

***MASCUPPIC LAKE DAM***  
**PHASE I**  
**INSPECTION / EVALUATION REPORT**



Dam Name: Mascuppic Lake Dam

NID ID#: MA01225

Owner: Town of Tyngsborough

Town: Tyngsborough

Consultant: Pare Corporation

Date of Inspection: October 15, 2020

## Dam Evaluation Summary Detail Sheet

<b>1. NID ID:</b> MA01225		<b>4. Inspection Date:</b> October 15, 2020	
<b>2. Dam Name:</b> Mascuppic Lake Dam		<b>5. Last Insp. Date:</b> May 13, 2015	
<b>3. Dam Location:</b> Tyngsborough, MA		<b>6. Next Inspection:</b> October 15, 2030	
<b>7. Inspector:</b> David M. Matheson, P.E.			
<b>8. Consultant:</b> Pare Corporation			
<b>9. Hazard Code:</b> Low		<b>9a. Is Hazard Code Change Requested?:</b> No	
<b>10. Insp. Frequency:</b> 10 Years		<b>11. Overall Physical Condition of Dam:</b> FAIR	
<b>12. Spillway Capacity (% SDF)</b> Unknown			
<b>E1. Design Methodology:</b> 2		<b>E7. Low-Level Discharge Capacity:</b> 4	
<b>E2. Level of Maintenance:</b> 3		<b>E8. Low-Level Outlet Physical Condition:</b> 4	
<b>E3. Emergency Action Plan:</b> 3		<b>E9. Spillway Design Flood Capacity:</b> 1	
<b>E4. Embankment Seepage:</b> 5		<b>E10. Overall Physical Condition of the Dam:</b> 3	
<b>E5. Embankment Condition:</b> 4		<b>E11. Estimated Repair Cost (\$1,000):</b> \$124.5k-\$171.5k	
<b>E6. Concrete Condition:</b> 4			

### Evaluation Description

**E1: DESIGN METHODOLOGY**

1. Unknown Design – no design records available
2. No design or post-design analyses
3. No analyses, but dam features appear suitable
4. Design or post design analysis show dam meets most criteria
5. State of the art design – design records available & dam meets all criteria

**E2: LEVEL OF MAINTENANCE**

1. Dam in disrepair, no evidence of maintenance, no O&M manual
2. Dam in poor level of upkeep, very little maintenance, no O&M manual
3. Dam in fair level of upkeep, some maintenance and standard procedures
4. Adequate level of maintenance and standard procedures
5. Dam well maintained, detailed maintenance plan that is executed

**E3: EMERGENCY ACTION PLAN**

1. No plan or idea of what to do in the event of an emergency
2. Some idea but no written plan
3. No formal plan but well thought out
4. Available written plan that needs updating
5. Detailed, updated written plan available and filed with MADCR, annual training

**E4: SEEPAGE (Embankments, Foundations, & Abutments)**

1. Severe piping and/or seepage with no monitoring
2. Evidence of monitored piping and seepage
3. No piping but uncontrolled seepage
4. Minor seepage or high volumes of seepage with filtered collection
5. No seepage or minor seepage with filtered collection

**E5: EMBANKMENT CONDITION (See Note 1)**

1. Severe erosion and/or large trees
2. Significant erosion or significant woody vegetation
3. Brush and exposed embankment soils, or moderate erosion
4. Unmaintained grass, rodent activity and maintainable erosion
5. Well maintained healthy uniform grass cover

**E6: CONCRETE CONDITION (See Note 2)**

1. Major cracks, misalignment, discontinuities causing leaks, seepage or stability concerns
2. Cracks with misalignment inclusive of transverse cracks with no misalignment but with potential for significant structural degradation
3. Significant longitudinal cracking and minor transverse cracking
4. Spalling and minor surface cracking
5. No apparent deficiencies

**E7: LOW-LEVEL OUTLET DISCHARGE CAPACITY**

1. No low level outlet, no provisions (e.g. pumps, siphons) for emptying pond
2. No operable outlet, plans for emptying pond, but no equipment
3. Outlet with insufficient drawdown capacity, pumping equipment available
4. Operable gate with sufficient drawdown capacity
5. Operable gate with capacity greater than necessary

**E8: LOW-LEVEL OUTLET PHYSICAL CONDITION**

1. Outlet inoperative needs replacement, non-existent or inaccessible
2. Outlet inoperative needs repair
3. Outlet operable but needs repair
4. Outlet operable but needs maintenance
5. Outlet and operator operable and well maintained

**E9: SPILLWAY DESIGN FLOOD CAPACITY**

1. 0 - 50% of the SDF or unknown
2. 50-90% of the SDF
3. 90 - 100% of the SDF
4. >100% of the SDF with actions required by caretaker (e.g. open outlet)
5. >100% of the SDF with no actions required by caretaker

**E10: OVERALL PHYSICAL CONDITION OF DAM**

1. UNSAFE – Major structural, operational, and maintenance deficiencies exist under normal operating conditions
2. POOR - Significant structural, operation and maintenance deficiencies are clearly recognized under normal loading conditions
3. FAIR - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters
4. SATISFACTORY - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.
5. GOOD - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF

**E11: ESTIMATED REPAIR COST**

Estimation of the total cost to address all identified structural, operational, maintenance deficiencies. Cost shall be developed utilizing standard estimating guides and procedures

### Changes/Deviations to Database Information since Last Inspection

## EXECUTIVE SUMMARY

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This Phase I Inspection/Evaluation Report details the inspection and evaluation of the Mascuppic Lake Dam located in Tyngsborough, Massachusetts. The inspection was conducted on October 15, 2020 by Pare Corporation (Pare) of Foxboro, Massachusetts. Mascuppic Lake Dam, an approximately 190-foot long 7-foot high earthen embankment dam, is currently classified as a **Small** size, **Class III (Low)** hazard potential dam. Appurtenant structures consist of a left outlet (located near the left end of the dam) and a right outlet (located approximately 290 feet to the right of dam embankment).

In general, Mascuppic Lake Dam was found to be in **Fair** condition. The following concerns have been noted:

1. An overgrown and unprotected upstream slope with scarping along the normal pool line.
2. A steep downstream slope covered with brush, small trees, and deadfall.
3. Scoured concrete surfaces, rusted stop log slots, and debris accumulation/flow restrictions at the left outlet.
4. Minor surface scour and an overgrown discharge channel at the right outlet.
5. No formal operations and maintenance (O&M) Manual.
6. No detailed Hydrologic/Hydraulic (H&H) evaluation; therefore, the dam's ability to accommodate the spillway design flood (SDF) event is unknown.
7. Other dam safety deficiencies and concerns as noted herein.

No emergency action plan (EAP) is known to exist for this structure. For a low hazard potential structure, an EAP is not required by the state.

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

Based upon the size and hazard potential of this structure, the spillway design flood (SDF) for the dam is the 50-year storm event. It is unknown if the appurtenant structures of the dam can accommodate the SDF.

Pare recommends the following actions be taken to address the deficiencies found at the dam during this inspection and evaluation:

1. Complete a detailed H&H evaluation to determine if the primary and offsite outlets can pass the SDF; evaluate the function of the dam as it relates to maximum water storage upstream of the dam through MA03417; Old Mascuppic Lake Dam.
2. Clear the outlets of accumulated debris.
3. Evaluate and repair the deterioration at the outlet's conduits and headwalls.
4. Develop a formalized O&M Manual.
5. Clear the upstream and downstream slopes of unwanted vegetation.
6. Provide upstream slope protection.
7. Conduct additional studies, evaluations, maintenance, and repairs as noted herein.

These repairs should be made in accordance with standard design practices, specifications, and construction methods. Design of the repairs, analyses to confirm the extent of the work, and observation to verify materials/methods used should be completed by a qualified engineer experienced in the design and rehabilitation of earthen dams throughout the evaluation, design, and construction process. All work should be undertaken in accordance with the dam safety regulations stated in 302 CMR 10.00.



## Mascuppic Lake Dam

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Prior to undertaking recommended maintenance, repairs and remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of local conservation commissions, MADEP, or other regulatory agencies.

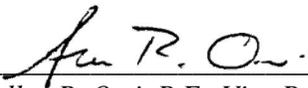


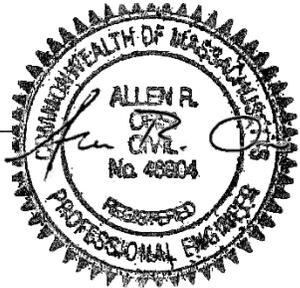
**PREFACE**

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection, observations during recent construction activity, and other data available to the inspection team.

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

  
Allen R. Orsi, P.E., Vice President  
Massachusetts License No.: 46904  
License Type: Civil  
Pare Corporation



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Figure 3:	Site Sketch

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Appendix C:	Previous Reports and References
Appendix D:	Common Dam Safety Definitions
Appendix E:	Visual Dam Inspection Limitations



## SECTION 1

### 1.0 DESCRIPTION OF PROJECT

#### 1.1 General

##### 1.1.1 Authority

The Town of Tyngsborough has retained Pare Corporation (Pare) to perform a visual inspection and develop a report of conditions for the Mascuppic Lake Dam in Tyngsborough, Middlesex County, Massachusetts. This inspection and report were performed in accordance with MGL Chapter 253, Sections 44-50 of the Massachusetts General Laws.

