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September 25, 2015

Mr. Richard A. Wilt
Town Supervisor
Town of Arietta
P.O. Box 37
139 Old Piseco Road
Piseco, NY 12139

Subject: Condition Inspection of Piseco Lake Outlet Dam

Dear Mr. Wilt,

In accordance with the agreement for professional engineering services between the Town of Arietta and MBP Consulting (MBP) dated June 2, 2015, MBP has performed the inspection of the Piseco Lake Outlet Dam and prepared this letter report on the findings. The report contains a review of available project data, results of the visual observation of the dam, condition assessment, and recommendations to improve the reliability and functionality of the structure.

General

The Piseco Lake Outlet Dam (State ID: 156-0615, Federal ID: NY01186) is located at the outlet of Piseco Lake, on Piseco Outlet Stream, a tributary to the West Branch Sacandaga River, in the Town of Arietta, Hamilton County, New York. The dam is situated about 100 feet downstream of the NYS Route 10 and is shown in the NYSDOT bridge replacement design drawings dated October 18, 1966. According to the New York State Inventory of Dams, the original dam was built in 1888 and has Class A low hazard classification. The NYS dam inventory data sheet, dam location map and NYSDOT design drawing are included in Attachment A to this letter. The owner of the dam is a private entity. The Town of Arietta (Town) operates the dam flashboards to control the lake level and has an easement to the site to operate and maintain the dam.

Dam Description[1]

The dam is a concrete gravity structure consisting of a spillway, an apron and abutment walls. The spillway is a 4.5-foot wide broad-crested weir divided by a 8-foot thick concrete pier on two bays: a left[2], 24-foot long bay and a right, 29-foot long bay. The spillway crest houses removable flashboards supported in each bay with a 2-inch high step in the concrete crest and a horizontal flanged steel I-beam elevated about 2 feet above the crest. The spillway concrete extends upstream from the flashboard line by about 8 feet in the right bay and about 2.5 feet in the left bay. The apron installed at the toe of the spillway crest is about 15 feet wide and inclines downward at an estimated slope 10H:1V (horizontal to vertical). Each abutment wall consists of two parts: about 15 feet long upstream wing section oriented at about 45 degrees to the direction of flow and downstream section, approximately 7 to 8 feet long and 6 to 7 feet thick. The height of the right wall and pier above the spillway crest is about 4 feet and the height of the left wall above the crest is about 5 feet. The wing walls are tapering upstream to a 1-foot thickness. The abutment walls and pier contain 12 by 12 inches slots to accommodate the flashboard supporting steel beams. A general arrangement of the dam, a plan and section, developed using field observations and measurements, is shown in an interpretive engineering sketch in Figure 1.

[1] This dam description is based on available project information and observations and measurements taken during this field inspection.
[2] The terms "left" and "right" refers to an orientation of dam structures or their parts looking in the downstream direction (toward the flow).

