DRAFT

BRISTOL MILLS DAM

INSPECTION / EVALUATION REPORT

DAM NAME:	**Bristol Mills Dam**
STATE DAM ID#:	**06063**
NID ID#:	**ME00280**
MEMA ID#:	**077**
OWNER:	**Town of Bristol**
TOWN:	**Bristol, Maine**
CONSULTANT:	**Wright-Pierce**
DATE OF INSPECTION:	**September 24, 2015**

WRIGHT-PIERCE
Engineering a Better Environment

EXECUTIVE SUMMARY

This Inspection/Evaluation Report details the inspection and evaluation of the Bristol Mills Dam (ME-00280) located in the Town of Bristol, Lincoln County, Maine on the Pemaquid River near the village of Bristol. The inspection was conducted on September 24, 2015 by Wright-Pierce.

Bristol Mills Dam is currently classified as an **Intermediate, Low** Hazard dam.

In general, Bristol Mills Dam was found to be in **Fair to Poor condition** with the following major deficiencies noted;

1. Cracks along the downstream abutment at the former penstock outfall result in water leakage
2. Voids at bottom of downstream wall may result in water leakage
3. There is vegetation along the upstream embankment
4. There is concrete spalling around the former intake structure and in the sluiceway channel resulting in exposed stones and concrete.

More detailed descriptions, additional deficiencies, recommended repairs, and opinions of probable repair costs are provided within this report.

It should be noted that a detailed Inflow Design Flood Study (IDF) was not performed as part of this study.

Wright-Pierce recommends that the following actions be taken to address the deficiencies found at the dam during the inspection and evaluation:

1. Repair the cracking on the downstream face by grouting the cracks
2. Fill the voids along the toe of the dam
3. Repair the spalled concrete areas along the upstream intake and sluiceway areas.
4. Prepare an Emergency Action Plan for the Dam
5. Prepare a structural stability analysis of the dam
6. Perform an Inflow Design Flood Study (IDF) to determine the appropriate design IDF and further evaluate the dam's spillway capacity to determine stability during the IDF event.

The repairs and recommendations noted above and described in more detail herein should be made in accordance to standard design practices, specifications and construction methods. Design of the repairs analyses to confirm the extent or the work should be completed by a qualified professional engineer experienced in the design and rehabilitation of dams throughout the evaluation, design and construction process.

PREFACE

The assessment of the general condition of the dam reported herein was based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations were beyond the scope of this report unless reported otherwise.

In reviewing this report, it should be realized that the reported condition of the dam was based on observations of field conditions at the time of inspection, along with data available to the inspection team.

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

Jan Wiegman, P.E.
Maine License No.: 5852
Project Manager
Wright-Pierce

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Page No.

APPENDICES

SECTION 1

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The Town of Bristol retained Wright-Pierce to perform a visual inspection and develop an Inspection/Evaluation report of conditions for the Bristol Mill dam in the Town of Bristol, Lincoln County, Maine. This inspection and report were performed in accordance with Maine Revised Statutes Title 37-B"Department of Defense, Veterans and Emergency Management" Chapter 24 Dam Safety.

1.1.2 Purpose of Work

The purpose of this investigation was to inspect and evaluate the present condition of the dam and appurtenant structures to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

The investigation was divided into four parts: 1) obtain and review available reports, investigations, and data previously submitted to the owner pertaining to the dam and appurtenant structures; 2) perform a visual inspection of the site; 3) evaluate the status of an emergency action plan for the site and; 4) prepare and submit a final report presenting the evaluation of the structure, including recommendations and remedial actions, and opinion of probable costs.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in Appendix D. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; and 5) miscellaneous.

1.2 Description of Project

Sections of this report are based upon available documentation, including previous inspection reports and other available information as identified in Appendix C. Other historical information obtained during the inspection, has been incorporated into this report. This material is intended to provide general information. The accuracy of this referenced information was not verified as it was outside the scope of work for this inspection.

The completion of detailed stability analyses, subsurface investigations, and underwater investigations are beyond the scope of this evaluation.

1.2.1 Location

Bristol Mills Dam, also known as Pemaquid River Dam, is located on the Pemaquid River in the Town of Bristol, Lincoln County, Maine. The dam was reportedly built by Lincoln County Electric Company in 1914. The dam impounds water from the Pemaquid River and is located at the southern end of the impoundment. The Pemaquid River originates from a series of three

nearby ponds, Pemaquid, McCurdy and Biscay ponds The center of the dam spillway is located at coordinates latitude 43^0 57.608' North and longitude 69^0 30.552' West.

There is no road over the dam. The dam is unsecured and can be accessed from the right embankment (west) from the Bristol Dam Loop or from the left embankment (east) cross private property.

The location of the Bristol Mills Dam and impoundment are shown in Figure 1: Locus Plan. An aerial photograph of the dam is provided as Figure 2: Aerial Map.

1.2.2 Owner/Caretaker

See Table 1.1 (end of this section) for current owner and caretaker data (names and contact information).

1.2.3 Purpose of the Dam

As indicated Table 1.1 the current purpose of the dam is for fishing, swimming and recreational use and as a source for fire protection water supply. The dam was apparently originally constructed for electrical generation purposes.

1.2.4 Description of the Dam and Appurtenances

Bristol Mills Dam, (National ID ME00280 / State ID 05063 MEMA ID 077) as shown in Figure 5: Site Sketch consists of a concrete gravity dam with a spillway, an old intake structure and an east wall with a fishway.

The dam appears to be founded on ledge with rock out croppings observed at the toe of the dam, along the western abutment and at the intake structure. No earth embankments are associated with this structure.

The dam is approximately 16 feet high at its maximum and 110 feet in length. The 36 foot long spillway is a broad crested weir with a flat 5 foot wide crest and battered upstream and downstream faces. The spillway crest contains three bays separated by 1 foot high by 2 foot wide piers and slots for stop logs. A 3 foot wide by 3.5 foot deep sluiceway is also incorporated into the crest of the structure. The sluiceway has stop log channels on the upstream side of the sluiceway.

In the center of the dam is a 20 foot wide former intake structure which was part of the former hydropower plant and contains a 64 inch steel penstock. The top of the intake is 12 feet wide and is 3 feet above the crest of the dam. The upstream end of the penstock is still open and there is a rectangular opening under the slab. The downstream face of the penstock has been filled with concrete and has a 12" diameter steel pipe with a butterfly valve as a low level outlet through the former penstock opening. It is not visible where the concrete fill of the penstock ends.

The primary water level control is through a three foot wide sluiceway with stop logs in the center of the dam. In addition there are three 5 foot wide be 1 foot deep weirs with stop logs on the spillway. The overall lowest spillway along the right side of the dam has a length of 33 feet and is a 5 foot wide broad crested weir. The fishway gate provides a secondary high water impoundment water level control and consists of a 3 foot wide by 5 foot tall hand operated wooden gate.

1.2.5 Operations and Maintenance

The dam is operated and maintained by the Town of Bristol, Maine.

1.2.6 Size Classification

Bristol Mills Dam height varies from 10 feet to 16 feet and has a maximum storage capacity of 8,534 acre-feet. Refer to Appendix D for definitions of height of dam and storage.

Bristol Mills Dam is an **Intermediate** size structure.

1.2.7 Hazard Potential Classification

The dam controls flow on the Pemaquid River, which begins at the outlet of Biscay Pond and flows south about 3 miles to the Bristol Mills Dam then flows south to Boyd Pond and then outlets to the Fossett's Cove in the Atlantic Ocean.

There is a bridge approximately 300 feet downstream of the dam and several residences along the river below the bridge. According to the State MEMA files the dam has a low hazard rating.

1.3 Pertinent Engineering Data

1.3.1 Impoundment

According to prior dam inspections the impoundment has a surface area of approximately 2,000 acres and a maximum storage of 8,534 acre-feet. The watershed area is approximately 31.9 square miles and includes the Pemaquid Chain of Lakes The drainage area is predominantly gently sloping and forested with some development, primarily seasonal and permanent residences on the shores of Biscay, Pemaquid and McCurdy Ponds.

1.3.2 Reservoir

The reservoir also known as Bristol Pond is a relatively small body of water between the dam and the Bridge immediately upstream of the dam. The impoundment extends northward and has a minor influence on the water levels in Biscay Pond approximately 14,000 feet up river. Biscay Pond does not have any outlet control other than the Pemaquid River.

1.3.3 Discharges at the Dam Site

No records of peak extreme discharges from the dam site were found nor reviewed.

1.3.4 General Elevations (feet)

Elevations are based upon an On-Ground Survey performed by Wright-Pierce. Vertical Datum is referenced to NGVD29.

A.	Top of Dam (at Concrete Pad)	Elevation 78.8+/- Feet
B.	Left dam crest	Elevation 80.4 +/- Feet
C.	Normal Pool	Elevation 77.0 +/- Feet
D.	Spillway Crest	Elevation 76.0 +/- Feet
E.	Upstream Water at Time of Inspection	Elevation 74.1 +/- Feet

F. Downstream Water at Time of Inspection — Elevation 62 +/- Feet

1.3.5 Main Spillway Data

A. Type — Broad crested, concrete spillway/weir
B. Weir Length — 33 +/- Feet
C. Weir Crest Elevation — Elevation 77.0 +/- Feet

1.3.7 Design and Construction Records and History

No construction records are available for this structure. A chronological record of significant events involving repairs is as follows;

- Circa 1914 – Built by Lincoln County Electric Company
- 1994 – Significant reconstruction work conducted on the dam
- 1998 – Inspection Report by MBP Consulting
- 1999 – Dam Condition and Hazard Inspections by Maine Emergency Management Agency

1.3.8 Operating Records

Limited operating records were reviewed during the inspection and preparation of this report.

1.4 Summary Data

1.1 SUMMARY DATA TABLE

Required Phase I Report Data	**Data Provided by the Inspecting Engineer**
National ID #	ME-00280
Dam Name	Bristol Mills Dam
Dam Name (Alternate)	Pemaquid River Dam
River Name	Pemaquid River
Impoundment Name	Pemaquid River
Hazard Class	Significnat
Size Class	Intermediate
Dam Type	Gravity - Dry-Laid Stone Rubble, Concrete
Dam Purpose	Recreational, Fire Protection
Structural Height of Dam (feet)	16 +/-
Hydraulic Height of Dam (feet)	16 +/-
Drainage Area (sq. mi.)	31.9 +/-
Reservoir Surface Area (sq. mi.)	3.1 +/-
Normal Impoundment Volume (acre-feet)	8,534 +/-
Max Impoundment Volume ((top of dam) acre-feet)	UNK
SDF Impoundment Volume (acre-feet)	UNK
Spillway Type	Broad Crested, Uncontrolled Weir
Spillway Length (feet)	33' +/-
Freeboard at Normal Pool (feet)	1.75' +/-
Principal Spillway Capacity (cfs)	404 +/-

Required Phase I Report Data	Data Provided by the Inspecting Engineer
Auxiliary Spillway Capacity (cfs)	Not Applicable
Low-Level Outlet Capacity (cfs)	20 +/-
Spillway Design Flood (100-year flow rate - cfs)	2524 +/-
Winter Drawdown (feet below normal pool)	none
Drawdown Impoundment Vol. (acre-feet)	Not Applicable
Latitude	43° 57' 36.95" N
Longitude	69° 30' 32.93" W
City/Town	Bristol
County Name	Lincoln
Public Road on Crest	No
Public Bridge over Spillway	No
EAP Date (if applicable)	None
Owner Name	Town of Bristol
Owner Address	1268 Bristol Road
Owner Town	Bristol, ME 04539
Owner Phone	207-677-2116
Owner Emergency Phone	
Owner Type	Municipality or Political subdivision
Caretaker Name	Town of Bristol
Caretaker Address	1268 Bristol Road
Caretaker Town	Bristol, ME 04539
Caretaker Phone	207-677-2116
Caretaker Emergency Phone	0
Date of Field Inspection	09/24/2015
Consultant Firm Name	Wright-Pierce
Inspecting Engineer	Jan B. S. Wiegman, P.E.
Engineer Phone Number	(207) 725-8721

- Low Level Outlet
  The low level outlet is a 12 inch diameter pipe that is located in the former penstock area and has a hand operated butterfly valve at the pipe outlet. The valve was open at the time of the inspection.

- Safety Fence
  There is a safety fence along the spillway to that consists of metal pipe posts fastened to the spillway and coated metal fabric fence material fastened to the posts. The bottom of the fence material is about 18" above the spillway crest and runs from the right embankment to the raised penstock slab and across the penstock slab at the face of the dam. The condition of the fence is fair and is makeshift in appearance. Access to the dam spillway is not restricted.

2.1.4 Downstream Area

The channel immediately downstream of the dam is comprised primarily of ledge and cobbles. There are boulders arranged in a line across the river to assist in directing fish to the entrance to the fishway on the east side of the river. The banks of the river have a moderate growth of trees and brush. About 300 feet downstream of the dam is a bridge crossing of Redonnett Mill Road. Approximately 800 feet downstream of the Redonnett Mill Road bridge is the Upper Round Pond Road bridge.

2.1.5 Reservoir Area

No unusual conditions were observed upstream of the dam. The upstream channel is formed by the Pemaquid River. Approximately 150 feet upstream of the dam there is a bridge crossing of the Pemaquid River which constricts the width of the river to approximately 15 wide opening under the bridge.

