10-18-1963

The Tellico Project on the Little Tennessee River.

Tennessee Valley Authority. Division of Water Control Planning.

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THE TELLICO PROJECT
ON THE
LITTLE TENNESSEE RIVER
CONDENSED SUMMARY OF PRINCIPAL FEATURES

(See Appendix A for Details)

LOCATION
On the Little Tennessee River arm of Watts Bar Lake at river mile 0.3.

STREAMFLOW
- Total drainage area above dam site: 2,627 sq. miles
- Uncontrolled drainage area below Fontana Dam: 1,056 sq. miles
- Design flood, regulated: 287,000 cfs
- Average flow (1921-1932): 5,820 cfs

RESERVOIR
- Maximum level for design: El. 817.5
- Normal maximum pool: El. 813
- Normal minimum pool: El. 807
- Length at El. 813—Little Tennessee River: 33.2 miles
- Tellico River: approx. 20 miles
- Length of shoreline at El. 813: 310 miles
- Volume at El. 813 (area = 16,500 acres): 414,600 ac.-ft.
- Controlled flood storage (El. 813-807): 126,000 ac.-ft.

MAIN DAM
- Type: concrete gravity, earth embankment
- Total length: 5,140 ft.
- Maximum height above foundation: 105 ft.
- Top level—concrete sections: El. 822
- —earth embankment: El. 828
- Spillway—crest level: El. 773
- —crest control: three 42-ft. high by 40-ft. wide gates, supervisory controlled from Ft. Loudoun
- —Discharge capacity at El. 817.5: 135,000 cfs

SADDLE DAMS
- Location: on left reservoir rim
- Lengths—No. 1 (maximum height—34 ft.): 2,046 ft.
- —No. 2 (maximum height—12 ft.): 370 ft.
- —No. 3 (maximum height—30 ft.): 320 ft.

CANAL
- Bottom width: 500 ft.
- Bottom level: El. 790
- Length: approx. 850 ft.

POWER
- Generating facilities: none installed in dam
- Increase in average annual energy at Ft. Loudoun: 200,000,000 kwh

ESTIMATED PROJECT COST: $41,000,000
THE TELLICO PROJECT
ON THE
LITTLE TENNESSEE RIVER

KNOXVILLE, TENNESSEE
OCTOBER 1963
TO: L. J. Van Mol, General Manager, 411 NSB
FROM: Reed A. Elliot, Director of Water Control Planning, 501 HFB
DATE: October 18, 1963
SUBJECT: TELLICO PROJECT - REPORT NO. 50-100

I am transmitting herewith project planning report No. 50-100 entitled "The Tellico Project on the Little Tennessee River," prepared by the Project Planning Branch. Other interested divisions have contributed fully to the investigations for the project and have reviewed the findings as set out in this report.

The proposed Tellico project, formerly known as the Fort Loudoun Extension, is a multiple-purpose water control project. The dam site is located near the mouth of the Little Tennessee River at mile 0.3. The reservoir would be joined to the Fort Loudoun Reservoir by a canal, thus permitting the two projects to effectively operate as one. The connecting canal and the proposed reservoir would provide a navigable channel approximately 30 miles in length up the Little Tennessee River. During the winter flood season the project would add 126,000 acre-feet of controlled flood storage. Power benefits from the project would accrue from the additional energy made available at the existing Fort Loudoun project due to the diversion of the Little Tennessee River flows.

By virtue of its location and the characteristics of the reservoir lands, the project offers exceptional opportunities for general economic development of the region. Therefore, a major objective of the Tellico project will be the development of the shoreline lands in such a way as to permit the project to make the maximum possible contribution to the economy of the region. It is proposed that TVA acquire nearly 17,000 acres of land immediately adjoining the reservoir. This land would be disposed of in such a manner as to assure a desirable and orderly development and the recoveries from the sale of this land would be returned to the Treasury, thereby reducing the net cost of the project.

The initial construction cost of the project, including the purchase of additional shoreline lands, is estimated to be $41,000,000. It is estimated that $10,500,000 would be realized from future sales of shoreline lands, which would reduce the Federal investment in the Tellico project to $30,500,000. The total benefits are estimated to be $45,900,000, with a resulting benefit-cost ratio of 1.5:1.0.
# THE TELLICO PROJECT
ON THE LITTLE TENNESSEE RIVER

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SUMMARY
SUMMARY

This report presents the results of engineering studies of a multiple-purpose water control project which would develop the lower portion of the Little Tennessee River. The proposed Tellico project, which was formerly known as the Fort Loudoun Extension, would be located near the mouth of the Little Tennessee River at mile 0.3. It would create a reservoir which would extend upstream approximately 33 miles to the Chilhowee project. The reservoir levels would be the same as those of the existing Fort Loudoun project, and by connection of the two reservoirs with a canal the two projects would effectively operate as one.

A major objective in the proposed Tellico project will be the development of the reservoir and adjoining lands in such a way as to permit the project to make the maximum possible contribution to the economy of the region. TVA's experience in the operation of the many reservoirs which it has constructed has made clear that proper use of the lands adjoining the reservoirs is fundamental to achieving their full economic value. It has become equally apparent that proper use of the shorelines cannot be obtained without planning for and control of their development. The lands along the shores of the reservoirs provide prime industrial sites and are the backbone for continually growing recreational and residential use, but with haphazard development neither the full potential for expanding employment opportunities nor the full potential of other values in the project can be achieved. Too often land which would be much more suitable for industrial use is subdivided into cabin sites, and lands required for industry or for recreation cannot be used.
because of fragmentation of ownership and unavailability, for one reason or another, of part of the land needed for an industrial or recreational site. In the interest, therefore, of a development of the Tellico project, which will make the maximum contribution to the economy of the region and as a demonstration that this can be accomplished through adequate control of waterfront lands, it is proposed that TVA acquire some 16,500 acres of shoreline lands which extensive studies have shown to be suited for development and use for industry, public and private recreation, and home sites; that detailed plans for the development of these shoreline lands be developed in cooperation with appropriate state and local agencies; and that the development plans be implemented through an orderly schedule of disposal of lands and land rights as the demand arises for industrial sites, home sites, and recreational development sites.

The shoreline lands to be acquired include at least 5,000 acres which are particularly suitable for use by industries requiring waterfront locations or close proximity to large supplies of water. The quality of these lands for such industrial use compares favorably with the sites which have come into industrial use along the main stream of the Tennessee River since its multiple-purpose improvement by TVA. An analysis of Tennessee River experience to date—where development of waterfront industry is still in a relatively early stage—indicates that a substantial occupancy of the industrial lands adjacent to Tellico Reservoir can be expected to occur over a development period of about 25 years. Further analysis of the Tennessee River experience suggests this development would create in the order of 6,600 new jobs in the
immediate vicinity, about 60 percent of which would be in new manufacturing
establishments. The net gain in wage income is estimated at about $18,000,000
annually.

As this development occurs it is anticipated that other areas along
the Tellico shoreline would come into demand for development as permanent
home sites or as recreational areas for people employed directly by the new
industries. The proximity of the Tellico project to the Great Smoky Mountains
National Park and its location athwart one of the access routes to the park add
greatly to its recreational potential. TVA estimates that visitor-day use of the
reservoir would average in the order of 1,750,000 annually after a very brief
development period. The shoreline lands to be acquired include the areas most
susceptible for development for use as home sites and for recreational purposes.

The project cost estimate of $41,000,000 includes the cost of shore­
line lands to be acquired, estimated to be $4,600,000. A careful analysis of
these lands, their potentialities for development, and TVA's extensive experience
with the changes in land values associated with reservoir development support
a conservative estimate that the disposal phase of the shoreline land develop­
ment program will yield recoveries, after expense of sales, of about $10,500,000.
TVA plans to return these recoveries to the Treasury and in this way effectively
reduce the Federal cost of the Tellico project. TVA estimates that in addition
to these recoveries for the Treasury, there will eventually be a further enhance­
ment in reservoir land values in the order of $5,200,000 which will accrue to
private owners.
The Tellico project is proposed for construction without power facilities at this time. The water of the Little Tennessee River can be diverted through the canal to the existing Fort Loudoun powerhouse and there generate most of the kilowatt-hours which are potential from the flow of the Little Tennessee River. The site is among the best remaining in the Tennessee Valley for a medium-head power development and, therefore, provision will be made for the possible addition of generating facilities at a later date.

The Tellico project would provide flood control benefits estimated to have a capital value of $10,700,000. As industries locate along the shoreline of Tellico Reservoir, transportation savings would be developed which are estimated to provide an equivalent capitalized navigation benefit of $11,800,000. Approximately 200,000,000 kilowatt-hours would be generated from the diversion of the flow of the Little Tennessee River through the Fort Loudoun powerhouse. Capitalized, these kilowatt-hours would provide a power benefit of $8,400,000.

The ultimate return to the Treasury of $10,500,000 from the management and sale of the 16,500 acres of shoreline land purchased for project purposes will reduce from $41,000,000 to $30,500,000 the net cost of this project to the Federal Government. It will be noted that the total of navigation, flood control, and power benefits is $30,900,000, which exceeds by a small margin the net cost of the project. There are in addition the very real benefits described briefly heretofore which will accrue from the development of industry and recreation along Tellico's shoreline. The value of these factors cannot be
stated completely and definitely at this time. It is clear, however, that their worth is substantial, and may well equal or exceed the aggregate of the traditional measures of the navigation, flood control, and power values of the project. However, TVA proposes to recognize these further benefits of the project to only a limited extent at this time and, therefore, is assigning a value of but $15,000,000 to the purpose of general economic development. Thus the benefits from navigation, flood control, power, and general economic development total approximately $45,900,000. The net cost of the project has been stated to be $30,500,000, resulting in an over-all benefit-cost ratio of 1.5.
Frontispiece – Aerial view of the Tellico dam site and surrounding area.
THE TELLICO PROJECT

This report presents the results of engineering investigations and economic studies for a multiple-purpose water control project on the lower reaches of the Little Tennessee River. The Tellico project would be, in effect, an extension to the Fort Loudoun project since the two reservoirs would be joined by a short canal.

