



Four Lakes Task Force Response to  
The Independent Forensic Team's Final Report (IFT Report)  
Investigation of Failures of the Edenville and Sanford Dams

May 25, 2022

TO: Luke Trumble, Michigan EGLE Dam Safety  
Kimberly Bose, Secretary, Federal Energy Regulatory Commission

RE: **Four Lake Task Force Response to the Independent Forensic Team's Final Report on the Investigation of the Edenville and Sanford Dams**

On May 4, 2022, the Independent Forensic Team (IFT) issued its Final Report on the Investigation of Failures of the Edenville and Sanford dams. This document is the Four Lake Task Force, including its consultants, and legal teams', analysis of the Independent Forensic Team's Final Report (IFT Report). The robust findings and learnings of this report are being addressed in the design, construction of the restoration, and long-term operations and maintenance of the Four Lakes system of dams.

- 1) The Secord and Smallwood Dams will be going under major repair, and the Edenville and Sanford Dam will have major restorations. FLTF is using current industry practices in the restoration of the dams, lake system and their ecosystems.
- 2) Information Management is a cornerstone of any risk management system. The documentation of our project and construction work will include long-term monitoring and data management of our operations and maintenance systems to optimize the health of the dams to create a long-term sustainable system.
- 3) FLTF will continue to update its hydrology and hydraulic modeling through the restoration design and will maintain their currency. In addition, FLTF has already increased the measurements being taken in the watershed.

Regulators' rule changes must include more robust oversight of a dam owner's financial capability to comply. Indeed, the Federal Energy Regulatory Commission (FERC) failed to recognize or act at the transfer of ownership, or in time to create change, when there was a non-compliant private hydroelectric dam owner that was underinvesting in Edenville. The solution required a change in the ownership or revenue model.

- 1) FERC rulemaking needs to identify license owners who do not have the financial resources to fulfill their license obligations. Rulemaking should be structured to proactively facilitate an ownership transfer if needed to assure a sustainable future for the project, dams or no dams.
- 2) Information management and information sharing are critical elements of a regulatory system to identify and mitigate risk. Recognizing much of FERC's information on high hazard dams is classified as Critical Infrastructure Information (CII), proactive engagement and information sharing still must occur between all parties before a system gets to a financial situation where a system is being underfunded.

What is the lesson for other lake communities and property owners? Lake communities tend to focus on the use and health of the lake. A lesson of the Four Lakes is the owner and regulators need to be very transparent on the long-term financing planned for the sustainability of their lakes, especially those that are impounded by a dam. Lake associations, townships and counties, if they aren't being included, should elbow their way into this conversation and bring in their own experts.

W.D. Boyce Trusts was able to purchase the dams, through a series of parent company and license name changes, that never yielded a plan to upgrade the Edenville Dam. Instead, FERC's later revocation of Boyce Hydro Power's license created an unstable and chaotic situation. FLTF takes one exception to the IFT Report, in the concept of "functional ownership." The Boyce entities as defined in Figure 7.1 sought and obtained ownership and control of the FERC projects and access to a natural resource for profit. They did not fulfill the higher obligation to public safety and protection of the environment. If they didn't have the funds to meet this obligation, the W.D. Boyce Trusts shouldn't have bought it, and FERC shouldn't have allowed it.

The Four Lakes Task Force, as the Delegated Authority of Gladwin and Midland counties, recognizes its obligation of stewardship to safely manage a complex system such as the Four Lakes for the benefit of the community and the environment. Safety will remain an integral part of our work, and it will be achieved in an open and transparent dialogue with the community.



David Kepler  
President, Four Lakes Task Force  
Gladwin and Midland Counties' Delegated Authority of the Four Lakes Special Assessment District



## PURPOSE AND USE OF THE IFT REPORT AND THE FLTF ANALYSIS

The Independent Forensic Team (IFT) report stated, “*The purposes of the investigation were to evaluate physical and human factors that contributed to the failures and to identify lessons to be learned by the industry, emergency management, agencies, and the public to prevent future similar failures.*” FLTF appreciates the work of the IFT in undertaking and compiling the IFT Report and the information and insight it provides.

***Four Lakes Task Force (FLTF) is providing an analysis of the IFT Report for the purpose of assuring the learnings are addressed in the restoration project and long-term management of the Four Lakes system. We also seek to provide insight into the improvement of the regulatory systems that impact their future.***

### FLTF PERSPECTIVE OF OWNERSHIP IS A POINT OF DIFFERENCE FROM THE IFT REPORT

While the IFT Report has an intended audience, the report will be reviewed and referenced by lawyers, public policy experts, and citizens. It is important that we point out early in this paper the exception FLTF takes with the term and concept introduced in the IFT Report Section 7.1.1 of “*functional*” ownership” and defining the situation of having two organizations *functionally* (not legally) in a dam owner’s role. FLTF has included Clark Hill’s legal opinion on this matter in **Appendix C**. FLTF believes if there was any confusion by the regulators, it was created by the unusual circumstances created by how the Edenville license was revoked.

1. FERC, by proposing to revoke the Edenville license, changed the bias of the administrative process to end power generation, and yet showed no interest in the consequence this would have on the community or the sustainability of the lake ecosystem created by the dam.
2. It is sound practice to establish a State Normal (Legal) Lake Level that aligns with the FERC license, even though the FERC license preempts the authority of the Michigan Department of Environment, Great Lakes and Energy (EGLE). This puts in place a structure to accept the transfer of ownership. This was not in place in early 2018, was by 2019 and ownership transferred in December of 2020.
3. FERC has a process outlined for license transfer<sup>1</sup>, that includes an owner surrendering a license with a plan for the post-license state. FERC should have been aware that there was no post-license plan, as the Lake Associations had communicated this fact several times.

Revoking the license created an unstable and uncertain outcome for the transfer of ownership, as reflected in the timeline in **Appendix D**. One might say, this is “the opposite of collaboration to solve a problem.”

This is an important clarification, as the transfer to public ownership of dams is an important aspect of creating new revenue sources to improve and maintain dams that impound lakes which create value to a community and the environment. FLTF’s view of the owner’s obligations are covered later in this report.

---

<sup>1</sup> FERC: Policy for License Transfers: <https://www.ferc.gov/types-license-transfers> Surrender applications for **constructed projects** should include a plan for decommissioning the project. Decommissioning can include leaving project features in-place for other uses, or removal of project features and site restoration. The plan should address any dam safety or environmental concerns that could remain after the license is surrendered

## CLARIFICATION ON EDENVILLE SPILLWAY GATE HOIST OPERABILITY

Edenville Dam was the only dam that relied on an A-frame system to lift the gates by their safety chains, at the time of the failure, to achieve its maximum reported height. It was unlikely this system, designed under Boyce, and represented to be operational in 2015 to increase gate height, was never a safe alternative to use in an emergency. The original gate hoists should have been replaced. **Appendix E** is Spicer Group's report on the capability of the hoists, and FLTF's plans to replace them in 2020, which were preempted by the failure.

## RESTORATION OF THE FOUR LAKES SYSTEMS

Significant study and engineering have been occurring while the IFT investigation has been underway. The IFT released an Interim Report that covered physical mechanisms of the Edenville embankment failure. This allowed for analysis and early review of the likely static liquefaction failure mechanism and is helping to inform the FLTF engineering effort of dam restoration. FLTF asked its consultants to review the final IFT Report to evaluate and ensure the work completed and underway was consistent with the findings of the IFT report, and to make any adjustments that may be required.

### GEI RESPONSE TO INDEPENDENT FORENSIC TEAM FINAL

GEI Consultants was asked to prepare a report regarding the IFT's evaluation of the mechanisms of embankment failure, key takeaways and lessons learned that will be incorporated into their design approach for dam reconstruction, long-term dam safety monitoring, operations, and maintenance. **Appendix A** includes the analysis and risk reduction measures from GEI Consultants, responsible for the engineering of the four dams' restoration.

This report reviews recommendations that are being implemented in the areas of:

- Interim risk reduction
- Safety improvements in the long-term reconstruction of the four dams
- Risk-based methodology using industry standard Semi Quantified Risk Assessment (SQRA) methods for the determination of Inflow Design Flood (IDF) for capacity
- Long-term dam safety monitoring, operations and maintenance to preserve dam safety, including:
  - New potential failure mode analysis
  - Updating the Dam Safety Monitoring Program (DSSMP)

### HYDROLOGY OF THE FOUR LAKES RIVER BASIN

FLTF requested Ayres to analyze the IFT Report in the context of its July 2021 Design Flood Hydrologic Analysis. The IFT report makes the essential point that in 2020 an unusual flood was produced by a critical combination of precipitation and antecedent watershed conditions. **Appendix B** outlines the steps taken to align Ayres' current hydrologic model to the May 2020 event, and how these steps align with the IFT report and recommendations.

In summary, the current model supporting spillway design represents the critical conditions experienced in May 2020 and aligns with the IFT opinion regarding impervious conditions. Ayres' model is slightly more conservative for runoff than the IFT estimate but compares favorably to the actual conditions experienced in both 2020 and 2014. Since these results are consistent with the IFT recommendations, we recommend no changes based on the IFT findings.

### INFORMATION MANAGEMENT

The IFT report pointed out significant gaps in information and follow-up, and the importance of information management. FLTF has established a data management system for the historical data we have collected, dam engineering records and studies, and construction. The system will also include DSSMP data, operational and maintenance documentation and compliance management. The ability to manage the long-term sustainability of the system will be an outcome of the Four Lakes Restoration Program.

## CONTRIBUTION OF HUMAN FACTORS

In its summary, the IFT Report states: *“During the era of FERC regulation of the four Boyce Hydro dams, the interactions of the various parties involved with the four hydroelectric projects contributed to the circumstances that resulted in the May 2020 failures. These parties included the three dam owners, the dam owner’s engineering consultants, FERC, EGLE, FLTF, FLTF’s engineering consultants, Consumers Energy, Gladwin and Midland Counties, the lakefront property owners, and lake users who did not own lakefront properties.”*

### FLTF POSITION ON FERC OVERSIGHT AND THE LEGAL OWNER’S OBLIGATION

FLTF places a greater expectation on FERC and the dam owners, in their legal and ethical obligations, in a regulated system. An owner that acquires the rights to profit from a natural resource has an obligation to protect that natural resource and the people around it. FERC had the oversight of all ongoing project operations, including dam safety and security inspections, public safety, and environmental monitoring<sup>2</sup>.

- Wolverine Power sold properties around the Four Lakes projects to what became residential lake properties. Deeded access was given to the lakes for recreation and the owner profited from those sales. There was no request, action or engagement to change this deeded right, by FERC when it obtained oversight.<sup>3</sup>
- The W.D. Boyce Trusts owned entities, which acquired the FERC licenses and properties in 2006, knew the dams were not in compliance. Boyce Hydro Power assumed the license’s obligations of safety of the public and the environment.
- FERC regulator obligations are very broad and have the primary oversight of the system.

To include the counties, lake front owners and lake users as contributors in the regulated system that failed is wrong. Their benefit described in the IFT report was sold and deeded to the owners. The license owner and FERC had the primary obligations to protect the public and the environment and engage them directly and with transparency.

