

January 31, 2014

William Salomaa, Program Manager
Massachusetts Office of Dam Safety
180 Beaman Street
West Boylston, MA 01583

**Re: Hamilton Reservoir Dam – MA00536
Holland, MA
Emergency Action Plan (EAP) Revision**

Dear EAP Document Holders:

In accordance with Dam Safety Regulation 302 CMR 10.11 (3), please find revised pages for the EAP for the above referenced dam on file at your office. Please insert the new pages in the appropriate locations in the three ring bound EAP in your possession.

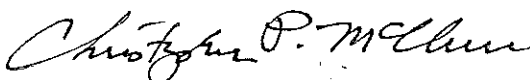
The following pages, tables, and figures included in the EAP have been revised:

- Cover Page
- Page 2 – Notification Flowchart
- Page 3, Table 1 – Downstream Property Owners
- Page 10, Table 3 – Emergency Response Contact Information
- Page 13 – Updated to include McClure Engineering.
- Page 23, Table 6 – Modeled Breach Parameters for Hamilton Reservoir Dam
- Table 9A.1 – Dam Failure during Spillway Design Flood
- Table 9A.2 – Dam Failure during Normal Flow Conditions
- Figure 3 – Inundation Mapping on USGS Mapping
- Figure 4 – Inundation Mapping on 2005 Aerial Photography

Please note that these revisions satisfy the requirements detailed in the letter dated November 15, 2013 from the Office of Dam Safety. The Owner understands that the EAP will continue to be reviewed on an annual basis.

If you have any questions, please contact the undersigned at any time.

Respectfully,



Christopher P. McClure, P.E.

cc: Erica Heidelberg, Massachusetts Emergency Management Agency, 400 Worcester Road, Framingham, MA 01702
Keith Beecher, U.S. Army Corps of Engineers, 24 Riverview Avenue, Fiskdale, MA 01518
Paul Foster, Chief, Holland Fire Department, 5 Sturbridge Road, Holland, MA 01521
Bryan Haughey, Chief of Police, Holland Police Department, 27 Sturbridge Road, Holland, MA 01521
Michael Kennedy, Holland Emergency Management, 27 Sturbridge Road, Holland, MA 01521
Brian Johnson, Holland Highway Department, 5 Sturbridge Road, Holland, MA 01521
James Wettlaufer, Holland Board of Selectmen, 27 Sturbridge Road, Holland, MA 01521

Holland, MA Hazard Mitigation Plan, Technical Assistance *Hamilton Reservoir Dam*

Information which may useful to add to the plan:

- Explain the legally ownership of the dam. Page 44 under Flood Control Structures does not explicitly state if the town or another group has clear title, or if dam ownership is unclear and the town has only taken over operation and maintenance.
 - Description of the dam's physical structure and state of maintenance.
 - Description of dam operation and maintenance. Identify the responsible agency(ies) or entity(ies).
 - Explain monetary, procedural, or other constraints affecting current operation and maintenance of the dam – as well as for proposed mitigation actions.
 - Explain what is legally required (and by whom) to meet municipal, state, and federal regulations for dam structural assessment, monitoring, and maintenance.
 - Identify real estate property and structures (dam, shoreline, and inundation areas) owned, controlled, and/or managed by the town.
 - Expanded description of USACE role in flood management for Hamilton Reservoir and its watershed. (Consider including a map.) Describe any formal coordination between USACE and the town.
 - Identify inundation areas potentially resulting from a Hamilton Reservoir dam breach (text and/or map)
 - Identify structures and utilities at risk from a dam breach. Include private, business, utility, municipal, state (including pier and boat launch), and federal property.
 - Identify location and acreage of *public and semi-public open space property* at Reservoir and downstream in potential inundation areas (text description and/or map).
 - Explain how Mashpaug Road (causeway) and access to the town would be affected by a dam breach.
 - Describe measures now in place to prevent blocking of the box culvert at the Hamilton Reservoir outflow (as occurred in 2005 by docks and canoes).
-

Proposed Mitigation Actions

The November draft plan proposes two actions specifically to mitigate flooding at the Hamilton Reservoir. (1) Dredging the Reservoir, and (2) erosion control and drainage projects. The current draft indicates other strategies might be added to the table of proposed mitigation actions (page 88).

- Page 18 – Add measures to prevent blockage of the box culvert at the Hamilton Reservoir outflow (physical and/or regulatory, if not already in place).
- Page 37 - The spillway of Hamilton Reservoir Dam is described as undersized.
- Pages 54 and 81 - The causeway is identified as needing to be raised.

The town might consider the following mitigation actions frequently taken by municipalities to reduce dam breach risks:

- Physical dam improvements based on an engineering study of the dam to assess condition, recommend improvements, maintenance, and changes in operation.
- Improvements to other retention structures upstream of the dam to reduce the potential for a chain reaction of dam failures. This may include placing water level control devices on natural beaver dams.
- Regulation of forestry, mining, and construction in the watershed above the dam in order to reduce rapid drainage during storm events.
- Municipal land acquisition and conservation restrictions on private property to preserve/create open space within potential inundation areas at risk from a dam breach or uncontrolled high water levels. This may also involve updating the town Open Space and Recreation Plan.
- Add municipal regulation of construction within potential inundation areas.
- Develop official agreements regarding responsibilities for dam improvements and maintenance between the town and other entities such as utilities, businesses, non-profits, state and federal agencies (as appropriate for each dam).
- On occasion, a dam may provide few community benefits, while risks and maintenance costs are high. In that case, steps may be taken to permanently remove a dam. (This does not appear to be an option for the Hamilton Reservoir due to sizable local benefits.)

END



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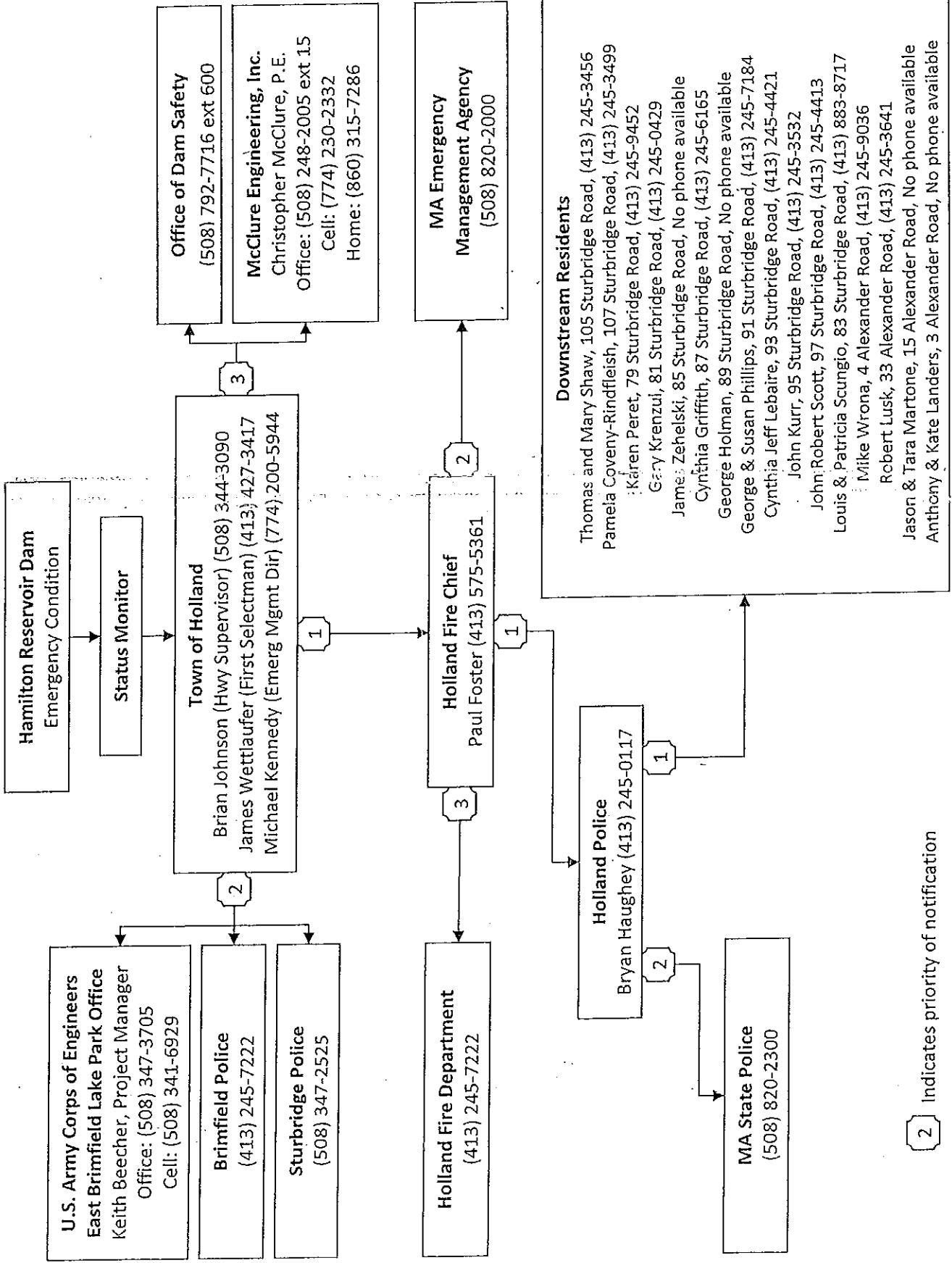
1 Notification Flowchart and Contact List

In the event of an emergency condition at the Hamilton Reservoir Dam, it is critical that an alert be issued immediately to the Town of Holland, local emergency management officials, federal and state emergency management agencies, downstream residents and property owners, operators of downstream dams or water retention facilities, the news media, and others. A notification flowchart is included on the following page showing who is to be notified, by whom, and in what priority. The procedure shown on the notification flowchart must be followed for the timely notification of persons responsible for taking emergency actions. A list of downstream property owners is included as *Table 1*.

The downstream property owners list does not include any property owners downstream of East Brimfield Road. It is assumed that a plan is already in place to notify the owners of properties located in the East Brimfield Dam flood storage area.