##### 1.1.2 Purpose of Work

The purpose of this investigation is to inspect and evaluate the present condition of the dam and appurtenant structures in accordance with 302 CMR10.07 to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

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

##### 1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in Appendix D. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; 5) general; and 6) condition rating.

#### 1.2 Description of Project

##### 1.2.1 General

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

The completion of detailed hydrologic/hydraulic studies, stability analyses, subsurface investigations, and underwater investigations is beyond the scope of this evaluation.



### 1.2.2 Location

Mascuppic Lake Dam is located within Middlesex County in the Town of Tyngsborough, Massachusetts. The dam impounds water at the Bull Run Brook which is consequently fed by Mascuppic Lake. The structure and impoundment are shown on the Nashua South, Massachusetts USGS quadrangle map near coordinates 42.67819°N/71.40183°W<sup>1</sup>.

The dam is accessible from Interstate 95 as follows: Take exit 32A for US-3 N/Northwest Expressway. Continue on US-3 N for 17 miles then take exit 34 to merge onto Westford Road towards Tyngsborough. Stay on Westford Road for 1 mile and then turn left onto MA-3A N/Middlesex Road. Continue on Middlesex Road for 0.5 mile then turn left onto Sherburne Avenue and stay that course for 0.7 mile. Last take a left onto Coburn Road and continue on for 0.6 mile and the dam will be on the right. A gravel parking area is located on the right of Coburn Road 375 feet further east of the dam. Sherburne Lumber (56 Coburn Rd) is located across the road from the dam.

### 1.2.3 Owner/Operator

The dam is currently owned by the Town of Tyngsborough and is maintained and operated by the Tyngsborough Highway Department.

### 1.2.4 Purpose of the Dam

The dam, formerly named the Shelburne Lumber Dam, was used as a water supply for this former mill. The dam is presently used for recreation and no longer serves its original purpose.

### 1.2.5 Description of the Dam and Appurtenances

Mascuppic Lake Dam (National ID MA01225/State ID 4-9-301-4) consists of an approximately 190-foot long, 7-foot high earthen embankment with a stoplog-controlled right outlet and a stoplog-controlled left outlet. The dam is located on the east side of the Town of Tyngsborough. The dam impounds water along Bull Run Brook to form the Mascuppic Lake. The dam is located 2,000 feet northwest of the transition from Mascuppic Lake to Bull Run Brook at MA03417 Old Mascuppic Lake Dam, as indicated on Figure 1: Locus Plan.

As shown in Figure 3: Site Sketch, the dam system consists of an approximately 190-foot long, slightly curved embankment which supports Coburn Road.

The upstream side of the dam is an approximately 2H:1V vegetated/unprotected slope. The slope is steeper towards the outlet and flattens out heading towards the abutments. The crest of the dam consists of a bituminous asphalt paved two-lane roadway (Coburn Road) with 1-foot-wide vegetated shoulders and guardrails on the upstream slope and along the right half of the downstream slope. The downstream side of the dam consists of a vegetated slope ranging from approximately 2H:1V to 3H:1V for the first five feet then becomes steep at about 1H:1V at the historic tailwater waterline.

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<sup>1</sup> As indicated in the MADCR ODS Dam Database.



The left outlet is located near the center of the earthen dam embankment and controls flow through the dam through a series of downstream structures that convey flow to a turbine. The system generally includes the following:

- The upstream headwall consists of a 20-foot long, 2-foot thick concrete headwall with steel stop log slots cast within a recessed section at the center of the wall.
- The conduit through the dam is a 48-inch high by 80-inch wide elliptical corrugated metal pipe that discharges through a ripped section of the downstream slope. A manhole cover (labelled sewer) provides access to the conduit from the crest of the dam.
- Discharge from the conduit enters the first of two pools downstream of the dam; discharge from the first pool to the second pool is via an uncontrolled culvert passing through an earthen driveway embankment.
- A gated outlet is present on the downstream right side of the second pool near the right side of a roadway embankment that functions to retain this pool.
- Flow then enters a penstock conduit which leads to a turbine in the basement of the building downstream of the second pool.

The right outlet is approximately 290 feet to the east (right) of the left outlet. It consists of a 2-foot wide by 14-foot long (upstream to downstream) rectangular concrete drop-inlet structure with a 2-foot wide bay of stoplogs in the upstream face of the drop inlet. A 24-inch high by 39-inch wide elliptical CMP conveys from the drop inlet and beneath the roadway to the downstream channel.

### 1.2.6 Operations and Maintenance

The Town of Tyngsborough Highway Department is responsible for the operations and maintenance of the structure.

### 1.2.7 DCR Size Classification

The Mascuppic Lake Dam has a maximum structural height of approximately 7 feet and a maximum storage capacity of approximately 40.5 acre-feet<sup>1</sup>. Therefore, in accordance with Department of Conservation and Recreation Office of Dam Safety classification, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00, Mascuppic Lake Dam is a **Small** size structure.

### 1.2.8 DCR Hazard Classification

Coburn Road traverses the embankment of Mascuppic Lake Dam. It appears that a failure of the dam would cause minimal property damage downstream and loss of life is not expected. Therefore, as reported in the 2015 Jurisdictional Determination, Mascuppic Lake Dam is currently classified as a **Class III (Low)** hazard potential structure. However, in accordance with Department of Conservation and Recreation classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00, the site may be more appropriately classified as a Significant hazard potential dam given the presence of the roadway across the crest of the dam.

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<sup>1</sup> Data based upon VIF Jurisdictional Determination Inspection by Fuss & O'Neill, dated June 29, 2015.



### 1.3 Engineering Data

#### 1.3.1 Drainage Area

As determined using the Massachusetts StreamStats program<sup>1</sup>, the drainage area for Mascuppic Lake Dam is approximately 2.2 square miles and has an average slope of 1.81 percent with 3.48 miles of streambed. The drainage area consists of 24.7% forest land and 23.2% of the area is covered by waterbodies and wetlands including Bull Run Brook, Mascuppic Lake, and Althea Lake.

Based upon a limited review of the drainage area, MA03417 Old Mascuppic Lake Dam was identified in the upstream watershed of the dam.

The watershed usage generally consists of mixed land use from significant residential development to undeveloped woods with flat to moderate slopes.

#### 1.3.2 Reservoir<sup>2</sup>

	Length (feet)	Width (feet)	Surface Area (acres)	Storage Volume (acre-feet)
Normal Pool	1,900 ±	250 ±	10.9 ±	16.4
Maximum Pool	2,100 ±	350 ±	16.9 ±	40.5 <sup>3</sup>
SDF Pool	Unknown	Unknown	Unknown	Unknown

#### 1.3.3 Discharges at the Dam Site

No records of discharges from the dam site were made available during the preparation of this report.

#### 1.3.4 General Elevations (feet)

The following elevations are based upon information provided within previous reports as well as relative elevation survey completed by Pare during the inspection. Survey elevations reference a temporary benchmark at the upstream right corner of the left outlet headwall with an assumed El. 100.00.

A. Top of Dam	100±
B. Spillway Design Flood Pool	Unknown
C. Normal Pool	96.9±
D. Upstream Water at Time of Inspection	96.01
E. Downstream Water at Time of Inspection	
1. Left Outlet Downstream Pool	95.30
2. Right Outlet Downstream Channel	92.85

#### 1.3.5 Left Outlet

A. Type	Controlled Elliptical CMP
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<sup>1</sup> As provided by the USGS StreamStats program on their website <http://water.usgs.gov/osw/streamstats/massachusetts.html>

<sup>2</sup> Data based upon geological map measurements and previous DCR Phase 1 report by MA ODS, dated November 15, 1999.

<sup>3</sup> As provided from the 2015 Jurisdictional Determination Report.



B. Controls	
i. Type	Timber Stoplogs
ii. Width	6.7 feet
iii. Top of Stoplog Slots	99.55 (R) / 100.2 (L)
C. Conduit	
i. Size	6.67-feet wide by 4-feet high
ii. Invert	94.34 (Upstream)
D. Downstream Channel	92.8

### 1.3.6 Right Outlet

A. Type	Trapezoidal Drop Inlet
B. Drop Inlet	
i. Size	14-feet wide by 4.42-feet long
ii. Wier Crest	2-feet wide
C. Controls	
i. Type	Stoplog Bay in Upstream face
ii. Width	2 feet
iii. Elevations	
1. Invert	96.01
2. Top of Stoplogs (During Inspection)	96.78
D. Conduit	
i. Type	Elliptical CMP
ii. Size	3.25-feet wide by 2-feet high
iii. Elevations	
1. Upstream Invert	93.97
2. Downstream Invert	92.2

### 1.3.7 Design and Construction Records

There were no design or construction records of the original construction of the dam available for review during the preparation of this report. Based upon an inspection report completed in May 1999, the dam was constructed around 1900.

### 1.3.8 Operating Records

No operating records were available or are indicated to exist during the inspection and preparation of this report.



