APPLICATOR

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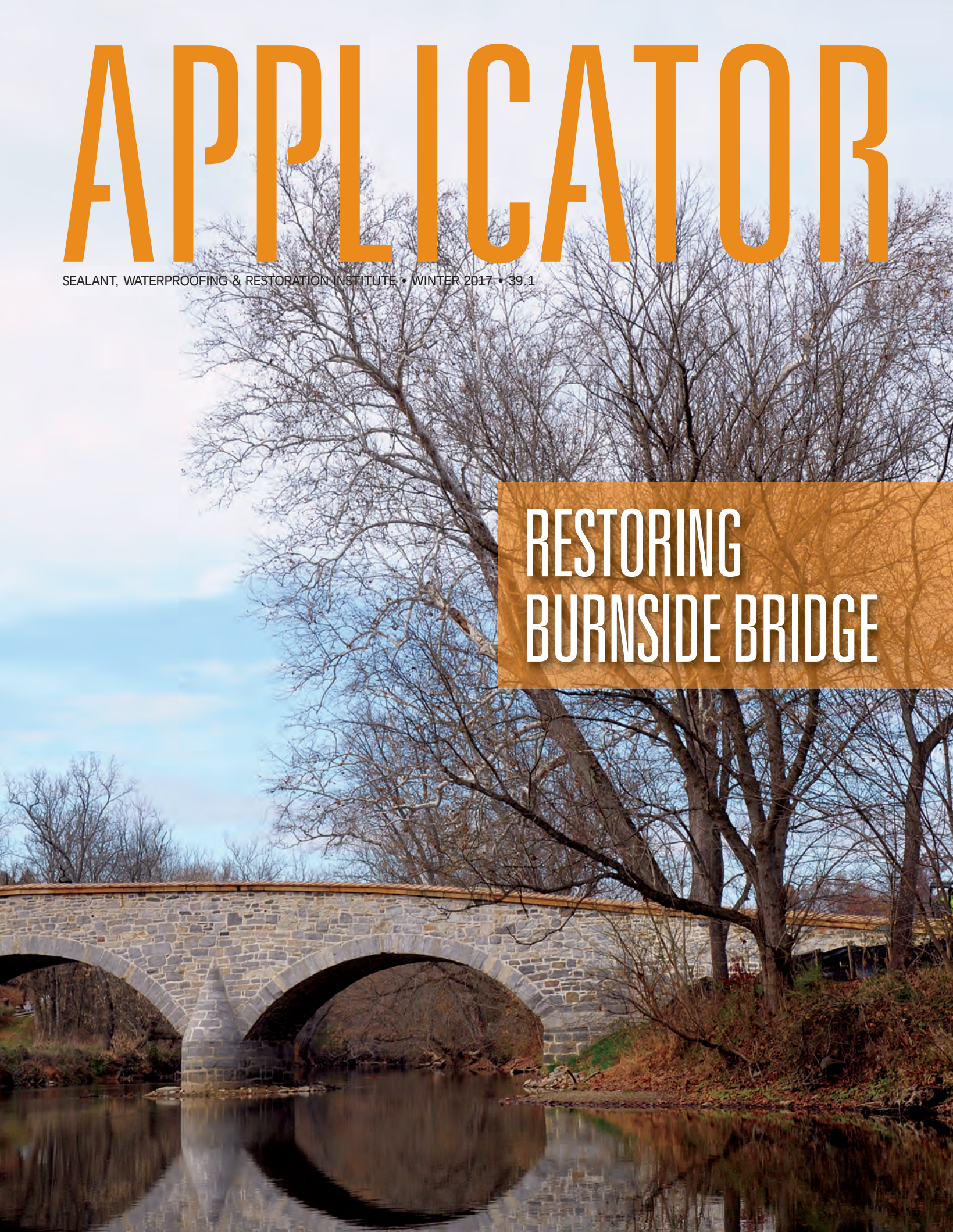


