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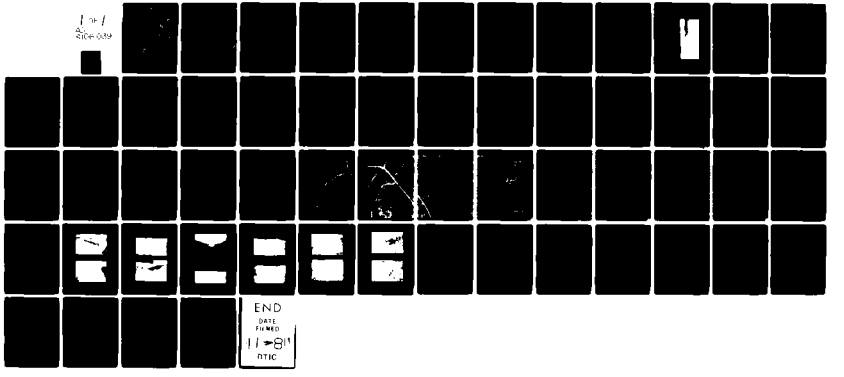

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UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

LAKEWOOD PARK LAKE DAM

FRANKLIN COUNTY, MISSOURI

MO 30804

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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St. Louis District

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

FOR: STATE OF MISSOURI

OCTOBER 1980

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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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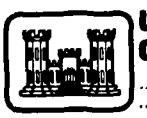
UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

LAKEWOOD PARK LAKE DAM

FRANKLIN COUNTY, MISSOURI

MO 30804

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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St. Louis District

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

FOR: STATE OF MISSOURI

OCTOBER 1980

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

REPLY TO ATTENTION OF

LMSED-P

SUBJECT: Lakewood Park Lake Dam, MO 30804, Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lakewood Park Lake Dam (MO 30804):

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

2) Overtopping of the dam could result in failure of the dam.

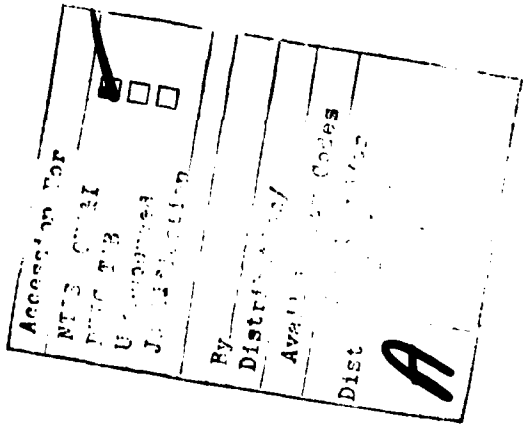
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division

28 OCT 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

28 OCT 1980
Date



LAKEWOOD PARK LAKE DAM

MISSOURI INVENTORY NO. 30804

FRANKLIN COUNTY, MISSOURI

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.

5200 OAKLAND AVENUE

ST. LOUIS, MISSOURI 63110

FOR:

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

CORPS OF ENGINEERS

OCTOBER 1980

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lakewood Park Lake Dam
State Located:	Missouri
County Located:	Franklin
Stream:	Tributary of Pin Oak Creek
Date of Inspection:	9 July 1980

The Lakewood Park Lake Dam was visually inspected by engineering personnel of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of this inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses a hazard to human life or property.

The following summarizes the findings of the visual inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team. Based on the visual inspection and the results of these hydrologic/hydraulic investigations, the present general condition of the dam is considered to be somewhat less than satisfactory.

The following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam:

1. An area of seepage with cattails, soft ground, and flowing water, exists in the vicinity of the downstream channel at the toe of the dam. Flowing water was also observed in the swale that parallels the dam at the downstream toe. However, it could not be determined if the flow in the swale was lake seepage or seepage from the sewage lagoon that lies just downstream of the dam. Uncontrolled seepage can develop into a piping condition (progressive internal erosion) that could result in failure of the dam.

2. Numerous small trees exist on the upstream face of the dam. Tree roots can provide passageways for lake seepage which can also develop into a piping condition that could result in failure of the dam.

3. Riprap has been placed along the upstream face of the dam, but does not extend up to or above the normal lake surface level. Erosion of the grass covered upstream face of the dam above the riprap, apparently by wave action and/or fluctuations of the lake surface level, has created a near vertical bank up to about 12 inches high. A grass covered slope is not considered adequate protection to prevent erosion by wave action or fluctuations of the lake level.

4. Both the upstream and downstream ends of the concrete spillway pavement have been undercut by erosion. Continued undercutting of the pavement could provide passagways for seepage and/or voids causing failure of the pavement due to inadequate subgrade support. It was reported that there has been considerable leakage through the bedrock and residuum under the spillway.

5. A hole, believed to be an animal burrow, is present on the upstream face of the embankment just above the normal waterline at about station 3+40. Animal burrows can also provide passageways for lake seepage which can develop into a piping condition.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Lakewood Park Lake Dam, which is classified as small in size and of high hazard potential, is specified to be a minimum of one-half the probable maximum flood (PMF). Considering the fact that numerous dwellings, house trailers, a campground, and several commerical establishments including a motel and a restaurant, are located within the estimated flood damage zone should failure of the dam occur, it is recommended that the spillway for this dam be designed for the PMF. The probable maximum flood (PMF) is the flood that may be expected for the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The PMF is ordinarily accepted as the the

inflow design flood for dams where failure of the structure would seriously increase the danger to human life.

Results of a hydrologic/hydraulic analysis indicated that the spillway is inadequate to pass lake outflow resulting from a storm of PMF magnitude without overtopping the dam. However, the spillway is capable of passing lake outflow resulting from the 1 percent probability (100-year frequency) flood and the outflow corresponding to about 22 percent of the PMF without overtopping the dam. According to the St. Louis District, Corps of Engineers, the length of the downstream damage zone, should failure of the dam occur, is estimated to be three miles. Accordingly, within the possible damage zone are 7 dwellings, 50-plus house trailers, a railroad embankment, a campground, a motel, a restaurant, 2 gas stations, Interstate Highway I-44, State Highways 50 and M, Sieve Road, 2 sewage lagoons, and several farm buildings.

A review of available data did not disclose that seepage or stability analyses of this dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the Owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein. The provision of additional spillway capacity should be pursued on a high priority basis.

Ralph E. Sauthoff
P. E. Missouri E-19090

Albert B. Becker, Jr.
P. E. Missouri E-9168

OVERVIEW LAKEWOOD PARK DAM

PHASE 1 INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

LAKEWOOD PARK LAKE DAM - MO 30804

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

LAKEWOOD PARK LAKE DAM - MO 30804

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, dated 8 August 1972, 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, directed that a safety inspection of the Lakewood Park Lake Dam be made.

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

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report to the Chief of Engineers on the National Program of Inspection of Non-Federal Dams", dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Lakewood Park Lake Dam is an earthfill type embankment rising approximately 39 feet above the natural streambed at the downstream toe of the barrier. The embankment has an upstream slope above the waterline of approximately 1v on 3.3h, a crest width of about 17 feet, and a downstream slope on the order of 1v on 3.1h. Near the center of the dam, a peninsula about 43 feet wide extends approximately 145 feet from the centerline of the dam into the lake. An old water well with a

windmill exists near the tip of the peninsula. The length of the dam is approximately 1,150 feet. Two sewage lagoons are located in the valley just downstream of the dam. A plan and profile of the dam are shown on Plate 3 and a cross-section of the dam is shown on Plate 4. At normal pool elevation the reservoir impounded by the dam occupies approximately 27 acres. The lake has no drawdown facility.

The spillway, a paved concrete trapezoidal section, is located at the right, or south, abutment. A fence, consisting of wire mesh fabric with 1-inch by 2-inch openings and supported by a 2-inch galvanized pipe frame spans the spillway opening. Mr. Ray Boston, Jr., a representative of the Owner, indicated that the fence is designed so that the bottom can swing upward to allow spillway releases should the fence become clogged by debris. The paved spillway section extends to a point about 95 feet downstream of the centerline of the dam where it discharges to an unimproved earth channel. An earth bank constructed on the left side of the paved section serves to confine flow to the channel. The outlet channel joins the original stream on which the dam is constructed at a point near the toe of the dam. A cross-section of the spillway is shown on Plate 5.

b. Location. The dam is located on an unnamed tributary of Pin Oak Creek, about 1 mile southwest of the intersection of St. Louis Rock Road and State Highway M, and approximately 1 mile west of Villa Ridge, Missouri, as shown on the Regional Vicinity Map, Plate 1. The dam is located in the northwest quadrant of Section 15, Township 43 North, Range 1 East within Franklin County.

c. Size Classification. The size classification based on the height of the dam and storage capacity, is categorized as small (per Table 1, Recommended Guidelines for Safety Inspection of Dams).

d. Hazard Classification. The Lakewood Park Lake Dam, according to the St. Louis District, Corps of Engineers, has a high hazard potential, meaning that if the dam should fail, there may be loss of life, serious damage to homes, or extensive damage to agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The

estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends three miles downstream of the dam. Within the possible flood damage zone are 7 dwellings, 50-plus house trailers, a railroad embankment, a campground, a motel, a restaurant, 2 gas stations, Interstate Highway I-44, State Highways 50 and M, Sieve Road, 2 sewage lagoons and several farm buildings. Those features lying within the downstream damage zone reported by the Corps of Engineers, St. Louis District, were verified by the inspection team.

e. Ownership. The lake and dam are owned by the Franklin County Development Company, Villa Ridge, Missouri 63089. The President of the company is Mr. Ray Boston, Jr.

f. Purpose of Dam. The dam impounds water for recreational use.

g. Design and Construction History. According to Ray Boston, Jr., the dam was designed and constructed in about 1970 by the Ray Boston Excavating Company. Mr. Ray Boston, Sr., who was the owner of the excavating company, is deceased.

h. Normal Operational Procedure. The lake level is unregulated. Lake outflow is governed by the capacity of an overflow type, trapezoidal section, paved concrete spillway.

1.3 PERTINENT DATA

a. Drainage Area. The area tributary to the lake is essentially meadowland. A mobile home type subdivision occupies the drainage area north of the lake. The watershed above the dam amounts to approximately 220 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 84 cfs* (W.S.Elev. 622.0)

(2) Spillway capacity ... 157 cfs.

c. Elevation (Ft. above MSL). Except where otherwise indicated, the following elevations were determined by survey and are based on topographic data shown on the 1969 Moselle, Missouri, Quadrangle Map, 7.5 Minute Series.

(1) Observed pool ... 617.1

(2) Normal pool ... 620.0

(3) Spillway crest ... 620.0

(4) Maximum experienced pool ... 622.0*

(5) Top of dam ... 622.8 (min.)

(6) Streambed at centerline of dam ... 587 ± (est.)

(7) Maximum tailwater ... Unknown

(8) Observed tailwater ... None

d. Reservoir.

(1) Length at normal pool (Elev. 620.0) ... 1,700 ft.

(2) Length at maximum pool (Elev. 622.8) ... 1,850 ft.

e. Storage.

(1) Normal pool ... 270 ac. ft.

(2) Top of dam (incremental) ... 80 ac. ft.

f. Reservoir Surface.

(1) Normal pool ... 27 acres

(2) Top of dam (incremental) ... 3 acres

*Based on an estimate of depth of flow at spillway as observed by Mr. Ray Boston, Jr., a representative of the Owner.

g. Dam. The height of the dam is defined to be the overall vertical distance from the lowest point of foundation surface at the downstream toe of the barrier, to the top of the dam.

(1) Type ... Earthfill, homogeneous*
(2) Length ... 1,150 ft.
(3) Height ... 39 ft.
(4) Top width ... 17 ft.
(5) Side slopes
    a. Upsteam ... 1v on 3.3h (above waterline)
    b. Downstream ... 1v on 3.1h
(6) Cutoff ... Core trench**
(7) Slope protection
    a. Upstream ... Grass and riprap
    b. Downstream ... Grass

h. Spillway.

(1) Type ... Uncontrolled, paved concrete, trapezoidal section
(2) Location ... Right abutment
(3) Crest ... Elevation 620.0
(4) Outlet channel ... Paved concrete, trapezoidal section to point 95 feet downstream of dam centerline; remainder is unimproved, irregular earth section.

i. Emergency Spillway ... None

j. Lake Drawdown Facility ... None

*Per Mr. Ray Boston, Jr., a representative of the Owner.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No engineering data relating to the design of the dam are known to exist.

2.2 CONSTRUCTION

As previously stated, the dam was constructed about 1970 by the Ray Boston Excavating Company. According to Ray Boston, Jr., a core trench about 12 feet wide was excavated along the axis of the dam for seepage cutoff. Reportedly the trench was excavated to a rock formation which was encountered at a depth about 10 feet below original grade. Mr. Boston also reported that the material used to backfill the trench and construct the dam was clay that was selected from areas to be occupied by the lake. Mr. Boston recalled that the embankment material was compacted using a sheepsfoot roller. No records of the construction of the dam were available.

2.3 OPERATION

The lake level is uncontrolled and governed by the elevation of the crest of a paved concrete overflow type spillway. No indication was found that the dam has been overtopped. Ray Boston, Jr. reported that the dam has never been overtopped and that the highest lake level experienced to date occurred in April of 1979 when the depth of flow at the spillway crest was estimated to be about 2 feet.

