LILY POND DAM IMPROVEMENTS ASSESSMENT

DEER ISLE, MAINE

PRELIMINARY DESIGN REPORT

ACADIA CIVIL WORKS
ENGINEERING DESIGN & CONSULTATION

December 20, 2022

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PRELIMINARY DESIGN REPORT

LILY POND DAM – IMPROVEMENTS ASSESSMENT
DEER ISLE, ME

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SECTION 1
INTRODUCTION

1.1 BACKGROUND

Lily Pond is a natural waterbody located in the heart of Deer Isle. The pond has an overall surface water area of approximately 37 acres and a maximum depth of 21 feet. While naturally formed, there is an earthen dam at the southwest end of the pond, which is responsible for approximately 6 feet of the water depth. A sandy beach is located adjacent to the dam, which is a popular recreational destination for island residents and provides ample freshwater swimming and sunbathing opportunities. A site location map has been included on the following page.

Approximately twelve years ago, the Island Heritage Trust (IHT) purchased the land encompassing the dam and beach with the goal "to maintain the popular beach and fresh-water pond so future generations of Island children can continue to have a place to take swimming lessons, to ice skate and enjoy the pond's beauty throughout the seasons" (IHT Fall 2009 Newsletter). Lily Pond has been a fixture of Island life for generations and is deeply valued by the community.

Lily Pond – View of swimming and kayaking activities from the Dam

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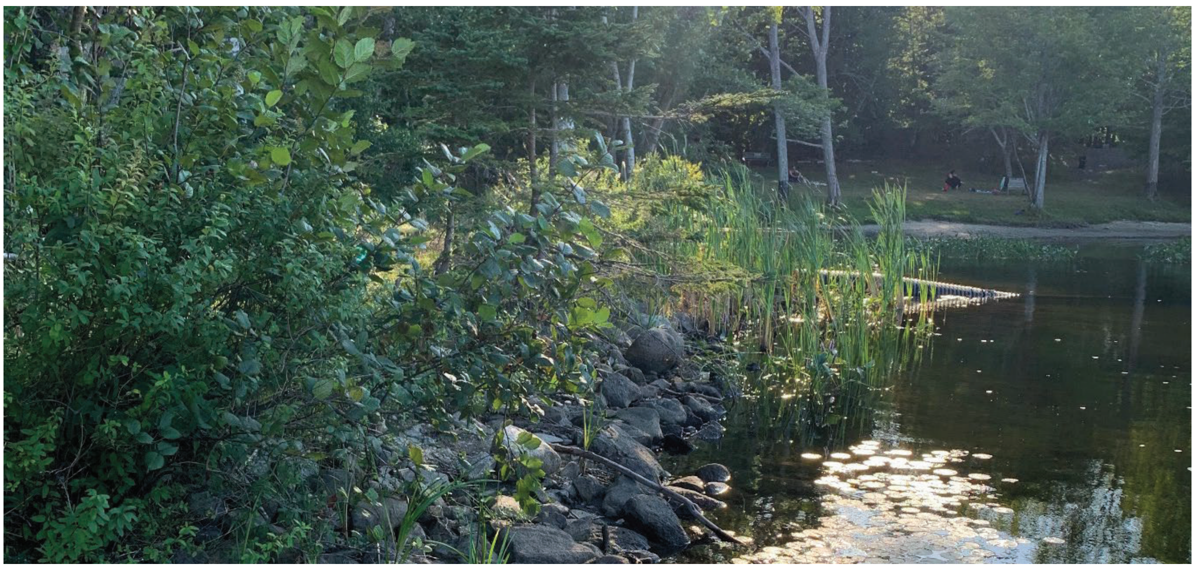
SITE LOCATION MAP
LILY POND DAM

DEER ISLE, ME | JULY 2022

FIGURE 1

In addition to swimming, skating, and beachgoing activities, Lily Pond also supports a valued fishery. The pond supports naturally reproducing populations of brook trout, rainbow smelt, and pumpkinseed sunfish. The catadromous American eel also resides in the pond. According to the Maine Department of Inland Fisheries and Wildlife (MDIFW), the brook trout fishery experienced some decline in the 1990's, and the Department initiated a stocking program to boost brook trout fishing opportunities, while also adding brown trout to the Pond. This stocking program and management continues to the present time.



Lily Pond – View of Dam (foreground) and Beach (background)

While the recreational and cultural value of Lily Pond is prized on the Island, the Lily Pond Dam has been deteriorating for decades. An inspection report commissioned by the Maine Emergency Management Agency (MEMA) in 1997 indicates that the dam was in "fair to poor" condition with substantive areas of concern including "insufficient hydraulic capacity for the sluiceway, potential instability of the downstream slope of the east dike, and seepage at the toe of the east dike." Despite these issues being raised by the inspection, little was done to address these issues in the following decades. As such, recent inspections by MEMA staff (2019) have highlighted the same issues, as well as new worsening conditions, including erosion of the spillway due to overtopping flows, as well as seepage boils in the area of the spillway.

Due to the pond's proximity to the center of the island, it is able to provide a primary source of firefighting water supply to the downtown area surrounding the intersection of State Route 15 and Main Street. When the fire department needs water from the pond, they open the Lily Pond dam spillway gates to increase discharge in the outlet stream which flows through the woods for several hundred feet prior to passing under State Route 15 via a culvert. The outlet of the culvert is fitted with a concrete tank structure, which allows the fire department to draw water from the tank and into trucks stationed at the hydrant and along the shoulder of Route 15.

Fire Water Tank at Outlet of Culvert – Looking upstream with Route 15 in the Background

This proximity of the pond to the center of Deer Isle is a great value, but also a substantive risk. If the Lily Pond dam was to fail, it could release a sudden and substantial volume of water. This surge of water could threaten the State Highway, as well as access to the fire fighting water supply. The threat posed by potential dam failure has resulted in MEMA classifying the dam as a "significant" hazard dam. While loss of life is not deemed likely in the event of dam failure, the risk to infrastructure warrants additional attention be paid to the dam. This includes requirements for the dam to provide increased structural capacity and improved hydraulic performance to ensure protection of the community.

1.2 PURPOSE OF REPORT

The purpose of this report is to provide design guidance and preliminary engineering solutions associated with improvement to the Lily Pond Dam. Due to the proximity and relationship of the fire water supply and culvert crossing of Route 15, additional engineering guidance is provided for improvement to this valuable downstream infrastructure. This report includes a summary of existing conditions and background data utilized in the preparation of this assessment, as well as pertinent hydrologic and hydraulic conditions at the Dam. The condition of the dam is reviewed and associated recommendations for improvement are provided, along with potential approaches to providing fish passage at the site. The report concludes with multiple conceptual design recommendations for the dam and downstream infrastructure alternatives, as well as approximate construction cost estimates.

1.3 PROJECT TEAM AND STAKEHOLDERS

Throughout the report there may be reference to the Project Team and/or Stakeholders. The following people/entities comprise the group and have participated in stakeholder meetings (to varying degrees) over the past few years:

- **Island Heritage Trust**: Bill Wiegman, Julia Zell, Tenley Wurglitz, Alex Drenga, Ann Hooke, Gordon Russell, Bert Yankielun, Dan Rajter
- **Maine Department of Marine Resources**: Mike Brown
- **Town of Deer Isle**: Jim Fisher, Brent Morey
- **Town of Stonington**: Kathleen Billings, Henry Teverow
- **Maine Department of Inland Fisheries and Wildlife**: Greg Burr
- **Maine Emergency Management Agency**: John Skelley, Andrew Manzi
- **Hancock County Emergency Management Agency**: Andrew Sankey

SECTION 2

SECTION 2
SURVEY AND EXISTING CONDITIONS DATA

2.1 INTRODUCTION

A variety of survey and data collection activities were undertaken to support this assessment. This includes new data collection, as well as a review of readily available data from GIS sources and record documents. Each of the substantive data collection efforts and data sets utilized in this assessment are described further in the following sections.

2.2 EXISTING CONDITIONS SURVEY

Acadia Civil Works retained Due North land surveying and mapping services to perform an existing conditions survey of the Lily Pond Dam and the downstream channel area. Field location was performed in January 2021. In addition to the topographic survey, Due North staff also performed research at Registry of Deeds to identify and locate property boundaries adjacent to the dam. This survey information is depicted on the plan titled "Existing Conditions Survey" (attached to this report at Appendix A).

Photo 1: Island Heritage Trust Staff (Tenley Wurglitz) assisting Due North with bathymetric data collection at the upstream toe of Lily Pond Dam in January 2021 (photo credit: Due North, Linda Campbell)

2.3 LiDAR DATA

Light detection and ranging (LiDAR) is a survey technique that uses focused light or lasers to rapidly scan and measure distances to a variety of fixed points. The resulting measurements create a "cloud" of points that describe the scanned object. There are a variety of LiDAR data collection methods, however aerial vehicles (airplanes) are a popular means of providing LiDAR devices with a good vantage of the landscape and effective collection of ground surface elevation data. Several governmental agencies have funded large scale LiDAR data collection efforts that span much of the State of Maine. In particular, the National Oceanic and Atmospheric Administration (NOAA) has collected multiple sets of LiDAR elevation data along the Gulf of Maine Coast. Additional LiDar data sets have also been collected by the State of Maine, USGS, and US Army Corps of Engineers.

Due North utilized LiDAR data on their "Existing Conditions Survey" (Appendix A) to supplement their field survey data collection. Acadia Civil Works also utilized the available LiDAR to determine stage-discharge relationships in Lily Pond and hydrologic watershed boundaries. More discussion on this data usage is contained in Sections 3 and 4.

2.4 SUBSURFACE EXPLORATION

Acadia Civil Works worked with Soil Metrics and Northern Test Boring, Inc. to explore subsurface conditions along the Lily Pond Dam. The primary goal of the explorations was to determine the native soil characterization and composition in the area of the Dam, as well as to determine the presence of bedrock (ledge). Additional information related to the subsurface exploration program and results can be found in the Geotechnical Report prepared by Soil Metrics, which has been attached to this report as Appendix B.

2.5 FISHERIES DATA

The Maine Department of Inland Fisheries and Wildlife (MeDIFW) has published a brief classification of Lily Pond in their collection of Maine lake surveys. Lily Pond was surveyed initially in 1952 and the survey description has been revised over the years, most recently in 2001. MeDIFW actively stocks Lily Pond with brook and brown trout. More information related to this survey and the lake fishery is contained in Section 6 of this Report.

The Maine Department of Marine Resources (MeDMR) was contacted regarding Lily Pond. They did not have any records on file related to Lily Pond, nor any information related to migratory fish species prior to the dam's construction.

2.6 INSPECTIONS BY OTHERS

Several Inspections of the dam have been performed over the last several decades. In November 1997, the dam was inspected by MBP Consulting. In May 2013, the dam was inspected by the Maine Emergency Management Agency (MEMA) Office of Dam Safety. A follow-up inspection of the dam was also performed by MEMA in December 2019. Each of these reports have been provided as Appendices C, D, and E, respectively. The reports provide valuable insight related to the dam's condition and how it has changed over time.

SECTION 3

SECTION 3
HYDROLOGIC DATA

3.1 INTRODUCTION

Hydrology is the science that encompasses the study of water on the Earth, both above and below the ground's surface. It is critical to understand the hydrologic conditions at a particular site when evaluating infrastructure options, as well as associated effects and impacts.

For the assessment at the Lily Pond Dam we have focused on the surface water hydrology driven by rainfall, runoff, and groundwater conditions. This flow is generally watershed driven and represents the flows (both normal and extreme) that will be generated upstream of the dam and will flow into Lily Pond and through the dam.

3.2 WATERSHED HYDROLOGY

3.2.1 Watershed Characteristics

The dam at Lily Pond has a tributary watershed of approximately 0.23 square miles (145 acres). Of this area, approximately 35 acres (24%) is associated with the water surface of Lily Pond. There are no substantial sand and gravel aquifers mapped in the watershed. Discharges from the Dam are discharged as a stream, which is connected to Mill Pond. Mill Pond has limited tidal activity, specifically during high tides, as it is connected to Northwest Harbor via two large circular culverts under Bridge Street. Northwest Harbor is on the northwest side of Deer Isle and is adjacent to East Penobscot Bay. There are no site-specific flow monitoring stations or data available within the watershed for this location.

3.2.2 Median Monthly Flows

If a person were to observe a stream on any given day, it is most probable that they would be witnessing the median flow condition (or something similar to the median condition). Certainly, periods of drought or periods of intense rainfall will influence those observations. However, statistically speaking, the median result is the one most likely to be experienced. These median flow rates are helpful to gauge the “typical” flow conditions at the site. The median condition for each month is provided below in Table 3.1.

TABLE 3.1
ESTIMATED MEDIAN MONTHLY FLOW RATES

Month	Median Flow (cfs)
January	0.4
February	0.3
March	1.1
April	0.6
May	0.9
June	0.3
July	0.03
August	0.01
September	0.01
October	0.1
November	0.6
December	0.7

Acadia Civil Works utilized regression techniques via the USGS StreamStats webtool to develop these flow rates. This methodology follows the equations and procedures established in USGS Scientific Investigations Report 2015-5151 to determine monthly flow rates at the crossing location. This methodology utilizes a number of stream flow gauging stations located around the state with a substantive history of recorded streamflow data to develop predictive equations based upon several explanatory variables. These variables include drainage basin area, areal fraction of the drainage basin underlain by sand and gravel aquifers, distance from the coast to the drainage basin centroid, mean drainage basin annual precipitation, and mean drainage basin winter precipitation.

It should be noted that some of the watershed characteristics are outside of the suggested range of parameters, and therefore these median monthly conditions have been extrapolated. Regardless, this technique provides a simple and relatively accurate means of understanding normal flow rates in the stream throughout the year. If more accurate base flow estimates are required at this site, more advanced hydrologic monitoring of the site will be required.

3.2.3 Extreme Flow Events (USGS Regression)

During heavy rainfall and extreme events, flow discharges at the Lily Pond Dam will be much higher than the median conditions. An extreme event is something that doesn't happen very often, such as a hurricane event or a very heavy rain coupled with melting snow or frozen ground. The likelihood of these rare events is often expressed as a "recurrence interval", such as the 100-year storm. Statistically, the 100-year storm will be equaled or exceeded at least once (and perhaps more than once) every 100-years. Another way of thinking about the recurrence interval is via its probability of annual occurrence. For example, a 100-year event has a 1% probability of occurring in any given year. Similarly, the 2-year event has a 50% chance occurring in any given year, and so on. The estimated extreme flow rates at the Dam are shown below in Table 3.2.

TABLE 3.2
ESTIMATED EXTREME FLOW RATES
USGS REGRESSION TECHNIQUE (SIR 2015-5049)

Recurrence Interval	% Annual Probability	Peak Flow (cfs)
1-year	99%	4
2-year	50%	12
5-year	20%	18
10-year	10%	22
25-year	4%	28
50-year	2%	32
100-year	1%	37
250-year	0.4%	41
500-year	0.2%	49

To determine these extreme flow rates, Acadia Civil Works utilized regression techniques via the USGS StreamStats webtool. This methodology follows the equations and procedures established in USGS Scientific Investigations Report 2015-5049. Similar to the methodology outlined in section 3.1.2, this methodology utilizes a number of stream flow gauging stations located around the state with a substantive history of recorded streamflow data to develop predictive equations based upon several explanatory variables. These variables include drainage basin area, as well as the areal fraction of NWI mapped wetland area.

It should be noted that some of the watershed characteristics are outside of the suggested range of parameters, and therefore these extreme flow conditions have been extrapolated. Regardless, this technique provides a simple and relatively accurate means of understanding the magnitude of flows that can be generated during extreme events.

3.2.4 Extreme Flow Events (TR-20 Methodology)

The Federal Emergency Management Agency (FEMA) has published dam spillway design capacity guidelines in their publication "Selecting an Accommodating Inflow Design Floods for Dams" dated August 2013 (FEMA P-94). This document provides detailed information about hydrologic design considerations for dam spillways and associated inflow design flood selection. In Table 2 of Section 2.3.3 of the document, FEMA prescribes and inflow design flood of the 1,000 year event (0.1% annual probability) for dams that are "Significant" hazard structures. As further discussed in Section 5.2 of this report, the Lily Pond Dam is classified as a "Significant" hazard structure.

To evaluate the 1,000 year event (0.1% annual probability), the Soil Conservation Service's (SCS) TR-20 methodology was utilized. HydroCAD (Version 10.00) computer modeling software was used to perform these computations. This method relies heavily upon detailed watershed characteristics and historical rainfall data to model estimated peak discharge at selected recurrence intervals. The information used for these computations and resulting peak flow rates are described as follows:

- Watershed Area: LiDAR topographic data (refer to section 2.3) was obtained from the NOAA Data Access Viewer (https://coast.noaa.gov/dataviewer/#/) and imported into AutoDesk ReCAP software for processing, prior to being transferred into AutoDesk Map software. Acadia Civil Works performed manual delineation of the overall watershed, as well as associated sub-watersheds used in the analysis.
- Watershed Land Cover: Orthographic Photos obtained from the Maine Office of GIS were imported into AutoDesk Map software, along with associated NRCS soil survey boundaries. The associated landcover and soil type were determined via manual delineation by Acadia Civil Works staff to determine appropriate curve number (CN) coefficients.
- Rainfall Data: Rainfall data utilized for this modeling effort was taken from NOAA Atlas 14, point precipitation frequency estimates at the centroid location of the Lily Pond Dam

watershed. NOAA Atlas 14 states that the 24-hour, 1,000-year rainfall total for Lily Pond is 10.4 inches.

- <u>Lily Pond Storage</u>: Similar to the delineation of watersheds, the stage-storage (volume-elevation) relationship for Lily Pond also utilized LiDar topographic data to estimate associated pond storage volume relative to water surface elevations. This data was determined utilizing the aforementioned AutoDesk Map software.

Incorporating the information as described above, the peak flow rates were calculated for the 1,000 year event (0.1% annual probability) for the inflow to Lily Pond and the discharge at Lily Pond Dam. Results are shown below in Table 3.3 for the existing dam condition.

TABLE 3.3 - LILY POND
ESTIMATED EXTREME FLOW RATES
SCS TR-20 METHODOLOGY

Recurrence Interval	% Annual Probability	Peak Inflow[1]	Peak Discharge[2]
1,000-year	0.1%	1,007 cfs	105 cfs

Notes:

1. Inflow represents the peak flow of water into Lily Pond via direct rainfall and overland flow.
2. Discharge represents the peak flow of water over/through the existing dam, which accounts for the storage/detention of Lily Pond. This discharge relationship will change if the existing spillway is modified.

SECTION 4

SECTION 4
HYDRAULIC ANALYSIS

4.1 INTRODUCTION

Hydraulics is an applied science concerned principally with the practical applications of fluids in motion. In this assessment, a computer model was constructed to evaluate the hydraulic performance of the existing and proposed infrastructure in a variety of geometric and hydrologic conditions. Additional details regarding the computer model and associated hydraulic modeling techniques, as well as associated hydraulic performance results are contained in the following sections.

The primary purpose of this hydraulic analysis is to provide recommendations on infrastructure improvements at Lily Pond Dam. While the modeling footprint covers a great extent of the Pond and some areas downstream, the ultimate focus of detail is specific to the associated dam embankment and spillways. HydroCAD computer modeling software (version 10.00) was utilized in the hydraulic analysis of this project.

4.2 POND LEVEL MANAGEMENT

At the time of survey (January 6, 2021), the water level of Lily Pond was 87.3' (NAVD88). A beaver deceiver with an 18" diameter corrugated HDPE pipe was installed upstream of the concrete outlet structure. The outlet structure itself consists of an approximate two foot (2') wide concrete spillway fitted with a metal gate. At the time of the survey, the top of the gate was approximately 87.1' (NAVD88). The gate is also fitted with a threaded rod that allows the gate to be slightly elevated to allow for limited discharge under the gate panel. Based upon conversations with the Island Heritage Trust staff, this gate elevation is generally maintained and fixed throughout the year.

Photo 4.1: Beaver Deceiver at the Outlet of Lily Pond (8/8/2020)

On August 8, 2020, the water surface of Lily Pond was approximately three inches (3") below the gate crest (approx. elevation 86.8'). On June 4, 2021 the water surface of Lily Pond was effectively the same elevation as the top of the gate crest (elev. 87.1'), with a subtle discharge over the plate. Gate and beaver deceiver conditions appeared to be the same as the conditions during the time of survey.

Photo 4.2: Two Foot (2') Wide Concrete Spillway Structure with Metal Gate (8/8/2020)

Considering the median monthly flow rates provided in Section 3 (Table 3.1), it is anticipated that Lily Pond will fluctuate between elevation 87.4' during high base flow months (March) to as low as 86.4' during low base flow months (August and September). During periods of extreme drought, pond levels could certainly be lower due to subsurface groundwater seepage through the dam. Additionally, water levels during and after extreme rainfall events will also be higher as outlined in Section 4.3.

4.3 DAM SPILLWAY CAPACITY

A dam spillway should be able to convey extreme flow events safely and without the risk of dam breach or failure. During a large storm, the water surface level in the impoundment will be increased above normal median conditions, however adequate freeboard should be maintained between the dam crest and the pond water surface level. Freeboard is defined as the difference between the lowest point of the dam crest and the peak water surface elevation during a particular event. Generally, at least one foot (1') of freeboard is required at smaller dam sites (such as Lily Pond).

The following sections describe the Existing Spillway performance during large storm events, as well as proposed spillway recommendations.

4.3.1 Existing Spillway Performance

Extreme Flow events were presented in Section 3 of this report. Those flows are reiterated in the Table below, as well as key existing hydraulic performance parameters.

TABLE 4.1
EXISTING POND SPILLWAY PERFORMANCE

Recurrence Interval	% Annual Probability	Peak Discharge (cfs)	Peak Water Surface Elevation (Feet)	Dam Crest Elevation (Feet)	Freeboard (Feet)
1-year	99 %	4	87.8'	88.7'	0.9'
2-year	50 %	12	88.6'	88.7'	0.1'
5-year	20 %	18	88.9'	88.7'	- 0.2'
10-year	10 %	22	89.0'	88.7'	- 0.3'
25-year	4 %	28	89.1'	88.7'	- 0.4'
50-year	2 %	32	89.2'	88.7'	- 0.5'
100-year	1 %	37	89.2'	88.7'	- 0.5'
1000-year	0.1 %	105	89.7'	88.7'	- 1.0'

As shown in Table 4.1, the spillway at the Lily Pond dam is inadequate. In the 1-year event, there is only 0.9 feet of freeboard, which is nearly, but not quite the 1 foot target. Negative free board elevations shown indicate that the dam is overtopping. Based upon this modeling data, it appears that the dam will overtop in the five year event, which has an approximate 20% chance of occurring in any given year.

The Lily Pond dam shows clear signs of overtopping. The lowest point of the dam crest is located adjacent to the dam spillway. This area has visible evidence of erosion occurring over time and is currently being reinforced with sand bags. Reports from Island Heritage Trust staff indicates that this location of the dam has required repair with gravel fill several times in recent history. These anecdotal accounts and visual evidence are in alignment with the modeling results.

Photo 4.3: Area of Sandbag Reinforcement of Dam Embankment Erosion

4.3.2 Proposed Spillway Recommendations

As noted above, a well-performing dam spillway should maintain at least one foot (1') of freeboard during the design storm event (Inflow Design Flood – IDF). As noted in Section 3.2.4, the IDF for the Lily Pond dam is prescribed as the 1,000 year event (0.1% annual probability).

To improve the performance of the spillway, several adjustments to the Dam spillway design can be made, as follows:

- Lower Normal Pond Level: When the normal pond level is lowered, additional storage volume is available for detention within the Pond.
- Raise Dam Embankment: Similar to lowering the normal pond level, when the dam embankment is raised, additional storage is available for detention in the Pond.
- Expand hydraulic capacity of Spillway: Expanding the capacity of the spillway will increase the discharge from the pond during lower pond surface elevations.

Lily Pond generally provides recreational opportunities such as swimming and fishing that benefit from higher normal pond levels. Additionally, the wetlands and habitats around the pond have adapted to the current water level management regime, which may be degraded by reduced pond levels. Considering these factors, lowering normal pond levels was not considered a viable strategy to improve the spillway capacity of the dam. As noted in Section 4.2, the normal pond level during higher flow periods (March) is approximately 87.4 feet. For the purposes of design, an elevation of 87.4 feet was utilized as the high normal pool prior to the IDF occurrence.

Several combinations of spillway capacity improvements and dam embankment heights were considered at the Lily Pond Dam. A dam height of approximately 90.7 feet was determined to be the highest elevation possible, without making substantive adjustments to the dam footprint, while also providing flexibility of spillway placement. To maintain one foot of freeboard during the IDF, the spillway must be widened to approximately ten feet (from the existing two foot width). It should be noted that the bankfull width of the Lily Pond outlet stream is also approximately ten feet.

TABLE 4.2
IMPROVED POND SPILLWAY PERFORMANCE

Recurrence Interval	% Annual Probability	Peak Discharge (cfs)	Peak Water Surface Elevation (Feet)	Dam Crest Elevation (Feet)	Freeboard (Feet)
1000-year	0.1 %	95	89.7	90.7’	1.0’

Table 4.2 presents the performance of the recommended conceptual improvements to dam spillway capacity. This includes raising the dam embankment to a minimum of 90.7 feet, as well as widening the existing spillway to approximately 10 feet. These spillway improvements are further discussed for several different concepts in Section 7.

SECTION 5

SECTION 5
DAM CONDITION ASSESSMENT

5.1 INTRODUCTION

The Lily pond dam has been inspected several times in recent years. These prior inspection reports have been provided as Appendices C, D, and E. Acadia Civil Works reviewed these reports in detail and reviewed the dam condition in the field on multiple reconnaissance efforts. Additionally, Soil Metrics was retained to perform subsurface explorations of and adjacent to the dam (refer to Appendix B). This section provides a summary of key dam parameters, as well as a summary of the dam condition. It concludes with recommendations for dam improvement.

5.2 DAM CLASSIFICATION

The Lily Pond dam height varies from 5.7 feet to 6.0 feet (existing) and will be approximately 7.7 to 8.0 feet tall if improved (refer to Section 4.3). The dam also has an estimated maximum storage capacity of 206 acre-feet (existing) and 275 acre-feet if improved (refer to Section 4.3). These terms are defined as follows:

- Height of Dam – Shall mean the vertical distance from the lowest point of the natural ground, including any stream channel, along the downstream toe of the dam to the lowest point on the crest of the dam.
- Maximum Storage Capacity – The volume of water contained in the impoundment at maximum water storage elevation, which may be released upon a breach of the dam.

Based upon these parameters, the Lily Pond Dam is classified as a dam structure in accordance with the Maine Revised Statutes Title 37-B "Department of Defense, Veterans and Emergency Management" Chapter 24 "Dam Safety." Additionally, it is considered a **"small"** dam as it has a height less than 15 feet and a maximum storage capacity that is less than 1,000 acre-feet.

The Maine Emergency Management Agency Office of Dam Safety has determined that the Lily Pond Dam has a **"significant"** hazard potential. The Federal Emergency Management Agency has defined a significant hazard dam as one that is not likely to cause a significant loss of human life upon failure (dam breach). However, FEMA further defines a significant hazard dam as one that will likely cause significant economic, environmental, and/or lifeline losses.

If the Lily Pond dam were to breach (fail), there is significant potential that the downstream state highway (Route 15) would be overwhelmed and fail. A local fire fighting water supply is also associated with the crossing of the outlet stream and State Route 15. This state highway is also an important emergency access route for the southern portion of the island and the Town of Stonington.

5.3 EMERGENCY ACTION PLAN

An Emergency Action Plan (EAP) has been developed for the Lily Pond Dam, dated April 2020 (refer to Appendix F). The EAP includes a notification flow chart that includes local and state emergency contact numbers; description of emergency conditions requiring an emergency response; and a list of recommended procedures for responding to a dam emergency. It also includes inundation maps developed and requirements for personal training programs.

5.4 DAM CONDITION

The dam has been noted as being in "poor" condition in prior inspections since at least the year 2000. Upon our recent review, Acadia Civil Works agrees with this classification. This is defined as follows:

- Poor Condition: Through file research and after visual inspection it has been determined that deficiencies are recognized that require engineering analysis and/or remedial action. A "Poor" condition is used when uncertainties exist as to critical analysis parameters, which identify a potential dam safety deficiency. Further investigations and studies may be necessary. Significant structural operation and maintenance deficiencies are clearly recognized for normal loading conditions.

A summary of significant deficiencies are as follows:

<u>Dam Spillway</u>

- The dam spillway is significantly undersized and does not provide adequate capacity for regularly occurring storm events (refer to Section 4.3.1 of this report).
- The existing beaver deceiver further reduces the capacity of the spillway, particularly as it collects vegetation and other organic matter that obstructs the spillway opening.

Photo 5.1: Woody root intrusion, typical along the majority of the dam

Right (West) Embankment

- The area immediately adjacent to the dam spillway structure shows signs of erosion and is being reinforced and temporarily stabilized with sand bags. Based upon anecdotal accounts and some visual evidence, this appears to be due to overtopping flow events.
- Significant woody growth is present along the embankment, as well as substantial root intrusion across the section.
- General erosion is occurring on the upstream embankment of the dam at the normal waterline of Lily Pond, due to wave action and hydraulic effects.

Left (East) Embankment

- There is significant variance associated with the top of dam elevation, which is being exacerbated by foot traffic erosion.
- Similar to the right embankment, significant woody growth is present along the embankment, as well as substantial root intrusion across the section.

- A portion of this embankment is supported by dry laid stonework. Some erosion of the embankment (likely due to overtopping) is occurring and causing loss of soil cover and stonework.
- General erosion is occurring on the upstream embankment of the dam at the normal waterline of Lily Pond, due to wave action and hydraulic effects.
- Seepage is evident along the downstream toe of the embankment, as well as some limited pools of standing water. This seepage has been evident since at least 2013.
- A significant "boil" of water is evident adjacent to the spillway along the downstream toe of the embankment. Sandbags have been placed around the boil to limit the overall hydraulic pressure. The boil does not appear to be an imminent threat, however this could change quickly during a large storm event that may increase hydraulic pressure and trigger a piping erosion failure.

Photo 5.2: Significant hydraulic boil located along the dam toe adjacent to the Spillway

5.5 IMPROVEMENT RECOMMENDATIONS

Based upon the dam condition described above, the following actions are recommended:

Immediate:

- Remove all woody vegetation along the dam embankment and within a distance of fifteen feet (15') from the toe of the dam. Do not remove the stumps, as this could trigger additional "boils" or piping erosion that may destabilize the dam.
- Clear the debris around the beaver deceiver and keep it clear at all times
- Closely monitor the existing "boil" of water adjacent to the dam spillway, as well as any observable seepage along the dam toe. If the "boil" appears to be worsening (i.e. appears to be dirty water and/or an increase in flow rate) or if new boils are noticeable, dam failure may be imminent and emergency personnel should be notified in accordance with the EAP.
- Closely monitor the dam during and after extreme storm events to observe if dam overtopping may occur and if there is a threat to the structural integrity of the dam due to overtopping erosion.
- Lower the lake level as much as possible, until permanent improvements can be accomplished.

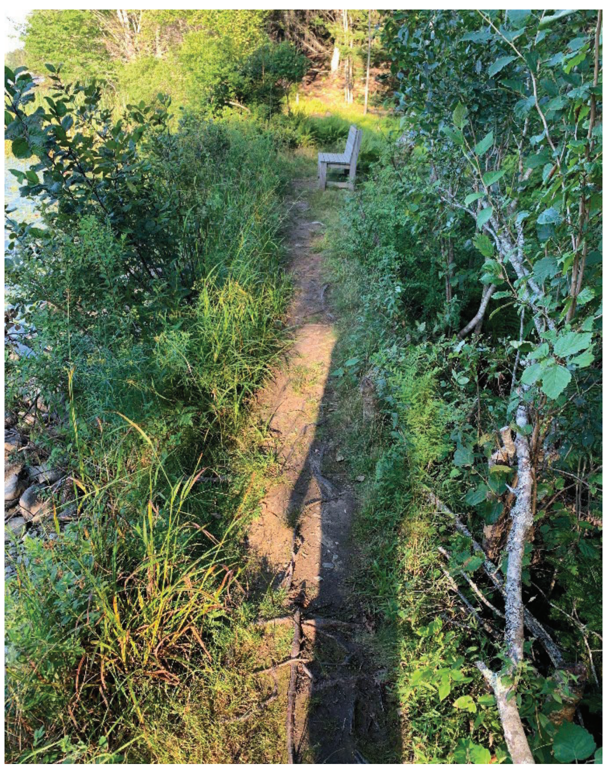


Photo 5.3: View of left embankment, including foot traffic erosion and root intrusion

Permanent Improvements:

Conceptual engineering improvement options for the dam are discussed further in Section 7 of this report. Refer to this section as well as the plans attached in Appendix G, for additional information on the various potential improvement options. In general, these improvements are intended to achieve the following recommendations:

- Prior to performing any of the improvements outlined below, a cofferdam shall be placed upstream of the dam so that the work can be performed in the dry and with reduced hydraulic pressures.
- Remove all woody vegetation along the dam embankment and within a distance of fifteen feet (15') from the toe of the dam. Also be sure to remove any significant stumps. Stump voids shall be backfilled with low-permeability material and compacted in accordance with the geotechnical engineer's recommendations (refer to appendix B).
- A sand filter and toe drain shall be installed along the entire downstream face of the dam in accordance with the recommendations of the Geotechnical Report (refer to appendix B).
- Additional low-permeability embankment material shall be placed as fill to raise and widen the embankment to slopes and grades as shown on the engineering plans.
- A well-established catch of grasses and/or wild flowers (non-woody stems) shall cover the earthen embankment.
- Stone shall be placed along the upstream face of the dam to limit erosion from wave action and hydraulic action associated with the normal pool elevation of Lily Pond.
- Limit foot traffic along the dam crest to avoid associated erosion and loss of vegetation.
- Improve the spillway capacity as outlined in Section 4.3.2 of this report.

