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ON THE GROUND

THE SPREADING OF TOXIC SLUDGE IN VERMONT

Who Is VPIRG?

The Vermont Public Interest Research Group is the state's largest environmental and consumer watchdog organization with 20,000 members statewide. Founded in 1972, VPIRG conducts research, organizing and advocacy campaigns to ensure policies are made in the public's interest. We rely on the generosity of individuals for two-thirds of our budget– if you find this report helpful and informative, please consider sending a donation to: VPIRG, 64 Main Street, Montpelier, VT 05602. Tax deductible donations may be made to the Vermont Public Interest Research Education Fund at the same address.

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Executive Summary

Thousands of tons of sewage sludge and septage have been distributed through Vermont's environment by being spread directly on land or composted and given away for use on home gardens, farms and landscape projects. In 1997 alone, 1,535 tons of sewage sludge were applied to Vermont land, while 767 tons were distributed as compost. Reusing clean human waste would be a positive practice. But sludge contains far more than just human waste.

The practice of applying municipal sludge to the land entails many serious risks to environmental sustainability and public health. It is economically short-sighted, given its potential to contaminate the land, undermine Vermont foods' reputation for purity, and undercut the pristine environmental image that brings so many tourists into our state. Many citizens oppose it on grounds ranging from issues of local control, to public health fears, to aesthetic concerns. Yet regulators with the state's Department of Environmental Conservation (DEC) steadfastly maintain that the only problem with sludge "recycling" is the public's attitude toward it, and insist that there is no need to reexamine the current system of regulation or make it more stringent.

Toxic Inflows

When we examine the materials currently flowing into our sewage systems, it becomes clear that the land application of sewage sludge and its distribution to the public as compost do not result in reuse of human waste materials alone. Toxic inflows to sewage treatment plants include industrial discharges containing heavy metals and persistent chemical compounds; millions of gallons of landfill leachate contaminated with hundreds of toxics; household discharges of cleaners, paints and pesticides that pose health risks; and unregulated discharges from small businesses that can contain materials regulated as hazardous waste when they are used or discharged in larger quantities.

Thus the disposal of sludge and septage across Vermont's landscape results in the distribution of persistent toxic materials throughout the state, the long-term contamination of agricultural land, and a significant redistribution of responsibility for industrial wastes from their producers to the ordinary citizens whose health and well-being may be undermined by the impact of toxic sludge. The policy of sludge spreading in Vermont is a policy of spreading toxics all over Vermont.

Persistent toxic contamination

As of 1997, there were 201 permitted sites in 53 communities across Vermont where "biosolids" – including municipal sludge, septage and a small amount of food processing wastes -- could be spread. These sites range from a few acres to 50 acres or more. Under federal and state sludge regulations, these 201 sites could receive sludge until <u>each acre</u> of land is contaminated with <u>268 pounds of lead, 34.8 pounds of cadmium, 36.6 pounds of arsenic, and 15.2 pounds of mercury.</u>

Lead, mercury and cadmium are substances that can cause irreversible health damage at extremely low levels of exposure. Because of the dangers they pose, environmental regulators and public health officials at all levels of government have expended great effort to prevent their discharge into the environment. Yet when they are contained in sewage sludge, regulators promote their disposal directly on the land.

The state's own figures on average concentrations of heavy metals in Vermont's sewage sludge and the amount of sludge and septage land spread or composted reveal that these materials are already contaminating our environment with persistent toxics. Our calculations show that <u>over</u>

the course of 1997, the land application of sewage sludge in Vermont resulted in an estimated 340 pounds of lead, 18.5 pounds of cadmium and 8 pounds of mercury being applied directly to Vermont soils. Some 170 pounds of lead, 9.3 pounds of cadmium and 4 pounds of mercury were distributed in the form of compost to be applied to residential and recreational lands by homeowners, landscapers and developers.[1]

State and federal regulations governing metals concentrations in sludge could allow still higher amounts of toxics on the land and in the hands of citizens. If the same 2302 tons of sludge and septage that were land applied and distributed in Vermont in 1997 contained the highest metals levels permissible under state and federal policy, their "recycling" would result in 2579 pounds of lead, over 30 pounds of mercury and almost 77 pounds of cadmium applied directly to the land, and 1288 pounds of lead, 15 pounds of mercury and 38 pounds of cadmium given away in compost.

Dioxin Distribution

State testing sponsored by EPA showed that every Vermont sludge and sludge compost tested contained dioxin in measurable concentrations. Sludge from Rutland contained almost 60 parts per trillion of this extremely potent poison, while one sample of Springfield's compost tested at almost 17 parts per trillion. (See Table 9 for dioxin test results.)

Dioxin is one of the most potent carcinogens known, and has been linked with immune system dysfunction, diabetes, developmental and reproductive problems at extremely low levels of exposure. EPA documents state that the average body burden of dioxin in US citizens is approaching the level at which health effects begin to be observed. Yet Vermont has no requirement that sludge or septage be tested for dioxins before being distributed across farmland, parks or housing developments. In fact, state regulators assert that sludge or septage containing dioxin concentrations up to 27 parts per trillion are acceptable for land application.

Untested Chemical Content

No testing is required of individual batches of sludge, septage or sludge products to determine what levels of the more than 80,000 chemicals in commercial use they contain before they are applied to land or given out to the public. Sludge or septage is tested infrequently for a limited range of toxics and those test results are assumed to be representative of all the material from a given facility.

This system fails to deal with the sporadic and changeable nature of sewage discharges, which mean that intermittent testing is meaningless for understanding the content of a particular batch of sludge. It fails to take into account the possibility of synergistic effects between multiple chemicals as they are mixed, heated and otherwise affected by sewage treatment and sludge disinfection procedures. And it completely ignores the potential environmental and health impact of so-called "endocrine disrupters" – chemicals that affect the functioning of the hormonal system, which regulates the body's essential functions. Such endocrine disrupters have been linked to reproductive and immune system problems, declines in fertility, learning difficulties and cancer cell growth at very low exposure levels.

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[1] Calculations based on figures in the State of Vermont Draft Solid Waste Plan Revisions, January 1999. Because they are based on average metals content, these figures may under- or overestimate the actual totals.

Regulations are not protective

For those few toxics that are limited by regulation, Vermont's rules set permissible levels as much as 90% higher than the actual levels commonly found in sludge and septage in Vermont. As discussed above, the land application of sludge and distribution of sludge products have already allowed significant amounts of highly toxic materials to be distributed throughout Vermont's environment.

A system of regulation that aims at allowing increasing amounts of toxics in sludge is not protective of the environment or public health. In fact, the only logical rationale for such a system is to enable the importation into Vermont of far more toxic sludge than that generated in-state, or to allow for a marked increase in industrial discharges to our sewer systems with no decrease in land disposal of the resulting toxic materials.