HAMILTON RESERVOIR DAM NOTIFICATION FLOWCHART

Revised January 29, 2014



2 Indicates priority of notification

- Downstream Residents**
- Thomas and Mary Shaw, 105 Sturbridge Road, (413) 245-3456
 - Pamela Coveny-Rindfleish, 107 Sturbridge Road, (413) 245-3499
 - Karen Peret, 79 Sturbridge Road, (413) 245-9452
 - Gary Krenzul, 81 Sturbridge Road, (413) 245-0429
 - James Zehelski, 85 Sturbridge Road, No phone available
 - Cynthia Griffith, 87 Sturbridge Road, (413) 245-6165
 - George Holman, 89 Sturbridge Road, No phone available
 - George & Susan Phillips, 91 Sturbridge Road, (413) 245-7184
 - Cynthia Jeff Lebaire, 93 Sturbridge Road, (413) 245-4421
 - John Kurr, 95 Sturbridge Road, (413) 245-3532
 - John Robert Scott, 97 Sturbridge Road, (413) 245-4413
 - Louis & Patricia Scungio, 83 Sturbridge Road, (413) 883-8717
 - Mike Wrona, 4 Alexander Road, (413) 245-9036
 - Robert Lusk, 33 Alexander Road, (413) 245-3641
 - Jason & Tara Martone, 15 Alexander Road, No phone available
 - Anthony & Kate Landers, 3 Alexander Road, No phone available

Table 1 (Revised January 30, 2014)		
Downstream Property Owners		
Name	Address	Phone
Thomas & Mary Shaw	105 Sturbridge Road	(413) 245-3456
Pamela Coveny-Rindfleish	107 Sturbridge Road	(413) 245-3499
Karen Peret	79 Sturbridge Road	(413) 245-9452
Gary Krenzul	81 Sturbridge Road	(413) 245-0429
James zehelski	85 Sturbridge Road	No phone available
Cynthia Griffith	87 Sturbridge Road	(413) 245-6165
George Holman	89 Sturbridge Road	No phone available
George & Susan Phillips	91 Sturbridge Road / P.O. Box 509	(413) 245-7184
Cynthia Jeff Lebaire	93 Sturbridge Road	(413) 245-4421 (413) 244-2421 (cell)
John Kurr	95 Sturbridge Road/ P.O. Box 523	(413) 245-3532
John Robert Scott	97 Sturbridge Road	(413) 245-4413
Louis & Patricia Scungio (House vacant since 2006)	83 Sturbridge Road 2390 Wilbraham Rd, Springfield, MA 01129	(413) 883-8717
Mike Wrona	4 Alexander Road	(413) 245-9036
Robert Lusk	33 Alexander Road 181A Westbourne Grove, London, England W11 2SB	(413) 245-3641 (seasonal only)
Jason & Tara Martone	15 Alexander Road	No phone available
Anthony & Kate Landers	3 Alexander Road	No phone available



2 Statement of Purpose

A dam failure can cause wide spread property damage, substantial economic loss and has potential for loss of life. The Commonwealth of Massachusetts holds dam owners responsible for preparing an emergency action plan to address the possibility of a dam failure.

This Emergency Action Plan (Plan) has been prepared for the Town of Holland, which has jurisdiction over the Hamilton Reservoir Dam (Dam). The purpose of the Plan is to safeguard the lives and reduce damage to the property of the citizens of Holland living and working downstream of Hamilton Reservoir, in the event of failure of the Dam, or flooding caused by large flood events. In accordance with guidelines provided by the Massachusetts Department of Conservation and Recreation (DCR) and the Federal Emergency Management Agency (FEMA), this Plan defines responsibilities and provides procedures designed to do the following:

- Identify emergency conditions at the Dam
- Take mitigative action to prevent failure of the Dam
- Notify the appropriate emergency management officials of possible, impending, or actual failure of the Dam
- Reduce loss of life and property should a failure of the Dam occur
- Provide lists of people and materials for carrying out response actions

The Plan should be periodically reviewed and updated to reflect changes in contact information and/or changes to the downstream properties.

This document draws heavily on material provided in the Federal Emergency Management Agency (FEMA)'s "Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owner (FEMA 64)."

3 Project Description

The following sections contain a description of the project including location, history, physical description, and a discussion of downstream hazards. A Summary Data Table for Hamilton Reservoir Dam is included as *Table 2*.

3.1 Location

Hamilton Reservoir Dam is located on the Quinebaug River at the north end of Hamilton Reservoir in the Town of Holland, Hampden County, Massachusetts. The coordinates of the dam are 42.06881° North 72.15318° West (WGS 84 Datum), as determined using Google Earth geographic information software. A locus map is provided as *Figure 1*.

**Table 2
Hamilton Reservoir Dam Summary Data Table**

Description	Data from 2010 Phase I Report
National ID #	MA00536
Dam Name	Hamilton Reservoir Dam
River Name	Quinebaug
Impoundment Name	Hamilton Reservoir
Hazard Class	High
Size Class	Large
Dam Type	Earth embankment with concrete spillway
Dam Purpose	Recreation
Structural Height of Dam (feet)	17
Hydraulic Height of Dam (feet)	12
Drainage Area (sq. mi.)	18
Normal Pool Reservoir Surface Area (acres)	405
Normal Impoundment Volume (acre-feet)	1,918
Max Impoundment Volume (acre-feet)	4,200
SDF Impoundment Volume (acre-feet)	5,500
Spillway Type	Concrete ogee spillway
Spillway Length (feet)	150
Freeboard at Normal Pool (feet)	5
Spillway Capacity (cfs)	5,870
Low-Level Outlet Capacity (cfs)	Approx. 140 cfs maximum
Spillway Design Flood (flow rate - cfs)	½ PMF / 18,696 cfs
Winter Drawdown (feet below normal pool)	2
Drawdown Impoundment Vol. (acre-feet)	1000
Latitude	42.06881° North
Longitude	72.15318° West
City/Town	Holland
County Name	Hampden
Public Road on Crest	No
Public Bridge over Spillway	No (Sturbridge Rd 60 ft downstream of dam)
Owner Name	Town of Holland
Owner Address	27 Sturbridge Road
Owner Town	Holland, MA 01521
Owner Phone	413-245-7108
Owner Emergency Phone	413-427-3417
Owner Type	Municipality or Political subdivision
Caretaker Name	Brian Johnson, Highway Surveyor
Caretaker Address	5 Sturbridge Road
Caretaker Town	Holland, MA 01521
Caretaker Phone	413-245-3276
Caretaker Emergency Phone	508-344-3090



3.2 Description of the Dam and Appurtenances

The Hamilton Reservoir Dam is an earth fill embankment with a concrete ogee spillway. The dam has a structural height of approximately 17 feet and a hydraulic height of 12 feet. The left embankment of the dam has a length of approximately 100 feet, with a fenced cantilevered concrete walkway along approximately half of its length. The visible portion of the upstream slope is armored with large riprap and the downstream slope is heavily vegetated. The walkway is approximately 4 feet wide, which constitutes the narrowest point along the crest.

The concrete ogee spillway is 150 feet long and constitutes most of the dam's total length. It has a drop height of approximately 11 feet. Three concrete apron slabs at its toe are stepped down parallel to the spillway's base and are curbed at the downstream edge, forming a series of plunge pools. The right concrete training wall is 104 feet in length with a maximum height of 14 feet, and also serves as a retaining wall for the right embankment. The spillway has 5 feet of freeboard up to the top of the training walls.

The reinforced concrete outlet control structure is at the end of the cantilevered walkway, at the intersection of the left embankment and the ogee spillway. The uncontrolled intake on the upstream face of the control structure is reportedly 8 feet high and 4.5 feet wide with a steel trash rack. The low-level outlet is 4 feet high and 2 feet wide on the downstream face of the control structure, and flow is controlled by a manually operated center-rising screw type sluice gate. The operator for this gate is located on top of the control structure. Two uncontrolled 1-foot square high-level outlets are located above the low-level outlet and have a sill elevation approximately 0.5 feet below the crest of the primary spillway. A manhole on top of the control structure provides access for cleaning and maintenance.

A sketch of the dam is included as *Figure 2*.

3.3 Access to the Site

To reach the dam from the center of Holland, take Sturbridge Road east 0.5 miles. The dam can be seen on the right just before reaching Leno Road, as Sturbridge Road crosses the river approximately 60 feet downstream from the dam. During a flood event the left (west) abutment of the dam can most readily be accessed from the private residence at 74 Sturbridge Road, while the right (east) abutment can be accessed from Leno Road near its intersection with Sturbridge Road.

3.4 Design and Construction

A rubble dam and spillway were originally constructed at the site to provide water power to the Hamilton Woolen Co. Mill. After this dam was partially destroyed by the 1955 flood, a new dam was designed by Tighe & Bond, Inc. of Holyoke, MA, and completed in approximately 1960. The original spillway and gatehouse were demolished and the rubble dam was covered by an earth embankment and incorporated into the new structure. The elevation of the dam was increased and the right end was extended to accommodate an enlarged spillway. The



reservoir is currently used for recreational purposes. Many of the homeowners abutting the impoundment have private docks and/or watercraft, and the Massachusetts Department of Fisheries & Wildlife maintains a concrete boat ramp, fishing pier, and parking lot near the dam.

3.5 DCR Size Classification

Hamilton Reservoir Dam has a height of dam of approximately 17 feet and a maximum storage capacity of approximately 4,200 acre-feet. Therefore, in accordance with Department of Conservation and Recreation (DCR) Office of Dam Safety classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, Hamilton Reservoir Dam is a Large size structure.

