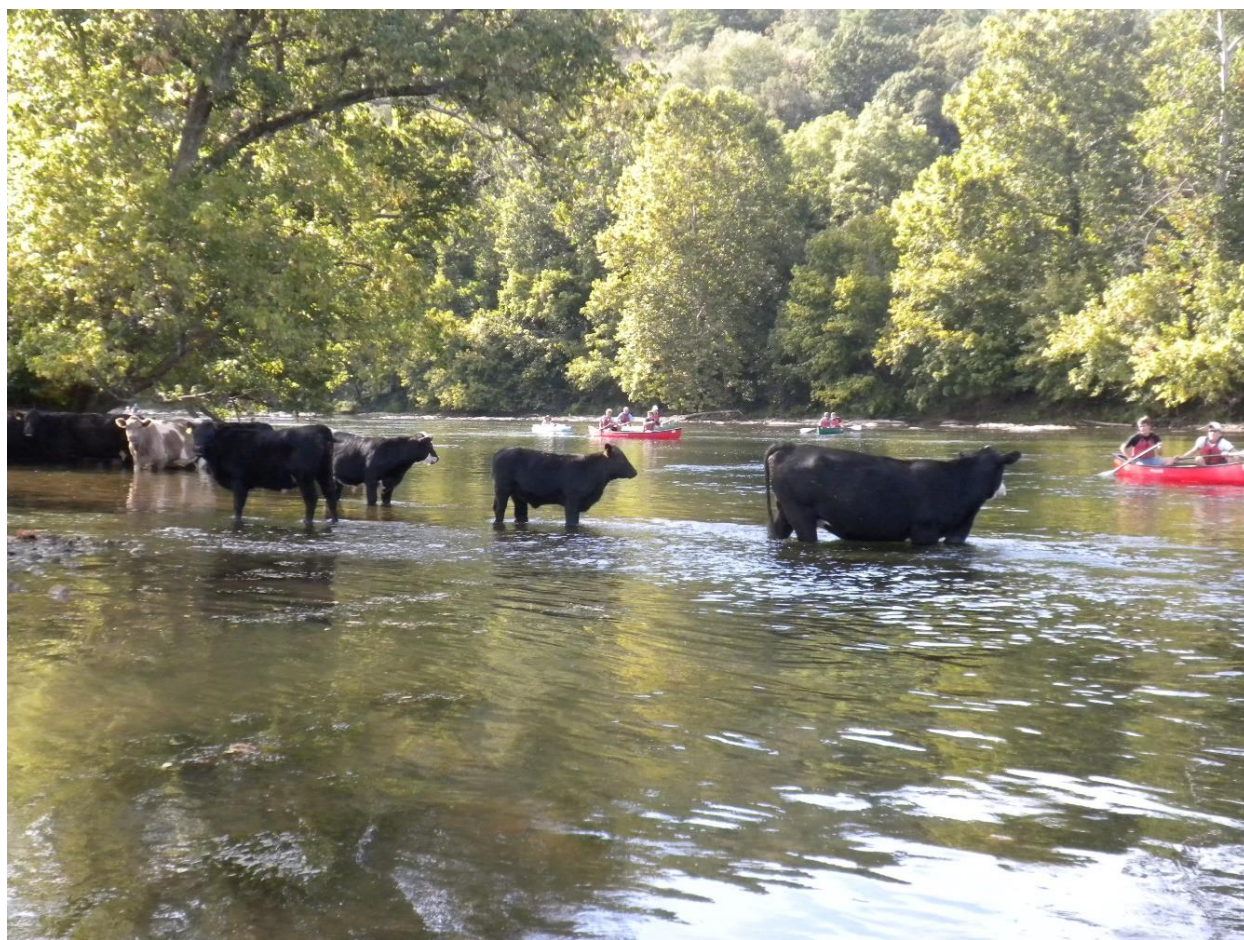


Livestock Fencing in the Shenandoah Valley

81% of Farms in VA's Two Largest Agricultural Counties Fail to Fence Cattle out of Streams, Contributing to Pollution



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THE ENVIRONMENTAL INTEGRITY PROJECT

The Environmental Integrity Project (<http://www.environmentalintegrity.org>) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for effective enforcement of environmental laws. EIP has three goals: 1) to provide objective analyses of how the failure to enforce or implement environmental laws increases pollution and affects public health; 2) to hold federal and state agencies, as well as individual corporations, accountable for failing to enforce or comply with environmental laws; and 3) to help local communities obtain the protection of environmental laws.

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Executive Summary

For many years, one of the most important, unanswered questions in the Chesapeake Bay cleanup has been: To what extent are farmers actually implementing pollution control practices, such as fencing cattle out of streams? How often are farmers maintaining strips of grasses and trees as green filters along waterways? These are the most cost-effective ways to reduce the nitrogen and phosphorus pollution that are impairing the nation's largest estuary, but not enough information is collected about how often these strategies are employed.

Farmers claim (without evidence) that they are voluntarily installing these best management practices far more often than they get credit for in the EPA's computer modeling of pollution reduction progress in the Chesapeake Bay. On the other hand, many environmentalists contend there is not enough verification of farm runoff control efforts and a lack of hard data showing how often these practices are actually installed and maintained over time. The result is a gap between projections and reality, and sometimes bitter debates about whether farmers are doing their fair share.

An important example concerns fencing along streams in pastures. Although bay restoration experts for decades have agreed that fencing livestock out of waterways is an important way to reduce nutrient, sediment and bacterial pollution, neither the EPA Chesapeake Bay Program nor any of the regional states knows—or even attempts to track—what percentage of farmers fence their cattle out of waterways. Virginia's official plan for reducing pollution to meet the

limits in the Chesapeake Bay Total Maximum Daily Load directs the state to fence cattle out of 95 percent of streams through farm pastures by 2025, just six years from now.¹ However, officials with the Virginia Department of Conservation and Recreation and EPA say they do not know how close Virginia is to achieving this goal.²



EIP's examination of Google Earth imagery of Augusta County, Virginia, revealed that only 19 percent (155 of 835) of livestock farms had fenced their animals out of waterways. These cows are contributing manure and sediment to the Middle River, a tributary to the Shenandoah in Augusta County.

To help clear up this question, the Environmental Integrity Project performed a research project that utilized an objective source of information. Using highly detailed Google Earth satellite images, combined with county tax maps and EPA's computerized mapping of streams, EIP's team of data analysts calculated what percentage of farms in one of Virginia's biggest agricultural counties—Augusta County, in the Shenandoah Valley—fenced their cattle out of streams on their property. Augusta County has about 95,000 beef cattle, the second most of any county in Virginia, and fourth most in the bay watershed.³

EIP examined Google Earth aerial photographs taken in 2017 of 835 farms in Augusta County with streams and livestock on them and found that 81 percent of the farms (680) had not fenced their cattle out of all waterways on their properties. That means only 19 percent had followed this best management practice for the health of the rivers and Chesapeake Bay.



Cows wade into the South River, a tributary to the Shenandoah, in Augusta County, Virginia. Most cattle farms in the county do not exclude their animals from rivers and streams, contributing to bacteria and sediment pollution.

In 2016, the nonprofit Shenandoah Riverkeeper organization performed a similar survey in neighboring Rockingham County (the state's largest agricultural county, with 110,868 cattle). This survey found that only about 20 percent of the 841 farms with livestock and streams fence their cows out of the waterways. That meant about 80 percent (or 675) of the county's cattle farms permitted the animals to have unfettered access into streams—allowing them to deposit fecal bacteria and nutrients into the waterways.