SECTION 6

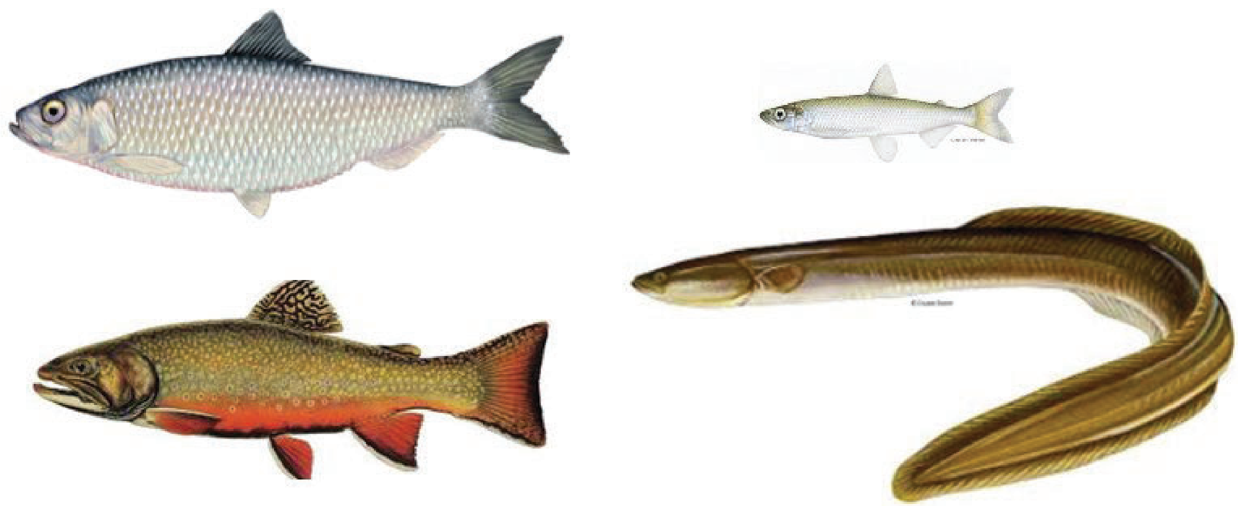
SECTION 6
FISH PASSAGE DESIGN CONSIDERATIONS

6.1 INTRODUCTION

The feasibility of fish passage options is dependent on a variety of factors. Some of the most critical are associated with site-specific existing conditions and the hydrology of the location. However, there are several other considerations, such as specific species of interest, biological capacity, and operational requirements which also play a role in selection.

6.2 SPECIES OF INTEREST

There are many aquatic organisms and fish assemblages that will benefit from improved habitat connectivity in Lily Pond and the outlet stream. However, from a habitat perspective, the river herring (particularly alewives) are likely the species with the most to gain and are also likely to experience the most significant tangible biological response. That said, several other species of fish also should be considered in the design, such as the rainbow smelt, brook trout and American eel.



Primary Species of Interest
Clockwise from the upper right: rainbow smelt, American eel, brook trout, alewife
Image Credit: NOAA, USFWS, MeDIFW, Kano Serrano, Jack Hornady, and Duane Raver

The alewife is considered an anadromous fish. This describes its general life cycle, which includes an upstream migration in the spring to freshwater bodies for spawning and incubation, with the adults migrating back downstream after reproduction to marine waters where they live the majority of their life. The newly hatched fish emerge in the summer and also migrate downstream to estuaries and salt-water rearing areas over the course of the summer and fall, as they gain in maturity and begin to live their life in these marine waters.

The American eel is considered a catadromous fish. Similar to anadromous fish, the American eel migrates from marine to freshwaters as part of its life cycle. However, the primary difference is that a catadromous fish reproduces in marine waters and lives the majority of its life in freshwater bodies. As such, it is the juvenile eels born in the sea, which migrate upstream in the Spring to lakes and freshwaters to live the bulk of their lives.

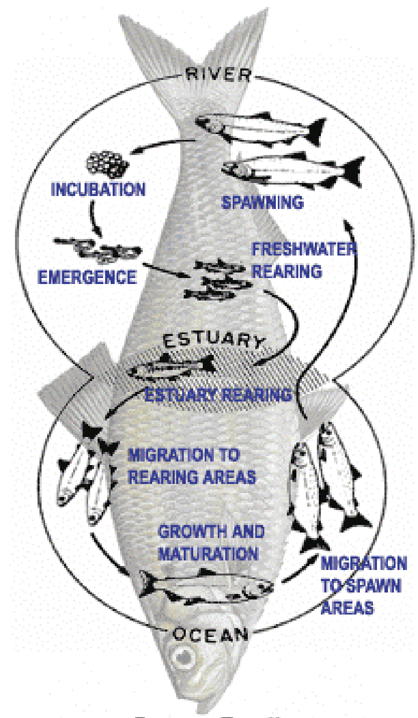


Image Credit: Penobscot River Restoration Trust

It is also important to note that the American eel is likely already present in Lily Pond. The juvenile American eel (also referred to as an elver) is somewhat capable of ascending over dams (or other traditional obstructions) provided that a rough and damp surface exists for them to climb. Generally under the cover of darkness, elvers can be observed during migration periods "climbing" up dams or natural ledge features to access upstream waters. While not necessarily efficient, there is the ability for some elver passage at this site, as they can climb various damp surfaces. Once these elvers reach the upstream waters they are able to mature and live much of their adult lives before heading back to the sea for reproduction.

Alewife are not known to be present in the Lily Pond system. It is unclear if there was a historic run, however it is clear that the current dam, as well as the downstream culvert at State Route 15, are a barrier to passage. The lack of alewife in the system is likely due to the inability for these fish to migrate and reproduce in Lily Pond, since there are ample alewife present in Penobscot Bay.

Brook trout are also notable in this system. Lily Pond has historically been a good brook trout fishery. However, according to MeDIFW, the fishery declined through the 1990s for a variety of reasons, including increased competition from other warm water fish (sun fish). As such, brown trout were introduced in 1999, as they had the potential compete better with the warm water fish.

MeDIFW continues to stock both brook trout and brown trout in Lily Pond. In 2021, MeDIFW stocked fifty (50) brown trout (@ 12" each) and 1,100 brook trout (@7" each), which is consistent with what has been stocked annually for the prior several years.

While brook trout are more known as a freshwater species, they have also historically been a common "sea-run" species. However, sea-run brook trout (aka "salters") have declined significantly across their range in recent decades. The potential connectivity between Lily Pond and Penobscot Bay could provide habitat for sea-run brook trout if connectivity were restored at both Route 15 and the Lily Pond Dam.

Rainbow smelt are also an interesting species at this location. There is a strong population of rainbow smelt in Lily Pond, however these are effectively a "landlocked" version of the species which has adapted over many centuries similar to manly lakes across the state of Maine. Of more significant restoration interest, is the sea-run variety of rainbow smelt, as they have been listed as a "Species of Concern" by the U.S. Federal Government since 2004. Similar to Alewife, these sea-run rainbow smelt are an anadromous species, which seek freshwater systems to spawn. However, unlike the alewife, the rainbow smelt is not a particularly strong swimmer and they are seeking stream habitat for reproduction (not lakes or ponds). As such, the habitat of value for the rainbow smelt is typically on the fringes of saltwater along this initial stream reaches just upstream from brackish water. As such, it is unlikely that fish passage restoration at the Lily Pond dam will be meaningful to the smelt. However, improvement to the culvert crossing at State Route 15, could provide valuable habitat for sea-run smelt as it would provide access to the stream habitat below Lily Pond and adjacent to Mill Pond (brackish).

6.3 HARVEST

The restoration of alewives is important to the ecology of freshwater, estuarine, and marine environments alike. They are a fundamental part of the food chain, not only as forage for marine fish (striped bass, tuna, cod), but also for freshwater fish (bass, pike, trout, salmon), birds (osprey, eagles, heron, loons), and mammals (racoon, weasel, fisher). Alewives and other migratory fish tie our marine and freshwater habitats together and improve the foundation of both ecosystems.

In addition to ecological benefits, the alewife is also a resource traditionally utilized by humans. In the 1800s, the bulk of alewife harvests was for human consumption, as they were well preserved in salt or smoked. However, with the advent of refrigeration technologies and a general shift in food supplies, the current harvest of alewives is predominantly as bait for the lobster industry. Hundreds of thousands of pounds of river herring are harvested annually, similarly valued in the hundreds of thousands of dollars for these annual landings.

Upon the restoration of river herring in the Lily Pond system, there is potential for future harvest of this renewable resource. As such, fish passage structures to be implemented in this system should consider the opportunity and potential for harvest in the future.

Regulated Commercial Alewife Harvest Operation at a the Webber Pond Fishway (Vassalboro)
Image Credit: Alewife Harvesters of Maine

In general, fisheries approved for harvest of river herring are allowed to remove approximately sixty percent of the of fish which return to spawn at any given location. The remaining forty percent of the population pass upstream to spawn to maintain a sustainable population. Harvested locations must pass a minimum of 35-fish per acre of pond habitat and observe returns of 235 fish per acre before the Atlantic States Marine Fisheries Commission (through consultation with Maine DMR) certifies the population as sustainable.

Commercial harvest season starts when the fish arrive and runs until June 5 of any given year. Harvest occurs four days during the week, allowing three days for required escapement. Towns coordinate all commercial harvest operations and manage the harvest in cooperation with the Maine Department of Marine Resources. The revenue from commercial harvest can be worth in excess of $150,000 annually. Towns within the watershed typically share revenue based on an interlocal agreement developed among the towns.

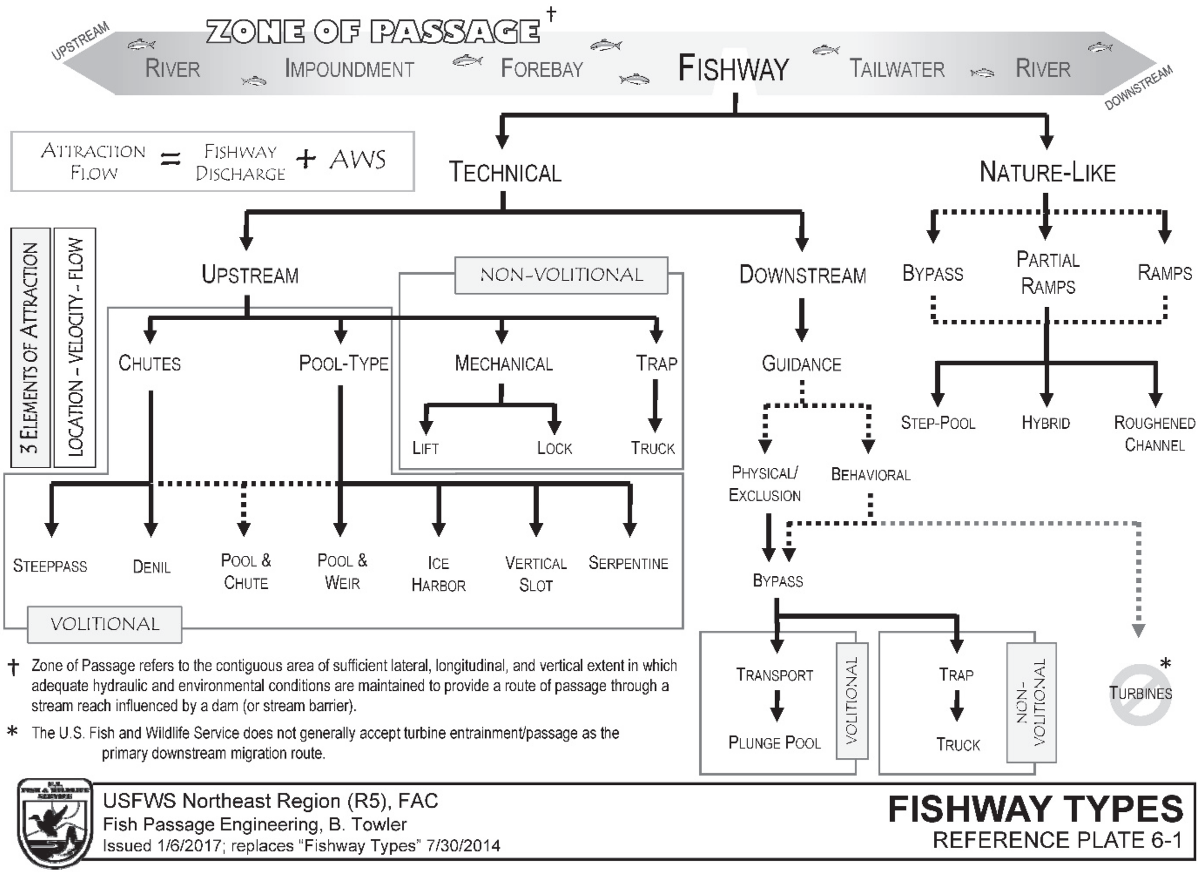
6.4 ESCAPEMENT AND PRODUCTION

The word "escapement" is a term used in fisheries management to refer to how many fish are able to "escape" premature death and complete their life cycle. In the context of this analysis at Lily Pond, it generally equates to the number of fish that can pass by the dam (via fishways or otherwise) and access the Pond habitat.

If unrestricted access (full escapement) is provided to alewives in Lily Pond, then there is the potential for a significant biological response in their production. This production is somewhat directly related to the available habitat upstream of the dams and accessible by the alewives. Based upon the water surface area of Lily Pond (approx. 35 to 37 acres depending on the precise water level), it could produce alewife runs in the range of 8,000 to 15,000 fish annually (based upon production rates of 235 per acre and 400 per acre, respectively).

6.5 FISHWAY STYLE OPTIONS

There are many different types of fish passage options. When complete removal of a barrier is not possible or desired, there are an array of structural options to consider. These options are primarily split into two (2) major categories: Technical and Nature-like. There are also many further divisions as shown on the following tree of fishway types provided by the U.S. Fish and Wildlife Service.



6.5.1 Nature-Like Fishways

Nature-like fishways consist of a family of structures that try to mimic natural stream and river forms, while also use "natural" materials like rock, gravel, and logs to provide passage for fish and aquatic organisms. Nature-like fishways can be an attractive option, both aesthetically (as it provides a more natural appearance than concrete or aluminum structures), as well as passage efficacy. Generally, nature-like fish passage structures provide a complex hydraulic condition that more closely mimics natural stream conditions. Nature-like fishways also generally require less operation and maintenance than technical fishways, which can be an added advantage. For additional detail and technical information, refer to the "Federal Interagency Nature-Like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes" dated May 2016, which is a collaboration of NOAA, the USGS, and the USFWS. Design information and nature-like structures considered in this report are generally in conformance with that document.

While there are many benefits to nature-like structures, the drawbacks are generally associated with their use at higher head (taller dam) sites. The slope of nature-like fishways is generally in the range of 1 foot vertical for every 20 to 30 foot horizontal. So, for a dam site that is 10 feet tall, a nature-like fishway would be in the range of 300 feet long, or likely more as resting areas are incorporated. So, at tall dams or high head barrier sites, nature-like fishway become less practical and less economically feasible.

Example of a Nature-Like Fishway (Patten Stream in Surry, ME)

When conditions are right, however, nature-like fishways generally provide better passage conditions than technical fishways. They are more open to natural sunlight and generally more like a natural stream (compared to a technical fishway). Nature-like fishways can provide better passage conditions to a wider array of aquatic organisms. They can also provide better efficacy with larger fish populations (greater biological capacity).

In the context of the Lily Pond Dam, it's relatively short height (hydraulic height of approximately six feet) makes "nature-like" fishway a feasible consideration. A nature-like fishway would also benefit the American eel, as well as other aquatic organisms that may not swim as strongly as the brook trout or alewife.

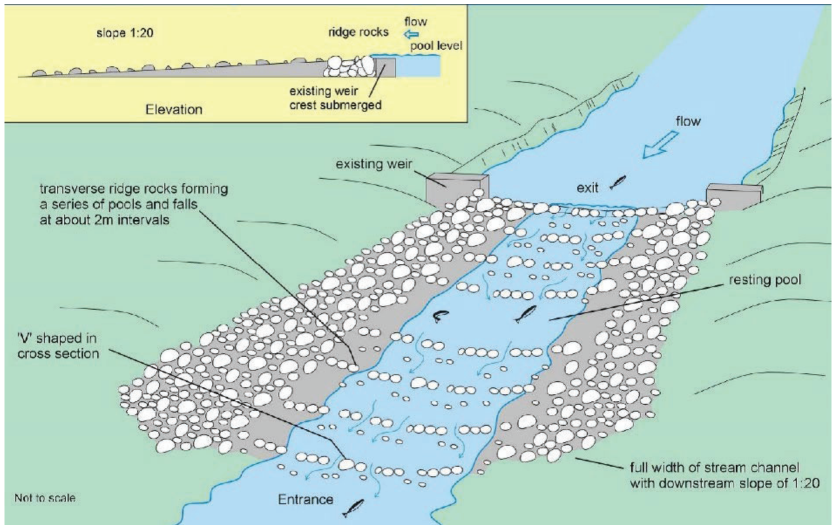
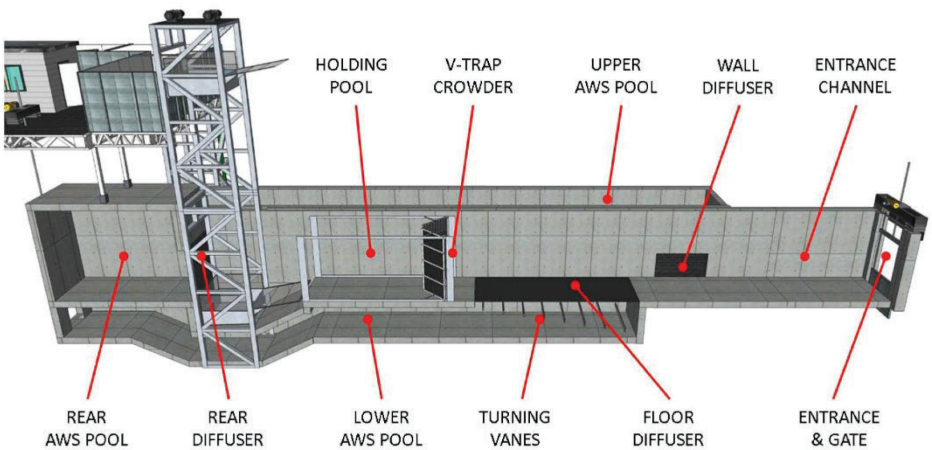


Illustration of a Nature-like Rock Ramp Fishway
Image Credit: Paragraphics

6.5.2 Technical Fishways

As noted above, technical fishways generally may not perform quite as well as nature-like fishways, however when properly designed, a technical fishway can provide outstanding efficacy in a smaller footprint. With higher head (taller) dam structures, technical fishways become more feasible and cost effective than their nature-like counterparts.



Cross Section of a Non-Volitional Fish Lift (Elevator)
Image Credit: U.S. Fish and Wildlife Service

The tree diagram of fishway types published by the USFWS (page 6 – 6), shows a series of technical fishways that are noted as non-volitional. These non-volitional fishways include options such as trapping and trucking, as well as lifts (elevators) and lock mechanisms. This study has not considered non-volitional fishway technologies. This is primarily due to the cost to construct these structures, as well as the operation and maintenance intensity that is required to keep non-volitional fishways effective. We anticipate that a volitional fishway will provide cost-effective and more sustainable solution at the Lily Pond dam.

The focus of technical fish passage styles most suited to Lily Pond are the baffled chute styles, particularly the steeppass and the Denil. The Each of these styles is generally described below.

The most popular types of chute style fishways in use on the East Coast are Alaska steeppass fishways and Denil fishways. Alaska steeppass fishways are quite effective when used appropriately, however they are small and have limited flow capacity, as well as limited biological capacity. Based upon USFWS data, an Alaska Steeppass can provide acceptable passage efficacy for approximately 50,000 adult river herring annually.

Example of an Alaska Steeppass fishway installed at a Low-head Concrete Dam
Image Credit: Sheepscot Fishways

A Denil style chute fishway may also be an appropriate technology to consider. While the U.S. Fish and Wildlife Service rates the biological capacity of a 4' Denil ladder to be approximately 200,000 fish annually, there are examples of Denil Ladders in Maine that carry as many as 1,000,000 fish annually. This type of capacity is excessive compared to the anticipated run at Lily Pond, however the Denil style fishway can provide better attraction conditions and efficacy than their Steeppass counterparts. Additionally, it is likely that a two (2) foot wide Denil would be most appropriate at Lily Pond, which will have more capacity than a Steepass, but will have significantly reduced capacity from its four-foot-wide version.

Example of a Denil fishway installed with two (2) ladder sections connected by a resting/turning pool

The chute style fishways functionality stems largely from the "baffles" that are placed in the chute. The slope, spacing, and dimensions of the baffle create a hydraulic condition that has proven effective for river herring and has been in use for nearly a century at various sites in North America. Generally, these fishways are broken up into a series of ladders (sloped chute sections with baffles), which allow fish to climb vertically. The individual ladders are generally limited to heights of six (6) to eight (8) vertical feet and are sloped are generally sloped (at 1:5 for Steepass and more gently at 1:8 for a Denil). These baffed chute ladder sections are interconnected with resting pools to allow for fish to ascend the chute and rest, before making an attempt at ascending the next section.

As noted above, river herring (blueback herring and alewife) are known to utilize chute style ladders effectively. However they are not effective with American eels. Provisions for separate eel passes may be warranted at either dam site to be utilized in combination with a chute style ladder. Additionally, many weaker swimming species (such as rainbow smelt) are not able to utilize these fishways.

6.6 ATTRACTION

In general, fishways will convey only portions of the discharge at a dam site. There is typically some other form of spillway that is also conveying flow. When fish approach a dam and fishway, they must be attracted to the fishway for it to be effective. For example, if fish are more attracted to the discharge from the dam spillway, as opposed to the entrance of the fishway, they may swim about in the spillway discharge for days before finding the fishway entrance. Worse yet, they may never find the fishway at all.

Successful fishways must create hydraulic signals strong enough to attract fish to the entrance in the presence of competing flows. Note that the left-hand side of the fishway style tree provided by the USFWS (page 6-6), states the three elements of fishway attraction are location, flow, and velocity. Each of these elements is described further in the following paragraphs.

If given the choice between a smaller flow or a larger flow, it is likely that a migrating fish would be initially more attracted to the larger flow. In fact, the most attractive flow conditions are when there is only one primary flow in the fishway (i.e. no competing flows). However, this is rarely the case, particularly with technical fishways.

Location and velocity can be further utilized to increase attraction to the fishway. From a location perspective, the fishway entrance should be placed in a location where fish would otherwise be attracted. This attraction could be due to channel geometry other spillway discharges or both. Additionally, a restriction at the entrance of the fishway (often times with some level of controlled adjustment) can be useful to create a velocity jet. The increased field of velocity directed in the appropriate location can greatly enhance fishway attraction.

For Lily Pond, the fishway entrance should be located as near to the dam spillway discharge as possible. Additionally, the relatively small median monthly flows at the site, including frequent rainfall events may be able to be routed entirely within the fishway itself, particularly with the use of a nature-like fishway or a Denil fishway. This routing of the entire discharge within the fishway will maximize attraction and overall efficacy. The Alaska steeppass should still be attractive, but may require more careful placement and consideration of the attraction jet.

SECTION 7

SECTION 7
DAM IMPROVEMENT CONCEPTS

7.1 INTRODUCTION

Utilizing data and information from each of the prior sections, Acadia Civil Works developed a series of conceptual improvements for the Lily Pond Dam. These improvements include several types of fishways, as well as several spillway improvement alternatives. Each concept is described in further detail in the following sections. Additionally, each concept has been depicted graphically on a plan in Appendix G.

It is important to note that each concept below has a different spillway and fishway combination. These spillways and fishways can be somewhat interchangeable. For instance, the open concrete spillway depicted on Concept B can be combined with the Steeppass fishway shown on Concept C. These concepts have been prepared to illustrate a variety of potential solutions at the site, which will be able to inform the next steps in the design direction for the project.

7.2 CONCEPT A – NATURE-LIKE SPILLWAY AND FISHWAY

Concept A reflects a “nature-like” styled, pool and weir channel. The channel is able to function as both the primary dam spillway, as well as a fishway. The overall slope of the channel is 1 foot vertical for every 20 feet horizontal, which is well suited for brook trout and alewife. American eel would also utilize this type of fishway. The overall bank width of the channel (10’ +/-) is similar to the natural stream bankfull width. This “nature-like” channel is also a fixed geometry, unlike some of the other concepts where boards and/or stoplogs are used to make pond water surface adjustments. As such, Concept A also reflects a 12” diameter ductile iron pipe for fire water supply purposes. More information about this fire water solution is provided in Section 8.

From a dam embankment perspective, Concept A depicts dam improvements as outlined in Section 5.5. The downstream face of the dam (as shown in cross section ‘X’) depicts the sand/gravel drainage filter with a toe drain. The slope is also reinforced with riprap at a 2H:1V slope. On the upstream face, the slope is more gentle (3H:1V). At the pond waterline, a boulder bank is shown to prevent erosion and also to maximize the vegetation along the embankment. Note that all trees and brush (woody stems) have been cleared from the dam footprint to at least 15 feet from the embankment toe.

7.3 CONCEPT B – OPEN CONCRETE SPILLWAY WITH DENIL

Concept B represents more traditional and structural spillway and fishway structures. At the center of the dam embankment is an open ten foot (10') wide spillway structure. In some ways, this spillway structure is similar to the existing two foot (2') wide concrete spillway, however this concept is a significantly expanded version. Wooden stoplogs are located at the spillway crest, which can be used to make adjustments to pond water surface levels. From a firefighting water supply perspective, these boards can also function much like the existing metal plate, whereas boards can be pulled to increase flow in the stream. However, a 12" ductile iron pipe with a gate valve has also been provided, similar to the other concepts and as described in Section 8.

From a dam embankment perspective, Concept B depicts dam improvements that are very similar to Concept A. The downstream face of the dam (as shown in cross section 'X') depicts the sand/gravel drainage filter with a toe drain. The slope is also reinforced with riprap at a 2H:1V slope. On the upstream face, the slope is more gentle (3H:1V). At the pond waterline, a boulder bank is shown to prevent erosion and also to maximize the vegetation along the embankment. Note that all trees and brush (woody stems) have been cleared from the dam footprint to at least 15 feet from the embankment toe.

Fish passage on this concept has been provided via a separate fishway. Concept B depicts a two foot (2') wide concrete Denil fishway. This type of baffled chute will provide adequate passage for alewife and brook trout. However, many other aquatic species may not be able to use this fishway, such as the American eel.

7.4 CONCEPT C – PRECAST CONCRETE CULVERT SPILLWAY WITH STEEPPASS

Concept C has been prepared with the goal of reflecting the least cost option for all improvements. As such, the spillway and fishway are all prefabricated structures, which are generally less expensive than fabricating onsite. This includes the use of precast concrete components for the dam spillway and culverts, as well as pre-fabricated aluminum fishway segments (steeppass).

The precast concrete spillway is also an enclosed spillway, where discharge from Lily Pond will spill into a vertical tank structure before being discharged through the dam embankment via a concrete box culvert. Due to the enclosed nature of the spillway, it may be susceptible to clogging and blockage during the extreme design flood. As such, an open emergency spillway will be required. This riprapped emergency spillway channel will rarely be wet, however it exists as a redundant spillway and may discharge during some of the larger storm events.

The steeppass fishway is the steepest, smallest, and most turbulent fishway option. However, this type of fishway had demonstrated adequate performance for both alewives and brook trout passage. Similar to the Denil (Option B) this type of fishway will not be friendly to all aquatic organisms, including the American eel.

Regarding fire water supply, it may be possible to fit the precast concrete spillway with boards to allow for pond level adjustments, as well as an ability to increase discharge for fire flows. That said, a 12" ductile iron pipe with a gate valve has also been included, similar to the other concepts.

A notable change to the dam embankment on Concept C, is the upstream face. It will likely be cheaper to riprap the entire upstream face (rather than carefully place boulders along the waterline). This is also a very stable and functional option. Yet, this riprap face will be a significant aesthetic factor. As opposed to a green and natural look (as provided in Concept A and B), the angular stone will look somewhat manufactured.

7.5 OPINION OF PROBABLE CONSTRUCTION COSTS

An estimate of the probable current cost of construction has been prepared for each option. These costs are outlined in the table below. Additionally, more detailed estimates for these concepts are included in Appendix H.

TABLE 7.1 - CONSTRUCTION COST ESTIMATE SUMMARY

	Concept A "Nature-Like"	Concept B Concrete-Denil	Concept C Precast-Steepass
Dam Improvements	$ 252,000	$ 323,000	$ 268,000
Fishway Improvements	$ 281,000	$ 277,000	$ 72,000
Est. Construction Cost	**$ 533,000**	**$ 600,000**	**$ 340,000**

SECTION 8

SECTION 8
DOWNSTREAM STRUCTURE ALTERNATIVES

8.1 INTRODUCTION

As discussed in Section 5.2, the Lily Pond Dam is classified as a "significant" hazard structure. Much of this classification is due to the infrastructure located at the downstream state highway (Route 15). The existing culvert crossing at Route 15 would not be able to handle the associated flow if the dam were to fail and a large volume of water was released from Lily Pond. This would almost certainly damage the roadway, as well as the associated fire fighting water supply at that location.

The following paragraphs of this report discuss each of these elements in more detail, as well as alternative strategies for improvement.

Fire Water Tank at Outlet of Culvert – Looking upstream with Route 15 in the Background

8.2 ROUTE 15 STREAM CROSSING

The stream crossing at Route 15 is a square, dry laid stone culvert structure with an approximate 24" to 30" span. At the inlet of the structure (upstream of Route 15) the structure has wingwalls of dry laid stone, as well as some sort of stone grade control structure in the channel. As the culvert crosses

Route 15 it ultimately discharges into an aging concrete tank on the downstream side of the culvert. This concrete tank is used by the fire department to draw water from the stream for fire fighting purposes. As shown in the photo on the prior page, the tank structure is deteriorating and it represents a barrier to fish passage.

Route 15 Culvert Inlet – Looking Downstream

Acadia Civil Works staff has walked the entire length of the stream from Lily Pond to Mill Pond and found no other distinct barriers to fish passage. However, the outlet of Mill Pond is tidal and only provides aquatic organism passage during the high portions of the tide cycle. However, anecdotal reports indicate that marine species are crossing through this partial barrier. As such, the only apparent barriers to restoring fish passage to Lily Pond are the dam itself and this crossing at Route 15.

Current State and Federal stream crossing regulations will likely someday require that this culvert crossing is replaced with a passable structure. Of particular note are the requirement to provide culvert crossing structures that span at least 1.2 times the bank width of the associated stream, as well as the provision for a natural stream channel invert (bottomless or buried invert structure). The bankfull width of the stream system is approximately 10 feet, which would suggest a structure with an approximate 12 foot span may someday be constructed at this location. Based upon our recent experience with culvert crossing infrastructure projects, we anticipate the current construction value of the crossing improvement is in the range of $350,000 to $500,000.

This stream crossing improvement may be complicated by the existing fire water supply, unless an alternative fire water intake can be developed. These fire water alternatives are discussed further in Section 8.3.

Improvement to the crossing infrastructure at Route 15 may also consider the potential breach of the dam at Lily Pond. If the crossing infrastructure is able to convey flow under Route 15 (without threatening the traveled way or causing damage to the associated highway infrastructure) it is likely that the Lily Pond Dam hazard classification could be reduced from its current "significant" hazard status to a "low" hazard status. However, it remains unclear how large this structure may need to become to accommodate the breach. It is likely that the 12 foot span (to accommodate bankfull requirements) may need to increase to 20 or more and could potentially double the construction value noted above. Further study is warranted to make more definitive determinations in this regard.

It should be noted that neither the Town nor the State of Maine have much motivation to increase the size of the Route 15 crossing beyond the regulatory requirements (i.e. 12 foot span). As such, it is unlikely that the crossing at Route 15 will be improved to a 20 foot span by either of those entities, unless additional separate funding is provided. As such, it is unlikely that the Lily Pond Dam will ever be reduced below its current "significant" hazard without a concerted effort to do so.

8.3 FIRE PROTECTION ALTERNATIVES

Acadia Civil Works retained the services of Rural Fire Protection to review the current fire water supply system and to evaluate alternatives. The following paragraphs are a summary of this exercise.

8.3.1 Existing Fire Protection Infrastructure

The existing fire water supply at Route 15 has been in place for many decades and represents a key fire water supply for the area businesses and structures along Route 15 and Main Street. That said, the current supply does not meet any current form of fire protection standards (NFPA), nor does it receive credit from ISO (Insurance Services Office) as a supply that reduces property insurance requirements for businesses and residents in the area. That said, it does represent a semi-practical fire water supply which may benefit fire fighting activities, if the supply is available.

In order for the Fire Department to utilize this supply, personnel must first travel up to the Lily Pond dam to pull the metal plate that is currently in the concrete spillway. By pulling this plate, discharge from the pond increases as it flows downstream to the Route 15 tank. However, there are times of year, particularly in August and September, when the water level of Lily Pond is at or below the bottom of the plate. So in these circumstances, additional discharge from Lily Pond is not available. Without that added discharge from the Pond, the stream base flow is not adequate to serve the pumping operation and the fire department will quickly pump the existing tank and stream dry.

During times when Lily Pond is high enough to provide the required discharge, the supply can be utilized. However, there is significant delay in response time associated with the supply. It can take a half hour or more to make the supply available as personnel travels up to the dam, removes the plate, and the stream flow eventually increases to the point of usage downstream at the tank. This type of response time is unacceptable from an ISO perspective and could certainly be improved.

The age of the tank is also notable. The concrete is in poor condition and spalling in several locations. It appears that there have been several attempts to repair the structure over time, including the use of masonry blocks, which are now also exposed and spalling. Overall the structure is serviceable, but requires significant repair to remain stable and useful for the years to come.

8.3.2 Fire Department Water Supply Needs

Rural Fire Protection staff (Mr. Troy Dare) has coordinated with the local fire department (Mr. Brent Morey) to determine the fire water supply needs for this location. Based upon those conversations, it appears that the fire department has two (2) pump trucks that can each pump at a rate of 1,250 gallons per minute (2,500 gpm total). Additionally, this pumping may need to occur for two (2) hours of continuous pumping in the event of a fire. Considering this duration and pumping capacity, an ideal volume of water for this supply is approximately 300,000 gallons.

The 300,000 gallon sizing would be ideal for the current capabilities of the fire department. However, ISO would give credit to a system that is able to produce a flow of at least 500 gallons per minute for the same 2-hour duration. While this system (requiring only 60,000 gallons of water storage) may provide some ISO benefits, it would not allow the fire department to function at maximum capacity.

Overall, the National Fire Protection Association (NFPA) standards for these fire protection systems give wide latitude to the Authority Having Jurisdiction (AHJ) to make determinations of the appropriate volumes and flow rates required of these fire water supply systems. While the flows noted above should be in the current range of sizing, final sizes and designs will need to be coordinated and approved by the local AHJ (fire department).

8.3.3 **Alternative Water Supply Concepts**

Rural Fire Protection staff (Mr. Troy Dare) coordinated with the fire department (Mr. Brent Morey) to find alternative water supply sources on the island. While there are a few other small ponds and sources on the island, none of them were in close enough proximity to this area of Town to be usable. Ultimately, Lily Pond is the only freshwater source in proximity to the Route 15 and Main street corridor to provide a similar function to the existing system, which also functions as a relay point for trucks to fight fires in other areas on the Island.

Each of the alternatives outlined below, continue to use Lily Pond as the source of fire fighting water, however they provide for alternatives that improve the current situation. Further engineering evaluation will be required of any of these concepts prior to moving forward.

<u>Concept A – Direct Pipe Connection to Lily Pond</u>

One of the first concepts discussed is associated with installing hydrant at the current location (Route 15 stream crossing) with a direct connection to Lily Pond. This concept involves running a pipe generally parallel to the existing stream for approximately 2,500 feet between the hydrant and Lily

Pond. This would provide a near unlimited supply of water (millions of gallons) at the current location that is available immediately, and does not rely upon dam operations.

