

-- LAKE SHIRLEY DAM --
EMERGENCY ACTION PLAN



Dam Name: Lake Shirley Dam
State Dam ID#: 4-9-270-3
NID ID#: MA00455
Owner: Town of Lunenburg
Owner Type: Municipality
Town: Lunenburg, MA
Consultant: Stantec Consulting Services, Inc.
Date of Issue: August 4, 2023 (Updated)

PREFACE

This document entitled "Lake Shirley Dam Emergency Action Plan Update (NID ID# MA00455)" was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of The Town of Lunenburg, Massachusetts (the "Client"). This document is also intended for the use by the Town of Shirley Emergency Management Personnel in the event of a potentially dangerous situation (Condition Yellow Alert) or a dam failure or overtopping of Lake Shirley Dam is imminent or has already occurred (Condition Red Alert). Any reliance on this document by any other third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by

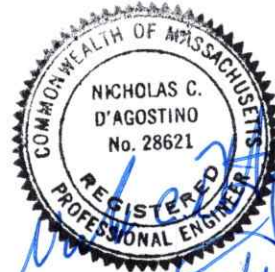

(signature)

Nicholas C. D'Agostino, P.E.

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License Type: Civil

Senior Associate, Geotechnical Engineer
Stantec Consulting Services Inc.



8/4/2023

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LAKE SHIRLEY DAM**

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1.0 Notification Flowchart

If an emergency condition arises at the Lake Shirley Dam, there are two possible warning levels that are available to the appropriate emergency response personnel. The Notification Flowchart (Figure 1-1) on the following page defines the notification requirements for Condition Red Alert and Condition Yellow Alert. The Flowchart identifies who shall be notified, the notification priority (numbers in circles), and means of notification (i.e., phone numbers).

1.1 CONDITION RED ALERT

An emergency condition exists at Lake Shirley Dam and a dam failure or overtopping is imminent or has already occurred. This is equivalent to a Type 3 Dam Failure as described in the Town of Shirley Comprehensive Emergency Management Plan.

Evacuation procedures must be followed immediately.

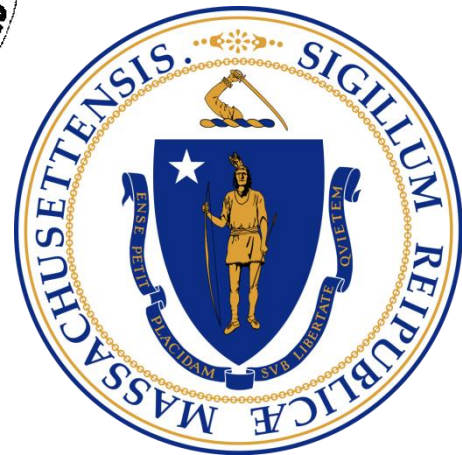
1.2 CONDITION YELLOW ALERT

A potentially dangerous situation may exist at Lake Shirley Dam that could jeopardize the integrity of the dam. Emergency response personnel shall be placed on alert and prepare for emergency evacuation and road closure measures should it become necessary. This scenario is where a failure (Condition Red Alert) may eventually occur but preplanned actions taken during certain events (such as major floods, earthquakes, evidence of piping) may moderate or alleviate failure. Such actions include emergency repairs to the dam. This is approximately equivalent to a Type 1 Dam Failure as described in the Town of Shirley Comprehensive Emergency Management Plan.

Prepare to implement evacuation procedures.



Figure 1-1 Notification Flow Chart



Condition Red Notification – An emergency condition exists at Lake Shirley Dam and dam failure or overtopping is imminent or has already occurred. Evacuation procedures must be followed immediately.
Condition Yellow Notification – A potentially dangerous situation may exist at Lake Shirley Dam that could jeopardize the integrity of the dam. Emergency response personnel shall be placed on alert and prepare for emergency evacuation and road closure measures should it become necessary. This is a situation where a failure (condition Red Alert) may eventually occur but preplanned actions during certain events (such as major floods, earthquakes, evidence of piping) may moderate or alleviate failure. Evacuation procedures must be prepared for.

NOTIFICATION FLOWCHART
For Condition Red and Yellow
Lake Shirley Dam
Lunenburg-Shirley, Massachusetts
State Dam ID# 4-9-270-3
NID ID# MA00455
EMERGENCY ACTION PLAN
Updated August 4, 2023

Dam Monitor
 Town of Lunenburg
 Ron Wilson – Dam Keeper
 (C) 978-852-2422

Assistant Dam Monitor
 Town of Lunenburg
 Richard Patry– Assistant Dam Keeper
 (H) 978-582-7853

Ayer Shirley Regional Dispatch Center (ASRDC)
 978-772-8200
 911 (Emergency-24hr)

⑥ = Order of Calls
 H = Home Phone No.
 W = Work Phone No.
 C = Cell Phone No.

①
Shirley Fire Department
 978-425-4334 (24hr)
 Contact/evacuate public within the inundation area. See Appendix A for evacuation procedures.

②
Shirley Police Department
 978-425-2642 (24hr)
 Perform necessary tasks to implement road closures to ensure public safety.

③
Town of Lunenburg Department of Fire and Emergency Services (Fire Chief)
 978-582-4155 (24hr)

④
Massachusetts Emergency Management Agency MEMA Communications Center
 508-820-2000 (24hr)

⑤
Infrastructure Services

Massachusetts Commuter Rail	617-222-6115 (24 hr)
Railroad District #3 Tower	800-955-9218 (24 hr)
	800-955-9208 (Alt.)
Railroad Slab City Area (Catacunemaug Road Area)	
Electric National Grid	800-322-3223 (24 hr)
Town of Shirley DPW Director	978-425-2628
Town of Shirley Water Dept.	978-425-2245
Town of Shirley Sewer Dept.	978-425-2600 x235

See **Figure 6-1** for inundation area. See **Appendix C** for flood characteristics to be considered in evacuation planning for the area encompassing the following roads:

- Brook Trail Road
- Catacunemaug Road
- MBTA Bridge over Catacoonamaug Brook
- Leominster Road/Main Street
- Fredonian Street
- Phoenix Street
- Shaker Road
- Canals Street, and
- Lowell Street

①
Lunenburg Town Manager Dam Owner Representative
 (W) 978-582-4130
 (C) 508-729-2782
 Organizes and makes necessary repairs, inspections, maintenance, etc.

①
Lunenburg Department of Public Works Director of Operations
 (W) 978-582-4160
 (C) 978-514-3635

②
Lunenburg Fire Department
 978-582-4155 (24hr)
 Assist Town of Shirley's emergency response officials.

③
Lunenburg Police Department
 978-582-4531 (24hr)
 Assist Town of Shirley's emergency response officials.

Massachusetts DCR, Office of Dam Safety
 William Salomaa – Director
 (W 508-792-7716 x 600 (Business Hours) ; (C) 617-719-1942 (24hr))
 Edward Conner - EAP Coordinator
 (C) 774-261-0207

2.0 Statement of Purpose

The Emergency Action Plan establishes the guidelines and procedures to be followed when an emergency condition is identified that may cause or is causing failure of the dam. The emergency conditions are usually identified by dam inspections, or triggered by an unusual rainfall event or earthquake. The purpose of this Emergency Action Plan (EAP) is to safeguard lives and reduce damage to the property of the citizens of the Town of Shirley and, to a lesser extent, the Town of Lunenburg, living along Catacoonamug Brook in the event of failure of the Lake Shirley Dam or flooding caused by large storm water runoff. When a hazardous condition is identified that could lead to dam failure or dam failure is imminent or in progress, this Emergency Action plan shall be implemented.

This plan defines responsibilities and provides procedures designed to identify unusual and unlikely conditions that may endanger Lake Shirley Dam in time to take action to mitigate and to notify the appropriate emergency management officials (as indicated in the Notification Flow Chart in Section 1.0) of possible, impending, or actual failure of the dam. The plan may also be used to provide notification when flood releases will create major flooding.

3.0 Project Description

3.1 SITE DESCRIPTION

Lake Shirley Dam is located within Worcester County, Massachusetts in the Town of Lunenburg on the Lunenburg/Shirley town line. It is located off of Cataconemaug Road about one mile north of Leominster Road. The dam impounds the water upstream of Catacoonamug Brook, a tributary to the Nashua River. The structure and impoundment are shown on the Ayer, Massachusetts USGS Quadrangle Map (1988) at coordinates 42°33'15"N, 71°40'32". The nearest population center is the Town of Shirley that is located approximately 1.25 miles southeast of Lake Shirley Dam. A site location map is presented on Figure 3-1.

Lake Shirley has an approximate area of 392.9 acres with a complex shape that has a maximum length of approximately 7,780 feet and a maximum width of approximately 4,340 feet. The lake is made up of two (2) large discrete basins (a north and south basin) that converge in on a shallow, central area enclosed by numerous peninsulas and composed of coves. The lake has a maximum storage capacity of 7,719 acre-feet.

3.2 APPURTENANT PARTS/FEATUES OF THE DAM

As shown on Figure 3-2, 'General Site Plan,' and Figure 3-3, 'Gatehouse Plan, Elevation, and Section, Spillway Plan and Profile,' the dam system is comprised of three major elements: the earth embankment, the primary spillway, and the mid/low level control piping. The embankment has a total structural height of approximately 21 feet, a hydraulic height of approximately 20.1 feet, and an overall length of approximately 400 feet.

The upstream side of the embankment has variable slope ranging from a 3 horizontal (H) to 1 vertical (V) slope to left of the spillway to a 5H: 1V slope to the right of the spillway. The slope is grassed with a concrete wave wall along the water's edge.

The top of the embankment is at elevation (El) 308.0, approximately 15-foot wide and grassed. A wire roped gate at the right end of the abutment limits vehicular access to the embankment crest.

The downstream side of the dam has a slope of approximately 2.5H: 1 V. A toe drain with cleanouts at either end runs along the toe of the embankment. The left and right toe drain outlet pipes each run under the large riprap in Catacoonamug Brook and outlet into the brook. The maximum embankment height is 21-foot in the area Catacoonamug Brook.

The principal spillway for the dam is an ogee weir spillway located in the central portion of the embankment. It is 30-feet wide with an 88-foot long concrete spillway apron chute, concrete abutment walls, and a concrete ogee weir with a crest at elevation (El) 298.25. The concrete spillway apron outlets onto a riprap covered channel located in the Catacoonamug Brook with an invert at El 287.00.

The dam also has mid- and low-level control piping used to lower Lake Shirley below the normal operating pool depth. The mid-level control pipe is a 24-inch diameter cast-iron pipe with the invert at El 292.00. The low-level control pipe is also a 24-inch diameter cast-iron pipe with an invert at El 288.25. Both the mid- and low-level piping have butterfly valves that are used to open and close the piping. The mid-level and low-level pipes converge into one 30-inch diameter cast-iron pipe that discharges onto the concrete spillway apron. The mid- and low-level piping are housed in the Gate House located to the right of the spillway.

3.3 SIGNIFICANT UPSTREAM AND/OR DOWNSTREAM DAMS

The Phoenix Pond Dam (Shirley, MA) is located approximately 2 miles downstream of Lake Shirley Dam. This dam is a low hazard dam.

The Houghton Mills Pond Dam (Shirley, MA) is located approximately 0.15 miles upstream of Lake Shirley Dam. This dam is a significant hazard dam.

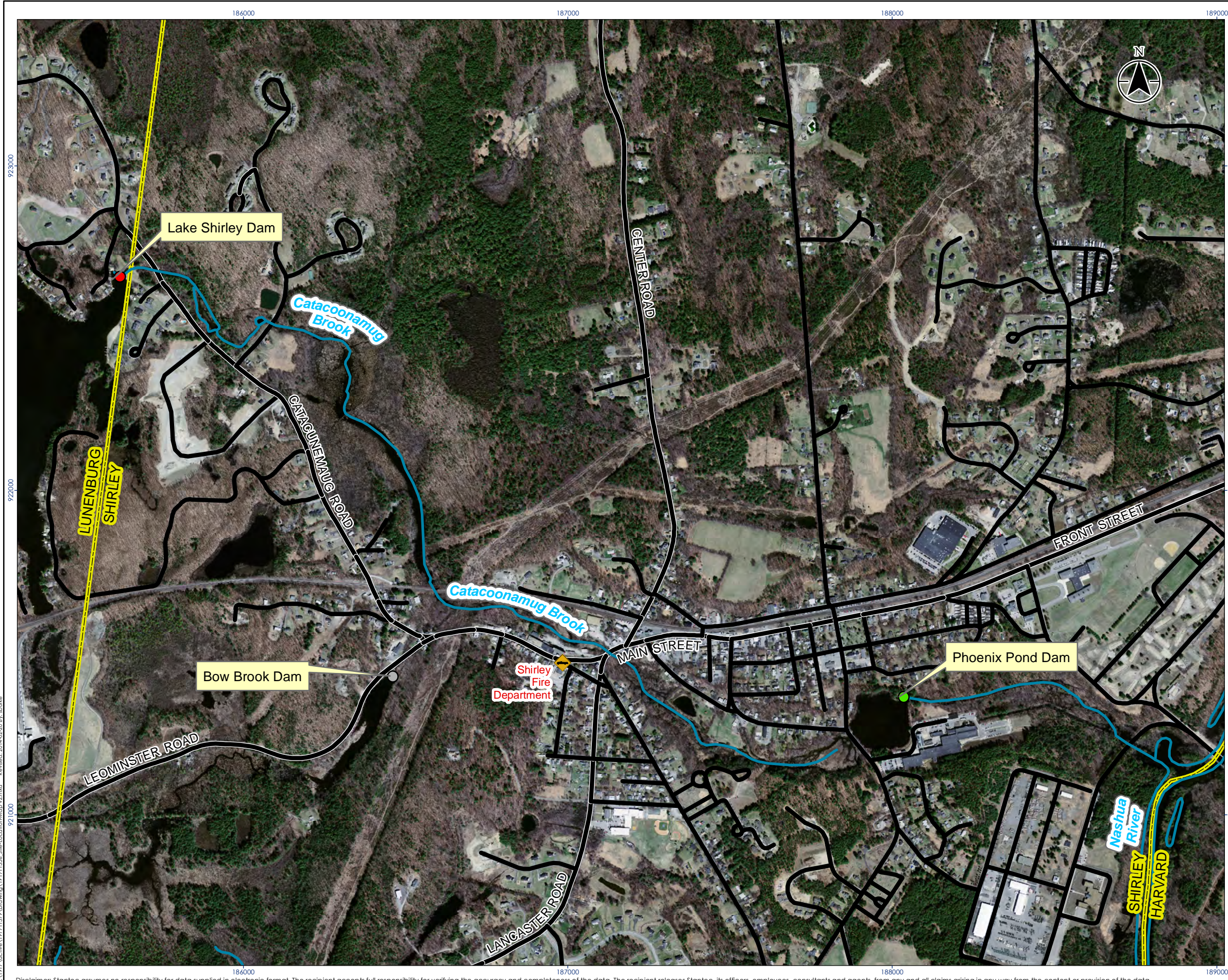
The Dam at Day Street (Leominster, MA) is located approximately 3 miles upstream of Lake Shirley Dam. This dam is a low hazard dam.

