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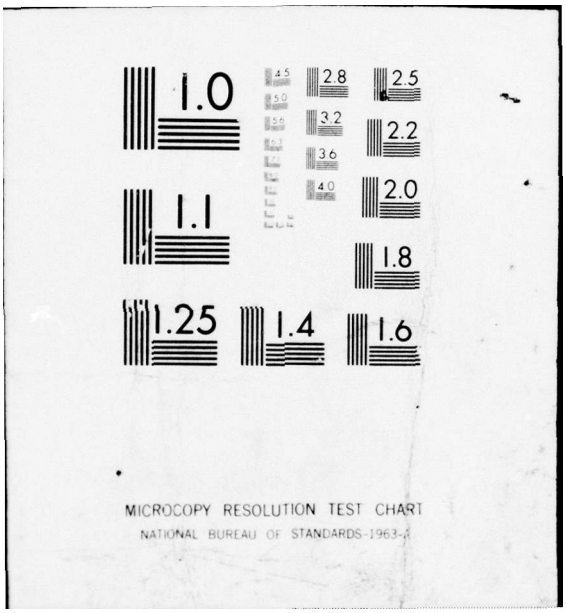
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SUMMARY

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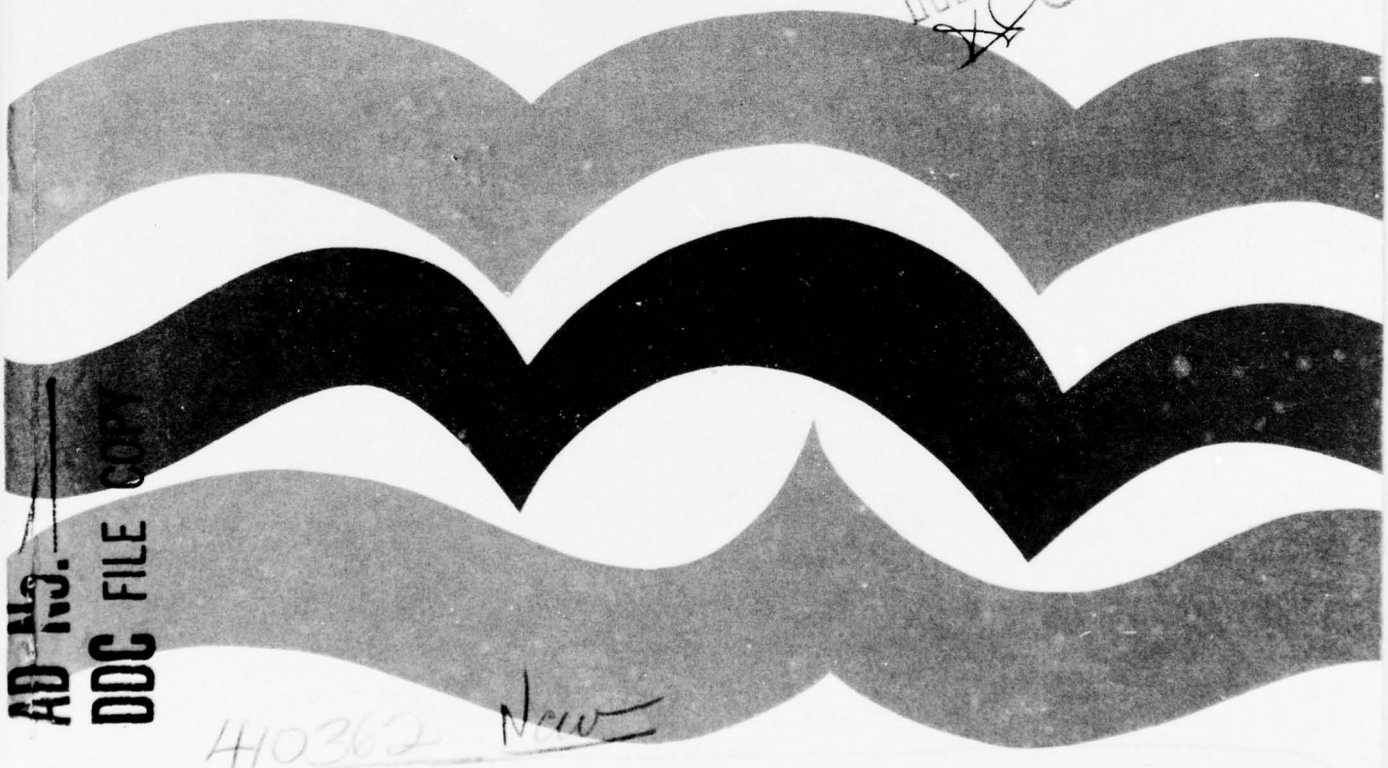

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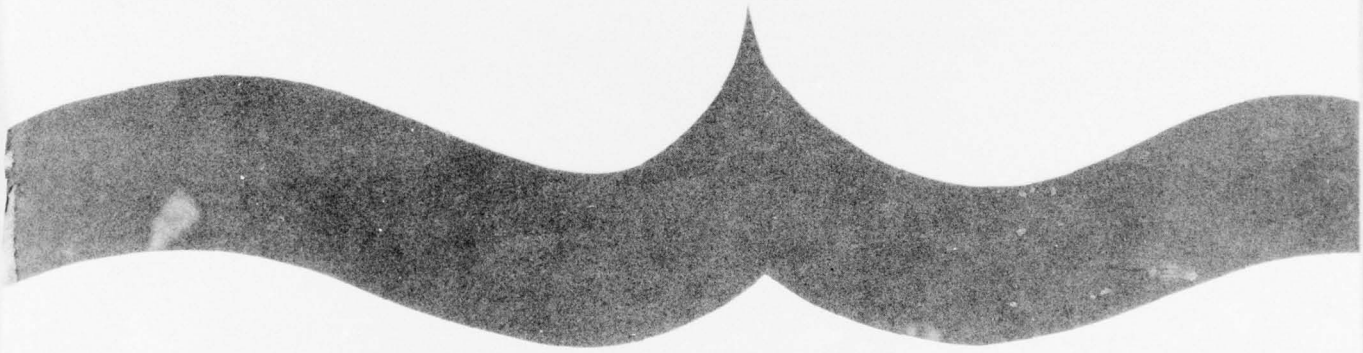

SUMMARY

Susquehanna

RIVER BASIN STUDY

JUNE 1970

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Coordinating Committee Statement . . .

This Report has been reviewed and approved by each member of the Susquehanna River Basin Study Coordinating Committee. The Committee was composed of representatives from the Departments of Agriculture; the Army; Commerce; Health, Education, and Welfare; Housing and Urban Development; the Interior; the Federal Power Commission; and the States of New York and Maryland, and the Commonwealth of Pennsylvania. It has guided staff work on the Study since its inception in 1963. A cooperative spirit has prevailed throughout the Study, and the Committee is pleased to present this report which contains several planning innovations.

The Report is subject to review by the interested Federal agencies at the departmental level, by the Governors of the affected States, and by the Water Resources Council prior to its transmittal to the Congress for its consideration of Federal participation in implementing the Plan.

Implementation of the recommended Plan in this Report would be an important step toward providing the residents of the Susquehanna River Basin and the Nation with a high quality of environment as well as providing, in an orderly manner, for a growing and vigorous regional and national economy.

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PREFACE

Americans are realizing that our natural resources are not inexhaustible, nor are they exempt from ruin and misuse. Indiscriminate use of resources, degradation of the air and water, and rapid population growth have made this all too evident. Many people are facing the future either with a pessimistic attitude that little can be done to correct the abuses, or with an apathetic attitude that resource problems will somehow solve themselves. Neither of these extremes needs dominate the future.

The Susquehanna River Basin Study demonstrates that with careful planning and judicious investment there can be ample water for all people and for all purposes without sacrificing the quality of the environment. Since the Study began in 1963, the collection and analysis of data and the formulation of a plan have been carried on intensively. This has been the most thorough study ever made of the water and related land resources of the entire Susquehanna River Basin. The recommendations in the Plan are the results of the efforts of many Federal departments and agencies, and of the three States through which the River and its tributaries flow. These recommendations have been agreed upon by the Coordinating Committee.

The objectives of the Susquehanna River Basin Study were to evaluate the water resource potential of the Basin, to determine the water resource requirements of the Basin's increasing population, to analyze alternative solutions, to recommend programs necessary to manage this valuable resource to best serve the economic and social needs of the people of the Basin, and to preserve the Basin's high natural values for the use of the present and future generations. This volume presents, in summary, the findings of the Study and how the above objectives were met. It also describes the physical nature of the Basin and the characteristics of the Basin's population and economy, the backdrop against which planning took place.

CHAPTER I
Preview

"And when I asked the name of the river from the brakeman, and heard that it was called the Susquehanna, the beauty of the name seemed to be part and parcel of the beauty of the land . . . . that was the name, as no other could be for the shining river and desirable valley."

Robert Louis Stevenson
"Across the Plains"

These words spoke of the beauty of the Susquehanna nearly a century ago. The "shining river and desirable valley" are still there----and much beauty still remains. But beneath its surface beauty, the Susquehanna River Basin is beset by numerous problems.

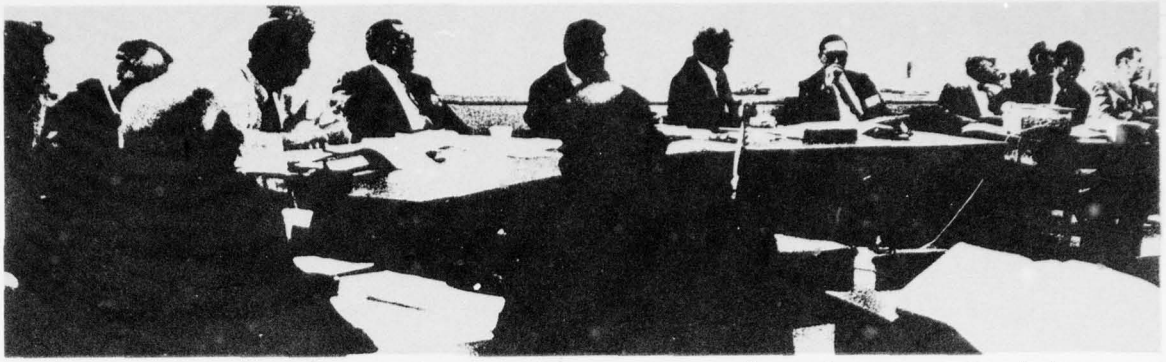
Many miles of the "shining river" are polluted by sewage from swelling populations, by wastes from multiplying industries, and by drainage from abandoned coal mines. Some parts of the "desirable valley" are plagued by unchecked floods causing millions of dollars of damage, by erosion from strip mines,and by poor land use management. Most important of all, the Basin has reached a point where it is barely able to meet today's burdens and demands, let alone those of the future.

Steps must be taken right now to remedy the Basin's present condition. Through careful planning, the River and its lands can provide ample resources for all the Basin's people and for all their purposes.

An opportunity----and a challenge----is offered to the people of the Susquehanna Basin. They and their representatives in government must set into motion action programs----programs supported by a public fully informed and aware of the Basin's problems and the alternative solutions to them.

A step----in fact, a giant leap----has already been made in this direction. In response to requests from Basin residents, the United States Senate, by a resolution of its Committee on Public Works in 1961, requested that a comprehensive plan be prepared "for the development of the water and related land resources of the Susquehanna River Basin in the States of New York, Pennsylvania, and Maryland." The study was to be carried out "in the combined interest of flood control, navigation, water supply, recreation, pollution abatement, and other beneficial water uses." The House of Representatives, by a similar resolution of its Committee on Public Works, joined with the Senate in its request.

The Study got underway in 1963 with the formation of the Susquehanna River Basin Study Coordinating Committee, consisting of representatives of the United States Departments of Agriculture; the Army; Commerce; Health, Education, and Welfare; Housing and Urban Development; and the Interior; the Federal Power Commission; the States of New York and Maryland; and the Commonwealth of Pennsylvania. The



job of the Coordinating Committee was to coordinate the many and varied facets of the Study and to make the decisions necessary to guide the sound conservation and development of the Basin's resources.

As many as 100 professional workers in the various Federal and State organizations were employed: engineers, economists, geologists, geographers, recreation specialists, fish and wildlife experts, ecologists, and others. They collected and evaluated a vast amount of data and, based on their evaluations and projections of the Basin's future population, determined the Basin's short-range and long-range water resource requirements. They looked, too, into land use and management which is directly related to water use and development.

During the Study, residents of the Basin were encouraged to take part in the planning process. In 1963, a series of seven public hearings was held throughout the Basin to determine from its residents the Basin's needs and problem areas. Twelve general meetings of the Coordinating Committee were open to the public, who participated, often with spirited discussion. The Committee periodically published a newsletter reporting on the progress of the Study. Local planning groups were brought into the decision-making process in its early stages. During the late Spring of 1969, nine public forums were held in the Basin, concentrating where there were problems and issues to be resolved, but with a coverage broad enough to give everyone an opportunity to attend. Many Basin residents, as well as many professional local planners, participated in these various meetings, and the Plan recommended by the Coordinating Committee is the better for it.

The Susquehanna River Basin drains an area of 27,500 square miles----6,300 in New York, 20,900 in Pennsylvania, and 300 in Maryland. The Basin extends from east to west for 160 miles and from north to south for 225 miles. Figure 1 shows the location of the Basin in relation to the Northeast.

The River, which rises at Lake Otsego in New York State, flows through intensively developed industrial areas, through productive farm lands, and through far-reaching stretches of unbroken forests.

The average flow of the Susquehanna River through the year is 25 billion gallons per day. This flow, however, is far from constant. During

the time that records have been kept, it has varied from a low of 1 billion gallons per day in September 1932 to a high of 536 billion gallons per day (830,000 cubic feet per second) at the time of the large flood of March 1936. It is significant that 85 percent of the fresh water that flows into Chesapeake Bay above the mouth of the Potomac River comes from the Susquehanna, which enters the Bay near its head at Havre de Grace. The health of the Bay is dependent upon this fresh water supply.

For all its size and diversity, the Susquehanna Basin is relatively undeveloped when compared with other areas around it. Great and rapidly

Figure 1 ---- Location Map - Susquehanna River Basin

growing urban complexes lie to the east and to the west of the Basin, to the north and to the south of it. As these areas grow, their demands on the Basin are sure to increase. The Basin's present population of 3.5 million is expected to increase to 9 million in the next 50 years.

All of this means opportunity----opportunity for economic development but opportunity, too, for improvement in the quality of living. With prudent conservation and far-sighted development of the Basin's resources, these opportunities may be realized.

A. The Basin's Needs

What are the problems of the Susquehanna River Basin? What will be required in both the immediate and the long-range future in water supply, for example, and in the improvement of water quality, in flood control, in additional recreational facilities, even in the protection and restoration of the natural beauty of the Basin, if the Basin's opportunity for development is to be met and if the needs of the Basin's increasing population are to be satisfied?

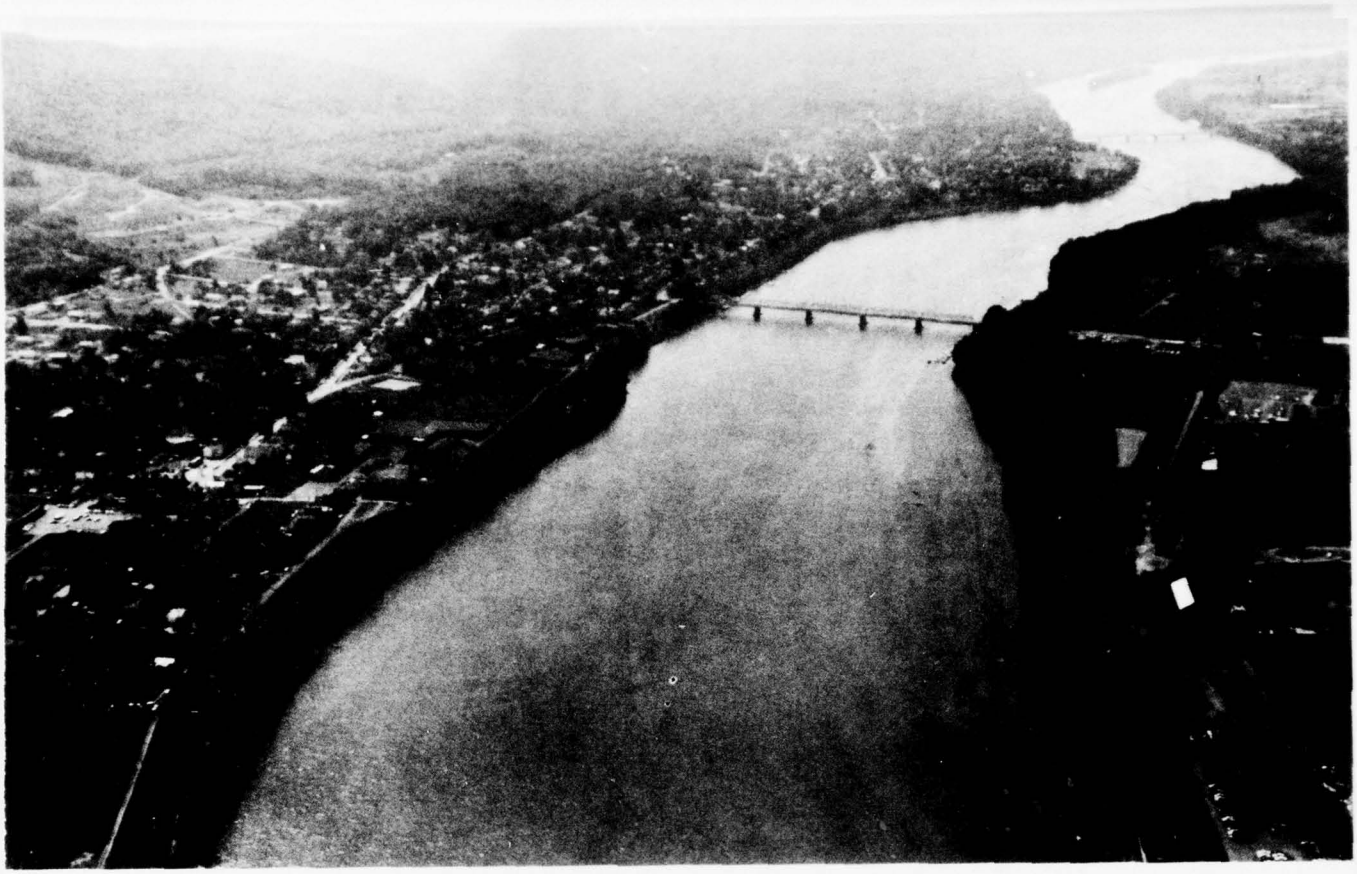
Water Quality

The greatest single problem in the Basin is pollution. Not only does the Susquehanna receive industrial and municipal wastes, both treated and untreated, but long stretches of the River and its tributaries are contaminated with acid drainage from coal mines. This acid drainage flows from both active and inactive mines with, by far, most of it coming from those which are no longer worked. Some 700 miles of the River and its major branches and 500 miles of significant tributaries are affected.

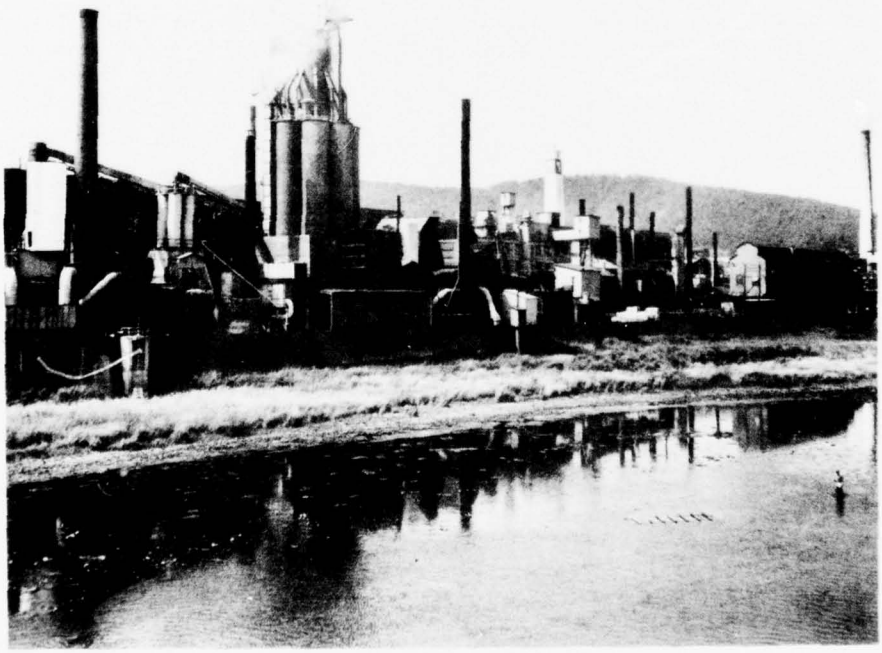
Inactive mines pour about 400 tons of acid, plus other contaminants, each day into the Basin's waters. Coal mine drainage pollution is a special water quality problem that has no ready solution since each case is unique. The immediate need is for research to find economical ways to alleviate this pollution and to find new institutional arrangements to finance the abatement program.

The abatement of pollution from municipal and industrial wastes is also an important water quality need. Wastes from an estimated equivalent of 1.5 million people are dumped into the Basin's waters.

But pollution can be controlled. It is not something that must be put up with as the price of industrial development and urban growth. Through water quality control, pollution caused by coal mine drainage, organic wastes, nutrients, sedimentation, and heated water discharges can be markedly reduced or halted completely. It is necessary that the quality of the water in the River and its tributaries meet certain minimum requirements if the water supply and recreational needs of the Basin are to be met.

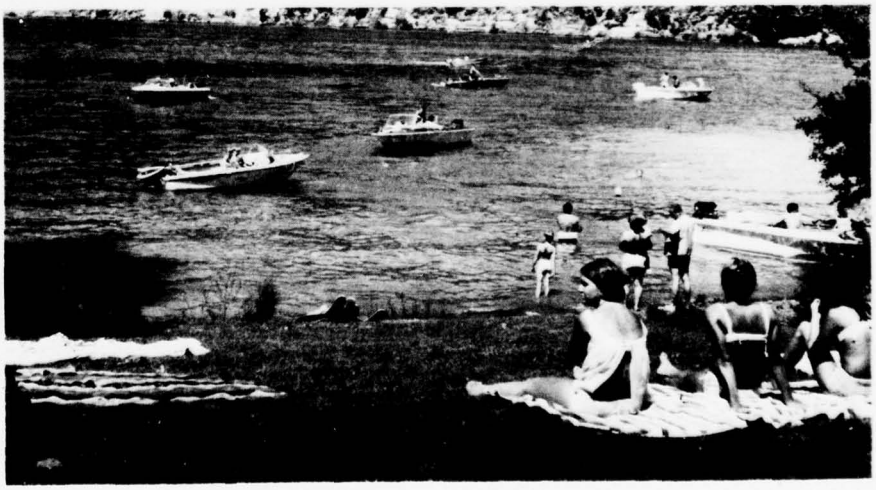


Industrial Water Use



Recreation

With its hundreds of streams and millions of acres of wooded hills and mountains, the Susquehanna Basin offers excellent recreational opportunities. But a sizeable development and management program is needed if this potential is to be realized without the overuse of the resources that leads to the destruction of the very opportunity that people seek. In the 1960's, more than 3 million people enjoyed swimming, boating, fishing, camping, and picnicking in the Basin. By 1980, it is expected that more than 5 million people will be looking to the Basin to fulfill their recreational desires. And this number will grow.



Additional recreational facilities are needed now; more will be needed in the future. Of special importance will be lakes for water-oriented recreation, such as swimming and boating and fishing. But the protection of flowing streams must not be overlooked; the fishing that they provide is one of the special delights of the Susquehanna country. The Basin is large enough to provide opportunities for many kinds of outdoor recreation without conflict, if careful planning and management are practiced.

Water Supply

More than 65 percent of the Basin's 3.5 million people and most of its industry are dependent on public water supply systems. The 550 public water systems in the Basin deliver an average of 600 million gallons of water a day. With the steady growth of metropolitan areas and the decline in rural population, an increasing number of people will be served by these public systems. At the same time, it is indicated that during at least the next 10 years agricultural water needs will increase for the watering of livestock, for supplemental irrigation, and for rural domestic use.

By 2020, it is estimated that the water supply requirements of the Basin will be almost four times the present demand. These requirements will so greatly exceed the capability of currently developed supplies that many additional supply, distribution, and treatment facilities must be developed.

Flood Control

Flood control is no longer the overriding problem that it once was in the Susquehanna Basin because so much has been accomplished in controlling floods during the past 30 years. Floods still cause much human suffering, however, and they still create economic hardship. Great floods occurred in the Basin in June 1889, July 1935, March 1936, and May 1946, and the recurrence of any one of these would be felt---and felt acutely. But every year smaller floods cause damages in limited areas---a small upstream town, a strip of cropland along a stream, a country road---and few of these have flood protection. The damages suffered in any one location might be small, but when added up over the length of a flooding stream, are impressive, as shown in Figure 2.

With the existing and soon-to-be-built flood control dams and other structures and taking into account the future growth which is expected, flood damages will average about $22 million a year in the Susquehanna Basin. These losses are suffered not only by those directly affected by floods but to some degree by everyone.

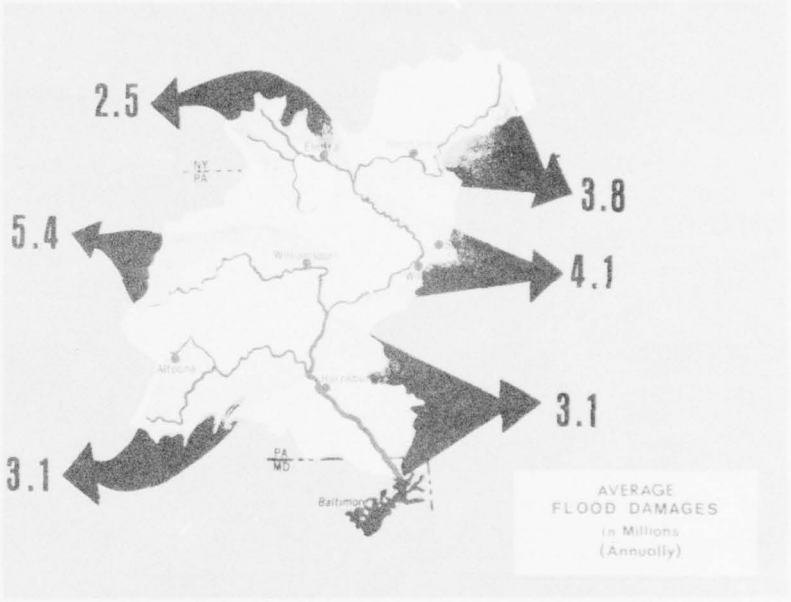


Figure 2 ---- Estimated Average Annual Flood Damages

Land Management

Land management goes hand in hand with water resource management. It reduces rapid runoff and the loss of life-sustaining soil. It expands the economy by increasing the quantity and quality of the products of field and forest, and it enhances wildlife habitat. At the same time, it adds much to the natural beauty of the Basin.

Fifty-five percent of the Basin is forested, 24 percent is cropland, 10 percent is in pasture or grass, 4 percent is urban, and 7 percent is in other use. Land treatment and improved management are needed on about

70 percent of the forest land, 65 percent of the cropland, and 60 percent of the pasture land. Erosion in some places, poor drainage in others, and unfavorable soil conditions are some of the problems that plague the croplands. Pasture land problems are those related to the improvement and maintenance of cover.

Land use in the Susquehanna Basin is changing rapidly, however. The major shift in land use has been from cropland and pasture land to urban and other non-agricultural uses such as highways, public buildings, and recreation. Urban and other land use will more than double by 1985. The amount of forest land is expected to increase, also, as the less productive cropland goes out of service.

As the Basin becomes more urban and as the total population grows, the demands on all of its resources become greater, and the need for planned growth becomes more urgent. Greater public investments will be needed in all areas---transportation, education, utilities, and many other services that are needed in an urban economy. Water and related land resource planning and investment takes its place alongside all of these; and to be sure that the economy does not lag for lack of investments in this sphere, future needs must be assessed carefully.

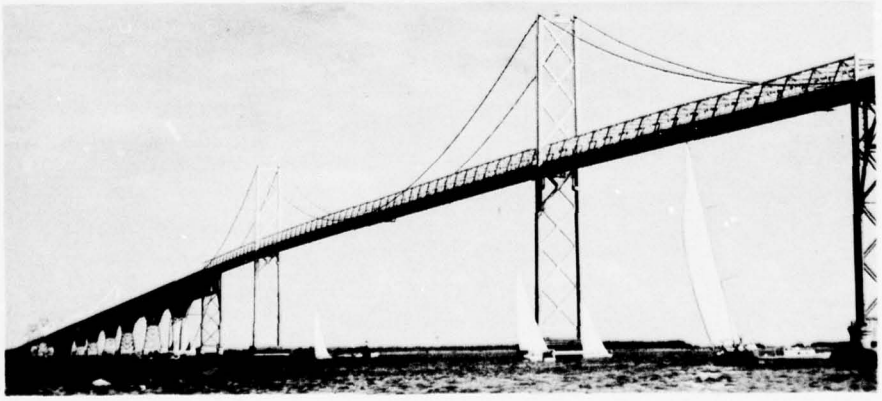
Other Needs

Over 85 percent of the fresh water input to Chesapeake Bay, above the mouth of the Potomac River, comes from the Susquehanna. The present ecological balance in the Bay could be seriously affected by upstream development on the Susquehanna, and there is a continuing need for careful study of the possible effects of such development.

Commercial navigation is not a feasible use of the River today. The days of the canal are past, and power dams on the lower Main Stem block river use above Conowingo Dam.

Other needs of the Basin are discussed in greater detail in Chapter III. These include electric power, streambank stabilization, and erosion control.

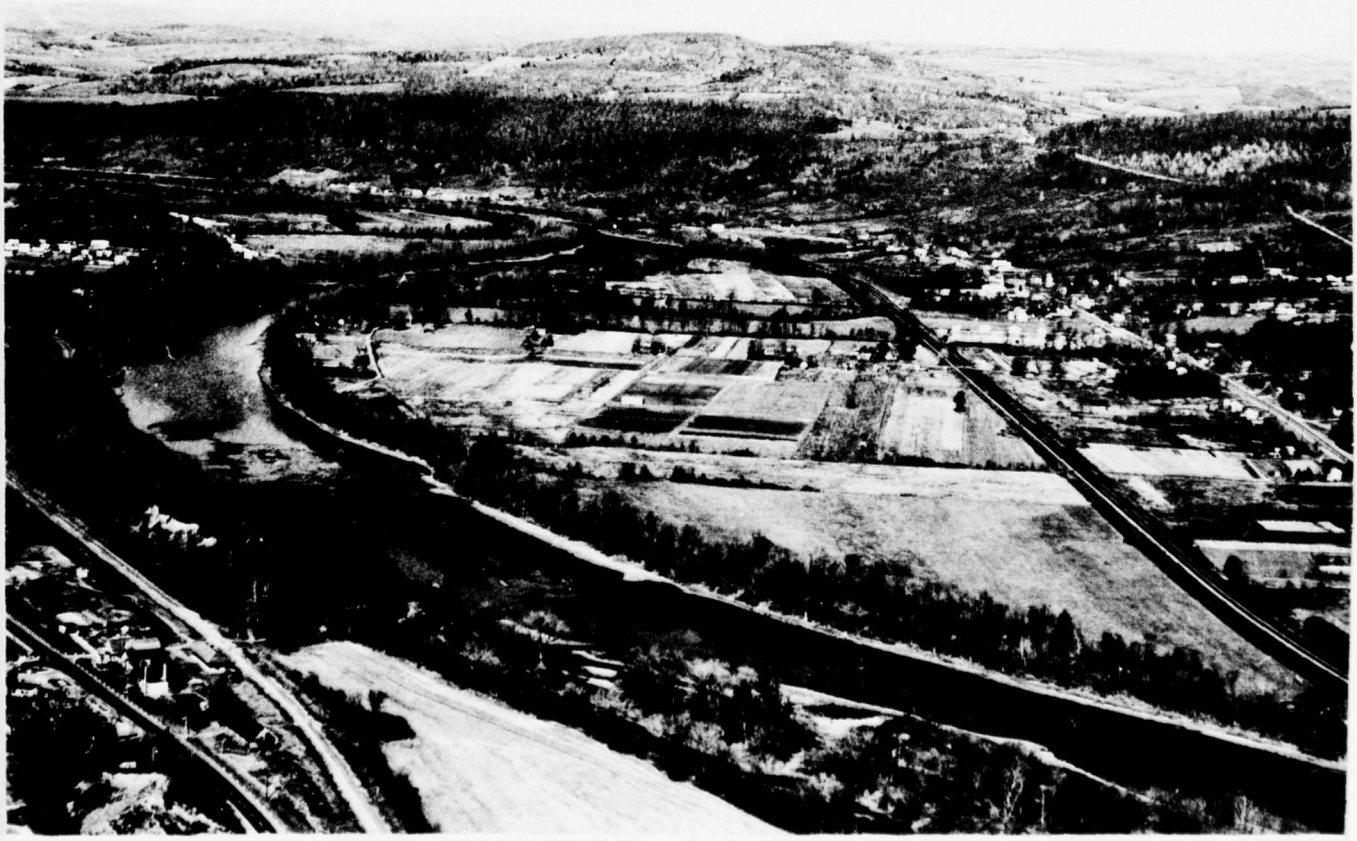
Chesapeake Bay

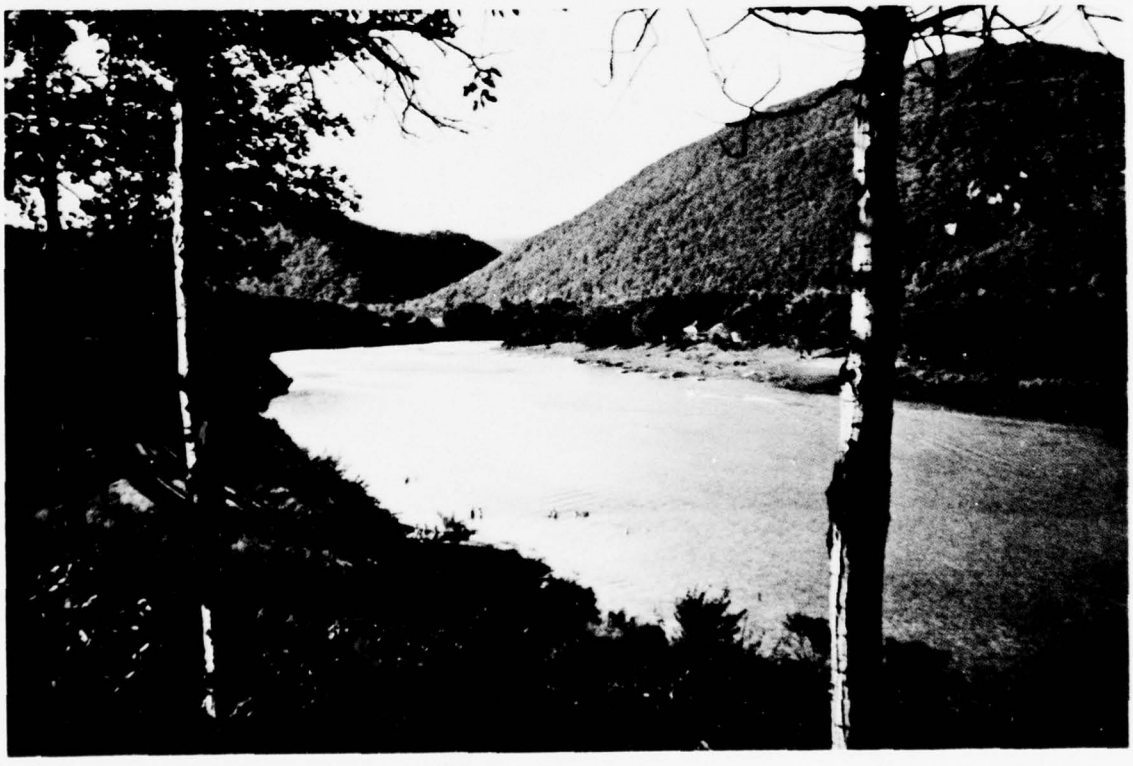


B. A Plan for the Susquehanna

In developing a plan to meet the needs and desires of the people of the Susquehanna River Basin, the Coordinating Committee used three specific objectives. The first was "environmental quality," which is concerned with keeping, and even restoring, a high quality environment. The second was "regional development," which encourages the expansion of the economy of the Basin itself. And the last was "economic efficiency," which seeks to achieve the greatest national economic benefits for the money spent. By using these three objectives, the Coordinating Committee considered more fully the various alternatives available for solving the water and land problems of the Basin.

The Committee developed an "Early Action" Plan and a "Framework" Plan. (These Plans are presented in greater detail in Chapter V of this Summary, in Supplement B, and in Appendix K(2).) The Early Action Plan (shown in Figures 4 through 6) looks to the conservation and development of resources in the Basin for the next 10 years----to 1980. The Framework Plan (shown in Figures 47 and 48 in Chapter V) looks to the long-range requirements and opportunities of the Basin, reaching to the year 2020.





Coal Mine Drainage Pollution Abatement

Inactive coal mines are the most critical sources of pollution in the Basin. A combination of measures has been recommended in the Early Action Plan for 13 locations, all within Pennsylvania. As specific solutions for the coal mine drainage problem vary greatly with the nature of each mine area, the Committee also recommends that additional and detailed studies be made.

The Framework Plan calls for 14 mine drainage pollution abatement projects in Pennsylvania. Eight are recommended for completion by 2000, and six by 2020. The locations of streams affected by these projects are shown on Figure 3.

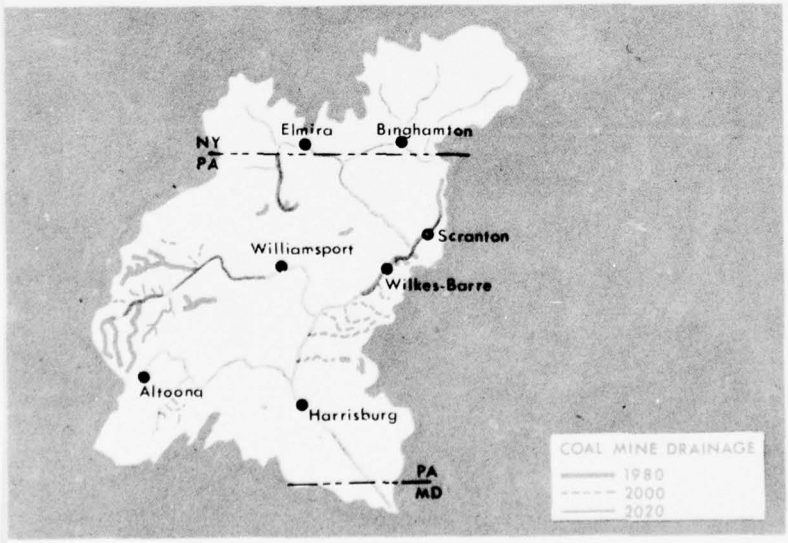
Waste Treatment Facilities

The Susquehanna and its tributaries provide most of the water used by homes, schools, restuarants, public buildings, and industries in the Basin. The used water returns to the River, but all too often it returns as sewage and industrial wastes. Over 430 miles of streams and rivers in the Basin are degraded by this pollution.

New York, Pennsylvania, and Maryland have adopted water quality standards. Communities throughout the Basin must provide at least secondary treatment (85 percent reduction in biochemical oxygen demand, which is a commonly used measure of organic pollution) of all municipal and industrial wastes. As population increases, communities will be required to provide the treatment facilities necessary to meet the adopted standards.

The Early Action Plan recommends that an advanced level of waste treatment (over 85 percent reduction in biochemical oxygen demand) be

Figure 3 ---- Coal Mine Drainage Pollution Abatement Plan



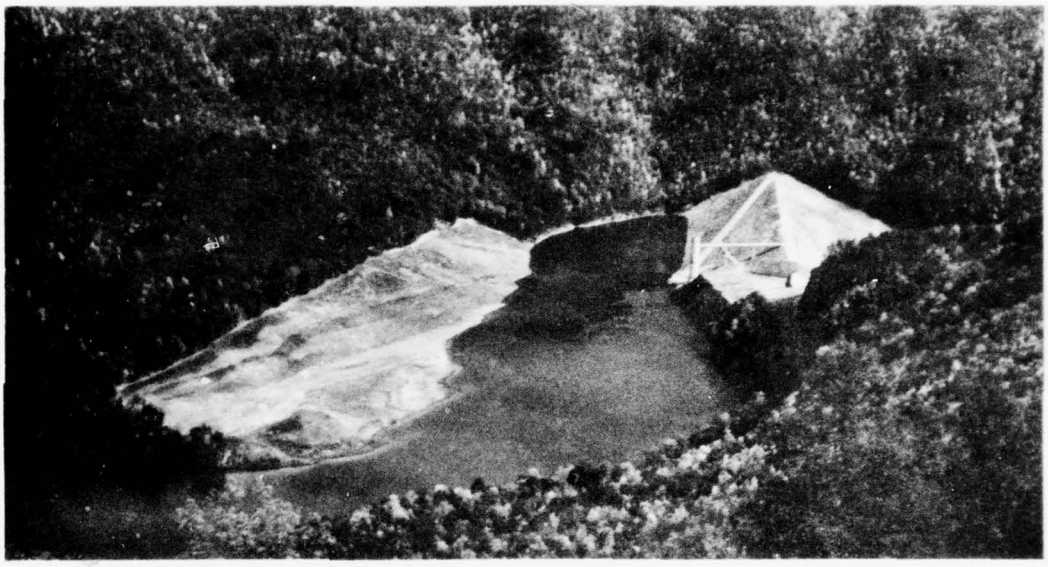
provided in 20 communities and be expanded in four communities. This higher level of treatment will be needed to meet the State water quality standards.

By 2020, the increasing waste load from population and industry will require many sewage serviceareas to construct additional advanced waste treatment plants. The Framework Plan recommends new or expanded advanced waste treatment plants at 40 sewage service areas.

Reservoirs For People

As leisure time increases, more and more people are using the water-oriented recreational facilities of the Basin. In the near future the limited area of recreational water will be overtaxed.

Alvin R. Bush Dam



To meet this growing demand, the Early Action Plan recommends construction of 62 small reservoirs (ranging from 30 to 1,100 acres). Twenty reservoirs would be in New York, 38 in Pennsylvania, and 4 in Maryland. Most of them would be constructed under the various Federal, State, and local programs that apply to water and related land resource development. Together, these reservoirs would initially provide over 8.5 million recreation days and almost 1 million fisherman-days. These reservoirs would ultimately provide 12 million recreation days.

To meet the demands beyond 1980, the Framework Plan recommends that 72 small reservoirs be built in New York, 44 in Pennsylvania, and 4 in Maryland. These reservoirs would ultimately provide 7 million recreation days and 850,000 fisherman-days.

