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SACO RIVER BASIN
EFFINGHAM, NEW HAMPSHIRE

HEAD WORKS DAM –
OSSIPEE LAKE
NH 00328

NHWRB 75.01A

BERRY BAY DAM –
OSSIPEE LAKE
NH 00329

NHWRB 75.01

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

NOVEMBER 1978

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DAMS, INSPECTION, DAM SAFETY,

Saco River Basin
Effingham, New Hampshire
Ossipee River

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

The dam is a 33 ft. long concrete gravity structure with a maximuj height of about 12 ft. It is intermediate in size with a low hazard potential. THe dams are in fair condition at the present time. Considerable operating and maintenance type repairs are required to preserve the long-term use and safety of the strucutres.

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REPLY TO
ATTENTION OF:

NEDED

JAN 23 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 Head Works Dam and Berry Bay Dam 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. In addition, a copy of the report has also been furnished the owner, Central Power Company, 8 Green Street, Augusta, Maine 04330.

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 yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

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As stated

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HEAD WORKS DAM
NH 00328

BERRY BAY DAM
NH 00329

SACO RIVER BASIN
EFFINGHAM, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	NH 00328 and NH 00329
NHWRB No.:	75.01A and 75.01
Name of Dam:	HEAD WORKS DAM AND BERRY BAY DAM
Town:	Effingham
County and State:	Carroll County, New Hampshire
Stream:	Ossipee River
Date of Inspection:	September 12, 1978

BRIEF ASSESSMENT

The Head Works and Berry Bay Dams are at the same location in the Ossipee River, but are separated by a small island. In essence, the dams act as a single hydraulic feature, with the Berry Bay Dam serving as the spillway and the Head Works Dam as the outlet works. For this reason, the dams are considered together.

The Head Works Dam is a 33 foot long, concrete gravity structure with a maximum height of approximately 12 feet. The structure contains five 4 foot wide by 6 foot high sluice gates operated from a gate house which spans across the entire dam.

The Berry Bay Dam is basically an 84 foot long, concrete gravity spillway with provisions for up to 2.5 feet of flashboards. The structure has a maximum height of approximately 5 feet. A steel service bridge provides access over the dam and permits the lowering and raising of swinging stanchions to support the flashboards.

Historical records indicate that the Head Works Dam was built in 1919. Since this dam could not function properly without some control on the other channel, it can be inferred that the Berry Bay Dam was originally constructed in the same year. This structure was, however, extensively altered in 1944. The Central Maine Power Company owns both dams and uses them to regulate flows for downstream hydroelectric power generation.

The dam's reservoir includes Ossipee Lake, Leavitt Bay, Berry Bay and Broad Bay and receives runoff from 357 square miles of gently to steeply sloping forest. The dams' maximum impoundment of 47,200 acre-feet places them in the INTERMEDIATE size category. The downstream topography and the lack of any appreciable development in the potential flood plain indicate a hazard potential classification of LOW.

Based on the size and hazard potential classifications and in accordance with the Corp's guidelines, an inflow Test Flood (TF) of 50,000 cfs is selected. This inflow yields a maximum outflow at the dams of over 32,000 cfs. Since the total discharge capacity of the dams prior to overtopping is only 2,270 cfs, or 7% of the Test Flood, it is apparent that the dams' discharge capacity is seriously inadequate for the Test Flood selected. In this case, the Head Works dam would be overtopped by as much as 11.3 feet. Therefore, considerable improvement in the discharge capacity of the dams or provision of suitable emergency spillway facilities is recommended.

Both dams are in FAIR condition at the present time. Considerable operating and maintenance type repairs are required to preserve the long-term use and safety of the structures. At the Berry Bay Dam these measures include repair of all damaged concrete, repair and monitoring of seepage areas, trimming or removal of overhanging trees and replacement of inadequate flashboards. At the Head Works Dam, the recommended remedial measures include repair of damaged concrete and rubble stone masonry, provision of a barrier to protect the gate house from ice and debris damage, removal of trees with eroded root structures in the downstream channel and trimming or removal of all other overhanging trees, monitoring of downstream channel erosion and training of municipal officials in dam operations.

The above recommendations and remedial measures should be implemented within one year of receipt of the Phase I Inspection Report by the owner. In light of the FAIR condition of both dams, periodic technical inspections should be conducted annually.

THE STATE OF NEW HAMPSHIRE
WILLIAM S. ZOINO
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REGISTERED PROFESSIONAL ENGINEER

COMMONWEALTH OF MASSACHUSETTS
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This Phase I Inspection Report on Head Works Dam and Berry Bay Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the <u>Recommended Guidelines for Safety Inspection of Dams</u>, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard F. Doherty

RICHARD F. DOHERTY, MEMBER
Water Control Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph A. McElroy

JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials 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.

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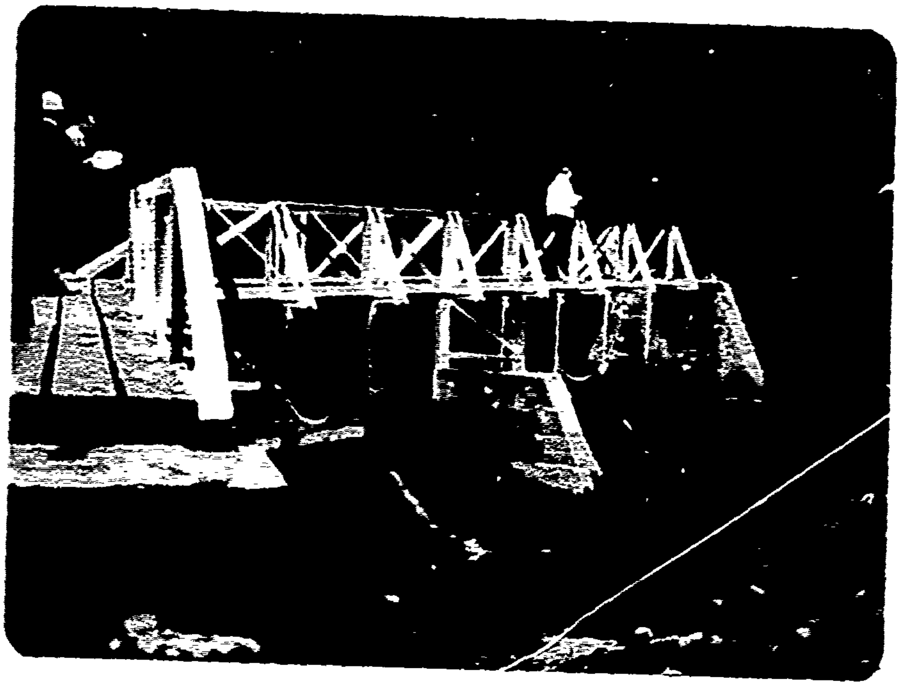
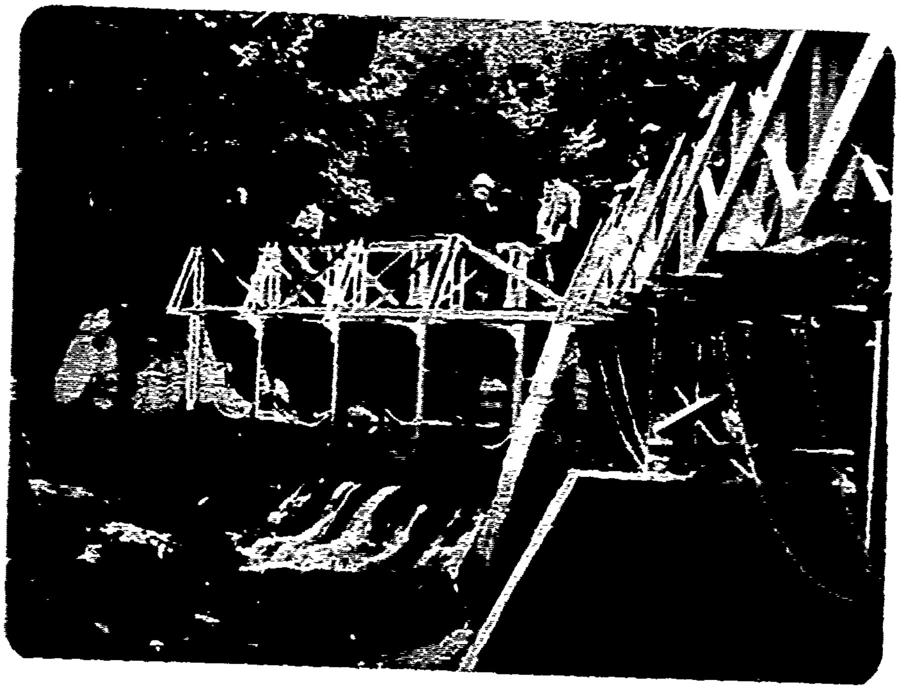
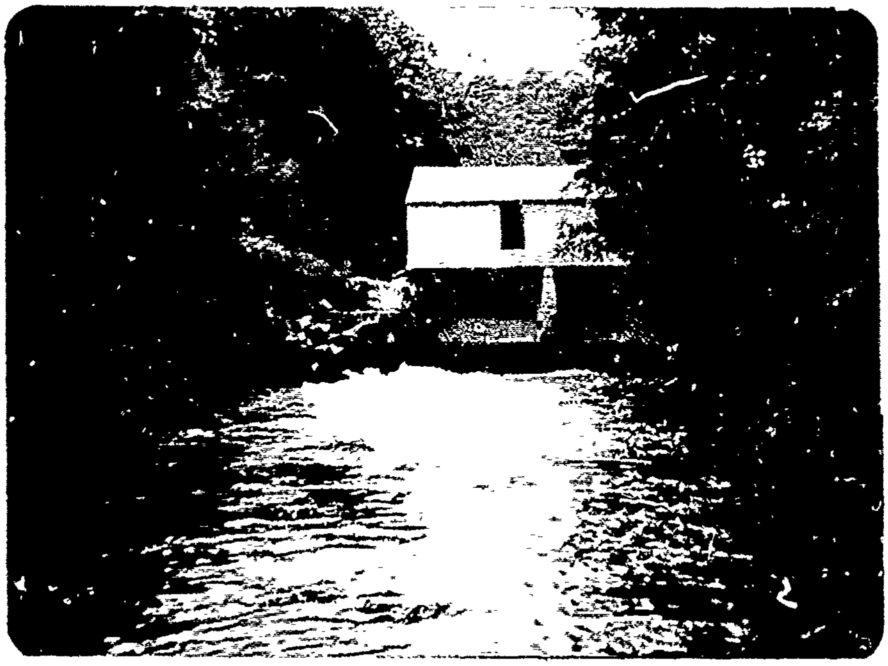


Berry Bay Dam - Overview from right abutment

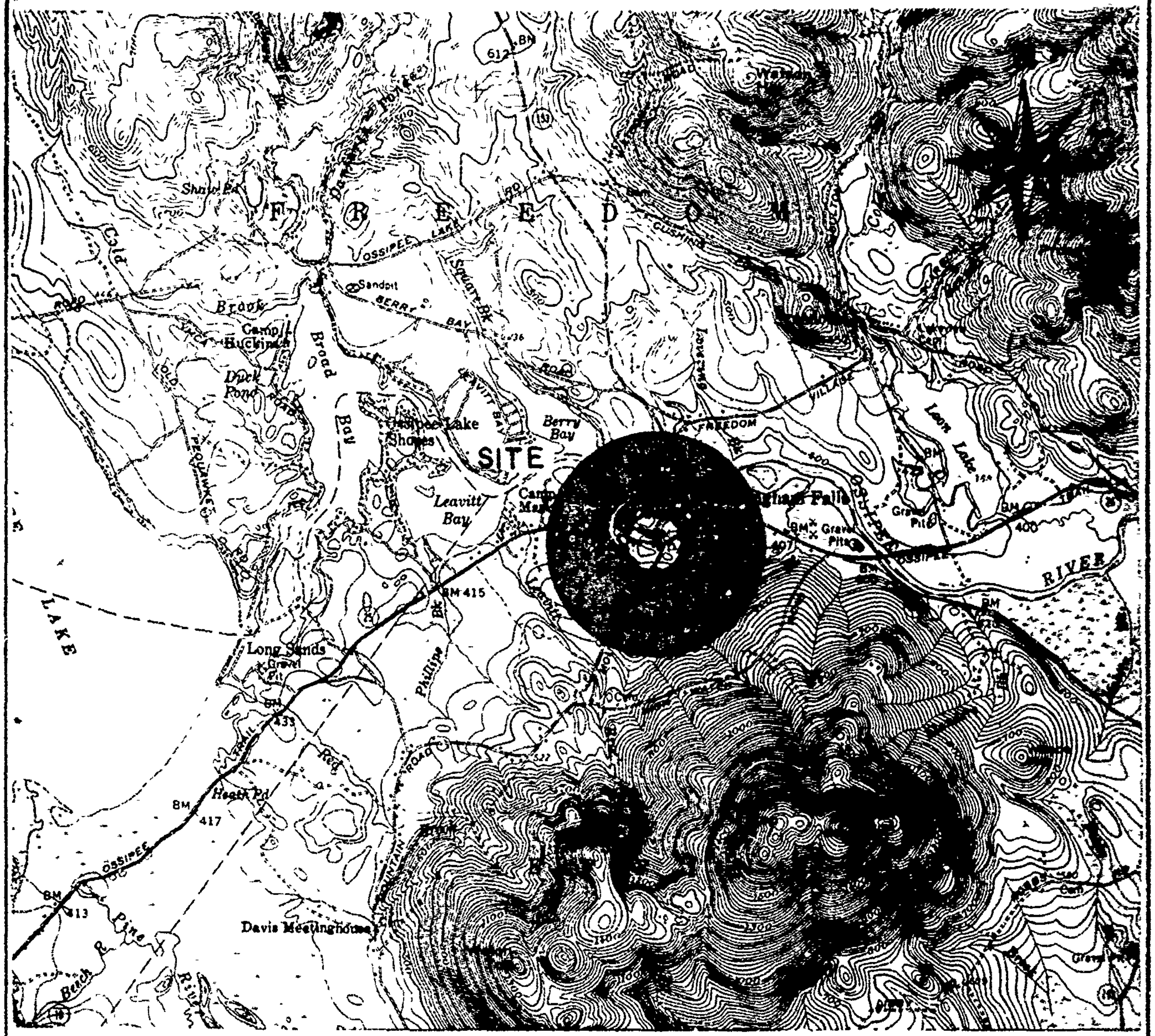


Berry Bay Dam - Overview from left abutment



Head Works Dam - Overview from downstream

Head Works Dam - Overview of left side of dam from upstream



– SCALE –

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FROM: USGS OSSIPEE LAKE, N.H. QUADRANGLE MAP

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

LOCUS PLAN

FILE No. 2067

HEAD WORKS DAM
BERRY BAY DAM

NEW HAMPSHIRE

SCALE AS NOTED

DATE SEPT 1978

PHASE I INSPECTION REPORT

HEAD WORKS DAM AND BERRY BAY DAM

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 was issued to GZD under a letter of August 22, 1978 from Colonel Ralph T. Garver, Corps of Engineers. Contract No. DACW33-78-C-0303 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.

1.2 Description of Project

(a) Location

The two dams which are the subjects of this report lie on the Ossipee River 0.45 miles west of the intersection of Routes 25 and 153 in Effingham Falls, N.H. The dams, which are approximately 100 yards north of Route 25, are accessible via a dirt road off the highway. The portion of the USGS Ossipee Lake, N.H. quadrangle presented previously shows this locus. Figure 1 of Appendix B presents a detail of the site developed from the map and site inspection.

(b) Description of Dam and Appurtenances

The engineering works creating Ossipee Lake and three smaller neighboring bays consist of two independent structures located at the same point in the river, but separated by a small island (Figure 1). The first of these structures, locally known as the Head Works Dam, is basically a 33 foot long, concrete gravity structure with concrete cutoff walls at both abutments (Figures 2 through 4). The top of the dam is approximately 12 feet above the stream bed. Five sluice gates, each approximately 4 feet by 6 feet, control the structure's discharge; three of the five gates are electrically operated. A gatehouse spans the entire dam.

The second structure, locally known as the Berry Bay Dam, is approximately 100 feet north of the first one, across a rocky outcrop in the river bed. This dam is primarily a concrete gravity spillway with a maximum height of 5 feet above the stream bed (page B-6). A service bridge spans the structure across 4 piers and permits the installation and removal of swinging stanchions which can support up to 2.5 feet of flashboards (page B-7). The stanchions, which remain raised during drawdown periods, are hinged at the service bridge and rotate down into locking shoes set in the concrete spillway (page B-7). The weir has a total length of 96 feet, including 11.5 feet of emergency spillway at the left abutment.

Because these two structures act essentially as one dam, with the Berry Bay Dam being the spillway and the Head Works Dam being the outlet works, they are discussed in one report.

(c) Size Classification

The two structures' maximum impoundment is approximately 47,200 acre-feet, which falls within the 1000 acre-feet to 50,000 acre-feet range defining the INTERMEDIATE size category.

(d) Hazard Potential Classification

The downstream reaches of these structures consist of 1000 feet of two relatively steep, narrow channels which abruptly widen at the confluence of the channels (Fig. 1). These features would tend to contain and then attenuate any flood wave. For this reason and since there is very little development downstream of the dams for at least 3 miles, a hazard potential classification of LOW is assigned.

(e) Ownership

The Central Power Company (MCPC), 9 Green Street, Augusta, Maine 04330, owns both structures.

(f) Operator

The office of Mr. Edward Cowles, Chief Load Dispatcher, directs the operation of the facility; its phone number is (207) 623-3521 ext. 401. The Portland Maine sub-office at telephone number (207) 772-7411 ext. 231 carries out the actual operations.

(g) Purpose of Dams

The structures serve to store water for hydroelectric power production at downstream generating stations. Between June 1 and October 12 of each year, the New Hampshire Water Resources Board (NHWRB) requires the company to maintain a lake level adequate to satisfy recreational interests; by agreement between CMPC and the NHWRB, this level is established at El. 405. In general, however, CMPC maintains the lake at El. 407 during the recreational season.

(h) Design and Construction History

An inscription on the upstream side of the Head Works Dam indicates that construction occurred in 1919. Neither the original designer nor contractor are known and no plans or documents pertaining to the original construction are available.

While available records do not contain an initial construction date for the Berry Bay Dam, the fact that the Head Works Dam would not function properly without some control on the other channel (Figure 1) indicates that original construction was probably also in 1919. Extensive modifications did, however, take place around 1944, to include construction of the service bridge, installation of the hinged stanchions and provisions for additional flashboards (pages B-6 and B-7).

(i) Normal Operational Procedures

Personnel from the Portland office visit the site weekly and report gage levels back to the Chief Load Dispatcher in Augusta. He, in turn, directs the necessary operations. The company uses only the gated Head Works Dam to control discharges. The flashboards of the Berry Bay Dam remain in place from early spring to fall at which time the company draws the lake and bays down in anticipation of fall storms and spring runoff.

1.3 Pertinent Data

(a) Drainage Area

Ossipee Lake, Broad Bay, Leavitt Bay and Berry Bay receive runoff from a 357 square mile drainage area. At least 10 small brooks and rivers carry runoff to the reservoir. The area around the reservoir is heavily forested and flat to gently sloping within 1 to 2 miles of the shoreline; beyond this point, the terrain rises sharply, most notably to the south and southwest. There is considerable development, both seasonal and year-round, along the reservoir shores, particularly on Ossipee Lake, Broad Bay and Leavitt Bay.

(b) Discharge at Dam Site

(1) Outlet Works (Head Works Dam)

The dams' outlet works consist of the five timber sluice gates, each approximately 4 feet wide by 6 feet high. The inverts of the gates are at El. 397 $\pm$.

(2) Maximum Known Flood at Damsite

The Central Maine Power Company has gage readings at the dam site dating back to the mid-1940's. These records reveal a maximum reading of 413.0, or 5 feet over the Head Works Dam, on April 1, 1953. The next highest reading occurred on April 3, 1945 when the level reached 411.8. Assuming all gates were open and all flashboards were removed at the time of the 413.0 reading, as would normally be the case, a computed flow of 10,790 cfs at the site results.

(3) Spillway capacity at maximum pool: 1320 cfs at El. 408.

(4) Gate capacity at normal pool: 1315 cfs at El. 407

(5) Gate capacity at maximum pool: 1400 cfs at El. 408.

(6) Total discharge capacity at maximum pool: 2720 cfs at El. 408.

(c) Elevation (ft. above MSL)

(1) Top dam (Head Works): 408 ±

(2) Recreational pool: 407 ±

(3) Spillway crest (Berry Bay)
-without flashboards: 405
-flashboards in place: 407.5

(4) Streambed at centerline of dam
Head Works: 396 ±
Berry Bay: 400 ±

(5) Maximum tailwater: Unknown

(d) Reservoir

(1) Length of recreational pool

-Lake: 3 miles
-Broad Bay: 1 mile
-Leavitt Bay: 0.6 miles
-Berry Bay: 1.4 miles (including unnamed body of water immediately behind the dam)

(2) Reservoir Area

-Ossipee Lake: 3200 acres
-Broad Bay: 385 acres
-Le itt Bay: 255 acres
-B y Bay: 255 acres (including unnamed body of water immediately behind the dam)

(3) Storage

-Recreational pool: 23,000 acre-feet
-Top of Dam: 47,200 acre-feet

(e) Dam (Head Works)

(1) Type: Gravity concrete

(2) Length: 33 ft.

(3) Height: 12 ft. $\pm$ structural
11 ft. $\pm$ hydraulic

(4) Top width: 2 ft. 8 in.