### CONTRIBUTION OF INADEQUATE FINANCING TO THE FAILURE

FLTF agrees with the IFT Report’s summary on the first page: *“...If, many years before the May 2020 failure, the dams had become publicly owned or a public-private partnership had been established, sufficient funds would have been available to upgrade the spillway capacity to pass an extreme flood, and therefore the rise of the lake in May 2020 would have been limited and the failure would almost certainly have been prevented. However, the embankment would have remained vulnerable to instability failure during future extreme floods if the embankment section that failed was not modified to increase stability.”*

The greatest opportunity for a positive change in ownership was in 2005/2006, when the ownership of a non-compliant system was transitioned through parent company restructuring and name changes, without significant review. FERC rules state, *“These transactions do not typically require a license transfer application and prior approval from the Commission. However, the Commission should be notified of these changes.”*<sup>4</sup> Buying into a dam, with a FERC license, should not have fewer ownership checks than what is required to buying into a tavern with a liquor license.

Since the implementation of the FERC licenses by the 1990s, *the Lake communities had implicitly accepted that their best interests are served by a private owner/operator, with oversight from FERC.* That has proven to be a false premise.<sup>5</sup>

---

<sup>3</sup> FLTF Feasibility Report, Memorandum – Legal Framework

<sup>4</sup> <https://www.ferc.gov/types-license-transfers>

<sup>5</sup> 2018 Four Lakes Taskforce Call to Action



## PURPOSE AND USE OF THE IFT REPORT AND THE FLTF ANALYSIS

The Independent Forensic Team (IFT) report stated, “*The purposes of the investigation were to evaluate physical and human factors that contributed to the failures and to identify lessons to be learned by the industry, emergency management, agencies, and the public to prevent future similar failures.*” FLTF appreciates the work of the IFT in undertaking and compiling the IFT Report and the information and insight it provides.

***Four Lakes Task Force (FLTF) is providing an analysis of the IFT Report for the purpose of assuring the learnings are addressed in the restoration project and long-term management of the Four Lakes system. We also seek to provide insight into the improvement of the regulatory systems that impact their future.***

### FLTF PERSPECTIVE OF OWNERSHIP IS A POINT OF DIFFERENCE FROM THE IFT REPORT

While the IFT Report has an intended audience, the report will be reviewed and referenced by lawyers, public policy experts, and citizens. It is important that we point out early in this paper the exception FLTF takes with the term and concept introduced in the IFT Report Section 7.1.1 of “*functional*” ownership” and defining the situation of having two organizations *functionally* (not legally) in a dam owner’s role. FLTF has included Clark Hill’s legal opinion on this matter in **Appendix C**. FLTF believes if there was any confusion by the regulators, it was created by the unusual circumstances created by how the Edenville license was revoked.

4. FERC, by proposing to revoke the Edenville license, changed the bias of the administrative process to end power generation, and yet showed no interest in the consequence this would have on the community or the sustainability of the lake ecosystem created by the dam.
5. It is sound practice to establish a State Normal (Legal) Lake Level that aligns with the FERC license, even though the FERC license preempts the authority of the Michigan Department of Environment, Great Lakes and Energy (EGLE). This puts in place a structure to accept the transfer of ownership. This was not in place in early 2018, was by 2019 and ownership transferred in December of 2020.
6. FERC has a process outlined for license transfer<sup>6</sup>, that includes an owner surrendering a license with a plan for the post-license state. FERC should have been aware that there was no post-license plan, as the Lake Associations had communicated this fact several times.

Revoking the license created an unstable and uncertain outcome for the transfer of ownership, as reflected in the timeline in **Appendix D**. One might say, this is “the opposite of collaboration to solve a problem.”

This is an important clarification, as the transfer to public ownership of dams is an important aspect of creating new revenue sources to improve and maintain dams that impound lakes which create value to a community and the environment. FLTF’s view of the owner’s obligations are covered later in this report.

---

<sup>6</sup> FERC: Policy for License Transfers: <https://www.ferc.gov/types-license-transfers> Surrender applications for **constructed projects** should include a plan for decommissioning the project. Decommissioning can include leaving project features in-place for other uses, or removal of project features and site restoration. The plan should address any dam safety or environmental concerns that could remain after the license is surrendered

## CLARIFICATION ON EDENVILLE SPILLWAY GATE HOIST OPERABILITY

Edenville Dam was the only dam that relied on an A-frame system to lift the gates by their safety chains, at the time of the failure, to achieve its maximum reported height. It was unlikely this system, designed under Boyce, and represented to be operational in 2015 to increase gate height, was never a safe alternative to use in an emergency. The original gate hoists should have been replaced. **Appendix E** is Spicer Group's report on the capability of the hoists, and FLTF's plans to replace them in 2020, which were preempted by the failure.

## RESTORATION OF THE FOUR LAKES SYSTEMS

Significant study and engineering have been occurring while the IFT investigation has been underway. The IFT released an Interim Report that covered physical mechanisms of the Edenville embankment failure. This allowed for analysis and early review of the likely static liquefaction failure mechanism and is helping to inform the FLTF engineering effort of dam restoration. FLTF asked its consultants to review the final IFT Report to evaluate and ensure the work completed and underway was consistent with the findings of the IFT report, and to make any adjustments that may be required.

### GEI RESPONSE TO INDEPENDENT FORENSIC TEAM FINAL

GEI Consultants was asked to prepare a report regarding the IFT's evaluation of the mechanisms of embankment failure, key takeaways and lessons learned that will be incorporated into their design approach for dam reconstruction, long-term dam safety monitoring, operations, and maintenance. **Appendix A** includes the analysis and risk reduction measures from GEI Consultants, responsible for the engineering of the four dams' restoration.

This report reviews recommendations that are being implemented in the areas of:

- Interim risk reduction
- Safety improvements in the long-term reconstruction of the four dams
- Risk-based methodology using industry standard Semi Quantified Risk Assessment (SQRA) methods for the determination of Inflow Design Flood (IDF) for capacity
- Long-term dam safety monitoring, operations and maintenance to preserve dam safety, including:
  - New potential failure mode analysis
  - Updating the Dam Safety Monitoring Program (DSSMP)

### HYDROLOGY OF THE FOUR LAKES RIVER BASIN

FLTF requested Ayres to analyze the IFT Report in the context of its July 2021 Design Flood Hydrologic Analysis. The IFT report makes the essential point that in 2020 an unusual flood was produced by a critical combination of precipitation and antecedent watershed conditions. **Appendix B** outlines the steps taken to align Ayres' current hydrologic model to the May 2020 event, and how these steps align with the IFT report and recommendations.

In summary, the current model supporting spillway design represents the critical conditions experienced in May 2020 and aligns with the IFT opinion regarding impervious conditions. Ayres' model is slightly more conservative for runoff than the IFT estimate but compares favorably to the actual conditions experienced in both 2020 and 2014. Since these results are consistent with the IFT recommendations, we recommend no changes based on the IFT findings.

### INFORMATION MANAGEMENT

The IFT report pointed out significant gaps in information and follow-up, and the importance of information management. FLTF has established a data management system for the historical data we have collected, dam engineering records and studies, and construction. The system will also include DSSMP data, operational and maintenance documentation and compliance management. The ability to manage the long-term sustainability of the system will be an outcome of the Four Lakes Restoration Program.

## CONTRIBUTION OF HUMAN FACTORS

In its summary, the IFT Report states: *“During the era of FERC regulation of the four Boyce Hydro dams, the interactions of the various parties involved with the four hydroelectric projects contributed to the circumstances that resulted in the May 2020 failures. These parties included the three dam owners, the dam owner’s engineering consultants, FERC, EGLE, FLTF, FLTF’s engineering consultants, Consumers Energy, Gladwin and Midland Counties, the lakefront property owners, and lake users who did not own lakefront properties.”*

### FLTF POSITION ON FERC OVERSIGHT AND THE LEGAL OWNER’S OBLIGATION

FLTF would place a greater expectation on FERC and the dam owners, in their legal and ethical obligations, in a regulated system. An owner that acquires the rights to profit from a natural resource has an obligation to protect that natural resource and the people around it. FERC had the oversight of all ongoing project operations, including dam safety and security inspections, public safety, and environmental monitoring<sup>7</sup>.

- Wolverine Power sold properties around the Four Lakes projects to what became residential lake properties. Deeded access was given to the lakes for recreation and the owner profited from those sales. There was no request, action or engagement to change this deeded right by FERC when it obtained oversight.<sup>8</sup>
- The W.D. Boyce Trusts owned the entities, which acquired the FERC licenses and properties in 2006, knew the dams were not in compliance, Boyce Hydro Power assumed the license’s obligations of safety of the public and the environment.
- FERC regulator obligations are very broad and have the primary for oversight of the system.

To include the counties, lake front owners and lake users as contributors in the system that failed is wrong. Their benefit described in the IFT report was sold and deeded to the owners. The license owner and FERC had the primary obligations to protect the public and the environment and engage them directly and with transparency.

### CONTRIBUTION OF INADEQUATE FINANCING TO THE FAILURE

FLTF agrees with the IFT Report’s summary on the first page: *“...If, many years before the May 2020 failure, the dams had become publicly owned or a public-private partnership had been established, sufficient funds would have been available to upgrade the spillway capacity to pass an extreme flood, and therefore the rise of the lake in May 2020 would have been limited and the failure would almost certainly have been prevented. However, the embankment would have remained vulnerable to instability failure during future extreme floods if the embankment section that failed was not modified to increase stability.”*

The greatest opportunity for a positive change in ownership was in 2005/2006, when the ownership of a non-compliant system was transitioned through parent company restructuring and name changes, without significant review. FERC rules state, *“These transactions do not typically require a license transfer application and prior approval from the Commission. However, the Commission should be notified of these changes.”*<sup>9</sup> Buying into a dam, with a FERC license, should not have fewer ownership checks than what is required to buying into a tavern with a liquor license.

Since the implementation of the FERC licenses by the 1990s, *the Lake communities have implicitly accepted that their best interests are served by a private owner/operator, with oversight from FERC.* That has proven to be a false premise.<sup>10</sup>

---

<sup>8</sup> FLTF Feasibility Report, Memorandum – Legal Framework

<sup>9</sup> <https://www.ferc.gov/types-license-transfers>

<sup>10</sup> 2018 Four Lakes Taskforce Call to Action



Four Lakes Task Force Response to  
The Independent Forensic Team's Final Report (IFT Report)  
Investigation of Failures of the Edenville and Sanford Dams

**APPENDIX A**  
**GEI CONSULTANTS' REPORT**

# Technical Memorandum

To: Mr. David Kepler  
CC: Mr. Ron Hansen, P.E., P.S.  
From: Richard J. Anderson, P.E. William H. Walton, S.E., P.E., Paul D. Drew, P.E.  
Date: May 18, 2022  
Re: GEI Response to Independent Forensic Team Final Report *Investigation of Failure of Edenville and Sanford Dams*  
Four Lakes Task Force (FLTF)  
Midland, Michigan  
GEI Project No. 2002879

## Introduction

Following the Edenville and Sanford Dam failure on May 19, 2020, the Federal Energy Regulatory Commission (FERC) engaged a five-member independent forensic team (IFT) to investigate the failure and the physical and human factors that contributed to the failures. On May 4, 2022, the IFT issued their Final Report (Ref. 1) on the physical mechanisms and human factors involved in the failures. As requested by the Four Lakes Task Force (FLTF), GEI has prepared this response regarding the IFT's evaluation of the mechanisms of embankment failure, key takeaways and lessons learned that will be incorporated into our design approach for dam reconstruction, long term dam safety monitoring, operations, and maintenance. Commentary regarding the technical aspects of the IFT's evaluation of the river basin hydrology and inflows to the reservoirs produced by the May 2020 storm event will be addressed on behalf of the FLTF by Ayres Associates.

