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June 22, 2018

Teresa Mills
Executive Director
Buckeye Environmental Network
2319 Parkridge Court
Grove City, OH 43123

Dear Ms. Mills:

I have reviewed the Ohio Department of Natural Resources Division of Oil and Gas Resources Management (DOGRM), Radiation Safety Section Interoffice Memorandum, prepared by Chuck McCracken, Manager of the Radiation Safety Section on July the 26th, 2017 at the request of Richard Simmers, Chief, Division of Oil & Gas. This memo clearly and irrefutably shows that AquaSalina deicing brine is not fit to be sold to the public as it contains levels of radioactivity that pose significant risks to public health and the environment.

This report evaluated the results of radiological testing of samples collected from a consumer product, AquaSalina, produced by Nature's Own Source. The product is sold as a deicing liquid that is produced from radioactive oil and gas industry waste. This report makes clear the public health risks that this product poses for consumers and for the environment. Unfortunately, the recommendations of the Radiation Safety Section of the DOGRM do not go far enough to protect the public and the environment from the high levels of radiation found in this consumer product. The testing done by DOGRM found the average level of radiation in the ten samples collected from around the state to be 346 times greater than the U.S. EPA Drinking Water standard for combined Radium-226 and Radium-228. The concentrations of combined Radium-226 and Radium-228 ranged from a low of 1,395 picocuries per Liter (pCi/L) to a high of 2,491 pCi/L. The average concentration was 1,731 pCi/L.[1] The U.S. EPA Drinking Water standard for combined Radium-226 and Radium-228 is 5 pCi/L. The highest concentration found was almost 500 times this standard. This sample was taken from a container of AquaSalina purchased from a hardware store in Hartville, OH.

[1] DOGRM calculated an average concentration of combined Radium-226/228 of 1,579 pCi/L after deleting the highest concentration found without stating their rationale for doing this. Perhaps their rationale was to consider the highest reading as an outlier. Whatever their reason, it is inappropriate to do this because of the small number of samples. The analysis in this letter report includes the results of all samples including the highest reading.

In addition, the concentration of combined Radium-226 and Radium-228 in all samples exceeded the environmental discharge limit of 120 pCi/L established in the Ohio Administrative Code 3701:1-38-12, Appendix C, Table II. The average concentration of combined Radium-226/228 was more than 13 times the administrative code limit, with a range from 11.6 to 20.8 times greater than this limit.

DOGRM staff collected samples of the liquid deicing brine, AquaSalina, produced and sold to consumers by Nature's Own Source. A total of 14 samples were collected from 6 locations in Ohio. Four of these samples were background samples, two of which were untreated tap water and two were tap water mixed with halite solution. The remaining 10 samples of the AquaSalina product were collected from 5 locations. Eight of these samples (including 2 duplicates) were collected from 3 different production facilities where samples were collected as a pre- and post-production liquid product. The final two samples were collected from two stores where the finished AquaSalina consumer product was purchased.

The brine used in Nature's Own Source's AquaSalina product is treated radioactive oil and gas industry waste. The company's treatment process appears to increase the concentration of combined Radium-226/228 in the final product. All three post-treatment samples collected from Nature's Own Source production plants had substantially more radiation than the pre-treatment samples indicating that the addition of the radioactive oil and gas industry waste was the primary source of the radiation. The increase in combined Radium-226 and Radium-228 ranged from 11% to 92% in these three samples as shown in the DOGRM memorandum. Left untreated, the waste produced as a by-product of the oil and gas activity would be classified as a Naturally Occurring Radioactive Material (NORM). However, the treatment process used by Nature's Own Source to manufacture AquaSalina increases the radioactivity of the material resulting in a Technologically Enhanced NORM, or TENORM.

DOGRM wrongfully dismissed the potential health risks these findings pose by arguing that "it is unlikely that radiation exposure to Ohioans from road spreading of vertical brine would exceed the 100 mrem/year [millirems per year] public dose limit" established by the U.S. Nuclear Regulatory Commission. This conclusion is inappropriate because it is based on a study conducted by the Pennsylvania Department of Environmental Protection (PA DEP) in May 2016 which may or may not reflect similar radiation levels and exposure conditions. Unfortunately, the details on how the exposure calculations were estimated are not included in the DOGRM report.

