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NATIONAL DAM SAFETY PROGRAM. STRUCTURE F-2 (MO 20513), VERDIGRI--ETC(U)
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STRUCTURE F-2

NEWTON COUNTY, MISSOURI

MO 20513

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST, 1980

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Structure F-2
Newton County, Missouri
Missouri Inventory No. 20513

This report presents the results of field inspection and evaluation of the Structure F-2. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

17 SEP 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

18 SEP 1980
Date

VERDIGRIS-NEOSHO RIVER BASIN

STRUCTURE F-2
NEWTON COUNTY, MISSOURI
MISSOURI INVENTORY NO. 20513

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

AUGUST, 1980

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
SUMMARY

Name of Dam: Structure F-2
State Located: Missouri
County Located. Newton
Stream: Tributary of Lost Creek
Date of Inspection: May 29, 1980

Structure F-2 was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately 1 mile downstream of the dam. Located within this zone are approximately 20 dwellings, all in the town of Seneca.

The dam is in the small size classification, since it is greater than 25 ft high but less than 40 ft high, and the maximum storage capacity is greater than 50 ac-ft but less than 1000 ac-ft.

Our inspection and evaluation indicates that the combined spillways do meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 75 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the height of dam (28 feet), and the maximum storage capacity (56 acre-feet) and the low volume of permanent water storage, 50 percent of the

PMF has been determined to be the appropriate spillway design flood. The 1 percent probability flood will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being exceeded in any given year.

Deficiencies visually observed by the inspection team were: (1) some small brush growth on the embankment faces; and (2) heavily wooded downstream channel.

Another deficiency was the lack of seepage and stability analysis comparable to the requirements of the recommended guidelines.

It is recommended that the owners take the necessary action without undue delay to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

Jack Healy, P.E.
Hanson Engineers, Inc.

Steve Brady, P.E.
Anderson Engineering, Inc.

Nelson Morales, P.E.
Hanson Engineers, Inc.

Tom Beckley, P.E.
Anderson Engineering, Inc.

AERIAL VIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
STRUCTURE F-2 ID NO. 20513

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Structure F-2 in Newton County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria.

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

Structure F-2 is an earth fill structure approximately 28 ft high and 330 ft long at the crest. The appurtenant work consists of a 30 inch diameter reinforced concrete primary spillway pipe with a reinforced concrete flow riser and an earth cut swale located at the east abutment.

Sheet 3 of Appendix A shows a plan, profile and typical section of the embankment as obtained from field inspection data. Sheets 6 through 10 of Appendix A are selected As Built drawings obtained from the U. S. Department of Agriculture, Soil Conservation Service, Columbia, Missouri.

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B. Location:

The dam is located in the southwestern part of Newton County, Missouri on a tributary of Lost Creek. The dam and lake are within the Seneca, Missouri 7.5 minute quadrangle sheet (Section 36, T25N, R34W - latitude 36°51.0'; longitude 94°36.4'). Sheet 2 of Appendix A shows the general vicinity. Sheet 5 of Appendix A is the Project Map developed as part of the Work Plan for Watershed Protection and Flood Prevention for the Lost Creek Watershed prepared by the Soil and Water Conservation District of Newton County.

C. Size Classification:

With an embankment height of 28 ft and a maximum storage capacity of approximately 56 acre ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam. The estimated damage zone extends approximately 1 mile downstream of the dam. Located within this zone are approximately 20 dwellings, all in the town of Seneca. The inspection team verified the existance of the dwellings located in the estimated damage zone. Photographs #11 and #12 show some of these dwellings.

E. Ownership:

The dam is owned by the Lost Creek Watershed Subdistrict, Jim Stone, Chairman, P. O. Box 149, Neosho, Missouri 64850; and is on property owned by Mrs. Paul Stelts, Seneca, Missouri 64865.

F. Purpose of Dam:

The dam was constructed under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Statue 666) as amended primarily for the purpose of a Debris Basin Structure for the Lost Creek Watershed, Newton County, Missouri.

G. Design and Construction History:

The dam was designed by the U. S. Department of Agriculture, Soil Conservation Service, Columbia, Missouri, under the Authority of the Watershed Protection and Flood Prevention Act. Prior to the design of the dams, a watershed work plan for the Lost Creek Watershed was prepared in January, 1971, by the Soil and Water Conservation District of Newton County with assistance by SCS. A partial set of As Built Plans are included as Sheets 6 through 10 of Appendix A. A complete set of plans are available through the Columbia, Missouri office of SCS.

Geologic Investigation and analysis completed by SCS are included as Sheets 3 through 20 of Appendix B.

The contract for construction was let on July 22, 1976, for Newton County Structure F-2. Newton County Structures F-1 and F-3 were included in the contract with Structure F-2.

The contractor for this project was Higginbotham Construction Company, Route 1, Brookline, Missouri. Construction commenced in October, 1976, and the dam was completed in July, 1977.

Inspection of the project was conducted under the control of Mr. Joe Green, Project Engineer, Soil Conservation Service, Mount Vernon, Missouri. Results of the inspection and testing including inspectors field notes, compaction and concrete reports, are currently on file in the Columbia, Missouri SCS office.

Mr. Higginbotham indicated that the dam was built in general conformance with the plans and that no modifications were required during construction. The core trench was excavated to the elevations shown on the plans and filled in with select material from the borrow area located within the lake bed. Compaction of the embankment was by the use of a double sheepsfoot roller. He stated that the emergency spillway section was excavated to the plan elevation and topsoil was placed over the exposed rock and compacted earth to the final spillway elevation.

Mr. Green likewise indicated that no modifications were required to the plans during the construction phase. He or one of his staff performed daily inspections during the course of construction.

H. Normal Operating Procedures:

All flows will normally be passed by the restricted flow riser to the 30 inch spillway pipe and the uncontrolled earth cut emergency spillway. Information obtained from Mr. Green indicates that the maximum pool level for this dam was approximately 2.5 feet above the 8 inch diameter slide gate.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment from field data obtained by the inspection team. Sheets 6 through 10 of Appendix A are selected sheets from the complete set of As Built plans prepared by the Soil Conservation Service.

A. Drainage Area:

The drainage area for this dam, as obtained from the Watershed Work Plan and As Built Plans (Sheet 10 of Appendix A) is approximately 80 acres.

B. Discharge at Dam Site:

(1) All discharge at the dam site is through the restricted flow riser for the 30 inch diameter principal spillway pipe and an uncontrolled earth cut emergency spillway.

(2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 947.4). 1096 cfs

(3) Estimated Capacity of Principal Spillway: 21 cfs

(4) Estimated Capacity of Emergency Spillway: 1075 cfs

(5) Estimated Experienced Maximum Flood at Dam Site. No Flow Through Spillways Reported

(6) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable

(7) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

(8) Gated Spillway Capacity at Pool Elevation: Not Applicable

(9) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed mean sea level elevation of 918.64 for T.B.M. #8, described in As Built Plans as nail in north side of 24 inch Mulberry Tree on left slope, 15 south of toe, approximately 30 feet east of north-south property line fence (See Sheet 6 of Appendix A).

(1) Top of Dam. 947.4

(2) Principal Spillway Crest: 931.9

(3) Emergency Spillway Crest: 943.3

(4) Principal Spillway Pipe Invert Elevation at Outlet: 917.6

(5) Streambed at Centerline of Dam: 920.0

(6) Pool on Date of Inspection: 927.8

(7) Apparent High Water Mark: 925.0

(8) Maximum Tailwater: None

(9) Upstream Portal Invert Diversion Tunnel: Not Applicable

(10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

(1) At Top of Dam: 800 Feet

(2) At Principal Spillway Crest: 400 Feet

(3) At Emergency Spillway Crest: 700 Feet

E. Storage Capacities:

(1) At Principal Spillway Crest: 7.6 Acre-Feet

(2) At Top of Dam: 56 Acre-Feet

(3) At Emergency Spillway Crest: 35.6 Acre-Feet

F. Reservoir Surface Areas:

(1) At Principal Spillway Crest: 1.4 Acres

(2) At Top of Dam: 4.9 Acres

(3) At Emergency Spillway Crest: 3.9 Acres

G. Dam:

(1) Type: Earth

(2) Length at Crest: 330 Feet

(3) Height: 28 Feet

(4) Top Width: 14 Feet

(5) Side Slopes: Upstream varies from 1V:2.83H to 1V:6.82H; Downstream varies from 1V.2.66H to 1V:3.49H

(6) Zoning: Gravelly Silt and Clay

(7) Impervious Core: 12 Feet Wide

(8) Cutoff: 8 Feet Below Base of Dam

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: Not Applicable

(2) Length: Not Applicable

(3) Closure: Not Applicable

(4) Access: Not Applicable

(5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

(1) Location. Centerline Dam Station 3 + 00

(2) Type: 30 Inch Diameter Reinforced Concrete Pipe with Restricted Flow Riser

I.2 Emergency Spillway:

(1) Location: East Abutment

(2) Type: Earth Cut Swale, 50 ft wide, embankment (north) slope 1V:3H, abutment (south) slope 1V:2H

(3) Upstream Channel: Grass covered earth channel

(4) Downstream Channel: Grass covered, steep to moderate earth slopes

J. Regulating Outlets:

The 8 inch diameter slide gate associated with the restricted flow riser is the only regulating outlet feature of the dam.

SECTION 2 ENGINEERING DATA

2.1 DESIGN:

Design calculations and construction plans were prepared by and are currently on file with the U. S. Department of Agriculture Soil Conservation Service in Columbia, Missouri. A partial set of these plans are included as Sheets 6 through 10 of Appendix A. A Watershed Work Plan was prepared for the Lost Creek Watershed prior to the design phase. A copy of the Project Map is included as Sheet 5 of Appendix A. This plan, prepared under the Authority of Public Law 566, is also on file in the Columbia SCS office.

A. Surveys:

A topographic survey was conducted by the Soil Conservation Service for the Lost Creek watershed. The survey was tied to the sea level datum, and temporary benchmarks were located at each dam site. Concrete monuments were set at each end of the embankment by SCS. A description of these benchmarks is shown on Sheet 6 of Appendix A. From the topographic survey data a 4 foot contour interval map was drawn for design purposes.

B. Geology and Subsurface Materials:

The site is located in the border zone between the Ozarks and Western Plains geologic regions of Missouri. This area is characterized topographically by rolling to hilly with oak and hickory forest areas. The sedimentary rock layers exposed in the Ozarks region dip downward away from the Ozarks region and the higher and younger sedimentary deposits become the surface ledges in southwest Missouri. The soils in this region are residual from cherty and dolomitic limestones of the Mississippian age. The site is located upon an outcrop of the Warsaw formation of the Meramecian series. The limestone bedrock occurs at an average depth of 10 feet below initial ground level along the entire dam centerline, as described in the Geologic Report on the site. The Geologic Report prepared by the Soil Conservation Service is contained in Appendix B.

Soils in the area of the dam are one of this area's most common soils. The embankment soils are reddish-brown silty clays (CL) with chert rock fragments. The chert is from the parent material and is found in each of the soil layers of this soil series. These soils generally make good fill material when properly compacted.

The "Geologic Map of Missouri" indicates that two known faults run in a northeast-southwesterly direction through or very near the dam site. The Missouri Geological Survey has indicated that these faults are known as the Seneca faults and there is no known activity or movement. These faults in this area are generally considered to be inactive. The publication "Caves of Missouri" indicates there are four caves in Newton County and these are several miles from the dam site.

C. Foundation and Embankment Design:

Included as Sheet 3 of Appendix B is the Geologic Investigation of Dam Site for this structure. The profile at the centerline of the dam shows the location of the borings as obtained by SCS. Sheets 4 through 13 of Appendix B are the detailed soil investigation with conclusions from the study. Sheets 12 and 13 of Appendix B are a discussion of the results from the Soil Mechanics Laboratory of SCS. One of the tests performed was slope stability analysis.

Based upon the available information, the basic foundation soil appears to be silty clays (CL). There is apparently no particular zoning of the embankment and no internal drainage features are known to exist.

D. Hydrology and Hydraulics:

The hydrologic and hydraulic design parameters of this dam are as shown on Sheet 10 of Appendix A. The Soil Conservation Service surveyed 17 valley cross-sections in the watershed and routed 8 evaluation storms through the channel using the T. R. 20 computer program. Assistance was obtained from the Tulsa District, Corps of Engineers for the study and evaluation. Based on the As Built Plans and a field check of spillway dimensions and embankment evaluations and a check of the drainage area on U.S.G.S. quad sheets, hydrologic analysis using U. S. Army Corps of Engineers guidelines was performed and appear in Appendix C as Sheets 1 through 9.

E. Structure:

The only structure associated with this dam is the restricted flow riser. Details of this riser appear as Sheet 9 of Appendix A.

2.2 CONSTRUCTION:

Inspection during the construction of the dam was performed by the Soil Conservation Service Office, Mount Vernon, Missouri, under the direction of Mr. Joe Green, Project Engineer. Mr. Green stated that daily inspection was performed during construction. The inspector's log and inspection tests, to include compaction and concrete testing, are currently on file at the Soil Conservation Service Office, Columbia, Missouri. The construction inspection data were not obtained.

2.3 OPERATION:

Normal flows would be passed by the restricted flow riser to the 30 inch diameter spillway pipe and the uncontrolled earth-cut spillway. Mr. Green stated that normally the 8 inch diameter slide gate on the flow riser is closed.

2.4 EVALUATION:

A. Availability:

The engineering data available are as listed in Section 2.1.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. Seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. The seepage analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

The As Built Plans and Soil Investigation data and test results prepared by the Soil Conservation Service included in Appendices A and B are valid engineering data on the design and construction of the dam.

SECTION 3 - VISUAL INSPECTON

3.1 FINDINGS:

A. General:

The field inspection was made on May 29, 1980. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri, and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steve Brady Anderson Engineering, Inc., (Civil Engineer)
Tom Beckley Anderson Engineering, Inc., (Civil Engineer)
Jack Healy - Hanson Engineers, Inc., (Geotechnical Engineer)
Nelson Morales - Hanson Engineers, Inc., (Hydraulic Engineer)

Photographs of the dam, appurtenant structures, reservoir, and downstream features are presented in Appendix D.

B. Dam:

The dam appears to be in good condition. No sloughing or sliding of the embankment was noted. The horizontal and vertical alignments of the crest were good, and no surfacing cracking or unusual movement was obvious. The crest of the embankment was 14 feet wide and the lowest crest elevation was 947.4. The field survey data obtained by the inspection team compared favorably to the As Built Plans for this dam.

On the date of inspection, the pool level was about 1.3 feet above the slide gate invert. An apparent high water mark was observed on the riser structure 1.2 feet above the inspected pool level. According to Mr. Green, that is the high water elevation to his knowledge. He stated that the dam has never held water. To his knowledge there has not been any attempt to locate the apparent leakage. The Lost Creek Watershed Work Plan noted that the geologic site conditions make permanent water storage unpredictable. As the structure was intended to function as a Debris Basin Structure, permanent water storage is not a major factor.

Shallow auger probes into the embankment indicated the fill material to be a reddish-brown silty clay (CL.). The embankment is grass-covered and appears to be in good condition. Due to the heavy grass cover, thorough inspection of the embankment was difficult. No sloughing of the embankment or seepage through the embankment was evident. No animal burrows were noted. No serious erosion was observed.

No rip rap was noted on the upstream face at normal pool elevation. Due to the lack of permanent water capability and the heavy grass cover, erosion does not appear to be a problem. A scattering of light brush growth on the embankment was noted.

No instrumentation (monuments, piezometers, etc.) other than T.B.M. #8 was observed.

C. Appurtenant Structures:

C.1 Principal Spillway:

The principal spillway consisting of the 30 inch reinforced concrete spillway pipe and associated flow restrictor riser is in good condition. The 8 inch diameter slide gate was in good working condition. Opening of the slide gate and permitting a small quantity of water to exit the spillway pipe was performed by the inspection team.

The approach to the inlet structure was clear. Considerable rip rap was placed around the inlet structure. The principal orifice (11 feet above the structure invert) did not appear to have been used. Past flow through the spillway pipe occurred when the slide gate was opened. Mr. Green stated that occasionally the slide gate would be open when he visited the site.

No rip rap was noted at the outlet of the spillway pipe. However, due to the absence of any appreciable flow through the pipe no erosion was observed.

C.2 Emergency Spillway:

The emergency spillway was located at the east abutment. The spillway channel appeared to be an earth cut channel. The grass cover in the channel was good with no noticeable erosion. The spillway has not been used since the dam was constructed. According to Mr. Higginbotham portions of the spillway were excavated to rock and then covered with topsoil. Continued use of the spillway would probably result in appreciable erosion.

The outlet channel is directed well away from the embankment. The outlet and inlet channel were clear.

D. Reservoir:

The immediate periphery of the lake was wooded and grass covered with moderate slopes. The reservoir banks appeared to be in good condition with heavy grass cover. No appreciable sedimentation was noted.

E. Downstream Channel:

Immediately downstream of the embankment the channel is grass covered. Approximately 50 yards downstream the channel becomes narrow with heavy brush and tree growth. The slopes are steep to moderate.

3.2 EVALUATION:

Due to the apparent geologic conditions, the dam does not impound any appreciable permanent water storage. With use as a debris basin structure with limited flows, the absence of rip rap on the upstream face of the embankment and at the principal spillway pipe and the unlined emergency spillway section do not appear to be significant.

Some light brush growth was noted on the embankment. The grass cover on the dam was good. The presence of any seepage areas could not be observed due to the lack of water impounded by the dam.

Photographs of the dam, appurtenant structures, and the reservoir are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

The operation and maintenance of the dam are the responsibility of the Lost Creek Watershed District Board in conjunction with the Soil and Water Conservation District, Neosho, Missouri. For the first three years after construction of the dam, a joint inspection is being conducted by members of the District Board and the Soil Conservation Service. After three years the District Board is responsible for providing yearly inspections. In addition to the annual inspection, the dam is to be inspected after each severe flood and after the occurance of any other unusual conditions which might adversely affect the structural measure. The inspection is to include the condition of primary spillway and its appurtenances, the emergency spillway, the earthfill and any other items installed as a part of the structure. Copies of the inspection report are forwarded to the Soil Conservation Service office in Springfield, Missouri. The last annual inspection was conducted on May 14, 1980, and the results are included as Sheet 11 of Appendix A.

4.2 MAINTENANCE OF DAM:

After the yearly inspection of the dam, the Lost Creek Watershed District Board determines the maintenance to be done. Monies for the required maintenance are derived from a tax levey imposed upon the residents of the Watershed District.

4.3 MAINTENANCE OF OPERATING FACILITIES:

The maintenance required for the restricted flow riser is accomplished after the yearly inspection by the Watershed District Board. The slide gate appeared to be in good condition.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

The general maintenance of the dam and associated items appeared to be in good condition. The brush growth should be removed from the dam on a yearly basis. Should the dam ever provide permanent water storage, rip rap may be required on the upstream face and at the outlet of the principal spillway.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

The hydrologic and hydraulic design data for this dam are as shown on Sheet 10 of Appendix A.

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were obtained for this lake and watershed. During the design phase, flood frequency used in evaluation of damages was obtained from six representative stream gauges in the surrounding area.

C. Visual Observations:

The approach channels to the spillway are clear. The emergency spillway is well separated from the embankment, and spillway releases would not be expected to endanger the dam. Spillway flows through the principal spillway pipe could result in erosion at the pipe outlet. The downstream channel has a dense growth of brush and trees.

D. Overtopping Potential:

The hydraulic and hydrologic analyses (using the U. S. Army Corps of Engineers guidelines and the HEC-1 computer program) were based on (1) a field survey of spillway dimensions and embankment elevations; (2) an estimate of the reservoir storage and the pool and drainage areas from the Seneca Missouri, 7.5 Minute U.S.G.S. quad sheet; and (3) data obtained from the As Built Plans for this project (See Appendix A, Sheets 6 through 10).

Based on the hydrologic and hydraulic analysis presented in Appendix C, the combined spillways will pass 75 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the height of dam (28 feet), the maximum storage capacity (56 acre-feet) and the low volume of permanent water storage 50 percent of the PMF has been determined to be the appropriate spillway design flood. The structure will pass a 1 percent probability flood without overtopping.

Application of the probable maximum precipitation (PMP), minus losses, resulted in a flood hydrograph peak inflow of 1964 cfs. For 50 percent of the PMP, the peak inflow was 982 cfs.

The routing of the PMF through the spillways and dam indicates that the dam will be overtopped by 0.76 feet at elevation 948.16. The duration of the overtopping will be .33 hours, and the maximum outflow will be 1609 cfs. The maximum discharge capacity of the spillways is 1096 cfs. The routing of 50 percent of the PMF indicates that the dam will not be overtopped. The maximum outflow will be 671 cfs. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

Design data obtained are included in Appendix A. Analysis of the soil structure is included in Appendix B. Additional design data and construction notes and test results are located at the Soil Conservation Service in Columbia, Missouri.

Seepage and stability analysis comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

There have been no reported post-construction changes to this dam.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analysis performed for this dam.

SECTION 7 ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is in good condition. Some items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) light brush present on the embankment faces; and (2) the downstream channel was heavily wooded.

Another deficiency was the lack of seepage and stability analyses comparable to the recommended guidelines.

The dam will be overtopped by flows in excess of 75 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will deteriorate and possibly could become serious in the future.

D. Necessity for Additional Inspection:

Based on the result of the Phase I inspection, no additional inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Alternatives:

Not Applicable

B. O & M Procedures:

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.

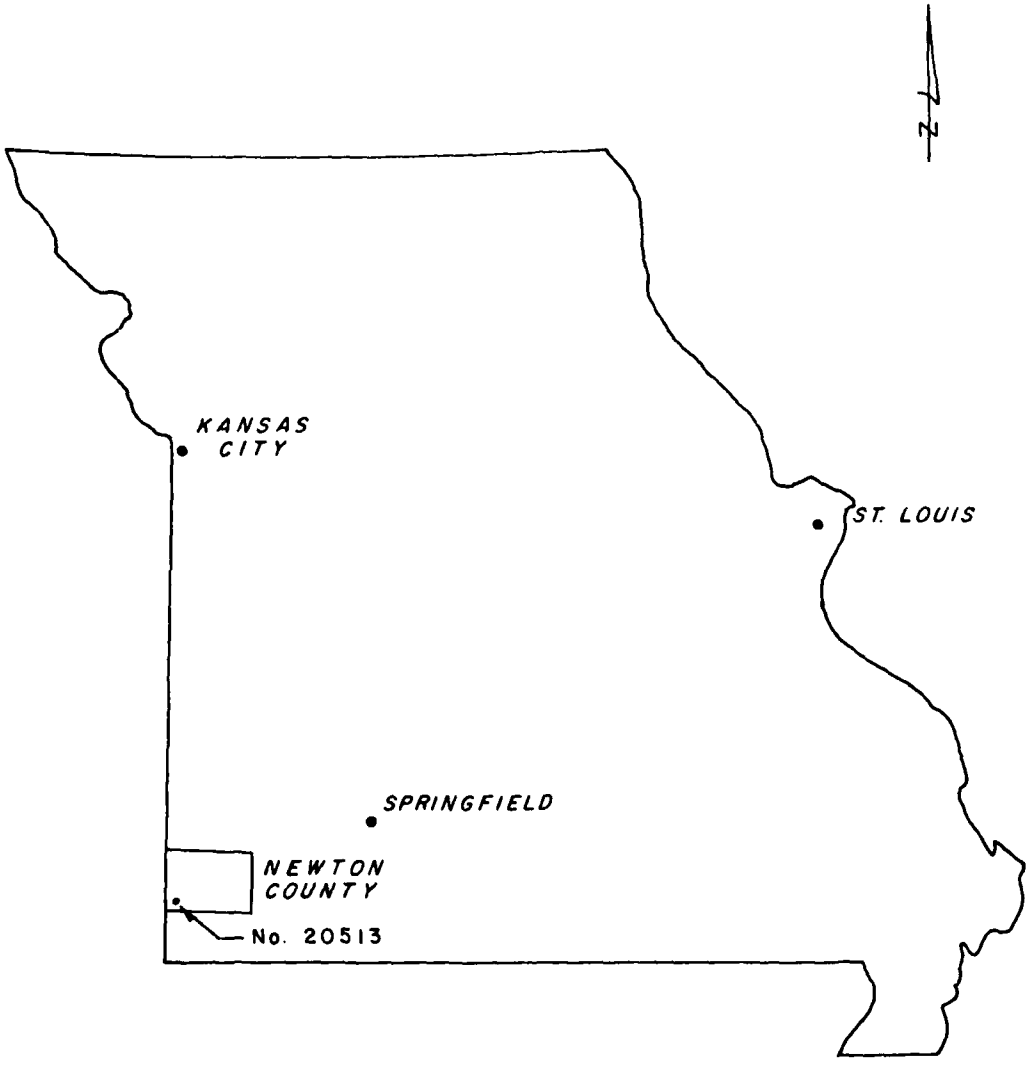
(2) The light brush growth should be removed and vegetative growth on the dam should be cut annually.