That's a vast chasm between reality and goals. Virginia's goal of protecting 95 percent of farm streams from livestock is far from the 19 percent execution by the farms in the state's two largest agricultural counties.⁴ The numbers provide a sobering reality check on the progress by farmers in the Chesapeake Bay cleanup. More specifically, the data support a powerful argument for increasing public funding to pay for farm fencing – and for Virginia to start requiring (or providing tax incentives) for farmers to fence their cattle out of streams. In 2012, Maryland imposed regulations that require farmers to exclude their cattle from streams; and that state reimburses farmers 87.5 percent of the costs of installing fencing and alternative watering devices, so cows aren't forced to drink from streams. Virginia reimburses farmers at a lower rate, 75 percent. Unfortunately, neither Maryland nor Virginia track how often farmers follow this practice. So more monitoring and information is needed in all Bay region states to determine what else needs to be undertaken by the agricultural sector.

Virginia should take the following steps to close the gap in its livestock fencing goals and reduce pollution in the Chesapeake:

- 1) Virginia should start requiring farmers to install livestock fencing. If this proves politically impossible, the Commonwealth and its counties should use tax incentives—creating a two-tiered “use value” taxation structure—to convince farmers to fence their cattle out of waterways and plant pollution-filtering strips of vegetation along streams, or face tax penalties in the form of a reduction in their agricultural tax breaks.
- 2) The state should return to its program of reimbursing livestock farmers 100 percent of the cost of fencing cattle out of waterways and providing alternative watering systems, which was in effect from 2012 to 2015.
- 3) To reduce the burden of forcing farmers to front the cost of pollution reduction projects, Virginia should pay landowners 50 percent of the cost up front, and then the remaining 50 percent when the projects are complete.
- 4) To encourage greater participation in the fencing program, Virginia and the U.S. Department of Agriculture should allow greater flexibility in accepting what varieties of fencing are acceptable.
- 5) Virginia should conduct or fund aerial photo surveys of streamside fencing compliance in all heavily agricultural counties within the state. Without this detailed information, the state will not know how far it has to go to achieve its own goals for water quality.
- 6) The Commonwealth should not move ahead with a proposal to eliminate streamside fencing goals as part of its next Chesapeake Bay cleanup plan (the so-called “Phase 3 Watershed Implementation Plan” for the EPA’s Bay Total Maximum Daily Load). A successful Bay cleanup plan will require more — not less — accountability and specific targets, especially for the agricultural sector, the largest source of pollution in the Chesapeake.



Cattle in Bell Creek in Augusta County, Virginia. To provide incentives to farmers to keep their animals out of waterways, EIP recommends that the state and counties should reduce real estate tax breaks for landowners who fail to install fences to reduce pollution.

Because streamside livestock fences serve an important public good — reducing pollution in the Shenandoah River and Chesapeake Bay — the public should pay for their construction, even on private land. Farmers, however, need to accept their fair share of the burden and implement requirements that keep their cattle away from streams and other waterways, or else face tax penalties. As demonstrated by data from Google Earth aerial photography in Virginia’s two largest agricultural counties, the purely voluntary system employed over the last three decades has fallen far short and will not meet the 2025 targets of the Chesapeake Bay cleanup. The current system needs an overhaul if Virginia is ever to restore the health of the Shenandoah River and the nation’s largest estuary.

The Value of Livestock Fencing

Across the Chesapeake Bay watershed, there are more than 3.5 million livestock animals on 2.4 million acres of pasture, including beef cattle and dairy cows, horses, sheep and goats, according to a report from the Chesapeake Bay Commission.⁵ Traditionally, many farmers allowed their cattle to wade into streams running through their property because these waterways provide free and convenient sources of drinking water and places to cool off during hot weather. But for decades, scientists have known that this practice harms water quality because cows churn up the banks, thus muddying the streams. Livestock also defecate and urinate directly into the water, polluting it with fecal bacteria and nitrogen and phosphorus pollution. The Bay Commission concluded: “The net result is significant damage to hundreds of miles of streams and stream banks. Despite the upland location of many smaller streams, the aggregated impact from livestock on all of these streams has been documented as a major source of nutrients, sediment and bacteria to the Bay.”⁶

In Virginia, 280 stream segments in agricultural areas have so much E-coli bacteria in them that they have been officially designated as “impaired” by the state and EPA, and the government agencies have written cleanup plans for them demanding reductions in feces from cattle.⁷ Fencing cattle out of streams can reduce erosion by 77 percent and phosphorus pollution by 81 percent, according to one Virginia study.⁸



Fencing cattle out of streams often requires farmers to install alternative watering devices like the one shown in this picture. To make the devices work, contractors often must extend plumbing or dig wells to provide water.

In addition to the ecological benefit of livestock fencing is an economic benefit to farmers. Cattle owners who have installed fences along streams report increased survival of calves

born on their farms, because fewer calves can wade into rivers, resulting in drownings. Fences also result in decreased leg injuries among cows, and overall improved herd health, including from diseases caused by polluted water, such as foot rot, bacterial inflammation, jaundice, fever, red nose, bovine virus diarrhea, tuberculosis and mastitis.⁹ Beef cattle that drink clean water out of man-made watering devices instead of polluted streams gain up to 25 pounds in weight due to improved health, which translates to more profit for the farmer.¹⁰

Despite these advantages, many cattle owners do not fence their animals out of waterways because of the prohibitive cost of fencing and installing alternative watering systems, as well as the time and money required to maintain and inspect fences. Some landowners also express a reluctance to break from tradition, and have cultural and aesthetic preferences for “clean-looking” (denuded) streambanks in pastures.

Virginia’s Program to Encourage Livestock Fencing

From 2012 to 2015, Virginia took steps forward to encourage livestock fencing by offering a special program that provided farmers with 100 percent reimbursement for the costs of installing fencing and alternative watering systems.¹¹ These costs for farmers can run \$3 per foot of fencing or more, which can translate to thousands of dollars. About 2,500 farmers took advantage of the program. But because of insufficient state funding, money for Virginia’s 100 percent reimbursement program ran out after June 30, 2015, leaving a backlog of 118 farmers who signed up during the enrollment period but are still seeking funding.¹² Since 2015, Virginia has been offering only 75 percent reimbursement to farmers for the cost of streamside fencing and other best management practices to reduce runoff pollution (a lower reimbursement rate than neighboring Maryland provides).¹³ Virginia also placed a cap on how much money farms could obtain for fencing.

In a Chesapeake Bay cleanup plan Virginia submitted to EPA in 2010, the state estimated that only about 15 percent of the linear feet of streams running through pastures in the Commonwealth were protected from cattle by fencing.¹⁴ Virginia promised the federal agency that the state would protect 45 percent of pasture stream footage by 2017; and 95 percent by the deadline of 2025. (The state made this pledge in its Watershed Implementation Plan to comply with the EPA’s “Total Maximum Daily Load” process for reducing pollution in the Chesapeake by 2025.) Two years later, in 2012, Virginia submitted a revised Bay cleanup plan to EPA that said that 11.6 million linear feet of fencing through pastureland had been installed out of a goal of 114 million feet by 2025.¹⁵ However, Virginia then failed to adequately track progress or monitor how many farms were actually installing streamside fences – and fell far short of its goals.