## Main Points of the IFT Final Report Regarding Embankment Failure

1. **Mechanism of Failure of Edenville.** Edenville dam did not overtop during the flood event but failed by downstream slope failure of a 40 to 80 ft length of the 600 ft long Left Embankment that, according to the IFT, was the likely result of static liquefaction of the loose, saturated embankment soils under a historically high reservoir pool. The shallow downstream failure occurred at 5:35 pm on Tuesday, May 19, 2020. The IFT concluded that static liquefaction occurred when the loose sandy soil comprising the downstream shell of the embankment, under already high initial shear stresses with the steep downstream slopes (1.6H to 1.8H:1V), rapidly lost strength upon saturation when the reservoir level rose and underwent rapid flow slide failure.

GEI takes no issue with the IFT's conclusion of a rapid downstream slope failure under a surcharged pool that had not yet overtopped the crest of the embankment. Approximately 30 minutes before the failure the crest reported settled about 1 ft, based on the available photographic and video evidence. The potential for static liquefaction was not previously identified as a dam safety issue at Edenville Dam in past FERC Consultant Safety Inspection Reports (CSIRs) or any other available engineering studies performed for Edenville Dam prior to failure. In fact, previous stability analyses on record for the project reported that the Edenville embankments were stable up to the point of overtopping (Ref. 2 - 2015 Supporting Technical Information Document (STID)). However, review of the historical stability analyses on record indicated no analyses were performed prior to May 2020 for the Left Embankment. Static liquefaction can occur in loose, saturated soils subjected to rapid, undrained loading (Ref. 6 - GEI, 2022a - White Paper on Static Liquefaction Triggering). If present, the conditions that made the embankment susceptible to static liquefaction, including loose, contractive sandy soils, and lack of either a seepage cutoff or an impervious central clay core to prevent saturation of the downstream shell under high pool conditions, would have been present since original dam construction.

As part of our design of Edenville Dam reconstruction, GEI has performed comprehensive subsurface investigations and is currently engaged in rigorous engineering analyses to evaluate embankment stability under all applicable State of Michigan Environmental, Great Lakes and Energy (EGLE) and FERC embankment dam loading conditions (see Ref. 8 - GEI (2022c)). Static liquefaction potential is being evaluated for all four dams and mitigation measures incorporated into design to address the potential for triggering during and after reconstruction.

2. **Mechanism of Failure of Sanford.** Sanford failed as result of overtopping after Edenville breached. The combined primary and auxiliary spillway capacity of Sanford Dam were insufficient to safely pass the Edenville Dam breach flood wave, resulting in an overtopping failure of the Sanford Dam embankments. Prior dam failure analyses used to inform the Emergency Action Plans (EAP) for Edenville, and Sanford Dams predicted this given the much larger volume of the Wixom Lake impoundment compared to the storage and spillway capacity available at Sanford Dam. We concur with this assessment.
3. **IFT Evaluation of Peak Reservoir Lake Levels under Various “What If” Scenarios.** At the time of embankment failure, the reservoir level (El. 681.3 feet +/-) was estimated to be within 1.0 to 1.5 feet of the dam crest with the dam failure section having 1-foot or less freeboard for at least 30 minutes prior to the downstream slide. This reservoir elevation at breach is approximately 5.5 feet higher than normal lake level El. 675.8 feet, and approximately 3 feet higher than the previously reported historic maximum lake elevation. The IFT considered several hypothetical alternatives related to hydrologic and hydraulics aspects of operations. Pertinent flood routing “what if” scenarios evaluated by the IFT concluded the following:
- Scenario 1: If dam had not failed, the impoundment is estimated to have peaked 0.3 feet higher at El. 681.6, which is still 0.5 feet below embankment crest (El. 682.1). Therefore, had the Left Embankment not failed, the embankments would not have overtopped.
  - Scenario 3: The Tainter gates at both the Tobacco and Tittabawassee spillways were only open to a reported 7 feet during the May 2020 flood event. At least 10 feet of opening is needed to fully lift the gates out of the flow to permit full, unrestricted capacity (i.e. prevent orifice flow). Between 2012 and 2015, Boyce fabricated a supplemental A-frame gate hoist system that could physically lift the gates to their fully open position of 10-feet above the rollway sill. However because of concerns for operator safety, the gates were not opened beyond 7 feet during the flood event. If gates had been opened to 10-feet as intended, the impoundment is estimated to have peaked at El. 680.2 feet, which is 1.1 feet below the reservoir level at failure and 1.4 feet below the predicted peak elevation if failure had not occurred.
  - Scenario 7: The ability to fully open all of the Tainter gates was determined by the IFT to be more beneficial in terms of reducing the reservoir level than a pre-flood pond drawdown. Had the impoundment been drawn down to run-of-river lake level (over the ogee crest of spillways – estimated at El. 670.0 feet), the impoundment is estimated to have peaked at El. 681.1 feet, which is only 0.2 foot below the reservoir level at failure.
  - Scenario 2a: Full opening of the Tainter gates to 10 feet was also determined to be more beneficial that if the two (2) powerhouse turbines were still available to pass flow. The IFT estimated that had the turbines been able to pass flow up until the point the reservoir surcharged by +3.0 feet above normal max pool (at which point they would have been shut down to protect the powerhouse), the impoundment would have peaked at El. 681.3 feet, which is equal to the elevation at which the embankment breached. Note that upon loss of the FERC operating license, flow could no longer be passed through the powerhouse, so any option involving passing flows through turbines is strictly hypothetical.
  - Scenario 9: The IFT stated that it cannot conclude with any confidence that any of these “what if” scenarios evaluated would have prevented embankment failure since the impoundment was still rising at the time of failure and the impoundment would have remained surcharged above historic maximum recorded level for at least another 24 hours. The only IFT reported option that would have eliminated the surcharging and prevented failure during the May 2020 flood event was if the spillway capacity upgrades were implemented prior to the flood by Boyce as proposed nearly 10 years prior.
4. **IFT Key Takeaways from the Geotechnical Analysis.** No other embankment sections exhibited loss of freeboard, slope instability, liquefaction, or flow sliding. Therefore, why did failure occur at the Left Embankment? According to the IFT:
- The finger drains over the foundation soil under the downstream dam shell composed of gravel-filled trenches with 4-inch I.D. clay tile pipes spaced ¼-inch apart at the embankment – foundation contact, the drain outlets could not be located at this location.
  - Photographic records from construction indicated that the embankments were dumped from rail cars and not compacted as specified in the original construction earthwork specifications.
  - The photographic records also suggest finer grained soils containing silts and clays were dumped along the upstream side of the embankment, and sands and silty sands were dumped along the downstream side. The upper reaches of the embankment were composed of more uniform sands and silts. This resulted in the embankments being composed of loose to very loose sandy soils under the downstream

shell and crest and soft clays and loose silts under the crest and upstream shell - see Left Embankment boring B-1 conducted by McDowell & Associates in 2005 and boring B-2 conducted by McDowell & Associates in 2010 (Ref. 2 - STID 2015).

- The Left Embankment downstream slopes were steeper than the other embankment reaches. Downstream slopes were estimated at 1.6 H:1V to 1.8H:1V, which resulted in high initial shear stresses.
- There was a lack of comprehensive geotechnical evaluations prior to 2020. No slope stability analyses had been conducted for the Left Embankment. Analyses would have indicated factors of safety (FS) below EGLE and FERC and requirements. A FS equal to or greater 1.5 is the required industry standard under normal pool conditions. Other sections that had been analyzed previously had been found lacking and were modified by slope flattening and buttressing, which may have prevented failure.

### **Lessons Learned and Recommended Risk Reduction Measures for Design / Construction to Prevent Failure**

GEI's final reconstruction designs and solutions will consider the findings of the IFT, and the failure mechanisms outlined in the IFT report. Considering the failure mechanisms outlined above and to prevent embankment failure from happening again at Secord, Smallwood, Edenville, or Sanford Dams, our proposed solutions are simple and practical. The following approach will be implemented to upgrade all four dams in accordance with industry standards of practice and reduce risks:

1. **Conducted Interim Risk Reduction Measures.** Until such time as repair or reconstruction is completed, we have recommended and the FLTF imposed a lower operating pool level at Secord and Smallwood Dams. At Edenville the Tobacco and Tittabawassee River are passing through the original spillway at a reduced pool. In addition, the spillway at Tobacco and Sanford have been lowered to become overflow sections that will serve as the foundation for the new low-level outlet and the deeper hydraulic crest gates. Once the lowered spillway at Sanford can function as a temporary ungated six bay weir, the right breach channel will be closed off and the Tittabawassee will be directed back to flow over the original spillway at a lower pool elevation. Work will be done the summer of 2022 to reestablish a portion of the entire right earth dam with a new sheet pile wall driven in hardpan glacial till and height enough to retain 200-year flood without overtopping.
2. **Performing concurrent Long-term Dam Reconstruction of Secord, Smallwood and Edenville and Sanford Dams.** The FLTF will construct GEI-designed dam safety improvements that will include the following:
  - Comprehensive surveys, hydrology and hydraulic studies, and extensive geotechnical explorations and testing to characterize the dams and foundations in their topographic, hydrologic, and geologic settings.
  - Increase primary spillway capacity using deeper hydraulic crest gates (e.g., from 10 ft to 16 ft).
  - Provide passive (non-gated) auxiliary spillways to pass flows beyond the capacity of the primary gated spillways up to the inflow design flood (IDF).
  - Install an impervious seepage barrier (driven steel sheet piles or mixed in place soil-cement-bentonite (SCB) walls) along the upstream edge of crest of the earth fill dams through the dam fill, alluvium and into hardpan glacial till to lower the phreatic surface within the downstream shell of the dams.
  - Raise and widen the dam crests to provide additional freeboard for wind, wave, and overtopping protection. Provide adequate freeboard to safely pass the IDF.
  - The upstream embankment slopes will be flattened to 2.5H:1V and new riprap over bedding placed to protect the dam during summer and winter pools and during flooding.
  - The downstream embankment slopes will be flattened to 3H:1V to allow safe mowing, reduce static shear stresses and improve downstream embankment stability. Slopes close to the spillways will be armored with bedding and riprap to reduce lateral earth pressures on improved spillway walls, avoid mowing and limit vegetative growth on the slopes. Also provide integral filter and drainage layers and a seepage collection system to provide additional protection against seepage-induced internal erosion for any seepage that bypasses the cutoff wall. The lower portions of the flattened downstream dam face will be protected bedding and riprap to protect the dams from high tailwater scour.
  - Abandon (at Sanford) and partially demolish (at Edenville) the powerhouse and provide new, low-level outlets with vertical slide gates manage minimum flows without frequent large gate operations and reduce ice build-up risks on the steel crest gates during the winter months.
  - Provide instrumentation monitoring and maintain a robust Dam Safety Surveillance Monitoring Program (DSSMP) at all four embankment dams. GEI and FLTF has been providing dam safety training to the operating staff.

- Update the dam operation SOP's and Emergency Action Plan (EAP) for standard of practice dam operation and emergency response.