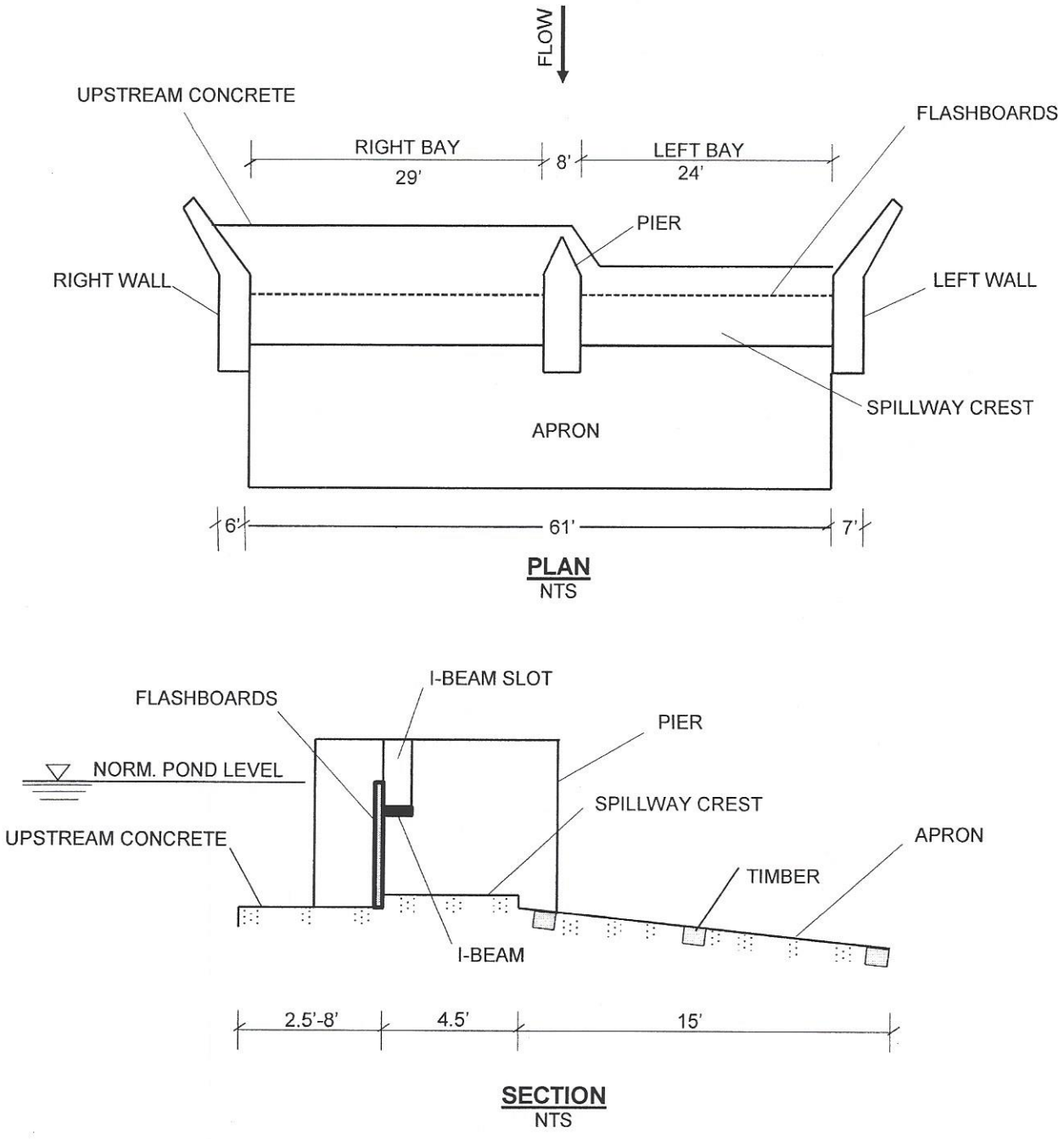

FIGURE 1. PISECO LAKE OUTLET DAM: PLAN AND SECTION

Dam Impoundment and Spillway Operation

The dam impoundment, Piseco Lake, has surface area 2842 acres and normal storage 164,836 acre-feet. The lake shores reportedly accommodate about 150 houses and camps year round. A watershed area at the dam is 59.4 square miles. The impoundment is used mainly for recreation and also for limited water supply and fire control. The lake level is monitored daily by the Town.

The lake level is controlled by operation of wooden flashboards installed on the spillway crest. The flashboards made of wooden boards, 1 inch by 6 inches, are 3 feet high and 4 feet high in the left and right spillway bays, respectively implying that the normal lake level is maintained at the top of the 3-foot flashboards. During higher flow, the lake level rises, overtops the 3-foot high flashboards and approaches the top of the 4-foot high flashboards in the right spillway bay. The lake level at the top of the 4-foot high stoplogs can be considered as the normal maximum lake level. The environmental flow to protect downstream habitat for fish and aquatic life is provided year round by a 3-foot wide opening in a flashboard barrier of each bay. The flashboards are in place from the end of May (Memorial Day) through the middle of October (Columbus Day). The spillway is cleared of flashboards between the middle of October and the end of May.

Inspection

The inspection of the Piseco Lake Outlet Dam was performed on September 14, 2015 by Myron Petrovsky of MBP accompanied by Messrs. Rick Wilt, Barry Baker, Chris Laver and Dick Miller, all representing the Town of Arietta, and Mr. W. Rarscow, the owner representative. Mr. Chris Laver assisted in field measurements and made reinstallation of the spillway flashboards. Mr. Miller provided a summary on lake level measurements in 2010 and 2011.

