-- GRANITE LAKE DAM --

VISUAL INSPECTION/EVALUATION REPORT

Dam Name: Granite Lake Dam

State ID#: NH ID #D166002

Owner: Granite Lake Village District

Town: Nelson, New Hampshire

Hazard Classification: High

Consultant: GZA GeoEnvironmental, Inc.

Date of Inspection: October 8, 2024

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December 16, 2024
GZA File No. 01.0177789.00

Granite Lake Village District
c/o Mr. Butch Roeder – Senior Commissioner
667 Granite Lake Road
Nelson, New Hampshire 03457

Re: Visual Inspection/Evaluation Report
Granite Lake Dam – NH ID D166002
Nelson, New Hampshire 03457

Dear Mr. Roeder:

In accordance with your request, GZA GeoEnvironmental, Inc. (GZA) has completed our visual inspection of the Granite Lake Dam, located in Nelson, New Hampshire. The visual inspection was completed in accordance with our contract signed September 13, 2024. The site visit was conducted on October 8, 2024. The purpose of our efforts was to provide the Client with an independent assessment of the current physical condition of the dam for use in consideration of routine operation and maintenance, and/or potential for short and long term rehabilitation needs. The results and recommendations contained herein are subject to the Limitations attached as **Appendix A**.

Based on our visual inspection, the dam is currently in **SATISFACTORY** condition, in our opinion. Although, overall, the dam is in compliance with New Hampshire Department of Environmental Services (NHDES) dam safety regulations and acceptable dam engineering standards, we observed various deficiencies that should be addressed to improve the dam's condition and extend its longevity. Further discussion of our evaluation and recommended action items are presented in the Inspection/Evaluation Report.

We are happy to have been able to assist you with this inspection. Please contact the undersigned if you have any questions or comments regarding the content of this Inspection/Evaluation Report.

Sincerely,
GZA GeoEnvironmental, Inc.

Suhi Clement
Water Resources Engineer

Derek J. Schipper, P.E.
Consultant/Reviewer

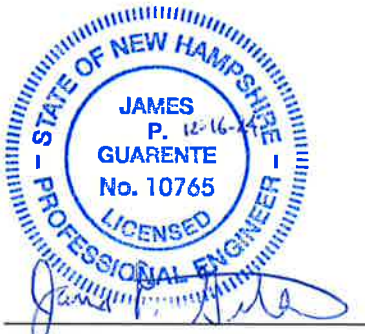
James P. Guarente., P.E.
Principal-In-Charge

PREFACE

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

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

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



JAMES P. GUARENTE, P.E.

New Hampshire License No.: 10765

Principal-in-Charge
GZA GeoEnvironmental, Inc.

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1.0 DESCRIPTION OF PROJECT

1.1 GENERAL

1.1.1 Authority

The Granite Lake Village District (Owner, Client) has retained GZA GeoEnvironmental, Inc. (GZA) to perform a visual inspection and develop a report of conditions for the Granite Lake Dam in Nelson, New Hampshire. The visual inspection was completed under GZA's contract with the Client signed September 13, 2024. The site visit was conducted on October 8, 2024. The inspection was performed in general accordance with New Hampshire Administrative Rules and Regulations for Dam Safety (Env-Wr 100-800), and standard visual type dam safety inspection procedures. This report is subject to the Limitations in **Appendix A.**

1.1.2 Purpose of Work

The purpose of this investigation is to visually inspect and evaluate the present condition of the dam and appurtenant structures to provide the Client with an independent assessment of the dam for use in consideration of routine operation and maintenance, and/or potential for short and long term rehabilitation needs. The primary objective is to observe existing surficial, above-water conditions at the dam, and render an opinion concerning maintenance measures, repairs, improvements, monitoring and/or investigations judged necessary to address deficiencies identified during the inspection.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in **Appendix E**. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) definition of dam; 2) orientation and general terms; 3) hazard classification; 4) condition rating; and 5) miscellaneous. Note the terms "left" and "right" when used in this report are oriented as facing downstream.

1.2 DESCRIPTION OF PROJECT

1.2.1 Location

The Granite Lake Dam is located in the Town of Nelson, Cheshire County, New Hampshire. The dam impounds Granite Lake and discharges to Otter Brook in East Sullivan, which is a tributary to the Ashuelot and Connecticut River. The dam is accessed via Granite Lake. The dam is at 72.1488 °W Longitude and 43.0148 °N Latitude. A locus map of the site is provided as **Figure 1**.

1.2.2 Owner/Operator

The dam is owned by the Granite Lake Village District. Mr. Butch Roeder is the Senior Commissioner and also acts as the operator/caretaker. See Table 1.1 for current owner and caretaker contact information.

1.2.3 Purpose of the Dam

The purpose of the dam is to support water related recreational uses.

1.2.4 Description of the Dam and Appurtenances

Based on review of files transmitted by Client, our observation during our site visit, and review of publicly available information, Granite Lake Dam was originally constructed in the 1800's as a stone faced embankment approximately 78-feet-long with a maximum height of approximately 15 feet above the streambed. The upstream face of the dam was covered in concrete in the 1930's. Top width of the dam is an approximately 34 feet and accommodates Mill Pond Road which is a paved two-way street. The downstream side of the dam consists primarily of a dry stone boulder wall with earth embankments immediately beyond which slope down from the abutments.

The spillway is located near the center of the dam and consists of a rectangular concrete weir with approximately 24-inch-high flashboards supported by steel pins in the concrete. The concrete entrance to the spillway starts out at about 11-feet-wide by 5-feet-high at the face of the dam and narrows down to about 8-feet-wide by 4.5-feet-high about 9.5 feet into the dam from the upstream face. At that point there is an approximately 5.5-foot vertical drop from the end of the floor of the concrete faced portion of the spillway which transitions to an approximately 7.5-foot-wide cast-in-place concrete channel spanned by a concrete roof deck (which has been paved over to support Mill Pond Road).

The concrete channel section downstream of the vertical drop was rehabilitated in 2008. Prior to this date the section consisted of a dry laid stone/boulder lined channel. The rehabilitation included filling in of an existing scour hole and along the channel floor with concrete as well as placement of fiber-reinforced concrete (in 2-foot increments) along both sides of the boulder-lined channel. In portions of the channel floor, concrete was poured over exiting stones.

From the vertical drop, the channel of the spillway extends approximately 24 feet to the outlet and downstream face of the dam. At the upstream face of the dam at the center of the spillway there is an 18-inch-diameter corrugated metal pipe (CMP) with hand-wheel operated slide gate that serves as a pond drain. The outlet to the drain is at the aforementioned vertical drop.

1.2.5 Operations and Maintenance

There are no formal written procedures for the operation and maintenance of Granite Lake Dam. The grass on the downstream side of the dam is periodically mowed and clearing of overgrown vegetation appears to be maintained. The reservoir is drawn down in winter by removing spillway flashboards (and pins) and operating the low-level outlet. It is done primarily for weed control and dam safety considerations.

1.2.6 Hazard Potential Classification

Granite Lake Dam is currently classified by the New Hampshire Department of Environmental Services (NHDES) as a HIGH hazard potential dam. This hazard classification is defined in Env-Wr 101.07(d) as:

A dam that has a high hazard potential because it is in a location and of a size that failure or mis-operation of the dam would result in probable loss of human life or meets other parameters set-forth below:

- One foot or more of flooding above the lowest finished floor elevation of a normally occupied residential, commercial, or industrial structure;
- One foot or more of flooding above ground surface at any point under or immediately adjacent to a normally occupied ground supported residential, commercial, or industrial structure;
- Failure of a structurally attached, normally occupied habitable residential, commercial, or industrial structure;

- Campsites receiving any level of flooding due to a dam failure; or
- Any other circumstance which would more likely than not cause one or more deaths.

We understand the hazard classification for Granite Lake Dam was upgraded by NHDES from Significant to its current High hazard rating in 2017 because breach failure scenarios would have direct impact to a residence approximately 600 feet downstream of the dam. A formal evaluation to reevaluate the Hazard Potential was outside of GZA's scope, but downstream visual observations suggest that the High Hazard classification is appropriate mainly due to the presence of residential development a short distance downstream of the dam.

1.3 PERTINENT ENGINEERING DATA

1.3.1 General Elevations (feet)

General elevations were approximated from available data from the 1978 Army Corps of Engineers Phase I Report for Granite Lake Dam – Nelson D166002. Elevations in the Army Corps Report are in feet and refer to Mean Sea Level (MSL) datum.