These proposed improvements to all four dams will maintain a lower reservoir pool during flood events, reduce the phreatic surface in the shell of the flatter downstream embankments and thereby reduce the risk of each of the failure mechanisms identified by the IFT (see Ref. 4 – GEI 2021a and Ref. 5 – GEI 2021b for the Secord and Smallwood 60% Design Reports).

3. **Incorporate Risk-Based Methodology using industry standard Semi Quantified Risk Assessment (SQRA) methods of analysis for the determination of the Inflow Design Flood (IDF) for design of spillway upgrade at Secord, Smallwood and Edenville Dams.** GEI, FLTF, EGLE and AECOM are in the process of performing risk assessments to determine the Inflow Design Flood (IDF) using the techniques prescribed in FEMA P-94 and corresponding required spillway capacity upgrades. The risk assessment for Secord and Smallwood was completed in January 2022 (Ref. 7 - GEI 2022b) and designs are nearing 90% complete. The risk assessment for Edenville and Sanford will be completed during Summer 2022 with the goal of having 60% designs ready by October 2022. The current flood frequency numbers suggest an IDF equal to 10,000-year storm at both Secord and Smallwood Dams. The flood study results have been posted to the FLTF document library website.

### **Recommendations for Long Term Dam Safety Monitoring, Operation and Maintenance to Preserve Dam Safety**

1. New Potential Failure Modes Analyses are being conducted to assess the potential failure modes (PFM's) related to the proposed designs and construction of each of the four dams. Representatives from GEI, Spicer Group, FLTF, AECOM and EGLE all contribute. By identifying the potential failure causes and development, provisions can be incorporated into the final designs to mitigate the identified PFMs. Risk reduction measures generated from the PFMA session will be provided in the 90% Design Reports for each of the Projects and will be used to guide development of the construction and long-term dam safety surveillance monitoring plans tailored specifically to the most credible PFMs at the Project.
2. Update the Dam Safety Monitoring Program (DSSMP): GEI is working with FLTF to prepare new DSSMPs to define required instrumentation monitoring frequencies and threshold values during construction, after construction when the impoundments are refilled, and to monitor the long-term performance of the dam.
3. Operator Training: GEI has developed a dam safety training program for FLTF operations staff.
4. Maintain an annually updated Emergency Action Plan.

### **Closing**

GEI appreciates the opportunity to review the IFT's Final Report dated May 4, 2022. Our final reconstruction designs and solutions will consider the findings of the IFT, and the failure mechanisms outlined therein. Considering the failure mechanisms outlined above and to prevent embankment failure from happening again at Secord, Smallwood, Edenville or Sanford we expect that these proposed improvements will greatly reduce the risk of each of failure mode identified by the IFT.

### **References**

1. Independent Forensic Team Final Report. *Investigation of Failure of Edenville and Sanford Dams*, May 2022.
2. Mead & Hunt (2005) *Supporting Technical Information Document (STID) for Edenville Dam*, December (last updated by Boyce Hydro in April 2015).
3. Federal Energy Regulatory Commission (FERC) *Engineering Guidelines for Evaluation of Hydropower Projects*, Chapters, 3, 4 and 10 (most recent versions).
4. GEI (2021a) 60% Design Report – Secord, November 12, 2021.
5. GEI (2021b) 60% Design Report – Smallwood, November 12, 2021.
6. GEI (2022a) Static Liquefaction Failure Mechanism - White Paper, February 14.
7. GEI (2022b) Semi-Quantitative Risk Analysis – Spillway Design, Secord and Smallwood Dams, FLTF, January
8. GEI (2022c) Edenville Geotechnical Data Report, April 8, 2022.



Four Lakes Task Force Response to  
The Independent Forensic Team's Final Report (IFT Report)  
Investigation of Failures of the Edenville and Sanford Dams

**APPENDIX B**  
**AYRES' REPORT**

---

---

**MEMORANDUM**

---

---

To: Mr. David Kepler, Four Lakes Task Force

---

From: Ellen Faulkner, P.E., Ayres Associates

---

Date: May 22, 2022

Project No.: 26-1145.00

---

Re: Comments on Design Flood Related Issues Raised in Independent Forensic Team Report, Edenville and Sanford Dam Failures

---

---

**Overview**

Ayres has reviewed the Independent Forensic Team (IFT) report on the 2020 failures of the Edenville and Sanford Dams, with particular attention to the IFT's discussion of the estimation of flood magnitude probabilities at the dams (Ref. 1). The findings and opinions of the IFT may pertain to the selection of design floods used in restoration of the Secord, Smallwood, Edenville, and Sanford Dams.

Appendix C of the IFT report describes hydrologic analyses conducted for the dams in the past, dating from a 1978 Probable Maximum Flood (PMF) analysis to the 2021 studies of the Probable Maximum Precipitation, PMF, and probability-based precipitation and flood estimates. As noted by the IFT, the studies prior to 2020 focused on the Probable Maximum Flood (PMF). The PMF is defined by the FERC as "...the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the drainage basin under study." (Ref. 2). The PMF has not traditionally been assigned a specific flood return period or probability.

The IFT report makes the essential point that in 2020 an unusual flood was produced by a critical combination of precipitation and antecedent watershed conditions. The following discussion outlines the steps taken to align Ayres' current hydrologic model to the May 2020 event, and how these steps align with the IFT report and recommendations.

**Response to Section 7 of the IFT report, titled "Contributions of Human Factors"**

The IFT asserts that:

*...the potential for non-extreme storms to produce unusually high runoff during the cold season (until about the end of May) due to ground freezing and saturation in the Edenville Dam watershed was not recognized by the dam owners, their engineering consultants, FERC, or EGLE, [although] there were several warning signs that such an event could occur.*

The IFT offers the opinion that the historic focus on the PMF and the lack of recognition of flood potential under frozen-ground conditions led these parties to misunderstand the likelihood of a flood having the magnitude of the May 2020 event. Watershed model studies through 2020 focused on the PMF because that was the basis for both FERC's and EGLE's design requirements. The 1994 Mead & Hunt PMF model explicitly considered frozen ground combined with snowmelt and found those conditions to be less critical than a warm-season Probable Maximum Storm. The 2020 Ayres PMF study presented a qualitative and quantitative discussion of potential frozen-ground and snowmelt flooding, with reference to the 1994 findings. The 2021 model studies considered flood frequency as well as the PMF and focused through calibration on the high-runoff-potential conditions that produced severe flooding in 2014 and 2020, as discussed below.

The IFT also emphasizes that flood risk should be considered across the range of observed and potential events rather than focusing on a single extreme design flood. That approach has been adopted by the design team for restoration of the dams.

For the reasons outlined below, we recommend no new modifications to the current HEC-HMS model to account for ground freezing and/or saturation in the watershed because the existing calibration procedure addressed the potential for impervious conditions combining with "non-extreme" or extreme storms.

The HEC-HMS model used to generate the flood probability curve proposed for use in the current design was calibrated to the May 2020 event and three others. The model specifies the proportion of the watershed that would behave as

completely or nearly impervious, which simulates frozen or saturated conditions. As described in Ayres' July 2021 *Design Flood Study* report (Ref. 3), the greatest weighting among the four calibration events was given to the 2020 flood, which exhibited the lowest loss rates of the four. The second-greatest weight was given to the loss rates calibrated to the April 2014 event. The 2014 flood was noted by the IFT for having produced a dam failure in a nearby watershed. This 2014 event was also used as the critical calibration event in Ayres' 2020 PMF study, completed just prior to the May 2020 flood.

The current model, calibrated to include the 2020 flood, represents 14 percent of the watershed as completely impervious and another 46 percent as nearly impervious with a soil infiltration rate less than 0.1 inch per hour. In calibration, the modeled runoff ratio (the percent of rainfall converted to direct runoff) for the 2020 event was 42 percent between May 17 and May 22, 2020. This result compares favorably to the IFT estimate of 35 percent (Ref. 1, Section 5.2.4).

The model calibration focused on reproducing the runoff that occurred in 2020 and 2014, without specifying a physical cause, because multiple causes or combinations could have been involved. The IFT's hypothesis that cold overnight temperatures before the May 2020 storm led to a frozen soil surface in some parts of the watershed may or may not be correct. We reviewed April and early May, 2020 soil and air temperature records at four agricultural research stations surrounding the watershed (McBain, Kawkawlin, Krueger Farms, and Mt. Pleasant), as recorded by the Michigan Automated Weather Network (<https://mawn.geo.msu.edu/>). Data from the station recording the lowest soil temperatures, Autumn Vista Dairy at McBain, are reproduced below.

**Enviro-weather**  
formerly Michigan Automated Weather Network (MAWN)

```

STATION:          mcbain
STATION ID:       mcb
LOCATION:          Autumn Vista Dairy
CITY:            McBain

LATITUDE:        44.1861 deg.
LONGITUDE:       -85.1251 deg.
ELEVATION:       359.66 m

LOGGER PROGRAM:   mcb-bbad
DATE/TIME:       2022-05-17/11:42:26
  
```

=====

DAILY WEATHER DATA - SUMMARY:

=====

DATE	ATMP_MAX	ATMP_MIN	PCPN	SOILO_MAX	SOILO_MIN	SOILL_MAX	SOILL_MIN	SRAD
04/15/2020	35.1	17.9	----	40.0	34.8	39.3	36.0	379.6
04/16/2020	38.1	21.8	----	40.8	34.3	39.4	35.3	433.3
04/17/2020	46.1	25.5	----	46.2	34.3	43.4	35.3	403.4
04/18/2020	54.1	27.2	----	49.7	35.5	46.3	36.5	546.0
04/19/2020	47.6	27.1	----	46.5	39.9	44.7	41.2	472.3
04/20/2020	55.9	24.0	0.23	50.5	35.8	46.9	37.1	494.1
04/21/2020	34.3	21.8	0.01	43.9	35.9	44.2	37.2	431.1
04/22/2020	36.8	19.2	0.01	41.8	34.2	40.4	35.2	254.4
04/23/2020	42.1	31.0	----	41.4	37.3	40.5	37.7	140.3
04/24/2020	53.5	32.7	----	49.2	38.0	46.5	38.3	396.2
04/25/2020	57.1	27.0	----	50.3	38.6	47.4	39.5	396.6
04/26/2020	63.7	29.9	----	52.1	39.3	49.0	40.3	608.1
04/27/2020	55.5	26.7	0.12	48.7	39.6	46.6	40.8	272.2
04/28/2020	65.9	40.7	0.07	57.7	44.0	53.5	44.0	424.7
04/29/2020	51.0	41.3	1.34	51.9	47.7	51.0	47.8	42.6
04/30/2020	41.7	36.9	0.11	47.7	43.7	47.8	44.3	109.3
05/01/2020	65.8	32.4	----	57.1	40.7	53.3	41.7	580.7
05/02/2020	70.5	47.2	----	59.0	48.8	55.5	48.5	487.4
05/03/2020	63.4	36.0	----	57.6	48.3	54.9	48.8	636.4
05/04/2020	54.1	33.9	----	54.7	44.2	52.2	45.2	598.0
05/05/2020	50.8	28.3	----	51.4	42.9	49.8	44.2	383.9
05/06/2020	59.9	27.4	----	54.1	41.6	51.4	43.1	647.3
05/07/2020	51.3	32.5	----	52.5	43.6	50.4	44.6	636.8
05/08/2020	37.5	25.3	0.01	45.1	39.0	46.3	40.8	448.8
05/09/2020	49.8	22.9	----	46.7	36.6	45.1	38.4	536.2
05/10/2020	40.6	31.2	0.27	43.0	38.5	43.5	39.6	159.0
05/11/2020	44.8	27.2	----	47.3	37.4	45.2	38.3	594.5
05/12/2020	49.4	22.5	----	48.5	36.5	46.2	38.0	655.8
05/13/2020	59.3	21.6	----	54.4	36.8	50.5	38.4	604.5
05/14/2020	55.5	41.6	0.05	49.2	45.7	47.9	45.5	104.5
05/15/2020	71.3	44.4	0.07	58.8	47.8	55.1	47.2	478.0
05/16/2020	68.5	37.3	----	62.1	47.4	57.7	47.9	596.6
05/17/2020	55.9	46.6	0.50	55.1	50.6	54.6	50.5	124.2
05/18/2020	52.2	48.7	2.88	50.6	49.9	50.5	49.6	55.0
05/19/2020	62.8	49.7	0.06	57.6	49.8	55.1	49.6	427.6