(5) Side slopes

-D/S (exposed): 1:1.2
-D/S (submerged): Vertical
-U/S Vertical

(6) Cutoff and grout curtain: No information

(f) Spillway (Berry Bay Dam)

(1) Type: Concrete weir with 2.5 ft. of flashboards

(2) Length of weir: 84 ft. plus 11.5 feet of emergency spillway

(3) Upstream channel: Shallow approach channel

(4) Downstream channel: Narrow channel with moderately steep sides and rocky bottom

(g) Regulating Outlets

Five gated openings, each approximately 4 feet wide by 5 feet high, control discharges at the Head Works Dam. The inverts of the gates are at elevation 397 $\pm$. An electric motor operates the three rightmost gates, while ratchet mechanisms permit control of the remaining two. The gates equipped with the electrical operating mechanism can also be operated manually.

SECTION 2 - ENGINEERING DATA

2.1 Design Records

The design of both structures is straightforward and incorporates no unusual features. No design calculations or design drawings of any type are available for either structure.

2.2 Construction Records

Original construction plans are available for neither structure. Plans for the 1944 alterations to the Berry Bay Dam are available and are quite detailed. Additionally, these drawings do provide some data on the original structure. No as-built drawings or construction logs were located.

2.3 Operational Records

The operation of these dams is in accordance with their intended purpose and engineering features. The CMPC maintains satisfactory records of all dam operations.

2.4 Evaluation

(a) Availability

The lack of any drawings for the Head Works Dam and the existence of only the alteration plans for the Berry Bay Dam warrant a marginal evaluation for availability.

(b) Adequacy

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam could not be assessed from the standpoint of reviewing design and construction data. The evaluation is thus based primarily on the visual inspection, past performance history and sound engineering judgement.

(c) Validity

Since the visual inspection generally confirms the sparse written data available, these sources warrant a satisfactory evaluation for validity.

SECTION 3 - VISUAL OBSERVATIONS

3.1 Findings

(a) General

Both the Head Works and Berry Bay Dams are in FAIR condition at the present time. Both structures require extensive operations and maintenance type repairs to insure their long-term safety and use.

(b) Additional Description

(1) Head Works Dam

This dam, which is the only controlled discharge for the reservoir, contains five splined timber sluice gates operated from a gate house spanning across the entire 33 foot long structure. The gate house sits on the approach and outlet training walls at each end of the dam and on two concrete piers at midspan. Additionally, a timber bent and an isolated timber column provide supplementary support between the gate house and the top of the dam.

Concrete cutoff walls extend into the banks perpendicular to the concrete and rubble stone masonry abutment walls. The front faces of the cutoff walls are approximately two feet downstream of the upstream face of the dam.

While the dam contains only five gates, concrete buttresses form six openings, three on the left side and two on the right side. The third opening from the right side has no gate and can pass no flow. The inverts of the openings are 11 feet below the top of the dam. There are three concrete buttresses, each 1.5 feet thick, on the upstream face of the dam. These elements are monolithic with the face of the dam and with the slab forming the top of the sluice gate outlets. The center buttress carries the two piers which support the center portion of the gate house.

The dam superstructure is constructed of cyclopean concrete masonry. The upstream training walls consist of cemented stone masonry, while the downstream walls are primarily dry stone masonry.

Electrically or manually operated rack gears permit opening and closing of the five gates. A four pulley reduction system connected to a belt driven worm gear meshed with a bull gear which drives a shaft provides the power for turning the rack gears on the three electrically operated gates. Clutches permit individual control of each gate. The electrical drive system consists of a one horsepower G.E. repulsion-induction motor drawing 5 amps at 220 volts or 10 amps at 110 volts.

The remaining two gates are raised and lowered using a six foot long, 2 inch by 2 inch bar which turns a ratchet connected by a shaft to their respective bull gears.

The owner's representative indicated that the gates receive regular inspections owing to the high incidence of vandalism of this dam.

(2) Berry Bay Dam

This dam consists of 3 spillway bays equipped with flash boards and an emergency spillway. The 1944 reconstruction drawings indicate that the concrete spillway is a broad crested weir, but visual inspections reveal that the structure is actually an ogee spillway. The combined length of the primary spillways is 84 feet and the emergency spillway is 11.5 feet in length. The crest of the emergency spillway is 3.08 feet above the primary spillways, which in turn are 3 feet below the top of the Head Works Dam. A steel truss service bridge spans over the three primary spillways. The spillways are divided by means of abutments and intermediate piers.

The right abutment, which is approximately 3 feet thick, is constructed on a rock outcrop. The right intermediate pier, which also serves as a transition for horizontal rotation of the dam axis by approximately 45°, varies in thickness from approximately 5 feet at its upstream face to 2 feet at its downstream face. The left pier is 2 feet thick, while the left abutment is 2.5 feet thick. All concrete, including the spillways, is of the cyclopean variety.

It should be noted that the left abutment was modified during the 1944 construction in order to permit construction of the emergency spillway from the left face of this abutment to the adjacent bank. The foundation conditions beneath the intermediate piers, the left abutment and the spillways are unknown.

The service bridge, including the floor framing, is fabricated from steel angle sections. The bent at the left intermediate pier is fabricated from steel column sections braced with steel angles. Steel bearing plates, which are welded to the pier bent columns, are bolted to this pier. The steel truss is anchored directly to the top surface of both abutments and the right pier. The walkway consists of 2 inch timber planking.

Flashboards are held in place by means of swinging "drop" stanchions. These movable stanchions are pinned to the lower chord of the upstream truss. A hinge pin which penetrates through a slotted hole in the stanchion assembly permits rotation about the lower chord members. The stanchions are lowered from beneath the service bridge by permanently installed chains and lock into slots set in the top of the spillway. There are four stanchions on the right spillway and three on each of the other two sections. Flashboards 15 inches in height have been fabricated from 2 inch by 8 inch lumber; the design height of flash boards is 2.5 feet.

(c) <u>Condition of Berry Bay Dam</u>

(1) <u>Abutments and Piers</u> (Photo 1)

The right abutment has been subject to erosion and spalling and contains a hole discharging considerable seepage. The surface spalls, with adjacent random cracking and minor efflourescence, are located adjacent to and above the ogee section. The construction joint between the abutment and the spillway exhibits minor erosion. A scour hole approximately 9 inches deep is located adjacent to the spillway crest, while a similar 20 inch deep hole is located adjacent to the base of the spillway. Both holes are outlets for considerable seepage.

Inspection of the right pier revealed that a horizontal construction joint on both the upstream and downstream faces is eroded approximately 2 inches deep. This construction joint is located approximately 3 feet below the top of the pier. Inspection of the left pier revealed that the base of the downstream end and adjacent sides of this pier is eroded immediately above its footing. Minor joint erosion was also observed at the joint between the spillway and this pier. The right abutment reveals similar erosion and an open joint between its wall and the ogee spillway. The top surfaces of the exposed pier and abutment footings suffer from minor surface erosion. Minor hairline cracks exist over random areas of the piers and abutments.

(2) Spillway (Photo 2)

The surfaces of the three primary spillways suffer from severe erosion which has resulted in exposure of cyclopean aggregate. Erosion has penetrated up to 2 inches beyond the original surface and was observed over 50 percent of the spillway surface.

(3) Service Bridge

The structural components of this structure are in good condition. While the stanchions which support the flashboards could not be inspected for east of operation, it is apparent that they can be readily relocated from a horizontal to a vertical position. Observations of the hinged connection reveal that they are well lubricated. The timber floor decking on the structure is in good condition. Representatives of the owner indicated that maintenance of the service bridge is a problem due to vandalism.

(4) Flashboards

The structural steel stanchions were fabricated to receive flashboards up to 4 inches in nominal thickness. The present flashboards are 2 inches nominal. The bottom section of the flashboards, which consist of two stacked 2 inch by 8 inch boards forming a flashboard 15 inches deep, have deflected due to a 30 inch hydrostatic head.

(4) Cut-off Walls

The exposed surfaces of these walls are in good condition.

(5) Sluice Gates

The operation of the three electrically driven sluice gates indicates that the motor drive, belt and gear system function properly when either opening or closing the gates. Manual operation of these three gates was not attempted by the Owner's representatives due to the strenuous labor effort required. The operation of the two manually operated gates, though cumbersome, was satisfactory.

The owner's representative indicated that the right three gates were replaced recently while the left two gates are approximately two years old.

(6) Gate House

This structure has been subjected to extensive vandalism. All vision glass has been removed and replaced with plywood, while doors on either end of the structure are reinforced. A timber bent and an isolated timber column were erected on the right quarter point of the spillway in order to preclude excessive deflection of the structure due the heavy loads induced by mechanical equipment required for the gate operation. Furthermore, the upstream face of the gate house between elevations 412 ± and 414 ±, has been subjected to damage from debris and ice during high water conditions. The bases of the bent and the isolated column are suitably anchored to resist lateral loading. The deficiencies noted above are primarily cosmetic in nature and do not require attention.

(e) Reservoir

An inspection of the reservoir shore revealed no evidence of movement or other instability. No sedimentation was evident behind the spillway, although some was noted in the narrow channels connecting the several ponds which make up the reservoir. A check of the surrounding area revealed no work in progress or recently completed which might increase the flow of sediment into the lake.

Additionally, there were no obvious changes to the surrounding watershed which might adversely affect the runoff characteristics of the basin.

There is considerable development, both seasonal and permanent, all around the reservoir. Much of the development is subject to flooding with even relatively small rises in the level of the lake and ponds.

(f) Downstream Channel (Photo 4)

There are no downstream conditions which adversely affect the operation of the dam or which pose a hazard to the safety of the structure. Of some concern, however, is the large number of trees which overhang the channels, particularly below the Head Works Dam. Along this reach, water discharged from the dam has eroded the root structures of many of the trees in the area, causing them to lean over the channel from both sides. These trees could fall in a severe flood and create a serious downstream restriction to flow.

3.2 Evaluation

Because the design of these dams is relatively simple and because most major components are readily accessible for inspection, the visual inspection is considered satisfactory to assign the FAIR condition rating.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

An operator from the CMPC Portland sub-office visits the dams weekly, usually on Friday, and reports the gauge reading back to the office of the Chief Load Dispatcher in Augusta. He, in turn, directs any changes in the dam's discharge. The operators control all discharges by means of the gated outlets. One gate remains half open at all times to insure a continuous downstream flow.

The company installs the flashboards on the Berry Bay Dam in early spring and they then remain in place until fall. At that time, Central Maine removes the flashboards and the reservoir drains in anticipation of the fall storms and spring runoff.

By agreement with the NHWRB, the company maintains the water level at a minimum elevation of 405 feet from 1 June to 12 October of each year to satisfy recreational interests. While El. 405 is the mandated level, CMPC generally keeps the reservoir at El. 407 during the summer.

4.2 Maintenance of Dam

During their weekly visits, the operators report any deficiencies noted back to the company's engineering department. Additionally, the Maintenance Engineer from the Hydroelectic Section of the Production Department inspects each dam at least yearly and arranges for any required maintenance.

4.3 Maintenance of Operating Facilities

The procedures discussed in section 4.2 also apply to the Head Works Dam's operating mechanisms.

4.4 Description of Any Warning System in Effect

No formal warning system exists for these facilities.

4.5 Evaluation

The Central Maine Power Company operates and maintains both structures in a generally satisfactory manner. Additional emphasis on routine maintenance is, however, indicated. In light of the LOW hazard potential rating, the lack of a formal warning system is not significant.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

(a) Design Data

Design data for neither dam is available. Basic information concerning the structures was obtained from prior inventories and inspection reports on file with the New Hampshire Water Resources Board (NHWRB). Included in these documents are reports by the New Hampshire Water Control Commission, prepared in 1936, entitled "Data on Dams in New Hampshire" and "Data on Reservoirs and Ponds in New Hampshire." Also available are a 1936 NHWRB inventory for the Head Works Dam, a 1930's Corps of Engineer report on Ossipee Lake, a 1952 CMPC discharge curve for the Head Works Dam, 1973 inspection reports by the NHWRB on both dams, and plans of the 1944 alterations to the Berry Bay Dam.

(b) Experience Data

Basic historical data concerning the hydraulic/hydrologic aspects of the dams are contained in subparagraph 1.3 (b). Additionally, following the severe flood in 1953, the CMPC carried out a study of lake levels during another less severe storm in May, 1954. The purpose of this study was to establish water levels back through the series of ponds and into Ossipee Lake relative to the level at the dams. The results of this survey indicated water levels about 2.1 feet higher in the main lake than at the dams. It was further noted that it is very common to have water levels during the spring runoff period cause flow over the top of the Head Works Dam (about elevation 408.0 feet) with flashboards removed at Berry Bay, as is standard practice at that time of year.

(c) Visual Observations

The Head Works Dam and the Berry Bay Dam are concrete gravity structures on the Ossipee River just upstream of Effingham Falls, New Hampshire. The dams create a series of ponds separated by narrow channels: Berry Bay, Broad Bay, Leavitt Bay, and Ossipee Lake. There is extensive development on the shores of these ponds. The CMPC own the dams and uses them to regulate flows for the generation of hydroelectric power at downstream locations.

The Head Works Dam is a concrete structure located on a narrow channel. It is used to control the discharges from the lake and the series of ponds through 5 sluice gates. A staff gauge on the approach channel to the dam is graduated at one tenth foot intervals to indicate water levels above the dam relative to mean sea level. Corresponding dam elevations are 408.0 feet at the dam crest and 397.0 feet at the sluice gate inverts. A gate house rests on piers at a height of about 3.3 feet above the dam's crest.

Berry Bay Dam serves as the spillway for the combined structure. It consists of an 84 foot long concrete weir with a smaller 11.5 foot weir to one side providing additional discharge capacity. The main weir is at 405 feet MSL, 3 feet below the crest of the Head Works Dam, with the small weir 3.08 feet higher. Flashboards are often maintained to a height of approximately 2 feet above the main weir throughout the summer months to maintain the lake at desirable levels, while still allowing regulation of discharge through the gates of the Head Works Dam. The Berry Bay Dam has no control features other than flashboards.

The two dams are separated by a low island approximately 100 feet wide. Their discharge channels rejoin about 1000 feet downstream after a drop of some 3 feet. The downstream channel then flattens and widens considerably. There are few low-lying structures in the floodplain immediately downstream of the dams.

(d) Overtopping Potential

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 dam discharge and storage characteristics to evaluate the impact of an appropriately sized Test Flood. None of the original hydraulic and hydrologic design records are available for use in this work.

Guidelines which determine a recommended Test Flood based on the size and hazard potential classifications of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers (COE). As shown in Table 3 of that document, the appropriate Test Flood for a dam classified as INTERMEDIATE in size with a LOW hazard potential would be between the 100-year flood and one-half of the Probable Maximum Flood (PMF).

The magnitude of the 100-year peak inflow of the lake is estimated using a regression equation provided by Dennis LeBlanc in USGS Water Resource Investigation 78-47, "Progress Report on Hydrologic Investigations of Small Drainage Areas in New Hampshire." This equation, which uses drainage area, mainstem slope, and average 2 year, 24 hour peak rainfall to estimate peak inflow for a given recurrence interval, yields 10,600 cfs as the 100-year peak inflow.

The PMF is estimated using the chart of "Probable Maximum Peak Flows" obtained from the COE New England Division. The drainage area contributing to Ossipee Lake is considered to have topography between "rolling" and "flat," but closer to rolling. For a drainage area of 357 square miles, the chart gives a PMF of 600 cfs/square mile for "rolling" topography. Using 500 cfs/square mile, the PMF for Ossipee Lake is 178,500 cfs and the one-half PMF is 89,250 cfs.

The "Recommended Guidelines" suggest that if a range of values is indicated for the Test Flood, the magnitude most closely related to the involved risk should be selected. Since the risk is in the middle of the LOW category, a Test Flood of 50,000 cfs is used as inflow to Ossipee Lake.

Application of the procedure sugges ·d by the COE New England Division for "Estimating the Ei.ect of Surcharge Storage on Maximum Probable Discharges" results in a final attenuated Test Flood of 32,450 cfs. Thus, the lake has a significant damping effect on the magnitude of the peak flow.

The Storage-Stage Curve used for these calculations is developed assuming that the surcharge storage available in a given part of the lake is equal to the surface area of that part of the lake times the depth of surcharge. No spreading or increase of area with depth is considered. The difference in water surface elevation (and, thus, in the depth of surcharge) between the dam and the various parts of the lake is determined from the 1954 measurements of water surface elevation during flood flows.

The Stage-Discharge curve results from summing the discharges through the gates (which are treated as orifices), over the spillway (Berry Pond Dam), over the dam crest (Head Works Dam), over the island between the dams, and over the banks beside the dams. The calculations assume that all gates are open and that no flashboards remain on the spillway.

The peak Test Flood discharge of 32,450 cfs would result in a maximum stage at the dam of 14.3 feet above the Berry Bay Spillway crest, or elevation 419.3 feet. This level of overtopping implies estimated elevations of 420.3 feet on Berry Bay, 420.4 feet on Leavitt Bay, 420.6 feet on Broad Bay, and 421.4 feet on Ossipee Lake. Surface elevations of this magnitude would obviously result in serious flooding in the developed areas around the ponds and lake. Due to the slow rate of rise which could be anticipated, however, it is unlikely that loss of life would result, although extensive property damage could be expected.

5.2 Hydrologic/Hydraulic Evaluation

The results of the hydrologic and hydraulic calculations indicate that the outlet capacity of the dams in question is insufficient to pass the applicable Test Flood resulting from the relatively large, contributing drainage area of 357 square miles. Potential depths of overtopping of the earthen embankments under these conditions would be about 9 feet at the Head Works and about 10 feet at Berry Bay.

It seems likely that the Head Works Dam was designed to pass flow through its gates, but not over its crest at elevation 408 feet. This being the case and assuming the same stage at the Berry Bay spillway, the resulting flow capacity would be about 2700 cfs. It is significant to note, however, that the dam apparently handled the 1953 flood (estimated flow of 9,500 cfs and stage of about 412.3 feet) without appreciable structural damage.

5.3 Downstream Dam Failure Hazard Estimates

The flood hazards in downstream areas resulting from a failure of one of these dams are estimated using the procedure suggested by the COE New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." This procedure accounts for the attenuation of dam failure hydrographs in computing flows and flooding depths for downstream reaches.

It is assumed that the dams are not likely to fail simultaneously. Therefore, the peak failure outflow from both dams is computed and routed to the point at which the streams reunite some 1000 feet below the dams. The larger flow of 2730 cfs from the failure of Head Works Dam, being the critical case, is then routed downstream.

For the purpose of these calculations, failure is assumed with upstream water levels just overtopping the abutments. The peak outflow from the Head Works impoundment is routed down a 1000 foot channel to the main stem of the Ossipee River. The 2nd reach (2250 feet long) extends along the Ossippee to the Route 153 bridge over the river. The 3rd reach is 3400 foot long and extends to a widening in the Ossipee past Effingham Falls. Beyond this point the river and floodplain both widen considerably and would therefore attenuate the flood wave quickly. Furthermore, there is no further development within this floodway to be affected.

None of the reaches defined above offers sufficient storage capacity to attenuate the peak failure flow, which would therefore remain at 2730 cfs through the region of interest. The resulting computed flood depths of about 8 feet in Reach 1, 5 feet in Reach 2, and 3.5 feet in Reach 3 do not appear to present a significant flooding threat anywhere within this region.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

(a) Visual Observations

The field investigation revealed no significant displacements or distress which warrant the preparation of structural stability calculations based on assumed sectional properties and engineering factors.

(b) Design and Construction Data

No plans or calculations of value to a stability assessment are available for the Head Works Dam. While no calculations exist for the Berry Bay Dam, the modification drawings would be useful were a stability analysis necessary.

(c) Operating Records

The Central Maine Power Company maintains excellent records since the mid-1940's. These records, supplemented by the company's and the state's inspections, reveal no evidence of instability despite at least two significant overtoppings of both structures.

(d) Post Construction Changes

The only alterations to either structure occurred to the Berry Bay Dam around 1944 and involved provisions for additional flashboards. Due to the size and nature of this structure, it is unlikely that the modifications significantly influenced its stability.

(e) Seismic Stability

These dams are located in Seismic Zone No. 2 and, in accordance with recommended Phase I guidelines, do not warrant seismic analyses.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The Head Works and Berry Bay Dams are in FAIR condition at the present time.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of these dams cannot be assessed from the standpoint of reviewing design and construction data. The assessment is thus based primarily on the visual inspection, past performance history and sound engineering judgement.

(c) Urgency

The recommendations and improvements contained herein should be implemented by the owner within one year of receipt of the Phase I Inspection Report.

(d) Need for Additional Investigations

Since the dams are significantly deficient in terms of discharge capacity, an investigation into alternatives for increasing capacity at the dams or for providing suitable emergency spillway facilities is indicated.

7.2 Recommendations

It is recommended that a competent engineer be retained to develop suitable alternatives for increasing the dams' discharge capacity or for developing suitable emergency spillway facilities.

Additionally, periodic technical inspections of the structures should be accomplished every year.

7.3 Remedial Measures

(a) Berry Bay Dam

This dam requires considerable operating and maintenance type repairs to insure its long term use and safety. Included in these repairs are:

(1) Repair of the eroded concrete on the spillway.

(2) Repair of the seepage points near the right abutment and monitoring of this area for future seepage problems.

(3) Repair of cracked, spalled and eroded concrete on the abutments and piers.

(4) Trimming or removal of trees overhanging the left side of the dam upstream and overhanging the entire immediate downstream channel.

(5) Replacement of 2 inch thick flashboards with 4 inch thick material.

(6) Provision of some type of safety device to limit the height to which flashboards can be placed. The primary concern in this area is that it not be possible to inadvertently place sufficient flash boards to create horizontal thrusts capable of deflecting or toppling the service bridge.

(b) <u>Head Works Dam</u>

This dam also requires considerable operating and maintenance type repairs for continued serviceability and safety. Included in these measures are:

(1) Repair of all cracked, spalled and eroded concrete, particularly on the end walls and buttresses.

(2) Repair of the void in the rubble masonry, upstream left side training wall.