Four low channel dams have also been included in the Early Action Plan to meet the recreation demand, particularly by providing additional

boating waters. Together, these sites, all of which are in Pennsylvania, would initially afford the opportunity for 850,000 recreation days. Over a 50-year period, recreational facilities would ultimately be developed to accommodate 8 million recreation days.

The three low channel dams recommended in the Framework Plan would annually provide 450,000 recreation days initially, and 5 million ultimately.

The Early Action Plan calls for six larger dam and reservoir projects on major tributaries of the River to provide flood control, water supply, and low flow augmentation, as well as recreation and fishing. These six projects would reduce annual flood damages by over $1.5 million. Water stored in the reservoirs could be released during the River's low flow periods for water supply, improvement of water quality, and irrigation. Over 3.5 million recreation days a year and almost 800,000 fisherman-days a year would be provided by the projects initially. Ultimately, they would provide almost 8 million recreation days.

These reservoir projects are: the *Charlotte Creek Development* in Delaware County, New York; the *South Plymouth Reservoir,* in Chenango County, New York; the *Fabius Reservoir,* in Cortland County, New York; the *Mud Creek Reservoir,* in Steuben County, New York; the *Five Mile Creek Reservoir,* in Steuben County, New York; and the *Shady Grove Reservoir*, in Franklin County, Pennsylvania.

The only major multiple purpose project in the Framework Plan is *East Guilford Reservoir,* in Otsego County, New York. Initially this reservoir would provide 1.2 million recreation days and 350,000 fisherman-days, and 2.4 million recreation days ultimately.

Other Sources of Water Supply

During the early 1900's, and for some time thereafter, ground water was primarily used to meet the requirements of people and livestock in rural areas and small towns. Today, at least one-fourth of the population of the Susquehanna River Basin is using water that comes from underground sources. More than 400 municipalities depend upon wells for all or part of their water supply, and this demand is expected to grow. One advantage of ground water is that it often needs only a minimum of treatment before it is used.

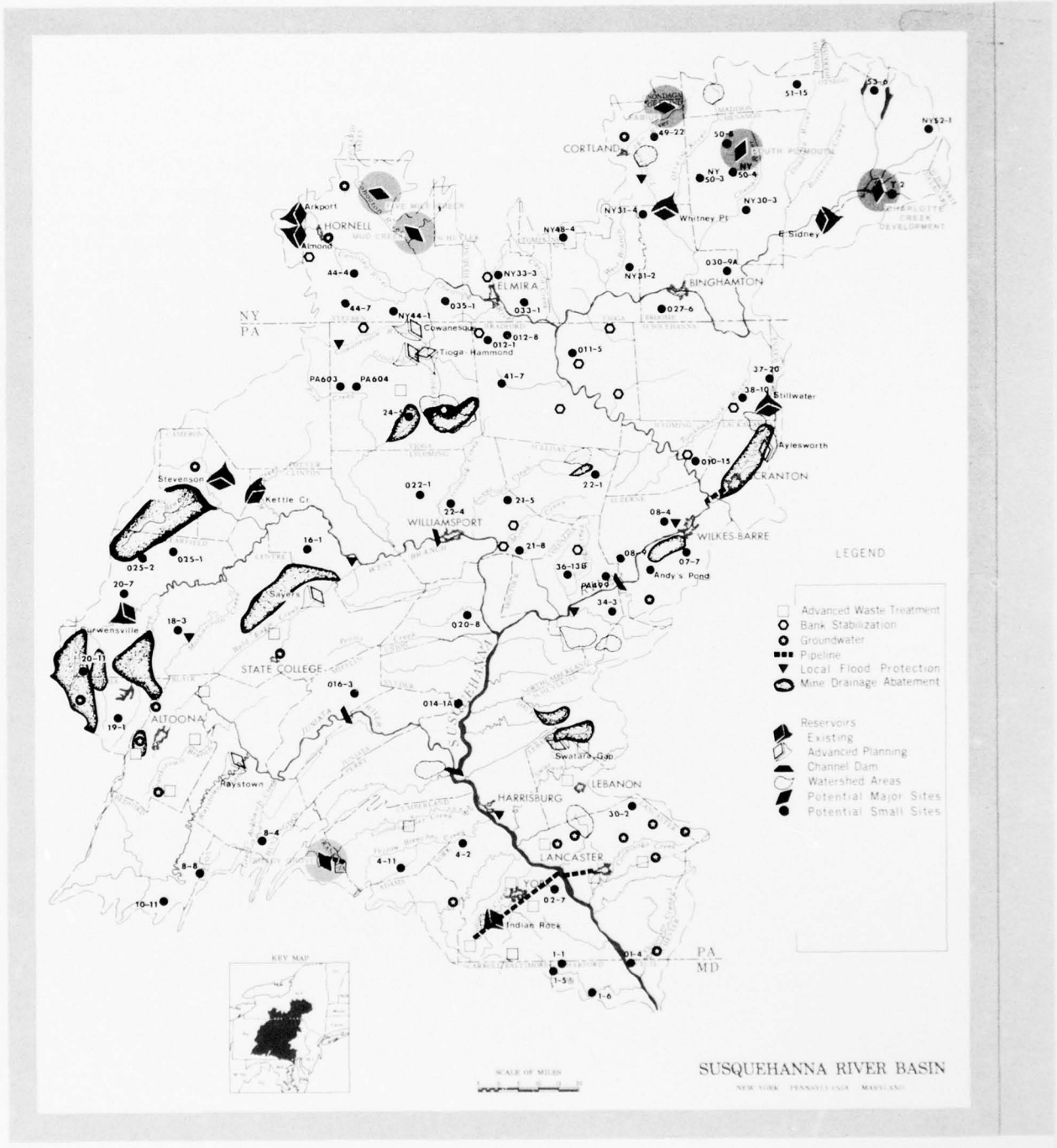
The Coordinating Committee selected 18 sites within the Basin for ground water development by 1980. Fifteen of the locations would provide water supply for cities and towns. Ground water development at the remaining three locations is recommended to meet expanding irrigation needs.

The Framework Plan recommends that three additional sites be developed for ground water.

The Early Action Plan also calls for a pipeline to Shippensburg from the Shady Grove Reservoir; a small reservoir to supply water to Philipsburg, Pennsylvania; and three pipelines from the Susquehanna River----one to Scranton, one to the York-Hanover area, and one to Lancaster.

No additional pipeline development is indicated in the Framework Plan.

Figure 4 ---- Early Action Plan Structural Measures



Structural Measures

Because of their location, a number of communities in the Susquehanna Basin would receive little, if any, flood protection from the six reservoir projects described above. Some are on tributary streams for which no reservoirs are proposed; some are too far downstream to feel the effects of distant upstream reservoirs. If these communities are to be protected, purely local works---channel deepening and widening, construction of flood walls and levees, raising of bridges---must be provided so that flood waters may be passed without causing damage.

But for such local flood protection works to be constructed, it must be shown that the damages which would be prevented would at least be equal to the cost of preventing them. On this basis, the Coordinating Committee recommends, in the Early Action Plan, the construction of local flood protection works at Marathon, New York, and Westfield, Philipsburg, Bloomsburg, Lock Haven, and Harrisburg, Pennsylvania, and the modification of the existing flood protection works at Kingston, Swoyersville, Forty-Fort, and Wilkes-Barre, all in Pennsylvania.

There are no local flood protection works included in the Framework Plan.

Flood Plain Management

Many millions of dollars have been spent for flood control works in the Susquehanna River, but the flood damages still increase because of the growing use of the flood plain. To reduce these damages, intensive management of the flood plain is needed.

Flood plain management regulates the use of lands lying adjacent to a river through carefully planned development. Regulation of the flood plain can be carried out by a variety of means, such as encroachment lines, zoning ordinances, subdivision regulations, and building codes. Flood damages can be reduced by such measures as flood proofing, flood forecasting, and flood warning signs.

All of the flood plain areas along the larger streams in the Basin were examined to determine the degree of flood plain management needed. It was determined, depending upon conditions, that either: (1) an intensive program requiring zoning and building codes, and including ample warning, flood proofing, and temporary or permanent evacuation, was warranted, or (2) a more limited program of warning and evacuation, with only occasional use of further management measures, would be adequate. This is a continuing program over the 50 year planning period. The Coordinating Committee recommends, however, that all subdivisions survey their needs and take action as soon as possible.

The Plan includes 111 reaches, many of which are shown below, where intensive flood plain management studies and practices are being recommended, including many urban places where recurring flood damages would be reduced. Included in these 111 reaches are 31 areas where damages are concentrated and high or expected to be high, but where no structural protection is justified. These areas should receive special priority

Figure 5 ---- Recommended Reaches for Flood Plain Management

for flood plain management action. In addition the seven areas where low dams are recommended should have detailed flood plain information study as a part of the plan for recreational facilities associated with the dam.

The Plan also recommends expansion of the existing flood warning system, or the initiation of such a system, for 126 reaches. Additional river and rainfall reporting stations are needed to cover more areas, and a special program giving attention to areas with short warning times is needed. In conjunction with this, threatened communities should prepare or review evacuation procedures and flood fighting plans.

Low Dam at Homer, N. Y.

Upstream Watershed Projects

Flood damages are often spread along miles of a stream that flows through upstream areas. To protect these areas, Public Law 566, commonly known as the Small Watershed Act of 1954, authorized the Department of Agriculture to cooperate with State and local agencies in works of improvement for flood protection and soil conservation.

The Early Action Plan recommends nine upstream watershed projects, two in New York and seven in Pennsylvania. Together these projects, which include 19 small dams, would provide average annual flood damage reduction of $755,000, and initially the opportunity for more than 300,000 recreation days and over 91,000 fisherman-days annually. Ultimately, they would provide almost 80,000 recreation days.

Mill Creek (Watershed Project)

Agricultural Water Supply

Marsh Creek (Watershed Project)

The Framework Plan does not recommend any additional upstream watershed projects to be constructed.

Stream Management

To improve and preserve the streams of the Basin for recreation and fishing, a wide-spread stream management system is proposed through both the early action and framework planning periods. Initiation of these management programs should be carried out by 1980 in order to help meet the recreation demand and to preserve many of the streams for the use of future generations. The streams recommended for recreation and fishing management are shown in Figure 6.

The streams have been placed into four categories which describe the character of the streams and define the kind of management the Coordinating Committee recommends.

A *Wild Stream* is a free flowing stream and very difficult to get to except by trail. The shoreline is still largely primitive and the waters are unpolluted. Wild river areas should be left undeveloped in order to maintain their character. Primitive campsites and a primitive trail are the only facilities recommended. Beech Creek from Pancake to Orviston, in Centre County, Pennsylvania, is the only stream placed in this category in the Plan.

A *Scenic Stream* is similar to a wild river except that in some places it is accessible by roads. Development on a river in this category is limited to 5 percent of its length. There are 18 streams designated as scenic rivers in the Plan, all of them located in Pennsylvania.

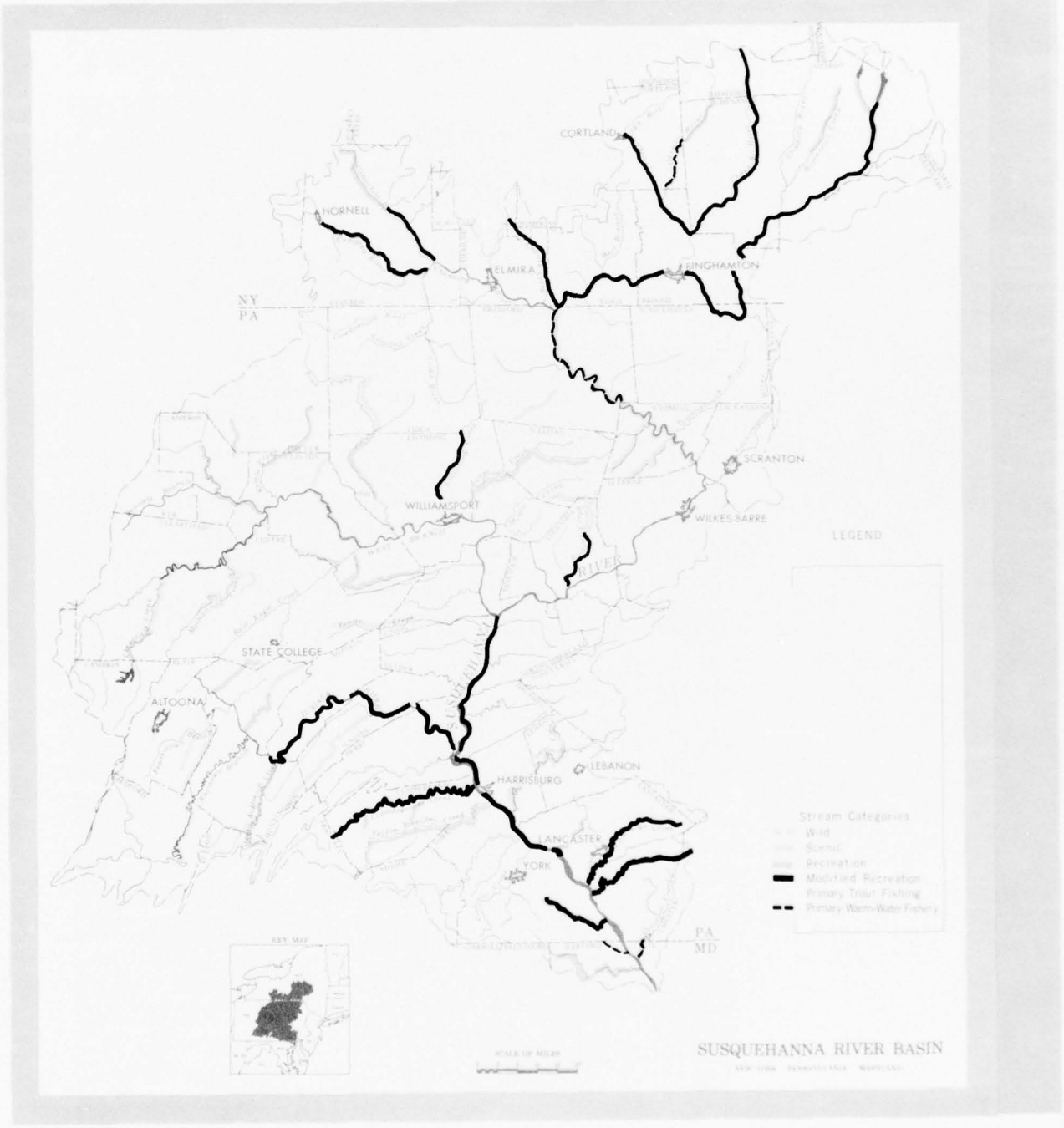
A *Recreational Stream* may have some impoundment or diversion of its waters and possibly some development along its shoreline. It is easily accessible by roads. For a recreational river, development may be as high as 10 percent of its length. Twenty-three streams are classified as recreational rivers----one in Maryland, four in New York, and the remainder in Pennsylvania.

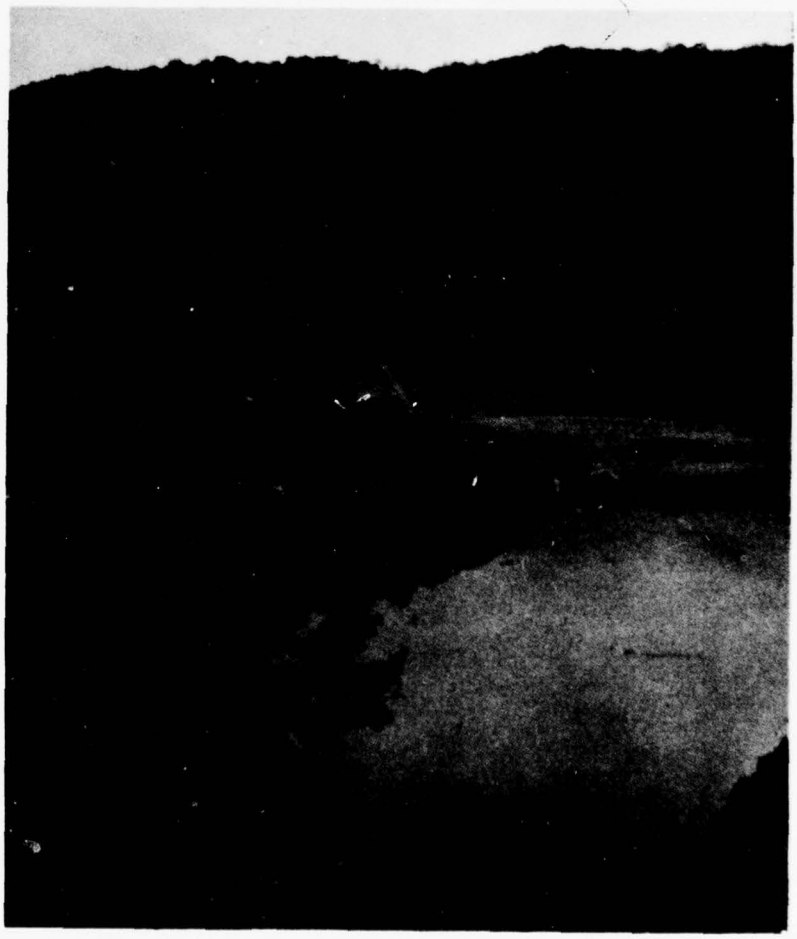
A *Modified Recreational Stream* is similar to a recreational river except that development of its shoreline may be as much as 20 percent of the length of the river. There are 14 modified recreational rivers in the Basin, six of which are in New York while the rest are located in Pennsylvania.

It has been recommended by the Coordinating Committee in the Early Action Plan that the wild river, Beech Creek, be left undeveloped and that all recreational facilities which may be needed on the scenic rivers be developed by 1980. Fifty percent of the recreational facilities on recreational and modified recreational rivers should be developed by 1980, with the remaining 50 percent to be developed by 1990.

In addition, 210 stream reaches have been identified as having exceptional value as trout or warm-water fisheries. It is recommended that action be taken to protect these fishing streams from any development that would damage their fishing values. Only local effort, however, can preserve these streams at present.

Figure 6 ---- Recommended Reaches for Streamside Recreation Management





Land Treatment

The Early Action Plan calls for accelerated land conservation practices on 131,000 acres located above recommended reservoirs to reduce sediment loads in the streams and reservoirs. Such measures would improve water quality as well as yield benefits to the land. This is in addition to the on-going land treatment program covering nearly 3 million acres. The Plan further designates 49,000 acres of critical areas subject to excessive runoff and erosion that need revegetation. The land treatment program of the Plan would conserve and improve natural resources, establish a balanced agriculture, improve the economy, and reduce the hazards of flooding and sedimentation.

The Framework Plan calls for 90,000 critical erosion and sediment producing acres to be treated.

The Coordinating Committee also recommends 14 streambank stabilization projects in the Early Action Plan. These projects would reinforce the banks of the streams to prevent erosion and reduce sedimentation. Two of these are in New York, and the other 12 are in Pennsylvania.

In the Framework Plan, one streambank stabilization project is recommended in Pennsylvania.

Streambank Stabilization Measures

C. Implementation of the Plan

How can the Plan that is set forth on the preceding pages be put into action? What part of it can be constructed by the Federal Government and what part is the responsibility of local (that is, non-Federal) governments? Who is to pay for the various parts of the Plan?

There are four general paths for financing:

(1) All costs are local.

(2) Federal grants-in-aid are made to local governments.

(3) Federal and local governments share the cost, with the shares varying in accordance with certain established conditions.

(4) All costs are borne by the Federal Government.

Low channel dams, bank stabilization, pipelines, ground water development, and stream recreational development must be undertaken, under present procedures, at State and local levels. There are Federal programs to help plan some of these projects, but the actual responsibility, particularly for recreation, rests at the local level.

Land management programs also rely primarily on local initiative, although some Federal aid is available.

Grant-in-aid programs are available for secondary and advanced waste treatment plants, interceptor sewers, and several drainage pollution abatement projects.

The Federal Government has the authority to construct reservoirs for flood control and water quality control, provided the benefits are widespread. It can also build local protection structures for flood control, such as levees or channel improvements. The bulk of the cost is borne by the Federal Government, with some participation by local governments, especially for lands and rights-of-way.

Federal and local interests may cooperate in constructing impoundments for purposes other than flood control and water quality. Water supply storage may be added to a Federal impoundment with the local interests reimbursing, with interest, the Federal Government for the added costs. The Federal investment in recreational and fish and wildlife facilities associated with reservoirs may amount to half of these added costs.

And, of course, if local governments wish, they may carry out at their own expense many of the projects for which the Federal Government has construction cost sharing authority, such as local flood protection and water quality control.

D. Policy Recommendations

The Coordinating Committee recommends that:

1. Authority and funding be provided by Congress to the appropriate Federal agency to begin detailed surveys for potential regional sewerage systems, and present Federal programs to assist communities in undertaking regional sewerage studies be combined and accelerated;

2. Federal law and policy permit sharing of costs for abating coal mine drainage pollution;

3. Regional income benefits be counted equally with national income benefits in meeting economic justification requirements on Federal water resource projects in designated regions of the Nation.

CHAPTER II
The Basin's Environment

As is true of any geographic area, the Susquehanna River Basin may be thought of as having many overlapping landscapes. There are the physical landscape, the human landscape, and the landscape of the works of man.

The physical landscape includes the many interdependent natural elements, such as the shape of the surface and the structure underlying it, the drainage pattern, the soils, the natural resources, the climate, and the natural vegetation.

Then there is the human landscape: the location and density of the population; the variations in the nature of that population from place to place, such as sex, age, education, income, and occupation; and the dynamics of these factors as they change with time.

Finally, there is the landscape of the works of man: his roads and railroads, cities and farms, schools and factories, places of work and play.

These three landscapes, and the elements within them, affect and are affected by resources development. Man affects the natural landscape and, also, the natural landscape affects man in creating new ecological relationships. This chapter discusses these complex relationships to provide an understanding of the Susquehanna River Basin, its problems, and----most importantly----its future.

A. The Physical Landscape

The Ancient Greek alchemists believed that everything was made from four elements: air, fire, water, and earth. While modern science has taken us somewhat beyond this, everything may still be classified under the four states of gas, energy, liquid, and solid that these "elements" symbolize. This Study is particularly interested in the interaction of water and earth, and this section describes the relationship of the water and earth in the Susquehanna River Basin.

The Susquehanna River Basin includes three major physiographic provinces: The Appalachian Plateau, the Valley and Ridge, and the Piedmont. Very small parts of the Blue Ridge and Atlantic Coastal Plain also intrude into the Basin. Differences in topography and geology form a basis for these natural subdivisions, although the whole area has a similar geologic history and related geological features. These differences form a basis, too, for the settlement patterns of the Basin. The provinces are shown on Figure 7.

Appalachian Plateau Province.

Fifty-six percent of the Susquehanna drainage area occupies the Appalachian Plateau Province in New York and Pennsylvania. This region is the remnant of an extended plain that has been carved into a succession of high hills and deep valleys by the Susquehanna and its tributaries. The Plateau stretches from the Catskill Mountains in New York to northern Alabama. Its eastern boundary is usually recognizable by the steep escarpment known as the Allegheny Front. On the west, the Plateau merges gradually into the Central Lowlands. The Appalachian Plateau has two regions with marked topographic differences. The northern portion was modified by Wisconsin glaciation 18,000 years ago, relatively recent in geologic time. Here the valleys are U-shaped and gentle. As a rule, the hills rise from 500 to 800 feet above the valleys, with comparatively steep but beautifully symmetrical slopes. In the unglaciated portion of the Plateau, the more rugged mountains have peaks that rise from 500 to 1,800 feet above the steep, generally V-shaped valleys. In both portions, settlement has taken place mostly in the valleys, and transportation routes wind their way along the valley bottoms.

Valley and Ridge Province.

The Valley and Ridge Province, like the Appalachian Plateau, extends from New York to Alabama. It is a mountainous region that covers approximately 37 percent of the Basin, including the Great Valley in the south that comprises about 6 percent of the Basin. This province contains rocks that were bent by great force into the folds which created the ridges and valleys that run roughly parallel in a northeast-southwest direction, sweeping off at the north in broad curves to the east. The ridges, which rise from 500 to 1,600 feet above the surrounding valleys, are broken in places by wind and water gaps. The northern part of the Valley and Ridge Province has been glaciated and shows some modified relief. In the eastern part the folding of the rocks created the distinctive anthracite coal fields of the Lackawanna-Wyoming Valley. As in the Appalachian Plateau, transportation routes and settlement have followed the valleys and the gaps in the ridges.

Piedmont and Blue Ridge Provinces.

The Piedmont and Blue Ridge Provinces also extend through the whole eastern part of the country, with the Blue Ridge extending into southern Pennsylvania. They have been described as the "Older Appalchians" in contrast to the "Newer Appalachians," a term applied to the Appalachian Plateau and Valley and Ridge Provinces. The Piedmont occupies about 7 percent of the area of the Basin. Relief ranges from 400 to 600 feet, with the Blue Ridge Province having a somewhat greater

Figure 7 ---- Physiographic Provinces

relief. The valleys of Lancaster and York Counties have comparatively low relief, allowing a dense and more even population distribution than in the more mountainous parts of the Basin.

Atlantic Coastal Plain Province.

The Atlantic Coastal Plain is less than 1 percent of the total Basin area and has a topography of low relief. Over 2 million years ago, when sea level was 250 to 300 feet lower than today, Chesapeake Bay and its tributaries formed part of the Susquehanna Basin in this Province.

The Rivers in the Basin.

The Susquehanna River is about 450 miles long. It rises in New York where a small stream leaves Lake Otsego at Cooperstown. The River flows southward into Pennsylvania around the "Great Bend" and back into New York, then westward through Binghamton to be joined by the Chemung River at Athens, Pennsylvania, just a few miles south of the New York State line. From this point, the River meanders southeastward across the Appalachian Plateau and through the steep Allegheny Front until it is met by the Lackawanna River at West Pittston, where it turns southwestward to its confluence with the West Branch Susquehanna River at Sunbury.

Confluence of West Branch Susquehanna and Main Stem at Sunbury

The Chemung River is formed by the confluence of the Cohocton and Tioga Rivers west of Corning. The headwaters of these two tributaries are in the glaciated plateau country of the northwestern portion of the Basin.

The West Branch rises in the Appalachian Plateau in the western part of the Basin and flows north then east through the Allegheny Front at Lock Haven, where it turns south and cuts through several ridges to its junction with the Susquehanna at Sunbury. The Juniata River, another major tributary, joins the Susquehanna at Duncannon, 38 miles downstream from Sunbury. The Juniata is formed by the confluence of the Frankstown Branch and Little Juniata River, which rise in the Appalachian Plateau.

Below its junction with the Juniata, the Susquehanna River enters the Piedmont Province, turns southeast and becomes an impressive stream nearly a mile wide. Just below Harrisburg, it flows through a series of gorges where the banks are heavily wooded. From the Maryland border, the River continues southeastward for 14 miles until it mingles its waters with the tidal Chesapeake Bay.

The Climate of the Basin.

The Susquehanna River Basin has a continental type of climate, modified somewhat by the moisture periodically entering the area from the Gulf of Mexico and the Atlantic Ocean. As a result, precipitation is greater and temperature less extreme than would otherwise be the case. Nevertheless, there is a wide variation of the weather patterns within the Basin.

Atmospheric conditions within the Basin are controlled primarily by high and low pressure systems that normally move eastward across the United States. Weather changes are frequent with high pressure systems usually bringing west to northwest winds, lower temperatures, and clearing skies, while low pressure areas normally bring southerly winds, rising temperatures, and some form of precipitation.

Periodically, storms develop along the southeastern coast of the United States and pick up considerable moisture as they move northward. Such storms usually bring moderate to heavy precipitation to the Susquehanna Basin. When temperatures are low, these storms frequently produce large amounts of snow.

During December, January, and February, Polar-Canadian and Arctic air sweep down into the Basin bringing cold and frequently unstable conditions. Winter precipitation is rather frequent but relatively light, with up to 60 percent of the seasonal total falling as snow in northern portions of the Basin.

In the spring, daytime temperatures are mild but nights generally remain cold into April with minimum temperatures around the freezing

point. The ground alternately freezes and thaws until April, when the growing season begins. Occasional late-season snowstorms bring large amounts of wet snow which melts rapidly. Rainfall also increases during this season.

Through most of July and August, and frequently into September, tropical maritime air continues to prevail resulting in the persistence of summer heat and high humidity. Several times during the summer, high pressure along the southeast coast strengthens to a point where southerly winds bring very warm moist air up from the Gulf of Mexico to produce prolonged heat waves in the Basin. Cooling from showers and thunderstorms often provides the only relief from this hot humid weather. These same showers and thunderstorms are the primary source of May through September rainfall. Hail and strong winds occasionally accompany the more intensive thunderstorms.

With shorter days during the fall season, summer heat and humidity decline, although warm days may continue into November. Nights get progressively cooler as Polar-Canadian air again becomes increasingly prevalent. The season's first frost, ending the growth season, usually occurs by mid-October in northern areas and by early November in southern sections. Dry weather prevails most of the time during autumn; rain-free days generally number more than 20 per month. Fall is not the driest season in terms of total precipitation, however, due to the occasional passage of tropical storms near or over the Basin. Such storms, which can develop anytime from June through November, produce as much as 5 to 10 inches of rain in 24 to 48 hours; but winds accompanying the hurricanes seldom exceed 60 to 80 miles per hour in the Basin. In December, the hours of sunshine are at a minimum, and rapidly changing weather conditions are commonplace as the atmospheric circulation increases and storms become more frequent along with cold air outbreaks from northern Canada.

The average annual temperature in the Susquehanna Basin ranges from about 44 degrees in the northern part of the Basin to about 53 degrees in the southern part. Average January temperatures range from 22 degrees at Montrose, Pennsylvania, to 33 degrees at York, Pennsylvania. Average July temperatures range from 66 degrees at Philipsburg, Pennsylvania, to 78 degrees at Holtwood, Pennsylvania. Extreme temperatures of 107 degrees and 39 degrees below zero have been recorded. The average annual growing season, measured by the average dates for the first and last killing frosts (28 degrees) at any place, ranges from 150 days around Binghamton, New York, to approximately 200 days around Harrisburg, Pennsylvania.

Average annual rainfall is about 39 inches over the entire Basin and ranges from 32 inches at Wellsboro, Pennsylvania to 45 inches at Cresson, Pennsylvania. In the extreme years, over 50 inches of rainfall have been recorded at various places, but drought years have seldom recorded less than 25 inches at any station.

Considerable variation in the average annual snowfall is found within the Basin, ranging from 28 inches at Holtwood, Pennsylvania, to 85 inches

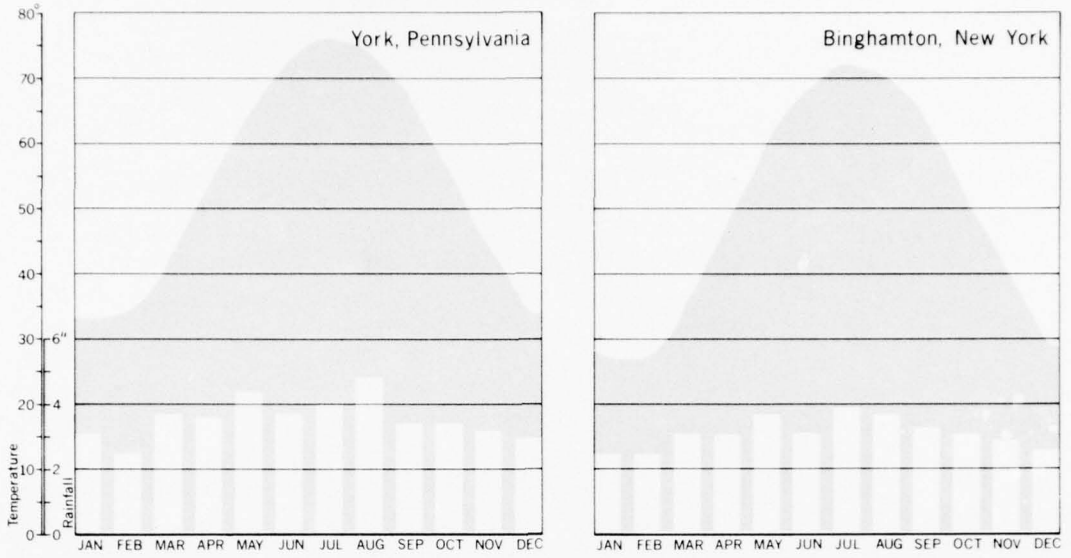


Figure 8 ---- Monthly Average Rainfall and Temperatures

at Binghamton, New York, with many mountain peaks receiving well over 100 inches every winter. The greatest annual snowfall in the Basin on record is 138 inches at Cortland, New York, in 1961. The smallest is 16 inches recorded in 1954 at Harrisburg, Pennsylvania.

Winds are predominantly westerly throughout the Basin and average about 10 miles per hour over the year. Extremes reached during hurricanes or thunder squalls have been recorded at 80 miles per hour.

Figure 8 shows monthly average temperatures and rainfall for two representative stations in the Basin.

Hydrology

Since the average annual rainfall in the Basin is about 39 inches per year, this means that over 50 billion gallons per day, on the average, falls in the Basin. An average of 23 billion gallons per day (46 percent) flows from the mouth of the Susquehanna into the Chesapeake Bay. Naturally, this flow varies from day to day and from year to year. Of particular interest are the extreme low-flows and high-flows, the droughts and the floods, and the flows that can be depended upon most of the time. Since the Susquehanna experiences considerable variations in flow over periods of years and during any one year, planning for the best utilization of the Basin's water becomes a difficult task.

To collect and analyze hydrologic data, the Susquehanna River Basin was divided into eight hydrologic sub-basins, as shown on Figure 9. These sub-basins, their principal streams, and their drainage areas are:

TABLE 1

Areas of Hydrologic Sub-Basins

Sub-basin	Drainage	Area (sq. mi)
I	Susquehanna River, upstream from Athens, Pa.	4,944
II	Chemung River	2,604
III	Susquehanna River, Sayre, Pa., to Sunbury, Pa.	3,755
IV	West Branch Susquehanna River, source to Renovo, Pa.	2,975
V	West Branch Susquehanna River, Renovo, Pa., to mouth	4,017
VI	Juniata River	3,406
VII	Susquehanna River, Sunbury, Pa., to Harrisburg, Pa. (excluding Juniata River)	2,399
VIII	Susquehanna River, Harrisburg, Pa., to mouth	3,410
TOTAL	SUSQUEHANNA RIVER BASIN	27,510

TABLE 2

HYDROLOGIC CHARACTERISTICS

	Precipitation	Runoff		Evapotranspiration	
Sub-basin I	38.3	20.8	54%	17.5	46%
Sub-basin II	34.0	13.2	39	20.8	61
Sub-basin III	36.9	18.2	49	18.7	51
Sub-basin IV	41.1	21.5	52	19.6	48
Sub-basin V	38.1	20.2	53	17.9	47
Sub-basin VI	39.5	16.5	42	23.0	58
Sub-basin VII	40.9	18.5	45	22.4	55
Sub-basin VIII	39.9	18.5	47	21.3	53
Basin wide Average	38.7	18.3	47	20.4	53

Table 2 shows the average runoff and evapotranspiration for each sub-basin. Land use, soil, and the type of vegetative cover affect runoff and evapotranspiration rates. For instance, in cities with large portions of their areas paved or covered with buildings, runoff would approach 100 percent; in heavily forested areas, runoff would be much lower and evapotranspiration would be correspondingly higher.

In terms of seasonal variations in average stream flow, virtually all the major streams experience their highest flows in March, April, and May, when melting snows combine with the spring rains. These three months

Figure 9 ---- Hydrologic Sub-basins

account for about one-half of the yearly runoff. Flows are lowest in these streams during the summer and early fall months, with most streams hitting their lowest levels in September. Figure 10 shows a typical flow pattern for the Basin as recorded for the Susquehanna River at Sunbury, Pennsylvania.

These flows are averages collected over long periods of time. They do not reveal periods of drought when, for a year or more, rainfall and runoff were below the averages; and they do not reveal floods that occurred

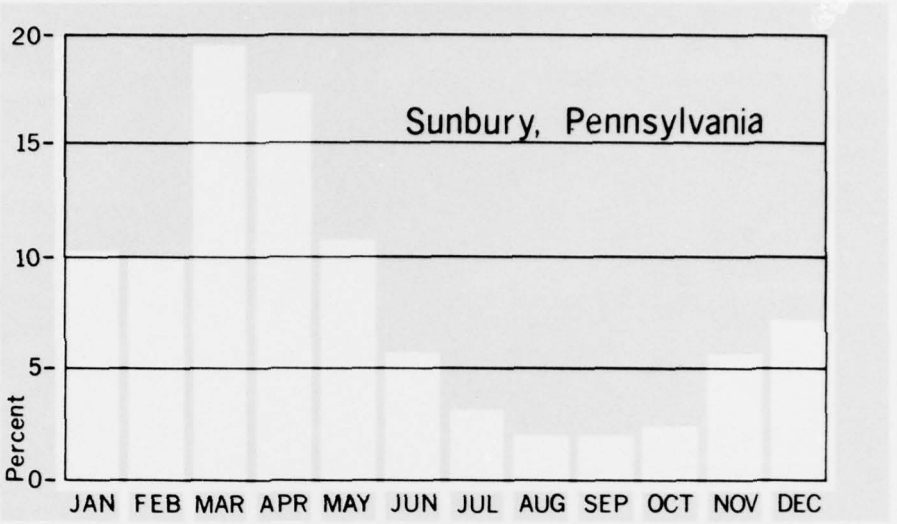


Figure 10 ---- Average Monthly Flows

on the major streams after severe regional storms, or floods that may have hit small tributaries because of local storms. It is possible for one portion of the Basin to be flooded while another is experiencing a drought.

Floods

Generally, floods occur each year in the Basin, and major floods can occur in all seasons of the year. The more frequent flooding, however, occurs in early spring, usually in March. Major floods have occurred as the result of heavy rainfall on top of heavy snowfall and as a result of heavy rainfall on previously saturated ground. Occasionally, local flooding is caused by ice jams. Flooding from high intensity summer storms is often aggravated by saturated ground conditions from previous storms, and flooding over small drainage areas also results from thunderstorms during the summer months. Record floods have occurred at most localities in the Susquehanna River Basin on one of the following dates: June 1889, July 1935, March 1936, and May 1946.

Sub-basin I. The greatest recorded floods in Sub-basin I occurred in July 1935 and March 1936. The July 1935 storm, which was a succession of heavy thunderstorms covering the Basin over a 3-day period, produced maximum peaks on most of the northern tributaries of the watershed west of the Unadilla River. The March 1936 flood was one of the largest floods on most of the major streams in the Basin, although it did not reach record stages on some of the tributaries. It was caused by prolonged heavy rainfall, an unusually heavy accumulation of snow cover, and warm temperatures. Other destructive floods occurred in parts of the sub-basin in March 1865 and March 1964.

Sub-basin II. Several major floods have been recorded at localities in the Chemung River Basin. The May 1946 flood was the largest of record on the Tioga and Chemung Rivers. The flood of July 1935 was the most severe on the Canisteo and Cohocton Rivers. Both floods resulted from intense rainfall on previously saturated ground. Records indicate that other floods of note occurred in parts of the sub-basin in October 1955 and March 1964.

Sub-basin III. Two major floods have occurred in the Lackawanna River watershed: August 1955 and May 1942. In the headwaters, at the old Stillwater Dam water supply reservoir, the greatest flood of record occurred on November 26, 1950; at downstream gages, it was only a minor flood. On the Susquehanna River, the floods of March 1936, May 1946, and March 1964 are among the largest floods which have occurred at Towanda, Pennsylvania, since 1865. Without the effect of the then existing reservoirs, it is estimated the March 1964 flood would have been the largest known flood at Towanda. On the Susquehanna River at Wilkes-Barre, below the confluence of the Lackawanna River, the two largest floods of record occurred in March 1936 and March 1964. At Danville, the three largest floods of record occurred in March 1902, March 1936, and May 1946.

Sub-basins IV and V. Two major floods have been recorded at localities on the West Branch. The March 1936 flood, the greatest known flood, was caused by prolonged heavy rainfall and the sudden melting of snow cover. The May-June 1889 flood was the second greatest known on the West Branch. It was caused by intense rainfall centered over the West Branch and Juniata Basins.

Sub-basin VI. The most notable flood events in this sub-basin also were those of May-June 1889 and March 1936. The 1889 flood stage exceeded the 1936 stage downstream from Mapleton Depot and was reported to be 1.6 feet higher at Newport. The 1936 flood was most severe on the major tributaries of the Juniata and was extremely damaging.

Sub-basins VII and VIII. On the Susquehanna River, the floods of June 1889, May 1894, March 1946, and March 1964 are, in decending order, the five largest which have occurred at Harrisburg since 1889.

Droughts

Compared with floods, droughts are long term events, resulting from deficiencies of rainfall over many months and even years. During periods of deficient rainfall, the streams are fed largely from stored ground water. But after long periods the ground water also becomes depleted and the streams may have such low flows that water supplies are threatened, waste discharges cannot be assimilated, oxygen is depleted causing algae growth and fish kills, and recreation is spoiled. Shorter periods of drought adversely affect agricultural production, as most crops have critical periods in their growth when water deficiencies are most harmful, but supplemental irrigation can alleviate the problem.

A drought may also be defined in relation to the need for water. Until recently the humid Northeast has been spared the problems of the arid West. But with population increasing, the heavily urbanized area on which the Susquehanna borders will have to be much more careful in using its waters than in the past.

While many droughts occurred in parts of the Basin at different times, the two most severe occurred in the 1930-34 period and the 1962-65 period. The drought of the 1930's left many streams dried-up, and water for domestic use had to be hauled to many places. The more recent drought of the 1960's was even more severe, in terms of intensity and the greater demands on the resource. Agriculture suffered, municipalities had to restrict water use drastically, and many streams dried up or were left with very poor quality water.

Ground Water

Ground water plays a major role in the modulation of streamflow. In humid areas, discharge from ground water storage maintains the flow of streams during periods of little or no precipitation. In such areas, geology determines streamflow characteristics. Streams underlain by shale tend to have rapid runoff characteristics compared to streams underlain by unconsolidated sands. Hence, a correlation can be made between streamflow characteristics and the water-yielding characteristics of the rocks of a basin. Basins whose streams have rapid runoff characteristics are usually underlain by rocks of lower permeability and storage capacity than are basins whose streams have a more uniform flow.

Most of the streams in the Susquehanna River Basin are "gaining streams," that is, water moves from the ground water reservoir to the surface streams. This condition may be reversed in some instances, and water may move from the stream to the ground water body resulting in a "losing stream."

Ground water has developed from a quantitatively minor (though critically important) source for domestic and small public supplies to a source supplying something like one-sixth to one-fifth of the total national water supply requirements. Ground water reservoirs will not only continue to be a major source for meeting withdrawal requirements, but will emerge as a possible medium for storing surplus streamflow for cyclic withdrawal as a phase of multipurpose water management. Where available in suitable quantity and quality, ground water provides a source of water without the necessity of long transmission lines. In areas where the available supplies of ground water may not equal the ultimately anticipated requirements, it may, nevertheless, be advisable to develop some ground water locally to meet needs until larger sources become economically more feasible. The ground water sources developed earlier can then be used as a supplementary supply.