3.6 DCR Downstream Hazard Potential Classification

Hamilton Reservoir Dam is located approximately 1.9 miles upstream of Holland Pond Dam and 6.2 miles upstream of the East Brimfield Lake Dam. The area between Hamilton Reservoir Dam and Holland Pond is generally forested and sparsely populated; however, a number of residential properties are located adjacent to the river in this area. Road crossings in the downstream area include Sturbridge Road 60 feet downstream of the dam, a private drive crossing at Alexander Road 0.7 miles downstream, and East Brimfield Road 1.2 miles downstream. In addition, both USGS and MassGIS mapping show an underground pipeline crossing (reportedly belonging to Tennessee Valley Gas Pipeline) approximately 0.75 miles downstream of the dam, which could be exposed and damaged in the event of a dam failure. The area downstream of East Brimfield Road, including Holland Pond, is part of the East Brimfield Lake flood control reservoir built and operated by the U.S. Army Corps of Engineers (USACE).

Department of Conservation and Recreation classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, stipulate that a dam be classified as a High Hazard potential structure if a failure of the dam at maximum pool "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)." Based on presence of the downstream facilities described above, the Office of Dam Safety has classified Hamilton Reservoir Dam as a High Hazard potential structure.



3.7 Documented Floods and Emergency Incidents

Two large flood events have been documented at the Hamilton Reservoir Dam:

- In 1955, the right abutment was breached and the spillway was destroyed. There was extensive damage to the Sturbridge Road Bridge embankment and abutments. The dam was redesigned and reconstructed in 1960.
- In October 2005 a large storm caused heavy flows in the watershed. An upstream dam performed an emergency release without notifying the Town of Holland in advance. Flood levels rose approximately to the top of the Hamilton Reservoir Dam, with tailwater between the dam and Sturbridge Road at the same level as the impoundment.

4 Emergency Detection, Evaluation, and Classification

4.1 Possible Emergency Conditions

Emergency conditions at the dam may be caused by any number of occurrences including but not limited to:

- Excessive Precipitation/Flood Flows
- Rapid Snow Melt
- Vandalism
- Seepage/Erosion
- Earthquake
- Spillway Blockage

The most likely of these to occur is excessive precipitation. Normally, advanced warning for flooding due to heavy rainfall is available; therefore, the majority of this Plan is predicated on the presumption that the cause of the emergency condition is excessive precipitation. If advanced warning is available for the other occurrences, the evacuation area and emergency response contacts would be equally applicable.

The size and hazard class of Hamilton Reservoir Dam require that the Spillway Design Flood (SDF) be one half of the Probable Maximum Flood ($\frac{1}{2}$ PMF), as stipulated in 302 CMR 10.14. Based on a hydrologic and hydraulic analysis prepared for the dam in 1993 by C.T. Male Associates, P.C., the maximum outflow from Hamilton Reservoir Dam during the SDF is estimated to be 18,700 cubic feet per second (cfs). The maximum water surface elevation associated with this flow is 690.5 feet NGVD, approximately 7.5 feet above the spillway crest and 2.5 feet above the walkway and dam crest. This flow and elevation are associated with 15.5 inches of precipitation occurring in 24 hours. The estimated capacity of the spillway is 5,870 cfs, or approximately 31% of the SDF.



As such, the capacity of the spillway could be exceeded and result in overtopping of non-overflow portions of the dam and abutments if any of the following conditions exists:

- Periods of unusually heavy or intense rainfall
- Excessive snow melt and/or frozen ground conditions
- Back to back rainfall events resulting in high antecedent water surface elevations
- Release from dam in the upstream watershed
- Spillway blockage by debris

It is important to note that the magnitude of flood flows generated by a given rain event is NOT solely dependant on the depth of precipitation. Factors that may increase flooding include, but are not limited to, wet antecedent conditions in the watershed (i.e. saturated ground), frozen ground, snow melt, reduced storage volume in upstream impoundments, etc.

4.2 Storm Event Monitoring Procedures

4.2.1 Inspection Frequency

When high runoff conditions are forecast, commence inspections at the following frequency:

- **Flood Watch:** Emergency operation monitoring by the owner and/or caretaker, (or the individual(s) designated by the owner or caretaker) of the Dam should commence when a Flood Watch alert is issued by the National Weather Service for Hampden County or when heavy runoff conditions are experienced at the Dam site. The inspection procedures outlined herein should be undertaken at once. Additional inspections should be conducted thereafter at intervals of no more than three hours.
- **Flood Warning:** If the Flood Watch is upgraded to a Flood Warning, the Dam should be inspected at intervals of no more than one hour.
- **Post Event:** Subsequent inspections should be made after the ground has dried sufficiently to allow for the identification of any new seepage areas in the vicinity of the Dam which could indicate the loss of or shifting of structural material within the structure.

A written record should be maintained of any observations made during the inspection. These procedures should be updated to reflect any future repairs or modifications at the site.

4.2.2 Safety Equipment and Procedures

All inspections should be performed with proper safety equipment. Means of remote communication (e.g., cellular phone or two way radio) should be maintained to allow prompt contact with emergency officials if unsafe conditions are found at the dam. Additionally, arrangements for mobile high intensity lighting systems should be made to allow observations

during darkness. Such systems may be available from the local fire department, state police, or the National Guard. If a failure of the dam appears imminent, care should be taken during the inspection to remain at a safe distance from the structure.

4.2.3 Responsible Personnel

Persons responsible for emergency operation monitoring and implementing emergency repairs are to be designated by the Town of Holland. The following individuals are responsible for emergency operation monitoring including listening for alerts from the National Weather Service, observing the dam during periods of rainfall and issuing early and final warnings and all clear notices:

Name	Affiliation	Phones*
Paul Foster, Chief	Fire Department	413-245-9733 (O) 413-245-7882 (H) 413-575-5361 (M)
Bryan Haughey, ACOP	Police Department	413-245-0117 (O) 508-361-2163 (M)
Michael Kennedy	Emergency Management	774-200-5944 (M)
Mary Nathan	Local Red Cross	413-737-4306 (O)
Brian Johnson	Dept. of Public Works	413-245-3276 (O) 413-245-0067 (H) 508-344-3090 (M)
David Kowalski	Health Department	413-245-7108, x112 (O) 413-245-5814 (H) 508-579-4688 (M)

* O = Office phone, H = Home phone, M = Mobile phone

The following individuals are responsible for coordinating and implementing emergency repairs at the Dam.

Name	Affiliation	Phones*
Brian Johnson	Dept. of Public Works	413-245-3276 (O) 413-245-0067 (H) 508-344-3090 (M)
James Wettlaufer	First Selectman	413-245-7108 (O) 413-427-3417 (M)

* O = Office phone, H = Home phone, M = Mobile phone

The contact information provided above should be updated as necessary to allow an efficient response in emergency situations. The general responsibilities of these individuals are further addressed in Section 5, later in the document.

4.3 Emergency Classification: Early and Final Warnings

An Early Warning means that a potential failure situation is developing. It is intended to orally inform local authorities that conditions at the Dam site exist that may require the evacuation of downstream residents within several hours to avoid loss of life in the event of a dam failure. Local authorities have the authority and responsibility of alerting the potentially affected downstream residents (see *Table 1*) of the possibility that evacuation may become necessary. The Early Warning notice and/or actual evacuation of downstream residents should be performed according to a pre-arranged plan prepared by local authorities.

A Final Warning, which is an evacuation notice, means that failure is imminent or has occurred. It should be initiated when, in the judgment of the inspector, a failure of the Dam is likely and evacuation of the downstream area is necessary. When issuing either an Early Warning or a Final Warning notice, the owner of the Dam (or the designated individuals) should only place calls to the agencies listed in the Notification Flowchart. **Only designated local emergency response officials have the authority to order an evacuation.**

One or more of the Responsible Personnel listed in Section 4.2.3 will determine whether a warning is should be issued using the criteria presented in Section 4.4.

4.4 Dam Condition Monitoring

When possible, the following steps should be taken in the order listed below to observe the condition of the Dam during a storm event and to issue warnings if deemed necessary. Early and Final Warnings are described in Section 4.3.

1. Rate of water level rise: Check the water level relative to the spillway training walls. For safety reasons, it may be preferable to make these observations near the upstream end of the right (east) training wall. Make a visual observation of the rate at which the water is rising, or make a record of several periodic observations to estimate the rise. As a maintenance item the Town should consider installing a staff gauge, marking the training walls at regular increments, or installing another type of water surface elevation monitoring device to facilitate judging the rate of water surface elevation rise and the freeboard available.
 - If the rate of rise in the water level is observed such that the dam embankment, meaning the concrete walkway and the top of the training walls (elevation of approximately 688 ft NGVD) would be overtopped within three hours, issue an Early Warning.



- If the water level rises to within one foot of the top of the training walls and is rising at a rate that would overtop the Dam within one hour, issue a Final Warning.
2. Erosion: Check the condition of earth embankment of the dam and the abutments for erosion. If rills or gullies are forming on the downstream embankment or on the abutments outside of the training walls or concrete walkway, erosion could quickly escalate to cause a breach.
 - If substantial erosion is occurring such that impounded water is escaping, issue a Final Warning.
 3. Seepage, soft spots, slumping: Check the downstream slope and downstream toe of both the dam and of Sturbridge Road for signs of seepage, soft spots or slumping of earth material on the slope.
 - If a marked increase in seepage through any of these areas, particularly if evidence of boiling (seepage under pressure which tends to transport the material through which it flows) is observed, issue an Early Warning.
 - If a noticeable, sudden increase in seepage flow or visible movement of soil is observed, issue a Final Warning.
 4. Concrete Structures: If conditions permit the inspector to approach the spillway, low level outlet structure, and concrete wall/walkway safely, check for cracking, settlement, or movement of the structures, training walls, and the surrounding embankment and abutment.
 - If any of these conditions is observed, issue a Final Warning.
 5. Other Conditions:
 - If any other conditions are observed at the Dam that may result in or indicate failure of the Dam (e.g. bulging, cracking, change in horizontal or vertical alignment), issue a Final Warning.

4.5 Final Warning Response Procedures

The procedures to be followed in issuing a Final Warning are as follows. These steps assume that the Town has already notified the Fire Chief (or other Incident Commander) of the emergency, and that this individual has determined that a Final Warning should be issued. A description of the roles and responsibilities of the key participants in these procedures is included in Section 5.2.