The Whalom Lake Dam in (Shirley, MA) is located approximately 4.1 miles upstream of Lake Shirley Dam. This dam is a significant hazard dam.

3.4 DOWNSTREAM COMMUNITIES POTENTIALLY AFFECTED BY A DAM FAILURE OR FLOODING

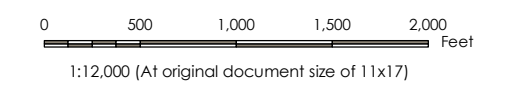
The primary community that will potentially be most affected by a dam failure or flooding as a result of large operational releases from Lake Shirley Dam will be the Town of Shirley, MA.

Dam-break flooding would flow along the Catacoonamug Brook through the Town of Shirley into the Nashua River approximately 2.7 miles downstream from the Lake Shirley Dam. At this point the floodwater will be significantly lessened.



Legend

- Major Road
- Minor Road
- Catacoonamug Brook
- Dam - High Hazard
- Dam - Low Hazard
- Dam - No Hazard Class



Notes
 1. Coordinate System:
 NAD 1983 StatePlane Massachusetts Mainland FIPS 2001



Project Location: N42.554372, W71.67502
 T. of Lunenburg, Worcester Co., MA
 Prepared by SBB on 2014-02-20
 Review by NAD on 2014-02-20

Client/Project:
 Town of Lunenburg
 Lake Shirley Dam
 Emergency Action Plan

Figure No.:
 3-1

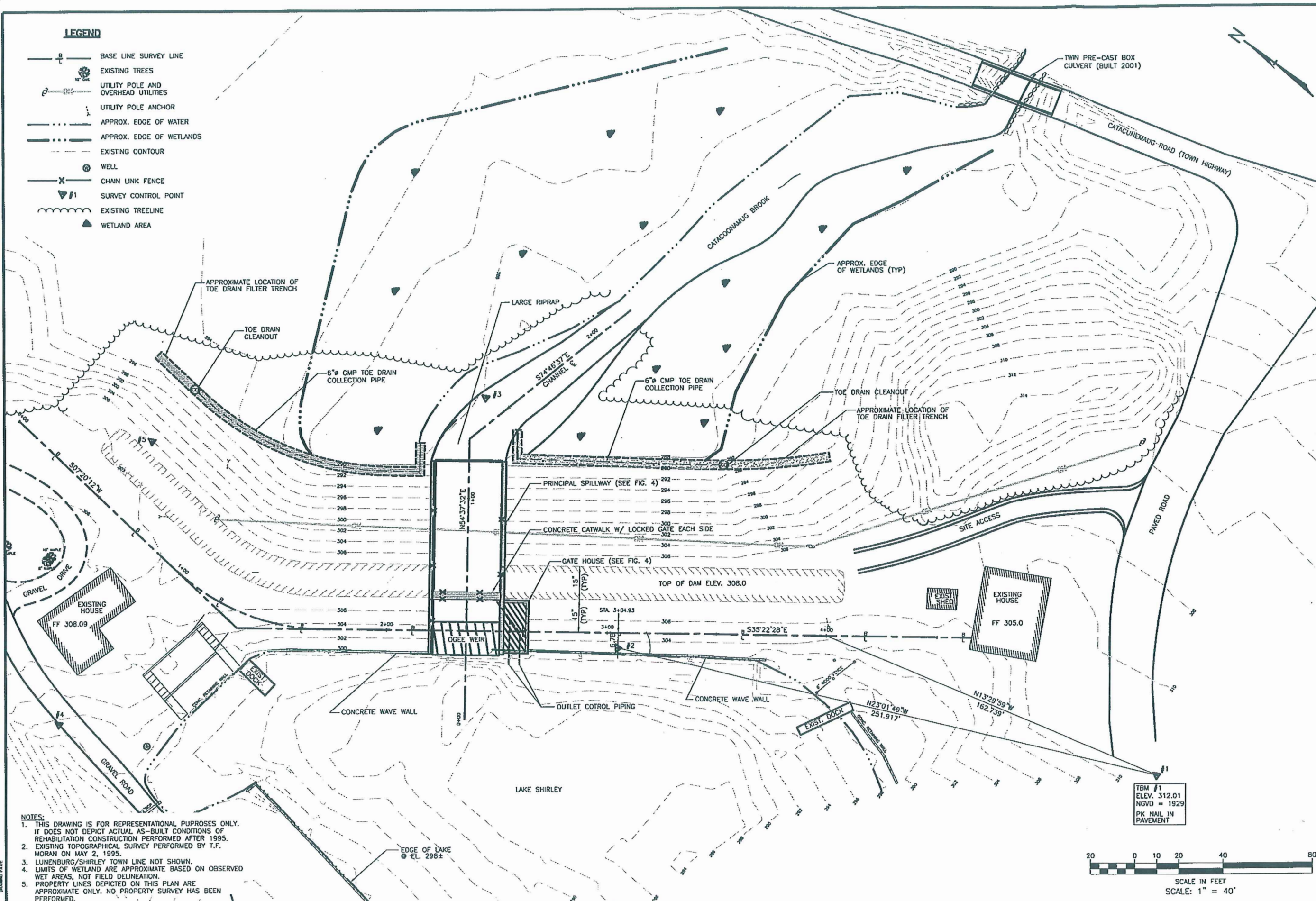
Title

SITE LOCATION MAP

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LEGEND

- +— BASE LINE SURVEY LINE
- 🌳 EXISTING TREES
- o— UTILITY POLE AND OVERHEAD UTILITIES
- x— UTILITY POLE ANCHOR
- - - - - APPROX. EDGE OF WATER
- · - · - APPROX. EDGE OF WETLANDS
- - - - - EXISTING CONTOUR
- ⊙ WELL
- x— CHAIN LINK FENCE
- ▲ #1 SURVEY CONTROL POINT
- 🌿 EXISTING TREELINE
- ▲ WETLAND AREA



NOTES:
 1. THIS DRAWING IS FOR REPRESENTATIONAL PURPOSES ONLY. IT DOES NOT DEPICT ACTUAL AS-BUILT CONDITIONS OF REHABILITATION CONSTRUCTION PERFORMED AFTER 1995.
 2. EXISTING TOPOGRAPHICAL SURVEY PERFORMED BY T.F. MORAN ON MAY 2, 1995.
 3. LUNENBURG/SHIRLEY TOWN LINE NOT SHOWN.
 4. LIMITS OF WETLAND ARE APPROXIMATE BASED ON OBSERVED WET AREAS, NOT FIELD DELINEATION.
 5. PROPERTY LINES DEPICTED ON THIS PLAN ARE APPROXIMATE ONLY. NO PROPERTY SURVEY HAS BEEN PERFORMED.

TOWN OF LUNENBURG
 17 MAIN STREET
 PO BOX 136
 LUNENBURG, MA 01462-0136

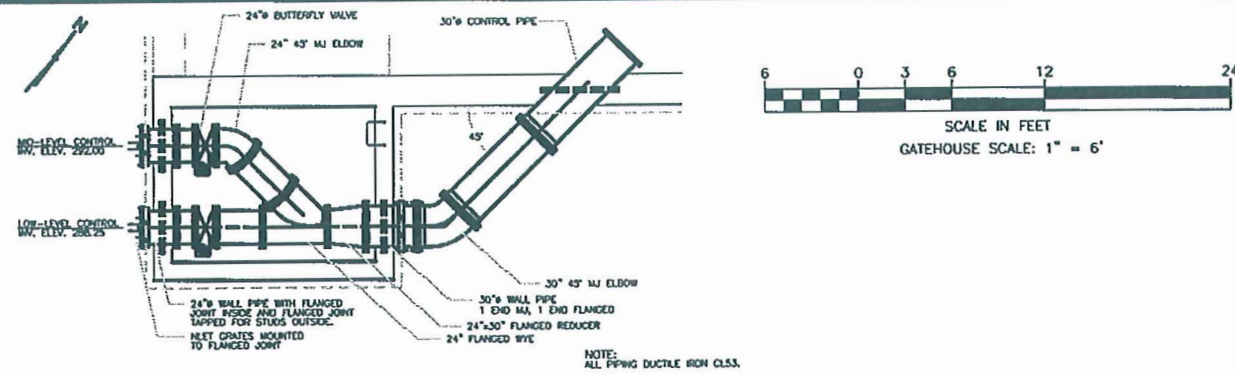
DUBOIS SKING
 28 NORTH STREET
 RANDOLPH, VT 05080
 PH: 802-728-0370
 FAX: 802-728-0350
 www.dubois-skiing.com
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NO.	DATE	DESCRIPTION	BY

