

Vermont Department of Environmental Conservation

Water Investment Division – Dam Safety Program
1 National Life Drive, Davis 3
Montpelier, VT 05620
Phone: 802-622-4093

Agency of Natural Resources

WATER CONTROL PLAN
April 12, 2021
AMHERST LAKE DAM, PLYMOUTH
State ID No. 156.05 / National ID No. VT00131

The purpose of this Water Control Plan is to document the need for risk reduction measures at Amherst Lake Dam based on a recent dam safety inspection by the Vermont Department of Environmental Conservation, Dam Safety Program (DSP), provide documentation of regulatory requirements around the risk reduction activities, as well as outline the necessary actions and procedures to accomplish the risk reduction measures and ongoing monitoring. The following appendices accompany this plan:

- **Appendix A:** Regulator E-mail Communications
- **Appendix B:** Contact List
- **Appendix C:** Weir and Gate Flow Tables
- **Appendix D:** March 18, 2021 Dam Safety Inspection Report

The Amherst Lake Dam is owned by Mike and Deb O'Loughlin at 1534 Scout Camp Road, Plymouth, Vermont. The risk reduction measures at Amherst Lake Dam will be undertaken by the dam owners and their representatives/contractors with assistance from the State of Vermont including Ben Green and Steve Hanna of the DSP and Todd Menees of the Vermont Rivers Program.

Dam Background

Amherst Lake Dam is a concrete gravity dam with a principal spillway and outlet works. The dam is currently classified as a SIGNIFICANT hazard potential. According to DSP files, the dam is approximately 115 feet long with a structural height of about 17 feet high and a hydraulic height during normal pool of approximately 6 to 8 feet. The principal spillway is an approximately 75-foot-long concrete weir fitted with approximately 2-inch diameter steel pipe flashboard supports that are approximately 2 feet on center. The flashboards are 1.5-inch thick by 11.5-inch-high timber boards. The principal spillway weir crest is approximately 9.4 feet below the dam crest/top of concrete training walls. To the right of the principal spillway is an outlet works consisting of an approximately 4-foot-wide channel with an 8-foot-high timber slide gate operated by a hand wheel mechanism on the concrete bridge above. The top and bottom of the gate are approximately 5.9 feet and 13.9 feet below the dam crest/top of concrete training wall, respectively.

It is our understanding the gate and flashboards have been operated seasonally in recent years as follows:

- In the fall, the two flashboards are both removed, and the concrete principal spillway weir controls flows and water levels from fall to spring (i.e., winter drawdown).
- In the spring, the flashboards are installed by stacking two boards high above the concrete principal spillway weir to a total height of approximately 23 inches.
- During flashboard removal and installation, the gate is operated to lower the water level and pass flows to facilitate these seasonal operations and for worker safety.

The drainage area of the dam is about 19.1 square miles. The dam impounds Amherst Lake, which is a recreational water body with a normal pool surface area of about 80 acres and normal and maximum storage capacities of 380 and 1,050 acre-feet, respectively. The dam raises the water level on this natural lake on the order of 6 to 8 feet. The dam discharges directly into the Black River and then into Echo Lake. The dam is reportedly founded on glacial till soils. The dam was reportedly constructed circa 1950 to replace a timber crib structure at the site. It is our understanding that in 2015, new flashboards were installed, and maintenance was performed to the supporting pins.

Based on review of the current Emergency Action Plan (EAP) for the dam, a sudden failure could result in the inundation of approximately 19 homes and 1 State Park located along Echo Lake, immediately downstream. It is anticipated that Echo Lake, Lake Rescue, and Lake Pauline (also known as Reservoir Pond) downstream along the Black River would provide some flood attenuation/storage and ability to “absorb” flood flows, potentially lessening impacts further downstream.

Despite the fact the dam supports public uses on Amherst Lake the risk, liability, and responsibility associated with ownership of the dam falls entirely to the private owner, despite the owner not having access to public funds to address maintenance or safety issues.

Condition History, Current Conditions, and Risk Reduction Measures

The dam has been inspected by the DSP in 1984, 2005, 2014, and 2019. The 2005 and more recent inspection reports are available in DSP files and rate the dam in POOR condition. The inspection reports note the deterioration of the right abutment and outlet works gate area including concrete cracks, section loss, and spalling that threaten the structural integrity of the dam. Based on the March 18, 2021 inspection, prompted by ongoing safety concerns, the overall condition of the dam was again rated as **POOR**, consistent with previous inspections. Continued deterioration of some concrete elements and concern for their stability were noted. A copy of the report is available in *Appendix D*. A range of alternatives were considered to reduce risk, including:

- Alternative A: Do nothing.
- Alternative B: Open the gate and draw the lake down on the order of 6 to 8 feet.
- Alternative C: Remove the flashboards, the associated pins, and adjust the height of the top of the gate to maintain the lake level at the spillway crest about 2 feet lower than recent summer lake levels throughout the year.

Alternative A essentially accepts the increased risk of an incident or dam failure and associated upstream and downstream impacts. It prioritizes existing summertime recreational uses over public safety and environmental risks of an uncontrolled release at the dam. This alternative was therefore considered unacceptable by the DSP and the owners.

Alternative B essentially eliminates the risk of an incident or dam failure under normal flow conditions and greatly reduces the risk during flood loading. This alternative also results in significant impacts to existing summertime lake uses. This alternative was not preferred by the owners at this time and was viewed as unwarranted by the DSP.

Alternative C represents what appears to be a reasonable compromise between the two other options. It has been estimated that this risk reduction measure will reduce normal pool loading on the dam on the order of 30%, and by reducing flood levels in the lake, greater load reductions during flooding events. It will also reduce the volume of impounded water behind the dam approximately 20 to 30%. Under this scenario, the lake approximately maintains its surface size and shape and while causing some challenges, maintains existing summertime recreational uses.

At this point in time, Alternative C was determined to be the most reasonable alternative as it strikes a balance between an appropriate level of risk reduction while still maintaining summertime uses. Alternative C should be implemented immediately and maintained until the dam can be rehabilitated or removed. Specifically, risk reduction measures under Alternative C includes the following:

- Remove the flashboards and pins and modify the gate as a public safety/risk reduction measure. The lower pool should be maintained until the dam is rehabilitated, removed, or conditions worsen further requiring additional reservoir-level reduction. The following actions are specifically recommended:
 - Develop this Water Control Plan that includes a narrative on the background of the dam and the public safety/risk reduction needed to perform these actions, outlines the procedure for how the risk reduction measures will be achieved, and address considerations of State and Federal regulatory entities.
 - Remove and do not reinstall the flashboards to lower the normal water level to the concrete principal spillway crest.

- Cut off the flashboard pins at grade to reduce debris clogging, for operator safety, and to reduce the potential for unauthorized operation (i.e., someone replacing the two flashboards on the spillway crest).
- Cut out the top timbers of the slide gate (not the frame or gate riser mechanism) so that the top approximately matches the crest of the principal spillway to reduce loading on the marginally stable structure. Maintain the operability of the slide gate for future use.

In addition, the inspection report included maintenance level recommendations that the dam owner can undertake on their own, studies and analyses that will require the assistance of a Vermont registered Professional Engineer experienced in the design, construction, and management of dams and dam safety engineering, as well as remedial measures necessary to bring the dam into compliance with current dam safety rules and guidelines, or alternately, dam removal.

Regulatory Requirements

The DSP worked with the owner and State and Federal environmental permitting officials to discuss the proposed risk reduction measures so their concerns and requirements could be incorporated into this plan. The agencies listed below were consulted and a brief synopsis of their feedback is provided.

DSP: Based on the recent inspection and deteriorating conditions at the dam, the risk reduction measures were recommended to protect public safety and the environment. The dam is a non-power, non-federal dam and is therefore under the regulatory jurisdiction of the DSP. A Dam Safety Application/Order is not required for the proposed activities and DSP requirements regarding the risk reduction measures have been written into the procedures in this document. From a dam safety prospective, drawdown rates should never exceed 1 foot per day. Outflows should be managed in accordance with environmental drawdown rates and outflow conditions. During the lowering of the water level as well as routinely going forward, the condition of the dam should be regularly monitored. It should be noted that the risk reduction measures are not considered a permanent solution and addressing the issues at the dam by either performing rehabilitation or removal at some point in the future will be necessary.

Vermont Wetlands: Wetland Program findings are that since the risk reduction measures of removing a flashboard are to reduce the potential for a failure or uncontrolled release that could harm people or the environment, removing a flashboard would be considered an emergency Allowed Use. Accordingly, a wetland permit is not required to remove a flashboard. Future measures such as dam rehabilitation or dam removal will require further review by the Wetland Program and may require a wetland permit (such as for construction access) or a restoration plan approved in writing by the Wetland Program. If the lake is left in the lowered state for a period exceeding five years and restoration of historic lake levels is desired, Wetlands will require re-evaluation of the wetlands/hydrology around the lake. Based on findings from that evaluation, restoring the water level to historic levels, depending on updated wetland impacts, may be restricted or require additional assessments and wetland permitting. For tracking purposes, the project was assigned wetland project #2021-227.

Federal Wetlands (United States Army Corps of Engineers, USACE): The USACE regulates the discharge of dredged or fill material into waters and wetlands of the United States. Accordingly, the proposed risk reduction measures are not under their jurisdiction. However, similar to Vermont Wetlands, future, permanent measures such as dam rehabilitation or dam removal may require a permit. Should dam rehabilitation be pursued, it is likely that restoring lake levels to historic levels will require an application through the USACE. If the reservoir is left in the drawn down state for a period exceeding two years, the USACE may require re-evaluation of the wetlands/hydrology around the lake prior to level restoration. Based on findings from that evaluation, restoring the water level to historic levels, depending on updated wetland impacts, may be restricted or require additional assessments and permitting.

Fish & Wildlife Department:

- Fisheries: In discussions with this program, it was requested that the lake lowering occur outside of smallmouth bass spawning season, which is May 15 to June 30. The lowering is planned for April/early May 2021 and will occur outside of that period. Fisheries also reviewed the Water Control Plan and provided no other comment.
- Endangered Species - Plants: In discussions with this program, a rare, threatened, or endangered (RTE) plant has been identified near the dam. It was last reported in Echo Lake, but at the northern end just downstream of the dam

and so is likely in Amherst Lake as well. However, it was the opinion of Fish & Wildlife staff that the proposed risk reduction measures will not impact the RTE plant. Accordingly, there are no special requirements associated with the RTE plant.

- Facilities (Boat Ramp): There is a Fish & Wildlife owned/maintained boat ramp at the northern end of the lake. The ramp can typically accommodate approximately 3 to 4 trailered vehicles. The water level resulting from the risk reduction measures will exclude motorboats from the lake due to resulting shallow depths at the ramp. However, non-motorized boats will still be able to access the lake during the lower levels. It was requested that DEC post information at the access regarding the risk reduction measures.