(3) Provision of a suitable barrier to keep ice and debris from piling up against the gate house during periods of high water.

(4) Removal of all trees in the downstream channel which have eroded root structures and which are leaning over the channel. Trimming or removal of all other trees, both upstream and downstream, which overhang the channel.

(5) Monitoring of erosion along the toe of the channel to preclude collapse of the steep banks.

(6) Instruction of local municipal officials such as the police and fire chiefs in the proper operation of the dam, and arrangement for their access to the gate house in the event of an emergency. Such a program might decrease response time in the event of unforseen circumstances.

7.4 Alternatives

As an alternative to increasing the dams' discharge capacity, the structures can be left as is. This action, however, would lead to continued overtopping of the Head Works Dam, which was not designed for flow over its crest. Such overtopping would almost certainly decrease the remaining life of the structure and would necessitate additional repairs. Similarly, the higher than anticipated flows over the Berry Bay Dam could generate horizontal thrusts beyond the resisting ability of the structure.

There are no meaningful alternatives to the routine operating and maintenance improvements.

APPENDIX A

VISUAL INSPECTION CHECKLIST

INSPECTION TEAM ORGANIZATION

Date: 12 September, 1978

NH 00329
BERRY BAY DAM
Effingham Falls, New Hampshire
Ossipee Lake
NHWRB 75.01

Weather: Cloudy and cool

INSPECTION TEAM

Nicholas Campagna	Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD)	Team Captain
Robert Minutoli	GZD	Soils
Andrew Christo	Andrew Christo Engineers (ACE)	Stuctural
Paul Razgha	ACE	Structural
Richard Laramie	Resource Analysis, Inc.	Hydrology

Mr. Harold Hebert, Area Supervisor for Central Maine Power Company, and Mr. Tom Rankin, also of Central Maine, accompanied the inspection team.

BERRY BAY DAM
Effingham, N.H.

September 12, 1978
NH 00329

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
SUPERSTRUCTURE		
a. General		
Vertical alignment and movement	M.C	No deficiencies noted
Horizontal alignment and movement		No deficiencies noted
Condition at abutments		Right abutment cast on bedrock outcrop; leakage of 5 gpm through scour hole 1" x 6" at junction of concrete and rock; left abutment okay
Unusual downstream seepage	MC	Seepage of 10 to 20 gpm through a 4" x 6" hole at base of spillway near right abutment
b. Spillway and Abutments	PR	
Erosion or cavitation		Entire length of spillway eroded up to 2" deep exposing aggregate in cyclopean concrete; 50% of surface damaged; right abutment shows minor erosion; minor erosion at construction joint between right abutment and spillway; minor erosion at base of both abutments
Spalling		Some surface spalling on right abutment adjacent to spillway
Cracking		Minor hairline cracking on both abutments
Condition of joints	PR	Minor erosion at construction joint between right abutment and spillway

BERRY BAY DAM
Effingham, N.H.

September 12, 1978
NH 00329

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
Rusting or staining on concrete	PR	None noted
Visible reinforcing		None noted
Any seepage or efflourescence	PR	Two seepages near right abutment mentioned previously; minor efflourescence on right abutment
OUTLET WORKS		
a. Approach Channel		
Slope conditions		Wide, shallow approach from pond
Bottom conditions		Rocky with some sediment
Rock slides or falls		None noted
Log boom		None on hand
Control of debris		Good
Trees overhanging channel		Numerous trees growing immediately on left shoreline and overhanging channel
b. Flashboards	PR	
Condition		Stanchions can accommodate 4" thick boards, but only 2" boards in place; boards deflecting considerably under 30" head
Mounting and seating		Good
Movable support system	PR	Good condition

BERRY BAY DAM
Effingham, N.H.

September 12, 1978
NH 00329

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
Adequately secured (tamperproof)	PR	Flashboards not locked in place
c. Service Bridge Superstructure		
Supporting piers		Horizontal construction joint on right pier shows 2" deep erosion; left pier reveals erosion just above base; minor joint erosion at junction of left pier and spillway; minor surface erosion and hairline cracks on all piers; some erosion under all piers
Anchor bolts		No deficiencies noted
Longitudinal members		No deficiencies noted
Vertical members		No deficiencies noted
Secondary bracing		No deficiencies noted
Deck		Good condition
Railings		Good condition
Paint	PR	Recent
d. Outlet Channel (immediate area)		
Slope conditions	nac	Banks 8 to 10 feet high and on 1:1 slope; natural rock protection
Rockslides or falls		None noted
Control of debris	nac	Good

BERRY BAY DAM
Effingham, N.H.

September 12, 1978
NH 00329

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
Trees overhanging channel	nAC	Many trees in and over channel
Other obstructions		None noted
e. Existence of Gages	nAC	Gage on Head Works Dam
RESERVOIR		
a. Shoreline		
Evidence of slides		None
Potential for slides		None noted; shoreline stable
b. Sedimentation		None noted near dam, but some in narrow channels connecting ponds
c. Upstream hazard areas in the event of back flooding		Many summer and permanent residences subject to flooding if reservoir rises 5 feet
d. Changes in nature of watershed (agriculture, logging, construction, etc.)		None noted
DOWNSTRFAM CHANNEL		
Restraints on dam operation	nAC	None noted
Potential flooded areas	nAC	Few structures would be affected by levels of 10 feet of above normal

BERRY BAY DAM
Effingham, N.H.

September 12, 1978
NH 00329

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
OPERATION AND MAINTENANCE FEATURES		
a. Reservoir regulation plan		
Normal procedures	mac	CMPC maintains reservoir at El. 405 from June 1 to Oct. 12 for recreational purposes; otherwise operates as needed for power generation downstream; reservoir drawn down in fall, flash boards installed in spring
Emergency procedures		Portland sub-office monitors dam at all times and can open or close as required; no local operator
b. Maintenance		
Quality		Service bridge well maintained; concrete elements display lack of maintenance
Adequacy	mac	Additional emphasis on routine maintenance

INSPECTION TEAM ORGANIZATION

Date: 12 September 1978

NH 00328
HEAD WORKS DAM
Effingham Falls, New Hampshire
Ossipee Lake
NHWRB 75.01A

Weather: Cloudy and cool

INSPECTION TEAM

Nicholas Campagna	Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD)	Team Captain
Robert Minutoli	GZD	Soils
Andrew Christo	Andrew Christo Engineers (ACE)	Structural
Paul Razgha	ACE	Structural
Richard Laramie	Resource Analysis, Inc.	Hydrology

Mr. Harold Hebert, Area Supervisor for Central Maine Power Company, and Mr. Tom Rankin, also of Central Maine, accompanied the inspection team.

HEAD WORKS DAM
Effingham, N.H.

September 12, 1978
NH 00328

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
SUPERSTRUCTURE		
a. General		
Vertical alignment and movement		No deficiencies noted
Horizontal alignment and movement		No deficiencies noted
Condition at abutments		Downstream corner of left abutment wall severely eroded and spalled; no erosion of soil near either abutment noted; exposed tops of cutoff walls in good condition
Abutment slope protection		Squared stone masonry and concrete walls protect earth from erosion; random boulders provide some protection farther downstream
Unusual downstream seepage		None noted
b. Condition of concrete		
Erosion or cavitation		Erosion up to 2" deep on upstream buttresses; central upstream buttress and left end wall (inside abutment) severely eroded
Spalling		Severe spalling on central upstream buttress and left end wall; evidence of surface spalling on concrete just below top of dam on upstream side

HEAD WORKS DAM
Effingham, N.H.

September 12, 1978
NH 00328

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
Cracking	PD	Random hairline cracking in most concrete
Condition of joints		Construction joint between central upstream buttress and pier supporting gate house eroded around perimeter; horizontal construction joint open over entire length of dam; construction joints between buttresses and slab forming top of gate outlets open
Rusting or staining on concrete		None noted
Visible reinforcing		None noted
Any seepage or efflourescence	PD	Considerable efflourescence around eroded and spalled concrete on buttresses and end walls
OUTLET WORKS		
a. Approach channel		
Upstream training walls		Fair condition; 6" x 18" void in rubble stone masonry on left wall near spillway
Bottom conditions		Deep approach; bottom not visible
Rock slides or falls		None noted
Log boom		On site, but stored for winter
Control of debris		Good

HEAD WORKS DAM
Effingh... N.H.

September 12, 1978
NH 00328

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
Trees overhanging channel		Shoreline heavily wooded with many trees growing over approach
b. Gates	PV	
Condition of gates		Good; right 3 gates replaced recently, left 2 replaced 2 years ago
Gate mountings		Gates slide in slots in upstream concrete buttresses; no deficiencies noted
Operating mechanisms		Right 3 gates can be operated electrically or manually; electrical mechanism performed satisfactorily, not operated manually; left 2 gates have only manual operation and worked satisfactorily
c. Gate house		
Condition		Evidence of damage on upstream side from ice and debris during high water periods; some additional timber supports placed under gate house to limit deflections created by heavy mechanical equipment; building is anchored to dam against uplift
Adequately secured	PV	All windows boarded up and doors reinforced to prevent vandalism which has occurred in the past

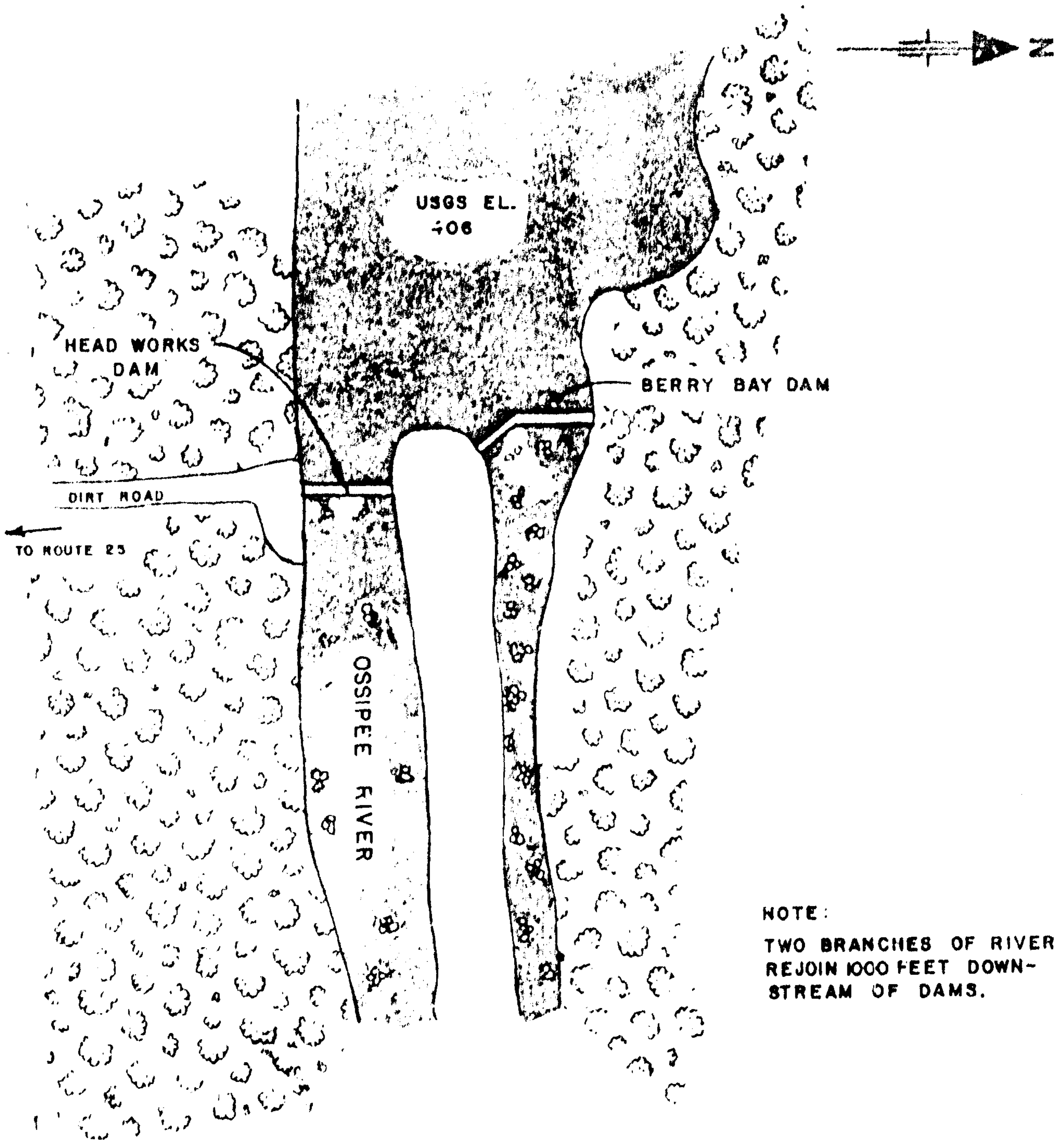
HEAD WORKS DAM
Effingham, N.H.

September 12, 1978
NH 00328

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
d. Outlet Channel (immediate area)		
Slope conditions	nac	Banks 10 to 12 feet high and steep; considerable erosion at toe of slope
Rockslides or falls		None noted; placed and natural boulders tend to protect curved portions of slope
Control of debris		Good
Trees overhanging channel		Root structures of many trees along channel severely eroded such that trees leaning over
Other obstructions		None noted
e. Existence of Gages	nac	Gage on left upstream training wall
RESERVOIR		
a. Shoreline		
Evidence of slides		None
Potential for slides		None noted; shoreline stable
b. Sedimentation		None noted near dam, but some in narrow channels connecting ponds
c. Upstream hazard areas in the event of back-flooding		Many summer and permanent residences subject to flooding of reservoir rises 5 feet

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
d. Changes in nature of watershed (agriculture, logging, construction, etc.)	nac	None noted
DOWNSTREAM CHANNEL		
Restraints on dam operation		None noted
Potential flooded areas		Few structures would be affected by levels of 10 feet above normal
OPERATION AND MAINTENANCE FEATURES		
a. Reservoir regulation plan		
Normal procedures		CMPC maintains reservoir at El. 405+ from June 1 to Oct. 12 for recreational purposes; otherwise operates as needed for power generation downstream; reservoir drawn down in fall, flashboards at Berry Bay Dam installed in spring
Emergency procedures		Portland sub-office monitors dam at all times and can open or close as required; no local operator
b. Maintenance		
Quality		Gates and operating systems good; structure needs attention
Adequacy	nac	Additional emphasis on routine maintenance

APPENDIX B



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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

FIG. 1

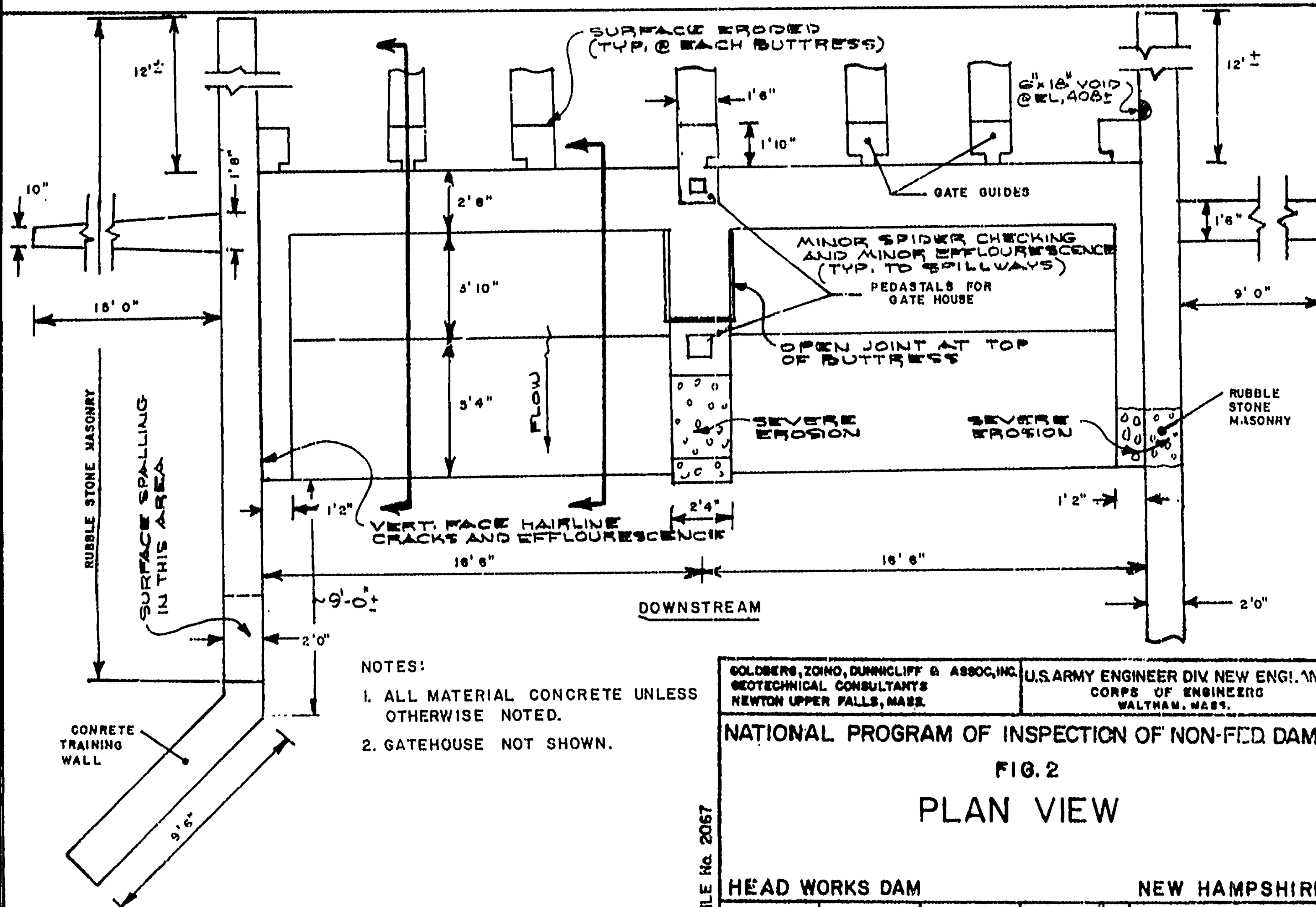
SITE PLAN

HEAD WORKS DAM
BERRY BAY DAM

NEW HAMPSHIRE

SCALE 1" = 100'
DATE SEPT. 1978

FILE No. 2067



NOTES:

1. ALL MATERIAL CONCRETE UNLESS OTHERWISE NOTED.
2. GATEHOUSE NOT SHOWN.

FILE No. 2067

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CORPS OF ENGINEERS
WALTHAM, MASS.