Unfortunately the logistics of running this pipe are challenging. There is the potential for significant environmental impact in trenching and laying pipe along this route. Additionally, easements to place and maintain this pipeline would need to be acquired from many private landowners along the route. As such, this option has not been well received in conversation. However, if the easements could be acquired and the tree clearing/environmental impact was tolerable, this pipe could probably be constructed for a cost in the range of $500,000 to $650,000.

Concept B – Underground Tank Storage Adjacent to Route 15

Another option discussed was associated with the placement of large underground storage tanks under the roadway and parking area at the current location (Route 15 stream crossing). By installing storage tanks at this location the water would always be immediately available and would not be dependent on dam operations at Lily Pond. The tanks could be filled slowly from the stream during periods when the fire water supply is not in use.

The primary drawback of this option is the land available for these tanks. It is unlikely that a tank system greater than about 20,000 or 30,000 gallons could be constructed at this location. This level of storage is not enough to meet ISO standards, nor the ideal supply volume, however it could provide for a reliable supplement that is ready at all times. Overall this tank system would require easements and coordination with the Maine DOT (in/adjacent to the right of way) and potentially the adjacent private property owner. The approximate construction value of this option is $250,000 to $350,000.

Concept C – Tank Located near the Ball Park off Church Street

To provide a full water supply (in the range of 100,000 to 200,000 gallons), alternative water storage tank locations were evaluated. One location identified was the Ball Field property located at the top of the hill (south of the current crossing location) and just north of the Town Office. An above ground tank could be located on this parcel for water storage, while also providing for fire truck access. This location is also more conveniently located to the nearby propane storage facility, which is the most significant fire risk in the area. Construction of storage tanks on this parcel could cost between $500,000 and $800,000 depending on the size of the storage volume desired.

In addition to these tanks, a hydrant could also be installed in the current crossing location, with a direct pipe connection to the tanks. This could be accomplished by running a pipe from the tanks and along the side of Route 15 down to the current site (approx. 1,800 feet). The additional cost of running this pipe and installing a hydrant at the Route 15 crossing would be approximately $300,000 to $400,000.

<u>Concept D – Pump House with Relay to the parcel adjacent to Deer Run Apartments</u>

A fourth concept has been developed that is somewhat different that the others, as this would move much of the fire truck activity away from the current location (culvert crossing at Route 15). For Concept D, a pumping relay would be established. This relay would effectively move fire truck traffic into the Deer Run Apartments driveway, which is the closest roadway to the Lily Pond Dam. It also has a wide roundabout which would allow for easy access for the fire trucks to enter and turnaround to queue for a firewater relay. Adjacent to the driveway would be a storage reservoir (perhaps 10,000 gallons) as well as a control station. Up at Lily Pond, a small pump house would be constructed, which contained a pumping unit that could draw water from Lily Pond and send it over to Deer Run. The Lily Pond Pump House and the tank at Deer Run would be connected by a forcemain pipe (between 3" and 6" in diameter). A sketch of this concept has been provided as Appendix I to this report.

In the event of a fire, the tank trucks would be able to go directly to the storage tank on Deer Run and begin taking water. The panel at Deer Run would control the pump equipment at Lily Pond, which would engage and relay water from Lily Pond to the tank at Deer Run. This system would maximize the availability of water (millions of gallons) as it would be drawing from the Lily Pond reservoir. However, the rate of flow has the potential to be a limiting factor. A 300gpm or 500gpm pump system will be less expensive than a 1,000gpm or 1,500gpm pump system.

The construction cost of this system is in the magnitude of $200,000 to $300,000 on the lower end of the pumping range to as much as $500,000 or more for additional pumping capacity. It should be noted that a single fire truck can pull water at a rate of approximately 1,250 gpm, however the pumping capacity does not necessarily need to match this rate. During the shuffling of pump trucks, there is some down time for the Lily Pond pump station to catch-up as trucks are connected and moved through the queue.

This system would also require easements from private properties that would need to be obtained and negotiated. However, much of the pump structure, tanks, and piping could be run in existing corridors and cleared areas. Refer to Appendix I for a schematic sketch of this concept.

SECTION 9

SECTION 9
CONCLUSION

The Lily Pond Dam is a "significant" hazard structure that is in "poor" condition. The most substantive dam deficiencies include the following:

- Significantly undersized spillway discharge capacity, which has led to regular overtopping of the embankment and erosion of the embankment crest requiring frequent repair and stabilization with sandbags.
- Overgrown woody vegetation, resulting is significant root intrusion of the earthen embankment.
- Piping and seepage through the embankment, as evidenced by the wet toe along the central portions of the embankment and the visible boiling of water near the spillway.
- Erosion of the upstream dam face due to wave and hydraulic action from Lily Pond
- Uneven dam crest elevations and erosion of the dam crest due to foot traffic

Overall, the dam requires significant improvements and repair to the earthen embankment section, including removal of the vegetation, raising and leveling the embankment with low-permeability material, stabilization of the dam faces with stone and riprap, and installation of a sand filter/toe drain along the downstream face. In addition to the embankment improvements, the spillway structure requires improvement to handle the inflow design flood (IDF). The existing 2' wide spillway should be expanded to at least 10 feet, in combination with raising the dam embankment crest appropriately.

Through this work, the establishment of fish passage could prove to be a valuable restoration effort. Sea run fish species, such as the alewife and American eel could benefit from improved passage, as well as providing for increasingly rare sea-run brook trout habitat. The installation of an appropriate nature-like or baffled chute style fishway could function to improve spillway capacity, while also providing passage for aquatic organisms.

Construction costs associated with the improvements to the Lily Pond Dam will vary based upon the design direction selected by Island Heritage Trust. On the lower end, the most cost-effective approach to just repair to the dam is likely in the range of $300,000. However as fish passage is included or more desirable spillway configurations and embankment features are selected, the project cost could increase to $600,000 or more.

The Lily Pond Dam is a “significant” hazard dam in large part due to the state highway (Route 15) and the Town’s fire water supply located downstream. There are many potential benefits to making improvements to this infrastructure or relocating it entirely. Improving the culvert crossing to meet modern state and federal regulations would likely expand the structure from its existing dry laid stone construction to a modern 12’ span structure with an earthen channel. An improved crossing would be less susceptible to damage in the event of dam breach and it would also allow for aquatic organism passage.

The aforementioned stream crossing improvements are complicated by the fire water supply tank. While the existing fire water supply tank does not meet current NFPA or ISO standards, it can provide a valuable fire fighting water when functional. However, the tank is in poor condition and requires repair. There are several options for replacing and/or improving the supply of fire fighting water. These solutions range from as little at $250,000 to as much as $1,000,000 or more depending upon the precise functionality and performance desired. Any of these fire fighting water supply solutions will require careful planning with the local fire chief, as well as some level of additional easement from adjacent properties.

APPENDIX A

N
S
E
W
18" maple
PROJECT BENCHMARK:
Top of mag nail set in small stump alongside maple tree Elevation=92.85 (NAVD 88)
BEACH
LILY POND
Water Level Elevation=87.3
(January 6, 2021)
edge of water
concrete sluiceway walls
wire mesh cage
top of steel gate elev=87.1
pipe invert=86.5
wood bridge elev=90.1
dam bottom
outlet stream
boulder
drill hole in rock
PROPERTY LINE
N 36°11'46" E
76.00'
PROPERTY LINE
N 35°44'02" E
382.16
land of
ISLAND HERITAGE TRUST
Book 5390 Page 251
March 26, 2010
Tax Map 24 Lots 10 & 18
land of
ISLAND HERITAGE TRUST
Book 6299 Page 133
October 15, 2014
Tax Map 24 Lot 7
land of
ELIZA ABBEY
Book6948 Page 36
April 23, 2019
Tax Map 24 Lot 5
See Conservation Easement
to Island Heritage Trust
Book 6945 Page 769
April 18, 2019
EXISTING CONDITIONS SURVEY
RECORD CLIENT
ISLAND HERITAGE TRUST
PO BOX 42, 420 SUNSET ROAD, DEER ISLE, ME 04627
SITE LOCATION
LILY POND DAM
DEER ISLE, MAINE
Date: January 2
LEGEND
STANDARD SYMBOLS WHICH MAY APPEAR ON THIS DRAWING
Edge of Pond or Stream
Intermediate Contour
Index Contour
Ground Elevation
Boulder
8" Birch Tree
Property Line
Stonewall

APPENDIX B

GEOTECHNICAL INVESTIGATION REPORT

for

Lily Pond Dam

Deer Isle, Maine

Prepared for
Acadia Civil Works
Lisbon, Maine

July 29, 2022

Table of Contents

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1.0 Introduction

Lily Pond is located on Deer Isle, Maine approximately 1500 feet east of State Route 15 as shown on Figure 1. The pond was formed by construction of a small earthen dam on the western end of the lake. A 1997 inspection report by MBP Consulting, MBP, (1997) indicated that the National inventory of Dams lists the dam as constructed in 1948, however, a 1904 USGS topographic map of Deer Isle (Figure 2) clearly shows the dam was in place at its current size on that survey. Lily Pond and the dam are owned by the Island Heritage Trust and is used for recreational purposes year-round.

Acadia Civil Works is conducting a feasibility study of the dam, including a feasibility study for improvements to the dam structure, the spillway, possible fish passage improvements, fire water supply concepts and Dam Reclassification. This geotechnical investigation supports conceptual design options for the embankment dam and spillway improvements.

2.0 Site Conditions

A recent topographic survey of the dam site prepared by Due North, LLC, shows that the dam is approximately 180 feet long (Figure 3). A small spillway structure is located roughly to the right/center of the dam (from viewer perspective facing downstream). The dam crest is very narrow, ranging from about 8 to 10 feet at the right side of the spillway to about 5 feet or less on the left side of the spillway. The maximum height of the dam is about 6 to 8 feet in the location of the spillway. The downstream slopes are steep (1H:1V or steeper) and in some areas consists of laid up rock that is nearly vertical. Tree growth is prevalent across the entire dam structure. Several photographs of the dam are provided on Figures 4 and 5. The toe of the dam is wet from the spillway to about 25 to 35 feet from the left abutment. There is one boil immediately downstream from the spillway structure. This boil has been surrounded by sand bags. The water exiting the boil was clear at the time of the subsurface investigation. Tree growth is also present immediately beyond the toe of the dam structure.

The sediment level on the upstream slope of the embankment is about 1 to 2 feet +/- below the water surface. This sediment was likely deposited over the 115 plus years that the dam has been in place.

The spillway structure is a narrow (2.2-foot wide interior) structure constructed out of concrete. Two exterior gravity walls are supported on a base slab. A center wall connecting the two exterior walls supports stop logs. A sketch of the spillway, taken from MBP, (1997) shows the rough dimensions (Figure 6). It is not known if there are any seepage cut off features extending into the earthen embankment from either of the concrete retaining walls or if there is a cutoff wall beneath the spillway structure.

The inlet to the spillway is controlled with a Beaver Deceiver™ (Figure 7). The Beaver deceiver is a structure consisting of a wide mesh screen structure extending into the head pond from the spillway entrance, with a large diameter HDPE pipe penetrating the mesh. The pipe extends several feet into the pond, and the inlet is protected with another mesh structure. This device prevents beaver dams from being constructed directly at the spillway inlet. The spillway flow through the inlet pipe is thereby uninterrupted by beaver activity or other woody debris that may obstruct the inlet.

2.0 Subsurface Investigation

The subsurface investigation included drilling five borings at locations shown on Figures 3. Three of the borings, B-1, B-2 and B-3 were drilled immediately downstream from the toe of the embankment dam to the left of the spillway. The dam crest was too narrow to support the drill rig on this side of the embankment. Borings B4 and B-5 were drilled to the right of the spillway structure.

The subsurface investigation was conducted on April 20, 2021. The borings were drilled by Northern Test Borings of Gorham, Maine under contract to Soil Metrics, using a track mounted drill rig. The borings were advanced using standard wash boring techniques and flush joint 4-inch ID casing. Standard Penetration N-Values were obtained continuously for a depth of 10 to 12 feet and at 5-foot intervals thereafter. The total depths of the borings ranged from 17 feet in Borings B1 through B-4 and 10 feet deep in boring B-5. The borings were tremie grouted with cement/bentonite grout to the surface. After the grout had settled in the borehole, the top 3 to 4 feet was plugged with bentonite chips.

The borings were logged in the field full time by a representative of Soil Metrics. Logs of the explorations are included in Appendix A. The logs include a description of the soils encountered, estimated water levels, and an interpretation of the strata encountered.

Six grain size analyses were conducted on representative samples recovered from the borings. The results are summarized in Appendix B and described on the boring logs in Appendix A.

3.0 Subsurface Conditions

Interpretive subsurface profiles have been developed along four cross sections of the embankment dam shown on Figure 8. The indicated stratification is based on the result of the explorations, visual observations of the embankments and assumptions on the likely dam construction techniques that were employed to construct the 100 + year old embankment in that time period.

3.1 Embankment Dam Stratigraphy:

Two of the borings, B-4 and B-5 were drilled through a portion of the embankments. The other three borings were drilled just beyond the toe of the embankment section to the left of the spillway. A description of the subsurface conditions is shown on Figure 8 for the embankments is summarized as follows:

Downstream Rockfill: Rockfill and laid up stonework is evident over much of the downstream slope on the majority of the embankment section left of the spillway. These stones were likely placed during construction as the first element and added to as the embankment height increased.

Embankment Core Material: Following an initial lift of stones, soil material was placed behind the stones to form the core of the embankment. While borings were not drilled on the left side of the structure, the borings drilled on the right side indicate that this soil material was a silty fine to coarse sand. The grain size analyses provided in Appendix B and soils descriptions from the logs indicate this was likely native glacial till soil. The soil was likely placed in lifts as the embankment became higher, with progressive lifts of stone/rockfill on the downstream slope. The core soil material is likely to be loose in consistency because modern compaction techniques were not available during that period. It is also likely that the fine-grained core material was placed directly adjacent to the downstream stonework which would have large open voids. Over the years as seepage passed through the embankment, some of this original material has likely washed through the large voids in the stonework. Modern dam constructions techniques would include a filter soil between the large stone and the finer grained "Core "material, thereby preventing the core material from piping through the embankment.

Upstream Slope: It is likely that some form of riprap was placed on the upstream slope to prevent erosion of the soil from wave action. While this would have been a typical construction technique during that period, the size of the stones may have been relatively small and in some areas have apparently been dislodged. It is also likely that additional riprap may have been placed on the upstream slope during periodic repairs.

Upstream Silt/Organic Deposition. The upstream slope has obviously been covered due to silt and or seasonal sand and silt deposition over the 100-year period. This silt material is likely fine grained and may also contain layers of organic material primarily in the form of leaves. This fine-grained deposition will have a relatively low permeability and has likely reduced seepage through the embankment over much of the embankment alignment.

Embankment Foundation: The embankment foundation soil is classified as a fine to coarse silty sand with smaller amounts of fine to coarse gravel and occasional cobbles and boulders. This foundation stratum is classified as a native glacial till. All of the borings were extended into this stratum to depths up to 17 feet below ground surface. Standard Penetration Test (SPT) samples were driven continuously with N-values ranging from 9 to 20 blows per foot. Based on these N-values, the Native glacial till is considered medium dense in consistency.

Seepage Conditions: The downstream toe of the embankment on the left side of the spillway was saturated at the ground surface for the entire alignment except the furthest 25 to 35 feet closest to the left abutment where the embankment and existing ground surface rises. There did not appear to be any seepage exiting the downstream toe of the embankment slope through the exposed rockfill. The absence of seepage on the downstream face could be seasonally related, or a year-round condition. The seepage observed at the ground surface is likely exiting right at the intersection of the embankment and the native ground, or it is upward flow from the native ground as depicted on the cross sections. It appears though that the upstream silt deposition has contributed to reducing the seepage quantity on this left side of the spillway.

There was no seepage noted on the embankment on the right side of the spillway. The embankment in this side is much wider, and the water level in the borings was a few feet below the ground surface. The largest area of concentrated seepage is occurring at the spillway. One boil is evident on the left side of the spillway where sand bags have been placed to contain the boil. There was no movement of fines from this boil at the time of the field investigation. The active seepage at the spillway is likely occurring at the interface of the concrete foundation abutment walls and possibly below the base slab.

4.0 Conceptual Design Modifications.

The embankment and spillway, in its present condition is serviceable, however it is generally in poor condition. It is understood that the existing spillway structure is likely undersized which could lead to overtopping. The top crest height may also be low in some portions of the embankment. The tree growth in the embankment is a possible source for future seepage paths which could lead to piping failures.

A series of conceptual options have been developed for upgrade the existing embankment structure to current design standards. Options for seepage cutoff concepts for the spillway structures are also presented. The concepts are provided on Figures 9 and 10 and discussed as follows:

4.1 Embankment Repairs:

A conceptual design sketch for embankment repairs is shown on Figure 9. The repairs would involve the following:

a. Cofferdam: Placement of a bulk bag cofferdam on the upstream side of the embankment to lower the water table in front of the upstream slope and reduce seepage coming from the dam/native foundation soil interface and upward from the dam foundation. This is a general recommendation for construction so that the work can be performed in case concentrated seepage is encountered during the repair elements discussed below. The cofferdam would be removed following construction.
b. Removal of trees and their root systems. The trees should be cut and the major root ball/system removed. This will undoubtedly result in some dislodging of some of the foundation stones on the upstream and downstream slopes. Backfilling of the tree removal areas depends on the location where the trees and roots are removed. Trees removed from the upstream slope should be backfilled with low permeable soil, such as the native glacial till soils. Trees removed from the downstream slope should be backfilled with a widely graded gravel material so that seepage through the embankment can freely drain.
c. Grub downstream toe of embankment. The downstream toe of the embankment out from the embankment slope should be grubbed to remove all organics down to mineral soil.

d. Sand Filter: Place a sand filter blanket on the downstream toe of the grubbed surface and downstream slope of the embankment. The filter thickness is intended to capture embankment and foundation seepage.
e. Toe Drain: Install a perforated drain along the toe of the embankment to collect seepage from the filter blanket and convey it to the stream downstream of the spillway structure. The drain will consist of a perforated pipe surrounded in filter stone and filter sand.
f. Embankment Fill: Place additional embankment fill on top of the filter soil and grade the slope to a minimum 2.5H:1V side slope.
g. Loam and Seed: Seed and loam disturbed downstream slope.
h. Dam Crest Fill: Place additional fill on dam crest to raise to minimum crest height based on hydraulic studies. The top surface can consist of crushed gravel or stone dust for walking paths.
i. Upstream Riprap: Place additional riprap on upstream slope to prevent scour from wave action.

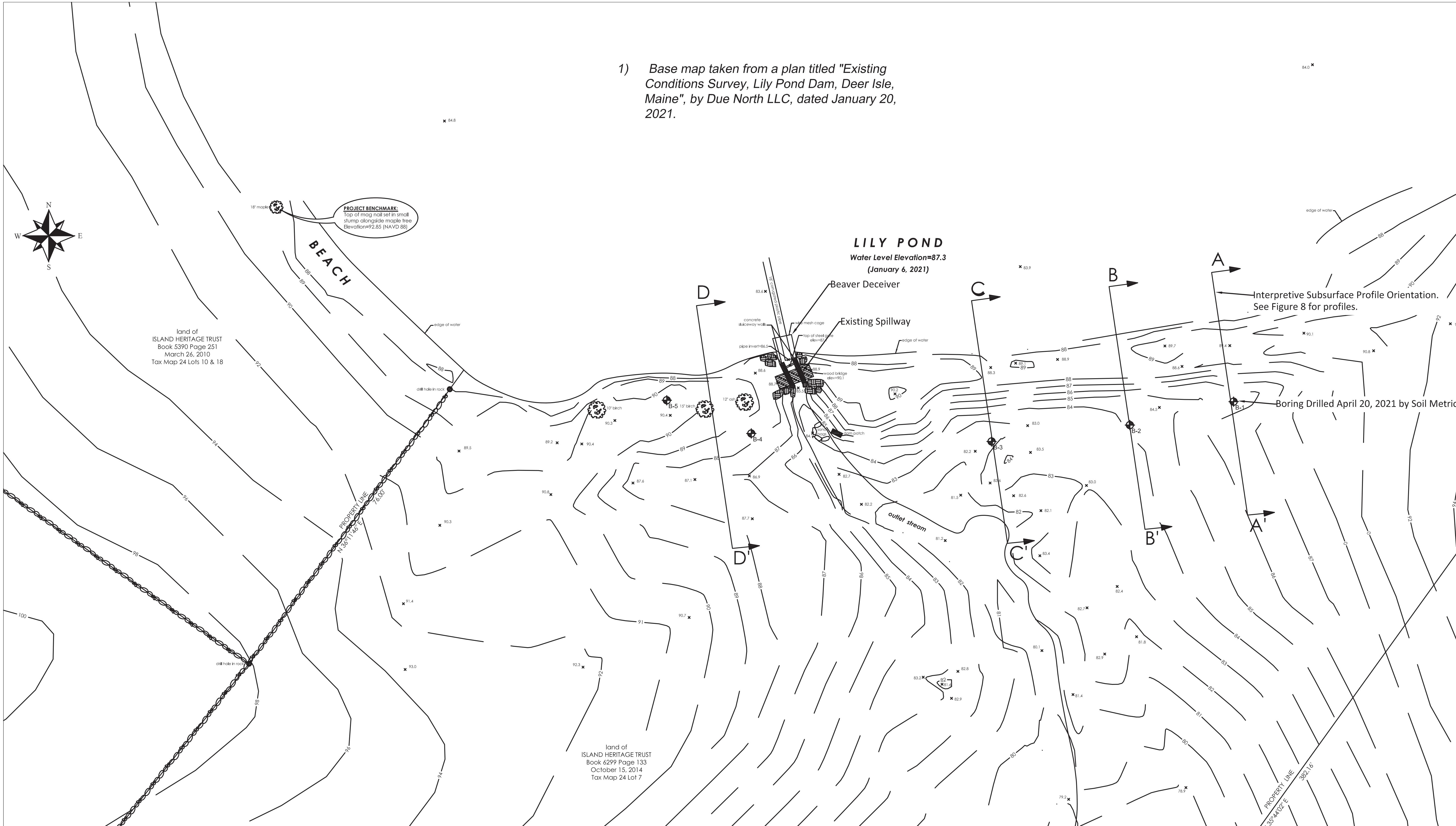
4.2 Spillway Repair Options related to Seepage Control

While there are a number of options available to increase the spillway capacity, the need for some element of seepage cutoff beneath and along the sides of any spillway structure will need to be incorporated. The foundations soils consist of glacial till. The most straightforward element to incorporate seepage cutoff below and around a spillway structure would be with sheetpiles. A few simple concepts for incorporating sheetpiles into the design are depicted on Figure 10.

FIGURES

Soil Metrics LLC Geotechnical Engineering	Project: Geotechnical Investigation Lily Pond Dam Deer Isle, Maine		Title: Project Location Map		By: SJR Checked: sjr Date: Oct. 2021
	Client:	Acadia Civil Works	Proj. No: 172-04	Scale: as noted	Fig. No: 1

Soil Metrics LLC Geotechnical Engineering	Project: Geotechnical Investigation Lily Pond Dam Deer Isle, Maine	Title: **Project Location Map**	By: SJR Checked: sjr Date: Oct. 2021
	Client: Acadia Civil Works	Proj. No: 172-04 / Scale: as noted	Fig. No: 1

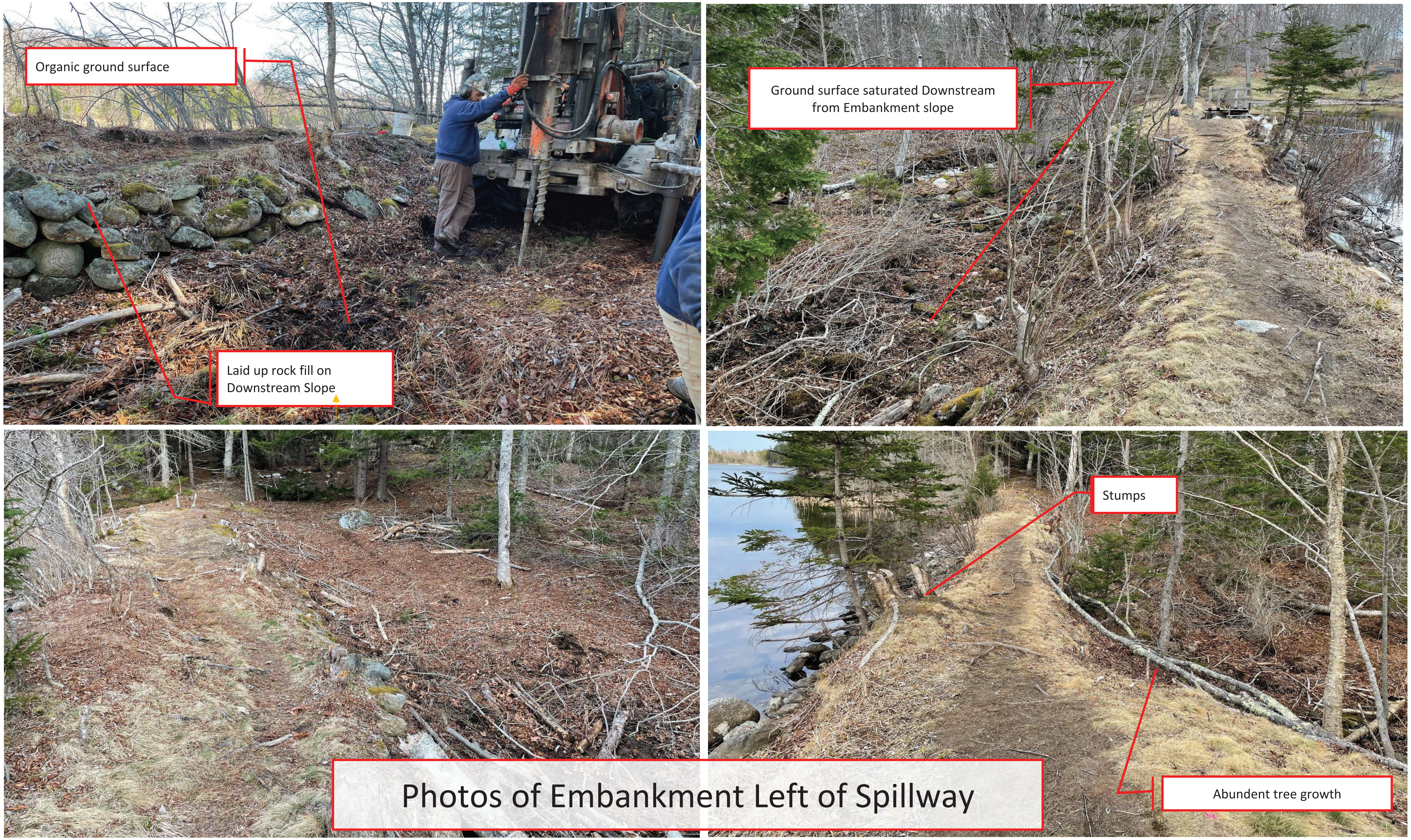


Soil Metrics LLC Geotechnical Engineering

12 Farms Edge Road,
Cape Elizabeth, ME 04107

Project No.:	172-04	**Project:**	Lily Pond Geotechnical Investigation Acadia Civil Works
Date:	10/2021		
By:	SJR	**Subject:**	Site and Boring Location Plan
Checked:	SJR		

Figure No. 3



Soil Metrics LLC
Geotechnical Engineering

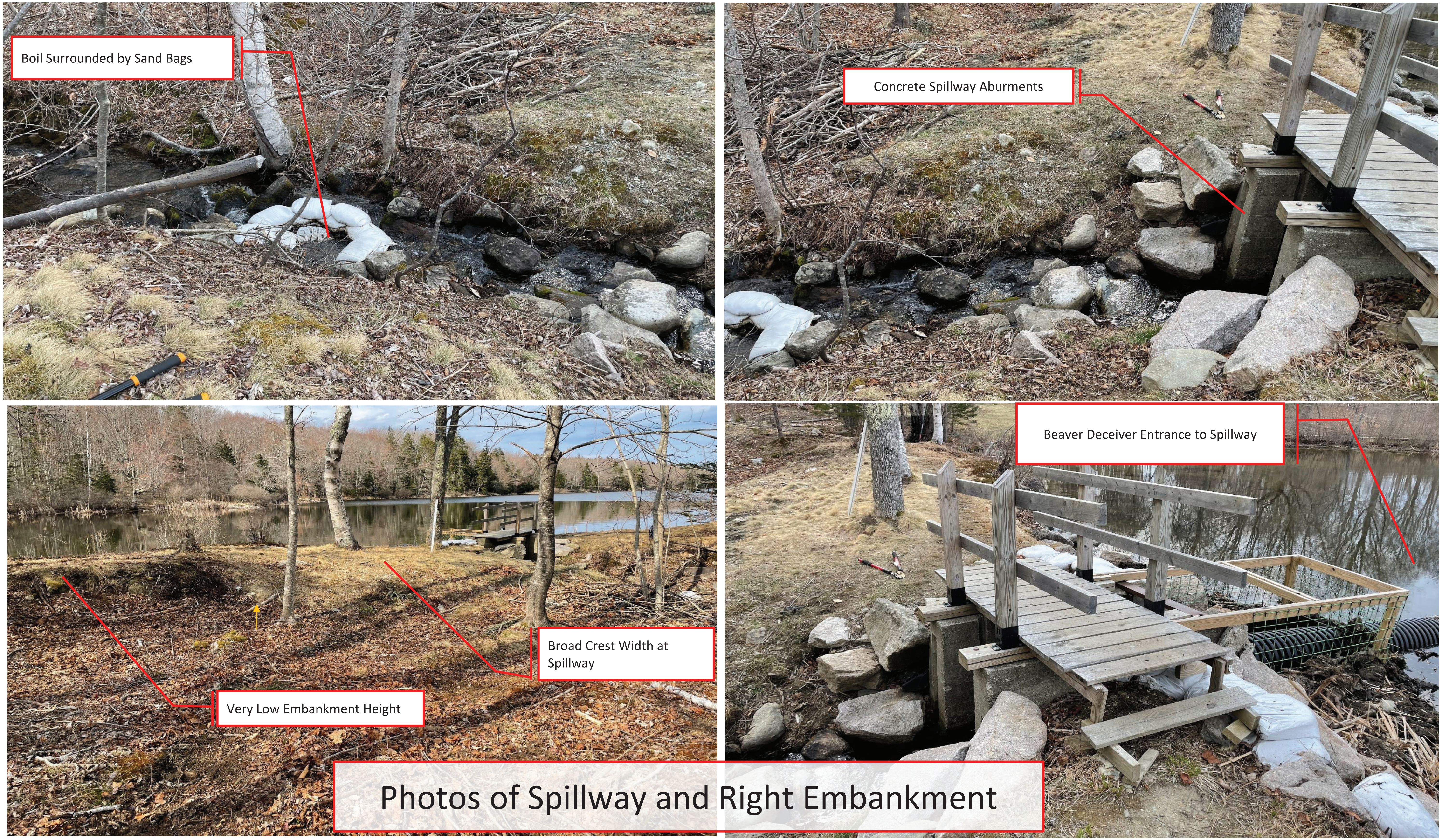
By : SJR
Checked: sjr
Date: Oct. 2021
Scale: as noted

Photographs of EmnabkmentL Left of Spillway
Geotechnical Investigation

Lily Pond Dam
Acadia Civil Works

Project No.
172-04

Figure No.
4



Photos of Spillway and Right Embankment

Soil Metrics LLC
Geotechnical Engineering

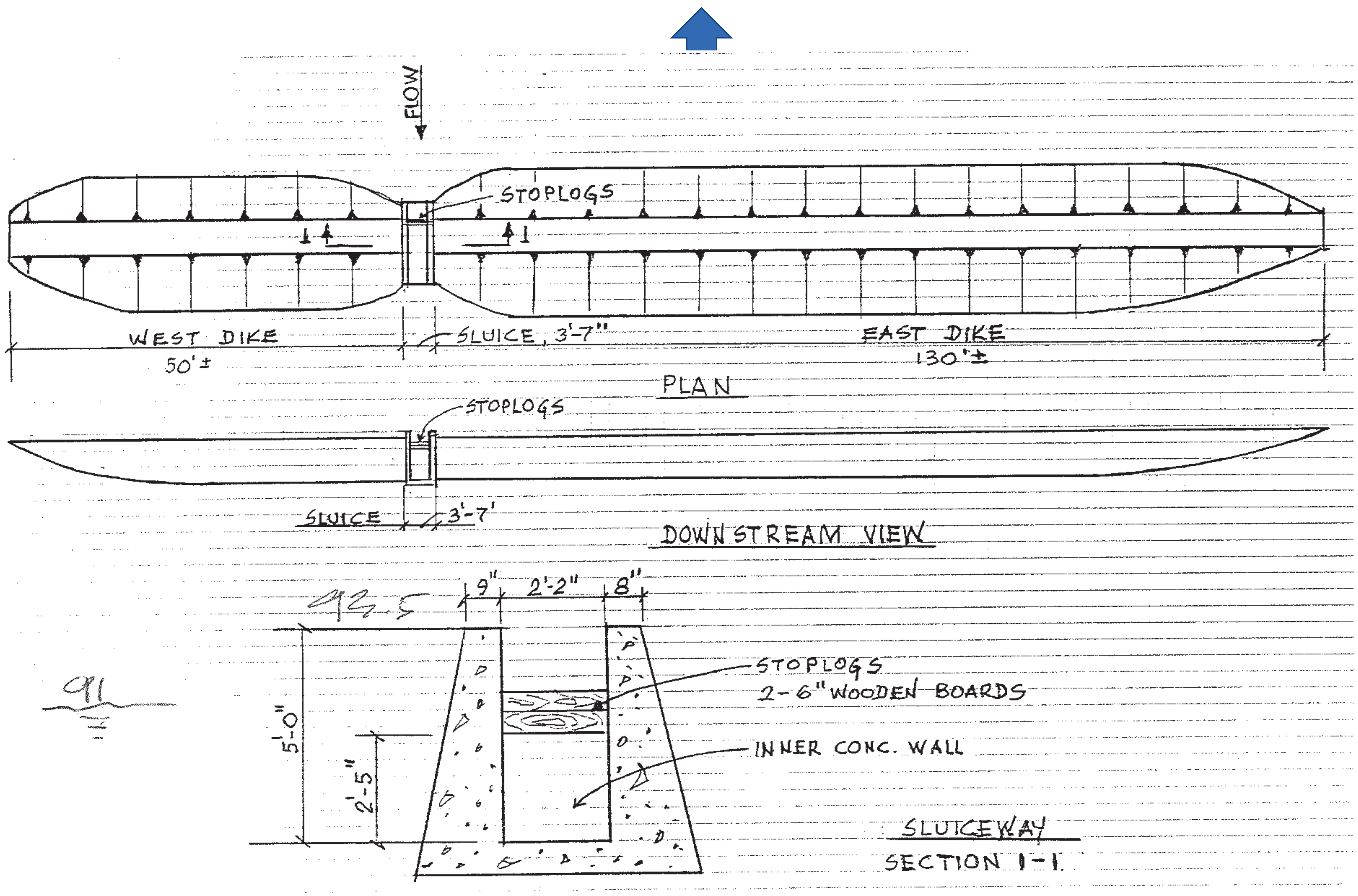
By : SJR
Checked: sjr
Date: Oct. 2021
Scale: as noted