=====

Variable Ids:

```

ATMP_MAX:      Max Air Temperature [1.5m] (F)
ATMP_MIN:      Min Air Temperature [1.5m] (F)
PCPN:         Precipitation (in)
SOILO_MAX:     Max Soil Temperature [5cm] (F)
SOILO_MIN:     Min Soil Temperature [5cm] (F)
SOILL_MAX:     Max Soil Temperature [10cm] (F)
SOILL_MIN:     Min Soil Temperature [10cm] (F)
SRAD:         Total Solar Flux (ly)
  
```

=====

Data provided by the Michigan Automated Weather Network (MAWN) and Enviro-weather Program.

This station is an agricultural research facility and likely is an unshaded, upland site. Still, we consider the following observations pertinent:

- Minimum daily soil temperatures at 2” and 4” depths (SOIL0\_MIN and SOIL1\_MIN, respectively) had not been below freezing for a month prior to the May 17-19 storm.
- Soil temperatures generally increased slightly with depth.
- Overnight low temperatures did not result in frozen soils at a 2” depth or a 4” depth.
- Over one inch of rainfall occurred at McBain at the end of April. At Gladwin, near the middle of the Edenville Dam watershed, the April 29-30 rain depth was 1.7 inches; and at West Branch, near the northern divide, it was 2.3 inches ( <https://www.ncei.noaa.gov/maps/daily-summaries/> ).

As the IFT points out, soil frost may have lingered longer in forested wetlands than at the MAWN sites. Even if the ground was not frozen, the watershed’s low-lying areas were likely in a critically saturated condition due to a significant rainfall shortly before the May 2020 storm and the time of year (early growing season and recent snowmelt). Our model, as noted above, showed a 42% runoff ratio in May 2020 compared to the IFT estimate of 35%.

In summary, the current model supporting spillway design represents the critical conditions experienced in May 2020 and aligns with the IFT opinion regarding impervious conditions. Ayres’ model is slightly more conservative for runoff than the IFT estimate but compares favorably to the actual conditions experienced in both 2020 and 2014. Since these results are consistent with the IFT recommendations, we recommend no changes based on the IFT findings.

Note that the HEC-HMS model was applied to estimate probability-based floods for the first time in 2021. Previously, HEC-HMS and HEC-1 were applied only to estimate the PMF, which was not related to any exceedance probability. Separate estimates of flood frequency at the dam sites were made in 2015 and 2021 by Ayres (Refs. 3,4) and in the Gladwin County Flood Insurance Study (Ref. 5) using statistical analysis of peak-flow records at the dams and at the U.S. Geological Survey’s Midland stream gage. These records include many March, April, and May floods and would be expected to represent the frozen or saturated watershed conditions of concern to the IFT.

### **Application of HEC-HMS Watershed Model for Design Flood Development**

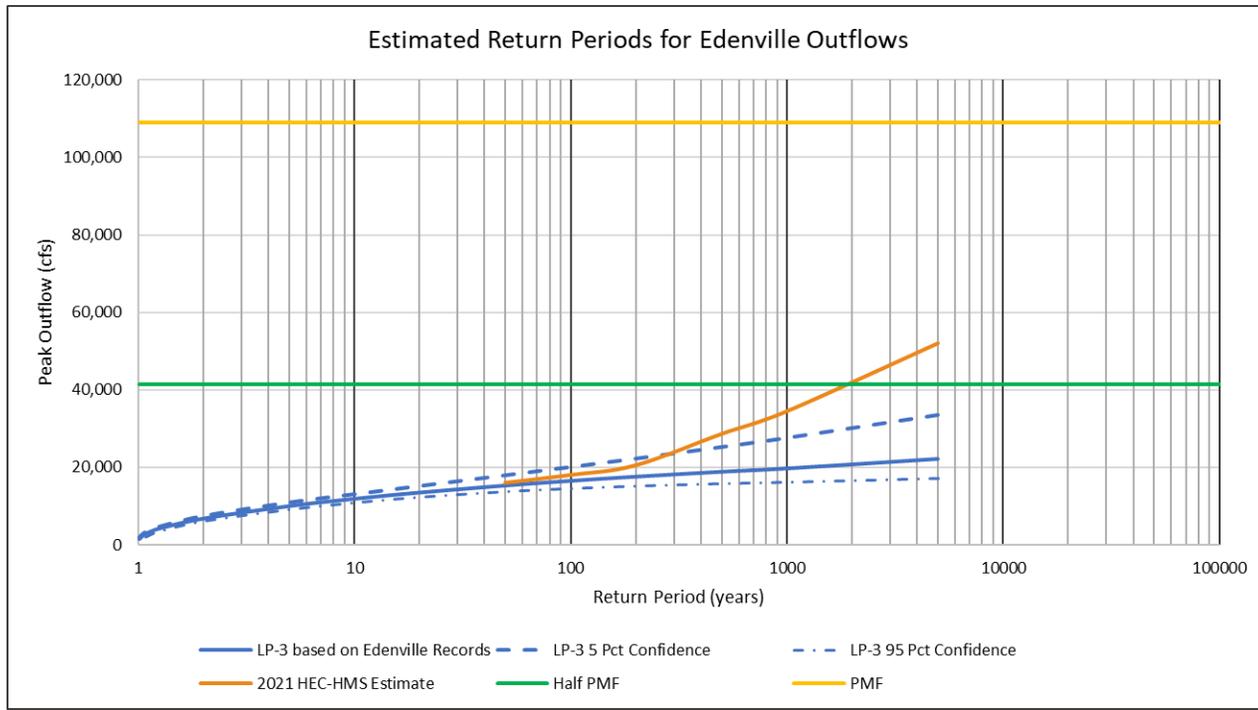
The IFT references several applications of the HEC-HMS and HEC-1 rainfall-runoff models prior to the 2020 flood, all used to estimate the Probable Maximum Flood at the Four Lakes dams. Following the 2020 flood and dam breaches, the design team increased the focus on considering risk over a range of flood magnitudes, necessitating estimates of the magnitude of very rare, probability-based floods.

Methods of estimating extreme flood probability fall into two broad categories – streamflow-record based and rainfall-runoff model based. The advantage of using streamflow records and a Log Pearson Type 3 statistical analysis is that a rainfall-runoff model does not have to be developed and calibrated; and an assumption that the *n*-year precipitation will cause the *n*-year flood is not involved. The disadvantage is that records are typically short compared to design event return periods, creating large statistical uncertainty bands for very rare floods.

Rainfall-runoff models range from very simple ones using standardized, literature-based loss and timing parameters to very complex ones utilizing large amounts of spatially and temporally detailed data for calibration and application. The Tittabawassee River HEC-HMS model now being used to inform design flood selection utilized four historic floods for calibration and a fifth for validation. Flood flows for calibration were derived from dam records and two USGS gages in the Tobacco River basin. The associated rainfall temporal and spatial distributions were estimated in a 2020-2021 analysis by Applied Weather Associates (Ref. 6). The HEC-HMS study explicitly acknowledged that effective hydrologic losses are not consistent across all flood events and applied a weighting procedure to favor (a) the events having the most complete and reliable calibration data; (b) for the PMF, the most critical events; and (c) for probability-based floods, the events in which the flood peak frequency and precipitation frequency most closely matched one another. As discussed above, the weighting process for both the PMF and probability-based floods gave the greatest weight to the 2020 event and second greatest weight to the 2014 event. Both of these involved the critical springtime flooding mechanisms raised by the IFT.

The chart below was generated by Ayres in 2021 (Ref. 7). It illustrates the similarities and differences between flood estimates based on direct flow records and on the calibrated HEC-HMS rainfall-runoff model. The blue solid line represents a Log Pearson Type 3 statistical analysis of recorded Edenville Dam outflows through 2020, and the blue dashed lines represent the statistical upper- and lower-95 percent confidence bounds. (Note that the calculated confidence bounds are related to the sample size and variance only, and do not include measurement uncertainty.) The orange line represents the results of 2021 HEC-HMS rainfall-runoff modeling for 72-hour storms having the specified return period, based on Applied Weather Associates’ 2020-2021 study (Ref. 8). These values (the orange line), updated for the proposed post-restoration spillway rating curves and extended to longer return periods, are being used in the spillway design. The estimated PMF and half-PMP flood are also shown for reference.

The rainfall-runoff model results track the statistical estimates quite closely through approximately the 200-year flood, and then begin to rise above the statistical curve. Computationally, this is due to the structure of the HEC-HMS model which allows certain portions of the watershed to begin generating significant runoff only when the rainfall intensity increases above the 200-year level. This representation cannot be tested for accuracy, but we consider it an appropriately conservative approach that responds to the IFT’s general observation that extreme floods may involve runoff processes not represented in the past record.



References

1. Independent Forensic Team, *Final Report: Investigation of Failures of Edenville and Sanford Dams*, May 2022.
2. Federal Energy Regulatory Commission Division of Dam Safety and Inspections, *Engineering Guidelines for the Evaluation of Hydropower Projects*, Chapter 8, 2001.
3. Ayres, *Design Flood Hydrologic Analyses, Secord, Smallwood, Edenville, and Sanford Dams*, July 2021
4. Ayres, *Flood Frequency Calculations*, Cited in Ref. 1; Letter from Boyce Hydro Power, LLC, to FERC, 2015
5. Federal Emergency Management Agency (FEMA), *Flood Insurance Study, Gladwin County, MI*, 2018.
6. Applied Weather Associates, SPAS Analysis of 1996, 2014, 2017, and 2020 Michigan Storms, provided as GIS and data files to Ayres, 2021.
7. Ayres, *Upper Tittabawassee River Flood Modeling*, PowerPoint Presentation to Michigan EGLE, June 9, 2021.
8. Applied Weather Associates, *Precipitation Frequency Analysis of Tittabawassee River Basin*, 2021.