RESTORING BURNSIDE BRIDGE

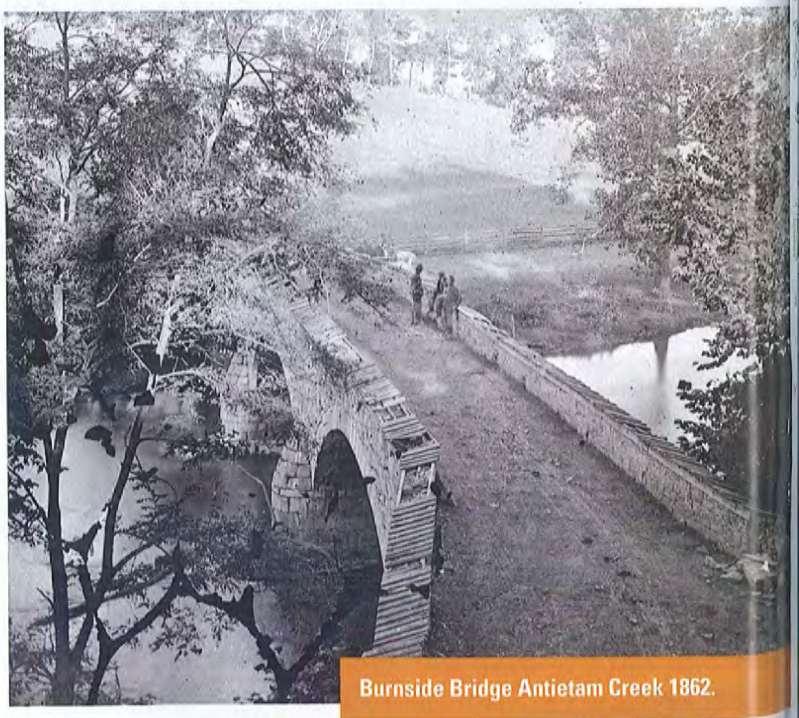
RESTORATION OF BURNSIDE BRIDGE

By Polly Raine

In March of 2014, staff from the National Park Service Historic Preservation Training Center found themselves pulling heaps of stones out of Antietam Creek – a section of stone facing had fallen into the water from the historic Burnside Bridge. The bridge - built in 1836 on what became the Antietam National Battlefield in Sharpsburg, Maryland - had received a handful of minor repairs over the years, but none could be categorized as comprehensive restorative efforts. It became clear that the long-term stability and preservation of this historic structure required an engineering assessment and commitment to qualified restoration.

HISTORY OF A BRIDGE

Once the epicenter of the "bloodiest one-day battle in American history", the Burnside Bridge is now nestled in peaceful, bucolic countryside approximately 60 miles west of Washington DC. On September 17, 1862 the bridge and surrounding landscape witnessed 23,000 soldiers killed, wounded or missing after 12 hours of brutal combat; the Battle of Antietam was a national tragedy of the greatest proportion.



Burnside Bridge Antietam Creek 1862.

The bridge was designed by master builder John Weaver, and built by local farmers – one of three similar spans over Antietam Creek. It has elegant proportions, at 14' 9" wide, 125-feet long and with three magnificent barrel arches, built of locally-sourced limestone with wooden parapets. Until 1966 the bridge had been used by local vehicle traffic, which proved a substantial contributor to its wear and tear. In 1966, the National Park Service allowed the original farm lanes leading to and from the bridge to grow over, and created an infrastructure on the Antietam National Battlefield that continues to impress historians, tourists, and visiting educational groups year-round. The importance of the Burnside Bridge to American history warranted every restorative effort, despite a 1.7 million dollar price tag and several months of limited to no-access for National Park Service visitors.

A team of preservationists and engineers were enlisted to assess needs. They took core samples and x-rayed the bridge for a comprehensive analysis. They found substantial deterioration of the walls, voids in the bridge's piers, and resultant water infiltration which had led to structural instability. A two-phase plan was created, where in-stream work on the stone piers and arches would be followed by selective dismantling and rebuilding of large sections of the bridge walls. The project officially began in October, 2015 and was completed late-December 2016.

The Witmer Group's contribution to this significant historic salvation included repointing of the abutments, piers, and arch soffits, installation of replacement footings, grout infill of pier voids, introduction of stainless steel tie rods, and the dismantling and re-building of parapets and spandrel stones. A team of craftsmen under Foreman Chuck Bowman were proud to be a part of a project that required dynamic problem-solving, meticulous planning, and experienced craftsmanship.