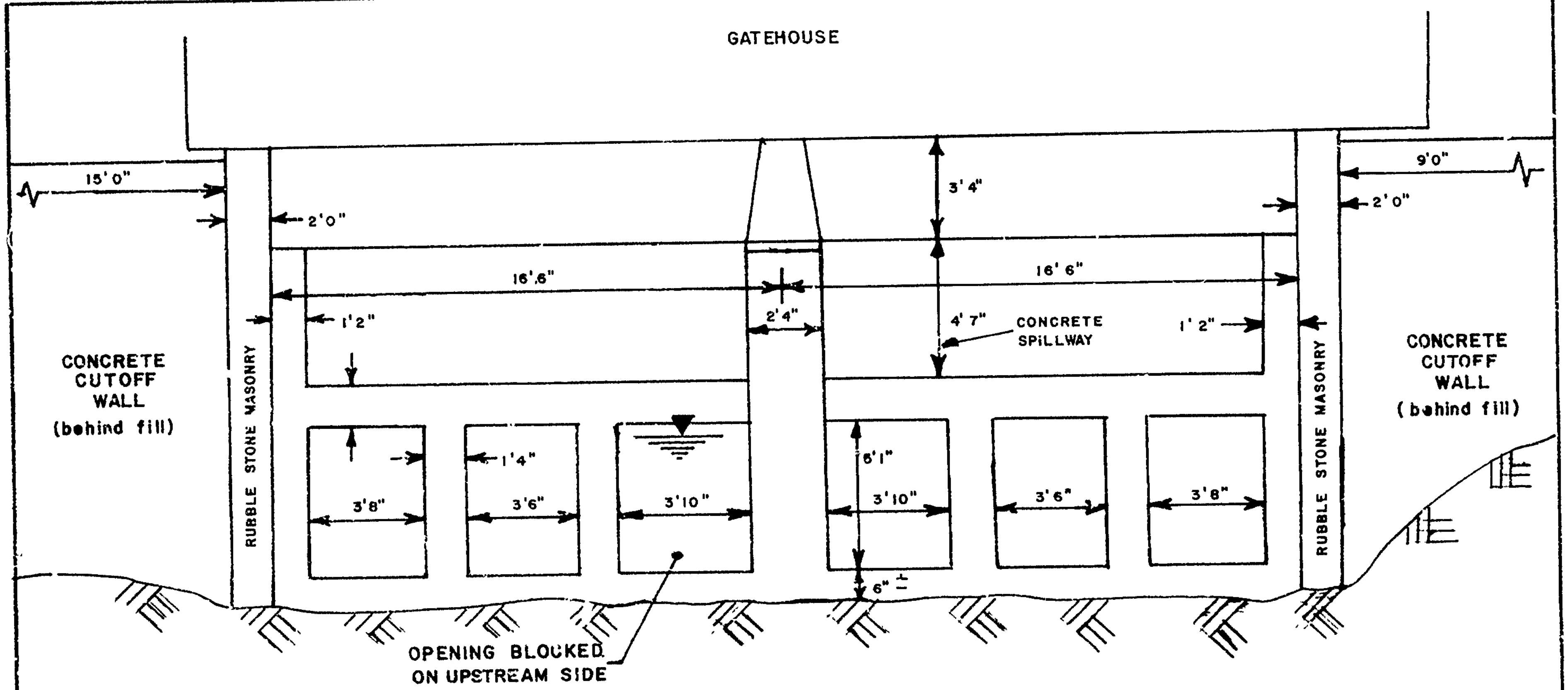
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

FIG. 2

PLAN VIEW

HEAD WORKS DAM — NEW HAMPSHIRE

SCALE 1" = 5'
DATE SEPT 1978



NOTES:

1. ALL MATERIAL CONCRETE UNLESS OTHERWISE NOTED.
2. SUBSURFACE PORTIONS OF STRUCTURE NOT OBSERVED, BUT GENERAL CONFIGURATION INFERRED FROM EXISTING DOCUMENTS,

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NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

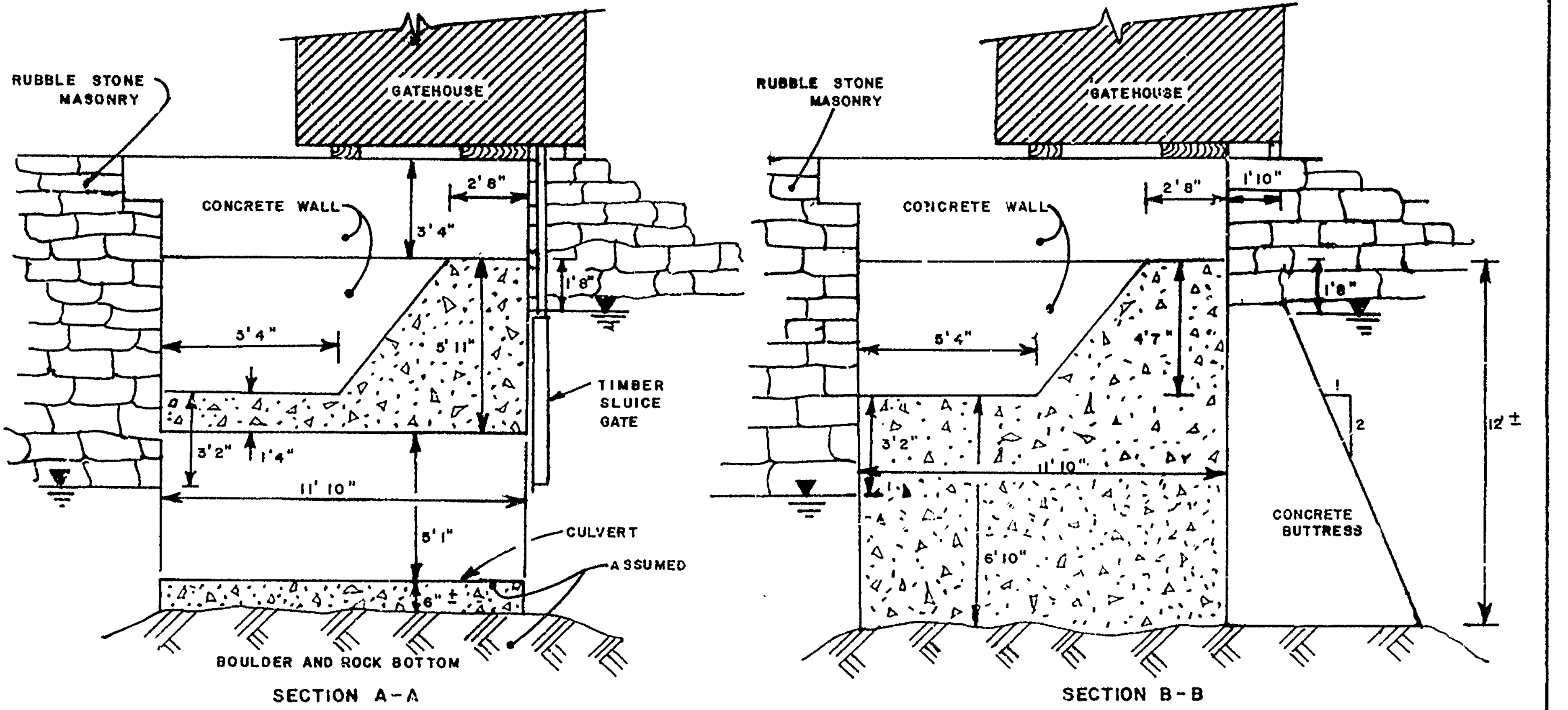
FIG. 3

ELEVATION FROM DOWNSTREAM

HEAD WORKS DAM — NEW HAMPSHIRE

FILE No. 2067

SCALE	1" = 5'
DATE	SEPT 1978



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

FIG. 4

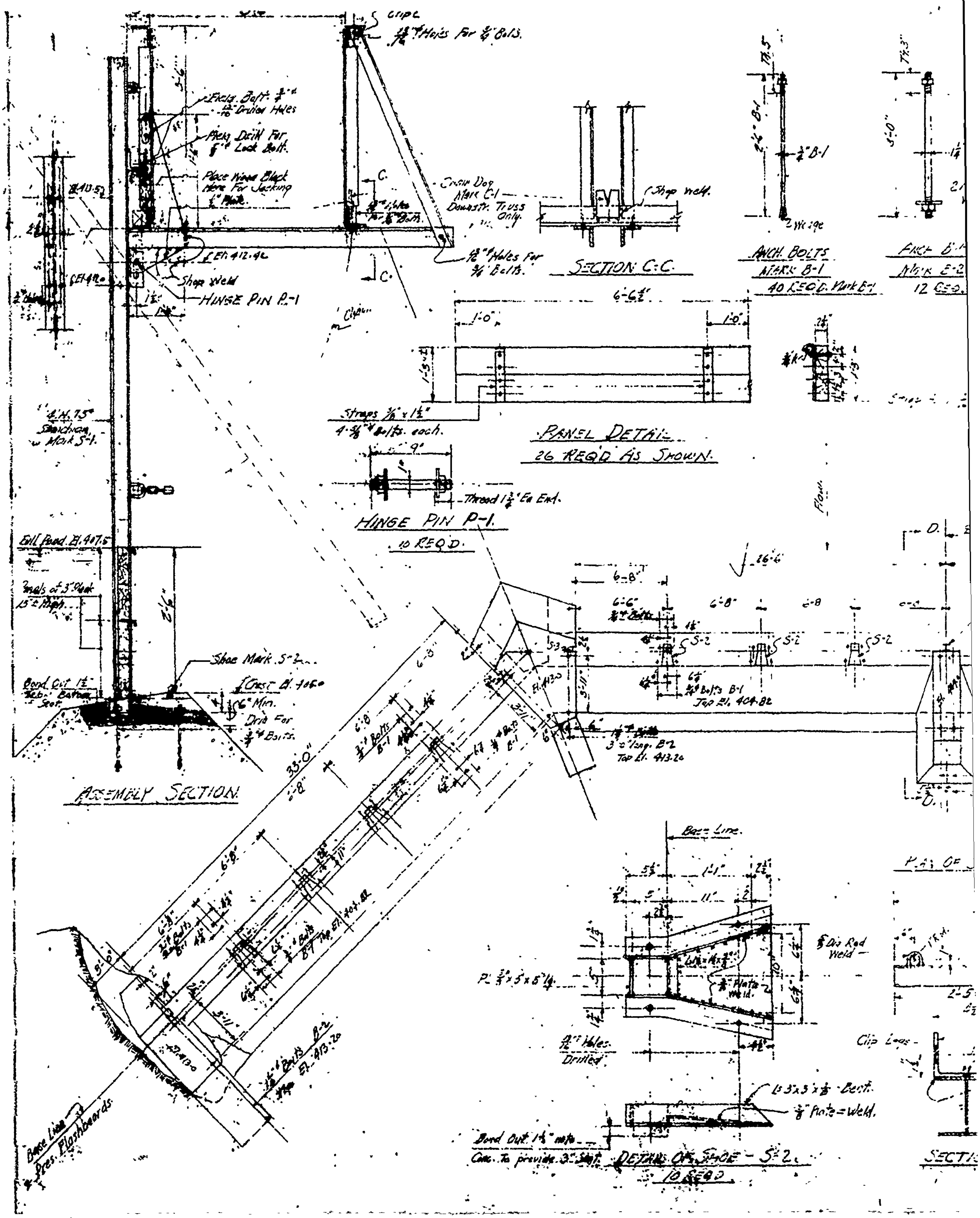
SECTIONS

HEAD WORKS DAM — NEW HAMPSHIRE

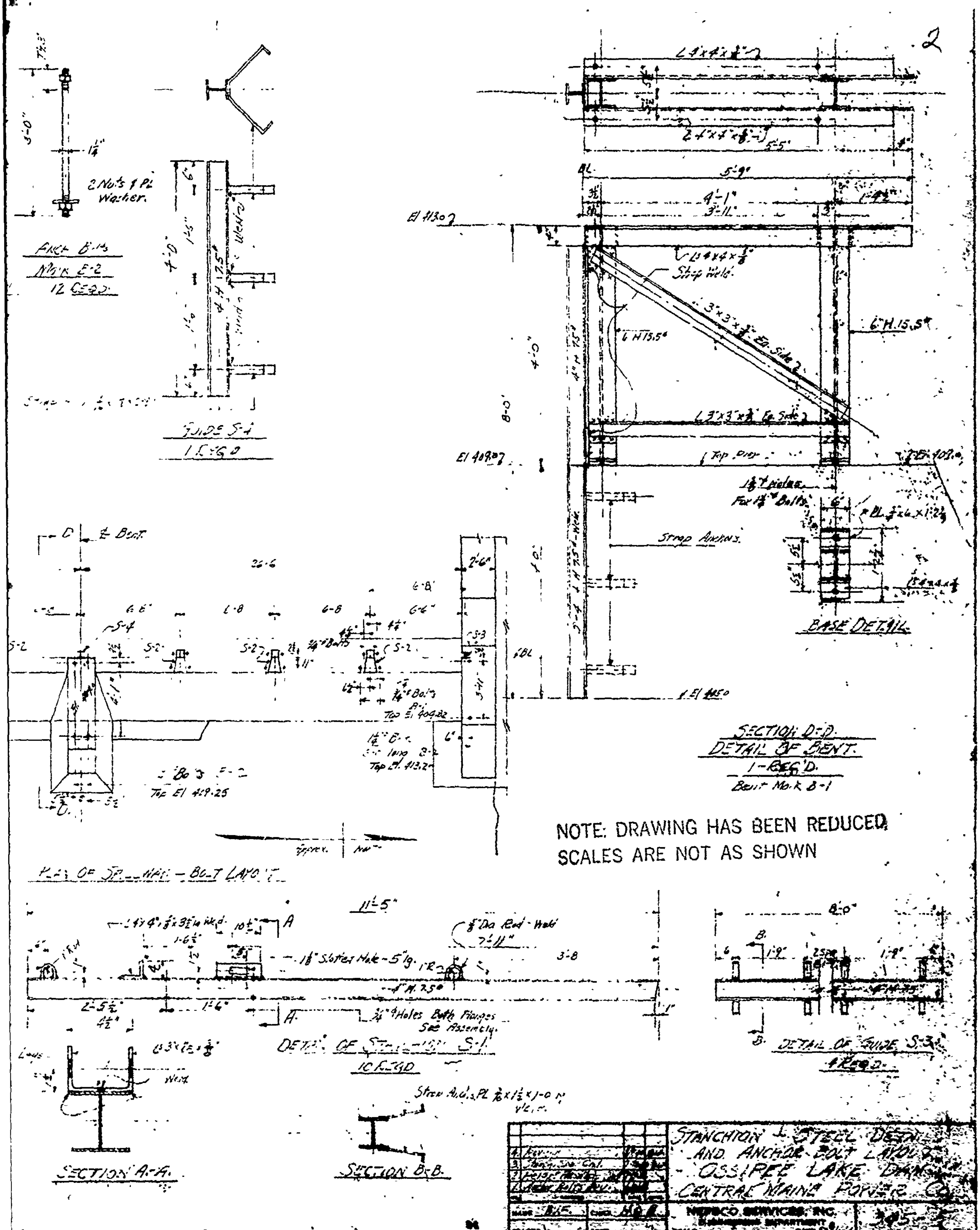
SCALE 1" = 5'

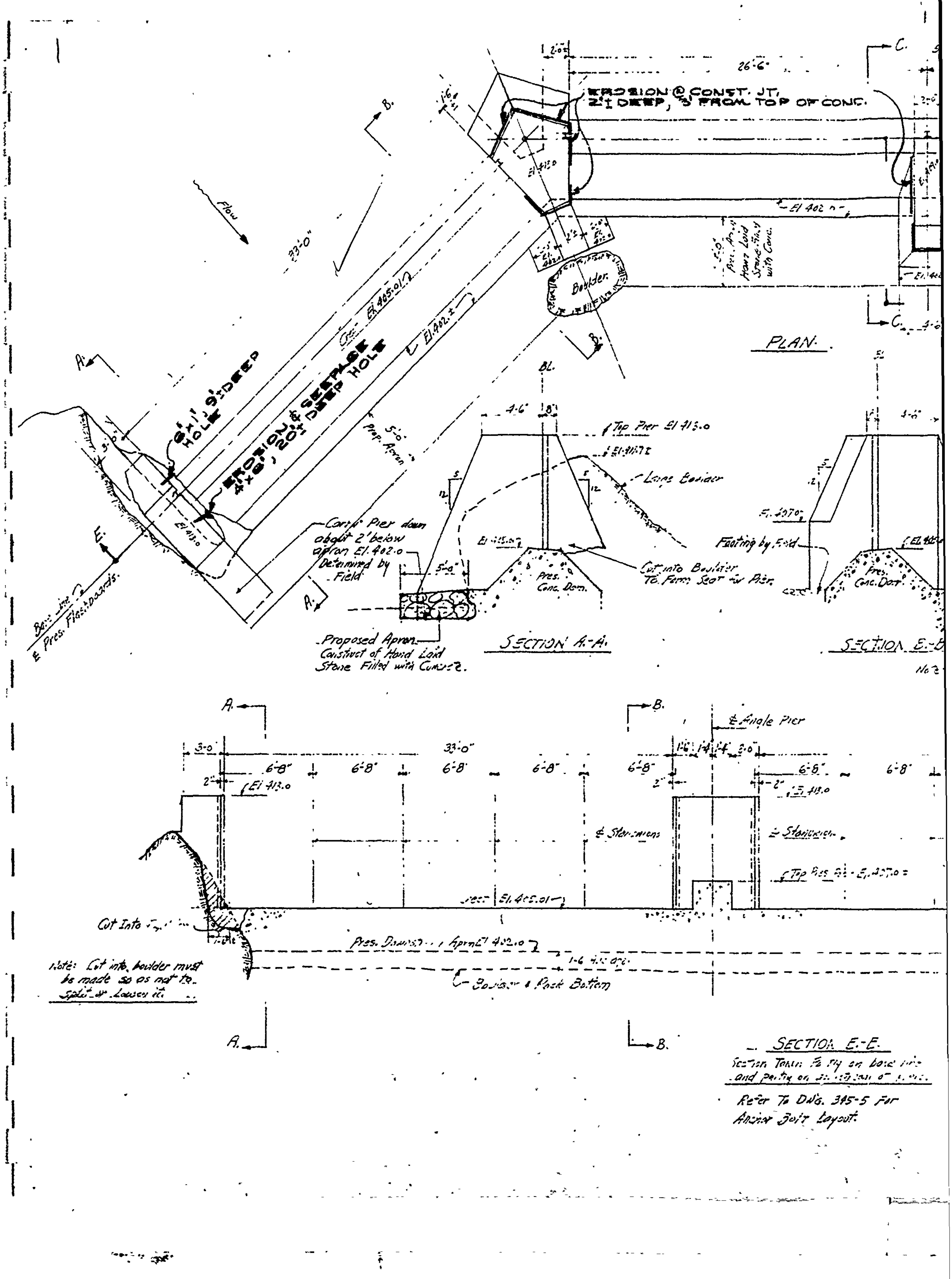
DATE SEPT 1978

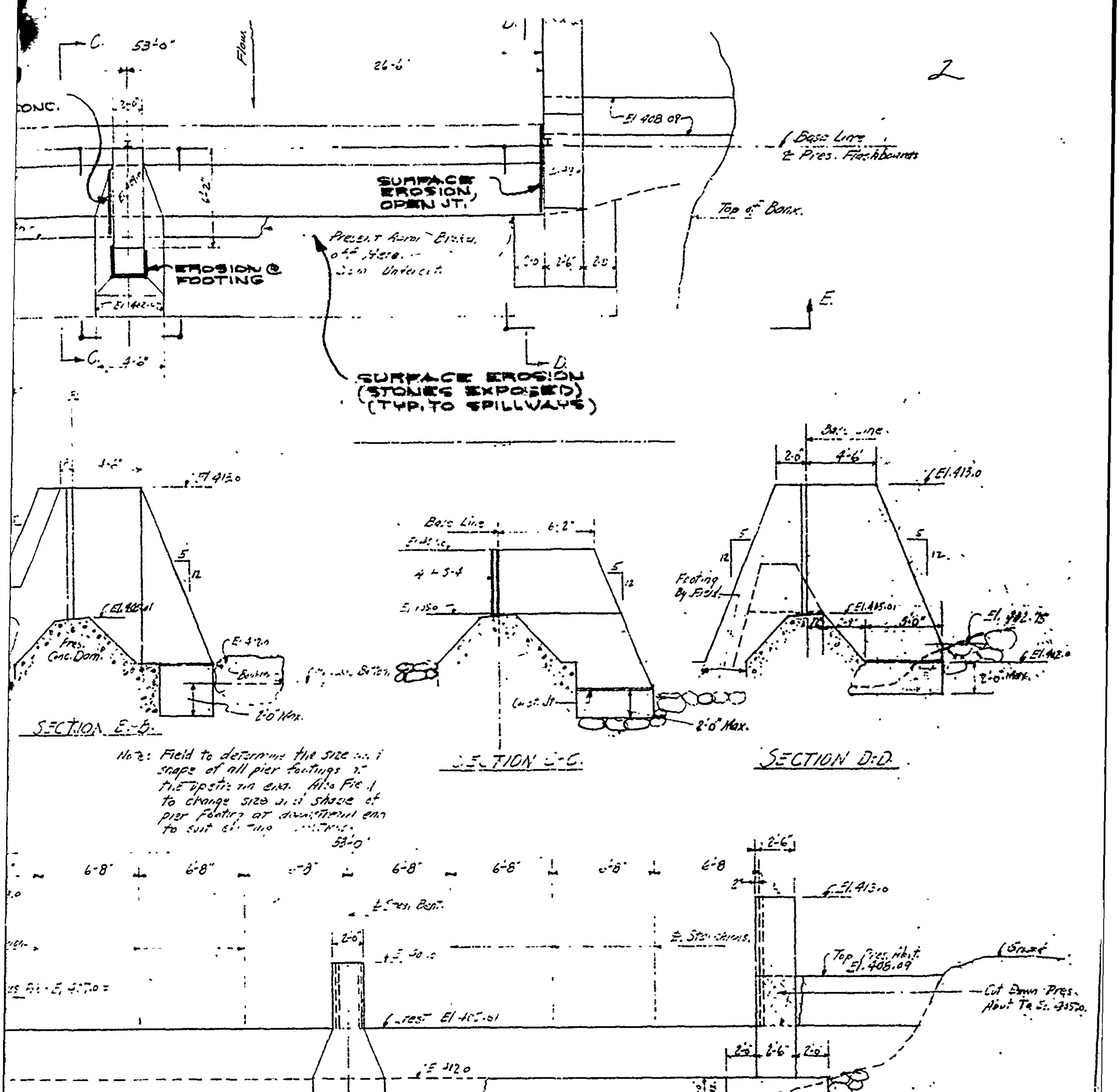
FILE No. 2067



ASSEMBLY SECTION
SECTION C-C
ANCH. BOLTS
MARK B-1
40 REQ'D. Mark B-1
PANEL DETAIL
26 REQ'D AS SHOWN.
HINGE PIN P-1.
10 REQ'D.
DETAIL OF SHOE - S-2.
10 REQ'D
Shoe Mark S-2
Hinge Pin P-1
Shop Weld
Crest El. 406.0
Fill Road El. 407.5
Straps 3/8" x 1 1/2"
Thread 1 1/2" Ea End.
Base Line
Pres. Flashboards
Clip Angs
Bond Out 1 1/2" min.
Conc. To provide 3" Seat.


2
SECTION D-D
DETAIL OF BENT
1-REQ'D.
Bent Mark B-1
BASE DETAIL
Strap Anchors
Shop Weld
6" H 15.5#
SECTION A-A
SECTION B-B
DETAIL OF GUIDE S-3
4 REQ'D.
GUIDE S-4
2 Nuts & PL Washer
NOTE: DRAWING HAS BEEN REDUCED
SCALES ARE NOT AS SHOWN
STANCHION & STEEL DESIGN AND ANCHOR BOLT LAYOUT
OSSIPEE LAKE DAM
CENTRAL MAINE POWER CO.
MERCO SERVICES, INC.


EROSION @ CONST. JT. 2"± DEEP, 3" FROM TOP OF CONC.
26'-6"
Flow
33'-0"
El. 405.01
El. 402 ±
EROSION & SEEPAGE 4"x8", 20"± DEEP HOLE
HOLE 9"±DEEP
Boulder
PLAN
Top Pier El 413.0
Large Boulder
Carry Pier down about 2' below apron El. 402.0 Determined by Field
Pres. Conc. Dam
Cut into Boulder To Form Seat for Pier.
Proposed Apron Construct of Hand Laid Stone Filled with Concrete.
SECTION A-A
Footing by Field
SECTION B-B
Angle Pier
El 413.0
Stanchions
Cut Into
Pres. Apron El 402.0
Boulder & Rock Bottom
Note: Cut into boulder must be made so as not to split or Loosen it.
SECTION E-E
Refer To DWG. 345-5 For Anchor Bolt Layout.