Lakes and Ponds/Shoreland Protection/Lakeshore Encroachment: In consultation with staff members from this program the following items were discussed:

- From a Shoreland Protection regulatory standpoint, no new impervious surface or cleared area is proposed as part of the risk reduction measures. Therefore, no Shoreland permit is required.
- From a Lake Encroachment regulatory standpoint, encroachments subject to the provisions of 10 V.S.A. Chapter 43, concerning dams, are exempt (29 V.S.A. § 403(d)).
- In accordance with the Vermont Water Quality Standards for Class B2 waters such as Amherst Lake, the Lakes and Ponds Program strives to manage waterbodies where artificial variations in water level take place in a manner that ensures full support of uses. It appears that the lake levels following risk reduction measures will continue to generally support public uses. The Lakes and Ponds Program also noted that it is possible that lake users who launch motorized vessels at the northern end of the lake may believe that boating uses are being compromised by the two-foot reduction in water levels associated with this dam safety action, and DEC should be prepared with appropriate outreach actions explaining why this action is being taken.
- It is acknowledged that a band of additional shoreland will be created, particularly at the northern end of the lake, following completion of the risk reduction measures. This band will be under the jurisdiction of Shoreland Protection. It is anticipated that this additional shoreland will be colonized by terrestrial plants. This zone will be monitored by State personnel for erosion and invasive species.

River Management - Streamflow Regulation: In discussions with this program no permit or formal approval is needed. This program indicated that they appreciate the public safety importance of the proposed risk reduction activities. They also support the elimination of flash board operation, as the Vermont Water Quality Standards require that natural flow regimes, also known as a crest controlled run-of-river flow, be supported instead of seasonal artificial manipulation. It was recommended that for lowering the water level, the rate be limited to 2 cubic feet per second per square mile of drainage area (csm) above baseflow, or approximately 38 cfs above the baseflow. Also, once the flashboards are removed, it is recommended that the gate not be operated with the exception of test operation or in the case of an emergency. Accordingly, lake levels under normal conditions will come into equilibrium at the spillway elevation and will fluctuate with natural variations.

Rivers Management – Stream Alteration: Since the dam is under the jurisdiction of the DSP, no stream alteration permit is required. Todd Menees from this program has participated in the recent dam inspection and will also provide field assistance and monitoring of the dam as well as downstream flows during the risk reduction measures. It has been suggested that flows from the dam during lowering the water level should not exceed the flows from a 2-year storm, also called the bank full storm, or the approximate storm that fills stream channels. The goal is to alleviate proximal streambank erosion in the Black River and the objective is to minimize downstream distal flooding and erosion impacts. Based on a USGS Stream Stats analysis of the watershed, a 2-year storm event is approximately 820 cfs.

The monitoring of released flow levels in the Black River below the dam and above Echo Lake can be achieved with close attention to the discharge depth in the river channel between the dam and Echo Lake. Todd Menees will assist in setting visual monitoring stream gages on the riverbank for recording daily observations to keep the river flows at or below about a 1.5-year storm event and below the top of riverbank.

Local Officials: Todd Menees, who is also a Plymouth resident, has had some informal discussion with local officials and addressed some questions regarding the proposed risk reduction measures. Todd has reached out to the Town Clerk's Office

about a discussion with the Town Selectboard regarding potential attendance by he and the DSP at a future meeting, perhaps in May, to provide additional information and address questions. Todd has also discussed the project in general with Larry Lynds, Road Foreman and Selectboard member, Mike Coleman, Chair of the Planning Commission, and Elaine Pauley, Assistant Town Clerk.

Following discussions with the above agencies, an e-mail was sent to each program asking for feedback to ensure that no agency guidelines or requirements were overlooked. A copy of these emails are included in *Appendix A*.

Risk Reduction Measures

The proposed measures are being performed to reduce the threat of a dam incident or failure. All activities should be performed carefully and in a controlled manner with public safety, the environment, as well as worker/operator safety in mind. The risk reduction measures are listed below in order of importance of completion:

- 1) Develop a Water Control Plan to guide implementation of these measures. This document represents this requirement.
- 2) Remove and do not reinstall the flashboards.
- 3) Cut off the flashboard pins at grade.
- 4) Cut out the top timbers of the slide gate so that the top approximately matches the crest of the spillway.
- 5) Perform these measures above with DSP Staff on-site for guidance and monitoring.

Communication:

The following communication activities should be performed prior to starting the risk reduction activities.

- Project Contacts and Correspondence: Important project contacts are included in the contact list in *Appendix B*. This list should be updated as needed. Project contacts include those for the DSP, Todd Menees of the Rivers Program, State regulatory personnel, the dam owners, and Town officials. In the event of an emergency, the dam's Emergency Action Plan (EAP) should be activated. A copy of the EAP should be kept onsite whenever activities are underway.

In addition, the following communications/outreach is planned:

- Local official notification: potential attendance at an upcoming Selectboard meeting is planned. Informal notification by Todd Menees has been performed.
- Targeted notification of Amherst Lake shore owners: The dam owners have obtained the addresses of the lakeshore owners from the Clerk's Office and are planning to send the Owners each a notification letter.
- Public notification:
 - The DEC plans to post information on our website and social media platforms.
 - It is planned that notices will be posted at the dam and public boat ramp that briefly describes the reasons for the risk reduction measures and provides contact information for the DSP to address questions or concerns.

Flashboard Removal:

The water level lowering consisting of removing one set of remaining flashboards should be conducted at a controlled rate not to exceed 0.5 to 1 foot per day in lake elevation. This rate of drawdown is necessary to reduce the risks of damage to the dam, reduce the potential for erosion in the reservoir area and downstream channels, and result in reasonable quantity and quality of discharges to the downstream channel of the Black River entering Echo Lake. Also, outflow from the dam during drawdown should be no more than the outflow from the 1.5-year storm event to mitigate flooding and damage downstream. The prescribed maximum discharge rates of 0.5 to 1 foot per day in water level lowering are approximately 20 to 40 cfs. Likewise, the discharge above baseflow of 2 csm is approximately 38 cfs. The estimated baseflow or normal seasonal spring inflow into the lake is approximately 4 csm or about 75 cfs. Accordingly, to achieve the 0.5 to 1 foot drawdown and not exceed the 2 csm above baseflow allowance, including overcoming estimated spring baseflow, outflows of approximately 95 to 115 cfs are necessary.

For comparison, the 2-year storm event (approximately 2.6 inches of rain falling over a 24-hour period) peak inflow to Amherst Lake and dam during is approximately 820 cfs based on USGS Stream Stats modeling. As long as the maximum water level lowering rate of 0.5 to 1 foot per day or slower is maintained, outflows will be well below the 2-year storm values.

It is anticipated that the lower lake level will be achieved using the gate, opened slowly over the period of several days to aid in discharging flow, followed by selective flashboard removal. Tables are provided in *Appendix C* with estimated outflows over the spillway weir with and without flashboards, for sections of the spillway to represent the removal of a single or multiple flashboards, as well as estimated outflows from the gate, all based on lake elevation. The DSP will assist with determining an operating regime to perform the lake water level lowering that meets necessary requirements.

The gate is operated via a secured handwheel on the right abutment area of the dam. Between operations the gate should be secured to prevent unauthorized operation or tampering. The amount the gate is opened can likely be determined by measuring the exposed stem or comparing the position of the top of the gate between open and closed positions. It is anticipated that the operation of the gate will be limited to the owner and their representative. DSP personnel will be available to monitor and assist as needed. It is our understanding that the gate is functional and has been used recently to discharge water downstream. It is recommended that the gate be opened in successive days on the order of 6-inches per day to increase flows downstream and begin lowering the water level.

As water levels approach a level where removal of a single or sections of flashboards can be done safely, removal should commence being careful not to cause rapid increases in discharge downstream. It is our understanding that the currently installed flashboards are set against the pins. Utmost care shall be taken with respect to operator safety when removing flashboards. It is anticipated the flashboards will be removed by the owner or their representative with monitoring and assistance performed by the State of Vermont, as needed. The Tables in *Appendix C* should be used to estimate flows from different gate operation/flashboard removal schemes. Once all of the flashboards are removed, the gate should be gradually closed in similar increments to how it was opened over a period of several days and not completely closed until flow depths over the spillway weir have begun to stabilize.

As the lowering is on the order of 1 to 2 feet, gradual gate and flashboard operations are recommended, and maximum lowering rates are 0.5 to 1 foot per day, the duration of the drawdown is anticipated to take several days to complete. External conditions such as rainstorms, limitations of gate capacity, and operator safety considerations could also affect the duration. The lowering will occur in the spring when flows are typically highest, further complicating the lowering. Water quality should be visually monitored through the lowering activity and the appearance of the water flow should be similar upstream of the dam versus downstream (i.e., not be overly turbid). If conditions not anticipated in this plan or water quality issues are encountered, the DSP should be contacted.

During this activity and until all flashboards are removed and the lake level stabilized at the lower level, daily site visits to monitor the water level and flow, perform gate and flashboard operations, and monitor the dam and discharge channels will be required. Todd Menees in the Rivers Program can daily assist the DSP staff due to his proximity.

Flashboard Pin Removal:

Removal of the flashboard pins will require a saw or grinder capable of rapidly cutting through the approximately 2-inch diameter pipe pins as near to the bases as possible. This activity should be performed during low flow conditions. It is likely that water control around the pins being cut can be achieved using several sandbags as necessary, to allow the cutting to be performed in-the-dry. Care should be taken to collect and properly dispose of cutoff pins. It is anticipated the owner will hire a contractor to perform this task.

Cutting Top of Gate to Approximately Match Spillway:

Removal of the upper boards of the gate will require accessing the gate via a ladder or scaffolding installed on the upstream side of the gate. Utmost care shall be taken when performing this task from a worker safety standpoint. Working from the downstream side of the gate is not recommended. This activity should only be performed when the gate is in the closed position and water levels are at or near the spillway weir and stabilized. It is anticipated that two to four horizontal boards

on the gate will need to be removed so that the top of the gate is slightly above the spillway level, but this shall be confirmed in the field and with the DSP before performing the work. It is anticipated the boards would be removed by cutting vertically down on either side of the operator stem, and then horizontally to sever the boards from the vertical stabilizer on the back of the gate. It is anticipated that the owner will hire a contractor to perform this task as well.

Observations and Record Keeping:

It is recommended that daily site visits and record keeping be performed during the lowering until lake levels have stabilized/reached equilibrium. In times of storm events more frequent visits may be warranted. The following records should be maintained through the duration of the lake level lowering as well as for the specific days that other risk reduction measures are performed:

A daily log to include the following:

- Personnel making site visit/performing operations.
- Date and time of site visit.
- Weather conditions including temperature, precipitation data and ice thickness in the reservoir, if applicable
- Reservoir Elevation and difference from preceding day for determination of drawdown rate. A specific location to take this measurement will be selected to ensure consistency.
- Discharge channel depth of flow
- Record of gate operations/adjustments and reason(s) for adjustments/outcome of adjustments, if applicable.
- Observation of dam condition
- Observation of discharge channel condition
- Narrative of activities/work completed.
- Any other pertinent observations
- List of any maintenance activities required/performed, if needed
- Photograph of reservoir and discharge channel as well as of any active/ongoing risk reduction activities

It is recommended that copies of the daily log be stored electronically for safe keeping and future reference. State of Vermont personnel from the DSP and Rivers Program will make regular site visits during the risk reduction activities to observe conditions and provide supplemental recommendations/assistance. At the conclusion, the DSP will document the work performed in a brief report for the project record.