A.	Top of Dam	1282.0±
B.	Normal Pool	1279.2± (includes 24" of wooden flashboards)
C.	Spillway Crest	1277.2±
D.	Elevation Pool during Inspection	1275.3±
E.	Tailwater during Inspection	1270 ±
F.	Depth of flow in Primary Spillway Outlet	N/A

1.3.2 Main Spillway

A.	Type	Ungated broad-crested concrete weir
B.	Length	12'±
C.	Crest Elevation	1277.2±
D.	Upstream Channel	Pond
E.	Downstream Water	Otter Brook

1.3.3 Low Level Outlet Data

A.	Invert	1271.5±
B.	Size	18-inch diameter
C.	Description	Corrugated Metal Pond Drain (plugged)
D.	Control mechanism	Cast-Iron slide gate

1.3.4 Auxiliary Spillway Data

N/A

1.3.5 Design and Construction Records

GZA reviewed drawings depicting existing conditions of Granite Lake Dam developed by Woods & Co. (Woods) in December 2007 (in support of potential rehabilitation). They include an overall plan sketch and spillway profile sketch. Apparently, there are no as-built drawings of the 2008 repairs. Hydrologic and Hydraulic computations calculated by Fay Spofford and Thorndike in support of the 1978 Army Corps Report were also reviewed.

1.3.6 Operating Records

An Operation, Maintenance, and Response (OMR) Information Form dated September 14, 2021 was completed by the Owner and submitted to NHDES. The Owner last updated the OMR in May 2024. Otherwise, there are no operating records for the dam.

1.3.7 Emergency Action Plan

The Owner had previously prepared an Emergency Action Plan (EAP) for the dam and the latest revision (dated November 9, 2023) is on file with NHDES. In accordance with Env-Wr 506.02, the Owner shall review the entire EAP annually to ensure its accuracy (prepare and include revisions if/as necessary), and submit written documentation or email confirmation to the NHDES Dam Bureau that the annual review of the EAP was performed, by providing one of the following:

- A statement that the EAP was reviewed and that no changes to the EAP are necessary; or
- An electronic copy in pdf format of the entire, revised EAP and confirmation that the revised EAP has been distributed to all holders of the EAP.

2.0 INSPECTION

2.1 VISUAL INSPECTION

Granite Lake Dam was inspected on October 8, 2024, by GZA GeoEnvironmental, Inc. (GZA). GZA's visual inspection team consisted of Jim Guarente, P.E., Derek J. Schipper, P.E. and Suhi Clement. They were accompanied by Butch Roeder (Granite Lake Village District Senior Commissioner and dam caretaker).

At the time of inspection, the weather was mostly sunny and the temperature about 65 degrees (Fahrenheit). The right abutment was accessed at Mill Pond Road, and the top of dam was walked. Access was gained to the top of the concrete spillway weir via a steel access step platform. Under normal operating conditions the platform is pivoted up and out of the spillway. The downstream area was accessed from the left and right abutments, with observations made of the toe area. Additionally, access was gained inside the spillway outlet channel from the downstream side. The inspection team was able to walk up the channel (i.e., below the road) to the downstream end of the vertical drop off. Photographs to document current conditions of the dam were taken during the inspection and are included as **Appendix B**.

Underwater areas were not observed. A copy of the inspection checklist is included in **Appendix C**.

2.1.1 General Findings

In general, Granite Lake Dam was found to be in **SATISFACTORY** condition, based on visual observations. This is consistent with the October 18, 2023 inspection by the NHDES. Attention is needed to address minor deficiencies associated with the concrete on the upstream side of the dam and within the spillway entrance area. Additionally, improvements should be made with respect to better routing/channeling of stormwater runoff such that it does not erode upstream and downstream earthen embankment portions. The specific dam safety related concerns are identified in more detail in the sections below:

2.1.2 Dam

- Abutments - **SATISFACTORY**

  The abutment contacts appear stable. There is minor growth of small trees and woody vegetation at and within 15 feet of the left and right abutment areas.

- Top of Dam (Crest) - **SATISFACTORY**

  The top of dam has Asphalt, with an approximately 5-foot-wide strip of grass on each shoulder. A portion of the asphalt is underlain by the concrete roof section which spans the primary spillway outlet channel. The asphalt is generally level with minimal cracking and no sinkholes. There are localized areas of slight heave and depressions along the downstream side of the roadway which is lined with concrete "jersey" barriers and a steel guard rail immediately downstream. The barriers and guardrail exhibit slight movement/leaning in the downstream direction, likely due to snowplows. There are localized depressed areas under the barrier which allow for surface water flow underneath and over the downstream side. A chain link fence is present along the upstream shoulder.

- Upstream Side – **FAIR to SATISFACTORY**

  The concrete facing along the upstream side of the dam is in fair to satisfactory condition with localized spalled areas and vertical cracking. Spalling is somewhat greater in areas below the normal pool level. There are small sections of moderate to significant spalling/cracking at the left and right ends of the spillway inlet which extend a

short distance inside the inlet area. Minor to moderate erosion of the soil section at the top of the right abutment contact is present due to storm water runoff from Mill Pond Road.

- Downstream Side – **FAIR to SATISFACTORY**

  The downstream side of the dam consists of a dry-laid rounded stone wall that transitions into the sloped earth abutments. Alignment of the wall is generally adequate though there are localized areas of shifted/bulging stones, missing or large gaps in between stones. Debris (i.e., concrete/steel former guardrail piers, and miscellaneous metal steel rod debris (typical of old dams of this hybrid-style construction) present within the stone wall matrix locally on the left side of the spillway outlet. The exposed downstream end of concrete roof over the spillway outlet makes up a portion of the downstream side. It is in fair to poor condition with several sections exhibiting significant spalling and moderate concrete loss.

- Downstream Slope – **FAIR to SATISFACTORY**

  The earthen segments that make up the downstream slope extending out from the abutment contacts are generally satisfactory with adequate grass cover. There were no wet areas or seepage observed (though it is noted the impoundment level was approximately 4 feet below normal pool at the time of the inspection). There is some minor sloughing on left side. Erosion from surface water road runoff was observed in the left embankment. A stone channel exits as erosion protection on this side, however, there are gaps in the channel and runoff appears to occur outside the channel leading to further erosion of the slope.

- Instrumentation

  There is no instrumentation associated with the dam.

- Access - **SATISFACTORY**

  The left and right sides of the dam can be accessed from Mill Pond Road. It is noted there is a load limit of 6 tons for the road portion over the top of the dam. The downstream area is accessible via the right and left abutment off of the road.

2.1.3 Appurtenant Structures

- Primary Spillway – **SATISFACTORY**

  As previously mentioned, the concrete associated with the intake and fixed weir area of the spillway shows minor to moderate cracking and spalling. Beyond the inlet area the remaining portion of the spillway training walls are in good condition with no concrete deficiencies noted. There appears, however, to be some minor deterioration and cracking/concrete loss along the bottom contact with the floor.

- Low Level Outlet - **SATISFACTORY**

  The low-level outlet consists of an 18-inch-diameter CMP with upstream end located below the weir. The downstream end is at the transition of the vertical drop with the remainder of the outlet channel some 9.5 feet downstream from the dam face A cast-iron slide gate with manual hand wheel controls flow into the outlet pipe. At the time of the inspection the gate was initially closed. Leakage of approximately 5 to 10 gallons per minute was observed. The gate was exercised during the visit and appear to be in good working order.

- Auxiliary Spillway

  There is no auxiliary spillway associated with the dam.

2.1.4 Downstream Area

Condition - **SATISFACTORY**

The downstream area has woody vegetation and small trees. The ground was generally dry and firm at the time of inspection. No abutment leakage and foundation seepage were observed during the time of inspection.

2.1.5 Reservoir Area

The immediate (approximately ¼-acre) impoundment shoreline upstream of the dam is gently sloping and predominantly tree-lined. The main reservoir shoreline (upstream of the West Shore Road culvert) area is gently to moderately sloping and significantly developed with residential dwellings and their associated dock and lawn areas. Undeveloped areas between dwellings consist of mature/healthy trees and vegetation.

2.2 CARETAKER INTERVIEW

The Granite Lake Village District Senior Commissioner Mr. Butch Roeder was present during the inspection. Mr. Roeder is also acting caretaker of the Granite Lake dam. The GZA inspection team discussed the recent history of the dam.

2.3 OPERATION AND MAINTENANCE PROCEDURES

2.3.1 Operational Procedures

The initial OMR Information Form dated September 14, 2021 was completed by the Owner and submitted to NHDES. The latest update is dated May 2024. Otherwise, there are no formal operational procedures or record keeping at the dam. Generally, vegetation maintenance/mowing is conducted twice a year. The flashboards at the spillway are removed in the winter to allow the impoundment to drop to the crest of the weir. Occasionally, the outlet is opened to lower the pond further so that lake abutters can affect maintenance and repair of in-water docks and related items. Flashboards are installed for the summer season around Memorial Day.

2.3.2 Maintenance of Dam and Operating Facilities

An OMR Information Form dated was initially completed by the Owner and filed with NHDES on September 14, 2021. The latest update by Owner is dated May 2024.

2.4 ENGINEERING STUDIES

According to their inspection notice dated April 26, 2024, NHDES performed a preliminary evaluation of the spillway in 2017. At that time the dam was classified as a Significant Hazard structure. According to the 2017 evaluation, the dam is anticipated to pass the 100-year storm with approximately 1.1 feet of freeboard. The magnitude of the 100-year storm was not provided in the notice. The 1978 USACE Phase I Inspection Report noted that the maximum known flood at the dam site occurred in September 1938 and had a magnitude of 380 cfs; the report does not indicate whether the dam was overtopped during this event.