By 2019, Virginia officials estimated that farmers had installed only about 22 million linear feet of fencing on pastureland.¹⁶ That would mean the state was only about 19 percent toward its goal for 2025, and less than half the way toward its target for 2017. However, in an interview with EIP, Russ Baxter, Deputy Director of the Virginia Department of Conservation and Recreation (VDCR), and Darryl Glover, Director of the agency’s

Division of Soil and Water Conservation, said that these estimates were incomplete and did not include fencing installed by farmers without government funding. State regulators did not attempt to track what percentage of farmers with livestock were installing fences, or how far Virginia was actually toward meeting its Bay cleanup goals for fencing.¹⁷ When asked why the state did not track this practice, James Martin-Davis, Chesapeake Bay Coordinator for the Virginia Department of Environmental Conservation, said in an email: “It is not possible to accurately quantify.”¹⁸ Russ Baxter of VDCR said: “It’s a manpower issue for us. We are hamstrung on the personnel side.”¹⁹ Instead of trying to meet Virginia’s ambitious 95 percent target for protecting streams, Baxter said the state, by April 9, 2019, plans to release a new proposed Bay cleanup plan that has eliminated all specific livestock fencing targets, replacing them (and other specific goals) with broader and more flexible pollution reduction targets for certain geographic areas of the state, as determined by computer modeling.²⁰ “We are no longer aiming for that goal,” of protecting 95 percent of streams, Baxter said. “That is not our goal anymore. It will be superseded by the strategies in the plan we are outlining in April.” That new “Watershed Implementation Plan” for Virginia (called a “Phase III WIP”) should be open for public comment for two months starting in April, with a final plan issued by the state in August, 2019.²¹

Animal Agriculture in the Shenandoah Valley

In the southern Shenandoah Valley, Augusta County has a total of 1,085 farms with 94,783 cattle, according to the most recent available U.S. Department of Agriculture census data.²² (Not all of these cattle operations have streams flowing through them, which were the subject of EIP’s analysis). The average farm with livestock has 87 cows. But there are also 216 farms in the county with between 100 and 499 head of cattle, and 28 operations with more than 500 animals. Augusta County produces \$232 million in agricultural commodities annually, making it the second-largest agricultural economy in Virginia, behind only Rockingham County, immediately to the north.²³ Rockingham County has 1,902 farms with 112,747 cattle, and produces \$659 million in agricultural products annually.²⁴

In April 2017, the Environmental Integrity Project (EIP) released a report documenting the over-application of manure on farmland up and down the Shenandoah Valley.²⁵ Livestock in the valley produce 1.15 billion gallons of liquid cow manure and 820 million pounds of poultry litter annually. The over application of this manure onto fields as fertilizer leads to runoff of excess nutrients into the Shenandoah River and its tributaries, which triggers chronic algal blooms. Although most of the manure is spread on local farm fields, only 12.5 percent of the 539,955 acres of farmland in the valley’s four central counties are covered by “nutrient management plans” designed to discourage farmers from over-applying manure, according to EIP’s review of the plans. Over half of the farm acres that are covered by plans do not need any more phosphorus from manure in their soil, because they already have enough. But on 82 percent of these saturated acres, the plans authorize the spreading of still more waste—leading to more phosphorus runoff into waterways. A lack of livestock fencing also allows cattle to defecate directly into streams and dislodge nutrient-laden sediment to the waterways. As result, *E. coli* bacteria levels in many of the valley’s waterways are too

high for safe swimming or water contact recreation, although rafting and kayaking are popular and lucrative industries in the valley.

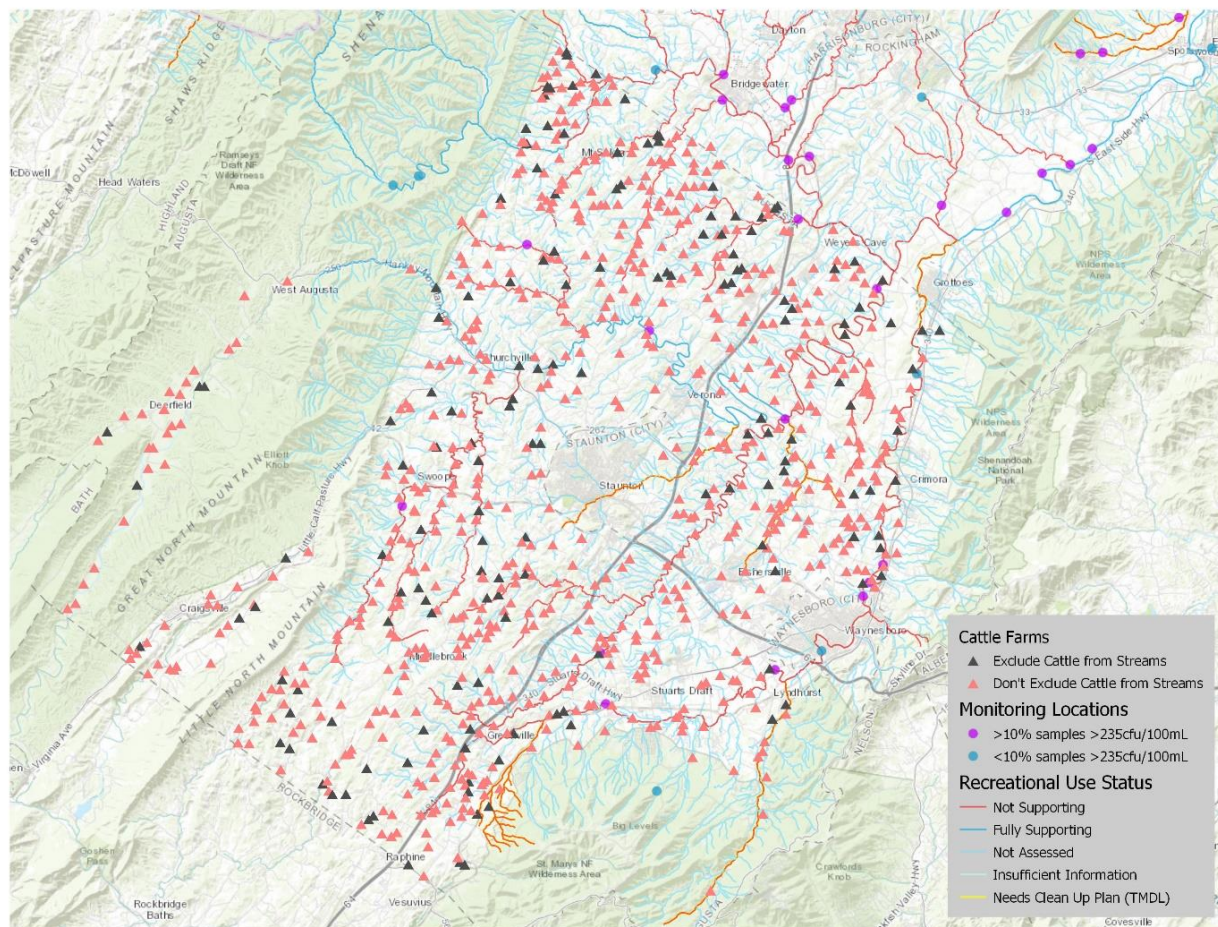


Cows cooling off beneath a bridge over Whiskey Creek in Augusta County. Although scenic, such use of waterways by livestock creates unhealthy bacteria levels downstream for people who want to swim or raft.

Analysis of Farm Fencing

In 2018, EIP conducted a pilot study to determine the extent of the problem of cattle entering waterways. Our organization used the most recent available Google Earth aerial photographs of farms in Augusta County (which were taken from January through October of 2017) to determine how often farms with livestock are fencing the animals out of streams on their properties. We counted farms with one or more locations where cattle could enter a waterway (as shown by muddied banks, a lack of fence, and no green zone of vegetation around a stream) as failing to fence their animals out of the waterway. (For a complete discussion of methodology, see Appendix A). Overall, we identified 835 cattle farms in Augusta County that had streams and found that 81 percent of the farms (680) had not fenced their cattle out of all waterways on their properties, while only 19 percent (155) had.

