAP

Installation of the dam is estimated to cost $1,200,000, including the costs for construction, engineering, rights-of-way, and project administration.

Approximately three miles of 8-inch diameter transmission line would be needed to transport the water from the dam to the treatment plant. At a cost of $12 per foot, this line is estimated to cost $190,100. In addition, a $50,000 pumping station would be required to pump the untreated water to the plant.

Removing sediment from the existing impoundment is also recommended as a short-term measure for increasing reservoir capacity by 50 to 100 percent. The cost of removing sediment from the existing impoundment is estimated to be about $25,000.

The total installation cost is estimated to be $1,465,100. Operation, maintenance, and replacement costs are expected to amount to about $20,000.

South Putnam PSD System

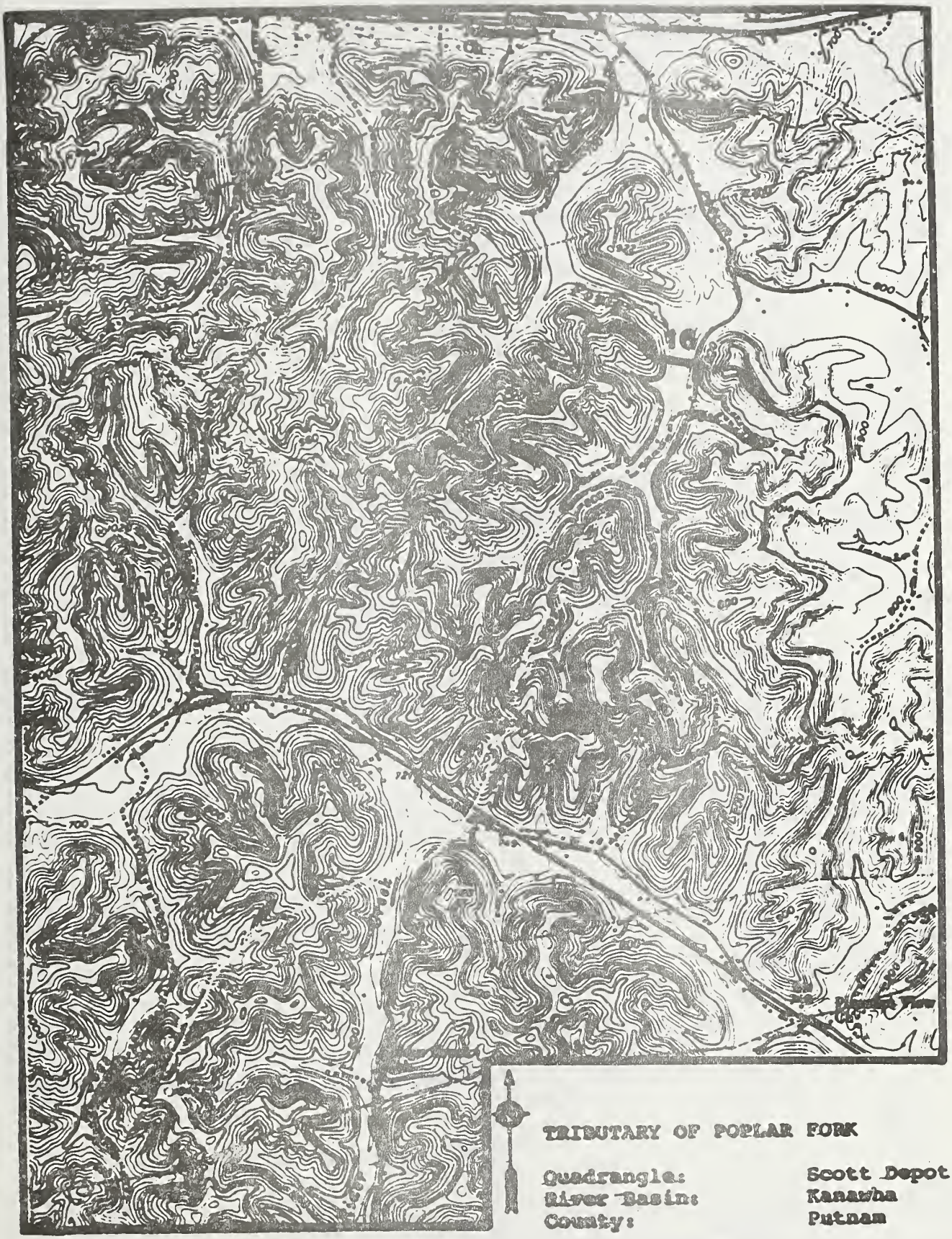
The South Putnam PSD is experiencing similar water supply problems as the Hurricane system - mainly a need for additional storage capacity.

Impoundment Site Number 16, located on a tributary of Poplar Fork at Latitude 38° 25' 33" N and Longitude 81° 55' 50" W (See Map 2) could be used to provide 800 acre-feet (261 million gallons) of additional storage for the South Putnam PSD. This amount of storage would require a dam 60-feet high and provide an annual draft rate of about 3 million gallons per day.[2] In addition to the dam, approximately three miles of transmission line and a pump station would be needed to transport the untreated water from the dam to the treatment plant.

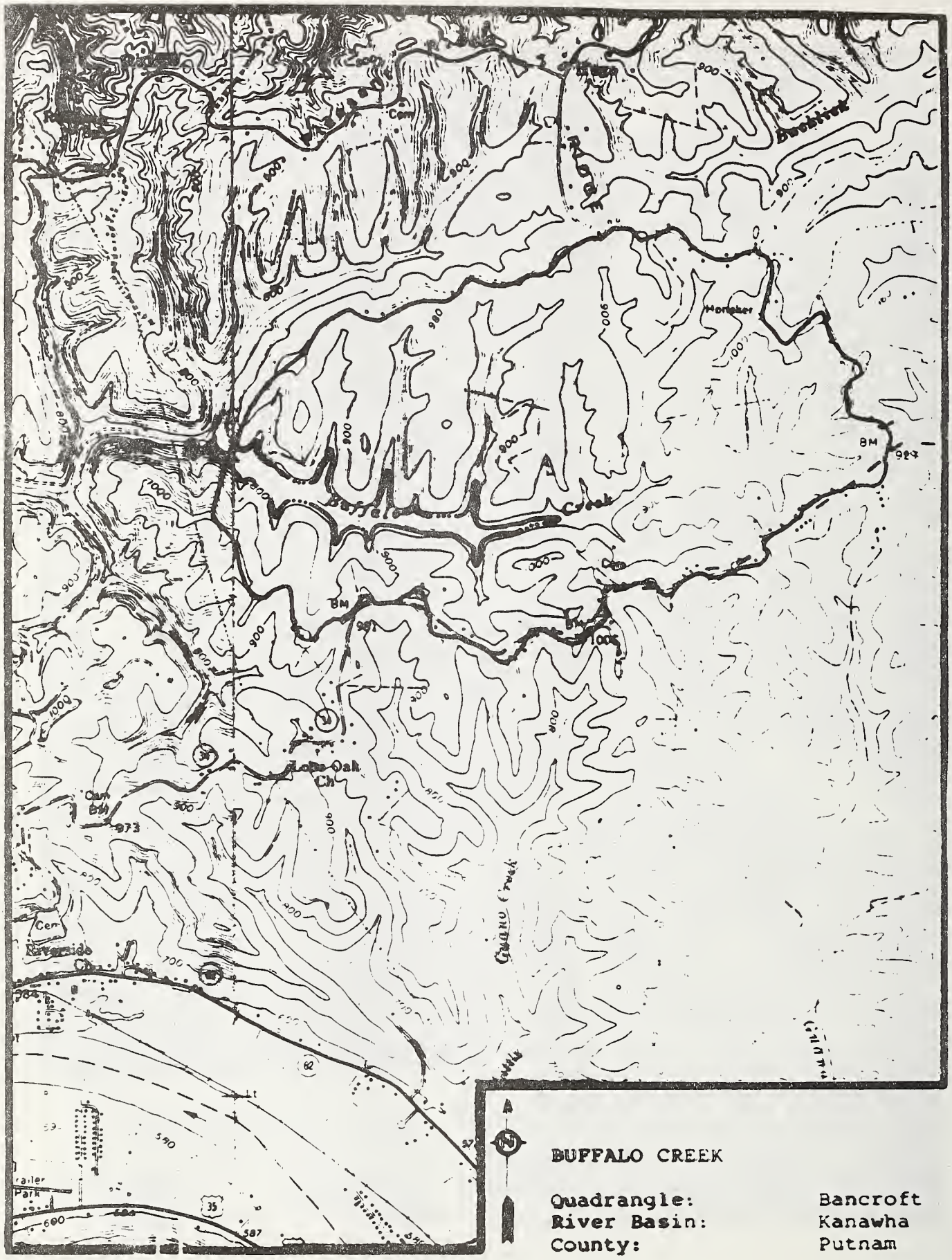
The estimated cost of these improvements is $1,340,100. This cost includes $1,100,000 for the dam, $190,100 for the transmission line, and $50,000 for the pumping station. These costs include construction, engineering, rights-of-way, and project administration. The operation, maintenance, and replacement cost is expected to be around $6,200 annually.

Winfield Water System

The Winfield Water System is also in need of additional water supply storage, and treatment plant renovation. Impoundment Site Number 34 is suggested for use to increase the storage capacity of the Winfield system. This site is located on Buffalo Creek at latitude 38° 33' 34" N and longitude 81° 52' 30" W (See Map 3) across the Kanawha River from Winfield. The dam could be used to store 1,000 acre-feet (325 million gallons) of water supply which would provide a draft rate of about 5 million gallons per day. The dam would have to be about 85 feet high.[2] In addition to the dam, improvements would include about three miles of transmission line, a river crossing, and a pump station.



Map 2 - POPLAR FORK



Map 3 - BUFFALO CREEK

The improvements are estimated to cost $1,478,100 including $1,100,000 for the dam , $328,100 for the transmission line and river crossing, and $50,000 for the pump station. Operation maintenance, and replacement costs are expected to be $6,000 annually.

Lake Washington PSD System

Suggested measures to improve the Lake Washington PSD system include the removal of sediment deposits from the existing water supply impoundment, construction of a new impoundment, renovation of the existing treatment plant, and installation of four miles of transmission line and a pump station to transport raw water from the new impoundment to the plant.

The removal and disposal of 4,000 to 5,000 tons of sediment in Lake Washington would temporarily increase the water supply capacity by approximately 1,000,000 gallons. The estimated cost of removing and disposing of this sediment is $35,000.

A more permanent solution to increase needed storage capacity for the Lake Washington PSD is construction of a new impoundment. Impoundment Site Number 14 located on Little Creek at latitude 38° 27' 10" W and longitude 82° 05' 15" W is suggested (See Map 4). A 75-foot high dam at this location could store 1,600 acre-feet (520 million gallons) which would provide an annual draft rate of about 6 million gallons per day. The estimated cost of installing the dam is $1,150,000.[2]

Renovation of the existing treatment plant is needed to improve its efficiency and provide the ability to better handle manganese and other types of pollutants. Renovation is expected to cost $50,000.

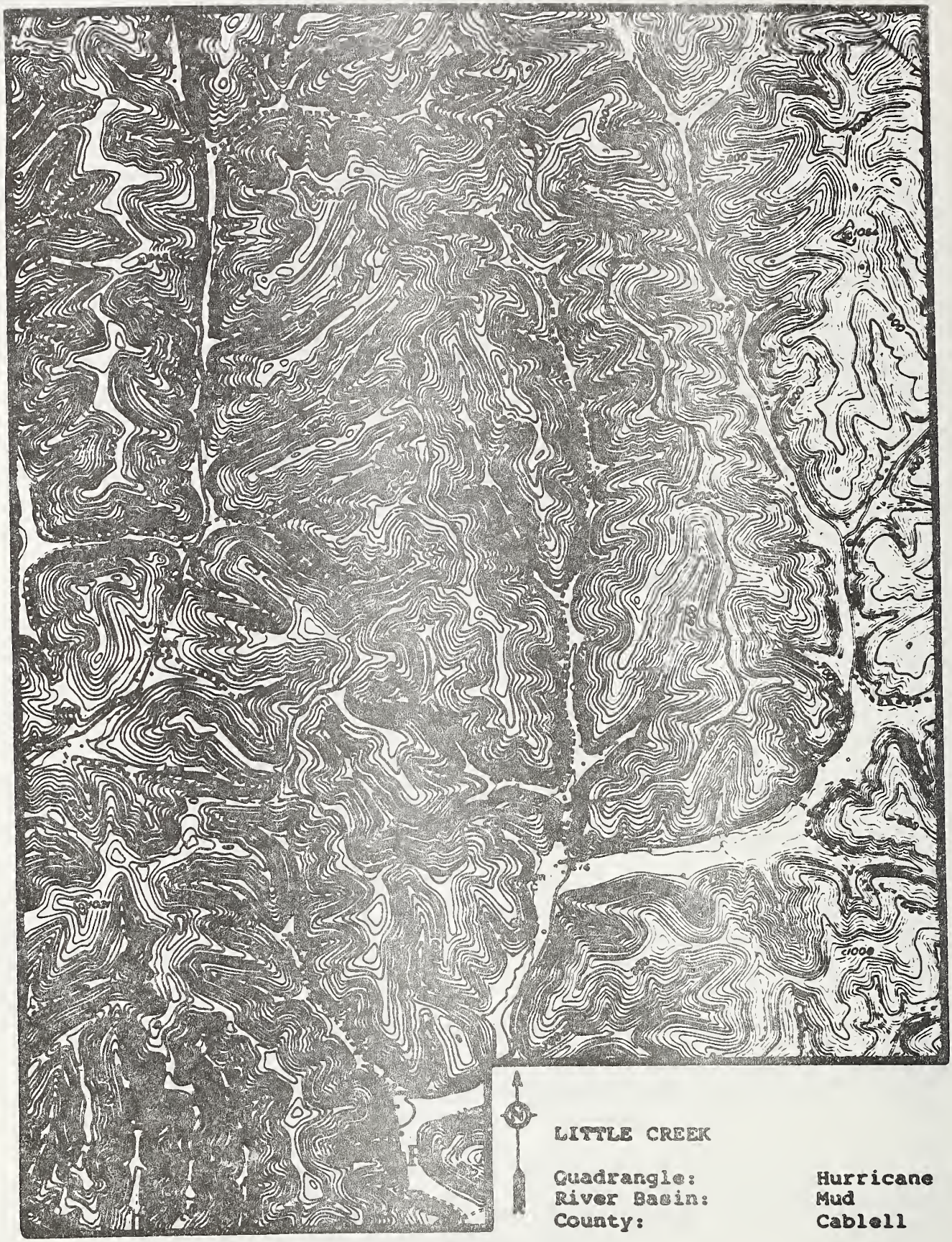
Approximately four miles of transmission line and a pump station would be required to transport the raw water from the new impoundment to the treatment plant. This line would have to be installed over rough terrain and would cost approximately $12.00 per foot or $253,400. The pump station would cost about $50,000.

Total cost of the suggested measures for the Lake Washington PSD is $1,538,400. Operation, maintenance, and replacement costs are expected to be $6,100 annually.

Portable Water Treatment Plant

This plan suggests that a portable water treatment plant mounted on a large tractor trailer be purchased by the Office of Emergency Services for use, primarily during emergency periods, throughout the Basin. The portable plant could be located at Charleston and be on call for use whenever an emergency occurred.

The acquisition of the portable water treatment unit could most likely be justified purely on the basis of emergency disaster relief. This unit could be rapidly moved into a devastated area and assuming adequate supply, could provide potable water at a rate of about 60 GPM



Map 4 - LITTLE CREEK

(system design). Operating for 20 hours per day, one unit would provide 72,000 gallons, or at 30 gallons per person per day, water for about 2,400 persons. In combination, two units would produce double that amount. The cost of treating 72,000 gallons of water on site, at a rate of $.65 per 1,000 gallons, is about $47 per day. If treated water was trucked to the area from an adjacent source the cost would be about $5.00 per 1,000 gallons ($2 purchase fee plus $3 per 1,000 gallon hauling fee) or $360 per day. This daily rate would increase progressively as distances increased.

Piping water to a devastated area from an adjacent source using temporary lines would be even more expensive. A temporary emergency waterline would cost between $20,000 and $40,000 per mile, depending on terrain conditions, and water purchased from the adjacent source would cost an additional $2 per 1,000 gallons.

The use of portable plants to bypass small community water treatment plants, during breakdowns or for performing routine maintenance, constitutes an additional justification for acquiring this unit. At present, a small community system cannot be shutdown for maintenance activities without disrupting service to customers. A 60 GPM portable unit would provide water to about 250 customers at a rate of 100 gallons per customer per day. Costs for maintaining limited supplies of water would be $47 per day using the portable treatment plant versus $360 per day for hauling water. Additional expense would be saved by performing routine or preventative maintenance on the treatment plant facilities, however, no estimate of these savings are available.

The estimated purchase cost of a portable unit is $79,200. Operation, maintenance, and replacement costs are estimated to be $17,200 annually. A breakdown of the costs for the portable unit follows.

PORTABLE WATER TREATMENT PLANT

Trailer Mounted Package Precipitator	$43,000.00
Permutit Package Precipitator	
Tank (Compartmentized)	
Tank Internals	
Agitator and Motordrive	
Sample Points	
Chevron Settlers	
Inlet Flow Meter	
Inlet Control Float Valve	
Single Drop Trailer (40' x 8' x 38")	
Accessories	
Chemical Feeders (Alum, Soda Ash, Chlorine)	$ 3,000.00
Settling Tank (7,000 gal.) and Chlorine Contact Tank (2,000 gal.), mounted and piped	9,400.00
Pumps, Piping, Starters and Wiring	2,300.00
Filters (Simplex) and Accessories	6,500.00
Neoprene Storage Bags (3,000 gal.) - SAT $3,000 each (U.S. Rubber Co.)	$15,000.00
	$79,200.00

Unit Dimensions: 40' x 8' x 14'
Shipping Weight: 6,000 pounds
Operating Weight: 27,700 pounds

Source: Dennis Gregor
August 28, 1984

Nationwide Boiler Incorporated
42400 Christy Street
Fremont, California 94538

Groundwater Protection

The groundwater protection aspects of Alternative 4 are also incorporated into the Suggested Plan. Much of the Lower Kanawha River Basin is considered to be rural, and as a result many of the Basin's residents depend on wells for their water supplies. Because of the importance of groundwater as sources for self-supplied water, consideration should be given to activities that might affect them.

Groundwater in the Basin is most often associated with one of three aquifer types. Coarse-grained sandstone and coal aquifers predominate in the southeastern portion of the Basin, while relatively low-yielding aquifers from fractured shale, coal, fine-grained sandstone, and thin limestone predominate in the northwestern section. Alluvial aquifers are associated with sand and gravel deposits along streams and riverbeds throughout the Basin. Alluvial aquifers have the ability to produce large quantities of water, but due to their close association with the streams, may be easily subject to contamination from waste disposal, nearby surface activities, or from the river proper.

Most wells in the Basin are drilled into rock aquifers. The productivity of these wells is determined by the porosity of the rock and by the presence of faults and fractures near the well site which may serve to store water or ease the amount of flow to or away from the well. Because rock strata in the Basin are nearly horizontal, the recharge of water to the aquifers takes place over large areas and results primarily from rainwater absorbed by overlying soils, from alluvial aquifers, and from surface ponds.

Much of the groundwater in the Basin is of good quality for drinking; however, in some areas groundwater contains varying amounts of sodium chloride (salt), iron, manganese and sulfates. These mineral laden aquifers often lie just under freshwater aquifers and may infiltrate the freshwater if subjected to heavy pumping. Additionally, mining activities, well fracturing and blasting may result in fractures that can facilitate the dewatering of aquifers or allow mineral laden water to infiltrate freshwater aquifers. These activities may also enhance the incorporation of contaminated surface drainage into aquifers, especially if they take place near important groundwater recharge areas.

An aquifer mapping study is being conducted jointly by the WVDNR Division of Water Resources and the U.S.G.S. in conjunction with the Underground Injection Control Program administered through the Division's Hazardous Waste Section. The Basin Atlas will address alluvial aquifers and their recharge areas, water quality and reported yields from private wells, and the relationship between alluvial and bedrock aquifers. The study was completed in late 1984.

This atlas should provide an important data base with regard to the aquifers underlying the lower Kanawha Study Area. In addition to being utilized with regard to underground injection practices, this document should also be consulted when considering other projects or activities that may be detrimental to important groundwater sources.

Investigations of the nature and extent of pollution and physical alterations to the Basin's aquifers should be initiated. A plan for the protection and development of the aquifers is also recommended as part of the groundwater protection plan element. The estimated cost of developing and implementing a groundwater strategy is $350,000.

Water Use Conservation Measures

Water use conservation measures consisting of a public information campaign to encourage individual repair of leaky pipes and dripping faucets, along with the proper use of existing supplies, should be a portion of all water supply plans. These measures are suggested for use in the Lower Kanawha River Basin.

WATER QUALITY

Water quality measures included in the Suggested Plan are the same as those appearing in Alternative Plan 4, Chapter 5. These measures include: 1) the installation of sewage treatment facilities, 2) a

sewage treatment control plan in the Coal River Subbasin, 3) a research and development project for Heizer-Manila Creek, 4) Pocatalico River chlorides identification study, 5) the installation of animal waste management systems, and 6) stronger enforcement action. These measures are described in detail as follows.

Sewage Treatment Facilities

These would be implemented at an accelerated rate sufficient for the installation of the 15 remaining projects in the Basin identified on the 1984 EPA Construction Grants List. These projects represent an expenditure of approximately $53,700,000. In order to install these projects by the year 2000, an annual acceleration of funding would be required from the present $1.27 million per year to about $3.35 million per year or about 2-1/2 times the current trend. This would appear feasible when considering that the Basin contains approximately 20 percent of the State's population but has been receiving only about 3.5 percent of the State's funds for sewage treatment facilities. An acceleration of funding allocations in the future to the Lower Kanawha River Basin area will be necessary if the needs for sewage treatment are to be satisfied. (See Addendum)

A Sewage Treatment Control Plan

This plan for the small ribbon-like communities in the Coal River Subbasin is recommended in conjunction with the need for additional sewage treatment facilities. Nine projects have been proposed in the Coal River Subbasin, involving 15 systems serving 65 communities and nearly 33,000 persons (See Table I). The total cost of these projects amount to about $59,900,000. Only one project, (Danville PSD) serving 5 communities and 4,840 persons is being constructed at a cost of about $6,988,000. This project should be operational in 1986.

TABLE 1
PROPOSED SEWAGE TREATMENT PROJECTS 1/
Coal River Subbasin
1984

Project	Served Communities	Population	Cost
Danville PSD	5	4,839	$ 6,988,000
Coal River PSD (7 systems)	20	6,133	$19,000,000
Boone Raleigh PSD	18	5,000	$ 8,000,000
Spruce Fork	4	2,500	$ 3,700,000
Van	1	3,800	$ 4,000,000
Little Coal River	1	2,200	$ 3,800,000
South Boone PSD	12	5,400	$ 7,512,000
Dorothy	1	1,200	$ 3,800,000
Glen White - Trap Hill	3	1,800	$ 3,100,000
Systems Approved (1)	5	4,839	$ 6,988,000
Systems Proposed (14)	60	28,033	$53,000,000
Systems (15)	65	32,872	$59,900,000

Source: WV Division of Water Resources, Construction Grants Branch.

1/ In accordance with the new West Virginia Municipal Strategy (April 1984), all of the projects listed in Table 1, except Danville, have been recategorized as low priority. This recategorization, however, does not preclude the need to investigate alternative methods for addressing sewage treatment problems in the Coal River Subbasin.

The remaining identified needs involve 14 systems serving 60 communities and about 28,000 persons and a projected cost of about $53,000,000. All of these proposals were killed due to strong public opposition within the local project areas. This opposition was largely due to the high cost to the users (monthly user fees were to be in the range of $25/month). Conversely, Water Resources personnel in the Construction Grants Branch maintain that the proposed systems were designed as "bare bones" with little or no room left to incorporate cost reducing alternatives. The possible use of less expensive sewage collection and treatment facilities should be investigated for these and other unidentified communities in the Coal River Subbasin. Additionally, a public education campaign might also be beneficial in reducing the public opposition to proposed projects. The estimated of cost of this study is $350,000.

A Research and Development Project

This is recommended to determine and propose measures to reduce mine drainage from abandoned mines in the Heizer-Manila Creek area of the Pocatalico River drainage. This area, primarily in Putnam County, was once extensively mined and has an abundance of abandoned deep and strip mines as evidence of past activities.

The main goals of the proposed study would be to identify primary mine drainage source areas, determine the types of pollution in which they contribute to the drainage area, and recommend measures to reduce or eliminate them. The study is estimated to cost approximately $50,000.

Pocatalico Chloride Identification Study

A study is recommended in order to identify specific sources of chloride contamination. Monthly chloride data collected at the U.S.G.S. monitoring station at Lanham (Pocatalico River M.P. 12) between 1975 and 1982 failed to show any conclusive correlation between gas and oil well drilling activities and chloride contamination in the upper Pocatalico River near Walton.

Historically, a chlorides problem has existed in the Pocatalico River and is ultimately the result of highly concentrated salt brines occurring near the surface in and around Walton. Salt brines are commonly encountered, when drilling for gas and oil in that area, but are to be contained underground through well casing procedures. Salt brines appearing at the surface of a well are to be collected in the pit, treated, and disposed of according to guidelines specified by the permit. Well fracturing activities may also contribute to the ability of salt brines to reach surface outlets. Other possible sources of chloride contamination may be the result of ground saturation during early era drilling activities when vast quantities of salt brines were released from wells to the ground or pumped into large surface storage ponds, or simply the result of natural seepage.

The inability of the Lanham monitoring station to provide adequate data regarding chlorides in the upper Pocatalico River is largely the result of the location of this station too far down stream from this problem area. The placement of an additional station upstream closer to Walton would reduce the effects of dilution for nonchloride bearing tributaries and would reflect more accurately the relationship between chloride levels and flow rates and drilling activities. This station could be added to the water quality monitoring network at a negligible cost to the program. Additional sampling in the Walton vicinity is recommended to further identify specific chlorides sources. The estimated cost of this study is $60,000.

Animal Waste Management Systems

Approximately 30 animal waste management systems are needed in the Basin. These systems would be used to store, treat, and safely dispose of animal wastes, and to exclude animals from high pollution

contributing areas. Depending on specific site areas, components may include holding tanks, treatment lagoons, ponds, disposal fields, outlet lines, fencing, and a management plan.

The estimated cost of each system would be about $25,000. The total cost of installing the 30 systems would be approximately $750,000.

Additional Surveillance and Enforcement to Meet Water Quality Standards

Enforcement as it relates to discharges from mining activities is recommended to reduce mine drainage pollution in the Basin, especially the Coal River Subbasin.

The employment of two additional inspectors would serve to deter some pollution problems through increased day to day contact. Each new inspector would cost $35,000 per year for salary and support.

In order to address the more severe problems resulting from repeat and negligent violators, more involved legal action, in the form of civil suits, would be necessary. It is recommended that additional legal services be acquired to address these problems. The cost of acquiring these legal services is estimated to be about $60,000 per year.

PLAN EFFECTS

Implementation of the Suggested Plan would reduce, by varying degrees, the major study concerns. Some concerns would be affected significantly; whereas, the effect on other concerns would be slight. Following is a discussion of the effects on each study concern.

FLOOD PREVENTION

Implementing the flood prevention measures in the Suggested Plan would produce both beneficial and adverse effects. Beneficial effects would accrue primarily to the economy of protected communities as a result of reduced flood damage losses and by the creation of employment opportunities. Beneficial effects would also result by a lessening of flood hazards detrimental to the health of Basin residents. Adverse effects would occur both to the economy in the form of costs needed to install the measures and to the environment as a result of earthmoving activities associated with constructing the measures.

Present condition average annual flood damages in the upstream watersheds would be reduced from $3,200,800 to $1,753,900. This amounts to a reduction of $1,446,900, or about 45 percent of existing damage. Approximately 681 residences, 48 businesses, 4 industries, and some miscellaneous structures would be protected to some degree if the Suggested Plan flood prevention measures were installed. Suggested Plan measures would have little or no effect in reducing flood damages along the main stem Kanawha River flood plain.

Construction activities necessary to install the measures would create 34 job opportunities, primarily in the construction industry. Approximately 20 skilled and 14 semiskilled jobs would be needed.

Secondary beneficial effects would include a lessening of flood associated problems which tend to degrade the health and welfare of residents. Inundation of highways would be reduced allowing greater access to hospitals and doctors. Flood depths would be lowered reducing the hazard of drowning. Mud and debris deposits would be reduced improving the visual aspect of the Basin.

Flood plain management and flood insurance options were not evaluated in monetary terms; however, it is anticipated that application of these options would produce beneficial economic effects. The detailed hydraulic data associated with flood plain management reports could be used by local planners in guiding flood plain development to insure that future development is flood free, thus minimizing future flood damage losses. Enrollment in the regular phase of the National Flood Insurance Program would reimburse Basin residents for actual flood damages sustained at premiums based on computed flood depths, which should be less than premiums paid under the emergency program.

Adverse economic effects are associated with the costs of resources needed to install the measures. These costs are estimated to be $6,588,400. This amount includes $5,608,700 to install the structural measures (primarily channel restoration), $650,000 for the flood plain management studies, $236,600 for flood insurance studies, and $93,100 for the Rock Branch nonstructural measures. This cost would average $552,100 annually when amortized at 8 3/8 percent interest over 100-years. Adding O, M, & R costs of $99,300 makes a total annual cost of $651,400. Comparing average annual costs to average annual benefits results in a benefit to cost ratio of 2.22:1.0 for flood prevention measures.

Adverse environmental effects would occur on 285.4 acres of terrestrial habitat and 44.1 miles of aquatic habitat disturbed by construction activities associated with implementing this plan. The vegetative pattern would be modified by the removal of vegetation along the streams. This would result in an associated loss of streambank habitat for riparian and terrestrial wildlife. It is generally accepted that existing habitats are being fully utilized; therefore, the introduction of displaced animals to adjoining habitats will not result in a net increase. The removal of sediment deposits and stream debris will disrupt the aquatic habitat and nesting areas. Stream temperatures will probably increase slightly due to the removal of low canopy. However, the impact on these and other environmental resources is not considered significant because of the limited biological resources and small scope of the Suggested Plan.

EROSION

The implementation of the erosion control measures of the Suggested Plan would produce both beneficial and adverse effects. Beneficial effects of the Suggested Plan would result from:

1. Reduced health and safety hazards of Priority I, II, and III abandoned mine lands,
2. Improved fish and wildlife habitat,
3. Reduced cost and need for stream and reservoir cleanout,
4. Reduced road maintenance,
5. Better agriculture and forest production, and
6. Improved aesthetics.

Adverse effects of the Suggested Plan would be to the economy in the form of installation costs and to the environment as a result of earthmoving activities associated with constructing the measures.

Abandoned Mine Lands

The average cost for an acre of reclaimed Priority I and II mined lands is approximately $10,700. This figure is 30% higher than similar reclamation done on Priority III lands because of hazards that exist on the priority I & II lands. The cost reflected in the tabulation below should allow 190 acres of abandoned mine lands to be reclaimed annually. The sloping, grading, mulching, fertilizing, and seeding of the reclaimed mine lands would reduce the erosion rate by 80 to 90 percent, to a rate within the acceptable tolerance of 4 to 5 tons/acre/year.

	ANNUAL COSTS	TOTAL COST
Installation Costs	$ 2,633,600	$ 31,434,500
Technical Assistance	501,600	5,987,500
	$ 3,135,200	$ 37,422,000

Roadbank Stabilization

Implementation of practices and control measures should reduce the erosion rate by approximately 90% to an acceptable rate of 5 tons/acre/year. Costs would average $1,000 per acre and result in the stabilization of 60 acres annually. Beneficial effects that would occur by the Year 2000 include:

1. Reduction in the maintenance of side ditches,
2. Improvement of the visual aspects of highway driving,
3. Reduction of culvert cleanout activities, and
4. Reduction of road maintenance expenditures by the WV DOH.

	ANNUAL COSTS	TOTAL COST
Installation Costs	$ 67,000	$ 800,000
Technical Assistance	10,700	128,000
	$ 77,700	$ 928,000

Construction

Implementation and enforcement of potential regulations with technical assistance from the appropriate agencies should decrease the erosion rate by 80 to 90% on those lands treated to an acceptable rate of 2 to 3 tons/acre/year. Technical assistance costs of $100,500 would result in 500 acres being treated annually. The cost per acre would vary due to the type and extent of construction.

Control ordinances and measures would not only be beneficial to the environment but also could be beneficial to developers because erosion damage to construction sites must be repaired and can cause delays in construction schedules.

Forest Land Access Roads and Livestock Grazing

This plan would reduce the erosion rate by 80-90% on those lands treated to an acceptable rate of 2 to 5 tons/acre/year. Costs for access roads would average $575 per acre with the costs on grazed forest lands averaging $61 per acre. This would result in the annual treatment of 216 acres of access roads by grading, sloping banks, mulching, fertilizing, and seeding and 571 acres of grazed land by fencing and reseeding.

	ANNUAL COSTS	TOTAL COST
Access Roads		
Installation Costs	$ 122,700	$ 1,464,000
Technical Assistance	5,600	67,000
	$ 128,300	$ 1,531,000
Grazed Land		
Installation Costs	$ 33,500	$ 400,000
Technical Assistance	2,500	29,500
	$ 36,000	$ 429,500

WATER SUPPLY

Implementing the Suggested Water Supply Plan would produce significant beneficial effects throughout the Basin. Approximately 13,000 people in six public service districts covering part of four counties would be provided a dependable supply of potable water at reasonable rates. Rationing of water during drought periods would be a thing of the past.

Installation of the four suggested surface impoundments could provide additional storage capacity of 4,250 acre-feet, or 1,383,000,000 gallons of water. This would nearly be sufficient to eliminate water shortages for the Teays River Valley. This amount of additional storage capacity would be approximately equivalent to a one year supply of water.

The assurance of dependable municipal and industrial water supplies may encourage proper development of land resources instead of the present haphazard development.

The portable water treatment plant would provide flexibility, especially during emergency drought periods, that presently does not exist in the Basin. First, these units would be beneficial for emergency disaster relief by providing a source of potable water to areas devastated by floods, or other events, detrimental to water service. Secondly, during nonemergency periods, these portable units could be utilized as alternative treatment systems to facilitate repairs and/or routine maintenance to the smaller community water treatment plants, without a significant disruption of service to customers.

The groundwater study would provide information that local and State government leaders could use to develop and implement a strategy for the use and protection of valuable groundwater resources, especially in the more rural areas where residents are primarily dependent on wells for their water source. The Basin Atlas will identify alluvial aquifers and their recharge areas, water quality and reported yields from private wells, and the relationship between alluvial and bedrock aquifers. The utilization of this information in locating sites for residential, commercial and industrial developments, and especially for projects dealing with waste disposal, should reduce the impacts that these practices may have on groundwater resources.

The plan measures would generate net economic benefits in excess of $258,000. These benefits were estimated by comparing the cost of plan measures to the cost of providing similar water supply using wells.

Installing the water supply measures in the Suggested Plan would also produce adverse impacts. Installation of the measures would require an expenditure of $6,525,900. Approximately 30 percent of this amount would come from the economic base of the Basin. The remainder would come from various Federal and State grants and loans. It is estimated that spending this amount of money would create approximately 35 temporary jobs and 10 permanent positions.

It would require between 250 and 300 acres of land to install the four dams and impoundments needed to increase storage capacity. Much of this land would be permanently covered by the water supply impoundments and unavailable for most uses except fishing and/or recreation. In addition, the installation of 13 miles of transmission lines and pump stations would temporarily disturb about 20 acres more. Practically all of this land is relatively good terrestrial wildlife habitat. This habitat is used primarily by nongame and small game animals such as rabbits and squirrels, and occasionally by white-tail deer. The impoundments would also inundate between 4 and 5 miles of relatively small streams. These streams provide freshwater aquatic habitat for minnow and small insects. It is unlikely that much prime farmland would be involved by the impoundments because of the narrow valleys to be inundated.

WATER QUALITY

The implementation of the water quality measures in the Suggested Plan would substantially reduce the effects of water pollution in the Basin by the year 2000.

The installation of 15 sewage treatment projects in the study area would complete the projects appearing on the EPA Construction Grants Priority List for 1984. This would considerably reduce the concentrations of coliform bacteria in some of the Basin's streams. The Sewage Treatment Control Plan for the Coal River Subbasin should investigate and identify the most cost effective solutions to sewage problems in that area. The development and implementation of a public awareness/education program should further enable local planners to address domestic pollution problems.

The studies to identify mine drainage and chloride pollution sources on Heizer-Manila Creek and the Pocatalico River, respectively, are the first step in developing plans to reduce these pollutants.

The installation of 30 animal waste systems in the agricultural areas of the Basin would improve farm management, as well as reduce concentrations of animal waste pollution in several first order tributaries to the Kanawha River.

To implement water quality elements in this alternative would require an expenditure of approximately $54,910,000. Construction activities required to install the measures are expected to create 42 skilled jobs and 30 unskilled jobs resulting in unemployment benefits of $1,947,900 annually. Other economic benefits would accrue to this plan; however, it was not possible to compute these benefits during the time allotted to this study.

ABILITY TO SATISFY NEEDS

Implementing the Suggested Plan would satisfy, to some degree, the needs of the Basin associated with the major study concerns (See TABLE 3). The estimated costs of implementing the Suggested Plan are shown in Table 4. All costs and monetary benefits are in 1982 dollars.

FLOOD PREVENTION

Flood prevention measures included in the Suggested Plan have the ability to provide flood prevention for both existing and future conditions. Structural and nonstructural measures suggested for seven Basin communities presently experiencing major flood damages could reduce flood losses in the upstream watersheds by 45 percent. In the specific communities where the measures would be installed flood damages would be reduced between 20 and 67 percent. The following table indicates damage reduction in each community area.

TABLE 2 - DAMAGE REDUCTION
Lower Kanawha River Basin

Community Area	Damage Reduction (Percent)
Danville-Madison	35
Greenview-Sharples	21
Sylvester-Whitesville	24
Van-Clinton	20
Fairdale	67
Shamrock Village	57
Rock Branch	60

Flood insurance, at actuarial insurance premiums, would be made available for all Basin residents. Residents would then have the opportunity to be partially reimbursed (less deductible) for flood losses.

