



**Highlanders for Responsible Development**  
P.O. Box 685 Monterey, VA 24465 [www.protecthighland.org](http://www.protecthighland.org)

April 28, 2015

Kimberly D. Bose, Secretary  
Federal Energy Regulatory Commission  
888 First Street, NE, Room 1A  
Washington, DC 20426

Re: Docket No. PF15-6-000, scoping comments

Dear Secretary Bose:

Highlanders for Responsible Development (HRD) is a citizens group dedicated to the preservation and responsible use of the natural environment in Highland County, Virginia. Highland has the smallest population and the highest mean elevation of any county east of the Mississippi River. The headwaters for both the James and Potomac Rivers are in our county, which is also home to bald and golden eagles, native brook trout, many rare species of birds, and high elevation flora and fauna.

The proposed Atlantic Coast Pipeline (ACP) would be the largest construction project ever undertaken in Highland County. Should the Federal Energy Regulatory Commission (FERC) approve any of the routes that have been reported to be under consideration for the ACP, there would be far-ranging, long-lasting impacts that threaten the many features that make our county so unique: water, topography, vegetation and animal species and habitats. Moreover, it would disrupt and diminish the commerce and quality of life of the county and its residents.

FERC's February 27 Notice to Prepare an Environmental Impact Statement (EIS) for the ACP invites comments on a range of impacts under certain specific headings. It also lists several issues already identified by the agency that it deems deserving of attention. HRD offers the following comments on several of those items and urges FERC to give serious consideration to our concerns as it prepares the EIS.

- **A pipeline built along the announced routes under consideration would seriously threaten the integrity and safety of the water supplies for many county residents, particularly those in the towns of Monterey and McDowell.** In both towns residents are supplied by water systems drawing from aquifers that would be adversely affected by construction of the pipeline. This issue is discussed in a recent newspaper article in our local paper, *The Recorder*. (Appendix A) One passage in the article reports that when the Mayor of

Monterey, Richard S. Holman, expressed a concern to a Dominion Resources representative about the threat to the town's water supply by the proposed pipeline and asked that Dominion issue a bond to guarantee against harm to the town's water supply. He was rebuffed and told to take up the matter with FERC. This flagrant demonstration of Dominion failing to take responsibility for a problem caused by its proposed project is of serious concern to Highland County residents. It should also be a serious concern to FERC. This conversation is also referenced in a letter sent to FERC on April 23, 2015 by the Mayor conveying to the agency a report prepared by a consulting hydrologist, William K. Jones, that addresses the adverse impacts on Monterey's water supply should the ACP be built along of the proposed routes. Mr. Jones observes that should a pipeline be built through Highland County, even one with a route farther away from Monterey's current wells, "the contractors should be held to a very high standard in this sensitive and relatively undisturbed natural setting."<sup>1</sup> (Appendix B) We request that FERC insist upon a bond to insure against damage to the water supplies of McDowell or Monterey should the agency approve the project.

- **There are serious safety risks associated with the construction of a pipeline through Highland County because of the proven instability of the karst topography that exists in the county.** Several experts made statements at the scoping meetings<sup>2</sup> that vividly described the inherent instability of karst topography to support a pipeline infrastructure such as the ACP. While Dominion spokespersons have proclaimed that karst topography would not present a serious problem for its construction of the ACP, other Dominion representatives have made statements to the contrary.

At the August 13, 2014 briefing Dominion presented to the Augusta County, VA Board of Supervisors, Supervisor Larry Willis noted the great prevalence of karst formations in Augusta County and asked what steps "will you be taking to prevent pipeline cracking and failure in the future because of the rock formations?" Bill Scarpinato, Dominion Resources' Environmental Manager, responded that the company would "avoid that type of geologic formation when we encounter it. The reason being that its construction would not be the best suitable." Brittany Moody, a Dominion Transmission, Inc. engineer, further commented that "we don't want to put our pipe in that situation. So, if it's something we can see up front, we're going to move around it."<sup>3</sup>

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<sup>1</sup> Mr. Jones is a world-recognized expert in hydrology and karst topography, particularly in the Appalachian regions of Virginia and West Virginia.

<sup>2</sup> Statements discussing features of karst topography in the Appalachian/Blue Ridge area and the challenges presented by constructing the ACP were presented at the Stuarts Draft, VA scoping meeting on March 19, 2015 by Diane Korte and Larry Korte, and at the Elkins, WV scoping meeting on March 23, 2015 by Art Dodds, Pamela Dodds and Rick Lambert.

<sup>3</sup> The comments attributed to Supervisor Willis, Mr. Scarpinato and Ms. Moody are extracted from a verbatim transcript of the Augusta Board of Supervisors meeting of August 13, 2014.

At several of the open houses that Dominion Resources conducted in September 2014 similar comments were made by Dominion representatives that the ACP route would avoid karst topography. However, it is not possible to build a pipeline through Highland County without encountering karst topography and creating the prospect of safety problems because of the instability of the rock formations. The previously referenced report in Appendix B discusses this further.