GZA estimates the capacity of the low-level outlet and primary spillway at maximum pool to be approximately 210 cfs with flashboards in place and 430 cfs without flashboards. GZA referred to the USGS StreamStats application for peak flow estimates at the dam. StreamStats estimates the 100-year flow at the dam to be 530 cfs. It should be noted that StreamStats only estimates up to the 500-year storm and does not provide an estimate for the 1,000-year storm which due it's recent upgrade to High Hazard is the regulatory inflow design event. However, given the dam's inability to pass the 100-year storm, the 1,000-year storm is expected to result in overtopping.

Structural and geotechnical evaluations were not available to GZA and were thus not reviewed as a part of this visual inspection. Recommendations for future engineering studies are described below.

GZA reviewed a series of Spillway Flashboard Support Pin Design calculations prepared by Woods performed in 2008 and 2010 for various pin/flashboard configurations. The intent of those calculations were to size the pin/flashboard system such that it automatically releases when the water level reaches a height of 24" above the top of the flashboards. However, a rain event in July 2023 resulted in flows higher than 24" over the boards without them releasing. Therefore, Client requested GZA perform independent calculations to assess the flashboard pin design and provide thoughts recommendations to address deficiencies as appropriate. Our evaluation is provided under separate cover.

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 ASSESSMENTS

Granite Lake Dam was found to be in **SATISFACTORY** Condition in GZA's opinion. Physical condition of the dam has not changed significantly from that described in NHDES' April 26, 2024 inspection Notice.

Rating	Structure	Noted deficiencies
Satisfactory	Access	-
	Abutments	• Erosion of right abutment upstream due to surface water runoff from Mill Pond. • Minor growth of small tress/vegetation within 15 feet of right downstream abutment.
	Top of Dam	• Minimal cracking of roadway asphalt. • Localized areas of slight heave and depressions along the downstream side of the roadway which is lined with concrete "jersey" barriers and a steel guard rail immediately downstream. The barriers and guardrail exhibit slight movement/leaning in the downstream direction, likely due to snowplows. • Localized depressed areas under the barrier which allow for surface water flow underneath and over the downstream side.
	Primary Spillway	• Minor to moderate cracking and spalling of concrete at intake and fixed weir area of the spillway shows minor to moderate cracking and spalling. • Minor deterioration and cracking/concrete loss of the spillway training walls along the bottom contact with the floor.
	Low Level Outlet	• Minor leakage (approximately 5 to 10 gallons per minute) when gate was in closed position.
	Downstream Area	• Woody vegetation and small trees present within 15 feet of downstream slope.
Fair to Satisfactory	Upstream Side	• Localized spalled areas and vertical cracking. • Small sections of moderate to significant spalling/cracking at the left and right ends of the spillway inlet which extend a short distance inside the inlet area.
	Downstream Side	• Localized areas of shifted/bulging wall stones. • Missing or large gaps in between stones particularly along the top portion to the right of the spillway outlet. • Debris (i.e., concrete/steel former guardrail piers and miscellaneous metal, steel rod debris present within the stone wall matrix locally on the left side of the spillway outlet.

		• Downstream end of concrete roof over the spillway outlet in fair to poor condition with several sections exhibiting significant spalling and moderate concrete loss.
	Downstream Slope	• Minor sloughing on left side. • Erosion from surface water road runoff observed in the left embankment. A stone channel exits as erosion protection on this side, however, there are gaps in the channel and runoff appears to occur outside the channel leading to further erosion of the slope.

What follows below are the general recommendations and remedial measures the Owner may consider addressing current deficiencies at the dam. Prior to undertaking recommended maintenance, repairs and remedial measures, the applicability of environmental permits would need to be determined for activities that may occur within the resource areas under the jurisdiction of local conservation commissions, NHDES, or other regulatory agencies.

3.2 STUDIES AND ANALYSES

GZA recommends the following studies be performed by a qualified, registered professional engineer experienced in dam safety:

1. Perform a detailed Hydrologic and Hydraulic (H&H) study to confirm the Spillway Design Flood characteristics and assess the discharge capacity of the Primary Spillway. We note due to the dam's recent upgrade from Significant to High Hazard potential NHDES will eventually undertake its own analysis of the spillway capacity and, if found to be inadequate (which is likely given our opinions explained in Section 2.4 above), require the Owner to engage a consultant to perform an independent one.

3.3 RECURRENT ADMINISTRATIVE RECOMMENDATIONS

1. Continue to review and update (as necessary) the Operations, Maintenance and Response (OMR) plan for the dam as it is currently configured (or otherwise changed should future remediation be needed) and submit to NHDES as appropriate.

2. Continue to annually review and update (as necessary) the Emergency Action Plan (EAP) for the dam and submit to NHDES as appropriate.

3.4 MAINTENANCE RELATED RECOMMENDATIONS

GZA recommends the following maintenance activities be performed on a regular basis after execution of the "Minor Repair Recommendations in Section 3.5 have been completed:

1. Monitor sloughing, voids, and shifting of boulders in the downstream stone masonry wall.
2. Monitor the condition of the spillway intake and training wall concrete.

3. Exercise the low-level outlet at least once a year.
4. Continue mowing grassed areas and clearing of vegetation.
5. Monitor condition of flashboards and pins and replace damaged items as necessary.
6. Monitor downstream side of masonry wall and slope for signs of seepage particularly at times when the impoundment is at or above normal pool.

3.4 MINOR REPAIRS RECOMMENDATIONS

1. Repair the erosion caused by surface water runoff. This includes the area on the right upstream abutment, the depressed/eroded area beneath/downstream of the "jersey" barrier on the downstream side of the crest roadway, and adjacent to the stone-lined channel in the left downstream embankment portion. Thereafter implement measures to prevent future surface water runoff erosion.

   For the right upstream abutment area, consider adding a stone-lined channel immediately adjacent to the pavement edge along Olde Town Road as it curves around to Mill Pond Road and carrying the channel down the upstream slope to a few feet below the normal winter drawdown pool elevation. As part of the downstream side erosion repairs, supplemental stone should be added to the rock-lined channel on the left side of the spillway outfall and the channel itself should be re-sized and re-shaped as necessary such that it serves to wholly catch/contain the surface water runoff until its discharge into the downstream channel beyond. Additionally, it is recommended that the existing jersey barriers be temporarily removed, the guardrail then removed and reset after ground leveling and/or stone channel placement along the crest edge/shoulder in the area is complete. Re-setting of the jersey barriers should be such that runoff is prevented from travelling beneath the barriers and onto to the unprotected slope. A stone-lined channel (similar in construction to that of the one on the left side of the spillway) might also be necessary in the downstream right side groin area to protect the downstream slope from future runoff events.

2. Repair deteriorated, cracked, chipped, and spalled concrete areas on along the upstream side of the dam, within the intake area entrance, along the bottom contact with the floor of the spillway training walls, and those associated with the downstream end of the spillway training wall outlet roof section. All areas to be repaired must be clean, sound and free of contaminants. General procedures for the various repair types should be as follows:

   Repair of Joints/Cracks and Thin/Shallow Surface Spalls

   Remove all loose and deteriorated concrete by mechanical means. Saw cut along the joint/crack generally to the depth of deterioration (or a minimum of 1-inch to a maximum of 4-inches deep as appropriate). Chip concrete substrate to obtain a surface profile of approximately 1/8-inch depth with a new fractured aggregate surface. The finished surface at the contact between the bottom of the training wall and the top of the spillway floor, can be tooled to form a smooth, tight, flush corner mimicking to the original contact geometry.

   Prime the prepared substrate by applying a coat of bonding agent (i.e. Sika Armatec 110). Form and pour a polymer modified concrete repair mortar (i.e., SikaTop 122 Plus on horizontal/near horizontal surfaces and SikaTop 123 Plus on vertical/near vertical surfaces) while bonding agent is still wet or within indicated open times appropriate for existing temperature conditions and materials used. When repair area is greater than 1 inch in depth, add 3/8-inch clean, coarse aggregate. Allow a moist cure at repaired areas for best results.

Repair of Larger/Deeper Spalls, Chips, and Void Areas

Saw cut around the deteriorated perimeter so that area to be repaired is squared-off in a neat fashion. Chip away deteriorated concrete to prepare the largest voids, cavities or otherwise deteriorated zones for grouting. Fully expose the entire extent of all voids, cavities, hollow zones, and loose concrete. Remove all loose, hollow, and deteriorated concrete by mechanical means. If reinforcing steel with active corrosion is encountered, remove all contaminants and rust. Clean inside all cracks and voids. Care must be taken where cracks are full depth not to wash backfill out from behind the wall. Where void area to be filled is large or otherwise as necessary, drill for and install anchor bolts to support new concrete. Bolts should be 4- to 6-inch long, ½-inch diameter, stainless steel, threaded rod with washer and nut drilled in at various angles. In general, one anchor bolt per every one square foot, with a minimum of two. Prime the prepared substrate with bonding agent. Fill deteriorated zones, cavities and major cracks with non-shrink grout or concrete. Care shall be taken to fill all voids without the creation of air voids. As applicable, use a one-sided form, dry packing, or other appropriate means to contain concrete.

