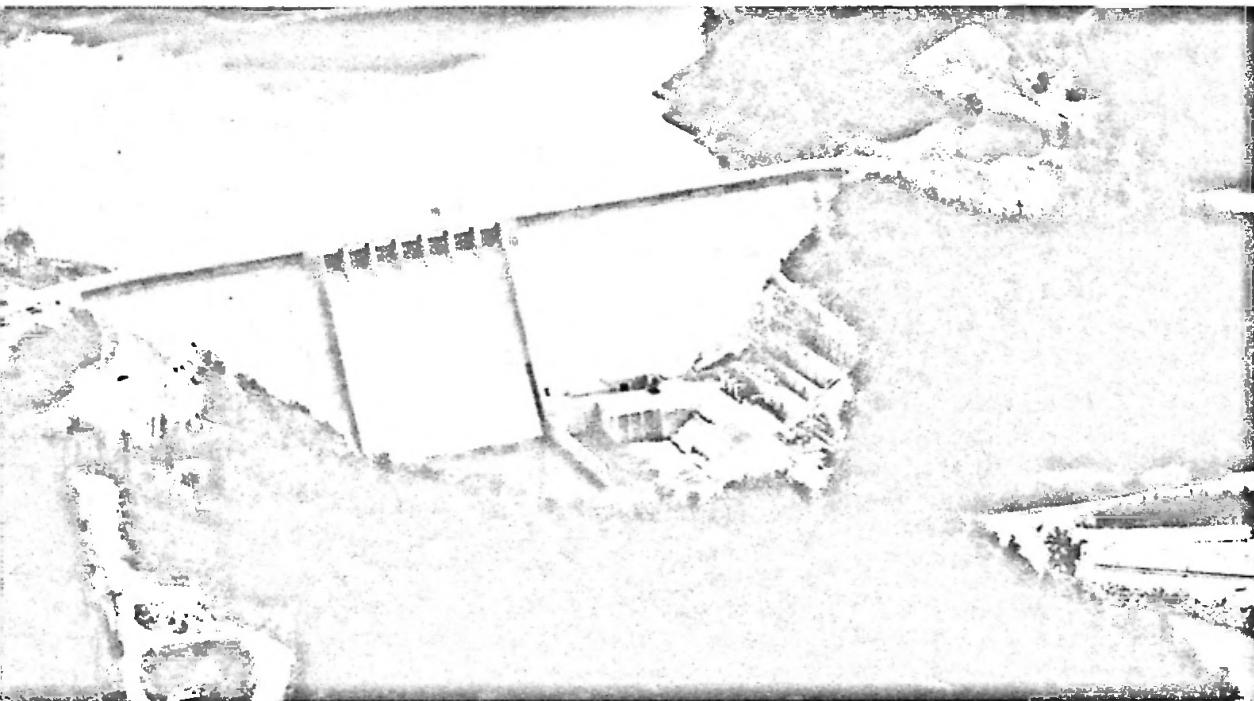


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TENNESSEE RIVER VALLEY



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For
The International Cooperation Administration
Washington 25, D. C.

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TENNESSEE RIVER VALLEY

A Case Study

by

A. J. Gray, Chief Community Planner
Government Research Branch
Tennessee Valley Authority

and

Victor Roterus, Director
Office of Area Development
U. S. Department of Commerce



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FOREWORD

The importance of physical planning in relation to economic development is being recognized more and more.

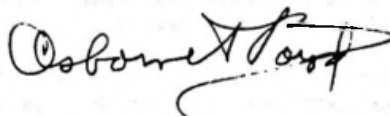
Because of this, the 1960 World Planning and Housing Congress, held in the Commonwealth of Puerto Rico, adopted as one of its two themes, "The Contribution of Physical Planning to Social and Economic Development." Furthermore, immediately prior to the Congress the International Cooperation Administration is sponsoring a Seminar on the same subject jointly with the Commonwealth of Puerto Rico. Both ICA technicians and ICA-sponsored participants will take part in this Seminar.

In submitting examples to the Congress of the contribution made by physical planning in the United States, two illustrations were chosen as the official U.S. Government submittal which are believed have considerable value and applicability to other countries. These are (1) The River Development Program of the Tennessee Valley Authority (TVA) and (2) The Planned Industrial Park.

These two illustrations were also the basis of an exhibit prepared by the Housing and Home Finance Agency in collaboration with the National Association of Home Builders, for display at the Congress.

This publication deals with the first of these two case studies--The Tennessee River Valley--and is based on the paper submitted to the Congress by A. J. Gray, Chief Community Planner, Government Research Branch, Tennessee Valley Authority and Victor Roterus, Director, Office of Area Development, U.S. Department of Commerce.

The Housing Division of the International Cooperation Administration takes pleasure in publishing this paper because it believes that U.S. experience in this field can be usefully studied by planners and government officials in other countries as well as by Planning and Housing Advisers of the International Cooperation Administration attached to United States Operations Missions.



Osborne T. Boyd
Chief, Housing Division
International Cooperation Administration

ILLUSTRATIONS

- Figure 1. Map of the Tennessee Valley Region showing TVA river improvement and other major projects and the relation of the TVA power service area to the Tennessee River watershed. The combined watershed and power service areas contain 92,000 square miles and just under six million people.
- Figure 2. The Decatur, Alabama, industrial waterfront on Wheeler Reservoir--one result of the cooperative planning program in the Tennessee Valley.
- Figure 3. Waterfront park and harbor at Guntersville, Alabama. The small insert map shows the industrial embayment to the east and the recreation embayment to the west of the Guntersville Peninsula. The boat harbor at the northern tip of the peninsula now is home port for pleasure craft valued at over \$800,000.
- Figure 4. The local planning assistance program of the Tennessee State Planning Commission which started in reservoir-affected communities now reaches communities and counties throughout the state. Only 53 percent of the State of Tennessee is within the Tennessee River watershed.
- Figure 5. Map of Norris Dam Reservation and State Park showing the facilities maintained and operated by the State of Tennessee and the visitor facilities maintained and operated by TVA. Note that the reservation also contains a forestry experimental area and the fish hatchery no longer needed to restock the reservoirs.
- Figure 6. Elizabethton, Tennessee--an example of a zoning proposal to adjust land use to the local flood situation.
- Figure 7. Lewisburg, Tennessee--parks and other types of open land uses which would not be damaged appreciably by flood waters are proposed for flood hazard areas.
- Figure 8. Through careful planning, wildlife resources of the Tennessee Valley are being protected and preserved.

INTRODUCTION

In order to identify and describe some of the contributions that physical planning can make to social and economic development, careful consideration was given to the selection of case examples from United States experience which would illustrate this theme in specific terms.

Excellent examples could be appropriately drawn from many fields of planning activity in the United States--urban redevelopment for residential and commercial purposes, urban and interstate highway and traffic schemes, urban waterfront development, civic center and public building groupings, shopping center developments, recreation and park planning, central business district renovation, comprehensive city planning, and others. It was decided, however, that in view of the limitation of available space, the United States contribution to the 1960 World Planning and Housing Congress would be centered on two types of physical planning, which, if not unique to the United States, have been highly developed there. These examples were also selected because they have a high degree of interest and applicability to other countries. The examples chosen were: (1) the planning of an entire river system for its multiple uses and then adapting this plan to the economic and social needs and opportunities of the region as a whole (as illustrated by the Tennessee Valley) which is the subject of this publication; and (2) the physical planning

of an efficient and aesthetic environment for accommodating industry in harmonious association with nearby residential and commercial land uses as illustrated by the planned industrial park described in IDEAS AND METHODS EXCHANGE NO. 57. Besides demonstrating that economic and social benefits result from purposeful planning, these examples highlight the view in the United States that planning and action are inseparable, and that planning should be conducted in reference to an action framework.

