

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LAKE LURE DAM

Rutherford, North Carolina

Inventory Number
Federal - NC 100
State - 81-003-H

BY

CHAS. T. MAIN, INC.

CHARLOTTE, NORTH CAROLINA

August, 1981

PREPARED FOR

LAND QUALITY SECTION
DIVISION OF LAND RESOURCES
NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
AND
COMMUNITY DEVELOPMENT

AND

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Cover Legend:

Green Front - Minor Observed Deficiencies
Black Back - High Hazard Potential Category

LAKE LURE DAM

PHASE I INSPECTION

Reviewed for compliance with National Guidelines and the State of North Carolina Dam Safety Program. The following State Personnel were involved with the inspection or review of this report:

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Chas H. Gardner

LAKE LURE DAM

This Phase I Inspection Report has been reviewed by the undersigned panel members. In our opinion, the reported findings, conclusions, and recommendations are consistent with COE's Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice.

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LAKE LURE DAM
PHASE I INSPECTION

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*Indicates field inspection team.

PREFACE

This report is prepared under guidance contained in Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams, for a Phase I investigation. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

The analyses and recommendations included in this report are related to the hazard classification of the structure at the time of the report. Future changes and conditions downstream from the dam may change the classification of the structure from that presented herein. A change in hazard classification may also change the design flood on which the hydraulic and hydrologic analyses are based and may have a significant impact on the assessment of the safety of the structure. It is important to note that the conditions of a dam depend on numerous and constantly changing internal and external conditions, and are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

SUMMARY ASSESSMENT

PHASE I REPORT

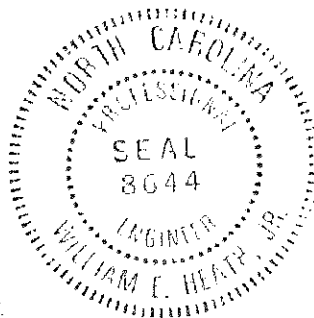
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Lure Dam
State Location: North Carolina
County Location: Rutherford
Water Course: Broad River
Date of Inspection: June 2, 1981

This concrete multiple-arch dam is "large" in size by National guidelines and "very large" in size by State guidelines. It is "high" in hazard potential by both State and National guidelines. Its maximum length is about 480 feet and maximum height is approximately 124 feet. The estimated lake storage capacity at normal pool is 32,295 acre-feet and the estimated maximum capacity at the top of the dam is 44,914 acre-feet. At the time of the field inspection, the water level was at about normal pool.

The spillway capacity is less than the required capacity based on both State (PMP) and National (PMF) guidelines; however, considering that the dam is concrete and in good condition, and the level abutments consisting of residual soils and rock outcroppings are protected from erosion with vegetation (and do not appear easily erodible), overtopping is not expected to promote structural, instability, or other safety related problems.

Visually, the structural condition of the dam appears to be good even though the concrete structure is showing some signs of minor spalling and efflorescence. A small amount of leakage was observed flowing through some construction joints in several of the arches. A slight amount of seepage was observed around the base of the concrete buttresses, but since the dam foundation is rock, the seepage does not appear to cause any problems. There is some minor erosion of concrete on the spillway adjacent to the left abutment. These deficiencies are considered minor and do not affect the structural stability of the dam, and are characteristic of a structure of this type construction and age. The dam appears to be well maintained.



A handwritten signature in dark ink, appearing to read "William E. Heath, Jr.", written over the printed name.

William E. Heath, Jr.
Registered, NC 8644

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LAKE LURE DAM
INVENTORY NUMBER
FEDERAL - NC 100
STATE - 81-003-H

1.0: PROJECT INFORMATION

1.1 General:

a. Authority:

Lake Lure Dam was inspected by Chas. T. MAIN, Inc. for the State of North Carolina and the U. S. Army Corps of Engineers as part of the National Dam Safety Program under Public Law 92-367, dated 8 August 1972.

b. Purpose of Inspection:

The purpose of the inspection was to assess the general condition of the dam and its appurtenances, evaluate its hydrologic and hydraulic capacities, identify hazards to human life and property, and determine the need for additional studies.

1.2 Description of Project:

Throughout this report, reference is made to the right and left sides of the reservoir, dam, and downstream channel. Unless otherwise noted, these directions are defined as when facing downstream.

a. Description of Dam and Appurtenances:

Lake Lure Dam is a concrete multiple-arch structure with 10 interior bays separated by buttress walls. Its overall length is about 480 feet and its structural height is approximately 124 feet. It has two small hydroelectric generators which are fed by penstocks (approximately 6.5 feet in diameter) with an intake structure located about 100 feet upstream of the dam. The penstocks are left open at all times except when maintenance on the turbines is required. On the dam, adjacent to the left abutment, there are four emergency spillways which are controlled by radial gates. Three of the gates are operated by a mechanical hoist which must be manually moved from one gate to the next and then hooked to a chain attached to the gate. The hoist is kept

in position over one gate to provide for quick opening of the gate in emergency situations. The fourth gate serves as a trash gate and is opened using a manual chain hoist. The crests of the concrete arches vary in elevation to provide additional spillway capacity while protecting the powerhouse. The two arches next to the spillways are 5.4 feet above normal pool elevation, while the next three are 13.4 feet above normal pool elevation. These three arches protect the powerhouse. The other five arches are 7.4 feet above the normal lake level. The dam appears to be supported on rock.

b. Location.

