Ms. Becky Keogh
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ADEQ
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VIA U.S. MAIL AND EMAIL

Re: **C & H Hog Farms, Inc. Regulation 5 Draft Permit - Number 5264-W**

Dear Director Keogh and Governor Hutchinson:
To begin my comments I'd like to share those of the venerated Kenneth Smith, author of the outstanding book, *Buffalo River Country,* and creator of the entire trail system for the Buffalo National River Park. He was among the first to work to save the Buffalo from being dammed by the Army Corps of Engineers in the 1960's, and helped to make this awesome river a national park for all Americans to enjoy. He received a coveted Hall of Fame tourism award this month at the annual Governor's Conference on Tourism. It behooves us all to listen to his wise words. Take a moment before reading further:

https://vimeo.com/208539794

In his book, The Battle for the Buffalo, Neil Compton wrote, "Its fate was still subject to whims of lawmakers. For that reason, it must be constantly monitored by level-headed conservationists and defended from exploitation…. The challenge goes on. I challenge you to step forward to protect and care for the wild places you love best."

Thank you for the opportunity to take that challenge and to comment on the C&H CAFO Reg 5 No Discharge permit. Since it is impossible for a "discharge" facility to suddenly become a functioning "no discharge" facility in a karst terrain, I would like to address an issue that I have observed since the original permit was approved. I continued to encounter this issue in the subsequent "harder look" that SBA and FSA were ordered to take in the additional Environmental Assessment by Federal Judge Marshall, as well as in the Harbor Drilling Study Work Plan and Report, and find it is ongoing through ADEQ's lack of adhering to the Arkansas Waste Management Field Handbook (AWMFH) guidelines for karst.

The issue I see is an obfuscation of the term "karst" that doesn't employ the accepted geologic definition specifying a terrain or region, nor does it recognize the complexities of karst environments and their attendant risks.
Using singular terms like fractures, voids, sinkholes, dry creeks, losing streams, caves, epikarst, etc., without acknowledging that all are individual characteristics and prime examples of the chemical make up of the karst limestone, dolomite, etc., terrain out of which these features develop, is confusing and employed apparently intentionally to distract the public, Governor Hutchinson, the regulatory agencies and the legislators. Without this basic understanding of the definition of karst, good and informed scientific decisions about land and water resources in karst terrains are impossible, and the results devastating. I will share some common examples of reliable information from several sources that I have found defining karst:

--- ***Karst Is a Landscape***, *Kentucky Geological survey*

https://www.uky.edu/KGS/water/general/karst/karst_landscape.htm

*A karst landscape has sinkholes, sinking streams, caves, and springs…. **Geologists have adopted karst as the term for all such terrain. The term "karst" describes the whole landscape, not a single sinkhole or spring.** A karst landscape most commonly develops on limestone, but can develop on several other types of rocks, such as dolostone (magnesium carbonate or the mineral dolomite), gypsum, and salt. Precipitation infiltrates into the soil and flows into the subsurface from higher elevations and generally toward a stream at a lower elevation. Weak acids found naturally in rain and soil water slowly dissolve the tiny fractures in the soluble bedrock, enlarging the joints and bedding planes.*

--- ***WHAT IS KARST? AND WHY IS IT IMPORTANT?*** *KARST WATERS INSTITUTE*

HTTP://KARSTWATERS.ORG/EDUCATIONAL-RESOURCES/WHAT-IS-KARST-AND-WHY-IS-IT-IMPORTANT/

*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. More than 25 percent of the world's population either lives on or obtains its water from karst aquifers. **In the United States… 40 percent of the groundwater used for drinking comes from karst aquifers.***

--- ***GROUND-WATER MONITORING IN KARST TERRANES: RECOMMENDED PROTOCOLS AND IMPLICIT ASSUMPTIONS*** *by James F. Quinlan, U.S. ENVIRONMENTAL PROTECTION AGENCY ENVIRONMENTAL MONITORING SYSTEMS LABORATORY LAS VEGAS, NEVADA 89193-3478*

http://karstwaters.org/wp-content/uploads/2015/04/gw-monitoring-in-karst.pdf

*The hydrology of karst terranes is significantly different from that of terranes characterized by granular and fractured rocks—**flow velocities in karst may be several orders of magnitude higher than in other ground-water settings; Darcy's Law describing flow is rarely applicable. For monitoring to be relevant and reliable in karst terranes, monitoring procedures must be radically different from those in non-karst terranes.***

Karst terrain has been explained by several representative reliable definitions above. I will take this opportunity to point out some of the obfuscating and contradictory descriptions in the **Harbor Environmental Drilling Report and its Work Plan** regarding karst and its inherent features. Note that except for the "potential concerns' raised by a citizen's group… due to karst terrain" in the initial "Purpose" section, karst is not mentioned at all in the entire "Physical Setting 2.2" section of the report. Instead, subcategories of karst characteristics and features are employed to describe the physical geology, soils, and terrain. This provides the illusion that karst is not present to most readers, just a possible but remote "concern raised by a citizen's group".

Harbor Environmental Drilling Report and its Work Plan *https://www.adeq.state.ar.us/water/bbri/c-and-h/pdfs/final-drilling-study-work-plan-8-26-16.pdf and https://www.adeq.state.ar.us/water/bbri/c-and-h/files/ch-farms-drilling-study-report-final-12.1.2016.pdf*

*-- Purpose: Interpreted results from a 2015 electrical resistivity imaging (ERI) survey commissioned by the Big Creek Research and Extension Team (BCRET), suggested vertical leakage from the waste storage ponds and possible fracturing within limestone bedrock below the site. Potential concerns raised by a citizen's group regarding the study included the rapid transport of contaminants in groundwater through weathered limestone pathways and subsidence or collapse of the ponds due to karst terrain. The group recommended a subsurface investigation prior to installation of synthetic liners within the ponds. **This Drilling Study is being conducted by the ADEQ to evaluate the lithology/geology below the site; and assess potential subsurface impacts from the waste storage ponds.***

A person unfamiliar with the definition of karst terrain would not understand that the following descriptions have omitted the elephant in the room, or that a truth seeking investigation into karst would necessarily have incorporated an evaluation of groundwater flow direction and lithology with several bore holes. (Despite the stated purpose above, note that Tai Hubbard, the study's principal geologist, remarks in his report in the appendix that this was not accomplished.)