Ground water may sometimes be preferable to surface waters because of its relatively uniform temperature, quantity, and quality throughout the

year. Currently at least one-fourth the population of the Susquehanna River Basin is estimated to use water derived from underground sources. More than 400 municipalities depend upon ground water for all or part of their supply. The total quantity of ground water use may be expected to increase even as major new urban supplies of surface water are developed.

Appalachian Plateau. The rocks of the Appalachian Plateau have not been widely utilized as a source of water because of the easy availability of water from the glacial deposits underlying the valley floors where the urban areas are situated. There is evidence of appreciable amounts of good quality water except near coal mines. In Pennsylvania, the average potential yield is about 200 gallons per minute (gpm). In New York, the yields of wells are significantly lower with an average potential of about 60 gpm.

Valley and Ridge Province. The quantity and quality of ground water differs greatly from place to place and depends mainly on local rock type. The wells in this province yield an average of 125 gpm, ranging from 20 gpm to several thousand gpm.

Piedmont and Blue Ridge Provinces. Yields of wells in most of this area are generally rather low, yielding an average of about 75 gpm, but ranging from 5 gpm to 1,000 gpm depending on local rock type. Quality is generally good, although in some locations it may be very hard.

Atlantic Coastal Plain. The Atlantic Coastal Plain contains aquifers that are not potentially very productive because of their limited thickness in the Basin. Yields of from 50 to 100 gpm of good quality water are possible.

Glacial Deposits. Water from the glacial deposits in the northern parts of the Appalachian Plateau and Valley and Ridge Provinces is generally of good quality. Yields are low, though adequate for domestic wells in the glacial till that mantles the uplands. In the stratified sands and gravels of glacial origin that are found in the valley bottoms, yields may be greater than 1,000 gpm. These glacial formations have excellent potential for recharge from surface water as a means of water storage.

Soils

Soil types are closely related to climate and geology. Since the climate of the Susquehanna Basin is relatively uniform, the soil types vary largely with the physiographic provinces as can be seen by comparing Figure 11 with Figure 7. Thus, the Susquehanna Basin can be divided into four very broad soil areas: the portion of the Appalachian Plateau modified by glaciation (140), the unglaciated portion of the Appalachian Plateau (127), the Valley and Ridge Province (147), and the Piedmont Province (148). On the moderately sloping uplands of the glaciated portion of the Plateau, the soils are developed in glacial till derived mainly from local sandstone and shale. They are deep and moderately well to poorly drained. Soils on the more strongly sloping uplands are moderately deep and usually well drained. Most of the soils contain considerable amounts of course

fragments, frequently have stones on the surface, and are in woodland. Drainage and infiltration capacity are often restricted by a slowly permeable layer within 2 feet of the surface. Natural fertility is moderate to low. The stream valleys contain deep deposits of glacial valley fill materials. Soils of the sandy and gravelly outwash deposits are predominantly deep and well drained. Soils formed in the finely textured valley deposits are deep and poorly drained.

In the unglaciated part of the Plateau, soils are formed in materials weathered from sandstone and shale. They are mostly moderately deep to deep, and well to poorly drained. Extensive areas are stony and ledgy and natural fertility is low. This area is largely in woodland.

In the Valley and Ridge Province, soils of the ridges are developed in materials weathered from sandstone, mostly moderately deep to deep, well drained, and very stony. Soils of the lower ridge slopes are deep, moderately well to poorly drained, and very stony. Soils of the shale valleys are mostly moderately deep to shallow, well to moderately well drained, with moderate to steep slopes. Soils of the limestone valleys are predominantly deep, well drained, productive, and in cropland.

Soils of the Piedmont Province are formed in parent materials weathered from a wide variety of rocks, including red shale, schist, gneiss, quartzite, diabase, and greenstone. The ridge soils are mostly deep, well drained, and very stony. Soils formed over the shales and other softer rocks are moderately deep to deep, well to poorly drained, and generally very fertile.

Mineral Resources

Geology also plays the major role in the occurrence of mineral resources. Geologic activity is responsible for the creation of coal, concentrations of building materials, and metal-bearing ores. A mineral occurring in the earth's surface becomes a mineral *resource* when technology makes it economical to recover. Without meeting this criterion, minerals are merely "rocks."

Coal has by far been the giant among mineral resources in the Susquehanna Basin, and will continue to be for some time. Many of the towns and cities in the Basin were built for the single purpose of coal mining. While coal provided a livelihood for thousands over many decades, the operators worked without regard to conservation. The land was stripped and deep mine wastes were left in enormous piles.

Many other important mineral resources that do not compare with coal in quantity and value are important as the basis of Basin industries or as construction material. These include glass sand, lime, clay, trap rock, sand and gravel, and stone. Figures 12 and 13 show the locations of these and other important mineral resources.

Figure 11 ---- Soils Map - Land Resource Areas

Figure 12 ---- Non-Metallic Mineral Resources

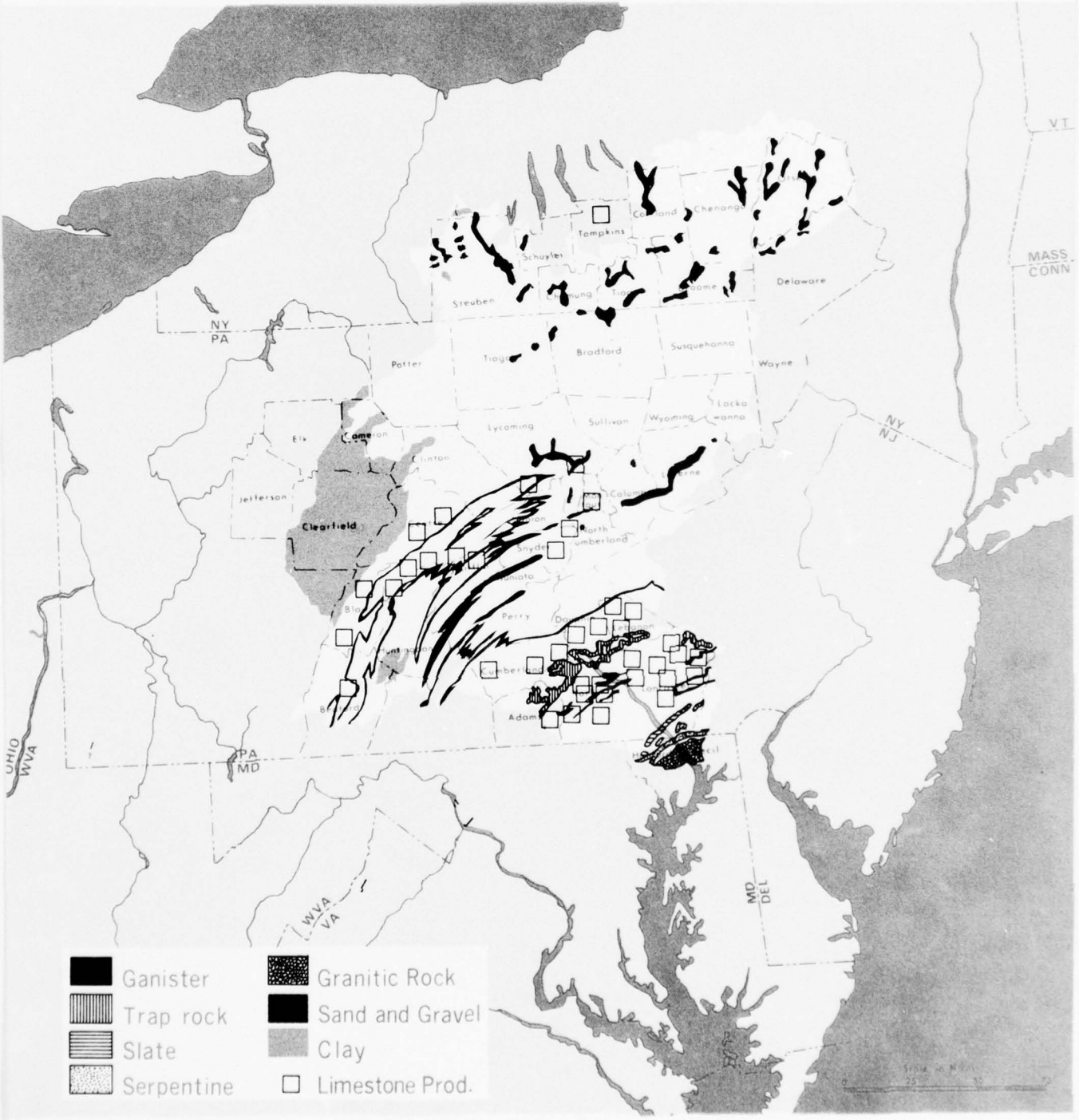
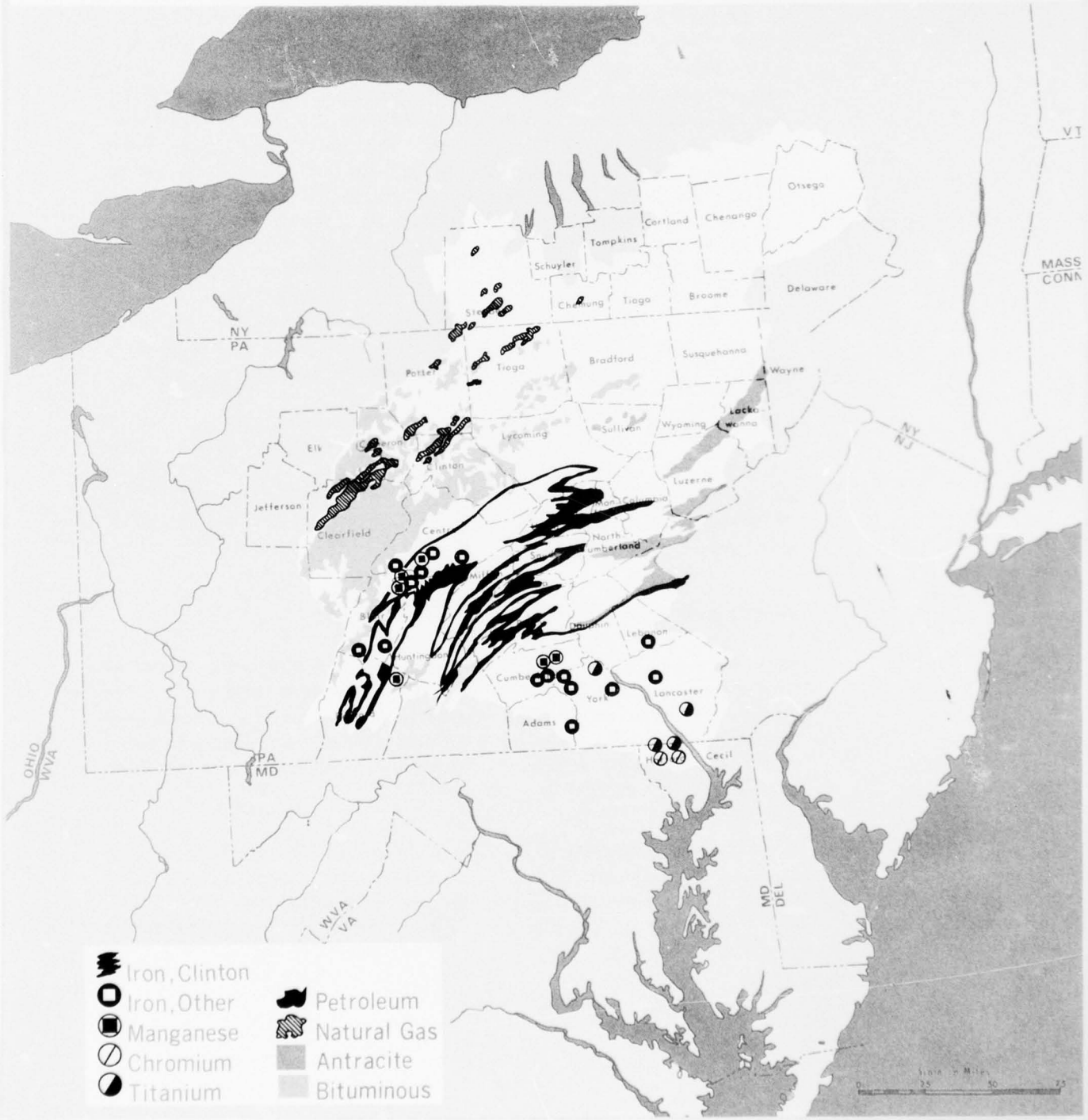


Figure 13 ---- Metallic and Fossil Mineral Resources



B. The Human Landscape

The landscape and the resources of the Susquehanna were major determinants in early settlement patterns, and while modern technology may allow men to live today in places where it was difficult to live in the colonial years, these early settlement patterns have largely held up through the vast changes that this country has undergone. The people of the Susquehanna Basin still live in the valleys, leaving the mountains and the ridges to nature. Cities have expanded on the sites of early small settlements near water, central to large farming areas, and close to valuable natural resources. While the original reasons for many of these centers' existence have passed, the centers continue to exist and find new functions and a new economy to nourish them. Men do not easily give up their established patterns. Thus, while the economy of Wilkes-Barre declined with the fall of the anthracite coal industry, and Altoona languished with the decline of the steam railroad engine, the people of these towns have fought to establish new industries and to revitalize their communities. Likewise, larger, more mechanized farm operations are replacing small one-man farms, and farm lands are returning to forest or becoming suburbs and industrial sites. The activities of men determine where they live and how they live, and the characteristics of those who live in any particular region. This section tells about the people of Susquehanna Basin.

The demands created by the human landscape create the need for water resource development. The location of the people determines the location of that development; the size of the population determines the amount of development needed; and the desires for quality of the environment by those people will be reflected in the quality of the development that takes place.

Density and Location

Figure 14 is a population density map that shows where the people of the Basin lived in 1960. While densely populated compared to the Western United States, the Basin stands out in the East as a comparatively sparsely settled pocket circled by major metropolitan areas. Figure 15 shows how the population density of the portion of each State in the Basin compares to the Nation as a whole.

There were 3,179,000 people living in the Susquehanna Basin in 1960. Eighteen and one-half percent lived in New York State on 22.4 percent of the Basin's area; 80.2 percent lived in Pennsylvania on 76.6 percent; and 1.3 percent lived in Maryland on 1.0 percent. These relationships are shown on Figure 16.

The proportion of the population classified as urban (towns with more than 2,500 people) varies from one part of the Basin to the next as can be seen in Figure 17. In New York, 60 percent of the population was

Figure 14 ---- Population Distribution, 1960

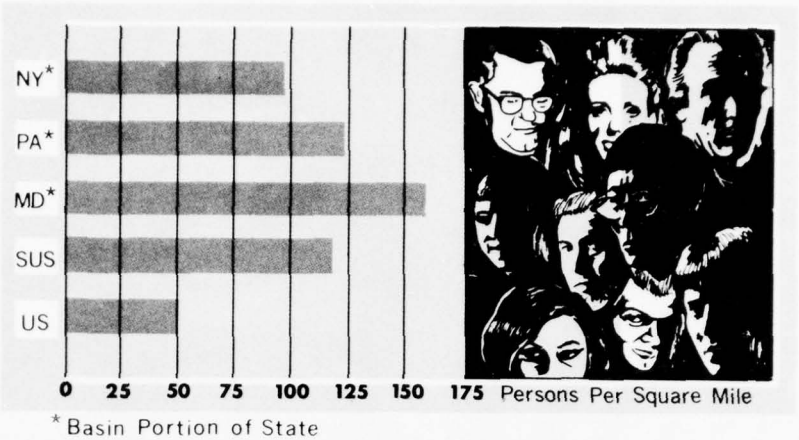


Figure 15 ---- Population Density, 1960 - Susquehanna vs. U.S.

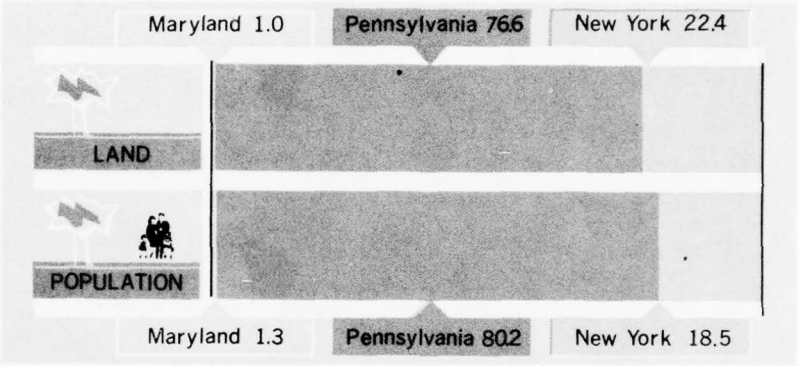


Figure 16 ---- Percent of Basin Land and Population by State, 1960

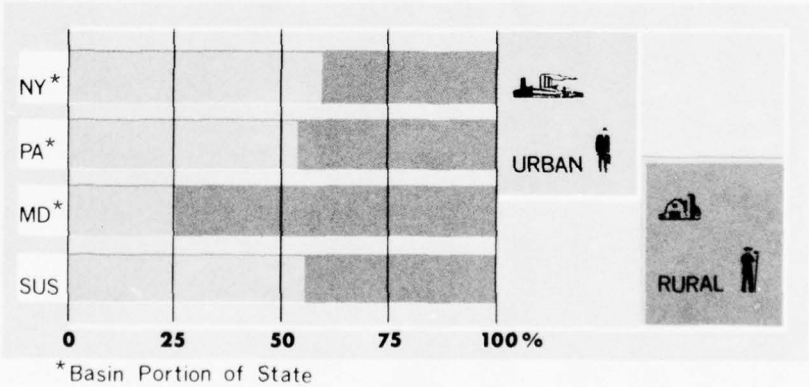


Figure 17 ---- Percent Urban-Rural Population, 1960 - Susquehanna Basin by State

urban, in Pennsylvania 56.5 percent, and in Maryland only 20 percent. For the whole Basin, 56.7 percent of the population was classified urban in 1960, and 43.3 percent was rural. The urban proportion is considerably below that of the Nation, which in 1960 was 70 percent of the population. The preliminary 1970 census has shown that the urban proportion in the U.S. has risen even higher, but it is also likely that the Susquehanna Basin will be nearer to the national proportion.

Because of increased mobility, a rural population does not necessarily mean a farm population. This is especially true in the Susquehanna Basin, where many people prefer to live in rural settings and commute to nearby towns and cities for urban jobs. Farmers are only a small part of the rural population. Therefore, while the Basin is in fact urbanizing rapidly and catching up to the national average, it is doubtful whether it will ever become as highly urbanized as the whole Nation and especially not as urbanized as the northeast. Many people live here because they prefer a rural setting, and this will probably continue to be the case in the future.

On the other hand, the existing urban areas will grow rapidly. Elmira, Binghamton, Wilkes-Barre — Scranton, Williamsport, Altoona, Lancaster-York-Harrisburg, and their immediate environs will absorb a major portion of the Basin's population and economic growth. The other small and medium sized towns will grow moderately, but slower than the bigger cities.

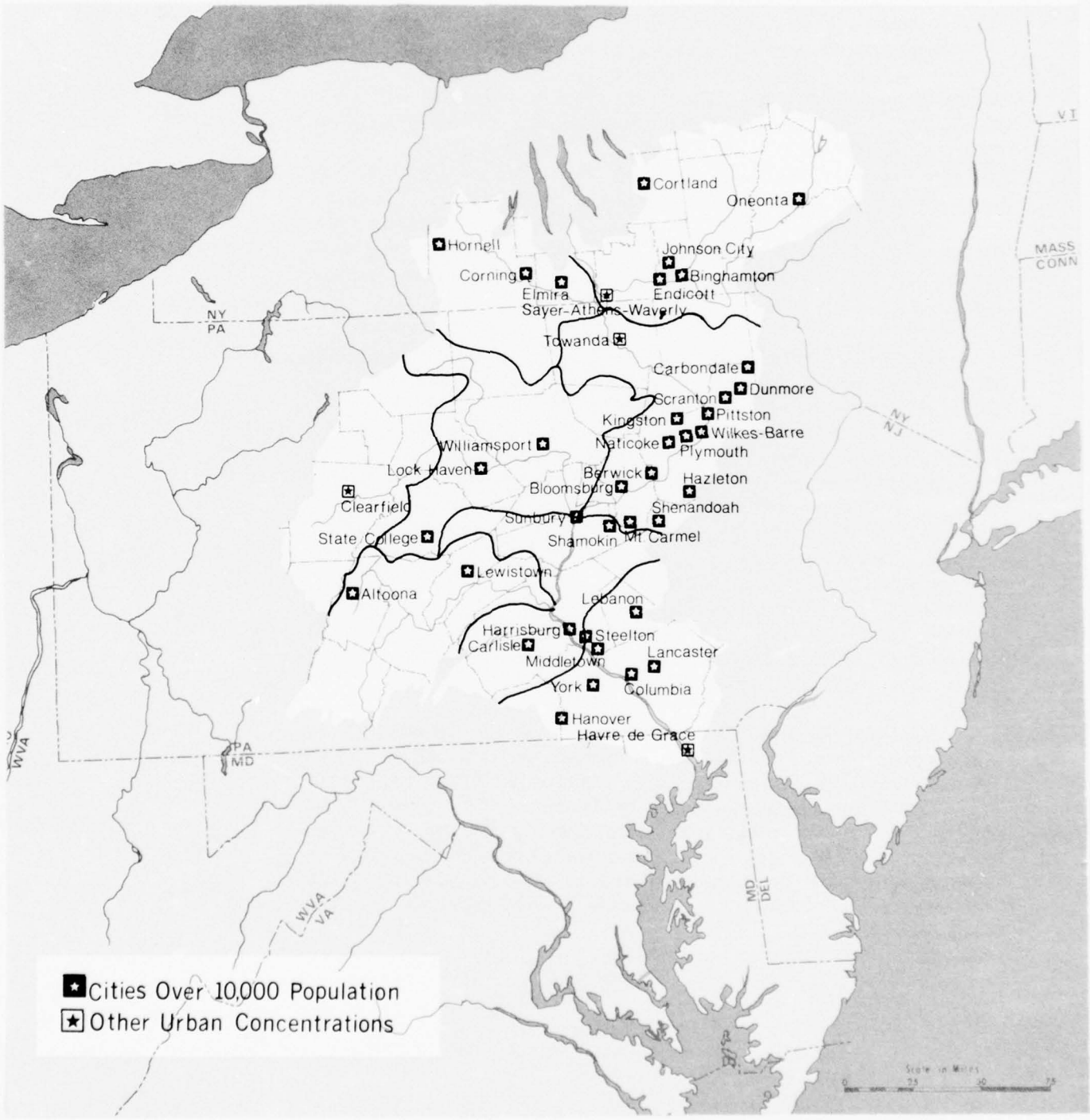
There is a considerable variation within the Basin concerning settlement patterns and urban-rural distribution. Major Urban Centers are shown on Figure 18 .

Sub-basin I contains 12.2 percent of the Basin's population. Approximately one-half of the people live in the 14 towns with a population over 2,500. Binghamton is the major concentration of population in this uppermost portion of the Susquehanna, with the city and its surrounding urban area having a population of over 176,000. Other important urban concentrations are Cortland on the upper Tioughnioga River, and Oneonta near the Susquehanna's source. The rural half of the population is scattered in small towns and farms throughout the many valleys formed by the tributaries of the Susquehanna River. These people are engaged in farming, small retail and service businesses, and light industry.

Sub-basin II, the Chemung Basin, has 7.6 percent of the Susquehanna's population. Almost 60 percent of its people live in the 15 towns with a population over 2,500. Metropolitan Elmira is the largest urban area in the sub-basin with over 75,000 people. Corning and Hornell are the only other towns with more than 10,000 people, but the Sayre-Athens-Waverly area on the Pennsylvania-New York border at the confluence of the Chemung and Susquehanna Rivers claims nearly 20,000. As in Sub-basin I, the rural population is in small valley towns and on farms.

Sub-basin III is the second most populous sub-basin, but it is by far the most heavily urbanized. Of the Basin's population, 22.4 percent live here, and nearly three-quarters of these people live in towns and cities over 2,500. Scranton, the largest city in the entire Basin, has over 111,000 people. The second largest city in the sub-basin is Wilkes-Barre with 64,000. Around these two cities strung along the Lackawanna and Susquehanna Rivers is a metropolitan area which contains almost one-half million people. These are the towns that were founded on the anthracite industry. Altogether, this sub-basin contains 43 subdivisions with more than 2,500

Figure 18 ---- Major Urban Concentrations



people each, including 12 with over 10,000 people; Hazleton with 32,000 people is on the Susquehanna-Delaware River Basin divide, and the Danville-Bloomsburg-Berwick area with over 30,000 people stretches along the Susquehanna River downstream from Wilkes-Barre. In contrast, the remainder of the sub-basin is extremely sparsely populated. It encompasses the eastern part of the northern tier of Pennsylvania, which is heavily forested and steeply mountainous. Farming is carried on in the valleys along the Susquehanna and its tributaries, but there are many large virtually inaccessible sections. Towanda, with 4,500 people, is the only town of urban size in this part of the sub-basin.

Sub-basin IV is the least populous in the Basin with only 4.1 percent of the Basin's population. Only a little more than one-fourth of the population in this western end of the West Branch Susquehanna River area live in the nine towns with more than 2,500 people. The largest, Clearfield, has less than 9,500 people. This area is heavily forested, with some sections ravaged by strip mining. There are extensive State forests and game lands. A few small industries, mostly coal- and timber-oriented, are scattered through the sub-basin. The rest of the economy is based largely on retail service or farming.

Sub-basin V, with 9.3 percent of the Basin's population, has more urban activity. Nearly 50 percent of the population live in the 14 towns with a population over 2,500, and three of these have over 10,000 people. Williamsport is the largest with 42,000 people and a metropolitan area with over 50,000. State College, the home of the Pennsylvania State University, has nearly 25,000* people located on a headwater tributary to the West Branch. Upstream from Williamsport on the West Branch is Lock Haven with 12,000 people. Most of the other towns in this sub-basin are located along the West Branch or in the State College area. The valleys are all heavily farmed, and the ridges are forested and largely uninhabited. In addition, large uninhabited areas are in State forest or game lands.

Sub-basin VI, the Juniata drainage area, has 9.6 percent of the Basin's population, of which only 40 percent are in the nine towns that have more than 2,500 population. Altoona is by far the largest city with a metropolitan area of 85,000 people. Lewistown, located along the Juniata, is the only other town with over 10,000 people. Most of the sub-basin is in the Valley and Ridge Province, with the ridges forested or strip mined. The valleys are farmed and dotted with small towns that function as service centers and the homes of light industries.

The oddly shaped Sub-basin VII contains 9.5 percent of the Basin's population, of which about 40 percent live in the 17 towns over 2,500 population. Four of these have over 10,000 people: Carlisle, Sunbury, Shamokin, and Mt. Carmel. Sunbury lies at the confluence of the West Branch and the Susquehanna, and the others are located near Main Stem tributaries. This area also includes the suburbs of Harrisburg, which have about 40,000 people. The rural portion of the population is scattered in the towns and farms of the Piedmont and Valley and Ridge portions of the sub-basin.

*Does not include students whose permanent residence is not State College.

Sub-basin VIII contains the largest number of people of all the sub-basins, with 25.4 percent of the Basin's population. Slightly over one-half of the Sub-basin's residents are in towns larger than 2,500. Five major urban aggregations occur among the gentle hills of this rich Piedmont farming area: Harrisburg on the Susquehanna, and Lancaster, York, Lebanon, and Hanover on tributary streams. Since this is the most extensively farmed area in the Basin, there is a large rural farm population, although there are still many rural commuters with urban occupations.

Figure 19 ---- Susquehanna Study Area - Economic Subregions

Population Characteristics

Since most detailed population data are collected on established political boundaries that seldom match the natural drainage divides of river basins, and since most people carry on their social and economic activities in areas that do not necessarily respect a basin's boundary, economic areas were used for the collection and projection of population data. Each of these areas includes complete counties, all or parts of which may lie outside of the Susquehanna Basin proper. These economic subregions taken together will be referred to as the Susquehanna Basin Study Area. They were determined by the National Planning Association for the Susquehanna Study, and are based on the commutation, buying, selling, and geographic movements of the Basin's population. Most of the people in each area carry on most of their social and economic activity within that area. In addition, it can be seen from the map (Figure 19) that each economic subregion has a fairly close correspondence with the hydrologic sub-basins that were shown on Figure 9. While not exact, the correspondence is as follows:

TABLE 3

Correspondence of Economic Subregions to Hydrologic Sub-Basins

Economic Subregion	Hydrologic Sub-basin
1	I
2	II
3	III
4	V
5	IV
6	VII and VIII
7	VI

Generally, the following social and economic indicators reflect an area that lags behind the national economic levels. Water resource investment is vital in helping the area to share more fully in the material wealth of the Nation and to maintain its abundant share of the intangible wealth----quality of the enviornment----that are necessary to the enjoyment of a healthy economy and a good life.

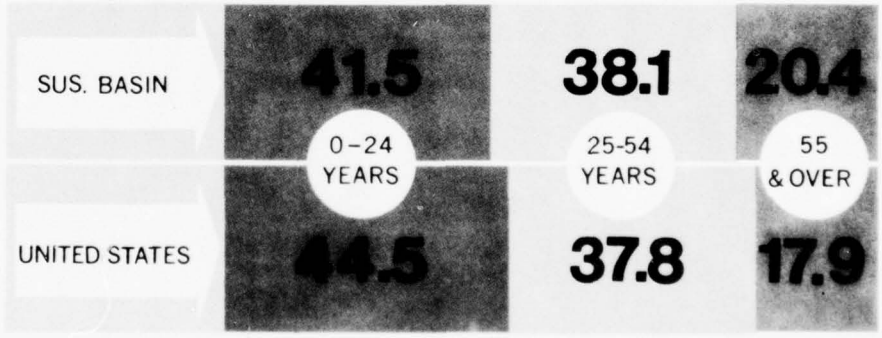
Age and Sex Structure and Migration

The Susquehanna Basin does not quite match the youthful complexion that this Nation is becoming known for. Outmigration of the younger and more talented people of the Basin has taken place for many years and has only recently begun to slow up. Many older people were left behind to earn a living as best they could, or to collect retirement

pay or welfare checks. Farmers retired while their better educated children found urban occupations, more often than not outside the Basin. Thus, as can be seen in Figure 20, the Susquehanna Basin has a lower proportion of people under 25 than the national proportion, and a higher proportion of people over 55 years old. While the difference is within only a few percentage points, this seemingly small fraction translates into many thousands of people in each category. The pattern of outmigration of younger people and the resulting older age structure has been a mark of all of Appalachia for many years, and only economic development can keep the residents from seeking a livelihood in what seems to them to be the greener pastures of the surrounding metropolitan areas. Since the 1960 census, however, most areas have reported a slowing outmigration.

For the same reasons, the sex structure (Figure 21) of the Basin's population varies from the national averages. There are fewer males and more females proportionately than in the Nation. This is due, in part, to the older average age of the population, since women dominate the older groups by a considerable margin. But more importantly it is a result of heavier male than female net outmigration. Conversely, the men had to migrate to find employment or else remain in an unaccustomed dependent role in the family. Much of this problem, which was generated in the 1950's, has been turned around in the 60's, and projections for population growth and migration in the future do not indicate any regressions.

Figure 20 ---- Percent Age Distribution, 1960



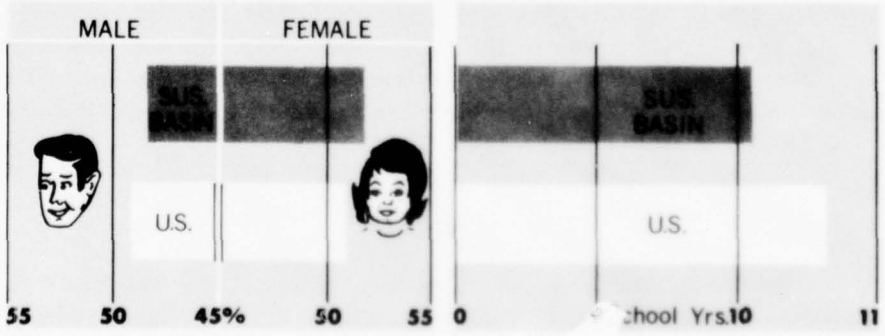


Figure 21 ---- Percent Sex Distribution, 1960

Figure 22 ---- M... School Years Completed, 1960

Educational Levels

Over all, the Susquehanna Basin is about half a year below the national educational level as shown in Figure 22. There is considerable variation within the Basin, depending on factors such as urbanization, the economy, and the availability of vocational schools and other advanced educational institutions. The Basin average was not quite up to national standards in 1960. It is expected that the 1970 census will show that the Basin is catching up, however.

Employment Levels and Income

In 1960, employme nd income patterns generally indicated that the Susquehanna Basin fel w national levels. The average Basin resident made a little less than the average U.S. resident. A worker was more likely to be a "blue collar" worker* than a "white collar" worker**, and there was a slightly better chance that the worker was a female. Some parts of the Basin are more affluent than others by virtue of their particular economic structures. Partially counteracting the lower income level, the cost of living is generally lower in the Susquehanna Study Area than it is in the big metropolitan areas.

Figure 23 shows the income distribution for the Susquehanna Study Area as compared to the U.S. Since generally the proportion of people

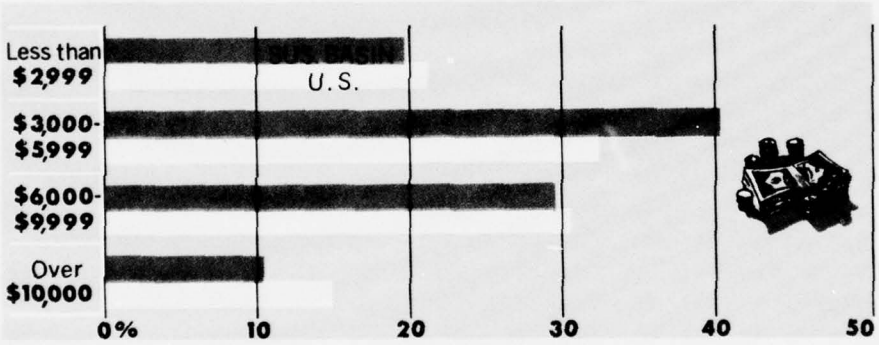
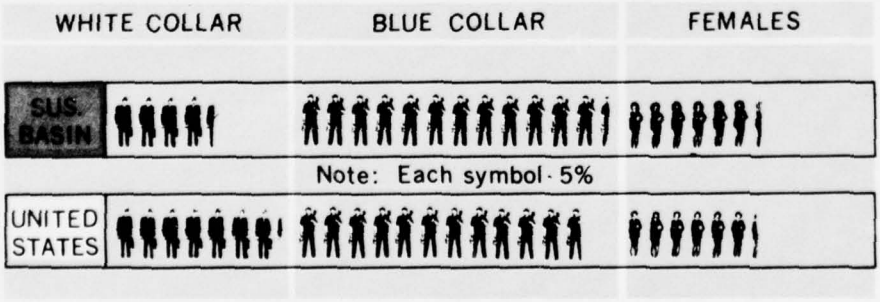


Figure 23 ---- Median Family Income Distribution, 1960

Figure 24 ---- Percent of Workers White Collar, Blue Collar, and Female, 1960



*Farmers and farm managers, craftsmen, foremen and kindred, operatives and kindred, service and private household workers, farm laborers and foremen, laborers, occupations not reported.

**Professional, technical and kindred, managers, officials and proprietors, clerical and kindred, sales workers.

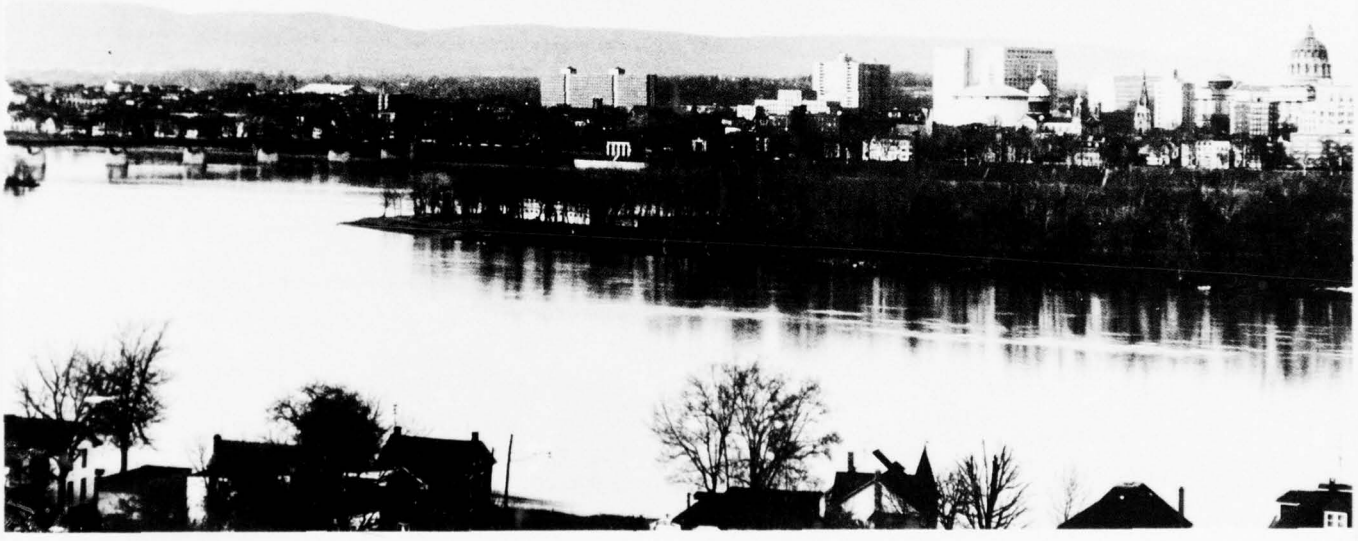
in the under $2,999, $3,000 to $5,999, and over $10,000 income categories falls below national averages, this deficiency is made up for in the lower middle income group, $3,000 to $5,999. Virtually every subregion is significantly above the national proportion in this category.

The reason for the patterns discussed above is revealed partly in Figure 24. Every subregion has a higher proportion of blue collar workers than the national proportion. These jobs are usually, though not always, lower paying than white collar occupations. This graph is also related to the lower rate of urbanization in the Study Area. Smaller towns mean a lower level of "white collar" services such as finance, central offices, major medical centers, and so on.

It is also interesting to note that every subregion except one has a proportion near or above the national proportion of female employment. This is the result of many industries locating in the area that use female labor: industries such as textiles and apparel, and electronics. In addition, regions with lower economic levels frequently have higher female employment ratios, simply because it more often takes two people working in a family to make ends meet.

Once again, although the 1970 census is not yet published, the trends in the factors above are expected to become closer to the national levels; and indeed the projections made for this Study for the next 50 years assume that the Basin's economy will become more and more similar to the Nation's economy.

Unemployment is more difficult to measure than the above indicators, because it changes so rapidly from one year to the next, and from one season to the next. Generally, when the Nation experienced high unemployment, the portions of the Basin in Appalachia experienced higher unemployment, while the remainder kept pace with the Nation. In better times, unemployment in the Basin has been comparable to the national unemployment levels, but with the more depressed areas such as Wilkes-Barre-Scranton and Altoona experiencing somewhat higher rates. But all areas are making progress toward stabilizing their economies to help minimize the effects of economic recessions on unemployment.



C. The Landscape of Man's Works

The landscape of man's works encompasses the activities of man from farm to factory; it is the story of how he uses the physical landscape and interacts with it to form the human landscape. This is the critical landscape because it is the connecting link between the physical and human landscapes and includes all the public and private facilities that man has built for work and recreation that have modified the natural landscape, and for better or worse have changed the ecology of the region.

This landscape can be divided into two categories: land intensive and land extensive. Land intensive uses include the urban functions where many people gather in small areas for their mutual benefit: factories, schools, offices, etc. Land extensive uses include the low density rural functions that by their nature require vast amounts of land but relatively few people: food production, some forms of recreation, forestry, wild areas, and so on.

Both intensive and extensive land uses have always been dependent upon the availability of water. Among the many works of man, water works of all types have been a key indicator of the strength of civilizations throughout history. Many early cities brought water great distances to supply their needs. In the Susquehanna Basin, people are fortunate to have abundant water nearby. The task has been to develop water works to serve men and, at the same time, not degrade the quality of the environment. While development has been extensive, a better job needs to be done to preserve and maintain the environmental quality of the Basin.

Land Use

There are five major land use categories: 1) cropland, 2) pasture land, 3) forest land, 4) urban land, and 5) other. "Other" includes land outside of urban areas of more than 2,500 population, and agricultural land not used for crop, pasture, or forest (idle farm land, recreation, parks, highways, water areas, and rural domestic water uses). The extent to which land is used for these various purposes has changed drastically over the years and is continuing to change rapidly. The land use of the 27,500 square mile Basin is compared in Figure 25 with a 172,600 square mile area of the populous northeast, inclusive of the Susquehanna Basin, for 1964 and projected to 1985. It shows comparatively more farm lands and less urban and forest land in the Basin. While this relationship will hold in the future, many changes will occur in the proportions. The big increase in the "other" category for the Susquehanna will be mostly from idle farm land.

The ability of the Susquehanna Basin to produce crops for livestock and human consumption is directly affected by the quantity and quality of land available for agricultural production. The most significant force affecting the future availability of agricultural land is the increasing demand for land for other uses as a result of a growing population. Although some of the land required for urban and other uses will be of poor quality, a major part will be taken from highly productive farm land. Between 1954 and 1963, cropland and pasture land decreased 13 percent and 25 percent, respectively, and the number of farms fell 33 percent. Although the average size of farms has risen steadily as consolidation took place, this was not enough to counter falling acreage.

The major shift in land use has been from agricultural uses into urban and other uses, with a slight shift into forest land. This trend will continue in the foreseeable future, with urban and other land uses projected to double by 1985. There are considerable variations among sub-basins, with the Piedmont (Sub-basin VIII) heavily farmed, and the mountainous areas heavily wooded. By national standards there is very little pasture land

in the Susquehanna Basin since it is more economical to grow forage crops for the animals than to let them graze on land that could be more productive.