Another safety concern involves the perils of constructing a pipeline over the steep and rugged terrain of Highland County. The possibility of accidents during construction or mishaps after a pipeline is in operation was an expressed concern of Highland County's Board of Supervisors when that body was briefed in early August 2014 by representatives of Dominion. The Supervisors pointed out the county's limited resources to respond to workplace accidents or a pipeline mishap and asked what assistance Dominion could guarantee it would provide in such circumstances. The company's response then and since has been remarkably evasive and unconvincing, much like its response to the Mayor of Monterey regarding his concern about the town's water supply. FERC must insist on a higher standard of accountability for the ACP. Building a pipeline through Highland County would not be business as usual and shouldn't be treated as such.

- **Building the ACP through the rugged and steep mountain terrain that predominates in Highland County would endanger the structural character of the mountains it crosses and seriously increase the possibility of long-term erosion.** Dominion has indicated it wishes a waiver to a Commonwealth of Virginia regulation limiting an open trench to be no more than 500 linear feet at a time. This standard exists for erosion and sediment control, a critical concern in terrain as steep as that which exists in Highland County. Dominion wishes to have the right to open a trench as long as 2000 feet. Should such a waiver be granted the potential for serious erosion and mudslides in heavy rains – which are frequent in Highland County – is profound. FERC should insist that the current 500 foot limitation be adhered to.
- **The ACP routes proposed would harm the habitat of many protected species of plants and animals that are unique to the Allegheny-Blue Ridge region.** For instance, the portion of Shenandoah Mountain, located along the eastern border of Highland County, over which the ACP would pass is home to the Cow Knob Salamander, a protected species that is subject to a conservation agreement between the U.S. Forest Service and the U.S. Fish and Wildlife Service.<sup>4</sup> A pipeline built along any of the contemplated routes would seriously impair the habitat of this rare species. There would be other adverse impacts on wildlife should the pipeline be built along these routes. As FERC knows from other projects it has overseen, whenever a pipeline such as the ACP is built through habitats of bear and wild turkey, these species abandon those areas and do not return for several years.

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<sup>4</sup> Memorandum of Understanding 94-SMU-058 between the U.S. Forest Service, U.S. Fish and Wildlife Service and the National Marine Fisheries Service, January 25, 1994.

- **The routing of the Atlantic Coast Pipeline through Highland County would diminish the value of private property and adversely affect innumerable cultural and recreational features of our county.** The effect of natural gas pipelines on property values has not been documented extensively. The studies that have been published (most of which having been commissioned by natural gas companies) have been based upon before and after sales records of suburban communities where the principal motivation for people to purchase homes is location to work. The motivation for people to purchase property in Highland County is a desire to live in our rural community with its many natural resource attributes. There is already a reduced demand for property in Highland County due to the very prospect of a pipeline bisecting the county. That view is not conjecture, but based on conversations that local Realtors have had with prospective buyers of property in the county. This circumstance has a dampening effect upon property values, which in turn will reduce property tax revenues for local government.

Tourism is an important and growing part of Highland County's economy. The construction of the ACP along the routes that have been proposed would cause considerable disruptions for tourists and the businesses that serve them. If the pipeline is built there would be a profound, long-lasting effect on the county's attractiveness as a tourism destination. People visit and move to Highland County because of its unique beauty and natural resource attributes. For instance, Dominion's preferred route through Highland would bisect the beautiful Blue Grass Valley and the 200+ year-old Hevener farm. This farm includes the headwaters for both the Potomac and James Rivers. The farm also includes one of the most valuable stands of sugar maple trees in the Allegheny Highlands, which would be destroyed should the pipeline be built along that route. The effect would be not only to permanently scar one of the most iconic and important agricultural settings in Virginia (the Hevener farm) but to destroy the business of one of the county's largest maple syrup producer, who has depended for decades upon the output from that maple tree stand. Maple syrup production is one of the important attractions in Highland County and is the basis for the annual Maple Sugar Festival, the largest tourist attraction event in our county and one of the most notable events of its kind in Virginia. These are issues that have been raised with Dominion by the owners of the farm and local officials, but without satisfactory responses. There are several other businesses in Highland County that would be adversely and permanently affected by the proposed routes. None have been able to engage in a meaningful dialogue with Dominion about their concerns.

- **The proposed routes could adversely impact several conservation easements in Highland County.** Conservation easements are an important tool to protect and conserve critical ecological and open space features of land from inappropriate development. Because of the interstate nature of the proposed ACP, the eminent domain powers that have been granted could trump affected conservation easements along the chosen route. This would be an unwelcome and unusual result for the impacted landowners and for Highland County as a whole, which depends upon these protected lands to enhance its attractiveness for tourism and agriculture.

Your invitation for comments during the scoping period are focused upon receiving input relative to the agency's preparation of an Environmental Impact Statement. However, I take this opportunity to raise some other serious questions that are central to your consideration of the Atlantic Coast Pipeline's application to FERC: the economic justification for the pipeline.

The premise for ACP's application, as announced by the company last May, is that:

1) there is an unending supply of natural gas reserves in the West Virginia Marcellus shale field in West Virginia;<sup>5</sup> 2) there is a growing demand for natural gas in North Carolina and southeast Virginia markets, particularly due to the U.S. Environmental Protection Agency's requirement that coal-fired power plants be converted to natural gas; and 3) considerable economic benefits would flow to all the communities affected and served by the proposed pipeline. There is one other pipeline application pending before FERC that seeks to serve the same general market (Mountain Valley Pipeline, MVP) and a third that has been announced (Appalachian Connector project by Transco). This raises several very basic questions of economics that have not been addressed by the partner companies of the ACP or MVP.