Such policy choices have far-reaching implications for agriculture, tourism, the environment and public health. They should be decided only after an inclusive and in-depth public debate. Instead, in the draft Solid Waste Plan, state regulators have proposed doubling the percentage of sludge and septage "recycled" in the state with no comprehensive review of the adequacy of current regulations.

Short Term Benefit, Long Term Disaster

For the past year, VPIRG has worked with Vermont citizens whose communities are impacted by existing or proposed sludge projects. We have spoken with advocates on both sides of the sludge debate, reviewed the research and risk factors used to develop the present sludge "safety" standards, encountered the promotional efforts of sludge "recycling" advocates, and learned the sad stories of the many farm families and ordinary citizens across the country whose lives have been changed for the worse through their exposure to contaminated sewage sludge.

The more information we amass, the more convinced we become that the land application of sewage sludge and its distribution to the public involves limited short term benefit, but carries the potential for irreparable long-term damage, to the environment, wildlife and people of Vermont.

VPIRG recommends that the state establish a policy to ban the application of any and all persistent toxics or endocrine disrupters to the land, and set a timetable and goals to achieve it in short order.

Because such a policy will need to be implemented over time, we also recommend eight transitional policies which can be put in place in the short run to prevent the application of toxic materials to Vermont's soils and end the practice of mixing human wastes with industrial and domestic toxics, so that they can eventually be safely reused. These are as follows:

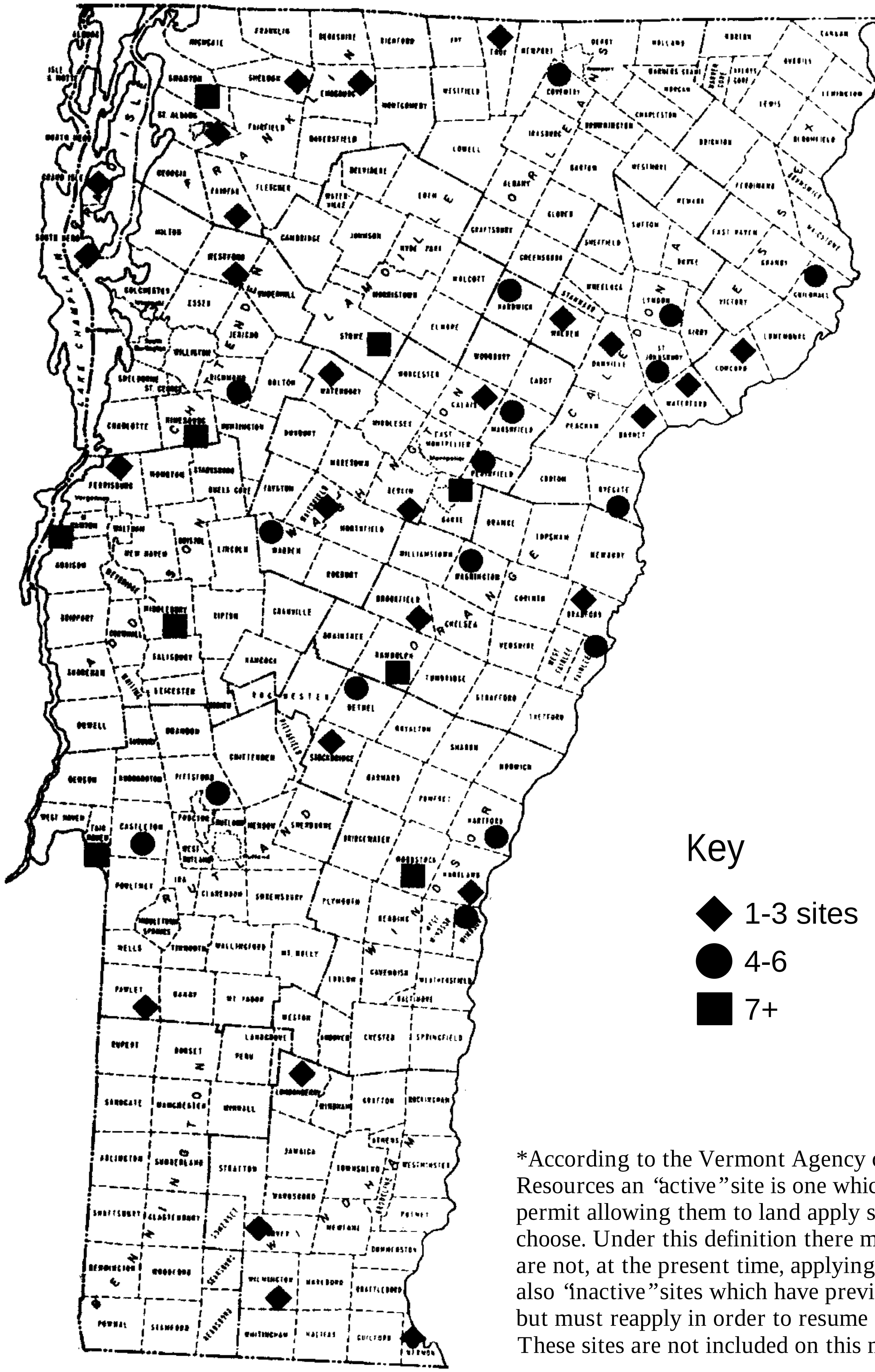
1. Immediately ban any industrial discharges or leachate inflows where land application or composting are operating or contemplated, and ban sludge reuse where there are industrial discharges or leachate inflows.
2. Prohibit the siting of sludge or septage facilities (including land application, composting or other processing sites) in towns that have not explicitly approved such a facility by a town-wide vote.
3. After January 1, 2000, place sludge and septage in landfills. Develop a system that economically and technically supports the use of sludge and septage materials as alternate daily cover for landfills.

4. Make municipalities clearly and continuously liable for land applied or processed sludge and septage following land application or distribution to the public.
5. Require maintenance of pH in perpetuity on all land application sites, whether closed or active.
6. Require recording of any land application of sludge or septage on all deeds, and require disclosure to potential buyers.
7. Stop encouraging sewering of communities through state laws and funding and begin subsidizing alternative systems.
8. Develop state-funded programs in all Solid Waste Districts to work aggressively and creatively with communities to detoxify their wastewater systems through small business and community education.

By issuing this report, VPIRG hopes to initiate a broad discussion among Vermonters that can allow us to move away from the practice of contaminating our land now and leaving future generations to deal with the impact of our actions. We believe that while alternatives to present-day sludge disposal practices may require creative thinking and some sacrifices, we can protect our farms, our citizens and our environment by taking steps now to prevent the buildup of toxics on

the soil.

