Dam Safety Inspection Report

Dam Safety Program
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Name: **Mackville Pond Dam**
State ID: **93.02** NID ID: **VT00245**
Hazard Class: **High Hazard Potential**

Town: **Hardwick**
Watershed: **Lamoille River**
Stream: **Nichols Brook**

Inspection Details

Inspection date: 08/10/2022 10:02

Inspection type: Periodic **Weather:** Cloudy, 68F

Inspected by: Benjamin Green, Andrew Sampsell

Dam Safety Recommendations

The following recommendations and remedial measures describe the recommended approach to address current deficiencies at the dam. 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. Remedial repairs will likely require obtaining a Dam Order from the Dam Safety Program.

Overall dam condition:

☐ Satisfactory ☑ Fair ☐ Poor ☐ Unsatisfactory ☐ Not Rated

**See General Information section at the end of report for further details*

Maintenance level recommendations	
General	• Perform an update to the Emergency Action Plan at least every other year and provide the updates to all key contacts. • On a regular basis and following the application of unusual or extreme loading conditions, perform monitoring of the dam and its appurtenances. Report any unsafe condition to the Dam Safety Program. • Establish and maintain vegetation clearing limits a minimum of 15 feet from all portions of the dam. Annually cut and remove grass, weeds, brush, and woody vegetation (but leave stumps) from the dam, particularly the right and left abutments, as well as upstream and downstream areas to near ground surface. The vegetation at the left abutment is so thick it is difficult to access the dam for inspection and maintenance. • Once tree stumps are suitably rotten, remove stumps and backfill resulting voids with compacted granular fill. Seed and mulch the ground surface to promote grass cover.
Crest area	• Monitor the concrete surface conditions. Perform minor surficial repairs as needed.

Maintenance level recommendations	
Spillways	• Maintain the principal and/or auxiliary spillway free of debris to ensure free-flow conditions. • Monitor the condition of the principal spillway outlet barrel.
Low-level outlets	• Test operate the low-level outlet twice yearly to maintain operability and check leakage. • Remove debris and maintain outlet trash racks
Gravity dam	• Monitor the upstream/downstream concrete/stone masonry walls for unusual movement. Monitor the concrete surface conditions. Perform minor surficial repairs as needed.
Design and Construction Records	• Provide available design and construction records to the DSP for record keeping purposes.

Studies and analysis	
Hydrology and hydraulics	• Perform a file review of the 2001 improvements to determine the depth of overtopping the dam was designed to safely withstand to determine hydraulic adequacy. If this information indicates the dam is hydraulically adequate (i.e. designed to be stable under SDF loading), no further action is needed. If this information indicates the dam is hydraulically inadequate or unavailable, perform updated hydrologic and hydraulic analyses, as needed.
Structural	• If, based on the above available information or study, the dam is found to not be designed to safely withstand SDF loading, determine alternatives to improve the stability of the dam.
Operation and maintenance	• Develop an Operations and Maintenance Manual for the dam and provide a copy to the Dam Safety Program for record keeping purposes.

Remedial repair recommendations
• If determined necessary based on the studies and analysis recommended above, improve the stability of the dam against SDF loading and perform repairs necessary to bring it into compliance with current dam safety rules and guidance.

Dam Information

Type: Gravity, Concrete, Masonry, Stone **Purpose:** Recreation. Formerly served hydropower purposes.	**Status:** In Service **Height:** 18 ft **Length:** 80 ft	**Construction date:** Originally constructed in 1900, rehabilitated to its current configuration in 2001.