Four Lakes Task Force Response to  
The Independent Forensic Team's Final Report (IFT Report)  
Investigation of Failures of the Edenville and Sanford Dams

**APPENDIX C**  
**LEGAL POSITION FROM CLARK HILL**  
**ON DAM OWNERSHIP IN MICHIGAN**

TO: Dave Kepler, President, Four Lakes Task Force

FROM: Joseph W. Colaianne

DATE: May 19, 2022

SUBJECT: Independent Forensic Team Final Report Investigation of Failure of Edenville and Sanford Dams; Four Lakes Task Force (FLTF), Midland, Michigan

---

## **Introduction**

Following the Edenville and Sanford Dam failure on May 19, 2020, the Federal Energy Regulatory Commission (FERC) engaged a five-member independent forensic team (IFT) to investigate the failure and the physical and human factors that contributed to the failures. On May 4, 2022, the IFT issued their Final Report on the physical mechanisms and human factors involved in the failures. As requested by the Four Lakes Task Force (FLTF), Clark Hill has reviewed the IFT report and prepared this response in connection with certain statements made in connection with the Counties, FLTF and lakefront property owners role leading up to and after the dam failures.

There is a fundamental mistake and/or misunderstanding in connection with the facts and opinions related to dam ownership and control detailed in Section 7 "Contributions of Human Factors to the Edenville Dam Failure" as it relates to the IFT's interpretation of dam ownership. At no time did the Counties, the FLTF, or the lakefront property owners have the legal authority to operate and control the dams prior to and immediately following the dam failures. Since 2006, W.D. Boyce Trust and its related entities (as detailed in Figure 7-1, IFT Report p76) retained ownership and Boyce Hydro Power exercised control of the dams (under FERC's regulatory authority, and for a short period, beginning in 2019 Edenville Dam was under EGLE's dam safety authority), until the Counties, through FLTF, condemned the Boyce-owned properties in July 2020 (with the vesting of title occurring in December 2020).

FERC's decision to revoke the Boyce Hydro Power Edenville License in early 2018 created an unintentional chaotic situation that could have been avoided. FERC did not prepare EGLE for the transition from FERC regulatory oversight to State regulatory oversight, and further, did not prepare or truly consider the impact the license revocation could or would have on the Four Lakes community that would be subject to the behavior of Boyce Hydro Power. Indeed, despite communication from the Four Lakes community of its concerns both prior to and at the time of license revocation that transitioning from a private ownership model to a public ownership model (or possibly a public-private ownership model), FERC did not take the appropriate action, and work with the Counties. The IFT Report missed the basic fact that FERC could not control the behavior of Boyce Hydro Power and its representative, Lee Mueller. The FERC record shows there was problem and Boyce Hydro Power was not in compliance with many aspects of its obligations. Specifically, in connection with the events leading up to, during and following the dam failures, Boyce Hydro Power did not have a "owner's" dam engineer available.

The IFT report states, "[U]nder, Part 315 and 307 of the Michigan Natural Resource and Protection Act, the *functional* [Italics from the report] 'ownership' of the dam from EGLE's perspective became less clear." The report improperly quotes different sections of Michigan law to introduce the undefined term "*functional ownership*"; and proceeds to apply this term to the FLTF. The IFT Report then renders the following opinion: "*the situation having two organizations functionally (not legally) acting in a dam owner's role did not generally result in significant gaps with respect to engineering studies and decisions under normal dam operating conditions; however, it did have implication for decision-making during the May 2020 event (See Section 6).*" This statement is both factually and legally unsupported and represents a fundamental flaw in the interpretations and opinions expressed in connection with the "human factors involved in the dam failures." The term "functional ownership" is a fictional term created by the authors of the IFT. It is not specifically defined in the report and creates unwarranted confusion. Indeed, quoting sections of Michigan law and drawing conclusions from comments received from EGLE without legal assistance and confirmation from other stakeholders, at a minimum, distracts from the purpose of the report. The IFT should have sought legal assistance in connection with the roles and legal responsibilities of the various stakeholders before drawing conclusions.

Neither the Counties of Midland and Gladwin, the FLTF or the lakefront property owners were in any position to control or regulate the dams without the consent of the dam owner. As discussed in more detail below, the legal process under Part 307 "Inland Lake Levels" of the Michigan Natural Resources and Environmental Protection Act, 1994, PA 451, as amended, (Part 307)<sup>11</sup> is a serial process, meaning there are a series of tasks that must be carried out in sequence before control/jurisdiction over the dams could be asserted by the Counties or its delegated authority, the FLTF. One of the critical steps was acquisition of the dams, either by "gift, grant, purchase or condemnation proceedings, of an existing dam". MCL 324.30708(2). This never happened prior to and leading up to the dam failures because acquisition of dams by the Counties/FLTF was not completed. The regulatory authority (and jurisdiction to order the dam owner to do anything), resided solely with federal and/or state regulatory agencies responsible for dam safety and protection of the public. The IFT report in regard to dam ownership and control responsibilities (outlined in Section 7 of the IFT Report) leading up to the dam failures creates unwarranted confusion as to the decision-making process. To reiterate, the term "functional ownership" is a fictional concept or term wholly unsupported factually and legally.

## **Discussion**

Michigan common law does not require a private dam owner to maintain the existence of a dam or the artificial level of a lake. The case of *Goodrich v McMillan*<sup>12</sup> established the rule in Michigan - that ownership of a dam does not impose a duty on the dam owner to maintain the water at an artificial level created by operation of a dam. The harshness of the common law created considerable uncertainty among lakefront property owners. Part 307 (and prior Michigan law dating back to the early 1900's) provides a public solution for preserving lakes that were created by the artificial impoundment of water. It provides a means to transition private ownership and control of dams to public ownership and/or control of dams.

The purpose of Part 307 is to provide for the control and maintenance of inland lake levels for the benefit and welfare of the public.<sup>13</sup> Part 307 essentially authorizes counties to make policy decisions as to the levels of their inland lakes, and to build and finance dams as necessary to maintain the desired lake levels.<sup>14</sup> Part 307 also provides the financial model for sustainability of lake level structures. Part 307 authorizes the establishment of a special assessment district to defray the costs in connection with administration, operation, maintenance and improvement of lake level structures.<sup>15</sup> Moreover, the special assessment district is authorized to issue municipal bonds, notes and lake level orders in anticipation of special assessments.<sup>16</sup> Municipal securities (i.e. Bonds and Notes) can be issued for up to a period of 40 years. The entity responsible for operating and maintaining the normal levels established by the circuit court, is the entity or "Delegated Authority" appointed by the county board of commissioners.

The process under Part 307 is a serial process that requires undertaking certain steps in sequence in order for a county to assume jurisdiction and control over lake level facilities. The steps include:

- (1) Petition by lakefront property owners to the county board of commissioners or upon motion of the county board of commissioners to petition the circuit court to establish the normal levels of an inland lake.
- (2) Before proceeding on a petition or motion, however, a county may require a preliminary study by a professional engineer to determine the feasibility of a lake level project.
- (3) Next, legal action in the county circuit court is required to establish normal levels and confirm the boundaries of the lake level special assessment district. The legal action requires notice to property owners within the proposed special assessment district, public corporations and state agencies. The circuit court is then required to make a determination considering multiple facts (as set forth in Part 307).
- (4) Once the lake level is established, the county will need to acquire or construct the lake level facilities. For an existing (privately owned) dam, the county may acquire either by "gift, grant, purchase or

---

<sup>11</sup> MCL 324.30701 et seq.,

<sup>12</sup> *Goodrich v. McMillan*, 217 Mich. 630, 187 NW 368 (1922).

<sup>13</sup> *In re Martiny Lakes Project*, 381 Mich 180, 187; 160 NW2d 909 (1968); *Lenawee Board of Comm'rs v Abraham*, 93 Mich App 774, 779; 287 NW2d 371 (1979).

<sup>14</sup> *In re Matter of Van Etten Lake*, 149 Mich App 517, 525; 386 NW 2d 572 (1986).

<sup>15</sup> MCL 324.30711(1): "The county board may determine by resolution that the whole or a part of the cost of a project to establish and maintain a normal level for an inland lake shall be defrayed by special assessments against the following that are benefited by the project: privately owned parcels of land, political subdivisions of the state, and state owned lands under the jurisdiction and control of the department. If the county board determines that a special assessment district is to be established, the delegated authority shall compute the cost of the project and prepare a special assessment roll."

<sup>16</sup> MCL 324.30705.

condemnation proceedings" of an existing dam. A county may also construct a new dam and may drill wells or pump water necessary to maintain the lake levels.

- (5) Prior to construction, the county delegated authority is required to obtain all necessary permits, and the plans and specifications must be approved by the State of Michigan.
- (6) Prior to construction, the county delegated authority must prepare a computation of cost, and if it intends to defray the costs associated with the lake level project, must prepare a special assessment roll and conduct a special assessment hearing.
- (7) Finally, before assessing the costs of a lake level project, the county board of commissioners must approve the project costs and special assessment roll.

In early 2018, a group of lakefront property owners learned that Boyce Hydro Power was not in compliance with its terms of the FERC license (in connection with the Edenville Dam) and that FERC was proposing to revoke the Edenville license. Concerned with the potential loss of Wixom Lake, and future loss of the other three lakes, the Four Lakes community was looking for a long-term solution to managing lakes levels, and if possible, transition private ownership of the dams to public ownership.

In July 2018, the Counties of Midland and Gladwin adopted resolutions recommending and inviting the lake associations or representatives for all Four Lakes, to form a "Citizen Task Force" to develop a plan and present recommendations for establishing the normal (i.e., legal) levels of all Four Lakes. The Citizen Task Force was also to address recommendations with respect to the potential special assessment boundaries and the entity to serve as the Counties' Delegated Authority (to oversee and manage the lake levels, prepare the special assessment district, and the options for the long-term ownership, finance, operations, maintenance and improvement of the lake level structures).

At this time, after years of noncompliance, obfuscation, needless extensions and outright delays perpetrated by Boyce Hydro Power, on September 18, 2018, FERC revoked the license for the Edenville dam. The water levels at Wixom Lake were lowered, and pending jurisdiction over dam safety was to transition from FERC oversight to Michigan's dam safety unit. The regulatory framework in place did not adequately address this transition, and the Four lakes community expressed concerns in connection with dam safety to FERC and the State of Michigan's Department of Environment, Great Lakes and Energy (EGLE).

In October 2018, the Counties adopted resolutions finding that in "order to protect the public's health, safety and welfare, to best preserve the natural resources of the state, and to preserve and protect the value of property around the lakes"<sup>17</sup> that it was necessary to establish the normal levels for all Four Lakes. In addition, the resolutions provided that all costs in connection with the maintenance of the normal levels of the Four Lakes "shall be defrayed by special assessments for the benefits derived against privately owned parcels of land, political subdivisions of the state, and state owned lands."<sup>18</sup> The Sanford Lake Preservation Association (now known as Four Lakes Task Force, FLTF) was appointed the Counties' Delegated Authority, and to act on behalf of the Board of Commissioners to oversee the lake level project, to prepare a special assessment district(s) and special assessment roll(s), and to "take all other actions as necessary and required by the delegated authority as provided in Part 307."<sup>19</sup> The Counties further directed their respective legal counsel to file a petition in the circuit courts of the Counties for the determination of the legal lake levels and boundaries of the special assessment district.