2.2 Physical Setting

2.2.1 – Physiography -- Mt. Judea is located within the Ozark Physiographic Region of Arkansas (Caplan, 1957), near the boundary of the Springfield Plateau (to the north) and the Boston Mountains (to the south). The Ozark Region, formed by uplift and erosion, is a thoroughly dissected area characterized by steep valley walls and narrow floors. The Springfield Plateau contains mostly Mississippian-aged limestone and chert formations and consists mostly of gently rolling hills or an undulating topography. The Boston Mountains contains younger strata at the surface, primarily early Pennsylvanian-aged sandstones and shales with minor limestones. The C&H Hog Farms facility slopes slightly to the east toward Big Creek, located roughly 2,500 feet east of the site. The site elevation ranges from approximately 895 to 920 feet above mean sea level (amsl). A small man-made pond is located northeast of the facility barns. Storm water runoff from the site exists primarily as sheet flow and is conveyed eastward, eventually entering an intermittent drainageway that traverses an agricultural field and discharges into Big Creek. Big Creek flows generally northward and receives runoff from Left Fork Creek prior to discharging into the Buffalo River at a point roughly 4.5 miles northeast of the hog farm near the Carver community.
2.2.3 -- Geology -- The uppermost geologic formation below the site is the Mississippian-age Boone Formation (Haley, et al., 1993). The Boone formation consists of gray, fine- to coarse-grained fossiliferous limestone interbedded with chert. Some sections may be predominantly limestone or chert. The cherts are dark in color in the lower part of the sequence and light in the upper part. The quantity of chert varies considerably both vertically and horizontally. The sequence includes an oolite (Short Creek) member near the top of the Boone Formation in western exposures and the generally chert-free St. Joe Member at its base. The Boone Formation is well known for dissolutional features, such as sinkholes, caves, and enlarged fissures. Thickness of the Boone Formation ranges from approximately 300 to 350 feet in most of northern Arkansas (McFarland, 2004).
*2.2.4 -- Hydrogeology -- Groundwater below the site is contained within the Ozark Plateaus aquifer system, which consists of three distinct water bearing zones separated by two distinct confining units. The uppermost aquifer is the Springfield Plateau aquifer, which is contained in the Boone Formation and the St. Joe Member of the Boone Formation (Renken, 1998…. The occurrence of groundwater within limestone is typically related to secondary porosity (fractures or dissolution features) that developed after rock formation. The anticipated groundwater flow direction in the vicinity of the site would generally be eastward, similar to surface topography; however, **the movement of groundwater within limestone is highly dependent upon the interconnection of fractures or other secondary features. It should be noted that groundwater flow direction will not be evaluated as part of the Drilling Study.***

The Buffalo National River Water Quality Report 1985 - 2011 Final.pdf on the karst geology of the region:

A general description of the geology (based primarily on summaries from Adamski and others, 1995; Mott and Luraas, 2004; and Kresse and others, 2014) follows. The rocks of the Buffalo River watershed are entirely sedimentary. They were deposited in near-shore and shallow marine basins during the Ordovician, Silurian, Devonian, Mississippian, and Pennsylvanian periods of the Paleozoic Era. The sedimentary sequence is punctuated by numerous unconformities where deposition ceased for a time and erosion occurred, to be followed by more deposition. The rocks have been subjected to erosional and tectonic forces and have developed many sinkholes, surface irregularities, fractures, and faults. These fractures and faults were further modified by erosion and dissolution processes of both surface water and groundwater.
*The Ordovician through Mississippian rocks host a complex karst terrain where losing streams, sinkholes, springs, and caves dominate much of the landscape. Most of these rocks are carbonates, either limestone or dolomite. They are particularly susceptible to dissolution. **These rocks are highly permeable to the movement of groundwater**. **Subsurface flow directions and rates of groundwater flow are difficult to predict and may rapidly change based upon the hydrologic events**. The river valley downstream from Boxley is entirely within this section of the sedimentary sequence (Haley and others, 1993).*

It should be pointed out that ADEQ is well aware of the guidelines for karst terrain set forth in the AWMFH that state the necessity to investigate groundwater flow direction in karst terrains, (651.0703 and 651.0702) **Why was flow direction specifically left out of the investigation,** especially when this rare opportunity of investigative drilling was already taking place, and the relative ease of evaluating flow and drilling several holes was at hand?

The Harbor report employs phrases that discount the importance of characteristic karst features such as the following: "*Weathered and fractured, fossiliferous gray to buff limestone was encountered from 20 to 28.5 feet. The driller reported potable drilling water loss in this zone. Competent, fossiliferous gray limestone (consistent with the Boone Formation), with some minor fracturing and bedding planes was encountered at 28.5 feet bgs, which generally extended to the TD of 120 feet bgs. **Zones of increased fracturing** were encountered around 70 feet and 90 feet bgs; however, **no Karst features such as dissolution features were encountered**.*" (p. 7 Harbor Report)

In spite of the previous statement, photographs in the record at the fractured depth (18.5-28.5) show

evidence of such a karst dissolution feature where calcite crystals have developed in the void zone and can be seen at the level of drilling water loss:

ch-farms-drilling-study-report-final-12.1.2016.pdf 58 / 542

Photo #:	12	**Date:**	9/21/16	**Time:**	1415	**Photographer:**	C. Yeatman
Description:	Core recovery from 18.5 to 28.5’						

Photo #:	11	**Date:**	9/21/16	**Time:**	1415	**Photographer:**	C. Yeatman
Description:	Core recovery from 18.5 to 28.5’						

Photo #:	12	**Date:**	9/21/16	**Time:**	1415	**Photographer:**	C. Yeatman

Date:	9/21/16	Time:	1427	Photographer:	C. Yeatman

Core recovery from 18.5 to 28.5’

Note this on page 8: “ ***Due to fracture zones encountered in the subsurface, the borehole took more grout than calculated for its volume*** *(see boring log in Appendix B). Borehole volume was estimated at 23.6 cubic feet (176 gallons). Total estimated grout placed in the borehole was approximately 280 gallons*.”