- 1) What is the projected need for more natural gas to serve the proclaimed markets by these pipeline projects? It should not be assumed that the need exists simply because the applicants says it does. Economic justification should be required.
- 2) What is the realistic likely life of the Marcellus Shale field in West Virginia to supply natural gas to the markets that would be served by the ACP or MVP? There have in recent months been several studies suggesting that the Marcellus field will reach peak production by or before 2020 and then begin to decline. What does this mean for the long-term need and economic viability of the ACP or MVP?
- 3) Whatever the future demand level for natural gas in the southeast Virginia and North Carolina markets that the ACP and MVP intend to serve, what is the adequacy of existing pipelines to serve those markets? Several recent studies have suggested there is unused capacity in the pipeline networks serving these markets and that the call for more pipelines is overstated. In particular, the U.S. Department of Energy issued a report in February 2015 on the infrastructure implications of increased demand from the electric power sector. One of the study's key findings was: "Higher utilization of existing interstate natural gas pipeline infrastructure will reduce the need for new pipelines."<sup>6</sup> Another report worth examining is a document released last summer by the Natural Gas Supply Association, "Twenty Questions About Natural Gas Performance During Winter 2013-2014."<sup>7</sup> The report provides a useful perspective that has been missing from

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<sup>5</sup> A Dominion executive, in answer to a question posed to him at the Augusta County Board of Supervisors briefing last August about how long the pipeline would be usable, suggested that the supply of natural gas from the West Virginia field would be reliably flowing for 70-100 years.

<sup>6</sup> "Natural Gas Infrastructure Implications of Increased Demand from the Electric Power Sector," U.S. Department of Energy, February 2015, p. vi

([http://energy.gov/sites/prod/files/2015/02/f19/DOE%20Report%20Natural%20Gas%20Infrastructure%20V\\_02-02.pdf](http://energy.gov/sites/prod/files/2015/02/f19/DOE%20Report%20Natural%20Gas%20Infrastructure%20V_02-02.pdf))

<sup>7</sup> <http://www.ngsa.org/winter-2013-14-market-conditions-frequently-asked-questions/#four>

the current discussions about the need for new pipelines. It notes that natural gas prices in the 2013-14 winter reached a 5-year high, but were still half of what they were in 2003. The report also notes that pipeline adequacies were only a problem in New England.<sup>8</sup>

We ask that FERC rigorously address these foregoing questions about pipeline economics as well as our concerns about issues related to the Environmental Impact Statement that will be prepared for the proposed Atlantic Coast Pipeline. Thank you for considering our views.

Sincerely,

Lewis Freeman, President  
Highlanders for Responsible Development



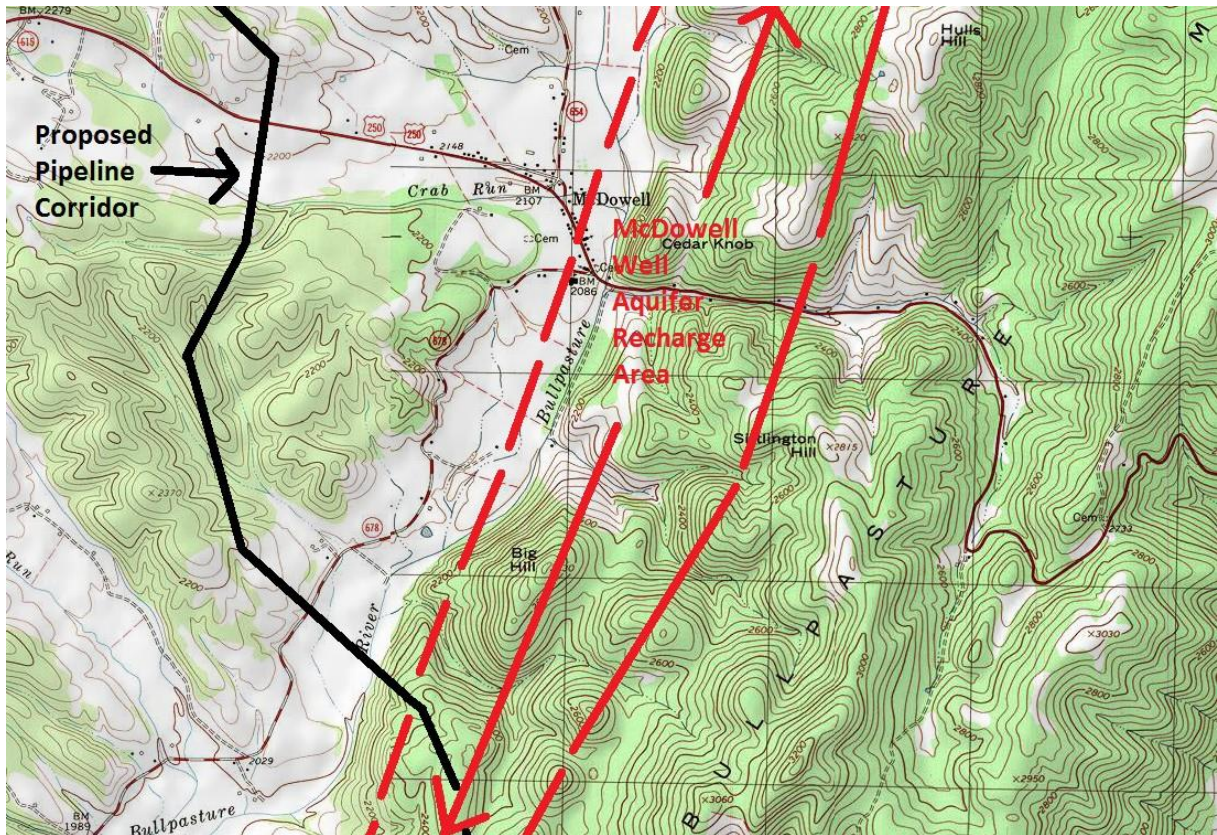
# The Recorder

IN THE COMMUNITY, ABOUT THE COMMUNITY, SINCE 1877.

