MORETRENCH

PROJECT SUMMARY

DAM REHABILITATION:
DEWATERING & EXCAVATION SUPPORT

Bear Creek Dam
Russellville, Alabama

Bear Creek Dam, in northwest Alabama, is a 68-foot high earthen structure with a crest length of 1385 feet, and retains a reservoir extending 12 miles upstream. It is founded on fractured karstic limestone consisting of Upper and Lower Bangor Limestone separated by a stratum of Pennington Shale. From its construction in 1969, the dam had experienced excessive foundation leakage, compromising its structural integrity. Efforts to control the leaks had proved to be effective only in the short term. Following an in-depth evaluation of viable long-term solutions, the Tennessee Valley Authority (TVA) initiated a remediation program that included the installation of a grout curtain groundwater cut-off beneath the existing dam and construction of a roller compacted concrete (RCC) structure at its downstream toe.

To facilitate construction of the RCC structure, Moretrench was retained by the TVA to

- Install a deep well system to intercept groundwater in the fractured karst formation.
- Install an eductor system to dewater the overburden and overburden/rock interface.
- Install soldier pile and lagging support systems with tiebacks for excavation to subgrade at the existing spillway and the in-service sluiceway.

Top: *Remediation of Bear Creek Dam involved excavation for the construction of a roller compacted structure at the toe of the existing dam.*

Above: *Moretrench performed construction dewatering (eductor system shown in foreground) and excavation support during the remediation program.*

Construction Dewatering

Dewatering was performed on both the upstream and downstream embankments surrounding the heart of the excavation for the RCC dam. The intent of the dewatering system was to lower the groundwater table below excavation subgrade for foundation construction. Selection of the type of dewatering system, installation method and well components were determined by the prevailing subsurface conditions and anticipated flow rates.

In addition to the wells, Moretrench also installed multiple sumps on the upstream slope just above the excavation in the event of seepage through the existing embankment during high reservoir levels from flood events. These conditions were not expected but needed to be anticipated.

Deep Well System

The project engineer, Paul C. Rizzo Associates, Inc. of Columbia, SC, had used geophysical methods, aerial views of the limestone features and stratigraphy analysis in an effort to identify water-bearing fractures and features in the limestone rock that would feed into the excavation. Moretrench's work was concentrated in those identified areas.

Thirty three deep wells were installed for dewatering of the rock formation. At each location, air rotary drilling techniques were used to advance a 10-inch diameter borehole, cased through the overburden, into the rock. The extent of rock drilling varied from as little as 8.5 feet to 101 feet, with 20 to 45 feet being the average. Elements of well construction included the installation of PVC high-flow wellscreen installed from top of rock. A pump test was performed on each well to determine its anticipated flow rate. Pump/Motors ranged from 5 to 30 HP in the wells.

The difficulty of pinpointing the subsurface features was highlighted by the fact that some wells were extremely low flow or dry, in which case a pump was not installed, and some went much deeper than anticipated.

Top: *Air rotary drilling (background rig) was used to install the deep wells, and sonic drilling (foreground rig) used for eductors and piezometers.*

Above: *The closely spaced eductors were connected to a central surface pumping unit.*

Eductor System

Near the existing sluiceway a permeable layer of overburden existed that needed to be addressed by a closely spaced dewatering system. However, a sand and gravel layer,

in thickness from inches to up to nine feet, was present at the overburden/rock interface at a depth from working grade that precluded single-stage wellpoint dewatering. A single-pipe eductor system was therefore specified.

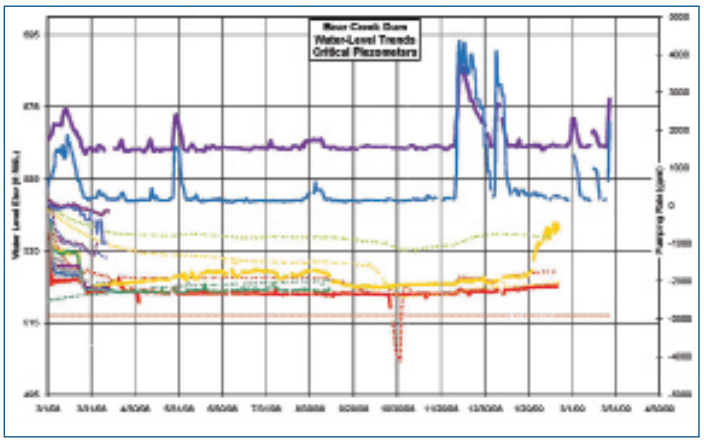
A total of 85 ejectors were installed along benches upstream and downstream of the excavation. Sonic drilling methods were used to advance 6-inch boreholes at 5-foot spacing to top of rock. The wells consisted of a 3-inch diameter screen, ranging in length from 5-10 feet, and sand filter pack. Each ejector line was connected to a central surface pumping unit powered by commercial power with generator back-up. Iron build-up on the system was a concern and the ejector pipes were flushed as part of the maintenance program.

Systems Operation and Monitoring

Dewatering operations continued for 16 months until construction of the RCC structure reached an elevation where it could be backfilled. The total system – deep wells, eductors and sumps– handled flows in excess of 4,000 gpm at times. Pumped water was channeled to the existing sluice for discharge.

During dewatering operations, system efficiency was verified by data retrieved daily by the on-site engineer from an array of piezometers and three inclinometers. The piezometers were used to verify groundwater conditions and the efficiency of the dewatering systems. Inclinometers were monitored to check for ground movement on the existing dam embankment due to construction.

All wells were filled with cement grout and abandoned on site upon completion of the project.



Top: *Piezometer data showed that the total system pumped as much as 4,000 gpm at times.*

Above: *During excavation, large fractures in the limestone rock were unearthed that were cleaned and filled with mass concrete by the TVA.*

On behalf of TVA, I would like to express our appreciation to…all the Moretrench crews for their outstanding efforts on our dewatering installation and soldier pile work at the Bear Creek Dam site.

In order to meet the [TVA] revised construction schedule for the soldier pile wall installation, the performance of these individuals went above what was originally anticipated…these tasks were critical to meeting the overall Bear Creek Rehabilitation construction schedule which could have been impacted without the superb efforts and teamwork of these individuals.

Sidney E. (Gene) Gibson

Excavation Support

Construction of the RCC structure encompassed the existing auxiliary spillway to the southeast of the dam and the in-service sluiceway to the northwest. With operational dewatering underway, Moretrench began installation of two soldier pile and lagging walls to support these structures during excavation to subgrade at depths of up to 35 feet.

The challenge here lay in that at both locations the walls turned a sharp angle. Moretrench worked with the TVA field crews to seamlessly coordinate the wall and anchor installation with the continued excavation in order to maintain the schedule.

W14 x 27 H-beams were drilled in place and socketed and concreted into the limestone rock. Due to the irregular rock surface, care and effort was made to structurally fit and install the 5000 square feet of lagging board required for the two walls.

Additional lateral wall restraint was provided by a total of 27, post-tensioned stranded anchors installed through previously welded-in-place walers and bonded in the underlying rock formation. Anchor design loads ranged from 105 to a maximum of 316 kips. Performance testing to 133% of design capacity was conducted on five spillway and two sluiceway anchors and the remainder proof-tested.

Top: *Installation of the excavation support at the spillway.*

Above: *Installation of post-tensioned, multi-strand rock anchors provided the additional lateral restraint needed to withstand the wall loading.*

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