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DUREPO BROOK DAM (ME..(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV SEP 81

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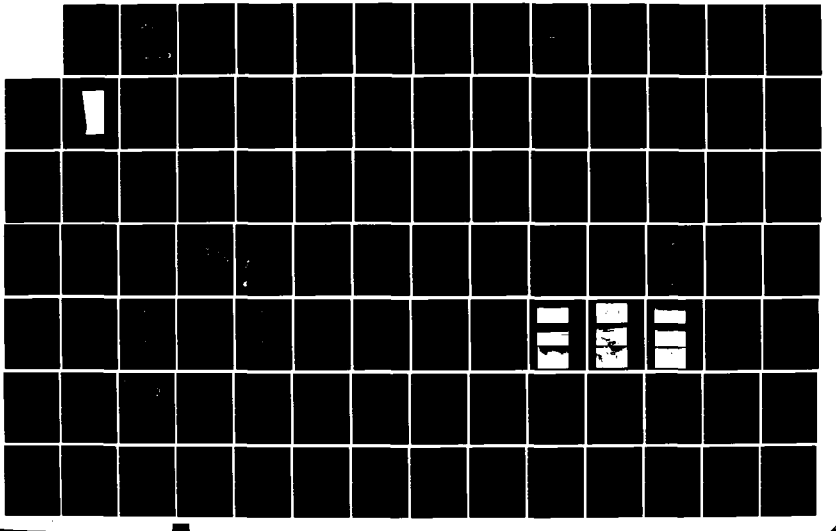

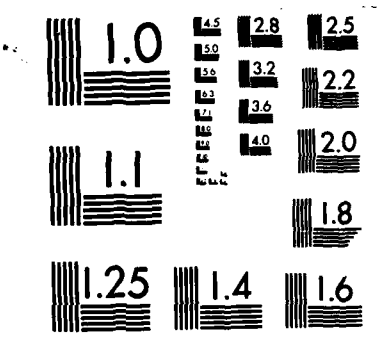

SAINT JOHN RIVER BASIN
Limestone, Maine

DUREPO BROOK DAM
ME 00348

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
Waltham, Mass. 02154

SEPTEMBER 1981

UNCLASSIFIED

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Limestone Maine
Durepo Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The earthfill embankment is 2850 ft. long and 60 ft. high. The facility was found to be in good condition. In the embankment itself there were no dips, sags or other evidence of distress. It is intermediate in size with a high hazard potential. Remedial measures include monitoring the project during heavy rainfall implementing a monthly visual inspection program, developing a downstream warning system and conducting bi-annual technical inspections.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

SEP 23 1981

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

Inclosed is a copy of the Durepo Brook Dam (ME-00348) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Agriculture and to the owner, the town of Limestone. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Agriculture for your cooperation in in this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

DUREPO BROOK DAM

ME 00348

ST. JOHN RIVER BASIN
LIMESTONE, MAINE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.	:	ME 00348
Name of Dam	:	Durepo Brook
Town	:	Limestone
County & State	:	Aroostook, Maine
Stream	:	Durepo Brook
Date of Inspection	:	November 8, 1979

BRIEF ASSESSMENT

Durepo Brook Dam is a seven year old dual purpose flood water retarding and low flow augmenting project designed by the USDA Soil Conservation Service. The earth fill embankment is 2850 feet long and 60 feet high. The downstream slope, the crest and the upstream slope above the normal pool are grass covered. A reinforced concrete drop inlet principal spillway leads to a 54 inch diameter reinforced concrete pipe conduit under the dam that discharges into a reinforced concrete impact basin. A grass lined earth cut emergency spillway is provided adjacent to to the right abutment. A sediment and municipal water storage pool is maintained behind the dam at a normal elevation of 615 feet.

The embankment dam, principal spillway drop inlet, principal spillway impact basin and emergency spillway were found in good condition. In the embankment itself, there were no dips, sags or other evidence of distress. While the reinforced concrete structures appeared sound with no evidence of deterioration, the Soils Conservation Service reported March 25, 1981 that the concrete riser has interior, structural cracking which will be repaired this year. The grass cover on the embankment and emergency spillway was well developed. The crest surface had a dirt road running the length of it which was moderately rutted.

Based on a maximum storage of 7,070 acre-feet and a height of 60 feet, Durepo Brook Dam falls within the intermediate size classification. The dam's hazard classification has been established as high based on the potential for loss of more than a few lives in the event of a dam failure. The test flood used was equal to the Probable Maximum Flood. The test flood was estimated for the 20.03 square mile drainage area of rolling terrain using the "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Safety Investigations", New England Division Corps of Engineers, March 1978. This yielded a peak inflow of 19,800 cfs and a peak routed outflow of 15,800 cfs.

The computed maximum reservoir level El. 641.6 was below the embankment crest El. 645 NGVD and no overtopping of the embankment would occur.

No urgent or emergency actions are required for Durepo Brook Dam based on this inspection. Remedial measures include monitoring the project during periods of intense rainfall, implementing a monthly visual inspection program, developing a downstream warning system and conducting bi-annual technical inspections.

J.E. Giles, Jr., P.E.
Project Manager
Massachusetts Registration No. 1643

This Phase I Inspection Report on Durepo Brook Dam (ME-00348) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechmical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of Phase I investigation: however, the investigation is intended to identify any need for such studies.

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

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project compliance with OSHA rules and regulations is also excluded.

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(2) Outlet works - The outlet impact basin (Photo 4 & 5) was found in good condition. All construction joints were tight. No spalling was observed.

(3) Emergency spillway - The emergency spillway was clear of debris and in good condition with a well developed grass cover (Photos 7 & 8).

d. Reservoir Area - No areas of potential or actual shoreline movement were observed.

e. Downstream Channel - The downstream channel (Photo 6) was clear with no evidence of erosion.

Evaluation - In general, the dam and appurtenances are in good condition. The slopes are stable and the crest is in good shape. The concrete structures are sound. No urgent or emergency repairs are required. The rutting on the crest should not be allowed to get any worse.

SECTION 3

VISUAL INSPECTION

1 Findings

a. General - The field inspection was conducted by L. Seward and J. Jonas of Chas. T. Main, Inc. on 8 November 1979, and J.E. Giles, Jr. on August 12, 1981. On the date of inspection, the Durepo Dam and appurtenances were in good condition. No urgent or emergency actions are required at this time.

b. Dam

(1) Crest - The embankment crest was true to line with no apparent dips, sags, cracks or other evidence of distress. The as-built camber was observed and appears unchanged. Wheel tracks and some minor rutting were observed on the crest (Photos 1 & 2). The crest is grass covered with no pavement.

(2) Upstream slope - The upstream slope riprap appeared in good condition. The slope above the normal pool El. 594 has a well developed tight grass cover (Photo 2). There was no evidence of sloughing or erosion on the slope.

(3) Downstream slope - The downstream slope has a well developed, tight grass cover (Photo 1). No significant gully action was observed on the slope. No slides or sags were observed.

(4) Downstream toe - The downstream toe is generally dry with no boils or seeps observed. A small area of stagnant water was observed 50 yards to the left of the impact basin (Photo 5). No seepage was observed.

(5) Underdrain system - Two 10-inch diameter toe drain collector pipes issue from the dam through a single common 10" outlet. This outlet is approximately 70' to the right of the impact basin at the toe of the dam. No flow was observed. A narrow channel has been formed at the drain outlet with riprap at the opening (photo 9).

c. Appurtenent Structures

(1) Principal Spillway - The principal spillway intake (Photo 4) was observed from shore. The exposed concrete and the trashrack steel appeared in good condition.

b. Adequacy: The lack of design calculations did not allow for a definitive review. Evaluation was based on visual inspection, past performance history, and sound engineering judgment and experience.

c. Validity: The limited data available restrict evaluation of the Durepo Brook Dam and appurtenances to the visual inspection and sound engineering judgment. The field inspection indicated that the external features of Durepo Brook Dam substantially agree with those shown on the available plans.

SECTION 2

ENGINEERING DATA

2.1 Design

As built drawings of Durepo Brook Dam are on file at the GSA Federal Archives and Records Center, 380 Trapelo Road, Waltham, MA 02154 (617-223-2657). Design calculations and specifications were not available. The December 1964 Limestone Stream Watershed Work Plan indicates that:

> ". . .hydrology and hydraulics analyses followed procedures given in the National Engineering Handbook of the Soil Conservation Service, Section 4, Supplement A, Hydrology (NEH 4A) and Section 5, Hydraulics (NEH 5)."

and for civil works:

> "All designs are in accord with the latest Soil Conservation Service design criteria as set forth in Engineering Memoranda SCS-27, 31, 4D and 42; Technical Release No. 10; Section 3.21, Hydrology, Supplement A of the National Engineering Handbook; U.S. Weather Bureau Technical Paper No. 40; and other sources of recognized engineering material."

2.2 Construction

The Durepo Dam and appurtenances were constructed in 1974 by the Star Construction Company. No construction records or photographs were available to the inspection team. A set of contract prints pertinent to this report are included in Appendix B.

2.3 Operation

No formal operational procedures were available for review. The principal and emergency spillways are uncontrolled structures requiring neither manual nor automatic operations. No records were found which indicated recent operation of the municipal water supply inlets. The operators stated that the drain sluice gate had been operated recently for the purpose of increasing downstream flow.

2.4 Evaluation

a. Availability: The Soil Conservation Service Construction Specifications for Durepo Brook Dam were reviewed.

j. Regulating Outlets

(1) Description

i. Sluice gate to drain reservoir

ii. Municipal water supply inlet

iii. Municipal water supply inlet

iv. Municipal water supply inlet

(2) Size

i. 30" I.D.

ii. 10" I.D.

iii. 8" I.D.

iv. 8" I.D.

(3) Invert

i. El. 593.83'

ii. El. 609.58'

iii. El. 607.42'

iv. El. 605.00'

(4) Control Mechanism

i. Sluice gate with screw operator

ii. 10" gate valve

iii. 8" gate valve

iv. 8" gate valve

(5) Other - N/A

(3)	Height	60 feet
(4)	Top Width	20 feet
(5)	Side Slopes	Upstream 3 Hor. to 1 Vert. Downstream 2.5 Hor. to 1 Vert.
(6)	Zoning	2 zones
(7)	Impervious Core	Most impervious toward the core
(8)	Cutoff	12'-15' trench
(9)	Grout curtain	Yes (See Page B-10)
(10)	Other	N/A

h. Diversion and Regulating Tunnel - None

i. Spillway (Principal)

(1) Type - Reinforced concrete inlet riser to 54" ϕ conduit

(2) Length of weir - 2 x 9'

(3) Crest elevation - El. 629.5

(4) Gates - ungated

(5) U/S Channel - N/A

(6) D/S Channel - Natural

(7) General - Reinforced concrete impact basin at outfall

Spillway (Emergency)

(8) Crest - El. 637.6

(9) Length of crest - 250'

(10) U/S Channel - Grass lined earth channel

(11) D/S Channel - Grass lined earth channel

(12) General - 3 Hor. to 1 Vert. side slopes

(7) Emergency spillway crest	637.6
(8) Design surcharge (Original Design)	Not Available
(9) Top of dam	645.0
(10) Test flood surcharge	641.6

d. Reservoir (Length in feet)

(1) Normal pool	2900
(2) Flood control pool	5000
(3) Spillway crest pool	3800
(4) Top of dam	5400
(5) Test flood pool	5000

e. Storage (acre-feet)

(1) Normal pool	270
(2) Flood control pool	4850
(3) Spillway (emergency) crest pool	4850
(4) Test flood pool	5740
(5) Top of dam	7500

f. Reservoir Surface (acres)

(1) Normal pool	200
(2) Flood-control pool	310
(3) Spillway crest	310
(4) Test flood pool	365
(5) Top of dam	425

g. Dam

(1) Type	Earthfill
(2) Length	2850 feet

b. Discharge at Damsite

(1) Outlet Works - A low stage 3'-4" x 5'-7" ungated inlet on the prinicpal spillway riser is located at invert Elev. 615 NGVD. The principal spillway crest is at Elev. 629.5 NGVD. The emergency spillway is an excavated, grass lined, earth channel. A screw operated sluice gate and 30"Ø CMP (maximim flow of 130 cfs at Elev. 615 NGVD) provide the capability to drain the reservoir to El. 593.8 NGVD. Three additional regulating inlets are incorporated in the spillway riser. These inlets are open to the reservoir and gated at the riser end. The gate valves are operated from the top of the prinicpal spillway riser.

(2) Maximum known flood - Unknown.

(3) Principal spillway capacity at top of dam - 650 cfs.

(4) Principal spillway capacity at emergency spillway crest elevation - 600 cfs.

(5) Gated spillway capacity at normal pond elevation - N/A.

(6) Gated spillway capacity at test flood elevation - N/A.

(7) Emergency spillway capacity at test flood elev. - 14,800 cfs @ El. 641.6.

(8) Total project discharge at top of dam - N/A. (Test flood is below top of dam).

(9) Total project discharge at test flood elevation - 15,800 cfs @ El. 641.6.

c. Elevations (feet above NGVD)

(1)	Streambed at toe of dam	585
(2)	Bottom of cutoff	573
(3)	Maximum tailwater	Not available
(4)	Normal pool (Depth = 30').	615
(5)	Full flood control pool	637.6
(6)	Principal spillway crest	629.5
	a. High stage	629.5
	b. Low stage	615.0

crest elevation of 637.6 NGVD feet with 3 horizontal to 1 vertical side slopes.

Plans, profiles, and sections of the dam and its appurtenent structures are included in Appendix B. Photographs are shown in Appendix C.

c. Size Classification - The maximum embankment height is 60 feet above the stream channel and the maximum storage is 7070 ac. ft. at Elev. 645 NGVD. This gives the dam an intermediate size classification due to both the height and storage in accordance with the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification - This facility is classified as a high hazard potential dam based on the potential for loss of more than a few lives in the event of a dam failure.

e. Ownership - The dam and associated works are owned by the Town of Limestone, Maine.

f. Operators - The project is designed for unsupervised operation. No manual operations are required to pass a flood flow. The project is operated and maintained by the Town of Limestone, Maine. The responsible person is Mr. Thomas Stevens, Town Manager, Limestone, Maine 04750, Telephone (207) 325-3131.

g. Purpose of Dam - The project is a dual purpose floodwater retarding and low flow augmentation structure of standard USDA SCS design. The reservoir drain intake sluice gate is currently closed and the reservoir maintained at Elev. 615 NGVD.

h. Design and Construction History - The project was designed by the Edward C. Jordan Company, Inc. of Portland Maine for the Soils Coservation Service in 1968 and constructed by Star Construction Company in 1974.

i. Normal Operating Procedures - The reservoir is normally maintained at Elev. 615 NGVD. If the water level falls below the spillway low stage inlet (Elev. 615) then one or more of the inlet valves can be opened to augment the downstream flow. All flood flows are passed through the principal and emergency spillways which are designed for uncontrolled discharge. No other operating procedures are in evidence.

1.3 Pertinent Data

a. Drainage Area - Durepo Brook Dam controls a drainage area of 20.03 square miles. The watershed is approximately 65 percent wooded and 35 percent agricultural with gentle sloping terrain. The range of watershed elevations is from Elev. 810 to Elev. 585. Approximately 4620 acres of the drainage area are within the Loring Air Force Base.

(2) A field inspection of the facility detailing the visual condition of the dam embankments and appurtenant structures.

(3) Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

(4) An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgment on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 Description of Project

a. Location - The Durepo Brook Dam is located on Durepo Brook approximately 100 feet downstream from its confluence with Butterfield Brook and 3.0 miles NNW of the Town of Limestone, Aroostook County, Maine. The dam location is included on U.S.G.S. 7.5 minute series Quadrangle, Limestone, Maine with approximate coordinates N46°56'43", W67°50'25".

b. Description of Dam and Appurtenances - The project is a dual purpose floodwater retarding and low flow augmentation structure. It consists of three principal features: an earthfill dam, a principal spillway, and an emergency spillway. The dam is 2850 feet long, 60 feet high, and 20 feet wide at its crest (Elev. 645.0 NGVD). Material excavated from the reservoir area was used for the fill in the dam. The fill materials are of glacial till origin with zoning limited to placing the more impervious material in the core and the more pervious material in the outside shells. The structure has a chimney drain and drain blanket system with two collector pipes and a central cutoff trench.

The principal spillway is an ungated drop intake to a 54 inch diameter reinforced concrete pipe under the dam. This riser has a high and low stage orifice. The low stage orifice at Elev. 615.5 NGVD is 3'-4" high x 5'-7". The principal spillway opening at Elev. 629.5 is open on two sides of the riser, each opening being 9'-0" wide x 4'-6" high. The 54-inch pipe is provided with anti-seep collars and discharges into a reinforced concrete impact basin (energy dissipator). There are three municipal water supply inlets on the spillway inlet riser. Two are 8" diameters at about elevations 605 and 608 and the third is a 10" diameter at elevation 610. All three have gate valves which are normally closed. A 30" Ø reservoir drain is provided to drain the storage to Invert Elev. 593.8 NGVD. The emergency spillway is an excavated, grass lined, earth channel adjacent to the right abutment. It is 250 feet wide at

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

DUREPO BROOK DAM, LIMESTONE MAINE

SECTION I

PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Chas. T. Main, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Maine. Authorization and notice to proceed were issued to Chas. T. Main, Inc. under a letter of November 6, 1979 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW 33-80-C-0011 has been assigned by the Corps of Engineers for this work.

b. Purpose - The purposes of the inspection program are:

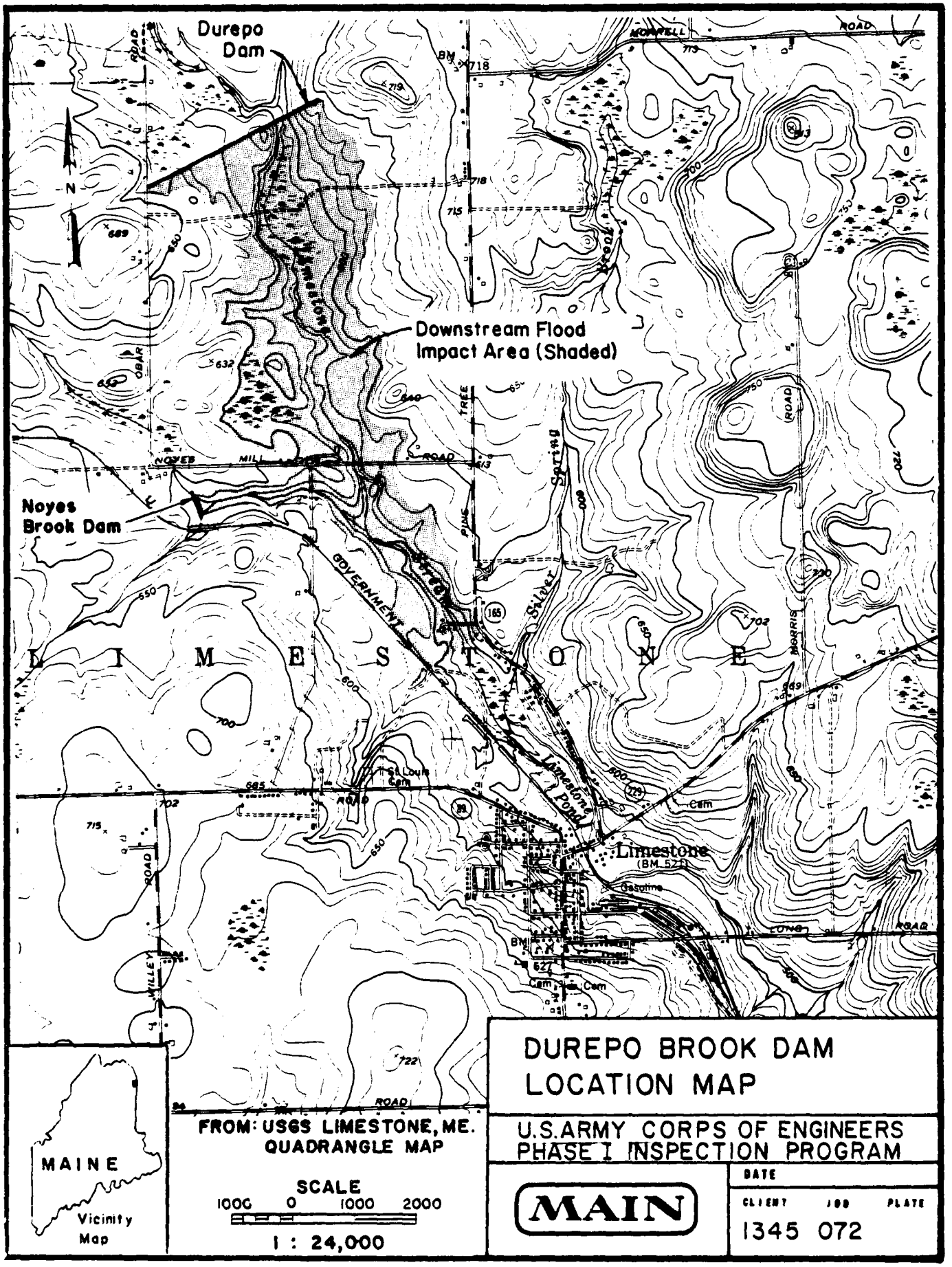
(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

(1) Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.



DUREPO BROOK DAM
LOCATION MAP

U.S. ARMY CORPS OF ENGINEERS
PHASE I INSPECTION PROGRAM

MAIN

DATE		
CLIENT	JOB	PLATE
	1345	072

DUREPO BROOK DAM

VIEW FROM RIGHT BANK OF RESERVOIR

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General: The principal and emergency spillways are uncontrolled crest structures. No manual operations are required to insure safe passage of a flood flow. No recent operation of the regulating outlet valves is reported. The 30" diameter reservoir drain was recently operated without problems according to the operator (Town Manager).

b. Description of Downstream Warning System: No warning system or emergency evacuation plans are in effect for this project.

4.2 Maintenance Procedures

a. General: The Town of Limestone has an operation and maintenance agreement with the Soil Conservation Service. Each dam is inspected at least once annually and after every major storm. An inspection report is prepared and any required maintenance is then performed by the town.

b. Operating Facilities: There are no manual operating facilities at this structure except for the reservoir drain gate and municipal water inlet valves on the principal spillway riser. No regular maintenance procedures for the project operating facilities are specified.

4.3 Evaluation

The operating and maintenance procedures are limited for this project. The owner should establish procedures to inspect the structures regularly, to keep the embankment free of brush and trees, and to monitor the project during periods of intense rainfall.

The owner should arrange to have a technical inspection made on an annual basis. The owner should establish a warning system to follow in the event of emergency conditions.

SECTION 5

EVALUATION OF HYDROLOGIC AND HYDRAULIC FEATURES

5.1 General - The watershed is 20.03 square miles of undeveloped rolling terrain. The dam is located on Durepo Brook, about 100' downstream from the confluence with Butterfield Brook. The earth embankment develops sufficient storage to reduce the Probable Maximum Flood (PMF) peak from 19,800 cfs to 15,800 cfs (about 20% reduction).

5.2 Design Data - The dam was designed by the Edward C. Jordan Co., Inc. for the Soil Conservation Service, U.S. Department of Agriculture. The top of the dam elevation is at Elev. 645.0 with a maximum height of 60 feet (capacity 7070 ac ft.). This dam is classified as intermediate size. The principal spillway consists of a reinforced concrete riser, a gated reservoir drain, a 54" Ø conduit with anti-seep collars and an energy dissipating structure at the outlet with a rip-rapped channel. The dam is equipped with an emergency spillway located adjacent to the right abutment. The plans show that the emergency spillway channel bottom width is 250 feet which has a crest elevation of 637.6 feet with channel side slopes of 3:1.

5.3 Experience Data - There are no records of past floods or any overtopping of the dam.

5.4 Test Flood Analysis - Based upon "Preliminary Guidance for Estimating Maximum Probable Discharge", dated March 1978, the watershed classification (rolling), and our hydraulic computations, the test flood for this high hazard, intermediate size dam is estimated to be equivalent to the PMF of 19,800 cfs. The flood routing starting elevation was selected to be the reservoir pool elevation 629.5, and the inflow hydrograph peak was reduced by the volume between emergency spillway crest and principal spillway intake elevations. For this particular portion of Maine, the PMF runoff is assumed to be 13". The routed test flood outflow was determined in accordance with Corps of Engineers "Guidance for Estimating Effect of Surcharge Storage on Maximum Probable Discharges", and the hydraulic characteristics of the dam. Spillway discharge was computed as open channel flow. The routed test flood outflow was determined to be 15,800 cfs, and the corresponding water surface El. 641.6 ft. The top of the dam El. is 645.0 ft and thus the dam would not be overtopped. The emergency spillway capacity is more tham 100 percent of PMF. As a check, a second test flood routing was performed assuming weir control in the emergency spillway and the dam was not overtopped under these conditions.

5.5 Dam Failure Analysis - The volume in the reservoir corresponding to the water surface elevation 641.6 is 5800 acre-feet which is considered at the time of dam of failure. The impact of failure was assessed using the "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs"

prepared by the Corps of Engineers. The breach discharge was estimated with the maximum water surface elevation during a PMF event. The breach width was selected to be 35 percent of the length of the dam at mid-height. The downstream discharge is a sum of the breach discharge and the discharge from the principal and emergency spillways. The total peak discharge was estimated to be 655,600 cfs. The result of the calculations included in Appendix D.