2.4 EVALUATION

a. Availability. Engineering data for assessing the design of the dam and spillway were unavailable.

b. Adequacy. No data available. 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. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Lakewood Park Lake Dam was made by Horner & Shifrin engineering personnel, R. E. Sauthoff, Civil Engineer, and A. B. Becker, Jr., Civil and Soils Engineer, on 9 July 1980. An examination of the dam area was also made by an engineering geologist, Jerry D. Higgins, Ph.D., a consultant retained by Horner & Shifrin for the purpose of assessing the site geology. Also examined at the time of the inspection, were the areas and features below the dam within the potential flood damage zone. Photographs of the dam taken at the time of the inspection are included on pages A-1 through A-6 of Appendix A. The locations of the photographs taken during the inspection are indicated on Plate 3.

b. Site Geology. The Lakewood Park Lake Dam is located within the Salem Plateau Section of the Ozark Plateaus Physiographic Province near the border with the Dissected Till Plains Section of the Central Lowlands Province. The topography is rolling, with a maximum of approximately 160 feet of relief between the reservoir and the surrounding drainage divides. The bedrock consists of gently northward-dipping Ordovician-age sedimentary strata of the Jefferson City-Cotter formation. No faults were observed or have been reported in the vicinity of the site. The Jefferson City-Cotter is a light brown, medium to finely crystalline dolomite or argillaceous dolomite. It is thin- to medium-bedded, often argillaceous, and cherty. Solution enlargement of joints and bedding planes frequently occurs in the dolomite, and the contact between bedrock and the overlying surficial materials is usually an irregular surface.

The unconsolidated surficial materials are composed primarily of residual clays, formed from weathering of the bedrock, overlain by loessal soils. The residual soils consist of stony, silty clays which are somewhat permeable and often cause seepage from reservoirs. According to the Unified Soil Classification System, the soil ranges from GM to GC material. These soils are exposed along the spillway cut and around the shoreline. The residuum is

covered with soils of the Union series. This series consists of deep, well-drained soils formed from the wind-deposited silts on the uplands adjacent to the Missouri River Valley. These soils are light brown silts near the surface and grade into a friable silty clay with depth. The soils are classified CL or CL-ML materials and are susceptible to erosion, especially on slopes. However, the residual clays and the loessal soils are generally suitable for small water impoundments.

A resident living approximately 2,000 feet downstream of the dam reported that there has been considerable leakage through bedrock and residuum under the concrete spillway. The most significant geologic problems at the dam site are considered to be the reported leakage under the spillway apron and the erodibility of the silty soils; however, these problems do not appear to affect the stability of the dam embankment.

c. Dam. The visible portions of the upstream and downstream faces of the dam (see Photos 1 through 3) as well as the dam crest were examined and appeared to be in sound condition. No sloughing of the embankment slopes, cracking of the surface, or excessive settlement of the dam crest was noted. The dam, except where protected by riprap, was well covered with grass that was about 6 inches high at the time of the inspection. Riprap, consisting of what appeared to be quarry-run limestone most of which was smaller than 12 inches in size although some stones were as large as 2 feet in diameter, covered the upstream face of the dam. However, the upper limits of the riprap was found to be below the normal waterline by about 6 inches, and erosion of the grass covered slope above the riprap had created a near vertical bank (see Photo 12) approximately 12 inches high along almost the entire length of the dam. For the most part the shoreline along the upstream face of the dam was lined with small trees up to about 2 inches in diameter. The wood retaining wall along the upstream face of the peninsula (see Photo 6) was inspected and appeared to be in sound condition. A hole about 6 inches in diameter, which appeared to be an animal burrow, was present on the upstream face of the embankment just above the normal waterline at about station 3+40. Examination of a soil sample obtained from the downstream face of the dam indicated the material to be a silty lean clay (CL) of low-to-medium plasticity.

A marshy area, (see Photo 10) as evidenced by cattails, soft ground, and standing water was present near the toe of the dam at the location of the original stream channel. Seepage, estimated to be on the order of 0.5 gpm, was observed within the original stream channel just downstream of the marshy area and upstream of the swale that parallels the toe of the dam. Seepage flow was also evident within the swale (see Photo 9) extending from near the center of the dam to the original stream; however, it could not be determined if the seepage originated from the lake or the adjacent lagoons. The seepage within the swale also appeared to be about 0.5 gpm.

The paved concrete spillway (see Photos 4 and 5) was examined and found to be in satisfactory condition with no major cracks or spalling of the surface. However, both the upstream and downstream ends of the spillway were undercut by erosion. At the upstream end of the structure, voids, about 3 inches deep extending up to 12 inches beneath the pavement were found, while at the downstream end, voids, about 8 inches in depth that extended approximately 12 inches beneath the concrete slab, were discovered. It is possible that additional voids exist beneath the spillway structure that were not observed during the visual inspection. The fence which extends across the spillway section was free of debris and appeared to be in good condition. The earthen spillway outlet channel downstream of the concrete spillway structure was inspected and, except for an erosion gulley about 6 feet deep and 8 feet wide approximately 115 feet downstream of the end of the concrete structure, was found to be in satisfactory condition.

The two sewage lagoons (see Photos 7 and 8) located just downstream of the dam appeared to be in satisfactory condition and well maintained. At the time of the inspection, the lower lagoon was empty and presumably out of service.

d. Appurtenant Structures. There are no appurtenant structures at this dam.

e. Downstream Channel. The downstream channel section is irregular and for the most part tree lined and, except for the following rail and highway crossings, unimproved. The Chicago, Rock Island and Pacific Railroad crosses the channel about 7,500 feet downstream, and State Highway M crosses the

channel about 8,500 feet downstream of the dam. The tributary then joins Pin Oak Creek about 9,000 feet downstream. Pin Oak Creek is crossed by Interstate Highway I-44 at a point approximately 12,500 feet downstream and State Highway 0 about 13,500 feet downstream of the dam. Pin Oak Creek joins the Bourbeuse River about 14,000 feet downstream of the dam.

f. Reservoir. The lake shoreline and adjacent slopes are for the most part grass covered. A subdivision of mobile homes is located on the hillside to the north of the lake. No erosion of the lake banks was noted, the water within the reservoir was clear and, at the time of the inspection, the lake level was approximately 2.9 feet below normal pool. The amount of sediment within the lake could not be determined; however, due to the grass covered slopes surrounding the lake, it is not expected to be significant.

3.2 EVALUATION

The deficiencies observed during this inspection and noted herein are not considered of significant importance to warrant immediate remedial action.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled. The lake level is governed by precipitation runoff, evaporation, seepage, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

According to Mr. Boston, a representative of the Owner, the dam receives periodic routine maintenance such as mowing of the grass on the dam, cleaning debris from the spillway fence, and removal of muskrats by trapping.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

No outlet facilities requiring operation exist at this dam, and thre is no reservoir regulation plan.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

The inspection did not reveal the existence of a dam failure warning system.

4.5 EVALUATION

It is recommended that maintenance of the dam also include the removal of trees along the upstream face of the dam. Measures should also be taken to prevent further erosion of the upstream face at the normal waterline and undercutting of the spillway pavement. It is also recommended that a detailed inspection of the dam be instituted on a regular basis by an engineer experienced in the design and construction of dams and that records be kept of all inspections made and remedial measures taken.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data are not available.

b. Experience Data. The drainage area and lake surface area were determined from the 1969 USGS Moselle, Missouri, Quadrangle Map. The proportions and dimensions of the spillway and dam were developed from surveys made during the inspection. Records of rainfall, streamflow, or flood data for the watershed were not available.

Due to the fact that the watershed for this reservoir is small and since there is no history of excessive reservoir leakage that would adversely affect the normal operating level of the lake, the lake level was assumed to be at normal pool as a result of antecedent storms prior to ocurrence of the PMF and the probabilistic storm.

According to the St. Louis District, Corps of Engineers, the estimated flood damage zone, should failure of the dam occur, extends 3 miles downstream of the dam. The embankment for the railroad which crosses the stream at a point about 1.3 miles downstream of the dam is expected to act as a barrier in the case of dam failure.

c. Visual Observations.

(1) The spillway, a broad-crested, paved concrete, trapezoidal section, is located at the right abutment.

(2) Spillway releases within the capacity of the spillway should not endanger the dam.

(3) The original stream channel abuts the toe of the dam.

d. Overtopping Potential. The spillway is inadequate to pass the probable maximum flood, or 1/2 of the probable maximum flood, without overtopping the dam. The spillway is adequate, however, to pass the 1 percent probability (100-year frequency) flood without overtopping the dam. The results of the dam overtopping analyses are as follows:

(Note: The data appearing in the following table were extracted from the computer output data appearing in Appendix B. Decimal values have been rounded to the nearest one-tenth in order to prevent assumption of unwarranted accuracy.)

Ratio of PMF	Q-Peak Outflow (cfs)	Max. Lake W.S. Elev.	Max. Depth (Ft.) of Flow over Dam (Elev. 622.8)	Duration of Overtopping of Dam (Hours)
0.50	1,552	624.2	1.4	5.5
1.00	3,743	625.0	2.2	8.1
1% Probability Flood	47	621.5	0.0	0.0

Elevation 622.8 was found to be the lowest point in the dam crest. The flow safely passing the spillway just prior to overtopping was determined to be approximately 157 cfs, which is the routed outflow corresponding to about 22 percent of the probable maximum flood inflow. During peak flow of the probable maximum flood, the greatest depth of flow over the dam is projected to be 2.2 feet and overtopping will extend across the entire right half of the dam, and across a section about 50 feet long near the left abutment.

e. Evaluation. Experience with embankments constructed of similar material (a silty lean clay of low-to-medium plasticity) to that used to construct this dam has shown evidence that under certain conditions, such as high velocity flow, the material can be very erodible. Such a condition exists during the PMF when large lake outflow, accompanied by high flow velocities, occurs. For the PMF condition where the depth of flow over the dam crest, a maximum of 2.2 feet, and the duration of flow over the dam, 8.1

hours, are substantial, damage by erosion to the crest and downstream face of the dam is expected. The extent of these damages is not predictable within the scope of these investigations; however, there is a possibility that they could result in failure by erosion of the dam.

f. References. Procedures and data for determining the probable maximum flood, the 1 percent probability (100-year frequency) flood, and the discharge rating curve for flow passing the spillway are presented on pages B-1 and B-2 of the Appendix. Listings of the HEC-1 (Dam Safety Version) input data for both the probable maximum flood and the 1 percent probability (100-year frequency) flood are shown on pages B-3 through B-5. Computer output data, including unit hydrograph ordinates, tabulation of PMF rainfall, loss and inflow data are shown on pages B-6 through B-9; tabulation of lake surface area, elevation and storage volume is shown on page B-10 and tabulations titled "Summary of Dam Safety Analysis" for the PMF and 1 percent probability (100-year frequency) flood are also shown on page B-10.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1c.

b. Design and Construction Data. No design or construction data relating to the structural stability of the dam are known to exist. 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. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to Mr. Ray Boston, Jr., a representative of the Owner, no records are kept of the lake level, spillway discharge, dam settlement, or seepage.

d. Post Construction Changes. According to Mr. Boston, no post construction changes have been made or have occurred which would affect the structural stability of the dam.

e. Seismic Stability. The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earth dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicated that the spillway is capable of passing lake outflow of about 157 cfs without the level of the lake exceeding the low point in the top of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicates that for storm runoff of probable maximum flood magnitude, the lake outflow would be about 3,743 cfs, and that for the 1 percent probability (100-year frequency) flood, the lake outflow would be about 47 cfs.

Seepage and stability analyses of the dam were not available for review, and therefore, no judgment could be made with respect to the structural stability of the dam.

Several items were noticed during the inspection that could adversely affect the safety of the dam. These items include seepage, trees on the upstream slope of the embankment, the lack of sufficient riprap slope protection to prevent erosion of the upstream face of the dam, the undercutting of the concrete spillway structure, and an apparent animal burrow on the upstream face of the dam.

b. Adequacy of Information. Due to lack of design and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessments of the hydrology of the watershed and capacity of the spillway were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of "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 for the items concerning the safety of the dam noted in paragraph 7.1a should be accomplished in the near future. The item recommended in paragraph 7.2a concerning provision of additional spillway capacity should be pursued on a high priority basis.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. Seismic Stability. The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earth dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. 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

a. Recommendations. The following actions are recommended.

(1) Based upon criteria set forth in the recommended guidelines, spillway size and/or height of dam should be increased in order to pass lake outflow resulting from a storm of probable maximum flood magnitude.

(2) Obtain the necessary soil data and perform dam seepage and stability analyses in order to determine the structural stability of the dam for all operational conditions. Seepage and stability analyses should be performed by a qualified professional engineer experienced in the design and construction of earthen dams. The presence of the two sewage lagoons near the downstream toe of the dam should be taken into consideration when these analyses are made.

b. Operations and Maintenance (O & M) Procedures. The following O & M Procedures are recommended:

(1) Provide some means of controlling seepage evident in the area adjacent to the downstream toe of the dam at the location of the original stream crossing. Uncontrolled seepage can lead to a piping condition (progressive internal erosion) which could result in the failure of the dam. Drainage of the areas affected by seepage should be one of the objectives of the seepage control measures since saturation of the soil weakens the

foundation which could impair the stability of the dam. It is also recommended that the source of the seepage evident within the swale located between the dam and the sewage lagoons be determined and appropriate measures taken should the seepage be originating from the lake.

(2) Remove the trees from the upstream face of the dam. Tree roots can provide passageways for lake seepage that could lead to a piping condition and failure of the dam.