53'-0"
Flow
26'-6"
CONC.
El 408.09
Base Line & Pres. Flashboards
SURFACE EROSION, OPEN JT.
Top of Bank
Present Apron Broken off Here - Dam Undercut
EROSION @ FOOTING
SURFACE EROSION (STONES EXPOSED) (TYP. TO SPILLWAYS)
SECTION E-E.
SECTION C-C.
SECTION D-D.
Base Line
El. 413.0
Footing By Field
El. 402.75
2'-0" Max.
Const. Jt.
Pres. Conc. Dam
Note: Field to determine the size and shape of all pier footings at the upstream end. Also Field to change size and shape of pier footing at downstream end to suit existing conditions.
53'-0"
6'-8"
2'-6"
El. 413.0
Top Pres. Abut. El. 408.09
Cut Down Pres. Abut.
2'-0" Max Below Average Stream Bed.
4'-6"
Note: All Contact Surfaces between new and existing to be chipped and cleaned to sound Conc. All concrete to be 1:2:4 Mix using ... sand and stone.
NOTE: DRAWING HAS BEEN REDUCED
SCALES ARE NOT AS SHOWN
CONCRETE DETAILS PIERS
OSSIPEE LAKE DAM
CENTRAL MAINE POWER CO.
NEPSCO SERVICES, INC.
ENGINEERING DEPARTMENT
Revised
345 C 7

The NHWRB, 37 Pleasant Street, Concord, N.H. 03301 maintains the following records on this dam:

(a) Letter dated 3 January 1975 from the NHWRB to the Central Maine Power Company listing minor deficiencies noted during a 14 June, 1973 inspection.

(b) Letter dated 28 September 1954 from the Central Maine Power Company to the NHWRB discussing the survey made of lake levels around the reservoir.

(c) A 1938 report on the Head Works Dam by the New Hampshire Water Control Commission entitled "Data on Dams in New Hampshire."

(d) An identical report on the Berry Bay Dam.

(e) A 1938 report by the same agency entitled "Data on Reservoirs and Ponds in New Hampshire."

(f) A 1936 report by the NHWRB entitled "Inventory of Dams and Water Power Developments."

COPY

CENTRAL MAINE POWER COMPANY

General Office — 9 Green Street — Augusta, Maine 04330

November 7, 1974

Broad-Leavitt Bay Association
Leavitt Road
Center Ossipee, New Hampshire 03814

Gentlemen:

I have your letter of October 31, 1974, concerning elevations of Great Ossipee Lake and I would like to explain and clarify Central Maine Power Company's position with respect to operation of that lake.

From our point of view, the purpose of the dam on the outlet of Great Ossipee is to retain water in storage which can be utilized in the production of hydroelectric energy. Our position is modified by an agreement with the State of New Hampshire, whereby we maintain the lake level at or above the 405' elevation from June 1 to October 12 each year. Please note that the 405' elevation allows a draw-down of 2½ feet below the crest elevation of the dam. In actual practice of recent years, we have generally maintained an elevation of 407' or higher between June 1 and Labor Day, after which we have utilized the draw-down to the 405' level before October 12. We have never agreed to hold any specific level after October 12 and through May 31 of the following year, and we would not now voluntarily relinquish the right to draw the stored water each year, after commitments for recreational use have been satisfied.

This year we had two specific requests to draw the lake down in October. A Mr. Herbert Merrow of Peabody, Massachusetts, had obtained a Special Board permit to work on a retaining wall, and a Mr. Cecil Neal of Leavitt Bay requested that the lake be pulled a foot lower than 1973 in order to clean his shore. Since the requests were not in disagreement with our plans to utilize the water as an energy source alternative to oil and nuclear fuels, we did pull the lake down to meet these specific requests. Mr. Merrow notified us on October 30 that his work was successfully completed. The lake level is now approximately

403' elevation and holding. It is probable now that it will not be drawn further unless there is heavy snow cover next spring, in which event we will draw the lake to an absolute minimum in anticipation of snow melt.

We recognize the fact that agreements concerning recreational lake levels were made in the past for people who were seasonal residents. In 1938 the agreement terminated on September 1; in 1958 the season was extended to October 12; now you point out that 40 of your association members are year-round residents. Obviously our use of Great Ossipee Lake as a hydroelectric storage pond is incompatible with the wishes of year-long residents of the lake shore. However at this time I can offer no solution to this dilemma. We consider it prudent operation to draw the lake down each year in anticipation of fall rains. Otherwise we might risk flooding of the lake shore whenever the fall rains are heavier than average.

I realize that this letter is not the reply which you hoped to receive from us, but I did feel that it was necessary to state the Company's position as to the operation of the lake for hydroelectric storage. To the best of our knowledge we are operating the lake in conformance with the laws of the State of New Hampshire according to the policies of its Water Resources Board.

If I can be of further assistance to your association in this matter, please call or write me at this address.

Very truly yours,

Edward R. Cowles

Edward R. Cowles
Chief Load Dispatcher

ERC/w

cc: Vernon Knowlton
N.H. Water Resources Board

OSSIPEE LAKE

Flood Crest Levels on May 11, 1954

On May 11, 1954, lake levels on Ossipee Lake and its connecting bays were taken during flood conditions. These elevations were determined in relation to a common datum on August 11, 1954 with the cooperation of Mr. Ira Cole, Central Maine Power Company engineer. A location map and data sheet showing elevations of reference bench marks, lake levels and times of observation accompany this report.

The common datum was ascertained by shutting all but one gate at the main dam and after stabilization, allowing five-hundredths foot for a velocity head loss. This was the amount determined by gauge reading at the end of two-hour shut down of all gates as against gauge readings while one gate was open. Reference bench marks #8, #9 and #10 used the corrected level taken at 12:30 P.M., while all others were taken in relation to the final corrected level obtained at 3:55 P.M. as their remoteness would not be affected by a drawdown in the bays near the dam. From levels taken from this static water surface, the elevations of the reference bench marks were obtained. By subtracting the amount these reference benches were above the adjacent flood levels on May 11, the May 11 flood levels were determined.

From inspection of the water levels during May 11, it appears that Ossipee Lake was at 412.56; Broad Bay at 411.77 (or a drop of 0.79 foot); Leavitt Bay at 411.56 (a further drop of 0.21 foot); Berry Bay at 411.49 (another drop of 0.07 foot); at about 500 feet upstream of the dam at 410.99 (another drop of 0.50 foot) and a final drop to the dam gauge at elevation 410.48 (showing a final channel and velocity head drop of 0.51 foot).

The flow past the dam on May 11, 1954 was approximately 5200 cubic feet per second. From a study of the daily gauge readings (taken in afternoon), the gauge read 409.0 on May 10, read 410.4 on May 11, and 410.8 on May 12. As the gauge peaked at some 4/10 foot higher than at the time of this survey, the lake and bay levels probably peaked at greater elevations, than recorded. Also, higher discharges would increase the differential between water bodies. No attempt has been made to standardize the lake levels at various points with a constant discharge. To do so, arbitrary assumptions as to differentials between water bodies would have to be made.

From the analysis of flood levels, it appears that the section between Ossipee Lake outlet to Broad Bay - a distance of some 4000 feet - and from the outlet of Berry Bay to the main dam - a distance of some 3000 feet - account for 32 percent of the drop between Ossipee Lake and a short distance upstream of the main dam during the May 11, 1954 flood. If these two sections were dredged to increase their hydraulic capacities, substantial lowering of flood crests on Ossipee Lake would result.

Francis C. Moore

Francis C. Moore
Civil Engineer

[illegible]

Best Available Copy

11

N. H. WATER RESOURCES BOARD
Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Effingham   Dam Number: 75.01

Inspected by: Robert B. Chamberlin   Date: June 14 1973

Local name of dam or water body: Lake Ossipee

Owner: Central Maine Power   Address: 9 Green St., Augusta, Me.

Owner was/was not interviewed during inspection.

Drainage Area: 357.2 sq. mi.   Stream: Ossipee River

Pond Area: 3100 Acre, Storage 12,300 Ac-Ft. Max. Head 15 Ft.

Foundation: Type ________, Seepage present at toe - Yes/No, ________

Spillway: Type Concrete, Freeboard over perm. crest: 5',

Width 45 + 35 + 6 gate turns, Flashboard height 30",

Max. Capacity 955 c.f.s.

Embankment: Type ________, Cover ________ Width ________,

Upstream slope ________ to 1; Downstream slope ________ to 1-

Abutments: Type Stone, Condition: Good, Fair, Poor

Gates or Pond Drain: Size 4' x 5' Capacity ________ Type Slide

Lifting apparatus Housed Operational condition Good

Changes since construction or last inspection: One gate still not operable. Concrete on downstream side of gate house piers chipped and eroded. Flashboards in drop stanchions on main spillway. Some stones missing from abutments of gate house

Downstream development: ________

This dam would/would not be a menace if it failed.

Suggested reinspection date: ________

Remarks: Pond height 408.0'

Central Maine Power Company

WILLIAM B. SKELTON, CHAIRMAN
WILLIAM F. WYMAN, PRESIDENT
GEORGE S. WILLIAMS, EXECUTIVE VICE-PRESIDENT
HAROLD D. JENNINGS, TREASURER

General Office
Augusta, Maine

August 5, 1952

Mr. Francis Moore, Civil Engineer
State Water Resource Board
Concord, N.H.

Dear Mr. Moore:

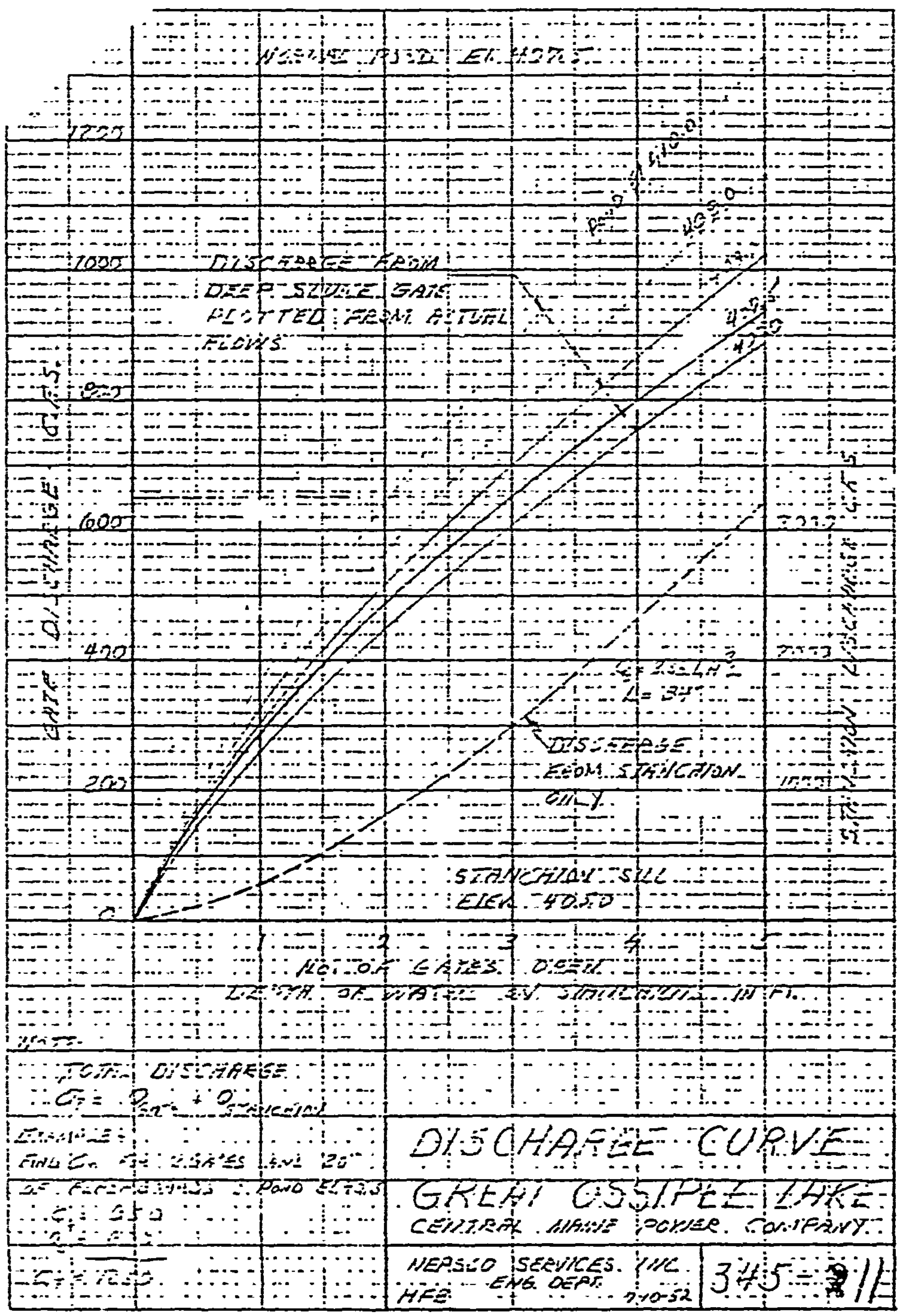
Enclosed please find discharge curve for spillway and gate openings at Great Ossipee Lake. We appreciate your patience during the time it has taken to assemble the necessary data for these curves. If we can be of further service, please do not hesitate to call.

Very truly yours,

CENTRAL MAINE POWER COMPANY

By J. A. Perry
J. A. Perry
Chief Load Dispatcher

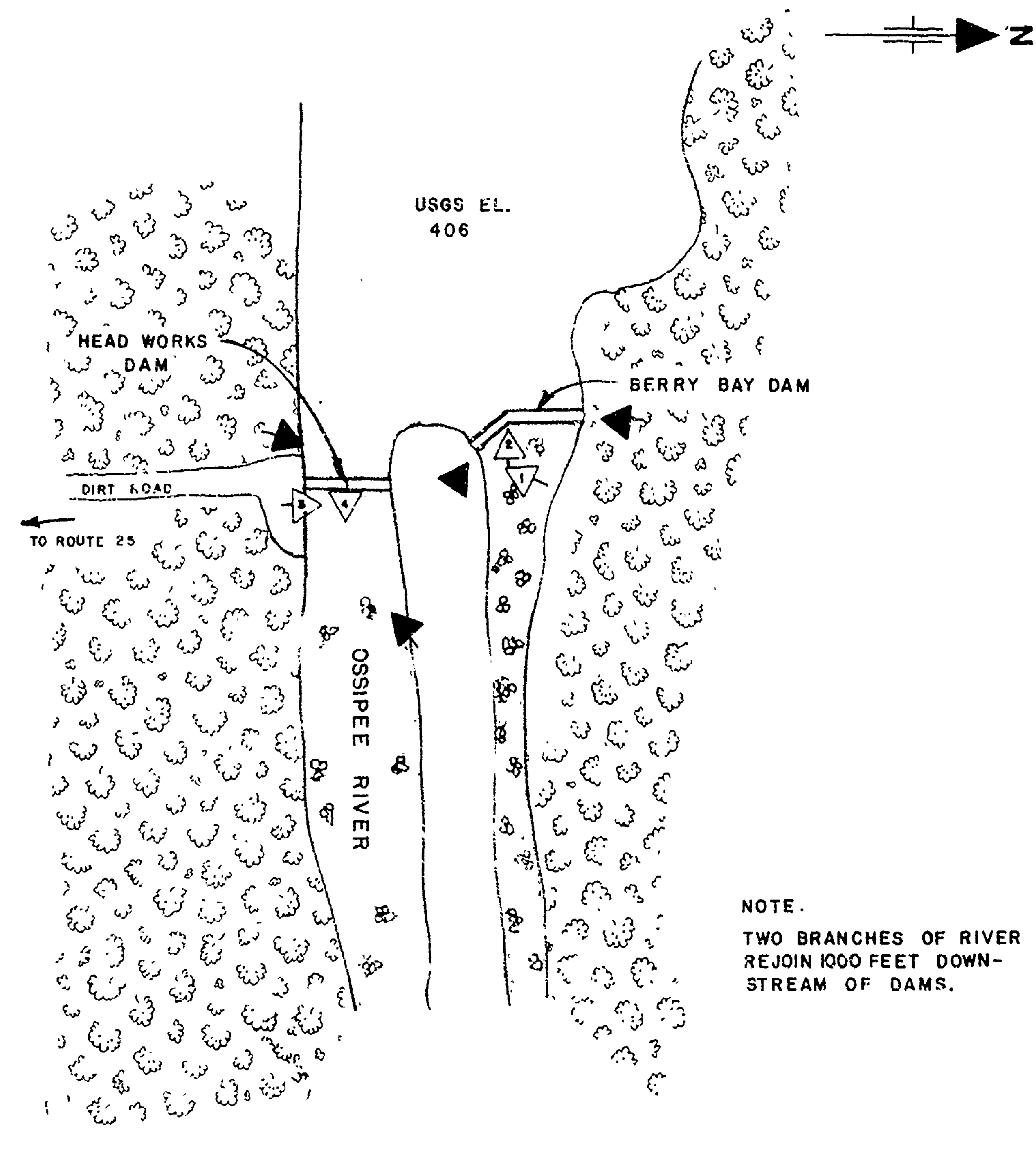
JAP/LK
Enc.



REDRAWN 8-4-52

APPENDIX C

SELECTED PHOTOGRAPHS



OVERVIEW PHOTOS

APPENDIX C PHOTOS

FILE No. 2067

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

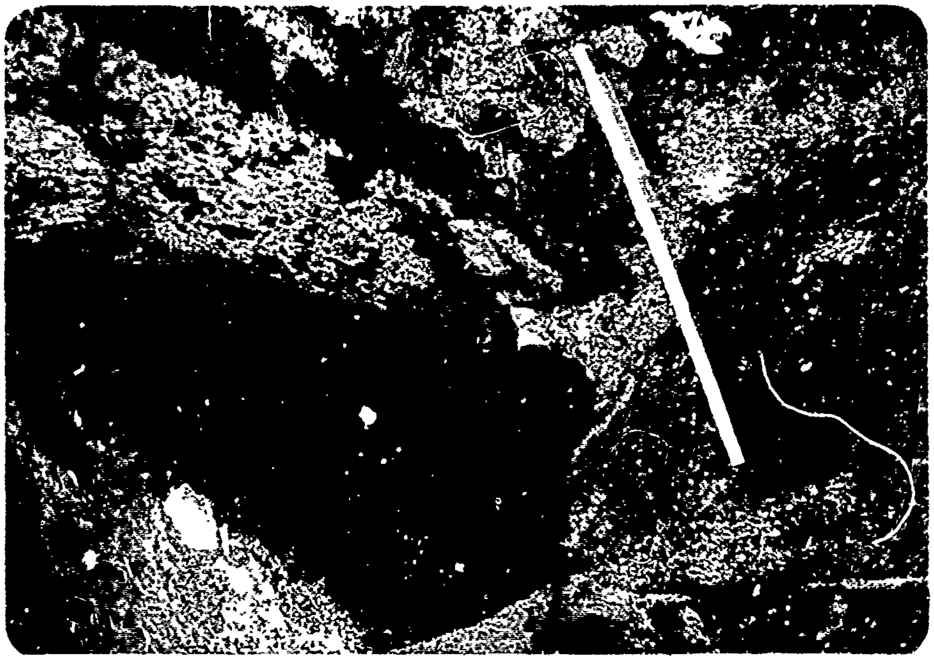
LOCATION AND ORIENTATION OF PHOTOS

HEAD WORKS DAM
BERRY BAY DAM

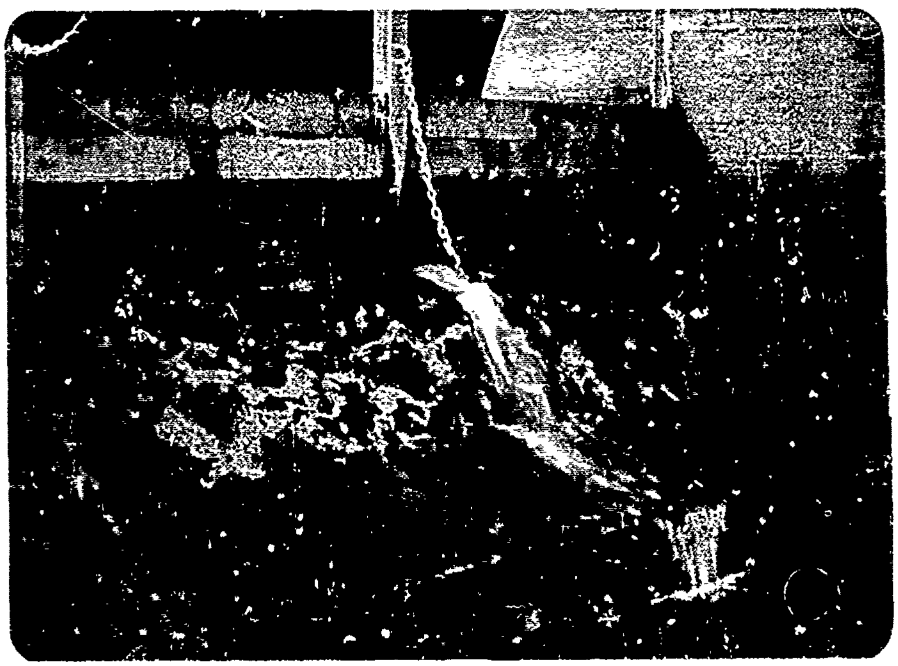
NEW HAMPSHIRE

SCALE 1" = 100"

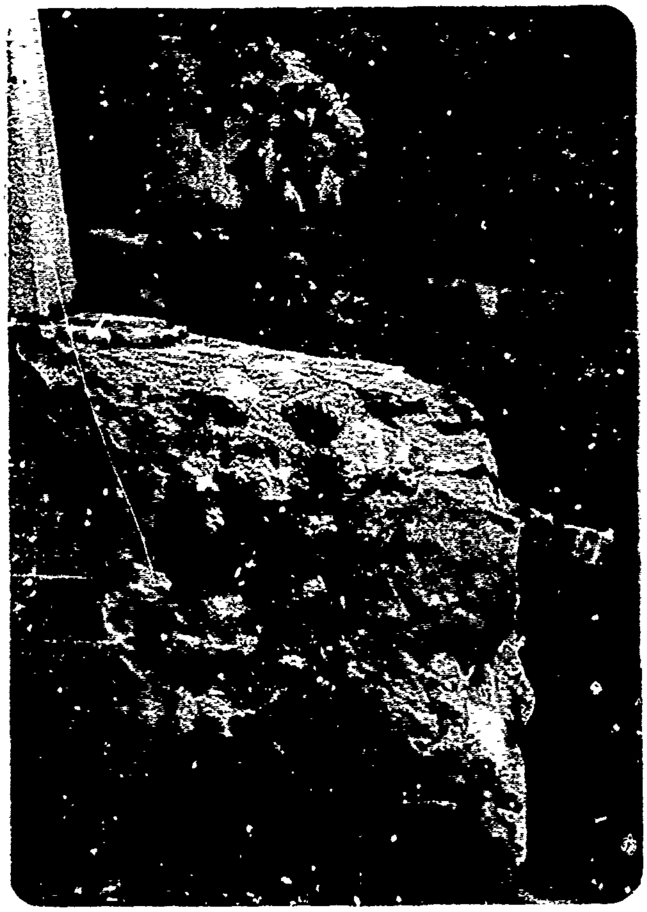
DATE SEPT 1978



1. Berry Bay Dam - View of seepage at right abutment



2. Berry Bay Dam - View of deteriorated concrete spillway



3. Head Works Dam - View of central pier and left endwall showing deteriorated concrete

4. Head Works Dam - View of downstream channel showing overhanging trees

APPENDIX D

HYDRAULIC/HYDROLOGIC COMPUTATIONS

SIZE CLASSIFICATION = INTERMEDIATE

HAZARD CLASSIFICATION = LOW

TEST FLOOD = 100 YR. FLOOD to 1/2 PMF.