Next Steps Following Completion of Risk Reduction Measures

Continued Monitoring:

Following completion of the risk reduction measures and after the lake levels and flows have reached equilibrium, the duration between monitoring site visits can increase, but they should still be made with some regularity for early detection of continued deterioration or stability issues. Site monitoring frequency on the order of once every several weeks or following large storm events/new loading conditions is recommended. This frequency may be able to be decreased as time passes and little to no changes at the site are noted.

Long Term Plan:

As noted above, the risk reduction measures should not be considered a permanent solution. In addition, in accordance with USACE and State Wetland rules, if the decision is made to rehabilitate the dam and restore the recent summertime water level, the 2-year and 5-year thresholds in those respective rules must be considered to ensure the project is permit-able. Alternatively, dam removal should be also considered on its risk reduction, elimination of future operation and maintenance costs, and environmental merits. Once the risk reduction measures are complete, returning to recent summertime water levels will not be permitted unless the dam is rehabilitated.

Closing

In the event that conditions are encountered that differ from those documented in this plan, the DSP should be contacted immediately.

Appendix A: Regulator E-mail Communications

Green, Benjamin

From: Chalmers, Rebecca
Sent: Wednesday, April 7, 2021 9:56 AM
To: Green, Benjamin
Subject: RE: Amherst Lake Dam, Plymouth, VT - Flashboard Removal - emergency

Hello Ben,

I defer to your analysis of the dams safety and the risk posed by the flashboards. Yes, I confirm that removing the flashboards qualifies as an Emergency Allowed Use 6.13 of the Vermont Wetland Rules. For tracking purposes this project was assigned wetland project #2021-227.

Sincerely,



Rebecca Chalmers, M.S., | District Wetlands Ecologist (she/her or they/their)
Vermont Department of Environmental Conservation
Watershed Management Division, Wetland Program
100 Mineral Street, Suite 303 | Springfield, VT 05156 | 802-490-6192 cell
<https://dec.vermont.gov/watershed/wetlands>

From: Green, Benjamin <Benjamin.Green@vermont.gov>
Sent: Wednesday, April 7, 2021 9:15 AM
To: Chalmers, Rebecca <Rebecca.Chalmers@vermont.gov>
Subject: Amherst Lake Dam, Plymouth, VT - Flashboard Removal - emergency

Hi Rebecca,

Regarding the current condition of Amherst Lake Dam in Plymouth, the dam is considered in poor condition with continued deterioration that impacts the stability and safety of the structure. The recommended risk reduction measures, as outlined in our March 2021 Dam Safety Inspection Report, include removal of flashboards. To reduce risks and protect public safety downstream, removal of the flashboards is considered an emergency activity that is to be performed in the coming days. We believe the proposed risk reduction measures, including flashboard removal, represent an emergency allowed use under your program, could you please confirm?

Thanks,

Ben



Benjamin Green, PE | Dam Safety Engineer
Vermont Department of Conservation
Water Investment Division | Dam Safety Program
1 National Life Drive, Davis 3 | Montpelier, VT 05620-3510
802-622-4093 (cell)
<https://dec.vermont.gov/water-investment/dam-safety>

Green, Benjamin

From: Repella, Angela C CIV USARMY CENAE (USA) <Angela.C.Repella@usace.army.mil>
Sent: Friday, April 2, 2021 4:44 PM
To: Green, Benjamin
Subject: RE: Amherst Lake Dam, Plymouth, VT

EXTERNAL SENDER: Do not open attachments or click on links unless you recognize and trust the sender.

Thanks Ben, your summary looks good to me. Thanks for keeping me in the loop on this work – and have a nice weekend!

Angela C. Repella
U.S. Army Corps of Engineers
New England District - Vermont Project Office
11 Lincoln Street, Room 210
Essex Junction, Vermont 05452
Cell: (802) 881-9565
Office: (978) 318-8639 or (802) 872-2893

In order for us to better serve you, we would appreciate your completing our Customer Service Survey located at http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey

From: Green, Benjamin <Benjamin.Green@vermont.gov>
Sent: Friday, April 02, 2021 4:06 PM
To: Repella, Angela C CIV USARMY CENAE (USA) <Angela.C.Repella@usace.army.mil>
Subject: [Non-DoD Source] Amherst Lake Dam, Plymouth, VT

Hi Angela,

Thanks for the call back today to discuss the Amherst Lake Dam risk reduction measures. As discussed, we are developing a water control plan to guide implementation of the risk reduction measures, hopefully starting as soon as next week. As part of the plan, we are discussing the proposed activities with other state regulators to make sure we are not missing anything. Below is the draft language for the plan, please let me know if this works or any changes you would like.

Federal Wetlands (United States Army Corps of Engineers, USACE): The USACE regulates the discharge of dredged or fill material into waters and wetlands of the United States. Accordingly, the proposed risk reduction measures are not under their jurisdiction. However, similar to Vermont Wetlands, future, permanent measures such as dam rehabilitation or dam removal may require a permit. Should dam rehabilitation be pursued, it is likely that restoring lake levels to historic levels will require an application through the USACE. If the reservoir is left in the drawn down state for a period exceeding two years, the USACE may require re-evaluation of the wetlands/hydrology around the lake prior to level restoration. Based on findings from that evaluation, restoring the water level to historic levels, depending on updated wetland impacts, may be restricted or require additional assessments and permitting.

Thanks and have a great weekend,

Ben



Green, Benjamin

From: Harris, Hannah
Sent: Wednesday, April 7, 2021 11:22 AM
To: Green, Benjamin; Buckley, Courtney
Subject: RE: Lake Amherst Dam - Site Visit Report --UPDATE

Thanks Ben. The plan looks good to me. The bass spawning season starts May 15 and goes until June 30. So if the lowering occurs before then, you should be set.

Thanks,
Hannah



Hannah Harris | Streamflow Protection Biologist (she/her)
Vermont Agency of Natural Resources
Department of Fish & Wildlife
Fish Division
1 National Life Drive, Davis 2 | Montpelier VT 05620-3522
802 279-7913 cell
hannah.harris@vermont.gov
www.vtfishandwildlife.com

From: Green, Benjamin <Benjamin.Green@vermont.gov>
Sent: Wednesday, April 7, 2021 10:53 AM
To: Harris, Hannah <Hannah.Harris@vermont.gov>; Buckley, Courtney <Courtney.Buckley@vermont.gov>
Subject: RE: Lake Amherst Dam - Site Visit Report --UPDATE

Hi Hannah,

When is small mouthed bass spawning season?

It is our hope to start lowering the dam as soon as possible following final discussions with you and completion of the Water Control Plan. At the dam spillway, one 11.5" high flashboard is installed and the water is a few inches above this flowing over. This flashboard will be removed and the water level in the lake will be controlled by the crest of the concrete principal spillway weir and allowed to come to equilibrium in terms of flow and elevation, resulting in a water level about 1 foot below current levels. We hope to pull that level down in a controlled manner over a few days.

I have attached the draft Water Control Plan, it is very near ready and includes requirements/signoffs from DEC regulatory programs including State and Federal Wetlands, F&W plants, F&W Facilities, Lakes and Ponds, Stream flow reg, and stream alt.

Please let us know your thoughts so we can finish up this plan and work with the dam owner to get rolling on these risk reduction measures as soon as possible.

Thanks,

Ben



Benjamin Green, PE | Dam Safety Engineer
Vermont Department of Conservation
Water Investment Division | Dam Safety Program
1 National Life Drive, Davis 3 | Montpelier, VT 05620-3510
802-622-4093 (cell)
<https://dec.vermont.gov/water-investment/dam-safety>

Due to the coronavirus (COVID-19) we are taking additional safety measures to protect employees and customers. Staff are working remotely while focusing on maintaining business processes functional. Please communicate electronically or via phone since postal mail may be slowed during this period. Division staff contact information is here: <https://dec.vermont.gov/water-investment/contacts>. Thanks for your patience during this challenging time. We wish you and your family the best

From: Harris, Hannah <Hannah.Harris@vermont.gov>
Sent: Wednesday, April 7, 2021 10:36 AM
To: Green, Benjamin <Benjamin.Green@vermont.gov>; Buckley, Courtney <Courtney.Buckley@vermont.gov>
Subject: RE: Lake Amherst Dam - Site Visit Report --UPDATE

Hi Ben,

To protect smallmouth bass spawning, we'd like to see the pond lowered before they spawn. Otherwise, you should wait until they've finished spawning. The instream construction period for bass is July 1-May 14. Could we also review the water control plan when it's ready?

Thanks,
Hannah



Hannah Harris | Streamflow Protection Biologist (she/her)
Vermont Agency of Natural Resources
Department of Fish & Wildlife
Fish Division
1 National Life Drive, Davis 2 | Montpelier VT 05620-3522
802 279-7913 cell
hannah.harris@vermont.gov
www.vtfishandwildlife.com

From: Green, Benjamin <Benjamin.Green@vermont.gov>
Sent: Tuesday, April 6, 2021 4:40 PM
To: Harris, Hannah <Hannah.Harris@vermont.gov>; Buckley, Courtney <Courtney.Buckley@vermont.gov>
Subject: RE: Lake Amherst Dam - Site Visit Report --UPDATE

Hi Hannah and Courtney

I hope all is well. Just wanted to follow-up on the email below from last week. Sorry to be pushy on this, but we are hoping to get rolling ASAP on the operations for the risk reduction measures and have a nice dry period ahead. Please let me know if you have any questions or concerns and can work to get them added into the plan and addressed.

Thanks,

Ben



Benjamin Green, PE | Dam Safety Engineer
Vermont Department of Conservation
Water Investment Division | Dam Safety Program
1 National Life Drive, Davis 3 | Montpelier, VT 05620-3510
802-622-4093 (cell)
<https://dec.vermont.gov/water-investment/dam-safety>

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From: Green, Benjamin
Sent: Wednesday, March 31, 2021 9:50 AM
To: Harris, Hannah <Hannah.Harris@vermont.gov>; Popp, Bob <Bob.Popp@vermont.gov>; Zaino, Robert <Robert.Zaino@vermont.gov>
Subject: FW: Lake Amherst Dam - Site Visit Report --UPDATE

Good day Fish & Wildlife folks!

I wanted to reach to you regarding Amherst Lake Dam in Plymouth. Following a dam safety inspection a few weeks back (report attached), we are recommending as a risk reduction measure, that the seasonal flashboards that hold the water level about 23 inches above the spillway not be installed to reduce the load on the dam (as well as a couple of other related safety activities). The Dam Owners are concerned about their risk and liability and willing participants in this activity. We have discussed with other DEC programs but have yet to reach out to you (although I do think that Mike W. has been contacted about the boat ramp). We are developing a "Water Control Plan" to document the problem, ANR requirements doing the risk reduction measures, etc. The activities will be monitored in the field by DSP or Todd Menees. I wanted to include any concerns or requirements you may want to see in the Water Control Plan.

Again, the end goal is to remove the flashboards permanently, resulting in lake lowering of about 23" below normal summertime levels until the dam can either be rehabilitated or removed. With a 2 foot lower pool level, the lake will still largely maintain the existing shape and size as well as existing uses, although with some challenges (see attached bathometric map).

Of particular concern, Rebecca Chalmers of Wetlands, who is considering this an allowed use as a safety issue/emergency identified an RTE plant.

On the fisheries side, I wasn't sure if this is Shawn or Lael's area?