TABLE 3
CAPABILITY OF SUGGESTED PLAN TO SATISFY NEEDS

Measure	Unit of Measure	Needs	Needs Met			
			Alt. 1 No Proj	Alt 2 NED	Alt 3 EQ	Alt 4 Comb
FLOOD PREVENTION MEASURE						
Flood Plain Management Studies	Miles	155.3	43.0	0.0	130.0	130.0
IFLOWS Flood Warning	Counties	6.0	6.0	0.0	0.0	0.0
Flood Insurance Studies	Reports	11.0	7.0	0.0	4.0	4.0
Upstream Flood Damages	Dollars	5,743.5	2,518.4	1,446.9	0.0	1,446.9
EROSION AND SEDIMENT						
Abandoned Mine Reclamation	Acres	10,000	688	0	10,000	3,500
Roadbank Stabilization	Acres	1,075	0	0	1,075	928
Construction Site Tech Asst	Acres	3,200	0	0	3,200	500
Forest Land Access Road Stab	Acres	10,600	85	0	10,600	216
Forest Land Grazing Control	Acres	7,500	0	0	7,500	571
WATER SUPPLY						
Renovated Water System	Number	9	6	6	0	6
Portable Treatment Plant	Number	1	0	1	0	1
Groundwater Aquifer Protect	Study	1	0	0	1	1
Teays Valley Area	System	1	0	0	1	0
WATER QUALITY						
New Sewage Systems	Number	8	8	0	0	0
Animal Waste Systems	Number	30	30	0	30	30
Sewage Treatment Facilities	Number	15	0	0	15	15
Sewage Treatment Control Plan	Study	1	0	0	1	1
Abandoned Mine Research	Study	1	0	0	1	1
Pocatalico Chloride Study	Study	1	0	0	1	1
Enforcement Water Quality	Personnel	3	0	0	3	3

TABLE 4
ANNUAL COSTS OF SUGGESTED PLAN
(Price Base 1982)

PLAN MEASURES	UNIT OF MEASURE	QUANTITY	FIRST COST $	AMORTIZED ANNUAL COST $	ANNUAL O,M,&R COST $	TOTAL ANNUAL COST $
Flood Prevention Measures						
1. Upper Rocky Fork Channel Work	Miles	0.5	159,400	13,400	1,300	14,700
2. Marsh Fork Channel Work	Miles	2.5	160,700	13,500	3,000	16,500
3. Danville - Madison Channel Rehab.	Miles	13.0	2,746,600	230,100	25,000	255,100
4. Greenview - Sharples Channel Rehab.	Miles	10.4	447,200	37,500	16,600	54,100
5. Sylvester - Whitesville Channel Rehab.	Miles	6.4	368,900	30,900	10,200	41,100
6. Van - Clinton Channel Rehab.	Miles	11.3	1,725,900	144,600	22,600	167,200
7. Rock Branch Nonstructural	Structures	9.0	93,100	7,800	5,400	13,200
8. Flood Plain Management Studies	Miles	130.0	650,000	54,500	6,500	61,000
9. Flood Insurance Studies	Reports	4.0	236,600	19,800	8,700	28,500
SUBTOTAL			6,588,400	552,100	99,300	651,400
Erosion & Sediment						
1. Abandoned Mine Reclamation	Acres	3,500	31,434,500	2,633,500	501,600	3,135,100
2. Roadbank Stabilization	Acres	928	800,000	67,000	10,700	77,700
3. Construction Site Technical Assistance	Acres	500	0	0	100,500	100,500
4. Forest Land Access Road Stabilization	Acres	216	1,464,000	122,600	5,600	128,200
5. Forest Land Grazing Control	Acres	571	400,000	33,500	2,500	36,000
SUBTOTAL			34,098,500	2,856,600	620,900	3,477,500
Water Supply						
1. Keith Water System	System	1	200,000	16,800	5,500	22,300
2. Buffalo Water System	System	1	75,000	6,300	2,900	9,200
3. Hurricane Water System	System	1	1,465,100	122,700	20,000	142,700
4. South Putnam PSD	System	1	1,340,100	112,300	6,200	118,500
5. Winfield Water System	System	1	1,478,100	123,800	6,000	129,800
6. Lake Washington PSD	System	1	1,538,400	128,900	6,100	135,000
7. Portable Water Treatment Plant	System	1	79,200	6,600	17,200	23,800
8. Groundwater Aquifer Study	System	1	350,000	29,300	-	29,300
9. Water Use Conservation	Studies	1	-	-	-	-
SUBTOTAL			6,525,900	546,700	63,900	610,600
Water Quality						
1. Sewage Treatment Facilities	Systems	15	53,700,000	4,498,800	423,700	4,922,500
2. Animal Waste Facilities	Systems	30	750,000	62,800	15,000	77,800
3. Abandoned Mine Research	Study	1	50,000	4,200	-	4,200
4. Sewage Treatment Control Plan	Study	1	350,000	29,300	-	29,300
5. Pocatalico Chloride Study	Study	1	60,000	5,000	-	5,000
6. Enforcement of Water Quality			-	-	130,000	130,000
SUBTOTAL			54,910,000	4,600,100	568,700	5,168,800
TOTAL SUGGESTED PLAN			102,122,800	8,555,500	1,352,800	9,908,300

Flood plain management measures for Boone, Lincoln, and Logan counties would provide local government planners with detailed hydraulic data they could use to regulate future flood plain development. Although not evaluated in monetary or numerical terms, the ability to properly guide future flood plain development is important, especially along the narrow flood plains of these counties.

EROSION

Abandoned Coal Mine Lands

AML and RAMP would reclaim 190 to 195 acres per year in the Basin, resulting in 3,100 acres reclaimed by the year 2000, assuming funding is extended beyond 1992. This reclamation would satisfy approximately 31% of the need.

Roadbank Stabilization

Stabilizing and revegetation of 800 acres of roadbanks in the Basin would satisfy 74% of the need.

Construction Sites

Erosion and sedimentation control regulations could satisfy up to 100% of the need. Degree of satisfaction would depend upon level of enforcement as well as the final provisions of the control regulations.

Forest Land

Forest land treatment measures would adequately treat 86% grazed forest land and 24% of eroding forest roads, which would result in an overall reduction of 50% of forest land needing treatment.

WATER SUPPLY

Implementation of the water supply measures in the Suggested Plan would satisfy all of the water supply needs identified in Chapter 2, Table 6, Community Water Systems With Problems, remaining after existing programs have been exhausted. Table 5 indicates needs remaining and the percentage of those needs satisfied by the Suggested Plan.

TABLE 5
PERCENT OF REMAINING NEEDS SATISFIED *
Lower Kanawha River Basin

COMMUNITY SYSTEMS/ / /NEEDS	INADEQUATE RAIN WATER SOURCE	INADEQUATE DISTRIBUTION STORAGE	INADEQUATE TREATMENT CAPACITY	INADEQUATE TREATMENT PROCESS/DEFICIENT WATER QUALITY	INADEQUATE TRANSMISSION SYSTEM	OTHER
Keith Water				X(100%)		X(100%)
Buffalo Water						
Hurricane Water	X(100%)				X(100%)	X(100%)
S. Putnam PSD	X(100%)					
Winfield Water	X(100%)			X(100%)		
Lake Washington PSD	X(100%)			X(100%)		X(100%)

* Remaining needs are those needs remaining after the measures in Alternative Plan 1 have been implemented with existing funds under existing programs.

WATER QUALITY

The installation of 15 sewage treatment facilities in the Basin would satisfy about 50% of the need for these systems.

The installation of 30 animal waste management systems would satisfy all of the need to reduce animal waste pollution in the Basin.

The employment of two additional inspectors and additional legal services should satisfy all the needs for increased enforcement to meet water quality standards in the Coal River Subbasin.

SHORT-TERM VS. LONG-TERM USE OF RESOURCES

Land use trends in the Lower Kanawha River Basin are toward urban development and a decline in agricultural and forest land use. (See Table 3 in Appendix A).

The Appalachian Water Resources Survey Report and the Kanawha River Comprehensive Basin Report both indicate that installation of the Suggested Plan will be compatible with the projected long-term use of the land, water, and other natural resources of the Basin. Development of planned measures will not only help alleviate immediate problems such as flooding and lack of sufficient water supply, but will enhance options available for long-term economic and urban growth. Short-term losses of increased costs of single family residential sites should be offset by decreased flood losses and associated personal suffering.

Cumulative desirable environmental effects within the Basin include the improvement of water quality and wildlife habitat. These effects will result from implmeneting land treatment measures, the maintenance and protection of riparian ecosystems, and to the reduction of stream sedimentation and turbidity. However, encroachment on wildlife habitat will occur in areas where urban development takes place.

This Plan is not expected to correct any environmental problems on a short-term basis. Pollution due to sediment, dust, and smoke is likely to occur during construction but will cease upon completion of planned measures.

Land treatment measures and the channel work will continue to be effective as long as they are properly operated and maintained. The proposed land treatment measures will meet the needs for sustained productivity.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Approximately 605 acres of land will be irreversibly and irretrievably committed to project purposes. Present use of this committed land is mostly idle and rural agricultural. The committed area does not include 57 acres for spoil disposal and 5 acres for equipment parking, since this land will be returned to its previous use.

Labor, energy and capitol resources required for construction and maintenance of measures will be irretrievably committed. This area of West Virginia, at present, has available labor. Approximately $102,122,800 will be committed to the installation of the Suggested Plan elements, while $1,222,800 will be committed annually for operation, maintenance, and replacement.

REFERENCES

1. Abandoned Coal Mine Lands, U.S Department of Interior, USGPO 1979--603-002138.

2. Reconnaissance Report - Water Supply Reservoir Site Study, Lower Kanawha River Basin, U.S. Army COE and GAI Consultants, Inc., October, 1983.

CHAPTER 4
OPPORTUNITIES FOR IMPLEMENTATION

EXISTING PROGRAMS

FLOOD PREVENTION AND WATERSHED PROTECTION

SCS provides technical and financial assistance to State and local organizations to help them plan and install flood prevention and watershed protection projects under authority of PL 83-566. To be eligible for assistance under this program, projects must be sponsored by a local government entity, prove to be economically feasible, and found to meet the best interests of the public. Sponsors must first notify, in writing, the State or area clearinghouse, of their intent to submit an application for assistance. They must then prepare and submit a formal application to the Chairman of the State Soil Conservation Committee at the Guthrie Agricultural Center, Charleston, West Virginia 25305.

All of the flood prevention measures included in the Suggested Plan, with exception of the flood insurance and flood plain management studies, would be eligible for assistance and could be implemented under this program. Although the opportunity for implementation exists under this program, the potential to implement the flood prevention measures in the Suggested Plan under the flood prevention and watershed protection program is relatively low because of higher potential for implementation under the Resource Conservation and Development Program and the Corps of Engineers local flood control program.

RESOURCE CONSERVATION AND DEVELOPMENT

The Resource Conservation and Development (RC&D) Program was authorized by the Food and Agriculture Act of 1962 and is administered by the USDA Soil Conservation Service. The RC&D Program expands opportunities for conservation districts, local units of government, and individuals to improve their communities in multiple county areas. There are five authorized RC&D areas in West Virginia. They are: 1) Potomac Headquarters area, 2) Wes-Mon-Ty area, 3) Mt. Dominion area, 4) Little Kanawha area, and 5) the Great Kanawha area. These areas cover 44 of the 55 counties in the State.

The Lower Kanawha River Basin is mostly within the Great Kanawha RC&D area, with only that portion of the Basin in Roane and Jackson counties in the Little Kanawha RC&D area. Between the two areas, the entire Basin is covered by an authorized RC&D area. As such, sponsors can plan and implement flood prevention measures anywhere within the Basin.

Measures eligible for technical and financial assistance are critical area treatment, flood prevention, land drainage, soil and water management for agriculture with related pollutant control, public water-based fish and wildlife and recreation development, and water quality management. Measures eligible for this type of assistance (1) must provide community benefits, (2) need an RC&D Measure Plan covering the planning area, and (3) must be sponsored by public bodies

or public nonprofit corporations having authority and ability to install, operate, and maintain community-type measures.

A typical RC&D Measure could range from the purchase of seeding materials on a simple critical area treatment measure, to a more complex flood prevention measure which may require construction of a flood control channel or dam. The Upper Rocky Fork channel work and the Rock Branch nonstructural plan are both examples of measures that could be implemented under the RC&D program. Local interest on the Rocky Fork channel work project is high with local sponsors already making application for implementation of this project under the RC&D program.

Although the opportunity exists to implement the other structural flood prevention measures in the Suggested Plan under RC&D, the potential for their implementation under the Corps of Engineers local flood control program is greater.

Other Suggested Plan measures that could be implemented under the RC&D program include the critical area roadbank stabilization measures and the forest land access road stabilization measures; however, a significant funding acceleration would be necessary to implement these stabilization measures.

RC&D programs can provide technical assistance on projects where another source has provided the financial assistance. ACP provides financial assistance for forest land access road stabilization and RC&D could provide technical assistance.

CONSERVATION OPERATIONS

SCS provides technical assistance under authority of PL 97-46 to farmers, landowners, units of local and State governments, groups, and organizations to help them plan, apply, and maintain conservation practices on their land. Assistance is provided primarily to Soil Conservation District cooperators. Soil Conservation Districts cover every county of the State. Cooperation is entirely voluntary and free. Technical assistance available to cooperators consists of detailed soil and land capability maps on which to base land use and treatment decisions, professional assistance in developing long range conservation plans, and engineering assistance in the design, construction, and maintenance of conservation practices on the land.

Opportunities exist under the Conservation Operations Program to assist farmers in developing waste water management systems. Financing for about 50 percent of the total cost of an animal waste treatment system can be obtained, by request, from the Agricultural Stabilization and Conservation Service (ASCS) under authority of PL 74-76, Small Farm Incentive Program.

Technical assistance is also provided to units of government to help them stabilize eroding roadbanks.

FLOOD INSURANCE PROGRAM

This program is administered by the Federal Emergency Management Agency (FEMA) under the authority of the National Flood Insurance Act of 1968, as amended, and the Flood Disaster Protection Act of 1973. The program enables property owners to buy flood insurance at a reasonable cost and in return, their communities are required to carry out local flood plain management measures to protect lives and new construction from future flooding.

The following is a list of communities or counties in the Lower Kanawha River Basin that are participating in the Emergency (E) or Regular (R) National Flood Insurance Program.

Community	Emergency or Regular Program	County(s)
Bancroft	E	Putnam
Buffalo	E	Putnam
Charleston	R	Kanawha
Dunbar	R	Kanawha
Eleanor	E	Putnam
Henderson	R	Mason
Kanawha County	E	-----
Leon	R	Mason
Mason County	R	-----
Nitro	R	Kanawha and Putnam
Poca	E	Putnam
Pt. Pleasant	R	Mason
Putnam County	E	-----
St. Albans	R	Kanawha
South Charleston	R	Kanawha
Winfield	E	Putnam

The Suggested Plan recommended that the flood prone communities of Danville, Madison, Whitesville, and Sylvester participate in the regular flood insurance program. It appears that there is an excellent opportunity for implementing the detailed hydraulic studies necessary to phase these communities into the regular flood insurance program.

FEMA is currently contracting with the U. S. Army Corps of Engineers, Huntington District, to conduct necessary detailed studies needed to convert local communities and counties to the regular program. The Corps is presently completing studies for the unincorporated areas of Kanawha and Putnam Counties. Additional funding will be necessary to study the remaining five communities.

Since participation in the flood insurance is strictly voluntary, local community leaders should contact the State Office of Emergency Services to make application for the program. After the application has been approved and the communities accepted into the program, detailed studies could be conducted for use in setting premium rates. Buying of flood insurance coverage is also voluntary. Flood insurance

will not reduce or eliminate flooding; however, it will partially reimburse individual property owners for losses incurred. In addition, participants in the program may be relieved of some of the anxiety associated with unexpected flood losses since they realize that they will be financially reimbursed for most of the flood damage costs they incur.

FLOOD PLAIN MANAGEMENT PROGRAM

SCS Administers the Flood Plain Management Program under authority of PL 83-566, Section 6, in accordance with BAP-150 Flood Plain Management Studies. Under this program, SCS cooperates with local government leaders in preparing detailed flood data for use by local planners and developers. Local leaders determine the areas to be studied and the type of flood data desired. Flood data may consist of detailed flood maps showing the extent of areas flooded with flood profiles that show the expected depths of various floods. Other data that can be developed may include potential flood free development sites, inventories of economic, historic, and natural resources, and a subjective evaluation of the relative potential of minimizing flood damage using various flood plain management options. SCS technical specialists would provide technical assistance to local leaders in developing the above data.

There is an excellent opportunity to implement the 130 miles of flood plain management studies in the Suggested Plan under this program. To be eligible for assistance, county and local government leaders would have to make application to the SCS State Conservationist at 75 High Street, Morgantown, West Virginia 26505, and agree to pay a portion of the study cost, either in cash, or in-kind contributions of labor or materials.

SCS is presently cooperating with local leaders in Beckley and Raleigh County in conducting a flood plain management study for Raleigh County. This study includes the Marsh Fork and Clear Fork portions of the Lower Kanawha River Basin. The Raleigh County study is scheduled for completion by 1985.

RURAL ABANDONED MINE PROGRAM

The Rural Abandoned Mine Program (RAMP) is authorized by Section 406 of the Surface Mining Control and Reclamation Act of 1977 for the purpose of restoring rural lands which were adversely affected by past coal mining practices to a productive use. The program is administered by the Soil Conservation Service (SCS) and may receive up to 20 percent of the money deposited in the Office of Surface Mining's Abandoned Mine Reclamation Fund. Funds accumulate from a tax placed on active coal mine operations at a rate of 35 cents per ton of surface mined coal and 15 cents per ton for deep mined coal.

The program provides technical and financial assistance to land users who voluntarily enter into 5-year to 10-year contracts for the reclamation of up to 320 acres of eligible abandoned coal mined lands. Problems associated with these lands consist of dangerous mine

openings, burning and severely eroding coal refuse piles, hazardous water impoundments and highwalls, mine subsidence, and old mine structures. A reclamation plan is required for financial assistance under the program. The plan is prepared by the land user with SCS technical assistance and states what will be done to reclaim the land each year and the amount of cost-share assistance involved.

Opportunity for implementation exists on the large acreage of abandoned surface mines and deep mine refuse piles and portals. Monies are allocated first for priority 1 and 2 areas, such as sites where open portals are creating a safety hazard, refuse piles creating a dangerous impoundment, acid mine drainage polluting a drinking water supply, etc. Other refuse piles or surface mine spoil creating erosion and sedimentation problems will not be selected and submitted for approval until all priority 1 and 2 areas have been treated. See Chapter 2 Erosion Problems and Concerns for a complete description of priorities.

Further accomplishments in solving the abandoned coal mine lands resource problem in the Basin through the RAMP program will depend on future allocations of funds for the program to SCS.

FOREST MANAGEMENT PROGRAMS

The Cooperative Forestry Assistance Program is authorized under Public Law 95-313 (92-Stat.-365), 1978. This Act authorizes the Secretary of Agriculture to assist nonfederal forest land owners in:

1. Advancement of forest resources management;
2. Encouragement of production of timber;
3. Prevention and control of insects and diseases affecting trees and forests;
4. Prevention and control of rural fires;
5. Efficient utilization of wood, including recycling;
6. Improvement and maintenance of fish and game habitat; and
7. Planning and conducting urban forestry programs.

This Act also authorizes the Secretary to work through, and in cooperation with, the State Foresters or equivalent State officials in implementing the following Federal programs affecting nonfederal forest lands by providing financial, technical, and other assistance in the areas listed.

Rural Forestry Assistance

1. Plant tree seeds and trees for afforestation or reforestation on suitable land for timber and other benefits;
2. Plan, organize, and implement measures on nonfederal forest lands to improve the multiple use management on these lands;
3. Protect or improve soil fertility on nonfederal forest lands and quality, quantity, and timing of water yields; and

4. Provide technical information, advice, and related assistance in:
   a. Harvesting, processing, and utilization of wood and wood products and other forest products;
   b. conversion of wood to energy for domestic, industrial, municipal, and other uses;
   c. management planting and treatment of forest lands to improve quality of timber and other resources;
   d. protection and improvement of forest soil fertility and quality, quantity, and timing of water yields; and
   e. effects of forestry practice on fish and wildlife and their habitats.

Rural Fire Prevention and Control

Besides the authority provided in the Federal Fire Prevention and Control Act of 1974, the Secretary is authorized to:

1. Cooperate with State Foresters in developing systems and methods for prevention, control, suppression, and prescribed use of fires on rural communities to protect lives and values;
2. Provide financial, technical, and related assistance to protect these lands, and
3. Finance the organizing and timing of fire fighting forces.

Agricultural Conservation Program

The Agricultural Conservation Program is administered by local offices of the Agricultural Stabilization and Conservation Service (ASCS). Through cost-sharing arrangements, landowners can solve resource conservation and pollution problems. Two of the Best Management Practices (BMP) that are available to forest land managers are a tree planting measure and a measure to establish permanent grass cover. Either or both can be used to resolve erosion problems on old fields, forest lands, and forest roads. The ASCS current cost-sharing rates pay from 50 to 65 percent of the total BMP cost.

Forestry Incentives Program

The Forestry Incentives Program is administered by local offices of the Agricultural Stabilization and Conservation Service (ASCS). Through cost-sharing, private landowners are able to obtain up to 65 percent of the cost of planting trees on lands suitable for the production of timber products. This program also cost-shares on such measures as pre-commercial thinning, pruning of crop trees, site preparation for natural regeneration, and releasing desirable seedlings and young trees.

WATER AND WASTE DISPOSAL LOANS AND GRANTS PROGRAM

An important part of the U. S. Department of Agriculture's rural and water resource development activities in the Lower Kanawha River Basin area has occurred through the Farmers Home Administration (FmHA)

under the auspices of the Under Secretary for Small Community and Rural Development. As the Federal government's largest lender, FmHA has financed nearly 20,000 water and waste disposal systems in small towns throughout America, 86 of which were in the Basin area. These projects have been funded wholly, or in part, by the FmHA's water and waste disposal loans and grants program for the installation of improvement of community water systems, sewer systems, and solid waste disposal systems serving small towns and rural areas. Other programs administrated by the Farmers Home Administration include: farm ownership loans for land purchases, construction, or repairs to buildings or farm land improvement; farms operating loans for production expenses; emergency loans to cover natural disaster losses; soil and water loans for the development use and conservation of water and land resources; limited resource loans to help low-income farmers improve their operation; youth project loans; rural housing loans to finance rural apartments for low to moderate income recipients; housing repair loans and grants to improve dwelling conditions; mutual self-help housing loans for home construction groups; rental assistance payments to owners of FmHA financed projects to reduce the rents paid by low income tenants; "other" community facilities loans to build or improve public facilities such as hospitals, fire halls, etc.; business and industry loan guarantees to help establish businesses and industrial operations in towns with 50,000 people or less.[1] The Farmers Home Administration also provides financial assistance to rural people and communities who cannot obtain commercial credit at affordable terms. Water and waste disposal loans and grants is one of fourteen categories of financial assistance available to rural residents for farm, business, personal and community purposes.

The U.S. Environmental Protection Agency (EPA), administers the Construction Grants Program and the Clean Water Act in cooperation with the State. Under these programs, EPA can provide various types of grants to the State to be used to improve water quality. The State allocates these grant monies to various projects on a priority basis developed by the Water Resources Division. Specific project measures included in Suggested Plan for the improvement of water quality, such as sewage treatment facilities, have a high degree of potential for implementation under programs administered by the EPA.

CORPS OF ENGINEER PROGRAMS

The Flood Control Program is administered by the U. S. Army Corps of Engineers under authority of many flood control laws. Under these authorities, the Corps functions as an engineering consultant to Congress and most of the Corps water resources projects are developed by specific Congressional authorization.

The Coal River Rehabilitation Project was authorized in 1970 for development by the Corps with participation by local nonfederal public interests. The channel rehabilitation measures included the following areas: Sylvester - Whitesville; Danville - Madison; Van - Clinton; and Greenview - Sharples.

The plan elements were primarily in Boone County and partially in Raleigh and Logan Counties. However, local interests were unable to complete the real estate acquisition required to undertake the project. The project was reclassified in 1980 to the "inactive" category of civil works projects.

A study is underway (1985) by the Corps to evaluate the feasibility of local flood protection at Fairdale on Marsh Fork.

Local flood control projects, such as the channel rehabilitation projects in the Coal River Subbasin and the Marsh Fork channel project at Fairdale could be implemented under the Corps of Engineer Programs; however, these local projects must be initiated by local Sponsors. Local sponsors for flood control projects may include municipal, county, or State governments. The Sponsors are generally responsible for providing real property rights for the projects and for performing needed operation and maintenance after the project has been installed.

STATE PROGRAMS

Public Law 92-500, Section 208, West Virginia's State Water Pollution Control Act, Chapter 20, Article 5A-3, provides the mechanism to monitor and control erosion and sedimentation from land disturbance activities, and the West Virginia Department of Highway's Standard Specifications, Section 642 addresses erosion and sedimentation from highway construction sites and associated roadbanks.

The Abandoned Mine Lands program (AML) is authorized under Section 406 of the Surface Mining Control and Reclamation Act of 1977. AML has the same provisions as RAMP but is administered by the State of West Virginia.

West Virginia's Abandoned Mine Lands Inventory is part of the national program coordinated by the U. S. Department of Interior, Office of Surface Mining. The purpose is to determine those lands or waters affected by mining conducted prior to 1977 which were left in an unreclaimed condition and for which no continuing reclamation responsibility exists. Phase II of the Inventory involves identification, data collection, and mapping of Priority I and II problem areas (those sites which adversely affect human health, safety, or general welfare). From the Inventory, the State selects problem areas and submits them, as projects, to OSM for approval and to receive funding allocations necessary for reclamation procedures under the Abandoned Mine Lands Program.

The West Virginia Department of Health provides the legal authority for the installation of municipal water supply systems and/or improvements. This authority is vested in the West Virginia Code in Chapter 1, Article 5, and specifies the regulation of water supply through a permit system. The permit is granted by the Department of Health.

Both State and Federal funding institutions are available to help finance water supply systems. The State programs are the Governor's Partnership Grant Program and the State Emergency Water and Sewer Program. The Governor's program can grant up to $250,000 to the PSD or community, which must provide some matching funds. The amount of matching funds is determined on a case by case basis. The State Emergency Water and Sewer Program can grant up to $25,000, with no local matching funds required, primarily to be used for emergency repairs to small systems with annual revenues of $200,000 or less.

The State Geological Survey and the Division of Water Resources (DNR) have the authority and responsibility to monitor and study groundwater aquifers. These institutions, with appropriate funding, could study the pollutional effects of chlorides and other mineralized substances, recharge from groundwater, and septic systems, and make recommendations for their protection.

The legal and institutional aspects of implementing municipal sewage treatment facilities are vested in the West Virginia Department of Health. Municipalities and public service districts must apply to the Department of Health for a permit to install sewage treatment facilities. After proper engineering studies and cost estimates have been made the Department of Health can approve the permit. Grant and loan monies to finance installation activities are generally obtained from EPA grants and/or FmHA loans. The Regional Planning Councils can provide assistance in establishing financial arrangements.

The Division of Water Resources Construction Grants Program, funded and directed by the EPA, is responsible for the construction of most of the municipal sewage treatment facilities in the State. The acceleration of funding on a statewide basis, would necessarily need the approval and support of the EPA. The redirecting of existing funding levels into the Lower Kanawha Basin area, particularly the Coal River Subbasin, can be reinforced by a more vocal interest to be expressed by the counties, PSDs and local communities in the areas exhibiting the greatest need for sewer systems. A show of public interest is especially needed in some of the Coal River communities where proposed projects were deactivated because of strong public opposition. (See Addendum)

The Division of Water Resources also administers Section 205(j) of the Federal Clean Water Act following EPA guidelines. This program is an important source of funding for conducting water quality assessments throughout the State, as well as, providing funding for studies relative to the abatement of pollution affecting water quality on a local or regional basis. The Heizer-Manila Creek abandoned mine drainage and Upper Pocatalico River chloride identification studies may both be accomplished through this program.

The Statewide Water Quality Monitoring Network consists of a system of sampling stations throughout the State where water quality is analyzed on a regular basis. Stations were strategically located with the intent that changes in water quality above them would be detected

and appropriate action could be initiated. Background monitoring data for the Pocatalico River chlorides identification study could be obtained by establishing or relocating monitoring stations on that stream to better reflect pertinent chlorides data.

In January 1985, a Memorandum of Agreement was made between the WV DNR's Divisions of Water Resources and Reclamation for the purpose of establishing and/or strengthening cooperative involvement in matters relating to water quality problems associated with abandoned mine lands. This agreement states that cooperative and coodinative efforts will be employed to maximize the use and protection of the State's water resources in all instances in which reclamation activities affect, or have the potential to affect, the integrity of the State's water resources. Both agencies will maintain direct communication prior to, during, and after reclamation activities to improve water quality and to prevent, to the greatest practical extent, degradation to state waters.

The justification for and subsequent acquisition of additional legal services and additional inspectors would be the responsibility of the Division of Water Resources. Legislative approval would be necessary to establish new positions.

LOCAL PROGRAMS

Since most water systems serve the general public, local residents often form a public service district (PSD) to coordinate the activities necessary for development and installation of the system. These districts generally receive State Recognition by being chartered. Once formed, they are responsible for setting boundaries of the area to be served, obtaining engineering studies for design of the most cost effective system, and seeking loans and/or grants necessary for financing the system.

Regional Planning and Development Councils are responsible for providing technical assistance to local governments as they plan and implement community projects. They conduct regional planning studies, which help to prioritize local needs, and coordinate activities to expedite their installation. The Regional Councils generally are not directly involved with implementation activities, but are important in maximizing opportunities to make improvements to the areas they serve.

County and municipal governments play an important role as they are the major entities responsible for both determining community needs and for initiating efforts to meet those needs.

NEW PROGRAMS AND CRITERIA NEEDED

While programs exist for providing assistance in planning and funding for flood prevention, erosion and sediment, water quality and water supply concerns, funding is inadequate to meet objectives. This plan recommends that funding be accelerated to implement measures that prove to be economically, environmentally, and socially viable.

Flood prevention measures can be implemented under existing flood prevention programs with accelerated funding. Funds to implement the flood prevention measures in the Suggested Plan by the Year 2000 would have to be accelerated in the following amounts: SCS $772,700, COE $4,797,700; FEMA $189,300; and $828,700 from local sources.

New program criteria are required to provide funding of preliminary engineering studies needed to define improvements and costs necessary in a water system. Without these studies, grant and loan applications for funding the construction of new or improved systems cannot be prepared. Most water systems do not have the surplus funds to pay for such studies, nor are there State or Federal funds available. Engineering consulting firms are generally expected to conduct preliminary studies on a contingency basis, with the understanding that if the preliminary study proves the system to be feasible, they may be selected to design the project and recover their costs when paid for final designs. It is recommended that the State Water Development Authority seek legislative authorization allowing it to participate in water system improvement programs similar to those designed for sewer system development, i.e., the authority to make loans for preliminary engineering studies to be repaid when construction is authorized.

There is a need to change Federal policy that limits funding for the design of water systems to existing customers rather than to allow for future growth. This policy restricts systems in the major growth areas of the Basin to rapid obsolescence and to a marginal capacity soon after completion. It is recommended that FmHA adopt a new or revised policy which recognizes the growth potential of these areas and provides water system designs and funding to accommodate this growth.

Federal, interstate, and State government roles in water supply should be restricted to research, data collection, planning, regulatory, and financial assistance functions. Design, construction, and operation of all water supply services facilities should remain at the regional and local level. State concerns should be geared to protecting Basin resource values, including maintenance of minimum stream flow and maintenance and/or improvement of water quality.

Local matching grants of 25 percent of the project cost should be financed through the same systems as local waste water treatment cost administered by the State Water Development Authority. DNR should begin a study to recommend legislation on the establishment of processes to arbitrate between competing uses, water allocation, water conservation, and water rights.

There is a need to improve the allocation process for monies collected to fund the Rural Abandoned Mined Program (RAMP) and the Abandoned Mine Lands program (AML) in West Virginia.

West Virginia currently contributes approximately $20 million dollars annually to the National AML fund through the tax imposed upon active operations of surface and deep mined coal. The Surface Mine Control and Reclamation Act of 1977 stated that a contributing state was to receive 50% of the funds that their state contributes. In addition, the USDA Soil Conservation Service was to receive up to 20% of the funds on a national basis. The remaining funds were to be distributed as follows: (1) 20% to the USDI Office of Surface Mining, (2) 10% to the Small Operators Assistance Program (SOAP). Neither the State of West Virginia nor the USDA Soil Conservation Service have received the maximum funds available for reclamation work.

Until recently, the State of West Virginia had received only partial funding. During the last two years this has improved to where West Virginia is now receiving about $15 million dollars annually. The USDA Soil Conservation Service has received only about 5% of its 20% share. The problem with the allotment of these funds occurs at the federal level as funds must be appropriated by Congress to the Office of Surface Mining of the Department of the Interior. With the current deficit and budget problems, Congress has been reluctant to appropriate the full amount.

Since these funds are collected from active mining operations for abandoned mine land reclamation work, they should not be considered the same as general tax dollars. Therefore, Congress nor the Administration should have the authority to retain the funds in escrow and not make the full appropriations of the funds collected. To accomplish this, the following changes would be the most desirable:

(1) The Congress of the United States needs to modify policy and criteria so that the full amount of funds collected are appropriated to the agencies responsible for reclamation work. To retain these in escrow monies does not permit the prompt reclamation of serious abandoned mine land problems which are threatening the health, safety and general welfare of the public. In addition, these problems are also causing serious environmental problems including water quality degradation, increased downstream flooding, and reduced visual quality.

(2) Amend the basic law so that funds are appropriated directly to the Soil Conservation Service of the Department of Agriculture by Congress for its part of the reclamation work. At present, funds are requested and appropriated to the Office of Surface Mining of the Department of the Interior and then transferred to the Soil Conservation Service of the Department of Agriculture. This method is cumbersome and does not allow for an efficient operation.

The above described modification in current policy could insure the reclamation of approximately 3,100 acres of abandoned mine land in the Basin by the Year 2000. The State of West Virginia and the USDA Soil Conservation Service already have the programs and personnel in place to fulfill this need should these modification occur and the funding be released.

REFERENCES

1. USDA, Vol. 42, No. 18, September 7, 1983, Washington, D.C.

CHAPTER 5
ALTERNATIVE PLANS

INTRODUCTION

This Chapter presents four alternative water and related land resource plans for public consideration. The first plan is a "No-Project" alternative that would allow existing trends to continue in a normal manner. The other three plans were formulated to satisfy all or part of the major study concerns of flood prevention, erosion and sedimentation, water supply, and water quality. The four alternative plans are summarized in Table 1.

Each alternative plan contains components that would help to satisfy at least one of the major study concerns. Some components will impact directly on more than one concern, and therefore; may be more desirable for inclusion in an alternative plan than others. For example, surface mine reclamation will not only reduce erosion and sedimentation, but may also improve water quality by reducing the amount of fine particles, especially coal particles, polluting streams. Table 2 shows the primary concern each component was formulated to meet along with the secondary impacts of each. The letter "P" in the table indicates the primary concern with the letter "S" indicating secondary impacts. The subscript number indicates a relative order of priority.

It should be noted for the following tables that the price base for evaluation is 1982; the period of analysis is 100 years and the discount rate is 8 3/8 percent.

TABLE 1
SUMMARY OF ALTERNATIVE PLANS

Alternative Number	Plan Description	Estimated Cost
1	No project alternative indicates future conditions without new or accelerated watershed related land resource programs.	$ 43,748,100
2	NED Plan that reasonably maximizes net economic benefits by improving the resource base to increase income or to reduce economic losses.	$ 11,877,700
3	Emphasizes environmental quality by erosion and sediment reduction and by minimizing water quality pollution.	$145,518,300
4	Considers a blend of economic development and environmental quality to satisfy major project concerns.	$102,122,800

TABLE 2
IMPACTS ON STUDY CONCERNS

Alternatives/ /Components	STUDY CONCERNS			
	Flood Prevention	Erosion & Sediment	Water Supply	Water Quality
Alternative Plan 1				
FPM Study	P_1	S_1	-	S_2
Flood Insurance	P_1	-	-	-
Flood Warning	P_1	-	-	-
Abandoned Mine Reclamation	S_1	P_1	-	P_2
Roadbank Stabilization	S_2	P_1	S_1	P_2
Erosion & Sediment Control	S_2	P_1	P_2	S_1
Forest Access Road Stab.	S_2	P_1	-	S_1
Oil & Gas Well Site Stab.	S_1	P_1	-	P_2
Water Systems Renovation	-	-	P_1	-
Sewage Systems	-	-	S_1	P_1
Animal Waste Systems	-	-	S_2	P_2
Alternative Plan 2				
Channel Rehabilitation	P_1	S_1	-	S_2
Non Structural	P_2	-	-	-
Water Systems Renovation	-	-	P_1	-
Port. Water Treatment Plan	-	-	P_2	-
Alternative Plan 3				
Flood Insurance	P_1	-	-	-
FPM Studies	P_2	S_2	-	-
Abandoned Mine Reclamation	S_1	P_1	-	P_2
Road Bank Stabilization.	S_2	P_1	S_1	P_2
Forest Access Road Stab.	S_2	P_1	-	S_1
Erosion & Sediment Control	S_2	P_1	P_2	S_1
Teay's Valley Water System	-	-	P_1	-
Ground Water Aquifer Protection	-	-	P_2	P_1
Water Use Conservation	-	-	P_1	-
Sewage Systems	-	-	S_1	P_1
Sewage Treatment Control Plan	-	-	S_1	P_1
Research & Develop. Project	-	-	-	P_2
Pocatalico Chloride Id Study	-	-	-	P_1
Animal Waste Systems	-	-	S_2	P_2
Enforcement of Water Quality Standards	-	-	S_1	P_1
Alternative Plan 4				
Channel Rehabilitation	P_1	S_1	-	S_2
Nonstructural	P_1	-	-	-
Flood Insurance	P_1	-	-	-
FPM Studies	P_2	S_2	-	-
Abandoned Mine Reclamation	S_1	P_1	-	P_2
Roadbank Stabilization	S_2	P_1	S_1	P_2
Forest Access Road Stab.	S_2	P_1	-	S_1
Erosion & Sediment Control	S_2	P_2	P_2	S_1
Water Systems Renovation	-	-	P_1	-
Portable Water Treat. Plant	-	-	P_2	-
Groundwater Protection Strategy	-	-	P_2	P_1
Water Use Conservation	-	-	P_1	-
Sewage Systems	-	-	S_1	P_1
Sewage Treatment Control Plan	-	-	S_1	P_1
Research & Develop. Project	-	-	-	P_2
Pocatalico Chloride ID Study	-	-	-	P_1
Animal Waste Systems	-	-	S_2	P_2
Enforcement of Water Quality Standards	-	-	S_1	P_1

ALTERNATIVE PLAN 1

This alternative is formulated to indicate the conditions expected by the Year 2000 in the absence of new or accelerated programs that would impact the major concerns of this study. Existing programs would continue to alleviate Basin concerns according to present trends. This rate would leave most of the major concerns partially unsatisfied and perhaps other concerns worse by the Year 2000 than they are today.