Dam Information

Owner/Contact/Operator:
Hardwick Electric Department
email: bessary@hardwickelectric.com
Address: PO Box 516 Hardwick VT 05843
Phone: 802-472-5201

Normal storage: 182 ac-ft	**Max storage:** 208 ac-ft	Dam has capability to impound **more than** 500k cubic feet (11.48 ac-ft)
Normal surface area: 12 ac	**Drainage area:** 10.7 sq. mi.	**Max surface area:** Not estimated
Pool elevation during inspection: 1 inch of water flowing over principal spillway crest.	**Tailwater elevation during inspection:** Normal/low	**Normal pool elevation:** Reportedly El. 924.5 (NGVD29, feet).
It is unknown if the dam has been breached or overtopped.		
Dam **does not** have public road on crest.	Dam **does not** have public bridge.	Dam **does not** have associated dike.
Reservoir shape: Irregular	**Reservoir average depth (ft):** Unknown	**Reservoir observations:** Calm on day of visit

Shoreline development:
☐ Undeveloped ☑ Semi-developed ☐ Developed ☐ Unknown

Reservoir slopes:
☑ Mild ☐ Moderate ☐ Steep ☐ Unknown

Inspection history: The dam was last inspected on July 15, 2019.

Notes:
The last inspection report rated the dam's condition as FAIR. The previous report recommended performing administrative updates to the Emergency Action Plan, preparing an operations and maintenance manual for the dam, during low flow conditions inspecting the interior of the drop inlet structure and outlet barrel, and maintaining 15 ft clearing limits from all portions of the dam. It was not apparent during the inspection that these recommendations had been followed.

Access road to dam

Type: Maintained paved road.	**Distance from access road to dam:** Approximately 50 ft

Seasonal access:
☑ Plowed winter ☐ Sanded winter ☐ Maintained in mud season ☐ Passable in all weather conditions ☐ Need high clearance vehicle

Access of emergency/construction equipment:

Action required: ☑ None ☐ Monitor ☐ Maintenance ☐ Engineer

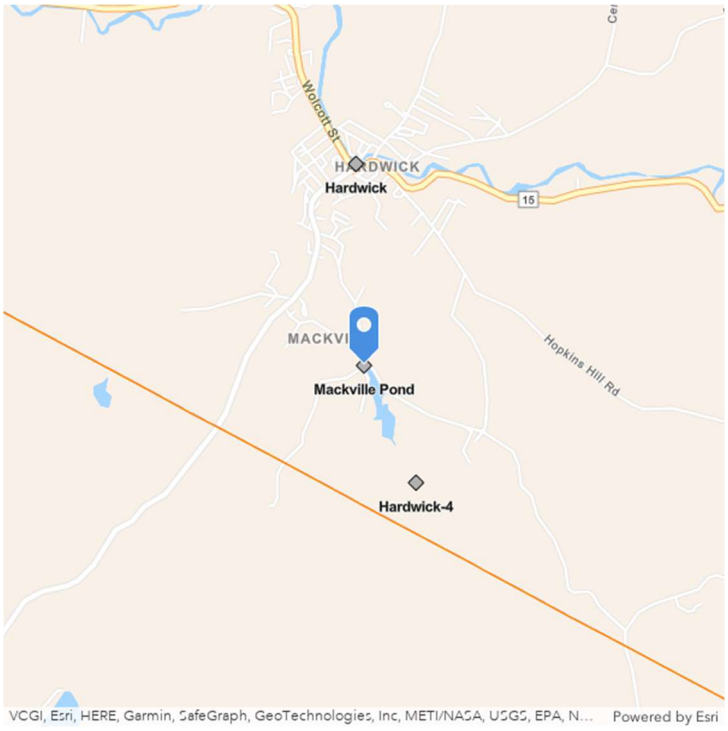
Security	
Device type(s): Chain-link fencing around dam.	Dam has **no** sign of vandalism, trespass or unauthorized operation.
Action required: ☐ None ☑ Monitor ☐ Maintenance ☐ Engineer	

Public/Inspection team safety at dam	
Confined space entry required: No	Fall protection required: Access to the spillway sections.
Other safety required: No	Public safety consideration: Fencing excludes public access to the dam.
Action required: ☑ None ☐ Monitor ☐ Maintenance ☐ Engineer	

