Regarding rule changes to Rules 5 and 6, docket numbers #19-0020R and #19-003-R

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The Ozark Society supports, and applauds, the changes to Rules 5 and 6 which would make permanent the current moratorium on medium and large swine CAFO’s in the Buffalo River watershed. This is a proper and much needed protection of our first national river.

In addition, we make four observations:

1. Statistical evidence from the Big Creek Research and Extension Team (BCRET), USGS, and the Buffalo River National Park (BRNP) shows significant increases in nutrient loads in Big Creek in the 2.5 mile stretch of Big Creek as it passes C&H hog farm, and almost continual exceedance of acceptable E. coli levels on Big Creek during the last 5 years. The evidence is strong that C&H hog farm is the major contributing factor. See below.
2. It is important that monitoring of the C&H farm continue for enough time (three years) after closure so that the impact of a medium swine CAFO, operated under the Arkansas Phosphorus Index (API) and current nutrient management plans (NMP), can properly be compared to “normal” non-intensive grazing management which presumably will continue after closure.
3. That dye testing, core drilling, and other engineering tests (e.g. permeability) be done at the lagoon sites in order to ascertain, even after the fact, the possible effects of karst on ground water at this particular site.
4. The C&H hog farm, like all CAFO’s, subjects its pasture land to a very intensive nutrient load – the waste of one million lbs of hogs (the impact of 5,000+ people) on one square mile of land. About 6,900 gallons a day. But at the USGS monitoring point below the farm at Mt. Judea, this effect is diluted by stream flow from 40 other square miles in the Big Creek drainage, mostly forest with some lower intensity grazing. Still, even with this dilution, the nitrate concentration in Big Creek goes up 116% while passing the farm. When Big Creek merges with the Buffalo River itself, the excess nitrate is further diluted with 395 square miles of upstream flow. But while the intense nutrient discharges on a single one square mile CAFO might be reduced somewhat by dilution and denitrification, dilution is not a pollution solution. Several medium or large CAFO’s on each tributary could overwhelm the river, like on the Illinois River – a moratorium is a primary step to protect Buffalo River water quality.

Statistical Evidence (in brief):

**Big Creek Nitrate Concentrations More Than Double in Passing C&H**

**Stream eutrophication risk increases as nitrogen and phosphorus levels increase**

*The graph below clearly shows nitrate levels in Big Creek below the farm are significantly higher than before the creek encounters the farm (p level < 10-30). Nitrate levels are not expected to show a longitudinal change if farm practices are stable because nitrate is water soluble and there is not much year-to year storage in fields. None-the-less, the regression lines suggest a rate of increase downstream (Bl) that is three times the rate upstream (Red). The high variation in concentrations (noise in the data) reflects biological activity in the stream, groundwater pollution and seasonal discharge changes in Big Creek (see next page).*

Nitrate Concentrations

 Mean Median Geomean

Above C&H 0.123 mg/L 0.110 0.105

Below C&H 0.266 0.252 0.235

% increase 116 % 129 % 124 %

**Nitrate Response Curves to Discharge in Big Creek**

**Reflects Groundwater Pollution Levels**

As observed on the previous page, nitrate concentrations in Big Creek below C&H are much higher than above the farm (116% higher), but the above graph shows that the difference is flow (discharge) dependent. The upstream regression curve is essentially flat with little change between high flow and low flow (R2= 0.0235). While the downstream regression curve is both higher and steeper (R2 = 0.2098). Even so, this regression curve does not entirely capture the steep change when flow is low (< 20 cfs). The stream responses are different for a reason.