3. Fill large gaps between stones in the downstream masonry wall particularly in the area along the top portion right of the spillway outlet. Remove soil as necessary to prepare space to receive new stone. Consider removing the debris which is present in portions of the wall to the left of the spillway outlet and replace voids resulting therefrom with new stone. “Use smaller stones to “chink” smaller gaps in other areas (both left and right of the outlet) necessary so that the wall matrix is more uniform and consistent. Excess soil and debris should be disposed of off-site.

4. Clear trees vegetation within 15 feet of downstream slope and abutments, remove rootballs and backfill with compacted gravel topped with loam and seed.

It is noted that effecting these minor repairs would most likely require the services of a general contractor with masonry expertise experienced in working on dams and that coordination would be required between the contractor and Owner would be necessary to schedule repairs during a time when the water is lowered similar to level during GZA’s recent inspection.

3.5 REMEDIAL MODIFICATION RECOMMENDATIONS

As mentioned above, it is likely that the results of the recommended H&H analyses would indicate a lack of adequate spillway capacity. Consequently, it would be expected that the NHDES would ultimately require you to engage a qualified dam engineering consultant to design means for appropriately increasing spillway capacity so that the Spillway Design Flood (i.e., the 1,000-year event) can safely be passed, and/or provide means to prevent embankment erosion during overtopping.

3.6 ALTERNATIVES

The dam functions to impound Granite Lake which is a recreational water body lined with residential dwellings in an active community. There are no appropriate alternatives to maintaining the dam in accordance with State Dam Safety regulations.

3.7 OPINION OF PROBABLE COSTS

The conceptual cost estimate for the recommended studies and minor repair measures is broken down in the table below as follows:

Studies and Analysis	**Conceptual Cost**
Detailed Hydrologic and Hydraulic Analyses	$8,000 - $10,000
Annual Review/Update of Emergency Action Plan (By Owner)	-
Update OMR as Necessary (By Owner)	-
Recurrent Maintenance Recommendations	-
Semi-Annual Mowing/Brush Removal (By Owner)	-
Minor Repair Items	
Repair Erosion Caused by Surface Water Runoff and Effect Repairs to Mitigate Erosion from Future Events	$15,000 - $20,000
Repair of Concrete on Upstream and Downstream Sides of Dam	$20,000 - $40,000
Fill Large Gaps Between Stones in the Downstream Masonry Wall	$10,000 - $15,000
Brush Removal, Weeding and Grass Maintenance/Restoration, and Subsequent Channeling/Clear-out.	$2,000 - $5,000
TOTAL	**$55,000 - $90,000**

It is noted that effecting remedial modifications to address spillway discharge inadequacy would require major contractor efforts to accommodate other construction related items including but not limited to mobilization/demobilization, water control during construction, and sedimentation and erosion controls. In addition to engineering design, costs would also be incurred to secure necessary wetlands, shoreline protection and dam safety permits. Engineering oversight during construction by a qualified dam engineer would also be required as a condition of the dam safety permit. Conceptual costs for these, more substantial, remedial measures are broken down in the table below:

Remedial Modification Recommendations	
Mobilization/Demobilization	$15,000 - $25,000
Water Control During Construction	$10,000 - $20,000
Erosion and Sedimentation Controls	$5,000 - $10,000
Address Inadequate Spillway Capacity	$70,000 - $125,000
Subtotal	**$100,000 - $180,000**
Contingency (~20%)	$20,000 - $40,000
Engineering, Bid Assistance, and Construction Oversight Services	$40,000 - $60,000
Permitting	$15,000 - $30,000
Total	**$175,000 - $310,000**

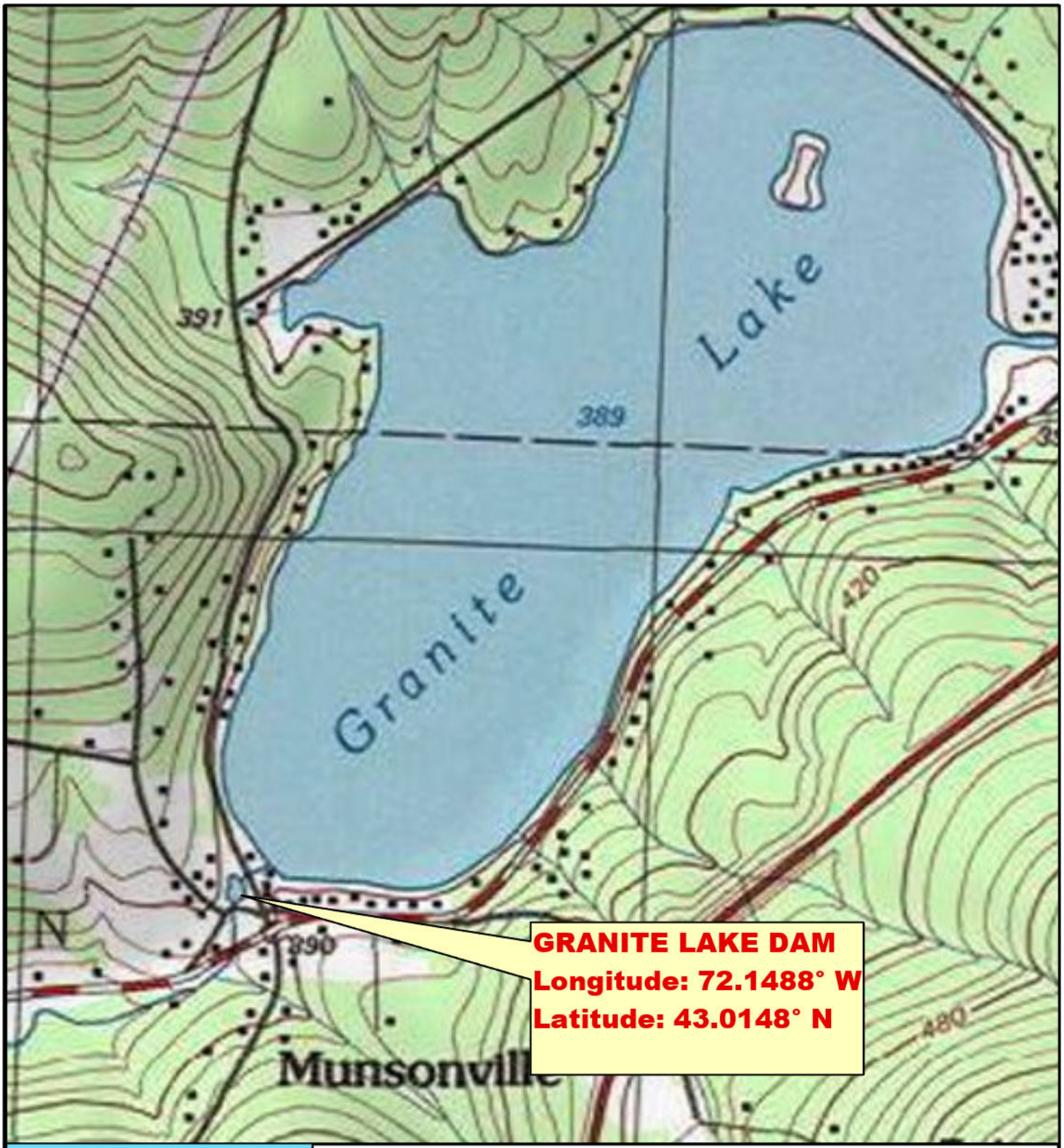
The wide price range associated with spillway modification is because the level of effort will be directly dependent upon results of the detailed H&H.

We emphasize that our cost estimates presented above are for comparative, or general planning purposes only. These estimates may involve approximate quantity evaluations and are not sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over the labor and

material costs required to plan and execute the anticipated work, our estimates were made using our experience and readily available information. Actual costs may vary over time and could be significantly more, or less, than stated.

We note a more detailed cost estimate, specific to actual remedial repairs chosen, would need to be undertaken to provide a more suitable cost estimate for capital planning and budgeting purposes. This level of estimate is beyond the scope of this visual inspection report and would need to be updated as a design of repairs proceeds, and more is known about actual remedial repair measures to be made.