Photographs of Spillway and Right Embankment
Geotechnical Investigation

Lily Pond Dam
Acadia Civil Works

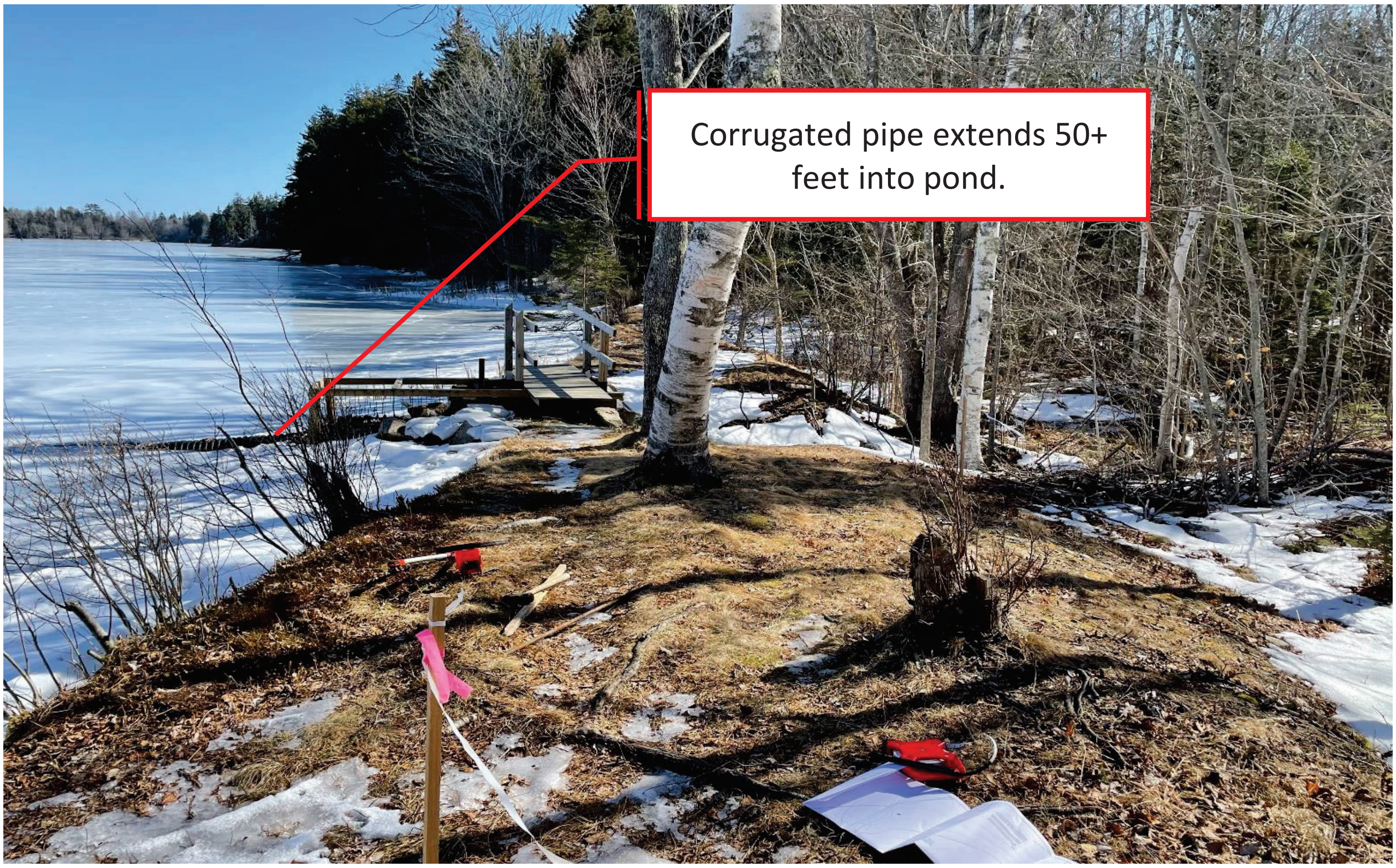
Project No.
172-04

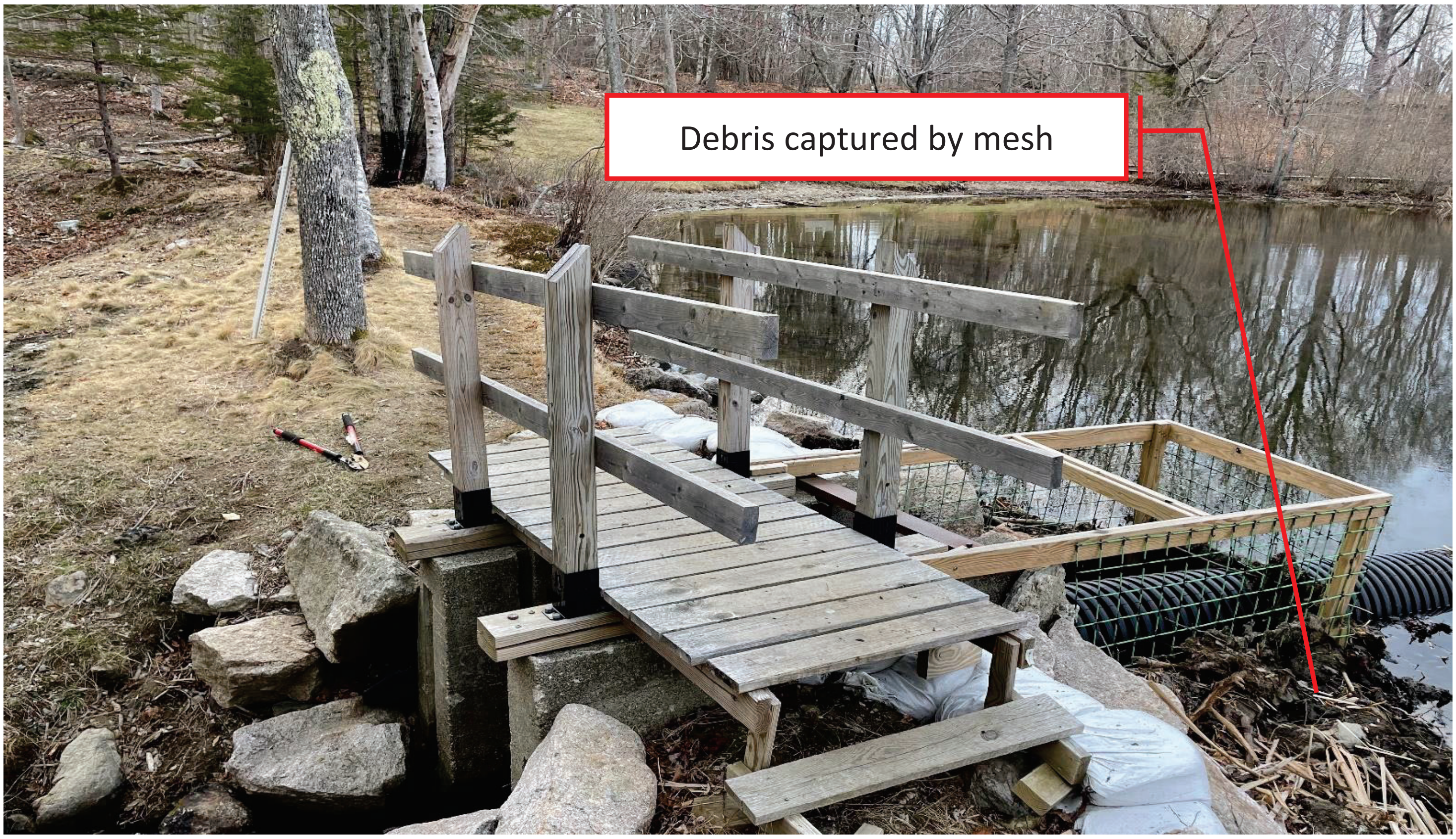
Figure No.
5



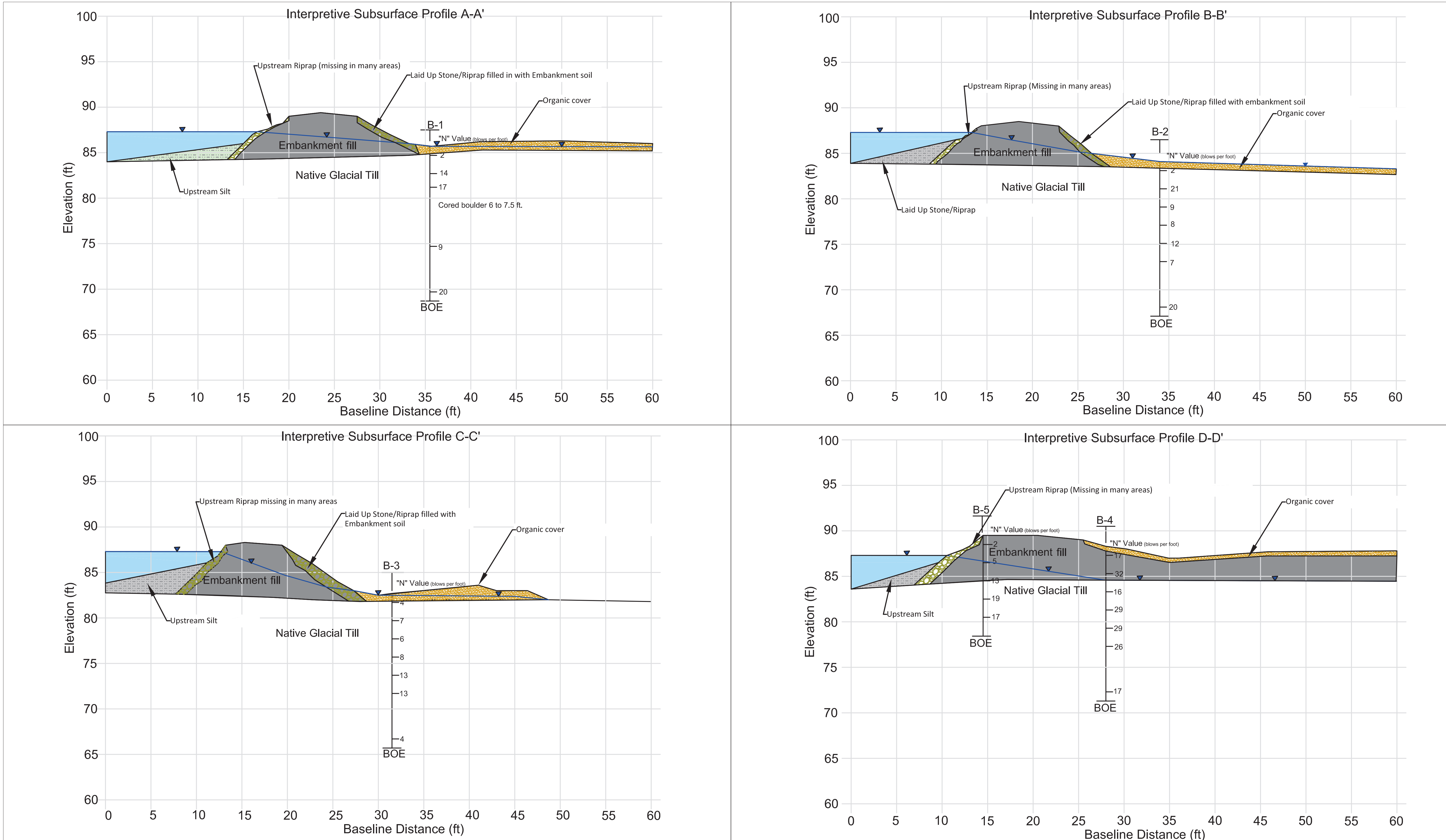
Plan taken from report titled "Inspection of Lily Pond Dam, Deer Isle, Maine, by MBP Consulting, November 1997.

Soil Metrics LLC Geotechnical Engineering	Project: Geotechnical Investigation, Lily Pond Dam, Deer Isle, Maine	Title: Approximate Spillway Dimensions	By: SJR; Checked: sjr; Date: Oct. 2021
	Client: Acadia Civil Works	Proj. No: 172-04; Scale: as noted	Fig. No: 6

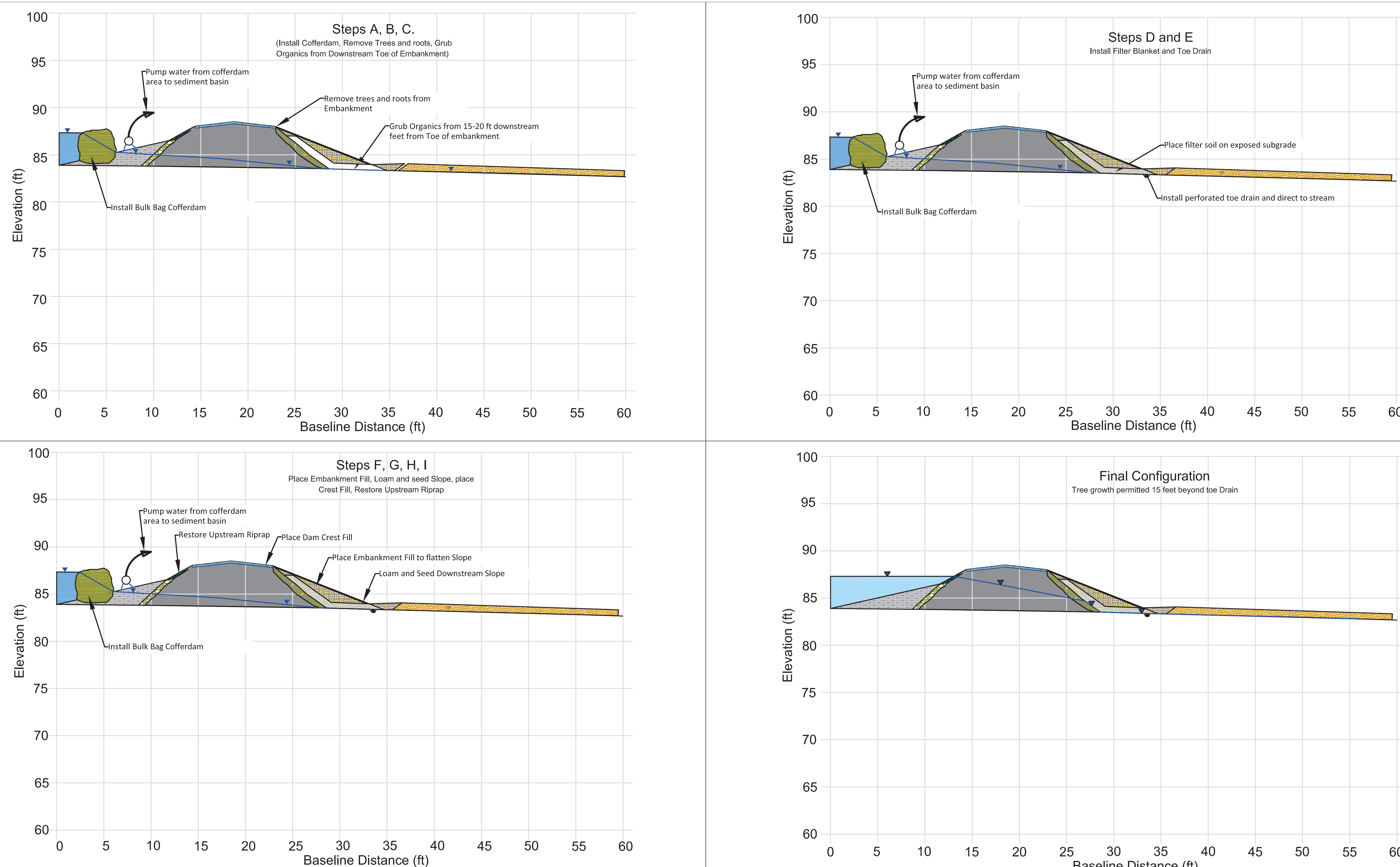




Soil Metrics LLC Geotechnical Engineering	Project: Geotechnical Investigation Lily Pond Dam Deer Isle, Maine	Title: Photographs of Beaver Deceiver		By: SJR Checked: sjr Date: Oct. 2021
	Client: Acadia Civil Works	Proj. No: 172-04	Scale: as noted	Fig. No: 7



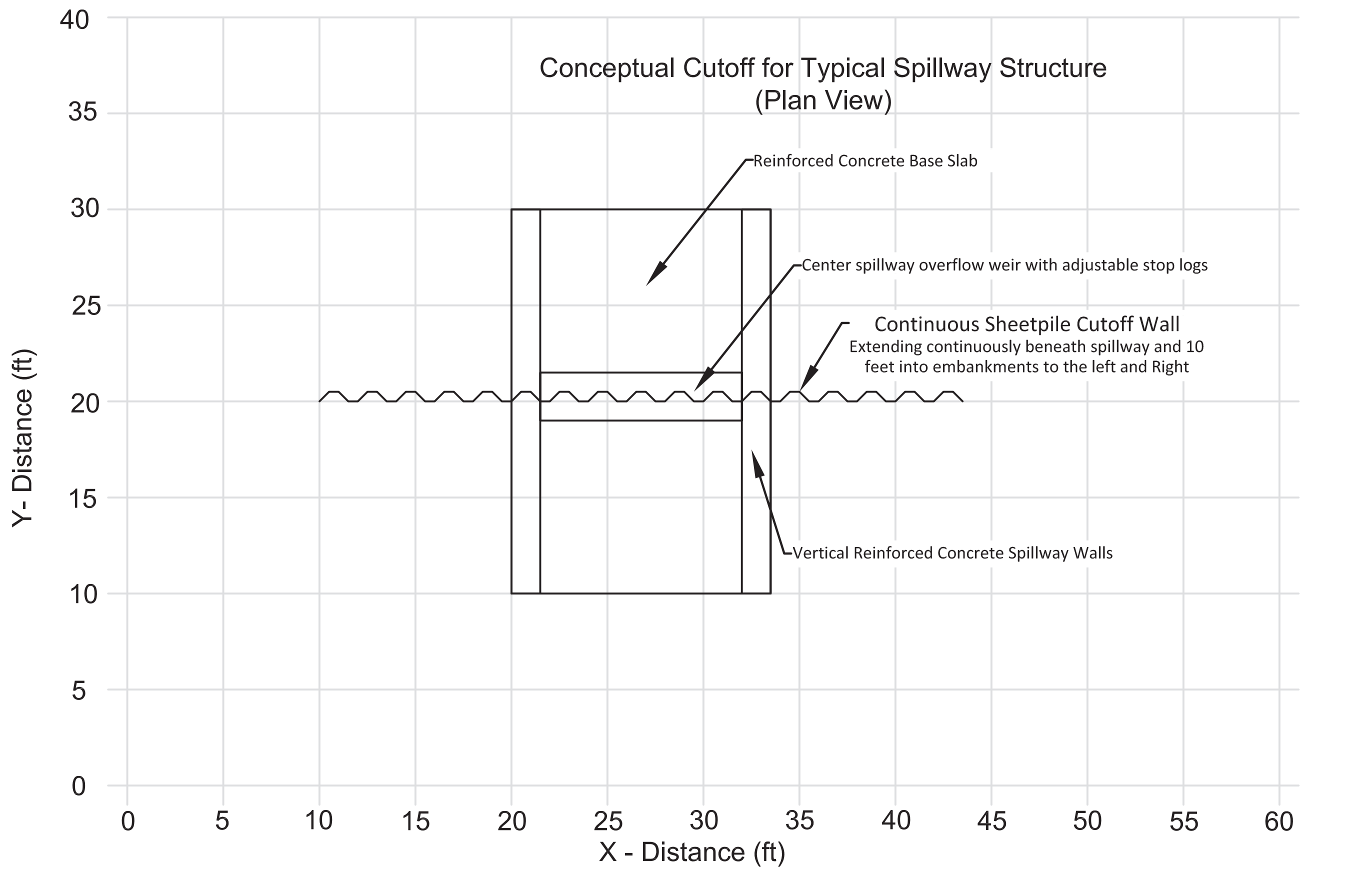
Soil Metrics LLC Geotechnical Engineering 12 Farms Edge Road, Cape Elizabeth, ME 04107	Project No.: 172-04 Date: 8/9/21 By: SJR Checked: sjr	Project: Lily Pond Geotechnical Investigation Acadia Civil Consultants Subject: Interpretive Subsurface Profiles	Figure No. 8

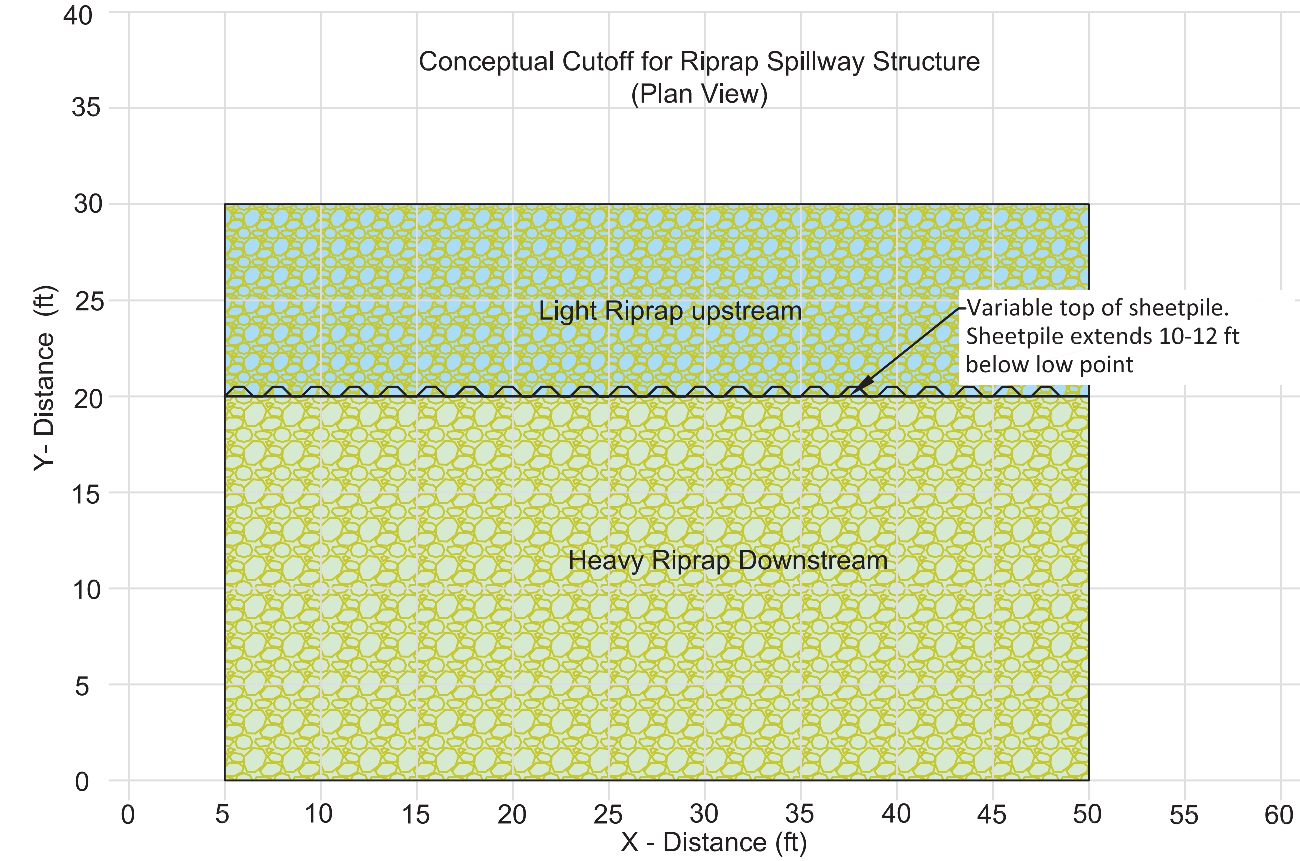


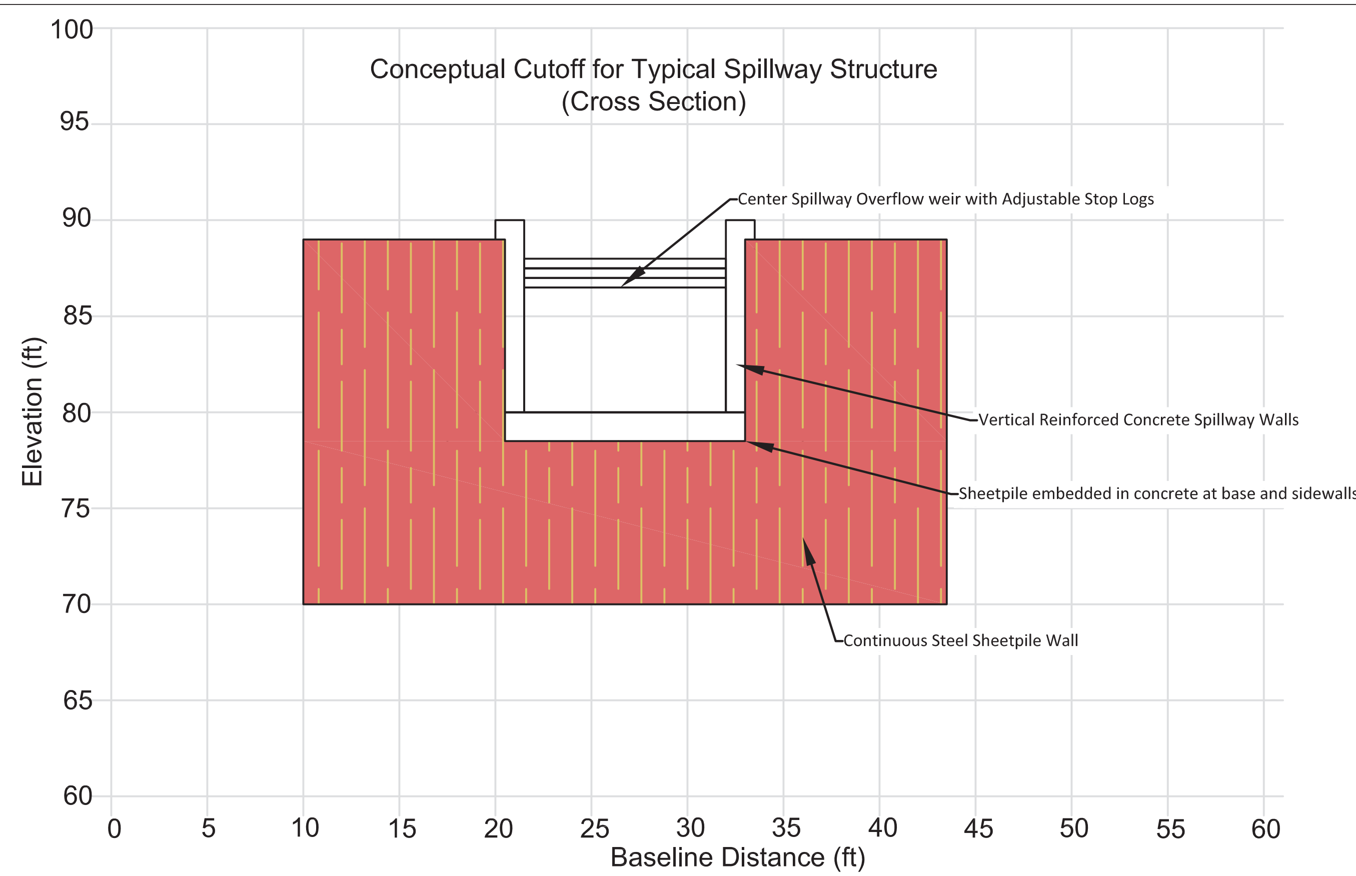
Soil Metrics LLC Geotechnical Engineering
12 Farms Edge Road,
Cape Elizabeth, ME 04107

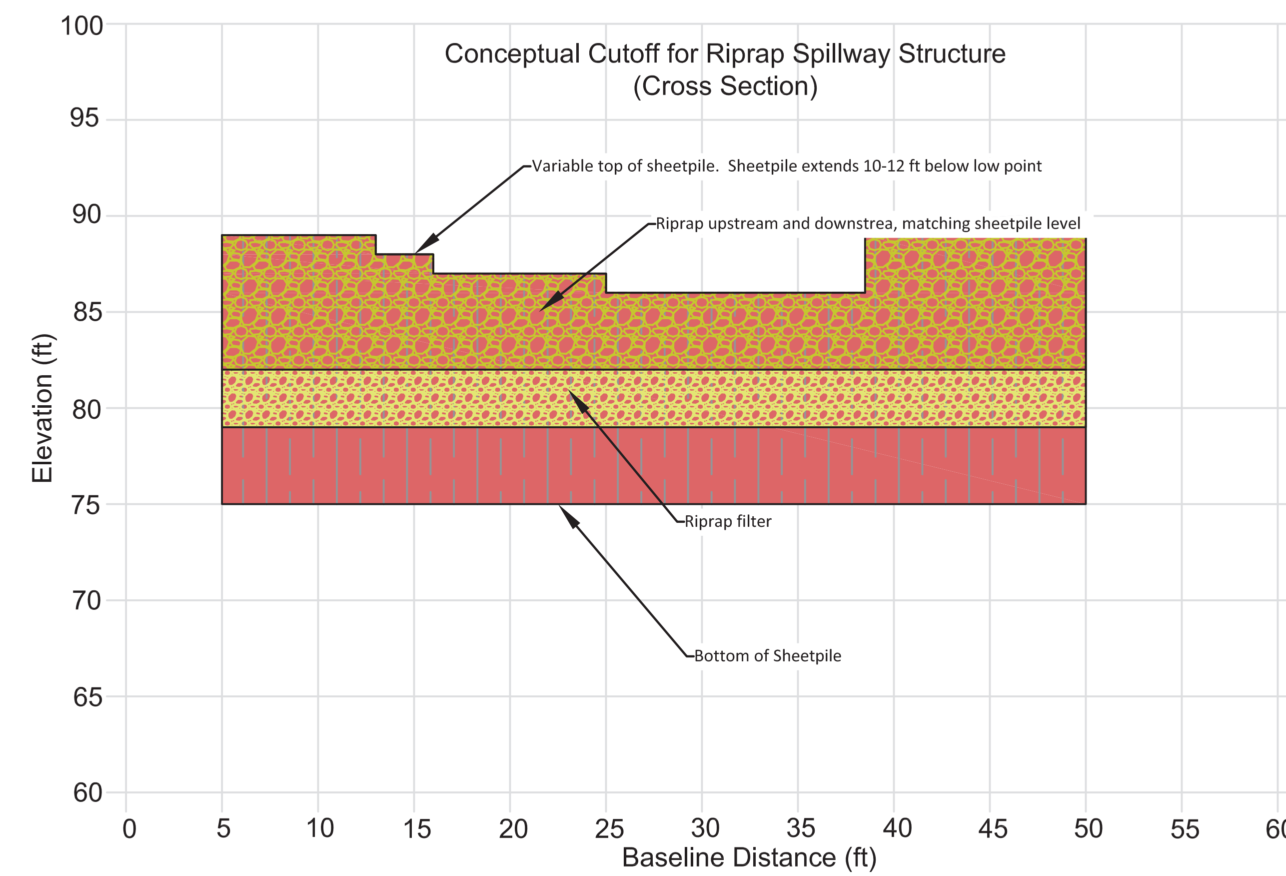
Project No.:	172-04	Project:	Lily Pond Geotechnical Investigation Acadia Civil Consultants
Date:	10/23/21		
By:	SJR	Subject:	Conceptual Embankment Repairs
Checked:	sjr		

Figure No.
9









Soil Metrics LLC Geotechnical Engineering
12 Farms Edge Road,
Cape Elizabeth, ME 04107

Project No.:	172-04	Project:	Lily Pond Geotechnical Investigation Acadia Civil Consultants
Date:	10/23/21		
By:	SJR	Subject:	Conceptual Options for Spillway Seepage Cutoff
Checked:	sjr		

Figure No.
10

APPENDIX A

Boring Logs

Soil Metrics LLC Geotechnical Engineering

Project:	Lily Pond Dam
Location:	Deer Island, Maine
Client:	Acadia Civil Works Lisbon, Maine

Boring: B-1
File No.: 172-04

Contractor:	Northern Test Borings	Drilling Method:	Wash Boring
Operator:	Mike Nadeau	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	4/20/2021 4/20/2021	Hammer Wt./ Fall:[2]	140# / 30 inches (Automatic Hammer)
Boring Location:	Refer to Plan in Report	Water Level[4]:	At surface
Ground Elev.[1]:	85.7 ft MSL		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_p = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
mc = Water Content, percent
oc = Organic Content, percent
f.c. = Fines Content (% passing # 200 sieve)

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)				SPT N Value[3]	Casing Blows[4]	Sample Description and Classification	Unified Class.	Notes	Piezometer Details:	Elevation
	S1	24/24	0.0 - 2.0	woh		2	3	2		**S1:** 0 - 1.0: Organics. 1.0 - 2.0: Brown silty fine to coarse SAND, trace coarse gravel. Saturated, loose, root hairs.	SM	See Grain size analysis for S1	No Piezometer	
	S2	17/24	2.0 - 4.0	4	4	10	12	14		S2: Similar to S-1, 1 to 2 ft. Brown with black spots medium dense. Native glacial till.	SM			
5	S3	18/24	4.0 - 5.5	5	5	12	50	17		S3: Similar to S-2, Brown, medium dense, saturated.(Native Glacial Till.)				80.7
	R1	5/20	5.8-7.5							R1: Cored cobble recovered 5 inches	SM	Drove casing to 5.8 ft, cleaned out and cored to 7.5 ft. Cored cobble.	`	
10														75.7
	S4	24/24	10.0 - 12.0	3	4	5	8	9		**S4**: Similar to S3, Gray, saturated, loose, (Native Glacial Till.)	SM			
15														70.7
	S5	24/24	15.0-17.0	7	8	12	14	20		**S5**: Similar to S4, medium dense, saturated, (Native Glacial Till)	SM			
										Bottom of Exploration at 17.0 ft.				
20														65.7
25														60.7
30														55.7

Notes

1. Reference elevations were interpolated from topographic plan of site by Due North, LLC dated January 20, 2021.
2. SPT Samples driven with a automatic hammer, 140 lb hammer, 30 inch drop, AW rods, Split spoon OD=1-3/8 inch, ID = 1-1/2 inch.
3. Uncorrected blow count.
4. Water level estimated from soil moisture and is approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Soil Metrics LLC Geotechnical Engineering	Project: Lily Pond Dam Location: Deer Island, Maine Client: Acadia Civil Works Lisbon, Maine	Boring: B-2	File No.: 172-04