The Pemaquid River flows from the outlet of Biscay Pond approximately 14,000 feet to the Bristol Mills Dam. Above Biscay Pond there are a series of ponds that are closely connected that form the headwaters of the Pemaquid River including Pemaquid Pond, McCurdy Pond, Duckpuddle Pond, Little Pond and Muddy Pond.

2.2 Caretaker Interview

No interview or information was obtained.

2.3 Operation and Maintenance Procedures

2.3.1 Operational Procedures

There are no written operational procedures for the Dam.

2.3.2 Maintenance of Dam

Maintenance has been performed on the Bristol Mills Dam on an as-needed basis by the Town of Bristol.

2.4 Emergency Warning System

No Emergency Action Plan (EAP) has been developed for Bristol Mills Dam.

2.5 Hydrologic/Hydraulic Data

The Bristol Mills Dam is an **Intermediate** sized, **Low** hazard structure. Maine Statues require that the Inflow Design Flood (IDF) is determined in accordance with U.S. Army Corps of Engineer's procedures.

We recommend that a formal IDF study is performed to determine the appropriate IDF for the structure.

2.6 Structural Stability

No formal stability evaluations have been completed for this structure since the original design; no records of the original design computations were available for review at the time of the preparation of this report.

SECTION 3

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

In general, the overall condition of Bristol Mills Dam is ***FAIR to POOR condition.*** The dam was found to have the following deficiencies:

1. Cracking in the concrete along the upstream face.
2. Spillway concrete erosion
3. Voids at bottom of downstream wall and along the rock interface near the penstock area
4. Cracks on the downstream face in the area of the former penstock
5. No formal Emergency Action Plan for the dam has been developed

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the dam. Prior to undertaking recommended maintenance, repairs, or remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of local conservation commissions, DEP, or other regulatory agencies.

3.2 Studies and Analyses

The following studies or analyses are recommended to evaluate concerns and comply with current regulations. These studies and analyses shall be performed by a qualified professional engineer experienced dams and hydrology, maintenance and monitoring activities.

1. Perform a site specific Inflow Design Flood (IDF) study in accordance with Maine Statute and the procedures outlined by the U.S. Army Corps of Engineers.

2. Perform a hydrologic and hydraulic analysis to determine performance of the Dam's Spillway during the IDF (see above). Prepare recommendations for spillway improvement based upon spillway performance during the IDF event. A structure that cannot discharge the inflow associated with the design flood will be overtopped in an uncontrolled manner that could damage the structure and threaten downstream areas.

3. Perform a structural stability analysis of the dam for overturning.

3.3 Recurrent (Yearly) Maintenance Recommendations

1. Perform regular monitoring and inspection of the dam, spillway, and gates, including areas of observed concrete deterioration, leakage through walls, unwanted vegetation development, accumulation of debris or other areas of suspected movement or concerns, to check for signs of deteriorating conditions. Complete formal inspections of the dam in accordance with current state regulations. As the dam is currently classified as a low hazard potential structure, formal inspections are required every ten (10) years.
2. Regular maintenance activities should be continued to control and prevent further growth of unwanted vegetation, as was noted in areas during the inspection, as well as remove debris from the spillway. Mowing grass and cutting brush should be performed at least twice per year (i.e., late spring and fall). All cuttings from brush and other vegetation should be removed from the site and properly disposed.

3.4 Minor Repair Recommendations

The following recommendations should be implemented to maintain the integrity and improve the overall condition of the dam but do not alter the current design of the dam. These recommendations may require design by a professional engineer and construction by a contractor experienced in dam construction or repair.

- There are no remedial modifications recommendations at this time.

3.5 Remedial Modification Recommendations

The following modifications should be implemented to improve the safety and integrity of the dam and to extend the life of the structure. These recommendations will likely require design by a professional engineer and construction by a contractor experienced in dam repair.

Repairs are needed to address the condition of the concrete on the downstream faces and at the sluiceway and around the former intake structure as well as improve the structural stability of the dam.

- Repair spalled concrete and fill cracks along the upstream face at the sluiceway walls and the former intake structure.
- Repair voids at the toe of the dam.
- Repair cracks on the downstream face at the former penstock outlet and along the rock interface with the dam
- Perform the additional studies noted in Section 3.2.

3.6 Alternatives

No alternatives for replacement were considered.

3.7 Opinion of Probable Construction Costs

The following conceptual opinions of probable costs have been developed for the recommendations and remedial measures noted above. The costs shown herein are based on limited investigation and are provided for general information only. This should not be considered an engineer's estimate, as construction costs may be less or considerably more than indicated.

Studies and Analyses

1. Site Specific IDF Study		$6,000 - $8,000
2. Prepare Emergency Action Plan		$3,000 - $4,000
3. Structural Stability Calculations		$2,000 - $3,000
	Total	$12,000 - $16,000

Recurrent (Yearly) Maintenance Recommendations

1. Regular monitoring and inspection		$1,000 - $3,000
2. Regular maintenance		$1,000 - $3,000
	Total	$2,000 - $6,000

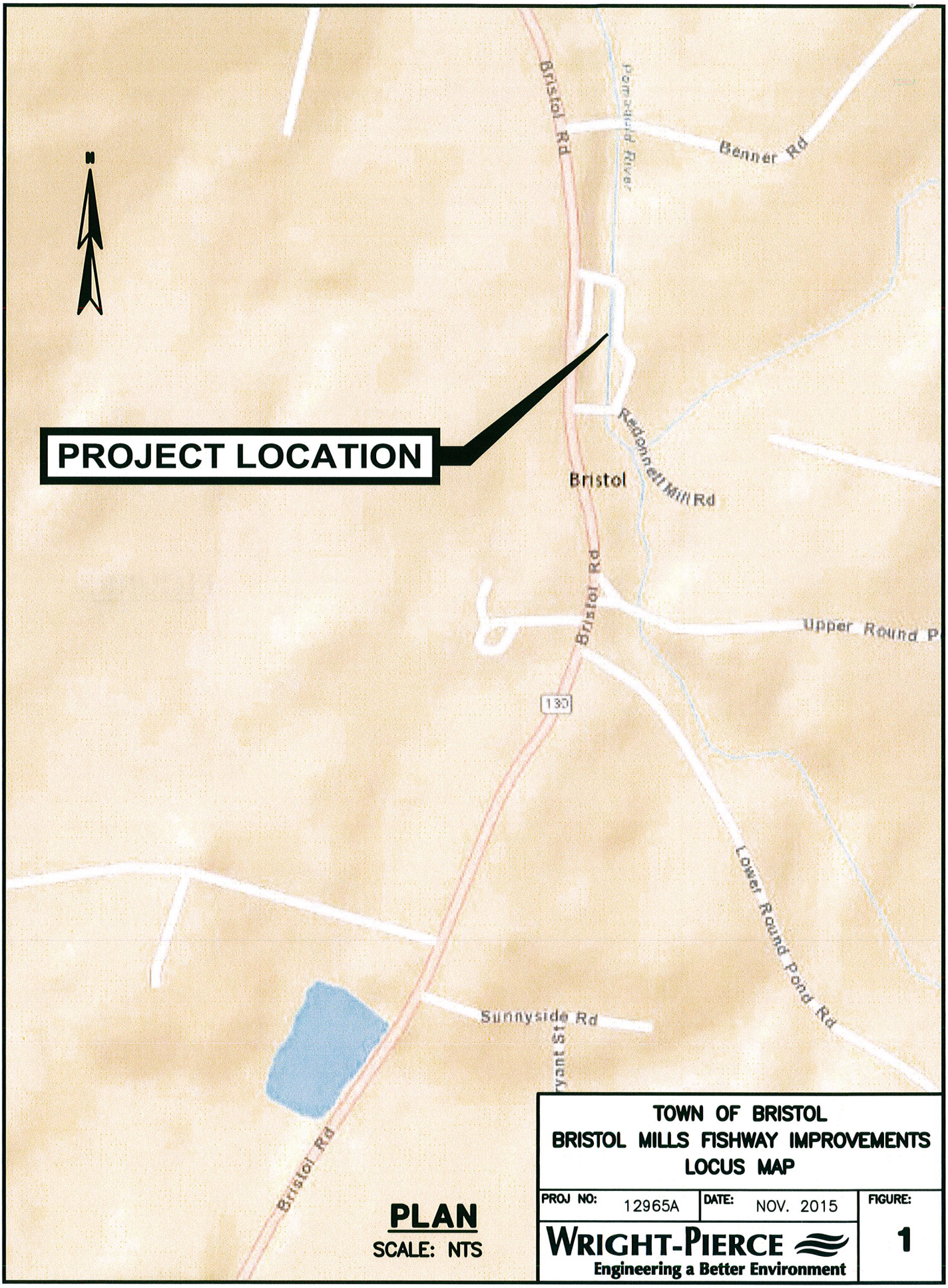
Minor Repair Recommendations

1. None

Remedial Modification Recommendations

1.	Mobilize / Demobilize	$ 7,000 - $ 10,000
2.	Upstream Face: repair spalled concrete and fill cracks in former intake and sluiceway	$ 8,000 - $ 12,000
3.	Fill Voids at Toe of Dam	$ 9,000 - $ 12,000
4.	Repair Cracks on Downstream face at penstock outfall and along rock interface	$ 8,000 - $ 11,000
	Subtotal	$32,000 - $45,000
	Engineering & Design	$ 2,500 - $3,500
	Permitting	$ 2,000 - $2,500
	Construction Administration	$ 2,000 - $3,000
		$6,500 - $9,000
	40%Contingency	$13,000 - $18,000
	Opinion of Probable Construction Cost	**$51,500 - $72,000**

FIGURES



PLAN
SCALE: NTS

TOWN OF BRISTOL
BRISTOL MILLS FISHWAY IMPROVEMENTS
LOCUS MAP

PROJ NO: 12965A	DATE: NOV. 2015	FIGURE: 1

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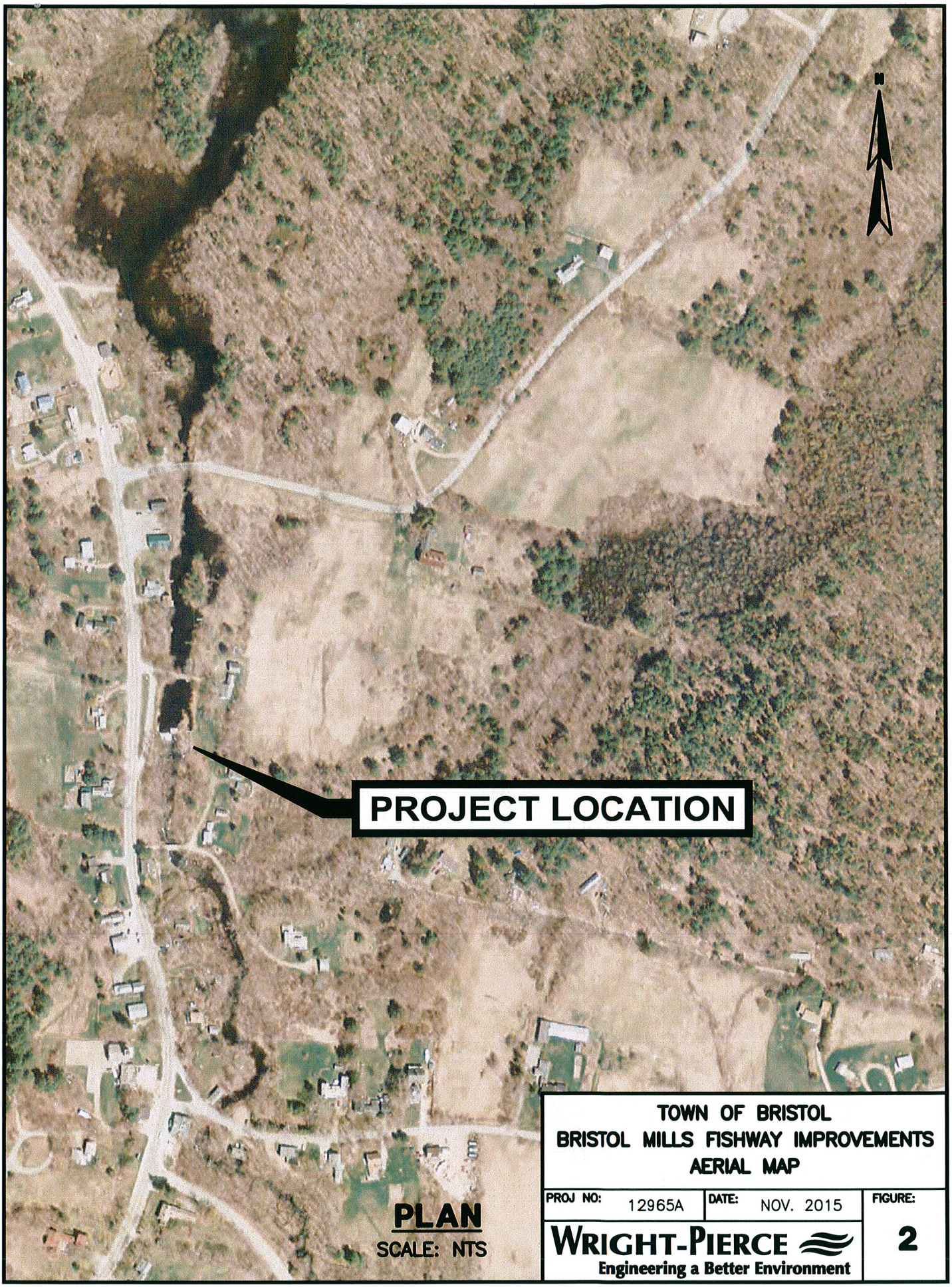
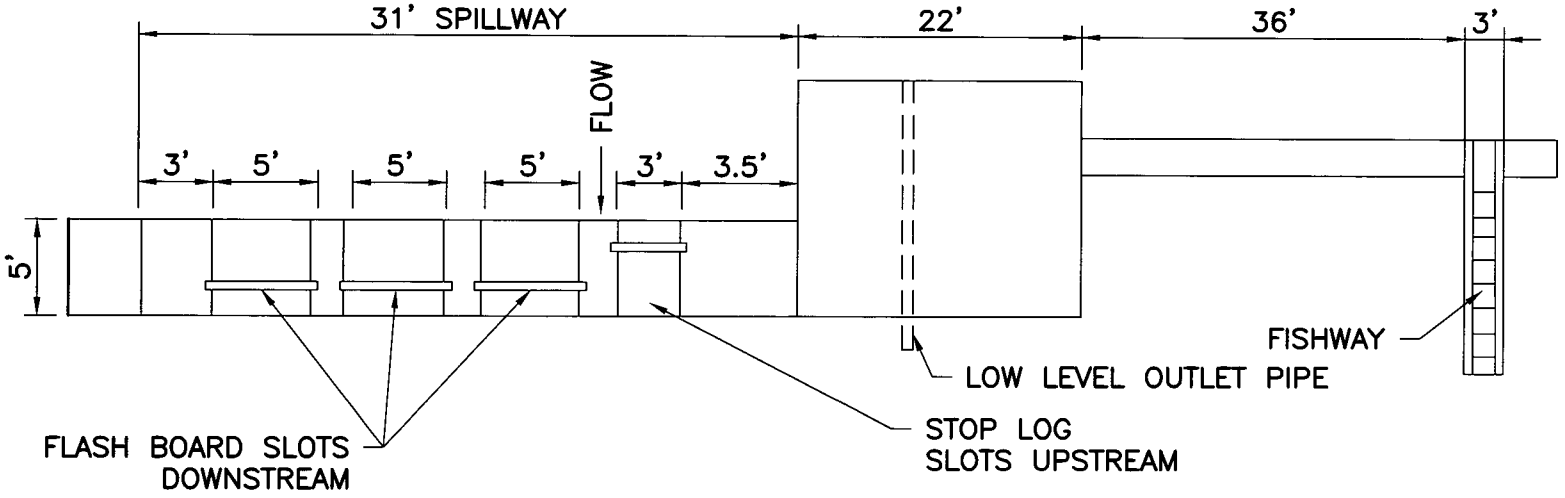