FIGURES



USGS QUADRANGLE LOCATION

Service Layer Credits: USA Topo Maps:
Copyright:© 2013 National Geographic

0 245 490 980 1,470 1,960
Feet

Data Supplied by : esri

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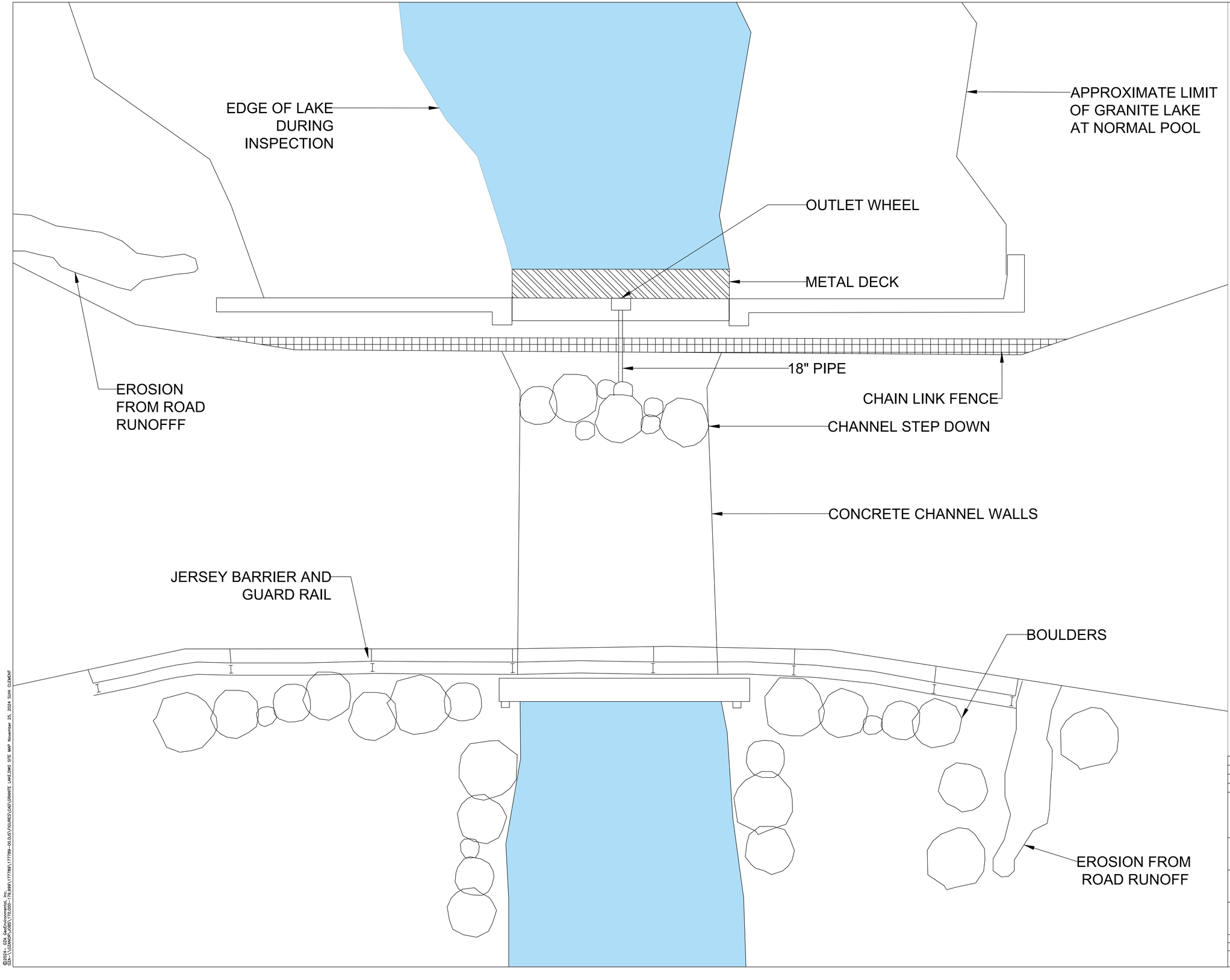
GZA	PROJ. MGR.: DJS DESIGNED BY: SC REVIEWED BY: DJS OPERATOR: SC DATE: 10-21-2024	SITE LOCUS PLAN	JOB NO. 01.177789.00
		GRANITE LAKE DAM NELSON, NEW HAMPSHIRE	FIGURE NO. 1

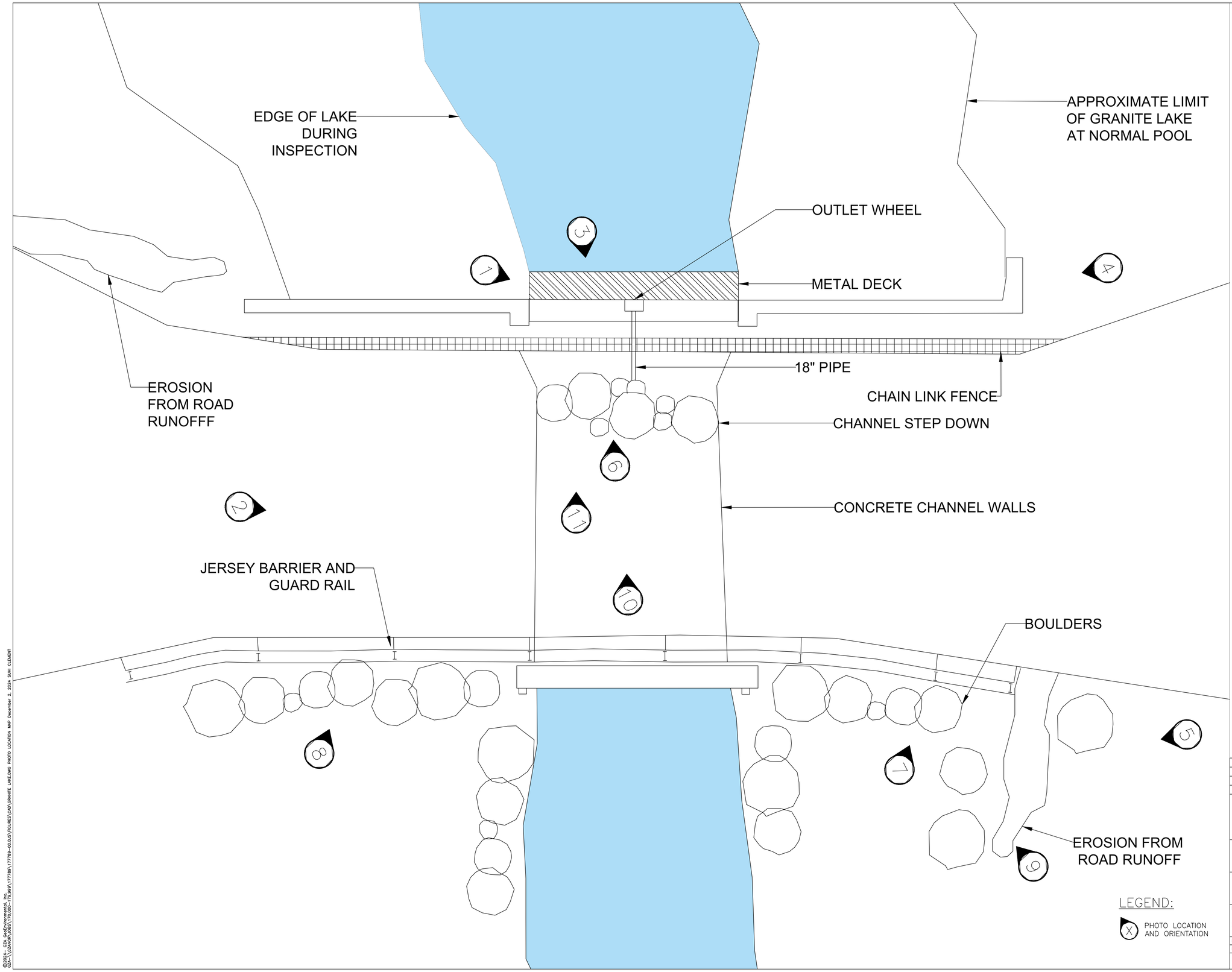


NO.	ISSUE/DESCRIPTION	BY	DATE

GRANITE LAKE DAM
667 GRANITE LAKE ROAD
NELSON, NH

DAM SITE SKETCH

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. www.gza.com		BUTCH ROEDER 667 GRANITE LAKE ROAD	
PROJ MGR: DJS	REVIEWED BY: DJS	CHECKED BY: DJS	FIGURE 2
DESIGNED BY: SC	DRAWN BY: SC	SCALE: NOT TO SCALE	
DATE: 10-21-2024	PROJECT NO. 177789	REVISION NO.	SHEET NO. 2



NO.	ISSUE/DESCRIPTION	BY	DATE

GRANITE LAKE DAM
667 GRANITE LAKE ROAD
NELSON, NH

PHOTO LOCATION SKETCH

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. www.gza.com		BUTCH ROEDER 667 GRANITE LAKE ROAD	
PROJ MGR: DJS	REVIEWED BY: DJS	CHECKED BY: DJS	FIGURE 3
DESIGNED BY: SC	DRAWN BY: SC	SCALE: NOT TO SCALE	
DATE: 10-21-2024	PROJECT NO. 177789	REVISION NO.	SHEET NO. 3

APPENDIX A – LIMITATIONS

DAM ENGINEERING REPORT LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of Granite Lake Village District (Client) for the stated purpose(s) and location(s) identified in the Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. Our findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Report and/or proposal and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. Conditions other than described in this report may be found at the subject location(s).