This case study of the Tennessee River Valley has been selected because it represents an advance in planning in the United States, although not all of the river systems of the United States have been developed with the idea of maximizing the many potential benefits that can be derived from the planning of a river system as a single entity.

However, this case example indicates that modern day planning not only is oriented to economic and social benefits, but involves concepts and techniques beyond mere physical design.

The Tennessee Valley illustrates the critical importance of cooperative participation in regional planning by all affected levels of government and private industry and the need for supplementing resource planning by planning in related fields of activity such as health.

THE TENNESSEE RIVER VALLEY

The drainage basin of the Tennessee River--fourth largest in the United States--contains the most fully developed and regulated river system in the world. An integrated system of 31 dams now controls the flow of water and produces major benefits for the multiple purposes of navigation, flood control, power, and other related regional benefits.

The river improvement system was designed, constructed, and is now operated by the Tennessee Valley Authority (TVA), a government corporation created by Congress in 1933. The basic legislative act directs TVA to improve the Tennessee River for purposes of navigation, flood control, and power; to fit the government owned chemical plant facilities at Muscle Shoals into the needs of national defense as well as the agricultural needs of the region; and to cooperate with states and localities in studies and surveys for the "purpose of fostering an orderly and proper physical, economic, and social development" of the Tennessee Basin and adjoining territory.

Two basic ideas underlie the legislation that created the agency as well as the manner in which it has carried out its responsibilities: (1) the concept of unified river improvement and (2) the concept of relating river improvements to the development of the region.

The Concept of Unified River Development

The concept of unified river improvement grew out of a long period of national concern with the problem of integrating river navigation, flood control, power development, fertilizer production, national defense, and other types of water use. This concern fostered the idea of placing responsibility for river improvement in the hands of a single administrative agency, and eventually led to the establishment of TVA.

For more than a century preceding the creation of the agency there had been interest in developing the water resources of the Tennessee River. As early as 1828 the Congress authorized surveys and cost estimates for a canal and locks around Muscle Shoals. A lateral canal was constructed along this stretch of the river, but fell into disuse because it was inadequate. Other unsuccessful attempts were

made to improve the river, but it was not until Wilson Dam was completed in 1925 that any substantial improvement was made. In the 1920's the Corps of Engineers made extensive surveys along the Tennessee River, including the possibilities for a navigation channel from Paducah to Knoxville. Out of these surveys came two proposals for improvement of the main Tennessee River: one advocated the construction of 32 low navigation dams and the other a system of 9 high dams.

High Dam vs. Low Dams--A Basic Planning Decision

The question of whether to construct a high or a low dam system for the Tennessee River was one of the first major planning decisions confronting TVA. In March 1936 TVA submitted to Congress a report entitled "The Unified Development of the Tennessee Valley System", which outlined the justification for recommending the high dam system for the Tennessee and provided a basis for the practical demonstration of the feasibility and economy of multipurpose river control programs.

The geologic conditions and the land forms of the area, the gradient of the stream, and other physical characteristics were unusually favorable for high dams. The system of 32 low navigation dams would have been less expensive, but would not have prevented extreme fluctuation of water at locks and at river terminals during periods of flood. Also, the 32-dam system would have required boats to stop for locking more than three times as often as would the system resulting from the nine high dams. Furthermore, the narrow and relatively crooked channels above the low dams would make navigation slower, difficult, and more hazardous. The high dam system was considered to be the best method of providing flood control in combination with navigation. As projected, the high dam system would be of value for flood control not only on the Tennessee River but also on the lower Mississippi River.

TVA also proposed a series of dams on the tributaries of the Tennessee River to store water during period of flood and to release water during periods of low stream flow. With stream flow stabilized, generation of large quantities of electric power would become feasible.

Thus, in the Tennessee Valley, possibilities existed to create a system of multipurpose dams which would provide adequately for the long-term development program outlined in the TVA Act. As TVA noted in its report to Congress, the alternative was a system of low single-purpose dams which "might result in one of those inadequate developments that are later lost in the process of reconstruction on a more effective scale. Substantially, that was the history of development on the Tennessee River until the construction of Wilson Dam."

Some Direct Benefits Accruing from the High Dam Decision

It is possible to enumerate here some of the navigational, flood control, and power benefits on an annual basis. Other economic and social benefits of a more indirect nature, and how they were achieved, are the substance of the major part of this discussion of the Tennessee Valley development.

Navigation improvements have created a 9-foot channel which connects with the inland waterway system of the United States and extends from the confluence of the Ohio and Tennessee Rivers at Paducah 650 miles upstream to Knoxville. In 1958 the river carried 12 million tons and 2.1 billion ton-miles of commercial traffic. Since 1938 the commercial tonnage on the river has increased 12 times and the commercial ton-miles, 38 times. Savings to shippers in 1958 were calculated to be \$24 million.

The system contains nearly 12 million acre-feet of flood storage to protect low-lying areas within the Tennessee Valley and along the lower Ohio and Mississippi Rivers. Since the system was placed in operation it is estimated to have prevented \$140 million in damages. In 1957 the flood which would have been the second largest ever recorded at Chattanooga was reduced by 22 feet, averting approximately \$66,000,000 in damages to that city alone.

The installed generating capacity at the dams is 2.7 million kilowatts. Steam plant capacity amounts to 6.8 million kilowatts. The rate at which residential, commercial, and industrial consumers are charged by municipal and cooperative distributors of TVA power averages approximately one cent per kilowatt hour. TVA estimates consumer savings of \$115,000,000 for the year 1958 based on the rates these con-

sumers would have paid at the average of the rate schedules in effect throughout the nation.

The Concept of Relating River Improvement to the Development of the Region

National concern with the integration of river development proposals was extended to a recognition of the interdependence of all resources. A leading force in national understanding of these principles was the National Conservation Commission. Its 1908 report was not only the first comprehensive inventory of the nation's basic resources, but, perhaps more important, it stressed the unity of these resources in dealing with conservation and use problems. These concerns led to the emphasis in the TVA Act of relating river improvement to the development of the entire region.

The Tennessee Valley Region

The drainage basin of the Tennessee River has diverse physical, social and economic characteristics, and through careful planning it was possible to extend the beneficial effects of the river improvements beyond those related directly to navigation, flood control, and power. The basin contains approximately 41,000 square miles and includes parts of seven states. It is an area of relatively heavy rainfall, with average precipitation of about 50 inches per year. Over half the Valley is forested.

The headwaters of the river are in the valley of southwestern Virginia and in the mountains of western North Carolina and northern Georgia. The main river first flows southwestward through the Great Valley of East Tennessee, which is shielded on the east by the Great Smoky Mountains and on the west by the Cumberland Plateau. Near Chattanooga the river cuts westward through the Plateau, flowing across northern Alabama and northeast Mississippi before turning abruptly north through western Tennessee and Kentucky to join the Ohio at Paducah. In this journey, the water falls over a mile, from an elevation of over 6,000 feet in the Great Smoky Mountains to about 300 feet at Paducah.

