PLAN FOR FLOOD DAMAGE PREVENTION

AT

SEVIERVILLE, TENNESSEE

A study and recommendations for alleviation
of flood damages at Sevierville, Tennessee

April 1965

SEVIERVILLE-SEVIER COUNTY

FLOOD STUDY COMMITTEE

E. T. King, Chairman

Fred C. Atchley
Robert Fox
Mrs. Marion Mangrum
Julian Schultz
J. B. Waters, Sr.

Flood Control Work Group

Fred C. Atchley, Chairman
J. B. Waters, Sr.
Raymond A. Wilhelm

Flood Proofing Work Group

Al Schmutzer, Chairman
Alfred Newman
David P. Waters

Flood Plain Regulations Work Group

Hugh E. Trotter, Chairman
Russell Hughes
James O. Miner

April 1965

CONTENTS

Tables

CONTENTS (Continued)

PLATES

(At End of Report)

I

INTRODUCTION AND RECOMMENDATIONS

City and county officials of Sevierville and Sevier County have recognized the existence of a flood problem for many years. Concern about the problem has been accentuated since the large flood of February 1957, which was the greatest in Sevierville in the previous 28 years. The next eight years saw that flood exceeded two times. The most recent occurrence was in March 1965 when the crest elevation in the central business district was the highest since April 1896.

This problem of frequent flooding has had a stifling effect on the development of the city, especially in the downtown area. Commercial interests have been reluctant to build new structures or improve existing ones because of the flood problem.

Soon after the February 1957 flood Sevierville officials recognized that orderly development of a major part of the business and industrial areas required factual knowledge of the flood problem. The Board of Mayor and Aldermen, through the Tennessee State Planning Commission, requested that the Tennessee Valley Authority make a study and prepare a report outlining the over-all flood situation. The report, "Floods on Little Pigeon and West Fork Little Pigeon Rivers in Vicinity of Sevierville, Tennessee," was completed and presented to the city in February 1958. That report, hereafter referred to as "the TVA report," contained all of the known data on floods of the past as well as those which will probably occur at some time in the future.

Limited use was made of the flood data for the next four years. A few structures were designed to be reasonably safe from flooding. The most notable example was the sewage disposal plant built in 1958, which was designed to operate during floods somewhat greater than any known.

A few days after the December 1961 flood the Mayor and one interested citizen met with a TVA engineer to discuss possible actions which the city might initiate. Late in January 1962 officials and others

from Sevierville and Sevier County met with TVA representatives in Knoxville. That conference decided that a local committee would be formed which would explore possible solutions to the flood problem, determine which would be most desirable, and recommend an action program to the city and county governments. TVA agreed to furnish counsel and technical assistance to the committee.

The Sevierville-Sevier County Flood Study Committee was organized on March 5, 1962, with three members appointed by the city and three by the county. A chairman was elected. It was decided to conduct the study by the use of work groups, each of which would study in detail a particular means of flood damage prevention. Initially, only the Flood Control Work Group was formed. As their study neared completion, the Flood Proofing and Flood Plain Regulations Work Groups were recruited.

TVA and TSPC agreed to furnish all possible assistance throughout the study. Each agency designated one person to maintain liaison between his agency and the Flood Study Committee. Additional personnel of both agencies were utilized as needed.

TVA has provided the engineering assistance required in studying the physical and economic feasibility of alternate flood control features and flood proofing. That organization has also been most cooperative and helpful in providing the major portion of the basic data as well as invaluable advice to this committee.

The Town of Sevierville

Sevierville is situated in eastern Tennessee, about 13 miles from the north boundary of Great Smoky Mountains National Park. It is the county seat of Sevier County, which was originally a hunting ground of the Cherokee Indians. The Treaty of the Holston, negotiated in 1791, defined the boundary between the United States and the Cherokees so that the Little Pigeon River watershed was in United States territory.

Sevier County was formed in 1794, and Sevierville was laid out in 1795 and incorporated in 1903. The U. S. Census of 1960 shows a County population of 24,251 of which 2,890 lived within the corporate limits of Sevierville.

Sevierville is the principal political and trading center of Sevier County and the Little Pigeon River watershed. Modern highways provide good access to the city from all directions. U. S. Highway 441, the principal route bringing tourists into the Great Smoky Mountains National Park from the North and Middle West, passes through the center of Sevierville.

Little Pigeon River Watershed

The Little Pigeon River watershed, all of which is in Sevier County, is shown on Plate 1. The river system flows generally northwest from the peaks in the Great Smoky National Park to a junction with the French Broad River about five miles below Douglas Dam.

Little Pigeon River is formed by the convergence of Middle Prong and Porters Creek within the national park. Downstream the river is joined by Webb Creek, Bird Creek, East Fork Little Pigeon River, West Fork Little Pigeon River, and Middle Creek. The West Fork heads at Newfound Gap and is joined downstream by LeConte Creek, Roaring Fork, Mill Creek, and Walden Creek.

The two main prongs divide the drainage above their junction at Sevierville into 201 square miles on the east and 151 square miles on the west. Together they comprise 92 percent of the total watershed area at the mouth, five miles below Sevierville. Drainage areas at significant locations in the system are shown in Table 1.

Developments in the Flood Plain

Nearly all of the business district and a large part of the residential district of Sevierville is in the flood plain between the Little Pigeon River and West Fork. The principal business district lies closer to the two streams and is generally on lower ground than the rest of the city. This area of roughly 20 blocks contains about 170 establishments, most of which have been flooded in the past. Included are grocery stores, hardware stores, clothing stores, appliance stores, offices,

TABLE I

DRAINAGE AREAS

LITTLE PIGEON RIVER WATERSHED

Stream	Location	Drainage Area Sq. Miles
Little Pigeon River	Mouth	381
	Sevierville Stream Gage	353
	Above West Fork	201
	Above Middle Creek	186
	Above East Fork	110
West Fork Little Pigeon River	Mouth	151
	Above Walden Creek	76.7
	Pigeon Forge	74.7
Walden Creek	Mouth	64.6
Middle Creek	Mouth	15.1
East Fork	Mouth	70.1

garages, filling stations, eating places, government buildings, and two feed and flour mills.

There are 558 homes in Sevierville subject to some degree of flooding. The most vulnerable of these are along Riverside Drive and the old Knoxville highway, and in Love Addition.

Within the city limits there are one highway bridge and a footbridge over Little Pigeon River, two highway bridges and one abandoned railroad bridge across West Fork, and one highway bridge and three secondary road bridges over Middle Creek. The main highway bridges are all adequate to pass large flood flows, but the highways are subject to flooding in the business district.

On Pigeon River at Mile 5.24 is a low dam which is part of the works providing power for Sevierville Mills.

Magnitude of Floods

The TVA report covers three phases of the Sevierville flood problem. The first brings together a record of the largest known floods of the past. The second treats of the Regional Floods. These are derived from consideration of the largest floods known to have occurred on streams of similar physical characteristics in the same general geographical region and within 75 miles of Sevierville. The third develops the Maximum Probable Floods. Floods of this magnitude on most streams are considerably larger than any that have occurred in the past. They are the infrequent floods that are considered in planning protective works, the failure of which might be disastrous.

Past Floods

Official flood records have been collected at the USGS gage on the Little Pigeon River just downstream from Sevierville since November 1920. To supplement those records, TVA personnel has conducted extensive research into newspaper files and historical documents, and has interviewed old residents of the area. A total of 74 floods were identified which exceeded bankfull stage of 8.5 feet at the USGS gage. Doubtless many of the lesser floods prior to 1920 are not included.

Damage does not become significant until a stage above 12 feet is reached at the gage. During the period of gage record, 26 floods have equalled or exceeded a 12-foot stage. All of the six earlier, known floods exceeded 14-foot stage. These 32 floods are shown in order of magnitude in Table 2. Of particular importance is the fact that eight of the floods in Table 2 have occurred in the last four years. The flood of March 26, 1965, is the fourth in order of magnitude and has not been exceeded since April 1896.

Regional Floods

Large floods have been experienced in the past on streams in the general geographical and physiographical region of Sevierville. Heavy rainstorms similar to those that caused these floods could occur over the Little Pigeon River watershed. In these events, the resulting floods on Little Pigeon River and its tributaries would be comparable in

TABLE 2

FLOOD CREST ELEVATIONS IN ORDER OF MAGNITUDE

LITTLE PIGEON RIVER AT SEVIERVILLE, TENNESSEE

FLOODS ABOVE 12 FEET ON GAGE

Order No.	Date of Crest	Gage Heights in Feet	
		Stage	Elevation
1	February 25, 1875	18.0	899.4
2	April 1, 1896	16.8	898.2
3	March 7, 1867	16.5	897.9
4	March 26, 1965	16.1	897.5
5	April 2, 1920	16.0	897.4
6	March 12, 1963	15.74	897.2
7	June 29, 1928	15.4	896.8
8	February 1, 1957	14.71	896.2
9	March 6, 1963	14.70	896.1
10	December 18, 1961	14.53	896.0
11	March 5, 1917	14.5	895.9
12	March 14, 1913	14.1	895.5
13	April 7, 1964	13.8	895.2
14	January 20, 1947	13.67	895.1
15	March 23, 1929	13.45	894.9
16	March 26, 1936	13.41	894.8
17	March 29, 1951	13.26	894.7
18	April 16, 1956	13.25	894.7
19	March 8, 1961	13.20	894.6
20	December 12, 1961	12.90	894.3
21	February 4, 1936	12.84	894.3
22	December 29, 1942	12.82	894.3
23	February 23, 1962	12.70	894.1
24	August 5, 1938	12.69	894.1
25	January 22, 1959	12.65	894.1
26	October 31, 1949	12.58	894.0
27	February 15, 1933	12.54	894.0
28	December 15, 1922	12.5	893.9
29	April 6, 1936	12.45	893.9
30	November 28, 1959	12.43	893.9
31	January 8, 1946	12.20	893.6
32	February 10, 1921	12.0	893.4

Gage heights and elevations are at the USGS stream gage on Little Pigeon River one-half mile downstream from the mouth of West Fork.

magnitude to those that are known to have occurred on the neighboring streams. Floods of this magnitude have been designated by TVA as Regional Floods. Table 3 shows the height of the Regional Flood at selected locations relative to the March 12, 1963, flood.

TABLE 3

RELATIVE FLOOD HEIGHTS FOR REGIONAL FLOODS

Stream	Location	Feet Above 1963 Flood
Little Pigeon River	At Stream Gage (Mile 4.53)	3.4
Little Pigeon River	Above West Fork (Mile 5.48)	4.7
West Fork Little Pigeon River	U. S. Hwy. 441 Bridge (Mile 1.27)	5.8
Middle Creek	Railroad Street Bridge (Mile 0.66)	4.0

Maximum Probable Floods

The Maximum Probable Flood on any stream is considered to be a reasonable upper limit of expected flooding. To determine the magnitude of this flood on Little Pigeon River and its tributaries, consideration was given to great storms and floods which have occurred elsewhere but could have occurred on these areas. The peak flow for Maximum Probable Floods on Little Pigeon River and West Fork would be more than twice that of February 1875, the highest known. Table 4 shows the height of the Maximum Probable Flood at selected locations relative to the March 12, 1963, flood.

Methods of Flood Damage Prevention

Although the traditional approach to the prevention or abatement of flood damages has generally been by the use of flood control only, several other measures may be taken either singly or as parts of a comprehensive plan. Because of many factors peculiar to the location of

TABLE 4

RELATIVE FLOOD HEIGHTS FOR MAXIMUM PROBABLE FLOODS

Stream	Location	Feet Above 1963 Flood
Little Pigeon River	At Stream Gage (Mile 4.53)	7.8
Little Pigeon River	Above West Fork (Mile 5.48)	8.4
West Fork Little Pigeon River	U. S. Hwy. 441 Bridge (Mile 1.27)	8.0
Middle Creek	Railroad Street Bridge (Mile 0.66)	4.4

Sevierville, total flood control is impractical. From the beginning of this study, it was decided that the plan would provide the largest amount of flood control which was reasonable, locally acceptable, and economically feasible. Additional protection would be provided through the use of flood plain regulations, flood proofing, and urban renewal.

The first three major elements of the plan--flood control, flood proofing, and flood plain regulations--are discussed in detail on separate sections of this report. The fourth--urban renewal--was considered only briefly because the planning commission has not had sufficient time since its establishment to develop specific projects. However, preliminary surveys by that commission indicate that a downtown urban renewal project is a future possibility. If it materializes, additional flood protection could be incorporated in the redevelopment plan.

Conclusions and Recommendations

The Flood Study Committee concludes that there is a very serious flood problem at Sevierville which threatens the life, health, security, and property of the citizens of the city and the region. The Committee recommends adoption of the following plan for greatly reducing the flood damage potential:

1. Enlarge and improve 2.8 miles of Little Pigeon River and 0.6 mile of West Fork Little Pigeon River. In addition, relocate the lower 0.7 mile of West Fork. This plan is shown on Plate 2, and in more detail on Plates 3 to 9. Total cost is estimated at $2,440,000. This improvement is economically feasible by a wide margin.

2. Enlarge, realign, and deepen the lower 0.96 mile of Middle Creek. The general alignment is shown on Plate 2. Total cost for the Middle Creek work is estimated to be in the order of $200,000.

3. Organize a program and employ a consultant to encourage and assist owners or occupants of property on the flood plains in flood proofing structures.

4. Adopt or revise a zoning ordinance, subdivision regulations, and building code to provide controls over uses of the flood plain areas.

5. In any future urban renewal, highway or street relocations, or other developments, take steps to insure that construction is located so as to minimize flood damage.

BLANK
Page

II

FLOOD CONTROL

This chapter presents the results of studies which were made to determine what measures might be taken to alleviate Sevierville's flood problem. Initially those studies were directed toward control of flood waters within the city of Sevierville only. Later, considerable attention was given to a plan which would provide flood control and other significant benefits to the city and Sevier County.

Property may be protected from floods by some form of physical construction, such as levees and walls, channel improvements and reservoirs. Another type of protection is removal to safe locations of damageable properties, or flood proofing of structures to prevent damage to goods and equipment. Any one of the methods, or any combination of them, may prove to be the most economical in a given situation. Dividing the needed protection between two or more methods may be reasonable when one method would be physically impracticable.

The following paragraphs describe the alternative methods of flood control which were investigated. Two economically feasible plans were developed. One would provide flood relief to Sevierville; the other would provide flood relief and water resource development to Sevierville and Sevier County. Neither plan would give complete relief from very large floods which might occur in the future. Therefore, any control plan adopted should be supplemented by flood proofing, flood plain regulations and other indirect measures.

Alternative Methods Considered

Levees or Walls

Levees or floodwalls are a positive means of holding flood waters away from valuable properties, but they have characteristics which frequently make them very expensive. The confinement of the flow within levees may raise the height of floods by elimination of valley storage

and flow area; therefore, care must be taken to allow for this increased height in the levee design. Pumping stations are frequently required for disposing of sanitary and storm drainage from the protected area. Roads and railroads passing through the levees must be provided with flood gates. Because of the greater development behind the levee, failure would mean disaster; therefore, they should not be planned for less than total protection. For those reasons, and because necessary levees would be very long, this method of flood control for Sevierville or Sevier County was obviously not feasible.

