Floods on North Toe River and Beaver, Grassy, and East Fork Grassy Creeks in the Vicinity of Spruce Pine, North Carolina

FLOODS ON NORTH TOE RIVER AND BEAVER, GRASSY, AND EAST FORK GRASSY CREEKS IN THE VICINITY OF SPRUCE PINE, NORTH CAROLINA

Flood Report
TVA/ONRED/AWR-85/32
September 1985

TENNESSEE VALLEY AUTHORITY

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Office of Natural Resources and Economic Development

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Flood Report

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Knoxville, Tennessee

September 1985

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FLOODS ON NORTH TOE RIVER AND BEAVER, GRASSY, AND EAST FORK GRASSY CREEKS IN THE VICINITY OF SPRUCE PINE, NORTH CAROLINA

INTRODUCTION

This flood hazard information report describes the extent and severity of the flood potential along selected reaches of the North Toe River and Beaver, Grassy, and East Fork Grassy Creeks in the Vicinity of Spruce Pine, North Carolina. It was prepared by TVA's Floodplain Management Program in response to a request by the town for up-to-date information regarding the flood potential along the studied stream reaches in order to better administer the local floodplain management program.

A previous TVA report "Floods on North Toe River and Beaver and Grassy Creeks in Vicinity of Spruce Pine, North Carolina," issued in October 1963 (reference 1) contains detailed information on historical, regional, and maximum probable floods. Since the 1963 report was issued, U.S. Highway 19E has been relocated to bypass Spruce Pine with a new highway bridge over the North Toe River in the vicinity of mile 32.1. The North Carolina Department of Transportation is presently (1985) replacing the North Carolina Highway 226 bridge across North Toe River with a new bridge immediately downstream at mile 31.43. Portions of North Carolina Highway 226 have been relocated in the Grassy Creek floodplain, and the Grassy Creek channel has been relocated between mile 1.0 and mile 1.5 for the construction of a shopping center which lies on the left bank between the stream and the highway. The town of Spruce Pine

has enlarged a water supply dam on Graveyard Creek, and a large dam and recreational lake have been built below the water supply dam.

This report does not propose plans for the solution of identified flood problems along the studied stream reaches. Rather, the information and technical data contained herein are intended to provide a sound basis for informed decisions regarding the wise use of flood-prone lands within the town of Spruce Pine and the surrounding portion of Mitchell County.

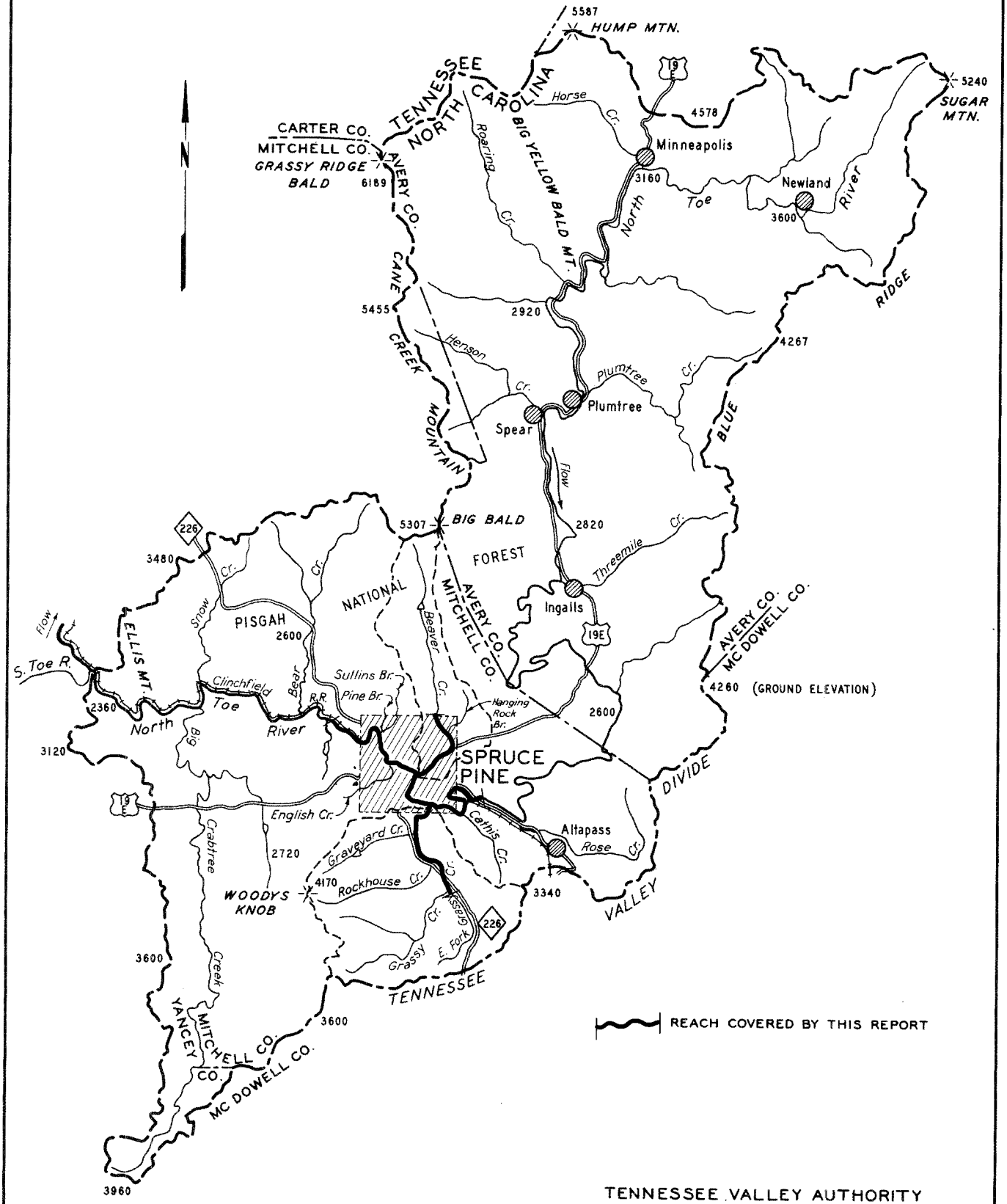
STUDY AND SCOPE

This report describes the flood situation along North Toe River from mile 29.22 below Spruce Pine upstream to mile 35.04 at the Altapass Highway Crossing, Beaver Creek from its mouth at North Toe River mile 31.89 upstream to mile 1.78 near the Spruce Pine corporate limits, Grassy Creek from its mouth at North Toe River mile 32.82 upstream to mile 2.59 at the confluence of East Fork Grassy Creek, and East Fork Grassy Creek from its mouth at Grassy Creek mile 2.59 upstream to mile 0.34.

The watershed map (plate 1) shows the stream reaches covered by this report.

The user of this report is cautioned that the information contained herein was developed to demonstrate the extent and severity of flood hazards along specific stream reaches. It does not imply that floods will not occur on other streams not covered by this report or that floods larger than those discussed will not occur. Flooding may occur along any stream or watercourse at any time. Floods larger than those discussed are possible and may occur infrequently. These flood risks should be considered by all users of this report.

PLATE 1



TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

UPPER NORTH TOE RIVER WATERSHED

SCALE 0 1 2 3 4 MILES

September 1985

WATERSHED DESCRIPTION

The North Toe River is the largest tributary of the Nolichucky River and drains an area of 442 square miles, all of which lies in North Carolina. The North Toe River watershed above the mouth of the South Toe River, with a drainage area of 183 square miles, is shown on plate 1.

The watershed above the lower limit of the Spruce Pine study is comprised of rugged mountain land in Mitchell and Avery Counties. Its shape is roughly rectangular, 20 miles in length and 5 to 10 miles in width. Much of the northern rim of the watershed is above 5000 feet in elevation and elevations range up to 6189 feet at Grassy Ridge Bald. Elevations are generally 3000 to 4000 feet along the southern rim. Throughout the study reach stream elevations range from 2460 feet up to 2540 feet with an average slope of 12.6 feet per mile and the overall width of the floodplain varies from about 200 to 600 feet.

Beaver Creek drains a long, narrow, and mountainous area of 5.34 square miles which lies to the north of Spruce Pine and is wholly within Mitchell County. The watershed is rectangular in shape, 5 miles in length and about one mile wide over most of its length. Elevations around the upper basin rim range from about 3600 feet up to 5307 feet at Big Bald at the upper tip of the watershed. Along the lower half of the watershed, the bounding ridges range in elevation from 2800 to 3600 feet. Throughout the 1.78 mile reach studied in this report, Beaver Creek falls from elevation 2654 to 2500 for an average slope of 87 feet per mile.

Grassy Creek drains an area of 11.4 square miles which lies wholly within Mitchell County. The watershed is fan shaped 3 1/2-miles long, and 4 miles wide at the widest point. Elevations around the basin

rim range from 2800 to 3800 feet on the Blue Ridge to the south, from 2800 to 3200 feet along Carter Ridge to the east and from 3000 to 4170 feet at Woodys Knob on the west, the highest point in the watershed. Two principal streams make up the headwater drainage system--Grassy Creek and East Fork Grassy Creek. Between the confluence with East Fork and the mouth, the stream channel falls from elevation 2608 to elevation 2508, a fall of 100 feet in 2.59 miles. Over the lower 0.8 mile--where the stream follows a narrow, wooded valley--the rate of fall is 56 feet per mile. Above mile 1.0, the stream flows through broad bottom lands, with a channel slope of about 31 feet per mile. (Elevations are feet above mean sea level, USC&GS 1936 Supplementary Adjustment).

Swiss Pine Lake Dam is located on Graveyard Creek, a tributary to Grassy Creek at mile 0.97. According to the May 1975 inventory of dams compiled by the U.S. Army Corps of Engineers (reference 3), the 34-foot high earthen dam was built in 1963 and creates a recreational lake with a maximum capacity of 245 acre feet. The Corps also determined the dam to be in the small-size, low-hazard potential category. The "Hydrology" section on page 6 of this report discusses the potential impacts of failure of Swiss Pine Lake Dam.

More detailed descriptions of the watershed and developments in the floodplain are found in the 1963 report (reference 1).

REVIEW OF HISTORIC FLOODS

A history of floods which occurred on the North Toe River, Beaver Creek, and Grassy Creek prior to 1963 is found in the 1963 report. That

report describes all known floods above bankfull stage at the former U.S. Geological Survey (USGS) stream gage at North Toe River mile 36.0 including the large floods of May 1901, July 1916, August 1940, August 1961, and March 1963.

The Tri-County News mentions highwater on April 4, 1974, with many streams overrunning their banks. It also mentions heavy rains in March 1977 with several landslides but does not give any account of flooding or flood damage.