(3) Wave protection should be provided for the upstream face of the embankment it permanent water storage is accomplished.

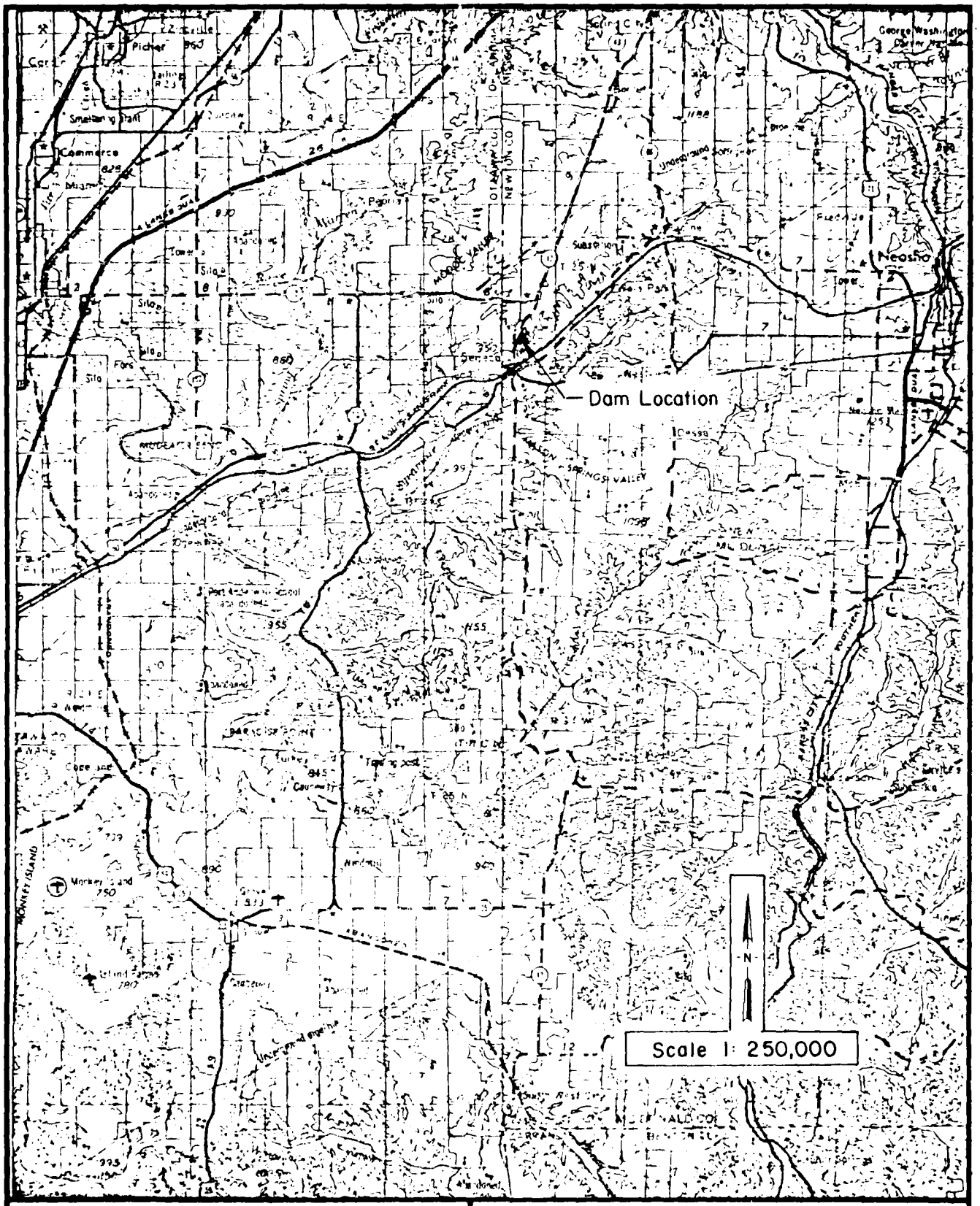
(4) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

Dam Location and Plans



LOCATION MAP



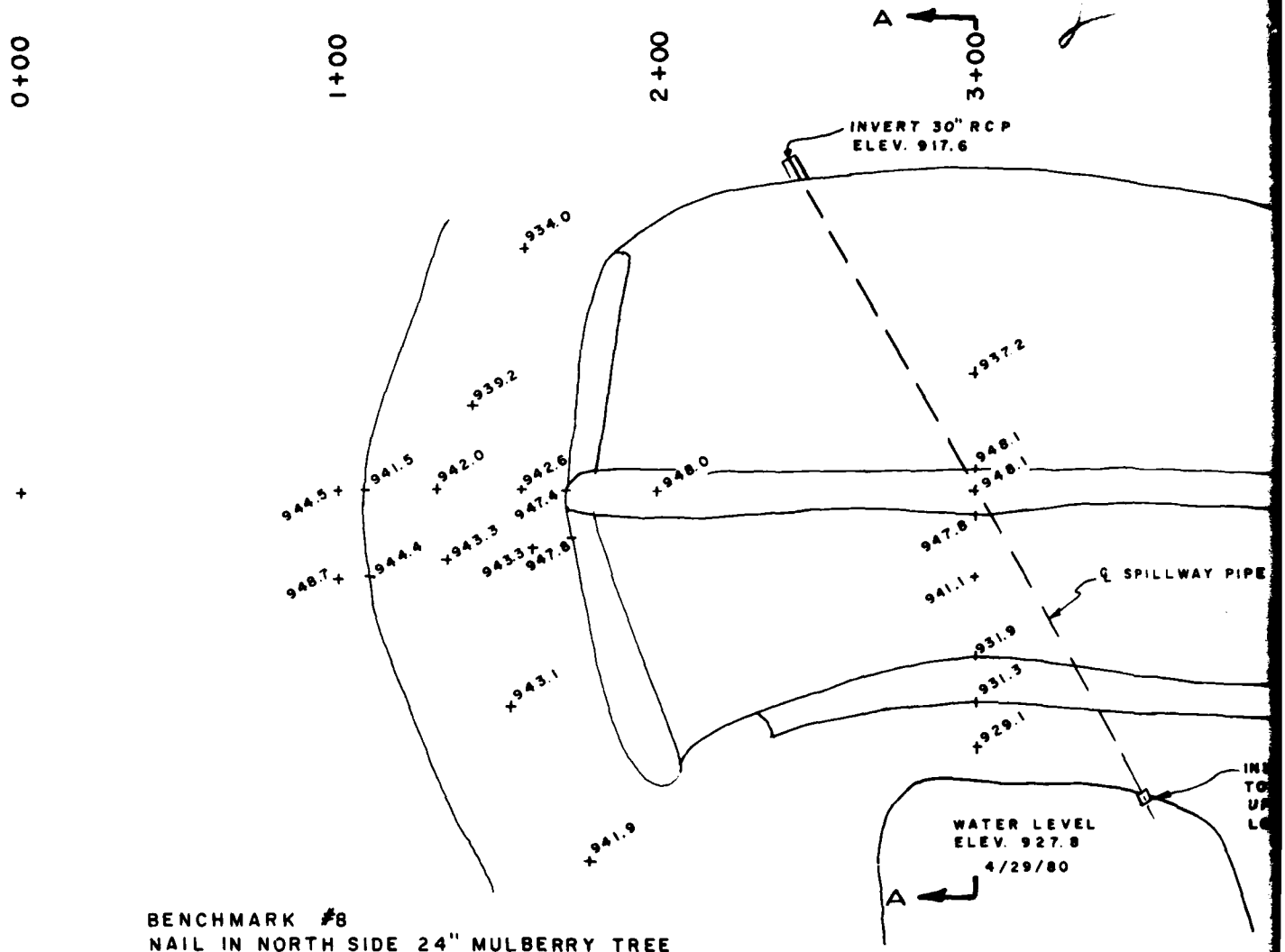
VICINITY MAP

HANSON ENGINEERS

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

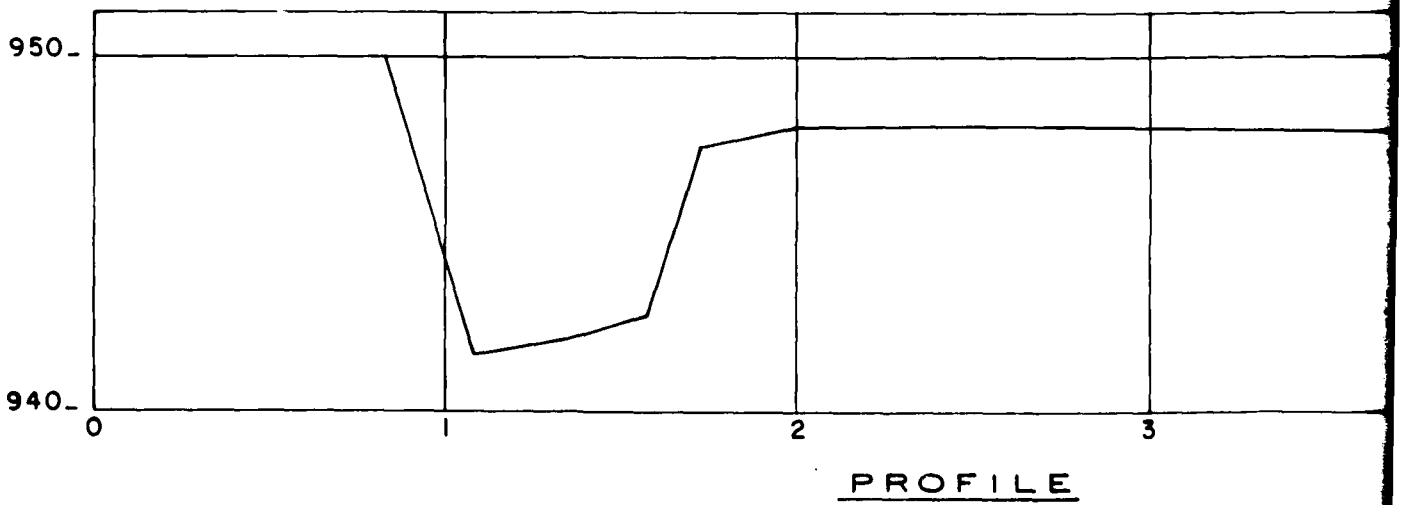
Newton County Structure F-2 Dam
Newton County, Missouri
Mo I.D. No 20513

Sheet 2, Appendix A

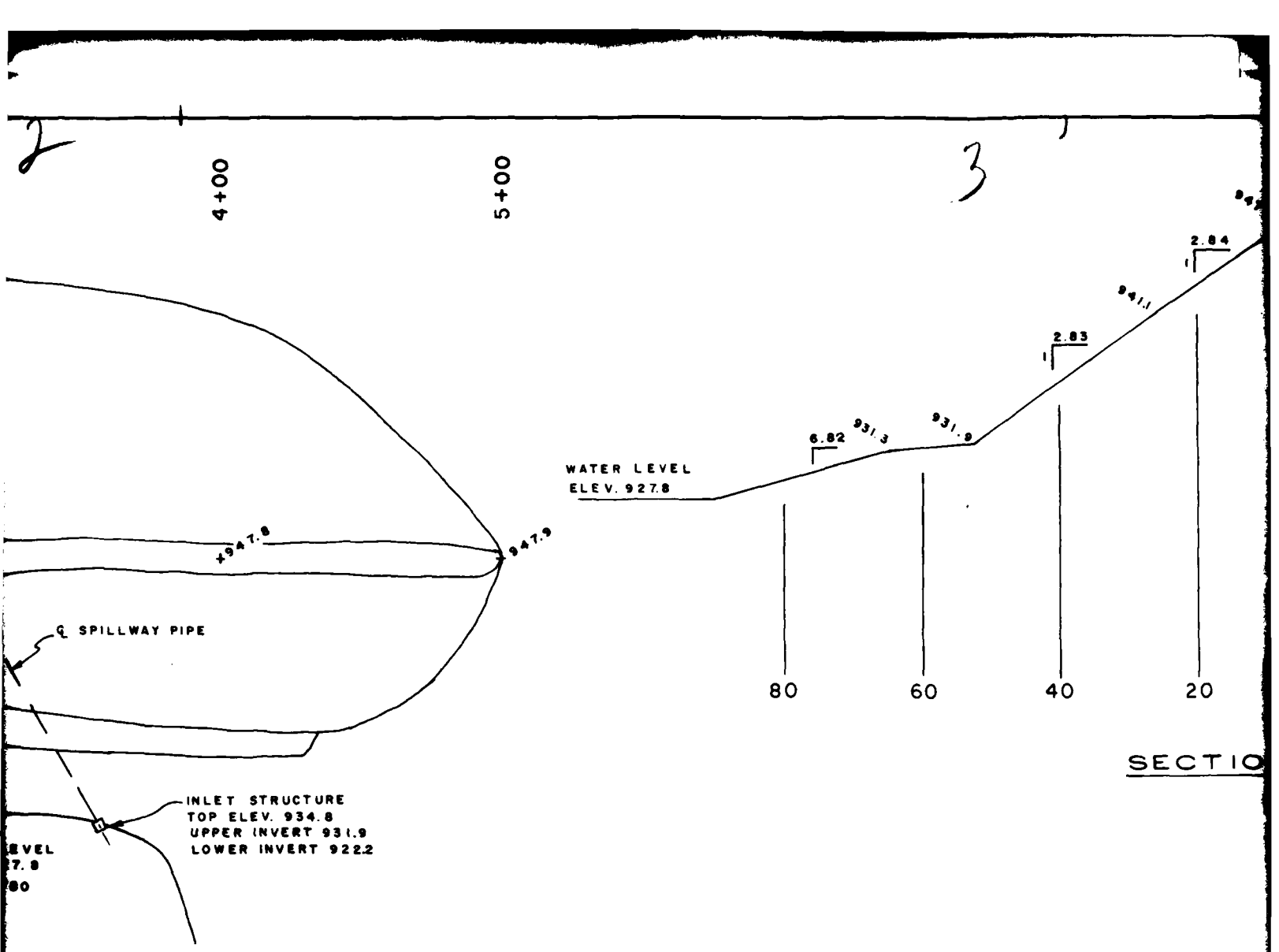


BENCHMARK #8
NAIL IN NORTH SIDE 24" MULBERRY TREE
LEFT SLOPE 15' SOUTH OF TOE
ELEV. 918.64

PLAN VIEW
SCALE 1" = 50'

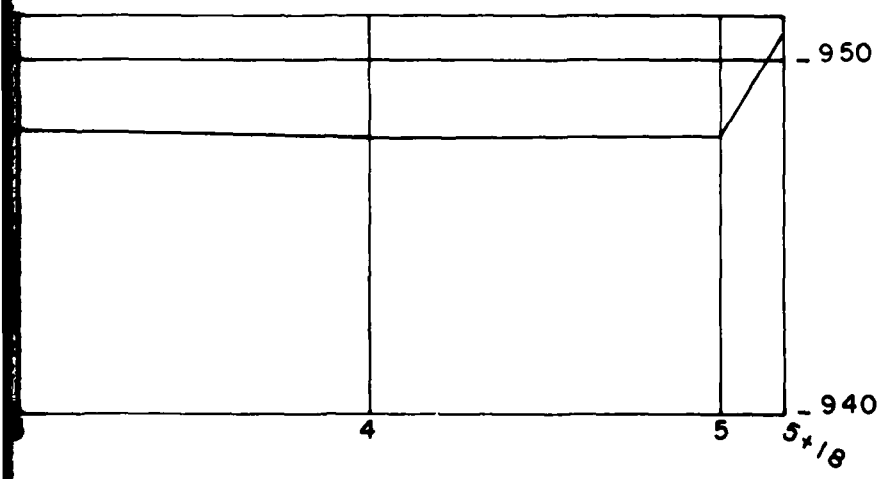


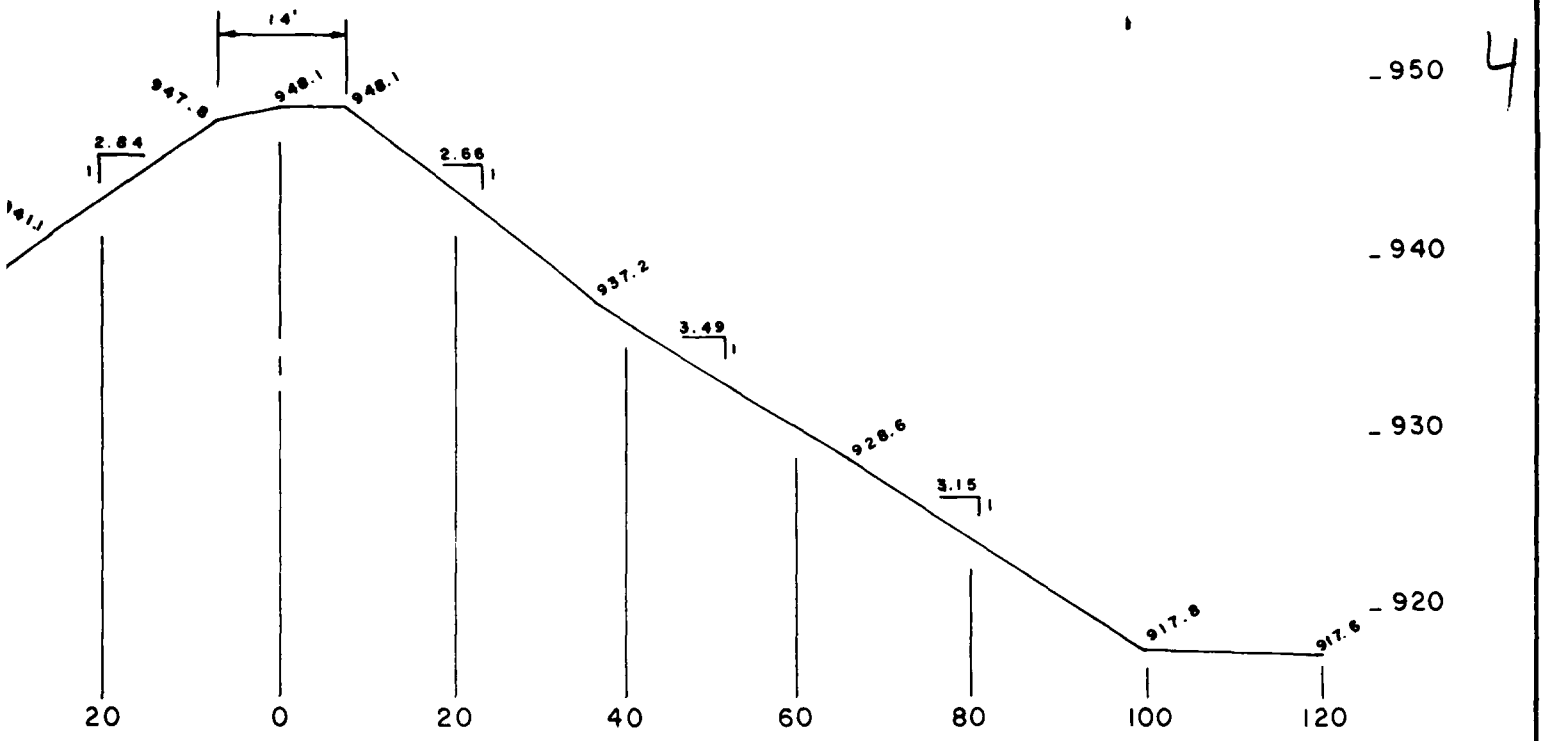
PROFILE


4+00
5+00
WATER LEVEL
ELEV. 927.8
6.82
931.3
931.9
2.83
2.84
80
60
40
20
+947.8
947.9
℄ SPILLWAY PIPE
INLET STRUCTURE
TOP ELEV. 934.8
UPPER INVERT 931.9
LOWER INVERT 922.2

SECTIO

VIEW


950
940
4
5
5+18



4

SECTION A-A STA 3+00

SHEET 3 APPENDIX A

ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

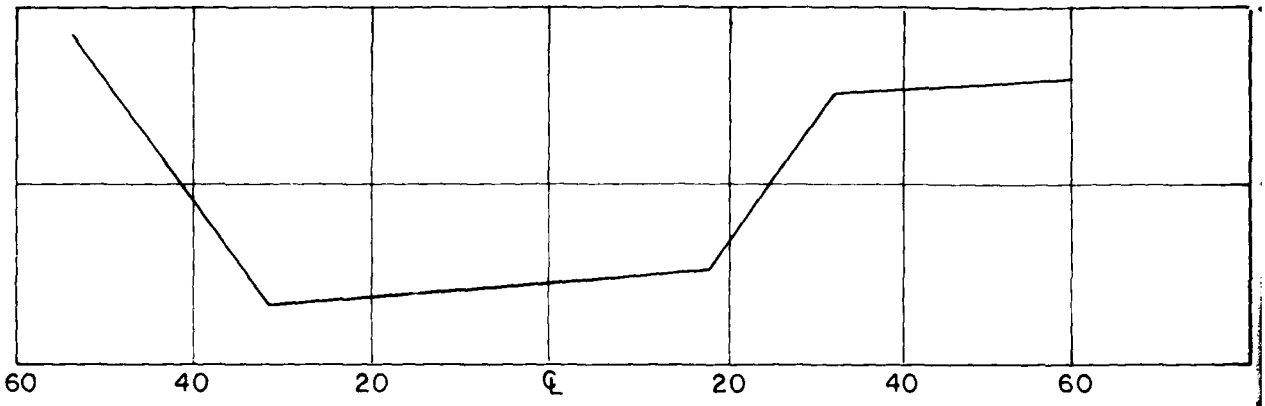
NEWTON COUNTY STRUCTURE F-2

MO. No. 20513

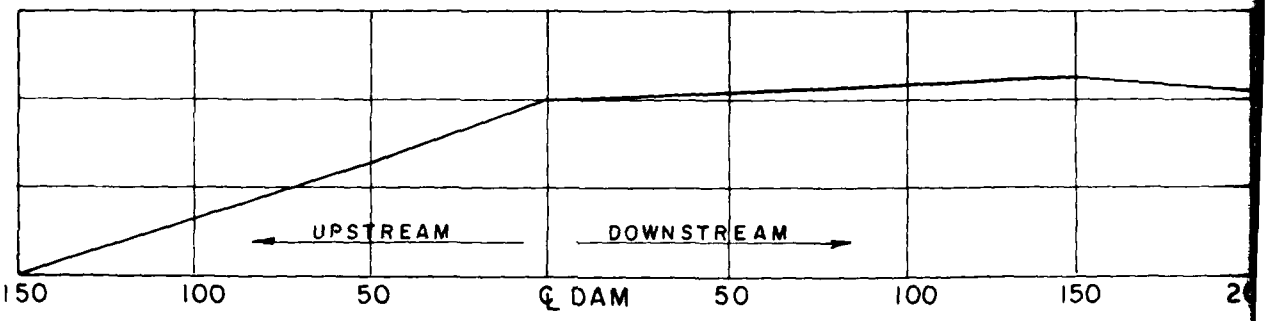
PLAN & PROFILE

NEWTON COUNTY, MO.

