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ANDERSON ENGINEERING INC SPRINGFIELD MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. STRUCTURE F-1 (MO 20512), VERDIGRI--ETC(U)
AUG 80 J HEALY, S BRADY, N MORALES, T BECKLEY DACW43-80-C-0073
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RESEARCH REPORT
NATIONAL BUREAU OF STANDARDS

PHYSICS DIVISION
WASHINGTON, D. C.

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property. | | |

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ATTENTION OF

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

SUBJECT: Structure F-1
Newton County, Missouri
Missouri Inventory No. 20512

This report presents the results of field inspection and evaluation of the Structure F-1. It was prepared under the National Program of Inspection of Non-Federal Dams.

SIGNED

SUBMITTED BY: _____
Chief, Engineering Division

17 SEP 1980
Date

APPROVED BY: _____
Colonel, CE, District Engineer

18 SEP 1980
Date

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VERDIGRIS-NEOSHO RIVER BASIN

STRUCTURE F-1
NEWTON COUNTY, MISSOURI
MISSOURI INVENTORY NO. 20512

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-1
State Located: Missouri
County Located: Newton
Stream: Tributary of Lost Creek
Date of Inspection: May 29, 1980

Structure F-1 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 2 miles downstream of the dam. Located within this zone are approximately 38 dwellings and buildings and Highway 43, 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.

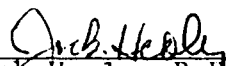
Our inspection and evaluation indicates that the combined spillways do meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 74 percent of the Probable Maximum Flood, without overtopping. The Probable Maximum Flood is defined 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 (30 feet), and the maximum storage capacity (63 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.

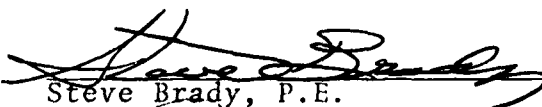
Deficiencies visually observed by the inspection team were. (1) some small brush growth on the embankment faces.

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

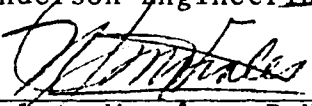
It is recommended that the owners take the necessary action without undue delay to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.




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



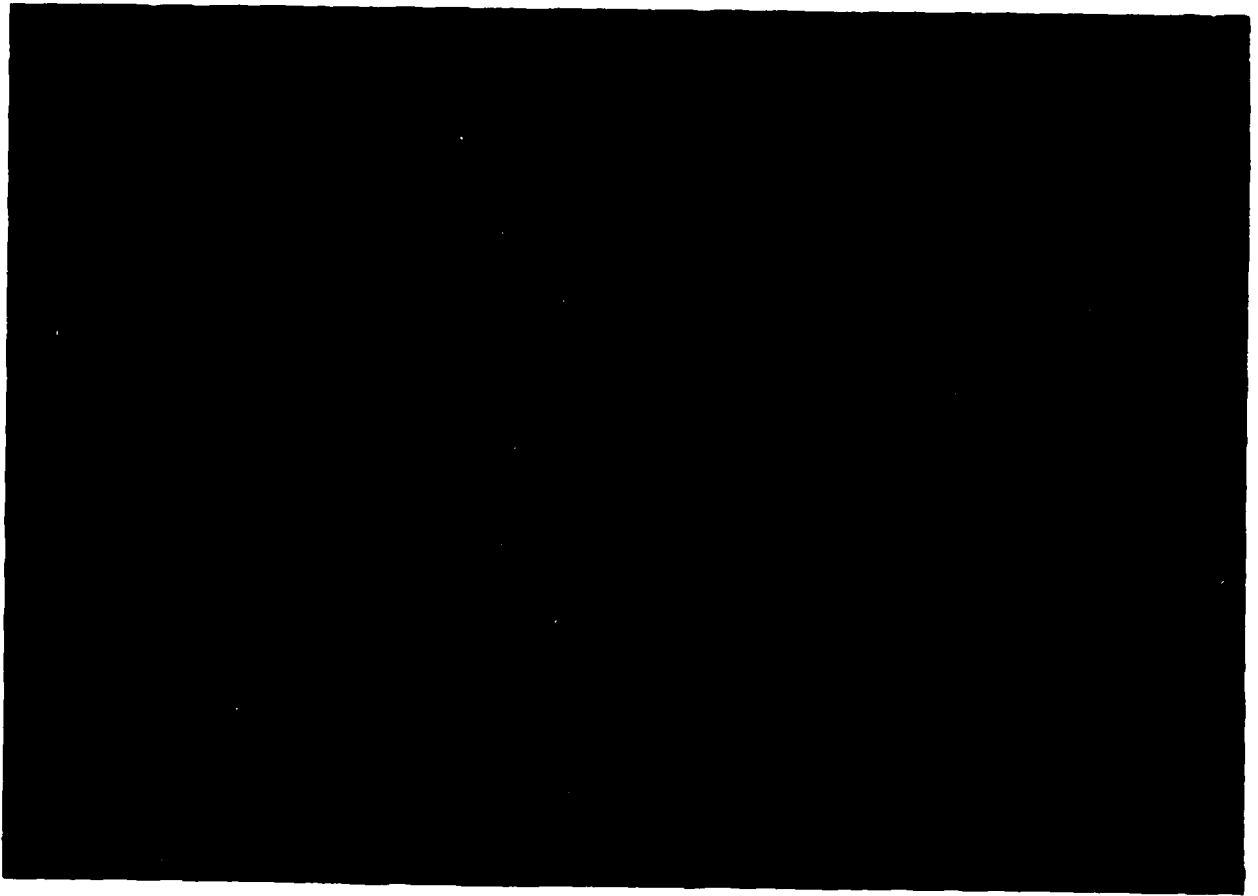
Steve Brady, P.E.
Anderson Engineering, Inc.



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



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



AERIAL VIEW OF LAKE AND DAM

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
STRUCTURE F-1 ID NO. 20512

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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-1 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-1 is an earth fill structure approximately 30 ft high and 300 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 west 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.

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 25, T25N, R34W - latitude 36°51.8'; longitude 94°36.2'). 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 30 ft and a maximum storage capacity of approximately 63 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 2 miles downstream of the dam. Located within this zone are approximately 38 dwellings and buildings and Highway 43, all in the town of Seneca. The inspection team verified the existence of the above items located in this estimated damage zone.

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 Mr. Gale Webb, Seneca, Missouri 64856.

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-1. Newton County Structures F-2 and F-3 were included in the contract with Structure F-1.

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 inspector's 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.

II. 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 and Mr. Webb indicates that the maximum water depth for this dam was approximately 3.0 feet.

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 99 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. 1028.2): 1151 cfs
- (3) Estimated Capacity of Principal Spillway: 31 cfs
- (4) Estimated Capacity of Emergency Spillway: 1120 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 1035.93 for B.M. #1, described in As Built Plans as top of concrete monument as Station 0 + 00 centerline of dam (See Sheet 6 of Appendix A).

- (1) Top of Dam: 1028.2 feet MSL
- (2) Principal Spillway Crest: 1013.4 feet MSL
- (3) Emergency Spillway Crest: 1023.6 feet MSL
- (4) Principal Spillway Pipe Invert Elevation at Outlet:
1000.2 feet MSL
- (5) Streambed at Centerline of Dam: 998.2
- (6) Pool on Date of Inspection: 998.7
- (7) Apparent High Water Mark: Unknown
- (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: 900 Feet
- (2) At Principal Spillway Crest: 300 Feet
- (3) At Emergency Spillway Crest: 700 Feet

E. Storage Capacities:

- (1) At Principal Spillway Crest: 9.4 Acre-Feet
- (2) At Top of Dam: 63 Acre-Feet
- (3) At Emergency Spillway Crest: 39.0 Acre-Feet

F. Reservoir Surface Areas:

- (1) At Principal Spillway Crest: 1.6 Acres
- (2) At Top of Dam: 6.2 Acres
- (3) At Emergency Spillway Crest: 4.0 Acres

G. Dam:

- (1) Type: Earth
- (2) Length at Crest: 300 Feet
- (3) Height: 30 Feet
- (4) Top Width: 14 Feet
- (5) Side Slopes: Upstream varies from 1V:2.26H to 1V:2.61H;
Downstream varies from 1V:2.88H to 1V:2.92H
- (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 2 + 54
- (2) Type: 30 Inch Diameter Reinforced Concrete Pipe with Restricted Flow Riser

I.2 Emergency Spillway:

- (1) Location: West Abutment
- (2) Type: Earth Cut Swale
- (3) Upstream Channel: Grass covered earth channel
- (4) Downstream Channel: Grass covered channel with moderate 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. 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 open.

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 and stability 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 INSPECTION

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 1028.2. 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 8.25 feet below the slide gate invert. No apparent high water mark was observed. According to Mr. Green, the maximum depth of water impounded has been only about 3 feet. 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 B.M. #1 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.

The approach to the inlet structure was clear. Considerable rip rap was placed around the inlet structure. The principal orifice (8.0 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.

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 west 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. The slopes are 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 primary 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 occurrence of any other unusual conditions which might adversely affect the structural measure. The inspection is to include the condition of principal 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 74 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 (30 feet), the maximum storage capacity (63 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 2107 cfs. For 50 percent of the PMP, the peak inflow was 1054 cfs.

The routing of the PMF through the spillways and dam indicates that the dam will be overtopped by 0.76 feet at elevation 1028.96. The duration of the overtopping will be .42 hours, and the maximum outflow will be 1603 cfs. The maximum discharge capacity of the spillways is 1151 cfs. The routing of 50 percent of the PMF indicates that the dam will not be overtopped. The maximum outflow will be 763 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 analyses 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.

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 74 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:

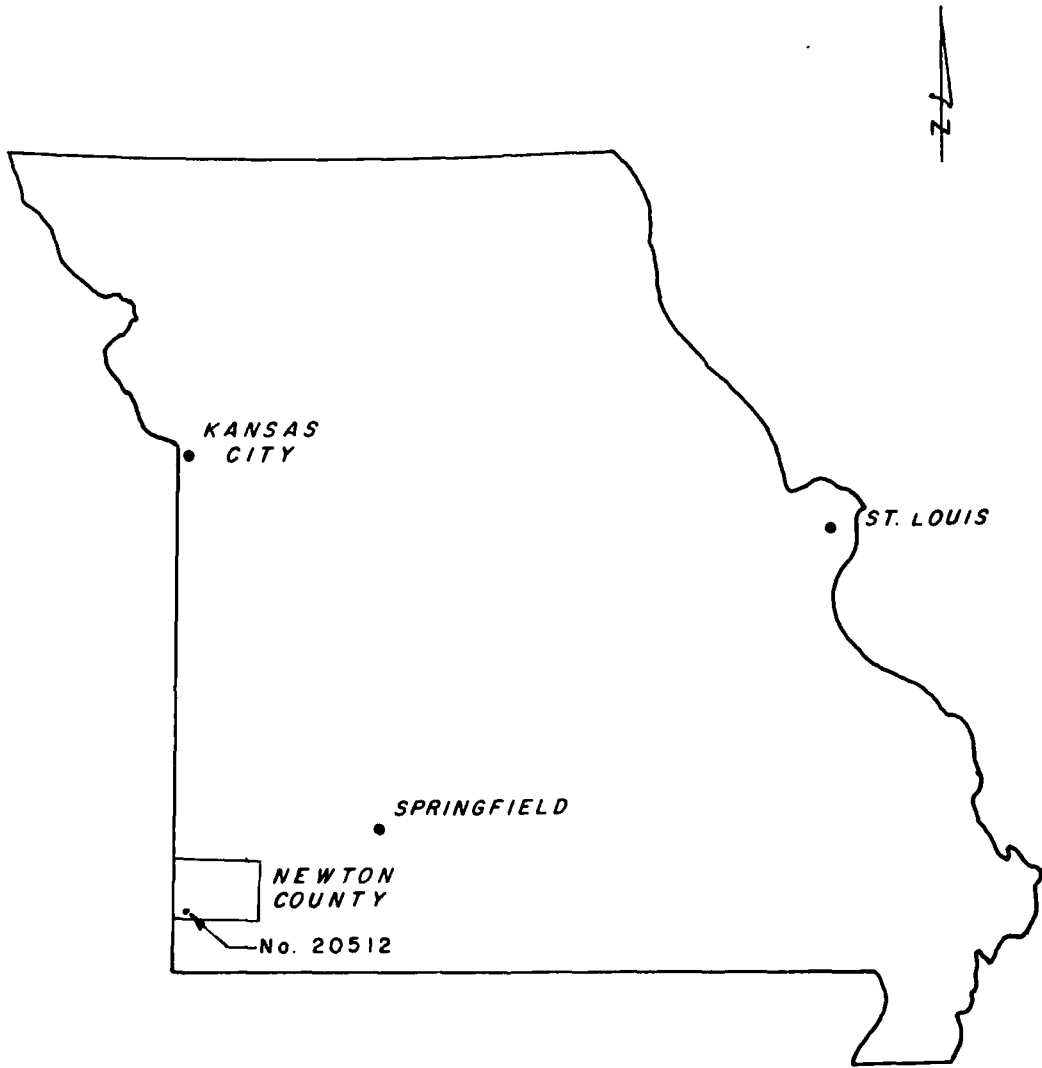
Not Applicable

B. O & M Procedures:

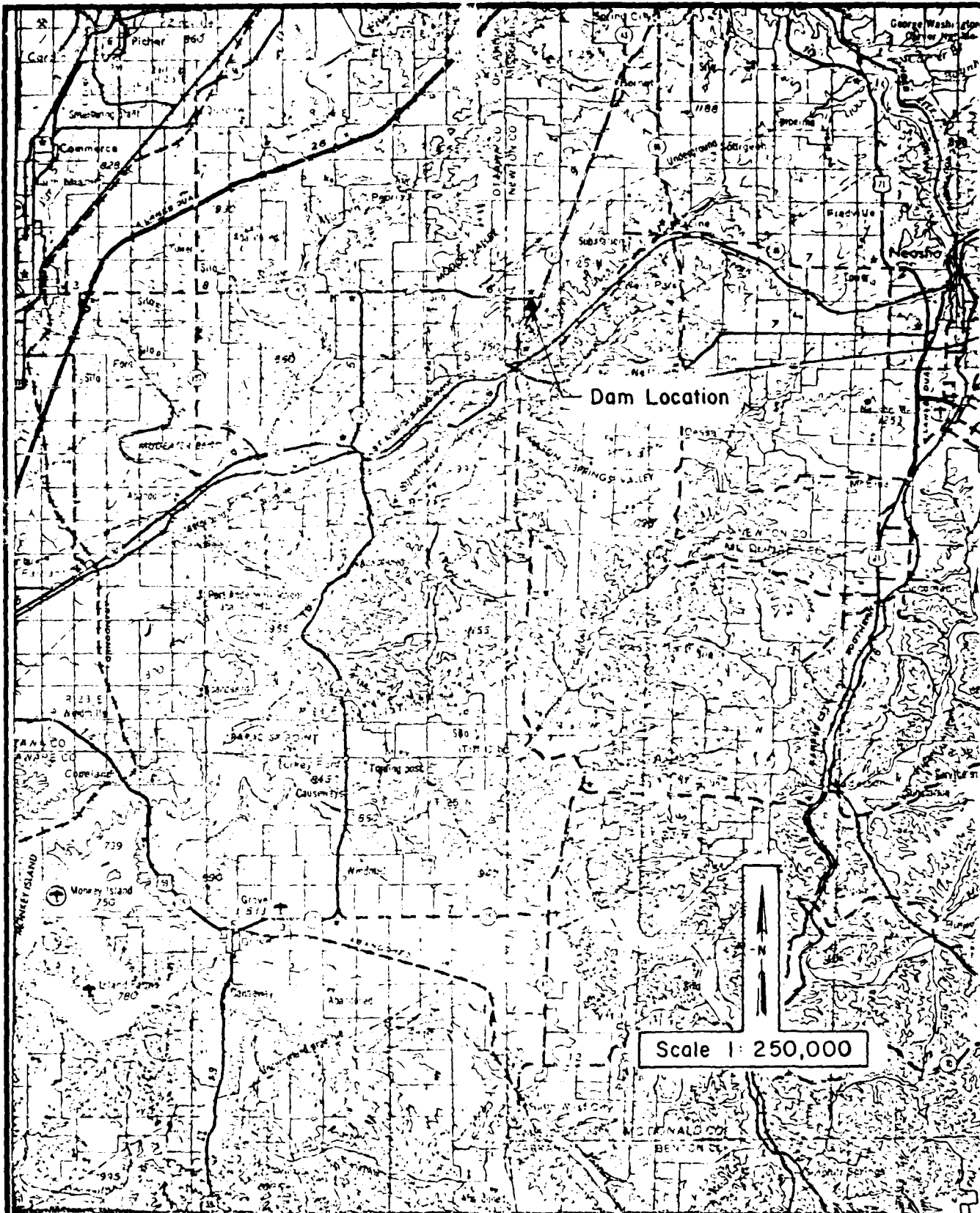
- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.
- (2) The light brush growth should be removed and vegetative growth on the dam should be cut annually.
- (3) Wave protection should be provided for the upstream face of the embankment if 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



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Newton County Structure F-1 Dam
Newton County, Missouri
Mo. I.D. No. 20512