EXISTING PROGRAMS

Measures included in this alternative plan consist of both nonstructural and structural elements currently being implemented or planned for implementation by the year 2000 to alleviate, partially or in whole, the major study concerns of flood prevention, erosion and sediment, water supply, and water quality.

Flood Prevention

Plan elements that would continue at present trends and satisfy a portion of the flood prevention concerns include:

The Raleigh County FPM Study

This study would provide flood hazard maps and flood elevations for 26.3 miles of Marsh Fork and 16.7 miles of Clear Fork flood plains in the upper portion of the Basin. Estimated cost of completing this study is $33,100.

The IFLOWS Flood Warning

This system would insure Basin residents of early detection and warning of impending floods in all counties of the Basin, with the exception of a small portion of Roane County. This amounts to about 95 percent of the total Basin area. Estimated cost of completing the flood warning system throughout the Lower Kanawha River Basin is $130,000.

The National Flood Insurance Program

This program will continue to provide reimbursement for flood losses for property owners enrolled in the program. Approximately 9 communities, including the city of Charleston, are enrolled in the regular phase of the program and receive full program benefits. Five communities and two counties are enrolled in the emergency phase of the program and receive limited insurance benefits. By the Year 2000, all of these are expected to be incorporated into the regular program. Estimated cost of computing the detailed studies necessary to phase these areas into the regular program is $850,000.

Erosion

There are five minor plan measures currently being implemented for erosion control in the Basin. These measures include:

Reclamation of Abandoned Mine Lands

Approximately 10,000 acres of abandoned mine lands exist in the Basin. These 10,000 acres consist of the Priority I, II and III areas described in Chapter 2. It is anticipated that about 540 acres of Priority I and II abandoned mine lands would be reclaimed by Year 2000, at present reclamation rates. Reclaiming these areas is estimated to cost $5,778,000 (see Table 4, Chapter 2).

The potential exists for solving some erosion and sediment problems in the Basin through ongoing Federal and State programs. The Rural Abandoned Mine Program (RAMP) and the West Virginia Abandoned Mine Lands Program provide for reclamation of abandoned mine areas through funds administered through the Office of Surface Mining, as specified in the Surface Mining Control and Reclamation Act of 1977.

Roadbank Stabilization

There are approximately 1,075 acres of eroding primary and secondary roadbanks in the Basin. Programs in existence that can assist in the maintenance of roadbanks are (1) West Virginia Department of Highways, County Maintenance Program, (2) RC&D, and (3) PL-566. Roadbanks generally are not treated until a condition exists that poses a danger to the general public (i.e. landslide, rock fall, etc.). Therefore, it is difficult to determine what has been treated in the past and what will be treated in the future. The possibility exists that 1,075 acres of eroding roadbank will exist in the Basin by the Year 2000 unless programs are accelerated.

Construction Sites

At present, there are approximately 3,200 acres of current construction in the Basin. This construction includes urban, suburban, industrial, utility right-of-ways, and private roads. Programs are available to the landowner, developer and/or contractor under Public Law 566. Under these programs, the individuals or corporations involved may request consultive technical assistance. Any and all structural erosion and sedimentation control measures are and will be the responsibility of the landowner, developer, and/or contractor. Presently, there is legislation pending before the West Virginia Legislature to implement erosion and sedimentation control regulations with enforcement provisions.

Forest Land

There is a total of 882,416 acres of forest land in the Basin. Forest access roads comprise 35,796 acres of this total. If the current 65% ACP cost sharing continues through the Year 2000, $68,000 will be allotted for forest access road work. This will result in reducing the erosion rate on approximately 85 acres.

Oil & Gas Well Sites and Roads

Oil and gas well sites and associated roads are currently regulated by the state of West Virginia, Department of Mines, Office of Oil and Gas. Should the recent increase in exploration continue, additional funding and personnel will be needed to insure satisfactory levels of monitoring. Present conditions would indicate a need for increased funding and personnel for site inspections to enforce present regulations and standards.

Water Supply

It is anticipated that several measures will be accomplished under existing program trends in an effort to satisfy water supply concerns throughout the Basin. Those measures that have been identified include:

South Boone Public Service District

The South Boone PSD is in the process of planning a new water supply system. The South Boone PSD is combining with the Van PSD to bring about a more efficient total system. A grant application has been submitted for funding for the extension of lines to connect Van PSD to South Boone PSD. If funded, this proposal would eliminate any immediate need for a new central treatment system as it is probable that the existing plants in these two systems will provide sufficient quantities of water once tied together. The cost estimate from the grant application is $266,000.

A suggestion has been proposed to abandon the present groundwater source in South Boone to purchase water from the Van PSD. Grant application has not yet been submitted. Project would involve 14,000 feet of 6-inch line and a booster station at an estimated cost of $234,000, based on a user fee of about $20/month.

A second proposal, for the future, is to extend service up James Branch (Pond Fork near Bald Knob) to Greenwood area. Estimated cost is $590,000.

In the Van PSD, a construction project to extend service and install a new settling pond is nearly complete.

Total cost of these measures is $1,090,000.

Keith Water System

Negotiations are currently being conducted to incorporate the Keith-Orgas area into the Big Coal River PSD to upgrade water service in that area. Presently, Big Coal River PSD transmission lines extend to and include Chickasaw Village which is within about 1/2 mile of the community of Orgas. In order to accomplish the incorporation of Keith-Orgas into the Big Coal River PSD, a boundary change, releasing Keith-Orgas from the Boone-Raleigh PSD, will need to be approved by the Boone County Commission. Approval for the boundary change is anticipated in early 1985.

The project would involve the construction of transmission lines sufficient to reach the community of Keith and a booster station at an estimated cost of $500,000. A new storage tank at Keith may also be needed at an estimated cost of $50,000. These projects are anticipated to be completed in 1987.

The remaining need to replace the local distribution system in Keith is estimated to cost $200,000.

Whitesville Water System

Renovation of the existing treatment plant at Whitesville is complete. Plans included an expansion of service to adjacent areas. Whitesville supplies all of the Boone-Raleigh PSD with municipal water. This element was installed and operational by early 1984. This new system satisfied all of the water supply concerns for the Whitesville water system. The cost of this work was $105,000.

Leon Water System

This measure consisted of installing a transmission line, connecting the Leon water system to the Mason County PSD system, to provide water to Leon. Installation costs were approximately $336,000 and the work was completed by the end of summer 1984. Connecting these systems will meet all of the water needs for residents of Leon.

Buffalo Water System

Water supply measures for the Buffalo water system include the development of a new raw water source and an extension of their transmission system to outlying communities. It is possible that the Buffalo water system will incorporate with the North Putnam PSD in an attempt to improve water service. This would involve the construction of a new water main from Eleanor to Buffalo and is expected to cost about $792,000. This measure is considered to be of low priority at this time, but may become a high priority project if additional problems develop. This work is expected to be completed by 1995.

This measure will satisfy all of the concerns with the Buffalo water system except for a need to renovate the existing treatment plant. This additional remaining need is anticipated to cost $75,000.

Winfield Water System

This measure consists of installing transmission lines to connect the Winfield, Hurricane, and South Putnam PSD water systems. Connecting these three systems will serve Winfield's need for a supplemental system during drought periods when recharge flows are low. Winfield's need will remain to have an additional raw water supply source and a need to improve treatment of the raw water.

The connecting lines are expected to cost $108,000 and be installed in 1984-85. The cost needed to meet the remaining needs is anticipated to be $1,478,100.

Water Quality

Overall water quality throughout the Basin has been steadily improving during the past decade. This improvement is a direct result of several State and Federal programs implemented during that time period. These programs are expected to continue into the foreseeable future and are included as measures in this alternative plan.

Sewage Treatment Facilities

These facilities will continue to be implemented at the present rate. Over the past 10 years seven projects costing approximately 12.7 million dollars have been completed in the Basin.[1] This is an average of 0.7 projects at 1.27 million dollars per year. At this rate, approximately $20,320,000 would be spent to install sewage treatment systems throughout the Basin by the Year 2000. Using the 1984 construction grants priority list, this amount of money would be sufficient to install the first four projects. These projects include Danville, Glen White-Traphill, and two projects in Charleston. In addition, the projects presently under construction or approved for construction at South Putnam, St. Albans, Nitro, and Sissonsville will be complete. The estimated cost of installing these eight projects is $34,120,000. With these projects completed, a need will remain for an additional 15 projects costing an estimated $53,700,000. In addition to these projects on the priority list, systems along the Coal River and its tributaries will still need treatment facilities (See Addendum).

Animal Waste Treatment Systems

These systems will continue to be installed and implemented under the existing conservation operations farm program. The present rate of installing animal waste systems throughout the Basin is two per year. At this rate, approximately 30 new systems could be implemented by the Year 2000. Estimated cost of installing these systems is $750,000.

PLAN EFFECTS

Flood Prevention

Existing flood prevention programs would continue to satisfy the Basin's concern of reducing flood damage at the present rate of damage reduction. The present rate of installing flood prevention programs throughout the Basin is relatively slow. Flood damages may have actually increased in recent years. Raleigh County officials would have detailed flood data and maps to use in regulating development along 26.3 miles of the Marsh Fork flood plain. This amounts to less than 20 percent of the total flood plains developed or suitable for development in the Basin. Five additional communities (Bancroft, Buffalo, Eleanor, Poca, and Winfield) along with Kanawha and Putnam Counties would have access to the regular flood insurance program. This amounts to about 70 percent of the incorporated cities and

unincorporated counties in the Basin. Installing the flood warning system would provide an early warning of impending floods to 95 percent of the Basin's residents. This would considerably reduce the hazard to loss of life from floods and result in a damage reduction of around $1,248,200 annually. The total cost of flood prevention elements in the "no-project" alternative would be approximately $1,013,100.

ALTERNATIVE PLAN 1 (EXISTING PROGRAMS)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To continue existing flood prevention programs at present rates.

PLAN ELEMENTS - Raleigh County FPM Study, IFLOWS Flood Warning System, and National Flood Insurance for Kanawha and Putnam Counties, and for the communities of Bancroft, Buffalo, Eleanor, Poca, and Winfield.

ACCOUNTS - Economic Development

Beneficial Effects		Adverse Effects	
1. Reduced flood damages	$2,518,400	1. Annual Installation Cost	$ 84,900
		2. Annual O, M, & R Cost	$ 30,000
TOTAL	$2,518,400	TOTAL	$114,900

Environmental Quality
(Beneficial and Adverse Effects)

1. Minimize land disturbance by avoiding construction activities.
2. Increase noise level during flood warning alerts.
3. Reduce terrestrial habitat loss by properly regulating flood plain development.

Other Social Effects

1. Minimize hazards to loss of life by early flood warning throughout 95 percent of the Basin.
2. Reduce flood losses suffered by flood plain residents.
3. Provide reimbursement for actual flood losses incurred.
4. Minimize future flood prone development.

Erosion

RAMP

Reclamation has been completed on one site located within the Lower Kanawha River Basin, the Lilly site in Upper Marsh Fork Watershed, Raleigh County. The site included approximately two acres of severely eroding deep mine refuse. Material was being deposited in Surveyor Creek, a tributary of Marsh Fork. The site was graded and revegetated, resulting in a reduction of erosion by 290 tons per year and a reduction in sediment yield of 174 tons per year.

As of October 1982, applications had been received for two other sites located within the Basin: (1) the Baldwin site, a 20-acre severely eroding, burning refuse pile depositing material into Pigtail Branch of Hewett Creek in the Spruce Fork Watershed, Logan County; and (2) the Westmoreland Coal Company site, approximately 10 acres of refuse depositing sediment into Spruce Laurel drainage in the Spruce Fork Watershed, Boone County.

WV-AML

As of March 1983, nine projects have been completed under West Virginia's Abandoned Mine Lands Program. However, none of these projects are located within the Lower Kanawha River Basin. Grant documentation is being prepared for two sites within the Basin:

(1) a 25-acre burning refuse pile (Milltown) in the Hopkins Fork drainage area of the upper Coal River Watershed, and (2) a half-acre burning refuse pile (Birchton) located on Marsh Fork.

Roadbank Stabilization

Unless current programs are accelerated, the possibility exists that 1,075 acres of eroding roadbank now present in the Basin will still be in existence in the Year 2000.

Construction Sites

Presently all erosion control measures are the responsibility of the landowner, developer, and/or contractor. Consultive technical assistance is available under Public Law 566 to assist the land user in alleviating erosion on these sites.

Forest Land

If the current 65% ACP cost sharing continues through the Year 2000, $68,000 will be allotted for forest access road work. This will result in reducing the erosion rate approximately 85 acres.

Oil & Gas Well Sites & Roads

Should the recent increase in exploration continue, additional funding and personnel will be needed to insure satisfactory levels of monitoring. (Present conditions would indicate a need for increased funding and personnel for site inspections to enforce present regulations and standards.)

ALTERNATIVE PLAN 1 (EXISTING PROGRAMS)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVE - Reduction of Erosion through Existing Programs

STUDY ELEMENTS - Erosion Reduction Land Treatment on Abandoned Mine Lands; Roadbanks, Construction Sites

ECONOMIC DEVELOPMENT ACCOUNT

Beneficial Effects	Annual Benefit	Adverse Effects	Annual Costs
Reduce Erosion by 100 Tons		1. Installation Costs	$409,200
		2. Technical Assistance Cost	$ 39,900
		TOTAL	$449,100

Environmental Quality Account

1. Protection of 15 acres annually
2. Enhanced Water Quality Through Erosion Reduction

Social Well Being Account

1. Employment of 59 Skilled Laborers
2. Employment of 1 Semiskilled Laborer

Water Supply

Installation of the water supply measures included in this alternative plan would completely satisfy the water supply concerns for three systems presently experiencing problems. In addition, a portion of the needs for another three systems would be met. Needs remaining after these measures have been installed are associated with six systems.

The estimated cost of installing these measures is $ 2,981,000.

ALTERNATIVE PLAN 1 (EXISTING PROGRAMS)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To provide adequate sustained yields to meet current water needs.

PLAN ELEMENTS - Water system facilities improvements for six community areas.

ACCOUNTS - Economic Development

Beneficial Effects			Adverse Effects	
1.	Water Supply	$589,600	1. Annual Installation Cost	$249,700
			2. Annual O, M, & R Cost	$ 37,200
	TOTAL	$589,600	TOTAL	$286,900

Environmental Quality

1. Temporary disturbances resulting in increased erosion and reduced visual amenities.
2. Conserve groundwater aquifers.
3. Encourage urban development.

Other Social Effects

1. More reliable supply of good quality water.
2. Creation of 10 skilled and 15 semiskilled jobs.
3. Water use rates may increase somewhat.

Water Quality

Implementation of water quality measures under existing programs will continue the present trend of improving water quality in Basin streams. Eight more communities would be provided proper sewage treatment. These eight new systems would serve approximately 17,800 people. Domestic pollution of streams in the vicinity of these communities would be reduced substantially, perhaps to the point they would meet State water quality standards; however, domestic pollution throughout the Basin would continue to be a problem with 15 other listed projects remaining to be built and numerous small communities not listed needing systems.

Installation of 30 animal waste systems would improve agricultural waste management on slightly more than half of the farms in the Basin presently experiencing some problems. Fecal coliform pollution would be substantially reduced in several small receiving streams in Mason and Putnam Counties; however, these systems would have little effect on water quality in the Kanawha River.

The total cost of implementing these measures is $34,870,000. Economic benefits were not estimated for water quality measures; however, an expenditure of $34,870,000 would create about 26 skilled jobs and 18 unskilled jobs, and generate approximately $1,285,800 in annual economic benefits in the Basin.

ALTERNATIVE PLAN 1 (EXISTING PROGRAMS)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To continue existing water quality programs at present trends.

PLAN ELEMENTS - Sewage treatment facilities for 8 communities and 30 animal waste systems.

ACCOUNTS - Economic Development

Beneficial Effects

Adverse Effects

1.	Annual Installation Cost	$2,921,300
2.	Annual O, M, & R Cost	$ 168,300
	TOTAL	$3,089,600

Environmental Quality

1. Reduce domestic and animal waste pollution in Basin streams.
2. Improve the visual amenities of the water resource base.

Other Social Effects

1. Create approximately 44 new jobs.
2. Reduce the potential health hazards associated with polluted water contact.
3. Improve the potential of water contact recreation in Basin streams.
4. Improve aquatic habitat.

ALTERNATIVE PLAN 2

This alternative was formulated to produce maximum net economic benefits by improving the water and related land resource base in an effort to increase income or to reduce income losses. Since this plan enhances economic development, it is the National Economic Development (NED) plan for the Basin. Economic development is emphasized in this plan by including components that produce positive net economic benefits that were identified and quantified in monetary terms. Those components are mainly associated with flood prevention and water supply.

PLAN MEASURES

This alternative includes both structural and nonstructural plan measures. Those measures that would produce net positive economic benefits are discussed below.

Flood Prevention

Flood prevention plan elements include channel work, channel rehabilitation, and nonstructural measures.

Upper Rocky Fork Channel Work

The channel work is located at Shamrock Village approximately 10 miles northwest of Charleston in Kanawha County.

a.	Probable Measures	Clearing and Snagging
b.	Installation Cost	$159,400
c.	Annual O, M, & R Cost	$ 1,300
d.	Total Annual Cost	$ 14,700
e.	Total Annual Benefits	$ 28,400
f.	Net Benefits	$ 13,700

Marsh Fork Channel Work

The channel work is located at the Fairdale-Glen Daniel community in Raleigh County.

a.	Probable Measure	Clearing & Grubbing
b.	Installation Cost	$160,700
c.	Annual O, M, & R Cost	$ 3,000
d.	Total Annual Cost	$ 16,500
e.	Total Annual Benefits	$409,400
f.	Net Benefits	$392,900

Danville-Madison Channel Rehabilitation

The channel work is located between the towns of Danville and Madison, West Virginia, on the Little Coal River in Boone County.

a.	Probable Measures	Channel shaping, Restoration, Debris Removal, and Selective Clearing
b.	Installation Cost	$2,746,600
c.	Annual O, M, & R Cost	$ 25,000
d.	Total Annual Cost	$ 255,100
e.	Total Annual Benefits	$ 466,100
f.	Net Benefits	$ 211,000

Greenview-Sharples Channel Rehabilitation

The channel work is located on Spruce Fork between Greenview and Sharples, West Virginia, in Boone and Logan Counties.

a.	Probable Measure	Selective Clearing and Debris Removal
b.	Installation Cost	$447,200
c.	Annual O, M, & R Cost	$ 16,600
d.	Total Annual Cost	$ 54,100
e.	Total Annual Benefits	$137,600
f.	Net Benefits	$ 83,500

Sylvester-Whitesville Channel Rehabilitation

The channel work is located between Sylvester and Whitesville, West Virginia, on the Big Coal River in Boone and Raleigh Counties.

a.	Probable Measures	Selective Clearing and Debris Removal
b.	Installation Cost	$368,900
c.	Annual O, M, & R Cost	$ 10,200
d.	Total Annual Cost	$ 41,100
e.	Total Annual Benefits	$ 74,000
f.	Net Benefits	$ 32,900

Van-Clinton Channel Rehabilitation

The channel work is located on Upper Pond Fork in the Van-Clinton area of Boone County, West Virginia.

a.	Probable Measure	Channel Shaping and Restoration
b.	Installation Cost	$1,725,900
c.	Annual O, M, & R Cost	$ 22,600
d.	Total Annual Cost	$ 167,200
e.	Total Annual Benefits	$ 300,100
F.	Net Benefits	$ 132,900

Rock Branch Nonstructural Plan

Rock Branch is located approximately 1.5 miles west of Nitro, West Virginia, in Putnam County where State Route 62 crosses Rock Branch.

a.	Probable Measures	Nonstructural
b.	Installation Cost	$ 93,100
c.	Annual O, M, & R Cost	$ 5,400
d.	Total Annual Cost	$ 13,200
e.	Total Annual Benefits	$ 31,300
f.	Net Benefits	$ 18,100

Erosion

Erosion is recognized as a serious problem throughout the Basin. However, the economic beneficiaries of erosion control measures are not easily identified. Therefore, since economic benefits cannot be readily quantified, erosion control measures are omitted from the NED Plan.

Water Supply

Municipal water supply systems that serve a population of 1,000 or more generally produce net economic benefits greater than their cost. In the Lower Kanawha River Basin six systems that serve more than 1,000 persons have been identified as being needed to help alleviate water supply concerns. These systems have been included in the NED alternative plan. They are:

Keith Water System

This system is located in the small community of Keith in Boone County, approximately three miles north of Sylvester, presently serves only 136 people (1982); however, once it is incorporated into the Whitesville water system (expected by 1986) the Keith water system will be part of a system that serves over 1,300 people.

a.	Probable Measures	Local Distribution System
b.	Installation Cost	$ 200,000
c.	Annual O, M, & R Cost	$ 5,500
d.	Total Annual Cost	$ 22,300
e.	Total Annual Benefits	$ 24,300
f.	Net Benefits	$ 2,000

Buffalo Water System

This system is located at Buffalo in Putnam County. This system serves 1,106 users (1982).

a.	Probable Measure	Treatment Plant Renovation
b.	Installation Cost	$ 75,000
c.	Annual O, M, & R Cost	$ 2,900
d.	Total Annual Cost	$ 9,200
e.	Total Annual Benefits	$ 11,500
f.	Net Benefits	$ 2,300

Hurricane Water System

This system is located at Hurricane in Putnam County and serves 5,500 people.

a.	Probable Measure	New Impoundment Dredge Existing Impoundment Transmission Line
b.	Installation Cost	$1,465,100
c.	Annual O, M, & R Cost	$ 20,000
d.	Total Annual Cost	$ 142,700
e.	Total Annual Benefits	$ 281,600
f.	Net Benefits	$ 138,900

South Putnam PSD

This public service district supplies treated water to 4,900 people in the southern portion of Putnam County.

a.	Probable Measure	New Impoundment
b.	Installation Cost	$1,340,100
c.	Annual O, M, & R Cost	$ 6,200
d.	Total Annual Cost	$ 118,500
e.	Total Annual Benefits	$ 202,300
f.	Net Benefits	$ 83,800

Winfield Water System

This system provides water to 1,000 people in Winfield, in the western portion of Putnam County.

a.	Probable Measure	New Impoundment Treatment Plant Renovation
b.	Installation Cost	$1,478,100
c.	Annual O, M, & R Cost	$ 6,000
d.	Total Annual Cost	$ 129,800
e.	Total Annual Benefits	$ 152,500
f.	Net Benefits	$ 22,700

Lake Washington PSD

This public service district supplies treated water to 1,000 people in the vicinity of Hurricane in Putnam County. Source of water is a lake that is partially silted in.

a.	Probable Measure	Treatment Plant Renovation New Impoundment Dredge Existing Impoundment
b.	Installation Cost	$1,538,400
c.	Annual O, M, & R Cost	$ 6,100
d.	Total Annual Cost	$ 135,000
e.	Total Annual Benefits	$ 150,500
f.	Net Benefits	$ 15,500

Portable Water Treatment Plant

This plant would consist of a tractor trailer mounted, 60 gallons per minute, treatment plant for the entire Basin. This portable plant could provide temporary water for 2,400 people.

a.	Probable Measure	Portable Treatment Plant
b.	Installation Cost	$79,200
c.	Annual O, M, & R Cost	$17,200
d.	Total Annual Cost	$23,800
e.	Total Annual Benefits	$80,800
f.	Net Benefits	$57,900

Water Quality

Water quality measures were not formulated for the National Economic Development plan because of the lack of direct financial relationship between costs and benefits. It is anticipated that the expenditure of funds to improve water quality throughout much of the Basin would prove costly and would not produce equal or positive economic benefits. Improvements in environmental quality, such as increased recreation and visual acuity, would result from reclaiming thousands of acres of abandoned mine lands and installing sewage treatment plants in non-served communities; however, very few economic benefits would result from such expenditures. It is doubtful that the cost of improving water quality would ever be recovered from savings in water treatment expenses, recreation expenditures, and aesthetics.

PLAN EFFECTS

Flood Prevention

Installing the flood prevention elements in this alternative plan would cost an estimated $5,701,800. Approximately $5,050,400 of this amount would come from the Federal government (SCS and COE) with the remaining $651,400 coming from local, county, or State government agencies. The elements of this plan would produce total economic benefits of $799,400 annually by providing flood damage reduction for 681 homes and 52 businesses. Total net annual benefits would be $243,700. Environmentally, this plan would disrupt aquatic and terrestrial habitat along 44.1 miles of streams. Erosion and sediment would occur from land and soil disruption during construction. Operating construction equipment would temporarily increase noise and air pollution levels. Aquatic and terrestrial habitat loss would be mitigated for either on or offsite.

ALTERNATIVE PLAN 2 (NED PLAN)

Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To maximize net economic benefits by reducing flood losses through the acceleration of flood prevention programs.

PLAN ELEMENTS - Flood prevention plans for the Upper Rocky Fork Watershed, Rock Branch Watershed, Marsh Fork Watershed at Glen Daniels-Fairdale, Danville-Madison area, Greenview-Sharples area, Sylvester-Whitesville area, and Van-Clinton area.

ACCOUNTS - Economic Development

Beneficial Effects		Adverse Effects	
1. Reduced Flood Damages	$1,446,900	1. Annual Installation Cost	$447,800
		2. Annual O, M, & R Cost	$ 84,100
TOTAL	$1,446,900	TOTAL	$561,900

Environmental Quality
(Beneficial and Adverse Effects)

1. Protection for 733 buildings.
2. Changed land use for 730 acres of land needed for the plan elements.
3. Modification of 44.1 miles of streams.

Other Social Effects
(Beneficial and Adverse Effects)

1. Employment opportunities for 20 skilled and 14 semiskilled employees.
2. Twenty-five percent flood damage reduction in upstream areas.
3. Improve health, safety, and welfare of Basin residents.

Water Supply

The total costs of implementing the water supply elements in this alternative are estimated to be $6,175,900. In addition, operation, maintenance, and replacement is expected to cost $63,900 annually. Total annual cost of these elements is estimated at $581,300.

Installation of these measures will meet the remaining needs for six municipal systems in the Basin, guaranteeing potable water for a population in excess of 13,600 in some of the more rapidly growing areas. Providing municipal water to these people would create $315,050 worth of benefits by allowing them to avoid the need of developing self-supply water systems such as wells.

Construction activities associated with installing the water supply systems would stimulate 38 new jobs. Total annual benefits would amount to $903,500.

ALTERNATIVE PLAN 2 (NED PLAN)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To provide adequate sustained yields to meet current and future water needs.

PLAN ELEMENTS - To provide improvements to six community water systems and to acquire a portable water treatment plant to facilitate water system maintenance and for emergency use.

ACCOUNTS - Economic Development

Annual Beneficial Effects		Adverse Effects	
1. Water Supply	$903,500	1. Annual Installation Cost	$517,400
		2. Annual O, M, & R Cost	$ 63,900
TOTAL	$903,500	TOTAL	$581,300

Environmental Quality
(Beneficial and Adverse Effects)

1. Temporary disturbances resulting in increased erosion and reduced visual amenities during installation.
2. Preservation of green space in contributory watersheds to reservoir sites.
3. Conserve underground aquifers.
4. Would encourage urban development

Other Social Effects
(Beneficial and Adverse Effects)

1. More reliable supply of good quality water.
2. Creation of 15 skilled and 23 semiskilled jobs.
3. Water user fees may increase somewhat.
4. Reduction of interruptions of service for maintenance activities.
5. Expedient and less expensive provision for temporary water service in the event of disasters or emergencies.

ALTERNATIVE PLAN 3

Alternative Plan 3 was formulated to emphasize environmental quality by minimizing erosion and sediment production and reducing water pollution. Erosion and sediment would be minimized by including plan elements that reduce erosion and sediment such as surface mine reclamation, provide treatment of pollution such as animal waste management systems, encourage enforcement of water pollution laws, and avoid construction activities that cause land disturbances.

PLAN MEASURES

Plan measures included in this alternative consist of both nonstructural and structural measures for flood prevention, erosion control, water supply, and water quality.

Flood Prevention

Flood prevention would be provided by the use of management type measures that would avoid earthmoving activities in an effort to minimize erosion and sediment from construction sites. Flood prevention plan elements are:

Flood Plain Management Studies

These studies are for the unincorporated communities of Boone, Lincoln, and Logan Counties within the Basin. These studies would provide reliable flood information along 112.3 miles of flood plains that could be used by county officials to properly manage flood plain land use.

a. Probable Measures	FPM Study
b. Study Cost	$ 650,000
c. Annual Benefits	Not Identified

National Flood Insurance Studies

These studies are for the incorporated communities of Whitesville, Sylvester, Madison, and Danville. Detailed studies would allow these communities to participate in the regular flood insurance program and provide full insurance benefits to landowners. Approximately 6.8 miles of flood plains would be studied.

a. Probable Measure	Flood Insurance Study
b. Study Cost	$ 236,600
c. Annual Benefits	Not Identified

Erosion

Plan measures would reduce erosion on abandoned mine lands, roadbanks, construction sites and forest land by the implementation of erosion control measures. These control measures would emphasize environmental quality and result in lowering erosion rates to allowable values.

Abandoned Mine Lands

The Plan elements would reduce the erosion rate on approximately 9,460 acres of abandoned mines, refuse piles and associated roads (see Table 4, Chapter 2). Emphasis would be placed on reclaiming the Priority I and II areas first, followed by the Priority III areas. A certain percentage of each site should have become "reclaimed naturally," becoming stable and revegetated over time. A site specific investigation should be conducted to determine the actual acreage of each site needing reclaimed. The cost estimates in the table reflect that 10% of the abandoned mine land will have been naturally reclaimed.

Reclamation would consist of: (1) backfilling of excavations, tunnels, and portals, (2) extinguishing, leveling, and grading spoil and/or refuse piles to blend with surrounding contours, (3) installing dams, culverts and basins, and (4) adding topsoil and soil additives to promote and establish vegetation. Technical assistance would be provided by the appropriate Federal and state agencies to insure proper planning, and design. Also, the installation of structural measures and practices to insure protection would be done under the supervision of said agencies.

Reclamation costs should average approximately $7,700 per acre. (See Reference 2).

	Total Cost	Annual Costs
Installation Costs	$ 65,557,800	$5,492,200
Technical Assistance	7,284,200	610,300
	$ 72,842,000	$6,102,500

Roadbank Stabilization

Roadbank stabilization measures would consist of sloping, grading, fertilizing, seeding, and mulching on 1,075 acres of critically eroding roadbanks for the purpose of reducing erosion. Federal and State agencies would provide the technical assistance necessary to insure proper installation. Treatment and implementation costs would average approximately $1,000 per acre and should reduce the erosion rate by about 90%, to an acceptable value.

	Total Cost	Annual Costs
Installation Costs	$ 1,075,000	$ 90,100
Technical Assistance	172,000	14,000
	$ 1,247,000	$ 104,100

Construction Sites

Plan elements include technical assistance to county and state governments in the formulation, drafting, and passage of erosion and sedimentation control ordinances and regulations. The implementation and enforcement of said regulations would affect 13,400 acres of new construction expected to occur in the Basin by the year 2000. Installation costs will be the responsibility of the developer, contractor and/or owner. Technical assistance would be provided by State and Federal agencies already established to insure proper implementation and installation of control measures on the industrial, urban, utility right-of-ways and private road construction sites.

	Total Cost	Annual Costs
Installation Costs	$ 0	$ 0
Technical Assistance	2,680,000	224,500
	$ 2,680,000	$ 224,500

Forest Land Access Roads and Livestock Grazing

Plan elements would reduce erosion rates on 7,500 acres of forest land subject to grazing and 10,600 acres of forest access roads to a value approaching the geologic rate. Reduction would be accomplished through proper planning, location, fencing, reclamation and protection. State and Federal agencies would provide technical assistance necessary to insure proper installation, treatment, and maintenance of these practices. (Treatment measures would cost $57 per acre on grazed forest land and $1,980 per acre on forest access roads. This would result in an 85-90% reduction of the overall erosion rate, to acceptable values of 2 to 3 tons/acre/year.)

	Total Cost	Annual Costs
Grazed Forest Land		
Installation Costs	$ 422,000	$ 35,400
Technical Assistance	36,900	3,100
	$ 458,900	$ 38,500
Forest Land Access Roads		
Installation Costs	$ 20,374,000	$1,706,900
Technical Assistance	614,000	51,400
	$ 20,988,000	$1,758,300

Water Supply

Water supply elements in this plan emphasize environmental quality by minimizing adverse impacts associated with construction activities. Measures include the incorporation of the entire Teays Valley area into the West Virginia Water Company System, protection of groundwater aquifers, and use of water supply conservation measures.

Teay's Valley Area

This element would provide water supply to the entire Teay's Valley through the West Virginia Water Company. It would replace existing systems at Buffalo, Hurricane, South Putnam, Winfield, and Lake Washington.

The West Virginia Water Company, Kanawha Valley District water treatment plant currently has a production capacity of about 40 million GPD and a present average daily demand of about 26 million GPD. Allowing for seasonal variation in demand and in treatment capacity, this treatment plant is capable of providing water to additional service areas.

Presently, the Teays Valley area is under agreement with the West Virginia Water Company to receive up to 5 million gallons per month as a supplemental supply; however, to date, the full monthly allotment has not been purchased. Purchases have averaged about 1 million gallons per month, except for a few instances involving spills and sewage contamination, which required additional supplies.

The West Virginia Water Company has installed new large-diameter transmission lines; however, constrictions in the transmission lines between the Teays Valley systems preclude them from being fully supplied. The construction of a new river crossing, near Nitro, would facilitate the transmission of greater amounts of water to the Teays Valley area.

The assumption of full responsibility for providing water to this area would place an additional demand of only about 1 million GPD on the West Virginia Water Company treatment plant, which is presently within its capacity. Increased supplies to the Teays Valley area, however, are not anticipated for at least five years.

Protect Groundwater Aquifers

An aquifer mapping study is being conducted jointly by the WVDNR Division of Water Resources and the USGS in conjunction with the Underground Injection Control program administered through the Division's Hazardous Waste Section. The Basin Atlas will address alluvial aquifers and their recharge areas, water quality and reported yields from private wells, and the relationship between alluvial and bedrock aquifers. The study is expected to be completed in late 1984.

This Atlas should provide an important data base with regard to the aquifers underlying the Lower Kanawha study area. In addition to being utilized with regard to underground injection practices, and other projects or activities that may be detrimental to important groundwater resources, this document should also be consulted for the development and implementation of a groundwater protection strategy.

Water Use Conservation Measures

This measure encourages the implementation of water use conservation measures.

Leaking pipes and extravagant use often results in the waste of significant amounts of water annually. In order to optimize the use of existing supplies, the implementation of conservation measures should be encouraged.

Water Quality

Water quality measures were formulated to satisfy concerns associated with domestic pollution, mine drainage in Heizer Creek, chloride pollution in the Pocatalico River, and animal waste pollution in some of the small streams in Mason and Putnam Counties. These measures are included in this plan because they tend to emphasize better environmental conditions.

Sewage Treatment Facilities

These facilities would be implemented at an accelerated rate sufficient to install the 15 remaining projects on the EPA Construction Grants List. These projects represent an expenditure of approximately $53,700,000. To install these projects by the Year 2000 would require an annual acceleration of funds from the present 1.27 million dollars to 3.35 million dollars or about 2-1/2 times the present trend. This appears reasonable when you consider that this Basin contains approximately 20 percent of the State's population but has been receiving only about 3.5 percent of funding for sewage treatment facilities. Acceleration of future funding in the Lower Kanawha River Basin is definitely needed if these needs are to be satisfied. (See Addendum)

Sewage Treatment Control Plan

This plan for the small ribbon-like communities, primarily in the Coal River Subbasin is recommended in conjunction with the need for additional sewage treatment facilities. Investigations for the possible use of less expensive alternative methods for sewage collection and treatment facilities will be necessary if sewage treatment needs are to be met in this area. In addition, a public education campaign is also recommended, especially in those areas where proposed projects were deactivated, to reduce public opposition to proposed projects. The estimated cost of this measure is $350,000.

Research and Development Project

A research and development project is recommended to determine and implement measures to reduce mine drainage from abandoned mines on Heizer-Manila Creek. The basic scope of this study would be to identify pollution sources, types of pollution, and recommend corrective measures. The study is estimated to cost approximately $50,000.

Pocatalico Chloride Identification Study

This study is included in this alternative in an effort to identify specific sources of chloride contaminants. The study will also attempt to quantify the overall extent of the problem in the Pocatalico River. Estimated cost of this study is $60,000.

Animal Waste Management Systems

These sytems are proposed to improve the water quality of several small streams in Putnam and Mason Counties. Funding should be accelerated to install about 30 systems by the Year 2000. Estimated cost of 30 systems is approximately $750,000.

Additional Surveillance and Enforcement to Meet Water Quality Standards

Enforcement standards as related to discharges from mining operations is recommended to reduce mine pollution in the Basin's streams, especially the Coal River.

The employment of two additional inspectors may serve to deter some pollution problems through increased day to day contact. Each new inspector would cost $35,000 per year for salary and support. In order to address the more severe problems resulting from repeat and negligent violators, more involved legal action through civil suits would be necessary. It is recommended that additional legal services be acquired to address these problems. These services would be affiliated with the State Attorney General's Office and would be funded and receive direction from the Division of Water Resources. The cost of acquiring additional legal services would be about $60,000 per year.

PLAN EFFECTS

Flood Prevention

Acceleration of existing flood prevention programs to provide for installation of the above plan elements by the Year 2000 would reduce flood damages throughout the Basin by less than five percent. This plan would cost approximately $886,600 with the Federal government paying about 80 percent, and other State or local agencies paying the remaining 20 percent. Approximately $520,000 of the Federal share would come from SCS and $189,300 from FEMA. The remaining share of $177,300 could come from State, county, municipal governments. Completion of the FPM studies would provide detailed hydraulic information

that State, county, and local government agencies could use to help regulate flood plain development. This data would facilitate conversion of communities and counties to the regular phase of the flood insurance program and with completion of the flood insurance studies, insure all Basin residents of access to full flood insurance benefits.

ALTERNATIVE PLAN 3 (EQ PLAN)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To reduce flood damages by elements that minimize environmental losses.

PLAN ELEMENTS - FPM studies for Boone, Lincoln, and Logan County portions of the Basin, and detailed Flood Insurance Studies for Danville, Madison, Sylvester, and Whitesville.

