Our Ref: ABP-301908-18
P.A.Reg.Ref:

Your Ref:

An Bord Pleanála

Brendan Regan
Delvin Road
Gormanston
Co. Meath

8th November 2018

Re:
Greater Dublin Drainage Project consisting of a new wastewater treatment plant, sludge hub centre, orbital sewer, outfall pipeline and regional biosolids storage facility.
Townlands of Clonshagh, Dubber & Newtown, Fingal County & Dublin

Dear Sir,

An Bord Pleanála has received your submission in relation to the above mentioned proposed development and will take it into consideration in its determination of the matter.

The Board will revert to you in due course in respect of this matter.

Please be advised that copies of all submissions / observations received in relation to the application will be made available for public inspection at the offices of Dublin City Council and Fingal County Council and at the offices of An Bord Pleanála when they have been processed by the Board.

More detailed information in relation to strategic infrastructure development can be viewed on the Board's website: www.pleanala.ie.

If you have any queries in the meantime please contact the undersigned officer of the Board. Please quote the above mentioned An Bord Pleanála reference number in any correspondence or telephone contact with the Board.

Yours faithfully,

Kieran Somers
Executive Officer
Direct Line:01-873 7107

PA09.LTR

Tel (01) 858 8100
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64 Marlborough Street
Dublin 1
D01 V902

Brendan Regan
Delvin Road,
Gormanston,
Co. Meath

16th October 2018

The Secretary.
An Bord Pleanala.
64 Marlborough Street.
Dublin 1.

RE: Planning Application Ref : 06F.PC 0152 (Greater Dublin Drainage Project)
An Bord Pleanala Ref: ABP- 301908 - 18

Dear Sirs and Madams,

Following receipt of copy of Mr. Kieran Somers letter to Ciaran O'Keeffe (Jacobs Engineering) dated 30th August 2018 and as a consequence, the extension of the period for submissions/observations until 18th October 2018; **I am pleased to reaffirm my strong objection to the construction of the Regional Biosolids Storage Facility at Newtown, Dublin 11 (just this segment of the Greater Dublin Drainage planning application).**
A building of this type is not required to store Biosolids when there is an option to incinerate this by-product of waste water treatment for energy, immediately and post production at the Covanta Incinerator at Poolbeg in Dublin and at the Indaver Ireland Incinerator at Carrenstown, Duleek, County Meath.

In the course of Irish Water's Public Consultation in November 2017 in connection with the construction of a proposed (at that time) Biosolids Storage Facility for the Greater Dublin Area; Indaver (Ireland) offered to take the Biosolids for Incineration. Obviously, Irish Water have decided not to take this offer on board.
Irish Water decided not to accept this offer, despite being made aware of increasing recommendations that Biosolids be incinerated instead of the spreading of Biosolids on farmland and forestry lands.

Biosolids are Biohazards a highly toxic by product of waste water treatment and the continuation of spreading this material on farmland, presents serious health risks to the population, our water supply and the food chain.
Ireland is heavily dependent on our food exports and the potential to compromise that dependency by continuing to spread Biosolids on Farmland is a very real threat to our economy.
European countries more aware of the dangers inherent in Biosolids are switching to incineration for energy as a means of disposal.

Furthermore at the Irish water Public Consultation in the Autumn of 2017, Irish Water failed to inform and provide accurate Indicative drawings or explanations for the proposed Regional Biosolids Storage Facility with **"Odour Discharge Flues."**

I include for your consideration support documentation (Enclosures listed below), outlining the toxins present in Biosolids and the dangers for Public Health and Safety and the Environment by continuing to Store and spread Biosolids on Farmland.

I request An Bord Pleanala to hold an **"Oral Hearing"** into this Project, in particular in respect of the proposed Biosolids Storage Facility at Newtown, Dublin 11 before any decision is finalised.

I understand that there is no requirement for an additional fee as the €50 fee for submissions/observations is already paid and I have received a receipt from An Bord Pleanala.

Yours Sincerely,

Brendan Regan
087 2556385
brendanregan@live.ie
16th October 2018

ENCLOSURES

1) Environment Protection Agency (EPA Ireland)
"EPA Research Report 200."

2) Water Technology Engineering Ltd., Yorkshire, Uk.
"Sewage Sludge, Humanure and Biosolids."

3) Pesticides and You Magazine. Volume 32 No. 3 Fall or Autumn 2012 (article)
"Biosolids or Biohazards"

EPA (IRELAND) 2017.

Research 200: Health and Water Quality Impacts Arising from Land Spreading of Biosolids

Authors: Mark G. Healy, Owen Fenton, Enda Cummins, Rachel Clarke, Dara Peyton, Ger Fleming, David Wall, Liam Morrison and Martin Cormican

Published: 2017 **ISBN:** 978-1-84095-698- **Pages:** 67 **Filesize:** 2,838KB **Format:** pdf

The aims of this study were to: (1) undertake a thorough literature review of the spreading of treated sewage sludge (biosolids) on land to include analysis of potential impacts on environmental and human health; (2) examine, under controlled conditions in the laboratory and field, the impact of the landspreading of biosolids (on grassland) on surface runoff/subsurface drainage/shallow groundwater of nutrients, solids, metals, pathogens and some specified emerging contaminants identified in the literature review, when spread based on N and P application rates; and (3) to model and conduct a risk assessment of potential hazards of human health concern.

Identifying Risks

Implementation of European Union Directives in recent decades concerning the collection, treatment and discharge of wastewater, as well as technological advances in the upgrading and development of wastewater treatment plants, has resulted in an increase in the number of households connected to sewers and an increase in the production of sewage sludge (the by-product of wastewater treatment plants). Recycling to land is currently considered the most economical and beneficial way for municipal sewage sludge management. However, despite the many potential benefits of recycling municipal sewage sludge to land, there are many risks, which include the presence of emerging contaminants in the sewage sludge that may enter the food chain, and the potential for surface runoff of contaminants into receiving waters. This project found that although the application of biosolids poses no greater threat to surface water quality than the land application of dairy cattle slurry, there is a possibility that many non-priority elements and emerging contaminants, for which no legislation currently exists, may be applied to land without regulation, and may accumulate in the soils and enter the food chain.