The dam is located in Rutherford County, North Carolina, on the Broad River on the eastern side of the town of Lake Lure. It is accessible from U. S. Route 64/74 which runs adjacent to the right side of the dam. Buffalo Creek Road, which intersects U.S. Route 64/74, runs over top of the dam.

The dam can be found on the USGS "Lake Lure," North Carolina, 15 minute quadrangle sheet at coordinates 35° 25.5' N latitude and 82° 11' W longitude.

c. Size Classification.

The dam has a structural height of approximately 124 feet. It impounds an estimated 32,295 acre-feet of water at normal pool and an estimated 44,914 acre-feet at maximum pool; therefore, the size classification is "large" by National guidelines and "very large" by State guidelines.

d. Hazard Potential Classification.

The hazard potential classification for this dam is "high" by both State and National guidelines. Uree, a town with a population of less than 100, is within one mile downstream of the dam.

e. Ownership.

The dam is owned by the Town of Lake Lure, P.O. Box 255, Lake Lure, North Carolina 28746. A contact for information concerning the dam is Emery Searcy, Disposal Plant and Electric Power Facility Operator, telephone (704)625-9396.

f. Purpose of Dam.

The purpose of Lake Lure Dam is to impound water to generate electricity and provide recreation.

g. Design and Construction History.

The dam designer is unknown. Original design plans are not available. As-built drawings were made in 1967 as part of a licensing requirement. The dam was constructed in about 1927, but the contractor is unknown. The Soil Conservation Service had no design or construction involvement with the Lake Lure Dam.

h. Normal Operational Procedures.

At the present time, water is continuously removed from the lake to run the electric generators, except when the generators are down for repairs. The plant operator carefully controls lake water level by using the penstocks and radial gates. The operator noted that he tries to keep the lake from rising more than 8 inches to prevent damage to upstream boat docks. He also indicated that in his eleven years as operator, he has only had to open one radial gate to prevent flooding.

1.3 Pertinent Data:

a. Drainage Area.

The contributory drainage area of Lake Lure Dam is 95 square miles. The predominant surface soil types in the watershed, according to information supplied by the SCS, are the Pacolet-Madison-Wedowee Association and the Hayesville-Saluda-Ashe Association (Hydrologic Soil Group B for both). The watershed slopes generally average about 30 percent.

b. Discharge at Dam Site:

Maximum known flood at dam site: No records available.

Normal flow at static pool level: 50 cfs (estimated).

Low stage spillway capacity: 9619 cfs (1 radial gate open).

Intermediate stage spillway capacity: (a) 9414 cfs (flow over 2 lowest arches).

(b) 16861 cfs (flow over 5 intermediate arches).

Emergency spillway capacity at maximum pool elevation: 1328 cfs (flow over 3 highest arches).

Gated spillway capacity at maximum pool elevation: 29789 cfs (total of 3 spillway gates and 1 trash gate open).

Total spillway capacity at maximum pool elevation: (a) 57392 cfs (all gates open and water overtopping all arches). (b) 37222 cfs (one gate open and water overtopping all arches).

c. Elevation:

The approximate mean sea level elevation of normal pool was estimated from the USGS "Lake Lure," North Carolina, 15 minute quadrangle sheet and as-built drawings to be 991 feet. An assumed datum of 100.0 feet was used for the lake normal pool water surface elevation to determine the following elevations. The assumed datum is not intended to be related to any existing mean sea level elevations.

Top of dam: 115.4 feet (top of road and abutments).

Maximum pool design surcharge: 115.4 feet.

Full flood control pool: N/A.

Recreation pool: 100.0 feet (normal pool).

Gated spillway crests: 89.4.

Low stage arch crest: 105.4 feet.

Intermediate stage arch crest: 107.4 feet.

High stage arch crest: 113.4 feet.

Lowest natural elevation at downstream toe: -8.6 feet (estimated).

Maximum tailwater: Unknown.

d. Reservoir:

Length of maximum pool: 12000 + feet.

Length of recreation pool: 12000 feet.

Length of flood control pool: N/A.

e. Storage.

Recreation pool: 32295 acre-feet.

Flood control pool: N/A.

Design surcharge: 12619 acre-feet.

Top of dam: 44914 acre-feet.

f. Reservoir Surface.

Top of dam: 910 acres.

Maximum pool: 910 acres.

Flood control pool: N/A.

Recreation pool: 746 acres.

Spillway crest: 670 acres.

g. Dam

Type: Concrete multiple-arch structure.

Length: 480 feet.

Structural height: 124.0 feet.

Hydraulic height: 122.0 feet.

Concrete arch thickness: 1.0 feet (estimated).

Volume of dam: 40000 cubic yards concrete (estimated).