DIVERTING WATER

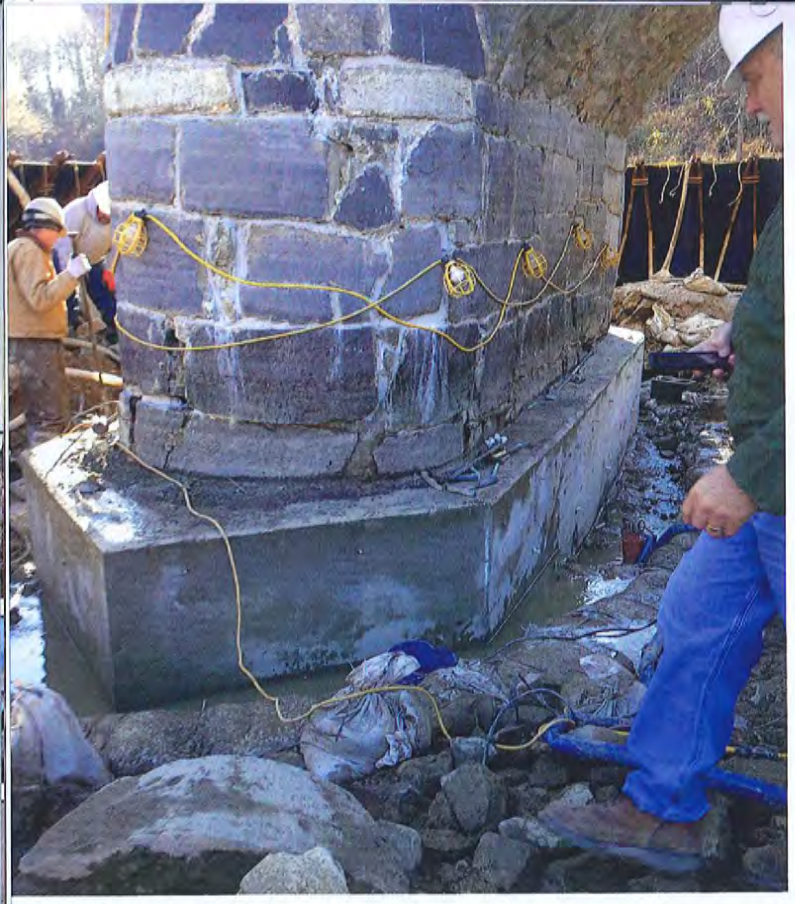
Water in Antietam Creek flows at a minimum of 200 cubic ft/second, up to 5ft. deep in portions. The Witmer Group's contract required that the work be performed dry, not only because materials demanded it, but out of safety concerns for those performing the work. Step one was to build coffer dams to partially divert water (dams were relocated as work progressed). A metal skeleton was built, then draped with waterproof poly and secured with sandbags.