Intensive Land Uses

The intensive land uses include urban areas and other non-agricultural land uses outside of urban areas, such as highways, factories, schools, and

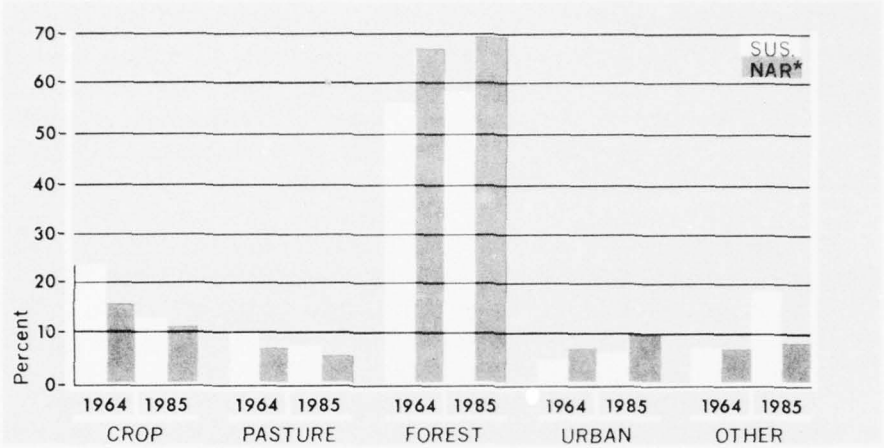
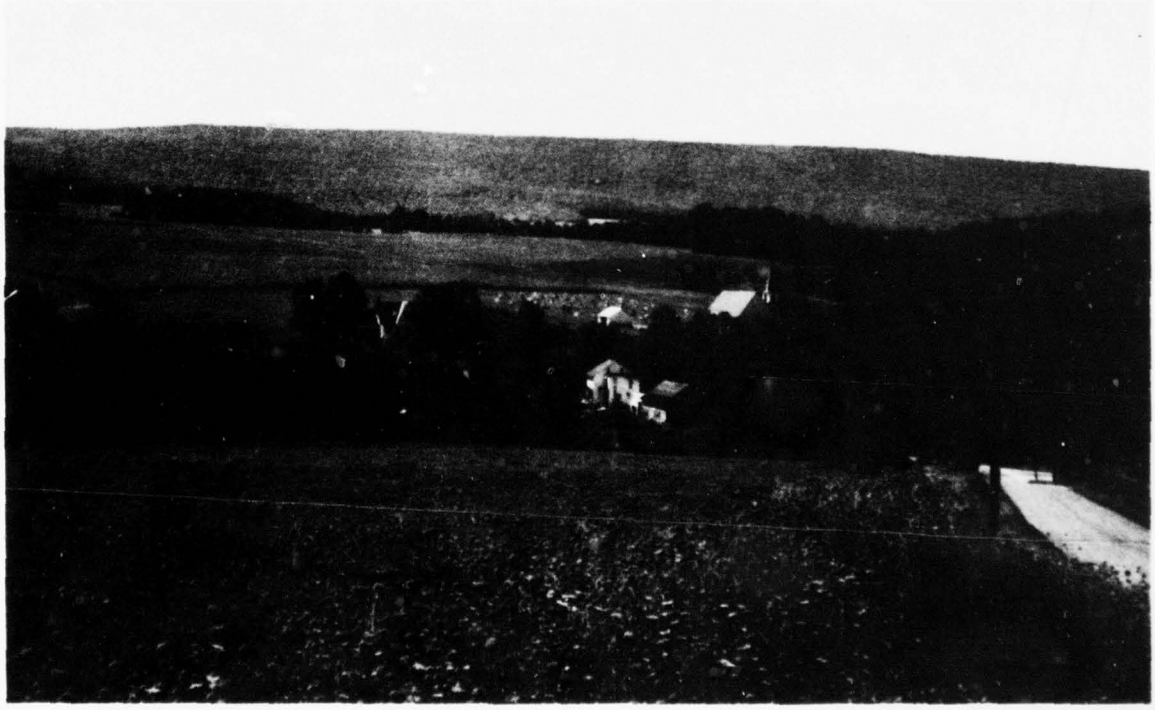


Figure 25 --- Projected Land Use Changes, 1964--1985



Vanishing Farmlands

so on. The location and size of the towns and cities of the Susquehanna Basin were discussed earlier by hydrologic sub-basin. This section will discuss the specific facilities of the Basin.

Transportation. Historically, ground transportation in the Susquehanna Basin has followed the natural topography. Highways and railroads have followed the stream valleys and flood plains, and the wind and water gaps in the ridges. As a result, direct through routes in the Basin, until recently, have been few. Navigation, except for recreational boating, is negligible. However, it had great importance in the history of the Basin's development. Commercial navigation gave way to the railroads, and the construction of large power dams on the lower Main Stem blocked any potential for boat traffic from Chesapeake Bay. Air transport is extremely important to the economic growth of a region and is rapidly growing even more important. Facilities are scattered throughout the Basin, but many of these are in need of improvements.

Highways. The lack of good highway transportation in the Susquehanna Basin once was a serious obstacle to economic development. Because of the terrain, high speed, limited access roads were rare. Until the 1960's, the only road of this kind was the Pennsylvania Turnpike, one of the earliest attempts at modern road building. The Interstate Highway Act of 1955 changed the situation drastically in the 1960's, and when the Appalachian Corridors, authorized by the Appalachian Regional Development Act of 1965, are completed during the next decade, the Susquehanna Basin will have a high speed highway network that will do as much as any single investment to bring it into the mainstream of the industrialized economy of the East and the Great Lakes region.

The adjacent map, shows the major highway routes through the Basin----existing, under construction, and planned.

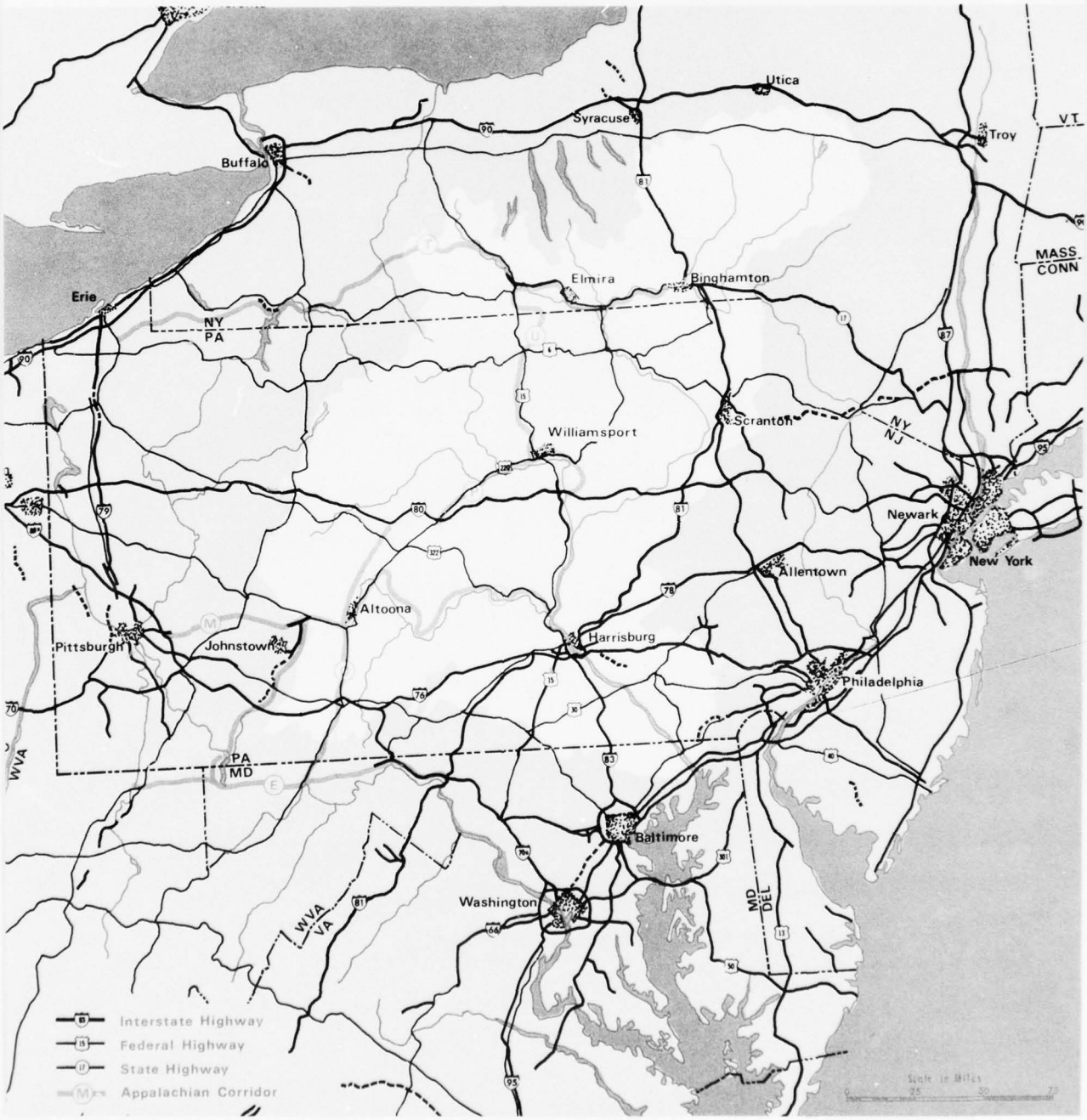
Since all of these highway projects are inter-city in nature, they can be expected to help the existing urban centers attract additional industry and help them build closer ties with the East Coast megalopolis. In addition, these roads allow recreationists in the surrounding metropolitan areas easy access to scenic and recreational areas of the Susquehanna Basin. If the recreational resources are properly managed, this can be an important source of new income to the rural Appalachian portion of the Basin.

Both the industrial growth in the cities and the recreational growth in the rural areas that could be stimulated by these new highways relate directly to water resource development. Many new industries will need processing water, and the growing populations will need domestic supplies. Additional recreational water with easy highway access will be needed by a growing population. Water is a primary ingredient in many kinds of recreation. Recreation facilities on slack water or along free running streams will attract users now that a good highway network is being built to connect with surrounding heavily populated areas.

Railroads. Several major lines serve the Susquehanna River Basin, connecting most communities with the surrounding major urban centers,

as can be seen in Figure 27. Penn-Central, Lehigh Valley, Baltimore and Ohio, Delaware and Hudson, and Erie-Lackawanna are some of the major roads serving the Basin. There are also a number of smaller local service lines operating in some areas. Because of the local topography, Altoona is a major switching point, car building, and repair center. Here engines are added to or taken off freight runs as trains enter or leave the steep grades of the Allegheny Mountains. Harrisburg is also a major switching point where east-west and north-south traffic cross.

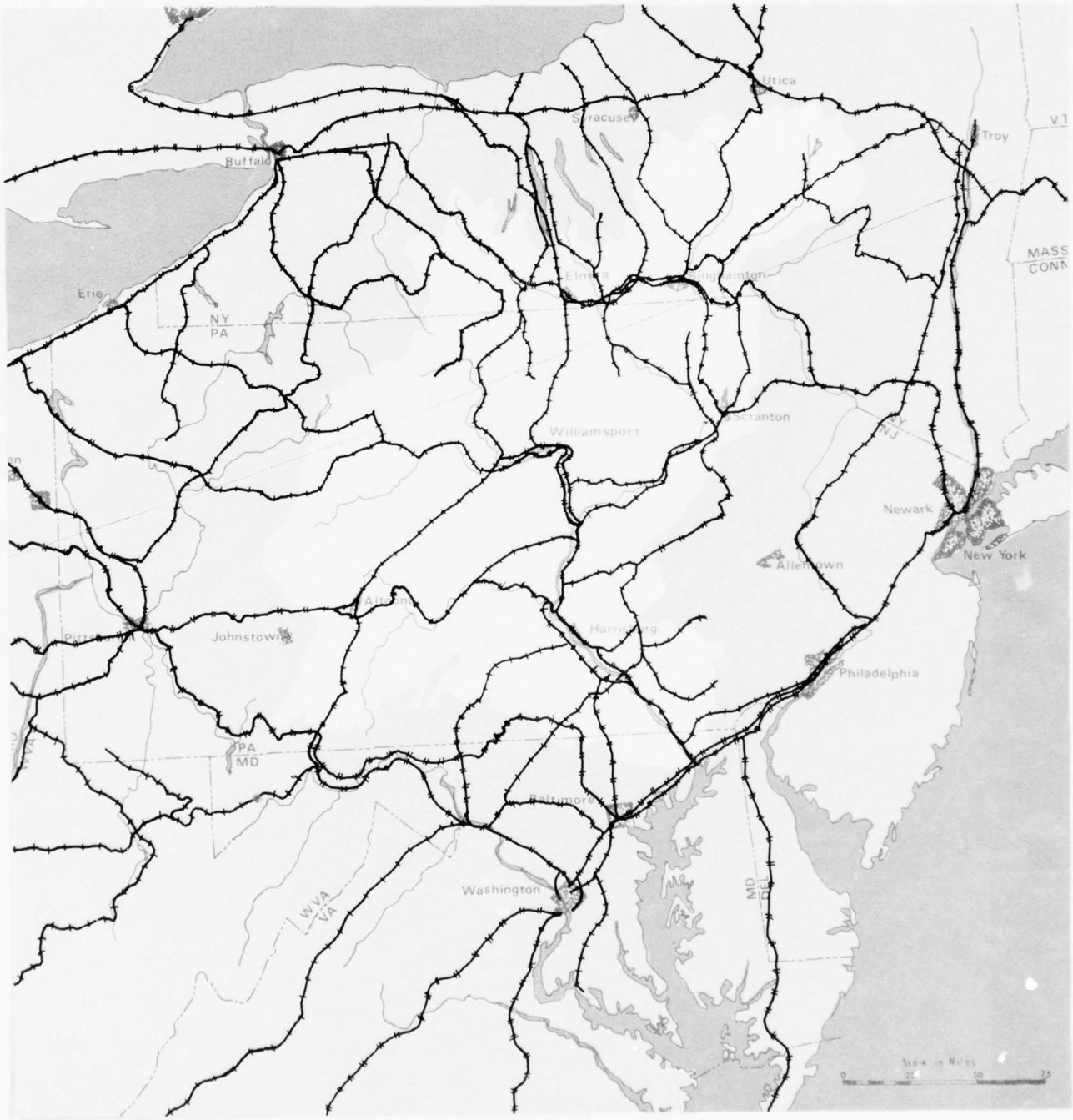
Figure 26 ---- Major Highway Routes



In cooperation with local land owners, 19 programs have been completed

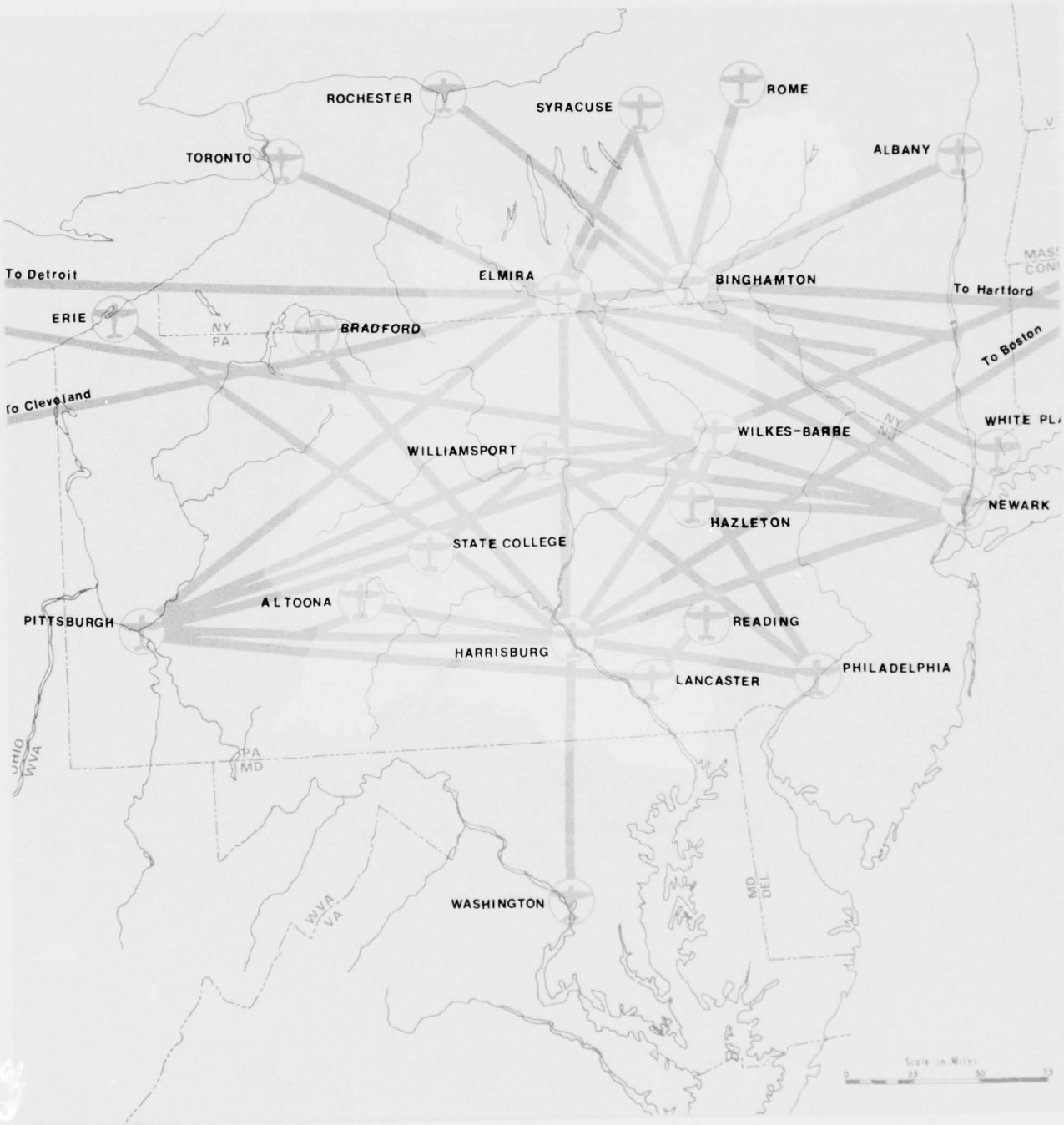
Air Transport. Adequate air facilities and scheduled service have become a necessity for any community hoping to attract business and industry. The location of the Susquehanna Basin, tucked between the large Eastern and Great Lakes metropolitan areas, leaves it in the shadow of the great cities' international airports. Nine airports in the Basin have scheduled commercial service connecting to the cities shown on Figure 28. Elmira, Binghamton, and Harrisburg have scheduled jet service for some flights. Good connections to the surrounding major airports, and good

Figure 27 ---- Major Railroads



local facilities that can handle the growing number of private aircraft, particularly the new small executive jets, are the important considerations for air travel in the future in the Basin. Another aspect of air transportation that is growing rapidly but has seldom been given much attention is air access to recreational areas. With the number of private aircraft growing at a great rate, and the number of private pilots growing even faster, recreational centers will find investment in new, or improvements in existing, airports worthwhile in future years.

Figure 28 ---- Scheduled Air Service



Presently there are general aviation and secondary airports in the Basin which range from sophisticated, highly instrumented terminals to dirt landing strips. Some funds from the 1965 Appalachian Act have been made available for airport development. Additional money is being spent by other public and private sources to improve facilities. The areas that build and maintain adequate facilities will have a definite advantage when industries make locational decisions.

Education. Skilled manpower is another vital part of the economic machine. There are 31 four-year colleges and universities within the Susquehanna Basin, with a total enrollment of about 100,000 students. Nearly half of the college students in the Pennsylvania portion of the Basin attend The Pennsylvania State University and its seven branches in the Basin. In addition there are eight two-year colleges----three in New York, and five in Pennsylvania----with a total of over 15,000 students.

In some respects vocational schools are of greater importance to the Basin than the colleges. These are the sources of a trained labor pool that helps attract higher wage industries. All three Basin States have intensive programs to bring this kind of education within commuting distance of most residents.

Industry. The nature and amount of industry in a region determines, to a large extent, the nature of the population and the water needs of that region. The best available measure of industry is employment data. The National Planning Association took considerable care in measuring and projecting employment by industry for the Susquehanna Study Area because this is an important indicator of economic growth. Like many aspects of the human landscape, the employment pattern is expected to become more and more like the national pattern. Presently, there is considerable divergence between the patterns of employment in the Study Area and the Nation as can be seen from Figure 29. The major difference is in the balance between services and manufacturing. In 1960, 36 percent of the jobs in the Study Area were in Manufacturing, as compared with 26 percent in the Nation. This contrasts with the 26 percent employed in Service and Government in the Study Area and 29 percent in the Nation. Services and Government, together with Construction, are the only sectors projected to increase proportionately in both the Basin and the Nation. Agriculture; Mining; Manufacturing; Transportation, Communication, and Public Utilities; and Wholesale and Retail Trade are all expected to decline proportionately.

It is important to emphasize that a proportionate decline does not necessarily mean a decline in the actual employment in a particular sector. Because total population is increasing, total employment will increase; but if total employment in a particular sector does not increase as fast as total population, it will show a proportionate decrease. The past and projected changes in absolute employment are shown in Figure 30. Agriculture, Mining, and Transportation, Communication, and Public Utilities show a

the regional economy. The philosophy behind this Act was that a chronically depressed region in the Nation is bad for the whole Nation

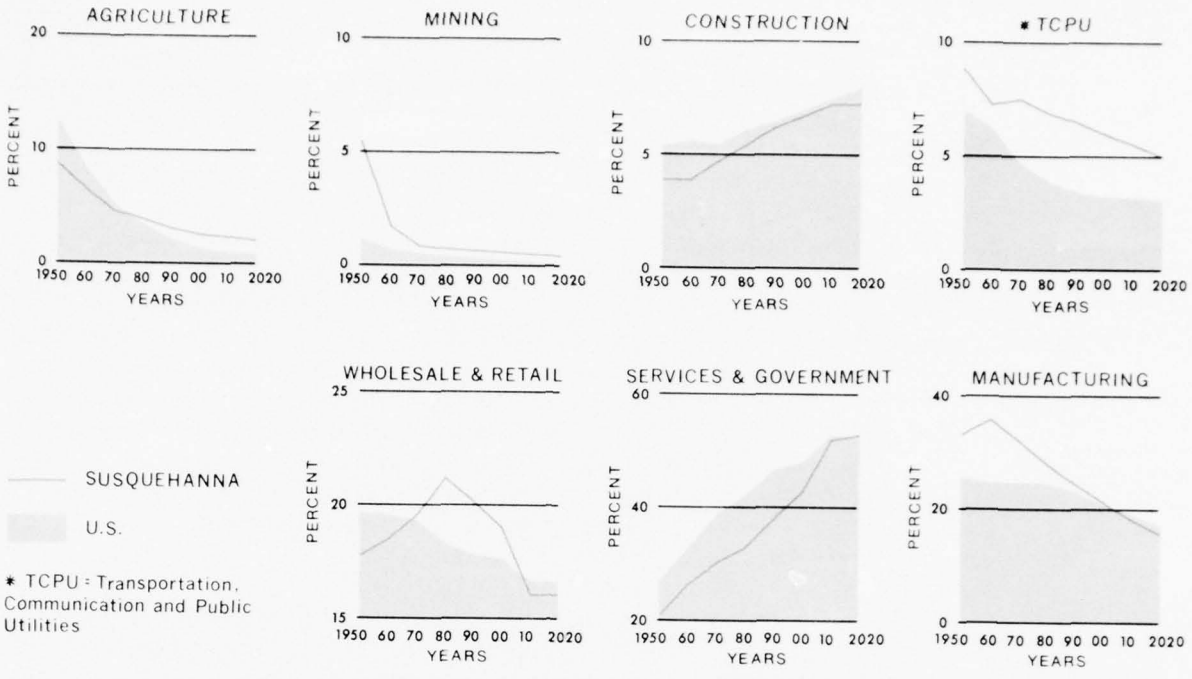


Figure 29 ---- Percent Employment by Industry, 1950--2020 - Susquehanna vs. U.S.

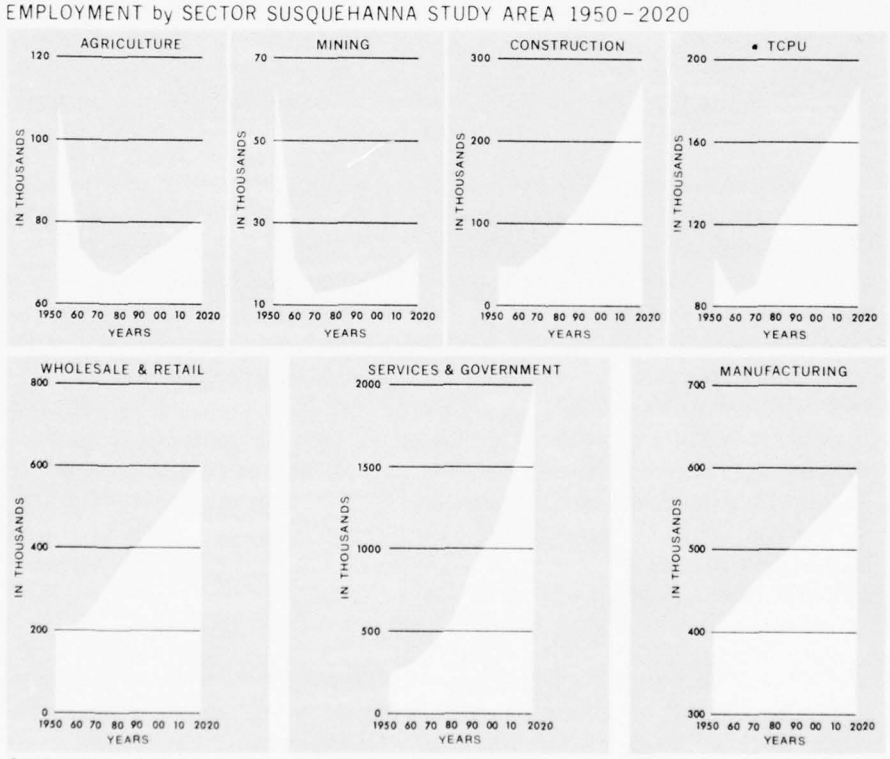


Figure 30 ---- Employment by Industry, 1950--2020 - Susquehanna Study Area

decline with an upturn at different times. Construction, Services and Government, Wholesale and Retail Trade, and Manufacturing increase employment steadily at various rates.

The bulk of the expected decrease in *Mining* employment has already occurred, although a gradual decline is expected to continue until 1980, when there should be a reversal. The reasons for this pattern are the declining demand for coal and the increasing mechanization in the mining industry. Anthracite production in the Lackawanna-Wyoming Valley (Subregion 3) is expected to all but disappear in the future. Bituminous coal, mined mostly in Subregions 4, 5, and 6, is expected to have increased employment in the future because of increasing electrical power demands and the development of mine-mouth power plants. The other mined products used for construction or industrial purposes will increase production modestly. Although water is used in the mineral industry for washing and market preparation, and actual consumption is low, the processes used do create a pollution problem.

Construction shows an absolute and proportionate gain in employment in the Basin. This reflects the increasing urbanization that will take place in the Basin causing an accelerating demand for homes, schools, factories, and commercial outlets. While worker productivity in this industry may be expected to increase, it will not be nearly enough to offset the projected increase in demand for building. Water is not an important factor in this industry directly, though indirectly the structures that will be built represent a large increase in water needs for all purposes.

Transportation, Communication, and Public Utilities' employment has reversed its decline of the last decades in absolute terms, and shows significant growth in the next 50 years, although a moderate proportionate decline is projected. This sector has a number of diverse elements in it, containing everything from disc jockeys to railroad enginemen. Generally, productivity will rise in the decades ahead, but the need for more automobile mechanics, telephone men, professional engineers, and so on will continue to rise rapidly in all areas. The only sector of this industry that needs significant water supplies other than for sanitary purposes is the electrical power utilities. Vast amounts are needed for cooling purposes in fossil fueled thermal power plants, and even larger amounts will be needed for planned nuclear power plants. Significant amounts will be consumed in evaporative cooling towers, making careful planning in this particular area of water use critical.

The future growth of *Wholesale and Retail Trade* is responsive largely to the growth of the basic manufacturing sectors of the economy. The larger the payrolls there, the greater will be the demand for wholesale and retail outlets. This sector is projected to grow steadily in absolute employment in the next 50 years, but it is expected to grow proportionately in the Basin until about 1980, when the proportion of total employment will decline rapidly. This will happen because, with rapid urbanization in

the next couple of decades, stores and shopping centers will be built faster than the national average. As the Susquehanna's economy approaches the national average, other sectors will grow even faster, leaving the Wholesale and Retail trade industry with a proportion near the national average. Water is not a significant factor in this sector, except as needed for sanitary purposes.

Services and Government employment is expected to grow rapidly in absolute and proportionate terms in the Susquehanna Basin. Because the Study Area has been highly rural it is lagging far behind the rest of the economy in the level of services offered. Most of the growth in this sector will take place in the subregions that are already highly urbanized since most of the new urban growth will take place around existing centers. In five subregions, services are projected to account for over one-half of total employment by 2020. By 2020, Service and Government employment will have caught up to the national level. Water use is not significant in this sector beyond the usual sanitary needs.

A rapid proportionate decline in *Manufacturing* employment is expected in the next 50 years, while the total number of manufacturing employees will increase steadily, but modestly. This is a result of increasing urbanization and increasing labor productivity. Manufacturing is in many ways the most important sector in the economy of the Study Area because it is the foundation of other commercial and service sectors. Manufactured products are sold mostly outside of the region where they are made, thereby bringing money into the region, money needed to buy local and imported services and goods. The types of industries (industrial mix) have a great deal of influence on the standard of living in every region. High wage industries that have good growth potential in a national market are the most desirable for a community; low wage industries that face a declining market for their products, or that are growing slowly, are less desirable. Regions with a large proportion of the latter usually reflect relative poverty all through their economies.

In addition to the desirability of industries from an economic point of view, there is increasing awareness that "clean" industries are more desirable regardless of their economics. An industry that produces little or no air and water pollution can be worth a great deal in terms of environmental quality---making communities and regions better places to live.

Each economic subregion in the Study Area has a unique industrial mix and a different prospect for the kind of industrial growth that is likely to occur there. Most subregions have a growing number of manufacturing employees with a decreasing proportion of manufacturing employment as compared with total employment.

Employment in *Agriculture* has been declining and will continue to decline as a proportion of total employment, although its declining trend in total employment will continue slowly until 1980, when it is projected

to measure a steady increase through 2020. While higher productivity will continue, increasing production should warrant this increasing employment.

The amount and type of industry in any particular place has a direct bearing on water needs and water quality. Some industries need water only for sanitary purposes, while others need vast quantities for processing their products. The water needs of various industries are discussed in detail in Appendix C.

Extensive Land Uses

The extensive land uses include crop, pasture, and forest lands, and agricultural land not used for any of the above. The natural ability of the land to support any particular use varies considerably with topography, soil conditions, and climate. The Department of Agriculture uses eight categories of land capability to define these various characteristics.

Figure 3l below shows the proportion of the Susquehanna Basin in each of these classes.

TABLE 4

LAND CAPABILITY CLASSES

Class	Description
I	Few limitations, highly productive agricultural land.
II	Some limitations, limiting choice of plants or needing simple conservation practices.
III	Severe limitations, limiting choice of plants, needing conservation practices, or both.
IV	Very severe limitations, limiting choice of plants, requiring very careful management, or both.
V	Limited use, largely for pasture, forest and woodland, or wildlife food and cover.
VI	Severe limitations, with use largely limited to pasture, forest, and woodland, or wildlife food and cover.
VII	Very severe limitations, with use restricted to grazing, forest, and woodland, or wildlife.
VIII	Severe limitations, with use restricted to recreation, wildlife, water supply, or aesthetic purposes.

Optimum utilization would have land classes I and II being used for crops, classes III, IV, V, and VI for pasture or forest, and classes VII and VIII for forest, recreation, and wildlife. In reality, much poor land is farmed and some good land is in forest, urban, or other uses. On the whole, however, the land in the Basin is used fairly efficiently from this point of view.

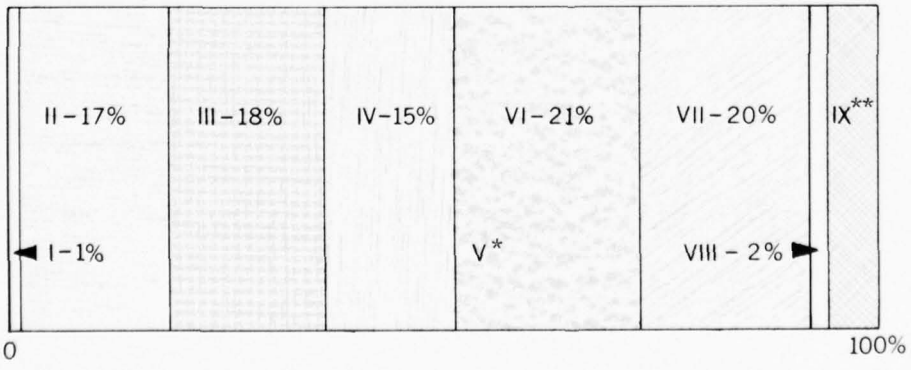
The agricultural products that are produced are a function of the soil capabilities and the competitive position of the Susquehanna Basin with respect to other regions of the country. Farmers in the Basin have specialized largely in high value products that serve their own local markets and the markets of the nearby major cities of Pittsburgh, New York, Philadelphia, and Baltimore.

Milk and other dairy products account for 46 percent of the value of all farm products sold. Because of increasing productivity in the dairy industry, dairying is projected as an increasingly important agricultrual industry. Poultry and poultry products are second in value of products sold, and hay, pasture, and feed grains are increasing in importance as dairy and other livestock enterprises grow. These latter items have increased production and acreage, often at the expense of the fruit, vegetable, and cereal grain production.

Forests, covering over 55 percent of the Basin area, support an important wood products industry. Over 90 percent of the timber is hardwood. Oak or oak-hickory type growth accounts for 44 percent of the forest growth, with beech, birch, and maple types making up 27 percent. Less than 25 percent of the hardwood stand will yield logs graded medium or better. This situation is expected to improve, however, as second and third growth forests mature and as better management methods develop.

In 1964 lumber production exceeded 330 million board feet, and pulpwood production was more than 400,000 cords. By 2020, production of lumber is projected to increase 75 percent and pulpwood by more than 500 percent.

Figure 31 ---- Percent Land Capability Classes



*V – 0% **IX – 6% Not Classified

Sedimentation. An important problem resulting from agricultural and forestry activity as well as urbanization is the change in the sedimentation rates. This relates directly with the physical landscape, as well, in that it is affected by slope, soil type, and climate. These same items are factors in the amount and intensity of runoff experienced during rainfalls. Soils exposed directly to rainfall without vegetative cover or conservation measures, such as improved rotations and strip cropping, cause the water to run off the land more quickly, not only increasing the flood hazard, but carrying more sediment into the streams, causing a degradation in stream quality and stream channel efficiency.

The Susquehanna River presently transports an average of about 3 million tons of sediment (110 tons per square mile) annually into Chesapeake Bay. Annual sediment yields may range from as little as 20 tons per square mile on established forest land to as much as 800 tons per square mile on disturbed areas. The widest range of annual sediment yields (20 to 800 tons per square mile) may be expected from the glaciated northern part of the Basin and from the anthracite areas within the Basin. Annual sediment yields in other parts of the Basin range from 20 to 500 tons per square mile, with the higher yields found in the more intensely farmed land of the Piedmont Province.

Aesthetics

The appearance of the landscape, the visual impression it leaves with any individual, is a personal thing. It can be said, though, that the present appearance of the landscape is a result of the interaction of man and nature. The millions of acres of forests in the Basin are second and third growth forests. Having once been cleared and farmed, the kinds, size, and appearance of the trees are different from their original natural state. The valleys are still filled with farms and farm houses, crossroads, railroads, and communities of all sizes. All of these are man-altered landscapes. Fortunately, the touch of man does not always create ugliness.

To the contrary, the Susquehanna River Basin is rich in scenic beauty. Because of its varied topography including long ridges and valleys broken by wind and water gaps, rolling plateaus combined with numerous streams and rivers, and a varied flora and fauna, some of the most beautiful country in the East is claimed by this Basin. Picturesque valley farms and small towns along waterways and highways are common views from many secondary roads and hiking trails. Major portions of the mountainous lands, while not in their original vegetation, are wild in character with few roads and a sparse population.

The lower portion of the Basin is rolling, farmed land with a patchwork quilt appearance. The farm land with its strip cropping, terraces, and diversions present a picturesque contrast to the dense patches of forest. This area is attractive at all times of the year, and many tourists pass through to see the farms, particularly in the "Amish country" in Lancaster County.

As a resource, the scenic beauty is important to the resident as well as to the sightseer coming from the metropolitan centers outside the Basin.

Seasonal interest in the scenic beauty, especially during the fall, is shown by foliage festivals, auto tourism, and specially scheduled trains and buses. Future development of Appalachian Corridors and other highways will open new areas of scenic beauty to the sightseers. In an area which has few natural lakes, water resource development such as the Tioga-Hammond, Blanchard, and Raystown Reservoirs, as well as other large and small water projects, will add greatly to the visual variety of the landscape.

Unfortunately, the scars left by surface mining operations and the related spoiling of streams by coal mine drainage mar the natural beauty of parts of the Basin. This problem occurs in both the anthracite coal area in the Lackawanna-Wyoming Valley and in the bituminous coal areas of the West Branch, Juniata, and Tioga Basins. A great amount of money is being spent in attempts to alleviate this problem and on research to develop additional solutions. Recent legal regulations governing the operation of active mining in the area will also help to prevent additional damage. It will be a long time, however, before all of these eyesores are removed.

Cold, rushing, high-country streams provide good trout fishing, while the warmer, slow-moving rivers offer fishing for bass, catfish, suckers, bullheads, and non-game species. These stream fisheries are enhanced by the hundreds of natural lakes and man-made reservoirs. Fishing resources are limited in some areas by flow fluctuations, poor habitat, and industrial, agricultural, domestic, and coal mine drainage pollution.

The varying habitat of this area supports an abundant wildlife population. White-tailed deer are found throughout the area and provide major hunter interest. Black bears are found in the mountainous areas and wild turkey populations are on the increase. Small game include grouse, pheasant, quail, rabbits, and squirrels. However, the major riverways provide only a marginal waterfowl habitat. Wildlife production is presently limited by loss of habitat due primarily to urban, industrial, and highway development in lowland areas. With the decrease in agricultural activities, farm game species, such as rabbits and pheasants, will decrease but will be offset somewhat by a corresponding increase in forest game species such as grouse and wild turkeys.

The Environmental Quality Act of 1969 will insure that proposed developments in the Susquehanna River Basin, along with the rest of the country, will receive adequate consideration of their environmental consequences *before* they are allowed to take place.

Present Water Facilities Development

Since this is a study chiefly concerned with the water resources of the Susquehanna River Basin, it is important to know just what man has done to date with the rivers and lakes of the Basin; how they are used, how they have been modified, and to what extent they are meeting immediate needs. In other words, what is the present status of water resource development in the Susquehanna Basin in terms of quantity and

quality? In surveying river basin development and use throughout the United States, the Susquehanna ranks as one of the least developed major basins, even though hundreds of millions of dollars have been invested in flood control, pollution control, water supply, recreation, power, and so on. Figure 32 is a map of major water facilities developments.

Water Quality

The present "stock" of water quality treatment facilities is grossly inadequate, as will be explained further in the chapter on needs. Organic wastes are discharged into the Basin's streams from 130 sewage service areas totaling a population equivalence of more than 3.5 million. Altogether, 310 miles of tributaries and 120 miles of principal rivers are degraded by organic wastes. About 1.8 million people are served by sanitary sewers: 360,000 (32 service areas) are served by systems that discharge untreated wastes into streams; systems serving about 870,000 people (46 service areas) discharge waste into streams after primary treatment only; and 542,000 people (52 service areas) are served by systems that discharge after secondary treatment. Forty-two sewage service areas, representing 54 percent of the Basin's population, have systems that mix storm runoff with municipal wastes. In addition, land treatment measures, such as those described previously, as well as other voluntary measures taken in the course of good farm practices, help reduce sediment loads in streams, although 3 million tons are still deposited in Chesapeake Bay annually. Other problems that are presently inadequately dealt with in the Basin are algal formations that result from inadequate organic waste treatment and runoff from agricultural areas where phosphate use is heavy and the thermal effects that result from heated discharges usually from electrical power plants. Pesticide pollution is also found chiefly in heavily farmed areas.

Recreation

In 1960, the Susquehanna Basin had about 101,400 surface acres of water, including lakes, impoundments, and areas of the major streams in the Basin. An estimated 64 percent of this area, 64,800 acres, was accessible to the public, with a capacity of over 31 million annual recreation days. With the addition of waters and access facilities already in planning or construction, that total surface acreage will be 116,800 acres, with 68 percent (79,800 acres) accessible to the public, and a capacity of over 36 million recreation days annually. The following chapter points out that this will still be inadequate for the projected demand. Of the 101,400 acres of water in the Basin in 1960, 71,500 acres are classified as boating waters, including areas with public access but privately controlled. A little less than half of this area is on small surfaces classified for restricted boating (boats of limited power or no power). The remainder is classified for unrestricted boating, useful for large power boats, water skiing, and so on. The seasonal capacity of the restricted water was about 10 million activity days, and with present plans this is expected to increase to about 13 million activity days by 2020. The corresponding figures for unrestricted boating are 2 million activity days in 1960 and 4 million by 2020.

The present amount of water-oriented recreation land in the Basin is nearly 2 million acres. Notable recreational sites include Naturealm, Shawnee State Park, Rickets Glen, Kettle Creek Reservoir, Leonard Harrison State Park, and Gifford Pinchot State Park.

There are 4,700 miles of significant trout fishing streams with 14,800 surface acres and 1,400 miles of warm water fishing streams with 47,600 acres in the Susquehanna River Basin. The Basin also contains about 53,000 surface acres of lakes, reservoirs, and artificial ponds which provide fishing

Figure 32 ---- Major Water Facilities Development, 1970

opportunity. Trout stocked in streams, lakes, and ponds total 478,000 pounds annually. Warm water fishing areas, providing 76 percent of stream fishery habitat, mostly in the lower Main Stem, are stocked with 37,000 pounds of fish annually. These resources presently provide over 6.5 million fisherman-days annually for 445,000 fishermen. Altogether, the 120,500 acres of streams, lakes, and impoundments in the Basin can provide 9.4 million fisherman-days, so that actual use is only 70 percent of the capability. But, due to the uneven distribution of the location of the demand and the supply, some parts of the Basin experience a shortage of fishing opportunities.

Present supplies of big game are capable of supporting only 24 percent of the demand and supplies of migratory game can support only 7 percent of the demand. Supplies of forest and farm varieties of small game are adequate to meet present needs.

In addition to these general recreational opportunities, the Susquehanna Basin is rich in historical and archaeological sites. Surveys have been made of these resources, both for their usefulness to tourists and scholars and for assurance that water resources developments will not interfere with any valuable and irreplaceable sites.

Water Supply

Water supply facilities fall into two categories: supply sources and works, and treatment and distribution systems. In the Susquehanna Basin there are 322 water supply impoundments owned by public agencies, industries, or private utilities. Other supply sources are streamside intakes and ground water. Currently 33 percent of the municipal-industrial water supply comes from ground water; the remaining 67 percent is from surface sources.

