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.