In view of these results it can be concluded that during prefailure conditions no homes will be damaged near the Noyes Mill Road Bridge (Reach 6, depth 12.9 ft) and two homes will be damaged near the Van Buren Road Bridge (Reach 14, depth 13.5 ft). In the event of a dam failure at least four homes will be impacted near the Noyes Mill Road Bridge and six homes will be impacted near the Van Buren Road Bridge by an initial wave of 30-35 feet. This wave would flood these homes by approximately 15-25 feet. Thus this dam represents a high hazard structure since it can be assumed that more than a few lives would be lost in the event of a dam failure.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observation

The visual inspection of November 8, 1979 revealed no dips, sags, depressions or other evidence of instability.

6.2 Design and Construction Data

Original design calculations and construction records were not available for review in preparing this report. The construction drawings for the dam were reviewed. The construction specification f Durepo Brook Dam was reviewed.

6.3 Post Construction Changes

No evidence of modification to the dam since construction was observed.

6.4 Seismic Stability

The dam is located in Seismic Zone No. 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - The visual inspection indicates that Durepo Brook Dam is in good condition.

b. Adequacy of Information - The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency - The remedial measures presented below should be implemented by the owner within two years of receipt of this Phase I Inspection Report.

7.2 Recommendations - None

7.3 Remedial Measures The owner should:

a. Develop a downstream warning plan to be implemented in the event of an emergency at the dam.

b. Establish a system to monitor the project during periods of intense rainfall.

c. Implement a monthly visual inspection program of the dam and appurtenances. Observations should be noted in a maintenance log.

d. Conduct a technical inspection of the project every two years.

e. Establish regular maintenance procedures at the project and continue to keep the embankment free of brush and trees.

f. Obtain and maintain a set of as-built drawings and exploratory program reports.

g. Assure operability of the four valves controlling the regulating outlets on the spillway riser; especially the low level drain.

h. Prevent the rutting on the crest from becoming more severe.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.

APPENDIX A

FIELD INSPECTION CHECK LIST

INSPECTION CHECKLIST

PARTY ORGANIZATION

PROJECT Durepo Brook Dam

DATE Nov. 8, 1979

TIME 14:00

WEATHER Fair-cold

U.S. ELEV. _____ U.S. ____ DN.S.

PARTY:

1. Lewis B. Seward - Hydrologist
2. Jan N. Jonas - Civil Engineer
3. Peerless J. Snow - Limestone Town Manager
4. J.E. Giles, Jr. - Project Manager
5. August 12, 1981
6. _____
7. _____
8. _____
9. _____
10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1. All of the project features were inspected by each party member.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

INSPECTION CHECKLIST

PROJECT Durepo Brook Dam **DATE** Nov. 8, 1979

PROJECT FEATURE Earthfill Dam -Flood Control **NAME** Lewis B. Seward

DISCIPLINE Hydro **NAME** Jan N. Jonas

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	645
Current Pool Elevation	not known - see pictures
Maximum Impoundment to Date	3,465 ac. ft.
Surface Cracks	none
Pavement Condition	unpaved roadway
Movement or Settlement of Crest	not visible
Lateral Movement	not visible
Vertical Alignment	not visible
Horizontal Alignment	not visible
Condition at Abutment and at Concrete Structures	no signs of deterioration; at concrete intake & outlet riprap
Indications of Movement of Structural Items on Slopes	none
Trespassing on Slopes	none
Vegetation on Slopes	thick grass, never mowed
Sloughing or Erosion of Slopes or Abutments	none
Rock Slope Protection - Riprap Failures	riprap at the upstream slope at waterline
Unusual Movement or Cracking at or near Toes	none
Unusual Embankment or Downstream Seepage	some wet spot with stagnant water at the downstream slope 50 yds from outlet
Piping or Boils	none
Foundation Drainage Features	none visible
Toe Drains	none visible
Instrumentation System	piezometers at d/s outlet structure

INSPECTION CHECKLIST

PROJECT Durepo Brook Dam **DATE** Nov. 8, 1979

PROJECT FEATURE Earthfill dam flood control **NAME** Lewis B. Seward

DISCIPLINE Hydro **NAME** Jan N. Jonas

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	not applicable
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	not applicable
Condition of Concrete	
Stop Logs and Slots	

INSPECTION CHECKLIST

PROJECT Durepo Brook Dam **DATE** Nov. 8, 1979

PROJECT FEATURE Earthfill dam - flood control **NAME** Lewis B. Seward

DISCIPLINE Hydro **NAME** Jan N. Jonas

AREA EVALUATED	CONDITIONS
LET WORKS - CONTROL TOWER	
Concrete and Structural	
General Condition	very good
Condition of Joints	construction tight
Spalling	none
Visible Reinforcing	none
Rusting or Staining of Concrete	none
Any Seepage or Efflorescene	none
Joint Alignment	good
Unusual Seepage or Leaks in Gate Chamber	not known
Cracks	none visible
Rusting or Corrosion of Steel	none
Mechanical and Electrical	
Air Vents	none
Float Wells	none
Crane Hoist	none
Elevator	none
Hydraulic System	none
Service Gates	in operation condition
Emergency Gates	not known
Lightning Protection System	none
Emergency Power System	none
Wiring and Lighting System in Gate Chamber	none

INSPECTION CHECKLIST

PROJECT Durepo Brook Dam **DATE** Nov.8, 1979

PROJECT FEATURE Earthfill dam flood control **NAME** Lewis B. Seward

DISCIPLINE Hydro **NAME** Jan N. Jonas

AREA EVALUATED	CONDITIONS
TLET WORKS - TRANSITION AND CON-IT	not applicable
neral Condition of Concrete	
ıst or Staining on Concrete	
ıalling	
'osion or Cavitation	
'acking	
.ignment of Monoliths	
.ignment of Joints	
ımbering of Monoliths	

INSPECTION CHECKLIST

:OJECT Durepo Brook Dam — DATE Nov. 8, 1979

:OJECT FEATURE Earthfill Dam - flood control — NAME Lewis B. Seward

:SCIPLINE Hydro — NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
ET WORKS - OUTLET STRUCTURE OUTLET CHANNEL	
ral Condition of Concrete	very good
or Staining	none
ling	none
ion or Cavitation	none
ble Reinforcing	none
Seepage or Efflorescence	none visible
lition at Joints	tight
n Holes	Foundation drain outlets at wing walls - no -outflow
nel	
oose Rock or Trees Overhanging Channel	none
ondition of Discharge Channel	grassed embankments w/riprap

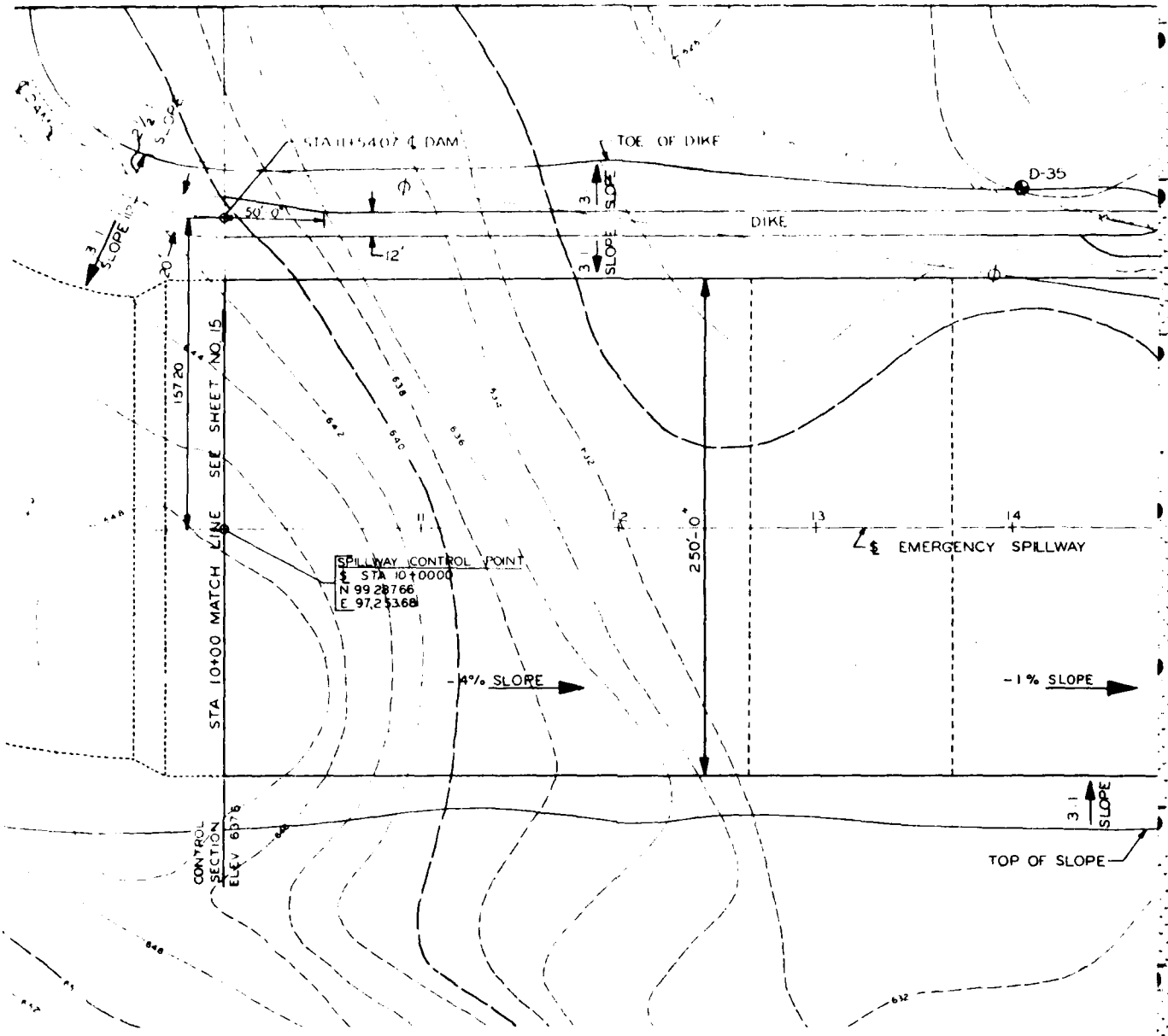
INSPECTION CHECKLIST

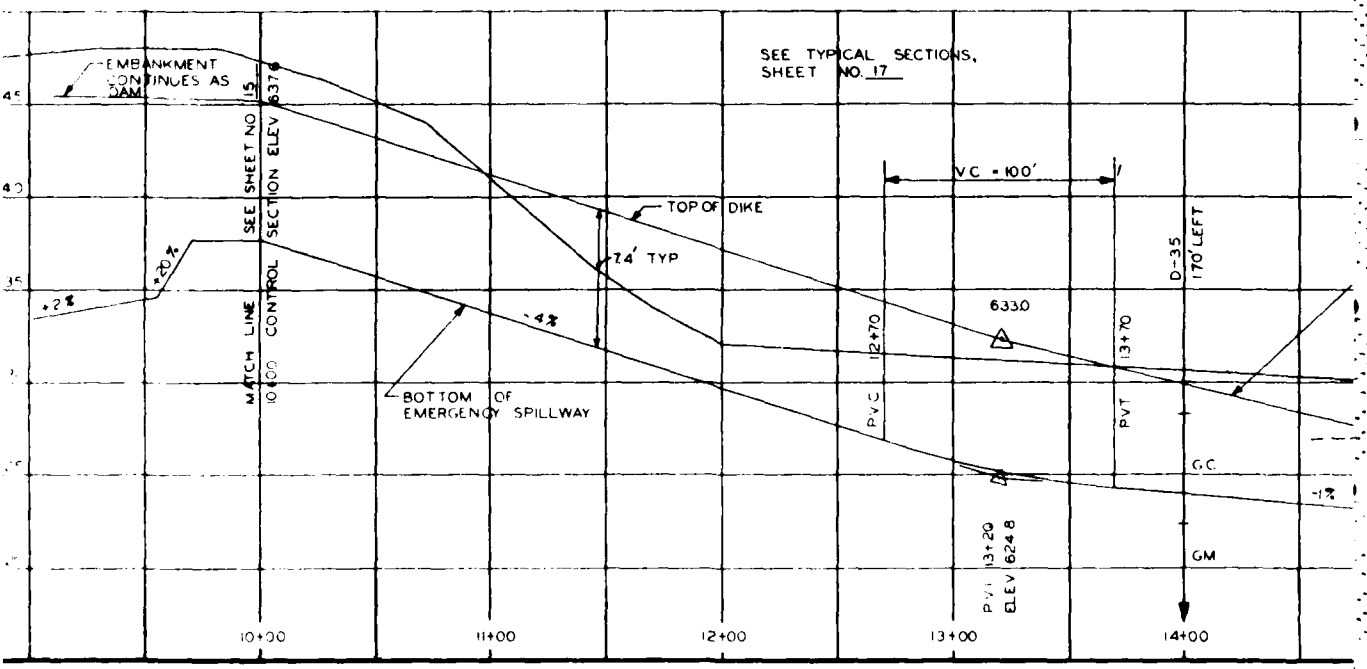
PROJECT Durepo Brook Dam **DATE** Nov. 8, 1979

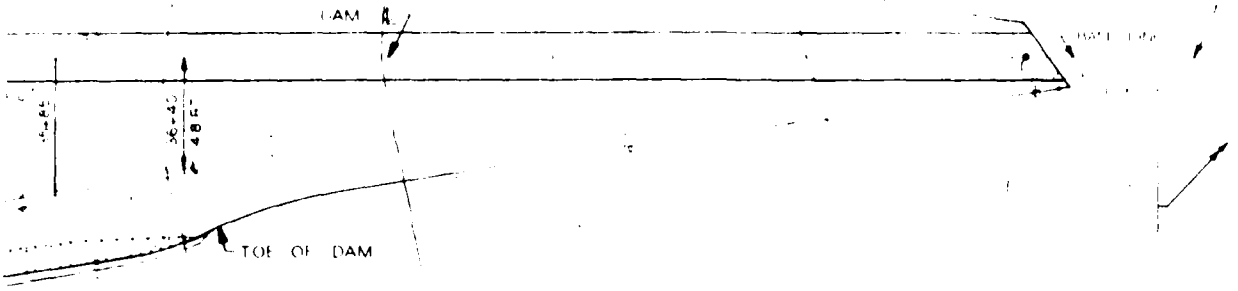
PROJECT FEATURE Earthfill dam - Flood control **NAME** Lewis B. Seward

DISCIPLINE Hydro **NAME** Jan N. Jonas

AREA EVALUATED	CONDITIONS
TLET WORKS - SPILLWAY WEIR, PROACH AND DISCHARGE CHANNELS	
Approach Channel	
General Condition	good - grassed excavated slopes
Loose Rock Overhanging Channel	none
Trees Overhanging Channel	none
Floor of Approach Channel	weathered rock partially grassed
Weir and Training Walls	not applicable
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	
Discharge Channel	nothing downstream
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Channel	
Other Obstructions	

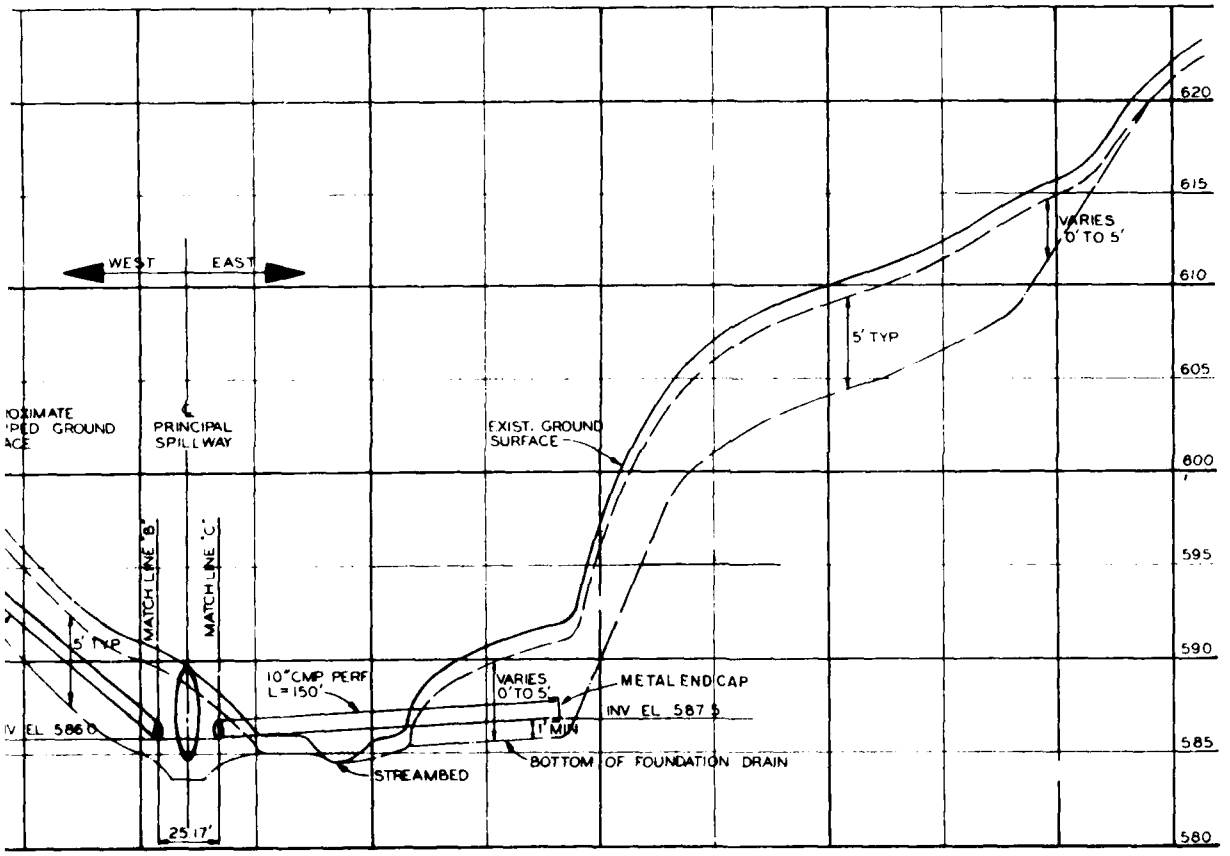






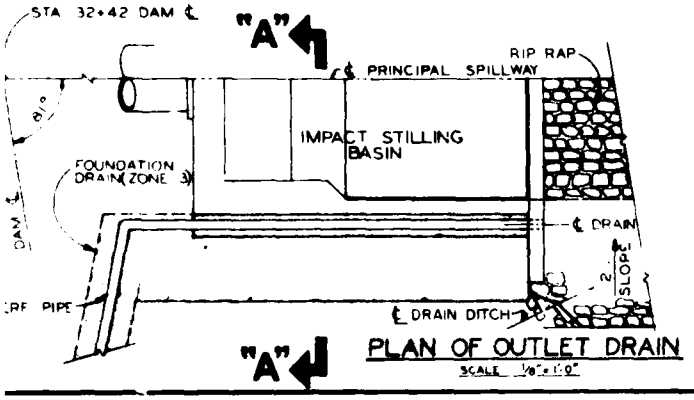
FOUNDATION DRAIN PLAN

SCALE 1"=40'



PROFILE ALONG CENTERLINE OF FOUNDATION DRAIN (DAM ℄ STA. 30+30 TO 36+40)

SCALE: 1"=5' VERT. 1"=40' HORZ.



PLAN OF OUTLET DRAIN

SCALE 1/8"=1'-0"

EDWARD C. JORDAN CO., INC.
CIVIL AND SANITARY ENGINEERS
PORTLAND, MAINE

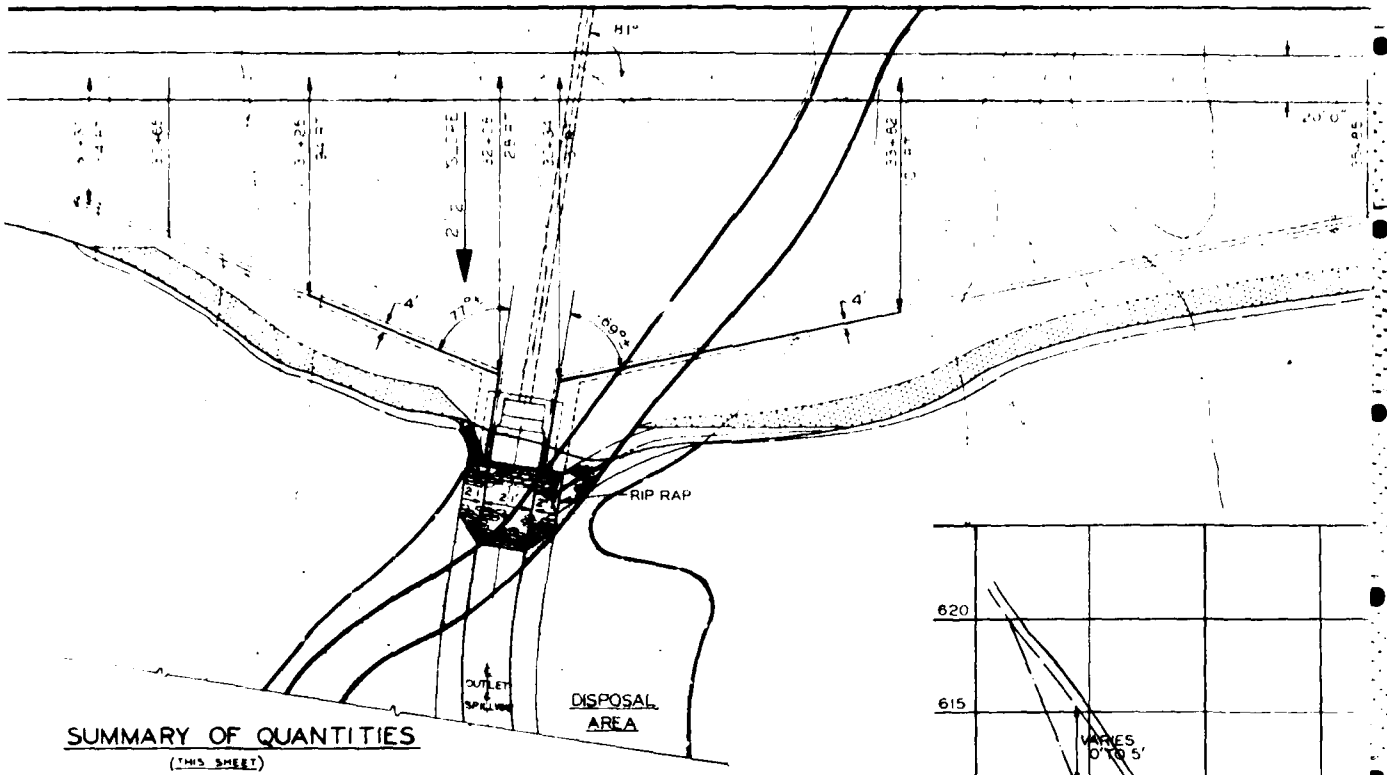
LIMESTONE STREAM WATERSHED PROJECT
MULTI-PURPOSE STRUCTURE NO. 1
DUREPO BROOK, LIMESTONE, MAINE

FOUNDATION DRAIN 2 OF 2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date		
Designed	S E WALKER	7-68	Approved by	
Drawn	R S COOK	7-68	Title	
Traced			Title	
Checked			Sheet No. 14 of 32	Drawing No. ME-502-P

35083 2

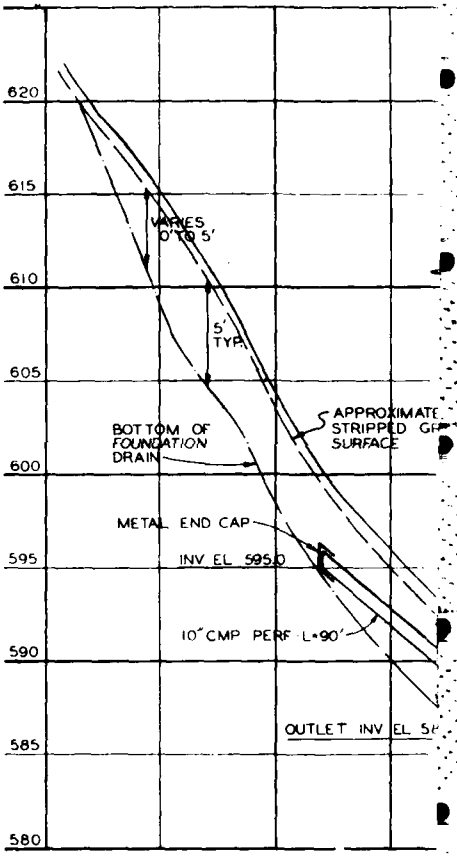


SUMMARY OF QUANTITIES

(THIS SHEET)

- 525 CU YDS OF DRAIN FILL (ZONE 3)
- 314 LF OF 10" DIA PERFORATED PIPE
- [illegible] 90° ELBOW
- [illegible] 45° ELBOW
- 2 METAL END CAPS