From past experience in the TVA area it is apparent that proper use of shoreline lands is vital to the achievement of the full economic value from a project. This report, therefore, recognizes that values stemming from recreational, industrial, and commercial developments are important benefits created by water resource projects, in addition to navigation, flood control, and power benefits.

THE DAM SITE

Location

The dam site is located on the Little Tennessee River 0.3 mile above its mouth, near the extreme upper end of Watts Bar Lake, in Loudon County, Tennessee, and 1 mile southeast of Lenoir City, Tennessee. Exhibit 1 shows the drainage basin of the Little Tennessee River, and exhibit 2 shows the location of the dam site and reservoir and its relation to the Fort Loudoun project.

The principal highway access to the site is expected to be by way of Tennessee State Highway 95 crossing Fort Loudoun Dam from U. S. Highway 11 at Lenoir City. The nearest railhead is located at Lenoir City with a spur line running to Fort Loudoun Dam.
Site Topography

The lowermost 10 miles of the Little Tennessee River flows almost due north through a valley of gently rolling hills. About 3 miles above the dam site the river abruptly changes its course and swings due east through a reversed "S" curve until it reaches the head of Bussell Island at about mile 1.2. From here the river flows in two separate channels through an area of gently rolling farmland to its mouth.

The left abutment at the dam site is a steep bluff extending from the bed of the river at approximately elevation 725 to elevation 820, at which point it rises at a more gentle slope reaching a crest at elevation 876 approximately 350 feet back from the river. The left channel of the river is approximately 230 feet wide and the right channel is approximately 180 feet wide, separated by Bussell Island which has a width of about 2000 feet measured along the axis of the dam. The island ranges in elevation from about 746 to its highest point at elevation 768, and for the greater part it is at elevation 760 or higher. The island has been in cultivation during the past few years. Access is provided by a privately owned steel and concrete bridge across the right (east) channel.

The right bank of the river gently slopes from the river to an elevation of about 820 with occasional crests of small hills reaching elevation 830. At the far eastern extremity of the dam site the embankment would very nearly join the south embankment of the Fort Loudoun Dam. Detailed site topography is shown on exhibit 20 and a photograph of the site is shown on figure 1.
Figure 1 - Tellico Dam and Canal Sites Showing Location in Relation to Ft. Loudoun Dam and Lenoir City
The left reservoir rim is a relatively low ridge between the Little Tennessee River and the southward bend of the main river. Along the rim are three low saddles which must be closed by dikes.

HYDROLOGY AND METEOROLOGY

Description of Drainage Basin

The Little Tennessee River and its tributaries flow generally in a northwesterly direction and drain an area of 2627 square miles, including parts of Tennessee, North Carolina, and the extreme northeastern tip of Georgia. The principal tributaries, as shown on exhibit 1, are the Tellico, Cheoah, Tuckasegee-Oconaluftee, and Nantahala Rivers. Originating in the western slopes of the Blue Ridge, the Little Tennessee, Tuckasegee, and Oconaluftee Rivers drain the entire eastern portion of the drainage basin. The Nantahala, Cheoah, and Tellico Rivers originate in the southern Appalachians where these mountains form the southern boundary of the Little Tennessee River Basin and the northern boundary of the Hiwassee River Basin.

For much of the distance from their sources to where the Little Tennessee and its tributaries emerge from the mountains, the rivers flow through areas of rugged mountainous country of steep cliffs and jutting rock outcrops. For the last 40 miles of its course, the Little Tennessee River changes its characteristics from those of a mountain stream to those of a rather placid valley stream having a fall of about 3 feet per mile.
Upstream Projects

The Little Tennessee River system is one of the most highly developed in the Tennessee Valley. There are 15 hydroelectric generating developments on the river and its tributaries, 14 of them owned by the Aluminum Company of America. Of the latter, all of which are single-purpose power projects, 11 are operated as part of the TVA system under the provisions of an agreement entered into by TVA and ALCOA originally in August 1941, and revised effective January 1, 1963.

The largest development is TVA's Fontana Dam, located at mile 61.0 on the Little Tennessee River. Fontana controls a drainage area of 1571 square miles, or 60 percent of the total drainage area of the entire basin. It has a minimum controlled flood storage reservation of 771,200 acre-feet available on January 1 of each year. The reservoir, with 1,157,300 acre-feet of useful controlled storage, provides practically complete streamflow regulation to the downstream Cheoah, Calderwood, and Chilhowee plants.

Rainfall

There are 28 stations in the Little Tennessee watershed where precipitation records have been kept for 25 years or more. At five of these stations, where there are continuous records for 50 years or more, the normal annual rainfall is 58.9 inches. By way of comparison, the mean annual rainfall for the Tennessee Valley above Chattanooga for the 70-year period 1890 through 1959 amounts to 51.0 inches.

The heaviest 12-month rainfall ever recorded in the Tennessee Valley occurred in the headwaters of the Little Tennessee River at Coweeta Hydrologic Laboratory, located near Franklin, North Carolina. During the
period from November 1948 through October 1949, a total of 145.5 inches was recorded at this location.

In the mountainous area above Fontana Dam the average annual rainfall for the 23-year period from 1937 through 1959 amounted to 59.9 inches. For the area below Fontana, during the same period the average was 57.1 inches; however, this included the Cheoah River Basin above Santeetlah Dam, which had an average of 64.9 inches annually during the same period.

Streamflow

Records of the streamflow of the Little Tennessee River in the vicinity of the Tellico Dam site are available at the McGhee gage (drainage area 2443 square miles) from 1904 to date and at Calderwood (drainage area 1862 square miles) from 1912 through 1957. The natural flows at these gages were slightly affected after 1919 when the upstream Cheoah project was placed in operation and in subsequent years following other upstream developments. The computed average annual streamflow at the Tellico Dam site for the 1921-through-1932 period, considered typical of long-term conditions, amounts to 5820 cfs.

Past Floods

Records of past floods on the lower reaches of the Little Tennessee River are available from gage records at Calderwood and McGhee. The yearly and seasonal distribution of floods at the McGhee gage is shown on exhibit 3.

Large pre-record floods at McGhee occurred in May 1840, March 1867, February 1875, March 1886, October 1898, and March 1902. It is thought that
the peak discharge of each of these exceeded 100,000 cfs. Since the McGhee gage has been installed, the peak natural discharges of three floods have exceeded 100,000 cfs, including that of February 1957.

The maximum known flood in the lower reaches occurred in March 1867 before any gages were established on the river. The peak discharge of this flood at McGhee was estimated from floodmarks and computed backwater profiles to have been 153,000 cfs. Approximate hydrographs, shown on exhibit 4, were estimated from other known flood hydrographs. Natural and regulated profiles for the major floods of record are shown on exhibit 5, and for various flows on exhibit 6.

**DESIGN FLOOD**

In determining the maximum probable flood for use in design of the Tellico project structures, all great storms of record considered appropriately transposable to the watershed were evaluated as to their flood-producing potential. In transposing these storms, allowances were made for differences in moisture potential between the area of occurrence and the Little Tennessee River watershed and for the effect of the mountains surrounding the watershed on storm isohyetal patterns. The maximum probable flood is a hypothetical flood computed by applying the unit-hydrograph technique to the transposed storm having the greatest flood-producing potential. The Altapass, North Carolina, storm of July 1916 was the critical storm in this study.

The storm used in the preliminary design of the structures would produce a runoff volume of about 8 inches on the entire 2627-square-mile
drainage area with a resulting natural peak discharge of 372,000 cfs at the site. It is estimated that regulation by Fontana Reservoir would reduce the natural peak inflow to 302,000 cfs at the Tellico Dam site. Of this amount about one-half would be outflow from Fontana Dam with the remainder coming from the 1056 square miles of uncontrolled area below Fontana. Both regulated and natural flow hydrographs of the Little Tennessee River maximum probable flood are shown on exhibit 7.

**SPILLWAY AND CANAL CAPACITIES**

The required discharge capacity of the spillway and canal was determined from studies of the maximum probable flood for the Little Tennessee River for various alternative combinations of canal sizes and spillway structures at the Tellico project. Both the Fort Loudoun and Tellico Reservoirs were assumed to be at summer level, elevation 813.0, at the beginning of the flood. The maximum headwater at Fort Loudoun Dam was limited to elevation 815.0. Maximum headwater at Tellico Dam was not limited to any particular elevation but was allowed to rise as high as was required to discharge the flood through the spillway and canal. Results of these studies for a spillway crest at elevation 773 are shown on exhibit 8. Three 42-foot-high by 40-foot-wide spillway gates in combination with a canal 850 feet long and 500 feet wide with bottom at elevation 790 and 3 on 1 side slopes would pass the maximum probable flood at a headwater elevation of 817.5. The discharge capacity of the canal is shown on exhibit 9 and spillway discharge capacity on exhibit 10.
Results of operation during the maximum probable flood on the Little Tennessee River with the adopted spillway and canal are shown on exhibit 7. The peak inflow of 302,000 cfs was reduced by storage in the combined reservoirs to a maximum discharge of 287,000 cfs at headwater elevation 817.5. Of this amount, it is estimated that 135,000 cfs can be discharged over the Tellico spillway and 152,000 cfs through the canal, and thence over the Fort Loudoun spillway. The estimated maximum velocity through the canal would be 10.6 feet per second. Canal velocities and elevations are shown on exhibit 9.