3

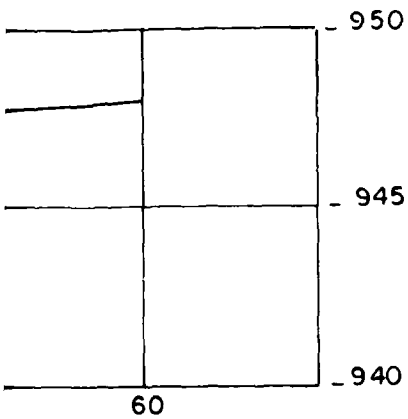


SPILLWAY SECTION ℄ DAM

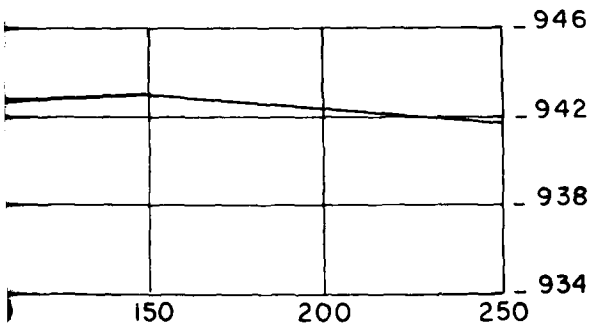


SPILLWAY PROFILE

2



M



E

SHEET 3A APPENDIX A

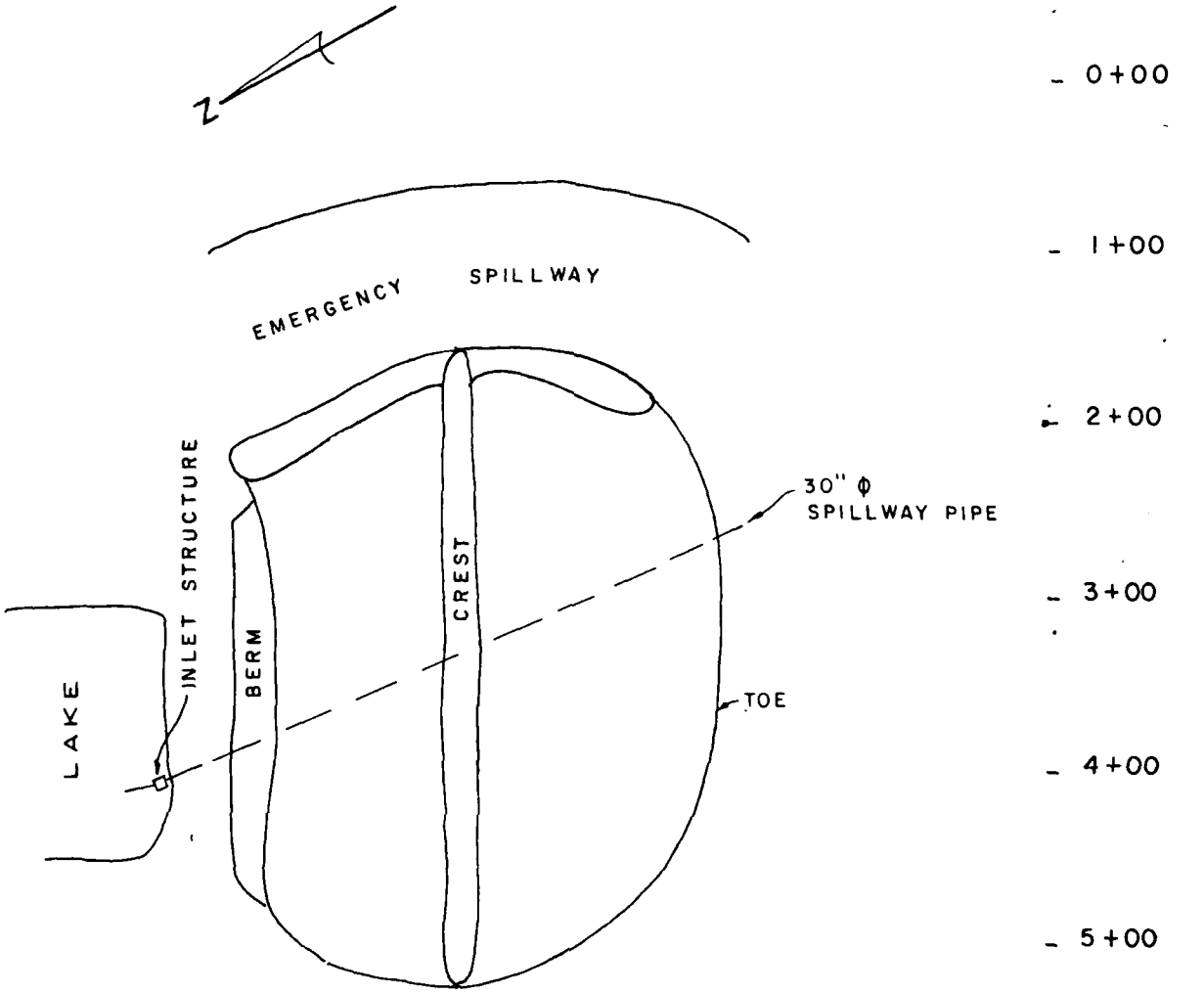
ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

NEWTON COUNTY STRUCTURE F-2

MO. No. 20513

SPILLWAY
SECTION & PROFILE

NEWTON COUNTY, MO.



PLAN SKETCH OF DAM

STRUCTURE F-2

MO. No. 20513

U S DEPARTMENT OF AGRICULTURE

LEGEND

WATERSHED BOUNDARY

DRAINAGE AREA CONTROLLED BY STRUCTURE

AREA BENEFITED

PROJECT MEASURES

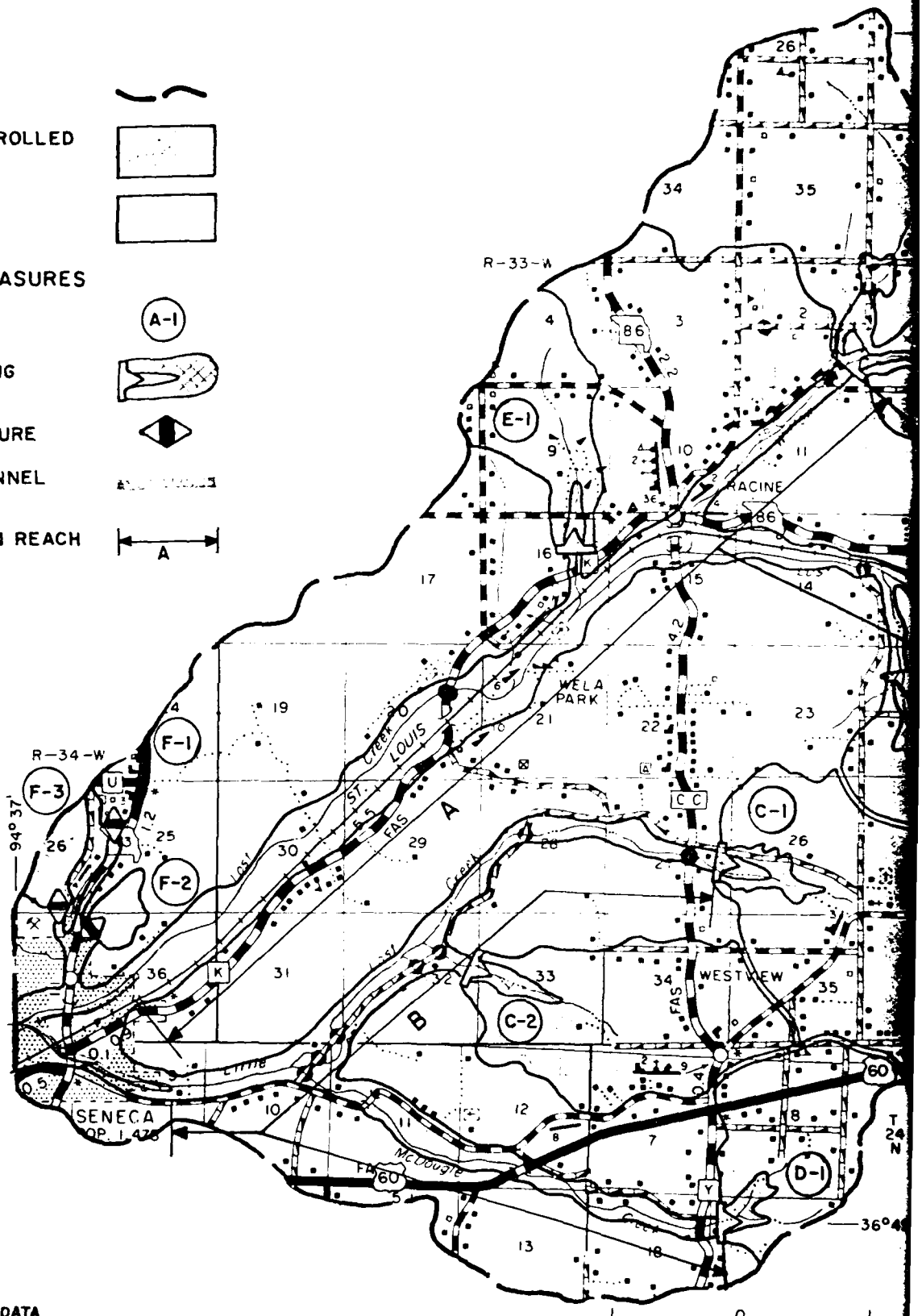
STRUCTURE NUMBER (A-1)

FLOODWATER RETARDING STRUCTURE

DEBRIS BASIN STRUCTURE

PROPOSED FLOOD CHANNEL CORPS OF ENGINEERS

ECONOMIC EVALUATION REACH (A)

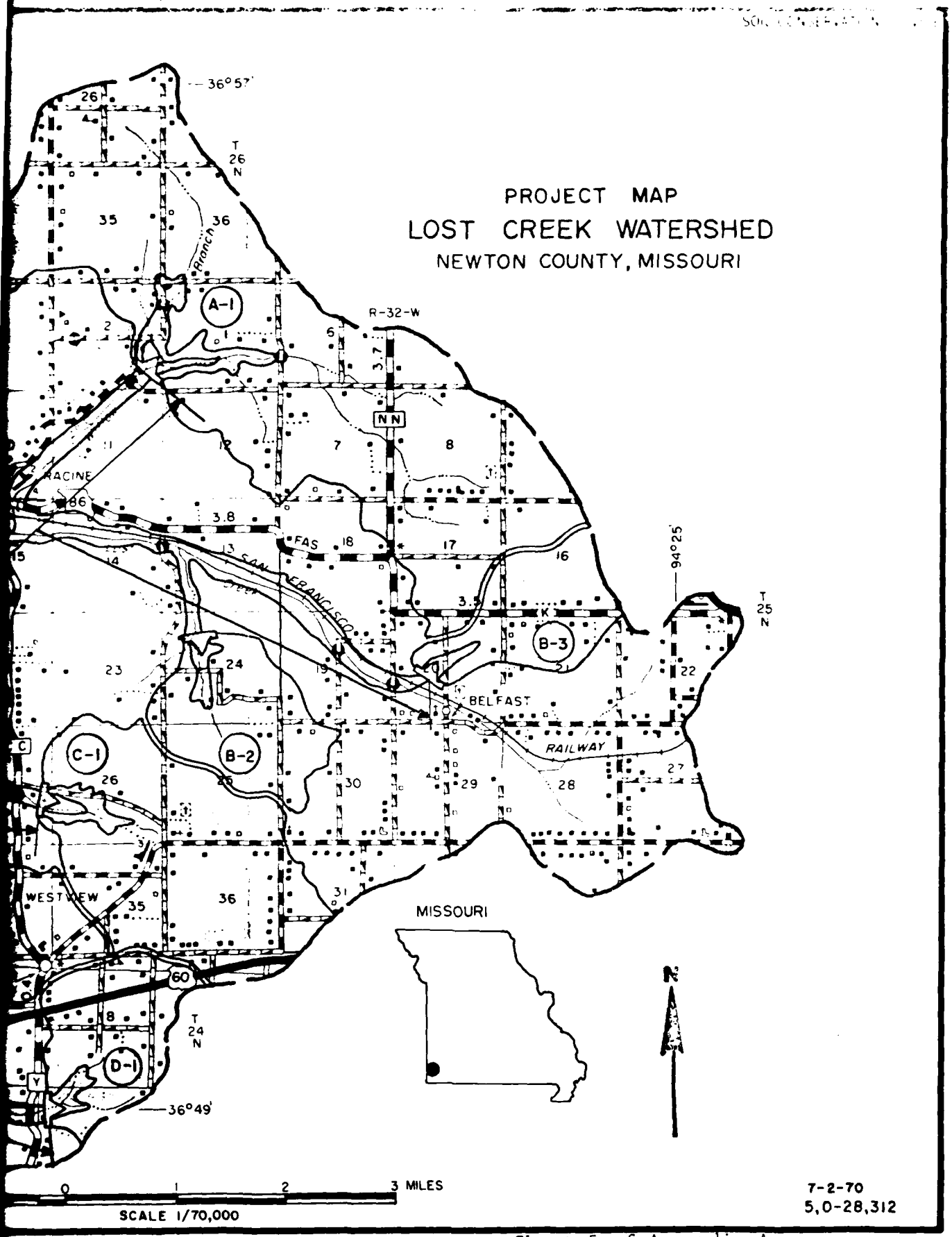


SOURCE
SCS BASE 5,0-28,307 AND DATA FURNISHED BY FIELD TECHNICIANS

USDA-SCS-LINCOLN NEBR 1970

POLYCONIC PROJECTION

SCALE 1/7


PROJECT MAP
LOST CREEK WATERSHED
NEWTON COUNTY, MISSOURI
36°57'
T 26 N
R-32-W
A-1
B-1
B-2
B-3
C-1
D-1
NN
K
C
Y
FAS
SAN FRANCISCO
RACINE
BELFAST
RAILWAY
WESTVIEW
MISSOURI
60
94°25'
T 25 N
T 24 N
36°49'
0 1 2 3 MILES
SCALE 1/70,000
7-2-70
5,0-28,312

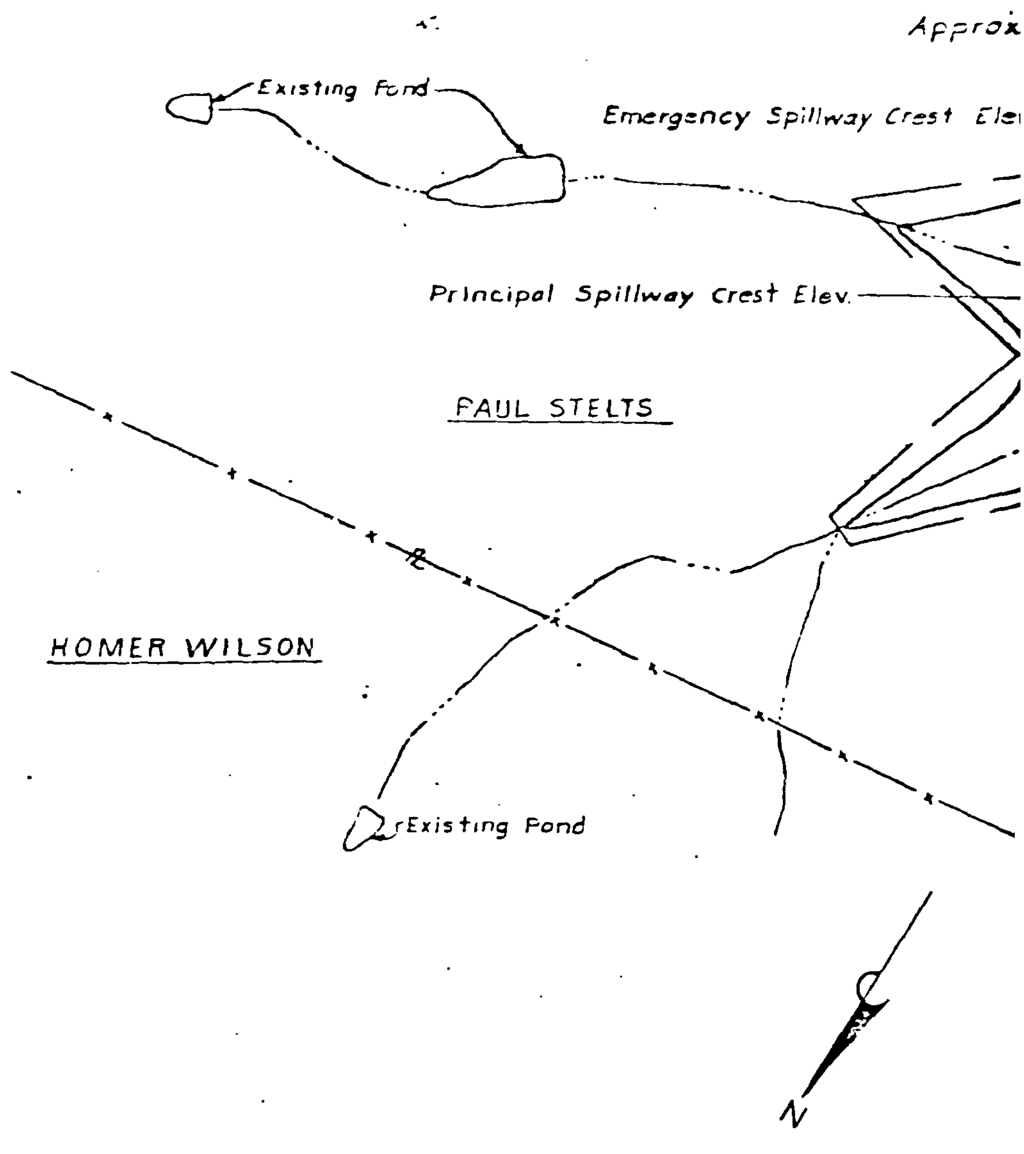
DATA TABLE	
[illegible] Area, Acres	80
[illegible] Storage, Acre Feet	7[illegible]
Retarding Storage, Acre Feet	250
Sediment Pool Acres	1.4
Retarding Pool, Acres	39

B.M. [illegible]
Top Concrete Monument [illegible]

T.B.M. #[illegible] Elevation-9[illegible].64
Nail in north side 24" Mulberry Tree on [illegible] slope, 15' south of toe, approx 30' east of north-south property line fence

B.M.#2 Elevation-956.83'
Top concrete monument Sta 5+15.25 ℄ Dam.

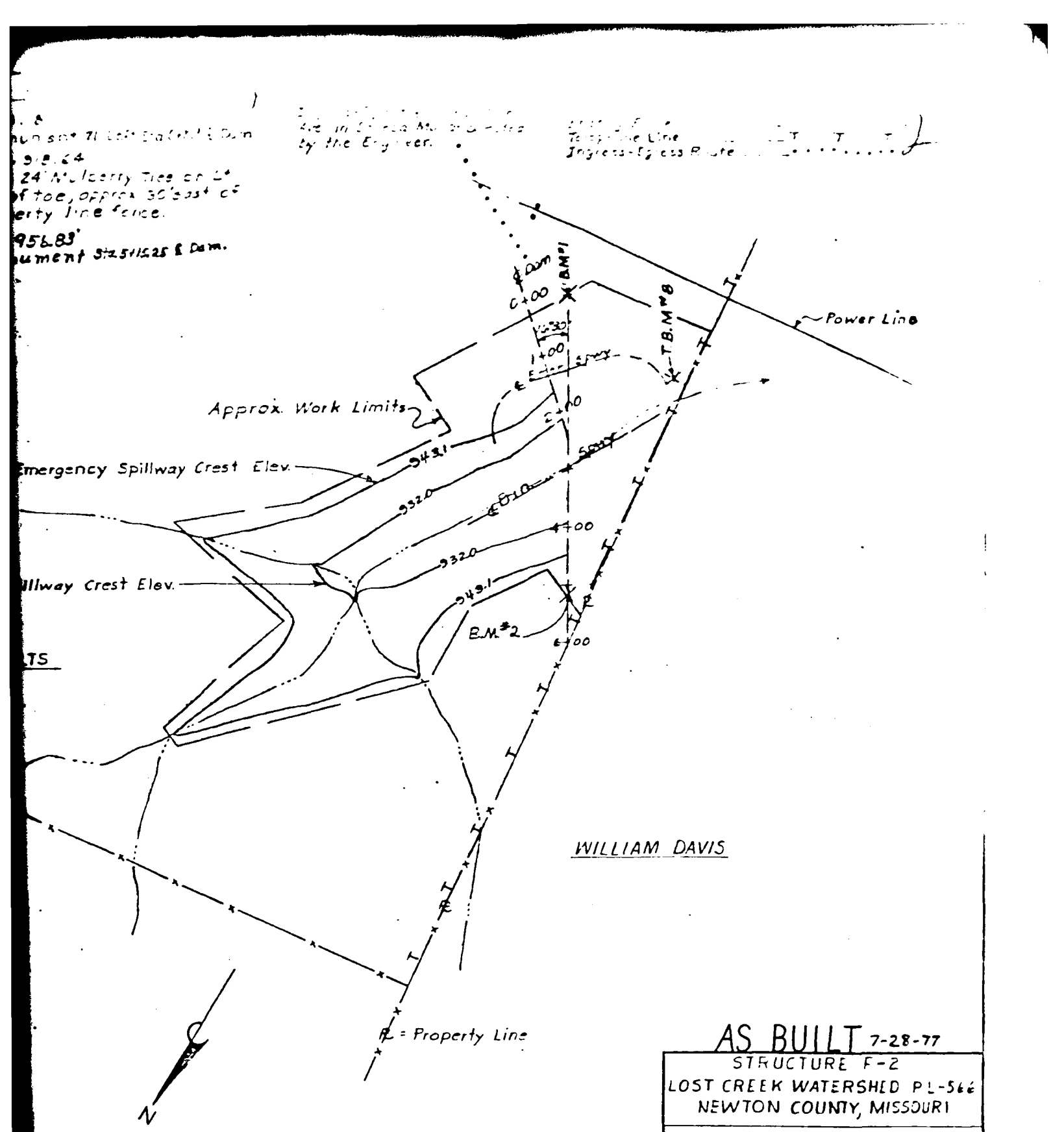
Structure F-2 located at the north edge of Seneca, Missouri in the N-W ¼ of Sec. 36, T. 25 N, R. 34 W.