Please let me know your thoughts, we are hoping to wrap up the plan and get the risk reduction measures completed as soon as possible.

Thanks,

Ben



Benjamin Green, PE | Dam Safety Engineer
Vermont Department of Conservation
Water Investment Division | Dam Safety Program
1 National Life Drive, Davis 3 | Montpelier, VT 05620-3510
802-622-4093 (cell)

Green, Benjamin

From: Popp, Bob
Sent: Thursday, April 1, 2021 10:16 AM
To: Green, Benjamin; Harris, Hannah
Cc: Sorenson, Eric; Chalmers, Rebecca
Subject: RE: Lake Amherst Dam - Site Visit Report --UPDATE

Ben, thank you for checking with us. The rare plants that Rebecca mentioned were actually last reported from Echo Lake, but at the very northern end just below the dam so they are likely in Amherst Lake as well. I don't believe there will be any impacts to them from a ca. 2 ft drawdown, but they would likely be impacted by removal of the dam if that were to occur being as they are more lacustrine than riparian species. So please keep me informed if the decision is made in the future to remove the dam and restore the river to its natural setting.

As an fyi the rare plants:

slender water-milfoil (*Myriophyllum alterniflorum*) last observed near the boat launch are on Echo Lake in 2018 and elsewhere in Echo earlier.

wire-stemmed pondweed (*Potamogeton strictifolius*) last observed in 1985, but not relocated during a 2000 survey.

Best
Bob

Bob Popp
Department Botanist
VT. Dept of Fish & Wildlife
5 Perry St. Suite 40
Barre, VT. 05641

802 476-0127 Office | 802 371-7582 Cell
<https://vtfishandwildlife.com>

From: Green, Benjamin <Benjamin.Green@vermont.gov>
Sent: Wednesday, March 31, 2021 9:50 AM
To: Harris, Hannah <Hannah.Harris@vermont.gov>; Popp, Bob <Bob.Popp@vermont.gov>; Zaino, Robert <Robert.Zaino@vermont.gov>
Subject: FW: Lake Amherst Dam - Site Visit Report --UPDATE

Good day Fish & Wildlife folks!

I wanted to reach to you regarding Aerst Lake Dam in Plymouth. Following a dam safety inspection a few weeks back (report attached), we are recommending as a risk reduction measure, that the seasonal flashboards that hold the water level about 23 inches above the spillway not be installed to reduce the load on the dam (as well as a couple of other related safety activities). The Dam Owners are concerned about their risk and liability and willing participants in this activity. We have discussed with other DEC programs but have yet to reach out to you (although I do think that Mike W. has been contacted about the boat ramp). We are developing a "Water Control Plan" to document the problem, ANR requirements doing the risk reduction measures, etc. The activities will be monitored in the field by DSP or Todd Menees. I wanted to include any concerns or requirements you may want to see in the Water Control Plan.

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Thanks,

Ben



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From: Green, Benjamin

Sent: Friday, March 26, 2021 12:22 PM

To: Hanna, Steven <Steven.Hanna@vermont.gov>; Evans, Rob <Rob.Evans@vermont.gov>; Crocker, Jeff <Jeff.Crocker@vermont.gov>; Menees, Todd <Todd.Menees@vermont.gov>; Pierson, Oliver <Oliver.Pierson@vermont.gov>; Cetner, Misha <Misha.Cetner@vermont.gov>; Chalmers, Rebecca <Rebecca.Chalmers@vermont.gov>; Caduto, Marie <Marie.Caduto@vermont.gov>; Smith, Hannah <Hannah.Smith@vermont.gov>

Cc: Blatt, Eric <Eric.Blatt@vermont.gov>; Kamman, Neil <Neil.Kamman@vermont.gov>

Subject: RE: Lake Amherst Dam - Site Visit Report --UPDATE

Good day all,

We wanted to provide an update from our last meeting. The inspection report was completed (attached) and it has been sent to the Owner. Todd, Steve, and I are meeting with the Owner to discuss the report, next steps, and address their questions on Monday. Following the meeting, we plan to start development of the Water Control Plan for performing the flashboard removal and other risk reduction measures. We plan to work closely with the Owner to develop this and circle back with regulatory programs to discuss (some of which has already started). Also, as many of you know, some potential language to be used for public notification has been kicking around and will be important to get zeroed in (perhaps with Elle O'Casey's help) where it can be posted on DEC website, etc. to help get the word out.

We will provide another update following the meeting with the Owner on Monday.

Please let me know if you have any questions or concerns.

Green, Benjamin

From: Cetner, Misha
Sent: Monday, April 5, 2021 3:37 PM
To: Green, Benjamin; Pierson, Oliver
Cc: Hanna, Steven
Subject: RE: Lakes and Ponds item in Water Control Plan for Amherst Lake

This looks good, Ben. I made only a couple minor edits to the language.

Thanks,
Misha



Misha Cetner, Lake & Shoreland Permit Analyst
Vermont Agency of Natural Resources | Department of Environmental Conservation
Watershed Management Division, Lakes & Ponds Program
1 National Life Dr, Davis 3
Montpelier, VT 05620-3522
802-490-6199 / Misha.Cetner@vermont.gov
<http://dec.vermont.gov/watershed/lakes-ponds>

From: Green, Benjamin <Benjamin.Green@vermont.gov>
Sent: Monday, April 5, 2021 9:27 AM
To: Pierson, Oliver <Oliver.Pierson@vermont.gov>; Cetner, Misha <Misha.Cetner@vermont.gov>
Cc: Hanna, Steven <Steven.Hanna@vermont.gov>
Subject: RE: Lakes and Ponds item in Water Control Plan for Amherst Lake

Thanks Oliver, I have put in this language and we will wait to finalize until we hear from Misha.

Thanks,

Ben



Benjamin Green, PE | Dam Safety Engineer
Vermont Department of Conservation
Water Investment Division | Dam Safety Program
1 National Life Drive, Davis 3 | Montpelier, VT 05620-3510
802-622-4093 (cell)
<https://dec.vermont.gov/water-investment/dam-safety>

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From: Pierson, Oliver <Oliver.Pierson@vermont.gov>
Sent: Monday, April 5, 2021 8:16 AM
To: Green, Benjamin <Benjamin.Green@vermont.gov>; Cetner, Misha <Misha.Cetner@vermont.gov>

Cc: Hanna, Steven <Steven.Hanna@vermont.gov>

Subject: RE: Lakes and Ponds item in Water Control Plan for Amherst Lake

Hi Ben,

I edited the second bullet a bit to reflect our conversation. See below. Hope this new text works for you. Misha may have some additional edits.

Regards,

Oliver

Oliver Pierson

Lakes and Ponds Program Manager

1 National Life Drive, Davis 3

Montpelier, VT 05620-3522

802-490-6198 / Oliver.Pierson@vermont.gov

www.watershedmanagement.vermont.gov

From: Green, Benjamin <Benjamin.Green@vermont.gov>

Sent: Friday, April 2, 2021 12:07 PM

To: Pierson, Oliver <Oliver.Pierson@vermont.gov>; Cetner, Misha <Misha.Cetner@vermont.gov>

Cc: Hanna, Steven <Steven.Hanna@vermont.gov>

Subject: Lakes and Ponds item in Water Control Plan for Amherst Lake

Hi Misha and Oliver,

Thanks for the time earlier today to discuss the Water Control Plan for Amherst Lake Dam. As discussed, here is what I pulled together for the Plan, please weigh in and modify as needed.

Lakes and Ponds/Shoreland Protection/Lakeshore Encroachment: In consultation with staff members from this program the following items were discussed:

- From a Shoreland Protection ~~and Lakeshore Encroachment~~ regulatory standpoint, no new impervious surface or cleared area is proposed as part of the risk reduction measures. Therefore, no Shoreland permit is required.
- From a Lake Encroachment regulatory standpoint, encroachments subject to the provisions of 10 V.S.A. chapter 43, concerning dams, are exempt (29 V.S.A. § 403(d)).
- In accordance with the Vermont Water Quality Standards for Class B2 waters such as Amherst Lake, the Lakes and Ponds Program ~~supports existing public uses~~ strives to manage waterbodies where artificial variations in water level take place in a manner that ensures full support of uses. It appears that the lake levels following risk reduction measures will continue to generally support public uses. The Lakes and Ponds Program also noted that it is possible that lake users who launch motorized vessels at the northern end of the lake may believe that boating uses are being compromised by the two-foot reduction in water levels associated with this dam safety action, and DEC should be prepared with appropriate outreach actions explaining why this action is being taken.
- It is acknowledged that a band of additional shoreland will be created, particularly at the northern end of the lake, following completion of the risk reduction measures. This band will be under the jurisdiction of Shoreland Protection. It is anticipated that this additional shoreland will be colonized by ~~litteral~~ terrestrial plants. This zone will be monitored by State personnel for erosion and invasive species.

Thanks,

Ben



Benjamin Green, PE | Dam Safety Engineer

Vermont Department of Conservation

Green, Benjamin

From: Crocker, Jeff
Sent: Monday, April 5, 2021 9:42 AM
To: Green, Benjamin
Subject: RE: Amherst Lake Dam - Water Control Plan, language

Ben,

A minor edit below in red. Otherwise it looks fine to me.

Thanks,

Jeff



Jeff Crocker | Supervising River Ecologist
Vermont Department of Environmental Conservation
Watershed Management Division // Rivers Program
Davis 3, 1 National Life Dr | Montpelier, VT 05620-3522
802-490-6151 (cell)
<https://dec.vermont.gov/watershed>

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Division staff contact information can be found online here: <https://dec.vermont.gov/watershed/contacts>.

Thank you for your patience during this challenging time. We wish you and your family the best.

From: Green, Benjamin <Benjamin.Green@vermont.gov>
Sent: Friday, April 2, 2021 3:20 PM
To: Crocker, Jeff <Jeff.Crocker@vermont.gov>
Subject: Amherst Lake Dam - Water Control Plan, language

Hi Jeff,

Thanks for taking my call just now. Below is the language we discussed for Amherst Lake Dam I plan to include in the Water Control Plan, please make any necessary changes.

Streamflow Regulation: In discussions with this program no permit or formal approval is needed. This program indicated that they appreciate the public safety importance of the proposed risk reduction activities. They also support the elimination of flash board operation, as the Vermont Water Quality Standards require that natural flow regimes, also known as a **crest controlled** run-of-river flow, be supported instead of seasonal artificial manipulation. It was recommended that for lowering the water level, the rate be limited to 2 cubic feet per second per square mile of drainage area (csm) above baseflow, or approximately 38 cfs above the baseflow. Also, once the flashboards are removed, it is recommended that the gate not be operated with the exception of test operation or in the case of an emergency. Accordingly, lake levels under normal conditions will come into equilibrium at the spillway elevation and will fluctuate with natural variations.

Thanks and have a great weekend,

Ben



Benjamin Green, PE | Dam Safety Engineer
Vermont Department of Conservation
Water Investment Division | Dam Safety Program
1 National Life Drive, Davis 3 | Montpelier, VT 05620-3510
802-622-4093 (cell)
<https://dec.vermont.gov/water-investment/dam-safety>

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Appendix B: Contact List

CONTACT LIST

The following State and Federal Regulators were consulted during the development of this plan.

