Protecting the heritage, resources and economy of the Allegheny-Blue Ridge region
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Via First Class U.S. Mail and Electronic Mail

October 23, 2019

Paul Phifer
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Ecological Services- Northeast Region
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RE: Section 7 Consultation on the Atlantic Coast Pipeline

Dear Mr: Phifer:

When the Fourth Circuit Court of Appeals vacated the second iteration of the Biological Opinion ("bi op") and Incidental Take Statement ("ITS") for the Atlantic Coast Pipeline ("ACP") in late July, 2019, the incidental take limits for Madison Cave Isopod were determined to be arbitrary and capricious because the Fish and Wildlife Service ("FWS") had not established legitimate habitat surrogates from which to base those take limits and from which to conduct the jeopardy analysis. In both this instance and the previous case where the court rejected your agency's approvals, conclusions about potential impacts to the Madison Cave Isopod ("MCI") relied on incomplete data and faulty assumptions. The Allegheny-Blue Ridge Alliance, a coalition of over 50 organizations in Virginia and West Virginia, urges the agency to resist pressure from the pipeline companies to again fast-track its review.

FWS must correct the deficiencies identified by the court, to fulfill its mandate under the Endangered Species Act ("ESA") to protect and conserve endangered and threatened species and their habitats. In support of that effort, we submit the attached comments to supplement the record for your action. We believe this information is vital to ensure that the Madison Cave Isopod is protected from negative impacts that may jeopardize the species and lessen its recovery prospects. Some of the most important issues addressed in the comments include the following:

<u>The FWS has defined an artificially small habitat area for MCI and failed to require testing necessary to define the true area accurately or to reliably estimate impacts to MCI</u>

As described in the comments below, in previous bi ops FWS erred by assuming MCI would only be impacted in the limited area near Cochran's Cave even though the agency

lacked evidence to support that assumption. Abundant evidence from the Final Environmental Impacts Statement and other sources makes clear that the entire extent of karst terrain along and adjacent to the ACP's path may harbor MCI and should be protected in accordance with that fact. FERC and other agencies have described testing they deemed necessary to make valid predictions and we find no evidence that that testing has been completed.

The FWS has ignored expert analyses and recommendations about certain high-risk areas that must be avoided to prevent harm to MCI

The Virginia Cave Board, the Virginia Department of Conservation and Recreation, and an expert hired by citizens have all provided detailed recommendations and reasoning to advocate that specific areas on the ACP path should be avoided to protect the MCI. These recommendations must be heeded or the FWS must provide valid reasons for rejecting them.

The FWS has mischaracterized the threat to groundwater from the ACP

Stunningly, FWS used water depth data from just one well as a basis to conclude that pipeline construction would not affect groundwater quality. The use of just one data point to characterize a vast and varied landscape is inexcusable. Further, pipeline impacts in the epikarst, which is often at or just below the ground surface, are just as great a threat to MCI habitat as those in the saturated zone below and this fact has not been reflected in previous FWS reviews.

Thank you for accepting these comments and we would be pleased to discuss them with you.

Sincerely,

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ALLEGHENY-BLUE RIDGE ALLIANCE

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Comments on the new Biological Opinion and Incidental Take Statement for the Atlantic Coast Pipeline

The U.S. Fish and Wildlife (FWS) Biological Opinion and Incidental Take Statement for the Madison Cave Isopod in regard to the construction and operation of the Atlantic Coast Pipeline (ACP) is problematic, not only for a single species, but for an entire subterranean habitat. The federal agency's Biological Opinion and Incidental Take Statement was stayed by the Fourth Circuit Court in December of 2018 and vacated in July of 2019.

In issuing its opinion, the court challenged "the validity of the take limits imposed for the Indiana bat and the Madison Cave Isopod. Because we find the FWS arbitrarily reached its no-jeopardy conclusions and failed to correct the deficiencies in the take limits that we identified in the previous appeal, we grant the petition and vacate the 2018 Biological Opinion and Incidental Take Statement."[1]

By examining one particular species, the Madison Cave Isopod (MCI) that is endemic to subterranean habitat in karst areas along the ACP in western Virginia and eastern West Virginia, the issues at stake as described by the court can be better understood. Further, it becomes clear that Dominion has created the problem by failing to get the data necessary to prove that they can protect the MCI and the associated fragile habitat in which it exists.