GENERAL PLAN OF RESERVOIR

100 50 0 100 200

Scale in Feet



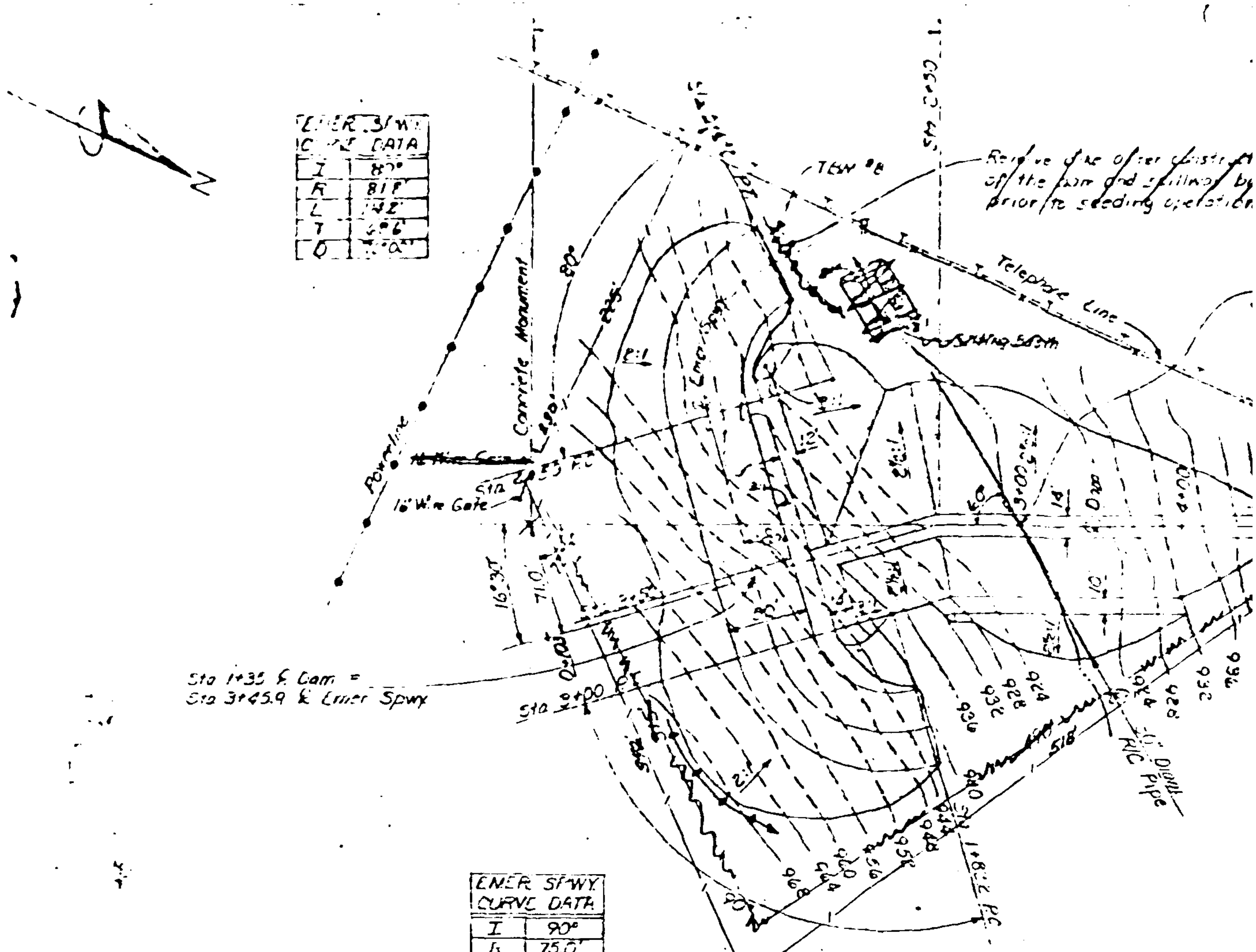
AS BUILT 7-28-77

STRUCTURE F-2
LOST CREEK WATERSHED PL-566
NEWTON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date
GREEN	11-75
JENNINGS	11-75
BLAINE & SMITH	3-75

SE-95 7/2



EMER. SPWY CURVE DATA	
I	80°
R	81.F'
L	142'
T	[illegible]
D	[illegible]

EMER. SPWY CURVE DATA	
I	90°
R	75.0'
L	117.8'
T	75.0'
D	76°24'

PLAN OF EMBANKMENT AND SPILLWAYS

50 0 50 100

Scale in Feet

NOTES:

Topsoil

A minimum of 6 (six) inches of topsoil to be placed on all compacted earth fill and in the earth portion of the emergency spillway.

Waste Areas

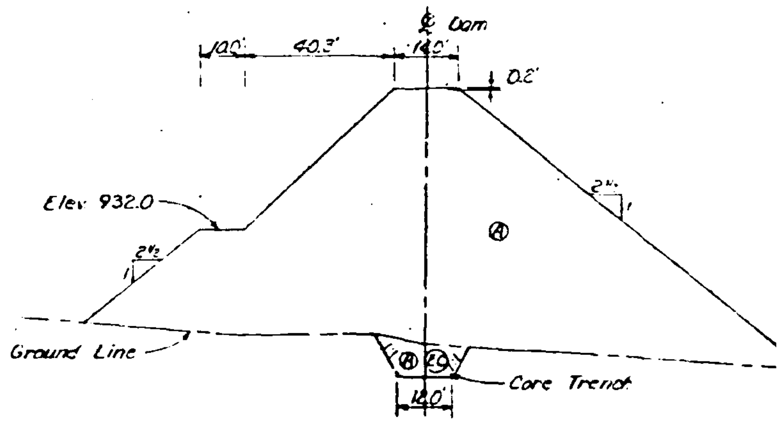
Waste areas to be as shown or as directed by the Engineer.

Protective Dike

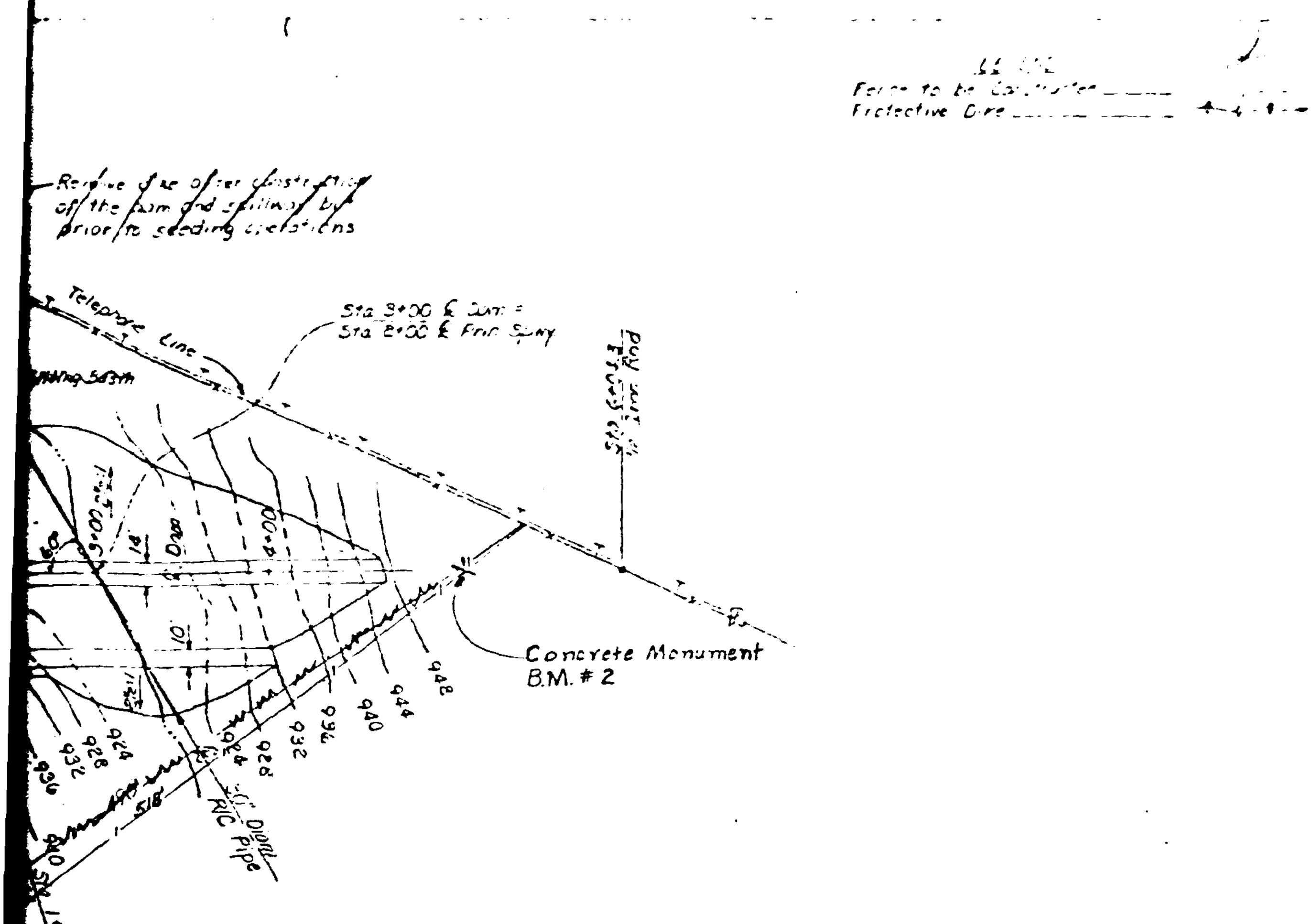
Protective dike dimensions; 12' effective height, 3:1 side slopes, 9' minimum base width.

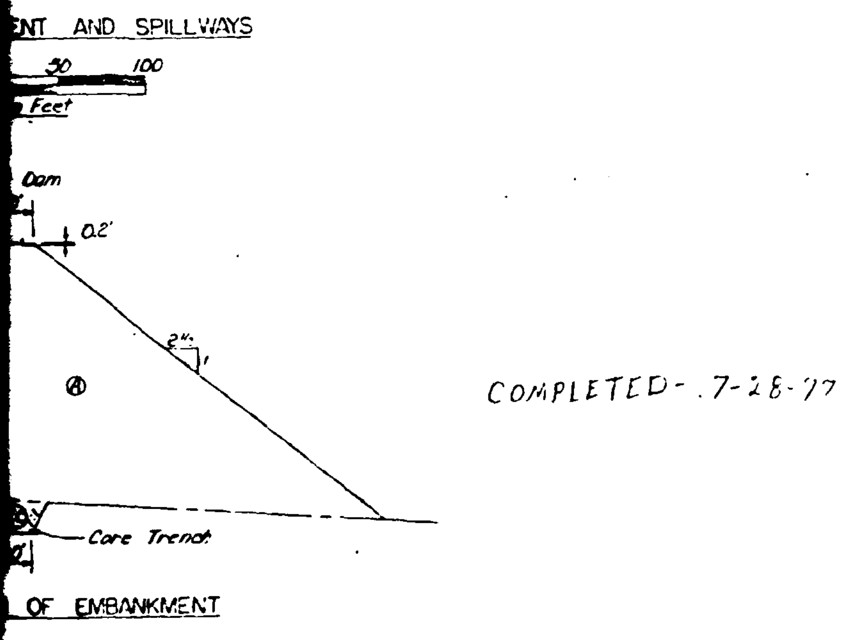
Silting Basin

The silting basin shall be constructed at the approx. location shown. The dimensions shall be: 10' bottom width, depth of 2' below channel grade, 2:1 side slopes and 30' length. The basin shall be filled to grade and blended to the surrounding area after all construction is complete and prior to seeding operations.



TYPICAL SECTION OF EMBANKMENT





COMPLETED - 7-28-77

AS BUILT 7-28-77

QUANTITIES			
Excavation Common (EC)			
Core Trench	765	~~[illegible]~~	Cu Yds
Structure & Silting Basin	489	~~573~~	Cu Yds
Total	1254	~~1,096~~	Cu Yds
Excavation Rock (ER)			
Emer. Spwy	467	~~[illegible]~~	Cu Yds
Earth Fill			
Class (A)	18,054	~~[illegible]~~	Cu Yds
* Topsoil	3,944	~~4,100~~	Sq Yds
Temp. Fence, Barbed Wire	[illegible]	~~[illegible]~~	Lin Ft
Seeding	1.5	~~4.9~~	Acres
Mulching	13.0	~~[illegible]~~	Tons
Temporary Seeding	0	~~[illegible]~~	Acres

~~* 4,100 Sq Yds at a depth of 6 (six) inches is equal to 683 Cu Yds~~

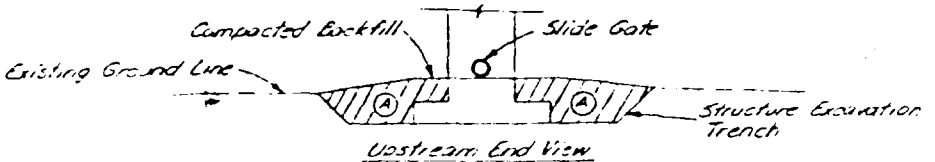
STRUCTURE F-2
LOST CREEK WATERSHED PL-566
NEWTON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed M.N.F.	1976	Approved by [signature]
Drawn J.A.G.	3-76	Head Design Section
Traced		
Checked F.E.S.	3-76	Sheet 3 of 15 — Drawing No. 5-E-35,712

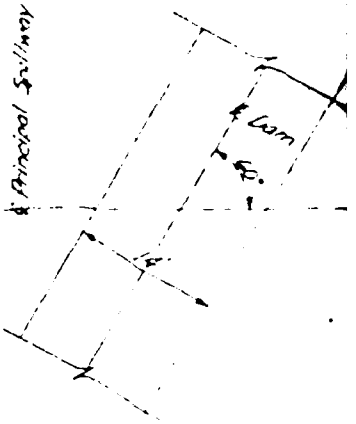
NOTES

1. Pipe elevations other than those shown in the table will be furnished by the Engineer, when required.
2. Antiseep collars shall not be placed closer than two (2) feet to a pipe joint.
3. Compacted backfill shall be placed over the riser footing up to the slide gate invert elevation. The backfill will be blended to the existing ground line as shown on the Riser Backfill Detail.

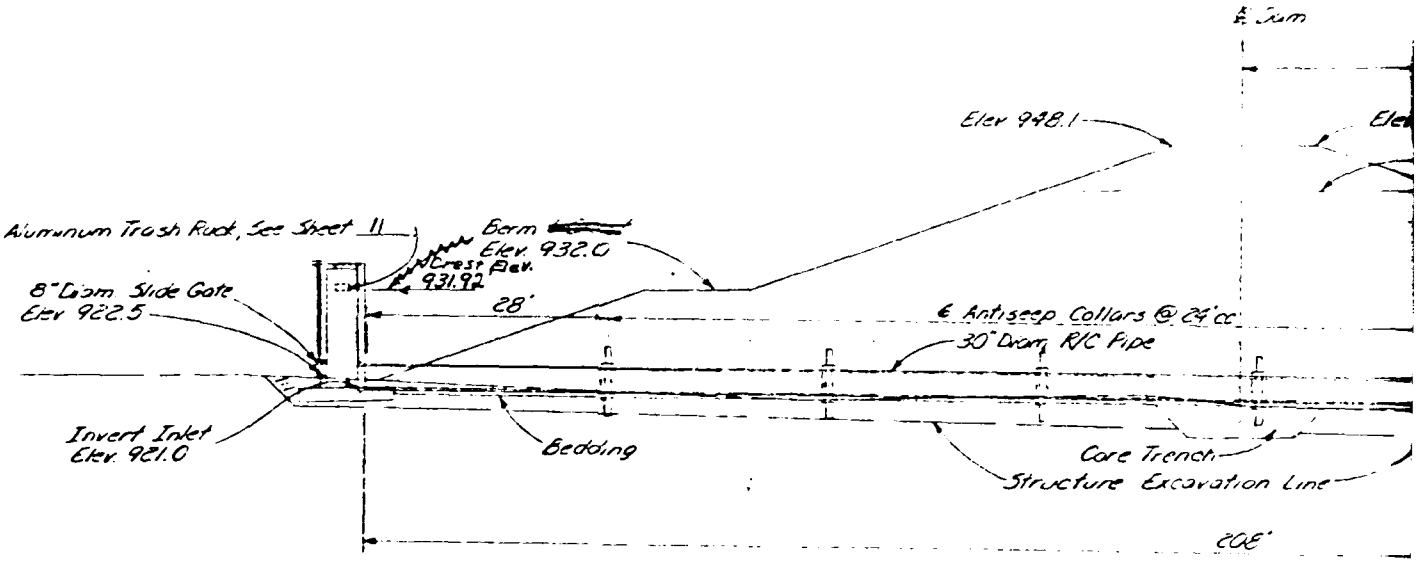


Upstream End View

RISER BACKFILL DETAIL



PARTIAL PLAN



SECTION ON CENTERLINE

0 5 10 20

Scale in Feet

MATERIALS

Concrete, Class 4000

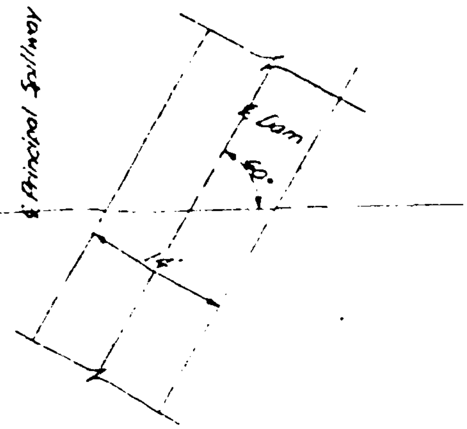
Steel Bar Reinforcement

Prestressed Concrete Pressure Pipe, 30" Diam, Steel Cylinder Type

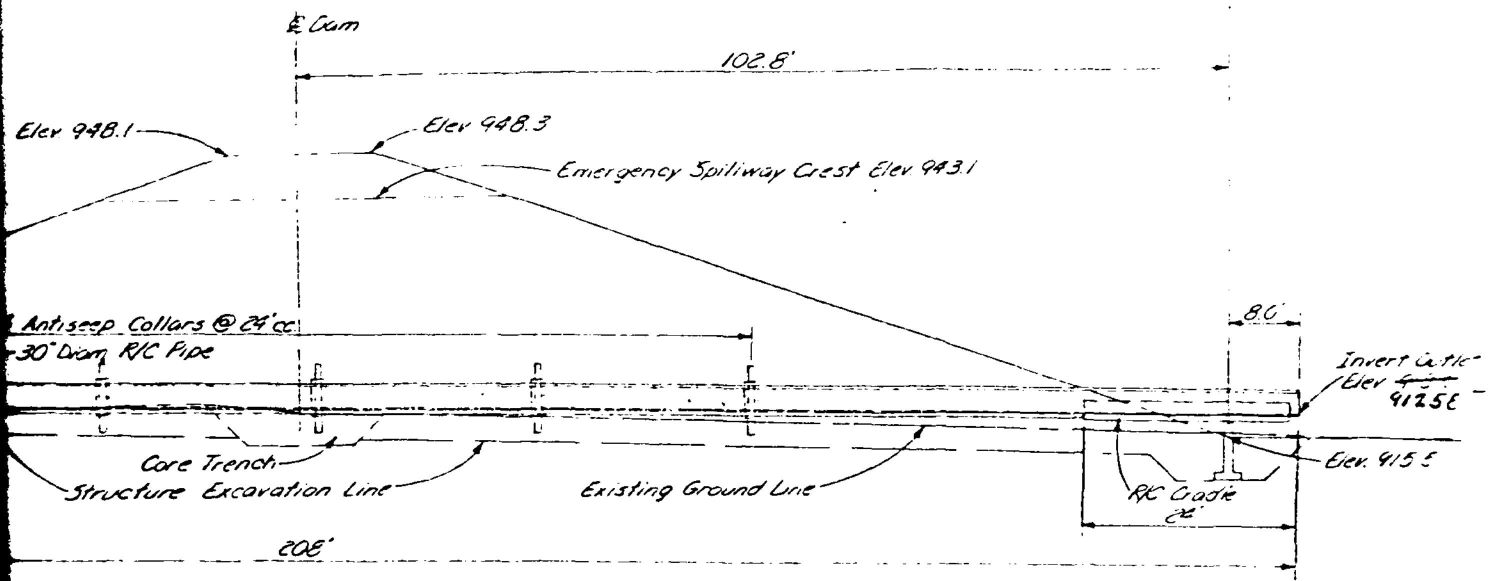
Aluminum Trash Rack

Slide Gate, 8" Diam

PIPE CAMBER TABLE	
Distance From Outlet	Elevation
0	918.00
16	918.23
24	918.35
40	918.68
56	918.99
72	919.28
88	919.55
104	919.80
120	920.02
136	920.23
152	920.43
168	920.61
184	920.79
200	920.95
208	921.05



PARTIAL PLAN



SECTION ON CENTERLINE

10 5 0 10 20
Scale in Feet

AS BUILT 7-2?-77

MATERIALS

— 46.3 Cu Yds
— 3,264 Pounds
30" Diam., Steel Cylinder Type — 208 Lin Ft
— Lump Sum
— 1 Each

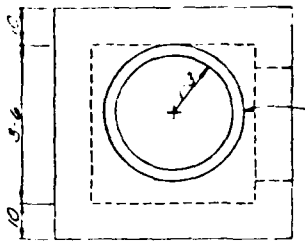
COMPLETED - 7-?-77

STRUCTURE F-2

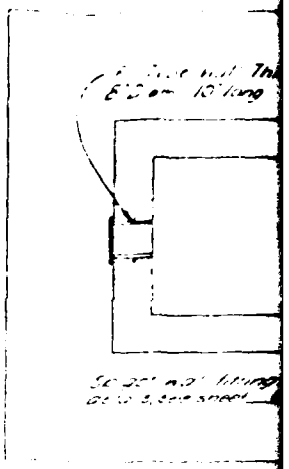
RESTRICTED FLOW INLET FOR 30" DAM P.F.
GENERAL LAYOUT
LOST CREEK WATERSHED PL 566
NEWTON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	MMB	2-76	Approved by
Drawn	BAE	3-76	Title
Traced			Title
Checked	BES & MMB	3-76	Sheet 4 of ... Drawing No. 5-E-3572