Informing Policy

Current legislation governing the land application of municipal sewage sludge to land considers certain priority pollutants and bio-essential elements. However, other emerging contaminants may be inadvertently applied to land. Regulations should be extended to cover non-priority elements, pharmaceuticals and personal care products (PPCPs). Non-priority elements are relatively inexpensive to measure, but PPCPs are prohibitively expensive as well as being continuously evolving. Wastewater treatment plants may be upgraded to include treatment of emerging contaminants, but the potential presence of known, as well as currently unknown parameters, raises concerns over the continued application of biosolids to land in Ireland.

Sewage Sludge, Humanure and Biosolids

The Dangers of Sewage Sludge 

Sewage sludge (Biosolids or Humanure) is the residue left after the sewage treatment process is complete. It is often dried and either incinerated, taken to landfill or used as an agricultural fertiliser. However, it is not a safe material, as research has recently found. It contains waste from industry, laboratories, hospitals, funeral parlours, in fact, all waste that is flushed down sinks and drains wherever they are.

The dangers fall into 3 main categories:

- Hormones and Synthetic Hormones
- Prion Contamination
- Toxin Contamination

Hormones and Synthetic Hormone Contamination

In 2012, Scientists at the University of Aberdeen studying sheep maintained on pastures fertilized with sewage sludge (treated waste derived from human sewage processing plants, often called Humanure) found a high incidence of abnormalities in the animals. The abnormalities are being attributed to the presence of man-made hormones, particularly as those found in the contraceptive pill, in the treated waste.

They found that exposure to the chemicals in sewage sludge or 'Humanure' as it is called in the UK, affected the structure or function of testes, ovaries, uteri, parts of the brain, and thyroid and adrenal glands of sheep foetuses. In adult sheep changes in bone structure, the testes and offspring behavior were observed.

The researchers explained that man-made chemicals known to be endocrine disruptors, found in such things as electrical equipment, building materials, plastics, adhesives, paints and vehicle exhaust, have long been considered a health hazard. However the synthetic hormones found in contraceptive pills, known as progestins, which mimic progesterone, either alone or combined with estrogen, and excreted in human waste pose a greater problem because they are not removed or destroyed by sewage treatment and find their way into the food chain.

"These chemicals are in our air, soil and water. Some are fat soluble and may accumulate in our bodies while others are water soluble and end up passing through us and being flushed down our toilets, entering our environment where they may affect other animals or enter our food chain re-exposing humans," said Dr Rhind at the British Science Festival 2012.

Toxin Contamination

There are 27 heavy metals found in sewage sludge. None of the toxic organic chemicals it contains are regulated, or even monitored. Not even priority pollutants, including pesticides, pharmaceuticals, and plasticizers are regulated in sewage sludge. May of these poisons are accumulative.

Sewage sludge has been spread on land for far longer in the USA than here in the UK. By the late 1990s, reports of adverse health effects started showing up in local newspapers across the United States and Canada. Skin lesions often developed in people who contacted the material. Residents near land application sites reported burning eyes, burning lungs, and difficulty breathing when exposed to dusts blowing from treated fields. People who couldn't afford to move away developed chronic infections and permanent scarring of the lungs. Some died.

In the 1990's, a dairy farming family claimed that hundreds of their cows died after sludge from an Augusta wastewater treatment plant was spread on their land in a program promoted by the U.S. Department of Agriculture. They claimed that the sludge contained high levels of heavy metals and other dangerous pollutants. This was denied for years by the Authorities. However, in February 2008, U.S. Southern District of Georgia Judge Anthony Alaimo ruled in favor of the dairy farmers, a family named McElmurray, that maintained the sludge contained dangerous pollutants like chlordane and metals such as thallium and arsenic. Alaimo said sludge application records from the city of Augusta were accepted by the USDA and EPA even though they were "unreliable, incomplete and in some cases fudged," and that when the dairy farmers showed federal officials evidence their land was contaminated, the evidence was ignored. Alaimo also wrote in his February ruling that "senior EPA officials took extraordinary steps to quash scientific dissent and any questioning of the EPA's biosolids program."

In 2014, one in six children suffers from some form of neuro-developmental abnormality. The causes are mostly unknown. Some environmental chemicals are known to cause brain damage and many more are suspected of it, but few have been tested for such damage.

The brain's development is uniquely sensitive to toxic chemicals, and even small amounts may negatively impact our academic achievements, economic success, risk of delinquency, and quality of life. Chemicals such as lead, mercury, polychlorinated biphenyls (PCBs), arsenic, and certain solvents and pesticides pose an insidious threat to the development of the next generation's brains. All of these chemicals are present in Biosolids. When chemicals in the environment affect the development of a child's brain, he or she is at risk for cognitive deficits, learning disabilities, more serious mental retardation, ADHD, autism, cerebral palsy, and other disorders that will remain for a lifetime. Please view this video with Proffessor Philippe Grandjean, 2013

It is our opinion that all spreading of sewage sludges, humanure and biosolids on agricultural land in the UK should be stopped until it is PROVED to be safe. The

Professor Fowler added, "Many of the changes we see are very subtle and not apparent in the living animal; nevertheless, they may be associated with disruptions of many different physiological systems and increased incidences of diseases and reproductive deficiencies such as those that have been reported in a variety of species, including humans. Embryos, foetuses and young animals appear to be particularly vulnerable.

"It's notable that incidences of breast and testicular cancer and of fertility problems in humans are increasing, while populations of animal groups as diverse as amphibians and honey bees are in decline."

Research into the fertility of sheep exposed to endocrine disruptors in the environment by Dr. Michelle Bellingham of the University of Glasgow found that abnormalities that could result in low sperm counts were found in the testes of 42% of the animals, which led her to suggest that the rise in the use of in-vitro fertilization in humans, particularly as a result of low sperm counts, is due to exposure to these chemicals in the environment.