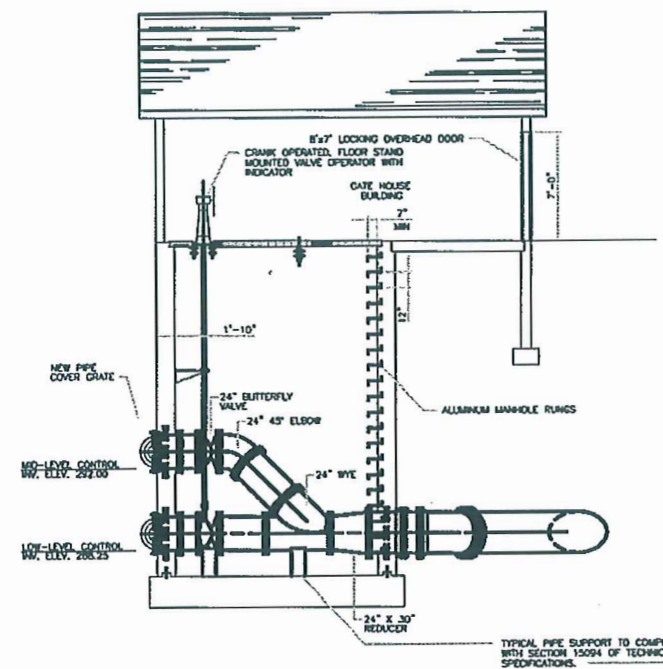
GENERAL SITE PLAN
LAKE SHIRLEY DAM
EMERGENCY ACTION PLAN
LUNENBURG, MA

DRAWN BY: DPM
 CHECKED BY:
 DESIGNED BY:
 APPROVED BY:
 PROJECT NUMBER: 619848P2
 SCALE: AS SHOWN
 DATE: 4-5-07

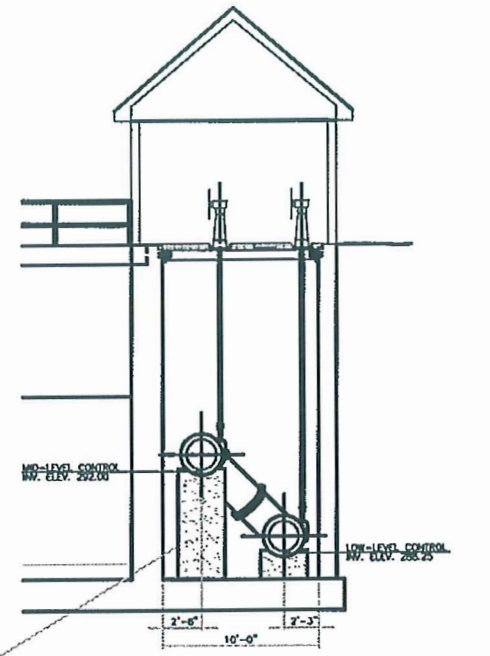
FIGURE: **3-2**



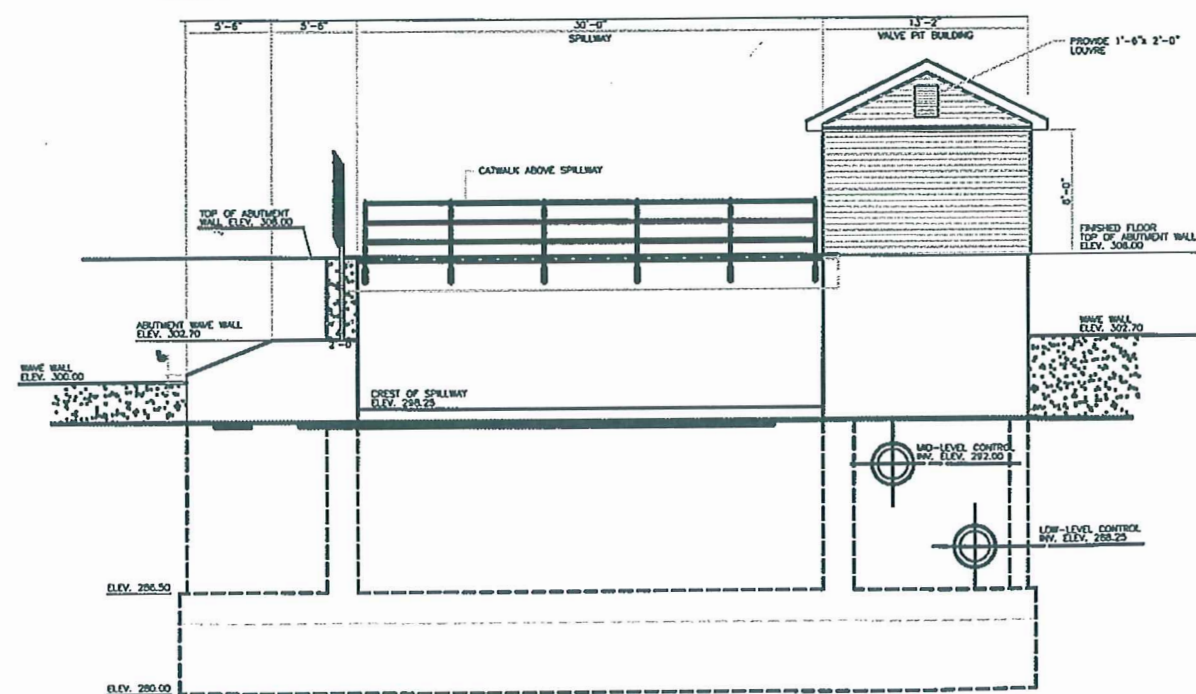
GATE HOUSE PLAN



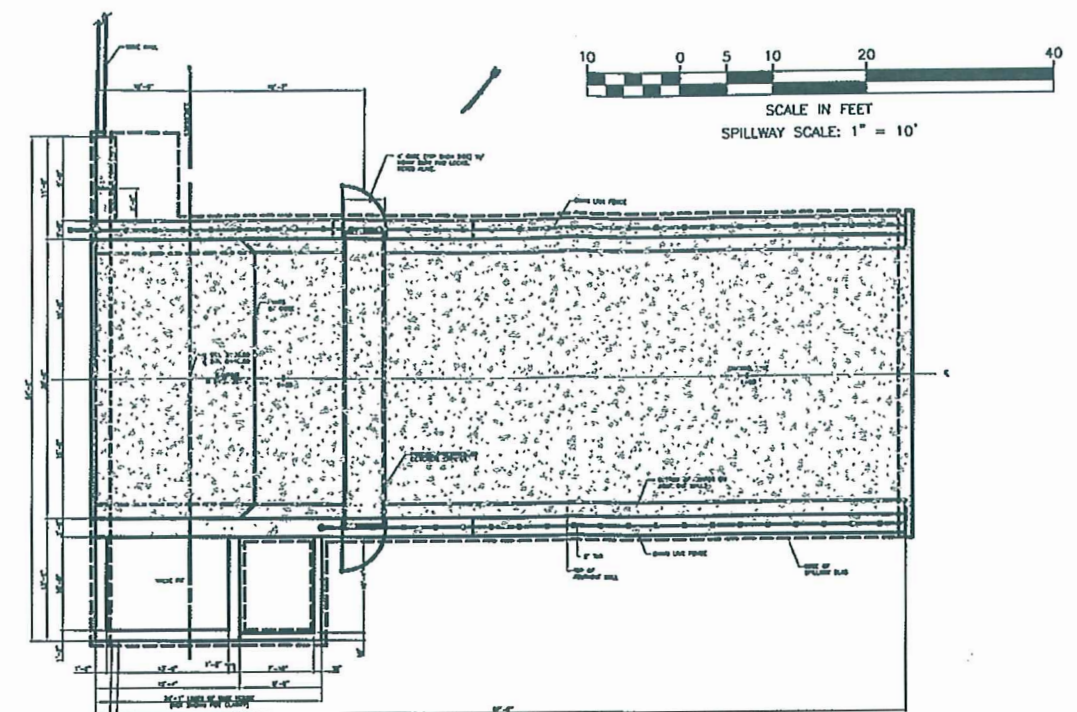
GATE HOUSE SIDE ELEVATION



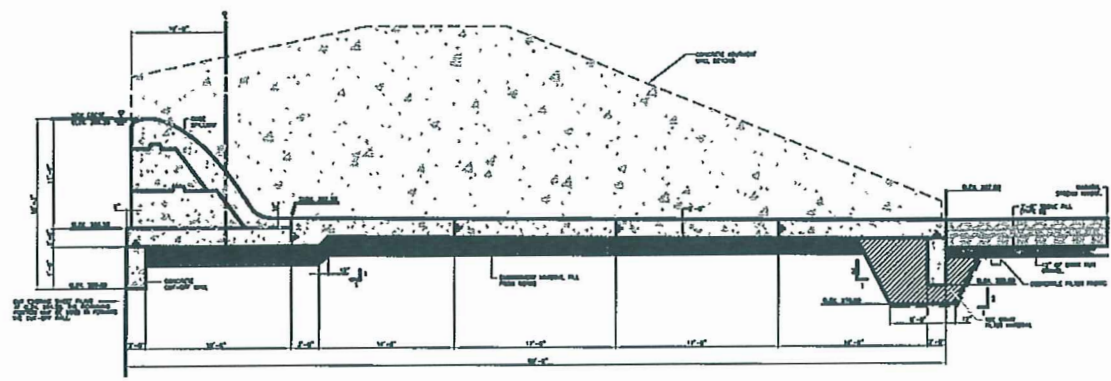
GATE HOUSE FRONT ELEVATION



GATE HOUSE SECTION



SPILLWAY PLAN



SPILLWAY PROFILE

NOTES:
 1. NOTE THIS DRAWING IS FOR REPRESENTATIONAL PURPOSES ONLY. IT DOES NOT DEPICT ACTUAL AS-BUILT CONDITIONS OF REHABILITATION CONSTRUCTION PERFORMED AFTER 1995.

TOWN OF LUNENBURG
 17 MAIN STREET
 PO BOX 149
 LUNENBURG, MA 01462-0149

DUBOIS SKIN
 ENGINEERING • DEVELOPMENT
 MANAGEMENT • DEVELOPMENT

NO.	DATE	DESCRIPTION	BY

**GATEHOUSE PLAN, ELEV., & SECT.
 SPILLWAY PLAN AND PROFILE**

**LAKE SHIRLEY DAM
 EMERGENCY ACTION PLAN
 LUNENBURG, MA**

DESIGNED BY: DPM	CHECKED BY:
DESIGNED BY:	APPROVED BY:
PROJECT NUMBER: 61984BP2	SCALE: AS SHOWN
DATE: 4-5-07	FIGURE: 3-3

4.0 Emergency Detection, Evaluation and Classification

4.1 DETECTION

Purpose: The first step in implementing the EAP is having a responsible person monitor the dam, evaluate and take action during periods of heavy precipitation, flooding, any unusual hydrologic events or any other potential structural failure. The owner must designate a qualified person or persons to perform this task.

Designated Monitor: The Town of Lunenburg owns Lake Shirley Dam and is responsible for monitoring the facility during both routine maintenance and emergency situations. The Town of Lunenburg appoints a Dam Keeper and an Assistant Dam Keeper annually from the Lake Shirley Improvement Corporation. Currently the Dam Keeper is Mr. Ron Wilson and the Assistant Dam Keeper is Mr. Richard Patry. The Town of Lunenburg has authorized these two lake residents to be the designated Dam Monitor and Secondary Dam Monitor and operators for purposes of this EAP. In the absence of the Dam Monitor, the Secondary Dam Monitor shall perform those duties designated to the Dam Monitor. Both Mr. Wilson and Mr. Patry live adjacent to the lake only minutes from the dam itself.

Dam Monitor: Mr. Ron Wilson - Dam Keeper
Telephone: Cell: 978-852-2422

Secondary Dam Monitor: Mr. Richard Patry - Assistant Dam Keeper
Telephone: Home: 978-582-7853

Normal routine inspections of the dam are recommended on a monthly basis or as needed to check embankments, abutments, clear debris from channel, and perform other routine repairs. These inspections may be made by the Dam Monitor, Secondary Dam Monitor, or another qualified individual appointed by the dam owner. Hazardous dam deficiencies are occasionally identified during these routine inspections or during a technical inspection by a professional engineer required by 302 CMR 10.0 every two (2) years for a high hazard dam. These hazardous dam deficiencies include, but are not limited to: severe cracking in the concrete principal spillway, major seepage in the earthen dam, high flows through the principal spillway, overtopping of the dam, sloughing of the earthen dam, etc.

The EAP Dam Monitor conducts inspections and evaluations during periods of heavy precipitation, flooding, or unusual hydrologic events and potentially dangerous structural conditions.

Training and Qualifications: The monitor and secondary monitor are knowledgeable in the operation and procedures of Lake Shirley Dam. They are able to reach the dam within a reasonable time frame during an emergency. They have been responsible for routine maintenance, operations, and general inspection of the dam since approximately 2008.

They have had sufficient experience to recognize the condition of the dam, identify and evaluate specific problem areas. They are capable of describing their observations and evaluations to local officials.

Communication System: The Emergency Notification Flowchart (Figure 1-1 presented in Section 1) developed specifically for Lake Shirley is intended to link the Dam Monitor with appropriate local officials in the event of a dam-failure. In the event of a potentially hazardous or actual emergency situation at the dam, the Dam Monitor and others in the notification chart are required to start the notification process.

The following communication systems between the Dam Monitor and local officials can be employed:

1. Normal telephone communication. The monitor should have access to the nearest available telephone or cellular phone and should have on his person the phone numbers of appropriate officials (Figure 1-1: Notification Flow Chart).
2. Radio Communications. If the phone system is out of order, the Dam Monitor should have access to a radio communication device or equivalent that can be monitored by officials at the police, fire and the emergency medical services. All communication equipment and other emergency working devices shall be tested at least yearly or as needed. The Town of Lunenburg will conduct an annual test of the emergency communication network for this high hazard structure with a dry-run of the emergency notification system.

4.2 EVALUATION

4.2.1 Purpose

In conjunction with the ability to assess the condition of the dam, the monitor should have the ability to determine and evaluate the nature of any existing problem. This is a crucial step in the EAP, because failure to accurately and promptly identify a problem may adversely affect the EAP warning system.

4.2.2 Preventive Actions

This section lists the conditions and actions which may be used as a guide for the Dam Monitor personnel to respond to the level of emergency response. Periodic inspections by the Dam Monitors will identify whether visual evidence of distress is present. In the event of an abnormal occurrence, such as a tornado, earthquake, or unusually heavy rainfall, special inspections by a registered engineer specializing in dam design and construction of the embankment and spillway are warranted.

Table 4-1 presents various signs of distress at the dam and provides a guide for emergency actions to be undertaken for the various conditions.

4.2.2.1 “Watch” Condition: A problem has been detected by the Dam Monitor which requires constant monitoring or immediate action to repair or correct. At this time, the distress condition is manageable by Town personnel. The Lunenburg Town Manager will designate the Lunenburg DPW Director of Operations to be responsible for monitoring and repair as soon as possible and implementing the appropriate Notification Flowchart. The following is a list of conditions which constitute “watch” conditions:

- Cloudy or dirty seepage or seepage with an increase in flow, boils, piping, or bogs.
- Seepage around conduits.
- Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.
- Any slide that degrades the crest of the embankment or that is progressively increasing in size.
- Cracking or movement of any concrete structure.

4.2.2.2 Possible Dam Failure Condition: A “watch” condition that is progressively getting worse is considered a possible dam failure. Efforts to correct the situation will continue, and—although there is no imminent danger—if conditions continue to deteriorate, a dam failure could occur. A “possible dam failure” condition generally has already involved extensive efforts by Town personnel and potentially other contractors. A “possible dam failure” condition will continue until the problem is corrected, or until an “imminent dam failure” warning is issued. Notifications have been issued and local law enforcement personnel are ready to begin evacuation of threatened areas.

The Lunenburg Town Manager will be responsible for initiating immediate repairs, including lowering the Lake level if appropriate and implementing the appropriate Notification Flowchart. The following is a list of conditions which constitute “possible dam failure” conditions:

- Large boils, increasing in size and flow rate, especially if there is flowing muddy water.
- Significantly increasing seepage, especially flowing muddy water.
- Slides involving a large mass of material that impairs the crest of the dam and is continuing to move.
- Sinkholes with seepage flowing muddy water.
- Large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam.
- An increase in the reservoir level to near the top of the dam.
- Overtopping of a dam that is not designed for overtopping.