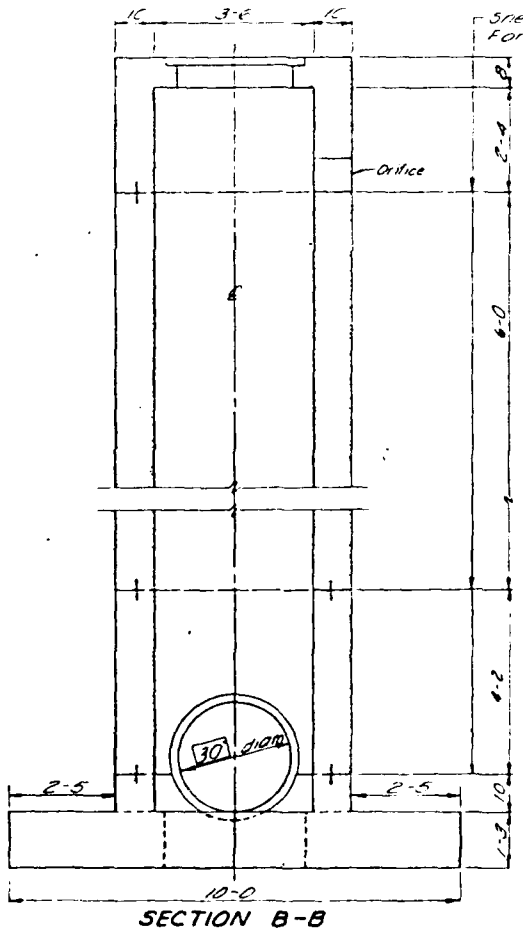


TOP PLAN

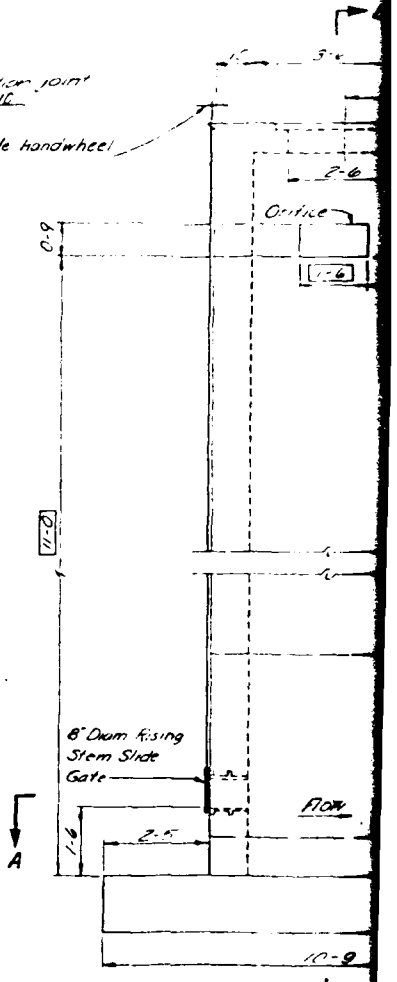


SECTION

NOTE: FOR DETAIL OF TRASH RACK AND ANCHORAGE SEE SHEET 1



SECTION B-B

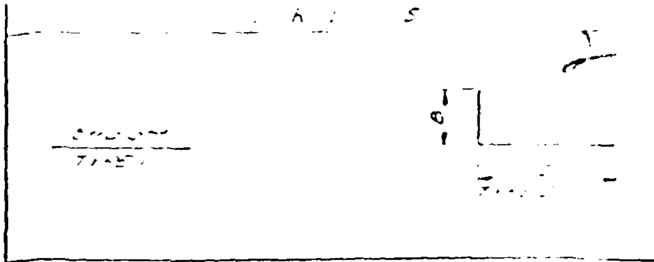


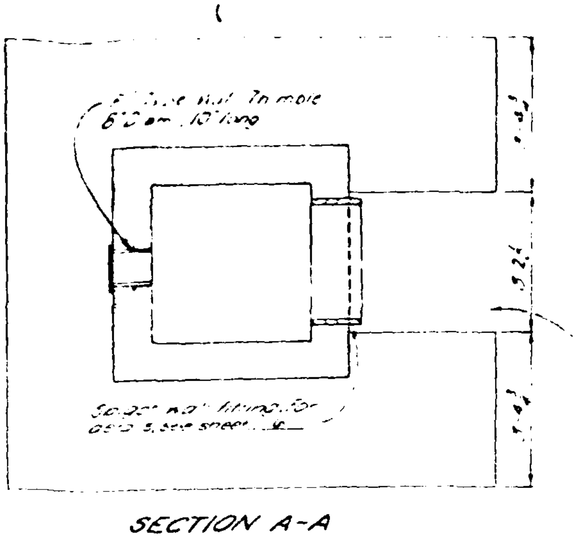
SIDEWALL EL

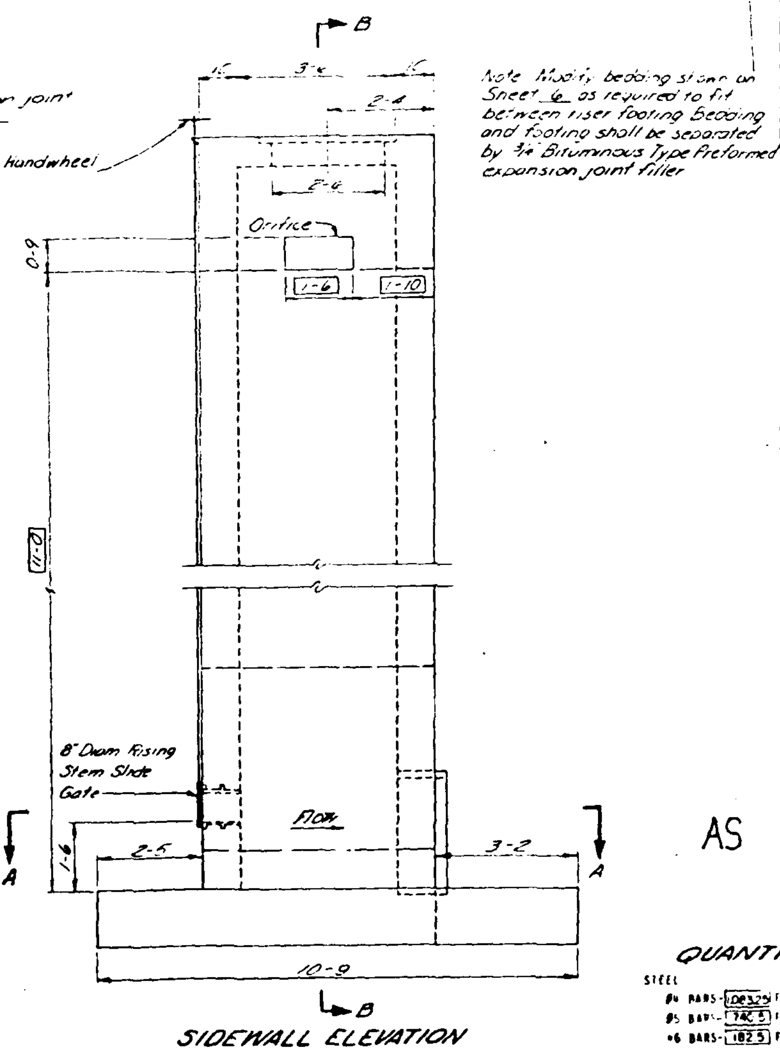
DETAILS OF 3'-6" x 3'-6" RESTRICTED FLOW RISER

(10' ≤ Height ≤ 15' W/ Sidewall Orifice)

E & WP UNIT - DESIGN SECTION LINCOLN, NEBRASKA
BASE DWG. NO. S.E - 13,850.227
DATE APPROVED: MAY 10, 1971 REV 8-71
SHEET 1 OF 4







STEEL SCHEDULE

Mark	Size	Quantity	Length	Total Length	Type	[illegible]	[illegible]
B1	5	9	9-6	85-6			
B2	5	8	3-0	24-0			
B3	5	8	10-3	82-0			
B4	5	5	7-0	35-0			
B5	5	9	9-6	85-6			
B6	5	8	3-0	24-0			
B7	5	8	10-3	82-0			
B8	5	11	7-0	77-0			
B9	6	12	10-3	123-0	2	3-3	7-0
B10	6	6	7-9	46-6	2	0-9	7-0
B11	4	3	4-0	12-0			
B12	4	10	7-6	75-0	2	0-9	6-9
B13	4	6	7-6	45-0	2	0-9	[illegible]
B14	4	3	4-0	12-0			
B15	5	2	4-0	8-0	2	0-9	3-3
B16	5	16	6-6	117-0	2	3-3	3-3
B17	4	2[illegible]	4-3	89-3			
B18	5	4	4-6	18-0	2	[illegible]	[illegible]
B19	6	2	3-9	7-6	[illegible]		
B20	6	2	2-9	5-6	2	0-9	2-0
M1	4	17	7-3	123-3			
M2	4	28	4-3	119-0	1		
M3	4	17	7-3	123-3			
M4	4	28	6-6	182-0	2	3-3	3-3
M5	4	6	5-9	34-6	1		
T3	4	14	6-6	91-0	2	3-3	3-3
T4	4	20	4-3	85-0			
T5	5	10	6-0	60-0	2	2-9	3-3
T6	5	2	3-6	7-0	2	0-9	2-9
T7	5	3	4-0	12-0	2	[illegible]	[illegible]
T8	5	1	2-9	2-9	2	1-0	1-9
T9	5	3	3-3	9-9	2	[illegible]	[illegible]
T10	5	2	4-3	8-6	2	1-6	2-9
T11	5	1	2-6	2-6	2	0-9	1-9
T12	4	4	1-3	5-0	1		
T13	4	4	2-3	9-0			
T14	4	15	2-9	41-3			
T15	4	4	1-9	7-0			
T16	4	4	4-9	19-0	2	1-6	3-3
T17	4	4	0-9	3-0	1		
T18	4	5	1-3	6-3	1		
T19	4	3	0-6	1-6	1		

NOTE. T1 and T2 Bars deleted from steel schedule

0 1 2 3 4
Scale in feet

AS BUILT 7-28-77

QUANTITIES

STEEL

- #4 BARS - 1083.25 FT. - 723.6 LB.
- #5 BARS - 740.5 FT. - 772.3 LB.
- #6 BARS - 182.5 FT. - 274.1 LB.
- TOTAL - 1770 LB.

CONCRETE, CLASS 4000 — 12.3 CU. YD.

STRUCTURE F-2

R/C RESTRICTED FLOW RISER
FOR 30" DIAM. R/C PIPE
LOST CREEK WATERSHED P.L.566
NEWTON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	B E S	3-76
Drawn	B A E	4-76
Traced		
Checked	M M B	4-76

Approved by
Title
Title
Sheet No. 7 of 15
Drawing No. 5, E-35 712

STRUCTURE DATA

Class of Structure "C" Debris Basin

Drainage Area (total) 80 Ac. 0.13 Sq.Mi.

(uncontrolled) 80 Ac. 0.13 Sq.Mi.

Time of Concentration 0.18 Hours

Soil Cover Complex Number 71 For A.M.C. II

Sediment Capacity Available 7.6 Ac.Ft. below Elev. 932.0

Total Sediment Capacity Available 7.6 Ac.Ft.

Capacity Equivalents (Vol.) 1.14 In.

Retarding Capacity Provided 28.0 Ac.Ft.

Capacity Equivalents (Vol.) 4.20 in.

Water Supply Provided None Ac.Ft.-Identify Uses

Principal Spillway:

Maximum Capacity ~~(low stage)~~ 18 c.f.s.

Maximum Capacity (high stage) —— c.f.s.

10 Day Drawdown Elev. 932.0

Emergency Spillway:

Percent Chance Use 1 Storm Duration 6 Hour

Type Vegetated Earth "n" Value Usec 0.04

Emergency Spillway Hydrograph for Class "C" Structures

Rainfall 12.00 in.

Runoff 8.19 in.

Peak Inflow 547 c.f.s.

Maximum Discharge - Emergency Spillway 105 c.f.s.

Maximum Water Surface Elev. 944.2

Velocity of Flow (Ve) 5.9 f.p.s.

Supplementary Data and Special Design Features:

Principal Spillway Crest Elev. = 932.0

Emergency Spillway Crest Elev. = 943.1

Emergency Spillway Bottom Width = 50'

Settled Top of Dam Elev. = 947.6

Height x Storage = 24.3 x 35.6 = 865

Freeboard Hy

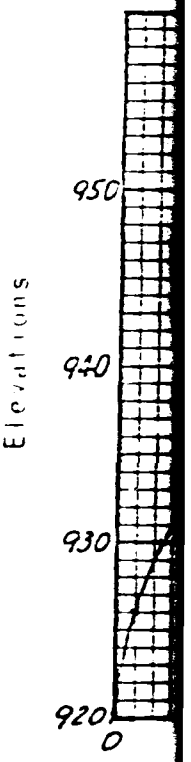
Rainfall

Runoff

Peak Inf

Maximum

Maximum



Supplementary
Special Desig

UCTURE DATA

Freeboard Hydrograph for Class "C" Structures

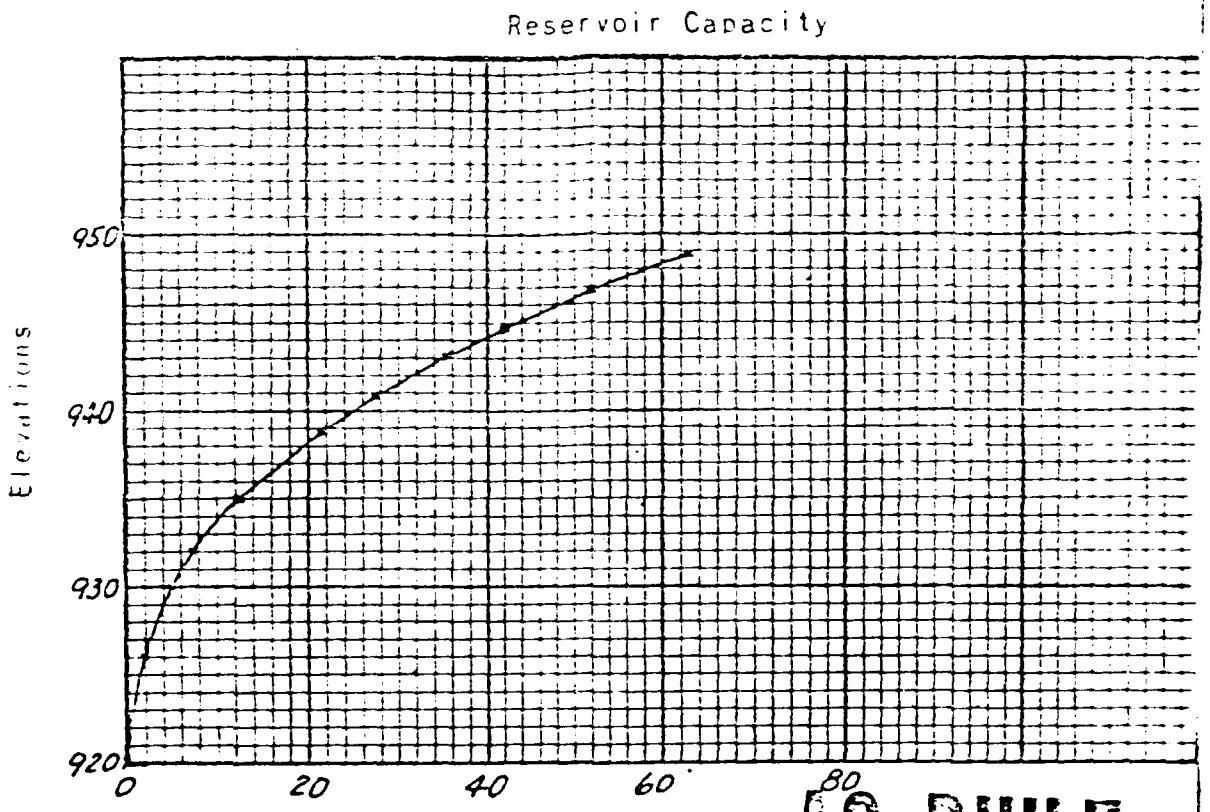
Rainfall 28.80 in.

Runoff 24.41 in.

Peak Inflow 1559 c.f.s.

Maximum Discharge - Emergency Spillway 1378 c.f.s.

Maximum Water Surface Elev. 947.6



AS BUILT
7-28-77

Supplementary Data and Special Design Features:

STRUCTURE F-2
LOST CREEK WATERSHED PL-566
NEWTON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JAG & MMB	1976	
Drawn	BES	3-76	
Traced			
Checked	MMB & NHR	3-76	S.E-35 712-A

?-AS-30a (11/70) UNITED STATES DEPARTMENT OF AG[illegible]
?ter to-WS-MO-5 SOIL CONSERVATION SERV[illegible]
File Code: AS-12-13 Columbia, Missouri 65201

OPERATION AND MAINTENANCE INSPECTION REPORT FOR STRUCTURES

May 14, 1980

Watershed Lost Creek Structure No. F-2 Inspection: Special /_/
Newton County Annual /x/

Item	Condition Satis-factory	Condition Unsatis-factory	Describe Maintenance and Needed Repairs	Esti-mated Costs	Agreed Date Repairs To Be Compl'd	Date Repairs Compl'd
Vegetation	✓					
Fences	✓					
Principal Spillway	✓					
Emergency Spillway	✓					
Embankment	✓					
Reservoir Area	✓					
Scour Hole & Outlet Chnl	✓					
Foundation Drains &	N.A.					
Relief Wells	N.A.					
Other a few [illegible] the fenced area			will be [illegible] and/or sprayed	$25	10-1-80	

Remarks: Reservoir holding only a small amount of water. Crown Vetch is invading spillway and other areas.

Warren H. George
District Conservationist

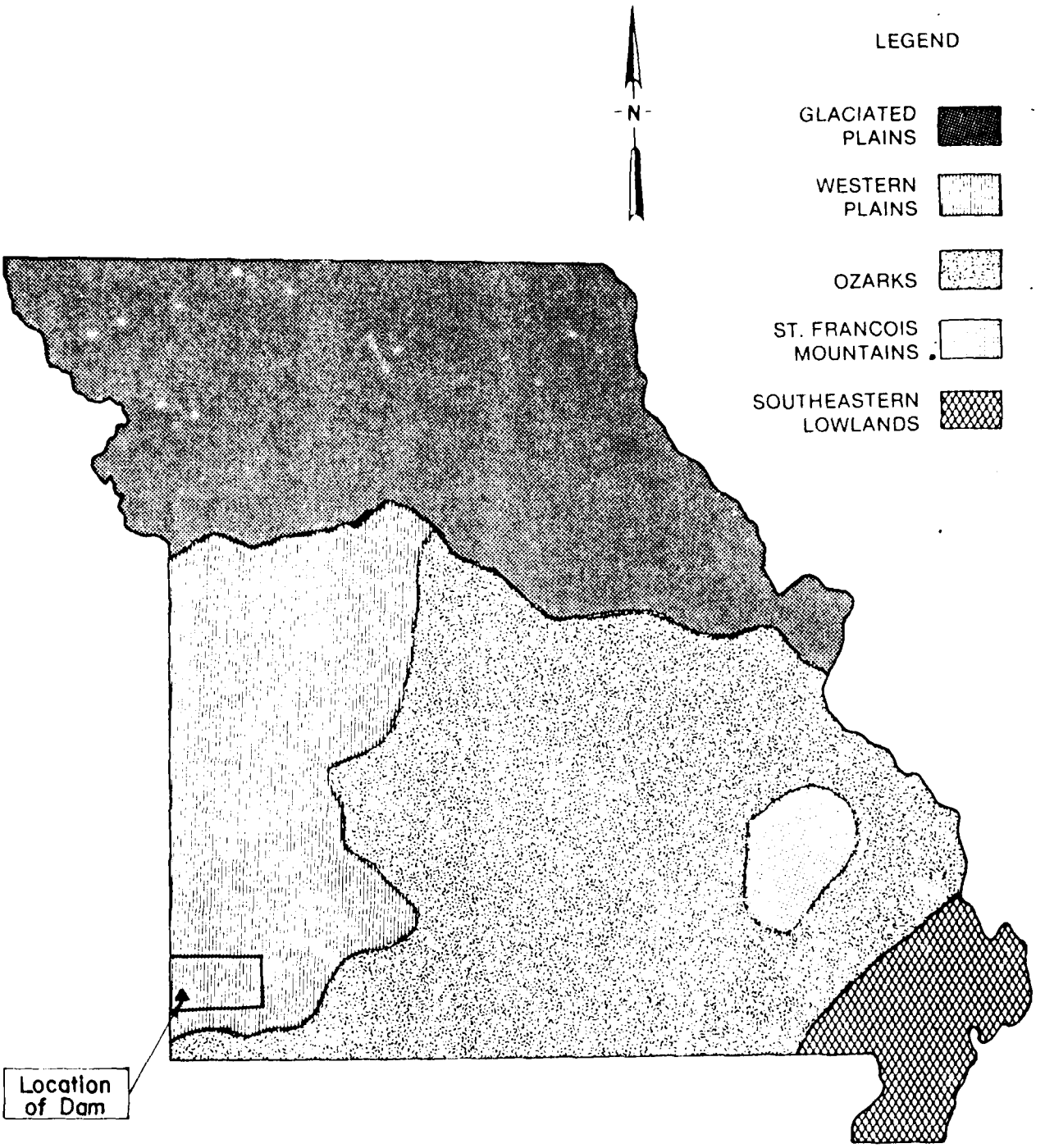
[illegible] Wilson
[illegible]
Sponsoring Local Organization Rep.

Newton [illegible] and [illegible]ter Conservation District
Sponsoring Local Organization

(Check list on reverse side)

APPENDIX B

Geology and Soils



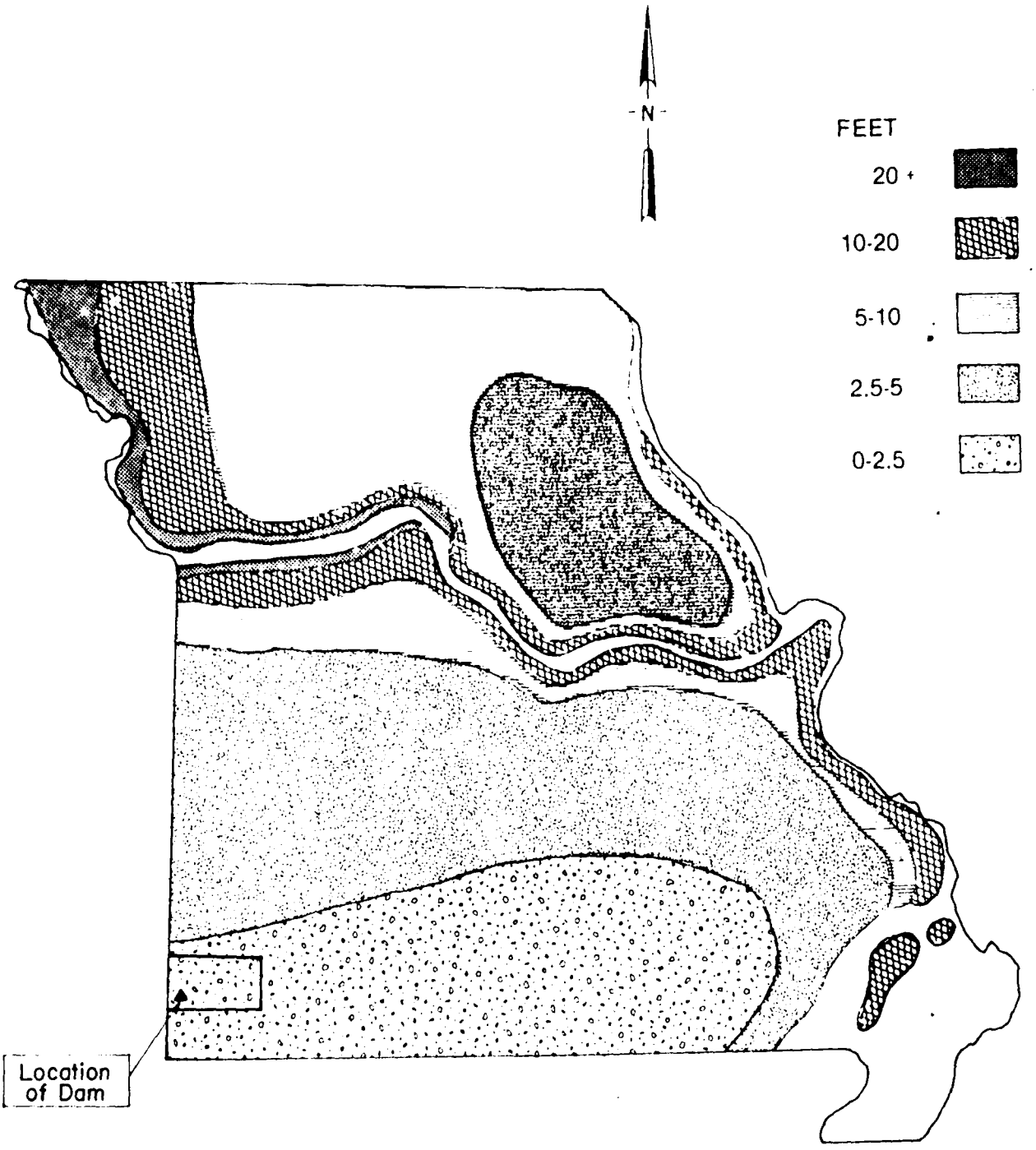
MAJOR GEOLOGIC REGIONS OF MISSOURI

HANSON ENGINEERS

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Newton County Structure F-2
Newton County, Missouri
Mo. I.D. No. 20513