CONSTRUCTION DETAILS
SEE SHEET NO. 13



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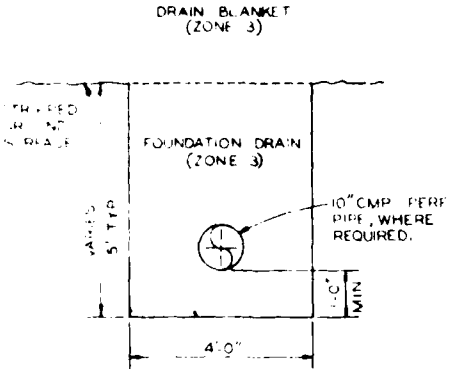
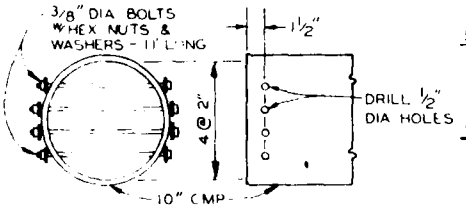
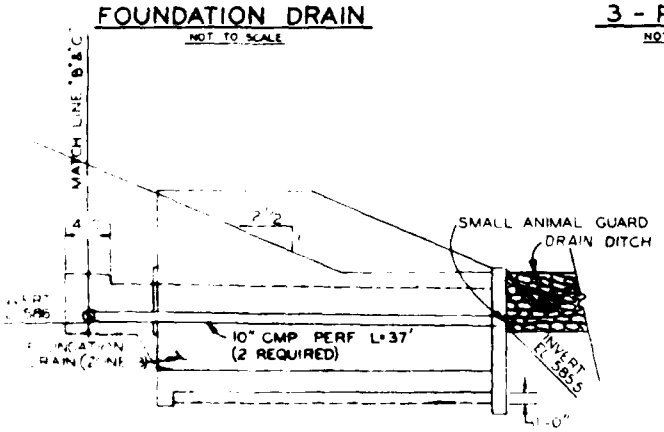


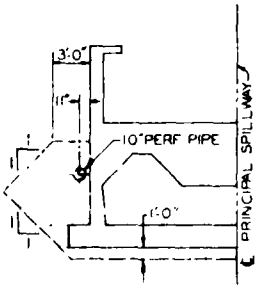
TYPICAL SECTION FOUNDATION DRAIN
NOT TO SCALE



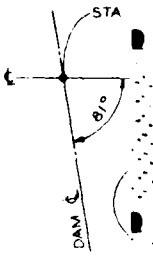
SMALL ANIMAL GUARD DETAIL
3 - REQUIRED
NOT TO SCALE



TYPICAL SECTION ALONG OUTLET DRAIN
SCALE

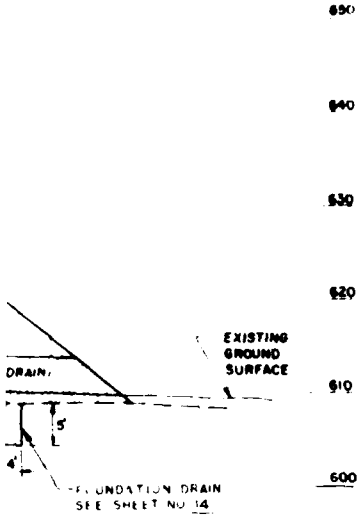


SECTION "A"-"A"
SCALE 1/8" = 1'-0"



CONSTRUCTION DETAILS:

1. MATERIALS NOT MEETING THE REQUIREMENTS FOR ZONE 2 BUT MEETING THE REQUIREMENTS FOR ZONE 1 MAY BE INCORPORATED IN THE UPSTREAM SHELL, HOWEVER THE DOWNSTREAM SHELL MUST BE CONSTRUCTED OF MATERIALS MEETING ZONE 2 REQUIREMENTS.
2. ALL PORTIONS OF THE STRIPPED FOUNDATION SURFACE ON WHICH ZONE 1 OR ZONE 2 MATERIALS ARE TO BE PLACE SHALL BE SCARIFIED TO A DEPTH OF 6 INCHES AND COMPACTED, PRIOR TO PLACEMENT OF THE EMBANKMENT MATERIALS
3. ALL PORTIONS OF THE STRIPPED FOUNDATION SURFACE ON WHICH ZONE 3 MATERIALS ARE TO BE PLACE SHALL BE PREPARED IN ACCORDANCE WITH CONSTRUCTION SPECIFICATION [redacted] 24
4. ALL BEDROCK SURFACES EXPOSED BY THE CUT-OFF TRENCH EXCAVATION SHALL BE THOROUGHLY CLEANED AND INSPECTED BY THE ENGINEER PRIOR TO THE PLACEMENT OF THE CUTOFF TRENCH BACKFILL



ON	REMARKS
IPACTION	
IMUM DENSITY	
F MAXIMUM DENSITY M D 698, METHOD D	MATERIAL MEETING THE REQUIREMENTS FOR ZONE 1 MAY BE ENCOUNTERED IN THE CUT-OFF TRENCH EXCAVATION AND IN PORTIONS OF BORROW AREA No 2
F MAXIMUM DENSITY M D 698, METHOD	MATERIAL MEETING THE REQUIREMENTS FOR ZONE 2 MAY BE ENCOUNTERED IN THE EMERGENCY SPILLWAY EXCAVATION AND IN PORTIONS OF BORROW AREA No 1
CONSTRUCTION FICATION [redacted] 24	LIMITED QUANTITIES OF MATERIAL MEETING THE REQUIREMENTS FOR ZONE 3 WERE ENCOUNTERED IN TEST PITS P-15 @ 3.5 TO 9.3' AND P-24 @ 2 TO 7'. AN OFF-SITE BORROW SOURCE MAY BE REQUIRED.
CONSTRUCTION IFICATION [redacted] 61	MATERIAL MEETING THE REQUIREMENTS FOR ZONE 4 MAY BE OBTAINED BY QUARRYING AT THE SITE, HOWEVER AN OFF SITE SOURCE MAY BE USED.

EDWARD C. JORDAN CO., INC
CIVIL AND SANITARY ENGINEERS
PORTLAND, MAINE

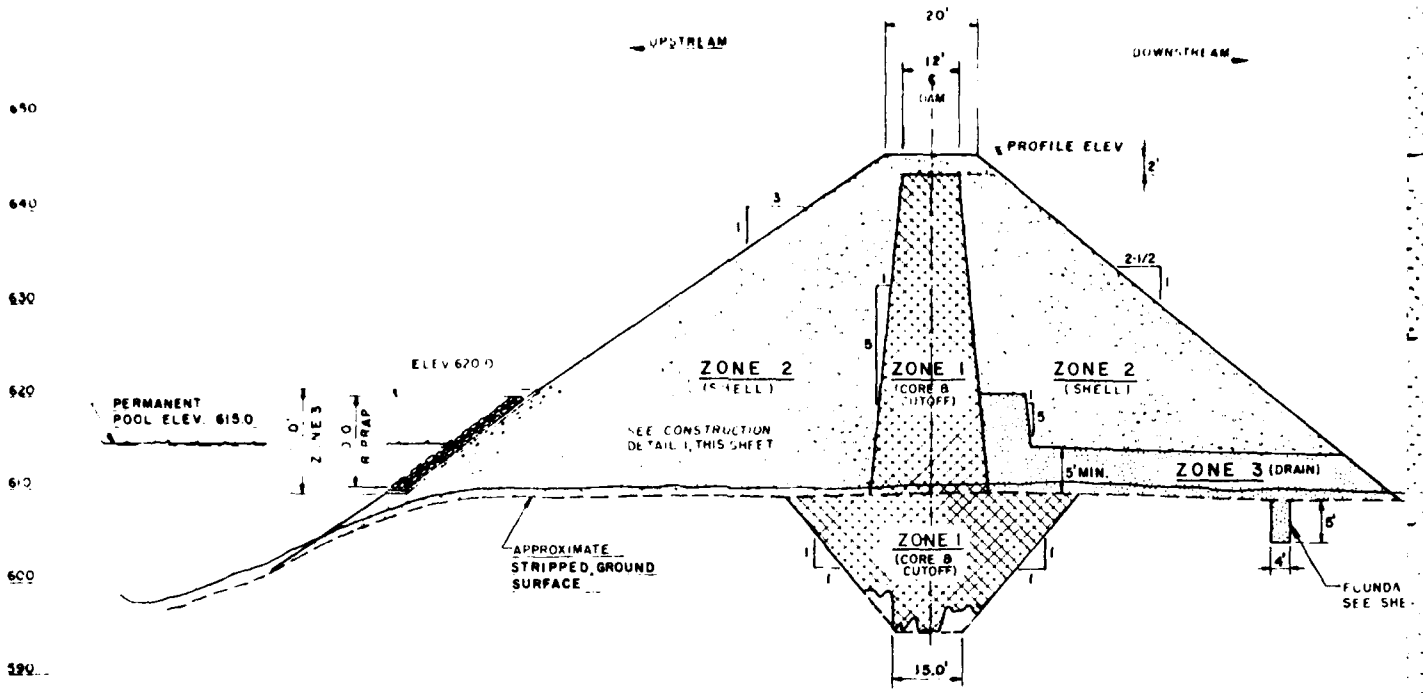
LIMESTONE STREAM WATERSHED PROJECT
MULTI-PURPOSE STRUCTURE NO 1
DUREPO BROOK, LIMESTONE, MAINE

EMBANKMENT SECTION 2 OF 2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed S.E. WALKER	7-68	Approved by
Drawn E.W. NC	7-68	Title
Traced		Title
Checked		Sheet No 12 of 32 — Drawing No ME-502-P

35083 2



EMBANKMENT SECTION AT ℄ STA. 35+00

TYPICAL — STA. 33+00 TO 37+00

Scale: HOR. 1"=20', VERT. 1"=10'

ZONE	MATERIAL								CONSTRUCTION			
	DESCRIPTION	GRADATION						PLASTICITY	MAXIMUM LIFT THICKNESS	MOISTURE CONTENT	COMPACTION	
		MAXIMUM PARTICLE SIZE	AVERAGE PARTICLE SIZE	PERCENT BY WEIGHT PASSING DESIGNATED SIEVE				PLASTICITY INDEX (LL-PL)			CLASS	MINIMUM DENSITY
				1 IN.	# 4	# 40	# 200					
1 CORE AND CUT OFF — CONST SPEC [redacted] 23	CLAYEY GRAVEL (GC) OR CLAYEY SAND (SC) (GLACIAL TILL) FROM EMERGENCY SPILLWAY EXCAVATION REPRESENTED BY MATERIAL IN TEST PIT TP-5 @ 2' TO 8' OR BORROW AREA Nº 1 REPRESENTED BY MATERIAL IN TEST PITS 3 @ 2 TO 5'	6 IN			50% (MIN.)		30% MIN.)	5 (MIN)	9 IN LOOSE	OMC-1% TO OMC+2%	A	95% OF MAXIMUM DENSITY BY ASTM D 698, METHOD
2 SHELL — CONST SPEC [redacted] 23	SILTY GRAVEL (GM) OR SILTY SAND (SM), FROM BORROW AREA Nº 2 REPRENTED BY MATERIAL FROM TEST PIT B-1 @ 15' TO 7'	10 IN			35% (MIN)		30% (MAX)	5 (MAX)	12 IN LOOSE	OMC-2% TO OMC+2%	A	95% OF MAXIMUM DENSITY BY ASTM D 698, METHOD D
3 DRAINS AND FILTERS — CONST SPEC [redacted] 24	WELL GRADED GRAVELLY SAND (SW) OR SANDY GRAVEL (GW)	6 IN			35% TO 75%	5% TO 30%	0% TO 5%	NON-PLASTIC	9 IN. LOOSE			(SEE CONSTRUCTION SPECIFICATION [redacted] 24
4 RIPRAP — CONST SPEC [redacted] 61	HARD DURABLE ROCK FRAGMENTS OR FIELD STONES	18 IN	12 IN	10% (MAX.)					18 IN LOOSE			(SEE CONSTRUCTION SPECIFICATION [redacted] 61

172

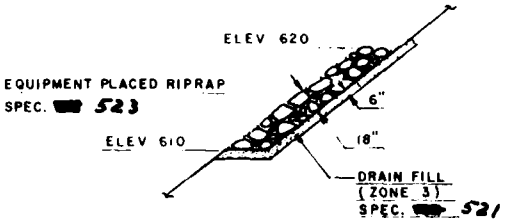
660

650

640

630

620



RIPRAP DETAIL

Not To Scale

650

640

630

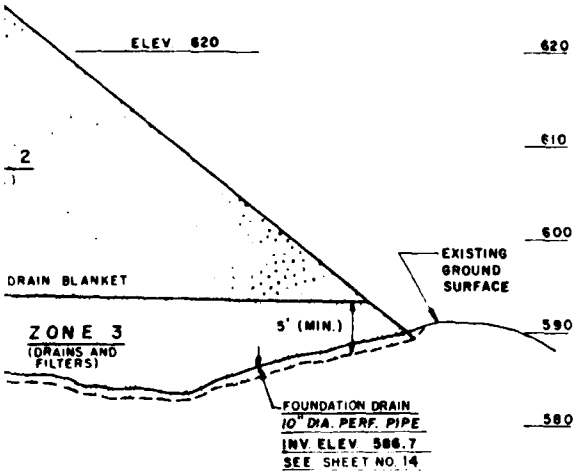
620

610

600

590

580

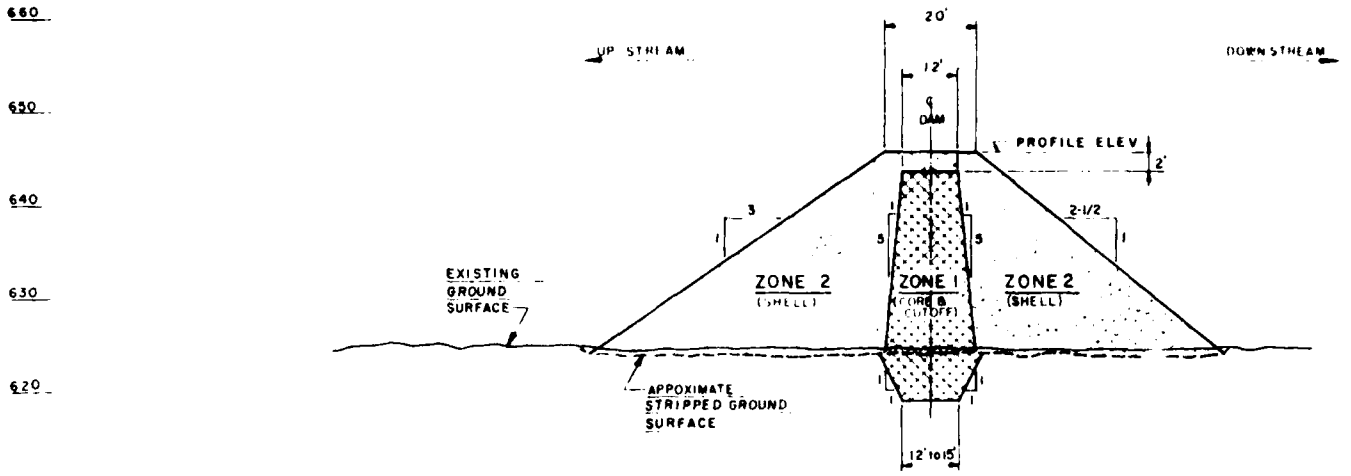


NOTE

FOR MATERIAL REQUIREMENTS AND CONSTRUCTION DETAILS SEE SHEET NO 12

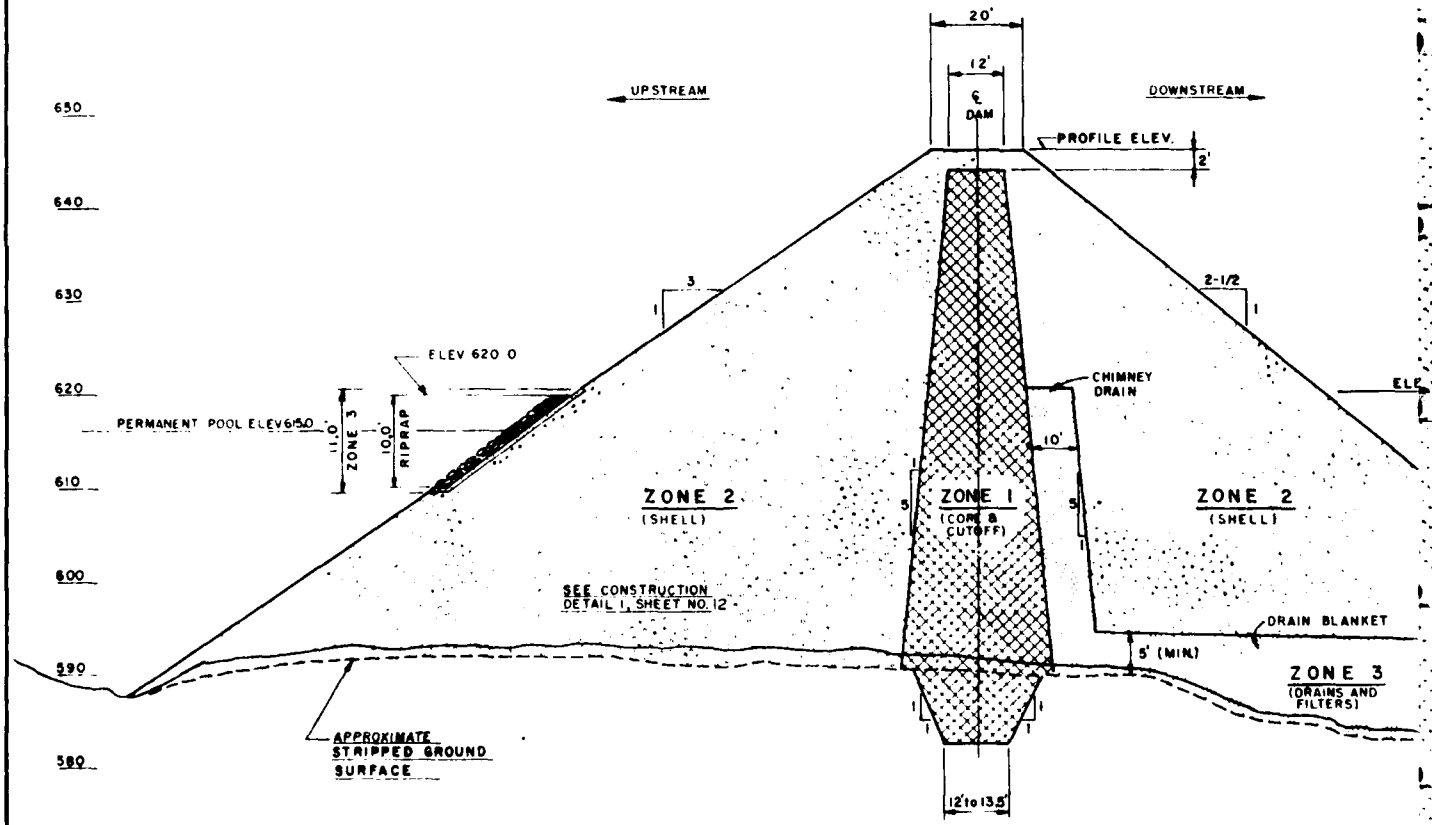
EDWARD C. JORDAN CO., INC. CIVIL AND SANITARY ENGINEERS PORTLAND, MAINE	
LIMESTONE STREAM WATERSHED PROJECT MULTI-PURPOSE STRUCTURE NO.1 DUREPO BROOK, LIMESTONE, MAINE	
EMBANKMENT SECTIONS 1 OF 2	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed S.E. WALKER 7-68	Approved by
Drawn F.W. N.C. 7-68	Title
Traced	Title
Checked	Sheet No 11 of 32 — Drawing No ME-502-P

35083.2



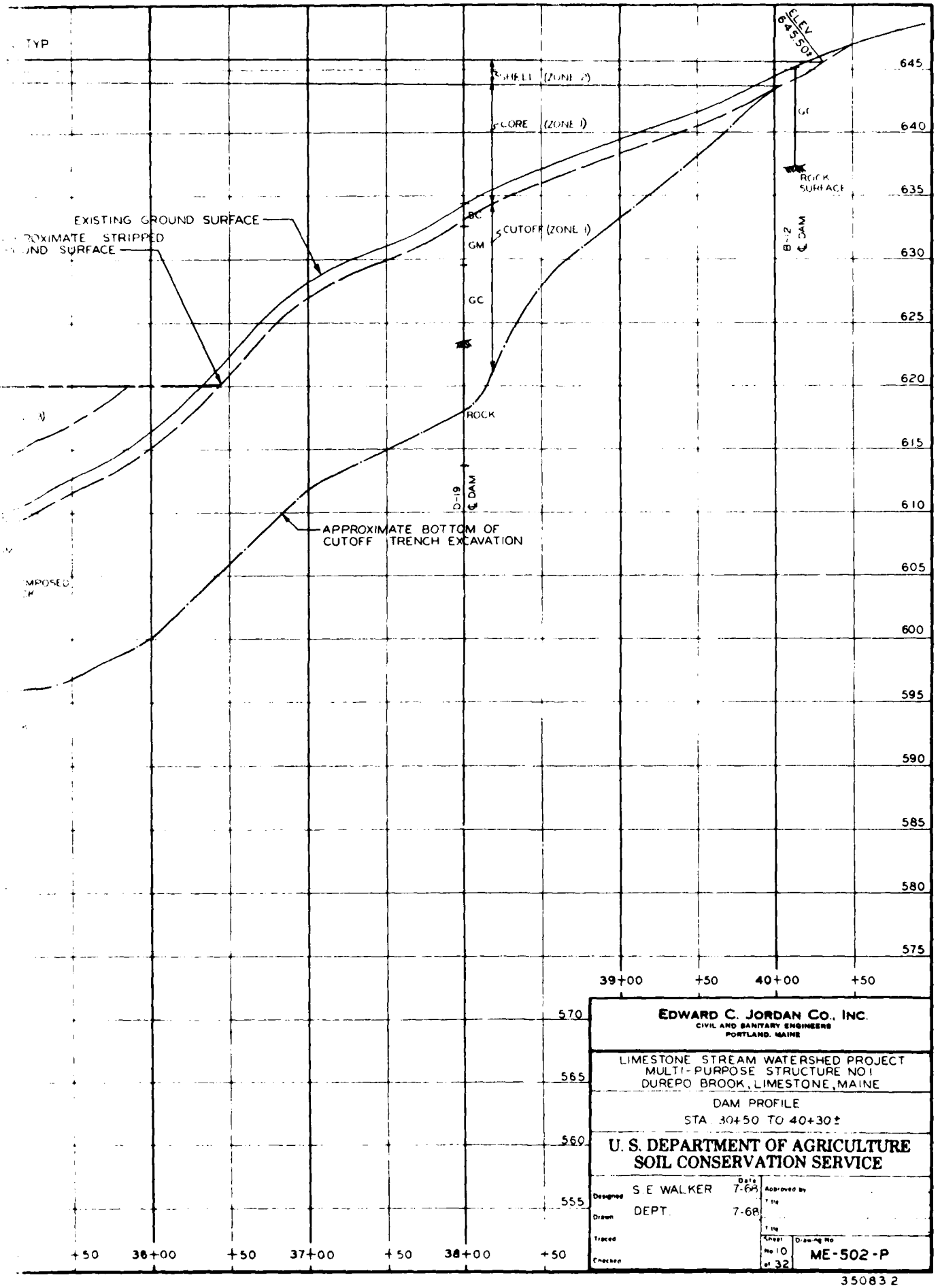
EMBANKMENT SECTION AT ℄ STA. 18+50
TYPICAL — STA. 11+54.07 TO 20+70
— STA. 37+00 TO 40+00

Scale: HOR 1"=20', VERT 1"=10'