Over 65 percent of the Basin's population and most of its industry are dependent on public water supply systems. The 550 public water supply systems operating in the Basin use an average of 600 million gallons of water per day. With rapid urban growth in the Basin's future, the trend is toward absolute and relative growth in the number of people served by municipal systems. There are, however, still 1 million people dependent on private individual sources, mostly ground water, in the rural areas of the Basin.

Flood Control

In the Susquehanna River Basin there are 104 projects completed, under construction, or in advanced planning that are partially or completely devoted to flood control. These include 55 projects by the Corps of Engineers: 13 dams, 6 small snagging and clearing operations, and 36 structural measures that include various combinations of levees, walls, and channel improvements. The Soil Conservation Service provides additional important flood control measures through its upstream watershed program.

In cooperation with local land owners, 19 programs have been completed or are under construction containing small impoundments and encompassing over 560,000 acres of land. The Commonwealth of Pennsylvania has constructed 30 projects, including 6 impoundments and 24 local flood protection projects at a total present cost of almost $30 million.

The damages that would be caused if the greatest flood of record was to recur today without these protection works have been calculated for five sample cites. In the Binghamton area a recurrence of the March 1936 flood would cause $34.1 million in damages if there were no upstream dams and local levees. That flood today, with existing projects would cause only $1.1 million in damages. In Elmira, a repeat of the 1946 flood would cause $37 million in damages, but with present protection, none. In the Wilkes-Barre area the corresponding figures are 80.1 million reduced to $200,000; at Williamsport $83.8 million reduced to $700,000; and in the Harrisburg area $33.1 million reduced to $9.1 million. These are impressive numbers, but it must be remembered that much development that would not otherwise have occurred has taken place because of the protection.

Furthermore, the next chapter on needs points out that in spite of protection works flood damages continue to be a problem in the Basin because of increasing development in unprotected areas, because of rising land and property values, and because of more accurate reporting techniques. Many of these damages can be dealt with by other programs in operation that reduce remaining flood losses without structural measures. Flood warning systems, evacuation procedures, flood plain management, and the flood insurance program are necessary items in controlling flood damages, and such measures are presently in operation to varying extents in the Basin.

Power

The Susquehanna River Basin has made good use of its available hydro-electric resources in supplying the power demands of its region. There are 12 hydro-electric power installations in the Basin with a total installed capacity of over 1,643 megawatts, and a combined average annual generation of over 3.4 billion kilowatt hours. Nearly all of this capacity is located on the Main Stem below Harrisburg in four installations totalling over 1,600 megawatts, including the 800 megawatt Muddy Run pumped storage project. The eight other projects are much smaller and are scattered throughout the Basin. The bulk of power production, however, uses thermal sources, both fossil and nuclear. These sources use water for condenser cooling, consuming through evaporation some of the amount withdrawn before it is returned to the streams.

CHAPTER III
The Environment, The Economy, and Water Resource Requirements

There are a great number of economic and social problems or needs in the Susquehanna River Basin. The people of the Basin's communities require schools, vocational training, highways, hospitals, and many other public works and public institutions if they are to keep pace with the changes certain to come about in the next several decades. Water and related land resource requirements are only a part, albeit an important part, of these total needs.

While development is necessary to a growing economy, a growing population, and an improved way of life, it has become apparent that non-development---protection of the natural environment---is as important to the full enjoyment of life as are the man-made and man-modified amenities. This Nation is rediscovering that man is just one of the species that inhabit the Earth, and that he must live in harmony with the rest of the natural world. If man indiscriminately damages his relationship to the land and waters on which he depends, as he has in the past, all of his material wealth will be for nought.

Three conclusions can be drawn from the last chapter that are necessary to understand the needs in the Susquehanna Basin. The first is that the original natural environment no longer exists in the Basin. Man has touched virtually every inch of the drainage area with his farm plow, his cities and roads; he has cleared and harvested the forests, and mined the land. Since there is no truly natural area left to preserve, the need in the future is to manage the environment, learning from past mistakes. Areas that have been badly damaged need to be restored so that they may be used and enjoyed again. The Basin is blessed with many beautiful forests in second and third growth, large areas in well managed and productive farms, and a multitude of streams that, while affected by a number of problems that will be discussed later, are in good condition compared to rivers and tributaries that drain more densely populated portions of the Northeast and Midwest. With proper environmental management, the quality of the water and related land resources in this Basin can be a model for the Nation.

The second conclusion relates to the regional social and economic patterns. The Susquehanna Basin, a large part of which is in Appalachia, is below the Nation in all of the key economic and social indicators. Chapter II shows that income, median education, age structure, occupational patterns, and so on generally reflect the classic pattern of regional poverty. Under the Appalachian Act of 1965, a heavy dose of public investment is being introduced into Appalachia in the form of educational grants, funds for highways and airports, aid to hospitals, and a special water resource study that was specifically aimed at identifying projects that would stimulate

the regional economy. The philosophy behind this Act was that a chronically depressed region in the Nation is bad for the whole Nation in both hard economic terms and in human terms. To remedy this, it was felt that major public improvements should be made without the immediate demonstrable demand for them; rather it was felt that the presence of the new facilities would help create the demand by attracting industry, reducing outmigration, and, in short, breaking the cycle that characterizes chronically depressed areas. Thus the second need in the Susquehanna Basin is to stimulate the regional economy by being sensitive to the projects and management measures that will help create permanent new jobs where they are needed.

The third conclusion from Chapter II is as obvious as it is important: that the Susquehanna River Basin is part of the United States. This means that Federal investments in the Basin compete with investments in all other parts of the country for the limited amount of money in the Federal budget. It would seem to be economically prudent that the Federal Government spend its money where it will yield the best returns to the National economy, as opposed to the best returns in any one region. In the past, there has not been enough Federal money to meet all the water resource needs identified in the Basin or in the Nation, which is part of the reason for the present water quality crisis. It is not likely that enough money will be available in the immediate future for these purposes. Therefore, the third need is to assess water project and management measures from the viewpoint of the national economy to insure that the Federal dollar is most wisely spent.

It may appear that these three conclusions are irreconciliable with each other. How can projects be built to meet growing needs and still preserve a high quality environment? How can the regional economy be stimulated if the investments needed to do that job take money from a prosperous region where investment would yield higher benefits to the national economy? The answer is a delicate balancing that requires restraint from overdeveloping to the point where the environment is destroyed, together with sensitivity to the needs and aspirations of the Basin's residents. The answer is the subject of Chapter IV, but first, we must identify the specific water and related land resource requirements of the Susquehanna River Basin over the next several decades.

Each river basin, and for that matter each sub-basin, is unique in *its pattern of requirements.* The relative importance of different needs will vary from one sub-basin to the next. This chapter discusses the needs and the priorities of needs from the viewpoint of the whole Susquehanna River Basin. Supplement B reviews these requirements for each sub-basin. These are the basis for the Coordinating Committee's recommendations for structural and management measures.

TABLE 5

Basin-Wide Needs Priorities

Early Action		Framework	
1.	Water Quality	1.	Recreation
2.	Recreation	2.	Water Supply
3.	Water Supply	3.	Water Quality
4.	Flood Control	4.	Flood Control

A. Water Quality

Coal Mine Drainage Pollution Abatement

The most pressing single problem in the Susquehanna Basin today is coal mine drainage pollution. While the damage it does to the aquatic environment is limited to certain streams, the costs in terms of loss of recreation and water supply mark it as the most serious water resource problem. The scarred landscapes from past strip mining abuses, the land subsidence caused by abandoned deep mines, and the smoke and ugliness of the culm piles add to this pollution problem.

The problem is all the more difficult because there is still a great need for additional research to find new, better, and more efficient methods of treating the polluted water draining from the coal mines.

Figure 33 shows the streams in the Basin affected by this pollution. Coal mine drainage causes severe water quality degradation in 715 miles of principal streams and 500 miles of tributary streams. The quality of an additional 135 miles of principal streams is intermittently degraded with "slugs" of mine drainage pollution. In the severely degraded streams, virtually no biological life can exist and yellow sulfuritic deposits called "yellow-boy" are left on streambed rocks. In the areas subjected to occasional "slugs" of acid, large fish kills can, and have, occurred. While this water is not useless for water supply, it increases treatment costs; and while it does eliminate fishing, it only limits active and aesthetic recreational uses. Skin contact with the water is not dangerous, in itself.

The sources of the polluted waters are the abandoned deep and strip coal mines. Abandoned deep mines are the main source, while strip mines contribute some acid but are also sources of large amounts of sediment.

Significant mine drainage discharges from 1,150 sources have been identified in the Susquehanna Basin, 970 of which are inactive mines. The inactive mines pour an average of 410 tons of acid into the Susquehanna waters every day, which is three-fourths of the 547 tons from all sources. There are 123,700 acres of strip mine spoil areas in the Basin and 22,500 acres of culm piles. Each of these sources and all of this acreage must be dealt with to solve the problem completely. This is, fortunately, the one problem which should not increase as a result of increasing population. With the laws controlling active mining operations and the recommendations of the Plan presented in Chapter V, coal mine drainage pollution will eventually become a lower priority.

Organic Pollution Abatement

The second most important need in the Susquehanna Basin is the abatement of organic pollution and the maintenance of good water quality. Other types of pollution----nutrients, sediment, color, heated waters, and other toxic materials----often must be treated at municipal and industrial waste treatment plants and, therefore, are a part of this problem.

Currently, three major segments of the Susquehanna River covering 60 miles are seriously degraded by organic pollution. These are the reaches

Figure 33 ---- Streams Degraded by Coal Mine and Organic Pollution

below Binghamton, Elmira, and Wilkes-Barre. In addition, 24 tributary streams are similarly polluted. The degraded reaches are shown in Figure 33. The 130 sewage service areas dump organic wastes estimated to be equivalent to 1.5 million people* into the Basin's waters. By 2020, a greater proportion of the Basin's population, which is projected at more than 9 million for that year, will be on municipal collection and treatment systems. The wastes of a population equivalent of over 16 million people will then be dumped into the Susquehanna's streams. The need for treatment will be more than proportionately greater than this increase, because higher and more difficult levels of treatment will be needed in more places.

While this problem is directly related to population size and economic growth, its priority with relation to the other water resource needs will slip a notch or two in future years, assuming that the Federal grant programs now getting started will be adequately funded, the backlog of problems will be eliminated, and that effective waste treatment to meet high water quality standards will become an adequate on-going program.

Nutrient pollution is the most widespread related problem. It originates from both municipal treatment plants and from runoff in heavily farmed regions. Algal blooms associated with excessive nutrients are a recurring problem in late summer in some parts of the Basin, especially in parts of the Chemung River, Spring Creek, Conodoguinet Creek, Swatara Creek, Conewago Creek, and the lower Susquehanna River below Harrisburg. This is a problem which needs additional study.

B. Recreation

The second immediate priority for the Basin is the need for water-based and related land recreational facilities. This includes general recreation, fishing, and hunting. The water quality measures discussed above directly affect the recreational capacity of the Basin, which is an added reason for their higher priority. Because of the Susquehanna's strategic location between the East Coast and Midwestern population centers, it is a natural target for much of the recreational activity of city dwellers from those areas. This, added to the growing need for recreation of the growing and urbanizing population of the Basin itself, means recreation could be an important part of the Basin's economy in the future. As pollution problems are solved in the coming years, recreation will become the top priority need by the end of the late action period.

The Susquehanna Basin is well suited to meet these recreational needs, and, with proper planning, a large percentage can be satisfied without overusing and degrading the environment. The Basin is mountainous, filled with beautiful forests and valley vistas, and contains large areas of relatively primitive countryside. These land and water resources *will* be used. It is important to plan and to take action to assure that they will not be so misused and overused as to diminish or destroy their values.

*This equals the number of people served by sewage service areas plus an industrial factor of 100 gallons of waste per employee per day.

General Recreation

Recreational needs were measured in terms of "net unsatisfied demand" in recreation days;* that is, the number of days of recreation over and above the supply that exists today or is in the planning stage today. Figure 34 shows graphically the net unsatisfied recreation demand throughout the study period. The total recreation demand includes both restricted and unrestricted boating** demand, but these latter are shown separately because they must be planned for differently. These graphs show clearly the skyrocketing demand in the late action period.

Fishing

Net unsatisfied fishing and hunting demand is projected much the same way. The graph of fishing demand and supply (Figure 35) shows an excess of supply until sometime after 1980 when a large deficit begins to accrue rapidly. As was pointed out in Chapter II, the early excess can be misleading because the location of some of this supply is not where it is needed, and because of the inbalance in the demand for trout vs. warm water fishing.

Hunting

The hunting graph (Figure 36) shows an excess of supply throughout the study period but with demand climbing rapidly and supply diminishing rapidly. Like the fishing demand, there are some regional needs deficits, and deficits in some types of hunting---large game animals and migratory water fowl.

C. Water Supply

Water supply is the third priority need, not because it is less a vital function, but because it is a relatively easy need to meet in this water-abundant Basin. In the late action period, however, when competition among different uses for water becomes more intensified, and as Basin population and economic growth accelerates, it becomes the second highest priority behind recreation.

Water supply requirements fall into two categories which are basically rural and urban definitions. The first, and largest, is municipal and industrial needs while the second is the rural community and agricultural needs. As with recreation, the ability of the Basin to meet these needs is closely related to water quality.

* A recreation day is one person participating in recreational activities for all or part of one day.

** Restricted boating includes power boats up to 20 horsepower, and unrestricted boating includes over 20 horsepower.

Figure 34 ---- Net Unsatisfied Recreation Demand, 1960--2020

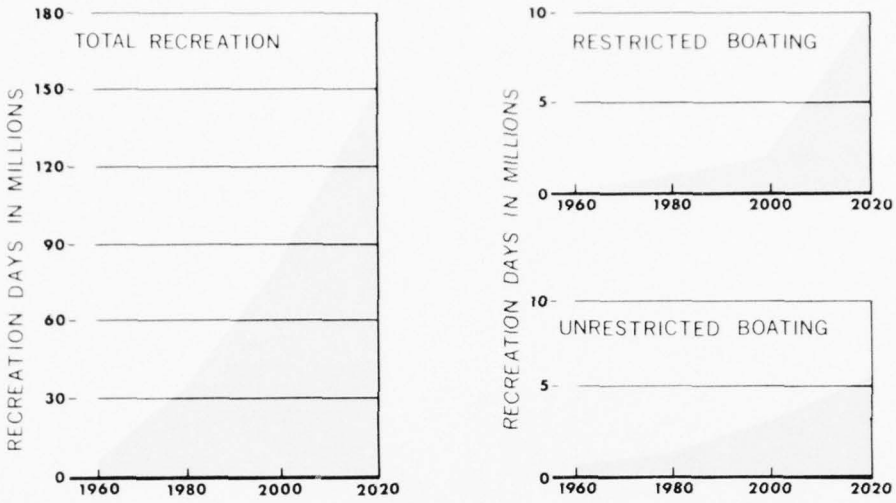


Figure 35 ---- Net Unsatisfied Fishing Demand, 1960--2020

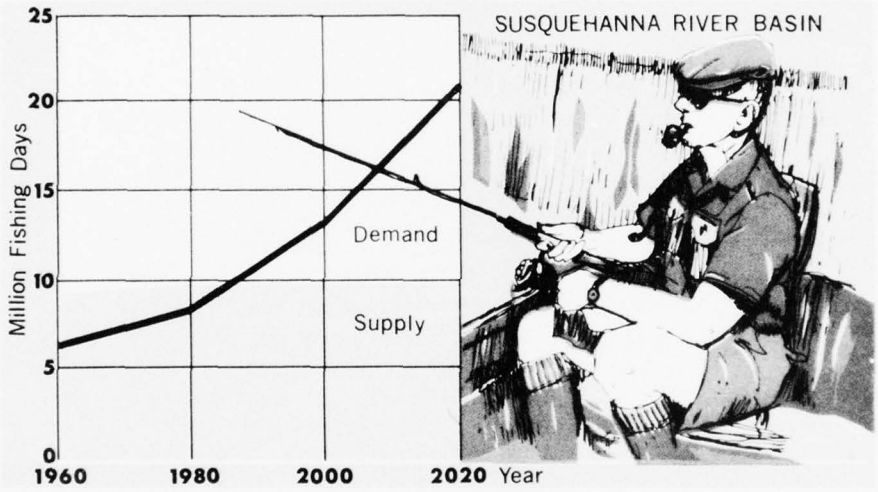
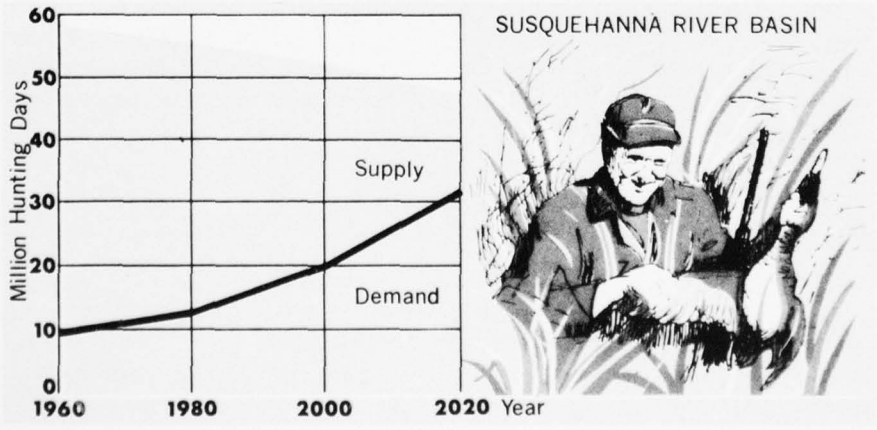


Figure 36 ---- Net Unsatisfied Hunting Demand, 1960--2020



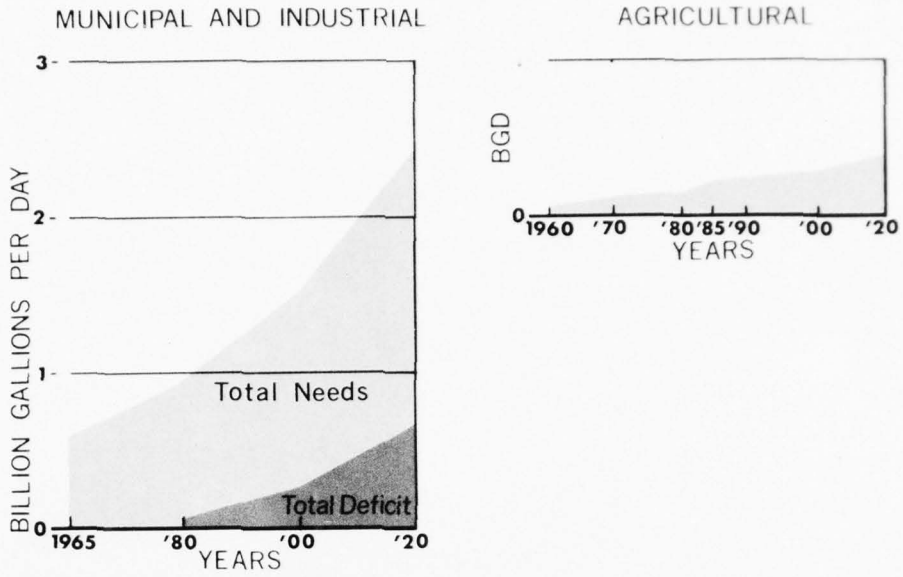


Figure 37 ---- Total Water Supply Needs and Deficits, 1960-2020

Furthermore, the abundant water in the Susquehanna Basin is being looked to by communities outside the drainage area as a supply source for the future. Currently, significant quantities of water are transmitted by pipeline to Chester, Pennsylvania and Baltimore, Maryland. The total water supply demand shown in Figure 37 represents only the in-Basin total needs. The deficit shown is the amount of water needed in addition to water that can be supplied by presently available sources. The communities facing this situation (Figure 38) will require special action if their requirements are to be provided for. In all remaining areas where adequate water is available, it is assumed that local water supply sources will be tapped as the needs arise.

Rural water supply needs will also increase rapidly throughout the period considered. This includes rural domestic use, livestock comsumption, and irrigation. Between 1960 and 2020, rural domestic water supply will increase four-fold, and irrigation use will increase five-fold. Figure 37 shows the increase in total agricultural water supply needs. The increases are not as dramatic as in the urban areas, but they are nevertheless substantial and must be planned for, particularly where they compete directly with urban needs.

D. Flood Control

The last item on the priority list is flood control. The lower order of this need reflects the already substantial investment in flood control projects in the Susquehanna Basin. This does not mean that the problem is solved. Even though most major population centers have some protection,

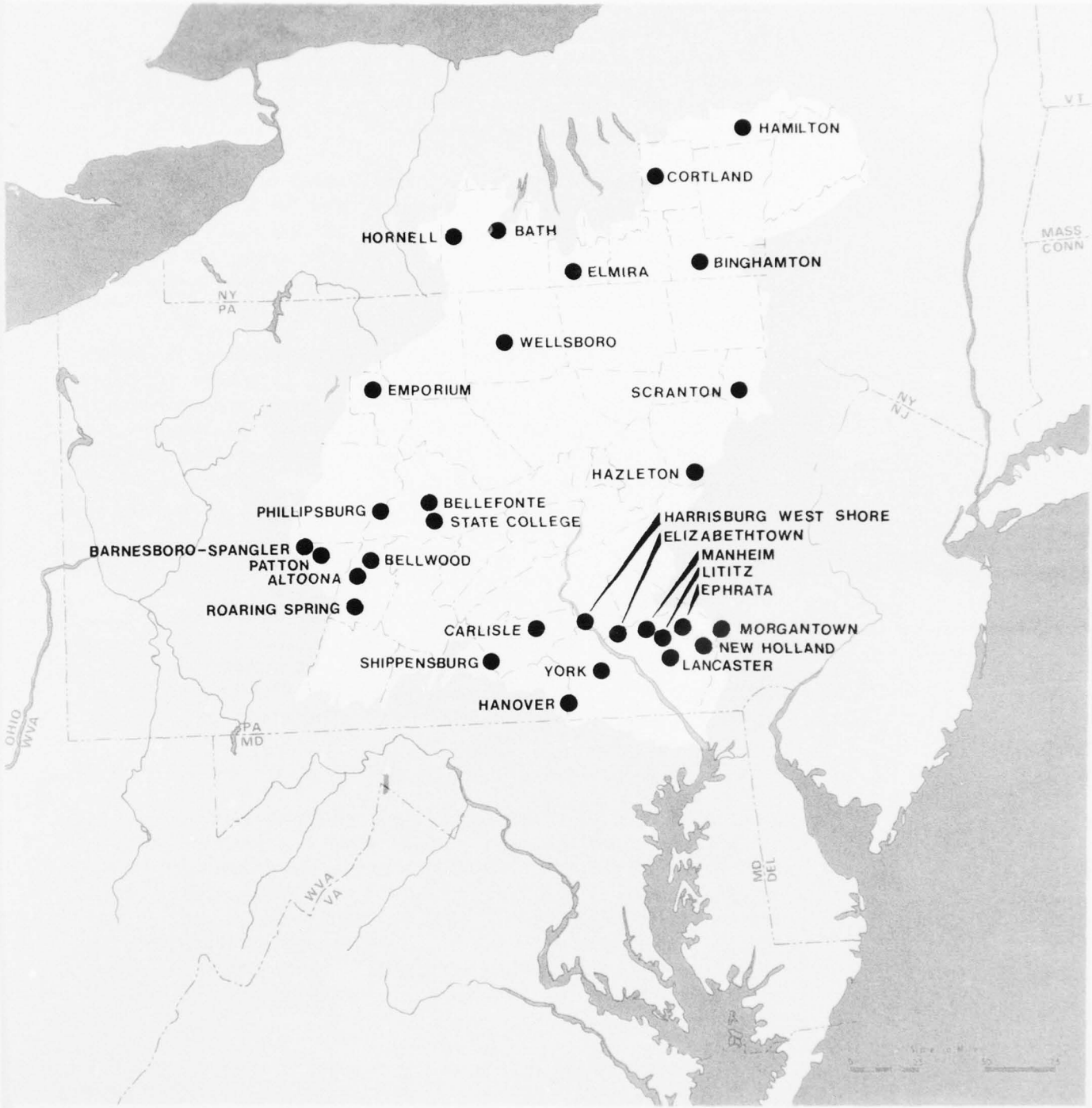


Figure 38 ---- Locations of Projected Water Supply Deficits

millions of dollars of damages are suffered regularly, and tens of millions more can occur under extreme flood conditions. Long stretches of the river through rural and forested areas have no protection at all, and it would be impractical to provide protection there. Thus, much of the potential

future damages are stretched out over many miles, but, in sum, they are large. Most future damages will be concentrated in unprotected areas near large population centers as these places grow and put more pressure on the surrounding land, some of which will be in the flood plain. In some cases, structural protection will be desirable, but the need for non-structural flood damage reduction measures is growing.

Over the next 50 years, taking into account existing and planned flood protection projects and taking into account the spreading of urban land uses and the increasing market value of land, average annual damages are projected to be $22.5 million (July 1969 Price Level), of which only about $1 million are agricultural damages. These damages are distributed as shown on Figure 2 in Chapter I.

The need then is to reduce this figure and to eliminate the human suffering and environmental damage that dollars cannot measure. The $22.5 million is at best a rough number and does not reflect possible lives lost, many regional business losses, the suffering of people that must be evacuated to live in temporary shelters, the erosion and silt problems, and many other losses that are part of a natural disaster.

E. Other Needs

There are many other water resource needs in addition to these four-top priorities. Land treatment, streambank stabilization, sediment reduction, electric power, thermal pollution abatement, commercial navigation, and the need for adequate flows into Chesapeake Bay to maintain its sensitive ecological balance are all important to varying degrees.

Land Treatment

In the broadest sense, land treatment and management is needed on every square inch of land in the Basin. Good land practices should be carried out as a matter of course by all public and private land owners. However, because of gross misuse of the land in the past, continuing misuse in some cases in the present, and occasional natural problems, land treatment needs special attention in many locations. These locations are usually where the land has been disturbed by various kinds of mining, where poor farming techniques have been used, and where land use has changed from one type to another.

The most pressing need is for the revegetation of 140,000 acres in the Basin where mining---mostly coal, but also sand, gravel, stone, and other quarries---has left the land barren allowing the rain to easily carry tons of sediment into the streams.

Beyond this, 70 percent (6.7 million acres) of the forest land, 65 percent (2.7 million acres) of the cropland, and 60 percent (1.0 million acres) of the pasture land needs improvement. The forest land needs fire control, reforestation, grazing control, erosion control, insect and disease

control, protection from improper cutting practices, and hydrologic stand improvement. On the cropland, problems of excess water, erosion, and unfavorable soil conditions could be corrected with improved management measures. Similarly, on pasture land, establishment (or re-establishment) of vegetative cover, protection from overgrazing, control of woody or noxious plant encroachment, and draining excess water could reduce erosion and increase the usefulness of these areas.

Streambank Stabilization

Streambank stabilization is needed in a few places along streams in the Basin. Through streamside erosion, many acres of farm and forest land will gradually be carried down the stream. In addition to destroying land, this adds to the sediment problem in the rivers. This is, however, a relatively small, local problem throughout the Basin.

Erosion Control

One of the major benefits of all types of land treatment is the reduction of erosion. Erosion is a natural process that cannot, nor should be, eliminated. But where man has changed or removed the vegetative cover the natural rate of erosion speeds up and may become a serious problem, simultaneously reducing soil fertility and reducing the efficiency of stream channels where it is deposited. The land treatment just discussed will help reduce excess erosion. Yet, it has been estimated that a large portion of the 3 million tons of sediment carried annually by the Susquehanna into the Chesapeake Bay comes from only 140,000 acres of "critical areas." These are primarily abandoned strip mines, but also include old quarries, sand pits, deep mine refuse piles, and other land left with little or no vegetative cover to protect it from direct contact with rainfall. By improving a relatively small land area, major benefits could be realized.

Power

Electric power needs are projected to grow nearly six times by 2000 and nearly 16 times by 2020. Most of the needed capacity will be met by some form of thermal generation, although hydro-electric production still has some potential, particularly in pumped storage projects. There is a need to assess hydro-electric power production to find out where it can economically fit in with power production from fossil and nuclear fueled thermal power plants.

Since most increases in power production in the near future are likely to be supplied by thermal power plants, considerable volumes of water will be used, heated, and discharged by these plants, particularly nuclear plants. Power companies are required to cool this water before returning it to the streams. However, present cooling methods cause the evaporative loss of substantial amounts of water, as can be seen in Figure 39. Two difficult

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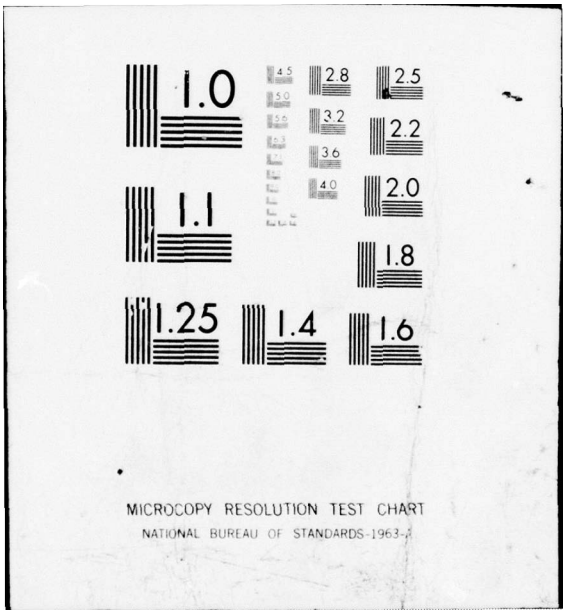
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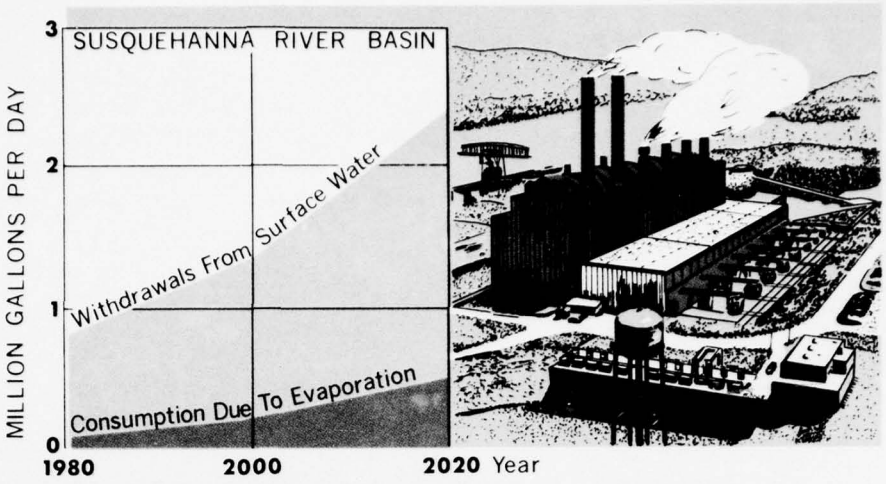


Figure 39 ---- Power Plant Cooling Water Needs and Consumptive Use, 1980--2020

environmental problems arise: 1) Large evaporative losses of water can reduce flows in the Susquehanna in later years, affecting water quality, water supply, and recreation. 2) Even when cooled to the levels required by the States, there is considerable debate concerning effects on the ecology of streams; this question must be studied, for in future years large proportions of water bodies may, in effect, be passed through power plants.

Navigation

While commercial navigation was important in the economic history of the Susquehanna, it is not a feasible use of the river today. The power dams on the lower Main Stem block use of the river above Conowingo Dam, and in any case, the railroad network is more than adequate to serve the freight needs of the Basin.

Chesapeake Bay

There is one last need which is of extreme importance. Eighty-five percent of the fresh water input to Chesapeake Bay above the mouth of the Potomac River comes from the Susquehanna, and any significant changes brought about by upstream development could affect the present ecological balance. From this point of view, although it was determined that the Coordinating Committee Plan will not have very large effects on the flow, there is a continuing need for careful study of any effects upstream development will have. Changes may or may not have adverse effects, but this must be determined before significant changes are made.

CHAPTER IV
Plan Formulation and Public Involvement

A. Background for Planning

The Susquehanna River Basin Study Coordinating Committee began early in 1966 to put together a plan to meet the present and projected water and related land resource needs of the Basin. This was a time when Americans were becoming increasingly concerned about the use and abuse of natural resources. The traditional "market-place" values applied to water resources development were being questioned because of their distorting influence on the planning and development process.

Evidence of the call for a new approach had been building for some years as the Susquehanna plan formulation effort began. Senate Document 97* in 1962 voiced many of the popular concerns for wise and equitable development of water resources, for preservation of important natural and cultural values, and for consideration of the overall well-being of the people in water resource use. This important policy statement was followed in 1965 by a number of significant legislative actions that began to shape a new planning direction for the Susquehanna Study. The first of these was the Appalachian Regional Development Act (Public Law 89-4), signed into law in March 1965. This act recognized the need to address the special problems of a broad regional area where resources are abundant, but where the national prosperity has eluded most of its people.

Following the Appalachian Act came, in July 1965, the Federal Water Project Recreation Act (Public Law 89-72). This act afforded water-based recreation and fish and wildlife an enhanced status in relation to the more traditional Federal project purposes of navigation, flood control, and reclamation. In addition, it established an equitable basis for local sharing of recreational and fish and wildlife enhancement costs at Federal projects. Also in July of 1965, the Water Resources Planning Act (Public Law 89-80) became law. This legislation established the Water Resources Council to coordinate Federal policies, standards, and procedures; afforded a means for establishing river basin commissions to prepare comprehensive plans; and provided authority for planning grants to assist the States in their efforts to improve their water resource planning and development capabilities. In October, the Water Quality Act of 1965 (Public Law 89-234) increased

* "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources," prepared under the direction of the President's Water Resources Council, Washington, D.C., 1962.

the emphasis on improving the overall quality of the Nation's water resources by establishing a national policy for prevention, control, and abatement of water pollution.

One immediate effect of the new legislation was to force recognition of the need to examine the planning process to see that it would be responsive to popular concern. This triggered two significant additional documents early in 1966 that raised fundamental questions concerning water resources planning. In February of 1966, the Civil Works Study Board's report to the Secretary of the Army* recommended a number of important changes in the planning process as it applied to the Corps of Engineers, including increased consideration and presentation of alternatives. At about the same time the Committee on Water of the National Academy of Sciences---National Research Council, published "Alternatives in Water Management."** This report dealt in some depth with the treatment of alternatives in planning for the development of the Nation's water resources, as well as with a number of basic planning attitudes, or principles, that warranted increased attention. The message of the latter two documents was not lost on the Susquehanna Coordinating Committee as they approached the plan formulation stage of the Study; innovations in the planning process would be required.

B. Plan Formulation

Figure 40 illustrates the place of plan formulation in the course of the Susquehanna Study. Data were collected on streamflows, flood damages, recreational visitation, water supply facilities, ground water availability, sewage treatment facilities, and so on. At the same time, information was developed on potential alternatives, such as pipelines, and sites for reservoirs of all sizes, as well as on management programs that relate to water resource problems. Also, an assessment of how the economy of the Basin would change over the next 50 years was made. From these economic projections came the quantitative evaluations of the water resource needs of the Basin, and the geographic location of these needs. The plan formulation process, then, fits the alternative projects and programs to the needs as they are expected to develop over the next 50 years. This is done in the context of broad, but defined, planning objectives.

The Coordinating Committee assigned the task of objectively matching the alternative solutions with the needs to a Plan Formulation

**"A Report to the Secretary of the Army by the Civil Works Study Board," printed for the Senate Committee on Public Works, Washington, D.C., 1966.

***"Alternatives in Water Management," A Report of the Committee on Water, Division of Earth Sciences, National Academy of Sciences-National Research Council, Washington, D.C., 1966.

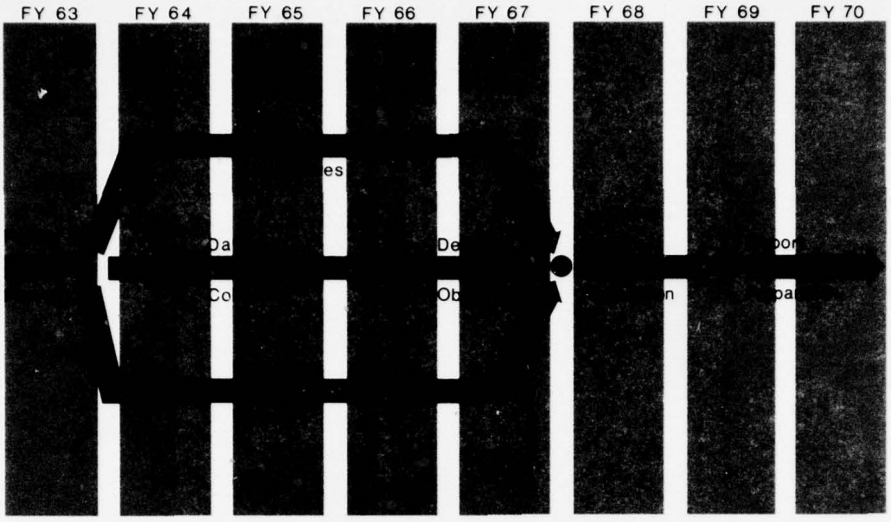


Figure 40 ---- Course of Susquehanna River Basin Study

Workshop which was made up of resource professionals representing the participating Federal agencies and States. They came from many disciplines associated with natural resources, and many had lived and worked in the Susquehanna Basin for years. The human and ecological element was injected into the plan formulation process throughout, and while it cannot be described in precise technical terms, its presence was evident in the final project selections.

The task of defining the objectives (shown in Figure 40 as preceding plan formulation) set in motion the first of two significant innovations intended to improve the planning process for the Susquehanna River Basin Study. The first was a decision to adopt an explicit multiple-objective approach to plan formulation. The other was a conscious attempt to increase the public interest and role in selecting the Plan for the Basin.

Figure 41 below shows the plan formulation process in more detail. It shows the incorporation of three broad objectives which encompass a range of interests in the Basin, and of public discussions which took place before the Coordinating Committee Plan was made final. The Plan Formulation Workshop prepared three separate "response systems" for each objective as a means of developing an improved understanding of the response of alternative selections to each objective. After this stage, the Workshop prepared a plan based on a blend of the objectives as appropriate to different portions of the Basin. This was submitted to the Coordinating Committee for review and modification. At this point, the public discussions of the proposals (called the Susquehanna Prospectus) began, backed by a broadened base of information on alternative solutions. The Coordinating Committee was to make its final decision on a plan only after this phase was completed.

The individual steps in plan formulation shown in Figure 41 warrant further explanation, beginning with the three objectives and their "response

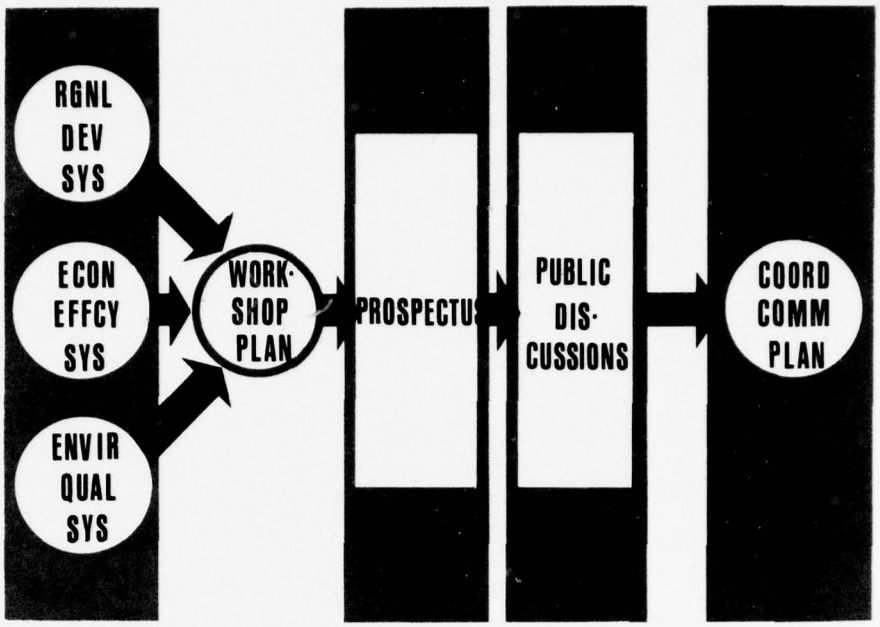


Figure 41 ---- Plan Formulation - Susquehanna River Basin Study

systems." The Coordinating Committee adopted these objectives to help assure that plan formulation would consider adequately a wide range of alternative solutions to water resource problems.

Environmental quality recognizes the concern for healthful and attractive surroundings. It reflects the importance of preserving scenic, cultural, historical, archeological, and wilderness values for the enjoyment of people, and the need for restoring and improving the less healthy and attractive areas----those scarred by mining, pollution, and improper land use. This objective has gained increasing popularity and concern in the Nation in the last few years, and is reflected by a decreased reliability on economic efficiency as a basis for decision.

Environmental quality combines both aesthetics and economics; it realizes that some portion of the natural environment will have to be altered to promote economic growth and development. The environment, however, cannot be totally sacrificed to the interests of economic gain as has so often happened in the past.

For the *regional development* objective, the planning viewpoint focuses on the Susquehanna Basin. It is an attempt to reflect the regional concern for programs of greatest benefit to a selected portion of the country. The Susquehanna Basin includes about 23,000 square miles in the Appalachian region, which is 80 percent of the entire Susquehanna drainage area.

The regional development objective was intended to concentrate on geographic areas or growth centers where the economy could be stimulated by water and related land resource development. One problem is that water

and related land resources development is only one of a number of means of stimulating the economy. Its success would depend on the availability of labor and investment in other sectors of development. In spite of these difficulties, both the Appalachian Regional Development Act and Senate Document 97 call for this objective to be included and for an attempt to be made to examine its impact on selection of measures in the Plan.

The *economic efficiency* objective reflects the concern that water resource investment be placed where it will do the most good in the long run for the national economy. Since economic efficiency has formed a firm basis for most Federal water resource planning efforts since the early 1950's, its importance as an established planning objective becomes clear, even though there has been considerable recent criticism of the type of analysis that is used to formulate solely for this objective.

Guidelines for the economic efficiency response system, are spelled out in the "Green Book."* Formulating for the economic efficiency objective, if carried to completion, would result in a plan which would maximize the net return of market-place goods and services from the national point of view.

The previous chapter outlined the water resource needs for the Susquehanna River Basin as the difference between the capacity of the existing and planned resource development and the projected demands in the Basin for these resources. The goal of the plan formulation task was to devise the apparent best system of measures to serve the growing population and economy projected through the year 2020. Such a plan conceivably could be produced by inserting all the "necessary" data into a vast computer system and asking the machine to turn out the most "efficient" answers in accordance with strict mechanical rules. There is a great deal more at stake, however, than just finding efficient answers. Political, social, and environmental factors must be considered and weighted against the engineering and economic factors, while evaluating a wide range of alternatives, to create a plan that is acceptable as well as feasible and efficient. This more intangible planning task is beyond any computer's capability.