April 23, 2015

## McDowell study advised for pipeline

BY JOHN BRUCE • STAFF WRITER



**Danger zone Map shows MacDowell aquifer and Dominion's preferred route for the proposed pipeline. (Courtesy RickLambert)**

MONTEREY — Highland supervisors learned at their April 15 work session that the county-owned McDowell water system could be in more peril than Monterey for potential contamination by construction of the proposed Atlantic Coast Pipeline.

Rick Lambert of Monterey, who is a member of the Virginia Speleological Society, described McDowell's aquifer as deep, narrow and confined, making it more susceptible to erosion runoff, sedimentation and construction related contamination.

He recommended supervisors write to the Federal Energy Regulatory Commission about the concern. "If you don't bring it up, they won't know," Lambert said.

Place the burden of performing a study of the potential impact on the aquifer on Dominion, Lambert suggested. He said an impact would not be hard to prove because the aquifer is so deep along the Bullpasture River Valley. He said streams flowing down Bullpasture Mountain are sinking streams and that as the water flows, it sinks into the aquifer.

Supervisor David Blanchard asked if the town were assessing the same thing. Mayor Rich Holman said the town was following the advice of Dominion government affairs manager Emmett Toms to take its concerns to FERC.

County attorney Melissa Dowd said any negative impact might happen quickly. The town voted in a special called meeting April 13 to hire William Jones, a karst specialist, to write a letter of opinion for FERC's consideration. Dowd asked about mitigation.

"You could ask them (Dominion) to move" the pipeline route, Lambert said. Dominion applied for an exemption to the open trench law, he added. He said having 2,000 feet of open trench and two inches of rain would create four times the sediment as a trench built at the 500-foot limit.

It was suggested the county ask FERC to reroute the pipeline corridor and limit the trench to 500 feet. In a related matter, the Virginia Cave Board filed a 50-page report by Lambert Monday recommending measures to mitigate damage to aquifers by rerouting the preferred route away from those of Monterey and McDowell, limiting open trenches to 500 feet, establishing a preconstruction baseline of karst environment health and many other safeguards.

Blanchard said any landowner needs to be aware of the open trench and that 2,000 feet "is pretty big. You might not be able to get from one side of your property to another without a bridge."

Lambert related Dominion's Toms said, "You have to make your case to FERC." Supervisor Lee Blagg said the county does not know exactly where the pipeline would go.

Dominion told Lambert the original route that passes west of McDowell is the preferred route.

No action was taken.



RICHARD S. HOLMAN  
MAYOR

RONALD D. WIMER  
VICE MAYOR

CYNTHIA L. KELLEY  
CLERK/TREASURER

MICHAEL S. ISLES  
UTILITIES OPERATOR

# TOWN OF MONTEREY

P.O. BOX 460  
50 FLEISHER AVENUE  
MONTEREY, VIRGINIA 24465  
PHONE: (540) 468-2472  
FAX: (540) 468-3472

COUNCIL MEMBERS

CODY COHEN

JOHN KILGALLEN

## Appendix B

April 23, 2015

Federal Energy Regulatory Commission  
888 First Street NE  
Washington, DC 20426

RE: Docket # PF15-6-000 Atlantic Coast Pipeline Project

Dear Commissioners,

The attached report from karst hydrologist William K. Jones contains details about potential impact on our municipal water system if construction of the Atlantic Coast Pipeline goes forward. Our system provides clear, clean drinking water to about 500-600 people. Any interruption or degradation of service will create extreme hardship to our financial and physical resources.

We asked Dominion representatives on multiple occasions to provide us with a plan to deal with any damage to our system. Finally a semblance of an answer was given by Dominion spokesman Emmett Toms. In his words his company will do "only what the Federal Energy Regulatory Commission requires...".

We are asking your agency to put strict, detailed, requirements on Dominion and ACP to conduct proper testing and evaluation of risks to our water sources. Also, the company should be required to prepare a workable plan to supply water in the event of interruption, shortage, contamination or degradation.

Above all, the full cost of construction of the pipeline, including any and all impacts upon our community, should be the responsibility of Dominion and the ACP. Those who will reap the rewards of doing business should cover all associated costs.

