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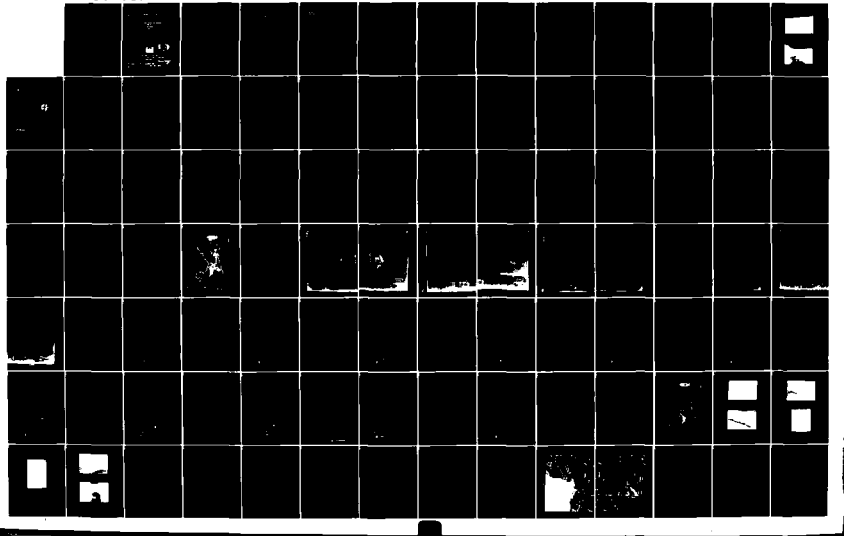

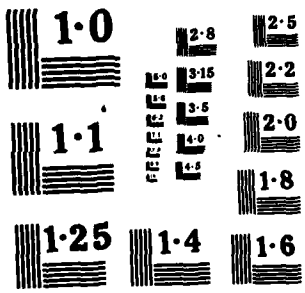
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MERRIMACK RIVER BASIN
NEW IPSWICH, NEW HAMPSHIRE

AD-A157 329

SOUHEGAN RIVER WATERSHED
DAM NO. 19

NH 00475

NHWRB 175.19

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST 1978

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NH 00475	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Souhegan River Watershed Dam No. 19 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE August 1979 13. NUMBER OF PAGES 62
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

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

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
New Ipswich New Hampshire
South Branch Of Souhegan River

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

The dam is about 720 ft. long and 35.5 ft. high. It is intermediate in size with a high hazard potential. In the event of failure of the dam, there is the potential of significant property damage and loss of life could result. The dam is in good condition at the present time. No conditions were observed which require additional investigation. There are a few remedial measure, which be implemented by the owner.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

SEP 24 1979

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

I am forwarding to you a copy of the Souhegan River Watershed Dam No. 19 Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved 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 a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire and owner of the project.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

SOUHEGAN RIVER WATERSHED DAM NO. 19
NH 00475

MERRIMACK RIVER BASIN
HILLSBOROUGH COUNTY, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

PHASE I REPORT

Identification No.:	NH 00475
NHWRB No.:	175.19
Name of Dam:	SOUHEGAN RIVER WATERSHED DAM NO. 19
Town:	New Ipswich
County and State:	Hillsborough County, New Hampshire
Stream:	South Branch Souhegan River
Date of Inspection:	May 1, 1979

BRIEF ASSESSMENT

The Souhegan River Watershed Dam No. 19 is located on the South Branch of the Souhegan River approximately 1600 feet upstream of Ashby Road in New Ipswich, New Hampshire. The dam is an earth embankment 720 feet long and 35.5 feet high with a drop inlet service spillway structure and a 30 inch outlet conduit. Modifications to enlarge the capacity of the emergency spillway system are presently under construction. The modification plans call for the filling of the left emergency spillway and replacing the right emergency spillway with a structural emergency spillway of higher capacity. The remaining opening in the right spillway will be closed with an earthfill dike.

The structural spillway will consist of a reinforced concrete box inlet, a reinforced concrete chute, and a St. Anthony Falls (SAF) stilling basin. The design flow for the spillway is 15,061 cfs. The energy dissipator has been hydraulically designed for 10,040 cfs.

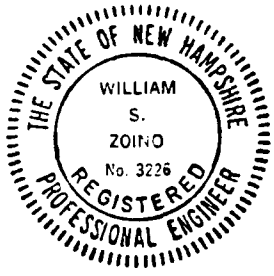
The dam is owned by the New Hampshire Water Resources Board. It was designed by the Soil Conservation Service for the purpose of flood protection in the Souhegan River Watershed. The modifications to the spillway system were designed by Camp, Dresser & McKee, Inc. of Boston, Massachusetts.

The drainage area of the dam covers 11.4 square miles made up primarily of rolling woodland with numerous small swamps and ponds. The dam normally impounds 85.3 acre feet at low stage but has a maximum impoundment of 2,378 acre feet. The dam is INTERMEDIATE in size and its hazard classification is HIGH since significant property damage and loss of life could result in the event of a dam failure.

The test flood for this dam is the Probable Maximum Flood. The peak inflow for this flood is 16,400 cfs. Because of storage the peak outflow for this flood is 13,250 cfs compared to a maximum spillway capacity of 15,680 cfs. The water surface would be at elevation 966.55 feet (MSL) or 0.45 feet below the top of the dam for this flood.

The dam is in GOOD condition at the present time. No conditions were observed which require additional investigation. Remedial measures to be undertaken by the owner include; backfilling animal burrows; removing shrubs or saplings, including their roots, and backfilling the resulting voids; cutting brush on slopes periodically; cleaning and painting trash racks; checking the operability of the pond drain gate as part of the annual inspection procedure; continuing the annual inspection program; and developing a formal written emergency flood warning system for the dam.

The recommendations and improvements outlined above should be implemented within two years of receipt of this report by the owner.



William S. Zoino
N.H. Registration No. 3226

Nicholas A. Campagna, Jr.
California Registration 21006

This Phase I Inspection Report on Souhegan River Watrshead Dam No. 19 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 A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

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 a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

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 unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the 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.

TABLE OF CONTENTS

Table of Contents - cont.

Overview of upstream slope

Overview of downstream slope

SECTION 3 - VISUAL INSPECTION

3.1 Findings

(a) General

The Souhegan River Watershed Dam No. 19 is in GOOD condition at the present time.

(b) Dam

1) Embankment (See photos #1 and #2)

Small animal burrows and tire tracks were found in both the upstream and downstream slopes. There are five evergreen trees, from one to four feet high, growing on the upstream slope and one on the downstream slope. There is approximately six inches of erosion from wave action at the waterline on the upstream slope.

Three piezometers and three observation wells were found downstream of the dam. The purpose of these instruments was probably for monitoring performance during construction. The piezometers were not read because a readout unit was not available. An observation well located approximately 130 feet to the left of the outlet pipe as measured along the downstream toe showed the water level to be about six feet below the ground surface. An uncased observation well located approximately 30 feet downstream of the toe showed the water level at four feet below ground surface and a third observation well approximately 130 feet downstream of the toe showed the water level to be essentially at ground surface (See pg. B-2A).

The two embankment drain pipes were submerged at the time of inspection.

2) Emergency Spillway (See photo #2)

The left emergency spillway is in GOOD condition. Material is being placed in the spillway area as part of the ongoing construction of the new structural emergency spillway.

The right emergency spillway has been isolated with an earthfill cofferdam and excavation is underway for the new structure.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

Among other design data available from the Soil Conservation Service are hydrologic and hydraulic computations, structural computations, a geological report, and a design report. The design report for the modifications to the emergency spillways, which are presently under construction, was obtained from Camp, Dresser & McKee, Inc.

2.2 Construction Data

"As built" plans are available for this dam and show good agreement with design plans and the visual inspection.

2.3 Operating Data

No operating data is available. The gate is operated only as part of infrequent maintenance checks.

2.4 Evaluation of Data

(a) Availability

Sufficient data is available to permit evaluation of the dam when combined with findings of visual inspections.

(b) Adequacy

There is sufficient design and construction data to permit an assessment of dam safety when combined with the visual inspection, past performance, and sound engineering judgment.

(c) Validity

Since the observations of the inspection team generally confirm the data, a satisfactory evaluation for validity is indicated.

2) Length of Weir:

(a) Pond drain inlet: 30 inch diameter pipe

(b) Low stage inlet: 7 feet, 6 inches

(c) High stage inlet: 18 feet

(d) Emergency spillway before modifications: 460 feet

(e) Emergency Spillway after modifications: 360 feet

3) Crest elevation (ft. above MSL)

(a) Pond drain inlet: 934.0

(b) Low stage inlet: 940.9

(c) High stage inlet: 955.5

(d) Emergency spillway before modifications: 961.0

(e) Emergency spillway after modifications: 961.0

4) Gates: 30 inch vertical lift sluice gate on pond drain inlet

5) Upstream channel: Reservoir

6) Downstream channel:

Before modification: Wide stream through woodland
After modification: St. Anthony Falls stilling basin

(j) Regulating Outlet

The only regulating outlet is a 30 inch diameter pipe controlled by a wheel operated sluice gate. The pipe invert is at elevation 934 feet (MSL). The purpose of this outlet is pond drainage, and it is normally closed.

5) Side slopes

Before modifications: 3 to 1
After modifications: 3 to 1

6) Zoning

Before modifications: Silty fine sand core; silt sand and gravel shells; seepage drain full length, of downstream embankment

After modifications: Same

7) Impervious core

Before modifications: Semi-pervious silty fine sand
After modifications: Same

8) Cutoff

Before modifications: 12 feet wide, earthfill
After modifications: Same

9) Grout curtain

Before modifications: None
After modifications: None

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillways

1) Type:

(a) Principal spillway: Reinforced concrete drop inlet

(b) Emergency spillway before modifications: Grass covered earth channels cut in left and right abutments

(c) Emergency spillway after modifications: Reinforced concrete box inlet, chute, and SAF stilling basin

3) Spillway crest pool:

a) Low stage inlet: 85.3

b) High stage inlet: 1268

c) Emergency spillway: 1650

4) Top of dam: 2378

5) Test flood pool: 2321

(f) Reservoir Surface (acres)

1) Normal pool: 27

2) Flood control pool: 115

3) Spillway crest pool:

a) Low stage inlet: 27

b) High stage inlet: 82 ±

c) Emergency spillway: 115

4) Test flood: 129

5) Top of dam: 130

(g) Dam

1) Type

Before modifications: Earth embankment
After modifications: Earth embankment

2) Length

Before modifications: 720 feet
After modifications: 1,250 feet

3) Height

Before modifications: 35.5 feet
After modifications: 35.5 feet

4) Top Width

Before modifications: 14 feet
After modifications: 14 feet

8) Project Discharge at Test Flood

The total project discharge at test flood elevation (966.55 feet MSL) will be 13,250 cfs after the modifications are completed.

(c) Elevation (feet above MSL)

1) Streambed at centerline of dam: 931.5

2) Maximum tailwater: No data

3) Upstream portal invert diversion tunnel: Not applicable

4) Normal pool: 940.9

5) Full flood control pool: 961.0

6) Spillway crest:

a) Pond drain inlet: 934.0

b) Low stage inlet: 940.9

c) High stage inlet: 955.5

d) Emergency spillway: 961.0

7) Design surcharge: 967.0

8) Top dam: 967.0

9) Test flood design surcharge: 966.55

(d) Reservoir

1) Length of maximum pool: 4500 ± ft.

2) Length of normal pool: 3000 ± ft.

3) Length of flood control pool: 4400 ± ft.

(e) Storage (acre feet)

1) Normal pool: 85.3

2) Flood control pool: 1650

(b) Discharge at Damsite

1) Outlet Works

Normal discharge at the site is through the 42 inch diameter outlet pipe. In the event of severe flooding water would flow over the emergency spillway at elevation 961.0 feet (MSL). The invert of the low stage orifices is at elevation 940.9 feet (MSL). The invert of the high stage orifices is at elevation 955.5 feet (MSL).

2) Maximum Known Flood

There is no data available for the maximum known flood at this damsite.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the principal spillway with the reservoir at top of dam elevation (967 feet MSL) is 279 cfs. The capacity of the emergency spillway will be 15,401 cfs at this level after the modifications are completed.

4) Ungated Spillway Capacity at Test Flood

The capacity of the principal spillway with the reservoir at test flood elevation (966.55 feet MSL) is 277 cfs. The capacity of the emergency spillway will be 12,973 cfs at this level after the modifications are completed.

5) Gated Spillway Capacity at Normal Pool

There are no gated spillways with the exception of the gated pond drain inlet which is normally closed.

6) Gated Spillway Capacity at Test Flood

As previously mentioned, there are no gated spillways.

7) Total Spillway Capacity at Test Flood

The total spillway capacity at test flood elevation (966.55 feet MSL) will be 13,250 cfs after the modifications are completed.

(g) Purpose of the Dam

The purpose of the dam is to reduce downstream flooding by providing temporary storage for the runoff from 11.4 square miles of watershed. This temporary storage is released through the low and high stage outlets of the principal spillway.

(h) Design and Construction History

The original dam was designed by the U.S. Department of Agriculture, Soil Conservation Service. It was completed in 1962.

Modifications to the emergency spillway are presently under construction. These modifications are being made in order to increase the capacity of the spillway system. The work is being done by Bridge Construction Corporation of Augusta, Maine, and is being inspected by Mr. Dean Sherman. The modifications were designed by Camp, Dresser & McKee, Inc. of Boston, Massachusetts for the Soil Conservation Service.

The modification plans call for the filling in of the left emergency spillway and replacing the right emergency spillway with a structural emergency spillway. The remaining opening of the right emergency spillway will be closed with an earth filled dike.

(i) Normal Operational Procedure

The dam is normally self regulating. At the time of inspection the pond drain had been opened to lower the reservoir during construction of the new emergency spillway.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers 11.4 square miles (7,277 acres). It consists primarily of rolling topography with numerous small swamps and ponds.

4) Foundation and Embankment Drainage (See pg. B-4)

A vertical seepage drain with a graded filter is located in the downstream foundation at a distance of 80 feet from the centerline of the dam. It extends across the valley parallel to the centerline of the dam and up each abutment to an elevation of 957.0 feet. This drain has a width of 4.0 feet and varies in depth from 8 to 9 feet. Accumulated seepage is discharged into the stilling basin through 10 inch bituminous coated corrugated metal pipes on each side of the principal spillway conduit.

(c) Size Classification

The dam's maximum impoundment of 2378 acre feet and height of 35.5 feet place it in the INTERMEDIATE size category according to the Corps of Engineers' Recommended Guidelines.

(d) Hazard Potential Classification

The hazard potential classification for this dam is HIGH because of the significant economic losses and the high potential for loss of life downstream in the event of dam failure. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The dam is owned by the New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire 03301. They can be reached by telephone at 603-271-3406.

(f) Operator

The operation of the dam is controlled by the New Hampshire Water Resources Board. Key officials are as follows:

George McGee, Chairman
Vernon Knowlton, Chief Engineer
Donald Rapoza, Assistant Chief Engineer

The Board's telephone number is 603-271-3406. Alternatively, the Board can be reached through the state capital at 603-271-1110.

The pipe penetrates the downstream side of the riser structure and the earth embankment is supported by a 10 inch thick concrete cradle within the embankment. Plans indicate six concrete anti-seep collars cast around the pipe within the core of the embankment. The end of the conduit and cradle extend downstream of the embankment approximately 16 feet. Plans indicate two 24 inch diameter cast-in-place piles supporting the end of the cradle. The conduit outlets into a stone revetted plunge pool.

3) Emergency Spillway (See pgs. B-3 and B-7)

An emergency spillway was excavated in earth in the left abutment. It curves slightly to the right around the embankment and is 300 feet wide at the control section. It is approximately 300 feet long with the control section approximately 6 feet below the top of the embankment. The side slopes are 3 horizontal to 1 vertical on the left side and 4 horizontal to 1 vertical on the right side.

An emergency spillway was excavated in earth in the right abutment. It curved to the left around the embankment and was 160 feet wide at the control section. This emergency spillway is no longer functional. An earth cofferdam has been constructed upstream of this spillway and excavation is underway for the proposed modifications.

The structural spillway which is being installed consists of a reinforced concrete box inlet, a reinforced concrete chute, and a St. Anthony Falls (SAF) stilling basin. The design flow of the spillway is 15,061 cfs. The energy dissipator has been hydraulically designed for 10,040 cfs. The spillway was hydraulically designed and model tested by the Soil Conservation Service. Detailed design plans are included in Appendix B of this report (pgs. B-8 through B-18).

The existing spillway channels will be diked with compacted glacial till. Soils and compaction methods will be the same as those used for the original dam.

2) Principal Spillway (See pgs. B-5 and B-6)

The principal spillway consists of a reinforced concrete drop inlet structure with a sluice gate controlled inlet pipe and two uncontrolled orifice inlets, an outlet pipe supported on a concrete cradle, and an impact basin.

The riser structure is 25 feet high and 11 feet wide normal to the axis of the dam. It is 5.5 feet long parallel to the embankment and flares to 16 feet long at the top. The walls of the structure are 12 inches thick and the top slab is 8 inches thick.

At the base of the structure is a 30 inch diameter, vertical lift, slide gate inlet which is controlled by a wheel operated Armco bench stand with a rising stem. The stem is protected by a steel stem cover which is capped. A 30 inch diameter, asphalt coated, corrugated metal pipe extends 22 feet upstream from the lift gate into the impoundment pool. Plans indicate a 48 inch perforated pipe riser structure 6 feet high at the upstream end of this pipe. The low stage inlet consists of two uncontrolled openings approximately 7.5 feet above the sluice gate invert. They are located on the left and right sides of the structure and are each 3 feet 9 inches wide and 12 inches high. The water flows over each orifice and drops into the inlet structure. Each orifice is protected by a trash rack assembly approximately 5 feet high and 4.5 feet wide. These painted assemblies are fabricated from steel angles and reinforcing rods.

The "high stage inlet" consists of two openings approximately 22 feet above the sluice gate invert. They are 9 feet wide and 21 inches high and are located in the left and right sides of the flared portion of the riser structure. They are protected by 3 galvanized steel pipes, 2 inches in diameter, placed in front of each high stage opening. A 24 inch diameter manhole permits access into the riser structure.

The riser structure is drained by an outlet conduit of 42 inch diameter reinforced concrete pressure pipe. It is approximately 202 feet long and drops approximately one foot over that length.

1.2 Description of Project

(a) Location

The Souhegan River Watershed Dam No. 19 is located on the South Branch of the Souhegan River in New Ipswich, New Hampshire. It can be reached by an access road off State Route 123A in New Ipswich, New Hampshire.

The dam is shown on USGS Ashby, MA quadrangle at approximately coordinates N 42° 43.4', W 71° 50.9' (See location map on page v). Figure 1 of Appendix B is a site plan for this dam.

(b) Description of Dam and Appurtenances

The dam consists of a zoned earthfill embankment with an earthfill cutoff trench below the embankment, a principal spillway with a concrete riser and outlet pipe, and two earth emergency spillways located in the left and right abutments.

Modifications are presently under construction to increase the capacity of the emergency spillway system. This will be accomplished by filling in the present earth channel spillways and installing a structural spillway and stilling basin of reinforced concrete. At the time of inspection, an earthfill cofferdam had been constructed across the upstream side of the right emergency spillway and excavation was under way for the proposed modifications.

1) Embankment (See pgs. B-3, B-4 and B-7)

The zoned embankment is made up of a central core of silty fine sand with exterior shells of silt, sand, and gravel. It is 720 feet long with a 12 foot wide compacted earthfill cutoff trench below the embankment over its full length. The dam is a maximum of 35.5 feet high. The upstream and downstream slopes are both 3 horizontal to 1 vertical and the width of the crest is 14 feet.

The dam is founded on sandy alluvial floodplain material which is underlain by glacial till and bedrock. The abutments are kame terraces which are deposits of coarse grained sediments formed by glacial melt water. When the modifications are completed, the earth embankment will be 1,180 feet long.

PHASE I INSPECTION REPORT

SOUHEGAN RIVER WATERSHED DAM NO. 19

SECTION 1

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. Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZD under a letter of March 30, 1979 from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-79-C-0058 has been assigned by the Corps of Engineers for this work.

(b) Purpose

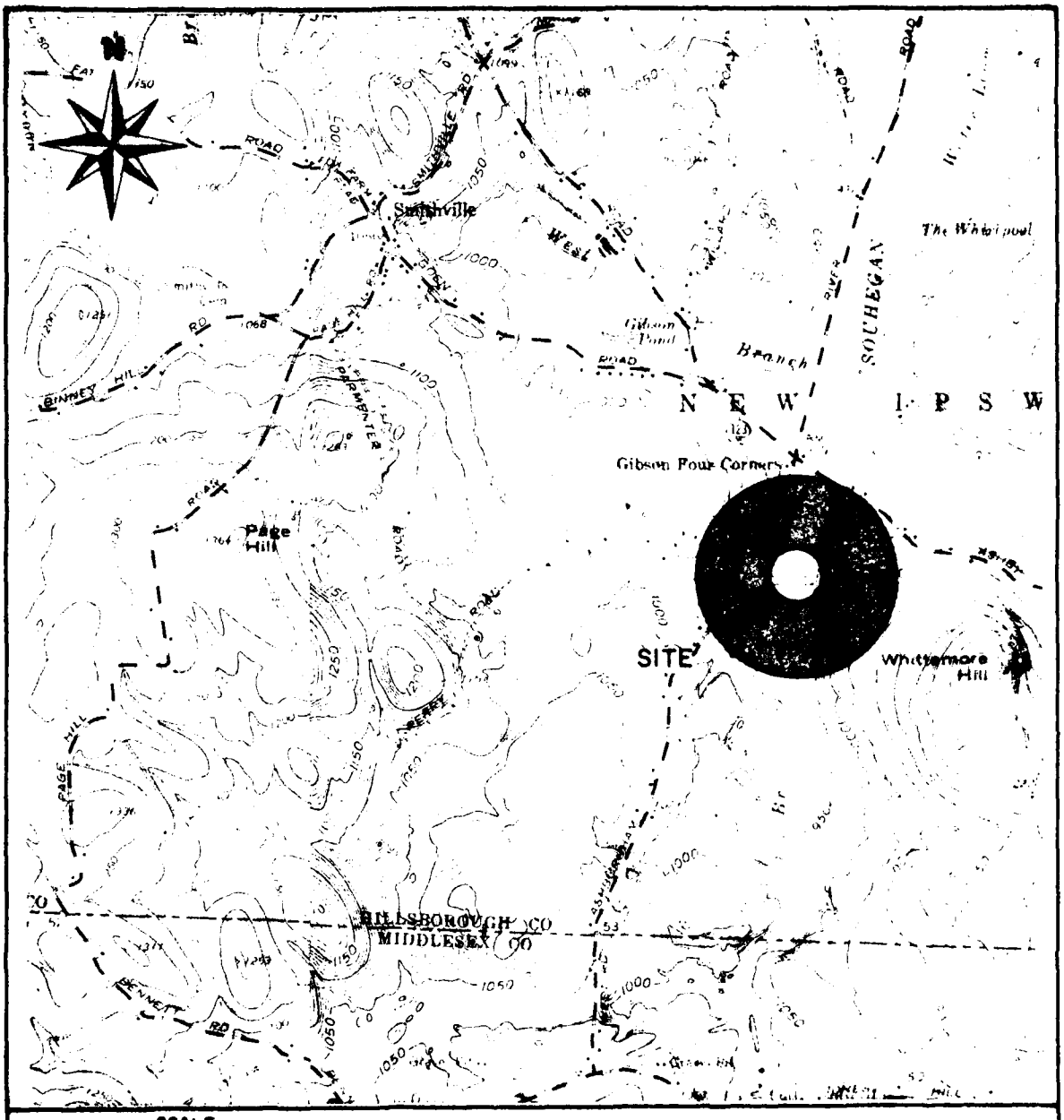
1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

3) Update, verify, and complete the National Inventory of Dams.

(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams, and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dams.



– SCALE –

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FROM: USGS ASHBY & ASHBURNHAM MASS.-N.H. QUADRANGLE MAPS.

GOLDBERG, ZOINO, DUNNCLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN

SOUHEGAN RIVER WATERSHED
DAM No. 19 NEW HAMPSHIRE

FILE No. 2327

			SCALE AS NOTED
			DATE MAY 1979

(c) Appurtenant Structures

1) Drop Inlet Service Spillway Structure (See photos #3 and #4)

The structure is in GOOD condition with the exception of erosion of the inverts of both low stage openings. This erosion is minor and is possibly due to cavitation. Otherwise, the structure shows no evidence of spalling, cracking or efflorescence. The sluice gate was submerged at the time of inspection. The bench stand is in good condition. The hand wheel has been removed from the site to preclude unauthorized use.

The low stage trash racks showed minor surface rust. The high stage trash racks are in GOOD condition. Some debris is caught in the low stage trash racks.

2) Pond Drain Inlet Pipe

At the time of inspection the 30 inch pond drain inlet pipe was completely submerged and could not be observed. The gate for this inlet was partially open and flow could be observed in the inlet structure.

3) Outlet Conduit (See photos #6 and #7)

The downstream end of this conduit is in good condition with no evidence of settlement or spalling. There is minor cracking with associated efflorescence on the crown over a length of approximately eight feet of the exposed pipe. The source of the present discharge is the partially open pond drain inlet and the low stage inlet openings.

3.2 Evaluation

The dam is generally in GOOD condition. The potential problems noted during the visual inspection are listed as follows:

a) Animal burrows in embankment slopes.

b) Saplings growing in embankment slopes.

c) Debris clogging the trash racks.

d) Trash racks rusted.

e) Low stage inverts eroding.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures exist for this dam. The pond drain is partially open at the present time to facilitate the ongoing construction. The pond drain is normally closed.

4.2 Maintenance of Dam

An annual inspection is made jointly by the New Hampshire Water Resources Board and the Soil Conservation Service. Recommendations resulting from this inspection are implemented by the NHWRB.

4.3 Maintenance of Operating Facilities

Operation of the sluice gate for the pond drain inlet is checked approximately once every four or five years by NHWRB.

4.4 Description of Warning System

There is no warning system in effect.

4.5 Evaluation

The established operational procedures for this dam are generally satisfactory. Additional emphasis on routine maintenance will assist the owners in assuring the long-term safety of the dam.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features

(a) General

The description of the dam, as it appears in this section, applies to the dam after the modifications have been completed. This is because the hydraulic calculations assume these conditions (See section 1.2(b) and 1.2(h).

Souhegan River Watershed Dam No. 19 is a Soil Conservation Service flood control dam on the South Branch of the Souhegan River in New Ipswich, New Hampshire. The dam is about 1600 ft. upstream of Ashby Road and about 3300 ft. upstream of the confluence of the South and West Branches of the Souhegan River. The upstream drainage area is 11.4 square miles with rolling topography and numerous small swamps and ponds.

The dam itself is an 1180 foot earth embankment with a 72 ft. wide concrete box drop inlet emergency spillway. The principal spillway consists of 4 orifices located on a riser in the reservoir. Flow from the orifices proceeds under the dam through a reinforced concrete pipe.

The elevation of the low stage inlet was determined by the 50 year sedimentation level of the watershed. The high stage inlet was set to allow storage of the four year, six hour storm without water passing over the high stage inlet. The emergency spillway crest was set to allow storage of the 100 year storm and the top of dam was determined based on the Probable Maximum Flood.

(b) Design Data

The data sources available for Souhegan River Watershed Dam No. 19 include the Soil Conservation Services (SCS) original "Hydrology/Hydraulics" Design Calculations. These calculations establish storage-elevation and stage-discharge curves for the dam and route storms of various magnitudes through the reservoir. These calculations are dated 1961.

A second set of Design Calculations, dated 1976, is also available. These calculations are part of the design for the reconstruction of the dam which is currently underway. This reconstruction is replacing two grass-lined emergency spillways with one concrete box drop inlet emergency spillway.

Also available are SCS "Maintenance Checklist" reports on dam inspections dated May 19, 1977 and June 16, 1978.

The plans for the 1962 construction of the dam and for the current reconstruction are also available for Dam No. 19.

(c) Experience Data

No records of flow or stage are known to be available for Souhegan River Watershed Dam No. 19.

(d) Visual Observations

Souhegan River Watershed Dam No. 19 is a flood control structure on the South Branch of the Souhegan River about 1600 ft. upstream of Ashby Road in New Ipswich, New Hampshire. The dam consists of an 1180 foot earth embankment with a crest elevation of 967 feet MSL.

The emergency spillway currently under construction will be a 72 foot wide concrete drop box inlet structure, with its crest of 961 feet MSL. The principal spillway consists of a concrete riser structure in the reservoir with four orifices; two 1.0 foot by 3.75 foot orifices with inverts at 940.9 feet MSL and two 1.8 foot by 9 foot orifices with inverts at 955.5' MSL. The flow from these orifices combines in the riser and flows under the dam through a 42 inch reinforced concrete pipe 202.3 feet long.

The only controlled outlet at the dam is a 30 inch corrugated metal pipe with its invert at 934 feet MSL which also feeds into the riser and to the 42 inch reinforced concrete pipe under the dam. This outlet is a pond drain, and is usually closed. It is operated by a valve on the riser structure.

The South Branch of the Souhegan downstream of the dam is generally wide and shallow, with a wide flood plain. The stream passes under Ashby Road about 1600 feet downstream of the dam through three 6 foot by 6 foot arch culverts. Immediately downstream of Ashby Road there are three houses in the east part of the flood plain with ground floors 10 to 15 feet above the streambed.

Some 1700 feet downstream of Ashby Road the South and West Branches of the Souhegan join to form the Souhegan River. Two more houses and a trailer are on the east edge of the flood plain here with ground floors about 10 to 15 feet above the streambed.

The Souhegan runs about 4000 feet from this confluence to the upstream end of Water Loom Pond. There is one house in this reach, on the west side of the river about 14 feet above the flood plain. River Road Runs parallel to and about 10 feet above the river here.

Water Loom Pond is about 6200 feet long. Downstream the river runs about 3000 feet to the village of High Bridge, and then about 2 miles to the Town of Greenville.

(e) Test Flood Analysis

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires using the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. The original hydraulic and hydrologic design calculations of the SCS are available for this dam.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of between 1000 and 50,000 acre feet and the height of less than 100 feet classify this dam as an INTERMEDIATE structure.

The appropriate hazard classification for this dam is HIGH because of the significant economic losses and high potential for loss of life downstream in the event of dam failure. As shown in the Dam Failure Analysis section of this report, the increase in flooding caused by failure would pose a threat to property and to lives at the houses near Ashby Road, the houses near the confluence of the South and West Branches of the Souhegan, the house near Water Loom Pond, the village of High Bridge, and the Town of Greenville. Other impacts of dam failure include possible damage to several well-traveled roads, damage to a lumber yard, and damage to Water Loom Pond Dam (see Dam Failure Analysis Section).

As shown in Table 3 of the Corps of Engineers' "Recommended Guidelines," the appropriate Test Flood for a dam classified as INTERMEDIATE in size with a HIGH hazard potential would be the probable maximum flood (PMF). The Corps of Engineers' New England Division's "Maximum Probable Flood Peak Flow Rates" curve gives a PMF of 1600 csm for a drainage area of 11.4 square miles with rolling topography. To account for storage in the numerous ponds and

swamps upstream of Souhegan River Watershed Dam No. 19, this was reduced by 10 percent to 1440 csm, which yields a Test Flood Inflow of 16,400 cfs. After attenuation by storage in the reservoir, the peak outflow is 13,250 cfs, which yields a peak water surface elevation of 966.55 feet MSL, 0.45 feet below the dam crest. This analysis assumes that the reservoir is at normal pool at the beginning of the storm. Drawdown time from the emergency spillway crest to normal pool is 7 days.

(f) Dam Failure Analysis

The peak outflow that would result from the failure of Souhegan River Watershed Dam No. 19 is estimated using the procedure suggested in the Corps of Engineers New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs," as clarified in a December 7, 1978 meeting at the Corps' Waltham office. Dam failure is assumed to occur when the water surface overtops dam crest, at elevation 967.0 feet MSL. This elevation is also the SCS Design High Water for this dam.

With the reservoir at this elevation, the discharge just prior to failure as determined from the Stage-Discharge Curve developed in Appendix D would be 15,680 cfs. The tailwater elevation prior to failure at this discharge would be about 946 feet MSL (10 feet of flow in the channel).