The Madison Cave Isopod, *Antrolana lira* (G2 and S2 LT Listed Threatened), is a tiny, blind crustacean that exists in the subterranean karst environment beneath our feet. That same environment, one of free-flowing waters, is the one that supplies essential water for the needs of the human populations living on the surface above the isopod's home. But out of sight should not be out of mind. This tiny isopod, which most of us have never seen, is an indicator species. If the isopod's population is healthy, then the habitat is healthy.

The U.S. Fish and Wildlife bulletin, produced in October 2010 on this species, describes it thusly: Madison Cave Isopod (*Antrolana lira*) is a tiny, eyeless, unpigmented, freshwater crustacean. "Found in flooded limestone caves beneath the Great Valley of Virginia and West Virginia where it swims freely through calcite-saturated waters of deep karst aquifers. Recent discoveries in caves and wells have extended the range of the species 200 miles."[2] The bulletin goes on to say that the population size is unknown at

most sites, and suggests that there is a lot still to be learned about this crustacean. Evidence so far indicates that, while it is long-lived, it has a low rate of reproduction, which means that impacts to its population by pipeline construction might be greater to the MCI than for other species. The MCI was federally listed as a threatened species on Nov. 3, 1982. "Agriculture and encroaching industrial and urban development threaten the quality of groundwater habitat and thus the survival of this species," states the bulletin.[3]

The FWS paper goes on to note that the protection of this species depends upon protecting the surface to avoid chemicals and sediment runoff that would enter the subterranean habitat. Sinkholes are of particular concern, the bulletin notes, "because harmful materials can end up in underground streams." It goes on to conclude: "By following these land use practices, you are not only protecting the habitat of cave creatures but also protecting the quality of your drinking water."[4]

That final sentence sums up reason enough to be concerned about the MCI. It is a representative of an entire subterranean habitat that is inextricably linked to the groundwater that communities rely upon for maintaining good health, prospering family farms, business development, and outdoor recreation. The MCI, then, is the canary in the coal mine, so to speak, that must be protected and monitored in order to protect the entire ecosystem.

On Sept. 11, 2018, the re-issued Biological Opinion (BiOp) concluded that the ACP would not jeopardize the survival and recovery of those species and would not exceed Incidental Take Statement (ITS) limits for each species. As the court explained in its opinion, the FWS "failed to create proper habitat surrogates, failed to explain why numeric take limits were not practical, and failed to create enforceable take limits for the clubshell (a mussel), rusty patched bumble bee, **Madison Cave Isopod (a crustacean)**, Indiana bat, and northern long-eared bat."[5]

In its opinion, the court found that "we must ensure that the agency has examined the relevant data and articulated a satisfactory explanation for its action."[6] As will be seen, the FWS has failed to require, and Dominion has failed to present or provide, sufficient research data in order to ensure that its construction will not threaten the very existence of the MCI and its associated habitat.

Both the 2017 and 2018 BiOps, admitted that the ACP construction path, rights-of-way, work spaces and access roads would impact 25 miles of potential MCI habitat. According to that opinion, the pipeline construction would crush or smother the crustaceans, lead to a temporary reduction in feeding and reproduction, and allow sediment to enter the subterranean habitat so that that habitat would be temporarily or permanently uninhabitable.

