BARNARD

On Site

Summer 2022

People building for People.

Meeting the Challenge:

Barnard Completes Final Work at Boone Dam

Inside

Boone Dam Internal Erosion Remediation Program

After a seven-year phased program to remediate internal erosion, the *Tennessee Valley Authority (TVA)* reopened Boone Dam's public recreation area just ahead of Memorial Day Weekend for the first time since 2014, when the dam was closed for emergency repairs. This spring, Barnard restored the crest of Boone Dam to its previous elevation and built a concrete floodwall. This work marked the final component of the **Boone Dam Internal Erosion Remediation Program**, the largest dam safety modification project in TVA's history. Today, the reservoir is back to full summer pool, allowing residents and visitors to enjoy Boone Lake.

Barnard was one of the first contractors onsite at Boone Dam in 2014, and we worked on several phases of the remediation program. The program presented a myriad of technical and logistical challenges, and its safe and successful completion will inspire future dam remediation efforts.

The Dam

Boone Dam, located on the South Fork Holston River approximately 17 miles upstream of Kingsport, Tennessee, was originally constructed in 1953. The dam retains a flood storage capacity of 75,800 acre-feet within the 4,520-acre Boone Lake. Hydroelectric facilities at the site provide a net generating capacity of 114 MW from three units. Boone is a tributary reservoir within TVA's integrated multi-purpose reservoir system, and reservoir operations directly support TVA's mission for flood control, water supply, hydrothermal regulation, water quality, local economic development, and the generation of renewable power.

The Challenge

In October 2014, a sinkhole was discovered near the downstream toe of Boone Dam. Within a week, TVA observed turbid discharge exiting from the riverbank downstream of the dam. Sinkhole occurrence is common in the region, but the location of the sinkhole and the muddy discharge indicated potential dam safety issues. In response, TVA closed the dam, lowered the reservoir level, and assembled a team of experts to investigate the source of the observed seepage.

At the time, Barnard was already in the region performing probable maximum flood upgrades on several of TVA's dams. Our team mobilized rapidly to Boone Dam to take part in the initial, fast-track emergency repairs, which included constructing a filter within the tailrace below the dam.