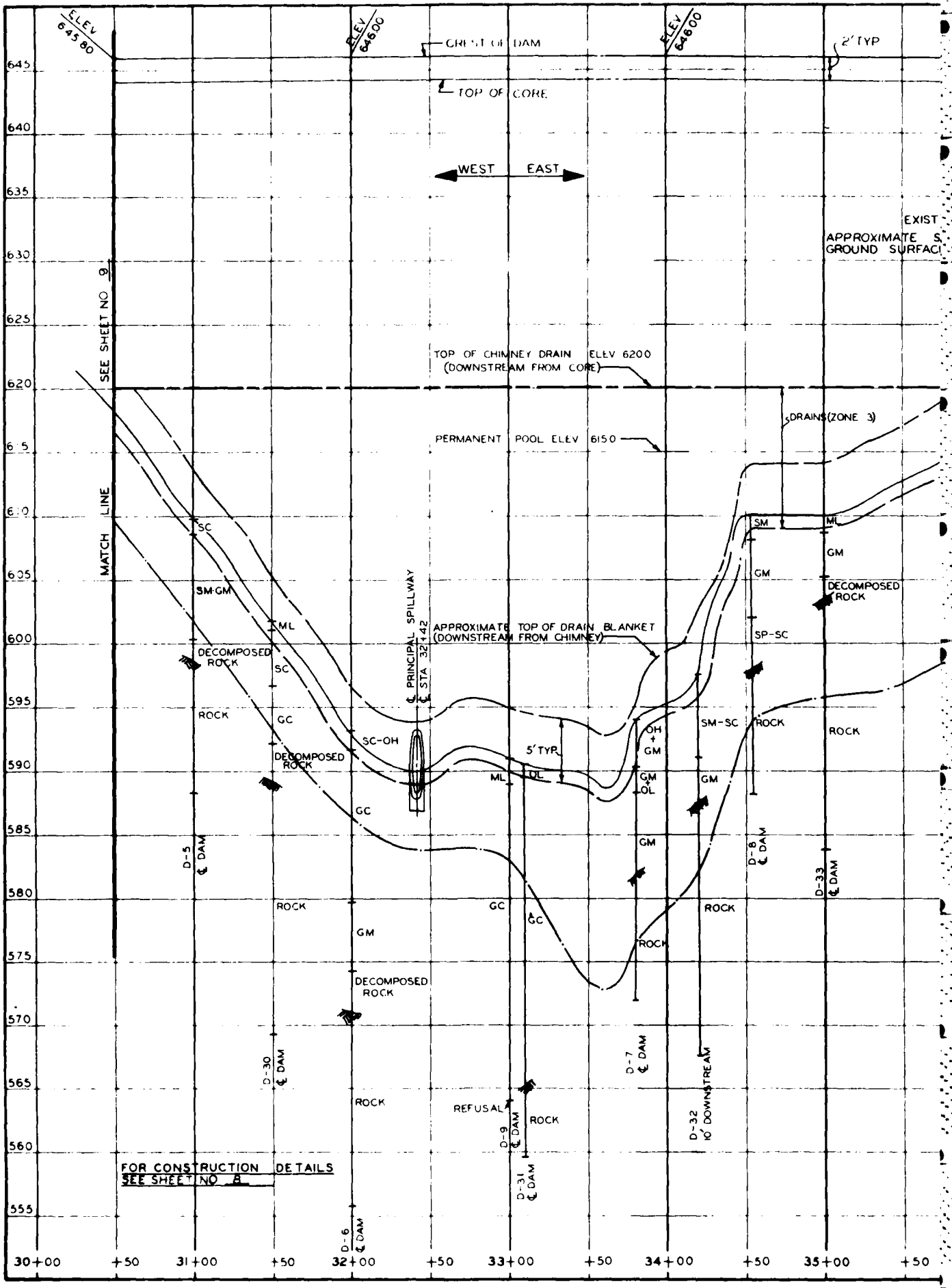
EMBANKMENT SECTION AT ℄ STA. 33+00
TYPICAL — STA. 20+70 TO 33+00

Scale: HOR. 1"=20', VERT. 1"=10'



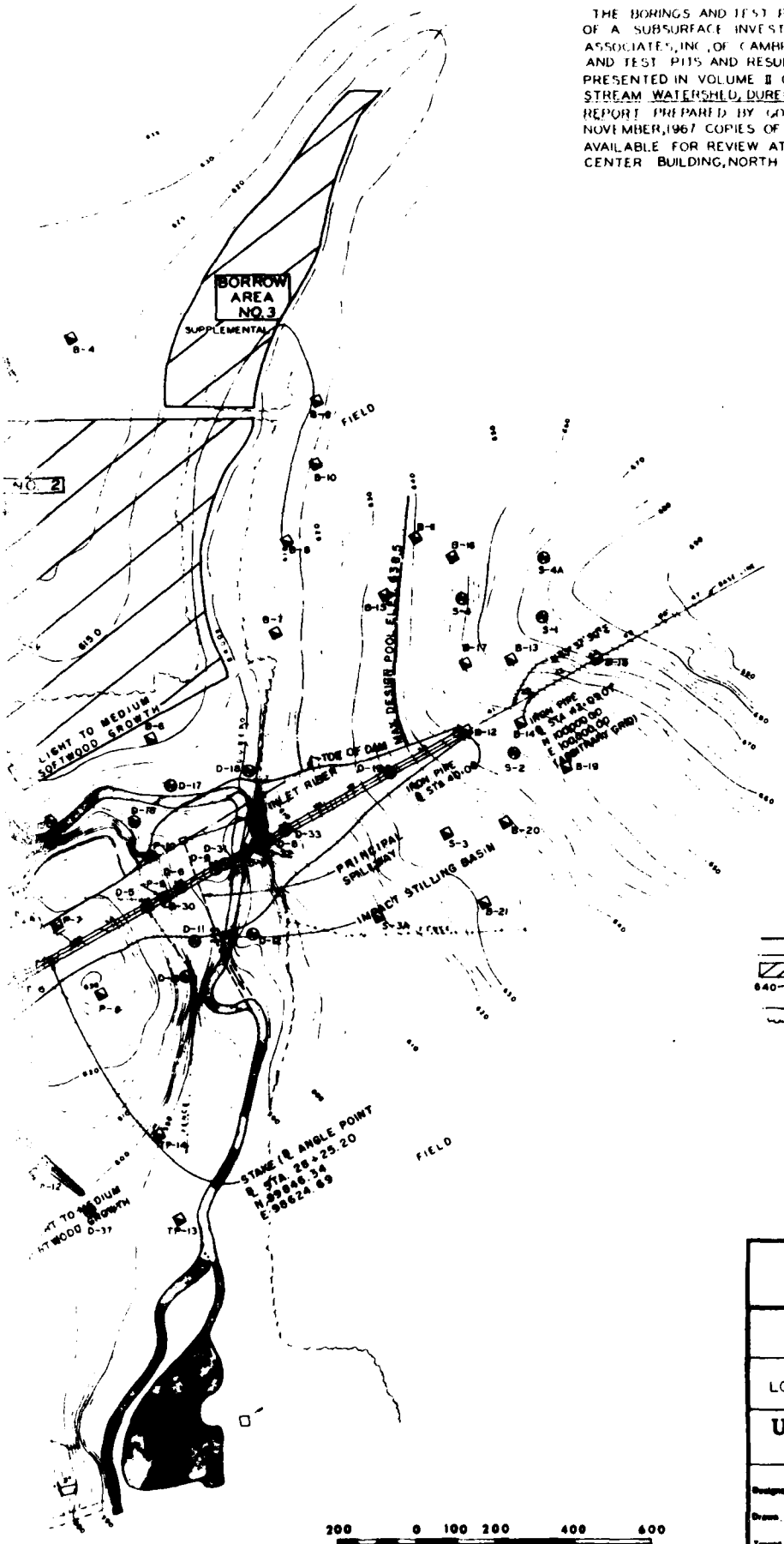
EDWARD C. JORDAN CO., INC. CIVIL AND SANITARY ENGINEERS PORTLAND, MAINE	
LIMESTONE STREAM WATERSHED PROJECT MULTI-PURPOSE STRUCTURE NO1 DUREPO BROOK, LIMESTONE, MAINE	
DAM PROFILE STA 30+50 TO 40+30±	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed S.E. WALKER Date 7-68	Approved by
Drawn DEPT. 7-68	Title
Traced	Title
Checked	Sheet no 10 of 32 — Drawing No ME-502-P

350832



(1)

THE BORINGS AND TEST PITS INDICATED WERE MADE AS PART OF A SUBSURFACE INVESTIGATION MADE BY GOLDBERG ZOINO & ASSOCIATES, INC. OF CAMBRIDGE, MASS. LOGS OF THE BORINGS AND TEST PITS AND RESULTS OF LABORATORY SOIL TESTS ARE PRESENTED IN VOLUME II OF A REPORT ENTITLED LIMESTONE STREAM WATERSHED, DUREPO BROOK SITE NO 1, FINAL GEOLOGY REPORT PREPARED BY GOLDBERG ZOINO & ASSOCIATES, DATED NOVEMBER, 1967 COPIES OF VOLUME II OF THIS REPORT ARE AVAILABLE FOR REVIEW AT THE AROOSTOOK AGRICULTURAL CENTER BUILDING, NORTH MAIN ST, PRESQUE ISLE, MAINE



LEGEND

- MAX. DESIGN POOL ELEVATION
- PERMANENT POOL ELEVATION
- BORROW AREA
- 640 CONTOUR
- ℄ BROOK
- WOOD LINE
- TEST BORING
- TEST PIT

EDWARD C. JORDAN CO., INC.
CIVIL AND SANITARY ENGINEERS
PORTLAND, MAINE

LIMESTONE STREAM WATERSHED PROJECT
MULTI-PURPOSE STRUCTURE NO.1
DUREPO BROOK, LIMESTONE, MAINE

LOCATION OF BORINGS AND TEST PITS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	S.E. WALKER	7-68
Drawn	J.D. DOWNES	7-68
Traced		
Checked		

Approved by ..... Title .....
Title .....
Sheet No. 4 of 32
Drawing No. ME-502-P

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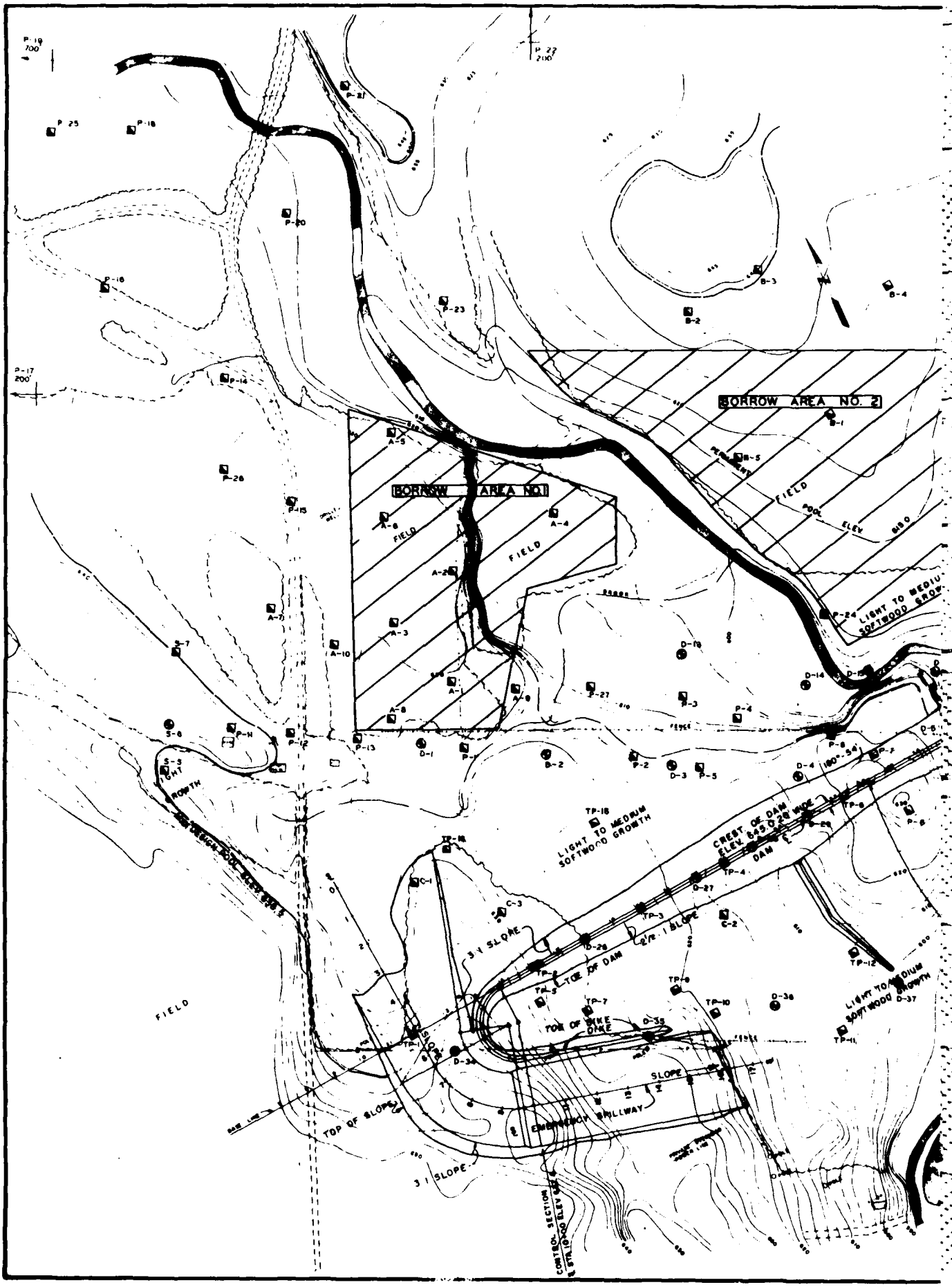


References

Material from the following references was extracted and incorporated herein:

a. "Limestone Stream Watershed Work Plan" Central Aroostook Soil Conservation District December, 1964.

b. "Durepo Brook Construction Drawings"

c. "Durepo Brook - Invitation to Bid" March 1971 SCS construction specification (Typ.)

d. SCS Technical Information Retrieval System Printout.

APPENDIX B

ENGINEERING DATA

Note: 1. All design records are in storage at the:

National Archives and Records Service
GSA Federal Archives and Records Center
380 Trapelo Road, Waltham, Massachusetts 02154
617-223-2657

2. No past inspection reports were available for review.

3. The following drawings are construction prints from the U. S. Department of Agriculture, Soil Conservation Service, Project No. ME-502-P.

	Title of Drawing	Sheet Number
1.	Location of Borings and Test Pits	4 of 32
2.	Dam Profile	10 of 32
3.	Embankment Sections 1 of 2	11 of 32
4.	Embankment Section 2 of 2	12 of 32
5.	Foundation Drain 2 of 2	14 of 32
6.	Plan/Profile Emergency Spillway 2 of 2	16 of 32
7.	Plan/Profile Principal Spillway	18 of 32
8.	Grouting Details	32 of 32

INSPECTION CHECKLIST

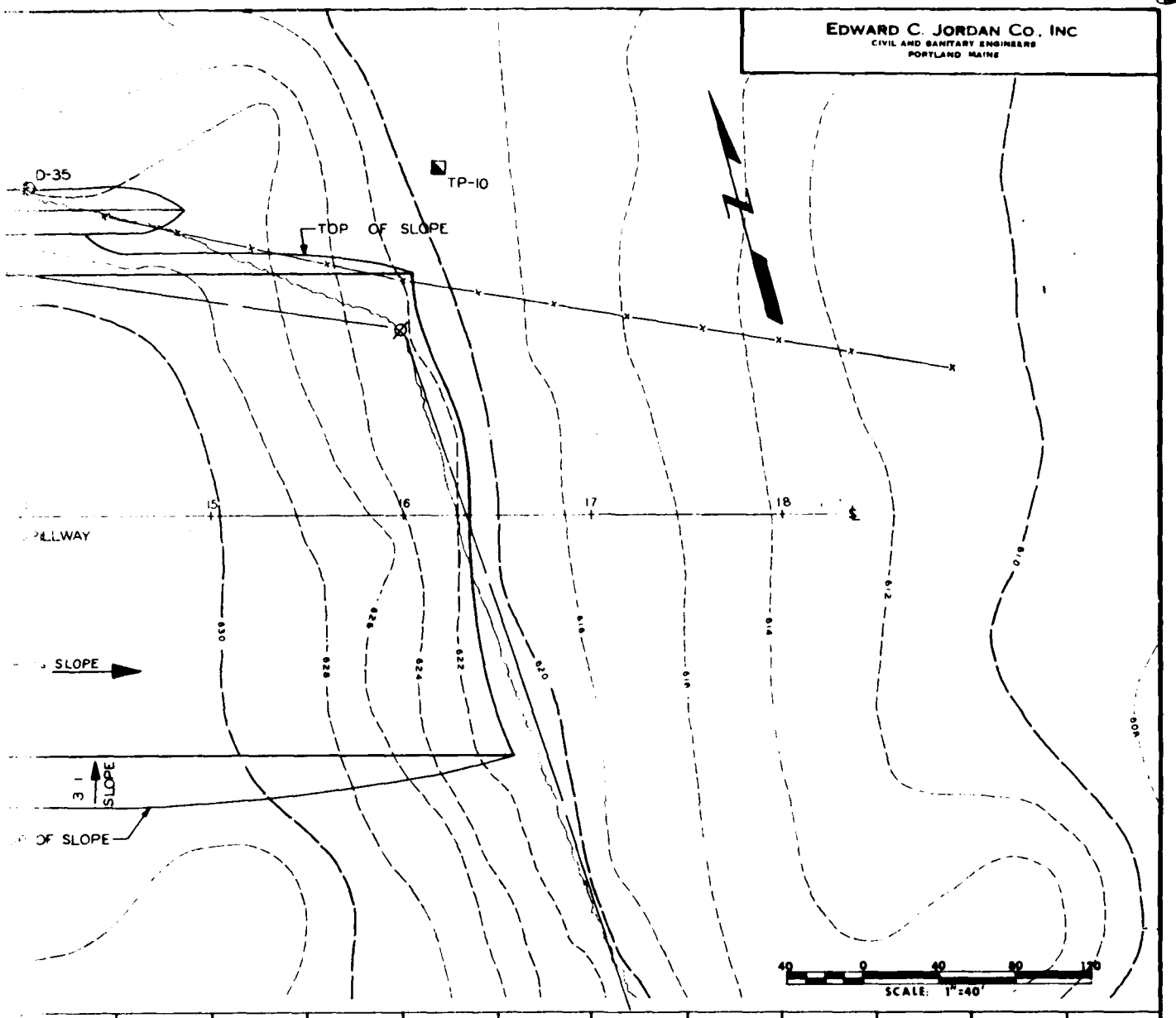
PROJECT Durepo Brook Dam **DATE** Nov. 8, 1979

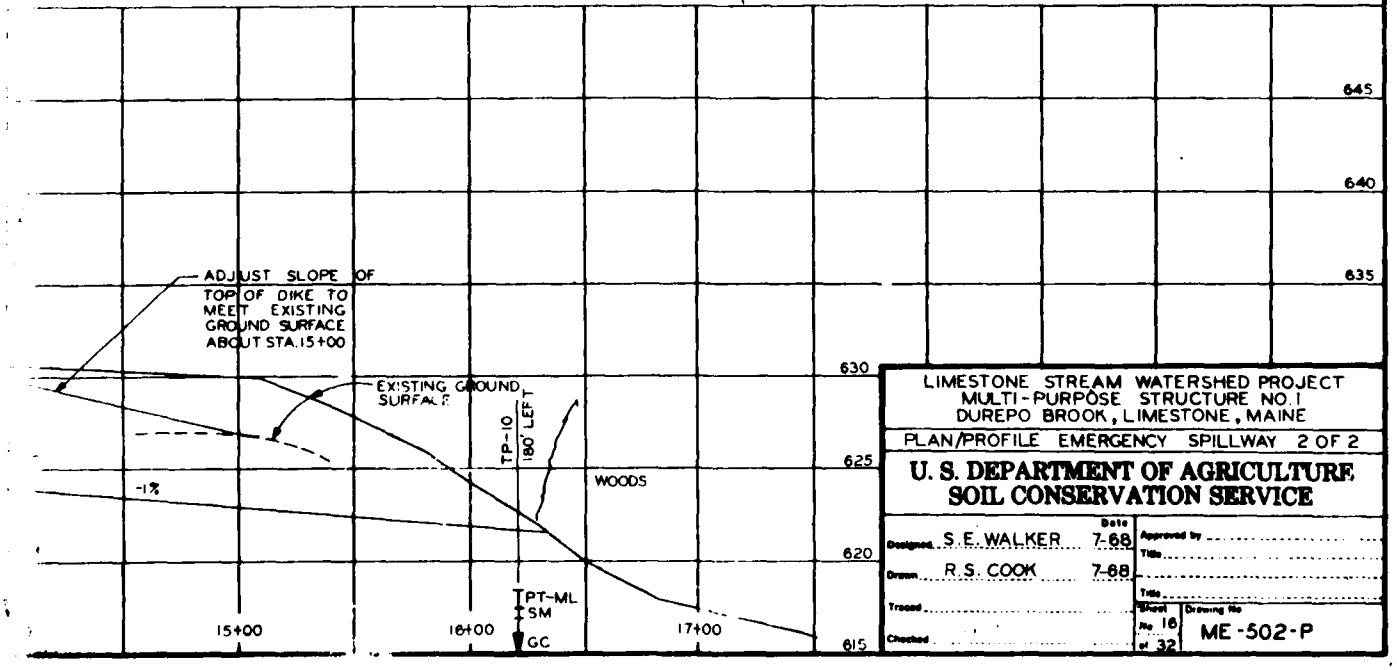
PROJECT FEATURE Earthfill dam flood control **NAME** Lewis B. Seward

DISCIPLINE Hydro **NAME** Jan N. Jonas

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	None
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

EDWARD C. JORDAN CO., INC
CIVIL AND SANITARY ENGINEERS
PORTLAND, MAINE





LIMESTONE STREAM WATERSHED PROJECT
MULTI-PURPOSE STRUCTURE NO. 1
DUREPO BROOK, LIMESTONE, MAINE

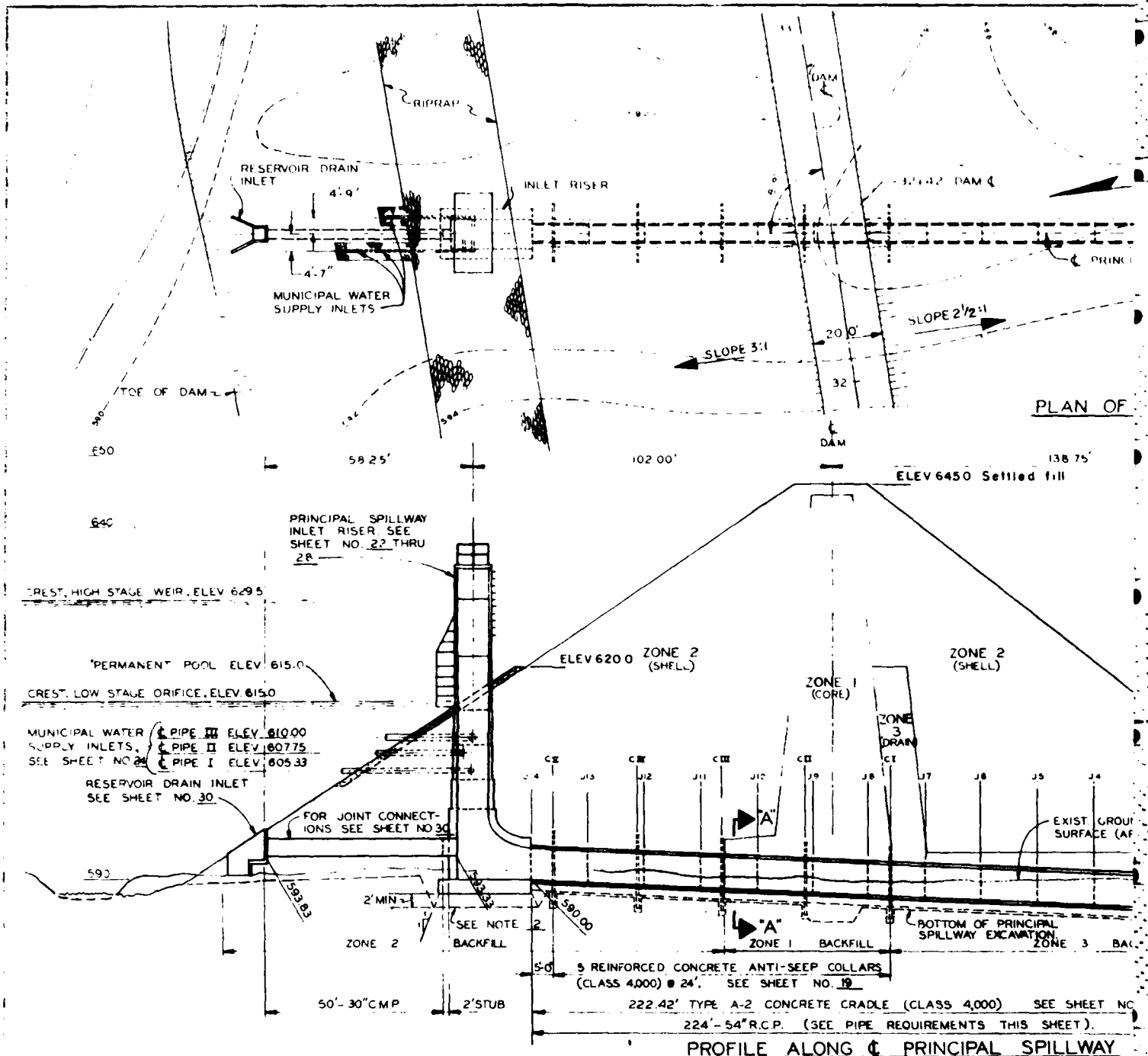
PLAN/PROFILE EMERGENCY SPILLWAY 2 OF 2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	S.E. WALKER	7-68	Approved by
Drawn	R.S. COOK	7-68	Title
Traced			Title
Checked			Sheet No. 16 of 32

Drawing No. ME-502-P

35083.2



PROFILE ALONG ℄ PRINCIPAL SPILLWAY

SCALE: 1"=10' VERT., 1"=50' HOR.