Groundwater flow predominates during low flow in Big Creek (for instance see, “Coupling High-Frequency Stream Metabolism … Downstream Nitrate Delivery,” Andrew Sharpley, et al, Environmental Sci. Technol. 2018, 52, 13798-13717). Thus, the groundwater nitrate levels adjacent to C&H are considerably higher (~ 0.4-0.5 mg/L) than above the farm (~0.12 mg/L). Possible sources of this excessive nitrate are the spread fields along Big Creek, leaky lagoons etc. at C&H, and the pervious karst. David Peterson, drpdrp@windstream.net, (2019)

**Groundwater Contamination at the C&H House Well**

The C&H “house well” is a deep well that serves as a water source for the farm. It is close to the barns. The graph below shows a steady increase in nitrate levels since 5/1/2014 indicating a nearby source of nitrate leaking into the well – perhaps the ponds leak, there is reoccurring surface spillage that eventually permeates the immediate area or there is some other explanation. In general, liquid waste lagoons have been found to leave a cone of contamination under the ponds after they are closed.

*The steady increasing trend in nitrate levels implies a long term source, which may be contaminating a larger area. Nitrate is mobile especially in Karst. The R2 = .52 indicates that the regression curve on the graph explains 52 percent of the variation in the data. In comparison, the mean surface water level of nitrate in Big Creek is:*

 *Above C&H Below C&H House Well (2019)*

*Mean = 0.123 mg/L 0.266 ~ 0.7*

Surface water in the ephemeral stream might contribute nitrate contamination in the well.

**High Nitrate & Phosphorus Levels in the Ephemeral Stream**

The ephemeral stream drains a steep draw directly south of C&H. It is short and flashy – dropping 409 ft in one mile and drains 0.17 square mile containing 36 acres of pasture (USGS StreamStats).

The C&H barns and lagoons sit on a ridge. In extended dry weather there is no surface flow. But the surface flow of nitrates is very high for the Buffalo River Tributaries (over 1 mg/L).

Likewise, phosphorus levels spike well above levels contributing to eutrophication (over 0.1 mg/L)

**Mean Nutrient Levels in Surface Water**

 **Nitrate Phosphorus**

**Above C&H, Big Creek 0.12 mg/L 0.036**

**Below C&H, Big Creek 0.27 0.044**

**Ephemeral Stream 0.85 0.071**

**Nutrient Management Plans for C&H Hog Farm Recommended NO Phosphorus for 2015-2019, But They Applied At High Rates Anyway**

Nutrient Management Plans (NMP) are required recommendations for nutrient applications for CAFO’s in Arkansas. A NMP can:

- Alert the farmer that applications of phosphate fertilizer (P) are not needed and therefore would be a waste of money, which no *real* farmer wants to do.

- Prevent build-up of soil phosphate from excessive manure loading (legacy phosphate) which increases P runoff into streams (see graph below).

**Field 7 at C&H is a classic example of a legacy P problem.** Despite having field P levels of 330 lbs/acre which is many times agronomic needs (20-30 lbs/acre), C&H applied 258 more lbs/acre in 2018. Why? Because C&H is mainly paid to get rid of manure, not farm, and field 7 is close to their barns, the cheapest option. Other C&H fields show similar problems.

**Legacy P leads to higher P runoff into streams and eutrophication.**

*The graph shows that as soil P levels increase (x axis), runoff of dissolved P increases (y axis). Andrew Sharpely, et al, “The national phosphorus project...” Pub. No 273. IAHS Press, 2003 [Note: the graphical presentations as they appeared do not match the given formulas, but the gist is correct]*

“The past three decades have witnessed a dramatic increase in the role of diffuse phosphorus (P) pollution in eutrophication of surface waters… Growing evidence indicates that a major reason … is the chronic release of P from ‘legacy sources’ … which may impair future water quality, over time scales of decades, and perhaps longer.” Andrew Sharpely, et al, “Water Quality… Legacy Phosphorus,” Environmental Science and Technology, 2013

**E. coli Problems on Big Creek**

*During the primary contact period (April – Sept.) streams are generally declared to be impaired for geomean levels above 104 colonies/100mg (over 5 successive readings). These yearly geomeans indicate that Big Creek has been generally impaired, especially compared to the main stem of the Buffalo River. There is an apparent significant upstream E. coli source on Big Creek which has not been studied.*

All data is from BCRET, USGS, or BRNP. Analysis by David Peterson, PhD mathematician.