In accordance with the Counties' resolutions, a petition was filed in both the circuit courts of Midland and Gladwin counties. By order of the State Court Administrator, Midland County Judge Stephen Carras was assigned to hear both cases, including the case filed in the Gladwin County Circuit Court. In preparation of the hearing, the counties commissioned Spicer Group, Inc., consulting engineers to prepare a lake level study. The "Four Lakes Lake Level Study" was issued in April 2019. The objective of the report was the establishment of normal levels for the Four Lakes. The report details conditions that existed at that time, and properties benefitting from the establishment of the normal levels. On May 3, 2019, Judge Carras received information supporting the petition, the Four Lakes Lake Level Report, and testimony. After providing an opportunity for all those present at the hearing and taking into consideration the factors set forth in Part 307, on May 28, 2019, Judge Carras established the normal levels for each of the Four Lakes. The levels established for each of the Four Lakes was

---

<sup>17</sup> County of Gladwin Resolution 2018-034 adopted October 9, 2018; County Midland Resolution, adopted October 16, 2018.

<sup>18</sup> Id.

<sup>19</sup> Id.

based on the historical water levels and conditions set forth in the FERC licenses. Judge Carras also approved the Four Lakes Special Assessment District.

Following the court hearing, FLTF proceeded to negotiate terms with the Boyce Entities (Boyce) to acquire the dams. A purchase agreement was signed on December 31, 2019. The purchase agreement, among other things, provided that Boyce would retain "possession and control of the dams through the date of the closing" (the formal transfer of the dams and related assets) in January 2022. In addition, the purchase agreement contemplated a series of payments, beginning with the "Option and First Installment Payment", "Quarterly Payments" and "Final Payment". None of the conditions precedent to the Closing and set forth in the purchase agreement would take effect until the "Option and First Installment Payment" was made. Originally, this first payment was to occur in January 2020, but the purchase agreement was amended in April 2020 (pushing back the dates in the purchase agreement). The "Option and First Installment Payment" was to be made in June 2020, but due to the catastrophic dam failures in May 2020, the transaction was terminated.

All actions taken by FLTF and its consultants prior to the dam failures, was due diligence in connection with the acquisition of the dams and hydroelectricity business. This due diligence included, among other things, engineering, hydrologic and hydraulic, environmental studies; financial feasibility analysis; and establishing the governance structure (i.e., Part 307 process) to carry out the transition from private ownership to public ownership. At all times during and leading up to the dam failures, however, the sole authority in connection with the ownership and operations of the dams resided with Boyce, and would have remained so, until Final Closing. Accordingly, contrary to the IFT's representations and opinions there was no confusion as the decision-making process, as Boyce Hydro Power had full and complete authority over operations.

This fact is never more illustrated by the events following the dam failures. Immediately after the dam failures, FLTF attempted to obtain access to the dam sites and facilities in order coordinate and facilitate emergency actions and debris removal. This was not able to take place until after the Midland and Gladwin Counties proceeded to exercise eminent domain and file legal action to condemn the Boyce-owned property. Emergency response was further delayed because Boyce Hydro Power filed for bankruptcy protection that impeded the Counties to condemn. Ultimately, after lengthy negotiations, a settlement was reached and US Bankruptcy Court approved settlement which led to the counties receiving title to the dams in December 2020.

## **Conclusion**

It defies all common sense and logic in the context of analyzing human factors involved in the dam failures, to suggest that the Counties, FLTF or the lakefront property owners would be contributing factor that led to the dam failures. Since 2006 Boyce profited from the revenue derived from production of hydroelectricity, failed to re-invest in infrastructure improvements (as the owner and operator should), and avoided/delayed compliance with its obligations under its FERC licenses.

W.D. Boyce Trusts acquired the Edenville dam knowing there was need for increased spillway. FERC should have facilitated a transfer of the FERC license years earlier to a different ownership model, rather than permitting Boyce Hydro Power to profit from hydroelectricity while neglecting dam safety and environmental compliance. The FLTF came into being in 2018 for the purpose of protecting the interests of the counties and Four Lakes community. The motives of the Four Lakes community cannot be said to have been a contributing factor in the dam failures.



Four Lakes Task Force Response to  
The Independent Forensic Team's Final Report (IFT Report)  
Investigation of Failures of the Edenville and Sanford Dams

**APPENDIX D**  
**CHRONOLOGY OF OWNERSHIP TRANSITION**  
**2017 to 2021**

## Ownership Transition of the Four Lakes June 2017 to June 2021

### Transition of Ownership

This timeline is constructed with the major milestones in the Journey from Private to Public Ownership. It does not cover the rescue, recovery or restoration actions, or dam operations during this period. FLTF believes, it provides an insight to a system that can be improved.

<b>June 2017</b>	FERC issues a Compliance Order to Boyce regarding the Edenville facility.
<b>November 2017</b>	FERC issues a Cease Generation Order to Boyce due to violations of the Federal Power Act, the Edenville power generation license, and the Compliance Order of June 15, 2017. As a result, Boyce can no longer run water through the turbines.
~~~	
<b>January 2018</b>	FERC issues a temporary stay on the Cease Generation Order until March 1, 2018. Boyce is allowed to run water through the turbines and generate electricity to safely manage Wixom Lake water levels during the winter months.  FERC grants a rehearing (appeal) of the Cease Generation Order.
<b>February 2018</b>	FERC issues an order denying a rehearing of the Cease Generation Order.  FERC issues an order proposing revocation of the Edenville License.
<b>March 2018</b>	Sanford Lake Preservation Association, Sanford Lake Association and Wixom Lake Association meet with staff members of Sen. Jim Stamas, Rep. John Moolenaar, EGLE and DNR to discuss the situation. The goal is to make sure the agencies and community understand FERC assumptions related to hydro facilities.  Wixom Lake Association (WLA) and Sanford Lake Preservation Association <sup>20</sup> (SLPA) file motions to intervene on the proposal to revoke the Edenville license.
<b>May 2018</b>	Edenville Dam safety inspection by FERC Chicago Regional Office. Report filed.
<b>July 2018</b>	Letter of Intent signed between SLPA and Boyce for the Purchase of the four hydro projects.  Wixom Lake Association (WLA), Sanford Lake Association (SLA), and Sanford Lake Preservation (SLPA) associations file first progress report on a project to preserve the Edenville Dam and Wixom Lake.
<b>September 2018</b>	FERC orders all four lakes' water levels to lower for inspection, per a national inspection program when license revocation occurs.  FERC issues Order Revoking License for the Edenville Dam because of noncompliance issues; dam reverts to state regulatory authority, in the period of the inspection.  Boyce Hydro lowers the lake level of Wixom Lake for inspection and keeps it lowered by 8 ft.

---

<sup>20</sup> Sanford Lake Preservation Association (SLPA) formed in January of 2011 to address repairs to restore the lake levels on Sanford Lake that lowered with an emergency permit in 2010 for repairs. SLPA acquired the Sanford bottomlands from Midland County in 2015 after the property was taken in a tax dispute. SLPA board voted to transition to the Four Lakes Task Force, with a change in operating and board by the end of 2018.

- October 2018** WLA and SLPA meet with DNR and EGLE to determine protocol. They learn that without a Part 307 order, EGLE Dam Safety cannot bring up the Wixom Lake water level unless the dam owner requests. At this meeting FLTF hears there has been little handoff of material from FERC to EGLE Dam Safety.
- State inspects Edenville Dam
- FLTF forms, via an MOU with lake associations, to establish legal lake levels in accordance with Part 307 Inland Lake Level of the Natural Resources and Environmental Protection Act, 1994 PA 451, MCL 324.30701 et seq.
- FERC issues Order Denying Rehearing (appeal) of Edenville license revocation.
- November 2018** Congressman Moolenaar and Dave Kepler meet on a call with FERC, asking for support of more time to manage the transition and to ensure a good transfer from Boyce.
- ~~~
- April 2019** FLTF and Boyce Hydro sign a tentative agreement to purchase the four lakes and dams with expectation to close in 2019.
- Boyce Hydro and FLTF agree to restore the water level for the summer of 2019, with the understanding that EGLE will permit this provided that a normal legal lake level is established and repairs to the Edenville Dam are implemented by 2024.
- FLTF submits an [engineering report](#) (developed by its consultant Spicer Group) to EGLE as support for the Gladwin Midland Circuit Court order to establish legal lake levels and establish the Four Lakes Special Assessment District (SAD) per resolution of the two counties.
- May 2019** Midland County Circuit Court Judge Stephen Carras, acting for Gladwin Circuit Court as well, enters an order establishing the SAD and setting the legal lake levels for the four lakes.
- June 2019** FLTF files to obtain a FERC preliminary hydro license to generate hydroelectric power for the Edenville Dam.
- FERC issues final denial of rehearing of Edenville Dam license revocation.
- August 2019** FLTF and engineering consultants begin due diligence review of dams and available records.
- Midland and Gladwin counties contract with FLTF as their legal Delegated Authority for acquiring, managing, repairing and maintaining the four dams.
- September 2019** FLTF submits inspection findings to EGLE, noting, “Since the dam was designed and constructed prior to the time of FERC and EGLE regulation, the original design did not consider present day design capacity requirements.” Additionally, the report explains that “[a]t this point in time, based on documents reviewed, the FLTF does not believe that the Edenville Dam can be operated to meet the EGLE dam safety requirement to pass the ½ PMF without certain repairs and improvements.”
- December 31, 2019** FLTF and Boyce Trusts sign a purchase agreement for the four dams, with anticipated Option and First Installment payment in January 2020 (and final closing and acquisition of dam facilities and properties to occur in January 2022).
- ~~~
- January 2020** EGLE confirms via e-mail the finding of FLTF’s consultants that Edenville Dam does not meet state requirements for spillway capacity (1/2 PMF).

Michigan Attorney General's Office informs Boyce Hydro and FLTF of its intent to file suit against Boyce Hydro for environmental damage due to drawdown below winter legal lake level.

FLTF bond attorneys raise concerns in connection with FLTF's request to proceed with interim bond financing for the acquisition. Accordingly, the Option and First Installment set forth in the purchase agreement was not paid to Boyce (and was delayed until June 2020).

**February 2020**

FLTF has preapplication meeting with EGLE staff to discuss status of project, potential schedule, conceptual auxiliary spillway locations, and permit requirements moving forward for Edenville Dam.

Boyce and FLTF meet with Attorney General's office and EGLE on a potential pre-litigation on the mussel matter between Boyce and the State.

EGLE issues Boyce Hydro Power a permit for concrete repairs to Edenville and Tobacco spillways under the administration of FLTF.

Boyce shares a redacted copy of the purchase agreement with the Attorney General's office.

**January-April 2020**

FLTF conducts three public hearings related to financing; Midland and Gladwin counties approve financing plans; FLTF pursues a bond anticipation note; bond financing not approved because of State of Michigan mussel lawsuit.

**April 2020**

Contractors complete concrete repairs on wing walls and pier noses of Edenville and Tobacco spillways. In addition, new lifting connections were installed on the existing gates to safely lift the gates to their maximum height once new hoist systems were installed. New hoists were ordered in April 2020 and were planned to be received and installed in the fall of 2020. EGLE issues permit to Boyce Hydro to raise Wixom Lake to summer level.

Resolution on impact of Attorney General's threatened litigation enables FLTF to move forward with the closing. FLTF and Boyce Hydro plan closing for early June 2020.

FLTF and Boyce agree to amend the Purchase Agreement and extend the Option and First Installment Date to June 1, 2020.

**April 29, 2020**

Boyce Hydro files a lawsuit against the State of Michigan.

**May 1, 2020**

Michigan Attorney General files a lawsuit against Boyce Hydro for environmental damage.

**May 9, 2020**

Boyce, FLTF and FLO complete an amendment to the purchase and license agreement setting the initial closing date for June 1, 2020 for the Option and First Installment Payment to Boyce (with the final closing to occur in January 2022).

**May 19, 2020**

**Edenville Dam fails along embankments and Sanford Dam experiences overtopping failure.**

FERC orders Boyce Hydro to draw down the remaining impounded water behind Secord, Smallwood and Sanford dams and form a fully independent forensic investigation team.

FLTF informs Boyce that the Purchase Agreement as contemplated cannot proceed.

FEMA issues a federal emergency declaration for the flooding. Governor Gretchen Whitmer also [requests a federal disaster declaration](#) for mid-Michigan counties impacted by flooding.

A crack is observed on the Tobacco River side of the Edenville Dam; EGLE Dam Safety informs Boyce Hydro of the need to have an engineer monitor the dam at all times; Boyce indicates no

engineer is available; FLTF gets formal request from Boyce in the interest of public safety, FLTF to stage an engineer at the dam for monitoring.

**June 2020**

Boyce Hydro informs FLTF that no employees representing FLTF are allowed on the dams; Boyce takes control of monitoring.

Gladwin and Midland Counties Resolve to Take Boyce Hydro Entities through the Authority under Part 307 of NEPRA, and the Michigan Uniform Condemnation Procedures Act. FLTF is assigned as their agent in this matter and the recovery of the four lakes, with resolution and amendment of the three-party contract between the parties.

**July 2020**

FLTF sends [letter](#) to FERC regarding Boyce Hydro's non-compliance.

President Donald Trump approves a major disaster declaration for Midland County and the surrounding area making millions of dollars in federal funds available.

Boyce Hydropower declares Bankruptcy

Judge Daniel Opperman of the U.S. Bankruptcy Court for the Eastern District of Michigan approves proceeding with the condemnation grants to allow FLTF to acquire title to the Boyce properties through condemnation.

**October 2020**

FLTF negotiates an [access agreement with Boyce Hydro](#) , to access properties and identify items for repair and compliance and prepare for winter and spring operations.

The [State of Michigan awards \\$15 million to FLTF](#) to aid in restoration efforts. Funding may be used for feasibility studies, and engineering design, flood and environmental studies, site readiness, and construction to restore lake levels.

FLTF and Boyce Hydro reach a settlement in connection with the condemnation litigation. In accordance with the [settlement agreement](#), the counties on behalf of the Four Lakes Special Assessment District, will obtain ownership of the Boyce properties.

USDA approves a low-interest loan for the recovery and rebuilding of the lakes and dams.

**December 7, 2020**

Judge Daniel Opperman of the U.S. Bankruptcy Court for the Eastern District of Michigan grants a motion to allow FLTF to acquire title to the Boyce properties through condemnation.