Map of Streamside Fencing at Cattle Farms in Augusta County, 2017

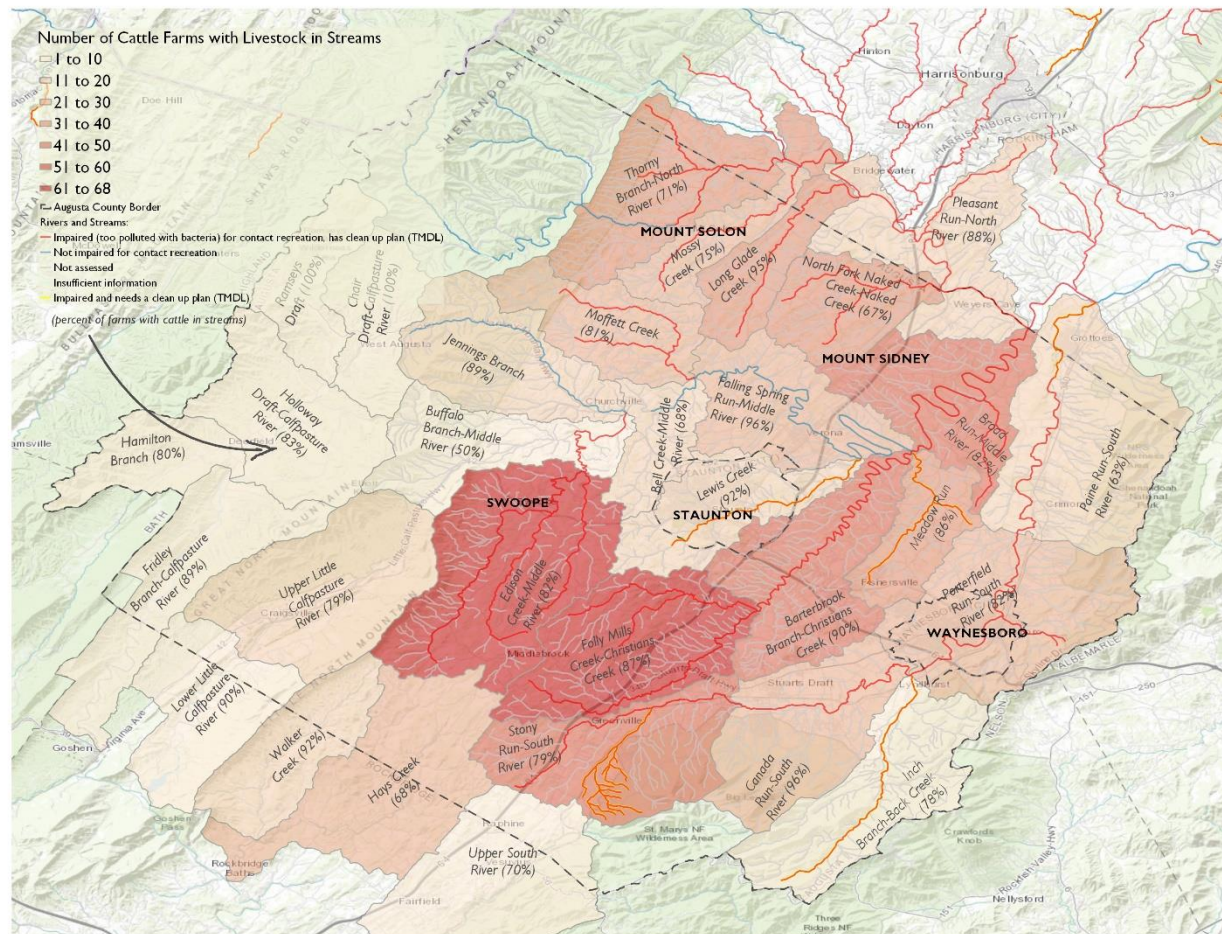


This map shows where cattle farms in Augusta County, VA have or have not fenced cattle out of streams, according to an analysis of Google Earth imagery from 2017. Red triangles represent farms that have not fenced cattle out of streams, while black triangles represent those that have. Red streams indicate waterways that are impaired because of high bacteria levels, meaning they are unsafe for activities like wading, swimming, and kayaking.

The section of Augusta County with the most cattle farms is west of Staunton, in the Eidson Creek/Upper Middle River subwatershed, which has 78 farms with both streams and cattle. Sixty-four of these farms (or 82 percent) fail to fence their livestock out of all of the waterways on their properties, according to EIP's analysis of Google Earth images of the farms. Surrounding these farms in this part of the county, portions of three streams—Middle River, Back Creek, and Eidson Creek—have been designated by the state as officially “impaired” by *E. coli* bacteria, meaning that they are so polluted they are not suitable for swimming or other water contact recreation.²⁶ Other parts of the county with large numbers of stream miles impaired by bacteria also have high concentrations of farms that have failed to fence their animals out of waterways, according to the aerial photography of the county.²⁷ For example, the Folly Mills Creek/Christians Creek subwatershed south of Staunton has three streams impaired by bacteria and 68 farms that have failed to fence their animals out

of the waterways on their properties. Likewise, northeast of Staunton, the Broad Run/Middle River subwatershed has two streams impaired by fecal bacteria and 47 farms that have failed to fence their cattle out of waterways. By contrast, in the Hamilton Branch, Chair Draft and Ramsey's Draft subwatersheds in the far western part of the county, there are no streams impaired by bacteria and also very few livestock farms that allow their animals into waterways. This suggests there is a correlation between parts of the county with fewer livestock in streams and better water quality.

Map of Streamside Fencing by Subwatershed, 2017



This map shows Augusta County subwatersheds that have the highest number of cattle farms that lack livestock stream fencing (dark red). The red colored streams are impaired with fecal bacteria, meaning they are not safe for swimming or water-contact recreation. The yellow highlighted streams still need clean up plans (TMDLs).

Streamside Fencing by Subwatershed in Augusta County, 2017

Subwatershed	Cattle Farms with Streams	Farms with Cattle in Streams	Percent of Farms with Cattle in Streams
Folly Mills Creek - Christians Creek	78	68	87
Eidson Creek - Middle River	78	64	82
Broad Run - Middle River	57	47	82
Barterbrook Branch - Christians Creek	49	44	90
Stony Run - South River	52	41	79
Long Glade Creek	39	37	95
Thorny Branch - North River	49	35	71
North Fork Naked Creek	51	34	67
Meadow Run	37	32	86
Falling Spring Run - South Run	25	24	96
Porterfield Run - South River	28	23	82
Hays Creek	34	23	68
Canada Run - South River	23	22	96
Moffet Creek	27	22	81
Mossy Creek	28	21	75
Jennings Branch	18	16	89
Pleasant Run - North River	17	15	88
Bell Creek - Middle River	19	13	68
Lewis Creek	13	12	92
Walker Creek	13	12	92
Paine Run - South River	19	12	63
Upper Little Calfpasture Run	14	11	79
Holloway Draft - Calfpasture River	12	10	83
Lower Little Calfpasture River	10	9	90
Fridley Branch - Calpasture River	9	8	89
Inch Branch - Back Creek	9	7	78
Upper South River	10	7	70
Buffalo Branch - Middle River	10	5	50
Hamilton Branch	5	4	80
Chair Draft - Calfpasture River	1	1	100
Ramseys Draft	1	1	100
Total	835	680	81

Unhealthy Bacteria Levels in Augusta County Waterways

EIP examined water quality monitoring data for the Shenandoah River and its tributaries collected by the Virginia Department of Environmental Quality between January 2017 and June 2018. We found that 85 percent (12 of 14) of monitoring locations on streams and rivers in Augusta County during this period had levels of E-coli bacteria that would make them unsafe for swimming or other water-contact recreation.²⁸ Virginia advises avoiding water contact in freshwater that exceeds 235 colony forming units (CFU) of *E. coli* per 100/mL of water more than 10 percent of the time, because the bacteria is often an indicator of fecal pathogens that can cause stomach and intestinal illnesses in children and adults who accidentally swallow water. The most frequent exceedances in Augusta County were in Christians Creek, south of Staunton, where 67 percent (4 of 6) of samples exceeded the state's threshold, and the reading from June 2018 was 426 CFU/100 ml. Some of the highest bacteria levels in 2018 were on Middle River west of Staunton, where the reading in June was 1,391 CFU/100ml (almost 14 times the standard). Almost 60 percent (10 of 17) of the samples at this location over the 18 months examined exceeded the safe level of bacteria.

The findings for bacteria levels Augusta County were similar to those throughout the Shenandoah Valley, water quality monitoring data indicate. Across the valley's four central counties, *E. coli* bacteria levels were above safe levels for swimming at 83 percent of 48 monitoring locations examined from January 2017 through June 2018. Despite the exceedances—and the frequency of kayaking, rafting, and other water contact recreation in the Shenandoah—Virginia officials do not issue warnings when bacteria levels spike in the valley. This lack of warning is unlike at swimming beaches on the state's Atlantic Coast, where local officials regularly warn swimmers with signs and health advisories.