CONSTRUCTION DATA

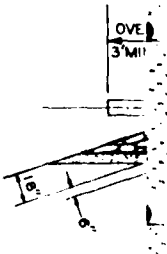
JOINT	DISTANCE FROM OUTLET END OF PIPE*	INVERT EL. 54" PIPE INCLUDING CHAMBER **	JOINT	DISTANCE FROM OUTLET END OF PIPE*	INVERT EL. 54" PIPE INCLUDING CAMBER **
0	0'	585.00	J-12	192'	589.58
1	16'	585.47	J-13	208'	589.81
2	32'	585.91	J-14	224'	590.00
3	48'	586.36	ANTI-SEEP COLLAR		
4	64'	586.78			
5	80'	587.19			
6	96'	587.59	C-I	122'	588.24
7	112'	587.98	C-II	146'	588.77
8	128'	588.36	C-III	170'	589.24
9	144'	588.71	C-IV	194'	589.62
10	160'	589.04	C-V	218'	589.91
11	176'	589.33			

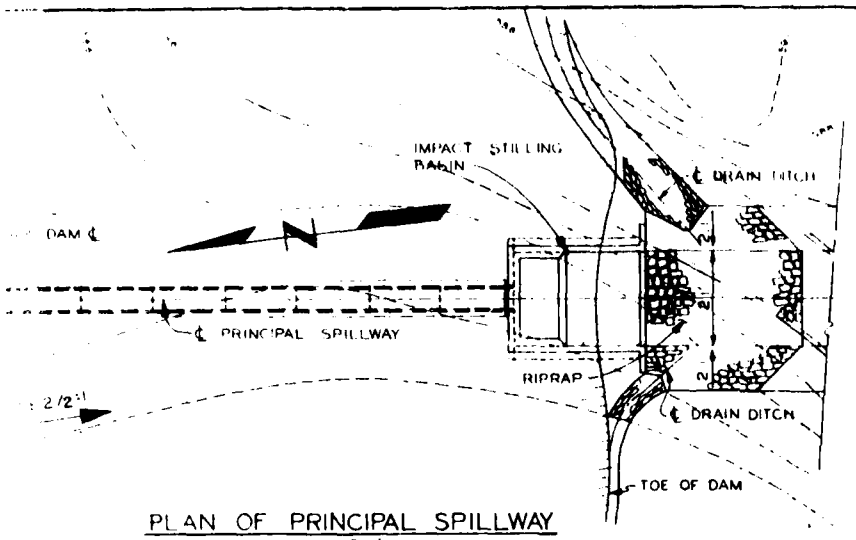
* ABOVE DISTANCES ARE BASED ON NOMINAL 16' LENGTHS OF PIPE AND DO NOT INCLUDE CREEP.

** MAX. CAMBER = 0.50' @ DAM ℄

PIPE REQUIREMENTS

INSTALLATION	SPECIFICATIONS
RESERVOIR DRAIN PIPE	MATERIAL SPECIFICATION [redacted] 54' 30" I.D., 16 GAGE, SHAPE 1, CLASS 1, TYPE "A" NON-PERFORATED.
PRINCIPAL SPILLWAY CONDUIT	MATERIAL SPECIFICATION [redacted] 541 54" I.D., PRESTRESSED STEEL CYLINDER TYPE, CONCRETE PRESSURE PIPE: A. EMBANKMENT LOAD ON PIPE = 76 300 LB./FT. (BASED ON 66" O.D.). B. MIN. 3-EDGE BEARING STRENGTH AT FIRST 0.001 INCH. CRACK = 19 200 LB/FT. (AWWA C-301) (BASED ON TYPE A-2 CONCRETE CRADLE). C. MIN. EFFECTIVE JOINT LENGTH = 1.60" (SEE DETAIL SHEET NO. 19).
MUNICIPAL WATER SUPPLY INLETS	MATERIAL SPECIFICATION 500 8" AND 10" I.D., A.S.A. THICKNESS CLASS 2, MECHANICAL JOINTS





PLAN OF PRINCIPAL SPILLWAY

SCALE 1"=20'

CONSTRUCTION DETAILS

1. ACTUAL REQUIRED HORIZONTAL AND VERTICAL ALIGNMENT OF THE PRINCIPAL SPILLWAY OUTLET CHANNEL TO BE DETERMINED IN THE FIELD BY THE ENGINEER.

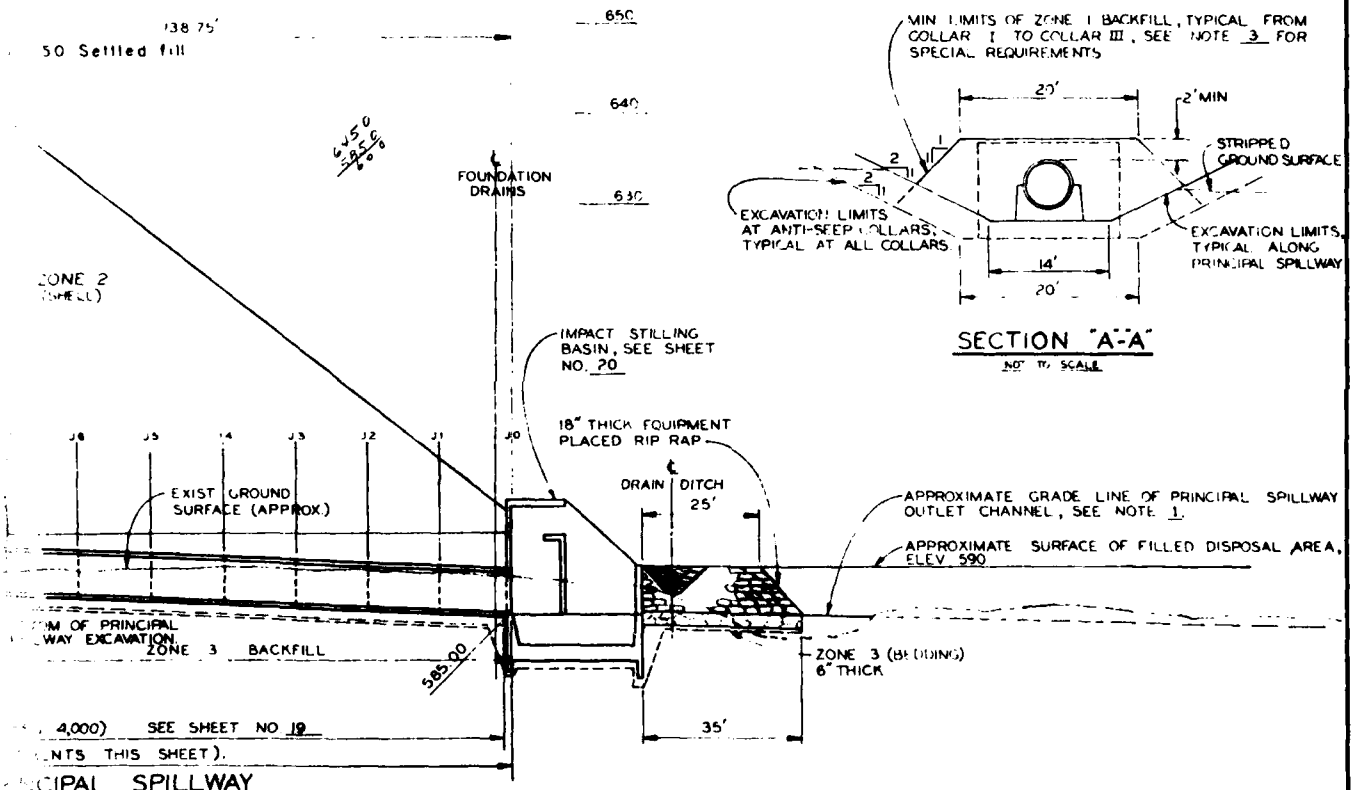
2. SUBGRADE FOR BENEATH INLET RISER FOUNDATION SHALL MEET THE MATERIAL REQUIREMENTS FOR ZONE 2 AND BE COMPACTED TO A DENSITY NOT LESS THAN 95% MAXIMUM DENSITY BY ASTM D 557, METHOD D.

3. CONDUIT BACKFILL (TO THE LIMITS INDICATED) SHALL MEET ZONE 1 REQUIREMENTS EXCEPT AS FOLLOWS:

   A. NO STONE LARGER THAN 3" IN MAX DIMENSION SHALL BE ALLOWED WITHIN 2' OF THE CONDUIT OR COLLARS.

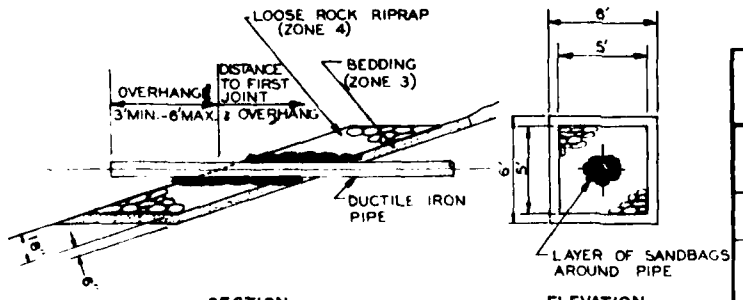
   B. PLASTICITY INDEX SHALL BE 10 OR GREATER.

   C. COMPACTION MOISTURE CONTENT SHALL BE BETWEEN OMC AND OMC+3%.



SECTION "A-A"

NOT TO SCALE



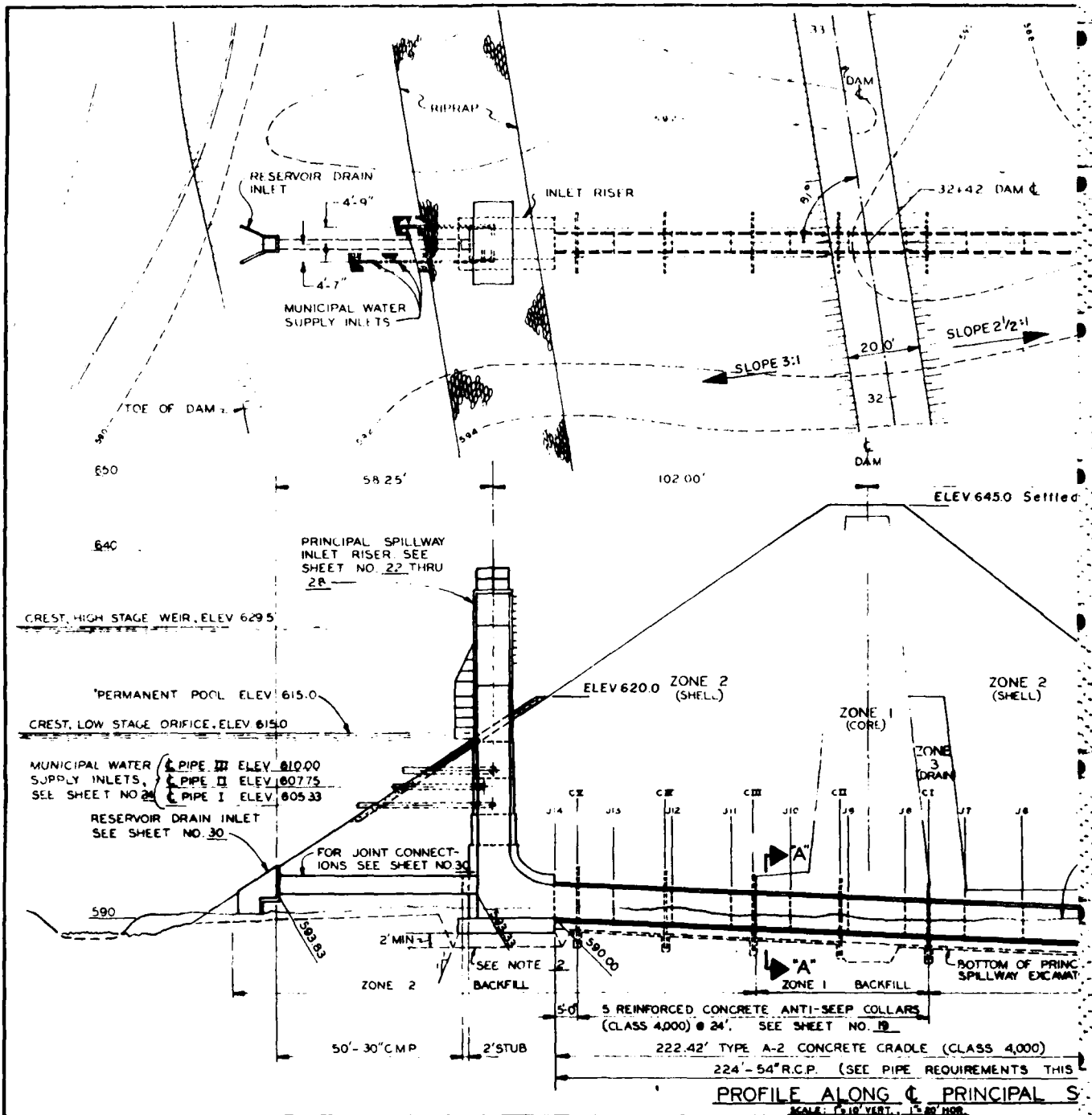
SECTION ELEVATION

TYPICAL WATER SUPPLY INLET RIPRAP DETAIL

(ADJUST ROCK RIPRAP DIMENSIONS AS REQUIRED)

NOT TO SCALE

EDWARD C. JORDAN CO., INC. CIVIL AND SANITARY ENGINEERS PORTLAND, MAINE	
LIMESTONE STREAM WATERSHED PROJECT MULTI-PURPOSE STRUCTURE NO.1 DUREPO BROOK, LIMESTONE, MAINE	
PLAN/PROFILE PRINCIPAL SPILLWAY	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed S.E. WALKER 7-68	Approved by Title
Drawn R.S. COOK 7-68	Title
Traced	Sheet No 18 of 32
Checked	Drawing No ME - 502-P



PROFILE ALONG ℄ PRINCIPAL S

SCALE: 1"=10' VERT., 1"=80' HOR.

CONSTRUCTION DATA

JOINT	DISTANCE FROM OUTLET END OF PIPE *	INVERT EL 54" PIPE INCLUDING CHAMBER * *	JOINT	DISTANCE FROM OUTLET END OF PIPE *	INVERT EL 54" PIPE INCLUDING CAMBER * *
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J - 1	16'	585.47	J - 13	208'	589.81
J - 2	32'	585.91	J - 14	224'	590.00
J - 3	48'	586.36	ANTI-SEEP COLLAR		
J - 4	64'	586.78			
J - 5	80'	587.19			
J - 6	96'	587.59	C - I	122'	588.24
J - 7	112'	587.98	C - II	146'	588.77
J - 8	128'	588.36	C - III	170'	589.24
J - 9	144'	588.71	C - IV	194'	589.62
J - 10	160'	589.04	C - V	218'	589.94
J - 11	176'	589.33			

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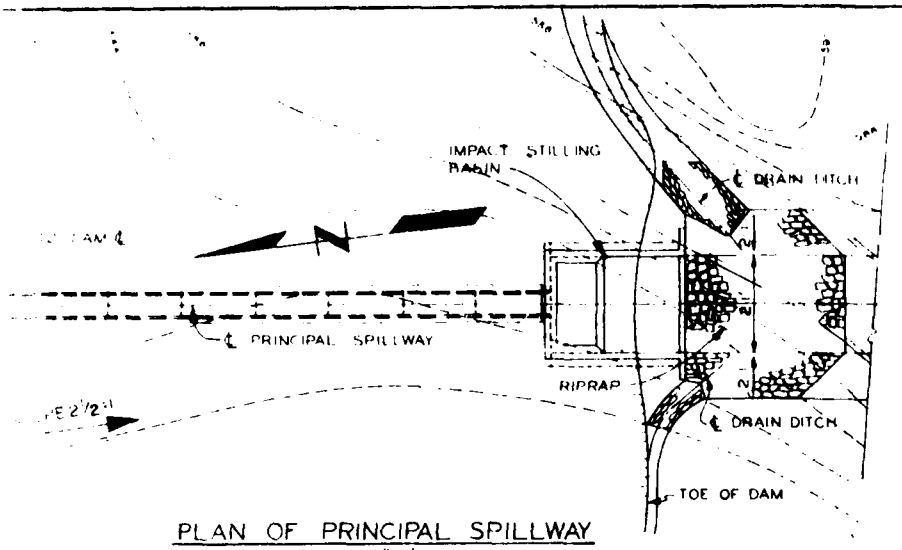
MUNICIPAL WATER SUPPLY INLETS	MATERIAL SPECIFICATION 500 8" AND 10" I.D, A.S.A. THICKNESS CLASS 2, MECHANICAL JOINTS



PLAN OF PRINCIPAL SPILLWAY

SCALE 1"=20'

CONSTRUCTION DETAILS

1. ACTUAL REQUIRED HORIZONTAL AND VERTICAL ALIGNMENT OF THE PRINCIPAL SPILLWAY OUTLET CHANNEL TO BE DETERMINED IN THE FIELD BY THE ENGINEER.

2. SUBGRADE FOR BENEATH INLET RISER FOUNDATION SHALL MEET THE MATERIAL REQUIREMENTS FOR ZONE 2 AND BE COMPACTED TO A DENSITY NOT LESS THAN 95% MAXIMUM DENSITY BY ASTM D 557, METHOD D.

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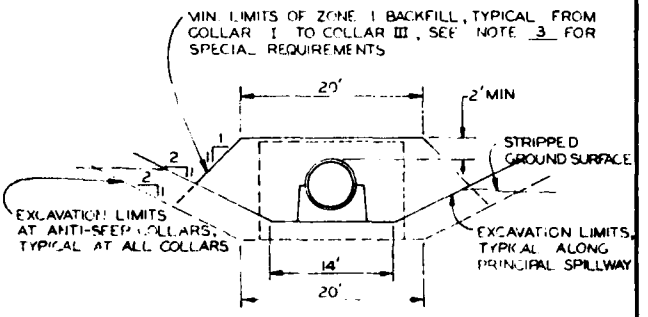
   B. PLASTICITY INDEX SHALL BE 10 OR GREATER.

   C. COMPACTION MOISTURE CONTENT SHALL BE BETWEEN OMC AND OMC+3%.



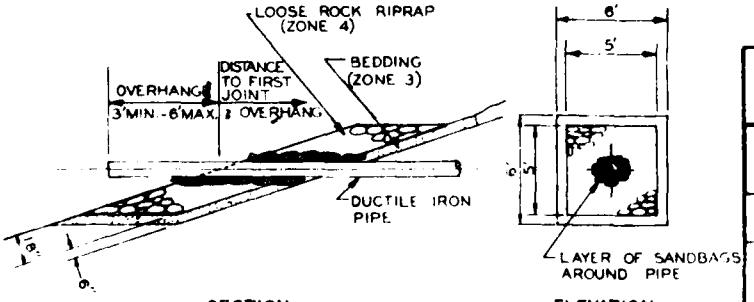
SECTION "A"-A"

NOT TO SCALE

...S 4,000) SEE SHEET NO 19

...MENTS THIS SHEET).

...NCIPAL SPILLWAY



SECTION ELEVATION

TYPICAL WATER SUPPLY INLET RIPRAP DETAIL

(ADJUST ROCK RIPRAP DIMENSIONS AS REQUIRED)

NOT TO SCALE

EDWARD C. JORDAN CO., INC.
CIVIL AND SANITARY ENGINEERS
PORTLAND, MAINE

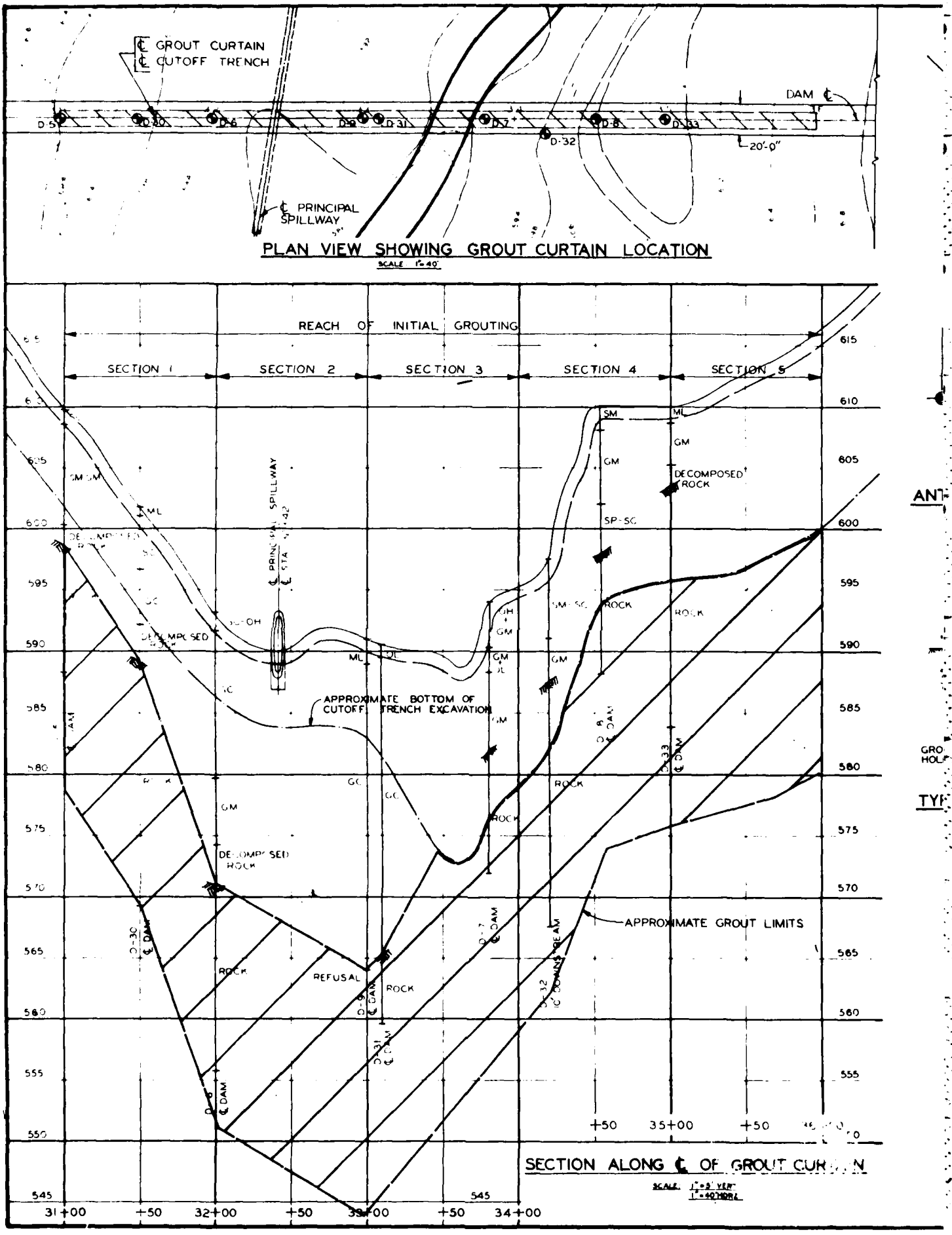
LIMESTONE STREAM WATERSHED PROJECT
MULTI-PURPOSE STRUCTURE NO.1
DUREPO BROOK, LIMESTONE, MAINE

PLAN/PROFILE
PRINCIPAL SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed S.E. WALKER	7-68	Approved by	
Drawn R.S. COOK	7-68	Title	
Traced		Title	
Checked		Sheet No. 18 of 32	Drawing No. ME-502-P

35083 2-



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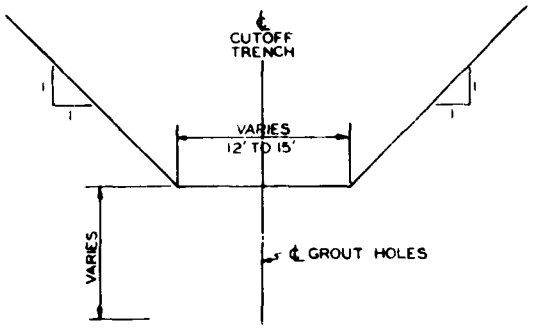
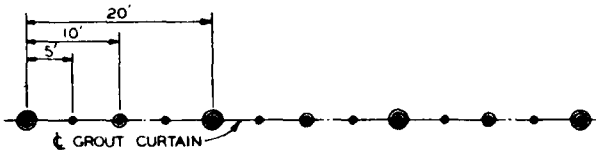


TYPICAL GROUT CURTAIN SECTION



LEGEND

- PRIMARY HOLE - APPROXIMATELY 20' INTO ROCK
- SECONDARY HOLE - APPROXIMATELY 15' INTO ROCK.
- TERTIARY HOLE - AS REQUIRED.

ANTICIPATED GROUT HOLE DRILLING PATTERN

CONSTRUCTION DETAILS

1. ALL DRILLING AND GROUTING SHALL BE CONDUCTED FROM THE BOTTOM OF THE CUTOFF TRENCH.

2. DRILLING IN ROCK MAY BE ACCOMPLISHED WITH EITHER ROTARY OR PERCUSSION TYPE DRILLING EQUIPMENT.

3. THE INDICATED GROUT LIMITS AND REQUIRED NUMBER OF GROUT HOLES ARE APPROXIMATE AND WILL BE ADJUSTED IN ACCORDANCE WITH THE CONDITIONS ENCOUNTERED.