The largest flood since 1963 occurred on November 6, 1977. At the former USGS stream gage this flood had an estimated recurrence interval of 25 years. This flood washed out a number of private bridges on Beaver Creek and several roads were completely or partially blocked. The North Toe River went out of banks and entered Duncan Trailer Park located on the left bank at mile 31.65. Several residents were forced to evacuate their homes as water reached about 3 feet deep in the park. Water also entered the town of Spruce Pine maintenance shop located on the right bank at mile 31.15. The November 1977 flood crested about 8 feet lower than the July 1916 flood, the largest flood known to have occurred since at least 1901.

COMPUTED FLOODS

To assist the town of Spruce Pine in administering its floodplain management program, flood discharges and elevations were computed for the 10-, 50-, 100-, and 500-year floods. Approximate floodplain boundaries were determined for the 100- and 500-year floods.

HYDROLOGY

Computed flood discharges on the North Toe River are based on an analysis of stream gage records from 1935 to 1958 at Altapass (mile 36.0) and historic information for the May 1901 and July 1916 floods. Discharges on Beaver and Grassy Creeks are based on stream gage records for similar watersheds in the region. The use of such regional relationships in the study is supported by the available historic information on Beaver and Grassy Creeks. All stream gage analyses followed standard procedures outlined in "Guidelines for Determining Flood Flow Frequency" (reference 4) including the skew map and adjustments for historic flood information where available.

An evaluation of the adequacy of the Swiss Pine Lake Dam to pass the 100- and 500-year floods indicates that the dam could withstand both floods without danger of failure due to overtopping. However, dam failure could result from overtopping by a larger flood or other causes not related to floods such as structural deficiencies or a large earthquake. An evaluation of the impact of dam failure during nonflood conditions indicated that the released waters would exceed the 500-year level of flooding on Grassy Creek.

Ten-Year Flood

The 10-year flood is defined as the flood which has 1 chance in 10 (10 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period, there is a 96-percent chance of its occurrence. The 10-year flood, based on current watershed and channel conditions, would range from about 4 to 5 feet below the November 6, 1977,

flood and about 12 to 14 feet below the July 1916 flood on the North Toe River. Information on the 10-year flood is provided because State of North Carolina regulations require that on-site waste disposal systems (septic tanks and drain fields) be located above the 10-year flood elevation.

Fifty-Year Flood

The 50-year flood is defined as the flood which has 1 chance in 50 (2 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period, there is a 45-percent chance of its occurrence. The 50-year flood, based on current watershed and channel conditions, would range from about 2 to 3 feet above the November 6, 1977, flood and about 8 to 10 feet below the July 1916 flood along the North Toe River. Information on the 50-year flood is included for use by the Federal Emergency Management Agency (FEMA) in any subsequent studies for the conversion of the community to the regular phase of the National Flood Insurance Program (NFIP).

One Hundred-Year Flood

The 100-year flood is defined as the flood which has 1 chance in 100 (1 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period, there is a 26-percent chance of its occurrence. The 100-year flood, based on current watershed and channel conditions, would range from about 4 to 5 feet above the November 6, 1977, flood and about 3 to 6 feet below the July 1916 flood along the North Toe River. The 100-year flood is the minimum standard required by the Federal Emergency Management Agency for floodplain management purposes for those communities participating in the National Flood Insurance Program.

Five Hundred-Year Flood

Although the 500-year flood may occur at any time, it is a relatively rare event with 1 chance in 500 (0.2 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period there is about a 6-percent chance of its occurrence. The 500-year flood, based on current watershed and channel conditions, would range from about 12 to 14 feet above the November 6, 1977, flood and about 2 to 5 feet above the July 1916 flood along the North Toe River.

The 500-year flood level is provided as a guide for planning community and industrial development in those instances where a greater degree of protection from flooding must be provided. In planning for floodplain development, TVA strongly recommends that the effects of a 500-year or higher flood be explicitly considered and minimized to the fullest extent practicable.

HYDRAULICS

The hydraulic characteristics of the North Toe River and Beaver, Grassy, and East Fork Grassy Creeks were analyzed using the U.S. Army Corps of Engineers HEC-2 backwater program (reference 2) to provide estimates of the 10-, 50-, 100-, and 500-year flood elevations at selected cross sections. These cross sections were field surveyed at bridges and other selected locations to define the floodplains of these streams. Locations of selected cross sections used in the hydraulic analyses are shown on the flooded area maps (plates 2-5).

The computed flood elevations for the 10-, 50-, 100-, and 500-year floods were plotted on a graph at the stream mile locations of the cross sections and joined by straight lines to create flood profiles (plates 6-9). The elevations are shown in feet above mean sea level, and the stream mileage is measured from the mouth upstream along the principal flow path. Tabulations of the 10-, 50-, 100-, and 500-year flood elevations and discharges for the studied streams are given in tables 1-3.

The computed flood elevations are based on the assumption that bridges and other hydraulic structures remain open and unobstructed. The accumulation of debris or other obstructions in bridge and culvert openings during the time of flooding may raise the flood elevations higher than those shown on the flood profiles.

The flooded area maps show the approximate areas which would be inundated by the 100- and 500-year floods. These maps were developed by using the flood profiles and recent TVA topographic maps with a contour interval of 40 feet to transfer flood elevations from the profiles to corresponding locations on the maps to establish the expected limits of flooding on the ground.

Floodways

Encroachments in the floodplain such as fill or structures reduce its flood-carrying capacity and increase the risk of flood damage in other areas. In reviewing floodplain development proposals, the economic gain of the proposed development must be compared to the possibility of increased flood damage to both the development and to existing neighboring developments. However, prohibiting any further floodplain development may be excessively restrictive.

TABLE 1

NORTH TOE RIVER PROFILE TABULATION

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
*	29.22	9,070	2476.4	19,420	2481.9	26,290	2484.7	51,170	2492.3
3	29.69 DS[a]	9,027	2480.3	19,328	2486.5	26,170	2489.6	50,912	2497.5
3	29.69 US[a]	9,027	2485.0	19,328	2488.8	26,170	2490.9	50,912	2497.8
3A	30.11	8,987	2488.2	19,246	2494.7	26,062	2497.7	50,682	2505.5
4	30.30	8,970	2494.7	19,210	2501.9	26,013	2505.8	50,577	2512.7
4A	30.68	8,934	2498.0	19,136	2504.8	25,915	2508.5	50,369	2516.1
5	30.80	8,923	2499.2	19,113	2506.1	25,884	2509.8	50,303	2518.2
5A	31.23	8,883	2503.5	19,030	2509.6	25,773	2512.8	50,067	2520.7
6	31.43 DS	8,863	2506.5	18,989	2513.2	25,719	2516.4	49,952	2524.5
6	31.43 US	8,863	2506.7	18,989	2513.5	25,719	2516.8	49,952	2525.3
6A	31.47	8,859	2507.0	18,981	2514.0	25,708	2517.5	49,930	2526.8
*	31.77	8,832	2509.3	18,925	2516.1	25,634	2519.6	49,771	2528.8
7	31.78	8,832	2509.6	18,925	2516.7	25,634	2520.2	49,771	2529.7
7A	31.94	8,580	2510.7	18,400	2517.8	24,800	2521.3	48,200	2530.7
8	32.27	8,580	2513.0	18,400	2519.5	24,800	2522.9	48,200	2532.2
8A	32.88 DS	8,025	2519.1	17,185	2525.2	23,182	2528.3	44,867	2537.1
8A	32.88 US	8,025	2520.2	17,185	2525.8	23,182	2528.8	44,867	2537.2
*	32.90	8,025	2520.3	17,185	2525.9	23,182	2528.9	44,867	2537.4
9	32.97 DS	8,018	2521.3	17,169	2526.8	23,161	2529.7	44,830	2538.1
9	32.97 US	8,018	2524.9	17,169	2529.0	23,161	2531.1	44,830	2538.7

*Section not shown on flooded area maps or profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

TABLE 1

NORTH TOE RIVER PROFILE TABULATION

(Continued)

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
10	33.53	7,980	2534.1	17,067	2540.4	23,034	2543.6	44,601	2551.9
11	33.86 DS[a]	7,958	2537.4	17,007	2543.8	22,959	2547.0	44,466	2555.6
11	33.86 US[a]	7,958	2537.6	17,007	2544.2	22,959	2547.4	44,466	2556.4
11A	34.10	7,941	2539.7	16,964	2546.1	22,905	2549.4	44,368	2558.6
12	34.23	7,933	2541.3	16,940	2548.0	22,875	2551.5	44,315	2561.1
*	34.45	7,916	2542.3	16,896	2548.9	22,820	2552.2	44,217	2561.5
13A	34.47	7,916	2542.3	16,896	2548.9	22,820	2552.2	44,217	2561.7
*	34.52	7,913	2542.5	16,887	2549.0	22,809	2552.3	44,196	2561.8
14A	34.77	7,896	2550.3	16,842	2555.2	22,752	2557.5	44,094	2565.4
15	34.95	7,883	2553.6	16,809	2558.8	22,711	2561.4	44,020	2568.7
16	35.04	7,880	2554.2	16,800	2559.5	22,700	2562.0	44,000	2569.0

*Section not shown on flooded area maps or profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

TABLE 2

BEAVER CREEK PROFILE TABULATION

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
*	0.00	1,120	2510.4[d]	1,955	2517.2[d]	2,415	2521.0[d]	3,720	2530.4[d]
1	0.03 DS[a]	1,120	2510.4[d]	1,955	2517.2[d]	2,415	2521.0[d]	3,720	2530.4[d]
1	0.03 US[a]	1,115	2510.5	1,955	2517.2[d]	2,410	2521.0[d]	3,720	2530.4[d]
2	0.04 DS	1,115	2510.8	1,955	2517.2[d]	2,410	2521.0[d]	3,720	2530.4[d]
2	0.04 US	1,115	2512.2	1,955	2517.2[d]	2,410	2521.0[d]	3,720	2530.4[d]
3	0.08	1,115	2513.6	1,950	2517.2[d]	2,405	2521.0[d]	3,705	2530.4[d]
4	0.10	1,110	2515.0	1,945	2517.3	2,400	2521.0[d]	3,700	2530.4[d]
*	0.15	1,105	2516.4	1,930	2518.2	2,380	2521.0[d]	3,670	2530.4[d]
5	0.20 DS	1,105	2518.9	1,930	2520.5	2,380	2521.1	3,670	2530.4[d]
5	0.20 US	1,105	2523.4	1,930	2524.3	2,380	2524.7	3,670	2530.4[d]
6	0.35 DS	1,090	2527.4	1,905	2528.8	2,350	2529.4	3,620	2531.0
7	0.40 US	1,090	2532.4	1,905	2533.8	2,350	2534.5	3,620	2539.2
8	0.42 DS	1,085	2537.2	1,895	2538.4	2,335	2539.0	3,600	2540.4
8	0.42 US	1,085	2540.1	1,895	2541.4	2,335	2541.9	3,600	2543.1
9	0.44 DS	1,085	2540.5	1,890	2541.9	2,335	2542.5	3,595	2543.7
9	0.44 US	1,085	2541.1	1,890	2543.5	2,335	2544.8	3,595	2548.0

*Section not shown on flooded area maps or profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).
d. North Toe River, mile 31.89 elevations at the mouth of Beaver Creek.