In reality, the impact to MCI by ACP construction would be even more significant than 25 miles. "The ACP crosses 71.3 miles of karst terrain," according to ACP's FEIS. Along this route, the most prominent karst features are sinkholes, "which comprise the greatest potential geohazard risk to any type of construction in karst terrain." The FEIS also

mentions caves and springs and disturbance to ground water as potential concerns, although it notes that "The great majority of the AP-1 mainline that is located through highly karstic terrain would be installed using standard overland construction techniques, which would generally limit disturbance to 6 to 8 feet below ground surface, whereas sensitive groundwater resources and cave systems of public concern are generally found at great depths." The FEIS did note that prior to construction ACP would conduct electrical resistivity imagery surveys.[7]

Importantly, in the ACP FEIS, FERC notes: "Development of karst features increase the susceptibility of underlying aquifer contamination," and "**We assume all karst features are suitable habitat for obligate species and assume their presence."**[8] In another place in the FEIS where karst features are discussed, it is written that **"Madison Cave isopod presence was assumed at open throat karst features and/or karst features with a potential drainage."**[9]

Inadequate Surveys

As FERC concluded in the FEIS, all of the 71 miles of karst that occur along the ACP should be considered MCI habitat and thus treated with extreme caution because potential MCI habitat is a sensitive karst environment. On the other hand, the FWS and Dominion have dismissed numerous karst systems along the route as not having MCI and thus not rising to a level of concern. FERC's conclusion that the MCI must be assumed present wherever the ACP crosses karst has thus been ignored by the FWS in its analysis of potential species impacts.

The FEIS is clear in the potential impact to species such as MCI and others. "ACP could impact cave invertebrates, and other subterranean obligate species (amphipods, isopods, copepods, flatworms, millipedes, beetles, etc.) that are endemic to only a few known locations. Atlantic's and DETI's Karst Mitigation Plan outlines measures to avoid or minimize potential impacts on karst and subterranean habitats. However, because certain subterranean obligate species are endemic to only a few known locations and are vulnerable to changes in hydrological pattern or water quality, it is possible that ACP-related construction impacts could have population-level effects on these species. Therefore, we recommend that Atlantic complete additional electrical resistivity imagery studies and analysis to identify surficial karst features and connectivity to karst voids and cave systems, and monitor the pipeline right-of-way in karst areas for subsidence following constructions. We are also consulting with the FWS to further minimize impacts on ESA-listed subterranean species."[10]

In order to address potential impacts to MCI and its habitat, Dominion was told that additional biological surveys and electrical resistivity imaging must be completed. The FEIS notes that "Atlantic would perform additional subsurface investigations in 2018 and 2019 to identify and/or verify the locations of voids to supplement mitigation planning once trees have been cleared from the construction right-of-way."[11] The FEIS pointed to "20 open throat sinkhole features where the presence of Madison Cave isopod is assumed, of which 9 are located with 25 feet of the trenchline and could be directly impacted by

construction activities." The report goes on to say that "water and sediment movement from construction activities may transfer to subterranean habitats occupied by Madison Cave isopod, altering habits used by the species." It also notes that "increased sedimentation may cause death" and alter the MCI habitat as to render it unusable. Further construction discharge could alter sinking streams, sinkholes, and cause cave entrance collapse, all of which would be detrimental to the subterranean habitat. Even activities such as vegetation clearing would be detrimental to the underground habitat as would, of course, fuel and chemical spills. "As noted above, because of the interconnected network of karst features, actions in one area can produce impacts considerable distances from the actual point of activity," the document stated.[12]

This paragraph in the FEIS serves to reiterate the point that the MCI is an indicator species for all of the subterranean habitat. The above listed cautions remain regardless of whether or not the MCI is actually present in the habitat. However, given that Dominion is assuming the presence of MCI in ALL of the karst located along the route, that distinction does not matter. If it is assumed that the MCI is present, then the assumption is that the species, and therefore the associated habitat, will be harmed. One cannot rely on a desktop survey to quantify such a huge risk.

It appears that Dominion has not followed FERC's recommendation as the electrical resistivity tests remain incomplete and inadequate. The only known survey for obligate species, such as MCI, occurred in Churchville and presumably the Cochran's Cave complex in Mint Spring although that report has not yet been made available, despite Dominion's premise that MCI occurs across the entire 71 miles of karst along the ACP route. Beyond that, despite noting very suitable habitat for MCI in several caves in Bath and Augusta, the FEIS said that "Species occurrence is based on a desktop review using the FWS IPaC website and on consultations with the FWS."[13] Such a selective application is not acceptable, because a non-arbitrary analysis relies on thorough and accurate surveys. Before Biological Opinions and Incidental Take Statements are recognized as valid, the required work must be done to provide accurate, quantitative reasoning for the numbers put forth in these key documents. The future existence of key species, such as MCI, and important habitats that are integral to clean water depend on these surveys and tests being accurate and complete. The alternative is complete avoidance of karst sites.