ACCOUNTS - Economic Development

Beneficial Effects		Adverse Effects	
1. Reduced Flood Damages	$ Unquantified	1. Annual Installation Cost	$ 74,300
		2. Annual O, M, & R Cost	$ 15,200
		TOTAL	$ 89,500

Environmental Quality
(Beneficial and Adverse Effects)

1. Potential development regulation for 130 miles of flood plains.
2. Avoid environmental losses generally associated with construction activities.

Other Social Effects
(Beneficial and Adverse Effects)

1. Improve health, safety, and welfare of Basin residents by describing flood hazards and alerting them of impending floods.
2. Provide opportunity for all residents to receive reimbursement for actual flood losses sustained through the regular flood insurance program.

Erosion

Implementing the plan measures would have an effect of reducing the erosion rates to the acceptable tolerances upon those lands by the reduction of sediment from the treated lands. Overall agricultural and forestry production would be improved. Reclaiming and treating severely eroding lands in the Basin will also improve the aesthetic quality of the Basin. A savings of money would also result from less frequent clean out at reservoirs, streams, side ditches, and culverts. The following is a brief description of the plan effects by category.

Abandoned Mine Lands

The annual cost reflected in plan measures would result in the reclamation of 568 acres of abandoned mine lands annually. This reclamation should reduce the overall erosion rate on those lands treated by 80-90%, to an acceptable rate of 4 to 5 tons/acre/year.

Roadbank Stabilization

Treatment and implementation costs should average approximately $1,000 per acre and should reduce the erosion rate on those roadbanks treated by about 90%, to an acceptable rate of 5 tons/acre/year.

Construction Sites

Implementation and enforcement of the regulations would result in a reduction of 80-90% in the erosion rate on those sites treated, to a rate of 2 to 3 tons/acre/year.

Forest Land Access Roads and Livestock Grazing

Treatment measures would result in an 85-90% reduction of the overall erosion rate on those lands treated, to a rate of 2.5 tons/acre/year.

ALTERNATIVE PLAN 3 (EQ PLAN)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To reduce erosion by elements that emphasize environmental quality.

PLAN ELEMENTS - Erosion control land treatment on abandoned mine lands, roadbanks, construction sites, access roads, and forest land livestock grazing.

Economic Development Account

Beneficial Effects

1.	Reduce erosion by 40,000 tons annually	$ Unquantified

Adverse Effects

1.	Annual installation cost	$7,324,600
2.	Annual technical assistance cost	903,300
	TOTAL	$8,227,900

Environmental Quality Account

1. Reduction of erosion by 80 to 90 percent on the lands treated
2. Protection of 2,600 acres annually
3. Eliminate areas hazardous to water quality, wildlife and domestic animals.

Social Effects

1. Eliminates areas hazardous to health and welfare
2. Employment of 1,049 Skilled laborers
3. Employment of 30 unskilled laborers

Water Supply

Implementation of water supply components in this alternative would minimize adverse impacts to the environment by limiting land disturbances associated with construction of water supply facilities. This is possible because the majority of the larger transmission lines necessary to connect the Teay's Valley water systems to the West Virginia Water Company have already been installed, with only a new river crossing remaining. With the new river crossing near Nitro, water could be available to Teays Valley within one year after the initiation of the project.

While the expense of providing expanded service to the Teays Valley area would be provided by the West Virginia Water Company, it can not be assumed that this will be the most cost efficient alternative to the consumer. This proposal would permit the expenditure of government assistance funds in additional areas exhibiting needs; however, the higher interest rates resulting from private financing, as well as the calculated return on the investment, would result in substantially higher consumer costs.

At present, because of the large treatment plant at the West Virginia Water Company, water treatment costs about 28 cents per 1,000 gallons. In comparison, treatment costs at the South Putnam PSD plant are about 65 cents per 1,000 gallons. While the larger plant can treat water at a less expensive rate, transportation costs and the maintenance of a greater distribution area adds significantly to the cost of delivering water. Similarly, the rates assessed for water are fairly uniform throughout the large service area and more closely reflect the costs for more expensive outlying areas. In essence, service fees for centrally located, densely populated areas, are higher. The smaller, more local community water systems are less expensive to maintain and can provide service at a significantly lower rate. It is concluded that the problems associated with the Putnam County community systems can be corrected at less expense to the consumer, as opposed to the potentially more expedient expansion of the West Virginia Water Company. In addition, the incorporation of the Teays Valley area into the West Virginia Water Company service area, would enhance that company's monopoly on water service. The presence of the smaller community systems as competitors should help keep consumer fees at reasonable levels.

As service areas increase in size, the population dependent upon a treatment system also increases. Considerations must be given to the potential effects of disrupted service to a large population, as well as to the possibilities of, and resultant effects of toxic substances or epizootic infections being introduced into the system.

Estimated cost of the water supply components in this alternative is $2,292,900. This cost includes $1,942,900 for incorporating the Teays Valley area into the West Virginia Water Company system and $350,000 to develop and implement the groundwater protection strategy.. The cost of the Teays Valley project was based on a 25% increase in consumer rates over the evaluation period of this project (to the Year 2000), and $150,000 for a river crossing at Nitro. The cost of the groundwater protection strategy was based on salaries and supporting costs of two groundwater specialists and a clerk-secretary, the development of a data management system, and the continual expansion of the data base.

Economic benefits would undoubtedly accrue to those water users that implement water conservation measures; however, those benefits could not be reasonably estimated. Most benefits that would accrue to this alternative would consist of the preservation of environmental values.

ALTERNATIVE PLAN 3 (EQ)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To provide adequate sustained yields to meet current and future water needs with minimal adverse environmental impacts.

PLAN ELEMENTS - To incorporate the Teays Valley area into the West Virginia Water Company service area and to implement water use conservation measures.

ACCOUNTS - Economic Development

Beneficial Effects		Adverse Effects	
	1.	Annual Installation Cost	$192,100
	2.	Annual O, M, & R Cost	$ 14,400
		TOTAL	$206,500

Environmental Quality
(Beneficial and Adverse Effects)

1. Eliminate need for 4 impoundments and transmission lines.
2. Reduced amounts of waste water needing treatment or to be assimilated into streams and/or aquifers.
3. Reduced energy consumption for hot water and appliances using water.

Other Social Effects
(Beneficial and Adverse Effects)

1. Higher user fees for consumers.
2. Most expedient alternative to improving service to the area.
3. Reduction of extravagant use of water resource.
4. More reliable supply of good quality water.

Water Quality

Implementation of the water quality measures in this alternative plan would have a substantial impact toward improving water quality throughout the Basin by the Year 2000.

Installation of 15 sewage treatment projects would complete the projects shown on the EPA Construction Grants Priority List compiled in 1984. This should considerably reduce concentrations of coliform organisms in Basin streams. The Sewage Treatment Control Plan for the Coal River area should pinpoint other areas of contamination and identify the most cost effective solutions. This data may enable local planners to even further deal with domestic pollution.

The studies to identify mine drainage and chloride pollution sources on Heizer-Manilla Creek and the Pocatalico River respectively, are the first step toward developing solutions to reduce these pollutants.

Implementing animal waste systems in the more agricultural areas of the Basin would improve farm management and reduce pollution of several direct tributaries to the Kanawha River.

To implement water quality elements in this alternative would require an expenditure of approximately $54,910,000. Construction activities required to install the measures are expected to create 42 skilled jobs and 30 unskilled jobs resulting in unemployment benefits of $1,947,900 annually. Other economic benefits would accrue to this plan; however, it was not possible to compute these benefits during the time allotted to this study.

ALTERNATIVE PLAN 3 (EQ Project)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To emphasize environmental quality by improving the water quality of the Basin.

PLAN ELEMENTS - Fifteen sewage treatment projects, sewage treatment control plan for the Coal River, research and development project for Heizer-Manilla Creek, Pocatalico chloride identification study, 30 animal waste systems, and adequate enforcement of water quality laws.

ACCOUNTS - Economic Development

Beneficial Effects

Adverse Effects

1.	Annual Installation Cost	$4,600,100
2.	Annual O, M & R Cost	$ 568,700
	TOTAL	$5,168,800

Environmental Quality
(Beneficial and Adverse Effects)

1. Reduce domestic, animal, and mine drainage pollution in Basin streams.
2. Improve visual amenities of the water resource base.
3. Identify specific pollution sources.

Other Social Effects
(Beneficial and Adverse Effects)

1. Create approximately 72 new jobs.
2. Reduce potential health hazards associated with water contact.
3. Improve the potential of water contact recreation in Basin streams.
4. Improve aquatic habitat.

ALTERNATIVE PLAN 4

This alternative was formulated to provide a reasonable blend of plan elements that provide both economic development benefits and environmental quality benefits. It includes plan elements from Alternative Plan 2 and Alternative Plan 3. Those elements that would meet study objectives and be least environmentally damaging were included from Plan 2; whereas, only the most effective elements from Plan 3 were included. Following is a listing of the various plan elements.

PLAN MEASURES

This alternative consists of measures for flood prevention, erosion control, water supply, and water quality.

Flood Prevention

Flood prevention plan elements include both structural and nonstructural elements. The structural elements provide for restoring channel capacity depleted over the years by excessive sediment deposits, debris, and heavy vegetation. Nonstructural elements include primarily warning and management measures.

Upper Rocky Fork Channel Work

a.	Probable Measures	Clearing and Snagging
b.	Installation Cost	$ 159,400
c.	Annual O, M, & R Cost	$ 1,300
d.	Total Annual Cost	$ 14,700
e.	Total Annual Benefits	$ 28,400
f.	Net Benefits	$ 13,700

Marsh Fork Channel Work

a.	Probable Measures	Clearing and Grubbing
b.	Installation Cost	$ 160,700
c.	Annual O, M, & R Cost	$ 3,000
d.	Total Annual Cost	$ 16,500
e.	Total Annual Benefits	$ 409,400
f.	Net Benefits	$ 392,900

Danville-Madison Channel Rehabilitation

a.	Probable Measures	Channel shaping, Restoration, Debris Removal, and Selective Clearing
b.	Installation Cost	$ 2,746,600
c.	Annual O, M, & R Cost	$ 25,000
d.	Total Annual Cost	$ 255,100
e.	Total Annual Benefits	$ 466,100
f.	Net Benefits	$ 211,000

Greenview-Sharples Channel Rehabilitation

a.	Probable Measures	Selective Clearing and Debris Removal
b.	Installation Cost	$ 447,200
c.	Annual O, M, & R Cost	$ 16,600
d.	Total Annual Cost	$ 54,100
e.	Total Annual Benefits	$ 137,600
f.	Net Benefits	$ 83,500

Sylvester-Whitesville Channel Rehabilitation

a.	Probable Measures	Selective Clearing and Debris Removal
b.	Installation Cost	$ 368,900
c.	Annual O, M, & R Cost	$ 10,200
d.	Total Annual Cost	$ 41,100
e.	Total Annual Benefits	$ 74,000
f.	Net Benefits	$ 32,900

Van-Clinton Channel Rehabilitation

a.	Probable Measures	Channel Shaping and Restoration
b.	Installation Cost	$ 1,725,900
c.	Annual O, M, & R Cost	$ 22,600
d.	Total Annual Cost	$ 167,200
e.	Total Annual Benefits	$ 300,100
f.	Net Benefits	$ 132,900

Rock Branch Nonstructural Plan

a.	Probable Measures	Nonstructural
b.	Installation Cost	$ 93,100
c.	Annual O, M, & R Cost	$ 5,400
d.	Total Annual Cost	$ 13,200
e.	Total Annual Benefits	$ 31,300
f.	Net Benefits	$ 18,100

Flood Plain Management Studies

These studies are for 112.3 miles of flood plains in Boone, Lincoln, and Logan Counties.

a.	Probable Measures	FPM Study
b.	Study Cost	$ 650,000
c.	Annual Benefits	Not Quantified

National Flood Insurance Studies

These studies are for Danville, Madison, Sylvester, and Whitesville.

a.	Probable Measure	Flood Insurance Study
b.	Study Cost	$ 236,600
c.	Annual Benefits	Not Quantified

Erosion

Plan elements would reduce, control and stabilize erosion rates on critically eroding abandoned mine lands, roadbanks, construction sites, and forest land. This plan emphasizes treating those critical areas that would provide the greatest benefit, both environmentally and economically. Plan measures would reduce the threat of physical damage from floods, landslides and excessive sedimentation.

Abandoned Mine Lands

Approximately 190 acres of critically eroding Priority I, II, and III abandoned mine lands and refuse piles would be reclaimed by this alternative, annually. Reclamation practices would consist of the following: (1) backfilling of portals, tunnels and excavation, (2) extinguishing burning refuse piles, (3) leveling, grading, and compacting waste materials to blend with surrounding contours, (4) installing drains, culverts and stilling basins, (5) adding topsoil and additives to provide a plant growing medium, and (6) establishing vegetation. Technical assistance to insure proper location, planning and design would be provided by the WVDNR and SCS. These agencies would also provide the necessary inspection to insure proper installation of the measures.

Reclamation costs should average $10,700 per acre. (See Reference #2)

	Total Cost	Annual Costs
Installation Costs	$ 31,434,500	$ 2,633,500
Technical Assistance	5,987,500	501,600
	$ 37,422,000	$ 2,135,100

Roadbank Stabilization

Approximately 800 acres of primary and secondary roadbanks would be stabilized by sloping, grading, fertilizing, seeding and mulching practices. The WVDOH would provide the technical assistance necessary to insure proper installation, treatment and maintenance to insure stability.

	Total Cost	Annual Costs
Installation Costs	$ 800,000	$ 67,000
Technical Assistance	128,000	10,700
	$ 928,000	$ 77,700

Construction Sites

Plan measures include technical assistance to help county and State governments in the formulation, drafting, and passage of erosion and sedimentation control ordinances and regulations. Implementation and enforcement of said regulations would effect the 13,400 acres of new construction expected to occur in the Basin by the Year 2000.

Technical assistance would be provided by the SCS, FS, WVDNR, and Soil Conservation Districts. These agencies would insure proper location, installation, and implementation of erosion and sedimentation control measures on the industrial, urban, utility right-of-ways, and private road construction sites in the Basin. Installation costs would be the responsibility of the developer, contractor and/or landowner.

	Total Cost	Annual Costs
Installation Costs	$ 0	$ 0
Technical Assistance	1,200,000	100,500
	$ 1,200,000	$ 100,500

Forest Land Access Roads and Livestock Grazing

Plan measures would reduce the erosion rate to the acceptable value on forest access roads by grading, sloping, installing ditches, culverts, and fertilizing, mulching and seeding.

Erosion would be reduced from grazed areas by fencing and seeding the disturbed areas.

(Costs for access roads would average approximately $575 per acre with grazed lands receiving $61 per acre.)

	Total Cost	Annual Costs
Access Roads		
Installation Costs	$ 1,464,000	$ 122,600
Technical Assistance	67,000	5,600
	$ 1,531,000	$ 128,200
Grazed Land		
Installation Costs	$ 400,000	$ 33,500
Technical Assistance	29,500	2,500
	$ 429,500	$ 36,000

Water Supply

This alternative combines both NED and EQ water supply elements. Those elements are:

Keith Water System

This system is located in the small community of Keith in Boone County.

		Local Distribution System
a.	Probable Measures	
b.	Installation Cost	$ 200,000
c.	Annual O, M, & R Cost	$ 5,500
d.	Total Annual Cost	$ 22,300
e.	Total Annual Benefits	$ 24,300
f.	Net Benefits	$ 2,000

Buffalo Water System

This system is located at Buffalo in Putnam County. This system serves 1,106 users (1982).

a.	Probable Measure	Treatment Plant Renovation
b.	Installation Cost	$ 75,000
c.	Annual O, M, & R Cost	$ 2,900
d.	Total Annual Cost	$ 9,200
e.	Total Annual Benefits	$ 11,500
f.	Net Benefits	$ 2,300

Hurricane Water System

This system is located at Hurricane in Putnam County and serves 5,500 people.

a.	Probable Measure	New Impoundment Dredge Existing Impoundment Transmission Line
b.	Installation Cost	$1,465,100
c.	Annual O, M, & R Cost	$ 20,000
d.	Total Annual Cost	$ 142,700
e.	Total Annual Benefits	$ 281,600
f.	Net Benefits	$ 138,900

South Putnam PSD

This public service district supplies treated water to 4,900 people in the southern portion of Putnam County.

a.	Probable Measure	New Impoundment
b.	Installation Cost	$1,340,100
c.	Annual O, M, & R Cost	$ 6,200
d.	Total Annual Cost	$ 118,500
e.	Total Annual Benefits	$ 202,300
f.	Net Benefits	$ 83,800

Winfield Water System

This system provides water to 1,000 people in Winfield, in the western portion of Putnam County.

a.	Probable Measure	New Impoundment Treatment Plant Renovation
b.	Installation Cost	$1,478,100
c.	Annual O, M, & R Cost	$ 6,000
d.	Total Annual Cost	$ 129,800
e.	Total Annual Benefits	$ 152,500
f.	Net Benefits	$ 22,700

Lake Washington PSD

This public service district supplies treated water to 1,000 people in the vicinity of Hurricane in Putnam County. Source of water is a lake that is partially silted in.

a.	Probable Measure	Treatment Plant Renovation New Impoundment Dredge Existing Impoundment
b.	Installation Cost	$1,538,400
c.	Annual O, M, & R Cost	$ 6,100
d.	Total Annual Cost	$ 135,000
e.	Total Annual Benefits	$ 150,500
f.	Net Benefits	$ 15,500

Portable Water Treatment Plant

This plant would consist of a tractor trailer mounted, 60 gallons per minute, treatment plant for the entire Basin. This portable plant could provide water for 250 people.

a.	Probable Measure	Portable Treatment Plant
b.	Installation Cost	$ 79,200
c.	Annual O, M, & R Cost	$ 17,200
d.	Total Annual Cost	$ 23,800
e.	Total Annual Benefits	$ 80,000
f.	Net Benefits	$ 57,000

Groundwater Protection Strategy

This strategy would consist of an investigation to determine the extent that pollution and physical alterations effect the Basin's aquifers and to develop and implement a plan to protect these aquifers from future pollution.

a.	Probable Measure	Groundwater Study
b.	Implementation Cost	$ 350,000
c.	Annual O, M, & R Cost	$ -
d.	Total Annual Cost	$ 29,300
e.	Total Annual Benefits	Unqualified
f.	Net Benefits	Unqualified

Water Use Conservation Measures

These measures would consist of repairing leaking pipes and faucets, and encourage proper use of existing supplies. Economic costs and benefits of this measure were not quantified during this study.

Water Quality

The water quality measures in Alternative Plan 4 are the same as those described for Alternative Plan 3.

PLAN EFFECTS

Flood Prevention

This alternative plan would make use of all existing flood prevention programs to meet the study concern of flood damage reduction by accelerating the programs through increased funding. Installing and implementing the plan elements by the Year 2000 would require approximately $6,588,400. Installing plan elements would result in flood damage reduction of about 25 percent in the upstream areas. Remaining economic losses could be offset by flood insurance payments, less the deductible. Detailed hydraulic information prepared during the FPM studies could be used to regulate future flood plain development or to convert counties to the regular flood insurance programs. Environmental damage associated with installing structural measures will be similar to that described in Alternative Plan 2.

ALTERNATIVE PLAN 4 (COMBINATION OF NED & EQ)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To reduce flood damages through a blend of NED and EQ elements.

PLAN ELEMENTS - Flood prevention plans for the Upper Rocky Fork Watershed, Rock Branch Watershed, Marsh Fork Watershed at Glen Daniels-Fairdale, channel rehabilitation at the Danville-Madison area, Greenview-Sharples area, Sylvester-Whitesville area, Van-Clinton area, FPM Studies for Boone, Lincoln and Logan Counties, and Flood Insurance Studies for Danville, Madison, Sylvester, Whitesville.

ACCOUNTS - Economic Development

Beneficial Effects		Adverse Effects	
1. Reduced flood damages	$1,446,900	1. Annual Installation Cost	$552,100
		2. Annual O, M, & R Cost	$ 99,300
TOTAL	$1,446,900	TOTAL	$651,400

Environmental Quality
(Beneficial and Adverse Effects)

1. Protection for 733 buildings.
2. Changed land use for 730 acres of land needed for the plan elements.
3. Modification of 44.1 miles of streams.
4. Potential development regulations for 130 miles of flood plains.
5. Reduce terrestrial habitat loss by proper flood plain development.

Other Social Effects
(Beneficial and Adverse Effects)

1. Employment opportunities for 20 skilled and 14 semiskilled employees.
2. Twenty-five percent flood damage reduction in upstream watersheds.
3. Improve health, safety, and welfare of Basin residents by identifying flood hazards and alerting them of impending floods.
4. Provide opportunity for all residents to be reimbursed for actual flood losses sustained through flood insurance payment.

Erosion

Abandoned Mine Lands

The cost reflected in the measures table would result in the reclamation of 190 acres of abandoned mine lands and refuse piles annually. This reclamation should reduce the erosion rate by 80 to 90% to an acceptable rate of 4 to 5 tons/acre/year, from each site reclaimed. The effects of the plan measures are 1) elimination of health and safety hazards, 2) improving the water quality by reduction of erosion, sedimentation and acid mine drainage and 3) improving the aesthetic quality of the area by returning the land to its original contours and revegetating.

Roadbank Stabilization

Control measures would reduce the erosion rate by approximately 90%, to an acceptable rate of 5 tons/acre/year, on those roadbanks treated. Costs would average approximately $1,000 per acre and result in the stabilization of 60 acres annually. A further beneficial effect of this stabilization would be a monetary saving to the WV DOH in the form of reduced ditch and culvert cleanout and maintenance.

Construction Sites

Implementation of plan elements would reduce erosion and sedimentation by assisting county and state governments in the formulation, drafting, and passage of erosion and sedimentation control ordinances and regulations for construction sites. It is projected that 13,400 acres of construction sites will exist in the Basin by Year 2000. Technical assistance would be provided by the SCS, FS, WV DNR, and soil conservation districts. The agencies would insure proper implementation and installation of control measures on the industrial, urban, utility, and private road construction sites. Implementation and enforcement of the regulations should result in a reduction of 80 to 90% in the erosion rate on those lands treated. Costs incurred would result in 500 acres being treated annually. Costs per acre would vary due to the type and extent of construction.

Forest Land Access Roads and Livestock Grazing

Implementation of plan elements would: 1) reduce erosion and sedimentation from forest land access roads in critically eroding areas of Kanawha, Mason, and Putnam Counties to a rate approaching the geologic rate, 2) reduce erosion and sedimentation from forest land due to livestock grazing in critical areas of Kanawha, Mason, and Putnam Counties and 3) provide under existing programs, the technical assistance necessary to insure proper implementation, installation and maintenance treatment. Costs would average $575 per acre on access roads, resulting in 216 acres treated annually. Treatment of grazed lands would average $61 per acre and result in 572 acres reclaimed annually.

ALTERNATIVE PLAN 4 (COMBINATION OF NED & EQ)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To reduce erosion by elements that emphasize treating the more critically eroding areas.

STUDY ELEMENTS - Erosion control land treatment on abandoned mine lands, roadbanks, construction sites, forest land access roads and forest land livestock grazing.

Economic Development Account

Beneficial Effects		Adverse Effects	
1. Reduce erosion	Unquantified	1. Annual installation cost	$2,856,600
		2. Annual technical assistance	620,900
		TOTAL	$3,477,500

Environmental Quality Account

1. Reduction of erosion by 80 to 90 percent on those lands treated.
2. Protection of 1,550 acres annually.
3. Eliminate areas hazardous to water quality, wildlife and domestic animals.

Social Effects

1. Eliminates areas hazardous to health and welfare.
2. Employment of 409 skilled labors.
3. Employment of 21 unskilled laborers.

Water Supply

The total costs of implementing the water supply elements in this alternative are estimated to be $6,525,900. In addition, operation, maintenance, and replacement is expected to cost $63,900 annually. Total annual cost of these elements is estimated at $609,700.

Installation of these measures will meet the remaining needs for six municipal systems in the Basin, providing potable water for a population in excess of 13,600 in some of the more rapidly growing areas. Providing municipal water to these people would create $903,450 worth of benefits by allowing them to avoid the need of developing self-supply water systems, such as wells.

ALTERNATIVE PLAN 4 (Combined Plan)
Lower Kanawha River Basin, West Virginia

STUDY OBJECTIVES - To provide adequate sustained yields of water to meet future needs.

PLAN ELEMENTS - Provide improvements to 6 community water systems, acquire a portable water treatment plant for emergency use and to facilitate treatment plant maintenance, and to implement water use conservation measures.

ACCOUNTS - Economic Development

Beneficial Effects			Adverse Effects	
1.	Water Supply	$903,500	1. Annual Installation Cost	$546,700
			2. Annual O, M, & R Cost	63,900
	TOTAL	$903,500	TOTAL	$610,600

Environmental Quality
(Beneficial and Adverse Effects)

1. Temporary disturbances resulting in increased erosion and reduced visual amenities during installation.
2. Preservation of green space in contributory watersheds to reservoir sites.
3. Conserve underground aquifers.
4. Encourage urban development.
5. Reduce amounts of waste water needing treatment or to be assimilated into streams and/or aquifers.
6. Reduced energy consumption for hot water and water using appliances.

Other Social Effects
(Beneficial and Adverse Effects)

1. More reliable supply of good quality water.
2. Creation of 17 skilled and 25 semiskilled jobs.
3. Potential water user fee increase.
4. Reduction in interruptions of water service for maintenance activities.
5. Expedient and less expensive provision for temporary water service in the event of disasters of emergencies.
6. Reduction of extravagant use of water resource.

Water Quality

Effects of Alternative Plan 4 are the same as those described for Alternative Plan 3.

OTHER ALTERNATIVES AND MEASURES CONSIDERED

Several other alternatives and measures were considered during the course of this study which were not included in the alternative plans formulated to meet the major study concerns. These may be of interest to local planners as they deal with specific local problems, and are briefly discussed herein.

Alternative flood prevention plans were considered for ten additional community areas. Both structural and nonstructural measures, along with combinations of these measures, were analyzed. They were not included in the alternative plans in this report because they were not economically feasible. The following table summarizes these alternatives.

TABLE 3
OTHER FLOOD PREVENTION ALTERNATIVES
Lower Kanawha River Basin

COMMUNITY AREA	LEAST COST ALTERNATIVE	ANNUAL COST ($)	ANNUAL DAMAGES ($)	DAMAGE COST RATIO
Dutch Hollow	Channel Work	33,000	28,800	0.7:1.0
Rock Branch	Channel Work	32,000	29,000	0.7:1.0
Dorothy	Nonstructural	437,000	354,000	0.8:1.0
Ameagle	Nonstructural	90,000	61,200	0.7:1.0
Colcord	Nonstructural	49,500	30,200	0.6:1.0
Loudendale	Combination	514,000	170,400	0.3:1.0
Fuquay-Priestly	Nonstructural	315,000	61,200	0.2:1.0
Tupper Creek	Channel Work	162,000	47,200	0.3:1.0
Rumble	Combination	389,000	82,300	0.2:1.0
Lower Marsh Fork	Nonstructural	1,449,000	362,300	0.2:1.0

Price base 1982, period of analysis 100 years, discount rate 8 3/8 percent.

Approximately 124 impoundment sites were evaluated to determine their use in meeting water supply concerns throughout the Basin. This study was conducted by a private consultant under contract to the U. S. Army Corps of Engineers, Huntington District. The study includes an analysis of the most outstanding impoundment sites in the Basin. See Figure 11, Appendix A, for the location of these sites. During the analysis, the cost of developing the impoundments was estimated for various heights and is displayed in graphical form. Available water supply storage and yields were also estimated and displayed for local planners. Results of this evaluation are included as Appendix D (unattached).

Two possibilities were considered for utilizing the Kanawha River as a supply source for meeting water supply needs. The first involved the construction of a large central treatment plant near St. Albans which would supply areas south and west of the facility including Teays Valley. The second involved the storage of water in impoundments to be pumped from the river and used as a supplemental supply source during drought periods. This water would be chemically analyzed for the development of specific treatment schemes for each batch. These measures were not included in the alternative plans because of concerns with the possibility of toxic organic chemical contamination and to a lack of economic feasibility.

The utilization of groundwater supplies as a major water source has been traditional, especially in rural areas. The drilling of individual wells for self-supplied water systems will continue to be important, particularly in areas where municipal water systems aren't feasible. While groundwater supplies are widespread, local quantities and qualities of water are not proven or assured and the potential for contamination by additional development is high. In rapidly developing areas, the construction of sewage collection and treatment systems prior to the installation of water systems, would preserve the quality of self-supplied water systems by preventing the contamination of groundwater in areas where septic fields would normally be relied upon for waste disposal.

Alternative methods of sewage disposal were also considered, especially with regard to addressing problems associated with the ribbon-type communities in the Coal River Subbasin. These included compost toilets[3&4] and a small-diameter, variable-grade, gravity sewer system (VGS).[5] Compost toilets were determined not to be feasible due to the expense of installation, special requirements, maintenance requirements, and the remaining need for an additional waste water disposal system. The VGS system, however, does appear to be promising and should be given consideration in developing the sewage treatment control plan recommended in the Suggested Plan (Chapter 3).

TABLE 4
CAPABILITY OF ALTERNATIVE PLANS TO SATISFY NEEDS - YEAR 2000
LOWER KANAWHA RIVER BASIN

ALTERNATIVE PLANS / STUDY CONCERNS	UNIT OF MEASURE	NEEDS	NEEDS SATISFIED**	NEEDS REMAINING	PROGRAM OPPORTUNITIES		
					FEDERAL	STATE	OTHERS
Alternative Plan I - Existing Programs							
Flood Prevention							
1. Flood Damage Reduction:							
a. Flood Warning System	Dollars	18,720,100	2,518,400*	16,201,700	National Weather Service - IFLOWS	Office of Emergency Mgmt- (OEM)	Counties
b. Raleigh County FPM Study	Miles	155.3	43.0	112.3	SCS RB-09 FPM	-	Counties
c. Flood Insurance	Reports	11	7	4	FEMA	OEM	Counties-Cities
Erosion & Sedimentation							
1. Reduction of Erosion:							
a. Abandoned Mine Reclamation	Acres	10,000	688	9,312	SCS PL 95-47 (RAMP)	AMP	SCD
b. Forest Land Road Stabilization	Acres	10,600	85	10,515	ACP w/FmHA Loans FS Coop. Forest Mgt	Forest.Div.	SCD
c. Roadbank Stabilization	Acres	1,075	0	1,075	-	DOH	-
d. Construction Sites	Acres	3,200	0	3,200	-	DNR	SCD
Water Supply Measures							
1. Public Water	Systems	9	6	3			
Water Quality Measures							
1. Sewage Treatment	Systems	37	8	29			
2. Animal Waste Treatment	Systems	60	30	30			

TABLE 4 (Continued)
CAPABILITY OF ALTERNATIVE PLANS TO SATISFY NEEDS - YEAR 2000
LOWER KANAWHA RIVER BASIN

ALTERNATIVE PLANS / / STUDY CONCERNS	UNIT OF MEASURE	NEEDS	NEEDS SATISFIED**	NEEDS REMAINING	PROGRAM OPPORTUNITIES FEDERAL	STATE	OTHERS
Alternative Plan 2 - (NED)							
Flood Prevention							
1. Flood Damage Reduction:							
a. Upper Rocky Fork Channel Work	Dollars		28,400		SCS RC&D Program	-	SCD&Sponsors
b. Marsh Fork Channel Work	Dollars		409,400		COE Local Protection Program	-	Counties
c. Danville-Madison Channel Rehab.	Dollars		466,100		" " "	-	Counties
d. Greenview-Sharples Channel Reh.	Dollars		137,600		" " "	-	Counties
e. Sylvester-Whitesville Channel Rehabilitation	Dollars		74,000		" " "	-	Counties
f. Van-Clinton Channel Rehab.	Dollars		300,100		" " "	-	Counties
g. Rock Branch Nonstructural	Dollars		31,300		SCS RC&D Program	-	Prop.Owners
Subtotal	Dollars	16,201,700	1,446,900	14,754,800	-	-	-
Water Supply Measures							
1. Public Water	Systems	6	6	0			
Water Quality Measures	(No water quality measures in the NED Plan)						

TABLE 4 (Continued)
CAPABILITY OF ALTERNATIVE PLANS TO SATISFY NEEDS - YEAR 2000
LOWER KANAWHA RIVER BASIN

ALTERNATIVE PLANS / STUDY CONCERNS	UNIT OF MEASURE	NEEDS	NEEDS SATISFIED**	NEEDS REMAINING	PROGRAM OPPORTUNITIES		
					FEDERAL	STATE	OTHERS
Alternative Plan 3 - (EQ Plan)							
Flood Prevention							
Flood Damage Reduction:	Dollars	16,201,700	0	16,201,700	-	-	-
1. Flood Plain Management Studies	Miles	112.3	112.3	0	SCS RB-09 FPM	-	-
					COE Flood Plain Info	-	-
2. Flood Insurance Studies	Reports	11	7	4	FEMA-FIP	OEM	Counties-Cities
Erosion & Sedimentation							
Reduction of Erosion:							
1. Abandoned Mine Reclamation	Acres	9,312	9,312	0	SCS PL 95-47 (RAMP)	DNR-AMP	SCD
2. Roadbank Stabilization	Acres	1,075	1,075	0	SCS RC&D Program	DOH	SCD
3. Forest Land Access Road Stab.	Acres	10,515	10,515	0	FS-CFM Program	Forest.Div.	SCD
4. Forest Land Grazing Control	Acres	7,500	7,500	0	FS-CFM Program	Forest.Div.	SCD
5. Construction Site Technical Asst.	Acres	3,200	3,200	0	SCS PL-46 (CO-1)	DNR	SCD
Water Supply Measures							
1. Public Water	Systems	6	5	1			
Water Quality Measures							
1. Sewage Treatment	Systems	29	15	14			
2. Animal Waste Treatment	Systems	30	30	0			

TABLE 4 (Continued)
CAPABILITY OF ALTERNATIVE PLANS TO SATISFY NEEDS - YEAR 2000
LOWER KANAWHA RIVER BASIN

ALTERNATIVE PLANS / / STUDY CONCERNS	UNIT OF MEASURE	NEEDS	NEEDS SATISFIED**	NEEDS REMAINING	PROGRAM OPPORTUNITIES FEDERAL	STATE	OTHERS
Alternative Plan 4 - (Combined Plan)							
Flood Prevention							
Flood Damage Reduction:							
1. Upper Rocky Fork Channel Work	Dollars		28,400		SCS RC&D Program	-	SCD-Sponsors
2. Marsh Fork Channel Work	Dollars		409,400		COE Local Protection	-	Counties
3. Danville-Madison Channel Rehab.	Dollars		466,100		Program	-	Counties
4. Greenview-Sharples Channel Rehab.	Dollars		137,600		" " " "	-	Counties
5. Sylvester-Whitesville Channel Reh.	Dollars		74,000		" " " "	-	Counties
6. Van-Clinton Channel Rehabilitation	Dollars		300,100		" " " "	-	Counties
7. Rock Branch Nonstructural	Dollars		31,300		SCS RC&D Program	-	Prop.Owners
Subtotal	Dollars	16,201,700	1,446,900	14,754,800	-	-	-
8. Flood Plain Management Studies	Miles	112.3	112.3	0	SCS RB-09 FPM	-	Counties
9. Flood Insurance Studies	Areas	4	4	0	FEMA	OEM	Counties-Cities
Erosion & Sedimentation							
Reduction of Erosion:							
1. Abandoned Mine Reclamation	Acres	9,312	3,150	6,162	SCD PL 95-47 (RAMP)	DNR-AMP	SCD
2. Roadbank Stabilization	Acres	1,075	800	275	SCS RC&D Program	DOH	SCD
3. Forest Land Access Road Stab.	Acres	10,515	2,550	7,965	FS CFM Program	Forest.Div.	SCD
4. Forest Land Grazing Control	Acres	7,500	6,560	940	FS CFM Program	Forest.Div.	SCD
5. Construction Site Technical Asst.	Acres	3,200	3,200	0	SCS PL-46 (CO-1)	DNR	SCD
Water Supply Measures							
1. Public Water	Systems	6	6	0			
Water Quality Measures							
1. Sewage Treatment	Systems	29	15	14			
2. Animal Waste	Systems	30	30	0			

* Needs satisfied were estimated by assuming that a basin-wide flood warning system would reduce flood damages approximately 15% along the Kanawha River and 10% in upstream areas.
** Needs satisfied were projected to the Year 2000 using a projection factor of 1.81.
Price base 1982, period of analysis 100 years, discount rate 8 3/8 percent.