Active* Sludge Sites in Vermont



*According to the Vermont Agency of Natural Resources an "active" site is one which holds a current permit allowing them to land apply sludge should they choose. Under this definition there may be sites which are not, at the present time, applying sludge. There are also "inactive" sites which have previously held permits but must reapply in order to resume spreading sludge. These sites are not included on this map.

Table 1. Active Land Application Sites by Town

Addison	**18**	**Orange**	**19**
Ferrisburg	3	Bradford	1
Middlebury	7	Brookfield	1
Panton	8	Fairlee	5
		Randolph	7
Caledonia	**27**	Washington	5
Barnet	2		
Danville	2	**Orleans**	**8**
Hardwick	5	Coventry	5
Lyndon	4	Troy	3
Ryegate	5		
St. Johnsbury	6	**Rutland**	**20**
Walden	1	Castleton	6
Waterford	2	Fair Haven	7
		Pawlet	2
Chittenden	**19**	Pittsford	5
Hinesburg	11		
Richmond	6	**Washington**	**32**
Westford	2	Barre	10
		Berlin	2
Essex	**5**	Calais	1
Concord	1	Marshfield	4
Guildhall	4	Plainfield	6
		Waitsfield	3
Franklin	**12**	Warren	5
Enosburg	1	Waterbury	1
Fairfax	1		
St. Albans	2	**Windham**	**6**
Sheldon	1	Dover	1
Swanton	7	Londonderry	2
		Vernon	2
Grand Isle	**3**	Wilmington	1
Grand Isle	2		
South Hero	1	**Windsor**	**25**
		Bethel	4
Lamoille	**7**	Hartford	5
Stowe	7	Hartland	1
		Stockbridge	1
		Windsor	6
		Woodstock	8

(Source: VT DEC 1997 Printout)

Chapter One: Content and Regulation of Sludge

A nation that destroys its soil destroys itself.
Franklin Delano Roosevelt

All over the country, grassroots activists are protesting the land application of municipal sewage sludge in their communities. Citizens are also protesting the construction and operation of sludge composting and pelletizing plants, and challenging the purity claims made by promoters of bagged sludge. The concerns expressed by these sludge activists include increased exposure to pathogenic organisms, the distribution of toxic materials through residential and farm communities, exposure to radioactive materials, odor issues, loss of property value and the preempting of local control.

As in the rest of the country, concern is growing in Vermont over the impact of sludge operations on local communities, and the long range effect such operations could have on public health and the environment in our state. Citizens in communities directly impacted by sludge composting and application programs are most active on the issue, but Vermonters in general have begun to ask whether the land application and composting of sewage sludge are appropriate or necessary practices for our state.

In order to understand the context these questions arise in, one must examine the regulatory structure that governs so-called "biosolids" and its historical roots.

Political History

Until the late 1980s, EPA strictly regulated sewage sludge and septage. Land application standards for sludge were sufficiently stringent that one study found only 7 of 30 municipal sludges tested met the standards in 1983 (Haag et al, 1992).

When a federal ban on the ocean dumping of sludge took effect in the late 1980s, many large municipal sewage plants were at a loss for sludge disposal options. Their sludge often failed to meet the toxics standards required for land disposal, and because of its great volume, sludge disposal in landfills was a very costly option for large cities.

Bowing to pressure from municipal wastewater authorities, EPA agreed to revise the standards for land application of sludge and distribution of sludge products such as compost. As sludge promoters like to point out, EPA studied sludge longer than any other single subject. They do not point out that following that long period of study, EPA issued draft standards for metals many times more stringent than those that are now law. During public comment on the draft sludge rules, EPA encountered intense pressure from industry and wastewater treatment groups to ease the regulations, since many municipal sludges did not meet the standards. Both groups objected that the standards were not attainable and that it would pose an unfair burden on manufacturers and treatment plant operators to meet them.

Following the public comment period, EPA staff rewrote the proposed rules under the guidance of consultant Dr. Terry Logan, a soil scientists at Ohio State University and board member of N-Viro Soil International, a corporation that markets municipal sludge "stabilized" with cement kiln dust (Bleifuss, 1995; Stauber and Rampton, 1995). Not surprisingly, the next round of rules relaxed the ceiling concentrations and loading limits considerably.

Biosolids: AKA Sewage Sludge

At the end of this revision process, EPA also helped the sewage treatment industry come up with a new name for sludge – "biosolids". The Washington D.C.-based public relations and lobbying firm, Powell Tate, in an effort funded by an EPA grant of $300,000 developed the term "biosolids" and a plan to promote its use (Stauber and Rampton, 1995). Documents that the firm developed to promote use of the term "biosolids" clearly demonstrate the name change was designed to confuse the debate over substances about which people have serious concerns – sewage sludge, septage and products made from them – by linguistically transforming them into something neutral or beneficial (Powell Tate, 1995).

Because the term biosolids is so politically charged and so unclear, we will be using the appropriate terms "sewage sludge" or "sludge" for short, "septage" and "sludge products" throughout this report to refer to the solid materials filtered out of sewage at the treatment plant, the slurry recovered when septic tanks are pumped, and the composted or otherwise treated sludge and septage materials distributed to the public.. Though there are significant differences in pathogen and toxicity characteristics between the sludge and septage, they are more similar than not; therefore to avoid wordiness, the term sludge will be used occasionally as the generic label for sludge and septage as a whole.

Classifications

As discussed above, EPA regulates sludge based on a complicated set of overlapping classifications that trigger different handling and disposal regulations. "Class A" sludge or septage is material treated to reduce pathogens to a very low level. Class B sludge is material which has a higher level of active pathogens. Class B sludge can only be applied to land, but Class A sludge can be distributed directly to the public with no requirement to limit application or provide information on possible contamination issues or dangers to human health.

EPA also classifies sludge according to its concentrations of nine heavy metals the agency considers "of concern". These include extremely toxic substances such as arsenic, lead, mercury and cadmium, as well as other metals less severely toxic to humans. EPA identifies two types of sludge based on metals content –Exceptional Quality or "EQ" sludge – which meets a more stringent set of metals limits-- and sludge that meets acceptable "ceiling concentrations" for metals that are significantly higher than the EQ standards. (See Table 2 for specifics on EPA's EQ and ceiling concentration standards).

Vermont's regulatory structure is somewhat more stringent than EPA's. Though the terms Class A and Class B sludge are not used in state rules governing sludge disposal, regulators use the same pathogen standards to determine which sludge can be land applied without a permit or distributed to the public – Class A – and which sludge or septage must have a permit for land application – Class B. Vermont sets uniform acceptable metals limits for all sludge and septage to be applied to land or distributed to the public. As is discussed below, the current Vermont metals standards (and draft revised standards) come close to EPA's EQ levels for metals concentration (see Table 4).