SHEET 1, APPENDIX B



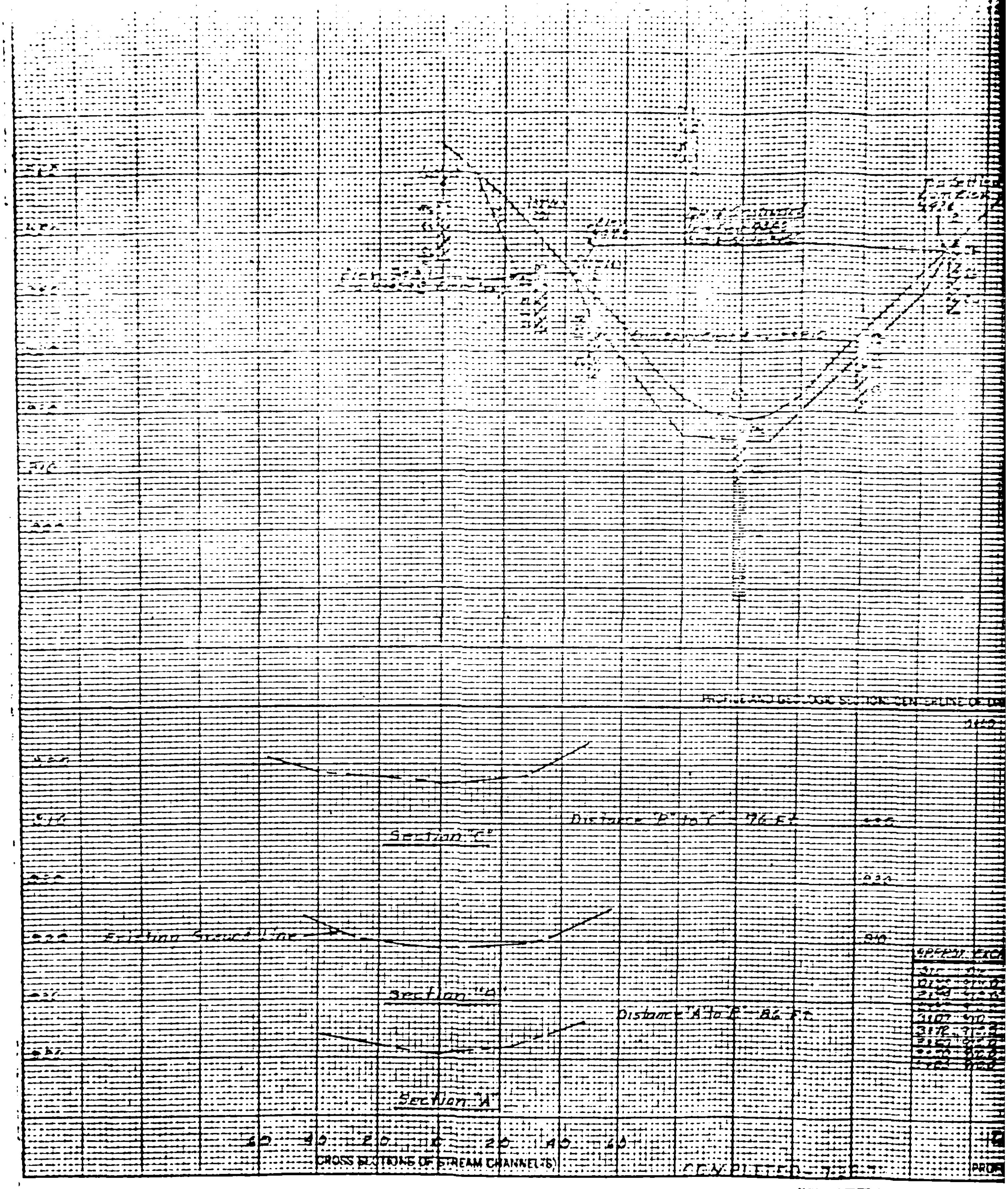
THICKNESS OF LOESSIAL DEPOSITS

HANSON ENGINEERS

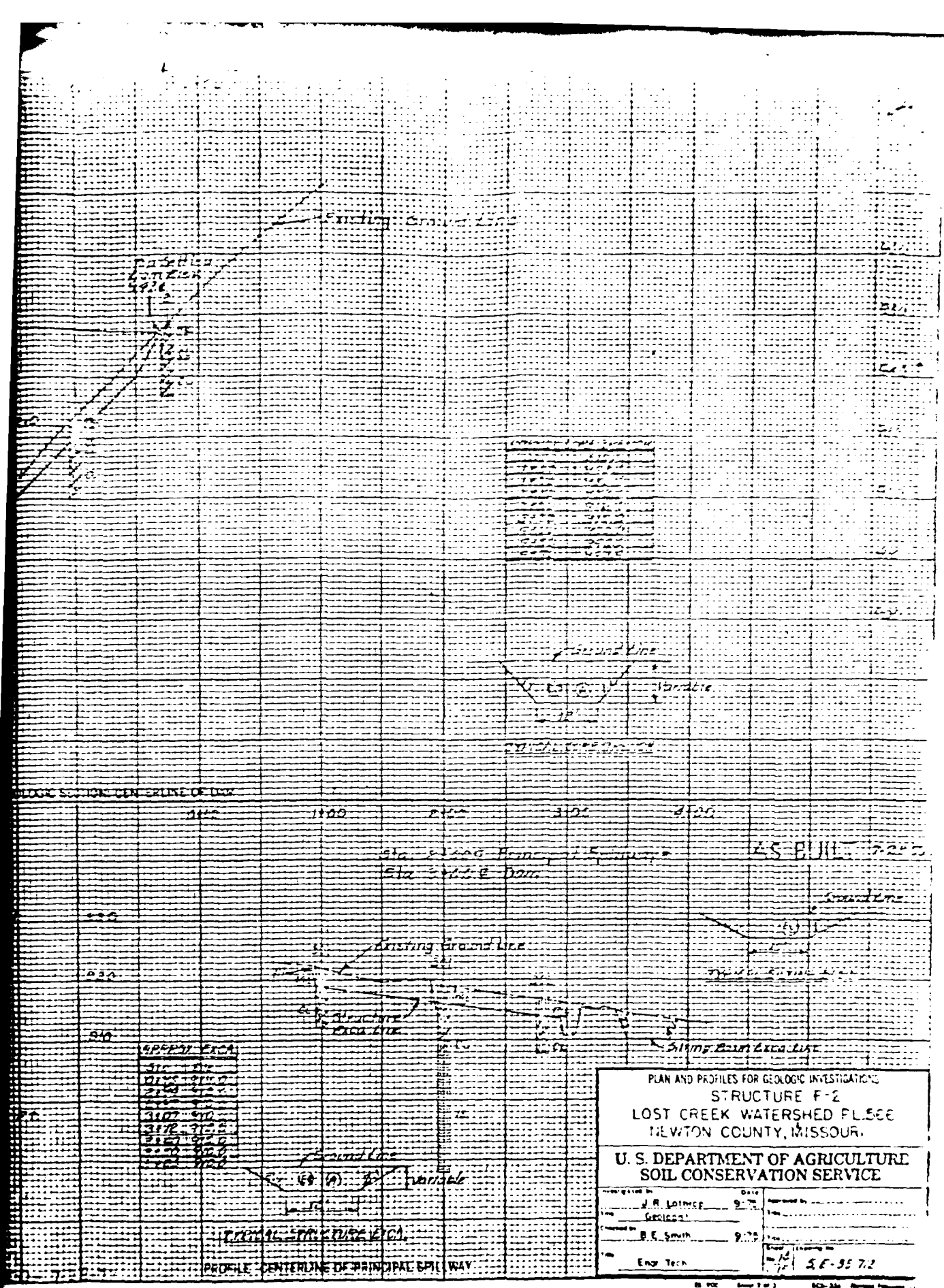
SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Newton County Structure F-2
Newton County, Missouri
Mo. I.D. No. 20513

SHEET 2, APPENDIX B



PROFILE AND GEOLOGIC SECTION CENTERLINE OF DA
Section "C"
Distance "B" to "C" - 76 Ft.
Existing Ground Line
Section "A"
Distance "A" to "B" - 86 Ft.
Section "A"
CROSS SECTIONS OF STREAM CHANNEL(S)


Existing Ground Line
Ground Line
Existing Ground Line
Structure Excavation Line
Sliding Beam Excavation Line
PROFILE CENTERLINE OF PRINCIPAL SPILLWAY
PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
STRUCTURE F-2
LOST CREEK WATERSHED PL.566
NEWTON COUNTY, MISSOURI.
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
J.R. Latimer
Geologist
B.E. Smith
Engr. Tech
SE-95 7-2

Form SCS 3764
Sheet 1 of 62

10-59

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri County Newton ; NW ¼, ¼, Sec. 36, T 25N R 34W ; Watershed Lost Creek

Subwatershed ____ Fund class WF-08 2018 (FP-2, WP-1, etc.) Site number F-2 Site group II Structure class C

Investigated by [signature] (signature and title) Equipment used Failing 1500 RD (Type, size, make, model, etc.) Date 9-21-75

1/ Geologist

SITE DATA

Drainage area size 0.13 sq. mi., 80 acres. Type of structure Compacted Earth Purpose Debris Basin

Direction of valley trend (downstream) SW Maximum height of fill 28.6 feet. Length of fill 355 feet.

Estimated volume of compacted fill required 17,450 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	7.6 Total	1.4	13.2
Floodwater	28	3.9	24.3

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Ozark Highland Topography Rolling ; Attitude of beds: Dip S Strike E-W

Steepness of abutments: Left 17 percent; Right 21 percent. Width of floodplain at centerline of dam 60 feet

General geology of site: This site is located upon an outcrop of the Warsaw formation of the Meramecian series and is Mississippian in age. Bedrock on the site is hardness 4-5 limestone which occurs at an average depth of 10 feet along the entire ℄ dam alignment. The bedrock surface may be expected to be uneven and pinnacled.

Soils developed above bedrock are of medium to stiff consistancy. Clayey gravelly silt (ML) and gravelly clays (CL).

The channel is grass covered and poorly defined and carried no water at the time of the site investigation. A water table was not encountered.

F-2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-376B
REV. 2-64
SHEET 2 OF 6

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE ℄ Dam

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	4	1	--	2	--
TOTAL	4	1	--	2	--

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

Hardness 4-5 limestone occurs at an average depth of 10 feet along the entire ℄ dam alignment.

Soils developed above bedrock are of medium to stiff consistancy. Clayey gravelly silt (ML) and chert gravelly clays (CL).

A water table was not encountered.

F-2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS 376B
REV 2-64
SHEET 3 OF 6

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Principal Spillway

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	3	1	1 (3") Shelby	1	--
TOTAL	3	1	1 (3")	1	--

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

Hardness 4-5 limestone bedrock was encountered at an average depth of 10 feet along the principal spillway alignment.

Soils developed above bedrock are a thin brown-black gravelly silt (ML) surface horizon overlying a brown-red silty gravelly slightly cobbly clay (CL) horizon. The second horizon extends to the bedrock contact.

A water table was not encountered.

F-2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-376B
REV. 2-64
SHEET 4 OF 6

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Borrow Area
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	4	1	--	2	--
TOTAL	4	1	--	2	--

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

Three soil horizons generally comprise the materials of the borrow. The surface horizon averaging 2 to 3 feet in depth, is a slightly gravelly silt (ML). The second horizon is a very cherty gravelly brown to light red clay (CL) that extends to an average depth of 5 feet. The third horizon is a cherty gravelly red clay (CL). The third horizon directly overlies limestone bedrock.

Hardness 4 to 5 limestone bedrock will limit borrowing to depths of 7 feet or less. Average depth to limestone is 9 feet.

Higher plasticity soils appear to increase with depth.

No water table was encountered in any of the borrow borings.

F-2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-376B
REV. 2-64
SHEET 5 OF 6

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Stream Channel

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
No borings					
TOTAL					

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

The principal spillway alignment is in the channel and the borings along that alignment are congruent to the channel sections. The channel is grass covered and poorly defined. Two major draws upstream contained farm ponds that were 65% full and no water was in the channel at the time of the site investigation.

F-2.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FORM SCS-376B
REV. 2-64
SHEET 6 OF 6

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Emergency Spillway

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
			UNDISTURBED	DISTURBED	
	EXPLORATION	SAMPLING	(STATE TYPE)	LARGE	SMALL
Failing 1500 RD	14	1	--	2	---
TOTAL	14	1	--	2	--

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

A thin brown silt (ML) surface horizon averaging 2 to 3 feet in depth overlies brown and red chert gravelly clay horizons, and these clay horizons extend to limestone bedrock. Hardness 4-5 cherty limestone bedrock occurs at an average depth of 10 feet. The limestone bedrock is encountered a few feet above proposed grade in the left or outside portions of the forebay, control and the lower exit areas.

Sheet 9 of Appendix B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-376C
REV. 2-64
SHEET 1 OF 1

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED	SUBWATERSHED	COUNTY	STATE
Lost Creek		Newton	Missouri

SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST)	DATE
F-2	II	C	[signature]	9-21-75

INTERPRETATIONS AND CONCLUSIONS

℄ Dam The recommended minimum cutoff trench depths should provide an adequate cut-off. The trench will bottom on both abutments in cherty gravelly clay (CL) material and through the floodplain section in silty chert gravelly clay material. Low seepage may be expected. It is not anticipated that the limestone bedrock will be uncovered, where there may be some highly permeable strata. [illegible]

Principal Spillway Location, alignment and foundation are satisfactory and the skewed location at station 3+00 ℄ dam is adequate. It is suggested that the ML surface material found along this alignment be removed during construction.

Drainage Not recommended.

Stream Channel Since the channel is grass covered and poorly defined normal stripping operations during construction should be adequate treatment.

Emergency Spillway An estimated 7,500 cubic yards of required excavation may be expected from this area of which an estimated 500 cubic yards of this amount may be expected to be rock excavation. The rock should be suitable for use for front berm protective cover.

Borrow Ample materials are available along with required excavation from the emergency spillway to construct the embankment. More plastic gravelly clay materials are found in the higher elevations than in the floodplain areas; and it is suggested that borrowing be limited in the floodplain areas.

[illegible]

ENGINEER'S REPORT

SITE F-2 LOST CREEK

1. STREAM CHANNEL - Stripping and foundation preparation and core trench excavation should eliminate all the stream channel cleanout needed.

2. DEPTH OF CORE - Recommend that the core trench be as shallow as possible, probably about 8 feet deep. Removing the upper highly cherty CL layer and penetrating approximately two feet (2') into the lower less cherty CL layer. Suggest 12.0 bottomwidth with 1:1 side slopes.

3. UNDESIRABLE MATERIAL - The only undesirable material is the rock excavation in the emergency spillway. Suggest this material be placed in the valley between the emergency spillway berm and back toe of the fill below the centerline of the dam or on the front slope of the dam below the upstream berm.

4. MATERIALS - Excavation from core and emergency spillway except for rock excavation may be used for fill. Emergency spillway excavation with 3:1 side slopes will amount to approximately 7,000 cubic yards of usable material. Ample material may be obtained by excavating below the emergency spillway elevation in the borrow area. Consideration should be given to steeper side slopes for the emergency spillway due to rock encountered above grade.

5. CONDUIT - Due to class of structure the conduit will be reinforced 30 inch concrete pipe with capped riser.

6. DRAINAGE - It is very doubtful that any type of drainage will be needed.

7. Recommend that fill placement control be class C compaction or class A compaction with controls on the minus 3/4" fraction.

Joe A. Green

Joe A. Green, Project Engineer
September 22, 1975

I concur in these recommendations
22222

A-3-4-1.
1-23-76

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE - Soil Mechanics Laboratory

800 "J" Street, Lincoln, Nebraska 68508

SUBJECT: ENG 13-18, Missouri WF-08, Lost Creek, Site F-2 (Newton County) **DATE:** January 22, 1976

TO: Monroe Dale
State Conservation Engineer
Soil Conservation Service
Columbia, Missouri

ATTACHMENTS

1. Form SCS-ENG-354, Soil Mechanics Laboratory Data, 1 sheet
2. Form SCS-ENG-355A & 355B, Triaxial Shear Test, 1 test, 2 sheets
3. Form SCS-366, Direct Shear Test, 1 sheet
4. Form SCS-ENG-392, Compaction and Penetration Resistance, 2 sheets
5. Form SCS-357, Summary - Slope Stability Analyses, 2 sheets

DISCUSSION

FOUNDATION

A. Bedrock. Limestone bedrock occurs at depths of about 9 to 13 feet on the abutments in the bottom of the valley.

B. Soil Classification. The soil mantling the bedrock is logged as about a 2-foot layer of ML overlying gravelly clay that is classed as CL. Samples 301-1 and 301-2 are from the gravelly clay layer. These samples have LL's in the range of 35 and PI's in the range of 12. They contain about 25 percent gravel and from 51 to 63 percent fines. They are classed as CL.

C. Dry Density. Test specimens trimmed from the core sample submitted had densities ranging from 1.57 g/cc to 1.64 g/cc. The difference in density of the test specimens is probably due to difference in gravel content.

D. Shear Strength. A direct shear test was made on core sample 301-2. The specimens were flooded prior to shear and the shear strength parameters are considered to represent the consolidated drained values. They are $\bar{C}$ = 350 psf, $\bar{\phi}$ = 0. The size of the core sample and the condition of the core prevented us from making a triaxial shear test as requested.

EMBANKMENT

A. Classification. Two samples were submitted from the emergency spillway area and two were submitted from the borrow area. Sample 307-1 is from the surface 1 to 3 feet and is classed as CL-ML. Sample 307-2 is a CL.

Both samples from the borrow area are from hole 101. They contain about 25 percent gravel and from 41 to 45 percent fines. They are classed as CL. The deeper sample 101-2 is more plastic than Sample 101-1. The clay fraction is non-dispersive.

B. Compacted Density. Standard Proctor compaction tests were made on two samples as requested. Density control on the minus 3/4-inch fraction is planned, so the laboratory tests were made on the minus 3/4-inch fraction. The moisture versus density relationship is shown on the attached Form SCS-ENG-352.

SHEAR STRENGTH

A triaxial shear test was made on Sample 101-1 as requested. The test was made on the minus 3/4-inch fraction at 95 percent of standard Proctor density. The test specimens were backpressured to saturation. The shear strength parameters obtained are $\phi = 17.5°$, $c = 375$ psf and $\bar{\phi} = 35.5°$, $\bar{c} = 175$ psf.

SLOPE STABILITY ANALYSIS

A stability analysis was made for the proposed $2\frac{1}{2}$:1 slopes. The analysis considered a phreatic line from emergency spillway elevation and the no-drain condition. The upstream slope was checked for the sudden-drawdown condition, and the downstream slope was checked for the steady-seepage condition. Shear strength parameters used were $\phi = 17.5°$, $c = 375$ psf. The factors of safety obtained were greater than 1.60. The foundation shear strength indicated by the undisturbed sample is high for the proposed embankment.

CONCLUSIONS AND RECOMMENDATIONS

We concur with the proposals outlined in the engineer's report for this site. With the embankment density controlled to 95% of Proctor density on the minus 3/4-inch fraction the proposed $2\frac{1}{2}$:1 slopes have acceptable factors of safety. The clay fraction of the proposed embankment soil is non-dispersive and this soil is expected to be quite erosion resistant, so a drain is probably not needed.

The consolidation potential of the CL foundation soil indicated by consolidation of the direct shear test specimens is [illegible] percent under a 1440-psf load, 3.2 percent under a 2880-psf load, and 5.2 percent under a [illegible]-psf load. These values could be used as estimates for computing horizontal strain on the conduit.

Torn P. Dunnigan
Head

Attachment

cc: Joe A. Green, [illegible], Mt. Vernon (c).
Basil H. [illegible], Lincoln, Nebr.