In 1930 the Tennessee Valley was a rural and agricultural area. More than half of its nearly three million people lived on farms,

and less than a quarter lived within incorporated cities. Most of the cities were small except for Chattanooga and Knoxville, each of which had a population of slightly over 100,000.

In the short span of 25 years the Valley has changed from a predominantly agricultural area to an urban centered area. By 1957 the population had grown to 3.6 million, but only 30 percent lived on farms. The remaining 70 percent were nonfarm people largely concentrated in and around the growing cities of the region.

The effects of the river improvement program are not confined to the basin of the Tennessee River. For example, the TVA power service area in some states extends well beyond the limits of the watershed. In Mississippi TVA provides power for about one-third of the state, only a small part of which is within the drainage basin. Conversely, about one-seventh of the total drainage areas of the Tennessee River is located within the State of North Carolina, but TVA furnishes power in only parts of three of the fifteen North Carolina counties within the drainage basin. These two areas--the watershed and the power service area--make up a region comprising 201 counties with a land area totaling 92,000 square miles and a population of just under 6 million people (see Figure 1).

Organizing for Regional Planning

One of the principal planning contributions of TVA has been the care with which river improvement has been related to fulfilling regional needs and potentialities and to assisting and strengthening existing state and local programs in achieving these objectives.

The 1936 TVA report to Congress referred to earlier also laid down basic policies for relating river improvement to the development of this region. The report pointed out that "many problems, such as flood control, navigation, the prevention of stream pollution and the silting of streams, the improvement of domestic and industrial water supplies, and the development of power are not only inter-related but are interstate problems, and require some agency to bring about and to facilitate cooperation of state governments and departments.

In the United States every level of government--Federal, state, and local--has a responsibility for regional development.

Although TVA was authorized to undertake surveys and make general plans for the purpose of aiding in the orderly economic and social development of the Tennessee Basin and adjoining territory, the basic problem was to find ways to work constructively with the state, county, and community agencies with which TVA shared responsibility for the development of the area.

In order to make its planning activities effective and to relate them to this basic principle of joint responsibility, TVA discarded the idea of a single regional plan developed by one central agency. Instead, TVA adopted the dominant American view that planning and action are inseparable and that planning must be carried out in an action framework.

TVA therefore encouraged the development of planning activities in cooperation with scores of agencies and institutions in the region. As Menhinick and Durisch pointed out in the July 1953 issue of Town Planning Review:

TVA's interpretation of its planning function. . . . has involved a continuing planning effort, affecting decisions made within--and many made outside--the agency. It has meant survey and research, often in cooperation with schools, universities, and other institutions in the area. It has meant effort directed to teamwork and to securing the technical contributions of many fields of specialization. It has meant concern for citizen attitudes and values and knowledge of the interests and programs of countless organizations and agencies in the region. It has meant education directed to regional problems and attention to regional opportunities. It has involved inventory of the resource base and the potential use of resources. It has meant a comprehensive approach to problems of resource development and an appreciation of the interrelationships of resources. The process of planning has involved the establishment of program objectives pointed to the goal of improved economic and social conditions for the region. It has involved appraisal of methods and results.

The remainder of this paper discusses specific examples of physical planning, as it affected urban and industrial areas, recreation, flood damage prevention, environmental sanitation, and fisheries and wildlife--all of which have been conducted

TENNESSEE VALLEY REGION

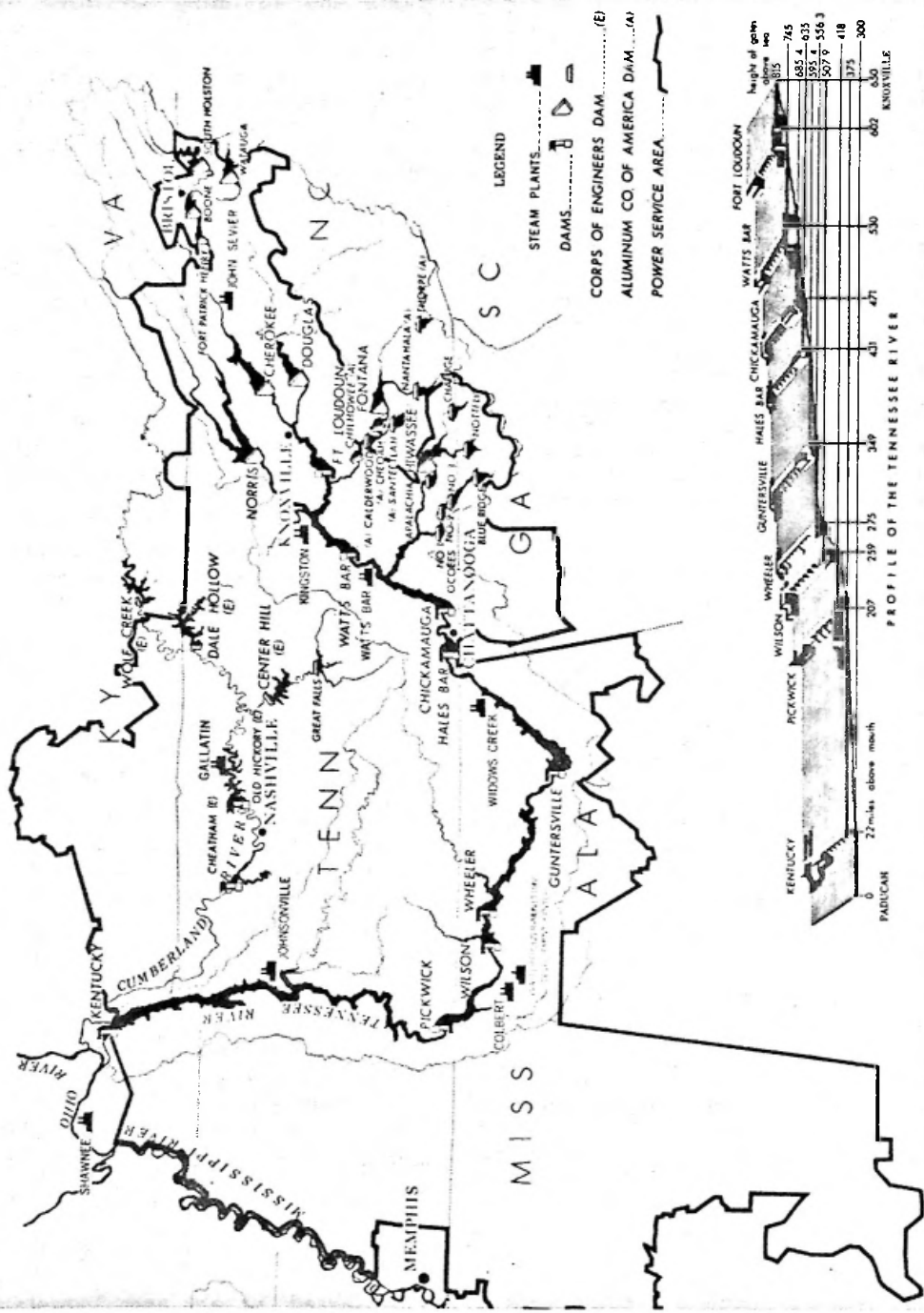


FIGURE 1.--Map of the Tennessee Valley Region showing TVA river improvement and other major projects and the relation of the TVA power service area to the Tennessee River watershed. The combined watershed and power service areas contain 92,000 square miles and just under six million people.

within a cooperative regional planning framework. Other important parts of the total regional program, such as forestry, agriculture, power transmission and distribution, and small watersheds, are not covered by this paper.