TABLE 5
ANNUAL COSTS OF ALTERNATIVE PLANS
LOWER KANAWHA RIVER BASIN
(Price Base 1982)

ALTERNATIVE PLANS / / / PLAN MEASURES	UNIT OF MEASURE	QUANTITY	FIRST COST ($)	AMORTIZED ANNUAL COST ($) 2/	ANNUAL O,M,& R ($)	TOTAL ANNUAL COST ($)
Alternative Plan 1 - Existing Programs						
Flood Prevention Measures						
1. Raleigh County FPM Study	Miles	43.0	33,100	2,800	300	3,100
2. IFLOWS Flood Warning	Counties	6	130,000	10,900	24,000	34,900
3. Flood Insurance	Reports	7	850,000	71,200	5,700	76,900
SUBTOTAL			1,013,100	84,900	30,000	114,900
Erosion & Sedimentation Measures						
1. Abandoned Mine Reclamation	Acres	688	4,816,000	403,500	39,100	442,600
2. Forest Land Road Stabilization	Acres	85	68,000	5,700	800	6,500
SUBTOTAL			4,884,000	409,200	39,900	449,100
Water Supply Measures						
1. Renovated Water Systems	Number	6	2,981,000	249,700	37,200	286,900
SUBTOTAL			2,981,000	249,700	37,200	286,900
Water Quality Measures						
1. New Sewage Systems	Number	8	34,120,000	2,858,500	153,300	3,011,800
2. Animal Waste Systems	Number	30	750,000	62,800	15,000	77,800
SUBTOTAL			34,870,000	2,921,300	168,300	3,089,600
TOTAL ALTERNATIVE PLAN 1			43,748,100	3,665,100	275,400	3,940,500

TABLE 5 (Continued)
ANNUAL COSTS OF ALTERNATIVE PLANS
LOWER KANAWHA RIVER BASIN
(Price Base 1982)

ALTERNATIVE PLANS / / / PLAN MEASURES	UNIT OF MEASURE	QUANTITY	FIRST COST ($)	AMORTIZED ANNUAL COST ($) 2/	ANNUAL O,M,& R ($)	TOTAL ANNUAL COST ($)
Alternative Plan 2-(NED Plan)						
Flood Prevention Measures						
1. Upper Rocky Fork Channel Work	Miles	0.5	159,400	13,400	1,300	14,700
2. Marsh Fork Channel Work	Miles	2.5	160,700	13,500	3,000	16,500
3. Danville-Madison Channel Rehab.	Miles	13.0	2,746,600	230,100	25,000	255,100
4. Greenview-Sharples Channel Reh.	Miles	10.4	447,200	37,500	16,600	54,100
5. Sylvester-Whitesville Channel Reh.	Miles	6.4	368,900	30,900	10,200	41,100
6. Van-Clinton Channel Rehab.	Miles	11.3	1,725,900	144,600	22,600	167,200
7. Rock Branch Nonstructural	Structures	9	93,100	7,800	5,400	13,200
SUBTOTAL			5,701,800	477,800	84,100	561,900
Erosion & Sedimentation Measures	(No Erosion & Sedimentation Measures in the NED Plan)					
Water Supply Measures						
1. Renovated Water Systems	Number	6	6,096,700	510,800	46,700	557,500
2. Portable Treatment Plant	Number	1	79,200	6,600	17,200	23,800
SUBTOTAL			6,175,900	517,400	63,900	581,300
Water Quality Measures	(No water quality measures in the NED Plan)					
TOTAL ALTERNATIVE PLAN 2			11,877,700	995,200	148,000	1,143,200

TABLE 5 (Continued)
ANNUAL COSTS OF ALTERNATIVE PLANS 1/
LOWER KANAWHA RIVER BASIN

ALTERNATIVE PLANS / / / PLAN MEASURES	UNIT OF MEASURE	QUANTITY	FIRST COST ($)	AMORTIZED ANNUAL COST ($) 2/	ANNUAL O,M,& R ($)	TOTAL ANNUAL COST ($)
Alternative Plan 3 - (EQ Plan)						
Flood Prevention Measures						
1. Flood Plain Management Studies	Miles	130.0	650,000	54,500	6,500	61,000
2. Flood Insurance Studies	Reports	4	236,600	19,800	8,700	28,500
SUBTOTAL			886,600	74,300	15,200	89,500
Erosion & Sedimentation Measures						
1. Abandoned Mine Reclamation	Acres	10,000	65,557,800	5,492,400	610,300	6,102,700
2. Roadbank Stabilization	Acres	1,075	1,075,000	90,100	14,000	104,100
3. Construction Site Technical Asst.	Acres	3,200	-	-	224,500	224,500
4. Forest Land Access Road Stab.	Acres	10,600	20,374,000	1,706,900	51,400	1,758,300
5. Forest Land Grazing Control	Acres	7,500	422,000	35,800	3,100	38,500
SUBTOTAL			87,428,800	7,324,600	903,300	8,227,900
Water Supply Measures						
1. Teays Valley Area	System	1	1,942,900	162,800	14,400	177,200
2. Ground Water Aquifer Protection	Study	1	350,000	29,300	-	29,300
3. Water Use Conservation	-	-	-	-	-	-
SUBTOTAL			2,292,900	192,100	14,400	206,500
Water Quality Measures						
1. Sewage Treatment	Systems	15	53,700,000	4,498,800	423,700	4,922,500
2. Sewage Treatment Control Plan	Studies	1	350,000	29,300	-	29,300
3. Abandoned Mine Research	Studies	1	50,000	4,200	-	4,200
4. Chloride	Studies	1	60,000	5,000	-	5,000
5. Animal Waste	Systems	30	750,000	62,800	15,000	77,800
6. Enforcement of Water Quality Standards	Personnel	3	-	-	130,000	130,000
SUBTOTAL			54,910,000	4,600,100	568,700	5,169,800
TOTAL ALTERNATIVE PLAN 3			145,518,300	12,191,100	1,501,600	13,692,700

TABLE 5 (Continued)
ANNUAL COSTS OF ALTERNATIVE PLANS 1/
LOWER KANAWHA RIVER BASIN

ALTERNATIVE PLANS / PLAN MEASURES	UNIT OF MEASURE	QUANTITY	FIRST COST ($)	AMORTIZED ANNUAL COST ($) 2/	ANNUAL O,M,& R ($)	TOTAL ANNUAL COST ($)
Alternative Plan 4 - (Combined Plan)						
Flood Prevention Measures						
1. Upper Rocky Fork Channel Work	Miles	0.5	159,400	13,400	1,300	14,700
2. Marsh Fork Channel Work	Miles	2.5	160,700	13,500	3,000	16,500
3. Danville-Madison Channel Rehab.	Miles	13.0	2,746,600	230,100	25,000	255,100
4. Greenview-Sharples Channel Rehab.	Miles	10.4	447,200	37,500	16,600	54,100
5. Sylvester-Whitesville Channel Reh.	Miles	6.4	368,900	30,900	10,200	41,100
6. Van-Clinton Channel Rehabilitation	Miles	11.3	1,725,900	144,600	22,600	167,200
7. Rock Branch Nonstructural	Structures	9	93,100	7,800	5,400	13,200
8. Flood Plain Management Studies	Miles	130.0	650,000	54,500	6,500	61,000
9. Flood Insurance Studies	Reports	4	236,600	19,800	8,700	28,500
SUBTOTAL			6,588,400	552,100	99,300	651,400
Erosion & Sedimentation Measures						
1. Abandoned Mine Reclamation	Acres	3,500	31,434,500	2,633,500	501,600	3,135,200
2. Roadbank Stabilization	Acres	928	800,000	67,000	10,700	77,700
3. Construction Site Technical Asst.	Acres	500	-	-	100,500	100,500
4. Forest Land Access Road Stab.	Acres	216	1,464,000	122,700	5,600	128,300
5. Forest Land Grazing Control	Acres	571	400,000	33,500	2,500	36,000
SUBTOTAL			34,098,500	2,856,600	620,900	3,477,500
Water Supply Measures						
1. Renovated Water Systems	Systems	6	6,096,700	510,800	46,700	557,500
2. Portable Water Treatment Plant	System	1	79,200	6,600	17,200	23,800
3. Groundwater Aquifer Study	Studies	1	350,000	29,300	-	29,300
4. Water Use Conservation			-	-	-	-
SUBTOTAL			6,525,900	546,700	63,900	610,600
Water Quality Measures						
1. Sewage Treatment Facility	Systems	15	53,700,000	4,498,800	423,700	4,922,500
2. Animal Waste Facility	Systems	30	750,000	62,800	15,000	77,800
3. Abandoned Mine Research	Study	1	50,000	4,200	-	4,200
4. Sewage Treatment Control Plan	Study	1	350,000	29,300	-	29,300
5. Pocatalico Chloride Study	Study	1	60,000	5,000	-	5,000
6. Enforcement of Water Quality	Personnel	3	-	-	130,000	130,000
SUBTOTAL			54,910,000	4,600,100	568,700	5,168,800
TOTAL ALTERNATIVE PLAN 4			102,122,800	8,555,500	1,352,800	9,908,300

Price base 1982, period of analysis 100 years, discount rate 8 3/8 percent.

TABLE 6
SUMMARY AND COMPARISON OF CANDIDATE PLANS

Effects	Alt 1	Alt 2 NED	Alt 3 EQ	Alt 4
Measures	Flood plain management studies. IFLOWS flood warning information. Flood insurance studies. Erosion and sediment control for abandoned mine reclamation and forest land access road stabilization. Renovation of water supply systems. New sewage systems and animal waste systems for water quality.	Channel modification. Renovation of water supply systems, and portable treatment plant.	Flood plain management studies, and flood insurance studies. Erosion and sediment control for abandoned mine reclamation, roadbank stabilization, construction sites, forest land access road stabilization, and forest land grazing control. A study on groundwater aquifer protection for water supply and a Teays Valley water study. Animal waste systems and sewage treatment systems for water quality. Studies for water quality on sewage treatment control, abandoned mine research, and a Pocatalico watershed chloride study. Water quality enforcement	Flood plain management studies. Channel modification. Erosion and sediment control for abandoned mine reclamation, roadbank stabilization, construction sites, forest land access road stabilization, and forest land grazing control. Renovation of water supply systems, and a portable treatment plant. A Pocatalico watershed chloride study. Water quality enforcement. A study on groundwater aquifer protection for water supply and a Teays Valley water study. Animal waste systems and sewage treatment systems for water quality. Studies for water quality on sewage treatment control, abandoned mine research, and a Pocatalico watershed chloride study. Water quality enforcement.

TABLE 6 (Continued)
SUMMARY AND COMPARISON OF CANDIDATE PLANS

Effects	Alt 1	Alt 2 NED	Alt 3 EQ	Alt 4
Project Investment	$43,748,100	$11,877,700	$145,518,300	$102,122,800
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT				
Adverse, Annualized	$3,940,500	$1,143,200	$13,692,700	$9,908,300
Beneficial, annualized	3,108,000	2,350,400	0	2,350,400
Net Beneficial	(832,500)	(1,207,200)	(13,692,700)	(7,588,000)
ENVIRONMENTAL QUALITY ACCOUNT				
Beneficial				
Provide erosion and sediment control for:				
Abandoned Mine Reclamation on acres	688	0	10,000	3,500
Roadbank Stabilization on acres	0	0	1,075	928
Construction Sites on acres	0	0	3,200	500
Forest Land Access Roads on acres	85	0	10,600	216
Forest Land Grazing control on acres	0	0	7,500	571
Provide a groundwater aquifer study	0	0	1	1
Provide new sewage systems	8	0	0	0
Provide animal waste systems	30	0	30	30
Provide sewage treatment facilities	0	0	15	15
Provide a sewage treatment control plan	0	0	1	1
Provide a study on abandoned mines	0	0	1	1
Provide a Pocatalico chloride study	0	0	1	1
Provide enforcement for water quality	0	0	3	3

TABLE 6 (Continued)
SUMMARY AND COMPARISON OF CANDIDATE PLANS

Effects	Alt 1	Alt 2 NED	Alt 3 EQ	Alt 4
Adverse				
Modify miles of stream channel	0	44.1	0	44.1
OTHER SOCIAL EFFECTS ACCOUNT				
Beneficial				
Provide miles of flood plain management studies	43.0	0.0	130.0	130.0
Provide IFLOWS flood warning system to counties	6.0	0.0	0.0	0.0
Provide flood insurance studies	7.0	0.0	4.0	4.0
Reduce flood damages	$2,518,400	$1,446,900	$0	$1,446,900
Provide water supply benefits	$589,600	$903,450	$0	$903,450
Renovated water systems	6	6	0	6
Provide portable treatment plant	0	1	0	1
Provide water system to the Teays Valley	0	0	1	0
Provide protection to buildings	0	733	0	733
Create skilled jobs	69	35	1,049	446
Create unskilled jobs	15	37	30	60
Create new jobs	44	0	72	72

Price base 1982, period of analysis 100 years, discount rate 8 3/8 percent.

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3. Report on Performance Evaluation of Clivies Multrum Compost Device, National Sanitation Foundation (1982), Wastewater Technology Report No. S-41-3.

4. Compost Toilets: A Guide For Owner - Builders, National Center For Appropriate Technology.

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APPENDICES

APPENDIX A - RESOURCES AND ECONOMY OF THE BASIN

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

The Lower Kanawha River Basin consists of three major drainage areas: the Coal River drainage, the Pocatalico River drainage, and the area along the main stem of the Kanawha River. Each section has different surface features, resources, and economic activities that distinguish it from the others, with the exception that practically all of the Basin is heavily forested. The Coal River section is an area of extremely steep topography with deeply dissected valleys. The valleys are very narrow and dominated by ribbon communities. Coal mining is the major industry and most economic activity revolves around it. The Pocatalico River section is considerably less steep than the Coal River section with wider valleys. The economy of this section is dominated by the oil and gas industry supplemented by small farms. Population is very sparse. The main stem Kanawha River section is the economic hub of the entire Basin. The relatively wide Kanawha River valley contains most of the cities and towns in the Basin, including Charleston, the capitol of the State. The economy of the valley is dominated by the chemical and manufacturing industry, public government, and expanding service sectors. The flat bottom lands along the main stem in Putnam and Mason Counties support active agricultural enterprises. This appendix highlights some of the more distinguishing features and diversified characteristics of the Basin's resources.

LOCATION AND SIZE

The Lower Kanawha River Basin is located in southwestern West Virginia (See FIGURE 6), the heart of the Appalachian Plateau Physiographic Province. The Basin contains 1,176,000 acres (1,838 square miles) and includes all lands drained by the Kanawha River from the confluence of the Elk River downstream to its confluence with the Ohio River at Point Pleasant. It includes parts of Boone, Jackson, Kanawha, Lincoln, Logan, Mason, Putnam, Raleigh, and Roane Counties.

Basin streams include the Kanawha River main stem, the Coal River, Little Coal River, Pocatalico River, and many smaller tributaries, including Davis Creek, Tuppers Creek, Marsh Fork, Spruce Creek, and Clear Fork. There are a total of 27 separate subwatersheds as defined in the Conservation Needs Inventory.

Major cities and their respective 1980 populations are: Charleston - 71,500, South Charleston - 18,000, Dunbar - 9,200, St. Albans - 15,000, Nitro - 8,200, Madison - 2,300, and Point Pleasant - 8,000. Many smaller towns and communities scattered throughout the Basin are generally located on the flood plains.

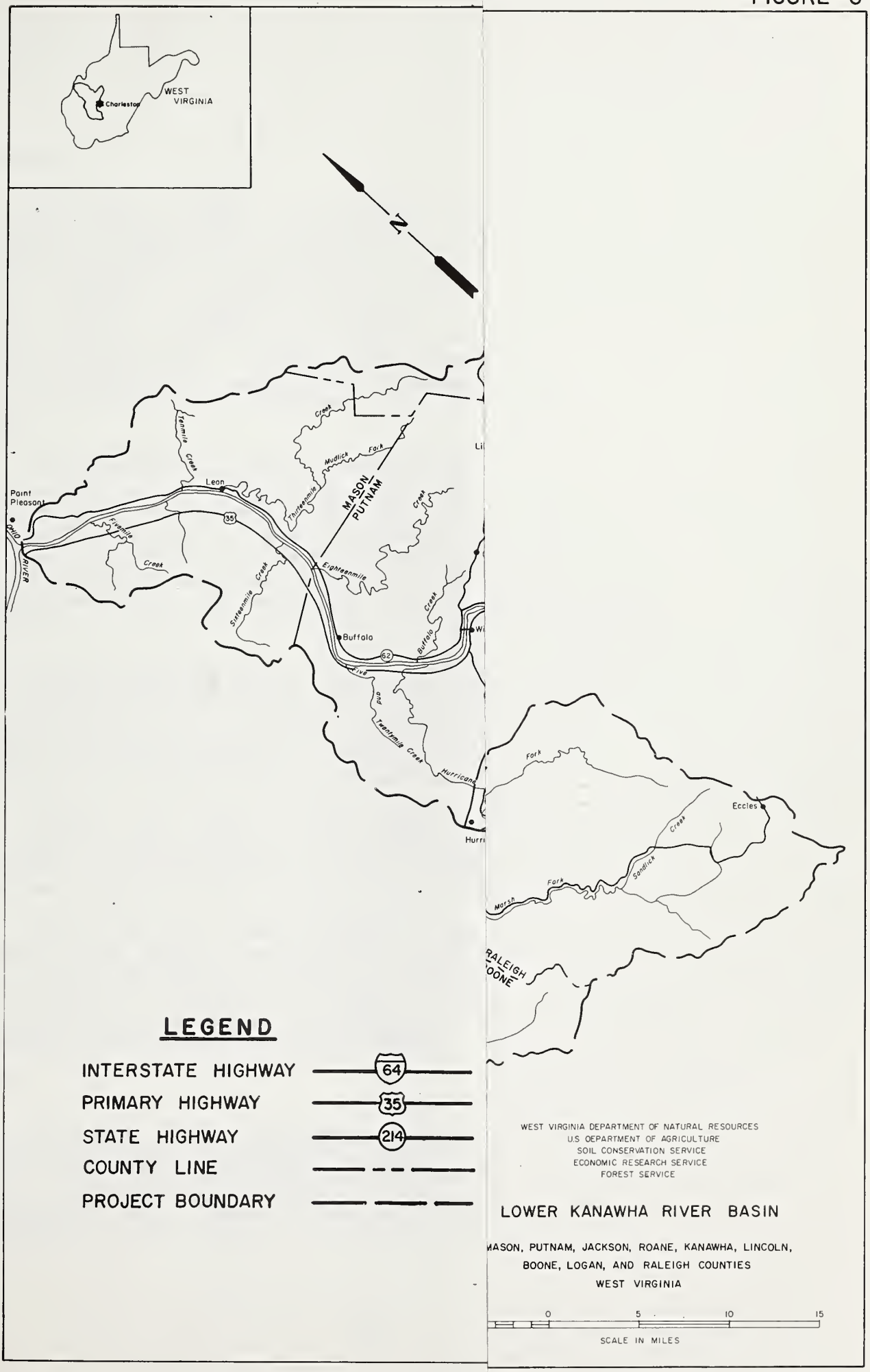

WEST VIRGINIA
Charleston
N
Point Pleasant
Leon
Buffalo
Eccles
Hurricane
Tenmile Creek
Mudlick Fork
Thirteenmile Creek
Fifteenmile Creek
Eighteenmile Creek
Sixteenmile Creek
Buffalo Creek
Five Pond
Marsh Fork
Sandlick Creek
OHIO RIVER
MASON
PUTNAM
RALEIGH
BOONE
35
62
LEGEND
INTERSTATE HIGHWAY
64
PRIMARY HIGHWAY
35
STATE HIGHWAY
214
COUNTY LINE
PROJECT BOUNDARY
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
0 5 10 15
SCALE IN MILES

FIGURE 6


WEST VIRGINIA
Charleston
N
ROANE
JACKSON
KANAWHA
MASON
PUTNAM
POCATALICO
Left Fork
Middle Fork
Sissonville
Liberty
Pocatalica
Leon
Point Pleasant
Eighteenmile Creek
Sycamore Creek
Buffalo Creek
Cantidence
Hurricane Creek
CHARLESTON
Buffalo
Winfield
KANAWHA
RIVER
Nitro
Dunbar
South Charleston
Davis Creek
Saint Albans
Teays Valley
Hurricane
COAL
LINCOLN
KANAWHA
BOONE
Racine
BIG COAL RIVER
Hopkins Fork
Whitesville
Clear Fork
Eccles
Marsh Fork
Sandlick Creek
RALEIGH
BOONE
LINCOLN
Madison
Pond Fork
Whorton
Spruce
BOONE
LOGAN
Sharples
LEGEND
INTERSTATE HIGHWAY
PRIMARY HIGHWAY
STATE HIGHWAY
COUNTY LINE
PROJECT BOUNDARY
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
5 0 5 10 15
SCALE IN MILES

CLIMATE

The Basin's climate is continental with a marked temperature contrast between summer and winter. Average summer minimum temperatures range from the middle 50's to the middle 60's while the average maximum temperatures generally exceed 85°F., except in the higher elevations. Temperatures near, or in excess of, 100°F. have been recorded throughout the Basin. Average winter minimum temperatures are in the 20's and winter maximum temperatures are in the middle and upper 40's. Average annual temperature is approximately 52°F, with the milder temperatures occurring near the Ohio River and the colder temperatures occurring in the mountainous regions to the west.

Summer weather is generally warm and humid, being influenced to a large extent by low pressure systems moving into the Basin from the Gulf of Mexico via the Ohio River. To a lesser extent, high pressure systems from the west and north bring dryer, cooler, and more pleasant weather to the Basin. Average annual precipitation is 42 inches, which is less than the mountainous counties of the State (up to 60 inches) but generally more than the eastern panhandle counties (as low as 30 inches).

Although precipitation is fairly well distributed annually, runoff is greatest during the winter and early spring months and lowest in late summer and fall. The highest monthly mean runoff has occurred in March or April with the lowest in September and October. The maximum monthly runoff has occurred in January or March and the minimum in September and October, depending on location.

Average annual runoff for the Kanawha River Basin is 18.5 inches at Charleston, West Virginia, which yields approximately 10.4 million acre feet. The maximum annual runoff of 23.96 inches occurred in 1958 and the minimum of 10.84 inches occurred in 1941.

Using Charleston, West Virginia, as the index station and the criterion that drought conditions exist when the annual precipitation is less than 85 percent of the mean, 16 of 76 years of weather record at Charleston are classified as droughts. The drought of 1930 was the most severe for the Basin as a whole, but in a few localities, the droughts of 1904 and 1953 were more severe.

LAND

There are three land resource areas within the Basin - the Cumberland Plateau and Mountains (LRA 125), the Central Allegheny Plateau (LRA 126), and the Eastern Allegheny Plateau and Mountains (LRA 127). These land resource areas are in the East and Central General Farming and Forest Region of national land resource regions. (See REFERENCE 1).

Physiography and Topography

The entire Lower Kanawha River Basin is located within the Appalachian Plateau physiographic province. The Plateau typically exhibits a rugged topography characterized by high, rounded or flat-topped ridges, rolling hills, steep valley slopes, and narrow valley floors. The drainage pattern is dendritic.

The northern section of the Basin includes large areas of rolling terrain, flat-topped interstream areas, and moderate valley slopes. The gentlest slopes are in Mason County along the Ohio River, and near the Kanawha River valley in Mason and Putnam Counties. The southern portion is strongly dissected, with steep slopes and narrow ridge tops. Average hillside slopes in Boone County generally exceed 40 percent. Elevations range from 3,555 feet adjacent to the Upper Pond Fork headwaters to 560 feet at Point Pleasant at the mouth of the Kanawha River.

Soils

The three land resource areas of the Basin are characterized by a unique combination of soils, slope, erosion characteristics, climate, vegetation, water resources, and land use. The Coal River Basin is primarily in the Cumberland Plateau and Mountains Land Resource Area. Soils in this area are deep colluvium covered with dense woods. These soils are being extensively disturbed by surface mining activities. They are highly erosive when left in a disturbed or unprotected condition. The Central Allegheny Plateau Land Resource Area includes deep alluvial soils adjacent to the Kanawha, Pocatalico, and Ohio Rivers. These soils represent the best agricultural land of the Basin. They include the Allegheny, Ashton, Clymer, etc. (see TABLE 1). A small portion of the Coal River Basin is in the Eastern Allegheny Plateau and Mountains Land Resource Area. Soils in this area consist of Upshur, Vandalia, Ernest, Dekalb, etc. These soils are shallow, on steep slopes, and highly erosive when exposed to the elements.

Soil series associations present in the Basin are shown on FIGURE 8. Suitability of the soil units within these associations for various uses and limitations for some specific purposes are summarized in TABLE 1. The map and interpretations are useful as a general guide, but site-specific planning should be conducted using detailed soil surveys and sampling.

Geology and Mineral Resources

The geology and mineral resources of the Basin are important because of their influence on the economy which is largely based on mineral extraction and other resource related industries. The Basin is rich in coal, natural gas, and other mineral resources. The growth of the Coal River Basin was largely due to the coal mining industry.

TABLE 1
SOIL SUITABILITIES AND LIMITATIONS
LOWER KANAWHA RIVER BASIN

SOIL	SLOPE RANGE	SUITABILITY FOR CROPLAND *	SUITABILITY FOR GRASSLAND **	SUITABILITY FOR WOODLAND ***	DEGREE OF SOIL LIMITATION AND MAJOR LIMITING FACTORS FOR: **** SEPTIC TANK ABSORPTION FIELDS	DWELLINGS WITHOUT BASEMENTS	CAMP SITES	PICNIC AREAS
ALLEGHENY	3-8	EXCELLENT	GOOD	HIGH	SLIGHT	SLIGHT	SLIGHT	SLIGHT
	8-15	GOOD	GOOD	HIGH	MODERATE-Slope	MODERATE-Slope	MODERATE	
	15-25	FAIR	GOOD	HIGH	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
ASHTON	0-3	EXCELLENT	EXCELLENT	VERY HIGH	MODERATE-Floods	SEVERE-Floods	SEVERE-Floods	SLIGHT
CLYMER	3-15	GOOD	GOOD	HIGH	MODERATE-Slope, Depth to Rock	MODERATE-Slope, Frost Action	MODERATE-Slope	MODERATE-Slope
	15-25	FAIR	GOOD	HIGH - MODERATELY HIGH	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
	25+	-	GOOD	HIGH - MODERATELY HIGH	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
DEKALB	3-15	-	POOR	MODERATELY HIGH	SEVERE-Depth to Rock	MODERATE-Slope, Depth to Rock	MODERATE-Slope, Large Stones	MODERATE-Slope, Small Stones
	15-35	-	POOR	HIGH - MODERATELY HIGH	SEVERE-Slope, Depth to Rock	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
	35+	-	-	HIGH - MODERATELY HIGH	SEVERE-Slope, Depth to Rock	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
ERNEST	3-15	-	GOOD	HIGH	SEVERE-Percs Slowly, Wetness	MODERATE-Slope, Wetness	MODERATE-Slope, Wetness	MODERATE-Slope
	15-35	-	GOOD	HIGH	SEVERE-Slope, Percs Slowly, Wetness, Slippage	SEVERE-Slope, Slippage	SEVERE-Slope	SEVERE-Slope

TABLE 1 (Continued)
SOIL SUITABILITIES AND LIMITATIONS
LOWER KANAWHA RIVER BASIN

SOIL	SLOPE RANGE	SUITABILITY FOR CROPLAND *	SUITABILITY FOR GRASSLAND **	SUITABILITY FOR WOODLAND ***	DEGREE OF SOIL LIMITATION AND MAJOR LIMITING FACTORS FOR: **** SEPTIC TANK ABSORPTION FIELDS	DWELLINGS WITHOUT BASEMENTS	CAMP SITES	PICNIC AREAS
GILPIN	3-15	FAIR	GOOD	MODERATELY HIGH	SEVERE-Depth to Rock	MODERATE-Slope, Depth to Rock, Frost Action	MODERATE-Slope	MODERATE-Slope
	15-25	FAIR	GOOD	HIGH - MODERATELY HIGH	SEVERE-Slope, Depth to Rock	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
	25+	-	GOOD	HIGH - MODERATELY HIGH	SEVERE-Slope, Depth to Rock	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
JEFFERSON	8-15	-	FAIR	MODERATELY HIGH	MODERATE-Slope	MODERATE-Slope	MODERATE-Slope, Large Stones	MODERATE-Slope, Small Stones
	15-35	-	FAIR	HIGH - MODERATELY HIGH	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope	SEVERE-Slope
KANAWHA	0-3	EXCELLENT	EXCELLENT	HIGH	MODERATE-Floods	SEVERE-Floods	SEVERE-Floods	SLIGHT
LINDSIDE	0-3	EXCELLENT	EXCELLENT	VERY HIGH	SEVERE-Floods, Wetness, Percs Slowly	SEVERE-Floods, Frost Action	SEVERE-Floods	MODERATE-Floods
MARKLAND	3-15	POOR	EXCELLENT	MODERATELY HIGH	SEVERE-Percs Slowly	SEVERE-Shrink-Swell	MODERATE-Slope, Percs Slowly	MODERATE-Slope
	15-25	-	GOOD	MODERATELY HIGH	SEVERE-Slope, Percs Slowly, Slippage	SEVERE-Slope, Shrink-swell. Slippage	SEVERE-Slope	SEVERE-Slope
MONONGAHELA	3-8	EXCELLENT	GOOD	MODERATELY HIGH	SEVERE-Percs Slowly	SEVERE-Frost Action	MODERATE- Wetness	SLIGHT
	8-15	FAIR	GOOD	MODERATELY HIGH	SEVERE-Percs Slowly	SEVERE-Frost Action	MODERATE - Slope, Wetness	MODERATE-Slope
	15-25	FAIR	GOOD	MODERATELY HIGH	SEVERE-Slope, Percs Slowly	SEVERE-Slope, Frost Action	SEVERE, Slope	SEVERE-Slope

TABLE 1 (Continued)
SOIL SUITABILITIES AND LIMITATIONS
LOWER KANAWHA RIVER BASIN

SOIL	SLOPE RANGE	SUITABILITY FOR CROPLAND *	SUITABILITY FOR GRASSLAND **	SUITABILITY FOR WOODLAND ***	DEGREE OF SOIL LIMITATION AND MAJOR LIMITING FACTORS FOR: **** SEPTIC TANK ABSORPTION FIELDS	DWELLINGS WITHOUT BASEMENTS	CAMP SITES	PICNIC AREAS
MOSHANNON	0-3	EXCELLENT	EXCELLENT	VERY HIGH	SEVERE-Floods	SEVERE-Floods	SEVERE-Floods	MODERATE-Floods
SENECAVILLE	0-3	EXCELLENT	EXCELLENT	VERY HIGH	SEVERE-Floods, Wetness	SEVERE-Floods,	SEVERE-Floods	MODERATE-Floods
UPSHUR	3-15	FAIR	EXCELLENT	MODERATELY HIGH	SEVERE-Percs Slowly	SEVERE-Shrink-swell	MODERATE-Slope, Percs Slowly	MODERATE-Slope Percs Slowly
	15-35	-	GOOD	MODERATELY HIGH - MODERATE	SEVERE-Slope, Percs Slowly, Slippage	SEVERE, Slope, Shrink-swell, Slippage	SEVERE-Slope,	SEVERE-Slope
	35+	-	GOOD	MODERATELY HIGH - MODERATE	SEVERE-Slope, Percs Slowly, Slippage	SEVERE-Slope, Shrink-swell, Slippage	SEVERE-Slope	SEVERE-Slope
VANDALIA	3-15	GOOD	EXCELLENT	MODERATELY HIGH	SEVERE-Percs Slowly	SEVERE-Shrink-swell	MODERATE-Slope, Percs Slowly	MODERATE-Slope, Percs Slowly
	15-35	-	GOOD	HIGH - MODERATELY HIGH	SEVERE-Slope, Slippage	SEVERE-Slope, Slippage	SEVERE-Slope	SEVERE-Slope
VINCENT	3-15	FAIR	EXCELLENT	HIGH	SEVERE-Percs Slowly, Wetness	SEVERE-Low Strength	MODERATE-Slope, Percs Slowly	MODERATE-Slope
	15-25	FAIR	EXCELLENT	HIGH	SEVERE-Slope, Percs Slowly, Wetness, Slippage	SEVERE-Slope, Low Strength, Slippage	SEVERE-Slope	SEVERE-Slope

TABLE 1 (Continued)
SOIL SUITABILITIES AND LIMITATIONS
LOWER KANAWHA RIVER BASIN

SOIL	SLOPE RANGE	SUITABILITY FOR CROPLAND *	SUITABILITY FOR GRASSLAND **	SUITABILITY FOR WOODLAND ***	DEGREE OF SOIL LIMITATION AND MAJOR LIMITING FACTORS FOR:**** SEPTIC TANK ABSORPTION FIELDS	DWELLINGS WITHOUT BASEMENTS	CAMP SITES	PICNIC AREAS
WHEELING	0-8	EXCELLENT	EXCELLENT	HIGH	SEVERE-Poor Filter	SLIGHT	SLIGHT	SLIGHT
	8-15	EXCELLENT	EXCELLENT	HIGH	SEVERE-Poor Filter	MODERATE-Slope	MODERATE-Slope	MODERATE-Slope

* The ratings given are based on bushels per acre of corn and are defined as follows: EXCELLENT = 110 or more, GOOD = 96-109, FAIR = 76-95, and POOR = 75 or less. A dashed line indicates that the soil is generally not suited to corn.

** Ratings are based on information in the Handbook for Conservation Planning of Grasslands, West Virginia, USDA-SCS, and are grouped as follows: EXCELLENT - ML, MH, FL; GOOD - FH, VL, W, AL, LU; FAIR - AH, VA, LH, DU; and POOR - DH, SD (DS), and SA. A dashed line indicates the soil is generally not suited to grassland uses.

*** Ratings are for upland oaks, and are based on the average height obtained by dominant and codominant trees at age 50 years. The ratings are as follows: VERY HIGH = a site index of 85 or more; HIGH = a site index of 75-84; MODERATELY HIGH = a site index of 65-74; MODERATE = a site index of 55-64; LOW = a site index of 45-54. Where more than one suitability class is shown, the first refers to north aspects and the second to south aspects. Woodland suitability classes for Berks, Calvin, Dekalb, Lehew, and Weikert may be one class lower than shown, when in areas with average annual rainfall less than 35 inches.

**** SLIGHT - Soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome. MODERATE - Soil properties or site features are not favorable for the indicated use and special planning, design or maintenance is needed to overcome or minimize the limitations. SEVERE - Soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Source - SCS Soil Survey Report.

The sediments forming the surface rocks of the Lower Kanawha River Basin accumulated during the Pennsylvanian and early Permian periods. These rocks (including sandstone, shale, limestone, conglomerate, and coal) were deposited in the coastal and near-shore environments of an inland sea. Each of these depositional environments (including rivers, deltas, marshes, swamps, backbarrier lagoons, and barrier islands) produced a characteristic sequence of sedimentary rocks. Migrations of the ancient coastline resulted in cyclical sequences of these coal-bearing rocks.

The essentially horizontal strata were eventually folded into northeast trending anticlines and synclines. The regional dip of the strata is 1 degree to 2 degrees to the northwest. Locally, the amount and direction of dip of bedrock has a significant impact on surface and underground mining.

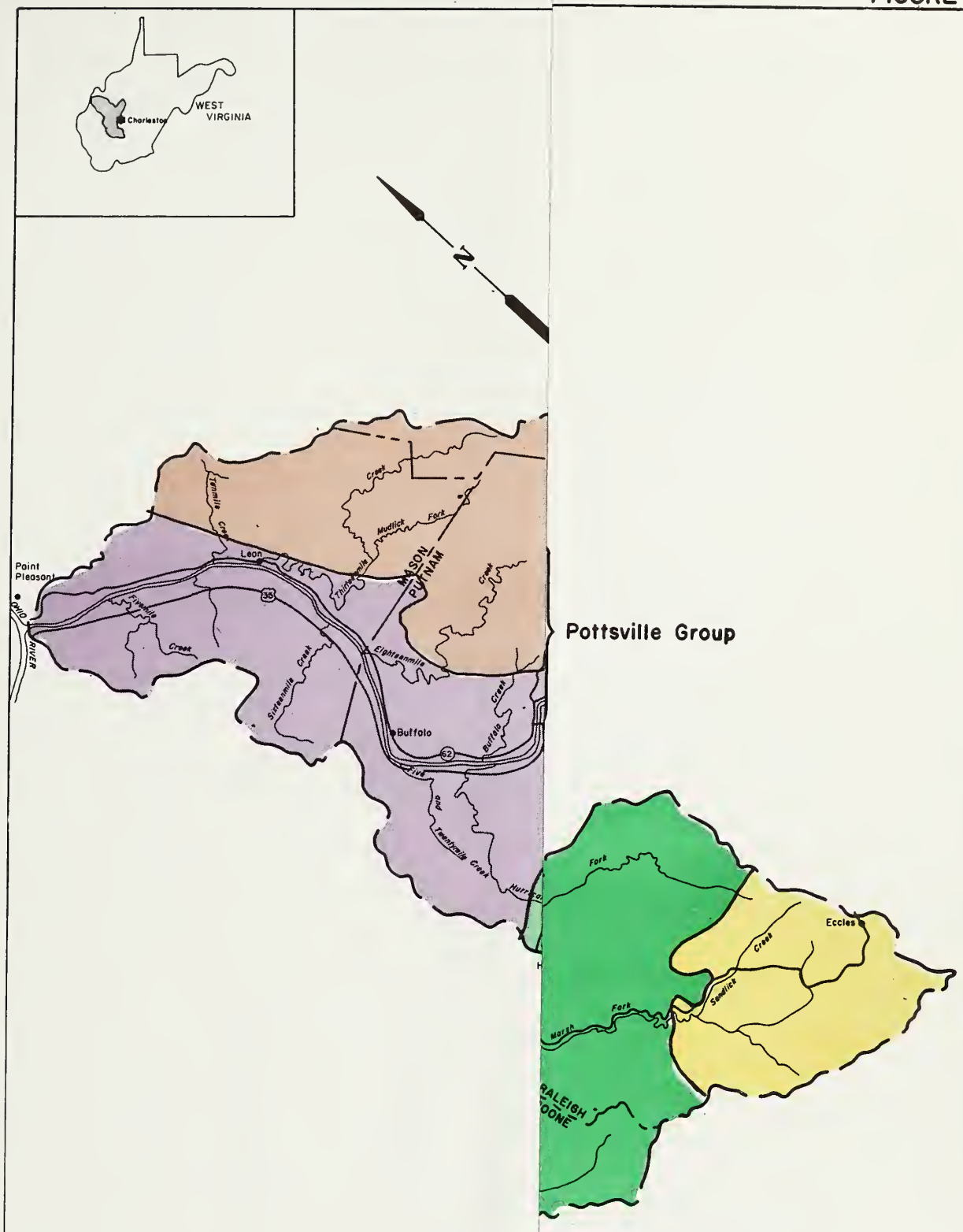
The Pennsylvanian and early Permian systems consist of the following rock units, from oldest to youngest, (1) Pottsville Group, containing the Pocahontas, New River, and Kanawha Formations; (2) Allegheny Formation; (3) Conemaugh Group; (4) Monongahela Group; and (5) Dunkard Group. These strata exhibit notable differences north and south of the "hinge line", which separates the northern and southern coalfields.

The region south of the "hinge line" contains only the Pottsville, Allegheny, and Conemaugh rock units. Essentially all the minable coals of this region are within the Pottsville. However, in the northern coalfield, the entire stratigraphic column, Pottsville through Dunkard, is represented. Here, the Pottsville strata lacks the thickness present in the southern coalfield and contains virtually no minable coals. The northern coal seams are essentially parallel, while the older coals in the southern coalfield are not parallel, becoming farther and farther separated to the southeast. Finally, the older coals of the southern coalfield are generally of higher quality than the younger coals of the northern coalfield.

These differences in thickness, distribution, and quality of the coal seams are due to differences in depositional environments and subsequent tectonic history of the strata.

The geologic formations are shown in FIGURE 7 and the coal seams contained in these formations which are minable in the Lower Kanawha River Basin are listed in Table 2.