In the interest of simplicity, we will make infrequent use of EPA's confusing overlapping classifications of sludge in the following discussion. Most sludge and septage generated within Vermont currently meets EPA's more stringent metals limits. About two thirds of the sludge that is "recycled" in the state meets "Class B" (less stringent) pathogen reduction standards and about one third is "Class A", with a higher standard of pathogen reduction.

For clarity in the following discussion, we will refer to these confusing classifications rarely, focussing on how the regulations play out rather than on explaining how regulators use specific terms. Because Vermont's metals standards are close to the EPA's "EQ" classification, our discussion of EPA regulation will focus primarily on these more stringent standards. It is important to understand that even EPA's strictest standards --and the Vermont standards patterned after them– present the potential for serious contamination of the land, degradation of the environment and risk to public health.

Table 2. Metals Concentration Limits

Metals	EPA Maximum Concentration in "EQ" Sludges	EPA Maximum Ceiling Concentration
Arsenic	41	75
Cadmium	39	85
Chromium	--	--
Copper	1500	840
Lead	300	57
Mercury	17	75
Nickel	420	420
Selenium	100	100
Zinc	2800	7500

(Source: Harrison et al, 1999)

Distribution of Sludge and Septage

Sewage treatment plants and septage haulers must dispose of large volumes of sludge and septage on a regular basis. In Vermont, 6,827 tons of sludge and septage were produced in 1997. Sludge and septage can be disposed of in a variety of ways. It can be placed in a landfill, or incinerated. Or it can be disposed of on land, either directly or through distribution to the public for use on lawns, parks, and gardens. Sludge regulators frequently refer to this method of disposal as "biosolids recycling", as Powell Tate suggested in their Communications Plan.

The EPA allows a variety of sludge and septage to be directly applied to the land with no permit, under what the Agency refers to as the "self-implementing" rules governing land application. Under Vermont's rules, land applications require a permit that sets limits for the levels of contamination that may not be exceeded on a given site, unless the sludge meets more stringent pathogen standards by undergoing additional processing. Such sludge can be land applied with no permit, despite the fact that it will still contain significant levels of toxic materials not affected by pathogen treatment.

In addition to treatments that produce this so-called Class A sludge in liquid form for land application, sludge and septage can also be composted, pelletized or otherwise treated to produce a marketable product. Once treated in this fashion, sludge and septage products that meet EPA's "EQ" (more stringent) metals limits can be distributed to the public for use around the home, on park land, in home gardens, etc – with no EPA or state requirement to label or otherwise warn consumers that the compost may contain heavy metals and other toxic contaminants that pose significant health concerns (Harrison et al., 1999).

Regulatory Overview

Both the federal and the state government regulate the land application, composting or other treatment, and distribution of municipal sludge and sludge products. To qualify for land disposal or distribution, sludge must currently meet limits for 9 heavy metals – arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium and zinc-- and PCBs. The sludge must also undergo processes to reduce pathogens and "vector attraction" ("vectors" is a fancy name for vermin-- rats, flies, etc). Vector attraction reduction also reduces the odor potential of the sludge or septage.

EPA does not require testing of sludge for any of the some 80,000 synthetic chemicals in commercial use prior to sludge distribution or landspreading, despite the strong associations between many such chemicals and human and animal health effects such as hormone disruption and carcinogenesis. A fraction of such chemicals are tested for very infrequently (in Vermont every five years), primarily to demonstrate that the sludge does not contain any toxic material at levels that would qualify it as a hazardous waste. Under the Part 503 regulations, if no federal standard is established for a particular toxic contaminant in sludge, land application is allowed even when that toxic substance is present at concentration levels up to .001(mg/kg) beneath the level that would qualify the material as a hazardous waste.(US EPA 1993, National Sludge Alliance 1997).

Despite the infrequency of testing for toxic contaminants in sludge and septage, test results are assumed to be representative of all sludge generated by a particular facility, despite the fact that sewage sludge is an extremely variable quantity subject to unpredictable toxic flows.

Vermont's regulations on sludge composting and land application are for the most part closely patterned on EPA's policies and are similarly inadequate on most fronts. Since 1993, when the federal standards for sludge application and distribution known as "40 CFR Part 503" or colloquially, the 503 regulations, were adopted, Vermont sludge must meet either the federal or the Vermont standard, whichever is the more stringent.

A brief review of the sources and impacts of the major contaminants in municipal sewage sludge, together with EPA and Vermont's regulation of this material, reveals many significant gaps in regulation that could have devastating ramifications in the long run for Vermont's farm economy, environment and public health.

Contaminants in Sewage Sludge

If sewage sludge contained only human waste, returning it to the land for beneficial reuse of its nutrients would make environmental and economic sense. But municipal sewage systems receive a wide range of toxic substances that no wastewater treatment plant can handle.

Industrial Discharges

Discharges to sewers from industrial facilities contain a myriad of toxic materials used in or produced by manufacturing processes, yet most permits for such discharges regulate toxic materials solely by concentrations, and not the total amount of materials contributed to the sewage system. In the case of persistent toxic materials that do not break down, even small concentrations can build up over time to significant levels (Colborn et al., 1997).

Vermont has only fifty-five industrial facilities that are required to get a permit to discharge to sewers. Many of them discharge metals and other persistent substances in their wastewater. Yet when permitting land application or composting of sludge from sewage plants, regulators from the Department of Environmental Conservation's Wastewater Residuals (sludge) Management section are not required to examine the nature of any such industrial inflows into a sewage plant or to independently assess their potential to contaminate sludge.

Household Hazardous Waste

An average US household contains from 50-100 pounds of accumulated household hazardous wastes, including leftover painting supplies, insecticides and herbicides, motor oil and cleaning products. Despite efforts to educate the public on the dangers these products can pose when released to the environment, their disposal through household hazardous waste collection is often inconvenient and costly and a large portion of them are dumped down drains. (Inform, Inc., 1992)

In addition, many apparently harmless household substances can contribute to the creation of toxic compounds when they break down or combine with other elements of the sewage waste stream. Concern is growing over the unintended hormone-disrupting effects of many synthetic chemicals previously considered safe. Because many of these products are designed for use as cleaning or personal care products, they are deposited in the sewage wastestream as a natural consequence of their use. As cancer and other patients are increasingly treated at home with powerful chemotherapeutic agents, the issue of whether or not such neoplastic substances can remain active in the sewage wastestream remains open (Morris, 1999). When discarded at hospitals, such materials must be treated as hazardous and disposed of as regulated medical waste because of their potential to cause cancer and other health problems in exposed humans.

Small Business Discharges

Many small businesses such as garages, dental offices, photo shops, print shops and textile dying or processing operations use amounts of toxic chemicals that come in just under the threshold for reporting and regulation. These toxics are often dumped down the drain because of the cost of proper disposal, ignorance about their toxic properties, or the sense that the small amount a shop uses or generates is not worth special handling. Unfortunately, many of these small discharges taken together can add up to a significant toxic load on the sewers (Reed and Stockett, 1990).