The Aberdeen researchers remarked that, "We are using our sewage sheep studies as a tool to investigate the impact on physiological systems of long-term exposure, to low concentrations of mixtures of chemicals because in the real world that is what happens."

"One solution to the problems that these chemicals pose," they point out, "might be to simply stop using them.

"So what we must do is attempt to identify the most critical disruptors and their impacts and we are beginning to do that in Aberdeen with our sewage sludge studies. We believe there should be a gradual reduction in the use of disruptors identified as being particularly problematic."

More ominously, the scientists warn that, "If we do nothing, endocrine disruptors may not only impact on human health but all the ecosystems including those on which we depend -- if we compromise soil productivity and sustainability of our agricultural systems or cause imbalance in marine and freshwater ecosystems through damage to populations of top predators, ultimately, we threaten our own survival."

Prion Contamination

Typical wastewater treatment processes do not degrade prions. Prions are virtually indestructable rogue proteins that cause incurable brain infections such as Mad Cow disease and its human equivalent, variant Creutzfeldt-Jakob Disease, are difficult to inactivate, resisting extreme heat, chemical disinfectants, and irradiation. Until now, scientists did not know whether prions entering sewers and septic tanks from slaughterhouses, meatpacking facilities, or private game dressing, could survive and pass through conventional sewage treatment plants.

However, recent simulated wastewater treatment shows that prions can be recovered from wastewater sludge after 20 days, remaining in the "biosolids," a byproduct of sewage treatment sometimes used to fertilize farm fields.

evidence that it is not at all safe is growing and that has been the opinion of WTE Ltd. from the beginning.

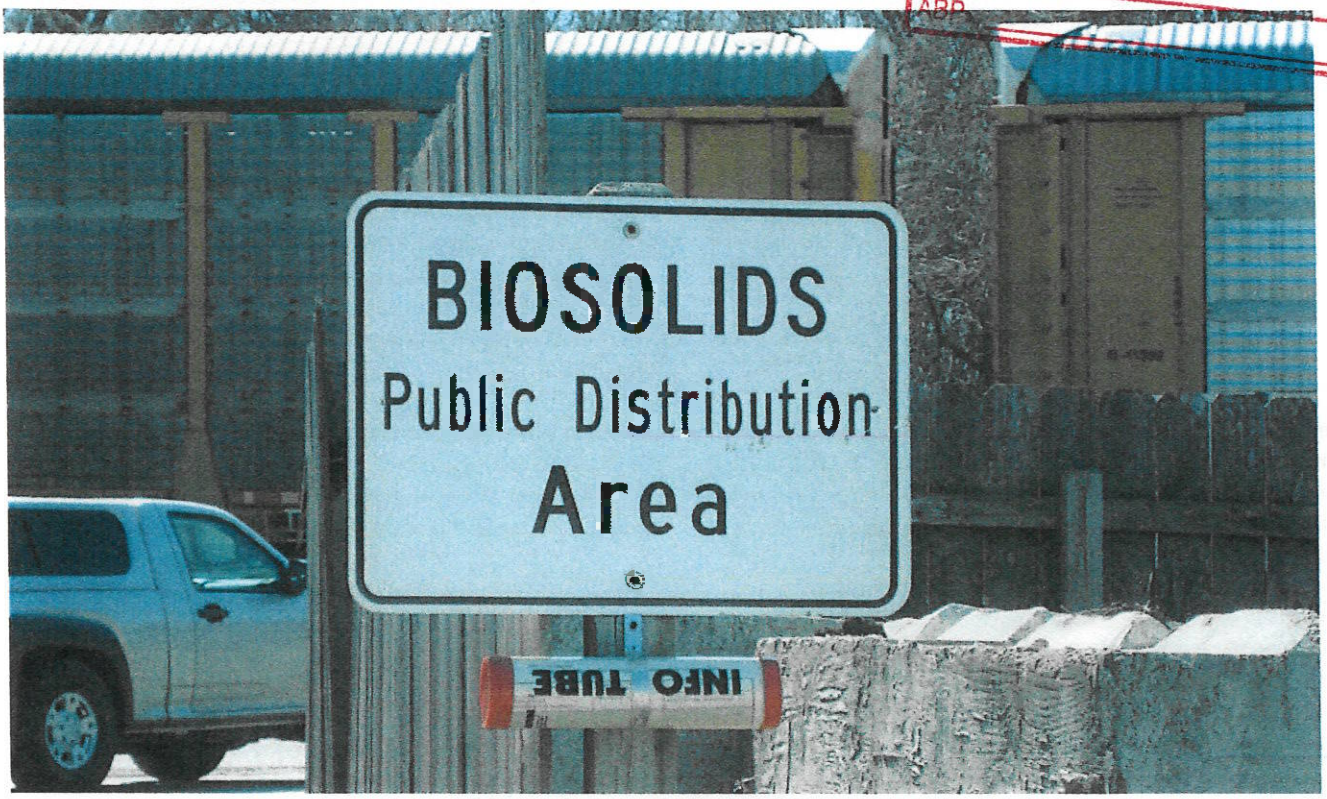
You will know if it is being spread on a field near you as it has a horrible, sickly sweet smell unlike any manure you have ever smelt. Stay away from it.

- **Water Technology Engineering Ltd.**
- Unit 2, Bolton Lane
- Bolton
- YORK
- Yorkshire
- YO41 5QX
- United Kingdom

- **Telephone:** 01759 369915

- **Email:** sales@wte-ltd.co.uk

Biosolids or Biohazards?



City of Lawrence, Kansas Wastewater Treatment Plant has a biosolids recycling program. According to the city, 90-95% of the biosolids are currently applied to local agricultural fields as a fertilizer and organic matter source. The remainder is made available for public distribution for residential uses on landscaping, gardening, etc. Photo by Joseph Mark Jarvis, http://bit.ly/RBJ7uj.