Channel Improvement

The purpose of channel improvements is to make a stream carry more water than formerly, thus reducing overflow and resulting flood damage for given flows. Channel improvements are often used in conjunction with storage reservoirs. The improvement in carrying capacity of the stream is accomplished by widening, deepening, realigning, or paving the channel. Often a considerable benefit may be obtained by cleaning the existing channel of bars, debris, and snags. In any channel improvement scheme, maintenance work will be required to continue the effectiveness of the improved waterway area. *

From the beginning of the flood control study it was apparent that channel improvement would merit careful consideration. This was the control method most often mentioned by the citizens responsible for initiating the flood study. Early inspection of the flood plain by TVA engineers disclosed that most of the land probably needed for channel enlargement was relatively free from developments, presumably because of the frequent flooding. This method lends itself to fairly rapid economic analysis. Because of the concern over the two major floods in March 1963, it was decided to confine the initial phase of the investigations to flood control by channel improvements.

Three schemes of local channel enlargement and three degrees of protection were studied by TVA. The study results were presented to the Flood Control Work Group which selected one plan for recommendation if further study disclosed that channel improvement was the desirable means of flood control.

The preferred plan consists of channel widening over a 2.8 mile length of Little Pigeon River and 0.6 mile of West Fork. In addition, the lower 0.7 mile of West Fork would be relocated away from the city, eliminating two sharp bends and increasing its slope and carrying capacity. These improvements would carry a flood like that of March 12, 1963, (the highest since 1920) within the banks. Total cost of this project is estimated at $2,440,000. Annual costs including interest, depreciation and maintenance would be $82,000. Annual benefits including prevented flood damages, improved land values, redevelopment and secondary are estimated to be $233,000. The benefit-cost ratio of 2.8 indicates the project to be economically feasible by a wide margin. This plan is discussed in greater detail further on in this chapter.

Upstream Reservoirs

The use of reservoirs for storing floodwaters to reduce downstream flood elevations has increased greatly in the past forty years. Their practicability depends largely on the availability of feasible upstream dam and reservoir sites of sufficient capacity to control a substantial part of the area. Such reservoirs substitute deep, controlled flooding on land reserved for that purpose for uncontrolled flooding of valuable downstream property.

Flood control reservoirs may be classified as to whether the discharge outlets are controlled by gates or have no gate control. The latter type, called detention basins, discharges at almost a uniform rate during a flood. This rate of discharge is determined in advance and usually is about equal to the channel capacity downstream. The amount of storage space to be provided in any reservoir depends on several factors, but mostly on the size of flood against which protection is to be given, the capacity of the channel at the flood-damaging stage, and the relative area controlled above the point of hazard.

Field and map reconnaissance by TVA engineers and members of the Flood Control Work Group identified four promising sites for detention dams and reservoirs. These sites were located on Little Pigeon River, East Fork, Walden Creek, and Middle Creek. No suitable site was found on West Fork proper. Following surface geologic examinations the East Fork site was shifted upstream and the Middle Creek site was eliminated.

The three sites selected for further study would control 52 percent of the watershed below the junction of Little Pigeon River with West Fork. This degree of control is considered good for the total watershed, but there is some unbalance in the eastern compared to the western segments of the drainage area. To compensate for that unbalance, and to provide additional control in Sevierville, some channel cleanup and enlargement would be needed to supplement reservoir control.

The present trend in planning reservoirs is to provide for multiple uses where practicable. The three sites selected for reservoirs are well located and could be operated to provide for water-use recreation while performing their flood control functions.

Preliminary estimates were made by TVA of the cost of the three-dam plan, including limited channel improvement, with a permanent recreation lake in each reservoir. Total capital cost for the project would be approximately $9,000,000. Annual charges including interest, depreciation, operation and maintenance would be $311,000. Annual benefits including prevented flood damages, improved land values, water-use recreation, redevelopment, and secondary are estimated to be $506,000. The benefit-cost ratio of 1:6 indicates that the project is economically feasible. The plan is discussed in greater detail further on in this chapter.

Removal to Safe Locations

Following the flood of April 1, 1896, the editor of "The Sevierville Star" published the following comment:

> Sevierville was evidently built in the wrong place and under present "inflooence" will keep on being built in the wrong place.

These words of warning were not heeded, and the entire business district and much of the residential district is now subject to flood damage. Removal to safe locations of damageable properties would be unreasonable and obviously not economically feasible. In the future, however, as commercial structures and residences need to be rebuilt, every encouragement should be given to their relocation to higher ground or to their being rebuilt with higher floor levels.

Flood Proofing

Structural adjustments to existing buildings as well as new structures can increase the degree of protection beyond that provided by a feasible flood control plan. This method of protection is discussed in Chapter III of this report.

The Channel Improvement Plan

Degree of Flood Protection

An ideal plan for flood control should provide complete protection from the Maximum Probable Flood. Such a flood would be catastrophic if it occurred in a populated and developed area such as Sevierville, but its size and rarity are such that protection against it by engineering works can very seldom be economically provided. It is physically possible to control a flood of that magnitude at Sevierville, but potential benefits would not justify the plan.

Conversely, a minor degree of protection is frequently economically justifiable but is not always desirable. In the case of flood control or protection of agricultural lands, a relatively small design flood may be adopted. Occasional flooding of farmland, even though a crop may be lost, would not be a catastrophe. Considerable caution should be exercised in selecting such small floods where the area to be protected is in residential and commercial uses. The presence of inadequate control works may create a false sense of security and encourage developments so that potential flood damages may actually increase.

A field inspection of Little Pigeon River and West Fork Little Pigeon River within the developed area of Sevierville showed that a reasonable amount of channel enlargement would be practical with minimum disturbance to existing developments. The preferred channel improvement plan (see Plate 2) would lower the March 1963 flood about 5 feet within the developed area of Sevierville, essentially to the top of banks level. Floods of that magnitude can be expected on an average of once in 30 years. The plan would eliminate most damages to present developments from floods of the magnitude to be expected on an average of once in 60 to 70 years. Larger floods such as the Maximum Probable or Regional would still pose flood threats, though lowered from 2 to 3 feet.

Physical Features

The plan calls for enlargement of 2.8 miles of Little Pigeon River, starting about 2.2 miles downstream from the Highway 66 bridge and extending about 0.6 mile upstream from that bridge. Because of the rather mild stream slopes involved, it is necessary that channel enlargement be extended a considerable distance downstream from the city in order to be fully effective.

The lower 0.7 mile of West Fork would be relocated away from the city, eliminating two sharp bends and increasing its slope and carrying capacity. The balance of West Fork would be enlarged upstream to the Highway 441 bridge. The relocated channel would pass through the present dryland relief span in Highways 441 and 411, and would enter Little Pigeon River about 0.4 mile downstream from the present mouth of West Fork.

Bottom channel widths for the plan, with approximate existing widths, are given in Table 5 for specific locations along both streams. The dryland overflow opening through which West Fork would be relocated would be deepened with a bottom width of about 220 feet in order to obtain the necessary clear area for flow. For stability and ease of maintenance, all channels were designed with uniform slide slopes of 2 to 1. Slopes would be seeded during construction and mowed periodically as a part of maintenance.

With the exception of the dryland overflow reach, no appreciable channel deepening was used. Probings indicated that rock level in the overflow plain is higher in some locations than the present stream bed. In such areas widening is generally limited in depth to top of rock so as to minimize expensive rock excavation.

Plates 3 to 9 show the widened and relocated channel, except the reach of Little Pigeon River from Mile 3.0 to Mile 4.2. Suitable maps were not available for that downstream portion, and field examinations revealed no unusual problems in the reach.

Except for relocation of West Fork, this plan offers a minimum of disturbance to developments along the streams. The relocated channel requires removal of several small houses and buildings. The present Hardin Lane fill would be removed to natural ground level. A new road would be constructed on the left (west) side of the relocated channel to

TABLE 5

CHANNEL WIDTHS AT PROPOSED GRADE LINE

River	Mile From	Mile To	Width (Feet)	Approximate Existing Width (Feet)
Little Pigeon	3.0	4.7	285*	150
	4.7	5.78	190	120
	Station From	**Station To**		
West Fork	0+00	31+00	150	
	31+00	38+00	150-200**	
	38+00	63+50	200	100

*Upstream from Mile 3.0 a 370-foot long transition reach was used between the present natural river and the enlarged channel.

**Transition reach between the present river course and the relocated channel.

replace Hardin Lane and a portion of the old Knoxville Road downstream from town. The plan assumes that permission can be obtained to cross the right-of-way of the discontinued Smoky Mountain Railroad without bridging the channel. On Little Pigeon River, about three-fourths of the Sevierville Mills dam would be removed.

Middle Creek Improvement

Although major channel improvements on Middle Creek do not seem to be economically feasible at this time, such work would be practicable and very desirable. Several residences and small commercial buildings are subject to damage by headwater floods on this stream. There is considerable land on both banks which has not been developed because of the threat of floods. This land is ideally located for present and future needs of the community. Its proximity to schools, the central business district, major thoroughfares, and water and sewer lines make it attractive for residential, public, or commercial uses.

A preliminary plan studied briefly by TVA would consist of channel enlargement, realignment, and deepening, starting at the mouth and extending upstream to the old highway 411 bridge. The general

alignment is shown on Plate 2. The improved and relocated channel would have a 50-foot bottom width with 1 on 2 side slopes. Channel grade at the mouth would have an upstream slope of about 0.4 percent to the Railroad Street bridge and about 0.3 percent for the remaining distance.

The channel as tentatively planned would provide essentially the same level of protection along Middle Creek as was used for the design of the improved channels on Little Pigeon River and West Fork. Two bridges would have to be removed and replaced with structures adequate to pass reasonable flood flows and adequate for anticipated public use. It is possible that some savings could be effected by either abandoning the Railroad Street bridge or replacing it with a footbridge.

Total project cost for the Middle Creek work is estimated to be in the order of $200,000. This figure may vary by more than plus or minus 30 percent when information is secured to permit more accurate planning.

Benefits

Presently identified benefits result from prevented flood damages, improved property values, and redevelopment and secondary influences. Individual values of these benefits, totalling $233,000 annually for the Channel Improvement Plan, are given in the benefit-cost comparison of Table 8.

Prevented Flood Damages--In 1962 a field survey and appraisal of potential flood damages up to the level of the Maximum Probable Flood were made by TVA personnel and members of the Flood Control Work Group. Every one of the 183 commercial and public properties and 558 homes subject to flooding in Sevierville was visited in the survey. Potential flood damages were appraised for at least four flood levels. The completed damage survey was carefully reviewed in a meeting between TVA engineers and that work group.

The occurrence of a major flood on March 12, 1963, offered an excellent opportunity to check the potential damage appraisal of 1962. About two months after the flood, two TVA engineers along with a work group member interviewed owners of a sampling of establishments concerning their recent flood losses. The total of the actual owner-appraised direct losses was solidly in line with the 1962 estimate.

Table 6 gives the results at appraised levels of the potential flood damage survey. Amounts shown include a 20 percent allowance for indirect damages such as lost wages and profits and relief costs. The potential flood damage curve was prepared and the flood elevation-frequency relationship determined by TVA. Based on those, the total potential average annual flood damage was computed to be $156,000. With the Channel Improvement Plan only residual annual damages would average $14,000, giving prevented flood damages of $142,000.

TABLE 6

POTENTIAL FLOOD DAMAGES
IN SEVIERVILLE, TENNESSEE

Flood Elevation at Stream Gage	Damages (Status of 1962)			
	Residential	Commercial	Industrial	Total
905	$1,705,000	$4,301,000	$643,000	$6,649,000
902	1,379,000	3,706,000	376,000	5,461,000
899	650,000	2,403,000	166,000	3,219,000
896	96,000	220,000	54,000	370,000

Improved Property Values--Within Sevierville, property values in most of the central business district and in several residential areas are significantly depressed because of past floods and the threat of floods. The total appraised present worth of the increase in values which would result from providing flood relief is estimated to be $2,165,000. Converting that sum to an annual value, with a proper reduction for the small overlap between prevented damages and increased values, the flood control benefits from increased property values are computed to be $66,000 annually.

Redevelopment and Secondary--Benefits accrue to an area when the construction phase or the operation and maintenance phase employ formerly unemployed or underemployed resources. The major such resource in Sevierville is labor. Sevier County has been designated an area of substantial persistent unemployment.

The total local labor bill for the project is estimated to be $710,000. Assuming that 20 percent of the skilled, 33 percent of the

semi-skilled, and 50 percent of the unskilled locally employed labor would have been unemployed or underemployed, the wage component to this local group would be $250,000. Converting this benefit based on a 100-year project life and a capital recovery factor of 3 percent results in an annual redevelopment benefit of $71,000.

Any increased income and expenditures in a given area create a multiple turnover of new money in the region's economy. The first-round increase in secondary activity in the local area resulting from the project is estimated to average $143,000 annually. Based on a net income of 10 percent on this first-round increase, the resulting annual secondary benefit is $14,000.

The combined redevelopment and secondary benefits of the Channel Improvement Plan total $25,000 annually.

Costs

The total estimated cost of this plan is $2,440,000. Details are shown in Table 7. Annual charges consist of interest and depreciation and maintenance. Using an interest rate of 3 percent and a service life of 100 years, average annual interest and depreciation charges would be $77,000.

Maintenance of the completed project will consist of periodic inspection; minor repairs and removal of deposits, trash and vegetal growth; mowing the sloping channel sides; and occasional major repairs. Maintenance should be relatively easy because a 10-foot easement can be obtained on both banks along most of the improved channel. Average annual maintenance costs are estimated to be $5,000.

Total average annual project charges are $82,000.

Economic Analysis

Table 8 gives a summary of average annual benefits along with average annual costs. The benefit-cost ratio of 2.8 indicates that the plan is economically feasible by a wide margin.

TABLE 7

ESTIMATED COST

CHANNEL IMPROVEMENT PLAN

LAND AND BUILDINGS	
Easement for Channel and Maintenance Strip	$ 96,500
Buildings, Improvements, Minor Obstructions	61,500
Construction Easement	40,000
Road Right-of-Way	17,000
Contingency	24,000
Acquisition Cost	50,000
TOTAL LAND AND BUILDINGS	$ 289,000
PREPARATION AND CONSTRUCTION	
Clearing and Grubbing	$ 50,000
Remove Dam, Structures, Railroad Track	27,000
Relocate Utilities Lines	22,000
Relocate River Gage Station	10,000
Relocate Roads	30,000
Rework Footbridge	1,000
Excavation, Earth and Rock	1,291,000
Dewatering	10,000
Seeding	4,000
Abutment Protection at Bridges	5,000
Distributable Cost	86,000
Total Direct Cost	$1,536,000
General Expenses, Contingency, and Overhead	615,000
TOTAL PREPARATION AND CONSTRUCTION	$2,151,000
TOTAL PROJECT COST	$2,440,000

The Three Reservoir Plan

Degree of Flood Protection

The three sites selected for dams and reservoirs would together control 52 percent of the watershed below the junction of Little Pigeon River and the West Fork. Richardson Cove and East Fork Dams and Reservoirs would control 68 percent of the eastern segment of the drainage area. This high degree of control renders unimportant the loss of control on Middle Creek due to unavailability of a practical location. Walden Dam and Reservoir would control 30.5 percent of the total West Fork watershed, which is less than is desired. Therefore, the plan would provide good

control of the total watershed, but there is some unbalance between the eastern and western segments.