Zoning: N/A.

Impervious core: N/A.

Cutoff: Unknown.

Grout curtain: Unknown.

Foundation: Rock (assumed from site inspection).

h. Diversion and Regulating Tunnel.

Diversion tunnel through dam was sealed with concrete after construction was completed.

i. Spillway System.

Type: Ogee weir with three large radial gates and one small trash gate.

Length of weir: 88.0 feet. (approximately)

Crest elevation: 89.4 feet.

Outlets and gates: There is an intake structure located 100 feet upstream of the dam. From this intake structure, two-6.5 feet diameter penstocks run to the powerhouse. These pipes draw water from the lake on a continuous basis to run the hydroelectric generators.

j. Bottom Drain.

There is no bottom drain associated with the dam. The penstocks and radial gates can be used to lower the lake level only about 10 to 15 feet.

k. Miscellaneous.

There are two small hydroelectric generators associated with the dam. The combined rated output of these generators is 3600 kw. Except during periods of maintenance, these generators constantly produce power which is sold to Duke Power Company. The generators may be isolated by using either the large drum gate at the intake structure or butterfly valves on the penstocks located inside the powerhouse.

There are no navigational locks at the dam.

2.0: ENGINEERING DATA

2.1 Design:

The dam designer is unknown. The original design plans are not available; however, several layout drawings, made by a surveying company for licensing requirements, are available in the Lake Lure Town Hall and are dated November, 1967. Pertinent information from the layout drawings have been included in the drawings in Appendix I. The Soil Conservation Service provided no assistance in the design of Lake Lure Dam.

2.2 Construction:

The dam was constructed in 1927. The contractor is unknown. The Soil Conservation Service provided no assistance in the construction of the dam.

2.3 Operation:

Presently, water is removed from the lake to run two small hydroelectric generators located in the powerhouse at the dam.

2.4 Evaluation:

a. Availability.

A set of engineering design plans for the dam is not available. An incomplete set of layout drawings, made by a surveying firm, is available at the Lake Lure Town Hall.

b. Adequacy.

Engineering plans are not available, and the layout drawings are not adequate to provide the basis for a complete safety evaluation of the dam.

c. Validity.

The available layout plans appear to be valid.

3.0: VISUAL INSPECTION

3.1 Findings:

a. General.

The dam was inspected on June 2, 1981 by W. Heath and H. Abrams of Chas. T. MAIN, Inc. Mr. Emery Searcy, Lake Lure Disposal Plant and Electric Power Facility Operator, accompanied the inspection team and provided some input. The dam generally appeared to be in good condition at the time of the inspection.

b. Dam.

The Lake Lure Dam is a concrete multi-arch dam. It consists of 10 individual arches and 10 buttress walls. Each arch has a 41 foot chord length and an upstream projection of about 10 feet. The typical arch has a very short vertical section at the crest of the dam and a long section angling downward on the upstream face at a slope of 1 horizontal to 1 vertical. The arches are held in place by the 10 buttress walls. The crest elevations of the arches vary. The two arches adjacent to the spillways have a crest elevation of 105.4 feet. The five arches adjacent to the right abutment have a crest elevation of 107.4 feet. The three remaining arches, which surround the powerhouse, have a crest elevation of 113.4 feet. The arrangement is assumed to provide maximum protection of the powerhouse and secondary protection to the right abutment in the event of an overtopping flood. The layout drawings of the dam show a 6-foot high tunnel running from the basement (under the turbine draft tubes) upstream to the toe of the concrete arch. The termination point of the tunnel is not defined and information concerning the purpose of the tunnel is not available. In the eighth arch from the right abutment, a sewer line, which runs under the lake and penetrates the arch, was noted. At the present time, a small lift station and V-notch weir are located in the confines of the arch and are used to monitor sewer flow. From this point, the sewer water is dumped into the Broad River. Adjacent to the left abutment is an ogee spillway crest. Flow over this spillway is controlled by three steel radial gates. A smaller ogee spillway, controlled by a small radial gate, is located adjacent to the others on the right side and is used as a trash release. A single-lane highway approximately 21 feet wide, runs along the crest of the dam and is supported on a reinforced concrete double T-beam section. The bridge structure appeared to be in good condition. The retaining wall at the left side of the spillway, extending downstream from the dam, also appeared to be in good condition.

The condition of the concrete at the time of inspection appeared to be very good. Several areas of minor spalling were located. In most cases, these spalls did not penetrate to the reinforcing steel. There were one or two places where spalling did expose rebars. These places were at a location where the concrete is under low stress; therefore, the spalls do not appear to affect the structural integrity of the dam. Some minor erosion of the concrete was noted on the spillway. This erosion is minor and is thought to be caused

by past leakage of water through the spillway gate seals. Some leakage was observed in the construction joints on some of the arches. This flow is minor and has caused some calcification of the concrete around the construction joints. This type of leakage, as well as the erosion and spalling, are typical of a concrete dam of this type of construction and age. In no case do these deficiencies appear to affect the structural integrity of the dam. Minor seepage flows were also noted at the base of the buttress walls and concrete arches. These flows are minor and clean. Since the foundation of the dam is on rock, these seepage flows do not appear to affect structural stability and are probably the result of water flow through fissures in the rock.