## 1.4 Summary Data Table

**Table 1.1 Summary Data Table**

National ID #	MA01225
Dam Name	Mascuppic Lake Dam
Dam Name (Alternate)	0
River Name	Bull Run Brook, Lawrence Brook - Merrimack River Tributary
Impoundment Name	Mascuppic Lake
Hazard Class	Low
Size Class	Intermediate
Dam Type	Earth and Rock Fill (RE)/ Gravity (PG)
Dam Purpose	Recreation
Structural Height of Dam (feet)	7
Hydraulic Height of Dam (feet)	4
Drainage Area (sq. mi.)	2.2
Reservoir Surface Area (acres)	10.9 +/-
Normal Impoundment Volume (acre-feet)	16.4
Max Impoundment Volume ((top of dam) acre-feet)	40.5
SDF Impoundment Volume (acre-feet)	Not Available
Spillway Type	Stop log controlled weir to 80" CMP culvert
Spillway Length (feet)	Drop Inlet 14 wide x 4.42 long
Freeboard at Normal Pool (feet)	3 +/-
Left Spillway Capacity (cfs)	Unknown
Right Spillway Capacity (cfs)	Unknown
Low-Level Outlet Capacity (cfs)	N/A
Spillway Design Flood (flow rate - cfs)	100-year flood / No H&H
Winter Drawdown (feet below normal pool)	N/A
Drawdown Impoundment Vol. (acre-feet)	N/A
Latitude	42.67819°N
Longitude	71.40183°W
City/Town	Tyngsborough
County Name	Middlesex
Public Road on Crest	Yes
Public Bridge over Spillway	Yes
EAP Date (if applicable)	N/A
Owner Name	Town of Tyngsborough
Owner Address	25 Bryant Lane
Owner Town	Tyngsborough, MA 01879
Owner Phone	(978) 649-2300 X158
Owner Emergency Phone	911
Owner Type	Municipality or Political subdivision
Caretaker Name	Engineering Department
Caretaker Address	25 Bryant Lane
Caretaker Town	Tyngsborough, MA 01879
Caretaker Phone	(978) 649-2300 X158
Caretaker Emergency Phone	0
Date of Field Inspection	10/15/2020
Consultant Firm Name	Pare Corporation
Inspecting Engineer	David M. Matheson, P.E.
Engineer Phone Number	508.543.1755



## SECTION 2

### 2.0 INSPECTION

#### 2.1 Visual Inspection

Mascuppic Lake Dam was inspected on October 15, 2020. At the time of the inspection, temperatures were near 73°F with clear skies. Photographs to document conditions were taken during the inspection and are included in Appendix A. The level of the impoundment was approximately 1 foot below the normal pool elevation. Underwater areas were not evaluated during this inspection. A copy of the inspection checklist is included in Appendix B.

For reference purposes, a baseline was established along the embankment crest during the inspection. STA 0+00 was located at the left abutment and STA 1+90 at the right abutment. Observations were made in relation to their location along the baseline as noted herein.

##### 2.1.1 General Findings

In general, the Mascuppic Lake Dam was found to be in **Fair** condition. The specific concerns are identified in more detail in the sections below.

##### 2.1.2 Dam

The following was noted along the embankment portion of the dam during the inspection.

###### *Upstream Side*

- Vegetation on the upstream slope consists of grass, weeds, saplings, and trees up to 6 inches in diameter.
- A cluster of two trees is located on the upstream slope 10 feet to the left of outlet. A second cluster of two trees is located 15 feet right of the outlet. Tree diameters range from 4 to 6 inches.
- The slope was unprotected; erosion and scarping with vertical faces up to 12 inches high and undermining of the root mat was present along the length of the embankment.
- The slope averaged near approximately 2H:1V for the entire upstream slope.

###### *Crest*

- The crest surface is comprised of the bituminous asphalt from Coburn Road and 1-foot vegetated shoulders with guardrails. Coburn Road had recently been repaved and is generally in new condition.
- Utility poles were observed along the crest shoulders at:
  - STA 0+90 next to the entranceway to Sherburne Lumber,
  - STA 1+90 on the upstream side of the crest,
  - STA 1+90 on the downstream side of the crest, and
  - Right of the right outlet.

The utility poles appeared stable with no apparent indications of movement (i.e. leaning in the down-slope direction) due to slope creep. The pole at STA 0+90 is leaning slightly in the



- upstream direction, likely as a result of the tension from the attached transmission wires pulling on the pole at an acute angle.
- Near STA 0+80 on the downstream side of the crest, depressions and patched potholes were observed on the right side of the asphalt entranceway for Sherburne Lumber property. The asphalt deterioration appears to be the result of normal wear of the roadway and did not appear indication of embankment concerns.

#### *Downstream Side*

- The downstream slope of the dam runs from STA 0+90 to STA 1+50. The top 5 feet of the slope varies from 3H:1V to 2H:1V then sharply drops off to 1H:1V below the apparent normal tailwater elevation.
- The slope is covered with vegetation consisting of brush, weeds, and tall grass. A cluster of trees, 4 to 6 inches in diameter, are growing on the left side of the tailwater pond and an approximate 8-inch diameter tree is growing at the toe on the right side of the pond.
- Deadfall is covering most of the ground, limiting inspections to spot checks.
- Armor stone riprap is present from the culvert discharge extending from STA 1+10 to 1+25 (i.e. the culvert discharge). Boulders were present on the right side of the discharge culvert from STA 1+25 to 1+30.

### **2.1.3 Appurtenant Structures**

The following was noted during the inspection:

#### *Left Outlet*

- In general, the left outlet structure appears to be in fair condition with scoured concrete surfaces, rusted stop log slots, and a partially clogged culvert as described herein.
- The approach and discharge areas were clear of debris besides lily pads and other submerged aquatic vegetation.
- Up to 1/8-inch of exposed aggregate resulting from scour is present along the front of the concrete headwall and around the stop log slots. The scour band extends up to 3 feet above the current pool level. Chipped concrete areas were observed over an 18-inch wide section on the right side of the headwall. It extended 3 inches downward from the top and about 1/2-inch deep.
- Stop logs were not in place at the time of the inspection.
- The stop log slots are corroding and rusting.
- The upstream end of the CMP is bent left of its crown; but otherwise, in good condition.
- Sediment buildup and woody debris is clogging the culvert. Reported beaver activity is most likely the cause of the buildup of branches and sticks.

#### *Right Outlet*

- To facilitate access to the drop-inlet concrete structure, Mr. Zwicker informed Pare that the Highway Department recently removed beaver debris from the left outlet approach. They also installed a blue 2-foot-square vertical bar trash rack in front of the notched stop log section.
- It appears that most of the exposed concrete surfaces suffer from minor scour resulting in about 1/6 inch of exposed aggregate.



- The inside of the drop inlet structure was generally clear of debris with a minor accumulation of leaf and woody debris.
- The trash rack frame and chain-link mesh appeared in satisfactory condition with minor surface rust.
- The blue trash rack appeared in good condition.
- The CMP leading to the culvert was deformed horizontally but appeared in working order. This observed deformation appeared historic as the concrete headwall conformed to the deformation with no indication of recent displacement.
- A 2-inch-wide gap separated the CMP and concrete on the sides and increased to 4 inches at the top of conduit beginning.
- The discharge channel consists of a natural stream that is heavily overgrown.

#### 2.1.4 Downstream Area

- Two tailwater ponds are present within 200 feet of the dam:
  - First Tailwater Pond – A roughly 0.03 acre 70-foot-long (left to right) by 30-foot-wide tailwater pond is present downstream of the dam. The left outlet discharge is located on the upstream side of the pond. The pond is surrounded entirely by vegetated slopes. The level of the water in the first tailwater pond is approximately El. 95.3 or about 0.7 foot lower than the impoundment water level. Downstream of this pond is a 20-foot-wide asphalt accessway followed by a second tailwater pond. The two ponds are hydraulically connected via a roughly 3-foot diameter uncontrolled CMP culvert. This culvert reportedly often gets clogged up due to Beaver activity. The Town uses an old telephone pole to push out the debris. The pole was observed lying on the right shoreline of the tailwater pond. The access road that runs across the conduit from the first to the second tailwater pond appeared in good condition.
  - Second Tailwater Pond – The second tailwater pond is approximately 0.2 acres and 110 feet in diameter. Its water level was measured at approximately El. 92.75 or about 3.3 feet lower than the impoundment water level. Based on the scour line and staining along a shotcrete covered wall on the downstream side, it appears that the typical water level is typically consistent with the impoundment level. There is a stop log-controlled concrete structure near its downstream right side. The asphalt-paved accessway behind this concrete wall has longitudinal cracking, vertical depressions and two potholes refilled. The dry set stone masonry wall at the building's foundation is in good condition. The stoplog system appears to be made up of timber planks and plexiglass. A steel lattice trash rack-protected overflow is present downstream of the flashboards. It is unclear how these flashboards are adjusted to control flows.
- Water discharges from the second pond over the flashboards and into a concrete chamber that transitions to a roughly 30-inch steel pipe that carries flows under one of the lumber buildings to a turbine then into the downstream channel. The turbine is reported to be functional; however, is used by the lumber company owner as a hobby rather than a power source.
- The discharge channel for the left outlet exits from the old mill building into a natural stream channel with vegetated slopes.
- The discharge area for the right outlet is a small pool that is heavily overgrown. In addition to the overflow structure's CMP, a storm drain also discharges into the pool which flows into a tributary to the Lawrence Brook for about 500 feet before converging with the left outlet discharge channel. The tributary flows for another 900 feet before converging with the



Lawrence River which carries water flows for almost a mile before discharging into the Merrimack River.