4.2.2.3 Imminent Failure: It has been determined that the condition at the dam will continue to progress to failure and result in the uncontrolled release of water, an “imminent dam failure” condition exists. Dam failure will most likely occur regardless of what actions are taken. Numerous forces are involved in trying to correct the situation. Evacuation has begun and will continue until the situation is stabilized.

The Lunenburg Town Manager is responsible for implementing the appropriate Notification Flowchart. The following is a list of conditions which constitute “imminent dam failure” or “dam failure” conditions:

- Rapidly increasing boils or the presence of new, significantly flowing boils, particularly muddy ones near previously identified ones.
- Rapidly increasing seepage, especially flowing muddy water.
- Slides involving a large mass of material or which have degraded the crest of the embankment to a level that approaches the water surface level, or if significant seepage is observed through the slide area.
- Settlement that is predicted to degrade to the reservoir level.
- Cracks that extend to the reservoir level.
- Significant movement or failure of any structure that forms an integral part of the dam.
- Overtopping of an earthen dam.
- Uncontrollable release of the Lake.

4.2.3 Safety Checklist

The following is a checklist that the monitor can use to prepare a safety assessment and evaluation of the dam. Under each item, the condition should be noted by time (hour, minute) and date of observations. The Dam Monitor can use the form that includes this checklist information as well as other site specific information that the dam owner would like recorded attached as Table 4-2. A notebook should be kept on file of all safety assessments.

Table 4-1: Event Observed and Actions to Mitigate

Event Observed	Specific Observation	Condition	Actions to Mitigate and Event Progression	Equipment Material and Supplies	Data to Record
Settlement	Obvious settlement of the crest of the embankment, especially adjacent to concrete structures.	Watch	Look for bulges on slope or changes in crest alignment	None	Size, location
	Settlement of crest of embankment that is progressing, especially adjacent to concrete structures or if any corresponding seepage is present.	Watch	Initiate 24-hour surveillance. Mobilize all available resources for repair operations to increase freeboard. Fill and stockpile sand bags. Identify any boils near settlement points for flowing material and pursue action for boils.	Sandbags dozer, shovels, source of earth fill	Size, location
	Settlement of crest of embankment that is rapidly progressing especially adjacent to concrete structures or if any corresponding seepage is flowing muddy water or increasing flow	Possible Failure	Continue monitoring and remedial actions as described above. Use sandbags to increase the freeboard on the dam if necessary.	Sandbags dozer, shovels, source of earth fill	Size, location
	Progressing settlement that is expected to degrade the embankment to Lake level.	Imminent Failure	Downstream evacuation. Utilize all available equipment and personnel to build up the crest in the area that is settling Identify any boils near settlement points for flowing material and pursue action for boils	Dozer, shovels, source of earth fill	Size, Location
Cracking	Cracks in the embankment crest or on slopes	Watch	Walk on entire crest and slope and check for additional cracking.	Stakes, tape measure	Size, location
	Numerous cracks in crest that are enlarging, especially those perpendicular to the center line of the dam.	Watch	Initiate 24-hour surveillance. Carefully monitor and measure cracking to determine the speed and extent of the problem. Mobilize to fill cracks. Cracks parallel to the centerline indicate a slide. Follow remedial action for slides.	Stakes, tape measure, dozer, shovels, source of earth fill	Size, location
	Large cracks in the crest that are rapidly enlarging, especially those perpendicular to the centerline of the dam.	Possible Failure	Continue monitoring and remedial action as described above.	Dozer, shovels, source of earth fill	Size, location
	Cracking that extends to pool elevation, increase in flow and muddy water.	Imminent Failure	Downstream evacuation. Continue remedial actions as described above.	Dozer, shovels, source of earth fill	Size, location

Event Observed	Specific Observation	Condition	Actions to Mitigate and Event Progression	Equipment Material and Supplies	Data to Record
Boils	Small boils, no increase of water flow, flowing clear water	Watch	Closely check all of downstream toe, especially in the vicinity of boil for additional boils, wet spots, sinkholes, or seepage. Closely monitor entire area for changes or flow rate increases	None	Site and location. approximate flow
	Large or additional boils near previously identified ones, without increasing flow rate, but carrying small amount of soil particles	Watch	Initiate 24-hour surveillance. Monitor as described above. Construct sandbag ring dikes around boils, to cover them with water to retard the movement of soil particles. Filter cloth may be used to retard soil movement, but do not retard the flow of water.	Sandbags, filter cloth	Site and location. approximate flow
	Large or additional boils near previously identified ones, increasing flow rate, carrying soil particles	Possible Failure	Continue 24-hour surveillance. Continue monitoring and remedial action as described above. Initiate emergency lowering of the Lake. Issue a warning to downstream residents.	Sandbags, pump	Site and location. approximate flow
	Rapidly increasing size of boils and flow increasing and muddy water	Imminent Failure	Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the boil area	Dozer, shovels, source of earth fill	Site and location. approximate flow
Seepage	Minor seepage of clear water at toe, on slope of embankment, or at the abutments	Watch	Closely check entire embankment for other seepage areas. Use wooden stakes or flagging to delineate seepage area. Try to channel and measure flow. Look for upstream whirlpools.	Wooden stakes, flagging	Site and location. approximate flow
	Additional seepage areas observed flowing clear water and/or increasing flow rate.	Watch	Initiate 24-hour surveillance. Monitor as described above. Construct measuring weir and channel all seepage through weir. Attempt to determine source of seepage.	Dozer, shovels	Site and location. approximate flow
	Seriously or rapidly increasing seepage, under seepage, or drain flow.	Possible Failure	Continue 24-hour monitoring and remedial action as described above. Initiate emergency lowering of the Lake. Construct a large ring dike around the seepage area.	Dozer, shovels, source of earth fill	Site and location. approximate flow
	Additional seepage areas with rapid increase in flow and muddy water	Imminent Failure	Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the seepage area.	Dozer, shovels, source of earth fill	Site and location. approximate flow

Event Observed	Specific Observation	Condition	Actions to Mitigate and Event Progression	Equipment Material and Supplies	Data to Record
Slides or Severe Erosion	Skin slide or slough on slope of embankment. No further movement of slide and embankment crest not degraded	Watch	Examine rest of embankment for other slides. Place stakes in slide material and adjacent to it for determining if further movement is taking place.	Stakes, tape measure	Distance between stakes
	Slide or erosion involving large mass of material, crest of embankment is degraded, no movement or very slow continuing movement.	Watch	Initiate 24-hour surveillance. Mobilize all available resources and equipment for repair operations to increase freeboard and to protect the exposed embankment material. Start filling sandbags and stockpile near slide area.	Dozer, shovels, sources of earth fill, sandbags	Distance between stakes
	Slide or erosion involving large mass of material, crest of embankment is degraded, progressively increasing in size.	Possible Failure	Continue monitoring and remedial actions as described above. Place additional material at the toe of the slope to stop the slide.	Dozer, shovels, source of earth fill, pump	Distance between stakes
	Slide or erosion involving large mass of material, crest of embankment is severely degraded, movement of slide is continuing and may reach pool level	Imminent Failure	Downstream evacuation. Utilize all available equipment and personnel to sandbag the degraded slide area to prevent it from overtopping.	Dozer, shovels, sandbags, pump	Distance between stakes
Sinkholes	Sinkholes anywhere on the embankment or within 500 feet downstream from the toe.	Watch	Carefully walk the entire embankment and downstream area looking for additional sinkholes, movement, or seepage.	Stakes, flagging	Size, location
	Sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	Watch	Initiate 24-hour surveillance. Monitor as above. Construct sandbag dike around the seepage exit point to reduce the flow rate. Start filling sandbags and stockpile near sinkhole.	Dozer, shovels, pump	Size, location
	Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	Possible Failure	Continue monitoring and remedial action as described above. Utilize sandbags to increase the freeboard on the dam if necessary.	Sandbags, dozer, pump	Size, location
	Sinkholes rapidly getting worse, seepage flowing water and increasing flow.	Imminent Failure	Downstream evacuation. Utilize all available equipment and personnel to attempt to construct a large ring dike around the area.	Dozer, shovels, pump	Size Location

Event Observed	Specific Observation	Condition	Actions to Mitigate and Event Progression	Equipment Material and Supplies	Data to Record
Cracking or Movement of Concrete Structure	Minor cracking and/or movement	Watch	Immediately install measuring device to monitor movement	Crack monitors, stakes, tape measure	Site and location.
	Significant cracking and/or movement	Watch	Initiate 24-hour surveillance. Lower burlap on upstream face of crack to reduce flow of soil particles. Dump rock fill downstream of moving concrete structure monolith to resist the movement.	Burlap, rock fill, dozer, shovels	Size, location, flow rate
	Serious cracking and/or movement	Possible Failure	Continue monitoring and remedial action as described above	Dozer, rock fill, burlap, crack monitors	Size, movement flow rate
	Major cracking and/or movement	Imminent Failure	Downstream evacuation. Continue monitoring and remedial actions as described above	Dozer, shovels, Rock fill	Size, location, flow rate
Upstream Whirlpool	Whirlpool in the lake in the vicinity of the embankment	Imminent Failure	Downstream evacuation. Attempt to plug the entrance of the whirlpool with riprap from the slope of the embankment. Search downstream for an exit point and construct a ring dike to retard the flow of soil particles	Dozer, source of earth fill, sandbags, filter cloth, straw, rocks	Size, location, flow rate
Broken Gate	Structural member of a gate or gate operator broken or severely damaged so as to prevent operation of the gate.	Possible Failure	Initiate 24-hour surveillance. Immediately place stop logs in front of gate and initiate necessary actions to get gate repaired.	Crane and welder	Type of problem, location
Rapidly Rising Lake	Lake level rising and rain continuing	Watch	Initiate 24-hour surveillance of lake level and rainfall.		Lake level, rainfall
Dam being Overtopped	Water flowing over the dam and Lake level continuing to rise	Possible Failure	Downstream evacuation. Continue monitoring.		Lake level, rainfall

Table 4-2: Safety Assessment and Evaluation of Lake Shirley Dam

Name of Evaluator:	
Date of Evaluation:	
Time of Evaluation:	
Structure/Location	Observation
Water Surface Elevation:	
Observed water height relative to crest of spillway and top of dam.	
Spillway:	
Clear or blocked by debris (If so, to what extent?)	
Cracks or other structural movement	
General conditions overall	
Low-level and Mid-level Valves:	
Check at least semi-annually to ensure the gates are operable.	
Top of Dam:	
Stability of cover	
Grass, bush or other woody vegetation growing on dam	
Evidence of erosion	
Evidence of Sinkholes	
Downstream Face of Dam:	
Stability of cover	
Evidence of any piping of water, seepage, boils, etc.	
Evidence of erosion	
Evidence of Sinkholes	
Identify problem(s) based on above observations; evaluate severity relative to normal conditions; estimate rate of change in conditions over time.	
Report dam status and conditions to Town of Lunenburg Town Manager	

4.3 CLASSIFICATION

Emergencies are classified according to their severity and urgency. An emergency classification system is one means to classify emergency events according to the different times at which they occur and to their varying levels of severity. The classification system indicates the urgency of the emergency condition.

Declaration of an emergency can be a very controversial decision. The issue should not be debated too long. An early decision and declaration are critical to maximize available response time.

NOTE: It should be remembered that it may be appropriate to immediately declare a Condition Red. However, there should be smooth transition from Condition Yellow Alert to Condition Red when using Condition Yellow Alert initially.

To assist the evacuating agencies in selecting their appropriate course of action and to provide a proper transition from Condition Yellow Alert to Condition Red Alert, the Dam Monitor should clearly communicate their assessment of the situation to the agencies. The Dam Monitor should consider placing the agencies on an initial alert and provide periodic updates on the situation as it develops so that the agencies can assess when they should implement their evacuation procedures.

The Dam Monitor is responsible for consulting with local emergency response officials, if there is an emergency condition developing or if one has already occurred. The local emergency officials shall include the Town of Lunenburg Fire Chief, The Town of Shirley Fire Chief, and the Lunenburg Town Manager. The Dam Monitor and the emergency response officials will then decide on if a Code Yellow or Red Alert is warranted and initiating the Notification Procedures as outlined in this EAP is necessary. The Notification Flowchart in Section 1.0 defines who shall be notified, the notification priority, and provides the means of notification.

4.3.1 Failure is Imminent or has Occurred (Condition Red Alert)

Town of Shirley Comprehensive Emergency Management Plan Type 3.

Generally, this situation should convey the impression that "time has run out" with respect to the failure of the dam. This is a situation where a failure either has occurred, is occurring, or obviously is just about to occur. The question is often asked, "How much time is available when failure is considered to be imminent?" It is impossible to determine how long it will take for a failure to occur or for a complete breach to occur once failure begins. **Therefore, once a Dam Monitor (and local emergency response officials) determines that there is no longer any time available to attempt corrective measures to prevent failure, the "failure is imminent or has occurred" the Dam Monitor will immediately initiate the Notification Flowchart attached in Section 1.0 and notify the authorities of the Condition Red Alert. The site will be monitored continuously until the emergency condition has subsided.**

During a Condition Red Alert, local emergency response personnel must notify impacted Town of Shirley residences to evacuate, close impacted roads, and reroute traffic.

