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10 January 2018

Paul T. Wessel
Safe Dams Program
Georgia Department of Natural Resources
2 Martin Luther King, Jr. Drive
Atlanta, Georgia 30334
404-463-1511

Subject: **DRAFT Emergency Action Plan for Petit Lake Dam, Revision 3**
Pickens County
Permit #112-009-0462

Dear Mr. Wessel:

Big Canoe Property Owner's Association (POA) and its consultant Geosyntec Consultants, Inc. (Geosyntec) received your comments on the Emergency Action Plan (EAP) for Petit Lake Dam in your letter dated 11 December 2017. This letter is our response to these comments within the 30 day period, as requested. For continuity and clarity, we have listed each of your comments below along with our responses immediately following.

1. Once all revision to the EAP are made, the EAP acceptance pages need to be completed.

   Geosyntec – Following the changes proposed herein, and the Safe Dams Program (SDP) concurrence, Geosyntec will collect signed acceptance pages, issue them in final hard copies, and send hard copies to all entities involved (including SDP).

2. The notification levels are listed as Condition C, Condition B, and Condition A, with Condition A being the condition where dam failure is imminent or has occurred. This differs from the standard Level 1, Level 2, and Level 3 designation. While the condition designated is not wrong, it may be unclear to emergency personnel what these designations are when they are accustomed to the other designations. In consultation with local Emergency Management, consideration should be given to renaming conditions.

   Geosyntec – Thank you for the suggestion. The notification levels Condition C, B, and A were used based on previous version of the owner's EAP. The notification levels will be kept. However, as the POA is involved with emergency management for its owners (e.g., fire and weather) and has created other emergency action plans, the levels will be updated to be consistent with those other plans used by the POA (i.e., Level C will be the highest). The standard designation of Level 1, 2, and 3 will be added in parenthesis on major tables and figures to correspond with the lettered levels.

3. The Condition C notification description states that it is the responsibility of the Dam Owner's Representative to assess the situation. In some cases, the Engineer of Record or State Dam Safety Program should be contacted to provide engineering evaluation of the situation. A notification flow chart should be developed for the Condition C event.

   Geosyntec – A notification flow chart will be created for Condition C.

4. The notification flow chart includes the Dawson County 911 Service. While part of Lake Petit is in Dawson County, failure of the dam would not result in a flood wave directly impacting Dawson County.

   Geosyntec – Agreed, the flood wave would not impact Dawson County. The Dawson County 911 service will remain in the flow chart for notification purposes, in case additional assistance is needed, as there is a mutual aid agreement between Pickens and Dawson Counties.

5. The inundation mapping is based upon a DAMBRK model performed in 1998 by Jordan, Jones and Goulding. This DAMBRK model only extends as far as Cox Lake, (Long Swamp Creek W/S Structure 14). As stated in Appendix B, "There is still substantial flow and elevation associated with the breach wave here and a modeling assessment of the capacity of Cox Lake is required." Inundation modeling should be extended until the engineer performing the routing determines the flood wave no longer poses a risk. The inundation mapping should be sealed by a licensed Professional Engineer in the State of Georgia, and the breach parameters included.

   Geosyntec – The DAMBRK model had previously been extended (by other consultants) downstream from Cox Lake using data gathered from Cox Lake Embankment Dam. The inundation areas shown in the maps use this updated analysis and were extended downstream to a location based on the previous engineer's judgement. Updated text from these calculations have been included in Appendix B to reflect this, but unfortunately the detailed calculations supporting this model have not been found at this time. Geosyntec understands that current SDP guidelines require inundation mapping to be conducted with HEC-RAS software. Big Canoe POA and Geosyntec are working together to create a plan to update the inundation mapping. We will coordinate with SDP on a path forward for this by 31 January 2018.

6. A listing of Big Canoe property owners with contact information was provided as Table 2 in the EAP. However, not all the properties listed will be impacted by the dam failure flood wave. The contact information should be reviewed and prioritized so that those properties that are impacted first by dam failure be notified first. In addition, this list is of Big Canoe property owners only. Dam failure will impact areas downstream of Big Canoe also. The notification list should include all impacted residences.

Geosyntec – Big Canoe POA has entered the contacts listed in Table 2 into an internal all-call system that notifies all entities in the list at the same time. Additionally, Big Canoe POA has worked with Pickens County 911 to create reverse 911 call list to notify the impacted residences downstream from the Big Canoe property, as shown in the Table 1 flow chart.

7. In the EAP, the dam height is listed as 115 feet, with the maximum storage as 6,000 acre-feet. Both the National Inventory of Dams (NID) and the Georgia Safe Dams database list a maximum storage of 7,500 acre-feet. The NID lists a height of 126 feet, and the Safe Dams program lists a height of 125 feet. The difference in height and volume will have an appreciable effect on the downstream inundation. These values should be checked, and if the State values are shown to be correct, they should be used in the EAP and in any subsequent dam breach modeling.

