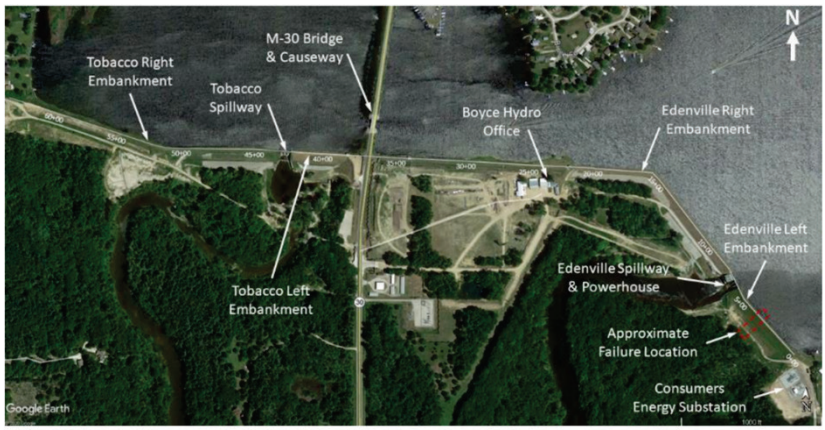
PRESS RELEASE

# FORENSIC INVESTIGATION FOR EDENVILLE DAM FAILURE

***Introduction.*** With a length of more than a mile and a maximum height of 52 feet, Edenville Dam impounded a lake with about 36,000 acre-ft of storage. Completed in 1925 and located in central Michigan, the dam is one of four hydropower embankment dams on the same river, with two dams upstream of it and one dam downstream of it.