Emergency Management Agencies for evacuation purposes, should conservatively interpret the phrase "failure is imminent" to mean that the dam is failing, i.e., **it should not be assumed that there is some time lag between "failure is imminent" and a "failure has occurred."**

4.3.2 Potential Failure Situation is Developing (Condition Yellow Alert)

Town of Shirley Comprehensive Emergency Management Plan Type 1.

Generally, this situation should convey the impression that a potentially dangerous situation exists at the Lake Shirley Dam that could jeopardize the integrity of the dam (i.e. major pitting, significant sink holes, whirlpool at spillway, major concrete cracking, etc.). Emergency response personnel shall be placed on alert and prepare for emergency evacuation and road closure measures should it become necessary. This is a situation where a failure (Condition Red Alert) may eventually occur but preplanned actions taken during certain events (such as major floods, earthquakes, evidence of piping) may moderate or alleviate failure. Such actions include emergency repairs to the dam (see below).

The Dam Monitor (and local emergency response officials) should assess the situation and determine the urgency of the emergency situation. Based on the Dam Monitor's (and local emergency response officials) assessment, the Dam Monitor will initiate the Notification Flow Chart attached in Section 1.0 and notify the authorities of the Condition Yellow Alert and all necessary resources are brought into action to remove the threat. A Condition Yellow Alert notification informs emergency response personnel that a potentially dangerous situation exists. At this time Town of Shirley officials should warn potentially impacted town residents of the situation at the dam and about the possibility of evacuation if the conditions worsen.

If it appears that a situation may take days or weeks before it could develop into a failure situation, the local authorities may decide on one course of action. During a Condition Yellow Alert, continuous inspection of the dam and periodic status report updates by the Town of Lunenburg are important because when it appears that the situation is continuing to worsen at the dam, in spite of the actions being taken to moderate or alleviate failure, the local authorities may decide to change their course of action. Depending on the location of downstream residents with respect to the dam and the estimated warning time available, the evacuating agencies should consider the prudence of early evacuation, or heightened awareness, of certain downstream areas until the emergency has passed.

The Town of Lunenburg will attempt to repair the dam if there is need of repair. Town of Lunenburg and contractor equipment should be mobilized from the sources listed in Tables 4.2, 4.3, and 4.4 presented in Section 4.0. Fill materials may be obtained from suppliers listed in Table 4.5 presented in Section 4.0 or from other sources. Lists of materials available from these suppliers are attached.

Table 4.3 Town Owned Equipment

Water District Equipment
Equipment stored at the Water District, 496 Massachusetts Avenue, Lunenburg, MA:
2000 Watt Generator 3000 Watt Generator 2" pump (100 gal/min) 3" pump (200+ gal/min) Diaphragm pumps/mud sucker (2) Chain saws (2) Cut off saws/demo saws with blades but cut metal or hot top (2) Pickup trucks (2) (one with a utility body with an 1800 watt inverter to supply power) One Ton Dump Truck
Communication Equipment:
All trucks have two way radios that can communicate on town frequencies. Five (5) or more portable radios that could be distributed if needed.

Table 4.4 Contractor Equipment Suppliers

The following CONTRACTORS own heavy excavating equipment such as large excavators and dozers. Inquiries can be made to these contractors to determine the availability of equipment needed.	
Ray Morin, Inc. 48 Youngs Road Lunenburg, MA (978) 342-2776	Robert Proctor Excavating P.O. Box 618 Lunenburg, MA (978) 582-4287
Powell Sand and Gravel 259 Leominster-Shirley Road Lunenburg, MA (978) 537-1881	M. Flagg Tree Service P.O. Box 236 Lunenburg, MA (978) 345-2126
Lunenburg Landscaping & Excavating P.O. Box 153 Lunenburg, MA (978) 582-7982	

Table 4.5 Construction Equipment Rentals

Maki Rental Station 160 Massachusetts Avenue (Rear) Lunenburg, MA (978) 345-7368	Powell Stone & Gravel 133 Leominster-Shirley Road Lunenburg, MA (978) 537-8100
Paul's Rental & Supply Center 999 Central Street Leominster, MA (978) 537-7285	Taylor Rental 195 Mill Street Leominster, MA (978) 537-9793

Table 4.6 Fill Material Vendors

Powell Stone and Gravel 133 Leominster-Shirley Road Lunenburg, MA (978) 537-8100	Central Mass Sand & Gravel 435 Lancaster Avenue Leominster, MA (978) 466-9500 (Office) (978) 466-1844 (Pit)
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4.3.3 Cessation of Emergency

A Condition Yellow Alert will cease when the Massachusetts Department of Conservation and Recreation (DCR) Office of Dam Safety, Shirley Fire Department, Shirley Chief of Police, Lunenburg Fire Department, and the Town of Lunenburg Town Manager have review the situation and determine that the condition of the dam is safe and no threat of dam failure remains to the general public.

A Red Condition Alert will cease when the Massachusetts Department of Conservation and Recreation Office of Dam Safety, Shirley Fire Chief, Shirley Chief of Police, and Town of Lunenburg Town Manager, working jointly with other state and municipal agencies and public utilities, determine that the affected areas are safe for the general public.

5.0 General Responsibilities under the Plan

The Dam Owner (Town of Lunenburg) responsibilities are defined below in Section 5.1. In general, the Dam Owner (Monitor) is also responsible for initiating Notification Procedures as outlined in this EAP. The Notification Flowchart in Section 1.0 defines who shall be notified, the notification priority and provides the means of notification.

Once the Notification process has been initiated by the Dam Monitor (Town of Lunenburg), the State and Local Emergency Response Personnel take the appropriate action to ensure public safety.

To ensure safe orderly notification, evacuation, and road closures, the State and Local Emergency Response Personnel shall utilize the "Town of Shirley Local Evacuation Procedures" outlined in Appendix A.

To assist State and Local Emergency Response Personnel with notification, evacuation and road closures, Section 6.0 includes Figure 6-1, Dam-Break Inundation Flood Analysis Map. This dam-break inundation map defines flooded areas based on a hypothetical dam failure occurring at the Lake Shirley Dam simulated using the National Weather Service DAMBRK computer program. A conservative area located outside the Storm-Day Dam Break Inundation Zone should be utilized in deciding upon the proper evacuation area extents for all emergency conditions (Red and Yellow).

The local community is responsible for development, implementation and dissemination of the local notification, evacuation and road closure procedures to be used as part of this Emergency Action Plan (EAP).

When an Emergency Action Plan is activated, and during the annual testing of the plan, each person responsible for a notification is requested to fill out, date, and sign the, appropriate checklist included in Appendix B, Notification Checklists. Appendix D, Plans for Training, Exercising, Updating, and Posting the EAP, provides a general description for training and testing.

The following describes the general responsibilities of various person(s) or organization under this plan.

5.1 DAM OWNER RESPONSIBILITIES

As the owner of the dam, the Town of Lunenburg is responsible for its safe operation and maintenance. The Town of Lunenburg designates a Dam Monitor as indicated in Section 4.0 above.

The Dam Monitor is responsible for regularly monitoring the condition of the dam and monitoring the conditions at the dam more frequently during high precipitation events.

According to Massachusetts Dam Safety Regulations (302 CMR 10.00: Dam Safety), the dam is required to have a Phase I Inspection performed on it every two (2) years. The last official Phase I Inspection was performed on November 19, 2021. The next scheduled Phase I Inspection will be performed no later than November 17 2023. The Town of Lunenburg is also responsible for having the Phase I Inspection performed by a professional engineer licensed in Massachusetts.

Section 4 of this Plan describes the measures taken for Emergency Detection, Evaluation, and Classification. In general, the Dam Monitor is responsible for consulting with local emergency response officials, if time allows, on if there is an emergency condition developing or if one has already occurred. The local emergency official shall include the Town of Lunenburg Fire Chief, The Town of Shirley Fire Chief, and the Lunenburg Town Manager. The Dam Monitor and the Emergency Response Officials will then decide on if a Code Yellow or Red Alert is warranted and initiating the Notification Procedures as outlined in this EAP is necessary. The Notification Flowchart in Section 1.0 defines who shall be notified, the notification priority and provides the means of notification.

The Town of Lunenburg shall be responsible for the immediate repair of the dam during an emergency situation. Lists of Town and contractor owned equipment and materials are provided in Tables 4.2, 4.3, 4.4, and 4.5 in Section 4.0.

The Town of Lunenburg shall also be responsible for having any required revisions made to the EAP.

5.2 EMERGENCY ACTION PLAN (EAP) COORDINATOR (LUNENBURG)

The designated EAP coordinator shall be the Lunenburg Fire Chief. The EAP Coordinator shall be responsible for EAP-related activities, including:

- Establishing training seminars,
- Coordinating EAP exercises.

The EAP Coordinator shall be the EAP contact if any involved parties have questions about the plan for emergencies or non-emergencies.

The Emergency Action Plan (EAP) Coordinator for Lunenburg shall also be one of the Emergency Response Officials who will assist the Dam Monitor and/or Assistant Dam Monitor in accessing the emergency condition of the dam when necessary and feasible.

5.3 AYER SHIRLEY REGIONAL DISPATCH CENTER (ASRDC)

The Ayer Shirley Regional Dispatch Center (ASRDC) shall be responsible for contacting the following entities in the order presented below:

- Shirley Fire Department
- Shirley Police Department
- Town of Lunenburg Department of Fire and Emergency Services
- Massachusetts Emergency Management Agency (MEMA)
- Infrastructure Services
- MBTA Commuter Rail
- Railroad District #3 Tower
- Town of Shirley Department of Public Works
- Town of Shirley Water and Sewer Department
- Electric - National Grid

5.4 TOWN OF SHIRLEY FIRE DEPARTMENT

The Town of Shirley Fire Department is responsible for contacting and evacuating the property owners located within the Inundation Zone (see Figure 6-1 presented in Section 6.0). Please refer to Appendix A for Town of Shirley Local Evacuation Procedures.

The Town of Shirley Fire Chief shall also be one of the emergency response officials who will assist the Dam Monitor and/or Assistant Dam Monitor in accessing the emergency condition of the dam when necessary and feasible.

5.5 TOWN OF SHIRLEY POLICE DEPARTMENT

The Town of Shirley Police Department is primarily responsible for performing necessary tasks to implement road closures and to ensure public safety. The Police Department shall also assist the Shirley Fire Department in contacting and evacuating the property owners located within the Inundation Zone (see Figure 6-1 presented in Section 6.0) if need be.

5.6 TOWN OF LUNENBURG DEPARTMENT OF FIRE AND EMERGENCY SERVICES

The Town of Lunenburg Department of Fire and Emergency Services (Fire Chief) is responsible for contacting the following entities associated with the performance of Lake Shirley Dam.

5.6.1 Town of Lunenburg Town Manager

The Town of Lunenburg Town Manager is considered to be the Dam Owner's (Lunenburg) representative. He/she is responsible for organizing any needed repairs, inspections, maintenance, etc. for the Lake Shirley Dam. He/she shall also be one of the emergency response officials who will assist the Dam Monitor and/or Assistant Dam Monitor in accessing the emergency condition of the dam when necessary and feasible.

5.6.2 Town of Lunenburg Fire Department

The Town of Lunenburg Fire Department is responsible for assisting Town of Shirley's Emergency Response officials.

The Town of Lunenburg Fire Chief shall also be one of the Emergency Response Officials who will assist the Dam Monitor and/or Assistant Dam Monitor in accessing the emergency condition of the dam when necessary and feasible

5.6.3 Lunenburg Police Department

The Town of Lunenburg Police Department is responsible for assisting Town of Shirley's Emergency Response officials.

5.7 MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY (MEMA)

The Massachusetts Emergency Management Agency (MEMA) is responsible for providing support and guidance in time of any sort of dam emergency. MEMA is also responsible for notifying the Massachusetts Department of Recreation and Conservation Office of Dam Safety.

5.8 INFRASTRUCTURE SERVICES

5.8.1 Massachusetts Commuter Rail

The Massachusetts Commuter Rail is responsible for shutting down the commuter rail travel through the Town of Shirley.

5.8.2 Railroad District #3 Tower (Freight Rail)

The Railroad District #3 Tower is responsible for shutting down the freight rail travel through the Town of Shirley.

5.8.3 Town of Shirley Department of Public Works (DPW)

The Town of Shirley Department of Public Works (DPW) is responsible for assisting with any maintenance problems that may arise due to a dam emergency and for assisting with road blockages if need be.

5.8.4 Town of Shirley Water and Sewer Department

The Town of Shirley Water and Sewer Department is responsible for assisting with any water or sanitary sewer maintenance problems that may arise due to a dam emergency.

5.8.5 Electric National Grid

The Electric National Grid is responsible for cutting off any power grids that need to be due to a dam emergency. They will also be responsible for making any necessary repairs as a result of a dam emergency.

6.0 Inundation Maps

The purpose of the Inundation Map is to delineate the extent of flooding associated with a hypothetical dam-break. The dam-break analysis uses a computer model to calculate flood wave peak discharges, flood depths and travel times in the Catacoonamug Brook valley downstream of Lake Shirley Dam. The Dam-Break Inundation Flood Analysis Map is attached in this Section 6.0 as Figure 6-1. The Dam-Break Flood Analysis Profile is attached in this section as Figure 6-2.