4. GENERALLY, WITHIN ANY ONE SECTION, ALL PRIMARY HOLES SHALL BE DRILLED, WASHED, PRESSURE TESTED, AND GROUTED PRIOR TO THE DRILLING OF SECONDARY HOLES. THIS PROCEDURE ALSO APPLIES TO SUBSEQUENT HOLES (TERTIARY, ETC.).

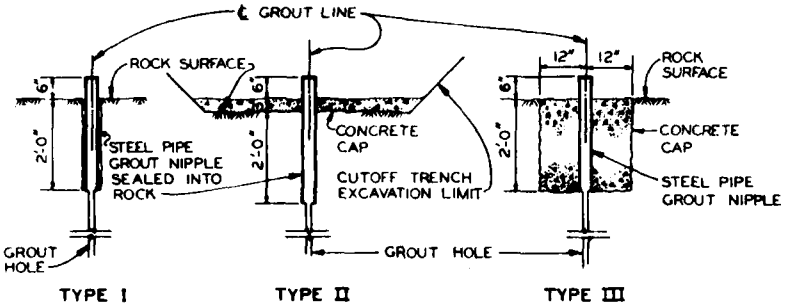
5. GENERALLY, ALL HOLES WILL BE DRILLED TO THE FULL REQUIRED DEPTH, WASHED, PRESSURE TESTED AT 5' INTERVALS, AND PACKER GROUTED AT 5' INTERVALS STARTING FROM THE BOTTOM OF THE HOLE.

6. MAXIMUM GROUTING PRESSURE SHALL NOT EXCEED 50 P.S.I. AT THE COLLAR OF THE GROUT HOLE.

7. CEMENT SHALL BE TYPE II.

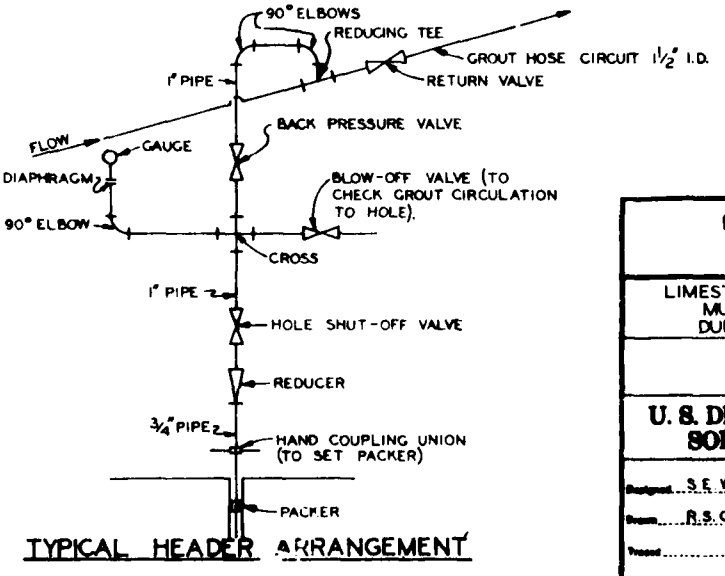
8. THE SELECTION OF NIPPLE SETTING TYPE I, II OR III WILL BE DESIGNATED IN ACCORDANCE WITH ROCK CONDITIONS EXPOSED AT THE BOTTOM OF THE CUTOFF TRENCH. CAPPING CONCRETE SHALL CONTAIN TYPE II CEMENT.

9. SEE FINAL GEOLOGY AND SOIL REPORT, VOLUME II, BY: GOLDBERG-ZOINO & ASSOCIATES FOR LOGS OF BORING AND RESULTS OF FIELD PERMEABILITY TESTS. (COPIES OF THE FINAL GEOLOGY AND SOILS REPORT, VOLUME II ARE AVAILABLE FOR REVIEW AT THE AROOSTOOK AGRICULTURAL CENTER BUILDING, NORTH MAIN STREET, PRESQUE ISLE, MAINE)



TYPE I TYPE II TYPE III

TYPICAL NIPPLE SETTING FOR GROUT HOLES DRILLED FROM ROCK SURFACE



TYPICAL HEADER ARRANGEMENT

EDWARD C. JORDAN CO., INC.
CIVIL AND SANITARY ENGINEERS
PORTLAND, MAINE

LIMESTONE STREAM WATERSHED PROJECT
MULTI-PURPOSE STRUCTURE NO. 1
DUREPO BROOK, LIMESTONE, MAINE

GROUTING DETAILS

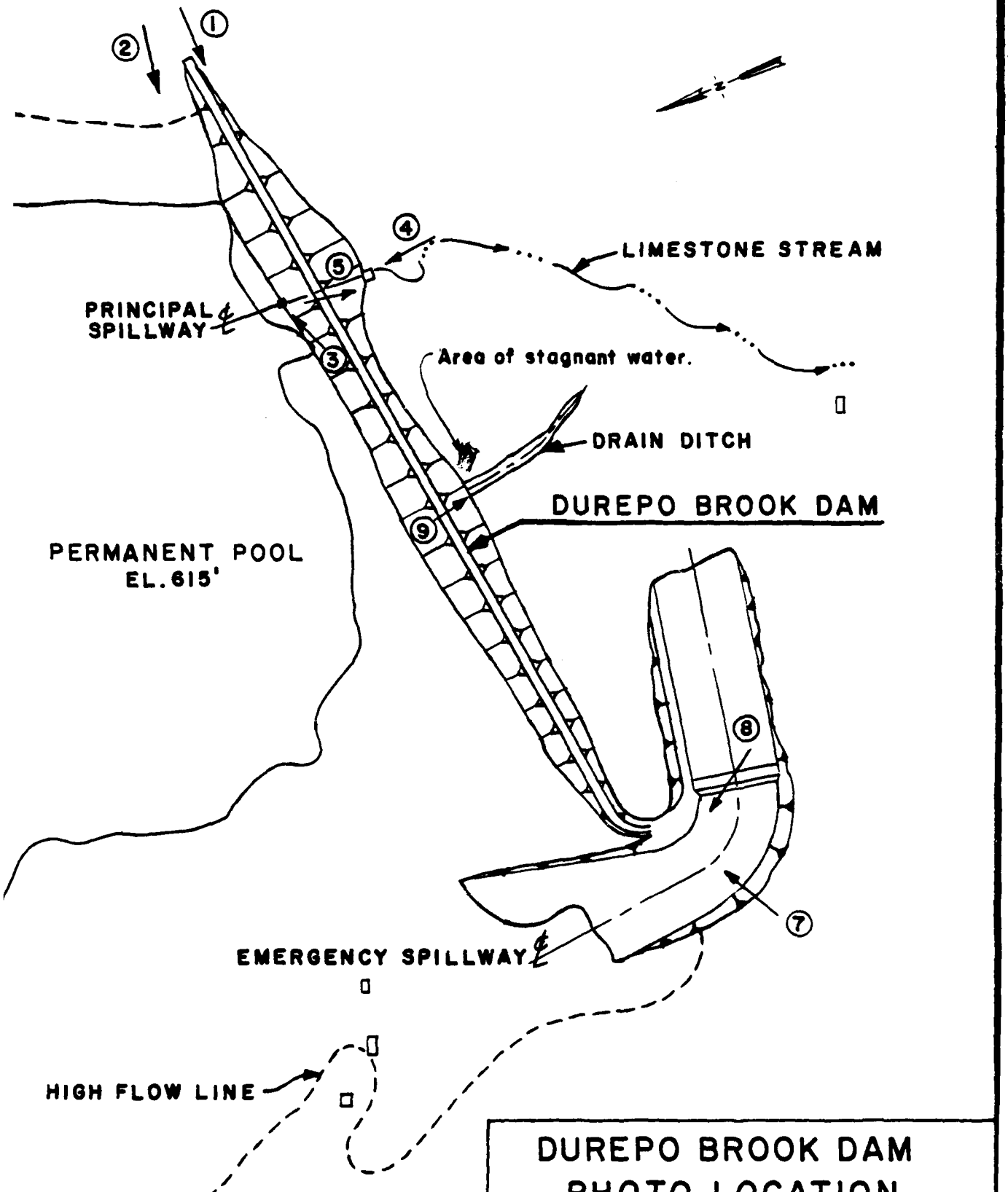
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	S.E. WALKER	7-66	Approved by
Drawn	R.S. COOK	7-66	Title
Traced			Title
Checked			Sheet / Drawing No. ME-502-P

202

APPENDIX C

PHOTOGRAPHS



LEGEND

① PHOTO LOCATION

NOTE: Photo No. 6 not shown on map.

DUREPO BROOK DAM
PHOTO LOCATION

U.S. ARMY CORPS OF ENGINEERS
PHASE I INSPECTION PROGRAM

MAIN

DATE		
CLIENT	JOB	PLATE
1345	72	5

Photo 1

Downstream Slope

from left Abutment

Photo 2

Upstream Slope from

left Abutment

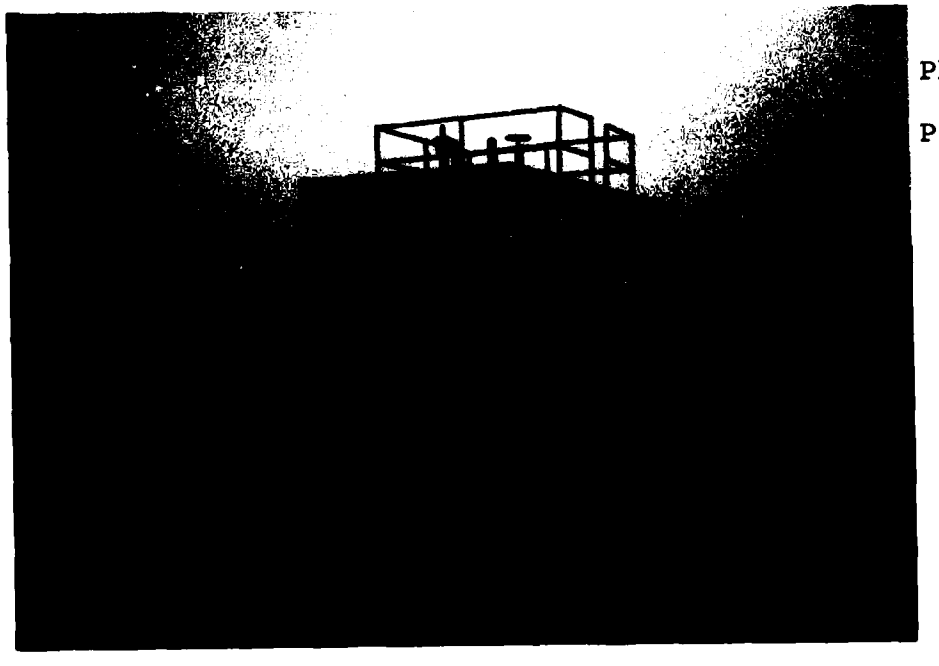


Photo 3

Principal Spillway

Photo 4

Impact Basin

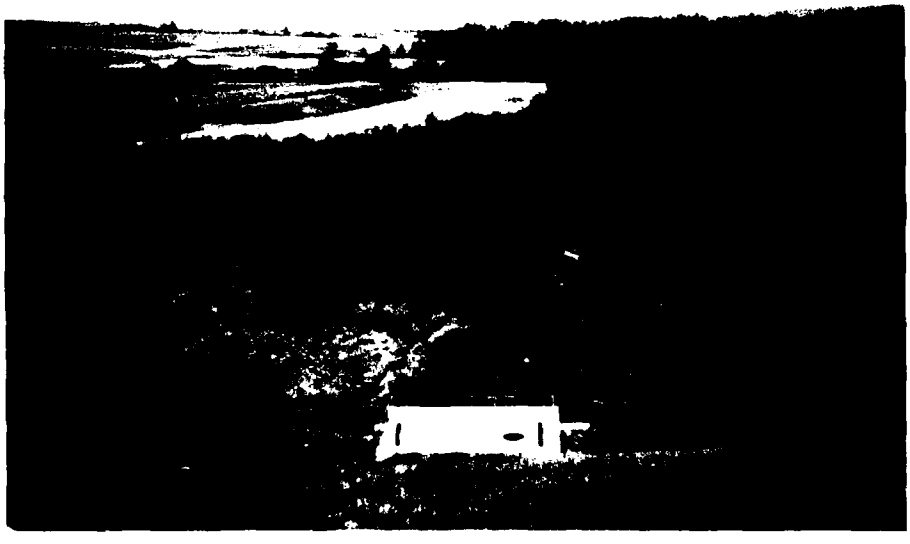


Photo 5

Downstream Channel

Photo 6

Noyes Mill Road

Box Culvert

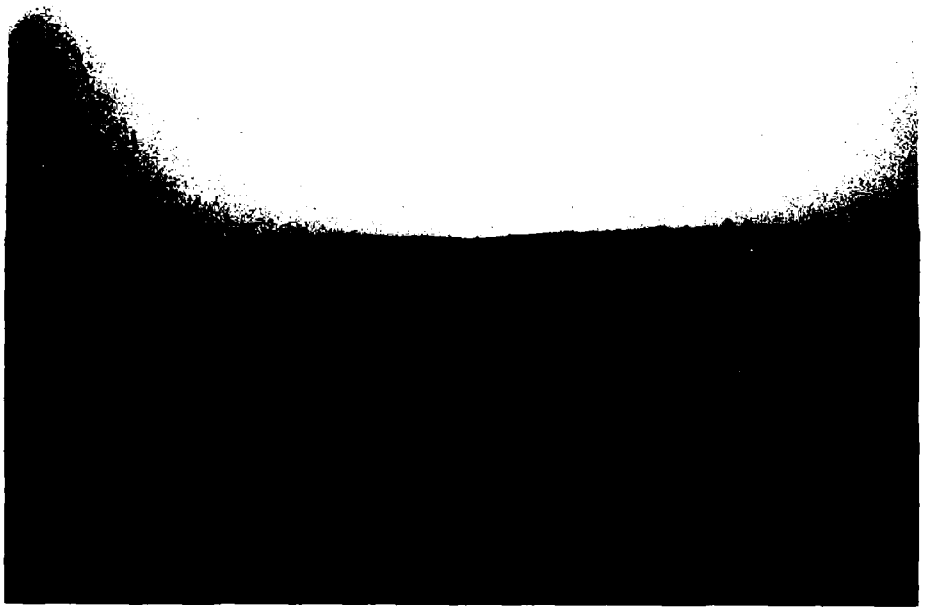


Photo 7

Emergency Spillway

& Right Abutment

Photo 8

Emergency Spillway

Upstream Approach

Channel looking

Upstream

Photo 9

Toe Drain outfall

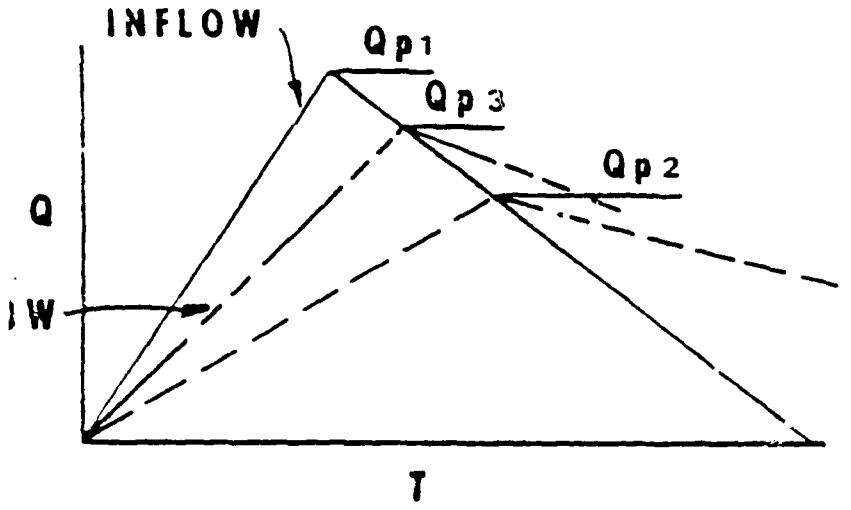
& Downstream Channel

St. 25+00

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



TEP 1: Determine Peak Inflow (Qp_1) from Guide Curves.

TEP 2: a. Determine Surcharge Height To Pass "Qp_1".

b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore:

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

TEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Qp_3".

MAIN

OF ENGINEERS — Job No. 1345-072-016 Sheet 11 of 27
RU BROOK RESERVOIR — By T. OTOVA Date 2-2-81
ROUTING — Ckd. _____ Rev. _____

esponding Discharge

= Qp1*(1-STOR1/R)
= 15761 (cfs)

E P 3

arge Height

a * Qp2 ^ b
(ft.)

arge Volume,STOR3)

= ELV3 + H
= 641.6 (ft.)

me = 5823.158 (ac-ft)

Volume = Volume - Volume2
Volume = 1189.066 (ac-ft)

= 1.11 (in.)

STOR.AVE.= (STOR1 + STOR3)

STOR.AVE = 1.15 (in.)

=Qp1*(1 - OLD STO.AVE. / R

= 15817 (cfs)

E P 4

arge Height

a * Qp3 ^ b
1.01 (ft.)

Volume,STOR3)

H2 + H1
641.61 (ft.)
me = E.P. El-m
me = 5836.132 (ac-ft)

= Volume - Volume2
= 1193.17 (ac-ft)

= 1.11 in.

NEW STO.AVE. = (OLD STO AVE. +
STOR3) / 2
NEW STO.AVE.= 1.13 (in.)

Qp4 = Qp1 * (1 - NEW STO.AVE.
R)
Qp4 = 15842 (cfs)

Surcharge Height

H4 = a * Qp4 ^ b
H4 = 4.02 (ft.)

E3 = H4 + H2
E3 = 641.62 (ft.)

C H E K I N G :

E3 - E3 = 0 (ft.)

R E S U L T S :

AVERAGED DISCHARGE= 15829 (cfs

WATER SURFACE ELEV = 641.61
(ft.)

SURCHARGE HEIGHT = 4.01 (ft.)

CREST ELEV. OF THE DAM:
Ec= 645 (ft.)

VOLUME AT DAM CREST ELEV.:
Vc = 7074.387 (ac-ft)

VOLUME AT MAX WATER SURFACE ELE

Vw = 5836.935 (ac-ft)

MAIN

PS OF ENGINEERS
REPO BROOK RESERVOIR
OD ROUTING

Job No. 1345-072 Sheet 10 of 27
By T. OTOVA Date 2-2-81
Chkd. Rev.

ESTIMATING

CT OF SURCHARGE STORAGE

AXIMUM PROBABLE DISCHARGES

e calculations are
ormed according to the
s of Engineers
lelines

IPO BROOK DAM

A T A

RAINAGE AREA.
20 03 (sq.mi.)

AK INFLOW.
= 19303 (cfs)

INCIPAL SPILLWAY CREST ELEV.
l= 629.5 (ft.)

ERGENCY SPILLWAY CREST ELEV.
2= 637.5 (ft.)

ergency Spillway Rating Curve
defined as :

= a * Q ^ b

0068
66

Capacity - Elv curve
defined as:

= m + n * Log(Volume)

499.149
17.582

AL PMF RUNOFF
17 (in.)

CALCULATIONS

S T E P 1

Reduction of the Qp1 due to
starting elevation at
Principal Spillway crest elev.

Volume at 629.5 (ft.)

Volume1 =Exp((ELV1-m)/n)
Volume1 = 2929.692 (ac-ft)

Volume at 637.5 (ft.)

Volume2 =Exp((ELV2-m)/n)
Volume2 = 4644.092 (ac-ft)

Diff of Volumes.

Diff.Volume = 1714.399 (ac-ft)
or.
Diff.Volume, D= 1.6 (in.)

NEW Qp1=Qp1*(1-D/R)
NEW Qp1 = 17358 (cfs)

S T E P 2

Surcharge Height.

H = a * Qp1 ^ b
H = 4.27 (ft.)

Surcharge Volume.

ELW=ELV2 + H
ELV= 641.87 (ft.)

Volume = 5931.836 (ac-ft)

STOR1 =Volume - Volume2

STOR1 = 1287.144 (ac-ft)
or
STOR1 = 1.13 (in.)

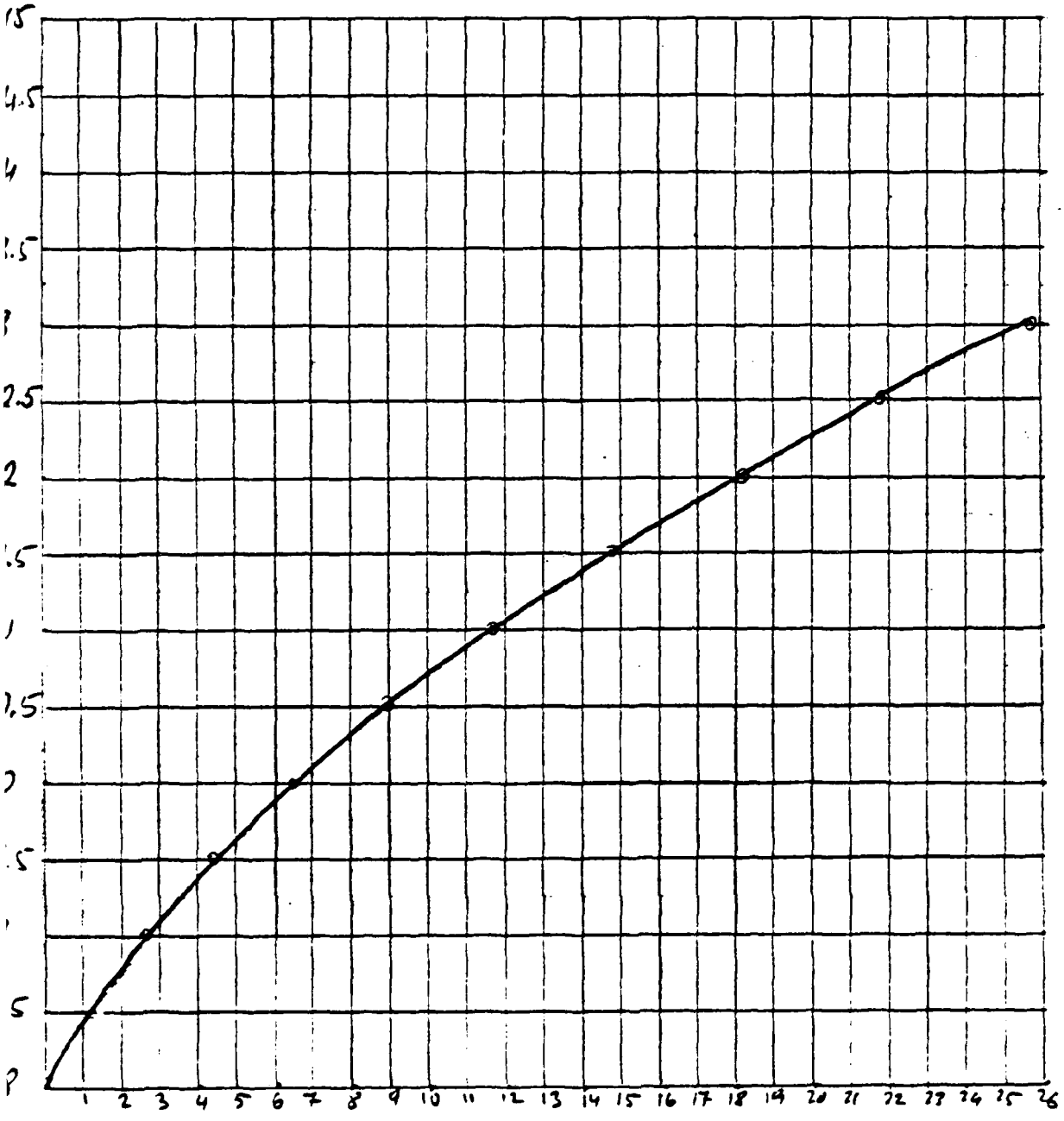
D-15

MAIN

CORPS OF ENGINEERS — Job No. 1345-0X2 — Sheet 9 of 27
DUREPO BROOK DAM — By T. OTOVA — Date 2-2-81
FLOOD ROUTING — Chkd. — Rev.

$$H = 0.0068 \times Q^{0.66} + 637.6$$

EMERGENCY SPILLWAY RATING CURVE



Discharge in 1000 CFS (Q)

MAIN

ARMS OF ENGINEERS — Job No. 1345-077 Sheet 8 of 27
NEPCO BROOK DAM — By T. OTEVA 016 Date 2-2-81
OUD ROUTING — Chkd. — Rev.