Contractor:	Northern Test Borings	**Drilling Method:**	Wash Boring
Operator:	Mike Nadeau	**Bore Hole ID/OD:**	4.0/4.5
Logged By:	sjr	**Auger ID/OD:**	NA
Checked By:	sjr	**Sampler:**	Std Split Spoon-24 inches
Date Start/Finish:	4/20/2021 4/20/2021	**Hammer Wt./ Fall:**[2]	140# / 30 inches (Automatic Hammer
Boring Location:	Refer to Plan in Report	**Water Level**[4]**:**	At Ground Surface
Ground Elev.[1]**:**	84.1 ft MSL		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_p = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
mc = Water Content, percent
oc = Organic Content, percent
f.c. = Fines Content (% passing # 200 sieve)

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)				SPT N Value[3]	Casing Blows[4]	Sample Description and Classification	Unified Class.	Notes	Piezometer Details	Elevation
	S1	18/24	0.0 - 2.0	1	1	1	4	2		**S1:** Top 1.0 ft brown organic silt. 1.0 to 2.0 ft: Gray/Brown mottled silty fine to coarse SAND, little fine gravel, saturated, loose.	SM	See Grain size analysis for S1	No Piezometer	
	S2	16/24	2.0 - 4.0	8	9	12	9	21		**S2:** Similar to S1, dense, saturated. (Native Glacial Till)	SM			
5	S3	20/24	4.0 - 6.0	4	5	4	4	9		**S3:** Similar to S2, Brown, and loose. (Native Glacial Till)	SM			79.1
	S4	16/24	6.0 - 8.0	4	4	4	4	8		**S4:** Similar to S2, except gray and loose. Saturated.	SM		`	
10	S5	24/24	8.0 - 10.0	6	7	5	5	12		**S5:** Similar to S-2 with fine silty sand layer at 8-9 feet. medium dense, saturated. (Native Glacial Till). .	SM			74.1
	S6	0/24	10.0 - 12.0	3	4	3	3	7		**S6:** No Recovery, pushed large gravel.	SM			
15														69.1
	S7	24/24	15.0-17.0	7	8	12	14	20		**S7:** Similar to S2, saturated. Dense (Native Glacial Till)	SM			
										Bottom of Exploration at 17.0 ft.				
20														64.1
25														59.1
30														54.1

Notes

1. Reference elevations were interpolated from topographic plan of site by Due North, LLC dated January 20, 2021.
2. SPT Samples driven with a automatic hammer, 140 lb hammer, 30 inch drop, AW rods, Split spoon OD=1-3/8 inch, ID = 1-1/2 inch.
3. Uncorrected blow count.
4. Water level estimated from soil moisture and is approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Soil Metrics LLC Geotechnical Engineering

Project:	Lily Pond Dam	Boring:	B-3
Location:	Deer Island, Maine	File No.:	172-04
Client:	Acadia Civil Works Lisbon, Maine		

Contractor:	Northern Test Borings	Drilling Method:	Wash Boring
Operator:	Mike Nadeau	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	4/20/2021 4/20/2021	Hammer Wt./ Fall:[2]	140# / 30 inches (Automatic Hammer
Boring Location:	Refer to Plan in Report	Water Level[4]:	At Ground Surface
Ground Elev.[1]:	82.4 ft MSL		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_p = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
mc = Water Content, percent
oc = Organic Content, percent
f.c. = Fines Content (% passing # 200 sieve)

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)				SPT N Value[3]	Casing Blows[4]	Sample Description and Classification	Unified Class.	Notes	Piezometer Details	Elevation
	S1	5/24	0.0 - 2.0	1	1	3	3	4		S1: Top 1.0 ft brown organic silt. 1.0 to 2.0 ft: Gray/Brown mottledsilty SAND. Glacial till.	SM		No Piezometer	
	S2	14/24	2.0 - 4.0	3	3	4	3	7		S2: Gray silty fine to coarse SAND, widely graded, loose, saturated. (Native Glacial Till)	SM	See Grain size analysis for S2		
5	S3	24/24	4.0 - 6.0	3	3	3	4	6		S3: Similar to S2, Gray, (Native Glacial Till).	SM			77.4
	S4	24/24	6.0 - 8.0	3	3	5	5	8		S4: Similar to S3. (Native Glacial Till).	SM		`	
	S5	24/24	8.0 - 10.0	6	6	7	7	13		S5: Gray fine to coarse silty SAND, trace fine gravel, medium dense, saturated. (Native Glacial Till),	SM	See Grain size analysis for S5		
10														72.4
	S6	24/24	10.0 - 12.0	6	7	6	7	13		S6: Similar to S5. (Native Glacial Till).	SM			
15														67.4
	S7	24/24	15.0-17.0	2	2	2	2	4		S7: Similar to S5, saturated, loose.	SM			
										Bottom of Exploration at 17.0 ft.				
20														62.4
25														57.4
30														52.4

Notes

1. Reference elevations were interpolated from topographic plan of site by Due North, LLC dated January 20, 2021.
2. SPT Samples driven with a automatic hammer, 140 lb hammer, 30 inch drop, AW rods, Split spoon OD=1-3/8 inch, ID = 1-1/2 inch.
3. Uncorrected blow count.
4. Water level estimated from soil moisture and is approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Soil Metrics LLC Geotechnical Engineering

Project:	Lily Pond Dam
Location:	Deer Island, Maine
Client:	Acadia Civil Works
	Lisbon, Maine

Boring: B-4
File No.: 172-04

Contractor:	Northern Test Borings	Drilling Method:	Wash Boring
Operator:	Mike Nadeau	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	4/20/2021 4/20/2021	Hammer Wt./ Fall:[2]	140# / 30 inches (Automatic Hammer)
Boring Location:	Refer to Plan in Report	Water Level[4]:	~ 3 to 4 ft
Ground Elev.[1]:	88.30 ft MSL		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_p = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
mc = Water Content, percent
oc = Organic Content, percent
f.c. = Fines Content (% passing # 200 sieve)

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)				SPT N Value[3]	Casing Blows[4]	Sample Description and Classification	Unified Class.	Notes	Piezometer Details	Elevation
	S1	11/24	0.0 - 2.0	2	15	2	2	17		S1: Top 0.2 ft brown organic silt. 0.2 to 2.0 ft: fine to medium fineSAND, moist, (Fill).	SM		No Piezometer	
	S2	14/24	2.0 - 4.0	12	15	17	17	32		S2: Light Brown mottled fine to medium sandy SILT or silty Sand. Moist, dense with root hairs. (Fill).	SM			
5	S3	24/24	4.0 - 6.0	2	4	12	12	16		S3: Top 1.0 foot similar to S2 - (Fill)	SM			83.3
										Bottom 1.0 foot: Brown fine to coarse silty SAND, little fine gravel, medium dense, Bottom saturated. (Native Glacial Till).		See Grain size analysis for S3		
	S4	24/24	6.0 - 8.0	12	14	15	19	29		S4: Similar to S3, except dense, saturated. (Native Glacial Till).	SM			
	S5	19/24	8.0 - 10.0	10	12	17	19	29		S5: Similar to S-3, dense, saturated. (Native Glacial Till).	SM			
10														78.3
	S6	19/24	10.0 - 12.0	10	12	14	14	26		S6: Similar to S3, dense, saturated. (Native Glacial Till).	SM			
15														73.3
	S7	14/24	15.0-17.0	7	7	10	12	17		S7: Similar to S3, moist, dense, (Native Glacial Till)	SM			
										Bottom of Exploration at 17.0 ft.				
20														68.3
25														63.3
30														58.3

Notes

1. Reference elevations were interpolated from topographic plan of site by Due North, LLC dated January 20, 2021.
2. SPT Samples driven with a automatic hammer, 140 lb hammer, 30 inch drop, AW rods, Split spoon OD=1-3/8 inch, ID = 1-1/2 inch.
3. Uncorrected blow count.
4. Water level estimated from soil moisture and is approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Soil Metrics LLC Geotechnical Engineering	Project: Lily Pond Dam Location: Deer Island, Maine Client: Acadia Civil Works Lisbon, Maine	Boring: B-5 File No.: 172-04

Contractor:	Northern Test Borings	**Drilling Method:**	Wash Boring
Operator:	Mike Nadeau	**Bore Hole ID/OD:**	4.0/4.5
Logged By:	sjr	**Auger ID/OD:**	NA
Checked By:	sjr	**Sampler:**	Std Split Spoon-24 inches
Date Start/Finish:	4/20/2021 4/20/2021	**Hammer Wt./ Fall:**[2]	140# / 30 inches (Automatic Hammer
Boring Location:	Refer to Plan in Report	**Water Level**[4]**:**	~ 5 ft.
Ground Elev.[1]**:**	90.4 ft MSL		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_p = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
mc = Water Content, percent
oc = Organic Content, percent
f.c. = Fines Content (% passing # 200 sieve)

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)	SPT N Value[3]	Casing Blows[4]	Sample Description and Classification	Unified Class.	Notes	Piezometer Details	Elevation
	S1	13/24	0.0 - 2.0	1 1 1 2	2		**S1:** Top 1.0 ft brown organic silt. 1.0 to 2.0 ft: Gray/Brown mottled sandy silt/silty Sand. Glacial till fill).	SM		No Piezometer	
	S2	11/24	2.0 - 4.0	2 3 2 3	5		**S2:** Similar to S1 1.0 to 2.0 ft: . (Fill), moist.	SM			
5	S3	24/24	4.0 - 6.0	4 5 8 9	13		**S3:** Top 1.0 ft: Similar to S2 (Fill) Bottom 1.0 ft: Brown fine to coarse sandy SILT), saturated, medium dense. (Native Glacial till at 5 feet).	ML	See Grain size analysis for S3		85.4
	S4	16/24	6.0 - 8.0	9 9 10 9	19		**S4:** Similar to S3.	ML			
	S5	24/24	8.0 - 10.0	7 8 9 10	17		**S5:** Similar to S-3	ML			
10							Bottom of Explotation at 10.0 feet				80.4
15											75.4
20											70.4
25											65.4
30											60.4

Notes

1. Reference elevations were interpolated from topographic plan of site by Due North, LLC dated January 20, 2021.
2. SPT Samples driven with a automatic hammer, 140 lb hammer, 30 inch drop, AW rods, Split spoon OD=1-3/8 inch, ID = 1-1/2 inch.
3. Uncorrected blow count.
4. Water level estimated from soil moisture and is approximate.

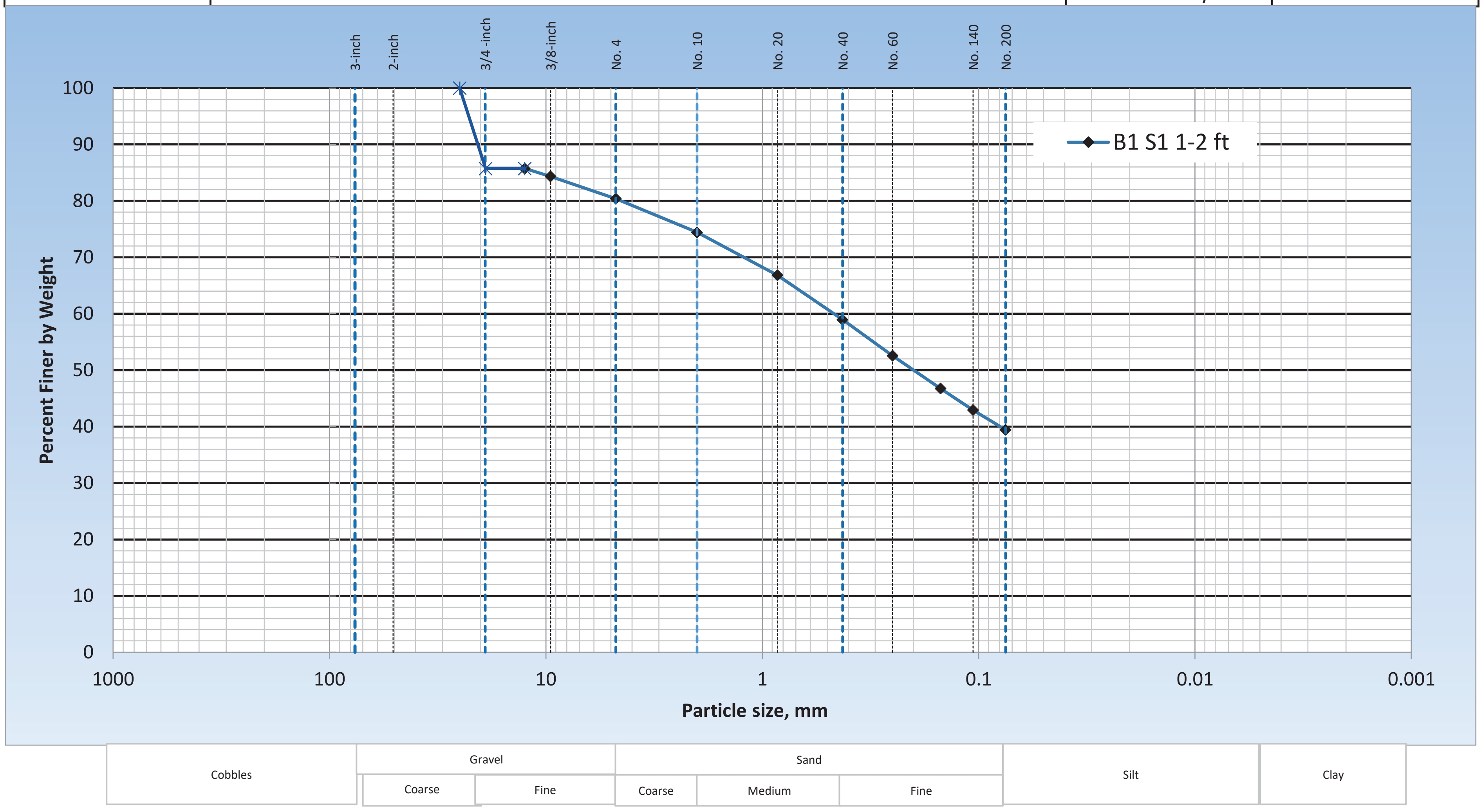
Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

APPENDIX B

Laboratory Testing

Particle Size Distribution

	Particle Size Distribution	Job No.:	172-04
		Client:	Acadia Civil
Site Name	Lily Pond	Client Project No.:	NA
		Boring/Test Pit No:	B1
Site Location	Deer Isle, Maine	Sample No:	S1
		Depth:	1-2 ft
Test Method	AASHTO 311	Sample Type:	Jar
		KeyLabID:	0



Sieving	
Particle Size mm	% Passing
100	100.0
75	100.0
50	100.0
37.5	100.0
25	100.0
19	85.8
12.5	85.8
9.5	84.3
4.75	80.4
2	74.4
0.85	66.9
0.425	59.0
0.25	52.6
0.15	46.7
0.106	42.9
0.075	39.4

Sample Proportions	% Dry Mass
Very Coarse > 75 mm	0.0
Coarse Gravel 75 mm - 19 mm	14.2
Fine Gravel 19 mm - 4.75 mm	5.4
Coarse Sand 4.75 to 2.0 mm	6.0
Medium Sand 2.0 to 0.435 mm	15.5
Fine Sand: 0.425 to 0.075 mm	19.5
Fines: <0.075 mm	39.4

Soil Classification
Brown silty fine to coarse SAND, little fine to coarse gravel (SM)

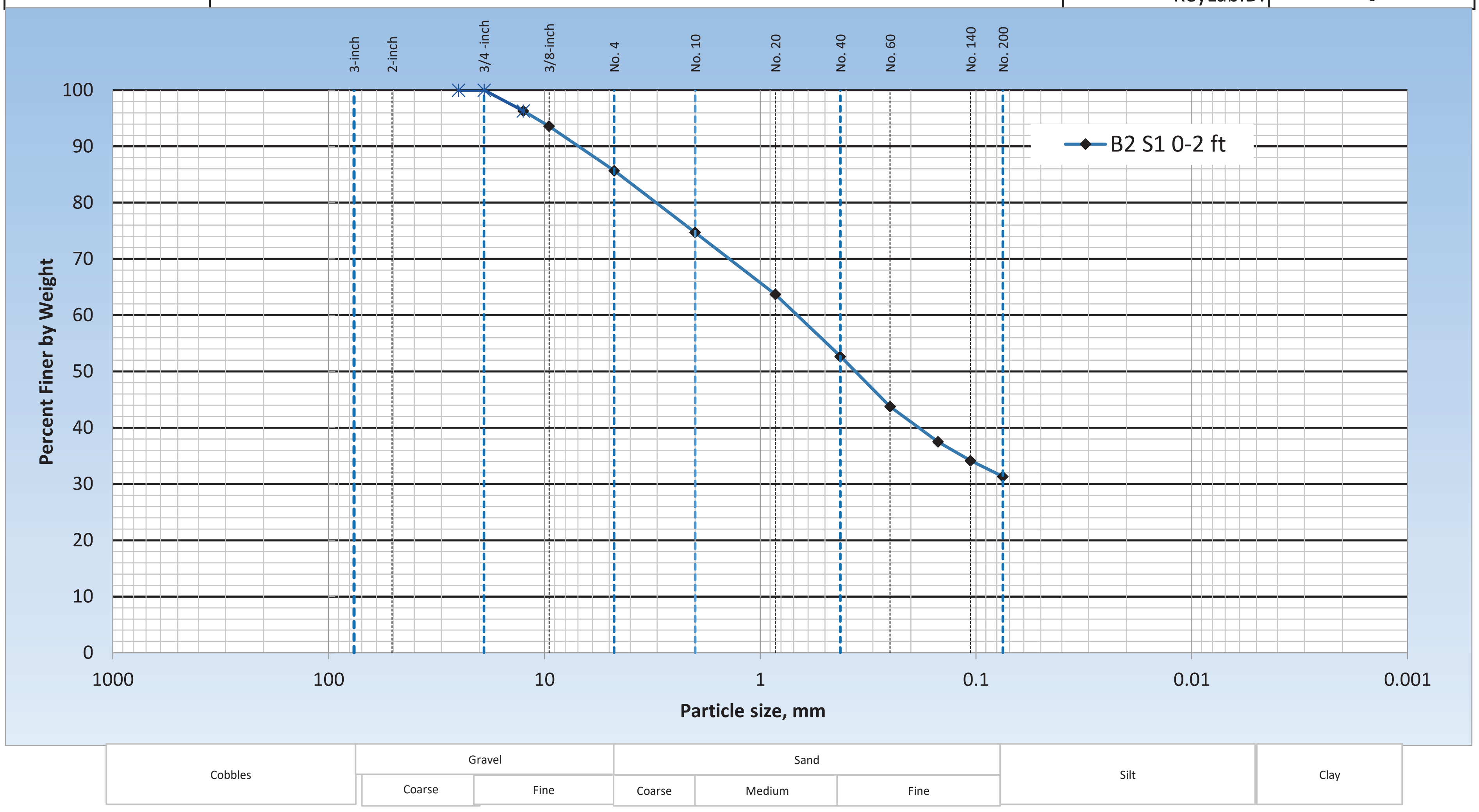
Moisture Content:	15.7

Tested by		Checked by		Approved by		Printed Date	Figure No.
SJR	Date	sjr	Date	sjr	Date		
	7/26/21		8/2/21		8/2/21		

Soil Metrics LLC Geotechnical Engineering

Particle Size Distribution

	Particle Size Distribution	Job No.:	172-04
		Client:	Acadia Civil
Site Name	Lily Pond	Client Project No.:	NA
		Boring/Test Pit No:	B2
Site Location	Deer Isle, Maine	Sample No:	S1
		Depth:	0-2 ft
Test Method	AASHTO 311	Sample Type:	Jar
		KeyLabID:	0



Sieving	
Particle Size mm	% Passing
100	100.0
75	100.0
50	100.0
37.5	100.0
25	100.0
19	100.0
12.5	96.3
9.5	93.6
4.75	85.7
2	74.7
0.85	63.7
0.425	52.7
0.25	43.7
0.15	37.5
0.106	34.1
0.075	31.3

Moisture Content:	18.6

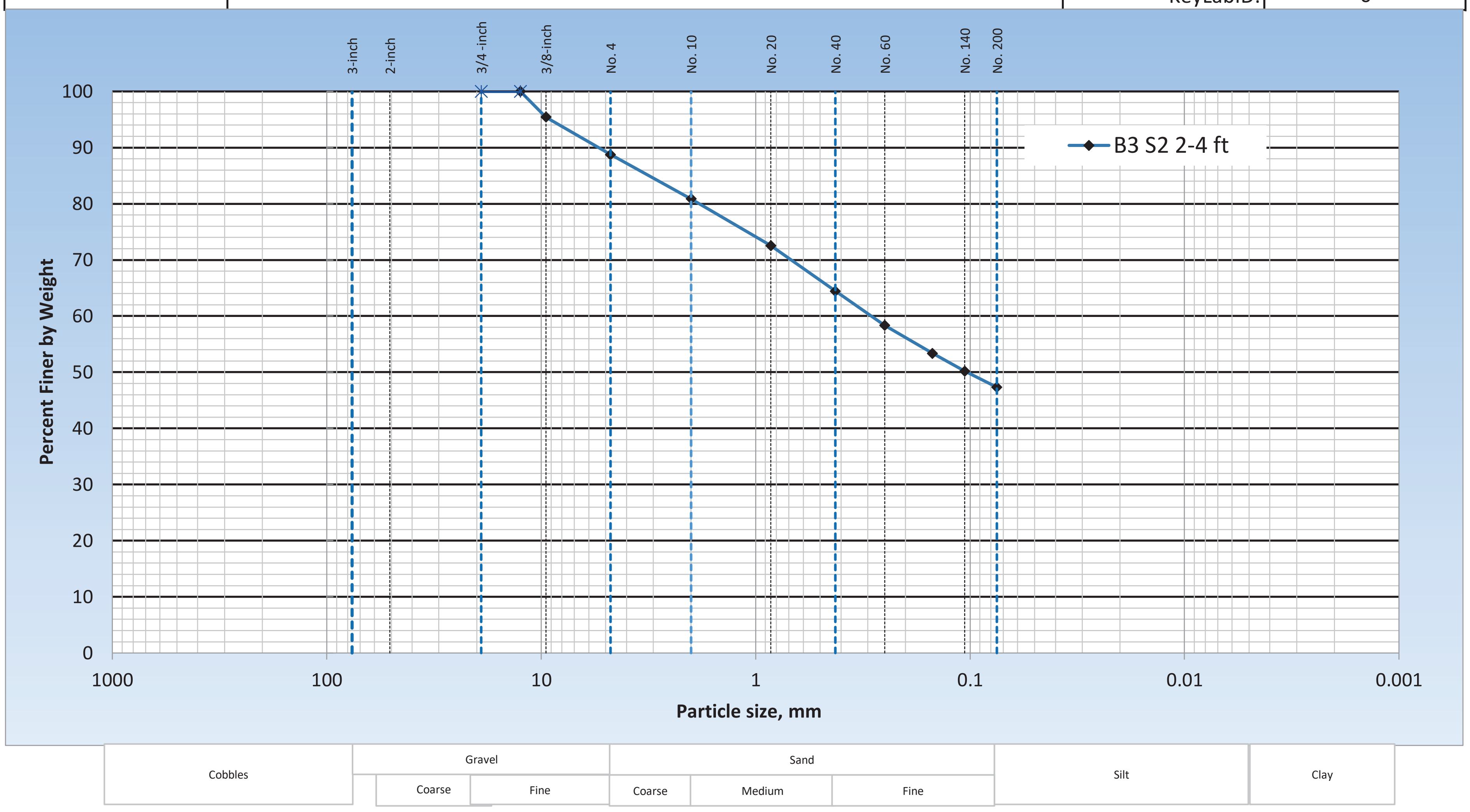
Sample Proportions	% Dry Mass
Very Coarse > 75 mm	0.0
Coarse Gravel 75 mm - 19 mm	0.0
Fine Gravel 19 mm - 4.75 mm	14.3
Coarse Sand 4.75 to 2.0 mm	11.0
Medium Sand 2.0 to 0.435 mm	22.0
Fine Sand: 0.425 to 0.075 mm	21.3
Fines: <0.075 mm	31.3

Soil Classification
Brown Silty fine to coarse SAND,little Gravel (SM)

Tested by		Checked by		Approved by		Printed Date	Figure No.
SJR	Date	sjr	Date	sjr	Date		
	7/26/21		8/2/21		8/2/21		

Soil Metrics LLC Geotechnical Engineering

	Particle Size Distribution	Job No.:	172-04
		Client:	Acadia Civil
Site Name	Lily Pond	Client Project No.:	NA
		Boring/Test Pit No:	B3
Site Location	Deer Isle, Maine	Sample No:	S2
		Depth:	2-4 ft
Test Method	AASHTO 311	Sample Type:	Jar
		KeyLabID:	0



Sieving	
Particle Size mm	% Passing
100	100.0
75	100.0
50	100.0
37.5	100.0
25	100.0
19	100.0
12.5	100.0
9.5	95.4
4.75	88.8
2	80.9
0.85	72.5
0.425	64.4
0.25	58.3
0.15	53.4
0.106	50.2
0.075	47.3

Sample Proportions	% Dry Mass
Very Coarse > 75 mm	0.0
Coarse Gravel 75 mm - 19 mm	0.0
Fine Gravel 19 mm - 4.75 mm	11.2
Coarse Sand 4.75 to 2.0 mm	7.9
Medium Sand 2.0 to 0.435 mm	16.4
Fine Sand: 0.425 to 0.075 mm	17.1
Fines: <0.075 mm	47.3

Soil Classification
Brown Silty fine to coarse SAND, trace fine gravel (SM)

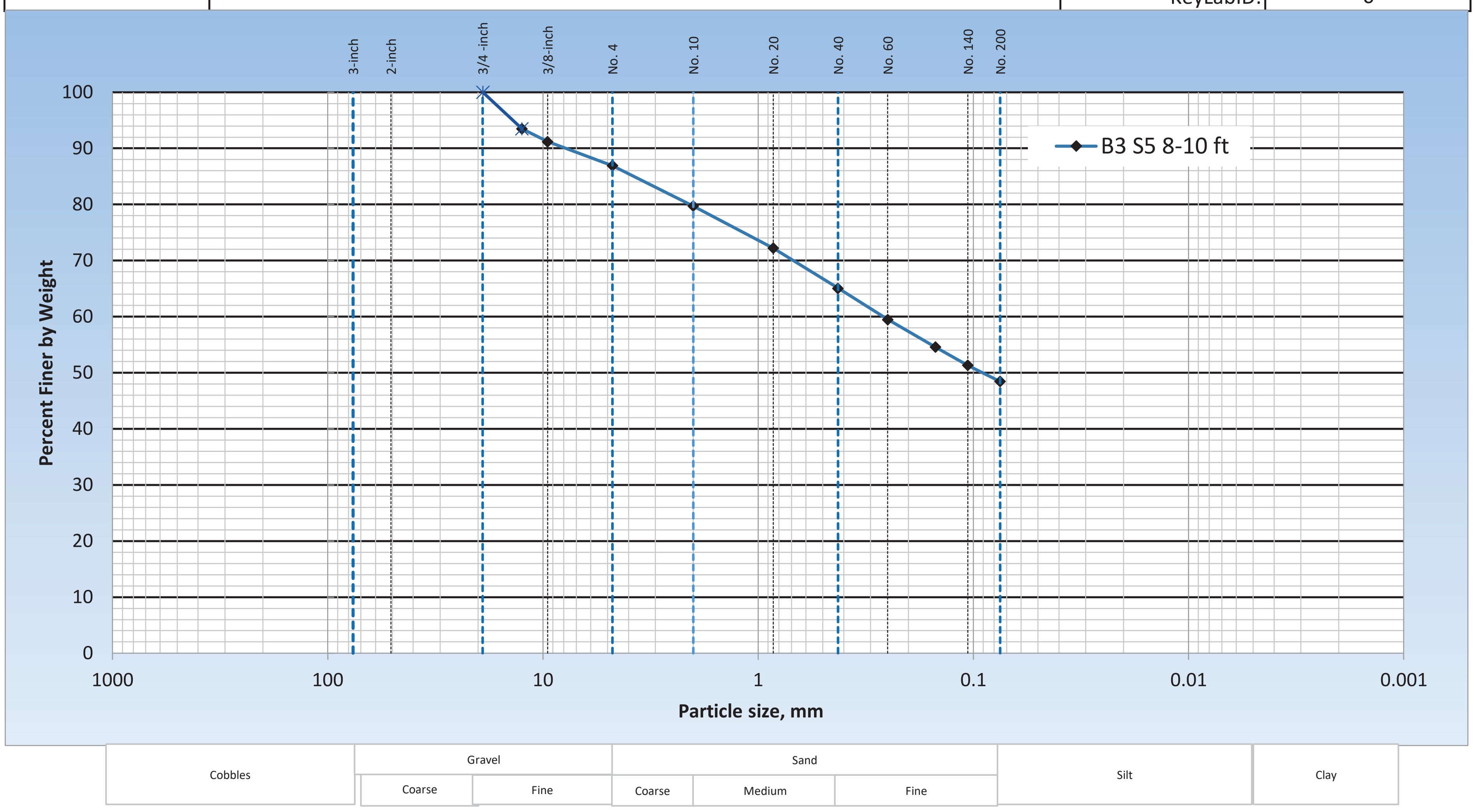
Moisture Content (%):	14.0

Tested by		Checked by		Approved by		Printed Date	Figure No.
SJR	Date	sjr	Date	sjr	Date		
	7/26/21		8/2/21		8/2/21		

Soil Metrics LLC Geotechnical Engineering

Particle Size Distribution

	Particle Size Distribution	Job No.:	172-04
		Client:	Acadia Civil
Site Name	Lily Pond	Client Project No.:	NA
		Boring/Test Pit No:	B3
Site Location	Deer Isle, Maine	Sample No:	S5
		Depth:	8-10 ft
Test Method	AASHTO 311	Sample Type:	Jar
		KeyLabID:	0



Sieving	
Particle Size mm	% Passing
100	100.0
75	100.0
50	100.0
37.5	100.0
25	100.0
19	100.0
12.5	93.5
9.5	91.2
4.75	86.9
2	79.7
0.85	72.2
0.425	65.1
0.25	59.5
0.15	54.5
0.106	51.3
0.075	48.4

Sample Proportions	% Dry Mass
Very Coarse > 75 mm	0.0
Coarse Gravel 75 mm - 19 mm	0.0
Fine Gravel 19 mm - 4.75 mm	13.1
Coarse Sand 4.75 to 2.0 mm	7.2
Medium Sand 2.0 to 0.435 mm	14.7
Fine Sand: 0.425 to 0.075 mm	16.6
Fines: <0.075 mm	48.4

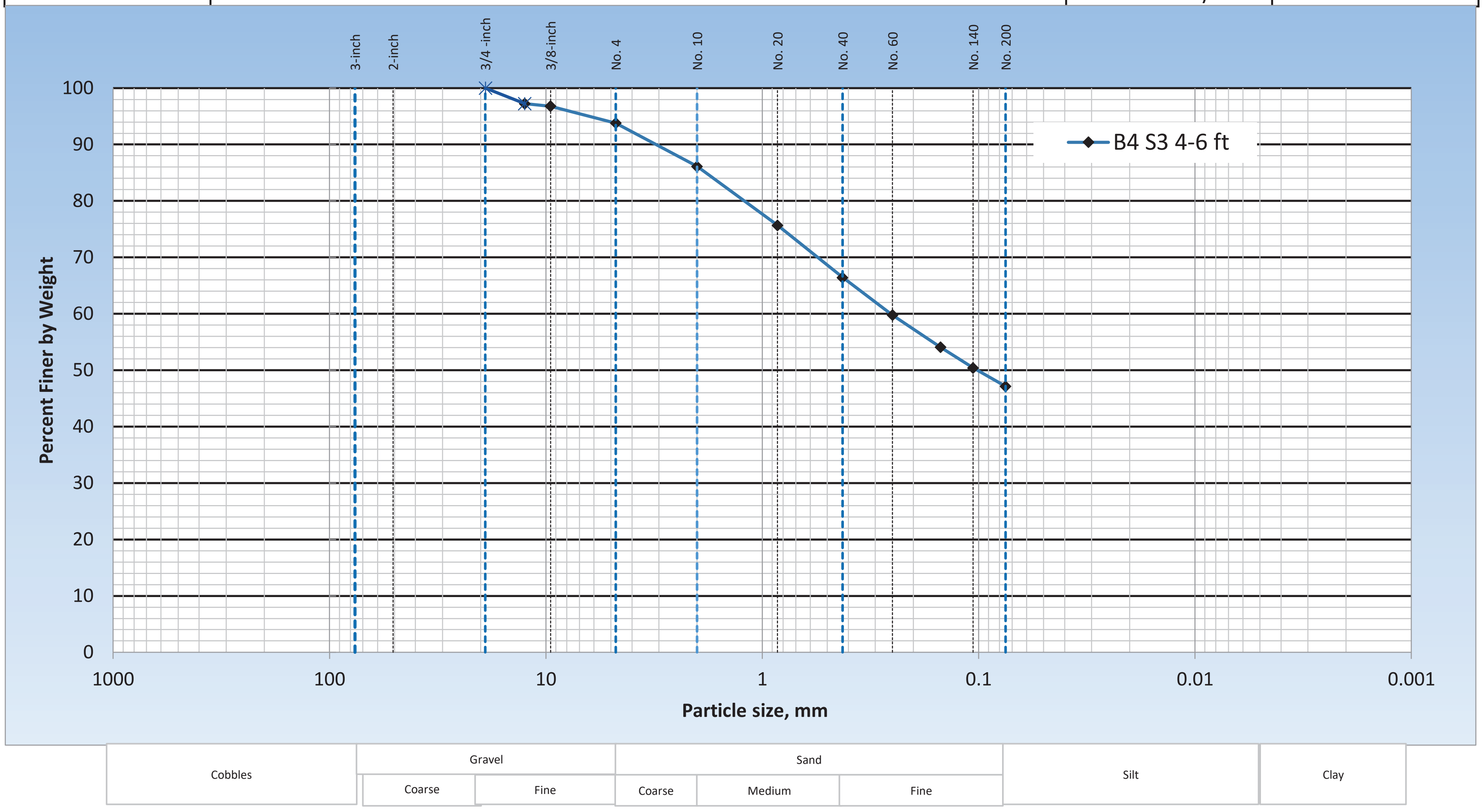
Soil Classification
Gray silty fine to coarse SAND, little fine gravel (SM)

Moisture Content:	11.0

Tested by		Checked by		Approved by		Printed Date	Figure No.
SJR	Date	sjr	Date	sjr	Date		
	7/26/21		8/2/21		8/2/21		

Soil Metrics LLC Geotechnical Engineering

	Particle Size Distribution	Job No.:	172-04
		Client:	Acadia Civil
Site Name	Lily Pond	Client Project No.:	NA
		Boring/Test Pit No:	B4
Site Location	Deer Isle, Maine	Sample No:	S3
		Depth:	4-6 ft
Test Method	AASHTO 311	Sample Type:	Jar
		KeyLabID:	0