The abutment contacts appear to be in good condition, with no signs of seepage, misalignments, settlement, or erosion. The abutments consist of both soil and rock and are covered with a thick layer of kudzu. This kudzu has helped protect the abutments from erosion.

c. Appurtenant Structures.

The lake level is normally controlled by the flow of water into the intake structure for the hydroelectric generators associated with the dam. These generators are run on a continuous basis and the electricity produced is sold to Duke Power Company. The intake structure is a large metal structure located about 100 feet upstream of the dam. It is surrounded by a large metal trash rack and contains a cylindrical gate which can be raised or lowered by an electric hoist to regulate flow into the penstocks. The control for the hoist and gate is located in the powerhouse. The gate, hoist and trash rack appeared to be well maintained and regularly painted to protect the metal from corrosion. Either the gate or several butterfly valves located on the penstock inside the powerhouse can be used to isolate the turbines from the flow. The combined rated output of the two generators is 3600 kw. The penstocks for the two generators are approximately 6.5 feet in diameter. The powerhouse in which these generators are housed is located in the seventh arch from the right abutment. The powerhouse is a brick structure with two concrete floors inside. Power lines connect the powerhouse to a Duke Power substation located on the right abutment.

Located adjacent to the left abutment is a low stage spillway with three radial gates and one smaller radial trash gate. The trash gate is raised and lowered by means of a manual chain hoist located on a catwalk adjacent to the gate. The three spillway gates are raised and lowered by means of a single mechanical hoist located on a catwalk over top the gates. Chains run from the gates up to the catwalk and must be manually attached to the hoist for lifting. Only one gate can be raised or lowered at a time. The mechanical hoist is electrically operated but must be manually moved from gate to gate. Intermediate and emergency spillway capabilities are available by overtopping of variable height concrete arches.

The plant operator, Mr. Emery Searcy, indicated that he always keeps the hoist hooked to one gate to allow for emergency raising of the gate. He also noted that he uses the penstocks and the gate to maintain the lake water

surface within 8 inches of normal pool. When the lake level approaches this 8 inch mark, he raises the first gate in 2 foot increments until the lake water surface begins to recede. If the lake rises more than 8 inches, damage may be sustained in upstream boat docks. In his 11 years as operator, Mr. Searcy has never had to open more than one gate to prevent flooding.

A concrete retaining wall is located at the left abutment. The wall separates the stream channel and spillway tailraces from the channel side slope. The wall appeared to be in good condition with no signs of spalling and cracking.

There is not a functional low level outlet for this dam. By using the gates and the penstock, the lake level can be lowered approximately 15 feet, but, beyond that point, there is no means to drain the lake.

A condition that does not affect the structural condition of the dam, but which may affect the safety of the powerhouse operator, is a leak in the powerhouse roof that discharges into one corner of the powerhouse near some electrical equipment. The wet conditions could increase the hazard to the operator if he happened to come in contact with the electrical equipment. The roof leaks should be sealed to eliminate this defect.

There is no instrumentation program associated with this dam. The only instrumentation is a headwater level indicator gage.

d. Reservoir Area.

Shoreline slopes are moderate to steep and consist of mainly wooded areas with some residential structures located on the lake shoreline. There are no signs of instability or abnormal erosion and sedimentation around the shoreline. One impoundment exists upstream of Lake Lure on the Buffalo Creek Watershed.

e. Downstream Conditions.

Downstream from Lake Lure Dam is U.S. Route 64/74. This road runs by a couple of houses, small shops, and one trailer approximately 1/2 mile downstream of the dam. A little farther downstream at a bridge crossing the river, there are several church buildings near the river. In this area, a new resort community is being built. The name of the development is called River Bend Development and is in the initial stages of construction. In this development, a dam has recently been built on a tributary to Broad River, impounding Mirror Lake. Around this lake and farther upstream, are several residential structures. However, neither the Mirror Lake Dam nor the residences upstream from this dam would be affected by major flooding on the Broad River. Approximately 1 mile downstream of the Lake Lure Dam and in the floodplain of the Broad River is a small village called Uree with an estimated population of less than 100 people. This village is expected to be flooded in case of a breach at Lake Lure Dam or major flooding on the Broad River.

f. Erosion Protection.

The abutments of the dam are covered with a heavy growth of kudzu. The abutments consist of both residual soil and numerous rock outcroppings. These abutments are not highly susceptible to erosion. The kudzu appears to be sufficient erosion protection in the areas covered with soil, even though kudzu is not considered a desirable ground cover for these steep slopes.

g. Hazard Evidence.

Within a 1/2 mile downstream of the dam, there are several houses and small shops and one trailer. Located further downstream U.S. Route 64/74 crosses the creek in an area where several church buildings are located. Also in this area, a new resort community is being built, which at present contains several residential structures. These downstream facilities, which could flood if the dam were to fail, resulting in loss of life and property damage, categorize the Lake Lure Dam as "high" (by both State and National guidelines) in hazard potential.

h. Foundation.