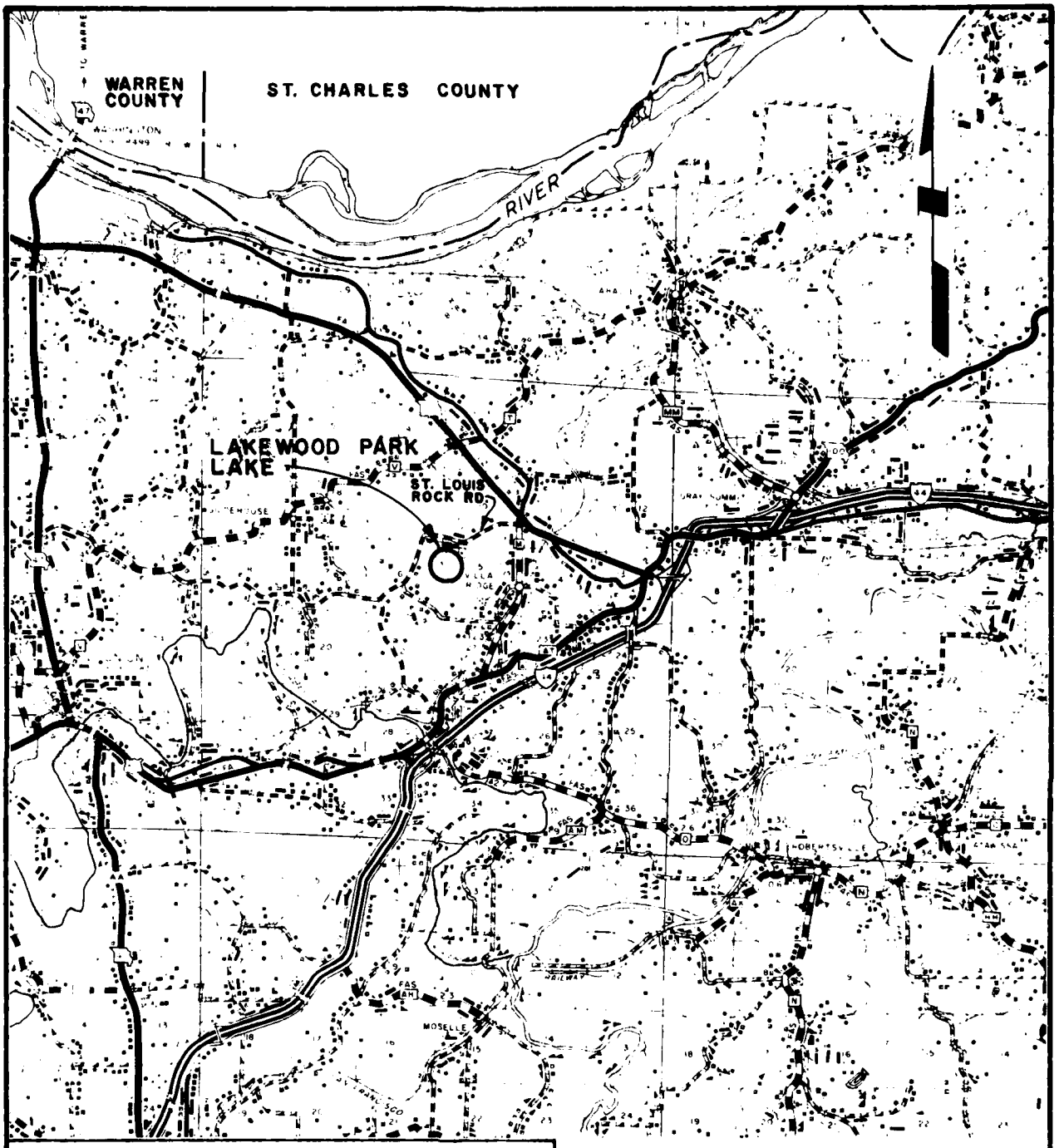
(3) Extend the riprap at the upstream face of the dam to include the areas of the dam affected when the lake is at normal level. A grass covered slope is not considered adequate protection to prevent erosion of the embankment by wave action or by a fluctuating lake level.

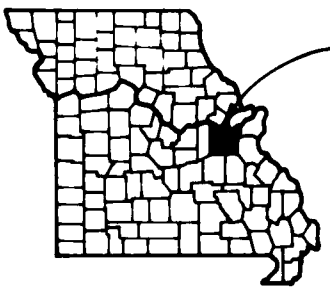
(4) Restore the undercut areas at each end of the concrete spillway pavement and provide some means of preventing future erosion of the subgrade. Voids beneath the spillway pavement can provide passageways for seepage that could lower the normal level of the lake. Also, loss of subgrade can result in settlement of the pavement and structural failure due to lack of foundation support.

(5) Restore the dam at the location of the apparent animal burrow. Animal burrows can also provide passageways for lake seepage that could lead to a piping condition.

(6) Provide maintenance of all areas of the dam and spillway on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

(7) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.





LOCATION MAP

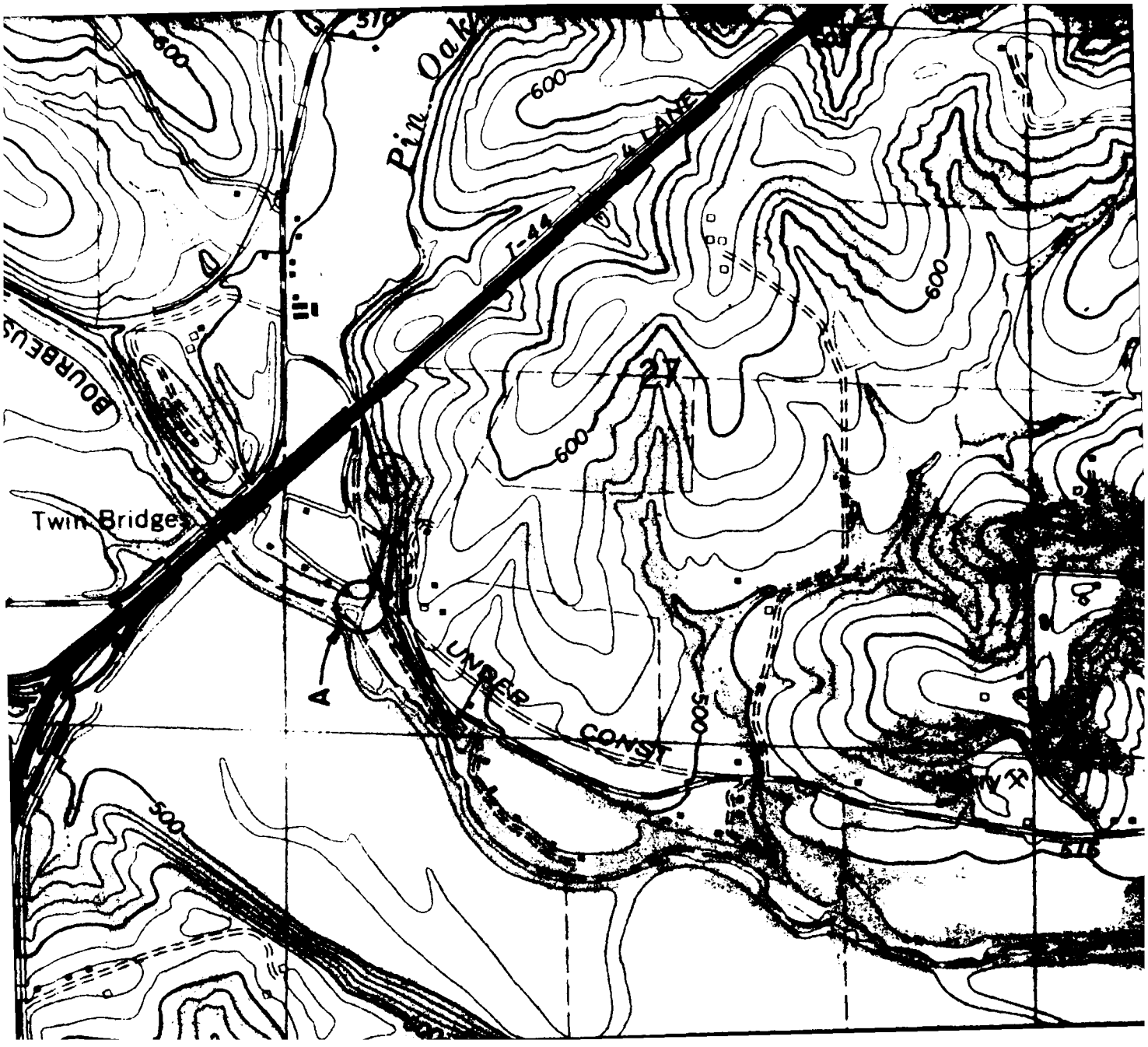
LAKEWOOD PARK LAKE

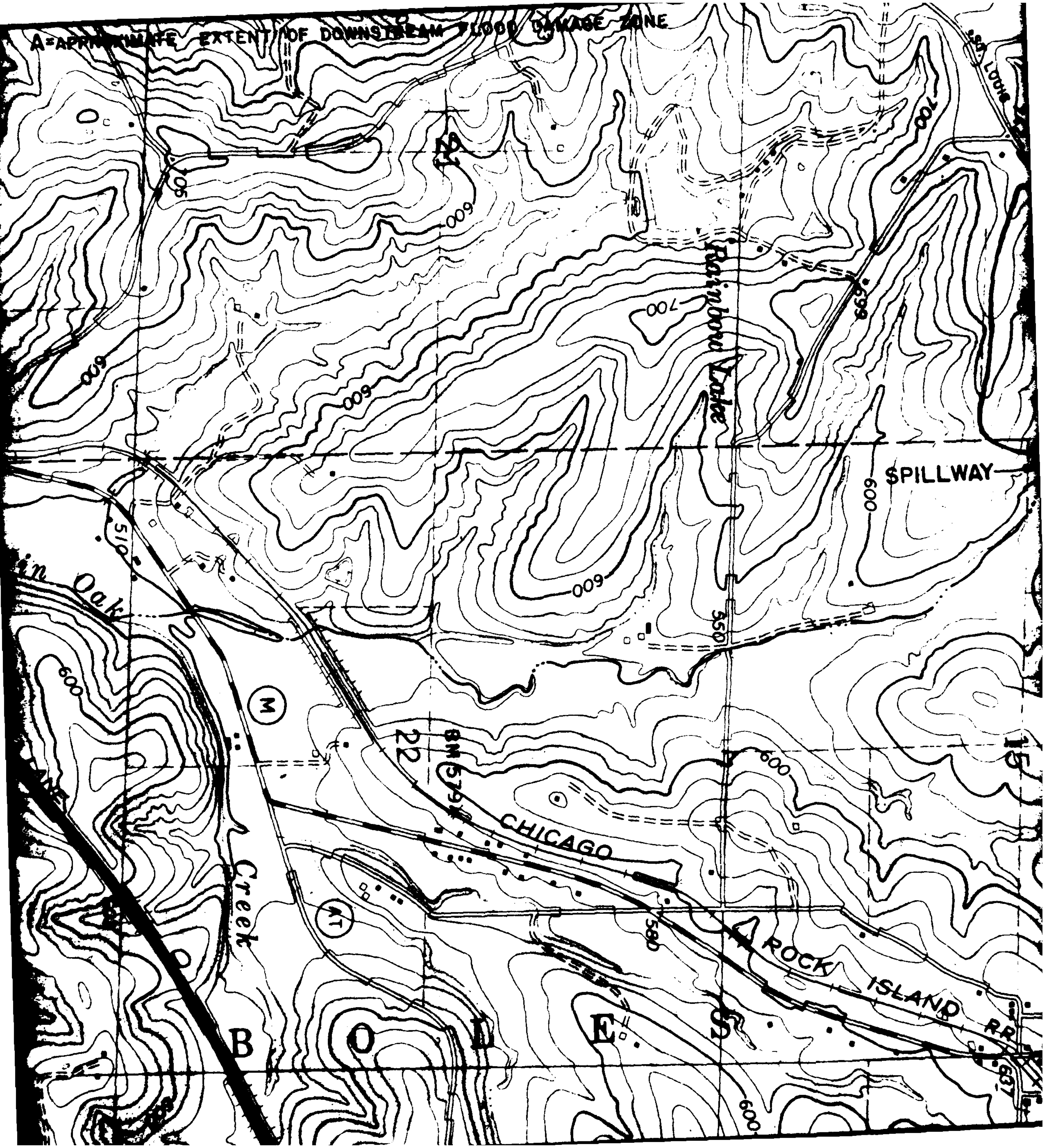
0 1 2 3 4

SCALE (MILES)