C&H Hog Farms Facility Mt. Judea, Arkansas	Date Completed:	9/23/16	Latitude: 35.92279
	Hole Diameter:	6.0 in.	Longitude: -93.073269
Prepared for: Arkansas Department of Environmental Quality	Drilling Method:	Rotosonic	Driller: Cascade Drilling
	Sampling Method:	10-Ft. Core Barrel/Sleeve	Logged By: T. Huetter, P.G.
	Total Boring Depth:	120.5 ft.	Company: Harbor Environmental

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Soil Sample (ft.)	REMARKS
0	CL		SILTY CLAY w/ some chert and limestone fragments, yellowish red (5YR 4/6), fill.	B-1S-1 (0-0.5 ft.)	Hand auger to 2.3 ft. (refusal) then commenced sonic drilling.
				B-1S-2 (5.0 ft.)	
10	CH		FAT CLAY, very few chert and limestone fragments, same color as above.	B-1S-3 (10.0 ft.)	
	LS		LIMESTONE, fine-grained, gray (5Y 5/1), fossiliferous.	B-1S-4 (13.5 ft.)	
	CH		Same FAT CLAY as above.	B-1S-5 (18.5 ft.)	Duplicate soil sample collected (BD-1).
20			LIMESTONE, fine-grained, weathered and fractured, gray (5Y 5/1) to buff, fossiliferous.		
			CLAY interval as above.	B-1S-6 (25.0 ft.)	Driller reported water loss at approx. 25 ft.
30			LIMESTONE, competent w/ some fracturing and bedding planes, gray (5Y 5/1), fossiliferous.		

Thomas Heutter, PG, Principal Senior Project Manager's notes in the report indicate the difficulty cementing above 25 ft bgs on Friday, 9/23/16 due to the presence of a "**void**". This becomes an issue when the ADEQ onsite independent senior geologist, Tai Hubbard, in his own report, in Table 1, states repeatedly, "*No voids noted during drilling*".

Before issuing a conclusion that this study confirms that the site is acceptable for a Reg 5 CAFO, permitting over two million gallons of swine waste storage and land application, ADEQ must bring these experts together to discuss karst features, epikarst, groundwater flow, rock quality determination and other components of this difficult to assess hydrogeology that affects the transport of liquids through karst terrain. Will they find a consensus of what they actually observed during the investigation? It is concerning that they report differing observations.

In the Report Appendix Tai Hubbard includes further evidence of the botched drilling study as documented:

-- Limitations of accomplishing the work plan: Limitations -- Based on that single boring location, certain limitations are inherent when assessing the Site geology. Limitations identified for this project include the following:
1.) Evaluation ***of lithologic contacts and bed orientations are limited, both horizontally and vertically, due to the inability to correlate observations collected at a single location to any other bore holes.***
2.) ***The drilling method*** *employed during this investigation consisted of* ***a rotosonic drill rig without a high speed rotation implement used for typical rock coring. This limitation resulted in poor rock core quality, preventing the calculation of Rock Quality Determination (RQD) as proposed.***
Based on the large percentage of mechanical breaks as a result of the drilling method, ***HGI did not perform Rock Quality Determination (RQD) calculations*** *as the mechanical breaks would mischaracterize the formation competency.* ***By definition RQD is intended to measure the degree of jointing and fractures in a rock formation. Mechanical breaks that were caused by the drilling process, specifically the collection and extrusion method, did not allow for an accurate representation of RQD.***

The highly weathered limestone bedrock and unconsolidated clay intervals observed between 13.8 and 28.0 ft.bgs. appeared to have the characteristics of ***epikarst****. With the understanding that epikarst is the weathered zone found at the interface of unconsolidated soils and bedrock, the Site setting would support this characterization…. The limestone bedrock at the Site is a part of the Boone Formation, a Mississippian aged limestone[2]. Core analysis from 28.0 ft.bgs. to the final termination depth of 120 ft.bgs. confirmed the characteristics of the Boone Formation, with evidence of sub-members such as the Short Creek Oolite and St. Joe Limestone member[3]****…. The primary karst feature during the drilling of B-1 is the previously identified epikarst zone noted between 13.8 ft.bgs. and 28.0 ft.bgs. (pp.3-4)*

Note the mention of the calcite crystals shown in the previous photographic log, indicative of dissolution features in the chart below from the Rock Core drilling log:

16.0	17.0	3	1.0	13.8 - 17.7	Limestone (Boone Formation) - Gray (5Y, 5/1), fossiliferous (brachiopods),
					medium to fine grained matrix, some amstomosing chert veins, clay filled vug
					at 14.0', with secondary calcite crystals. Massive, slightly decomposed,
					moderate disintegration (from 13.8 - 14.5 '), moderately fractured.
					* NOTE: Rock core pulverized by drilling process (no water used). Clear contact
					at 17.7 back to Clay indicating potential terrace material (large rock fragment)
					or epikarst. ** Driller did not indicate any voids during drilling.
17.0	18.5	4	1.5	17.7 - 19.0	CL - Clay, Yellowish Red (5YR, 4/6), trace silt, plastic , non-sticky, firm, faint
					blocky structure, with black planes of organic material (former root structures or
					plant matter). * Note - Limestone fragment (0.3' diameter) at 9.6 ft. bgs.
18.5	26.5	5	8.0	19.0 - 28.0	Limestone (Boone Formation) - Gray (5Y, 5/1), Highly fractured, moderately
26.5	28.5	6	2.0		decomposed, moderately disintegrated, fossiliferous (brachiopods), intervals
					of mixed clay, Yellowish Red (5YR, 4/6), and angular rock fragments. Although
					drilling process may have pulverized sensitive zones, clay infilling was evident
					(Epi-Karst). **Drilling observations did not indicate voids, only incompetent rock.