FILE CODE ENG-13-18 — 17,450 cu yc — Class C Debris Basin

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

11/13/75 — MISSOURI — Lost Creek Site: F-2

Laboratory Sample Number	Field Number	Location and Description		Depth	Field Classification	.002	.005	.02	.05	#200	#140	#60	#40	#20	#10	#4	3/8"	1/2"	3/4"	1"	1 1/2"	3"	LL	PI	Unified Classification	Soluble Salts	Dispersion %	Moisture-Density
76W																												
767	301-1	Prin. Spwy., 2+00 ₵ PS ≅ 3+00 ₵ Dam	L. Bag	3-11'	CL	15	21	33	45	51	52	55	58	62	67	75	85	89	95	98	100		35	13	CL		9	
768	301-2	" "	Undist	4-5.5'		19	25	47	61	63	64	68	69	71	72	73	74	75	77	85	90	100	35	12	CL			
769	207.1	Emer. Spwy., 25' L 3+50 ₵	L. Bag	1-3'	ML	7	15	38	57	57	59	61	61	63	66	71	78	82	76	90	95	100	35	14	CL-ML		23	
770	207.2	" "	L. Bag	3-10'	CL	18	24	39	54	56	55	61	63	67	73	85	92	95	98	99	100		35	14	CL		3	
																							Dry density = [illegible]					[illegible]
771	101-1	Borrow, ₵ 4+00	L. Bag	2-5'	CL	13	18	28	37	41	42	44	49	55	63	75	86	91	97	99	100		27	12	SC		TR	
																							Density = [illegible]					[illegible]
772	101-2	" "	L. Bag	5-8'	CL	22	29	37	44	45	45	49	53	55	62	75	79	84	78	99	100		47	26	SC		TR	

Sheet 14 of Appendix B

SCS-[illegible]-1[illegible] (Rev. 3-70)
FILE CODE ENG-22

LABORATORY NO. 26M271

MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: Lost Creek STEP F-2, Missouri
SAMPLE LOCATION: Borrow, E 11+00
FIELD SAMPLE NO: 101-1
DEPTH: 3 - 5'
GEOLOGIC ORIGIN:
TYPE OF SAMPLE: Compacted
TESTED BY: SML - Lincoln
APPROVED BY:
DATE:

INDEX TEST DATA

USCS SC ; LL 29 ; PI 10
% FINER (mm): 0.002 15 ; 0.005 19 ;
0.074 (#200) 41
G_s (-#4) 2.64 ; G_s (+#4)
STANDARD: γ_d MAX. 115.5 pcf; w_o 15.0 %
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

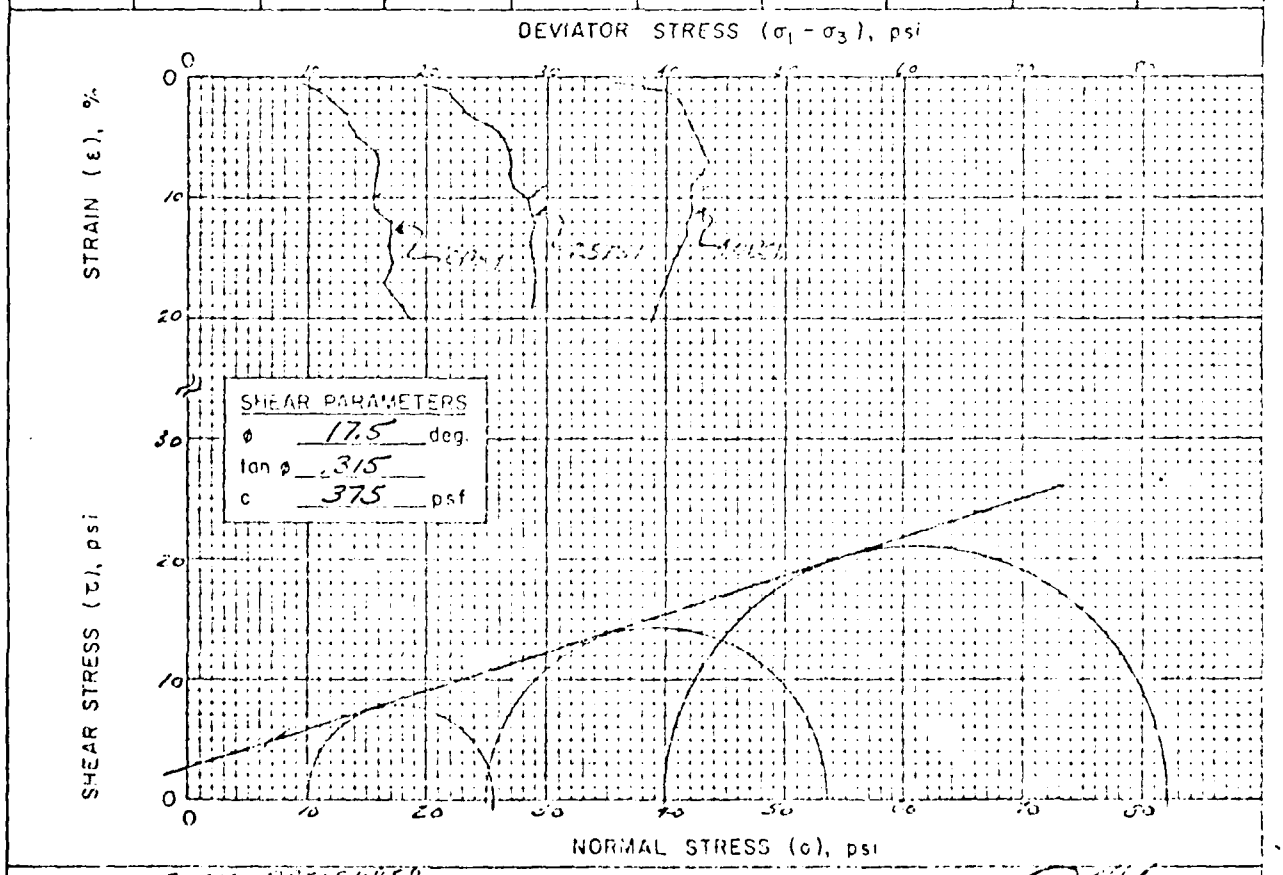
SPECIMEN DATA

HEIGHT 8.0 "; DIAMETER 4 "
MATERIALS TESTED PASSED 3/4" SIEVE
METHOD OF PREPARATION STATIC COMPACTED IN 4 LIFTS
MOLDING MOISTURE 16.0 %
MOLDED AT 99.1 % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☐
$\overline{CU}$ ☑
CD ☐

DRY DENSITY INITIAL pcf ☐ g/cc ☐	DRY DENSITY CONSOLIDATED pcf ☐ g/cc ☐	B PARAMETER	MOISTURE CONTENT, % START OF TEST	MOISTURE CONTENT, % DEG. OF SAT. AT START OF TEST	MOISTURE CONTENT, % END OF TEST	TIME OF CONSOLIDATION (hrs)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
109.6	[illegible]	0.96	16.8		18.2	16.17	10	15.6	10.0
110.2	[illegible]	0.97	16.0		16.9	63.95	25	28.4	10.0
110.9	[illegible]	0.89	15.2		16.7	15.92	40	42.0	10.0



REMARKS BACK-PATSCURED

[illegible] PRACTICABLE

SCS-ENG-351(6-71)
FILE CODE ENG-32

LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST with *pore pressure measured*

PROJECT and STATE: Last Creek Site 6-2, Mississippi

SAMPLE LOCATION: Borrow Pit 4+00

TYPE OF SAMPLE: Compacted

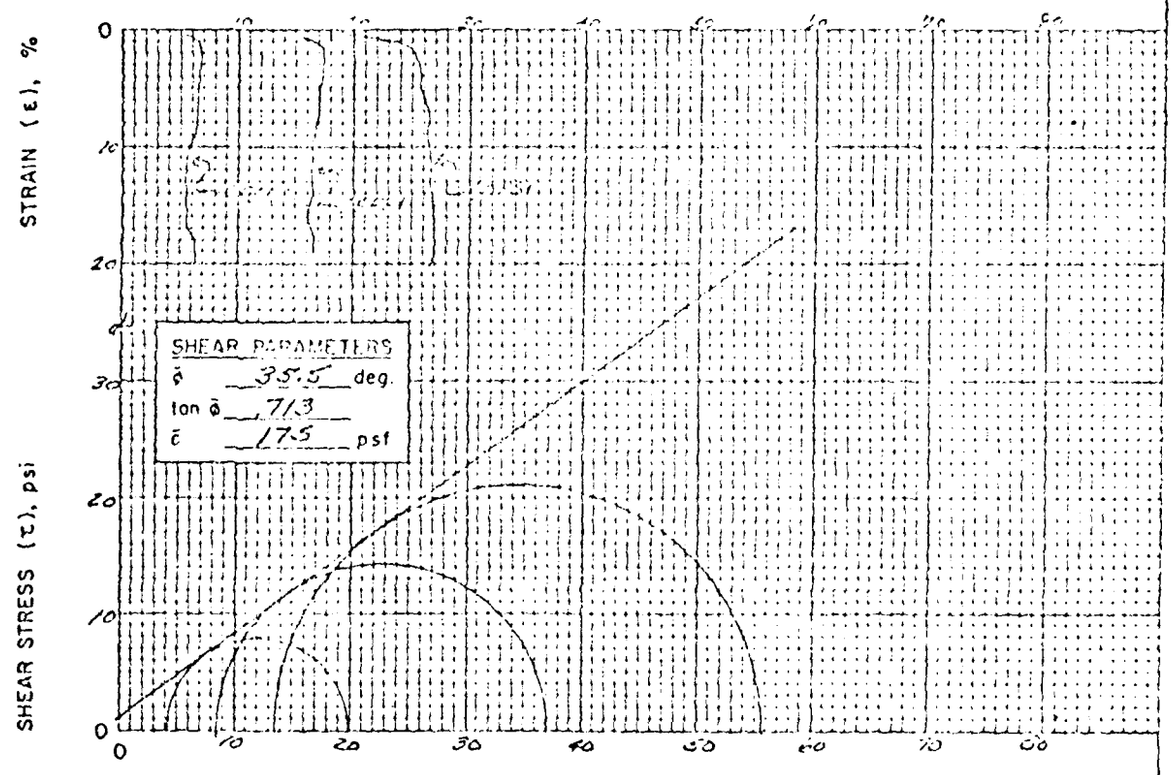
TESTED AT: Soil-Lineal

APPROVED BY:

DATE:

MINOR PRINCIPAL STRESS, σ_3 (psi)	PORE PRESSURE, u (psi)	EFFECTIVE MINOR PRINCIPAL STRESS, $\bar{\sigma}_3$ (psi)	DEVIATOR STRESS, $\sigma_1 - \sigma_3$ (psi)	FAILURE CRITERIA	AXIAL STRAIN AT FAILURE, ϵ (%)
10	5.8	4.2	15.6		10.0
25	16.4	8.6	20.4		10.0
40	26.4	13.6	42.0		10.0

PORE PRESSURE (u), psi



REMARKS: BACK-PRESSURED

Sheet 16 of Appendix B

LABORATORY NO. NW 768

MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	DIRECT SHEAR TEST

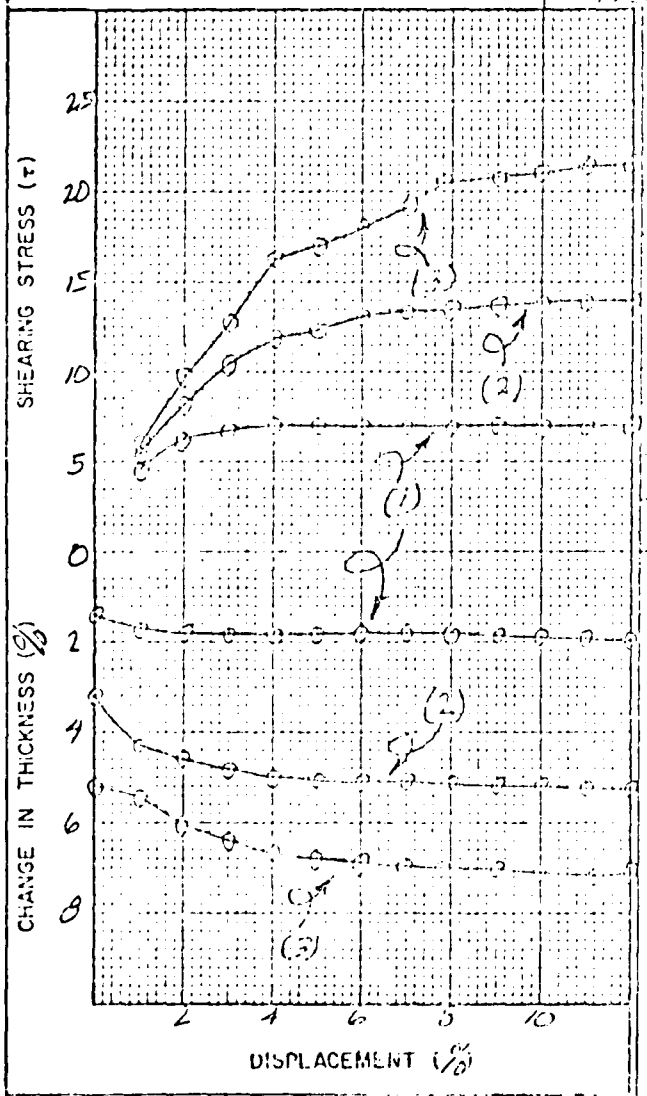
PROJECT and STATE: LOST CREEK SITE F-2 MISSOURI
SAMPLE LOCATION:
FIELD SAMPLE NO: 301.2
DEPTH:
GEOLOGIC ORIGIN:
TYPE OF SAMPLE: UNDISTURBED
TESTED AT: SML LINCOLN
APPROVED BY:
DATE:

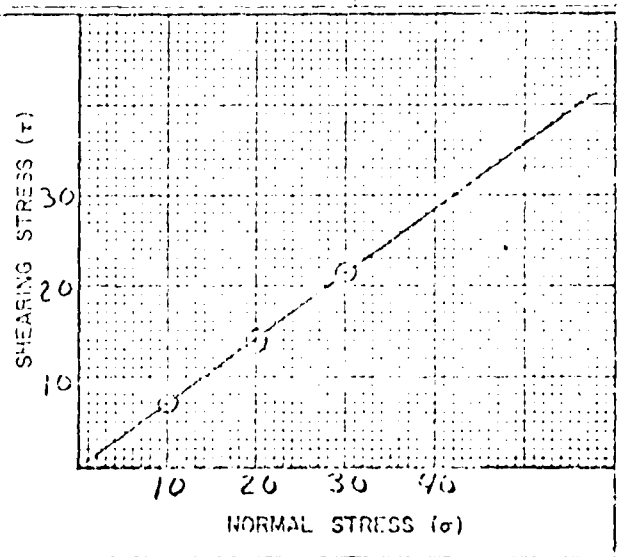
CLASSIFICATION: CL LL 34 PI 12
SPECIFIC GRAVITY

TYPE OF TEST: Consolidated Drained
CONTROL: STRAIN
$G_s(-)$ #4: 2.67
RATE OF LOADING (in/min):
MOISTURE CONDITION: FLOODED
$G_s(+)$ #4:
TYPE OF SPECIMEN:
AREA (sq in): 4.0
THICKNESS (in): 1.0
G_m(bulk)(+) #4*:

TEST NO	1	2	3	4
INIT MOISTURE, %	23.3	23.3	23.3	
DRY DENSITY, pcf	1.57	1.58	1.60	
INIT VOID RATIO	.7006	.6890	.6689	
TEST DURATION, (hr)	312	333	333	
FINAL MOISTURE, %	24.3	23.3	21.9	
NORMAL STRESS	10	20	30	
MAX SHEAR STRESS	7	14	21.5	

SHEAR VALUES	ϕ	C
AT MAXIMUM STRESS	35½	0





REMARKS

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Sheet 17 of Appendix B

SCS-ENG-352 (REV. 3-70)
FILE CODE ENG-22

LABORATORY NO. 770223

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Lamb Creek # F-2, Missouri.

FIELD SAMPLE NO	LOCATION	DEPTH
202.2	Emb. Spwy. 25' L 3+50 ℄	3-10'

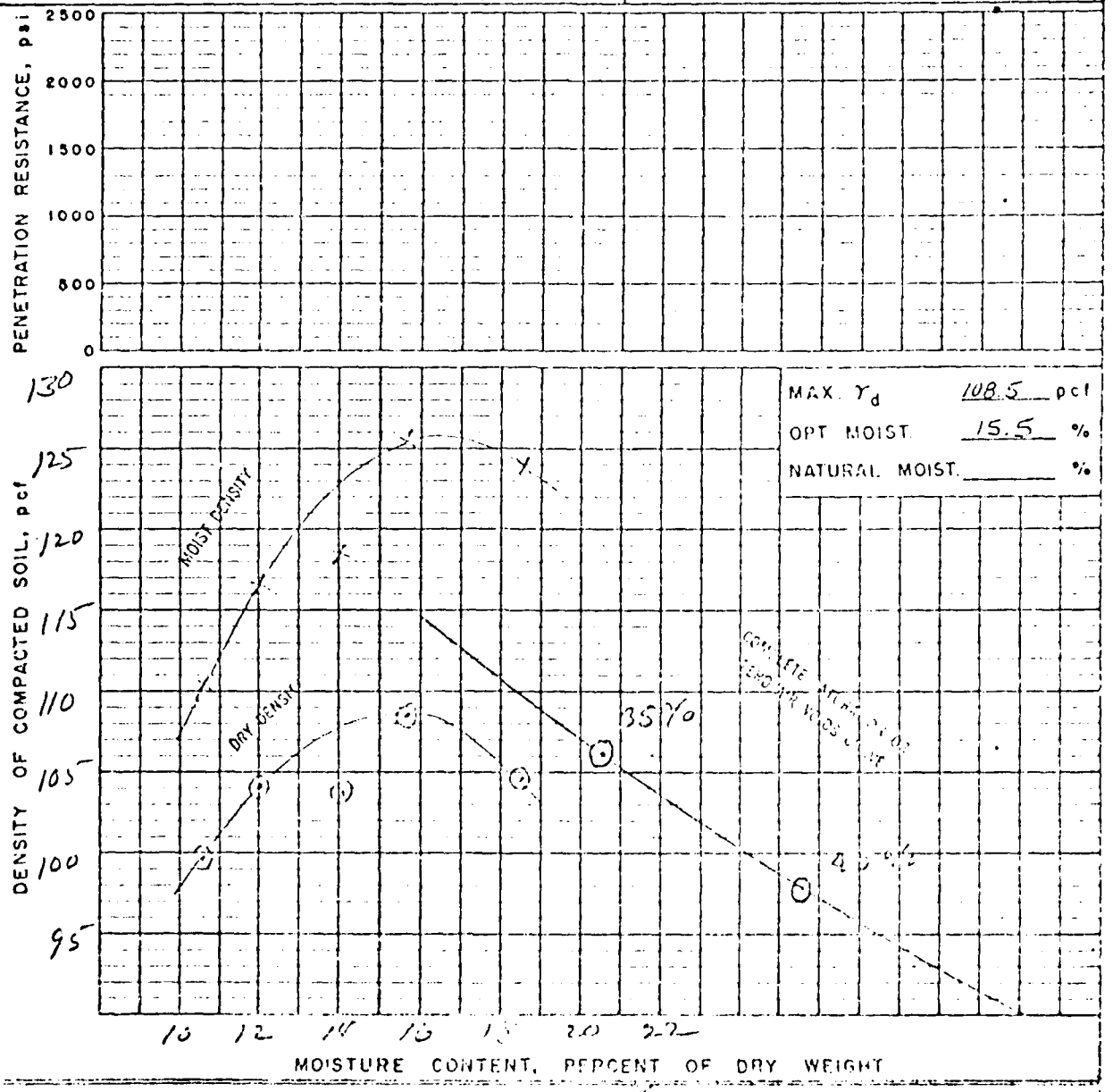
GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN		

CLASSIFICATION CL LL 35 PI 14 — CURVE NO. 1X OF 2

MAX. PARTICLE SIZE INCLUDED IN TEST 2" — STD (ASTM D-698) [X]; METHOD A

SPECIFIC GRAVITY (G_s) { MINUS NO 4 2.637 — MOD (ASTM D-1557) ☐; METHOD ____

PLUS NO. 4 2.46 Av. 2.61 — OTHER TEST ☐ (SEE REMARKS)



REMARKS

CURVE IS FOR THE MINUS NO. 4 FRACTION

GRADATION OF TOTAL SAMPLE

< NO. 200 5% ; < NO. 4 35% ; < 1/2 IN. 100%

SCS-ENG-352 (REV. 3-70)
FILE CODE ENG-22

LABORATORY NO. 760771

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Lost Creek #- E-2, Missouri.

FIELD SAMPLE NO.	LOCATION	DEPTH
101-1	Borrow, B 4+00	2.5'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
	SML-LINCOLN		

CLASSIFICATION SC LL 27 PI 10 — CURVE NO. 2X OF 2

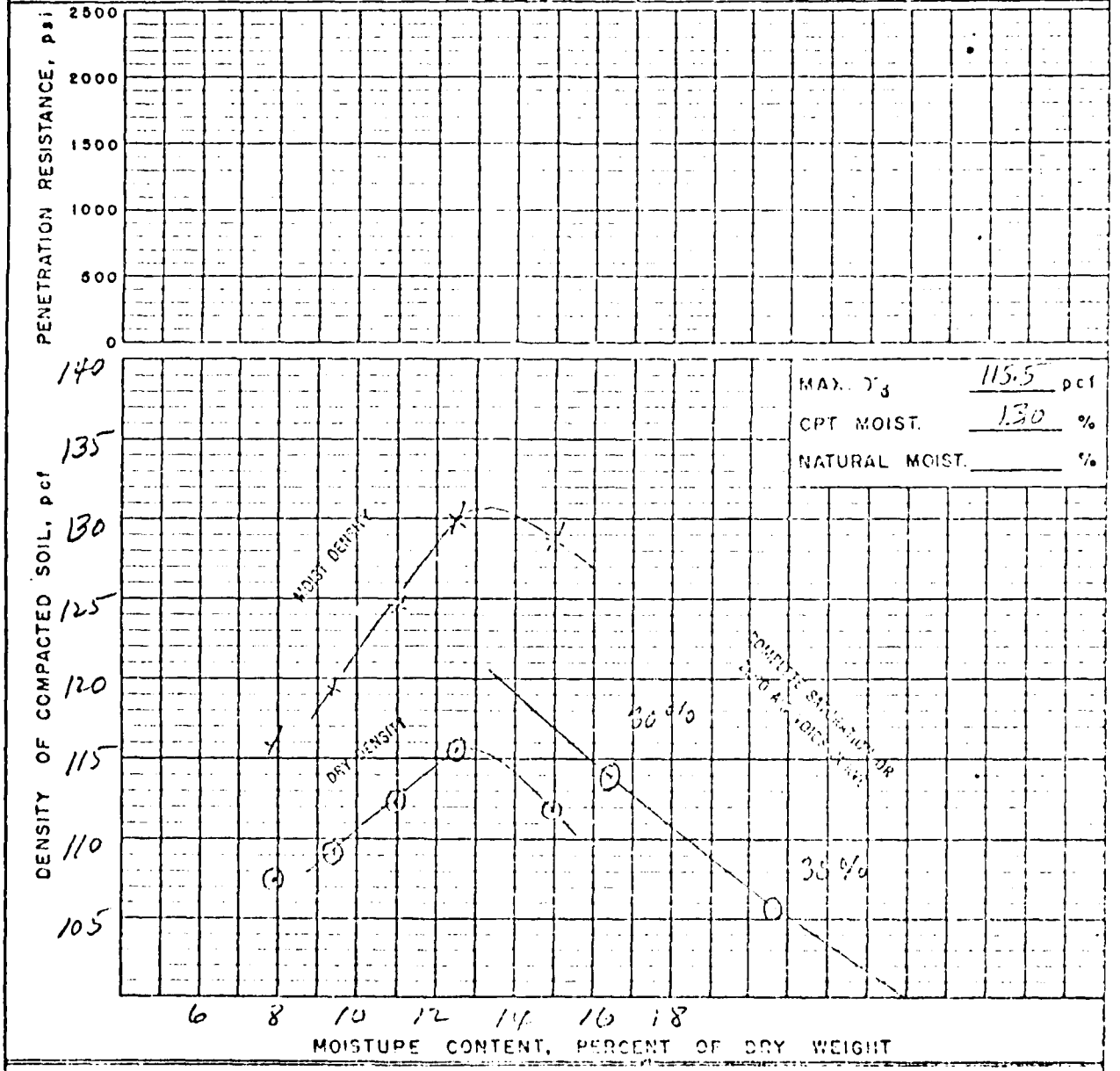
MAX. PARTICLE SIZE INCLUDED IN TEST < 3/4"

SPECIFIC GRAVITY (G_s) { MINUS NO 4 2.64f; PLUS NO. 4 2.48; AV. 2.62 }

STD. (ASTM D-698) [X]; METHOD C

MOD (ASTM D-1557) [ ]; METHOD

OTHER TEST [ ] (SEE REMARKS)



REMARKS

CURVE IS FOR THE MINUS NO 4 FRACTION

GRADATION OF TOTAL SAMPLE

< NO. 200 41 %; < NO. 4 75 %; < 1½ in. 100 %

Form SCS 357
Rev. 6-65

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SUMMARY - SLOPE STABILITY ANALYSIS

PROJECT and STATE: LOST CREEK #F-2 MISSOURI

DATE: 1-5-76

METHOD OF ANALYSIS: ICES

ANALYZED AT: [illegible]