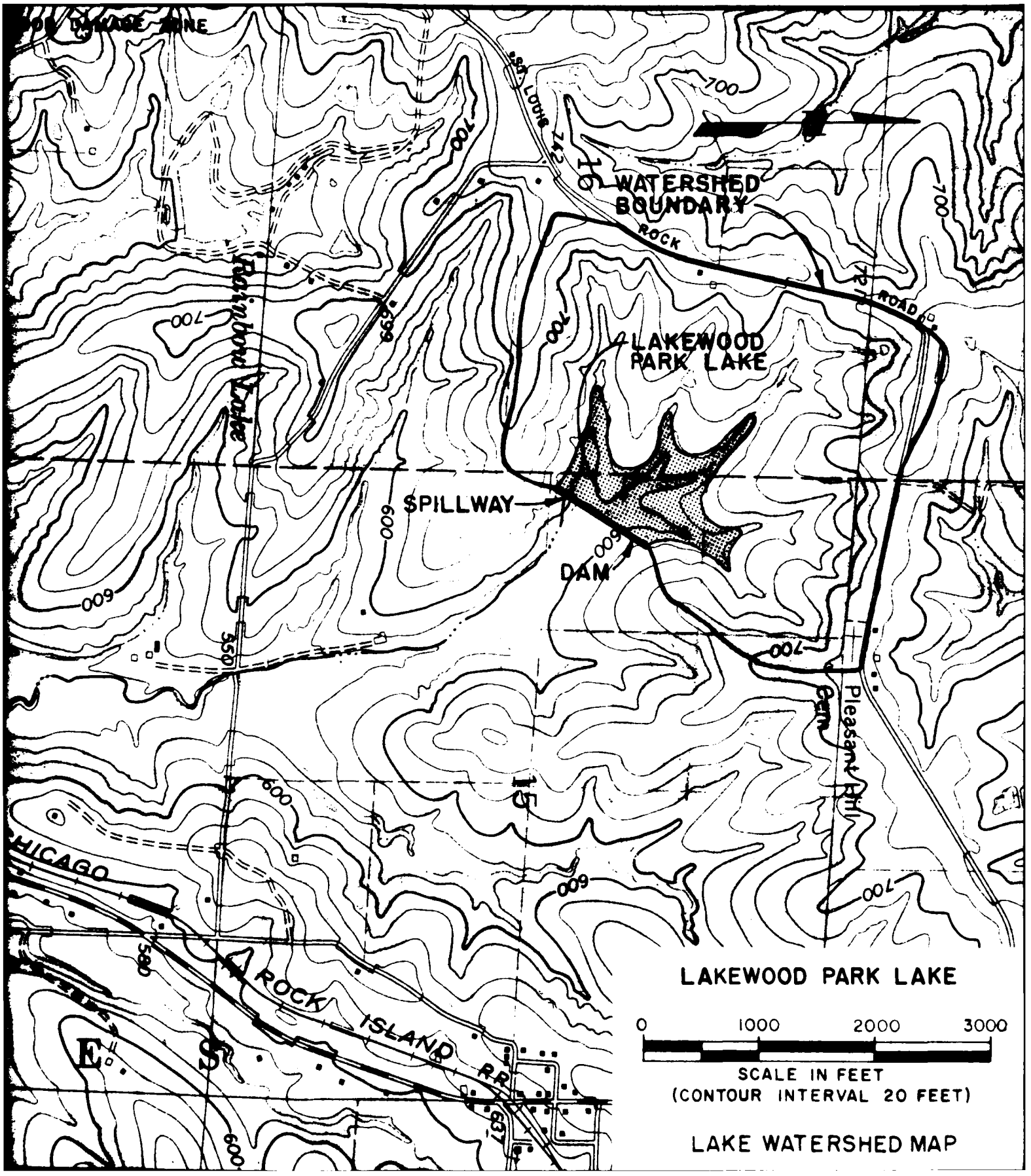
REGIONAL VICINITY MAP

PLATE 1

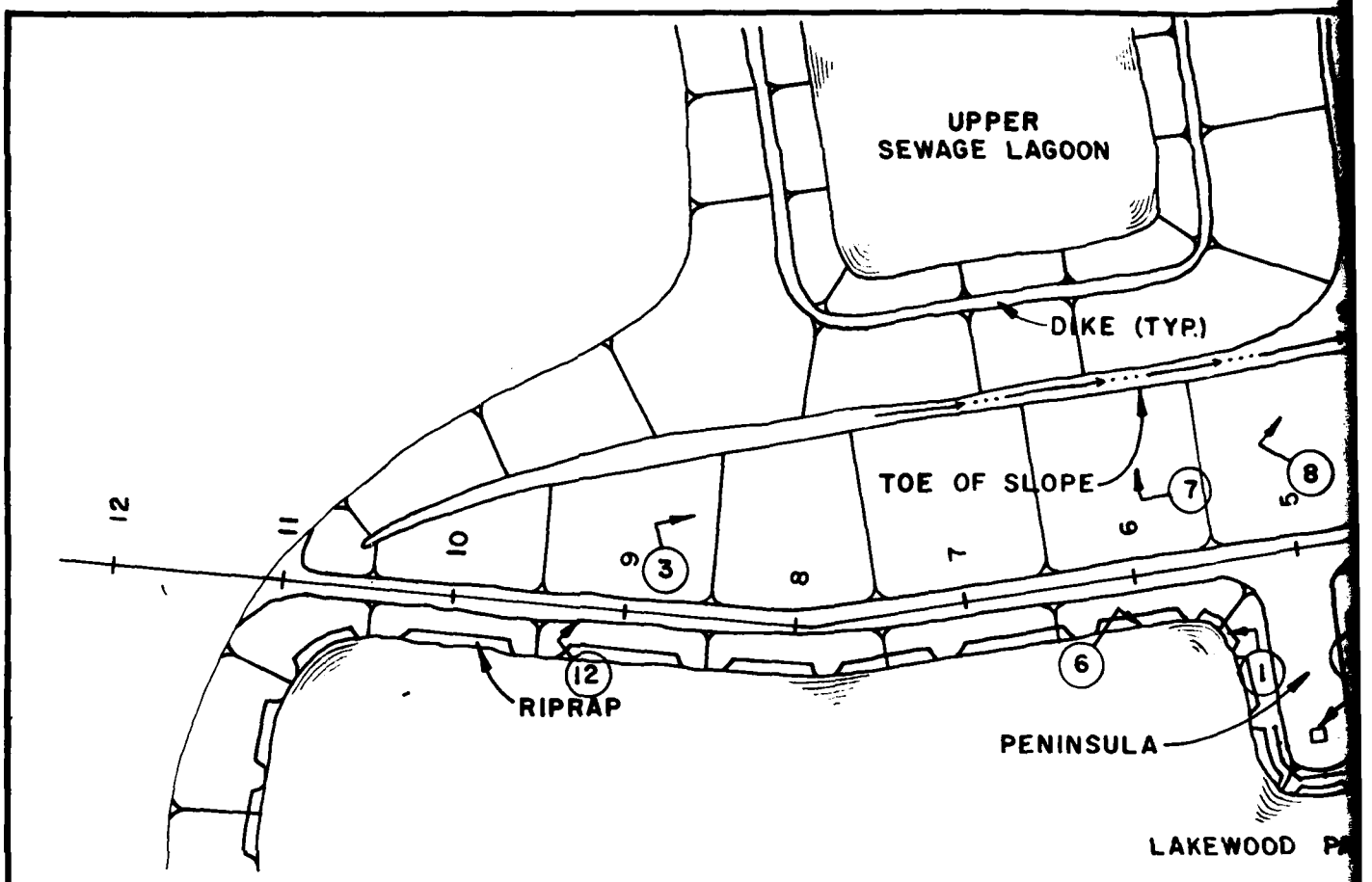

Pin Oak
I-44
600
600
600
600
27
BOURBEUS
Twin Bridges
UNDER CONST
500
500



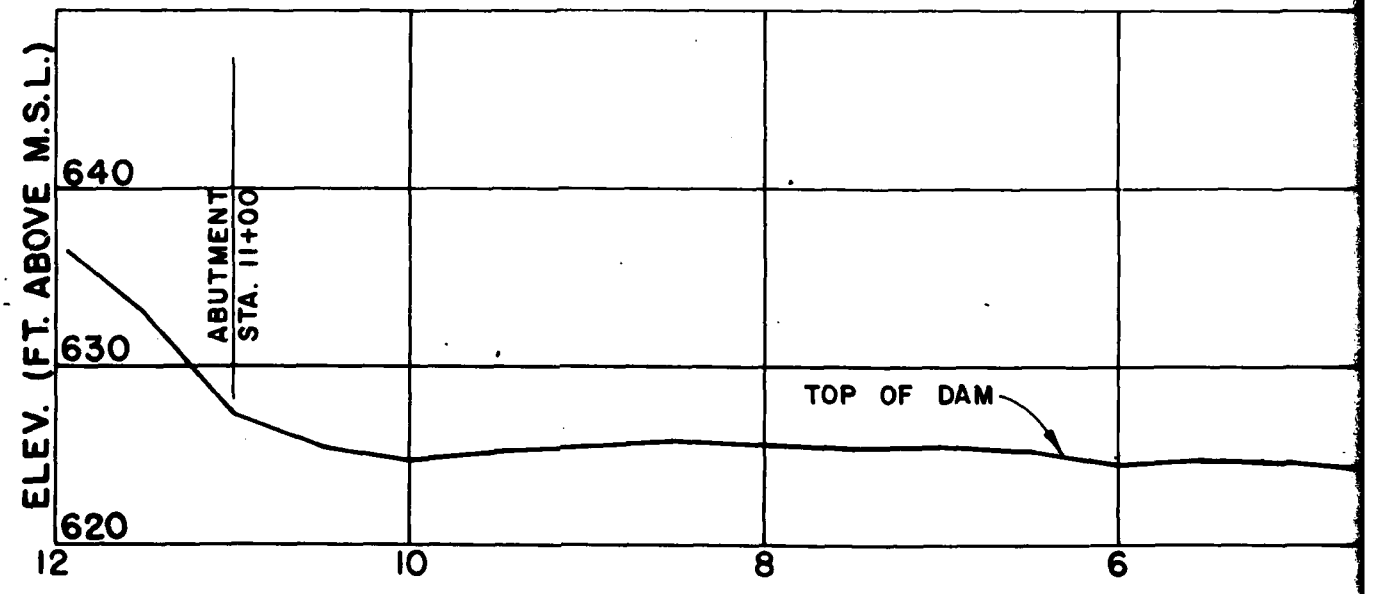
A=APPROXIMATE EXTENT OF DOWNSTREAM FLOOD DAMAGE ZONE
Rainbow Lake
SPILLWAY
CHICAGO
ROCK ISLAND RR
Creek
Oak
B O O N E
600
700
550
580
BM 579
22
15
M
AT



LAKE WATERSHED MAP

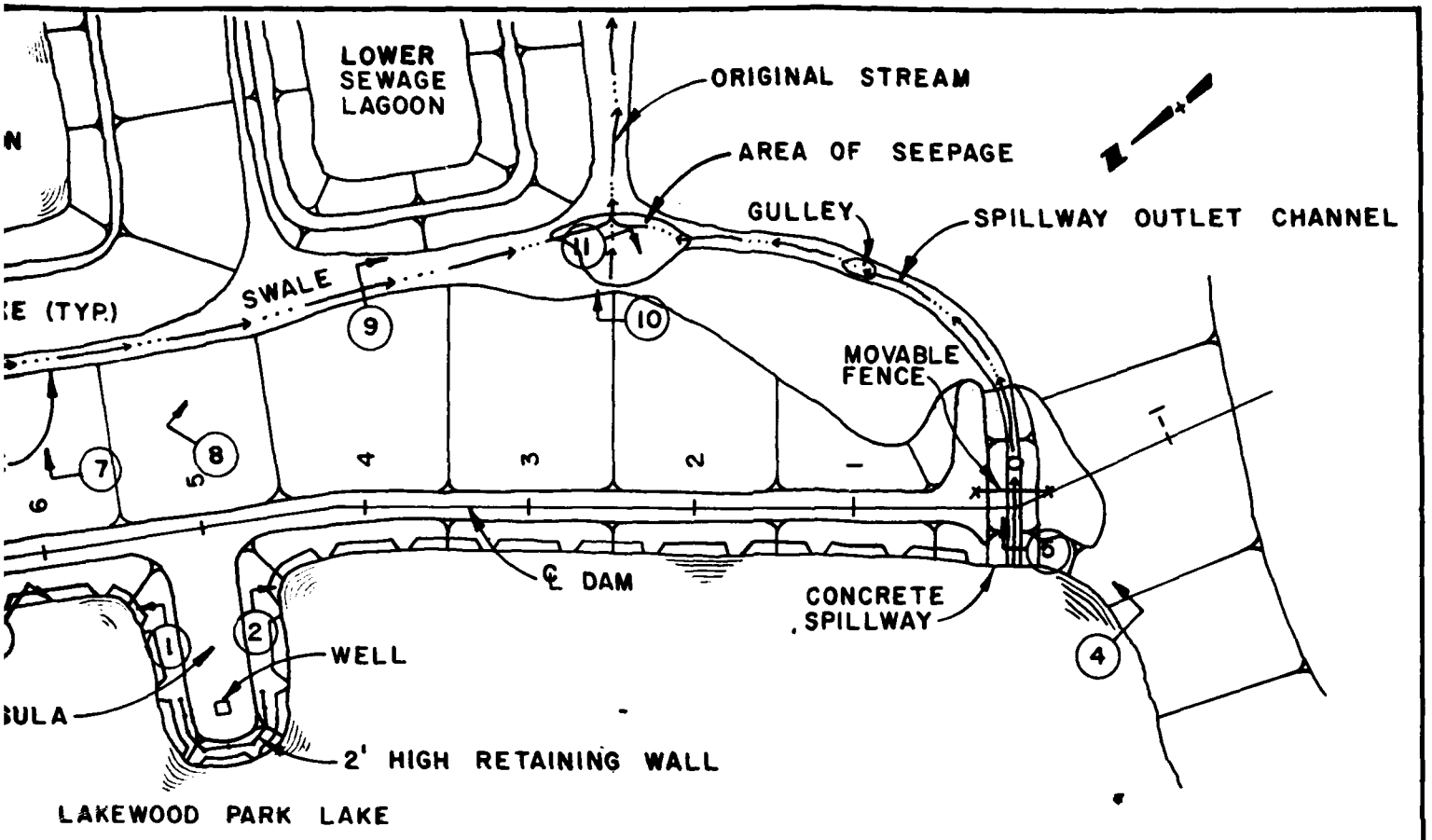


GENERAL PLA
SCALE: 1"



