Blackstone, VA Filter Upgrade

MULTICRETE™ II Retrofit for Wheeler Bottom Underdrains

CASE STUDY

Photograph by J.J. Prats

Location: **Blackstone, Virginia**
Owner: **Town of Blackstone**
Engineer: **B&B Consultants**
Contractor: **GMW General Contractors, Inc.**

Blackstone, Virginia, is located 50 miles south of Richmond, Virginia. The Town of Blackstone owns and operates Blackstone Water Treatment, which provides water for approximately 3,500 town citizens and for the inhabitants of the nearby Fort Pickett Military Reservation. In addition to treating water for the approximately 6,000 people who occupy the town and military reservation, the water treatment plant supports thousands of tourists who come every year to enjoy the town's rich history.

The plant uses five gravity filtration basins, each 15 feet x 24 feet, to treat surface waters from the Nottoway Reservoir for iron and manganese removal. The filters were originally designed with sand media on a gravel support bed and a surface wash. The plant's maximum treatment capacity is 5 million gallons per day of water.

Problem

Blackstone Water Treatment began the search to find potential upgrade options for its existing gravity filters because the filters were no longer operating at the desired performance level. The primary issue was underdrain failure. Like many plants with gravity filters, Blackstone Water Treatment had installed Wheeler Bottom underdrains. Once a popular option for gravity filtration, plants have discovered that Wheeler Bottom underdrains have a limited life. Predictably, this has negatively affected the underdrains' popularity.

"No one is promoting and selling new Wheeler underdrains anymore," explains Peter Levorson, P.E., a Proposal Manager at WesTech. "They are basically retired from the industry and old plants are removing and replacing them over time."

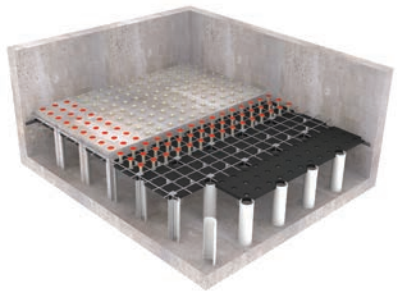
Wheeler Bottom underdrains have an old-style, precast floor. Many of the plants that installed these underdrains are now considering replacing them with block underdrains. However, this approach entails using massive amounts of concrete to fill in the plenum beneath the existing underdrains and to form a flume. In addition to the expense of pouring large amounts of concrete, this approach raises the elevation of the underdrain, which further limits filtering head and may reduce media depth.

"Block underdrains also generally have a higher headloss than nozzle underdrain systems, which could affect the plant's hydraulics," adds Levorson.

Analysis of Alternatives

Blackstone evaluated multiple underdrain upgrade options after deciding not to replace its failing Wheeler Bottom underdrains in kind. (The plant was not happy with the Wheeler Bottom's short lifecycle.) Common issues associated with these underdrains include wear on the ceramic balls that lie within the Wheeler Bottom's inverted pyramids, loss of filter media during backwash, and insufficient head loss to provide good flow distribution.

The town manager reached out to WesTech's representative to learn about potential options for retrofitting its existing underdrain cells. WesTech offered two potential solutions: the MULTICRETE™ II underdrain system and the MULTIBLOCK® underdrain system.



Cutaway rendering of the MULTICRETE II

WesTech®

Solution

The plant selected the MULTICRETE II underdrain retrofit solution for two key reasons. First, the MULTICRETE II underdrain is well suited for Wheeler Bottom underdrain retrofits. Similar to the Wheeler Bottom underdrain, the MULTICRETE II underdrain is based on a monolithic concrete design. The design similarities between the two types of systems make it possible to perform a retrofit without extensively reshaping the filter floor, which would require extra time and expense. Because of the similarities, the MULTICRETE II underdrain allowed continued access to the plenum area through an existing access hatch.

MULTICRETE II retrofit requires less concrete

Second, the MULTICRETE II underdrain's nozzle-type system easily integrates with WesTech's MULTIWASH® backwash, enabling the plant to upgrade its former surface wash process to the most effective simultaneous air and water backwash process on the market today. The superior cleaning performance of the MULTIWASH process maximizes filter run lengths, extends media replacement frequencies, and reduces long-term operational costs by improving the overall efficiency of the filtration process.

Implementation

The MULTICRETE II underdrain system offers two options: non-media retaining, which includes support gravel, and direct media retention, which eliminates support gravel. The Blackstone plant chose the non-media retaining option. The plant wanted a gravel support bed, so the implementation team supplied in-bed airwash grids to introduce air into the filter cells for the backwash process. The remaining media bed consists of 18 inches of anthracite atop 12 inches of sand. To retain the media in the filter cells during the scouring action of the MULTIWASH process, the implementation team complemented the MULTIWASH baffles by adding ESSD™ washtroughs to the filter cells. The washtrough baffles are specifically designed to retain media during simultaneous air and water backwash for the full duration of the backwash while water is overflowing the trough weirs. This minimizes media loss for essentially any type of media.

While upgrades to the underdrains and washtroughs were taking place, the plant took advantage of other potential upgrades that WesTech could offer. For example, the implementation team provided a new filter control panel to control the five filter cells. The plant also opted to upgrade its existing valves with new Bray electric valves and to incorporate new instrumentation for feed-flow and headloss monitoring.

The plant focused mainly on the gravity filters during the upgrades, but it also integrated upgrades to its sedimentation basins to achieve a more updated treatment plant overall. The plant has four sedimentation basins, each measuring 85 feet x 24 feet. WesTech provided new Sludge Sucker™ sludge removal assemblies for each basin. Sludge Suckers are cost-effective and efficient sludge removal mechanisms that remove lightweight sludges. Sludge Sucker assemblies are easily customizable to fit within existing basins, which appealed to the Blackstone plant.

Results

Blackstone Water Treatment's gravity filters have been working extremely well since the upgrades to MULTICRETE II underdrains were completed. Not only did the plant save on installation costs over those of replacing its Wheeler Bottom underdrains with a block-style underdrain system, but it also benefited from a much-improved backwash system – MULTIWASH – that is designed for thorough cleaning and excellent media retention.

Gravity Filter Media	
Anthracite Coal Media	
Depth	18”
Effective Size	0.95-1.05 mm
Sand Media	
Depth	12”
Effective Size	0.45-0.55 mm
Support Gravel Media	
Depth	9”
Total Media Depth	39”

As for the plant's operators, they are also very happy with the performance of the gravity filters and sedimentation basins. They have had no issues with the MULTICRETE II underdrains, ESSD washtroughs with MULTIWASH baffles, or Sludge Sucker assemblies.

Gravity Filter Design Criteria	
Quantity	5
Filter Area/Unit	360 ft^2
Design Filtration Rate	2.41 gpm/ft^2 w/one filter offline
Backwash Rate (air/water)	9 gpm/ft^2 and 3 $scfm/ft^2$
Backwash Rate (water only)	$\leq$ 20 gpm/ft^2

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