FIGURE 7



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LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

0 5 10 15

SCALE IN MILES

FIGURE 7

GENERALIZED GEOLOGIC MAP

EXPLANATION

PERMIAN

- Dunkord Group

PENNSYLVANIAN

- Monoghela Group
- Conemaugh Group
- Allegheny Formation
- Kanawha Formation
- New River Formation

Pottsville Group

WEST VIRGINIA

Charleston

N

Walton

ROANE

JACKSON

KANAWHA

Liberty

Sissonville

Pocatalico

CHARLESTON

South Charleston

Dunbar

Nitro

Saint Albans

Confidence

Point Pleasant

MASON

PUTNAM

Leon

Buffalo

Winfield

TEAYS VALLEY

Hurricane

LINCOLN

BOONE

Racine

Whitesville

RALEIGH

Eccles

Madison

Sharples

Wharf

BOONE

LOGAN

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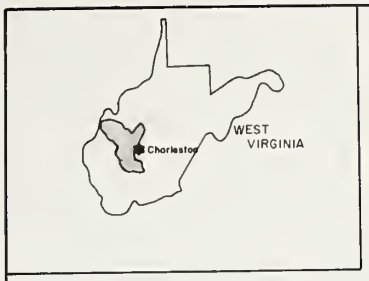
LOWER KANAWHA RIVER BASIN

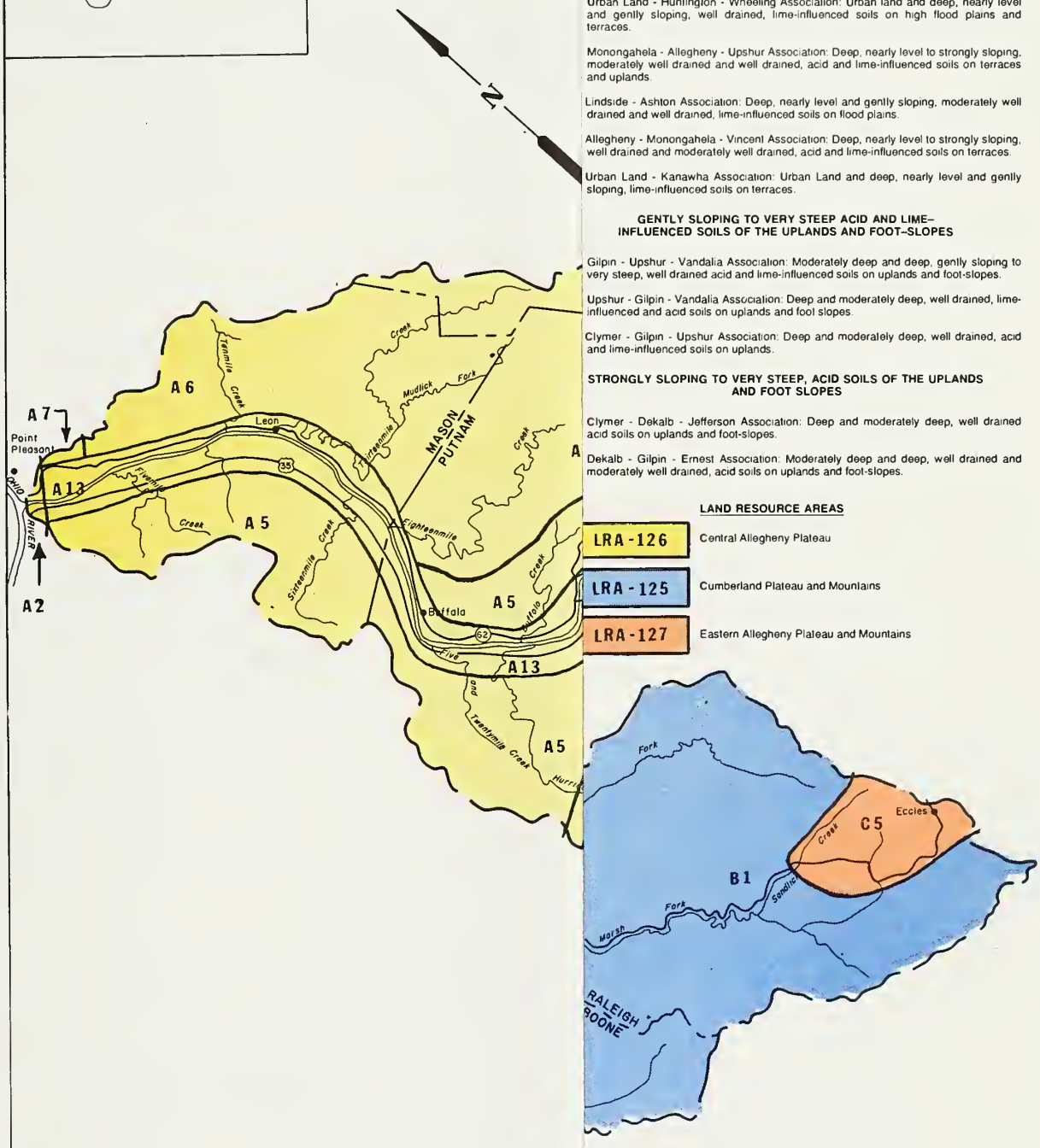
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15

SCALE IN MILES

FIGURE 8





GENERAL SOIL MAP

SOIL ASSOCIATIONS

RLY LEVEL TO MODERATELY STEEP ACID AND LIME-INFLUENCED SOILS OF THE FLOOD PLAINS AND TERRACES

Urban Land - Huntington - Wheeling Association: Urban land and deep, nearly level and gently sloping, well drained, lime-influenced soils on high flood plains and terraces.

Monongahela - Allegheny - Upshur Association: Deep, nearly level to strongly sloping, moderately well drained and well drained, acid and lime-influenced soils on terraces and uplands.

Lindside - Ashton Association: Deep, nearly level and gently sloping, moderately well drained and well drained, lime-influenced soils on flood plains.

Allegheny - Monongahela - Vincent Association: Deep, nearly level to strongly sloping, well drained and moderately well drained, acid and lime-influenced soils on terraces.

Urban Land - Kanawha Association: Urban Land and deep, nearly level and gently sloping, lime-influenced soils on terraces.

GENTLY SLOPING TO VERY STEEP ACID AND LIME-INFLUENCED SOILS OF THE UPLANDS AND FOOT-SLOPES

Gilpin - Upshur - Vandalia Association: Moderately deep and deep, gently sloping to very steep, well drained acid and lime-influenced soils on uplands and foot-slopes.

Upshur - Gilpin - Vandalia Association: Deep and moderately deep, well drained, lime-influenced and acid soils on uplands and fool slopes.

Clymer - Gilpin - Upshur Association: Deep and moderately deep, well drained, acid and lime-influenced soils on uplands.

STRONGLY SLOPING TO VERY STEEP, ACID SOILS OF THE UPLANDS AND FOOT SLOPES

Clymer - Dekalb - Jefferson Association: Deep and moderately deep, well drained acid soils on uplands and foot-slopes.

Dekalb - Gilpin - Ernest Association: Moderately deep and deep, well drained and moderately well drained, acid soils on uplands and foot-slopes.

LAND RESOURCE AREAS

LRA-126	Central Allegheny Plateau
LRA-125	Cumberland Plateau and Mountains
LRA-127	Eastern Allegheny Plateau and Mountains

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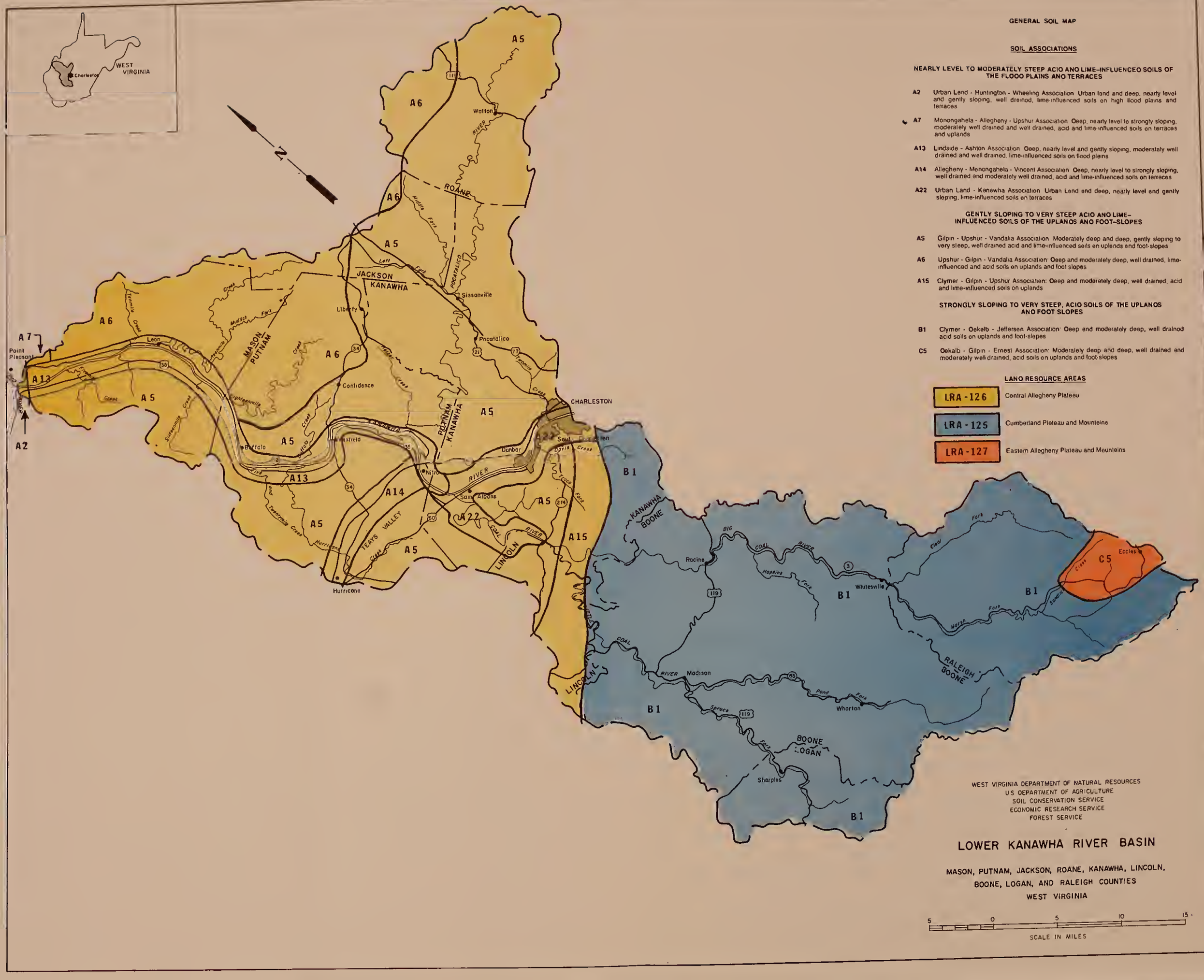
LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

0 5 10 15

SCALE IN MILES



GENERAL SOIL MAP

SOIL ASSOCIATIONS

NEARLY LEVEL TO MODERATELY STEEP ACID AND LIME-INFLUENCED SOILS OF THE FLOOD PLAINS AND TERRACES

A2 Urban Land - Huntington - Wheeling Association. Urban land and deep, nearly level and gently sloping, well drained, lime-influenced soils on high flood plains and terraces.

A7 Monongahela - Allegheny - Upshur Association. Deep, nearly level to strongly sloping, moderately well drained and well drained, acid and lime-influenced soils on terraces and uplands.

A13 Lindside - Ashton Association. Deep, nearly level and gently sloping, moderately well drained and well drained, lime-influenced soils on flood plains.

A14 Allegheny - Monongahela - Vincent Association. Deep, nearly level to strongly sloping, well drained and moderately well drained, acid and lime-influenced soils on terraces.

A22 Urban Land - Kanawha Association. Urban Land and deep, nearly level and gently sloping, lime-influenced soils on terraces.

GENTLY SLOPING TO VERY STEEP ACID AND LIME-INFLUENCED SOILS OF THE UPLANDS AND FOOT-SLOPES

A5 Gilpin - Upshur - Vandalia Association. Moderately deep and deep, gently sloping to very steep, well drained acid and lime-influenced soils on uplands and foot-slopes.

A6 Upshur - Gilpin - Vandalia Association: Deep and moderately deep, well drained, lime-influenced and acid soils on uplands and foot slopes.

A15 Clymer - Gilpin - Upshur Association: Deep and moderately deep, well drained, acid and lime-influenced soils on uplands.

STRONGLY SLOPING TO VERY STEEP, ACID SOILS OF THE UPLANDS AND FOOT SLOPES

B1 Clymer - Oekalb - Jefferson Association: Deep and moderately deep, well drained acid soils on uplands and foot-slopes.

C5 Oekalb - Gilpin - Ernest Association: Moderately deep and deep, well drained and moderately well drained, acid soils on uplands and foot-slopes.

LAND RESOURCE AREAS

LRA-126	Central Allegheny Plateau
LRA-125	Cumberland Plateau and Mountains
LRA-127	Eastern Allegheny Plateau and Mountains

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LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN, BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES

TABLE 2
MINABLE COAL SEAMS
LOWER KANAWHA RIVER BASIN

Geologic Unit	Coal Seam
Dunkard Group	
Monongahela Group	Redstone
	Pittsburgh
Conemaugh Group	Little Pittsburgh
Allegheny Formation	Lower Freeport
	Upper Kittanning
	Middle Kittanning
	Lower Kittanning
	Clarion
Kanawha Formation (Pottsville Group)	Stockton-Lewiston
	Coalburg
	Winifrede
	Chilton
	Hernshaw
	Williamson
	Cedar Grove
	Lower Cedar Grove
	Alma
	Peerless
	Campbell Creek
	Powellton
	Eagle
	Little Eagle
	Little War Eagle
	Glenalum Tunnel
	Gilbert
	Douglas
New River Formation (Pottsville Group)	Sewell
	Beckley
	Fire Creek
Pocahontas Formation (Pottsville Group)	Pocahontas No. 6
	Pocahontas No. 3
	Pocahontas No. 2

The most actively mined seams in the southern field of the Lower Kanawha River Basin are the Pocahontas No. 3, Beckley (Pocahontas No. 12), Sewell, Eagle, Campbell Creek (No. 2 Gas), Cedar Grove, Winifrede, Coalburg, Stockton-Lewiston, and Lower Kittanning (No. 5 Block). The Pittsburgh and Redstone coal seams have been the highest producing seams in the northern part of the Basin. The estimated recoverable reserves, as of 1974, of the counties located wholly or partially within the Basin are given in the following tabulation:

ESTIMATED RECOVERABLE RESERVES

	County	Short Tons
Northern Coalfield:	Kanawha	589,025,171
	Mason	152,373,385
	Putnam	178,675,208
Southern Coalfield:	Boone	4,540,818,837
	Kanawha	2,356,100,684
	Lincoln	1,057,599,076
	Logan	3,860,712,455
	Putnam	59,558,402
	Raleigh	1,872,945,776
	TOTAL	14,667,808,994

Oil and gas are second to coal in value among mineral products in the Basin. The most important producing formations and their respective ages, from youngest to oldest, are (1) Salt sands, Lower Pennsylvania; (2) Maxon, Big Lime, Big Injun, Weir, and Berea, all Mississippian; (3) the "Devonian Shales", Upper and Middle Devonian; (4) Huntersville, Middle Devonian; (5) Oriskany, Lower Devonian; and (6) Newburg, Silurian.

About half of the largest gas field ever found in West Virginia is located in the Basin in Putnam, Jackson and Kanawha Counties. The Oriskany is the major producing formation with lesser production from the Big Lime and Big Injun formations. This field, named the Elk-Poca or Sissonville, is now predominantly a gas storage area. Discovered in 1936, the cumulative marketed production to 1973 for the entire 165,000-acre field was 962,207,000 MCF (thousand cubic feet).

The most active oil field in the State during the 1970's is located within the Basin, in the Upper Pocatalico River area of Roane County. The Walton Field comprises approximately 11,000 acres, with production from the Big Injun formation. Reserves (as of 1977) have been estimated at 10 to 25 million barrels of oil, with cumulative production to 1973 at 13,630,000 barrels.

Important areas of more recent drilling activity include the Midway-Extra gas field in Putnam County with the Devonian Shale sequence being the most important producing zone, and the Rock Castle and Foster Chapel gas fields, Jackson and Mason Counties.

Production is predominantly from the Oriskany, with some from the Devonian Shale and Newburg. Extensive drilling for oil has taken place in the Griffithsville field in northern Lincoln County and in Kanawha County.

Active drilling in the early 1970's occurred in the Hopkins Fork-Jarrolds Valley gas field in Boone and Raleigh Counties, the Curry-Jeffrey gas field in Boone and Logan Counties, the Clover-Rush Run-Triplett oil field in Roane County, and the Rocky Fork gas field in Kanawha and Putnam Counties.

Oil and gas fields and areas containing minable coal are shown on FIGURE 9, Mineral Resources Map. Other minerals produced within the Basin include sandstone, clay and shale, sand and gravel, and brine. The area most favorable for sandstone corresponds approximately to the area favorable for natural gas and petroleum. Clay and shale suitable for making brick and tile occur within a few miles of nearly any part of the Basin. Sand and gravel occur chiefly in the recent alluvium of local stream flood plains and in terraces formed during earlier stages of the stream. Reserves of sand and gravel are in and along the Kanawha River. Salts have been produced from brine in Kanawha County for use in the chemical industry.

FIGURE 9

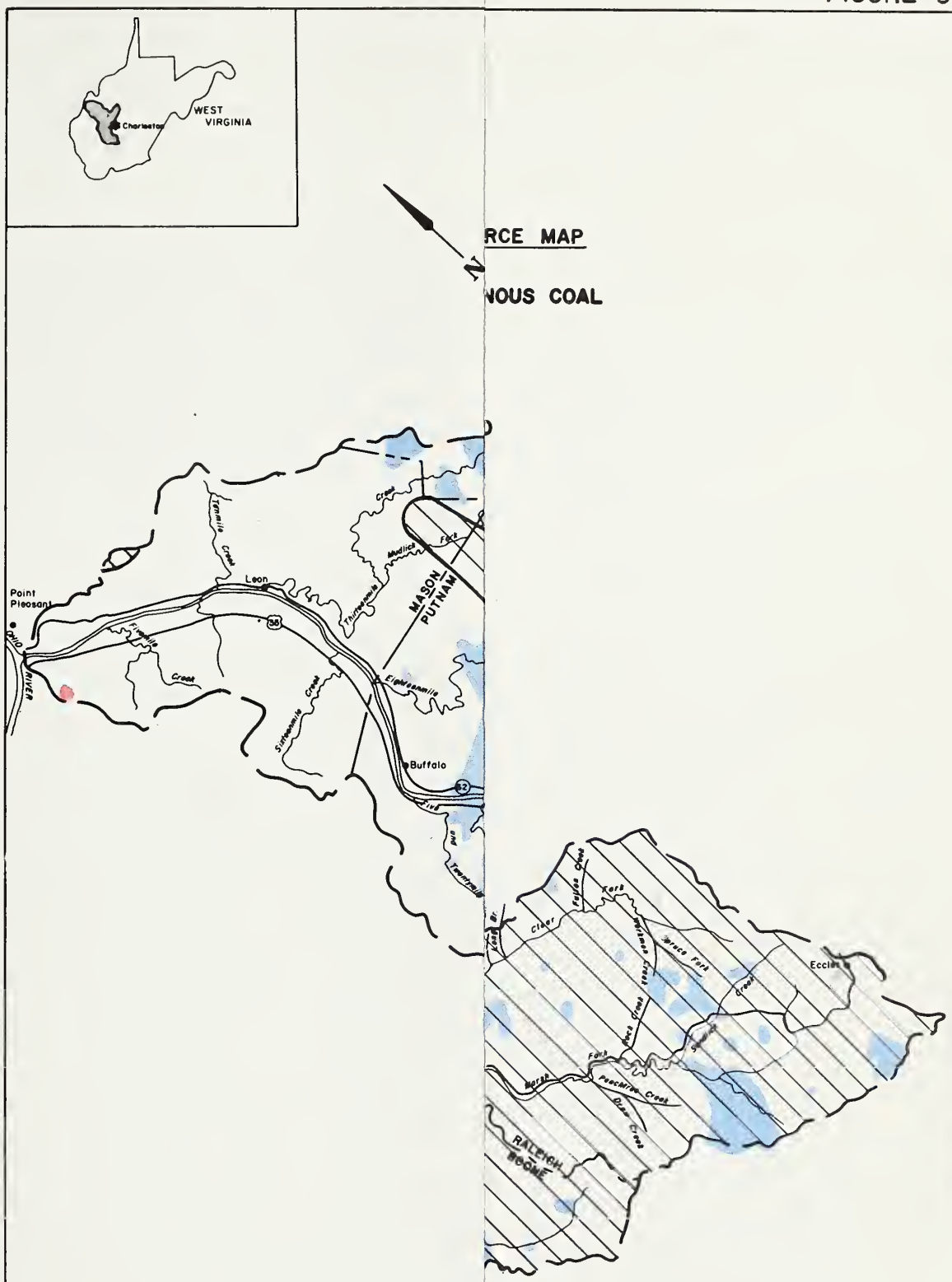
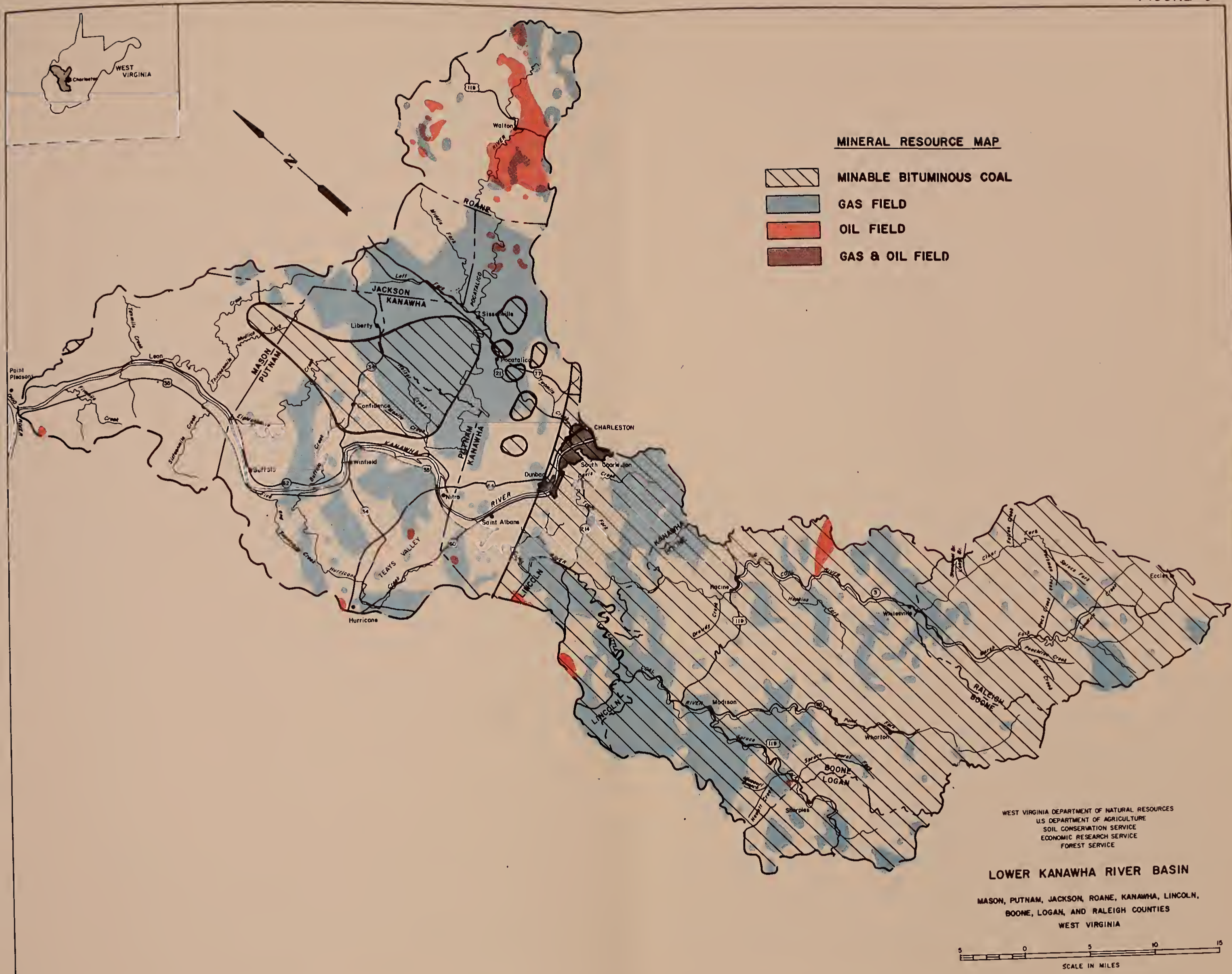

WEST VIRGINIA
Charleston
RCE MAP
NOUS COAL
Point Pleasant
OHIO RIVER
Leon
MASON
PUTNAM
Buffalo
RALEIGH
BOONE
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
0
5
10
15
SCALE IN MILES

FIGURE 9


WEST VIRGINIA
Charleston
N
MINERAL RESOURCE MAP
MINABLE BITUMINOUS COAL
GAS FIELD
OIL FIELD
GAS & OIL FIELD
ROANE
JACKSON
KANAWHA
MASON
PUTNAM
PUTNAM
KANAWHA
LINCOLN
LINCOLN
BOONE
LOGAN
RALEIGH
BOONE
Walton
Liberty
Sissonville
Pocatalico
Leon
Point Pleasant
Confidence
Winfield
Buffalo
Nitro
Saint Albans
CHARLESTON
South Charleston
Dunbar
TEAYS VALLEY
Hurricane
Racine
Madison
Whitesville
Wharton
Sharples
Eccles
Middle Fork
Left Fork
Pocatalico
Elk River
Kanawha River
Coal River
Hurricane Creek
Buffalo Creek
Davis Creek
Hamlins Fork
Spruce Laurel Fork
Peachtree Creek
Spruce Fork
Marsh Fork
Clear Laurel Creek
Laurel Creek
Big Coal River
Drawdy Creek
Hewett Creek
Sycamore Creek
Turtle Creek
Elk River
Kanawha River
Coal River
Big Coal River
Middle Fork
Left Fork
Pocatalico
Hamlins Fork
Spruce Laurel Fork
Peachtree Creek
Spruce Fork
Marsh Fork
Clear Laurel Creek
Laurel Creek
Drawdy Creek
Hewett Creek
Sycamore Creek
Turtle Creek
Hurricane Creek
Buffalo Creek
Davis Creek
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
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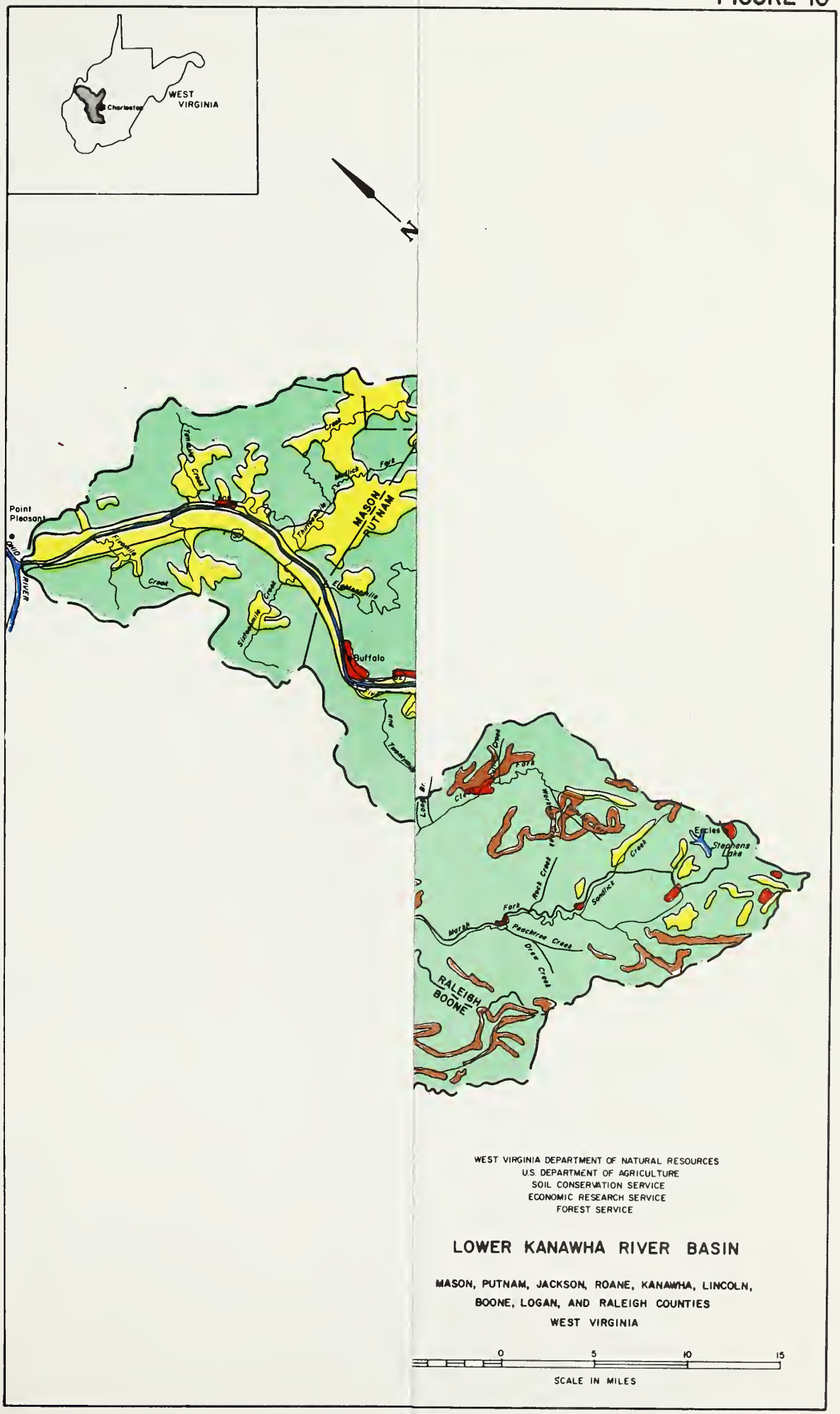
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
5 0 5 10 15
SCALE IN MILES

Land Use

Forest land is the major land use in the Basin (FIGURE 10). It comprises approximately 75% of the Basin, or 882,416 acres. Agriculture rates second with 13%, or 153,069 acres. The mining industry competes with urban, commercial, and industrial development for the third largest land use in the Basin. Mining (active surface mines, abandoned refuse piles, airshafts, mine roads, etc.) occupies about 5% of the Basin area (53,342 acres), while urban, commercial, and industrial development comprise 4% (47,485 acres). Other miscellaneous land uses (rural residences, water and wetlands, golf courses, etc.) make up the remaining 39,688 acres or 3%. (See REFERENCE 2 and TABLE 3).

FIGURE 10



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LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

FIGURE 10

LAND USE MAP

- FOREST LAND
- FARM LAND
- URBAN LAND
- MINED LAND
- WATER

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LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES

TABLE 3
PRESENT AND FUTURE LAND USE
LOWER KANAWHA RIVER BASIN

	COAL RIVER BASIN		REST OF BASIN		TOTAL	
LAND USE	PRESENT	FUTURE	PRESENT	FUTURE	PRESENT	FUTURE
FOREST	479,834	473,589	402,582	400,708	882,420	874,300
CROPLAND	2,391	2,229	20,036	17,625	22,427	19,854
PERMANENT PASTURE	8,241	8,058	76,849	71,867	85,090	79,925
PERMANENT HAYLAND	4,190	4,141	28,710	26,599	32,900	30,740
ORCHARDS	210	215	188	176	398	391
OTHER AG.	2,920	2,630	9,334	7,996	12,254	10,626
URBAN COMMERCIAL & INDUSTRY	7,517	8,659	39,968	52,229	47,485	60,888
WATER	3,611	3,661	5,291	5,510	8,902	9,171
WETLAND	4,371	4,266	612	609	4,983	4,875
ROADS	3,689	3,938	6,069	6,201	9,758	10,139
MINING	50,844	55,002	2,498	1,480	53,342	56,482
OTHER NON-AG.	10,432	11,862	5,613	6,750	16,045	18,612
TOTAL	578,250	578,250	597,750	597,750	1,176,000	1,176,000

Source - W.Va. Agricultural Water Quality Management Plan, SCS, 1979.

Land use descriptions are as follows:

Forest Land

Land having at least a 10% cover of trees or brush and used primarily for forest products, wildlife, and/or recreation purposes.

Agriculture

a. Cropland:
Land used for row crops or close-grown field crops including rotations, which include row or close-grown crops at least 1 year in 5. (This would include land used for truck crops, strawberries, and similar crops.)

b. Permanent Pasture:
Land used for grazing. (This would include land used primarily for grazing, but may have scattered trees and brush covering 25 percent or less of the area.)

c. Permanent Hayland:
Land used for hay production. (This land may also be used for pasture during part of the year.)

d. Orchards:
Land used for apple, peach, pear, cherry, or other similar fruit production.

e. Other Agriculture:
Land used for farmsteads, idle farmland, farm gardens, nurseries, or other miscellaneous agricultural purposes.

Urban, Commercial, and Industrial

Land used for housing, commercial, and industrial purposes including associated facilities located in cities, towns, or small communities. (Roads, parks, city gardens, and similar uses serving these purposes would be part of this land use. This use would also include rural built up areas.)

Mining

Land committed to mining purposes including active surface mines, abandoned mines not adequately reclaimed for other uses, land areas used for deep mines (entrances, airshafts, buildings, mine wastes, etc.) and associated facilities such as mining roads. This does not include surface mine lands that have been adequately reclaimed and are being used for other uses. These areas would be identified with the present use as forest, pasture, etc.

Other

(1) Water - Land occupied by lakes, streams, rivers, or other water areas. (This would include only permanent water areas measured at average conditions and not the flood plains associated with streams and rivers.

(2) Wetland - Land with vegetative cover and water conditions as defined by the United States Department of Interior, Circular No. 39, Wetlands of the United States, Wetland Types III through VIII.

As the population of the Basin continues to grow, agricultural lands will be converted to urban, commercial, and industrial uses. The agricultural land base is expected to decline by nearly 20,000 acres between now and the Year 2000. Most of the build-up is expected to occur in Kanawha, Putnam, and Mason Counties.

Future land use changes projected in 1979 are already being realized, with increasing urbanization in the Teays Valley Area in Putnam County, decreasing cropland in the Pocatalico River Basin area, and increasing urbanization along the Coal River drainages, such as the Danville-Madison area of the Lower Little Coal River Watershed.

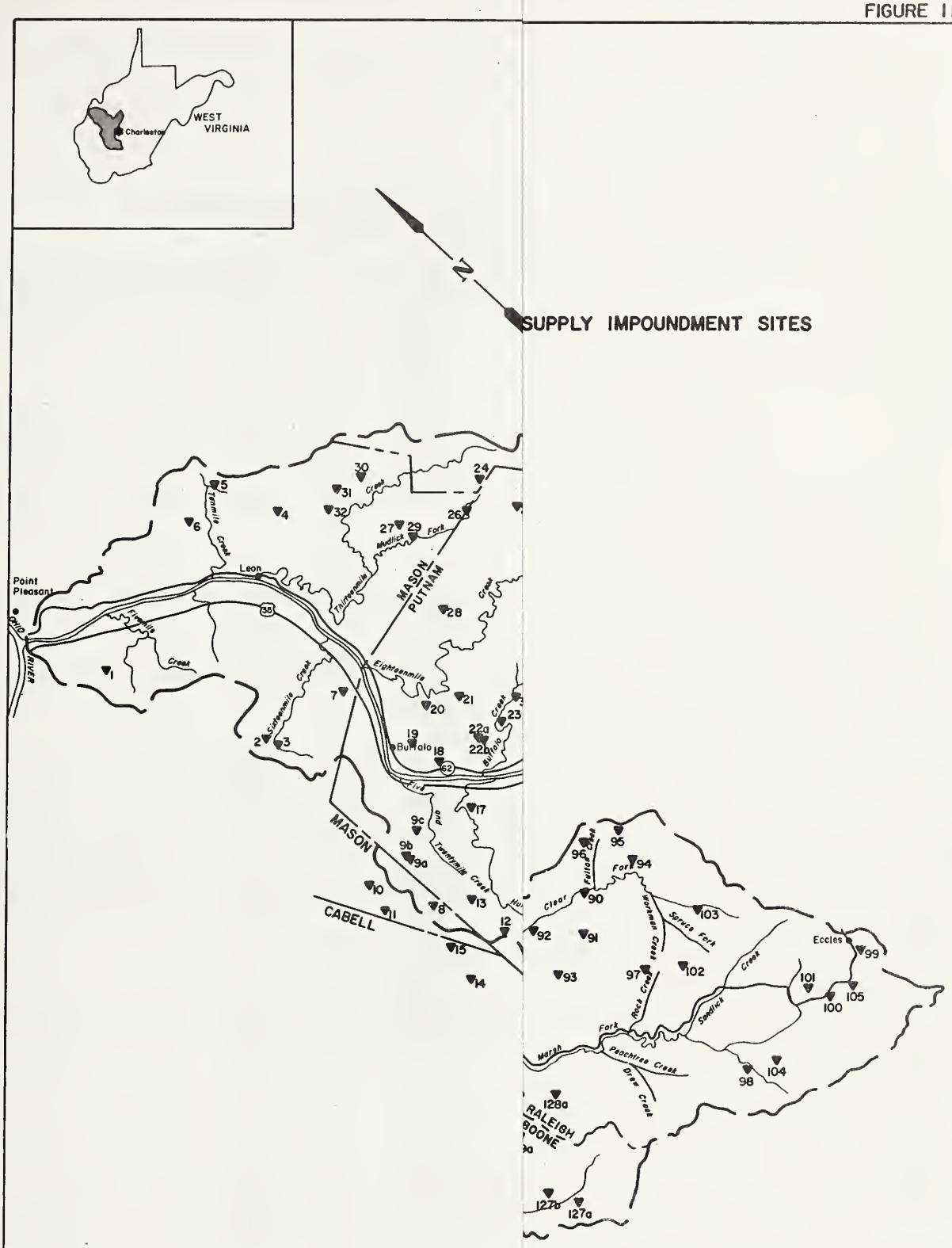
Prime and Unique Agricultural Land

Prime farmland is land best suited for producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods. Prime farmland gives the highest yields with the lowest inputs of energy or money and with the least damage to the environment. It can be farmed indefinitely with good management. Unique farmland is land other than prime farmland used to produce specialized high value food and fiber crops.

There is no unique farmland identified in the Lower Kanawha Basin. Most of the prime farmland is located in the northern half of the Basin along the Kanawha and Pocatalico Rivers. The extensive bottomlands in this area provide the soil characteristics necessary to sustain high yields of crops such as corn, small grain, and hay. Mason, Putnam, and Kanawha Counties account for the largest share of prime land in the Basin; however, these counties are rapidly losing prime farmland, as its gentle slopes and proximity to utilities make it highly attractive for residential, commercial, and industrial development.