(Ed. note: This piece has been edited to clarify issues related to the plant uptake of contaminants in biosolids, 5/1/13)

by Xoco Shinbrot

Biosolids, or treated domestic sewage sludge, processed at wastewater treatment plants and used as fertilizer, is something that few people think about when they flush the toilet. However, treated and packaged sewage sludge has gained increasing attention and generated heated discussion as researchers increasingly find that it contains high concentrations of known toxicants and heavy metals.

Communities around the nation are required to treat their waste water under the *Clean Water Act*. The wastewater treatment process produces the semi-solid by-product called sewage sludge, or biosolids, which may be applied to the land, incinerated or landfilled, depending on the level of treatment. According to the U.S. Environmental Protection Agency (EPA), of approximately seven million dry tons of biosolids produced each year,[1] 50 percent is applied to land.[2] While less than one percent of the nation's agricultural land is biosolid-treated, biosolid application is increasingly considered by farmers, homeowners, and landscapers as an inexpensive and rich source of nutrients for their plants and agricultural commodities. Biosolids can be applied on farms by conventional farmers, as long as they receive a permit from their EPA Region. Users must prove that their application meets the human health standards of the *Standards for the Use or Disposal of Sewage Sludge*,[3] which limits the concentration of nine heavy metals and four pathogens. Proponents frame the discussion around its use as a solution to future fertilizer shortages, touting it as a sustainable option that should be considered compatible with organic agriculture. However, there are a variety of chemicals in biosolids that people flush into the system, such as pharmaceuticals, household care products, and a cocktail of other constituents that are not removed during waste water treatment. Currently, USDA organic certification is the only regulatory safeguard from biosolids threats to human health, given their prohibition in the *Organic Foods Production Act*.

Toxic Findings, Limited Regulation

Growing concern has prompted EPA to increase its efforts to answer questions about the presence of a broader range of chemicals in biosolids. In 2009, EPA released the results from its *Tar-*

geting National Sewage Sludge Survey (TNSSS), which measures chemical concentrations in land-based biosolid application areas.[4] The results are striking. Out of 84 samples:

- 27 metals are found in virtually every sample with antimony found in no less than 72 samples;
- Of six semi-volatile organics and polycyclic aromatic hydrocarbons (PAHs), four are found in 72 samples, one is found in 63 samples and one found in 39 samples;
- Of 72 pharmaceuticals, three (i.e. ciprofloxacin, diphenhydramine, and triclocarban) are found in all 84 samples, nine are found in at least 80 samples;
- Of 25 steroids and hormones, three steroids are found in 84 samples and six are found in 80 samples; and,
- All flame retardants, except one, are found in nearly every sample.

Over the past 30 years, a significant body of research has been compiled on the organic chemical contaminants in land applied biosolids that support these findings. While the focus has ranged from persistent organic pollutants, such as chlorinated dioxins/furans, to polycyclic aromatic hydrocarbons, organochlorine pesticides, heavy metals, PCBs, and pharmaceutical contaminants, only dioxins have been assessed by EPA. While they took no action based on the assessment, they determined that risks were below the levels of action.

Pumpkin seedlings planted out on windrows of composted biosolids at community compost education garden.

The results of TNSSS prompted EPA to develop a list of nine pollutants (nitrite, nitrate, barium, manganese, silver, fluoranthene, pyrene, and 4-chloroaniline) that are being evaluated based on biosolids exposure and hazards assessments. EPA officials have indicated that rulemaking on these nine chemicals may take place within 2013 or 2014. As for more than 130 other pollutants identified in TNSSS, no timeline for rulemaking has been set.

EPA's failure to fully regulate biosolids and threats to human health has come under scrutiny as news articles, exposés, and non-fiction novels have critiqued land applied sewage sludge. John Stauber and Sheldon Rampton were two of the first authors, in their exposé *Toxic Sludge is Good for You*, to publicly chastise public relations manipulators for misleading the public on biosolids. The authors examine the ongoing marketing campaign to redefine sewage sludge as a beneficial, cheap, and risk-free fertilizer. As part of this effort to sell sludge, the most active pro-sludge advocacy group, Water Environment Federation (WEF), coined its new name. "It's not toxic, and we're launching a campaign to get people to stop calling it sludge. We call it 'biosolids,'" said then WEF director of information Nancy Blatt.

During this campaign, companies like Heinz, Nestlé, and Del Monte, which expressed staunch support of biosolid-free agriculture, began to seriously consider growing their raw agricultural products in soils treated with biosolids.[5] Representatives for Del Monte indicated that their "long-standing position ... to avoid using raw agricultural products grown on soils treated with municipal sludge" was likely to change in the future. It's unclear whether Heinz and Nestle have changed their stance, but according to their website on corporate responsibility, Del Monte has avoided products grown with sewage sludge.[6] Many conventional farmers and food processors, however, still use biosolids as a crop fertilizer and have strongly opposed labeling legislation (see H.R. 207, *Sewage Sludge In Food Production Consumer Notification Act* of 2005) to inform consumers on whether food is grown on biosolid-treated land.

Human Health and Unregulated Toxicants

Plant uptake and ingestion

Since the early 1980s, scientists have been cognizant of heavy metal uptake by food plants fertilized with biosolids. Keefer et al. (1986)[7] analyzed the impact of biosolids rich in cadmium, zinc, nickel, copper, chromium, and lead on the edible and inedible portions of radishes, carrots, cabbage, green beans, sweet corn and tomatoes grown in biosolids. As expected, many of the crops in biosolid amended soils have higher concentrations of heavy metals than the control crops. Nickel concentration is higher in both edible and inedible parts of most of the vegetables, and copper and zinc concentrations are also higher in those vegetables. Though levels are highly dependent on the species type, the heavy metal, the plant part, and the level of absorption, concentrations of heavy metals in crops grown in sludge-amended soil can have serious consequences.