1. The Public Works Director or his designee will be posted at the dam as a **status monitor** to constantly monitor its condition. This person will be equipped with a cell phone, radio or other communication device that can contact police or other emergency personnel. Otherwise, a police officer or fire fighter with adequate

communication equipment should be posted with the status monitor to facilitate communication.

2. The Incident Commander will notify the Police Chief of the dam emergency. The Police Chief will contact the **potentially affected properties** listed in *Table 1*, and inform them of the situation.
3. The Fire Chief will begin to coordinate the **evacuation of the inundation area** using the Town's emergency response plans. Evacuated residences must be instructed not to cross the Quinebaug River. Residents should be directed uphill and away from the dam. Residents should be instructed not to drive on Sturbridge Road, Alexander Road, or East Brimfield Road if possible.
4. The Town of Holland will contact the **U.S. Army Corps of Engineers (USACE) East Brimfield Lake Park Office**, which has responsibility for East Brimfield Dam, Lake Siog (a.k.a. Holland Pond), and the Pond Road bridge. The USACE will maintain a copy of this plan on file.
5. The Public Works Director or one of the other responsible personnel will contact the **Office of Dam Safety and McClure Engineering, Inc.** to ensure that a professional engineer will be on-site during response activities.
6. The Incident Commander will contact the **Massachusetts Emergency Management Agency**, which will maintain this plan on file.
7. The Public Works Director will mobilize Public Works staff, supplies, and equipment to the dam site to make **emergency repairs** if possible, or, if overtopping is possible, to raise the overflow elevation with sandbags or reduce the probability of erosion if overtopping is imminent.
8. The Police Chief will dispatch officers to the **Sturbridge Road, East Brimfield Road, and Pond Road bridges** to prevent crossing by nonessential personnel. Because these bridges could overtop under certain flood or breach conditions, the officers should be in constant communication with the status monitor to ensure their safety.
9. The Police Chief will determine whether additional personnel are necessary and contact the **Massachusetts State Police** if required.
10. The Police Chief will dispatch staff to **close roads** at the approximate limits of the inundation area shown in *Figures 3 and 4*.
11. The Town Administrator or one of the other responsible personnel will contact the **Towns of Brimfield and Sturbridge**, which are the next two municipalities downstream, informing them of the situation while informing them that a breach is unlikely to impact residents there.



communication equipment should be posted with the status monitor to facilitate communication.

2. The Incident Commander will notify the Police Chief of the dam emergency. The Police Chief will contact the **potentially affected properties** listed in *Table 1*, and inform them of the situation.
3. The Fire Chief will begin to coordinate the **evacuation of the inundation area** using the Town's emergency response plans. Evacuated residences must be instructed not to cross the Quinebaug River. Residents should be directed uphill and away from the dam. Residents should be instructed not to drive on Sturbridge Road, Alexander Road, or East Brimfield Road if possible.
4. The Town of Holland will contact the **U.S. Army Corps of Engineers (USACE) East Brimfield Lake Park Office**, which has responsibility for East Brimfield Dam, Lake Siog (a.k.a. Holland Pond), and the Pond Road bridge. The USACE will maintain a copy of this plan on file.
5. The Public Works Director or one of the other responsible personnel will contact the **Office of Dam Safety and Fuss & O'Neill** to ensure that a professional engineer will be on-site during response activities.
6. The Incident Commander will contact the **Massachusetts Emergency Management Agency**, which will maintain this plan on file.
7. The Public Works Director will mobilize Public Works staff, supplies, and equipment to the dam site to make **emergency repairs** if possible, or, if overtopping is possible, to raise the overflow elevation with sandbags or reduce the probability of erosion if overtopping is imminent.
8. The Police Chief will dispatch officers to the **Sturbridge Road, East Brimfield Road, and Pond Road bridges** to prevent crossing by nonessential personnel. Because these bridges could overtop under certain flood or breach conditions, the officers should be in constant communication with the status monitor to ensure their safety.
9. The Police Chief will determine whether additional personnel are necessary and contact the **Massachusetts State Police** if required.
10. The Police Chief will dispatch staff to **close roads** at the approximate limits of the inundation area shown in *Figures 3 and 4*.
11. The Town Administrator or one of the other responsible personnel will contact the **Towns of Brimfield and Sturbridge**, which are the next two municipalities downstream, informing them of the situation while informing them that a breach is unlikely to impact residents there.



4.6 All Clear Notice

In the event that a Final Warning is issued and the evacuation occurs, the following steps must be completed prior to the issuance of the All Clear Notice.

1. Determine that the flood emergency has abated. The dam safety emergency can be considered abated when the dam has been completely breached (and the reservoir is empty) or the emergency situation has been stabilized.
2. Determine that a flood wave caused by a dam failure has attenuated in the downstream channel and no longer threatens downstream properties.
3. Have the Dam inspected by DCR Dam Safety personnel or a licensed professional engineer experienced with dams.
4. If the Dam is not found to be in danger of failing, an authorization for issuance of an All Clear Notice should be sent to the local officials.
5. The local officials may then issue an All Clear Notice allowing the return of evacuated residents to their dwellings.

5 General Responsibilities under the EAP

5.1 General

It is critical that all individuals listed in the notification flowchart understand their responsibilities and are diligent in performing them. In general terms, the Town of Holland is responsible for developing, maintaining, and implementing the EAP; coordinating long-term maintenance and capital improvements to the dam; and identifying possible emergency conditions at the dam. Local and state emergency management officials are responsible for coordinating an emergency response and for warning and/or evacuating downstream residents, if necessary. Local and state police are responsible for securing the site, controlling traffic into and out of affected areas, and assisting with evacuation activities. The Public Works / Highway Department is responsible for ongoing maintenance of the dam and for supplying equipment, materials, and labor in the event of a dam emergency.

In the event of an emergency condition at the Hamilton Reservoir Dam, the Fire Chief or an assigned representative will assume the primary coordinating role of Incident Commander. If the Fire Chief is unable to fulfill these duties, the Holland First Selectman will be the Incident Commander. If both the Fire Chief and First Selectman or designated representatives are unavailable, the Police Chief will assume the role of Incident Commander.

Any evacuation due to a dam emergency will focus on areas along the Quinebaug River, beginning at the dam and extending downstream to East Brimfield Road. The U.S. Army Corps of Engineers must also be notified immediately to organize a response for their facilities and recreational areas further downstream. The primary method of resident notification will



be by telephone, but alternate plans should be in place in case of a telephone service outage. It may be necessary for police to broadcast an emergency notification from their vehicles while driving to residences not reached by phone or residences having special needs. Special needs should be identified ahead of time and plans put in place to address them. Current contact lists for downstream residents must be kept with this EAP to facilitate prompt notification of the citizenry.

5.2 Key Participant Responsibilities

The specific responsibilities of key participants in the planning, implementation, and execution of the EAP are outlined in the following sections.

5.2.1 Holland Fire Chief

The Fire Chief is the Incident Commander in the event of an emergency at the Hamilton Reservoir Dam. The Incident Commander is to establish an Emergency Command Center (ECC), outfitted with critical resources such as communication equipment, maps, contact information for local and state emergency management personnel, and copies of the EAP. The ECC should be located outside of the potential inundation area, in a previously determined and easily accessed location.

The Incident Commander is responsible for monitoring the situation at the dam, notifying and coordinating with local and state authorities, and coordinating any emergency response in the impacted area. He/she serves as the contact point for disseminating all updates and should keep local and state authorities apprised of conditions before, during, and after an emergency event.

5.2.2 Holland Board of Selectmen

As owner of the dam, the Town of Holland is responsible for the long-term condition and safety of the dam. The Town must monitor the dam for potentially dangerous conditions, especially when high flood flows are forecast. Any situations of concern must be evaluated and classified to determine the appropriate level of response. The Town should notify local authorities (i.e. the Fire Chief) of any dam incident report, then follow up with additional information regarding the need to implement the EAP.

The Holland First Selectman is to serve as Incident Commander if the Fire Chief or assigned representative is unable to do so.

5.2.3 Holland Highway Department

The Highway / Public Works Department is responsible for the operation, care, and ongoing maintenance of the dam. They are also to provide equipment, labor, and manpower as requested by the Town, Incident Commander, or other emergency response personnel to address potential emergency conditions at the dam or to define evacuation limits. Additional information regarding emergency repair measures is included in Section 7 and a list of available equipment and supplies is available in *Table 5*.

5.2.4 Holland Police Department

The Police Department acts under the direction of the Incident Commander to secure the site, control traffic into and out of the inundation zone, monitor/control access to downstream road crossings, and implement a declared evacuation of potentially inundated areas. They should be prepared to notify downstream residents and implement other evacuation procedures.

The Police Chief is to serve as Incident Commander if the Fire Chief and First Selectman, or assigned representatives, are unable to do so.

5.2.5 Holland Fire Department

The Fire Department is to assist the Incident Commander, provide evacuation support, and be prepared to assist in evacuating special needs populations.

5.2.6 Massachusetts State Police

At the request of the local Police Department, the Massachusetts State Police is to assist in securing the site, controlling traffic, and implementing an evacuation.

5.2.7 Massachusetts Emergency Management Agency (MEMA)

The Massachusetts Emergency Management Agency (MEMA) is a planning resource to assist in developing and maintaining an effective emergency plan. MEMA also conducts training seminars for first responders.

At the request of the Incident Commander, MEMA Region 3 is to assist with public notification, mobilize necessary equipment and resources, and assist with the aftermath of a dam breach or flood scenario.

5.2.8 Holland Emergency Management Director

The Emergency Management Director of the Town of Holland is to direct and coordinate emergency planning, including the EAP. Responsibilities include preparing revisions to the EAP, establishing training seminars, coordinating training exercises, and serving as the contact point for questions regarding the EAP or its implementation.



6 Emergency Repair Measures

Emergency repair measures are taken to prevent a dam failure incident or to help reduce the effects of a dam failure. The following actions describe some of the steps that could be taken at the dam to prevent or delay failure after an emergency is first discovered (NRCS, 2003). These actions should only be performed under the direction of the Office of Dam Safety or other qualified licensed professional engineers with experience in dam safety. It is important to note that undertaking emergency measures does not eliminate the need to issue the appropriate warnings to the local authorities.