To determine the 100 yr. flood flow, we will use LeBlanc's Regression Equations from U.S.G.S. Water Resource Investigation 78-47.

$P_{100} = 0.55\ A^{1.05}\ S^{.56}\ I^{2.72}$,

where: P = Peak Discharge, cfs
A = Drainage area, in sq. mi.
S = main channel slope, ft./mi.
I = 24 hr., 2 yr. precipitation, "

A = 357 sq. mi

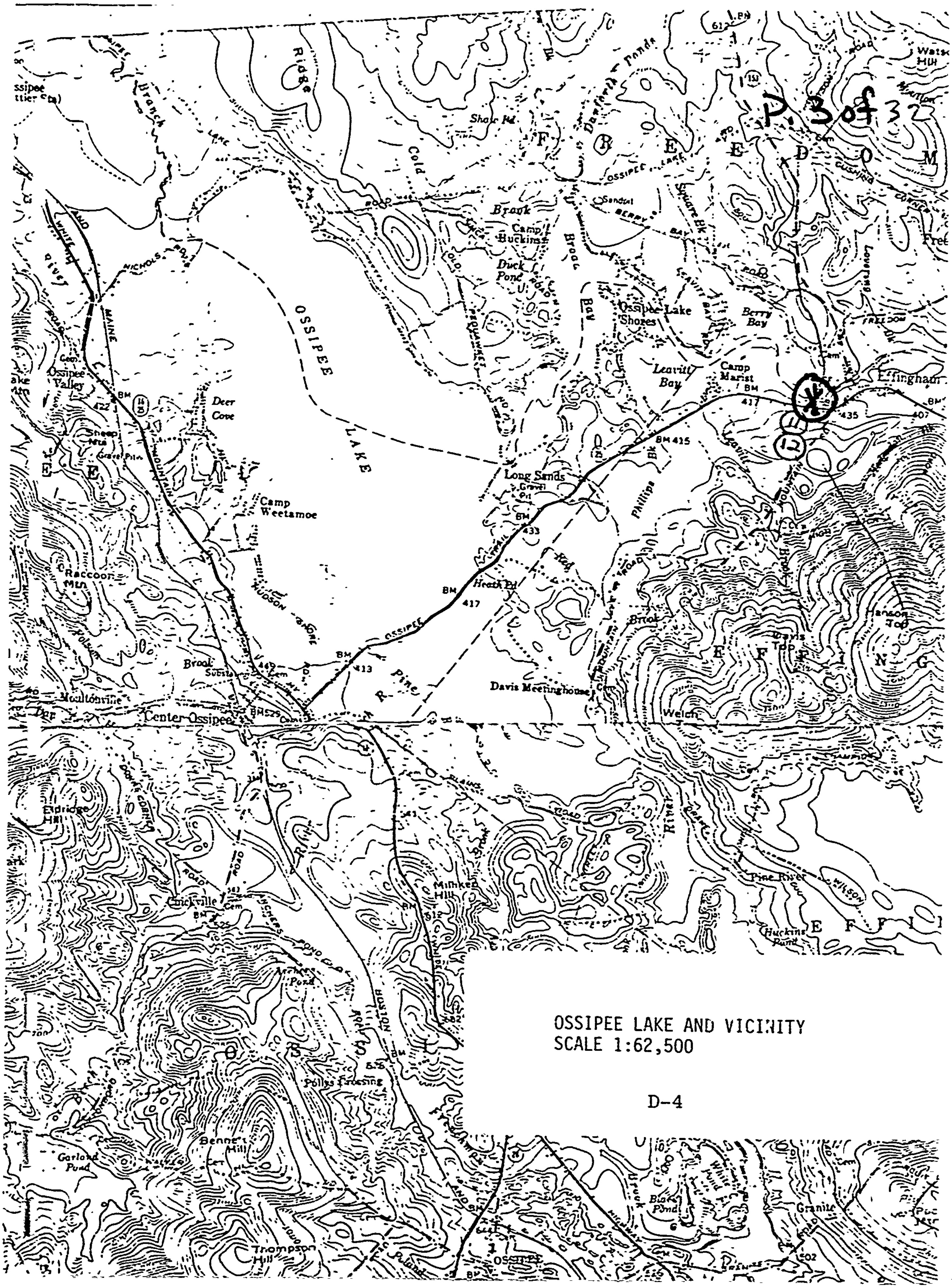
$S = \frac{450 ft}{15 mi} = 3$ ft/mi.

I = 3.1 from W.R. Inv. 7847, station 064800

So $P_{100} = 0.55\ 357^{1.05}\ 2^{.56}\ 3.1^{2.72}$
$= 8{,}428$ cfs

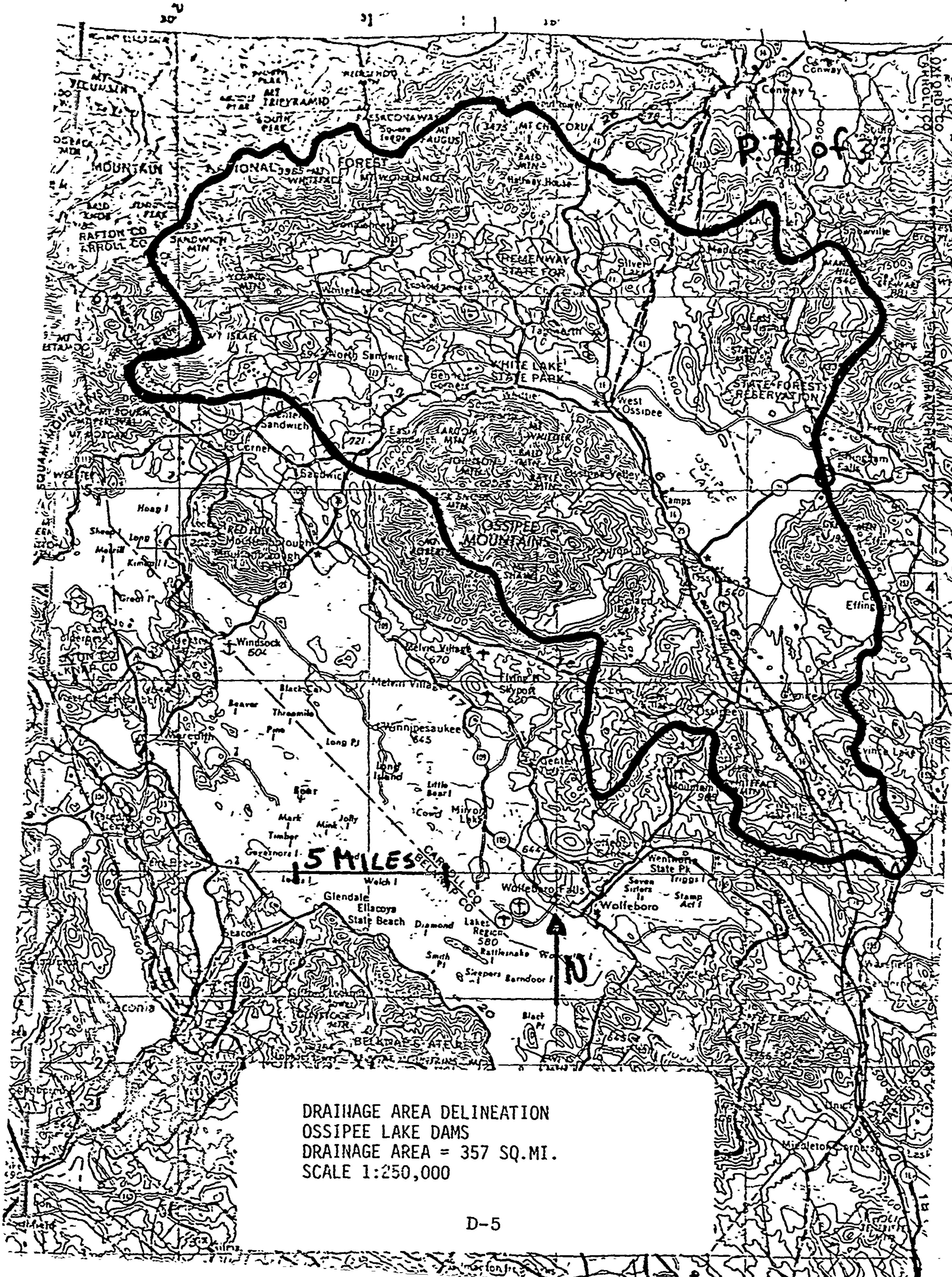
FOR 1/2 PMF, we will use the NED of CoE's "MAXIMUM PROBABLE FLOOD PEAK FLOW RATES" (DEC, 1977). Given a drainage area of 357 sq. mi, and rolling topography, the curve gives ~ 600 cfs/sq. mi. We will reduce that slightly to 500 cfs/sq. mi, because of the flatness of much of the drainage area. The PMF = 357(500) = 178,500 cfs. 1/2 of this is 89,250 cfs.

The test flood is between 8,428 & 89,250 cfs. We will use a test flood of 50,000 cfs



OSSIPEE LAKE AND VICINITY
SCALE 1:62,500

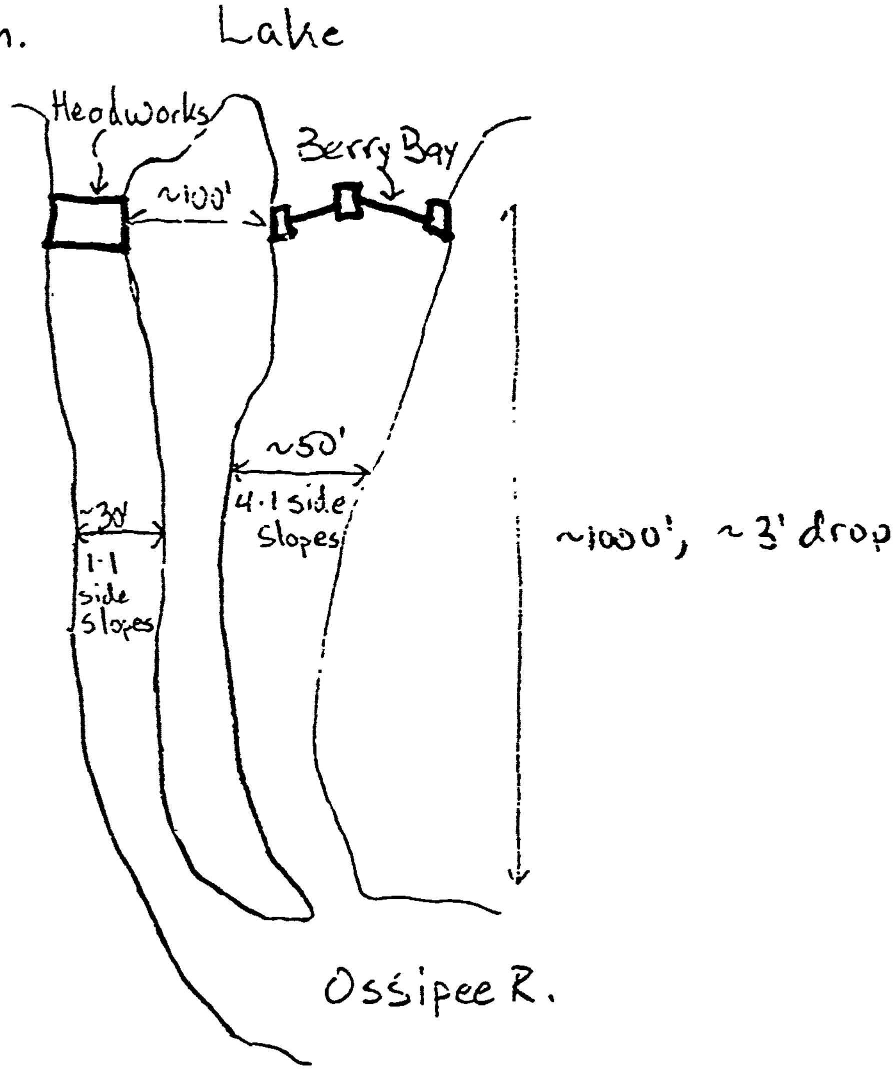
D-4



DRAINAGE AREA DELINEATION
OSSIPEE LAKE DAMS
DRAINAGE AREA = 357 SQ.MI.
SCALE 1:250,000

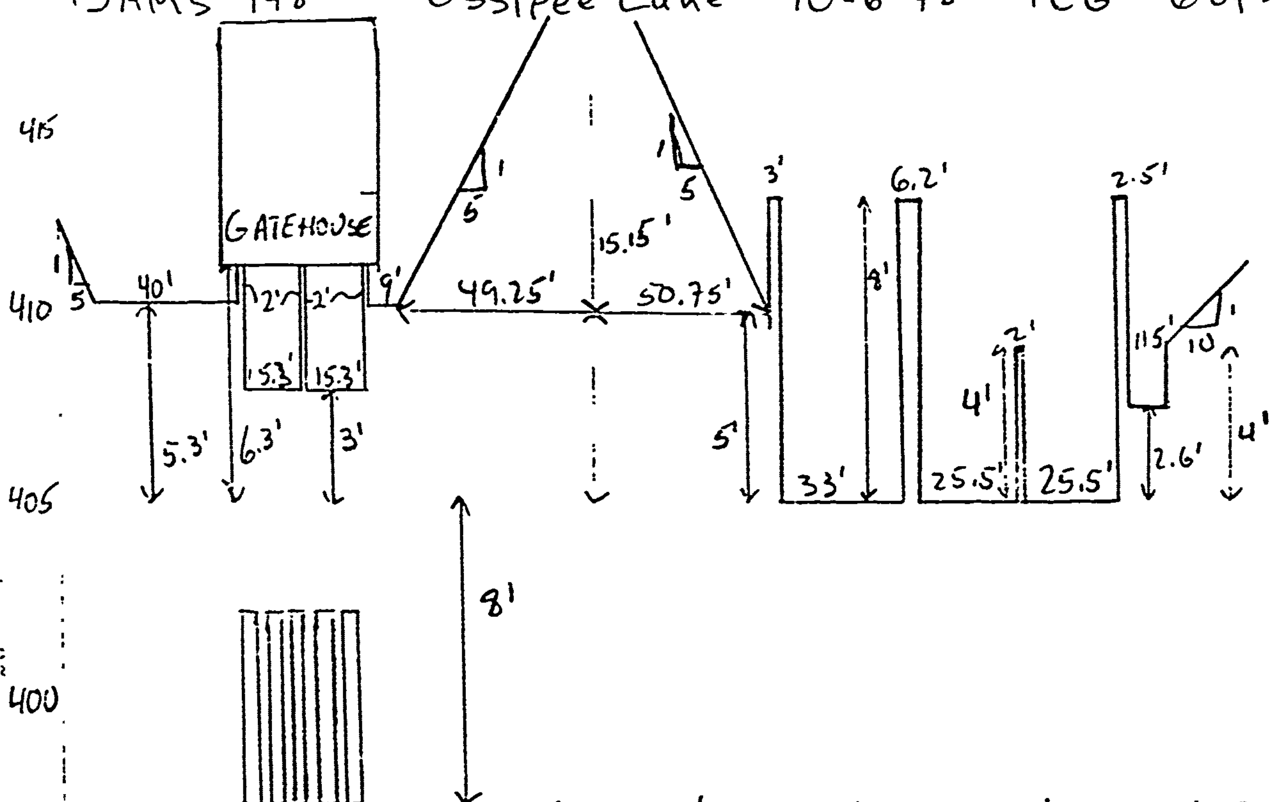
Ossipee Lake Dams:

The dams which form Ossipee Lake, Headworks Dam and Berry Bay Dam, are separated by an island, but form essentially one dam.



PLAN VIEW, NOT TO SCALE

DAMS 148 Ossipee Lake 10-6-78 TCG 6 of 32



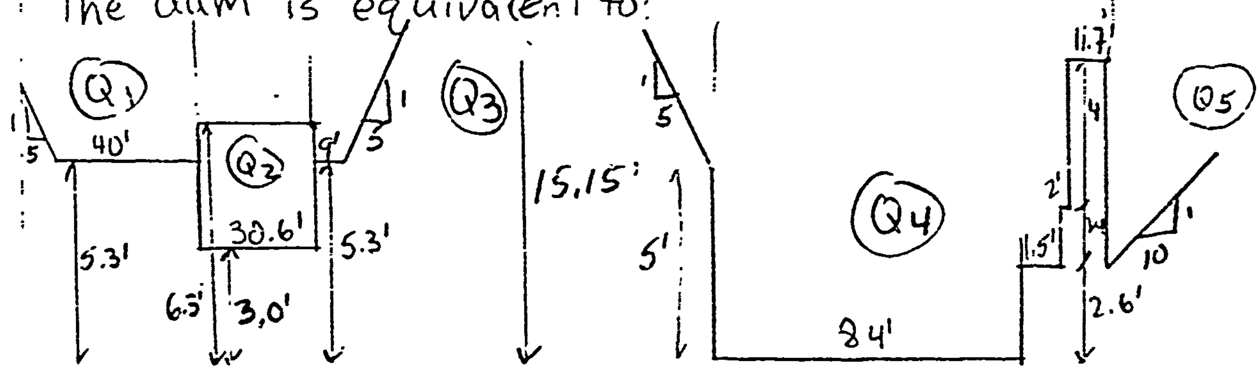
5 gates, 2-3.5'x5.08', 2-3.67'x5.08', 1-3.83'x5.08'

Elevation, 1" ≈ 5' vertically

1" ≈ 50' horizontally

The above schematic ignores the effect of the walkway over Berry Bay Dam. For calculations we assume that the gates act as orifices, that all gates are open, and that no stoplogs are in place.

The dam is equivalent to:



ODDDD gates = Q6

$H = 0$ at spillway crest.