TABLE 2

BEAVER CREEK PROFILE TABULATION

(Continued)

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
10	0.48	1,080	2544.3	1,885	2546.4	2,325	2547.5	3,585	2550.3
11	0.55 DS[a]	1,075	2549.4	1,875	2551.5	2,310	2552.5	3,560	2554.9
11	0.55 US[a]	1,075	2552.3	1,875	2554.1	2,310	2554.5	3,560	2555.8
12	0.61	1,070	2554.9	1,865	2557.1	2,300	2558.0	3,545	2559.6
13	0.66	1,070	2558.0	1,855	2560.2	2,290	2561.2	3,525	2563.4
14	0.77	1,060	2565.6	1,840	2567.3	2,270	2568.1	3,495	2569.9
15	0.84 DS	1,050	2568.9	1,825	2570.6	2,250	2571.4	3,465	2573.2
16	0.88 US	1,050	2573.2	1,825	2574.8	2,250	2575.8	3,465	2584.0
17	0.97 DS	1,045	2580.0	1,805	2581.4	2,230	2582.1	3,430	2585.6
18	1.01 US	1,040	2584.1	1,800	2586.8	2,220	2587.3	3,425	2592.1
19	1.07 DS	1,010	2587.0	1,745	2588.6	2,150	2589.2	3,310	2592.4
19	1.07 US	1,010	2589.8	1,745	2591.6	2,150	2592.3	3,310	2594.1
20	1.16 DS	960	2594.2	1,665	2595.7	2,050	2596.5	3,145	2598.3
20	1.16 US	960	2596.5	1,665	2599.2	2,050	2599.5	3,145	2600.3

*Section not shown on flooded area maps or profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

TABLE 2

BEAVER CREEK PROFILE TABULATION

(Continued)

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
21	1.28 DS[a]	900	2604.6	1,560	2605.9	1,915	2606.5	2,925	2607.9
21	1.28 US[a]	900	2606.0	1,560	2608.0	1,915	2609.3	2,925	2611.6
*	1.43	875	2618.3	1,515	2620.2	1,860	2621.2	2,845	2622.4
22	1.44 DS	875	2620.8	1,515	2622.9	1,860	2623.4	2,845	2624.6
22	1.44 US	875	2623.0	1,515	2625.4	1,860	2625.7	2,845	2626.5
*	1.55	865	2638.1	1,490	2638.9	1,830	2639.6	2,805	2641.2
23	1.56 DS	865	2639.2	1,490	2640.7	1,830	2641.4	2,805	2643.3
23	1.56 US	865	2641.0	1,490	2644.1	1,830	2645.2	2,805	2646.6
24	1.63 DS	855	2646.6	1,480	2647.7	1,815	2648.3	2,780	2649.7
24	1.63 US	855	2647.9	1,480	2648.9	1,815	2649.2	2,780	2650.2
25	1.75	845	2658.0	1,455	2659.2	1,785	2659.6	2,740	2660.5
26	1.78	840	2660.9	1,450	2662.0	1,780	2662.4	2,730	2663.5

*Section not shown on flooded area maps or profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

TABLE 3

GRASSY CREEK PROFILE TABULATION

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
*	0.00	1,930	2518.5[d]	3,410	2524.6[d]	4,240	2527.8[d]	6,630	2536.6[d]
1	0.08	1,930	2519.8	3,410	2524.6[d]	4,240	2527.8[d]	6,630	2536.6[d]
2	0.30 DS[a]	1,930	2531.6	3,410	2533.9	4,240	2534.9	6,630	2537.1
2	0.30 US[a]	1,930	2539.7	3,410	2541.3	4,240	2542.0	6,630	2543.9
*	0.47	1,930	2540.7	3,410	2542.7	4,240	2543.6	6,630	2546.0
3	0.55	1,930	2545.7	3,410	2547.2	4,240	2547.9	6,630	2549.7
4	0.67	1,930	2556.0	3,410	2557.4	4,240	2558.1	6,630	2559.7
5	0.88	1,930	2563.1	3,410	2564.6	4,240	2565.3	6,630	2567.2
6	0.97 DS	1,680	2565.4	2,970	2567.0	3,685	2567.7	5,745	2569.4
6	0.97 US	1,680	2566.9	2,970	2568.9	3,685	2570.1	5,745	2571.8
7	1.01	1,660	2567.7	2,935	2569.6	3,640	2570.7	5,675	2572.4
*	1.08	1,625	2570.7	2,875	2572.6	3,565	2573.4	5,550	2575.3
8	1.12	1,605	2571.7	2,840	2573.6	3,520	2574.4	5,475	2576.4
9	1.24	1,545	2572.9	2,730	2574.7	3,385	2575.4	5,260	2577.2
10	1.41	1,460	2576.3	2,575	2578.1	3,190	2578.8	4,960	2580.4
11	1.52 DS	1,405	2580.3	2,480	2581.8	3,065	2582.6	4,760	2583.8
11	1.52 US	1,405	2581.4	2,480	2582.3	3,065	2582.9	4,760	2584.1
12	1.83 DS	1,255	2590.2	2,200	2591.7	2,720	2592.1	4,205	2593.2
12	1.83 US	1,255	2592.1	2,200	2594.0	2,720	2594.8	4,205	2596.0

*Section not shown on flooded area maps or profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).
d. North Toe River, mile 32.82 elevations at the mouth of Grassy Creek.

TABLE 3

GRASSY CREEK PROFILE TABULATION

(Continued)

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
13	1.86	1,240	2592.4	2,175	2594.3	2,685	2595.1	4,155	2596.5
14	2.06	1,140	2596.6	1,995	2597.8	2,460	2598.4	3,795	2599.6
15	2.20	1,070	2601.1	1,870	2602.4	2,300	2603.0	3,545	2604.3
16	2.23 DS[a]	1,055	2601.8	1,840	2603.3	2,265	2604.0	3,490	2605.8
16	2.23 US[a]	1,055	2602.5	1,840	2606.0	2,265	2607.8	3,490	2609.1
*	2.29	1,025	2603.8	1,790	2606.7	2,200	2608.4	3,385	2609.9
17	2.49	925	2611.2	1,610	2613.0	1,975	2613.8	3,025	2615.5
18	2.58	880	2614.0	1,530	2615.6	1,875	2616.3	2,865	2618.0
19	0.32[d]	650	2625.7	1,120	2626.3	1,370	2626.5	2,080	2627.1

*Section not shown on flooded area maps or profiles.

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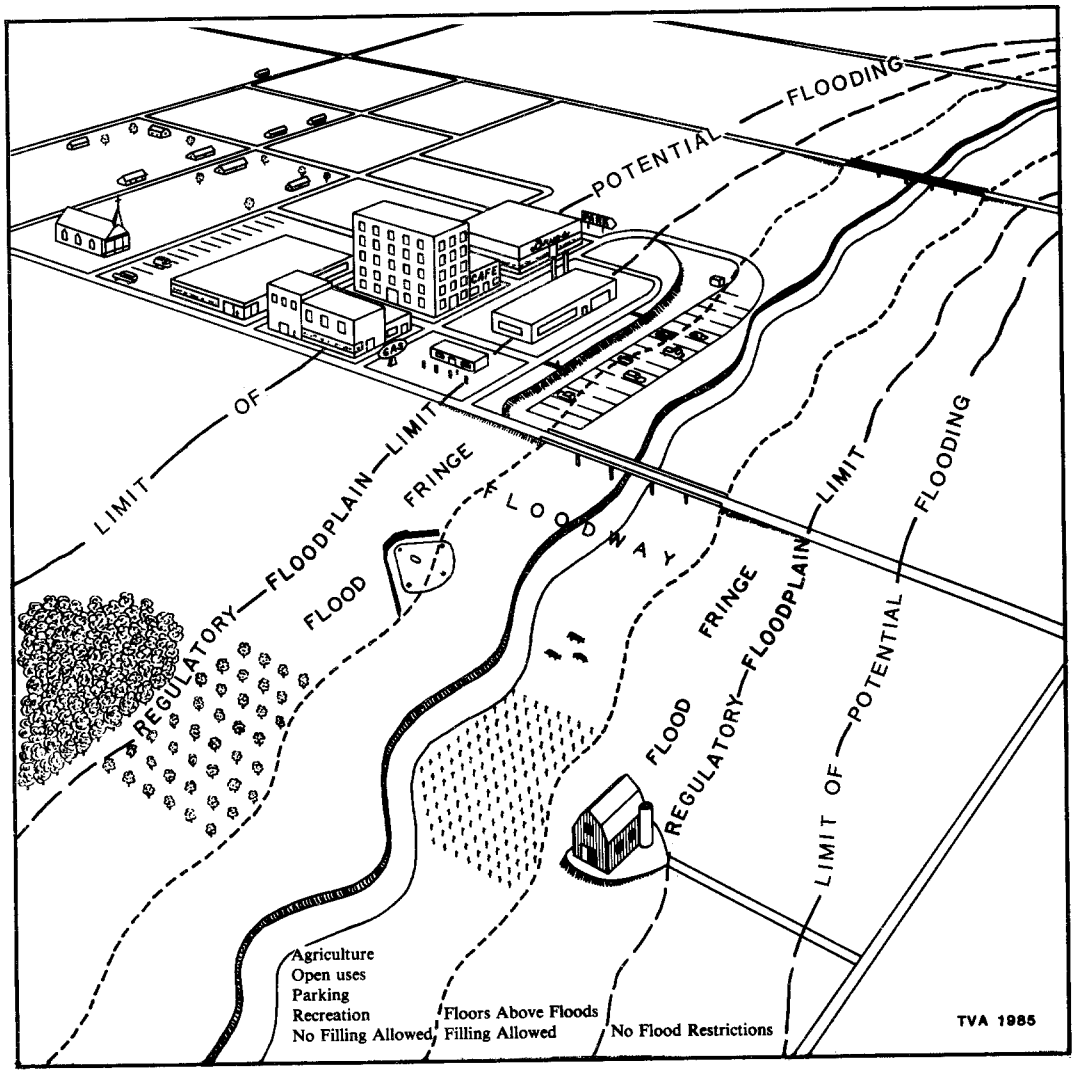
a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).
d. East Fork Grassy Creek

Frequently, the community must decide how much additional floodplain development to allow, what the effects of such development on flood levels will be, and where the development should take place. If the community is participating in the National Flood Insurance Program, it must not allow additional development which will cumulatively increase the existing level of the 100-year flood by more than 1 foot at any point along the stream.