Urban and Industrial Areas

An undertaking of the magnitude of TVA affects cities and towns in many ways. Because some cities located on the river were partially flooded by the new reservoirs, changes were required in the location of buildings, streets, and utilities. In some instances reservoirs flooded parts of trade areas of towns causing changes in the economic base of those localities. But the reservoirs also created waterfront land in and near many cities and provided new and realizable opportunities for commerce, manufacturing, and recreation.

Some of the effects of the reservoirs on cities were more indirect. Abundant low-cost power stimulated industry, giving new opportunities to use local resources and to provide employment. Development of new industries, improvement in agricultural and forestry practices, and growth of new tourist and recreation business increased income and purchasing power and expanded needs for urban services and facilities.

But in order for the cities of the Valley to benefit from these opportunities, state and local action was essential. One crucial problem necessary for such action, and one which is common to most development programs, is finding ways by which these governmental units might obtain the technical personnel and assistance necessary for carrying out what frequently are new functions and responsibilities.

Because of their interest in most matters affecting state and local development, TVA proposed that the state planning agencies of the Valley states give technical assistance to local communities on planning and development matters. Most of these state agencies had the statutory authority to assist, advise, and cooperate with local planning agencies. Unfortunately, during the early stages of the TVA program most state planning agencies had inadequate appropriations and technical staffs.

To help overcome these deficiencies, TVA entered into agreements with the state planning agencies, starting initially with Alabama and Tennessee--the two states in which most TVA construction was taking

place. Under these agreements the state planning agencies recognized their responsibility to stimulate and encourage planning in communities and counties, to provide technical planning assistance to reservoir-affected communities, and to make the results of studies known to cities throughout the states. TVA also agreed to reimburse the states for technical services to those communities directly affected by reservoir construction and, where possible, to make additional technical personnel available from its own staff when requested by the state planning agencies.

These agreements have resulted in a general expansion of the planning function within both the local communities and the state and have provided the machinery for relating the use and development of reservoirs to state and local plans.

In the acquisition of land for reservoirs TVA bought some property above reservoir level. As the reservoirs were filled, there was an immediate demand for sites for all kinds of recreation activity: residential and vacation subdivisions, commercial boat operations, group camps, and private clubs. In contrast, demand for industrial waterfront land was small, although it may develop slowly over the years. Frequently prime industrial land--land on deep water with suitable terrain and easy access to rail and highway transportation as well as to housing and other community facilities--was included within the areas for which there was an immediate recreational demand.

To meet this situation, TVA and state and local planning agencies systematically studied reservoir lands to determine their potentiality for recreational, industrial, river terminal, and other uses and how these uses might be related to detailed community plans. The general agreements on land use which resulted from these cooperative studies became the basis for TVA land use control over the limited shore line property which it owned and for community control over abutting private properties through the exercise of zoning and subdivision standards, and in some cases through outright acquisition.

This kind of joint effort is illustrated by the development of the Decatur, Alabama, industrial waterfront (Figure 2) and also by the planning program at Guntersville, Alabama, a small community located 10 miles upstream from Guntersville Dam.

Prior to the construction of the dam the town was a rural trading center of about



FIGURE 2.--The Decatur, Alabama, industrial waterfront on Wheeler Reservoir--one result of the cooperative planning program in the Tennessee Valley.

3,000 population. As construction began on the dam, TVA suggested that the city create its own planning agency to study effects of the reservoir on the town and to recommend steps the town might take to adjust to its new situation. Technical assistance was provided to the Guntersville Planning Commission by the Alabama State Planning Board, supplemented on special studies by personnel from the University of Alabama and TVA.

Initial studies estimated a possible 20 to 30 percent decline in town income due to the flooding of farm land within the trade area. Industries on the new waterway and the development of recreation areas seemed to offer possibilities to compensate for this loss of income. Careful planning of the town's physical structure was necessary to take advantage of these new opportunities.

A general community plan was prepared designating the deeper and navigable embayment east of the town for commerce and industry and the shallower embayment to the west for recreation (see inset map on Figure 3). This basic plan affected all decisions on reservoir readjustments necessary in the town. The problem as to whether a dike should be built on the east side of the town to protect low-lying industrial and business lands, or whether the land should be purchased and flooded, was decided in favor of the dike because it would give industrial properties access to a deep water navigation channel. TVA proposals for railroad, street, and utility readjustments were judged according to this same basic pattern. Railroads were to be kept to the east of the town; causeways leading into the town were to be located so as not to prevent access to the navigation channel; public access to the lake was to be provided at points where main roads (the tourist routes) approach the reservoir. These considerations figured prominently in the final transportation and utility readjustments.

In connection with the construction of the dike which protects the town, a small level area had to be built at the north entrance to the town. Companies seeking a location for bulk storage tanks for oil brought in by barge approached TVA for the use of the area. TVA referred the matter to the Guntersville Planning Commission. The Commission recommended that the area be reserved as a waterfront park and pleasure boat harbor and then worked with TVA and the state to find a suitable site for

an oil terminal on the eastern or industrial embayment (see Figure 3).

A detailed waterfront development plan was completed. Recreation and school plans were prepared. A zoning ordinance was adopted by the city council. Because of the extremely rugged terrain, a topographic map with 5-foot contour intervals was prepared as a basis for the development of a major street plan. To assure continuity of the street system on the hilly peninsular town site, and to help in the administration of subdivision standards, center lines and rights of way were established for the major and secondary streets. Recently the city acquired most of the land on the industrial embayment and has prepared a plan for its development.

These studies, carried on over a 20-year period, have helped to detail the plan for the town and keep it up to date. During this period the population has grown from 3,000 to approximately 6,000. Gradually the city is solving its major development problems.

The significance of this illustration is that state-sponsored local planning assistance programs which started in reservoir-affected communities such as Guntersville have been extended to cities and counties throughout the several states in the TVA area. (Figure 4 shows local planning commissions in Tennessee.) As a result, the number of local planning agencies in the watershed has increased from 2 in 1933 to over 100 in 1958.

Recreation

New recreational opportunities were also made possible by the development of the Tennessee River, and the realization of these opportunities was a result of joint planning between TVA and state and local agencies. As the region changed from an agricultural to an urban-centered area and as highways improved, providing access to the region from the large urban centers of the East and the Midwest, the chain of lakes created by TVA has become a major recreation asset. Currently the recreation use of TVA lakes totals about 35-40 million person-day visits a year.