### 2.1.5 Reservoir Area

The impoundment, known as Bull Run Brook, is located in between Old Mascuppic Lake Dam and Old Mascuppic Lake Dam. The impoundment for Old Mascuppic Lake Dam is located within a residential and wooded area of the Town of Tyngsborough on the border with the town of Dracut. The perimeter is mostly surrounded with residential houses besides 800 feet on the southwest side of the lake which is marshland. Since Old Mascuppic Lake Dam is an unregulated dam its flow capacity is unknown. Mascuppic Lake Dam could effectively impound backwater over the entirety of the lake during elevated pool levels.

## 2.2 Caretaker Interview

The Tyngsborough Highway Department is primarily responsible for the operations and maintenance of the structure. Mr. Jake Zwicker, Town Engineer, was present during the inspection and information provided by Mr. Zwicker has been incorporated into this report.

## 2.3 Operation and Maintenance Procedures

### 2.3.1 Operational Procedures

A formal operations and maintenance (O&M) manual for this structure was not available for review nor is one known to exist. Operations are limited to removing and installing stop logs at the right outlet notched weir.

Based on the accumulated sediment at the left outlet, it does not appear that operations are performed at this structure. The outlet structure at the second tailwater pond is regulated with flashboards. It is unclear how and when this tailwater pond structure is operated.

### 2.3.2 Maintenance of Dam and Operating Facilities

Mr. Zwicker reported that the Tyngsborough Highway Department performs occasional maintenance on the dam including maintaining the roadway over the crest, cutting, and removing vegetation from the upstream slope, and clearing debris from both outlets.

## 2.4 Emergency Warning System

An Emergency Action Plan (EAP) is not known to exist for this structure. For a low hazard potential structure, an EAP is not required by the state.

## 2.5 Hydraulic/Hydrologic Data

Mascuppic Lake Dam is a **Small** size, **Low** (Class III) hazard potential structure. Therefore, in accordance with current state regulations, the spillway design flood (SDF) for the dam is the 50-year storm event.

No formal Hydrologic/Hydraulic (H&H) Evaluations were available for review nor are known to exist.



## **2.6 Structural and Seepage Stability**

Based upon a visual assessment of the dam, the slopes at the dam appear stable with no signs of immediate global or isolated instability were observed.

### **2.6.1 Embankment Structural Stability**

Based upon a visual assessment of the dam, the embankment structure, inclusive of the upstream slope, crest, and downstream slope, appears to be structurally stable. The steep downstream slopes along the tailwater pond should be addressed as they likely do not meet required factors of safety against slope failure.

### **2.6.2 Structural Stability of Non-Embankment Structures**

Non-embankment structures include the left and right outlets.

Based upon a visual assessment, there were no apparent signs of immediate structural instability of any of the structures during the inspection.

### **2.6.3 Seepage Stability**

Based upon a visual assessment of the dam, no current signs of immediate instability due to seepage were observed.



## SECTION 3

## 3.0 ASSESSMENTS AND RECOMMENDATIONS

## 3.1 Assessments

In general, Mascuppic Lake Dam was found to be in **Fair** condition. The following concerns were noted during the inspection:

<i>Deficiency Number</i>	<i>Description</i>
1	An overgrown and unprotected upstream slope with scarping along the normal pool line.
2	A steep downstream slope covered with brush, small trees, and deadfall.
3	Scoured concrete surfaces, rusted stop log slots, and debris accumulation/flow restriction at the left outlet.
4	Minor surface scour and an overgrown discharge channel at the right outlet.
5	No formal O&M Manual
6	No detailed H&H evaluation; therefore, the dam's ability to accommodate the spillway design flood event is unknown.
7	Other dam safety deficiencies and concerns as noted herein

Based upon comparisons to reported conditions and photographs included within the previous Phase I Inspection/Evaluation performed in 1999 and a Jurisdictional Review performed in 2015, the condition of the dam is similar to that previously reported with the exception of a newly paved roadway over the crest.

Previously reported conditions and recommendations and their current status are summarized in the following table:

<i>Previously Identified Deficiency/Recommendation</i>	<i>Resolution or Current Condition</i>
Beaver debris in front of the left outlet and right outlet-upstream and downstream	Beaver activity continues to be an ongoing maintenance issue. The Tyngsborough Highway Department removed beaver debris before Pare performed the inspection.
Remove unwanted trees and brush on the crest, slopes, and downstream toe area	No apparent change
Develop an Operations and Maintenance Manual	No apparent change
Complete an Emergency Action Plan	No apparent change; however, not required by the state for a Low Hazard Potential Dam.

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the dam. Prior to undertaking recommended maintenance, repairs and remedial measures, the applicability of the dam safety regulations through 302 CMR 10.00 and the environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of local conservation commissions, MADEP, or other regulatory agencies. In general, repairs to impacting the structure of the dam or the appurtenant structures will require a permit from the Office of Dam Safety.



It should be noted that the scope and extent of required repairs and remedial measures may be significantly different if size and/or hazard potential evaluations suggest reclassification is warranted.

### 3.2 Engineering Studies and Evaluations

It is recommended that the owner of the dam arrange for the following investigations to be performed by a qualified registered professional engineer experienced with embankment dams and hydrology, maintenance, and monitoring activities.

1. Complete a slope stability analysis of the embankment slopes to estimate the factor of safety against slope failure under various conditions (i.e. normal pool, sudden drawdown, earthquake) and to evaluate slope modifications. A subsurface investigation program consisting of borings is required to be completed to develop representative soil parameters for use in the stability models.
2. Complete wave height analysis to determine the type of upstream slope protection that would be required for the embankment.
3. Review the storage capacity of the dam. Based upon the site geometry and elevations, the dam may effectively impound water within the main body of Mascuppic Lake which would warrant a size reclassification. Additional storage may also warrant hazard reclassification.
4. Complete a detailed hydrologic and hydraulic (H&H) analyses to evaluate the ability of the dam to accommodate the spillway design flood (SDF).
5. Given the age of the dam and CMP construction of the outlet conduits, complete a video pipe inspection to review condition of the conduits. Clearing of debris will be required prior to the completion of the inspection at the left outlet.
6. An Operations and Maintenance (O&M) manual should be prepared for this structure. The O&M manual should include procedures for adjusting the level of the impoundment seasonally and periodically, as required, to provide additional freeboard in anticipation of runoff due to precipitation or snow melt. The manual should also include schedules for routine maintenance and inspections to observe conditions at the dam.
7. Review the hazard potential classification including a dam break analysis and the preparation of an inundation map based upon modeled breach parameters, inflow characteristics, and downstream topography.

### 3.3 Yearly & Recurrent Maintenance Recommendations

The following recommendations should be performed on a regular schedule and allotted for within yearly operational budgets for the structure:

1. Perform regular monitoring and inspection of the dam and appurtenant structures to check for changes in the observed seepage/leakage conditions along the, depressions, erosion, or other areas of suspected movement. Consult a registered professional engineer if any changes or new areas of concern are identified. Complete formal inspections in accordance with current state regulations. As the dam is currently classified as a Low hazard potential dam, formal inspection is required every 10 years.
2. Regular maintenance activities should be continued to:



- a. Control and prevent the growth of unwanted vegetation on the upstream and downstream slopes and of the downstream area corresponding to the right outlet.
- b. Remove accumulated debris from the approach areas of both outlets.
- c. Keep discharge areas of drains and pipes clear of debris and vegetation.
- d. Cutting and removal of vegetation and mowing grass should be performed at least twice per year (i.e., late spring and fall). Mowing and fertilizing should be continued and performed at least twice per year. Mowing at longer intervals will likely require that the clippings be bagged and disposed of offsite or fully mulched to limit the build-up of thatch and the potential for choking of the grass. All cuttings from brush or other vegetation should be removed from the site and properly disposed.

### 3.4 Minor Repair Recommendations

The minor repairs presented below should be implemented to maintain the integrity of the structure. If deferred these maintenance items could develop into larger deficiencies that are more costly to address.

1. Address minor maintenance deficiencies. This will include repairing areas of erosion and scarping, and filling low areas.
2. Patch/resurface scoured concrete surfaces along both outlet structures.
3. Patch/repair areas of chipped/spalled concrete.
4. Clear the upstream and downstream slopes of unwanted vegetation and trees. Grub the associated root systems.
5. Establish a healthy stand of grass along earthen portions of the upstream and downstream slopes.

### 3.5 Remedial Modification Recommendations

It is recommended that the owner of the dam arrange for the following modifications to be undertaken to improve the safety and integrity of the dam and to extend the life of the structure. Prior to undertaking these recommendations, review and design by an engineer will likely be required.

1. Based on the results of the slope stability analysis, regrade the downstream slope to a stable section.
2. Based on the results of the wave height analysis, install an erosion protection system along the upstream slope.
3. Pending the results of the H&H analysis, implement modifications to the dam to accommodate the required spillway design flood event (if any).

### 3.6 Alternatives

Alternative to implementing the repairs noted above, breaching of the dam is a viable alternative for addressing safety and stability concerns at the dam. While this alternative will address the safety concerns, it will result in the loss of the recreational and environmental resource created by the dam. Additionally, while this will result in elimination of yearly operating and maintenance expenses, permitting activities and construction costs associated with dam removal may exceed those of rehabilitation and operations and



maintenance. Given the recreational and environmental resources provided by the impoundment, this alternative may not be feasible.