To accommodate some reasonable level of floodplain development, the floodplain can be divided into two separate parts--the floodway and the flood fringe (figure 1). The division recognizes the natural functions of the floodplain. The floodway is the stream channel and that portion of the adjacent floodplain which must remain open and unobstructed to permit safe passage of floodwaters. The floodwaters flow deepest and swiftest in the floodway, and structures and other uses located in this area are subject of the greatest danger during times of flooding. The remainder of the floodplain is called the flood fringe. Here the water is more shallow and may have little or no movement. Floodwaters in the flood-fringe area are being temporarily stored until they can pass downstream. Most communities, therefore, permit development in this portion of the floodplain provided the development is elevated or otherwise protected to the regulatory (usually 100-year) flood level.

While a community may have some flexibility in setting the limits, a floodway must be determined which is capable of accommodating all of the floodwaters which are expected to occupy the entire floodplain area during the occurrence of the regulatory flood. When making this determination, it is assumed that development will be permitted in the remainder of the



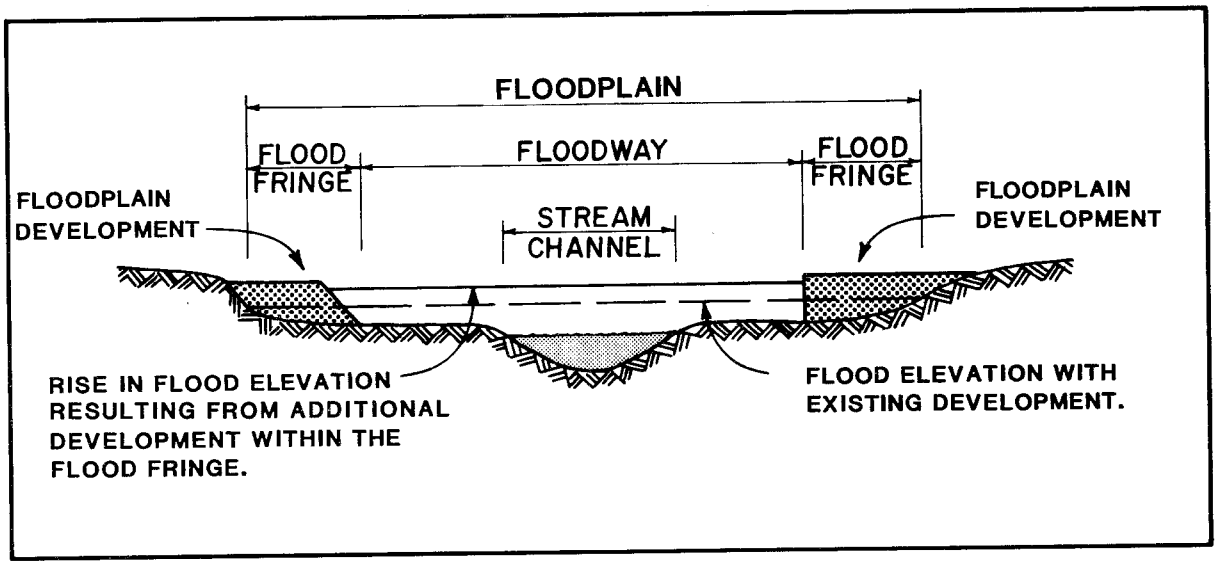


FIGURE 1. FLOODPLAIN AND FLOODWAY SCHEMATIC

remainder of the floodplain (flood-fringe area) and that total development of the flood-fringe area will ultimately occur, thereby prohibiting the flow of floodwaters through the developed area.

The floodway areas needed to safely pass floodwaters through the community without causing increases in flood heights by more than the National Flood Insurance Program requirement of 1 foot maximum, or to a lesser amount if desired by the community, are determined by engineering calculations and are field checked for reasonableness and accuracy. Once the floodway boundaries are determined and officially designated by local ordinance, total filling or development of the flood-fringe areas will not increase flood levels by more than the previously determined amount (usually 1 foot). Tabulations of 100-year floodway data are given in tables 1A-3A. Proposed floodway boundaries are shown on the flooded area maps (plates 2-5).

STUDY USE

The information and technical data contained in this report may be used as the engineering basis for adopting and administering regulations governing the use and development of flood-prone lands within the town of Spruce Pine. Such regulations may be in the form of a separate floodplain management ordinance or may be incorporated into the community's zoning and subdivision regulations and building codes. The adoption of land use regulations governing the development and use of flood-prone lands is a major requirement for community participation in the National Flood Insurance Program. The town of Spruce Pine has participated in the emergency phase of the flood insurance program since July 7, 1975.

TABLE 1A

NORTH TOE RIVER 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway	Water Surface Elevation[b] Without Floodway	Water Surface Elevation[b] Difference
3	29.69 DS[a]	190	4,008	6.5	2490.1	2489.6	0.5
3	29.69 US[a]	190	3,666	7.1	2491.4	2490.9	0.5
3A	30.11	95	1,538	16.9	2498.4	2497.7	0.7
4	30.30	130	3,019	8.6	2506.1	2505.8	0.3
4A	30.68	140	2,982	8.7	2509.1	2508.5	0.6
5	30.80	250	4,627	5.6	2510.7	2509.8	0.9
5A	31.23	163	2,293	11.2	2513.5	2512.8	0.7
6	31.43 DS	120	2,546	10.1	2516.9	2516.4	0.5
6	31.43 US	120	2,593	9.9	2517.3	2516.8	0.5
6A	31.47	105	2,473	10.4	2517.5	2517.5	0.0
7	31.78	180	3,820	6.7	2521.2	2502.2	1.0
7A	31.94	200	3,997	6.2	2522.3	2521.3	1.0
8	32.27	160	3,104	8.0	2523.9	2522.9	1.0
8A	32.88 DS	165	2,691	8.6	2528.9	2528.3	0.6
8A	32.88 US	165	2,794	8.3	2529.5	2528.8	0.7
9	32.97 DS	180	2,271	10.2	2530.3	2529.7	0.6
9	32.97 US	180	2,195	10.6	2531.3	2531.1	0.2

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

TABLE 1A

NORTH TOE RIVER 100-YEAR FLOODWAY DATA

(Continued)

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway	Water Surface Elevation[b] Without Floodway	Water Surface Elevation[b] Difference
10	33.53	158	2,986	7.7	2543.8	2543.6	0.2
11	33.86 DS[a]	130	2,702	8.5	2547.7	2547.0	0.7
11	33.86 US[a]	130	2,744	8.4	2548.0	2547.4	0.6
11A	34.10	120	2,462	9.3	2550.1	2549.4	0.7
12	34.23	190	3,757	6.1	2552.1	2551.5	0.6
13A	34.47	165	2,768	8.2	2553.1	2552.2	0.9
14A	34.77	105	1,571	14.5	2558.0	2557.5	0.5
15	34.95	125	2,080	10.9	2562.3	2561.4	0.9
16	35.04	120	2,252	10.1	2562.8	2562.0	0.8

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

TABLE 2A

BEAVER CREEK 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway[c]	Water Surface Elevation[b] Without Floodway[c]	Difference
1	0.03 US[a]	25	260	9.3	2515.5	2515.5	0.0
2	0.04 DS[a]	100	367	6.6	2515.8	2515.8	0.0
2	0.04 US	100	630	3.8	2518.3	2517.3	1.0
3	0.08	100	658	3.7	2518.8	2517.9	0.9
4	0.10	100	738	3.3	2519.1	2518.2	0.9
5	0.20 DS	70	269	8.8	2521.2	2521.1	0.1
5	0.20 US	70	420	5.7	2525.6	2524.7	0.9
6	0.35 DS	55	275	8.5	2529.5	2529.4	0.1
7	0.40 US	55	216	10.9	2534.5	2534.5	0.0
8	0.42 DS	55	209	11.2	2539.0	2539.0	0.0
8	0.42 US	55	431	5.4	2542.8	2541.9	0.9
9	0.44 DS	45	306	7.6	2543.3	2542.5	0.8
9	0.44 US	45	259	9.0	2544.8	2544.8	0.0
10	0.48	30	209	11.1	2547.5	2547.5	0.0
11	0.55 DS	60	347	6.7	2552.6	2552.5	0.1
11	0.55 US	60	357	6.5	2555.5	2554.5	1.0
12	0.61	35	265	8.7	2558.1	2558.0	0.1
13	0.66	40	272	8.4	2561.2	2561.2	0.0
14	0.77	50	304	7.5	2568.1	2568.1	0.0
15	0.84 DS	35	250	9.0	2571.6	2571.4	0.2
16	0.88 US	50	351	6.4	2576.2	2575.8	0.4

a. Downstream and usptream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).
c. Elevations computed without consideration of backwater effects from North Toe River.

TABLE 2A

BEAVER CREEK 100-YEAR FLOODWAY DATA

(Continued)

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway[c]	Water Surface Elevation[b] Without Floodway[c]	Water Surface Elevation[b] Difference
17	0.97 DS[a]	60	298	7.5	2582.2	2582.1	0.1
18	1.01 US[a]	45	298	7.4	2587.3	2587.3	0.0
19	1.07 DS	50	239	9.0	2589.5	2589.2	0.3
19	1.07 US	50	261	8.3	2592.3	2592.3	0.0
20	1.16 DS	40	233	8.8	2596.9	2596.5	0.4
20	1.16 US	40	281	7.3	2599.7	2599.5	0.2
21	1.28 DS	50	228	8.4	2607.4	2606.5	0.9
21	1.28 US	50	326	5.9	2609.3	2609.3	0.0
22	1.44 DS	75	252	7.4	2623.6	2623.4	0.2
22	1.44 US	75	299	6.2	2626.7	2625.7	1.0
23	1.56 DS	50	171	10.7	2641.4	2641.4	0.0
23	1.56 US	50	312	5.9	2646.0	2645.2	0.8
24	1.63 DS	75	319	5.7	2848.5	2648.3	0.2
24	1.63 US	75	438	4.1	2650.1	2649.2	0.9
25	1.75	50	198	9.0	2659.7	2659.6	0.1
26	1.78	50	297	6.0	2663.3	2662.4	0.9

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).
c. Elevations computed without consideration of backwater effects from North Toe River.