PLAN
SCALE: NTS

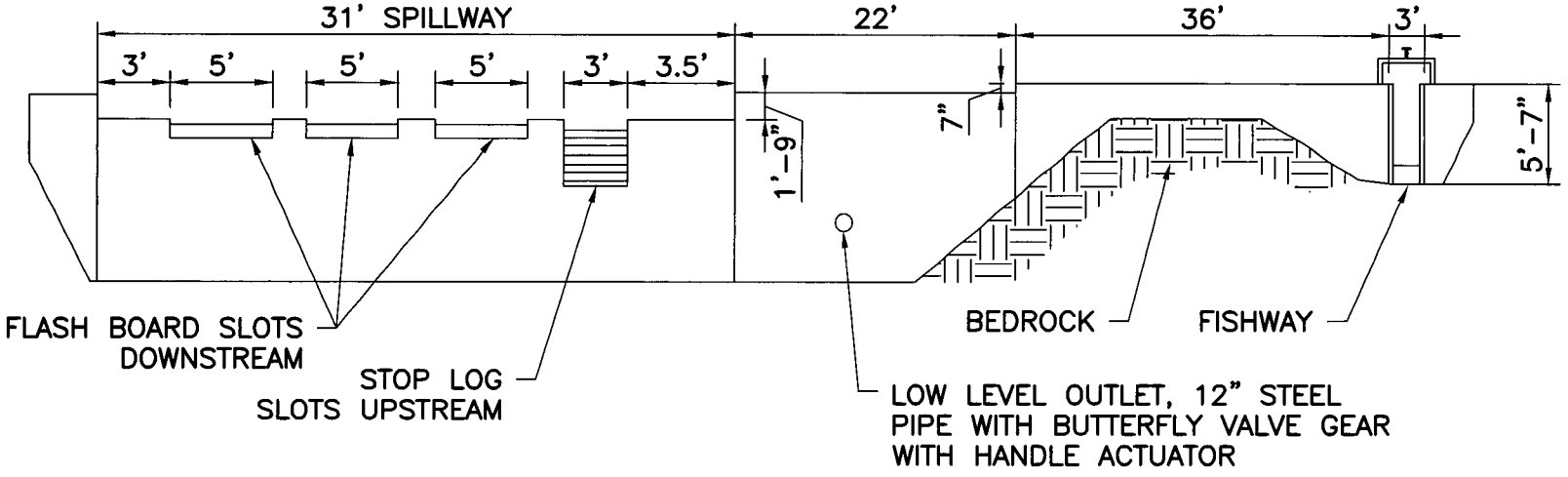
TOWN OF BRISTOL
BRISTOL MILLS FISHWAY IMPROVEMENTS
AERIAL MAP

PROJ NO:	DATE:	FIGURE:
12965A	NOV. 2015	2

WRIGHT-PIERCE
Engineering a Better Environment



PLAN VIEW
NTS

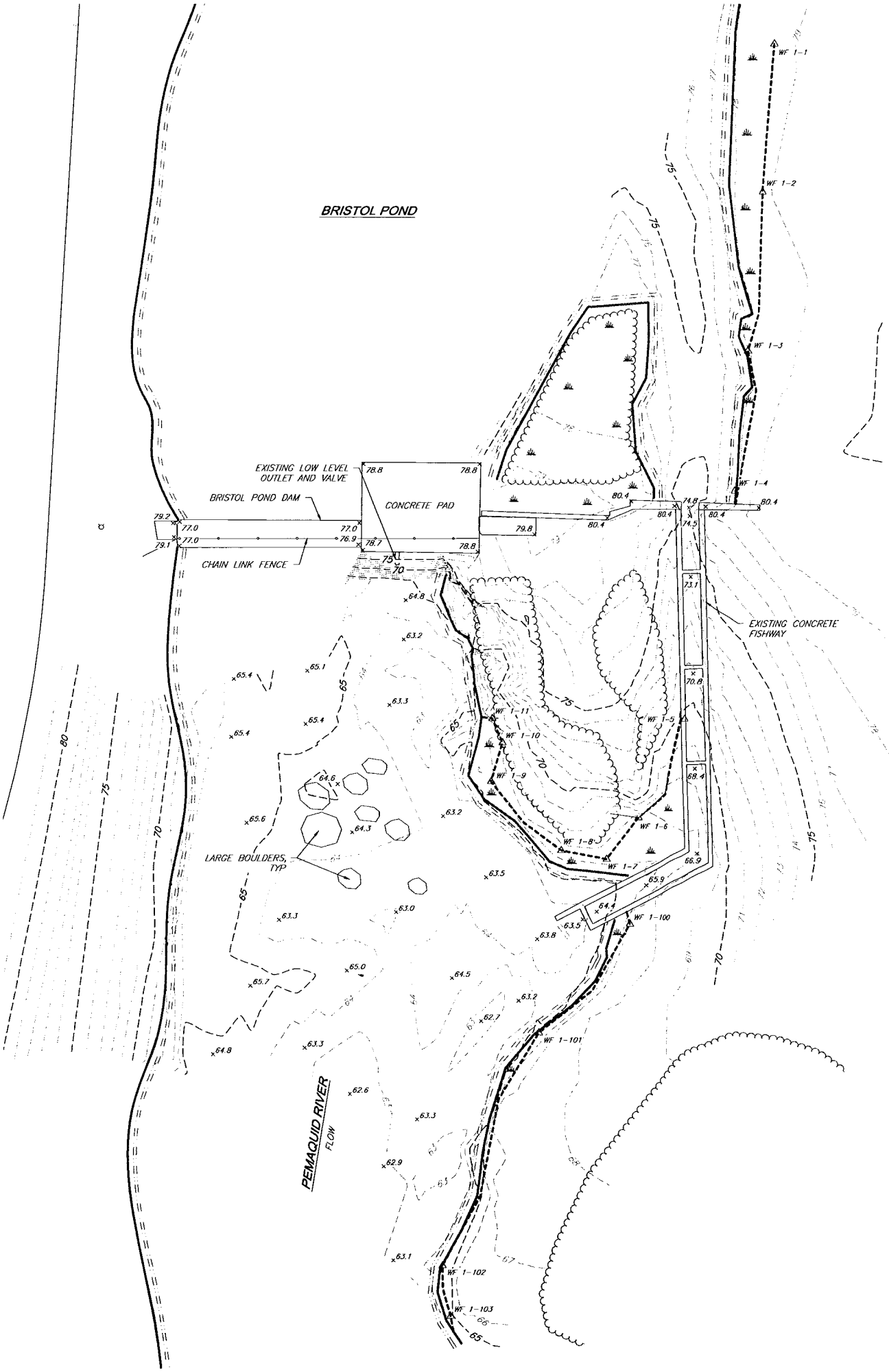


DOWNSTREAM ELEVATION
NTS

TOWN OF BRISTOL
BRISTOL MILLS FISHWAY IMPROVEMENTS
DAM ELEVATIONS AND PLAN VIEW

PROJ NO: 12965A
DATE: NOV. 2015
FIGURE: 4

WRIGHT-PIERCE
Engineering a Better Environment


BRISTOL POND
EXISTING LOW LEVEL OUTLET AND VALVE
BRISTOL POND DAM
CONCRETE PAD
CHAIN LINK FENCE
EXISTING CONCRETE FISHWAY
LARGE BOULDERS, TYP.
PEMAQUID RIVER
FLOW
WF 1-1
WF 1-2
WF 1-3
WF 1-4
WF 1-5
WF 1-6
WF 1-7
WF 1-8
WF 1-9
WF 1-10
WF 1-11
WF 1-100
WF 1-101
WF 1-102
WF 1-103

APPENDIX A
Photographs

Photo #1 - Overview of Dam from Upstream

Photo #2 – Overview of Dam from Downstream

Photo #3 – Overview of Left Abutment

Photo #4 - Overview of Downstream Face Right Abutment

Photo #5 – Overview Upstream of Spillway Crest

Photo # 6 – Fishway Control Gate on Left Abutment

Photo #7 – Overview Upstream Face Right Abutment

Photo #8 - Downstream Face Left Abutment

Photo #9 – Overview of the Upstream Impoundment

Photo #10 – Overview of the Downstream River

Photo #11 – Left Spillway from Downstream

Photo #12 – Left Spillway from Downstream

Photo #13 – Upstream View of Former Penstock Intake

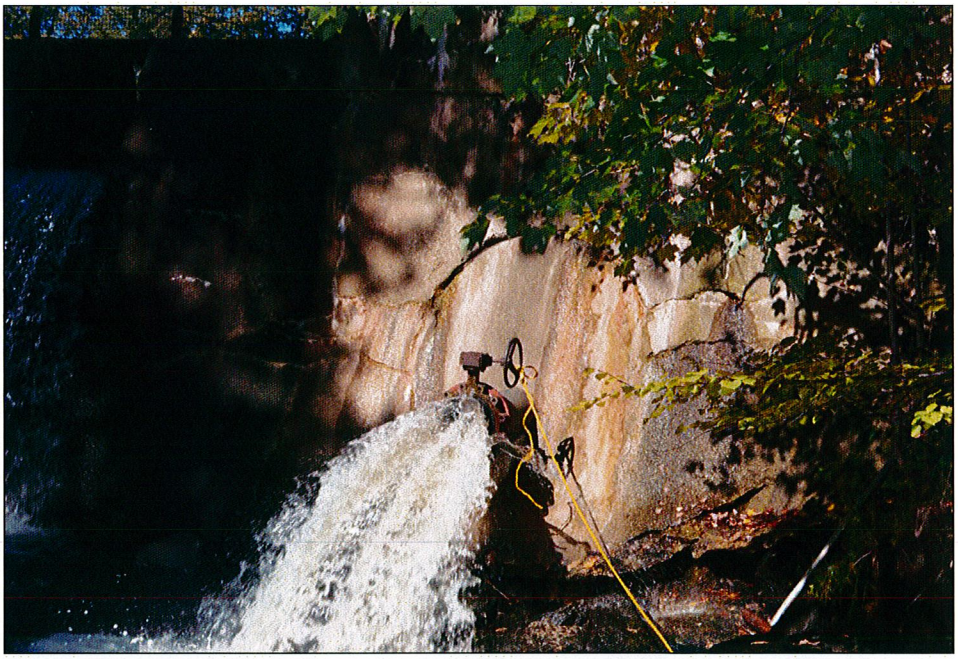


Photo #14 – Downstream View of Former Penstock with Low Level Outfall

Photo #15 – Voids at Abutment near Penstock Ledge Interface

Photo # 16 – Cracks in Downstream Face Right Side

Photo # 17 – Voids at base of Downstream Abutment

Photo 18 – Minor Concrete Erosion At Spillway Crest

Photo #19 – Penstock Intake with Loss of Concrete

Photo #20 – Sluiceway with Concrete Cracking and Exposed Rocks

APPENDIX B
Inspection Checklist

Dam Inspection Checklist

Dam Name: Bristol Mills Dam
Inspector: Jan Wiegman, PE
State Id # 05063 Nat. ID # ME00280
Wright-Pierce
MEMA # 077
Owner: Town of Bristol
River/Stream/Lake: Pemiquid River
Address: 1268 Bristol Road
Current Hazard Potential High___ Significant ___ Low___
Address: Bristol, ME 04539
Dam Location (Town) Bristol Mills Dam
Dam Type: Concrete and masonry
Date of Inspection: 9/24/2015
Laditude: 43°57.615" Longitude: 69°30.550"
Genreal Comments: Water level had been drawn down to approximately 35" below crest
All stop logs and flash boards were remooved Low level outlet was open