As noted in the field inspection and as seen on the layout drawings, the dam appears to be supported on bedrock.

3.2 Evaluation:

The dam and abutments appear to be in good condition. Several deficiencies were observed and are as follows: An area of erosion of the concrete was noted in the spillway. Some leakage was seen in the construction joints of several of the concrete arches. Some seepage was observed at the base of the dam underneath the buttress walls and concrete arch toes. There is no known low-level outlet structure for this dam. The deficiencies, with the exception of the lack of a low-level outlet, are minor and characteristic of a concrete dam of the nature and age of Lake Lure Dam and do not affect the structural stability of the dam. A roof leak in the powerhouse, which does not affect the structural integrity of the dam, poses some increased hazard to the powerhouse operator by increasing the danger of electric shock.

4.0: OPERATIONAL PROCEDURES

4.1 Procedures:

There are apparently no defined operational procedures for Lake Lure Dam. The dam and powerhouse are operated by the plant operator using his discretion based on judgement and experience. Operations include running the hydroelectric generators on a continuous basis and maintaining the lake level at a fairly constant elevation. His duties include general inspections of the dam and appurtenances and performing maintenance on an as-needed basis.

4.2 Maintenance of Dam:

The dam and spillway equipment are kept in good working order by the plant operator. Visual inspection of the dam indicated that all the steel surfaces, such as the gates, hoist, and catwalks, have been cleaned and painted within the last three to four years. The operator indicates that he periodically cleans trash and debris from the upstream edge of the spillway gates to prevent blocking of the spillways.

4.3 Maintenance of Operating Facilities:

Maintenance on the powerhouse equipment is performed by the plant operator when required. The turbines can be isolated by using either the cylindrical gate at the intake structure or butterfly valves on the penstocks located in the powerhouse. The generators are kept running on a continuous basis with shutdowns for maintenance only.

4.4 Description of Warning Systems in Effect:

There are no apparent warning systems in effect for this dam.

4.5 Evaluation:

The dam is in good condition. It appears that no consistent maintenance plan is in effect for this dam; however, maintenance is performed on an as-needed basis. No operational procedures are defined, but the dam is smoothly run by the plant operator. It should be noted that the plant operator, Emery Searcy, appears to be a very conscientious man who does a good job in keeping the dam and powerhouse running efficiently.

5.0: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features:a. Design Data.

No design data are available.

b. Experience Data.

No experience data are available.

c. Visual Observations.

The dam does not appear to have overtopped in the recent past. There is some seepage at the base of the dam, but since the foundation is rock, this does not appear to cause a problem. Some leakage was observed in several of the arches at construction joints in the concrete. The flow is minor and does not appear to affect the integrity of the dam. Areas of minor erosion of concrete were seen on the spillways and are probably the result of past leakages through the gate seals. These deficiencies are minor and are characteristic of a dam of the age and construction of Lake Lure Dam.

d. Overtopping Potential.

No streamflow records were obtained for the Broad River near the dam site. Inflow estimates for Lake Lure Dam were derived synthetically as described in Appendix III.

The dam is "large" in size by National guidelines and "very large" in size by State guidelines. The hazard potential classification is "high" by both State and National guidelines screening criteria. The required spillway design flood (SDF) by State guidelines is the flood which results from a full PMP storm. By National guidelines, the SDF is the flood which results from a PMF. Calculations and computer printouts for the inflow hydrograph and flood routing through the reservoir are found in Appendix III.

Based on the SCS methods of determining the inflow rate and reservoir storage-routing, the abutments of the dam will overtop in the event of a storm equivalent to about 33% of the PMP with one radial gate open. The calculated peak flood outflow for a full PMP storm (State guidelines) is about 251,886 cfs and the abutment would overtop by about 15.0 feet (assuming only one radial gate is open). Flow velocities are estimated to be 18.03 feet/second.

Using the Corps of Engineers regionalized equation, the peak PMF inflow is 213,250 cfs. Assuming no storage in the reservoir, the peak outflow, with one radial gate open, is also 213,250 cfs. For this outflow, the abutments would overtop by approximately 12.9 feet and the outflow velocity

would be approximately 16.7 feet/second. The inflow for a 1/2 PMF is 106,625 cfs. Assuming the same conditions above the outflow will also be 106,625 cfs. For this outflow the abutments would overtop by approximately 6.7 feet and the outflow velocity would be approximately 11.6 feet/second.

The calculations presented above are based on a single storm with the water level at normal full pond at the beginning of storm inflow. The flow rates and overtopping depths are based on preliminary calculations and may not be suitable for design.

Since the dam is concrete and the abutments are relatively level, and consist of rock and residual soils well protected with vegetation, significant erosion is not expected to occur on the abutments; therefore, the effect of the stability of the structure by overtopping is expected to be relatively minor.

6.0: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability:

a. Visual Observations.