Sheet 2, Appendix A

0+00

1+00

2+00

3+00



PLUNGE POOL
ELEV. 998.7

INVERT 30" R
ELEV. 1000.2

1002.2

x1018.3

x1035.9

x1028.2

x1029.4

x1029.4
x1029.3

x1029.3

x1021.7

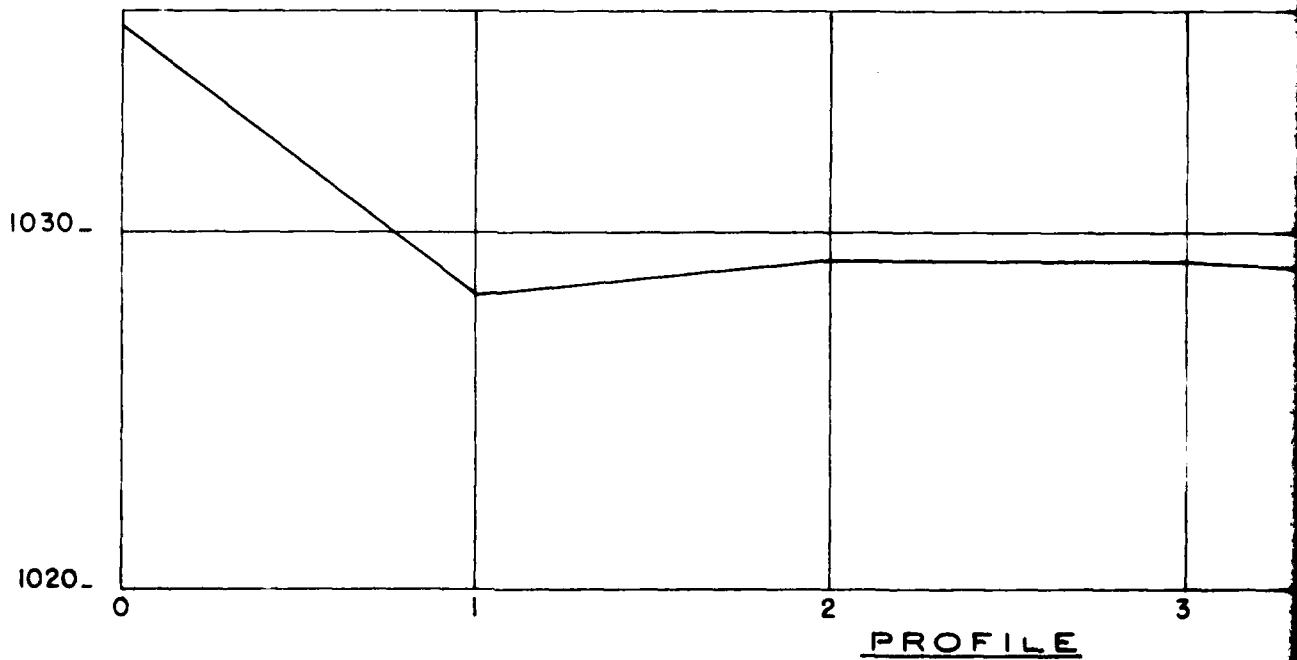
1014.5
1013.9

BENCHMARK #1
TOP CONCRETE MONUMENT AT
STA 0+00 @ DAM
ELEV. 1035.93

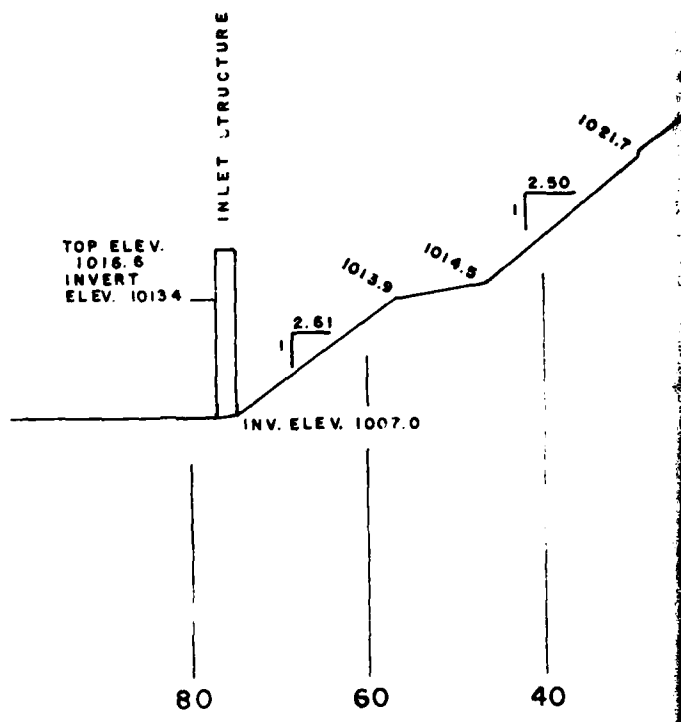
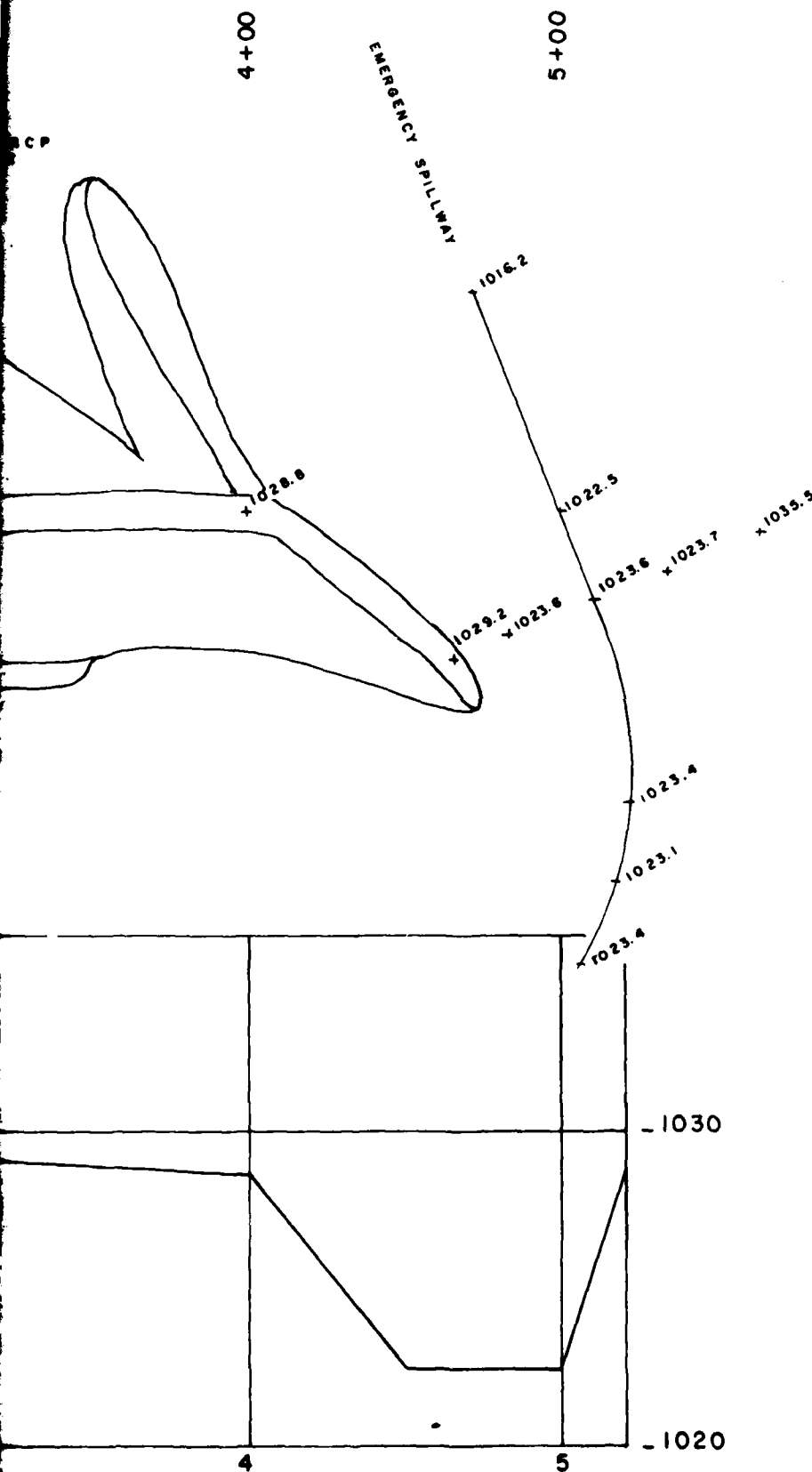
TOP ELEV. 1016.6
UPPER INV. ELEV. 1013.4
LOWER INV. ELEV. 1007.0

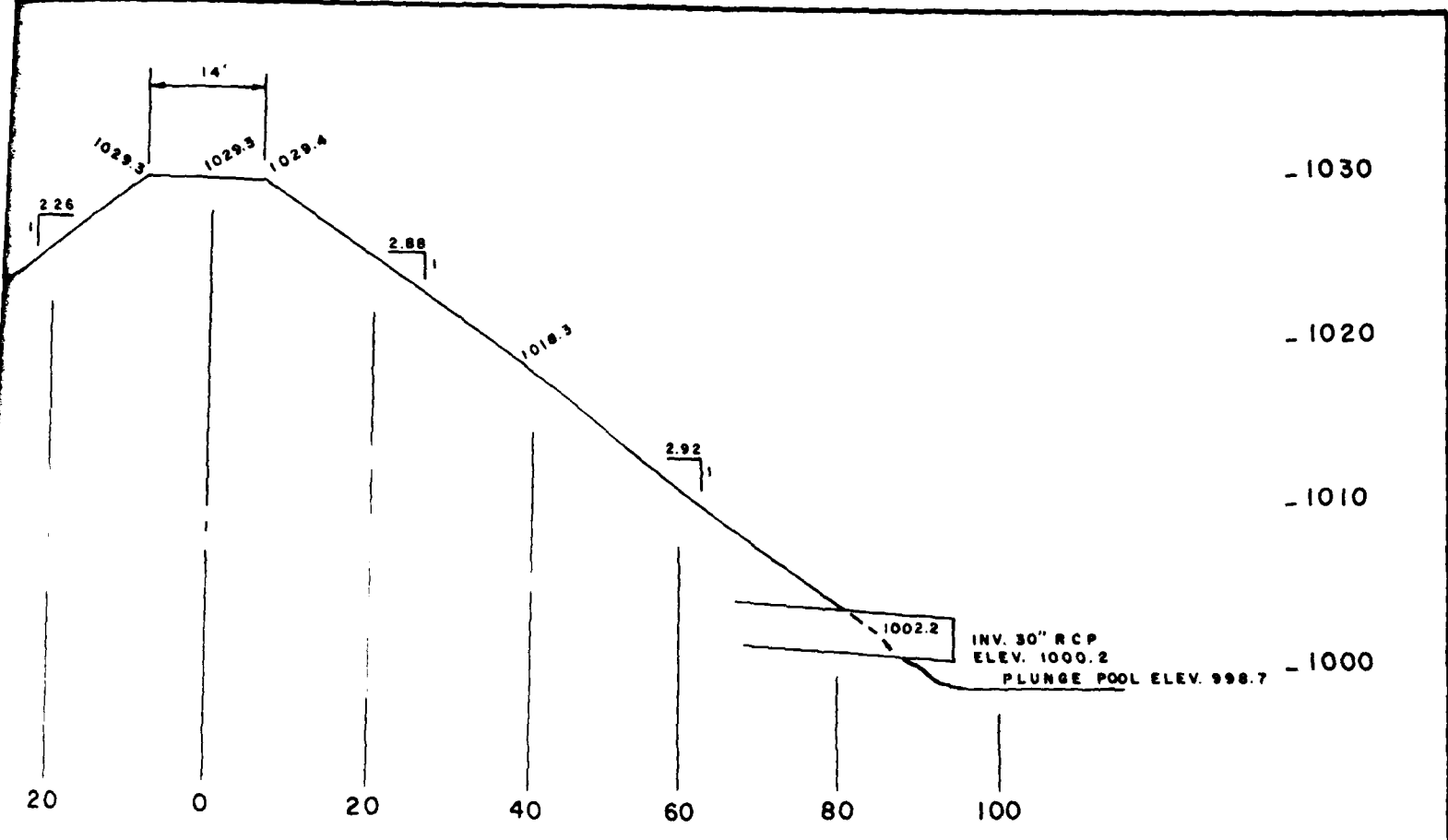
INLET STRUCTURE

POOL



PROFILE





SHEET 3 APPENDIX A

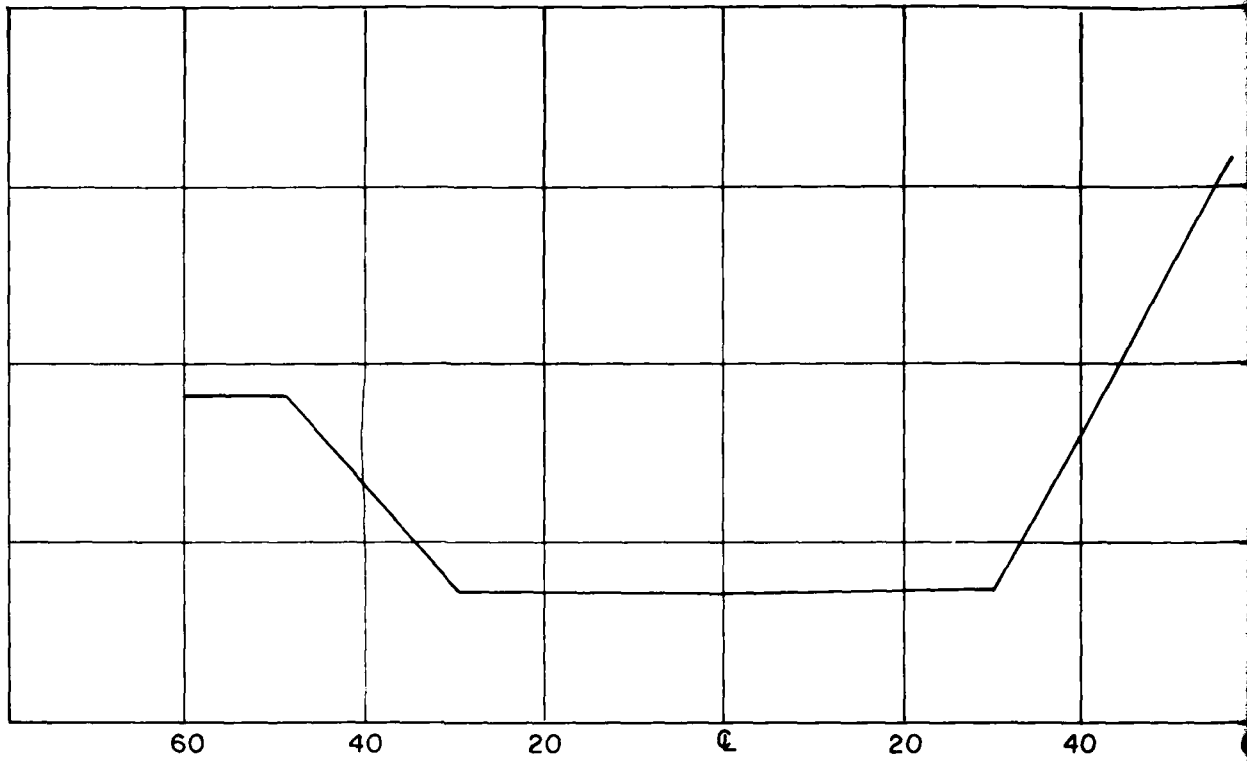
ANDERSON ENGINEERING, INC.
 730 NORTH BENTON AVENUE
 SPRINGFIELD, MISSOURI 65802

NEWTON COUNTY STRUCTURE F-1

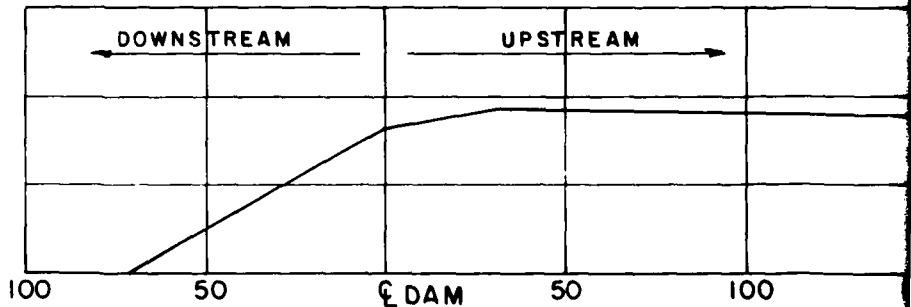
MO. No. 20512

PLAN & PROFILE

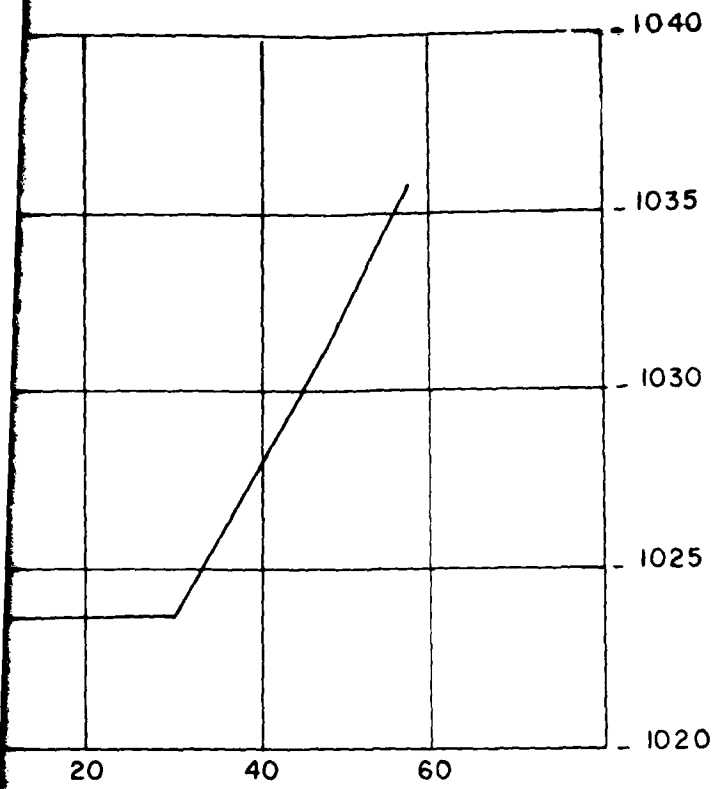
NEWTON COUNTY, MO.



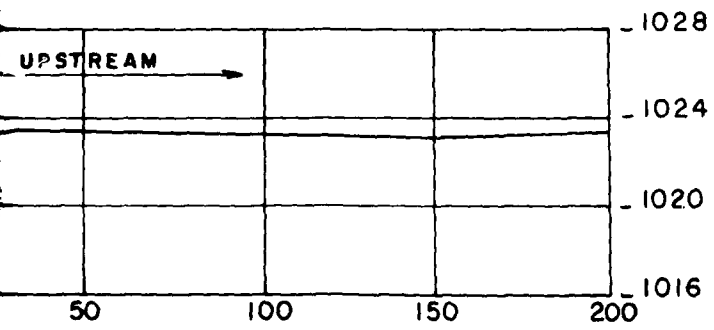
SPILLWAY SECTION
30 FT. RIGHT ζ DAM



SPILLWAY PROFILE



ION



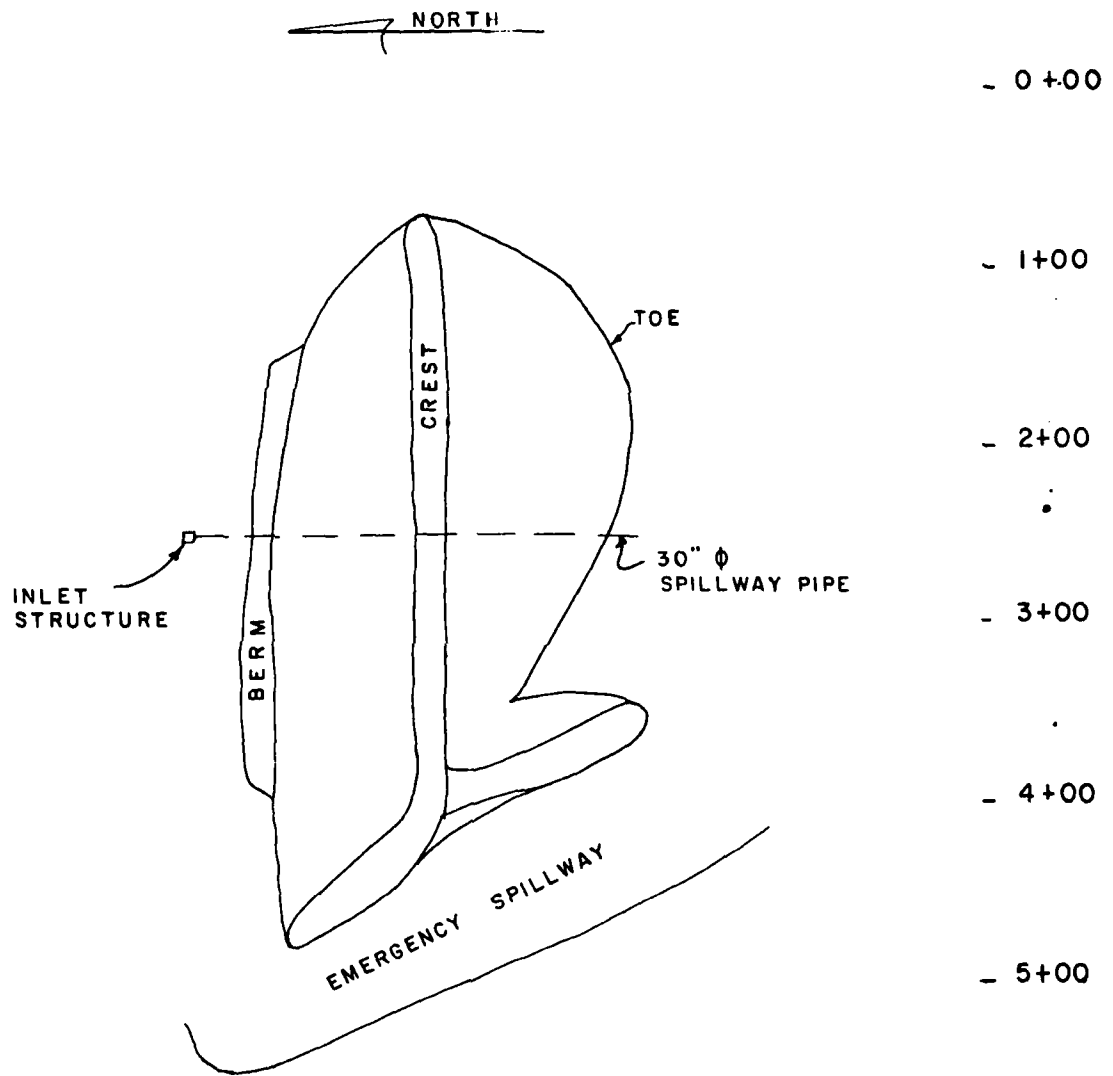
SPILLWAY PROFILE

SHEET 3A APPENDIX A
ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

NEWTON COUNTY STRUCTURE F-1
MO. No. 20512

SPILLWAY
SECTION & PROFILE
NEWTON COUNTY, MO.