Actions to be taken in the event of:

- Overtopping by flood waters:
 - A. Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas.
 - B. Place sandbags along crest. Flow should be diverted away from the erodible embankment of the dam and the adjacent abutments
- A slide or slumping of the earth on the upstream or downstream slope of the abutment, or spillway side walls:
 - A. Lower the water level in the reservoir at a rate, and to an elevation, that is considered safe given the slide condition. If the outlet is damaged or blocked, pumping, siphoning, or a controlled breach may be required.
 - B. Stabilize slides on the downstream slope by weighting the toe area below the slide with additional soil, rock, or gravel.
- Erosional seepage or leakage (piping) through the embankment, foundation, or abutments:
 - A. Plug the flow entrance with whatever material is available (hay bales, bentonite, or plastic sheeting) if the entrance to the leak is in the reservoir.
 - B. Lower the water level in the reservoir until the flow decreases to a non-erosive velocity or until it stops.
 - C. Place an inverted filter (riprap on top of geotextile filter fabric) over the exit area to minimize embankment material loss.
 - D. Place sandbags in a ring dike around the boil (the location where flow is exiting the soil) to impound water and counteract the driving hydraulic head.
 - E. Continue lowering the water level until a safe elevation is reached; continue operating at a reduced level until repairs are made.
- A Mass Movement of the Dam on its Foundation (Spreading or Mass Sliding Failure):
 - A. Immediately lower the water level by pumping, or siphoning until excessive movement stops.
 - B. Continue lowering the water level until a safe level is reached; continue operation at a reduced level until repairs are made.



- Excessive Settlement of the Embankment:
 - A. Lower the water level by releasing it through the outlet or by pumping, or siphoning.
 - B. If necessary, restore freeboard, preferably by placing sandbags.
 - C. Lower water level in the reservoir to a safe level; continue operating at a reduced level until repairs can be made.
- Malicious Human Activity (Sabotage, Vandalism, or Terrorism)
 - A. If malicious human activity that could endanger public safety is suspected, contact law enforcement to help evaluate the situation.
 - B. If the principal spillway has been damaged or plugged, implement temporary measures to protect the damaged structure. Employ experienced, professional divers, if necessary, to assess the problem and possibly implement repair.
 - C. If the spillway embankment has been damaged or partially removed, provide temporary protection in the damaged area by placing sandbags, riprap materials, or plastic sheets weighted with sandbags. Use pumps and siphons to help reduce the water level in the reservoir.

7 Preparedness

Preparedness actions involve the identification of necessary equipment or the establishment of procedures to be used when facing a potential dam emergency. Their purpose is to prevent an emergency condition from developing, facilitate the operation of the dam to limit adverse impacts, minimize the effects of an emergency situation, and/or warn of an emergency condition in progress.

The following sections discuss information to be used in planning and preparing for an emergency condition at the dam.

7.1 Surveillance

Early detection of emergency conditions is primarily by non-routine visual observation by Town personnel (for instance; Police, Highway Department). Such visual observations would be of visible deterioration, blocked or damaged spillway, accidental boat impact, vandalism, or sabotage.

Town personnel should stay informed of rainfall or upstream release events that could cause an emergency condition at the dam. Weather forecast information, including flood watches and warnings, can be obtained on the NOAA National Weather Service website at <http://www.nws.noaa.gov/>



7.2 Dam Operations and Maintenance Manual

At the time of writing there is no operations & maintenance (O&M) manual in place for the Hamilton Reservoir Dam. The Town is currently pursuing options for the development of an O&M manual which should include procedures for operation during both normal conditions and emergency conditions.

7.3 Training and Exercising

Training is essential to ensuring that those involved in the implementation of this EAP are familiar with their roles and responsibilities. Training exercises can be used to develop and maintain operational readiness, timeliness, and responsiveness. Key personnel from state and local emergency management agencies should be encouraged to participate in any training and exercises of the EAP, where possible and appropriate.

Following are five types of training exercises, in order of increasing complexity (FEMA 64). In general, emergency exercises should be practiced in increasing order of complexity in order to build on a foundation of essential skills.

1. Orientation Seminar – A meeting of interested parties (e.g. the Town, state and local emergency management agencies) to discuss the EAP and initial plans for an annual drill or more in-depth comprehensive exercise. Participants become familiar with the roles, responsibilities, and procedures of those involved.
2. Drill – The exercise of skills in a single emergency response procedure (e.g. calling to verify the validity of telephone numbers). Drills are part of necessary ongoing training to test, develop, or maintain required skills.
3. Tabletop Exercise – A meeting between the dam owner and state and local emergency management officials in a conference room environment. Simulated events are described, followed by a discussion by participants to evaluate the EAP and response procedures and resolve concerns regarding coordination and responsibilities.
4. Functional Exercise (at least once every 5 years) – A simulated dam failure in conjunction with other specified events, wherein participants “act out” their actual roles in a stress-induced environment and under time constraints. It involves personnel from the various levels of the dam owner, state, and local emergency management.
5. Full Scale Exercise (optional, as needed to evaluate a specific need) – A realistic exercise in which personnel and resources are actually deployed to evaluate the operational capability of all facets of the emergency management system (including state and local emergency management agencies). Participants play out their roles including field movement and deployment.



Training should take place annually except as noted above, and should be followed by an oral and written evaluation of the procedures that worked well and those that did not. Input from all participating parties should be solicited. A frank assessment of events before, during and after the emergency; actions by participants; and time required to complete various steps will provide useful information for making improvements to the plan for future use.

7.4 Updating the EAP

Without periodic maintenance, this EAP will become outdated and ineffective. The plan should be reviewed annually to assess its workability and efficiency and improve weak areas. Updates should be made to address changes in personnel, communications systems, and contact information of downstream property owners. Procedures should be modified based on lessons learned during training exercises.

The following documentation should be referenced during the review process:

- Most recent dam inspection report
- Correspondence from upstream and downstream dam owners received since last review (if none, it is recommended to contact dam owners for any updates)
- Input from Town personnel related to any incidents involving the dam, or observations and notes when conducting maintenance on or near the dam.

7.5 Emergency Response Coordination

In the event of an emergency situation, the Emergency Management Director or a designated Incident Commander must establish an Emergency Command Center (ECC) to serve as the main distribution center for warning and evacuation activities. This individual is also responsible for the organization and execution of the EAP, and must coordinate all activities with state and local authorities.

7.6 Downstream Residents Contact Lists

The addresses of homes and businesses that could be inundated in the event of a dam breach are listed in *Table 1*. This contact list should be updated at least annually and should be ordered such that those who could be inundated first, or those requiring extended time to evacuate, are notified first.

7.7 Alternate Systems of Communication

A secondary system of communication should be in place in case the primary system fails. Emergency personnel should carry radios for use in the event of a cell phone outage, and the ECC should be supplied with radio equipment for communication with emergency personnel.

7.8 Emergency Labor, Supplies, and Equipment

An inventory of available equipment, materials and manpower which could be utilized to clear debris blocking the spillway, repair erosion of the embankment, place sandbags, etc. is listed in *Table 5*. This list should be maintained by the Town of Holland and revised as necessary. It may be possible to enlist the service of a reliable construction contractor(s) who can be made available to supply needed manpower and equipment for emergency situations. This equipment should be used to buttress the existing dam structure (e.g., raise the crest of the dam or buttress eroded embankment areas) before water levels rise appreciably, or if possible, to perform emergency repairs during flooding.

**Table 5
Equipment, Materials and Manpower**

Materials/ Equipment	Holland Hwy Dept	Holland Fire Dept	Kaitbenski Construction
<i>Phone Number</i>	413-245-3276	413-245-3788	508-347-3003
<i>Address</i>	5 Sturbridge Rd Holland, MA	5 Sturbridge Rd Holland, MA	110 Brookfield Rd Sturbridge, MA
Dump Truck	Y	N	Y
Backhoe	Y	N	Y
Emergency Lighting	Y	Y	Y
Generator	Y	Y	Y
Barriers/Barricades	Y	N	Y
Hand Tools	Y	N	Y
Sand	Y	N	Y
Sandbags	N	N	N
Filter Fabric	Y	N	N
Stone/Riprap	N	N	Y

Town Department:	Police	Fire	Highway
Personnel Available:	8	5	5



8 Potentially Affected Downstream Properties

8.1 General

Outflow from the dam discharges to the Quinebaug River. The river passes below Sturbridge Road approximately 60 feet downstream of the dam, and then passes through a heavily forested reach with light development including a number of residences. The channel is relatively steep and rocky until it nears East Brimfield Road, 1.2 miles downstream of the dam.

At East Brimfield Road, the river enters the flood storage area of East Brimfield Dam, a flood control dam built and maintained by the U.S. Army Corps of Engineers. The river flows sluggishly across this broad floodplain, through Lake Siog/Holland Pond (1.9 miles downstream of the dam) and eventually under East Brimfield Holland Road (5.0 miles downstream) into the permanent/recreational pool of East Brimfield Lake. East Brimfield Dam is 6.2 miles downstream of Hamilton Reservoir Dam. Between the Hamilton Reservoir Dam and the East Brimfield Dam, the Quinebaug River is conveyed under five roadways by culverts or bridges.

A dam breach analysis was completed to assess the areas downstream of Hamilton Reservoir Dam that may be inundated in the event of a complete failure of the Dam. Dam break analyses were completed for two failure scenarios including:

- A sunny day failure in which the dam fails during 'normal' flow conditions in the downstream reach
- A Spillway Design Flood (SDF) failure in which the dam fails during one half the probable maximum flood (1/2 PMF)

Mapping showing the area to be inundated during each of the dam breach scenarios is presented as *Figures 3 and 4*. *Table 1* lists the potentially affected downstream properties.

8.2 Methodology

The dam break analysis for Hamilton Reservoir Dam was performed using the unsteady flow modeling module of "Hydrologic Engineering Center – River Analysis System" (HEC-RAS) version 4.1.0 software released by the USACE. Data for the analysis was obtained from available sources and supplemented with field measurements of bridges and crossings.