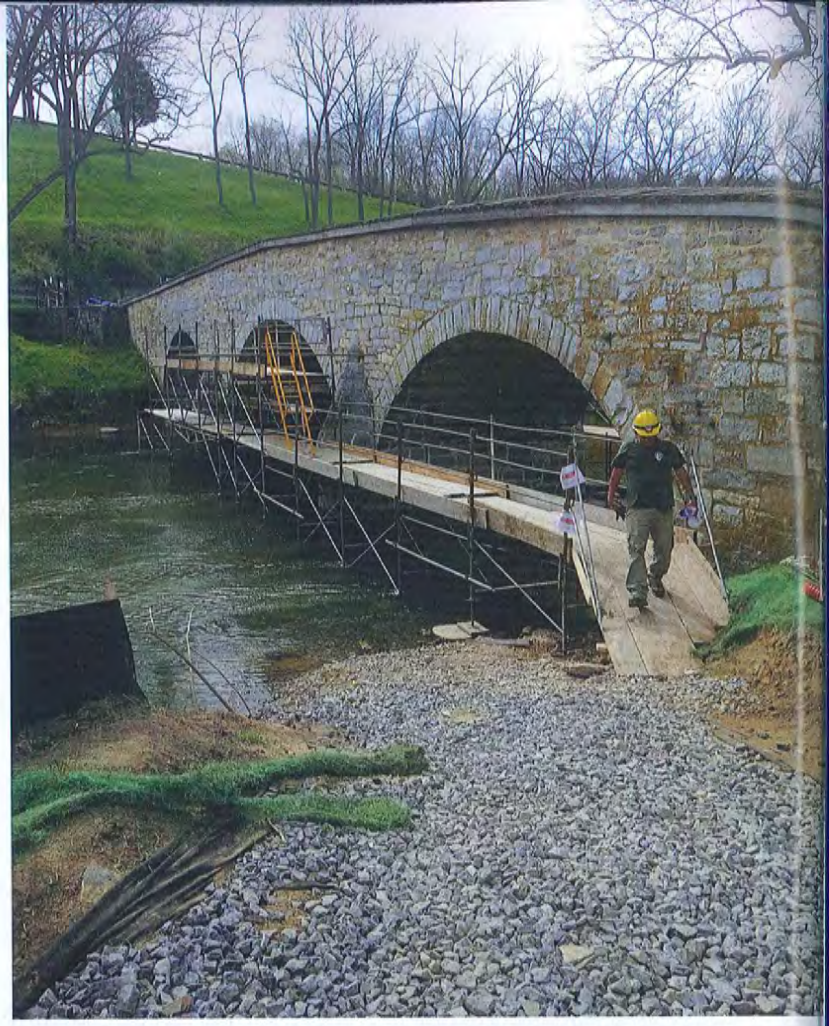
The initial design allowed for water seepage through the sediment, requiring the addition of seven water pumps. The solution included two large pumps for substantial standing water, along with up to five small pumps to remove puddled water. (The pumps continued to prove beneficial later in the project, being reversed-out to provide high pressure washing in prep for repointing, and to aid in cleaning.)

Coffer dams were a necessity, and for the most part successful at diverting creek water. After initial adjustments, they remained intact with one exception - the winter of 2015/16 saw a heavy local storm that deposited 3 feet of snow. Water rose rapidly upon snow melt, flowing at a rate of 1,000 cubic feet/second overtaking the dam. Work was delayed for one month while waters receded and work areas dried.

WHAT DRY GROUND REVEALED

Once creek beds were dry and the footings fully exposed, the crew was quick to learn the supports had severely deteriorated, requiring underpinning before moving forward. Sandbags were installed to line trenches dug around





the piers. Once pumped dry, footing extents were wrapped in epoxy- coated rebar followed by forms. Witmer's crew poured new concrete footings for both piers – 8 cubic yards of concrete for each.

Some careful forethought allowed for predetermination of the layouts for future scaffold while the ground was dry. Bases were poured in a grid pattern, 1 foot deep into the sediment, onto which scaffold would be securely erected months later when the dams were removed (concrete scaffold bases were likewise removed when the job was complete).

FURTHER STABILIZING PIERS

To internally stabilize piers, a natural cement grout was hand-pumped into all pier cavities as flowable fill. The material is inherently expensive, hard to find, and in this case, difficult to effectively inject into hidden, uncharted empty spaces. Piers were divided into two lateral segments, the first from the footing to approximately half-way up the springline, the second ending at the bottom of the existing concrete slab (concrete slab was added to support the roadway as a part of previous repairs). Grout was piped into ports until forced out of exit ports above. Lower ports were sealed, and the process was repeated in the upper section.

The concrete slab (which rested on the piers below) had been removed in order to add one-inch threaded stainless steel tie rods for additional structural

support. New slab was poured to encase the new and existing tie rods. With new footings, flowable fill stabilizing every crevasse, and the added tie rods, the piers' long-term structural integrity was assured.

BARREL ARCHES

With pier work complete, scaffolding was erected simultaneously on both sides of the bridge, one barrel at a time. With a closer look at the undersides of the arches, large cracks were found – an additional previously unknown defect needing to be rectified. The crew also found large voids in the wall, from 1 - 2 feet deep in need of immediate attention. By introducing a variety of stone sizes into cavities, using gravity and natural lime mortar, voids were filled and cracks stabilized. Helical rods spiraled to tie everything together.

