



Ohio Department of Natural Resources

JOHN R. KASICH, GOVERNOR

JAMES ZEHRINGER, DIRECTOR

May 25, 2016

Mr. James Zehringer
Director, Ohio Department of Natural Resources
2045 Morse Road, Building D-3
Columbus, Ohio 43229

RE: Buckeye Lake State Park
Buckeye Lake Dam Improvements
Project Number: DNR-150080

Dear Director Zehringer:

As chief of the Ohio Department of Natural Resources (ODNR) Division of Engineering and as the owner's agent representing the ODNR Division of Parks and Recreation, I concur with the conclusions and recommendations from our consulting engineer Gannett Fleming that structural and operational risk-reduction measures at Buckeye Lake Dam to date have provided a current level of safety that will allow us to partially raise the lake pool elevation without posing an unacceptable risk to the public. This concurrence is based on consultations with Gannett Fleming and the Dam Safety Program at ODNR, and on the ODNR Division of Engineering's independent observations and analysis.

Specifically, while dams always pose inherent risk, I concur with Gannett Fleming's opinion that the lake level may be allowed to rise naturally to target elevation of (El.) 890.5 feet during the 2016 summer recreation season as long as effective measures are undertaken to reduce risk to acceptable levels. This interim target elevation is two feet higher than the current target El. 888.5 feet (in place since spring of 2015) and represents an acceptable level of risk.

Note: All elevations given in this letter are referenced to the 1929 National Geodetic Vertical Datum (NGVD29). Findings and recommendations from Gannett Fleming and the Dam Safety Program are provided in more depth below.

Structural Risk Reduction Measures. The primary components of Phase I are an embankment stability berm placed against the upstream face of the existing dam embankment and a soil mix (seepage) cutoff wall installed through the stability berm and extending into the foundation to a depth of 43 feet below the stability berm finish grade along the majority of the dam's four-mile plus length. The nominal top of the stability berm and cutoff wall is El. 892.9 feet. Select low areas in the existing embankment crest will also be raised as part of Phase I such that its minimum crest level will be El. 894.0 feet.

The primary impetus for implementing Phase I was to respond to the findings documented in the U.S. Army Corps of Engineers, Huntington District (Corps) report dated March 2015 (March 2015 Corps Report). That report concluded that even though available data on the condition of the dam was limited, ...*“Nevertheless, the available data are sufficient to support the District’s opinion that the likelihood of embankment failure is high based on adverse conditions existing and occurring frequently at and above normal pool, posing significant risks to the public.”* It is interpreted that the reference to “normal pool” relates to the traditional summer pool level which is currently understood to be El. 891.50 feet.

Three potential failure modes for the existing embankment dam were identified by the Corps and others consisting of (1) internal seepage erosion for lake levels at and above normal conditions; (2) embankment slope instability for lake levels at and above normal conditions; and (3) embankment overtopping and erosion for unusually high lake level conditions caused by extreme flood events.

I concur with Gannett Fleming’s finding that the cutoff wall and stability berm eliminate credible existing embankment failure modes associated with internal seepage erosion and slope instability so long as lake level is adequately maintained below El. 892.9 feet, the nominal top of the stability berm and cutoff wall. Until a new replacement dam is completed, the lake should be maintained at a level to reasonably prevent the potential for overtopping of the stability berm/cutoff wall and the existing embankment. Raising the minimum existing embankment crest to El. 894.0 feet further reduces overtopping potential. When completed in 2019, the new replacement dam will include features to allow it to withstand flood-induced overtopping events and completely address all three failure modes identified by the Corps.

The March 2015 Corps Report also discussed the importance of performing hydrologic and hydraulic analyses to better assess flood risk for the existing dam. Such analyses were completed by Gannett Fleming during Phase I to address this recommendation. I concur with Gannett Fleming’s analysis that maintaining the lake at the “winter” pool level indicates that a 1,000-year flood can be contained with zero freeboard at the top of the stability berm/cutoff wall, and that the level of risk increases to a 200-year flood for a proposed interim summer pool starting condition and to a 50-year flood for a traditional “summer” pool starting condition. (Note: Statistically, a 50, 200 and 1,000-year flood have a 2.0%, 0.5%, and 0.1% risk of occurrence, respectively, in any given year.) Further, at any of these three pool starting conditions, a 1,000-year flood would not overtop the embankment crest at El. 894.0 ft.