During the inspection, the weather was cool, overcast with little drizzle and the ambient temperature about 55° F. Prior to the inspection, a prolong drought has caused a drop in the lake level to its historic low. The inspection was performed in two phases: with spillway flashboards removed to lower the lake and expose the upstream portion of the dam for observation and then

with the flashboards reinstalled to dewater and observe the downstream portion of the dam. At the beginning of the inspection with the flashboards removed the lake level was 3.6 feet below the top of right abutment wall and the water depth over the spillway crest was about 0.2 foot (2½ inches). Following completion of the inspection of the upstream area of the dam, the flashboards were reinstalled. Reinstallation of flashboards was completed in about a half hour. Leakage through the flashboards was moderate permitting observation of main dam features.

The inspection was performed in accordance with the guidelines of the State of New York, Department of Conservation (NYSDEC) and federal regulatory agencies for existing dams. A list of references related to the safety inspection of existing dams is contained at the end of this report.

The inspection included visual observation of the accessible dam structures for signs of extensive weathering, deterioration, erosion, cracking, settlement, lateral movement, seepage, leakage, and undermining. The dam abutments were observed for excessive vegetation, erosion, leakage, and animal activities. The pond at the dam and river channel were examined for silt accumulation, scour, and stream encroachments. Spillway flashboards used for the lake level control were checked for general condition, serviceability, and ease of access. Representative photographs showing the condition of the dam at the time of the inspection are included in Attachment B to this report. The condition of the following dam structures was observed:

Right Abutment Wall

The right concrete wall showed general weathering with exposed aggregate on the waterside and appeared stable, free of major cracks and deterioration (Photos 1, 2, 4). Concrete erosion, 1 to 2 inches deep, was more pronounced along the wall base on the spillway side. The wall appeared watertight with no signs of seepage observed. The abutment slope was relatively steep and overgrown with heavy vegetation (brush, trees) obstructing the inspection. Rock outcrop was visible in the right abutment downstream of the wall near the apron (Photo 7). The abutment slope upstream and downstream of the wall appeared stable, free of significant erosion and benching.

Spillway

The spillway crest was even, moderately weathered (more along the downstream edge) and showed no visible signs of significant cracking or movement (Photos 4, 5, 10). The flashboards holding a water pressure of about 6-8 inches at the time of the inspection were reasonably watertight. Some boards were observed to be worn out and not tightly connected to each other exposing open gaps (Photos 1, 3). The 5 inch by 10 inch steel I-beams installed in each spillway bay about 2 feet above the spillway crest to provide the upper support for the flashboards were slightly rusted, true to the original alignment and appeared sound (Photos 2-4).

Pier

A 8-foot thick, 12-foot long, sharp-nosed concrete pier separating spillway bays appeared in adequate condition (Photos 1, 2, 6). The pier concrete above the high waterline mark contained surficial, shrinkage type cracks and was generally intact. Below the waterline mark, the concrete was pitted and weathered, more deeply along cracks. The base of the pier near the spillway crest and apron was eroded to a depth of 2-3 inches. The pier appeared stable with no signs of movement observed.

Left Abutment Wall

The left abutment wall appeared in stable and fair condition (Photos 1, 3, 5, 6, 10, 12). The top of the wall exhibited several cracks filled with a sealant to prevent entry of water inside of the structure. This maintenance work was reportedly done by the previous dam owner. The wall top contained an imprint in concrete "Oct. 19, 1957" which was evidently the date when the dam was rebuilt (Photo 12). The wall on the pond side showed weathered concrete surface with exposed aggregate below high watermark, similar in the pier and right abutment wall. The base of the wall along the spillway apron was deeply eroded and undermined to a depth of 4 inches (Photo 10). It appeared that this concrete erosion was attributed to a horizontal construction joint.