Vermont Solid Waste officials estimate that small businesses and households in Vermont generate 232,100 gallons of waste paint and 930,000 gallons of waste oil each year. They do not have information on how much antifreeze, household chemicals or pesticides are disposed of annually (Solid Waste Division, 1999). In a citizen survey conducted as part of the Solid Waste Plan drafting process, 38% of respondents said they had no convenient way to dispose of paint, 32% said they had no convenient disposal method for used oil and 39% said they had no convenient disposal method for pesticides (Solid Waste Draft, 1999). All liquid wastes including oil, pesticides, paint and other household chemicals, are banned for landfill disposal in the state.

Given these facts, a significant portion of toxic wastes generated by households and small businesses may well end up in our sewer systems and septic tanks. Judging by estimates of hazardous waste generation among small businesses in Vermont that differ by as much as 100%, it appears that state and local officials have insufficient data to determine what this proportion might be for households or exempt small generators (Reed and Stockett, 1990). When asked for any compilation of estimated numbers of small businesses potentially discharging toxic materials in the state, Vermont regulators in the Pollution Prevention Program and the Environmental Assistance Program were unable to come up with this basic information. Without some master list that estimates numbers of photo shops, dentists, garages, dry cleaners and so on in the state, regulators cannot fully understand the impact such inflows may have on sewage sludge in the state.

Landfill Leachate

Leachate – the liquid that percolates through landfills-- is a highly toxic brew of multiple contaminants that seriously impairs groundwater when it runs off from unlined pits (Holm, J. et al., 1995; Rugge, K. et al., 1995). Up to 100 toxic substances have been analyzed in leachate, many at levels exceeding federal action levels (Inform, Inc., 1992). Yet it is frequently collected and disposed of through sewer systems, despite the fact that such systems cannot treat many of its toxic contaminants. The persistent toxic load of leachate is not diminished by sewage treatment, though some of its contaminants will vaporize during treatment and some are likely to be discharged in effluent. Instead, a major portion of the toxic contaminants in leachate will end up filtered into a sewage plant's sludge.

By mandating leachate collection systems for all landfills, the state of Vermont has attempted to responsibly deal with a horrendous groundwater contamination problem. However the state's own Solid Waste Plan (1989) points out that "most existing municipal waste water treatment plants are not designed to treat leachate. Therefore, waste water treatment plants will likely 'treat' leachate primarily by dilution."

However the state's own Solid Waste Plan (1989) points out that "most existing municipal waste water treatment plants are not designed to treat leachate. Therefore, waste water treatment plants will likely 'treat' leachate primarily by dilution."

Evaluating the toxic load that landfill leachate contributes to wastewater sludge is difficult, primarily because leachate is an extremely variable quantity that changes day to day due to volumes of precipitation, opening up of previously covered areas, decomposition of materials over time and so forth.

As the DEC's <u>Leachate Management Guidance Document</u> (1989) notes, "The types of materials deposited in the landfill, the percentages of household, commercial and industrial wastes, will determine the quantity and types of constituents present in the leachate. Waste recycling programs, household hazardous waste disposal programs, leachate recycling systems and other measures will reduce contaminant levels to varying degrees." When we look at estimated rates of hazardous waste capture of under 5% in the various Waste Management Districts (Reed and Stockett, 1990), it appears there is a very high likelihood that a significant amount of those hazardous materials are going into the dump (where they are not, as discussed earlier, going down the drain.).[2]

Persistent Toxics in Sludge

As more sewage plants come on-line in previously unsewered communities in Vermont, and as existing sewage treatment plants upgrade their efficiency, increasing amounts of toxic materials are filtered out of the waste stream and prevented from contaminating the state's surface waters. Unfortunately, this does not mean that these contaminants go away. It means instead that they become increasingly concentrated in the plants' sludge – the very substance that is now being promoted as a beneficial soil amendment or fertilizer.

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[2] A full analysis of the contribution of leachate inflows, household toxics and small business discharges is outside the scope of this report. Such research will be part of VPIRG's ongoing sludge andseptage research and education effort.

Some of the substances contributed to sewers by small business, household, industrial and leachate inflows are volatile and will tend to "cook off" or evaporate during the treatment process. Indeed, regulators have come to realize that these contaminants, including toluene, xylene, benzene, and chloroform, volatilize to such an extent that wastewater treatment facilities can be significant sources of air pollution. But wastewater treatment has no effect on heavy metals or persistent compounds such as dioxins, PCBs and other organochlorines. These substances will resist decomposition, and be filtered out into sewage sludge at the end of the treatment process. Because of their persistence and their demonstrated links to a host of health problems, they render sludge "recycling" potentially dangerous.

Toxics are known as "persistent" when they do not break down readily (or break down only partially, into persistent metabolites). Such toxics tend to build up in the environment and in the tissues of living organisms over time. When released to the environment, these persistent compounds have a cumulative impact, unlike substances which readily degrade into less toxic constituent molecules. Persistent toxics also bioaccumulate – meaning that as predator species eat organisms lower on the food chain that have absorbed these materials, they take in contaminants at an exponentially higher rate. In some predator species such as bald eagles or herring gulls, this magnification effect can result in concentrations of persistent chemical compounds millions of times higher than found in species lower on the food chain (Colborn et al., 1997).

Because they do not break down quickly and will eventually accumulate to amounts that are known to be dangerous, no level of persistent toxic pollutants released to the environment can be considered safe. Heavy metals such as cadmium, mercury and lead, and organochlorine compounds such as dioxins and furans, PCBs and some pesticide formulations are sources of extensive environmental contamination and are linked to multiple human and animal health impacts.

Heavy Metals: Mercury, Lead, and Cadmium

Concentrations of such heavy metals as mercury, lead and cadmium have been shown incontrovertibly to effect human and animal development. Cadmium is a recognized carcinogen (State of California, 1999), has been strongly associated with reproductive problems such as miscarriage, stillbirth and birth defects (State of California, 1996). It also has effects on kidney function and cardiovascular health at levels close to average environmental exposures (Kopp et al., 1982; Piscator, 1985).

Exposure to tiny amounts of mercury at key moments in fetal development can lead to lifelong learning deficits and neurological disorders, even when the exposed mother shows no effects (US-EPA, 1996). Every state in the US has mercury fish consumption advisories in place because of extensive contamination of the nation's waters with this toxic substance. In Vermont, every body of water carries fish consumption advisories for pregnant women and small children, who are the most vulnerable to the health impacts of mercury.

Mercury is an extremely potent neurotoxin – one gram can contaminate a 20 acre lake sufficiently to trigger fish consumption advisories. Yet federal and state sludge regulations allow pounds of this toxic substance – each containing 454 grams -- to be distributed in sludge.