Epikarst is cited many times in the Harbor Report without explaining that it is fragmented karst that varies widely and forms the main conduit for surface waters to flow laterally once they infiltrate below the thin soil in karst landscapes. Due to this high variability**,** groundwater flow direction is an essential part of a competent drilling investigation as explained in the following document, and yet remember that the **Harbor Work plan specifically stated that groundwater flow direction evaluation would not be included.**

The following explanations by expert geologists demonstrate the necessity of evaluating groundwater flow and lithology and exemplify the inadequacy of the Harbor Report's accuracy and its use as a legitimate investigation into the subsurface karst geology of C&H CAFO.

--- ***Aquifers of Arkansas—Protection, Management, and Hydrologic and Geochemical Characteristics of Groundwater Resources in Arkansas*** *By Timothy M. Kresse, Phillip D. Hays, Katherine R. Merriman, Jonathan A. Gillip, D. Todd Fugitt, Jane L. Spellman, Anna M. Nottmeier, Drew A. Westerman, Joshua M. Blackstock, and James L. Battreal2Groundwater Discharge to Surface-Water Bodies*

Freiwald (1987) conducted extensive groundwater discharge gain and loss measurements on eight streams and their tributaries representative of streams across the Ozark Plateaus in northern Arkansas. Study results illustrated the importance of groundwater contribution to streams in maintaining flow and affecting water quality. The study was designed to identify the relative importance of gaining and losing sections of typical Ozark streams and to characterize the degree of surface-water/groundwater interaction in this karst area. Three streams were shown to be gaining— receiving groundwater—throughout their reaches; the remaining five streams were shown to be gaining streams through the majority of their reaches. Groundwater contributed measurable and substantial stream flow in 51 of 61 measured reaches. Losing sections—where water moves from a stream into groundwater—tended to be relatively short in length. ***Results indicated that lithology and the presence of faults were strong controls on the degree of interchange between the groundwater and surface-water environments.*** *Stream reaches that received larger inputs of groundwater tended to lie in or near Mississippian-age, carbonate-rock outcrop areas; stream reaches where water moved into the groundwater environment were typically associated with fault zones. Groundwater also had a substantial influence on stream-water quality causing a notable increase in specific conductance and affecting moderation of stream temperature. (pp.52,53)*

--- Role of the Epikarstic Zone, Down but not straight down: significance of lateral flow in the vadose zone of karst terrains, *Thomas J. Aley • Shiloh L. Kirkland Accepted: 6 June 2012 / Published online: 17 June 2012 Springer-Verlag 2012*
http://www.ozarkundergroundlab.com/assets/aley---beeman---down-but-not-straight-down.pdf

The epikarstic zone is the interface zone between soil and regolith and rock in soluble rock landscapes (Jones et al. 2004). Thicknesses are commonly on the order of 10 m but are highly variable (Ford and Williams 1989). An introduction to a symposium on the epikarst (Jones et al. 2004) described ***the epikarst as including ''…solid carbonate rock, wholesale openings in the rock, and unconsolidated sediments, including soil, regolith, silt, clay, trapped rock rubble, and trapped vegetative debris, thereby making it highly physically heterogeneous.''*** *White (2004) includes some sketches showing highly variable epikarstic conditions resulting from features such as shaley limestone, massive limestone, barrier layers, and dipping beds. In addition, experience has shown that* ***the nature and extent of epikarstic development can vary dramatically over short distances. The epikarstic zone is where much of the lateral water movement is observed in karst areas. Both vertical and horizontal permeabilities are routinely greater in the epikarstic zone than in the underlying rock mass that has been less affected by dissolution. This commonly results in ponding of water and lateral movement along preferential flow routes to localized features and zones where the water can flow to lower elevations. This in turn helps explain why the distances traversed by lateral water movement sometimes increase between low and high flow conditions. It also explains why the direction of flow may change between low and high flow conditions.***

When I look further back in time at this resultant "harder look" **Environmental Assessment** ordered by Judge Marshall, contracted by Cardno, submitted by the USDA (SBA and FSA), and accepted by ADEQ, I observe more evidence of an apparent intentional dismissal of the significance of karst terrain.
The introduction of the term "karst" doesn't occur in the assessment document until 3.10, p. 34, and then only after many references to individual characteristic features and components of karst. For instance, such descriptors as the Ozark Aquifer, Ozark and Springfield Plateaus, Boone Formation, etc., are all made without remarking or associating the inclusive and comprehensive karst terrain of which each forms its part. Please note the following excerpts that distract from the severe limitations of placing CAFOs inherent in karst terrain.
If the Harbor Report itself and the karst explanations given above do not satisfy, perhaps this report from the USDA will shed more light on how the complexities and issues of karst terrain have been essentially dismissed from consideration:

-- Final Environmental Assessment C&H Hog Farms Newton County, Arkansas, *prepared by: United States Department of Agriculture Farm Service Agency Small Business Administration, Finding of No Significant Impact C&H Hog Farms Newton County, Arkansas December 2015*
https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Environ-Cultural/fonsi_hog_farms_final_assesment.pdf