<u>Department of Environmental Conservation</u>		
<i>Dam Safety Program</i>		
Ben Green	Benjamin.green@vermont.gov	802-622-4093
Steve Hanna	Steven.hanna@vermont.gov	802-490-6123
<i>Rivers Program</i>		
Todd Menees	Todd.menees@vermont.gov	802-345-3510
<i>Vermont Wetlands</i>		
Rebecca Chalmers	Rebecca.chalmers@vermont.gov	802-490-6192
<i>Federal Wetlands (USACE)</i>		
Angela Repella	Angela.C.Repella@usace.army.mil	802-881-9565
<i>Fish & Wildlife Department</i>		
Fisheries – Courtney Buckley	Courtney.buckley@vermont.gov	8052-595-0911
Plants – Bob Popp	Bob.popp@vermont.gov	802-476-0127
Facilities – Mike Wichrowski	Mike.wichrowski@vermont.gov	802-917-1347
<i>Lakes & Ponds</i>		
Oliver Pierson	Oliver.pierson@vermont.gov	802-490-6198
Misha Cetner	Misha.cetner@vermont.gov	802-490-6199
<i>Streamflow Regulation</i>		
Jeff Crocker	Jeff.crocker@vermont.gov	802-490-6151
<i>Town of Plymouth</i>		
Elaine Pauley, Asst. Town Clerk	asstclerk@plymouthvt.org	802-672-3655
Mike Coleman, Chair Planning Commission		
Larry Lynds, Road Foreman and Select Board member	asstclerk@plymouthvt.org	802-672-3535
<i>Emergency Personnel</i>		
SEE THE EMERGENCY ACTION PLAN		

Appendix C: Weir and Gate Flow Tables

AMHERST LAKE DAM - ESTIMATED SPILLWAY OUTFLOWS												
OVER CONC. SPILLWAY WEIR, ENTIRE LENGTH					OVER IN-PLACE FLASHBOARD, ENTIRE LENGTH					OVER CONC. SPILLWAY WEIR, 16 FT LENGTH		
Length	75.00 feet				Length	75.00 feet				Length	16.00 feet	
C	3.00				C	3.20				C	3.00	
H	varies				H	varies				H	varies	
Crest El.	100.00 feet				Crest El.	100.96 feet				Crest El.	100.00 feet	
OVER CONCRETE SPILLWAY WEIR					OVER IN-PLACE FLASHBOARD					OVER CONCRETE SPILLWAY WEIR		
H					H					H		
inches	feet	WSE Elev (feet)	Q (cfs)		inches	feet	WSE Elev (feet)	Q (cfs)		inches	feet	WSE Elev (feet) Q (cfs)
1	0.08	100.08	5.4		1	0.08	101.04	5.8		1	0.08	100.08 1.2
2	0.17	100.17	15.3		2	0.17	101.13	16.3		2	0.17	100.17 3.3
3	0.25	100.25	28.1		3	0.25	101.21	30.0		3	0.25	100.25 6.0
4	0.33	100.33	43.3		4	0.33	101.29	46.2		4	0.33	100.33 9.2
5	0.42	100.42	60.5		5	0.42	101.38	64.5		5	0.42	100.42 12.9
6	0.50	100.50	79.5		6	0.50	101.46	84.9		6	0.50	100.50 17.0
7	0.58	100.58	100.2		7	0.58	101.54	106.9		7	0.58	100.58 21.4
8	0.67	100.67	122.5		8	0.67	101.63	130.6		8	0.67	100.67 26.1
9	0.75	100.75	146.1		9	0.75	101.71	155.9		9	0.75	100.75 31.2
10	0.83	100.83	171.2		10	0.83	101.79	182.6		10	0.83	100.83 36.5
11	0.92	100.92	197.5		11	0.92	101.88	210.6		11	0.92	100.92 42.1
12	1.00	101.00	225.0		12	1.00	101.96	240.0		12	1.00	101.00 48.0
13	1.08	101.08	253.7		13	1.08	102.04	270.6		13	1.08	101.08 54.1
14	1.17	101.17	283.5		14	1.17	102.13	302.4		14	1.17	101.17 60.5
15	1.25	101.25	314.4		15	1.25	102.21	335.4		15	1.25	101.25 67.1
16	1.33	101.33	346.4		16	1.33	102.29	369.5		16	1.33	101.33 73.9
17	1.42	101.42	379.4		17	1.42	102.38	404.7		17	1.42	101.42 80.9
18	1.50	101.50	413.4		18	1.50	102.46	440.9		18	1.50	101.50 88.2
19	1.58	101.58	448.3		19	1.58	102.54	478.2		19	1.58	101.58 95.6
20	1.67	101.67	484.1		20	1.67	102.63	516.4		20	1.67	101.67 103.3
21	1.75	101.75	520.9		21	1.75	102.71	555.6		21	1.75	101.75 111.1
22	1.83	101.83	558.5		22	1.83	102.79	595.8		22	1.83	101.83 119.2
23	1.92	101.92	597.0		23	1.92	102.88	636.8		23	1.92	101.92 127.4
24	2.00	102.00	636.4		24	2.00	102.96	678.8		24	2.00	102.00 135.8
25	2.08	102.08	676.6		25	2.08	103.04	721.7		25	2.08	102.08 144.3
26	2.17	102.17	717.6		26	2.17	103.13	765.4		26	2.17	102.17 153.1
27	2.25	102.25	759.4		27	2.25	103.21	810.0		27	2.25	102.25 162.0
28	2.33	102.33	802.0		28	2.33	103.29	855.4		28	2.33	102.33 171.1
29	2.42	102.42	845.3		29	2.42	103.38	901.6		29	2.42	102.42 180.3
30	2.50	102.50	889.4		30	2.50	103.46	948.7		30	2.50	102.50 189.7
31	2.58	102.58	934.2		31	2.58	103.54	996.5		31	2.58	102.58 199.3
32	2.67	102.67	979.8		32	2.67	103.63	1045.1		32	2.67	102.67 209.0
33	2.75	102.75	1026.1		33	2.75	103.71	1094.5		33	2.75	102.75 218.9
34	2.83	102.83	1073.1		34	2.83	103.79	1144.6		34	2.83	102.83 228.9
35	2.92	102.92	1120.8		35	2.92	103.88	1195.5		35	2.92	102.92 239.1
36	3.00	103.00	1169.1		36	3.00	103.96	1247.1		36	3.00	103.00 249.4
37	3.08	103.08	1218.2		37	3.08	104.04	1299.4		37	3.08	103.08 259.9
38	3.17	103.17	1267.9		38	3.17	104.13	1352.4		38	3.17	103.17 270.5
39	3.25	103.25	1318.3		39	3.25	104.21	1406.2		39	3.25	103.25 281.2
40	3.33	103.33	1369.3		40	3.33	104.29	1460.6		40	3.33	103.33 292.1
41	3.42	103.42	1421.0		41	3.42	104.38	1515.7		41	3.42	103.42 303.1
42	3.50	103.50	1473.3		42	3.50	104.46	1571.5		42	3.50	103.50 314.3
43	3.58	103.58	1526.2		43	3.58	104.54	1628.0		43	3.58	103.58 325.6
44	3.67	103.67	1579.8		44	3.67	104.63	1685.1		44	3.67	103.67 337.0
45	3.75	103.75	1633.9		45	3.75	104.71	1742.8		45	3.75	103.75 348.6
46	3.83	103.83	1688.7		46	3.83	104.79	1801.3		46	3.83	103.83 360.3
47	3.92	103.92	1744.0		47	3.92	104.88	1860.3		47	3.92	103.92 372.1
48	4.00	104.00	1800.0		48	4.00	104.96	1920.0		48	4.00	104.00 384.0
49	4.08	104.08	1856.5		49	4.08	105.04	1980.3		49	4.08	104.08 396.1
50	4.17	104.17	1913.7		50	4.17	105.13	2041.2		50	4.17	104.17 408.2
51	4.25	104.25	1971.4		51	4.25	105.21	2102.8		51	4.25	104.25 420.6
52	4.33	104.33	2029.6		52	4.33	105.29	2164.9		52	4.33	104.33 433.0
53	4.42	104.42	2088.5		53	4.42	105.38	2227.7		53	4.42	104.42 445.5
54	4.50	104.50	2147.8		54	4.50	105.46	2291.0		54	4.50	104.50 458.2
55	4.58	104.58	2207.8		55	4.58	105.54	2355.0		55	4.58	104.58 471.0
56	4.67	104.67	2268.3		56	4.67	105.63	2419.5		56	4.67	104.67 483.9
57	4.75	104.75	2329.3		57	4.75	105.71	2484.6		57	4.75	104.75 496.9
58	4.83	104.83	2390.9		58	4.83	105.79	2550.2		58	4.83	104.83 510.0
59	4.92	104.92	2452.9		59	4.92	105.88	2616.5		59	4.92	104.92 523.3
60	5.00	105.00	2515.6		60	5.00	105.96	2683.3		60	5.00	105.00 536.7

*assumes the concrete principal spillway crest is at El. 100.00 (in feet), assumed datum.