The spillway design flood (SDF) inflow hydrograph (shown in *Figure 5*) was developed based on data from a 1993 study by CT Male Associates. The SDF is one half the probable maximum flood (1/2 PMF), calculated based on a 6-hour rainfall distribution. The peak inflow into the reservoir for this model scenario is 21,198 cfs. The dam was assumed to fail when the reservoir water surface elevation reached its highest point.

The online USGS statistical stream flow estimate package StreamStats was used to estimate typical sunny day failure flow rates. The D50, the flow that is estimated to be equaled or exceeded 50 percent of the time (the median flow), was estimated by StreamStats to be 65 cfs

for the Quinebaug River at the dam. To avoid computational instabilities in the model, a sunny day base flow of 100 cfs was used.

The time of breach development and the breach dimensions were estimated using equations developed by VonThun & Gillette and reported in Wahl (2004) for the sunny day and spillway design flood failure conditions. The estimated time of failure used was 15 minutes. Because Sturbridge Road has been overtopped during past flooding, it was assumed that the roadway embankment failed at the same time as the dam. For the dam, the breach bottom width was modeled as 80 feet wide during the sunny day failure and 170 feet wide during the design storm failure. For Sturbridge Road, the breach bottom width was also modeled as 80 feet wide during the sunny day failure and 175 feet wide during the design storm failure. The side-slopes of the breach openings were modeled as 1H:1V slope extending from the breach base to the intersection with the crest.

Table 6 outlines breach parameters and resulting breach discharges used for analysis for the breach scenarios:

Table 6 (Revised January 29, 2014)

Modeled Breach Parameters for Hamilton Reservoir Dam

Parameter	Sunny Day Failure	SDS Failure
Breach width - Bottom	80 feet	170 feet
Maximum breach height	17 feet	
Breach development time	15 min.	
Water depth above concrete weir invert at failure (feet)	0.4 feet	6.9 feet
Pre-breach outflow (cfs)	100 cfs	9,809 cfs
Peak breach outflow (cfs)	3,907 cfs	13,185 cfs
Initial flood wave arrival at East Brimfield Road	30 minutes following start of breach	10 minutes following start of breach
Peak flood wave arrival at East Brimfield Road	85 minutes following start of breach	40 minutes following start of breach

The detailed study area ends at East Brimfield Road, approximately 1.2 miles downstream from the dam. Inundation mapping was completed for this reach only, although areas downstream of East Brimfield Road were also modeled to obtain flood wave timing information and to estimate whether a dam breach would overtop the East Brimfield Dam.

Under SDF flow conditions the dam (i.e. walkway and abutments) is predicted to be overtopped by approximately 1.9 feet. This elevation could erode the dam embankment or abutments, resulting in failure. The HEC RAS model indicates that when the dam and Sturbridge Road are breached at this peak flow condition, the water surface elevation will in general increase less than 1 foot across the downstream areas. During an SDF, the potentially

affected properties listed in *Table 1* should be contacted before SDF conditions fully develop, when monitoring of water surface elevation rise suggests that the pond water surface elevation may overtop the dam, or if the Sturbridge Road embankment shows indications that it may fail.

A map of the inundated area for both scenarios is provided as *Figures 3 and 4*. Should the Dam appear likely to fail, a Final Warning should be issued and the area within the mapped inundated area should be evacuated at once. The addresses of homes and businesses that could be inundated are listed in *Table 1*. The limits of potential flooding could be greater if substantial debris accumulates within the stream channel or at roadway crossings which is likely during a catastrophic flood such as this. If debris accumulation occurs, additional structures and homes may be subject to flooding.

The timing and depth of flooding at downstream road crossings is summarized in *Tables 7 – 9*.

Summary of Potential Downstream Flooding

Table 7 – Scenario: Failure During Normal Flow Conditions

Location	Approx. River Mile	Estimated Max. WSE*	Depth of Potential Overtopping	Estimated Time to Peak Flow**
		feet	feet	min
Sturbridge Road	0.02	681.7	N/A	20
Private Drive off Alexander Road	0.70	660.4	0.4	45
East Brimfield Road	1.20	644.6	N/A	85

*Vertical Datum: NGVD 29

** Time measured from start of breach development

Table 8 – Scenario: Spillway Design Flood with No Dam Failure

Location	Approx. River Mile	Estimated Max. WSE*	Depth of Potential Overtopping	Estimated Time to Peak Flow**
		feet	feet	min
Sturbridge Road	0.02	689.0	6.0	N/A
Private Drive off Alexander Road	0.70	663.7	3.7	N/A
East Brimfield Road	1.20	659.6	0.6	N/A

*Vertical Datum: NGVD 29

** Time measured from start of breach development

Table 9 – Scenario: Failure during Spillway Design Flood

Location	Approx. River Mile	Estimated Max. WSE*	Depth of Potential Overtopping	Estimated Time to Peak Flow**
		<i>feet</i>	<i>feet</i>	<i>min</i>
Sturbridge Road	0.02	689.0	6.0	20
Private Drive off Alexander Road	0.70	664.7	4.7	30
East Brimfield Road	1.20	660.2	1.1	40

*Vertical Datum: NGVD 29

** Time measured from start of breach development

8.3 Downstream Dams

Two dams are located downstream of Hamilton Pond Dam within the study area:

- Lake Siog Dam (a.k.a. Holland Pond Dam), 1.9 miles downstream
- East Brimfield Dam, 6.2 miles downstream

Two recreational facilities are located on the shores of Lake Siog: the Lake Siog Recreation Area operated by the USACE, and Camp Mishnoah operated by the Springfield Girls' Club. East Brimfield Dam is a large flood control structure also operated by the USACE. Recreational facilities on East Brimfield Lake include state-owned boat ramps, swimming beach, and picnic areas.

Lake Siog/Holland Pond Dam would be overtopped and could potentially fail in the event of a breach of Hamilton Reservoir Dam. Because of its relatively small height and the fact that it is located within the flood storage area for the East Brimfield Dam, a breach of Lake Siog/Holland Pond Dam was not specifically modeled. The East Brimfield Dam is not expected to overtop in either the sunny day or flood breach scenario due to its conservative design as a flood control structure and the large amount of available flood storage. Both of these downstream dams are under the control of the East Brimfield Lake Park Office of the USACE, who should be promptly notified in the event of an emergency at Hamilton Reservoir Dam.

8.4 Downstream Bridges

The following culvert/bridge crossings are within the downstream inundation area:

- Sturbridge Road, 60 feet downstream
- Private Drive off Alexander Road, 0.7 miles downstream
- East Brimfield Road, 1.2 miles downstream
- Pond Bridge Road, 1.9 miles downstream
- East Brimfield Holland Road, 5.0 miles downstream

Table 9A.1 - Dam Failure during Spillway Design Flood, summary of downstream flooding

Location	Approx. River Miles	Timing of initial Flood Wave (Min.)*	Timing to Peak Flow (Min.)*	Peak Water Surface Elevation (Feet)**	Depth of Potential Overtopping (Feet)
Sturbridge Road	0.02	N/A	20	689.0	6.0
Private drive off Alexander Road	0.70	N/A	30	664.7	4.7
East Brimfield Road	1.20	85	40	660.2	1.1

* Time measured from start of breach development.

** Vertical Datum: NVGD 1929.

Table 9A.2 - Dam Failure during Normal Flow Conditions

Location	Approx. River Miles	Timing of initial Flood Wave (Min.)*	Timing to Peak Flow (Min.)*	Peak Water Surface Elevation (Feet)**	Depth of Potential Overtopping (Feet)
Sturbridge Road	0.02	N/A	20	681.7	N/A
Private drive off Alexander Road	0.70	N/A	45	660.4	0.4
East Brimfield Road	1.20	30	85	644.6	N/A

* Time measured from start of breach development.

** Vertical Datum: NVGD 1929.



Following a sunny day failure, Sturbridge Road and the private crossing off Alexander Road may fail. East Brimfield Road in Holland is not expected to be overtopped during a sunny day breach scenario, although damage could occur to the bridge embankment or concrete conduit structures due to scour from the high flows. Bridge safety could potentially be compromised. Pond Bridge Road is located within the East Brimfield Lake flood storage area, and is expected to overtop for any breach scenario.

During a Spillway Design Flood failure of Hamilton Reservoir Dam all bridges listed above, with the exception of East Brimfield Holland Road Bridge in Brimfield, are likely to be overtopped and are likely to fail and thus may be impassible to local and emergency response traffic.

Alexander Road does not cross the Quinebaug River, but portions of it could become inundated and impassable during a flood event or dam breach.