Sincerely,



Richard S. Holman, Mayor

# **Possible Impacts to the Water Resources of Monterey, Virginia from Construction of the Proposed Dominion High Pressure Gas Pipeline**

**Prepared for: Town of Monterey**

**Prepared by: William K. Jones, Hydrologist**

**Environmental Data**

**PO Box 356**

**Warm Springs, Virginia 24484**

**April 20, 2015**

## **Monterey Water Supply Wells**

The town of Monterey is the county seat of Highland County and has a population of about 140 people. It is situated in a synclinal valley between Monterey Mountain to the west and Jack Mountain to the east (Figure 1). The valley is about two miles wide at this point and is underlain by Devonian and Silurian rocks. The Devonian Millboro shale and Ridgely sandstone are exposed at the surface, but carbonate rocks of the Helderberg Group and the Tonoloway limestone underlie the town and crop out on the eastern and western flanks of the syncline (Figure 2). The drillers log for well number 1 shows 280 feet of shale and 60 feet of sandstone. The estimated depth from the land surface to the top of the carbonate rocks is about 380 feet at wells 1 and 3. Monterey is rather interestingly situated with the surface drainage divide passing through the middle of town for the north-flowing Potomac waters and the south-flowing Jackson (James River) waters.

The town of Monterey in Highland County has three wells that serve for the municipal water supply. Wells number 1 and 3 are situated about 1.6 miles north of the proposed Dominion gas transmission pipeline. The wells are just to the west of the axis of the Monterey Syncline (Figure 2 from Wilkes, 2013). Well number 3 is 805 feet deep and appears to be drilled through the Millboro Shale and completed in carbonate rocks (Helderberg Group and Tonoloway Limestone). Water reportedly enters the well along fractures at 565 feet below land surface (bls) and 750 feet bls. Yield is about 53 gpm at 581 feet of drawdown (see drillers log in Appendix). The specific capacity is 130 gallons per day per foot of drawdown (130 gpd/ft). The static water level was at 42 feet bls, so the well has characteristics of tapping a confined aquifer with the pressure head 500 hundred feet higher than the water bearing fractures. (The geologic log for this well does not appear to be very exact.)

Well number 1 is 360 feet deep and is probably completed in the Ridgely Sandstone. The static water level was 10 feet bls and the reported yield was 70 gpm with 90



feet of drawdown. This shows a specific capacity of 1120 gpd/ft. No record is available for well number 2 at this time.

The recharge areas for the town wells are presumably along the flank of Jack Mountain to the east of town where the producing formations are exposed to the surface and the rocks dip steeply toward the trough of the syncline and the wells. Recharge may also come from the west side of the syncline and it is impossible to determine the extent of the recharge zones to the north and south of the wells.

Neither wellhead protection zones nor recharge areas have been delineated for these wells. Both wells would be expected to produce elliptical shaped pumping cones of depression with the long axis extending NE-SW in the direction of the stratigraphic strike. No data is available to determine the extent of the cone of depression for these wells. It should be assumed that this is a confined fractured rock aquifer and with over 500 feet of drawdown at well number 3 the cone of depression could extend over a mile in the strike direction so the proposed route of the pipeline may pass over the area where the water table (piezometric surface) is lowered in the process of supply water to the town wells.

### **Karst Aquifers**

Karst is a special type of landscape that is formed by the dissolution of soluble rocks, including limestone and dolomite. Karst regions contain aquifers that are capable of providing large supplies of water. The main characteristic of karst aquifers is the rapid recharge of the aquifer through sinkholes and sinking streams and turbulent underground flow through caves and fractures enlarged by dissolution. There is a close connection between surface and ground water resources in these aquifers. The flow is typically at rates of feet per minute and water may emerge at springs some miles from the sink points.

Flow in karst aquifers is often modeled in terms of two zones of permeability. The classic karst aquifer is a high permeability zone characterized by pipe flow (open or closed channel) through discrete conduits. The bulk of the flow in carbonate aquifers passes through this zone. The second part of the aquifer consists of flow through tighter and typically deeper fractures. These fractures contain slower moving ground water under pressure and many water wells are supplied by flow from these deeper fractures. There is usually some interchange of water between the conduits and the fractures, but this is very difficult to quantify. Primary permeability (flow through intergranular pore spaces) is generally negligible in older carbonates such as found in the Monterey area.

Another complication in studying carbonate aquifers is that recharge may be by the direct capture of surface water from sinking or losing streams, fast infiltration of rainfall through dolines (sinkholes), and slower percolation of rainfall through smaller pathways from the land surface (epikarst).

Basic questions such as where the water from a sinking stream emerges or the recharge area for a spring may be studied using water-tracing techniques. Water wells that draw from the deeper parts of the aquifer may be studied using conventional pump-test time draw down methods (with caution) but the delineation of the recharge zones is problematic at best. Wells that produce muddy water after heavy pumping or storm events are deemed to be “surface-water influenced” and require more stringent water treatment. Events on or in the shallow subsurface that change the recharge characteristics to the aquifer may decrease or possibly increase flow to the well, but often with a degradation in water quality.

Characteristics that make protection karst or carbonate aquifers difficult include:

1. Often direct links to the land surface and rapid percolation of precipitation;
2. Enlarged fractures and conduits favor turbulent flow and little “filtering” of particulate mater;
3. Unpredictable flow routes and direction;
4. Events such as sinkhole collapse or the plugging of formerly open conduits may occur very suddenly.

### **Installation and Operation of Gas Pipelines**

The proposed pipeline will cut across the structural grain of the Monterey Valley and will intersect a wide range of rock types and geologic structures. Of most concern to the town will be any activities or land disturbances that affect recharge to the wells or introduce sediments or other pollutants within the capture zone of the wells.