Dam Description/Background

Mackville Pond Dam is a concrete and stone masonry gravity dam with an upstream concrete cut-off wall, a drop inlet and broad crested weir, and a low-level outlet (LLO). The dam is located within the channel of Copper Brook and is a run-of-the-river style dam. The dam is currently classified as a HIGH hazard potential. According to file information, the dam has a total length of 80 feet and a structural height of 18 feet. The dam is founded on bedrock. The upstream reinforced concrete portion consists of a 6-foot-wide crest width at approximately El. 928.0 (equal to that of the stone masonry crest) with a 1H:1.5V upstream face. Elevations reportedly reference the National Geodetic Vertical Datum of 1929 (NGVD29 in feet). Reinforcing bars are drilled and grouted into the underlying bedrock and embedded in the concrete section. The downstream face of the dam is constructed of large masonry blocks placed in a stepped configuration. The drop inlet spillway is located on the left side of the dam and has interior dimensions of 5 feet by 9 feet with a trash rack and crest at El. 924.5. The broad crested weir spillway has a length of approximately 50 feet and a crest elevation approximately equal to that of the drop inlet. For purposes of this report, the drop inlet is considered the principal spillway and the broad crested weir is considered the auxiliary spillway. The LLO is located on the upstream face of the drop inlet and consists of a 3-foot square opening with slide gate with invert at El. 915.0. The drop inlet and LLO discharge through the dam via a 3-foot diameter pipe. The drainage area of the dam is roughly 6,850 acres including East Long Pond and Nichols Pond. At normal pool, the pond is roughly 12 acres. The normal storage capacity is 182 acre-feet and the maximum storage capacity is 208 acre-feet. The dam was originally constructed circa 1900 for hydropower purposes but has not been used for that purpose for some time. In 2001, the dam was rehabilitated to its current configuration, including construction of the upstream concrete wall, drop inlet, and left and right cutoffs.

Dam Location



Emergency Action Plan

EAP **on** file
EAP type: High Hazard

If dam is a SIGNIFICANT or HIGH Hazard dam, an up-to-date EAP with dam failure flood hazard inundation map is highly recommended.
Has the EAP been exercised? ☐ Yes ☑ No

What issues are present with the EAP?	Action
☐ None ☑ Revisions required ☐ Not approved ☐ No plan available ☐ Inundation study required ☐ Format out of date ☐ Under review	☐ None ☐ Monitor ☑ Maintenance ☐ Engineer

Operation & Maintenance Manual

O&M Manual **not on** file

Operation & Maintenance Manual

Accessibility to outlets or low-level outlet (LLO): From dam crest.	**Frequency of outlet or LLO discharge:** Unknown
Frequency of mowing: Unknown	**Seasonal drawdown?** ☐ Yes ☑ No
Frequency of dam owner surveillance: Periodic	**Owner surveillance during storm events:** ☐ Yes ☑ No
Operating problems since last inspection: Unknown	**History of repairs since last inspection:** Unknown

What issues are present with the O&M Manual?	Action
☐ None	
☐ Revisions required	☐ None
☐ Not approved	☐ Monitor
☑ No plan available	☐ Maintenance
☐ Format out of date	☑ Engineer
☐ Under review	

Downstream Hazard Classification

Current classification: High Hazard Potential
Current classification appears appropriate, and an inundation map was used to determine the classification.

Hydrologic/Hydraulic Data

Drainage Area = 10.7 sq. mi.
Principal Spillway (Drop Inlet Structure) = El. 924.5 (NGVD29 feet)
Auxiliary Spillway (Overflow Crest) = El. 924.5 (NGVD29 feet)
Dam Crest = El. 928.0 (NGVD29 feet)

Based upon the dam's HIGH hazard potential classification the default spillway design flood (SDF) is the probable maximum flood (PMF) according to Federal guidance currently used in the State of Vermont. A hydrologic and hydraulic analysis performed by DuBois & King, Inc. in 2012 indicates the following.