Reactions from the Farm Bureau and USDA

EIP shared the results of our study with the Augusta County Farm Bureau and the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). NRCS works to encourage streamside fencing in the Shenandoah Valley.

Bradley Dunsmore, a rancher and President of the Board of the Augusta County Farm Bureau, said that EIP's methods and research are valuable because nobody else has attempted an objective survey of how often farmers are actually employing "best management practices" such as fencing cattle out of streams.²⁹ He said farmers often feel that federal and state governments don't give them enough credit for installing fencing and planting rows of trees along streams. This is because government agencies only count the practices when taxpayers help to pay for them, leaving a paper trail. In reality, he said, some farmers have long installed fences and planted trees along streams



Bradley Dunsmore, President of the Board of the Augusta County Farm Bureau, said that EIP's examination of livestock fencing was valuable because there has been a lack of good data on the practice.

without any government incentives. Dunsmore suggested that the EPA's computer modelling of progress in the Chesapeake Bay cleanup should reflect all efforts by farmers toward meeting pollution reduction targets for 2025 in the bay cleanup plan (also known as the TMDL), not just those bankrolled by taxpayers and therefore listed in official records.

"I absolutely think it's valuable," Dunsmore said of EIP's aerial survey of livestock fencing. "Because we've noticed there are some problems with the overall Chesapeake Bay model, as far as the TMDL and the Bay cleanup getting all of the information into that model. Anybody in the Virginia Department of Environmental Quality, in the governor's administration, or the soil and water conservation districts, will admit there is a real issue with getting accurate data on this issue."

Robert Drumheller, a soil conservationist with the U.S. Department of Agriculture's Natural Resources Conservation Service who works to promote streamside fencing in Augusta County, said EIP's 19 percent compliance figure is in line with USDA's rough estimates, although he noted that government agency had never attempted a similar aerial survey of farm fencing.³⁰ "I'd say that's pretty accurate," Drumheller said of EIP's numbers. "When my former supervisor was here, we did a study on how much work we were doing per year, and we figured we were getting about 1 percent of the streams fenced per year. That's been roughly 20 years ago, so your number fits in right with that estimate."

If farmers in Augusta County continue installing livestock fencing at the current pace under the existing voluntary program, it could take until the year 2096 for all farms in the county to protect their waterways from the bacteria and nutrients produced by cattle—seven decades after Virginia's 2025 target.

Dunsmore said he has fenced his 80 beef cattle out of streams on the 120 acres of farmland he owns in the northern part of Augusta County. He said he was a bit surprised by EIP's conclusion that so few of his neighboring farmers are following the practice. "I would have thought it would have been a little higher—probably in the one-third range," Dunsmore said. "I would not have expected it to be a half or three quarters or anything like that. Streamside fencing is something that more farmers are adopting over time. But there are some limitations to the practice, in terms of what's practical and what's feasible; and there are some logistical limitations for farmers."



Robert Drumheller, cattle farmer and soil conservationist with USDA, said that EIP's conclusions about a need for more streamside fencing are in line with his agency's estimates, although USDA has never performed a survey of the practice.

The costs of installing streamside fencing can be considerable, he noted, especially when the expense of building alternative watering systems for cattle is included. If cows can't drink from a stream, the installation of such watering devices is necessary for cattle to survive. The devices include plastic basins for holding water, plumbing extensions, and sometimes the digging of new wells. The cost of installing such systems for the Dunsmore farm was \$35,000. The family had to front 100 percent of the expense before being reimbursed for 80 percent of that money by the U.S. Department of Agriculture and Virginia. That meant that the Dunsmore family still had to pay \$7,000 out of their own pocket to fence their 80 cattle out of the streams on their property. "Cost is absolutely one of the biggest barriers, as well as the overall structure of the program. Farmers have to have everything done first, and it's got to be approved before any of that money comes back. That's a substantial barrier for farmers. Certainly, if some of the projects could be funded on the front end, I think that that would be a major help to these farmers."

Also an encouragement for farmers, Dunsmore added, would be a state or federal program that would help pay for the replacement or repair of streamside fencing destroyed by the Shenandoah River's frequent flooding. The government could also assist farmers by allowing flexibility in its definition of what types of fencing should qualify for cost-share grants. Although government programs typically require multi-strand barbed wire or electric fences, Dunsmore said a single strand of electrified high-tensile steel wire works just as well, costs half as much, and is less likely to be swept away by floodwaters. It's also easier to replace after a flood. Dunsmore said most Virginia farmers would strongly oppose any proposed mandates for livestock exclusion, such as those imposed by Maryland in 2012. "I know the livestock producers, and if you start coming onto farms and telling people, 'You have to do this, and you have to do that,' on private property, that's not going to be a very popular thing for those folks to hear," Dunsmore said.

However, the evidence gathered through EIP's aerial survey—documenting that almost 80 percent of farmers are still not fencing their cattle out of streams two decades after the government started offering voluntary financial incentives—suggest that such a move toward a requirement might be necessary.

An Example of Livestock Fencing on a Family Farm

Bobby Whitescarver, a cattle farmer in the Shenandoah Valley, strode through a pasture to the edge of a murky stream that snaked its way through the rolling landscape that has been in his wife's family since 1746.

"That flows into the south fork of the Shenandoah River, and when it floods, this whole area is underwater," Whitescarver explained.

Although the river is scenic and historic, his family never swims in it because of extremely high fecal bacteria levels. The *E. coli* is deposited into the water by the herds of cattle that waded into it upstream from his farm in Augusta County.

"I sample the water for bacteria just 200 yards upstream from here and it has consistently over 1,000 colony forming units of *E. coli* per 100 ml of water," Whitescarver said. "A thousand! That's nearly four times the swimming standard of 235 (CFU/100 ml). So you wouldn't want to put your hands in the water and then put them in your mouth or rub your eyes, or you could get something."

A James Madison University researcher worked with the Virginia Department of Conservation and Recreation to perform genetic testing on the bacteria, and found that 94 percent of the bacteria was, in fact, coming from livestock.³¹ The findings on the farm where Whitescarver lives and works (which is owned by his wife, Jeanne Hoffman) were even higher than the average bacteria levels found by EIP when it examined state water quality monitoring data across the Shenandoah Valley.³²

Nearby on the Hoffman farm, a workman with a wrench knelt and tightened a wire on an additional stretch of fencing he was installing to keep cattle out of the waterway.



Bobby Whitescarver (left) and his wife Jeanne Hoffman stand beside a livestock fence on her family's farm in Swoope, Virginia. He works to promote streamside fencing and forested buffers as practices that clean rivers and improve cattle health.



Fencing contractor Jake Wilson installs additional fencing on the Hoffman/Whitescarver property to keep their cattle out of the South Fork of the Shenandoah River.

“It’s important to install fencing, because cattle will totally destroy a stream,” Whitescarver said. “You know, the average cow is about 1,100 pounds, and she’s got cloven hooves. When she climbs up the side of the streambank, it tears the soil off, and that soil gets in the water. Soil in the water absolutely kills the macro invertebrates, because they’ve got external gills. So you’re going to destroy the aquatic ecosystem by having sediment in the water. And the cows also defecate and urinate in the water, which is full of pathogens and nutrients.”

Whitescarver, 63, has been working to convince his neighbors and farmers across the commonwealth to install streamside fencing since 1998, when government programs began to offer incentives to landowners to encourage the practice. In addition to farming, he also runs a consulting business out of an 1817-era farmhouse in Swoope, Virginia, called Whitescarver Natural Resources Management, LLC. The company advises farmers on ways to install best management practices to reduce water pollution with partial government funding, such as planting rows of trees as natural filters along streams and building alternative watering devices so cows don’t need to wade into creeks to drink.

Over the last two decades, Whitescarver said he has helped hundreds of farmers across Virginia install a combined 600 miles of livestock fencing to exclude cattle from waterways. He’s worked tirelessly to try to convince his neighbors—and others—to follow this practice. But he’s frustrated because he’s had only limited success.