The National Weather Service Dam-Break Flood Forecasting Model (DAMBRK) developed by D.L. Fread and packaged by the BOSS Corporation was the computer program used for this analysis. Documentation is provided in attached Appendix C.

The flood limits shown on Figure 6-1 are the result of hypothetical dam breach analyses under both storm-day conditions and sunny-day conditions. Appendix C contains important information on flood characteristics for selected locations downstream of the dam based on of results of the breach analyses such as:

- Estimated peak discharge rates,
- Estimated peak water surface elevations and corresponding flood depths, and
- Estimated time from start of the breach to peak flood arrival.

This information may be useful to planning evacuation measures and routing.

Due to the high degree on variability in the type, size, and timing associated with dam breaches and flooding and the variability of the weather, the depth and associated aerial extent of flooding may increase or decrease depending on the exact circumstances of a particular dam breach or flooding scenario. Also the computer modeling of the dam-break flood wave down the Catacoonamug Brook valley assumes that the valley and structures such as bridges and culverts do not become partially or fully blocked with debris. If a structure becomes blocked with debris, then the peak water surface behind the blockage could increase to flood depths higher than estimated.



LEGEND

- INUNDATION CROSS-SECTIONS
- RAILROAD
- EXIST. CONTOUR (FT)
- TOWN BOUNDARY

INUNDATION ZONES

- STORM DAY - DAM FAILURE
- SUNNY DAY - DAM FAILURE

TOWN OF LUNENBURG
17 MAIN STREET
LUNENBURG, MA 01462

28 NORTH STREET
RANDOLPH, VT 05060
PH. 802-728-3376
FAX. 802-728-4830
www.dubois-king.com

DuBois & King Inc.
ENGINEERING • PLANNING •
MANAGEMENT • DEVELOPMENT

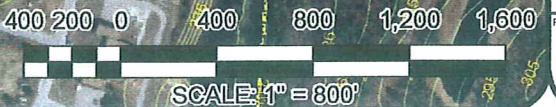
NO.	DATE	DESCRIPTION	BY

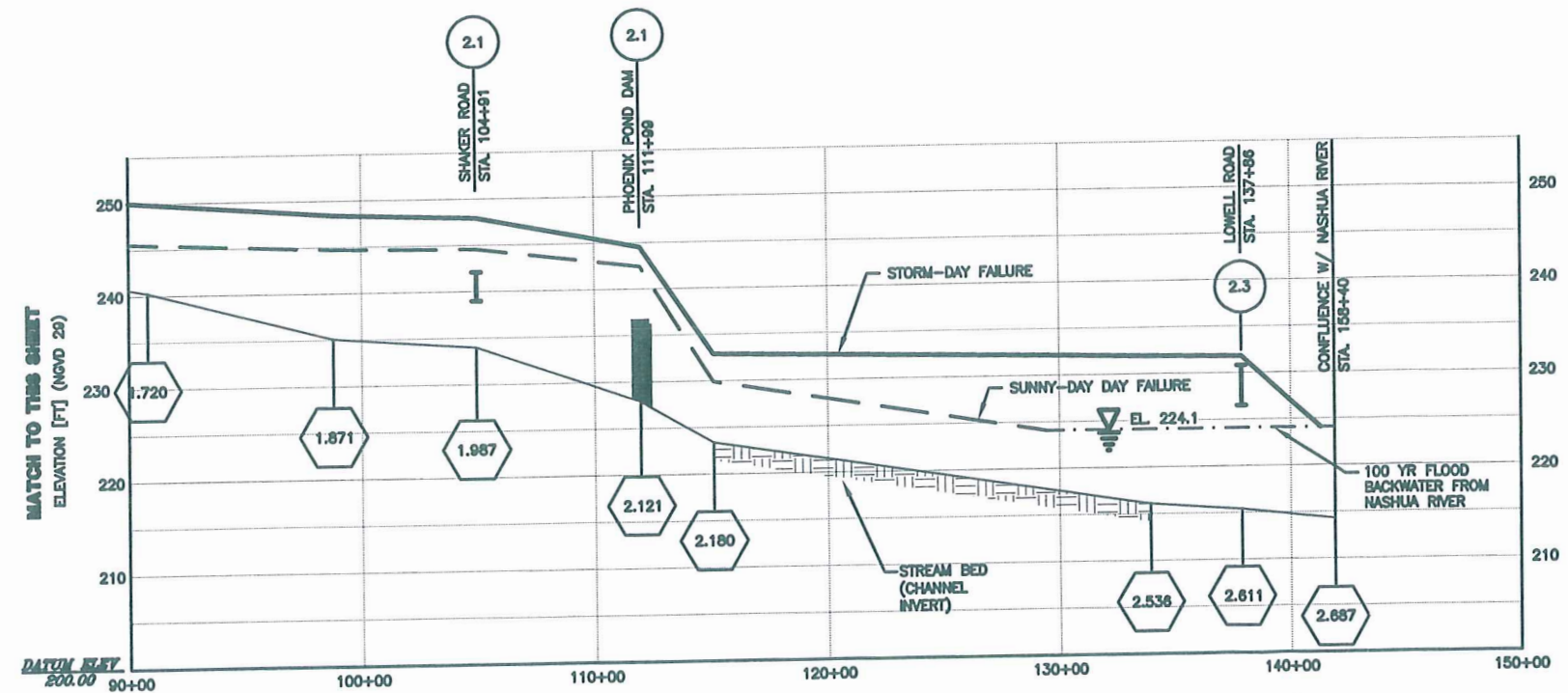
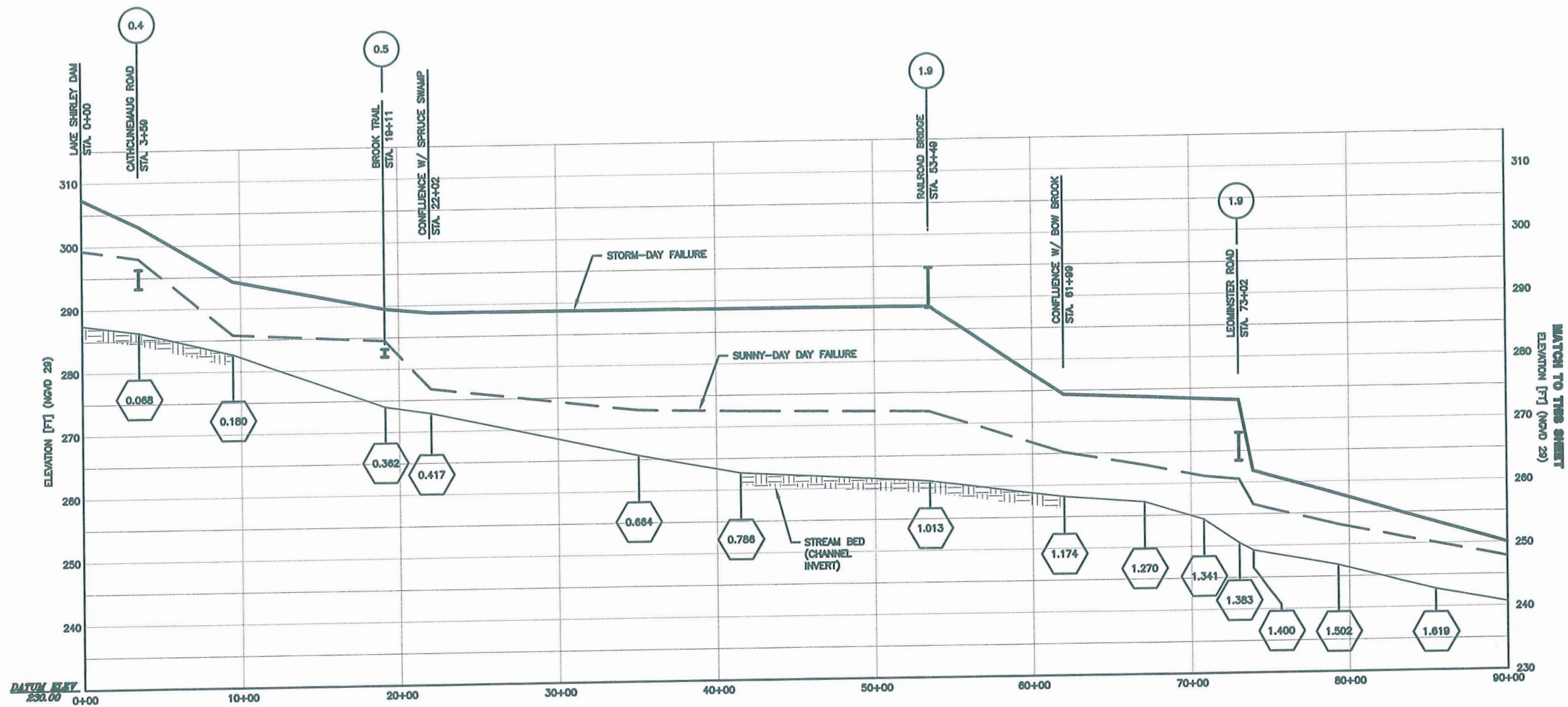
**DAM-BREAK
INUNDATION FLOOD ANALYSIS MAP**

**LAKE SHIRLEY DAM
EMERGENCY ACTION PLAN
LUNENBURG, MASSACHUSETTS**

DRAWN BY:	DPM	CHECKED BY:	
DESIGNED BY:		APPROVED BY:	
PROJECT NO:	619848P2	DATE:	4/27/07
SCALE:	AS SHOWN	FIGURE:	6-1









2005 AERIAL ORTHOGRAPHIC IMAGERY, 1997 TOPOGRAPHY, AND HYDROLOGIC DATA WAS OBTAINED FROM OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MassGIS) MASSACHUSETTS GEOGRAPHIC INFORMATION SYSTEMS WEB SITE. THE LOCATIONS OF THE DAMS WERE APPROXIMATED USING COORDINATE INFORMATION PROVIDED BY THE NATIONAL DAM SAFETY DAM INVENTORY DATABASE. INUNDATION AREAS WERE APPROXIMATED BY DUBOIS & KING, INC. VIA DAM-BREAK ANALYSIS AND FIELD ADJUSTMENTS. PLEASE NOTE THIS DATA IS FOR INFORMATIONAL PURPOSES ONLY. IT IS NOT MEANT FOR DESIGN, LEGAL, OR ANY OTHER USES. THERE ARE NO GUARANTEES ABOUT ITS ACCURACY. DUBOIS & KING, INC. ASSUMES NO RESPONSIBILITY FOR ANY DECISION MADE OR ANY ACTIONS TAKEN BY THE USER BASED UPON INFORMATION OBTAINED FROM THE ABOVE DATA.





WATER SURFACE PROFILE
 SCALE: HORIZ. 1" = 800'
 VERT. 1" = 20'

LEGEND

-  STORM-DAY FAILURE
-  SUNNY-DAY FAILURE
-  100 YR FLOOD BACKWATER FROM NASHUA RIVER
-  STREAM BED
-  CROSS SECTION LOCATION
-  HOURS FROM START OF FAILURE TO PEAK STAGE FOR SUNNY-DAY & STORM-DAY FAILURE
-  HYDRAULIC STRUCTURE (BRIDGE)
-  HYDRAULIC STRUCTURE (DAM)

NO.	DATE	DESCRIPTION	BY

DAM-BREAK FLOOD ANALYSIS PROFILE CATACONNAUG BROOK	
LAKE SHIRLEY DAM EMERGENCY ACTION PLAN LUNenburg, MA	
DESIGNED BY: DPM	CHECKED BY:
DESIGNED BY:	APPROVED BY:
PROJECT NUMBER 619848P2	
SCALE AS SHOWN	DATE 4-5-07
FIGURE 6-2	

Appendix A Town of Shirley Local Evacuation Procedures

10/14/10 09:02AM

Shirley Fire Dept.

9784259437

p.01

TOWN OF SHIRLEY



FIRE DEPARTMENT
P.O. BOX 716
SHIRLEY, MA 01464

CHIEF: DENNIS C. LEVESQUE

Date: 10.13.2010

To: Andrew Walker

From: Dennis Levesque
Fire Chief

In the event that the Lake Shirley Dam should fail, the following evacuation process would take place. Our dispatch center would alert the department through our paging network of the emergency and personnel would respond to Fire Department Headquarters. This process would alert 30 firefighters and would be assigned to respond to the areas in need of assistance. Personnel will respond with fire apparatus and go door to door along with using their P.A. systems. The streets that would be affected would be those marked out on the mapped provided. At the same time a dispatcher will be going down a phone list of the affected areas maintained by our center. Once all areas have been checked we would monitor the situation and handle any emergencies that might happen.

Sincerely,

A handwritten signature in cursive script, appearing to read "Dennis C. Levesque".