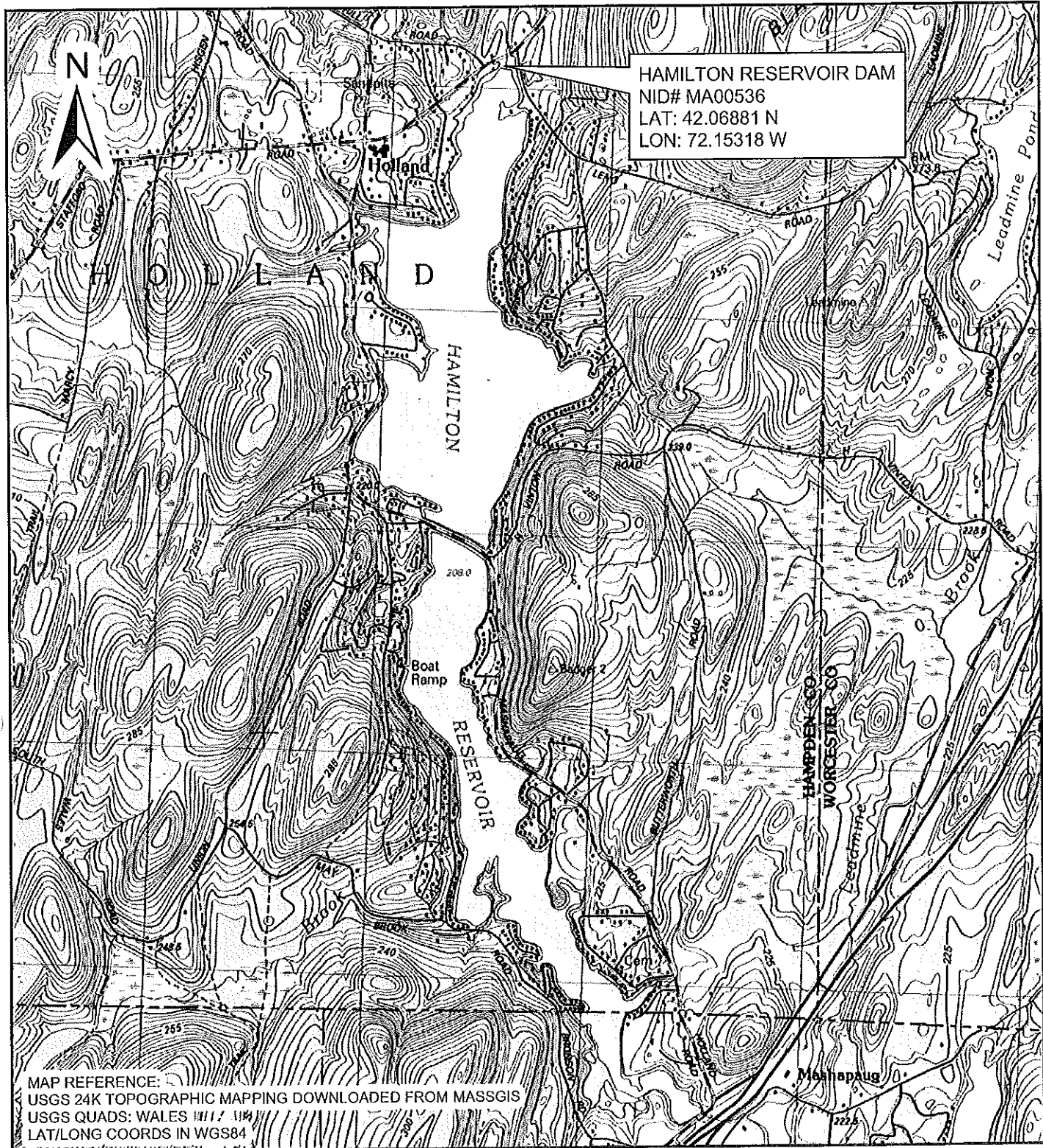
9 References

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

1. "Hamilton Reservoir Dam Phase I Inspection/Evaluation Report," Fuss & O'Neill, Inc., West Springfield, MA, Inspection Date July 29, 2008.
2. "Emergency Action Plan for Hamilton Reservoir Dam," Town of Holland, Massachusetts, October 2007.
3. "Levee Owner's Manual for Non-Federal Flood Control Works – The Rehabilitation and Inspection Program (Public Law 84-99)," U.S. Army Corps of Engineers, March 2006.
4. "Uncertainty of Predictions of Embankment Dam Breach Parameters," Wahl, Tony L, Journal of Hydraulic Engineering, American Society of Civil Engineers, May 2004.
5. "Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owner," Federal Emergency Management Agency, April 2004.
6. "Hamilton Reservoir Dam Inspection Report", C.T. Male Associates, P.C., New York, Inspection Date Jun 1993.
7. "National Dam Inspection Program Phase I Inspection Report for Hamilton Reservoir Dam", Department of the Army New England Division Corps of Engineers, Waltham MA, November 1978.



Figures



MAP REFERENCE:
 USGS 24K TOPOGRAPHIC MAPPING DOWNLOADED FROM MASSGIS
 USGS QUADS: WALES 1117 1114
 LAT/LONG COORDS IN WGS84

JUNE 2010

FIGURE 1



TOWN OF HOLLAND

SCALE
 HORZ: 1 INCH = 2,000 FEET
 VERT:
 DATUM
 HORZ:
 VERT: NAD83 (3-METER CONTOURS)



LOCUS MAP
 HAMILTON RESERVOIR DAM (MA00536)
 HOLLAND, MASSACHUSETTS



FUSS & O'NEILL
Disciplines to Deliver

PREPARED
BY
DWH

DATE

CHECKED
BY

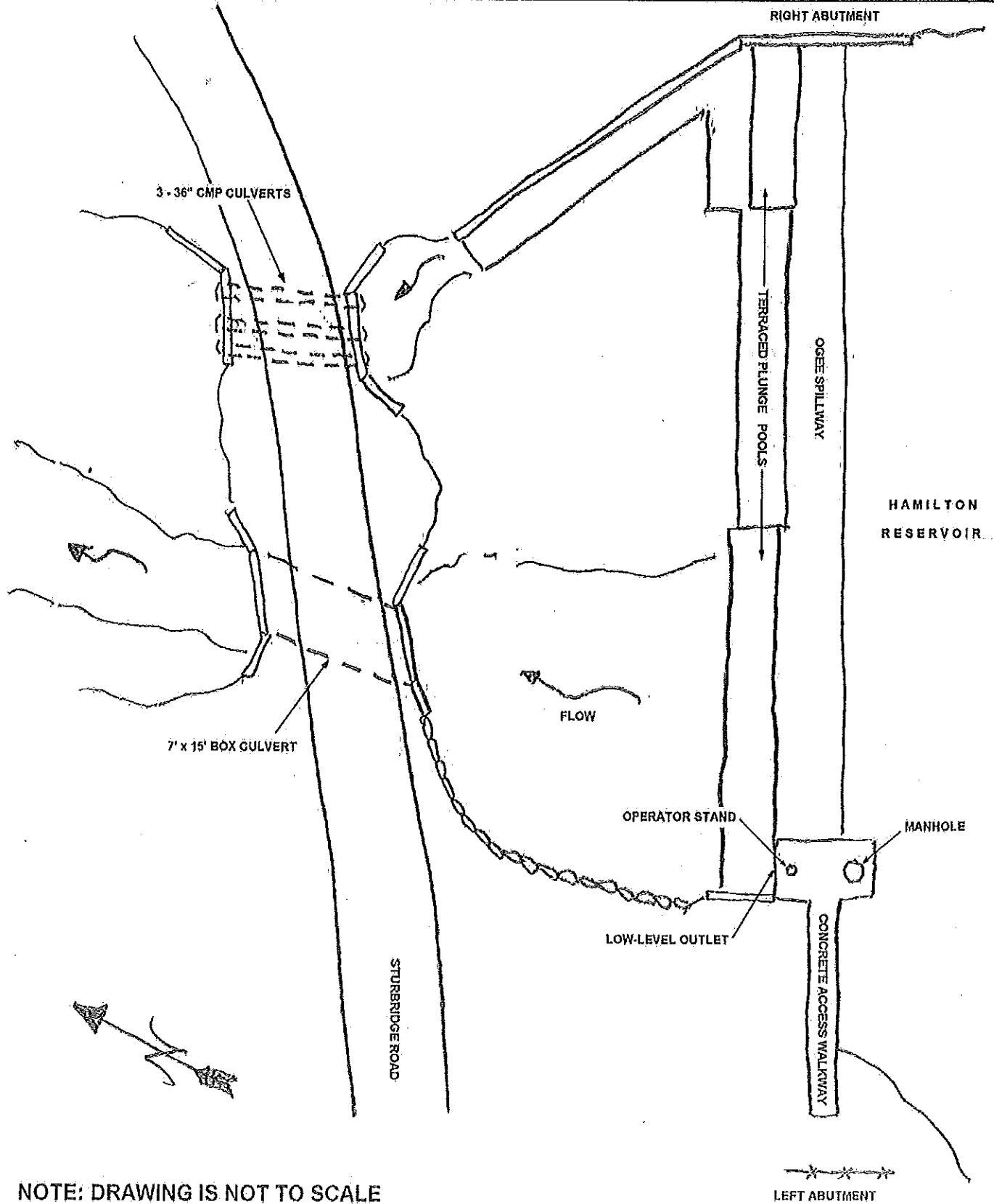
DATE

PROJECT NO.

20080630.A20

FIGURE 2 - HAMILTON RESERVOIR DAM (NID# MA00536)