Item	Yes	No	N/A	Remarks:
1. Crest				
a. Settlement?		X		
b. Misalignment?		X		
c. Cracking?		X		
d. Trees/Brush?		X		
e. Evidence of Major Rehabiliation?				
2. Upstream Slope				
a. Adequate grass Cover?	X			
b. Erosion?		X		
c. Trees/brush on Slope?	X			Left side
d. Longitudinal Cracks?		X		
e. Transverse Cracks?		X		
f. Adequate Riprap Protection?	X			
g. Any Stone deterioration?		X		
h. Visual depressions or buldges?		X		
i. Visual settlements?		X		
j. Debris or trash present?	X			
3. Downstream Slope				
a. Adequate grass Cover?	X			
b. Erosion?	X			On either side of the fishway
c. Trees/brush on Slope?	X			
d. Longitudinal Cracks?	X			
e. Transverse Cracks?		X		
f. Visual depressions or buldges?		X		
g. Visual settlements?		X		
h. Is the tow drain dry?			X	
i. Are drainage well flowing?			X	
j. Are boils present at the toe?				Could not observe toe because back water

Item	Yes	No	N/A	Remarks:
k. is seeppage present?				Toe was partially submerged
l. Soft or spongy zones present?		X		
m. Are foundation toe drains pipes			X	
(1) Broken, bent, or missing?				
(2) corroded or rusted?				
(3) Obstructed?				
(4) Is discharge carring sediment?				
4. Abutment Contacts				
a. Any erosion?		X		
b. Visual differential movement?		X		
c. Any cracks noted	X			Minor cracks noted on both left and right sides
d. Is sepage present	X			Minor seepage noted on left and right contact areas
5. Pricncipal Spillway Inlet				
a. Do concrete surfaces show:				
(1) Spalling?		X		
(2) Cracking?		X		
(3) Erosion?		X		
(4) Scaling?		X		
(5)Exposed rebar?		X		
b. Do Joints show:				
(1) Displacement of offset?		X		
(2) Loss of joint material?		X		Water was flowing in spillway did not see bottom joint
(3) Leakage?		X		
c. Metal Appertenances:			X	
(1) Rust present?				
(2) Broken components?				
(3) Anchor system Secure?				
d. Trashrack operational?				
6. Principal Spillway Conduit				
a. Is the Conduit Concrete?	X			
b. Do concrete surfaces show:				
(1) Spalling?	X			Inside of sluiceway wall
(2) Cracking?	X			inside sluiceway wall
(3) Erosion?		X		
(4) Scaling?		X		
(5)Exposed rebar?		X		
c. Do Joints show:				
(1) Displacement of offset?		X		
(2) Loss of joint material?	X			Inside of the sluiceway walls

Item	Yes	No	N/A	Remarks:
(3) Leakage?		X		
d. Is the conduit metal?		X		
(1) Rust present?				
(2) Protective coatings adequate?				
(3) Is the conduit misaligned?				
e. Seepage around the conduit?		X		
7. Stilling Basin				
a. Do concrete surfaces show:			X	
(1) Spalling?				
(2) Cracking?				
(3) Erosion?				
(4) Scaling?				
(5)Exposed rebar?				
b. Do Joints show:			X	
(1) Displacement of offset?				
(2) Loss of joint material?				
(3) Leakage?				
c. Do energy disapators show:			X	
(1) Signs of deterioration				
(2) Accumulation of Debris				
d. Is the channel:				
(1) Eroding?		X		
(2) Sloughing?		X		
(3) Obstructed?		X		
e. Is discharged water:				
(1) Undercutting the outlet?	X			Voids observed at toe of downstream face left side
(2) Eroding the embankment?		X		
8. Emergency Spillway				
a. Does Concrete spillway show:				
(1) Spalling?		X		
(2) Cracking?		X		
(3) Erosion?		X		
(4) Scaling?		X		
(5)Exposed rebar?		X		
b. Do Joints show:				
(1) Displacement of offset?		X		
(2) Loss of joint material?		X		
(3) Leakage?		X		
c. Is spillway in Rock or Soil?			X	

Item	Yes	No	N/A	Remarks:
(1) Are slopes eroding?				
(2) Are slopes sloughing?				
d. Is the discharge channel :				
(1) Eroding or back cutting?				
(2) Obstructed?				
(3) Is vegetative cover adequate?				
e. Has discharged water:				
(1) eroded the embankment?		X		
(2) Undercut the Outlet?		X		
f. Is weir in good condition?	X			
9. Valves/Gates				
a. Are valves/gates:	X			
(1) Broken or bent?		X		
(2) Corrroded or rusted?		X		
(3) Periodically maintained?		X		As reported by Town
(4) Operational?	X			
b. Is there a low level valve?	X			
c. Is the low level valve operational?	X			Functioning during inspection
10. Area Downstream				
a. Recent downstream development?		X		
b. Seepage or wetness?		X		

Notes:

1. Screen on the low level inlet was temporary and should be made more substantial to keep debris out of inlet area
2. Slight seepage on downstream left side where rock and concrete interface/contact area
3. Minor leakage from cracks around tailrace plug on down stream face
4. Slight leakage along right side contact area
5. Some small trees on penninsula above dam
6. Some erosion alonf outside of walls of fshway
7. Fence and posts along top of dam. Public access to top of dam

APPENDIX C
Previous Reports and References

PREVIOUS REPORTS AND REFERENCES

The following is a list of reports that were located during the file review, or were referenced in previous reports.

1. Inspection of Bristol Mills Dam for the Maine Emergency management Agency by MBP Consulting date May 1998.

2. MEMA Inspection Report #077 Bristol Mills Dam, Bristol, Maine dated 24 August 1999

The following references were utilized during the preparation of this report and the development of the recommendations presented herein.

1. "ER 1110-2-106-Recommended Guidelines for Safety Inspection of Dams", Department of the Army, September 26, 1979

2. "Design of Small Dams", United States Department of the Interior Bureaus of Reclamation, 1987

INSPECTION
OF
BRISTOL MILLS DAM

BRISTOL, MAINE

MAINE EMERGENCY MANAGEMENT AGENCY

MAY 1998

MBP Consulting
PLANNING AND ENGINEERING

INSPECTION OF BRISTOL MILLS DAM

BRISTOL, MAINE

National ID: ME00280 State ID: 05063 MEMA ID: 077

Submitted to:

Maine Emergency Management Agency
Augusta, Maine

Submitted by:

MBP Consulting
Portland, Maine

May 1998

TABLE OF CONTENTS

SUMMARY

Based on review of the project information and the October 8, 1997 field inspection findings, the structures of Bristol Mills Dam are considered to be in fair to poor condition. Although no signs of immediate failure of the dam were observed, there are concerns which may present a threat to the integrity of the dam and public safety. The major concerns are significant seepage through the intake structure, reduced spillway hydraulic capacity after the 1994 restoration work, and inaccessibility of the spillway and sluice stoplogs during flood events. General deficiencies of the project include the absence of written operating and maintenance procedures.

To improve the integrity of the dam and protect the public safety, it is recommended that the Owner of the dam obtain the services of a registered professional engineer to implement the following corrective measures within 1 year of receipt of this report:

1. Reduce seepage through the intake and rehabilitate the deteriorated base of the spillway and old intake structure.

2. Evaluate the effect of the reduced spillway hydraulic capacity on stability of the dam.

3. Provide access to the spillway and sluice stoplogs during flood conditions.

The implementation of these recommendations should include determination of the appropriate spillway design flood based on the dam hazard classification and stability evaluation, as necessary.

To improve operation and maintenance of the dam and adequately respond to emergency conditions threatening the dam and public safety, it is recommended that the Owner implement the following within 1 year of receipt of this report:

1. Repair a void in the east sidewall of the sluice.

2. Repair the deteriorated timber noses of the spillway piers.

3. Operate the spillway and sluice stoplogs on a regular basis.

4. Remove all the sluice stoplogs annually to flush silt and debris.

5. Cut and remove trees and brush from the dam and within 20 feet of the dam abutments.

6. Monitor the dam semi-annually for seepage and changes in condition and record the observations in a monitoring log.

7. Engage a registered professional engineer to conduct a detailed inspection of the dam and appurtenant facilities every 5 years.

8. Establish written operation and maintenance procedures at the dam.

9. Establish an emergency action plan, if necessary, for conditions that could threaten the dam and public safety.

1.0 INTRODUCTION

In accordance with the agreement for professional services between the State of Maine Emergency Management Agency (MEMA) and MBP Consulting (MBPC) dated April 17, 1997, MBPC has performed the inspection of Bristol Mills Dam and prepared the report of the findings. This report contains a review of the project data, results of the visual observation of the project facilities, assessment, and recommendations.

As a follow-up to the recent history of dam failures in Maine, MEMA conducted a brief, statewide inspection in 1996 and 1997 of about 220 dams with significant and high hazard potential identifying the dams requiring detailed inspection and condition evaluation by a professional engineer. The purpose of the 1997 inspection program is to perform a visual inspection and evaluation of significant and high hazard dams, which may threaten the public safety, and recommend corrective measures, if required.

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

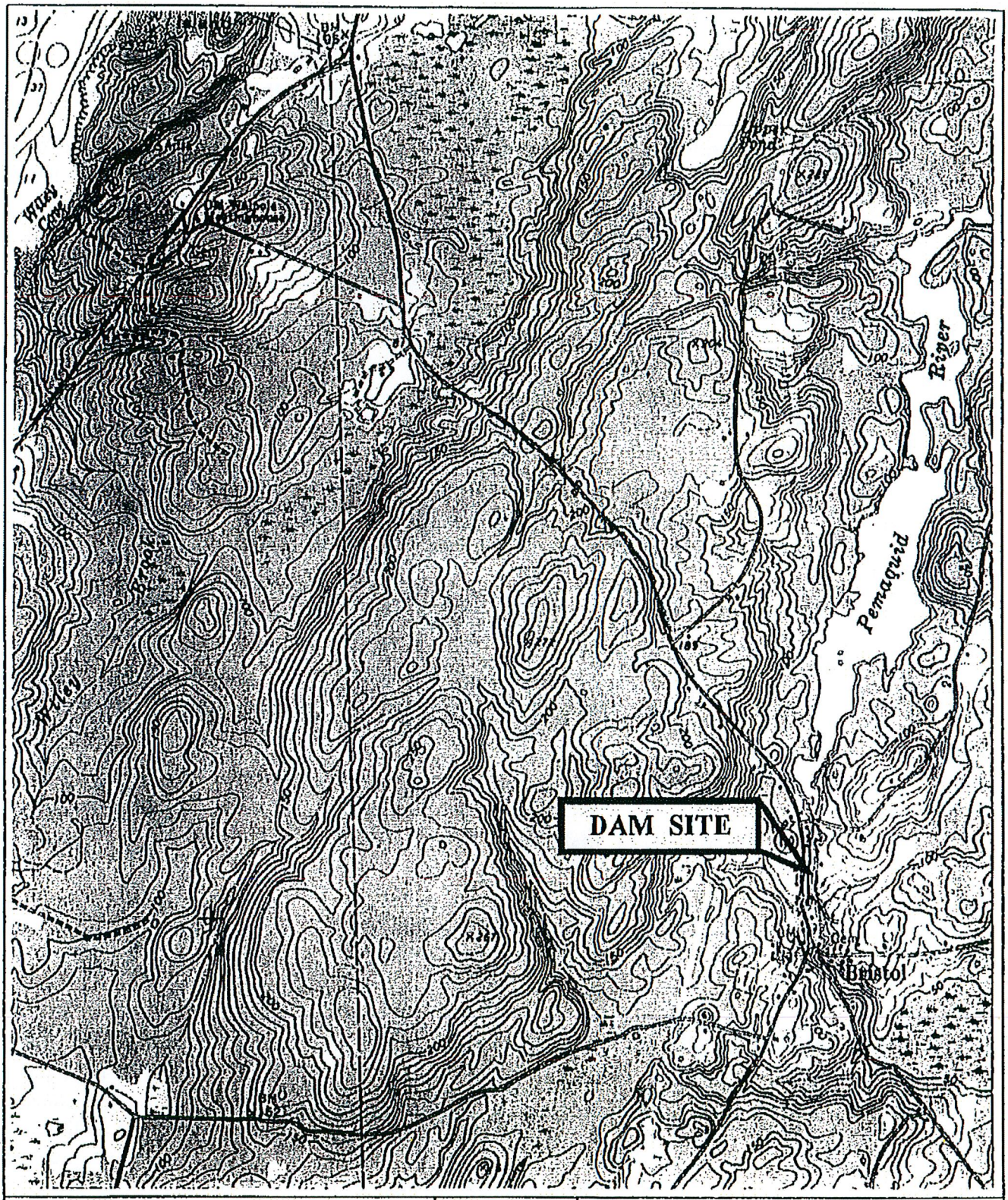
2.0 PROJECT DESCRIPTION

Bristol Mills Dam, also known as Pemaquid River Dam, (National ID # ME00280, State ID # 005063, MEMA ID # 077) is located on the Pemaquid River, in the Town of Bristol, Lincoln County, Maine (Figure 1). Bristol Mills Dam was reportedly built by Lincoln County Electric Company in 1914.