TABLE 8

ECONOMIC ANALYSIS

CHANNEL IMPROVEMENT PLAN

Total Capital Cost	$2,440,000
Average Annual Charges	
Interest and Depreciation	$ 77,000
Maintenance	5,000
Total Annual Charges	$ 82,000
Average Annual Benefits	
Prevented Flood Damages	$ 142,000
Improved Property Values	66,000
Redevelopment and Secondary	25,000
Total Annual Benefits	$ 233,000
Ratio, Annual Benefits to Annual Charges	2.8
Net Annual Benefits	$ 151,000

In addition to the considerations discussed under the Channel Improvement Plan, the probable frequency of use of the emergency spillways at the dams influences the degree of flood detention capacity. For high dams located above developed areas, emergency spillways with grassed side channels should not be used often.

For the East Fork and Walden Creek reservoirs, flood detention capacity was provided above the permanent lakes for control of floods to be expected at about 100-year intervals on the average. Flood detention capacity was provided in Richardson Cove project for control of a somewhat lower (70-year average) flood, because of the large degree of control on the eastern segment of the watershed.

Protection provided by the reservoirs is adequate for the rural areas, but there is need for additional control in developed Sevierville. In the city, some channel cleanup and enlargement, supplementing reservoir

control, is planned to prevent significant channel overflow in the average 100-year flood.

In the rural areas below the dams on Little Pigeon River, East Fork, and Walden Creek, the plan would reduce the height of the big March 1963 flood essentially to within bank tops. Along the rural reaches of West Fork there would be overflow in low areas. In Sevierville the plan would contain still larger floods within bank tops. Flood heights of the larger Maximum Probable and Regional Floods would be reduced by varying amounts depending on a great many factors, including the location with respect to control works.

Physical Features

The plan consists of three reservoirs and four miles of channel improvement. Each of the reservoirs would contain a recreation lake in addition to the flood detention capacity. Richardson Cove Dam would be located at Mile 14.9 on Little Pigeon River, East Fork Dam at Mile 8.5 on East Fork Little Pigeon River, and Walden Dam at Mile 4.7 on Walden Creek. These locations are shown on Plate 10. Table 9 gives statistics for the dams and reservoirs.

Limits of channel work, necessary bottom width, and degree of necessary enlargement of present channel are also shown in Table 9. The location of planned channel work is also shown in abbreviated form on Plate 11. The improvements extend only through the developed area of Sevierville plus a sufficient amount downstream to render effective the work done in town. Diversion of the lower 0.6 mile of West Fork (similar to that included in the Channel Improvement Plan) was considered briefly. Preliminary estimates indicate that diversion would be more costly than following the present course.

Benefits

Presently identified benefits result from prevented flood damages, improved property values, water-use recreation, shoreland development, and redevelopment and secondary. Individual values of these benefits, totalling $505,000 annually for the Three Reservoir Plan, are given in the benefit-cost comparison of Table 11.

TABLE 9

STATISTICS FOR THREE RESERVOIR PLAN

Dams and Reservoirs

	Damsite		
	Richardson Cove	East Fork	Walden Creek
Drainage Area (Square Miles)	84.6	52.1	46.0
Top of Dam - Elevation	1,132	1,067	1,068
Maximum Height of Dam (Feet)	122	87	82
Surface Area (Acres)	820	742	678
Lake - Nominal Elevation	1,070	1,020	1,020
Surface Area (Acres)	260	318	245
Clearing Line Elevation	1,072	1,022	1,022
Emergency Spillway - Crest Elevation	1,104	1,047	1,047
Width (Feet)	150	150	120
Surface Area (Acres)	488	545	485
Permanent Conduit			
Size (Feet)	7 x 7	$5\frac{1}{2}$ x $5\frac{1}{2}$	$5\frac{1}{2}$ x $5\frac{1}{2}$
Downstream Invert - Elevation	1,010	980	986
Maximum Probable Flood			
Natural Peak Discharge (CFS)	55,000	35,000	39,000
Regulated Peak Discharge (CFS)	41,900	21,160	21,200
Maximum Water Level - Elevation	1,124.3	1,059.7	1,061.2

Supplemental Channel Enlargement

River	Mile From	Mile To	Improved Bottom Width (Feet)	Enlargement of Present Channel (%)
Little Pigeon	3.0	5.13	175	17
	5.13	5.78	90	Nominal
West Fork	0.0	1.27	150	50

Prevented Flood Damages--The potential flood damage curve was prepared and the flood elevation-frequency relationship determined by TVA as was described in the Channel Improvement Plan. The total potential average flood damage was computed to be $156,000. Residual damage with the project would average $2,000 annually. The difference, $154,000, is the estimated average annual flood control benefit.

Improved Property Values--Within Sevierville, the total appraised present worth of the increase in values which would result from providing flood relief is $2,165,000, the same as for the Channel Improvement Plan.

Additional benefits would certainly result from reduced flooding along the reaches of streams below the three dams. In order to evaluate these benefits, the area of potential damage was identified, the reduced flooding from the project was computed, and the resulting increase in value of the properties was appraised for the higher use made possible because of flood control. The present net worth of this enhancement in rural areas was determined to be $1,405,000.

Within the limits of the flood plains given protection by the Three Reservoir Plan the total appraised present worth of the increase in values is estimated to be $3,570,000. Converting the sum to an annual value with a proper allowance for the small overlap between prevented damage and increased values, the flood control benefit from increased property values is $120,000.

Water-Use Recreation--TVA recreation specialists estimate that the permanent lakes would experience a person-day use within 5 years after construction as follows:

Project	Annual Person-Day Use
Richardson Cove	100,000
East Fork	125,000
Walden Creek	155,000

Presently there is no wholly acceptable means to evaluate recreation benefits. Some Federal and state agencies have used amounts ranging from $0.50 to $1.50 for each person-day of expected use. For this report the conservative minimum value is used. The computed annual benefits for the three reservoirs follow:

Project	Annual Benefits
Richardson Cove	$44,000
East Fork	55,000
Walden Creek	67,000
	$166,000

Shoreland Development--Substantial areas around the reservoirs above the elevation of the Maximum Probable Flood would increase in value as a direct result of the permanent lakes. Of this, about 260 acres

should be acquired to prevent severance damage, to avoid leaving in private ownership land which would be without road access, and to assure full and maximum development of the shoreline for recreation and for other purposes.

After construction of the reservoirs, and following tract realignment as well as completion of coordinated plans for development of the shorelands, most of this land could be disposed of over a period of about five years subject to appropriate conditions and restrictions. The present net worth of the future value is estimated at $254,000. Its equivalent annual amount of $8,000, shown as "Shoreland Development" in the economic analysis of Table 11.

Redevelopment and Secondary--Based on the same assumptions as explained for the Channel Improvement Plan, the total local labor bill for the $9,000,000 project will be about $2,600,000. The wage component to unemployed and underemployed labor will be $930,000. The annual redevelopment benefits for the project life are $29,000.

Secondary activity in the watershed resulting from the project is estimated to average $286,000 annually. The resulting annual secondary benefit is $28,000 based on a net income of 10 percent of this first-round increase.

The combined redevelopment and secondary benefits of the Three Reservoir Plan total $57,000 annually.

Costs

The total estimated cost of this plan is $9,000,000 divided as shown in Table 10. Using an interest rate of 3 percent and a service life of 100 years, average annual interest and depreciation charges would be $282,000.

The annual cost of operation and maintenance is estimated to average $29,000, composed of $8,000 per year for each of the three dams and $5,000 per year for the four miles of enlarged channels.

Total average annual project charges are $311,000.

TABLE 10

ESTIMATED COST

THREE RESERVOIR PLAN

RICHARDSON COVE DAM AND RESERVOIR	
Total Land and Improvements	$ 604,000
Total Preparation and Construction	1,609,000
Total Direct Cost	$2,213,000
EAST FORK DAM AND RESERVOIR	
Total Land and Improvements	$ 546,000
Total Preparation and Construction	1,313,000
Total Direct Cost	$1,859,000
WALDEN CREEK DAM AND RESERVOIR	
Total Land and Improvements	$ 781,000
Total Preparation and Construction	811,000
Total Direct Cost	$1,592,000
CHANNEL IMPROVEMENTS	
Total Land and Improvements	$ 123,000
Total Preparation and Construction	633,000
Total Direct Cost	$ 756,000
TOTAL DIRECT PROJECT COST	$6,420,000
Construction Facilities	605,000
General Field Expense	475,000
Overhead and Contingency	1,500,000
TOTAL PROJECT COST	$9,000,000

Economic Analysis

Table 11 gives a summary of the average annual benefits along with the average annual costs. The benefit-cost ratio of 1.6 indicates that the plan is economically feasible by a substantial margin.

Conclusions

The foregoing results of studies of possible flood control measures for Sevierville and Sevier County lead to the following conclusions:

TABLE 11

ECONOMIC ANALYSIS

THREE RESERVOIR PLAN

Total Capital Cost	$9,000,000
Average Annual Charges	
Interest and Depreciation Excluding Reservoir Land	$ 232,000
Interest on Reservoir Land	50,000
Operation and Maintenance	29,000
Total Annual Charges	$ 311,000
Average Annual Benefits	
Prevented Flood Damages	$ 154,000
Improved Property Values	120,000
Water-Use Recreation	166,000
Shoreland Development	8,000
Redevelopment and Secondary	57,000
Total Annual Benefits	$ 505,000
Ratio, Annual Benefits to Annual Charges	1.6
Net Annual Benefits	$ 194,000

1. A $2,440,000 channel improvement project would provide a high degree of flood control for developed Sevierville only, and is economically feasible by a wide margin.

2. A $9,000,000 project consisting of three reservoirs and channel enlargement would provide a higher degree of flood control and substantial recreation value to a broad region including Sevierville.

3. Construction and operation of either plan would have a significant, favorable, direct and secondary impact on the area's economy and would provide job opportunities in a high unemployment area.

4. Channel improvement on Middle Creek is a very desirable addition to either plan.

5. The Sevierville-Sevier County Flood Study Committee recognizes the many advantages of the Three Reservoir Plan over the Channel Improvement Plan. However, contacts with city and county officials and leading citizens of the area failed to locate any substantial support

for the Three Reservoir Plan. In fact, there is almost unanimous local agreement that the city and county would not provide funds for the local share of that project.

Recommendations

It is recommended that the Channel Improvement Plan and the Middle Creek improvement as described in this chapter be adopted as the flood control portion of the flood damage prevention plan.

It is further recommended that the Tennessee Valley Authority be requested to continue work with the Committee to determine whether or not a plan utilizing multiple-purpose dams and reservoirs would be economically feasible after completion of the Channel Improvement Plan.

One member of the Committee, Mr. J. B. Waters, Sr., requests that the record show that he favors the Three Reservoir Plan.

BLANK
PAGE

III

FLOOD PROOFING

The objective of this chapter is to examine the possible role of flood proofing in a comprehensive flood damage abatement program for Sevierville.

Flood proofing has been defined as adjustments to structures and contents which are designed or adapted primarily to reduce flood damages. The existence in a few areas of buildings which have been flood proofed is evidence of the engineering feasibility of such schemes. An outstanding example is the Golden Triangle area of Pittsburgh, Pennsylvania, where several old buildings have been adjusted to withstand large floods, and flood proofing provisions have been incorporated in the design of new structures.

In order to determine the practicability of flood proofing in Sevierville, the Flood Proofing Work Group undertook a study of selected buildings which would be subject to residual flooding after completion of the proposed improved channels. A flood proofing specialist from TVA provided technical assistance. Much of the data used in this chapter was determined by that study.

Concept of Flood Proofing

One of the situations where flood proofing warrants consideration is where a higher degree of protection is desired than that which is provided by a flood control project. Flood plain regulations could have the immediate effect of preventing the residual flood problem from increasing in magnitude; however, they would not prevent damages to existing developments in the flood plain. This is the situation at Sevierville where total flood control is not economically feasible.

This chapter presents the results of a study of existing structures only, but the concept is also applicable to proposed new structures. In fact, flood proofing can be incorporated in plans for new buildings at much less extra cost than for adjusting older buildings. This is

especially important at Sevierville. With the proposed channel improvements completed, much additional land adjacent to the central business area will be available for use, and it will be developed eventually. To require that all structures be elevated above the height of infrequent floods will not always be reasonable. Flood proofing of proposed new structures can greatly reduce their vulnerability to flood damages without changing the desired use of the property.

Field Study

Within the corporate limits of Sevierville, 73 commercial structures were identified as being subject to flooding by the Regional Floods even after the channels of the three streams are improved. Since it appears that the cost of flood proofing must be borne by the owner or occupant of a building, it was decided that a sampling of these persons should be interviewed to determine whether or not they would be willing to spend money for this purpose. Accordingly, 19 establishments were selected for detailed study.

With the assistance of TVA engineers, a preliminary plan for flood proofing each building was prepared. The plan would provide protection to the elevation of the Regional Flood (Improved Conditions). The work necessary for flood proofing and the estimate of cost of that work were included in the plan.

In order to standardize the plans insofar as was practicable, certain general criteria were adopted. Bulkheads for doors were designed to be removable, bolted either inside or outside (at least one for each structure must be bolted outside), and made of either steel or aluminum. Bulkheads for other openings would be of steel, permanently mounted, or the openings could be closed with masonry. Bulkheads for windows would be installed outside for glass protection. In many cases the simplest scheme for flood proofing show windows was to raise and remodel the sills.

When the flood proofing plans were completed the owner or occupant of each of the 19 buildings was contacted at the site. The purpose of the study was explained to him. He was asked whether or not he would flood proof his building to the elevation of the Regional Flood (Improved Conditions) if the proposed channel improvements were made.

Results of the Study

Table 12 lists data used in the study with a condensation of statements given to the interviewers. Only one owner stated that he would flood proof to the extent indicated by the preliminary plan. Six were willing to do some work if a less costly plan could be designed. The four who answered "Maybe" were either short-term lessees or were not convinced that flood proofing will be needed.

TABLE 12

RESULTS OF FLOOD PROOFING STUDY

Building Identification	Regional Flood (Improved Conditions) Depth Over Floor (Feet)	Regional Flood (Improved Conditions) Flood Proofing Cost	Comments of Owners
10-1	2.9-3.5	$12,090	Will do reasonable amount.
10-9A	3.1	3,695	Will do reasonable amount.
10-10B	1.3	1,640	Will do reasonable amount.
11-17	2.1	3,560	Maybe. Not convinced it is needed.
21-10	2.4	2,150	Maybe. Depends on future lease arrangements.
22-4A	1.3	8,090	No. Floor replacement too costly.
22-7	3.3	2,700	Yes.
22-10	2.9	2,725	No.
22-18	2.9	12,300	Some, if much less costly plan can be found.
22-19	2.9-4.4	29,640	Later, as part of remodeling.
22-24A	3.1	7,300	Maybe. Depends on lease arrangements next year.
22-25B	3.1	3,120	Maybe.
23-5	2.6	5,220	Yes. Some now, more later.
26-8A	1.7	6,280	Some.
27-8A	2.2	1,600	No.
27-8B	2.1	2,285	No.
27-8C	2.0	5,555	No.
27-8D	2.0	5,555	No.
27-12,13	2.7	3,405	No.