1. Trenching and installation of the pipe temporally exposes bare ground to possible sediment runoff during storm events. Blasting may adversely affect the bedrock fractures and conduits by closing existing fractures and mobilizing sediments in the aquifer. Several documented dolines are within the proposed pipeline corridor and excavating a ten-foot deep trench will certainly cause alteration of the epikarst and affect ground-water recharge along the route.
2. Although rare, explosions and leaks from high-pressure gas pipelines do occur. Regular inspections of the condition of the pipe are conducted, but even Dominion admits “no operator can assure or guarantee safety”.
3. The pipeline will have some finite design life and will eventually be abandoned. The plan for abandonment and the probable environmental affects should be documented in the EIS.

### **Recommended Actions for the Town of Monterey**

The town should assemble all available documentation to establish the present yield and water quality for the water supply wells. This baseline data will be needed if any changes occur during or after construction of the pipeline. A monitoring plan should be part of the requirements for Dominion Power to proceed with construction of the pipeline if approved. Special attention should be given to tracking ground-water levels and water quality (especially turbidity). A mitigation



plan should be presented to the town to cover any interruption of the current water supply. Some planning should go into considering the location for additional wells if the need arises in the future.

The town should be in a better position to consider potential threats to their water supply when more information is available. It is hoped that the Environmental Impact Statement will be very thorough and objective. The EIS should include LIDAR imagery along the proposed corridor. The EIS should also include estimates for the recharge areas of wells and springs that could be impacted by the pipeline. The town may request a route further away (to the south) but that would present a different set of threats to springs and the Jackson River. Wherever the line is routed, the contractors should be held to a very high standard in this sensitive and relatively undisturbed natural setting.

### References

Emery & Garrett Groundwater Investigations, 2014, Report prepared for Augusta County Service Authority on risks of proposed Dominion pipeline in the Staunton area: 21p.

Field, M.S. 1990, Transport of chemical contaminants in karst terranes-outline and summary: Selected papers on Hydrogeology, 28<sup>th</sup> Intl. Geologic Congress, v.1.

Jones, W.K., Hobbs, H. H., III, Wicks, C.M., Currie, R.R., Hose, L.D., Kerbo, R.C., Goodbar, J.R., and Trout, J., 2003, Recommendations and guidelines for managing caves on protected lands: Karst Waters Institute, Special Publication 8, Charles Town, 81p.

Lambert, R., 2015, Highland County Cave Survey Karst Feature Maps PR-4 and PR-5: Unpublished Report, 4 pages.

Virginia Places, Year?, Natural gas pipelines in Virginia:  
[www.virginiaplaces.org/transportation/gaspipeline.html](http://www.virginiaplaces.org/transportation/gaspipeline.html)

Wilkes, G.P., 2013, Geology of the Monterey Quadrangle, Virginia: VA Div. of Geol. and Mineral Resources, Publication 178, 24pp plus Map.

## Figures

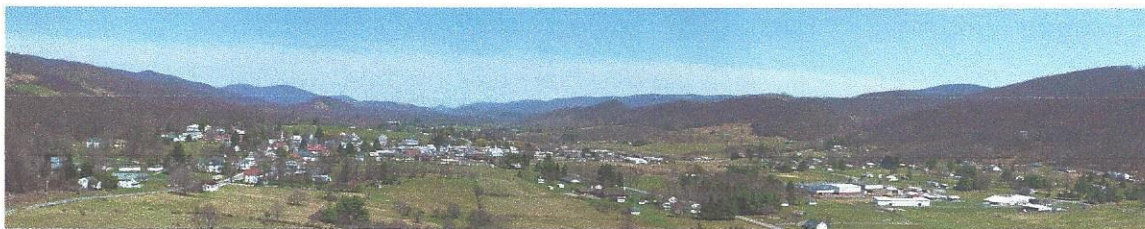


Figure 1. Photo showing town of Monterey looking north from Trimble Knob.

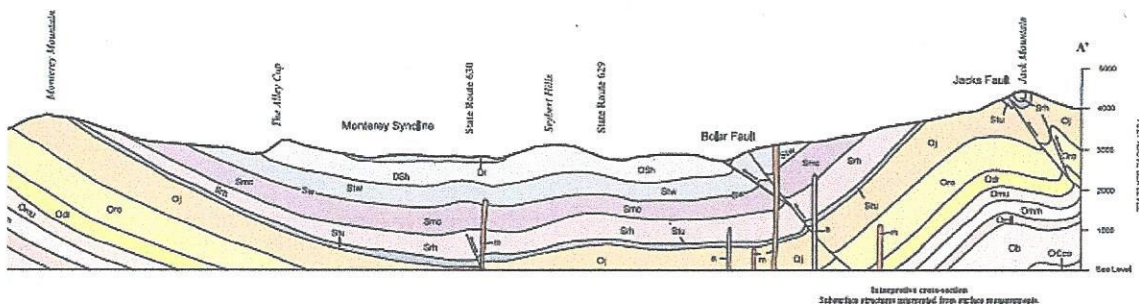


Figure 2. Geologic cross section taken just north of town showy the Monterey Syncline (from Wilkes, 2013). The Millboro shale does not extend as far north as this cross section but overlies the Ridgely sandstone and appears to be about 300 feet thick at town well number 1.