### 3.7 Opinion of Probable Costs

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

#### *Engineering Studies and Evaluations*

1. Slope Stability Analysis and Boring Program	\$ 5,000	-	\$ 10,000
2. Wave Height Analysis	\$ 1,000	-	\$ 2,000
3. Storage Analysis	\$ 1,500	-	\$ 2,500
4. H&H Evaluation	\$ 8,000	-	\$ 12,000
5. Video Pipe Inspection	\$ 3,000	-	\$ 4,000
6. O&M Manual	\$ 2,000	-	\$ 4,000
7. Hazard Potential Review	\$ 9,000	-	\$ 13,000
<b>Subtotal</b>	<b>\$ 29,500</b>	<b>-</b>	<b>\$ 47,500</b>

#### *Yearly Activities*

1. Regular Monitoring and Inspection	\$ 2,000	-	\$ 4,000/yr.
2. Regular Maintenance Activities	\$ 2,000	-	\$ 4,000/yr.
<b>Subtotal</b>	<b>\$ 4,000</b>	<b>-</b>	<b>\$ 8,000/yr.</b>

#### *Recommendations, Maintenance, and Minor Repairs*

1. Address Minor Maintenance Issues	\$ 10,000	-	\$ 15,000
2. Reseal Scoured Concrete Surfaces	\$ 10,000	-	\$ 12,000
3. Patch/Repair Chipped/Spalled Concrete	\$ 3,000	-	\$ 6,000
4. Cut & Remove Vegetation and Trees, & Grub Roots	\$ 8,000	-	\$ 10,000
5. Establish Grass Growth	\$ 2,000	-	\$ 3,000
<b>Subtotal</b>	<b>\$ 58,000</b>	<b>-</b>	<b>\$ 76,000</b>

#### *Remedial Modification Recommendations*

1. Regrade the downstream slope	\$ 8,000	-	\$ 10,000
2. Upstream Slope Erosion Protection System	\$ 25,000	-	\$ 30,000
3. Implement Spillway Modifications (if Needed)	<i>More Information Needed</i>		
Subtotal	\$ 33,000	-	\$ 40,000
Engineering & Design	\$ 5,000	-	\$ 8,000
Permitting	\$ 8,000	-	\$ 12,000
Contingency	\$ 10,000	-	\$ 12,000
<b>Subtotal</b>	<b>\$ 33,000</b>	<b>-</b>	<b>\$ 40,000</b>



**RECOMMENDATIONS TOTAL      \$124,500      -      \$171,500**

When comparing costs, the total cost including design, engineering, permitting, construction, and long-term maintenance should be considered.

While most of these activities can be undertaken as maintenance activities under 302 CMR 10 Dam Safety and will only require that the Office of Dam Safety be notified of the activities, the applicability of other environmental permits (i.e., NOI, PGP, Water Quality Certificate, etc.) needs to be determined prior to undertaking maintenance activities that may occur within resource areas under the jurisdiction of MADEP, the local conservation commission or other regulatory agency.



**FIGURES**  
*Mascuppic Lake Dam*  
*Tyngsborough, MA*

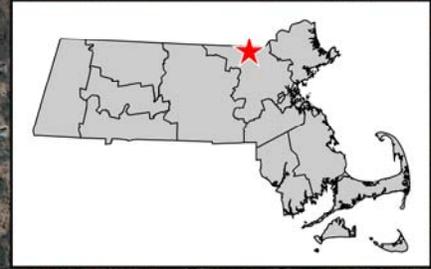


**MASCUPPIC LAKE DAM**  
 MA01225  
 TYNGSBOROUGH, MASSACHUSETTS  
 TOWN OF TYNGSBOROUGH

**LOCUS PLAN**  
 OCTOBER 2020  
 FIGURE 1



SCALE: 1"=250'



**MASCUPPIC LAKE DAM**  
42.67819° N  
71.40183° W  
NASHUA SOUTH, MA USGS QUAD

USGS ORTHOPHOTO FROM OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

1"=1500'  
0" ————— 1"

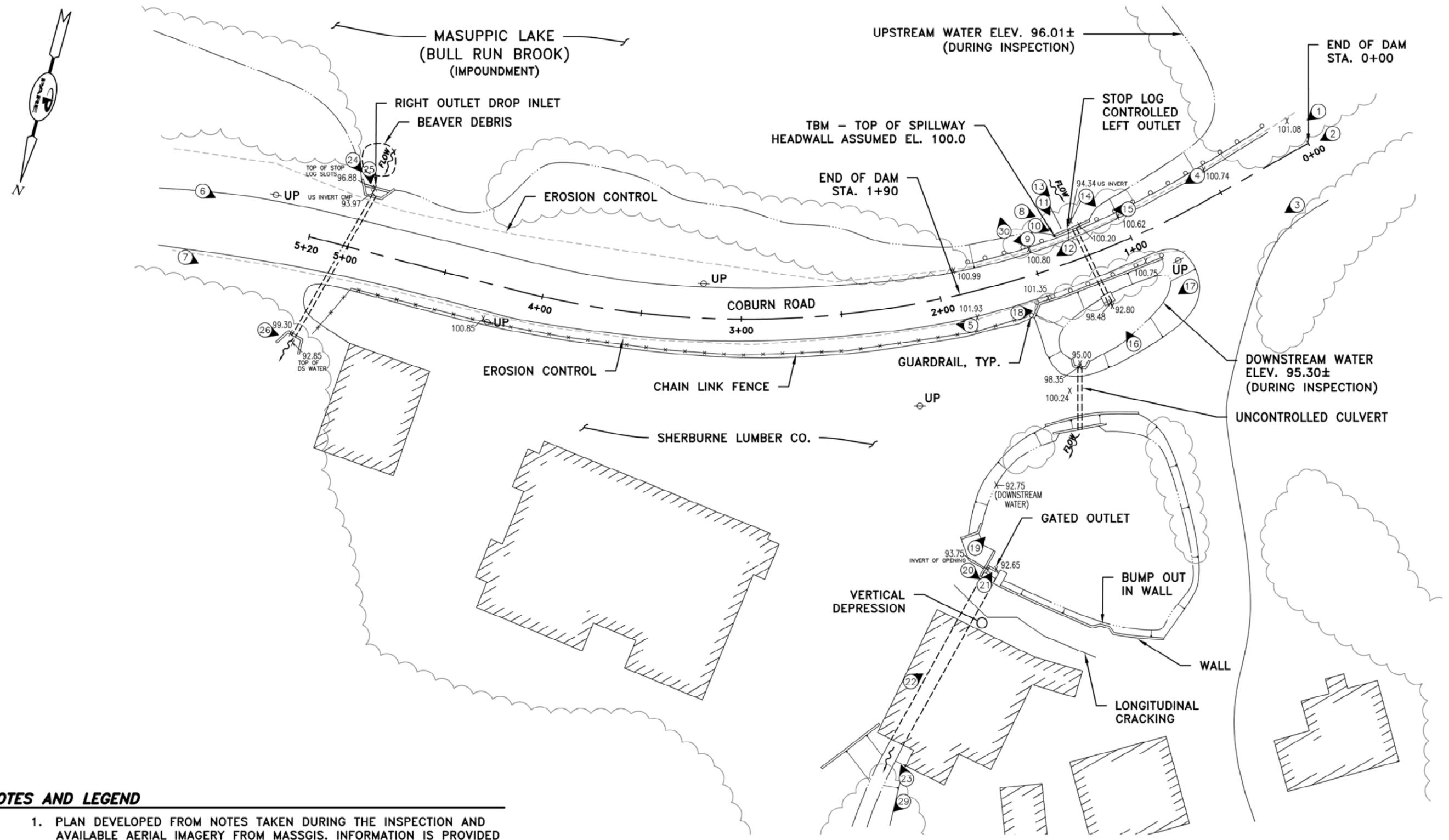


**MASCUPPIC LAKE DAM**  
MA01225  
TYNGSBOROUGH, MASSACHUSETTS  
TOWN OF TYNGSBOROUGH

**AERIAL PLAN**  
OCTOBER 2020      FIGURE 2

REVISIONS:	

PROJECT NO.: 20163.00  
 DATE: OCTOBER 2020  
 SCALE: AS NOTED  
 DESIGNED BY: KAD  
 CHECKED BY: DMM  
 DRAWN BY: LMC  
 APPROVED BY: ARO



**SITE SKETCH**  
 SCALE: 1"=50'±

**NOTES AND LEGEND**

1. PLAN DEVELOPED FROM NOTES TAKEN DURING THE INSPECTION AND AVAILABLE AERIAL IMAGERY FROM MASSGIS. INFORMATION IS PROVIDED FOR REFERENCE PURPOSES ONLY.
2. ELEVATIONS REFERENCE THE TOP OF THE RIGHT UPSTREAM CORNER OF THE LEFT OUTLET WALL WITH ASSUMED EL. 100.0.

- x 125.00 SPOT ELEVATION AS DETERMINED BY RELATIVE ELEVATION SURVEY COMPLETED BY PARE DURING THE INSPECTION.
- Ⓝ DENOTES APPROXIMATE LOCATION AND DIRECTION OF PHOTOGRAPH.
- 1+00 BASELINE AND STATIONING

Y:\JOBS\20 Jobs\20163.00 Tyngsborough-Mascuppic Lake Dam Phase 1-MA\DWG\FIG 3 SITE SKETCH.dwg

**APPENDIX A**  
**Photographs**  
*Mascuppic Lake Dam*  
*Tyngsborough, MA*



Photo No. 1: Left abutment looking right towards the upstream slope of the embankment from STA 0+00.