For $H \le 0$

$Q_1 = Q_2 = Q_3 = Q_4 = Q_5 = 0$

$Q_6 = C_d A \sqrt{2gh} = .65\,(92.3)\,\sqrt{2g\,(H+5.46)}$ *

for $0 \le H \le 2.6$

$Q_6 =$ same

$Q_4 = 3.0\,(84)\,H^{3/2}$

$Q_1 = Q_2 = Q_3 = Q_5 = 0$

for $2.6 \le H \le 3.0$

$Q_4 = 3.0\,(84)\,H^{3/2} + 3.0\,(11.5)\,(H-2.6)^{3/2}$

$Q_6 =$ same

$Q_5 = 2.8\,(10\,(H-2.6))\,(.5\,(H-2.6))^{3/2}$

for $3.0 \le H \le 4.0$

$Q_4 =$ same

$Q_5 =$ same

$Q_6 =$ same

$Q_2 = 3.0\,(30.6)\,(H-3.0)^{3/2}$

for $4.0 \le H \le 5.0$

$Q_4 = 3.0\,(84)\,H^{3/2} + 3.0\,(11.5)\,H-2.6)^{3/2} + 3.0\,(2)\,(H-4)^{3/2}$

* Rouse, <u>Engineering Hydraulics</u>, p. 48

Q_2 = same

Q_5 = same

Q_6 = same

for $5 \le H \le 5.3$

Q_2 = Same

Q_4 = same

Q_5 = same

Q_6 = same

$Q_3 = 2.8(5(H-5))(.5(H-5))^{3/2}$

for $5.3 \le H \le 6.3$

Q_2 = same

$Q_3 = 2.8(5(H-5))(.5(H-5))^{3/2} + 2.8(5(H-5.3))(.5(H-5.3))^{3/2}$

Q_4 = same $\qquad + 3.0(9)(H-5.3)^{3/2}$

Q_5 = same

Q_6 = same

$Q_1 = 2.4(5(H-5.3))(.5(H-5.3))^{3/2} + 2.8(40)(H-5.3)^{3/2}$

for $6.3 \le H \le 8$

Q_1 = same

$Q_2 = .9(102.51)\sqrt{2g(H-4.65)}$

Q_3 = same

Q_4 = same

Q_5 = same

Q_6 = same

for $8 \le H \le 15.15$

Q_1 = Same

Q_2 = Same

Q_3 = same

$$Q_4 = 3.0(84)H^{3/2} + 3.0(11.5)(H-2.6)^{3/2} + 3.0(2)(H-4)^{3/2} + 3.0(11.7)(H-8)^{3/2}$$

Q_5 = same

Q_6 = same

for $H \ge 15.15$

Q_1 = same

Q_2 = same

$$Q_3 = 2.8(49.25)(H-12.73)^{3/2} + 2.8(50.75)(H-12.58)^{3/2} + 3.0(9)(H-5.3)^{3/2}$$

Q_4 = Same

Q_5 = Same

Q_6 = same

A program to calculate a stage-discharge relationship follows, with output.

```
100 REMARK: DISCHARGE CALCULATION FOR OSSIPEE LAKE DAMS - GATES OPEN
110 PAGE
120 E=1.5
130 PRINT "DISCHARGE FROM OSSIPEE LAKE DAMS - GATES OPEN"
140 PRINT USING 150:
150 IMAGE // 2T"HEAD"30T"DISCHARGE"
160 PRINT USING 170:
170 IMAGE 1T"(FEET)"32T"(CFS)"
180 PRINT USING 190:
190 IMAGE 10T"TOTAL    GATES   BERRY BAY   HEADWATER   ISLAND    BANKS"
200 REMARK:      Q1 is flow over the bank by Headwater Dam, Q2 is flow
210 REMARK: over Headwater Dam, Q3 is flow over the island between the
220 REMARK: two dams, Q4 is flow over Berry Bay Dam (the spillway), Q5
230 REMARK: is flow over the bank by Berry Bay Dam, and Q6 is flow
240 REMARK: through the gates.
250 FOR H=0 TO 27 STEP 0.5
260 Q4=3*84*H↑E
270 Q6=0.65*92.3*(2*32.2*(H+5.46))↑0.5
280 Q1=0
290 Q2=0
300 Q3=0
310 Q5=0
320 IF H<=2.6 THEN 540
330 Q9=3*11.5*(H-2.6)↑E
340 Q4=Q4+Q9
350 Q5=2.8*(10*(H-2.6))*(0.5*(H-2.6))↑E
360 IF H<=3 THEN 540
370 Q2=3*30.6*(H-3)↑E
380 IF H<=4 THEN 540
390 Q9=3*2*(H-4)↑E
400 Q4=Q4+Q9
410 IF H<=5 THEN 540
420 Q3=2.8*(5*(H-5))*(0.5*(H-5))↑E
430 IF H<=5.3 THEN 540
```

P. 10 of 32

P.110-32

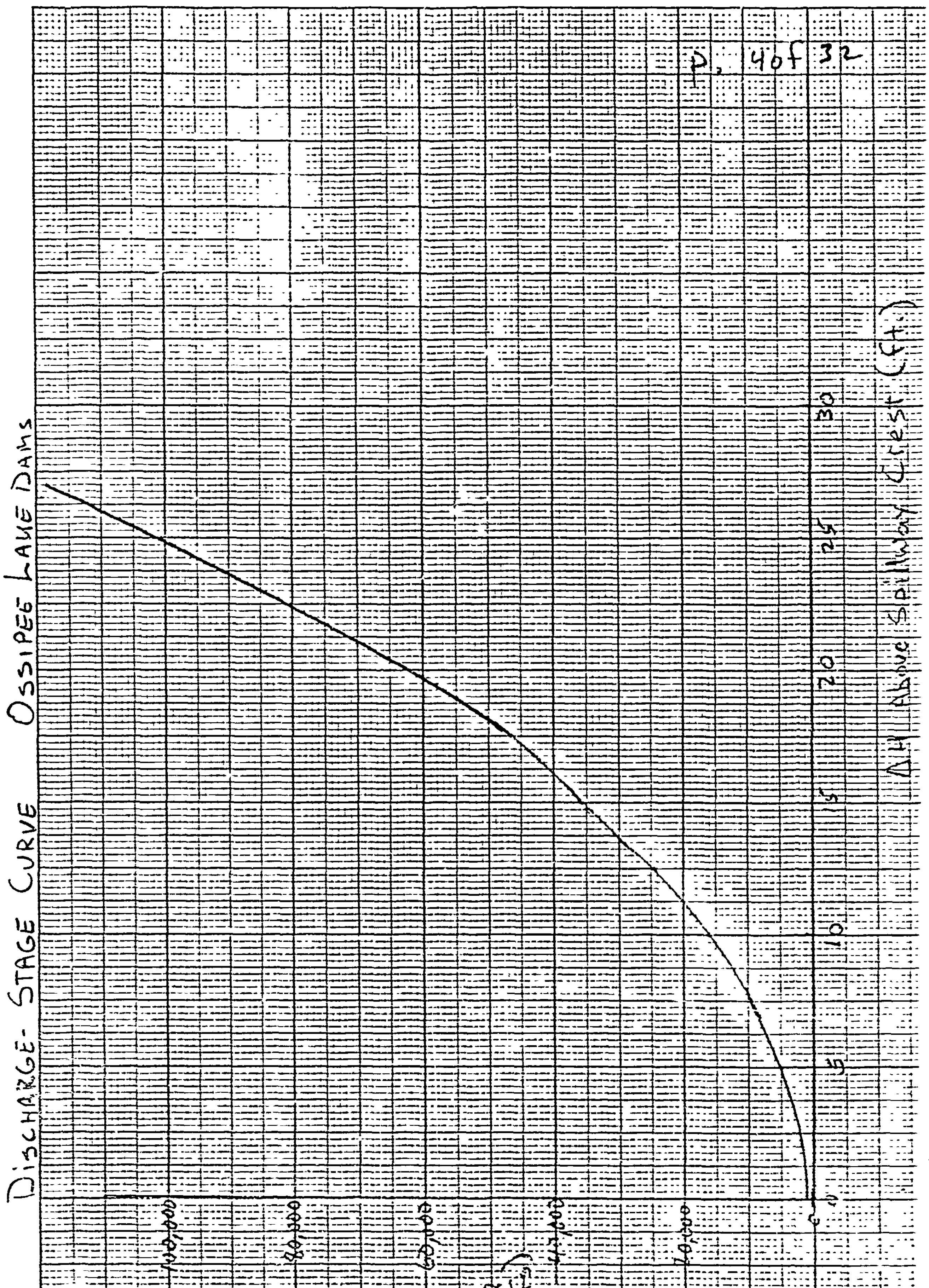
```
440 Q9=2.8*(5*(H-5.3))*(0.5*(H-5.3))↑E+3*9*(H-5.3)↑E
450 Q3=Q3+Q9
460 Q1=2.8*(5*(H-5.3))*(0.5*(H-5.3))↑E+2.8*40*(H-5.3)↑E
470 IF H<=6.3 THEN 540
480 Q2=0.9*102.51*(2*32.2*(H-4.65))↑0.5
490 IF H<=8 THEN 540
500 Q9=3*11.7*(H-8)↑E
510 Q4=Q9+Q4
520 IF H<=15.15 THEN 540
530 Q3=2.8*49.25*(H-12.73)↑E+2.8*50.75*(H-12.58)↑E+3*9*(H-5.3)↑E
540 Q7=Q1+Q2+Q3+Q4+Q5+Q6
550 Q8=Q1+Q5
560 PRINT USING 570:H,Q7,Q6,Q4,Q2,Q3,Q8
570 IMAGE 1T,2D.2D,9D,9D,11D,11D,10D,10D
580 NEXT H
590 END
```

P.12 of 32

DISCHARGE FROM OSSIPEE LAKE DAMS - GATES OPEN

HEAD (FEET)	DISCHARGE (CFS) TOTAL	GATES	BERRY BAY	HEADWATER	ISLAND	BANKS
0.00	1125	1125	0	0	0	0
0.50	1264	1175	89	0	0	0
1.00	1476	1224	252	0	0	0
1.50	1733	1270	463	0	0	0
2.00	2028	1315	713	0	0	0
2.50	2354	1358	996	0	0	0
3.00	2720	1400	1318	0	0	1
3.50	3161	1441	1680	32	0	8
4.00	3669	1481	2073	92	0	23
4.50	4235	1519	2498	169	0	49
5.00	4857	1557	2952	260	0	88
5.50	5544	1594	3432	363	3	152
6.00	6345	1630	3937	477	23	279
6.50	7647	1665	4466	1007	57	452
7.00	8627	1699	5017	1135	106	669
7.50	9672	1733	5589	1250	173	927
8.00	10788	1766	6183	1355	236	1227
8.50	11988	1799	6809	1453	359	1569
9.00	13274	1831	7465	1544	481	1953
9.50	14644	1862	8146	1631	624	2381
10.00	16098	1893	8851	1712	789	2853
10.50	17639	1923	9578	1791	977	3370
11.00	19267	1953	10327	1866	1188	3933
11.50	20983	1983	11097	1938	1424	4542
12.00	22790	2012	11885	2007	1685	5199
12.50	24688	2040	12695	2074	1973	5905
13.00	26679	2069	13523	2139	2287	6660
13.50	28764	2096	14370	2203	2630	7466
14.00	30946	2124	15234	2264	3001	8323

14.50	33224	2151	16116	2324	3401	9232
15.00	35600	2178	17015	2382	3831	10194
15.50	36009	2204	17931	2439	2224	11210
16.00	38526	2230	18864	2494	2659	12281
16.50	41149	2256	19813	2549	3124	13407
17.00	43868	2282	20778	2602	3618	14590
17.50	46686	2307	21758	2654	4138	15829
18.00	49602	2332	22754	2705	4683	17127
18.50	52614	2357	23765	2755	5253	18484
19.00	55723	2381	24791	2805	5846	19901
19.50	58928	2405	25832	2853	6461	21377
20.00	62229	2429	26887	2901	7097	22915
20.50	65626	2453	27956	2948	7754	24515
21.00	69119	2477	29040	2994	8431	26178
21.50	72708	2500	30137	3039	9128	27905
22.00	76394	2523	31248	3084	9843	29695
22.50	80175	2546	32373	3128	10577	31551
23.00	84052	2568	33511	3172	11329	33472
23.50	88026	2591	34663	3214	12098	35459
24.00	92096	2613	35827	3257	12885	37514
24.50	96264	2635	37005	3299	13688	39637
25.00	100528	2657	38195	3340	14508	41828
25.50	104890	2679	39398	3381	15343	44088
26.00	109349	2700	40614	3421	16195	46419
26.50	113906	2722	41841	3461	17062	48820
27.00	118561	2743	43082	3500	17944	51292


P. 4 of 32
DISCHARGE- STAGE CURVE OSSIPEE LAKE DAMS
ΔH Above Spillway Crest (Ft.)
0
5
10
15
20
25
30
Q (cfs)
0
20,000
40,000
60,000
80,000
100,000

Storage-Stage Relationship:

The storage-stage relationship at Ossipee Lake is complicated by the fact that the water surface elevation is not level at flood flows.

In 1954, Francis Moore of Central Maine Power Company obtained measurements of lake elevations during a flood flow. These are his results:

Elevations, May 11, 1954

Location	Elevation ('MSL)	Height above water level at dam
Dam	410.48	—
500' upstream	410.99	.51'
Berry Bay	411.49	1.01'
Leavitt Bay	411.56	1.08'
Broad Bay	411.77	1.29'
Ossipee Lake	412.56	2.08'

Since we are primarily concerned with surcharge storage at flood flows, we will use this data and the surface areas of the ponds to generate a surcharge-storage vs. elevation curve.

Location	surface area (acres)	Ht. above dam water level (ft)
Berry Bay	255	1.01
Leavitt Bay	255	1.08
Broad Bay	385	1.29
Ossipee Lake	3200	2.08

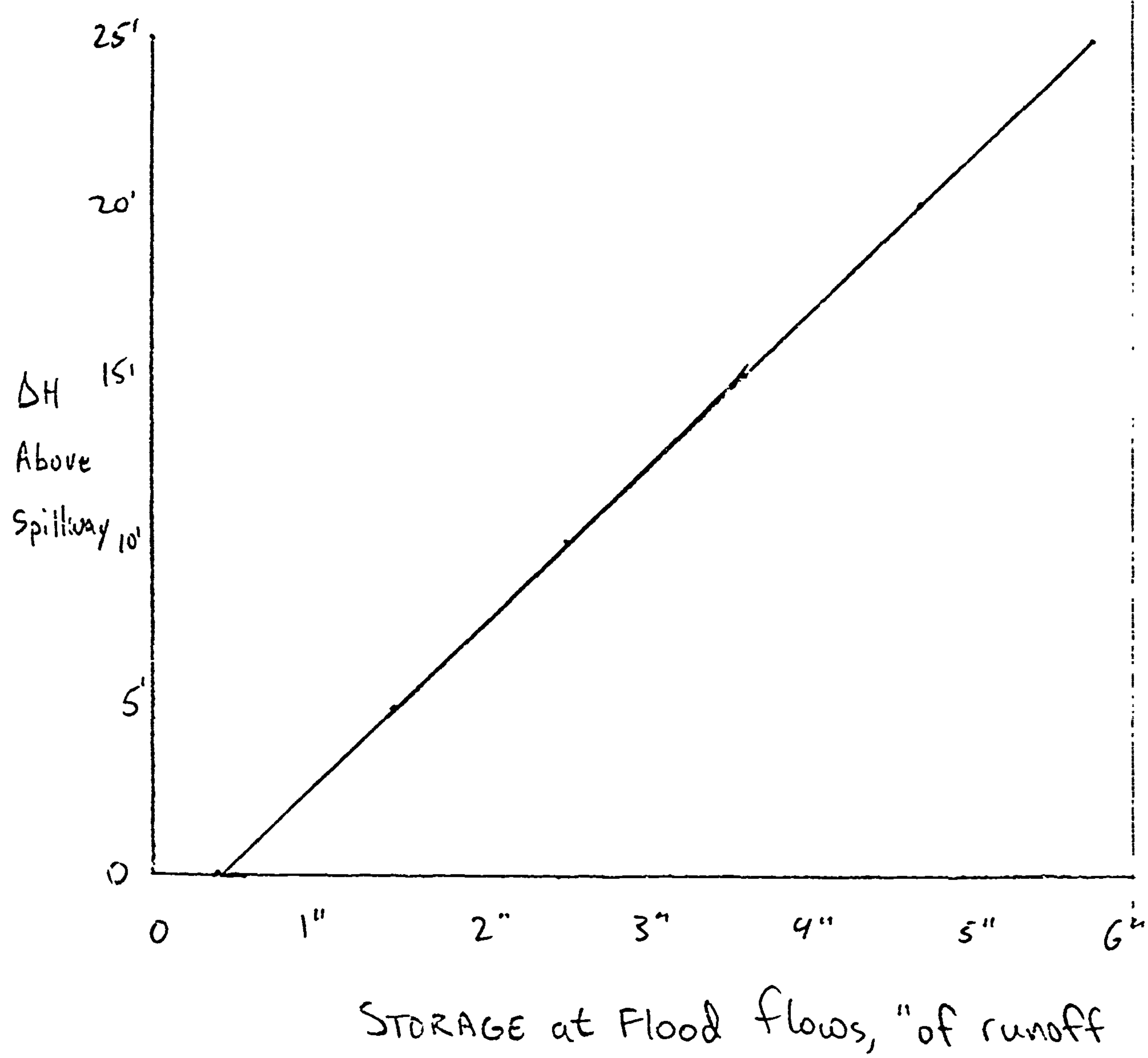
Listing of and output from a computer program to calculate surcharge storage at flood flows are attached.

The calculation assumes no spreading of the water surface as it rises.

The Drainage area of 357 sq.mi. means that 1" of runoff =

$$1'' \left(\frac{1'}{12''}\right)\left(357 \text{ sq.mi}\right)\left(\frac{640 \text{ ac}}{\text{sq.mi}}\right) = 19{,}040 \text{ ac-ft.}$$

At Flood Flows:



25'
20'
15'
ΔH
Above
Spillway
10'
5'
0
0
1"
2"
3"
4"
5"
6"
STORAGE at Flood flows, "of runoff

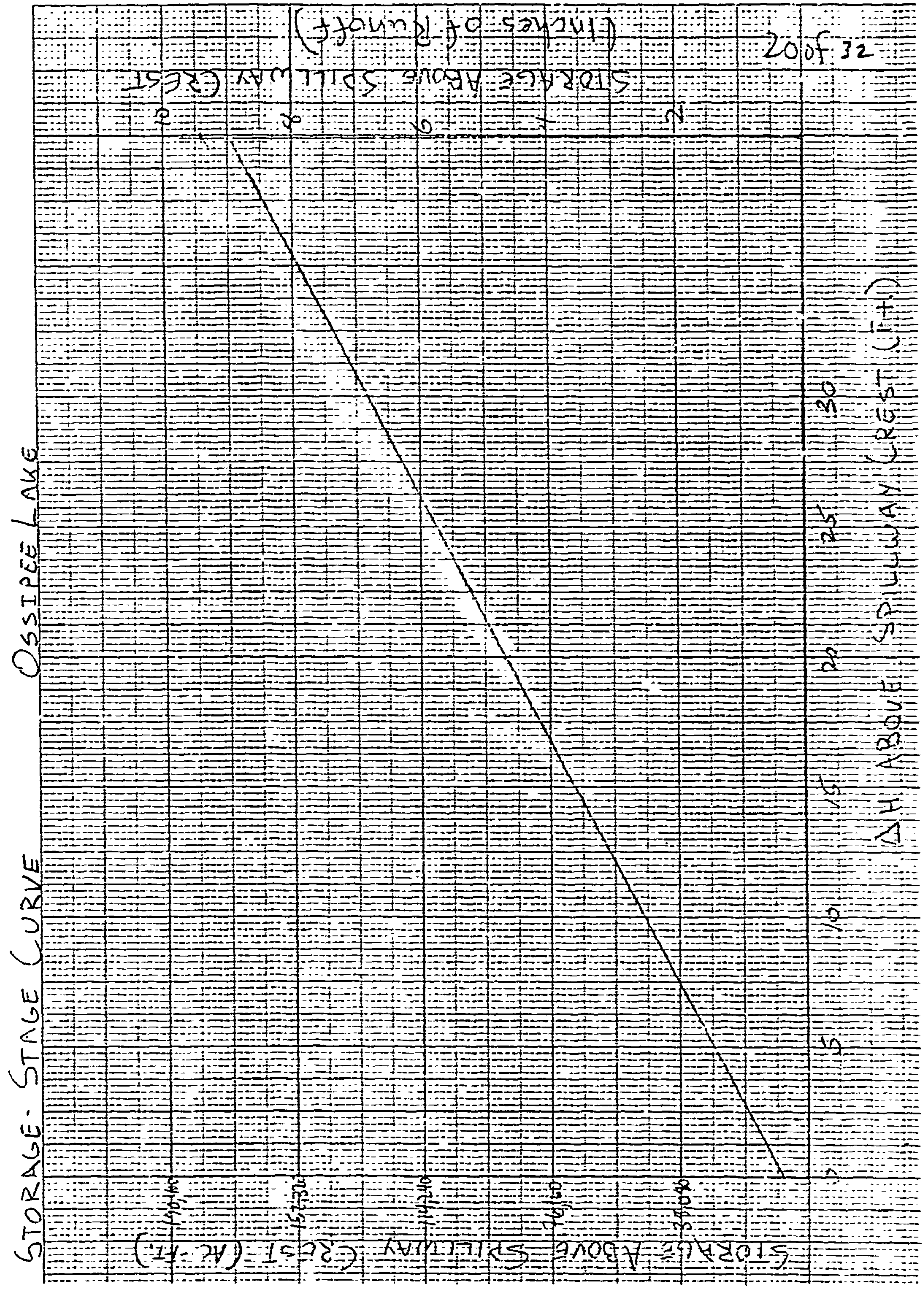
```
LIST
100 REMARK: SURCHARGE STORAGE AT FLOOD FLOWS FOR OSSIPEE LAKE
110 PAGE
120 PRINT "SURCHARGE STORAGE AT FLOOD FLOWS FOR OSSIPEE LAKE"
130 PRINT "  HEAD     SURCHARGE STORAGE"
140 PRINT " (FEET)        (ACRE-FEET)"
150 PRINT " "
160 FOR H=0 TO 27 STEP 1
170 A=255*(H+1.01)+255*(H+1.08)+385*(H+1.29)+3200*(H+2.08)
180 PRINT USING 190:H,A
190 IMAGE 3T,2D.2D,06X,9D
200 NEXT H
210 END
```

D-9 of 32

4. 95-32

SURCHARGE STORAGE AT FLOOD FLOWS FOR OSSIPEE LAKE

HEAD (FEET)	SURCHARGE STORAGE (ACRE-FEET)
0.00	7686
1.00	11781
2.00	15876
3.00	19971
4.00	24066
5.00	28161
6.00	32256
7.00	36351
8.00	40446
9.00	44541
10.00	48636
11.00	52731
12.00	56826
13.00	60921
14.00	65016
15.00	69111
16.00	73206
17.00	77301
18.00	81396
19.00	85491
20.00	89586
21.00	93681
22.00	97776
23.00	101871
24.00	105966
25.00	110061
26.00	114156
27.00	118251


STORAGE-STAGE CURVE
OSSIPEE LAKE
20 of 32
STORAGE ABOVE SPILLWAY CREST (AC-FT.)
STORAGE ABOVE SPILLWAY CREST
(Inches of Runoff)
ΔH ABOVE SPILLWAY CREST (FT.)
5
10
15
20
25
30
76,140
20 X 20 PER INCH

REDUCTION IN FLOW DUE to STORAGE

Assume total storm volume = 10"

Use COE suggested methodology with additional iterations.