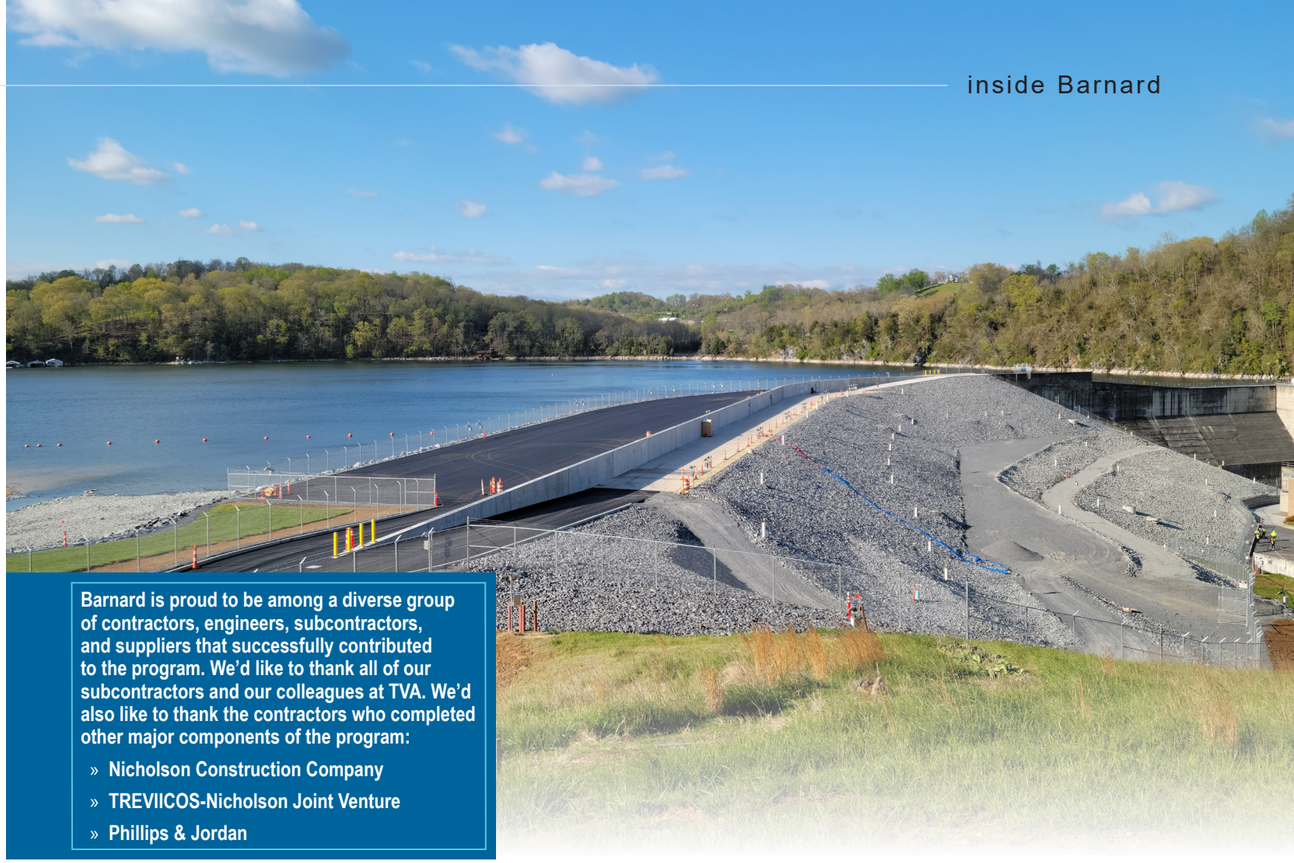
The Program

In July 2015, TVA announced the five-phase Boone Dam Internal Erosion Remediation Program to construct an internal erosion barrier through the dam and its foundation. The program phases included a low mobility grout curtain, high mobility grout curtain, upstream and downstream berms, cutoff wall, and crest floodwall. TVA selected a group of specialty contractors to complete the various scopes of work.

In 2015, Barnard performed the test grouting, which helped TVA develop project specifications for grouting mixes and techniques. Over the next two years, Barnard and subcontractor *Nicholson Construction Company (Nicholson)* went on to complete the low mobility and high mobility grouting programs. The low mobility grouting filled voids and reduced permeability within zones of soft soils existing near the top of rock in the dam's foundation. The high mobility grouting reduced permeability within the deep portions of the rock foundation. Combined with the subsequent cutoff wall, the high mobility grout forms the composite seepage barrier that provides the greatest safety risk reduction.

Both grouting programs provided valuable exploratory data that informed the design and construction of subsequent project components. During these grouting programs, Barnard and Nicholson performed more than 112,000 LF of drilling and pumped more than 475,000 gallons of grout into the dam's foundation.

In July 2021, our team returned once more to help TVA complete the repairs and restore the dam and project site to pre-repair conditions. This phase required multiple modifications to the existing crest and embankment slopes, including construction of a 10-ft.-tall, 825-ft.-long concrete floodwall.



Barnard is proud to be among a diverse group of contractors, engineers, subcontractors, and suppliers that successfully contributed to the program. We'd like to thank all of our subcontractors and our colleagues at TVA. We'd also like to thank the contractors who completed other major components of the program:

- **Nicholson Construction Company**
- **TREVIICOS-Nicholson Joint Venture**
- **Phillips & Jordan**

The Successful Outcome

The full reopening of Boone Lake has restored recreational and economic opportunities to the region. In April, the program earned the **2022 United States Society on Dams' (USSD) Excellence in the Constructed Project Award**, recognizing the work of TVA and their contractors to mitigate the risk of potential dam failure and safely restore the dam and lake to normal operations.