The dam impoundment has a surface area of 2,000 acres and maximum storage of 8,534 acre-feet and is shown on the USGS "Bristol" Quadrangle Map (Figure 1). The dam is classified as an intermediate size structure (the dam height is less than 40 feet, impoundment storage between 1,000 and 50,000 acre-feet) with significant hazard potential[1]. The dam is owned and operated by the Town of Bristol, Maine (Owner).

The 16-foot-high, 110-foot-long concrete gravity dam consists of a spillway, an old intake structure, and an east wall. The dam apparently is founded on bedrock. Rock outcrops were observed along the downstream toe of the dam and at the dam abutments. A field sketch prepared during this inspection shows a plan, downstream view, and sections of the dam (Figure

[1] Significant hazard potential category structures are usually located in predominantly rural or agricultural areas where failure may cause serious damage to isolated homes, secondary highways, or minor railroads; cause interruption of use or service of relatively important public utilities; or cause some incremental flooding of structures with possible danger to human life. (Federal Energy Regulatory Commission. *Engineering Guidelines for Evaluation of Hydropower Projects*, 1991).



BRISTOL MILLS DAM
BRISTOL, ME

National ID: ME00280
Maine ID: 05063
MEMA ID: 077

N

FIGURE 1
LOCATION MAP

USGS Quadrangle
"BRISTOL", ME
Approx. Scale: 1" = 2000'

2). The following description of the dam is based on the available project information and visual observations during this inspection which included an approximate dimensional survey.

The 36-foot-long spillway is a broad-crested weir with a flat, 5-foot-wide crest and battered upstream and downstream faces. The spillway crest contains three bays separated by 1 feet high, 2 feet wide piers and housing 8-inch-high stoplogs. A 3.3-foot-wide, 3-foot-deep sluice equipped with wooden stoplogs is also incorporated into the spillway crest.

The 20-foot-long old intake structure flanks the east spillway side. The intake was a part of the abandoned hydropower plant and contained a 64-inch steel penstock. The top of the intake is 12 feet wide and is 3 feet above the spillway crest. The structure contains a 12-inch outlet pipe with a valve at the downstream end.

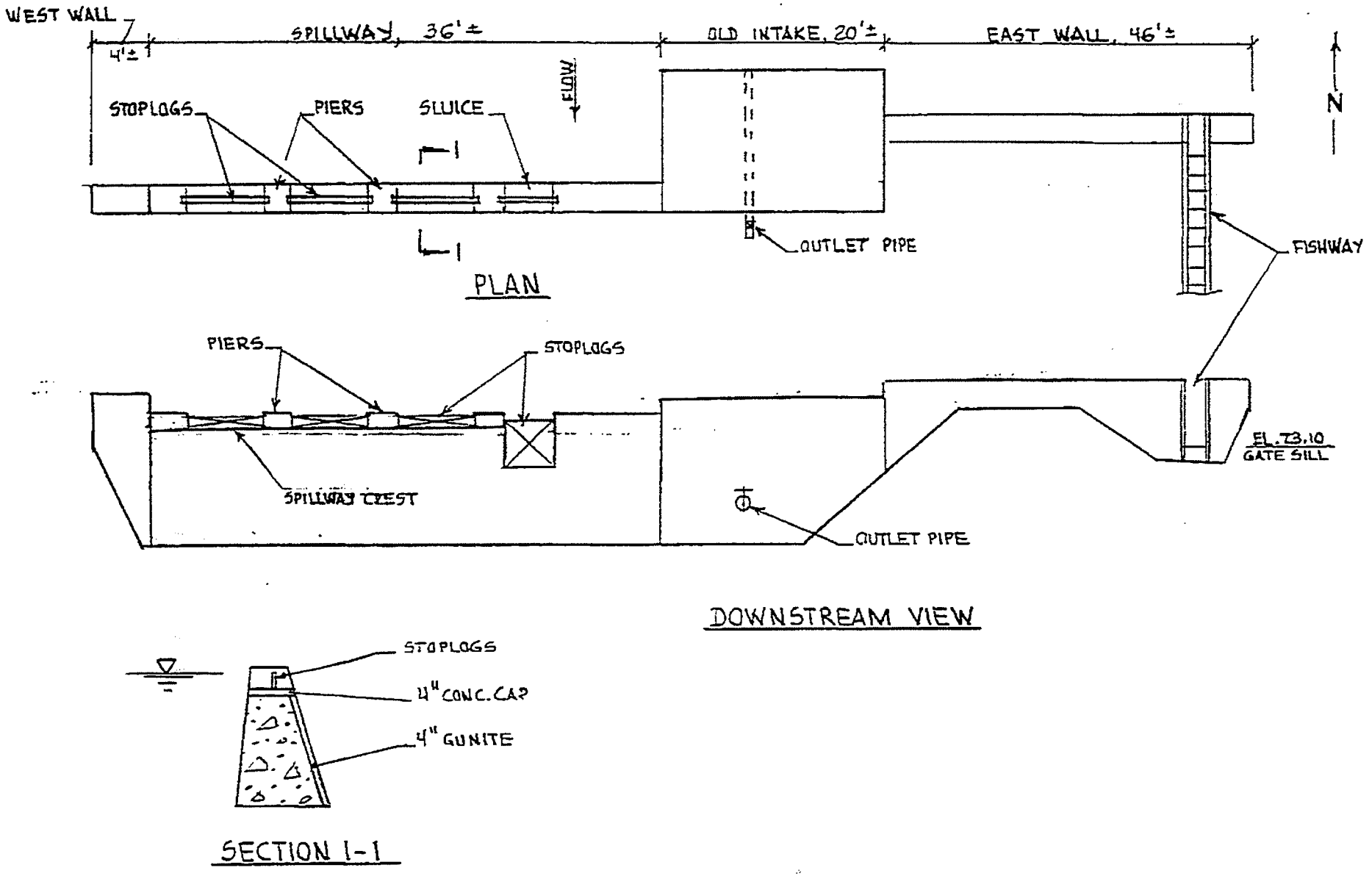
The east wall connects the old intake structure with the east abutment of the dam. The wall is a gravity structure, 2 to 7 feet high, 46 feet long, and 1 to 1.5 feet wide at the top. The wall contains a fishway at the dam abutment operated by the Maine Department of Marine Resources.

3.0 PROJECT INFORMATION

The following project data were available for review and preparation of this report:

- Pemaquid Dam Restoration, Proposed Modification. Five Project Drawings. Applied Engineering, Inc., Wiscasset, Maine, July-August 1994.
- Pemaquid Dam Restoration Project. Notice to Bidders. Applied Engineering, Inc., Wiscasset, Maine, September 1994.
- Bristol Mills Dam. Maine Dams Registration Master Report. Maine Department of Environmental Protection (MDEP), January 23, 1993.
- Bristol Mills Dam Database Sheet. MEMA.
- Bristol Mills Dam Inspection Checklist. MEMA, June 19, 1996.

Significant reconstruction work was conducted at the dam site in 1994. The work included lowering the top of the old intake and installation of a new concrete platform on the top of the intake, installation of a new, 12-inch steel outlet pipe in the old 64-inch steel penstock, and filling the penstock with concrete. A 6-inch concrete cap was removed from the spillway crest and a new concrete cap was installed. Four, 1-foot-high, 2-foot-wide concrete piers were installed over the crest between the sluice and west spillway side. The spillway crest between the sluice and old intake was raised by placement of a 1-foot-high concrete overlay. The downstream face of the spillway and old intake structure was rehabilitated with installation of a 4-inch-thick layer of gunite. The dam restoration work was conducted by Knowles Industrial Services, Portland, Maine.



Bristol Mills Dam, Bristol, ME **Maine Emergency Management Agency** **State Dam Inspection Program**	**Field Sketch:** **Plan, Downstream View, and Sections** Not to Scale	**MBP Consulting** **Portland, ME**	**FIGURE 2**

Appendix A contains project information including the dam datasheets prepared by MEMA and MDEP, and a checklist of the inspection conducted by MEMA.

There were no maintenance records available for review.

4.0 PROJECT OPERATION AND MAINTENANCE

The normal summer pond is reportedly maintained 6 inches above the spillway crest. The typical spring pond level is about 1 inch above the top of the spillway piers with stoplogs in place. The spillway and sluice stoplogs are usually closed and are not used to control the pond level or discharge over the spillway. The fishway gate is operated regularly by a dam keeper.

There were no written operation and maintenance procedures or records available for review on the project events, such as floods, heavy rainfall or ice impact.

5.0 FIELD INSPECTION

The field inspection of the dam was performed on October 8, 1997 by Myron Petrovsky of MBPC assisted by Dwayne Boynton (Owner). The Owner was interviewed at the site on the project data, events, repairs, and operation and maintenance. The inspection was conducted on a sunny day with the ambient temperature about 50 degrees F. At the time of the inspection, the pond level was 0.1 feet above the spillway crest, the spillway and sluice stoplogs were in place, and the fishway gate was open 1.5 feet.

The inspection was performed by visually observing the accessible project structures. The structures, abutments, and downstream discharge channel were observed for signs of weathering, deterioration, erosion, cracking, steel and reinforcement corrosion, movement, seepage, leakage, undermining, vegetation, siltation, and accumulation of debris. Photographs showing the condition of the dam structures at the time of the inspection are presented in Appendix B.

Spillway. The spillway (Photos B-1 and B-2) was inspected with some flow over the crest and wetted downstream surfaces. The crest and upstream face were free from major cracks and deterioration. The pier noses built of 4-inch square timbers showed some splitting and erosion. The downstream face contained a few cracks of shrinkage type with efflorescence. The toe of the spillway at the deepest section was not observed for scour and seepage due to a pool of water. The exposed portion of the base adjacent to the intake was undermined resulting in a loss of contact with rock.

Sluice. The east sidewall of the spillway sluice contained a 6-inch by 8-inch void at the stoplog guide. Flow at an estimated rate of 40 to 60 gallons per minute (gpm) was coming through the void and bypassing the stoplogs. Total leakage through the pressure treated timber sluice stoplogs was 80 to 100 gpm.

Intake. The old intake structure (Photo B-2) exhibited cracks and efflorescence in the 1994 gunite on the downstream face. The base of the structure was significantly deteriorated and undermined to a depth of 2 feet. Two seepage areas were observed at the base. A 2-foot-long area with a flow of 20 to 40 gpm was located immediately west of the 12-inch pipe outlet (Photo B-3). The majority of the flow was coming between the gunite layer and original concrete. The second seepage area was located farther east of the pipe outlet in the exposed base rock. The seepage was about 20 gpm and extended along a 10-foot-length and originated from rock joints and fissures.

East Wall. The east concrete wall (Photo B-4) was in fair condition. The 2 to 7-foot-high wall was dry on the upstream and downstream sides with the wall base mostly located above the pond level. A few cracks of old origin were observed in the downstream face. The area downstream of the wall and dam abutment were overgrown with trees and brush impeding the inspection.

Downstream Channel. The streambed and banks of the downstream discharge channel within 100 feet from the dam were free from debris and large trees which may obstruct movement of water during flood events.

6.0 ASSESSMENT

On the basis of the October 8, 1997 inspection, review of the project data, and the interview with the Owner, the following assessment was made:

1. In general, Bristol Mills Dam appears to be in fair to poor condition. Although no signs of immediate failure of the dam were observed, there are concerns which may present a threat to the integrity of the dam and public safety. The major concerns are significant seepage through the intake structure, reduced spillway hydraulic capacity after the 1994 restoration work, and inaccessibility of the spillway and sluice stoplogs during flood events.

2. Significant concrete deterioration was observed at the base of the spillway and old intake structure rehabilitated in 1994. The deterioration was apparently caused by seepage emanating from the original concrete and exiting behind the gunite layer. The continuous seepage caused detachment of the gunite layer and degradation of the gunite at the base. The base undercutting extended up to 2 feet into the structure. Seepage through the intake was also exiting through the joints and fissures in the base bedrock. Continuing seepage, if left unchecked, may accelerate the process of deterioration of the structure and foundation bedrock which may cause stability problems.