Storm Event	Inflow (cfs)	Outflow (cfs)	Peak WS El.	Freeboard (+) or Overtopping (-)
100-Year	768	759	927.5	0.8
½ PMF	5,605	5,591	932.0	-3.7
Full PMF	17,507	17,449	937.0	-8.7

The dam has 3.5 feet of freeboard between the principal spillway crest and the dam crest which exceeds the VT dam safety requirement of 3.0 feet. The dam is overtopped by 8.7 feet of water during the spillway design flood which does not meet the dam safety requirement of maintaining 1.5 ft of freeboard.

However, as noted above, the structure is a run-of-the-river style dam and under conditions exceeding the 100-year flood, the bank and floodplain areas in the vicinity of the river and dam would be flooded. Due to this configuration, a dam capable of passing the storm SDF without overtopping would not be practicable. The dam is likely designed to be completely overtopped being constructed of concrete and masonry with significant concrete cutoff walls secured to bedrock. However, the DSP does not have the design and construction records from the 2001 construction improvements, so it is not clear what depths of overtopping the structurally independent wall was designed to safely withstand. Accordingly, the hydraulic adequacy of the dam is considered unknown.

Upstream Structurally Independent Cutoff Wall

The upstream structurally independent cut off wall is mostly submerged by the normal pool elevation of the pond which makes inspecting the condition of the wall not possible without a drawdown or dive inspection. The observable portions of the wall appeared to be in satisfactory condition. Some minor efflorescence, and surface cracking was observed.

Additional comments: Comments regarding the crest of the upstream wall are reserved for the following section.

Upstream wall	Action
The upstream structurally independent cutoff wall is tied into bedrock.	Monitor

Upstream wall issues	Action
Minor Concrete Efflorescence	☐ None ☑ Monitor ☐ Maintenance ☐ Engineer
Minor Concrete Cracking	☐ None ☑ Monitor ☐ Maintenance ☐ Engineer

Upstream wall images

Crest (concrete gravity dam)

Length: 80 ft **Width:** 7 ft

Freeboard:
Principal Spillway Crest to Dam Crest = 3.5 ft
Auxiliary Spillway Crest to Dam Crest = 3.5 ft

Crest issues	Action
Concrete scaling was observed along the crest of the structurally independent concrete cutoff wall.	☐ None ☑ Monitor ☐ Maintenance ☐ Engineer

Crest images

Downstream Masonry Wall

The downstream masonry wall appears stable based on visual observation. Several voids (missing stones) are present.

The downstream masonry wall is stepped and acts as a splash pad for water spilling over the structurally independent upstream concrete cutoff wall constructed in 2001. The downstream

Downstream Masonry Wall

masonry wall prevents inspection of the downstream face of the structurally independent upstream cutoff wall.

Downstream Masonry Wall Protections	Action
Water spilling over the dam crest, and through the principal spillway flows onto a bedrock foundation.	Monitor

Downstream Masonry Wall Issues	Action
The downstream masonry wall is not considered integral to the performance of the dam due to the structurally independent upstream concrete cutoff wall.	n/a

Downstream Masonry Wall Images

Seepage Collection Systems	Number
There are no seepage collections systems part of this dam.	

Instrumentation

No instrumentation found.