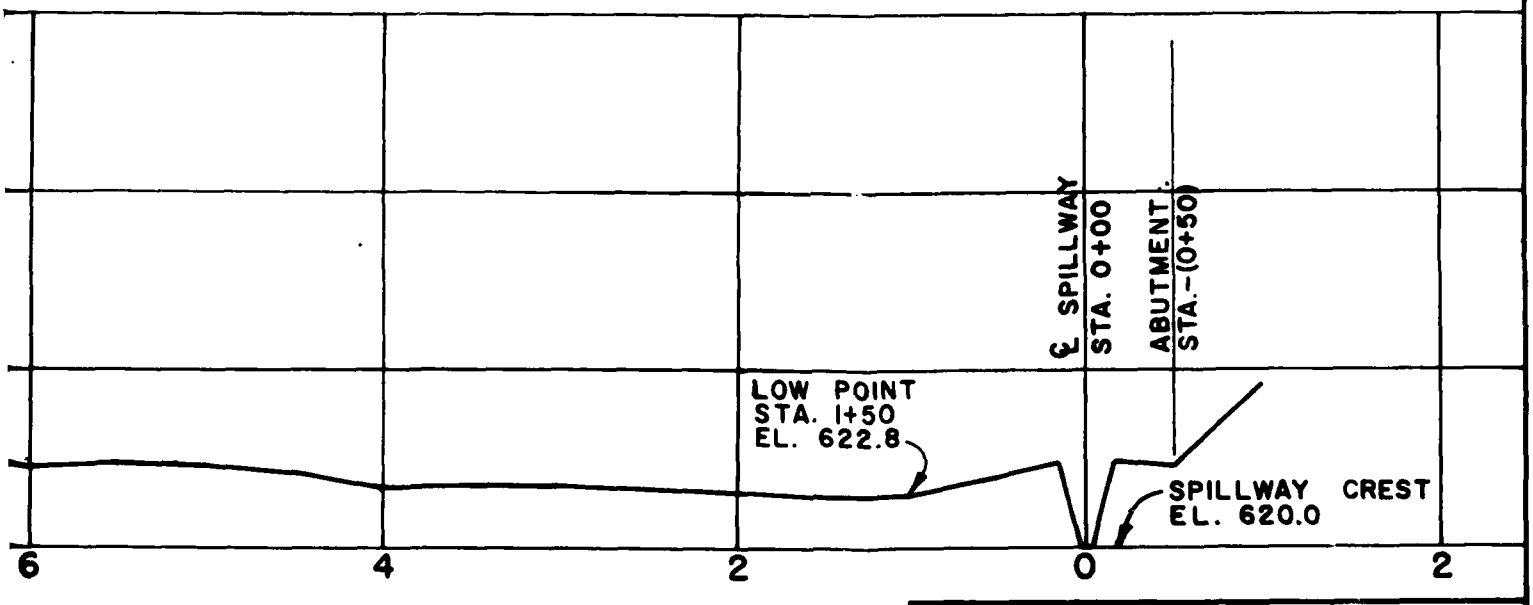
PROFILE DA
SCALES: 1"=10'V.

6
PHOTO LOCATION & KEY
(SEE APPENDIX A)



GENERAL PLAN OF DAM

SCALE: 1"=100'



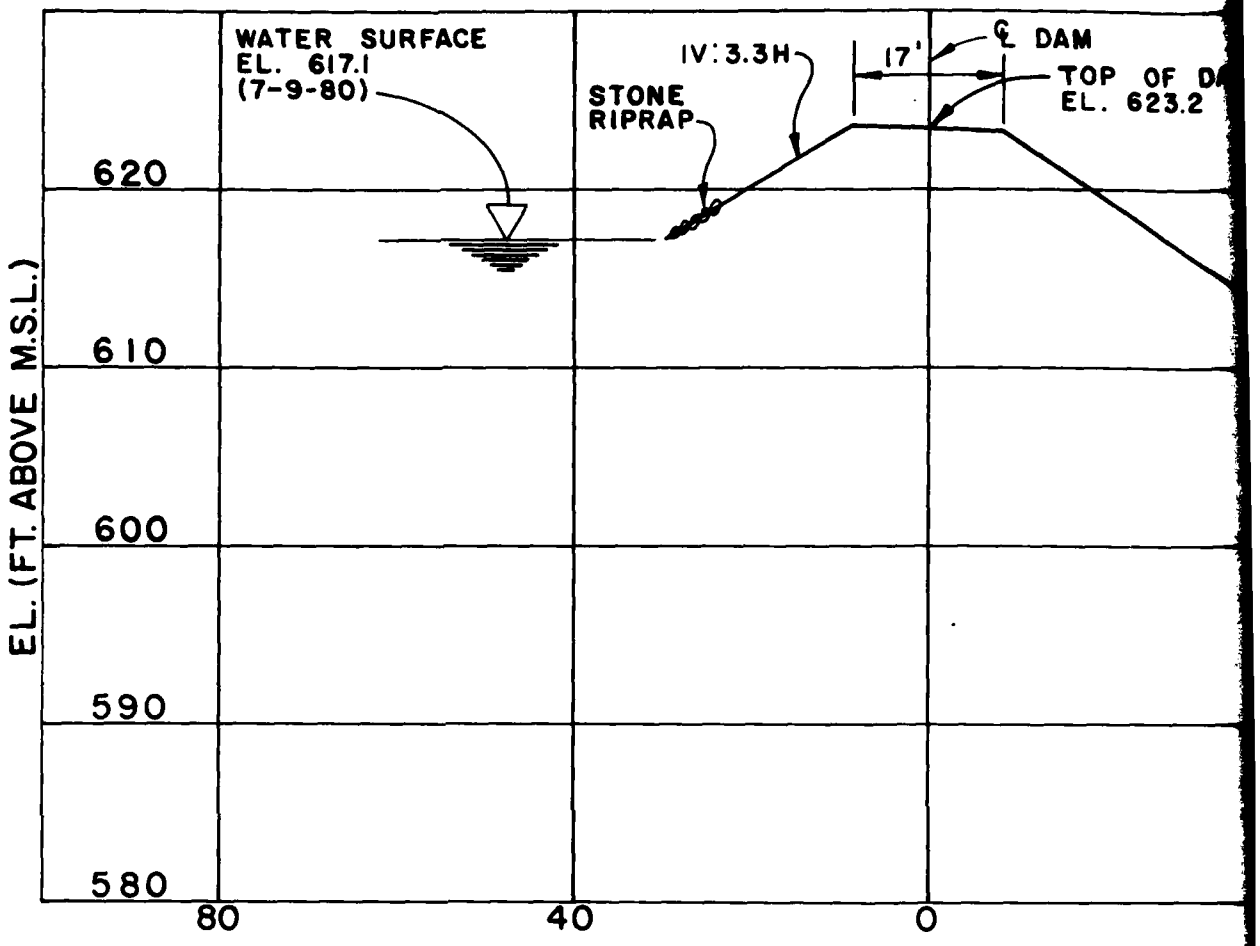
PROFILE DAM CREST

SCALES: 1"=10'V., 1"=100'H.

LAKEWOOD PARK LAKE DAM PLAN & PROFILE

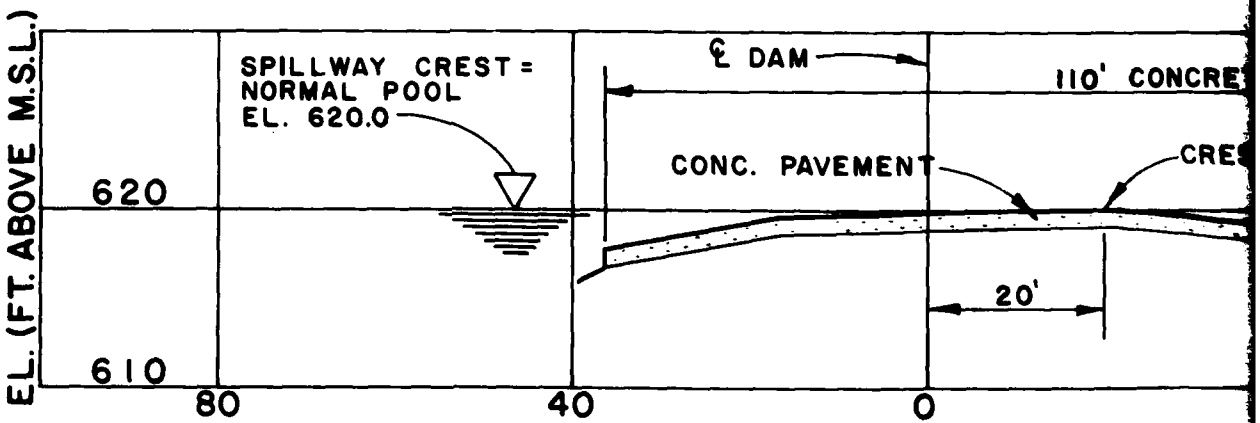
Horner & Shifrin, Inc. August 1980

PLATE 3



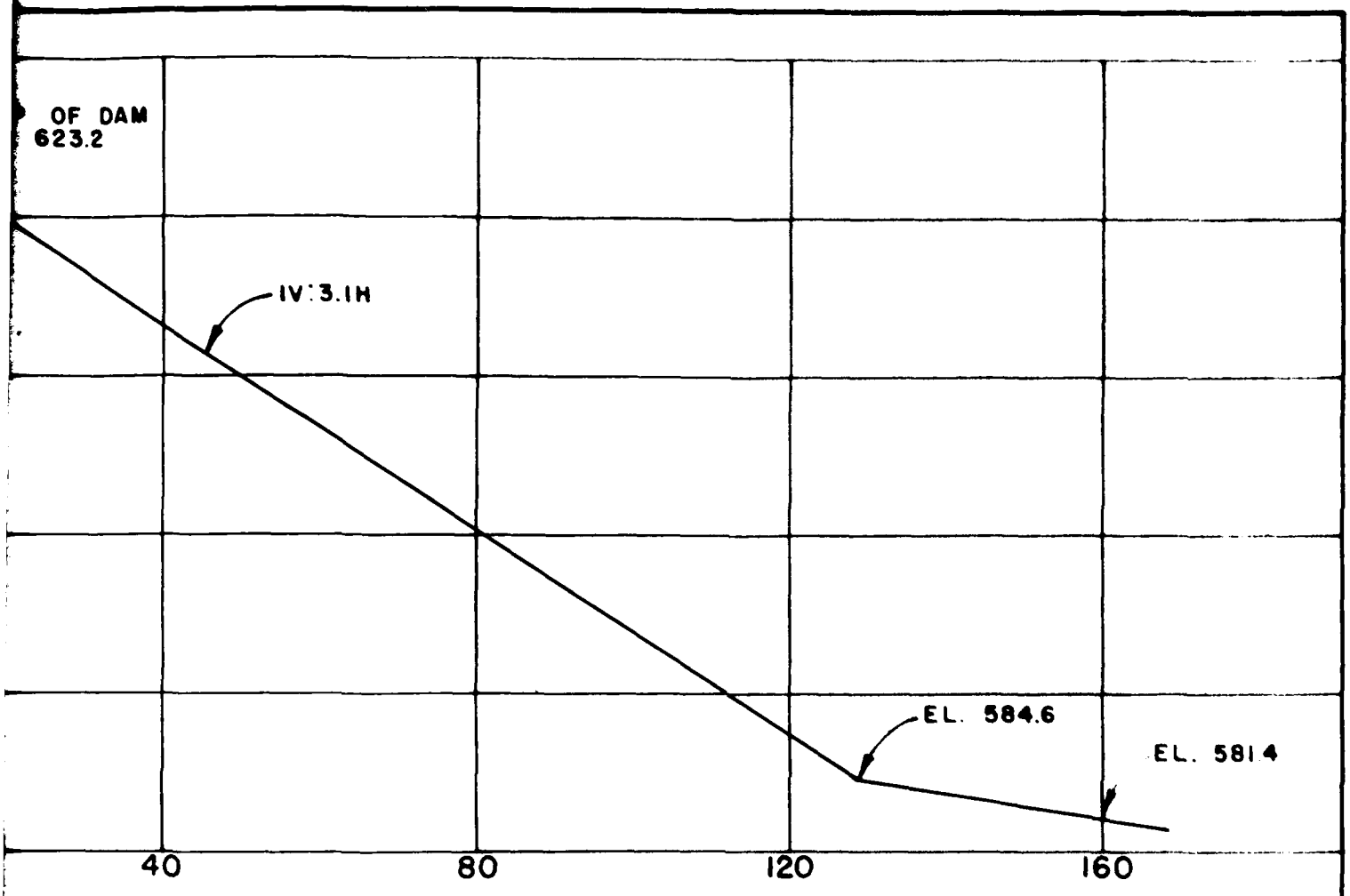
DAM CROSS-S

SCALES:

