

## PROJECT DESCRIPTION

Geosyntec Consultants

USA



As part of evaluation of seismic performance of this 175-foot high hydraulic fill dam located at a confidential site in the southeast Appalachia region, Geosyntec hired Itasca Consulting Group (Itasca) to perform deformation analyses for seismic loading of the dam using numerical modeling. Prior to the deformation analyses, Itasca also assisted Geosyntec with numerical simulations to assess the liquefaction potential of the dam using the cyclic stress ratio approach.

The main goal of the project was to look at the seismic performance of the dam in the current configuration, which included some recent improvements, and determine if additional retrofitting is required. The analyses were carried out for multiple operating water levels and extreme ground motion cases.

## ITASCA'S ROLE

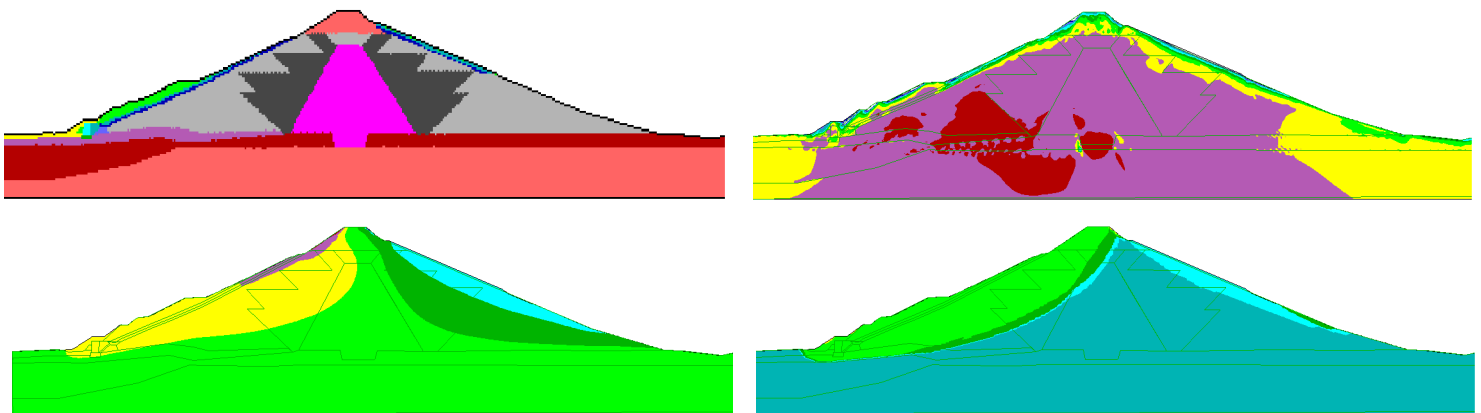
Itasca ran two-dimensional nonlinear dynamic analyses and generated factor of safety against liquefaction plots to determine liquefaction susceptibility of the dam. The plots were generated using the cyclic stress ratio from numerical simulations and the cyclic resistance ratio from empirical correlations in the literature. This was followed by seismic deformation analyses where potentially liquefiable regions of the dam were modeled using more comprehensive constitutive models. Analyses were carried out using both **PM4SAND** and **UBCSAND** dynamic material models to improve confidence in the results.

The purpose of the modeling effort was to provide the following deliverables: (1) estimate cyclic shear stress ratios from seismic loading; (2) estimate the deformations in different regions of the dam caused by seismic loading; (3) estimate development of excess pore pressures in dam due to seismic loading; and (4) generate factor of safety contour plots for post-seismic shaking.

Itasca also aided in numerical model calibration of the embankment models using a series of single-zone virtual lab tests.

## PROJECT RESULTS

The analyses indicated cyclic shear stress ratios less than 0.15 and excess pore pressure ratio less than 0.5, except near the slopes and crest. The results from both constitutive models were found to be in reasonably good agreement.



Plots showing model geometry (top left), cyclic stress ratio (top right), horizontal seismic deformations (bottom left), and post-seismic factor of safety (bottom right) for one of the ground motions.