PE-AREA METHOD

OF CROSS-SEC POINTS = 4

PE = .04

1 = 645
2 = 627.6
3 = 587.6
4 = 545

1 = 0
2 = 22.2
3 = 173.8
4 = 394.4

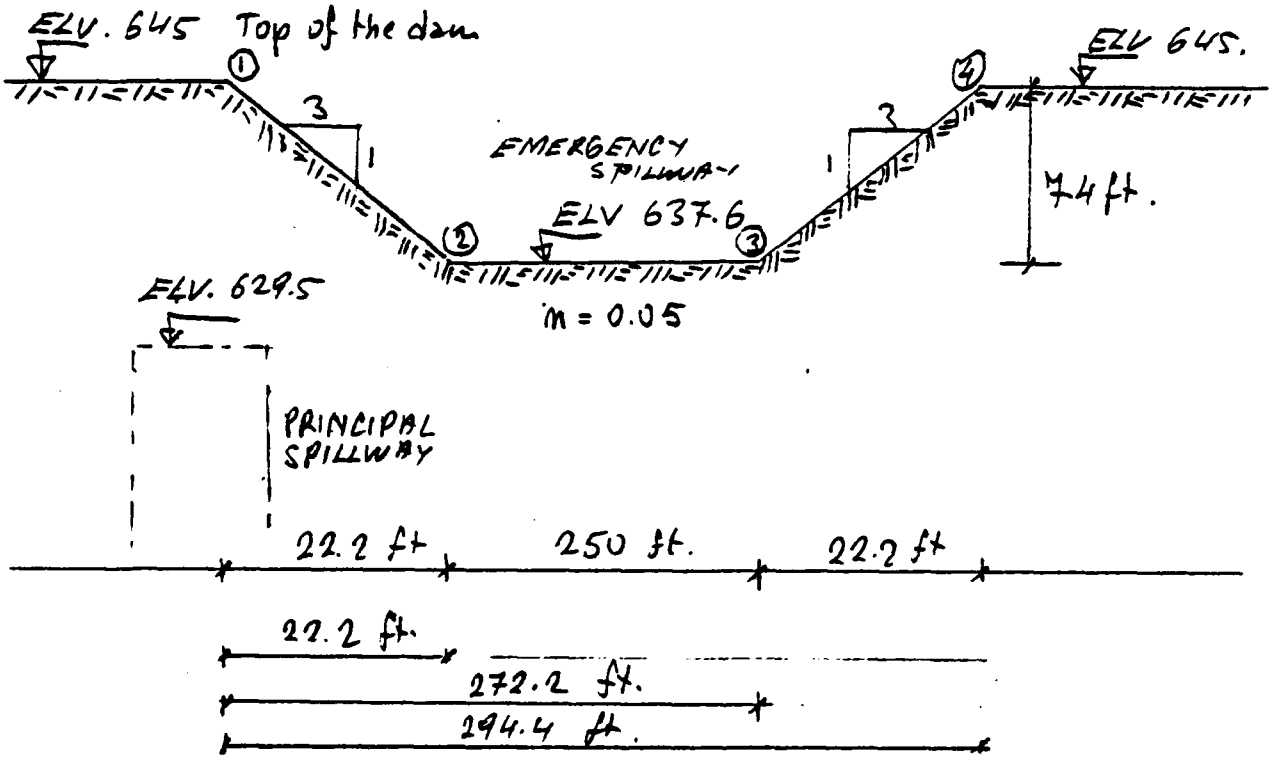
1 = .05
2 = .05
3 = .05

ELEV.	DISCHARGE
38	324.5
38.5	1258.2
39	2837.2
39.5	4403
40	6523.4
40.5	8973.1
41	11738.9
641.5	14807.5
642	18169.1
642.5	21915.9
643	25741.3
643.5	29939.8
644	34406.9
644.5	39138.7
645	44131.5
645.5	49424.1
646	55083.4
646.5	60933.9
647	67029.9
647.5	73355.8
648	79915.2
648.5	86700.6
649	93709.5
649.5	100938.9
650	108384.3

MAIN

CORPS OF ENGINEERS — Job No. 345-072 — Sheet 7 of 27
DUREPO BROOK DAM — By T. OTOVA-016 — Date 2-2-81
FLOOD ROUTING — Ckd. — Rev.

EMERGENCY SPILLWAY



$$Q = \frac{1.49 \times A \times R^{2/3} \times S^{1/2}}{n}$$

A = Area
R = Hydraulic Radius
S = Slope
n = Roughness Coeff.

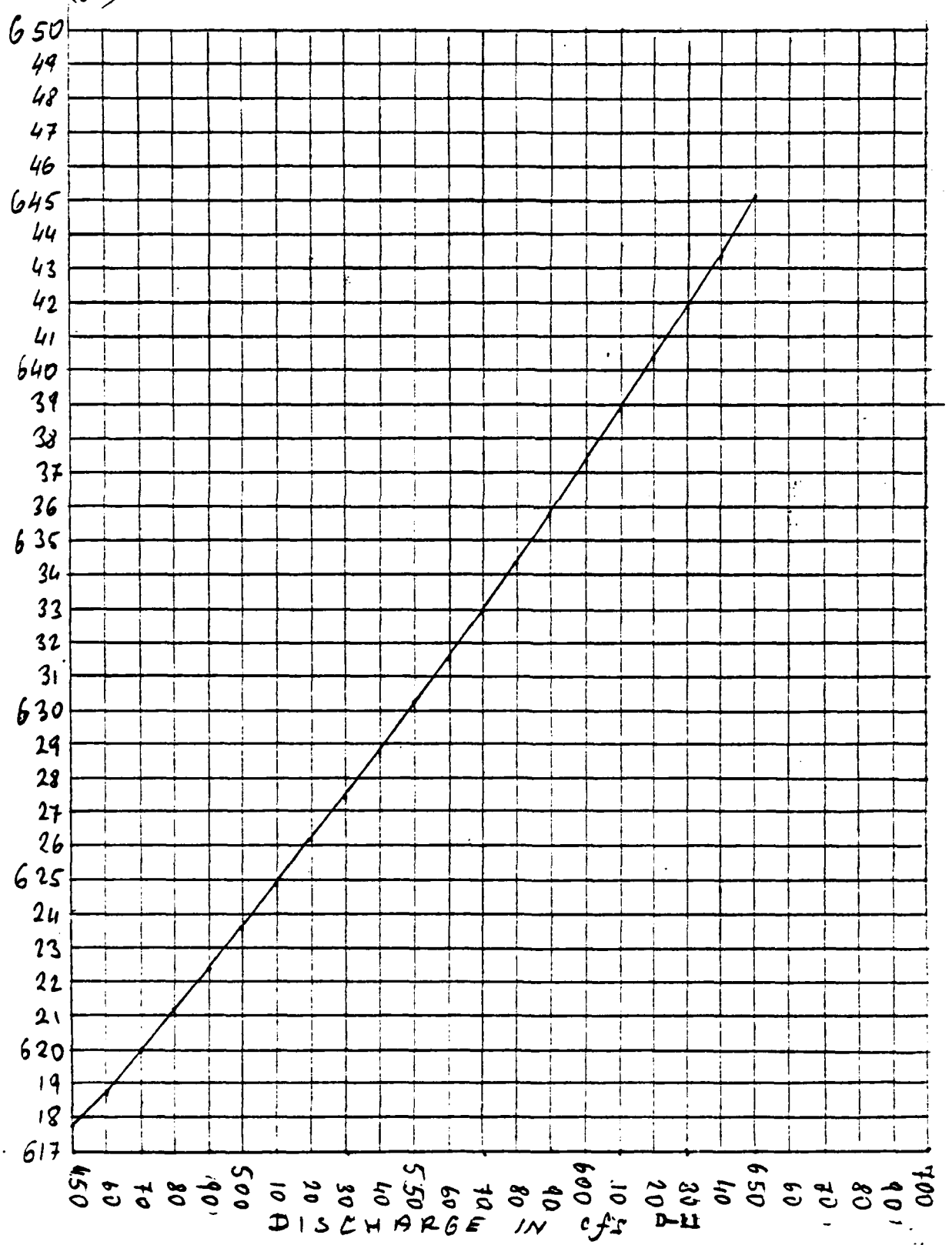
The slope of the channel is 0.04
The rating table is presented in page 5.
The rating curve is illustrated in page 6.
A curve fitting calculation is performed and the following relationship is derived

$H = 0.0268\, Q^{0.66} + 637.6$

MAIN

nt CORPS OF ENGINEERS Job No. 1345-072-016 Sheet 6 of 27
ject DUBERO BROOK DAM By T. OTOVA Date 2-2-81
FLOOD ROUTING Ckd. Rev.

ELV (ft) PRINCIPAL SPILLWAY RATING CURVE



Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 5 of 27
Project DUBBO BROOK DAM By T. OTOVA -016 Date 2-2-81
FLOOD ROUTING Chkd. Rev.

FE SPILLWAYS

INCIPAL SPILLWAY

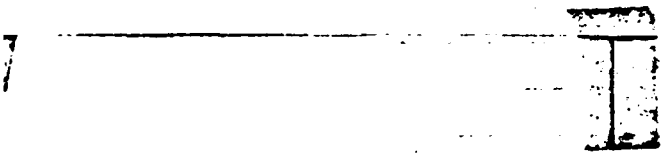
e formula used in these calcul
tions is presented in the "Sure
of Reclamation's
IGN OF SMALL DAMS
ge 567, Figure 8-10,
ear 1977)

=[.2 5204*(1+Ke)*D^4+466.19*n^
- D^(16/3)] * (Q/10)^2

here,

= Head in feet
= Entrance loss coefficient
= Diameter of pipe in feet
= Mannings roughness coefficie

= Length of culvert in feet
= Design discharge rate in cfs



Ke = .2

D = 4.5 (ft)

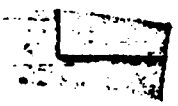
n = .012

L = 230 (ft)

ENTRANCE ELV = 615 (ft)

OUTLET ELV = 592.5 (ft)

ELEVATION (ft)	DISCHARGE (cfs)
617.53	450
618.83	460
619.98	470
621.17	480
622.37	490
623.6	500
624.86	510
626.14	520
627.45	530
628.78	540
630.14	550
631.52	560
632.93	570
634.36	580
635.81	590
637.29	600
638.8	610
640.33	620
641.88	630
643.46	640
645.07	650



MAIN

CORPS OF ENGINEERS — Job No. 1345-072 -016 — Sheet 4 of 27

DUREPO BROOK DAM — By T. OTOVA — Date 2-2-81

FLOOD ROUTING — Chkd. — Rev.

E SPILLWAYS

ERVOIR DRAINAGE

formula used in these calcul
ons is presented in the 'Bure
of Reclamation's
IGN OF SMALL DAMS
e 557 Figure B-10.
ar 1977)

[2.5204*(1+Ke)/D^4+466.18*n^
D^(16/3)] * (Q/10)^2

re:

= Head in feet
= Entrance loss coefficient
: Diameter of pipe in feet
: Mannings roughness coefficie
: Length of culvert in feet
: Design discharge rate in cfs

Ke = .1

D = 2.5 (ft)

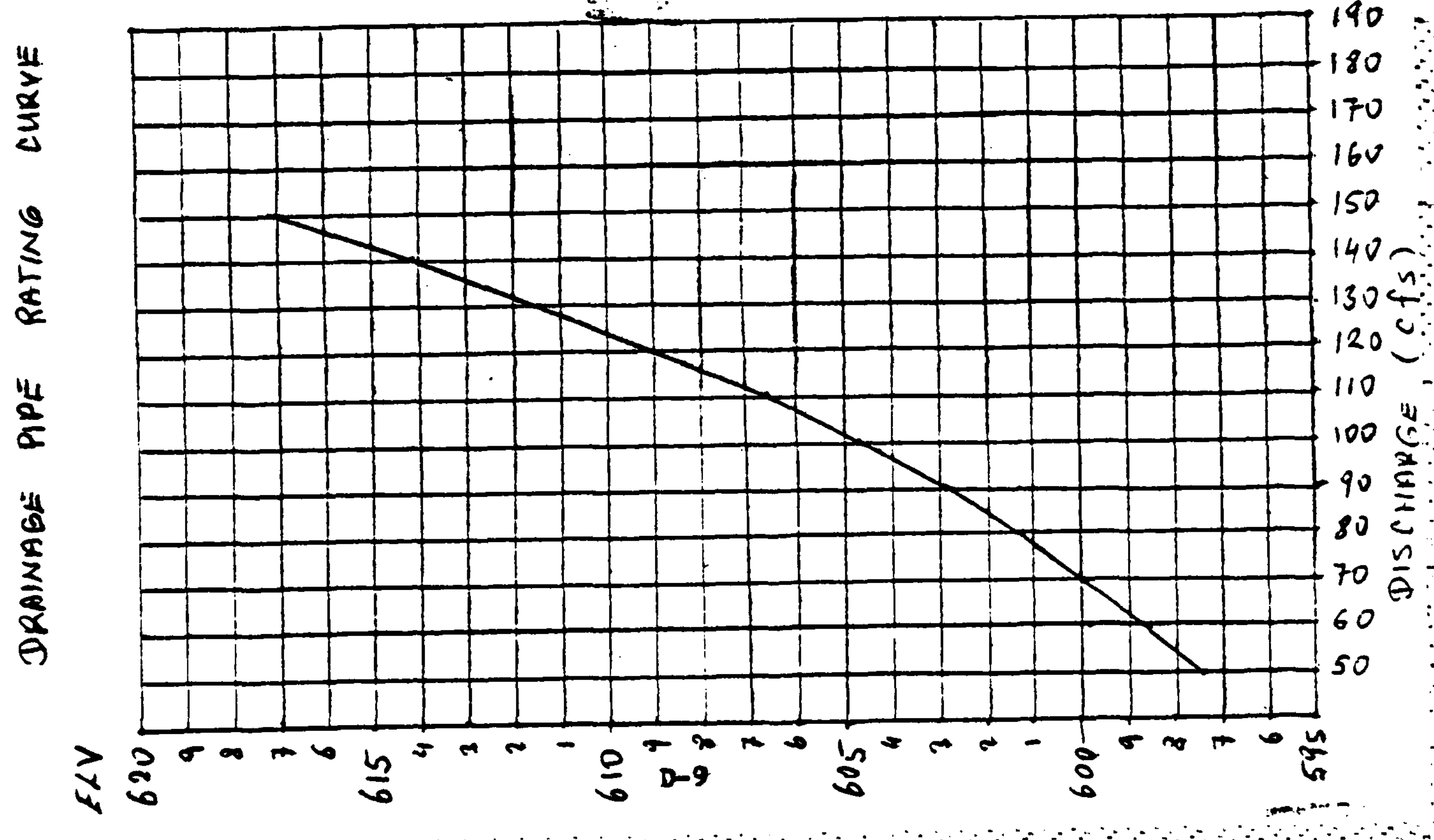
n = .012

L = 52.5 (ft)

ENTRANCE ELV = 595 (ft)

OUTLET ELV = 595 (ft)

ELEVATION (ft)	DISCHARGE (cfs)
597.43	50
598.51	60
599.78	70
601.24	80
602.9	90
604.75	100
606.8	110
609.04	120
611.48	130
614.12	140
616.95	150



MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 3 of
Subject DUREDO BROOK DAM By T. DIOVA Date 2-2-81
FLOOD ROUTING Chkd. Rev.

DRAINAGE AREA = 20.03 sq. mi.

For rolling terrain PMF Curves (Corps of Engineers Guidelines, March 1978), yield 1445 cfs/sq. mi. peak discharge.

The total peak discharge = 1445 × 20.03 = 28943 cfs

The Guideline Curves are derived for 19" runoff. In this part of New England, Maine, Depth-Area-Duration curves show a 13" of runoff and this is confirmed by Corps of Engineers. Then, test flood is assumed to be equal to PMF which is

$$Q_{Test} = 28943 \times \frac{13"}{19"} = 19803 \text{ cfs.}$$

The emergency spillway is assumed to be an open channel. The roughness coefficient is estimated to be 0.05. (This assumption was considered more conservative than a broad crested weir. Manning's formula is used to derive the discharge rating curve.

MAIN

Client CORPS OF ENGINEERS Job No. 134-012-016 Sheet 2 of 27

Subject DUREPO BROOK RESERVOIR By T. OTEVZA Date 2-7-91

CAPACITY CURVE FITTING Chd. Rev.

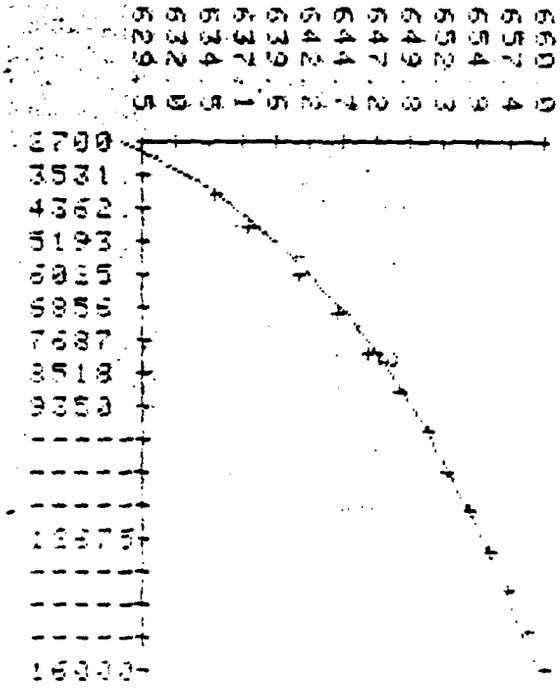
I	X(I)	Y(I)
1	3700.0000	669.5000
2	4000.0000	635.0000
3	4650.0000	637.6000
4	5000.0000	641.3000
5	7000.0000	644.3000
6	8000.0000	646.7000
7	9000.0000	649.0000
8	10000.0000	651.0000
9	11000.0000	652.6000
10	12000.0000	654.3000
11	13000.0000	655.7000
12	14000.0000	657.3000
13	15000.0000	658.8000
14	16000.0000	660.0000

MOV: LOG REG CODE 2

SOURCE	DF	SS	MS	F
TOTAL	13	1156.9		
REG	1	1152.2	1152.2	999.9
RESID	12	4.7	0.4	

R SQUARE = 0.996

YHAT= 489.149+ 17.582LOG X



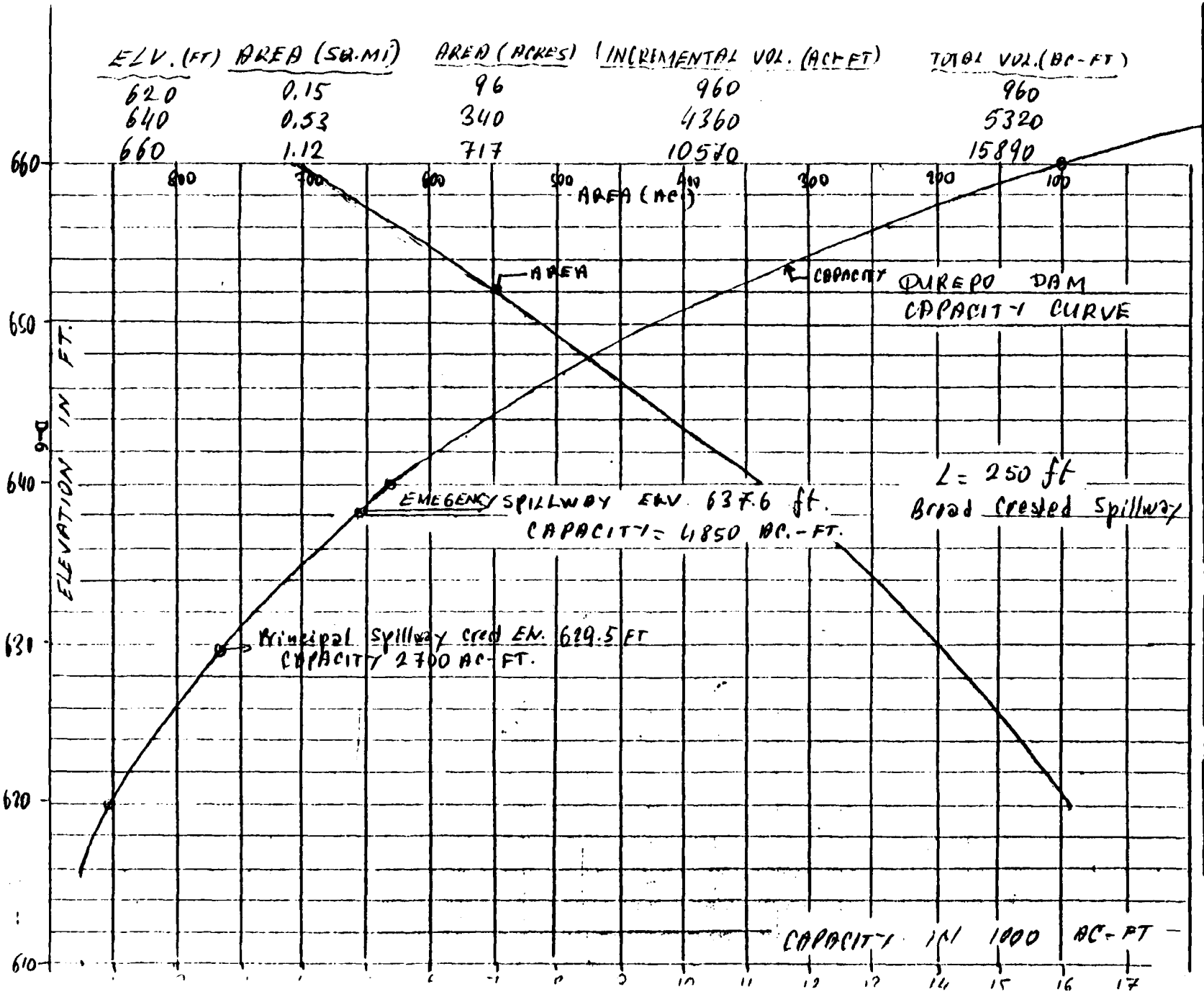
Client CORPS OF ENGINEERS Job No. 1345-032-016 Sheet 1 of 27

Subject DUREPO DAM FLOOD ROUTING By T. OTOVA Date 2-2-81

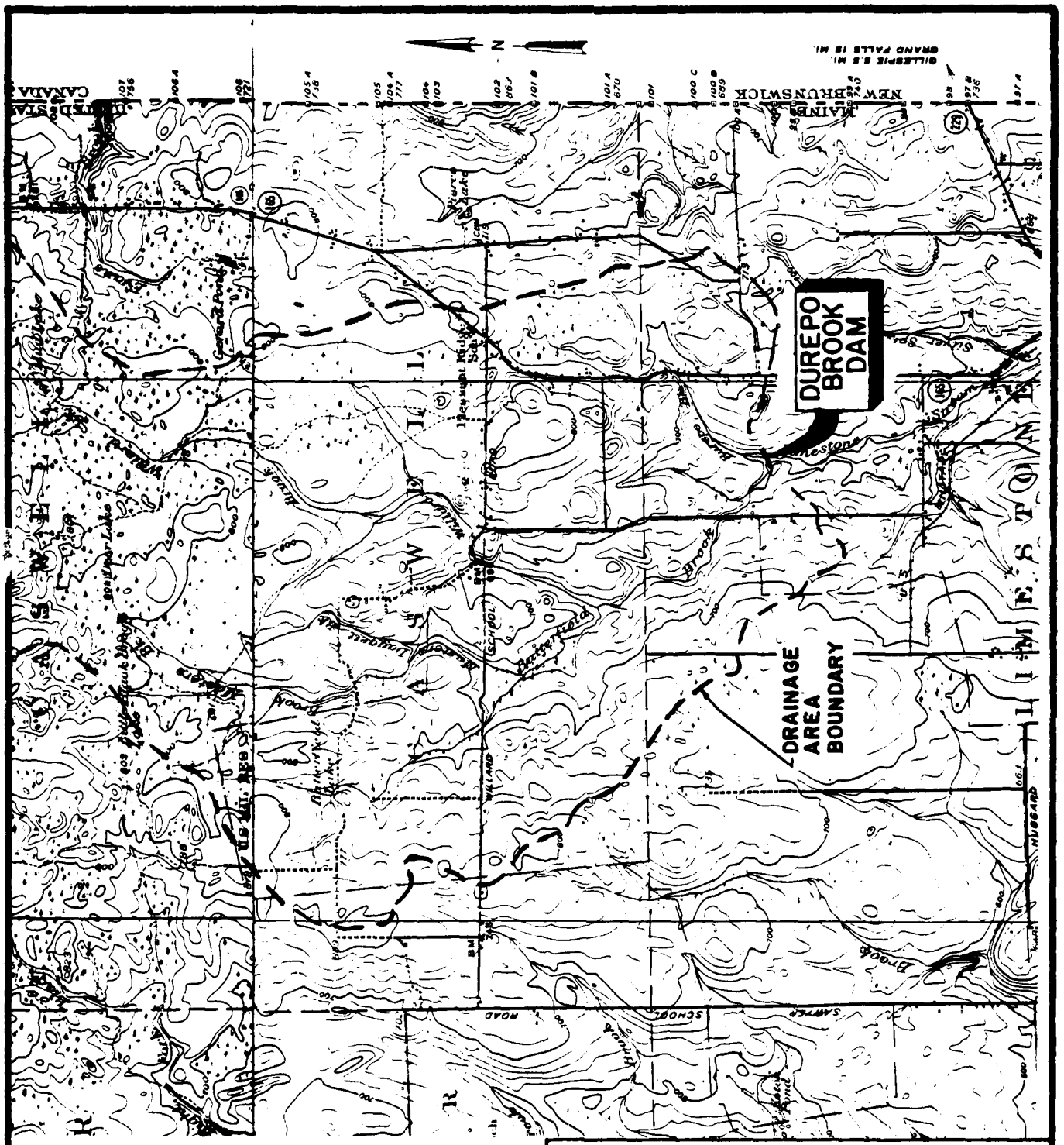
Chkd. Rev.