Credible recommendations ignored

Recommendations have been made by multiple agencies to modify the route to avoid sensitive karst areas. The MCI becomes emblematic of that issue. It carries the banner for the entire subterranean, karst ecosystem. As the Virginia Cave Board noted in 2015: "In karst some aquatic and terrestrial organisms have adapted to the caves and conduits within karst systems, and their confinement to these systems has created a high degree of specific adaptation to these environments. These organism's [sic] dependence upon this environment, coupled with the often low numbers, and their tendency for endemism, has created a situation in which they are often highly susceptible to impact and environmental degradation."[14]

It is important to remember also that there is a critical distinction between "caves and sinkholes" and entire karst systems. The latter is far more extensive than the former, but the two are inextricably linked. The ACP's potential impacts to the entire karst are spelled out in a report by Western Kentucky University's Chris Groves, PhD, in a report that he prepared for the Southern Environmental Law Center. In that paper, he expounded upon the idea that the karst systems of underground and interconnected conduits are far larger than known caves that have been mapped by humans and thus impacts would be more far-reaching than previously thought.

"In karst regions, and in associated environmental assessments of them, mapped caves are often considered to be the principal relevant underground features. To understand environmental conditions there, however, we should consider an idea posed by Curl (1986) that the length of passages shown on a cave map actually depends on the size of the explorer. Existing cave maps showing the extent of passages that might be considered in an environmental assessment were made by human-sized explorers who obviously had to be able to fit into the passages they were exploring and mapping. A map made by such explorers is limited to passages of that size. If, say, the explorers were instead the size of groundhogs, they could fit into smaller passages and the cave would be more extensive. Such "caves" mapped by mouse-sized explorers would be even longer, and so on, consisting of increasingly extensive and complex networks of passages and fractures, including both the large and tiny ones, as smaller and smaller "explorers" are invoked. As these get smaller and the passage systems more extensive, it is not hard to imagine these networks permeating the rock body both in between and far beyond the boundaries of the human-produced cave maps. Curl (1986, p. 771) showed that it is expected that as the size of the explorer decreases, not only does the network of passages in a single cave get longer, but what were separate caves can get connected, and caves that didn't exist at all because the larger explorers couldn't fit into them now come into existence. It is reasonable that at some point in the progression that more and more caves within a given region of a rock body may be all at some point, converge to form a single integrated system of interconnected spaces ranging from the relatively large passages shown on cave maps down to fine fractures. What is the fundamental size of an "explorer" that would properly be invoked to understand the relevant geometry of a karst flow network with regard to environmental planning? It is not a human, but indeed the liquid or gas molecules that flow through these systems. At that scale it is reasonable to expect that virtually all interconnected spaces within the rock participate in the flow system. This also highlights a critical observation with regard to understanding karst resources—that the explored and mapped caves within a particular area offer only a fragmented and incomplete picture of what is there."[15]

The degradation problems than can occur during construction and operation of the pipeline are magnified within the karst environment and the size of the karst environment itself is magnified if the boundaries are extended to encompass the complete karst system. These problems include sedimentation, water contamination, sinkholes, cave collapse, chemical contamination from above ground spills such as fuel and underground from pipe coating, and air quality problems within the underground voids. Again, the MCI

stands as a representative of the sensitivity of the subterranean environment to these issues.