For example, cadmium accumulation varies distinctly in different plant types, but is regarded as the most hazardous metal element based on its concentration in sewage sludge. In the short-term, ingesting high levels of cadmium residues can cause vomiting and stomach irritation, but prolonged exposure to low levels can cause kidney damage and bone fragility.[8] The Agency for Toxic Substances and Disease Registry cites research showing that cadmium tends to accumulate in plant leaves, and therefore is more risky, especially for leafy vegetables grown on contaminated soils.[9] Tobacco, lettuce, and spinach, are known to be particularly prone to cadmium absorption. Currently, the *Standards for the Use or Disposal of Sewage Sludge*[10] regulate the application of biosolids with concentration limitations for heavy metals—specifically for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel,

selenium, and zinc. EPA's established standards on pollutant concentrations, pathogen density, and the attraction of potential pathogen vectors (e.g., insects, scavenging mammals, and birds) can be found in the Biosolids Rule (40 CFR Part 503). This regulation requires farmers to monitor these parameters at least once a year and up to 12 times a year, depending on the total amount of biosolids used.[11] While heavy metals, pathogens, and disease vectors are regulated, there are a myriad of chemicals, pesticides, and emerging contaminants in biosolids that do not have any regulatory limits.

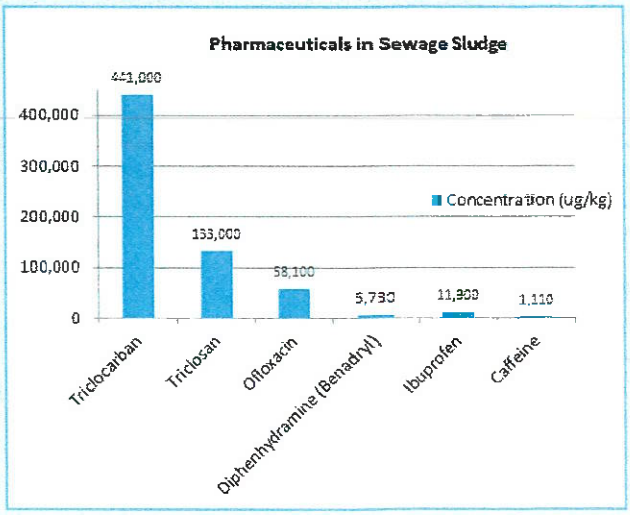
A recent study conducted by Wu et al. (2012) documents the transfer of pharmaceutical and personal care products (PPCPs) into the tissues of five widely consumed crops, namely peppers, collard, lettuce, radish, and tomato. Drugs and other contaminants enter the sewage system through various pathways, but trace amounts may come from urine or fecal matter or pharmaceuticals dumped down the drain. Therefore, researchers chose three of the most frequently detected pharmaceuticals in biosolids, according to EPA's 2009 Targeted National Sewage Sludge Survey, to study under laboratory conditions: a prescription drug for epilepsy, nerve pain, and bipolar disorder (carbamazepine); an over-the-counter drug for allergic reactions and motion sickness, better known by its brand name Benadryl (diphenhydramine); and an antibacterial agent used in disinfectants and soaps (triclocarban). The treatment group of plants were grown in biosolids-based potting soil and fortified with additional pharmaceutical and personal care products to ensure detection. Added PPCP concentrations were comparable to those detected in agricultural soils treated with biosolids. All three compounds were found in every one of the studied crops grown in biosolid-treated soils. Triclocarban had the highest root concentration in all the plants, while carbamazepine had the highest above ground concentrations particularly for collards, peppers, and lettuce. Additionally, diphenhydramine was concentrated in the fruits of both the tomato and pepper plants. In other words, pharmaceuticals were found in the edible portions of the plant.[12]

Previous studies had shown that emerging contaminants can be transported into plants in hydroponic systems[13] and from soils low in organic matter.[14] The above described study demonstrates that the organic matter in biosolids does not prevent the uptake of some emerging contaminants. Finally, the work of Wu et al. (2012) builds on his own research demonstrating that not only are pharmaceuticals taken up by crops, but some are persistent in soils.[15]

These studies are largely conducted in the greenhouse and laboratory setting rather than in the field, although one study conducted under normal farming conditions does suggest that PPCPs may be taken up by vegetables grown on biosolid amended soils.[16] More research is certainly needed on plant uptake of emerging contaminants, however, the current results are alarming particularly as the Biosolid Rule only requires pathogen reduction and monitoring for heavy metals.

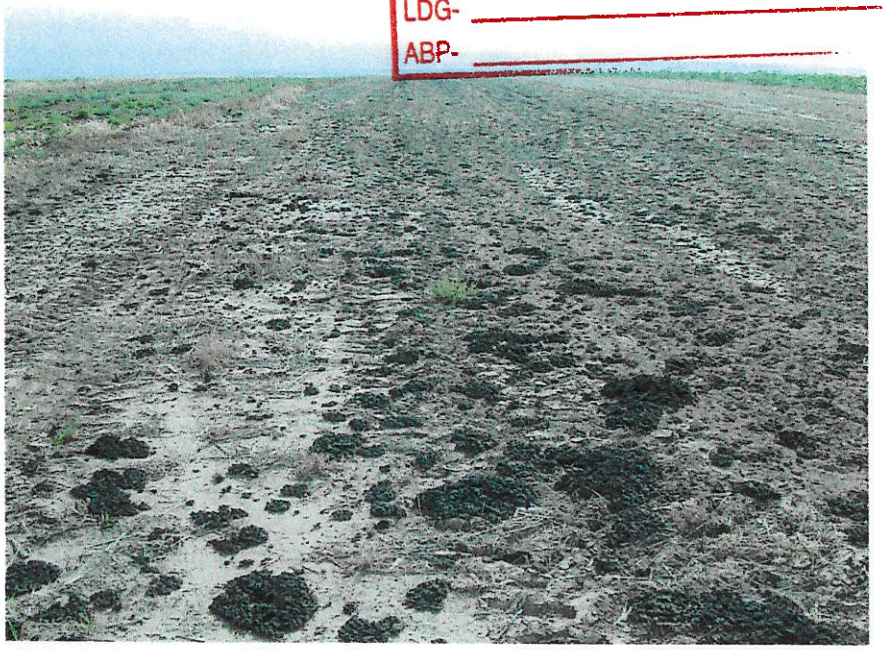
Antibacterial Pesticides Persist in Biosolids