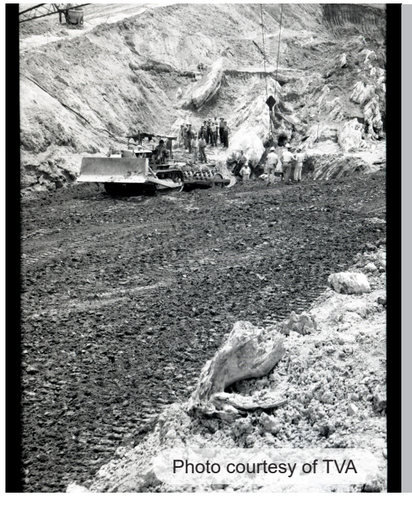


Photo courtesy of TVA

Geological Challenges

The region's geology of highly weathered rock has presented a challenge since the dam's early days. During construction in the 1950s, TVA encountered an irregular karst bedrock surface of limestone pinnacles with open voids and deposits of soft soils in the crevices in between. This porous, permeable "epikarst" zone held a complex network of interconnected groundwater seepage paths. To limit reservoir seepage underneath the dam, early engineers placed compacted clay within a deep cutoff trench extending through the foundation soils to the bedrock surface and further injected grout along a line of holes located at the center of the cutoff trench. At the time, this approach was state-of-the-art, but dam safety engineers now recognize that this construction introduced an inherent vulnerability to internal erosion.