The fact that eight--almost one-third of those interviewed--gave a negative answer calls for some explanation. These persons were receptive to the idea of flood proofing, and were hopeful that feasible

plans could be devised for their buildings. Unfortunately, most of these buildings are old and have wooden floors, making flood proofing difficult and costly. The Regional Flood (Improved Conditions) would be only about 2 feet over the floors. It did not seem prudent to spend large sums on old buildings for protection from such infrequent floods.

Recommendations

It is recommended that the Town of Sevierville encourage and provide technical assistance to owners or occupants of property on the flood plains in flodd proofing existing structures to the elevation of the Regional Flood (Improved Conditions). It is further recommended that any new or reconstructed structure be required to have the first floor above that elevation or be flood proofed at least to that elevation.

IV

FLOOD PLAIN REGULATIONS

The Channel Improvement Plan and the Middle Creek Improvement described in the chapter on Flood Control will afford substantial protection against floods which have been experienced in Sevierville, and will reduce the damage to be expected in the future from larger floods. Additional protection for those structures now located in the flood plain will be provided by the application of flood proofing measures. However, it is economically impractical at this time to prevent all flood damage by physical works.

Past experience indicates that to be fully effective the use of protective works to reduce or prevent flood damages must be supplemented by other measures. The most prominent of these originate from the police power, particularly the power to zone and to regulate the subdivision of land. It would appear to be only reasonable that the local government should prohibit developments which might increase the flood damage potential after heavy investment is made in flood protective channel improvements.

In this chapter primary emphasis is placed upon regulating the occupancy of currently undeveloped flood-prone areas so that developments flowing into such areas will not result in needless new losses. Secondary consideration is given to the application of regulatory techniques to existing developed areas which are already subject to flood damage.

Elements of Flood Plain Regulations

Parts of the flood plains of Little Pigeon River, West Fork Little Pigeon River, and Middle Creek may be utilized without unduly restricting the effectiveness of a particular section to pass floodwaters. However, study of the flood data indicates the need for maintaining at least a minimum floodway. The purpose of a floodway is to assure that floodwaters which can reasonably be expected can be accommodated within the floodway limits. This is based on two major considerations.

First, indiscriminate land fill, structures and other restrictions to the flow of water in the stream or on the flood plain could cause increased flood heights upstream. A well-known local example is Hardin Lane, an access road which was built across the flood plain of West Fork in recent years. In March 1963, flooding in the developed areas upstream was increased markedly by heading up at this road.

A second consideration on the need for a floodway is that areas subject to flood may be hazardous to life and property. Authorities agree that the really dangerous flood areas are those covered by two or more feet of water, and located in the part of the flood plain where velocities are likely to be high. Where these two conditions--water depth and water velocity--are present, more is involved than an individual taking a calculated risk by building in an area subject to flood.

A significant percentage of the population of the United States moves each year from one locality to another. Those who wish to build or buy in the flood plain may have no knowledge of the risk involved. Furthermore, those who knowingly build in such areas make demands upon the public to assist in rescue operations and relief, and to bear the cost of flood protective works once the area is built up.

It is hoped that eventually a clear floodway, free of structures that would materially affect flood heights and of property that would be damaged by floods, can be obtained. This situation is attainable in Sevierville because very few buildings will be in the required floodway area after the channel improvements are completed. It is important that no new or substantially altered structures be permitted into or over the floodway which will significantly increase flood heights.

Designation of a floodway does not mean that other land would be free from flooding. Those flood fringe areas where floodwaters tend to eddy do not materially help the flow through the general area and need not be included within the floodway. The objective in control of flood fringe areas should be the protection of the lives and property of the users. In these areas all legal uses would be permitted, including land fill, provided first floors of structures were above reasonable flood elevations or they were structurally designed to be flood proof up to such elevation.

Criteria for Regulations

From the planning standpoint the problem of flood plain regulations hinges on the delineation of areas that are to be considered as subject to flooding. It is further complicated by a need for defining within that area the portion that should be considered the floodway and subject to more restrictive regulations than the remainder of the flood plain.

The initial step in determining areas subject to flooding is the selection of the flood magnitude which is to be used as a base. This selection is dependent on many technical considerations. In the end, however, selection of the magnitude of flood to protect against, or make adjustments to, becomes a matter of decision-making on the part of the local governing body. Those elected officials will have the ultimate responsibility of enforcement. Because of the many complex problems involved and in order to be equitable, selection of the flood magnitude frequently necessitates sacrificing the ideal in order to reach the attainable.

Floods of record as well as floods which might occur in the future have been considered as to their applicability for this purpose. It is believed that the Maximum Probable Floods, even after reduction by the improvements, are too large and infrequent for this purpose. The intensive land uses presently occupying a large part of the flood plain make it both uneconomical and impractical to adopt such floods for regulatory purposes. However, elevations for the Maximum Probable Floods should be shown on the profile sheets which are a part of any flood plain regulations. These will be of assistance to persons who want to locate on flood-free or minimum-risk sites.

The TVA flood study, and supplemental data supplied by TVA, indicates that planning based only on known floods of the past would involve considerable risk. Although the March 1963 flood was the largest since 1920, floods of that magnitude can be expected on the average about once in 30 years.

Studies of maximum known floods on other streams in the immediate region of Sevierville provide a practical indication of the size of floods that may reasonably be expected on Pigeon River and its

tributaries. Floods of this magnitude are termed Regional Floods and are considered the most reasonable basis for flood plain regulations. The current Subdivision Standards for both Sevierville and Pigeon Forge contain provisions regulating subdivision of land which would be inundated by the Regional Flood.

Additional studies were made by TVA as a guide to delimiting of floodways required to pass major floods without unduly increasing flood heights. These studies show that confining the Regional Flood to a floodway consisting of the improved channel plus the 10-foot maintenance strip on each bank would increase elevations of the Regional Flood on each stream approximately 1.6 feet. With the improved channel plus a 100-foot strip on each bank for a floodway, elevations would be increased about one foot. Because a flood of that magnitude would occur on an average very infrequently, and because the use of the maximum amount of the flood plain is important to Sevierville, it seems reasonable to designate the Floodway as the improved channel plus a 50-foot strip on each bank.

Within the Floodway, subdivision of land would not be permitted and building for human habitation would be prohibited. In order that flood heights would not be increased appreciably, filling of land would be prohibited. Agriculture, recreation, parking, and other open-type uses not subject to great damage by floods and not constituting restrictions to the flow of water would be permitted.

The recommended Floodways should be shown on the Zoning Map for Sevierville. Controlling elevations can be determined from the profile charts, Plates 12, 13, and 14. Specific provisions which should be included in the zoning ordinance and subdivision regulations are given in detail on the following pages.

Zoning Ordinance Provisions

The following provisions are recommended for inclusion in the Zoning Ordinance for Sevierville in order to guide developments in areas subject to flood.

1. In the DEFINITIONS chapter include the following:

   FLOOD PROOFING: A combination of structural changes and adjustments to properties subject to flooding primarily for the reduction of flood damages.

   REGIONAL FLOOD (IMPROVED CONDITIONS): The elevation of the Regional Flood (Improved Conditions) shall be determined by the charts, "High Water Profiles, Little Pigeon River, Vicinity of Sevierville, Tennessee" (Tennessee Valley Authority, April 1965); "High Water Profiles, West Fork Little Pigeon River, Vicinity of Sevierville, Tennessee" (Tennessee Valley Authority, April 1965); and "High Water Profiles, Middle Creek, Vicinity of Sevierville, Tennessee," (Tennessee Valley Authority, April 1965), which charts are made a part of this Ordinance.

2. In the SPECIFIC DISTRICT REGULATIONS chapter include the following:

   Section . F-1 Floodway District. In order to meet the needs of streams to carry water in time of flood and to protect the stream channels and flood plain from encroachment so that flood heights and flood damage will not be appreciably increased, a floodway is hereby established. Within the F-1 Floodway District, the following regulations shall apply:

   (A) Permitted Uses and Structures. The following open-type uses are permitted subject to the approval of the Planning Commission and to such conditions as the Planning Commission may specify to protect the public interest.

(1) Agricultural uses.

(2) Railroads, streets, bridges, and public utility wire and pipe lines for transmission and local distribution purposes.

(3) Open-type public and private recreation facilities such as public parks, golf courses and driving ranges, boat docks, fishing lakes and drive-in theaters.

(4) Circuses, carnivals, and similar transient amusement enterprises.

(5) Storage yards for equipment and material not subject to major damage by floods, provided such use is auxiliary to uses permitted in an adjoining district and materials do not include flammables such as gasoline.

(6) Open-type uses, such as loading and unloading areas, parking lots, used car lots, billboards, and gardens auxiliary to uses permitted in an adjoining district.

(7) Other similar uses accessory to those permitted in the adjoining district

(B) Planning Commission Approval. No permit shall be issued for the construction of any building or for any use within the floodway area until the plans for such construction or use have been submitted to the Planning Commission and approval is given in writing for such construction or use by the Planning Commission. The Planning Commission may make its approval subject to such conditions necessary to carry out the purpose of this district. In its review of plans submitted the Planning Commission shall be guided by the following standards, keeping in mind that the purpose of this district is to prevent encroachments into the floodway area which will unduly increase flood heights and endanger life and property.

(1) Any use permitted shall be a type not appreciably damaged by floodwaters, provided no structures for human habitation shall be permitted.

(2) Filling of land shall not be permitted.

(3) Any structure permitted shall be designed, constructed, and placed on the lot so as to offer the minimum obstruction to the flow of water.

(4) Any structure permitted shall be firmly anchored to prevent the structure from floating away and thus threatening to further restrict bridge openings and other restricted sections of the stream.

(5) Where, in the opinion of the Planning Commission, topographic data, engineering, and other studies are needed to determine the effects of flooding on a proposed structure and/or the effect of the structure on the flow of water, the Planning Commission may require the applicant to submit such data or other studies prepared by competent engineers or other technical people.

(6) The granting of approval of any structure or use shall not constitute a representation, guarantee, or warranty of any kind or nature by the Corporation of Sevierville or the Planning Commission or by any officer or employee of either of the practicality or safety of any structure or use proposed, and shall create no liability upon or cause action against such public body, officer, or employee for any damage that may result pursuant thereto.

3. In the SUPPLEMENTARY REGULATIONS chapter include the following:

Section . Flood Fringe Areas. For the purposes of this ordinance land below the elevation of the Regional Flood (Improved Conditions) shall be considered subject to flood. Land lying outside the F-1 Floodway Districts but subject to flood shall be subject to the following regulations:

(A) No building or structure shall be erected and no existing building or structure shall be extended or moved unless the main floor of said building or structure is placed above the elevation of the Regional Flood (Improved Conditions), or the building or structure is flood proofed up to such elevation. No basement floor or other floor shall be constructed below or at a lower elevation than the main floor. Foundations of all structures shall be designed to withstand flood conditions at the site.

(B) Land may be filled within these flood fringe areas provided such fill extends twenty-five (25) feet beyond the limits of any structures erected thereon.

(C) Any structure proposed to be located outside the F-1 Floodway District but within fifty (50) feet of any lake or of any main drainage channel or stream within the Corporation of Sevierville must be approved by the Building Inspector and reviewed by the Planning Commission. The Planning Commission shall determine on the basis of the area of the watershed and the probable runoff the openings needed for the stream or how close a structure may be built to a lake or to any main drainage channel or stream in order to assure adequate space for the flow of floodwater; provided, however, no structure shall be permitted within ten (10) feet of the top of the bank of any stream.

Subdivision Regulations Provisions

The Subdivision Standards of the Sevierville, Tennessee, Regional Planning Commission which were adopted and made effective on March 25, 1963, contain provisions regulating subdivision of land subject to flooding. The Regional Flood was used as the basis for the flood plain provisions. The flood control improvements will reduce that flood significantly through Sevierville. The following changes are recommended to recognize the lower flood heights:

1. ARTICLE II. Section B. Subsection 2. Revise paragraph i to read:

   i. If any portion of the land being subdivided is subject to flood as defined in ARTICLE III, Section E, the limit of such flood shall be shown.

2. ARTICLE II. Section C. Subsection 5. Revise paragraph h to read:

   h. If any portion of the land being subdivided is subject to flood as defined in ARTICLE III, Section E, the limit of such flood shall be shown.

3. ARTICLE III. Revise Section E to read:

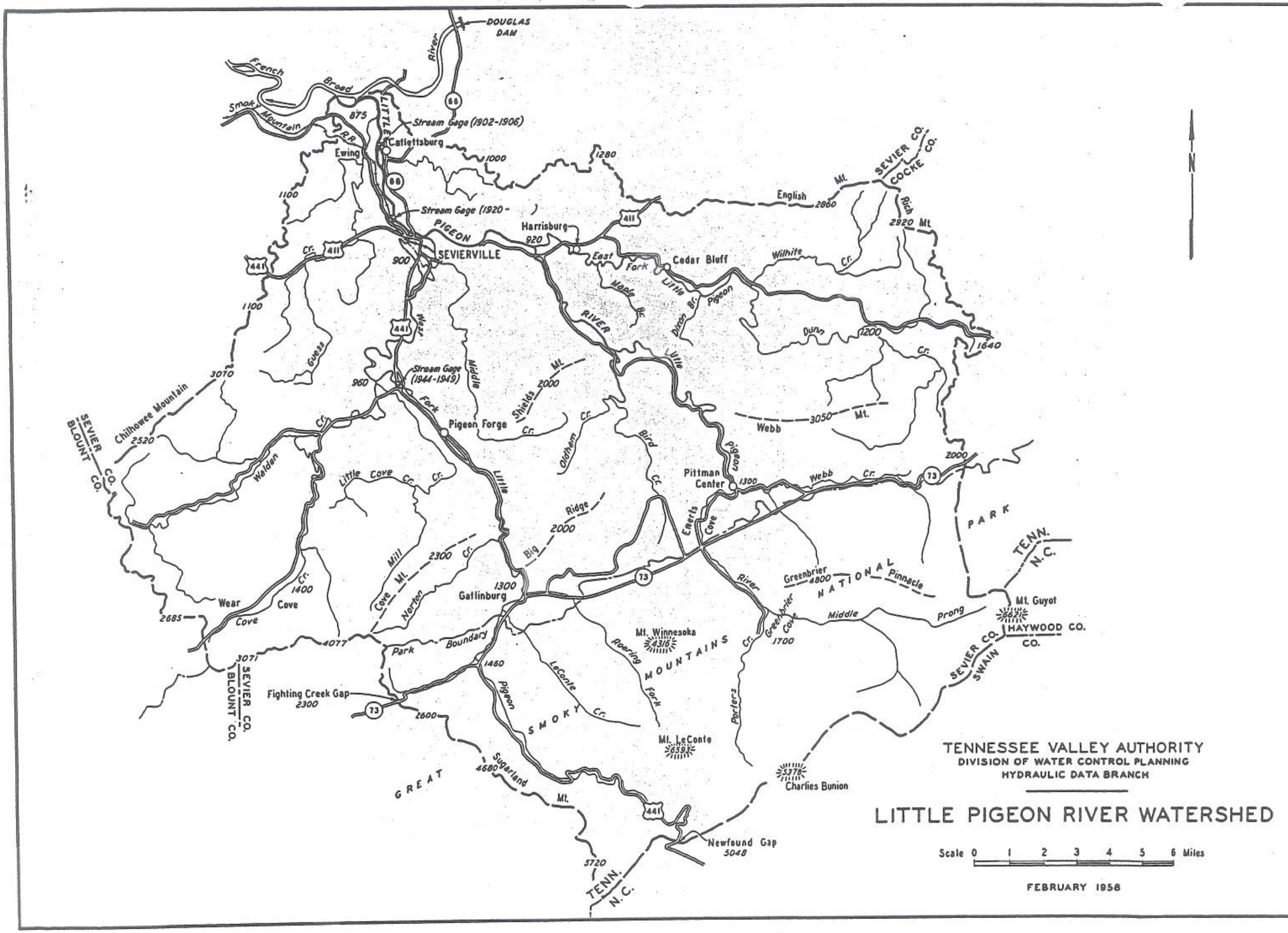
   (E) Suitability of the Land. The planning commission shall not approve the subdivision of land if, from adequate investigations conducted by all public agencies concerned, it has been determined that in the best interest of the public the site is not suitable for platting and development purposes of the kind proposed.