Lake level at concrete principal spillway weir		AMHERST LAKE DAM - ESTIMATED GATE OUTFLOWS																																																
		Elevation bottom gate (ft)	Elevation of bottom of gate and gate opening in inches																																															
			95.58	95.67	95.75	95.83	95.92	96.00	96.08	96.17	96.25	96.33	96.42	96.50	96.58	96.67	96.75	96.83	96.92	97.00	97.08	97.17	97.25	97.33	97.42	97.50	97.58	97.67	97.75	97.83	97.92	98.00	98.08	98.17	98.25	98.33	98.42	98.50	98.58	98.67	98.75	98.83	98.92	99.00	99.08	99.17	99.25	99.33	99.42	99.50
inches	feet	Gate Opening in inches Water Surface Elev.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	0.08	100.08	3.5	7.0	10.5	13.9	17.3	20.7	24.1	27.4	30.6	33.9	37.1	40.2	43.3	46.4	49.5	52.5	55.5	58.4	61.4	64.2	67.1	69.9	72.6	75.3	78.0	80.7	83.3	85.8	88.4	90.8	93.3	95.7	98.0	100.3	102.6	104.8	107.0	109.2	111.3	113.3	115.3	117.2	119.2	121.0	122.8	124.6	126.3	128.0
2	0.17	100.17	3.6	7.1	10.6	14.1	17.5	20.9	24.3	27.6	30.9	34.2	37.4	40.6	43.8	46.9	50.0	53.1	56.1	59.1	62.0	64.9	67.8	70.7	73.5	76.2	78.9	81.6	84.3	86.9	89.4	92.0	94.5	96.9	99.3	101.7	104.0	106.2	108.5	110.7	112.8	114.9	117.0	119.0	120.9	122.8	124.7	126.5	128.3	130.0
3	0.25	100.25	3.6	7.2	10.7	14.2	17.7	21.1	24.5	27.9	31.2	34.5	37.8	41.0	44.2	47.4	50.5	53.6	56.7	59.7	62.7	65.6	68.6	71.4	74.3	77.1	79.8	82.6	85.3	87.9	90.5	93.1	95.6	98.1	100.5	102.9	105.3	107.6	109.9	112.1	114.3	116.5	118.6	120.6	122.7	124.6	126.5	128.4	130.2	132.0
4	0.33	100.33	3.6	7.2	10.8	14.3	17.8	21.3	24.7	28.1	31.5	34.9	38.2	41.4	44.7	47.9	51.0	54.2	57.3	60.3	63.4	66.3	69.3	72.2	75.1	77.9	80.7	83.5	86.2	88.9	91.6	94.2	96.8	99.3	101.8	104.2	106.6	109.0	111.3	113.6	115.9	118.1	120.2	122.3	124.4	126.4	128.4	130.3	132.2	134.0
5	0.42	100.42	3.7	7.3	10.9	14.5	18.0	21.5	25.0	28.4	31.8	35.2	38.5	41.8	45.1	48.3	51.5	54.7	57.8	60.9	64.0	67.0	70.0	73.0	75.9	78.8	81.6	84.4	87.2	89.9	92.6	95.3	97.9	100.5	103.0	105.5	107.9	110.4	112.7	115.1	117.4	119.6	121.8	124.0	126.1	128.1	130.2	132.1	134.1	136.0
6	0.50	100.50	3.7	7.4	11.0	14.6	18.2	21.7	25.2	28.7	32.1	35.5	38.9	42.2	45.5	48.8	52.0	55.2	58.4	61.5	64.6	67.7	70.7	73.7	76.7	79.6	82.5	85.3	88.1	90.9	93.7	96.3	99.0	101.6	104.2	106.7	109.2	111.7	114.1	116.5	118.8	121.1	123.4	125.6	127.7	129.9	131.9	134.0	135.9	137.8
7	0.58	100.58	3.7	7.4	11.1	14.7	18.3	21.9	25.4	28.9	32.4	35.8	39.2	42.6	45.9	49.3	52.5	55.8	59.0	62.1	65.3	68.4	71.4	74.5	77.5	80.4	83.4	86.2	89.1	91.9	94.7	97.4	100.1	102.8	105.4	108.0	110.5	113.0	115.5	117.9	120.3	122.6	124.9	127.2	129.4	131.6	133.7	135.8	137.9	
8	0.67	100.67	3.8	7.5	11.2	14.8	18.5	22.1	25.6	29.2	32.7	36.1	39.6	43.0	46.4	49.7	53.0	56.3	59.5	62.7	65.9	69.0	72.2	75.2	78.3	81.2	84.2	87.1	90.0	92.9	95.7	98.5	101.2	103.9	106.6	109.2	111.8	114.3	116.8	119.3	121.7	124.1	126.5	128.8	131.0	133.2	135.4	137.5	139.6	141.7
9	0.75	100.75	3.8	7.5	11.3	15.0	18.6	22.3	25.9	29.4	33.0	36.5	39.9	43.4	46.8	50.2	53.5	56.8	60.1	63.3	66.5	69.7	72.8	76.0	79.0	82.1	85.1	88.0	90.9	93.8	96.7	99.5	102.3	105.0	107.7	110.4	113.0	115.6	118.2	120.7	123.1	125.6	128.0	130.3	132.6	134.9	137.1	139.3	141.4	143.5
10	0.83	100.83	3.8	7.6	11.4	15.1	18.8	22.4	26.1	29.7	33.2	36.8	40.3	43.8	47.2	50.6	54.0	57.3	60.6	63.9	67.2	70.4	73.5	76.7	79.8	82.9	85.9	88.9	91.9	94.8	97.7	100.5	103.4	106.1	108.9	111.6	114.3	116.9	119.5	122.0	124.6	127.0	129.5	131.9	134.2	136.5	138.8	141.0	143.2	145.3
11	0.92	100.92	3.8	7.7	11.4	15.2	18.9	22.6	26.3	29.9	33.5	37.1	40.6	44.1	47.6	51.0	54.5	57.8	61.2	64.5	67.8	71.0	74.2	77.4	80.5	83.7	86.7	89.8	92.8	95.7	98.7	101.6	104.4	107.2	110.0	112.8	115.5	118.2	120.8	123.4	125.9	128.5	130.9	133.4	135.8	138.1	140.5	142.7	145.0	147.1
12	1.00	101.00	3.9	7.7	11.5	15.3	19.1	22.8	26.5	30.2	33.8	37.4	41.0	44.5	48.0	51.5	54.9	58.3	61.7	65.1	68.4	71.7	74.9	78.1	81.3	84.4	87.5	90.6	93.7	96.7	99.6	102.6	105.5	108.3	111.2	113.9	116.7	119.4	122.1	124.7	127.3	129.9	132.4	134.9	137.3	139.7	142.1	144.4	146.7	148.9
13	1.08	101.08	3.9	7.8	11.6	15.4	19.2	23.0	26.7	30.4	34.1	37.7	41.3	44.9	48.4	51.9	55.4	58.8	62.3	65.6	69.0	72.3	75.6	78.8	82.0	85.2	88.4	91.5	94.6	97.6	100.6	103.6	106.5	109.4	112.3	115.1	117.9	120.6	123.4	126.0	128.7	131.3	133.9	136.4	138.9	141.3	143.7	146.1	148.5	150.7
14	1.17	101.17	3.9	7.8	11.7	15.6	19.4	23.2	26.9	30.6	34.3	38.0	41.6	45.2	48.8	52.3	55.9	59.3	62.8	66.2	69.6	72.9	76.2	79.5	82.8	86.0	89.2	92.3	95.4	98.5	101.6	104.6	107.5	110.5	113.4	116.2	119.1	121.9	124.6	127.4	130.0	132.7	135.3	137.9	140.4	142.9	145.3	147.7	150.1	152.4
15	1.25	101.25	4.0	7.9	11.8	15.7	19.5	23.3	27.1	30.9	34.6	38.3	42.0	45.6	49.2	52.8	56.3	59.8	63.3	66.8	70.2	73.5	76.9	80.2	83.5	86.8	90.0	93.2	96.3	99.4	102.5	105.5	108.6	111.5	114.5	117.4	120.3	123.1	125.9	128.6	131.4	134.1	136.7	139.3	141.9	144.4	146.9	149.4	151.8	154.2
16	1.33	101.33	4.0	8.0	11.9	15.8	19.7	23.5	27.3	31.1	34.9	38.6	42.3	46.0	49.6	53.2	56.8	60.3	63.8	67.3	70.8	74.2	77.6	80.9	84.2	87.5	90.8	94.0	97.2	100.3	103.4	106.5	109.6	112.6	115.6	118.5	121.4	124.3	127.1	129.9	132.7	135.4	138.1	140.8	143.4	145.9	148.5	151.0	153.4	155.9
17	1.42	101.42	4.0	8.0	12.0	15.9	19.8	23.7	27.5	31.4	35.1	38.9	42.6	46.3	50.0	53.6	57.2	60.8	64.3	67.9	71.3	74.8	78.2	81.6	84.9	88.3	91.5	94.8	98.0	101.2	104.4	107.5	110.6	113.6	116.6	119.5	122.4	125.5	128.4	131.2	134.0	136.8	139.5	142.2	144.8	147.5	150.0	152.6	155.1	157.5
18	1.50	101.50	4.0	8.1	12.1	16.0	20.0	23.9	27.7	31.6	35.4	39.2	42.9	46.7	50.4	54.0	57.7	61.3	64.9	68.4	71.9	75.4	78.8	82.3	85.7	89.0	92.3	95.6	98.9	102.1	105.3	108.4	111.6	114.6	117.7	120.7	123.7	126.7	129.6	132.4	135.3	138.1	140.9	143.6	146.3	149.0	151.6	154.2	156.7	159.2
19	1.58	101.58	4.1	8.1	12.1	16.1	20.1	24.0	27.9	31.8	35.7	39.5	43.3	47.0	50.8	54.5	58.1	61.8	65.4	68.9	72.5	76.0	79.5	82.9	86.4	89.7	93.1	96.4	99.7	103.0	106.2	109.4	112.5	115.7	118.8	121.8	124.8	127.8	130.8	133.7	136.6	139.4	142.2	145.0	147.7	150.4	153.1	155.7	158.3	160.9
20	1.67	101.67	4.1	8.2	12.2	16.2	20.2	24.2	28.1	32.0	35.9	39.8	43.6	47.4	51.1	54.9	58.6	62.2	65.9	69.5	73.1	76.6	80.1	83.6	87.1	90.5	93.9	97.2	100.5	103.8	107.1	110.3	113.5	116.7	119.8	122.9	126.0	129.0	132.0	134.9	137.8	140.7	143.6	146.4	149.2	151.9	154.6	157.3	159.9	162.5
21	1.75	101.75	4.1	8.2	12.3	16.4	20.4	24.4	28.3	32.3	36.2	40.1	43.9	47.7	51.5	55.3	59.0	62.7	66.4	70.0	73.6	77.2	80.7	84.3	87.7	91.2	94.6	98.0	101.4	104.7	108.0	111.3	114.5	117.7	120.8	124.0	127.1	130.1	133.2	136.1	139.1	142.0	144.9	147.8	150.6	153.4	156.1	158.8	161.5	164.1
22	1.83	101.83	4.2	8.3	12.4	16.5	20.5	24.5	28.5	32.5	36.4	40.3	44.2	48.1	51.9	55.7	59.4	63.2	66.9	70.5	74.2	77.8	81.4	84.9	88.4	91.9	95.4	98.8	102.2	105.6	108.9	112.2	115.4	118.7	121.9	125.0	128.2	131.3	134.3	137.4	140.3	143.3	146.2	149.1	152.0	154.8	157.6	160.3	163.0	165.7
23	1.92	101.92	4.2	8.3	12.5	16.6	20.7	24.7	28.7	32.7	36.7	40.6	44.5	48.4	52.3	56.1	59.9	63.6	67.4	71.1	74.7	78.4	82.0	85.6	89.1	92.6	96.1	99.6	103.0	106.4	109.8	113.1	116.4	119.7	122.9	126.1	129.3	132.4	135.5	138.6	141.6	144.6	147.5	150.5	153.4	156.2	159.0	161.8	164.6	167.3
24	2.00	102.00	4.2	8.4	12.6	16.7	20.8	24.9	28.9	32.9	36.9	40.9	44.8	48.7	52.6	56.5	60.3	64.1	67.9	71.6	75.3	79.0	82.6	86.2	89.8	93.3	96.9	100.4	103.8	107.2	110.6	114.0	117.3	120.6	123.9	127.1	130.3	133.5	136.6	139.7	142.8	145.8	148.8	151.8						

Appendix D: March 18, 2021 Dam Safety Inspection Report

Vermont Department of Environmental Conservation

Water Investment Division – Dam Safety Program

1 National Life Drive, Davis 3

Montpelier, VT 05620

Phone: 802-622-4093

*Agency of Natural Resources***MEMORANDUM**

TO: Michael and Deborah O'Loughlin, Dam Owners

FROM: Benjamin Green, PE, Dam Safety Engineer
Steven Hanna, Dam Safety Engineer

DATE: March 25, 2021

SUBJECT: Visual Dam Safety Inspection of Amherst Lake Dam, Plymouth, Vermont
State ID No: 156.05, National ID No: VT00131

On March 18, 2021, Benjamin Green and Steven Hanna of the Dam Safety Program (DSP) performed a visual dam safety inspection of the Amherst Lake Dam. The dam is owned by Michael and Deborah O'Loughlin (Owner) who provided permission for and attended the inspection. Todd Menees, PE, of the DEC Rivers Program also attended the inspection. The inspection was prompted by outreach by the Owners to various DEC programs regarding a proposal to remove or not re-install the timber flashboards at the dam as a risk reduction measure. Refer to the Dam Safety Inspection Program General Information page at the end of this report for more information and definitions of terms used in this report. The last documented inspection of the dam was on July 8, 2019.