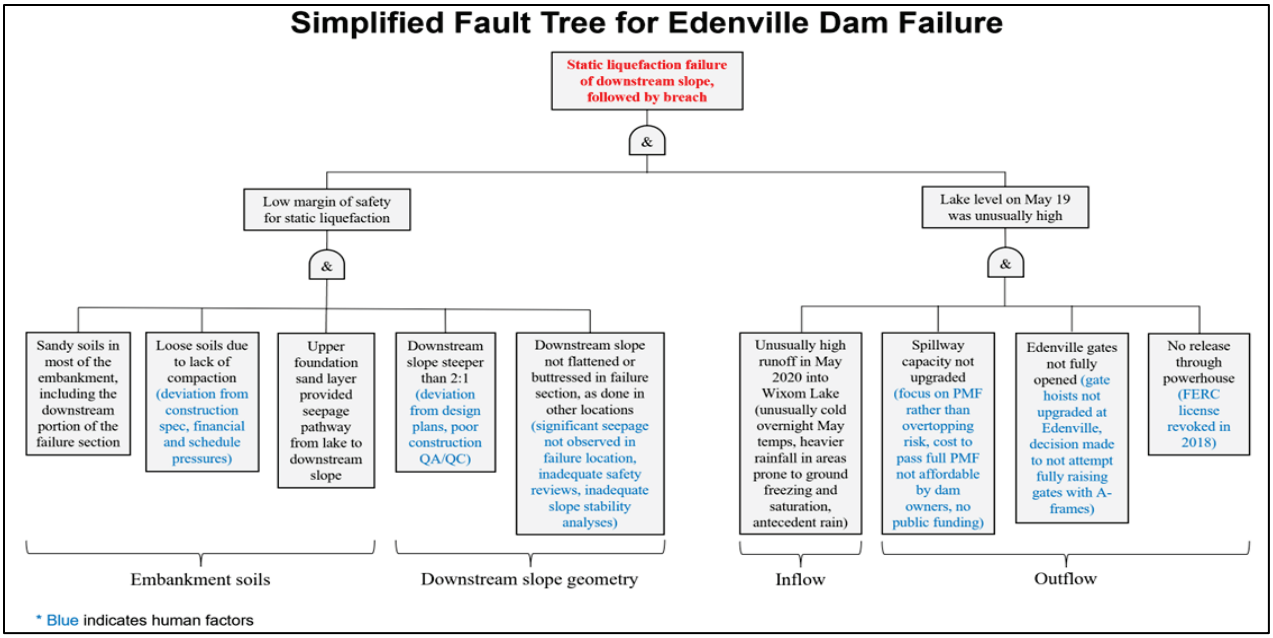

*Edenville Dam Layout*

As documented in extensive media coverage, a 25- to 50-year storm caused the lake behind Edenville Dam to rise to a record level and, on May 19, 2020, the dam experienced a sudden static liquefaction instability failure at a section of the embankment (a very rare failure mode), resulting in the release of almost the entirety of the volume of the lake. About three hours later, the resulting flooding overtopped the downstream Sanford Dam and caused failure of that dam as well. As a precautionary measure, evacuation of about 11,000 people had been ordered several hours before the dam failures, and this fortunately prevented loss of life, although the property damage resulting from the flooding was estimated at more than $200 million.

*Embankment Instability Failure*

The Federal Energy Regulatory Commission (FERC) required the dam owner to have an independent forensic investigation conducted, and the President & Chief Engineer of Alvi Associates, Irfan A. Alvi, PE, was selected as one of the five team members, leading the team's investigation of human factors. Alvi Associates also participated in all aspects of investigation of physical factors in the areas of hydrologic, hydraulic, geotechnical, and structural engineering, and was instrumental in determining that frozen ground was the main reason for the storm producing a disproportionately high 100- to 200-year runoff. The forensic team released its 502-page final report in May 2022 (link to report).

***Complexity.*** As part of its large-scale, multifaceted, and multidisciplinary investigation, the forensic team conducted a wide variety of tasks. These tasks include reviewing thousands of pages of documents; site inspection; review of post-incident photos, videos, and forensic test data; engineering analyses; interviewing more than 25 people; preparation of interim and final reports; and briefings to the media and FERC. Alvi Associates participated in all of these tasks, and led the team's investigation of human factors, which involved the complexities of understanding judgment and decision-making at scales of the individuals, groups, organizations, and the overall national and international dam safety framework,




considering events spanning a period of a century. The complexity of the interactions of physical and human factors leading to this dam failure is illustrated in the fault tree shown above.

***Social, Economic, and Sustainable Development Considerations.*** There are major implications associated with unforeseen cascading dam failures which necessitate a large-scale evacuation. As a result, the investigation identified lessons learned to help improve dam safety throughout the United States and the world. The forensic team presented these lessons in its reports, national conferences, a FERC briefing, and media briefings. Alvi Associates also presented a two-hour webinar focused on the human factors to a large live audience. These presentations and the forensic team's reports have been well received by the public, media, regulators, professional organizations, and the dam owner.

***Uniqueness, Innovative Application of New or Existing Techniques, Future Value to the Engineering Profession, and Public Perception.*** This was only the second major investigation of a dam incident or failure in which human factors have been given the same level of attention as physical factors. Alvi Associates led the human factors investigation in both cases, using a framework pioneered by the firm over the past decade. In this investigation, the framework was expanded in two innovative ways: application of 'game theory' to understand the interactions of the parties, and analysis of the role of 'luck' in the failures. Due to the high profile of this investigation, it is hoped and expected that this framework will be applied in investigation of future dam failures, and even more importantly, will contribute to implementation of lessons learned which help prevent future failures. The independence and thoroughness demonstrated by the forensic team also contributed to restoring public trust in how dam safety is managed in Michigan.

***Fulfillment of Client/Owner Needs.*** This complex and high-profile investigation involved many thousands of hours of effort, with about 2,700 hours spent by Alvi Associates. The forensic team managed the delicate balance of maintaining its independence while working cooperatively with the owner, the regulator, and other parties, and worked cost-effectively. The forensic team's findings and recommendations have been well-received by the owner and regulator, and have resulted in significant positive changes in the regulator's dam safety program.