For an assumed breach width equal to 40% of the dam width at the half-height, the gap in the embankment due to failure would be 230 feet. The resulting increase in flow would be 37,200 cfs, for a total flow of about 52,900 cfs. This would increase the tailwater elevation by 5 feet, to 15 feet of flow in the channel. The flood peak would be attenuated to 50,200 cfs and 15 feet of flow by the time the dam failure outflow reached Ashby Road 1600 feet downstream.

The only development in this reach is an open pit gravel mine, which would experience some flooding at the pre-failure flow of 15,680 cfs. This flooding would increase after failure, but it is unlikely that any loss of life would result at this location. Ashby Road itself would probably be washed out by the pre-failure outflow.

Just downstream of Ashby Road there are 3 houses between 10 and 15 feet above the streambed. These houses would be affected by dam failure, as flooding would suddenly increase from little or nothing to about 3' to 5'. This would cause serious damage, and would probably present a threat to life at these houses.

The 1700 foot reach from Ashby Road to the confluence of the South and West Forks of the Souhegan offers considerable temporary storage in the broad marshy floodplain so that the flood wave should be significantly attenuated in passing this reach. The prefailure outflow of 15,680 cfs would cause a stage about 12 feet above the steambed in this reach. The attenuated flow after failure at the confluence of the South and West Forks is 43,800 cfs, which represents a stage 17 feet above the streambed. Near the end of this reach there are three houses and one trailer home about 10 to 15 feet above the streambed which would be affected by dam failure. The dam failure flow would cause flooding at these dwellings to increase from 1 to 2 feet or less to about 3 to 6 feet. Again, this would cause serious property damage and present a threat of loss of life.

The 4,000 foot reach from the confluence to the upstream end of Water Loom Pond would have a stage of 14 feet at the pre-failure flow of 15,680 cfs. After failure the peak flow into Water Loom Pond would be 36,500 cfs, which would yield a stage of 18 feet above the streambed.

The only impacted dwelling in this reach is a house about 14 ft. above the streambed near the end of the reach. Dam failure would increase flooding at this house from negligible to 4 ft. Also, River Road runs parallel to the Souhegan about 10 feet above the streambed in this area, and would be flooded.

The magnitude of inflow to Water Loom Pond before dam failure is such that Water Loom Pond Dam, which has a spillway capacity of about 2,000 cfs, would be severely overtopped. Flows on the Souhegan downstream of the dam would be at dangerous levels. The failure of S.R.W. Dam No. 19 would increase these flows a great deal and present threats of serious flooding in the village of High Bridge (4 dwellings and a major road bridge on the river) and the Town of Greenville (15 to 20 dwellings on the river). High Bridge is about 3 miles downstream of S.R.W. Dam No. 19, and Greenville is about 5 miles downstream of the dam. Below Greenville there is little development on the Souhegan for 10 miles or so, which would give the dam failure flood wave an opportunity to dissipate.

The chart on the following page summarizes the downstream impacts of dam failure down to Water Loom Pond.

DOWNSTREAM IMPACTS OF DAM FAILURE

Reach	# Dwellings	Level Above Streambed (ft.)	Flow & Stage Before Failure	Flow & Stage After Failure	Comments
Dam to just D/S of Ashby Rd. (1600')	3	10-15	15,680 cfs 10 ft.	50,200 cfs @ Ashby Rd. 15 ft.	Also gravel mine & Ashby Road crossing affected. Flooding goes from 0 to 3-5 ft. at houses
Ashby Road to confluence of W & S Forks of Souhegan (1700')	3	10-15	15,680 cfs 12 ft.	43,800 cfs @ confluence 17 ft.	Flooding goes from 0-2 to 3-5 ft. at houses
Confluence W&S Forks to Water Loom Pond (4000')	1	14	15,680 cfs 14 ft.	36,500 cfs @ Pond 18 ft.	Flooding from 0 to 4 ft. at house. River Rd. flooded. Major flooding possible downstream of Water Loom Pond in High Pond & Greenville

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

(a) Visual Observations

There has been no significant displacement or distress which would warrant the preparation of structural calculations.

(b) Design and Construction Data

1) Embankment

Analysis carried out during the design and construction phase included infinite slope and sliding wedge methods of slope stability analysis. Slopes of 3:1 upstream and 2.5:1 downstream were recommended based on these results. The slopes actually constructed were 3:1 for both upstream and downstream.

For the new construction the dikes are to have slopes of 3:1 also. Haley & Aldrich, Inc. of Cambridge, MA made a slope stability evaluation of the dikes which is included in the Camp, Dresser & McKee, Inc. design report dated May 1978.

2) Appurtenant Structures

A review of the structural calculations for the design of the drop inlet service spillway structure and the outlet conduit (primary spillway) revealed that these structures have been designed on the basis of sound engineering practice.

(c) Operating Records

There are no known operating records for this dam.

(d) Post Construction Changes

With the exception of the curent construction discussed in section 1.2(h), there have been no known construction changes since the dam was completed in 1962.

(e) Seismic Stability

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

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The dam and its appurtenances are generally in GOOD condition at the present time.

(b) Adequacy of Information

There is sufficient design and construction data to permit an assessment of dam safety when combined with the visual inspection, past performance, and sound engineering judgment.

(c) Urgency

The engineering studies and remedial measures described herein should be implemented by the owner within two years of receipt of this Phase I Inspection Report.

(d) Need for Additional Investigations

None

7.2 Recommendations

No conditions were observed which require further investigation.

7.3 Remedial Measures

It is recommended that the owner institute the following remedial measures:

1) Remove shrubs or saplings, including roots, from slopes and backfill the resulting voids with suitable material.

2) Monitor the erosion of the low stage orifice inverts.

3) Clean and paint the upper portion of each low stage trash rack.

4) Check the operation of the pond drain gate annually as part of the maintenance inspection procedure.

5) Continue the annual maintenance inspection program.

6) Develop a formal written emergency flood warning system for the dam.

7) Implement and intensify a program of diligent and periodic maintenance including, but not limited to:

   a) Brush cutting on embankment slopes

   b) Backfilling animal burrows in embankment slopes with suitable, well tamped material

   c) Cleaning debris from trash racks

8) Consider monitoring the piezometers and observation wells as part of the inspection procedure.

7.4 Alternatives

There are no meaningful alternatives to the recommendations presented above.

APPENDIX A

INSPECTION CHECKLIST

INSPECTION TEAM ORGANIZATION

Date: May 1, 1979

Project: NH 00475
SOUHEGAN RIVER WATERSHED DAM NO. 19
New Ipswich, New Hampshire
NHWRB 175.19

Weather: Cloudy, 60°

INSPECTION TEAM

Nicholas A. Campagna	Goldberg, Zoino, Dunnicliff & Assoc. (GZD)	Team Captain
William S. Zoino	GZD	Soils
M. Daniel Gordon	GZD	Soils
Jeffrey M. Hardin	GZD	Soils
Paul Razgha	Andrew Christo Engineers (RAI)	Structures
Carl Razgha	ACE	Structures
Tom Gooch	Resource Analysis, Inc. (RAI)	Hydrology
Robert Fitzgerald	RAI	Hydrology

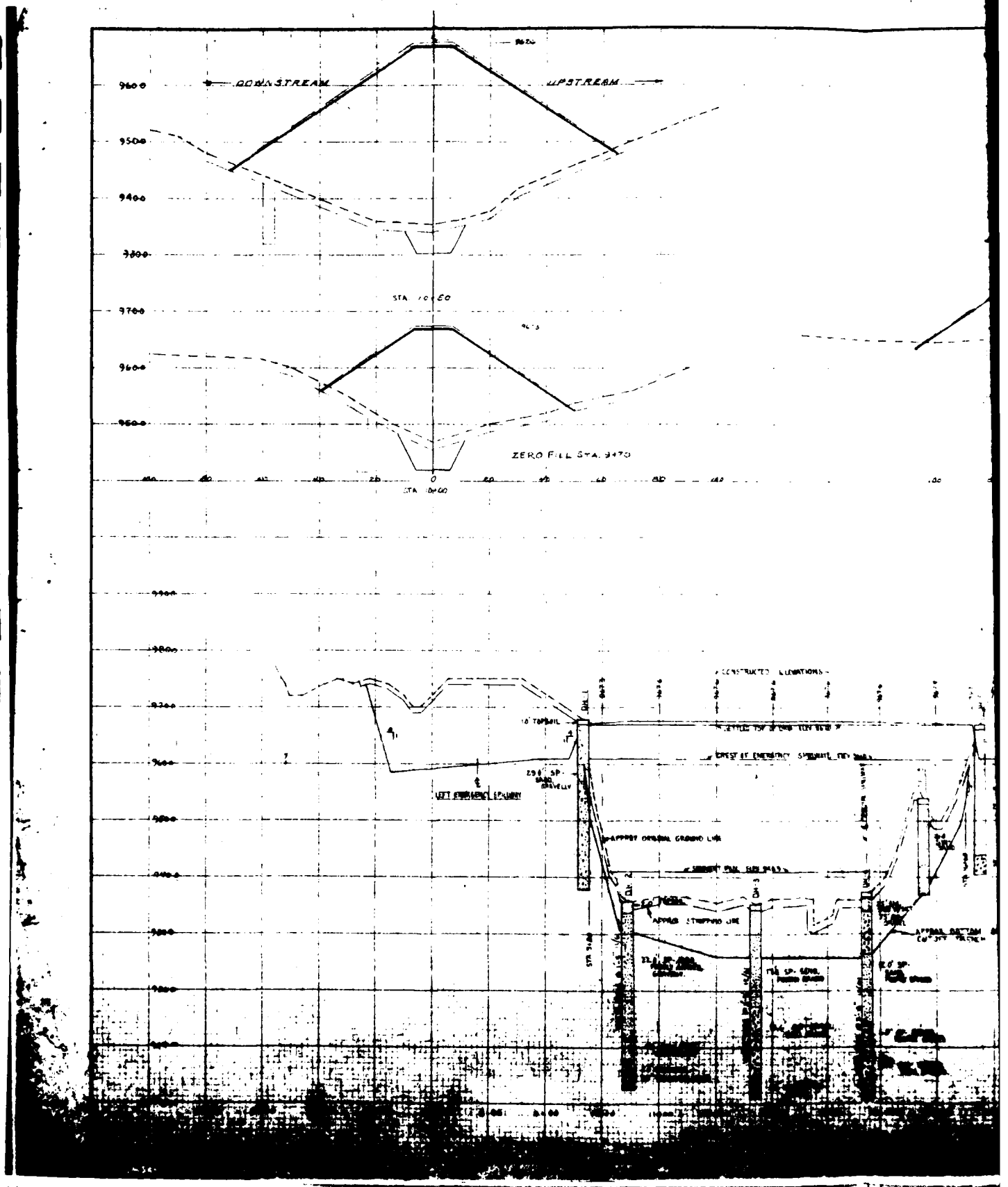
Owner's Representative Present

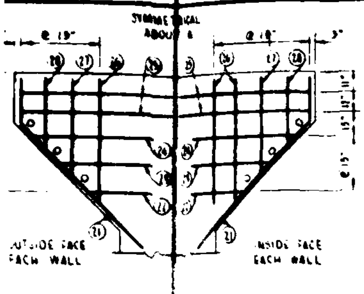
Gary Kerr - New Hampshire Water Resources Board

SOUHEGAN RIVER WATERSHED DAM NO. 19 — June 1, 1979
New Ipswich, New Hampshire — NH 00475

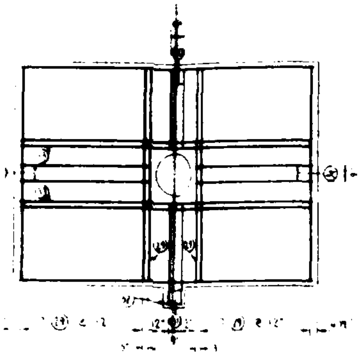
CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
DAM EMBANKMENT		
Crest elevation	NAC	967.0'
Current pool elevation		942.1'
Maximum impoundment to date		No data
Surface cracks		None
Pavement condition		Not applicable
Movement or settlement of crest		None
Lateral movement		None
Vertical alignment		Good
Horizontal alignment		Good
Condition at abutment and at concrete structures		Good
Indications of movement of structural items on slopes		None
Trespassing on slopes		Five pine trees 1-4' high on upstream slope; 3 to 5 rodent holes and tire tracks on upstream and downstream slopes
Sloughing or erosion of slopes of abutments		None
Rock slope protection - riprap failures		No riprap - approximately 6" erosion at water line
Unusual movement or cracking at or near toes	NAC	None

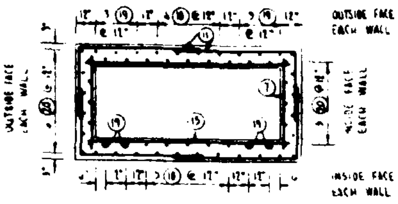

DOWNSTREAM
UPSTREAM
9600
9500
9400
9700
9600
ZERO FILL STA. 9470



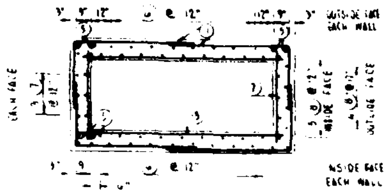
STEEL DETAILS OF ANTI-VORTEX DEVICE



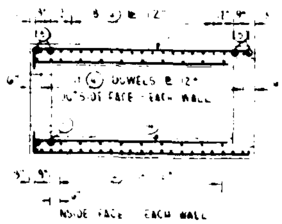
PLAN



SECTION DD



SECTION CC

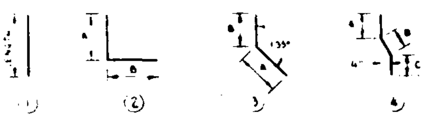


SECTION BB

STEEL SCHEDULE

MARK	LOCATION	QUAN.	SIZE	LENGTH	TYPE	A	B	C	TOTAL FT.
[illegible]	RISER	[illegible]	5	[illegible]	1				154 00
[illegible]		[illegible]	5	13 [illegible]	1				39 00
[illegible]		[illegible]	5	6 0	1				7[illegible] 00
[illegible]		22	5	4 [illegible]	2	[illegible]	[illegible]		88 [illegible]
[illegible]		[illegible]	[illegible]	[illegible] 9					9[illegible]
[illegible]		[illegible]	5	[illegible]	[illegible]				[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	1				[illegible] 0
[illegible]		[illegible]	[illegible]	[illegible]					31 [illegible]
[illegible]		8	7	[illegible]	2	[illegible]	[illegible]		14 00
		[illegible]		[illegible] 9	[illegible]	[illegible] 2	[illegible]		18 00
[illegible]		34	5	9 5	2	[illegible] 4	6		9[illegible]3.33
[illegible]		8	5	[illegible] 7	2	3 4	5 3		52 67
[illegible]		8	5	[illegible] 0	[illegible]				40 00
[illegible]		[illegible]	[illegible]	4 [illegible]	[illegible]				228 00
[illegible]		52	5	10 [illegible]					520 00
[illegible]		3	5	3 3	1				26 00
[illegible]		[illegible]	7	4 [illegible]	1				8 00
[illegible]		[illegible]	5	13 3					238 50
[illegible]		[illegible]	5	5 3	1				[illegible]
[illegible]		[illegible]	5	[illegible]					[illegible] 5[illegible]
[illegible]	[illegible]	8	[illegible]	[illegible]	2	8 [illegible]	[illegible]		84 00
[illegible]		8	5	3 3	[illegible]				[illegible]
		[illegible]	[illegible]	[illegible]	1				[illegible] 00
[illegible]		[illegible]	5	[illegible]					[illegible] 00
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]				24 00
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]				15 00
		[illegible]	[illegible]	[illegible]	1				40 00
[illegible]		[illegible]	[illegible]	[illegible]	1				28.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				65 00
[illegible]		[illegible]	5	4 [illegible]					8 [illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 67
[illegible]			[illegible]	[illegible]					[illegible].83
[illegible]		[illegible]	[illegible]	[illegible]					186.00
[illegible]		4	[illegible]	[illegible]					26.00

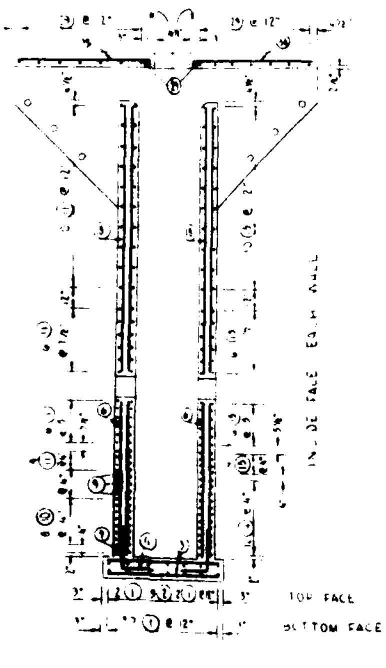
BAR TYPES



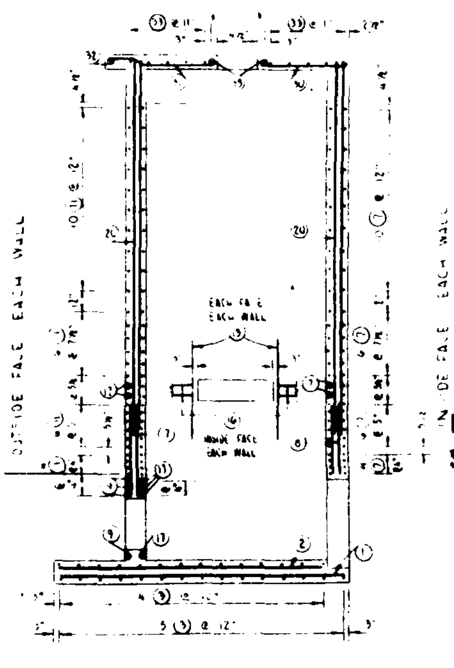
QUANTITIES THIS SHEET ONLY

STEEL	CONCRETE
Nº 5 BARS [illegible] LIN FT [illegible] LBS	CLASS "B" TYPE 1 [illegible] CU YDS.
Nº 7 BARS [illegible] LIN FT [illegible] LBS	

GENERAL NOTES & TOTAL QUANTITIES ON SHEET 7



SECTION AA



SECTION ALONG CENTERLINE

NOTE: DRAWING HAS BEEN REDUCED
SCALES ARE NOT AS SHOWN

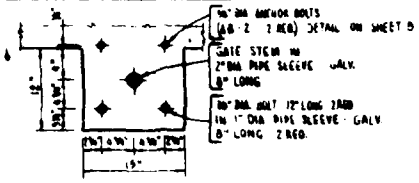
SCALE 1/4" = 1'-0"

SOUHEGAN RIVER WATERSHED PROJECT
FLOODWATER RETARDING DAM NO 19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

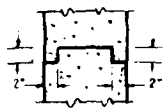
RISER DETAILS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

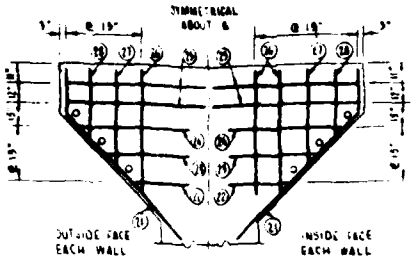
Designed	Date	Approved by
W J CARROLL	MAR '62	Title
Drawn: H T BROWNING JR	MAR '62	Title
Traced		
Checked: B J GERMANA	MAR '62	Sheet 6 of 8 — Drawing No. NH-573-[illegible]



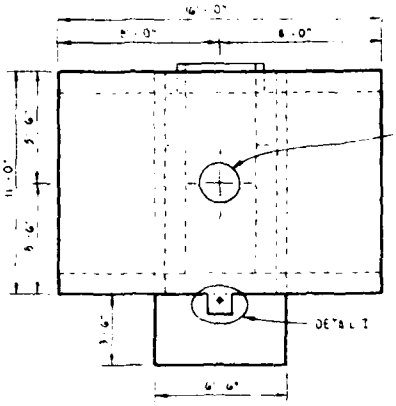
DETAIL I



TYPICAL CONSTRUCTION JOINT



STEEL DETAILS OF ANT. VORTEX DEVICE



PLAN

SLIDE GATE NOTES:

30" DIA SLIDE GATE ARMCO MODEL 35 050 OR APPROVED EQUAL

LIFT CPE 2

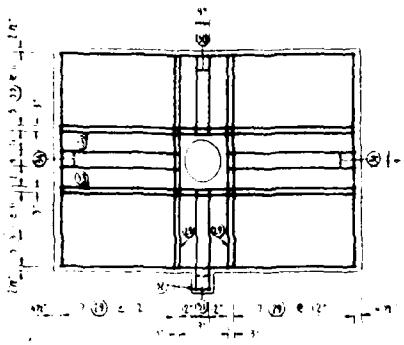
OPERATING HEAD 8 FT MAX SEATING HEAD 25 FT

STEM LENGTH 26 FT (ENCASED)
1½" DIA

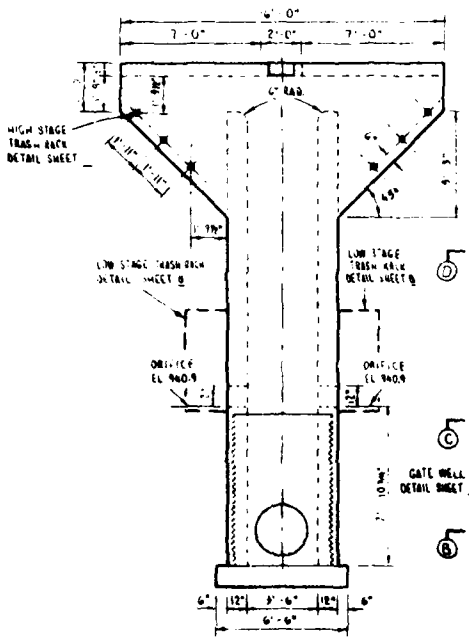
BRONZE SEAT FACINGS STEM & LIFT NUTS

FLAT BACK SEAT WITH WALL THIMBLE, TYPE F-1 ROUND OPENING SQUARE FLANGE

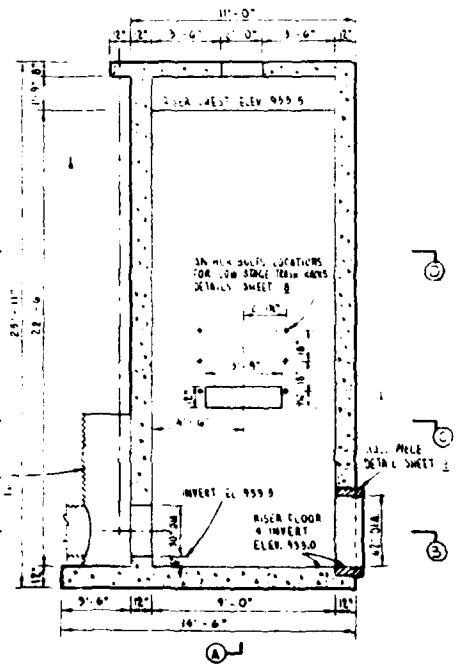
LOCATE STEM GUIDES & ANCHOR BOLTS ACCORDING TO MANUFACTURERS RECOMMENDATIONS



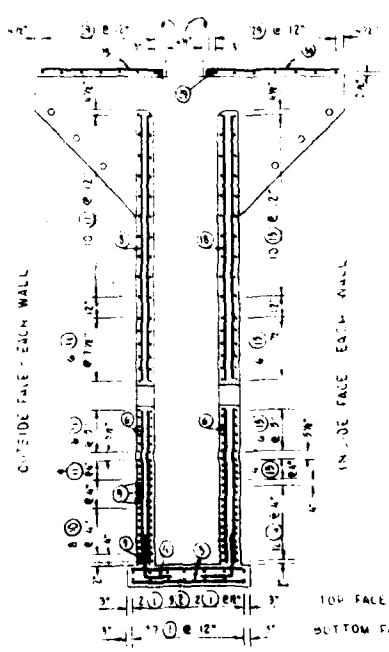
SECTION AB



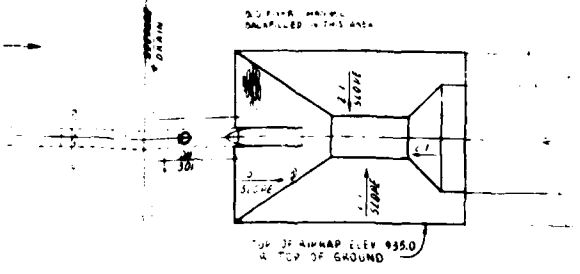
UPSTREAM ELEVATION



SECTION ALONG CENTERLINE



SECTION AA

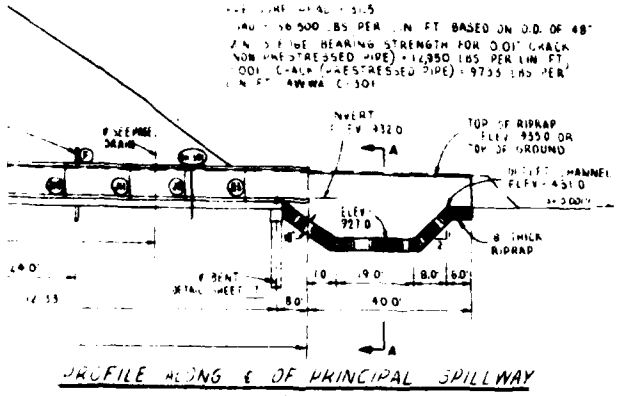


SLOPE FT/FT	POINT	DISTANCE FROM RISER WALL PIECE	INVERT ELEV OF 42" PIPE
0.00205	J 1	0.00	933.00
	J 2	10.00	932.98
	J 3	26.00	932.95
	J 4	42.00	932.92
	J 5	58.00	932.88
	J 6	74.00	932.85
0.00566	J 7	90.00	932.74
	J 8	106.00	932.64
	J 9	122.00	932.53
	J 10	138.00	932.42
	J 11	154.00	932.32
	J 12	170.00	932.21
	J 13	186.00	932.10
	CONNECT	202.00	932.00

NOTE: ABOVE DIMENSIONS FOR LENGTHS OF PIPE ARE NOMINAL AND DO NOT INCLUDE CREEP.

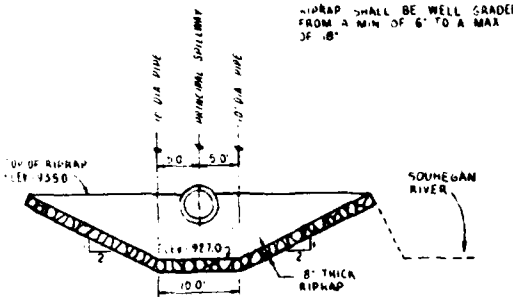
SLOPE FT/FT	POINT	DISTANCE FROM RISER	INVERT ELEV OF PIPE @ COLLAR
0.00203	A	21.00	932.96
	B	45.00	932.91
	C	66.00	932.87
0.00566	D	93.00	932.72
	E	117.00	932.56
	F	141.00	932.40

NOTE:
RIPRAP SHALL BE WELL GRADED FROM A MIN OF 6" TO A MAX OF 18"



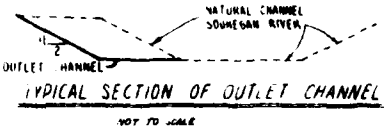
PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY

SCALE HORIZ 1"=20.0'
VERT 1"=10.0'



SECTION A-A

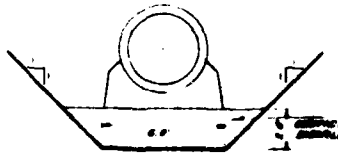
SCALE 1"=10.0'



TYPICAL SECTION OF OUTLET CHANNEL

NOT TO SCALE

NOTE: DRAWING HAS BEEN REDUCED SCALES ARE NOT AS SHOWN



TYPICAL SECTION OF PRINCIPAL SPILLWAY EXCAVATION

NOT TO SCALE

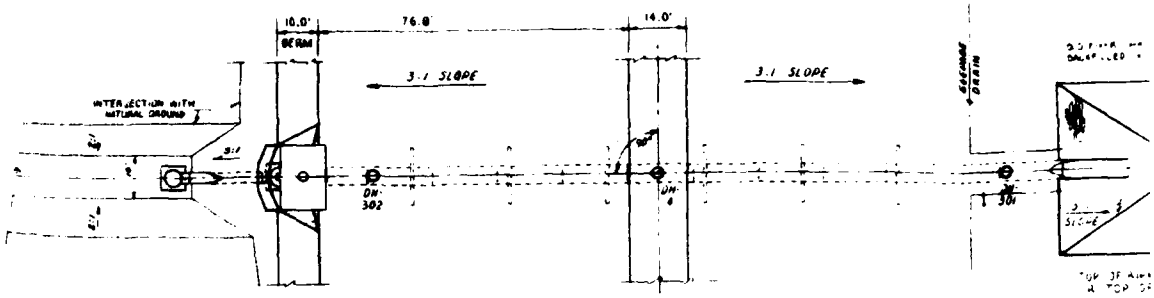
SOUHEGAN RIVER WATERSHED PROJECT
FLOODWATER RETARDING DAM NO 19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

PLAN - PROFILE OF PRINCIPAL SPILLWAY

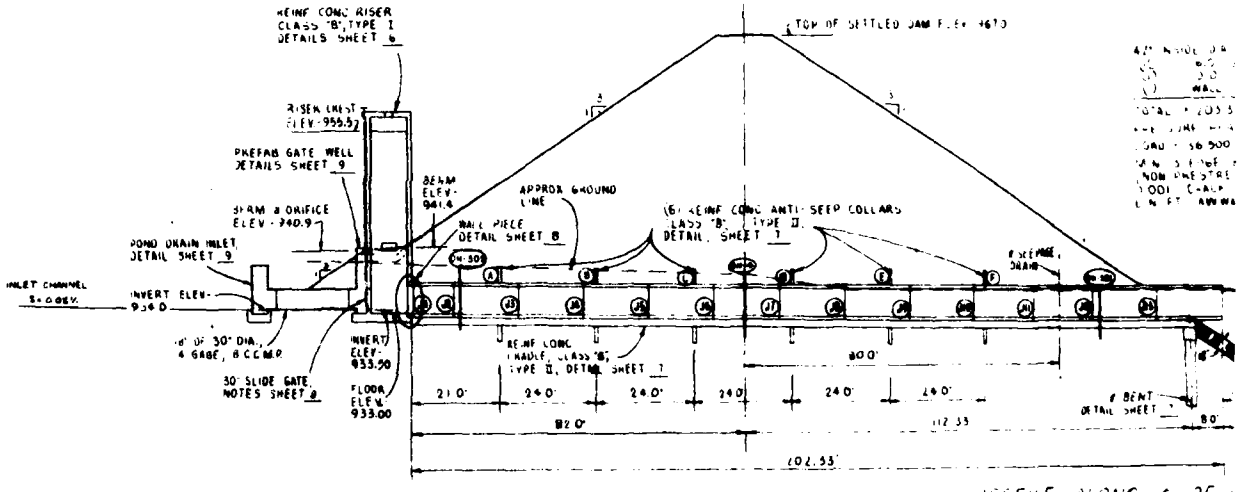
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed W J CARROLL Date MAR '66	Approved by Title
Drawn C.B. FORD Date MAR '66	Title
Traced	Title
Checked L.A. GRAY Date APR '66	Sheet No. 9 of 13 sheets; Drawing No. NH-573-P

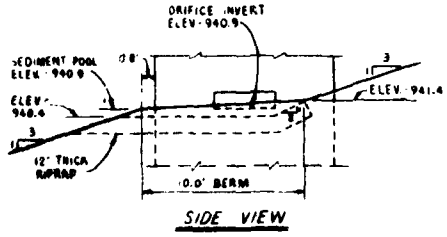
B-5



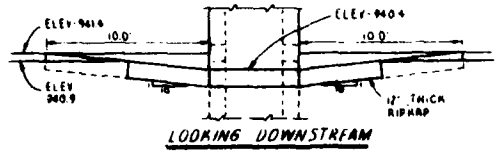
PLAN
SCALE 1" = 20'



PROFILE ALONG ℄ OF
SCALE HORI.
VERT.