Multiple agencies, such as the Virginia Department of Conservation and Recreation and the Virginia Cave Board as well as numerous other credible experts have recommended that the ACP be routed around sensitive karst areas including, but not limited to, Valley Center, Burnsville Cove, Little Valley, and Cochran's Cave. Dominion's answer that it is "not practicable" is not acceptable, especially in light of the fact that those same agencies have offered to help with rerouting options. Dominion's timetable and bottom line are not acceptable reasons for avoiding their legal responsibilities. Further, had Dominion followed the avoidance and rerouting recommendations, many of which were presented five years ago, there would be no pressure because of time constraints. Dominion's wounds here are self-inflicted rendering worthless their excuses for not following the recommendations of the public institutions charged with protecting the plants and animals of this nation.

Cochran's Cave Complex

One specific example of the inadequacy of the ACP to properly address concerns regarding the effects of the ACP on MCI and its associated habitat is the work that has been done regarding the Cochran's Cave complex located along the route (MP140) near Mint Spring in Augusta County. According to the Fourth Circuit opinion, because of the MCI's small size, subterranean habitat, and a lack of effective survey protocols, FWS cannot practically estimate the number of MCI that may be taken by ACP construction. Therefore, FWS relies on a habitat surrogate to establish take limits. "FWS has shown that a numeric take limit is not practical here. *Sierra Club*, 899 F.3d at 278. At issue, however, is the soundness of that habitat surrogate. Reviewing the 2018 habitat surrogate, we conclude that FWS again has established an arbitrary take limit for this species."[16]

The 2017 BiOp states that there would be 1,974 acres of potential MCI habitat in Augusta County, at Cochran's Cave, affected by ACP. Although there are no known documented MCIi "localities" in the ACP path, FWS assumed MCI presence in Cochran's Cave in Augusta County where 11.2 acres would be impacted. "Due to karst terrain, FWS determined that the ground-disturbing activities within this 11.2 acre zone will have ripple effects extending out half a mile, such that MCI will be taken a total of 896.7 acres." The ITS says that "pipeline construction will kill a "[s]mall percent" of MCI on the 11.2 and harm or harass '[a]ll individuals present with the 896.7 acres."[17] Nothing was said about the remainder of the 1,974 acres of MCI habitat here or along the remainder of the 71 miles of karst that is on the pipeline route and is assumed, per both Dominion and FERC, to be considered MCI habitat.

Inaccurate water table statements

The lack of concern regarding the MCI is based on inadequate surveys and inaccurate information. For instance, page 29 of the biological opinion states that "We do not anticipate impacts to MCI in the remainder of the 1,974 surface acres (Yehond the 11.2 and 885.5 surface acres) due to the AMMs (Appendiz B Table 6) and the depth of the

phreatic water (at least 20 ft below ground surface) they inhabit. The depth to groundwater level in Augusta County is approximately 20 ft below the ground surface. The limit of project disturbance is 6-8 ft below ground surface and therefore not expected to pose a significant risk to groundwater (FERC 2017)."[18]

Reference to a single site as a blanket statement effectively abdicates responsibility for the entire 71 miles of karst along the ACP route. Again, such arbitrary assumptions are not acceptable. In some areas the phreatic zone is much closer to the surface, while in some areas it is deeper. In many areas the groundwater is less than 10 feet, which would mean that the pipeline construction could penetrate the subterranean habitat. USGS sources indicate that there are only two monitoring sites in the Ridge and Valley region that are anywhere near the ACP route through karst, one is in Augusta and one is in Bath County and the latter is not particularly close to the ACP route.[19] The only way to know whether these two areas are representative of areas along the pipeline path is to see how the geology compares. Those geological surveys have not been done and thus the potential impacts to sensitive habitat suitable for MCI populations is unknown.

Avoidance should be the rule

As has been put forth by multiple experts and agencies during the last five years, the only way to properly protect MCI and its critical habitat is avoidance. Avoidance should be delineated based on proper surveys and research and in consultation with experts in the field. Dominion has had five years to do this, but has chosen, instead, to rely on the statement that avoidance is "not practicable" rather than follow the established stipulations and guidelines. For instance, in a letter dated Aug. 21, 2017, the Virginia Department of Conservation and Recreation—Natural Heritage filed a document on the ACP FERC docket regarding concerns about rare, threatened, or endangered plant and animal species as well as their association habitats, natural communities, and significant geologic formations. This was supplemental information to what Natural Heritage had already filed on the docket.