Because 95% of the uses of the antibacterial pesticide triclosan, and its cousin triclocarban, are in consumer products that are disposed of down residential drains, sewage and wastewater provide a prime medium for their entry into the larger environment. Triclosan and triclocarban are found in high concentrations in biosolids. Triclosan, while not completely removed from water during the treatment process, accumulates in sewage sludge in municipal wastewater systems. After treatment, biosolids are recycled on land, and triclosan can then leach down through the soil and run off into surface water from the fields. Triclosan has been shown to persist in the runoff from treated fields for as long as 266 days after biosolid application and to persist in the sediment for long periods of time. EPA, in its *Targeted National Sewage Sludge Survey Report*, found that triclosan was detected in 79 of a total of 84 sludge samples used in the survey.(See chart).



Triclosan-contaminated biosolids can pose longer term risks to environmental and human health. One study reported that, "The beneficial reuse of digested municipal sludge as agricultural fertilizer represents a mechanism for the reintroduction of substantial amounts of [triclosan] into the environment."[20] Subsequently, agricultural lands exposed to contaminated biosolids can leave residues in earthworms, crops, and wildlife. Once in soil, it has been shown that triclosan is in fact taken up and translocated in plants. In soybean plants, triclosan was observed to be taken up from the roots and eventually translocated to the beans.[21] This suggests that people may also be exposed to triclosan by unknowingly consuming contaminated food.

Among those contaminants of concern include so-called nanomaterials, materials that are engineered at the ultra fine molecular scale that display novel characteristics like increased strength or conductivity. In the study, "Soybean susceptibility to manufactured nanomaterials with evidence for food quality and soil fertility interruption," researchers found that biosolid application to soybeans caused zinc oxide nanoparticles to bioconcentrate in soybean tissues, especially the leaves, and that nano-cerium oxide completely shut down nitrogen fixation. "Juxtaposed against widespread land application of wastewater treatment biosolids to food crops, these findings forewarn of agriculturally associated human and environmental risks from the accelerating use of MNMs [manufactured nanomaterials]," the study finds. [17]



Field after application of biosolids at Colorado State University's Biosolids Research site in Byers, Colorado. Photo courtesy CSU College of Agricultural Sciences, Soil Crop and Sciences Dept. http://biosolids.agsci.colostate.edu

User and bystander exposure

Beyond those chemicals that are ingested, the total number of potential health impacts due to contact with contaminants are numerous, ranging from rashes, cough and headaches, to vomiting and nosebleeds. The Cornell Waste Management Institute published a report (2008) that compiled all the health complaints associated with land application of biosolids.[18] Some of the most important impacts include: asthma, allergies, birth complications, congenital defects, respiratory complications and failure, eye problems, gastrointestinal complications, inflammation of the lungs due to irritation caused by the inhalation of dust, alterations in pulmonary function, chronic bronchitis, chronic emphysema, inactive tuberculosis, cardiovascular effects, lesions, nausea, and tumors.

Symptoms, including rashes, have been linked to proximity to agricultural soils treated with biosolids. For example, one study published in 2009, "Interactions of pathogens and irritant chemicals in land-applied sewage sludges (biosolids)," found that 25 percent of residents studied living within approximately one kilometer (0.6 miles) of land application sites were affected by *Staphylococcus aureus* in their skin and respiratory tracts, including two who died. While *S. aureus* infections frequently accompany diaper rash, the effects can be lethal.[19]

Biosolid impacts on nature

In addition to extant chemical residues on food crops and direct exposure for applicators and bystanders, biosolids pose significant potential hazards to surrounding ecosystems. Leaching of personal care products, pharmaceuticals, and other classes of micropollutants into local waterways have gained regulatory and scientific scrutiny.[22]

Soil runoff, fish kills, fresh water eutrophication, and reproductive disruption for aquatic animals are just a few of the potential environmental hazards of biosolids application. One of the most potent impacts occurs as biosolids are washed downstream into waterways and groundwater. Biosolids are rich in phosphorus and nitrogen, which are required for crop growth. Unfortunately, as nutrient rich soils flow into local waters, it stimulates the prolific growth of microorganisms and algae. This algal growth harms the aquatic ecosystem in two major ways: first, algae blocks sunshine, depressing growth of underwater vegetation that fish and aquatic life rely on for food; second, when the blooms die, their decay depletes the dissolved oxygen in the water, slowly suffocating aquatic life. Thus, increasing use of biosolids is not just an aesthetic issue of algal blooms, it poses serious environmental problems.[23]

As with human health, environmental health is severely affected by additives that are not removed by wastewater treatment plants. For example, pharmaceuticals like birth control pills have dramatically changed fish reproductive patterns and health. In 2008, researchers reported that minute quantities of estrogens found in the birth control pill alter sperm development by changing the number of chromosomes, which can lead to lower survival and long-term health problems in offspring.[24] In 2010, more research reveals that small concentrations of synthetic progesterone-like hormones found in contraceptive drugs, not just synthetic estrogen, threaten fish reproduction.[25]