Sieving	
Particle Size mm	% Passing
100	100.0
75	100.0
50	100.0
37.5	100.0
25	100.0
19	100.0
12.5	97.2
9.5	96.8
4.75	93.8
2	86.1
0.85	75.7
0.425	66.4
0.25	59.8
0.15	54.1
0.106	50.4
0.075	47.1

Sample Proportions	% Dry Mass
Very Coarse > 75 mm	0.0
Coarse Gravel 75 mm - 19 mm	0.0
Fine Gravel 19 mm - 4.75 mm	6.2
Coarse Sand 4.75 to 2.0 mm	7.7
Medium Sand 2.0 to 0.435 mm	19.7
Fine Sand: 0.425 to 0.075 mm	19.3
Fines: <0.075 mm	47.1

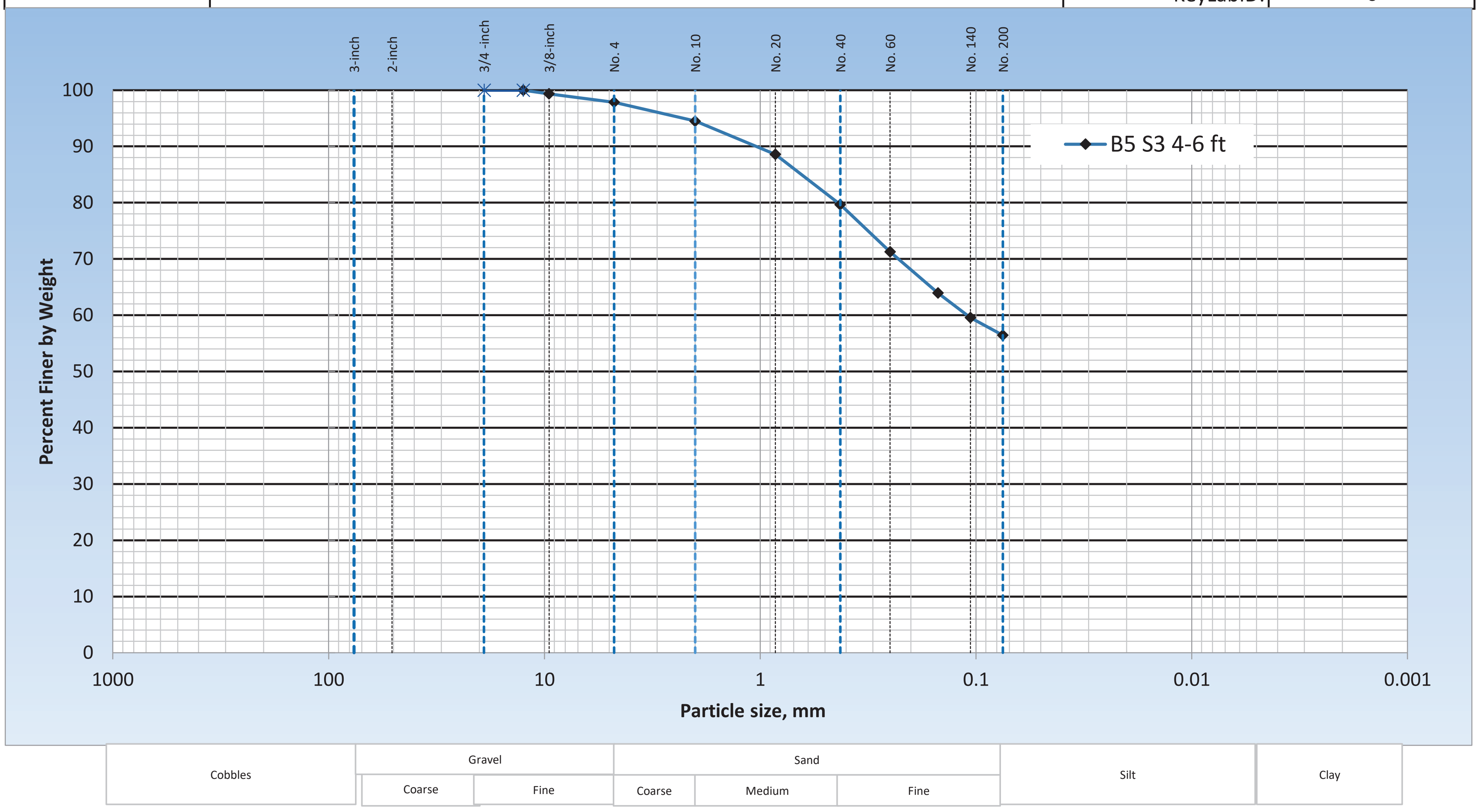
Soil Classification
Brown silty fine to coarse SAND, trace fine gravel (SM)

Moisture Content:	15.4

Tested by		Checked by		Approved by		Printed Date	Figure No.
SJR	Date 7/26/21	sjr	Date 8/2/21	sjr	Date 8/2/21		

Soil Metrics LLC Geotechnical Engineering

	# Particle Size Distribution	Job No.:	172-04
		Client:	Acadia Civil
Site Name	Lily Pond	Client Project No.:	NA
		Boring/Test Pit No:	B5
Site Location	Deer Isle, Maine	Sample No:	S3
		Depth:	4-6 ft
Test Method	AASHTO 311	Sample Type:	Jar
		KeyLabID:	0



Sieving	
Particle Size mm	% Passing
100	100.0
75	100.0
50	100.0
37.5	100.0
25	100.0
19	100.0
12.5	100.0
9.5	99.3
4.75	97.9
2	94.5
0.85	88.6
0.425	79.7
0.25	71.3
0.15	63.9
0.106	59.6
0.075	56.4

Sample Proportions	% Dry Mass
Very Coarse > 75 mm	0.0
Coarse Gravel 75 mm - 19 mm	0.0
Fine Gravel 19 mm - 4.75 mm	2.1
Coarse Sand 4.75 to 2.0 mm	3.4
Medium Sand 2.0 to 0.435 mm	14.8
Fine Sand: 0.425 to 0.075 mm	23.2
Fines: <0.075 mm	56.4

Soil Classification
Brown medium to fine sandy SILT, trace coarse sand and fine gravel (ML)

Moisture Content:	16.5

Tested by		Checked by		Approved by		Printed Date	Figure No.
SJR	Date 7/26/21	sjr	Date 8/2/21	sjr	Date 8/2/21		

Soil Metrics LLC Geotechnical Engineering

APPENDIX C

INSPECTION
OF
LILY POND DAM

DEER ISLE, MAINE

MAINE EMERGENCY MANAGEMENT AGENCY

NOVEMBER 1997

MBP Consulting
PLANNING AND ENGINEERING

mema.insplilypond708

INSPECTION OF LILY POND DAM

DEER ISLE, MAINE

National ID: ME00585 MEMA ID: 106

Submitted to:

Maine Emergency Management Agency
Augusta, Maine

Submitted by:

MBP Consulting
Portland, Maine

November 1997

TABLE OF CONTENTS

SUMMARY

Based on review of the project information and the July 15, 1997 field inspection findings, the structures of Lily Pond Dam are considered to be in fair to poor condition. Although no signs of immediate failure of the dam were observed, there are concerns which may present a threat to the integrity of the dam and public safety. Major areas of concern include insufficient hydraulic capacity of the sluiceway, potential instability of the downstream slope of the east dike, and seepage at the toe of the east dike. General deficiencies of the project include the absence of written operating and maintenance procedures and an Emergency Action Plan.

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

- Cut and remove the existing inner wall of the sluiceway to increase hydraulic capacity; and
- Repair the east dike to increase stability of the downstream slope and improve control of the existing seepage.

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

- Repair areas of erosion on the top of the west dike and downstream slope of the east dike;
- Repair riprap on the upstream slopes of the east and west dikes;
- Cut and remove trees and brush from the top, slopes, toe, and abutments of the east and west dikes and from the downstream discharge channel;
- Engage a registered professional engineer to conduct a detailed inspection of the dam and appurtenant facilities every 5 years;
- Prepare drawings of the dam for future reference;
- Establish operation and maintenance procedures at the dam; and
- Develop an Emergency Action Plan for conditions that could threaten the dam and public safety.

1.0 INTRODUCTION

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

As a follow-up to the recent history of dam failures in Maine, MEMA conducted a brief, statewide inspection in 1996 of about 180 dams with significant and high hazard potential identifying the dams requiring detailed inspection and condition evaluation by a professional engineer. The purpose of the 1997 inspection program is to perform a visual inspection and evaluation of significant and high hazard dams, which may threaten the public safety, and recommend corrective measures, if required.

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

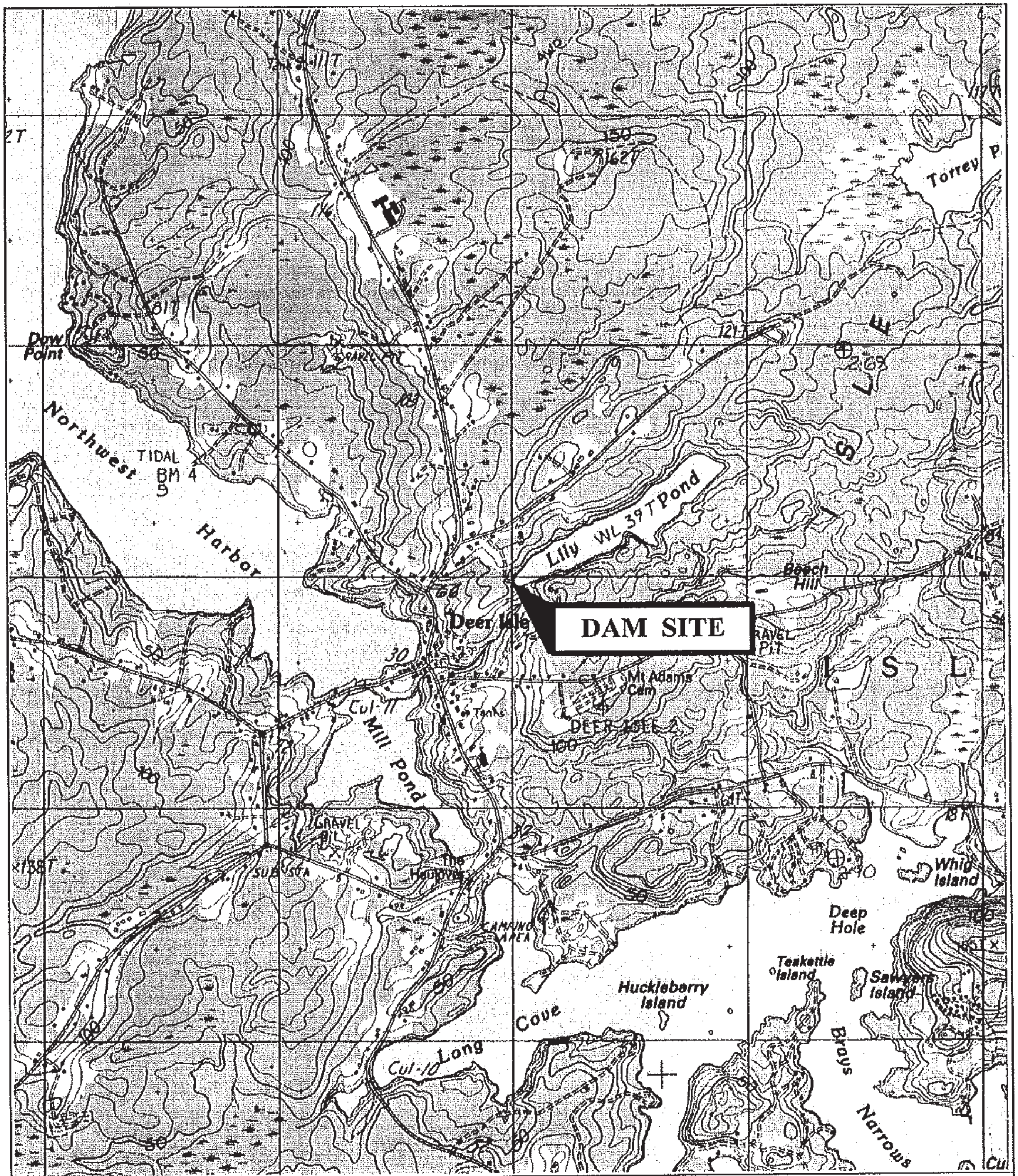
2.0 PROJECT DESCRIPTION

Lily Pond Dam (National ID # ME00585, MEMA ID # 106) is located on Lily Brook, in the Town of Deer Isle, Hancock County, Maine (Figure 1). Lily Brook flows about 3,000 feet westerly and empties through Mill Pond into its tidal estuary, Northwest Harbor. According to the National Inventory of Dams, the Lily Pond Dam was built in 1948.

The dam impoundment, Lily Pond, which is used for storage, fire protection, and recreation, has a maximum storage of 257 acre-ft. The normal pond level is at elevation 39.0 feet National Geodetic Vertical Datum (NGVD) and is shown on the USGS "Deer Isle" Quadrangle Map (Figure 1). It is assumed in this report that the normal pond level is at the permanent crest of the dam sluiceway. The dam is classified as a small size structure (the dam height is less than 40 feet and impoundment storage less than 1,000 acre-ft) with significant hazard potential[1] and was inspected by MEMA on June 6, 1996. The dam is owned and operated by Town of Deer Isle (Owner).

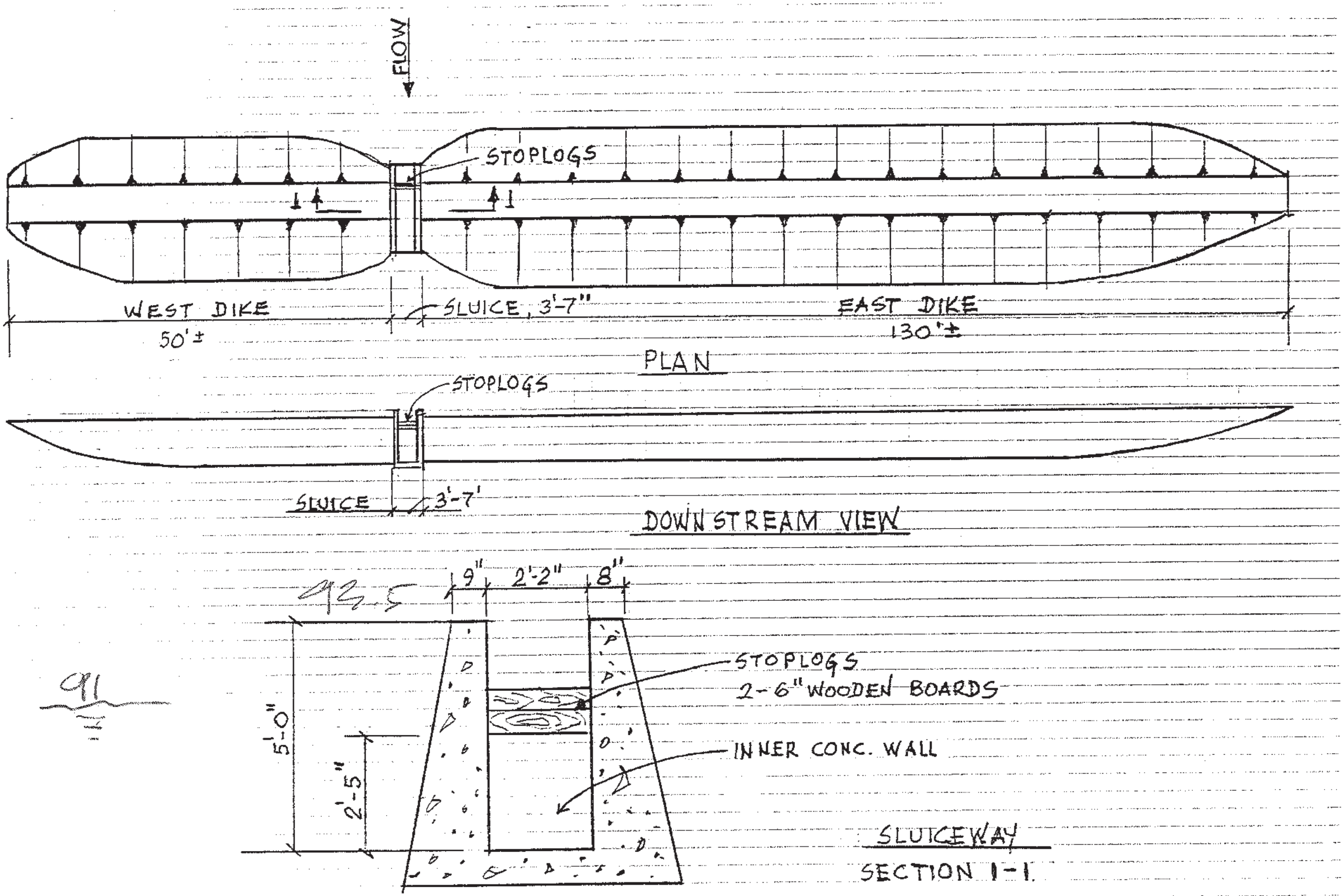
The approximately 180-foot-long, 11-foot-high dam consists of a sluiceway and east and west earthen dikes. A field sketch prepared during this inspection shows a plan, downstream view, and section of the dam (Figure 2). The following description of the dam facilities is based on the available project information and visual observations during this inspection.

[1] **Significant hazard potential category** structures are usually located in predominantly rural or agricultural areas where failure may cause serious damage to isolated homes, secondary highways, or minor railroads; cause interruption of use or service of relatively important public utilities; or cause some incremental flooding of structures with possible danger to human life. **Hazard classification** does not indicate the structural integrity of the dam itself, but rather the effects if a failure should occur. (Federal Energy Regulatory Commission. *Engineering Guidelines for Evaluation of Hydropower Projects*, 1991).



LILY POND DAM NATIONAL ID: ME00585 MAINE ID: MEMA ID: 106	N	**FIGURE 1** **LOCATION MAP** USGS QUADRANGLE "DEER ISLE", ME Approx. Scale: 1" = 2000'

mema.insp/lilypond702



Lily Pond Dam, Deer Isle, ME Maine Emergency Management Agency State Dam Inspection Program	Field Sketch: Plan, Downstream View, and Sections Not to Scale	MBP Consulting Portland, ME	FIGURE 2

The 2.2-foot-wide concrete sluiceway consists of two exterior gravity walls constructed on a base slab. The inner concrete wall installed across the flow supports wooden stoplogs or boards which control the water level in the pond. The top of the inner wall is 2.6 feet below the top of the exterior walls and is considered as the permanent crest of the sluiceway.

The east and west earthen dikes are approximately 130 feet long and 50 feet long, respectively, and typically 3 feet wide at the top. The dike slopes vary between 1H:1V and 1.5H:1V (horizontal : vertical) and steeper. The upstream slopes of both dikes are reinforced with riprap.

3.0 PROJECT INFORMATION

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

- Lily Pond Dam, National Inventory of Dams.
- Lily Pond Dam Inspection Checklist. MEMA, June 6, 1996.

No major construction activities at the project site were reported since construction of the dam in 1948.

Appendix A contains a checklist of the inspection conducted by MEMA and data from the National Inventory of Dams.

There were no project drawings or operation and maintenance records available for review.

4.0 PROJECT OPERATION AND MAINTENANCE

The normal pond level is maintained within 6 inches over the permanent sluiceway crest. The normal high pond level during the spring runoff is at 12 inches above the permanent crest of the sluiceway. By August-September, the impoundment is drawn down by 2 to 3 feet below the spring level. The maximum pond level was reportedly observed at 8 inches below the top of the sluiceway walls. There were no written operation and maintenance procedures or records on the project events, such as floods, heavy rainfall or ice impact, available for review.

5.0 FIELD INSPECTION

The field inspection of the dam was performed on July 15, 1997 by Myron Petrovsky of MBPC assisted by Sean Thies (MEMA) and Neville Hardy (Owner). The owner was interviewed at the site on the project data, events, repairs, and operation and maintenance. The inspection was conducted on a sunny day with the ambient temperature about 75 degrees F. At the time of the inspection, the pond level was 2.2 feet below the top of the sluiceway walls.

The inspection was performed by visually observing the accessible project structures. The structures, abutments, and downstream discharge channel were observed for signs of weathering, deterioration, erosion, cracking, steel and reinforcement corrosion, movement, seepage, leakage, vegetation, and undermining.

Sluiceway. The sluiceway (Photos B-1 and B-2) was observed with two stoplogs or boards, each 6 inches high, installed on the top of the crest. The stoplogs were leaking at an estimated rate of 30 to 50 gallons per minute (gpm). The structure appeared to be in fair condition and no significant cracking, structural movement, or seepage around the facility was observed. The concrete showed general wear with exposure of coarse aggregate and some erosion along the wall edges. The areas of deep erosion in the dike soil around the sluice walls reported during the June 1996 MEMA inspection were repaired by placement of sandbags.

East Dike. The earthen east dike appeared to be in poor condition. The top of the dike, about 3 feet wide and 1 to 1.5 feet below the top of the sluiceway wall, was uneven, irregular, and eroded at several places. The upstream slope is covered with riprap and showed significant erosion and benching along the shoreline and displacement and loss of protective stone. The steep downstream slope was significantly eroded in the middle. It appeared that the slope has experienced stability problems in the past and was reinforced at some areas with riprap and a stone wall. Exposed riprap on the slope was loose. A small stream of water seeping at the rate of 1-2 gpm was observed at the toe in the mid-section of the dike (Photo B-3). The soil at that area was saturated and soggy for a length of approximately 20 feet. The top, slopes, and toe of the dike were overgrown with large trees and dense brush obstructing further examination of the structure.

West Dike. The top and slopes of the earthen west dike were uneven, irregular, and covered with trees and dense brush hampering the inspection (Photo B-4). An area with significant erosion, about 10 feet long and 3 feet wide, was observed on the top of the dike near the abutment area. The upstream dike slope exhibited undercutting, benching, and displacement of riprap stones. The downstream slope was relatively flat, about 3H:1V, and stable. No signs of seepage were observed on the downstream slope or at the toe of the dike.

Downstream Channel. The streambed of the downstream discharge channel at the sluice (Photo B-2) was covered with large, scattered stones. Trees and brush growing on the floor and banks of the stream were overhanging the downstream channel.

6.0 ASSESSMENT

On the basis of the July 15, 1997 inspection, review of the project data, and the interview with the Owner, the following assessment was made:

1. In general, Lilly Pond Dam appears to be in fair to poor condition. Although no signs of immediate failure of the dam were observed, there are concerns which may present a threat to the integrity of the dam and public safety. Major areas of concern include the insufficient hydraulic capacity of the sluiceway, signs of instability of the downstream

slope of the east dike, and seepage at the toe of the east dike. General deficiencies of the project include the absence of written operating and maintenance procedures and an Emergency Action Plan.

2. The concrete sluiceway appeared to be in fair condition. No significant deterioration of the sluice since construction was observed. The sluice has a limited hydraulic capacity which was evidenced by the formation of erosion gullies around the sluice walls during the high water. The maximum pond level was reportedly observed at 8 inches below the top of the sluice walls which could result in overtopping of the dikes by 4 to 10 inches. Removal of the existing inner concrete wall will significantly increase hydraulic capacity of the sluiceway and improve control of the impoundment.

3. The east and west dikes were in poor condition. The top of the dikes were uneven and irregular. Areas with significant erosion were located on the top of the west dike at the dam abutment and on the downstream slope of the east dike. The upstream slopes were undercut, benched, and riprap was displaced exposing unprotected dike earthfill to wave and ice impact. The downstream slope of the east dike apparently has experienced some stability problems in the past which was evidenced by the presence of riprap and a supporting stone wall. Moderate seepage and a large area of wet soil were observed along the toe of the east dike at the mid-section where the signs of the stone armoring were observed. Both dikes were overgrown with large trees and brush obstructing the inspection and routine monitoring of condition of the structures.

4. The discharge channel downstream of the sluiceway was in poor condition. The presence of large trees and brush growing in the streambed and overhanging the banks of the discharge channel may obstruct movement of water during flood events.

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

6. There is no an Emergency Action Plan (EAP) in effect to respond to emergency conditions threatening the dam and public safety.

7.0 RECOMMENDATIONS

A. Remedial Measures

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

1. Cut and remove the inner concrete wall of the sluiceway to increase hydraulic capacity.

2. Repair the east dike to increase stability of the downstream slope and improve control of the existing seepage.

B. Operation and Maintenance

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

1. Repair areas of erosion on the top of the west dike and the downstream slope of the east dike.

2. Repair riprap on the upstream slopes of the east and west earthen dikes.

3. Cut and remove trees and brush from the top, slopes, toe, and abutments of the east and west earthen dikes within 10 ft of the dam. Establish a grass cover on the top and downstream slopes of the dikes and mow on a regular basis.

4. Cut and remove trees, brush, and debris from the streambed and banks of the downstream channel and continue it on a regular basis.

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

6. Conduct a topographic survey of the dam and prepare project drawings for future reference.

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

    - A schedule and guidelines for maintenance of the impoundment water level;

    - A schedule and guidelines for regular maintenance of the dam facilities such as brush and tree removal, debris control, grass mowing, and repair of deteriorated concrete, earthfill, and riprap.

    - A schedule and guidelines for inspection and monitoring of the dam and appurtenant facilities including a checklist of inspection items. The inspection of the dam should be conducted semi-annually and immediately after significant floods, heavy rainfall or other major project events. The observation findings should be recorded in a maintenance log.

8. Establish an EAP which will provide the following:

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

APPENDIX A

PROJECT INFORMATION

NATIONAL INVENTORY OF DAMS
LILY POND DAM
DEER ISLE, MAINE

Dam Name	State ID	National ID	MEMA #	Lat Deg	Lt Mn	Lt Sc
LILY POND DAM		ME00585	106	44	13	645
Long Deg	**Ln Mn**	**River/Strm**	**Nrst. City**	**Dist.**	**Owner Name**	**Fed.**
68	41	LILY BROOK	DEER ISLE	0	DEER ISLE, TOWN OF	N
Dam Type	**Yr. Compl.**	**Lngth**	**Struct Ht**	**Hydr. Ht**	**Max Sto**	**Nrm Sto**
REPG	1948	100	11	9	257	225
Srfc Area	**Drng Area**	**Haz**	**Phase I**	**Ins Date**	**St. Reg.**	**Condit.**
		S	N	35222	MEMA	U
Phone	**Address**	**City**	**State**	**Zip Co**	**Recent Development**	
3482324						
Train. Requests	**Residential**	**Campsites**	**Comments**			
Y	R					

lilypond701exc

#106

MAINE EMERGENCY MANAGEMENT AGENCY
DAM INSPECTION CHECKLIST

Dam Name: Lily Pond Dam — Owner: Town

River, Stream or Lake: Lily Brook — Address:

Current Hazard Potential: High_ Significant_ Low_ — Address:

Dam Location (Town): Deer Isle — Dam Type: Embankment

Date of Inspection: 6/6/96 — Latitude: 44°13.645 Longitude: 68°41.478

Picture # 23

ITEM	YES	NO	N/A	REMARKS
1. Crest				
a. Settlement ?	X			Around Outlet Gate
b. Misalignment ?		X		
c. Cracks ?		X		
d. Trees and Brush ?	X			Well established birch & ash
e. Evidence of Major Rehabilitation ?		X		If yes, complete Dam Structural Measurement Report
2. Upstream / Downstream Slopes				
a, Slope Protection ?	X			Rocks have moved off lower side into lake
b. Erosion / Beaching ?	X			
c. Trees and Brush ?	X			
d. Visual Settlements ?	X			Left embankment
e. Sinkholes ?		X		
f. Animal Burrows ?		X		
g. Seepage ?	X			Left embankment
h. Toe drains ?		X		
i. Relief wells ?		X		
j. Slides / Slumps ?	X			
3. Abutment Contact				
a. Erosion ?	X			At contacts with outlet structure
b. Seeping ?		X		
c. Boils ?		X		
d. Springs ?		X		

APPENDIX B

INSPECTION PHOTOGRAPHS

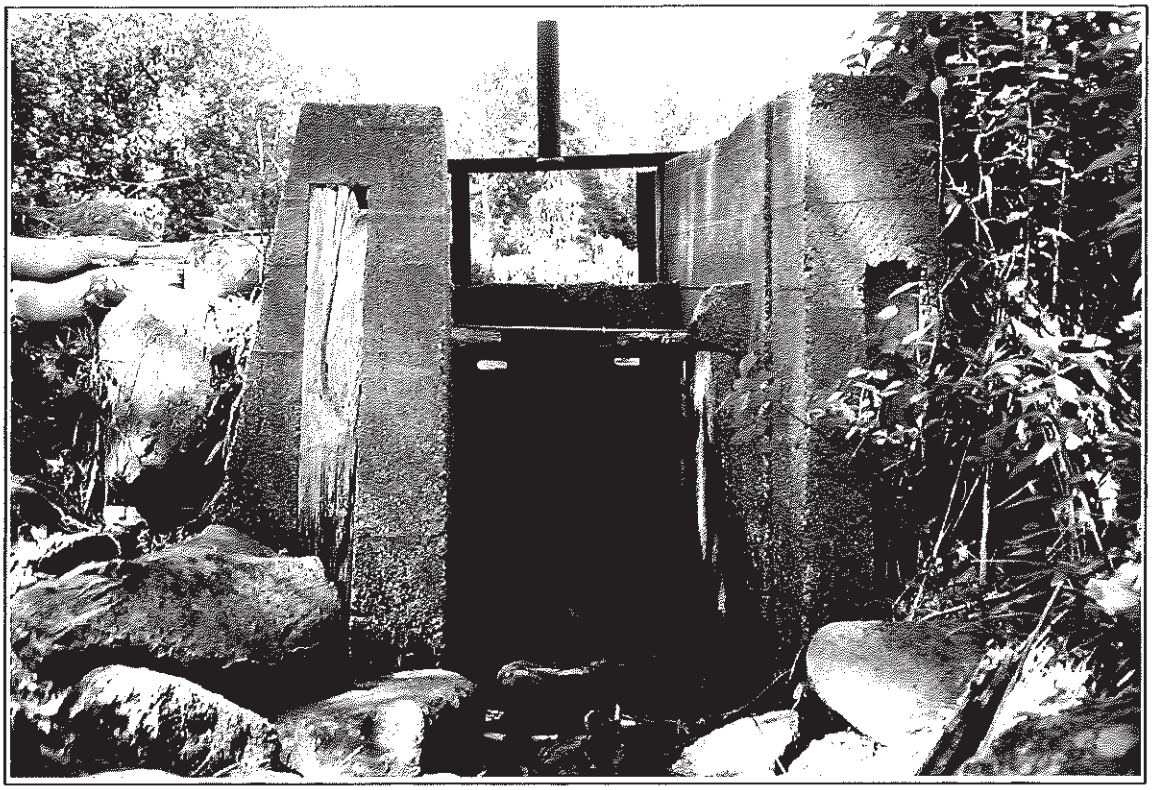


Photo B-1 Lily Pond Dam.
Downstream View of Sluiceway Structure.

Photo B-2 Lily Pond Dam.
Sluiceway and Downstream Channel.

Photo B-3 Lily Pond Dam.
East Earthen Dike. Note Erosion on Downstream Slope and Seepage at Toe of Dike.

Photo B-4 Lily Pond Dam.
Top and Upstream Slope of West Earthen Dike.

APPENDIX D

From: Richard Avery [mailto:averybarn@gmail.com]
Sent: Tuesday, May 14, 2013 1:01 PM
To: Fletcher, Tony; Ayotte, Tara
Subject: Re: #106 Lily Pond Dam, EAP update and Dam Safety Inspection 5/1/13

Dear Mr. Fletcher,

I received your email and report regarding the condition of the dam at the Lilly Pond, Deer Isle.

I will compile an updated EAP shortly and send it in to Ms. Ayotte.

The use by the Deer Isle fire department of the pond and spillway for their cistern system complicates any lowering of the water level -- they would understandably be very upset if I unilaterally lowered the water level. I will start a discussion with them and abutters shortly about the long term maintenance of the dam.

Regards,

Richard Avery

On Tue, May 7, 2013 at 9:44 PM, Fletcher, Tony <Tony.Fletcher@maine.gov> wrote:

Dear Mr. Avery,

I understand that you are the current owner of #106, Lily Pond Dam, located in the town of Deer Isle, Hancock County, ME. When you read this letter, you will see that the situation at Lily Pond dam needs urgent attention by the dam owner. So if you are not owner of Lily Pond dam in Deere Isle, ME., please let me know so that MEMA may take the necessary action to secure this dam.

Our records show that #106, Lily Pond Dam, has been classified a "significant potential hazard dam" (SH) by the Maine Emergency Management Agency (MEMA). On 4/26/13 Ms. Ayotte, the MEMA dam EAP coordinator, reported to me that the dam emergency action plan (EAP), namely the plan to manage an emergency at your dam, had expired on 8/13/12, despite 4 earlier letters she sent to you dated; 7/8/12, 9/18/13, 12/18/12 and 1/31/13. As you are aware, the dam's EAP is a plan of action to be used during any emergency at the dam, and is required by Title MRSA 37B, C24 "Dam Safety".

To apprise myself of the current situation at Lily Pond Dam, I arranged to inspect Lily Pond dam on the morning of 5/1/13 for both "hazard" and "condition" (per Title MRSA 37B C24 "Dam Safety"). The inspection was done at short notice. Ms. Ayotte, our dam EAP coordinator, did try to arrange for you, and the Hancock County EMA Director, Mr. Andrew Sankey, to be present at the inspection. I understand from her that you did not respond to her email, and Mr. Sankey was previously engaged, so I inspected the dam alone. A follow up survey was done of the dam on the following day, 5/2/13, to confirm its basic dimensions.

Before my inspection, I read reports A&B attached below, and the 11/18/97 dam safety report by Myron B. Petrovsky PE. (If you have not read the MBP report, please let me know, and I will ensure you get a copy delivered to you). Amongst other things, these reports concluded that the dam does not have the capacity to pass major floods, has an unstable east dike, is leaking uncontrollably along the downstream toe of the east dike, is covered by tree and brush and has no written operating and maintenance procedures. Further, I found no design or construction records for the dam which means we have no idea whatsoever of its design criteria, its stability, its factor of safety or if there were defects during its construction. USGS maps show "normal pool" (NP) elevation of the dam as 91.0'. Also from the USGS maps we have measured the normal lake area of Lily Pond to be 32 acres, at the outlet of a 152 acre river basin. From this data, "normal storage" is calculated to be 160 acre feet. Since the dam height is >6', and the storage > 15 acre feet, the dam qualifies for regulation by the State of Maine. The dam is located close to the end of Deer Road in Deere Isle, ME.

My inspections were done in mild, clear weather, without foliage blocking observation. I began the day by inspecting the dam to assess its "condition", followed by an inspection of the downstream watercourse, to assess its hazard.