2



PLAN SKETCH OF DAM
 STRUCTURE F-1
 MO. No. 20512

LEGEND

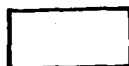
WATERSHED BOUNDARY



DRAINAGE AREA CONTROLLED BY STRUCTURE



AREA BENEFITED



PROJECT MEASURES

STRUCTURE NUMBER



FLOODWATER RETARDING STRUCTURE



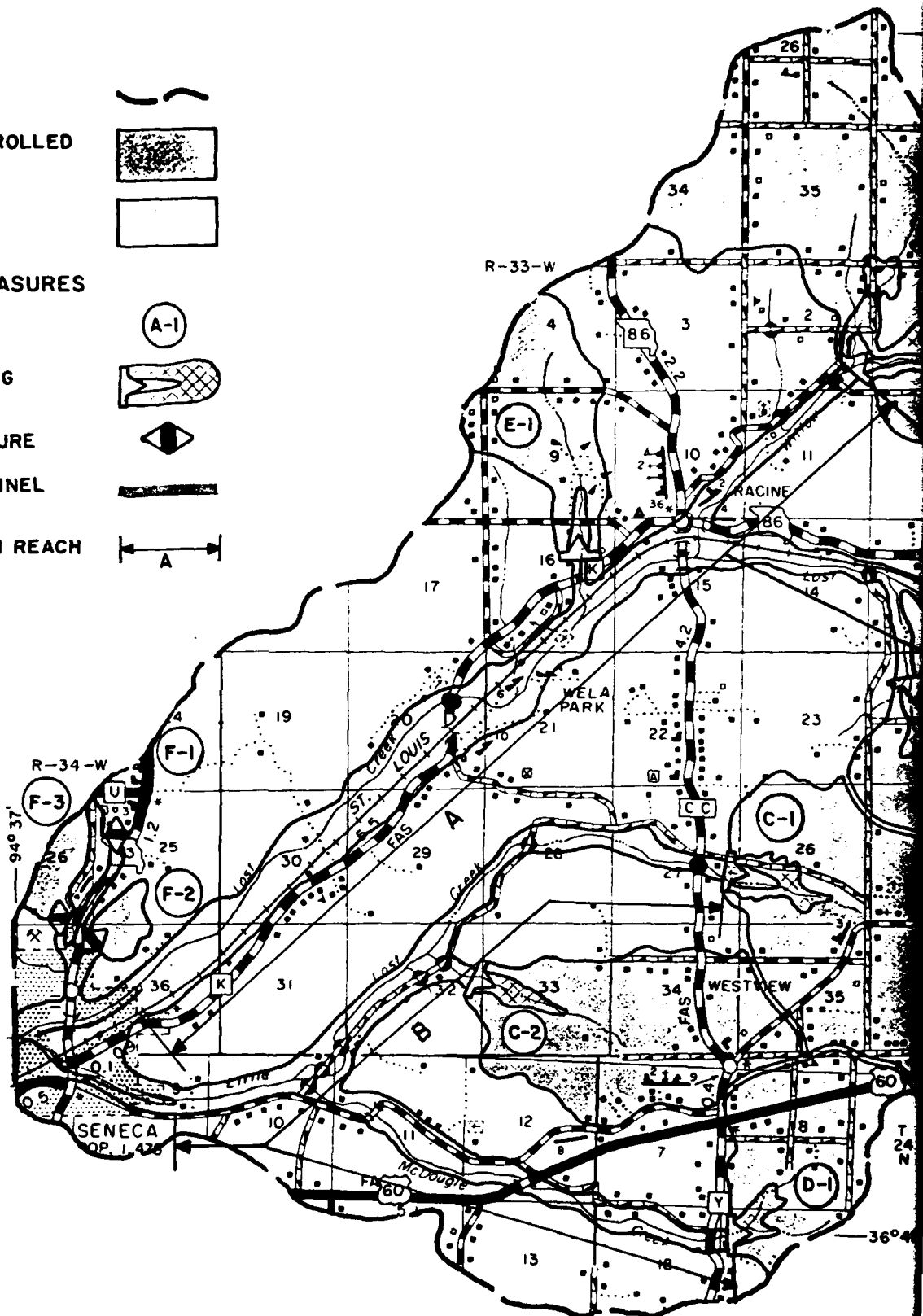
DEBRIS BASIN STRUCTURE



PROPOSED FLOOD CHANNEL CORPS OF ENGINEERS



ECONOMIC EVALUATION REACH



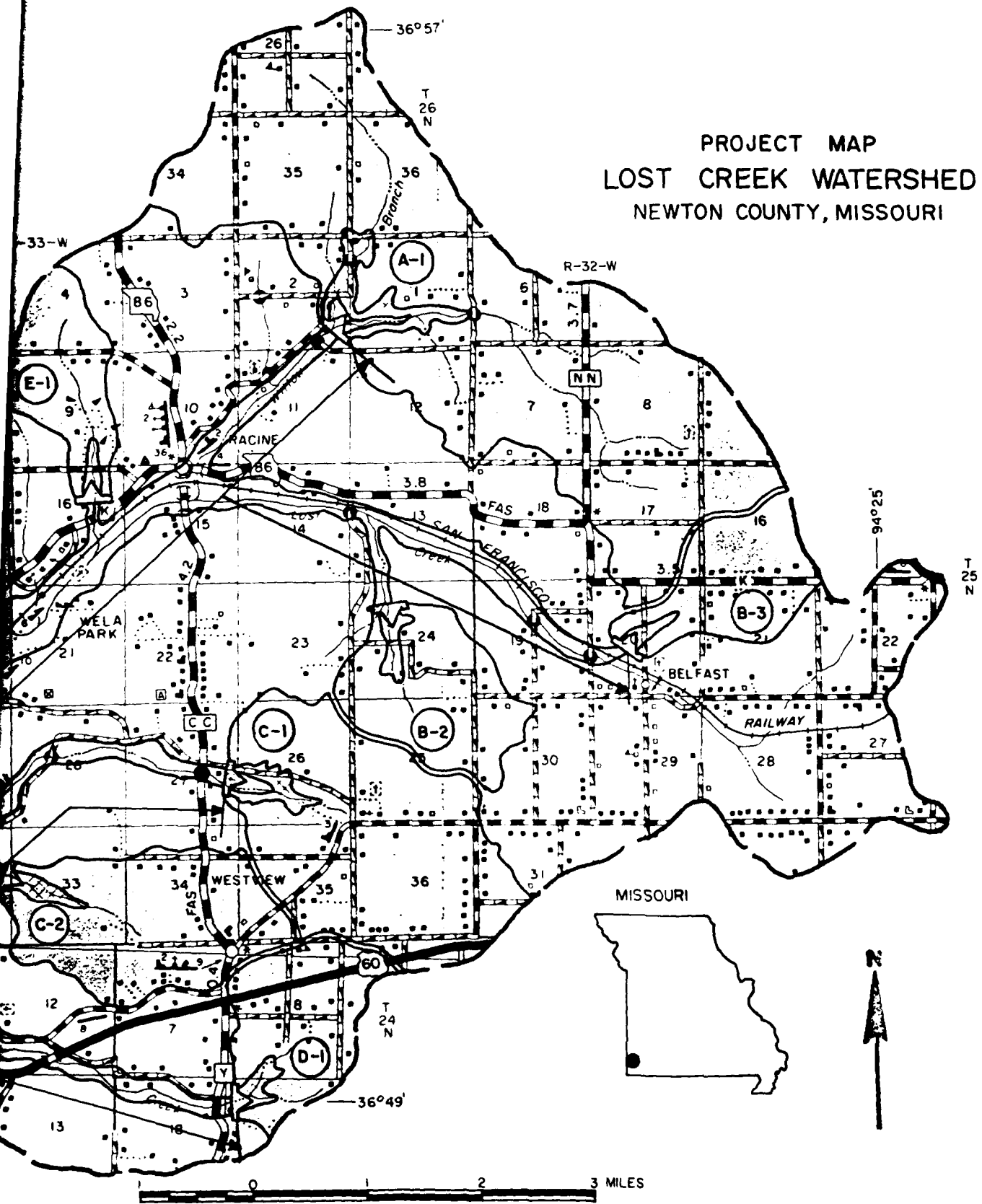
SOURCE
SCS BASE 5,0-28,307 AND DATA
FURNISHED BY FIELD TECHNICIANS

9500-SCS-LINCOLN 0100 1970

POLYCONIC PROJECTION

SCALE 1/70

PROJECT MAP LOST CREEK WATERSHED NEWTON COUNTY, MISSOURI



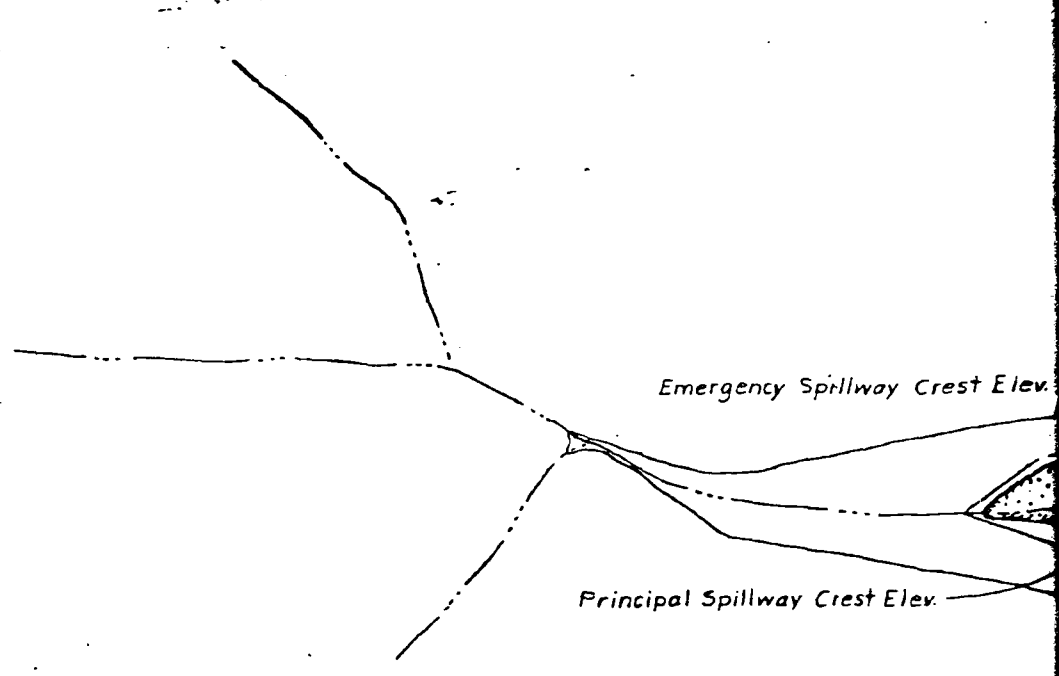
0 1 2 3 MILES

SCALE 1/70,000

7-2-70
5,0-28,312

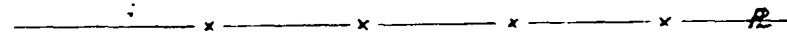
LESSAR
 Clearing & Grubbing _____
 Existing Fence _____
 Fence to be Removed _____
 Ingress-Egress Route _____

Ingress
 Highway
 Engine



Structure F-1 located approx. one mile
 north of Seneca, Missouri in the N.W
 1/4 of Section 25, T. 25 N., R. 34 W.

Clearing and Grubb
JOSIE KUHN



DATA TABLE

| | |
|------------------------------|------|
| Drainage Area, Acres | 99 |
| Sediment Storage, Acre Feet | 94 |
| Retarding Storage, Acre Feet | 27.6 |
| Sediment Pool, Acres | 1.6 |
| Retarding Pool, Acres | 4.3 |

QUANTITIES

Clearing and Grubbing _____ Lump Sum
 (Approx. 5.2 Acres)

GENERAL PLAN OF RESERVOIR



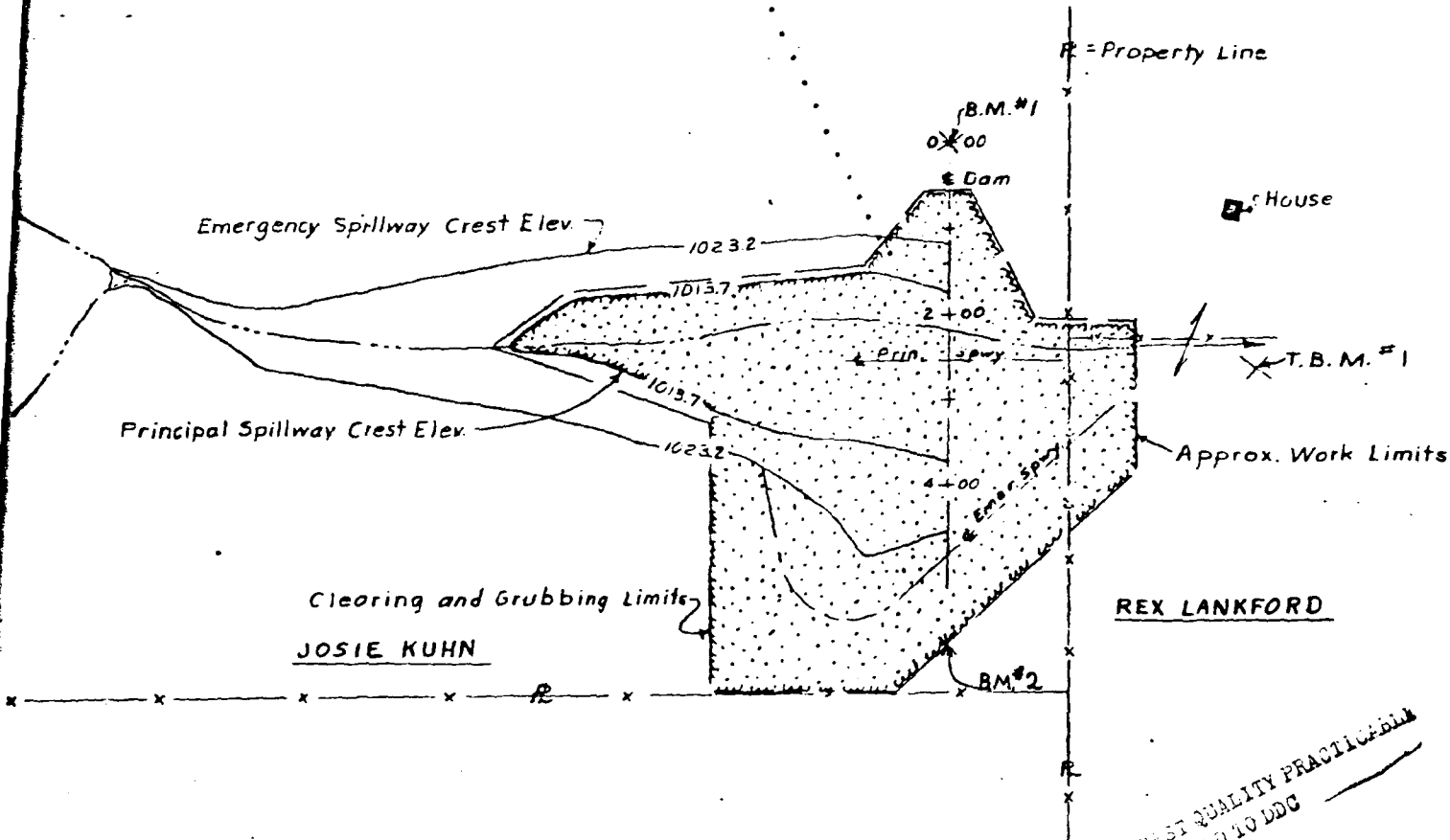
Scale in Feet

LEGEND

- Grubbing
- Removed
- As Route

Ingress-Egress will be from Highway 43 as directed by the Engineer.

- B.M. #1 Elevation - 1035.03
Top Concrete Monument at Sta. 0+00
- T.B.M. #1 Elevation - 296.42
60 D Spike in west side of 27" Red Oak Tree, approx. 150' S.W. of Lankford house in middle of garden. (Approx. 1' above ground)
- B.M. #2 Elevation - 1037.15
Top Concrete Monument 204.8' post 5' x 10' E. dam and approx. 53' east of E. fence.

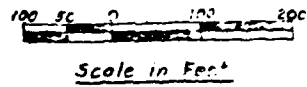


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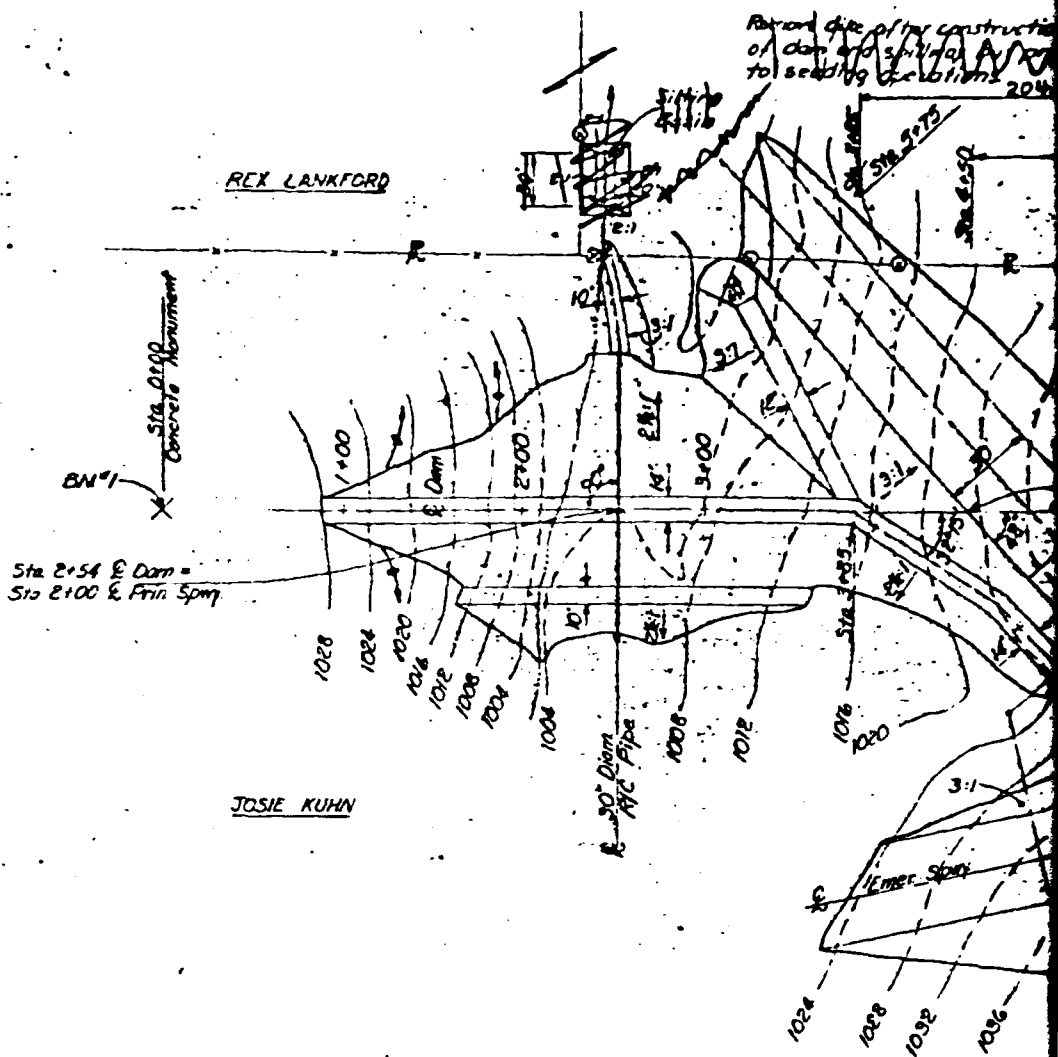
| | |
|--|------------------|
| STRUCTURE F-1 | |
| LOST CREEK WATERSHED PL-56 | |
| NEWTON COUNTY, MISSOURI | |
| U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE | |
| Drawn by: SPREEM | Date: 11-75 |
| Checked by: JENNINGS | Date: 11-75 |
| Designed by: BLAINE & SMITH S.R. | Date: 5E-35, 7/1 |

GENERAL PLAN OF RESERVOIR



COMPLETED - 7-28-77

2



Revised date of final construction of dam and spillway to seedling operations 2044

NOTES:

Topsoil

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

Protective Dike

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

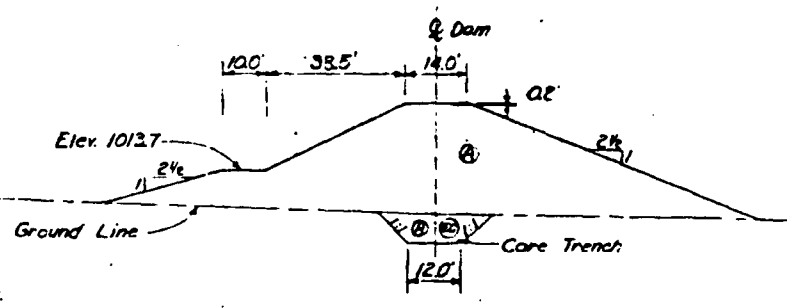
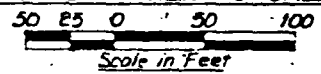
Waste Areas

Waste areas will be as designated by the Engineer.

Sitting Basin

The sitting 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.

PLAN OF EMBANKMENT & SPILLWAYS

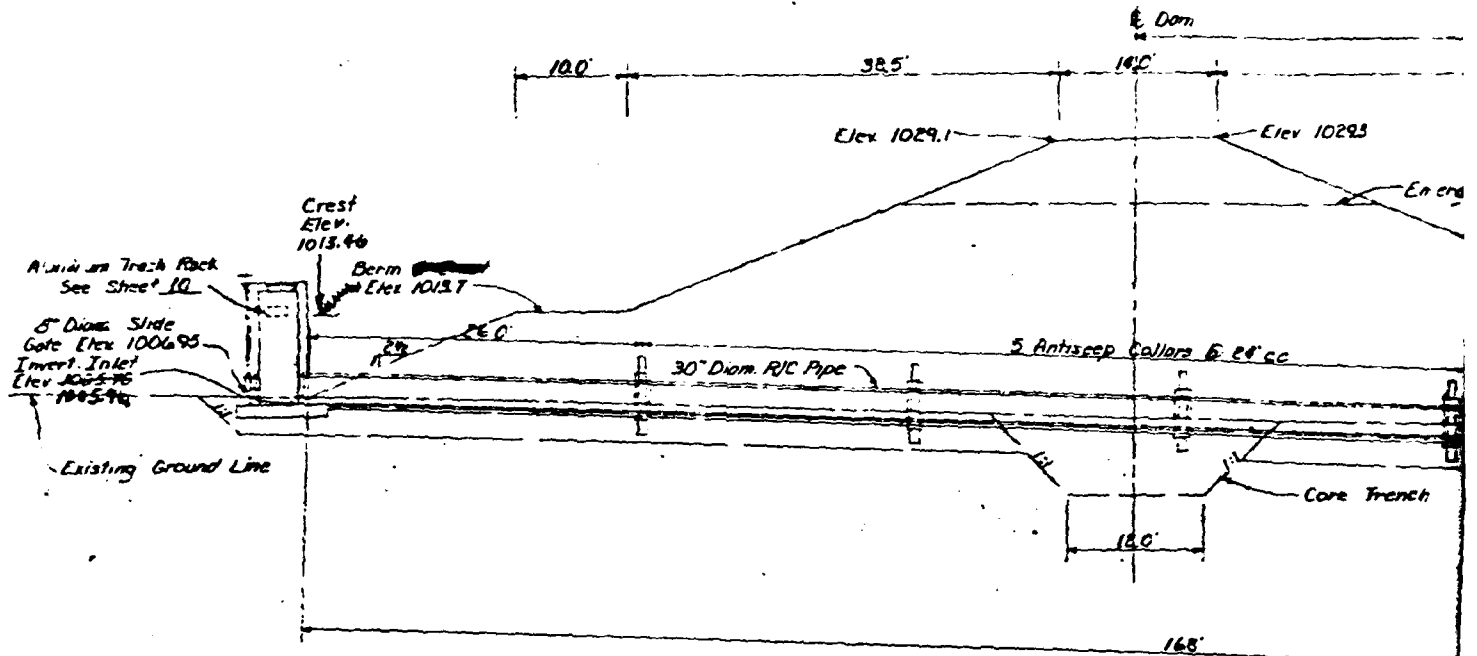


TYPICAL SECTION OF EMBANKMENT

| PIPE CENTER TABLE | |
|----------------------|-----------|
| Distance From Center | Elevation |
| 0 | 1000.00 |
| 16 | 1000.38 |
| 24 | 1003.8 |
| 40 | 1001.59 |
| 50 | 1002.10 |
| 72 | 1002.82 |
| 88 | 1003.41 |
| 104 | 1003.92 |
| 120 | 1004.41 |
| 136 | 1004.86 |
| 152 | 1005.30 |
| 168 | 1005.70 |

NOTES:

1. Antiseep collars shall not be placed closer than two (2) feet to a pipe joint.
2. Pipe elevations other than those shown will be furnished by the Engineer, when required.
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 in the Riser Backfill Detail.