Visually, the dam structure appears stable and in good condition. There is no visual indication of movement or cracking in the dam. There is some minor erosion of concrete on the spillway. Several seepages are located at the base of the dam apparently resulting from minor flow through the rock foundations. Leakages were observed at construction joints in some of the arches. Areas of minor spalling and efflorescence were noted in the concrete arches. These deficiencies are minor and characteristic of concrete dams. They do not appear to affect the structural stability of the dam. They should be monitored in the future to ascertain any changes in conditions which might impair the dam's stability.

b. Design and Construction Data.

Design plans are not available. Some layout drawings, made by a surveying company several years ago, are available for inspection at the Lake Lure Town Hall. Construction data concerning the dam are not available.

c. Operating Records.

There are no known operating records for this dam.

d. Post-Construction Changes.

There are no known post-construction changes in the dam structure.

e. Seismic Stability.

Provisions in the design for the seismic stability of the structure are unknown. The dam is located in seismic zone 2, a zone of moderate seismic damage potential. The stability of the dam during flooding was not evaluated.

7.0: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment:

a. Safety.

Visually, the structural condition of the dam is good. The dam is a "high" hazard potential structure because houses and U.S. Route 64/74 are situated in the floodplain about 3000 feet downstream.

The capacity of the spillway is inadequate to pass the spillway design flood peak based on both National (PMF) and State (PMP) guidelines screening criteria; however, since the dam is concrete and the abutments are rock and residual soils which are relatively level and protected by vegetation, the overtopping of the abutments is not expected to promote structural instability, or other safety-related problems.

b. Adequacy of Information.

Quantitative information on structural stability is not available. Hydrologic and hydraulic calculations are based on generalized hydrologic data.

The condition of the dam was such that a thorough inspection could be performed. Additional Phase I inspections of Lake Lure Dam are not required at this time.

c. Urgency.

The dam appears to be in good repair and is occasionally inspected. Repairs are not required at this time due to the condition of the dam. Deficiencies previously noted should be monitored in the future to determine if any degradation to the dam is occurring. This action is not urgent, based on the visual condition of the structure at the present time.

d. Necessity for Additional Studies.

No additional studies are considered necessary.

7.2 Remedial Measures:

a. Alternatives.

Repairs to the dam are not considered necessary at this time. Deficiencies noted are characteristic of concrete dams and do not appear to affect the dam's stability or performance. The deficiencies should be monitored on a regular basis to ascertain any changes in conditions which might affect the dam. The powerhouse roof, however should be repaired as soon as possible to prevent further leakage into the powerhouse around electrical gear.

An additional precaution that is suggested is that a warning system be installed to alert the Highway Department that high waters will be experienced at the bridge during flood conditions.

b. Operation and Maintenance Procedures.

The dam should be inspected annually. Any deficiencies observed during future inspections should be repaired promptly upon discovery.

APPENDIX I

Drawings



Scale 1:250,000

0 5 10 15 20 25 Statute Miles

CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL



QUADRANGLE LOCATION

WATERSHED BOUNDARY

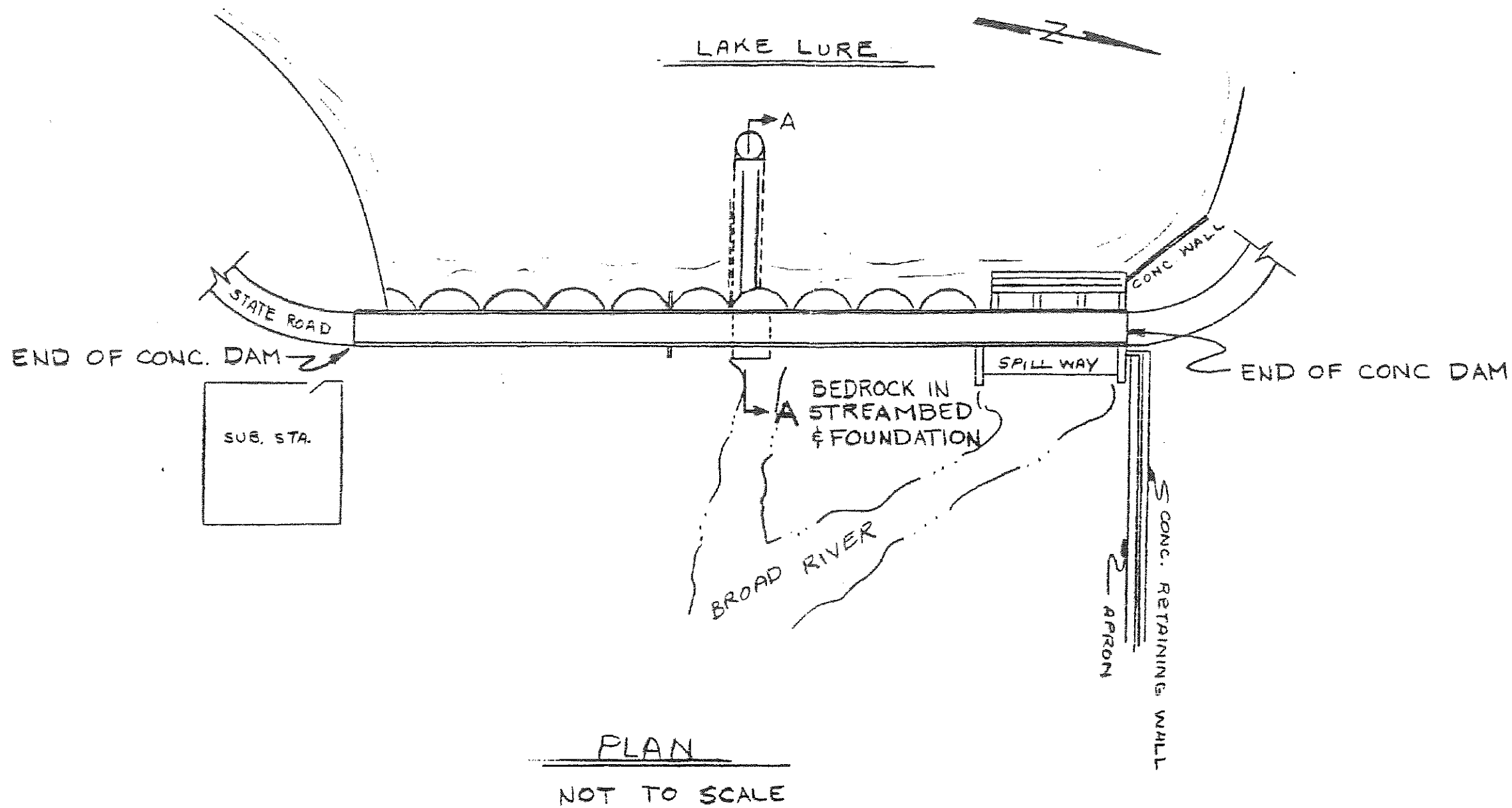
N.C. DEPT. OF NAT. RES. & COMM. DEV.