A major recreation problem has been to assure the general public opportunities for full use and enjoyment of the lakes. TVA approached the problem by joining with state planning and conservation agencies in studies of the basic recreation resources of the entire region, including those along

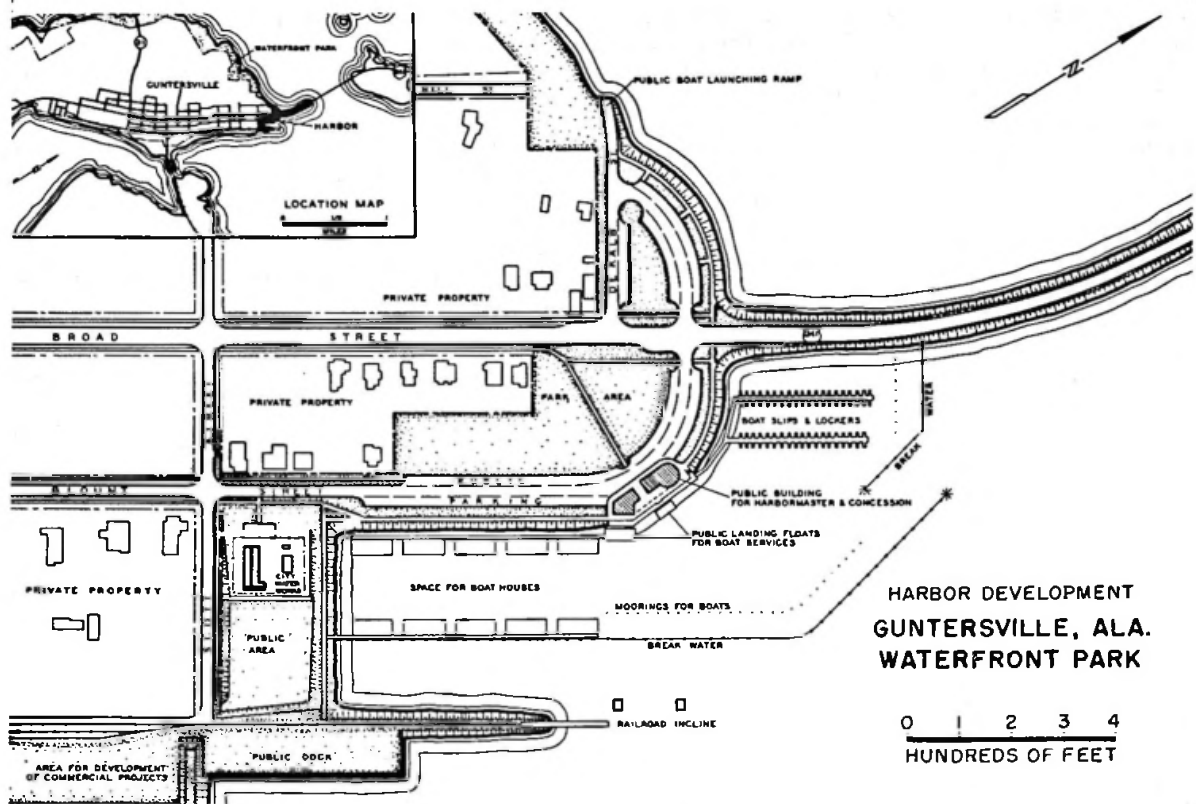


FIGURE 3.--Waterfront park and harbor at Guntersville, Alabama. The small insert map shows the industrial embayment to the east and the recreation embayment to the west of the Guntersville Peninsula, The boat harbor at the northern tip of the peninsula now is home port for pleasure craft valued at over \$800,000.

existing and proposed TVA reservoirs. These studies were followed by appraisals of the possible recreational use of specific reservoir tracts in TVA ownership. In a few instances TVA constructed demonstration parks to show the benefits to be gained from such public facilities.

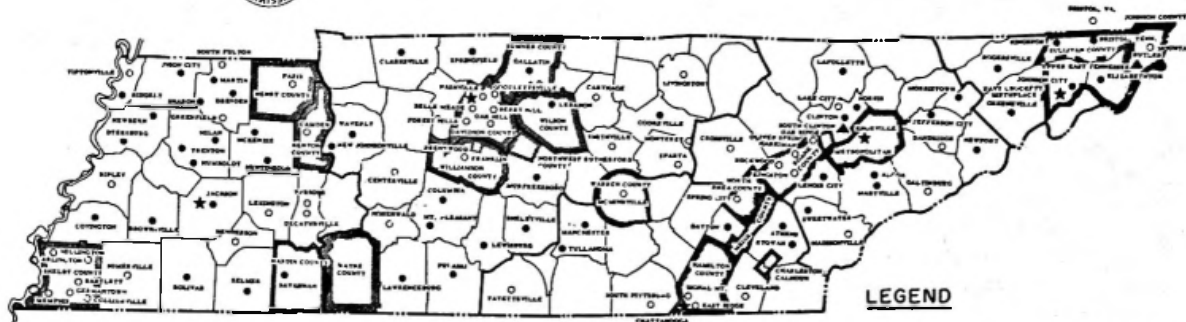
This approach to the recreation problem has had significant results. The demonstration parks stimulated the creation of state park systems including parks on TVA lakes and at other outstanding scenic areas. Thirteen state parks totaling more than 19,000 acres are now located on TVA lakes. Alabama operates two; Kentucky, three; Tennessee, seven; and Mississippi, one. These parks feature such activities as overnight accommodations, picnicking, outdoor games, swimming, boating, and hiking (see Figure 5).

In addition, there are 62 county municipal parks having a total of 8,500 acres on the shore lines. These are being improved by the local communities as part of their park systems.

Hundreds of smaller areas averaging less than 10 acres in size have been reserved to assure additional public access to the reservoirs. These areas are scattered along the thousands of miles of shore lines and are generally located at highway crossings and at road entrances to lakes. In some cases these areas have been turned over to the states. For example, over 250 public waterfront access points on 11 reservoirs have been turned over to the State of Tennessee. Several hundred more are being held by TVA pending such time as states and localities can take over the operation and maintenance of these areas.

Wilson Reservoir, completed in 1925 (before TVA was created), provides a contrast to what has happened on the reservoirs built by TVA. This reservoir has only one public access area--a small one-acre tract formerly used as a malaria control base.

TVA itself provides and maintains visitor facilities for the 10 to 12 million people who each year visit the dams and steam



★ TSPC REGIONAL FIELD OFFICES

○ MUNICIPAL PLANNING COMMISSION	(53)
● MUNICIPAL COMMISSION DESIGNATED REGIONAL	(53)
▨ REGIONAL	(24)
▲ COMMUNITY	(2)
TOTAL	(132)

FIGURE 4.--The local planning assistance program of the Tennessee State Planning Commission which started in reservoir-affected communities now reaches communities and counties throughout the state. Only 53 percent of the State of Tennessee is within the Tennessee River watershed.

plants. Figure 5, a map of Norris Dam Reservation, shows the type of facilities generally provided.

In addition to these programs designed to meet public recreation needs, TVA works with state and local planning and state park agencies to locate areas suitable for semi-public, private, and commercial recreation. TVA leases and sells land to public and semi-public groups such as Boy Scouts, Girl Scouts, Future Farmers of America, YMCA, YWCA, and educational institutions. TVA relies on local communities to control through zoning and subdivision standards private developments such as vacation subdivisions. It is interesting to note that there are already over 5,400 summer cottages valued at \$31.3 million along the shores of TVA reservoirs.

Flood Damage Prevention

Another type of cooperative planning relates to flood damage prevention. The

construction of protective works such as reservoirs, levees, sea walls, and channel improvements has been the generally accepted approach to the solution of flood problems. One result of the attention given to these measures is that the alternative or supplementary methods of land use control for dealing with problems of flooding generally have not been used or even adequately explored. This is especially important to planning agencies in communities faced with flood problems, because proposals for flood damage prevention, including those involving protective works, condition and frequently limit the community land use patterns which may be feasible.

