Memo of Support
Connecticut General Assembly Environmental Committee
Public Hearing March 13, 2017

HB 6329 AN ACT CONCERNING HYDRAULIC FRACTURING WASTE IN CONNECTICUT To permanently prohibit the storage, disposal, handling and use of hydraulic fracturing waste in Connecticut.

Grassroots Environmental Education commends the introduction of HB 6329 and strongly supports this critically important legislation that will protect the health and safety of Connecticut residents and the state's natural resources. We urge inclusion of the following important changes to strengthen the bill:
1) Definition of fracking waste should also include all relevant forms of oil and gas extraction, production and storage waste including liquid or solid waste or its constituents generated as a result of natural gas and oil extraction activities which may consist of water, brine, chemicals, naturally occurring radioactive materials, heavy metals or other contaminants; leachate from solid wastes associated with natural gas and oil extraction activities; any waste that is generated as a result of or in association with the underground storage of natural gas and liquefied petroleum gas well storage operations; any products or byproducts resulting from the treatment, processing or modification of any of the above wastes. 2) Provision to be included in bids and contracts related to the construction or maintenance of all publicly owned roads or real property within the state regarding purchase or acquisition of materials or retention of services. 3) Inclusion of penalties for each violation of law e.g. fine of $25,000 per violation for the sale, application and/or acceptance of natural gas waste or oil waste (Bans enacted in New York counties and New York City include such penalties)

Grassroots Environmental Education is a science-based, environmental health nonprofit, providing public education on environmental health issues and practical solutions for local and state governments, health care providers, school systems, environmental and health organizations nationwide. Grassroots works directly with a network of leading medical and scientific experts in the field of environmental health to bridge the gap between emerging science and public understanding through evidence-based tools and educational programs.

Highly contaminated radioactive fracking waste byproducts and their constituents continue to pose an urgent public health threat due thousands of oil and gas wells and other production, storage and processing operations in neighboring states. Proliferation of radioactive waste byproducts and their constituents could result in irreversible damage and place significant financial and health burdens on taxpayers. Due to the huge volume of fracking waste produced, industry is increasingly interested in repurposing waste byproducts by grinding and blending them with other materials for roads and construction. Other companies are processing or dewatering the waste and using the salts for icemelt. Significant gaps and serious concerns remain regarding the safety of processing fracking waste resulting in end products that could be even more hazardous containing excessively high levels of radioactive materials and other contaminants. [1]

In recognition of this urgent public health threat, to date, public officials are taking precautionary steps to protect the health and safety of residents and their water supplies. To date, ten Connecticut towns have already enacted fracking waste bans and more than a dozen other towns are actively engaged in the process. In New York fifteen counties have enacted fracking waste bans including Westchester, Nassau, Suffolk, Rockland, Putnam, Ulster, Orange, Albany, Schoharie, Oneida, Tompkins, Cayuga, Clinton, Onondoga and Erie Counties. In August 2016, New York City enacted a comprehensive fracking waste ban that now protects the health and safety of its eight and a half million residents and its natural resources. The State of Connecticut must follow their lead without further delay.

Hydraulic fracturing, also known as " hydrofracking", is a technology used for oil and gas extraction from shale formations which involves the injection of millions gallons of fresh water mixed with hundreds of chemicals and sand forced under high pressure into the well bores to crack open the shale. Ten to forty percent of this highly toxic mixture is returned to the surface with the oil or gas and additional contaminants including volatile organic compounds (VOCs) such as benzene, a carcinogen linked with blood disorders, heavy metals (e.g., arsenic, lead, chromium, mercury), brine 8 times saltier than seawater, and radioactive elements including Radon and Radium which are known carcinogens.

The extraction process produces two types of wastewater. Flowback water is the chemically treated fracking fluid that returns to the surface shortly after a fracking operation. Produced water, also known as formation water or fracking brine, is the fluid that comes out of the target drilling formation along with the oil or gas. The process also produces tons of semi-solid waste in the form of drilling muds, sludge and cuttings.

Produced water or fracking brine has high levels of chlorides and bromides and contains toxic heavy metals. Produced water and semi-solids (drill cuttings, sludge and drilling muds) can contain high levels of Radium-226 and Radium-228. Radium-226 has a half-life of 1600 years and is linked to anemia, cataracts, bone, liver and breast cancers and death.[2] It also emits gamma radiation that can travel fairly long distances through air, raising risks for cancer in communities. Radon, a decay product of Radium is considered the leading cause of lung cancer in non-smokers with no safe level of exposure. [3] There are approximately 21,000 deaths per year attributed to Radon. [4]. Radioactive materials including Radium and its decay product, Radon, are known to be significantly higher in the Marcellus Shale. [5]