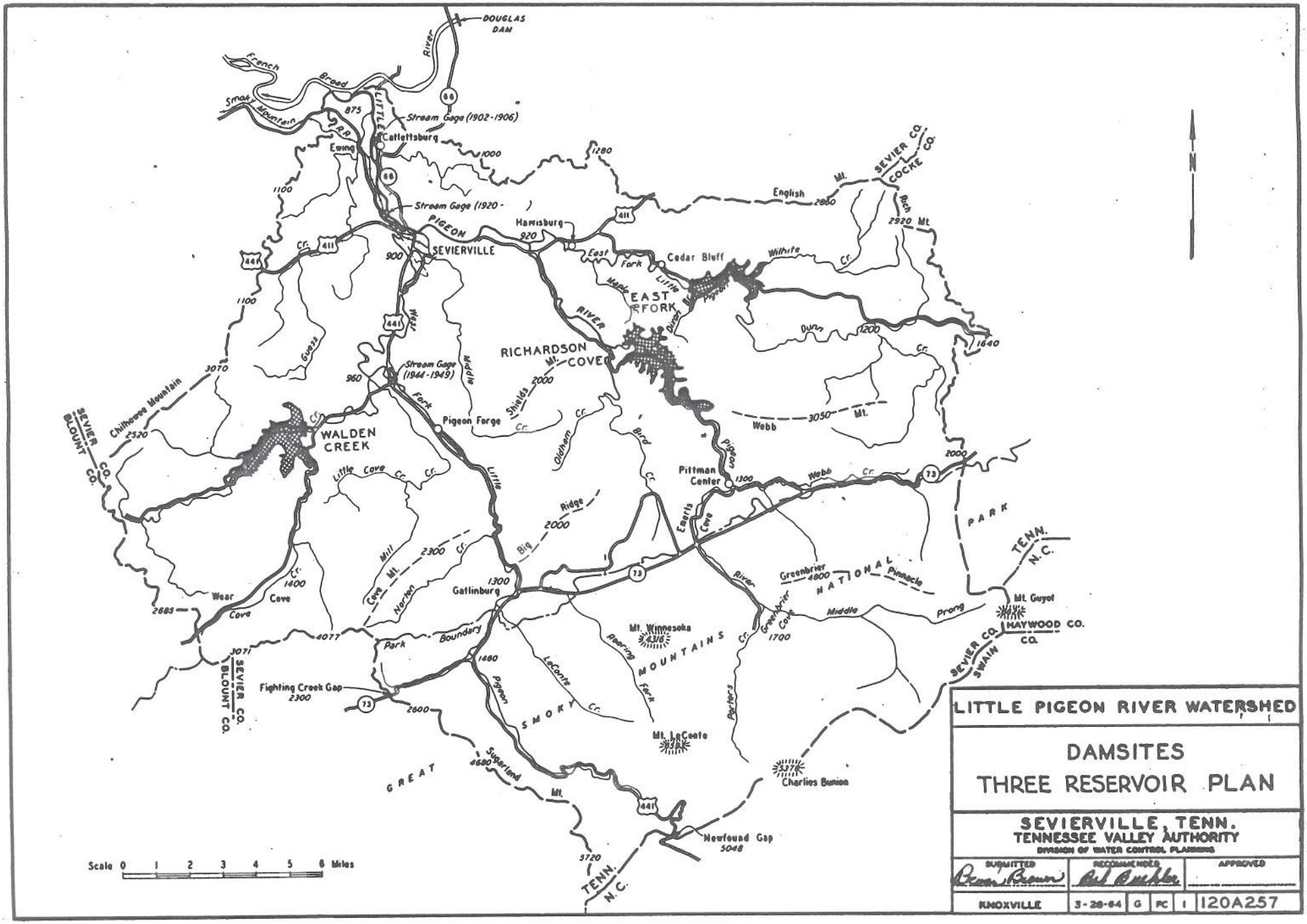
   Land within the Floodways shall not be platted for residential occupancy or building sites. Other land subject to flooding may be platted for residential occupancy or for such other uses which will not increase the danger to health, life, and property. Fill may not be used to raise land within the Floodway areas. In other areas subject to flood fill may be used provided the proposed fill does not restrict the flow of water and unduly increase flood heights.

   In applying this provision, land below the elevation of the Regional Flood or the Regional Flood (Improved Conditions), whichever is lower, shall be considered subject to flood. The elevation of these controls shall be determined from the charts, "High Water Profiles, Little Pigeon River, Vicinity of Sevierville, Tennessee" (Tennessee Valley Authority, April 1965); "High Water Profiles, West Fork Little Pigeon River, Vicinity of Sevierville, Tennessee" (Tennessee Valley Authority,

April 1965); and "High Water Profiles, Middle Creek, Vicinity of Sevierville, Tennessee" (Tennessee Valley Authority, April 1965), which charts are made a part of these regulations.

Areas included in the Floodways along the improved portions of Pigeon River, West Fork Pigeon River and Middle Creek shall consist of the improved channel plus a fifty (50) foot wide strip along each bank. These and other Floodway areas are shown on the maps, "Floodway, Little Pigeon River and Middle Creek, Sevierville, Tennessee" (Sevierville Regional Planning Commission, 19); "Floodway, Little Pigeon River below Sevierville, Tennessee," (Sevierville Regional Planning Commission, 19); and "Floodway, West Fork Little Pigeon River, Vicinity of Sevierville, Tennessee" (Sevierville Regional Planning Commission, 19), which maps are made a part of these regulations.


TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH
LITTLE PIGEON RIVER WATERSHED
Scale 0 1 2 3 4 5 6 Miles
FEBRUARY 1958
N
DOUGLAS DAM
French Broad River
Smoky Mountain R.R.
LITTLE PIGEON
875
Stream Gage (1902-1906)
Catlettsburg
Ewing
1000
1100
1280
Stream Gage (1920-
Harrisburg
920
SEVIERVILLE
900
East Fork Little Pigeon RIVER
Cedar Bluff
Maple Br.
Dixon Br.
Wilhite Cr.
English Mt. 2860
SEVIER CO.
COCKE CO.
Rich Mt. 2920
Dunn Cr.
1200
1640
Guess Cr.
3070
Chilhowee Mountain
2520
SEVIER CO.
BLOUNT CO.
West Fork
Middle
Stream Gage (1944-1949)
960
Pigeon Forge
Shields Mt. 2000
Oldham Cr.
Bird Cr.
Webb Mt. 3050
Pittman Center
1300
Webb Cr.
2000
Walden Cr.
Little Cove Cr.
Big Ridge 2000
Emerts Cove
PARK
TENN.
N.C.
Mill Cove Mt. 2300
Norton Cr.
Gatlinburg
1300
Greenbrier 4800
NATIONAL
Pinnacle
Mt. Guyot 6621
HAYWOOD CO.
Wear Cove
Cr. 1400
2685
4077
3071
Park Boundary
Mt. Winnesoka 4316
Roaring Fork
MOUNTAINS
Greenbrier Cove
1700
Middle Prong
SWAIN CO.
Fighting Creek Gap 2300
1460
LeConte Cr.
Porters Cr.
2600
Pigeon
SMOKY
Mt. LeConte 6593
Charlies Bunion 5378
GREAT
Sugarland Mt. 4680
Newfound Gap 5048
5720
TENN.
N.C.



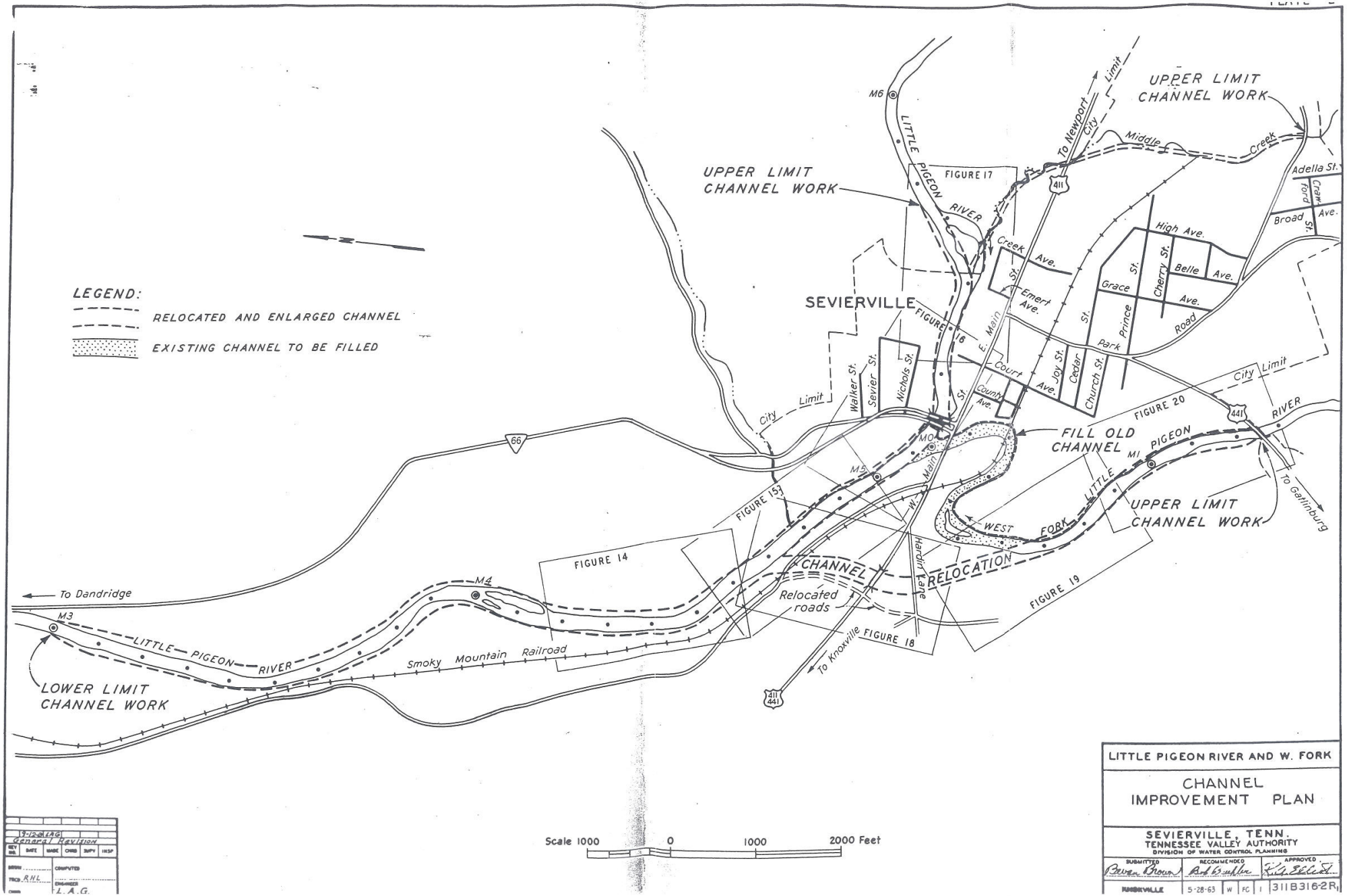
LITTLE PIGEON RIVER WATERSHED

DAMSITES
THREE RESERVOIR PLAN

SEVIERVILLE, TENN.
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED	RECOMMENDED	APPROVED

KNOXVILLE	3-28-64	G	PC	1	120A257



3-12-63 LAG	General Revision				
NO.	DATE	MADE	CHKD	SUPV	INSP

DRAWN: COMPUTED
TRCD. RHL
CHKD. ENGINEER L. A. G.