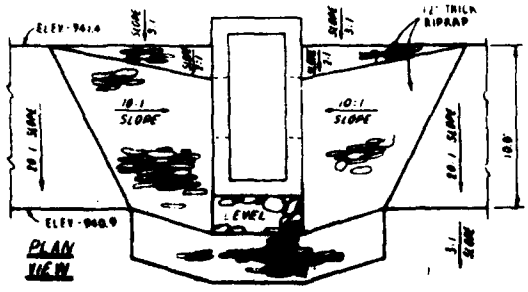


SIDE VIEW

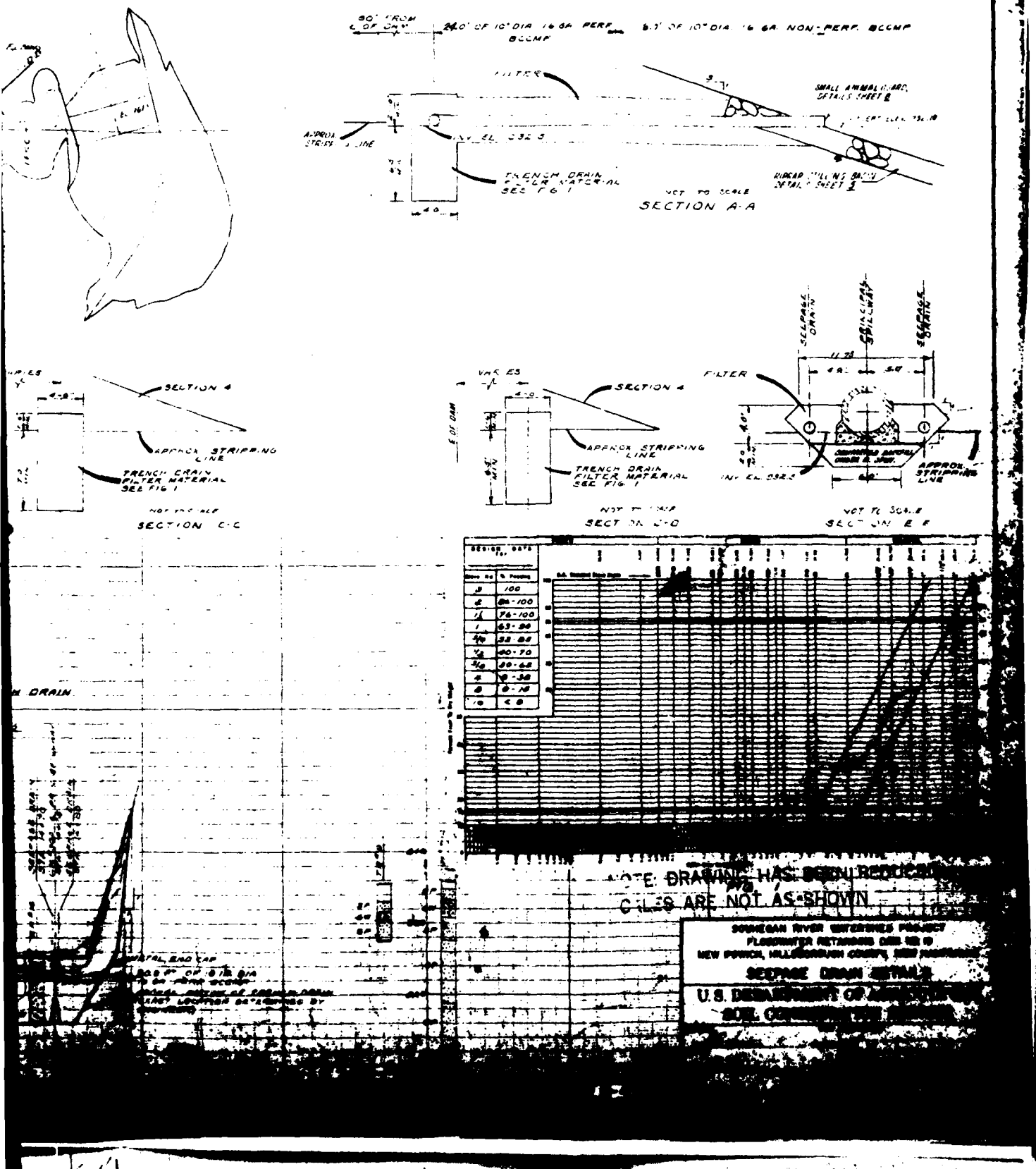


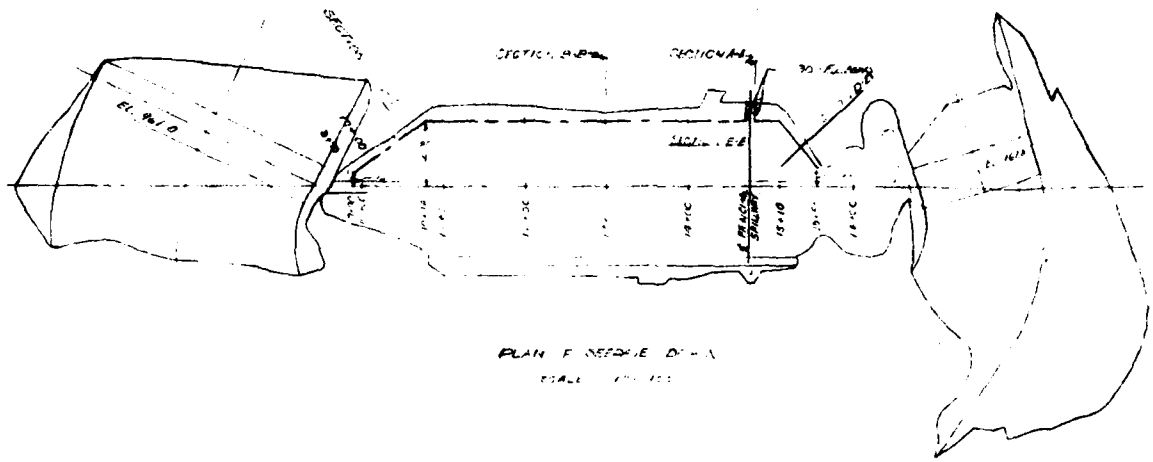
LOOKING DOWNSTREAM

DETAILS OF ORIFICE INLET
SCALE: 1" = 5.0'

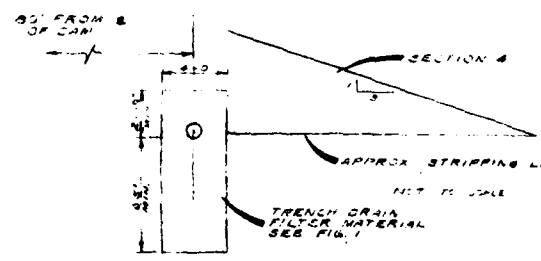


TYPIC

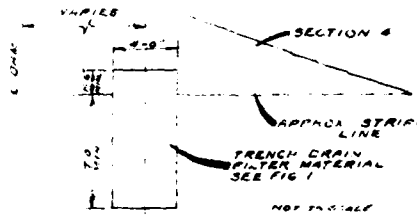

SECTION A-A
SECTION C-C
SECTION D-D
SECTION E-E
FILTER
SECTION 4
APPROX. STRIPPING LINE
TRENCH DRAIN FILTER MATERIAL SEE FIG 1
SEEPAGE DRAIN
NOTE: DRAWING HAS BEEN REDUCED
CALES ARE NOT AS SHOWN
SEEPAGE DRAIN DETAILS
U.S. DEPARTMENT OF AGRICULTURE



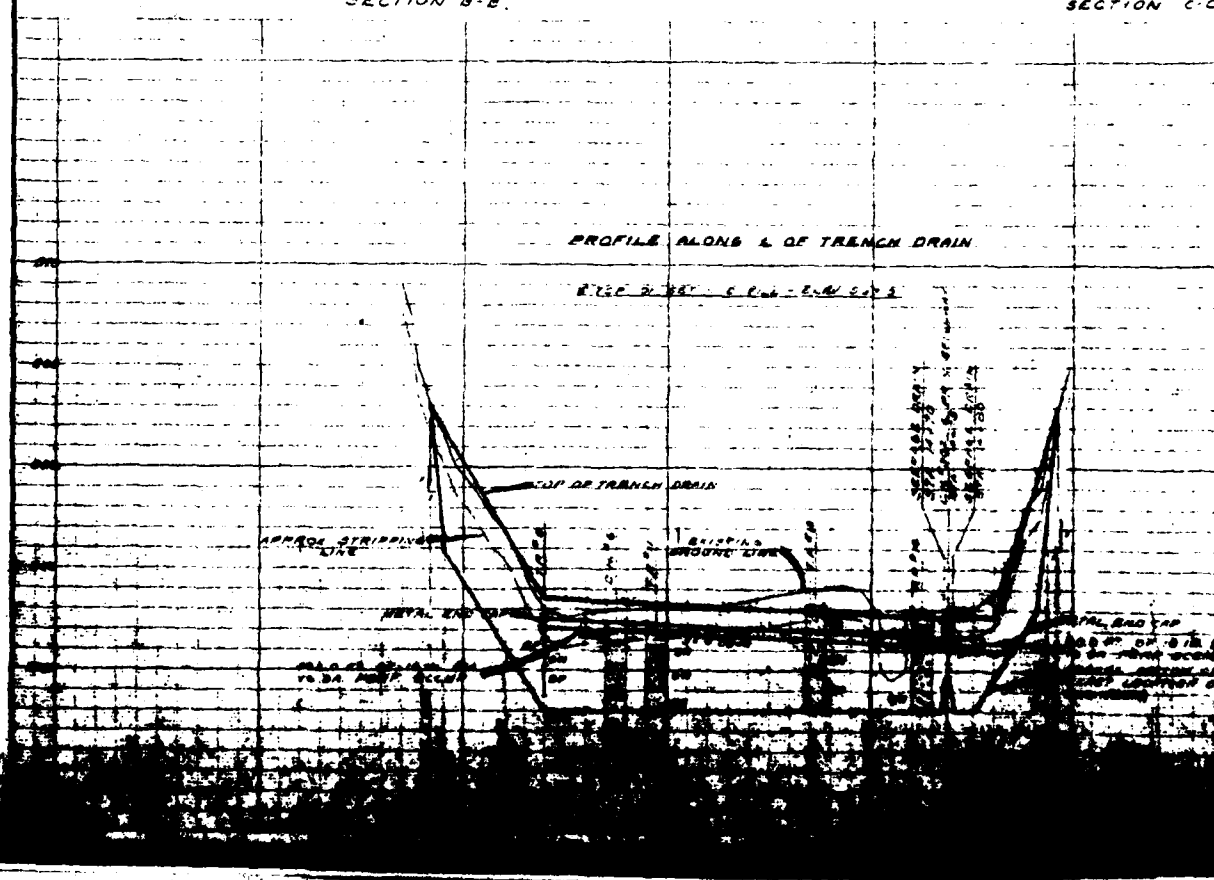
PLAN OF NEEDLE DAM

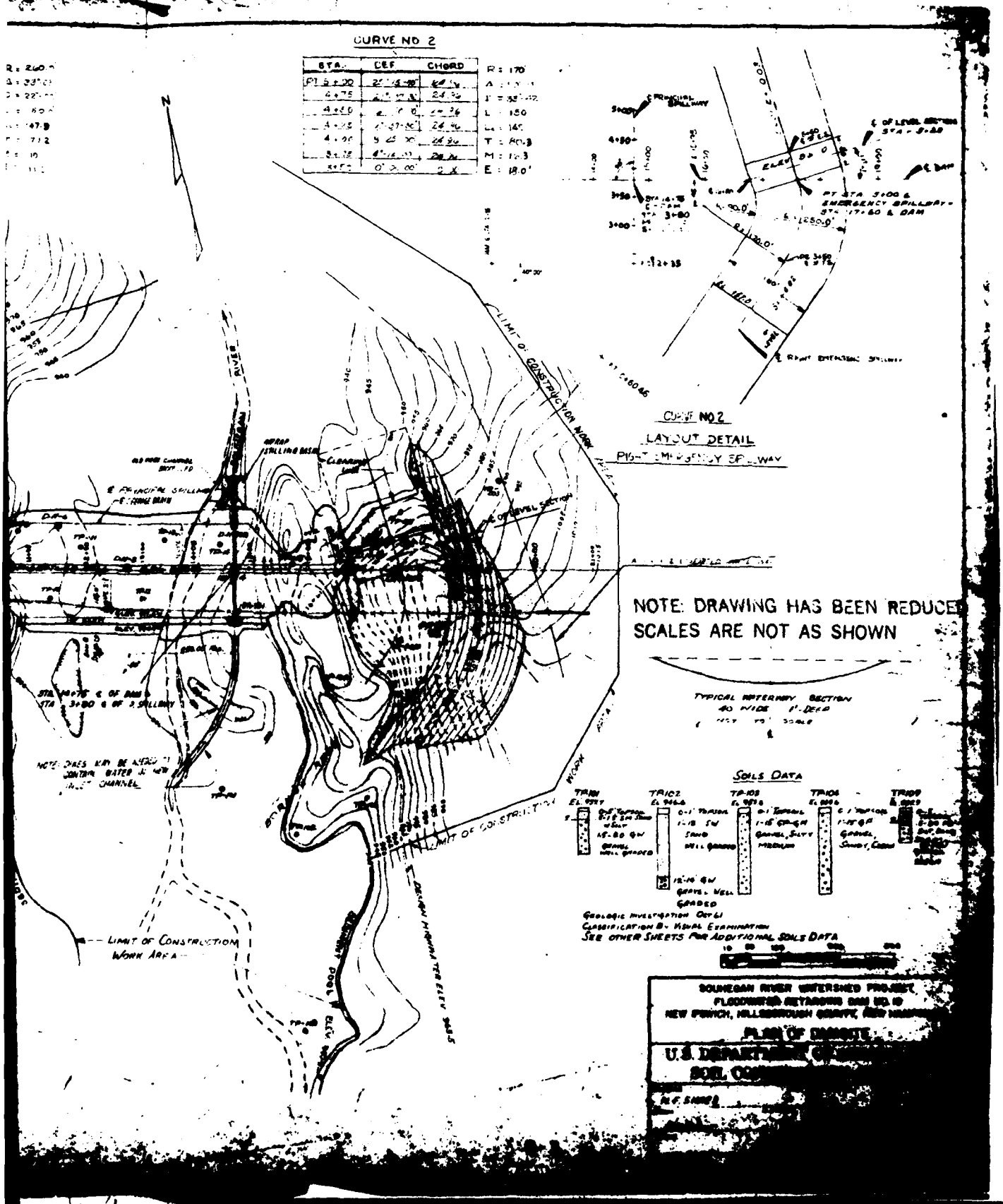


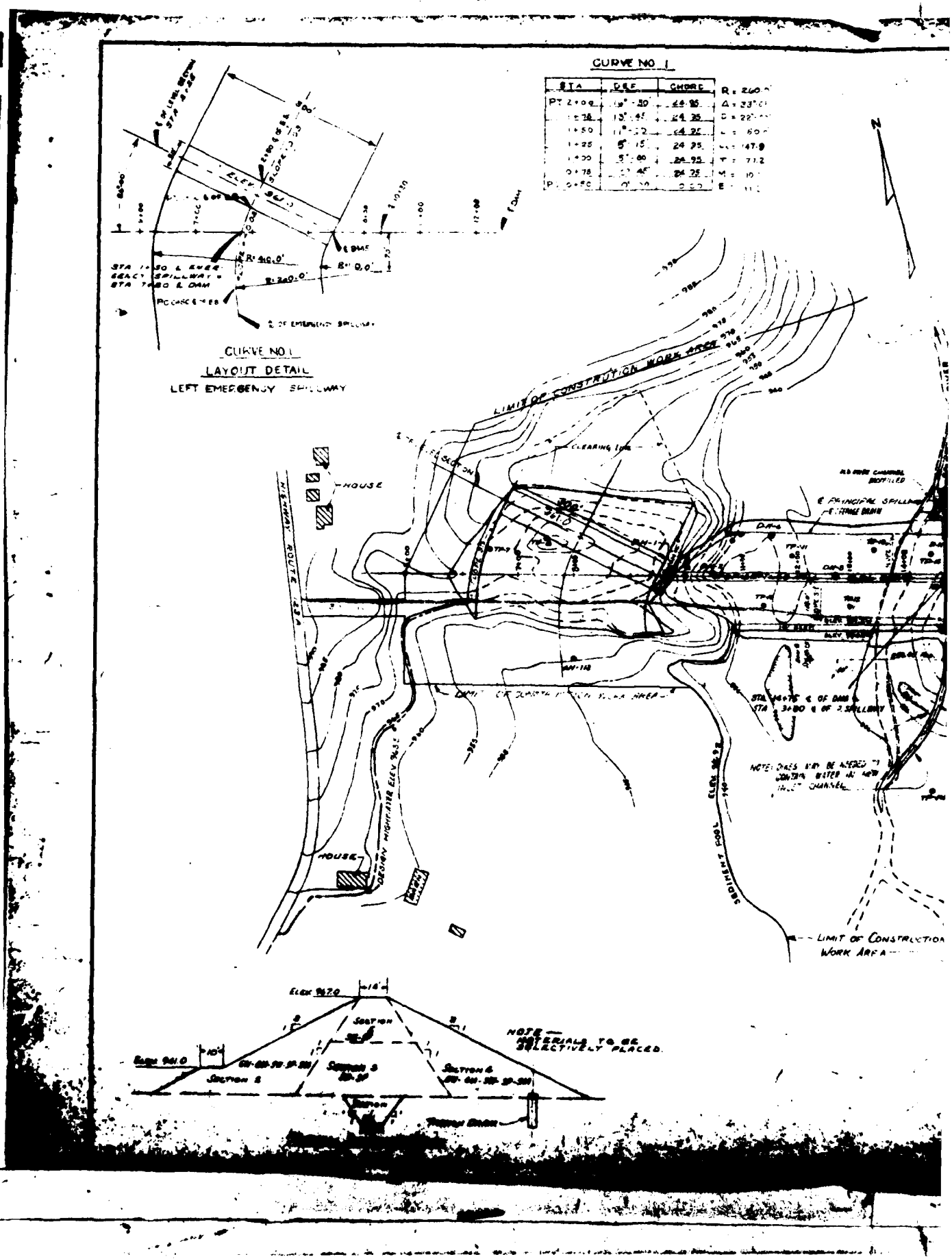
SECTION B-B

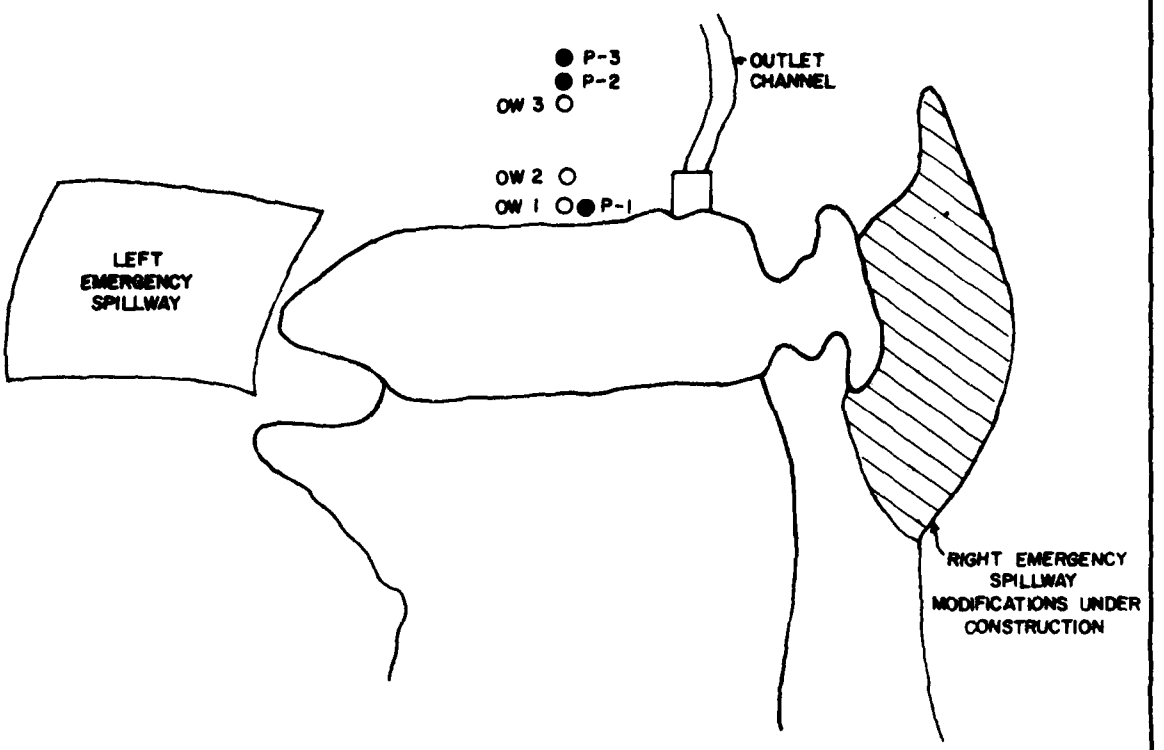


SECTION C-C




CURVE NO 2
STA.
DEF
CHORD
R = 170
Δ =
T = 80.3
M = 76.3
E = 18.0'
L = 150
N
LIMIT OF CONSTRUCTION WORK
LIMIT OF CONSTRUCTION
CURVE NO 2
LAYOUT DETAIL
EMERGENCY SPILLWAY
NOTE: DRAWING HAS BEEN REDUCED
SCALES ARE NOT AS SHOWN
TYPICAL INTERIOR SECTION
40' WIDE
SOILS DATA
TP-101
TP-102
TP-103
TP-104
TP-105
Geologic Investigation Only
Classification By Visual Examination
See other Sheets For Additional Soils Data
SOUHEGAN RIVER WATERSHED PROJECT
FLOODWATER RETARDING DAM NO. 10
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE
PLAN OF DAM SITE
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE


CURVE NO. 1
CURVE NO. 1
LAYOUT DETAIL
LEFT EMERGENCY SPILLWAY
LIMIT OF CONSTRUCTION WORK AREA
HOUSE
HOUSE
DESIGN HIGHWATER ELEV. 945.2
SPILLWAY POOL ELEV. 943.2
NOTE — MATERIALS TO BE SELECTIVELY PLACED.
LIMIT OF CONSTRUCTION WORK AREA



LEGEND:

- ○ OBSERVATION WELL
- ● PIEZOMETER

NOTES:

1. WATER LEVEL READINGS TAKEN MAY 1, 1979.
2. LOCATION OF INSTRUMENTS IS APPROXIMATE.

WATER TABLE READINGS

OW 1	6 FT BELOW SURFACE
OW 2	4 FT BELOW SURFACE
OW 3	0 FT BELOW SURFACE

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

INSTRUMENTATION LOCATION PLAN

SOUTHEGAN RIVER WATERSHED

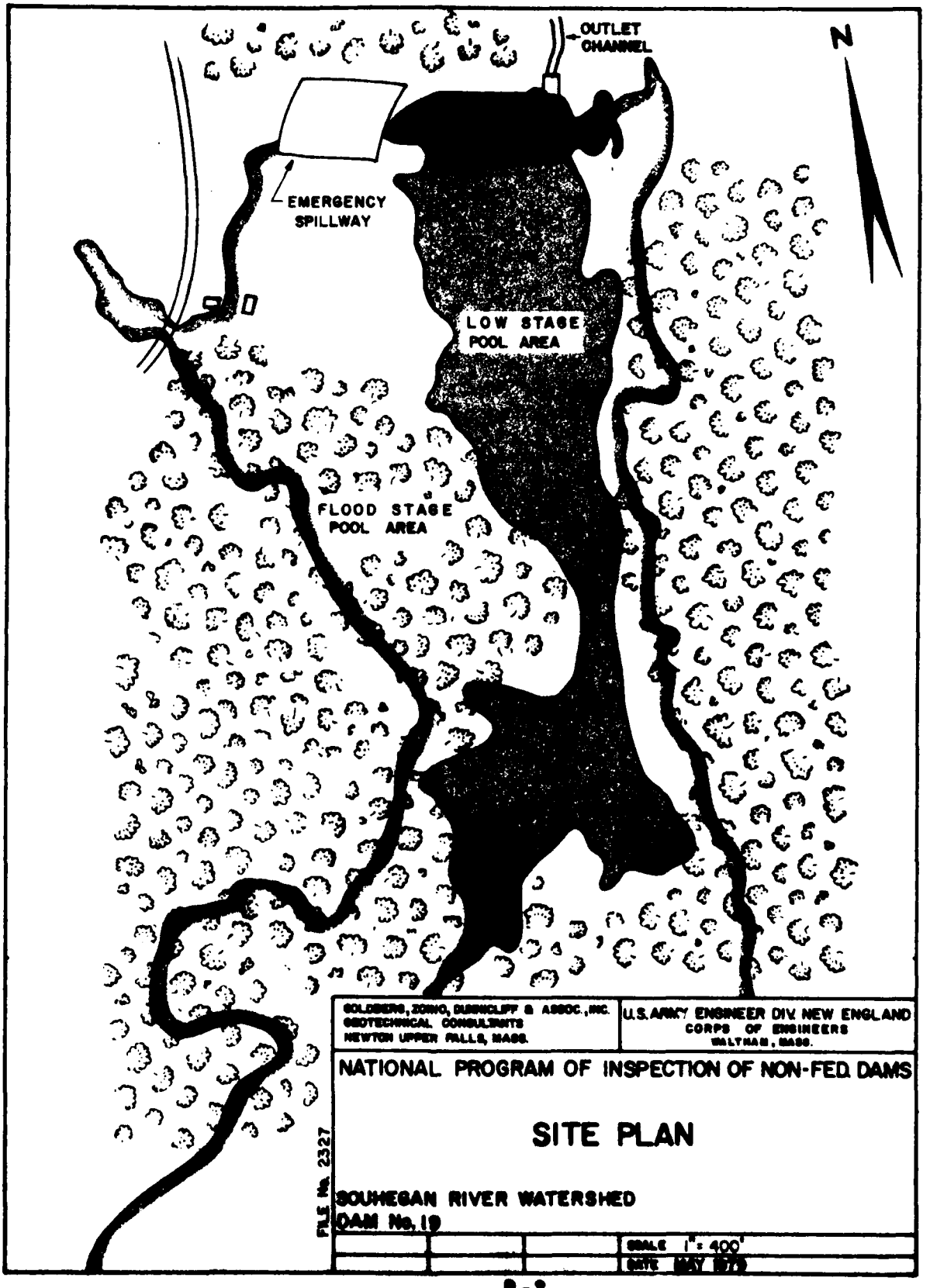
DAM No. 19 NEW HAMPSHIRE

FILE No. 2327

SCALE 1" = 200'

DATE

B-2A


OUTLET CHANNEL
N
EMERGENCY SPILLWAY
LOW STAGE POOL AREA
FLOOD STAGE POOL AREA
GOLDBERG, ZOINO, DUNNCLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
SITE PLAN
SOUHEGAN RIVER WATERSHED
DAM No. 19
FILE No. 2327
SCALE 1" = 400'
DATE MAY 1975