Operation of the spillway and canal during a Valley-wide flood approximately equal to the March 1867 flood is shown on exhibit 4. In this flood both Fort Loudoun and the Tellico projects would store from the winter level, elevation 807.0, to the top of gates, at elevation 815.0. The resulting peak flow on the Tennessee River below the mouth of the Little Tennessee River as regulated by Douglas, Cherokee, Fontana, Fort Loudoun, and Tellico Reservoirs would be 147,000 cfs, a reduction in peak discharge of 10,000 cfs resulting from the Tellico project. The natural flow at this location would have been 376,000 cfs.

**RESERVOIR LEVELS AND PROJECT OPERATION**

The Tellico Reservoir, as an integral part of the Fort Loudoun Reservoir, would be operated consistent with the TVA water control system, primarily in the interests of flood control, navigation, and the generation of electric power. Under normal conditions the operating level of the reservoir would range between elevations 807 and 813, as shown on exhibit 11.
Flood Control

During a flood operation in advance of large floods the main river reservoir would be drawn to a level governed by the streamflow required to maintain elevation 807 for navigation at Knoxville. In this event the Tellico Reservoir would likewise recede to the same level as Fort Loudoun and may possibly be drawn as low as elevation 801 at the dam.

During the winter flood season the reservoir would be operated at near minimum level to provide the greatest amount of flood storage capacity available in the reservoir. Between normal minimum pool, elevation 807, and top of gates, elevation 815, the reservoir would add 126,000 acre-feet of controlled flood storage to the TVA flood control system.

In the event the maximum probable flood should occur, the reservoir may reach a level as high as elevation 817.5 at the dam.

Navigation

At normal minimum pool, elevation 807, the Tellico Reservoir and its connecting canal to the Fort Loudoun Reservoir would create a 9-foot navigation channel up the Little Tennessee River a distance of about 30 miles. On the Tellico River, commercial traffic would be limited to the lower 3.5 miles because of bridge clearances; however, pleasure craft could operate to about mile 20.

Power

With a wide canal of minimum length connecting the proposed reservoir with the present Fort Loudoun Reservoir, the effect essentially would be to create one common reservoir to serve the Fort Loudoun generating station. Head differential and time of travel between the reservoirs would be negligible.
under normal conditions, thereby making the water from the Little Tennessee River easily available for use through the Fort Loudoun powerhouse. Variable inflow and generation at the Fort Loudoun powerhouse would require frequent use of the canal for power purposes; however, curves of canal discharge capacity and velocity (exhibit 9) show that velocities would be low.

Detailed power studies of the 1921-through-1932 period of typical streamflow conditions indicate that the proposed Tellico project would add an average of about 200,000,000 kilowatt-hours per year (exhibit 13) to the output of the TVA-ALCOA-Cumberland system. This energy would be made available by diversion of the Little Tennessee water through the Fort Loudoun powerhouse. The average annual capacity factor of the Fort Loudoun plant would be raised from 52 percent to 70 percent.

The operating level of the combined reservoirs would be governed by multiple-purpose rules essentially the same as for the Fort Loudoun Reservoir, as shown on exhibit 11, with usual winter fluctuation between elevations 807 and 809 and full summer pool at elevation 813.

Tailwater

The tailwater elevation at the Tellico Dam site during the maximum probable flood on the Tennessee River will be about elevation 785. A recurrence of the March 1867 flood, after regulation by existing upstream storage projects would cause a tailwater of about elevation 762.5. The minimum tailwater as regulated by Watts Bar Lake would be elevation 735. The tailwater rating curve for various Watts Bar headwater elevations is shown on exhibit 12.
GEOLOGY AND FOUNDATION CONDITIONS

The areal geology of the lower section of the valley of the Little Tennessee River is shown on exhibit 16. The river flows northward across a wide belt of dolomites and limestones of the Knox group to mile 4.15. There it crosses the Knoxville fault which brings the Lower Knox (Copper Ridge) dolomite in contact with the Sevier shale. About 0.1 mile farther downstream it recrosses the fault and again flows over the Copper Ridge dolomite to mile 3.35. There it again crosses the fault, swings first to the east, then to the northwest, crossing successively belts of Moccasin limestone, Sevier shale, Moccasin limestone, Sevier shale, and Tellico sandstone. The Tellico sandstone is the same belt which forms the right abutment of Fort Loudoun Dam.

Stratigraphically, the Tellico sandstone is the lowermost and oldest formation present in the vicinity of the site. Although it is not involved in the dam site, it crops out a short distance downstream. It consists of about 600 feet of cross-bedded, sandy, coarsely crystalline limestone of light- to dark-gray color. The uniformity of the lithology is interrupted by thin beds of laminae of dark shale and fossiliferous shaly limestone.

The Sevier formation as a whole is quite diversified, ranging from pure coarsely crystalline (marble) through less pure fine-grained, limestone, shaly limestones to fine-grained, bluish-gray calcareous shales. At the dam site, it is about 1650 feet thick. On the basis of lithology, the formation may be subdivided into at least ten members or units; on the basis of predominant lithology, the number of units may be reduced to three:
Unit 1 - The lowermost 225 feet of the formation consists predominantly of limestones which range from grayish, fine-grained, impure limestones to gray and light pink, fine to coarsely crystalline, fossiliferous limestones with thin laminae of shale.

Unit 2 - Consists of 325 feet of irregularly interbedded limestone and shale in nearly equal proportions. Wavy shale laminations are numerous and give the rock a somewhat nodular appearance. Bedding planes are indistinct. Although in some beds the argillaceous material is in such abundance that the rock is essentially a calcareous shale, the unit as a whole is predominantly a shaly limestone. Occasional thin beds of bluish-gray, fossiliferous limestone are mixed with the shaly limestones.

Unit 3 - The upper 1100 feet of the formation consists very largely of gray calcareous shale with some interbedded limestone members. The thickness zone of interbedded shaly limestone, occurring near the middle of the unit, is approximately 100 feet thick; but in most places such zones do not exceed 20 feet in thickness. The shale is dark gray when fresh but weathers to yellow or buff.

The Moccasin limestone, the exact time equivalent of the Bays sandstone into which it grades, consists of 1100 to 1300 feet of brownish to red, thin-bedded, argillaceous limestone and mudstone. Thin beds of pure limestone occur at irregular intervals; and the thin beds of altered volcanic ash (meta bentonite), characteristic of the formation, are present. The formation is soluble and weathers down to a purplish-red clay residuum containing slabby fragments of undissolved rock.

Geologic Structure

In the main, the geologic structure at the site is quite simple. The strata exhibit northeast-southwest strikes ranging from N 40° to 50° E, and the dip toward the southeast at angles ranging from 20 to 40 degrees. There
is one major fault within a mile of the dam site. This, the Knoxville fault, brings the Cambrian Copper Ridge dolomite up over the Ordovician Moccasin limestone and Sevier shale formations. As a result of the overthrusting, the less competent Moccasin and Sevier formations are much fractured. Unit 3 of the Sevier formation is cut by numerous strike faults of moderate displacement. In addition to the faults, all rocks in the area are cut by two intersecting sets of joints, one essentially parallel to the strike and the other normal to the strike. Random joints and irregular cracks are also developed.

Exploratory work indicates that all rock in the dam site area contains cavities to some degree. Fractures, especially joints, cracks, and faults, have long permitted the ingress and movement of ground water in the rock mass of predominantly carbonate composition. In the limestones, open solution channels have been developed; and in the calcareous shales the carbonate has been leached out, leaving hydrated clay materials as "mud seams." Subsequent to their development, a large percentage of the solution cavities have become filled with mud. The extensiveness of the cavities and the depths to which they extend are shown on exhibit 18, and the location and summary of core drilling are shown on exhibit 19.

Overburden

Bussell Island is composed entirely of alluvium. In the dam site area to the east of the island the overburden consists almost entirely of alluvium, either recent flood plain deposits or ancient alluvial terrace deposits. The thickness of the overburden ranges from 20 to 70 feet. Along the location of the proposed canal, the thickness ranges from 30 to 75 feet, extending to below elevation 790, the proposed excavation grade of the canal.
Reservoir Rim

Although the rock in the dam site area contains cavities, it can be made watertight by a suitable treatment program. Between the dam site and mile 4.0 on the Little Tennessee River, there are some sections that would require rim tightening. The rim between Tellico Reservoir and Watts Bar Lake is a narrow ridge in which dolomite is faulted over mudstone, limestone, and shale. Exhibit 19 shows the location and summary of all core drilling done to date in this area. Further exploration and treatment would be required, particularly between miles 3 and 4, and also at dike site No. 1 across the Sevier shale southwest of the dam site.

Future Exploration

Indications are that, with treatment, a satisfactory foundation for supporting the project structures is available. However, the amount of treatment that will be required cannot be accurately estimated without a more detailed exploration program at the location of the proposed structures and along the left reservoir rim.

PROJECT FEATURES

The structures comprising the Tellico project include two concrete gravity nonoverflow sections, a 3-bay concrete spillway, a main embankment of rolled earth fill, three rolled earth-fill saddle dams, and a canal connecting the Tellico and Fort Loudoun Reservoirs. A project layout showing the main dam structures and their location in relation to the Fort Loudoun project is shown on exhibit 21.