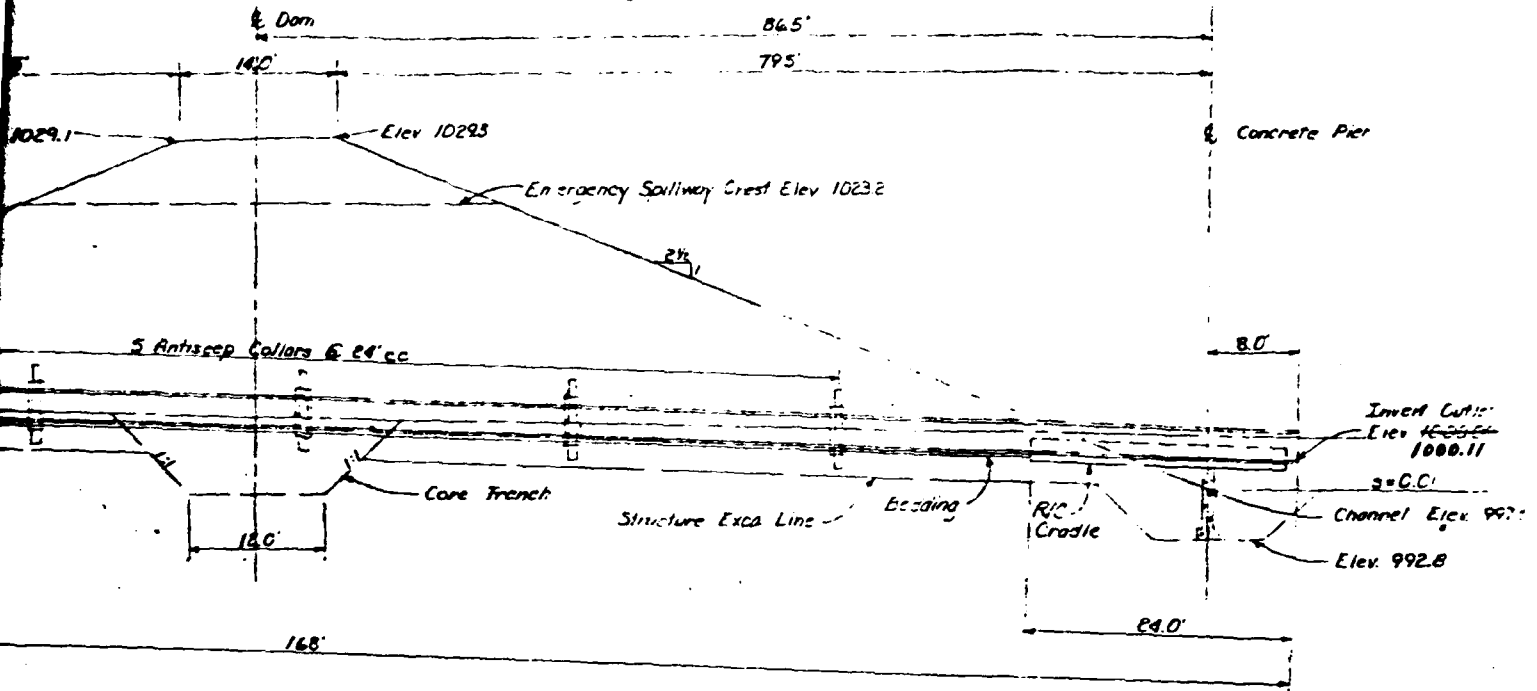
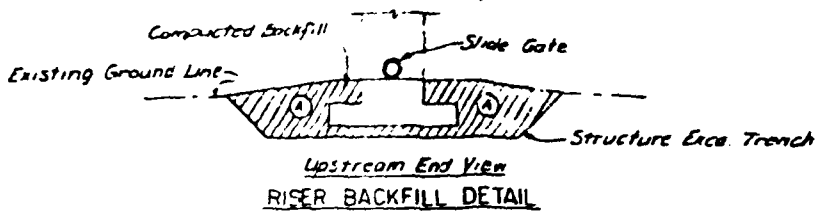
SECTION ON CENTERLINE



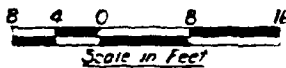
MATERIALS

- Concrete, Class 4,000 _____
- Steel Bar Reinforcement _____
- Prestressed Concrete Pressure Pipe, 30" Diam., Steel Cylinder Type _____
- Aluminum Trash Rack _____
- Slide Gate, 8" Diam _____

Artiscep collars shall not be placed closer than two (2) feet to a pipe joint.
 Pipe elevations other than those shown will be furnished by the Engineer, when required.
 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 in the Riser Backfill Detail.



SECTION ON CENTERLINE



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MATERIALS

| | |
|--|--------------|
| Structure Pipe, 30" Diam., Steel Cylinder Type | 37.6 Cu Yds |
| | 2,561 Pounds |
| | 168 L.F.F. |
| | Luto Sm |
| | 1 Each |

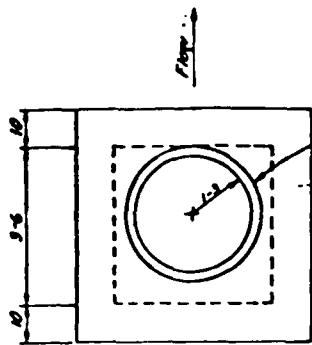
STRUCTURE F-1

R/C DROP INLET FOR 30" DIAM. P.F.E.
 GENERAL LAYOUT
 LOST CREEK WATERSHED PL-56E
 NEWTON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

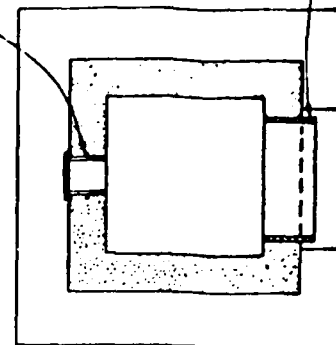
Drawn: M.M.F.
 Checked: J.A.G.
 Date: 7-28-77
 Project: R.E.S. & M.M.B. 77-35,711

2



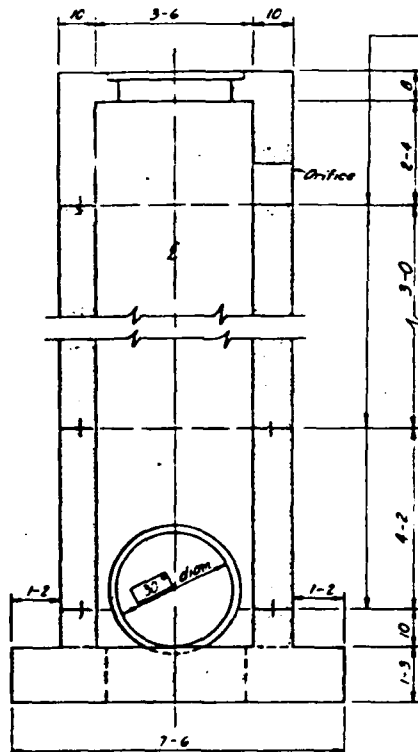
TOP PLAN

1" Type Wall Tee-plate
8" Dia., 10" Long



SECTION A-A

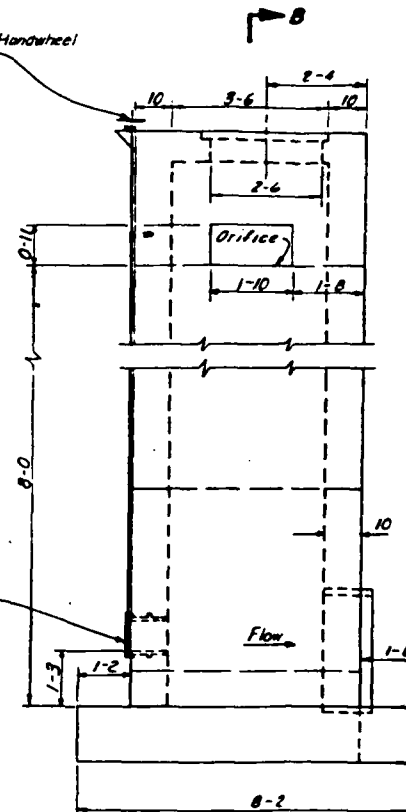
NOTE: FOR DETAIL OF TRASH BACK AND ANCHORS



8" Diam. Rising Stem
Side Gate

Removable Handwheel
With Lift

Shear plate construction joint,
for detail see sheet B

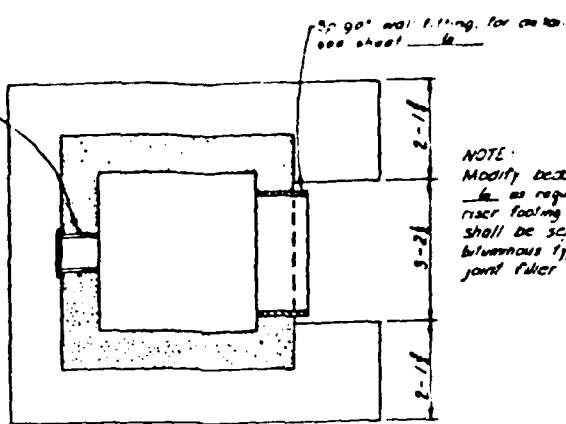


SIDEWALL ELEVATION

**DETAILS OF 3'-6" x 3'-6" SECTION B-B
RESTRICTED FLOW RISER**
(10' High Sewerall Orifice)

| |
|---|
| E & WP UNIT - DESIGN SECTION LINCOLN, NEBRASKA |
| BASE Dwg NO. S.E.-13, 890229 |
| DATE APPROVED JAN 6, 1970 REV 8-71 |
| SHEET 1 OF 3 |

Straight
Type 1



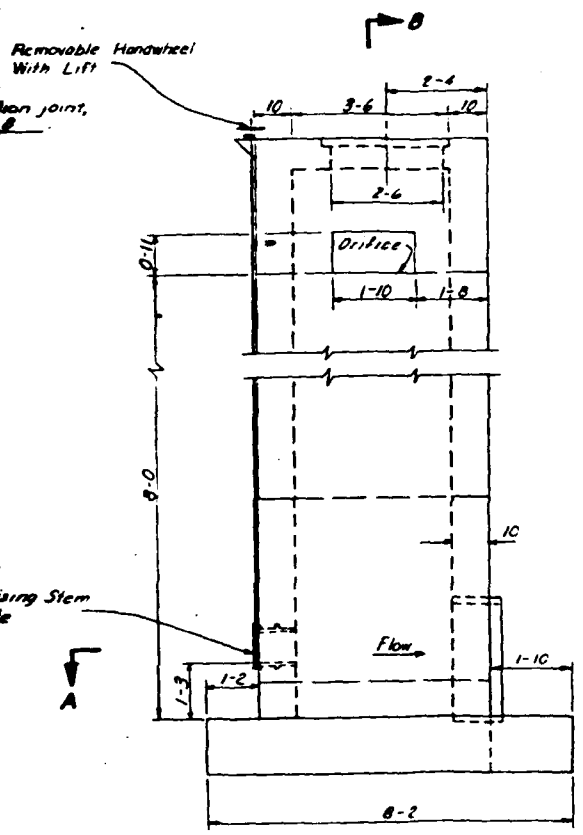
NOTE:
Modify bedding shown on sheet
as required to fit between
riser footing. Bedding and footing
shall be separated by 3/4"
blunt-nose type preformed expansion
joint filler.

SECTION A-A

NOTE: FOR DETAIL OF TRASH RACK AND ANCHORAGE SEE SHEET 10.

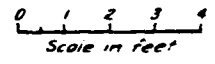
STEEL SCHEDULE

| MARK | SIZE | QUANTITY | LENGTH | TOTAL LENGTH | TYPE | B | C |
|------|------|----------|--------|--------------|------|-----|-----|
| B1 | 5 | 8 | 7-0 | 56-0 | 1 | | |
| B2 | 5 | 4 | 1-0 | 7-0 | 1 | | |
| B3 | 5 | 8 | 7-0 | 56-0 | 1 | | |
| B4 | 5 | 5 | 6-0 | 30-0 | 1 | | |
| B5 | 5 | 7 | 7-0 | 49-0 | 1 | | |
| B6 | 5 | 4 | 1-0 | 7-0 | 1 | | |
| B7 | 5 | 8 | 7-0 | 56-0 | 1 | | |
| B8 | 5 | 5 | 6-0 | 30-0 | 1 | | |
| B9 | 5 | 12 | 10-0 | 120-0 | 2 | 3-0 | 7-0 |
| B10 | 5 | 8 | 7-0 | 56-0 | 2 | 0-0 | 7-0 |
| B11 | 5 | 6 | 6-0 | 36-0 | 1 | | |
| B12 | 5 | 16 | 7-6 | 120-0 | 2 | 0-0 | 6-0 |
| B13 | 5 | 1 | 2-3 | 2-3 | 2 | 0-0 | 1-0 |
| B14 | 5 | 1 | 2-6 | 2-6 | 2 | 0-0 | 1-0 |
| B15 | 5 | 2 | 4-0 | 8-0 | 2 | 0-0 | 3-0 |
| B16 | 5 | 18 | 6-6 | 117-0 | 2 | 3-2 | 3-0 |
| B17 | 5 | 21 | 4-3 | 89-3 | 1 | | |
| B18 | 5 | 4 | 6-6 | 26-4 | 2 | 1-3 | 2-0 |
| B19 | 4 | 2 | 4-3 | 8-6 | 1 | | |
| T1 | 5 | 37 | 4-3 | 157-3 | 1 | | |
| T2 | 5 | 5 | 2-9 | 13-9 | 1 | | |
| T3 | 5 | 32 | 6-6 | 208-0 | 2 | 3-3 | 2-0 |
| T4 | 5 | 36 | 8-3 | 153-0 | 1 | | |
| T5 | 5 | 10 | 6-0 | 60-0 | 2 | 2-6 | 2-0 |
| T6 | 5 | 2 | 3-6 | 7-0 | 2 | 0-0 | 2-0 |
| T7 | 5 | 4 | 4-0 | 16-0 | 2 | 1-3 | 2-0 |
| T8 | 5 | 1 | 3-9 | 3-9 | 2 | 1-0 | 2-0 |
| T9 | 5 | 3 | 3-3 | 9-9 | 2 | 0-0 | 1-0 |
| T10 | 4 | 2 | 1-3 | 2-6 | 1 | | |
| T11 | 5 | 2 | 2-6 | 5-0 | 2 | 0-0 | 1-0 |
| T12 | 4 | 4 | 0-9 | 3-0 | 1 | | |
| T13 | 5 | 4 | 2-3 | 9-0 | 1 | | |
| T14 | 5 | 15 | 2-9 | 41-3 | 1 | | |
| T15 | 5 | 4 | 1-9 | 7-0 | 1 | | |
| T16 | 5 | 4 | 5-3 | 17-0 | 2 | 1-3 | 2-0 |
| T17 | 5 | 4 | 1-3 | 5-0 | 1 | | |
| T18 | 5 | 3 | 1-0 | 3-0 | 1 | | |
| T19 | 5 | 3 | 0-6 | 1-6 | 1 | | |



SIDEWALL ELEVATION

AS BUILT 7-28-77



QUANTITIES

STEEL
 #4 BARS - 1,192.75 FT. - 796.0 LB.
 #5 BARS - 317.50 FT. - 331.2 LB.
 #6 BARS - 56.0 FT. - 84.1 LB.
 TOTAL 1,566.25 FT. - 1,211.3 LB.
 CONCRETE, CLASS 4000 - 8.8 CU. YD.

STRUCTURE F-1

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

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

| | | |
|------------------|------------|---------------------|
| Drawn: R.E.S. | Date: 3-76 | Approved by: |
| Checked: J.A.G. | Date: 3-76 | Reviewed by: |
| Designed: M.M.B. | Date: 3-76 | Project No: 5E-9571 |

2

STRUCTURE DATA

Class of Structure "C" Debris Basin
 Drainage Area (total) 99 Ac. 0.15 Sq.Mi.
 (uncontrolled) 99 Ac. 0.15 Sq.Mi.
 Time of Concentration 0.24 Hours
 Soil Cover Complex Number 71 For A.M.C. II
 Sediment Capacity Available 9.4 Ac.Ft. below Elev. 1013.7
 Total Sediment Capacity Available 9.4 Ac.Ft.
 Capacity Equivalents (Vol.) 1.14 In.
 Retarding Capacity Provided 27.6 Ac.Ft.
 Capacity Equivalents (Vol.) 3.35 In.
 Water Supply Provided None Ac.Ft. - Identify Uses

Freeboard H
 Rainfal
 Runoff
 Peak In
 Maximum
 Maximum

Principal Spillway:

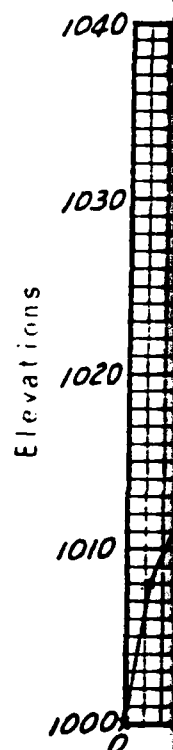
Maximum Capacity (~~low stage~~) 24 c.f.s.
 Maximum Capacity (high stage) c.f.s.
 10 Day Drawdown Elev. 1013.7

Emergency Spillway:

Percent Chance Use 1 Storm Duration 6 HOUR
 Type Vegetated Earth "n" Value Used 0.04

Emergency Spillway Hydrograph for Class "C" Structures

Rainfall 12.00 in.
 Runoff 8.19 in.
 Peak Inflow 612 c.f.s.
 Maximum Discharge - Emergency Spillway 133 c.f.s.
 Maximum Water Surface Elev. 1024.8
 Velocity of Flow (Ve) 6.1 f.p.s.



Supplementary
Special Design

Supplementary Data and Special Design Features:

Principal Spillway Crest Elev. = 1013.7
Emergency Spillway Crest Elev. = 1023.2
Emergency Spillway Bottom Width = 50'
Settled Top of Dam Elev. = 1028.3
Height x Storage = 24.2 x 37 = 895

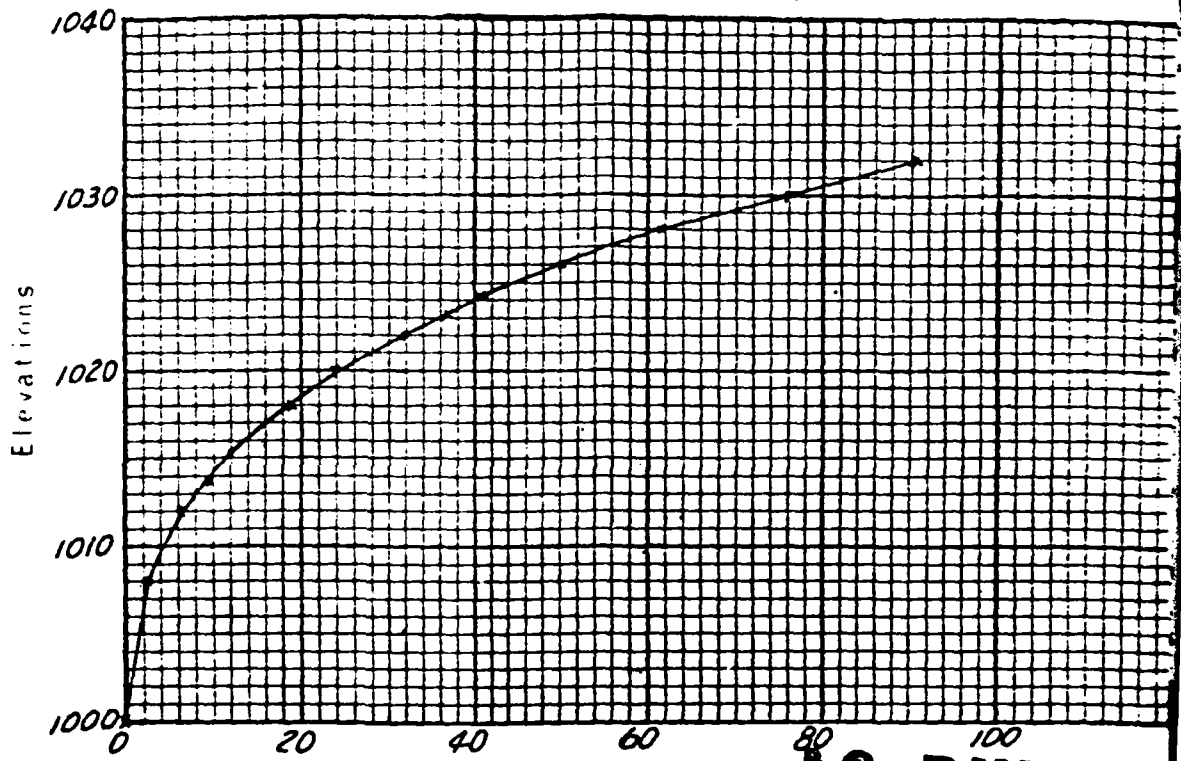
STRUCTURE DATA

Freeboard Hydrograph for Class "C" Structures

Sq. Mi.
 Sq. Mi.
 Hours
 M.C. II
 Lev. 1013.7
 Ac. Ft.
 In.
 Ac. Ft.
 In.
 fy Uses
 c.f.s.
 c.f.s.
 6 HOUR
 Structures
 c.f.s.
 f.p.s.
 ures:

Rainfall 28.80 in.
 Runoff 24.41 in.
 Peak Inflow 1777 c.f.s.
 Maximum Discharge - Emergency Spillway 1384 c.f.s.
 Maximum Water Surface Elev. 1028.3

Reservoir Capacity



Total Storage - Ac. Ft.