**Appendix 1 – Drillers logs for Wells 1 and 3.**

**Appendix 2 – CV for William K. Jones**

FROM : UDH DDW LFO

FAX NO. : 5404633892

Mar. 01 2012 09:13AM P2/5

P.O. Box 11143  
2111 North Hamilton Street  
Richmond, Virginia 23230

COMMONWEALTH OF VIRGINIA  
STATE WATER CONTROL BOARD

WATER WELL COMPLETION REPORT  
(Certification of Completion)

BWCN WELL NO. 1

PERMIT NUMBER \_\_\_\_\_

DATE REC'D \_\_\_\_\_

Chapter 3.4 62.1-44.90, Groundwater Act of 1973, requires well owners to submit information to the State Water Control Board. Complete fully and accurately. Send to Office of region where drilling was done. Drilling contractors acting as agents for owners please complete this report on behalf of owners.

NAME of well Leavitt's Well no. \_\_\_\_\_  
Owner Town of Monterey Address Monterey, Va. 24465  
Drilling contractor Ronald R. Roberts Address Box 67 - Kingsville, Va. 24430

WELL LOCATION: County/City Highland-Monterey; Located approx. 300 feet/miles South  
(direction) of Town of Monterey and \_\_\_\_\_ feet/miles (direction) of \_\_\_\_\_  
(Use county map points as reference points)

Include copy of county or 7 1/2 minute topographic map with well location marked. If a partial map is copied, mark the name of the map on the map.

OFFICE USE: Topo. no. \_\_\_\_\_ Va. Plane Coord. \_\_\_\_\_ N \_\_\_\_\_ E  
U.S.G.S./Obs. Well no. \_\_\_\_\_ Lat. & Long. \_\_\_\_\_ N \_\_\_\_\_ W

Total depth 360 ft.; Date started 6-19-77 completed 6-22-77; Type rig C.P. Rotary  
WELL: (circle one) New Alteration, Rehabilitation, Extension of existing well.

Numbers of Certificates of Groundwater Right of existing wells \_\_\_\_\_  
WELL USE: (circle one) Home, Farm, Irrigation, Town Subdivision, School, Public Bldg., Industry, Commercial, Research, Heat Exchange, Injection, Recharge, Exploration, Other \_\_\_\_\_

No. of people served \_\_\_\_\_ No. of connections expected \_\_\_\_\_

WATER DATA: Water level unpumped stands 10 feet below surface or has a natural flow of \_\_\_\_\_ gpm and a pressure of \_\_\_\_\_ psi. Stabilized, pumping, water level stands 100 feet below the surface at 70 gpm.

WATER: Color Clear Taste good Odor none Temp. \_\_\_\_\_ °F  
Description of impurities \_\_\_\_\_

Analysis available yes? Where? Bach + Highland County Health Dept.  
Depths of useable water: from 10 to 360 ft, from \_\_\_\_\_ to \_\_\_\_\_ ft, from \_\_\_\_\_ to \_\_\_\_\_ ft.

Drill cuttings? Yes/No (required by State Water Control Board unless exempted). \* Sent to Left with Mr. Leavitt for delivery to Control Board When? 6-22-77

Geophysical logs made? Yes/No, Type \_\_\_\_\_, Copy sent? Yes/No\*

Geologic log made? Yes/No, \* Sketch made of well? Yes/No\* Type mud \_\_\_\_\_

HOLE SIZE: 10 inches from 0 to 100 ft.  
6 inches from 100 to 360 ft.

\_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

UNDERCUT: \_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

\_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

\_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

SCREENS: \_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

\_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

GROUTING: from 0 to 100 ft.

from \_\_\_\_\_ to \_\_\_\_\_ ft.

type Portland

CASING (OUTER) 6 3/4 inches from 0 to 100 ft.

\_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

\_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

(INNER) 6 inches from 0 to 100 ft.

\_\_\_\_\_ inches from \_\_\_\_\_ to \_\_\_\_\_ ft.

PUMP DATA: Brand name \_\_\_\_\_ Type \_\_\_\_\_ Model no. \_\_\_\_\_

Rated capacity: \_\_\_\_\_ gpm at \_\_\_\_\_ ft. of head, Rated horsepower \_\_\_\_\_, Depth of intake \_\_\_\_\_

\* Send to Regional Office, State Water Control Board (see map) express collect. Sample bags free upon request.

FROM :VDH DDW LFO

FAX NO. :5404633892

Mar. 01 2012 09:14AM P3/5

**WATER WELL COMPLETION REPORT**  
(Certification of Completion)

WELL NAME:

*Leustig*

BWCM WELL NO.