Photo No. 2: Crest of the embankment-left abutment contact at STA 0+00 looking right.





Photo No. 3: Downstream slope-left abutment contact looking right at STA 0+00.



Photo No. 4: Upstream slope looking right at STA 0+50. Note the sediment control sock next to the guardrail.





Photo No. 5: STA 1+90 looking right towards the right outlet.



Photo No. 6: Coburn Road looking left towards Sherburne Lumber. The right outlet is after the parked car on the left.





Photo No. 7: Road sign on the downstream side of Coburn road close to the discharge channel for the right outlet.



Photo No. 8: Concrete headwall of the left outlet looking left from the impoundment.





Photo No. 9: Upstream slope at STA 1+35 looking right. Scarping up to 1 was estimated on the upstream slope.



Photo No. 10: Left Outlet: Abrasion observed on right side of concrete headwall extending 3 feet above current pool elevation.





Photo No. 11: Left Outlet: Concrete chipping on the concrete headwall, the top right side of left outlet.



Photo No. 12: Rusty and corroded stop log slots within the opening of the left outlet. Photo is of the right slot.



Photo No. 13: Vegetative debris in left outlet culvert entrance and concrete deterioration observed around the arch.



Photo No. 14: Close up of accumulated debris (anticipated due to beavers) within the left outlet culvert.



Photo No. 15: Woody vegetation and 6-inch diameter trees seen on both sides of the upstream slope of dam.



Photo No. 16: Downstream end of the left outlet CMP culvert. Note the slope protection along the downstream slope on both sides of the culvert.



Photo No. 17: First tailwater pond as viewed from the left outlet discharge opening with telephone pole lying on top of culvert leading to the second tailwater pond.



Photo No. 18: Damaged guardrail at STA 1+50.



Photo No. 19: Downstream side of the culvert between the two downstream pools viewed from the gated outlet on the downstream side of the second tailwater pond.



Photo No. 20: Upstream wall and roadway along crest of embankment impounding the second tailwater pond. Note vertical irregularity, patched depressions, and cracking on the roadway.





Photo No. 21: Second tailwater pond gated outlet with accumulated debris within the inlet.



Photo No. 22: The conduit conveying flow from the second tailwater pond gated outlet to the turbine structure.



Photo No. 23: Discharge channel running beneath Sherburne Lumber building.



Photo No. 24: Right outlet with trash rack.



Photo No. 25: Brush growing around the right outlet concrete intake structure. The DPW crew recently cleared brush that had formed in front of the structure from beaver activity.



Photo No. 26: Discharge end of right outlet CMP culvert.



Photo No. 27: The left outlet discharge channel after the water flows underneath the Sherburne Lumber building.



Photo No. 28: Impoundment.





Photo No. 29: Foot bridge over Old Mascuppic Lake Dam at the transition from Mascuppic Lake to Bull Run Brook. Photo is looking left.



Photo No. 30: Upstream side of Old Mascuppic Dam Culvert behind Berry's Grove Campground.



**APPENDIX B**  
**Inspection Checklist**  
*Mascuppic Lake Dam*  
*Tyngsborough, MA*

### DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: <u>Mascuppic Lake Dam</u>	STATE ID #: <u>4-9-301-4</u>
REGISTERED: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	NID ID #: <u>MA01225</u>
STATE SIZE CLASSIFICATION: <u>Intermediate</u>	STATE HAZARD CLASSIFICATION: <u>Low</u>
	CHANGE IN HAZARD CLASSIFICATION REQUESTED?: <u>No</u>
<b><u>DAM LOCATION INFORMATION</u></b>	
CITY/TOWN: <u>Tyngsborough</u>	COUNTY: <u>Middlesex</u>
DAM LOCATION: <u>Access via Coburn Street across from Sherburne Lumber entranceway</u> (street address if known)	ALTERNATE DAM NAME: _____
USGS QUAD.: <u>Nashua South</u>	LAT.: <u>42.67819°N</u> LONG.: <u>71.40183°W</u>
DRAINAGE BASIN: <u>Merrimack</u>	RIVER: <u>Bull Run Brook, Lawrence Brook - Merrimack River Tributary</u>
IMPOUNDMENT NAME(S): <u>Mascuppic Lake</u>	
<b><u>GENERAL DAM INFORMATION</u></b>	
TYPE OF DAM: <u>Earth and Rock Fill (RE)/ Gravity (PG)</u>	OVERALL LENGTH (FT): <u>140</u>
PURPOSE OF DAM: <u>Recreation</u>	NORMAL POOL STORAGE (ACRE-FT): <u>16.4</u>
YEAR BUILT: <u>1900</u>	MAXIMUM POOL STORAGE (ACRE-FT): <u>41</u>
STRUCTURAL HEIGHT (FT): <u>7</u>	EL. NORMAL POOL (FT): <u>96.9</u>
HYDRAULIC HEIGHT (FT): <u>4</u>	EL. MAXIMUM POOL (FT): <u>100 (top of dam)</u>
<b><u>FOR INTERNAL MADCR USE ONLY</u></b>	
FOLLOW-UP INSPECTION REQUIRED: <input type="checkbox"/> YES <input type="checkbox"/> NO	CONDITIONAL LETTER: <input type="checkbox"/> YES <input type="checkbox"/> NO

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

INSPECTION SUMMARY

DATE OF INSPECTION: October 15, 2020

DATE OF PREVIOUS INSPECTION: May 13, 2015

TEMPERATURE/WEATHER: 73°F, Clear

ARMY CORPS PHASE I:  YES  NO

If YES, date \_\_\_\_\_

CONSULTANT: Pare Corporation

PREVIOUS DCR PHASE I:  YES  NO

If YES, date May 13, 2015

BENCHMARK/DATUM: upstream right corner of the left outlet headwall with an assumed El. 100.00

OVERALL PHYSICAL

CONDITION OF DAM: FAIR

DATE OF LAST REHABILITATION: Unknown

SPILLWAY CAPACITY: Unknown

EL. POOL DURING INSP.: 96.01

EL. TAILWATER DURING INSP.: 95.3 (Left Outlet) / 92.85 (Right Outlet)

PERSONS PRESENT AT INSPECTION

<u>NAME</u>
<u>David M. Matheson, P.E.</u>
<u>Kyle Dubuc</u>
<u>Jake Zwicker</u>

<u>TITLE/POSITION</u>
<u>Senior Project Engineer</u>
<u>Engineer I</u>
<u>Town Engineer</u>

<u>REPRESENTING</u>
<u>Pare Corporation</u>
<u>Pare Corporation</u>
<u>Town of Tyngsborough</u>

EVALUATION INFORMATION

	Click on box to select E-code
E1) TYPE OF DESIGN	<u>2</u>
E2) LEVEL OF MAINTENANCE	<u>3</u>
E3) EMERGENCY ACTION PLAN	<u>3</u>
E4) EMBANKMENT SEEPAGE	<u>5</u>
E5) EMBANKMENT CONDITION	<u>4</u>
E6) CONCRETE CONDITION	<u>4</u>
E7) LOW-LEVEL OUTLET CAPACITY	<u>4</u>

Click on box to select E-code
<u>2</u>
<u>3</u>
<u>3</u>
<u>5</u>
<u>4</u>
<u>4</u>
<u>4</u>

E8) LOW-LEVEL OUTLET CONDITION	<u>4</u>
E9) SPILLWAY DESIGN FLOOD CAPACITY	<u>1</u>
E10) OVERALL PHYSICAL CONDITION	<u>3</u>
E11) ESTIMATED REPAIR COST	<u>\$124.5k-\$171.5k</u>
ROADWAY OVER CREST	<u>YES</u>
BRIDGE NEAR DAM	<u>NO</u>

Click on box to select E-code
<u>4</u>
<u>1</u>
<u>3</u>
<u>\$124.5k-\$171.5k</u>
<u>YES</u>
<u>NO</u>

NAME OF INSPECTING ENGINEER: David M. Matheson, P.E.