BACKGROUND

Amherst Lake Dam is a concrete gravity dam with a principal spillway and outlet works. The dam is currently classified as a SIGNIFICANT hazard potential. According to DSP files, the dam is approximately 115 feet long with a structural height of about 17 feet high and a hydraulic height during normal pool of approximately 6 to 8 feet. The principal spillway is an approximately 80 foot long concrete weir fitted with approximately 2-inch diameter steel pipe flashboard supports that are approximately 2 feet on center. The flashboards are 1.5-inch thick by 11.5-inch-high timber boards. The principal spillway weir crest is approximately 9.4 feet below the dam crest/top of concrete training walls. To the right of the principal spillway is an outlet works consisting of a 5-foot-wide channel with an 8-foot-high timber slide gate operated from by a hand wheel mechanism on the concrete bridge above. The top and bottom of the gate are approximately 5.9 feet and 13.9 feet below the dam crest/top of concrete training wall, respectively.

It is our understanding the gate and flashboards are typically seasonally operated as follows:

- In the fall, the flashboards are removed and the concrete principal spillway weir controls flows and water levels from fall to spring (i.e., winter drawdown).
- In the spring, the flashboards are installed by stacking two boards high above the concrete principal spillway weir to a total height of approximately 23 inches.
- During flashboard removal and installation, the gate is operated to lower the water level and pass flows.

The drainage area of the dam is about 19.1 square miles. The dam impounds Amherst Lake, which is a recreational water body with a normal pool surface area of about 80 acres and normal and maximum storage capacities of 380 and 1,050 acre-feet, respectively. The dam raises the water level on this natural lake on the order of 6 to 8 feet. The dam discharges directly into Echo Lake and the Black River. The dam is reportedly founded on glacial till soils. The dam was reportedly constructed circa 1950 to replace a timber crib structure at the site. It is our understanding that in 2015, new flashboards were installed and maintenance was performed to the supporting pins.

The dam has been inspected by the DSP in 1984, 2005, 2014, and 2019. The 2005 and more recent inspection reports are available in our files and rate the dam in POOR condition. The inspection reports note the deterioration of the right abutment

and outlet works gate area including concrete cracks, section loss, and spalling that threaten the structural integrity of the dam.

CONDITION RATING AND RECOMMENDATIONS FOR OWNER

Based on this visual inspection, the overall condition of the dam is considered **POOR**, consistent with the condition ratings from previous inspections. Continued deterioration of some concrete elements that threaten stability were noted. Risk reduction measures including reservoir-level restriction/reduction until the dam can be rehabilitated or removed are recommended below. The specific concerns are identified in more detail in the Inspection Findings section. The following recommendations and remedial measures describe the recommended approach to address current deficiencies at the dam. It is intended that maintenance level activities can be performed by the Owner, while Studies and Analyses and Remedial Repair Recommendations will require the services of a qualified professional engineer registered in the State of Vermont who is experienced in dam safety engineering design, permitting, and construction.

For Immediate Attention:

The following items shall be performed with assistance from the DSP and other DEC programs.

1. Remove the flashboards and pins and modify the gate as a public safety/risk reduction measure. The lower pool should be maintained until the dam is rehabilitated, removed, or conditions worsen further requiring additional reservoir-level reduction. It has been estimated that these risk reduction activities will reduce normal pool loading on the dam on the order of 30%, and by reducing flood levels in the lake, greater load reductions during flooding events. The following actions are specifically recommended:
 - Develop a Water Control Plan that includes a narrative on the background of the dam and the public safety/risk reduction need to perform these actions, outlines the procedure for how the risk reduction measures will be achieved, and address considerations of DEC Programs including Dam Safety, Wetlands, Flow Protection, and Lakes and Ponds. Dam Safety Staff will remain available to assist in the development and implementation of this plan and help in consultation with other DEC programs.
 - Remove and do not reinstall the flashboards to lower the normal water level to the concrete principal spillway crest.
 - Cut off the flashboard pins at grade to reduce debris clogging, for operator safety, and to reduce the potential for unauthorized operation.
 - Cut out the top timbers of the slide gate (not the frame) so that the top approximately matches the crest of the principal spillway to reduce loading on the marginally stable structure.

Maintenance Level Recommendations:

1. Maintain clearing limits for brush and trees a minimum of 15 feet from all portions of the dam, including the abutments. Monitor stumps as they decay.
2. Maintain the approach and discharge areas of the dam clear of debris to promote free flow conditions.
3. Test operate the outlet works gate at least once or twice annually and perform maintenance.
4. During low flow conditions, inspect the principal spillway apron to determine the degree and extent of undermining and if there is seepage coming under the dam.
5. Regularly monitor the condition and stability of the concrete training walls. Take care to note continued deterioration, tilting, or displacement.
6. Monitor the condition of the timber gate and any associated leakage.

Studies and Analyses:

1. Perform an updated hydrologic and hydraulic analysis of the dam to determine hydraulic adequacy. As part of the analysis, perform dam breach and flood inundation mapping for use in hazard classification confirmation and emergency action planning, recommended below.
2. Address the comments provided below on the Emergency Action Plan. Perform more detailed dam breach and flood inundation analysis under sunny and stormy day conditions to determine the timing, depth, and velocity of flooding of homes downstream.

3. Perform an assessment of the structural stability of the training walls and identify repair alternatives.
4. Investigate the undermining of the spillway apron and seepage/stability impacts.
5. Develop an Operations and Maintenance Manual for the dam.

Remedial Repair Recommendations:

1. Design and implement repairs to the dam based on the findings of the work performed above, including addressing concrete deterioration and stability of the outlet works. Alternately, consider a dam removal alternative and the associated risk reduction and environmental benefits versus public and recreational uses/benefits.

INSPECTION FINDINGS

The Amherst Lake Dam was inspected on March 18, 2021. The weather was overcast with light rain and temperatures in the 30s. At the time of the inspection, one set of 11.5-inch-high timber flashboards were installed over the principal spillway weir and the lake level was approximately 15.5-inches above the concrete weir with approximately 4-inches of flow depth over the flashboards. Snow covered the abutments of the dam. Photographs to document the current conditions of the dam were taken and are kept on file. Several select photographs documenting the deficiencies are appended to this report. Only exposed, accessible portions of the dam were inspected (i.e., underwater areas were not inspected).

- **Changes/Updates from Previous Report:** The intent of this section is to document any newly observed deficiencies, observed changes to the dam, as well as any operation or maintenance measures implemented by the owner since the previous inspection. Further detail on these items are incorporated in the sections below:
 - Tree and brush removal within the dam footprint was completed.
 - The handwheel on the outlet gate has been secured to discourage unauthorized operation.
 - The Emergency Action Plan was updated.
 - Safety signage warning of safety hazards were observed at both abutments.
 - Continued deterioration of concrete elements including the right abutment/training wall and wall separating the principal spillway from the outlet works was observed through additional concrete section loss, tilting, crack propagation, and displacement, threatening the stability of the structure.
- **Abutments:** The abutments key into natural ground. The abutment contacts appeared to have good horizontal and vertical alignment, although were snow covered preventing a thorough inspection.
- **Drains/Seepage Collection:** There is no drains or collection systems at the dam.
- **Instrumentation:** There is no instrumentation associated with this dam. Painted water level markings were observed on the left training wall.
- **Principal Spillway:** The broad crested weir appeared to be in fair condition. The approach and discharge areas were generally clear with some minor debris. At the time of the inspection, the flashboards were installed one board high with what is typically the upper flashboard installed adjacent to the lower flashboard. The flashboards appeared to be in fair condition. The steel supporting pins, which are grouted in place, generally appeared to be in fair condition. Typically, flashboard support pins are designed to bend over or release at a certain reservoir level or load to reduce loading on the dam during a severe flood event. It is not clear if these support pins were designed in this way and under what storm event/depth of overtopping they may release. Several pins have rotated slightly in the downstream direction and the left most pin has corroded through. A section of steel flashing meant to reduce flashboard leakage was observed.

The flow over the installed flashboards obscured the view of the boards and concrete downstream preventing a thorough inspection. The surficial conditions of the sloping and level concrete splashpad appeared fair. The concrete joints also appeared to be in fair condition. There was up to approximately 12 inches and potentially deeper undercutting under the downstream end of the splashpad/apron where it could be accessed. Tailwater prevented

further investigation into the undercutting and detection of any under leakage. At the right downstream end of the splashpad, a large concrete mass was observed. The purpose of this concrete mass is not known.

The left concrete training wall appeared to be in fair condition. Minor surficial surface cracking was observed in a few areas. The wall is tilted inwards towards the spillway approximately 1 to 3 degrees past vertical (approximately 0.5 to 1 inch horizontally per 24 inches vertically)

The right concrete training wall is also the dividing wall between the spillway and the gated outlet channel. The condition of this wall is poor as the downstream end of the wall is completely undermined with loss of support for approximately 10 feet laterally except for several corroded, 0.75-inch diameter rebar. The concrete is heavily deteriorated with exposed aggregate, delamination, and cracking. A horizontal crack extends on the gate side of the wall from the gate in the downstream direction and displacement towards the spillway along the crack was observed. The wall above the crack is tilted towards the spillway greater than 3 degrees past vertical. It should be noted that at the top of the wall is a short concrete bridge that supports the gate mechanism and ties the wall to the right abutment wall. The connection of the wall to this bridge appeared good, but it was noted that both the walls are similarly tilted (racked) towards the spillway. Based on review of past inspection report photographs, continued concrete section loss, cracking, and tilting was observed. The wall appears marginally stable under normal loading conditions.

- **Auxiliary Spillway:** There is no auxiliary spillway at the dam.
- **Low Level Outlet/Drawdown Facility:** The outlet consists of a concrete channel and timber slide gate that can be opened to discharge flow/lower the impoundment. The gate was not test operated as part of the inspection, but the Owner reported the gate was last operated without issue in Fall 2020. The right concrete training wall of the outlet works is also the right abutment wall of the dam. The wall has a vertical crack between the main portion of the wall and the wing wall on the upstream side that has an opening up 2-inches. On the face of the wall at this location near the normal water level, an approximately 18-inch-deep section loss with exposed spalling concrete/aggregate was observed and appears to be worsening based on review of past inspection photographs. The wall appears to be tilted inwards towards the outlet/spillway on the order of 1 to 3 degrees, similar to the left wall dividing the outlet channel from the spillway. As noted above, the left wall is in poor condition, cracked at the gate contact, tilted towards the spillway, and undermined at the downstream end.

The gate appeared to be in fair condition overall. The right and left sides are set in a steel channel lined slots/guides. Some concrete deterioration and section loss was observed at the water level on the right gate slot/guide. Minor leakage was observed around the ends of the gate in several locations. The timber boards comprising the gate generally appeared to be in fair condition, although the top two appeared to be rotting. The operating mechanism appeared to be in fair condition and was secured to prevent unauthorized use. The concrete bridge that spans the outlet channel and supports the operating mechanism appeared to be in fair condition.