3. Our services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

Subsurface Conditions

4. If presented, the generalized soil profile(s) and description, along with the conclusions and recommendations provided in our Report, are based in part on widely-spaced subsurface explorations by GZA and/or others, with a limited number of soil and/or rock samples and groundwater /piezometers data and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extent of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then appear evident, it will be necessary to reevaluate the conclusions and recommendations of this report.

5. Water level readings have been made in test holes (as described in the Report), monitoring wells and piezometers, at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the groundwater and piezometer levels, however, occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, reservoir and tailwater levels, the presence of subsurface utilities, and/or natural or artificially induced perturbations.

General

6. The observations described in this report were made under the conditions stated therein. The conclusions presented were based solely upon the services described therein, and not on scientific tasks or procedures beyond the scope of described services or the time and budgetary constraints imposed by the Client.

7. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein available to GZA at the time of the evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

8. Any GZA hydrologic analysis presented herein is for the rainfall volumes and distributions stated herein. For storm conditions other than those analyzed, the response of the site's spillway, impoundment, and drainage network has not been evaluated.

9. Observations were made of the site and of structures on the site as indicated within the report. Where access to portions of the structure or site, or to structures on the site was unavailable or limited, GZA renders no opinion as to the condition of that portion of the site or structure. In particular, it is noted that water levels in the impoundment and elsewhere and/or flow over the spillway may have limited GZA's ability to make observations of underwater portions of the structure. Excessive vegetation, when present, also inhibits observations.

10. In reviewing this Report, it should be realized that the reported condition of the dam is based on observations of field conditions during the course of this study along with data made available to GZA. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued inspection and care can there be any chance that unsafe conditions be detected.

Compliance with Codes and Regulations

11. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

12. This scope of work does not include an assessment of the need for fences, gates, no-trespassing signs, boat/swimmer barriers, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

Cost Estimates

13. Unless otherwise stated, our cost estimates are for comparative, or general planning purposes. These estimates may involve approximate quantity evaluations and may not be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over the labor and material costs required to plan and execute the anticipated work, our estimates were made using our experience and readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

Additional Services

14. It is recommended that GZA be retained to provide services during any future: site observations, explorations, evaluations, design, implementation activities, construction and/or implementation of remedial measures recommended in this Report. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

APPENDIX B – PHOTOGRAPHS

Photographic Log

Photo 1: Upstream side of dam. Note spillway intake and low-level gate at center.

Photo 2: Top of dam from right abutment.

Photo 3: Upstream concrete wall at spillway. Note cracking/spalling at spillway inlet area.

Photo 4: Upstream of the dam from left abutment.

Photo 5: Downstream side of the dam from left embankment.

Photo 6: Downstream end of 18'' diameter low-level discharge pipe at the downstream side of concrete faced portion of the spillway.

Photo 7: Downstream side of dam at the left abutment contact.

Photo 8: Downstream side of dam near right abutment contact.
Note – voids in dry-stone masonry and spalling of concrete roof section.

Photo 9: Erosion from road runoff in the stone-lined channel in the left downstream embankment portion facing downstream.

Photo 10: View of depressed/eroded area beneath/downstream of the “jersey” barrier on the downstream side of the crest roadway. Deficiency caused by uncontrolled surface water runoff.

Photo 11: Top view of concrete side channels and roof deck (supporting crest roadway) downstream of low-level outlet discharge pipe.

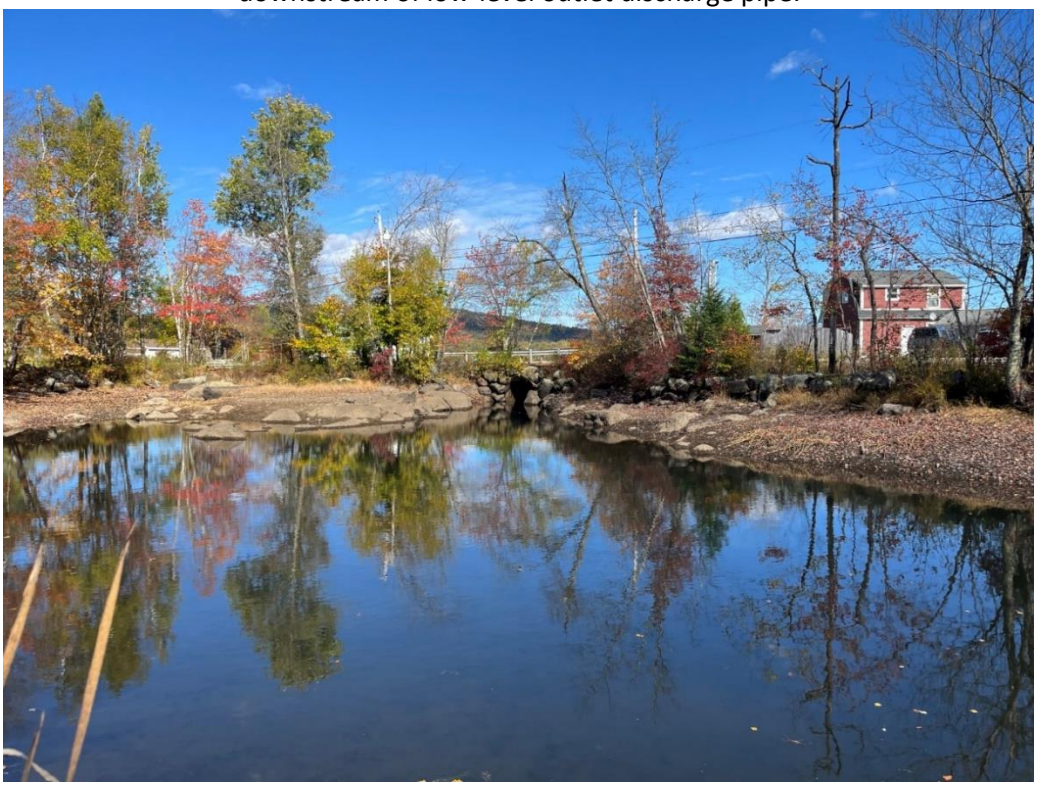


Photo 12: View of pond from top of dam

APPENDIX C – INSPECTION CHECKLIST

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: Granite Lake Dam

STATE ID #: NH DAM #D166002

REGISTERED: ☑ YES ☐ NO

NID ID #: NH00336

STATE SIZE CLASSIFICATION: Intermediate

STATE HAZARD CLASSIFICATION: High

CHANGE IN HAZARD CLASSIFICATION REQUESTED?: No

DAM LOCATION INFORMATION

CITY/TOWN: Nelson

COUNTY: Cheshire

DAM LOCATION: Mill Pond Road
(street address if known)

ALTERNATE DAM NAME: N/A

USGS QUAD.: Lovewell Mountain

LAT.: 43.0148 °N

LONG.: 72.1488 °W

DRAINAGE BASIN: Connecticut River Basin

RIVER: N/A

IMPOUNDMENT NAME(S): Granite Lake

GENERAL DAM INFORMATION

TYPE OF DAM: Concrete, Dry-Stone Masonry with Earth Infill

OVERALL LENGTH (FT): 79

PURPOSE OF DAM: Recreation

NORMAL POOL STORAGE (ACRE-FT): 2204

YEAR BUILT: 1800's

MAXIMUM POOL STORAGE (ACRE-FT): 2734

STRUCTURAL HEIGHT (FT): ~15

EL. NORMAL POOL (FT): 1279.2

HYDRAULIC HEIGHT (FT): ~13

EL. MAXIMUM POOL (FT): 1282.0

FOR INTERNAL NHDES USE ONLY

FOLLOW-UP INSPECTION REQUIRED: ☐ YES ☐ NO

CONDITIONAL LETTER: ☐ YES ☐ NO

NAME OF DAM: Granite Lake Dam | STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 | NID ID #: NH00336

INSPECTION SUMMARY

DATE OF INSPECTION: October 8, 2024 | DATE OF PREVIOUS INSPECTION: October 18, 2023 (by NHDES)

TEMPERATURE/WEATHER: Partly cloudy 65F | ARMY CORPS PHASE I: ☑ YES ☐ NO | If YES, date May 1979

CONSULTANT: GZA GeoEnvironmental, Inc. | PREVIOUS NHDES PHASE I: ☐ YES ☐ NO | If YES, date

BENCHMARK/DATUM: Mean Sea Level

OVERALL PHYSICAL CONDITION OF DAM: SATISFACTORY | DATE OF LAST REHABILITATION:

SPILLWAY CAPACITY: 210 cfs w/flashboards; 430 cfs without

EL. POOL DURING INSP.: 1275.3 | EL. TAILWATER DURING INSP.: 1270+/-

PERSONS PRESENT AT INSPECTION

NAME	TITLE/POSITION	REPRESENTING
James P. Guarente, P.E.	Associate Principal	GZA GeoEnvironmental, Inc.
Derek J. Schipper, P.E.	Associate Principal	GZA GeoEnvironmental, Inc.
Suhi Clement	Engineer II	GZA GeoEnvironmental, Inc.
Butch Roeder	Senior Commissioner	Granite Lake Village District