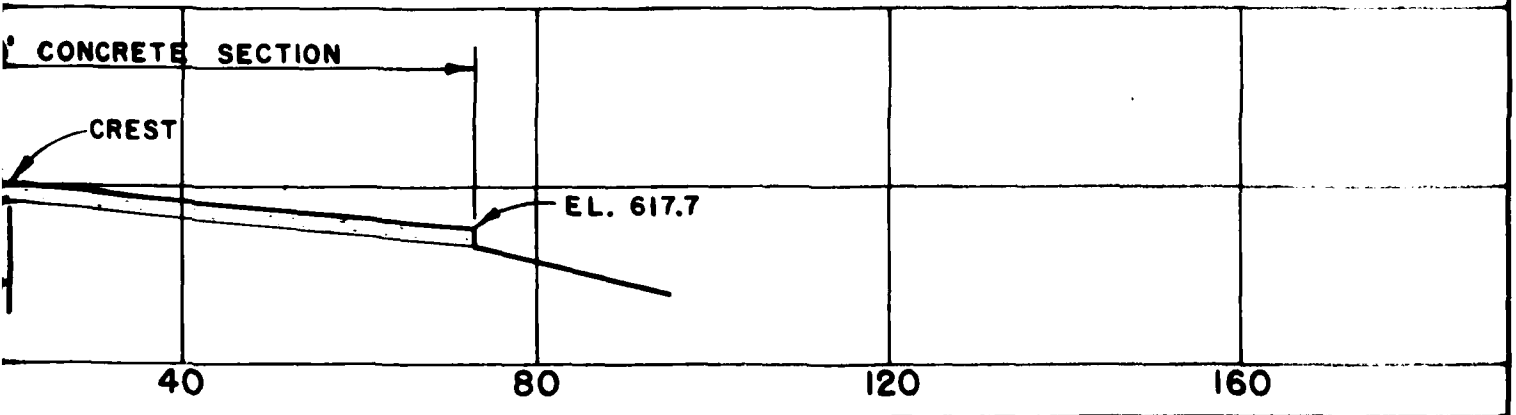


PROFILE PR

SCALES: 1



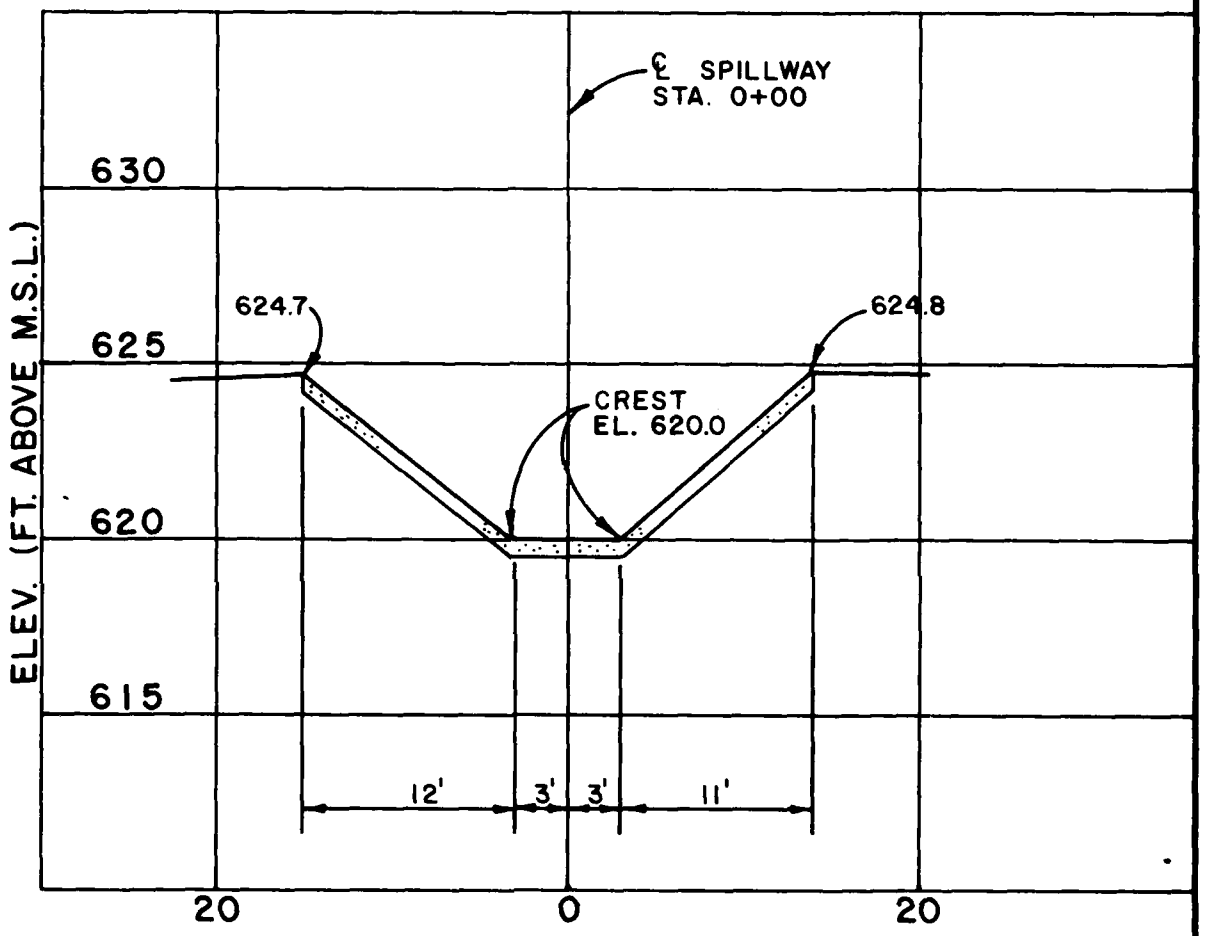
ROSS-SECTION STA. 2+50
SCALES: 1"=10'V., 1"=20'H.



ILE PRINCIPAL SPILLWAY
SCALES: 1"=10'V., 1"=20'H.

LAKEWOOD PARK LAKE
DAM CROSS-SECTION &
SPILLWAY PROFILE
Horner & Shifrin, Inc. August 1980

PLATE 4



SPILLWAY CROSS-SECTION

SCALES: 1"=5'V., 1"=10'H.