DOGRM did prepare a follow-up calculation in July of 2017, using the maximum concentration of combined radium found in the AquaSalina samples to calculate an estimated dosage of radiation a recreational Ohio citizen would experience from roads treated with the

spreading of the radioactive brine product. This analysis did find that radioactive exposures were twice as high as in the PADEP study, as DOGRM simply adopted the PA DEP exposure estimates without providing any details on how the exposures were determined. For example, no details are provided on how the recreational user is exposed including by what routes of exposure, how often, over what period-of-time, via how many routes of exposure, or whether cumulative exposures were taken into consideration. These details have potentially huge variability. Furthermore, no specific reference to the PA DEP report is provided.

A paper published in the scientific peer-reviewed journal *Environmental Science & Technology* in May 2018 by researchers at Penn State University evaluated the potential environmental and human health impacts of spreading oil and gas waste on roads for deicing and dust suppression. The findings in this paper are quite relevant to the questions raised about the risks posed by the sale of AquaSalina for deicing purposes. Over the course of six years of research, the authors of this paper found that radium was not fully retained by the roads where it was applied, and that the majority of contaminants (the authors looked at chemical as well as radioactive contaminants) were absorbed into runoff, entering groundwater, lakes, and streams where it could impact the environment and human health. The median concentration of radium in the commercial wastewater evaluated in this study was only 1,230 pCi/L, significantly less than the average concentration found in the commercially available AquaSalina samples analyzed by DOGRM staff.[2]

The researchers commented that the "release of radium, a known human carcinogen, is a potential threat to human health. In Pennsylvania, we found that radioactivity associated with radium released to the environment via road spreading exceeds the radioactivity of radium released by spill events or waste water treatment plants." The authors found that spreading oil and gas waste brine releases more radiation to the environment than typical oil and gas activities including all other wastewater disposal options. They estimated that spreading oil and gas brine released over four times more radium than oil and gas waste treatment facilities and over 200 times more radium than oil and gas spill events. The authors concluded that oil and gas brine that is applied to roads should contain less than 60 pCi/L radium and recommended that standards be developed for oil and gas waste water that would be spread on roads to "help reduce the potential toxicity concerns associated with this problem."

It is clear from this paper that these researchers are very concerned about the public health and environmental risks posed by spreading of radioactive brine as a deicing agent or as a dust suppressant. This paper provides hard scientific evidence that was not previously available that spreading oil and gas wastewater is a potential threat to human health and

[2] Radium in this paper is identified only as "radium" and is not separated into radium-226 and radium-228.

aquatic life and that the radium concentration in the waste water should not exceed 60 pCi/L.[3]

Without details on the exposure estimates used by DOGRM to evaluate public health risks, it is not possible to independently evaluate how this estimate was made. It is important, to note, however, the ease with which AquaSalina can contaminate watersheds, recreational areas, and drinking water supplies if its continued use and application is allowed. The inherent purpose of the product is to lower the freezing point of water, either preventing liquid water from freezing or making it easier for solid water to melt. The intended use of this product brings huge volumes of water into direct contact with highly radioactive waste material before it flows off and joins the greater watershed. Streams, rivers and lakes used for recreation, fishing, and ultimately for drinking water, can be adversely impacted by this product that contains high levels of radioactivity, increasingly so as more consumers apply this product. It is also problematic that AquaSalina is not only used for deicing roadways, but it can also be used by consumers on sidewalks, driveways, and steps increasing the risk of tracking the radioactive waste into residential homes.

The recommendations by DOGRM call for more testing, which certainly makes sense, especially in light of the recent findings by the researchers at Penn State University. The DOGRM recommendations, however, fail to require the company to take any action to address the uncertainty of the public health and environmental risks that exist when using this product as a deicing agent. Consequently, the public will continue to be unaware of the risks using this product poses not only to human health but to the environment. Consumers will also be needlessly exposed to high levels of radiation including to radon gas, a decay product of radium, when they open the packaging of AquaSalina.

The state of Ohio would be derelict in its duty to protect the public and the environment from the high levels of radiation found in this consumer product if it takes no further action. At a minimum, more testing is needed, and further sales of this product should be halted until additional testing information can be acquired and evaluated.

I hope these comments are helpful. Feel free to contact me if you have any questions or need further clarification.

Sincerely,

Stephen Lester
Science Director

[3] The full paper is "Environmental and Human Health Impacts of Spreading Oil and Gas Wastewater on Roads, Tasler, TL, Burgos, WD, Piotrowski, P, Castillo-Meza, L, Blewett, TA, Ganow, KB, Stallworth, A, Delompre, M, Goss, GG, Fowler, LB, Vanden Heuvel, JP, Dorman, F and Warner, NR., *Environmental Science & Technology*, DOI: 10.1021/acs.est.8b00716. The paper can be found at https://pubs.acs.org/doi/10.1021/acs.est.8b00716.