TABLE 3A

GRASSY AND EAST FORK GRASSY CREEKS 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway[c]	Water Surface Elevation[b] Without Floodway[c]	Difference
1	0.08	77	522	8.1	2522.9	2522.9	0.0
2	0.30 DS[a]	80	525	8.1	2534.9	2534.9	0.0
2	0.30 US[a]	80	853	5.0	2542.0	2542.0	0.0
3	0.55	80	428	9.9	2548.0	2547.9	0.1
4	0.67	65	434	9.8	2558.5	2558.1	0.4
5	0.88	170	1,178	3.6	2566.3	2565.3	1.0
6	0.97 DS	85	571	6.5	2568.5	2567.7	0.8
6	0.97 US	85	685	5.4	2570.9	2570.1	0.8
7	1.01	90	671	5.4	2571.5	2570.7	0.8
8	1.12	80	657	5.4	2575.0	2574.4	0.6
9	1.24	95	609	5.6	2576.3	2575.4	0.9
10	1.41	65	363	8.8	2579.3	2578.8	0.5
11	1.52 DS	195	758	4.0	2583.0	2582.6	0.4
11	1.52 US	175	744	4.1	2583.8	2582.9	0.9
12	1.83 DS	85	452	6.0	2592.5	2592.1	0.4
12	1.83 US	85	712	3.8	2595.5	2594.8	0.7
13	1.86	130	1,002	2.7	2595.9	2595.1	0.8
14	2.06	140	613	4.0	2599.2	2598.4	0.8
15	2.20	50	307	7.5	2603.3	2603.0	0.3

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).
c. Elevations computed without consideration of backwater effects from North Toe River.

TABLE 3A

GRASSY AND EAST FORK GRASSY CREEKS 100-YEAR FLOODWAY DATA

(Continued)

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway[c]	Water Surface Elevation[b] Without Floodway[c]	Water Surface Elevation[b] Difference
16	2.23 DS[a]	50	328	6.9	2604.2	2604.0	0.2
16	2.23 US[a]	50	486	4.7	2608.0	2607.8	0.2
17	2.49	55	293	6.7	2614.1	2613.8	0.3
18	2.58	70	449	4.2	2616.8	2616.3	0.5
19	0.32[d]	80	242	5.7	2627.4	2626.5	0.9

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea leve (USC&GS 1936 Supplementary Adjustment).
c. Elevations computed without consideration of backwater effects from North Toe River.
d. East Fork Grassy Creek.

In addition to use by town building officials and local planning commission members, the flood profiles and flooded area maps contained in this report can be used by developers, engineers, industries, businesses, individuals, and others to gain knowledge of the extent and severity of flood hazards at specific locations within the town of Spruce Pine.

The information contained in this report may also be used as a basis for further study and planning on the part of the town of Spruce Pine in developing and evaluating alternative long-term solutions to local flooding problems.

USER'S GUIDE

TVA has published a document entitled "Guide for the Use of Technical Information and Data for Floodplain Management in the Tennessee River Basin" to assist those who use this report and other flood hazard data in interpreting and applying such information and technical data to specific lands or development proposals.

The "User's Guide," together with this flood hazard information report, can be a valuable tool in assisting the town of Spruce Pine to administer and enforce its floodplain management program. Copies of the "User's Guide" are available upon request from the following TVA offices:

Floodplain Management Staff
Division of Services and
Field Operations
Tennessee Valley Authority
179 Charlotte Street
Asheville, North Carolina 28801
Telephone: (704) 254-8346

or

Floodplain Management Program
Flood Protection Branch
Tennessee Valley Authority
200 Liberty Building
Knoxville, Tennessee 37902
Telephone: (615) 632-4792

ACKNOWLEDGEMENTS

The data and plates included in this report were prepared by the Flood Protection Branch, Division of Air and Water Resources, with assistance from Data Services Branch, Mapping Services Branch, and Field Operations Eastern Area, Division of Services and Field Operations.

DEFINITION OF TERMS

Computed Flood - An estimated future flood based on a hydraulic analysis of the potential storm runoff from an area and flow of water through the floodplain.

Cross Section of a Floodplain - A vertical section of the floodplain surface, normally taken at right angles to the direction of floodflow.

Effective Stream Mileage - The point along the centerline of the stream channel which has the same flood elevation as a specified location in the floodplain.

Flood - A temporary rise in water levels or an accumulation of water runoff, resulting in inundation of areas not ordinarily covered by water.

10-Percent-Chance (10-Year) Flood - A flood having 10 chances in 100 (1 chance in 10) of being equaled or exceeded in any 1-year period.

2-Percent-Chance (50-Year) Flood - A flood having 2 chances in 100 (1 chance in 50) of being equaled or exceeded in any 1-year period.

1-Percent-Chance (100-Year) Flood - A flood having 1 chance in 100 of being equaled or exceeded in any 1-year period.

0.2-Percent-Chance (500-Year) Flood - A flood having 0.2 chance in 100 (1 chance in 500) of being equaled or exceeded in any 1-year period.

Flood Boundary - The estimated outermost limit the waters of a flood of a certain magnitude will reach.

Flood Elevation or Water Surface Elevation - The height (expressed in relation to mean sea level) reached by floods or channel flows of various magnitudes.

Flood Fringe - The area of a floodplain which is outside of the floodway.

Flood Profile - A graph of flood elevations along a stream.

Flood Stage - The vertical distance to the surface of the floodwater as measured from or compared to some arbitrarily fixed and generally accepted point such as a United States Geological Survey stream gage. Local residents may more commonly use the term "flood depth," which is the vertical distance from the water surface to some point such as the floor, ground, or road.

Floodflow Line - A line drawn on a map indicating the general direction of the floodwaters in a floodplain.

Flooded Area Map - A map which shows the horizontal flood limits for one or more floods.

Floodplain - Any land area susceptible to inundation by water from any source including, at a minimum, that area subject to a 1-percent or greater chance of flooding in any given year.

Floodplain Management - A term applied to the full range of public policy and action for ensuring wise use of the floodplains. It includes, but is not limited to, collection and dissemination of flood control information acquisition of floodplain lands, enactment and administration of floodplain regulations including building codes, and construction of flood-modifying structures.

Floodplain Regulations - A general term applied to the full range of codes, ordinances, and other regulations relating to the use of land and construction within designated floodplain limits.

Floodway - The channel of the stream and those portions of the adjoining floodplain which carry and discharge floodwaters of a particular flood event.

Historic Flood - A flood known to have occurred in a specific area.

Maximum Known Flood - The largest flood known to have occurred on a stream or in an area.

Mean Sea Level - The average height of the sea for all stages of the tide over a 19-year period.

Peak Discharge - The greatest rate of flow normally expressed in cubic feet per second (cfs), occurring during a period of high water.

Reach - Segments of a stream which mark boundaries such as the limits of a study, corporate limits, State or county lines, or other definable features.

Stream Gage - An instrument which makes regular observations of either the water surface elevation (measured from some arbitrary point) or streamflow at a particular site on a stream, canal, lake, or reservoir.

Stream Mileage - Distance measured along the centerline of the stream from some designated point, usually where the stream enters into a larger body of water.

U.S. Coast and Geodetic Survey Levels - The vertical control surveys conducted to establish permanent elevation references.

BENCH MARKS[a]

Beaver Creek

Reference No.[b]	Elevation[c]	Description
TBM- 1	2515.2	A chiseled triangle on top of culvert headwall at downstream right end of culvert at mile 0.04.
TBM- 2	2534.4	A chiseled square on downstream right end headwall of 233-foot long box culvert at mile 0.35.
TBM- 4	2538.9	A chiseled square on upstream end of right headwall of box culvert at mile 0.40.
TBM- 6	2550.0	A chiseled square on upstream right bank wingwall of driveway bridge at mile 0.55.
TBM- 8	2573.6	A chiseled square on downstream end of right bank headwall of 246-foot long Highway 19 Bypass box culvert at mile 0.83.
TBM- 9	2576.7	A chiseled square on upstream end of right bank headwall at entrance to 246-foot long box culvert, mile 0.88.
TBM-10	2585.9	A chiseled square on downstream end of right bank headwall of 215-foot long box culvert at mile 0.97.
TBM-11	2588.3	A chiseled square on upstream end of right bank headwall of 215-foot long box culvert at mile 1.01.

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a. Bench marks are fourth-order accuracy unless otherwise indicated.

b. Temporary bench marks are numbered according to field data and therefore are not consecutive.

c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

BENCH MARKS[a]

Beaver Creek

(Continued)

Reference No.[b]	Elevation[c]	Description
TBM-12	2596.5	A chiseled square on upstream end of right bank headwall of bridge at mile 1.07.
TBM-13	2597.8	A 60D nail in transformer power pole #AU 15 on right bank 20 feet downstream of bridge at mile 1.16.
TBM-14	2606.8	A 60D nail in downstream right wingwall-headwall 1.0 foot below top of wingwall on right downstream side at mile 1.27.
TBM-15	2624.7	A 60D nail in upstream left bank guardrail post of bridge at mile 1.44.
TBM-16	2644.0	A chiseled square on upstream right bank wingwall of bridge at mile 1.56.
TBM-18	2658.2	A 60D nail 0.4 foot above ground in power pole no. AX 02 across road from Beaver Creek Baptist Church on right bank at mile 1.75.

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a. Bench marks are fourth-order accuracy unless otherwise indicated.

b. Temporary bench marks are numbered according to field data and therefore are not consecutive.

c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

BENCH MARKS[a]

Grassy Creek

Reference No.[b]	Elevation[c]	Description
TBM-19	2529.3	A chiseled square 7.2 feet below top of dam at left end, 4.0 feet landward from left end of spillway on top of first concrete step up from tailwater at mile 0.30.
TBM-20	2570.1	Top of bolthead in upstream left bank end of bridge curb at mile 0.97.
TBM-22	2574.3	A chiseled square on upstream end of shopping center sidewalk on upstream landward corner near Sky City entrance, on left bank about 250 feet from left water edge at mile 1.24.
TBM-24	2581.1	A 60D nail in downstream end of left bank headwall of wooden bridge at mile 1.52.
TBM-25	2590.9	A chiseled square on downstream left bank end of highway culvert over Rockhouse Creek, tributary to Grassy Creek at mile 1.69.
TBM-27	2605.3	A 60D nail in power pole no. CM 99 on left bank 15 feet from edge of highway and about 160 feet from left water edge at mile 2.06.
BM-2602.7	2602.97	A chiseled square painted "US 2602.7 BM" located on south side of road in east end of curb of culvert at mile 2.23 and 0.2 miles south of Grassy Creek Baptist Church. Third order accuracy.

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a. Bench marks are fourth-order accuracy unless otherwise indicated.

b. Temporary bench marks are numbered according to field data and therefore are not consecutive.

c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

BENCH MARKS[a]

Grassy Creek

(Continued)

Reference No.[b]	Elevation[c]	Description
TBM-29	2617.2	A chiseled square on top of flat rock located 3 feet below top of right bank and 11 feet from right water edge at confluence of Grassy and East Fork Grassy Creeks at mile 2.59.
TBM-30	2633.1	A 60D nail in downstream right bank headwall of private driveway bridge at mile 0.34 on East Fork Grassy Creek.