MAIN

ELV. (FT)	AREA (SQ.MI)	AREA (ACRES)	INCREMENTAL VOL. (AC-FT)	TOTAL VOL. (AC-FT)
620	0.15	96	960	960
640	0.53	340	4360	5320
660	1.12	717	10570	15890



Approx. 1.0 sq. mi. of Drainage Area not shown on map.



FROM USGS FORT FAIRFIELD, ME. & VAN BUREN, ME. QUADRANGLE MAPS

Vicinity Map

SCALE

1 1/2 0 Miles 1

1 : 62,500

DUREPO BROOK DAM DRAINAGE AREA MAP

U.S. ARMY CORPS OF ENGINEERS
PHASE I INSPECTION PROGRAM

MAIN

DATE		
CLIENT	JOB	PLATE
1345	072	01

SURCHARGE STORAGE ROUTING SUPPLEMENT

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Avg "$STOR_1$" and "$STOR_2$" and Compute "Qp_3".

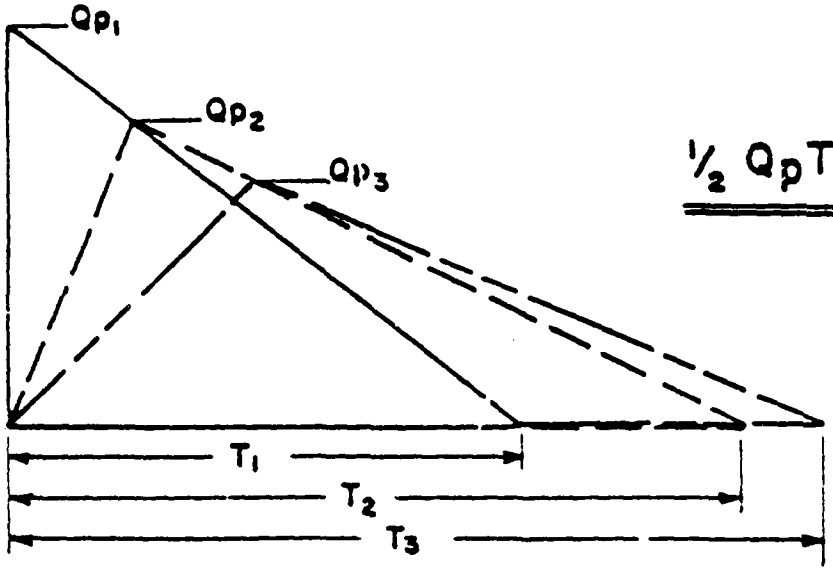
c. If Surcharge Height for Qp_3 and "$STOR_{AVG}$" agree O.K. If Not:

STEP 4: a. Determine Surcharge Height and "$STOR_3$" To Pass "Qp_3"

b. Avg. "Old $STOR_{AVG}$" and "$STOR_3$" and Compute "Qp_4"

c. Surcharge Height for Qp_4 and "New $STOR_{Avg}$" should Agree closely

"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Q_{p_1} = \frac{8}{27} W_b \sqrt{g} Y_o^{3/2}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 4[illegible] OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Q_{p_2}(\text{TRIAL}) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Q_{p_2} = Q_{p_1}\left(1 - \frac{V_{avg}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

Client CORPS OF ENGINEERS Job No. 1215-172 Sheet 2 of 21

Subject FAILURE ANALYSES By T. OTOVIC Date 2-2-81

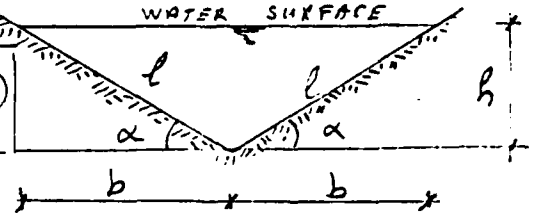
Ckd. Rev.

DERIVATION OF STAGE - DISCHARGE RELATIONSHIP

Area, $A = \frac{h \times b}{2} \times 2$ $\quad A = h \times b$

$\frac{h}{b} = \tan\alpha \quad b = \frac{h}{\tan\alpha}$

$$A = \frac{h^2}{\tan\alpha} \cdots (II)$$



Wetted Parameter, W,

$W = 2l \quad \frac{b}{l} = \cos\alpha \quad l = \frac{b}{\cos\alpha} \quad W = 2\frac{b}{\cos\alpha}$

Hydraulic Radius, R,

$R = \frac{A}{W} = \frac{bh}{2\frac{b}{\cos\alpha}} = \frac{h}{2} \cdot \cos\alpha \quad R^{2/3} = \left(\frac{h \cdot \cos\alpha}{2}\right)^{2/3}$

Manning's Formula, $Q = \frac{1.49 \times A \times R^{2/3} \times S^{1/2}}{n}$

S is the slope

n is the roughness coefficient

$Q = \frac{1.49}{n} \times \frac{h^2}{\tan\alpha} \times \left(\frac{h \cdot \cos\alpha}{2}\right)^{2/3} \times S^{1/2}$

$Q = \frac{1.49}{n} \times \frac{S^{1/2}}{\tan\alpha} \times \frac{(\cos\alpha)^{2/3}}{2^{2/3}} \times h^{8/3}$

$h = \left[\frac{n \times \tan\alpha \times 2^{2/3}}{1.49 \times (\cos\alpha)^{2/3} \times S^{1/2}} \times Q\right]^{3/8}$

$$h = \left[\frac{1.068 \times n \times \tan\alpha}{(\cos\alpha)^{2/3} \times S^{1/2}} \times Q\right]^{3/8} \quad \ldots \quad I$$

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 12 B of 27
Subject DUREE BROOK DAM By T. OTOVA Date 2-2-81
FAILURE ANALYSES Ckd. Rev.

DUREE BROOK
DAM FAILURE ANALYSES

These calculations are performed according to the RULE OF THUMB procedures of the Corps of Engineers

The breach discharge:
Qbr = 8/27 * Wb * g^0.5 * Yo^3/2

Where:

Yo is the height of the breach (from river bed to the max. pool level)

Wb is 35% of the length of the dam or Wb = .35 * Wd

g is the acceleration of the gravity (32.2 ft/sec^2)

Yo = 56.61 (ft)

Wb = 2550 (ft)

Wd = 7286 (ft)

From above equation:
Qbr = 370149 (c.f.s)

The natural channel cross sections are simplified as triangular cross sections

The stage-discharge relationship becomes as:

h = [1.068 * n * Tan(a) * Q / Cos(a)^2/3 / S^.5]^3/8 ....(I)

Where:

Q = Discharge (c.f.s)
a = Side slope angle (deg)
S = Channel slope

The cross section Area:

A = h^2 / Tan(a) ....(II)

The Volume of the Reservoir:
V = 5837 (ac-ft)
or
V = 254259720 (cub-ft)

B E A C H (1) CALCULATIONS

Test flood discharge:
Qt = 15454 (cfs)

e = 2.86 (deg)
f = .0032
r = .07
L = 1000 (ft)

From Formula (I),

Prefailure height,

h1 = 13.7 (ft)

From Formula (II),

A1 = 3790 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 54.7 (ft)

From Formula (II),
Total Area,
A = 60106 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 56316 (sq-ft)

Residual Volume,

V = L * A2

V1 = 56316798 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 497582 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 514036 (cfs)

h = 50 (ft)

From Formula (II),

A = 50082 (ft)

Residual Area,

A2 = A - A1

A2 = 46292 (ft)

V2 = A2 * L

V2 = 46292457 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 51304426 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 510181 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 50.4 (ft)

RESULTS :

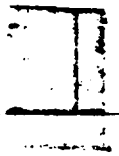
1) Prefailure Height = 13.7 (ft)

2) Postfailure Height = 50.4 (ft)

3) Breach Discharge = 510181 (cfs)

4) Reach Length = 1000 (ft)

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 14 of 27
Subject DUREPO BROOK DAM By T. OTOWA Date 2-2-81
FAILURE ANALYSES Ckd. Rev.



REACH (2) CALCULATIONS

Test flood discharge
Qt = 16454 (cfs)

s = 2.35 (deg.)
S = .0032
n = .07
L = 1000 (ft)

From Formula (I),

Prefailure height,

h1 = 12.7 (ft)

From Formula (II),

A1 = 3980 (sq ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 46.8 (ft)

From Formula (II),
Total Area,
A = 53559 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 49579 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 49579558 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 410698 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 427152 (cfs)

h = 43 (ft)

From Formula (II),

A = 45776 (ft)

Residual Area,

A2 = A - A1

A2 = 41796 (ft)

V2 = A2 * L

V2 = 41796343 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 45687951 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 418507 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 43.6 (ft)

RESULTS :

1) Prefailure Height = 12.7 (ft)

2) Postfailure Height = 43.6 (ft)

3) Breach Discharge = 418507 (cfs)

4) Reach Length = 1000 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 15 of 27
Subject DURBRO BROOK DAM By T.OTOOLE Date 2-2-81
FAILURE ANALYSES Chkd. Rev.

R E A C H (3) CALCULATIONS

Test flood discharge:
Qt = 16454 (cfs)

s = 2.18 (deg.)
S = .0032
n = .07
L = 1000 (ft)

From Formula (I),

Prefailure height,

h1 = 12.4 (ft)

From Formula (II),

A1 = 4055 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 42.4 (ft)

From Formula (II),
Total Area,
A = 47280 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 43224 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 43224755 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 347359 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 363813 (cfs)

h = 39 (ft)

From Formula (II),

A = 41352 (ft)

Residual Area,

A2 = A - A1

A2 = 37296 (ft)

V2 = A2 * L

V2 = 37296969 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 40260862 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 352238 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 39.2 (ft)

RESULTS

1.) Prefailure Height = 12.4 (ft)

2.) Postfailure Height = 39.8 (ft)

3.) Breach Discharge = 352238 (cfs)

4.) Reach Length = 1000 (ft)

Client CORPS OF ENGINEERS Job No. 1345-072-016 Sheet 16 of 27
Subject DUREPO BROOK DAM FAILURE ANALYSES By T. OTOVA Date 2-2-81
Ckd. Rev.

REACH (4) CALCULATIONS

Test flood discharge
Qt = 16454 (cfs)

s = 1.72 (deg.)
n = .0032
m = 0?
L = 750 (ft)

From Formula (I),

Pretailure height,

h1 = 11.3 (ft)

From Formula (II),

A1 = 4302 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 36.4 (ft)

From Formula (II),
Total Area,
A = 44313 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 40010 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 30007866 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 310667 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 327121 (cfs)

h = 34 (ft)

From Formula (II),

A = 40510 (ft)

Residual Area,

A2 = A - A1

A2 = 36207 (ft)

V2 = A2 * L

V2 = 27155754 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 28581810 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 312642 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 34.9 (ft)

RESULTS

1) Pretailure Height = 11.3 (ft)

2) Posttailure Height = 34.9 (ft)

3) Breach Discharge = 312641 (cfs)

4) Reach Length = 750 (ft)

Client CORPS OF ENGINEERS Job No. 1345-072-016 Sheet 17 of 27
Subject DUREPO BROOK DAM By T. OTOVA Date 2-2-81
FAILURE ANALYSES Ckd. Rev.

R E A C H (5) CALCULATIONS

Test flood discharge:
Qt = 16454 (cfs)

s = 1.6 (deg.)
f = .0032
n = .07
L = 1000 (ft)

From Formula (I),

Prefailure height,

h1 = 11 (ft)

From Formula (II),

A1 = 4381 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 34 (ft)

From Formula (II),
Total Area,
A = 41435 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 37054 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 37054215 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 267080 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 283534 (cfs)

h = 32 (ft)

From Formula (II),

A = 37053 (ft)

Residual Area,

A2 = A - A1

A2 = 32672 (ft)

V2 = A2 * L

V2 = 32672637 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 34863426 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 269773 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 32.2 (ft)

RESULTS

1) Prefailure Height = 11 (ft)

2) Postfailure Height = 32.2 (ft)

3) Breach Discharge = 269773 (cfs)

4) Reach Length = 1000 (ft)

MAIN

CORPS OF ENGINEERS — Job No. 1345-072 Sheet 18 of 27
DUBEPO BROOK DAM — By T. OTOVIC Date 2-2-81
FAILURE ANALYSES — Ckd. — Rev.

P E A C H (6) CALCULATIONS

Test flood discharge
Qt = 16454 (cfs)

a = 2.45 (deg.)
i = .0032
n = .07
L = 2100 (ft)

From Formula (I),

Prefailure height,

h1 = 12.9 (ft)

From Formula (II),

A1 = 3939 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 37.8 (ft)

From Formula (II),
Total Area,
A = 33552 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 29613 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 62188385 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 203790 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 220244 (cfs)

h = 34 (ft)

From Formula (II),

A = 27565 (ft)

Residual Area,

A2 = A - A1

A2 = 23626 (ft)

V2 = A2 * L

V2 = 49616248 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 55902316 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 210460 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 34.7 (ft)

RESULTS

1.) Prefailure Height = 12.9 (ft)

2.) Postfailure Height = 34.7 (ft)

3.) Breach Discharge = 210460 (cfs)

4.) Reach Length = 2100 (ft)

D-24

R E A C H (7) CALCULATIONS

Test flood discharge
Qt = 16454 (cfs)

s = 3.81 (deg)
f = .011
m = .07
L = 800 (ft)

From Formula (I),

Prefailure height,

h1 = 12.1 (ft)

From Formula (II),

A1 = 2221 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 32.5 (ft)

From Formula (II),
Total Area,
A = 15894 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 13673 (sq-ft)

Residual Volume,

W1 = L * A2

W1 = 10938763 (cub-ft)

Qp2 = Qp1 * (1 - W1 / W)

Qp2 = 201406 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 217860 (cfs)

h = 32 (ft)

From Formula (II),

A = 15416 (ft)

Residual Area,

A2 = A - A1

A2 = 13195 (ft)

W2 = A2 * L

W2 = 10556296 (cub-ft)

Wave = (W1 + W2) / 2

Wave = 10747529 (cub-ft)

Qp2 = Qp1 * (1 - Wave / W)

Qp2 = 201564 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 32 (ft)

RESULTS :

1.) Prefailure Height = 12.1 (ft)

2.) Postfailure Height = 32 (ft)

3.) Breach Discharge = 201564 (cfs)

4.) Reach Length = 800 (ft)

MAIN

ARMY CORPS OF ENGINEERS — Job No. 134-077 — Sheet 20 of 27
DURFEE BROOK DAM — By T. OTOVA-016 — Date 2-2-81
FAILURE ANALYSES — Chk. — Rev.

E A C H (3) CALCULATIONS

et flood discharge
= 15454 (cfs)

= 3.2 (deg.)
= .0077
= .07
= 1100 (ft)

rom Formula (I),

retailure Height,

1 = 12.1 (ft)

rom Formula (II),

1 = 2651 (sq.ft.)

= Qp1 + Qt

rom Formula (I),
otal Height,
= 32 (ft)

rom Formula (II),
otal Area,
= 18414 (sq-ft)

esidual Area,
2 = A - A1
2 = 15762 (sq-ft)

esidual Volume,

1 = L * A2

1 = 17339168 (cub-ft)

Qe2 = Qp1 * (1 - V1 / V)

Qp2 = 187818 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 204272 (cfs)

h = 31 (ft)

From Formula (II),

A = 17536 (ft)

Residual Area,

A2 = A - A1

A2 = 14885 (ft)

V2 = A2 * L

V2 = 16373597 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 16856382 (cub-ft)

Qe2 = Qp1 * (1 - Vave / V)

Qp2 = 188201 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 31.3 (ft)

RESULTS

1) Pretailure Height = 12.1 (ft)

2) Posttailure Height = 31.3 (ft)

3) Breach Discharge = 188201 (cfs)

4) Reach Length = 1100 (ft)

D-26

MAIN

RPS OF ENGINEERS — Job No. 1345-072 Sheet 21 of 27
IRERO BROOK DAM — By T.OTOVA Date 2-2-81
FILURE ANALYSES — Chd. — Rev.

A C H (9) CALCULATIONS

r flood discharge
= 16454 (cfs)

3.2 (deg)
.0043
.07
300 (ft)

m Formula (I),

failure height,

= 13.5 (ft)

m Formula (II),

= 3298 (sq.ft.)

Qp1 + Qt

m Formula (I),
al Height,
34.9 (ft)

m Formula (II),
al Area,
21849 (sq-ft)

idual Area,
= A - A1
= 18550 (sq-ft)

idual Volume,

= L * A2

= 5565116 (cub-ft)

Qe2 = Qp1 * (1 - V1 / V)

Qe2 = 184082 (cfs)

From Formula (I),

Q=Qe2+Qt

Q = 200536 (cfs)

h = 34 (ft)

From Formula (II),

A = 21518 (ft)

Residual Area,

A2 = A - A1

A2 = 18219 (ft)

V2 = A2 * L

V2 = 5465915 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 5515515 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 184119 (cfs)

From Formula (I),

Q = Qe2 + Qt

h2 = 34.6 (ft)

RESULTS :

1) Prefailure Height = 13.5 (ft)

2) Postfailure Height = 34.6 (ft)

3) Breach Discharge = 184119 (cfs)

4) Reach Length = 300 (ft)

D-27

ARC OF ENGINEERS — Job No. 1345-072-016 — Sheet 22 of 27
REED BROOK DAM — By T. ODUA — Date 2-2-81
FAILURE ANALYSES — Chd. — Rev.

A C H (10) CALCULATIONS

flood discharge
= 16454 (cfs)

3.2 (deg.)
.0043
.07
300 (ft)

n Formula (I),

failure height,

= 13.5 (ft)

n Formula (II) ,

= 3298 (sq.ft.)

Qp1 + Qt

n Formula (I),
al Height,
34.6 (ft)

n Formula (II),
al Area,
21521 (sq-ft)

idual Area,
= A - A1
= 18222 (sq-ft)

idual Volume,

= L * A2

= 5466801 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 180160 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 196614 (cfs)

h = 34 (ft)

From Formula (II),

A = 21202 (ft)

Residual Area,

A2 = A - A1

A2 = 17903 (ft)

V2 = A2 * L

V2 = 5370989 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 5418895 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 180194 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 34.4 (ft)

RESULTS

1.) Prefailure Height = 13.5 (ft)

2.) Postfailure Height = 34.4 (ft)

3.) Breach Discharge = 180194 (cfs)

4.) Reach Length = 300 (ft)

MAIN

OF ENGINEERS — Job No. 1345-072-016 Sheet 23 of 27
EPD BROOK DAM — By T. OTOVA Date 2-2-81
URE ANALYSES — Ckd. Rev.

C H (11) CALCULATIONS

Flood discharge
16454 (cfs)

3.2 (deg.)
.0043
.07
300 (ft)

Formula (I),

ilure height,

13.5 (ft)

Formula (II),

7298 (sq ft.)

Qp1 + Qt

Formula (I),
Height,
34.1 (ft)

Formula (II),
Area,
21305 (sq-ft)

ual Area,
A - A1
17906 (sq-ft)

ual Volume,

L * A2

5371931 (cub-ft)

Qp2 = Qp1 * (1 - V1)

Qp2 = 175387 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 192941 (cfs)

h = 34 (ft)

From Formula (II),

A = 20696 (ft)

Residual Area,

A2 = A - A1

A2 = 17597 (ft)

V2 = A2 * L

V2 = 5279239 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 5325585 (cub-ft

Qp2 = Qp1 * (1 - Vave /)

Qp2 = 175429 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 34.1 (ft)

RESULTS

1) Prefailure Height = 17.3 (ft)

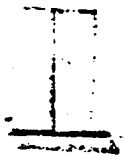
2) Postfailure Height = 34.1 (ft)

3) Breach Discharge = 175429 (cfs)

4) Reach Length = 300 ft

MAIN

S OF ENGINEERS — Job No. 1345-087 Sheet 24 of 27
EPO BROOK DAM — By T. OTOVA-076 Date 2-2-81
LLURE ANALYSES — Ckd. ____ Rev. ____



C H (12) CALCULATIONS

loog discharge
15454 (cfs)

.2 (deg.)
3043
07
00 (ft)

ormula (I),

lure height,

13.5 (ft)

ormula (II),

3298 (sq.ft.)

1 + Qt

ormula (I),
Height,
4.1 (ft)

ormula (II),
Area,
0899 (sq-ft)

al Area,
- A1
17600 (sq-ft)

al Volume,

* A2

5280078 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 172757 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 189211 (cfs)

h = 33 (ft)

From Formula (II),

A = 20600 (ft)

Residual Area,

A2 = A - A1

A2 = 17301 (ft)

V2 = A2 * L

V2 = 5190506 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 5235272 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 172788 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 33.9 (ft)

RESULTS

1) Prefailure Height = 13.5 (ft)

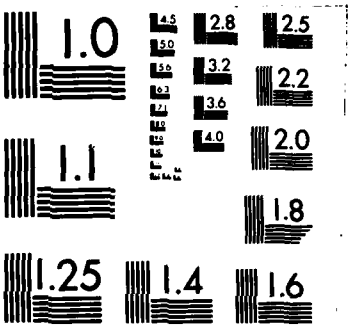
2) Postfailure Height = 33.9 (ft)

3) Breach Discharge = 172788 (cfs)

4) Reach Length = 300 (ft)

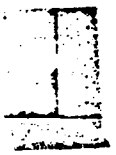
AD-A156 234 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
DUREPO BROOK DAM (ME.. (U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV SEP 81

UNCLASSIFIED F/G 13/13 NL



MAIN

Client CORPS OF ENGINEERS Job No. 1345-072-016 Sheet 25 of 27
Subject DUARDO BROOK DAM FAILURE ANALYSES By T.OTOLA Date 9-2-81
Chkd. Rev.



B E A C H (13) CALCULATIONS

Test flood discharge
Qt = 16454 (cfs)

s = 3.2 (deg.)
S = .0043
n = .07
L = 300 (ft)

From Formula (I),

Prefailure height,

h1 = 13.5 (ft)

From Formula (II),

A1 = 3298 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 33.9 (ft)

From Formula (II),
Total Area,
A = 20603 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 17304 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 5191267 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 169260 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 185714 (cfs)

h = 33 (ft)

From Formula (II),

A = 20314 (ft)

Residual Area,

A2 = A - A1

A2 = 17015 (ft)

V2 = A2 * L

V2 = 5104645 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 5147956 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 169289 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 33.7 (ft)

RESULTS

1.) Prefailure Height = 13.5 (ft)

2.) Postfailure Height = 33.7 (ft)

3.) Breach Discharge = 169239 (cfs)

4.) Beach Length = 300 (ft)

Client CORPS OF ENGINEERS Job No. 1345-72 Sheet 26 of 27
Subject DUREDO BROOK DAM By T. O'DELL Date 2-1-81
FAILURE ANALYSES Chkd. Rev.

R E A C H (14) CALCULATIONS

Test flood discharge
Qt = 16454 (cfs)

s = 3.2 (deg.)
S = .0043
n = .07
L = 300 (ft)

From Formula (I),

Prefailure height,

h1 = 13.5 (ft)

From Formula (II),

A1 = 3298 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 33.7 (ft)

From Formula (II),
Total Area,
A = 20316 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 17017 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 5105369 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 165890 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 182344 (cfs)

h = 33 (ft)

From Formula (II),

A = 20037 (ft)

Residual Area,

A2 = A - A1

A2 = 16738 (ft)

V2 = A2 * L

V2 = 5021519 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 5063444 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 165918 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 33.4 (ft)

RESULTS

1.) Prefailure Height = 13.5 (ft)

2.) Postfailure Height = 33.4 (ft)

3.) Breach Discharge = 165918 (cfs)

4.) Reach Length = 300 (ft)

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 27 of 27
Subject DURFEE BROOK DAM By T. OTOVA Date 2-2-81
FAILURE ANALYSES Chkd. Rev.

REACH (15) CALCULATIONS

Test flood discharge:
Qt = 16454 (cfs)

a = 3.2 (deg.)
S = .0043
n = .07
L = 300 (ft)

From Formula (I),

Prefailure height,

h1 = 13.5 (ft)

From Formula (II),

A1 = 3238 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 32.4 (ft)

From Formula (II),
Total Area,
A = 20039 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 16740 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 5022209 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 162641 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 179095 (cfs)

h = 33 (ft)

From Formula (II),

A = 19768 (ft)

Residual Area,

A2 = A - A1

A2 = 16470 (ft)

V2 = A2 * L

V2 = 4941000 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 4981604 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 162667 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 33.2 (ft)

RESULTS

1.) Prefailure Height = 13.5 (ft)

2.) Postfailure Height = 33.2 (ft)

3.) Breach Discharge = 162667 (cfs)

4.) Reach Length = 300 (ft)

APPENDIX E

INFORMATION AS CONTAINED IN THE

"NATIONAL INVENTURY OF DAMS IN THE UNITED STATES"

NOT AVAILABLE AT THIS TIME

END

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