His part of Augusta County—west of Staunton, in the Eidson Creek/Upper Middle River subwatershed—contains the highest concentration of farms lacking livestock fencing in the whole county. Seventy-eight farms in his area have both cattle and streams, but only 14 of them fence their cattle out of the waterways, while 64 others allow their animals into the waterways.

That means that Whitescarver’s years of preaching have been successful in convincing only *18 percent of his own neighbors* to follow this best management practice. This is in part because what he’s advocating is entirely voluntary. For this reason, Whitescarver said he is now an advocate of imposing tax consequences to nudge farmers to act.

The idea he’s promoting is this: Virginia and its counties should create a two-tiered land-use tax system, with one very low tax rate (or none at all) for farmers who have implemented a state-approved resource management plan that would include streamside fencing, and higher taxes for farmers who choose to continue with the status quo and do nothing to

reduce runoff pollution. Farmers currently receive a huge tax break on pasture and cropland and pay a very modest tax on valuable property that doesn't require much in community service.

"We have so many 'property rights' farmers. They are just not going to do it (install livestock fencing) unless there is some kind of a penalty," Whitescarver said. "The next step is to change local land-use taxes so polluting farmers don't get the big tax break they receive today. We need to incentivize good behavior."

His wife, Jeanne Hoffman, is from a family that has raised cattle and farmed the land since before the American Revolution. She is also an advocate of fencing because the practice improves not only water quality, but the cattle's health. Cows can contract a variety of diseases by drinking out of streams swarming with viruses and bacteria from their own feces.

"Fencing saves you sickness and death in your cattle, and it saves you on veterinary bills," Hoffman said. "Cattle inevitably will go to a creek to calve, and then the baby is in the water, and so it has a tendency to get sick or drown or die. It is just easier all the way around—for the cattle and the farmers—if you fence the cattle out."

The barriers to convincing farmers to install streamside fencing include not only installation costs, but also the time and labor required to continually inspect, maintain, and replace fencing and watering systems in valleys that are often ravaged by flooding.

Beyond those economic considerations are cultural and aesthetic issues. Many landowners in the Valley grew up seeing bald streambanks in the pastures near their homes as more attractive and desirable. Folks have a perception that denuded streambanks look less "messy" than trees and bushes because they were taught to cut away this brush as children.

In some cases, even 100 percent government reimbursement for installing fences might not be enough to convince farmers to change, because these landowners are opposed to fences for reasons that are not entirely financial, but based on tradition, emotion, and aesthetics.

"People are resistant to change," said Whitescarver. "They've always done it this way, so why do it differently? They don't like the idea of government intrusion. So we've got to do a better job of selling the program from the farmer's perspective. What additional incentives can we put in the program to help the farmer?"

Conclusion and Recommendations

It is, perhaps, not a surprise that the Environmental Integrity Project's examination of aerial photographs of farms in Augusta County, and state maps showing which streams in the county are impaired by fecal bacteria, suggest that there is a correlation between this pollution and failing to fence cattle out of waterways. This is why water quality experts, for decades, have been arguing that excluding livestock from streams is a "best management practice" for cleaning up the Chesapeake Bay and its tributaries. This is why Virginia set a goal as part of its official cleanup plan submitted to EPA for restoring the Chesapeake of

protecting 95 percent of stream footage on farms with livestock fencing. The clear evidence of the benefit of livestock exclusion is also the reason that most states and the federal government have been offering voluntary programs to help farmers pay for the cost of fences and alternative cattle watering systems.

What is surprising, given the universal acknowledgement of the value of livestock fencing, is that neither Virginia nor any of the Bay region states, or the EPA, even attempt to track what percentage of farmers actually follow this “best management practice.” Without information about exactly how often, and where, this pollution control strategy is being employed, state and federal regulators lack a rationale for investing more funding to encourage this practice, or to impose requirements for fencing. This is where EIP’s research, using objective aerial photography, fills an important gap, because it demonstrates, conclusively, that the voluntary programs currently being employed to encourage fencing are falling far short of Virginia’s own goals. In Augusta County, the Commonwealth’s second-largest agricultural area, 81 percent of the 835 livestock farms with streams fail to fence their animals out of the waterways, according to EIP’s analysis. Just north, in Rockingham County, Virginia’s biggest farming jurisdiction, another aerial survey by Shenandoah Riverkeeper in 2016 reached a similar conclusion, with 80 percent of the 841 livestock farms failing to exclude the animals from all of the streams and rivers on their property. Clearly, Virginia is not on a pace to reach its goal of 95 percent adoption within six years.

For decades, federal and state agencies have thrown money at this problem by offering more grants to help farmer pay for streamside fencing. For years, the farm lobby has asserted that farmers are doing their part to clean up the bay. Clearly, more needs to be done. The evidence shows that the conventional strategy of how to encourage change among farmers – through voluntary programs and partial government funding – has not worked and needs to be replaced with fresh thinking. The Environmental Integrity Project recommends:

- 1) Virginia and its counties should start requiring streamside fencing. If this proves politically impossible, the Commonwealth and its counties should use tax incentives—creating a two-tiered “use value” taxation structure—to convince farmers to fence their cattle out of waterways and plant pollution-filtering strips of vegetation along streams, or face tax penalties in the form of a reduction in their agricultural tax breaks.
- 2) The Virginia General Assembly should return to its program of paying 100 percent of the cost for livestock farmers to fence their cattle out of waterways and provide alternative watering systems.

- 3) To reduce the financial burden for farmers of having to “front” the cost of fencing projects, and then later apply for reimbursement, Virginia should pay landowners 50 percent of the costs up front, and then the remaining 50 percent when the projects are complete.



- 4) To encourage greater participation in the fencing program, Virginia and the U.S. Department of Agriculture should allow greater flexibility in accepting what varieties of fencing are acceptable.
- 5) Virginia should conduct or fund aerial surveys of streamside fencing compliance in all heavily agricultural counties of the Commonwealth. Without this accurate information, the state will not know where and how to accurately target financial incentives and penalties to encourage reductions in agricultural pollution.
- 6) The Commonwealth should not move ahead with a proposal to eliminate numeric streamside fencing goals as part of its next Chesapeake Bay cleanup plan (the so-called “Phase 3 Watershed Implementation Plan” for the EPA’s Bay Total Maximum Daily Load). A successful bay cleanup plan will require more – not less -- accountability and specific targets, especially for the agricultural sector, the largest source of pollution in the Chesapeake.

Because recreation on the Shenandoah River is so important for Virginia’s economy and culture, Virginia and its counties should create real estate tax incentives for farmers to fence their cattle out of waterways. Stronger incentives are needed to reduce the unhealthy levels of fecal bacteria often found in the river.

The aerial photographic evidence examined by the Environmental Integrity Project – as well as data supplied by the Virginia Department of Environmental Quality, in response to our information request³³ – prove that Virginia is falling woefully short of meeting its livestock fencing goals that were an important part of the state’s Chesapeake Bay cleanup plan for 2025. But now Commonwealth officials are proposing to change the goals in their bay cleanup plan, so that it is not readily apparent that they are failing to meet their objectives. In the process, the state is rewarding farmers who dug in their heels and said no to following best management practices for cleaning up local waterways and the bay. In effect, by eliminating this goal, Virginia is punishing farmers who did the right thing by investing in streamside fencing years ago and by shouldering the responsibility and cost of maintaining those fences. This sets a bad precedent by suggesting that the best approach for landowners is to simply wait the government out when it comes to employing pollution control practices.

There is no question that fencing livestock out of streams requires a cultural shift and some sacrifice for Shenandoah Valley farmers. However, through a lack of action, the livestock industry in the valley has already sacrificed something even more important: The precious natural resource of the Shenandoah River and its tributaries, which are often so laden with fecal bacteria in certain areas that Virginia's families can't safely use them for the canoeing, tubing, and swimming that are treasured Shenandoah River traditions. That needs to change, for everyone's benefit.