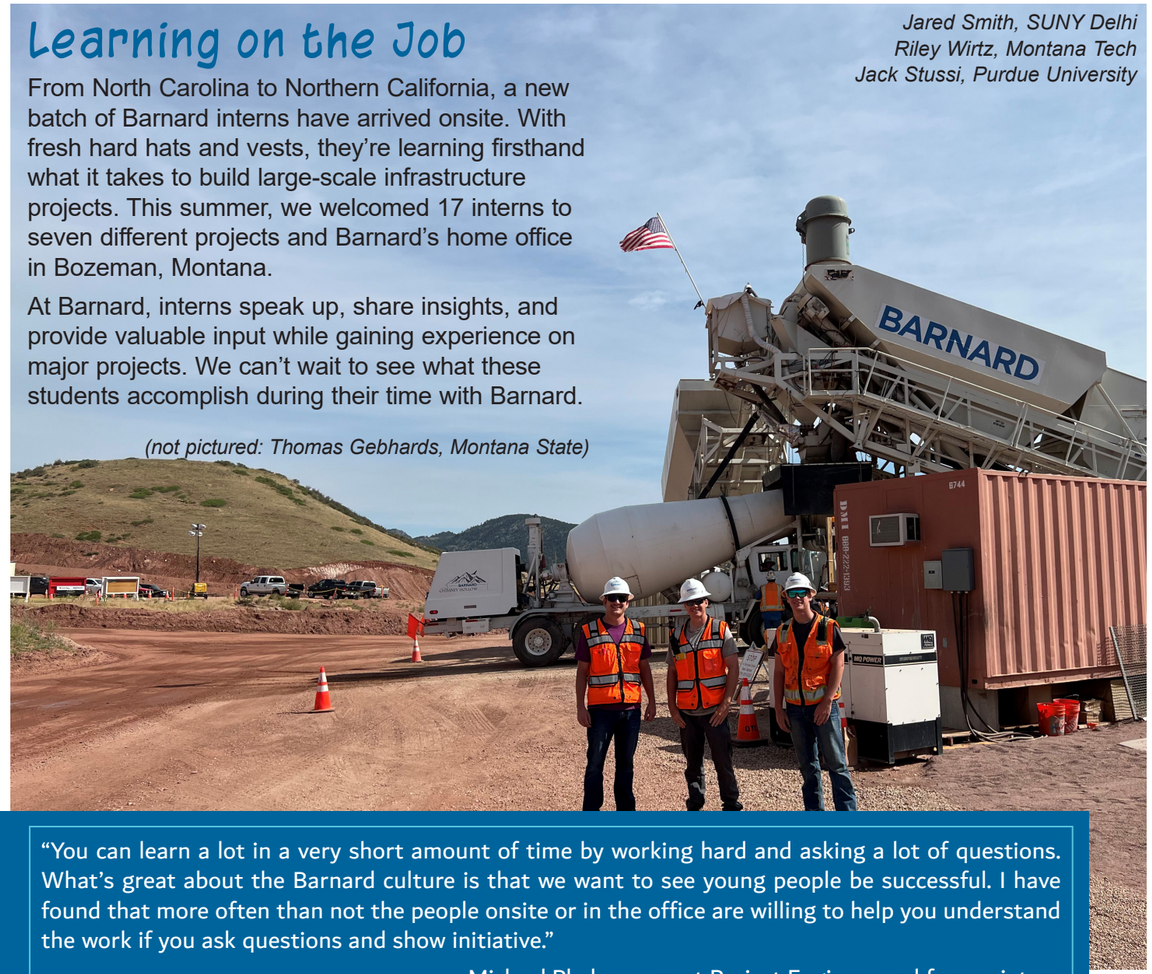
Learning on the Job

Jared Smith, SUNY Delhi
Riley Wirtz, Montana Tech
Jack Stussi, Purdue University

From North Carolina to Northern California, a new batch of Barnard interns have arrived onsite. With fresh hard hats and vests, they're learning firsthand what it takes to build large-scale infrastructure projects. This summer, we welcomed 17 interns to seven different projects and Barnard's home office in Bozeman, Montana.

At Barnard, interns speak up, share insights, and provide valuable input while gaining experience on major projects. We can't wait to see what these students accomplish during their time with Barnard.

(not pictured: Thomas Gebhards, Montana State)



"You can learn a lot in a very short amount of time by working hard and asking a lot of questions. What's great about the Barnard culture is that we want to see young people be successful. I have found that more often than not the people onsite or in the office are willing to help you understand the work if you ask questions and show initiative."

–Michael Phelps, current Project Engineer and former intern


Tucker Gaustad, Montana State


Derek Simmons, Montana Tech

Jace Barcus, Montana State

Christian Fraser, Boise State

Zack Kuniak, Slippery Rock University

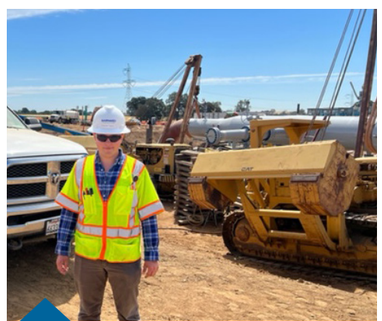
"This internship has challenged my creative thinking on a unique project and pushed me to develop problem-solving skills that will help me through my career."

–Miles Risinger
Eastern Kentucky University


Matt Dyson, Montana State

Loren Alexander, Montana Tech

Katie Adams, Cal Poly



"It doesn't matter how old you are or what your job title is. If you show that you can take on more responsibility, it will be given to you"

–Patrick Reed
Colorado School of Mines

Landon Battle, Appalachian State
JT Wolke, Slippery Rock University
Brady Hull, South Dakota State

Barnard Begins Two New Pipeline Projects

Along the British Columbia-Alberta border in the Rocky Mountains, Barnard is starting two new projects to deliver natural gas produced in western Canada to domestic and export markets. The **Yahk and ABC Projects** are located 215 km (133 miles) apart near the towns of Creston, British Columbia, and Coleman, Alberta, respectively. Barnard and joint venture partner *Steel River* established a main yard in Cranbrook, British Columbia, between the two project locations.

Drilling operations to blast grade at the ABC Project.

Work at the ABC Project is underway and involves the construction of 5.2 km (3.2 miles) of 48-in. pipeline and in-line inspection launching and receiving facilities. The ABC Project will deliver natural gas to *TC Energy's* Nova Gas Transmission Line (NGTL) system.

At the Yahk Project, set to start later this summer, Barnard Steel River Joint Venture will construct approximately 12.5 km (7.7 miles) of 48-in. pipeline and in-line inspection launching and receiving facilities. The Yahk Project will deliver natural gas to TC Energy's Foothills Pipeline system. Both the ABC and Yahk pipelines will have a maximum operating pressure of 8,690 kPa.

Haskell Team Travels Overseas to Visit Manufacturing Facilities

Throughout the spring, Barnard has focused on the engineering phase of the **Haskell Canyon Switching Station to Sylmar Switching Station - PP1/PP2 Transmission Line Conversion Project**, which kicked off in January 2022. This project will increase the power transmission capacity between the Haskell Canyon Switching Station and the Sylmar Switching Station, allowing the *Los Angeles Department of Water and Power (LADWP)* to introduce additional renewable energy to the Los Angeles electric grid.