The number one recommendation put forth by the letter was that **"DCR-DNH continues to recommend the avoidance of all conservation sites intersected by the pipeline footprint."**[20] These would include karst subterranean habitats Bath and Augusta counties in Virginia as well as those outside of DCR's purview in Pocahontas and Randolph counties in W.Va. All of these support MCI habitat and thus all should be properly surveyed and avoided.

Regarding karst, Natural Heritage had this to say about several karst areas. In Bath County on both the Valley Center route and variation: "Both the approved corridor and the Valley Center Route Variation have high potential to impact karst resources, including significant springs and rare cave fauna associated with subterranean ecosystems. …DCR-DNH recommends avoidance of the Valley Center karst."[21]

The previously mentioned Cochran's Cave Conservation Site raised similar concerns from Natural Heritage. Although the FEIS (pages 4-16 and 4-18) stated that VDCR concluded that because of route adjustments and ACP's commitment to use onsite karst specialists

during construction that potential impacts to Cochran's Cave had "been mitigated to the maximum extent practicable." DCR in its August 2017 letter, however, added that the above conclusion was "based on the premise that avoidance was not an option. **Avoidance of the Cochran's Cave conservation site remains DCR-DNH's recommendation, with mitigation a secondary option."**[22]

Concerns regarding Cochran's Cave have been expressed by other authorities as well. The Virginia Cave Board comments, in April of 2015, contain the following descriptions and concerns regarding this Augusta County cave complex.

"Cochran's Cave Number 2 is designated as significant under the Virginia Cave Protection Act of 1979. While considered significant in terms of hydrology, geology, and esthetics, the cave is also likely to be significant biologically. The cave lies just east of Route 11 beneath the current proposed alignment in Augusta County. The cave has a perennial stream upwelling near the back of the cave, and is within the range of the Madison Cave isopod (*Antrolana lira*), listed as threatened under the US Endangered Species Act. In addition, there is a high likelihood that several other globally rare, cave-adapted species are present in this cave….Ceiling heights of 70 feet are reported in the cave, bringing documented cave passage in close proximity to the base of the pipeline trench along the proposed alignment. Therefore, the Cave Board strongly recommends local rerouting of the pipeline to avoid passing over or within the conservation area of Cochran's Cave Number 2."[23]

Although some rerouting of the ACP around some of the Cochran's Cave complex did occur, it is not enough to avoid subterranean impact as is noted in the supplemental filing done by Dominion in January of 2017 that included a report that ACP commissioned by GeoConcepts Engineering, Inc.

In that report, GeoConcepts notes: "The CCCA is a conservation area which has been delineated by the Virginia Department of Conservation and Recreation – Natural Heritage Program in an effort to protect Cochran's Cave No. 2, considered a "Significant Cave" due to its hydrology (a perennial stream), and geological and aesthetic features (well-developed speleothems). Cochran's Cave No. 2 is also a potential habitat locality for the Madison Cave Isopod, designated as a rare, threatened and endangered species by the US Fish and Wildlife Service. The CCA encompasses a broad, shallow swale, approximately 1.4 miles in length and 0.75 mile in width at its widest point….The Dominion ACP alignment was previously planned to cross over the underground course of CC2, but was subsequently rerouted to the south to avoid the cave. However, the currently proposed alignment passes across a broad, shallow "closed depression" containing four sinkholes, one of which contains the vertical entrance to Cochran's Cave No. 3. The depression is internally drained by these sinkholes."[24] The GeoConcepts memorandum to Dominion includes no recommendations or cautions, but the evidence presented makes it abundantly clear that all of the subterranean complex at the site are interconnected and, thus, the potential for irreparable harm to the rare karst habitat and potentially the MCI remain.