MAIN

LAKE LURE DAM
RUTHERFORD COUNTY, N.C.

TOPOGRAPHIC MAP

AS20-51 52.1 5/27/60 1909-7-1-R1



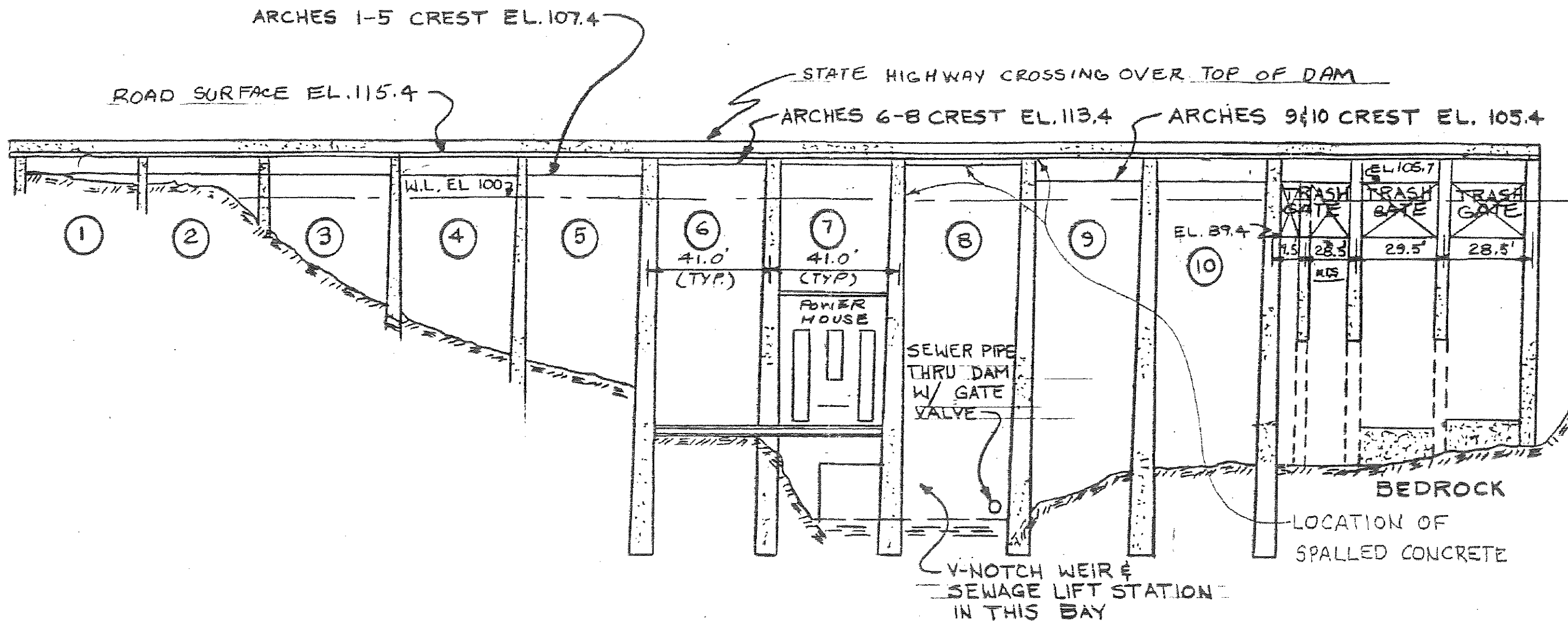
N.C. DEPT. OF NAT. RES. & COMM. DEV.