AS BUILT
 7-28-77

Supplementary Data and Special Design Features:

| | |
|--|----------------------------------|
| STRUCTURE F-1 | |
| LOST CREEK WATERSHED PL-566 | |
| NEWTON COUNTY, MISSOURI | |
| U. S. DEPARTMENT OF AGRICULTURE | |
| SOIL CONSERVATION SERVICE | |
| Designed <u>J.A.G. & M.M.B. 1976</u> | Approved by _____ |
| Drawn <u>B.E.S. 3-76</u> | Title _____ |
| Traced _____ | Scale _____ |
| Checked by <u>M.M.B. & N.H.R. 3-76</u> | Drawing No. <u>5, E-35,711-H</u> |

✓

1-AS-32a (11/70)
 Form No. 1-MS-MO-5
 File Code: AS-12-13

UNITED STATES DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE
 Columbia, Missouri 65201

OPERATION AND MAINTENANCE INSPECTION REPORT
 FOR STRUCTURES

May 14, 1980

Special

Watershed Lost Creek Structure No. F-1 Inspection:
Newton County

Annual

| Item | Condition Satisfactory | Condition Unsatisfactory | Describe Maintenance and Needed Repairs | Estimated Costs | Agreed Date Repairs To Be Compl'd | Date Repairs Compl'd |
|----------------------------------|------------------------|--------------------------|---|-----------------|-----------------------------------|----------------------|
| Vegetation | ✓ | | | | | |
| Fences | N.A. | | | | | |
| Principal Spillway | ✓ | | | | | |
| Emergency Spillway | ✓ | | | | | |
| Embankment | ✓ | | | | | |
| Reservoir Area | | | | | | |
| Scour Hole & Outlet Chnl | | | | | | |
| Foundation Drains & Relief Wells | | | | | | |
| Other | | | | \$125 | 10-1-80 | |
| Remarks: | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

*4' amount of
 spillway*

District Conservationist

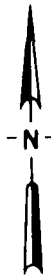
Sponsoring Local Organization Rep.

Newton Soil and Water Conservation District
 Sponsoring Local Organization

(Check list on reverse side)

APPENDIX B


Geology and Soils



LEGEND

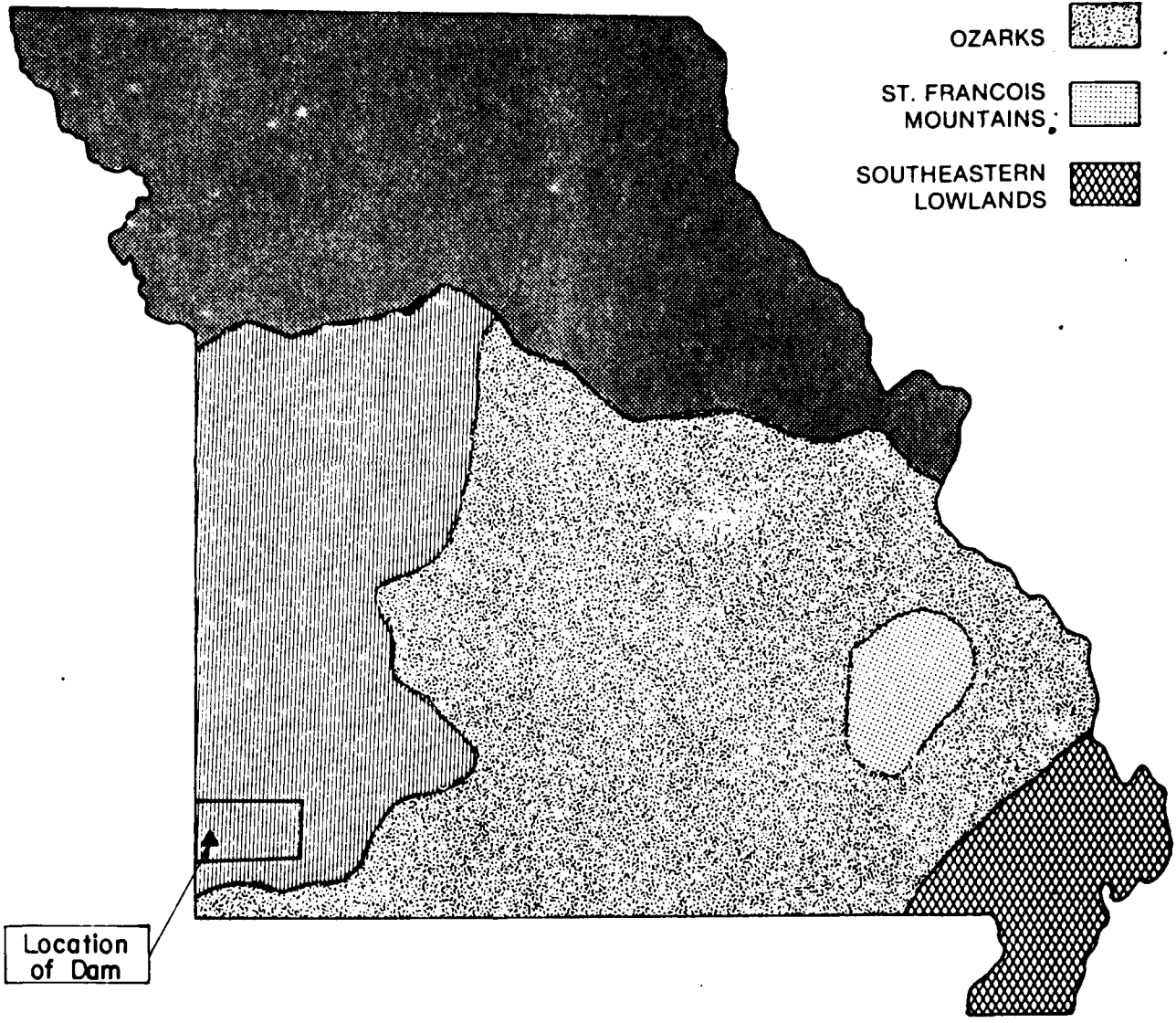
GLACIATED PLAINS 

WESTERN PLAINS 

OZARKS 

ST. FRANCOIS MOUNTAINS 

SOUTHEASTERN LOWLANDS 



Location of Dam

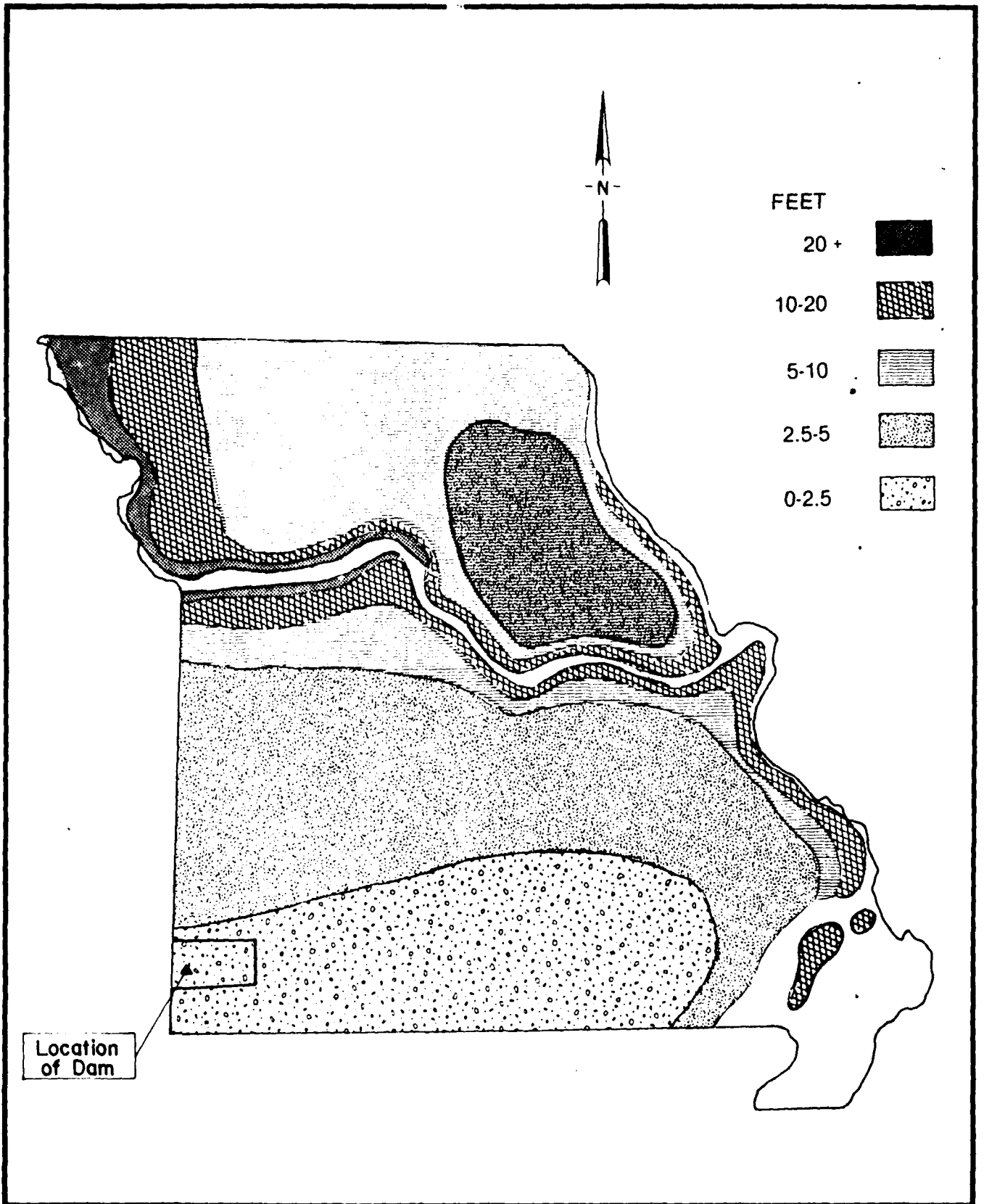
MAJOR GEOLOGIC REGIONS OF MISSOURI



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Newton County Structure F-1
Newton County, Missouri
Mo. I. D. No. 20512

SHEET 1, APPENDIX B



FEET

| | |
|-------|--|
| 20 + | |
| 10-20 | |
| 5-10 | |
| 2.5-5 | |
| 0-2.5 | |

Location of Dam

THICKNESS OF LOESSIAL DEPOSITS



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Newton County Structure F-1
 Newton County, Missouri
 Mo. I. D. No. 20512

SHEET 2, APPENDIX B

1040
1035
1030
1025
1020
1015

existing ground line

Settled to level
of proposed

of constructed dam
to be 1020 ft

to be 1020 ft

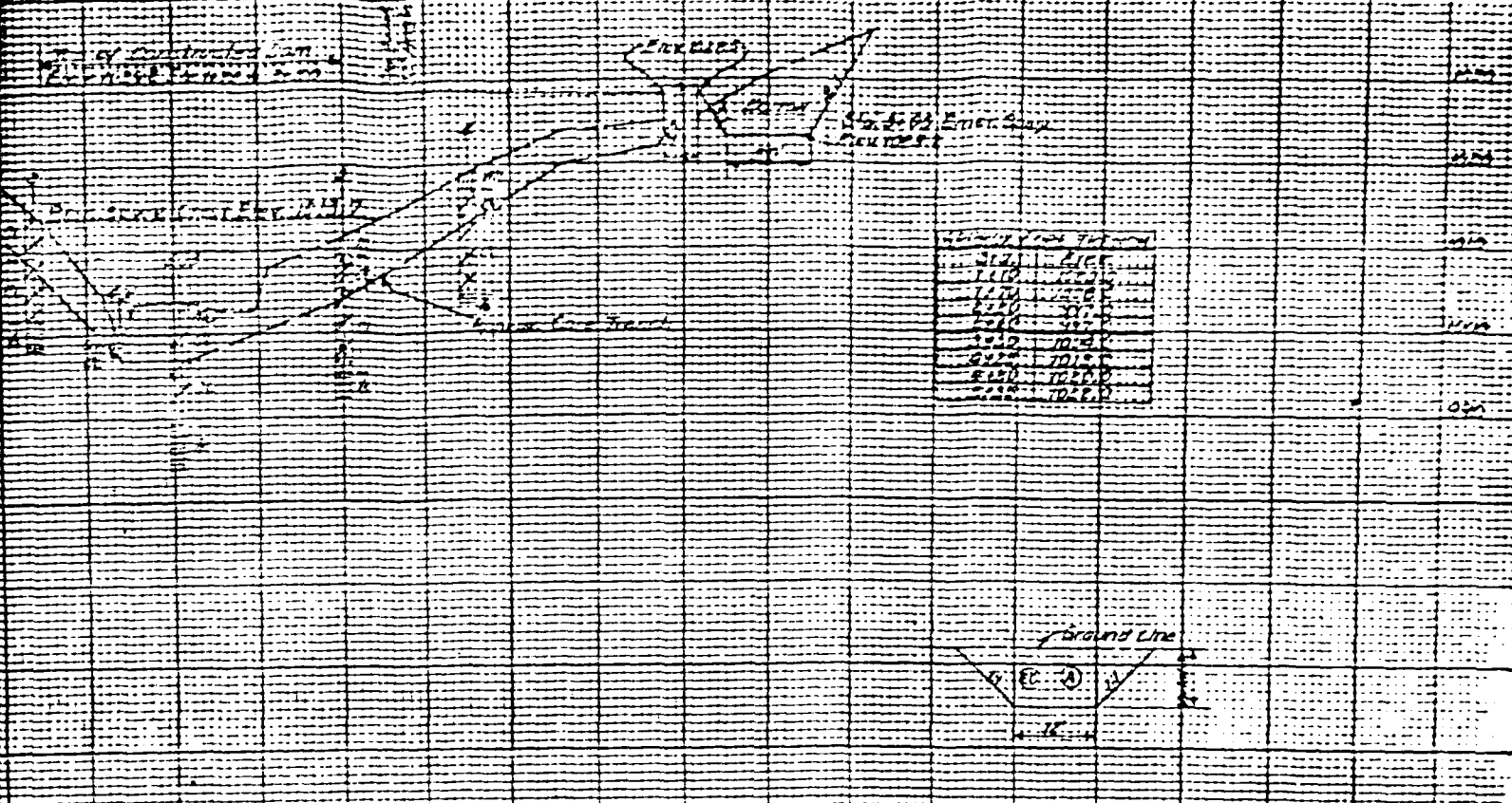
PROFILE AND GEOLOGIC SECTION CENTERLINE OF DAM

1010
1000
950

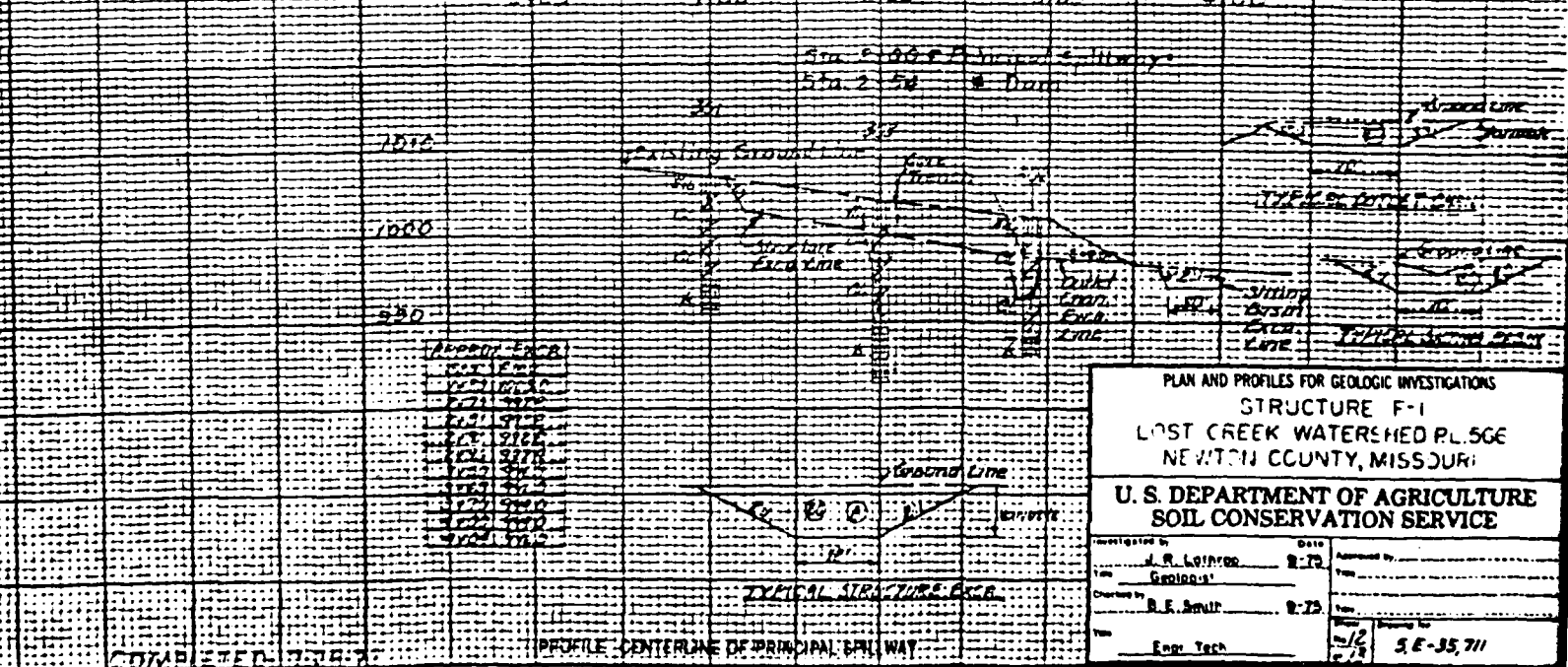
| | |
|------|------|
| 1000 | 1000 |
| 950 | 950 |
| 900 | 900 |
| 850 | 850 |
| 800 | 800 |
| 750 | 750 |
| 700 | 700 |
| 650 | 650 |
| 600 | 600 |
| 550 | 550 |
| 500 | 500 |
| 450 | 450 |
| 400 | 400 |
| 350 | 350 |
| 300 | 300 |
| 250 | 250 |
| 200 | 200 |
| 150 | 150 |
| 100 | 100 |
| 50 | 50 |
| 0 | 0 |

CROSS SECTIONS OF STREAM CHANNELS

COMPLETED 1957



PROFILE AND GEOLOGIC SECTION CENTERLINE OF DRAIN AS BUILT 7-20-71



PLAN AND PROFILES FOR GEOLOGIC INVESTIGATIONS
 STRUCTURE F-1
 LOST CREEK WATERSHED PL. 566
 NEWTON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

Investigated by: J. R. Leiferman Date: 8-73
 Checked by: R. E. Smith Date: 8-73
 Drawn by: Eng. Tech. Date: 12/73

Project No: 5E-35,711

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

| | | | | |
|---|--------------|---|----------------------|---------------------------------------|
| WATERSHED Lost Creek | SUBWATERSHED | SITE NO. F-1 | COUNTY Newton | STATE Missouri |
| LOCATION NW ¹ / ₄ , Sec. 25, T. 25N, R. 34W. | | SITE GROUP II | STRUCTURE CLASS C | FUND CLASS (FP-C3 WP-08 ETC) WF-08 |
| INVESTIGATED BY: SIGNATURE OF GEOLOGIST <i>[Signature]</i> | | EQUIPMENT USED TYPE, SIZE, MAKE, MODEL Failing 1500 RD | | DATE 9-21-75 |

SITE DATA

| | | |
|--|--|-----------------------------------|
| DRAINAGE AREA SIZE SQ. MILES <u>0.15</u> ACRES <u>99</u> | TYPE OF STRUCTURE Compacted Earth | PURPOSE Debris Basin |
| DIRECTION OF VALLEY TREND (DOWNSTREAM) South | MAXIMUM HEIGHT OF FILL <u>29</u> ¹ / ₂ FEET | LENGTH OF FILL <u>415</u> FEET |
| ESTIMATED VOLUME OF COMPACTED FILL REQUIRED YARDS <u>18,027</u> | | |

STORAGE ALLOCATION

| | VOLUME (AC. FT) | SURFACE AREA (ACRES) | DEPTH AT DAM (FEET) |
|-------------|-----------------|----------------------|---------------------|
| SEDIMENT | 9.4 Total | 1.6 | 14.7 |
| FLOOD WATER | 27.6 | 3.9 | 24.2 |

SURFACE GEOLOGY AND PHYSIOGRAPHY

| | | |
|--|------------------------|---|
| PHYSIOGRAPHIC DESCRIPTION Ozark Highland | TOPOGRAPHY Rolling | ATTITUDE OF BEDS STRIKE <u>E-W</u> DIP <u>S</u> |
| STEEPNESS OF ABUTMENTS LEFT <u>20</u> PERCENT | RIGHT <u>9</u> PERCENT | WIDTH OF FLOODPLAIN AT CENTER LINE OF DAM <u>90</u> 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 with seams of chert which occurs at an average depth of 14 feet along the dam alignment. The bedrock surface is pinnacled and uneven.