As synthetic chemicals are continually being introduced, EPA has not yet worked out a process to regulate these chemicals. Pesticides are only now being identified for testing to determine

whether they are endocrine disruptors, chemicals that interfere with development, hormones, and reproduction through the Endocrine Disruptor Screening Program. In 2007, U.S. Representative Henry Waxman (D-CA) and others harshly criticized EPA for failing to provide a comprehensive endocrine disruptor screening program. In 1996, the *Food Quality Protection Act* (FQPA) required such a program for endocrine-disrupting pesticides to be implemented by 1999: "Today, over ten years after the law was passed and eight years after the FQPA deadline, EPA has not tested a single chemical for endocrine-disrupting effects...,"[26] said Rep. Waxman. In 2006, EPA had developed its first draft list of chemicals to be screened by pesticide manufactures, but included only a portion of 1,700 chemicals identified for screening under FQPA mandate, which is minute compared to more than 75,000 chemicals listed under the *Toxic Substances Control Act*. By 2010, EPA finally released its Endocrine Disruptor Screening Program, which developed Tier 2 tests for endocrine disruptors and implemented draft policies and procedures that the agency will use to require screening.[27] Tier 2 testing, however, is still in progress and EPA has not implemented regulations. Meanwhile, the European Union (EU) has already launched its *EU-Strategy for Endocrine Disruptors,* including a comprehensive priority list of chemicals requiring regulation.[28]

Regulatory pitfalls: A focus on pathogens

Current biosolid regulations

The Standards for the Use or Disposal of Sewage Sludge (Title 40, Code of Federal Regulations, Part 503) was published in the Federal Register on February 19, 1993. This document established a set of general requirements for pollutant limits, management practices, and operational standards for biosolids. It describes the procedure for land application of biosolids, surface disposal, landfilling, and incineration. The EPA Office of Water's risk assessment of biosolids established limits based on current toxic exposure data, oral reference dose, and human cancer potency values. The analysis compared 14 different chemical exposure pathways and EPA chose the final limits based on the most toxic pathway for exposure.[29]

The biosolids regulation is based on heavy metal loading and pathogen concentrations. None of the nine heavy metals may exceed the promulgated ceiling levels. Processes for reduction or elimination of pathogenic bacteria, entric viruses, and helminth ova must be used. Standards for Class B biosolids require that pathogens are reduced by at least 99 percent, while Class A biosolids require further treatment. Because Class B biosolids still contain traces of pathogens, farmers may only use them if they receive a permit, enforce a buffer, restrict public access, and restrict crop harvesting. Most farmers are required to implement a 30-day waiting period after application to "ensure" the pathogens are killed. For root crops, which come into contact with the soil, the waiting period can be as long as 38 months.[30]

Pesticide Law and Biosolids

EPA regulates pesticides under the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA), which requires EPA to ensure that pesticides do not pose unreasonable risk to human health and the environment. EPA has interpreted its authority under FIFRA's "unreasonable adverse effect" standards by conducting risk assessments on pesticides. Unfortunately, EPA's risk assessment process does not fully take into account the environmental fate and effect of pesticide use and the potential risks of pesticide reintroduction into the environment via biosolids, especially those pesticides that are persistent, and cannot be removed from sludge through treatment outlined in the *Biosolids Rule*. Additionally, pesticide residues which make their way into crops grown in biosolids, contaminate food. These residues must then adhere to standards set by the *Food Quality Production Act* (FQPA), which regulates the residue allowed on crops with tolerance levels. However, pesti-

Biosolids application site in Saskatoon, Canada. After the treatment process, the biosolids are stored in asphalt-lined storage cells until the spring and fall when they are spread on nearby farmers' fields by a process called liquid injection. Image Courtesy City of Saskatoon, Canada. http://bit.ly/TKdjSc.

Branded products that contain sewage sludge/biosolids*

Source: Sludge News. 2006. About Sewage Sludge. http://bit.ly/w2n8bh

- Agresoil (MA)
- All-Gro (Synagro)
- Bay State Fertilizer (Boston, MA)
- Chesapeake Sunshine
- CompostT (Pennsylvania)
- ComPro (Washington, D.C.)
- Dillo Dirt (Austin, TX)
- EarthBlends (New York City, a product of Synagro, sold by WeCare)
- Earthlife (New England, a product of New England Organics)
- EarthMate (Philadelphia, PA)
- EKO Compost (Missoula, Maui, Lewiston plant on Idaho-Wahington border)
- Glacier Gold (Olney, MT)
- Granulite (Synagro)
- GroCo (Seattle, WA)
- Growers' Blend by Earthwise Organics (a Synagro subsidiary)
- Hou-Actinite (Houston, TX)
- Kellogg Nitrohumus, Gromulch, Amend and Topper (Kellogg Garden Products, Los Angeles, CA)
- Landscapers' Advantage (Camden, NJ)
- MetroGro (Madison, WI)
- Milorganite (Milwaukee, WI)
- Mine Mix (Philadelphia, PA)
- Miracle-Gro Organic Choice Garden Soil
- Nutri-Green (Virginia Beach, VA)
- N-Viro BioBlend
- N-Viro Soil
- Oceangro (NJ)
- ORGRO (Baltimore, MD, Veolia Water North America)
- SilviGrow (Seattle, WA)
- SoundGro (Pierce County, WA)
- TAGRO (Tacoma, WA)
- TOPGRO (Los Angeles, CA)
- Unity Fertilizer (Unity Envirotech LLC, Florida-based)
- WeCare Compost (NY)

**Sewage sludge or biosolid products can be disguised in many different ways, sometimes it is sold as "compost," while other times it's dried into pellets and bagged, or blended into other fertilizers. There are no labeling requirements for biosolid-containing fertilizers. Additionally, there is no federal rule that prohibits the use of the term "organic" on biosolids, despite the fact that there is no USDA organic certification of biosolids.*

cide tolerances have been severely criticized for not being stringent enough, allowing ingested residues to pose short and long-term risks to the human population. Furthermore, ensuring that chemical contamination of crops grown with biosolids does not exceed tolerances requires that such crops be tested regularly for residues. In addition, although food tolerances may cover pesticide residues in foods, they do not affect other avenues of exposure, including inhalation and dermal exposure to dust. Nor do they cover ecological impacts. While the Biosolids Rule provides the guidelines for biosolid treatment, disposal, and reuse, biosolid recycling is a key example of the inadequacies of federal pesticide (and other chemical) risk assessments.