Given the lake’s primary purpose is recreation and that lake operation at the winter pool level significantly hampers boating recreation, I concur with Gannett Fleming’s recommendation that consideration be given to implementing an interim summer pool level to better facilitate boating during the summer season while continuing to reduce failure risk until the new replacement dam is completed in 2019. A target interim summer pool level of El. 890.5 feet (one foot below traditional summer pool level) could be utilized to achieve this goal, as analyses indicate that an interim summer pool level at El. 890.5 feet can contain a 200-year flood with zero freeboard at the top of the stability berm/cutoff wall and contain a 1,000-year flood with 0.53 feet of freeboard for the existing embankment crest.

Operational Risk Reduction Measures. In addition to structural risk reduction measures, additional risk reduction activities related to routine and emergency operation of the dam and reservoir are referenced below and are also planned or underway for the interim period. In transitioning from the completion of Phase I to the three year interim period until construction of the new replacement dam (Phase II) is complete, I concur with Gannett Fleming's recommendations that the following conditions be met:

Phase I Completion:

1. Cutoff Wall Verification Testing: Ongoing verification testing when fully completed must indicate that the design intent of the cutoff wall is satisfied. Otherwise, structural remediation and/or more conservative lake operations may be undertaken.
2. Stability Berm/Cutoff Wall Finish Grade: The design finish grade (El. 892.9 feet) for the stability berm/cutoff wall must be confirmed once active construction that can disturb finish grade has ceased.
3. Minimum Existing Embankment Crest Level: Select low areas must be raised so that the minimum existing embankment crest level is El. 894.0 feet.

Interim Period (Next three years):

1. Lake Level Monitoring: Since lake level monitoring is a key component of lake operation and the operating range is relatively narrow, one or more secondary means of measurement in addition to the USGS gage should be implemented in case the USGS gage were to malfunction.
2. Water Control Plan: The recently developed water control plan and dam safety surveillance and monitoring plan (DSSMP) must be strictly practiced. For example, since spring of 2015 ODNR has been utilizing the dam's lake drains to actively manage the lake level. More conservative lake operations should be considered whenever significant to extreme rainfall is forecast.
3. Storm Forecasting: Use of available storm forecasting tools and alerts in concert with regular coordination with the local National Weather Service with regard to short and long-term precipitation forecasts and use of their emergency alert system is highly recommended. Consideration should also be given to installing one or more weather stations within the watershed to help monitor precipitation.
4. Corps Recommended IRRMs: The interim risk reduction measures outlined in the March 2015 Corps Report (pp. 16-18) must continue to be practiced. These measures are implemented, underway or in the planning stage now.
5. Stability Berm/Cutoff Wall Finish Grade: The design finish grade (El. 892.9 feet) for the stability berm/cutoff wall must continue to be monitored and maintained for the full length of the structure.
6. Seasonal Lake Levels: If an interim summer pool level is implemented, the traditional practice of

lowering the lake level to winter pool level (El. 888.5 feet) in the fall and utilizing spring snowmelt and rain events to raise lake level in March and April must be maintained as a flood risk reduction measure.

Dam Safety Program Guidance. In addition, I concur with the findings and recommendations on this matter by the ODNR Division of Water Resources, Dam Safety Program, which has no objections to the proposal to modify the lake level as long as it is understood that:

- Coring, testing and surveying of the recently completed soil cement seepage barrier wall is continuing and will be completed over the next several weeks. Any concerns noted must be satisfactorily addressed.
- The project to raise the low areas on the crest of the dam to El. 894.0 feet will continue and is anticipated to be completed by May 28, 2016.
- The dam tender and engineering consultant will continue to closely monitor the dam (e.g., performing visual inspections, reading piezometers, etc.) for any dam safety concerns that may develop during this interim period until Phase II construction of the dam is completed.
- The lake level will be actively managed according to the latest Water Control Plan developed for the dam.
- Design and construction of Phase II repairs for full remediation of the dam will be completed by the end of 2019, barring any unforeseen or extreme circumstances.
- If any substantial dam safety issues develop with the dam, there may be the need to take mitigating actions, which may include but not be limited to again reducing the lake level to bring the dam to an acceptable level of risk.

Conclusion. In summary, I have reviewed an analysis by Gannett Fleming of the work completed to date at the Buckeye Lake Dam improvement project. As part of this analysis, Gannett Fleming has completed a hydrologic and hydraulic analysis to assess the maintenance of the pool level at winter pool, a proposed summer interim pool, and at a traditional summer pool. While dams always pose inherent risk, I concur with the conclusion reached in Gannett Fleming's analysis that the pool level can be raised to an interim target elevation of 890.5 feet without posing an unacceptable risk to the public during the 2016 summer recreation season.

Sincerely,



Hung Thai, P.E.

Chief Engineer, Division of Engineering
Ohio Department of Natural Resources

cc: Deputy Director/Chief Gary Obermiller, Division of Parks and Recreation