LITTLE PIGEON RIVER AND W. FORK

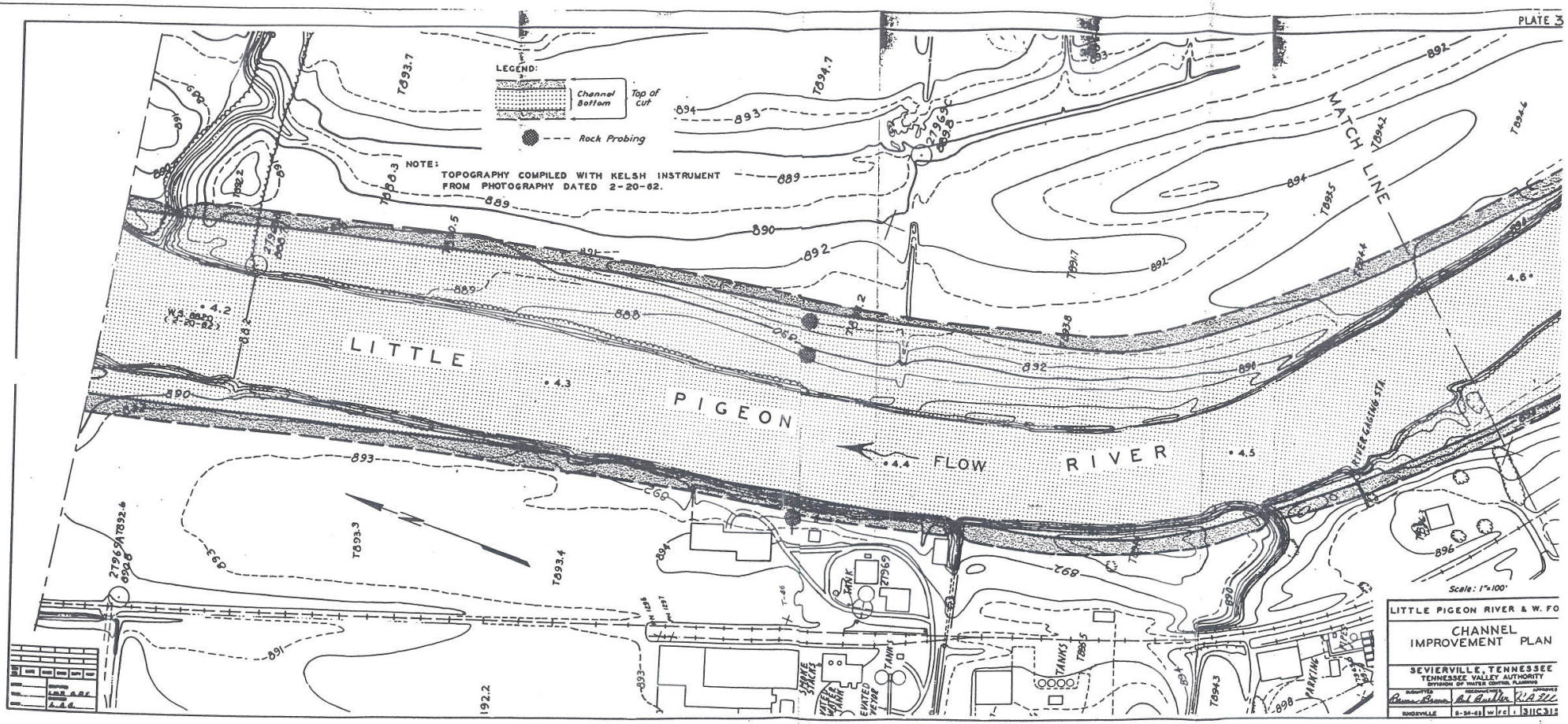
CHANNEL IMPROVEMENT PLAN

SEVIERVILLE, TENN.
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED	RECOMMENDED	APPROVED
Brown	Bob Gamble	T. G. Elliott

KNOXVILLE | 5-28-63 | W | FC | 1 | 311B316-2R1

PLATE 3


LEGEND:
Channel Bottom
Top of cut
Rock Probing
NOTE:
TOPOGRAPHY COMPILED WITH KELSH INSTRUMENT
FROM PHOTOGRAPHY DATED 2-20-62.
MATCH LINE
LITTLE PIGEON RIVER
FLOW
LITTLE PIGEON RIVER & W. FO
CHANNEL IMPROVEMENT PLAN
SEVIERVILLE, TENNESSEE
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
Scale: 1"=100'

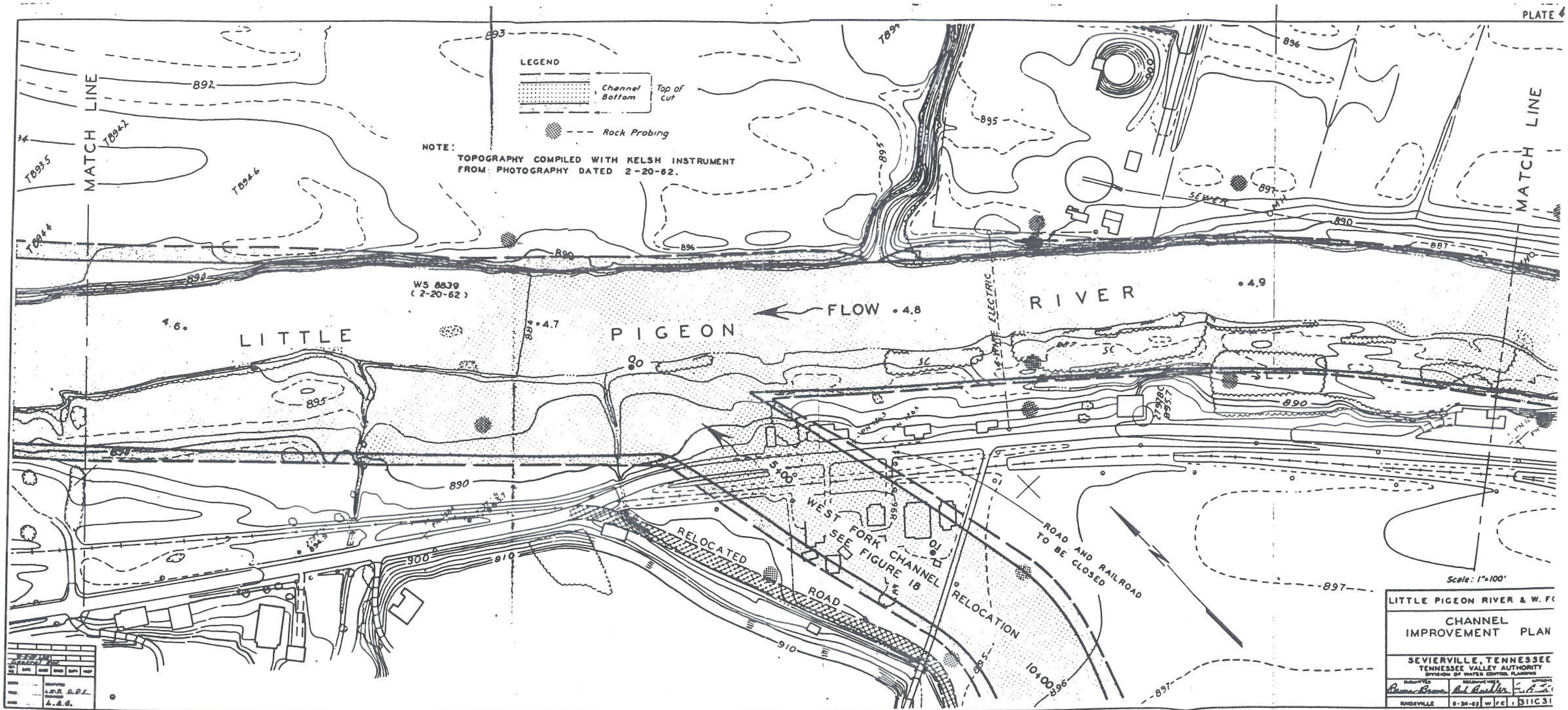


PLATE 4
MATCH LINE
MATCH LINE
LEGEND
Channel Bottom
Top of Cut
Rock Probing
NOTE: TOPOGRAPHY COMPILED WITH KELSH INSTRUMENT FROM PHOTOGRAPHY DATED 2-20-62.
WS 883.9 (2-20-62)
LITTLE PIGEON RIVER
FLOW
WEST FORK CHANNEL SEE FIGURE 18
RELOCATED ROAD
RELOCATION
ROAD AND RAILROAD TO BE CLOSED
SEWER
ELECTRIC
Scale: 1"=100'
LITTLE PIGEON RIVER & W. F
CHANNEL IMPROVEMENT PLAN
SEVIERVILLE, TENNESSEE
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
KNOXVILLE
311C31

PLATE 5

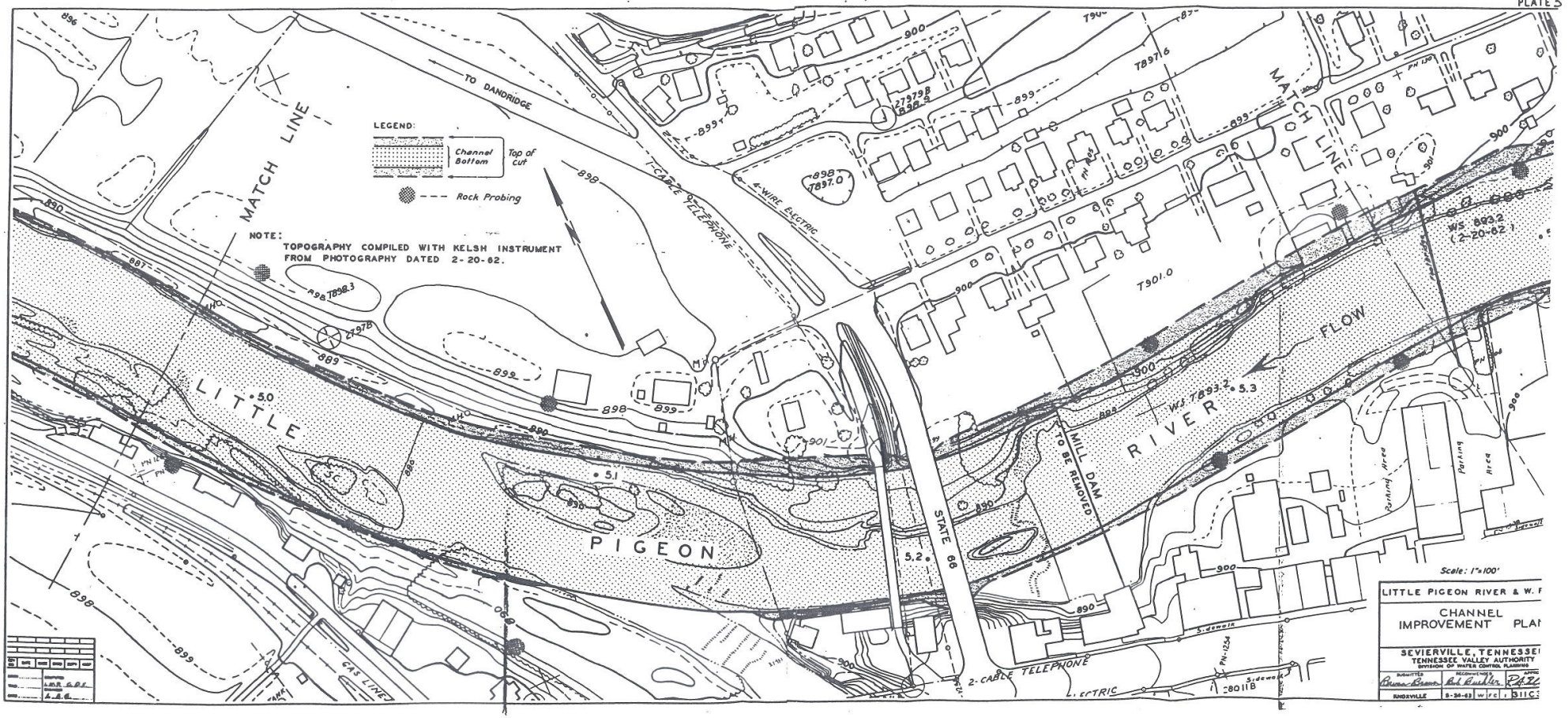
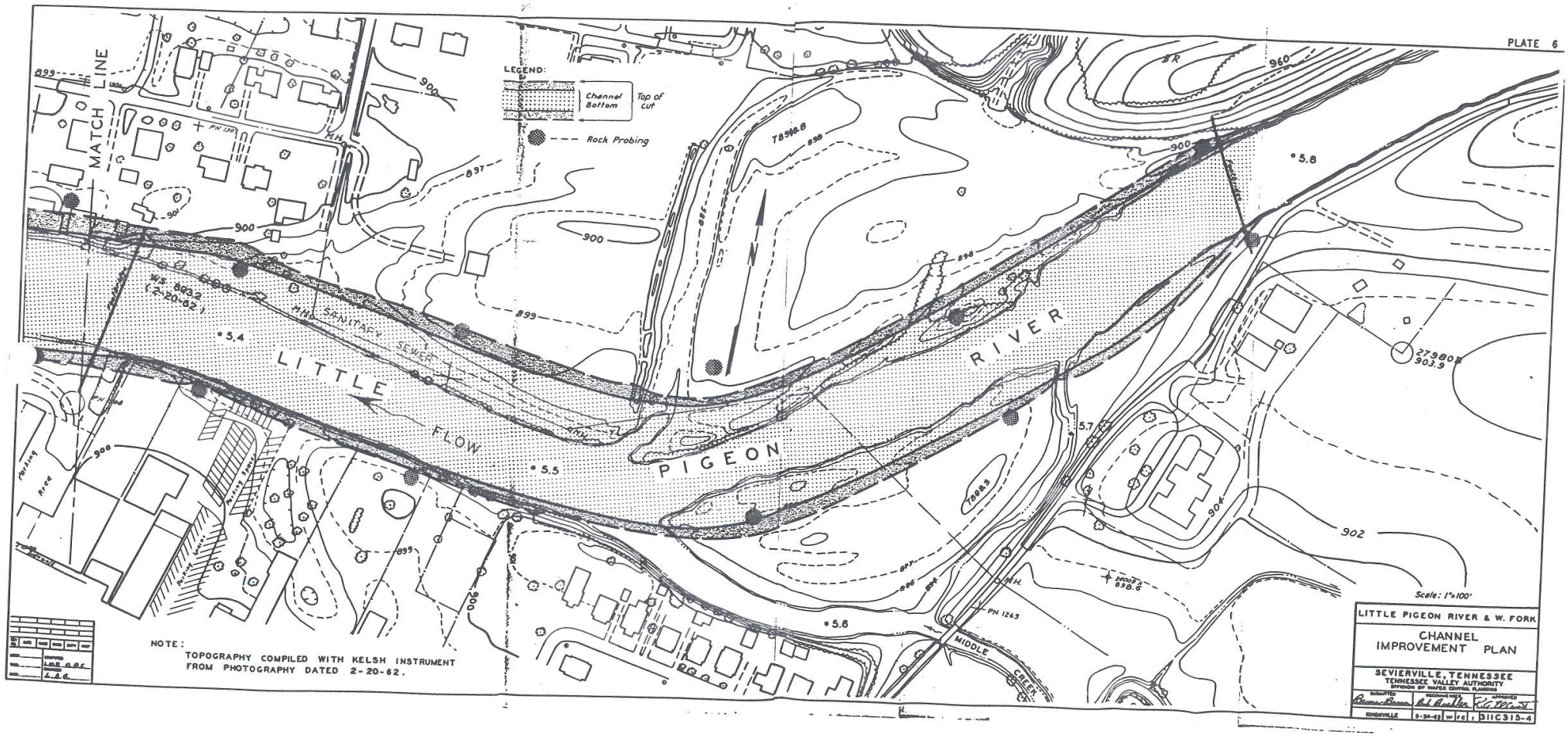

LEGEND:
Channel Bottom
Top of cut
Rock Probing
NOTE:
TOPOGRAPHY COMPILED WITH KELSH INSTRUMENT FROM PHOTOGRAPHY DATED 2-20-62.
MATCH LINE
MATCH LINE
TO DANDRIDGE
T-CABLE TELEPHONE
4-WIRE ELECTRIC
LITTLE
PIGEON
RIVER
FLOW
MILL DAM TO BE REMOVED
STATE 66
2-CABLE TELEPHONE
ELECTRIC
GAS LINE
WS 893.2 (2-20-62)
WS 893.2
5.0
5.1
5.2
5.3
Scale: 1"=100'
LITTLE PIGEON RIVER & W. F
CHANNEL IMPROVEMENT PLAN
SEVIERVILLE, TENNESSEE
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
KNOXVILLE
5-24-63

PLATE 6


MATCH LINE
LEGEND:
Channel Bottom
Top of Cut
Rock Probing
LITTLE PIGEON RIVER
FLOW
MRS SANITARY SEWER
W.S. 893.2 (2-20-62)
PN 1263
MIDDLE CREEK
Scale: 1"=100'
NOTE:
TOPOGRAPHY COMPILED WITH KELSH INSTRUMENT FROM PHOTOGRAPHY DATED 2-20-62.
LITTLE PIGEON RIVER & W. FORK
CHANNEL IMPROVEMENT PLAN
SEVIERVILLE, TENNESSEE
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
SUBMITTED
RECOMMENDED
APPROVED
SEVIERVILLE
3-30-62
W&C
311C315-4