National Academy of Sciences Critique

The regulatory pitfalls are best enumerated in the 2002 biosolid assessment by the National Research Council (NRC) of the National Academy of Sciences (NAS).[34] This group reports that there are major data gaps in the science underlying current rules, as well as a lack of epidemiologic studies on exposed populations, and inadequate programs to ensure compliance with biosolid regulations. Under the *Clean Water Act*, EPA is required to review existing biosolid regulations every two years in order ~~to identify pollutants that need to~~ be regulated. However, EPA has only researched a fraction of the chemicals that are known to exist in sludge and, of those researched, only some have risk assessments.

While chemical regulations are based on traditional risk-based limits established in the Integrated Risk Information System (IRIS) and the Office of Pesticide Programs (OPP) for human health risks, as yet there are no regulations for chemical pollutants in biosolids, with the exception of heavy metals. By contrast, established pathogenic regulations are based on treatment and site restrictions, completely divorced from traditional risk-based assessments. Instead of explicitly delineating acceptable pathogen risks concentration, EPA developed a risk characterization process that ignores complex chemical-pathogen and pathogen-pathogen interactions that are known to occur. For instance, workers exposed to silica dust (chemical-based) have a higher likelihood of tuberculosis infections (pathogen-based). Such enhanced adverse interactions are not addressed or explored by EPA assessments.

NRC's report, "Biosolids Applied to Land: Advancing Standards and Practices," reflects skepticism over the biosolid assessment process:

"Even if a summary index of the risk of an adverse response to mixtures was available, it would not necessarily reflect the total hazard of exposure to biosolids because of the inability to identify all of its hazardous constituents and their potential for interaction *in vivo*. Moreover, the composition of biosolids is susceptible to unanticipated changes from time to time and place to place. *Thus, it is not possible to conduct a risk assessment for biosolids at this time (or perhaps ever) that will lead to risk-management strategies that will provide adequate health protection* without some form of ongoing monitoring and surveillance."[35] (emphasis added)

EPA's reliance on mathematical estimates of individual pathogens and chemicals ignores secondary transmission potential for pathogens. Currently, only the direct transmission of pathogens is considered, despite the fact that interactions between people and through environmental pathways can cause population-wide

transmission. In summation, NRC concludes that EPA's biosolids risk-assessment and regulatory process is cumbersome and slow, with large information gaps on complex pathogenic interactions, and ignoring important secondary transmission pathways.

In 2003, EPA responded to NAS recommendations by releasing an action plan to determine the potential risks of select pollutants, measure those pollutants, characterize potential volatile chemicals and improve risk management practices. Since then, EPA has released its TNSSS and is in the processes of evaluating 26 of the 49 pollutants identified in the 2009 Biennial Review, including important hormones, antibiotics, PBDEs, and antimicrobials.[36] While EPA has identified 31 pollutants as candidates for further regulation during its second round of pollutant evaluation, it has not regulated any of these pollutants that are commonly detected in biosolids. According to the EPA, its action plan has been undermined by "budget constraints and competing priorities within the Agency, [such that] EPA is not able to implement all of the NRC's recommendations."[37]

Application site advisory sign. Image courtesy Florida Department of Environmental Protection.

The NRC proposed improvements to EPA's risk assessment process, and it proposed monitoring and surveillance as a means of dealing with the uncertainties in assessing risks of complex mixtures, including mixtures of chemicals and pathogens. However, the approach is still one of assessment and management of risks, as opposed to prevention. The NRC identified inherent limitations of risk assessment when applied to mixtures and combinations of chemicals and pathogens, but proposed only a band aid approach. A preventive (or precautionary) approach is more likely to lead to solutions that are truly protective. This approach would ask, "Is there anything we can do differently in order to eliminate problems associated with sewage sludge?" One problem is that the system encourages the mixture of pathogens and toxic chemicals. So, how do we separate the two? What if we created a system in which human "wastes" were composted and the compost used locally? We would still need to establish pathogen requirements and requirements for pharmaceuticals, but we would avoid mixtures with industrial chemicals and lawn pesticides. What if we prohibited the use of toxic pesticides that might get flushed down drains or washed into combined sewers? Creative solutions are possible if we define the problem as avoiding that complex mixture of toxic chemicals and pathogens, rather than searching for a place to put it and a way to make it "acceptable."

Alternative strategies for the future

Biosolid use for energy production

As the discussion around biosolids rages on, innovators have focused on alternatively using biosolids as a renewable energy source, arguing that biosolids can displace fossil fuels for powering waste water treatment plants, reduce dependence on oil, reduce costs for energy and demand on the power supply, and solve a waste management problem. On the other hand, others believe utilizing biosolids this way is not a solution for fossil fuel dependence, cleaner air, and by extension global climate change. This, too, will require more thorough assessment.

Conclusion

Organic foods: an escape from biosolids

For now, organic certification is the last safe haven from biosolids for consumers. Farms that are USDA organic certified are expressly prohibited from applying biosolids under the National Organic Standards Rule, which ensures that raw foods are grown without hormones or synthetic fertilizers and only approved synthetics in an organic soil-building system. When the proposed Rule first came out in 1997, EPA feared that it would deter new users from using biosolids as a fertilizer and pressed the USDA to exempt biosolids from the ruling. In fact, in 1998, USDA released proposed organic standards that would allow bioengineered crops, irradiation, and sewage sludge in organic production, which became known as the "big three." The release sparked 325,603 mostly horrified public comments. USDA reconsidered and prohibited the "big three" in the final rule.

We know now that biosolids have a complex array of biological pathogens, chemical contaminants, pharmaceuticals, hormones, and emerging contaminants that are not completely eliminated by waste water treatment plants. The land application of biosolids should be abandoned immediately, considering that the current regulatory restrictions and biosolid treatment programs allow for the continuing contamination of the environment and threaten human health. That means we stop using them and stop making them. In lieu of those immediate changes, at the very least, the waste streams for toxic chemicals should be separated from human organic wastes that are applied to agricultural fields.

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