   Geosyntec – The dam dimensions will be checked with available records and updated in the EAP. The values determined will be discussed with SDP prior to additional dam breach modeling.

8. Figure 2 routes traffic across East Branch Long Swamp Creek on Wilderness Parkway, which is in the path of the flood wave. The evacuation map should clearly state that this route should only be used before dam failure.

   Geosyntec – Agreed, the clarification that the noted evacuation route should only be used before dam failure will be displayed more prominently in Figure 2.

We are currently working to update the EAP based on your comments and are planning to send the revised version to SDP in PDF format by 31 January 2018. Should there be no further comments, we will then issue a final hard copy version of this EAP, with the signature sheets included, to the entities involved in the emergency response, including yourself.

On behalf of Big Canoe POA, Geosyntec thanks you for your review and comments, and looks forward to working with you to finalize this EAP. Please contact the undersigned, at (423) 385-2312, if you have any questions.

Sincerely,

Wesley MacDonald, P.E
Project Engineer

R. Neil Davies, C.Eng., MICE, P.E
Senior Consultant

cc: Big Canoe Property Owner's Association
attachment: Updated text from Appendix B (breach model inundation mapping)

Area Description

Petit Lake is a 115 foot high earthen embankment in the upper reaches of the Blackwell Creek drainage basin in northeastern Pickens County. It impounds approximately 6,000 acre-feet of water, according to National Inventory of Dams data (1992). The contributing drainage area is approximately 1.53 square miles consisting primarily of heavily wooded residential development and heavily wooded undeveloped land.

Approximately 1.0 mile downstream of Petit Lake on Blackwell Creek is Sconti Lake. The embankment here is approximately 40 feet high and only impounds approximately 260 acre-feet according to the National Inventory of Dams data (1992). The drainage area to Sconti, minus the area into Petit, is approximately 3.3 square miles, again consisting primarily of heavily wooded residential and heavily wooded undeveloped land.

Between the two lakes, the valley is partially cleared and serves primarily as a golf course and for other recreational activities. Downstream of Sconti the valley is relatively narrow, typical of North Georgia undeveloped streams, and is generally heavily wooded.

Approximately 1.33 miles downstream of Sconti is a two-lane roadway (Wilderness Parkway) crossing of Blackwell Creek consisting of a covered bridge approximately 100 feet in length. The roadway connects to the south main entrance to the Big Canoe community.

Approximately 0.6 miles further downstream is another two-lane roadway crossing named Cove Road. This is a county maintained road. This crossing consists of three 10' x 10' box culverts.

Downstream of Cove Road, according to the U.S.G.S. Nelson Quadrangle Map, is Cox Lake. The embankment is approximately 97 feet high

Downstream of Cox Lake, the stream is again relatively narrow and heavily wooded. There are several homes at various points along the stream in this area and the stream adds some additional tributaries. Just east of the Marblehill community and parallel to the north of Georgia Hwy. 53, the stream widens into a small floodplain consisting of cultivated fields.

From here, the stream curls to the northwest and then south around a small rise and goes under Hwy. 53 in Marblehill. It then turns to the northeast to travel through Marblehill, going under a railroad bridge in the center of Marblehill.

From Marblehill the stream enters a relatively wide floodplain extending to the east of Marblehill and parallel to the south of Hwy. 53.

Modeling

The stream from Petit Lake to the floodplain east of Marblehill has been modeled using the National Weather Service program, DAMBRK. The dam breach flood volume and peak downstream times, elevations and flows have been calculated using this program.

Cox Lake has been modeled using design plans provided by the NCRS office in Jasper, Georgia. It was initially hoped that the flood wave would be stopped and held in this structure. However, the magnitude of the flood wave is such that the dam is overtopped with substantial flow occurring through the emergency spillway and over the top of the dam. The height of the modeled overtopping is approximately 1.25 feet or 0.75 feet below the breach elevation (two feet above top of dam). It is assumed since this is an engineered structure and has been periodically inspected through the years, it would be able to withstand this overtopping without breaching.

The covered bridge road and Cove Road were both modeled as dams with minimal initial flow-through for initial conditions computations. The area of opening capacity for both roads below the roadway elevation is insignificant compared to the magnitude of the breach flood peak, therefore it is not necessary to explicitly model the bridge openings.

In contrast, the Hwy. 53 and railroad bridge in Marblehill were modeled as bridges with the area of opening below the embankment defined. The two crossings were field measured and both are in good structural condition. However, the breach wave height exceeds the embankment height by more than two feet for both crossings resulting in breaching of both crossings.