National Park Service-provided certifications allowed some of Witmer's crew the select use of power tools in inconspicuous areas (e.g. in under-barrel areas). Power tools proved helpful in what was otherwise a painstakingly lengthy process of cutting out joints overhead. Once voids were filled, and face-pointing was complete, the team hand-pumped grout into PVC tube grout ports. The consistency of molasses, the grout proved to fill voids as small as 1/16in to the extent that it seeped across sides and met piers.

Once this procedure was complete, the top side of the bridge was dug up in order to install additional 1" stainless steel tie rods over each vault. Grout was poured into the top of the vault followed by flowable fill for under-deck areas, and later topped with decking.

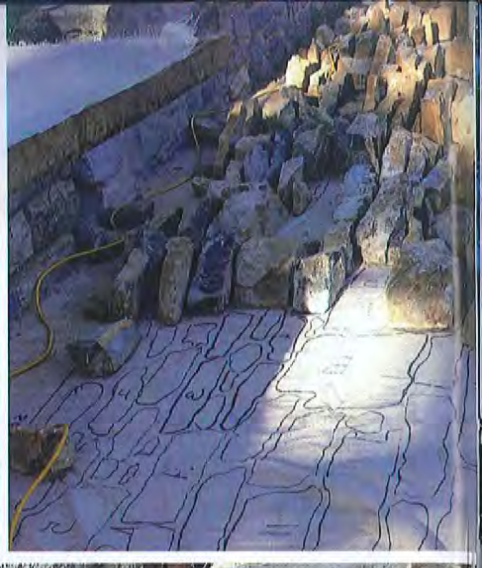
STONE BY STONE

Phase Two's focus was to dismantle and rebuild stone facing. The majority of facing stones were removed and cleaned (fortunately arch keystones remained strong and in-tact), the deteriorated material immediately behind removed (nets across the scaffolding captured virtually all debris, preserving the creek waters below), corrugated strap anchors epoxied into interior stones to build upon stability (backup stones were largely captured by concrete slab introduced in previous preservation efforts, and then facing stones were replaced into their original configuration. The Witmer Group's team devised a system that divided and marked the project into vertical numbered segments, allowing them to create an accurate map. The goal: a finished product which would be barely discernable from the original.

The crew hung poly sheets, outlining each stone, numbering character stones on both map and stone faces. A duplicate copy of the map was created and laid on the ground, onto which stones that had been

extracted would be temporarily placed. In some sections, walls were up to one foot out of plumb – an issue able to be corrected in the finished product.

Once sections were reconstructed and repointed, a natural lime mortar wash was added atop the side walls in preparation for a waterproof membrane, stainless steel pan flashing system, and finally a rough sawn oak system at the parapets to match the original design.



OPPORTUNITY CHALLENGES

How does a contractor bid a job with so many unknowns? How does a company navigate the Federal Government's National Park Service, and the inherent challenges regulation and administration impose? What happens when critical hard-to-find natural lime mortar sourced from France, becomes unavailable due to a strike? What happens when dry working ground is flooded by storm waters – for a month? ...when century-old artifacts are found buried in a structure overseen by the National Park Service? ...when your team must deconstruct and reconstruct what many believe to be hallowed ground?

THE WITMER GROUP'S ANSWERS

The contract requires careful language to equally protect the contractor and the owner entities. Use your resources, know your client, fully grasp the scope of work, forecast potential challenges and discuss them in advance for clarity and understanding – prior to contract execution. First and foremost, be prepared by knowing the project inside and out in order to build it first in your head. With that picture in mind, potential challenges can be addressed as they occur without consequence.

The National Park Service has an understandably stringent set of standards, rules, regulations and processes to uphold. Make it a priority to develop a healthy working relationship from a place of mutual respect. By honoring the client's methods, communicating clearly, in-haste and with honesty 100% of the time, your own expertise and professionalism will be rewarded. That is how to keep things moving.

Be sure if you choose uncommon and extraordinary products, that they are available from more than one supplier and across multiple channels, and secure a relationship with back-up vendors prior to job-start whenever possible.

Mother-nature is unpredictable. That said, the extent of damage – whether time or materials-based – can be somewhat controlled with strategic planning. Always have a back-up plan for surprises. When stop-work is unavoidable, have a planned communications response that is both pro-active and reassuring, know how to help those out-of-work, and have a proven plan to keep work-to-date, materials, and the jobsite stable.