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

Circulation was lost while drilling borings in the clay-limestone bedrock contact zone. See logs of test holes.

No water was in the channel at the time of the site investigation and a water table was not encountered in any of the site borings.

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Q 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 | | |
|-----------------|-----------------|----------|-------------------------|-----------|-------|
| | EXPLORATION | SAMPLING | UNDISTURBED | DISTURBED | |
| | | | (STATE TYPE) | LARGE | SMALL |
| Failing 1500 RD | 4 | 1 | -- | 3 | -- |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| TOTAL | 4 | 1 | -- | 3 | -- |

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

Hardness 4-5 limestone bedrock was encountered at an average depth of 14 feet along the Q dam alignment.

Three horizons are developed above bedrock. The surface horizon, present on the right flank is 2 to 3 feet in depth. The ML is not present on the steep left abutment. The second horizon is a 40% gravelly and cobbly brown-red clay (CL-GC) that extends to an average depth of 6 feet. Material in this horizon is cobble size 2 to 4 inch hard cherty irregular limestone with some boulders and has clay in the cracks and seams. The third horizon is a slightly cherty gravelly waxy-red clay. This horizon overlies a pinnacled and weathered limestone surface. The third horizon appears to be altered weathered and rotten limestone mixed with clay (CL).

Boring #4 and the centerline intersect boring #303 lost circulation while drilling the clay-limestone zone.

A water table was not encountered.

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 | | |
|------------------------|-----------------|-----------|-------------------------|-----------|-----------|
| | EXPLORATION | SAMPLING | UNDISTURBED | DISTURBED | |
| | | | (STATE TYPE) | LARGE | SMALL |
| <u>Failing 1500 RD</u> | <u>3</u> | <u>--</u> | <u>--</u> | <u>--</u> | <u>--</u> |
| _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ |
| TOTAL | <u>3</u> | <u>--</u> | <u>--</u> | <u>--</u> | <u>--</u> |

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

Hardness 4-5 limestone with chert lenses was encountered at an average depth of 14 feet along the principal spillway alignment. The bedrock surface may be expected to be uneven and pinnacled.

Soils developed above bedrock are a medium consistency brown silt (ML) surface horizon which extends to a depth of 2-3 feet. Below the surface horizon, the second horizon is a gravelly and cobbly brown-red clay (CL) with an average thickness of 5 feet. The third horizon is a slightly gravelly red clay (CL). The third horizon directly overlies limestone and is probably residuum from the weathering of the limestone bedrock.

All three borings lost circulation while drilling the clay-limestone zone. High permeability strata are probably both in the red clay and in the top portion of the weathered limestone.

A water table was not encountered.

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 | | |
|-----------------|-----------------|----------|-------------------------|-----------|-------|
| | EXPLORATION | SAMPLING | UNDISTURBED | DISTURBED | |
| | | | (STATE TYPE) | LARGE | SMALL |
| Failing 1500 RD | 6 | 1 | -- | 2 | -- |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| TOTAL | 6 | 1 | -- | 2 | -- |

*Where is Borrow?
is it from Spillway?*

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 gravelly and cobbly brown-red clay (CL) that extends to an average depth of 4-5 feet. The third horizon (if present) is a slightly cherty gravelly clay (CL). The horizon directly overlies a pinnacled and uneven surface limestone bedrock. Higher plasticity soils appear to increase with depth.

The hardness 4-5 cherty limestone bedrock will limit borrowing in some areas to a depth of 6 feet or less. Average depth to limestone is 8 feet.

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

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 | | |
|------------------------|-----------------|----------|-----------------------------|----------|-----------|
| | EXPLORATION | SAMPLING | UNDISTURBED (STATE TYPE) | LARGE | SMALL |
| <u>Failing 1500 RD</u> | <u>8</u> | <u>1</u> | <u>--</u> | <u>2</u> | <u>--</u> |
| _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ |
| TOTAL | <u>8</u> | <u>1</u> | <u>--</u> | <u>2</u> | <u>--</u> |

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

A thin brown silt (ML) surface horizon averaging 2 feet in depth overlies a 40% cobble and gravelly brown brown-red clay second horizon that extends to an average depth of 7 feet. The third horizon is a slightly gravelly red waxy clay that extends to below proposed grade.

The cobbly clay second horizon or the slightly clay third horizon will be encountered at proposed grade at all stations.

No water table was found in any of the emergency spillway borings.

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 | | |
|----------------|-----------------|----------|-------------------------|-----------|-------|
| | EXPLORATION | SAMPLING | UNDISTURBED | DISTURBED | |
| | | | (STATE TYPE) | LARGE | SMALL |
| Hand Auger | 1 | -- | -- | -- | -- |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| TOTAL | 1 | -- | -- | -- | -- |

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

Poorly sorted gravel and sand with some cobbles is present on the channel floor and extends to a depth of 1 foot. The gravel overlies moist cobbly brown-red clay. Trash and organic debris litter the channel.

No water was present in the channel at the time of the site investigation.

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

| | | | | | |
|-------------------------|------------------|----------------------|---|------------------|-------------------|
| WATERSHED Lost Creek | | SUBWATERSHED | | COUNTY Newton | STATE Missouri |
| SITE NO. F-1 | SITE GROUP II | STRUCTURE CLASS c | INVESTIGATED BY: (SIGNATURE OF GEOLOGIST) <i>James H. Bell</i> | | DATE 9-21-75 |

INTERPRETATIONS AND CONCLUSIONS

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

Principal Spillway - Location alignment and foundation are satisfactory and the location at station 2+53 Q dam is adequate. It is suggested that the ML surface material found along this alignment be removed during construction.

Drainage - Not recommended

Stream Channel - 1 to 2 foot cleanout at all sections should eliminate objectionable gravel, sand, trash and organic debris. This cleanout should bottom on gravelly brown-red very stiff clay.

Emergency Spillway - An estimated 12,000 cu. yds. of common excavation may be expected from the emergency spillway area.

Limestone bedrock was not encountered above proposed grade in any of the spillway borings and the spillway should bottom in cobbly gravelly clay at all stations.

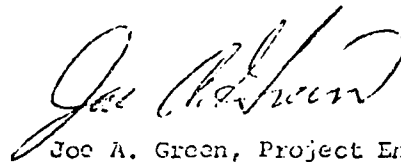
Borrow - Ample materials, along with required excavation from the emergency spillway are available from the suggested borrow area limits to construct the embankment.

More plastic soil materials may be expected in the higher elevations, located on the flanks of the floodplain; and for this reason as well as the highly permeable clay-limestone zone that may be expected from 8 to 14 foot depths, it is suggested that borrowing in the floodplain areas be limited to depths of 6 or 7 feet.

The cobbles in the borrow soils should be suitable for use in embankment slope and berm protective cover.

ENGINEER'S REPORT
SITE F-1 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, should penetrate the lower CL material approximately one foot (1'). Recommend the core trench bottom width be 12 feet with 1:1 side slopes.
3. UNDESIRABLE MATERIAL - There appears to be no large amount of undesirable material in the foundation area that needs to be removed other than normal stripping and topsoil removal.
4. MATERIALS - Excavation from core and emergency spillway may be used for fill. Emergency spillway excavations with 3:1 side slopes will amount to approximately 12,000 cubic yards. Any additional fill material needed can be obtained from below the principal spillway crest elevation in the borrow area.
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, Project Engineer
September 24, 1975

mf

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-1 **DATE:** January 21, 1976
(Newton County)

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-ENG-352, Compaction and Penetration Resistance, 3 sheets
4. Form SCS-357, Summary - Slope Stability Analysis, 2 sheets

DISCUSSION

FOUNDATION

- A. Bedrock. Limestone bedrock occurs at depths of about 12 to 16 feet.
- B. Soil Classification. The soil on the right abutment and in the flood-plain is logged as a 2 or 3-foot layer of ML overlying CL. The soil on the left abutment is logged as CL.

Three bag samples were submitted from test hole 3 on the right abutment. The sample from the surface zone is classified as ML or CL-ML. The intermediate zone from the 2 to 6-foot depth is classed as SC, and the zone from the 6 to 16-foot depth is a CH that contains 67 percent fines.

No undisturbed samples were submitted for testing.

EMBANKMENT

- A. Soil Classification. Two samples were submitted from the emergency spillway area and two samples were submitted from the borrow area.

The samples from the emergency spillway contain about 15 to 20 percent gravel, and slightly more than 50 percent fines. They are classed as CL.

Sample 103-1 from the borrow area is from the 2 to 6-foot depth, and it is similar to Sample 3-2 from the centerline. It contains 22 percent gravel and 49 percent fines and is classed as CC. Sample 103-2 is comparable to Sample 3-3 from centerline, and it is also classed as CH.



- B. Compacted Density. Compaction tests were made on two of the samples as requested. Tests were made on the minus 3/4-inch fraction to comply with plans for control on the minus 3/4-inch fraction. There is not much gravel-size material in these samples, so an additional compaction test was made on the minus No. 4 fraction of Sample 103-1 to provide data so that the shear test could be made on the minus No. 4 fraction with small-size test specimens rather than on the larger size test specimens required if the gravel were included.
- C. Shear Strength. A \overline{CU} triaxial shear test was made on the minus No. 4 size material from Sample 103-1 (76W765). The test specimens were compacted to 95 percent of Proctor density. The saturated shear strength parameters obtained are $\phi = 12^\circ$, $c = 900$ psf, and $\bar{\phi} = 35^\circ$, $\bar{c} = 0$. The stress-strain curves indicate that the material is quite brittle, and to make some allowance for foundation strain failure was picked at 5 percent strain, which results in a deviator stress less than the peak deviator stress.

SLOPE STABILITY

The stability of the proposed $2\frac{1}{2}:1$ slopes was checked with a circle method of analysis. Conditions assumed for the analysis were (1) foundation strength greater than the embankment strength (no cores were submitted, (2) full drawdown from emergency spillway elevation for the upstream slope, (3) steady-seepage condition with a phreatic line from emergency spillway elevation and no embankment drain for the downstream slope, and (4) the shear strength parameters outlined previously. For these conditions the analysis shows that the proposed $2\frac{1}{2}:1$ slopes have acceptable factors of safety.

CONCLUSIONS AND RECOMMENDATIONS

We concur with the proposal outlined in the engineer's report. The core trench should bottom in the zone represented by Sample 3-3. Compaction can be controlled on the minus 3/4-inch fraction as proposed. Proposed slopes of $2\frac{1}{2}:1$ have an acceptable factor of safety providing the foundation strength is as assumed.

Lorn P. Dunnigan

Lorn P. Dunnigan
Head

Attachments

cc: Joe A. Green, Project Engr., Mr. Vernon (2)
Buell M. Ferguson, Lincoln, Nebr.

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

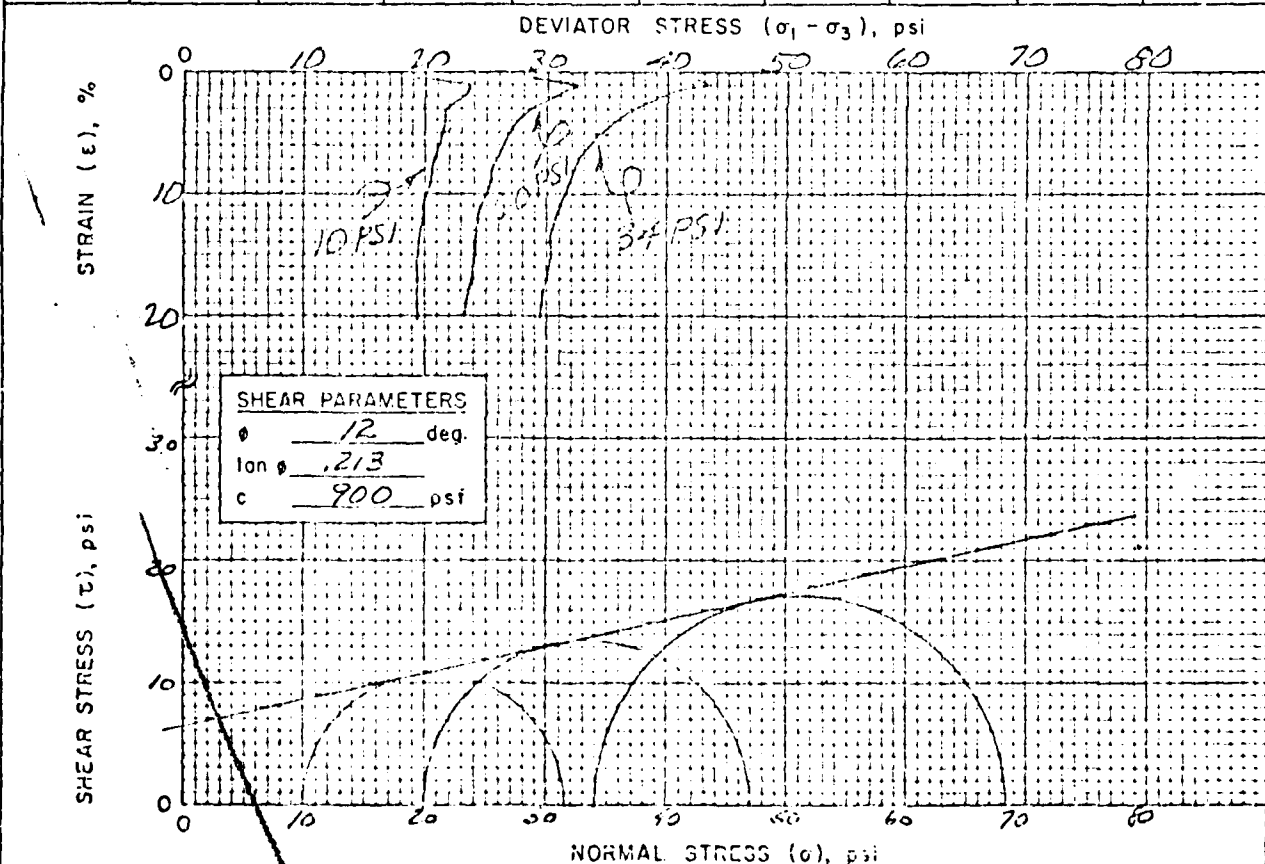
PROJECT and STATE: LOST CREEK SITE, F-1 MISSOURI SAMPLE LOCATION: Section B 3+00

FIELD SAMPLE NO: 103-1 DEPTH: 6-10 GEOLOGIC ORIGIN:

TYPE OF SAMPLE: COMPACTED TESTED AT: SAIL LINCOLN APPROVED BY: DATE:

| INDEX TEST DATA | | SPECIMEN DATA | | TYPE OF TEST |
|-------------------------------|--|-------------------------|---|---|
| USCS | <u>SC</u> ; LL <u>35</u> ; PI <u>15</u> | HEIGHT | <u>3.0</u> "; DIAMETER <u>1.4</u> " | UU <input type="checkbox"/> CU <input type="checkbox"/> CU <input checked="" type="checkbox"/> CD <input type="checkbox"/> |
| % FINER (mm): | 0.002 <u>14</u> ; 0.005 <u>19</u> ; 0.074 (#200) <u>49</u> | MATERIALS TESTED PASSED | <u>#4</u> SIEVE | |
| G _s (#4) | <u>2.65</u> ; G _s (#4) | METHOD OF PREPARATION | <u>STATIC 2 LAYER COMPACTION</u> | |
| STANDARD: γ _d MAX. | <u>110.5</u> pcf; w _o <u>14.5</u> % | MOLDING MOISTURE | <u>16.2</u> % | |
| MODIFIED: γ _d MAX. | pcf; w _o % | MOLDED AT | <u>94.8</u> % OF γ _d MAXIMUM | |

| DRY DENSITY | | B, Parameter | MOISTURE CONTENT, % | | | TIME OF CONSOLIDATION (hrs.) | MINOR PRINCIPAL STRESS σ ₃ (psi) | DEVIATOR STRESS σ ₁ - σ ₃ (psi) | AXIAL STRAIN AT FAILURE, ε (%) |
|---|---|--------------|---------------------|------------------------------|-------------|------------------------------|---|---|--------------------------------|
| INITIAL pcf <input checked="" type="checkbox"/> g/cc <input type="checkbox"/> | CONSOLIDATED pcf <input type="checkbox"/> g/cc <input type="checkbox"/> | | START OF TEST | DEG OF SAT. AT START OF TEST | END OF TEST | | | | |
| <u>104.8</u> | | <u>0.95</u> | | | <u>21.5</u> | <u>10.25</u> | <u>21.4</u> | <u>5.0</u> | |
| <u>104.8</u> | | <u>0.95</u> | | | <u>21.0</u> | <u>40.00</u> | <u>26.8</u> | <u>5.0</u> | |
| <u>104.6</u> | | <u>0.95</u> | | | <u>20.8</u> | <u>40.17</u> | <u>34.2</u> | <u>5.0</u> | |



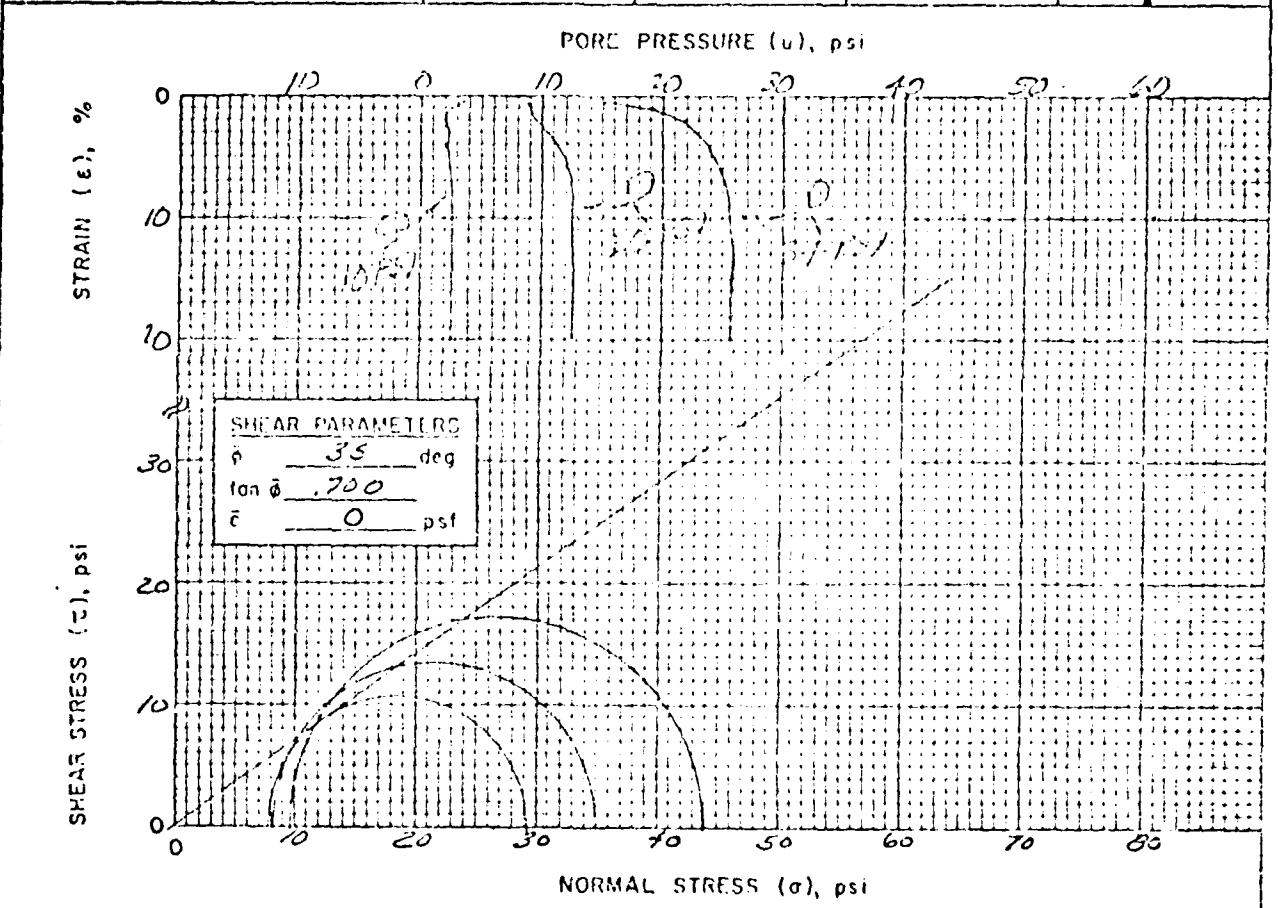
REMARKS BACK-PRESSURED

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

PROJECT and STATE: *LOST CREEK SITE: F-1 MISSOURI* SAMPLE LOCATION: *Rollway, B 3+00*

TYPE OF SAMPLE: *COMPACTED* TESTED AT: *SML LINCOLN* 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 (%) |
|--|--------------------------|--|--|------------------|---|
| <i>10</i> | <i>2.2</i> | <i>7.8</i> | <i>21.4</i> | | <i>5.0</i> |
| <i>20</i> | <i>11.9</i> | <i>8.1</i> | <i>26.8</i> | | <i>5.0</i> |
| <i>34</i> | <i>24.3</i> | <i>9.7</i> | <i>34.2</i> | | <i>5.0</i> |
| | | | | | |
| | | | | | |



REMARKS: *BACK-PRESSURED*

[Signature]