Cleaner water and an improved quality of life are well worth the investment.

Appendix A: Methodology

To study the implementation of livestock exclusion practices in Augusta County, Virginia, the Environmental Integrity Project (EIP) examined several years of Google Earth image data. EIP determined the locations of farms using a common sense definition of “cattle farm,” identifying pastures with cows and cattle trails in them and the surrounding clusters of barns and farm buildings (see caveats below). We also referred to county tax maps as a reference. If we noticed a cattle trail spanning two separately owned properties, we assumed that the same herd grazed on both properties. We also used a common sense definition of a stream, using the U.S. Geological Services National Hydrography Dataset (NHD) and historic leaf-off/wet season imagery as a guide.

Data sources:

1. Aerial imagery. We used the most recent aerial imagery available from Google Earth, along with the U.S. Department of Agriculture’s (USDA) National Agriculture Imagery Program (NAIP) to identify cattle farms, pastures, fencing, and stream intrusion points. Historical aerial imagery in Google Earth was used to verify stream locations, especially for intermittent or smaller stream reaches.
2. Stream locations and watershed boundaries. We used the most recent version of EPA’s Watershed Assessment, Tracking and Environmental Results System (WATERS) dataset, along with U.S. Geological Survey’s National Hydrography (NHDplus) and Watershed Boundary Datasets (WBD) to identify waterways and watershed boundaries.
3. Tax maps. To assist in the identification of farms under common ownership and parcel boundaries, EIP used Augusta County’s most recent tax map address and parcel viewer.³⁴

Project Setup:

EIP research analysts were trained by Alan Lehman, agricultural policy analyst with the Shenandoah Riverkeeper, to identify cattle on Google Earth images, along with cattle intrusion areas, cattle tracks on the landscape, farm structures (barns, manure storage, watering devices, etc) that are often present at beef and dairy farms, streams, rivers, ponds, fencing, vegetative buffers, and cattle intrusion areas.

Waterway locations and sub-watershed boundaries listed above was imported into Google Earth Pro. Data conversions (i.e. shapefile to KML or KMZ) were performed using ArcGIS Desktop. Small subwatershed (HUC 12) boundaries were used to parse our analysis into manageable tasks. Data in Google Earth were organized in folders for each subwatershed and aggregated by county at the end of the analysis.

Analysis:

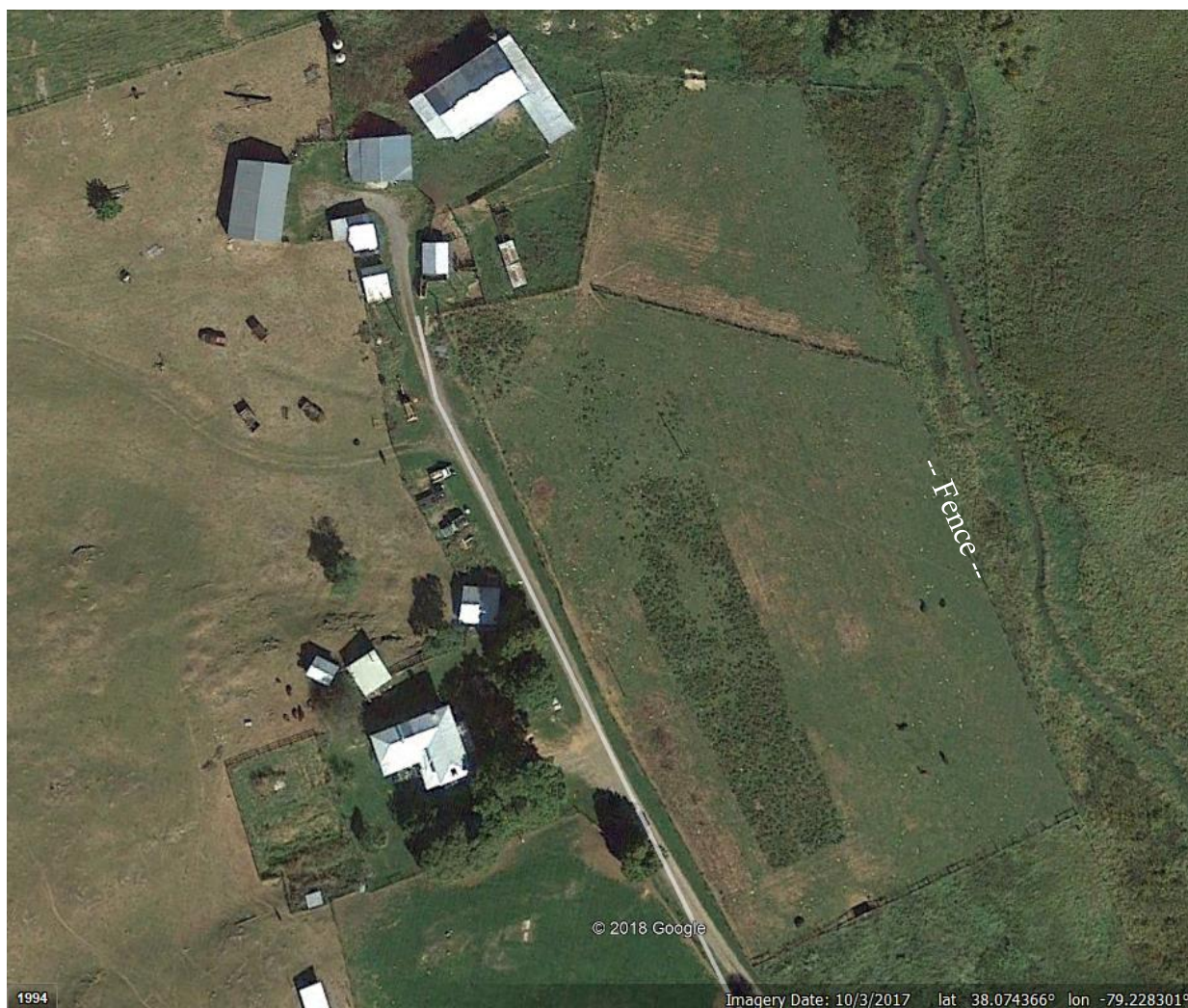
We created a point data layer in Google Earth for each HUC 12 subwatershed. This data layer identified cattle and dairy farms, which we coded by the following: a) whether or not the farm does or does not have stream access, or whether stream access is uncertain, and b) if it does have stream access, whether cattle are or are not excluded from waterways, or

whether exclusion is uncertain. Farm points were numbered, and no individual farmers' names or farm names were used. Farms with both cattle and streams, where any of the animals had access to the streams—as indicated by brown and trampled streambanks and a lack of fences—were counted as farms that failed to exclude their livestock from waterways. Once all subwatersheds in a county were processed, we combined the resulting files into a single county-level file for Augusta County.

The aerial images from Google Earth, below, show examples of farms that do and do not use streamside fencing to keep cattle out of waterways.



This Google Earth image depicts a farm that does not fence cattle out of streams. Cattle trails (thin brown lines through pasture) lead to “denuded” areas (circled yellow) where cattle have eroded the banks of Back Creek, in the Eidson Creek-Middle River subwatershed. The fact that vegetation is a consistent texture and color from the pasture down to the stream also demonstrates that the farm does not have fencing to keep cattle out of the waterway.



This Google Earth image depicts a farm that fences cattle out streams. The fence runs along the west bank of Back Creek in the Eidson Creek-Middle River subwatershed. There is an observable difference in vegetation on the pasture versus along the stream. The rougher green vegetation along the stream is protected from cattle and serves as a buffer zone that captures nutrients and bacteria from runoff before it enters the creek.

Data Validation:

Each watershed was reviewed twice: once to mark all farms and initially code results, and again to check and confirm those results. These tasks were carried out by different analysts to control for observational differences. After EIP's analysis of the Google Earth images was complete, we gave the dataset to Alan Lehman, agricultural policy analyst for the Shenandoah Riverkeeper, who then used his personal observations and field visits to confirm our conclusions about 25 of the farms.