Condition Inspection

The dam height of 11', and length of 180' were confirmed on site. As a datum, the "top of dam" (TOD) was taken to be the top of the concrete spillway. No alterations or repairs to the dam were found to have been done. The dam is an earth dam of indeterminate age, which, judging by its use of a downstream stone retaining wall, is likely to be considerably older than the 65 years implied by the "1948" etched on its concrete sluiceway. The dam has no fishway. On the day, the reservoir was drawn down about 2.3' from the top of the concrete spillway and the spillway was overflowing at about 10 gpm. Some debris had collected on the stoplogs and in the spillway. The top, downstream and upstream faces of the dam were covered by trees and brush, and some large trees, one in particular was dead. There appears to be extensive root penetration into the structure, forming pipes through the dam, and waterways once the dead roots have rotted. The top of the dam was not a level plain, but an irregular exposed earth surface, varying in width between 2' and 15', and up to 2.1' in height, across the length of the dam, compounded by what appears to be foot paths. The undulating nature of the top of the dam is likely caused by pedestrian traffic, erosion, consolidation and settlement. Water leaking through the dam may also generate settlement in the dike. The stone walls, along the downstream toe of the embankment were crumbling or collapsed. The upstream embankment, despite randomly placed stonework along the upstream shoreline of the dam, showed significant wave and overtopping erosion. The dam leaked extensively along the toe of left dike. The dam has one concrete spillway located approximately 40' from the right abutment. This spillway is a 2'2" wide, 5' high and 6' long rectangular concrete channel with 9" side walls (see sketch in MBP Report dated 11.97). The spillway uses stoplogs to control pond elevation using stoplogs set against vertical steel angles fixed to the inner channel walls, and on the day one stoplog was in place. Each side of the spillway has eroded to a depth of 1.2' along the right wall and 2.1' along the left wall.

Hazard Inspection

I inspected the downstream watercourse from the dam to Route 15, a distance of 2,000 feet. I measured the R15 culvert and then inspected the remaining watercourse to its estuary. I saw no new developments along the downstream watercourse that could be impacted by a breach of the dam, and saw no changes to existing infrastructure from that of previous years. The dam should remain a SH dam.

Note; A later estimate of the dynamics of a breach found that the watercourse downstream of the dam has an average slope of 1:24. A breach flow of 160 cfs is likely to reach speeds in excess of 20 feet per second. This high speed flow is called "supercritical flow" which is highly turbulent and can cause great damage. Consider this; if the dam were under observations and were to begin failing, the time available to warn traffic on R15 would be less than 2 minutes. In fact one could not drive from the dam to R15 in that time. The anticipated damage due to a breach of Lily Pond dam is very significant indeed.

Conclusion

#106 Lily Pond Dam is an unsafe, defective, significant hazard dam, which, if breached, is likely to wash out R15. The dam has not undergone any repairs, despite recommendations by MEMA or MBP. Defects include; the necessary spillway capacity to pass large storms, severe erosion of the earth embankment either side of the spillway, signs of both wave and overtopping erosion, general leaking along the toe of the left dike, tree root penetration, embankment settlement and collapsed downstream stone retaining walls. These defects indicate instability of the structure, and the severity of the defects that the dam's breach is imminent. Please regard your dam as unsafe and a menace to public safety. What exacerbates the situation is that the dam does not have an EAP, not is one tested.

Recommendations

Considering the situation, I recommend that you do the following immediately;

1. Reduce the level of the pond by removing all stoplogs and completely opening the dam's spillway

2. Maintain the reduced operating elevation of the pond until dam repairs are approved by the State Dam Inspector

3. Update the dam EAP without further delay

4. Test the new dam EAP by June 3, 2013

5. Employ an engineer, qualified in dam design and repairs, to design and implement repairs to the dam

Please contact me if you have any queries. I have copied this report to the Director of Operations, MEMA, the Town of Deer Isle and The Hancock County EM Director.

Sincerely,

Tony Fletcher

State Dam Inspector

ATTACHMENT A

09/20/2010

Lily Pond Dam- ME ID: 106 NID ID: ME00585

Deer Isle

The Lily Pond dam is a dam created originally for fire protection and ice making purposes. It currently is for fire protection and recreational purposes. The dam impounds approximately acre-ft, has a surface area of 35 acres, and a total watershed area of 187 acres. The downstream effects of a dam breach could affect two houses and a Route 15 washout. The owner of the dam could not be reached before inspection time, and his EAP is currently past due with multiple reminders sent by Tara.

The dam itself is in fair to poor condition. The condition has not changed drastically since the last pictures/report. The spillway is leaking and is unable to regulate flow or water level. Bothe embankments are overgrown with grass/brush/trees. They have signs of animal crossing, erosion due to rock reinforcements falling, and wave erosion.

The downstream assessment shown in the EAP seems to be correct. Route 15 would most likely washout in the case of a dam breach. There are also two structures that could be in danger, one in particular that is located 20 ft from the Route 15 crossing. This is definitely a significant hazard dam, and I will be doing a follow-up to get accurate measurements and flow calculations.

ATTACHMENT B

Subject: #106 Lily Pond Dam, Deer Isle, Hancock, ME

Public Safety Hazard: Significant.

Project: Old dam of unknown age modified in 1948. Ownership recently changed. Earthfill dam. From right to left looking downstream the dam comprises a 20' long earth dike, a small 3' wide 4' high concrete outlet box with a timber plank flashboard weir, discharging directly into the stream and a further 80' of earth dike. The maximum height of the dam is 11'. The estimated storage is 1,100 acre feet and the lake area is 257 acres. Composition of the earth dike is unknown. There is no fishway. The dam was previously inspected by MEMA in 1997 and 2001. Failure of the dam will overtop and possible damage Route 15 and 2 houses along the downstream watercourse.

Dates of inspection: 14 April 03.

Scope of inspection: Downstream watercourse to check current structures. Visual inspection of the dam and appurtenances. No tests or design assessments were done.

Baseline data: Report 8 & 11 Dec 2000 by Maine State Dam Inspector on file.

Maintenance and repairs: None noted and nothing on file.

Inspection findings: (see report 8 Dec 2000 on file)

1) Conditions: Underfoot – firm. Weather fine and sunny – temperature 50F. No snow on the ground. No ice on the lake or in waterway. Lake full and overtopping about 6".

2) Maintenance: Except for stoplogs, no noticeable repairs or maintenance done at dam.

3) Downstream: Under high flow conditions the failure of this dam would present a serious "significant" hazard to downstream houses and Route 15 serving Stonington.

4) Vegetation: Extensive tree and shrub growth. Some grass growth.

5) Wave protection: None. Serious erosion along full length of the dike. Average freeboard about 15" on day of inspection and could be less. Insufficient freeboard to prevent wave overtopping the crest in high winds.

6) Dam crest: Uneven crest surface with pathway. Crest width varies 5'-10' in width and undulates about 12".

7) Embankment: Localized settlement noted all over dike. Appearance indicates areas of erosion, collapse or settlement which may lead to failure. Dam features compare well with 1980 report photos.

8) Spillway: On the day of inspection, water was flowing at about 1-2cfs past the principal (and only) concrete spillway on the right through a gully eroded into the embankment. This could lead to embankment failure at the spillway. Under maximum storage conditions, stoplogged weir is inadequate to handle 100yr flood without overtopping dam.

The spillway capacity is less that 10% probable maximum flood. The dam will therefore overtop during a major flood which may wash out Route 15 and damage nearby residences.

Dam defects which could lead to failure of the dam and/or threaten public safety:

1) Erosion through wall at spillway which could lead to breach.

2) Small freeboard coupled with uneven crest surface due to settlement, erosion and wave action.

3) No wave protection.

4) Inadequate spillway capacity to handle major floods.

5) No tested Emergency Action Plan (EAP).

Recommended remedial actions:

1) Reduce water level to 1' above spillway invert.

2) Repair all sections which are and can be overtopped immediately.

3) Complete EAP and test effectiveness of EAP by conducting a "tabletop" exercise. Deadline September 2003. Monitor and evaluate performance of the EAP and make good any deficiencies found. (Tabletop exercise to include owner, Deer Isle emergency services and any permanent residents affected)

4) Develop inspection checklist for regular dam inspection by owner and include with EAP.

5) Monitor dam and maintain written record of owner inspections, dam operation and maintenance.

6) Repair remaining defects noted during inspection by fall 2003.

7) Make Town and downstream property owners aware of the dam's significant hazard potential and of emergency plans (including those for significant rainfall events.)

8) Prepare standard operating procedures for regular operation such as setting lake levels.

9) Prepare standard operating procedures for use in advance of a hurricane warning.

Tony Fletcher

Maine State Dam Inspector

APPENDIX E

From: Skelley, John
To: twurglitz@islandheritagetrust.org
Cc: pmiller@islandheritagetrust.org; Ayotte, Tara; Manzi, Andrew; Mallory, Steven
Subject: RE: Lily Pond Dam Issues
Date: Friday, December 20, 2019 10:27:33 AM
Attachments: Lily Pond Report - 2013.pdf
Vegetation on Left Embankment.JPG
Seepage Path to Spillway Outlet.JPG
Left Embankment.JPG
Beaver Deceiver Vegetation.JPG
Erosion on Left Embankment.JPG

Hi Tenley,

It was great to meet out in Deer Isle this past Wednesday 12/18 to partially inspect the Lily Pond Dam, a significant hazard dam as classified by MEMA. As you had alerted our office earlier this week, the spillway of the dam wasn't able to pass the flow from the rain event over the weekend, and the Pond was draining around the concrete spillway section. Please keep in mind that the following notes are not indicative of a formal inspection; a formal inspection will be performed in the spring of 2020 when ground cover and weather permits. Attached is an inspection email from my predecessor detailing his inspection back in 2013. Please let me know if you have any questions or need any more info.

Notes:

- The day was intermittent clouds and sun with a slight breeze, temps around 25F
- Light snow cover on the ground around the dam, and on top of the dam; approximately 2-3 inches in some places.
- The pond appears to still be at a high level from the recent rain event, freeboard averaged from approximately 0.75' to 2 feet along top of dam.
- Present: J. Skelley, A. Manzi, T. Wurglitz
- Findings:
    - Spillway
        - All immediate flow being diverted around the spillway opening had stopped, but the ground alongside the spillway outlet was still saturated
        - The concrete appeared to be in fair condition
        - It appears that the left concrete spillway wall (looking downstream from the top of the dam) may be rotating inward toward the spillway channel
        - It appears the spillway is fairly undersized, but a hydraulic analysis will need to be done in order to confirm
        - One stop log had been raised to the "open position"
        - A "Beaver Deceiver" was apparently just installed near the spillway this past year
            - Pond plants, sticks, and reeds have accumulated around the device fencing, and may be restricting drainage flow out of the spillway.
    - Right Embankment (looking downstream from top of dam spillway outlet)
        - No major issues could be seen due to snow cover, but the height of the dam appeared to only provide around a foot or so of freeboard (extra capacity to store water in relation to the top of dam elevation and the current water elevation)
    - Left Embankment (looking downstream from top of dam spillway outlet)

- The top of dam elevation varied significantly along this embankment section, probably due to historical overtopping and footpath traffic
- The embankment itself varies in width. No exact measurements were taken, but the width of embankment near the spillway is estimated to be about 10 feet, but in other sections, particularly around the middle of the embankment, the width is estimated to be only about 5-6 feet.
  - The width of the dam is important because the weight associated with the material in the dam helps resists the overturning and sliding forces that the water puts on the dam. Less material means less resistance, which means high chance of failure
- There seems to be erosion in the top of the embankment causing loss of stonework (sliding down to the drainage swale below) or loss of soil cover
- There is a drainage swale at the toe of the dam that directs runoff from the hill next to the dam into the downstream spillway channel
  - This appears to be natural
  - At the time of inspection, the ground was still wet and standing water was present. The storm had ended about 3 days prior to the inspection, so any runoff should have ceased at that time. There could also be pools of standing water as well.
  - Given the time delay between the storm and there still being water present at the toe of the dam, this is indicative of seepage through the dam. This is further reinforced by seeing what appears to be iron bacteria in the water (usually a result of groundwater interacting with minerals in the soil).
  - This seepage was noted by my predecessor all the way back in 2013
    - Remedial actions detailed in this report include reducing the water level in the pond to relieve the dam of hydraulic pressure (we discussed this actually, but at the time I did not know the history of the dam)
      - Other actions include hiring an engineer to assess the dam and recommend actions to improve the safety of the dam
      - Remove vegetation from the embankments
      - Clear vegetation and maintain clear flow paths around the spillway
- There are a number of trees and shrubs within both embankment confines

- Recommendations: As discussed on-site please look into the following remedial actions-
  - Immediate:
    - Research and hire a qualified engineer to assess the dam and recommend courses of further remedial action
    - Remove vegetation on the embankments, including stumps where applicable (should be done under the direction of a licensed professional engineer and removing stumps within the embankment can cause instability and a proper fix to the embankment will need to be done after the stumps are removed)
    - Clear the spillway structure of debris around the Beaver Deceiver and keep the structure clear

        - Potentially sandbag the outlet structure and raise low points in the top of the dam to create more freeboard in the event of high water
        - Discuss with the fire chief on the island with the potential of lowering the pond even further while still having the water access for fire-fighting demand.
            - We had discussed this on site and I wasn't sure what the probability of it happening was, but after reading past inspection notes on the dam (noted as "poor" all the way back in the early 2000s) it would be prudent to lower the lake level as much as possible until further notice
        - Complete the Emergency Action Plan (EAP) which is currently being worked on, and exercise it when possible. Tara Ayotte of MEMA has been providing assistance on this matter.
    - Long-Term:
        - A redesign or improvement of the spillway is likely needed to pass flows of certain storm intensity and frequency
        - The left embankment structure may need a complete rebuild, but this should be determined by a licensed professional engineer

We will place the Lily Pond Dam on our monitor list and make all the effort to make trips out to Deer Isle when requested. Please do not hesitate to ask any questions, or have us visit the dam and meet with you personally if you feel you need clarification on anything.

Thanks,

John Skelley, P.E.
State Dam Inspector
Maine Emergency Management Agency
72 State House Station
45 Commerce Drive
Augusta, ME 04333
Desk: (207) 624-4465 | Cell: (207) 458-9556
john.skelley@maine.gov

From: twurglitz@islandheritagetrust.org <Twurglitz@islandheritagetrust.org>
Sent: Wednesday, December 18, 2019 3:03 PM
To: Skelley, John <John.Skelley@maine.gov>
Cc: pmiller@islandheritagetrust.org; Ayotte, Tara <Tara.Ayotte@maine.gov>; Manzi, Andrew <Andrew.Manzi@maine.gov>
Subject: RE: Lily Pond Dam Issues

Hi John and Andrew,

Thank you again for coming out to look at the Lily Pond Dam this morning. My colleagues and I really appreciate your help and expertise and we look forward to seeing your notes and the previous inspection reports.

As recommended, we will be monitoring the dam carefully and will implement the short term fixes we discussed. And, Tara, I'll continue working on tracking down the last couple folks who need to sign the EAP so we can finalize the update.

Many thanks from Deer Isle!
Tenley

Tenley Wurglitz
Land Steward
Island Heritage Trust
P.O. Box 42 // 420 Sunset Road
Deer Isle, ME 04627
(207) 348-2455
www.islandheritagetrust.org

From: twurglitz@islandheritagetrust.org [mailto:Twurglitz@islandheritagetrust.org]
Sent: Wednesday, December 18, 2019 8:51 AM
To: 'Skelley, John' <John.Skelley@maine.gov>
Cc: 'pmiller@islandheritagetrust.org' <pmiller@islandheritagetrust.org>; 'Ayotte, Tara' <Tara.Ayotte@maine.gov>; 'Manzi, Andrew' <Andrew.Manzi@maine.gov>
Subject: RE: Lily Pond Dam Issues

Sounds good, John. Please drive carefully.

Tenley Wurglitz
Land Steward
Island Heritage Trust
P.O. Box 42 // 420 Sunset Road
Deer Isle, ME 04627
(207) 348-2455
www.islandheritagetrust.org

From: Skelley, John [mailto:John.Skelley@maine.gov]
Sent: Tuesday, December 17, 2019 5:36 PM

To: twurglitz@islandheritagetrust.org
Cc: pmiller@islandheritagetrust.org; Ayotte, Tara <Tara.Ayotte@maine.gov>; Manzi, Andrew <Andrew.Manzi@maine.gov>
Subject: Re: Lily Pond Dam Issues

Tenley,

Sounds great, we will meet you in the parking lot on quaco road at 11. We will call if we have any delays from snowy roads.

Thanks!

John

Get Outlook for iOS

From: twurglitz@islandheritagetrust.org <Twurglitz@islandheritagetrust.org>
Sent: Tuesday, December 17, 2019 3:23:32 PM
To: Skelley, John <John.Skelley@maine.gov>
Cc: pmiller@islandheritagetrust.org <pmiller@islandheritagetrust.org>; Ayotte, Tara <Tara.Ayotte@maine.gov>; Manzi, Andrew <Andrew.Manzi@maine.gov>
Subject: RE: Lily Pond Dam Issues

EXTERNAL: This email originated from outside of the State of Maine Mail System. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi John,

I really appreciate you coming out tomorrow to take a look at the dam. 11am sounds great. Shall we meet at our new Lily Pond Preserve parking area on Quaco Road? Here's a GoogleMaps link to the location. As you drive south on Route 15, Quaco Road is on your left just before you reach Deer Isle Village. After you turn left on Quaco Rd, the parking area is about 800 feet up on your left.

In case you need to get in touch in the morning, our office number is 348-2455 and my cell is 301-461-4016.

I look forward to meeting you tomorrow,
Tenley

Tenley Wurglitz
Land Steward
Island Heritage Trust
P.O. Box 42 // 420 Sunset Road
Deer Isle, ME 04627
(207) 348-2455
www.islandheritagetrust.org

Island Heritage Trust is a member-supported, community-based non-profit dedicated to contributing *to the well-being of the island community by conserving its distinctive landscapes and natural resources, maintaining public access to valued trails, shoreline and islands, and by providing educational programming for all ages.*

From: Skelley, John [mailto:John.Skelley@maine.gov]
Sent: Tuesday, December 17, 2019 2:31 PM
To: twurglitz@islandheritagetrust.org
Cc: pmiller@islandheritagetrust.org; Ayotte, Tara <Tara.Ayotte@maine.gov>; Manzi, Andrew <Andrew.Manzi@maine.gov>
Subject: Lily Pond Dam Issues

Tenley,

Thanks for sending our office photos of the Lily Pond Dam after this weekend's wind and rain event. The dam is scheduled to be inspected by June 2020, but I will make a trip down there tomorrow 12/18 to check things out. If the ground isn't too snow covered I will do a full inspection, but if there is enough of it covered I'll just check out the issues in the pictures you sent and see if there is anything else that sticks out to me, and then do a full inspection when the weather cooperates. How does 11 AM sound? A full inspection should take a couple of hours, a cursory one if the weather doesn't cooperate will take a little less time.

In the meantime, it looks like the water levels could have naturally gone down since the weekend after peaking early this week. I would just say monitor the water level today and if it isn't flowing around the concrete spillway, that's good. At some point you would want to build up the top of the dam in that area and around the spillway to fill in any gaps that may have form from water piping around the spillway. It's kind of a "band-aid" fix, but armoring the upstream face only helps with longevity. The erosion is probably indicative of not having enough or any rip rap on the upstream face of the dam to prevent wave action eroded the bank. Long term, you would want to rebuild the upstream face and rip rap it. The fixes may end up being minor, but I won't really know the extent of what I'd recommend until our office takes a look at it. Of course, cost is always a concern and we aware of such concerns.

Thanks for bringing this to our attention!

If you have any questions, please let me know.

Thanks,

John Skelley, P.E.
State Dam Inspector
Maine Emergency Management Agency
72 State House Station
45 Commerce Drive
Augusta, ME 04333

Desk: (207) 624-4465 | Cell: (207) 458-9556
john.skelley@maine.gov

APPENDIX F

EMERGENCY ACTION PLAN (EAP)

FOR

<u>Lily Pond (Deer Isle) Dam</u>

MEMA #106
NID# ME00585

LOCATION: Deer Isle, Hancock County, ME
COORDINATES: 44° 13' 39" N 068° 40' 23" W

Owner: Island Heritage Trust

Dated 04/03/2020
Expires 04/03/2022

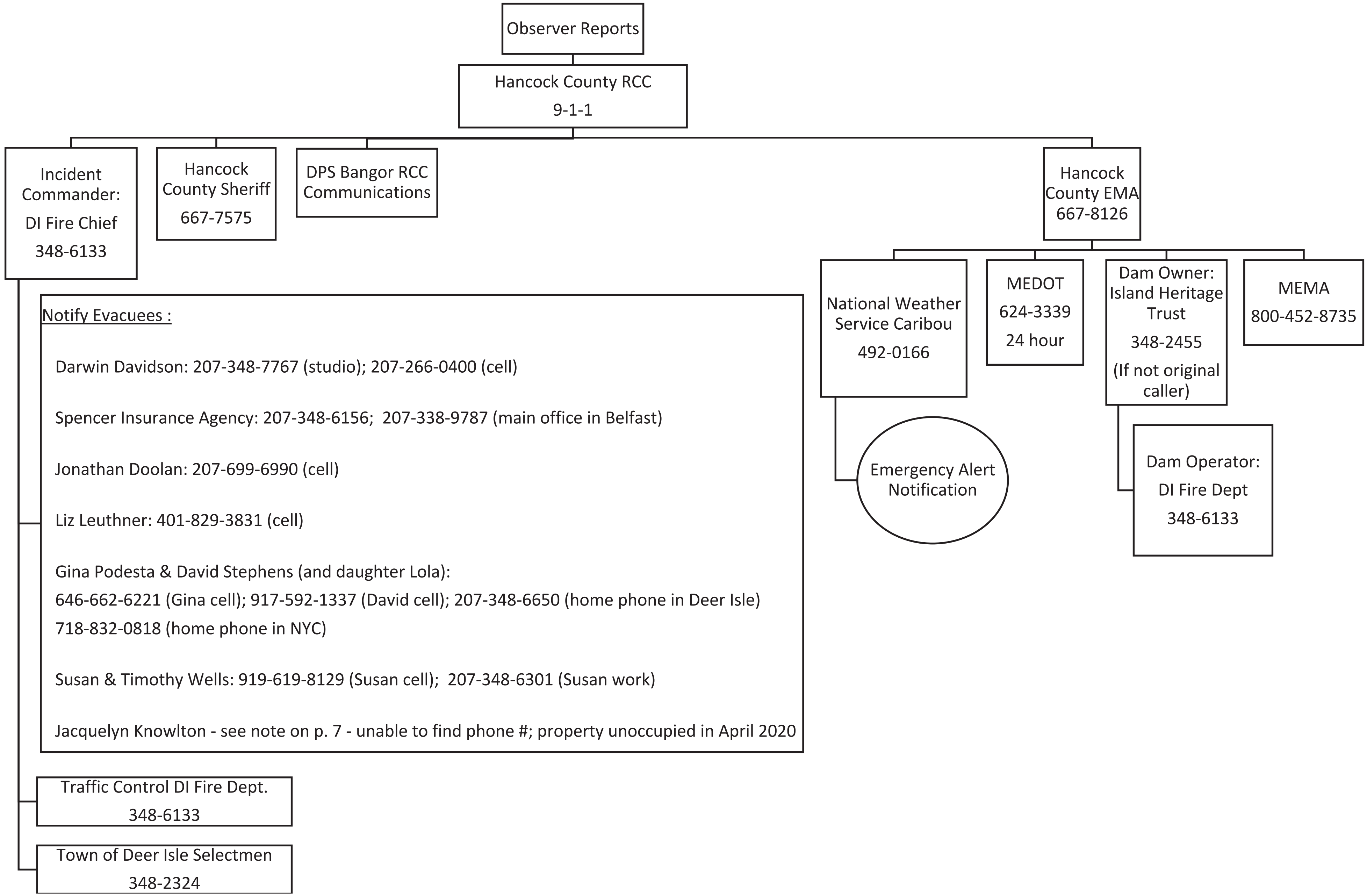
PHOTO OR TWO OF ACTUAL DAM IF AVAILABLE

Tree removal from the dam in 2016

Lily Pond Dam Location

Table of Contents

I. Notification Flow Chart



PURPOSE & DISTRIBUTION

1. Purpose

The sudden release of water stored behind the Lily Pond Dam is a potential hazard for downstream inhabitants and property. To minimize the chances for loss of life and damage to property, it is important to respond quickly to a potentially hazardous situation and to provide a coordinated effort that clearly assigns major areas of responsibility.

The first few minutes following an actual or impending failure often make the difference between disjointed and ineffective actions and a coordinated and effective response.

This plan is intended to outline a coordinated and effective emergency response. It is essential that the proper organizations and agencies be notified on a timely basis so that properly trained people can perform the functions they are qualified to do. Local responders have been involved in the development of this plan, and it is exercised periodically.

2. Distribution

a. The Notification Flow Chart must be prominently posted at the dam site to facilitate use by observers equipped with cellular telephones or radios.

b. The Notification Flow Chart must be prominently posted within the first downstream inhabitant, structure, or facility equipped with a telephone and (owner)

c. This Emergency Action Plan will be distributed to each of the following persons or agencies as a minimum:

1. DAM OWNER – ISLAND HERITAGE TRUST
2. DAM OPERATOR – DEER ISLE FIRE DEPT
3. 9-1-1 / HANCOCK COUNTY RCC
4. DEER ISLE FIRE AND RESCUE (incident commander)
5. HANCOCK COUNTY SHERIFF
6. MAINE DEPT OF TRANSPORTATION
7. HANCOCK COUNTY EMA
8. MEMA
9. NWS – For Public alerting and Weather updates
10. DEER ISLE LOCAL LAW ENFORCEMENT

I. PROJECT DESCRIPTION & IMPACT (this section may take several pages)

A. Identification: Lily Pond Dam #106, outlet of the Lily Pond, Deer Isle. Rebuilt in 1948

B. Impoundment: The Lily Pond is 37 acres in extent, and holds 156 acre-feet of water. Its principle use is for recreation and as a source to resupply the Deer Isle Fire Department cistern on Route 15.

C. Physical properties: The Dam is 11 feet high at its highest point and 150 long. The concrete spillway was installed in 1948. The spillway is controlled by flashboards. In summer 2019, a “Beaver Deceiver” was installed to discourage beavers from damming up the entrance to the spillway and maintain the level of the pond at a desirable level.

D. Downstream characteristics: The stream flowing out of Lily Pond heads southwest towards Deer Isle Village and crosses under Route 15 before flowing into Mill Pond. As noted above, the stream supplies a cistern on the western side of Route 15 that is used by the Deer Isle Fire Department.

IMPACTED AREA: See Inundation Maps on pages 12 & 13 and the table on page 7 with information on “Downstream roads, bridges, houses, and buildings.”

Downstream roads, bridges, houses and buildings:

BUILDINGS			
Type	Owner/Occupant	Telephone #	Address
Commercial (Photography Studio and Insurance Agency)	Darwin Davidson (owner of building with 2nd floor studio) Spencer Insurance Agency (downstairs tenant) (Agency owner: Mike Giles)	207-348-7767 (O) 207-266-0400 (C) 207-348-6156 (O) 207-338-9787 (main office in Belfast)	4 Main Street, Deer Isle
Commercial & Residential	Jonathan Doolan (owner of building) Liz Leuthner (tenant in back apartment)	207-699-6990 (C) 401-829-3831 (C)	6 Main Street, Deer Isle
Commercial (Old Parish House)	Gina Podesta and David Stephens (and daughter Lola Stephens) (owners of building– no current tenants)	646-662-6221 (Gina cell) 917-592-1337 (David cell) 207-348-6650 (home phone in Deer Isle) 718-832-0818 (home phone in NYC)	7 Church Street, Deer Isle
Residential	Susan and Timothy Wells	919-619-8129 (C) 207-348-6301(W)	10 Church Street, Deer Isle
Empty residential lot (former site of mobile home)	Jacquelyn Knowlton (property owner) Mailing address: P.O. Box 1031 Blue Hill, ME 04614	No one currently lives at this address. Unable to obtain a phone number for Ms. Knowlton in 2020.	2 Church Street, Deer Isle

INFRASTRUCTURE			
Route	Type	Owner	Description
15	Highway	State of Maine	Two lane highway (aka Church St.)

II. EMERGENCY CONDITIONS

An emergency means breaches and all conditions leading to or causing a breach, overtopping and any other condition in a dam and its appurtenant structures that may be construed as unsafe or threatening to life and property. The prominent causes of dam failure emergencies include: Earthquake, Landslide - generated wave, Extreme storm, Piping, Equipment malfunction, Structural damage and/or deterioration, Foundation failure, and Sabotage.

The causes of emergencies may not all be pertinent to a given structure. The type of dam, topography, geology, design features, and age are all important considerations that need evaluation relative to the possibility and cause of failure.

At least two types of dam failures are possible that could trigger an emergency condition. Normal and Adverse Conditions.

A Normal Conditions dam failure could occur with the reservoir at normal full pond elevation and with a normal river flow prevailing. This type of failure could occur with very little warning, and for this reason, is generally considered to have the most potential for loss of human life.

A second type of dam failure could occur during a flood flow condition that is commonly referred to as the Adverse Conditions. The Adverse Conditions is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the drainage basin. The PMF (Probably Maximum Flood) is the upper limit for determining the inflow design flood (IDF). The IDF is the flood condition above which failure of an impounding structure has an insignificant effect on downstream flooding. A failure at the IDF is considered to show the upper limit of inundation.

III. EAP ACTIVATION

"Activation Levels" for State Regulated Dams

EAP Activation - Level 1 (READY) – EAP agreed and functional. The EAP will always be activated to this Level 1. Owner must test communication on an ongoing basis. Any changes to the document must be made immediately. **(Use EAP Agreement Form next page)**

EAP Activation – Level 2 (SET) – Any developing situation which threatens the integrity of the dam. Level 2 activation must place the dam under watch (surveillance). The tipping point to a Level 2 activation of the EAP should be anything, which in the opinion of the dam owner or observer, which could lead to dam failure.

Triggers -gate failure, blocked spillway (debris or ice), misoperation, developing defect, flood warning, continuing heavy rain, an earthquake, ground movement or developing seepage

EAP Activation – Level 3 (GO) – this is when a dam emergency is declared and people are evacuated. Here the dam must be failing or about to fail. The incident can be a development from Level 2, the dam actually breaching or overtopping.

EAP Activation - Level 1 EAP AGREEMENT FORM

By my signature, I acknowledge that I, or my representative, have reviewed this plan and concur with the tasks and responsibilities assigned herein for me and my organization.

1. ______________________________ **Island Heritage Trust** ______________
Signature Organization Date
Printed Name and Title: *Paul Miller, Executive Director Island Heritage Trust, Dam Owner*

2. ______________________________ **Hancock Cnty RCC** ______________
Signature Organization Date
Printed Name and Title: *Bob Conary*, *Hancock County RCC*

3______________________________ **Deer Isle Fire Dept** ______________
Signature Organization Date
Printed Name and Title: *Deer Isle Fire & Rescue*

4. ______________________________ **Hancock County Sheriff** ______________
Signature Organization Date
Printed Name and Title: *Hancock County Sheriff*

5. ______________________________ **Hancock County EMA** ______________
Signature Organization Date
Printed Name and Title: *Andrew Sankey, Hancock County EMA*

6______________________________ **MDOT** ______________
Signature Organization Date
Printed Name and Title: *Maine Dept. of Transportation, Region 4*

7. ______________________________ **MEMA** ______________
Signature Organization Date
Printed Name and Title: *Tara Ayotte, Dam Safety Administrator, MEMA*

8. ______________________________ **DPS Bangor RCC** ______________
Signature Organization Date
Printed Name and Title: *Jeffery Coon, DPS Bangor RCC Communications Supv.*

IV. TERMINATION

Whenever the EAP has been activated, an emergency level has been declared, all EAP actions have been completed, and the emergency is over, the EAP operations must eventually be terminated and follow-up procedures completed.

Termination Responsibilities

The town, city or county official in charge is responsible for terminating EAP operations and relaying this decision to the owner. It is then the responsibility of each person to notify the same group of contacts that he or she notified during the original event notification process to inform those people that the event has been terminated.

Prior to termination the owner should inspect the dam (in coordination with a professional engineer) to determine whether any damage has occurred that could potentially result in loss of life, injury, or property damage. If it is determined that conditions do not pose a threat to people or property, the owner's engineer may advise the town, city or county official to terminate EAP operations as describe above.

The owner shall document the emergency event and assure all actions were taken. The owner shall provide documentation to the Maine Emergency Management Agency.

V. MAINTENANCE – EAP REVIEW AND REVISION

EAP Annual Review

The owner will review and, if necessary, update the EAP at least once each year. The EAP annual review will include the following:

1. Calling all contacts on the notification flowchart in the EAP to verify that the phone numbers and persons in the specified positions are current, The EAP will be revised if any of the contacts have changed.
2. Contacting the local law enforcement agency to verify the phone number and persons in the specified positions. In addition, the owner will ask if the person contacted knows where the EAP is kept and if responsibilities as described in the EAP are understood
3. Call the locally available resources to verify that the phone numbers, addresses, and services are current.