Similarly, exposure to excess amounts of lead in early childhood can cause serious and irreversible behavioral and learning problems. Lead exposure is considered one of the most serious preventable public health hazards to children in the US (Landrigan, 1992), with an estimated 9%, or 1.7 million, preschool-age children affected nationwide (Batts, 1996). One lead expert estimates that the increase of lead levels in soils where sludge is land applied is equivalent to that produced by sixty years of leaded gasoline use near the same site (Tackett, 1995).

Some heavy metals are readily taken up through the roots of plants and thus made potentially available to foraging animals, or to humans eating plants grown on metal-contaminated soils. There is ample evidence that cadmium is taken up particularly efficiently by a variety of leafy greens (US EPA, 1983), and that lead is available for ingestion by grazing animals or the humans who eat them (US EPA, 1983). Several studies have shown that earthworms in sludge applied soils can also become highly contaminated with cadmium (Helmke et al., 1979). This could pose a significant danger to wild birds who could accumulate large amounts of cadmium in their tissues through ingestion of contaminated worms.

Table 3. Health Effects of Metals

Metal	Health Effects
Arsenic	Respiratory and digestive system irritant, liver damage, central nervous system effects, skin, liver, bladder, kidney and lung cancer
Cadmium	Chronic lung disease, kidney dysfunction, lung cancer
Chromium	Skin ulcers, perforation of nasal septum, lung cancer
Lead	Deficits in childhood IQ, reduced childhood growth, low birth weight, blood effects, high blood pressure, damage to kidneys and reproductive organs
Mercury	Acute bronchitis and pneumonia, kidney damage, central nervous system effects, delayed development
Nickel	Respiratory system carcinogen, allergic skin reaction
Selenium	Nausea, dizziness, eye and nose irritation, possible liver carcinogen
Zinc	Digestive system disorders, neurologic effects

(Goyer, 1986)

Mercury releases to the environment through sludge applications are also significant. Regulators had assumed that most of the mercury in sludge was in the inorganic form, which is not readily absorbed by living things, but increasing evidence suggests that most mercury in wastewater becomes methylated in the treatment process so that it is available for absorption (Carpi, 1997).

Mercury is an extremely potent neurotoxin – one gram can contaminate a 20-acre lake sufficiently to trigger fish consumption advisories. Yet federal and state sludge regulations allow <u>pounds</u> of this toxic substance – each containing 454 grams -- to be distributed in sludge. Environmental consultants retained by Ontario, Canada recently estimated that releases from sludge-applied land are the second largest source of environmental mercury contamination in that province.[3]

EPA regulation of heavy metals in sludge

Heavy metals are the one class of toxic material out of thousands of possible contaminants in sludge for which EPA has set 'allowable concentration' standards, because they are common in all sludges tested. Monitoring is required for nine heavy metals of concern: Arsenic, Cadmium, Copper, Mercury, Molybdenum, Nickel, Lead, Selenium and Zinc. For each of these metals, EPA

[3] Richard Phillips, Environmental Assistance Division, VT Dept. of Environmental Conservation. Testimony to House Natural resources Committee, March 1999, personal communication, Ian Smith, Ontario Ministry of the Environment, May 1999.

has set a limit that sludge cannot exceed if it is to be land applied or processed for distribution (see Table 4). Most of these metals are associated with serious health impacts in laboratory research and epidemiological studies (see Table 3).

The levels that EPA considers acceptable for land disposal or compost distribution seem very high to many knowledgeable scientists. Cornell University soil scientist Murray MacBride (1995) has pointed out that EPA's "acceptable levels" "will permit concentrations of particular toxic metals to increase locally on agricultural land by a factor of a hundred or more above present soil concentrations."

The rate at which EPA assumes that a child will absorb lead from the soil is some nine times lower than the usual estimated rate of absorption.

MacBride and many others have pointed out that EPA's assumption that metals will remain immobilized in soils over time is highly questionable, especially in the Northeastern United States, where precipitation is highly acidic and could increase leaching of metals from the soil over time (Harrison et al., 1997). In fact, Rufus Chaney, the USDA soil scientist whose work EPA has relied on most heavily in developing the Part 503 metals standards has himself said that "pH is the most important single factor to control metal transfer and toxicity" (Chaney, 1990).

Lead in soils is of particular concern, since research clearly demonstrates irreversible changes in behavior and mental function in children exposed to lead at key moments of brain development. Lead experts have expressed concern about the methodology EPA used to assess the risks posed to children by lead exposures associated with sludge. For example, the figure (10 micrograms per deciliter of blood) that EPA chose as a "safe" blood level in children is in fact the level at which permanent lowering of a child's IQ can occur (Bleifuss, 1995) And the rate at which EPA assumes that a child will absorb lead from the soil is some nine times lower than the usual estimated rate of absorption (Tackett, 1995). EPA's own documents acknowledge that sewage sludge will significantly raise lead levels in soils, and that it can endanger foraging animals (US EPA, 1983).

EPA Standards Trail Europe and Canada

Metals limits in most European countries and Canada are as much as ten times more stringent than the EPA limits, because they are based on the assumption that such limits should be protective, not permissive (see Table 4). In fact, the Netherlands mandates cleanup and remediation of soils at concentration levels well below the cumulative loading limits EPA terms acceptable for cadmium and mercury (Harrison et al, 1997).

Table 4. Maximum Concentration of Metals Allowed in Soil when Sludge is Applied (mg/kg)

Country	Year	Cd	Cu	Cr	Ni	Pb	Zn	Hg
European Community	1986	1-3	50-140	100-150	30-75	50-300	150-300	1-1.5
France	1988	2.0	100	150	50	100	300	1.0
Germany	1992	1.5	60	100	50	100	200	1.0
Italy	-	3.0	100	150	50	100	300	-
Spain	1990	1.0	50	100	30	50	150	1.0
United Kingdom	1989	3.0	135	400	75	300	300	1.0
Denmark	1990	.5	40	30	15	40	100	.5
Finland	1995	.5	100	200	60	60	150	.2
Norway	-	1.0	50	100	30	50	150	1.0
Sweden	-	.5	40	30	15	40	100	.5
United States	1993	20.0	750	1500	210	150	1400	8.0

(Source: Harrison, et al 1999)

Before the Part 503 rules were adopted in 1993, standards regulating municipal sludge disposal were considerably more stringent. One study found that only 7 of 30 municipal sludges tested met the standards for metals required for land application in 1983 (Haag et al, 1992). EPA's current standards for "acceptable levels" of metals in sludge for land application and composting are also significantly higher than originally proposed (Bleifuss, 1995).