Well No. 1

**DRILLER'S LOG**

DEPTH (feet)		TYPE OF ROCK OR SOIL PENETRATED		Drilling Time (minutes)	REMARKS (Water, caving, cavities, broken, screen, reaming, shot, core, etc.)
From	To	Color	Hardness Fossils & Minerals Rock Type (gravel, clay, etc.)		
0	20'		yellow clay dirt		good solid formation to 340' 6" opening at 340' bitting water in.
20'	300'		black shale		
300'	360'		black very hard sand stone		



FROM : VDH ODW LFO  
06/12/2003 09:08

15404653474

FAX NO. : 5404633892

Mar. 01 2012 09:14AM P4/5

Jun 06 09:16

Drinking Water-LFO

540-463-3892

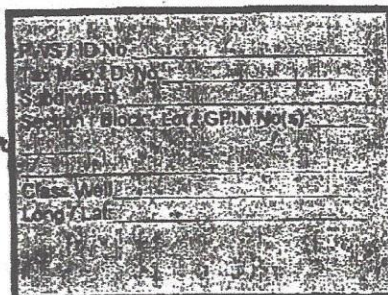
p.2

WATER WELL COMPLETION REPORT  
(Certificate of Completion)

Well No. 3

County/City Town of Monterey• Owner Town of Monterey• Well Designation of Number #3Address Route 200 South  
Carver Meadow  
MontereyPhone 540-468-2472

• Drilling

Contractor Nicely's Contracting603 Main StAddress Clifton Forge Va24422Phone 540 862 3191

WELL LOCATION: 300 (feet/miles South direction of 220 arc 100 FT  
feet/miles West direction of 220 From Stop Light  
in Monterey in the Carver Meadow  
(If possible please include map showing location marked)

• Date started 8/15 • Date completed 8/22 Type rig AIR

1. WELL DATA: New ☒ Rework ☐ Deepened ☐• Total Depth 1205 ft• Depth to bedrock 4 FT ft

• Hole size (Also include reamed zones):

• 10 inches 0 to 105 ft• 6 inches 105 to 1205 ft

• inches to ft

• Casing size (I.D.) and material

• 6 inches 0 to 105 ftMaterial SteelWt. per foot or wall thickness 1/2 in

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

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Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

Wt. per foot or wall thickness

• inches to ft

Material

• Gravel sack

• Size From 10 to 10 ft• Size From 10 to 10 ft

• Grout

• From 0 to 100 ft. Type concrete pump• From 10 to 10 ft. Type

2. WATER DATA: Water temperature

• Static water level (unpumped level-measured) 42 ft• Stabilized measured pumping water level 623 ft• Stabilized yield 33.9 gpm after 48 hoursNatural Flow: Yes ☒ No ☐ flow rate 33.9 gpmComment on quality Good water3. WATER ZONES: From 10 To 10 ftFrom 10 To 10 ftFrom 10 To 10 ft4. PUMP DATA: Type PERISTALTIC Rate of H.P. 15• Intake cap 100 Capacity 52 ft 125 head

• Model &amp; No.

5. DISINFECTION: Well disinfected ☒ yes ☐ noDate 8/22 Disinfectant used CHLORINEAmount 20 lbs. Hours used

6. ABANDONMENT: Date

Casing pulled yes ☐ no ☒ not applicable

Cemented well (explain method)

Plugging grout From 10 to 10 ft material

FROM : VDH ODW LFO

FAX NO. : 5404633892

Mar. 01 2012 09:14AM P5/5

12/2003 09:08

15404683472

TOWN OF MONTEREY

PAGE 03

Jun 06 03 09:17a

Drinking Water-LFO

540-463-3892

p.3

Well No. 3

Owner Town of Monterey

7. DRILLERS LOG (use additional sheets if necessary)			
Depth (feet)		TYPE OF ROCK OR SOIL	REMARKS
From	To	(color, material, fossils, hardness, etc.)	(water, caving, cavities, broken, core, shot, etc.)
0	4	dirt	
4	805	lime stone. All the way down	CORE WAS broken AT 300 FT small AMOUNT OF WATER
0	105 FT	CASING AND GRANT CONCRETE pump in from bottom up	CORE WAS broken AT 565 FT 10 GPM
			CORE WAS broken 750 FT 40 GPM PLUS THE ROCK STAYED in lime stone

I certify that the information contained herein is true and correct and that this well has been installed and constructed in accordance with the requirements for well constructions specified in compliance with appropriate county or independent city ordinances and the laws and rules of the Commonwealth of Virginia.

Signature

William H. Jones  
(Well Driller or authorized person)

(State), Date

License No. 2705-04447

623922  
4252162

21'

38 24 40  
79 34 50

**William K. Jones**

Hydrologist

Environmental Data

P. O. Box 356

Warm Springs, VA 24484

540-839-3377

[www.karsthydrology.com](http://www.karsthydrology.com)

Mr. Jones is a consulting hydrologist with Environmental Data in Warm Springs, Virginia. He studies physical hydrology of surface and ground-water resources with an emphasis on areas underlain by carbonate (karst) aquifers. He has studied karst areas across North America, France, Eastern Europe, China and Southeast Asia. Mr. Jones is the author of over thirty papers on karst hydrology and water tracing. He is the author of the **"Karst Hydrology Atlas of West Virginia"** (1997) and served as the guest editor for a special issue of the National Speleological Society Bulletin on water tracing using fluorescent tracers (1984). He wrote chapters on karst and water tracing for the **"Encyclopedia of Caves"**. He is a consultant to the US Army Environmental Center on the remediation of hazardous wastes in karst aquifers on military bases. He also studies ground-water movement in fractured aquifers and statistical characterization of water resources. Current research projects include the problems of instrumenting small catchments to measure precipitation and flows for water balance studies. Mr. Jones holds a BSF degree in Forest Management from West Virginia University (1973) and an MS degree in Environmental Science (Hydrology) from the University of Virginia (1989). He was an adjunct professor of hydrology at the American University, Washington, DC and is on the board of directors of the Karst Waters Institute, Leesburg, Virginia.