Worst Case Scenario

Two scenarios are generally appropriate for modeling a dam breach wave. One scenario would consist of a sunny day breach which have the model beginning with a full reservoir to the top of dam elevation with all outflow structures blocked. The other would consist of a project storm breach consisting of water level beginning at normal pool, normal outflow occurring, and a project storm hydrograph entering the reservoir with the breach occurring at the peak time of the inflow hydrograph. The two scenarios would be compared and the worst case used to define the dam breach flood zone. For dams with large storage capacities and large drainage areas, the two scenarios are generally necessary for determining the worst case for downstream flooding.

Petit Lake has a large storage capacity and small inflow drainage basin. Only one breach scenario has been modeled for this EAP, the sunny day breach. The storm breach analysis was limited because the excess storage capacity before the dam is overtopped minus the spillway outflow is adequate to contain the storm runoff from this relatively small sparsely developed drainage basin. The peak breach wave from this model at Petit Lake is 225,253 cubic feet per second. With the starting water surface level at the top of dam elevation, the freeboard is completely filled.

Preliminary project storm hydrographs have been developed for both Petit Lake and Sconti Lake using HEC-1. The hydrographs are for PMP rainfall, taken from Hydrometeorological Report No. 51 from the National Weather Service, consisting of 30.2 and 41 inches for the 6-Hour and 24-Hour duration storms, respectively. A Curve Number and Lag Time have been determined using Soil Conservation Service (now National Resource Conservation Service) techniques. The peak flow for Petit Lake for the two storms is 14,624 cfs (6-Hour) and 7,100 cfs (24-Hour). This is less than 10% of the modeled initial peak breach flow. For Sconti Lake (not including the Petit Lake drainage area) the two peaks are 18,830 cfs (6-Hour) and 13,294 cfs (24-Hour), again less than 10% of the breach flow.

During the project storm scenario, the freeboard storage and outflow capacity of Petit Lake would cause the dam breach to begin at a level substantially below the top of dam elevation, thus producing a lowered volume and peak when compared to the sunny day scenario. The project storm hydrograph into Sconti Lake would not raise a total project storm breach flow peak to above the level of the sunny day scenario.

Because of the large storage capacity of Petit Lake and the relatively small PMP inflows to both Petit and Sconti Lakes, we are confident the sunny day scenario represents the worst case. The mapped extents of the sunny day model represents the maximum area of flood that would occur for any breach scenario.

Modeling Parameters

Modeling parameters have been developed in accordance with the Georgia Safe Dams Program Engineering Guidelines, 1998 Edition [1]. The following breach parameters have been used:

Petit Lake
- Starting Water Surface Elevation = Top of Dam (1648 msl)
- [1] Breach Base Width = Height of Dam (118 feet)
- Breach Side Slope = 1:1
- [1] Time to Complete Failure = 0.5 hours

Sconti Lake
- Starting Water Surface Elevation = Normal Pool (1464.3 msl, approx.)
- [1] Breach Base Width = Height of Dam (40 feet)
- Breach Side Slope = 1:1
- [1] Time to Complete Failure = 0.5 hours

Covered Bridge
- Starting Water Surface Elevation = Calibrated for Initial Conditions
- [1] Breach Base Width = Height of Embankment (31 feet)
- Breach Side Slope = 1:1
- Time to Complete Failure = 0.1 hours

Cove Road
- Starting Water Surface Elevation = Calibrated for Initial Conditions
- [1] Breach Base Width = Height of Embankment (30 feet)
- Breach Side Slope = 1:1
- Time to Complete Failure = 0.1 hours

Cox Lake
- Starting Water Surface Elevation = Normal Pool (1276.2 msl)
- [1] Breach Base Width = Height of Dam (97 feet)
- Breach Side Slope = 1:1
- Time to Complete Failure = 0.5 hours

Hwy. 53 in Marblehill
- Starting Water Surface Elevation = Calibrated for Initial Conditions
- [1] Breach Base Width = Height of Embankment (22 feet)
- Breach Side Slope = 1:1
- Time to Complete Failure = 0.1 hours

Railroad Bridge in Marblehill
- Starting Water Surface Elevation = Calibrated for Initial Conditions
- [1] Breach Base Width = Height of Embankment (22 feet)
- Breach Side Slope = 1:1
- Time to Complete Failure = 0.1 hours

Manning's values and expansion/contraction coefficients were based on engineering judgment after visual inspection of the Blackwell Creek valley. Sections were obtained from a digital terrain model developed from U.S.G.S. quad topography and were adjusted to reflect visual inspection of the stream valley channel. Minor adjustments were made in stream reach distances to promote numerical stability in the model.