3. The 1994 restorative work improved the overall condition of the dam. However, installation of the concrete piers on the spillway crest and filling the crest between the sluice and intake with the 1-foot-high concrete overlay have caused a reduction of the spillway hydraulic capacity by approximately 15 percent. This reduction in the spillway

capacity may result in overtopping, increased hydrostatic loading on the dam, and stability problems.

4. The spillway and sluice stoplogs are usually in place and not used to control the pond level. Considering the reduction in the spillway capacity, it is important to operate the spillway and sluice stoplogs on a regular basis. The stoplogs are inaccessible during flood events when the spillway piers are overtopped.

5. There are no formal written operation and maintenance procedures in effect to control the impoundment level, routinely inspect the condition of the dam, and regularly provide necessary repairs.

6. There is no emergency action plan (EAP) in effect to respond to emergency conditions threatening the dam and public safety.

7.0 RECOMMENDATIONS

A. Remedial Measures

To improve the integrity of Bristol Mills Dam and protect the public safety, it is recommended that the Owner obtain the services of a registered professional engineer to implement the following corrective measures within 1 year of receipt of this report:

1. Reduce seepage through the intake and rehabilitate the deteriorated base of the spillway and old intake structure.

2. Evaluate the effect of the reduced spillway hydraulic capacity on stability of the dam.

3. Provide access to the spillway and sluice stoplogs during flood conditions.

The implementation of these recommendations should include determination of the appropriate spillway design flood based on the dam hazard classification and stability evaluation, as necessary.

B. Operation and Maintenance

To improve operation and maintenance of the dam and adequately respond to emergency conditions threatening the dam and public safety, the Owner should implement the following within 1 year of receipt of this report:

1. Repair a void in the east sidewall of the sluice.

2. Repair the deteriorated timber noses of the spillway piers.

3. Operate the spillway and sluice stoplogs on a regular basis.

4. Remove all the sluice stoplogs annually to flush silt and debris.

5. Cut and remove trees and brush from the dam and within 20 feet of the dam abutments.

6. Monitor the dam semi-annually for seepage and changes in condition and record the observations in a monitoring log.

7. Engage a registered professional engineer to conduct a detailed inspection of the dam and appurtenant facilities every 5 years.

8. Establish written operation and maintenance procedures at the dam. The procedures should include the following:

   - A schedule and guidelines for maintenance of the impoundment water level.
   - A schedule and guidelines for regular maintenance of the dam facilities such as brush and tree removal, debris control, grass mowing, and repair of deteriorated structures.
   - A schedule and guidelines for inspection and monitoring of the dam and appurtenant facilities including a checklist of inspection items. The inspection of the dam should be conducted semi-annually and immediately after significant floods, heavy rainfall or other major project events. The observation findings should be recorded in a maintenance log.

9. Establish an EAP, if necessary, to provide the following:

   - Identify emergency conditions threatening the dam and public safety.
   - Establish effective response actions to prevent failure of the dam.
   - Reduce loss of life and property damage should failure of the dam occur.

APPENDIX A

PROJECT INFORMATION

Maine Dams

BRISTOL MILLS DAM

05053

ME00260

077

S

NR

UPPER PEMAQUID RIVER BISCAY

BRISTOL

LINCOLN

BRISTOL, TOWN OF

BENNER, WILLIAM-SELECTMAN

P. O. BOX 147

BRISTOL

ME

04539

563-5270

43

57

531

69

30

575

N

0

CN

PFR

9/19/90

N

110

530

2,000

0

6,534

0

11

6,705

18

MEMA

N

Y

STATE ID #	CORPS ID #	NAME OF DAM	BODY OF WATER IMPOUNDED	RIVER BASIN
5063	280	BRISTOL MILLS DAM	UPPER PEMAQUID RIVER BISCAY	WEST COASTAL

FERC #: 99999 FERC PROJECT NAME: TOPO MAP: BRISTOL SIZE: 7.5

DAM LOCATION: BRISTOL COUNTY: LINCOLN GEOCODE: 15050

EXEMPT FROM PAYMENT	IS DAM LEASED	BILL THE OWNER	5 YEAR PAYMENT	AMOUNT PAID CURRENT YEAR	AMOUNT PAID LAST YEAR	REGISTRATION EXPIRES
NO	NO	YES	NO	$100	$64	1994

OWNER OF DAM: BRISTOL, TOWN OF P. O. BOX 147 BRISTOL ME 04539 ( )563-5270
CONTACT PERSON: SELECTMEN

IMPOUNDMENT:

TOTAL VOLUME	SURFACE AREA (ACRES)	CAPACITY (ACRE/FT)	EST CAPACITY (SA X HT X .4)	DRAINAGE AREA (SQ.MI.)	WATER LEVEL SET	YEAR LEVEL SET	EXEMPT FROM SETTING WATER LEVEL
	2,000	8,534	12,800		NO		NO

USAGE: FIRE CONTROL , WILDLIFE

DESCRIPTION:

YEAR BUILT	STRUCTURAL HEIGHT	HYDRAULIC HEIGHT	LENGTH	YEAR OF LAST MAJOR REPAIR	GEN COND	CONSTRUCTION PLANS AVAIL	YEAR LAST INSPECTED	NAME OF INSPECTING ENGINEER	INSP ENGINEER TELEPHONE
	0	16	110		UNK	UNK			

CONSTRUCTION: CONCRETE

OF GATES: TYPES OF MECHANISMS:

	HEIGHT	WIDTH	CONDITION	DRAWDOWN AVAILABLE	SPILLWAY LENGTH	SPILLWAY HEIGHT	SPILLWAY ELEVATION	OPERATING FISH PASSAGEWAY	INSTALLED CAPACITY	HYDROMECHANICAL POWER
1.								UP AND DOWNSTREAM	0	0

DEVELOPMENT:
UPSTREAM: DOWNSTREAM: CONCENTRATION - UNKNOWN
NUMBER OF DWELLINGS DEVELOPMENT TYPES -
AROUND IMPOUNDMENT: UNK TYPES OF ROADS -

HAZARD CODE CLASSIFICATIONS:

COE CODE	SCS CODE	DEP CODE
2		

COMMENTS: WATER IMPOUNDED INCLUDES PEMAQUID PONDS

#??

MAINE EMERGENCY MANAGEMENT AGENCY
DAM INSPECTION CHECKLIST

Dam Name: Bristol Mills Dam — Owner: Town of Bristol

River, Stream or Lake: Pemaquid River — Address:

Current Hazard Potential: High__ Significant X Low__ — Address:

Dam Location (Town): Bristol — Dam Type: Concrete

Date of Inspection: 6/19/96 — Latitude: 43°57.631 Longitude: 69°80.575

Pictures 6 & 7

ITEM	YES	NO	N/A	REMARKS
1. Crest				
a. Settlement ?		X		
b. Misalignment ?		X		
c. Cracks ?		X		
d. Trees and Brush ?		X		
e. Evidence of Major Rehabilitation ?	X			If yes, complete Dam Structural Measurement Report
2. Upstream / Downstream Slopes				New left side abutment & cap new fishway
a. Slope Protection ?	X			
b. Erosion / Beaching ?		X		
c. Trees and Brush ?	X			Upstream left side (brush)
d. Visual Settlements ?		X		
e. Sinkholes ?		X		
f. Animal Burrows ?		X		
g. Seepage ?	X			Left side abutment near toe a steady stream of water
h. Toe drains ?	X			
i. Relief wells ?		X		
j. Slides / Slumps ?		X		
3. Abutment Contact				
a. Erosion ?		X		
b. Seeping ?	X			Same as 2g
c. Boils ?		X		
d. Springs ?		X		

APPENDIX B

INSPECTION PHOTOGRAPHS

Photo B-1 Bristol Mills Dam.
Spillway and old intake from west abutment. Note concrete piers and stoplogs on spillway crest installed in 1994.

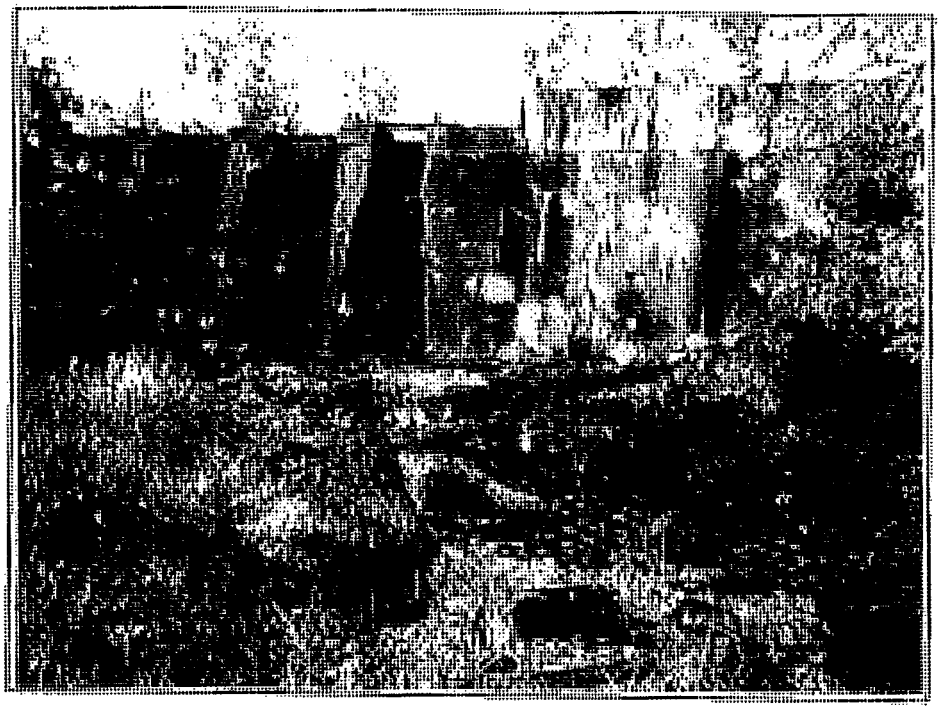


Photo B-2. Bristol Mills Dam.
Downstream face of spillway and old intake with outlet pipe. Note cracks in intake gunite placed in 1994.

Photo B-3 Bristol Mills Dam.
Old intake. Note deterioration of 1994 gunite and seepage at base.

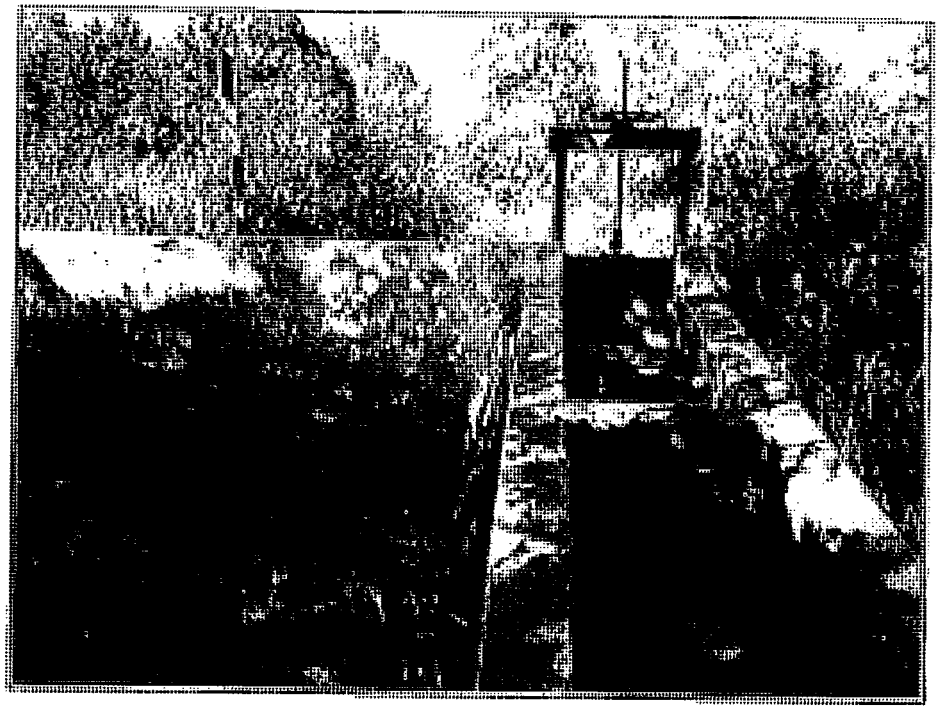


Photo B-4. Bristol Mills Dam.
East wall and fishway. Note crack on downstream face of east wall and vegetation of east abutment.

Angus S. King, Jr.
Governor
State of Maine
(207) 287-3531

Earl L. Adams
Major General
Commissioner
(207) 626-4205

DEPT. OF DEFENSE, VETERANS AND EMERGENCY MANAGEMENT

CAMP KEYES, AUGUSTA, MAINE 04333-0033

December 22, 1999

Office of The Commissioner

Town of Bristol
Attention: Mr. Craig Elliott
P.O. Box 147
Bristol, Maine 04539

RE: Bristol Mills Dam

Dear Mr. Elliott:

Under the provisions of MRSA Title 37B, Chapter 22, "Dam Inspections", dam condition and hazard inspections were carried out by our dam inspector on December 13, 1999, to review the dam hazard rating. The report is attached for your information and contains recommendations by the engineer concerning operation, maintenance, rehabilitation and repairs considered necessary for the safe operation of the dam, which I encourage you to address.

The dam is now classified a "low hazard" dam, and in terms of the law an Emergency Operations Plan is not required.