Dennis C. Levesque
Fire Chief

Appendix B Notification Checklists

Lake Shirley Dam
Lunenburg, MA



B.1

Emergency Action Plan May 11, 2007
Updated April 11, 2014
Updated October 26, 2018
Updated December 30, 2021
Updated August 4, 2023

DAM MONITOR (Lake Shirley Dam Keeper)

Notification Checklist

(To be filled out during any Condition Yellow or Condition Red incident and during annual testing of the EAP)

<i>Name:</i>		
<i>Date:</i>	<i>Time:</i>	
<i>Check if:</i> <i>Condition Yellow</i> <input type="checkbox"/>	<i>Condition Red</i> <input type="checkbox"/>	<i>Notification Test</i> <input type="checkbox"/>
<i>Party Contacted</i>	<i>Time</i>	<i>Person Contacted</i>
Ayer Shirley Regional Dispatch Center (ASRDC) 978-772-8200 911 (Emergency-24hr)		

Dam Monitor Signature: _____

Ayer Shirley Regional Dispatch Center (ASRDC)
--

(To be filled out during any Condition Yellow or Condition Red incident and during annual testing of the EAP)

<i>ASRDC Dispatcher Name:</i>		
<i>Date:</i>	<i>Time:</i>	
<i>Check if:</i> <i>Condition Yellow</i> <input type="checkbox"/>	<i>Condition Red</i> <input type="checkbox"/>	<i>Notification Test</i> <input type="checkbox"/>
<i>Party Contacted</i>	<i>Time</i>	<i>Person Contacted</i>
1. Shirley Fire Department 978-425-4334 or 978-425-4333 (24 hr)		
2. Shirley Police Department 978-425-2642 or 978-425-2644 (24 hr)		
3. Town of Lunenburg Public Safety Department 978-582-4531(24 hr)		
4. Massachusetts Emergency Management Agency 508-820-2000 (24 hr)		
5. Massachusetts Commuter Rail 617-222-6115 (24 hr)		
6. Railroad District #3 Tower 800-955-9218 or 800-955-9208		
7. Town of Shirley DPW 978-425-2628 Paul Farrar (Foreman) <i>(Via Pager and/or Radio on file at SCC)</i>		
8. Town of Shirley Water Dept. 978-425-2245		
9. Town of Shirley Sewer Dept. 978-425-2600 Ext. 236		
10. Electric National Grid 800-322-3223 (24 hr)		

***ASRDC Dispatcher
Signature:*** _____

TOWN OF SHIRLEY FIRE DEPARTMENT
--

(To be filled out during any Condition Yellow or Condition Red incident and during annual testing of the EAP)

<i>Shirley Fire Department Respondent Name:</i>		
<i>Date:</i>	<i>Time:</i>	
<i>Check if:</i> <i>Condition Yellow</i> <input type="checkbox"/>	<i>Condition Red</i> <input type="checkbox"/>	<i>Notification Test</i> <input type="checkbox"/>
<i>Party Contacted</i>	<i>Time</i>	<i>Person Contacted</i>
1. Residents/Business within Inundation Limits		
Refer to Appendix A for evacuation procedures. The following roads are fully or partially within the inundation limits:		
• Brook Trail Road		
• Catacunemaug Road		
• MBTA Bridge over Catacoonamug Brook		
• Leominster Road/Main Street		
• Fredonian Street		
• Phoenix Street		
• Shaker Road		
• Canal Street, and		
• Lovell Street		
For reasons of privacy protection the Town of Shirley has elected to exclude the property owner contact information from this document. The information is maintained by the Shirley Fire Department and Emergency Mgmt. Coordinator.		



Shirley Fire Department Respondent Signature: _____

<p>TOWN OF LUNENBURG PUBLIC SAFETY DEPARTMENT</p>
--

<p>Notification Checklist</p>

(To be filled out during any Condition Yellow or Condition Red incident and during annual testing of the EAP)

<i>Lunenburg Emergency Management Dispatcher Name:</i>		
<i>Date:</i>	<i>Time:</i>	
<i>Check if:</i> <i>Condition Yellow</i> <input type="checkbox"/>	<i>Condition Red</i> <input type="checkbox"/>	<i>Notification Test</i> <input type="checkbox"/>
<i>Party Contacted</i>	<i>Time</i>	<i>Person Contacted</i>
1. Lunenburg Fire Department 978-582-4155 (24 hr)		
2. Lunenburg Police Department 978-582-4531 (24 hr)		
3. Lunenburg Town Manager (W) 978-582-4164 (Cell) 978-400-1797		
4. Lunenburg DPW Director (W) 978-582-4160		

Lunenburg Emergency Management Dispatcher Signature: _____

**MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY
(MEMA)**

Notification Checklist

(To be filled out during any Condition Yellow or Condition Red incident and during annual testing of the EAP)

<i>MEMA Respondent Name:</i>		
<i>Date:</i>	<i>Time:</i>	
<i>Check if:</i> <i>Condition Yellow</i> <input type="checkbox"/>	<i>Condition Red</i> <input type="checkbox"/>	<i>Notification Test</i> <input type="checkbox"/>
<i>Party Contacted</i>	<i>Time</i>	<i>Person Contacted</i>
1. Massachusetts Office of Dam Safety West Boylston, MA Office 508-792-7716, ext 600 617-719-1942 (cell)		
2. Massachusetts Office of Dam Safety Emergency Action Plan Coordinator 774-261-0207		

MEMA Respondent Signature: _____

Appendix C Investigation and Analyses of Dam-Break Floods and Photographs

This appendix summarizes the Lake Shirley Dam storm-day dam break flood analysis prepared for the Town of Lunenburg by DuBois & King, Inc. dated April 2007.

The dam-break failure analysis and downstream flood wave routing was simulated using the BOSS Corporation's package of the National Weather Service DamBreak Flood Forecasting model (DAMBRK computer program) developed by D.L. Fread. The program predicts downstream flood wave peak discharges, depths, and travel times for selected downstream locations.

Inundation Mapping for Storm-day dam failure

Inundation mapping delineates the areas that may be flooded based on the hypothetical storm-day dam failure that may occur during the 1/2 probable maximum flood (PMF) scenario. The inundation maps are included in Section 6.0 of this EAP.

Summary Tables of Storm-day and Sunny-day Dam-break Failure Flood Analysis

The results of the storm-day dam break flood analysis, as well as the sunny-day dam break flood analysis, are summarized in Table C-1 and C-2, respectively. Tables C-1 and C-2 provide the flood wave peak discharge, flood wave peak water surface elevation, flood depth, and flood wave time to peak. Figure 6-2, the Dam-break flood profile along Catacoonamug Brook from Lake Shirley Dam to the Nashua River is also included at the end of Section 6.0.

Flood Wave Impact on Phoenix Pond Dam

Inundation mapping for both the storm-day and sunny-day dam break flood analysis indicates that Phoenix Pond Dam is substantially overtopped during both failure scenarios for Lake Shirley Dam.

Storm-Day Failure: The storm-day dam failure scenario will result in a height of water of approximately 8 feet over the crest of Phoenix Pond Dam and a differential head of approximately 13 feet. Lowell Road would be overtopped during this event by approximately one foot and failure of Phoenix Pond Dam at the crest of the flood wave would result in the release of the stored (impounded) water upstream of the dam and surcharging the flow downstream from the dam to Lowell Road. The surcharge is expected to result in some additional increase in the overtopping of Lovell Road.

The reported time of travel of the flood wave at Shaker Road immediately upstream from Phoenix Pond Dam is 2.1 hours. This duration provides Shirley emergency officials an opportunity to close Shaker Road prior to the arrival of the flood wave. Shaker Road would be overtopped and closure of the road in the event of a storm-day failure would be appropriate.

Sunny-Day Failure: The sunny-day dam failure scenario will result in a height of water of approximately 6 feet over the crest of Phoenix Pond Dam and a differential head of approximately 14 feet. As depicted in Figure 6-2, the calculated water surface elevation is approximately 1.5 feet below the low chord of the Lowell Road bridge. Failure of Phoenix Pond Dam at the crest of the flood wave would result in the release of the stored (impounded) water upstream from the dam, and surcharging the flow downstream from the dam to Lovell Road. This would result in the potential overtopping of the bridge and/or adjacent roadway.

The reported time of travel of the flood wave at Shaker Road immediately upstream from Phoenix Pond Dam is 2.1 hours (this is the same as for the storm-day failure scenario). This duration provides Shirley emergency

officials an opportunity to close Shaker Road prior to the arrival of the flood wave. Shaker Road would be overtopped, and closer of the road in the event of a sunny-day failure would be appropriate.

Table C-1: Dam Failure Summary-Failure of Lake Shirley Dam during “Storm-day” Conditions

Downstream Location on the Catacoonamug Brook (Mile Marker (MM) in miles)	Storm-day Failure Results ¹			
	Peak Discharge (CFS)	Peak Water Surface Elevation (NGVD 1929)	Flood Depth Above Streambed (Feet)	Time to Peak ² Hours (Minutes)
MM 0.068 Catacunemaug Road (El 286.3)	18,159	303.1	16.8	0.4 (24)
MM 0.362 Brook Trail Road (El 274.0)	17,956	289.6	15.6	0.5 (30)
MM 1.013 Railroad Bridge (El 261.0)	11,238	288.7	27.7	1.9 (114)
MM 1.383 Leominster Road (El 250.5)	11,698	273.1	22.6	1.9 (114)
MM 1.987 Shaker Road (El 234.0)	11,695	247.9	13.9	2.1 (126)
MM 2.611 Lovell Street (El 215.4)	11,560	231.8	16.4	2.3 (138)

Notes:

- ¹ Failure analysis assumed breach bottom width opening equal to 46 feet, breach side slopes of 1.0 vertical to 0.75 horizontal and time to failure was assumed to be 0.5 hours.
- ² Time to peak measured from start of breach at Lake Shirley Dam.

Table C-2: Dam Failure Summary-Failure of Lake Shirley Dam during “Sunny-day” Conditions

Downstream Location on the Catacoonamug Brook (Mile Marker (MM) in miles)	Sunny-day Failure Results ²			
	Peak Discharge (CFS)	Peak Water Surface Elevation (NGVD 29)	Flood Depth Above Streambed (Feet)	Time to Peak ² Hours (Minutes)
MM 0.068 Catacunemaug Road (El 286.3)	3,197	298.0	11.7	0.4 (24)
MM 0.362 Brook Trail Road (El 274.0)	3,133	284.5	10.5	0.5 (30)
MM 1.013 Railroad Bridge (El 261.0)	2,524	272.0	11.0	1.9 (114)
MM 1.383 Leominster Road (El 250.5)	2,524	260.6	10.1	1.9 (114)
MM 1.987 Shaker Road (El 234.0)	2,522	244.6	10.0	2.1 (126)
MM 2.611 Lovell Street (El215.4)	2,520	221.6	6.2	2.3 (138)

Notes:

- ¹ Failure analysis assumed breach bottom width opening equal to 28 feet, breach side slopes of 1.0 vertical to 0.75 horizontal and time to failure was assumed to be 0.4 hours.
- ² Time to peak measured from start of breach at Lake Shirley Dam

Storm day Dam-break Flood Analysis Impact Areas

Populated areas and transportation routes that would experience flooding as a result of a failure at Lake Shirley Dam include:

- The bridge at Catacunemaug Road will be overtopped by approximately 7-feet.
- There are approximately 5 to 6 homes in the vicinity of Brook Trail Road Bridge (MM 0.362) that will be inundated by the storm-day flood waters. The bridge at Brook Trail Bridge will be overtopped by approximately 6 feet.
- At MM 1.013 the Railroad bridge will not be overtopped. The flood water depths at the railroad bridge will be 27.7 feet.
- At MM 1.383 the Leominster Road Bridge, the flood waters would be approximately 5-feet over the bridge deck. A number of commercial structures in the vicinity of the Leominster Road Bridge will be inundated by a storm-day type dam failure.
- The bridge at Shaker Road, MM 1.987, will be overtopped by approximately 6-feet. There are a number of residential structures located upstream of Shaker Road and along Fredonian Street that are located in the storm-day inundation area. There is a large commercial structure just downstream of Shaker Road on Canal Street that will be impacted by flood waters associated with a storm-day dam failure.
- The bridge at Lovell Street, MM 2.611, will be overtopped by approximately 1-foot.

Photographs of Lake Shirley Dam and the Catacunemaug Brook Valley potential flood wave impact areas downstream of the dam are included at the end of Appendix C.

SUPPORTING DOCUMENTATION

Summary Table of Dam Breach Parameters

The discharge hydrograph from a dam failure, or breach discharge hydrograph, is a function of the routed inflow hydrograph and the breach parameters, time of breach formation, size and shape of breach associated with the hypothetical dam failure analyzed. The breach parameters are established based on the Federal Energy Regulatory Commission (FERC) guidelines. The total flow from the dam during a dam failure is a combination of flow through the breach opening and flow through the spillways. The parameters used in this storm-day and sunny-day dam-break flood analysis are summarized in Table C-3.

Table C-3: Summary of Dam Breach Parameters for Lake Shirley Dam

Description of Breach Parameter	Sunny-day Failure Condition	Storm-day Failure Condition
Initial Pool level at start of computations NAVD 88	299.4	299.4
Pool level at dam failure NGVD 29	299.4	307.3
Breach invert elevation NGVD 29	287.0	287.0
Breach bottom width (Feet)	28	46
Time to complete breach formation (hours)	0.4	0.5
Assumed pre-breach flow immediately downstream of dam, prior to dam failure	100 cfs	5,195 cfs

Inflow Design Hydrographs

As part of the dam-break flood analysis it was necessary to evaluate the effects of the Probable Maximum Flood (PMF) storm event on the Lake Shirley Dam's reservoir storage capacity and its spillway capacity. CVPS provided the PMF inflow hydrograph for the Lake Shirley Dam, the uncontrolled spillway rating curve and the storage characteristics of the Lake Shirley Reservoir utilizing this data and the National Weather Service Dam-Break Flood Forecasting Model the peak outflow and the maximum reservoir water surface elevation were determined. Table C-4 summarizes the results of the evaluation of the PMF storm event.