SIGNATURE: David M. Matheson

NAME OF DAM: <u>Mascuppic Lake Dam</u>		STATE ID #: <u>4-9-301-4</u>	
INSPECTION DATE: <u>October 15, 2020</u>		NID ID #: <u>MA01225</u>	
OWNER: ORGANIZATION	<u>Town of Tyngsborough</u>	CARETAKER: ORGANIZATION	<u>Town of Tyngsborough</u>
NAME/TITLE	<u>Engineering Department</u>	NAME/TITLE	<u>Engineering Department</u>
STREET	<u>25 Bryant Lane</u>	STREET	<u>25 Bryant Lane</u>
TOWN, STATE, ZIP	<u>Tyngsborough, MA 01879</u>	TOWN, STATE, ZIP	<u>Tyngsborough, MA 01879</u>
PHONE	<u>(978) 649-2300 X158</u>	PHONE	<u>(978) 649-2300 X158</u>
EMERGENCY PH. #	<u></u>	EMERGENCY PH. #	<u></u>
FAX	<u></u>	FAX	<u></u>
EMAIL	<u><a href="mailto:jzwicker@tyngsboroughma.gov">jzwicker@tyngsboroughma.gov</a></u>	EMAIL	<u><a href="mailto:jzwicker@tyngsboroughma.gov">jzwicker@tyngsboroughma.gov</a></u>
OWNER TYPE	<u>Municipality or Political subdivision</u>		
LEFT OUTLET TYPE	<u>Stop log controlled weir to 80" CMP culvert</u>		
RIGHT OUTLET LENGTH (FT)	<u>Drop Inlet 14 wide x 4.42 long</u>	RIGHT OUTLET CAPACITY (CFS)	<u>Unknown</u>
LEFT OUTLET TYPE	<u>6.7 ft wide timber stop log weir</u>	LEFT OUTLET CAPACITY (CFS)	<u>Unknown</u>
NO. OF OTHER OUTLETS	<u>0</u>	OTHER OUTLET(S) CAPACITY (CFS)	<u>(N/A)</u>
TYPE OF OUTLETS	<u>N/A</u>	TOTAL DISCHARGE CAPACITY (CFS)	<u>Unknown</u>
DRAINAGE AREA (SQ MI)	<u>2.2</u>	SPILLWAY DESIGN FLOOD (PERIOD/CFS)	<u>100-year flood / No H&amp;H</u>
HAS DAM BEEN BREACHED OR OVERTOPPED	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	IF YES, PROVIDE DATE(S)	<u></u>
FISH LADDER (LIST TYPE IF PRESENT)	<u>No</u>		
DOES CREST SUPPORT PUBLIC ROAD?	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	IF YES, ROAD NAME:	<u>Coburn Road</u>
PUBLIC BRIDGE WITHIN 50' OF DAM?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	IF YES, ROAD/BRIDGE NAME:	<u></u>
		MHD BRIDGE NO. (IF APPLICABLE)	<u></u>

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**EMBANKMENT (CREST)**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Bituminous Asphalt with vegetated shoulders		X	
	2. SURFACE CRACKING	Coburn Road was repaved within the past couple of months- no cracking observed		X	
	3. SINKHOLES, ANIMAL BURROWS	None observed		X	
	4. VERTICAL ALIGNMENT (DEPRESSIONS)	None observed		X	
	5. HORIZONTAL ALIGNMENT	The road naturally curves closer to Sherburne Lumber starting around the left abutment in a northern direction before straightening back in a northeast direction around the off site structure			X
	6. RUTS AND/OR PUDDLES	None observed		X	
	7. VEGETATION (PRESENCE/CONDITION)	Maintained weeds along shoulders		X	
	8. ABUTMENT CONTACT	Appears good		X	

ADDITIONAL COMMENTS: Manhole cover on center of crest goes to left outlet discharge culvert. Not inspected due to high levels of traffic on Coburn Road

\_\_\_\_\_

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\_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam STATE ID #: 4-9-301-4  
 INSPECTION DATE: October 15, 2020 NID ID #: MA01225

**EMBANKMENT (D/S SLOPE)**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	None observed		X	
	2. SEEPAGE	None observed		X	
	3. SLIDE, SLOUGH, SCARP	None observed. Slope is approximately 2H:1V		X	
	4. EMB.-ABUTMENT CONTACT	Potholes are observed at the left abutment embankment contact next to the telephone pole where the Sherburne Lumber driveway starts. This asphalt deterioration may be caused from rutting from automobiles leaving and entering the business as well as installation of the telephone pole.		X	X
	5. SINKHOLE/ANIMAL BURROWS	None observed		X	
	6. EROSION	Erosion observed extending from the right of left outlet (LO) CMP culvert 15' to the right. Vertical drop in slope of 3 inches. It appears boulders were placed to the right of LO CMP culvert extending 5'. Riprap was placed to the left of the left side of the LO CMP 11 ft to the left.		X	X
	7. UNUSUAL MOVEMENT	None observed		X	
	8. VEGETATION (PRESENCE/CONDITION)	Downstream slope is grass covered with a woody stem shrub on both sides of LO CMP extending out of the embankment slope. 6" diameter trees on both embankment-abutment contacts. Grass does not look like it has been cut recently.		X	X

ADDITIONAL COMMENTS: Telephone pole at left embankment-abutment contact along with pallets of masonry rocks in between Sherburne Lumber driveway and slope down to tailwater pond.  
Erosion control sock laid in front of guardrail and around slope corners; still in place from recent paving operations on Coburn Road

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**EMBANKMENT (U/S SLOPE)**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	Scarping observed on the normal pool line up to 12 inches		X	X
	2. SLOPE PROTECTION TYPE AND COND.	None observed		X	
	3. SINKHOLE/ANIMAL BURROWS	None observed		X	
	4. EMB.-ABUTMENT CONTACT	Appears good		X	
	5. EROSION	Minor erosion seen from vegetation transition to mudline		X	X
	6. UNUSUAL MOVEMENT	None observed		X	
	7. VEGETATION (PRESENCE/CONDITION)	Covered with dense woody stem shrubs. Two clusters of 6" diameter trees are growing on left and right upstream slopes close to the left outlet.		X	X

ADDITIONAL COMMENTS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**INSTRUMENTATION**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	None observed	X		
	2. OBSERVATION WELLS	None observed	X		
	3. STAFF GAGE AND RECORDER	None observed	X		
	4. WEIRS	None observed	X		
	5. INCLINOMETERS	None observed	X		
	6. SURVEY MONUMENTS	None observed	X		
	7. DRAINS	None observed		X	
	8. FREQUENCY OF READINGS	None observed	X		
	9. LOCATION OF READINGS	None observed	X		

ADDITIONAL COMMENTS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**DOWNSTREAM MASONRY WALLS**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO	ACTION	MONITOR	REPAIR
D/S WALLS	1. WALL TYPE	<b>NOT APPLICABLE TO THIS STRUCTURE</b>				
	2. WALL ALIGNMENT					
	3. WALL CONDITION					
	4. HEIGHT: TOP OF WALL TO MUDLINE					
	5. SEEPAGE OR LEAKAGE					
	6. ABUTMENT CONTACT					
	7. EROSION/SINKHOLES BEHIND WALL					
	8. ANIMAL BURROWS					
	9. UNUSUAL MOVEMENT					
	10. WET AREAS AT TOE OF WALL					

ADDITIONAL COMMENTS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**UPSTREAM MASONRY WALLS**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO	ACTION	MONITOR	REPAIR
U/S WALLS	1. WALL TYPE	<b>NOT APPLICABLE TO THIS STRUCTURE</b>				
	2. WALL ALIGNMENT					
	3. WALL CONDITION					
	4. HEIGHT: TOP OF WALL TO MUDLINE					
	5. ABUTMENT CONTACT					
	6. EROSION/SINKHOLES BEHIND WALL					
	7. ANIMAL BURROWS					
	8. UNUSUAL MOVEMENT					

ADDITIONAL COMMENTS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NAME OF DAM: <u>Mascuppic Lake Dam</u>		STATE ID #: <u>4-9-301-4</u>			
INSPECTION DATE: <u>October 15, 2020</u>		NID ID #: <u>MA01225</u>			
<b>DOWNSTREAM AREA</b>					
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	None observed		X	
	2. FOUNDATION SEEPAGE	The road downstream of the second tailwater pond and in front of the store had longitudinal cracking, vertical depressions, and two potholes refilled which may be an indication of possible seepage. The dry set stone masonry wall in between the building the road is in good condition. The road between the two tailwater ponds was in good condition			X X
	3. SLIDE, SLOUGH, SCARP	None observed		X	
	4. WEIRS	See 9.		X	
	5. DRAINAGE SYSTEM	The downstream channels discharge to the Lawrence Brook which flows into the Merrimack River.			X
	6. INSTRUMENTATION	None observed	X		
	7. VEGETATION	The perimeters of the tailwater ponds are gradually sloped with leaf debris and trees 6" in diameter and greater dotting the edges. The downstream wall for the second tailwater pond is a vertical concrete wall that juts out at one point due to possible bedrock.			X
	8. ACCESSIBILITY	Sherburne Lumber driveway and parking lot gives access to the two downstream tailwater ponds. The discharge channels run through the old mill building through a dropshaft continuing around a turbine. The parking lot in back of the main building gives access to the natural streambed channel of the left outlet which flows to Lawrence Brook.			X
	9. DOWNSTREAM HAZARD DESCRIPTION	Two tailwater ponds exist downstream of the left outlet. The first tailwater pond is roughly 1,250 ft <sup>2</sup> pond and the second tailwater pond is roughly 7,700 ft <sup>2</sup> . The first tailwater pond connects to the second pond via a CMP culvert. A stop log controlled weir is situated on the second tailwater pond. This leads to the old mill building that uses to spin a turbine.			X
	10. DATE OF LAST EAP UPDATE	N/A			X
ADDITIONAL COMMENTS: _____					
_____					
_____					