Should you have any questions, please contact me at 626-4271.

Sincerely,

Earl L. Adams
Major General
Commissioner

Do not remove from file. Copy for your use 10/17/2000

Attachment

Copies Furnished:
Lincoln County Emergency Management Agency
Town of Bristol
Senator Marge Kilkelly
Representative Wendy Pieh

MAINE EMERGENCY MANAGEMENT
72 State House Station
Augusta, Maine 04333-0072
(207) 287-4080
Fax: 287-4079

MAINE VETERANS' SERVICES
117 State House Station
Augusta, Maine 04333-0117
(207) 626-4464
Fax: 626-4471

MILITARY I
33 State Hou
Augusta, Maine
(207) 626
Fax: 626

To: The Director, Maine Emergency Management Agency
From: Tony Fletcher, Civil Engineer 1
Date: 13 December 1999

Subject: Dam hazard and condition report.

1. Inspection certificate:

In terms of Maine Revised Statutes Annotated 37B, Chapter 22, a combined downstream hazard and dam condition inspection has been carried out for this dam. Little background material exists on file for this dam. The dam hazard assessment was conducted 2 miles downstream of the dam into the marsh to Boyd pond. Findings and recommendations of both inspections follow. Copies of the report may be sent to the current and new dam owners, the County EMA Director and the Town Manager.

2. Attachments:

A Dam data sheet
B Locality and watershed plan
C Downstream plan
D Drawings and sketches done on site of the dam
E Maine Department of Defense, Veterans and Emergency Management (DVEM) dam checklist
F nil

3. Inspection findings:

3.1 General description of dam, ownership and orders:

3.1.1 Ownership of the dam is vested with the Town of Bristol.
3.1.2 Originally the dam served as a power and water supply dam, but now serves as a recreational lake and possibly for fire water.
3.1.3 The dam is a small, old mill, 12' high (low) head, masonry and concrete structure with a single gated outlet, 75' long, with a short right earth embankment abutment and a 40' left earth dike where the fishway passes through.
3.1.4 The service spillway is a 3' x 5' deep, sluice gate controlled, fishway.
3.1.5 The auxiliary spillway is a partially controlled overspill broad crested weir with stoplog openings and side upstands.
3.1.6 There is no emergency spillway. Under extreme emergency conditions the dam and dikes would be over topped.
3.1.7 The water level is controlled by the stoplogs. Control and operation is in the hands of the owners.
3.1.8 No DEP water level order is in place. There are no dams downstream. Boyd pond lies between the dam and the sea.
3.1.9 A security fence runs the length of the top of the dam but the public are allowed on the wall.

3.2 Condition of dam:

3.2.1 Reservoir upstream of wall: The lake shows some slight shoreline erosion and sedimentation.
3.2.2 Upstream face: The upstream face of the dam appears sound. No debris has collected at the weir.
3.2.3 Crest: The crest of the dam appears to have been rebuilt at some stage.
3.2.4 Downstream: The downstream masonry face shows no deformation and little sign of leakage with some surface deterioration.
3.2.5 Abutments: The dam has 2 sound abutments between the concrete barrage and dikes. No adverse leakage or vegetation evident.
3.2.6 Operation: No dam operation plan exists and the gates, stop logs and draw off are operated as required.
3.2.7 Structures: There are no structures on the dam except a sluice mechanism which is in reasonable repair.
3.2.8 Downstream waterway is rocky with vegetation on the banks.
2.2.9 The dam is under regular surveillance.
3.2.10 No failure or distress seems to have occurred during the historic 1997 flood of record.
3.2.11 The dam is in good serviceable condition. Masonry deterioration is not considered significant. Vegetation growth is minor.
3.2.12 Intermittent minor seepage observed but it did not threaten the structure.
3.2.13 Total leakage through stop logs and flash boards was insignificant.
3.2.14 Results of previous inspection and construction reports are not summarized here.

3.3 Dam hazard classification:

3.3.1 The current classification is "significant" based upon Corps of Engineers Inspections, Phase 1, national dam inspection program.
3.3.2 The dam may be defined as small in height and intermediate in capacity. Little or minor damage would be caused if it failed on a Normal day.
3.3.3 If the dam dike failed, the reservoir would empty to about 5' above the riverbed.
3.3.4 The unattenuated 100 year flood is estimated to be 2524 cfs. (attenuation is the reduction in flow as a result of flood storage)
3.3.5 The dam's spillway capacity is 16% of this 100 year flood, but under current conditions the attenuation effects from the lake would keep overflow to a estimated maximum of 2 feet which is a manageable level.
3.3.6 The estimated unattenuated PMF flood is 8387 cfs. The maximum rise in top water level due to PMF flooding is about 6' which would overtop the dike. The estimated flood of record to date is about 1500 cfs. The "probable maximum flood" (PMF) is 6 times this value. Dam breach under PMF conditions would not significantly increase the downstream flood elevations.
3.3.7 The "sunny day breach", based on an assumed width of 3 times the height, is 61 % of the 100 year flood. The sunny day breach would not flood any infrastructure or buildings downstream.
3.3.8 Inspection revealed that there was one lake and no dam downstream, and the stream drained into the sea.
3.3.9 Dam breach under normal and PMF flood conditions would not contribute to significant property damage along the downstream watercourse to the confluence with the sea.

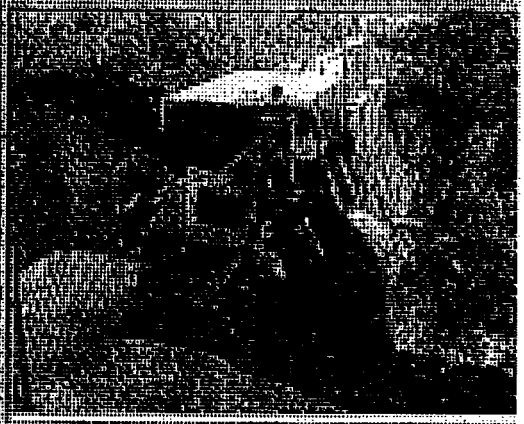
4. Assumptions

4.1 The condition assessment is visual and no testing of materials or detailed calculations were done. No stability analysis was performed and no strength assessments were done of the dam and appurtenances.
4.2 Downstream hydraulic assessments were based on visual inspection only.
4.3 Indicator values of flow and condition are based on ratios defined on Attachment A. The condition index is based on the sum of the Partial Indices for each item divided by their sum less 15.

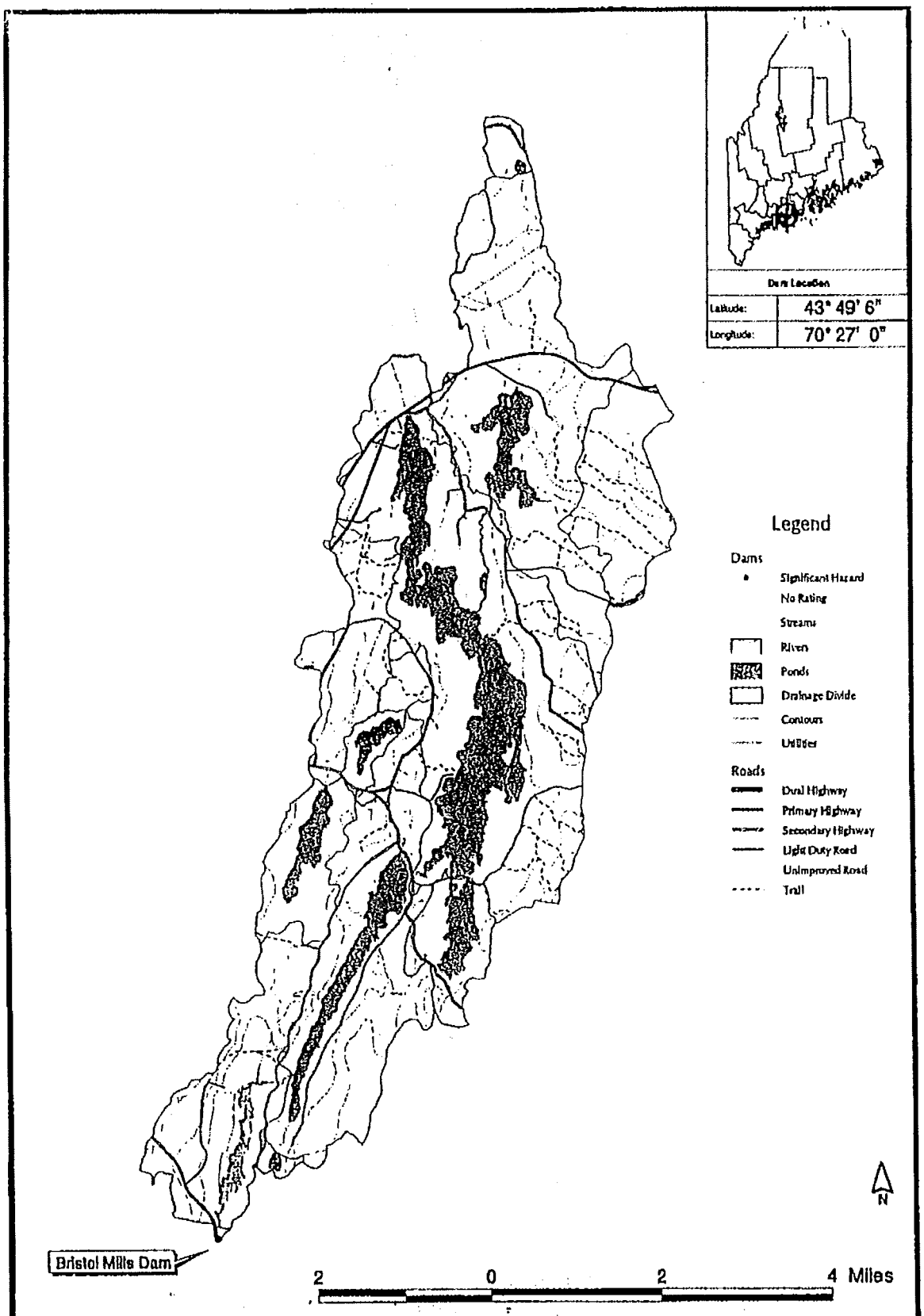
5. Based on the above findings I recommend that:

5.1 the dam be reclassified a low hazard dam, and that the condition of the dam be recorded as fair,
5.2 the Owner note the contents of this inspection report,
5.3 the Owner note that the spillway be maintained at a level to accommodate the 100 year flood,
5.4 written "standard operating procedures" (SOP's) be developed for the correct operation and maintenance of the dam
5.6 the new owner carry out voluntary regular dam inspections and report significant findings and dam incidents to this office
5.7 the affected Town and County EMA be notified of these findings and recommendations
5.8 the dam be inspected at minimum every 6 years by this Department.