Radon is an odorless, tasteless and colorless gas formed by the radioactive decay of Radium, Uranium and Thorium and has a half-life of 3.8 days. Polonium and Lead, the decay products of Radon, have a half-life of 138 days and 22.3 years respectively and are solids known to attach to dust particles. Lead is a neurotoxin with no safe threshold level of exposure and is linked with cognitive deficits and attention deficit/hyperactivity disorder in children and low birth weight. It is linked to elevated blood pressure in adults and is an important risk factor for renal failure. [6] U.S. EPA classifies Lead as a probable human carcinogen while Polonium is considered a radioactive carcinogen. Radon absorbed by the lungs decays further into Polonium and Lead damaging lung tissue. Lead and Polonium can also damage DNA and RNA. [7] The exposure pathway of all three of these radioactive materials is through inhalation and possible ingestion.

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[1] Earthworks, "Wasting Away: Four States' Failure to Manage Gas and Oil Field Waste from the Marcellus and Utica Shale", April 2015
[2] http://www.atsdr.cdc.gov/toxprofiles/
[3] http://www.epa.gov/radon/
[4] Ibid.
[5] E. Rowan, M. Engle, 2011, Radium content of oil and gas field produced waters in the northern Appalachian Basin, U.S. Geological Survey Report 2011-1135
[6] Textbook of Children's Environmental Health, Edited by P. Landrigan, R. Etzel, Oxford University Press, 2014
[7] Ibid.

Data from the Pennsylvania Department of Environmental Protection (DEP) reveals that from 2010-2014, other states have accepted hundreds of thousands of tons of fracking waste byproducts, including wastewater and drill cuttings, from fracking operations in Pennsylvania into landfills. [8] Leachate from those landfills is accepted at wastewater treatment plants ill equipped to process hazardous chemicals and radioactive materials in oil and gas drilling waste byproducts.

State and federal laws exclude oil and gas waste byproducts from the definition of hazardous waste even though it exceeds criteria for hazardous classification. These exemptions eliminate hazardous waste tracking requirements for handling, storage, treatment and disposal. [9]

In his report, **Consideration of Radiation in Hazardous Waste Produced from Horizontal Hydrofracking**, [10] Ivan White, a staff scientist for the congressionally commissioned National Council on Radiation Protection charged with the protection of military and civilian populations, expressed concern regarding the cavalier attitude toward human exposure to radioactive material and stated that radioactivity should never be released into the environment in an uncontrolled manner because of the potential for exposure from the many potential pathways that exist. [11] Radioactive materials can migrate through air exposing crops and plants, soil, animals, livestock, food supplies and humans. Radioactive contaminants can also migrate through soil and surface or groundwater exposing sand and sediment, aquatic animals and plants, fish, irrigation water, vegetation, animals, livestock, food supplies and humans. He further stated that the type of radioactive material found in the Marcellus Shale formation and brought to the surface by hydrofracking is the type that has a long half-life and could easily bio-accumulate over time delivering a dangerous radiation dose to potentially millions of people long after the drilling is over. [12]

According to a U.S. Geological Survey study, levels of total Radium tested in the wastewater from eleven active New York vertical gas wells averaged over 8,400 pCi/L exceeding the EPA's maximum contaminant level for drinking water (5 pCi/L for combined Radium-226 and Radium-228) by more than 1,000 times. [13]

In a 2011 review of federal, state and company records, the New York Times reported that in a sampling of wells studied in Pennsylvania and West Virginia, reported levels of Radium or other radioactive elements exceeded EPA's maximum contaminant level for drinking water by 100 times to more than 1,000 times. [14]

The TENORM report released by the Pennsylvania Department of Environmental Protection (PA DEP) indicates significant radioactivity levels in waste associated with gas development and production exceeding EPA's maximum contaminant levels by more than several thousand times. Radium-226 levels in flowback samples were measured between 551 pCi/L and 25,500 pCi/L while Radium-228 levels were measured between 248 pCi/L and 1,740 pCi/L. Radium-226 levels in produced water or brine samples were measured between 40 pCi/L and 26,600 pCi/L while Radium-228 concentrations were measured between 26 pCi/L and 1,900 pCi/L. [15]

Naturally occurring radioactive materials (NORM) are distributed through geologic formations and exist undisturbed in nature whether at the earth's surface or below the surface. However, when NORM are disturbed and transported by human activity to human environments they are considered

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8 http://www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968
9 http://www.earthworksaction.org/files/publications/FS_LoopholesForPollutersNEW.pdf
10 http://www.grassrootsinfo.org/pdf/whitereport.pdf
11 Ibid.
12 Ibid.
13 E. Rowan, M. Engle, Radium content of oil and gas field produced waters in the northern Appalachian Basin, U.S. Geological Survey Report 2011-1135
14 http://www.nytimes.com/interactive/2011/02/27/us/natural-gas-documents-1-intro.html?ref=us
15 http://www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968

technologically enhanced naturally occurring radioactive materials (TENORM) increasing potential of exposure that may result in concentration levels above background levels. [16] The term NORM is often misused when applied to radioactive material introduced into human environments by oil and gas extraction, production and storage operations. Typically, radioactive oil and gas drilling waste byproducts are improperly classified as NORM instead of TENORM that have special disposal requirements.