Caveats and Challenges:

First, definitions of a “stream” vary between farmers, the state government, and EPA. EIP used a common sense definition of a stream, meaning a geological feature, obvious from satellite imagery, with a defined path and banks. Some of the streams identified by EIP may qualify as “intermittent” or “ephemeral” streams under the EPA’s definitions of the terms, meaning waterways that only flow in the spring or after rain. Not all of these streams identified by EIP are mapped in the USGS’ NHD dataset. Second, EIP also used common sense definitions of “farms,” meaning a cluster of pastures around a barn and farmhouse and related structures. In some cases, a farmer may own more than one farm, and lease land at other locations around the state. This scattered management would not be reflected in EIP’s analysis, which looks only at visually-identifiable farm units, not legal ownership by different people. Third, in some cases, fencing and stream intrusion areas may not all be visible due to tree cover. In an attempt to compensate for this, we used multiple years of images, including images in the winter when there are no leaves on the trees. Fourth, in some cases, there was some uncertainty in differentiating, via photographs, cattle vs. other livestock like mules, horses, and sheep. Finally, our analysis was limited to the latest year for which aerial imagery was available. In most of Augusta County, this was October 2017. In some cases, we also looked at historic images dating back to 2008 to verify if streams existed.

NOTES

¹ Commonwealth of Virginia Chesapeake Bay TMDL Phase I Watershed Implementation Plan, Nov. 29, 2010. The goal for 2025 is expressed as 95 percent of linear feet of streams on farms protected by fencing.

Link: <https://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/Baywip/vatmdlwipphase1.pdf>

² Telephone interview with Russ Baxter, Deputy Director of the Virginia Department of Conservation and Recreation, on January 30, 2019. On January 29, EPA Press Officer David Sternberg responded to an emailed question on the subject by referring the inquiry to the Virginia Department of Environmental Quality, which forwarded the question to Baxter.

³ USDA agricultural census for Augusta County, Virginia, available at:

https://www.nass.usda.gov/Publications/AgCensus/2012/Online_Resources/County_Profiles/Virginia/cp51015.pdf

⁴ EIP is aware that VDEQ's metric (percent of linear feet of streams on livestock farms) and EIP's metric (percentage of livestock farms with fencing along streams) are slightly different. However, EIP's overall conclusion – that only about 19 percent of farms in Augusta and Rockingham counties are installing fences – is similar to, and logically consistent with, VDEQ's own limited data, which suggest that approximately 19 percent of linear feet of streams on farms were protected with fences in 2018 (although this may not include some privately-funded fences). Moreover, the U.S. Department of Agriculture's Natural Resource Conservation's rough estimate (20 percent) was also similar to both EIP's conclusion and VDEQ's numbers.

⁵ Chesapeake Bay Commission report, "Healthy Livestock, Healthy Streams," May 2015. Link:

<http://www.chesbay.us/Publications/Healthy%20Livestock,%20Healthy%20Streams.pdf>

⁶ Ibid.

⁷ Ibid.

⁸ Ibid.

⁹ Ibid.

¹⁰ Ibid.

¹¹ Chesapeake Bay Foundation, "2017 Virginia Midpoint Assessment: Is Virginia on track to meet its 2025 pollution-reduction commitments?" May 30, 2018. Link: <http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/2017-virginia-midpoint.html>

¹² Telephone interview with Russ Baxter, Deputy Director of the Virginia Department of Conservation and Recreation, and Darryl Glover, Division Director for Soil and Water, on January 30, 2019.

¹³ Virginia Department of Conservation and Recreation, "Program Year 2019 Virginia Agricultural Cost-Share (VACS)

BMP Manual." Link: <http://consapps.dcr.virginia.gov/htdocs/agbmpman/csmanual.pdf>

¹⁴ Virginia's "Phase I Watershed Implementation Plan" for the EPA Chesapeake Bay Total Maximum Daily Load (TMDL), November 29, 2010. Link:

<https://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/Baywip/vatmdlwipphase1.pdf>

¹⁵ Virginia's "Phase II Watershed Implementation Plan" for the EPA Chesapeake Bay "Total Maximum Daily Load," March 30, 2012. Link:

<https://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/Baywip/vatmdlwipphase2.pdf>

¹⁶ Interview with Russ Baxter, Deputy Director of the Virginia Department of Conservation and Recreation, and Darryl Glover, Division Director for Soil and Water, on January 30, 2019. Also, email from James Davis-Martin, Chesapeake Bay Coordinator for Virginia Department of Environmental Quality, on Feb. 5, 2019.

¹⁷ Ibid.

¹⁸ Email from James Davis-Martin, Chesapeake Bay Coordinator for Virginia Department of Environmental Quality, on Feb. 5, 2019.

¹⁹ Interview with Russ Baxter, Deputy Director of the Virginia Department of Conservation and Recreation, and Darryl Glover, Division Director for Soil and Water, on January 30, 2019

²⁰ Ibid.

²¹ Ibid.

²² U.S. Department of Agriculture census data from 2012.

- ²³ USDA agricultural census for Augusta County, Virginia, available at: https://www.nass.usda.gov/Publications/AgCensus/2012/Online_Resources/County_Profiles/Virginia/cp51015.pdf
- ²⁴ Ibid, from 2012 USDA Agricultural Census.
- ²⁵ Environmental Integrity Project, “Water Pollution from Livestock in the Shenandoah Valley,” April 26, 2017. <http://www.environmentalintegrity.org/reports/water-pollution-from-livestock-in-the-shenandoah-valley/>
- ²⁶ Virginia Department of Conservation and Recreation, “Fecal Bacteria and General Standard Total Maximum Daily Load Development for the Middle River and Upper South River Watersheds,” April 2014. <https://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shenrvr/middle.pdf>
- ²⁷ In this discussion, we are using the Virginia Department of Environmental Quality’s 2016 listings of impaired waterways, as approved by EPA on March 6, 2018. This does not include some segments that the state has proposed for de-listing (or re-listing) that have not yet been approved by EPA. Link: https://apps.deq.virginia.gov/mapper_ext/default.aspx?service=public/draft_2018_adb_rec
- ²⁸ Environmental Integrity Project, “Virginia Monitoring Data Show Shenandoah Valley Waters Remain Bacteria Hotspot,” August 30, 2018. Link: <http://www.environmentalintegrity.org/news/virginia-monitoring-data-show-shenandoah-valley-waters-remain-bacteria-hotspot/>
- ²⁹ Interview with Bradley Dunsmore, President of the Board of the Augusta County Farm Bureau, on December 6, 2018.
- ³⁰ Interview with Robert Drumheller, soil conservationist with the U.S. Department of Agriculture’s Natural Resources Conservation Service, on December 6, 2018.
- ³¹ Virginia Department of Conservation and Recreation, “Fecal Bacteria and General Standard Total Maximum Daily Load Development For Impaired Streams in the Middle River and Upper South River Watersheds, Augusta County, VA,” April 28, 2004. See page C-9. Link: <https://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/shenrvr/middle.pdf>
- ³² Environmental Integrity Project reports, “Virginia Monitoring Data Show Shenandoah Valley Waters Remain Bacteria Hotspot,” August 30, 2018. Link: <http://www.environmentalintegrity.org/news/virginia-monitoring-data-show-shenandoah-valley-waters-remain-bacteria-hotspot/>. And EIP report, “Water Pollution from Livestock in the Shenandoah Valley,” April 26, 2017. Link: <http://www.environmentalintegrity.org/reports/water-pollution-from-livestock-in-the-shenandoah-valley/>
- ³³ Email from James Davis-Martin, Chesapeake Bay Coordinator for Virginia Department of Environmental Quality, on Feb. 5, 2019.
- ³⁴ Augusta County tax map viewer, available at: <http://augustacountyva.maps.arcgis.com/apps/webappviewer/index.html?id=3e10ba78e6be4ce2936a3be2955b1a45>