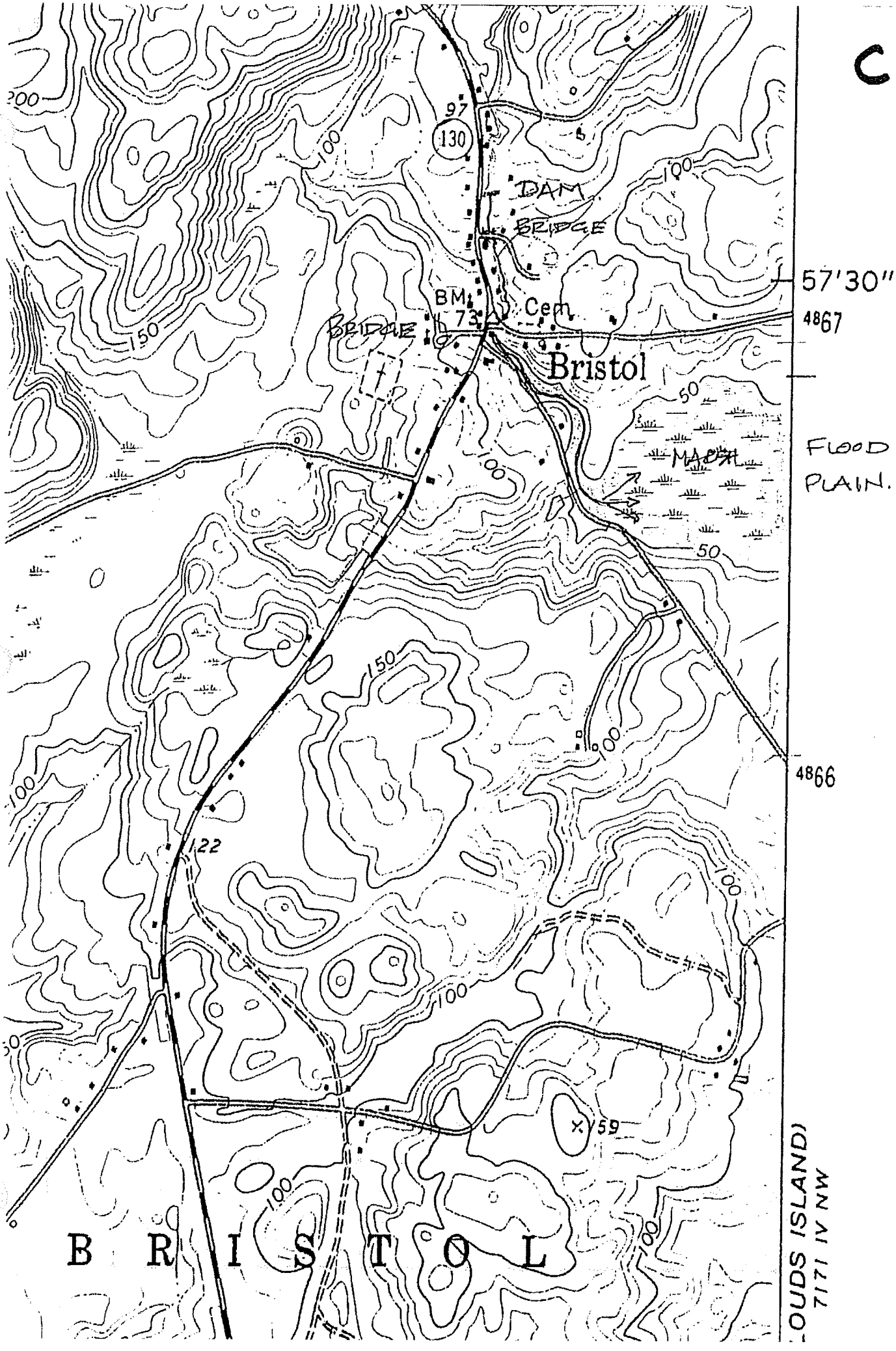
Tony Fletcher PE
Civil Engineer 1



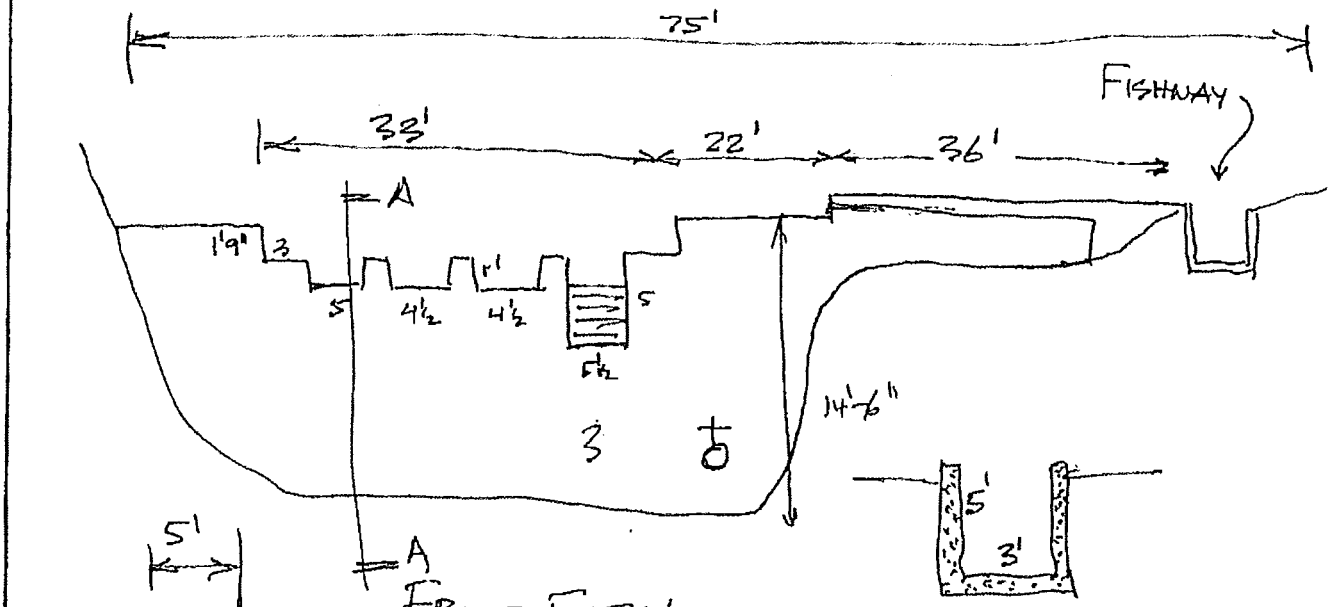
B

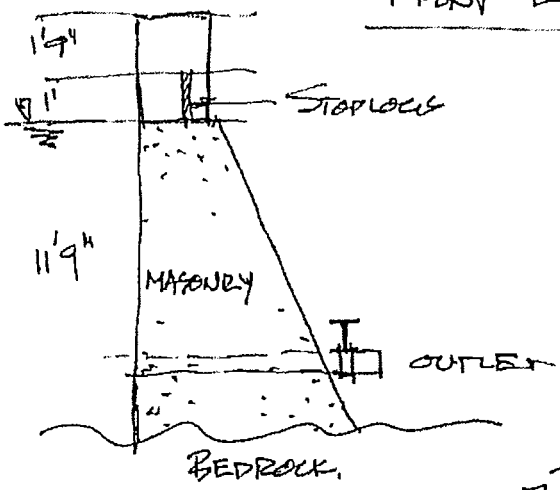


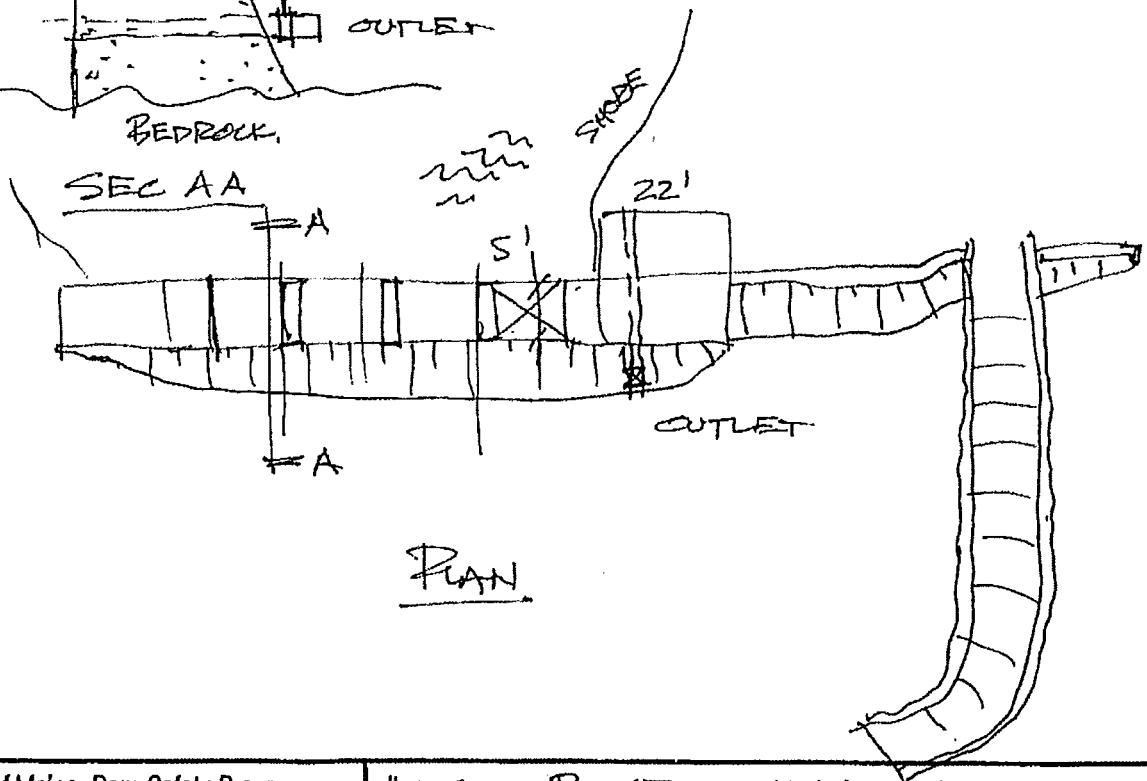
State of Maine, Dam Safety Program		Bristol Mills Dam		Watershed: 31.03 (sq. miles)
Department of Defense, Veterans and Emergency Management 72 SHS, Augusta ME 04333-0072 Tel: (207) 626 [illegible]		Watershed & Impoundment Area		Watercourse: 13.07 (miles)
By: Nathan Howard	Date: 8/18/99	Town: Bristol	Date:	Impoundment: 2658.35 (acres)
Checked:	Date:	County: Lincoln	Amended:	Dwg No: C77/99A


C
DAM
BRIDGE
BM 73
Cem
BRIDGE
Bristol
MARSH
FLOOD PLAIN.
57'30"
4867
4866
97
130
100
150
50
122
59
B R I S T O L
LOUDS ISLAND
7171 IV NW

D







State of Maine, Dam Safety Program Department of Defense, Veterans & Emergency Management 72 SHS Augusta ME 04333-0072 Tel: (207) 626 7824		#077 BRISTOL MILLS DAM. FIELD SKETCH		
By: TF	Date: 14 DEC 99	Town: BRISTOL MILLS	Date 14 DEC 99	Scale: NTS
Checked:	Date:	County:	Amended:	Dwg.No: C77 / 1

E

MAINE EMERGENCY MANAGEMENT AGENCY
DAM INSPECTION CHECKLIST

Dam Name: Bristol Mills Dam — Owner: Town of Bristol

River, Stream or Lake: Pemaquid River — Address:

Current Hazard Potential: High__ Significant X Low__ — Address:

Dam Location (Town): Bristol — Dam Type: Concrete

Date of Inspection: 6/19/96 — Latitude: 43°57.631 Longitude: 69°80.575

Pictures 6 & 7

ITEM	YES	NO	N/A	REMARKS
1. Crest				
a. Settlement ?		X		
b. Misalignment ?		X		
c. Cracks ?		X		
d. Trees and Brush ?		X		
e. Evidence of Major Rehabilitation ?	X			If yes, complete Dam Structural Measurement Report
2. Upstream / Downstream Slopes				New left side abutment & cap new fishway
a. Slope Protection ?	X			
b. Erosion / Beaching ?		X		
c. Trees and Brush ?	X			Upstream left side (brush)
d. Visual Settlements ?		X		
e. Sinkholes ?		X		
f. Animal Burrows ?		X		
g. Seepage ?	X			Left side abutment near toe a steady stream of water
h. Toe drains ?	X			
i. Relief wells ?		X		
j. Slides / Slumps ?		X		
3. Abutment Contact				
a. Erosion ?		X		
b. Seeping ?	X			Same as 2g
c. Boils ?		X		
d. Springs ?		X		

E2

ITEM	YES	NO	N/A	REMARKS
4. Appurtenances / Structures				
a. Timbers deteriorated ?			X	
b. Timber fasteners in place ?			X	
c. Crib ballast loss ?			X	
d. Cribs secure ?			X	
e. Concrete condition: Spalling, Cracking, Exposed reinforcement, Loss of Joint filler, Scaling ?	X			Some erosion aroung toe of left side abutment
f. Drains, Weepholes ?		X		
g. Stone displacement / removal ?			X	
h. Gates / Sluices serviceable ?	X			
i. Spillway obstructed / bypassed ?		X		
5. Reservoir				
a. Signs of shoreline instability ?		X		
b. Sedimentation ?		X		
c. Excessive debris ?		X		
d. Ice related problems ?		X		
e. Environmental Concerns ?		X		
f. Other ?				
6. Downstream Channel				
a. Eroding or Backcutting ?		X		
b. Sloughing ?		X		
c. Obstruction ?		X		
7. Emergency Action Plan				
a. Current Plan Posted ?				
b. Alerting and Warning System ?				
c. Certification of last test ?				
d. New development downstream ?				
e. Changed hazard potential ?				

APPENDIX D
Definitions

COMMON DAM SAFETY DEFINITIONS

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean structures, either in dams or separate therefrom, including but not be limited to, spillways; reservoirs and their rims; low-level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

Size Classification

Large – structure with a height greater than 40 feet or a storage capacity greater than 50,000 acre-feet.

Intermediate – structure with a height between 15 and 40 feet or a storage capacity of 1,000 to 50,000 acre-feet.

Small – structure with a height less than 15 feet and a storage capacity less than 1,000 acre-feet.

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Hazard Classification

High Hazard (Class I) – Shall mean dams located where failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).

Significant Hazard (Class II) – Shall mean dams located where failure may cause loss of life and damage to home(s), industrial or commercial facilities, secondary highway(s) or railroad(s), or cause the interruption of the use or service of relatively important facilities.

Low Hazard (Class III) – Dams located where failure may cause minimal property damage to others. Loss of life is not expected.

General

EAP – Emergency Action Plan – Shall mean a predetermined (and properly documented) plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam failure.

O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.

Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. One million U.S. gallons = 3.068 acre feet.

Height of Dam (Structural Height) – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the lowest point on the crest of the dam.

Hydraulic Height – means the height to which water rises behind a dam and the difference between the lowest point in the original streambed at the axis of the dam and the maximum controllable water surface.

Maximum Water Storage Elevation – means the maximum elevation of water surface which can be contained by the dam without overtopping the embankment section.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

Maximum Storage Capacity – The volume of water contained in the impoundment at maximum water storage elevation.

Normal Storage Capacity – The volume of water contained in the impoundment at normal water storage elevation.

Condition Rating

Unsafe – *Major structural**, operational, and maintenance deficiencies exist under normal operating conditions.

Poor – *Significant structural**, operation and maintenance deficiencies are clearly recognized for normal loading conditions.