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**MISCELLANEOUS**

AREA INSPECTED	CONDITION	OBSERVATIONS	
MISC.	1. RESERVOIR DEPTH (AVG)	Bull Run Brook: Unknown; Mascuppic Lake:AVG: 12' MAX: 33'	
	2. RESERVOIR SHORELINE	Mascuppic Lake has residential properties surrounding the perimeter. 1000 feet on the left of the lake is an undeveloped wooded area leading to Bull Run Brook. Bull Run Brook is primarily wooded all sides.	
	3. RESERVOIR SLOPES	Gradual, appear stable.	
	4. ACCESS ROADS	To access the start of the Bull Run Brook, Beech Street is located 1000 feet east of the right outlet off of Coburn Road. At the end of Beech Street on the right is the transition from MA03417 Old Mascuppic Lake Dam to Bull Run Brook.	
	5. SECURITY DEVICES	Unknown if security devices exist around the impoundment	
	6. VANDALISM OR TRESPASS	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	WHAT: Dam is open to the public
	7. AVAILABILITY OF PLANS	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	DATE: No plans were found during file review
	8. AVAILABILITY OF DESIGN CALCS	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	DATE: N/A
	9. AVAILABILITY OF EAP/LAST UPDATE	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	DATE: Not Required for Low Hazard Dam
	10. AVAILABILITY OF O&M MANUAL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	DATE: N/A
	11. CARETAKER/OWNER AVAILABLE	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	DATE: October 15, 2020
	12. CONFINED SPACE ENTRY REQUIRED		PURPOSE: Manhole access in middle of left outlet culvert

ADDITIONAL COMMENTS: \_\_\_\_\_  
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 \_\_\_\_\_  
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NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**LEFT OUTLET**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
LEFT          OUTLET	SPILLWAY TYPE	7-ft wide stop log regulated weir to 6.7' wide x 4' high oval CMP	X		
	WEIR TYPE	Timber stop logs	X		
	SPILLWAY CONDITION	Fair. Stop logs are not currently utilized to control water due to beaver action blocking culvert.		X	X
	TRAINING WALLS	Abrasion was observed on both sides of the concrete headwall extending 3 ft up from the waterline. Abrasion also observed surrounding stop log slots from top to bottom. Concrete chipping was seen at the top right headwall on the corner of the outlet.		X	X
	SPILLWAY CONTROLS AND CONDITION	Stop log timbers were not seen during inspection. The stop log slots were corroding and rusting. They extend 2.5-inches above the headwall.		X	X
	UNUSUAL MOVEMENT	None observed		X	
	APPROACH AREA	The water level was below normal pool in Bull Run Brook; lillipads were on top of the water and the mudline was visable in randomized spots along the brook.		X	X
	DISCHARGE AREA	Tailwater pond has lillipads and leaf litter		X	X
	DEBRIS	Sediment has built up a third of the way inside the culvert. Branches, sticks, and leaves are chocking the culvert allowing little water to flow through.		X	X
	WATER LEVEL AT TIME OF INSPECTION	96.01		X	

ADDITIONAL COMMENTS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**RIGHT OUTLET**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
RIGHT OUTLET	SPILLWAY TYPE	2-ft wide stop log controlled overflow spillway with a drop structure leading to a 3.25' wide x 2' high elliptical CMP culvert	X		
	WEIR TYPE	2-ft wide flash board controlled	X		
	SPILLWAY CONDITION	Fair. The 14-ft wide concrete drop structure endured abrasion on the outside of it. The trashrack on top has rusty poles and the 24-inch high by 39-inch wide CMP appears semi-crushed and is stretched disproportionately. Sticks and leaves are scattered on the bottom of the drop-inlet structure.		X	X
	TRAINING WALLS	N/A	X		
	SPILLWAY CONTROLS AND CONDITION	Appears good		X	
	UNUSUAL MOVEMENT	None observed		X	
	APPROACH AREA	Approach area appeared clear due to Owner clearing out beaver timber debris		X	
	DISCHARGE AREA	Wooded area with natural stream channel. During inspection fallen tree limbs were sticking out of the water. Boulder headwall retains earth as discharge CMP protrudes out.			X
	DEBRIS	The Owner had an excavator clear out woody debris front in front of the structure constructed by beavers.		X	
	WATER LEVEL AT TIME OF INSPECTION	96.01			

ADDITIONAL COMMENTS: \_\_\_\_\_  
 \_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**OUTLET WORKS**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR	
OUTLET WORKS	TYPE	The Right Outlet also functions as a low level outlet (Refer to this page)		X		
	INTAKE STRUCTURE			X		
	TRASHRACK				X	
	PRIMARY CLOSURE				X	
	SECONDARY CLOSURE				X	
	CONDUIT				X	
	OUTLET STRUCTURE/HEADWALL				X	
	EROSION ALONG TOE OF DAM				X	
	SEEPAGE/LEAKAGE				X	
	DEBRIS/BLOCKAGE				X	
	UNUSUAL MOVEMENT				X	
	DOWNSTREAM AREA					X
	MISCELLANEOUS					X

ADDITIONAL COMMENTS: \_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**CONCRETE/MASONRY DAMS**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
GENERAL	TYPE	<b>NOT APPLICABLE TO THIS STRUCTURE</b>			
	AVAILABILITY OF PLANS				
	AVAILABILITY OF DESIGN CALCS				
	PIEZOMETERS				
	OBSERVATION WELLS				
	INCLINOMETERS				
	SEEPAGE GALLERY				
	UNUSUAL MOVEMENT				

ADDITIONAL COMMENTS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**CONCRETE/MASONRY DAMS (CREST)**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	<b>NOT APPLICABLE TO THIS STRUCTURE</b>			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	HORIZONTAL ALIGNMENT				
	VERTICAL ALIGNMENT				

ADDITIONAL COMMENTS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE	<b>NOT APPLICABLE</b>			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACT				
	LEAKAGE				

ADDITIONAL COMMENTS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NAME OF DAM: Mascuppic Lake Dam

STATE ID #: 4-9-301-4

INSPECTION DATE: October 15, 2020

NID ID #: MA01225

**CONCRETE/MASONRY DAMS (UPSTREAM FACE)**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR	
U/S FACE	TYPE	<b>NOT APPLICABLE TO THIS STRUCTURE</b>				
	SURFACE CONDITIONS					
	CONDITIONS OF JOINTS					
	UNUSUAL MOVEMENT					
	ABUTMENT CONTACTS					

ADDITIONAL COMMENTS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**APPENDIX C**  
**Previous Reports and References**  
*Mascuppic Lake Dam*  
*Tyngsborough, MA*

### PREVIOUS REPORTS AND REFERENCES

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

1. “*Verification in Field Jurisdictional Determination Inspection Report for Mascuppic Lake Dam*” prepared by Fuss & O’Neill, Inc., dated June 29, 2015.
2. “*Inspections Summary and Recommendations for Mascuppic Lake Dam*” prepared by DEM-ODS, dated November 15, 1999.
3. “*Inspection Report – Sherwood Lumber Dam*” prepared by C. Johns, dated September 26, 1974.

During the development of the report Pare also reviewed available information included within the following databases:

1. MADCR – Department of Environmental Management DAM Database.

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

1. “Design of Small Dams”, United States Department of the Interior Bureau of Reclamation, 1987.
2. “ER 110-2-106 - Recommended Guidelines for Safety Inspection of Dams”, Department of the Army, September 26, 1979.
3. “Guidelines for Reporting the Performance of Dams” National Performance of Dams Program, August 1994.
4. 302 CMR: Department of Conservation and Recreation Section 10.00 Dam Safety.



**APPENDIX D**  
**Common Dam Safety Definitions**  
*Mascuppic Lake Dam*  
*Tyngsborough, MA*

## COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to 302 CMR10.00 Dam Safety, or other reference published by FERC, Dept. of the Interior Bureau of Reclamation, or FEMA. Please note should discrepancies between definitions exists, those definitions included within 302 CMR 10.00 govern for dams located within the Commonwealth of Massachusetts.

### Orientation

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

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

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

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

### Dam Components

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

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

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

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

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

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

### Size Classification

(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 *Dam Safety*)

Large – structure with a height greater than 40 feet or a storage capacity greater than 1,000 acre-feet.

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

Small – structure with a height between 6 and 15 feet and a storage capacity of 15 to 50 acre-feet.

Non-Jurisdictional – structure less than 6 feet in height or having a storage capacity of less than 15 acre-feet.



### **Hazard Classification**

(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 *Dam Safety*)

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

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

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

### **General**

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

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

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

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

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

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

### **Condition Rating**

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

Poor - Significant structural, operational and maintenance deficiencies are clearly recognized for normal loading conditions.

Fair - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters.

Satisfactory - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.

Good - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF.



**APPENDIX E**  
**Visual Dam Inspection Limitations**  
*Mascuppic Lake Dam*  
*Tyngsborough, MA*

## VISUAL DAM INSPECTION LIMITATIONS

### Visual Inspection

1. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report.
2. In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection, along with data available to the inspection team.
3. In cases where an impoundment is lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions, which might otherwise be detectable if inspected under the normal operating environment of the structure.
4. It is critical to note that the condition of the dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

### Use of Report

1. The applicability of other environmental permits (i.e. NOI, PGP, Water Quality Certificate, etc.) needs to be determined prior to undertaking maintenance activities that may occur within resource areas under the jurisdiction of MADEP, the local conservation commission or other regulatory agency.
2. This report has been prepared for the exclusive use of the Town of Tyngsborough for specific application to the Mascuppic Lake Dam in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.
3. This report has been prepared for this project by Pare. This report is for preliminary evaluation purposes only and is not necessarily sufficient to support design or repairs or recommendations or to prepare an accurate bid.