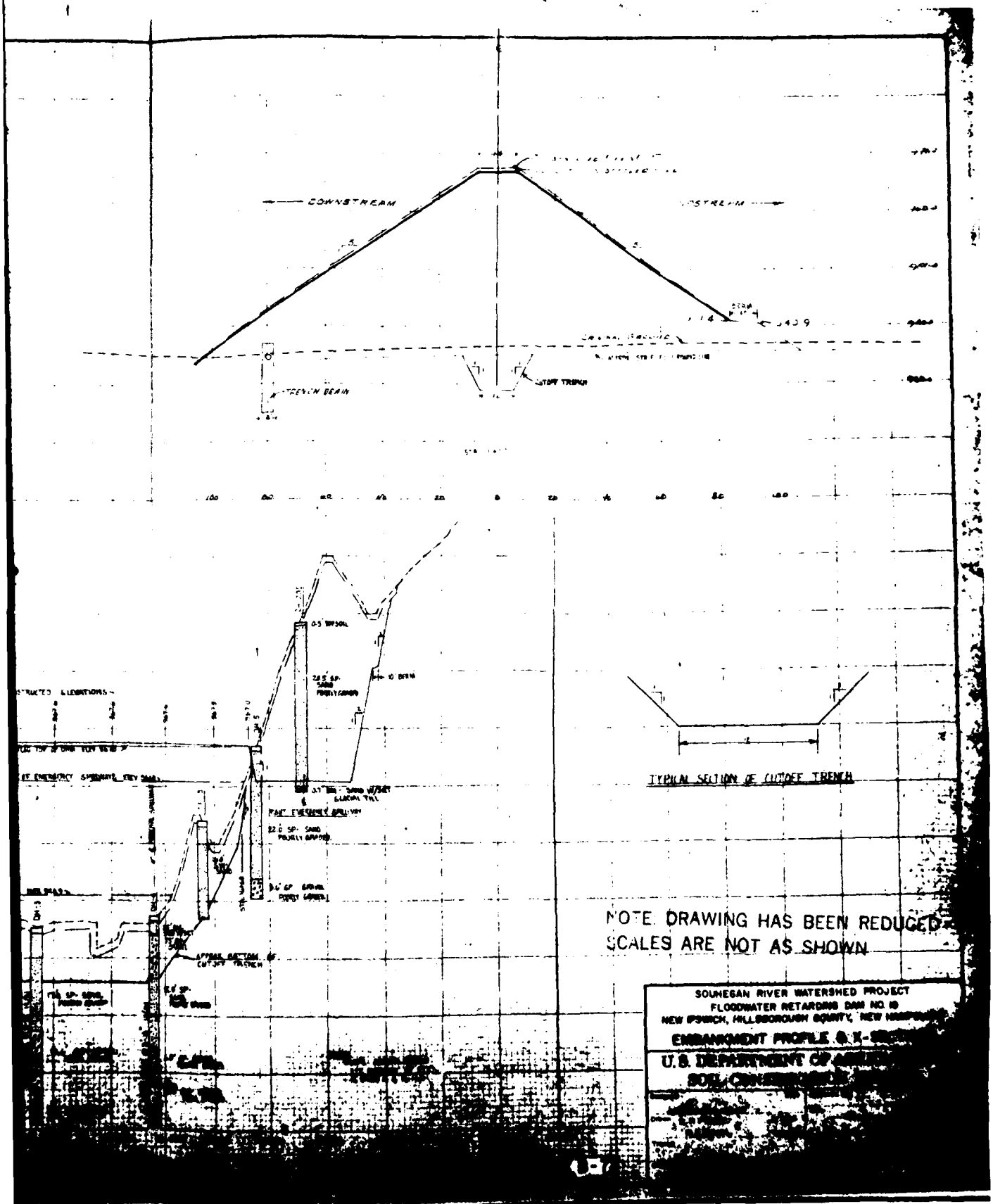
APPENDIX B

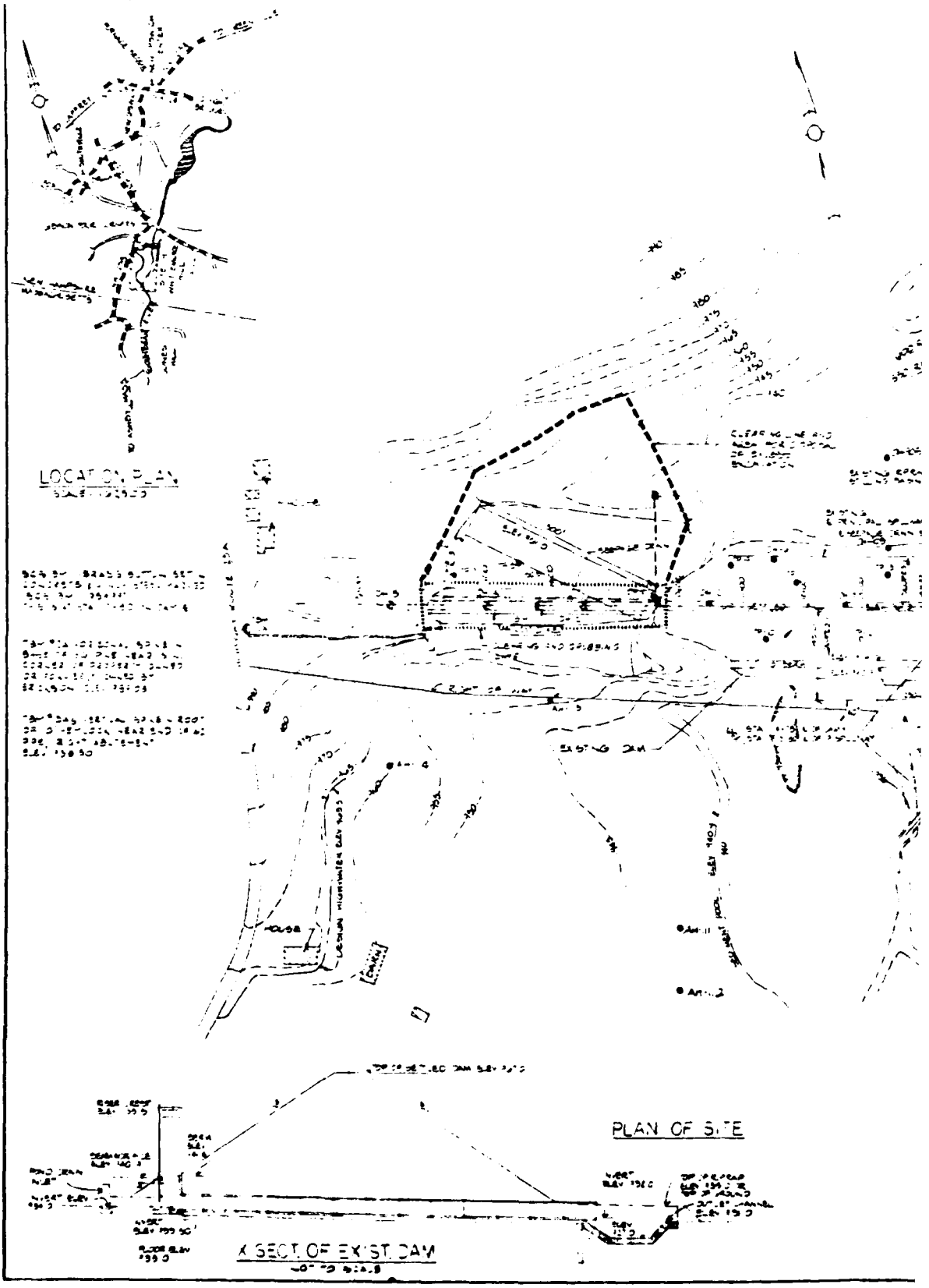
CHECK LISTS FOR VISUAL INSPECTION

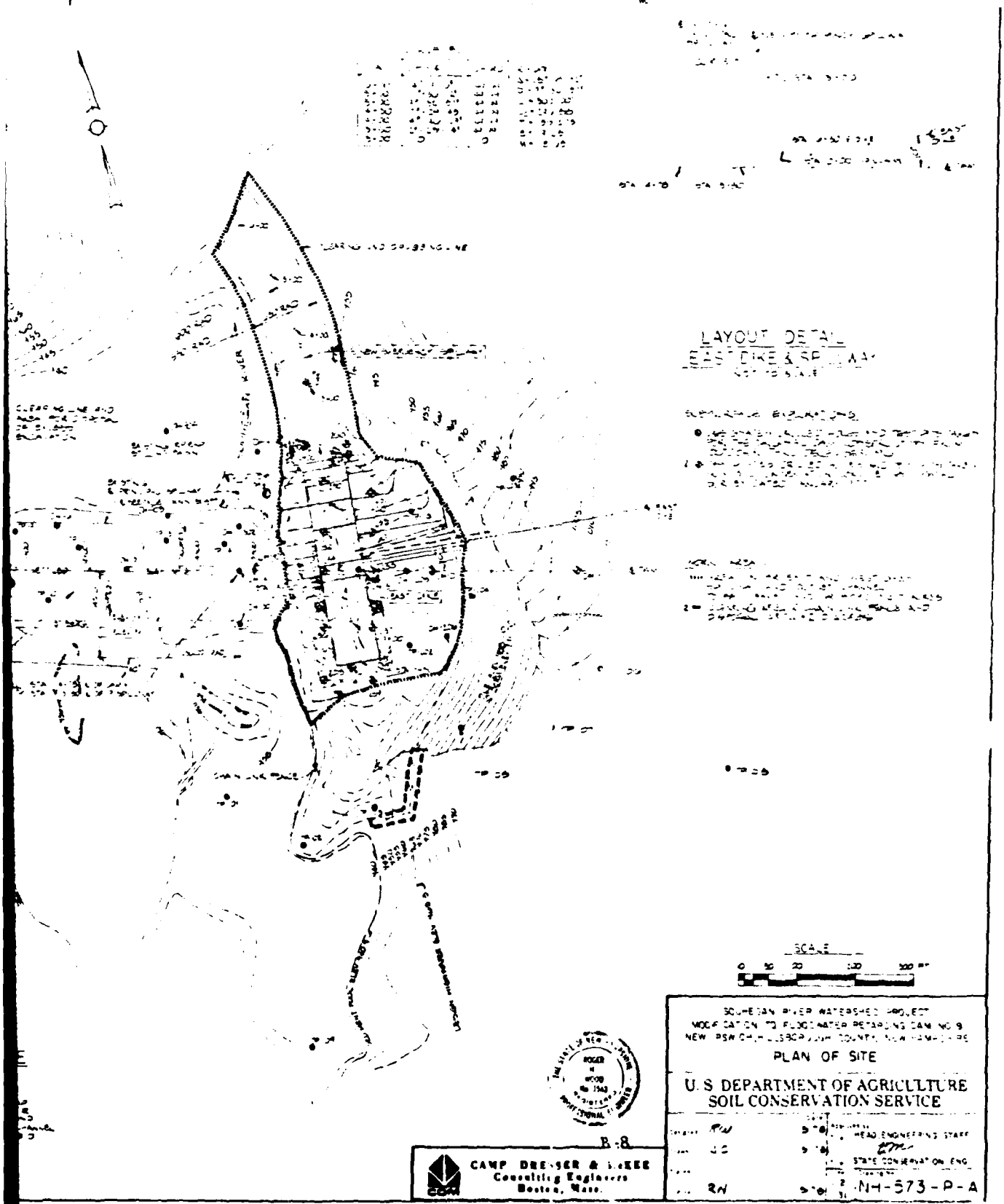
AREA EVALUATED	BY	CONDITION & REMARKS
Gate Bench		No deficiencies noted
B. Reservoir Discharge Conduit	PR	Submerged, could not be observed
C. Outlet Conduit (primary spillway)		
Condition of pipe	PR	Minor cracking and efflorescence at crown, 8' long

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
DAM EMBANKMENT - cont.		
Unusual embankment or downstream seepage	NAC	None
Piping or boils		None
Foundation drainage features		Toe drains
Toe drains		Submerged at time of inspection
Instrumentation system	NAC	Three piezometers not read; three observation wells read; see instrumentation plan (pg. B-2A)
APPURTENANT STRUCTURES		
A. Drop Inlet Service Spillway Structure		
Condition of concrete	FR	Good
Spalling		None noted
Erosion		Minor at inverts of both low stage orifice openings
Cracking		None noted
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Efflorescence		None noted
Trash Racks		
Upper stage trash racks		No deficiencies noted
Lower stage trash racks	FR	Surface rusting; debris caught in trash racks


DOWNSTREAM
UPSTREAM
CUTOFF TRENCH
TYPICAL SECTION OF CUTOFF TRENCH
NOTE: DRAWING HAS BEEN REDUCED
SCALES ARE NOT AS SHOWN
SOUHEGAN RIVER WATERSHED PROJECT
FLOODWATER RETARDING DAM NO. 10
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE
EMBANKMENT PROFILE & K-
U.S. DEPARTMENT OF
SOIL CONSERVATION


LOCATION PLAN
PLAN OF SITE
X SECT. OF EXIST. DAM



SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO. 9
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

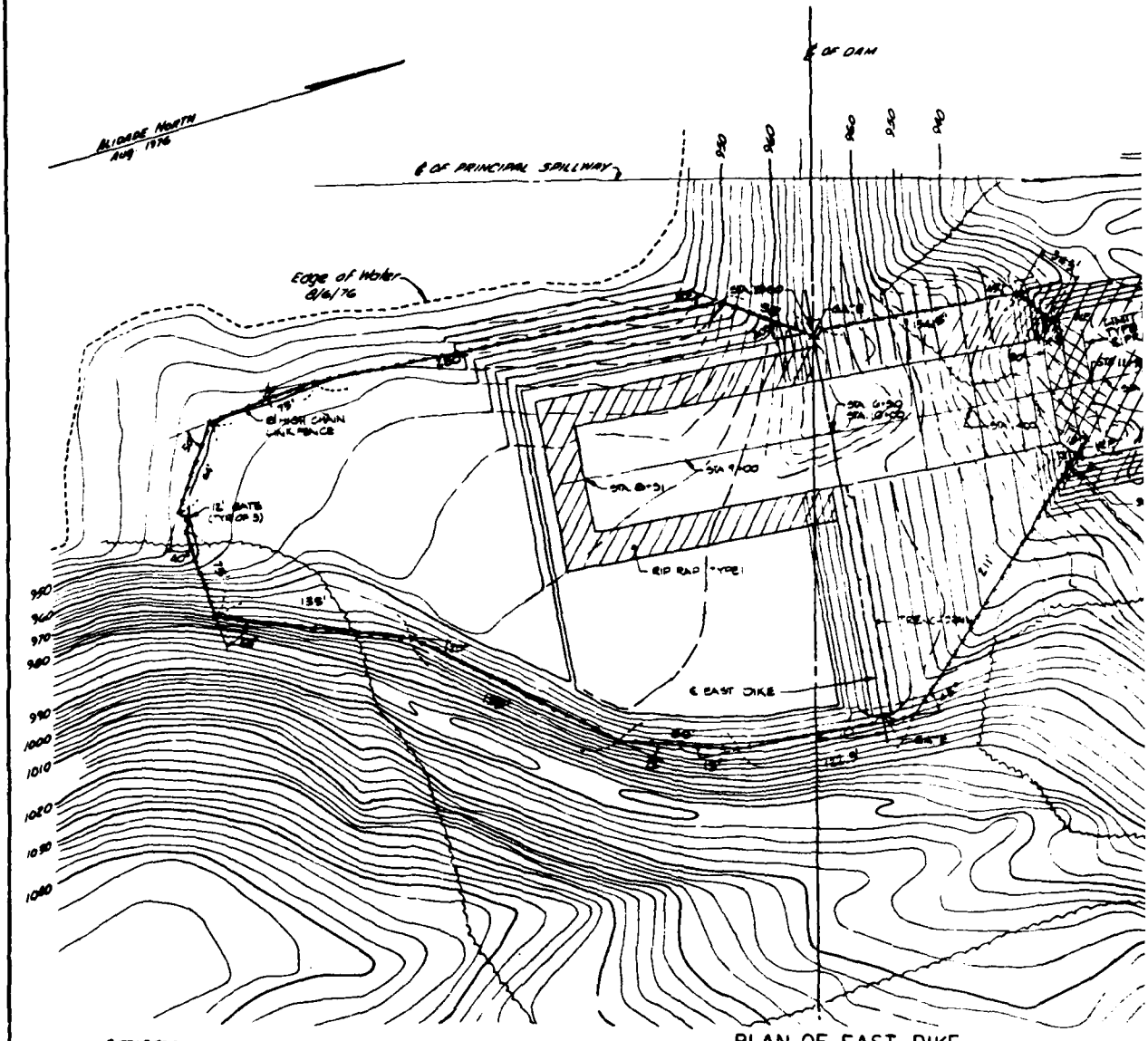
PLAN OF SITE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED	RW	DATE	APPROVED: HEAD ENGINEERING STAFF
DRAWN	J.C.	DATE	
TRACED		DATE	APPROVED: STATE CONSERVATIONIST
CHECKED	RW	DATE	SHEET NO. NH-573-P-A

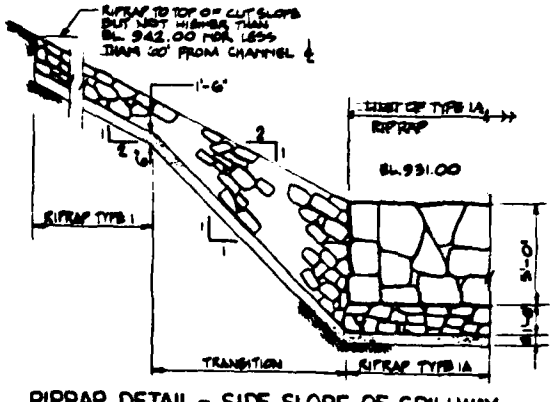
B-8

CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.



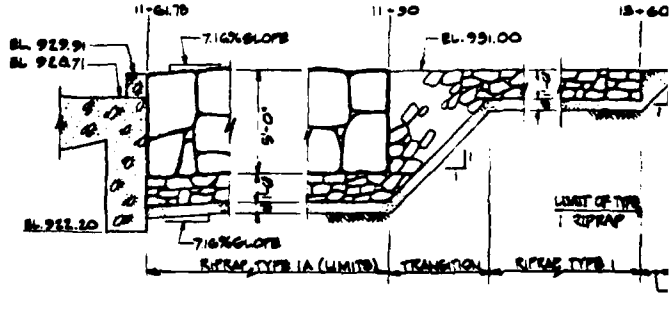
PLAN OF EAST DIKE

SCALE: 1"=50'



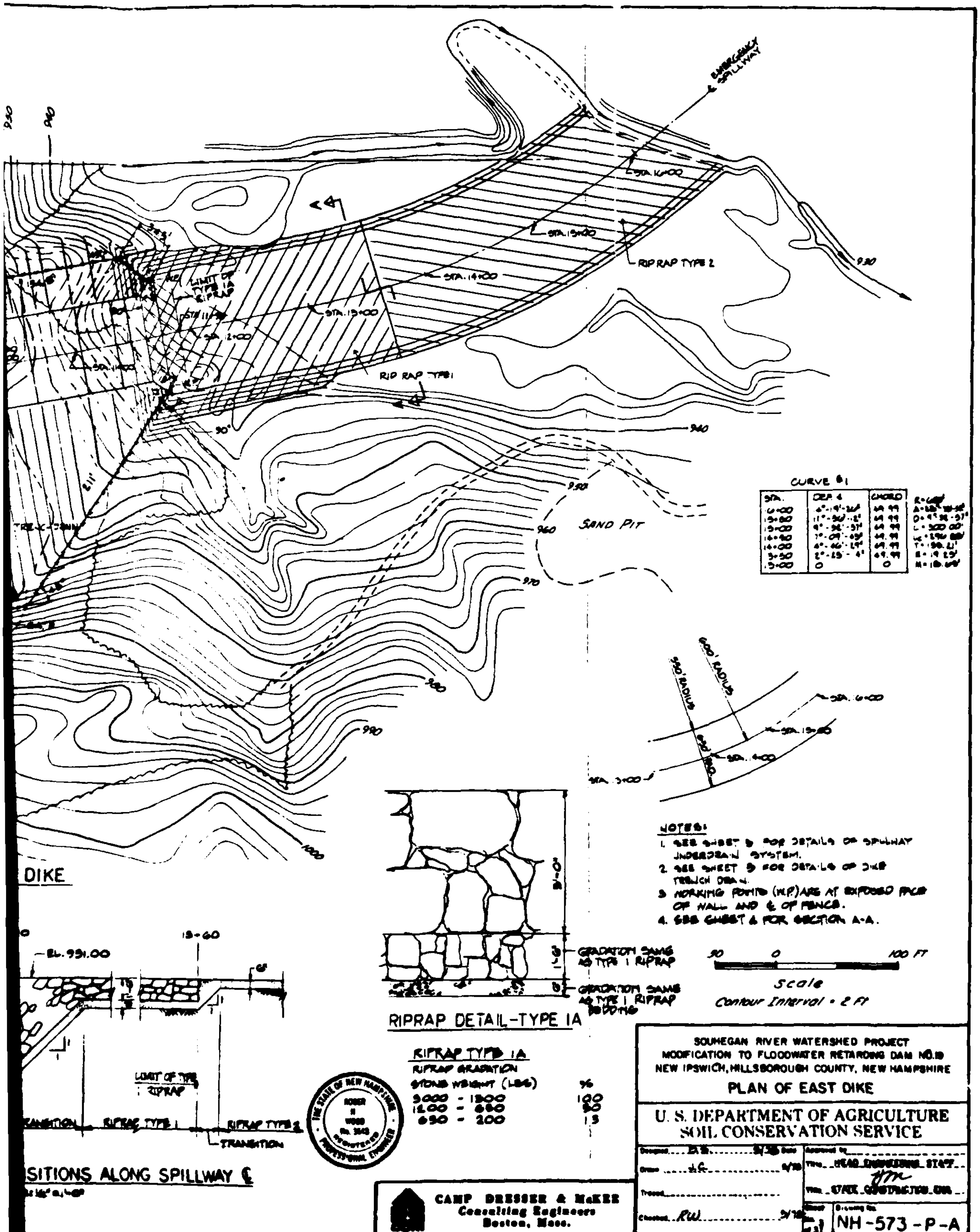
RIPRAP DETAIL - SIDE SLOPE OF SPILLWAY

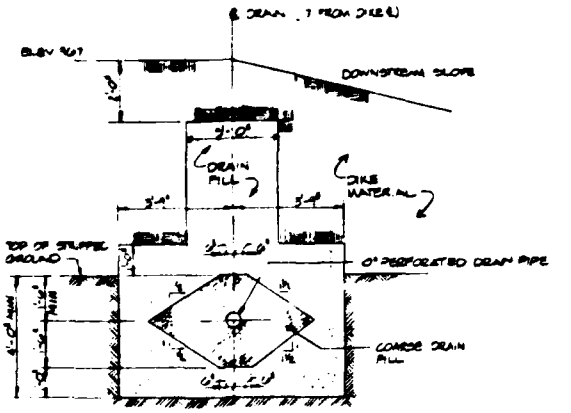
SCALE: 1/8"=1'-0"



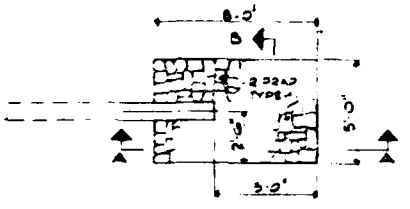
DETAIL - RIPRAP TRANSITIONS ALONG SPILLW

SCALE: 1/8"=1'-0"

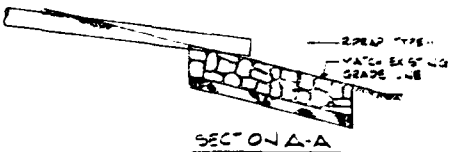

EMERGENCY SPILLWAY
STA. 16+00
STA. 15+00
RIP RAP TYPE 2
STA. 14+00
STA. 13+00
RIP RAP TYPE 1
LIMIT OF TYPE 1A RIPRAP
930
940
950
960
970
980
990
1000
SAND PIT
CURVE #1
STA.
DEF. ∠
CHORD
600' RADIUS
STA. 6+00
STA. 15+00
STA. 4+00
STA. 3+00
NOTES:
1. SEE SHEET 9 FOR DETAILS OF SPILLWAY UNDERDRAIN SYSTEM.
2. SEE SHEET 9 FOR DETAILS OF DIKE TRENCH DRAIN.
3. WORKING POINTS (W.P.) ARE AT EXPOSED FACE OF WALL AND ℄ OF FENCE.
4. SEE SHEET 6 FOR SECTION A-A.
GRADATION SAME AS TYPE 1 RIPRAP
GRADATION SAME AS TYPE 1 RIPRAP BEDDING
RIPRAP DETAIL-TYPE 1A
RIPRAP TYPE 1A
RIPRAP GRADATION
STONE WEIGHT (LBS) %
3000 - 1200 100
1200 - 650 50
650 - 200 15
50 0 100 FT
Scale
Contour Interval = 2 Ft
DIKE
EL. 991.00
13+60
LIMIT OF TYPE 1 RIPRAP
TRANSITION
RIPRAP TYPE 1
RIPRAP TYPE 2
TRANSITION
SITIONS ALONG SPILLWAY ℄
CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.
SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE
PLAN OF EAST DIKE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Drawn
Traced
Checked RW
Title HEAD ENGINEERING STAFF
Title STATE CONSTRUCTION ENG.
Drawing No.
NH-573-P-A



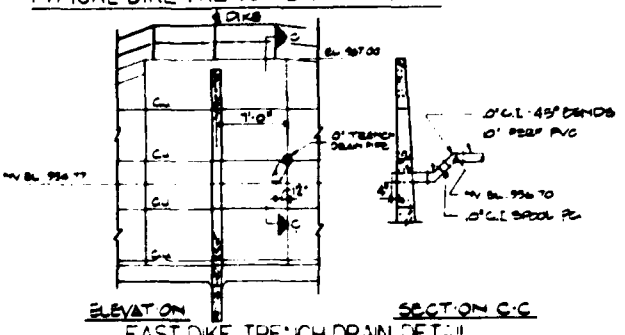
TYPICAL DIKE TRENCH DRAIN DETAIL



PLAN



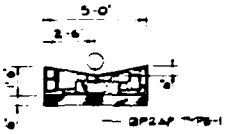
SECTION A-A



ELEVATION SECTION C-C

EAST DIKE TRENCH DRAIN DETAIL

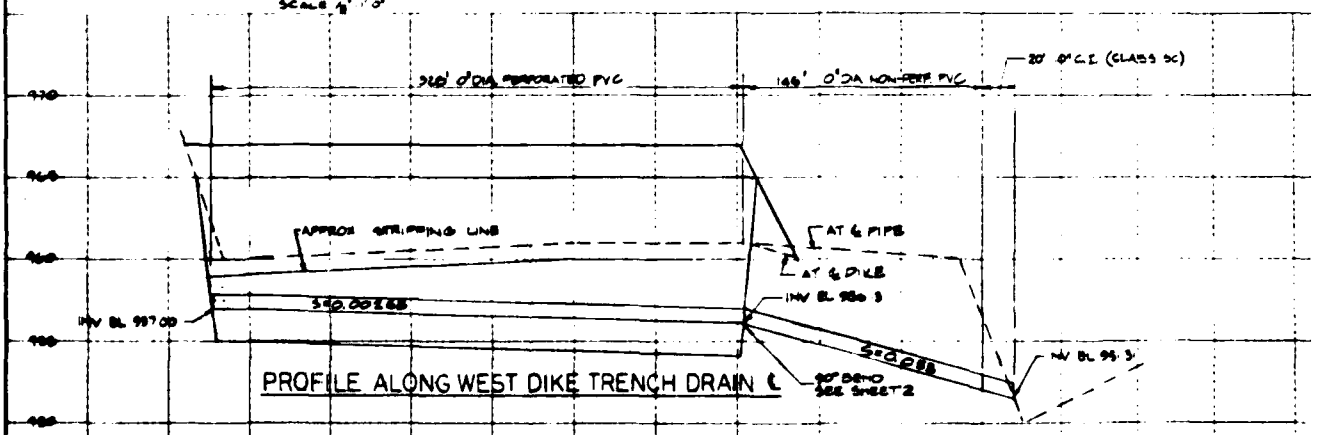
SCALE 1" = 0"



SECTION B-B

WEST DIKE TRENCH DRAIN OUTLET

NO SCALE



PROFILE ALONG WEST DIKE TRENCH DRAIN ℄

GRADATION LIMITS

COARSE DRAIN

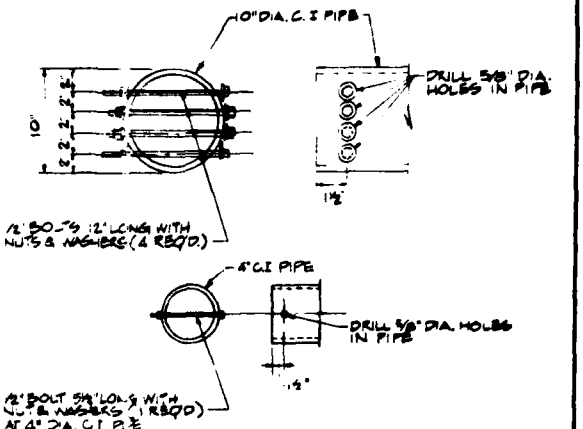
U.S STANDARD SIEVE SIZE	PERCENT PASSING
3"	100
2"	70-100
1"	10-70
3/4"	0-45
3/8"	0-10
NO 4	0-2

DRAIN FILL

3"	100
2"	85-100
1"	65-100
3/8"	45-85
NO 4	25-60
NO 10	5-40
NO 40	0-15
NO 200	0-3

IMPERVIOUS BLANKET

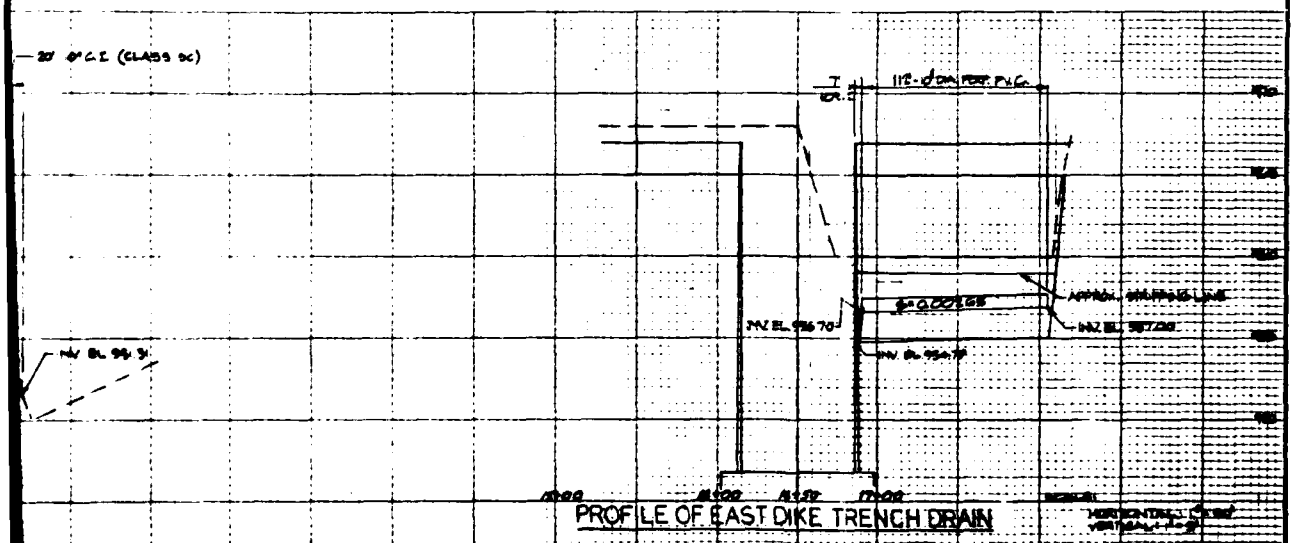
3"	100
NO 0	60-95
NO 40	40-80
NO 200	MIN 30



DRAIN PIPE OUTLETS
DETAIL OF SMALL ANIMAL GUARDS

10" DIA. C.I DRAIN PIPE OUTLETS	6 REQUIRED
4" DIA. C.I DRAIN PIPE OUTLETS	22 REQUIRED

NOTE: BOLTS, NUTS & WASHERS GALVANIZE IN ACCORDANCE WITH MATERIAL SPEC. 502



PROFILE OF EAST DIKE TRENCH DRAIN

SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

DRAIN DETAILS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	D.S.	9/10
Drawn	J.C.	9/10
Traced		
Checked	R.W.	9/10

Approved by
Title ... NE-SD. ENGINEERING STAFF.
Title ... STATE CONSERVATION ENG.

Sheet No. 9 of 31
Drawing No. NH-573-P-A

FORM SCS - 315 (NOV. 1966)

ALIDADE NORTH
AUGUST 1976

EARTH FILL REQUIREMENTS - SPILLWAY [1]

AREA	MATERIAL	MAX. ROCK SIZE	MIN. LIFT THICK	MOISTURE CONTENT	COMPACTION CLASS	COMPACTION DESCRIPTION
PERVIOUS FILL	SHOWN ON DRAWING NO. 5	6" [3]	8" [3]	1% BELOW TO 3% ABOVE OPTIMUM	A	95% MAXIMUM DENSITY BY ASTM-D698 METHOD C
EARTH FILL	EXCEPT AS NOTED ON DRAWINGS No. 27 AND 29	6" [3]	8" [3]	1% BELOW TO 3% ABOVE OPTIMUM	A	95% MAXIMUM DENSITY BY ASTM-D698 METHOD C
DRAIN FILL	SHOWN ON DRAWING NO. 5	3" [3]	8" [3]	WET [4]	B	4 PASSES WITH CRAWLER TRACTOR OR EQUAL, NOT LESS THAN 80 TONS
COARSE DRAIN FILL	SHOWN ON DRAWING NO. 5	3" [3]	8" [3]	WET [4]	B	4 PASSES WITH CRAWLER TRACTOR OR EQUAL, NOT LESS THAN 80 TONS

NOTE: INDICATES NOTE DES... SEE SHEET 6 FOR ...

ROTATE DOWNWARD TO MATCH PIER SLOPE = 0.070 (TYPICAL SE CORNER)

INV. EL. 992.16

ROTATE DOWNWARD TO MATCH PIER SLOPE = 0.070 INV. EL. 992.79

SYMMETRICAL ABOUT ℄ OF SPILLWAY S = 0.070

INV. EL. 992.16 S = 0.070

4" C.I. OUTLET (TYP)

DETAIL B

INV. EL. 995.06 | INV. EL. 994.03 | INV. EL. 993.50 | INV. EL. 992.97 | INV. EL. 992.43 | INV. EL. 991.91 | INV. EL. 991.81

5 SPACES @ 24'-0" = 120'-0"

LEVEL AT INV. EL. 992.90

PLAN OF SPILLWAY DRAINAGE SYSTEM

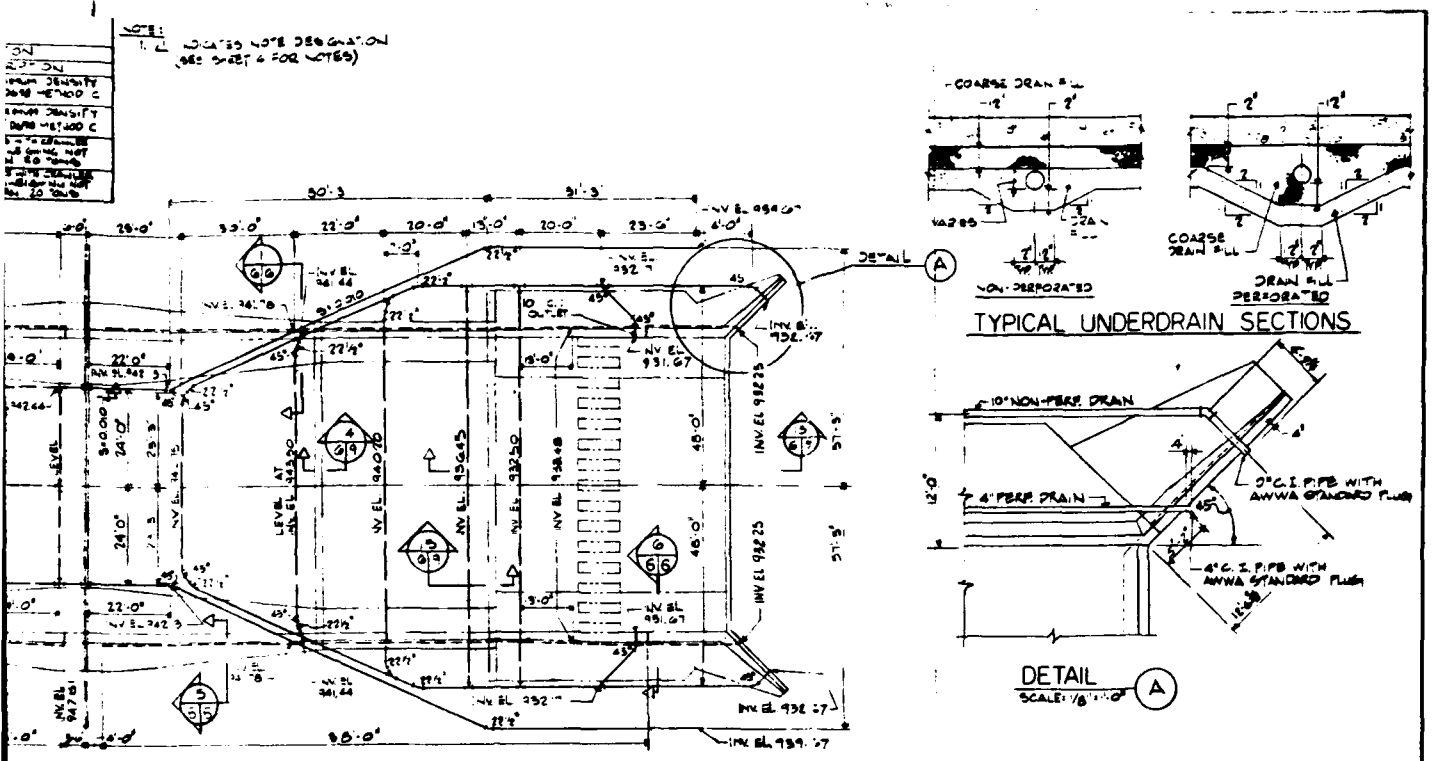
SCALE: 1"=20'

SECTION 2 6/6

SECTION 3 6/6

SECTION 4 6/6

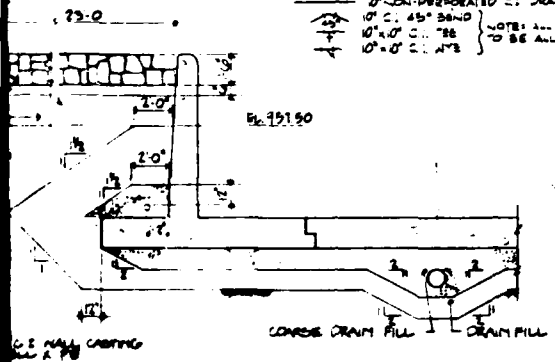
RIPRAP
BEDDING
IMPERVIOUS LAYER
COARSE DRAIN FILL
DRAIN FILL
EARTH FILL
EL. 991.90
4'C.I. WALL CASTING
4'x4' C.I. TEE
4" PVC
DETAIL B
SCALE 1/2"=1'-0"
12'-0"
24'-0"
(TYP)



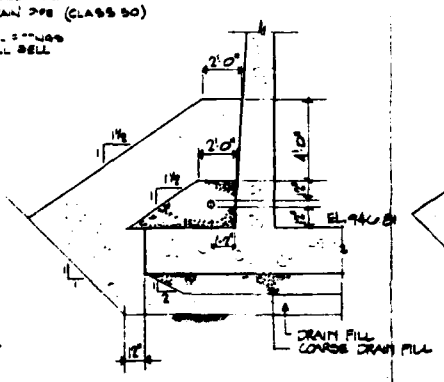
TYPICAL UNDERDRAIN SECTIONS

DETAIL (A)
SCALE: 1/8"=1'-0"

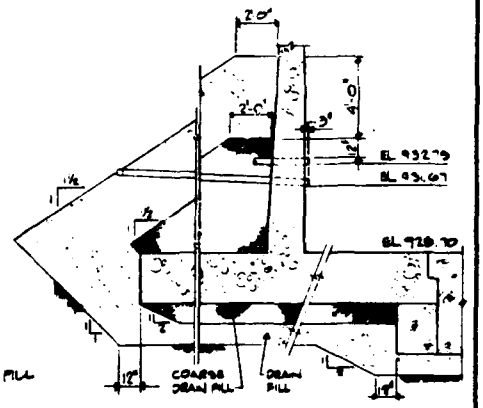
LEGEND
- 4" PERFORATED PVC DRAIN ABOVE FOOTING
- 10" PERFORATED PVC UNDERDRAIN
- 10" NON-PERFORATED C.I. DRAIN PIPE (CLASS 50)
- 10" C.I. 45° BEND
- 10"x10" C.I. TEE
- 10"x10" C.I. WYE
- NOTE: ALL FITTINGS TO BE ALL BELL



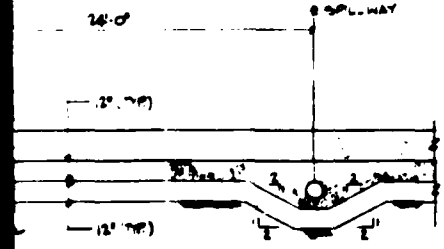
SECTION (3) 6/6



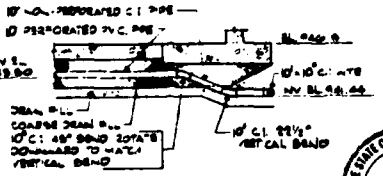
SECTION (5) 6/6



SECTION (6) 6/6



SECTION (4)



SECTION (1) 6/6

SCALE: 1/4"=1' UNLESS NOTED OTHERWISE.

SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

PLAN OF EMERGENCY SPILLWAY UNDERDRAINS

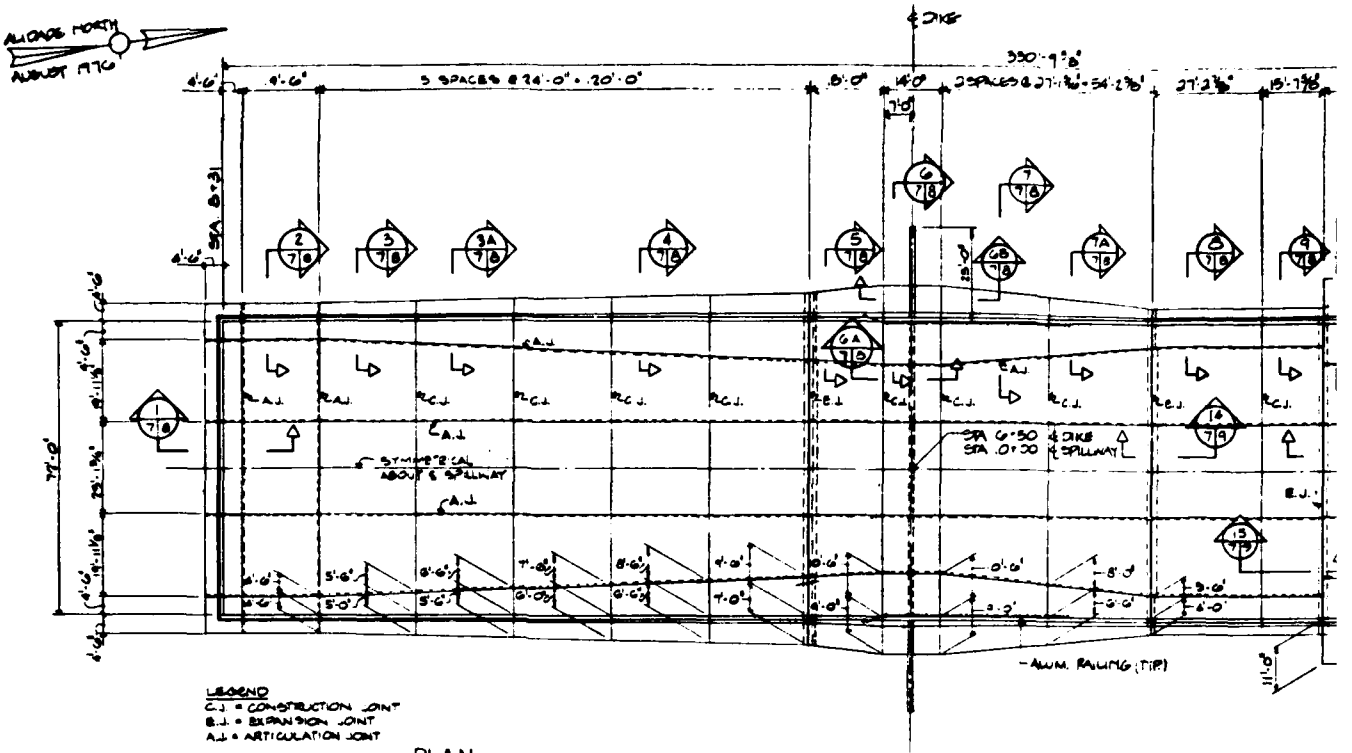
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	RPH	5/78	Approved by: HEAD, ENGINEERING STAFF
Drawn	ADC/DD	5/78	STATE CONSERVATIONIST
Traced			STATE CONSERVATION ENG.
Checked	RPH	5/78	Drawing No. NH-573-P-A

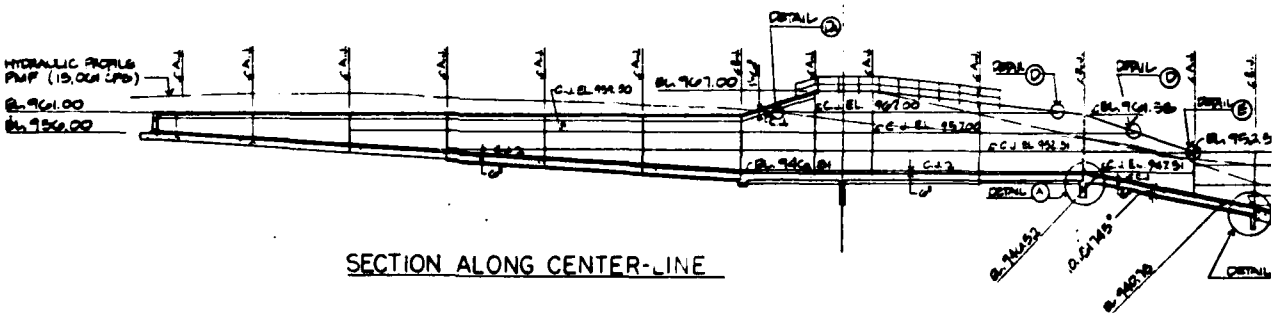
B-11

CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.

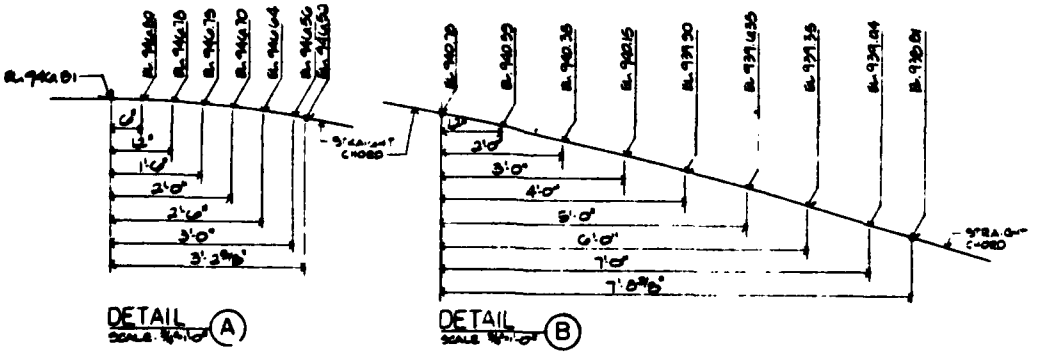
THE STATE OF NEW HAMPSHIRE — ROGER N. WOOD No. 3548 — REGISTERED PROFESSIONAL ENGINEER



PLAN

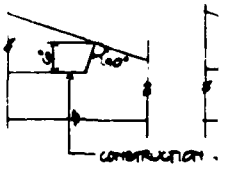


SECTION ALONG CENTER-LINE



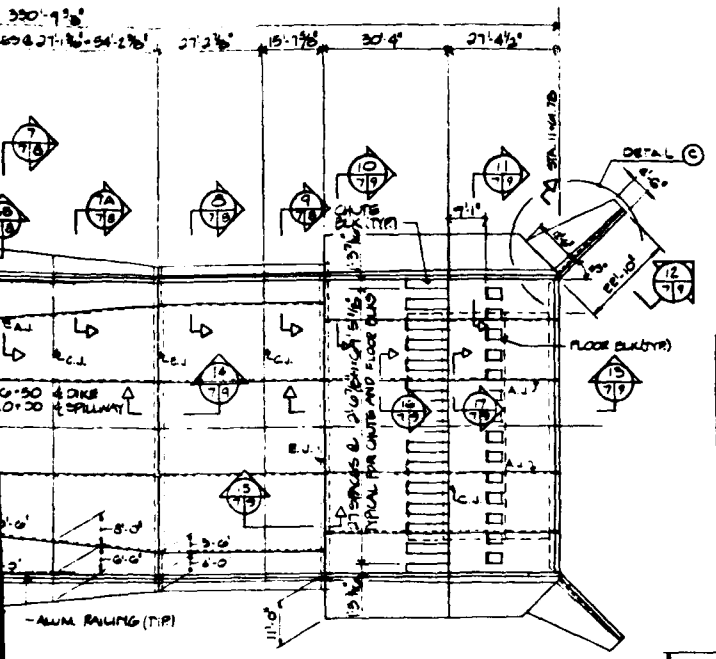
DETAIL (A)

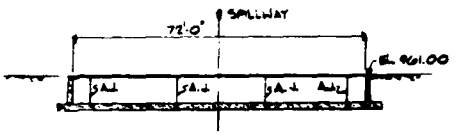
DETAIL (B)



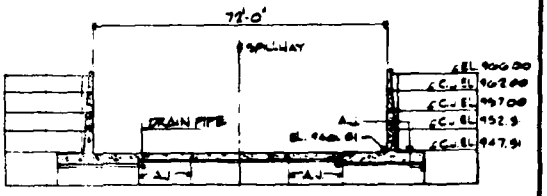
DETAIL (D) (DA)

NOTE (DA) OPPOSITE HAND

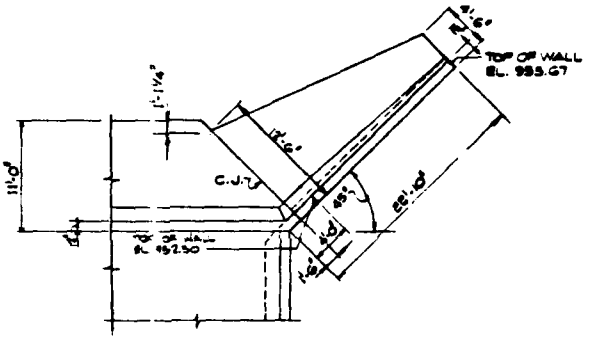




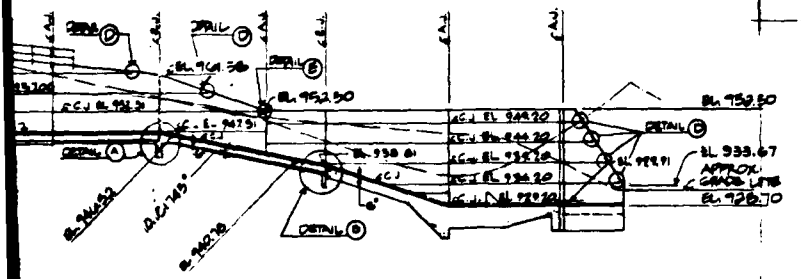
CROSS SECTION OF BOX INLET

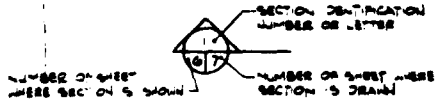


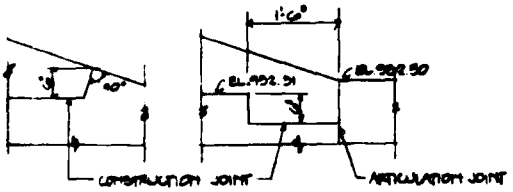
CROSS SECTION AT CUT OFF WALL



DETAIL (C)
SCALE 1"=1'-0"







DETAIL (D)(Da)
SCALE 3/4"=1'-0"

DETAIL (E)
SCALE 3/4"=1'-0"

NOTE (a) OPPOSITE HAND

SCALE 1"=10' UNLESS NOTED OTHERWISE

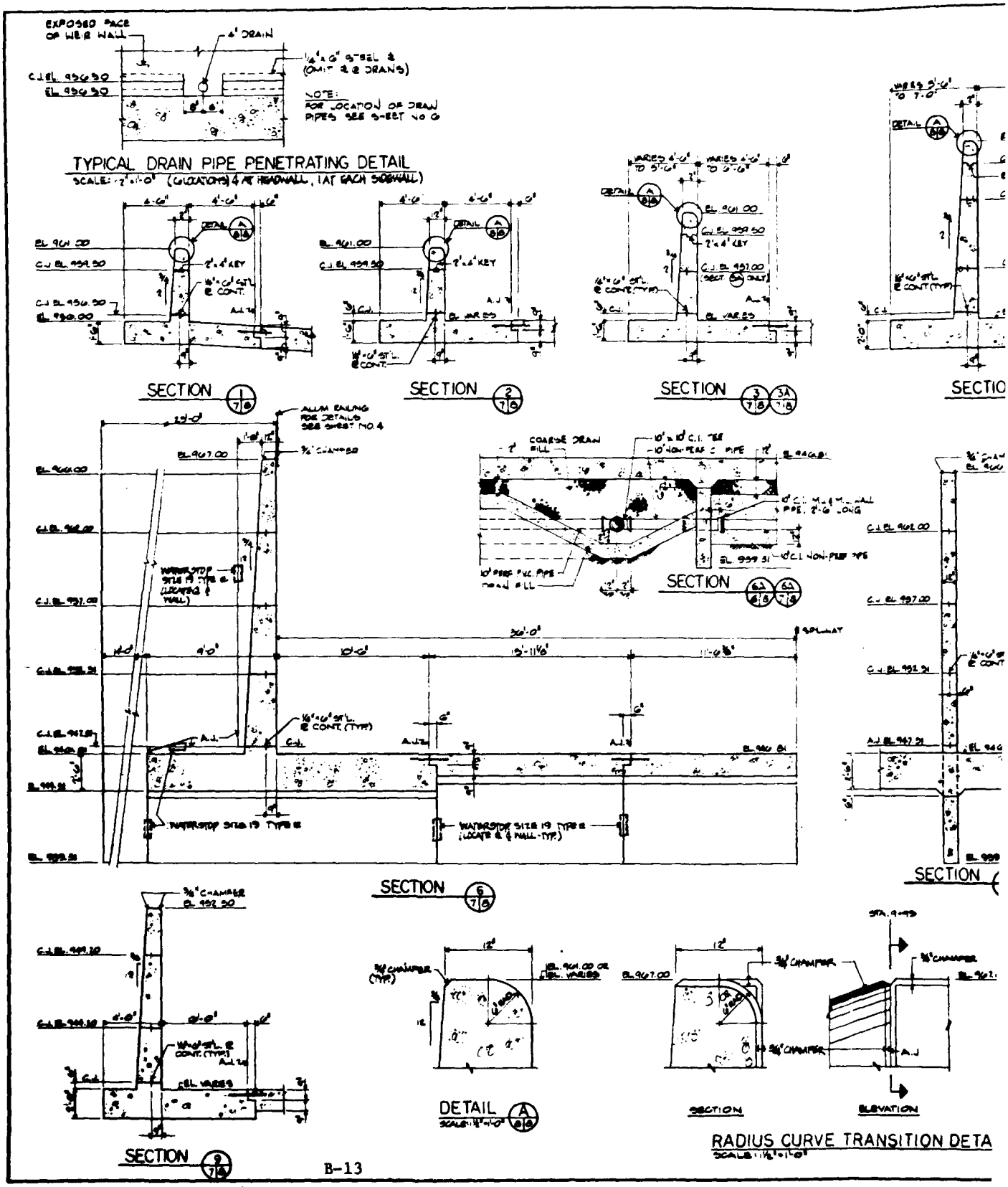
SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

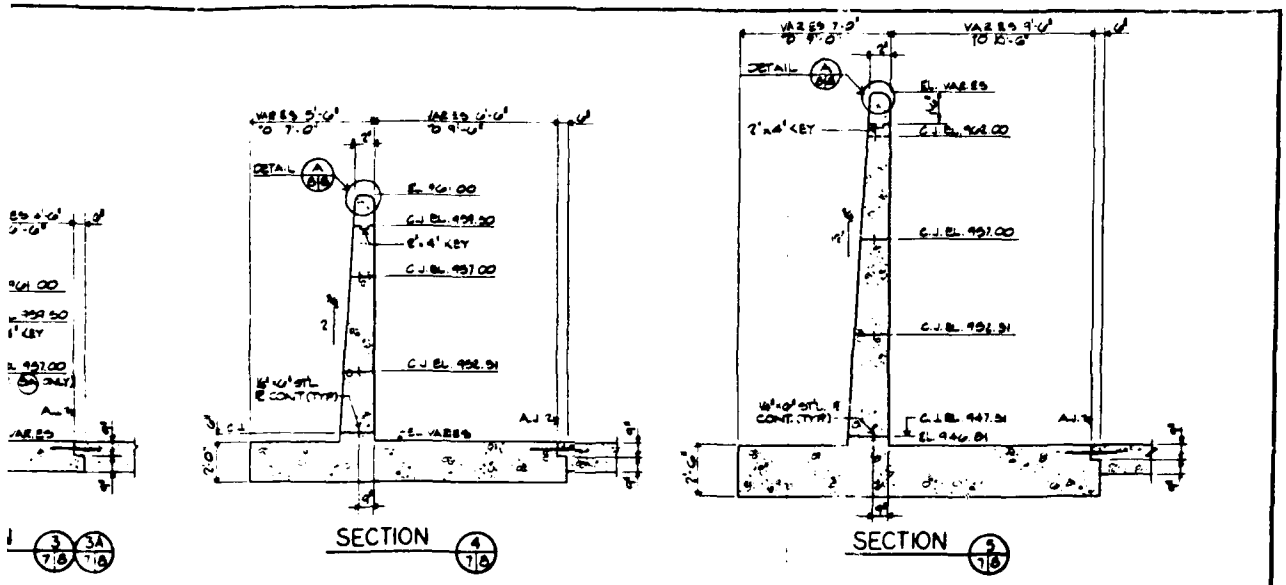
CONCRETE—EMERGENCY SPILLWAY PLAN AND SECTIONS

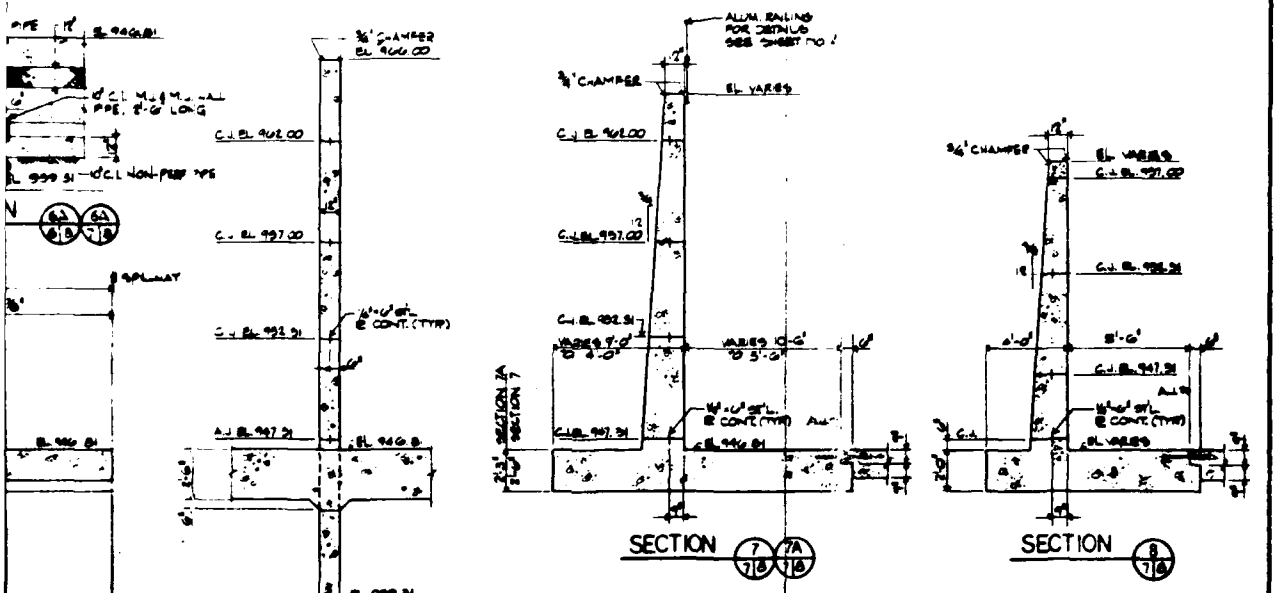
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

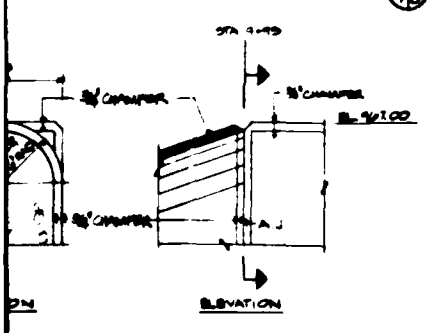
		Date	Approved by
Designed	RPH	9/78	Title HEAD, ENGINEERING STAFF
Drawn	ADC/DD	9/78	Title STATE CONSERVATIONIST
Traced			
Checked	RPH	9/78	Sheet 7 of 21 — Drawing No. NH-573-P-A

CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.


EXPOSED FACE OF WEIR WALL
4" DRAIN
NOTE: FOR LOCATION OF DRAIN PIPES SEE SHEET NO 6
TYPICAL DRAIN PIPE PENETRATING DETAIL
SECTION 1
SECTION 2
SECTION 3
SECTION 3A
ALUM RAILING FOR DETAILS SEE SHEET NO. 4
COARSE DRAIN FILL
SECTION 6A
SECTION 6
SECTION 9
DETAIL A
SECTION
ELEVATION
RADIUS CURVE TRANSITION DETA







ADIUS CURVE TRANSITION DETAIL

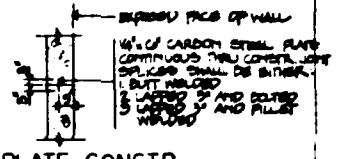


PLATE CONSTR. JOINT DETAIL

LEGEND
C.J. - CONSTRUCTION JOINT
A.J. - ARTICULATION JOINT
NOTE: ALL EXPOSED VERTICAL ARTICULATION JOINTS ON THE EXPOSED FACE SHALL HAVE ¾" CHAMFER.

SCALE: ½"=1'-0" UNLESS NOTED OTHERWISE

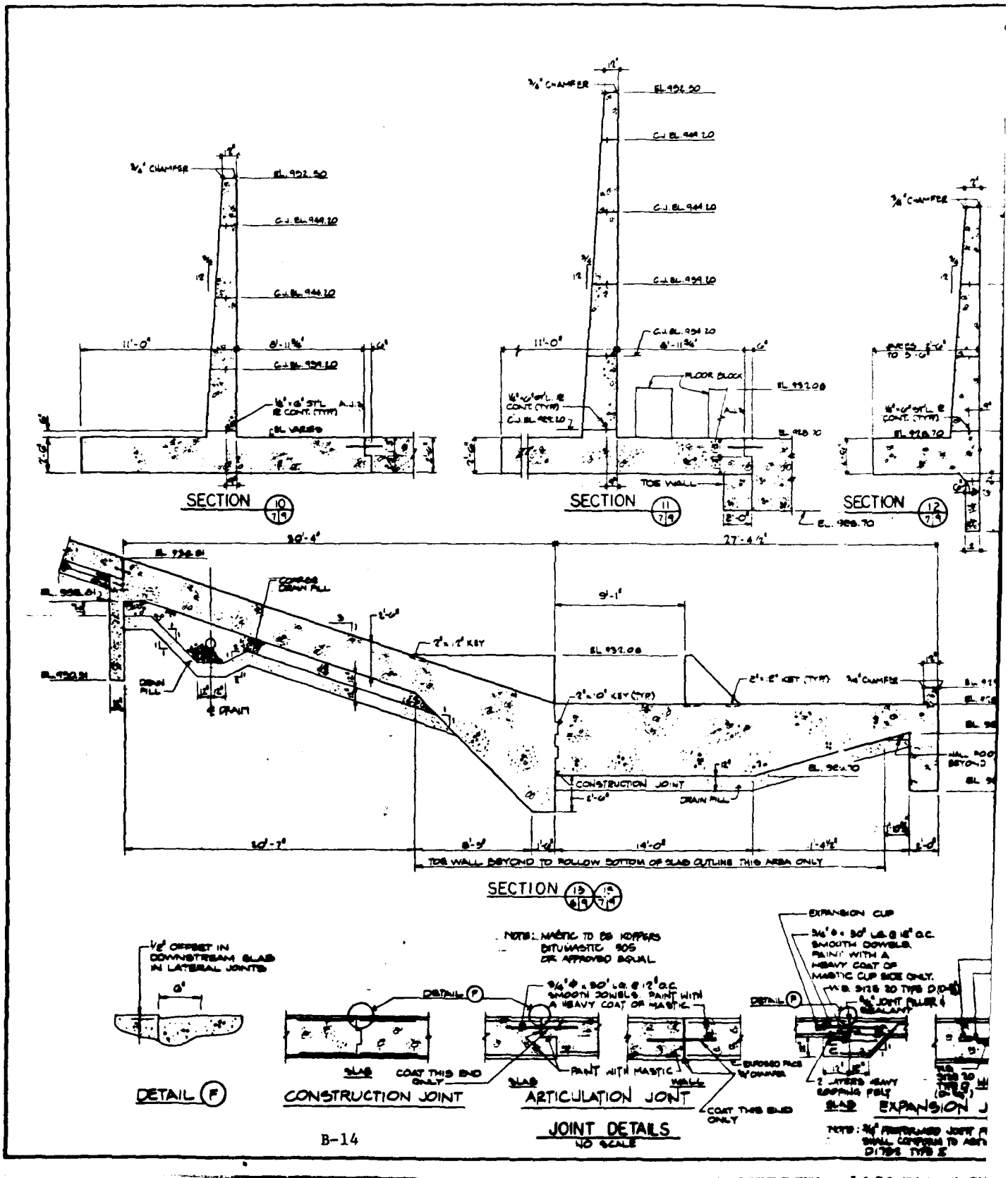
SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.18
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

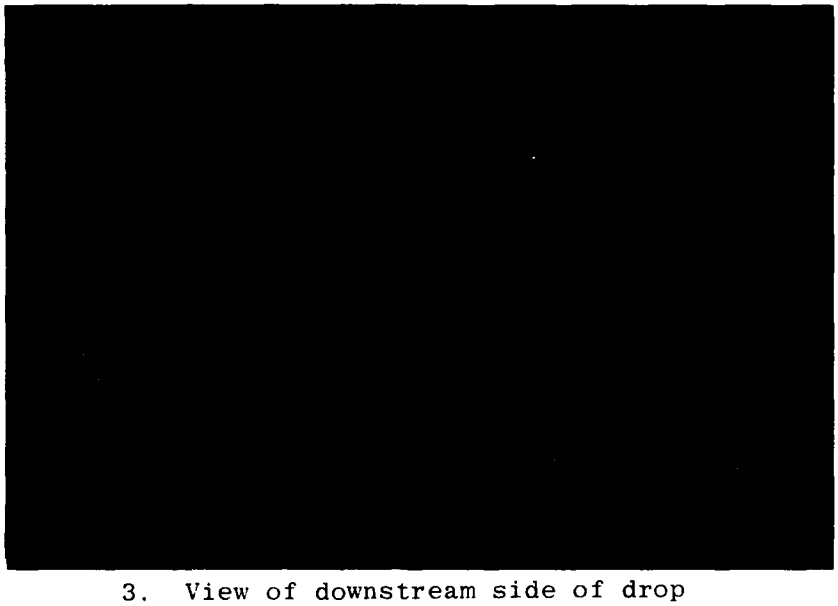
CONCRETE - SECTIONS I

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

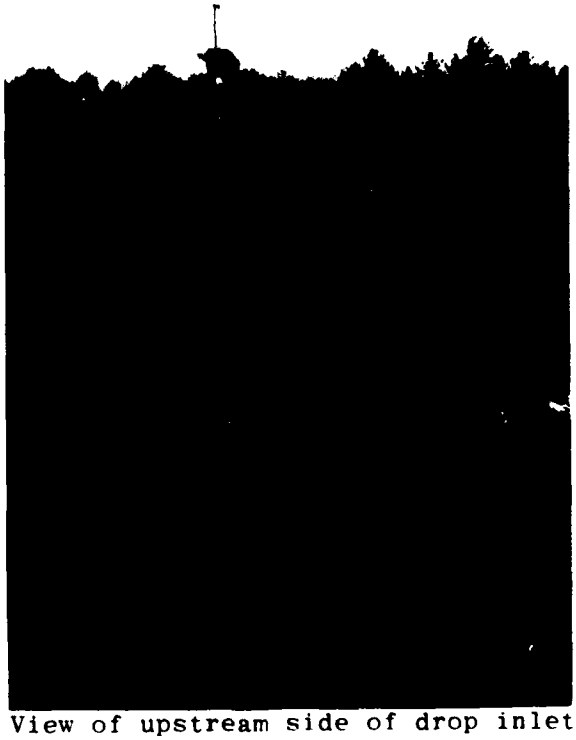
Designed	RPH	9/78	Approved by — Title: HEAD, ENGINEERING STAFF
Drawn	ADC/JC	9/78	Title: STATE CONSERVATIONIST
Traced			Sheet No. 8 of 31
Checked	RPH	9/78	Drawing No. NH-573-P-A

CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.