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a. Bench marks are fourth-order accuracy unless otherwise indicated.

b. Temporary bench marks are numbered according to field data and therefore are not consecutive.

c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

BENCH MARKS[a]

North Toe River

Reference No.[b]	Elevation[c]	Description
TBM-32	2507.1	A chiseled square on upstream riverward corner of railroad signal light foundation at railroad mile post 182, river mile 30.39.
BM X-59	2518.597	A brass tablet on Highway 19 bridge, mile 31.45. Second order accuracy.
TBM-36	2523.6	A chiseled square on downstream end of left headwall of railroad bridge over Beaver Creek at North Toe River mile 31.9.
TBM-38	2529.6	A chiseled square on ledge rock 15 feet from right bank protruding out into river, 125 feet downstream from section number 12, low water bridge at mile 34.23.
TBM-39	2547.6	A door sill of old abandoned stream gage house on right bank at mile 34.51.
TBM-39A	2531.9	A chiseled square on top of concrete at right downstream end of dam at mile 34.47.
TBM-40	2553.5	A chiseled square on upstream end of Banjo Branch culvert under highway on right bank at North Toe River mile 34.8.

---

a. Bench marks are fourth-order accuracy unless otherwise indicated.

b. Temporary bench marks are numbered according to field data and therefore are not consecutive.

c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

REFERENCE

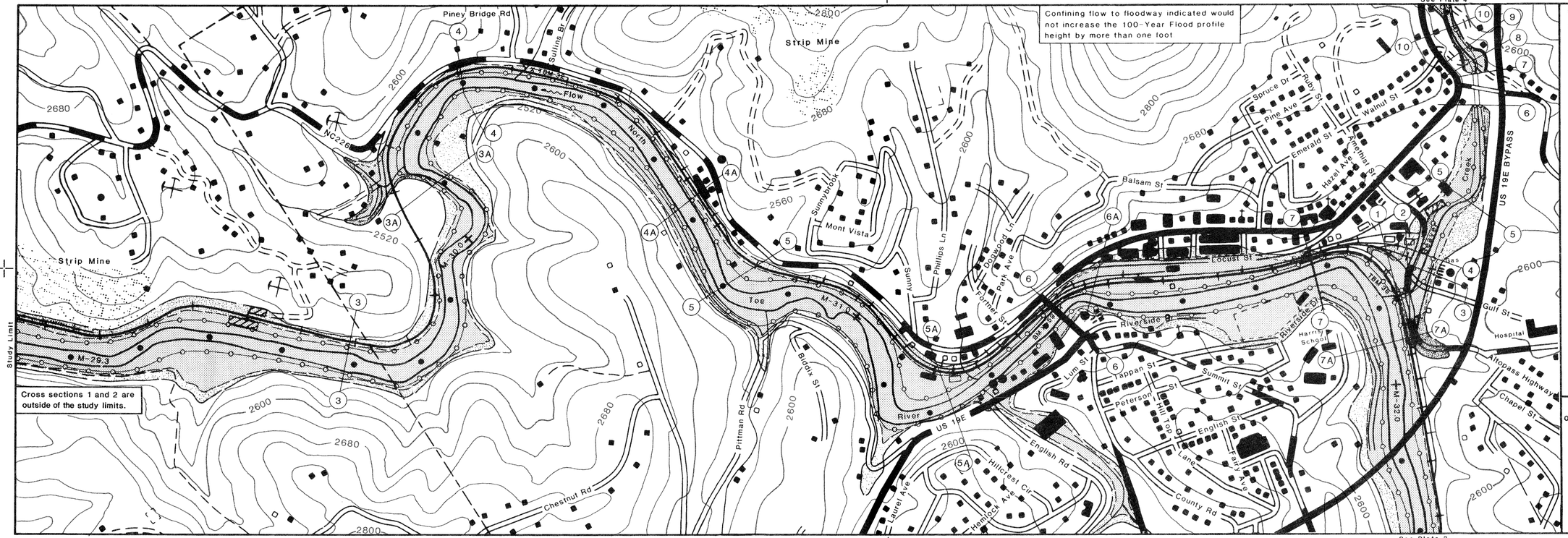
1. Tennessee Valley Authority, Division of Water Control Planning, Floods on North Toe River and Beaver and Grassy Creeks in Vicinity of Spruce Pine, North Carolina, Report No. 0-6372, Knoxville, Tennessee, October 1963.

2. U.S. Army Corps of Engineers, HEC-2 Water Surface Profiles Generalized Computer Program, Hydrologic Engineering Center, Davis, California, April 1980.

3. U.S. Army Corps of Engineers, National Program of Inspection of Dams, Volume III, Washington, D.C., May 1975.

4. U.S. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B of the Hydrology Committee, Washington, D.C., September 1981.

PLATE 2



LEGEND:

OVERFLOW LIMITS:

100 YEAR FLOOD

500 YEAR FLOOD

+ M-31.0 MILES ABOVE MOUTH

• 1/10 MILE MARK

5 — 5 CROSS SECTION

Floodway

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground

Base map is a portion of USGS-TVA Topographic Quadrangle map 209 NE dated 1978 with minor revisions.

Contour interval 40 feet

TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOODED AREAS
WITH PROPOSED FLOODWAY

North Toe River

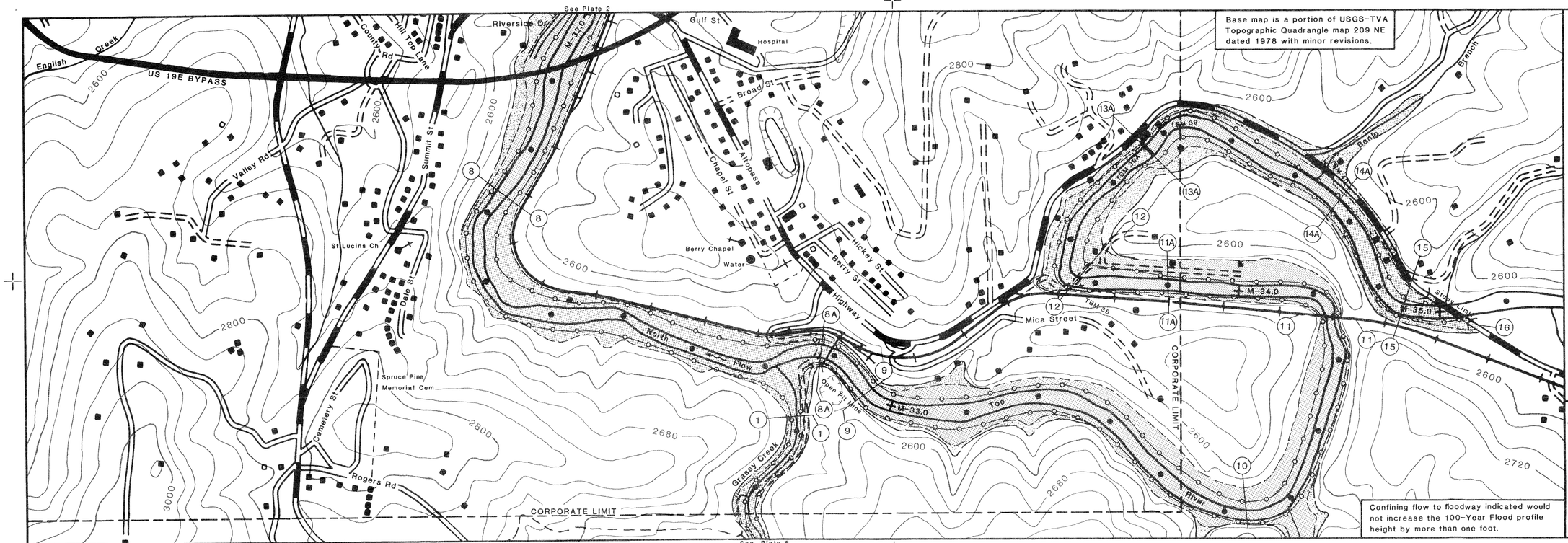
Mile 29.22 To Mile 32.20

Spruce Pine N.C.

SCALE 0 400 800 FEET

September 1985

PLATE 3



Base map is a portion of USGS-TVA Topographic Quadrangle map 209 NE dated 1978 with minor revisions.

Confining flow to floodway indicated would not increase the 100-Year Flood profile height by more than one foot.

LEGEND:

OVERFLOW LIMITS:

100 YEAR FLOOD

500 YEAR FLOOD

+ M-33.0 MILES ABOVE MOUTH

1/10 MILE MARK

9 9 CROSS SECTION

Floodway

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground

Contour interval 40 feet

N

TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOODED AREAS WITH PROPOSED FLOODWAY

North Toe River

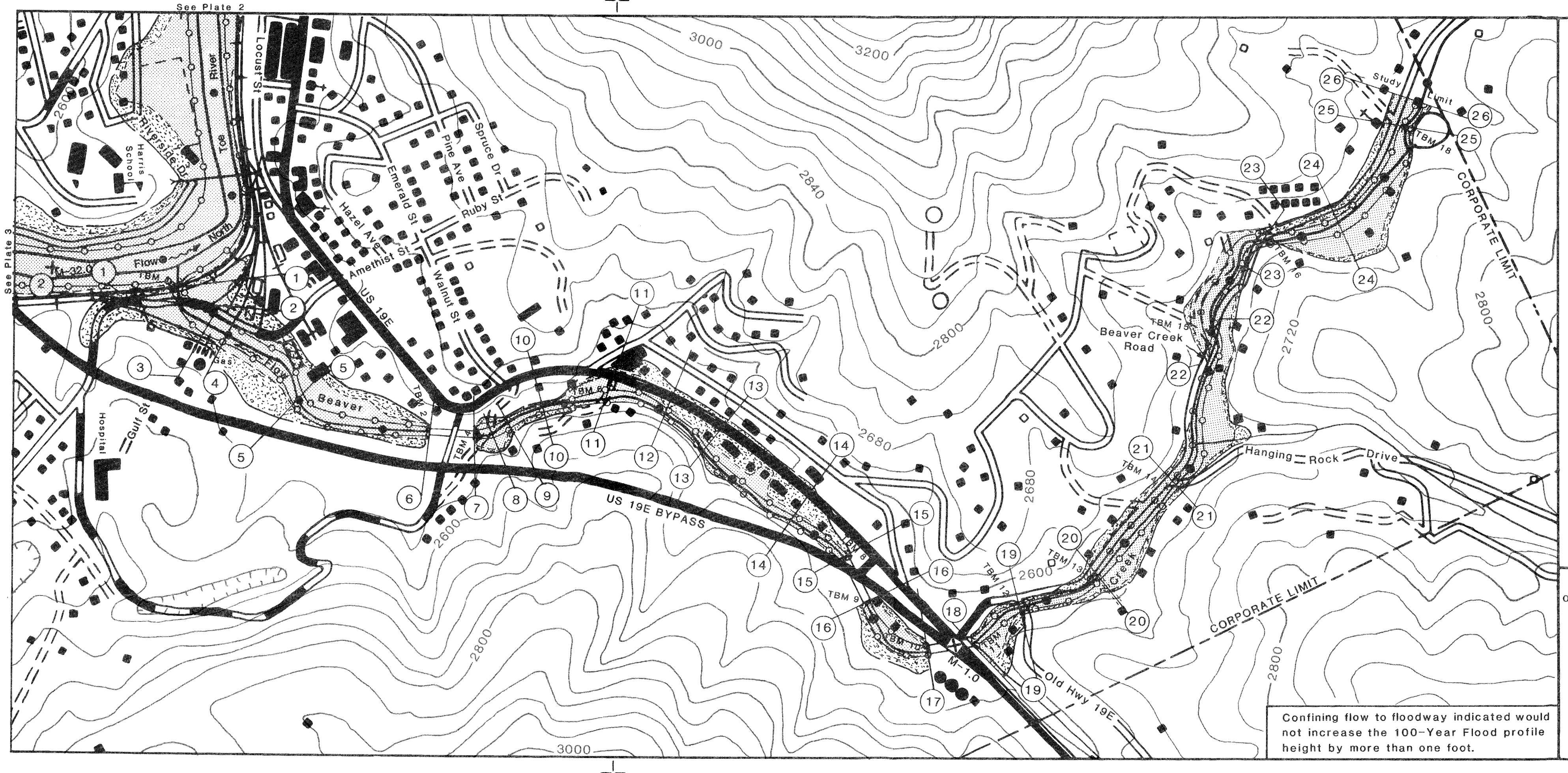
Mile 32.00 To Mile 35.18

Spruce Pine N.C.