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

PROJECT and STATE Lusk Creek # F-1, Missouri

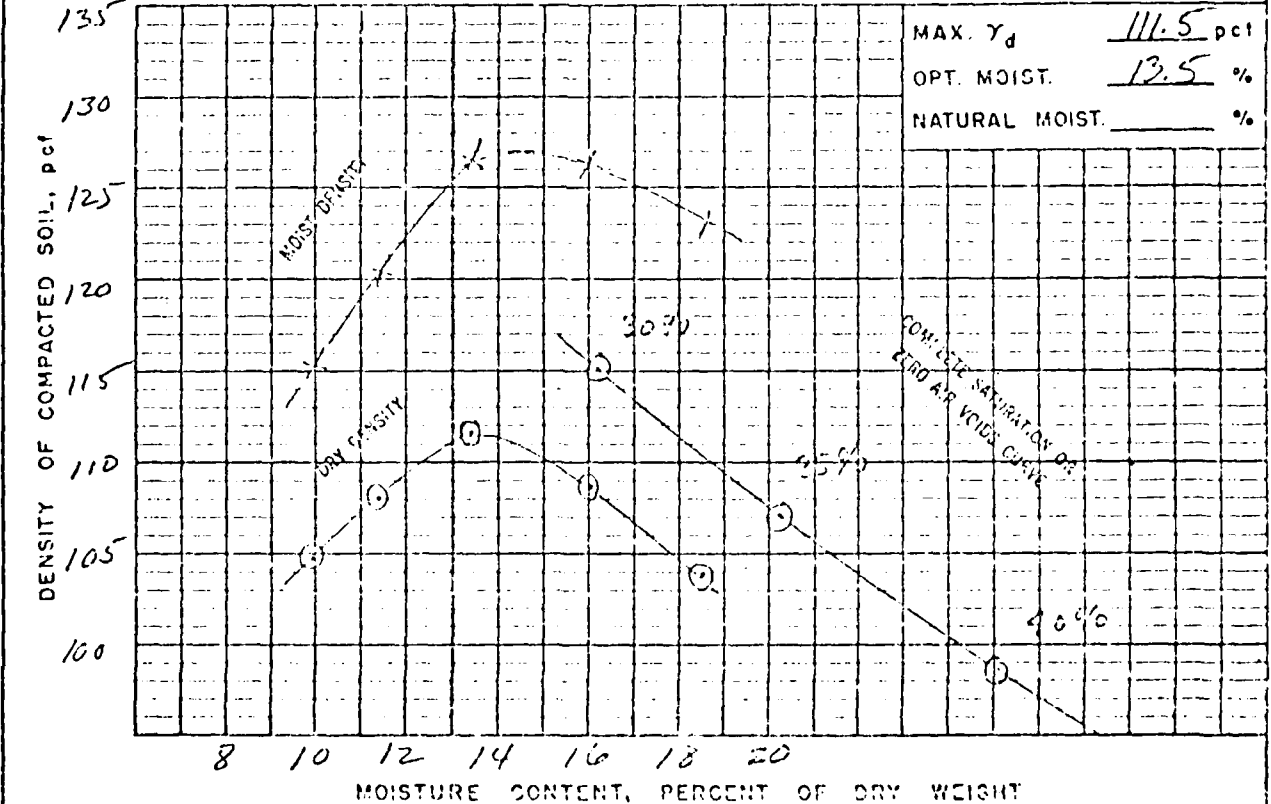
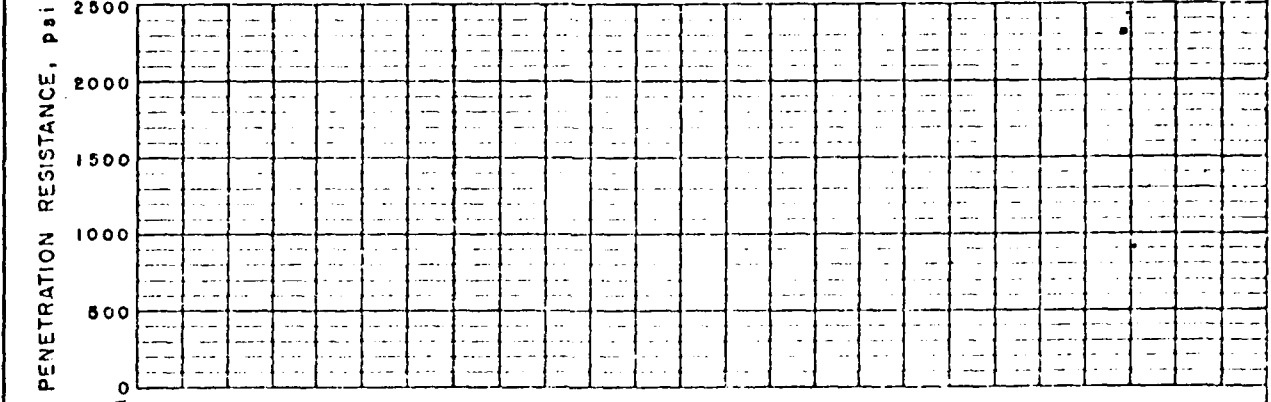
FIELD SAMPLE NO 2661 LOCATION Emery Spwy. 3+50 E.F.S. DEPTH 2-6'

GEOLOGIC ORIGIN _____ TESTED AT SML-LINCOLN APPROVED BY _____ DATE _____

CLASSIFICATION CL LL 34 PI 16 CURVE NO. 1X OF 2

MAX. PARTICLE SIZE INCLUDED IN TEST 2 3/4" STD. (ASTM D-698) ; METHOD C

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.64 PLUS NO. 4 _____ MOD. (ASTM D-1557) ; METHOD _____ OTHER TEST (SEE REMARKS)



REMARKS CURVE IS FOR THE MINUS NO. 4 FRACTION GRADATION OF TOTAL SAMPLE
= NO. 200 51 % = NO. 4 85 % = 1 IN. 100 %

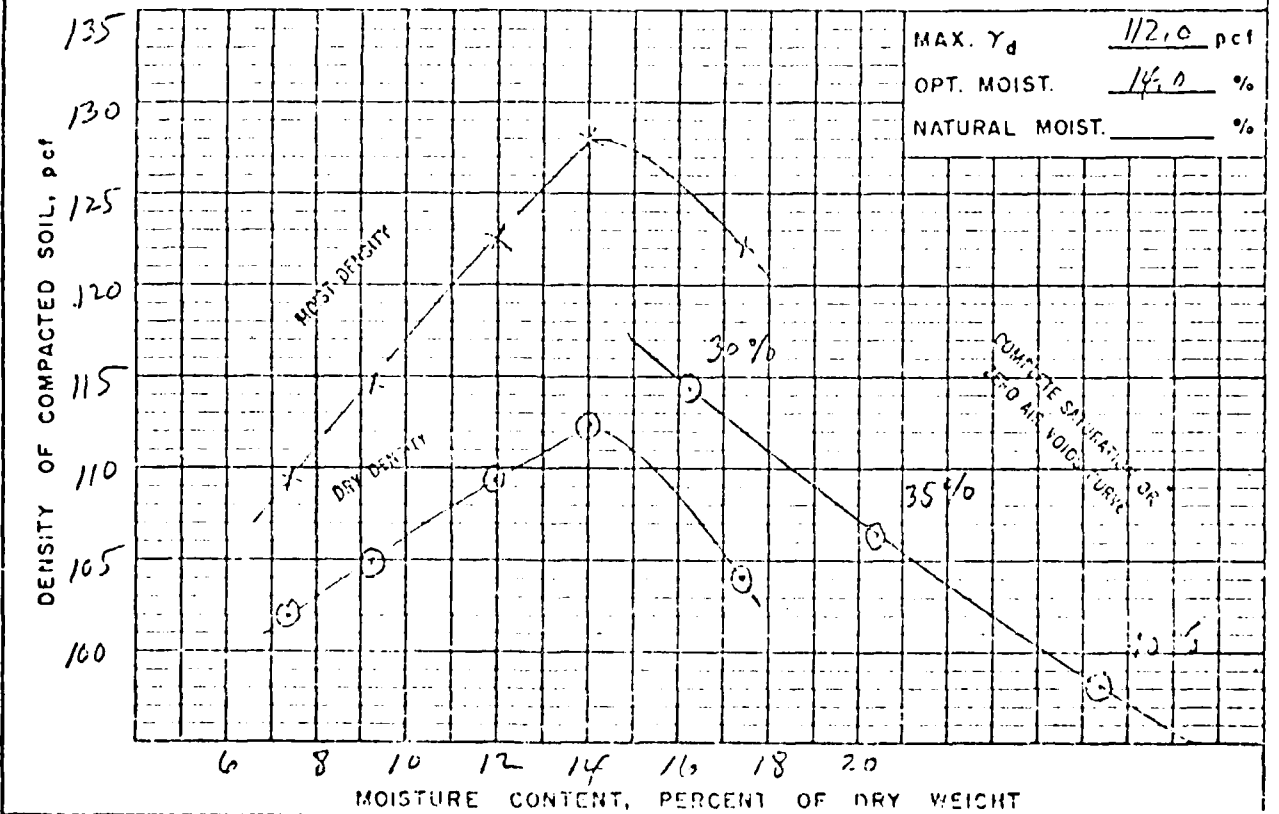
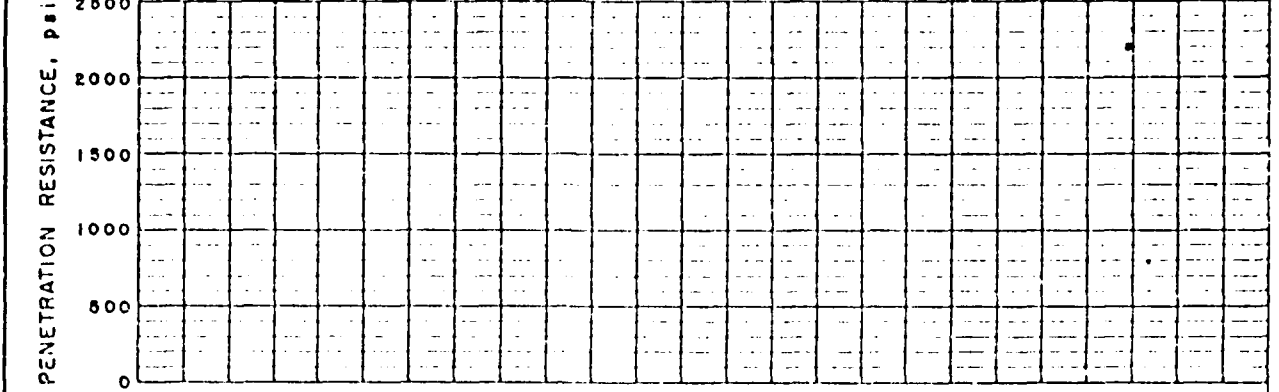
MATERIALS TESTING REPORT U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE 103-1 Creek # E-1, Missouri

FIELD SAMPLE NO. 103-1 LOCATION Borrow, B 3+00 DEPTH 2-6'

GEOLOGIC ORIGIN _____ TESTED AT SML-LINCOLN APPROVED BY _____ DATE _____

CLASSIFICATION SC LL 35 PI 15 CURVE NO. 2X OF 2
 MAX. PARTICLE SIZE INCLUDED IN TEST 1.3 STD. (ASTM D-698) ; METHOD C
 SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.65 MOD. (ASTM D-1557) ; METHOD _____
 PLUS NO. 4 2.48 OTHER TEST (SEE REMARKS)
 AV. 2.61



MAX. γ_d 112.0 pcf
 OPT. MOIST. 14.0 %
 NATURAL MOIST. _____ %

REMARKS
 CURVE IS FOR THE MINUS NO. 4 FRACTION
 GRADATION OF TOTAL SAMPLE
< NO. 200 49% ; < NO. 4 78% ; < 1/8" 100%

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

| | |
|---|------------------------|
| PROJECT and STATE <i>LOST CREEK # F-1 MISSOURI</i> | DATE <i>1-13-75</i> |
|---|------------------------|

| | | |
|--|---|-------------|
| METHOD OF ANALYSIS <i>MODIFIED SWEDISH CIRCLE</i> | ANALYZED AT <i>S.M.H. Lincoln, NE.</i> | APPROVED BY |
|--|---|-------------|

| TRIAL NO. | SLOPE | SOURCE AND USE OF MATERIALS | CLASSIFICATION | ADOPTED DESIGN DATA | | | | | | REMARKS | |
|------------|----------------|---------------------------------|----------------|---|--------------|--------------|-------------|-----------|-------------|------------|--------------------------|
| | | | | Yd (pcf) | Ym (pcf) | Ysat (pcf) | γsub (pcf) | φ (deg) | 10n φ | | c (psf) |
| ① | | <i>Embankment</i> | <i>SC</i> | <i>104.7</i> | <i>120.0</i> | <i>127.5</i> | <i>65.0</i> | <i>12</i> | <i>.213</i> | <i>900</i> | |
| ② | | | | | | | | <i>35</i> | <i>.700</i> | <i>0</i> | |
| ③ | | | | | | | | | | | |
| ④ | | | | | | | | | | | |
| ⑤ | | | | | | | | | | | |
| ⑥ | | | | | | | | | | | |
| ⑦ | | | | | | | | | | | |
| ⑧ | | | | | | | | | | | |
| | | | | CONDITIONS <i>Downstr. - Steady Seepage</i> | | | | | | | |
| <i>11a</i> | <i>2 1/2:1</i> | <i>Upstream - Full drawdown</i> | | | | | | | | | <i>F_s 2.9</i> |
| <i>21a</i> | <i>2 1/2:1</i> | <i>Embank. (12°-900) only</i> | | | | | | | | | <i>2.5</i> |
| <i>31a</i> | <i>2 1/2:1</i> | <i>Embank. (12°-900) only</i> | | | | | | | | | <i>2.1</i> |
| <i>41a</i> | <i>2 1/2:1</i> | <i>Embank. (12°-900) only</i> | | | | | | | | | <i>2.3</i> |
| <i>51a</i> | <i>2 1/2:1</i> | <i>Embank. (12°-900) only</i> | | | | | | | | | <i>2.6</i> |
| <i>61a</i> | <i>2 1/2:1</i> | <i>Embank. (12°-900) only</i> | | | | | | | | | <i>2.9</i> |

APPENDIX C

Overtopping Analysis

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 1013.7) 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 1013.7 (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) | 0.15 sq. miles |
| Length of Watercourse (L) | 0.55 miles |
| Difference in elevation (H) | 87 feet |
| Time of concentration (Tc) | 0.24 hours |
| Lag Time (Lg) | 0.14 hours |
| Time to peak (Tp) | 0.18 hours |
| Peak Discharge (Qp) | 403 c.f.s. |
| Duration (D) | 5 min. |

| <u>Time (Min.)(*)</u> | <u>Discharge (cfs)(*)</u> |
|------------------------|----------------------------|
| 0 | 1 |
| 5 | 162 |
| 10 | 397 |
| 15 | 320 |
| 20 | 148 |
| 25 | 72 |
| 30 | 34 |
| 35 | 16 |
| 40 | 8 |
| 45 | 4 |
| 50 | 2 |
| 55 | 0 |

(*) From the computer output

FORMULA USED:

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

$$L_g = 0.6 T_c$$

$$T_p = \frac{D}{2} + L_g$$

$$Q_p = \frac{484 A \cdot Q}{T_p} \quad Q = \text{Excess Runoff} = 1 \text{ inch}$$

TABLE 2

RAINFALL-RUNOFF VALUES

| <u>Selected Storm Event</u> | <u>Storm Duration (Hours)</u> | <u>Rainfall (Inches)</u> | <u>Runoff (Inches)</u> | <u>Loss (Inches)</u> |
|-----------------------------|-----------------------------------|------------------------------|----------------------------|--------------------------|
| PMP | 24 | 35.49 | 33.50 | 1.99 |

Additional Data:

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

TABLE 3

ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

| <u>Elevation (feet-MSL)</u> | <u>Lake Surface Area (acres)</u> | <u>Lake Storage (acre-ft)</u> | <u>Spillways Discharge (cfs)</u> |
|---------------------------------|--|-----------------------------------|--------------------------------------|
| 998.2 | 0 | 0 | 0 |
| *1013.7 | 1.6 | 9.4 | 0 |
| 1020.0 | 3.1 | 24.2 | 20 |
| 1023.6 | 4.0 | 39.0 | 25 |
| **1028.2 | 6.2 | 63.0 | 1151 |
| 1030.0 | 7.0 | 76.0 | 2080 |
| 1032.1 | 7.3 | 91.0 | 3735 |

*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

| <u>Reservoir Elevation Ft (MSL)</u> | <u>Primary Spillway (c.f.s.)</u> | <u>Emergency Spillway (c.f.s.)</u> | <u>Total Discharge (c.f.s.)</u> |
|---|--|--|---|
| 1013.7 | 0 | 0 | 0 |
| 1015.0 | 9 | 0 | 9 |
| 1023.6 | 25 | 0 | 25 |
| 1024.6 | 26 | 80 | 106 |
| 1025.1 | 27 | 130 | 157 |
| 1026.1 | 28 | 295 | 323 |
| *1028.2 | 31 | 1120 | 1151 |
| 1029.1 | 32 | 1580 | 1612 |
| 1030.1 | 33 | 2150 | 2188 |
| 1031.1 | 34 | 2850 | 2884 |
| 1032.1 | 35 | 3700 | 3735 |

*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 ft² (11" x 22")

g = Acceleration of gravity = 32.2 ft/sec²

h = Head from reservoir elevation to the center of the opening (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 |
|--------------|-------------------|-------------------------------|-------------------------|--------------------|-----------------------------|
| - | 0 | *1013.7 | 9.4 | 0 | - |
| 0.20 | 421 | 1024.1 | 42 | 67 | - |
| 0.25 | 527 | 1024.9 | 46 | 137 | - |
| 0.30 | 632 | 1025.7 | 50 | 262 | - |
| 0.35 | 738 | 1026.3 | 53 | 410 | - |
| 0.40 | 843 | 1026.7 | 55 | 556 | - |
| 0.50 | 1054 | 1027.2 | 58 | 763 | - |
| 0.74 | 1493 | **1028.2 | 63 | 1151 | 0 |
| 0.75 | 1581 | 1028.3 | 63 | 1184 | 0.1 |
| 1.00 | 2107 | 1029.0 | 68 | 1603 | 0.8 |

The percentage of the PMF that will reach the top of the dam is 74 percent.

*Primary spillway crest elevation

**Top of dam elevation

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 |
| HYDROGRAPH AT | 1 | 0.15 (0.39) | 1 | 421. (11.93) | 527. (14.92) | 632. (17.90) | 738. (20.89) | 843. (23.87) | 1054. (29.84) | 1581. (44.76) | 2107. (59.67) |
| ROUTED TO | 2 | 0.15 (0.39) | 1 | 67. (1.90) | 137. (3.89) | 262. (7.41) | 410. (11.61) | 556. (15.75) | 763. (21.61) | 1184. (33.52) | 1603. (45.41) |

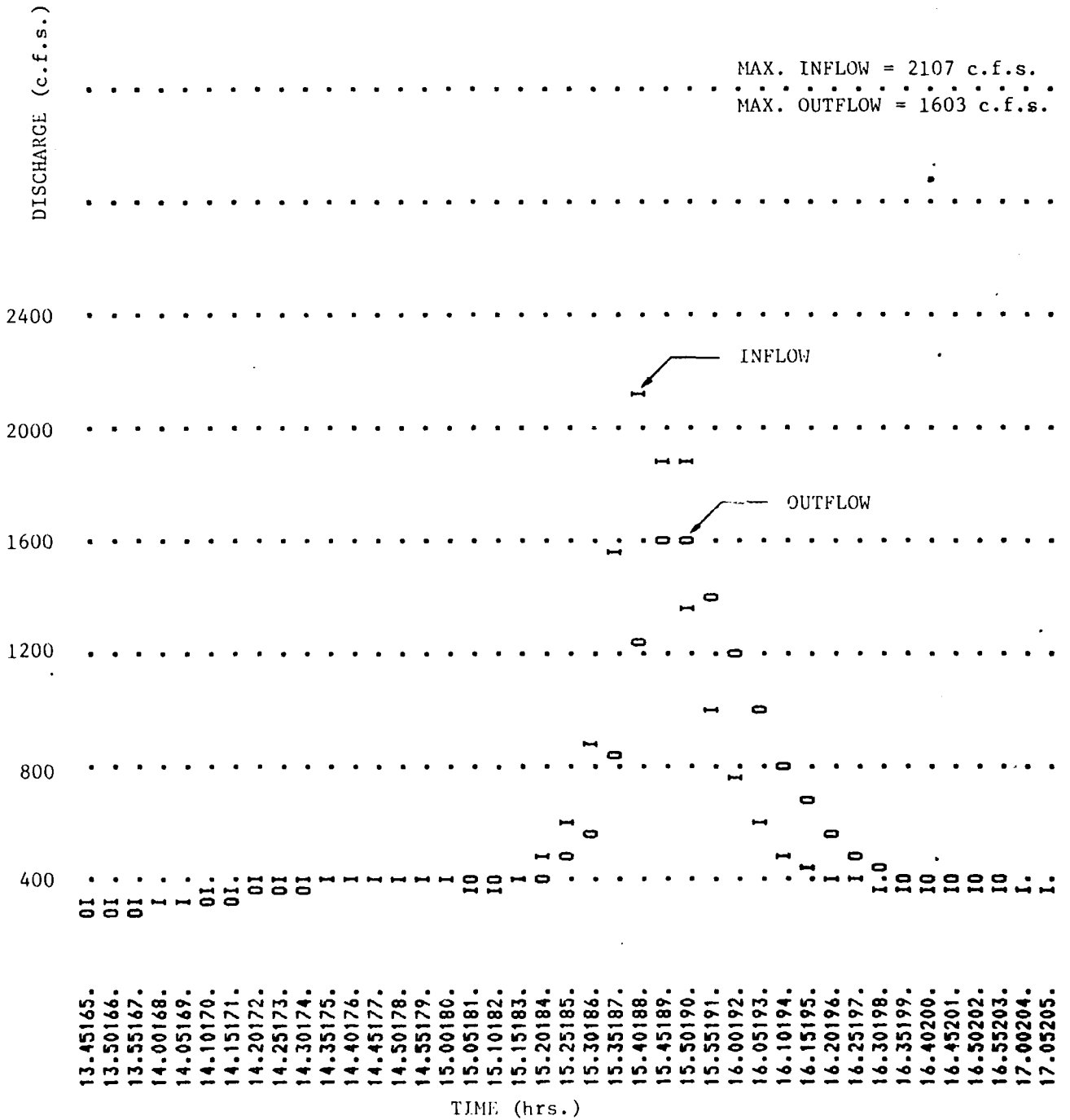
SUMMARY OF DAM SAFETY ANALYSIS

| PLAN 1 | ELEVATION | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|--------------|-----------|---------------|----------------|------------|
| | STORAGE | 1013.70 | 1013.70 | 1028.20 |
| | OUTFLOW | 9. | 9. | 63. |
| | | 0. | 0. | 1151. |

| RATIO OF PHF | MAXIMUM RESERVOIR U.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 |
|--------------|----------------------------|------------------------|-----------------------|---------------------|-------------------------|---------------------------|-----------------------|
| | | | | | | | |
| 0.25 | 1024.91 | 0.00 | 46. | 137. | 0.00 | 16.08 | 0.00 |
| 0.30 | 1025.73 | 0.00 | 50. | 262. | 0.00 | 16.00 | 0.00 |
| 0.35 | 1026.32 | 0.00 | 53. | 410. | 0.00 | 15.92 | 0.00 |
| 0.40 | 1026.69 | 0.00 | 55. | 556. | 0.00 | 15.83 | 0.00 |
| 0.50 | 1027.22 | 0.00 | 58. | 763. | 0.00 | 15.83 | 0.00 |
| 0.75 | 1028.26 | 0.06 | 63. | 1184. | 0.17 | 15.83 | 0.00 |
| 1.00 | 1028.96 | 0.76 | 68. | 1603. | 0.42 | 15.83 | 0.00 |