~~~

**January 2021**

FLTF [informs FERC](#) it does not intend to recover the investments needed to keep hydropower generation on the dams and requests that FERC finds a path to move regulatory authority to the State of Michigan.

FLTF officially receives ownership of Boyce Hydro properties.

**February 2021**

Boyce Hydro [applies to surrender FERC licenses](#).

**May 2021**

FLTF publishes comprehensive ["Plan for the Restoration of the Four Lakes."](#)

[FERC surrenders hydropower licenses](#) of Secord, Smallwood and Sanford dams, transferring jurisdiction to the state and counties.

Members of Michigan legislative delegation send [letter](#) to FERC and EPA encouraging assistance and support.

**June 2021**

EGLE Director Liesl Clark [thanks FLTF](#) for its cooperative engagement with the Agency and affirms its support of our path forward.

Luke Trumble, EGLE Dam Safety sends Letter to FLTF “ We have determined, based in part on a December 2020 consent judgement, that Midland and Gladwin Counties are the owner of four dams, Secord, Smallwood ,Edenville, and Sanford Dams, located on the Tittabawassee River in Gladwin and Midland Counties ” The letter informs FLTF of some of its key responsibilities, per the provisions of Parts 307 and 315. Part 307, Part 31 and EGLE’s administrative rules.



Four Lakes Task Force Response to  
The Independent Forensic Team's Final Report (IFT Report)  
Investigation of Failures of the Edenville and Sanford Dams

**APPENDIX E**  
**SPICER GROUP GATE TEST REPORT**



TO: Dave Kepler  
Four Lakes Task Force  
(989) 948-1438  
[dave@keplertcp.com](mailto:dave@keplertcp.com)

FROM: Ron Hansen, P.E., P.S.  
Principal Engineer  
Spicer Group, Inc.  
(989) 928-8021  
[ronh@spicergroup.com](mailto:ronh@spicergroup.com)

DATE: May 20, 2022

RE: Four Lakes – IFT Report Gate Tests

---

Dave,

In our capacity as a consulting engineer for the Four Lakes Task Force (FLTF), Spicer Group (SGI) referenced numerous times in the IFT report, most commonly with respect to the Spicer 2019 report to the gate tests. Below are several excerpts from the IFT report and some additional commentary from SGI:

*A letter from Boyce Hydro to FERC, dated August 31, 2015 (Boyce Hydro 2015d), indicated the following gate opening capabilities: Five of the six gates at Edenville Dam (Tobacco and Edenville spillways) could be lifted 11.2 feet with the A-frame system; Gate 1 at the Edenville spillway (adjacent to the powerhouse) could be lifted only 8 feet with the A-frame because of a restriction from bulging concrete, which has since fallen off; all six gates could be opened 7.5 feet without the A-frame.*

*Hence after 2019, Edenville Dam was the only one of the four dams where the gates could not be opened fully without the A-frame system.*

*A gate operation test was completed at Edenville Dam on June 14, 2019. The results were documented in a report from Spicer Group (Spicer) to EGLE, dated September 18, 2019 (Spicer 2019). That report included the following statements:*

*The current engineering opinion, based on observation of the gate tests, is the gates at Edenville should only be operated with the original hoist mechanisms until they can be replaced with electric hoists. Using the portable A-frames and the manual lever hoist is cumbersome and requires too much time to operate under emergency conditions. Most importantly, though, the A-frames require that a minimum of three operators be at each site. Those operators would be exposed to unsafe conditions, which is unacceptable. From discussions with the parties involved, the IFT understands that plans were being developed to modify the Edenville Dam gate hoists late in 2020 to allow for full opening, but at the time of*

*the May 17 through May 19 flood, the engineering guidance was that use of the A-frames was unsafe.*

With respect to the gate tests, on June 14, 2019, SGI was asked by the FLTF to observe the gate test for Edenville Dam. This is the first time SGI was allowed on the Edenville Dam by Boyce Hydro. Our role was to observe gate tests which were being conducted by Boyce's 12D engineering consultant, Purkeypile Consulting. The observations and conclusion of this gate test were summarized by Purkeypile and were presented to Boyce, along with FLTF in a June 19, 2019, technical memorandum. In this June 19 memorandum, it was stated that the gates should only be operated with the original hoist mechanisms until they can be replaced, and the A-Frame's put the operators in unsafe conditions "which is unacceptable". The memo went on to state the A-frames should not be used to raise the gates to PMF level openings. In summary, this engineering opinion stated in the IFT was originally put forth by the 12D dam safety engineer. Upon receiving this memo, the FLTF requested that SGI communicate the findings of the gate test with EGLE, this culminated in the September 18, 2019, memo referenced in the IFT report.

The gate heights that were achieved during this gate test were properly documented in the Spicer 2019 report. It should be noted, there was a new steel plate link installed to connect to the safety chains and a bending moment was observed on this steel plate link. Due to this bending moment, engineers were concerned with opening the gates higher than what was achieved that day.

At the time of the gate test, SGI was not aware of the August 2015 letter from Boyce to FERC stating the gates could be opened to a higher elevation. The 2015 CSIR, completed by Purkeypile stated under PMF 3, which addresses gate capacity, "The Licensee's plan for spillway capacity modifications include remotely operated gate modifications with individual gate operators." SGI was also not aware of this at the time of the inspection, but in retrospect, it is not likely that this CSIR statement was referenced to the A-frame system. It is not clear if any prior 12D consultant reviews of the A-Frame were conducted prior to 2019.

The FLTF asked SGI to communicate the findings of the gate test with EGLE and this culminated in the Spicer 2019 report, which reiterated the engineer opinions and identified, based on rating curves provided by EGLE, that the Edenville Dam did not meet current State of Michigan requirements. It was indicated in this memo to EGLE that installation of the new gate hoist was part of the FLTF plan. The FLTF had secured \$5M in funding from the State of Michigan, portions of which were used to enter into a contract with Lemke to fabricate new hoists. The IFT report addresses this as follows:

*During February 2020, FLTF contracted with Fisher Contracting to perform concrete repairs to Edenville Dam. Repair locations included the upstream piers and wingwalls on both the Tobacco and Tittabawassee spillways, and repairs consisted of removing and replacing deteriorated concrete. In addition, new lifting connections were installed on the existing gates to safely lift the gates to their maximum height once new hoist systems were installed. New hoists were ordered in April 2020 and were planned to be received and installed in the fall 2020, but the failure occurred in May 2020 before the hoists could be installed.*

The IFT report also looked at hypothetical scenarios and states the following:

*Three different pre-lowering scenarios were considered for the case of Edenville and Tobacco spillway gates opened at 7 feet (the estimated opening during the May 2020 event): (1) pre-lowering Wixom Lake to winter lake level (El. 672.8), (2) pre-lowering the lakes at all four Boyce Hydro dams to winter lake levels (3 feet below normal lake levels), and (3) pre-lowering Wixom Lake to run-of-the-river operations over the concrete spillway crests (estimated to be El. 670). For the first case, the estimated maximum lake level is 0.1 feet higher than the lake level at the time of failure, assuming no embankment failure. For the*

*other two scenarios, the reduction in the estimated maximum Wixom Lake level is estimated to be 0.2 feet relative to the lake level at the time of failure, at El. 681.1.*

*The remaining hypothetical scenarios, all of which assumed full opening of the spillway gates to 10 feet or more, resulted in peak lake level reductions between 1.1 and 1.8 feet. As the peak lake level reduction increases, the likelihood that the failure would have been prevented increases. However, for the range of peak lake level reductions of 1.1 to 1.8 feet, the IFT cannot be confident that failure would have been prevented, and hence judges for these scenarios that the instability failure may or may not have happened.*

In summary, as stated above in the IFT report, the hypothesis is, a lake drawdown would have minimal benefit to reducing peak flood flows or flood elevations during extreme storm events. The FLTF put forth an action plan that included, first, installing new gate hoist on the Edenville Dam, and second, by increasing spillway capacity. The IFT report hypothesis is the water level would have been 1.1 foot or lower had the new gate hoists been installed. This was a solution the FLTF was pursuing, as the FLTF actions included:

- Informing the dam did not meet dam safety standards
- Informing that new gate hoist were needed
- Allocated funds secured from the state of Michigan to purchase and install gate hoist
- Install brackets on the gates to accommodate new gate hoist in early 2020
- Entering contracts to start fabricating new gate hoist in early 2020
- Scheduling for the construction and installation of the gate hoist in fall of 2020

We believe the IFT report acknowledges that the FLTF was taking positive and appropriate actions and expeditiously implementing critical dam safety improvements, unfortunately the disaster of May 2020 occurred.