The Plan Formulation Workshop developed a different set of criteria or "ground rules" for each of the three objectives, and for each water resource need category. This explicit testing of alternatives using different basic viewpoints had not been tried in a similar study. The screening of projects or programs earlier in the formulation phase eliminated alternatives that would be clearly impracticable to implement, particularly over the next 10 or 15 years. Eliminated in this screening were such measures as weather modification, due to its unreliability to solve specific problems in the Basin, and desalinization, since it could not meet the criteria of any of the objectives in competition with a broad range of alternatives. Three "response systems" were developed that were notably different for many

*Report to the Inter-Agency Committee on Water Resources prepared by the Subcommittee on Evaluation Standards, "Proposed Practices for Economic Analysis of River Basin Projects," Washington, D.C., Rev. Ed. May 1958.

parts of the Basin. The extent of difference reflected the sensitivity of selection among alternatives to the basic objectives; the points of similarity indicated that some alternatives would be responsive to a wide range of differing objectives. Additional information on these "response systems" and the criteria used for each are contained in Supplement A.

To combine the three response systems into a meaningful Plan, the Coordinating Committee designated compatible objectives for different portions of the Susquehanna Basin. Some areas would be more compatible with the environmental quality objective, for instance, while others to regional development or economic efficiency, depending on present development, resources, and economic health. This geographical blending of the three objectives was the basis for formulating the Susquehanna Prospectus that emerged in December 1968 as a central focus for public review and response, prior to the Coordinating Committee deciding on a final Basin Plan.

C. Public Involvement

The Coordinating Committee clearly recognized that the Basin's citizens have responsible opinions, when they are given adequate information, on how their rivers and streams should be developed. Determining these opinions requires a program to provide information to the public and to receive its reply, a time-consuming and unpredictable task not consciously attempted before in a comprehensive water resources planning study of a major river basin. The task was made more difficult because new ground had to be covered over a path where mistakes would be made before new lessons could be learned.

A research team from the University of Michigan School of Natural Resources was engaged to help set up and evaluate a program of identifying and informing interested persons who might best be able to express local preferences for planning objectives and alternatives. At the beginning of planning, some public communication was already underway. In 1963 seven public hearings were held to gain the sense of public sentiment at the outset

of the Study. The general meetings of the Coordinating Committee had been open to the public, and the Committee periodically published a newsletter. Many personal contacts had also been made as needed. These efforts, however, were not enough to do an adequate job of informing the public; a broader program was needed.

The question was raised of what audiences the Coordinating Committee wanted to reach. Some of those identified were:

- The planning commissions and agencies (county and regional), not solely concerned with water.
- Elected officials representing the general public.
- Organizations representing special interest groups.
- Individuals who shape public opinion and stimulate action.
- Those who review recommendations, up to the Congress of the United States.

The Committee knew it could not include all of these groups, since resources and time were limited. Two basic groups were therefore selected: the local planning agencies and the general public. The review levels were not selected as a direct target of the public information program, since they would receive the final report reflecting the public involvement.

The items selected to carry out the public information program were: an updated *leaflet* describing the study, a renewed *newsletter* series, a series of closed local planning *workshops,* a series of *Public Forum* meetings, and a *brochure* describing the Early Action Plan. The local planning workshops and the Forums were the two most significant efforts, and were the type of activity not attempted in past comprehensive river basin studies as a part of the planned study effort. Both warrant further discussion here. Appendix A describes the overall public information program for the Study at still greater length.

In the series of workshops held throughout the Basin early in 1969, the Prospectus, with alternatives, was presented to local planners, officials, and other interested local leaders to seek their reactions and to find out if the Prospectus accurately met local water and related land resource needs as they saw them, and in a way that was compatible with their plans and attitudes. The local planning workshop meetings provided local leadership an opportunity to learn more about their water problems and some possible solutions. The workshops also sharpened understanding of the Federal and State planning staffs for the principal concerns of the local leaders.

Changes in the Prospectus resulting from the series of local planning meetings formed the basis for a revised Prospectus which was presented to the general public at nine regional Public Forums at key locations throughout the Basin. These Forums were intended to reach the public

at large, not only through attendance at the meetings, but through adequate news media coverage prior to, during, and after the Forums. The response from these Forums was valuable not only in terms of specific changes that were made in the Prospectus, but also in terms of the less tangible, and more far reaching improvement in communications between the Federal and State planners, and the local interests that would be most directly affected by the recommended Basin Plan. Even though all requested changes could not be accommodated, the Plan results clearly seemed to reflect citizen preferences and expectations to a greater degree than before the public discussions began, and confirmed that, on the whole, the Propsectus was in keeping with the public's desires.

The public information program achieved the following results: communication between the public and the planning staff was substantially improved; a number of locally significant adjustments were made in the Plan; the confidence of the local leadership in the planning staff was improved; and the realization was gained that value judgments of the planning staff must be in line with those of the affected citizens to gain their acceptance of technical judgments.

CHAPTER V
The Comprehensive Plan for the Basin

As discussed in Chapter IV, the Plan blends the objectives of environmental quality, regional development, and economic efficiency. Some features of the Plan cannot satisfy all three objectives simultaneously, but relatively few real conflicts of objectives remain when considering the entire Basin's needs and natural resources.

The following pages present each element of the Basin-wide Plan. The Early Action Plan, which is recommended for immediate implementation is presented first, followed by the Framework Plan which is recommended as a guide to future planning.

A. The Early Action Recommended Plan

The Coordinating Committee recommends that the Early Action Plan be implemented as soon as possible. The need for these measures is urgent, and all local, State, and Federal agencies should begin more detailed planning immediately to effect these recommendations by 1980.

Structural Measures

A total of 304 structural projects or programs are recommended for construction in the Susquehanna River Basin in the next 50 years, over one-half of which are recommended in the Early Action Plan. The recommended structural measures fall into seven categories:

1. Water quality measures, including advanced waste treatment, coal mine drainage pollution abatement, and low flow augmentation;

2. Major multiple purpose dams and reservoirs for various combinations of water supply, recreation, flood control, fishing, irrigation, and flow augmentation purposes;

3. Reservoirs for recreation and fish habitat, some of which may contain flood control, flow augmentation, water supply, or wildlife benefits (these include large and small tributary reservoirs and low channel dams);

4. Municipal and industrial water supply measures, including ground water development, pipelines, and a reservoir;

5. Local flood protection projects consisting of channel improvements, levees, and walls, in different combinations;

6. Upstream watershed programs which involve land treatment in conjunction with one or more impoundments for various purposes; and

7. Other structural measures which include bank stabilization projects where there are particularly bad erosion and sediment problems, and ground water development for irrigation.

TABLE 6

EARLY ACTION PLAN STRUCTURAL MEASURES
BY SUB-BASIN: 1970-1980

Sub-basin	I	II	III	IV	V	VI	VII	VIII	TOTALS
Water Quality Measures									
Mine Drainage Pollution Abatement	0	1	2	4	3	1	1	1	13
Advanced Treatment	0	0	0	0	2	4	2	16	24
Major Multiple Purpose Reservoirs	3	2	0	0	0	0	1	0	6
Reservoirs for Recreation and Fish Habitat									
Low Channel Dams	0	0	1	0	1	1	1	0	4
Small Tributary Reservoirs	14	8	12	5	10	4	1	8	62
Municipal and Industrial Water Supply Measures									
Ground Water	1	1	1	2	1	3	0	6	15
Pipelines	0	0	1	0	0	0	1	2	4
Reservoirs	0	0	0	1	0	0	0	0	1
Local Flood Protection Projects	1	1	2	1	1	0	0	1	7
Upstream Watershed Programs (Number of Reservoirs)	2(4)	1(4)	3(5)	0(0)	1(1)	0(0)	1(1)	1(4)	9(19)
Others									
Ground Water for Irrigation	0	1	0	0	0	0	0	2	3
Bank Stabilization	1	5	6	0	2	0	0	0	14
TOTALS	22	20	28	13	21	13	8	37	162

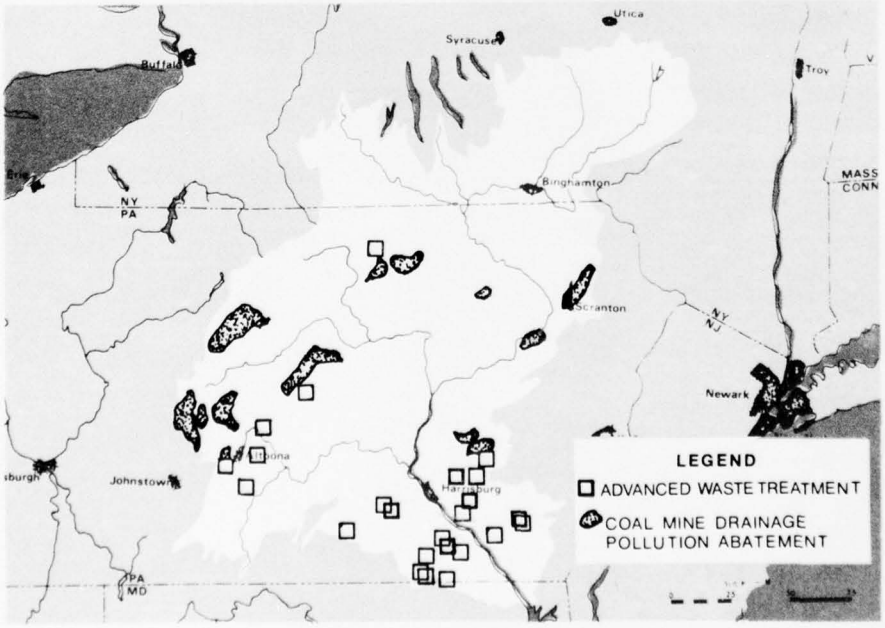
Table 6 above shows the number and type of projects recommended for each sub-basin for the early action period. These projects are shown together on Figure 4 in Chapter I.

Water Quality Measures

Coal Mine Drainage Pollution Abatement. Thirteen abatement projects shown on Figure 42 are recommended in Pennsylvania. The Committee does not now have the detailed information necessary to specify how the abatement is to be accomplished on each of the 13 watersheds. The estimated costs of abatement are based on a combination of preventive measures and on a lime-neutralization treatment process which appears to be the most successful treatment process to date. A detailed study by the Corps of Engineers, now underway, is aimed at determining the specific solutions to this problem, and its completion is important to carrying out this recommendation. The estimated cost of abatement is $103 million.

Sub-basin II:	Tioga River.
Sub-basin III:	Lackawanna River, Wyoming Valley.
Sub-basin IV:	Upper West Branch Susquehanna River, Chest Creek, Clearfield Creek, Bennett Branch Sinnemahoning Creek.
Sub-basin V:	Babb Creek, Loyalsock Creek, Beech Creek.
Sub-basin VI:	Beaverdam Branch.
Sub-basin VII:	Mahantango Creek.
Sub-basin VIII:	Swatara Creek.

Figure 42 ---- Early Action Plan Water Quality Measures



Waste Treatment Facilities. The construction of waste treatment plants and associated collection facilities at many sewage service areas is needed to meet existing State and Federal water quality standards, where they have been established, and to meet the standards adopted for this Study. Since the States are requiring all sewage service areas to install adequate treatment where needed (many areas already have plants under construction or in advanced planning, and the remainder are under orders to initiate action), the Coordinating Committee recommendations are limited to those places where conditions indicate the need for new or expanded advanced waste treatment plants to meet water quality standards. Recommendations for new advanced waste treatment for 20 sewage service areas and expanded advanced waste treatment for four sewage service areas are listed below and shown on Figure 42. The total estimated cost for these projects is $158 million.

Sub-basin V:	Bellefonte, Wellsboro.
Sub-basin VI:	Tyrone, Roaring Spring, Altoona (Southwest), Williamsburg.
Sub-basin VII:	Shippensburg, Carlisle.
Sub-basin VIII:	Spring Grove, York, Dallastown-Yoe, Lebanon, Annville*, Lititz*, Elizabethtown, Lancaster (River), Mt. Holly Springs*, Lancaster (South), New Holland, Red Lion, Fredericksburg, Hanover, New Freedom-Shrewsbury, Penn Township*.

*Expand existing facilities.

In addition, the Coordinating Committee recognizes the need for new and expanded primary and secondary treatment facilities. Most communities are under State orders to provide this treatment within the

TABLE 7

EARLY ACTION PRIMARY AND SECONDARY TREATMENT, AND COLLECTION FACILITIES NEEDED BY SUB-BASIN

Sub-basin	I	II	III	IV	V	VI	VII	VIII	TOTALS
Primary Treatment Plants	0	0	1	2	1	0	8	0	12
New & Expanded Secondary Treatment Plants	7	1	6	4	9	12	3	6	48
New & Expanded Collection Facilities	9	7	14	4	12	19	7	30	102
TOTALS	16	8	21	10	22	31	17	36	162

next few years. Collection facilities (new sewer pipelines) that are an integral part of any sewerage system will, of course, be needed along with treatment facilities. While these are not part of the recommended Plan, they are being listed because of the extraordinary contribution they will make to environmental quality. Table 7 above lists those facilities needed to meet State requirements in the next few years. Those places with adequate existing plants, or plants under construction or in advanced planning are not counted. The locations of these plants are listed in Appendix K(2). The estimated cost for the treatment facilities is $192 million while the collection systems cost is $704 million. These costs are not part of the Coordinating Committee Plan.

The potential for combination of some of these individual service area plants into regional systems is indicated in Supplement B. Potential savings in first and operating costs, as well as in treatment reliability and efficiency, warrant further detailed study of the impact of regionalization.

Low Flow Augmentation. Storage for low flow augmentation to enhance water quality is included in five of the six major multiple purpose reservoirs discussed below.

Major Multiple Purpose Reservoir Projects

The Early Action Plan calls for six dam and reservoir projects on major tributaries of the Susquehanna River to provide flood control, water supply, and low flow augmentation, as well as recreation and fishing. These projects are shown on Figure 43. Five of the projects would reduce annual flood damages by over $1.5 million. Water stored in the reservoirs could be released during the River's low flow periods for water supply, improvement of water quality, and irrigation. Over 7 million recreation days a year and nearly 775,000 fishing days a year would be provided by the projects by 2020. The estimated costs of these projects total $173 million.

The Charlotte Creek Development Complex in Delaware County (Sub-basin I) contains two impoundments: a multiple purpose reservoir (121) and a single purpose reservoir for recreation (T-2). The latter is listed under "Small Tributary Reservoirs." Operation of the larger reservoir, 6 miles above Oneonta, would significantly reduce flood damages downstream to the mouth of the Chemung River, particularly at Oneonta and Unadilla. Releases during low flow periods would furnish water supply and aid in the maintenance of State water quality standards. This project would also provide recreation and fishing on and around its permanent 2,350 acre pool.

South Plymouth Reservoir (114) would be located on Canasawacta Creek 2 miles above Norwich in Chenango County (Sub-basin I). Its flood control capability would reduce flood damages at Norwich, Oxford, and Greene and other downstream points. In addition, the reservoir would furnish some limited but needed water supply at Norwich. Recreation and fishing would be provided on the 565 acre lake.

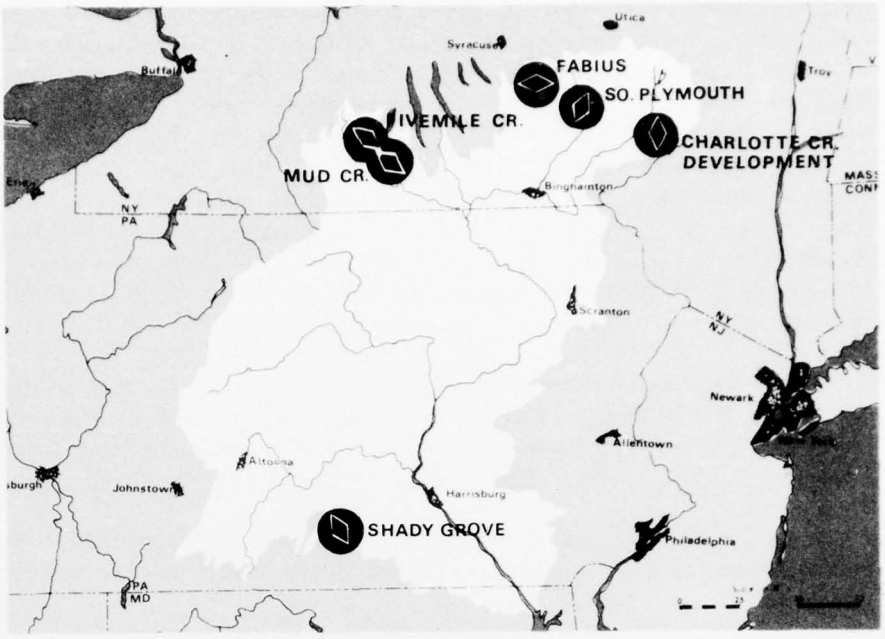


Figure 43 ---- Early Action Plan Major Multiple Purpose Reservoir Projects

Fabius Reservoir (49-28), about 16 miles northeast of Cortland, would be located on the West Branch Tioughnioga Creek, a tributary of the Tioughnioga River, in Cortland County (Sub-basin I). This project would reduce flood heights, especially at Cortland, and would also contribute some needed low flow augmentation for water quality improvement. Recreation would be provided on a permanent 1,300 acre pool.

Mud Creek Reservoir (96), on Mud Creek, about 3 miles northeast of Savona, in Steuben County (Sub-basin II), would furnish low flow augmentation for water quality and water supply in the Corning-Elmira area. It would aid in the control of floods along the Cohocton River, and would provide recreation and fishing on a permanent pool of 2,050 acres.

Fivemile Creek Reservoir (97) is upstream from the Village of Bath in Steuben County, New York (Sub-basin II). This reservoir would provide flood reduction at Bath as well as downstream along the Cohocton, low flow augmentation for water quality and water supply, and would furnish recreation and fishing on its 1,100 acre lake.

Shady Grove Reservoir (12) would be located on Conodoguinet Creek, about 4 miles from Shippensburg, in Franklin County, Pennsylvania (Sub-basin VII). Its principal function would be to supply water to meet growing demands at Carlisle and the Harrisburg West Shore area. The reservoir would also furnish water for irrigation in the valley and some low flow augmentation to help maintain water quality standards in the Carlisle area. It would provide considerable recreation and fishing opportunity on its 2,250 acre pool.

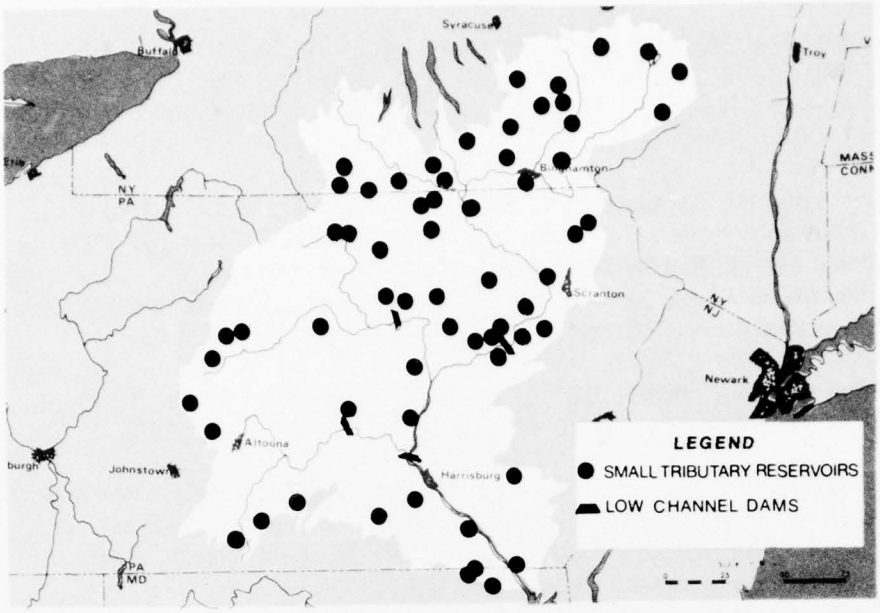


Figure 44 ---- Early Action Plan Reservoirs for Recreation and Fish Habitat

Reservoirs for Recreation and Fish Habitat

Low Channel Dams. Four low channel dams in Pennsylvania, shown on Figure 44, will provide a total of 6,300 acres of new water surface for boating, and afford the opportunity for 6.8 million annual recreation days for general recreation by 2020. These impoundments and the initial recreational facilities would cost $11 million initially and $60 million for additional recreational facilities in the framework period.

Sub-basin III:	Berwick.
Sub-basin V:	Williamsport.
Sub-basin VI:	Lewistown.
Sub-basin VII:	Duncannon.

Small Tributary Reservoirs. Sixty-two small tributary reservoirs (each with less than 25,000 acre-feet of storage) are recommended for construction: 20 in New York, 38 in Pennsylvania, and 4 in Maryland. These projects vary in size from 30 acres to 1,100 acres. The reservoirs will provide 14,300 acres for 12 million recreation days and 1 million fisherman-days by 2020. Some of the projects would also provide limited flood control for upstream areas. These reservoirs and their initial recreational facilities would cost $100 million. They are shown on Figure 44.

Sub-basin I: Charlotte Creek (T-2; part of Charlotte Creek Development with 121), Bundy Creek (49-22), East Branch Canasawacta Creek (50-8), Beaver Creek (51-15), Allen Lake tributary to Otsego Lake (53-6), West Fork Little Snake Creek (027-6), Still Creek (030-9A), Mud Pond Run (NY30-3), Tributary to Crocker Creek (NY31-2), Nanticoke Creek (NY31-4), Michigan Creek (NY48-4), Five Streams (NY50-3), Mill Brook (NY50-4), Oak Creek (NY52-1).

Sub-basin II: North Branch Tuscarora Creek (44-4), South Branch Tuscarora Creek (44-7), Buck Creek (012-1), Tributary to Fall Creek (012-8), Wynkoop Creek (033-1), Hendy Creek (035-1), Baldwin Creek (NY33-3), Elk Creek (NY44-1).

Sub-basin III: Beaver Run (34-3), Green Creek (36-13B), East Branch Lackawanna River (37-20), East Branch Tunkhannock Creek (38-10), Sugar Creek (41-7), Wapwallopen Creek (07-7), Harvey's Creek (08-4), Little Shickshinny Creek (08-9),Buttermilk Creek (010-15), Parks Creek (011-5), Little Wapwallopen Creek (Andy's Pond), Briar Creek (PA499).

Sub-basin IV: Beaver Dam Run (19-1), Bigler Run (20-7), Beaver Run (20-11), Gifford Run (025-1), Alex Branch Trout Run (025-2).

Sub-basin V: Swamp Branch Big Run (16-1), Big Run (21-5), Little Muncy Creek (21-8), Loyalsock Creek (22-1), Mill Creek (22-4), Babb Creek (24-5), Turtle Creek (020-8), Larrys Creek (022-1), Left Branch Asaph Run (PA603), Right Branch Asaph Run (PA604).

Sub-basin VI: North Branch Little Aughwick Creek (8-4), Sideling Hill Creek (8-8), Shaffer Creek (10-11), Meadow Creek (016-3).

Sub-basin VII: West Mahantango Creek (014-1A).

Sub-basin VIII: Island Branch Deer Creek (1-1), Deer Creek (1-5A), Stout Bottle Branch (1-6), Stoney Run (4-2), Mountain Creek (4-11), Cocalico Creek (30-2), Conowingo Creek (01-4), Cabin Creek (02-7).

Municipal and Industrial Water Supply Measures

Ground Water. There are 15 wellfield developments recommended for municipal and industrial water supply, as shown on Figure 45. These ground water developments would cost $13 million initially, and $66 million additional for expansion in the framework period.

Sub-basin I:	Cortland.
Sub-basin II:	Hornell.
Sub-basin III:	Hazleton.
Sub-basin IV:	Barnesboro-Spangler-Patton, Emporium.
Sub-basin V:	State College.
Sub-basin VI:	Altoona, Bellwood, Roaring Spring.
Sub-basin VIII:	Elizabethtown, Morgantown, New Holland, Ephrata, Lititz, Manheim.

Pipelines. Four pipelines are recommended for municipal and industrial water supply (Figure 45). They would cost $30 million initially and $49 million additional for expansion in the framework period.

Sub-basin III:	From the Susquehanna River to Scranton.
Sub-basin VII:	From Conodoquinet Creek to Shippensburg.
Sub-basin VIII:	From the Susquehanna River to York-Hanover; from the Susquehanna River to Lancaster.

Reservoirs. A single purpose water supply reservoir (18-3) on Little Laurel Run in Sub-basin IV is recommended for Philipsburg, Pennsylvania, (Figure 45). It would cost $2.3 million.

Figure 45 ---- Early Action Plan Municipal and Industrial Water Supply Measures

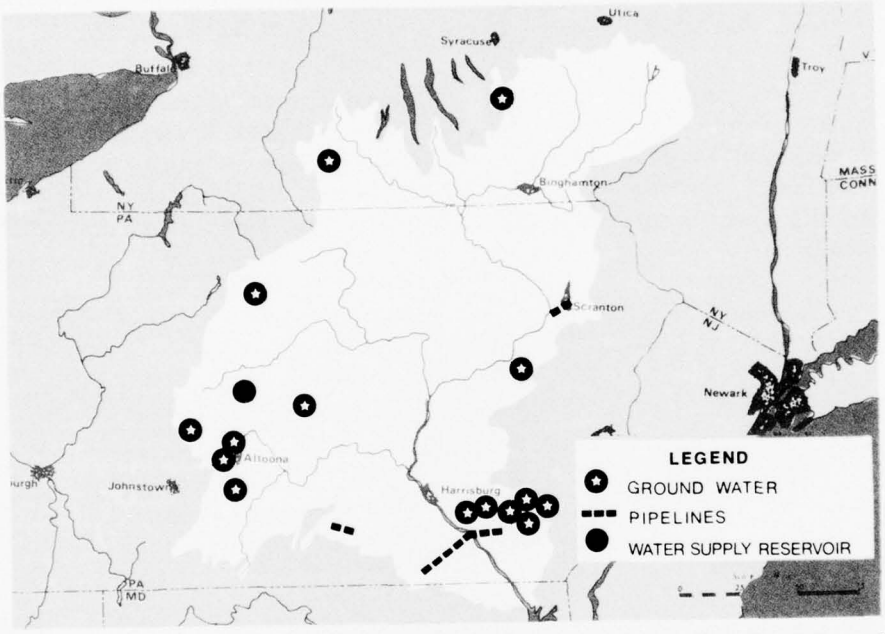
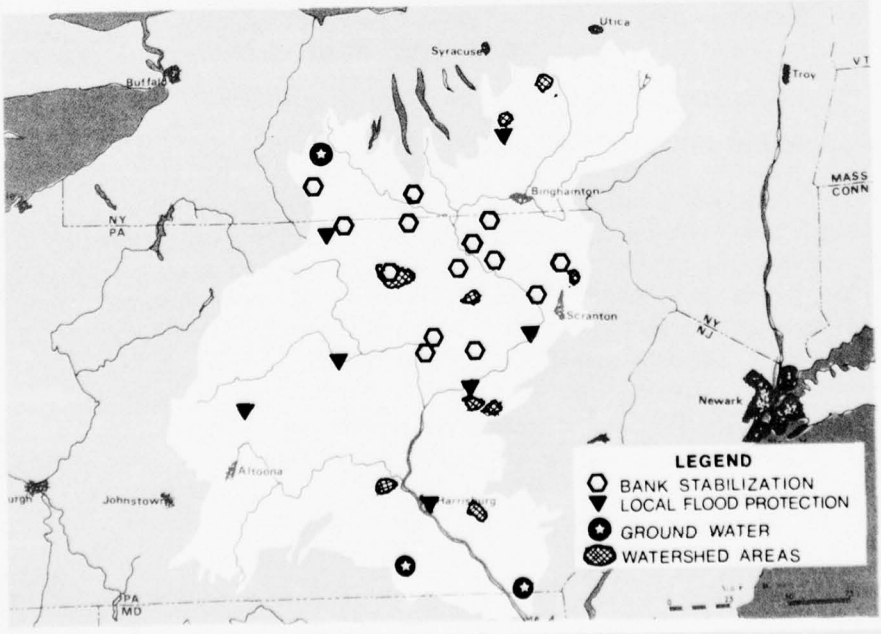


Figure 46 ---- Early Action Plan Flood Control and Other Structural Measures



Local Flood Protection Projects

Local flood protection projects at seven locations shown on Figure 46 are recommended by the Coordinating Committee. These projects would reduce average annual flood damages by approximately $1.2 million in these communities and reduce the danger of loss of life from flooding. They would cost $30 million.

Sub-basin I:	Marathon.
Sub-basin II:	Westfield.
Sub-basin III:	Wyoming Valley Levee System, Bloomsburg.
Sub-basin IV:	Philipsburg.
Sub-basin V:	Lock Haven.
Sub-basin VIII:	Harrisburg.

Upstream Watershed Projects

The Coordinating Committee recommends nine upstream watershed projects (Figure 46) including 19 small impoundments. Collectively these projects would provide average annual flood damage reductions estimated at $755,000, the opportunity for 318,000 annual recreation days initially, and the opportunity for 76,000 fisherman-days. They would cost $14 million.

Sub-basin I:	Trout Brook (49-15A, 49-34), Upper Otselic River (49-2, 49-3).
Sub-basin II:	Upper Tioga River (46-1, 46-2, 46-15, 46-16).
Sub-basin III:	Dundaff Creek (38-6), Crooked Run (34-9), Roaring Creek (06-6, 06-7, 06-8).
Sub-basin V:	Little Loyalsock Creek (22-6).
Sub-basin VII:	Little Juniata Creek (013-5).
Sub-basin VIII:	Chickies Creek (03-1, 03-3, 03-0, 03-9).

Miscellaneous Structural Measures

Ground Water for Irrigation. Ground water is recommended in three watersheds to meet the expanding irrigation needs in the early action period (Figure 46). About 13,000 acre-feet of available ground water storage will be needed to meet 1980 irrigation demands along these streams. These projects would cost $5 million initiaily and $9 million additional for expansion in the framework period.

Sub-basin II:	Cohocton River.
Sub-basin VIII:	Conewago Creek, Octoraro Creek.

Streambank Stabilization. The Coordinating Committee recommends 14 bank stabilization projects (Figure 46) which would cost $10 million.

Sub-basin I:	Wappasening Creek.
Sub-basin II:	Newtown Creek (Horseheads), Purdy Creek (Hartsville), Coal Run, Cowanesque River, Bentley Creek.
Sub-basin III:	Wysox Creek, Towanda Creek, East Branch Tunkhannock Creek, South Branch Tunkhannock Creek, Fishing Creek, Wyalusing Creek.
Sub-basin V:	Muncy Creek, Little Muncy Creek.

Management Measures

Land Management

Accelerated land treatment and management is recommended on 131,000 acres upstream from the recommended reservoirs and within recommended upstream watershed project areas. In addition, 49,000 acres of critical areas are recommended for accelerated treatment to reduce erosion and runoff, much of which is from abandoned strip mine spoil areas. The cost of this treatment program would be $7.3 million. These recommendations are over and above the on-going land treatment program involving almost 3 million acres of Basin land which will cost $70 million.

TABLE 8

EARLY ACTION LAND TREATMENT
(acres)

Sub-basin	On-going Land Treatment	Accelerated Land Treatment	Critical Area Treatment
I	609,000	27,000	300
II	341,000	31,000	700
III	329,000	25,000	10,000
IV	164,000	2,000	20,000
V	327,000	12,000	4,000
VI	326,000	8,000	2,800
VII	233,000	15,000	7,000
VIII	586,000	11,000	4,000
TOTALS	2,915,000	131,000	48,800

The agricultural lands of Lancaster County, Pennsylvania, represent a unique area of cultural, aesthetic, and economic value to the Basin. The Coordinating Committee, recognizing these values, recommends that no large disruptive reservoir developments be placed in the Lancaster County area south of the Pennsylvania Turnpike.

Stream Management

To meet a greater percentage of the anticipated 1980 demand for water-oriented recreation, as well as to preserve aesthetic and cultural values, the Coordinating Committee recommends streamside management on selected streams. This program includes a combination of preservation and recreational development for the stream reaches shown on Figure 6 in Chapter I. These selected reaches should be managed to maintain their scenic values and to enhance their recreational potential. In some cases, pollution abatement must be carried out before the full potential can be realized. The four management categories are: Wild, Scenic, Recreation, and Modified Recreation. In addition, streams reaches have been identified for their special value as either trout or warm-water fisheries.

The assigned category not only describes the potential of the stream, but also defines the recommended management.

Wild. Streams, or sections of streams, that are free of impoundments and relatively inaccessible except by trail. Their watersheds or shorelines must be essentially primitive and their waters unpolluted. A 16-mile portion of Beech Creek in Sub-basin V is the only stream in the Basin in this category.

Scenic. Streams, or sections of streams, that are free of impoundments but accessible in places by road. Their watersheds or shorelines must still be largely primitive and their waters unpolluted.

Sub-basin III: Schrader Creek (20 mi.), Bowman Creek (15 mi.), Mehoopany Creek (22 mi.), Fishing Creek (7 mi.).

Sub-basin IV: Black Moshannon Creek (16 mi.), Moshannon Creek (28 mi.), Clearfield Creek (20 mi.), West Branch Susquehanna River (62 mi.), Lick Run (10 mi.).

Sub-basin V: Young Woman's Creek (14 mi.), Pine Creek (16 mi.).

Sub-basin VI: Standing Stone Creek (12 mi.), Raystown Branch Juniata River (32 mi.), Tuscarora Creek (41 mi.), Clover Creek (14 mi.), Piney Creek (6 mi.).

Sub-basin VII: Penns Creek (24 mi.).

Sub-basin VIII: Octoraro Creek (14 mi.).

TABLE 9

MILES OF STREAMS RECOMMENDED FOR CATEGORIZATION IN THE SUSQUEHANNA RIVER BASIN PLAN BY SUB-BASIN

Sub-basin	I	II	III	IV	V	VI	VII	VIII	Total
Wild	0	0	0	0	16	0	0	0	16
Scenic	0	0	64	136	30	105	24	14	373
Recreation	53	31	72	99	147	68	13	107	590
Modified Recreation	271	58	16	0	33	78	147	101	704
TOTAL	324	89	152	235	226	251	184	222	1,683

Recreation. Streams, or sections of streams, that are readily accessible by road or railroad and have some development along their shorelines. These streams may have had some impoundments or diversions in the past.

Sub-basin I: Otselic River (17 mi.), Butternut Creek (26 mi.), Oaks Creek (10 mi.).

Sub-basin II: Cohocton River (31 mi.).

Sub-basin III: Susquehanna River (72 mi.).

Sub-basin IV: First Fork Sinnemahoning Creek (25 mi.), Sinnemahoning Creek (31 mi.), Kettle Creek (30 mi.), Clearfield Creek (13 mi.).

Sub-basin V: West Branch Susquehanna River (36 mi.), Beech Creek (11 mi.), Pine Creek (25 mi.), Loyalsock Creek (40 mi.), Fishing Creek (35 mi.).

Sub-basin VI: Standing Stone Creek (19 mi.), Aughwick Creek (28 mi.), Spruce Creek (21 mi.).

Sub-basin VII: Letort Spring (8 mi.), Big Spring (5 mi.).

Sub-basin VIII: Chickies Creek (12 mi.), Swatara Creek (35 mi.), Yellow Breeches Creek (47 mi.), Deer Creek (10 mi.).

Modified recreation. Streams, or sections of streams, that have some development along their shorelines. They may have had impoundments in the past and may have impoundments upstream, and low dams or diversions within the reach which do not interfere in any great way with public use of the stream and their surroundings.

Sub-basin I: Cayuga Creek (31 mi.), Chenango River (70 mi.), Susquehanna River (141 mi.), Tioughnioga River (29 mi.).

Sub-basin II: Cohocton River (19 mi.), Canisteo River (39 mi.).

Sub-basin III: Fishing Creek (16 mi.).

Sub-basin V: Lycoming Creek (33 mi.).

Sub-basin VI: Juniata River (78 mi.).

Sub-basin VII: Conodoquinet Creek (72 mi.), Susquehanna River (75 mi.).

Sub-basin VIII: Muddy Creek (15 mi.), Conestoga Creek (52 mi.), Pequea Creek (34 mi.).

Primary fishing. Streams, or sections of streams, which have the greatest potential for high quality fishing. The Committee recommends that no impoundments be built on primary trout streams, unless or until there is an urgent need for such development, and that only low channel dams be permitted on primary warm-water streams. These streams are also shown on Figure 6, and they are listed by Sub-basin in Supplement B.

The Coordinating Committee recommends that recreational facilities be developed on suitable land adjacent to all categories of streams generally in accordance with the design standards outlined in Appendix K(3). All recreational facilities to meet the "design load" should be installed on the one "wild" and all the "scenic" streams by 1980; "recreation" and "modified recreation" streams should receive 50 percent of the intended facility investment by 1980 with the exception of streams in Sub-basin VI where facility development may be postponed. The Committee also suggests that any recreational facilities on non-categorized streams be deferred until the period after 1980. By that time, facilities on some of these streams will be needed for meeting the unsatisfied recreational demand. Under this scheme, 8 million recreation days could be provided by 1980. The cost of land and facilities along these streams is estimated to be $28 million by 1980, and $26 million more in the framework period for expanded recreational facilities.

Flood Plain Management

Where the value of existing flood plain development is relatively high, close management of the use of the flood plains is, at best, only a limited substitute for adequate structural measures. Informed management can, however, significantly affect the rate of increase of such damages in the future and, in isolated cases, gradually reduce average annual losses over an extended period of time. Where damages are not concentrated or where values are relatively low, flood plain management must be the main measure to keep flood losses to a minimum. Even at locations where significant investments have been made, or are recommended, for structural means of reducing flood damages, management of the unprotected or partially protected lands nearby is a necessity.

For the unprotected flood plains now containing concentrated development, or having a potential for such in the future, the Coordinating Committee recommends an intensive management program. On the other hand, rural areas with scattered development would find an expanded, reliable warning and evacuation system to be adequate. All flood plain reaches were reviewed to determine the relative intensity of flood plain management required: (1) an intensive flood plain management program requiring zoning, building codes, flood proofing, ample warning, and temporary or permanent evacuation; or (2) a more limited program of warning and evacuation with only occasional use of further management measures.

TABLE 10

MILES OF STREAM RECOMMENDED FOR
FLOOD PLAIN MANAGEMENT
IN THE SUSQUEHANNA RIVER BASIN PLAN
BY SUB-BASIN

Sub-basin	I	II	III	IV	V	VI	VII	VIII	Totals
Flood Plain Management	211	53	113	29	175	199	139	328	1,249
Warning and Evacuation	296	184	298	227	141	128	65	0	1,339
TOTALS	507	239	411	256	316	327	204	328	2,588

The Coordinating Committee selected 111 areas (Figure 5, Chapter I) that would benefit most from intensive management practices and another 125 areas that would need only the more limited warning and evacuation program. From the 111 areas, the 17 listed below were selected as having high priority needs in the early action period: 13 because of high concentrated potential damages that could not be protected by structural means under existing practices. These are reaches where there is concentrated urban development or where urban growth is very likely to spread in the next few years. The remaining four reaches were selected for intensive study and management in conjunction with the recommended low channel dams and their associated recreational facilities. All of these reaches are listed by sub-basin in Supplement B; they are shown on Figure 5 in Chapter I.

The location of the high priority and low channel dam studies are as follows:

Sub-basin I: Marathon, Chenango Bridge to Binghamton, Great Bend to Binghamton, Binghamton to Endicott.

Sub-basin II:	Corning to Elmira.
Sub-basin III:	Scranton, Pittston to Plymouth, Berwick (low dam).
Sub-basin V:	Lewisburg, Milton, Muncy, Jersey Shore to Montoursville, Williamsport (low dam), Mill Hall to Lock Haven.
Sub-basin VI:	Altoona to Tyrone, Lewistown (low dam).
Sub-basin VII:	Duncannon (low dam).

The Coordinating Committee further recommends improvement of the existing flood warning network to minimize the risk of loss of life and damage to property for all identified reaches, regardless of the intensity of structural or other management measures provided. The expanded flood warning service will require additional instrumentation to gather and evaluate hydrologic data, and extended ability to inform and assist public officials and the general public in times of emergency. A necessary and vital part of this expanded service is an effective organization of local officials and citizens to receive and spread flood warnings, and to plan and carry out evacuation procedures.

Continued Data Collection and Additional Studies

Some new or expanded efforts are recommended to point the way to the best use of the Basin's water resources during the framework period.

Data Collection

An *expanded water quality sampling network* is recommended to monitor key water quality parameters at appropriate time intervals, but particularly during low streamflow conditions. This network would provide the necessary information on streamflow, dissolved oxygen, temperature, specific contaminants (including pesticides at some locations), and nutrient levels. The water quality monitoring network would be established as an expansion of the existing program of the Basin States, to include at least one station downstream from the following locations: Norwich, Cortland, Sidney, and Endicott (Sub-basin I); Hornell, Bath, Lindley, Corning, Elmira, and Elkland (Sub-basin II); Scranton, Plymouth, and Hazleton (Sub-basin III); State College, Bellefonte, Lock Haven, Wellsboro, and Lewisburg (Sub-basin V); Bellwood, Tyrone, Roaring Spring, Hollidaysburg, Williamsburg, and Lewistown (Sub-basin VI); Shamokin, Carlisle, and Mechanicsburg (Sub-basin VII); McSherrystown, Spring Grove, York, Hummelstown, Ephrata, Lancaster, Columbia, and Conowingo Dam (Sub-basin VIII). Water quality monitoring should also be included by the operating agency at all major reservoirs where low flow augmentation or recreation are project purposes, and by the States at lakes and on small

streams where local quality problems are recognized. Appendixes F and K(3) provide additional information on water quality management.

Collection of hydrologic data should be expanded to improve upstream watershed project planning and management.

Periodic surveys of Basin-wide recreation market and service area patterns and regional public preferences for water-based outdoor recreation should be carried out jointly by the appropriate State and Federal agencies.

Further Studies

The *Susquehanna Mine Drainage Study* should be actively pursued and completed as a cooperative Federal-State effort to provide essential information on specific measures to best reduce mine drainage pollution.

Regional sewerage studies of the service area complexes listed in Supplement B should be completed as soon as possible to determine whether the water quality standards can be met at reduced cost or increased reliability by expanding the scale and scope of sewerage systems.

A study in depth is required of the costs of the several aspects and techniques for *flood plain management* to reduce flood losses.

Analyses of the cost of alternative cooling methods and locations for producing *electric power* from thermal energy sources should be made to reduce the potential impact of consumptive water losses.

Research is needed on *irrigation water requirements* and the corresponding yield as it pertains to humid conditions in the Basin.

Research is also needed on management methods to reduce peak seasonal *water requirements for municipal and industrial water supply* when they correspond with periods of critical low streamflow.