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{STOR1}{10}\right)$$

(1) Q_{P_1} = 50,000 cfs → H = 14.06' → 81,640 ACFt $\left(\frac{1}{19040}\right)$
= 4.29

Q_{P_2} = 50,000 $\left(1 - \frac{4.29}{10}\right)$ = 28,560 cfs

(2) Q_{P_2} = 28,560 H = 13.45' → STOR = 3.30

Q_{P_3} = 50,000 $\left(1 - \frac{3.30}{10}\right)$ = 33,500

(3) Q_{P_3} = 33,500 → H = 14.56' → STOR = 3.54

Q_{P_4} = 50,000 $\left(1 - \frac{3.54}{10}\right)$ = 32,300 cfs

(4) Q_{P_4} = 32,300 → H = 14.3 → STOR = 3.48

USE STOR = $\frac{3.48 + 3.54}{2}$ = 3.51

Q_P = 50,000 $\left(1 - \frac{3.51}{10}\right)$ = 32,450

→ H = 14.33' above spillway, which is 11.3 above the crest of Headworks Dam, and 8.0' above the bottom of the gatehouse.

We can use the Height above Dam water level shown on p. 16 to estimate water levels in various locations

LOCATION	Height Above Crest	Elevation
Spillway	14.3	419.3
Berry Bay	15.3	420.3
Leavitt Bay	15.4	420.4
Broad Bay	15.6	420.6
Ossipee Lake	16.4	421.4

CALCULATION OF Estimate Downstream Dam Failure FLOOD STAGES- BASED ON COE "RULE OF THUMB" GUIDELINES, April, 1978.

It is unlikely that the two dams which form Ossipee Lake would fail simultaneously. Therefore, to estimate downstream flood stages, we will first establish the flow caused the failure of each dam at the point where the channels unite. We will then route the larger of the two flows downstream.

STEP 1: RESERVOIR STORAGE AT TIME OF FAILURE;

Assume failure occurs with flood flows when the water overtops the concrete cutoff wall.

A. Headworks Dam: Elevation = 410.3 H: 5.3
STORAGE = 23,300 + 29,390 = 52,690 Ac-Ft.

B. BERRY BAY DAM: Elevation: 410 ft, H: 5.0
STORAGE = 23,300 + 28,161 = 51,460 Ac-Ft.

STEP 2 PEAK FAILURE OUTFLOW

$$Q_{p1} = 8/27\ W_b \sqrt{g}\ y_o^{3/2}$$

A. Headworks: W_b = 30', Y_o = 410.3 - 396 = 14.3

$Q_{p_1} = 8/27\ (30)\ \sqrt{32.2}\ (410.3 - 396)^{3/2} = 2728\ cfs$

B, Berry Bay : $W_b = 40$, $y_0 = 410 - 400 = 10'$

$Q_{p_1} : 8/27 (40)\ \sqrt{32.2}\ (10)^{3/2} = 2127\ cfs$

STEP 3: Develop Stage-Discharge Routing for Down stream Reaches

ASSUMED Cross-Sections for the Downstream Reaches shown on p. 5 and on the U.S.G.S. topo are plotted below.

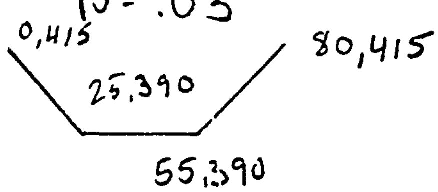
REACH 1:

A. Headworks Dam side

$L = 1000'$

$S = \frac{3}{1000} = .003$

$N = .03$

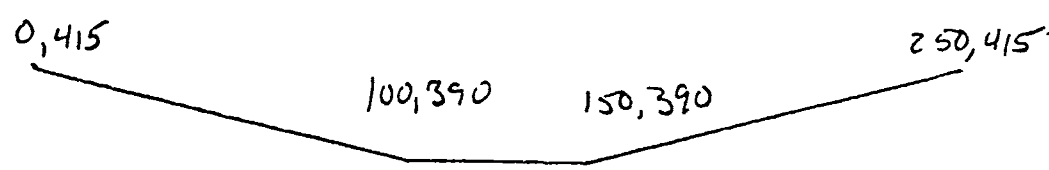


B. Berry Dam Side

$L = 100'$

$S = .003$

$n = .03$

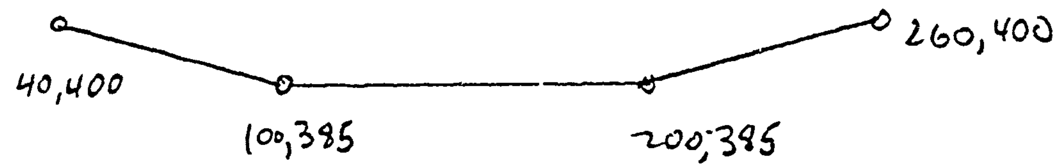


REACH 2:

L = 2250

S = .002

n = .04

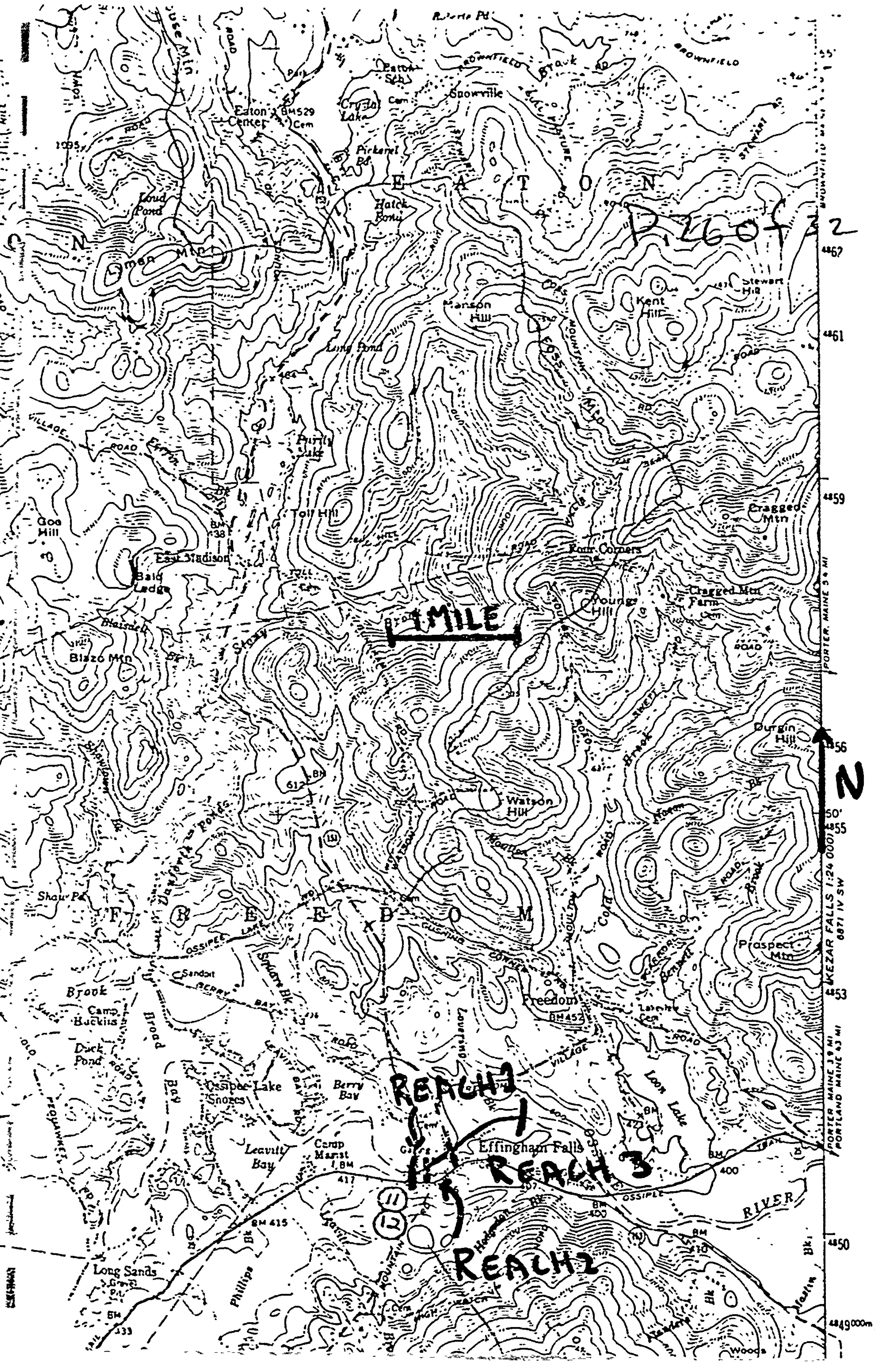


REACH 3:

L = 3400

S = .002

n = .04


Eaton Center
Snowville
Crystal Lake
Pickerel Pd
E A T O N
Loud Pond
Hatch Pond
Omen Mtn
Manson Hill
Kent Hill
Stewart Hill
Long Pond
Purity Lake
Toll Hill
Goe Hill
East Madison
Bald Ledge
Four Corners
Cragged Mtn
Young Hill
Cragged Mtn Farm
1 MILE
Blazo Mtn
Durgin Hill
N
Watson Hill
Shaw Pd
F R E E D O M
Prospect Mtn
Freedom
Brook
Camp Huckins
Duck Pond
Ossipee Lake Shores
Berry Bay
Leavitt Bay
Camp Marist
REACH 1
Effingham Falls
REACH 3
Loon Lake
RIVER
REACH 2
Long Sands
KEZAR FALLS 1:24 000
6871 IV SW
PORTER, MAINE 3.4 MI
4849000m N.

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	390.0	0.0	0.0	0.0	0.0	0.0
0.5	390.5	15.3	31.4	0.5	9.4	25.6
1.0	391.0	31.0	32.8	0.9	29.8	81.2
1.5	391.5	47.3	34.2	1.4	58.6	159.3
2.0	392.0	64.0	35.7	1.8	94.5	257.2
2.5	392.5	81.3	37.1	2.2	137.1	373.0
3.0	393.0	99.0	38.5	2.6	185.9	505.8
3.5	393.5	117.3	39.9	2.9	240.6	654.6
4.0	394.0	136.0	41.3	3.3	301.1	819.0
4.5	394.5	155.3	42.7	3.6	367.1	998.6
5.0	395.0	175.0	44.1	4.0	438.6	1193.0
5.5	395.5	195.3	45.6	4.3	515.4	1402.1
6.0	396.0	216.0	47.0	4.6	597.6	1625.7
6.5	396.5	237.3	48.4	4.9	685.1	1863.8
7.0	397.0	259.0	49.8	5.2	777.9	2116.2
7.5	397.5	281.3	51.2	5.5	876.0	2382.9
8.0	398.0	304.0	52.6	5.8	979.3	2664.0
8.5	398.5	327.3	54.0	6.1	1087.9	2959.4
9.0	399.0	351.0	55.5	6.3	1201.7	3269.2
9.5	399.5	375.3	56.9	6.6	1320.9	3593.4
10.0	400.0	400.0	58.3	6.9	1445.5	3932.2
10.5	400.5	425.3	59.7	7.1	1575.4	4285.6
11.0	401.0	451.0	61.1	7.4	1710.7	4653.6
11.5	401.5	477.3	62.5	7.6	1851.4	5036.4
12.0	402.0	504.0	63.9	7.9	1997.5	5434.0
12.5	402.5	531.3	65.4	8.1	2149.2	5846.6
13.0	403.0	559.0	66.8	8.4	2306.4	6274.3
13.5	403.5	587.3	68.2	8.6	2469.2	6717.2
14.0	404.0	616.0	69.6	8.9	2637.7	7175.4
14.5	404.5	645.3	71.0	9.1	2811.8	7649.0

P. 27 of 32.

OSSIPEE LAKE DAMS - REACH 1A (HEADWORKS DAM CHANNEL)

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	390.0	0.0	0.0	0.0	0.0	0.0
0.5	390.5	26.0	54.1	0.5	15.9	43.4
1.0	391.0	54.0	58.2	0.9	51.3	139.7
1.5	391.5	84.0	62.4	1.3	102.5	278.7
2.0	392.0	116.0	66.5	1.7	168.1	457.4
2.5	392.5	150.0	70.6	2.1	247.9	674.5
3.0	393.0	186.0	74.7	2.5	341.7	929.5
3.5	393.5	224.0	78.9	2.8	449.4	1222.6
4.0	394.0	264.0	83.0	3.2	571.3	1554.1
4.5	394.5	306.0	87.1	3.5	707.4	1924.4
5.0	395.0	350.0	91.2	3.8	858.1	2334.4
5.5	395.5	396.0	95.4	4.2	1023.6	2784.6
6.0	396.0	444.0	99.5	4.5	1204.2	3275.9
6.5	396.5	494.0	103.6	4.8	1400.2	3809.1
7.0	397.0	546.0	107.7	5.1	1611.9	4385.1
7.5	397.5	600.0	111.8	5.4	1839.7	5004.6
8.0	398.0	656.0	116.0	5.7	2083.8	5668.7
8.5	398.5	714.0	120.1	5.9	2344.6	6378.3
9.0	399.0	774.0	124.2	6.2	2622.5	7134.1
9.5	399.5	836.0	128.3	6.5	2917.7	7937.2
10.0	400.0	900.0	132.5	6.8	3230.6	8788.5
10.5	400.5	966.0	136.6	7.1	3561.6	9688.8
11.0	401.0	1034.0	140.7	7.3	3910.9	10639.0
11.5	401.5	1104.0	144.8	7.6	4278.9	11640.2
12.0	402.0	1176.0	149.0	7.9	4666.0	12693.1
12.5	402.5	1250.0	153.1	8.2	5072.4	13798.7
13.0	403.0	1326.0	157.2	8.4	5498.5	14957.9
13.5	403.5	1404.0	161.3	8.7	5944.5	16171.6
14.0	404.0	1484.0	165.4	9.0	6411.1	17440.6
14.5	404.5	1566.0	169.6	9.2	6898.3	18765.8

OSSIPEE LAKE DAMS - REACH 1B (BERRY BAY DAM CHANNEL)

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	385.0	0.0	0.0	0.0	0.0	0.0
0.5	385.5	51.0	104.1	0.5	31.7	52.8
1.0	386.0	104.0	108.2	1.0	101.3	168.7
1.5	386.5	159.0	112.4	1.4	200.4	333.9
2.0	387.0	216.0	116.5	1.9	326.1	543.2
2.5	387.5	275.0	120.6	2.3	476.5	793.8
3.0	388.0	336.0	124.7	2.7	650.7	1084.0
3.5	388.5	399.0	128.9	3.1	847.9	1412.6
4.0	389.0	464.0	133.0	3.5	1067.8	1778.9
4.5	389.5	531.0	137.1	3.9	1310.1	2182.5
5.0	390.0	600.0	141.2	4.2	1574.6	2623.1
5.5	390.5	671.0	145.4	4.6	1861.3	3100.6
6.0	391.0	744.0	149.5	5.0	2170.1	3615.0
6.5	391.5	819.0	153.6	5.3	2501.0	4166.4
7.0	392.0	896.0	157.7	5.7	2854.3	4754.9
7.5	392.5	975.0	161.8	6.0	3230.0	5380.7
8.0	393.0	1056.0	166.0	6.4	3628.2	6044.1
8.5	393.5	1139.0	170.1	6.7	4049.1	6745.3
9.0	394.0	1224.0	174.2	7.0	4492.9	7484.6
9.5	394.5	1311.0	178.3	7.4	4959.8	8262.4
10.0	395.0	1400.0	182.5	7.7	5450.0	9078.9
10.5	395.5	1491.0	186.6	8.0	5963.6	9934.7
11.0	396.0	1584.0	190.7	8.3	6501.1	10830.0
11.5	396.5	1679.0	194.8	8.6	7062.5	11765.2
12.0	397.0	1776.0	199.0	8.9	7648.1	12740.7
12.5	397.5	1875.0	203.1	9.2	8258.1	13757.0
13.0	398.0	1976.0	207.2	9.5	8892.9	14814.4
13.5	398.5	2079.0	211.3	9.8	9552.6	15913.4
14.0	399.0	2184.0	215.4	10.1	10237.6	17054.4
14.5	399.5	2291.0	219.6	10.4	10947.9	18237.9

'OSSIPEE LAKE DAMS - REACH 2

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	380.0	0.0	0.0	0.0	0.0	0.0
0.5	380.5	101.0	204.1	0.5	63.2	105.2
1.0	381.0	204.0	208.2	1.0	201.2	335.2
1.5	381.5	309.0	212.4	1.5	396.8	661.0
2.0	382.0	416.0	216.5	1.9	643.1	1071.3
2.5	382.5	525.0	220.6	2.4	936.1	1559.3
3.0	383.0	636.0	224.7	2.8	1272.9	2120.5
3.5	383.5	749.0	228.9	3.3	1651.7	2751.5
4.0	384.0	864.0	233.0	3.7	2070.9	3449.9
4.5	384.5	981.0	237.1	4.1	2529.4	4213.7
5.0	385.0	1100.0	241.2	4.6	3026.3	5041.5
5.5	385.5	1221.0	245.4	5.0	3560.9	5932.0
6.0	386.0	1344.0	249.5	5.4	4132.6	6884.4
6.5	386.5	1469.0	253.6	5.8	4740.9	7897.7
7.0	387.0	1596.0	257.7	6.2	5385.4	8971.3
7.5	387.5	1725.0	261.8	6.6	6065.8	10104.9
8.0	388.0	1856.0	266.0	7.0	6782.0	11297.9
8.5	388.5	1989.0	270.1	7.4	7533.6	12550.1
9.0	389.0	2124.0	274.2	7.7	8320.7	13861.2
9.5	389.5	2261.0	278.3	8.1	9143.0	15231.0
10.0	390.0	2400.0	282.5	8.5	10000.5	16659.5
10.5	390.5	2541.0	286.6	8.9	10893.2	18146.6
11.0	391.0	2684.0	290.7	9.2	11821.0	19692.3
11.5	391.5	2829.0	294.8	9.6	12784.0	21296.5
12.0	392.0	2976.0	299.0	10.0	13782.2	22959.3
12.5	392.5	3125.0	303.1	10.3	14815.6	24680.8
13.0	393.0	3276.0	307.2	10.7	15884.3	26461.2
13.5	393.5	3429.0	311.3	11.0	16988.4	28300.4
14.0	394.0	3584.0	315.4	11.4	18127.9	30198.7
14.5	394.5	3741.0	319.6	11.7	19303.0	32156.3

OSSIPEE LAKE DAMS - REACH 3

32

STEP 4: CALCULATE DOWNSTREAM ATTENUATION

REACH 1-A:

$Q_{P1} = 2730$

$H = f(Q_{P1}) = 8.11'$

AREA at $8.11' = 309.1$ sq. ft.

$V_1 = L_1 \times AREA = \frac{309.1\,(1000)}{43,560} = 7.10$ ac.-ft.

$QP2T = QP1\left(1 - \frac{7.10}{52,690}\right) \rightarrow$ unattenuated

REACH 1B:

$Q_{P1} = 2130$ cfs

$H = 4.75' \rightarrow A = 285$ sq. ft.

$V = \frac{285\,(1000)}{43560} = 6.54$ Ac.

$QP2T = QP1\left(1 - \frac{6.54}{51,460}\right) \rightarrow$ unattenuated.

The flow from REACH 1-A, failure of Headworks Dam, is greater.

REACH 2:

$QP1 = 2730 \rightarrow H = 5.1' \rightarrow A = 614.2$ sq. ft.

$V = \frac{614.2\,(2250)}{43,560} = 31.73$

$QP2T = QP1\left(1 - \frac{31.73}{52,690}\right) \rightarrow$ unattenuated.

REACH 3:

$QP1 = 2730 \rightarrow H = 3.48' \rightarrow A = 747$ sq.ft.

$$V = \frac{747(3400)}{43560} = 58.31 \text{ Ac-ft}$$

$$QP2T = \left(1 - \frac{58.31}{52{,}690}\right) \rightarrow \text{unattenuated.}$$

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
NH	329	NED	NH	003	01				BERRY BAY DAM	4347.7	7103.7	13NOV78

POPULAR NAME	NAME OF IMPOUNDMENT
	OSSIPEE LAKE-LEAVITT BAY-BERRY BAY

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	04	OSSIPEE RIVER	EFFINGHAM FALLS	1	360

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
C1PG	1919	HR	5	6	47200	25300	NED	N	N	N	N	13DEC78

REMARKS
22-ALTERED 1944

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
3	109	U	84	1320												

OWNER	ENGINEERING BY	CONSTRUCTION BY
CENTRAL MAINE POWER CO		

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RSRCS BD	NH WATER RSRCS BD	NH WATER RSRCS BD	NH WATER RSRCS BD

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
GOLDBERG ZOINO DUNNICLIFF + ASSOC	12SEP78	PUBLIC LAW 92-367

REMARKS
47-1944 ALTERATIONS BY NEPSCO 32-ADDITIONAL EMERGENCY SPILLWAY 11.5 FT

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONG. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
NH	328	NED	NH	003	01				HEAD WORKS DAM	4347.7	7103.7	13NOV78

POPULAR NAME	NAME OF IMPOUNDMENT
	OSSIPEE LAKE-LEAVITT BAY-HERRY BAY

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	04	OSSIPEE RIVER	EFFINGHAM FALLS	1	360

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUC-TURAL HEIGHT (FT.)	HYDRAU-LIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
CTPG	1919	HR	12	12	47200	23300	NED	N	N	N	N	13DEC78

REMARKS

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
3	33															

OWNER	ENGINEERING BY	CONSTRUCTION BY
CENTRAL MAINE POWER CO		

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RSRCS BD	NH WATER RSRCS BD	NH WATER RSRCS BD	NH WATER RSRCS BD

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
GOLDBERG ZOINO DUNNICLIFF + ASSOC	12SEP78	PUBLIC LAW 92-367

REMARKS
31-ADJACENT HERRY BAY DAM SERVES AS SPILLWAY