In May, the Haskell team successfully submitted the 90 and 100 percent design packages to LADWP for review and comment. The team aims to have the civil Issued for Construction (IFC) package submitted and accepted by LADWP by mid-July, with the overhead IFC package following at the beginning of August. Our team plans to mobilize to the project in late July and start construction activities in early August.

As we progress toward the IFC design package, our team has worked closely with design consultant *Black & Veatch (B&V)* and our material vendors for the lattice steel towers and tubular steel poles as well as the conductor, which will be the first permanent material delivered to the project in late July. Team members recently visited our conductor manufacturer, *Midal Cables*, in the Kingdom of Bahrain. The team spent two days in Bahrain touring Midal's manufacturing facilities and auditing their QA/QC procedures.

The Haskell team inspects a suspension lattice tower that will be erected with a helicopter on the project.

The Haskell team visits the Anıtkabir, the mausoleum of Mustafa Kemal Atatürk, the founder of the Republic of Turkey.

After taking off from Bahrain, the team spent three days in Ankara, Turkey, at the facilities of our lattice steel tower vendor, *Mitas Industry*, where they witnessed the prototype assembly of the project's three lattice steel tower types.

Other preconstruction activities have included permitting acquisition for the project's three major CalTrans freeway crossings and two railroad crossings, removal of asbestos from existing concrete foundations prior to demolition, and protection of the existing Los Angeles Aqueduct that runs along much of the transmission line's alignment.

Approaching Full Power:

Keeyask Project Brings Seventh Unit Online

The month of May marked a significant milestone for the **Keeyask Generation Project**: the seventh (and final) Voith Hydro unit is now in service in the powerhouse. This achievement comes after eight years of construction and extensive electrical work—not to mention millions of cubic meters of excavation, aggregate screening, and concrete placement to build the powerhouse, three dams, 13 cofferdams, and 23 kilometers of dykes.

Keeyask began generating electricity in February 2021, when the first unit went into operation. In the subsequent 15 months, the project team worked steadily to complete, turn over, and commission the other six units. At peak capacity, the powerhouse will generate up to 695 MW of renewable hydroelectricity—enough to power 400,000 homes.

Even as the project team celebrates this achievement, they continue to chip away at the remaining project tasks. Currently, they are working to complete and commission the support systems, including HVAC and fire detection and suppression. In May, the team commissioned the Domestic Water Treatment Plant and Wastewater Treatment Plant systems and completed the plumbing finishes, moving one step closer to having fully functioning services at Keeyask. The civil team finalized the cleanup of both the east and west generator rooms after the commissioning activities were completed, and these areas have been turned over to the care and custody of the Owners. Together, the team is making great strides toward substantial completion.

The Keeyask Generation Project, located in Northern Manitoba, is being developed by *Keeyask Hydropower Limited Partnership (KHLP)*, a partnership between *Manitoba Hydro* and four Manitoba First Nations: *Tataskweyak Cree Nation*, *War Lake First Nation*, *York Factory First Nation*, and *Fox Lake Cree Nation*. *BBE Hydro Constructors LP*, a limited partnership between Barnard, *Bechtel*, and *EllisDon Corp.*, is serving as the General Civil Contractor.

Top: Keeyask Generation Station, as viewed from the Nelson River.

Bottom: A view inside of the powerhouse.

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Toledo Substation

Central Oregon Team Remobilizes for the Summer

After a pause in construction for the winter months, the **Central Oregon Coast Bundle Project** team remobilized in May. The work underway at the Tahkenitch Substation includes installation of new station service foundations and transformers, construction of new conduits throughout the yard for substation lighting, and work on the relay panels. The Tahkenitch Substation will be completed once cable is delivered to the site. At the Toledo Substation, Barnard and subcontractor *Granite Construction* began installing the 69kV bay alongside the new 230kV bay expansion. Granite Construction also began installing the retaining wall in the substation expansion area. Starting in June, crews will be working under outages as they tie in the new 230kV bay and begin bay-by-bay upgrades.

Barnard's "Next Generation"

Baby boy born to **Kyle** and **Chloe Strozzi**. **Knox William Strozzi** was born on May 14 weighing 7 lbs. 10 oz.

Baby boy born to **Derek** and **Erika DeJong**. **Bronson Carter DeJong** was born on June 3 weighing 7 lbs. 1 oz.