MAIN

LAKE LURE DAM
RUTHERFORD COUNTY, N.C.

PLAN

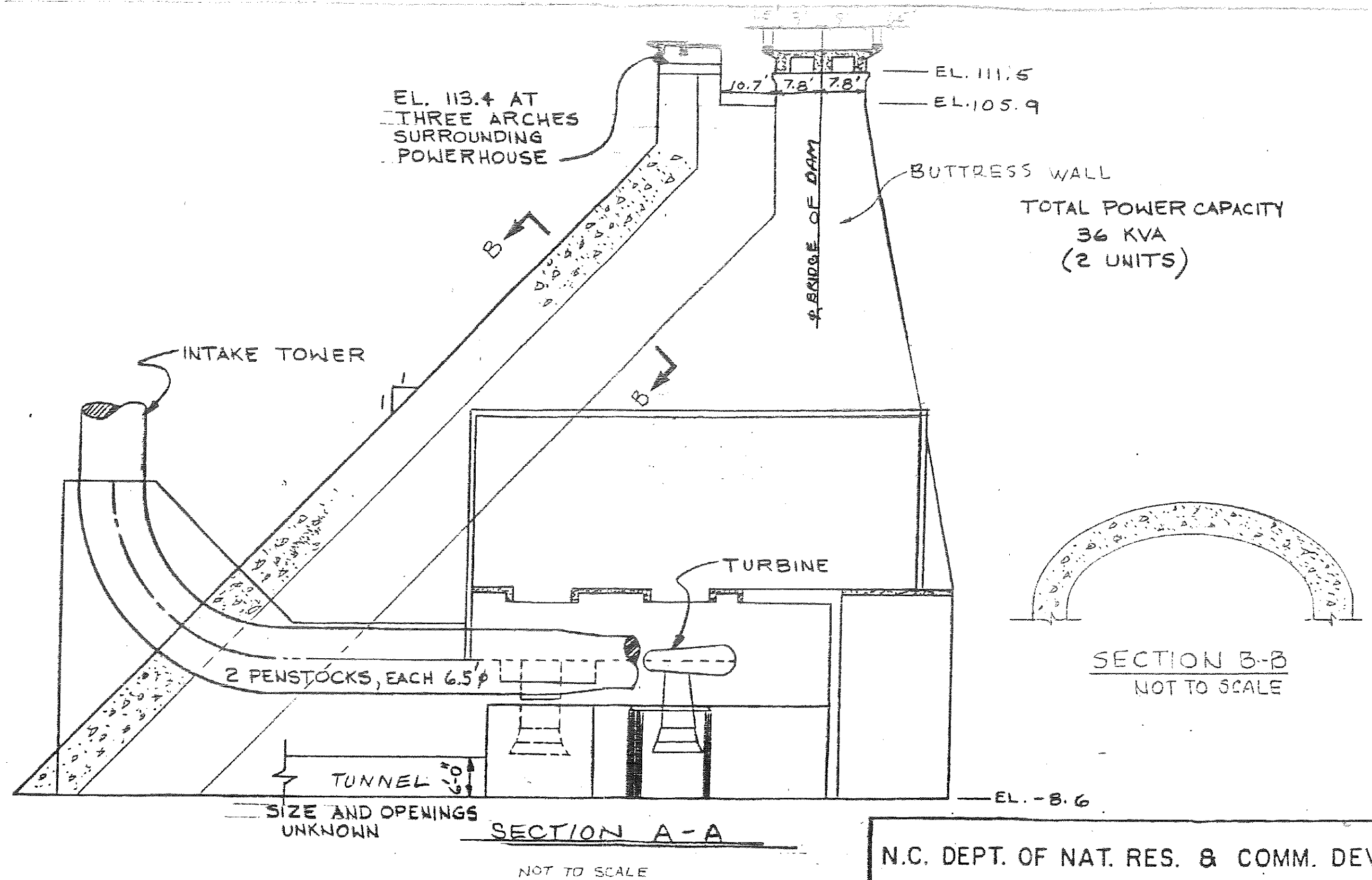
DRAWN BY DATE DWG NO. 1000-1 FIG. 1



DOWNSTREAM ELEVATION

NOT TO SCALE

N.C. DEPT. OF NAT. RES. & COMM. DEV.			
MAIN		LAKE LURE DAM RUTHERFORD COUNTY, N. C.	
DOWNSTREAM ELEVATION			
DRAWN BY ACH	DATE 6-12-81	DWG NO. 1909-7-7	FIG. 2



N.C. DEPT. OF NAT. RES. & COMM. DEV.

MAIN

LAKE LURE DAM
RUTHERFORD COUNTY, N.C.

SECTION

DRAWN BY
A.C.

DATE
6-12-31

DWG NO.
1909-7-7

FIG. 3