Principal Spillway

Spillway type: Rectangular drop inlet with trash rack. **Primary material:** Concrete

Spillway location: Left side

Water level measured against principal spillway crest: 1 inch above crest **Erosion control structures**: None

Spillway components:

☐ Anti-vortex plate	☐ Filter Diaphragm	☐ Training Walls
☐ Flashboard	☑ Trashrack	☐ Other:

Additional comments: Generally, appears to be in satisfactory condition

Principal spillway issues	Action
Deteriorating concrete Issues: ☐ Bug holes ☑ Popouts ☐ Isolated crack ☑ Hairline crack ☐ Honeycombing ☐ Exposed rebar ☑ Efflorescence ☐ Scaling ☐ Disintegration ☐ Spalling ☐ Crazed/Map cracks ☐ Other: Impacted area: Location: Other; Dam crest behind principal spillway. Other: The outlet barrel extending through the dam appeared to be in fair condition. The pipe is slightly squished, which has been observed during previous inspections.	☐ None ☑ Monitor ☐ Maintenance ☐ Engineer

Principal spillway drains	Number
No drains were observed during inspection.	0

Principal spillway images

Auxiliary Spillway

Spillway type: Weir	**Primary material:** Concrete	**Weir:** Broad-Crested
Spillway location: Right Abutment		**Gate:** None
Water level measured against auxiliary crest: 1 inch		**Erosion control structures**: None

Spillway components:

☐ Anti-vortex plate	☐ Filter Diaphragm	☑ Training Walls
☐ Flashboard	☐ Trashrack	☐ Other:

Additional comments: Appears to be in satisfactory condition, incorporates the upstream independent wall and the downstream masonry wall.	**Number of auxiliary spillways:** 1

Auxiliary spillway issues			Action
Deteriorating concrete			
Issues:			
☐ Bug holes	☐ Popouts	☐ Isolated crack	☐ None
☑ Hairline crack	☐ Honeycombing	☐ Exposed rebar	☑ Monitor
☐ Efflorescence	☑ Scaling	☐ Disintegration	☐ Maintenance
☐ Spalling	☐ Crazed/Map cracks	☐ Other:	☐ Engineer
Impacted area: 7 ft x 7 ft ft			
Location: Right End			

Auxiliary Spillway Drains	Number
No drains were observed during inspection.	0

Auxiliary spillway images

Low-Level Outlet

The dam includes a low-level outlet (LLO) which can be used to drain the pond. The LLO consists of a slide gate located at the base of the principal spillway drop inlet structure which can be operated via an operator located in top of the drop inlet structure. There did not appear to be leakage at the LLO.

The LLO was not test operated during the inspection.

It is unknown when the LLO was last test operated.

Low Level Outlet Images

GENERAL INFORMATION

Website: https://dec.vermont.gov/water-investment/dam-safety

The Dam Safety Program conducts periodic safety inspections of non-federal, non-power dams to determine their condition and the extent to which they pose a potential or actual threat to life, property, and the environment. The condition rating reported herein was based on available data and visual inspection. Detailed investigations/analyses were beyond the scope of this report. It should be realized that the reported condition 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 in the future. Only through continued care and inspection can there be any chance that unsafe conditions are 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:

SATISFACTORY: No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.
FAIR: No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.
POOR: A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. POOR may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.
UNSATISFACTORY: A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.
NOT RATED: The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

Definitions:

Upstream: The side of the dam that borders the impoundment located up gradient of the dam.
Downstream: The side of the dam opposite the upstream side, located down gradient of the dam.
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 non-overflow 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 non-overflow 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 non-overflow part of the structure or dam crest.
Principal spillway: A structure that maintains normal pool conditions and over which daily non-storm 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. Dam safety rules under development are considering the following prescriptive SDF's, Low and Minimal = 100-year Storm, Significant = 1,000-year storm, High = 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 written plan that identifies the area that would likely be inundated by the failure of a dam and identifies the actions that should be taken by the Owner to protect life, property, lifelines, and the environment in the event of a dam failure or threatening condition at the dam. The plan is usually implemented in cooperation with the local, regional, and state emergency personnel.
Operation and Maintenance Plan or "O&M": A plan that provides guidelines for the necessary, regular operation and maintenance activities at a dam.

Complete list of definitions from the Vermont Dam Safety Rule:
https://anrweb.vt.gov/DEC/IronPIG/DownloadFile.aspx?DID=185352&DVID=0