A most critical study yet required is the analysis of the relationship of the seasonal flows of the Susquehanna River to *the fresh water dynamics of the upper Chesapeake Bay.* While Appendix B, State of Maryland Report, provides some information on this problem, detailed study is necessary to determine the importance of this relationship to the Coordinating Committee Plan. Accordingly, the Chesapeake Bay Study and hydraulic model should be aggressively pursued to completion.

Studies of *measures to restore anadromous fishery runs* past existing hydroelectric power dams should be continued.

B. The Framework Plan

The Framework Plan is recommended, as its title states, for further study in future planning efforts. The recommended measures appear to be the best for meeting the needs beyond 1980. However, as time passes, technology changes, distant population trends come into sharper focus, and public attitudes and priorities evolve. Development in the Susquehanna River Basin should constantly be reevaluated in the light of these changing conditions.

TABLE 11

INTERMEDIATE PLAN STRUCTURAL MEASURES
BY SUB-BASIN: 1980-2000

Sub-basin	I	II	III	IV	V	VI	VII	VIII	TOTALS
Water Quality Measures									
Mine Drainage Pollution Abatement	0	0	2	2	0	1	3	0	8
Advanced Treatment	0	2	2	0	4	1	4	2	15
Major Multiple Purpose Reservoirs	1	0	0	0	0	0	0	0	1
Reservoirs for Recreation and Fish Habitat									
Low Channel Dams	0	0	0	0	0	1	0	1	2
Large Tributary Reservoirs	1	0	1	0	1	0	0	0	3
Small Tributary Reservoirs	19	6	4	3	2	1	4	2	41
Municipal and Industrial Water Supply Measures									
Ground Water	1	0	0	0	0	0	0	0	1
Others									
Bank Stabilization	0	0	0	0	1	0	0	0	1
TOTALS	22	8	9	5	8	4	11	5	72

Structural Measures

Water Quality Measures

Coal Mine Drainage Pollution Abatement. Fourteen coal mine drainage pollution abatement projects are recommended at an estimated cost of $161 million.

Sub-basin III: Nescopeck Creek (2000) , Catawissa Creek (2000).

Sub-basin IV: Anderson Creek (2000), Kettle Creek (2000), Congress Run - Deer Creek - Sandy Run - Adler Run, and other minor tributaries, (2020), Moshannon Creek (2020).

TABLE 12

LATE ACTION PLAN STRUCTURAL MEASURES
BY SUB-BASIN: 2000-2020

Sub-basin	I	II	III	IV	V	VI	VII	VIII	TOTALS
Water Quality Measures									
Mine Drainage Pollution Abatement	0	0	0	2	0	4	0	0	6
Advanced Treatment	0	1	1	0	4	4	2	13	25
Reservoirs for Recreation and Fish Habitat									
Low Channel Dams	0	0	0	0	0	0	1	0	1
Large Tributary Reservoirs	0	0	2	0	0	0	0	1	3
Small Tributary Reservoirs	8	1	2	4	6	3	4	3	31
Municipal and Industrial Water Supply Measures									
Ground Water	0	0	0	0	2	0	0	0	2
Others									
Irrigation Reservoir	0	0	0	0	0	0	1	0	1
Drainage Project	1	0	0	0	0	0	0	0	1
TOTALS	9	2	5	6	12	11	8	17	70

Sub-basin VI: Great Trough Creek (2000), Roaring Run (2020), Six Mile Run (2020), Longs Run (2020), Sh[illegible]s Run (2020).

Sub-basin VII: Mahanoy Creek (2000), Wiconnisco Creek (2000), Shamokin Creek (2000).

Waste Treatment Facilities. The construction of forty new or expanded advanced waste treatment plants will be required to meet the State water quality standards under the increasing waste load. The estimated cost of these facilities would be $200 million.

Sub-basin II: Elmira (2000), Hornell (2000), Elmira (2020)*.

Sub-basin III: Hazleton (2000), Scranton (2000), Scranton (2020)*.

Sub-basin V: Bellefonte (2000)*, Lock Haven (2000), State College (2000), Wellsboro (2000)*, Bellefonte (2020)*, Lock Haven (2020)*, State College (2020)*, Wellsboro (2020)*.

Sub-basin VI: Williamsburg (2000)*, Altoona Northeast (2020), Altoona Southwest (2020)*, Roaring Spring (2020)*, Tyrone (2020)*.

Sub-basin VII: Mechanicsburg (2000), Shamokin (2000), Shenandoah (2000), Shippensburg (2000)*, Carlisle (2020)*, Shippensburg (2020)*.

Sub-basin VIII: Ephrata (2000), Glen Rock (2000), Dallastown-Yoe (2020)*, Elizabethtown (2020)*, Ephrata (2020)*, Fredericksburg (2020)*, Glen Rock (2020)*, Lancaster River (2020), Lebanon (2020)*, Lititz (2020)*, New Freedom-Shrewbury (2020)*, New Holland (2020)*, Penn Township (2020)*, Red Lion (2020)*, York (2020)*.

TABLE 13

FRAMEWORK PLAN SECONDARY TREATMENT AND COLLECTION FACILITIES NEEDED

	I	II	III	IV	V	VI	VII	VIII	TOTAL
Secondary Treatment									
New 2000	2	4	7	3	3	3	7	3	32
Expanded 2000	7	0	5	2	6	8	3	1	32
New 2020	0	0	0	0	0	2	0	3	5
Expanded 2020	1	0	2	2	9	4	0	4	22
Collection Facilities									
2000	9	7	13	6	12	22	8	28	105
2020	9	7	14	6	12	21	7	28	104
Total	28	18	41	19	42	60	25	67	300

*Expand existing facilities.

New and expanded secondary treatment plants and collection facilities will continue to be needed throughout the framework period due to the growing population in the Basin. Table 13 above shows the distribution of treatment and collection measures that will be needed to maintain stream quality standards. These are not part of the recommended Plan, but are included to emphasize what must be done to maintain water quality in the Basin. The locations of these measures are listed in Appendix K(2). The treatment facilities would cost about $398 million and the collection facilities cost would be $2.7 billion.

Low Flow Augmentation. Water quality storage is included in the East Guilford multiple purpose reservoir on the Unadilla River.

Major Multiple Purpose Reservoirs

One major multiple purpose dam and reservoir project is recommended for the year 2000. The East Guilford Reservoir (115) on the Unadilla River in Sub-basin I would provide flood control, flow augmentation, recreation, and fishing. The cost of this project would be about $74 million. It would provide 2.4 million recreation days ultimately, 350,600 fisherman-days on a 5,000 acre conservation pool, and would reduce average annual flood damage by $1.2 million as far downstream as Danville. The flood protection in this reservoir would reduce the probability of water overtopping the existing flood protection works at Binghamton.

Reservoirs for Recreation and Fish Habitat

Three *low channel dams* are recommended by the Coordinating Committee at an estimated cost of $10 million, including initial recreational development for 438,000 recreation days, and $27 million for recreation facilities to be added later.

Sub-basin VI:	Thompsontown (2000).
Sub-basin VII:	Harrisburg (2020).
Sub-basin VIII:	Marietta (2000).

Six *large tributary reservoirs* (each having over 25,000 acre-feet of storage) are recommended. At a cost of about $210 million, they would provide 8.3 million recreation days ultimately and 265,000 fisherman-days.

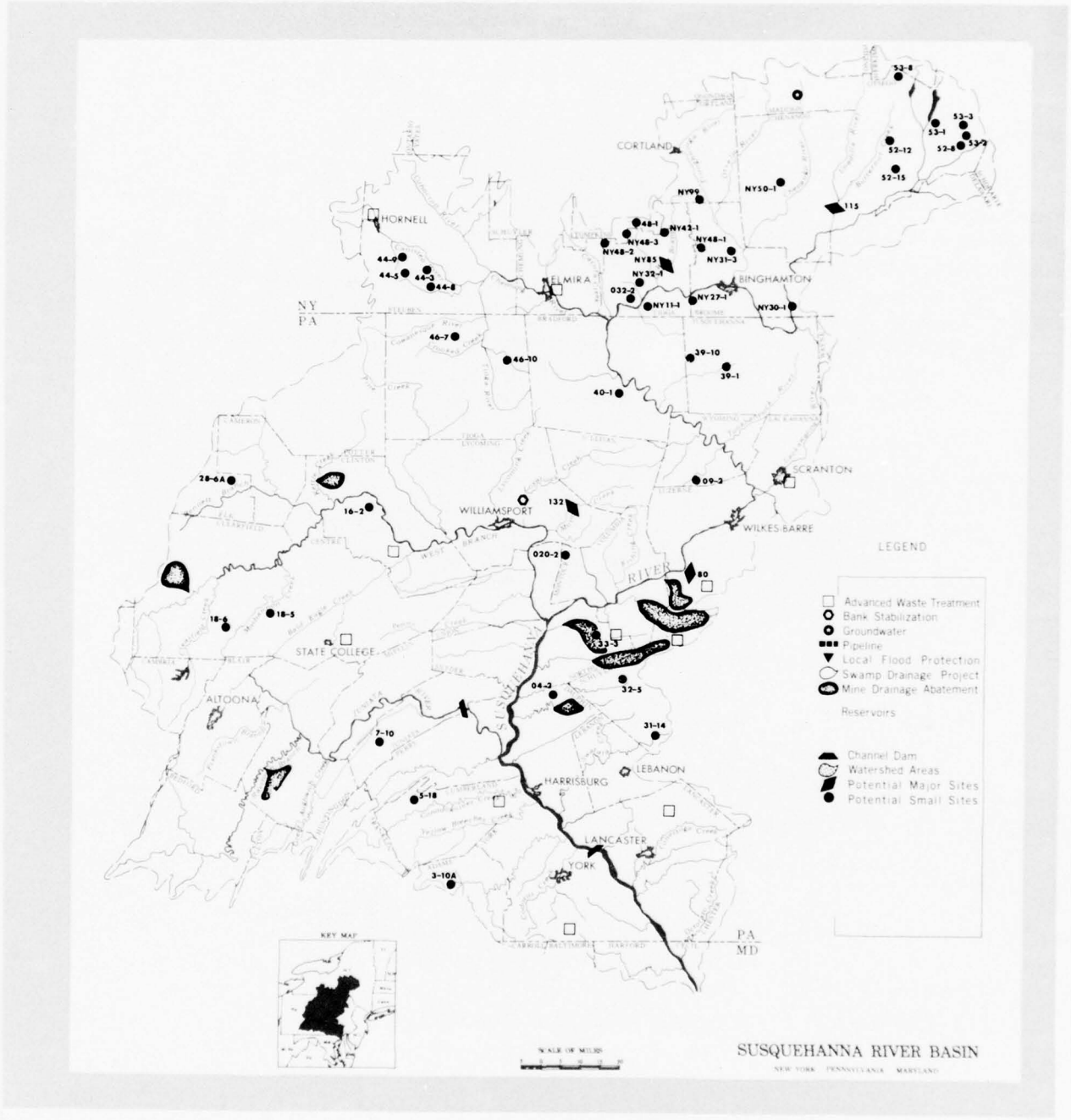
Sub-basin I:	West Branch Owego Creek (85NY, 2000).
Sub-basin III:	Wapwallopen Creek (80, 2000), Jonestown (77, 2020), Tunkhannock Creek (87, 2020).
Sub-basin V:	Muncy Creek (132, 2000).
Sub-basin VIII:	Conewago Creek (10, 2020).

Seventy-two *small tributary reservoirs* are recommended in the Framework Plan. They would provide 7.2 million recreation days utlimately and 849,000 fisherman-days at an approximate cost of $122 million.

Sub-basin I

2000: Danby Creek (48-1), Oak Creek (52-8), West Branch Otego Creek (52-12), West Branch Otsdawa Creek (52-15), Shell Rock Creek (53-1),

Figure 47 ---- Intermediate (2000) Plan Structural Measures



Tributary to Pleasant Brook (53-2), Tributary to Cherry Valley Creek (53-3), Hyder Creek (53-8), Tributary to Pipe Creek (032-2), Russell Run (NY11-1), Mutton Hill Pond (NY27-1), Mud Pond (NY30-1), Glen Castle Creek (NY31-3), Tributary to Pipe Creek (NY32-1), Tributary to East Branch Owego Creek (NY48-1), Michigan Creek (NY48-2), Miller Creek (NY48-3), Tributary to Tillotson Creek (NY50-1), Jennings Creek (NY99).

Figure 48 ---- Late Action (2020) Plan Structural Measures

2020: Brakel Creek (49-1), Deacon Branch Mitchell Creek (028-1), Wylie Brook (030-5), Yaleville Brook (NY30-4), Barnes Creek (NY31-1), Tributary to Nanticoke Creek (NY31-5), Dachman Swamp (NY32-2), Kedron Brook (NY50-2).

Sub-basin II

2000: Tracy Creek (44-3), Tributary to Tuscarora Creek (44-5), Tributary to Tuscarora Creek (44-8), Taibot Creek (44-9), Elkhorn Creek (46-7), Elk Run (46-10).

2020: Mill Creek (46-5A).

Sub-basin III

2000: Pettis Creek (39-1), North Branch Wyalusing Creek (39-10), Tributary to South Branch Towanda Creek (40-1), Beaver Run (09-2).

2020: Tributary to Tuscarora Creek (010-9), Rummerfield Creek (011-1).

Sub-basin IV

2000: Six Mile Run (18-5), Little Beaver Run (18-6), Dents Run (28-6A).

2020: Haslett Run (20-1), Wilson Run (28-2A), Mountain Run (28-3), South Branch Bennett Branch (28-4).

Sub-basin V

2000: East Branch Big Run (16-2), West Branch Mahantango Creek (020-2).

2020: Beaver Run (21-3), Joe Gray Run (22-5), West Branch Wallis Run (22-8), West Branch Pine Creek (24-1), Nine Mile Run (24-3), Galeton Reservoir (133).

Sub-basin VI

2000: Dougherty Run (7-10).

2020: Great Trough Creek (9-2), Clear Creek (10-10), Cocolamus Creek (015-6).

Sub-basin VII

2000: Doubling Gap Creek (5-18), Deep Creek (32-5), Tributary to Shamokin Creek (33-3), Tributary to Wiconisco Creek (04-2).

2020: Pine Creek (13-5), Mahantango Creek (32-9), East Branch Rattling Creek (04-3), Armstrong Creek (04-8).

Sub-basin VIII

2000: Conewago Creek (3-10A), Little Swatara Creek (31-14).

2020: Paradise Creek (3-3), Knight Run (29-5), Manada Creek (31-2A).

Ground Water for Municipal and Industrial Water Supply

In addition to three new projects, existing water supply systems, whether ground water or surface water, will have to be expanded to meet the increasing need in the framework period. The ground water measures below would cost $13 million.

Sub-basin I

2000: Hamilton.

Sub-basin V

2020: Bellefonte, Wellsboro.

Miscellaneous Structural Measures

One small *irrigation* reservoir (13-2) is recommended in 2020 on a tributary to Penns Creek in Sub-basin VII. Its estimated cost is $312,000.

One *streambank stabilization* project is recommended in Sub-basin V on Loyalsock Creek (2000) which would cost almost $950,000.

A *drainage* project is recommended at Sangerfield Swamp in Sub-basin I (2020), estimated to cost $846,000.

Management Measures

Land Management

Land treatment and management on 90,000 acres of critical areas is recommended in addition to the on-going treatment program covering 3.6 million acres in the Basin. The estimated cost for the critical area treatment is $3 million, and $87 million for the on-going program.

Stream Management

The Framework plan calls for a continuation of the programs recommended for the early action period. Specific late action additional measures include placing additional recreational facilities on "recreation" and "modified recreation" streams between 1980 and 1990, as well as on non-categorized streams. The cost is estimated at $26 million for land and facilities.

TABLE 14

FRAMEWORK LAND TREATMENT
(acres)

Sub-basin		On-going Land Treatment	Critical Area Treatment
I	2000:	412,000	300
	2020:	246,000	400
II	2000:	217,000	700
	2020:	111,000	600
III	2000:	254,000	10,000
	2020:	159,000	9,000
IV	2000:	175,000	20,000
	2020:	146,000	17,600
V	2000:	328,000	4,000
	2020:	251,000	3,000
VI	2000:	296,000	2,800
	2020:	204,000	2,400
VII	2000:	176,000	7,000
	2020:	97,000	6,000
VIII	2000:	385,000	4,000
	2020:	151,000	3,000
TOTALS	2000:	2,243,000	48,800
	2020:	1,365,000	42,000

Flood Plain Management

The recommended early action measures should be continued in addition to 24 intensive flood plain management studies.

Sub-basin I:	2000: Oneonta, Unadilla, Norwich Cortland to Blodgett Mills, Chenango Forks to Chenango Bridge, Owego.
	2020: Sidney, Oxford, Greene.
Sub-basin II:	2000: Erwins to Painted Post, Campbell to Painted Post, Blossburg.
Sub-basin III:	2000: Carbondale, Scranton to Pittston.
	2020: Tunkhannock.
Sub-basin V:	2000: Lock Haven to Jersey Shore.
	2020: Renovo and South Renovo.
Sub-basin VI:	2000: Bedford, Lewistown, Thompsontown (low dam).
	2020: Alexandria, Petersburg.
Sub-basin VII:	2020: Harrisburg (low dam).
Sub-basin VIII:	2000: Harrisburg to Royalton, Marietta (low dam).

CHAPTER VI
Adequacy and Effects of the Plan

The Susquehanna River Basin Study Coordinating Committee believes that the Plans presented in Chapter V are the best combination of structural and management measures to meet the needs of the Basin. The Plans reflect the multiple-planning objectives of environmental quality, regional development, and economic efficiency, and they reflect what was learned from the public information program. These objectives may conflict with each other, and at times may conflict with fully meeting the projected needs. The purpose of the unique plan formulation procedure was to do a better job of planning----meaning flexibility and compromise in selection among alternatives. In some places, development that appeared desirable for economic growth was sacrificed to maintain the natural beauty of a valley or the productivity of good farm land. In some cases the opportunities foregone could be made up by alternative recommendations, such as streamside recreation or flood plain management. As a result of the plan formulation procedure, more avenues were examined more thoroughly for meeting the needs.

An important aspect of the Plan is its flexibility----flexibility in terms of the actual measures and in terms of how the measures may be financed and implemented. The planning has taken place in a period of change in public attitudes toward national resource development. Institutions are now responding to these changes and the publication of this Study comes during a time of institutional response and transition. While the Plan itself presents what now appears to be the best solutions to the Basin's problems, many reasonable alternatives to the recommendations are presented in Supplements A and B, and Appendix K(1). An explanation for the inclusion in or exclusion from the Plan is given for each alternative. These alternatives are still available for consideration by the general public and by planners. It is possible that they will appear to be better solutions to the needs of the Basin in future years as conditions, priorities, and technology change. In addition to these structural and non-structural management recommendations, the Coordinating Committee has made policy and legislative recommendations (Chapter VII) aimed toward expanding the flexibility of public agencies in implementing river basin plans.

A. Water Quality Measures

The recommended Plan contains a variety of measures to clean up the streams in the Basin to within accepted standards, and suggests measures to prevent the degradation of streams where water is presently of good quality. The Plan goes even further to recommend measures to clean up aesthetic nuisances, problems that need attention whether or not they are health hazards, whether or not they will pay for themselves in economic terms.

Coal Mine Drainage Pollution Abatement

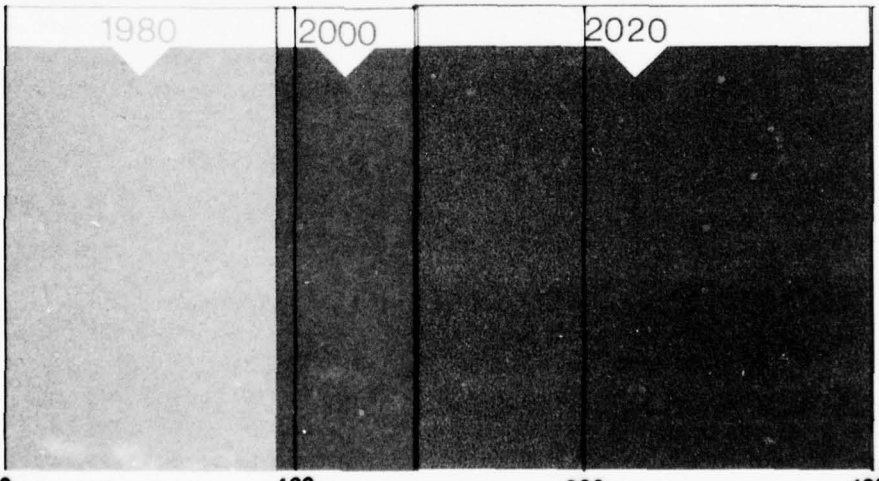
Construction of the 13 early action and 14 framework coal mine drainage pollution abatement projects will virtually eliminate this problem in the Basin. Figure 49 shows how these abatement projects are phased. The first projects scheduled are those with the greatest cost effectiveness----that is the largest return for what they will cost. The large jump in improved stream mileage in the late action period is the result of the cumulative effect of all the small abatement projects on the larger rivers and tributaries. This same cumulative effect in the late action period will minimize the threat of intermittent acid "slugs."

The benefits from these programs will make a major contribution to environmental quality. Restoration of fishing on these streams is estimated at almost 600,000 fisherman-days. Recreation will be enhanced with almost 2 million additional recreation days resulting from the improved water quality. The ugly sulphur deposits in the streambed would wash away. Sediment from the coal mines would be reduced significantly. The projects would reduce the cost of treating water supply for municipal and industrial use and would make water available for irrigation in agricultural areas, all of which would contribute to regional and national economic growth. Related land treatment, such as the elimination of culm piles, particularly in the Wilkes-Barre-Scranton area, will help change the images of these cities from dingy coal towns to the modern attractive cities that they, in reality, are. This will improve the local urban environment and at the same time improve the economy by helping to attract new industries and residents.

Organic and Other Water Quality Control Measures

The recommended water quality measures would make all streams in the Susquehanna Basin safe for water contact recreation and water supply.

Figure 49 ---- Adequacy of the Plan for Coal Mine Drainage Pollution Abatement



In operation, these projects will maintain a healthy ecological balance for beneficial organisms so that fish will multiply and any remaining pollution will be assimilated by the natural ability of a stream to clean itself. Municipalities must install the quantity and quality of waste treatment to maintain adequate dissolved oxygen in the streams (5 milligrams per liter) for low flow periods in the summer and fall. The only exception to organic treatment requirements is in streams polluted by coal mine drainage; waste treatment beyond the primary level will not be required in those places until the acid pollution is abated. The reservoir storage for low flow augmentation and the advanced waste treatment facilities recommended by the Plan, together with the secondary treatment that is currently being required by the States, will guarantee good stream conditions in the future, except in the case of unusually severe droughts*. Regional approaches to the waste treatment problem offer promise to increase the reliability of the system.

Advanced Waste Treatment

Twenty-two Early Action and 40 Framework advanced waste treatment plants and plant expansions have been recommended where streamflows would be insufficient to assimilate the amount of effluent from secondary treatment. In some cases, Elmira for example, high level treatment plants are necessary in conjunction with low flow augmentation from upstream reservoirs. The extra flow provided by reservoirs would allow high level treatment facilities to be installed at a later date than would otherwise be necessary. Special local pollution problems, such as excess nutrients, color, and industrial waste by-products, will have to be dealt with on an individual basis, and proper treatment at these locations should be provided. Additional detailed studies may be needed to identify and cope with these problems in the next few years, particularly as nutrients create problems in the upper Chesapeake Bay.

Low Flow Augmentation

The six multiple purpose reservoirs in the Early Action Plan contain storage for low flow augmentation. These will have significant impact on flows in three areas: the Chemung River to Sayre-Athens, the Susquehanna River to Sayre-Athens, and Conodoquinet Creek. The effects of low flow augmentation on water quality were discussed above.

Sediment Control

A number of types of measures in the recommended Plan affect erosion and sediment. Chief among these is land treatment on critical areas, the major concentrated sources of sediment. Revegetation of the nearly 140,000 acres of denuded lands in the Basin would solve serious local problems where stream channels become filled, beneficial biota on the

*Statistically, this drought would occur for a 30-day period once in 20 years in Pennsylvania, and a 30-day period once in 50 years in New York.

channel bottoms are killed, and the ability of the channel to carry flood flows is reduced. Additional land treatment----the accelerated program recommended in the Early Action Plan, and the on-going land treatment program----will aid the reduction of the problem. The 15 bank stabilization projects (all but one are in the Early Action Plan) will reap additional benefits from the reduction of excess sedimentation in particular streams. Since over 55 percent of the Basin is forest land, and since forest land is the lowest sediment producing land use, sediment reduction measures will have their greatest impact by improving the ecology in restricted local areas.

Water Quality Surveillance

Under rare severe low flow conditions the water quality measures in the Plan would not be sufficient. The recommended water quality surveillance system that would warn when streamflows have reached critical levels near susceptible treatment plants would further minimize the impact of pollution. With proper warning, plant operators could take extraordinary measures to stop pollution.

B. Recreation and Fishing Measures

New water-oriented recreation and fishing will be provided by a wide range of opportunities in the recommended Plan. In addition to slack water pools that most people think of in connection with recreation, the Coordinating Committee is recommending that streamside recreational facilities be developed in order to both preserve and use the existing natural environment. The water quality measures described above will make this possible in many areas where health hazards presently exist and in places that may be aesthetically unattractive. Proper management and regulation by local authorities will be needed to maintain or restore streamside areas.

Recreation

Figure 50 illustrates the extent to which the Plan meets the net unsatisfied recreation demand. The recreation on the chart is supplied in the Early Action Plan by six multiple purpose reservoirs, 48 small tributary reservoirs, four low channel dams, six upstream watershed projects, 1,683 miles of categorized streams, and 360 miles of streams where coal mine drainage pollution will have been cleaned up. The Framework Plan supplies recreation at one multiple purpose reservoir, six large tributary reservoirs, 45 small tributary reservoirs, three low channel dams, and 804 miles of streams with coal mine drainage pollution abatement. It is obvious that not all of the demand, as projected, will have been met. The Coordinating Committee decided that to do so would overtax the Basin's resources and

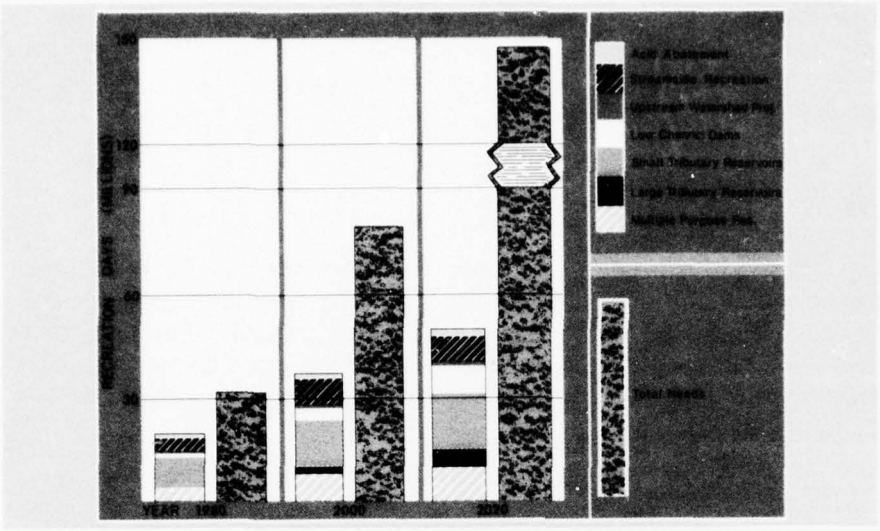


Figure 50 ---- Adequacy of the Plan for Meeting Recreation Demand

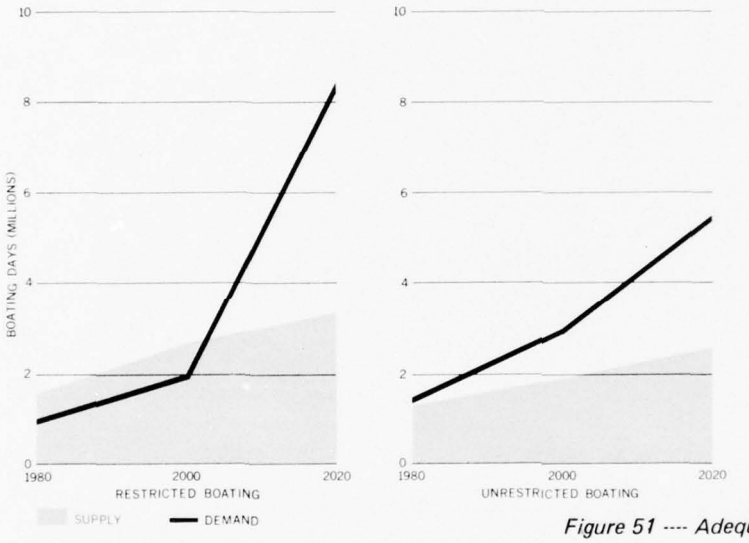


Figure 51 ---- Adequacy of the Plan for Meeting Boating Demand

require additional structural development that would be inconsistent with the environmental quality objective of the Plan. Large Main Stem impoundments could be built to meet this need that would fill the economic efficiency and regional development objectives. These possibilities were eliminated because they would create both environmental disruption and large population and agricultural displacements. Excess recreation demand will have to be met by new private development within the Basin or by recreational opportunities outside the Basin.

Recreational boating, as a key part of the recreation demand, is provided for in the Plan to the extent indicated in Figure 51.

If the recreation demand projections prove to be accurate, or even low, the recreational facilities in the Basin will become overcrowded. For the years to come, the reasonable matching of water-based recreation supply

and demand can be best accommodated by adjusting the rate of implementation of recreational facilities identified in the Plan. Continuous reevaluation and further planning will be required in the future, as the requirements come into better focus.

Fishing

Figure 52 illustrates the extent to which the Plan meets the projected fishing needs in the Basin. Fishing is supplied in the Early Action Plan by six multiple purpose reservoirs, 55 small tributary reservoirs, seven upstream watershed projects, and 1,683 miles of categorized streams. The Framework Plan includes fishing at one multiple purpose reservoir, six large

Figure 52 ---- Adequacy of the Plan for Meeting Fishing Demand

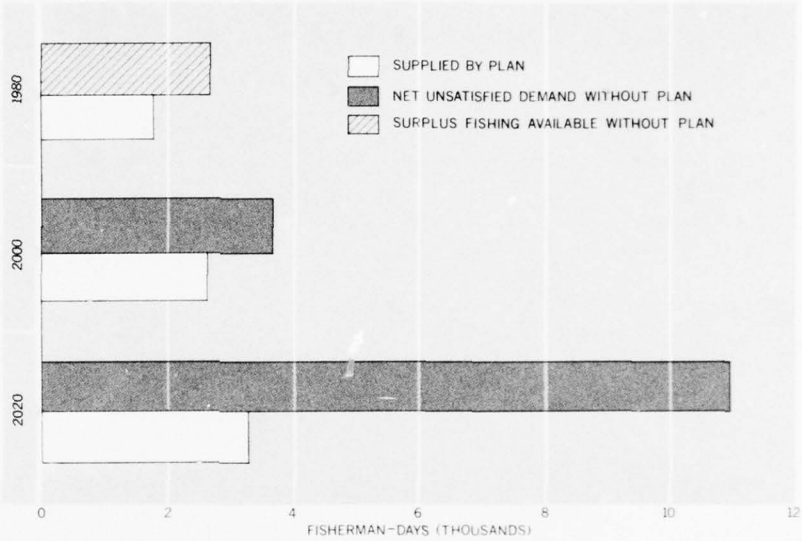
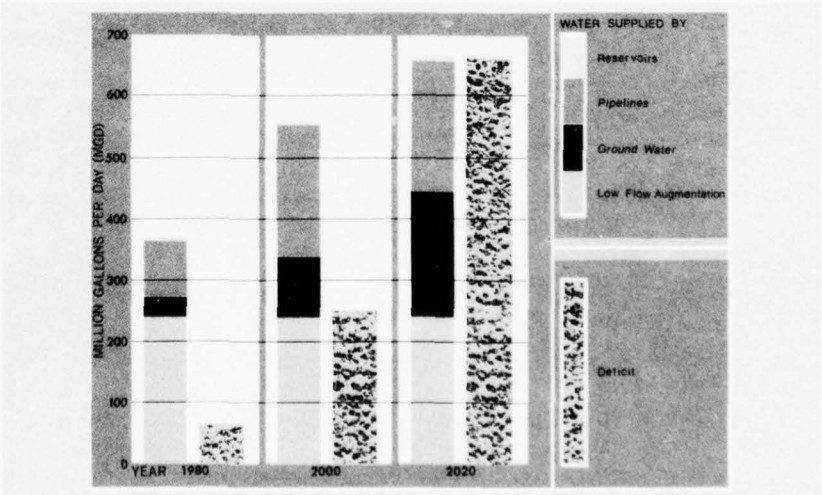


Figure 53 ---- Adequacy of the Plan for Meeting the Water Supply Deficit



tributary reservoirs, and 11 small tributary reservoirs. The surplus of fishing opportunity in the early action period reflects the Coordinating Committee's desire to improve the dispersal of opportunity in the Basin and to attract fishermen from beyond the normal market area. While there is surplus fishing opportunity in the early action period without additional projects, the framework period will experience a large deficit even with the Plan.

As is the case with attempting to meet all of the projected recreation demand, meeting all of the fishing demand in the framework period would mean inundating more valuable land than would be worth the price in terms of environmental quality and disruption of existing development. It should be noted that the fishing provided by the Plan has been adjusted for the small amount of stream fishing lost to slack-water fishing. Appendix G(2) discusses the details of the fishing opportunity supplied by the Plan.

C. Water Supply Measures

The Coordinating Committee Plan meets all of the identified municipal, industrial, and thermal power water supply needs in the Basin through the entire 50-year planning period. Only communities that would have a population of at least 5,000 by 1980 were specifically considered. Measures were recommended only where established sources near communities or flows in nearby streams would not be adequate to meet the projected demands of that community. While all reasonable alternatives were studied, ground water was most often the cheapest source. It was recommended for 15 localities in the Early Action Plan and in three additional places in the Framework Plan. Three pipelines, one water supply reservoir, and storage for water supply in four multiple purpose reservoirs make up the other Early Action Plan water supply recommendations. Expansion of ground water facilities and pipeline measures recommended in the Early Action Plan increase the available supply in the framework period, in addition to development of new sources.

Figure 53 shows how these measures meet the projected water supply deficit in the Basin. It can be seen that, until 2020, the supply has been developed well in advance of the projected demand. It is, of course, good planning to develop water supplies in advance of the demand so that communities have a reasonable cushion in case of a drought such as that experienced in the 1960's. It can also be seen that a large part of this "excess" supply is from flow augmentation in the early action multiple purpose reservoirs which principally effect the Susquehanna and Chemung Rivers in the New York portion of the Basin. There is an immediate need for reservoirs to meet the identified recreation, fishing, and flood control needs. Even though flow augmentation is included in these projects, a majority of this storage will not be used until the framework period. However, it is more economical to provide for future needs when the reservoir is built, than to expand the reservoir or build a new one at a later date.

TABLE 19

The Coordinating Committee Plan also contains recommendations for water supply for irrigation purposes: three ground water developments, one reservoir, and storage in two multiple purpose reservoirs (Charlotte Creek and Shady Grove). There is adequate water in the Basin to meet all projected irrigation requirements if the Plan is implemented, although this use will contribute to depleted summer flows in the lower Susquehanna River and some tributaries.

The long term effect of the Plan on the flows in the lower Main Stem and into Chesapeake Bay is not completely clear at this point in time. Consumptive losses from all uses have been projected through 2020, but because of the possibility of major technological changes, these projections cannot be made with any degree of certainty beyond the immediate future. Consumptive losses occur from municipal and industrial water use, from irrigation withdrawals, from electric power production, and from diversions out of the Basin. Losses from municipal and industrial water use vary between 10 and 25 percent of withdrawals depending on the time of year. Irrigation loss is at least 70 percent of withdrawals, but ranges to 100 percent. No significant changes in these proportions are expected to take place during the Study period. However, the large losses from power plant cooling towers under present methods are subject to change as new technology is developed. New power production methods are being researched which will increase generating efficiency or require minimum cooling facilities, both of which could reduce consumptive losses considerably (Appendix H contains a discussion of power production technology and research).

If the projections are correct, however, there would not be enough water during extended drought periods to meet the quantitative requirements of the lower Main Stem - Chesapeake Bay area. Increased low flow augmentation or curtailment of use would be required. The Coordinating Committee Plan is sufficiently flexible, however, to permit operation of the larger Framework Plan reservoir projects to meet additional requirements if this should become necessary. Beyond this, recommendations to resolve this sensitive problem would be premature. The final answers must wait for the Chesapeake Bay Study and hydraulic model to be completed, and for further developments in power production technology. Supplement A contains a more detailed account of the low flow and consumptive use projections made for the Susquehanna Study.

D. Flood Damage Reduction Measures

The Coordinating Committee Plan proposes both structural and management measures for reducing the effects of floods. It has been roughly estimated that the large number of protection works already built, in advanced planning, or under construction prevent 3/4 of the damages that would occur without them, under present development conditions. The amount of structural protection that can be economically built to reduce the remaining damages is limited. Therefore, management alternatives have been recommended to take care of this residual problem. Since these

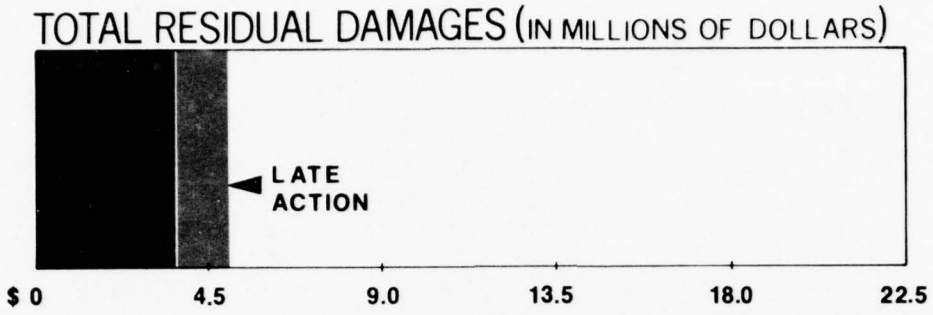


Figure 54 ---- Adequacy of the Structural Measures in the Plan for Reducing Residual Flood Damages

measures are largely under local control, with some Federal and State assistance, it cannot be predicted where and how effectively these flood plain management practices will be implemented, and therefore to what extent they will reduce damages in the Basin. Figure 54 shows the impact the structural measures recommended in the Plan will have on residual flood damages while illustrating the size of the job left to be done by management programs. It must be emphasized that floods are a natural phenomenon and no amount of protection and management can eliminate damages completely.

The structural measures to reduce flood damages in the Early Action Plan include seven local flood protection projects, nine upstream watershed projects, and storage in six multiple purpose reservoirs. The Framework Plan contains flood control storage in one multiple purpose reservoir. Land treatment and management measures also contribute to reducing flood flows. It is difficult to measure their effect exactly, but they generally provide local reductions in storm runoff, thus reducing damages.

E. Other Measures

Land Treatment and Management

The Early Action Plan provides for land treatment and management on the land upstream from all recommended reservoir projects. These are areas that in due course would receive treatment under the on-going land treatment program, but were recommended for acceleration to help maintain the high quality of the water entering the reservoirs from the time they are built. The Framework Plan has no such recommendations because it

is expected that the on-going land treatment program will have accounted for most of the drainage areas of Framework Plan reservoirs by the time they are constructed.

The Plan also provides for the treatment of all critical areas in the Basin---35 percent in the early action period and the remainder in the framework period.

Streambank Stabilization

The total estimated length of stream channels in the Susquehanna River Basin with drainage areas greater than 1 square mile is about 25,000 miles. An estimated 5,500 miles of single (one-side) streambank is presently being eroded. The Coordinating Committee has recommended streambank stabilization along about 90 miles of stream channel, including the most severe erosion problem reaches.

Power

No recommendations for specific water resource projects to generate hydroelectric power are included in the Plan. It is expected that private hydroelectric, and fossil and nuclear fueled thermal power generating facilities will be adequate to meet the projected power demands, particularly during the early action period. Consumptive losses of water for cooling at thermal power plants have been considered in the low flow systems analyses. This loss will contribute to the depletions of low flow anticipated in the lower Susquehanna River, particularly during the late action period. The Plan recommendations are designed to complement private power development in the Basin, with considerable flexibility to adopt to changes in projected water demands.

Commercial Navigation

The Plan contains no recommendations to improve or restore commercial navigation in the Basin. The Coordinating Committee has found that commercial navigation investments would be neither feasible nor desirable for the foreseeable future. The development of commercial navigation, particularly on the lower main stem of the Susquehanna, might someday become feasible in a form not now reasonably anticipated; the Plan does not preclude future modifications for navigation.

CHAPTER VII
Putting the Plan into Action

The programs recommended in the Susquehanna River Basin Plan place a large amount of responsibility on local and State governments for the initiation and implementation of its components. The power to zone, to develop sewerage and water supply facilities, to build local recreational areas and facilities, and to restore abandoned mined areas traditionally rests with county, municipal, and State governments. Although there are many Federal programs to share the costs of these items, it is the local governments which must initiate the actions leading to Federal grants and loans.

The implementation powers of the Federal Government for the recommendations in the Plan are limited to multiple purpose reservoirs and local flood protection built by the Corps of Engineers. Almost every project requires some State or local cooperation and funding. Headwater reservoirs and associated land treatment programs are the responsibility of the Department of Agriculture, but, under present practice, this program requires local sponsors. Nothing can be accomplished in either of these programs without local and State participation in the form of cooperative agreements and funding.

In a number of cases the Coordinating Committee felt that the existing legal and institutional arrangements for implementing the Plan were not adequate. Changes in laws and changes in the methodology for formulating projects, with regard to the levels and types of participation of local and State governments, are needed to serve the best interests of the people of the Basin and the Nation. Conservation of the water and related land resources of the Susquehanna River Basin in the context of economic and population growth is the primary concern in this Study, and the institutional structure dealing with these resources needs to be changed in a number of ways to serve that end.