VI. INUNDATION MAPS

Notes:
-Datum/Proj: NAD 83/UTM Zone 19N

-The areas depicted in the following maps can be found Maine Atlas and Gazetteer Map(s): 15

-All Flood data are estimates made using a FEMA sponsored program called DSS-WISE Lite

-Areas inundated will depend on the actual flood/failure conditions, and the resulting inundated areas may be different than what is shown on the map

Peak Breach Flow Estimates:
(Times measured from the moment the breach begins forming)
-Fair Weather
-Peak Flow: 137 cfs
-Occurs at: 34 minutes
-Volume Released: 28/45 acre-feet
-Overtopping
-Peak Flow: 1,520 cfs
-Occurs at: 51 minutes
-Volume Released: 108/108 acre-feet

Sources:
Maine OGIS, MEMA

Legend

Floodlines
- Observation Line
- Fair Weather Breach
- Overtopping Breach

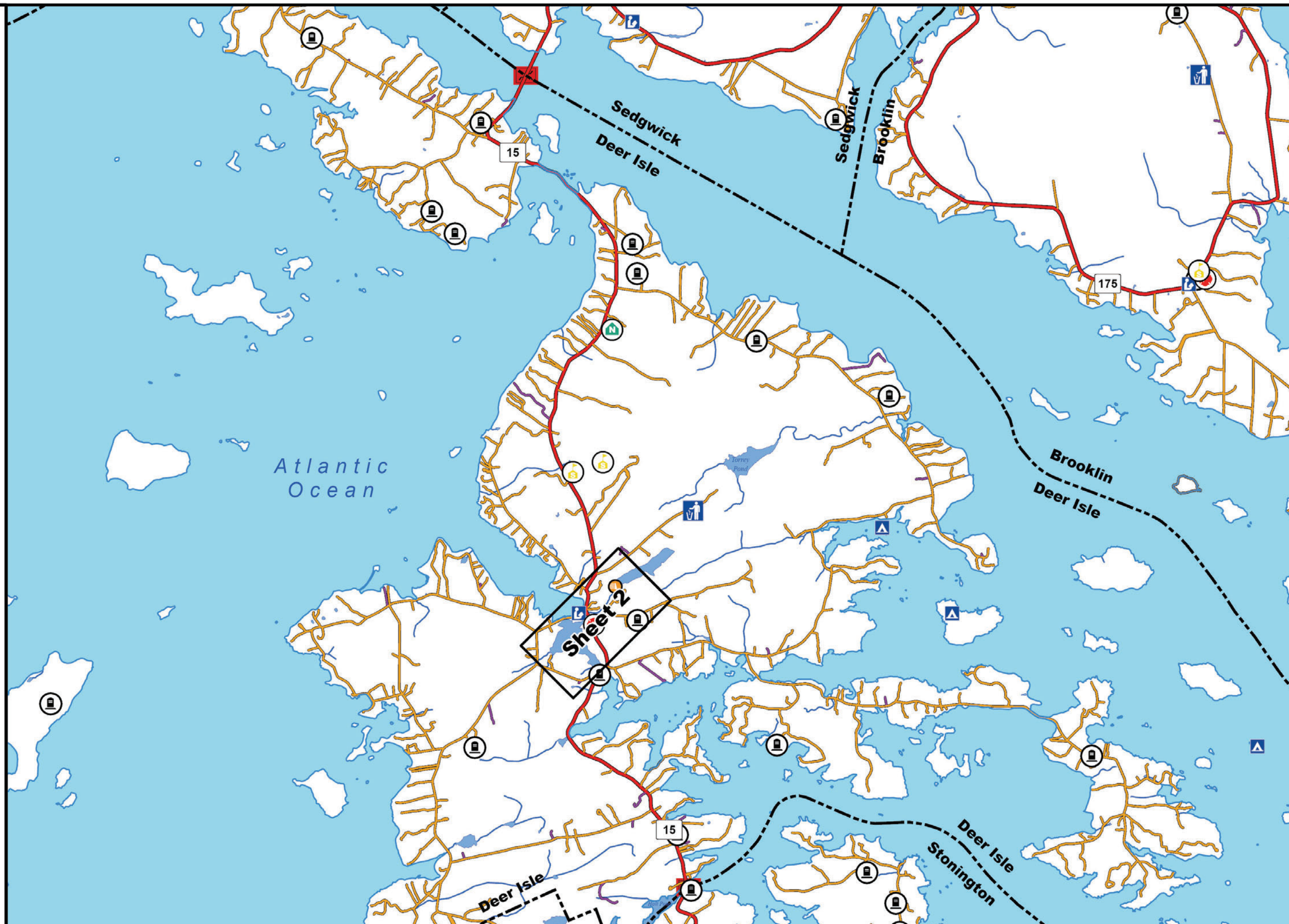
Boundaries
- Town Line
- Map Outline

Locations
- Nursing Home
- School
- Fire/EMS Station

- Campsite
- Library
- Cemetery
- Municipal Landfill
- Address Point

Infrastructure
Roads
- Secondary
- Local/Town
- Private

Bridges
- MEDOT



#106 Lily Pond Dam
Dam Breach Inundation Map

Project Location: **Deer Isle, Hancock County, ME**

Owner: **Island Heritage Trust**

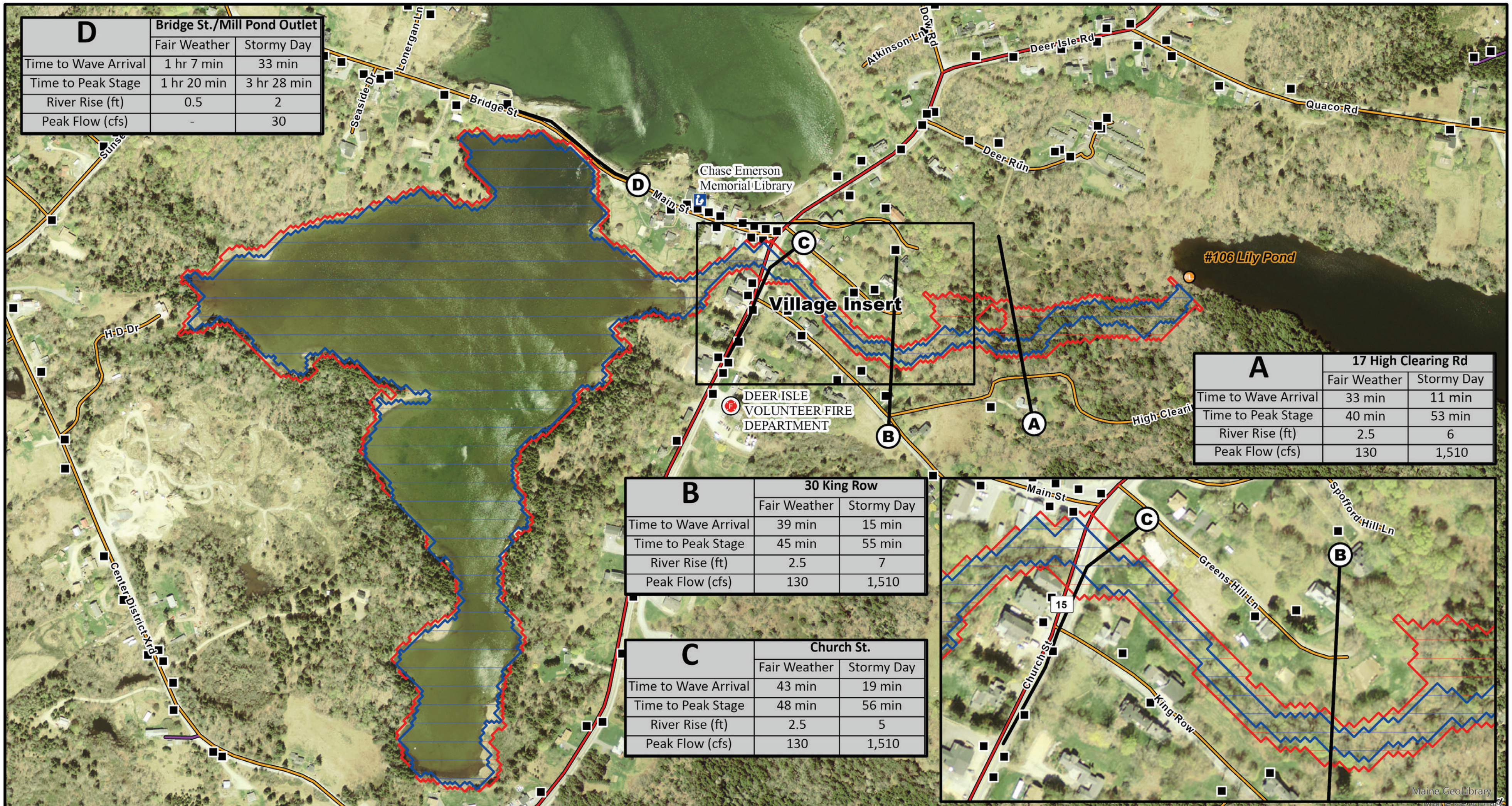
0 2,500 5,000 10,000 15,000 20,000

Map Scale: 1 inch = 5,000 feet

Rev	Drawn By:	Drawn On:	CHK'd By:	CHK'd On:	Rev. Made:
1.0	Andrew Manzi	12/23/2019	John Skelley	12/24/2019	Initial Draft

Office of Dam Safety at Maine Emergency Management Agency
(207) 624-4400
45 Commerce Dr.
Suite #2
Augusta, ME 04330
STATE OF MAINE

Sheet: 1 of 2



D	Bridge St./Mill Pond Outlet	
	Fair Weather	Stormy Day
Time to Wave Arrival	1 hr 7 min	33 min
Time to Peak Stage	1 hr 20 min	3 hr 28 min
River Rise (ft)	0.5	2
Peak Flow (cfs)	-	30

A	17 High Clearing Rd	
	Fair Weather	Stormy Day
Time to Wave Arrival	33 min	11 min
Time to Peak Stage	40 min	53 min
River Rise (ft)	2.5	6
Peak Flow (cfs)	130	1,510

B	30 King Row	
	Fair Weather	Stormy Day
Time to Wave Arrival	39 min	15 min
Time to Peak Stage	45 min	55 min
River Rise (ft)	2.5	7
Peak Flow (cfs)	130	1,510

C	Church St.	
	Fair Weather	Stormy Day
Time to Wave Arrival	43 min	19 min
Time to Peak Stage	48 min	56 min
River Rise (ft)	2.5	5
Peak Flow (cfs)	130	1,510

#106 Lily Pond Dam
Dam Breach Inundation Map

Project Location: **Deer Isle, Hancock County, ME**

Owner: **Island Heritage Trust**

0 200 400 800 1,200 1,600

Map Scale: 1 inch = 400 feet

Rev	Drawn By:	Drawn On:	CHK'd By:	CHK'd On:	Rev. Made:
1.0	Andrew Manzi	12/23/2019	John Skelley	12/24/2019	Initial Draft

Office of Dam Safety at Maine Emergency Management Agency
(207) 624-4400
45 Commerce Dr. Suite #2
Augusta, ME 04330
STATE OF MAINE

TESTING

Once a year for significant and high hazard dams the owner shall conduct or arrange to have conducted a test of the emergency notification procedure.

The owner or designee will initiate the test by calling 9-1-1, and indicating **"This is a test of the Emergency Action Plan for Lily Pond Dam, in Deer Isle."**

Each person responsible for making calls, as indicated on the Notification Flowchart, will make contacts as indicated, stressing that this is a test of the procedures.

Report results with form below.

EAP Test Notifications Form

(Use of this form is optional; you may in turn summarize the results in a note to the Maine Emergency Management Agency Dam Safety unit).

I conducted a test of the EAP for #106 Lily Pond dam, in Deer Isle Maine on ________________.

Check the box that applies:

_____ All contacts were made in accordance with the most recent flowchart.

_____ Some contacts were not made, but all participants are aware of their role in the plan and have a copy of the EAP.

_____ Other

(comments)

____

Signed: ____

Return to: Dam Safety Administrator/ EAP Coordinator
Maine Emergency Management Agency
72 State House Station
Augusta, ME 04333
Tara.ayotte@maine.gov

VII. EVACUATION PLAN

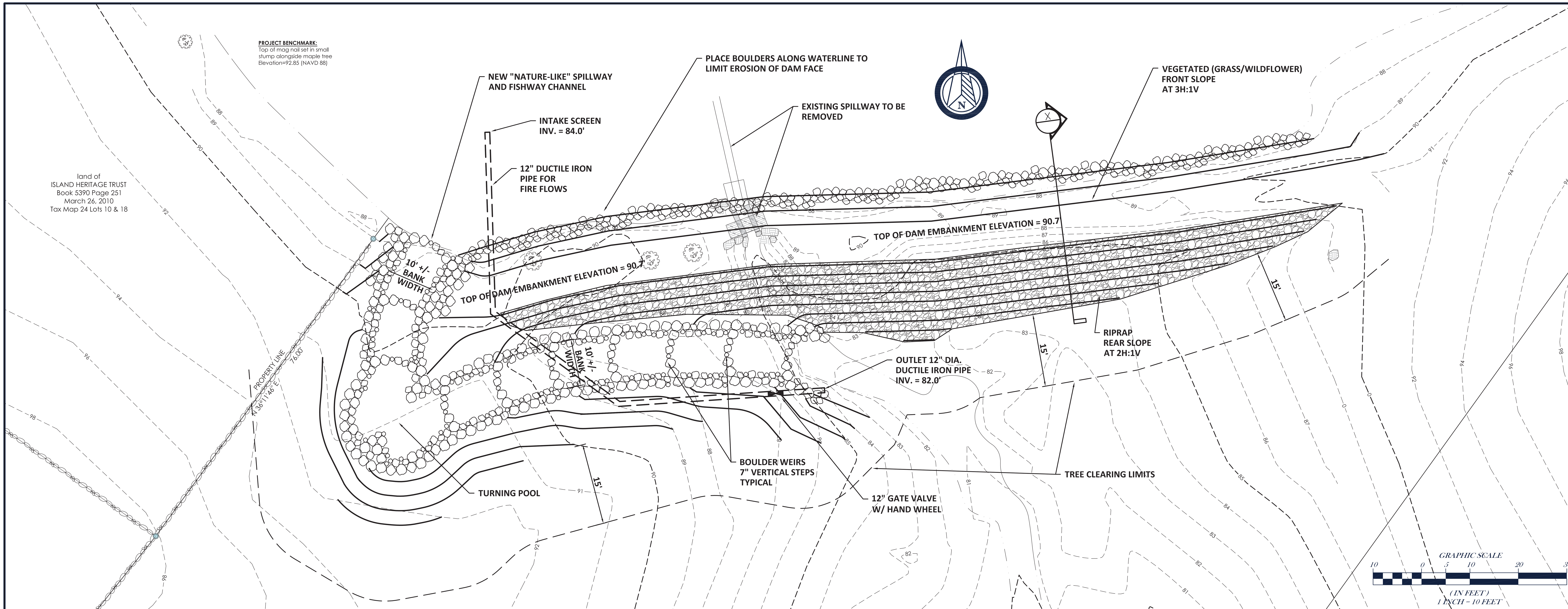
Notification of downstream property owners and tenants will initiate evacuations of residential and commercial buildings that could potentially be threatened by a dam breach. Contact information for downstream property owners is provided in the "Notification Flow Chart" on page 4. Additional details about the property owners and tenants for each downstream building potentially threatened by a dam breach is provided in the table on page 7.

The Deer Isle Fire Department will block Route 15 at King Row and at Main Street – directing traffic around the Deer Isle Mill Pond – i.e. on the Center District Crossroad.

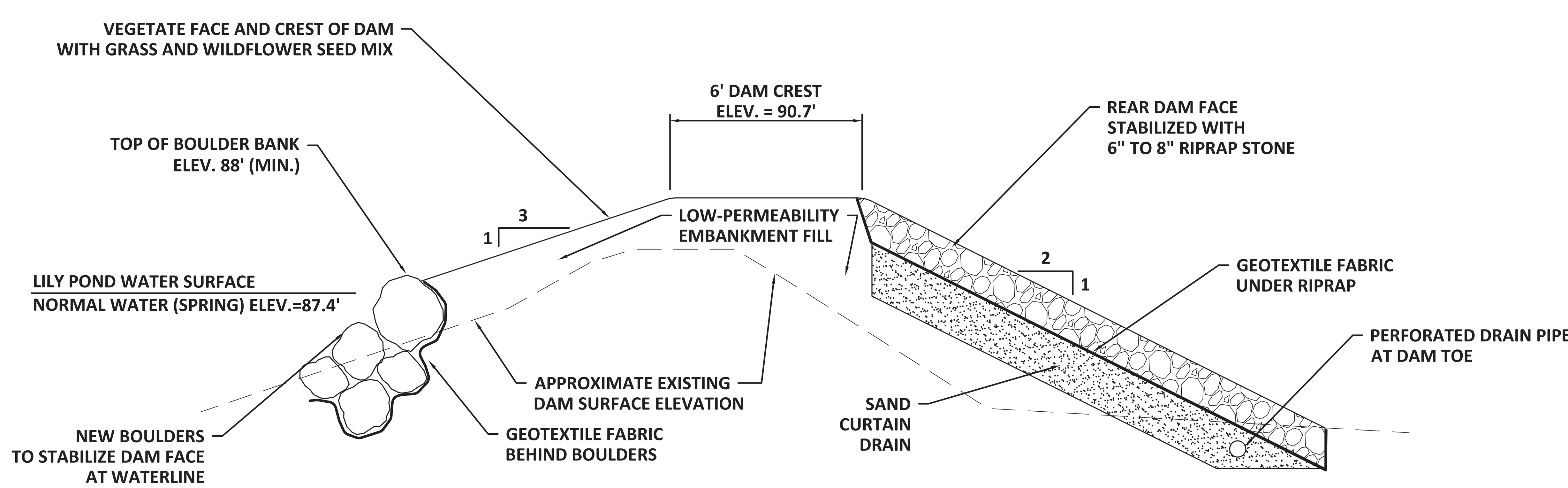
EAP to be included in the Deer Isle Town Operation or Evacuation Plan

APPENDIX G

ACADIA CIVIL WORKS



PLAN VIEW OF DAM
1" = 10'



DAM SECTION X
1" = 3'

(207) 212-9350
PO Box 212
Leeds, Maine
acadiacivilworks.com
ACW ACADIA CIVIL WORKS
ENGINEERING DESIGN & CONSULTATION

NO.	REVISION	APP'D	DATE

PROGRESS PRINT
PRELIMINARY
08/28/2022

LILY POND DAM
DAM AND FISHWAY ASSESSMENT
DEER ISLE, ME
ISLAND HERITAGE TRUST

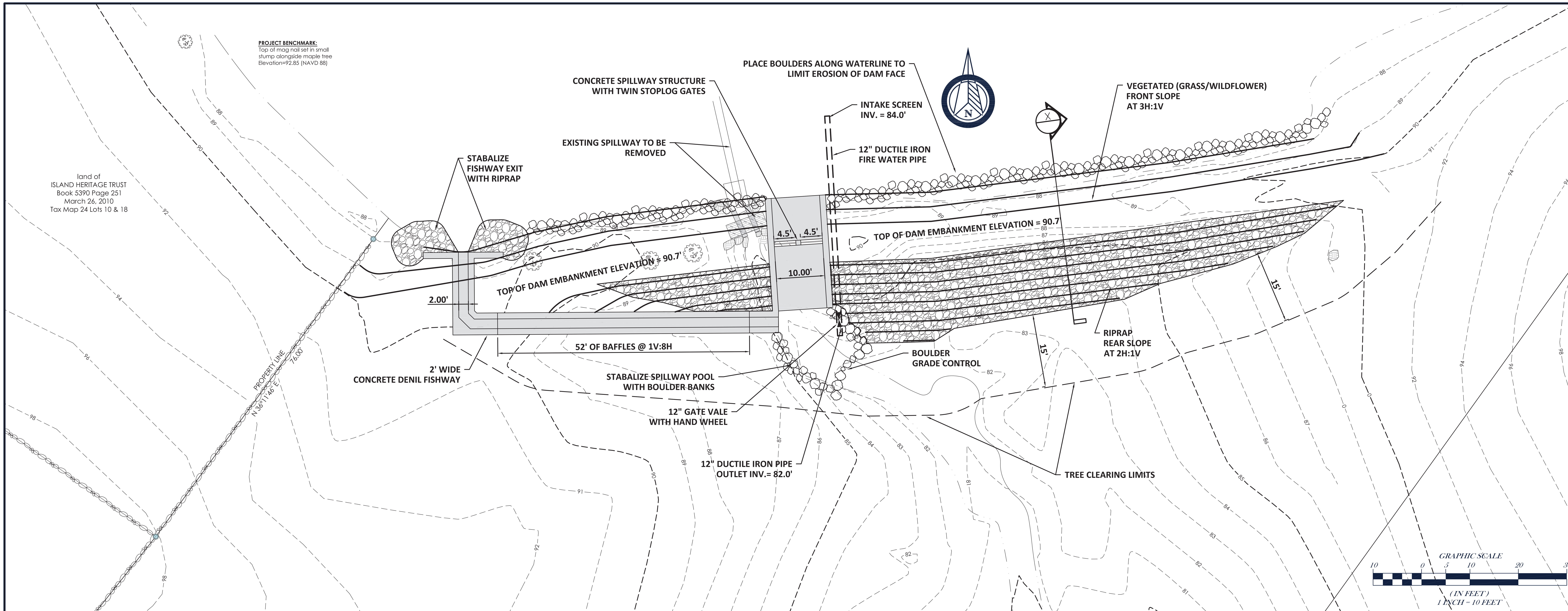
CONCEPT A - "NATURE-LIKE"

MAY 2022

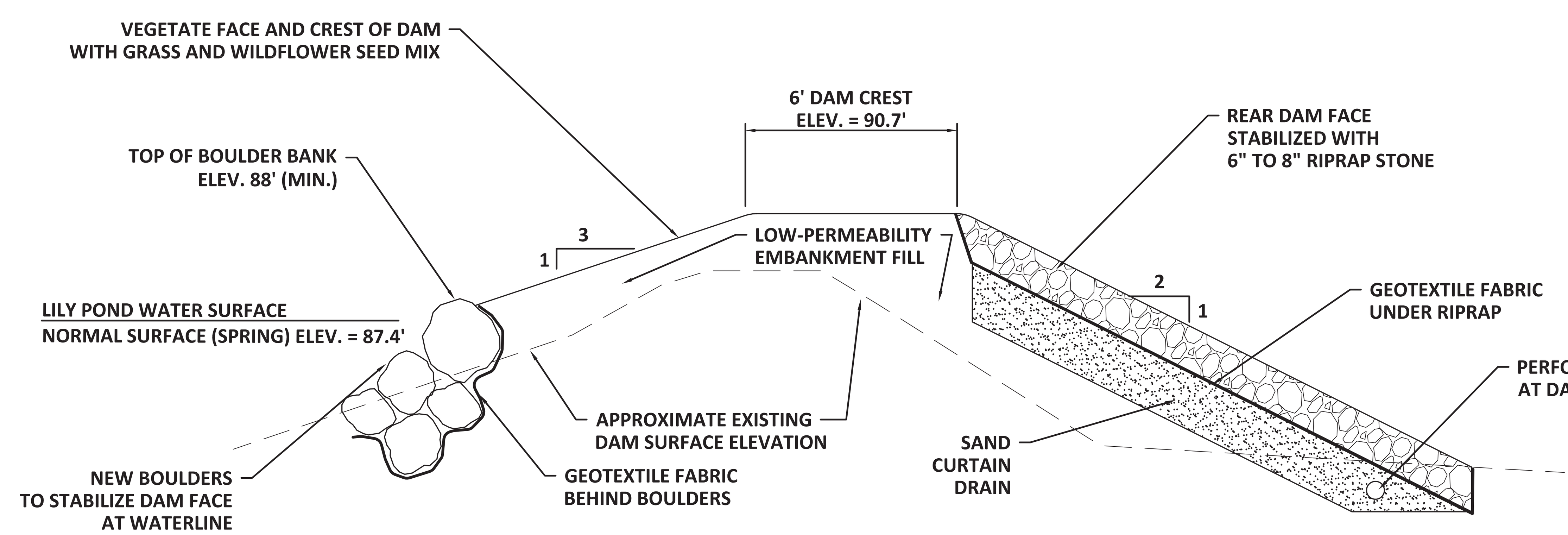
ACW

DRAWING
SK-A

ACADIA CIVIL WORKS



PLAN VIEW OF DAM
1" = 10'



DAM SECTION X
1" = 3'

(207) 212-9350
PO Box 212
Leeds, Maine
acadiacivilworks.com

ACADIA CIVIL WORKS
ENGINEERING DESIGN & CONSULTATION

NO.	REVISION	APP'D	DATE

PROGRESS PRINT
PRELIMINARY
08/28/2022

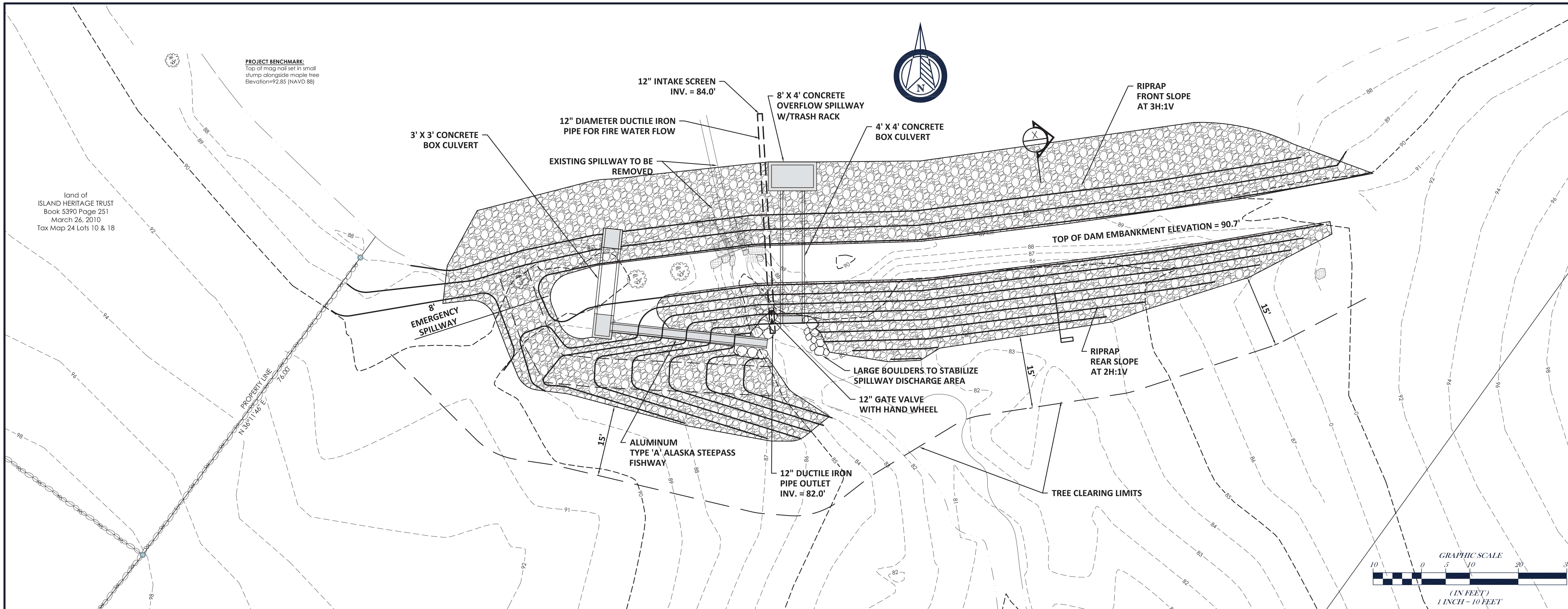
LILY POND DAM
DAM AND FISHWAY ASSESSMENT
DEER ISLE, ME
ISLAND HERITAGE TRUST

CONCEPT B - CONCRETE DENIL

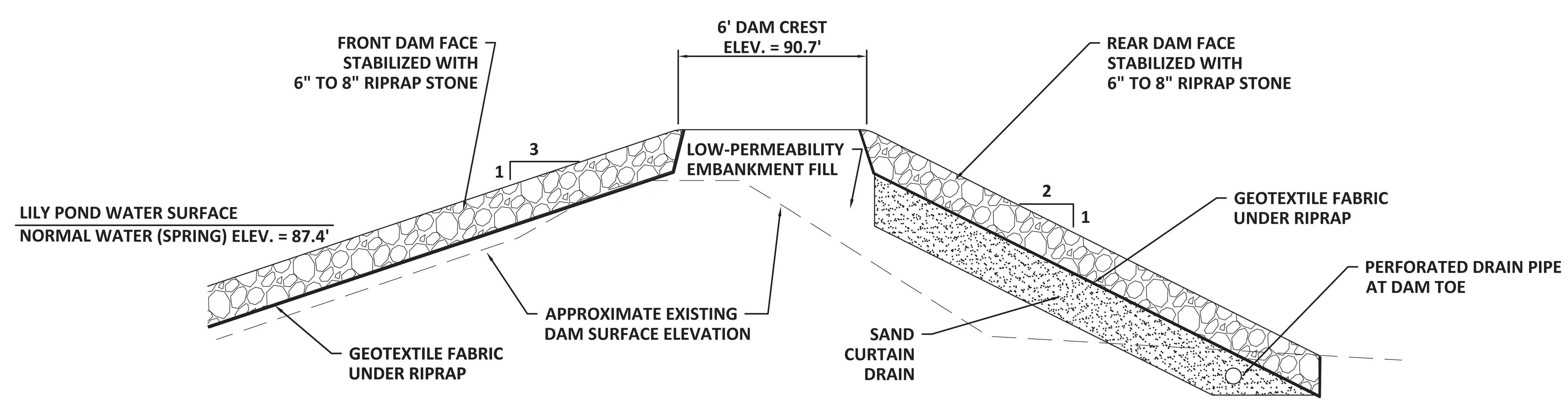
MAY 2022

DRAWING
SK-B

ACADIA CIVIL WORKS



PLAN VIEW OF DAM
1" = 10'



DAM SECTION X
1" = 3'

(207) 212-9350
PO Box 212
Leeds, Maine
acadiacivilworks.com
ACW ACADIA CIVIL WORKS ENGINEERING DESIGN & CONSULTATION

NO.	REVISION	APP'D	DATE

PROGRESS PRINT PRELIMINARY 08/28/2022

LILY POND DAM
DAM AND FISHWAY ASSESSMENT
DEER ISLE, ME
ISLAND HERITAGE TRUST

CONCEPT C - PRECAST-STEEPPASS

MAY 2022

ACW

DRAWING
SK-C

APPENDIX H

Conceptual Estimate of Construction Costs
Lily Pond Dam Improvements - Concept A
Deer Isle, ME - August 2022

ACW
ACADIA CIVIL WORKS
ENGINEERING DESIGN & CONSULTATION

Dam Construction	Unit	Quantity	Unit Price	Subtotal
Mobilization/Demobilization	LS	1	$15,000	**$15,000**
Clearing/Stump/Grub	SY	1,250	$10	**$12,500**
Cofferdam/Dewatering	LS	1	$25,000	**$25,000**
Common Excavation	CY	55	$30	**$1,650**
Riprap	CY	85	$175	**$14,875**
Low Permeability Embankment Fill	CY	200	$200	**$40,000**
Curtain Drain	CY	110	$200	**$22,000**
6" Underdrain	LF	180	$50	**$9,000**
Boulder Shoreline	CY	130	$350	**$45,500**
Loam and Seed	LS	1	$7,500	**$7,500**
Erosion and Sediment Control	LS	1	$15,000	**$15,000**
Fire Water Discharge Pipe and Valve	LS	1	$25,000	**$25,000**
Admin/Submittals/Bonds/Insurance	LS	1	$10,000	**$10,000**
			Contingency (25%)	$60,756
			Subtotal	$251,281

Fishway Construction	Unit	Quantity	Unit Price	Subtotal
Common Excavation	CY	430	$30	**$12,900**
Weir Backfill	CY	75	$150	**$11,250**
Cofferdam/Dewatering	LS	1	$15,000	**$15,000**
Bank Boulders	CY	250	$300	**$75,000**
Weir Boulders	CY	110	$500	**$55,000**
Loam and Seed	LS	1	$5,000	**$5,000**
Cutoff Sheeting	LS	1	$50,000	**$50,000**
			Contingency (25%)	$56,038
			Subtotal	$280,188

CONSTRUCTION COST ESTIMATE **$531,469**

Conceptual Estimate of Construction Costs

Lily Pond Dam Improvements - Concept B

Deer Isle, ME - August 2022

ACADIA CIVIL WORKS
ENGINEERING DESIGN & CONSULTATION

Dam Construction	Unit	Quantity	Unit Price	Subtotal
Mobilization/Demobilization	LS	1	$15,000	**$15,000**
Clearing/Stump/Grub	SY	1,250	$10	**$12,500**
Cofferdam/Dewatering	LS	1	$35,000	**$35,000**
Common Excavation	CY	120	$30	**$3,600**
Concrete Spillway	CY	50	$1,200	**$60,000**
Riprap	CY	75	$175	**$13,125**
Low Permeability Embankment Fill	CY	200	$200	**$40,000**
Curtain Drain	CY	110	$200	**$22,000**
6" Underdrain	LF	180	$50	**$9,000**
Boulder Shoreline	CY	130	$350	**$45,500**
Loam and Seed	LS	1	$7,500	**$7,500**
Fire Water Supply Pipe and Valve	LS	1	$20,000	**$20,000**
Erosion and Sediment Control	LS	1	$15,000	**$15,000**
Admin/Submittals/Bonds/Insurance	LS	1	$10,000	**$10,000**
			Contingency (25%)	$77,056
			Subtotal	$322,781

Fishway Construction	Unit	Quantity	Unit Price	Subtotal
Common Excavation	CY	430	$30	**$12,900**
Concrete Fishway	CY	75	$2,500	**$187,500**
Cofferdam/Dewatering	LS	1	$10,000	**$10,000**
Bank Boulders	CY	15	$300	**$4,500**
Weir Boulders	CY	8	$500	**$4,000**
Loam and Seed	LS	1	$2,500	**$2,500**
			Contingency (25%)	$55,350
			Subtotal	$276,750

CONSTRUCTION COST ESTIMATE **$599,531**

Conceptual Estimate of Construction Costs
Lily Pond Dam Improvements - Concept C
Deer Isle, ME - August 2022

ACADIA CIVIL WORKS
ENGINEERING DESIGN & CONSULTATION

Dam Construction	Unit	Quantity	Unit Price	Subtotal
Mobilization/Demobilization	LS	1	$15,000	**$15,000**
Clearing/Stump/Grub	SY	1,250	$10	**$12,500**
Cofferdam/Dewatering	LS	1	$20,000	**$20,000**
Common Excavation	CY	150	$30	**$4,500**
Precast Spillway	CY	15	$1,000	**$15,000**
Box Culvert	CY	14	$800	**$11,200**
Trash Rack	LS	1	$5,000	**$5,000**
Low Permeability Embankment Fill	CY	200	$200	**$40,000**
Curtain Drain	CY	110	$200	**$22,000**
6" Underdrain	LF	180	$50	**$9,000**
Loam and Seed	LS	1	$7,500	**$7,500**
Riprap	CY	260	$175	**$45,500**
Fire Water Supply Pipe and Valve	LS	1	$20,000	**$20,000**
Erosion and Sediment Control	LS	1	$15,000	**$15,000**
Admin/Submittals/Bonds/Insurance	LS	1	$10,000	**$10,000**
			Contingency (25%)	$63,050
			Subtotal	$267,750

Fishway Construction	Unit	Quantity	Unit Price	Subtotal
Common Excavation	CY	430	$30	**$12,900**
Box Culvert	CY	10	$800	**$8,000**
Prefabricated Steeppass	LS	1	$25,000	**$25,000**
Cofferdam/Dewatering	LS	1	$5,000	**$5,000**
Bank Boulders	CY	5	$300	**$1,500**
Weir Boulders	CY	10	$500	**$5,000**
			Contingency (25%)	$14,350
			Subtotal	$71,750

CONSTRUCTION COST ESTIMATE **$339,500**

APPENDIX I


QUACO ROAD
NORTH DEER ISLE ROAD
RT. 15
Lily Pond
-INTAKE
PUMP HOUSE
MILL STREAM
3" WATERLINE WITH CONTROL CABLE
PUMP HOUSE
RESERVIOR
POWER LINE
DEER RUN
024.009
1.9A.
KING ROW
P/O 22-7
LEGEND
PARCEL NUMBERS 1
ADJACENT MAPS 2
MATCH LINE
For Assessment Purposes
Not to be used for Conveyances
PROPERTY MAP
TOWN OF DEER ISLE
HANCOCK COUNTY, MAINE
PREPARED BY
JAMES W. SEWALL COMPANY OLD TOWN, MAINE
SCALE 1 INCH = 100 ± FEET
24

ACADIA CIVIL WORKS
ENGINEERING DESIGN & CONSULTATION