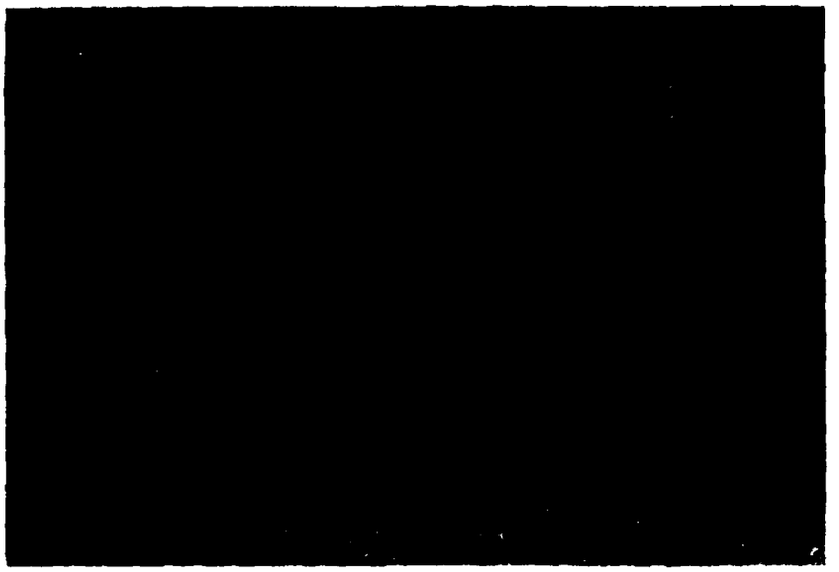

SECTION 10/9
SECTION 11/9
SECTION 12/9
SECTION 13/9 14/9
DETAIL F
CONSTRUCTION JOINT
ARTICULATION JOINT
EXPANSION J
JOINT DETAILS
NO SCALE



3. View of downstream side of drop inlet structure

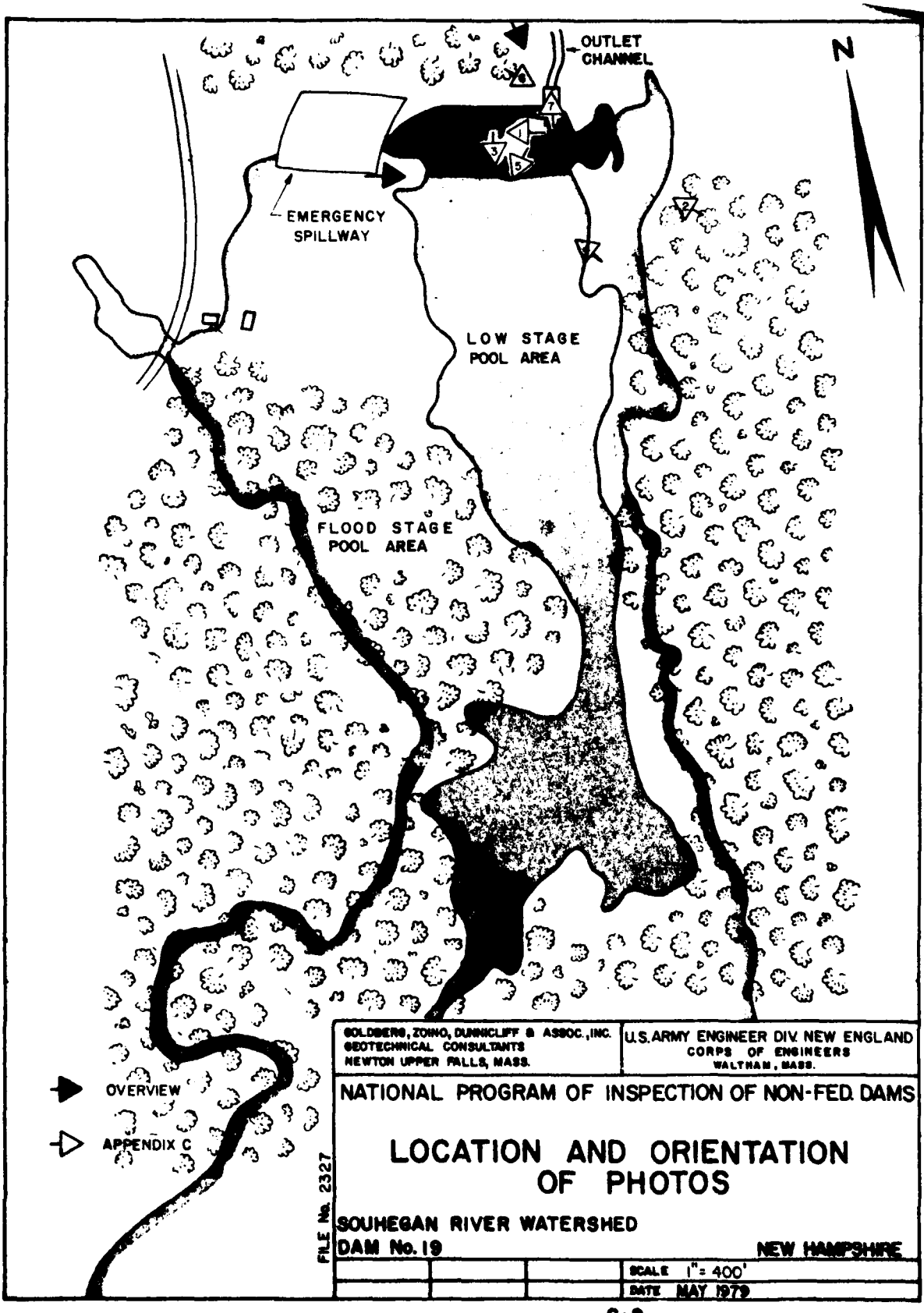


4. View of upstream side of drop inlet structure



1. View of downstream slope showing brush growth and location of piezometer pipe

2. View of ongoing construction at right abutment


OUTLET CHANNEL
N
EMERGENCY SPILLWAY
LOW STAGE POOL AREA
FLOOD STAGE POOL AREA
OVERVIEW
APPENDIX C
GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
LOCATION AND ORIENTATION OF PHOTOS
SOUHEGAN RIVER WATERSHED
DAM No. 19
NEW HAMPSHIRE
FILE No. 2327
SCALE 1" = 400'
DATE MAY 1979

APPENDIX C

PHOTOGRAPHS

The U.S.D.A. Soil Conservation Service (SCS) located in Durham, New Hampshire, maintains a file for this dam. Included in this file are:

1) SCS "Design Report" dated 4/9/62.

2) SCS "Hydrology and Hydraulics" design calculations dated 1961.

3) SCS stuctural design calculations dated 1962.

4) SCS "Detailed Geological Investigation of Dam Sites" dated 1961.

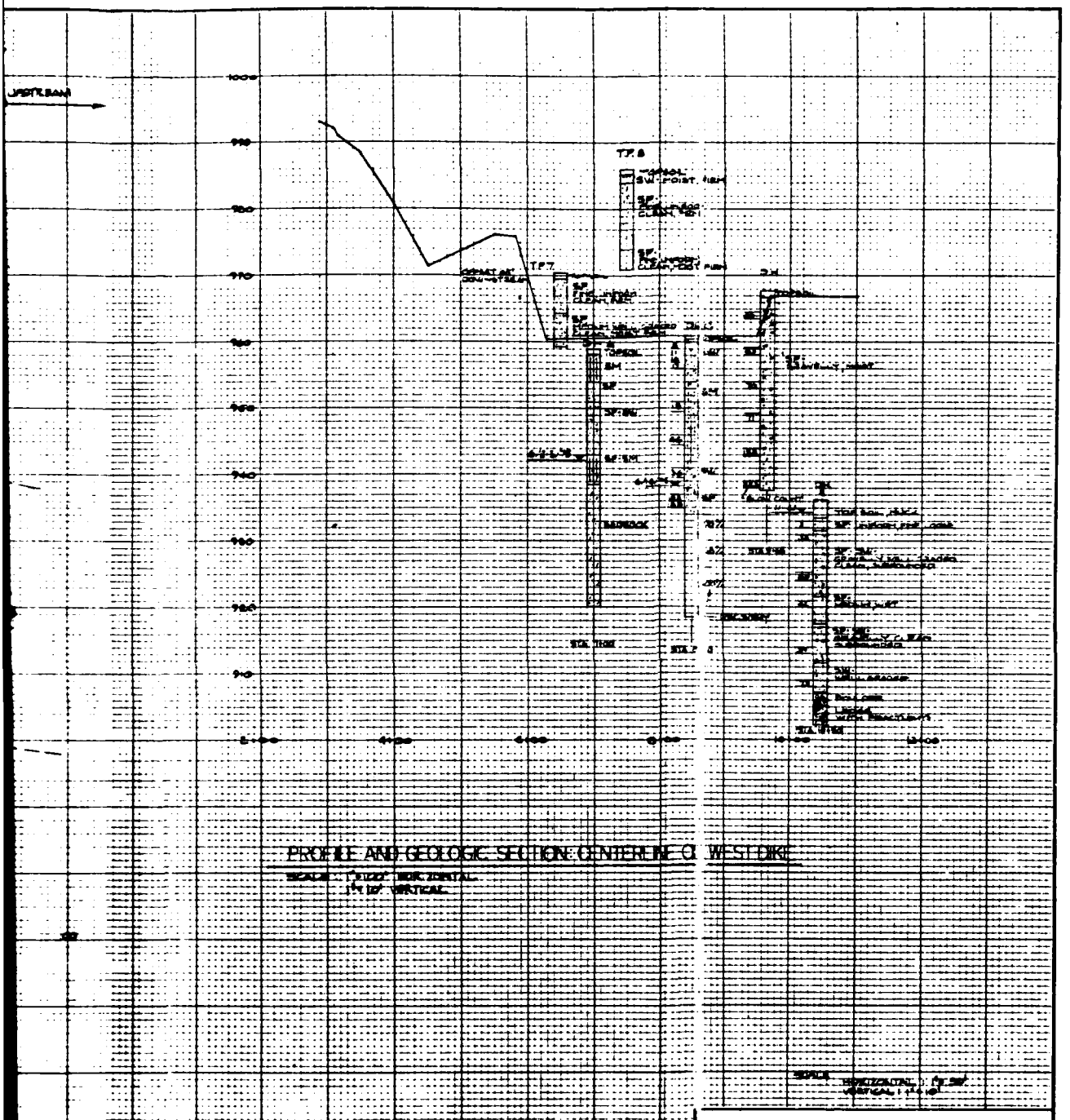
5) SCS soil mechanics laboratory data sheets dated February 1962.

6) SCS "As Built" drawings dated 1962.

The New Hampshire Water Resources Board (NHWRB) maintains a correspondence file on this dam. Included in this file are:

1) Maintenance inspection checklists dated May 19, 1977 and June 16, 1978.

Camp, Dresser & McKee, Inc. of Boston, Massachusetts provided a copy of the "Design Report" for the modification to the emergency spillways. This report is dated May 1978.



PROFILE AND GEOLOGIC SECTION CENTERLINE OF WEST DIKE

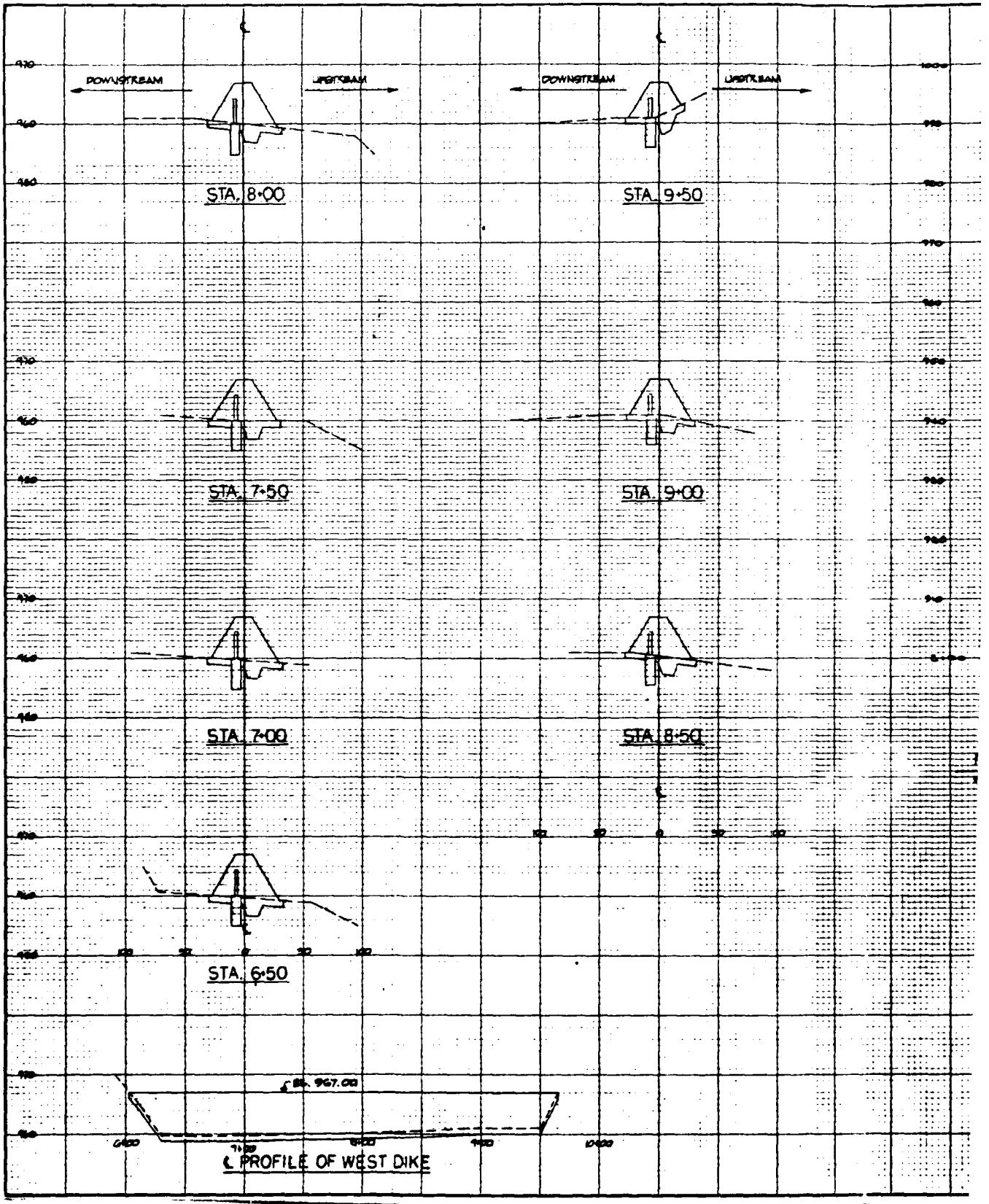
SCALE: 1" = 100' HORIZONTAL
1" = 10' VERTICAL

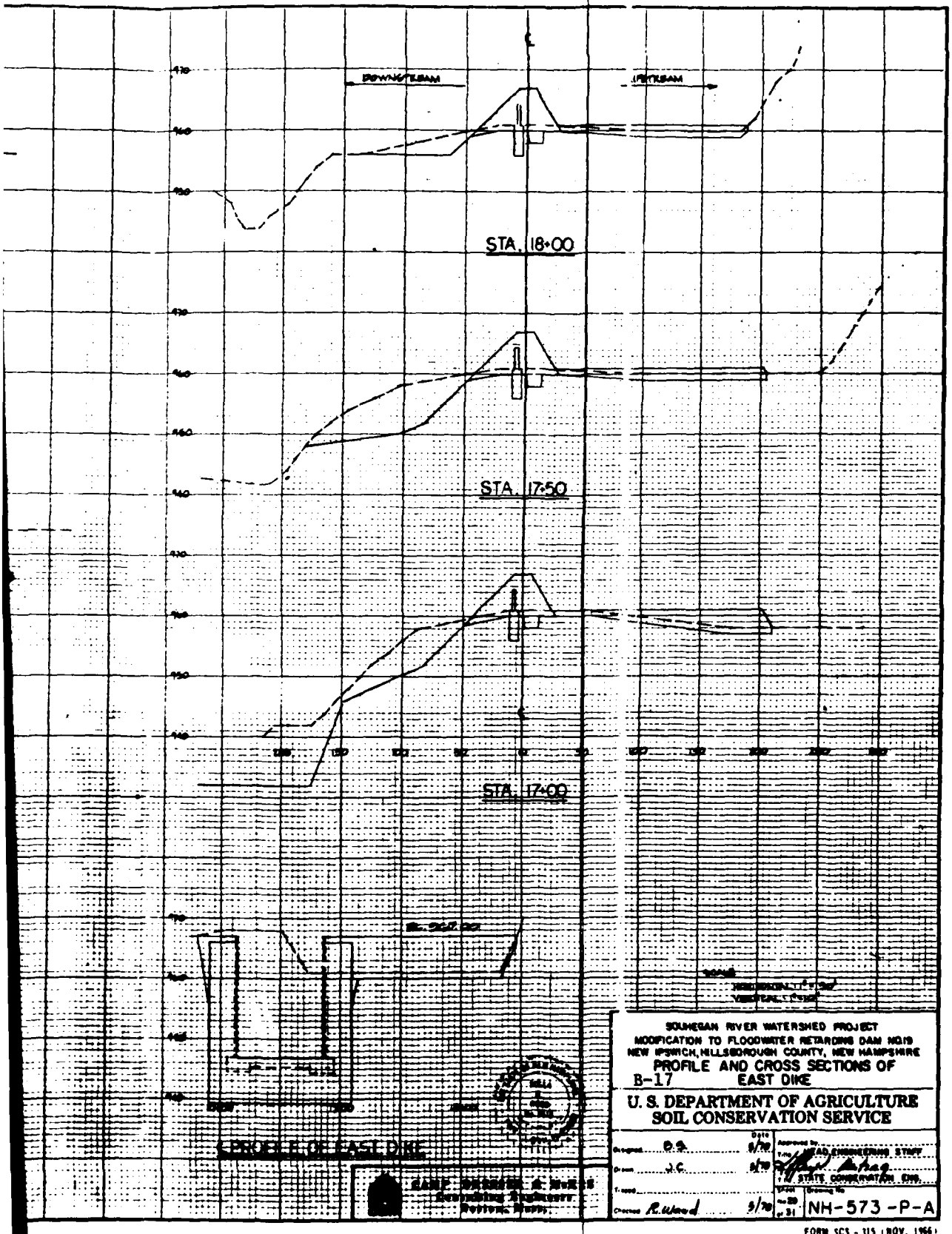
SCALE: HORIZONTAL 1" = 50'
VERTICAL 1" = 10'

SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.B
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE
PROFILE AND CROSS SECTIONS OF
B-18 WEST DIKE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed B.S./J.L.	Date 9/78	Approved by Title HEAD ENGINEERING STAFF	
Drawn J.C.	9/78	Title STATE CONSERVATION ENG.	
Traced			
Checked R. Wood	5/79	Sheet No. 30 of 31	Drawing No. NH-573-P-A

CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.


DOWNSTREAM
UPSTREAM
STA. 8+00
STA. 9+50
STA. 7+50
STA. 9+00
STA. 7+00
STA. 8+50
STA. 6+50
EL. 967.00
℄ PROFILE OF WEST DIKE



SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE
PROFILE AND CROSS SECTIONS OF
B-17 EAST DIKE

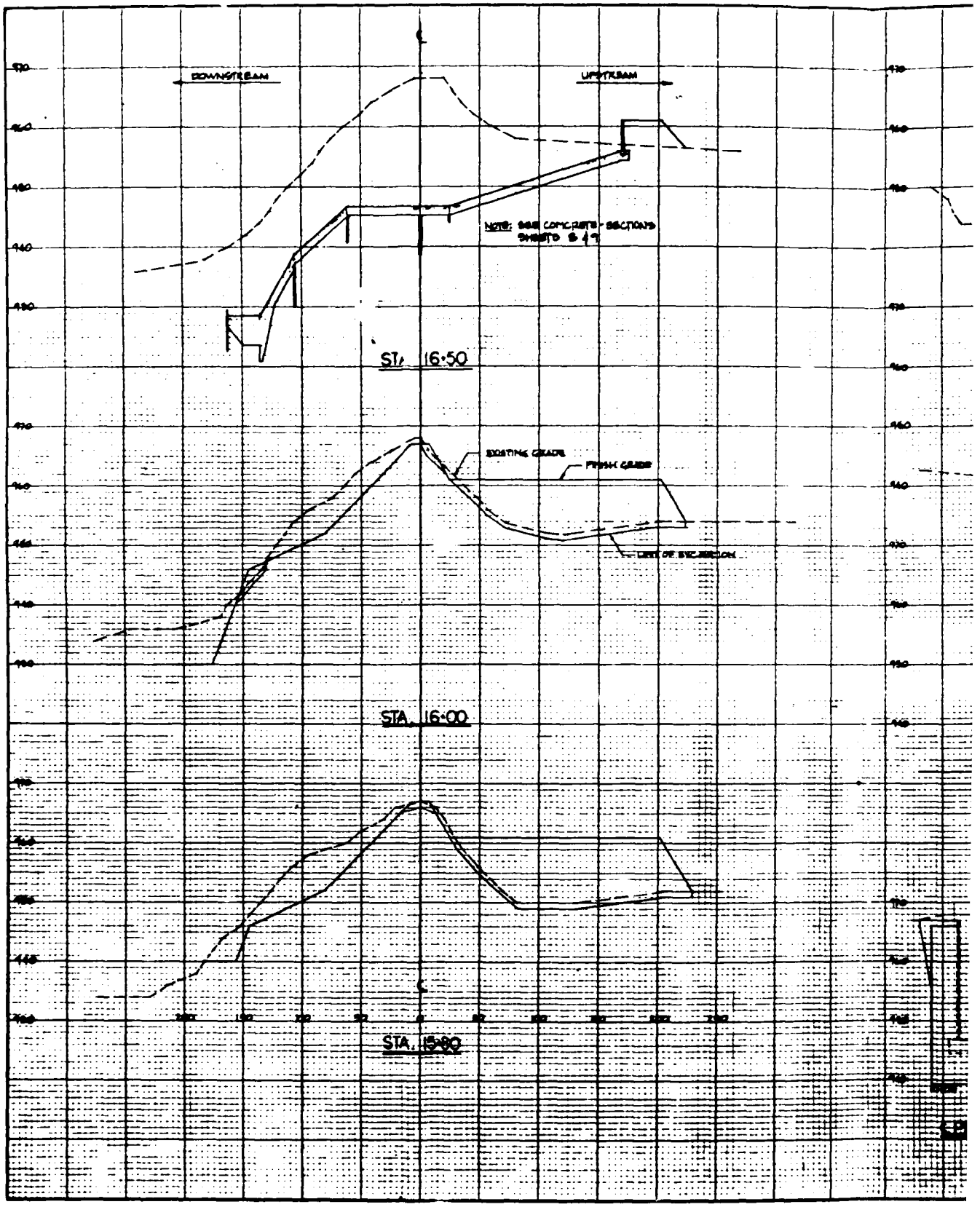
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

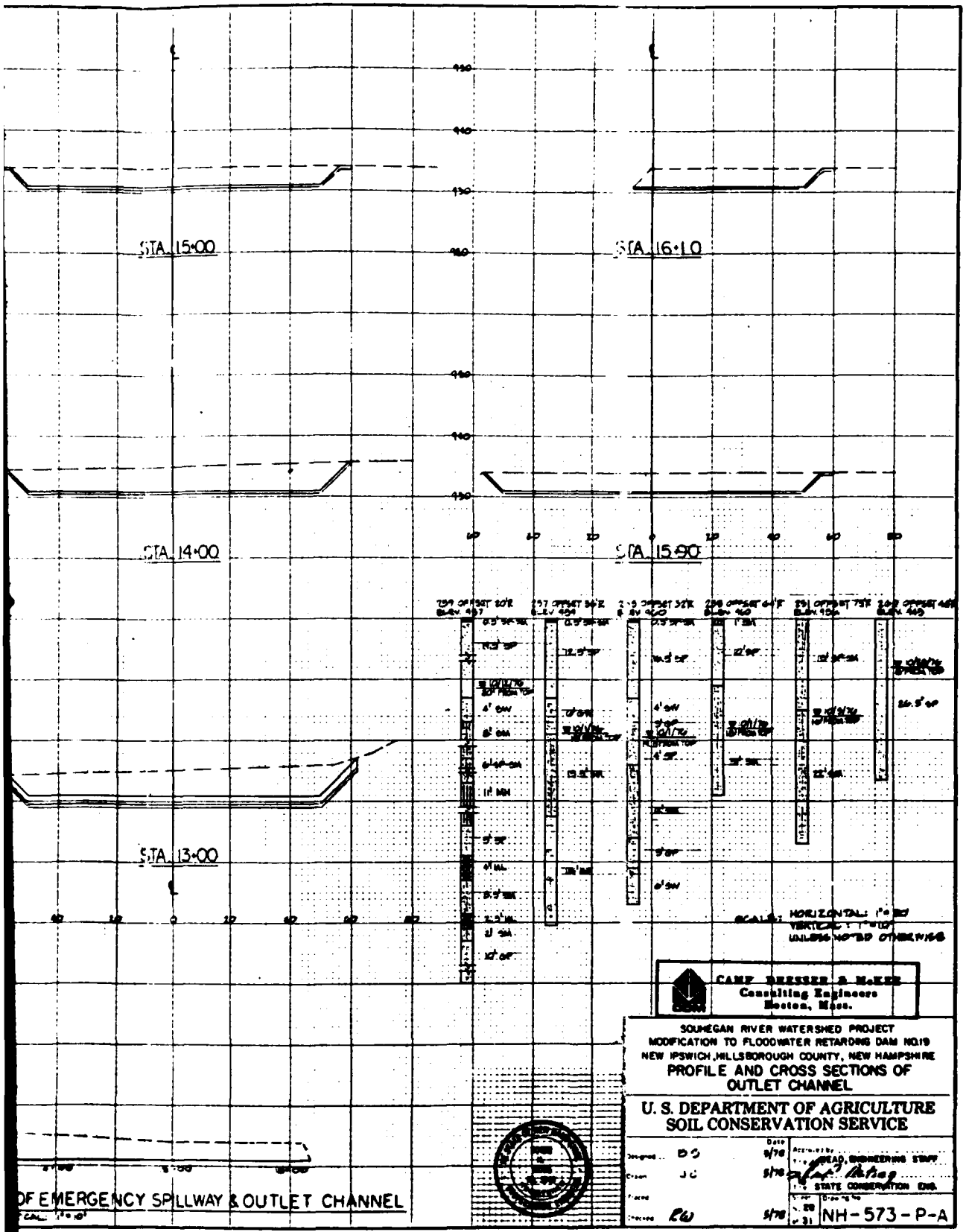
Designed D.S. 5/70
Drawn J.C. 5/70
Traced
Checked R.Ward 5/70

Approved by
Title HEAD, ENGINEERING STAFF
STATE CONSERVATION ENG.

Sheet No. 20 of 31 Drawing No. NH-573-P-A

FORM SCS - 315 (NOV. 1966)


DOWNSTREAM
UPSTREAM
NOTE: SEE CONCRETE SECTIONS SHEETS 8 & 9
STA. 16+50
EXISTING GRADE
FINISH GRADE
LIMIT OF EXCAVATION
STA. 16+00
STA. 15+80



CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.

SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.19
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

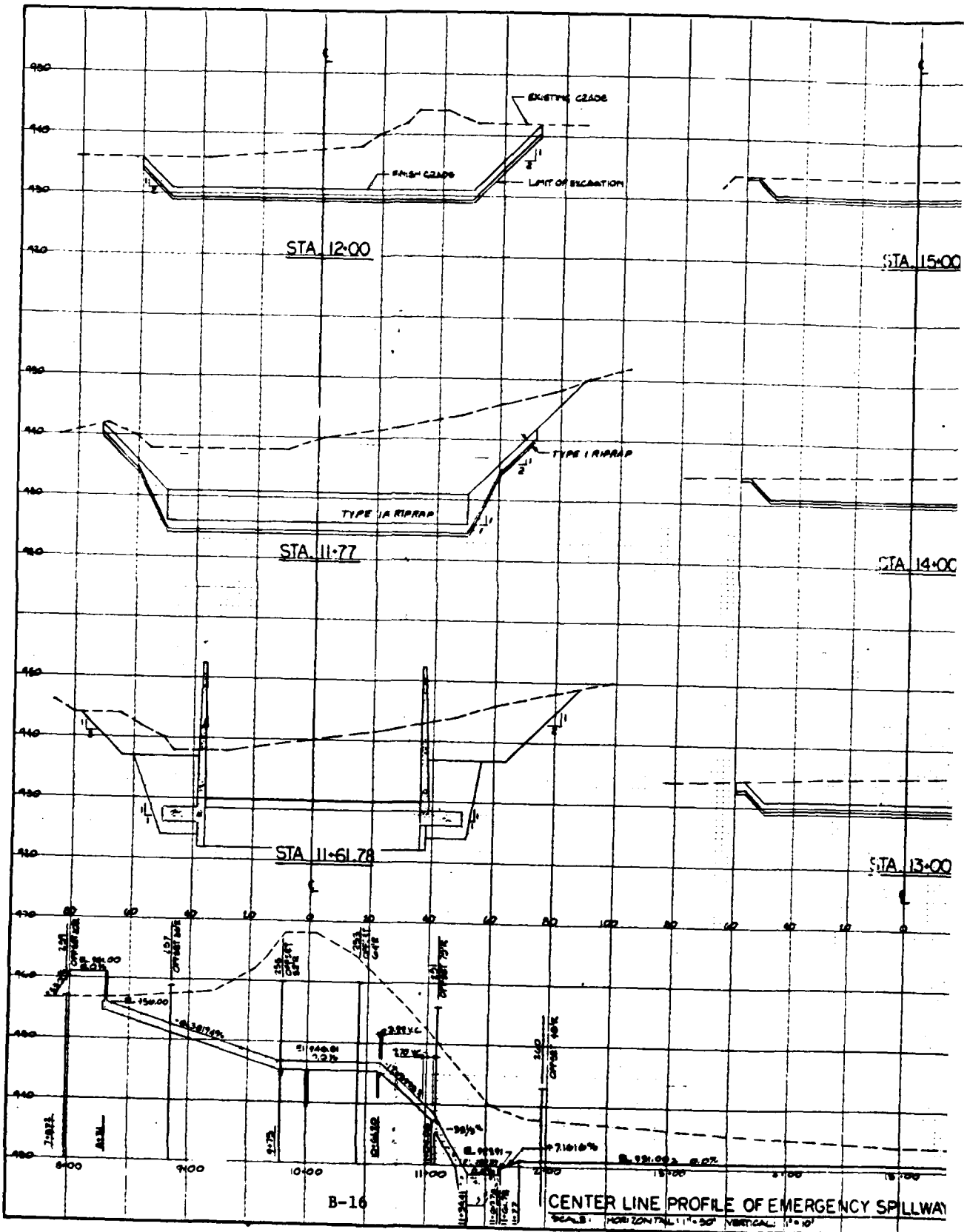
PROFILE AND CROSS SECTIONS OF OUTLET CHANNEL

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	D D	5/78
Drawn	J C	5/78
Traced		
Checked	R W	5/78

Approved by: HEAD, ENGINEERING STAFF
STATE CONSERVATION ENG.