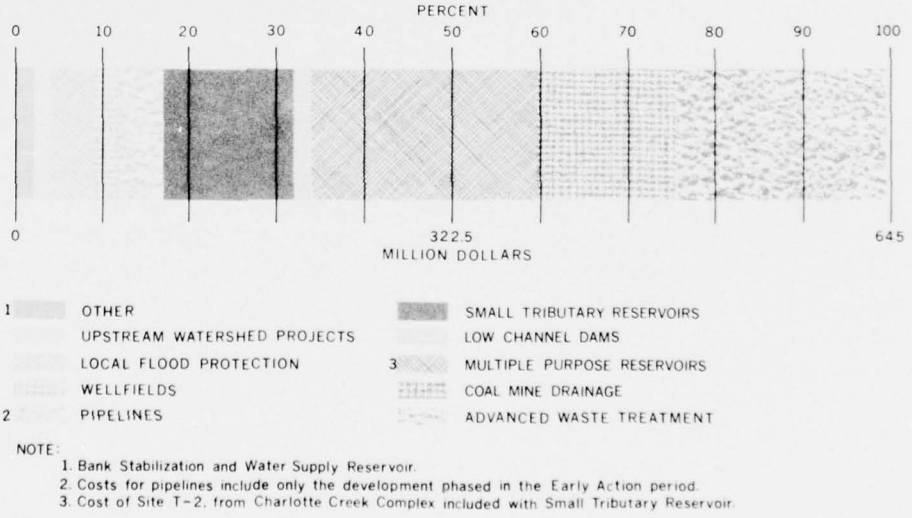
The Coordinating Committee thus had to face the dilemma common to many studies currently being carried out across the country: to recommend a plan with projects and programs that conform to the current laws and practices even though this may be inadequate in some cases, or to include in the Plan projects and programs that do not meet the present criteria precisely and recommend innovations that may or may not be adopted in order to satisfy the needs of the Basin? Further complicating the decisions involved in resolving the many conflicts that arise from this dilemma is the fact that resource and environmental planning is undergoing extensive reexamination at the highest levels of Federal and State governments. Changes are imminent, but the exact nature and extent of these changes are not yet clear.

In this changing context, the Coordinating Committee has charted a middle course. To be practical in terms of getting the job done in the early action period, implementation of the Plan is being recommended largely under present constraints, with some innovations in practice advocated where necessary. For the longer run, however, a set of recommendations for more sweeping changes in laws, practice, and cost sharing arrangements are made. As new institutional tools become available, whether they are those recommended by the Coordinating Committee, or others, the Plan presented in Chapter V is flexible enough to respond to those changes. Those recommendations that are entirely local in responsibility, such as flood plain management and streamside recreation, to name the most important, are made with the hope that the proper authorities will initiate action to use these ideas effectively. It is their privilege and responsibility to consider these proposals.

A. Implementation of the Early Action Plan

Implementation of the Early Action Plan is based largely on existing laws and practice. Funding of the projects and programs in the Plan, as presented in the following discussion, is assumed to be along the lines of present cost sharing arrangements. It is fully recognized, however, that if all of the recommended measures in the Plan were fully funded in accordance with present procedures, the amount of money available for these various cost sharing programs at the present time would be inadequate. Priority decisions are left to the affected agencies and governmental units as to how limited amounts of money will ultimately be distributed.

Figure 55 ---- Plan Cost by Project Category



NOTE:
1. Bank Stabilization and Water Supply Reservoir.
2. Costs for pipelines include only the development phased in the Early Action period.
3. Cost of Site T-2, from Charlotte Creek Complex included with Small Tributary Reservoir.

Structural Measures

Figure 55 shows the relative proportions of the costs of the structural measures recommended in the Early Action Plan.

Water Quality Measures

Forty percent of the cost of the Early Action Plan is for the improvement and maintenance of water quality in the Basin for advanced waste treatment and coal mine drainage pollution abatement.

Coal Mine Drainage Pollution Abatement. Since this problem occurs in the Basin only in the Commonwealth of Pennsylvania, programs dealing with this type of pollution have been primarily the responsibility of two State agencies: the Pennsylvania Department of Health and the Pennsylvania Department of Mines and Mineral Industries. The latter has an on-going program funded by a $150 million bond issue to help reduce coal mine drainage pollution. In addition, the FWQA is carrying out several research and demonstration abatement projects in areas plagued by this problem. Three of these projects are in the Susquehanna Basin in the Catawissa Creek, Bennett Branch Sinnemahoning Creek, and Beech Creek watersheds. Another Federal program aimed at dealing with this problem is the Appalachian Act, which provides that the Appalachian Regional Commission and the Department of the Interior can assist States in planning comprehensive environmental improvement programs where coal mine drainage is a major problem.

Implementation of the 13 early action recommendations for coal mine drainage abatement centers around a recently initiated study by the Corps of Engineers. While the Coordinating Committee has gone a long way toward collecting data and identifying the location and extent of this problem, the cost estimates for control of the problem are extremely tentative because no detailed evaluations have been made of each of the problem areas, and specific engineering measures to correct it have not been identified. Under a Senate Public Works Committee resolution of April 1964, the Corps of Engineers has started to develop such information.

The degree of Federal involvement in this problem has not yet been clearly defined beyond those special programs mentioned above. The Corps of Engineers study, in addition to developing detailed information and solutions, is expected to determine the amount and type of Federal participation justified in the construction of coal mine drainage abatement projects. There is a clear Federal interest in the problem that must be translated into specific terms. Coal provided most of the Nation's energy for over 150 years and during two World Wars. The environmental blight would have been less if the cost of removing the scars and restoring the land had been added to the price of coal over the years. The total cost of the 13 early action projects would be $103 million.

Sewage Treatment and Collection. Planning and construction of facilities for sewage collection and treatment is the responsibility of individual municipalities and/or industries. There are several Federal and State programs to help communities finance their sewage systems. Since all three States have adopted water quality standards, many communities are currently under orders from State health departments to achieve adequate treatment within the next 2 years. There are numerous qualifications that a community must meet in order to receive money from the State and Federal sources. Even if these requirements are met, it is doubtful that there will be enough money to go around. Therefore, the Coordinating Committee recommends that everything possible be done to raise the funding of these aid programs to adequate levels. Construction of the required facilities is often an impossible fiscal burden on the communities that must build them. The Federal and State funding programs are as follows:

1. The Federal Water Quality Administration (FWQA) of the Department of the Interior can pay up to 55 percent of the cost of constructing treatment plants and interceptor sewers under the Federal Water Pollution Control Act of 1956, as amended. This program has not been adequately funded in the past.

2. The Department of Housing and Urban Development (HUD) can pay up to 50 percent of the construction costs of waste collection systems under the Housing and Urban Development Act of 1965. This program has also been inadequately funded when measured against the need. There would have to be a many fold increase in funds over the 1970 level to meet the needs in the Susquehanna Basin.

3. In New York State, 30 percent of the cost of construction of sewage treatment plants and interceptor sewers is available to communities under the New York Pure Waters Bond Act of 1965. This is in addition to the FWQA program.

4. In the Commonwealth of Pennsylvania, a similar program will provide up to 25 percent of construction costs.

5. Selected projects in the Appalachian portion of the Basin are eligible for 80 percent funding under the Appalachian Regional Development Act of 1965.

6. HUD also provides assistance for general regional planning under its 701 program. Resulting plans usually provide framework designs for sewerage and water development and are oriented toward projects that will qualify for construction grants under the HUD and FWQA programs.

It should be noted that there is a gap in assistance when it comes to the cost of detailed engineering and design studies for collection and treatment facilities. These costs must be borne by the municipalities or regional sewer authorities at the present time. The Coordinating Committee recommends that a new Federal program be initiated to provide planning funds.

TABLE 15

PRIMARY AND SECONDARY TREATMENT
AND COLLECTION FACILITIES COSTS BY STATE

	TREATMENT		COLLECTION		TOTAL COST
	Number of Measures	Cost	Number of Measures	Cost	
New York	7	$ 56 million	12	$199 million	$755 million
Pennsylvania	53	136	90	505	641
TOTAL	60	$192 million	102	$704 million	$896 million

All of the 24 new and expanded advanced waste treatment plants in the Early Action Plan are in Pennsylvania. The total cost of these plants would be $158 million.

The cost of primary and secondary treatment plants and collection facilities is not part of the Coordinating Committee Plan. However, due to the importance of building these facilities soon and the large investment needed, information is presented on them here. The 12 new primary treatment plants, 48 new or expanded secondary treatment plants, and 100 new or expanded collection systems needed will cost $896 million, distributed as shown in Table 15.

Under the HUD 701 program, "area-wide" planning agencies have recently been organized throughout the Basin in order to carry out regional planning programs. These organizations are just now submitting their plans to HUD for review. The Coordinating Committee recommends that wherever practical, regional collection and waste treatment facilities be installed. This is often a much more efficient system for the taxpayers in small communities that are being required under State laws to build facilities.

It is suggested that regional sewerage surveys be undertaken at an early date for the following areas: Binghamton (Sub-basin I); Elmira (Sub-basin II); Lackawanna Valley (Sub-basin III); Williamsport, Spring Creek, Milton-Lewisburg (Sub-basin V); Altoona (Sub-basin VI); Shamokin Creek, Conodoquinet Creek, Harrisburg West Shore (Sub-basin VII); Swatara Creek, Codorus Creek, Lancaster (Sub-basin VIII).

Major Multiple Purpose Dams and Reservoirs

It is the responsibility of either the Corps of Engineers or the States to construct the six major multiple purpose reservoirs recommended in the Early Action Plan. There are well established procedures used by the Congress for authorizing and providing funds for a project constructed by

the Corps of Engineers. Insofar as these projects meet the established criteria for authorization, standard procedures should be followed. Some of the recommended reservoirs, however, do not follow precisely the regular procedures.

Federal interest in this type of project is defined by a number of laws enacted over the years by the Congress: the Flood Control Act of 1936 as amended, the Water Supply Act of 1958, the Federal Water Pollution Control Act amendment of 1961, and the Federal Water Project Recreation Act of 1965.

Generally, a Federal reservoir project must be economically justified; that is, the dollar benefits must exceed the dollar costs of the project. Also, not more than half of the costs can be attributed to recreation. States and/or municipalities must contract with the Federal Government to reimburse with interest that part of the cost of the project that is chargeable to water supply. Water quality storage and its releases is a Federal responsibility requiring no local participation provided the benefits are widespread. These are just the most important of myriad requirements that must be met before a project is authorized and constructed under current procedures. The economic analysis involved is discussed in detail in Appendix C.

Charlotte Creek Project. The Charlotte Creek Complex consists of two impoundments. The smaller (T-2) is a single purpose recreational reservoir which would be implemented by the State of New York and is included with the discussion of single purpose sites that follows. The larger, and principal, project is at the site of the already authorized Davenport Center Dam and Reservoir Project.

The Coordinating Committee recommends that detailed planning on this project be started by 1972 and that construction start as soon as possible thereafter. Construction at the smaller upstream site will have to be coordinated with the larger downstream project, requiring some new State legislation. Another innovation will be required because there is no present arrangement for reimbursing the Federal Government for the cost of irrigation storage planned for the project. The estimated cost of the multiple-purpose reservoir is $43.5 million, of which $1.5 million would be borne by the State. The subimpoundment would cost an additional $3.4 million, of which $700,000 would be non-Federal funds.

South Plymouth Project. Although this project is authorized under previous legislation, additional authorization may be needed to build the reservoir as formulated in this Study. South Plymouth does not meet the usual criterion of a cost-benefit ratio greater than 1:1; rather it relies on secondary (or expansion) benefits for its justification. Changes in Federal policy will be needed to build this project; otherwise the State of New York or other non-Federal interests would have to undertake its construction. It is expected to have substantial impact in helping the general economy of the region by supplying recreation and attracting industry and residents to the Norwich area.

The Coordinating Committee recommends that detailed planning for this project begin by 1975, following authorization.

This estimated cost sharing, if it were constructed by the Federal Government, would be $26.2 million from the Federal Government and $900,000 from non-Federal sources.

Fabius Project. This project meets the established criteria for Corps of Engineers multiple purpose projects, and the Coordinating Committee recommends that it be authorized for construction by 1972. The estimated cost is $17.6 million, of which $300,000 would be from non-Federal sources.

Mud Creek Project. This project also meets the established criteria for multiple purpose projects constructed by the Corps of Engineers. The Coordinating Committee recommends that its construction be authorized by 1972. The estimated cost is $23.0 million, with $3.3 million coming from non-Federal sources.

Fivemile Creek Project. The Fivemile Creek project is not economically justified by conventional methods. On the basis of its regional merits and importance, however, the Coordinating Committee recommends that its authorization be sought by 1973. If changes in present Federal policy are not made, the State of New York or some other non-Federal agency would have to undertake the construction with the possibility of some Federal grant aid. The estimated cost is $31.8 million. Non-Federal costs would be $4.3 million of this if the Federal Government were to construct the reservoir project.

Shady Grove Project. This project is justified under established criteria. However, like the Charlotte Creek Project, irrigation is one of the purposes of the reservoir, and some new institutional arrangement may be necessary for irrigators to reimburse the Federal Government for this storage. The Coordinating Committee recommends that this project be authorized by 1973 and built as soon as possible thereafter.

The estimated cost is $27.0 million, with $12.4 million of this to be non-Federal costs.

Reservoirs for Recreation and Fish Habitat

These reservoirs fall into two categories: (1) low channel dams that the States would build with the possibility of some Federal assistance, and (2) impoundments for recreation and fishing that either the Department of Agriculture or the States would build, depending on the specific circumstances.

Low Channel Dams

Four low channel dams have been recommended by the Coordinating Committee on the basis of information provided by the Commonwealth of Pennsylvania. The Coordinating Committee recommends that these dams be built by the Commonwealth during the early action period. There are two Federal cost sharing programs available to help pay for these projects:

1. The Land and Water Conservation Fund of the Department of the Interior. Projects funded under this program must be part of a state-wide outdoor recreation plan to be eligible.

2. The Open Space Land Program administered by the Department of Housing and Urban Development. This program will pay for 50 percent of land acquisition for recreational facilities.

The Coordinating Committee's recommendation is that these dams be constructed in the early action period and that recreational facilities be developed over the next 50 years as the demand grows and as more funds become available. The costs of $11.4 million are for the early action phase only, including dam construction and provision of several boat access ramps at each site. Recreational facilities to be built after the early action period are estimated at $60 million.

Tributary Reservoirs for Recreation and Fish Habitat

The small tributary reservoirs for recreation and fishing could be implemented either by a sponsor of a watershed work plan under the Watershed Protection and Flood Prevention Act, as amended, or by the respective State fishery agencies. The former, known as PL 566, is administered by the Department of Agriculture and provides up to 50 percent funding of upstream watershed projects. However, for these reservoirs to be implemented under this program as recommended by the Coordinating Committee, policy change will be needed. These reservoirs are presented separately from upstream watershed programs which are recommended for implementation under this same law. The difference is that these recreation and fishing reservoirs have few flood reduction benefits. While the PL 566 does not specify that this is the only criterion for funding a project under that law, it has been almost exclusively interpreted that way. Therefore, the Coordinating Committee recommends that the application of PL 566 be extended to single purpose recreation and fishing projects so that they may be built with Federal funding on a 50-50 basis.* The costs of these 62 reservoirs range from about $75,000 to almost $5 million. Together they would cost $100 million including construction, lands, and related recreational facilities. Table 17 below shows these costs by State.

* With the exception of site T-2 (Charlotte Creek, Sub-basin I) where the Federal share is somewhat greater since it is part of the Charlotte Creek Complex.

TABLE 16

COSTS OF LOW CHANNEL DAMS IN THE EARLY ACTION PLAN

Low Channel Dam	Total Initial Cost	Framework Period Recreation Facilities Costs
Berwick	$ 1.9 million	$ 6.1 million
Williamsport	4.7	20.3
Lewistown	0.8	17.2
Duncannon	4.0	16.0
TOTAL	$11.4 million	$59.6 million

TABLE 17

COSTS OF SMALL TRIBUTARY RESERVOIRS BY STATE IN EARLY ACTION PLAN

Location	Number of Sites	Total Cost
New York	20*	$21.0* million
Pennsylvania	38	73.0
Maryland	4	6.0
TOTAL	62	$100.0 million

Ground Water and Pipelines for Municipal and Industrial Water Supply

Both ground water and pipeline planning and construction are the responsibility of local authorities with some help, up to 50 percent, available from the Federal Government.

Ground Water

The 15 ground water wellfields recommended in the Early Action Plan must be implemented by the local governments or water authorities. Up to 50 percent Federal grants are available under the Housing and Urban Development Act of 1965. However, this grant program would need a

* includes site T-2.

TABLE 18

STAGED COSTS OF GROUND WATER RECOMMENDATIONS IN EARLY ACTION PLAN

Early Action Cost	$13.0 million
Framework Cost	66.4
TOTAL COST	$79.4 million

many fold increase in its actual funding if the recommendations of the Coordinating Committee are to receive the full share of aid allowed by the law.

These ground water developments have been staged so that the supply will be expanded in time to meet growing water supply needs through the year 2020. The staged costs of the development for the fifteen locations are shown above.

Pipelines

The funding, cost sharing, and laws affecting the four pipelines recommended in the Early Action Plan are the same as those for ground water development.

The pipelines, while recommended in the Early Action Plan, have been staged so they will meet the growing water supply needs through the year 2020. The costs of the staged development of each pipeline are shown in Table 19.

Water Supply Reservoir. The Coordinating Committee recommends that the reservoir on Little Laurel Run for water supply for Philipsburg be implemented locally. Fifty percent cost sharing is available under the Housing and Urban Development Act of 1965. If these funds were used, the Federal Government and local shares would each be about $1.15 million, the total project cost being estimated at $2.3 million.

Local Flood Protection Projects

Six of the local flood protection projects in the early action period could be implemented by the Corps of Engineers (with State or local participation) under the Flood Control Act of 1936. The remaining project, at Philipsburg is already partially completed by the Commonwealth of Pennsylvania, and it is recommended that the Commonwealth complete the

TABLE 19

STAGED COSTS OF PIPELINES RECOMMENDED IN EARLY ACTION PLAN

Project	Early Action Cost	Framework Cost	Total Cost
Scranton	$ 8.5 million	$ 7.3 million	$15.8 million
Shippensburg	1.1	1.2	2.3
Lancaster	9.3	12.3	21.6
York-Hanover	11.6	28.0	39.6
TOTAL	$30.5 million	$48.8 million	$79.3 million

TABLE 20

COST SHARING OF LOCAL FLOOD PROTECTION PROJECTS IN EARLY ACTION PLAN

Project	Federal Share	Non-Federal Share	Total
Marathon	$ 1.63 million	$ 0.06 million	$ 1.69 million
Westfield	0.90	0.03	0.93
Bloomsburg	7.90	0.24	8.14
Wyoming Valley	1.26	0.03	1.29
Philipsburg	-	1.00	1.00
Lock Haven	11.17	0.50	11.67
Harrisburg	4.85	0.01	4.86
TOTAL	$27.71 million	$1.87 million	$29.58 million

project. One of the recommended projects does not meet the established criterion of the cost-benefit ratio being greater than 1:1. The project Bloomsburg would protect a larger area than is economically justified. It is justified, however, if secondary, or expansion, benefits are taken into account. This project would open up for development, excellent land that currently is not near to being fully used because of the threat of floods. The law requires certain local participation and cooperation in all Corps of Engineers flood protection projects, particularly in the furnishing of lands and rights-of-way and in the maintenance and operation of the completed projects. The cost sharing on the local flood protection projects is shown in Table 20.

Upstream Watershed Programs

The Coordinating Committee recommends that the nine upstream watershed projects be implemented under the Watershed Protection and Flood Prevention Act, as amended (PL 566). This Act requires that the projects be sponsored by political subdivisions. Planning and technical assistance are provided by the U.S. Department of Agriculture. Under the provisions of the act, the Federal Government may pay all the costs of engineering and construction related to flood control; it may pay all of the engineering and 50 percent of the construction costs dealing with irrigation, drainage, and fish and wildlife development; and it may pay up to 50 percent of the cost of land, construction, and facilities for recreation. The Coordinating Committee recommends that the Department of Agriculture and local sponsors implement these nine projects as soon as possible. The cost sharing for these projects is shown in Table 21.

Other Structural Measures

Other structural measures include irrigation ground water wellfields and streambank stabilization.

Irrigation Wellfields. The three recommended wellfields for irrigation would be implemented by the irrigators. Up to 80 percent Federal assistance is available through the Agriculture Conservation Program (PL 87-703), as amended, administered by the Department of Agriculture. There is precedent for groups of farmers to collectively finance this type of irrigation project. The estimated staged cost of these three projects is shown below.

Streambank Stabilization. The Soil Conservation Service and Agricultural Stabilization and Conservation Service of the USDA provide technical assistance and Federal cost-sharing for streambank stabilization in rural areas. Also, Federal assistance for emergency bank protection is authorized by the 1946 Flood Control Act. Beyond these activities, the extent of the Federal interest in such work is defined only by precedent established in previously authorized projects. However, the existing authority for Federal participation in beach erosion projects (Section 103 of the River and Harbor Act of 1962, as amended) could logically be extended to cover streambank erosion with similar cost-sharing provisions, based on specific studies of a problem area.

The Coordinating Committee recommends that streambank stabilization be accomplished by the States with Federal matching funds (up to 50 percent) under PL 566 or under a subsequent River and Harbor Act, as dictated by the extent of the specific problem surveyed. The cost for the recommended streambank stabilization is about $10.2 million.

Management Measures

Three management programs have been recommended by the Coordinating Committee: land management, streamside management, and flood plain management. The responsibility for all of these programs rests with local governments and individual land owners. Some Federal assistance is available through various cost sharing arrangements with several agencies.

Land Management

There are two programs of land management recommended by the Coordinating Committee: (1) an accelerated land treatment program associated with recommended reservoirs and upstream watershed programs and (2) a critical area treatment program aimed at the major sources of erosion and sediment in the Basin. These are in addition to the on-going land treatment and management program carried out by the Department of Agriculture. Additional detail on these programs is provided in Appendixes J and K(3), and Supplement B.

TABLE 21

COST SHARING OF UPSTREAM WATERSHED PROJECTS IN EARLY ACTION PLAN

Federal Costs	$ 9.6 million
Non-Federal Costs	4.2
TOTAL COST	$13.8 million

TABLE 22

STAGED COST OF IRRIGATION RECOMMENDATIONS IN EARLY ACTION PLAN

Project	Early Action Cost	Framework Cost	Total Cost
Cohocton River	$0.27 million	$0.53 million	$ 0.80 million
Octararo Creek	2.02	2.34	4.36
Conewago Creek	2.64	6.44	9.08
TOTAL	$4.93 million	$9.31 million	$14.24 million

On-going Land Treatment Program. This program is implemented by individual land owners and farmers with technical assistance provided by local soil and water conservation districts with the help of the U.S. Department of Agriculture. Cost sharing, up to 80 percent, is available under the Agricultural Conservation Program Act (PL 87-703). This program is not included in the recommended Plan since it is part of the normal operations of the Department of Agriculture.

Accelerated Land Treatment Program. This program would be carried out in the same manner as the on-going land treatment program. The Coordinating Committee recommends, however, that additional money for cost sharing and technical assistance be made available to speed up treatment of lands above the recommended reservoir sites to reduce soil erosion, sediment production, and direct runoff. There are 131,048 acres recommended for this accelerated treatment.

The estimated cost of this accelerated program is $3.2 million, made up of $2.1 million for installation costs and $1.1 million for technical service costs.

Critical Area Treatment Program. The land treatment and revegetation of mined areas needs to be accomplished to aid in coal mine drainage pollution abatement discussed earlier, and to reduce a major source of sediment in the Susquehanna River and its tributaries. This program would be carried out with technical assistance and cost sharing administered by the Department of Agriculture as described above. There are 139,600 acres of such areas in need of treatment. It is recommended that 48,800 acres of this be treated in the early action period at an estimated cost of $4.2 million. Technical service costs would be $0.8 million, and installation costs would be $3.4 million.

Stream Management

The Coordinating Committee recommends that the management of streams and streamside areas be implemented at the local level. The recommendation is that all facilities be provided in the early action period on "Wild" and "Scenic" streams, and that 50 percent of the facilities be provided on "Recreation" and "Modified Recreation" streams.

Local zoning powers and purchase of easements or land for recreational development will have to be employed to implement this recommendation. Cost sharing from the Federal Government is available in limited quantities under the Land and Water Conservation Fund Act, as amended, administered by the Department of the Interior, and under the Open Spaces Land Program administered by the Department of Housing and Urban Development, to acquire streamside areas for preservation and recreational use. Under the former, a comprehensive statewide outdoor recreation plan is required for eligibility for funds. The applications for money must be for projects consistent with this statewide plan. Costs for land and recreational facilities are shown below.

TABLE 23

STAGED COSTS FOR RECREATIONAL FACILITIES ON CATEGORIZED STREAMS IN THE EARLY ACTION PLAN

Early Action Costs	$28 million
Framework Costs	26
TOTAL COSTS	$54 million

Flood Plain Management

Like streamside management, flood plain management is a local responsibility, falling under local zoning and building code enforcement powers. The Corps of Engineers, upon request, will carry out a flood plain information study that defines the flood problem in some detail, and will act in an advisory capacity in carrying out flood plain management measures. The Weather Bureau of the Department of Commerce operates the flood warning system in the Basin and is also available for consultation to aid communities in their flood plain management problems.

The Department of Housing and Urban Development operates a flood insurance program for which municipalities may apply. Communities are required to take certain flood plain management and zoning measures to be eligible for the program. This program is an important incentive in moving communities toward better management of their flood plains.

B. Implementation of the Framework Plan

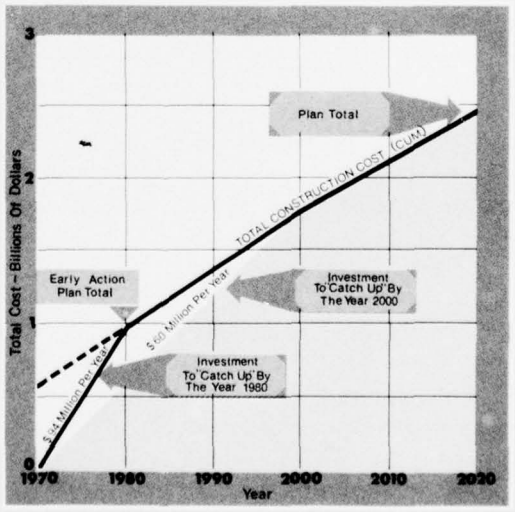
Implementation of the projects and programs in the 2000 and 2020 Plans, whether they are new projects or parts of on-going programs from the early action period, would be substantially the same as described for the early action period. It is reasonable, however, to expect changes in laws and institutions that deal with water and related land resources over such a long period of time. No one, of course, now knows what these changes will be. Therefore, the Coordinating Committee recommends that the Framework Plan measures be reconsidered in the context of whatever future cost sharing and planning arrangements evolve in the decades ahead. The costs for the measures in the Framework Plan are shown in Table 24.

TABLE 24

FIRST COST OF FRAMEWORK PLAN STRUCTURAL MEASURES

	Number of Projects	2000 Cost	Number of Projects	2020 Cost
Water Quality Measures				
Coal Mine Drainage Abatement	8	$56 million	6	$105 million
New and Expanded Advanced Waste Treatment Facilities	15	57	25	143
Major Multiple Purpose Reservoirs	1	74	-	-
Reservoirs for Recreational Habitat				
Low Channel Dams*	2	27	1	10
Large Tributary Reservoirs	3	123	3	87
Small Triburary Reservoirs	41	50	31	72
Ground Water for Municipal and Industrial Water Supply*	1	1	2	12
Other				
Bank Stabilization	1	1	-	-
Irrigation Reservoir	-	-	1	**
Drainage Project	-	-	1	1
TOTAL	72	$389 million	70	$430 million

Figure 56 ---- Water Resource Investment Rates



*Includes initial and staged costs. **Less than $500,000.

C. Investment Analysis and Priorities*

Program Investment Summary

The Coordinating Committee Plan calls for a significant investment of public funds, Federal and non-Federal, as well as of private capital. The Plan is superimposed on a background of past and present investments that have been woefully inadequate to meet some basic needs. The inadequacy of investment is most apparent when related to the requirements to restore and maintain satisfactory quality in the streams of the Basin. Likewise, development of adequate water-based recreational opportunity has seriously lagged behind overall demand. Only in the effort to ease the more critical flood problems, and to provide municipal and industrial water supplies, has the level of investment been nearly adequate.

The tables and charts which follow present information on the extent and rate of investment in the Basin required over the next 50 years to implement the Plan recommended by the Coordinating Committee. Table 25 lists the construction costs of the Plan by project category. The first column of figures headed "Required to 1980" lists the costs of the Early Action Plan*. Note that the investment required to provide treatment facilities for municipal and industrial wastes is about 37 percent of the total construction cost of the entire Early Action Plan. The multiple purpose reservoirs and the smaller, headwater-type projects *combined* represent about 30 percent of the total, while mine drainage pollution abatement is 11 percent of the Early Action Plan cost. Waste treatment facilities are expected to demand about the same share of the total cost beyond 1980. Note also in Table 25, that a number of programs (reservoirs, local flood protection, streambank stabilization, and tributary streamside recreational development) place the bulk of the recommended construction investment in the early action period. The other programs are more evenly distributed over the 50-year planning period. This difference is related to the timing and urgency of the water resource deficits which the specific program was intended to meet.

Figure 56 presents graphically the total "first cost" estimates from the bottom line of Table 24. The construction costs shown by the solid line are accumulated over the 50-year planning period to 2020. Beginning in 1970 an average of about $94 million *each year* must be invested in Basin-wide water resource restoration and development to "catch up" with the total needs by 1980. If the investment rate was permitted to slip to around $60 million each year, we could not close the gap until the end of this century. The annual cost of operating and maintaining the investment already in place are not included in the above figures. Also note on Figure 56 that at the present time (1970), we are about $600 million behind in committing money to meet water resource deficiencies, as indicated by the point where the dashed line meets the vertical axis.

*The discussion in this section includes secondary sewage treatment plants, and the on-going land treatment program as part of the cost of the Plan.

The Plan for the Susquehanna is directed toward producing water-related benefits in the Basin. The water resource investment needs can be examined from this viewpoint as well. Table 26 lists the same investment totals previously shown in Table 25, but this time broken down by benefit category. The dollar figures are *not* the "market values" of each category of benefit, but rather the planned investment needed to obtain the desired level of benefits. Most obvious is the dominance of water quality as an overriding investment need, about 50 percent of the total for all categories. Each benefit category includes the allocated cost of storage in reservoirs for that purpose, as well as the cost of single-purpose facilities.

Investment Priorities

A basic Study assumption worth restating at this point is the early completion of all water resource projects presently under advanced planning,

TABLE 25

COST SUMMARY BY PROJECT CATEGORY*
($ million - July 1969 Prices)

Project Category	Required to 1980 $	%	Additional to 2000 $	%	Additional to 2020 $	%	First Cost Total $	%
Mine Drainage Pollution Abatement	103	11	56	7	105	14	264	11
Sewage Treatment Facilities	350	37	302	36	296	41	948	38
Data Collection Systems	+	+++	-	-	-	-	+	+++
Major Multiple Purpose and Large Tributary Reservoirs++	173	18	197	23	87	13	457	19
Tributary Reservoirs**	112	12	50	6	72	9	234	10
Low Channel Dams	11	1	40	5	57	8	108	4
Ground Water Wellfields***	18	2	27	3	60	8	105	4
Pipelines	30	3	49	6	-	-	79	3
Local Flood Protection	30	3	-	-	-	-	30	1
Streambank Stabilization	10	1	1	+++	-	-	11	+++
Drainage Projects	-	-	-	-	1	+++	1	+++
Accelerated and On-going Land Treatment	73	8	54	10	33	6	160	6
Critical Area Land Treatment	4	+++	4	+++	4	+++	12	+++
Streamside Management	28	3	26	3	-	-	54	2
TOTAL	942	100	806	100	715	100	2,463	100

*Annual operating and maintenance costs not included. **All reservoirs less than 25,000 acre-feet including upstream watershed projects and water supply and irrigation reservoirs. ***All ground water including municipal and industrial water supply, and irrigation. +Less than $500,000. ++Includes site T-2. +++Less than 0.5%.

design, and construction. Such projects as the Raystown Reservoir (on the Raystown Branch of the Juniata River in Pennsylvania) and the waste treatment plants well along in planning will make an important contribution toward meeting present water resource needs. Early completion of all such projects----Federal, State, and municipal----must be given the highest priority for investment in the Susquehanna River Basin.

Looking beyond the investments assumed accomplished for the purposes of this Study, the Coordinating Committee members fully realize the burden the recommended Plan places upon regional and national financial resources. A look at the past rates of investment in water resources restoration and development, and the present level of financing of needed measures, clearly points to the difficult decisions of priority that must be made. The Committee members and planning staff do not wish to make implied judgments on priorities by further deferring or eliminating projects and programs now in the recommended Plan. Instead, the Committee members, guided by the public interest and the stated and implied will of those citizens served by the Susquehanna, have agreed on a broad ranking of investment priorities to assist in making the choices for early action investment.

Table 27 on the following page summarizes the consensus of the Susquehanna Coordinating Committee members toward the priorities for investment by States during the early action period. The priorities for

TABLE 26

COST SUMMARY BY BENEFIT CATEGORY*
($ million - July 1968 Prices)

Benefit Category	Required to 1980 $	%	Additional to 2000 $	%	Additional to 2020 $	%	First Cost Total $	%
Mine Drainage Pollution Abatement	103	11	56	7	105	15	264	11
Organic and Other Pollution Abatement	395	42	302	36	296	41	993	40
Water Supply	87	9	76	9	60	8	223	9
General Outdoor Recreation	184	18	249	29	183	25	616	24
Fish and Wildlife	34	4	43	5	33	5	110	4
Flood Damage Reduction	62	7	22	3	1	-	85	3
Land Conservation	77	9	58	11	37	6	172	9
TOTAL	942	100	806	100	715	100	2,463	100

*Annual operating and maintenance costs not included

TABLE 27

SUSQUEHANNA BASIN COMPREHENSIVE PLAN
EARLY ACTION PRIORITY GROUPINGS

Members' Consensus By State	Priority Group I	II	III	IV
New York	a. Data Collection Systems b. Sewage Collection and Treatment Facilities (including regional studies)* c. Mine Drainage Pollution Abatement ** d. Ground Water Wellfields	a. Major Multiple Purpose Reservoirs (five in N.Y.) b. Headwater Reservoirs	a. Local Flood Protection (Marathon, N.Y.) b. Flood Plain Management (including studies) c. Land Treatment	a. Streamside Recreation b. Streambank Stabilization
Pennsylvania	a. Data Collection Systems b. Sewage Collection and Treatment Facilities (including regional) studies) c. Mine Drainage Pollution Abatement (including mine drainage studies)	a. Major Multiple Purpose Reservoir (Shady Grove) b. Water Supply Pipelines c. Ground Water Wellfields	a. Headwater Reservoirs b. Streamside Recreation c. Low Channel Dams for Recreation d. Land Treatment	a. Local Flood Protection b. Flood Plain Management (including studies) c. Streambank Stabilization
Maryland	a. Chesapeake Bay Flow Requirements Studies + b. Data Collection Systems c. Sewage Collection and Treatment Facilities ++ d. Mine Drainage Pollution Abatement	a. Major Multiple Purpose Reservoirs ++	a. Headwater Reservoirs b. Streamside Recreation	a. Land Treatment b. Flood Plain Management

any one State reflect not only the views of that State representative on the Coordinating Committee, but incorporate as well the views of the other members who have expressed priority preferences.

The Coordinating Committee does not believe that limited money would be best spent by concentrating on the higher priority programs to the complete exclusion of the lower priority measures. High priority, however, does imply a degree of urgency that cannot be ignored in favor of low priority measures. Nor does the Committee presume to take away

* Priority committment under New York Pure Waters Law

** Investment in Tioga County, Pennsylvania - some benefits accrue in New York

\+ This includes a wide range of studies related to the estuarine ecology of Chesapeake Bay and quantities of inflow

++ All investments in upstream states - part of benefits accure in Maryland

local, regional, or national prerogatives to implement a given program element or specific project as it sees fit to meet local conditions and changing times. The Committee is obligated, however, to offer its best opinion on where limited money would be well spent to serve the entire population of the Basin.

Table 27 shows a high degree of conformity among the listed priorities for programs and project categories in each of the States. Without exception, the Coordinating Committee membership has read the popular sentiment and the urgency of water resource problems as a mandate for significantly improved and protected water quality, closely followed by an adequate water supply. Even though very few projects in the recommended Plan would be located in Maryland, the same concern for water quality and quantity, as it affects the Chesapeake Bay and the Baltimore Metropolitan Area, is strongly reflected.

The general Basin-wide recommendations of the Coordinating Committee can be more simply stated as preferring investments in measures that yield water resource benefits in the following order:

1. Water Quality
2. Water Supply
3. Recreation (and Fish and Wildlife)
4. Flood Control

This listing is generally valid throughout the Basin with one broad exception. In the State of New York, flood control measures should be rated a priority generally higher than recreation, as Table 27 clearly reflects under Priority Groups II and III.

An integral part of implementing the Plan, and adjusting it to the future as changing times dictate, is the continued collection of new information to guide future decisions. The major special studies required during the early action period are listed below. These studies are beyond the scope of the Susquehanna River Basin Study, but will be essential to develop the necessary detailed data to carry out the Coordinating Committee's recommendations for the Basin.

1. Regional Sewerage Studies
2. Coal Mine Drainage Studies
3. Flood Plain Management Studies
4. Chesapeake Bay Flow Requirements Studies

D. Policy and Legislative Recommendations

The Coordinating Committee recommends a number of changes in legislation and policy. These changes are intended to assist all levels of government in implementing the Early Action Plan, and to provide an improved basis for water and related resource management, particularly in the Susquehanna River Basin. In addition, past experience has shown that many economic and environmental concerns have not been reflected in development decisions as they affect the broad public interest. Both the National Environmental Policy Act of 1969 (Public Law 91-190) and the Environmental Quality Improvement Act of 1970 (Title II, Public Law 91-224) call for higher standards of policy and public law as they relate to man's use of natural resources to promote his own well-being.

Water Quality Management

Regional Sewerage Studies

The Coordinating Committee recognizes that the several States in the Basin have made good progress toward meeting their water quality standards in cooperation with the efforts of local governments and the concerned Federal agencies. The cost of adequate waste treatment facilities, as previously noted, will require about 37 percent of the total first cost of the Early Action Plan, based on individual plants for each sewage service area. About half of these service areas are so situated that they could conceivably be combined into 13 regional systems as a means of reducing the cost of construction or operation, or of improving their efficiency and reliability.

Studies of the potential for partial regionalization have been completed or are planned by local authorities in a number of the possible regions. A significant advance in such studies from the viewpoint of Basin-wide and regional water management for all purposes is required to provide the basis for improved allocation of waste treatment construction money--Federal, State, and local. Accordingly, the Coordinating Committee recommends that authority and funding be provided by the Congress to an appropriate Federal agency to begin as soon as possible the detailed surveys of the potential for regionalization, as outlined in Chapter IX of Supplement B.

Present Federal programs of planning assistance to local communities should be continued and accelerated under existing legislation toward a cooperative and early completion of the highest priority areas, as a logical component of implementation of the Plan for the Susquehanna River Basin.

Coal Mine Drainage Pollution Abatement

Pollution of streams by drainage from abandoned coal mines has remained a persistent problem in the Susquehanna Basin, as well as in other areas that in the past have yielded the supply of coal to support the Nation's early growth. The Commonwealth of Pennsylvania has made a strong start toward solving the massive mine drainage problem, with little assistance from the rest of the Nation.

In view of the interstate impact of the problem, and the general policy stated in the National Environmental Policy Act of 1969, the Coordinating Committee recommends a change in Federal law and policy to permit sharing of the costs of abating pollution from abandoned coal mines, in accordance with specific project recommendations in the survey reports for the individual watersheds to be included in the Susquehanna Mine Drainage Study (see Supplement B).

Pollution by drainage from coal mines upstream from all existing, planned, or recommended federally assisted reservoirs,and drainage polluting interstate waters and their tributaries, particularly warrant greater Federal involvement. In selected cases, the Federal Government should be authorized to undertake abatement projects dealing with mine drainage pollution originating from abandoned coal mines. The benefits of coal mining over the years have accrued to the entire Nation; the costs of environmental degradation were deferred to remain a burden on the coal region and its people.

Federal Water Resource Projects

Federal law and policy should permit equitable sharing of costs for all flood damage reduction measures, structural and non-structural, and for water based recreation. The goal of broad solutions to problems, not solely projects, should be the guiding force.

The present evaluation procedures for Federal water resource projects do not allow regional income benefits to be counted in meeting economic justification requirements. The Coordinating Committee recommends that regional income benefits be given equal weight with national income benefits in the decision to provide a federally assisted water resource development project in designated regions of the Nation.

Even though the net impact on regional income is difficult to evaluate, the Committee believes that it is in the national interest to enhance the growth of certain regions (such as Appalachia). Projects should be considered for Federal investment if either the national income or the regional income returns, as quantitatively described in the project reports, appear to warrant the investment. Conversely, projects economically justified, but resulting in significant loss in important non-quantifiable values, should be deferred or dropped from consideration unless no other viable or practicable alternative exists.

Concluding Statement . . .

The National Environmental Policy Act of 1969 has formalized the national concern for environmental quality by instituting a procedure designed to ensure consideration of the environmental effects of all on-going and future Federal activities and programs. In general, the Act " . . . declares, that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."

More specifically, the Act declares that for any Federal action which will significantly effect the quality of the environment, a detailed "impact statement" must be prepared. This statement must respond to the following five questions.

1. What is the environmental impact of the proposed action?
2. What adverse environmental effects cannot be avoided?
3. What alternatives are there to the proposed action?
4. What is the relationship between short term uses of man's environment and the maintenance and enhancement of long term productivity?
5. What irreversible or irretrievable committment of resources would be involved?

Many of the activities of Federal agencies affect the area in which they are carried out. The immediate and short term effects of structural projects such as interstate highways, reservoirs, and suburban developments are the most evident, and certainly the most controversial. Long term effects are not always as easily predicted. Non-structural activities, and other Federal programs, while not as noticeable to the general public, often have the same far-reaching consequences and must be considered of equal, if not greater, importance in their effect on the environment. Management of Federal lands, water quality management, soil conservation practices, pest eradication programs, and dissemination of Federal grants are but a few of the activities which may not only prove to be of immediate benefit, or harm, to the environment, but which also may exert a strong influence on the future development of an area or the future direction of research.

It is the purpose of the Federal Government to serve both the short and long term interests of the people, and one purpose of the Coordinating Committee is to serve the interests of the people who live within the Susquehanna River Basin. This report had its origins in legislation passed long before the conception of the National Environmental Policy Act of 1969, and even before the relatively recent public interest in the long term consequences of actions which affect the environment. It was, however, one of the aims of Congress, and therefore of the Coordinating Committee, to construct a plan for the future development of the Basin which was ecologically sound and aesthetically pleasing.

The Environmental Policy Act sets up a standard procedure for treating all Federal actions and an organization, the Council on Environmental Quality, to administer the new law and ensure that it is carried out both in letter and spirit. The five major subjects in the impact statement should be considered by any reasonably prudent and experienced resource planner. While the format of this report was determined long before the Act was passed, this study has carefully weighed and concisely presented both environmental and economic consequences of all suggested actions, and presents both in the light of public desires. The Coordinating Committee believes that the Plan, in meeting its objective of developing a concept for water and related land resource management in the Susquehanna Basin, has optimized the environmental, economic, and aesthetic considerations---and is ecologically sound, economically reasonable, and aesthetically pleasing. It is capable of implementation if adequate local, State, and Federal support are demanded by those who only can determine the future of the Basin---the people of the Susquehanna River Basin.

Acknowledgements

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