When you are working on preserved grounds, respond with exaggerated care to every found object - a farmer's pipe buried in the year 1836, antique coins and nails – no matter your assumptions about their value. Not only may your client's regulations call for specific follow-through, but you'll benefit from your own documentation (if not for your records, for the stories you'll share with employees and clients later).

RESPECT PLACE, AND THOSE TIED TO IT. ALWAYS.

Honoring the extraordinary losses of the Civil War by preserving the beauty, integrity, and history in the Burnside Bridge has been a proportionate honor for The Witmer Group's Masonry Restoration Division. As of December 2016, the bridge has re-opened. It is a shining example of what craftsmanship, preservation expertise, and innovative problem-solving can achieve.

ABOUT THE AUTHOR

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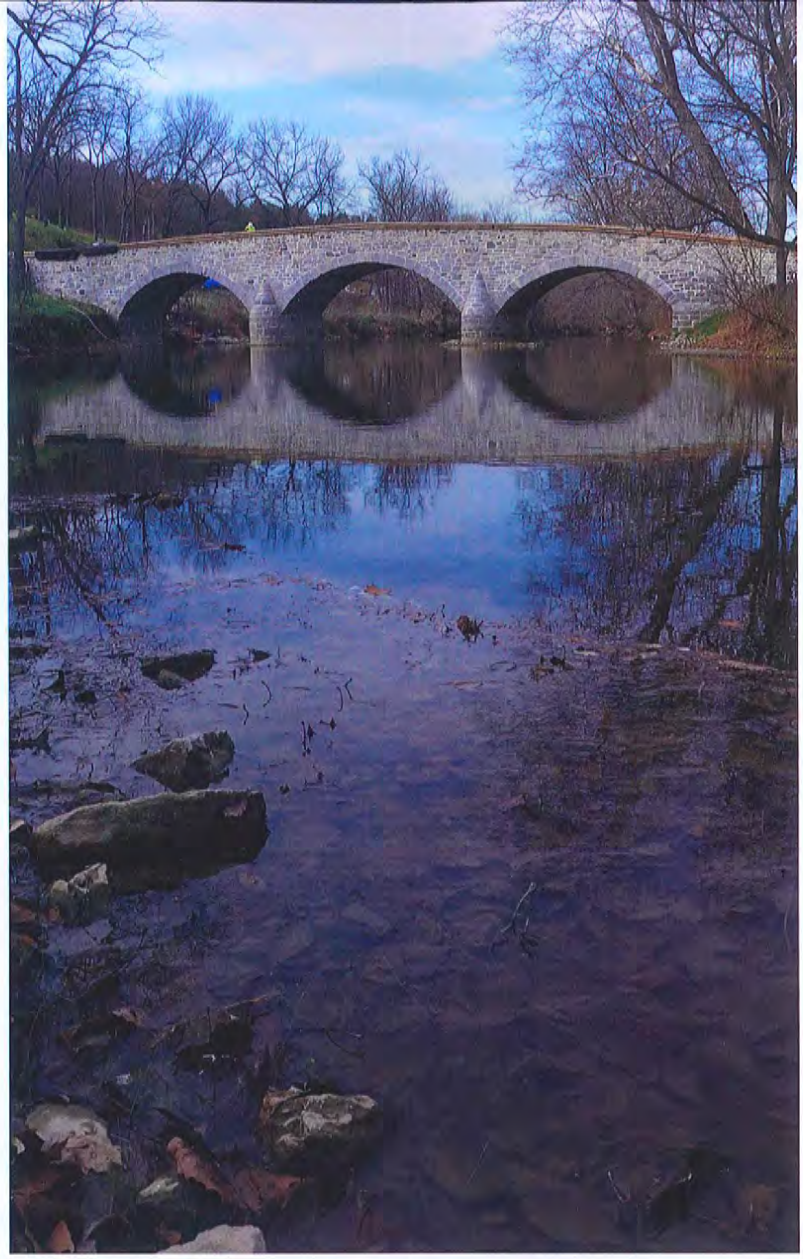

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