-- Groundwater

Regional Groundwater Supply and Sources *-- C&H Hog Farms is located in the Ozark Plateau aquifer system, which consists of three regional aquifers: from shallowest to deepest, the regional aquifers are the Springfield Plateau, the Ozark, and the St. Francois…. Specifically, the farm is located on the regional Springfield Plateau aquifer system. The Springfield Plateau aquifer crops out along the southern and western perimeter of the Springfield Plateau as a narrow belt 5- to 10-miles wide in north-central Arkansas, but is exposed in a more than 50-mile wide band in northwestern Arkansas….. The Springfield Plateau aquifer generally ranges from 200- to 400-feet thick throughout northern Arkansas and is composed entirely of limestones and cherty limestones of the Mississippian-age Boone Formation and its basal member, the St. Joe Limestone (Adamski et al. 1995). The surface of the unconfined Springfield Plateau aquifer generally reflects overlying topography (Imes and Emmett 1994; Adamski et al. 1995). The unconfined Springfield Plateau aquifer is recharged nearly everywhere by precipitation. Groundwater flows mostly laterally and then discharges into springs and seeps along streams (Adamski et al. 1995). The primary Springfield Plateau Aquifer of the region, which consists locally of Boone Formation limestone, is characterized by moderate to high secondary porosity.* ***Karst features*** *and springs are more abundant in the nonchert-bearing limestones, such as the St. Joe Limestone of the Boone Formation…..* ***Groundwater flow rates are difficult to model and quantify in karst systems due to complex dissolution features and preferential flow.*** *As reported by Soto (2014), groundwater dye trace studies have been conducted in eight watershed areas around the area of the Buffalo National River to determine the sources of water that feed the river.* ***Groundwater flow in karst systems can cross the surface watershed boundaries, and may not correspond with surficial drainage basin divides (Soto 2014). Such conditions are not observed in the southern part of the Buffalo River watershed where the farm is located****… Results of the Buffalo National*

River dye trace studies indicate that not all caves and /or springs in the Buffalo area appear to share watersheds (Soto 2014).

*In 1999, field observations and dye-tracer studies conducted in the Buffalo National River indicated that water discharged from some springs in the Buffalo River watershed originated in the Bull Shoals Lake watershed and traveled at velocities exceeding 640 meters per day (Murray and Hudson 2002). The Bull Shoals Lake Watershed is located northeast of the C&H Hog Farms….. **Because much of the Bull Shoals watershed is covered by agricultural land, consisting mostly of livestock operations, it is possible that nutrient contaminants from these agricultural activities reach the Buffalo River by interbasin transfer of groundwater** (Murray and Hudson 2002).*

It is interesting to note that the USDA EA authors preferred to propose that inter-basin transfer of agricultural contaminants might travel to the Buffalo from Bull Shoals lake reservoir area on the border of the Missouri/Arkansas state line rather than the nutrient contamination from a single large CAFO facility and its application fields that are spread with the equivalent of the raw sewage from a city with a human population of 25,000-35,000, located in the Buffalo River watershed itself. Instead, an in-depth karst description is stated, but downplayed and its significance minimized for the site of the C&H CAFO. Big Creek is a notable losing or sinking stream, as are several named "dry" creeks in its vicinity that are detailed in expert geologist Tom Aley's comments below, yet read the lengths to which this EA report goes to deny the impact of this karst feature:

-- Site Groundwater Quality and Use (p.35) -- *The soluble nature of limestones gives rise to **karst terrain** in the southern Ozarks region. Highly soluble conditions in certain areas of the Buffalo River watershed**, distant from the site**, including the western and north-central parts of the watershed, have produced pervasive occurrence of karst features, including caves, sinkholes, springs, and sinking streams (Hudson et al. 2001, Soto 2014). However, the **C&H Hog Farms site and vicinity do not exhibit strongly developed karst landforms….** Although a hydraulic connection of surface water and groundwater typifies large-scale features of the Boone Formation (Kresse et al. 2014) in areas of significant karst landform development or at streams that have incised alluvium or overburden, the western floodplain and basal hillslopes above the floodplain in the vicinity of the C&H Hog Farms do not appear to match this characterization. **Big Creek's elevation and comparison to intermittent streams on the topographic map suggest that it lies below the regional water table elevation and is therefore not a sinking stream.** Sinking streams have a channel that flows across a karst feature that is sufficiently large to drain the entire base-flow volume, if the underlying karst aquifer water level is below the stream elevation. That is, if a losing stream condition applies, so that a losing stream condition and a feature large enough are present, the stream disappears into the underlying formation. A losing stream condition is one where the surface water is recharging the underlying aquifer. A gaining stream is one that is gaining water from discharge of the aquifer. Due to the proximity of higher terrain to the east and west, it would be expected that localized recharge of the Boone Formation would result in discharge/gaining stream conditions in the base of a valley, except in very dry conditions**… and the USGS topographic quadrangle map supports this conclusion by showing Big Creek as a perennial stream. More detailed hydrogeological and hydraulic evaluation would be needed to establish a history of losing/gaining stream conditions on a seasonal basis**.*