Power generating facilities will not be included in the Tellico project at this time. However, should it become advisable to install generating facilities at some future date, the section of nonoverflow dam to the east of the spillway could be converted into an intake section and the powerhouse constructed immediately
Another possibility for the construction of a future powerhouse would be at the location of saddle dam No. 3 (exhibit 19). At this location tailwater levels would be somewhat lower than at mile 0.3 on the Little Tennessee River since the powerhouse would discharge through an excavated canal into Watts Bar Lake below Fort Loudoun Dam. If it is deemed advisable to add power facilities in the future, a review of the planning studies will be made in order to determine the most desirable location for the powerhouse.

Alternative locations for the dam and arrangement of project features are discussed in appendix C. Although these alternatives are based on the assumption that power facilities would be included, this would have no bearing on the choice of the site.

**Concrete Structures**

The spillway and the nonoverflow sections on either side of the spillway would be the only concrete structures in the entire dam. These would be in the left channel of the river, to the west of Bussell Island (exhibit 22). The nonoverflow sections would be of gravity design having top widths of 12 feet at elevation 822, 4.5 feet above the level of the maximum probable flood.

The 3-bay, ogee-shaped spillway would have its crest at elevation 773. Each bay would be equipped with a 42-foot-high by 40-foot-wide radial gate with an individual gate hoist located on the 26-foot-wide operating deck at elevation 822. Operation of the spillway gates would be by remote control from the Fort Loudoun powerhouse.

Although the rock foundation on which the spillway would be located is considered capable of withstanding the infrequent discharges expected without undergoing excessive erosion, a flat apron rather than a bucket design is incorporated in the layout and the cost included in the cost estimate. Considering the relative infrequency of expected spillway operation, it is quite possible that the
cheaper bucket-type apron would be economical. However, it is recommended that model tests be made to determine the proper type and shape of the spillway apron.

Main Embankment

The site topography (exhibit 20) and the project layout (exhibit 21) show the location of the main embankment of the dam. The total length of the embankment would be approximately 4420 feet and would require the placement of an estimated 1,265,000 cubic yards of impervious rolled fill. It would have a top width of 20 feet at elevation 828 which would provide a freeboard of 15 feet above the normal maximum pool level and a minimum freeboard of 10.5 feet above the headwater level during the maximum probable flood. A section through the embankment is shown on exhibit 22. The cutoff wall would require 1,730 tons of steel sheet piling.

It is proposed that the area upstream from the dam between the right bank of the river and the road leading to Bussell Ferry (exhibit 20) be opened as a borrow area for the fill material to be used in the embankment. Soil samples tested at the Singleton laboratory confirmed the suitability of the material for use in the embankment. Use of the material from this borrow area would provide ample quantities of fill for all of the embankment and would shorten the length of the canal, thereby improving navigation and hydraulic conditions. It is suggested that the top soil in the borrow area be stripped and used to fill the line of sinks just upstream from the dam (exhibit 20) and that the entire area be excavated to at least elevation 790, the level of the floor of the canal. Since it is not planned to relocate the transmission line towers near the entrance to the canal, the islands on which the towers would stand should be protected by riprap.
Saddle Dams

On the left reservoir rim, separating the Little Tennessee River from the southward bend of the Tennessee River, there are three low saddles across which dikes would be constructed (exhibit 19). The first and longest of these would be located about 2500 feet southwest of the left abutment of the dam and would extend in a northwesterly-southeasterly direction. This dike would have a total length of 2045 feet and a maximum height of 32 feet. The second dike is to be located approximately 3000 feet south of dike No. 1 on the left bank of the Little Tennessee River opposite mile 3.2. This dike would have a total length of 370 feet and a maximum height of 14 feet. The third dike would be about 1500 feet south of dike No. 2 and would have a total length of 320 feet and a maximum height of 28 feet. Each of the dikes would have the same cross section as the main embankment except that no downstream berms would be provided. The total volume of impervious rolled fill contained in the dikes is estimated to amount to approximately 130,000 cubic yards.

The rim separating the Tellico Reservoir and Watts Bar Lake would require treatment. This rim extends, generally, along the centerline of the dike sites and for some distance beyond. The estimated cost of this work is included in the detailed cost estimate, appendix B.

Canal

Since navigation would require a canal only 200 feet wide, it was necessary to determine from hydraulic studies the most economical combination of spillway and canal sizes which would pass the maximum probable flood at reasonable head differentials between the two reservoirs. These studies resulted in the selection of a canal having a bottom width of 500 feet at elevation 790 with side slopes of 3 on 1. Curves showing the relationship between
headwater levels and number of gates and canal sizes are shown on exhibit 8. Canal discharge capacities and velocities are shown on exhibit 9.

The total length of the canal between the two reservoirs would be approximately 850 feet. The sides would be riprapped below elevation 820 to protect against erosion from wave action and velocity of the water flowing through the canal. It is estimated that the volume of material to be removed in the canal would amount to 713,000 cubic yards, composed entirely of overburden.

Tennessee State Highway 95 crosses the location of the canal. This would require construction of a bridge providing standard major tributary stream clearances.

RESERVOIR

Extent

The reservoir created by the Tellico Dam would inundate lands in Loudon, Blount, and Monroe Counties, Tennessee (exhibit 2). At normal maximum pool, elevation 813, it would extend up the Little Tennessee River a distance of approximately 33 miles to Chilhowee Dam, and up the Tellico River a distance of approximately 20 miles. The reservoir would be about one-half mile in width for the lower 16 miles; but beyond that point, near Rose Island and Calloway Island, there would be two broad areas which would be over 1 mile wide.

At elevation 813 the reservoir would cover an area of 16,500 acres, of which approximately 2,100 acres would be in the present river channel. The
total length of shoreline, including islands, would be 310 miles. Reservoir areas and volumes for the Tellico project are shown on exhibit 14, and for the combined Fort Loudoun and Tellico projects on exhibit 15.

**Backwater**

Profiles for flows up to 250,000 cfs for natural and reservoir conditions are shown on exhibit 6. Natural and regulated profiles for the maximum known flood of March 1867 and the floods of January-February 1957 and April 1936, together with the regulated design flood, are shown on exhibit 5. For a flood of the magnitude of the maximum known flood, the natural profile would intersect the normal maximum reservoir level, elevation 813, at mile 28.

**Clearing Limits**

It is recommended that the upper limit for clearing the reservoir be set at elevation 814, or 1 foot above the normal maximum pool level. The lower limit should be set at elevation 788 except for that portion of the Tellico River arm of the reservoir above the highway bridge about 3 miles upstream from its mouth. Since it is expected that no commercial traffic will move up the Tellico River beyond the bridge, clearing to elevation 794 beyond this point should suffice.

With clearing to elevation 788, navigation could continue in the event the reservoir is drawn to elevation 801, which would be an exceptional operation in advance of a major flood. It is not considered necessary to clear the entire reservoir down to the original river banks; however, if stands of commercially valuable timber are found below elevation 788 and it is found economically feasible to remove these, it should be done.
It is suggested that a survey of the reservoir area be made at an appropriate time to determine whether a sufficient amount of saw timber and pulpwood is available to warrant contracting the clearing of the entire reservoir.

**Adjustments**

**Population and Business**—Much of the reservoir area is in pasture or under cultivation and, other than the farm homes, it is sparsely settled. There are two small communities which would be affected, one at Burton Mill, opposite river mile 11, and the other at Morganton, opposite mile 13.7. Reconnaissance studies reveal that about 300 families would be directly affected by the reservoir and 5 churches and 4 schools would have to be relocated.

The Hiwassee Land Company, a subsidiary of Bowaters Southern Paper Corporation, owns and has developed the west half of Rose Island (mile 17) for a tree nursery (figure 2). The company has planted large beds of seedlings, installed an irrigation system, and connected the island to the mainland with a heavy-duty bridge. The entire island would be inundated by the reservoir. The project cost estimate takes into consideration the value of this property.

**Highways, Railroads, and Bridges**—Impoundment of the reservoir would necessitate building or raising approximately 65 miles of highways, 2.5 miles of railroad, and 18 bridges, as shown on exhibit 2. The highways affected vary from narrow, low-type dirt roads to the high-type U. S. Highway 411. In some areas, sections of highways would be abandoned since they would no longer serve a useful purpose.
Two major bridges now cross the Little Tennessee River. One of these is the L&N railroad bridge at mile 18.8 which has low steel at elevation 810.6 and a horizontal clearance of 130 feet. The other is U. S. Highway 411 bridge, 0.3 mile upstream from the railroad bridge, which now has a controlling vertical elevation of 823 and a horizontal clearance of 150 feet. These bridges are shown on figure 3. Both bridges will require reconstruction to provide adequate clearances over the reservoir. The cost estimate is based on constructing a new railroad bridge and raising the highway bridge in place. Detailed studies will be necessary to determine the most appropriate solution, taking into account the problem of handling traffic during construction and the possible interests of the State Highway Department for a wider roadway.

Tennessee State Highway 95, which crosses Fort Loudoun Dam, would require a bridge across the canal. In the preliminary plan, the highway bridge extends from the end of the south embankment of Fort Loudoun Dam and crosses the canal on a curve. It would be supported by two center piers providing a horizontal clearance of about 300 feet. A minimum vertical clearance of 42 feet above elevation 813 would be provided. Total length of the bridge between abutments would be about 900 feet.

The total length of highway adjustments to Federal and State highways is estimated to amount to 13.1 miles; to Monroe County highways, 34.7 miles; and to Loudon County highways, 17.5 miles. Each of the new highways would be constructed to a quality equal to that of the highway which would be displaced. These mileages would vary somewhat with the policy of land purchasing finally determined.
The estimated cost of highway and railroad adjustments is the largest single item of cost in the entire project.