NAME OF INSPECTING ENGINEER: James P. Guarente, P.E. | SIGNATURE: James P. Guarente

NAME OF DAM: Granite Lake Dam

STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024

NID ID #: NH00336

OWNER:		CARETAKER:	
ORGANIZATION	Granite Lake Village District	ORGANIZATION	Granite Lake Village District
NAME/TITLE	B. Roeder - Senior Commissioner	NAME/TITLE	Butch Roeder
STREET	667 Granite Lake Road	STREET	667 Granite Lake Road
TOWN, STATE, ZIP	Nelson, NH 03457	TOWN, STATE, ZIP	Nelson, NH 03457
PHONE		PHONE	
EMERGENCY PH. #		EMERGENCY PH. #	
FAX	N/A	FAX	N/A
EMAIL	butch.roeder63@gmail.com	EMAIL	butch.roeder63@gmail.com
OWNER TYPE			

PRIMARY SPILLWAY TYPE: Fixed Crest Concrete

SPILLWAY LENGTH (FT): 11.6

SPILLWAY CAPACITY (CFS): 180 cfs with flashboards; 400 cfs without

AUXILIARY SPILLWAY TYPE: N/A

AUX. SPILLWAY CAPACITY (CFS): N/A

NUMBER OF OUTLETS: 1

OUTLET(S) CAPACITY (CFS): 30 cfs

TYPE OF OUTLETS: 18" CMP

TOTAL DISCHARGE CAPACITY (CFS): 210 cfs with flashboards; 430 cfs without

DRAINAGE AREA (SQ MI): 4.2

SPILLWAY DESIGN FLOOD (PERIOD/CFS): 1000-yr/746 cfs (for the 500yr)

HAS DAM BEEN BREACHED OR OVERTOPPED ☐ YES ☑ NO IF YES, PROVIDE DATE(S)

FISH LADDER (LIST TYPE IF PRESENT): No

DOES CREST SUPPORT PUBLIC ROAD? ☑ YES ☐ NO IF YES, ROAD NAME: Mill Pond Road

PUBLIC BRIDGE WITHIN 50' OF DAM? ☐ YES ☑ NO IF YES, ROAD/BRIDGE NAME:

MHD BRIDGE NO. (IF APPLICABLE)

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

EMBANKMENT (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Asphalt (Mill Pond Road), with thin grassed strip each side. (1)	X		
	2. SURFACE CRACKING	Minor pavement cracks in road; slight undulation/depression at d/s side alng barriers.		X	
	3. SINKHOLES, ANIMAL BURROWS	None	X		
	4. VERTICAL ALIGNMENT (DEPRESSIONS	Depressions/undulations along downstream side.		X	
	5. HORIZONTAL ALIGNMENT	Good	X		
	6. RUTS AND/OR PUDDLES	None	X		
	7. GRASS COVER CONDITION	Grassed areas on shoulders is in good condition.	X		
	8. WOODY VEGETATION (TREES/BRUSH)	None	X		
	9. ABUTMENT CONTACT	Good	X		
	10. EROSION	Minor to moderate erosion of downstream shoulder in areas where surface water (2)			X

ADDITIONAL COMMENTS: (1) Chain link fence along u/s shoulder; "jersey" barriers and steel guardrail along d/s shoulder.
(2) runoff flows under existing depressions present below the jersey barriers.

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	None observed		X	
	2. SEEPAGE	None observed		X	
	3. SLIDE, SLOUGH, SCARP	Some minor shifting of dry-stone wall boulders has led to minor sloughing on left side.		X	
	4. EMB.-ABUTMENT CONTACT	Good	X		
	5. SINKHOLE/ANIMAL BURROWS	None observed	X		
	6. EROSION	Some minor to moderate erosion on left side adjacent to/within stone channel (3)			X
	7. UNUSUAL MOVEMENT	No unusual movement of soil. Localized shifted stones in downstream wall (4)		X	
	8. GRASS COVER CONDITION	Satisfactory	X		
	9. WOODY VEGETATION (TREES/BRUSH)	Not on slope but present within 15 feet of toe.		X	

ADDITIONAL COMMENTS: (1) Impoundment level some 4 feet below normal pool during time of inspection.

(2) Descriptions this page pertain to earthen segments that extend out (toward the outlet stream channel) from the abutment contacts. See Concrete or Masonry -DS Face checklist page for additional information.

(3) which was apparently placed in the past to protect against erosion damage from surface water runoff.

(4) See Concrete or Masonry -DS Face checklist page for additional information.

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	N/A			
	2. SLOPE PROTECTION TYPE AND COND.				
	3. SINKHOLE/ANIMAL BURROWS				
	4. EMB.-ABUTMENT CONTACT				
	5. EROSION				
	6. UNUSUAL MOVEMENT				
	7. GRASS COVER CONDITION				
	8. WOODY VEGETATION (TREES/BRUSH)				

ADDITIONAL COMMENTS:

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	N/A			
	2. OBSERVATION WELLS				
	3. STAFF GAGE AND RECORDER				
	4. WEIRS				
	5. INCLINOMETERS				
	6. SURVEY MONUMENTS				
	7. DRAINS				
	8. FREQUENCY OF READINGS				
	9. LOCATION OF READINGS				

ADDITIONAL COMMENTS: Town planning to install dry hydrant US of dam

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

DOWNSTREAM AREA

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	Not observed	X		
	2. FOUNDATION SEEPAGE	Not observed	X		
	3. SLIDE, SLOUGH, SCARP	Localized minor sliding of soil slopes along outlet channel in downstream area.		X	
	4. WEIRS	None	X		
	5. DRAINAGE SYSTEM	None	X		
	6. INSTRUMENTATION	None	X		
	7. VEGETATION WITHIN 15 FT	Small trees and woody vegetation present along earthen portions (1)			X
	8. ACCESSIBILITY	Good - Accessible from road and abutment ends.	X		
	9. DOWNSTREAM HAZARD DESCRIPTION	Munsonville, DS of the dam and East Sullivan Village, 3 miles DS of the dam			

ADDITIONAL COMMENTS: (1) within 15 feet of downstream area.

NAME OF DAM: Granite Lake Dam | STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 | NID ID #: NH00336

MISCELLANEOUS

AREA INSPECTED	CONDITION	OBSERVATIONS
MISC.	1. RESERVOIR DEPTH (AVG)	Granite Lake reportedly is as deep as 111 feet in localized areas.
	2. RESERVOIR SHORELINE	Shoreline significantly developed with residential dwellings.
	3. RESERVOIR SLOPES	Moderately sloping and stable.
	4. ACCESS ROADS	Mill Road top of dam
	5. SECURITY DEVICES	Fence on u/s top of dam, concrete barriers and guardrail on d/s top.
	6. WATER PUBLIC HAZARDS & PROTECTION	Fencing on u/s side
	7. VANDALISM OR TRESPASS	☐ YES ☑ NO WHAT:
	8. AVAILABILITY OF PLANS	☑ YES ☐ NO DATE: 12/2007 (existing condition sketches)
	9. AVAILABILITY OF DESIGN CALCS	☑ YES ☐ NO DATE: Calcs available for stoplog pins
	10. AVAILABILITY OF EAP/LAST UPDATE	☑ YES ☐ NO DATE: EAP filed with NHDES, last updated 11/9/2023
	11. AVAILABILITY OF O&M MANUAL	☑ YES ☐ NO DATE: OMR filed with NHDES last updated 5/2024
	12. CARETAKER/OWNER AVAILABLE	☑ YES ☐ NO DATE: October 8, 2024
	13. CONFINED SPACE ENTRY REQUIRED	☐ YES ☑ NO PURPOSE:

ADDITIONAL COMMENT

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Concrete	X		
	WEIR TYPE	Fixed Crest (1)			X
	SPILLWAY CONDITION	Fair (2)			X
	TRAINING WALLS	Originally dry-stone extending from intake area through dam which outlets (3)	X		
	SPILLWAY CONTROLS AND CONDITION	Functional low level outlet gate, operated during inspection.	X		
	UNUSUAL MOVEMENT	None	X		
	APPROACH AREA	Granite Lake, clear.	X		
	DISCHARGE AREA	Otter Brook, generally clear.	X		
	DEBRIS	None observed.	X		

ADDITIONAL COMMENTS: (1) Provisions for 2-feet of stop logs. Held by 4 -1" OD pipe intend to fail when impoundment at approximately 2 feet above logs.
(2) Minor to moderate spalling, voids and cracking observed at u/s end of intake area.
(3) to downstream channel (Otter Brook). Dry-stone walls covered with concrete as part of 2008 repairs. Walls in good condition.