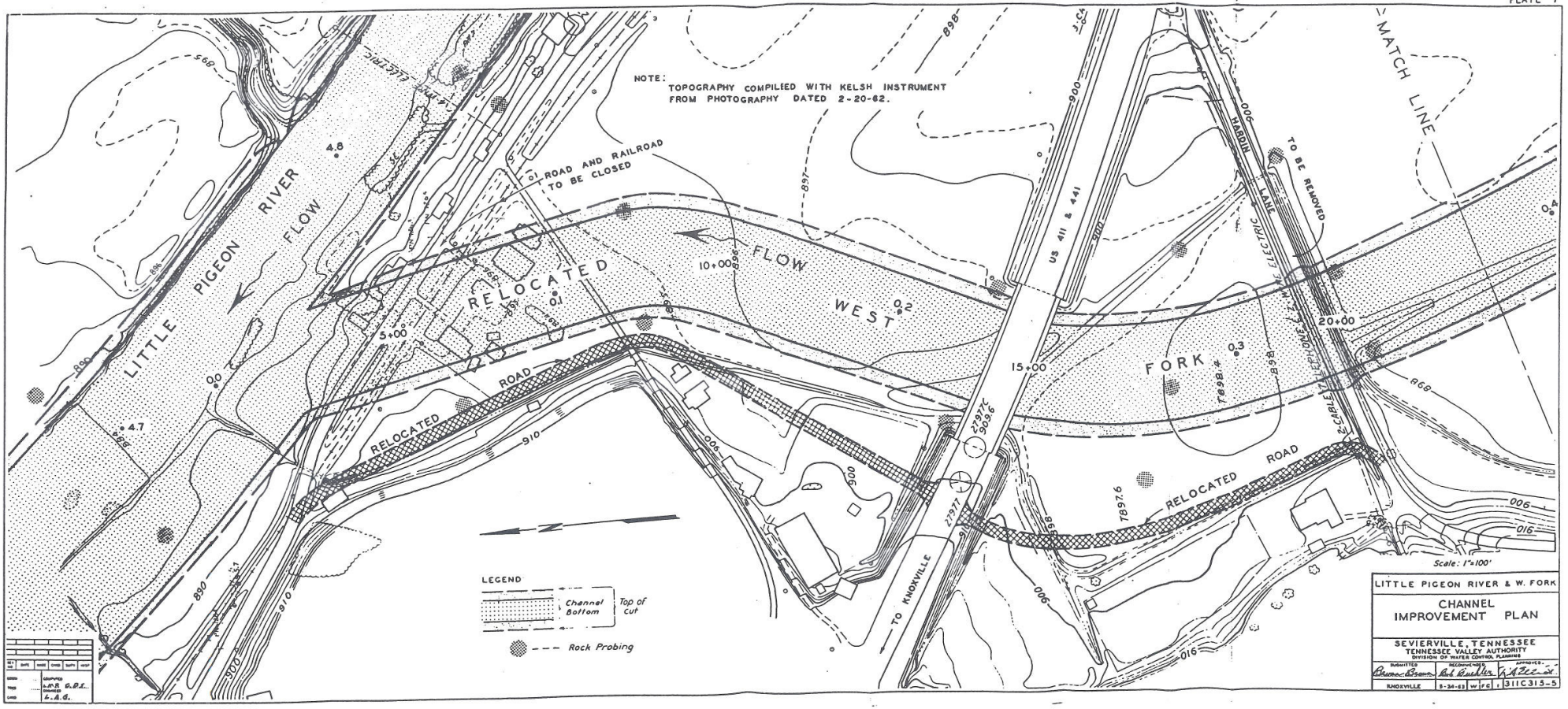

NOTE:
TOPOGRAPHY COMPILED WITH KELSH INSTRUMENT
FROM PHOTOGRAPHY DATED 2-20-62.
LITTLE PIGEON RIVER
FLOW
RELOCATED
FLOW WEST
FORK
ROAD AND RAILROAD TO BE CLOSED
RELOCATED ROAD
RELOCATED ROAD
TO BE REMOVED
US 411 & 441
HARDIN LANE
ELECTRIC
TELEPHONE
CABLE
MATCH LINE
TO KNOXVILLE
5+00
10+00
15+00
20+00
Scale: 1"=100'
LEGEND
Channel Bottom
Top of Cut
Rock Probing
LITTLE PIGEON RIVER & W. FORK
CHANNEL IMPROVEMENT PLAN
SEVIERVILLE, TENNESSEE
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
KNOXVILLE
5-24-63
311C315-5

PLATE 8

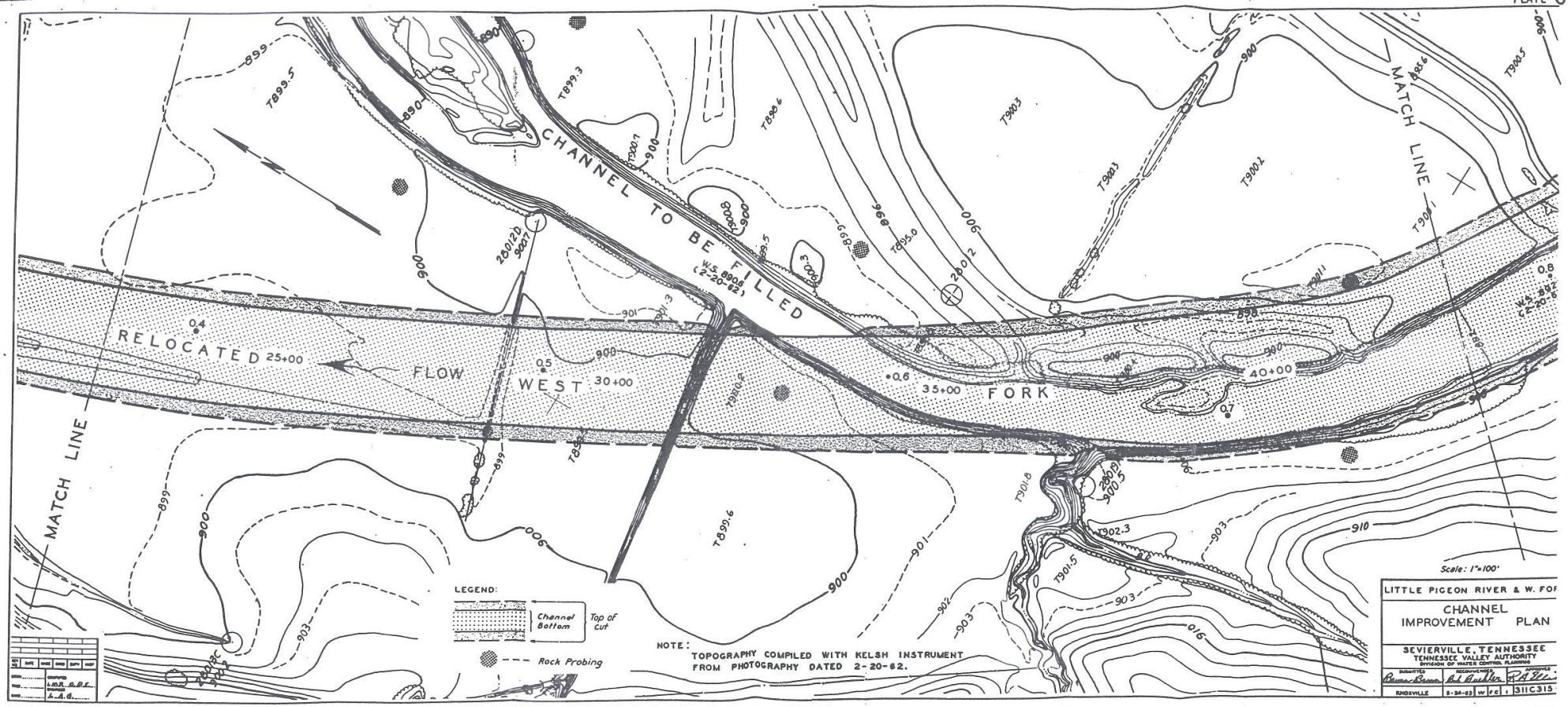

CHANNEL TO BE FILLED
RELOCATED 25+00
FLOW
WEST
30+00
35+00
FORK
40+00
MATCH LINE
MATCH LINE
W.S. 899.5 (2-20-62)
W.S. 897.6 (2-20-62)
LEGEND:
Channel Bottom
Top of cut
Rock Probing
NOTE: TOPOGRAPHY COMPILED WITH KELSH INSTRUMENT FROM PHOTOGRAPHY DATED 2-20-62.
Scale: 1"=100'
LITTLE PIGEON RIVER & W. FOR
CHANNEL IMPROVEMENT PLAN
SEVIERVILLE, TENNESSEE
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
KNOXVILLE
3-26-63
311C315

PLATE 9

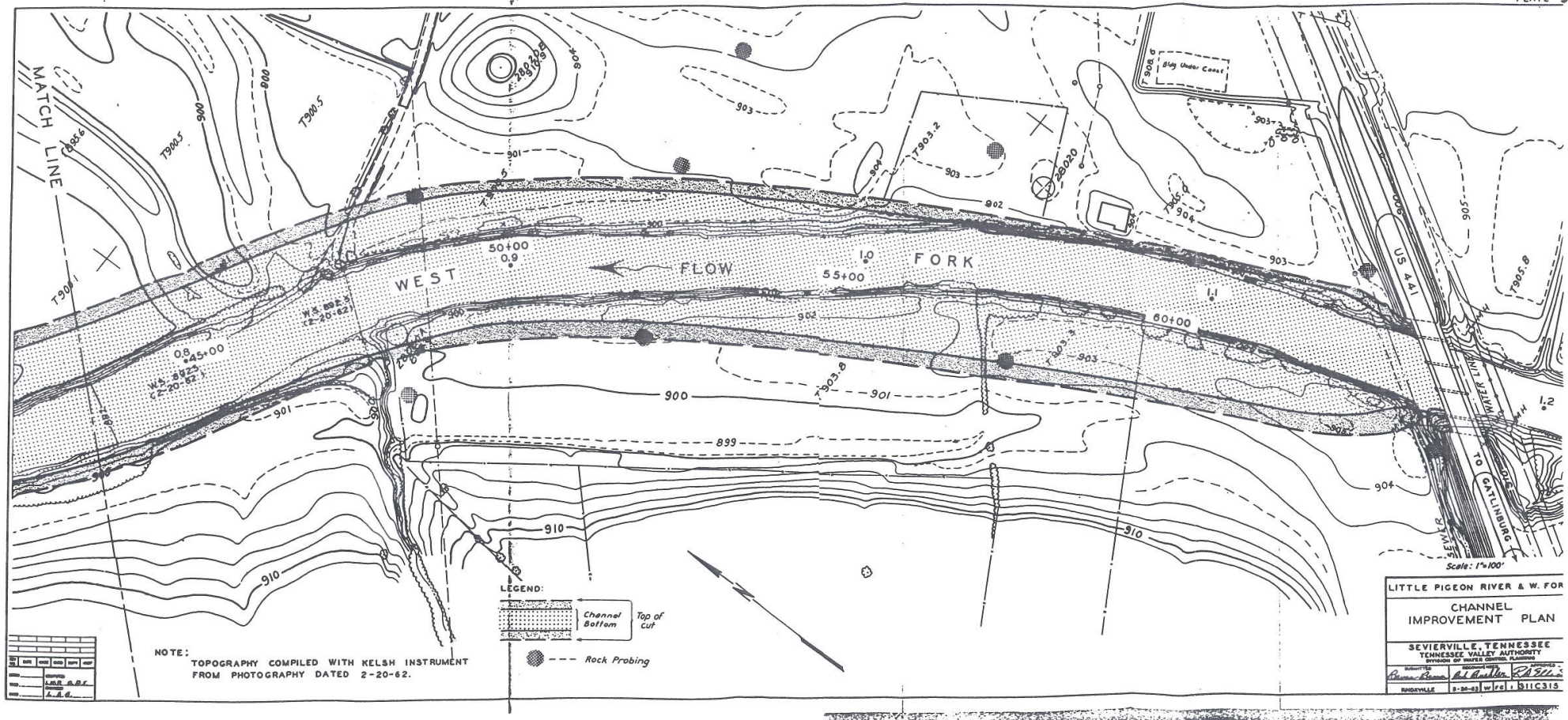

MATCH LINE
WEST FORK
FLOW
50+00
55+00
60+00
45+00
W.S. 892.5 (2-20-62)
W.S. 892.5 (2-20-62)
US 441
TO GATLINBURG
WATER LINE
SEWER
Bldg Under Const
LEGEND:
Channel Bottom
Top of Cut
Rock Probing
NOTE:
TOPOGRAPHY COMPILED WITH KELSH INSTRUMENT FROM PHOTOGRAPHY DATED 2-20-62.
Scale: 1"=100'
LITTLE PIGEON RIVER & W. FOR
CHANNEL IMPROVEMENT PLAN
SEVIERVILLE, TENNESSEE
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
SEVIERVILLE
2-20-62
W R D
SIIC315