Mineral Deposits--There is no known mining, quarrying, or prospecting for minerals at the present time in the reservoir and very little, if any, has been done in the past. Several mineral deposits are known to exist in the reservoir area, or within a few miles of it; however, the quantity and quality of these are such that they have no commercial value. From past experience, it must be expected that claims would arise for deposits such as limestone, dolomite, sand, and gravel; but it is unlikely that any of these claims could be proven feasible.

Other Adjustments--The Fort Loudoun Association is now restoring the old Fort Loudoun (figure 4) on its original foundation, at mile 20 on the Little Tennessee River. The fort was erected by the British in 1756. Later, it was besieged by the Cherokee Indians who occupied it and then burned it. A portion of the fort site would be flooded by the reservoir. It is proposed that the area be protected by dikes, and an allowance has been made in the cost estimate for such protective works.

At Niles Ferry Bridge (U. S. Highway 411) there is a large brick ante-bellum home known as the Ben C. Clark property. A 1-story, brick building at the rear of the main dwelling served for many years as a well-known way-station on the old stage road between Maryville and Madisonville. This road was built about 1817. Both of these buildings would be affected by the reservoir.
Figure 3 - U. S. Hwy. 411 and L&N RR Bridges Crossing Little Tennessee River Near Mouth of Tellico River
Between miles 17 and 33 on the left bank of the Little Tennessee River there are seven known sites of Indian villages. In the past there have been limited amounts of archeological excavations at some of these sites. The names of these and their locations are:

- Mialaquo - mile 17.3, opposite Rose Island
- Toskegee - mile 20.5
- Tommotley - mile 22.0
- Toqua - mile 23.3, opposite Calloway Island
- Chote - mile 26.3
- Settacoo - mile 30.7
- Halfway Town - mile 32.6

It is understood that archeological societies or agencies will request that TVA allow cooperative excavations of these sites prior to impoundment of the reservoir. The project cost estimate makes no provision for any participation by TVA.

**CONSTRUCTION PROGRAM**

The construction planning schedule is shown on exhibit 23. It is planned that the project would be constructed in two stages, requiring a total elapsed time of approximately 3 years. During the first stage, cofferdam dikes would be constructed across the left or west channel of the river and the entire flow diverted through the right channel. Construction of the concrete sections of the dam would then proceed. This work, together with stripping of the area for the earth dam, foundation treatment, and construction of the steel sheet pile cutoff wall, is expected to be substantially completed during the first 14 months. This would permit earthfill operations to begin in July of the second year.
During the second stage of construction, dikes would be built across the right or east channel and the flow passed through openings left in the spillway section. During this stage the main embankment and the saddle dams would be completed, excavation for the canal would be completed except for an earth plug which would be left in place, and the reservoir prepared for impounding. Final closure is scheduled for July of the third year.

It is anticipated that diversion during the second stage would require either three openings in the dam 10 feet high by 26 feet wide or six openings 10 feet high by approximately 13 feet wide. During final closure, bulkheads would be used to close off these openings so that they could be plugged with concrete. After the reservoir is filled to the level of Fort Loudon Lake, the earth plug left in the canal would be removed.

Land purchase and reservoir relocations should begin shortly after project authorization.

ESTIMATES OF COST

The total cost of the Tellico project is estimated to be $41,000,000. The detailed cost estimate is contained in appendix B. A summary of the major items is as follows:

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<th>Estimated Cost</th>
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<td>Land and acquisition</td>
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<td>Reservoir preparation and relocations</td>
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<td>Dam structures</td>
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<td>Canal</td>
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<td>General yard improvements</td>
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<td>Total direct cost</td>
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<td>General expense and contingencies</td>
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<tr>
<td>Total Project Cost</td>
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Costs are predicated on present-day prices for labor and materials and a construction program utilizing a 5-day workweek. Land prices reflect 1963 general real estate price levels, land ownership and use patterns, and general economic conditions of the area.

**ECONOMICS**

**Annual Costs**

It has been assumed that the Tellico project would be financed from appropriations. Interest has been computed at a rate of 3 percent and the investment, exclusive of land, has been amortized over the estimated service life of the project. The investment in land has not been amortized since the salvage value is assumed to be at least equivalent to the original cost. Operation and maintenance charges are based on costs at comparable TVA projects. Total annual charges are estimated to be $1,050,000.

**Annual Benefits**

Although the Tellico project would serve the purposes of navigation, flood control, and power, experience with existing TVA water control projects has demonstrated that the proper use of land along the shoreline of a reservoir is necessary in order to achieve the fullest economic benefit. The shoreline lands become favored locations for industry, provide opportunities for the development of recreational enterprises and other possibilities for the stimulation of economic growth.
The Tellico Reservoir would be located approximately 350 miles from the geographical center of population of the United States. It is within 25 miles of the metropolitan centers of Knoxville and Oak Ridge and the cities of Kingston and Harriman, Tennessee. The town of Lenoir City, immediately downstream from Fort Loudoun Dam, would be within 0.5 mile of Tellico Reservoir. These location advantages plus the high water quality and scenic surroundings were all given consideration in developing the over-all value of benefits.

Navigation--The principal source of potential traffic on the reservoir would be associated with the development of industrial lands along its perimeter. This potential traffic was analyzed in relation to the pattern of recent industrial development that has occurred along the Tennessee River. The transportation benefits accruing to industries which have a choice of location which is regionwide were computed and found to produce an average annual transportation benefit equivalent to about $80 per acre of industrial site occupied. These are the types of industry which would be expected to locate on the Tellico shoreline and include, for example, synthetic fiber, electro-chemical, electro-metallurgical, hardwood pulp and felt, and light and heavy metal-fabricating industries.

The lands having the best access to rail, highway, and barge transportation, favorable topography, and freedom from flood damage were estimated to be about 5,000 acres. These lands would have the greatest potential and could be reasonably protected through purchase and zoning for future
development by waterfront industries. However, about 19,000 acres has been identified as having some industrial potential. Applying the unit benefit of $80 per acre to the 5,000 prime acres gives an average gross annual benefit in transportation savings of $400,000. The equivalent capital value after deducting annual operating and maintenance costs amounts to $11,800,000.

**Flood Control**—The greatest actual and potential urban damage from floods in the Tennessee Valley has been in Chattanooga, one of several communities which are only partly protected by the TVA reservoir system. Flood storage capacity in the Tellico Reservoir would aid substantially in operating the system to reduce flood crests at Chattanooga. It would also aid in reducing flood damages to smaller communities and to agricultural lands along the Tennessee River.

Major tributary reservoirs control 63 percent of the drainage area above Chattanooga, providing flood storage on January 1 equivalent to 8.4 inches over their watersheds. The remaining 37 percent of the drainage area above Chattanooga has relatively little control by the main river reservoirs, which provide flood storage equivalent to an average of only 1.9 inches. Consequently, more flood storage can be used effectively above Chattanooga. During the winter flood season the proposed Tellico project would add 126,000 acre-feet of controlled flood storage (elevations 807-815) to the TVA flood control system.

Recent studies in connection with potential flood damage in the upper Tennessee Valley indicate that storage for flood control purposes in the Tellico
Reservoir would have an annual value of approximately $2.90 per acre-foot. On this basis, the gross annual value of 126,000 acre-feet provided at Tellico would amount to about $365,000, or an equivalent capital value after deducting annual operating and maintenance expenses of $10,700,000.

**Power**--The power benefits from the Tellico project would be the additional energy which could be generated at the Fort Loudoun powerhouse due to the diversion of the Little Tennessee River flows, through a canal, into the Fort Loudoun Reservoir. By this means about 85 percent of the potential energy production can be gained without installing generating units at the Tellico project. However, since there will be no increase in the dependable capacity of the system, no benefit for capacity will accrue.

Hydro power benefits usually are measured by the cost of adding an equivalent amount of alternative thermal generating capacity. In this case, since no capacity would be added to the system, the value of the additional hydro energy has been measured in terms of the savings in system production expense brought about by the reduction in kilowatt-hours which otherwise would have to be produced by existing and future system steam plants, and the annual power benefits accruing from the Tellico project due to the production of 200,000,000 kilowatt-hours would vary accordingly over the life of the project. After deducting additional annual operating and maintenance costs at Fort Loudoun and annual operating and maintenance costs at Tellico, the equivalent capital value amounts to $8,400,000.
General Economic Development--The utilization of waterfront lands along the Tellico Reservoir by manufacturing plants would produce economic benefits over and above the savings due to the availability of the navigable channel. Based on experience in industrial development along the main Tennessee River, it is estimated that the 5,000 acres of potential waterfront industrial lands would attract, after a 25-year development period, an ultimate investment of $265,000,000 in plants and facilities. The average investment over the life of the project would be $160,000,000. With one job being provided for each $40,000 of plant investment, as experienced on the main river, a total of 4,000 new manufacturing jobs would be created. The history of industrial growth indicates that 65 new jobs are gained in nonmanufacturing activities for each 100 new manufacturing jobs. Thus, a total of 6,600 new jobs would be created. On the basis of the latest Census of Manufacturing and Census of Business (1958), these new jobs would produce gross annual wages of $22,500,000. It is likely that the workers filling these new jobs would be those presently employed in agriculture, where they would have earned $4,300,000. It is estimated, therefore, that the net effect to the region due to the wages produced by industrial development of waterfront lands along Tellico Reservoir would be about $18,000,000 per year. This would not include other appreciable benefits due to increases in profits, rents, and other non-wage income.