One of the purposes of the system of dams and reservoirs in the Tennessee Valley is to reduce the height of major floods on the Tennessee River and its tributaries and on the lower Mississippi. Although the system solves some local flood problems, it is not intended to meet every flood problem in the more than 41,000 square miles which make up the Tennessee

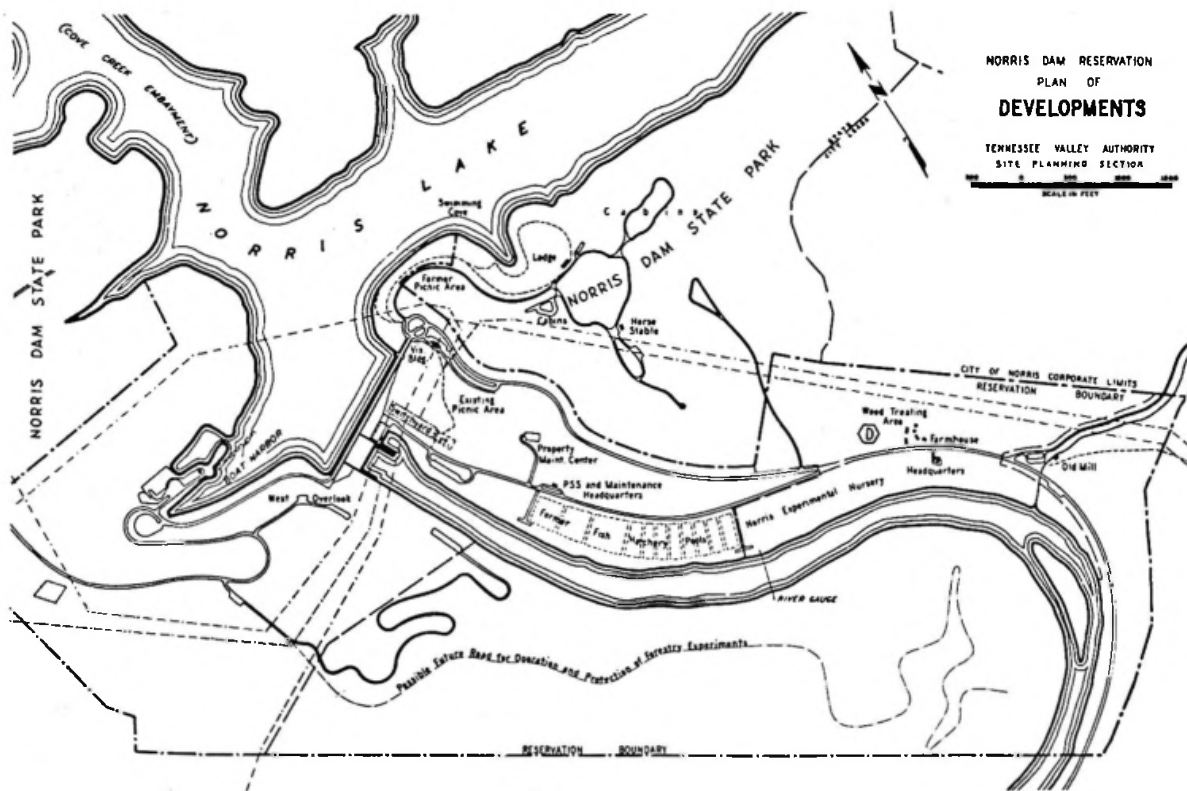


FIGURE 5.--Map of Norris Dam Reservation and State Park showing the facilities maintained and operated by the State of Tennessee and the visitor facilities maintained and operated by TVA. Note that the reservation also contains a forestry experimental area and the fish hatchery no longer needed to restock the reservoirs.

River watershed. Both on the main river and the tributary streams there are local flood situations resulting from encroachments into remaining flood hazard areas. An example is a community located on a tributary stream on which no control structures have been built.

With the growth of urban population during the past decade, these encroachments have increased. If the encroachments continue, the Valley could have a high flood damage potential even though the Tennessee River is the most completely controlled of any in the world.

To meet this problem TVA began in 1950 a systematic study of local flood problems throughout the Tennessee drainage basin. Two conclusions were drawn from these studies: First, local protective works are not economically feasible in an overwhelming proportion of communities having flood problems (the ratio is at least 1 to 20); and second, any complete flood damage prevention program for the Valley requires action at all levels of government; that is, TVA

as a Federal agency can handle only a segment of the problem. Other supplementary actions by states and localities are necessary for a regional or Valley-wide flood damage prevention program.

In 1952 a series of discussions was held with state planning agencies to determine how a region-wide program of flood damage prevention could be initiated. It was agreed that there was need for a systematic compilation and analysis of hydrologic and meteorologic data in a form usable in local planning and development activities, and that these data would be useful in other state and local planning and development activities.

To implement this program, TVA made available to state planning agencies data on rainfall runoff and stream flow which it had accumulated for use in the design and operation of the Tennessee system of dams and reservoirs. These data were compiled into reports quite different from those usually prepared for flood control or engineering works. Solutions to flood problems

were not proposed. Instead the reports were designed to develop an understanding of the nature and magnitude of a flood problem centered in a specific community.

About 100 communities in the Tennessee Valley have local flood problems. To date the flood problem in some 35 of these communities has been analyzed and reports have been made available to planning and other agencies. This part of the program will proceed systematically until studies are available for all flood-affected communities in the Valley.

The state and local planning agencies occupy a key role in this region-wide flood damage prevention program. As flood data become available, planning agencies study the effects of flooding on community development. Some have advanced their studies to the point of recommending that provisions for adjusting land use to the flood situation be incorporated into the zoning and subdivision regulations. Figure 6 shows how one community related its flood problem to its zoning ordinance.

The solutions to local flood problems are not limited to zoning and subdivision regulations. For example, the city officials in Cleveland, Tennessee, expanded their purchase of a school site to include flood-free land suitable for buildings. The land subject to flood is being used for playgrounds and parking space. In Shelbyville and Knoxville, Tennessee, flood data are used in planning urban renewal projects which include relief from flood damages. Figure 7 illustrates a proposal for redeveloping the business district of Lewisburg, Tennessee, to adjust to its flood situation.

As a result of this activity, there is emerging within the Tennessee Valley a basin-wide program of flood damage prevention which includes both stream regulation and land use adjustment and involves actions by Federal, state, and local agencies.

Environmental Sanitation

Health objectives are an important aspect of any regional program, and they can be furthered when river improvements are planned imaginatively. This section of the paper will comment on how two important problems--stream sanitation and malaria control--were handled in the planning of the Tennessee Valley.

An abundant supply of water of a quality suitable for essential uses is necessary

for the growth and development of a region. The system of TVA dams assured an abundant supply of water throughout the Tennessee Valley watershed, but other actions were necessary to assure that the quality of this water would meet the needs of the region.