TABLE 4 lists soils which have the attributes necessary to be considered prime farmland. Potential water supply impoundment site are shown on FIGURE 11.

FIGURE 11



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LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

0 5 10 15
SCALE IN MILES

FIGURE 11

WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
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LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES

TABLE 4
PRIME FARMLAND SOIL CHARACTERISTICS
LOWER KANAWHA RIVER BASIN

Series	Type	Slope (%)	Other Characteristics
Allegheny	l	3-8	Shale substratum
	fsl	3-8	
	sil	0-8	
	sl	0-8	
	col		
Ashton	fsl	0-8	
	l		
	sl	0-10	
Chagrin	sl		
	l		
	l	3-8	Gravelly varient
	fsl		
Chavies	fsl	0-8	
	gsl		
	l		
Clymer	fsl		
	fsl	3-10	
	gl	3-10	
	l	0-10	
Cookport	l	2-8	
Culleoka	sil	3-8	
Culleoka-Westmoreland	sil	3-8	
Dekalb	fsl	3-8	
Gilpin	sil	3-8	
	sil	0-8	Soft shale substratum
Hackers	l	0-8	
	sil	0-10	
Holston	sil	2-8	
Huntington	sil		
	fsl		
	fsl	0-5	
	l		
	sil	0-10	
	sicl	0-3	
	sil	low bottom	
Kanawha	fgsl		
	sil		
	l		
	fsl	0-8	
Landes	fsl		
Lindside	sil		

TABLE 4 (Continued)
PRIME FARMLAND SOIL CHARACTERISTICS
LOWER KANAWHA RIVER BASIN

Markland	sil	0-6	
Monongahela and Tilsit	sil	0-3	
Monongahela	sil	0-3	
Moshannon	sil gsil sil	0-10	 Course subsoil variant
Muskingum	sil chsil	3-10 3-8	
Philco	gl l fsl sil sil		 High bottom
Pope	fsl fsl gsl sl l sl sil gsil	 0-6	Sandy subsoil variant
Pope Variant	sil		
Rayne	sil	3-10	
Sciotoville	sil sil	 0-3	
Senecaville	sil sil	 0-3	
Shelocta	sil chl	3-8 3-8	
Westmoreland	sil	3-8	
Wheeling	fsl sl sil	0-8 0-3 0-3	

col: cobbly loam
chsil: channery silt loam
ctfsl: cherty fine sandy loam
ctl: cherty loam
ctsil: cherty silt loam
fsl: fine sand loam
gl: gravelly loam
chl: channery loam
gsl: gravelly sandy loam
chfsl: channery fine sandy loam
gsil: gravelly silt loam
l: loam
ls: loamy sand
shsil: shaly silt loam
sicl: silty clay loam
sil: silt loam
sl: sandy loam

Source - SCS

WATER

Water resources of the Basin are abundant and of sufficient quantity and quality to satisfy most needs, especially when treated and properly managed.

Quantity

The quantity of surface water is relatively evenly distributed in all parts of the Basin. Surface waters are contained primarily in rivers, smaller streams, and manmade lakes. There are no natural lakes in the Basin.

The major river of the Basin is the Kanawha River. It enters the Basin at the confluence of the Elk River in Charleston and flows generally northwest for approximately 60 miles to its confluence with the Ohio River at Point Pleasant. It has a gradient of 0.5 feet per mile over this distance. Flow records at Charleston indicate that Kanawha River discharges have averaged 14,800 cubic feet per second (cfs) over the past 45 years, with a maximum flow of 216,000 cfs on August 15, 1940, and a minimum flow of 1,030 cfs during October 1-5, 1953. Other important rivers and streams of the Basin, as discussed in the Kanawha River Comprehensive Study (See Reference 3), are shown in the following table.

TABLE 5
WATER RESOURCE DATA
LOWER KANAWHA RIVER BASIN

RIVER OR STREAM	LENGTH (Miles)	FALL (Ft.)	GRADIENT (ft/mi.)	MAXIMUM DISCHARGE (cfs)	MINIMUM DISCHARGE (cfs)	AVERAGE DISCHARGE (cfs)
Kanawha River	60	28	0.5	216,000	1,030	14,800
Big Coal River	56	224	4.0	35,800	33	1,232
Little Coal River	26	1,704	66.6	42,800	15	350
Pocatalico River	66	384	5.8	17,000	0	296
Marsh Fork	40	1,510	37.7	-	-	-
Clear Fork	21	1,310	62.4	-	-	-
Spruce Fork	31	1,680	51.0	-	-	-
Pond Fork	35.5	2,030	57.2	-	-	-
Davis Creek	13.5	584	43.3	-	-	-
Hurricane Creek	16	262	16.4	1,800	0	13
Eighteenmile Creek	27	310	11.5	-	-	-
Thirteenmile Creek	8	416	52.0	-	-	-
Kanawha Twomile Creek	9	384	42.7	-	-	-

Source - Kanawha River Comprehensive Study, SCS and COE, June 1971, and Water Resources Data for W.Va., 1973.

In addition to rivers and streams, surface water resources are contained in 15 manmade lakes. Lake Stephens, with a 300-acre surface area, is the largest of these lakes. It is operated by Raleigh County as a recreation facility. The other lakes are much smaller, generally averaging less than 50-acres in surface area. Most are used either for recreation or municipal water supply. The total quantity of water in these lakes is insignificant relative to the quantity of water in river and streams. Even a lesser amount of surface water is contained in farm ponds and ponds used for treatment of municipal and industrial wastes.

The quantity of groundwater is generally insufficient for large users; however, groundwater quantities throughout the Basin, are normally sufficient for individual home or farm use. The most important groundwater aquifer consists of a relatively thick deposit of Quaternary alluvium along the Kanawha River. This alluvium is more than 100 feet thick in some places and consists mostly of unconsolidated river deposits of poorly to well sorted sand, silt, clay, and gravels. This alluvium produces high yields in some locations. The city of Point Pleasant operates two wells in this alluvium that average 100 and 250 gpm.

Quarternary deposits in the pre-glacial Teays Valley are between 50 and 100-feet thick. These deposits produce yields ranging between 20 and 50 gpm.

The underlying bedrock consists of the Conemaugh, Monongahela, and Dunkard Formations. They are composed of shales and sandstones interbedded with thin seams of coal, fire clay, limestone, and black carbonaceous shale. These formations are poor aquifers, generally producing yields of less than 20 gpm, and in most wells only around 5 gpm.

Quality

Surface water quality varies from fair or good to very poor, whereas, groundwater quality is generally considered good throughout most of the Basin. Surface water pollutants consist primarily of domestic sewage, salt brines, urban and industrial discharges (heavy metals and toxic wastes), acid mine drainage, and sediment.

High coliform concentrations, which are indicative of domestic pollution, exist from the headwater streams to the mouth of the Kanawha River. Concentrations are generally higher along the smaller streams where development has occurred without adequate sewage treatment facilities. Concentrations over 1,000 colonies per 100 milliliters of fecal coliform bacteria are common. These concentrations exceed the State standard of 200 colonies per 100 milliliters.

The Pocatalico River contains large concentrations of chlorides (salt brines). Between 1965 and 1970 chloride concentrations were high enough to render the stream water unpotable. Potable drinking water for the Walton High School was hauled from Spencer during periods of high concentrations. Although concentrations of chlorides are generally lower today than in 1970, they still exceed State standards in some areas.

Urban and industrial discharges are generally high in the lower portion of the Basin along the Kanawha River. Concentrations of iron (1,500 ug/l), manganese (160 ug/l), and barium (100 ug/l) normally exceed State standards in the lower Kanawha River. Frequent spills of toxic wastes from chemical plants often result in fish kills in the Kanawha River. Such spills are becoming less frequent as plants install better holding and treatment facilities. Fishing and boating in the Kanawha River are becoming popular recreational pursuits.

Pollution from acid mine drainage is apparent in Heizer Creek, and sediment pollution from surface mines occurs in the Coal River, especially upstream from Madison.

Although surface waters of the Basin contain most types of pollution known, surface water quality is considerably better today than 20 years ago.

Groundwater quality is generally good for most uses, and is used for domestic purposes throughout the Basin. However, there are specific areas where groundwater contains various pollutants. Notable among the pollutants are the high chloride concentrations found in wells in the Pocatalico River drainage, and the high iron concentrations in wells in the Coal River drainage. Some of the chloride pollution may be associated with gas and oil well drilling that penetrated Pennsylvanian and Mississippian strata containing salt brines, with the iron concentrations associated with coal seams.

Potential for Improvement

The potential for improving surface water quality is relatively high, whereas, the potential for improving groundwater quality is quite limited. Enforcement of the Clean Water Act has resulted in significant improvement of surface water throughout the Basin in recent years. Continued enforcement of the Act, along with an acceleration of installing waste treatment systems for small communities and industrial plants has a potential of improving water quality in the Basin for most uses.

Since most groundwater pollution is from natural sources, the potential for improvement is limited. However, some potential may exist to reduce chloride pollution in the Pocatalico drainage by plugging some of the deep wells that serve as vertical conduits which allow deep salt brines to rise and pollute wells closer to the surface.

BIOLOGICAL RESOURCES

Land use in the Basin is conducive to a wide range of biological resources. With 75 percent of the Basin acreage in forest, terrestrial resources are abundant, exceeding 882,400 acres. Aquatic resources, although plentiful, are generally of only moderate quality; however, quality is improving.

Terrestrial

The upland forest in the Coal River drainage of the Basin is characterized by mixed oak hardwoods on southern and western exposures and yellow poplar and associated hardwoods on northern slopes. In the remainder of the Basin, the upland forest is composed of the oak-hickory association, interspersed with mixed mesophytic species in cool, moist areas.

Although the Basin supports a rich and varied complex of wildlife species, wildlife populations have been adversely effected by extensive mining operations, timbering activities, and land disturbances associated with development. Major game species found in the Basin include white-tailed deer, wild turkey, ruffed grouse, fox and gray squirrels, raccoon, cottontail rabbit, bobwhite quail, mourning dove, and various waterfowl and furbearers. In addition, the European wild boar has been successfully introduced by the WV DNR into the Spruce-Laurel drainage of Boone County, and is expanding its range. Areas in the Basin which are maintained and managed for wildlife habitat include about 26,070 acres of public hunting areas.

Aquatic

Many Basin streams do not provide high quality aquatic habitat due to water pollution, sedimentation, and natural deficiencies, such as extremely low flows during dry periods. The major water pollution source in the Coal River drainage is surface and deep mining. Mining activities diminish aquatic life through the discharge of iron and manganese compounds, sulfates, other inorganic complexes, and sediment. The Pocatalico drainage is unique in that it is the only area of the Basin which occasionally suffers from chloride pollution which may be a result of oil and gas well drilling. The main stem Kanawha River has for years been subjected to heavy loads of industrial waste; however,

recent improvements in water quality have occurred as a result of the Clean Water Act and greater public awareness of the problem. Lock chamber samples on the Kanawha River main stem and electrofishing on the Coal River have shown substantial improvement in both total pounds and in species diversity over the last several years. This reflects improved water quality. Bacterial contamination of Basin waterways from sewage also affects the nature and diversity of aquatic life present. In spite of heavy discharges of pollutants over much of the Basin, aquatic fauna has survived in most streams.

Nineteen streams in the Basin are on the WV DNR high quality list. Three streams, totalling 21.5 miles, are stocked with trout by the WV DNR on a put-and-take basis. Other major game fish found in the Basin include spotted bass, smallmouth bass, largemouth bass, rock bass, bluegill, longear sunfish, white crappie, black crappie, channel catfish, flathead catfish, walleye, sauger, white bass, and muskellunge.

Threatened and Endangered Species

Other than occasional transient individuals, the only Federally listed endangered species which may occur in the Basin are the pink mollusk pearly mussel and the tubercled-blossom pearly mussel. These two species of freshwater mussel, known to occur in the Kanawha River drainage in West Virginia, were afforded endangered status June 14, 1976.

HUMAN RESOURCES

Nine counties in the Basin contain about one-third of the total population of the State. Charleston, with its population of approximately 71,500 is the largest city in the Basin. The total population of the Basin is approximately 395,270. Mean per capita income is, and has been, lower than the national average. Unemployment rates have consistently been above the national level. In spite of these statistics, the standard of living for the majority of residents is good, and generally higher along the mainstem Kanawha River, around Charleston, than it is in the perimeter areas.

ECONOMIC LINKS OF THE BASIN

Seven of the nine counties which comprise the Lower Kanawha River Basin (hydrologic area) are part of a larger eighteen county economic area designated as BEA Economic Area 60. The other two counties, Mason and Lincoln, are part of the adjacent BEA Economic Area 59. These economic areas are linked to a dominant trade center through which a

high proportion of the area's commerce passes. The Charleston Standard Metropolitan Statistical Area (S.M.S.A.) which includes Kanawha and Putnam Counties, is the dominant trade center for the Basin.

As the largest economic area within West Virginia, the boundaries of Economic Area 60 generally match those of the Kanawha River Basin, the largest drainage system in the state. This reflects the influence of natural features on drainage and economic activity. Throughout the state the economic areas closely approximate the drainage areas due to the natural divisions made by the mountainous terrains. And, as is the case in the Lower Kanawha, the dominant economic centers in these areas are near the terminal points of the major rivers where water transportation has been more efficient than railroad or highway travel through the mountains.

Improvements in the network of ground transportation, particularly in parts of the Basin which were less accessible, are expected to stimulate additional local and inter-area commerce. These developments will compliment the existing water transportation system and increase the economic importance of the lower basin area as the major trade center and nodal growth point of Economic Area 60. Part of the projected growth will be attributable to the lack of other competitive centers within a 100-mile radius of the Charleston S.M.S.A.

Continued growth is also projected for Economic Area 59 on the Basin's western border. With similar features such as access to water transportation, a well-developed chemical industry and other important manufacturing activities, the areas are expected to expand toward each other along the general path of Interstate Highway 64. It is quite probable that by the end of the century a larger economic area will exist with Charleston-Huntington as the co-centers.

POPULATION CHARACTERISTICS

Symptomatic of the relative economic disadvantage of the entire Appalachian region, of which the Basin is a part, the Basin population has not grown at the same rate as the nation since 1940 (Table 6). Due to war related industrial activity, the decade of the 40's was the last period during which local economic activity was on a par with national growth. For the next two decades the population losses reflected the fundamental economic changes which occurred nationwide, and excluded much of the Basin where problems such as mechanization, consolidation, and competition for sales in the coal industry magnified the problems of a region out of the national mainstream. The entire Basin economy experienced the effects of the period, but they were more pronounced in the counties where coal was extracted. It wasn't until the mid-1970's resurgence in the coal markets that the counties of Boone, Kanawha, Logan, and Raleigh began to recoup some of the population losses suffered during the previous two decades.

TABLE 6
POPULATION GROWTH RATES
LOWER KANAWHA RIVER BASIN

YEAR(S)	UNITED STATES (Percent)	LOWER KANAWHA RIVER BASIN (Percent)
1940-1950	14	17
1950-1969	19	-.5
1960-1970	12	-.8
1970-1980	9	9
1940-1980	66	18

Source - Economic Research Service

It is interesting to note (TABLE 7) that in the counties with little or no coal production, comprising roughly the lower one-half of the Basin, steady population gains were posted since 1940. In some cases the rates were nearly equal to (Jackson County, 55 percent) or greater (Putnam, 95 percent) than the national rate. This pattern of growth in turn reflects the more diverse nature of the expanded economy in and around this area. Factors such as recently improved access to these areas, via improved roads, relatively more land suitable for suburban development in terms of both the topography and the land's aesthetic appeal, and more job opportunities in nonmanufacturing industries, have stimulated the population growth.

TABLE 7
HISTORIC POPULATION
LOWER KANAWHA RIVER BASIN

County	Year: 1940**	1950**	1960**	1970**	1980**
Boone	28,556	33,173	28,764	25,118	30,447
Jackson*	8,133	7,497	9,085	10,242	12,639
Kanawha	195,619	239,629	252,925	229,515	231,414
Lincoln*	2,975	2,921	2,634	2,459	3,078
Logan*	11,520	13,156	10,467	7,866	8,615
Mason	10,244	10,827	11,251	11,181	12,441
Putnam	19,511	21,021	23,561	27,625	38,181
Raleigh*	53,745	59,690	48,252	43,450	53,829
Roane	6,028	5,338	4,559	4,092	4,626
TOTAL	336,331	393,252	391,498	361,548	395,270

* Part of the county in the Basin.
** Adjusted for the population within the Basin
Source - Economic Research Service

As a result of both natural increases and internal migration, primarily from Kanawha County, the pattern of population expansion in this section of the Basin has been building steadily without any apparent connection to the economic cycles. This simply indicates that no divergence from the pattern should be expected in the future.

Population projections indicate that the total population of the Basin will increase. Two sets of population projections were included to facilitate comparisons.

The OBERS projections, recognized as the nationally consistent data base for water resources planning, were derived from economic data and differ from the state projections which were based on demographic data. (See Reference 5) The OBERS historical series measured industrial activity by groups and the growth trends in the industries regional contribution to national totals. Economic growth in each region was determined by the mix of basic industries and their potential for growth. Population was projected as a function of income and employment growth. Interregional migration was determined by employment opportunities rather than by historic migration rates, and due to the location of the Basin in two economic areas, it was assumed that the Basin's historic share of the 1980 population of these areas would not change. This assumption, therefore, precludes county population growth at rates higher than the economic area. For Putnam and Mason Counties, with higher actual growth, the projected OBERS population data underestimated the potential growth.

"Health Planning Guideline: Midyear County Population Projections 1981 - 1998" were developed by two state health planning agencies and adopted by the Governor's Office of Economic and Community Development Population Projection Task Force. Unlike previous population projections used by state agencies, the current set was based on final population enumerations of the 1970 and 1980 decennial census of population. Previous projections had used annual estimates of the population between census years as the base.

The demographic model calculated the projected population as the sum of four components. These included the current population, the natural increase of the original population, net migration and the natural increase of the migrants. Results from the model are purported not as forecasts, but rather as projections of current trends for a short time into the future. (See REFERENCE 6)

More specific assumptions of the model include: (1) a continuation of the current rate of natural increase; (2) exponential total population increases caused by natural increases; (3) a constant, current, net annual migration rate; (4) a linear relationship between population changes and migration; (5) rates of natural increases of migrants identical to the overall population, but (6) for only one-half of the projection period; and (7) a population total altered only by migration and natural increases.

Data in Table 8 represent four intermediate variables calculated from the four initial variables of average population, birth rates, death rates and average migration. The average population was half the sum of the enumerated population on April 1, 1970 and 1980. Birth and death rates represent the actual number of events divided by the average population and divided by 10 to express an annual rate for the decade. Total migration represents the difference between the 1980 and 1970 enumerated populations, minus the number of births plus the number of deaths with the average annual migration being one-tenth of this total. The rate of natural increase represents the difference between the birth and death rates.

TABLE 8
POPULATION PROJECTION VARIABLES
LOWER KANAWHA RIVER BASIN

County	Average Population	Birth Rate	Death Rate	Average Annual Net Migration
Boone	27,677	.01869	.00995	269.8
Jackson	23,250	.01417	.00800	325.9
Kanawha	226,699	.01554	.01038	-1733.5
Lincoln	20,886	.01805	.01039	235.0
Logan	48,390	.02006	.01048	- 39.5
Mason	25,535	.01582	.00938	81.3
Putnam	32,190	.01536	.00759	662.9
Raleigh	77,990	.01738	.01130	1107.8
Roane	14,955	.01527	.01186	117.8

Source: - "Health Planning Guideline: Midyear County Population Projections 1981-1998," "State Health and Planning and Development Agency and the West Virginia Department of Health," July 21, 1981, p.11.

Use of the intermediate variables in the equations yielded the projected population for each county. Table 9 contains the projected populations by counties. Data in this table were adjusted by the proportion of the 1980 population which was estimated as the resident population in the Basin. This was based on a district by district basis. If more than one-half of a district was within the hydrologic boundaries of the Basin, the total population of the district was included.

TABLE 9
DEMOGRAPHICALLY PROJECTED POPULATION
LOWER KANAWHA RIVER BASIN

County	Year: 1980**	1985**	1990**	1995**	2000**
Boone	30,477	33,434	36,411	39,523	42,778
Jackson*	12,639	13,957	15,253	16,590	17,970
Kanawha	231,414	232,449	233,460	234,493	235,548
Lincoln*	3,078	3,422	3,762	4,116	4,484
Logan*	8,615	9,038	9,461	9,905	10,370
Mason*	12,441	13,134	13,818	14,524	15,253
Putnam	38,181	44,050	49,865	55,911	62,201
Raleigh*	53,829	59,533	65,138	70,919	76,883
Roane*	4,626	4,913	5,192	5,476	5,764
TOTAL	395,300	413,930	432,360	451,457	471,251

* Part of the county in the Basin.
** Adjusted for the population within the Basin
Source - Health Planning Guideline: Midyear County Population Projections 1981-1998. State Health and Planning and Development Agency and the West Virginia Department of Health, July 21, 1981.

The projected population of the Basin will include 76,029 more residents and total 471,251 by the Year 2000. This represents a very modest increase of 19 percent or a growth rate of slightly less than 1 percent per year.

This distribution of growth will be very uneven. As might be expected, the most rapid growth will occur in Putnam County, where both the rate of growth and absolute increase of the population will rank the county as the leading growth center in the Basin. It appears that this growth will continue to occur at the expense of adjacent Kanawha County which has the lowest projected growth rate of any county in the Basin. Although the projected growth rate for Lincoln and Jackson rank respectively behind Putnam, the base population was low and the absolute increase for both counties will only total 6,849 people by the Year 2000. With the exception of some possible movement of Charleston SMSA residents to the eastern fringe of Lincoln County, most of the growth rate will be attributed to the influence of the Huntington SMSA suburban development with its effects on the northwestern parts of the county.

With moderate to high projected growth rates for Raleigh and Boone Counties, about two percent per year, these counties will rank second and third respectively for absolute population increases with a combined total of 35,000 plus. Due to the high growth rates of these counties during the last decade, these data appear to project a period during which the cyclical upswing of the coal industry in these

counties during the last decade, these data appear to project a period during which the cyclical upswing of the coal industry in these counties encouraged growth that has since been partially eroded. The employment opportunities will decrease and lower the high net migration rates which caused the projected population to be higher.

Compared to the population projections represented by the disaggregated OBERS series (Table 10), made on the assumption that there will be no change in the region's historic share of the national population, overall growth would exceed the state series through 1990, but lag by the Year 2000. If a moderate change in the region's historical share would take place by the Year 2000, the projected population would exceed the state figure slightly.

TABLE 10
OBERS PROJECTED POPULATION
LOWER KANAWHA RIVER BASIN

County	Year: 1985	1990	2000*	2000**
Boone	33,800	35,000	35,700	36,900
Jackson	14,100	14,600	14,900	16,800
Kanawha	255,600	264,100	270,000	279,000
Lincoln	3,300	3,400	3,600	3,700
Logan	9,500	9,900	10,400	10,600
Mason	13,700	14,400	15,000	15,300
Putnam	42,500	43,900	44,800	46,400
Raleigh	59,300	61,400	62,600	64,800
Roane	5,000	5,200	5,300	5,500
TOTAL	436,800	451,900	462,300	479,000

* No change in region's historic share of national growth.
** Moderate change in region's historic share of national growth.
Source - Economic Research Service

As an overall guide to regional growth the OBERS projections reinforce the expected pattern of growth basin-wide, and indicate that population growth will be steady, but not explosive. As a guide to local resource management policies the projections do not allow for competition between the counties and fail to indicate the important local growth areas. This is due to the limitation of the projection methods which used disaggregated national data as opposed to the state projections which used the previously mentioned micro variables to construct the series at the county level.

INCOME

During the past quarter of a century income levels in the Basin were remarkably lower than the National standards. As primary measures of economic activity, relatively lower personal and per capita income levels reflected unfavorable reactions of the Basin economy to national business cycles and the Basin's narrow economic base. These factors were particularly influential earlier in the period when per capita income levels ranged between 60 to 70 percent of the national average. Such a remarkable disparity was directly attributed to depressed employment and sales in the basic industries.

By the late sixties, and into the decade of the seventies, local economic conditions had improved. Market conditions for the basic products and industries, coal, oil, gas and chemicals, had recovered and growth in the service industries had begun to accelerate. Commensurate with the renewed economic growth was a broader based economy with relatively higher income levels. The gap in the local per capita income had decreased to 25 percent of the National average, and by 1978, per capita income levels had risen to 86 percent of the national standard. The outlook is for continued relative and absolute income gain.

Projections of income levels indicate that the Basin will grow at a faster rate than the State and nation. Growth rates for personal and per capita incomes, as measured by the respective indices with 1978 as the base year equal to 1.00, will be higher in the Basin than for the nation (TABLE 11). The net effect will be that the gap between local and national income levels will be reduced and by the Year 2000 the Basin will be on a parity with the nation.

Within the Basin the higher income levels have historically been centered in the counties of Kanawha and Putnam which comprise the Charleston SMSA. Higher growth rates, however, are projected for the non-SMSA counties. These higher percentage gains can be partly attributed to the lower base, but they do indicate an expected increase in economic activity in the rural part of the Basin. The high rate of increase for personal income for the non-SMSA portion of the Basin will be tempered by the growing non-SMSA population. The net effect will be higher per capita income levels, but lower than the Basin. By the Year 2000, non-SMSA per capita income is projected to equal $18,267. This is equivalent to 89 percent of the Basin's average.

TABLE 11
PER CAPITA INCOME
LOWER KANAWHA RIVER BASIN

	YEAR			
	1978	1985	1990	2000
PERSONAL INCOME				
U.S. (billions of 1972 dollars)*	1,140	1,492	1,772	2,337
U.S., index of	1.00	1.31	1.55	2.05
Basin (millions of 1972 dollars)*	2,937	4,267	5,211	6,823
Basin, index of	1.00	1.45	1.77	2.32
Non-SMSA (million of 1972 dollars)**	1,511	2,279	2,810	3,644
Non-SMSA, index of	1.00	1.51	1.86	2.41
PER CAPITA INCOME				
U.S. (1972 dollars)*	5,227	6,420	7,294	8,993
U.S. (1982 dollars)	11,970	14,701	16,703	20,594
U.S., index of	1.00	1.23	1.40	1.72
Basin, (1972 dollars)*	4,508	5,928	7,003	8,986
Basin (1982 dollars)	10,323	13,575	16,037	20,577
Basin, index of	1.00	1.31	1.55	1.99
Basin relative to U.S. (U.S.=1.00)	.86	.92	.96	1.00
Non-SMSA (1972 dollars)***	3,868	5,221	6,223	7,977
Non-SMSA (1982 dollars)	8,858	11,956	14,251	18,267
Non-SMSA, index of	1.00	1.35	1.61	2.06
Non-SMSA, relative to Basin	.86	.88	.89	.89

* Data from Health Planning Guidelines: Mid-year County Population Projections 1981 - 1998, State Health Planning and Development Agency and the West Virginia Department of Health, July 21,1981,p.5.
** Data from 1980 OBERS BEA Regional Projections, Volume 2, Economic Areas, U.S. Department of Commerce, Bureau of Economic Analysis.
*** Data from West Virginia Agricultural Water Quality Management Plan, State Soil Conservation Committee and Department of Natural Resources, June 1979.
Source - Economic Research Service

EMPLOYMENT

Kanawha County will continue to be the center of economic growth and source of employment for residents in the nearby counties of Putnam, Lincoln and Mason as it has in the past (Table 12). Hinterland counties will benefit from increased employment in coal mining due to the expected overall increase in national coal utilization and from reserves of lower sulphur coal which will be in increased demand to

meet higher air quality standards, particularly for reduced sulphur dioxide requirements. The rise in this basic employment will accelerate the growth of the service and trade industries. Government employment will also increase and add stability to the area and help offset the historic problems of cyclical swings in mining and manufacturing activities. As a proportion of total employment, manufacturing jobs will decrease, but the overall importance of manufacturing activities will increase as more people are employed.

TABLE 12
PERCENT OF EMPLOYMENT BY INDUSTRY
LOWER KANAWHA RIVER BASIN

INDUSTRY	Year:	1970 *			1980 *			2000 **		
	Location:	Basin	State	U.S.	Basin	State	U.S.	Basin	State	U.S.
		PERCENT								
Agriculture Forestry, Fisheries		1	2	4	1	12	3	1	< 1	3
Mining		10	9	1	11	a	1	14	11	1
Construction		9	7	5	8	8	5	6	6	5
Manufacturing		19	23	24	16	18	21	12	14	19
Transportation, communications, and public utilities		9	8	5	9	8	5	5	5	5
Trade, wholesale and retail		20	19	19	20	19	21	23	23	22
Finance, insurance, and real estate		3	3	5	4	4	5	4	4	6
Services:		24	25	18	25	26	21	20	21	23
business, personal, repair, entertainment, and recreation		(7)	(7)	(10)	(6)	(6)	(10)	b	(8)	(9)
health		(6)	(6)	(4)	(8)	(8)	(5)	b	(8)	(8)
education, welfare, religious, and non-profit organizations		(9)	(10)	(3)	(8)	(9)	(4)	b	(3)	(4)
legal, engineering and miscellaneous professional		(2)	(2)	(1)	(3)	(3)	(2)	b	(21)	(2)
Government		5	4	19	6	5	18	15	16	16
TOTAL		100	100	100	100	100	100	100	100	100

a - Combined with Agriculture
b - Not Available
* Data from General Social and Economic Characteristics, 1970, 1980, Bureau of the Census, U. S. Department of Commerce.
** Data from 1980 OBERS BEA Regional Projections, Volume 2, Economic Areas, U.S. Department of Commerce, Bureau of Economic Analysis.
Source - Economic Research Service

HOUSING

Between 1970 and 1980 the Basin's population increased nine percent but the number of housing units increased a remarkable 24 percent (See TABLES 13 and 14). The highest rates of gain for new housing units, 51 percent, and population growth, 38 percent, were in Putnam County, the leading growth area in the Basin. The lowest growth rates were in Kanawha County where the population increased about 1 percent and the number of housing units increased a moderate 15 percent. At the current ratio of people to housing units, an additional 29,489 units will be required to house the population projected for the Year 2000. As a result of these basic demographic changes there were related developments of significance to water supply issues and policies.

A very high proportion, 77 percent, of the new housing units were supplied by a publicly, and/or, privately owned water system. Since 1970 there was an absolute increase of about 31,196 users of system supplied water, while during the same period the number of users supplied by wells and other sources remained the same. In some counties, system supplied water apparently displaced wells and other sources. These developments indicate that the reliance on the traditional sources of rural domestic water, wells and surface sources, has decreased. In the rapidly growing counties of Putnam and Mason, 89 and 74 percent of the new housing units were system supplied. These figures are similar to the level in Kanawha County where, for the reasons of the highest population density, a surplus of readily available water, and the most intensively developed county with the most extensive public water works, 92 percent of the new housing units were system supplied. This high level of public water use will be replicated in the future as water systems are expanded to serve new tract developments and existing housing units that switch to public water systems as they become available.

TABLE 13
HOUSING UNITS AND WATER USE
LOWER KANAWHA RIVER BASIN

County	All Year Housing *			Domestic Water Sources **					
				Public System or Private			Wells and Other		
	1970	1980	Change (%)	1970	1980	Change (%)	1970	1980	Change (%)
Boone	8,123	10,741	32	2,696	4,512	73	5,514	5,942	8
Jackson	6,898	9,252	20	2,609	4,186	60	4,285	4,452	4
Kanawha	78,837	90,751	15	68,723	79,694	16	10,068	9,854	-2
Lincoln	5,969	8,103	36	1,547	2,693	93	4,424	4,823	9
Logan	14,602	17,150	17	10,879	12,189	12	3,723	4,536	22
Mason	8,193	10,212	25	4,404	5,900	34	3,789	3,305	-13
Putnam	9,081	13,707	51	5,312	9,446	78	3,762	3,345	-11
Raleigh	23,425	31,976	37	18,759	26,803	43	4,671	3,844	-18
Roane	4,993	5,979	26	1,491	1,814	22	3,489	3,649	5
TOTAL	160,121	197,871	24	116,330	147,526	27	43,725	43,750	0

* Data from Census of Housing 1970, 1980, General Housing Characteristics, West Virginia, U.S. Department of Commerce, Bureau of the Census.

** Data from Census of Housing, 1970, 1980, Detailed Housing Characteristics, West Virginia, U. S. Department of Commerce, Bureau of the Census.

Note: The data are for entire counties and were not adjusted for the parts within the Basin. Adjusted data are contained in Table 14.

Source - Economic Research Service

TABLE 14
PROJECTED HOUSING UNITS
LOWER KANAWHA RIVER BASIN

County	Number of Housing Units 1980	Additional Housing Units by 2000	Total Number of Housing Units by 2000
Boone	10,741	4,537	15,278
Jackson	4,513 *	1,905 *	6,418
Kanawha	90,751	3,468	94,219
Lincoln	1,061 *	485 *	1,546
Logan	2,872 *	585 *	3,457
Mason	4,608 *	1,041 *	5,649
Putnam	13,707	8,508	22,215
Raleigh	19,937 *	8,538 *	28,475
Roane	1,713 *	422 *	2,135
TOTAL	149,903	29,489	179,392

* Based on the whole county ratio of population to housing units adjusted for the population of the county in the hydrologic area.

Source - Economic Research Service

DEVELOPMENT AND ECONOMY

The economic development of the Basin has been highly influenced by the severe mountainous topography and water resources. Early development followed the major rivers upstream from the Ohio with the flood plains along the Kanawha, Coal and Pocatalico Rivers being developed into a thriving agricultural economy. As the river arteries were expanded to accommodate heavier traffic by the construction of locks and dams, development of heavy industries occurred along the river. Construction of the railroads and secondary highways supplemented river transportation and allowed development to occur in the more remote uplands. Recent construction of the interstate system (I-64, I-77 and I-79) is expected to accelerate increased economic activity and development to the end of the century.

TRANSPORTATION

As important as the lack of easy overland access was to the slow initial development of the Basin, existing and planned transportation facilities will be positive forces in the continued economic development of the Basin. Existing principal transportation facilities include a good mixture of highways, railroads, pipelines, navigable rivers, and a regional airport.

Because of the rugged topography, the early network of Federal, State, and local highways was substandard, to the extent that they were generally narrow, winding and hilly. These factors restricted traffic flows and added significantly to the costs of transporting goods into and out of the Basin. Over its history, eastward travel from the Basin was particularly difficult.

The recently completed network of interstate highways (I-64, I-77 and I-79) within the Basin and the prospects of near completion of links such as I-64 to the east, and Appalachian Corridor G from Charleston to southeastern Kentucky, means that the Kanawha Valley will be increasingly more important as the transportation and trade center of West Virginia (See Figure 6). Over these roads, direct efficient access in all directions will be possible for the first time in the history of the Basin. Major terminal points will include places such as Pittsburgh, Cleveland, and Erie, to the north; Roanoke and Richmond to the east; Charlotte, to the south; and Louisville and Lexington, to the west. The advantages will be many, as a result of the increased interaction of local resources and the easier access to more distant markets.

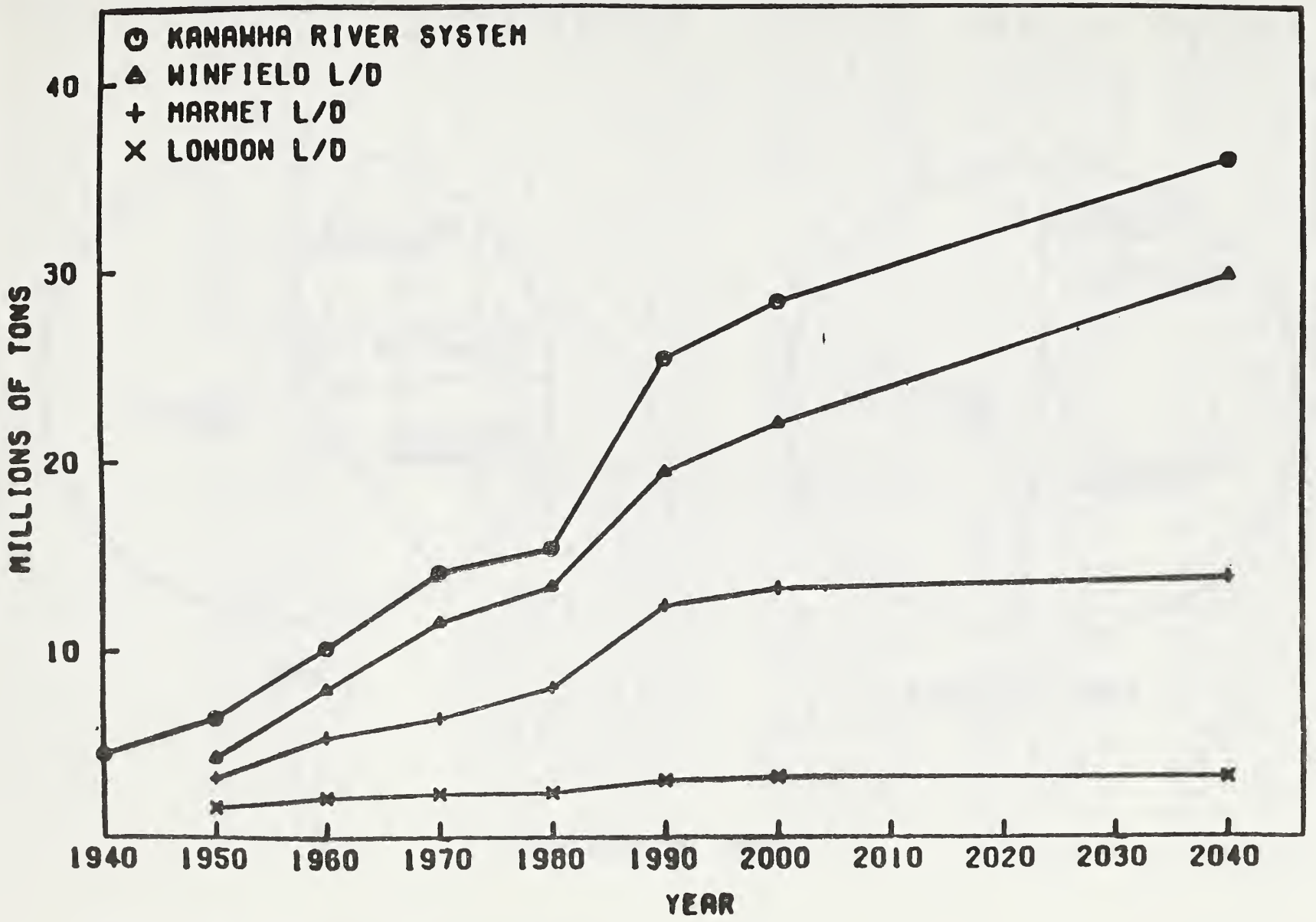
Rail service has been, and remains, a significant asset to the Basin since it was largely responsible for a period of intensified industrial development and still links the Basin effectively with other industrial centers. Major rail lines passing through, or near, the Charleston area include the Chessie System, Conrail, and Norfolk and Western.