Spillway Apron

The spillway concrete apron apparently built over the old timbercrib work was in fair to poor condition (Photos 4-6). Three rows of 5-inch wide timbers, 6 feet on center, were embedded in

concrete and extending along the entire apron. The timbers were likely served as a formwork during crib concreting. The timbers extending along the downstream edge of the apron were separated from concrete, moved downstream and were partially missing at the apron section near the left abutment. The apron concrete slab measured at the downstream end was about 8 inches thick. The slab was typically undermined to a depth up to 20 inches. The apron of the left spillway bay showed significant concrete deterioration. The eroded voids, 1-3 inches deep, were extending up to 3-5 feet upward from the downstream apron edge. The voids near the apron end were typically 4-5 inches deep (Photo 8) with some voids penetrating through the apron slab. Several wooden boards were observed lying in the middle of the left bay apron (Photo 5). The boards were placed along the flow and anchored to concrete. The apron concrete near and under the boards appeared most deteriorated (Photo 9).

Left Abutment

The earthen left abutment appeared flatter and lower than the right abutment with the top at and below the top of the left abutment wall. No signs of significant erosion of the abutment soil due to dam overtopping or rainfall were noticed. A large, concentrated leakage flow estimated at 200-400 gallons per minute (gpm) was observed at the area about 5-8 feet downstream of the left abutment wall (Photos 5, 11). The leakage flow was clear and free of suspended soil fines. No deposition of silt below the leakage exit was found. The leakage was emerging from rocks and was covered by dense brush. Attempts to find the leakage flow entry on the pond side were unsuccessful.

The abutment appeared to be protected with riprap (Photo 5). The riprap stone was mostly rounded with an average size about 8-12 inches and extending about 1 foot above the apron floor and 2 feet above the tailwater. A small area of riprap near the abutment wall was embedded in concrete. The riprap blanket appeared to be displaced and washed out at many places which could be caused by spillway discharges.

Approach and Downstream Channels

The upstream approach channel between the NYS Route 10 bridge appeared to be clean and free of large debris. Floating debris can cause blockage of the spillway, reduce its capacity, and raise the lake level. The downstream discharge channel contained no significant obstruction to the spillway flows. A large plunge pool formed by operation of the spillway was extending about 30 feet downstream of the dam (Photo 1). The streambed near spillway apron was covered with submerged timbers and rocks. The area outside the plunge pool contained numerous rounded rocks which could be washed out from original timbercribs and riprap blanket installed at the toe of the apron in the past.

Discussions and Conclusions

Based on review of the project information and field inspection findings, the overall condition of the dam is judged to be fair[3] to poor[4]. The dam appeared to be stable and operational at the time of the inspection. However, the observed dam deficiencies, such as significant concrete deterioration, excessive leakage, difficulties to operate flashboards during high water, and potentially limited spillway hydraulic capacity may require at some point in the future to perform some repairs and modifications to improve condition and operation of the dam and reduce a risk of dam failure. The following considerations regarding the condition and operation of the dam are offered:

1. The dam has experienced considerable weathering and erosion of concrete structures with deeper deterioration along cracks and joints including both abutment walls, central pier and spillway apron. The base of the left abutment wall on the spillway side was undermined exposing a 4-inch void. The apron showed severe concrete erosion especially in the area below the left spillway bay and along the downstream edge. The eroded voids were 4 to 6 inches deep almost penetrating through the 8-inch thick apron slab. Wooden logs protecting the toe of the apron against scour were moved, separated from concrete and missing at some areas. The apron slab

[3] "Fair" is defined as a component that requires maintenance.
[4] "Poor" is defined as a component that has deteriorated beyond a maintenance issue and requires repair; the component no longer functions as it was originally intended.

was deeply undermined, up to 20 inches, as measured at accessible locations. The moved logs resulted in exposure of the concrete toe to the abrasion erosion by direct impact of waterborne rocks. A number of voids in apron concrete was located near and under wooden boards fastened to the apron floor of the left spillway bay. The boards were likely a contributing factor to the concrete damage due to separation of flow and eddy currents.

2. The dam, in general, appeared to be reasonably watertight. No significant seepage was observed through concrete structures, at the toe of the apron, and around the dam at the right abutment. The left abutment has developed significant leakage with the exit located downstream of the abutment wall. The leakage exit was surrounded by rocks hidden in dense vegetation. A total leakage flow was estimated between 200 to 400 gpm with the pond level about 6-8 inches above the spillway crest. The leaking water was clear, with no suspended fines. After several attempts the leakage entry on the pond side was not identified in the field. Possible leakage paths could be located in the left abutment wall, under the wall base, or around the wall. Rising the pond can significantly increase this leakage flow.