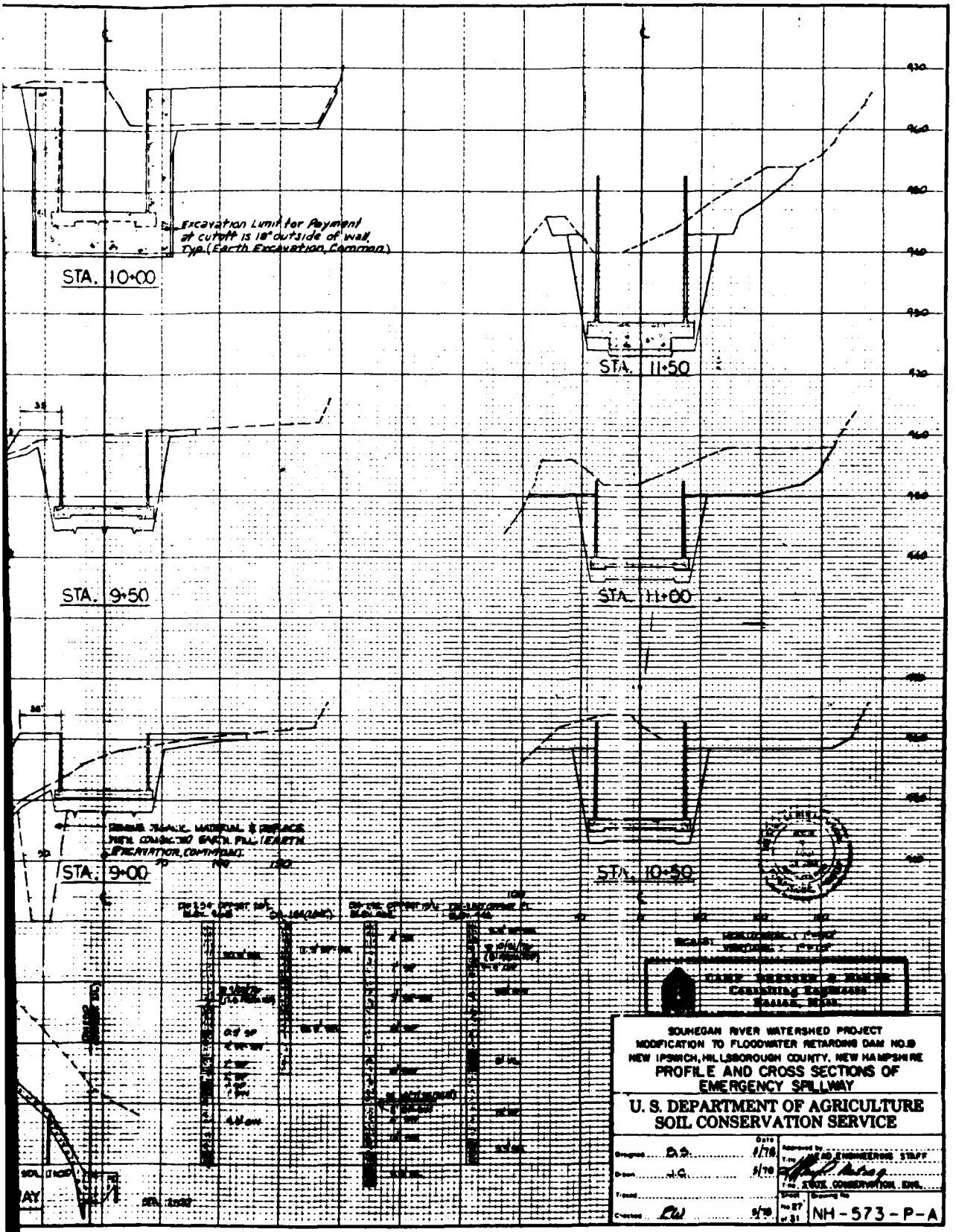
Sheet 20 of 31 — NH-573-P-A

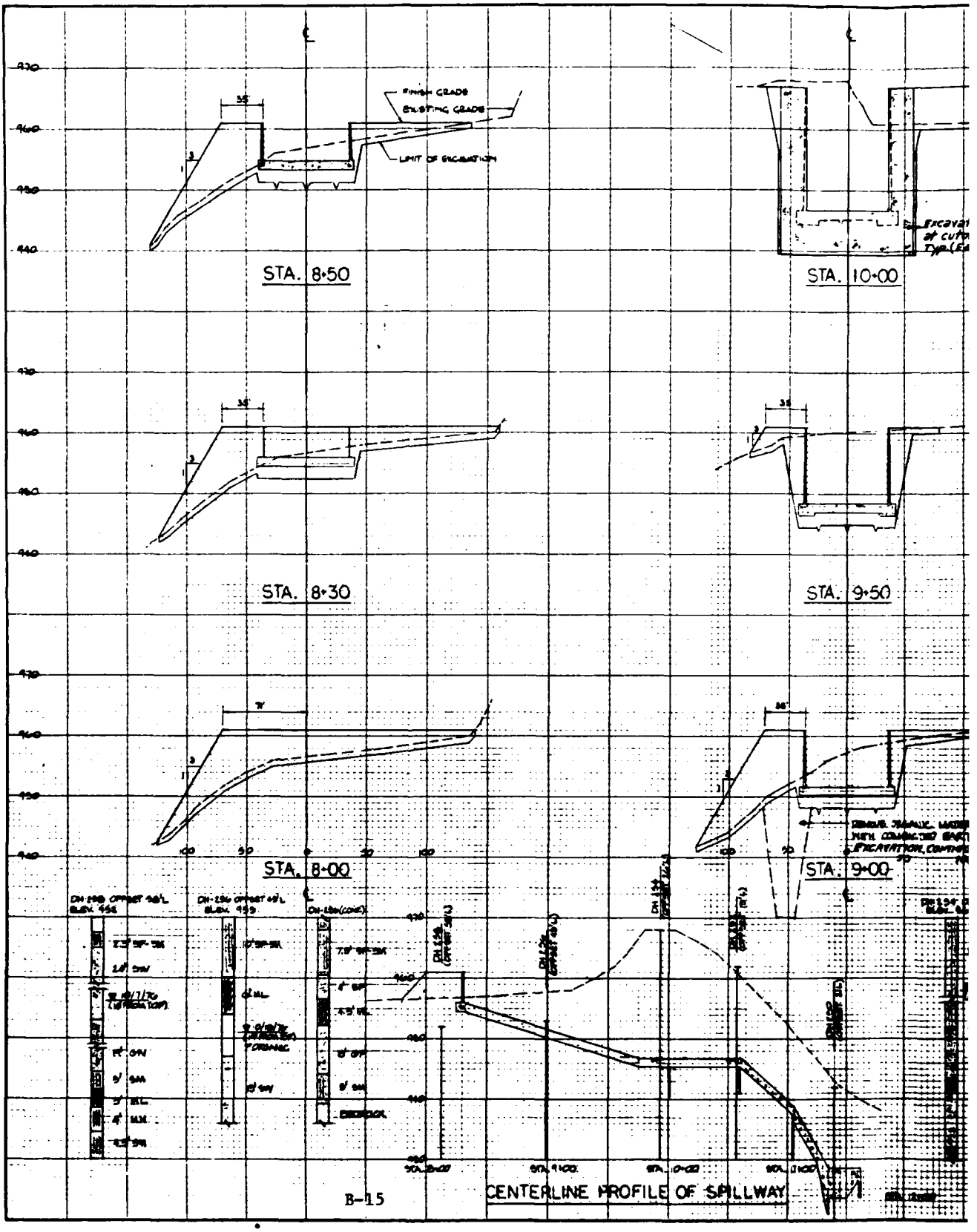


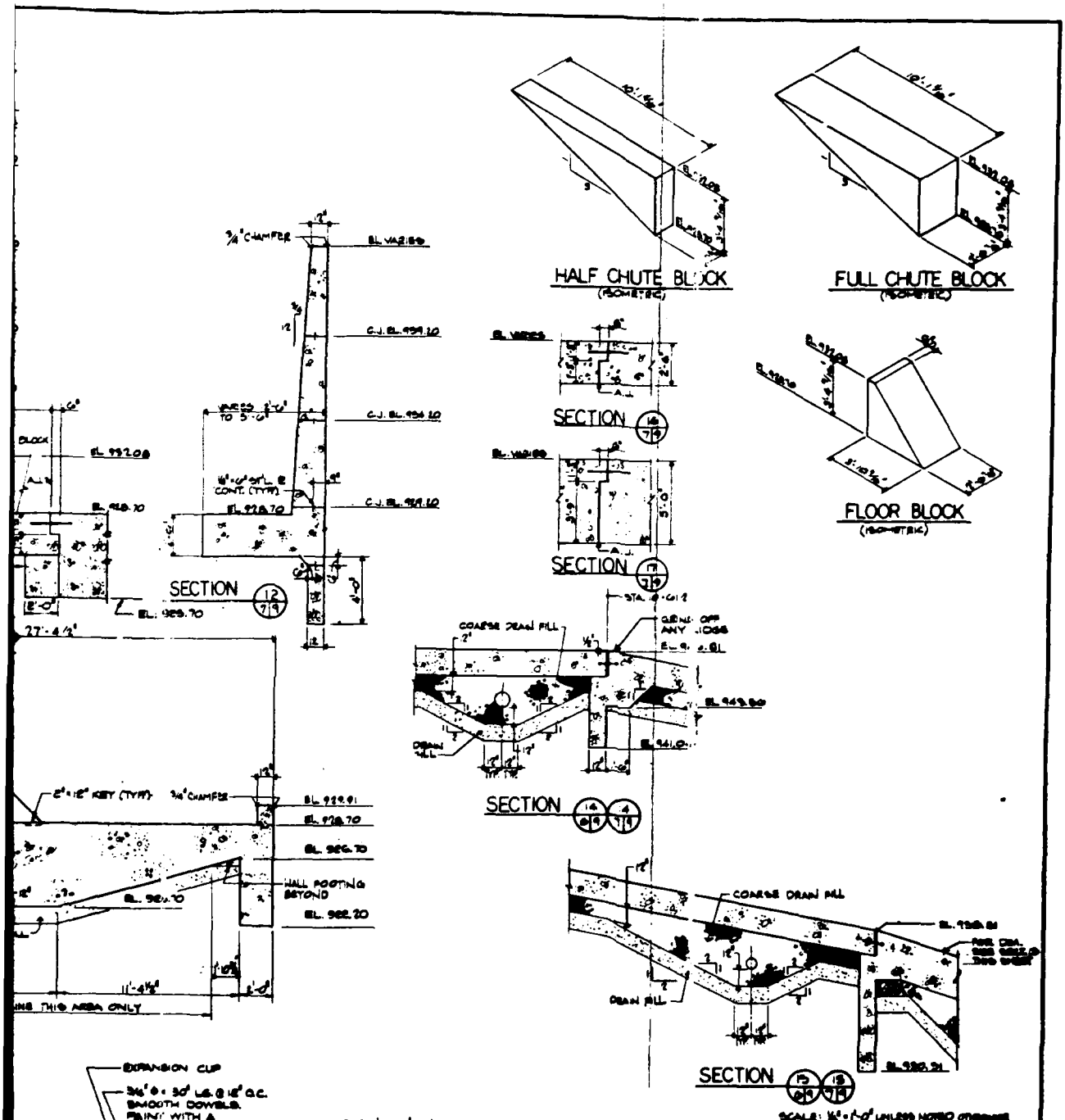
B-16

CENTER LINE PROFILE OF EMERGENCY SPILLWAY

SCALE: HORIZONTAL 1" = 50' VERTICAL 1" = 10'


Excavation Limit for Payment at cutoff is 18" outside of wall. Typ. (Earth Excavation, Common)
STA. 10+00
STA. 11+50
STA. 9+50
STA. 11+00
STA. 9+00
STA. 10+50
SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.9
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE
PROFILE AND CROSS SECTIONS OF EMERGENCY SPILLWAY
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed D.S. 8/70
Drawn J.G. 9/70
Traced
Checked RW 9/70
NH-573-P-A


FINISH GRADE
EXISTING GRADE
LIMIT OF EXCAVATION
STA. 8+50
STA. 10+00
STA. 8+30
STA. 9+50
STA. 8+00
STA. 9+00
CENTERLINE PROFILE OF SPILLWAY



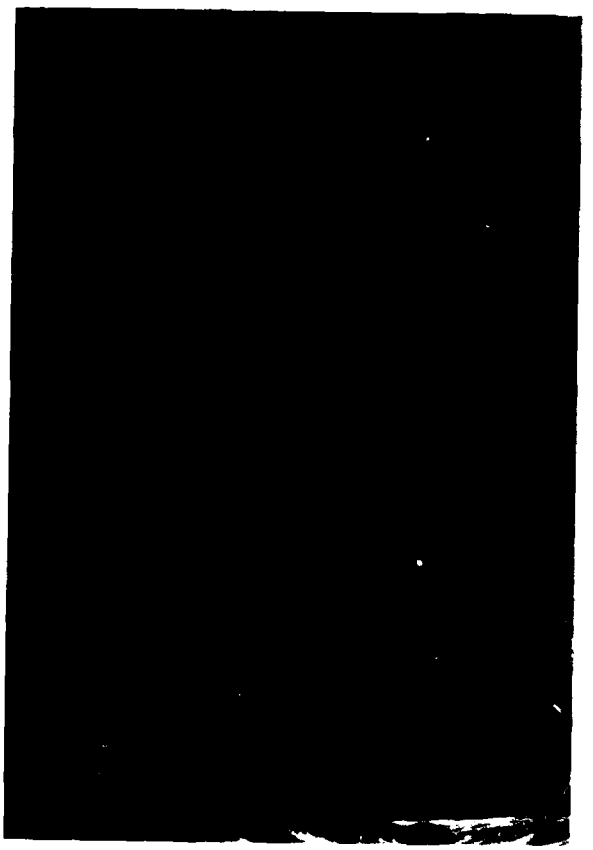
SOUHEGAN RIVER WATERSHED PROJECT
MODIFICATION TO FLOODWATER RETARDING DAM NO.10
NEW IPSWICH, HILLSBOROUGH COUNTY, NEW HAMPSHIRE

CONCRETE – SECTIONS II AND APPURTENANCES

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CAMP DRESSER & McKEE
Consulting Engineers
Boston, Mass.

Designed	RPH	9/79	Approved by
Drawn	JC/WBK	9/79	Title STATE CONSERVATIONIST
Traced			
Checked	RPH	9/79	Drawing No. NH-573-P-A



5. View of lowstage inlet showing debris clogging the trash racks

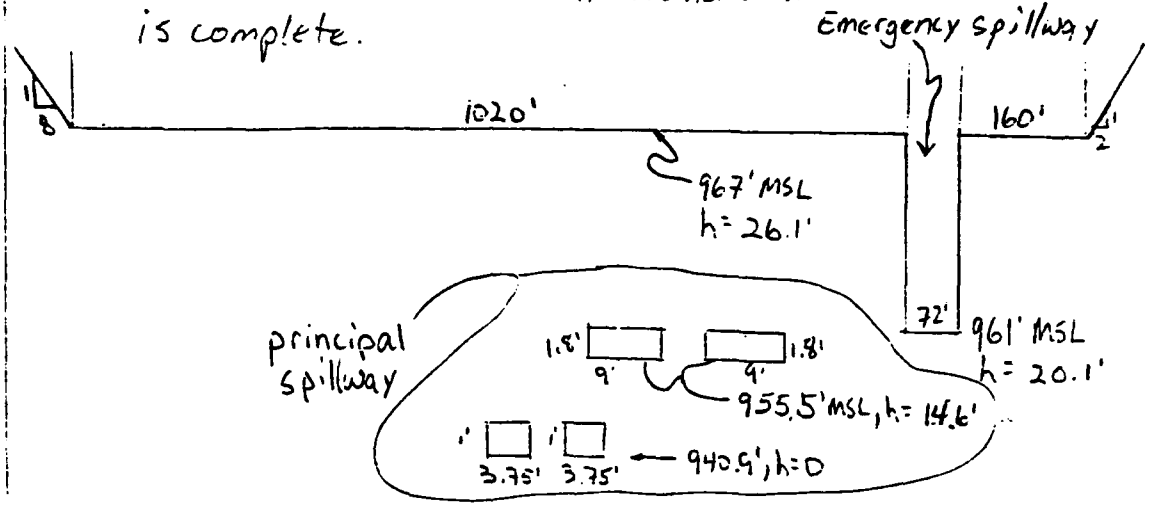
6. View of outlet pipe showing efflorescence

7. View of downstream channel from toe

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The information used to establish this elevation of Souhegan River Watershed Dam #19 was determined from field notes and S.C.S. as built drawings (1962) & Comp, Dresser, & Mckee reconstruction plans (1978). The dam is considered as it will be when current reconstruction is complete.



The two 1' x 3.75' orifices and the two 1.8' x 9' orifices are on a riser structure in the reservoir. The flows from these outlets combine and flow under the dam through a 42" reinforced concrete pipe with its invert at 933.0' MSL. The pipe is 202.3' long and has an outlet invert of 932.0' MSL. At high flows the pipe controls total outflow from the riser, which is also called "principal spillway" outflow.

There is one additional source of inflow to the riser - a "pond drain inlet" which is 19' of 30" corrugated metal pipe with the invert at 934.0' MSL. This inlet is not generally operated. Its flow combines with that from the orifices

on the riser and goes under the dam through the 42" outlet conduit. In the stage-discharge computations which follow it is assumed that the pond drain inlet is closed.

The S.C.S. developed a stage-Discharge relationship for the principal and emergency spillways:

Elevation (Ft. MSL)	Stage (h) (Ft. above Low flow Outlet, 940.9' MSL)	Principal Spillway* Outflow (cfs)	Emergency Spillway** Outflow (cfs)	Total Outflow (cfs)
940.9	0 (Low flow outlet) (orifice)	0	0	0
941.4	.5	7	0	7
941.9	1.0	25.5	0	26
942.4	1.5	33.7	0	34
945	4.1	68.4	0	68
950	9.1	105.7	0	106
955	14.1	132.9	0	133
955.5	14.6 (crest of weirs)	135.3	0	135
956.5	15.6	199.0	0	199
957	16.1	235.3	0	235
958	17.1	240.3	0	240
960	19.1	250.1	0	250

* Sheet 24 of SCS. Hydrologic and Hydraulic Calculations, dated 15 Nov., 1961

** Sheet 2/3 of SCS "72' x 144' Box Inlet Drop Spillway" outflow calculations, D-3 dated 9/27?

183 Dam Safety Saukegan R. W. Dam #19 TCG, 5/14/79, p 3

Stage Vs. Discharge (cont.)

Elevation (Ft. MSL)	Stage (h) (Ft. above Low flow outlet)	Principal Spillway Outflow* (cfs)	Emergency Spillway Outflow** (cfs)	Total Outflow (cfs)
961	20.1 (em. spillway crest)	254.7	0	255
961.5	20.6	257.7	320	578
962	21.1	259.4	907	1166
963	22.1	264.0	2585	2849
964	23.1	268.4	4783	5051
965	24.1	273.3	7632	7905
966	25.1	275.6 ***	11,250	11,526
967	26.1	278.9 ***	15,401	15,680
967.5	26.6	280.6 ***	16,048	18,498 *†

* Sheet 24 of SCS Hydrologic and Hydroulic Calculations, dated 15 Nov., 1961

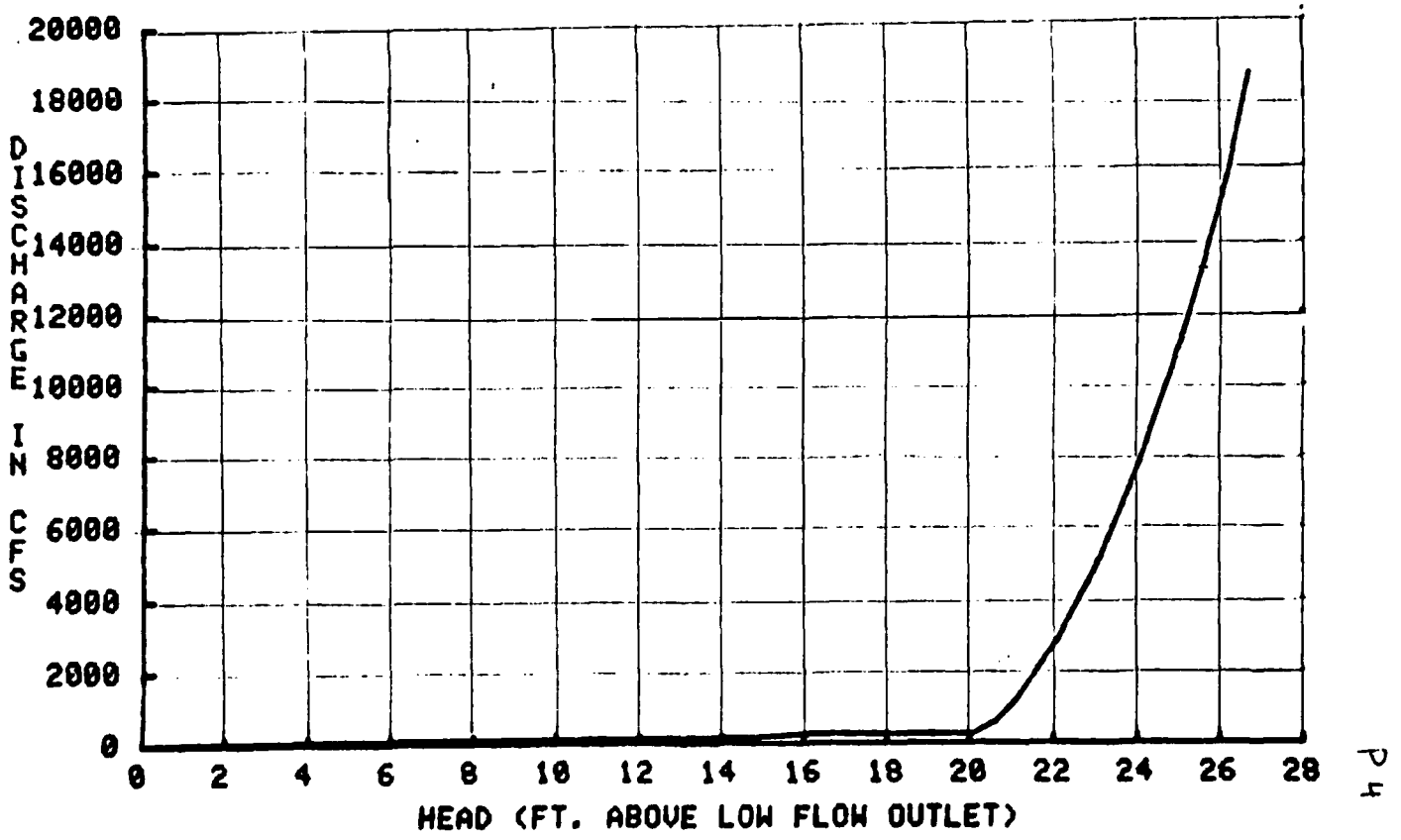
** Sheet 2/3 of SCS "72' x 144' Box Inlet Drop Spillway' outflow calculations, dated 9/17/79

*** Estimated by Extrapolation from S.C.S. work

*† includes flow over dam crest = $2.6\,(1180)\,(.5)^{\frac{1}{2}} = 2169$ cfs

P. 4 gives the Stage-Discharge Curve for this dam.

STAGE-DISCHARGE CURVE AT SOUHEGAN R. W. DAM # 19



Storage-Elevation Curve

The following Elevation-Storage Curve was taken from SCS Hydrology and Hydraulics calculations, p. 5, dated 9 Nov., 1961.

Elevation (Ft. MSL)	Stage (Ft. above Low Flow Outlet)	Current Storage (Ac-Ft)	Available Storage (After 50 yrs. sediment) (Ac-Ft.)
935	-5.9	0	0
940	-.9	62	0
940.9	0	85.3	0
945	4.1	239.8	126.1
950	9.1	560.3	446.6
955	14.1	1004.4	890.7
960	19.1	1531.8	1418.1
965	24.1	2122.7	2009.0
970	29.1	2761.4	2647.7

The elevation-Storage curve is given on p.6

For the drainage area of 7277 acres, 1 inch of runoff = 1/12 (7277) = 606.4 ac-ft.

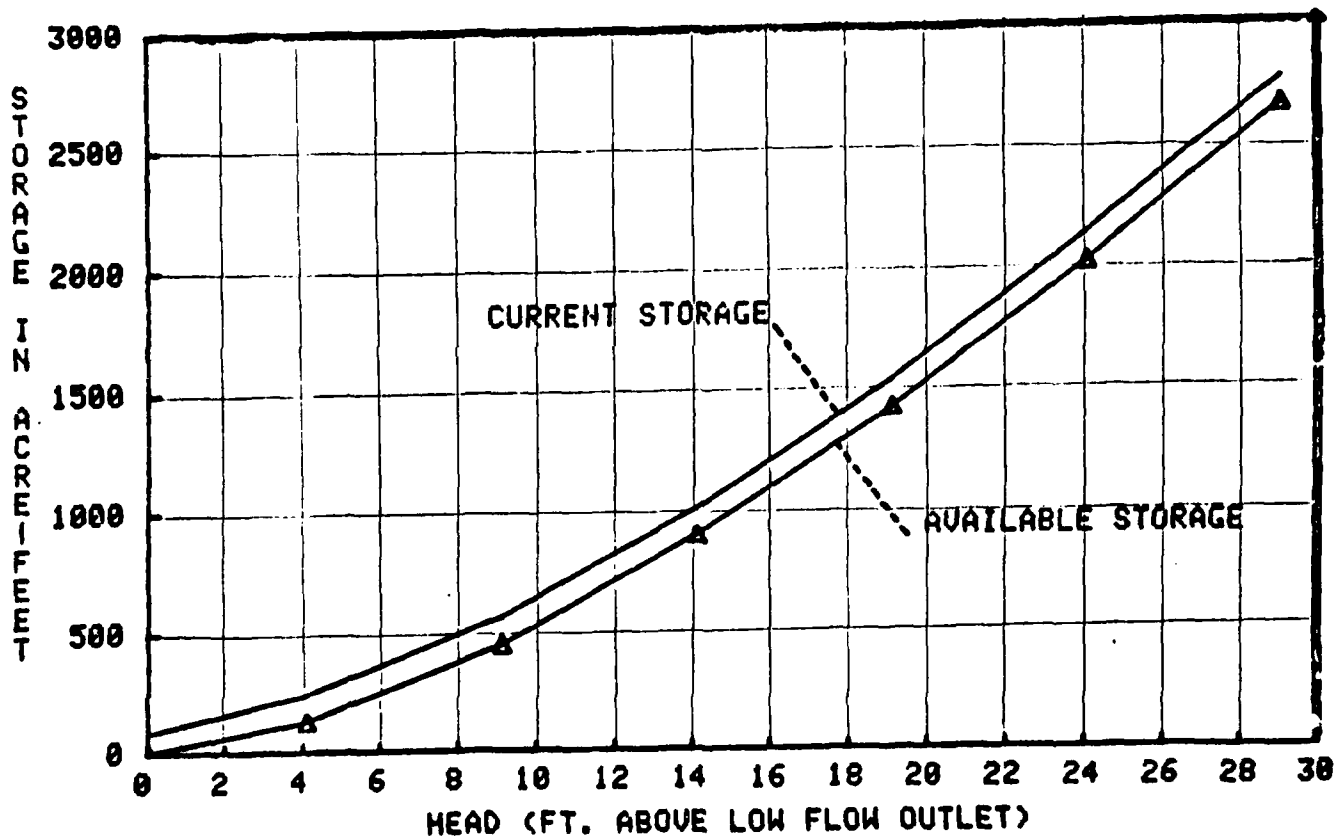
1 Ac-ft = $\frac{1}{606.4}$ = .00165" of runoff

Available storage to emergency spillway crest = 1536(.00165) = 2.53"

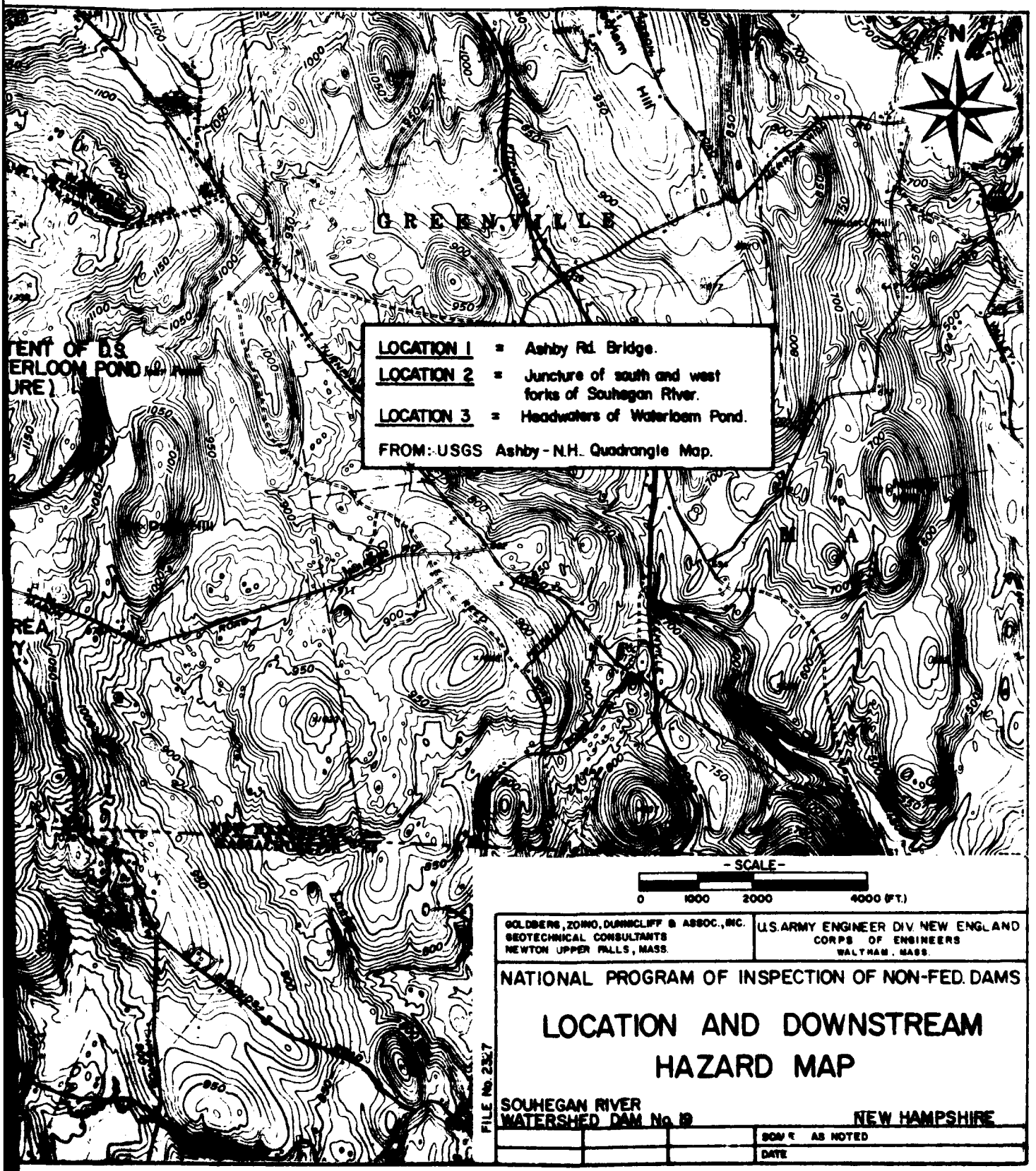
Available storage to dam crest = 2648(.00165) = 4.37"

NO-6

ELEVATION-STORAGE CURVE AT SOUHEGAN R. W. DAM # 19



Waterloom Pond
Gibson Pond
APPROXIMATE EXTENT OF D.S. FLOODING TO WATERLOOM POND (AFTER DAM FAILURE)
DRAINAGE AREA BOUNDARY
1
2
3



GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

SOUHEGAN RIVER
WATERSHED DAM No. 19 NEW HAMPSHIRE

FILE No. 2327

			SCALE AS NOTED
			DATE

Dam Failure Analysis

P. 7 is a location and Downstream Hazard Map for S.R.W. Dam # 19.

The Design High Water for Souhegan River Watershed Dam #19 is a water surface elevation at the top of the dam, 967.0' MSL, 6 ft. above the emergency spillway crest. Therefore, failure is assumed to occur with the water surface at this elevation. Storage at this elevation is 2648 Ac-Ft.

Peak failure outflow = Normal outflow + Breach outflow

Normal outflow = 15,680 cfs

Breach outflow:

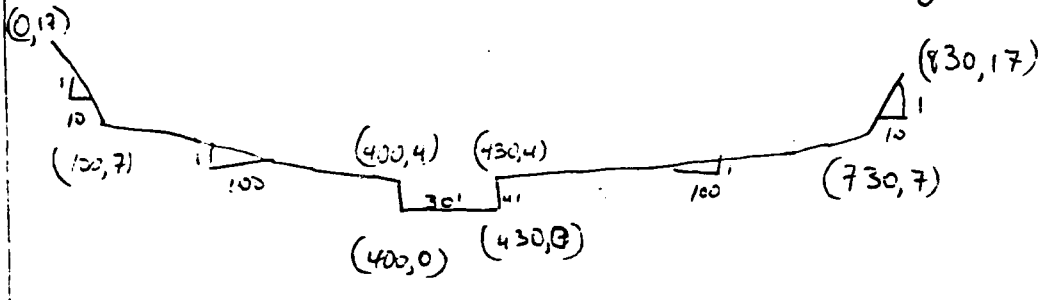
$$Q_{f_1} = 8/27 \sqrt{g}\, W_b\, y_o^{3/2}$$

y_o = elevation above tailwater.