LAKEWOOD PARK LAKE
SPILLWAY CROSS-SECTION

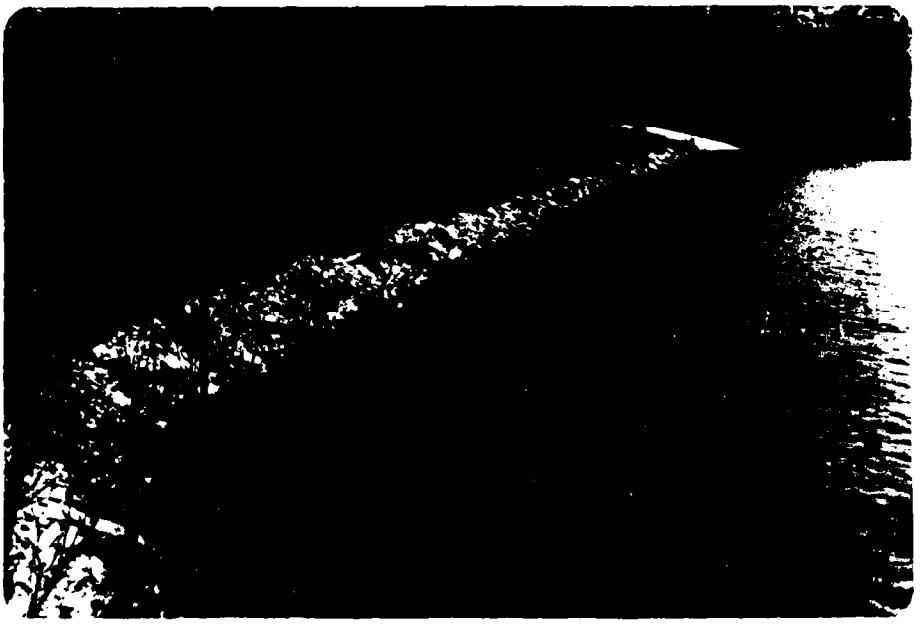
Horner & Shifrin, Inc. Oct. 1980

PLATE 5

APPENDIX A

INSPECTION PHOTOGRAPHS

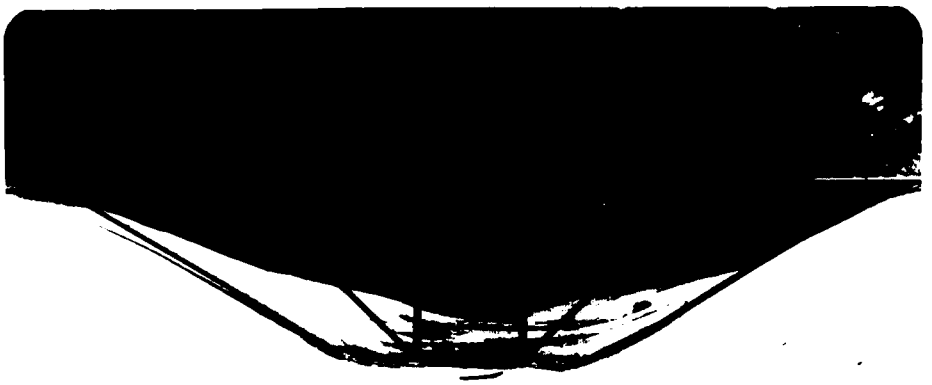
NO. 1: UPSTREAM FACE OF DAM LOOKING TOWARD LEFT ABUTMENT



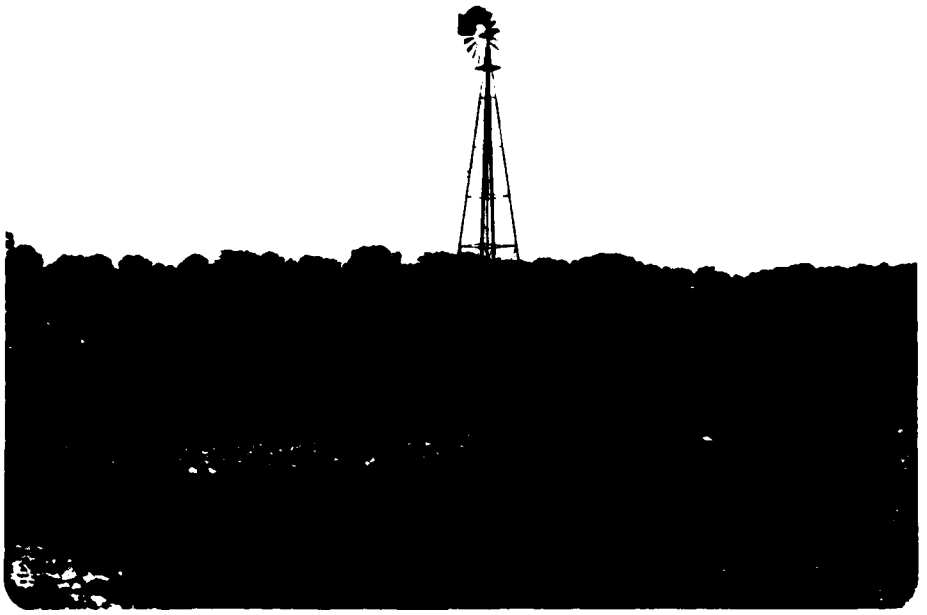
NO. 2: UPSTREAM FACE OF DAM LOOKING TOWARD RIGHT ABUTMENT

NO. 3: DOWNSTREAM FACE OF DAM

NO. 4: UPSTREAM END OF SPILLWAY

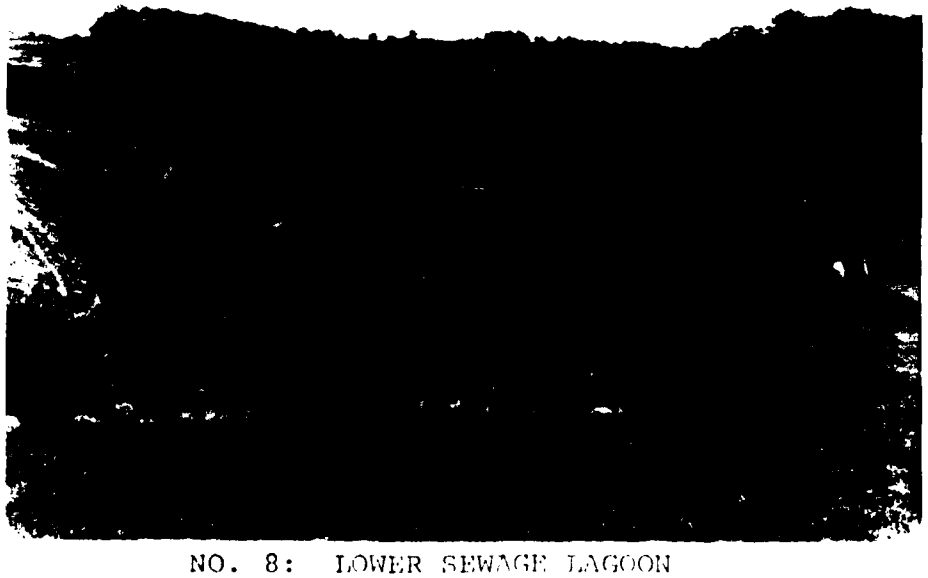


NO. 5: SPILLWAY CREST AND GATE



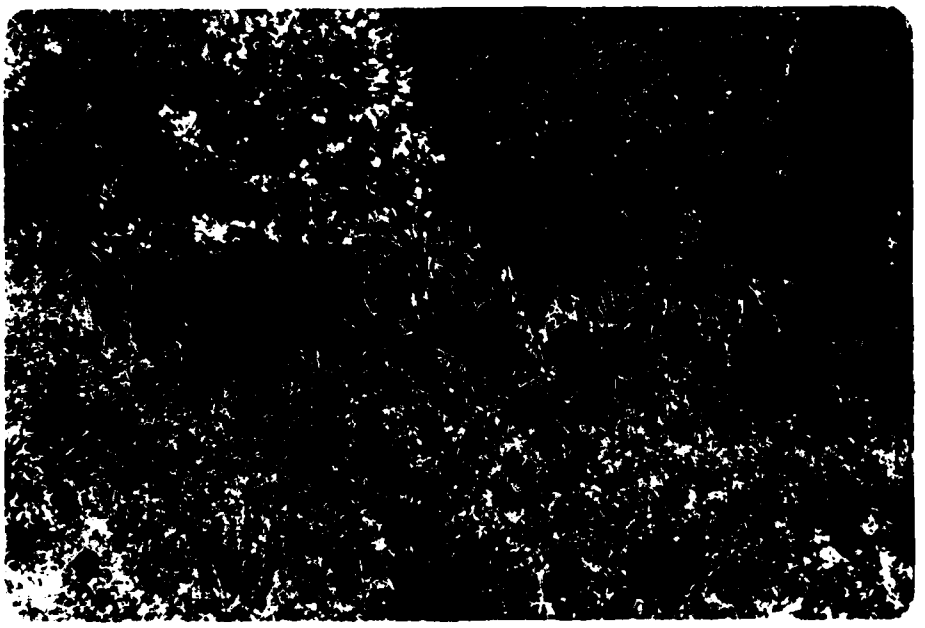
NO. 6: DAM PENINSULA

NO. 7: UPPER SEWAGE LAGOON

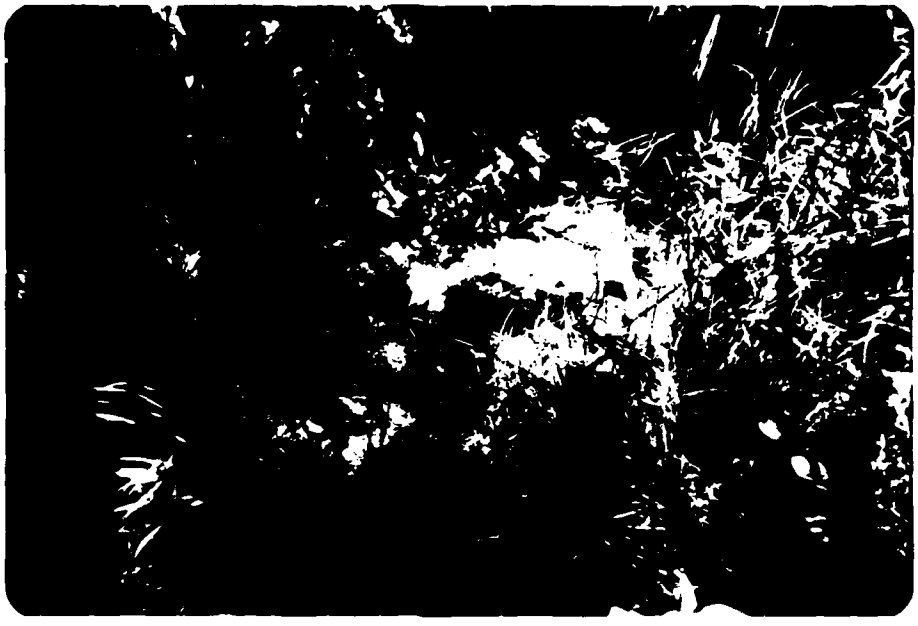


NO. 8: LOWER SEWAGE LAGOON

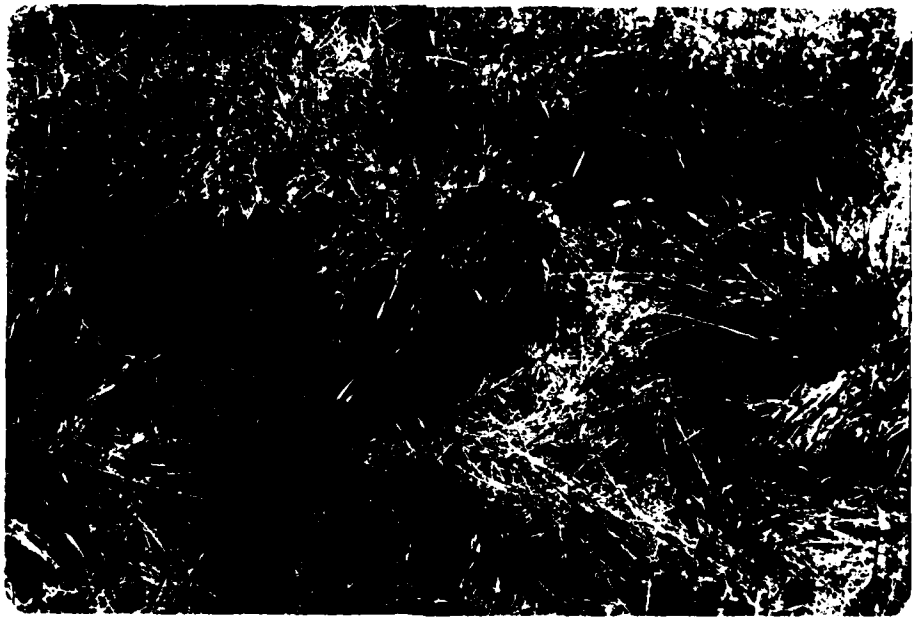
NO. 9: SWALE ALONG DOWNSTREAM TOE OF DAM



NO. 10: MARSHY AREA AT TOE OF DAM



NO. 11: DAM SEEPAGE IN ORIGINAL STREAM



NO. 12: EROSION OF UPSTREAM FACE ABOVE RIPRAP

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978, Modified 26 February 1979) program was used to develop inflow and outflow hydrographs and dam overtopping anlyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.4 inches) from Hydrometeorological Report No. 33. The precipitation data used in the analysis of the 1 percent probability (100-year frequency) flood was provided by the St. Louis District, Corps of Engineers.

b. Drainage area = 0.343 square miles = 220 acres.

c. SCS parameters:

$$\text{Time of Concentration } (T_c) = \left(\frac{11.9L^3}{H}\right)^{0.385} = 0.119 \text{ hours}$$

Where: T_c = Travel time of water from hydraulically most distant point to point of interest, hours

L = Length of longest watercourse = 0.360 miles

H = Elevation difference = 140 feet

The time of concentration (T_c) was obtained using Method C as described in Figure 30, "Design of Small Dams", by the United States Department of the Interior, Bureau of Reclamation, and was verified using average channel velocity estimates and watercourse lengths.

Lag Time = 0.071 hours (0.60 Tc)

Hydrologic Soil Group = 50% B (Krakow and Menfro Series) and 50% C (Bucklick Series) per County SCS Soil Report

Soil type CN = 68 (AMC II, 1 percent probability flood condition)

= 84 (AMC III, PMF condition)

2. The spillway section consists of a broad-crested, trapezoidal section for which conventional weir formulas do not apply.

Spillway release rates were determined as follows:

a. Spillway crest section properties (area, "a" and top width, "t") were computed for various depths, "d".

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth was computed as $Q_c = (\frac{a^3 g}{t})^{0.5}$ for the various depths, "d". Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.* Reference, "Handbook of Hydraulics", Fifth Edition, by King & Brater, page 8-7.

c. Static lake levels corresponding to the various flow values passing the spillway were computed as critical depths plus critical velocity heads ($d_c + H_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

3. The profile of the dam crest is irregular and flow over the dam cannot be determined by application of conventional weir formulas. Crest length and elevation data for the dam crest proper were entered into the HEC-1 Program on the $L and the $V cards. The program assumes that flow over the dam crest section occurs at critical depth and computes internally the flow over the dam crest and adds this flow to the flow over the spillway as entered on the Y4 and Y5 cards.

* $v_c = \frac{Qc}{a}$; $Hvc = \frac{v_c^2}{2g}$

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKEWOOD PARK DAM
A3       RATIOS OF PMF ROUTED THROUGH RESERVOIR
B     288        0        5        0        0        0        0        0        0        0
B1      5
J       1        4        1
J1   0.22     0.23     0.50     1.00
K       0  INFLOW                                          1
K1       INFLOW HYDROGRAPH
M       1        2    0.343                        1.0                          1
P       0     25.4      102      120      130
T                                                      -1      -84
W2           0.071
X    -1.0     -.10      2.0
K       1      DAM                                      1
K1       RESERVOIR ROUTING BY MODIFIED PULS
Y                                      1        1
Y1      1                                          270.00       -1
Y4  620.0    620.7    621.4    622.0    622.7    623.3    624.0    624.6    625.2    625.9
Y4  626.1    626.3    627.0    627.8    628.5    629.3    630.0
Y5      0       13       42       82      145      215      318      426      555      722
Y5    775      830     1039     1290     1528     1810     2075
$A      0     27.0     38.8     51.7     65.5
$E    590      620      630      640      650
$$  620.0
$D  622.8
$L      0      165      349      476      513      619      844     1097     1149     1189
$V  622.8    623.2    623.5    624.5    624.7    624.8    625.4    625.8    627.1    629.2
K      99
```

```
1A1       ANALYSIS OF DAM OVERTOPPING USING 100-YR FLOOD
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKEWOOD PARK DAM
A3       100-YR FLOOD ROUTED THROUGH RESERVOIR
B     288         0         5                                                  4
B1      5
J       1         1         1
J1   1.00
K       0   INFLOW                                          1
K1        INFLOW HYDROGRAPH
M       0         2    0.343                        1.0                       1
O     288    7.224
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
O1  .007     .007     .014     .014     .014     .014     .014     .014     .014     .014
O1  .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
O1  .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
O1  .014     .014     .014     .014     .014     .014     .014     .014     .022     .022
O1  .022     .022     .022     .022     .022     .022     .022     .022     .022     .022
O1  .022     .022     .022     .022     .022     .022     .031     .031     .031     .031
O1  .031     .031     .061     .061     .061     .061     .061     .061     .132     .132
O1  .132     .252     .252     .552     .826     .384     .252     .132     .132     .132
O1  .061     .061     .061     .061     .061     .061     .031     .031     .031     .031
O1  .031     .031     .022     .022     .022     .022     .022     .022     .022     .022
O1  .022     .022     .022     .022     .022     .022     .022     .022     .022     .022
```

100-YR. FLOOD (Cont'd)

```
O1   .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
O1   .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
O1   .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
O1   .014    .014    .014    .014    .014    .014    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    .007    .007
T                                                     -1      -68
W2          0.071
X    -1.0    -.10     2.0
K       1     DAM                                      1
K1          RESERVOIR ROUTING BY MODIFIED PULS
Y                                    1       1
Y1      1                                          270.00      -1
Y4  620.0   620.7   621.4   622.0   622.7   623.3   624.0   624.6   625.2   625.9
Y4  626.1   626.3   627.0   627.8   628.5   629.3   630.0
Y5      0      13      42      82     145     215     318     426     555     722
Y5    775     830    1039    1290    1528    1810    2075
$A      0    27.0    38.8    51.7    65.5
$E    590     620     630     640     650
$$  620.0
$D  622.8
$L      0     165     349     476     513     619     844    1097    1149    1189
$V  622.8   623.2   623.5   624.5   624.7   624.8   625.4   625.8   627.1   629.2
K      99
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ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKEWOOD PARK DAM
RATIOS OF PMF ROUTED THROUGH RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= .22 .23 .50 1.00

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

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	INFLOW	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.34	0.00	.34	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	25.40	102.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-84.00	0.00	0.00

CURVE NO = -84.00 WETNESS = -1.00 EFFECT CN = 84.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .07

RECESSION DATA
STRTQ= -1.00 QRCSN= -.10 RTIOR= 2.00

TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

UNIT HYDROGRAPH 6 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .07 VOL= 1.00
1240. 1006. 289. 86. 26. 8.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.22	.20	.02	332.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.22	.20	.01	476.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.22	.20	.01	519.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.22	.20	.01	533.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.22	.20	.01	539.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.22	.20	.01	542.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.22	.21	.01	543.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.22	.21	.01	545.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.22	.21	.01	546.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.22	.21	.01	547.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.22	.21	.01	549.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.22	.21	.01	550.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.26	.25	.01	602.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.26	.25	.01	645.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.26	.25	.01	659.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.26	.25	.01	663.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.26	.25	.01	666.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.26	.25	.01	667.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.26	.25	.01	668.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.26	.25	.01	669.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.26	.25	.01	670.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.26	.25	.01	670.
1.01	1.55	23	.01	0.00	.01	0.	1.01	13.55	167	.26	.25	.01	671.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.00	168	.26	.25	.01	672.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.05	169	.32	.32	.01	751.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.10	170	.32	.32	.01	816.
1.01	2.15	27	.01	.00	.01	0.	1.01	14.15	171	.32	.32	.01	835.
1.01	2.20	28	.01	.00	.01	0.	1.01	14.20	172	.32	.32	.01	841.
1.01	2.25	29	.01	.00	.01	1.	1.01	14.25	173	.32	.32	.01	843.
1.01	2.30	30	.01	.00	.01	1.	1.01	14.30	174	.32	.32	.01	845.
1.01	2.35	31	.01	.00	.01	2.	1.01	14.35	175	.32	.32	.01	845.
1.01	2.40	32	.01	.00	.01	2.	1.01	14.40	176	.32	.32	.01	846.
1.01	2.45	33	.01	.00	.01	3.	1.01	14.45	177	.32	.32	.00	846.
1.01	2.50	34	.01	.00	.01	3.	1.01	14.50	178	.32	.32	.00	847.
1.01	2.55	35	.01	.00	.01	4.	1.01	14.55	179	.32	.32	.00	848.
1.01	3.00	36	.01	.00	.01	4.	1.01	15.00	180	.32	.32	.00	848.
1.01	3.05	37	.01	.00	.01	4.	1.01	15.05	181	.20	.19	.00	693.
1.01	3.10	38	.01	.00	.01	5.	1.01	15.10	182	.39	.39	.00	808.
1.01	3.15	39	.01	.00	.01	5.	1.01	15.15	183	.39	.39	.00	968.
1.01	3.20	40	.01	.00	.01	6.	1.01	15.20	184	.59	.58	.01	1256.
1.01	3.25	41	.01	.00	.01	6.	1.01	15.25	185	.69	.68	.01	1587.
1.01	3.30	42	.01	.00	.01	7.	1.01	15.30	186	1.67	1.66	.02	2956.
1.01	3.35	43	.01	.00	.01	7.	1.01	15.35	187	2.76	2.74	.02	5321.
1.01	3.40	44	.01	.00	.01	7.	1.01	15.40	188	1.09	1.08	.01	4643.
1.01	3.45	45	.01	.00	.01	8.	1.01	15.45	189	.69	.69	.00	2887.
1.01	3.50	46	.01	.00	.01	8.	1.01	15.50	190	.59	.59	.00	2011.
1.01	3.55	47	.01	.00	.01	9.	1.01	15.55	191	.39	.39	.00	1451.
1.01	4.00	48	.01	.00	.01	9.	1.01	16.00	192	.39	.39	.00	1159.
1.01	4.05	49	.01	.00	.01	9.	1.01	16.05	193	.30	.30	.00	957.