Recreation as visualized in this report includes only those activities and facilities usually thought of in connection with vacations at fresh-water lakes. These are leisure-time aspects of permanent homes, summer cottages and camps, restaurants, concession stands, boat docks,
boats, swimming, etc. Fishing, hunting, and associated services are also included in the concept of recreation. In all of these phases, the Tellico Reservoir would have a very great recreational potential because of its strategic location. It would be located in an area rapidly developing for recreation. A portion of the reservoir would lie within the Cherokee National Forest, and its headwaters would be close to the Great Smoky Mountains National Park. Also, old Fort Loudoun, located at the mouth of the Tellico River, just south of U. S. Highway 411, is a point of historic significance.

Consideration was given to the many advantages previously mentioned in estimating that the average visitor-day use of the Tellico Reservoir within 5 to 7 years after completion would be in the order of 1.75 million per year. This number of visits would result in a considerable benefit to the area from expenditures made for facilities and equipment associated with recreational use of the reservoir.

The upstream developments of the Aluminum Company of America and the Fontana project presently provide sufficient regulation to assure a generous supply of high-quality water for municipal and industrial developments which are likely to locate along the lower Little Tennessee River. The Tellico project would, however, extend the potential usefulness of this water supply by making available a reservoir from which vast quantities of water would be available for industrial use of a recirculative nature. There would be a further benefit to water users along the reservoir due to ready access of water and a reduction in pumping heads resulting from the higher permanent
water level. This is particularly true of a potential industrial complex in the vicinity of Vonore where the Louisville and Nashville Railroad and U. S. Highway 411 cross the reservoir. These main transportation routes connect the population centers of Knoxville and Atlanta.

Impoundment of the Tellico Reservoir would, in addition, improve the quality of water available for potential municipal or industrial use. Possible benefits are the following:

1. Clearer water—easier and cheaper to treat.
2. Lower bacterial concentrations—reduces potential danger to human life.
3. More uniform physical and chemical qualities—makes treatment easier, cheaper, and more effective.
4. Reduced period of high hardness in water. This period would otherwise extend throughout the late summer and fall.
5. Cooler water in summer and fall—a benefit to industry for cooling purposes.

Although these benefits are recognized as accruing from a water control project such as Tellico, they have not been evaluated in this report.

It is apparent that the value of general economic development of the region due to the construction of the Tellico project would be considerable in magnitude. However, it is proposed that these benefits be recognized only to a limited extent at this time and therefore a capital value of only $15,000,000 has been assigned to this purpose of the project.
Land Management and Disposal--The impoundment of Tellico Reservoir would enhance land values and provide benefits to the surrounding area. Past experience in TVA reservoir areas indicates that land adjacent to the Tellico Reservoir will increase substantially in value over the life of the project. The unique combination of favorable terrain, good-quality water, favorable climate, easy accessibility from populous centers, unusual historic interest, and scenic attractiveness are exceptionally promising for shoreline development for industry, home sites, and recreational use. Inasmuch as such development would not take place in the absence of the project, it seems reasonable that the value of these benefits should be credited to the project.

Studies have been made to determine the effect of the Tellico project on the value of land adjacent to the reservoir shoreline. These studies involve three factors: (1) estimates of the present values of the land adjacent to the reservoir, (2) estimates of future land values, and (3) estimates of the rate of development.

It is estimated that a total of about 22,000 acres of land adjacent to the shoreline of the reservoir would be subject to considerable enhancement due to the construction of the Tellico project. In determining the enhancement value, a development period of 50 years was assumed.

It is proposed that TVA acquire 16,500 acres of this land and retain it for a 10-year period, on the average, in order to assure that maximum benefits be realized through orderly and desirable shoreline development. The
recoveries derived from the future sale of these lands would be credited to the project cost. It is estimated that this land could be purchased for a net cost of $4,600,000. After allowing for the expense to TVA for managing and selling the land, there will be a net recovery of $10,500,000 which would be returned to the Treasury. It is estimated that there will be additional enhancement after recoveries for the Treasury of about $5,200,000 on this land and on adjoining land not included in this acreage, which will accrue to private owners.

Economic Justification

After deducting the amount recovered from the sale of land from the estimated project cost of $41,000,000, the net cost for comparison with project benefits would be $30,500,000. The annual benefits estimated to result from the construction of the Tellico project and which are evaluated in this report are those due to navigation, flood control, power, and an allowance for general economic development. The total benefit from the purposes of navigation, flood control, and power, of $30,900,000 is more than equal to the net cost of the project of $30,500,000. With the addition of the allowance for general economic development, the over-all benefit-cost ratio becomes 1.5:1.0, resulting in a clear justification for the project. The values of the benefits considered are as follows:

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APPENDIXES
APPENDIX A

SUMMARY OF PRINCIPAL FEATURES

Location
On the Little Tennessee River arm of Watts Bar Lake, 0.3 mile above its confluence with the Tennessee River; in Loudon County, Tennessee; 1 mile southeast of Lenoir City; 33.2 miles downstream from Chilhowee Dam.

Access
Tennessee State Highway 95 crossing Fort Loudoun Dam from U. S. Highway 11 at Lenoir City.

Railroad facilities available on main line of Southern in Lenoir City with a spur line to Fort Loudoun Dam.

Streamflow
Drainage area:
- Total above dam site ........................................ 2,627 sq miles
- Uncontrolled (below Fontana Dam) ....................... 1,056 sq miles
- Design flood, regulated .................................... 287,000 cfs
- Maximum known flood (March 1907):
  - Natural ..................................................... 153,000 cfs
  - Regulated .................................................. 119,000 cfs
  - Average (1921-1932) .................................... 5,820 cfs

Reservoir
- Counties affected (Tennessee) ....................... Loudon, Monroe, Blount
- Operating levels at dam:
  - Maximum used for design ....................... El. 817.5
  - Top of gates ........................................ El. 815
  - Normal maximum .................................. El. 813
  - Normal minimum ................................ El. 807
  - Exceptional operation (in advance of floods) ...... El. 801
- Length at El. 813 - Little Tennessee River ..... 33.2 miles
  - Tellico River ........................................ approx 20 miles
  - Length of shoreline at El. 813 - Main shore .... 302 miles
    - Islands ............................................... 8 miles
  - Original river area within reservoir ........... 2,133 ac.
  - Area to be cleared .................................. approx 2,400 ac.
  - Families affected ..................................... approx 300
- Relocations:
  - Highways - Federal and State .................... 13.1 miles
    - Monroe County ...................................... 34.7 miles
    - Loudon County ...................................... 17.5 miles
  - Railroad - Louisville and Nashville ............. 2.5 miles
Reservoir (continued)
Volume (flat-pool assumption):

Total at El. 815 (area = 17,300 ac.) .... 447,300 ac.-ft
Total at El. 813 (area = 16,500 ac.) .... 414,600 ac.-ft
Total at El. 807 (area = 14,200 ac.) .... 321,300 ac.-ft
Controlled flood storage (El. 815 - 807) .... 126,000 ac.-ft
Pondage (El. 813 - 807) .... 93,300 ac.-ft

Main Dam
Material and type ........... concrete gravity nonoverflow dam
and spillway, impervious rolled
earth-fill embankment
Foundation ............ Sevier formation
Total length along axis of dam ........... 5,140 ft
Maximum height above foundation
on baseline ........... 105 ft
Nonoverflow sections;
Top level ........... El. 822
Total length (two sections) ........... 570 ft
Earth embankment:
Top level ........... El. 828
Total length ........... 4,420 ft
Spillway:
Crest level ........... El. 773
Crest length - clear ........... 120 ft
Crest control ........... three radial gates, each 42 ft high by 40 ft wide, separated by 7.5-ft-thick piers
Top of gates ........... El. 815
Operation ........... by individual fixed-type hoists, supervisory controlled from Fort Loudoun project
Discharge capacity at El. 817.5 ........... 135,000 cfs

Saddle Dams
Location ........... on left reservoir rim; Nos. 1, 2, and 3 are
2,500, 5,500, and 7,000 feet respectively southwest from left abutment of main dam
Material ........... impervious rolled earth-fill
Top level ........... El. 828
Lengths - No. 1 (max. height = 34 ft) ........... 2,045 ft
- No. 2 (max. height = 12 ft) ........... 370 ft
- No. 3 (max. height = 30 ft) ........... 320 ft
Canal

- Bottom width: 500 ft
- Bottom level: El. 790
- Side slopes: 3 on 1
- Length: approx 850 ft

Power

No generating facilities installed in Tellico Dam. Flows of the Little Tennessee River diverted through the Fort Loudoun powerhouse.

Increase in average annual energy at Fort Loudoun: 200,000,000 kwh

Estimated Land Requirements

For dam, reservoir, and relocations: approx 23,000 ac.
For shoreline development: approx 16,500 ac.