At the flows we are concerned with, tailwater is probably controlled by the shape of the natural valley in the reach from the dam to Ashby Rd. The culvert under Ashby Rd. does present a constriction, but the Ashby Rd. embankment is likely to be washed

out by the time flow reaches 15,000+ cfs.

The following typical cross-section downstream of the dam is based on field notes and U.S.G.S. quad sheet:



$n = .050$

$S = .0033$

P. 10 shows a stage-Normal flow relationship for this channel. Prior to failure the depth of flow in the channel would be about 10.3 ft. At the dam the channel bottom is at 935.5' → tailwater el. = 935.5 + 10.3

$= 946' \pm$

$Y_o = 967 - 946 = 21'$

W_b = width of breach = .4 (width of dam at ½ height)

$= .4(580) = 230' \pm$

$Q_p = 8/27 \sqrt{g} (230)(21)^{3/2} = 37,200$ cfs

peak failure outflow = 15,680 + 37,200 = 52,900 cfs.

This would raise the depth of flow immediately downstream of the dam from 10.3' to 15.5', or increase of 5.2'.

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.5	15.0	31.0	0.5	9.2	15.8
1.00	1.0	30.0	32.0	0.9	28.7	49.2
1.50	1.5	45.0	33.0	1.4	55.3	94.7
2.00	2.0	60.0	34.0	1.8	87.6	150.0
2.50	2.5	75.0	35.0	2.1	124.7	213.5
3.00	3.0	90.0	36.0	2.5	165.8	283.9
3.50	3.5	105.0	37.0	2.8	210.5	360.4
4.00	4.0	120.0	38.0	3.2	258.4	442.3
4.50	4.5	160.0	138.0	1.2	176.6	302.3
5.00	5.0	250.0	238.0	1.1	258.3	442.2
5.50	5.5	390.0	338.0	1.2	429.0	734.5
6.00	6.0	580.0	438.0	1.3	699.5	1197.4
6.50	6.5	820.0	538.0	1.5	1086.1	1859.3
7.00	7.0	1110.0	638.0	1.7	1605.9	2749.1
7.50	7.5	1427.5	648.1	2.2	2417.3	4138.0
8.00	8.0	1750.0	658.1	2.7	3359.9	5751.8
8.50	8.5	2077.5	668.2	3.1	4427.3	7579.0
9.00	9.0	2410.0	678.2	3.6	5614.3	9611.0
9.50	9.5	2747.5	688.3	4.0	6917.0	11841.1
10.00	10.0	3090.0	698.3	4.4	8332.4	14264.1
10.50	10.5	3437.5	708.4	4.9	9858.0	16875.7
11.00	11.0	3790.0	718.4	5.3	11491.7	19672.4
11.50	11.5	4147.5	728.5	5.7	13231.8	22651.2
12.00	12.0	4510.0	738.5	6.1	15076.9	25809.8
12.50	12.5	4877.5	748.6	6.5	17025.8	29146.2
13.00	13.0	5250.0	758.6	6.9	19077.7	32658.7
13.50	13.5	5627.5	768.7	7.3	21231.7	36346.1
14.00	14.0	6010.0	778.7	7.7	23487.1	40207.1
14.50	14.5	6397.5	788.8	8.1	25843.4	44240.9
15.00	15.0	6790.0	798.8	8.5	28300.3	48446.7
15.50	15.5	7187.5	808.9	8.9	30857.3	52823.9
16.00	16.0	7590.0	818.9	9.3	33514.2	57372.2
16.50	16.5	7997.5	829.0	9.6	36270.8	62091.2

REACH From DAM to Ashby Rd.

AD A157 329 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS SOUHEGAN RIVER WATERS..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV AUG 79 2/2

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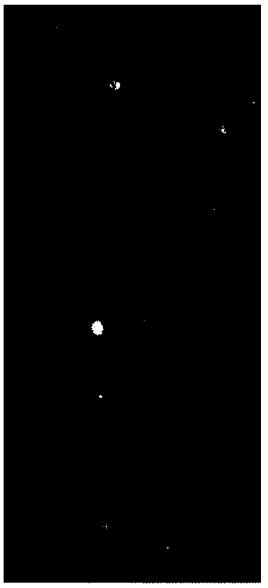


The attenuation due to storage in this reach can be estimated by establishing the increase in channel area multiplied by the channel length of 1600'. (see p.12)

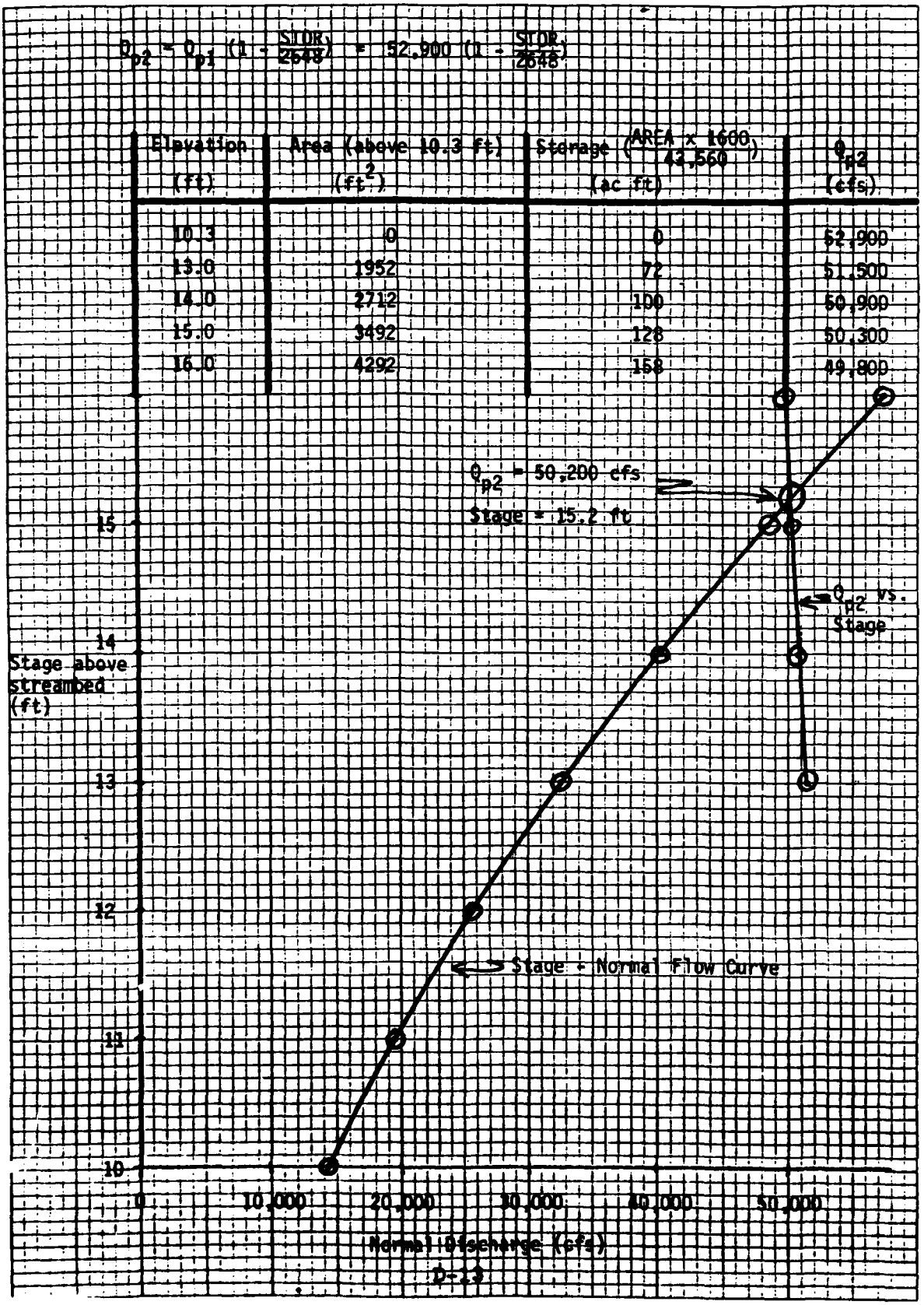
The attenuated peak dam failure outflow is 50,200 cfs, which yields a stage 15.2 ft. above the streambed. In the reach from the dam to Ashby Rd, the only development in the floodplain is an open pit gravel mine about 1200' downstream of the mine and 5-10 ft. above the streambed. Dam failure would increase the flooding at the mine. This should not present a major threat of loss of life, as the mine does not appear to be worked continuously, and would be abandoned at the level of flooding prior to failure.

Just downstream of Ashby Rd. there are 3 houses between 10 and 15 feet above the streambed. These houses would be affected by dam failure, as flooding would suddenly increase from little or nothing to about 3'-5'. This would cause serious damage, and would possibly present a serious threat to life at these houses.

The next reach impacted by dam failure runs from Ashby Rd. to the confluence of the West and South Forks of the Souhegan. The following typical

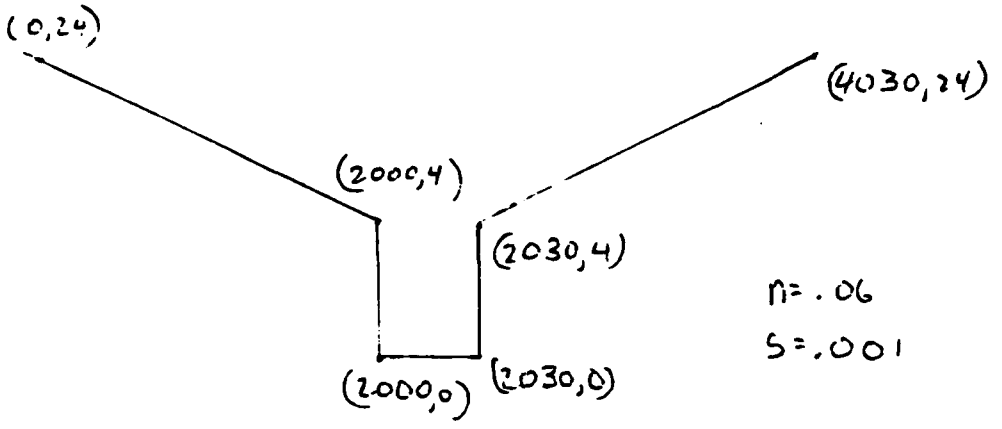
$$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{2648}\right) = 52{,}900\left(1 - \frac{STOR}{2648}\right)$$

Elevation (ft)	Area (above 10.3 ft) (ft^2)	Storage ($\frac{AREA \times 1600}{43{,}560}$) (ac ft)	Q_{p2} (cfs)
10.3	0	0	52,900
13.0	1952	72	51,500
14.0	2712	100	50,900
15.0	3492	128	50,300
16.0	4292	158	49,800



D-13

cross-section for this reach is based on field notes and information from a 1:24,000 U.S.G.S. Quad sheet.



NOT TO SCALE

P. 14 gives a Stage-Normal flow relationship for this reach.

The attenuation due to storage in this reach can be estimated by establishing the increase in channel area multiplied by the channel length of 1700' as an estimate of storage, and applying COE methodology (see p. 15) (The pre-failure stage in this reach for the flow of 15,680 cfs would be 12.4 ft. above the streambed.)

The attenuated peak dam failure flow is 43,800 cfs which represents a stage of 16.5ft above the streambed (an increase of 4.1 ft.). Near the end of this reach there are three houses and one trailer home. The trailer home and two of the houses are 10-15 ft. above the streambed. The dam failure flow would cause flooding to

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	30.0	32.0	0.9	28.7	22.6
2.00	2.0	60.0	34.0	1.8	87.6	68.8
3.00	3.0	90.0	36.0	2.5	165.8	130.2
4.00	4.0	120.0	38.0	3.2	258.4	202.9
5.00	5.0	250.0	238.0	1.1	258.3	202.9
6.00	6.0	580.0	438.0	1.3	699.5	549.3
7.00	7.0	1110.0	638.0	1.7	1605.9	1261.1
8.00	8.0	1840.0	838.0	2.2	3109.1	2441.6
9.00	9.0	2770.0	1038.0	2.7	5330.8	4186.3
10.00	10.0	3900.0	1238.1	3.2	8383.9	6583.9
11.00	11.0	5230.0	1438.1	3.6	12373.8	9717.1
12.00	12.0	6760.0	1638.1	4.1	17400.4	13664.5
13.00	13.0	8490.0	1838.1	4.6	23559.0	18500.8
14.00	14.0	10420.0	2038.1	5.1	30940.8	24297.8
15.00	15.0	12550.0	2238.1	5.6	39634.0	31124.6
16.00	16.0	14880.0	2438.1	6.1	49723.7	39048.0
17.00	17.0	17410.0	2638.1	6.6	61292.5	48132.9
18.00	18.0	20140.0	2838.1	7.1	74420.7	58442.5
19.00	19.0	23070.0	3038.1	7.6	89186.7	70038.2
20.00	20.0	26200.0	3238.2	8.1	105667.0	82980.2
21.00	21.0	29530.0	3438.2	8.6	123936.4	97327.1
22.00	22.0	33060.0	3638.2	9.1	144068.2	113136.6
23.00	23.0	36790.0	3838.2	9.6	166134.3	130465.1
24.00	24.0	40720.0	4038.2	10.1	190205.2	149367.9

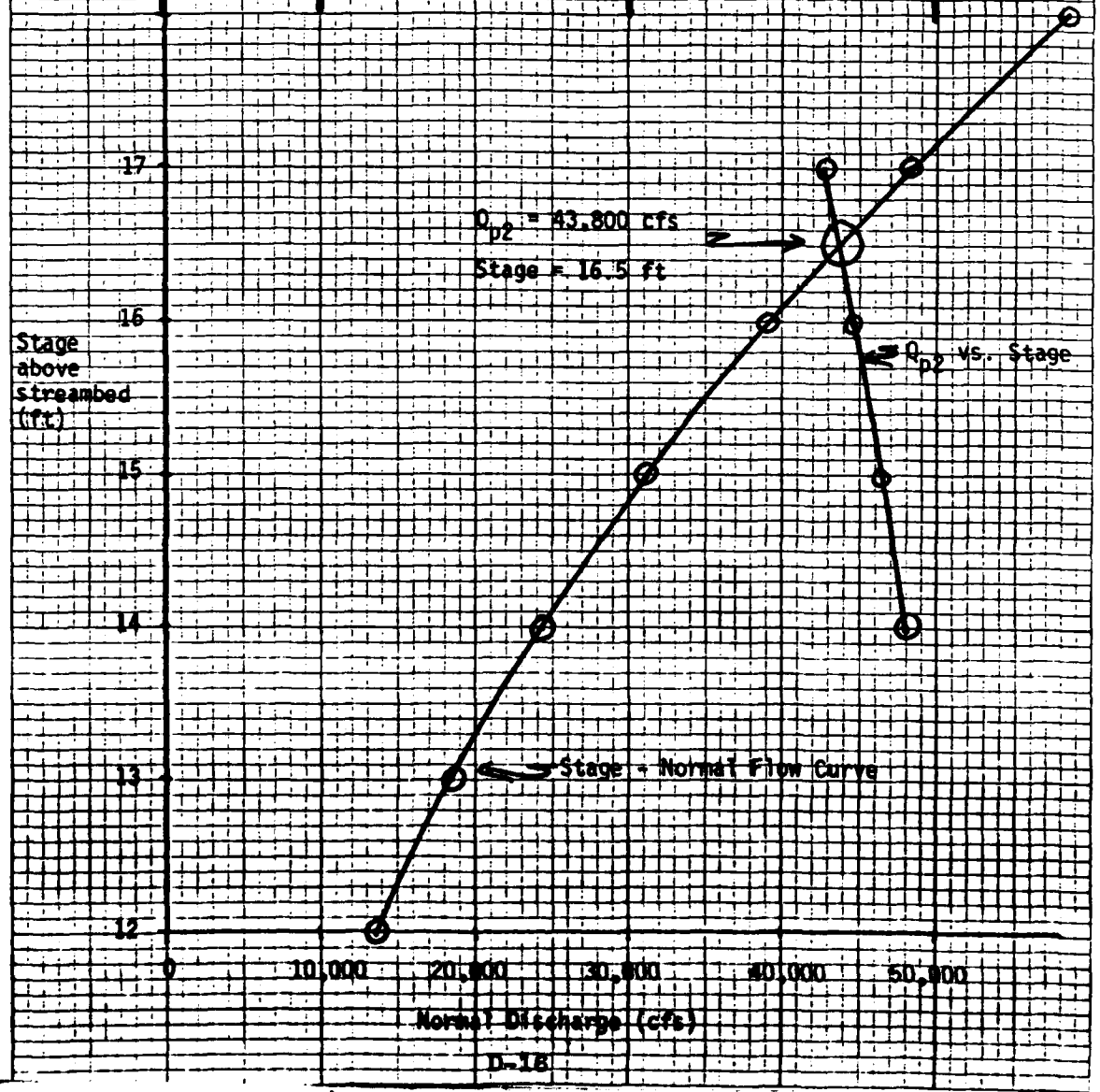
Reach from Ashby Rd. to Juncture of South and West Forks of Souhegan

Attenuated Failure Outflow at Confluence of West and South Forks

$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{2648}\right) = 50{,}200\left(1 - \frac{STOR}{2648}\right)$

TGG, 6/4/79, p. 15

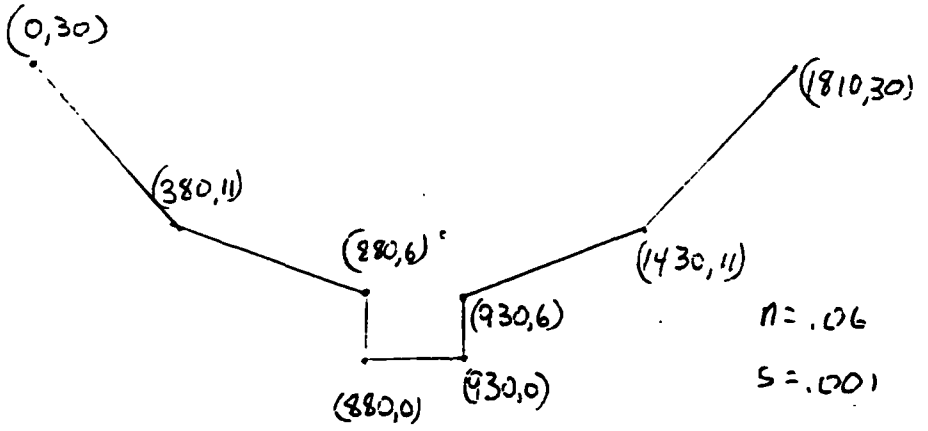
Elevation (ft)	Area (above 12.4 ft) (ft^2)	Storage $\left(\frac{AREA \times 1700}{43{,}560}\right)$ (ac ft)	Q_{p2} (cfs)
12.4	0	0	50,200
13	1038	40.5	49,400
14	2968	116	48,000
15	5098	199	46,400
16	7428	290	44,700
17	9958	389	42,800



these dwellings to increase from negligible to about five feet. Again, this would cause serious property damage and present a threat of loss of life. The 3rd house is probably above the dam failure flood level.

The next reach to be considered is the approximately 4000' long reach from the juncture of the South and West Forks to the upstreamend of Water Loom Pond.

The following typical cross-section for this reach is based on field notes and information from a one:24,000 U.S.G.S. quad sheet.



NOT TO SCALE

A Stage-Normal Flow relationship for this reach is given on p. 17. At the pre-failure flow of 15,800 c.f.s. the stage would be about 14 ft above the streambed.

The attenuation due to storage in this reach is established as in the previous reaches on p. 18. The attenuated peak flow at the upstreamend of Water Loom

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	50.0	52.0	1.0	48.7	38.3
2.00	2.0	100.0	54.0	1.9	150.8	118.4
3.00	3.0	150.0	56.0	2.7	289.4	227.3
4.00	4.0	200.0	58.0	3.4	456.7	358.6
5.00	5.0	250.0	60.0	4.2	647.6	508.6
6.00	6.0	300.0	62.0	4.8	858.7	674.3
7.00	7.0	450.0	262.0	1.7	645.5	506.9
8.00	8.0	800.0	462.0	1.7	1153.8	906.1
9.00	9.0	1350.0	662.0	2.0	2171.4	1705.2
10.00	10.0	2100.0	862.0	2.4	3803.1	2986.6
11.00	11.0	3050.0	1062.0	2.9	6164.4	4840.9
12.00	12.0	4120.0	1102.1	3.7	9928.2	7796.6
13.00	13.0	5230.0	1142.1	4.6	14429.2	11331.2
14.00	14.0	6380.0	1182.2	5.4	19640.4	15423.6
15.00	15.0	7570.0	1222.2	6.2	25545.7	20061.0
16.00	16.0	8800.0	1262.3	7.0	32134.9	25235.5
17.00	17.0	10070.0	1302.3	7.7	39402.8	30943.0
18.00	18.0	11380.0	1342.4	8.5	47346.9	37181.5
19.00	19.0	12730.0	1382.4	9.2	55967.5	43951.2
20.00	20.0	14120.0	1422.5	9.9	65266.2	51253.5
21.00	21.0	15550.0	1462.5	10.6	75246.4	59090.9
22.00	22.0	17020.0	1502.6	11.3	85912.3	67466.8
23.00	23.0	18530.0	1542.6	12.0	97268.9	76385.2
24.00	24.0	20080.0	1582.7	12.7	109322.2	85850.6
25.00	25.0	21670.0	1622.7	13.4	122078.5	95868.1
26.00	26.0	23300.0	1662.8	14.0	135544.6	106443.0
27.00	27.0	24970.0	1702.8	14.7	149727.7	117581.0
28.00	28.0	26680.0	1742.9	15.3	164635.4	129288.0
29.00	29.0	28430.0	1782.9	15.9	180275.3	141570.0
30.00	30.0	30220.0	1823.0	16.6	196655.6	154433.4

REACH FROM JUNCTURE OF SOUTH AND WEST FORKS TO H/W OF WATER LOOM POND

Attemuated Failure Outflow at Headwaters of Water Loom Pond TCG, 6/5/79, p. 18

$$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{2648}\right) = 43{,}800\left(1 - \frac{STOR}{2648}\right)$$

Elevation (ft)	Area (above 14.0 Ft) (ft^2)	Storage ($\frac{AREA \times 4000}{43{,}560}$) (ac ft)	Q_{p2} (cfs)
14	0	0	43,800
15	1190	109	42,000
16	2420	222	40,100
17	3690	339	38,200
18	5000	459	36,200
19	6350	583	34,200

Q_{p2} = 36,500 cfs

Stage = 17.9 ft

Stage vs. Q_{p2}

Stage vs. Normal Flow

Stage above streambed (ft)

18

17

16

15

14

13

0 10,000 20,000 30,000 40,000 50,000

Normal Discharge (cfs)

D-19

DIETZGEN CORPORATION MADE IN U.S.A.

NO. 340-10 DIETZGEN GRAPH PAPER 10 X 10 PER INCH

Pond would be 36,500 cfs, which would yield a stage of 17.9 ft. above the streambed. The only impacted dwelling in this reach is a house about 14 ft. above the streambed near the end of the reach. Dam failure would increase flooding at this house from negligible to 4 ft. Also, River Road runs parallel to the Souhegan in this area, and would be flooded.

The magnitude of inflow to Water Loom Pond before dam failure is such that Water Loom Pond Dam, which has a spillway capacity of about 2000 cfs, would be severely overtopped. Flows on the Souhegan downstream of the dam would be at dangerous levels. The failure of S.R.W. Dam #19 would increase these flows a great deal and present threats of serious flooding in the village of High Bridge (4 dwellings + a major road bridge on the river) and the town of Greenville (15-20 dwelling on the river). High Bridge is about 3 miles downstream of S.R.W. Dam #19, and Greenville is about 5 miles downstream of the dam. Below Greenville there is little development on the Souhegan for 10 miles or so, which would give the dam failure flood wave an opportunity to dissipate.

The chart on the following page summarizes the downstream impacts of dam failure down to Water Loom Pond.

183 Dam Safety Souhegan R. Dam # TC 6/5 Eq = 20

Reach	# Dwellings	Level above Stream bed (ft.)	Flow + Stage before failure	Flow + Stage after failure	comments
Dam to just d/s of Ashby Rd. (1600)	3	10-15	15,680 cfs → 10.3 ft	50,200 cfs @ Ashby Rd. → 15.2 ft.	Also gravel mine & Ashby Rd. crossing affected. Flooding goes from 0 to 3.5 ft. at houses
Ashby Rd. to juncture of W. & S. Forks of Souhegan (1700)	3	10-15	15,680 cfs → 12.4 ft	43,800 cfs @ confluence → 16.6 ft	Flooding goes from 0-2 to 4-6 ft at houses.
juncture W. & S. Forks to headwaters Water Loom Pond (4000)	1	14	15,680 cfs → 14.0 ft	36,500 cfs @ Pond → 17.9 ft.	flooding from 0 to 4 ft. at house. River Rd. flooded. Major flooding possible downstream of Water Loom Pond in High Pond & Greenville (see p. 19).

Test Flood Analysis

Size classification: Intermediate
Hazard classification: High

The hazard classification is high because of the potential for serious economic losses and loss of life in the 7 dwellings between the dam and Waterloom Pond, the village of High Bridge, and the town of Greenville.

Test Flood. PMF

Using the NED COE "Maximum Probable Flood Peak Flow Rates", the upstream drainage area of 11.4 sq. mi. with rolling terrain would yield a peak pmf inflow of 1600 csm. To account for storage in the numerous ponds & swamps upstream we will use .9(1600) = 1440 CSM.

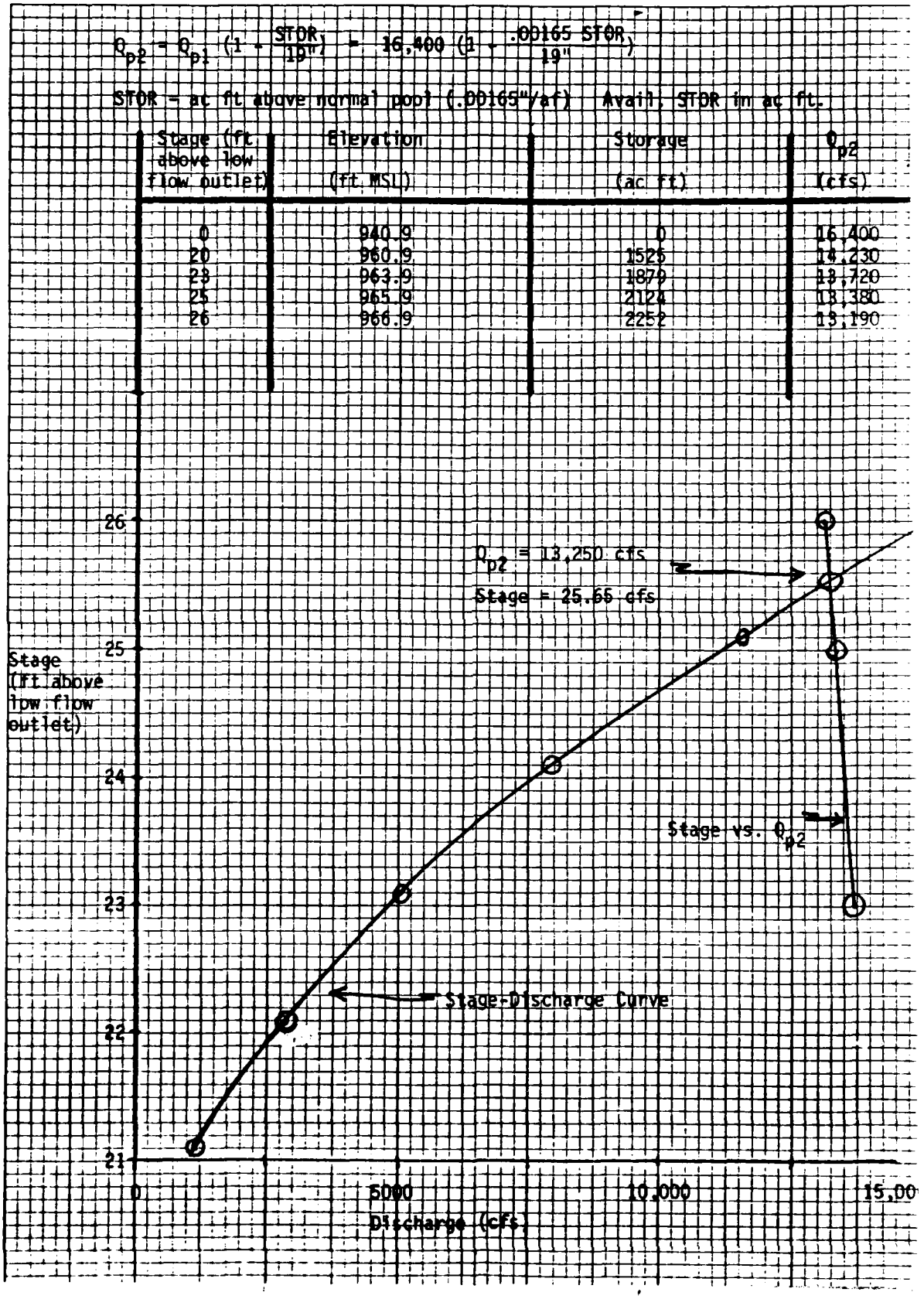
Peak inflow = 1440(11.4) = 16,400 cfs.

The peak inflow would be attenuated by storage to 13,250 cfs (see p. 22), which would yield a peak stage 25.65' above the crest of the low flow outlet at elevation 966.55 ft. MSL, .45 ft. below the dam crest.

$$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{19"}\right) = 16{,}400\left(1 - \frac{.00165\ STOR}{19"}\right)$$

STOR = ac ft above normal pool (.00165"/af) Avail. STOR in ac ft.

Stage (ft above low flow outlet)	Elevation (ft MSL)	Storage (ac ft)	Q_{p2} (cfs)
0	940.9	0	16,400
20	960.9	1525	14,230
23	963.9	1879	13,720
25	965.9	2124	13,380
26	966.9	2252	13,190



Drawdown time

On p. 25 of the original Hydraulic and Hydrologic Design notes for this dam, dated 3/2/62, the S.C.S. gives the drawdown time from the emergency spillway crest (elevation 961' MSL) to the normal pool (940.9' MSL) as 6.96 days.

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR. DIST.	(7) STATE	(8) COUNTY	(9) CONGR. DIST.	(10) NAME	(11) LATITUDE (NORTH)	(12) LONGITUDE (WEST)	(13) REPORT DATE DAY | MO | YR
NH	675	NED	NH	011	02				SOUHEGAN RIVER WATERSHED DAM NO 19	4243.4	7150.9	29JUN79

(14) POPULAR NAME	(15) NAME OF IMPOUNDMENT

(16) REGION	(17) BASIN	(18) RIVER OR STREAM	(19) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(20) DIST FROM DAM (MI.)	(21) POPULATION
01	05	SOUTH BRANCH SOUHEGAN RIVER	GREENVILLE	3	

(22) TYPE OF DAM	(23) YEAR COMPLETED	(24) PURPOSES	(25) STRUCTURAL HEIGHT (FT.)	(26) HYDRAULIC HEIGHT (FT.)	(27) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(28) NORMAL (ACRE-FT.)
PGRE	1962	C	41	36	2378	86

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	B	29JUN79

(29) REMARKS

(30) D/S HAS	(31) SPILLWAY CREST LENGTH	(32) SPILLWAY TYPE	(33) SPILLWAY WIDTH (FT.)	(34) MAXIMUM DISCHARGE (FT.)	(35) VOLUME OF DAM (CY)	(36) POWER CAPACITY INSTALLED (MW)	(37) POWER CAPACITY PROPOSED (MW)	(38) NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
A	720	U	360	15061	60400											

(39) OWNER	(40) ENGINEERING BY	(41) CONSTRUCTION BY
NH WATER RESOURCES BOARD	USDA SCS	

(42) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

(43) INSPECTION BY	(44) INSPECTION DATE DAY | MO | YR	(45) AUTHORITY FOR INSPECTION
GOLDBERG ZOINO DUNNICLIFF + ASSOC	01MAY79	PUBLIC LAW 92-367 8AUG1972

(46) REMARKS
32 33 AS MODIFIED BY PRESENT CONSTRUCTION 48 MOD BY BRIDGE CONS CO. AUGU


DAT
FILM