- **Downstream Area:** The downstream area is a short channel centered on the right side of the dam that leads directly into Echo Lake. Some evidence of scouring of the stone armoring downstream of the principal spillway was observed. During a storm event, the hydraulic capacity of the dam may be impacted by backwater from Echo Lake.
- **Reservoir Area:** The reservoir area consists of Amherst Lake. The shoreline is generally vegetated and largely undeveloped except for some residential homes/camps and a state highway along the western and north/northeastern shore. The slopes around the reservoir generally appear to be moderate to steep but do not appear to be overly susceptible to erosion.
- **Access Roads and Gates:** The dam can be accessed on the right/west from Amherst Road, that extends approximately 600 feet from Vermont Route 100 to the right abutment of the dam. Access to the left abutment and dam is from the owner's property on Scout Camp Road.

- **Operation and Maintenance:** There is no Operation and Maintenance Manual on file for the dam. As noted above, there are seasonal operations at the dam and the current owner has been performing some dam maintenance.
- **Emergency Action Plan (EAP) and Hazard Classification:** The most current version of the EAP was provided by the Owner during development of this report and was reportedly updated recently. Since the dam is currently classified as a SIGNIFICANT hazard, it is recommended that an EAP be maintained and kept up to date. Review of the EAP and updates including names and phone numbers of key emergency personnel and review of inundation mapping for any new development is recommended, at a minimum, on a two-year basis.

Based on review of the EAP, a sudden failure of the dam could result in the inundation of approximately 19 homes and 1 State Park located along Echo Lake, immediately downstream of the dam. It is anticipated that Echo Lake, Lake Rescue, and Lake Pauline (also known as Reservoir Pond) located downstream along the Black River would provide some flood attenuation/storage and ability to “absorb” flood flows, potentially lessening impacts further downstream. The current version of the EAP was reviewed, our comments are as follows:

- It is noted that this EAP was originally developed in 2018 and has undergone some minor revisions since. It is recommended that each time a revision is made, the table, “Record of Revisions and Updates Made to EAP” be updated and the date of the revision be placed on the cover for document control.
- On page 4 under roles and responsibilities, it is noted that personnel from Hawk Mountain Resort are the Owner’s representative. During the site visit, it was indicated by the Owner that this relationship was informal. It is suggested that expectations and roles and responsibilities of the Owner’s representative be made clear and confirm the chosen entity in this role understands and agrees.
- On page 6:
 - It is noted that the Municipal Manager is responsible for classifying the event emergency level. The Municipal Manager does not appear to be defined or used elsewhere in the EAP. Typically, emergency level determination, depending on time available, would be a decision made between the Dam Owner, technical representatives, and emergency management personnel.
 - The EAP appears to indicate participation in an emergency by Natural Resource Conservation Service (NRCS) personnel. In our experience, it is unlikely the NRCS would play a role in dam safety emergencies. The mention of NRCS personnel in the EAP should be addressed throughout.
 - Flow through the earth spillway is noted on this page. This dam does not have an earthen auxiliary spillway. It is recommended this statement be removed.
- On page 7, it is recommended that the earth spillway flow event be removed and the table and following pages be reviewed for events that are probable given the configuration of the dam.
- On the Emergency Level Notifications, please confirm the role of the State Conservation Engineer. In our experience, he does not play a role in dam safety emergencies. It is also recommended for Level 1 notifications, that the Incident Commander and Emergency Coordinator be informed of the situation at the dam with no necessary action for them, but to make them aware of the potential for event progression.
- Emergency Services Contacts on page 15, remove Vermont DEC Facilities Engineering Division, this is the former name of our division and Stephen Bushman was our former, but now retired lead.
- Page 21, Record of Holders, please note under copy number 8, the VT ANR is no longer located in Waterbury, but at the address at the top of this report.
- It is noted that the signature and concurrence pages are not signed. While not critical, the more important thing is that key emergency management personnel have reviewed this plan, provided any comments, and agreed to their role and responsibilities.
- It appears that the inundation map and estimate of impacted properties downstream was developed using ANR’s Flood Ready Map, which depicts potential flooding extents from a 100-year storm event without dam failure. While this may give a good indication of potential flood impacts from a dam failure under certain conditions, it did not consider a dam breach under sunny day and storm conditions and it is not clear how backwater impacts from Echo Lake were accounted for. Since 19 homes are anticipated to be flooded based on this mapping, the estimated time to flooding, flood depths, and velocities at and near these structures should be determined to better understand the risk associated with the dam and confirm the hazard

classification (i.e., determine if the hazard classification is correctly classified as SIGNIFICANT or if a different classification is more appropriate).

- **Hydrologic/Hydraulic Data:** Since Amherst Lake Dam is a SIGNIFICANT hazard dam, the Spillway Design Flood (SDF) is considered to be the 1,000-year flood event according to Federal Guidance currently used in the State of Vermont. It appears that there were two cursory studies performed in the 1950s that considered potential impacts of flashboard failure at the dam. However, no comprehensive hydrologic and hydraulic study of the dam was found in State records.

With water levels at the concrete principal spillway crest or the top of timber flashboards (23-inches above), the dam has approximately 9.3 feet and 7.5 of freeboard, respectively, between the water level and the dam crest. In both cases, this exceeds the minimum normal pool freeboard (3-feet) required by State standards. Since there is no available hydrologic and hydraulic study for the dam, the ability of the dam to safely pass the SDF is considered unknown.

- **Structural Stability:** Engineering analyses of static and dynamic stability of the training walls, outlet structure, and spillway were not available and have not been conducted for this study. The principal spillway weir appeared stable under normal loading conditions based on visual inspection. The left training wall of the spillway appeared to be tilting slightly. The right spillway training wall/left outlet wall is undermined, cracked, tilting towards the spillway, and appeared marginally stable under normal loading conditions. Continued deterioration of this wall or the application of flood load conditions could cause instability and failure of this wall, which supports the gate, resulting in a partial failure of the dam and uncontrolled release. The right outlet works training wall is cracked with section loss and exposed aggregate and is also tilted towards the spillway. Structural evaluation and repair of these elements is recommended to ensure continued, reliable service.
- **Seepage:** No uncontrolled leakage or seepage was observed at the dam.
- **Inspection Safety Considerations:** Other than the standard safety protocols when working adjacent to reservoirs and/or flowing water, there are no special inspection safety considerations for this dam.

Amherst Lake Dam



Photo 1: March 2021, an overview of the dam from the left abutment area



Photo 2: March 2021, an overview of the dam from the downstream area looking upstream.

***Photos 3 through 6 from 2010 to 2021 to show rate of change of condition of concrete wall**



Photo 3: August 2010, downstream end of concrete wall separating the spillway from the outlet works.



Photo 4: July 2014, downstream end of concrete wall separating the spillway from the outlet works, note continued section loss and deterioration.



Photo 5: July 2019, downstream end of concrete wall separating the spillway from the outlet works, note continued section loss and deterioration.



Photo 6: March 2021, downstream end of concrete wall separating the spillway from the outlet works, note continued section loss and deterioration.

***Photos 7 and 8 from 2014 and 2021 to show rate of change of condition of concrete wall**



Photo 7: July 2014 looking upstream at the gate structure and wall separating the outlet from the spillway. Note the crack and deteriorated concrete.



Photo 8: March 2021 looking upstream at the gate structure and wall separating the outlet from the spillway. Note the continued deterioration of concrete and displacement of the wall towards the spillway above the crack.



Photo 9: March 2021 looking downstream from the right abutment area. Note the section loss of the right training wall.

DAM SAFETY INSPECTION PROGRAM GENERAL INFORMATION

The Dam Safety Program conducts periodic safety inspections of non-federal, non-hydroelectric dams to determine their condition and the extent, if any, to which they pose a potential or actual threat to life and property. Dams that impound more than 500,000 cubic feet of liquid require approval from the Department under provisions of 10 VSA Chapter 43 before alternating, reconstructing or removing.

The condition rating assigned to the dam reported herein was based on available data and visual inspection. Detailed investigations and analyses were beyond the scope of 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. 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.

Hazard Potential Classifications:

HIGH: Dams where failure or mis-operation will probably cause loss of human life.

SIGNIFICANT: Dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

LOW: Dams where failure or mis-operation results in no probable loss of human life and low economic and environmental losses.

MINIMAL: A dam that meets the LOW hazard definition, above, but is only capable of impounding less than 500,000 cubic feet.

Condition Ratings:

Good: No existing or potential deficiencies recognized except for minor operational and maintenance deficiencies. Safe performance is expected under all loading including the Spillway Design Flood.

Fair: Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual or extreme loading conditions up to and including the Spillway Design Flood.

Poor: Significant structural and or operation and maintenance deficiencies are clearly recognized under normal loading conditions.

Definitions:

Upstream: The side of the dam that borders the impoundment.

Downstream: The side of the dam opposite the upstream side.

Right: The area to the right when looking in the downstream direction (also known as “river right”).

Left: The area to the left when looking in the downstream direction (also known as “river left”).

Structural Height-of-dam: The vertical distance from the lowest point in the stream bed or native ground surface at the downstream toe of the dam to the elevation of the lowest nonoverflow section of the dam crest.

Embankment: An artificially constructed feature usually consisting of earth and rock with sloping sides and a flat crest, intended to provide a permanent barrier that impounds or is capable of impounding water.

Dam Crest: The top of the nonoverflow portion of the dam.

Abutment: The part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed at the interface with a concrete gravity section.

Normal Pool: The water elevation, reservoir surface area, and reservoir storage capacity that is prevalent at the site or typical under normal, non-storm conditions. Typically, this level is controlled by the principal spillway.

Maximum Pool: The highest water elevation, reservoir surface area, and reservoir storage capacity that could be impounded by the dam, including accumulated sediments, with the water or liquid level at the top of the lowest nonoverflow part of the structure or dam crest.

Impoundment: The body of water or other liquid created by the dam.

Principal spillway: A structure that maintains normal pool conditions and over which daily nonstorm related and flood flows are discharged. Also called a primary or service spillway.

Auxiliary Spillway: The secondary spillway not in use under normal conditions but used when needed to pass flood flows that exceed the capacity of the principal spillway.

Low-level outlet or “LLO”: An installed pipe and operable gate or valve typically located in or near the foundation of a dam that can be used to alter water levels, drain the reservoir, or otherwise meet operational or safety needs. Also called a pond drain.

Spillway Design Flood or “SDF”: The storm event which the hydraulic capacity of the spillway structure and dam is designed and required to safely pass. Based on Army Corps of Engineers Guidance, the following ranges of SDF's have historically been used in Vermont, Low Hazard = 100-year Storm, Significant Hazard = 100-year Storm to ½ Probable Maximum Flood (PMF), High Hazard = ½ PMF to PMF. New dam safety rules currently under development are considering the following prescriptive SDF's, Low and Minimal Hazard = 100-year Storm, Significant Hazard = 1,000-year storm, High Hazard Dam = PMF. The use of incremental consequence analysis or risk-informed decision making to evaluate the potential of selecting a smaller/site specific SDF is permitted.

Emergency Action Plan (EAP): 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.

Operation and Maintenance Plan or “O&M”: A plan that provides guidelines for the necessary, regular operation and maintenance activities at a dam.