Estimated Major Construction Quantities

- **Dam and spillway:**
  - Earth excavation: 47,500 cu yd
  - Rock excavation: 17,300 cu yd
  - Concrete: 86,400 cu yd
- **Earth embankment:**
  - Impervious rolled fill: 1,265,000 cu yd
- **Saddle dams:**
  - Impervious rolled fill: 139,000 cu yd
- **Canal:**
  - Earth excavation: 713,000 cu yd

Estimated Project Cost

- Direct cost: $31,781,000
- Overheads and contingencies: $9,219,000
- Total project: $41,000,000
APPENDIX B

DETAILED ESTIMATE OF COST

Knoxville, Tennessee
October 1963
# TELLICO PROJECT
## DETAILED ESTIMATE OF COST

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<th>Amount</th>
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| 201    |        | EXPENSE OF LAND AND PRIVILEGE ACQUISITION |          |      |       |        |
|        |        | TOTAL RELOCATING PRICE OF LAND AND PRIVILEGE |          |      |       | 1,300,000 |

| 304    |        | RELOCATING HIGHWAYS AND HIGHWAY BRIDGES |          |      |       |        |
| -0     |        | Federal and state highways | 18.7 | mile |       | 1,730,000 |
| -3     |        | Monroe County | 14.0 | mile |       | 1,640,000 |
| -6     |        | Total bridges and trestles |          |      |       | 2,442,000 |
|        |        | TOTAL RELOCATING HIGHWAYS AND HIGHWAY BRIDGES |          |      |       | 4,871,000 |

| 205    |        | RELOCATING RAILWAYS AND RAILWAY BRIDGES |          |      |       |        |
| -0     |        | Railroad | 2.5 | mile | 344,000 | 927,000 |
| -5     |        | Engineering - Design |          |      |       | 174,000 |
|        |        | TOTAL RELOCATING RAILWAYS AND RAILWAY BRIDGES |          |      |       | 2,059,000 |

| 207    |        | RELOCATING AND PROTECTING OTHER STRUCTURES AND IMPROVEMENTS |          |      |       |        |
| -0     |        | Public utilities - Construction |          |      |       | 300,000 |
| -3     |        | Engineering | 300,000 | L.S. |       | 93,000 |
| -5     |        | Miscellaneous |          |      |       | 116,000 |
|        |        | TOTAL RELOCATING AND PROTECTING OTHER STRUCTURES AND IMPROVEMENTS |          |      |       | 559,000 |

| 21     |        | STRUCTURES AND IMPROVEMENTS |          |      |       |        |
| 212    |        | GENERAL YARD IMPROVEMENTS | 56,000 | L.S. |       | 56,000 |

| 31     |        | RESERVOIRS, DAMS, AND WATERWAYS |          |      |       |        |
| 310    |        | RESERVOIR | 2,000 | acre |       | 200,000 |
|        |        | TOTAL RESERVOIR |          |      |       | 1,028,000 |

| 321    |        | CONCRETE DAM AND SPILLWAY |          |      |       |        |
| -0     |        | Excavation and care of water |          |      |       | 600,000 |
| -2     |        | Construction and backfill | 47,000 | cu yd | 30.00 | 1,410,000 |
| -23    |        | Operating equipment - Earth | 17,350 | cu yd | 6.00 | 104,000 |
| -3     |        | Foundation preparation and treatment |          |      |       | 165,000 |
| -4     |        | Concrete |          |      |       | 1,260,000 |
| -46    |        | Overflow repair and lining | 21,000 | cu yd | 27.00 | 560,000 |
| -41    |        | Nonoverflow repair and lining | 21,000 | cu yd | 27.00 | 560,000 |
| -42    |        | Spillway control and lining | 6,000 | cu yd | 27.00 | 160,000 |
| -43    |        | Spillway operating bridge | 150 | cu yd | 150 | 22,500 |
|        |        | TOTAL CONCRETE DAM AND SPILLWAY |          |      |       | 3,258,000 |

| 322    |        | AUXILIARY STRUCTURES AND EQUIPMENT |          |      |       |        |
| -0     |        | Marine structure - Spillway operating bridge |          |      |       | 32,000 |
| -05    |        | Miscellaneous metal work | 1,400 | L.S. |       | 14,000 |
| -50    |        | Piping | 1,400 | L.S. |       | 1,400 |
| -51    |        | Miscellaneous |          |      |       | 10,000 |
|        |        | TOTAL AUXILIARY STRUCTURES AND EQUIPMENT |          |      |       | 47,000 |

| 323    |        | Electrical work | 65,000 | L.S. |       | 65,000 |

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<td>41,000,000</td>
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Tennessee Valley Authority
Division of Water Control Planning
Project Planning Branch

APPENDIX C

TELLICO PROJECT
FACTORS INFLUENCING THE
LOCATION OF THE AXIS OF THE DAM

Knoxville, Tennessee
October 1963
APPENDIX C

TELLICO PROJECT

FACTORS INFLUENCING THE

LOCATION OF THE AXIS OF THE DAM

Selection of the location of the axis of the Tellico Dam crossing the Little Tennessee River was based on the results of comparative estimates of three alternative locations. The comparative costs were influenced not only by the surface topography, which affected the quantities and costs of the structures themselves, but also by subsurface conditions, which affect the cost of treating the reservoir rim and preparing and treating the foundation for the different structures.

As discussed in this report under "Geology and Foundation Conditions," the two major geologic formations in the area are the Tellico formation and the Sevier formation. The latter is generally subdivided into units Nos. 1, 2, and 3. The contact between the Tellico formation and Sevier No. 1 is about 1100 feet upstream from the mouth of the Little Tennessee; the contact between No. 1 and No. 2 is about 2000 feet upstream; and the contact between No. 2 and No. 3 is about 3100 feet upstream. (See plate C-1.) The exploratory core drilling just above the mouth of the river was not sufficient to permit the drawing of detailed geologic sections of the area. However, the drilling that has been done indicates that conditions similar to those encountered in the construction of Fort Loudoun Dam across these same formations could be expected at the Tellico Dam.
At Fort Loudoun Dam, the north abutment and first three powerhouse units are founded on the Tellico formation. Unit 4 and most of the spillway are built on the Sevier No. 1 formation. The south end of the spillway, the lock, and a portion of the south embankment are built on the Sevier No. 2 formation. The remainder of the south embankment is on the Sevier No. 3 formation. In general, the foundation conditions were extremely poor in the Tellico formation, becoming gradually better as they progressed further into the Sevier formation.

The Tellico formation underlying the north abutment of Fort Loudoun Dam was found to be dissected by a complex series of vertical joints along which considerable weathering had developed to great depths. This condition was aggravated by disconformity seams which were overlain by several feet of sound rock. In some locations the rock below the disconformity seams was intersected by highly weathered joints. Several different methods of foundation treatment were employed in this area, including open-cut trench excavation, overlapping 36-inch core drill holes, and manual seam mining. All of the foregoing work was ultimately filled with concrete.

The Sevier No. 1 formation underlying the spillway of Fort Loudoun Dam was intricately dissected by weathered seams and cavities for its top 30 feet. Below that level the rock was essentially sound except for the presence of three master bedding cavities which were continuous and extended to great depth. The Sevier No. 1 may be considered a transition section between the poor rock of the Tellico and the better rock of Sevier No. 2.
In the Sevier No. 2, forming the foundation of the lock, very little work, other than standard pressure grouting, was required.

Using actual costs incurred at Fort Loudoun Dam and adjusting them to present-day prices, the estimated costs of rim treatment and foundation preparation and treatment in each of the above formations are as follows:

<table>
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<th>Formation</th>
<th>Rim Treatment</th>
<th>Foundation Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tellico</td>
<td>$900</td>
<td>$2100</td>
</tr>
<tr>
<td>Sevier No. 1</td>
<td>900</td>
<td>1500</td>
</tr>
<tr>
<td>Sevier No. 2</td>
<td>-</td>
<td>420</td>
</tr>
</tbody>
</table>

For each alternative location of the dam axis, a common point on the right bank of the right channel of the Little Tennessee River was used as reference. From this point the left end of the dam was rotated to three positions referred to as the upper site, the intermediate site, and the lower site. (See plate C-1.)

The upper site is exclusively on the Sevier No. 2 formation. It would require the longest section of earth-fill embankment of the three schemes. The left abutment is very steep and, consequently, would require only a short section of nonoverflow bulkhead between the spillway and abutment.

The intermediate site is located principally on the Sevier No. 2 and Sevier No. 1 formations, with the left abutment extending onto the Tellico formation. The earth-fill section on the right bank would be shorter than that required at the upper site, but this would be partially offset by the longer section required between the spillway and the gently sloping left abutment.
The lower site is also located on all three formations but extends for a greater length onto the Tellico formation than the other two axes. The total length of the structures at this location would be the shortest but would extend over the greatest area of bad rock. In addition, the lower site would require extensive reservoir rim treatment because a very narrow ridge of the Tellico formation would separate the Tellico Reservoir from Watts Bar Lake.

The major differences in cost between the three sites would be the expense of preparing and treating the foundation for the structures and treatment of the reservoir rim. These costs are estimated as follows:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Upper Site</th>
<th>Intermediate Site</th>
<th>Lower Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth embankment</td>
<td>$535,000</td>
<td>$868,000</td>
<td>$450,000</td>
</tr>
<tr>
<td>Concrete dam and spillway</td>
<td>125,000</td>
<td>538,000</td>
<td>970,000</td>
</tr>
<tr>
<td>Powerhouse*</td>
<td>100,000</td>
<td>360,000</td>
<td>430,000</td>
</tr>
<tr>
<td>Reservoir rim and saddle dams</td>
<td>1,000,000</td>
<td>1,585,000</td>
<td>2,485,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,760,000</strong></td>
<td><strong>$3,351,000</strong></td>
<td><strong>$4,335,000</strong></td>
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</tbody>
</table>

These figures have been incorporated in the estimate of the total project costs as shown on table C-1.* From this summary it can be seen that the upper site, although the longest of the three layouts, is the least expensive; and, consequently, it was chosen as the location for the proposed axis in the project planning report.