The levels at which sludge can currently be land applied would disqualify it from disposal in a sludge landfill under a different section of the 503 rules

In fact, the levels at which sludge can currently be land applied would disqualify it from disposal in a sludge landfill under a different section of the 503 rules (US-EPA, 1993). Those landfill rules specify that sludge disposed of within 25 meters of the landfill boundary must meet standards for arsenic, chromium and nickel up to <u>twice as stringent</u> as levels for land application. Thus the federal land application standards actually encourage municipalities to land apply sludge that is considered unsafe for deposit in a sludge landfill!

Similarly, if sludge were regulated under federal solid waste regulations instead of under the Clean Water Act, the metals levels considered acceptable for land application under the 503 regulations would require landfilling. Disposing of them on the ground would be considered "open dumping", which is forbidden (National Sludge Alliance, #105, 1997)

If the amount of toxics contained in sludge were not diluted through mixing with the rest of the sewage going into a treatment plant, they might qualify for regulation as hazardous materials under other federal laws. Unfortunately, the federal laws also contain a loophole for toxics mixed into the sewage waste stream that allows such dilution (40CFRsubpart 266). Under the sludge regulations, where there is no federal standard established for a toxic contaminant in sludge, the level permitted is up to the level that would qualify the materials as a hazardous waste, minus .001 (EPA Reference 1993).

Political History

As discussed earlier, EPA's proposed standards for heavy metals were many times higher than those the Agency adopted after a highly contentious public comment process.

Annual loading limits for land application allowable under the 503 regulations also rose significantly. The amount of lead that could be spread on a site annually rose from a proposed

111 pounds to 267 pounds per acre. The revised regulations now allowed 50 pounds per acre per year of mercury, instead of the original standard of 12.5 pounds. The permitted annual level of arsenic rose from 12.5 pounds per acre to 36 pounds per acre.(Bleifuss,1995) Cumulative metals loading limits for sludge application sites also rose precipitously from the earlier standards -- the new standards for cadmium and lead were twice as high as in the original proposal and other limits rose by as much as 3000% (Coalition for Sludge Education, 1994).

pH Levels Affect Groundwater Leaching

Sludge proponents point out that the organic material in sludge and septage tends to bind with heavy metals and inhibit their leaching into groundwater or otherwise becoming available (Chaney, 1980). However, changes in soil pH affect this binding ability markedly. Some metals, like arsenic and molybdenum, tend to leach more readily in an alkaline environment, as when lime is added to sludge for pathogen reduction. Conversely, acid conditions can cause other metals like lead to leach more readily than they would under neutral pH conditions (Harrison et al, 1997).

The Northeastern US has highly acidic soils and acid precipitation that increases that acidity over time, making metals leaching quite likely. Yet the requirement that the pH of sludge-applied soils be maintained by liming of land application sites is dropped as soon as sludge application stops, ensuring that acidity will increase and metals will become more likely to leach. (Harrison et al., 1999).

Vermont Regulation of Metals

Vermont's current ceiling concentrations for metals differ from EPA's maximum pollutant concentration in EQ sludges, as indicated in Table 5. For chromium, copper, mercury, nickel and zinc, the Vermont standard is more protective than the federal standard. In other cases Vermont either has no standard or has a standard appreciably less stringent than the federal level. Where this is the case, as noted earlier, the federal standard prevails. Prior to adoption of Part 503 rules in 1993 however, Vermont used its own, more lax standards for some years.

Table 5. Comparison of Vermont and Federal Metals Concentration Limits (mg/kg)

Metals	Current Vermont Standard	EPA Maximum Concentration in "EQ" Sludges	EPA Maximum Ceiling Concentration
Arsenic	N.S.	41	75
Cadmium	25	39	85
Chromium	1000	--	--
Copper	1000	1500	840
Lead	1000	300	57
Mercury	10	17	75
Nickel	200	420	420
Selenium	N.S.	100	100
Zinc	2500	2800	7500

N.S.= no standard
(Source: Harrison et al., 1999, VT Solid Waste Rules, Subchapter 7)

The most striking instance of this is lead, where Vermont tolerated up to 1000 mg/kg in land applied or composted sludge while the federal standard forbids reuse of any material containing more than 840 mg/kg. Vermont's rules also set no ceiling level for arsenic, though it is both an acute poison and a known carcinogen (ATSDR, 1993; Goyer, 1986). Land where sludge was applied using these standards could have been contaminated at levels significantly higher than those now allowed.

Rule changes currently under consideration by the Agency of Natural Resources will eliminate some of the discrepancies between the state and federal metals concentration standards. The concentration standard for lead will be set at 300, consistent with the most stringent federal standard and new standards will be set at EPA's levels for arsenic, molybdenum and selenium, which currently have no standard set by Vermont rule (see Table 6).

Table 6. Current and Proposed Vermont Metals Limits

Metal	Vermont Standard (mg/kg dry weight)	Proposed Vermont Standard (mg/kg dry weight)
Arsenic	N.S.	10
Cadmium	25	21
Chromium	1000	1200
Copper	1000	1500
Lead	1000	300
Mercury	10	10
Nickel	200	420
Selenium	N.S.	100
Zinc	2500	2800

N.S. = no standard (Source: VT Solid Waste Rule Revisions Draft (Subch. 7)

Vermont Proposes to Relax Standards

As part of the rule change process, however, sludge regulators in Vermont have proposed that current concentration standards for copper, chromium, nickel and zinc be relaxed, despite the fact that average levels of these metals found in Vermont sludge are far below the current regulatory standard. Copper and chromium are known to be phytotoxic, meaning they can harm or kill growing plants, and metals imbalances can cause serious health problems in grazing animals (Bolton, B., 1997). Promoting an increase in their application to Vermont's farmland seems a questionable choice.

In addition, the new regulations could significantly increase the amount of toxic metals applied to Vermont land or composted and distributed. Prior to these rule revisions, Vermont sludge and septage regulations followed federally established cumulative loading standards. The only specific limit set by the state was for cadmium. Now the state has proposed new annual and cumulative loading limits for each individual metal. Though this looks like an improvement, in fact the most striking effect of the proposed rule change will be to relax the cadmium limit significantly. Increasing the amount of cadmium that can be applied to Vermont land, when cadmium can cause health effects at extremely low levels of exposure, seems a misguided and potentially dangerous choice.

Table 7. Annual and Cumulative Loading Limits, Vermont Draft Rule Revisions

Metal	Annual Loading Limit (pounds/acre/year)	Cumulative Loading Limit (pounds/acre)
Arsenic	1.8	36.6
Cadmium	1.7	34.8
Chromium	134.0	2676.0
Copper	67.0	1338.0
Lead	13.4	268.0
Mercury	.76	15.2
Molybdenum	3.3	67.0
Nickel	18.7	375.0
Selenium	4.5	89.2
Zinc	125.0	2498.0

(Source: VT Solid Waste Rules Draft Revision Subchapter 7)

The Case of Cadmium

Under Vermont's current rules, application of cadmium in sludge or septage is limited to .45 pounds (less than half a pound) per acre per year. Under the proposed rules, this level would rise to 1.7 pounds. Current rules restrict total cumulative loading of cadmium to 4.5 pounds per acre -- the proposed rule changes would raise that amount to 34.8 pounds.