In a recent peer-reviewed study at University of Texas and University of North Texas Health Science Center, School of Public Health, Department of Environmental and Occupational Health, [17] soil and water (sludge) obtained from reserve pits used in unconventional natural gas activities were analyzed for the presence of technologically enhanced naturally occurring radioactive material (TENORM). Samples were analyzed for total gamma, alpha, and beta radiation, and specific radionuclides. Laboratory analysis confirmed elevated beta readings. Specific radionuclides present included Thorium-232 and Radium-226 radionuclides. According to the authors, many of the radionuclides found in oil and gas drilling waste and their constituents are not addressed by regulatory guidance documents and negligible information is provided in determining potential of cumulative effects of simultaneous exposure to several radionuclides or potential human and animal health impacts. The study also indicated that the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC) do not have established federal regulations that directly govern NORM waste from the oil and gas industry. [18]

The authors describe synergistic catalysis, a relatively new field of chemical study concerned with the ability of synthetic chemicals to spontaneously form new chemical bonds when exposed to sunlight, water, air and radionuclides or other chemical catalysts. [19] The potential health risks of resulting compounds are unknown and pose a public health threat as mixtures of hydrofracking chemicals, interaction of chemicals with radioactive materials and reaction of chemicals with other contaminants under heat and pressure cause unknown synergistic reactions. [20]

Regulators and operators may be grossly underestimating radioactivity levels in oil and gas waste by using improper methods to detect radiation. Dr. Julie Weatherington, a soil scientist, describes the inability of casual readings of radioactivity of oil and gas waste byproducts for its proper assessment. She points out Radium-226 and Radium-228 emit Alpha and Beta but that the Gamma emitters cannot be measured in the field. [21] A sample must be taken and a minimum of 21 days waiting period is required in order to get an ingrowth curve measuring Lead and Bismuth, decay products of Radium. [22] At that time, gamma spectrometry must be conducted in the lab to assess the gamma emitters in the fracking waste sample.

Dr. Michael Schultz and his colleagues at the University of Iowa, in their peer-reviewed study, [23] tested the accuracy of the Radium measurement technique used and recommended by the U.S. EPA for analyzing radioactivity in drinking water since studies have shown that the drinking water method is unsuitable for solutions with high radioactive concentrations characteristic of fracking waste byproducts. Several methods were used to assess Radium isotopes in a sample of gas drilling waste from the Marcellus Shale. One method, the co-precipitation technique used by the EPA recovered less than 1 % of Radium-226, the most abundant Radium isotope in the gas drilling waste byproduct sample. Another method known as gamma-ray spectroscopy, the gold standard for Radium analysis, detected 91% of

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[16] http://www.ncbi.nlm.nih.gov/pubmed/23552651
[17] Ibid.
[18] Ibid.
[19] Ibid.
[20] Ibid.
[21] https://www.youtube.com/watch?v=J9VIUa9AIB4 https://www.youtube.com/watch?v=s0zI9lX2EwU
[22] Ibid.
[23] http://pubs.acs.org/doi/abs/10.1021/ez5000379?source=cen

the Radium. [24] The authors' findings indicated that the EPA method is ineffective for analyzing oil and gas drilling waste byproducts. Their subsequent study calls attention to the use of radium alone to predict radioactivity concentrations can greatly underestimate total radioactivity levels and that uranium and thorium decay series require scrutiny as well.[25]

The Pennsylvania Department of Environmental Protection (DEP) data noted a marked increase in radiation alarms at Pennsylvania landfills between 2009-2012 triggered by waste trucks from hydrofracking wells with over 1,000 of those radiation alarms coming from oil and gas drilling waste byproducts. [26]

Bill Hughes, chair of the Wetzel County Solid Waste Authority in West Virginia, reported that tests on water leaching from the Meadowfill landfill shows varying levels of radioactivity averaging 250 pCi/L in 2013 and at times spiking as high as 2,000 pCi/L, many times higher than the clean drinking water standard while another local landfill in Wetzel taking large amounts of hydrofracking waste also demonstrated significant levels of radioactivity. [27] Hughes acknowledged that radioactivity occurs in the drill cuttings and brine from the Marcellus gas wells.