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	N/A			
	WEIR TYPE				
	SPILLWAY CONDITION				
	TRAINING WALLS				
	SPILLWAY CONTROLS AND CONDITION				
	UNUSUAL MOVEMENT				
	APPROACH AREA				
	DISCHARGE AREA				
	DEBRIS				

ADDITIONAL COMMENTS:

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE	18" diameter corrugated metal pipe (CMP).	X		
	INTAKE STRUCTURE	None; pipe entrance is at face of upstream side of dam.	X		
	TRASHRACK	None.		X	
	PRIMARY CLOSURE	Cast-iron slide gate with hand-operating wheel.	X		
	SECONDARY CLOSURE	None.	X		
	CONDUIT	CMP extends approximately 9.5 into dam from upstream face. Thereafter (1)	X		
	OUTLET STRUCTURE/HEADWALL	Downstream side is concrete floor and sidewalls with concrete lintel (2)	X		X
	EROSION ALONG TOE OF DAM	Not observed.	X		
	SEEPAGE/LEAKAGE	Not observed.	X		
	DEBRIS/BLOCKAGE	Not observed.	X		
	UNUSUAL MOVEMENT	None observed.	X		
	DOWNSTREAM AREA	Stream channel relatively clear of debris.	X		
	MISCELLANEOUS				

ADDITIONAL COMMENTS: (1) flow discharges into concrete lined (chute) channel discharging on downstream side of dam (through dry-stone wall).
(2) Lintel is significantly deteriorated/spalled.

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

CONCRETE/MASONRY DAMS (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	N/A			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	HORIZONTAL ALIGNMENT				
	VERTICAL ALIGNMENT				

ADDITIONAL COMMENTS:

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE	Dry-stone boulder wall.		X	
	SURFACE CONDITIONS	Localized larger gaps/missing stones.		X	
	CONDITIONS OF JOINTS	Gaps could benefit from addition of chinking stones.		X	
	UNUSUAL MOVEMENT	There are localized areas of shifted/bulging stones, missing or large gaps in between stones.		X	
	ABUTMENT CONTACT	Adequate		X	
	LEAKAGE	None observed (note pool was some 4-feet below normal at time of inspection.		X	

ADDITIONAL COMMENTS:

NAME OF DAM: Granite Lake Dam STATE ID #: NH DAM #D166002

INSPECTION DATE: October 8, 2024 NID ID #: NH00336

CONCRETE/MASONRY DAMS (UPSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE	Concrete facing over (former stone masonry).	X		
	SURFACE CONDITIONS	Fair to satisfactory with localized areas of vertical cracking and spalling. Spalling (1)			X
	CONDITIONS OF JOINTS	Vertical cracking along several on the joints observed.			X
	UNUSUAL MOVEMENT	None observed.	X		
	ABUTMENT CONTACTS	Generally good. Minor erosion along right groin where wall tie into earth due to (2)			X

ADDITIONAL COMMENTS: (1) more prevalent below normal pool level and in areas spillway intake area.
(2) surface water runoff from Mill Pond Road.

APPENDIX D – PREVIOUS REPORTS AND REFERENCES

PREVIOUS REPORTS AND REFERENCES

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

1. Army Corp of Engineers 1978 report.
2. Inspection Notice Letter from New Hampshire Department of Environmental Services – Dam Bureau dated April 26,2024.
3. Preliminary Report on Reconstruction of Dam by Woods &Co., December 2007.
4. Spillway Flashboard Support Pin Design calculations by Woods & Co., August, 2008 and June 2010.
5. Neil H. Daniels, Inc, Invoice for Concrete Repairs dated November 30, 2008.
6. Operation, Maintenance, and Response (OMR) Information Form prepared by Owner and last updated May 2024.
7. Emergency Action Plan (EAP) prepared by Owner and last updated November 9, 2023.

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

1. New Hampshire Administrative Rules and Regulations for Dam Safety, Env-Wr 100-800 – effective May 24, 2024.

APPENDIX E – DEFINITIONS

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to RSA 482 and New Hampshire Administrative Rules Env-Wr-100-800 for Dam Safety/Definitions, or other reference published by FERC, Dept. of the Interior Bureau of Reclamation, or FEMA. Please note should discrepancies between definitions exist, those definitions included within Env-Wr-100-800 govern for dams located within the State of New Hampshire.

1. Definition of a Dam *per Env-Wr 101*

Dam	Any artificial barrier, including appurtenant works, which impounds or diverts water and which has a height of 6 feet or more, or is located at the outlet of a great pond.

2. Orientation & General Terms

Upstream	Shall mean the side of the dam that borders the impoundment.
Downstream	Shall mean the high side of the dam, the side opposite the upstream side.
Right	Shall mean the area to the right when looking in the downstream direction.
Left	Shall mean the area to the left when looking in the downstream direction.
Abutment	Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.
Crest	Shall mean the top of the dam, usually provides a road or path across the dam.
Embankment	Shall mean the fill material, including but not limited to rock or earth, placed to provide a permanent barrier that impounds water.
Appurtenant Works	Shall mean any ancillary feature of a dam including such structures as dikes, training walls, spillways, either in the dam or separate there from, low level outlet works, and water conduits such as tunnels, channels, pipelines or penstocks, either through the dam or its abutments.
Spillway	Shall mean a structure, a low area in natural grade or any part of the dam which has been designed or relied upon to allow normal flow or major flood flow to pass over or through while being discharged from a reservoir.

3. Hazard Classification *per Env-Wr 101*

High Hazard	Shall mean a dam that has a high hazard potential because it is in a location and of a size that failure or mis-operation of the dam would result in probable loss of human life as a result of: (a) Water levels and velocities causing the structural failure of a foundation of a habitable residential structure or a commercial or industrial structure which is occupied under normal conditions;

(b) Water levels rising above the first floor elevation of a habitable residential structure or a commercial or industrial structure which is occupied under normal conditions when the rise due to dam failure is greater than one foot;

(c) Structural damage to an interstate highway which could render the roadway impassable or otherwise interrupt public safety services;

(d) The release of a quantity and concentration of materials which qualify as "hazardous waste" as defined in RSA 147-A:2, VII; or

(e) Any other circumstance which would more likely than not cause one or more deaths.

Significant Hazard — Shall mean a dam that has a significant hazard potential because it is in a location and of a size that failure or mis-operation of the dam would result in any of the following:

(a) No probable loss of life;

(b) Major economic loss to structures or property;

(c) Structural damage to a Class I or II road which could render the road impassable or otherwise interrupt public safety services;

(d) Major environmental or public health losses, including:

(1) Damage to a public water system, as defined by RSA 485:1-a, XV, which will take longer than 48 hours to repair; or

(2) The release of liquid industrial, agricultural, or commercial wastes, septage, sewage, or contaminated sediments if the storage capacity is 2 acre-feet or more; or

(3) Damage to an environmentally-sensitive site that does not meet the definition of reversible environmental losses.

Low Hazard Dam — Shall mean a dam that has a low hazard potential because it is in a location and of a size that failure or mis-operation of the dam would result in any of the following:

(a) No probable loss of life;

(b) Low economic loss;

(c) Structural damage to a town or city road or private road accessing property other than the dam owner's which could render the road impassable or otherwise interrupt public safety services;

(d) The release of liquid industrial, agricultural, or commercial wastes, septage, or contaminated sediment if the storage capacity is less than 2 acre-feet and is located more than 250 feet from a water body or water course; or

(e) Reversible environmental losses to environmentally-sensitive site.

Non-Menace Dam	Shall mean a dam that is not a menace because it is in a location and of a size that failure or mis-operation of the dam would not result in probable loss of life or loss to property, provided the dam is: (a) Less than 6 feet in height if it has a storage capacity greater than 50 acre-feet; or (b) Less than 25 feet in height if it has a storage capacity of 15 to 50 acre-feet.

4. Condition Rating

Unsafe	Major structural*, operational, and maintenance deficiencies exist under normal operating conditions.
Poor	Significant structural*, operation and maintenance deficiencies are clearly recognized for normal loading conditions.
Fair	Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters.
Satisfactory	Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.
Good	No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF.

* Structural deficiencies include but are not limited to the following:

- Excessive uncontrolled seepage (e.g., upwelling of water, evidence of fines movement, flowing water, erosion, etc.).
- Missing riprap with resulting erosion of slope.
- Sinkholes, particularly behind retaining walls and above outlet pipes, possibly indicating loss of soil due to piping, rather than animal burrows.
- Excessive vegetation and tree growth, particularly if it obscures features of the dam and the dam cannot be fully inspected.
- Deterioration of concrete structures (e.g., exposed rebar, tilted walls, large cracks with or without seepage, excessive spalling, etc.).
- Inoperable outlets (gates and valves that have not been operated for many years or are broken).

5. Miscellaneous

EAP	Emergency Action Plan (EAP) shall mean a predetermined (and properly documented) plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam failure.
O&M Manual	Operations and Maintenance (O&M) Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

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

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

Height of Dam — Shall mean means the vertical distance from the elevation of the uppermost surface of a dam to the lowest point of natural ground, including any stream channel, along the downstream toe of the dam.

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

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

Probable Loss of Human Life Shall means loss of human life that is likely to occur, or reasonably or realistically expected. This definition does not include persons who are only incidentally in the potential inundation area downstream of a dam. Examples include walking on the dam, driving on lightly traveled roads on or downstream of the dam and recreating downstream of the dam provided the area is not an established recreational area.

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

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

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