*The cost estimates shown are based on preliminary studies which assumed that power facilities would be included in the project; however, this has no bearing on the outcome.
<table>
<thead>
<tr>
<th>Item</th>
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<th>Lower Site</th>
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<td>$17,123,000</td>
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<tr>
<td>General yard improvements</td>
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<td>150,000</td>
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<td>Powerhouse</td>
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<td>3,353,000</td>
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<tr>
<td>Foundation preparation and treatment</td>
<td>100,000</td>
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<td>430,000</td>
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<tr>
<td>Control building</td>
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<td>2,385,000</td>
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<td>Nonoverflow sections</td>
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<td>Foundation preparation and treatment</td>
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<td>$49,250,000</td>
<td>$49,700,000</td>
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ALTERNATIVE LOCATIONS OF AXIS OF DAM

TEDLICO PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED
RECOMMENDED
APPROVED

NO. 6.00
	Al. M. White
	K. E. Miller

KNOXVILLE 6-22-60 OA PP 1\120N232
EXHIBIT 2

Reservoir shown at E/8/5.
Adjustments taken from Division of Design studies.
Base map from dwg 5045M04.

RESERVOIR MAP
SHOWING PROPOSED
HIGHWAY AND RAILROAD
ADJUSTMENTS

TENNESSEE VALLEY AUTHORITY

NOTES:
Reservoir shown at E/8/5.
Adjustments taken from Division of Design studies.
Base map from dwg 5045M04.

SWEETWATER
NOTES:
Since Nov. 7, 1944, estimated natural crests which would
have occurred without regulation at Fontana Dam are shown thus, O.
Crests since Jan. 1928, shown thus, @, are from recording gages at the
present USGS gage, 100 feet above the highway bridge. Earlier crests shown
thus, @, are estimated from gages at slightly different locations and apply
at the present gage. Flows for pre-record floods shown by dashed lines,
are from gages furnished by the Hydraulic Data Branch.
On the upper diagram estimated natural crests are related to
corresponding observed crests by means of lower case letters. Since
Nov. 1944 only natural crests are shown on the lower diagram.

THIS DRAWING SUPERSEDES: Fu 82-10.04, w/F-10-311B2220

LITTLE TENNESSEE RIVER
MILE 19.15

DISTRIBUTION OF FLOODS
AT MC-GHEE, TENN
Approximate 1867 Flood
Natural and Regulated

Tellico Project
Tennessee Valley Authority
Division of Water Control Planning

MARCH

Natural Flow
Reg. Flow without Tellico
Reg. Flow with Tellico

Below mouth of Little Tennessee River
EXHIBIT 5

LEGEND:
- Regulated profiles with Fontana and Tellico Dams.
- Natural profiles for conditions prior to TVA.
  - April 1936 floodmark.
  - March 1867 floodmark.

NOTE:
Natural profiles are based on available floodmarks and computed flow profiles.

LITTLE TENNESSEE RIVER - MI 0-34
NATURAL AND REGULATED FLOOD PROFILES

TELLICO PROJECT
TENNESSEE VALLEY AUTHORITY

SCALE = 1" = 1 MI AT MOUTH 0-34

Miles Above Mouth

LITTLE TENNESSEE RIVER - MI 0-34
NATURAL AND REGULATED FLOOD PROFILES

TENNESSEE VALLEY AUTHORITY

SCALE = 1" = 1 MI AT MOUTH 0-34

Miles Above Mouth
NOTE:
Canal - 850' long  
Bottom width - 500'  
Bottom elev - 790' above MSL  
Spillway - 3 42' high by 40' wide gates  
Crest elev - 773' above MSL

LEGEND:
- - - - Natural
- - - - Reg HW, Vel, or Disch
- - - - Reg Inflow
- - - - Canal Flow
- - - - - - - Spillway Discharge

NATURAL AND REGULATED HYDROGRAPHS  
MAXIMUM PROBABLE FLOOD  
LITTLE TENN RIVER

TELLICO PROJECT  
TENNESSEE VALLEY AUTHORITY  
DIVISION OF WATER CONTROL PLANNING

KNOXVILLE 3-29-60 DA FC 1 311A273
Canal
Length - 850 feet
Bottom El 790
Side Slopes - 1 on 3

Gated Spillway
Crest El 773

Elevations
Initial
Ft. Loudoun - 813
Tellico - 813

Maximum
as required

Headwater Elevation Required for Various Size Outlets
Maximum Probable Flood
NOTE:
Width 500' at bottom
Elevation 790'
Side slopes 1 on 3
Length 850'

EXHIBIT 9

FLOW - 1000 CFS

ELEVATION OF HIGHER RESERVOIR

ELEVATION OF LOWER RESERVOIR

VELOCITY FT PER SEC

820
818
816
814
812
810
808
806
804

FLOW - 1000 CFS

CANAL DISCHARGE CAPACITY
AND VELOCITY

TELLICO PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

KNOXVILLE 3-24-60 321A754
NOTE:
For 3'-42' high x 40' wide gates.
Crest Elev 773.0
During November the drawdown rate may vary, depending on hydrological conditions, but after December the pool must be kept within the winter fluctuating range.

NOTES:
(1) Elevations apply only at dam.
(2) Maximum level assumed for design of dam - EL 817.5.
(3) Under extreme flood conditions the reservoir may be surcharged as high as EL 817.5.
(4) Project is designed so that if necessary reservoir may be drawn as low as EL 601 at Dam prior to flood crest if levels in Fl. Loudoun Reservoir will provide navigation depth to Knoxville.

RECOMMENDED: L.F.C.
NOTE:
These curves represent average flow conditions in the Tennessee and Little Tennessee Rivers based on observed discharges.
EXHIBIT 13

NOTE:
Curves show duration of weekly average power at Fort Loudon, before and after diversion of the Little Tennessee River by the Tellico Project. These curves result from power studies based on the 1931-1932 typical stream flow period, with inflow regulated by Cherokee, Douglas, Fontana, and Santeetlah reservoirs.
RESERVOIR AREAS & VOLUMES

<table>
<thead>
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<th>ELEVATION</th>
<th>AREA 1000 ACRES</th>
<th>VOLUME 1000 ACRE-FEET</th>
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<tr>
<td>730</td>
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NOTES:
Areas obtained by planimeter from USGS-TVA topographic maps, scale 1"=2000'; contour interval 20'. Drainage area at site = 2,627 square miles. Area of original river within reservoir to Chilhowee Dam = 2,133 acres.
EXHIBIT 15

RESERVOIR AREAS & VOLUMES

<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>AREA 1000 ACRES</th>
<th>VOLUME 1000 ACRE- FEET</th>
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</thead>
<tbody>
<tr>
<td>820</td>
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<td>1,008.5</td>
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<tr>
<td>815</td>
<td>32.6</td>
<td>833.8</td>
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<tr>
<td>813</td>
<td>31.1</td>
<td>772.4</td>
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<td>810</td>
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<tr>
<td>730</td>
<td>0.0</td>
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</tr>
</tbody>
</table>

NOTES:
Areas and volumes are the summations of those shown on drawings 10 DA 1-321G424 and 10A PPI-321C751.
Total drainage area = 12,177 sq. Miles.

TENNESSEE RIVER - MILE 602.3 PLUS
LITTLE TENNESSEE RIVER - MILE 6.5

COMBINED RESERVOIR AREAS AND VOLUMES

TENNESSEE VALLEY AUTHORITY

THIS DRAWING SUPERSEDES 10 PPI-321G61X
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<th>HOLE NUMBER</th>
<th>ELEVATION</th>
<th>TOP OF BED</th>
<th>MATTING</th>
<th>MILE</th>
<th>REMARKS</th>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>

**NOTES:**
- Geologic sections shown on drawing.
- Scale: 200 ft = 1 in.

**PROJECT:**
- TENNESSEE VALLEY AUTHORITY

**LOCATION AND SUMMARY OF CORE DRILLING**

**MAIN DAM AND CANAL**

**Scale:** 200 ft = 1 in. 400 ft = 16 in.
### Construction Planning Schedule

**Tellico Project**

**Tennessee Valley Authority**

**Division of Construction**

**General**

**Construction Planning Schedule**

#### STAGES

<table>
<thead>
<tr>
<th>CNTRB.</th>
<th>DATE</th>
<th>MAC</th>
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<td><strong>CONSTRUCTION PROCEDURE:</strong></td>
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<td>1. Protect earth fill dam area on island with dikes, work on foundation treatment, cut-off wall and stripping. Coffer dam west channel and build concrete dam and spillway. River flow diverted thru east channel.</td>
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<td>2. Cofferdam west channel and build earth fill dam. River flow diverted thru culverts in spillway.</td>
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<td>3. Place bulkheads at entrance to culverts. When reservoir has filled to the elevation of Fort Loudoun Reservoir remove plug in canal.</td>
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**Fiscal Year:**

<table>
<thead>
<tr>
<th></th>
<th>1965</th>
<th>1966</th>
<th>1967</th>
<th>1968</th>
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<tbody>
<tr>
<td><strong>Concrete Dam</strong></td>
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<tr>
<td><strong>Spillway</strong></td>
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<tr>
<td><strong>Auxiliary Dams</strong></td>
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<td><strong>Main Earth Dam</strong></td>
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<td><strong>Canal</strong></td>
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<td><strong>Reservoir Work</strong></td>
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<td><strong>General Yard Improvements</strong></td>
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</tbody>
</table>

**CONSTRUCTION PROCEDURE:**

1. Protect earth fill dam area on island with dikes, work on foundation treatment, cut-off wall and stripping. Cofferdam west channel and build concrete dam and spillway. River flow diverted thru east channel.
2. Cofferdam west channel and build earth fill dam. River flow diverted thru culverts in spillway.
3. Place bulkheads at entrance to culverts. When reservoir has filled to the elevation of Fort Loudoun Reservoir remove plug in canal.