PLATE 11

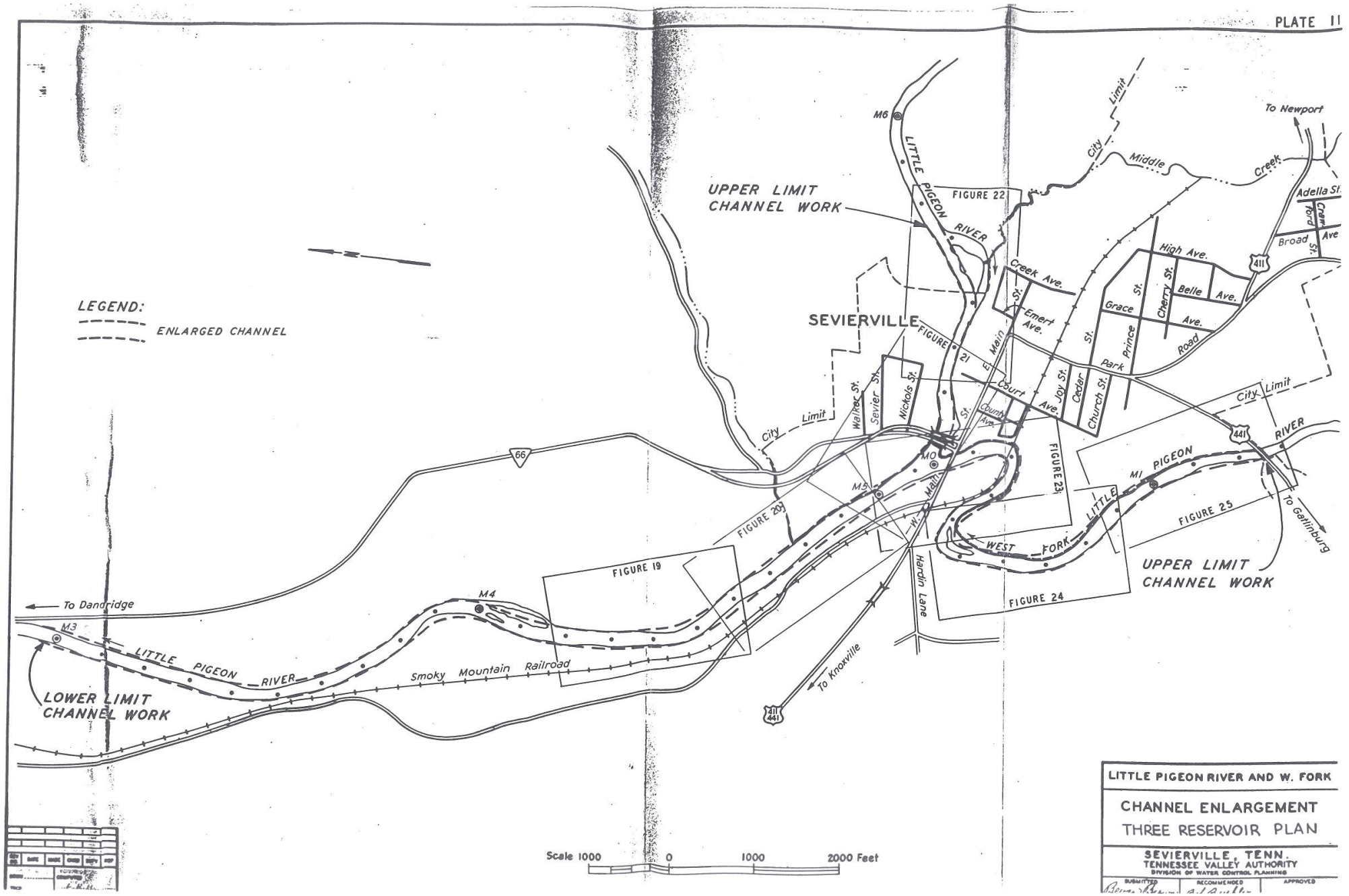
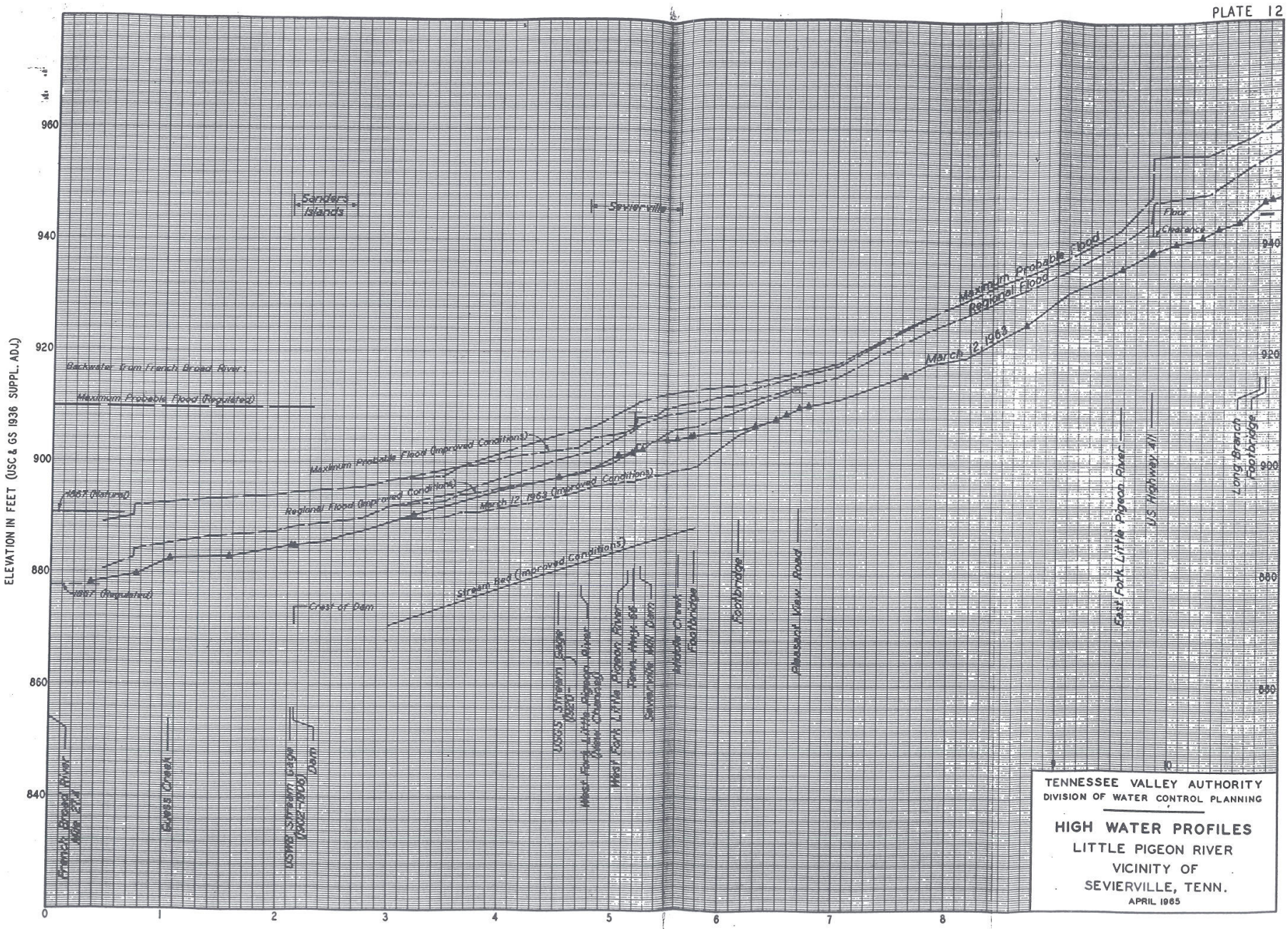

LEGEND:
ENLARGED CHANNEL
UPPER LIMIT CHANNEL WORK
LOWER LIMIT CHANNEL WORK
SEVIERVILLE
LITTLE PIGEON RIVER
WEST FORK
Smoky Mountain Railroad
To Dandridge
To Knoxville
To Newport
To Gatlinburg
City Limit
Middle Creek
Creek Ave.
Emert Ave.
Main St.
Court Ave.
Walnut St.
Sevier St.
Nickols St.
Joy St.
Cedar St.
Church St.
Prince St.
Grace St.
Cherry St.
Park Road
Belle Ave.
High Ave.
Broad St.
Adella St.
Hardin Lane
M0
M1
M2
M3
M4
M6
66
411
441
FIGURE 19
FIGURE 20
FIGURE 21
FIGURE 22
FIGURE 23
FIGURE 24
FIGURE 25
Scale 1000 0 1000 2000 Feet
LITTLE PIGEON RIVER AND W. FORK
CHANNEL ENLARGEMENT
THREE RESERVOIR PLAN
SEVIERVILLE, TENN.
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
SUBMITTED
RECOMMENDED
APPROVED

PLATE 12

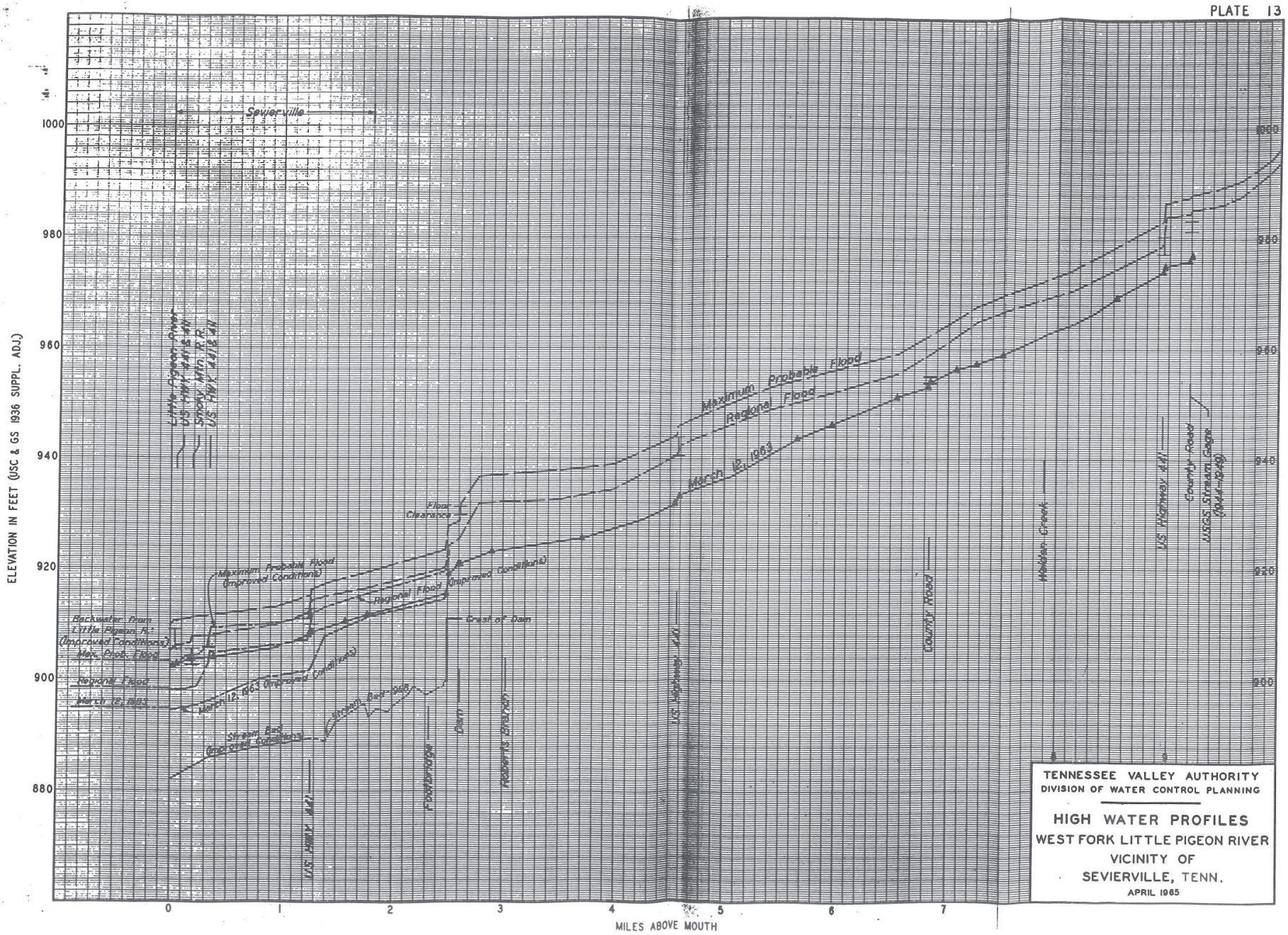


TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

HIGH WATER PROFILES
LITTLE PIGEON RIVER
VICINITY OF
SEVIERVILLE, TENN.

APRIL 1965

PLATE 13

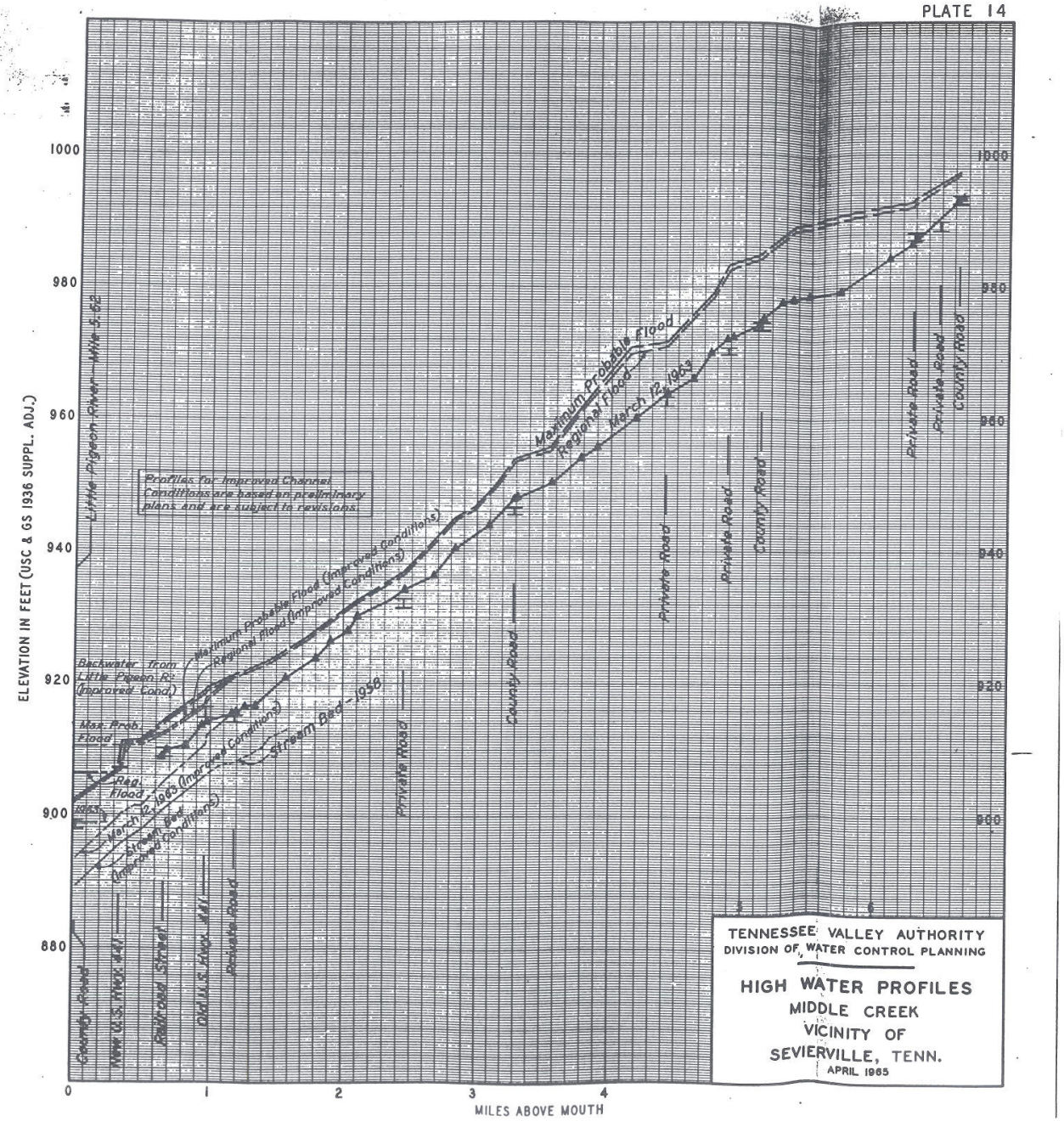


TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

HIGH WATER PROFILES
WEST FORK LITTLE PIGEON RIVER
VICINITY OF
SEVIERVILLE, TENN.

APRIL 1965

PLATE 14



TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

HIGH WATER PROFILES
MIDDLE CREEK
VICINITY OF
SEVIERVILLE, TENN.
APRIL 1965