Landfill disposal of radioactive waste from oil and gas extraction, production and storage operations could contaminate them for thousands of years. All landfill membranes fail eventually and leaching or flooding could result in contamination of nearby ponds, streams, or groundwater. Leachate from landfills is a frequent cause of groundwater contamination and its disposal cannot be safely handled by wastewater treatment facilities or via applications on farmland or other real property.

Fifty-nine scientists attested to the fact that wastewater treatment facilities are not designed to treat chemicals, contaminants and highly radioactive materials produced from hydrofracking operations. [28] High bromide levels in oil and gas waste byproducts are highly corrosive to equipment and can react during water treatment to form brominated trihalomethanes linked to bladder and colon cancers and are associated with birth defects. Once added to drinking water supplies, trihalomethanes are difficult to eliminate. [29]

According to another study conducted at Duke University, authors examined water quality and radioactivity of discharged effluents, surface waters, and stream sediments associated with a treatment facility site in western Pennsylvania. [30] Downstream from the treatment facility, concentrations of chloride and bromide were above background levels and Radium-226 levels in stream sediments at the point of discharge were 200 times greater than upstream and background sediments and above radioactive waste disposal threshold regulations posing potential public health and environmental risks of Radium bioaccumulation in areas of shale gas waste byproduct disposal. [31]

Agricultural areas are especially vulnerable to the immediate threat posed by radioactive oil and gas waste byproducts and their constituents. Mounting evidence reveals livestock illness and death from acute toxicity poisoning from harmful exposures to oil and gas drilling waste byproducts. Reproductive problems in cows and higher rates of stillborn and deformed calves have also been reported. [32]

Presence of highly radioactive materials and other contaminants on farmland and in food products can

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24 Ibid.
25 http://ehp.niehs.nih.gov/wp-content/uploads/advpub/2015/4/ehp.1408855.acco.pdf
26 http://triblive.com/business/headlines/3945499-74/gas-radiation-radioactivity#axzz3X9aXRbFF
27 http://www.publicnewsservice.org/2014-04-21/environment/marcellus-waste-radioactivity-in-water-leaching-from-landfills/a38864-1
28 http://www.psehealthyenergy.org/site/view/1035
29 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566350/
30 http://pubs.acs.org/doi/abs/10.1021/es402165b
31 Ibid.
32 http://www.psehealthyenergy.org/data/Bamberger_Oswald_NS22_in_press.pdf

cause irreparable damage and serious financial impacts. Protection of the quality and safety of food production is imperative for the health and safety of residents and to ensure consumer confidence in food production.

Vehicles transporting radioactive fracking waste byproducts increase the risk of human and animal exposure and contamination of water, air, soil and farmland when accidents, leaks, and spills occur. Due to lack of proper hazardous classification and tracking requirements, trucks hauling the waste have no special hazardous waste warning signs or emergency instructions placing first responders and residents at risk.

Truck accidents, spills, leaks and road spreading applications can expose drivers, passengers, pedestrians, animals and livestock to radioactive materials while contaminating nearby surface waters, residential areas, school properties and cropland. Radioactive particles may become airborne as trucks and passenger vehicles travel along roads and can be tracked on tires into driveways and garages and ultimately tracked in on shoes into homes. Rain and snowmelt carrying radioactive materials can run off road surfaces where it can migrate onto nearby property, farms and into streams, ponds and irrigation systems, leach into soil or seep into groundwater. These numerous pathways of exposure pose increased risk for human and livestock inhalation and ingestion of highly radioactive materials, and carcinogenic and endocrine disrupting chemicals.

Potential exposure to toxic chemicals and radioactive contaminants comes at a tremendous toll to human health and the economy. An updated and expanded analysis of the costs of environmentally mediated diseases in children nationwide by Dr. Leo Trasande, Associate Professor in the Department of Pediatric Environmental Medicine and Population Health at NYU Medical Center, found that the costs of childhood cancer, asthma, and neurological disorders had escalated from $54.9 billion in the 2002 analysis to $76.6 billion in 2008. Dr. Trasande states that the analysis re-emphasizes for policy makers the implications of failing to prevent toxic chemical exposures not only for the health of children but also for the health of the economy. [33]

Emphasis must be placed on primary prevention, eliminating hazards BEFORE children and adults are exposed. Disease and dysfunction triggered by toxins can be prevented and it is imperative that strong measures be taken to prevent harmful exposures to hazardous materials in oil and gas waste from extraction, production and storage operations. The potential for irreversible damage is far too great a socio-economic burden for any region to withstand. The mere perception of contamination could have far-reaching consequences.

Grassroots Environmental Education strongly urges the swift passage of HB6329 with full inclusion of the aforementioned edits to protect public health and safety and resources.

Grassroots is available to answer any questions you may have and provide further documentation.

Respectfully submitted by,

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33 http://content.healthaffairs.org/content/30/5/863.abstract