***3.28 Geology** (p. 52)*

*The farm is located in the northeastern part of the Boston Mountains and the southern part of the Springfield Plateau in the Ozark Plateaus. The Ozark Plateaus are an ancient, variably karstified region that has more than 8,000 reported caves and tens of thousands of springs, and a wide and diverse suite of accompanying karst landforms (Imes and Emmet 1994). Karst is discussed in more detail in Section 3.2 under Groundwater. Surface geology in and near the farm ranges from alluvium (clay, silt, sand, and gravel) along streams and rivers to a thick sequence of limestone bedrock. Surficial deposits underlying the farm consist of an approximate 4-foot thick veneer of soil and alluvium (BCRET 2014a). Bedrock underlying the soil and alluvium consists of the 300- to 350-feet thick Mississippian-age Boone Formation and the basal St. Joe Limestone, which ranges in thickness from a feather edge to over 110 feet in thickness (McFarland 1998; Braden and Ausbrooks 2003). The Boone Formation, a major karst formation in the region, consists of gray, fine- to coarse-grained fossiliferous limestone interbedded with chert. Some sections may be predominantly limestone or chert. The quantity of chert varies considerably both vertically and horizontally. **The Boone Formation is well known for dissolutional features such as sinkholes, caves, and enlarged fissures** (McFarland 1998; Braden and Ausbrooks 2003). The St. Joe Limestone is a fine-grained crinoidal limestone that may contain some smooth bedded chert in limited places (McFarland 1998; Braden and Ausbrooks 2003). Structurally, bedrock in the area where the barns and ponds are located is nearly flat lying. Dips are typically less than 3-degrees except for locations where faulting has occurred. Uplift is observed to increase near the Buffalo River National River where river bluffs and vertical cave entrances are consistent with uplift from tens to hundreds of meters compared with the same formations in nearby counties (Tennyson et al. 2008).*

In the following excerpt from Karst hydrogeologist, Tom Aley, in his comments on the draft EA, a telling difference is presented:

--- A TECHNICAL ASSESSMENT OF THE ADEQUACY AND ACCURACY OF THE DRAFT ENVIRONMENTAL ASSESSMENT FOR C&H HOG FARMS, NEWTON COUNTY, ARKANSAS, *TESTIMONY FOR PRESENTATION AT A PUBLIC HEARING AUGUST 27, 2015 AT JASPER, ARKANSAS.* Tom Aley, Arkansas Professional Geologist #1646, President and Senior Hydrogeologist, Ozark Underground Laboratory, Inc., August 18, 2015

The EA conducted for the FSA and SBA shows a gross lack of understanding of the intimate and integral interactions of surface water and groundwater in karst areas of the Ozarks. This demonstrates a lack of hydrogeological expertise relevant to conditions found in karst areas of northern Arkansas.

The EA fails to recognize that this entire hog farm operation and the associated manure disposal fields (with the exception of portions of Field 17) are located on top of a well developed karst aquifer within the Boone Formation *and possibly other deeper geologic units. Were it not for the karst development in the region, there would be much more water on the surface of the land within the Big Creek topographic basin than is the case.*

In karst areas the adjective "Dry" is commonly applied to streams and valleys where the proportion of surface water lost to the groundwater system is exceptionally great. The vicinity of the C&H Hog Farm is characterized by an exceptionally large proportion of the surface water being lost to the groundwater system as illustrated by the following:

- *Dry Creek, a stream with a topographic basin of 7.23 square miles, is located along the southern margin of the hog farm operations. Three of the manure disposal fields (Fields 15, 16, and 17) are topographically tributary to Dry Creek.*
- *Dry Branch, a stream tributary to the Left Fork of Big Creek at a point 11,600 feet west of Field 5.*
- *Dry Branch, a northward flowing stream tributary to Big Creek. The small community of Mt. Judea is on the ridge between Dry Branch (to the east) and Big Creek (to the west) and roughly parallels Big Creek. Dry Branch is within 2200 feet of Field 1 and is 3,500 to 6,100 feet from Fields 5, 6, 7, 9, and 10.*

The hog farm operation is bordered on the west, south, and east by streams named Dry Creek and Dry Branches. The hog farm operation is on the Mt. Judea 7.5 minute topographic quadrangle map. There are few if any other 7.5 minute quadrangle maps in the karst areas of north Arkansas that have three separate streams with the adjective "Dry" in the name. The hog farm is clearly in the middle of a well developed karst area.

Despite the eventual detailing of karst terrain and its many variable features wherein the CAFO and its fields are located, this EA arbitrarily goes on to recommend that no action be taken beyond adhering to conditions already in the faulty permit. A "harder look" worthy of government expenditures of taxpayer dollars would certainly have incorporated the AWMFH karst guidelines as conditions of a CAFO permit to protect the karst terrain of the Buffalo National River, its watershed, and underlying aquifers. This necessarily would have required the recommended action of seeking an alternate location for the C&H CAFO facility and its spreading fields since the entire operation is sited in the middle of the unstable, unpredictable, highly porous, faulted and fractured Boone formation of the Ozark Plateau karst terrain, which copious research and investigations have ascertained over and over again. Groundwater and surface water intermingle and are connected both laterally and vertically. Filtration is negligible. Flow directions are unpredictable without extensive and exhaustive subsurface studies. The site is documented as unsuitable for a Reg 5 permitted facility. Read what the Arkansas Pollution Control and Ecology Commission says about the BR watershed when it approved Reg 5.9.

The Arkansas Pollution Control and Ecology Commission (APC&EC) established a ban or moratorium on adding swine CAFOs to the Buffalo River watershed in 2014, recognizing the extreme limitations of karst terrains for the siting of CAFOs stating:

The Buffalo River's watershed is located in a karst region. Karst geology is comprised of an abundance of limestone. Limestone is typically porous rock that can form pathways resulting in rapid discharges into nearby ground and surface water resources…. Swine CAFOs and swine confined animal operations have a propensity to produce large amounts of manure and wastewater annually. The manure and wastewater from a swine CAFO and swine confined animal operations are typically land applied. Because General Permit ARG590000 does not distinguish between karst regions and other regions of the State, and because Commission Regulation No.5 and General Permit ARG590000 do not expressly limit swine CAFOs and swine confined animal operations from being established in the Buffalo River's watershed, the Commission finds that a proliferation of medium and large swine CAFOs and swine confined animal operations in the Buffalo River's watershed will pose an unnecessary risk to the public health, safety and welfare which requires a change in existing rules….