1.01	4.10	50	.01	.00	.01	10.	1.01	16.10	194	.30	.30	.00	843.
1.01	4.15	51	.01	.00	.01	10.	1.01	16.15	195	.30	.30	.00	811.
1.01	4.20	52	.01	.00	.01	10.	1.01	16.20	196	.30	.30	.00	802.
1.01	4.25	53	.01	.00	.01	11.	1.01	16.25	197	.30	.30	.00	799.
1.01	4.30	54	.01	.00	.01	11.	1.01	16.30	198	.30	.30	.00	799.
1.01	4.35	55	.01	.00	.01	11.	1.01	16.35	199	.30	.30	.00	799.
1.01	4.40	56	.01	.00	.01	12.	1.01	16.40	200	.30	.30	.00	799.
1.01	4.45	57	.01	.00	.01	12.	1.01	16.45	201	.30	.30	.00	799.
1.01	4.50	58	.01	.00	.01	12.	1.01	16.50	202	.30	.30	.00	799.
1.01	4.55	59	.01	.00	.01	13.	1.01	16.55	203	.30	.30	.00	799.
1.01	5.00	60	.01	.00	.01	13.	1.01	17.00	204	.30	.30	.00	799.
1.01	5.05	61	.01	.01	.01	13.	1.01	17.05	205	.24	.24	.00	719.
1.01	5.10	62	.01	.01	.01	13.	1.01	17.10	206	.24	.24	.00	654.
1.01	5.15	63	.01	.01	.01	14.	1.01	17.15	207	.24	.24	.00	636.
1.01	5.20	64	.01	.01	.01	14.	1.01	17.20	208	.24	.24	.00	630.
1.01	5.25	65	.01	.01	.01	14.	1.01	17.25	209	.24	.24	.00	629.
1.01	5.30	66	.01	.01	.01	15.	1.01	17.30	210	.24	.24	.00	628.
1.01	5.35	67	.01	.01	.01	15.	1.01	17.35	211	.24	.24	.00	628.
1.01	5.40	68	.01	.01	.01	15.	1.01	17.40	212	.24	.24	.00	628.
1.01	5.45	69	.01	.01	.01	15.	1.01	17.45	213	.24	.24	.00	628.
1.01	5.50	70	.01	.01	.01	16.	1.01	17.50	214	.24	.24	.00	628.
1.01	5.55	71	.01	.01	.01	16.	1.01	17.55	215	.24	.24	.00	628.
1.01	6.00	72	.01	.01	.01	16.	1.01	18.00	216	.24	.24	.00	628.
1.01	6.05	73	.06	.03	.03	44.	1.01	18.05	217	.02	.02	.00	509.
1.01	6.10	74	.06	.03	.03	69.	1.01	18.10	218	.02	.02	.00	475.
1.01	6.15	75	.06	.03	.03	79.	1.01	18.15	219	.02	.02	.00	443.
1.01	6.20	76	.06	.03	.03	85.	1.01	18.20	220	.02	.02	.00	414.
1.01	6.25	77	.06	.03	.03	89.	1.01	18.25	221	.02	.02	.00	386.
1.01	6.30	78	.06	.04	.03	93.	1.01	18.30	222	.02	.02	.00	360.
1.01	6.35	79	.06	.04	.03	96.	1.01	18.35	223	.02	.02	.00	336.
1.01	6.40	80	.06	.04	.03	99.	1.01	18.40	224	.02	.02	.00	314.
1.01	6.45	81	.06	.04	.02	102.	1.01	18.45	225	.02	.02	.00	293.
1.01	6.50	82	.06	.04	.02	105.	1.01	18.50	226	.02	.02	.00	273.
1.01	6.55	83	.06	.04	.02	107.	1.01	18.55	227	.02	.02	.00	255.
1.01	7.00	84	.06	.04	.02	110.	1.01	19.00	228	.02	.02	.00	238.
1.01	7.05	85	.06	.04	.02	112.	1.01	19.05	229	.02	.02	.00	222.
1.01	7.10	86	.06	.04	.02	114.	1.01	19.10	230	.02	.02	.00	207.
1.01	7.15	87	.06	.04	.02	116.	1.01	19.15	231	.02	.02	.00	193.
1.01	7.20	88	.06	.04	.02	118.	1.01	19.20	232	.02	.02	.00	180.
1.01	7.25	89	.06	.05	.02	120.	1.01	19.25	233	.02	.02	.00	168.
1.01	7.30	90	.06	.05	.02	121.	1.01	19.30	234	.02	.02	.00	157.
1.01	7.35	91	.06	.05	.02	123.	1.01	19.35	235	.02	.02	.00	146.
1.01	7.40	92	.06	.05	.02	125.	1.01	19.40	236	.02	.02	.00	136.
1.01	7.45	93	.06	.05	.02	126.	1.01	19.45	237	.02	.02	.00	127.
1.01	7.50	94	.06	.05	.02	127.	1.01	19.50	238	.02	.02	.00	119.
1.01	7.55	95	.06	.05	.01	129.	1.01	19.55	239	.02	.02	.00	111.
1.01	8.00	96	.06	.05	.01	130.	1.01	20.00	240	.02	.02	.00	103.
1.01	8.05	97	.06	.05	.01	131.	1.01	20.05	241	.02	.02	.00	96.
1.01	8.10	98	.06	.05	.01	132.	1.01	20.10	242	.02	.02	.00	90.
1.01	8.15	99	.06	.05	.01	133.	1.01	20.15	243	.02	.02	.00	84.
1.01	8.20	100	.06	.05	.01	135.	1.01	20.20	244	.02	.02	.00	78.
1.01	8.25	101	.06	.05	.01	136.	1.01	20.25	245	.02	.02	.00	73.
1.01	8.30	102	.06	.05	.01	136.	1.01	20.30	246	.02	.02	.00	68.

1.01	8.35	103	.06	.05	.01	137.	1.01	20.35	247	.02	.02	.00	64.
1.01	8.40	104	.06	.05	.01	138.	1.01	20.40	248	.02	.02	.00	59.
1.01	8.45	105	.06	.05	.01	139.	1.01	20.45	249	.02	.02	.00	56.
1.01	8.50	106	.06	.05	.01	140.	1.01	20.50	250	.02	.02	.00	56.
1.01	8.55	107	.06	.05	.01	141.	1.01	20.55	251	.02	.02	.00	56.
1.01	9.00	108	.06	.05	.01	141.	1.01	21.00	252	.02	.02	.00	56.
1.01	9.05	109	.06	.05	.01	142.	1.01	21.05	253	.02	.02	.00	56.
1.01	9.10	110	.06	.05	.01	143.	1.01	21.10	254	.02	.02	.00	56.
1.01	9.15	111	.06	.05	.01	143.	1.01	21.15	255	.02	.02	.00	56.
1.01	9.20	112	.06	.05	.01	144.	1.01	21.20	256	.02	.02	.00	56.
1.01	9.25	113	.06	.05	.01	145.	1.01	21.25	257	.02	.02	.00	56.
1.01	9.30	114	.06	.05	.01	145.	1.01	21.30	258	.02	.02	.00	56.
1.01	9.35	115	.06	.06	.01	146.	1.01	21.35	259	.02	.02	.00	56.
1.01	9.40	116	.06	.06	.01	146.	1.01	21.40	260	.02	.02	.00	56.
1.01	9.45	117	.06	.06	.01	147.	1.01	21.45	261	.02	.02	.00	56.
1.01	9.50	118	.06	.06	.01	147.	1.01	21.50	262	.02	.02	.00	56.
1.01	9.55	119	.06	.06	.01	148.	1.01	21.55	263	.02	.02	.00	56.
1.01	10.00	120	.06	.06	.01	148.	1.01	22.00	264	.02	.02	.00	56.
1.01	10.05	121	.06	.06	.01	149.	1.01	22.05	265	.02	.02	.00	56.
1.01	10.10	122	.06	.06	.01	149.	1.01	22.10	266	.02	.02	.00	56.
1.01	10.15	123	.06	.06	.01	150.	1.01	22.15	267	.02	.02	.00	56.
1.01	10.20	124	.06	.06	.01	150.	1.01	22.20	268	.02	.02	.00	56.
1.01	10.25	125	.06	.06	.01	151.	1.01	22.25	269	.02	.02	.00	56.
1.01	10.30	126	.06	.06	.01	151.	1.01	22.30	270	.02	.02	.00	56.
1.01	10.35	127	.06	.06	.01	151.	1.01	22.35	271	.02	.02	.00	56.
1.01	10.40	128	.06	.06	.01	152.	1.01	22.40	272	.02	.02	.00	56.
1.01	10.45	129	.06	.06	.01	152.	1.01	22.45	273	.02	.02	.00	56.
1.01	10.50	130	.06	.06	.01	152.	1.01	22.50	274	.02	.02	.00	56.
1.01	10.55	131	.06	.06	.01	153.	1.01	22.55	275	.02	.02	.00	56.
1.01	11.00	132	.06	.06	.01	153.	1.01	23.00	276	.02	.02	.00	56.
1.01	11.05	133	.06	.06	.01	153.	1.01	23.05	277	.02	.02	.00	56.
1.01	11.10	134	.06	.06	.01	154.	1.01	23.10	278	.02	.02	.00	56.
1.01	11.15	135	.06	.06	.01	154.	1.01	23.15	279	.02	.02	.00	56.
1.01	11.20	136	.06	.06	.01	154.	1.01	23.20	280	.02	.02	.00	56.
1.01	11.25	137	.06	.06	.01	154.	1.01	23.25	281	.02	.02	.00	56.
1.01	11.30	138	.06	.06	.01	155.	1.01	23.30	282	.02	.02	.00	56.
1.01	11.35	139	.06	.06	.01	155.	1.01	23.35	283	.02	.02	.00	56.
1.01	11.40	140	.06	.06	.00	155.	1.01	23.40	284	.02	.02	.00	56.
1.01	11.45	141	.06	.06	.00	156.	1.01	23.45	285	.02	.02	.00	56.
1.01	11.50	142	.06	.06	.00	156.	1.01	23.50	286	.02	.02	.00	56.
1.01	11.55	143	.06	.06	.00	156.	1.01	23.55	287	.02	.02	.00	56.
1.01	12.00	144	.06	.06	.00	156.	1.02	0.00	288	.02	.02	.00	56.

SUM	33.02	30.84	2.18	86384.
	(839.)	(783.)	(55.)	(2446.12)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5321.	938.	300.	300.	86365.
CMS	151.	27.	8.	8.	2446.
INCHES		25.44	32.53	32.53	32.53
MM		646.21	826.30	826.30	826.30
AC-FT		465.	595.	595.	595.
THOUS CU M		574.	734.	734.	734.

SURFACE AREA=	0.	27.	39.	52.	66.
CAPACITY=	0.	270.	597.	1048.	1633.
ELEVATION=	590.	620.	630.	640.	650.

SUMMARY OF DAM SAFETY ANALYSIS

PMF

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	620.00	620.00	622.80
STORAGE	270.	270.	350.
OUTFLOW	0.	0.	157.

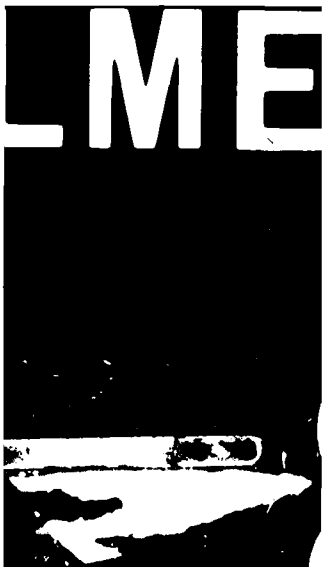
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.22	622.73	0.00	348.	149.	0.00	17.17	0.00
.23	622.82	.02	351.	159.	1.08	17.08	0.00
.50	624.21	1.41	393.	1552.	5.50	15.75	0.00
1.00	625.03	2.23	420.	3743.	8.08	15.75	0.00

SUMMARY OF DAM SAFETY ANALYSIS

100-YR. FLOOD

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	620.00	620.00	622.80
STORAGE	270.	270.	350.
OUTFLOW	0.	0.	157.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	621.48	0.00	311.	47.	0.00	13.92	0.00


LME