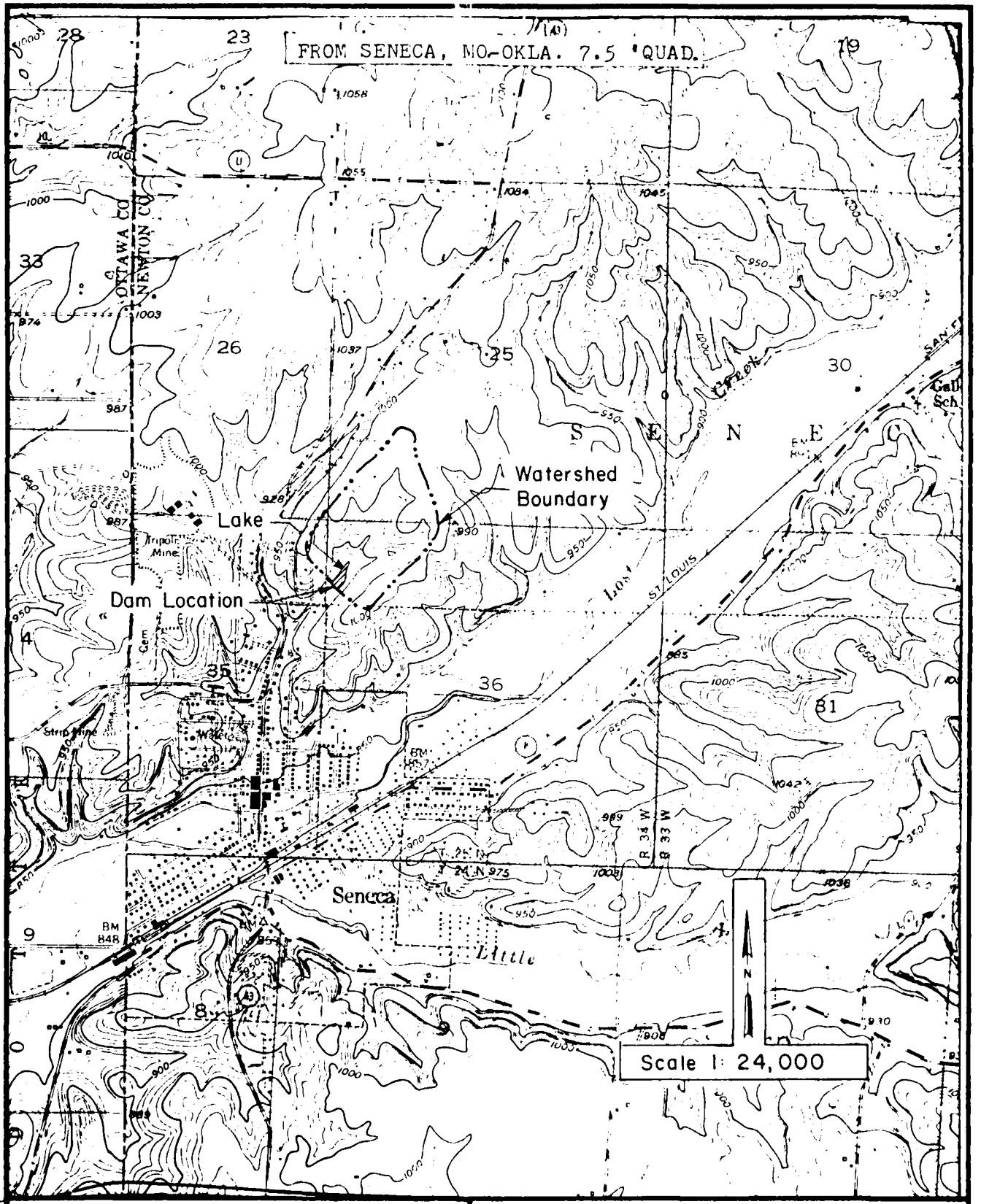
APPROVED BY:

	SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA: γ_d (pcf)	γ_m (pcf)	γ_{sat} (pcf)	γ_{sub} (pcf)	ϕ (deg)	tan ϕ	c (psf)	REMARKS
①	Embankment	SC	112.2	124.5	130.5	63.0	17.5	.315	375	
②							35.5	.713	175	
③										
④										
⑤										
⑥										
⑦										
⑧										

TRIAL NO.	SLOPE	CONDITIONS: Upstream - Fulldrawdown / Dnstr. - Steady Seepage	Fs	Fs
		Maximum Section @ Station 3+10	Bishop	Swedish Circle
1	2½:1	Embank. (17.5°-375) only, 12' berm @ elev. 32.0.	1.77	1.75
2	2½:1	Embank. (17.5°-375) only.	1.62	1.60

APPENDIX C

Overtopping Analysis



LAKE AND WATERSHED MAP

HANSON ENGINEERS

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Newton County Structure F-2 Dam
Newton County, Missouri
Mo. I.D. No. 20513

Sheet 1, Appendix C

APPENDIX C

HYDROLOGIC AND HYDRAULIC ANALYSIS

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm duration was assumed according to the procedures outlined in EM 1110-2-1411 (SPD Determination).

The synthetic unit hydrograph for the watershed was developed by the computer program using the SCS method. The parameters for the unit hydrograph are shown in Table 1 (Sheet 4, Appendix C).

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2 (Sheet 5, Appendix C).

The reservoir routing was accomplished by using the Modified Puls Method. The hydraulic capacity of the spillway was used as an outlet control in the routing. The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation-surface area--storage-discharge relationships shown in Table 3 (Sheet 5, Appendix C). This dam has been designed for flood control purposes, and the water surface elevation is maintained below the primary spillway invert elevation. To consider the effect of the reservoir storage, an antecedent storm of 25 percent and 50 percent of the PMF was considered (assuming the reservoir at the sedimentation pool elevation 932.0) to determine the starting reservoir elevation for the routing of 50 percent and 100 percent of the PMF respectively. The antecedent storms were assumed to occur four days prior to their corresponding storm. Both antecedent storms will fill the reservoir beyond the emergency spillway level, but at the end of the four days, the reservoir will reduce to the sedimentation pool level since the primary spillway is unregulated. Thus, the final routing analysis was accomplished considering the starting reservoir level at the primary spillway invert elevation 932.0 (sedimentation pool).

The result of the routings of the PMF ratios indicate that the dam will pass the 1 percent probability flood without overtopping the dam.

The rating curve for the spillways (see Table 4 Sheet 6, Appendix C) was determined assuming orifice flow for the primary spillway and channel flow for the emergency spillway.

The flow over the crest of the dam during overtopping was determined using the non-level dam option ($L and $V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir.

A summary of the routing analysis for different ratios of the PMF is shown in Table 5 (Sheet 7, Appendix C).

The computer input data, a summary of the output data, and a plot of the inflow-outflow hydrograph for the PMF are presented on Sheets 8, 9 and 10 of Appendix C.

TABLE 1

SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	0.13 sq. miles
Length of Watercourse (L)	0.45 miles
Difference in elevation (H)	103 ft
Time of concentration (Tc)	0.18 hours
Lag Time (Lg)	0.11 hours
Time to peak (Tp)	0.15 hours
Peak Discharge (Qp)	420 cfs
Duration (D)	5 min.

Time (*)	(*) Discharge (cfs)
0	0
5	235
10	413
15	213
20	87
25	35
30	14
35	6
40	3
45	0

(*) From the computer output

FORMULA USED:

$$Tc = \left(\frac{11.9\,L^3}{H}\right)^{0.385}$$

$$Lg = 0.6\ Tc$$

$$Tp = \frac{D}{2} + Lg$$

$$Qp = \frac{484\ A.Q}{Tp} \qquad Q = \text{Excess Runoff} = 1 \text{ inch}$$

TABLE 2

RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
PMP	24	35.49	33.52	1.97
1% Prob. Flood	24	8.39	5.03	3.37

Additional Data:

1) Soil Conservation Service Soil Group D
2) Soil Conservation Service Runoff Curve CN = 85 (AMC III) for the PMF
3) Soil Conservation Service Runoff Curve CN = 71 (AMC II) for the 1 percent chance flood
4) Percentage of Drainage Basin Impervious 3 percent

TABLE 3

ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillways Discharge (cfs)
920.0	0	0	
* 932.0	1.4	7.6	0
943.3	3.9	35.6	18
** 947.4	4.9	56	1096
950.0	5.1	69	2523

*Primary spillway crest elevation
**Top of dam elevation

The above relationships were developed using data from the SCS plans and the U.S.G.S. SENECA, MO.-OKLA. 7.5 minute quadrangle map.

TABLE 4

SPILLWAYS RATING CURVE

Reservoir Elevation	Primary Spillway (c.f.s.)	Emergency Spillway (c.f.s.)	Total Discharge (c.f.s.)
932.0	0		0
935.0	9		9
940.0	15		15
943.3	18	0	18
943.8	18	28	46
944.3	19	95	114
944.8	19	189	208
945.3	20	308	328
946.3	21	625	646
* 947.4	21	1075	1096
949.0	22	1890	1912
950.0	23	2500	2523

* Top of Dam Elevation

METHOD USED:

1) Primary Spillway: Assuming orifice flow

$Q = C.A. (2g.h)^{1/2}$

Q = Discharge in c.f.s.
C = Discharge coefficient = 0.60
A = Opening area in ft^2 (9" x 18")
g = Acceleration of gravity = 32.2 ft/sec^2
h = Head measured from reservoir elevation to center of orifice (in ft)

2) Emergency Spillway: Assuming open channel flow
Using charts from "UD Method of Reservoir Flood Routing," S.C.S. Technical Release No. 35, February 1967.

TABLE 5

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam
		* 932.0	7.6	0	
0.10	196	938.8	24	14	
0.20	393	943.9	38	56	
0.25	491	944.4	41	137	
0.30	589	945.1	44	274	
0.35	688	945.6	47	412	
0.40	786	945.9	48	507	
0.50	982	946.4	51	671	
0.75	1473	** 947.4	56	1084	0
1.00	1964	948.2	60	1609	0.8

* Primary spillway crest elevation

** Top of dam elevation

The percentage of the PMF that will reach the top of the dam is 75 percent.

```
A       OVERTOPPING ANALYSIS FOR NEWTON CO. STRUCTURE F-2 DAM ( # 3 )
A       STATE ID NO. 20513  COUNTY NAME : NEWTON
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB # 80S3001
B    300                5
B1     5
J      1        9        1
J1   .10      .20      .25      .30      .35      .40      .50      .75      1.0
K      0        1                                  3        1
K1       INFLOW HYDROGRAPH COMPUTATION **
M      1        2     0.13              0.13        1                          1
P      0     27.3      102      120      130
T                                                            -1      -85              0.03
W2  0.18     0.11
X      0     -.1        2
K      1        2                           0        4        1
K1       RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE **
Y                                    1        1
Y1     1                                                    7.6       -1
Y4   932      935      940    943.3    943.8    944.3    944.8    945.3    946.3    947.4
Y4   949      950
Y5     0        9       15       18       46      114      208      328      646     1096
Y5  1912     2523
$S   7.6     35.6       56       69
$E   932    943.3    947.4    950.0
$$   932
$D 947.4
$L     0       20      153      192      328      332      335      338
$V 947.4    947.8    947.9    948.0    948.1    949.0    950.0    951.0
K     99
```

Sheet 5, Appendix C

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				0.10	0.20	0.25	0.30	0.35	0.40	0.50	0.75	1.00
HYDROGRAPH AT	1	0.13	1	196.	393.	491.	589.	688.	786.	982.	1473.	1964.
	(	0.34)	(	5.56)(	11.13)(	13.91)(	16.69)(	19.47)(	22.25)(	27.81)(	41.72)(	55.63)
ROUTED TO	2	0.13	1	14.	56.	137.	274.	412.	507.	671.	1084.	1609.
	(	0.34)	(	0.38)(	1.59)(	3.89)(	7.76)(	11.66)(	14.35)(	19.01)(	30.69)(	45.55)

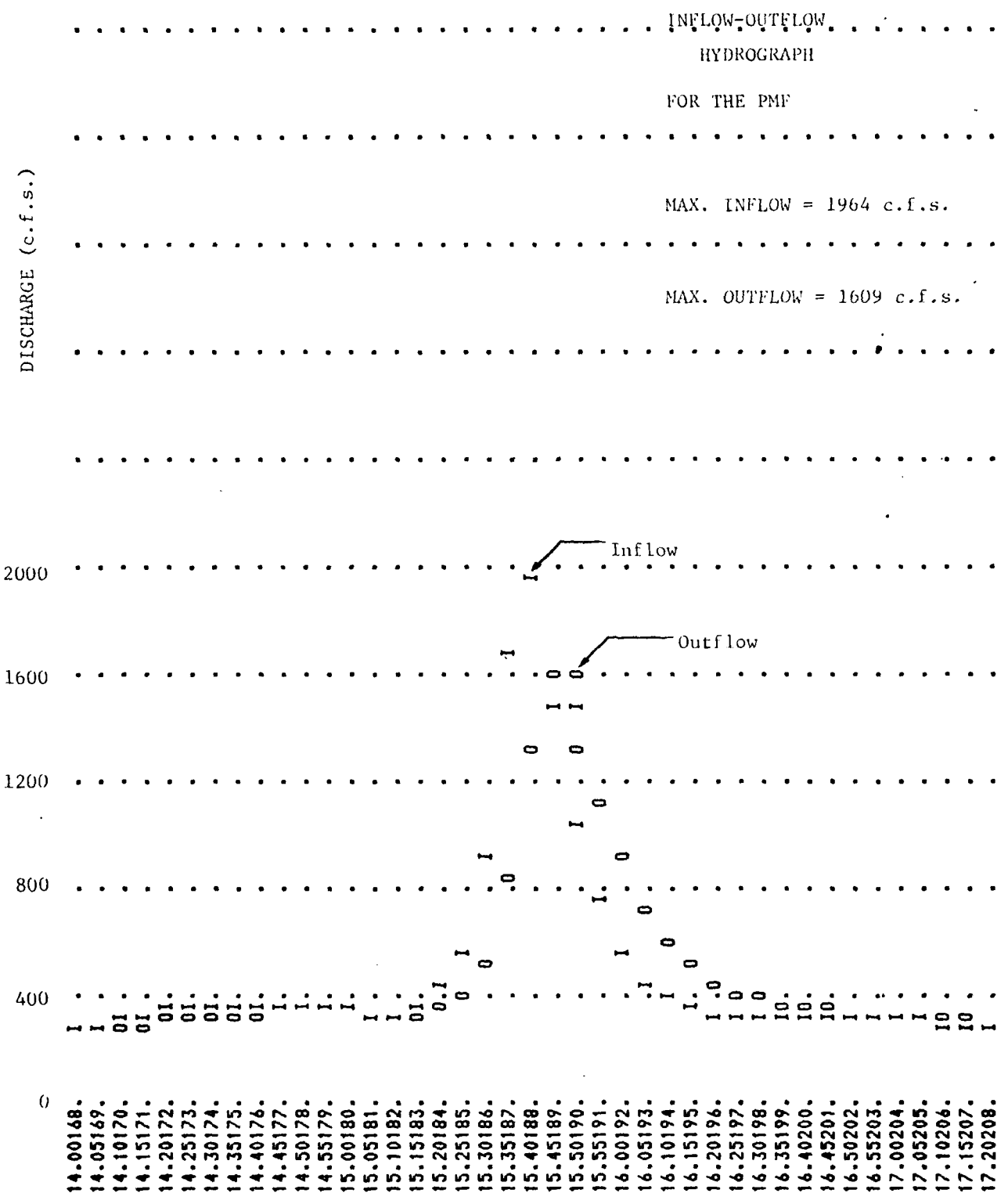
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	932.00	932.00	947.40
STORAGE	8.	8.	56.
OUTFLOW	0.	0.	1096.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	938.80	0.00	24.	14.	0.00	18.50	0.00
0.20	943.87	0.00	38.	56.	0.00	17.17	0.00
0.25	944.42	0.00	41.	137.	0.00	16.00	0.00
0.30	945.07	0.00	44.	274.	0.00	15.83	0.00
0.35	945.56	0.00	47.	412.	0.00	15.83	0.00
0.40	945.86	0.00	48.	507.	0.00	15.75	0.00
0.50	946.36	0.00	51.	671.	0.00	15.75	0.00
0.75	947.37	0.00	56.	1084.	0.00	15.75	0.00
1.00	948.16	0.76	60.	1609.	0.33	15.75	0.00

PMF Ratios
Output Data


INFLOW-OUTFLOW
HYDROGRAPH
FOR THE PMF
MAX. INFLOW = 1964 c.f.s.
MAX. OUTFLOW = 1609 c.f.s.
DISCHARGE (c.f.s.)
Inflow
Outflow
2000
1600
1200
800
400
0
14.00168.
14.05169.
14.10170.
14.15171.
14.20172.
14.25173.
14.30174.
14.35175.
14.40176.
14.45177.
14.50178.
14.55179.
15.00180.
15.05181.
15.10182.
15.15183.
15.20184.
15.25185.
15.30186.
15.35187.
15.40188.
15.45189.
15.50190.
15.55191.
16.00192.
16.05193.
16.10194.
16.15195.
16.20196.
16.25197.
16.30198.
16.35199.
16.40200.
16.45201.
16.50202.
16.55203.
17.00204.
17.05205.
17.10206.
17.15207.
17.20208.
TIME (hrs.)

APPENDIX D

Photographs

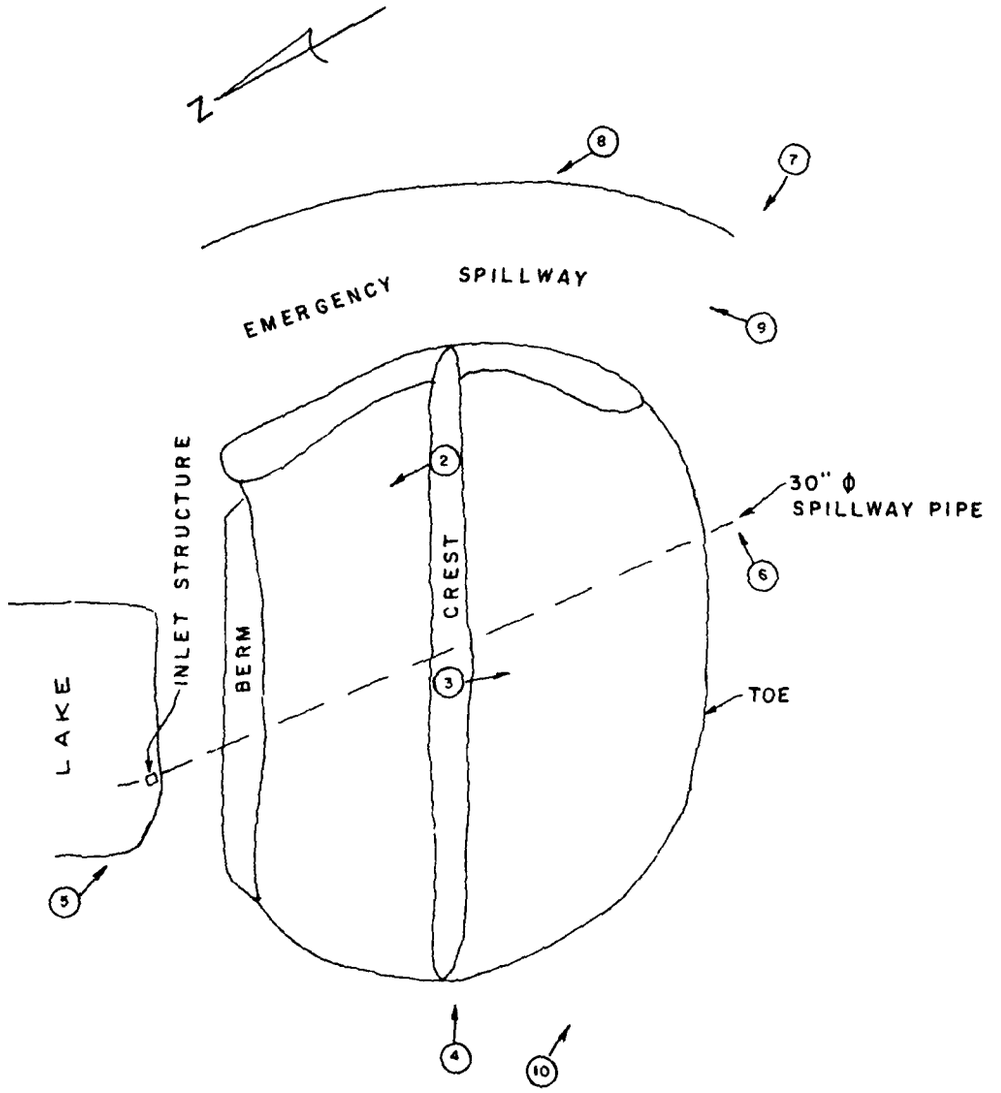


PHOTO INDEX

STRUCTURE F-2

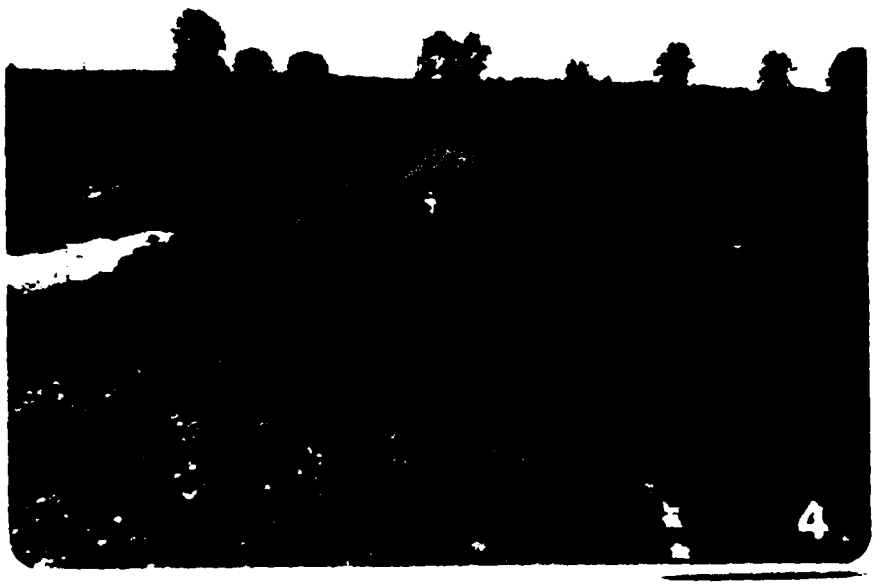
MO. No. 20513

LIST OF PHOTOGRAPHS

Photo No.	Description
1	Aerial View of Dam
2	Upstream View of Lake (Looking Northeast)
3	Downstream View From Crest (Looking Southwest)
4	View of Crest (Looking Southeast)
5	View of Inlet Structure (Looking North)
6	View of Spillway Outlet (Looking West)
7	Downstream Face of Embankment (Looking North)
8	View of Emergency Spillway and Lake (Looking North)
9	Upstream View of Emergency Spillway (Looking North)
10	Downstream View (Looking East)
11	Downstream Hazard (Looking East)
12	Downstream Hazard (Looking Southeast)


1


2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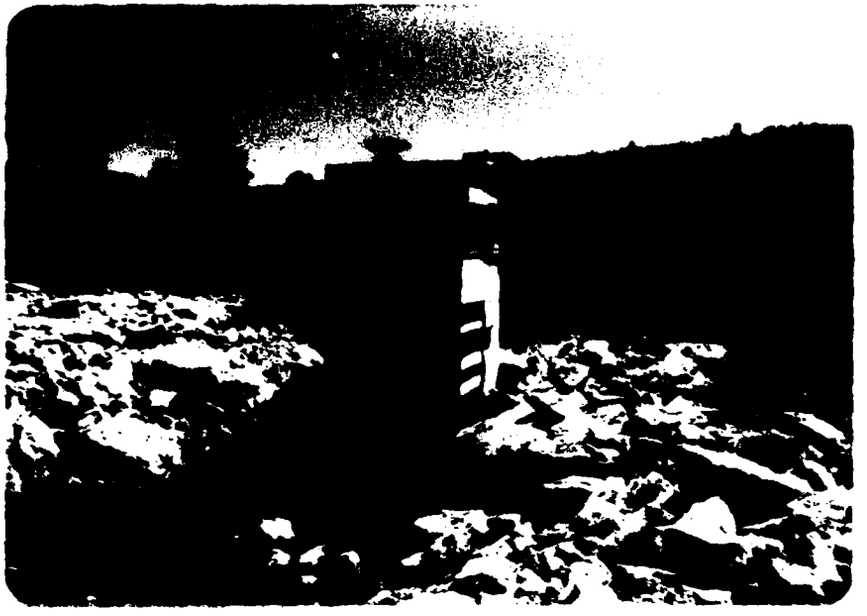


6


7


8


10


11


12


ATE
LME