Areas of off-channel storage have been incorporated at appropriate locations in the model.

Additional parameters were included or modified based on requirements for calculating initial conditions and for promoting numerical stability through a complete peak assessment for all sections. These additional parameters include: section smoothing, delta x distances, constant turbine flow, additional reservoir inflow, lateral inflow, and others as required. These additional parameters serve only to promote the numerical stability of the model and do not minimize the magnitude of the peak elevation and flow results.

Results

The modeling results indicate that Sconti Lake Dam, the covered bridge road, and Cove Road would all be breached under a substantial flood wave.

Peak elevations indicate that a small portion of Steve Tate Road would be underwater.

The model indicates that Cox Lake would be overtopped but not breached. Portions of Hwy. 53 to the east and to the west of Marblehill would be temporarily submerged but are on the edge of the main flood channel. The crossings in Marblehill would be breached and areas in Marblehill within the floodplain south of Hwy. 53 would be inundated and in the direct path of the breach wave.

The model indicates that the breach wave is dissipated to a height of approximately 22 feet just upstream of where Hwy. 53 again crosses the stream, east of Marblehill. The height of the bridge/embankment here is approximately 27 feet. It is therefore assumed this crossing serves to break the flood wave and dissipate the volume in the upstream floodplain.

The extent of the breach flooding is shown on the attached maps. DAMBRK and HEC-1 input and output is attached.

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Richard E. Dunn, Director

Watershed Protection Branch
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Suite 1152, East Tower
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404-463-1511

December 11, 2017

FILE COPY

Dr. Robert Bachus, P.E.
Geosyntec Consultants
61255 Roberts Blvd. NW, Suite 200
Kennesaw, GA, 30144

SUBJECT: Petit Lake Dam
Pickens County
Permit #112-009-0462

Dear Dr. Bachus:

The Safe Dams Program has completed its review of the Emergency Action Plan submitted for the above-referenced project, received on July 5, 2017. The following comments must be addressed:

1. Once all revisions to the EAP are made, the EAP acceptance pages need to be completed.
2. The notification levels are listed as Condition C, Condition B, and Condition A, with Condition A being the condition where dam failure is imminent or has occurred. This differs from the standard Level 1, Level 2 and Level 3 designation. While the condition designation is not wrong, it may be unclear to emergency personnel what these designations are when they are accustomed to the other designations. In consultation with local Emergency Management, consideration should be given to renaming the conditions.
3. The Condition C notification description states that it is the responsibility of the Dam Owner's Representative to assess the situation. In some cases, the Engineer of Record or State Dam Safety Program should be contacted to provide engineering evaluation of the situation. A notification flow chart should be developed for the Condition C event.
4. The notification flow chart includes the Dawson County 911 Service. While part of Lake Petit is in Dawson County, failure of the dam would not result in a flood wave directly impacting Dawson County.
5. The inundation mapping is based upon a DAMBRK model performed in 1998 by Jordan, Jones and Goulding. This DAMBRK model only extends as far as Cox Lake, (Long Swamp Creek W/S Structure 14). As stated in Appendix B, "There is still substantial flow and elevation associated with the breach wave here and a

modeling assessment of the capacity of Cox Lake is required." Inundation modeling should be extended until the engineer performing the routing determines the flood wave no longer poses a risk. The inundation mapping should be sealed by a licensed Professional Engineer in the State of Georgia, and the breach parameters included.

6. A listing of Big Canoe property owners with contact information was provided as Table 2 in the EAP. However, not all the properties listed will be impacted by the dam failure flood wave. The contact information should be reviewed and prioritized so that those properties that are impacted first by dam failure be notified first. In addition, this list is of Big Canoe property owners only. Dam failure will impact areas downstream of Big Canoe also. The notification list should include all impacted residences.
7. In the EAP, the dam height is listed as 115 feet, with the maximum storage as 6000 acre-feet. Both the National Inventory of Dams (NID) and the Georgia Safe Dams database list a maximum storage of 7500 acre-feet. The NID lists a height of 126 feet, and the Safe Dams program lists a height of 125 feet. The difference in height and volume will have an appreciable effect on the downstream inundation. These values should be checked, and if the State values are shown to be correct, they should be used in the EAP and in any subsequent dam breach modeling.
8. Figure 2 routes traffic across East Branch Long Swamp Creek on Wilderness Parkway, which is in the path of the flood wave. The evacuation map should clearly state that this route should only be used before dam failure.

Please provide this office with an updated Emergency Action Plan addressing these comments, or a schedule for addressing these comments, within 30 days. If you have any questions, please contact our office at (404) 463-0655.

Sincerely,

Paul T. Wessel
Environmental Engineer
Safe Dams Program

PTW:kb

cc: Big Canoe Property Owner's Association