3. The left dam abutment appears to be lower than the right abutment. The abutment with the grade at or below the top of the left abutment wall could be overtopped during high flows. The abutment on the downstream side is protected with riprap against the spillway flows and tailwater fluctuations. The riprap consisting of irregular, rounded stone and raising about 1 foot above the apron floor was displaced and missing in some areas and appeared inadequate for abutment protection against erosion.

4. The spillway apron toe is not protected against high flow velocities. A riprap blanket, if installed in the past, does not currently present and was likely washed out. A large field of rounded stone deposited outside the plunge pool was observed. Small size stone currently located at the apron toe may become waterborne during high spillway discharges and cause concrete abrasion and undermining of the apron.

5. Heavy overgrowth of the right abutment with brush and trees was obstructing inspection and quick and reliable evaluation of this area of the dam. Tree roots penetrating into the right

abutment wall may damage the structure and loose abutment rocks. The area containing significant leakage in the left abutment was covered with a large brush obstructing direct observation. This area was likely not observed by the previous inspections.

6. The spillway controls the lake level by operation of vertical removable flashboards supported by flanged steel beams at the top and a step in the spillway crest. The flashboard height is uneven: 3 feet and 4 feet in the left and right bays, respectively. This flashboard arrangement results in more frequent operation of the left spillway bay. It was noticed that the apron in the left bay is more deteriorated that the apron in the right bay. During this inspection the flashboards were installed fairly quickly (in a half hour) and were reasonably watertight at the pond level about 6-8 inches above the spillway crest.

Flashboards, by a definition of the NYSDEC dam guidelines (Reference 1), is a temporary facility designed to fail under a specified overtopping head. A flashboard arrangement typically includes horizontal wooden boards attached to steel pins spaced at pre-selected intervals. The current flashboards are actually functioning as stoplogs which are operated manually during removal and re-installation process. A passage of high floods through the dam involves the need for an advanced notice for flashboard removal and then a significant waiting time for the lake to recede to reinstall the boards. If flashboards left in place during a flood event, the rising lake can overtop the dam and abutments which may cause premature failure of the dam or its components (Reference 1: Lake Algonquin Dam, Wells, NY).

7. There is little project data on history of the dam, its composition, foundation type (soil or rock), dam drawings, and repair and performance record. Based on available information and observation during this inspection, it appears that the original dam built in 1888 was a rockfill timbercrib structure. The timbers are still visible in the apron and at the toe of the dam. The dam was modified in 1957. During that time, the concrete spillway was likely installed, timbercrib apron grouted, and abutment walls and central pier installed or overlaid with concrete. The dam is seemingly founded on bedrock which was observed at the right abutment. Several borings drilled by NYSDOT in 1965 for replacement of the upstream Route 10 bridge encountered rock

2.5-3 feet below the stream water level. A geologic map of NYS Geological Survey characterizes bedrock of dam area as quartz-feldspar gneiss (Reference 7).

Recommendations

The following are short- and long-term operation, maintenance and remedial measures suggested to prolong useful life of the dam and improve its safety, integrity, and functionality:

Short-Term Measures

1. Trees and brush within 20-30 feet of the left and right dam abutments should be cut and removed to provide unobstructed observation of the dam and its vicinity and protect the structures from tree root penetration.

2. The deteriorated and undermined area observed at the base of the left abutment wall and the erosion voids in the spillway apron should be repaired with reinforced concrete where practical. Prior to this concrete repair work, the wooden boards anchored to the apron floor should be removed.

3. The timbers separated from the apron toe should be removed and the apron toe protected against high velocity flows with placement of an engineered heavy riprap blanket.

4. The left abutment of the dam impacted by fast moving spillway discharges should be protected by installation of a riprap cover or similar erosion protection measures.

5. The area of the left abutment where a significant source of leakage (estimated at 200-400 gpm) is located should be sealed. The leakage entry on the pond side should be found and plugged with concrete or other appropriate means.

6. The left spillway bay with 3-foot high flashboards is operated more frequently, therefore, providing more erosive impact on the apron and abutment than the right bay where 4-foot high flashboards installed. It is suggested to change the height of flashboards in each bay annually or bi-annually to provide more balanced spillway flow distribution in the long-term.