Table C-4: 1/2 Probable Maximum Flood Evaluation at the Lake Shirley Dam³

Storm Event Frequency	Total Inflow Peak Discharge (cfs)	Routed Outflow Peak Discharge (cfs)	Maximum Lake Level (NGVD 1929)	Available Freeboard (feet)
1/2 PMF	8,110	3052	307.1	0.9

Notes:

1. 1/2 PMF (SDF) numbers was developed by DuBois & King, Inc. in 1995-1996 as part of the Rehabilitation Design for the Lake Shirley Dam



Photograph No.1: Catacunemaug Road (MM 0.682) is overtopped by approximately 7-feet during the hypothetical storm-day dam failure



Photograph No.2: Brook Trail Road (MM 0362) is overtopped by approximately 6-feet during the hypothetical storm-day dam failure



Photograph No.3: Railroad Bridge (MM 1.013)



Photograph No.4: Leominster Road (MM 1383) is overtopped by approximately 5-foot during the hypothetical storm-day dam failure.



Photograph No. 5: Shaker Road (MM 1.987) is overtopped by approximately 6-feet during the hypothetical storm-day dam failure.



Photograph No. 6: Lowell Road (MM 2.611) is overtopped by approximately 1-foot during the hypothetical storm-day dam failure

**Appendix D Plans for Training, Exercising, Updating and Posting
the EAP**

D.1 Training

The Town of Shirley's and Lunenburg's local emergency response officials will coordinate annual training with Dam Owner EAP Coordinator.

Training of people involved in implementation of the EAP should be conducted to ensure that they are thoroughly familiar with all elements of the plan, the availability of equipment, and their responsibilities and duties under the plan.

Technically qualified personnel should be trained in problem detection and evaluation and appropriate remedial (emergency and non-emergency) measures. This training is essential for proper evaluation of developing situations at all levels of responsibility which, initially, is usually based on on-site observations. A sufficient number of people should be trained to ensure adequate coverage at all times.

D.2 Annual Testing

Every year the Town of Shirley's and Lunenburg's local emergency response officials shall conduct or arrange to have conducted a test of the emergency notification procedure. The Town of Shirley's Fire Department shall monitor the test and collect a copy of the notification checklists (attached in Appendix B) noting any large discrepancy in the times calls were received by the different organizations/agencies. The results shall also be discussed with all participating parties to ensure the success of the test. All completed checklists shall be filed at the end of Appendix B in the Town of Shirley Fire Department's copy of the EAP. Copies of these checklists shall also be forwarded to the Town of Lunenburg Town Manager (see Table D-1 below). The Lunenburg Town Manager shall file the copies of the completed checklists at the end of Appendix B in the Town of Lunenburg's copy of the EAP on file at the Office of the Board of Selectman-Town Hall located at 17 Main Street, Lunenburg, MA.

D.3 Posting of the Notification Flowchart/EAP

A complete and up-to-date copy of the EAP shall be posted at the Town of Lunenburg Board of Selectman-Town Hall located at 17 Main Street, Lunenburg, MA 01462-0135, at the Town of Shirley Town Office at 7 Keady Way, Shirley MA 01464, and inside the Gatehouse located at the Lake Shirley Dam at all times. In addition, all persons and agencies listed below have been issued a copy of the EAP, and shall be provided with an up-to-date copy of the plan. It is the responsibility of the Town of Lunenburg Chief Administrative Financial Officer to disseminate the EAP to the appropriate local emergency response personnel not listed below.

An up-to-date copy of the Notification Flowchart (Figure 1-1) should be posted in prominent locations at the dam site and local emergency operations center as appropriate.

The Notification Flowchart should be posted at each phone and radio transmitter at the dam and at all other desirable locations.

Table D-1: List of individuals or agencies that have this EAP

1. Dam Monitor: Ron Wilson 701 Reservoir Road Lunenburg, MA 01462	2. Asst. Dam Monitor: Richard Patry 655 Reservoir Road Lunenburg, MA 01462
3. Ayer Shirley Regional Dispatch Center (ASRDC) 54 Park Street Ayer, MA 01432	4. Shirley Fire Department Chief Troy Cooley 8 Leominster Rd Shirley, MA 01464
5. Shirley Police Department Chief Sam Santiago 11 Keady Way Shirley, MA 01464	6. Shirley Town Administrator Michael McGovern 7 Keady Way Shirley, MA 01464
7. Town of Lunenburg Town Manager Ms. Heather Lemieux Office of the Board of Selectman - Town Hall 17 Main Street, PO Box 135 Lunenburg, MA 01462	8. Town of Lunenburg Fire Department Chief Patrick Sullivan 655 Massachusetts Avenue Lunenburg, MA 01462
9. Town of Lunenburg Police Department Chief Thomas Gammel 655 Massachusetts Avenue Lunenburg, MA 01462	10. Town of Lunenburg Department of Public Works William Bernard, Operations Director 520 Chase Road Lunenburg, MA, 01462
11. Massachusetts Emergency Management Agency (MEMA) Erica Heidelberg, EAP Coordinator 400 Worcester Road Framingham, MA 01702	12. Massachusetts Department of Conservation and Recreation - Office of Dam Safety Edward Connor, EAP Coordinator 180 Beaman Street West Boylston, MA 01583
13. Town of Shirley Department of Public Works David Schwartz, DPW Director 158 Great Road Shirley, MA 01464	

D.4 Record of Changes and Additions

The following Table D-2 shows pages that have been updated or added.

Table D-2 Record of EAP Changes and Additions

Page Number	Date of Revision	Reason for Change
Notification Flow Chart	December 30, 2021	Update contacts
4.11	December 30, 2021	Updated Table 4.3
4.12	December 30, 2021	Updated Tables 4-5 and 4-6
Notification Flow Chart	August 4, 2023	Changed Shirley Communications Center to Ayer Shirley Regional Dispatch Center
5.1	August 4, 2023	Changed dates of last and next Phase I Dam inspections
5.2	August 4, 2023	5.3 Changed Shirley Communications Center to Ayer Shirley Regional Dispatch Center
5.3	August 4, 2023	5.6 Changed Lunenburg Department of Public Safety to Department of Fire and Emergency Services
B.2	August 4, 2023	Changed Shirley Communications Center to Ayer Shirley Regional Dispatch Center
B.3	August 4, 2023	Changed Shirley Communications Center to Ayer Shirley Regional Dispatch Center
D.3	5i i gh(z&&	Updated names of individuals receiving updated copies of EAP

The EAP should be updated promptly after each change that involved personnel or their telephone numbers, or after completion of a scheduled exercise.

A review of the adequacy of the EAP should be conducted at intervals not to exceed 1 year. During the review, an evaluation of any changes in flood inundation areas, down steam developments, or in the reservoir should be made to determine whether any revisions to the current EAP (including inundation maps) are necessary.

Reviews should be conducted on or about the same date each year. If no revision is necessary, a statement that the review was made and no revision to the EAP was necessary should be provided to each recipient of the original EAP.

Copies of any revisions that do result from updating the EAP or from periodic exercises of the EAP should be furnished to all individuals to whom the original EAP was distributed.





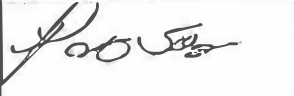


Appendix E Documentation

This Appendix is for including forms, letters, and any other documentation related to the implementation and/or approval of this Emergency Action Plan (EAP). A complete and up-to-date copy of the EAP shall be posted at the Town of Lunenburg Board of Selectman - Town Hall located at 17 Main Street, Lunenburg, MA 01462-0135, at the Town of Shirley Town Office at 7 Keady Way, Shirley MA 01464, and inside the Gatehouse located at the Lake Shirley Dam at all times. The Town of Lunenburg Town Manager shall be responsible for keeping this Appendix E up to date and for distributing copies of any documentation to all parties who have a copy of the EAP to insert into their copy. Please see the document(s) already included for examples.

Appendix F Approval of the EAP

This section of the EAP contains the signatures of all parties involved in the plan indicating their approval of the plan and agreement to their responsibilities for its execution.

Table F-1: Approval of EAP

Organization	Title	Printed Name	Signature	Approve or Disapprove
Town of Lunenburg	Dam Monitor (Dam Keeper)	Mr. Ron Wilson		Approve <input checked="" type="checkbox"/> Disapprove <input type="checkbox"/>
Town of Lunenburg	Asst. Dam Monitor (Asst. Dam Keeper)	Mr. Richard Patry		Approve <input checked="" type="checkbox"/> Disapprove <input type="checkbox"/>
Ayer Shirley Regional Dispatch Center (ASRDC)				Approve <input type="checkbox"/> Disapprove <input type="checkbox"/>
Shirley Fire Dept.	Shirley Fire Chief	Chief Dennis Levesque		Approve <input checked="" type="checkbox"/> Disapprove <input type="checkbox"/>
Shirley Police Dept.	Shirley Police Chief	Chief Sam Santiago		Approve <input type="checkbox"/> Disapprove <input type="checkbox"/>
Town of Lunenburg Public Safety Dept.				Approve <input type="checkbox"/> Disapprove <input type="checkbox"/>
Town of Lunenburg Dam Owner (Representative)	Town Manager	Ms. Heather Lemieux		Approve <input type="checkbox"/> Disapprove <input type="checkbox"/>
Lunenburg Fire Dept.	Lunenburg Fire Chief	Chief Patrick Sullivan		Approve <input checked="" type="checkbox"/> Disapprove <input type="checkbox"/>
Lunenburg Police Dept.	Lunenburg Police Chief	Chief James Marino		Approve <input checked="" type="checkbox"/> Disapprove <input type="checkbox"/>
Town of Lunenburg	Department of Public Works Director of Operations	formerly Jack Rodriquez now William Bernard		Approve <input checked="" type="checkbox"/> Disapprove <input type="checkbox"/>
Massachusetts Department of Conservation and Recreation Office of Dam Safety	EAP Coordinator	Edward Conner		Approve <input checked="" type="checkbox"/> Disapprove <input type="checkbox"/>
Massachusetts Emergency Management Agency (MEMA)	EAP Coordinator			Approve <input type="checkbox"/> Disapprove <input type="checkbox"/>

Appendix G Glossary

For the purpose of these guidelines the following definitions apply:

Breach

An opening through the dam resulting in partial or total failure of the dam.

Comprehensive EAP Exercise

An in-depth exercise of an EAP that involves the interaction of the dam owner with the state and local emergency management agencies in a stressful environment with time constraints. Functional and full scale EAP exercises are considered comprehensive EAP exercises.

EAP Exercise

An activity designed to promote emergency preparedness; test or evaluate EAPs, procedures, or facilities; train personnel in emergency management duties; and demonstrate operational capability. Exercises consist of the performance of duties, tasks, or operations very similar to the way they would be performed in a real emergency. However, the exercise performance is in response to a simulated event.

Consequences

Potential loss of life or property damage downstream of a dam caused by floodwaters released at the dam or by waters released by partial or complete failure of dam. Includes effects of landslides upstream of the dam on property located around the reservoir.

Dam Failure

Catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters which adversely affect a dam's primary function of impounding water is properly considered a failure. Such lesser degrees of failure can progressively lead to or heighten the risk of a catastrophic failure. They are, however, normally amendable to corrective action.

Emergency Alert System

A federally established network of commercial radio stations that voluntarily provide official emergency instructions or directions to the public during an emergency.

Emergency Management Agency

The state and local agencies responsible for emergency operations, planning, mitigation, preparedness, response, and recovery for all hazards. Names of emergency management agencies may vary such as: Division of Emergency Management, Comprehensive Emergency Management, Disaster Emergency Services, Civil Defense Agency, Emergency and Disaster Services.

Emergency Operations Center (EOC)

The location or facility where responsible officials gather during an emergency to direct and coordinate emergency operations, to communicate with other jurisdictions and with field emergency forces, and to formulate protective action decisions and recommendations during an emergency.

Flood Hydrograph

A graph showing, for a given point on a stream, the discharge, height, or other characteristic of a flood with respect to time.

Flood Routing

A process of determining progressively over time the amplitude of a flood wave as it moves past a dam or downstream to successive points along a river or stream.

Hazard Potential

A situation which creates the potential for adverse consequences such as loss of life, property damage, or other adverse impacts. Impacts may be for a defined area downstream of a dam from flood-waters released through spillways and outlet works of the dam or waters released by partial or complete failure of the dam. They may also be for an area upstream of the dam from effects of backwater flooding or effects of landslides around the reservoir perimeter.

Headwater

The water immediately upstream from a dam. The water surface elevation varies due to fluctuations in inflow and the amount of water passed through the dam.

Inflow Design Flood

The flood flow above which the incremental increase in water surface elevation due to failure of a dam or other water impounding structure is no longer considered to present an unacceptable threat to downstream life or property. The flood hydrograph 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, height of dam, and freeboard requirements.

Inundation Map

A map delineating areas that would be flooded as a result of a dam failure.

Notification

To inform appropriate individuals about an emergency condition so they can take appropriate action.

Tailwater

The water immediately downstream from a dam. The water surface elevation varies due to fluctuations in the outflow from the structures of a dam. Tailwater monitoring is an important consideration because a failure of a dam will cause a rapid rise in the level of the tailwater.