SCALE 0 400 800 FEET

September 1985

PLATE 4



LEGEND:

OVERFLOW LIMITS:

100 YEAR FLOOD

500 YEAR FLOOD

+ M-1.0 MILES ABOVE MOUTH

• 1/10 MILE MARK

5 5 CROSS SECTION

Floodway

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground

Base map is a portion of USGS-TVA Topographic Quadrangle map 209 NE dated 1978 with minor revisions.

Contour interval 40 feet

Confining flow to floodway indicated would not increase the 100-Year Flood profile height by more than one foot.

TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOODED AREAS WITH PROPOSED FLOODWAY

Beaver Creek

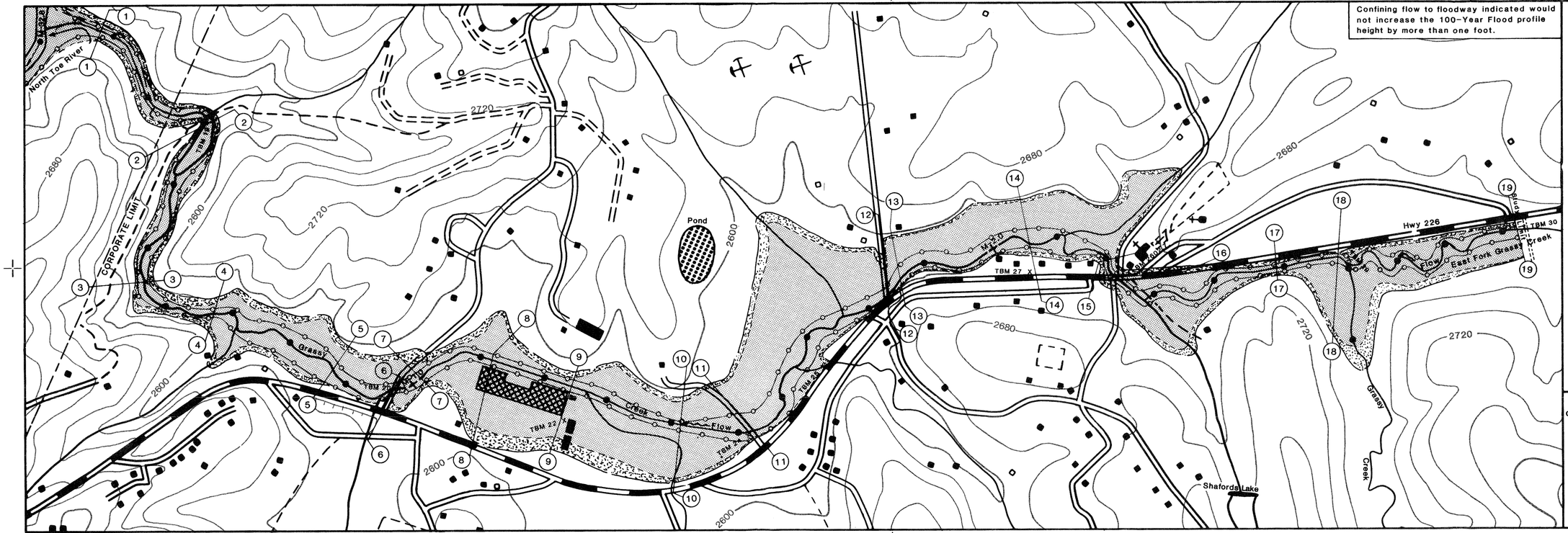
Mile 0.00 To Mile 1.88

Spruce Pine N.C.

SCALE 0 400 800 FEET

September 1985

PLATE 5



LEGEND:

OVERFLOW LIMITS:

100 YEAR FLOOD

500 YEAR FLOOD

+ M-2.0 MILES ABOVE MOUTH

1/10 MILE MARK

7 — 7 CROSS SECTION

Floodway

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground

Base map is a portion of USGS-TVA Topographic Quadrangle map 209 NE dated 1978 with minor revisions.

Contour interval 40 feet

TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOODED AREAS WITH PROPOSED FLOODWAY

Grassy Creek

Mile 0.00 To Mile 2.59

East Fork Grassy Creek

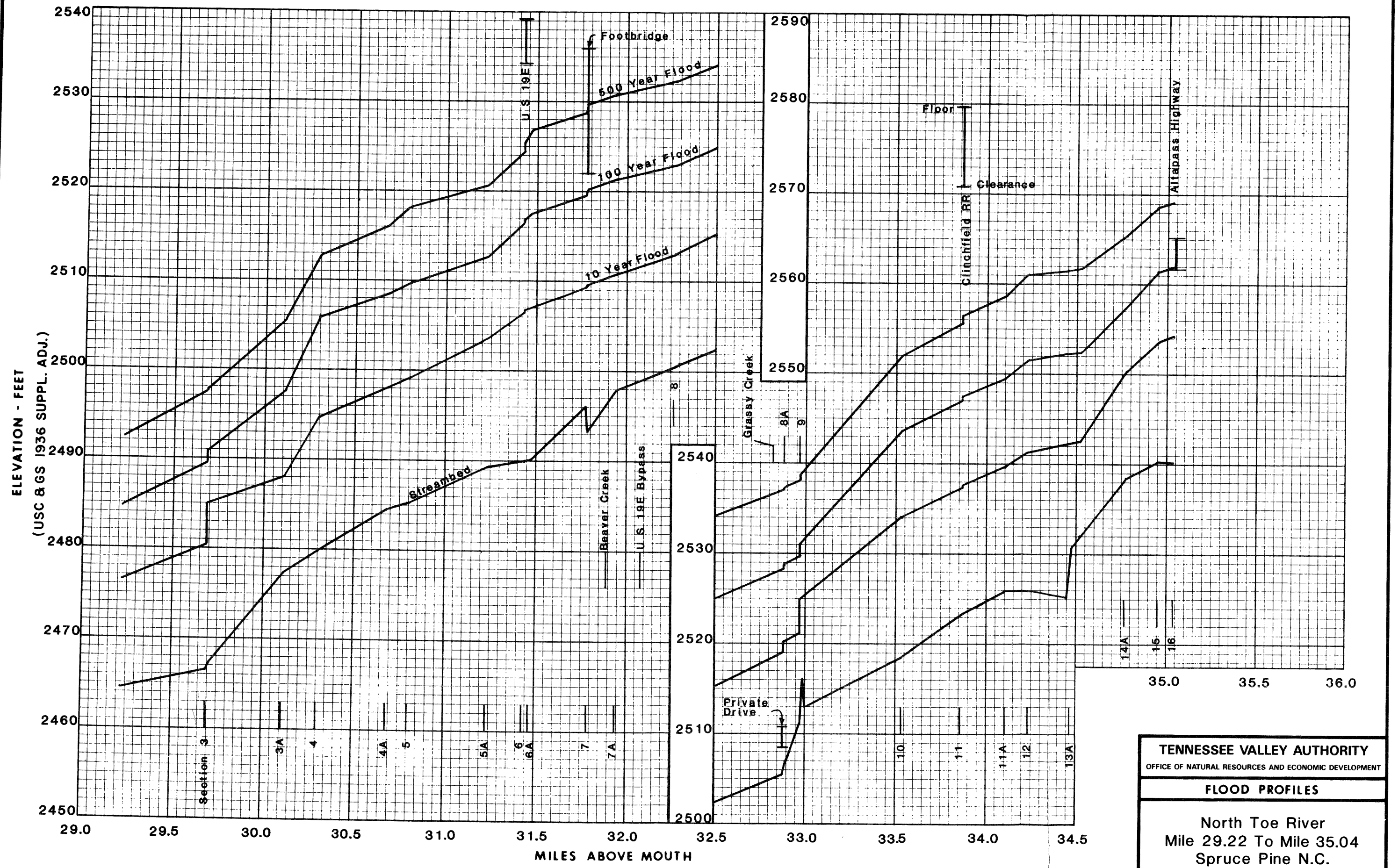
Mile 0.00 To Mile 0.39

Spruce Pine N.C.