PMF Ratios
 Output Data

INFLOW-OUTFLOW
HYDROGRAPH
FOR THE PMF



APPENDIX D

Photographs

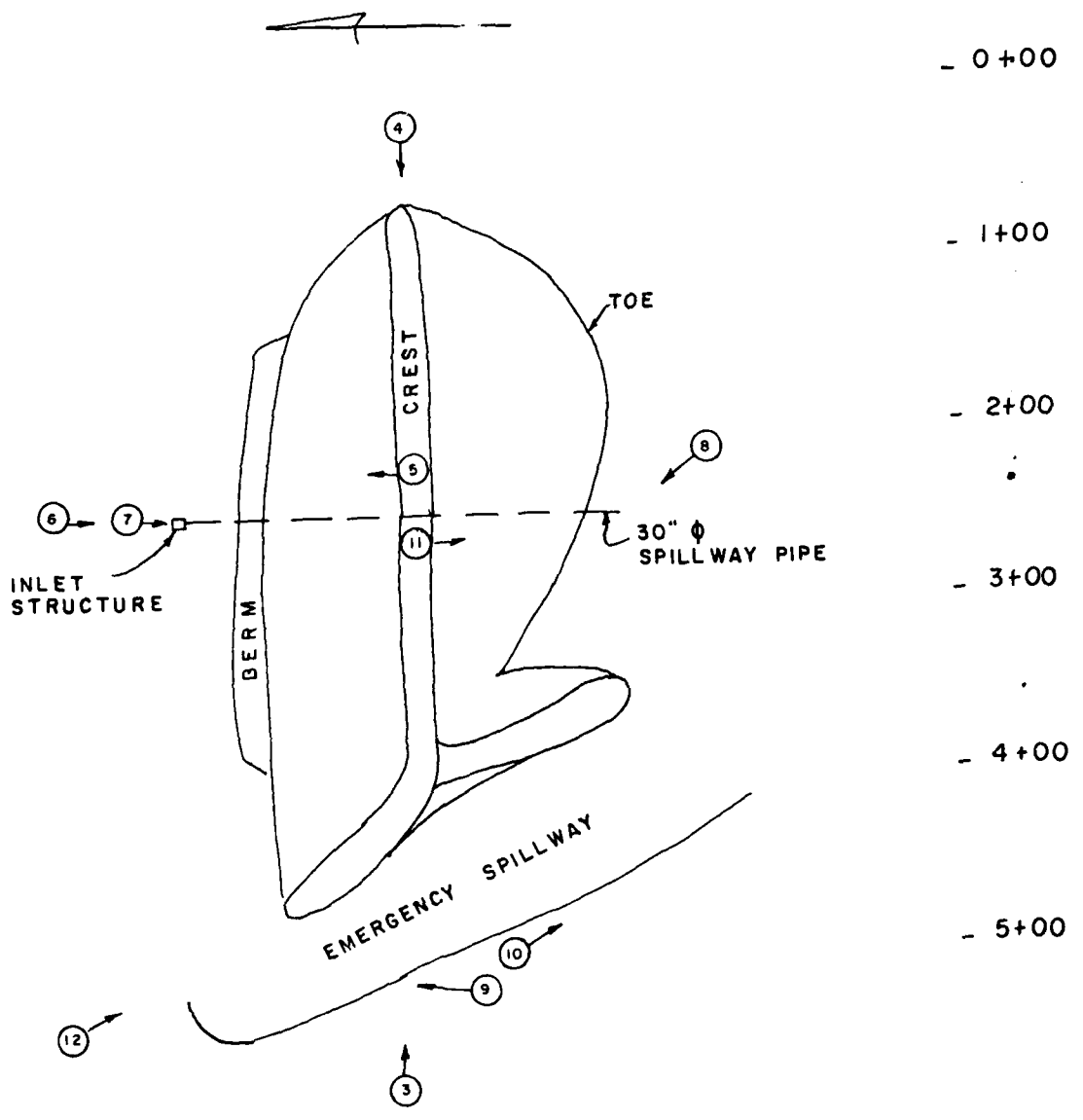
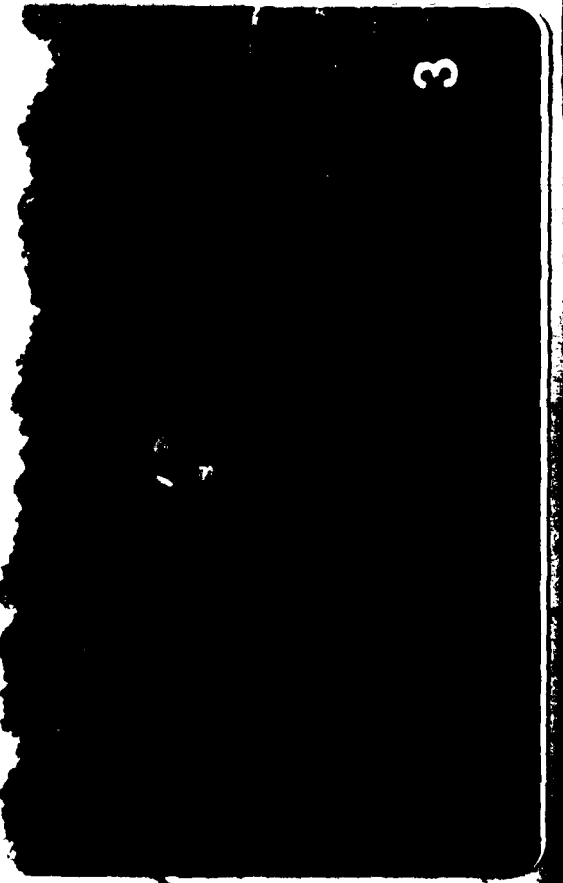
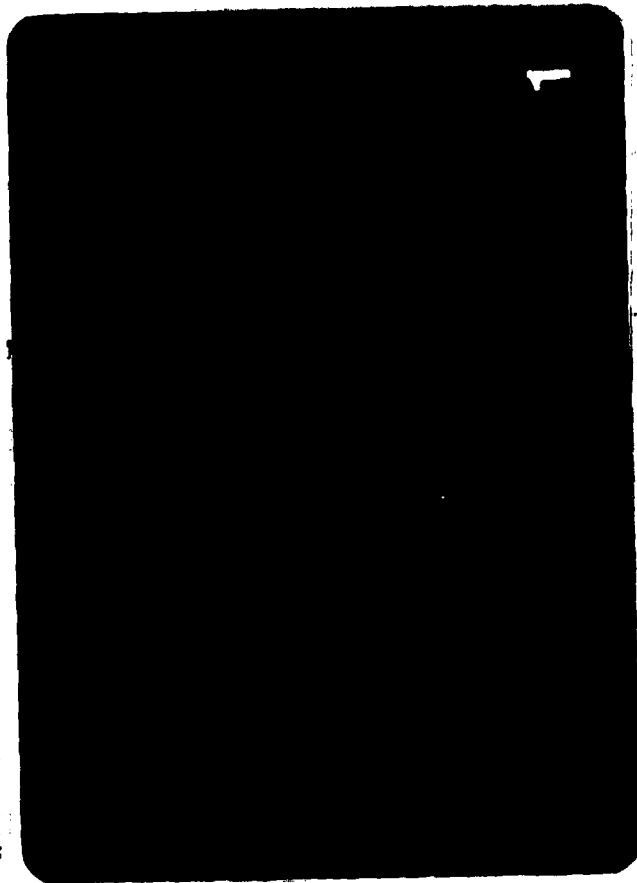
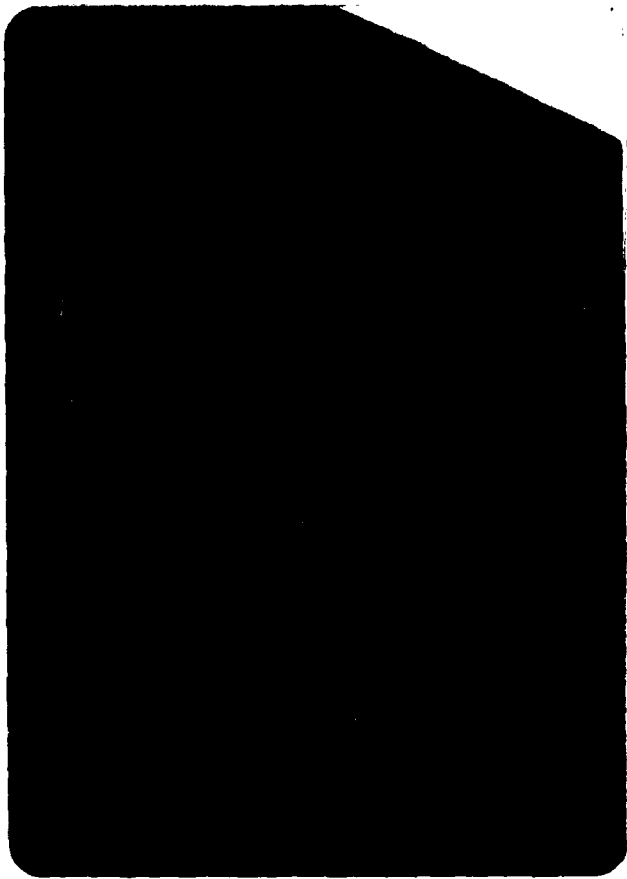
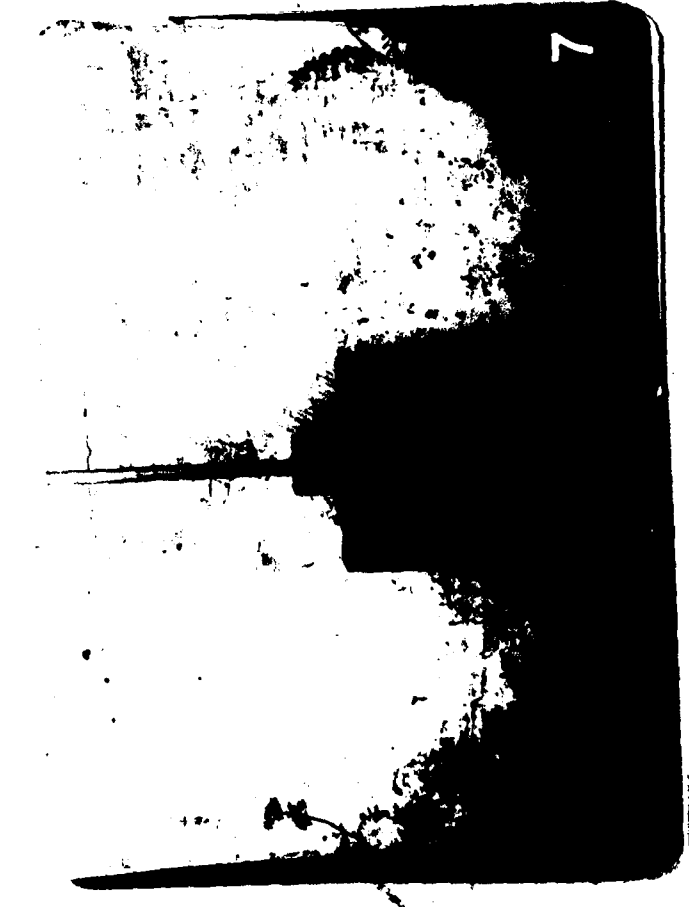
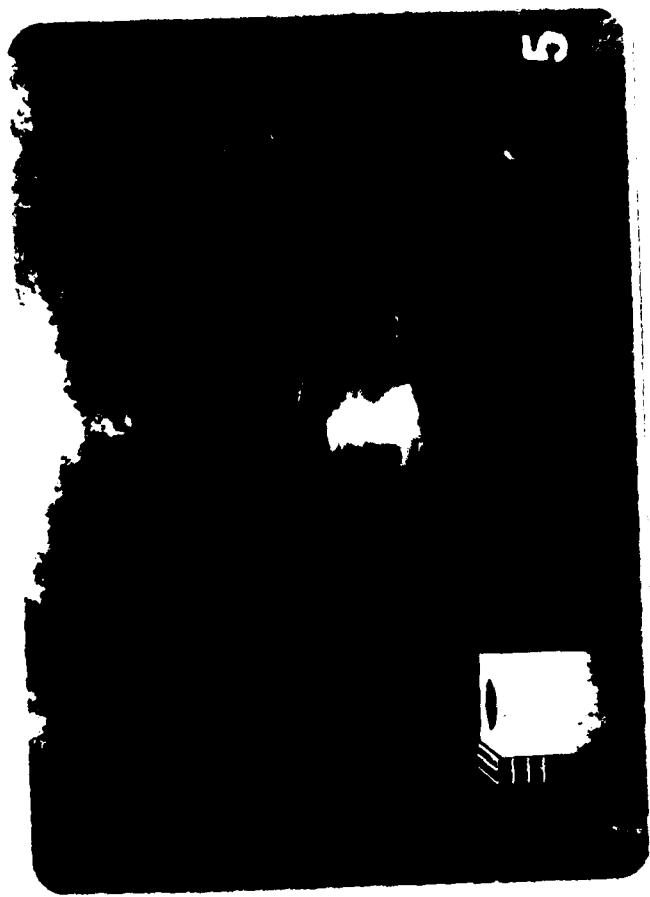
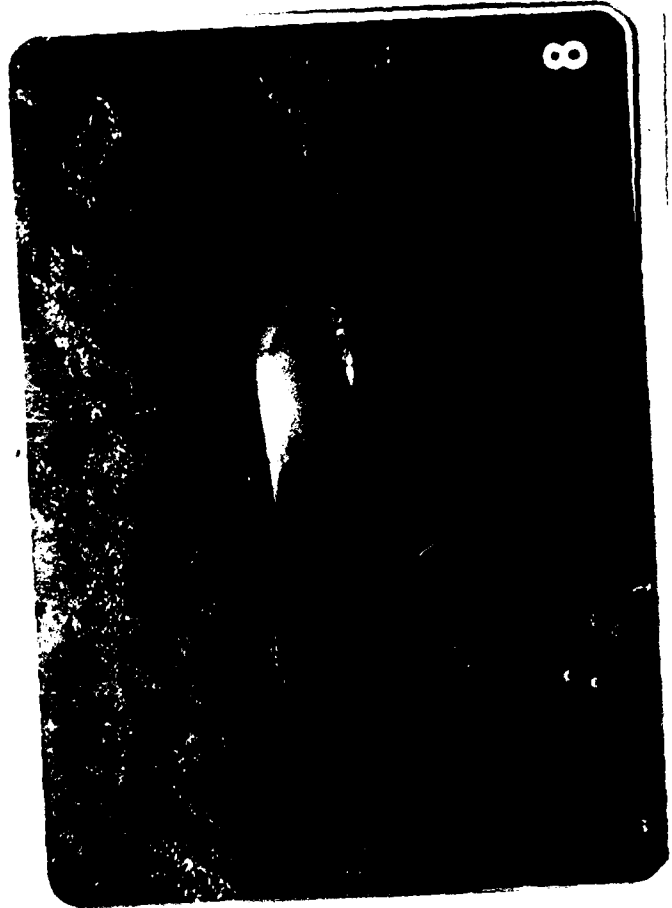


PHOTO INDEX
 STRUCTURE F-1
 MO. No. 20512

LIST OF PHOTOGRAPHS

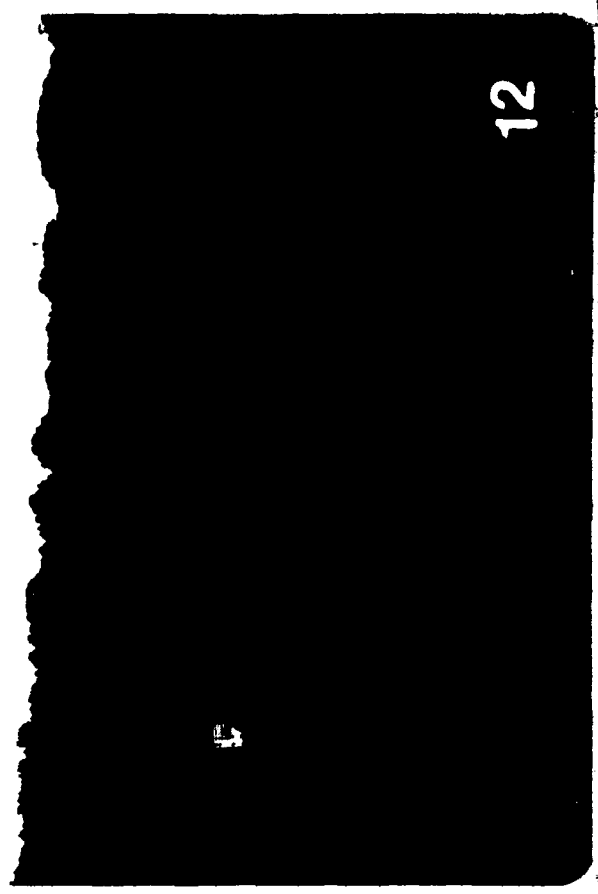
| <u>Photo No.</u> | <u>Description</u> |
|------------------|---|
| 1 | Aerial View of Dam |
| 2 | Aerial View of Dam |
| 3 | View of Crest (Looking East) |
| 4 | View of Crest (Looking West) |
| 5 | View Upstream from Crest (Looking North) |
| 6 | View of Inlet Structure (Looking South) |
| 7 | Closeup of Inlet Structure (Looking South) |
| 8 | View of Spillway Outlet (Looking Northwest) |
| 9 | Upstream View of Emergency Spillway (Looking North) |
| 10 | Downstream View of Emergency Spillway (Looking South) |
| 11 | Downstream View from Crest of Dam (Looking South) |
| 12 | View of Upstream Face of Embankment (Looking Southeast) |



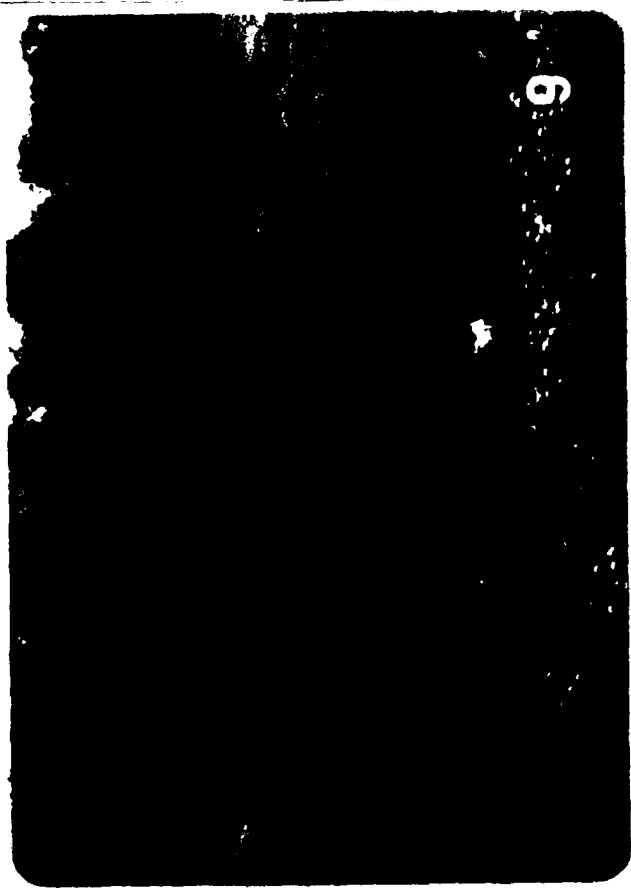




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