The conclusion of the FEIS in regard to the effect of the ACP on the MCI is as follows: "Therefore, we have determined that ACP *may effect*, and is *likely to adversely affect* the Madison Cave isopod. However, in the absence of subterranean karst feature mapping that would indicate the potential for and magnitude of construction-related downstream impacts on the Madison Cave isopod priority area, the FWS is unable to quantify the potential incidental take of this species. This information is required to inform the Biological Opinion and complete section 7 consultation. Pending the results of this data, additional conservation measures may also be required by the FWS to mitigate impacts on this species."[25]

There is, then, no way, without doing boots on the ground surveys of these sensitive subterranean habitats that are inextricably linked to healthy human communities existing above ground, that a biological opinion or an incidental take statement can be accurately and legally issued. The FWS and Dominion can't have it both ways. If the entire 71 miles of karst along the ACP is to be considered MCI habitat as is stated in the FEIS, then that must be avoided or further delineated with credible scientific surveys, electrical resistivity imagery, and analysis. They cannot arbitrarily choose to shrink the amount of impact through desktop surveys. This leaves too much environmental risk to the subterranean obligates unaddressed despite concern postulated by credible experts.

It should also be pointed out that MCI is just one of dozens of threatened or endangered flora and fauna species and the karst subterranean habitat is just one of many unique natural communities that are in imminent danger because of the ACP and the lack of proper surveys and adherence to the law in regard to how such species and communities should be addressed by the developers.

This excerpt to FERC from the Virginia Department of Conservation and Recreation regarding the impact of the ACP on these natural communities provides an appropriate summary: "DCR recommends coordination with the United States Forest Service to ensure impacts to [state-listed threatened and endangered plant and insect species] these resources are avoided and the rare plants are protected during the construction and operation of the pipeline."[26]

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[1] U.S. Court of Appeals for the Fourth Circuit, No. 18-2090, Defenders of Wildlife; Sierra Club; Virginia Wilderness Committee, vs. U.S. Department of the Interior; U.S. Fish and Wildlife Service, 3-4.
[2] U.S. Fish & Wildlife Service flyer, "Madison Cave Isopod, *Antrolana Lira*," October 2010.
[3] Ibid.
[4] Ibid.
[5] Ibid., 8.
[6] Ibid., 9.
[7] FEIS, 4.
[8] FEIS, 4.3.1.7 and 4.5.2.4.
[9] FEIS, 4-294.
[10] FEIS, ES-11.
[11] FEIS, 4-177.
[12] FEIS, 4-298.
[13] FEIS, 4-294.

[14] Richard Lambert, "Assessments of Four Karst Systems in Highland-Bath Counties, Virginia Along the GWNF-6 Route of the Proposed Atlantic Coast Pipeline," as quoted from Virginia Cave Board, 2015, June 2, 2016.
[15] Chris Groves, PhD, "Karst Landscapes and Aquifers of the Central Appalachian Mountains and Implications for the Proposed Atlantic Coast Pipeline," Comments prepared for Southern Environmental Law Center, Charlottesville, Va. April 3, 2017, 9.
[16] U.S. Court of Appeals for the Fourth Circuit, 45.
[17] Ibid., 45-46.
[18] ACP Biological opinion.
[19] https://waterdata.usgs.gov/va/nwis/uv/?site_no=382523078535501&PARAmeter_cd=72019,72
[20] Letter from Commonwealth of Virginia, Department of Conservation and Recreation-Natural Heritage, filed with FERC, Docket CP15-554-000, Atlantic Coast Pipeline Final EIS, Aug. 21, 2017, 1.
[21] Ibid., 7.
[22] Ibid., 10.
[23] Letter from Commonwealth of Virginia, Department of Conservation and Recreation-Virginia Cave Board, filed with FERC, Docket No. PF15-6-000, "Virginia Cave Board Comments and Recommendations on the Proposed Dominion Atlantic Coast Gas Pipeline, April 17, 2015.
[24] Atlantic Coast Pipeline, LLC, Atlantic Coast Pipeline and Dominion Transmission. Inc., Supply Header Project, Supplemental Filing, January 27, 2017, Appendix A, Cochran's Cave Conservation Area Investigation Update, GeoConcepts Engineering, Inc., Memorandum, Jan. 20, 2017.
[25] FEIS4-301
[26] DCR letter, pg. 5.