Water transportation, more than any other form, has had the greatest role in the historic development of the Basin economy. Beginning with the initial discovery and settlement of the region, water moved travelers and basic goods. The existing water transportation system interconnects the major industrial facilities and provides access to national and international markets for locally produced raw, intermediate, and finished goods and production inputs via the vast Ohio-Mississippi inland water system. The important international markets, particularly for coal and chemicals, are served by exports from the port at New Orleans, Louisiana.

Modern navigational improvements in the forms of high-lift locks and dams, were constructed on the Kanawha River between 1931 and 1937. These structures provide a channel 91 miles long with a minimum depth of nine feet between the Ohio River at Point Pleasant and Alloy, West Virginia. The system consists of lock and dam structures at Winfield, Marmet, and London on the Kanawha River operated in conjunction with the Gallipolis pool in the Ohio River. Twin lock chambers, 56-feet wide and 360-feet long, are provided at the Kanawha River facilities.

The volume of traffic at the three structures amounted to 23 million tons in 1982, composed primarily of coal, chemicals, ores and aggregates. The majority of this tonnage, 14 million tons, moved through the lower most structure on the river at the Winfield lock and dam. Due to its location between the industrial area of the Kanawha River and the Ohio-Mississippi inland waterway, more traffic has historically moved through Winfield than the total for Marmet and London. In addition, the majority of the Kanawha River System (KRS) traffic moved on the Winfield pool. KRS traffic data include interpool movements which do not pass through a lock and dam but benefit from the pools formed by the structures. KRS tonnage equalled 15.3 million tons in 1980. It is projected to surpass 28 million tons by the Year 2000, and 35 million tons by the Year 2040. This is an average annual increase in system traffic of 3.12 percent for the 1980-2000 period, compared to a 2.13 percent annual increase for the 1960-1980 period. Historic and projected Kanawha River traffic and traffic distribution by commodities for 1980 and 2040 is shown in the following two graphs.

There is a potential for a more effective waterway transportation system and improvements are currently being studied. The locks and dams at Gallipolis and Winfield are major constraints on the inland waterway system. The small lock chambers at these structures, combined with increased traffic levels, have created higher lockage and staging times for the tows. Waterway shipment costs have risen as a direct result. In view of the current congestion problems and projected increases in traffic demand, the Corps of Engineers has recommended a lock replacement plan at Gallipolis and is analyzing the need for improvements to the locks and dams on the Kanawha River.



HISTORIC AND PROJECTED TRAFFIC

KANAWHA RIVER

Source: Corps of Engineers, Huntington District.

COMMODITY SHARES OF KANAWHA RIVER SYSTEM TRAFFIC

MILLIONS OF TONS

Source: Corps of Engineers, Huntington District.

The importance of water transportation to local commerce was demonstrated by the conclusion that "the relative costs of transporting inputs and outputs for the (chemical) industry among water, rail and truck per ton mile are in the ratio of 1:7:13. Inexpensive water transportation is definitely a benefit to the industry. Without this benefit, the manufacture of some chemicals would be done elsewhere." (See REFERENCE 7).

Commercial air service for all aircraft up to the size of, but not including jumbo jets, has been available at Charleston with connections to many major air centers. A major regional air center between the Charleston SMSA and Huntington SMSA was at one time under consideration. Such a facility would improve air service and intensify the already high rate of development centered in the Teays Valley corridor between these cities along the general path of Interstate 64.

The Kanawha Basin has petroleum and natural gas reserves and a well-developed system of pipelines which serves local residential, commercial, and industrial demands in addition to providing the means for the export of these resources. Some local and national interest has recently developed in the feasibility of coal slurry and coal-water medium pipelines. With the primary resources of coal and water in local abundance, such developments would be economic stimulants to the local economy.

Among the myriad of economic forces which have the potential to directly affect the continued economic development of Basin, none will be more important than those related to improved transportation. When all the major highway and waterway improvements are completed, this transportation hub of the state will be poised to share the additional commerce as it passes through the region, and more importantly, the additional income generated from the improved competitiveness of the Basin's resources. From the standpoint of a complete transportation network, no other area of the state is in a better position to capitalize on the advantages of its transportation base than the lower Kanawha Valley.

ECONOMIC SITUATION OF FOREST RESOURCES

Timber harvesting within the study area is currently at a low level. This is due to several factors. A poor National economy has affected markets, and industry expansion and forest landowners' unwillingness to harvest their timber are the primary reasons for the current levels of timber harvesting. It is estimated that about 57 percent of the growing-stock's annual growth is being harvested within this area. (See REFERENCE 8)

A 1983 survey of 42 sawmills within or adjacent to the watershed found the mills had produced 44,000,000 board feet of lumber during the year. These mills employed 800 people and paid wages totaling $7,822,000. (See REFERENCE 9)

The sale of the lumber from these mills produces $18,810,000 in receipts. The multiplier used to estimate the worth of the lumber industry to the local, regional, and State areas is 7.

The projection of the timber harvesting for the area is to remain relatively unchanged, while timber growing stock will continue to increase.

This area of West Virginia is currently under consideration for constructing a hardwood pulpmill. If a pulpmill or another type of hardwood using industry were to locate within or adjacent to the study area, it could be assumed that the volume of timber harvested would more closely approach the volume of annual net growth.

EXISTING, UNDERWAY, AND PROPOSED PROJECTS

There are several existing, underway, and proposed Federal, State, and local projects that will impact on the major study concerns of the Basin (FIGURE 12). Basin planners have for years, been concerned with meeting flood prevention and water supply needs, and more recently, with trying to reduce excessive erosion and improving water quality. As a result of their efforts, several projects have developed. Some of these are described below.

FIGURE 12

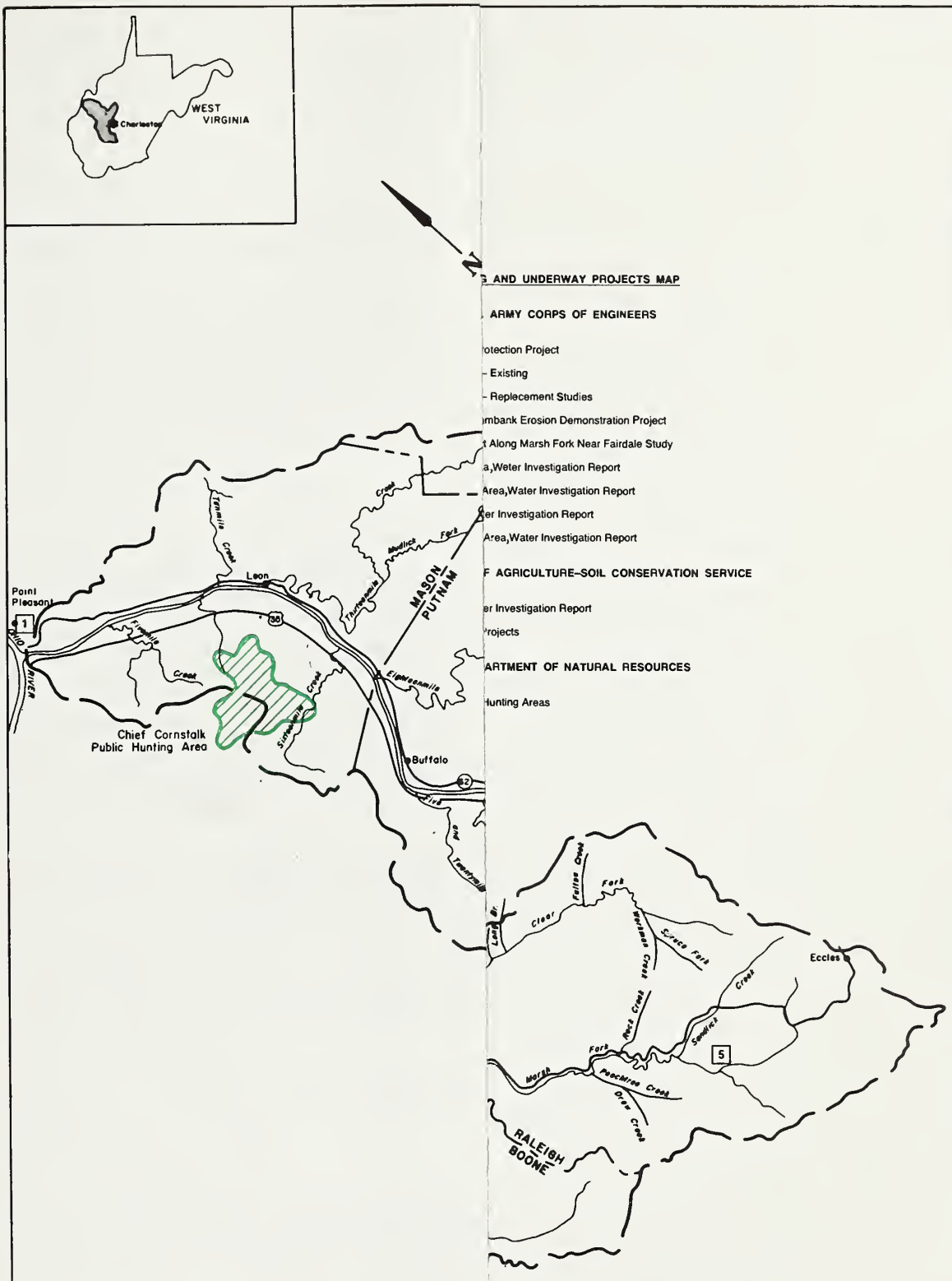
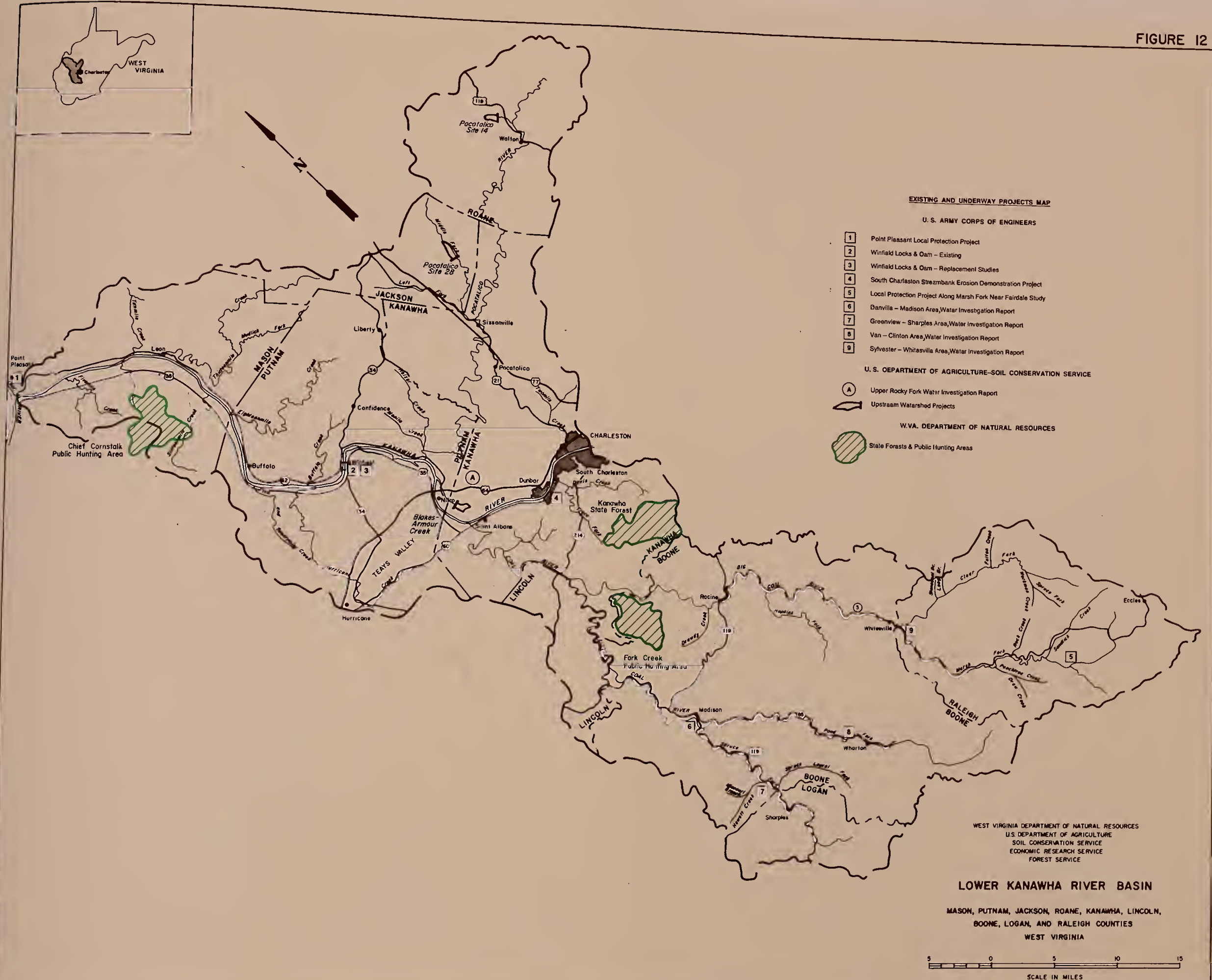

WEST VIRGINIA
Charleston
S AND UNDERWAY PROJECTS MAP
ARMY CORPS OF ENGINEERS
otection Project
Existing
Replecement Studies
mbank Erosion Demonstration Project
t Along Marsh Fork Near Fairdale Study
a,Weter Investigation Report
Area,Water Investigation Report
er Investigation Report
Area,Water Investigation Report
F AGRICULTURE-SOIL CONSERVATION SERVICE
er Investigation Report
Projects
ARTMENT OF NATURAL RESOURCES
Hunting Areas
Point Pleasant
Leon
MASON
PUTNAM
Chief Cornstalk
Public Hunting Area
Buffalo
Eleanor
Eccles
RALEIGH
BOONE
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
LOWER KANAWHA RIVER BASIN
MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA
0 5 10 15
SCALE IN MILES

FIGURE 12



EXISTING AND UNDERWAY PROJECTS MAP

U. S. ARMY CORPS OF ENGINEERS

1. Point Pleasant Local Protection Project
2. Winfield Locks & Dam – Existing
3. Winfield Locks & Dam – Replacement Studies
4. South Charleston Streambank Erosion Demonstration Project
5. Local Protection Project Along Marsh Fork Near Fairdale Study
6. Danville – Madison Area, Water Investigation Report
7. Greenview – Sharples Area, Water Investigation Report
8. Van – Clinton Area, Water Investigation Report
9. Sylvester – Whitesville Area, Water Investigation Report

U. S. DEPARTMENT OF AGRICULTURE–SOIL CONSERVATION SERVICE

- (A) Upper Rocky Fork Water Investigation Report
- Upstream Watershed Projects

W.VA. DEPARTMENT OF NATURAL RESOURCES

- State Forests & Public Hunting Areas

WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE

LOWER KANAWHA RIVER BASIN

MASON, PUTNAM, JACKSON, ROANE, KANAWHA, LINCOLN,
BOONE, LOGAN, AND RALEIGH COUNTIES
WEST VIRGINIA

5 0 5 10 15
SCALE IN MILES

Federal

Several Federal programs being administered in the Basin deal with flood prevention. Some of those are:

a) National Flood Insurance Program,
b) IFLOWS Flood Warning Program
c) Upstream Watershed Protection and Flood Prevention Program,
d) Resource Conservation and Development Program,
e) Flood Control Program, and
f) Joint Corps and SCS Program.

National Flood Insurance Program

The National Flood Insurance Program is administered by the Federal Emergency Management Agency; U. S. Department of Housing and Urban Development under authority of the Flood Disaster Protection Act of 1973. This Act requires the purchase of flood insurance as a condition of receiving any form of federally related financial assistance in an identified flood plain area. The program will not prevent existing flood damages; however, it has the potential of preventing future flood damages by requiring that future flood plain development financed by federal monies be essentially flood free. Existing property owners that purchase flood insurance are partially (less deductible) reimbursed for flood losses they sustained.

The National Flood Insurance Program has been active in the Basin since its conception in 1973. Since that time, the following communities and counties have enrolled in the program: (See REFERENCE 10).

1) Communities - Bancroft, Beckley, Buffalo, Charleston, Danville, Dunbar, Handley, Hartford, Henderson, Hurricane, Leon, Madison, Mason, Nitro, Poca, Pratt, South Charleston, Sylvester, Whitesville, and Winfield.

2) Counties - Kanawha, Mason, Putnam, Raleigh, and Roane.

IFLOWS Flood Warning Program

The National Oceanic and Atmospheric Administration is in the initial stages of establishing a coordinated flash flood warning program throughout the Basin. The major components of the program are:

1) A network in each county of volunteer rainfall and stream observers coordinated by a County Flood Warning Coordinator.

2) Automated rainfall reporting rain gauges and stream alarms.

3) Improved communications within and between counties, and between appropriate State and National Weather Service offices.

4) Improved regional and national rainfall and flood forecasting capabilities.

The program is administered by the National Weather Service and the State Offices of Emergency Services. Local county governments have the responsibility of establishing and operating the rainfall and stream observing system under the leadership of the County Flood Warning Coordinators.

Upstream Watershed Protection and Flood Prevention Program

The Upstream Watershed Protection and Flood Prevention Program is a local, State, and Federal program under the leadership of the Soil Conservation Service. This program, administered under authority of Public Law 83-566, is initiated by request of local people within a watershed area. SCS provides technical assistance to help the local people assess their problems, and to evaluate alternative solutions. The local people select the solution best suited to their needs after considering inputs from other interested agencies and groups. SCS pays for construction of the project along with the cost of engineering and project administration, and the local people pay for the real property rights needed for the project and for operation, maintenance, and replacement.

There are only two upstream watershed protection and flood prevention projects in the Basin. The Blakes Creek-Armour Creek Watershed at Nitro and Kanawha Twomile Creek Watershed at Charleston. The Blakes Creek-Armour Creek project consists of land treatment on 775 acres and a multiple-purpose flood prevention and recreation dam constructed across Blakes Creek. The project was completed in 1975 and protects the large residential area of Nitro. At 1982 prices, this project would reduce flood damages by $77,850 annually. (See REFERENCE 11).

The Kanawha Twomile Creek Watershed project was planned in 1969. The project, as planned, consisted of 3,170 acres of land treatment, three flood prevention dams and one multiple-purpose flood prevention and recreation dam. Approximately 2,272 acres of land treatment has been installed; however, none of the dams have been built. In 1975 project sponsors requested that the project be placed in an inactive status, where it has remained to date. A recent feasibility evaluation indicated that the project would be infeasible under todays prices and

safer engineering criteria for dams. Under these conditions, construction of this project is unlikely and, therefore, it will have no effect in reducing damages. Preliminary screening of PL-566 projects indicated that economic justification of additional projects under this authority will be unlikely.

Resource Conservation and Development Program

The Lower Kanawha River Basin is in the Great Kanawha Resource Conservation and Development (RC&D) Area. The RC&D Program was authorized by the Food and Agricultural Act of 1962, and is administered by the Soil Conservation Service. The program provides opportunities for individuals and local governments to improve their communities through proper planning and use of the resource base.

There are three completed RC&D project measures in the Basin. They are all critical area treatment measures consisting of the revegetation of 9.7 acres of critically eroding land, 400 feet of subsurface drains, 115 feet of diversion, and 500 feet of grassed waterway. (See Reference 12)

Flood Control Program

The Flood Control Program is administered by the U. S. Army Corps of Engineers under authority of many flood control laws. Under these authorities, the Corps functions as an engineering consultant to Congress and most of the Corps water resources projects are developed by specific Congressional authorization.

There are two completed Corps projects in the Basin, and three projects located upstream from the Basin that significantly reduce flood damages along the main stem of the Kanawha River.

The Winfield Locks and Dam is located at river mile 31.1 on the Kanawha River, Putnam County, West Virginia. The project was completed in 1937 and has two lock chambers, each being 56-feet wide and 360-feet long. During the past 46 years, river traffic has increased five times. Replacement studies for the Winfield Lock and Dam are currently underway.

Point Pleasant Local Protection Project is located on the left bank of the Ohio River (river mile 265) and on the right bank of the Kanawha River at its confluence with the Ohio River at Point Pleasant, Mason County, West Virginia. The project, completed in June 1951, consisted of 7,365 feet of concrete wall, 4,740 feet of earthen levee, 3 pump stations, 15 gate openings, a vehicular ramp and 2,400 feet of diversion channel.

There are three major reservoirs, Bluestone, Sutton and Summersville Lakes in the upper Kanawha Basin which are currently operated as multi-purpose projects.

Bluestone Lake, located about 162 miles above the mouth of the Kanawha River on New River, a tributary of the Kanawha River, controls 4,603 square miles of drainage area. This project has 592,650 acre feet (2.43 inches, in terms of runoff) of seasonal flood control capacity, 600,100 acre feet (2.46 inches) of winter flood control capacity, and has been in operation since 1947. Flood reductions are effected in the lower reach of New River, in the upper and two lower reaches of the Kanawha River, and along the Ohio River downstream from Point Pleasant, West Virginia. Flood damages prevented by this project since it became operational are estimated to be about $529,000,000.

Sutton Lake, located (about 160 miles above the mouth of the Kanawha River) on the Elk River, a tributary of the Kanawha River, controls 537 square miles of drainage area. This project has 201,100 acre feet (7.0 inches) of seasonal flood control capacity, 261,200 acre feet (9.1 inches) of winter flood control capacity, and has been in operation since 1960. Flood reductions are effected in the reaches along Elk River, in the two lower reaches of the Kanawha River, and on the Ohio River downstream from Point Pleasant, West Virginia. Flood damages prevented in these reaches are estimated to be about $143,000,000 since the project became operational.

Summersville Lake, located (about 132 miles above the mouth of the Kanawha River) on the Gauley River, a tributary of the Kanawha River, controls 803 square miles of drainage area. This project has 221,800 acre feet (5.2 inches) of seasonal flood control capacity, 383,730 acre feet (9.0 inches) of winter flood control capacity, and has been in operation since 1966. Flood reductions are effected in the lower reach along the Gauley River, in the upper and two lower reaches along the Kanawha River, and on the Ohio River downstream from Point Pleasant, West Virginia. Total flood damages prevented by Summersville Lake are estimated to be about $219,000,000.

All three lake projects are operated for flood control, fish and wildlife, and recreation. Sutton and Summersville Lakes are also operated for pollution abatement.

The authorized Coal River Rehabilitation Project for clean out of stream channels in the Basin was placed in an "inactive" category in 1980 because local interests were unable to provide the necessary real estate acquisitions.

A local protection study for flood control is underway (1985) on Marsh Fork of the Coal River at Fairdale.

Joint Corps and SCS Program

The Corps and SCS participated in a joint study in the Pocatalico River Basin under authority of Public Law 87-639 (See Reference 13). This project consists of two multiple-purpose flood prevention and water supply dams. The project was authorized in October 1974. Since that time, one dam, Site 14, located upstream from Walton, West Virginia, has been built. This dam provides municipal water supply and flood protection for Walton and vicinity. The Corps is not involved in completion of the two authorized dams.

Purchase of real property rights for the other dam, Site 28, located upstream from Sissonville, West Virginia, is underway. Construction is expected to start in 1985. This dam would provide water supply and flood protection for Sissonville.

State

The Kanawha River survey to assess toxic conditions in the river was completed August 24, 1984. The survey consisted of effluent and stream samples which were analyzed for chronic toxicity. EPA and the DNR's Division of Water Resources expended approximately $200,000 for the joint project. The results were available in late 1984.

Hydrologic groundwater atlases have been prepared to provide information regarding the State's groundwater conditions and to promote a more informed approach toward water use. The atlases were prepared by the WV Division of Water Resources in cooperation with the U.S. Geological Survey and the U.S. Environmental Protection Agency.

The atlases show the geology as it relates to the hydrologic conditions that exist in each river basin. They include a text, tables, and small inset maps describing water-bearing properties of rocks, groundwater yield, and groundwater quality. Availability, occurrence, and groundwater flow are mapped along with natural and man-induced salt water conditions. Information describing the topographical areas most suited to water well development in terms of both quantity and quality is shown in the atlases. The possible effects of surface and underground coal mining on groundwater quality are also illustrated.

The nonpoint source water quality management program is authorized through Section 208 of the Clean Water Act (PL 92-500) as amended in 1977. The program's primary concern is with the control of erosion and sedimentation resulting from earth disturbing activities which tend to increase erosion. Four major categories of activities are included in the program. These are construction, forestry, oil and gas, and agriculture.

The program consists of the development of a water quality management plan specific to the site where the activity is planned. Once approved, the plan is implemented onsite through the installation of sediment control measures for both the construction and reclamation phases, where applicable, of the project.

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11. Blakes Creek-Armour Creek Watershed Work Plan, SCS, Jan. 1966.

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13. Pocatalico River Basin Joint Study, Interim Report, Corps of Engineers and Soil Conservation Service, June 1973.

APPENDIX B - GLOSSARY OF TERMS

ADEQUATELY TREATED LAND - Cropland, pastureland, forest land or other land used within its capability, on which the conservation treatments essential to its protection and planned improvements have been applied.

APPALACHIAN REGIONAL COMMISSION (ARC) - The ARC, created by the U. S. Congress, annually allocates discretionary funds to each of the Appalachian States. ARC monies are used as basic and supplemental funds for eligible costs up to 80 percent of the total project costs. The remaining 20 percent is comprised of nonfederal sources. Projects eligible for ARC funding include water and sewer, as well as solid waste treatment.

AQUIFER - A water bearing stratum of permeable rock, sand, or gravel.

BASIN - In general, that area in which the natural drainage ultimately finds its way to the central stream or river for which the basin is named; a "subbasin" refers to a component part of a major basin, that is, one whose natural drainage is collected by a subordinate stream.

CAPABILITY - The maximum load which a machine, station, or system can carry under specified conditions for a given time interval.

C.F.S. or c.f.s. - Cubic feet per second, the unit or discharge for measurement of flowing liquid. Also called second feet.

COLIFORM BACTERIA (Fecal coliform) - The group of aerobic and facultative anaerobic bacteria commonly found in the feces of various warm blooded mammals. Counts of fecal coliform are often used as an indicator for the presence of domestic sewage and agriculture animal waste in streams.

COMMERCIAL FOREST LAND - Forest land that is producing or capable of producing crops of wood for industrial use and is not withdrawn from timber utilization.

CONDUCTIVITY - A numerical expression, usually in micromhos/cm, of the ability of a water sample to carry an electric current.

CROPLAND - Land currently tilled, including cropland harvested, crop failure, idle cropland, cropland in cover crops or soil improvement crops not harvested or pastured, rotation pasture, and cropland being prepared for crops or newly seeded crops. Land in vegetables, fruits, and nuts, including those grown for home use, is also considered to be cropland.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD) - HUD was created as a result of the Housing and Development Act of 1977. Funds, of up to 100 percent from this program, are used for community development projects which often include water and sewage treatment facilities.

DISSOLVED OXYGEN (DO) - A numerical expression, usually in mg/l, of the amount of oxygen dissolved in water dependent upon the physical, chemical, and biochemical activities prevailing in that water.

ECONOMIC DEVELOPMENT ADMINISTRATION (EDA) - EDA provides funds for industrial and public works development based on the projected economic impact on the area. EDA loans and grants applicable to water and sewer needs are designed to provide long-term economic development. The State must match 25 percent of the Federal funds allocated under this program.

ECOSYSTEM - The interacting system of a biological community and its nonliving environment.

EFFLUENT - (1) A liquid which flows out of a containing space. (2) Sewage, water, or other liquid, partially or completely treated, or in its natural state, as the case may be, flowing out of a reservoir, basin or treatment plant, or part thereof.

ENVIRONMENTAL QUALITY (EQ) - Pertaining to the enhancement of the environment by management, conservation, preservation, creation, restoration, or improvement of the quality of natural and cultural resources and ecological systems.

EROSION - The group of processes whereby soil or rock material is loosened or dissolved and removed from any part of the earth's surface.

EROSION, GULLY - Land worn by running water and marked by the formation of gullies or miniature valleys along the slopes of a drainage area. If allowed to continue, destruction is rapidly progressive and may lead to complete loss of the land for any agricultural use.

EROSION, SEVERE - Erosion visible with the naked eye.

EROSION, SHEET - The type of erosion which occurs when water flows in a sheet down a sloping surface and removes material from the surface in a sheet of relatively uniform thickness.

FARMERS HOME ADMINISTRATION (FmHA) PROGRAMS - Included among FmHA programs are those designated to help communities plan and install water and sewer systems. Grants may consist of up to 50 percent of the total project cost. However, low-interest loans are only made to cover the nonfederal share of this expense.

FARMLAND OF STATEWIDE IMPORTANCE - This is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.

FARMLAND OF LOCAL IMPORTANCE - In some local areas there is concern for certain additional farmlands for the production of food, feed, fiber, forage, and oilseed crops, even though these lands are not identified as having national or statewide importance. Where appropriate, these lands are to be identified by the local agency or agencies concerned.

FEDERAL LAND - Includes the acreage of all Federally owned lands. (Most of these lands are forested, with a large proportion in National forests.)

FLOOD PLAIN MANAGEMENT - Flood plain management refers to the proper use of flood prone land areas to minimize hazards to loss of life and property from flooding. Techniques to promote proper land use include, but are not limited to (1) regulations, (2) zoning, (3) building codes, and (4) flood insurance.

FLOOD PLAIN MANAGEMENT REPORTS - A report prepared by local Sponsors with assistance from SCS technical specialists that identifies flood prone areas, quantifies the hazards from flooding, and lists alternative management options that could be implemented to promote proper flood plain land use.

FOREST LAND - Land which is at least 10 percent stocked by forest trees of any size and capable of producing timber or other forest products, or capable of exerting an influence on the water regime, lands from which the trees described above have been removed to less than 10 percent stocking and which have not been developed for other uses; and afforested (planted) areas. NOTE: The term woodland as applied in this report refers to those tracts of wooded land on farms used primarily for the production of wood products or to provide tree cover. When the term forest land is used alone it includes wooded areas. Woodland is sometimes used with the term forest land because it is a term common to parts of the basin.

GABIONS - Wire baskets filled with rock, often placed on a stream embankment to prevent erosion.

GEOLOGIC EROSION - Erosion of the land in its natural environment, undisturbed by human activity.

GOVERNOR'S PARTNERSHIP FUND - The Governor's Partnership Fund is funded entirely by appropriations from the West Virginia Legislature for projects which have an impact on the growth and economic development of an area and which stimulate the investment of private capital. Eligible projects include water and sewer development which will improve an area and attract private investment. Funds from this program are to supplement projects which have received primary funding from other sources.

HARDNESS - A characteristic of water, chiefly due to the existence therein of the carbonates and sulfates and occasionally the nitrates and chlorides of calcium, iron, and magnesium, which causes "curdling" of the water when soap is used, and increased consumption of soap, the deposition of scale in boilers, injurious effects in some industrial processes, and sometimes objectionable taste in the water.

HIGHWALL - The high vertical face of rock and earth remaining after removing a portion of steep hillside to expose a coal seam during surface mining activities.

HYDROLOGIC SOIL GROUP - A group of soils having the same runoff potential under similar storm and cover conditions.

LAND TREATMENT MEASURES - Measures consisting of both vegetative and mechanical methods for the purpose of reducing runoff and erosion. Land treatment measures normally consist of vegetative plantings, tree plantings, grass waterways, diversions, gully stabilization, terraces, etc.

LAND USE - The actual uses or condition of the land broadly classified as agricultural land (cropland and pastureland), forest land, urban land, wetland, and barren land.

LEACHATE - A solution resulting from the percolation of water through materials containing soluable components.

MINED LAND - Land committed to mining purposes including surface mines, abandoned mines not adequately reclaimed for other uses, land areas used for deep mines (entrances, airshafts, buildings, etc.) and associated facilities as mining roads. (Does not include surface mine lands that have been adequately reclaimed and are being used for other uses. These areas would be identified with the present use as forest, pasture, etc.).

NATIONAL ECONOMIC DEVELOPMENT (NED) - Pertaining to increases in the value of the Nation's output of goods and services and improvement of national economic efficiency.

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) - A national program for issuing, denying, modifying, revoking and reissuing, suspending, revoking, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under Sections 307, 318, 402, and 405 of the Clean Water Act, including any approved State program.

NEPA - The National Environmental Policy Act of 1969, as amended.

NONADEQUATELY TREATED LAND - Cropland, pastureland, forest land or other land on which the conservation treatments essential to its protection and planned improvements have not been applied.

NONCOMMERCIAL FOREST LAND - Forest land that is incapable of yielding timber crops because of adverse site conditions and productive forest land that is withdrawn from commercial timber use through statute or administrative regulations.

NONSEVERE EROSION - Erosion not apparent to the naked eye.

NONSTRUCTURAL MEASURES - Works of improvement for the purpose of providing flood prevention by the exclusion of floodwater into or around individual buildings or groups of buildings. Nonstructural measures include, but are not limited to (1) acquisition of flood prone land, (2) relocation of flood prone buildings, (3) floodproofing, and (4) flood warning systems.

OM&R - Operation, maintenance, and replacement.

OPERATING EXPENSE - Includes labor, materials, equipment, overhead, and other expenses (except maintenance).

OTHER LAND - Acreage of nonfederal rural land which is not classified as cropland, pastureland, or forest land. This category includes stripmined and borrow areas, and gravel pits.

PASTURELAND - Land in grasses or long-term forage growth that is used primarily for grazing. Pastureland includes grassland, nonforested pasture, and other grazing land with the exception of pasture in crop rotations.

pH - The index of a measure of the hydrogen ion concentration in a solution, the figure 7.0 denoting neutrality, a smaller figure measuring more acid and a higher figure meaning more alkaline.

PL 92-500 - The Federal Water Pollution Control Act (as amended by the Clean Water Act of 1977). This legislation calls for the restoration and maintenance of the chemical, physical, and biological integrity of the nations waters.

P.P.M. or p.p.m. - Parts per million. The weight of the specified substance in one million parts (volume) of the sewage, wastes or solution examined. The expression "one part per million" is usually understood to mean one pound per million.

PRIME FARMLAND - Prime farmland is land best suited for producing food, feed, forage, fiber, and oilseed crops, and also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.

RIPARIAN - Relating to or located on streambanks.

ROCK RIPRAP - Rock placed directly upon stream embankment to prevent erosion.

SEDIMENT - Material that is in suspension, is being transported, or has been moved from its site of origin by wind or water and has reached a waterway.

SEMISKILLED JOBS - Jobs created by construction activities that require moderate degrees of skill such as laborers, janitors, and night watchmen.

SEWAGE - Largely, the waste water supply of a community after it has been fouled by various uses; a combination of the liquid of water-carried wastes from residences, businesses, institutions, and industrial processes. It may also be composed of nonspecific sources such as groundwater, surface water, and storm water.

SKILLED JOBS - Jobs brought about by constuction activities associated with plan implementation that require a high degree of skill such as heavy equipment operators, project managers, mechanics, electricians, and carpenters.

STRUCTURAL MEASURES - Works of improvement for the purpose of providing flood prevention by the exclusion of floodwater from the flood plain. Structural measures include, but are not limited to (1) floodwater retarding dams, (2) channel work, (3) dikes, (4) debris and sediment basins, (5) floodways, and (6) floodwater diversions.

SUBSIDENCE - The downward movement of strata over a mined out void.

SUBSURFACE WATER - All water located beneath the earth's surface but contained near the surface in sand, gravel, or rock aquifers, limestone caverns; and deep mines.

SURFACE WATER - All water located on the surface of the earth and contained in streams, rivers, or lakes.

URBAN AND BUILT-UP - Areas that include cities, villages, and built-up areas of more than 10 acres; industrial sites (except strip mines, borrow areas, and gravel pits), railroad yards, railroads, roads, cemeteries, airports, golf courses, shooting ranges, and so forth; institutional and public administrative sites; and similar types of areas. Farmland inside corporate limits is excluded.

WATERSHED PLANS - A watershed plan is a report prepared by local Sponsors with assistance from SCS technical specialists that describes the watershed and its problems, sets forth a plan for the selected works of improvement, provides a general sequence for installation, indicates estimated costs and cost sharing arrangements, and lists responsibilities of those participating in the project.

WEST VIRGINIA WATER DEVELOPMENT AUTHORITY (WDA) - Provides loans and grants for projects receiving funds through the EPA Section 201. Loans of up to 25 percent are available for feasibility study and facility design. The WDA may make a 5 percent grant on eligible project costs during actual construction.

WETLAND - An area inundated by surface or groundwater with a frequency and duration sufficient to support a prevalence of vegetative or aquatic life that requires saturated soil conditions for growth and reproduction.

APPENDIX C - PUBLIC INVOLVEMENT

The public involvement plan for the Lower Kanawha River Basin Study was somewhat limited in scope, primarily depending on integrating activities with those in existing agencies and groups who have an interest in the study area.

The plan was developed by a four-member work group with representatives from the USDA Soil Conservation Service, WV Department of Natural Resources, USDA Extension Service, and the WV Department of Highways. The directors of the Region II and Region III Planning and Development Councils had also been invited to participate but did not attend the planning meetings in the spring of 1982.

Most of the activities were directed to local agencies who, in turn, had an established constituency. In February 1982, a letter announcing the study and the plan of work were mailed to study participants and local decision makers. One example of working with other agencies was an October 1982 meeting that SCS personnel had with the Resource Development Authority to discuss critical flooding problems in the Kanawha County portion of the Lower Kanawha Basin.

In March 1983, an offer was made to make presentations to the two regional councils in the study area. The purpose of this offer was to make the councils aware of the study and to solicit any comments they had. As a result of that contact, the WV Department of Natural Resources made a presentation at Region III's meeting on May 25, 1983.

The only technique aimed directly at the general public was the use of news releases. The first release, in September 1982, announced the beginning of the study; it was sent to 44 media outlets within the Basin. A similar article was published in the WV DNR Division of Water Resources' newsletter, Mainstream, in December 1982.

When the Lower Kanawha Study reached the draft stage, it was distributed to nine public libraries and the two Regional Planning and Development Councils, where it was made available for public review. A news release was prepared, announcing the location of the documents and the beginning of a 30-day public comment period.

At the close of the comment period, the comments were reviewed and addressed in the final plan. The final document was distributed to the same libraries and regional councils, and was made available to the public upon request. The news release was again used as a method to publicize the availability of the plan.