7. To improve operation of the spillway flashboards, installation of a walkway across the spillway is suggested. The walkway will provide unrestricted access to the flashboards year-around and improve safety of operation personnel.

8. To facilitate operation and reduce leakage, consideration should be given to replacing the current flashboards with tongue and groove plank or plywood panels.

9. Warning signs should be installed on both dam abutments and upstream of the NYS Route 10 bridge to improve public safety and reduce the town's potential liability in the event of an accident. The warning signs should meet the requirements of the Federal Energy Regulatory Commission (FERC) for signage installation (Reference 8).

10. A 6-foot high safety fence should be installed on both dam abutments to prevent unauthorized access to the dam and mitigate vandalism.

Long-Term Measures

The long-term approach should include appropriate remedial measures to extend design life of the dam and bring it in compliance with the current State of New York dam safety regulations and requirements. The following is suggested:

1. Perform a topographic and bathymetric survey of the dam, dam abutments, pond floor between the dam and Route 10 bridge, and the area downstream of the dam. The surveyed abutment areas should be at least 50 feet wide and include the right abutment access and parking area. The area downstream of the dam should be at least 50 feet wide along the stream and include

stream banks and the plunge pool shown in Photo 1 in Attachment B to this report. The survey drawing should include 1-foot topographic contours, property boundaries, and vertical datum used for survey. A sketch of the dam shown in Figure 1 in this report may be used as a guide in survey work.

2. Perform hydrologic and hydraulic analyses and develop the spillway design flood (SDF). The SDF for the Class A, low hazard Piseco Lake Outlet Dam is the 100-year flood (Reference 1).

3. Perform stability analysis of the dam for the loading conditions required (Reference 1).

4. Perform test borings to determine a composition of the dam, its interior condition, and bedrock location and quality.

5. Based on the results of the survey, hydrologic/hydraulic study, stability analyses, and test borings:

- Develop a conceptual remedial design
- Estimate a preliminary construction cost

6. Following a completion of the conceptual design and preliminary construction cost estimate, the Towns and other stakeholders should choose, based on their priorities, preferences and funding resources, the most appropriate approach to the permanent dam remediation.

The permanent dam repair measures may include:

- Installation of new flashboards designed to fail automatically under a specified overtopping head or replacement of current flashboards with new gates.
- Replacement of two 3-foot wide openings in spillway flashboards with a gate to provide specified minimum environmental flow releases year-round.

- Modification of the spillway apron which may include installation of a reinforced concrete overlay, concrete cutoff wall at the toe, extension of abutment walls, and placement of a riprap blanket downstream of the apron.
- Protection of dam abutments against erosion when insufficient spillway hydraulic capacity (which is expected) would cause overtopping of the dam during significant flood events. Potential remedial measures may include raising the dam and/or installation of stone riprap or articulated concrete blocks on dam abutments.

When the dam repair approach and funding were finalized, the subsequent phases of engineering work can be performed including final design, construction cost update, permitting, contract documents, bidding, and construction management.

List of References

1. NYSDEC (1989), Guidelines for Design of Dams, January 1985, Revised January 1989.
2. NYSDEC (2009), A Template for an Inspection And Maintenance Plan for Dams, Draft.
3. NYSDEC (1987), An Owners Guidance Manual for the Inspection of Dams in New York State, DEC June 1987.
4. FERC (2005), Engineering Guidelines for the Evaluation of Hydropower Projects, 2005.
5. USBR (1980), Safety Evaluation of Existing Dams, 1980.
6. USACE (1979), Recommended Guidelines for Safety Inspection of Dams, September 1979.
7. NYS Geological Survey (1999), 1:250,000 Bedrock Geology of NYS, 1999, http://www.nysm.nysed.gov/gis.html.
8. FERC (2001), Safety Signage at Hydropower Projects, October 2001.

If you have any questions or need clarification regarding this report, please contact me at 207-773-5425 or myronp@maine.rr.com.

Sincerely,

MBP CONSULTING

MBPetrovsky

Myron B. Petrovsky, P.E.
Principal

Attachments:

A. Project Documentation
B. Inspection Photographs