http://buffaloriveralliance.org/Resources/Documents/ADEQ%20Moratorium.pdf

Since the APC&E commission understands the mistaken siting of C&H, the opportunity for ADEQ now exists to rectify that mistake by denying the permit. It must act responsibly, admit the mistake of having once

erroneously and possibly through sheer ignorance of karst terrain, permitted a CAFO unsuitable for location in the pristine watershed of Arkansas' only National River. With the advent of this new Reg. 5 permit application ADEQ has the regulatory authority, opportunity, and power to do what should have been done in 2012. ADEQ can now adhere to karst terrain AWMFH guidelines. They were written and published for ADEQ to implement in just such scenarios. They give substantial grounds for denying the permit, and fulfilling Arkansas' duty and privilege to protect and preserve the Beautiful Buffalo River for all of us today and for the future generations of Americans.

Besides the arguments for denying the C&H permit on the basis of its inappropriate location, I will add that the economic value of ecotourism in the rural environment of the Buffalo National River watershed is the other elephant in the room that ADEQ ignores as a legitimate consideration. Almost a thousand people in this remote region make a living through tourism related employment. In 2016, over 1.7 million people visited Buffalo National River. Economic figures are not in for 2016, but they are for 2015. Economic figures for 2015 show that this translated to $62.2 million for BNR. These expenditures supported a total of 969 jobs, $24.5 Million in labor income, $40.2 Million in value added, and $72 Million in economic output in local gateway economies surrounding Buffalo National River. This is based on visitation of 1,463,304 visitors in 2015.
The World Economic Forum's 2015 Global Risk Report ranked water as the top societal risk facing the world in terms of potential economic impact. We are certainly seeing this on the local scale in the risk to the environment of the BR watershed. Water as a valuable economic resource is unequivocal for the state of Arkansas. The economic value of the water quality of the Buffalo National River for both public health and the tourism industry of state and local economies demands that ADEQ answer these environmental questions and deny the permit. Who will provide bottled water for Mt. Judea residents to drink when their wells test too high from pollutants? Why is ADEQ stretching its interpretations of its own regulations to permit a single operation, sited inappropriately, that employs under ten people in a risky business, when the income of almost a thousand residents in the area that is growing steadily through tourism related businesses relies wholly on the pristine water quality and beauty of the watershed?

Recently an article in the Newton County Times featured news that the state highway department had awarded a contract of almost $90,000 to improve a short .6-mile segment of extremely rural road in the Mt. Judea area, specifically #466 (see below) lying between the C&H CAFO and its increasing number of spreading fields. In addition to the stated inability of the $75,000 botched Harbor drilling investigation to accomplish its goals, and the cumulative $700,000 costs of BCRET's limited monitoring of just three unrepresentative spreading fields with no evaluation or interpretation of results for ADEQ to use in making its permit decision, how can ADEQ not support a reasonable rationale and acknowledge applicable scientific evidence for denying this boondoggle permit? Taxpayers are footing the bill for a road improvement to haul a private business's swine waste for disposal on unsuitable application field destinations. Will ADEQ's approval of the permit cause more increases in unnecessary taxpayer subsidies? Who chooses such road "improvements"? Does this take advantage of the limited allocations of state road improvement funds? Does Governor Hutchinson condone this expenditure for a road that benefits nobody but the C&H CAFO?
See the photographs below for the location of this "improvement" and its connection to C&H and its swine waste application fields:
In the first photo, C&H is on the bottom right. The second photo shows the route to added EC fields. The third shows a Google map of locations of the increased number of fields in the BR watershed. After just three years most of these fields will likely be at above optimum phosphorus levels, just as the original application fields are right now. With a Reg 5 permanent permit how will ADEQ even know when this actually occurs since reporting soil test results is only required every 5 years? Where will C&H find additional fields as fields become oversaturated with phosphorus? Will state government approve additional remote "improvements" to rural roads then to ease the continuing spread of C&H waste across more fields in the watershed? When will enough be enough to end the mitigations that obviously only serve to amplify the original permitting mistake? Isn't it time to deny the permit instead of making it permanent?