SCALE 0 400 800 FEET

September 1985

PLATE 6



TENNESSEE VALLEY AUTHORITY

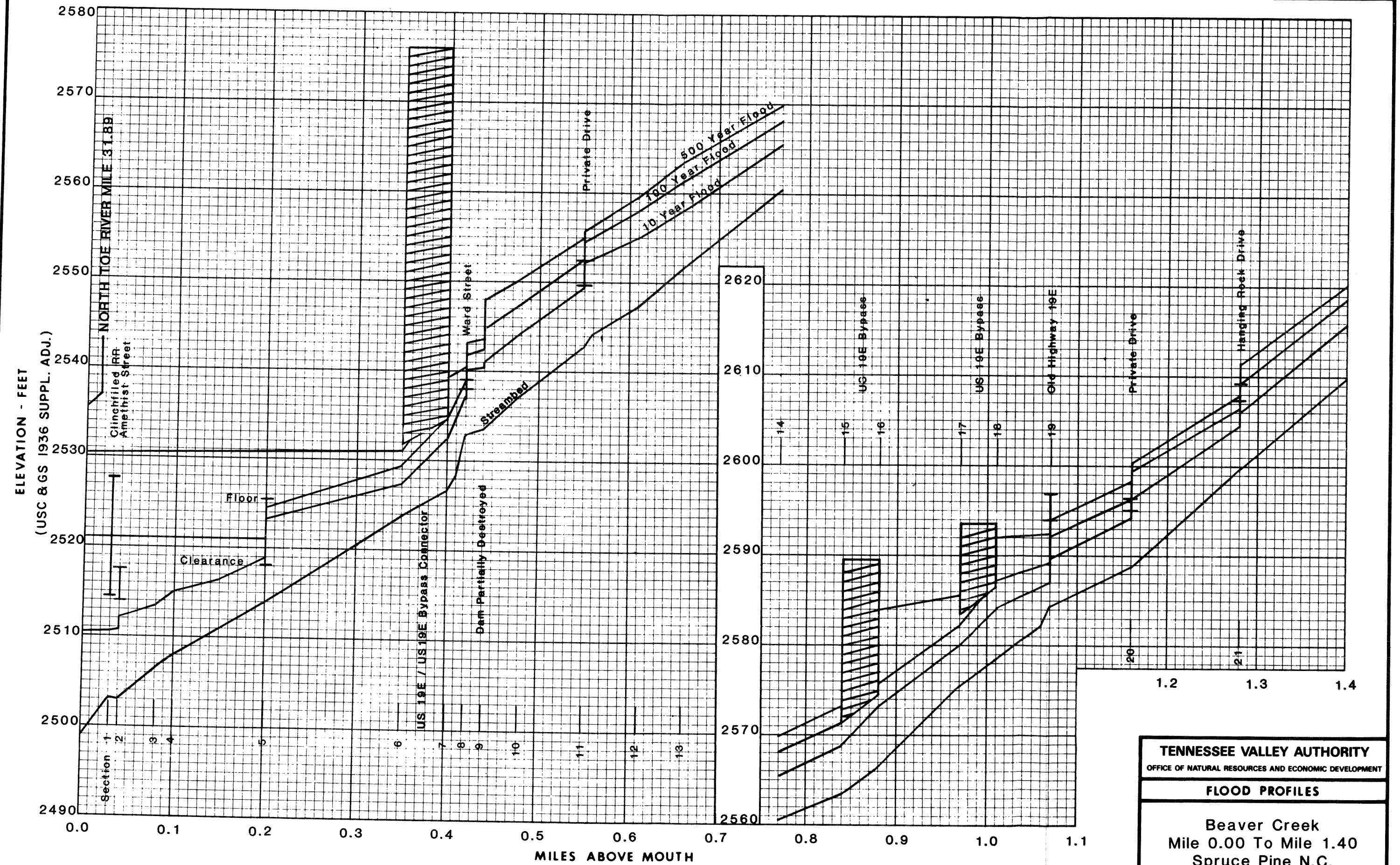
OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

North Toe River
Mile 29.22 To Mile 35.04
Spruce Pine N.C.

September 1985

PLATE 7



TENNESSEE VALLEY AUTHORITY

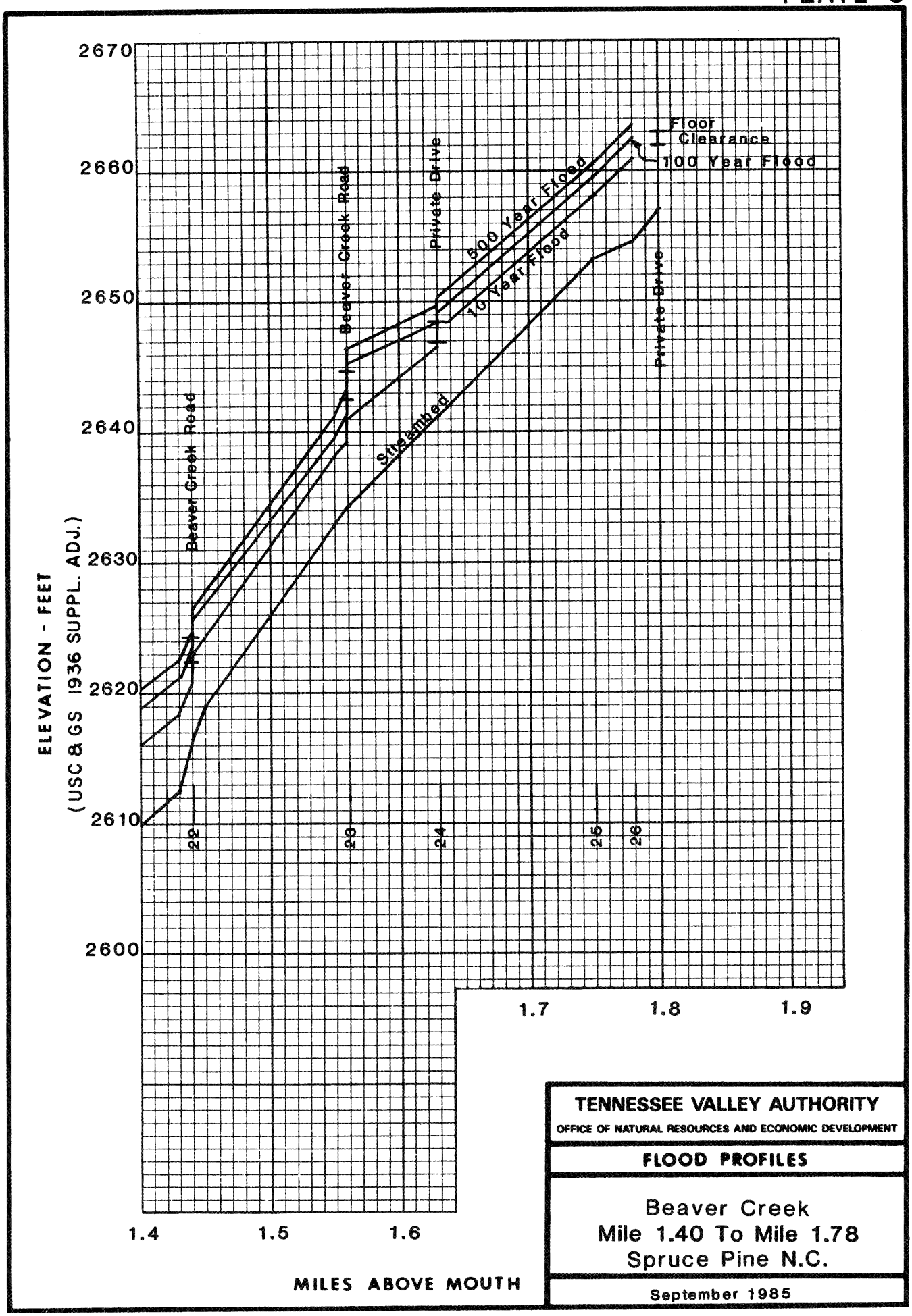
OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Beaver Creek
Mile 0.00 To Mile 1.40
Spruce Pine N.C.

September 1985

PLATE 8



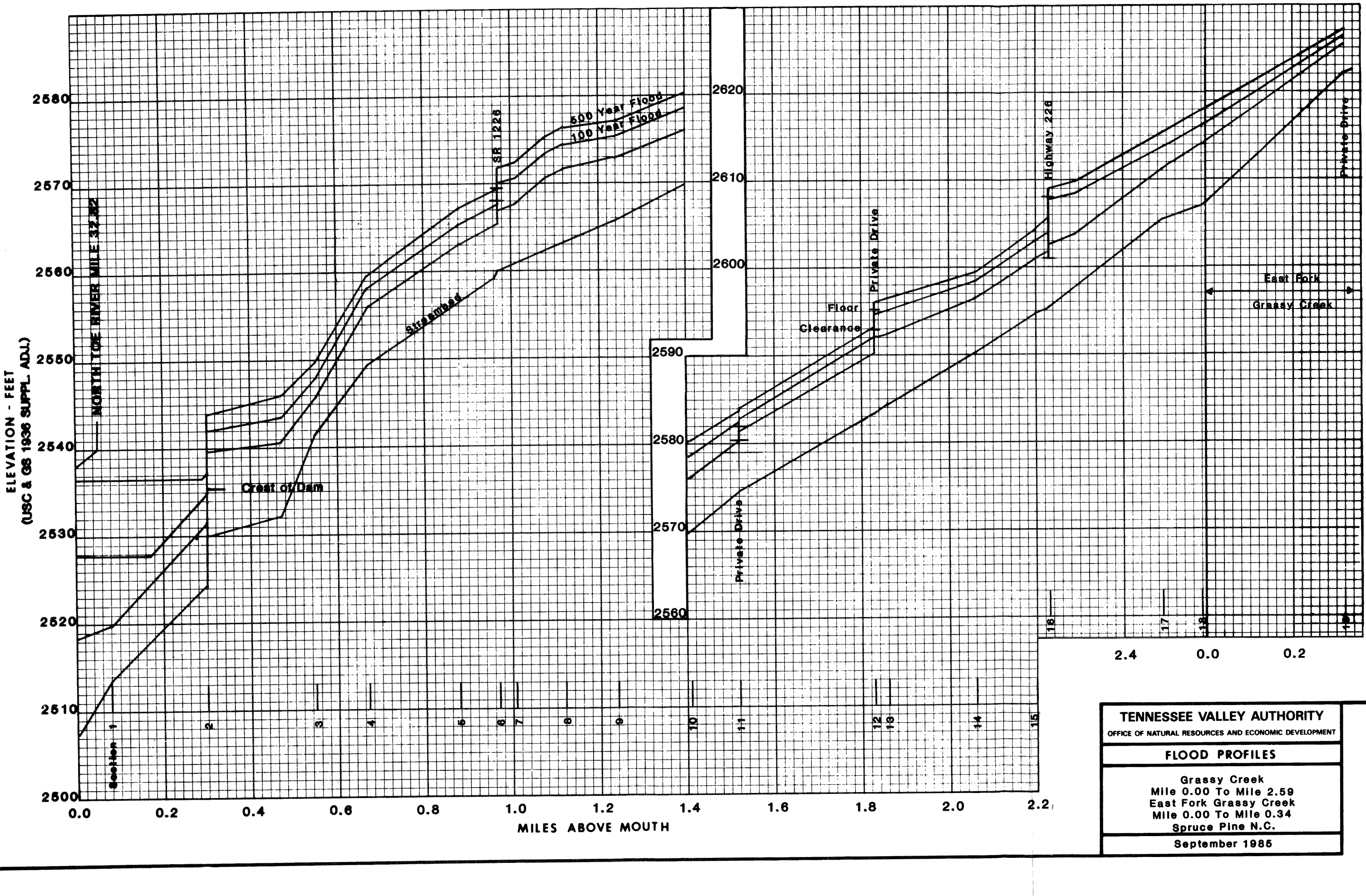
TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Beaver Creek
Mile 1.40 To Mile 1.78
Spruce Pine N.C.

September 1985



TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Grassy Creek
Mile 0.00 To Mile 2.59
East Fork Grassy Creek
Mile 0.00 To Mile 0.34
Spruce Pine N.C.

September 1985