The construction of dams and reservoirs results in significant changes in the physical, chemical, and biological characteristics of surface waters. To meet this problem TVA undertook two important lines of investigation. The first was concerned with the physical and chemical characteristics of reservoirs and their ability to support aquatic and animal life. The second, made in conjunction with health departments of Valley states, was designed to establish the nature and degree of stream pollution existing in the Valley. The latter studies defined sources and magnitudes of the pollution and the effects on the receiving streams. Tennessee was the first of the Valley states to adopt specific and comprehensive pollution control regulations. Other Valley states have followed. As a result, all of the states have aggressive programs to correct problems of stream pollution caused by domestic and industrial wastes which assure a continuing supply of high quality water throughout the Valley. More recently, the Valley states have joined together in a compact to continue cooperation between the states in maintaining this water quality throughout the entire basin.

Malaria was an old problem in the Tennessee Valley. From its inception TVA recognized that the incidence of malaria in the Tennessee Valley might be increased by the construction of reservoirs unless proper control measures were devised and put into effect. TVA attacked this problem by measures designed to interrupt the life cycle of the mosquitoes responsible for the spread of malaria. The first measure was the preparation of reservoirs before filling so as to create an environment unfavorable for mosquito propagation. The reservoirs were cleared of timber, brush, shrubs, and other vegetation; and ditches were constructed to drain marginal depressions and swamps. TVA also instituted a program of water level management along its main reservoirs. By this method the reservoirs were raised above the normal maximum summer level in late winter or early spring and then dropped rapidly in order to strand the winter's accumulation of drift and foliage. This was followed by a fluctuation of water levels of about one foot in order to

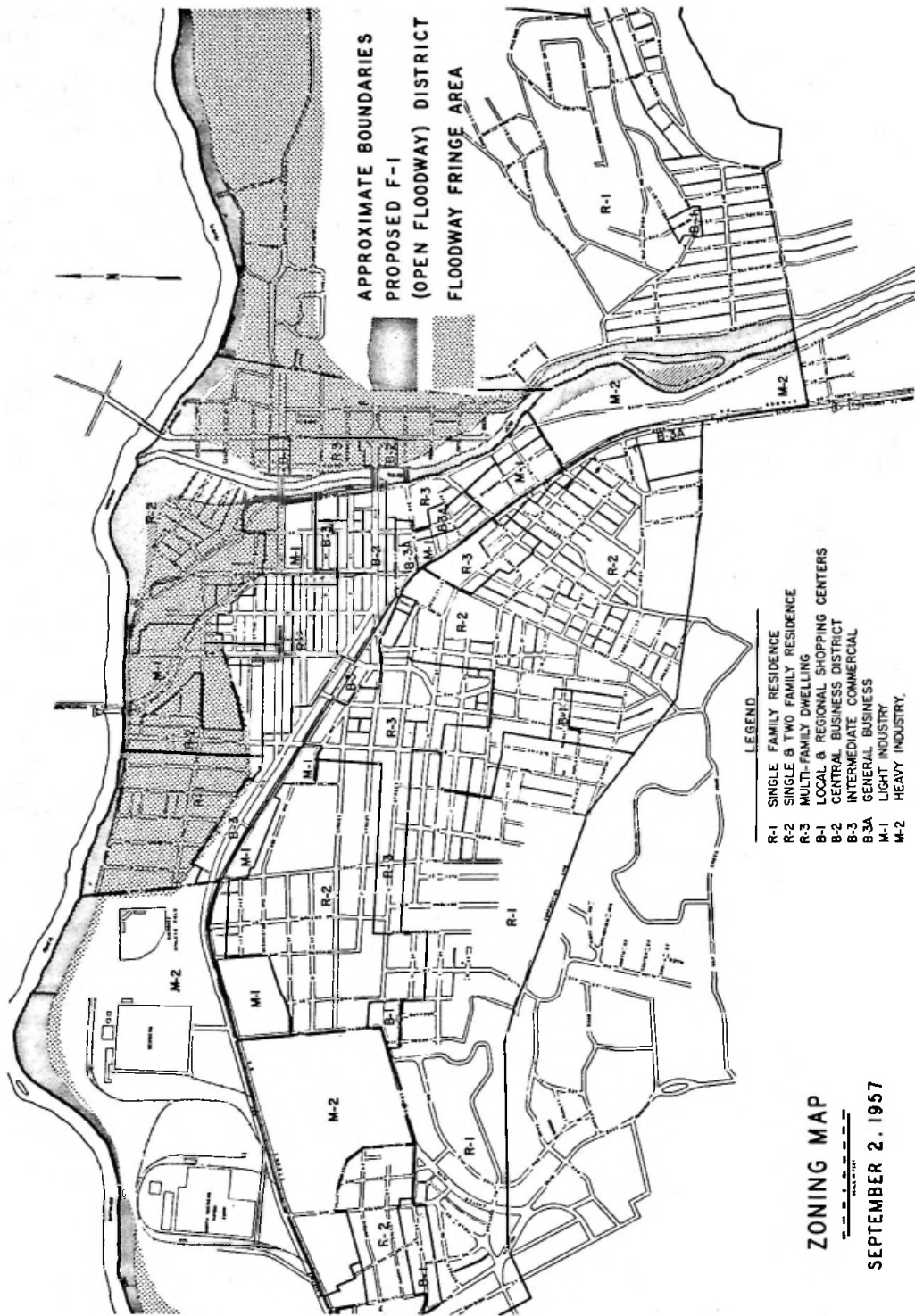


FIGURE 6.--Elizabethhton, Tennessee--an example of a zoning proposal to adjust land use to the local flood situation.

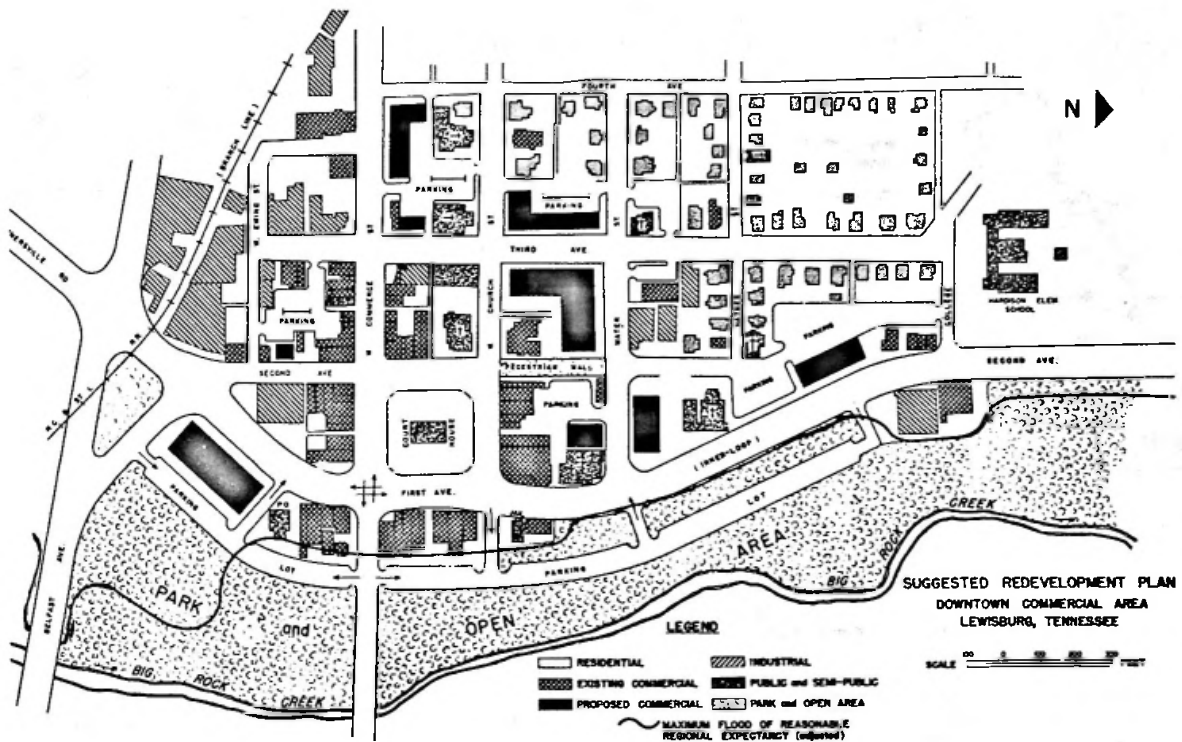


FIGURE 7.--Lewisburg, Tennessee--parks and other types of open land uses which would not be damaged appreciably by flood waters are proposed for flood hazard areas.