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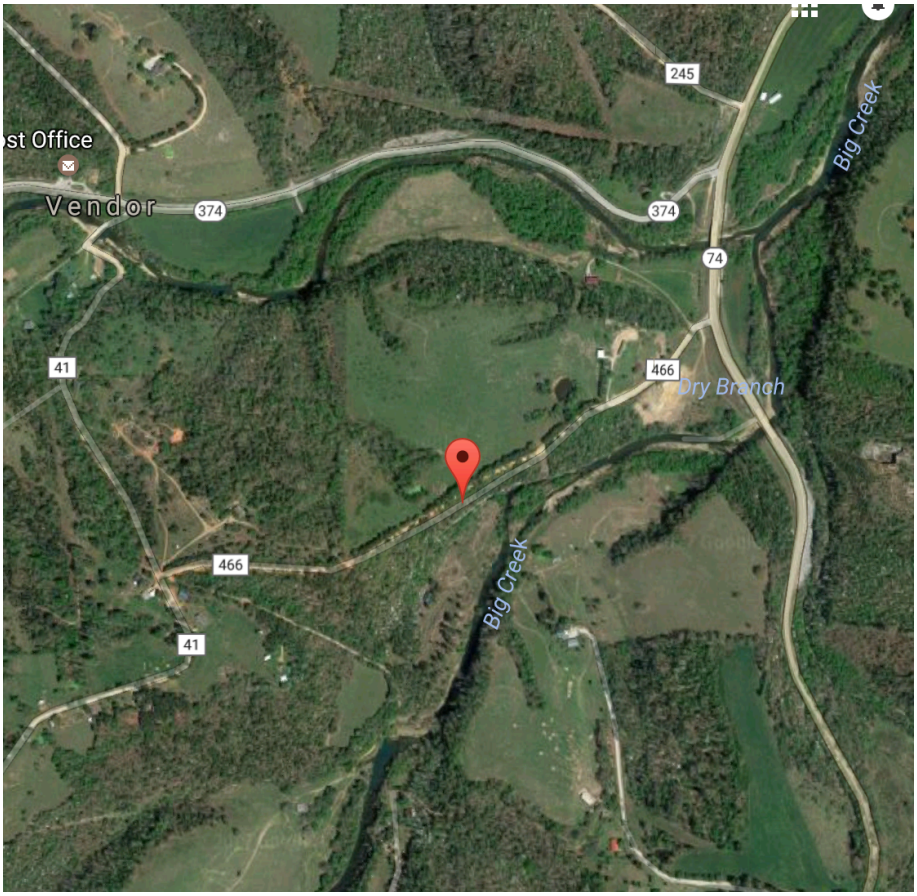
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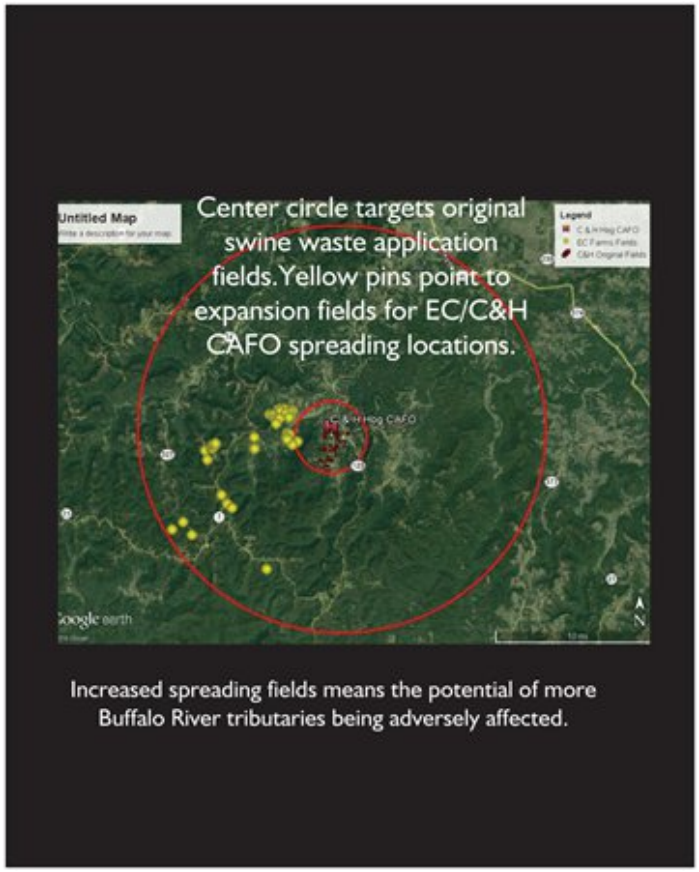

Why are the citizens of Arkansas paying for the unnecessary support of a private operation by state government agencies? Other local businesses are not benefiting from government funds in this way.

In light of scientific data that now show the operation is destined to fail, isn't it timely to deny the permit? High phosphorus levels don't dissipate easily or quickly. The Arkansas Phosphorus Index misrepresents the Soil Test Phosphorus levels, and results in over application on sensitive fields. Erosion from oversaturated thin soiled fields carries these phosphorus laden sediments and peak levels of nitrates during rain events into Big Creek and subsurface fractures. Low dissolved oxygen is killing off the prized Smallmouth Bass of Big Creek (See previous concerned comments from Arkansas Game and Fish Commission.) Undeniably, karst terrain carries surface waters from application fields approved despite inaccurate agronomic uptake calculations to undetermined local drinking water wells, aquifers, streams and springs through fractures, voids and epikarst.

Does ADEQ acknowledge that the C&H facilities and application fields are located atop karst terrain? Why was a detailed geologic investigation as specified in the AWMFH Section 651.0704(b) not required?
Why is ADEQ attached to continuing to permit this facility instead of protecting the environmental quality of the watershed for the many hard working residents and the millions of visitors who depend on its preservation and protection instead? Will ADEQ take this last and fitting opportunity to deny the C&H Reg 5 permanent permit based upon the available science from so many exhaustive studies, textbooks, handbooks, manuals, investigations, and its own acknowledgement and understanding of the unsuitability of the Buffalo River watershed karst terrain for a CAFO location as described in Reg 5.9?

ADEQ must recognize, acknowledge, and act upon the presence of karst and the harm that previous obfuscation, intentional or not, has caused through the original permitting of the C&H facility and its application fields, on Big Creek, and the Buffalo National River. In order to avoid adhering to the stringent measures for liquid waste disposal management in karst as described in the AWMFH, ADEQ has misled the public, the CAFO owners, JBS, Governor Hutchinson and our Arkansas state legislators. Honesty and integrity must guide ADEQ's present actions and require it to deny this Reg 5 permit based upon its unfortunate site in the highly variable karst terrain of the Buffalo National River watershed.

I also adopt the comments of the Buffalo River Watershed Alliance, including previous Environmental Assessment and major modification comments concerning endangered species, and those of Dane Schumacher, including supplements.

Sincerely,

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Subject:	[BULK] Comments on C & H Hog Farms, Inc. Regulation 5 Draft Permit - Number 5264-W
Date:	Friday, March 17, 2017 8:50:39 AM
Attachments:	Olesen Reg 5 comments 3-17-17.pdf

Please see my comments attached. I would appreciate a response that they have been received.

Thank you,

Marti Olesen