SHEET NO.
1 of 1



NOTE: DRAWING IS NOT TO SCALE

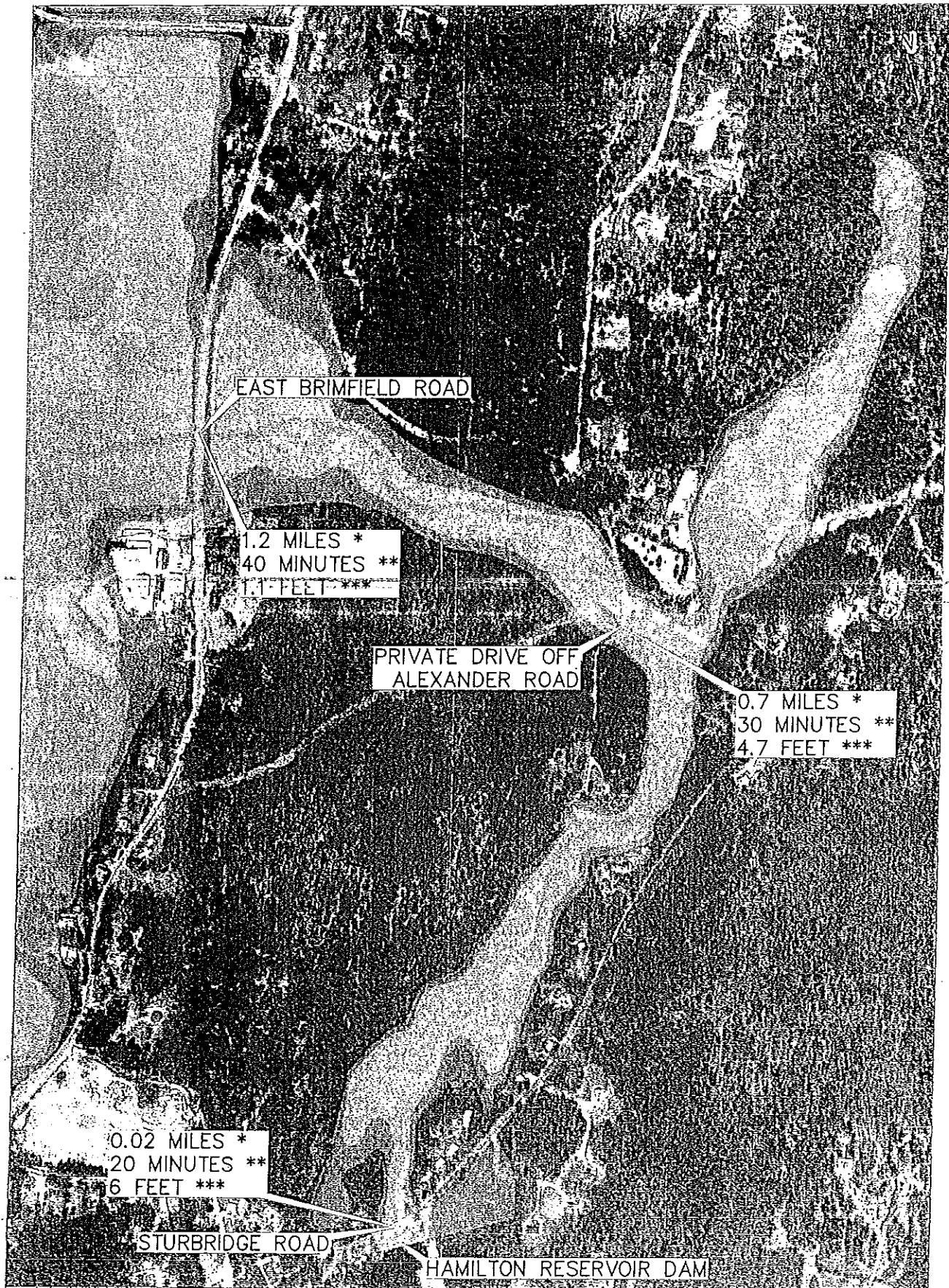
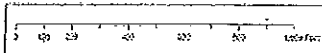


FIGURE 4 NOVEMBER 2013



Legend

1. The information contained herein is the property of Fuss & O'Neill, Inc. and is confidential. It is to be used only for the purposes intended by the client. No part of this information is to be distributed, copied, or otherwise made available to any other person without the prior written consent of Fuss & O'Neill, Inc. 2. The information contained herein is based on the best available information at the time of preparation. Fuss & O'Neill, Inc. does not warrant the accuracy or completeness of the information. 3. The information contained herein is not to be used for any purpose other than that intended by the client. Fuss & O'Neill, Inc. is not responsible for any consequences arising from the use of this information for any other purpose.

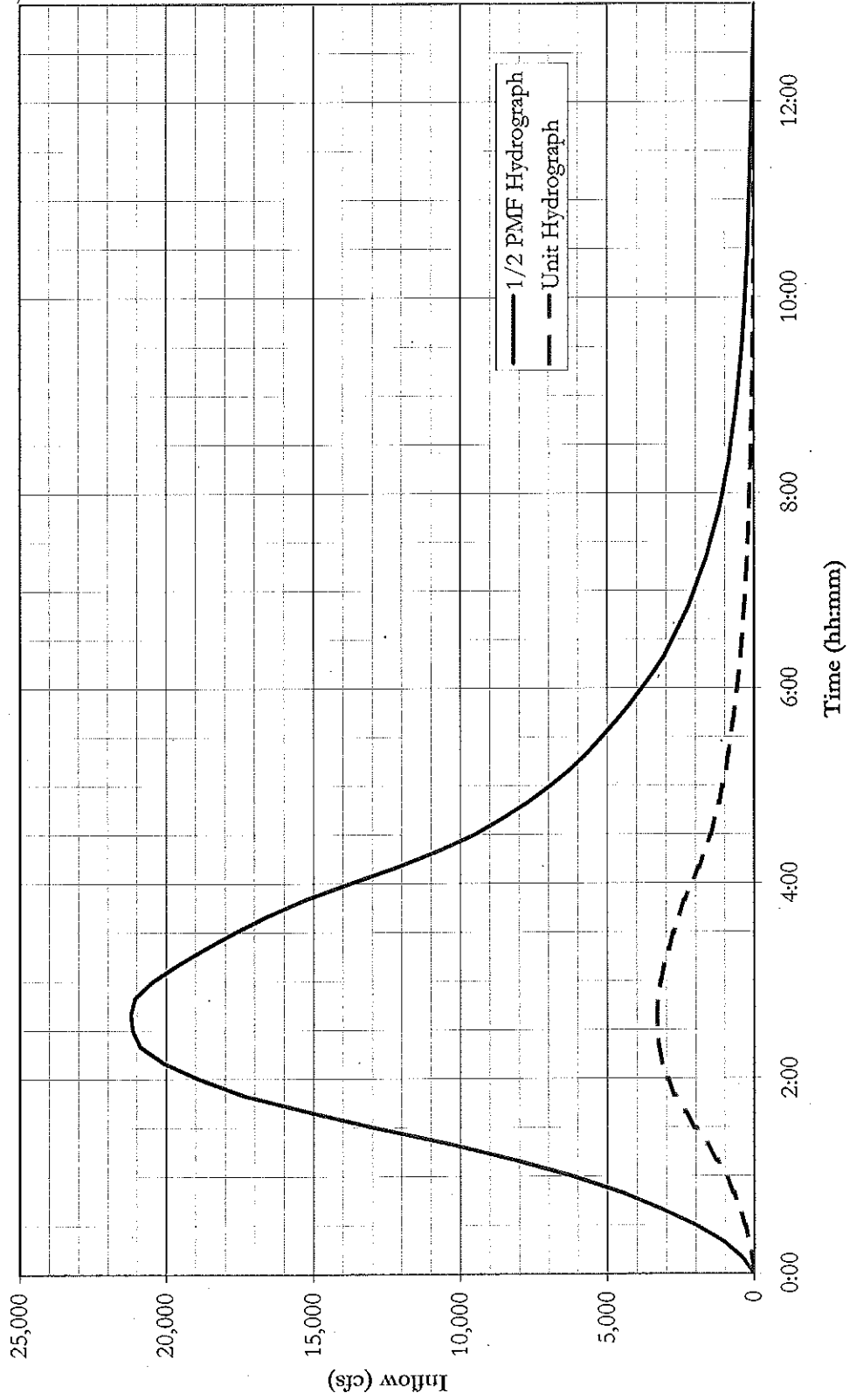
- * RIVER MILES, DOWN STREAM OF DAM
- ** TIME FROM START OF DAM BREACH DEVELOPMENT
- *** DEPTH OF POTENTIAL OVERTOPPING

DAM BREACH INUNDATION AREA
ON AERIAL PHOTOGRAPHY
HAMILTON RESERVOIR DAM



FUSS & O'NEILL
Disciplines to Deliver

Hamilton Reservoir Half PMF Inflow Hydrograph



Based on data from June 17, 1993 report by CT Male Associates, P.C., Latham, NY

FIGURE 5

Appendix



VERIFICATION OF REVIEW

Project

Emergency Action Plan
Hamilton Reservoir Dam
MA00536
Town of Holland, MA

The following verification of review is required under MGL Chapter 253 and 302 CMR 10.0. This verification of review is to become a part of the Emergency Action Plan and is to accompany the copies of the Plan submitted to the Department of Conservation and Recreation, Office of Dam Safety and the Massachusetts Emergency Management Agency. The purpose of this verification is to document that state and local emergency management officials and participants in the Plan have received and reviewed a draft copy of the Plan and provided comments, if necessary. These officials and participants are also to be provided with a final copy of the Plan.

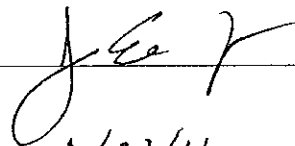
Signing of this document by the person specified below, or designated representative, acknowledges that the review process described above has taken place.

CHAIRMAN OF LOCAL BOARD OF SELECTMEN

Community: HOLLAND

Name: JAMES WOTTLAUFER

Title: CHAIRMAN BOARD OF SELECTMEN

Signature: 

Date: 2/23/11



VERIFICATION OF REVIEW

Project

Emergency Action Plan
Hamilton Reservoir Dam
MA00536
Town of Holland, MA

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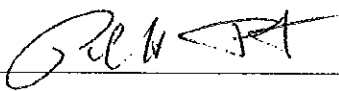
Signing of this document by the person specified below, or designated representative, acknowledges that the review process described above has taken place.

LOCAL FIRE CHIEF

Community: HOLLAND

Name: PAUL H FOSTER

Title: CHIEF OF THE FIRE DEPARTMENT

Signature: 

Date: 2/28/11



VERIFICATION OF REVIEW

Project

Emergency Action Plan
Hamilton Reservoir Dam
MA00536
Town of Holland, MA

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Signing of this document by the person specified below, or designated representative, acknowledges that the review process described above has taken place.

SUPERVISOR OF LOCAL HIGHWAY DEPARTMENT

Community: Holland

Name: William S. Soren

Title: Highway Supervisor

Signature: [Handwritten Signature]

Date: 4-25-11



VERIFICATION OF REVIEW

Project

Emergency Action Plan
Hamilton Reservoir Dam
MA00536
Town of Holland, MA

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Signing of this document by the person specified below, or designated representative, acknowledges that the review process described above has taken place.

LOCAL POLICE CHIEF

Community: Holland

Name: Bryan C. Haughey

Title: Chief

Signature: Bryan C. Haughey

Date: 05/11/2011



VERIFICATION OF REVIEW

Project

Emergency Action Plan
Hamilton Reservoir Dam
MA00536
Town of Holland, MA

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Signing of this document by the person specified below, or designated representative, acknowledges that the review process described above has taken place.

LOCAL EMERGENCY MANAGEMENT DIRECTOR

Community: Holland

Name: Michael Kennedy

Title: Emergency management Director

Signature: Michael Kennedy

Date: 4/21/2012