kill mosquito larvae by stranding them on the shore or exposing them to natural enemies such as minnows. Finally, in severe problem areas shore alterations were made to eliminate permanently the mosquito-breeding areas.

These programs were also supplemented when necessary by larvicidal applications in quantities which were fatal to mosquito larvae but too small to be harmful to fish and other wildlife.

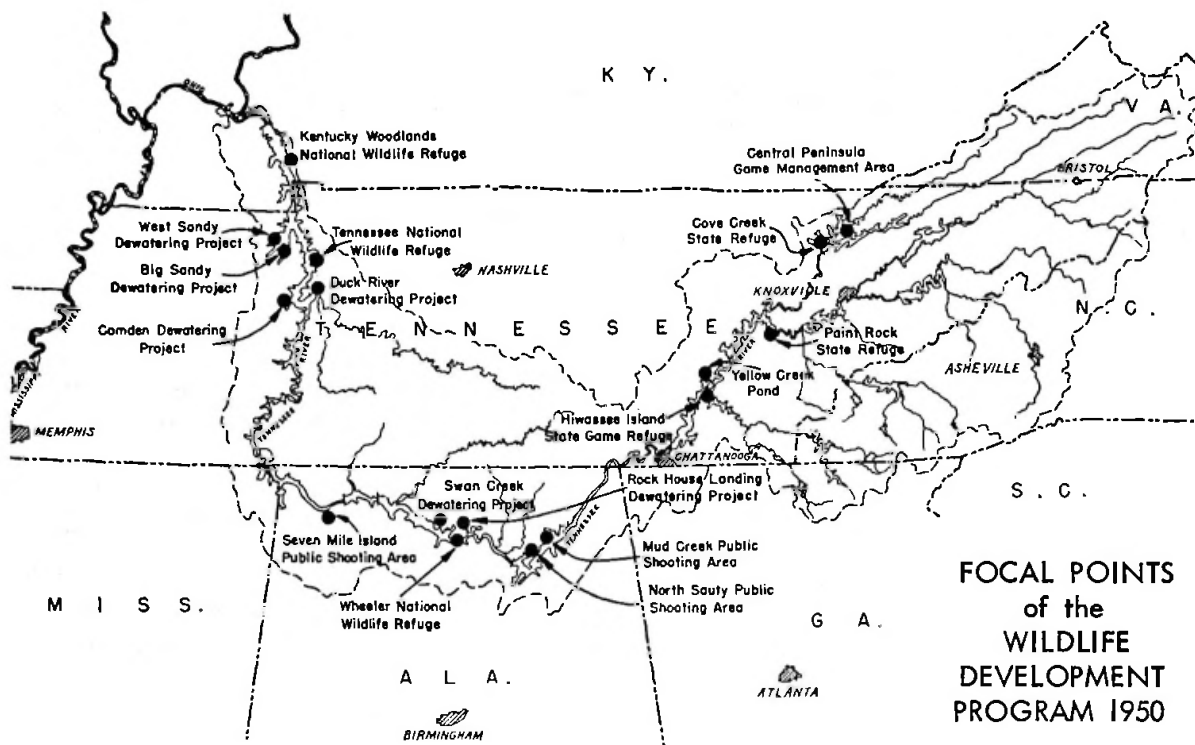
Since 1949 there has not been a single case of malaria attributed to the reservoirs in the Valley.

Fisheries and Wildlife

The transition of the water environment from a river to reservoir conditions and the management of the reservoirs for navigation, flood control, and power production have a very definite effect on the wildlife resources of the region. Biological problems are created; and these problems must be understood, and actions must be

planned and undertaken if the full potentialities for fish and game production are to be realized. The economic and social benefits of these resources are as real as those from navigation, flood control, and power--income and food are involved as well as recreation.

As the Tennessee River was being transformed from a river to a series of lakes, TVA was concerned that the changed water environment would cause a decline in the fish population. To make up for any deficiencies TVA originally built and maintained two fish hatcheries. Research on the distribution and movement of fish eventually proved that reservoirs actually improve the environment for fish and that the available game fish crop of the reservoirs remains unharvested. With state agencies, TVA undertook studies such as the effect of oxygen content and temperature of the water, the effects of drawdown on fishing, and the desirability of installing brush shelters to concentrate fish. These studies have led the states to eliminate the closed season for fishing on all TVA waters. The



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FIGURE 8.--Through careful planning, wildlife resources of the Tennessee Valley are being protected and preserved.

fish hatcheries are no longer needed (see Figure 5). Today the number of one-day fishing trips on TVA waters is estimated at more than 2 million per year, and the catch, including sport and commercial fishing, exceeds 10 million pounds annually.

One of the interesting aspects of the transformation of the Tennessee River to a chain of lakes was the increased number of migratory wildfowl which were diverted from the established Mississippi River Flyway into the Tennessee basin. To improve the habitat for the thousands of ducks and geese coming into the area, TVA, the U. S. Fish and Wildlife Service, and the state conservation departments investigated the need for refuge and feeding areas. They studied TVA lands and waters best suited for this purpose, out of which grew a general plan for the location of game refuge areas (see Figure 8). At the present time, about 195,000 acres (126,000 acres of water, 68,000 acres of land) of TVA land are within 15 national and state refuge and wildlife management areas, controlled by either the U. S. Fish and Wildlife Service or the states.

Conclusions

Only a few of the examples of the planning methods employed in the development of the Tennessee Valley region and of the benefits resulting from such planning have been cited in this discussion. In this total program TVA has recognized that planning for the unified development of the river system must be supplemented by planning in related fields of activity. Because other governmental agencies are responsible for many of these activities, only a cooperative planning program can realize the full economic and social benefits that are attainable.

The cooperative program has been an important force in the region for adjustment to the change from an agricultural to an urban industrial economy. It has extended the benefits of the river improvement program by capturing values which promote the sound social and economic development of the entire basin and adjoining territory. Among these are a vast and growing water-oriented recreation development by states, counties, cities, and private interests; industrial expansion

supported by ample sources of power, by flood control and by a navigable channel which rounds out the transportation system of the region; expansion of basic resources through improved soil and forestry management practices; the orderly growth and planning of urban centers; fish and wildlife

propagation and conservation; improved commercial fishing and musseling; control of malaria mosquitoes which has virtually eliminated the disease from the region; and improved quantity and quality of water supplies for municipal and industrial use.