Cadmium is of special concern not only because it has been associated with human reproductive problems, thinning of bone, kidney disease and cancer at very low exposure levels, but because [illegible] m in Americans' diet is already considered at a maximum safe level as regards [illegible] dysfunction and cardiovascular effects (Kopp,1982; Piscator, 1984) Deer in our [illegible] wn elevated levels of cadmium in their livers, triggering warnings against [illegible] and indicating significant levels of environmental cadmium exposure (Graham, [illegible] is very readily taken up by green leafy plants such as spinach, kale and chard [illegible] – making the application of sewage sludge compost to home gardens a [illegible] erous route of human exposure. Though each dose of cadmium ingested in such [illegible] be tiny, the metal remains in the body over time and has a cumulative toxic effect. By weakening the cadmium standard, environmental regulators will increase the likelihood that the public's exposure to this metal will reach critical levels.

Mercury Standards

Incredibly, at one point in internal Agency discussion, regulators proposed relaxing the mercury standard from 10 mg/kg to the 17 mg/kg EPA level.[4] With every lake and stream in Vermont currently under fish consumption advisories (Vermont Department of Health, 1997), the Vermont Agency of Natural Resources has identified the reduction and/or elimination of environmental mercury releases as a top priority. To argue that regulation of mercury releases to the environment should be relaxed is to ignore the reality of the significant environmental health risks due to mercury in our region.

Cumulative Loading: Toxic Buildup over Time

[4] personal communication, Michael Bender, Mercury Policy Project 1997.

The proposed Vermont rules permit each acre of land to receive 268 pounds of lead, 34.8 pounds of cadmium, 36.6 pounds of arsenic and 15.2 pounds of mercury. In addition, each acre of a given site could receive 2676 pounds of chromium, 1338 pounds of copper, 67 pounds of molybdenum, 375 pounds of nickel, 89.2 pounds of selenium and 2498 pounds of zinc.

Because metals are persistent and will build up over time in sludge applied soils, it is important to consider not just the concentration standards applied to each batch of sludge but the overall limits restricting the total amount of cumulative metals "loading" at each disposal site. Vermont currently operates under EPA's "cumulative loading" standards for each of the ten heavy metals of concern; proposed rule changes would establish those loading limits as part of Vermont's own regulations. In practice, calculations regarding the estimated amount of metals applied with each batch of sludge are used to ascertain whether cumulative loading limits are reached.

The cumulative loading levels considered acceptable are strikingly high. They permit sludge disposal on a land application site until each acre of land has received 268 pounds of lead, 34.8 pounds of cadmium, 36.6 pounds of arsenic and 15.2 pounds of mercury. In addition, each acre of a given site could receive 2676 pounds of chromium, 1338 pounds of copper, 67 pounds of molybdenum, 375 pounds of nickel, 89.2 pounds of selenium and 2498 pounds of zinc. Since no background testing of land application sites is required prior to sludge application, the actual amounts of metals in the soil could be higher than these figures.

To put this in perspective: it would take close to 2200 thermostats (at 3 grams each) to equal 15 pounds of mercury and 446 gallons of lead based paint (at .6 lbs lead per gallon) to equal 268 pounds of lead. Despite the relatively tiny amount of toxics they contain, lead paint and mercury-containing thermostats are banned from landfill disposal and collected as hazardous wastes because of the significant cumulative risk they pose to human and animal health. Yet toxic metals that cannot be legally placed in a contained and regulated landfill, when found in sludge or septage, can be spread out over the landscape with impunity.

Actual Levels

Because metals are regulated by concentrations, not aggregated amounts, in sewage inflows, in effluent and in sludge, the cumulative environmental impact of metals in sludge is difficult to assess. By translating concentrations into actual amounts, we can get a better sense of what that environmental impact is on average.

Multiplying the state's figures for average concentrations of metals in Vermont sludge by the total amount land applied and composted in 1997 (Solid Waste Division, 1999) yields some sobering figures. At current average concentrations, we are distributing over 340 pounds of lead, 18.7 pounds of cadmium and 8 pounds of mercury across Vermont farmland. In addition, we are distributing some 170 pounds of lead. 9.3 pounds of cadmium and 4 pounds of mercury in sludge compost to be applied to home gardens, spread under swingsets and used as fill in residential developments.[5]

At current concentrations, we are distributing over 340 pounds of lead, 18.7 pounds of cadmium and 8 pounds of mercury across Vermont farmland. In addition, we are distributing some 170 pounds of lead,9.3 pounds of cadmium and 4 pounds of mercury in sludge compost to be applied to home gardens, spread under swingsets and used as fill in residential developments.

Vermont's rules do not require liming or other methods to maintain neutral pH levels in the soils following closeout of a site where sludge

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ıt Draft Solid Waste Plan Revisions, January 1999. Because es may under- or overestimate the actual totals.

has been applied. There is no requirement that sludge or septage compost bear labels requiring pH maintenance, acidity in the soils where sludge materials are applied will inevitably increase over time. With this increased acidity, leaching of lead and other toxic metals to ground or surface waters is likely (Harrison et al, 1999).

Table 8: Vermont Metals Standards vs Average Concentrations in Sludge

Metal	**Vermont Standard (mg/kg dry weight)**	**Average (1997) Concentration in Vermont Sludge and Septage (mg/kg dry weight)**
Arsenic	N.S.	10.47
Cadmium	25	6.08
Chromium	1000	58.69
Copper	1000	783.80
Lead	1000	112.14
Mercury	10	2.58
Nickel	200	34.82
Selenium	N.S.	5.07
Zinc	2500	994.52

(Source: VT Solid Waste Plan Draft Revision Jan. 1999)

Allowable Levels

More troubling still, the metals limits set by Vermont's sludge regulations are much higher than the levels presently found in Vermont's sludge and septage. The average concentrations of metals in Vermont sludge are as much as 95% lower than the standard established in the regulations (Solid Waste Division, 1999). The amounts of metals that could be legally released to the environment through sludge application and distribution are much higher than the figures cited above.

Distribution of sludge containing cadmium, lead and mercury at the ceiling concentrations specified in the current rules – sludge that would be considered acceptable under Vermont and federal law for land application and composting – could result in astounding amounts of contamination: <u>Under current standards, 2579 pounds of lead, over 30 pounds of mercury and almost 77 pounds of cadmium could be land applied per year in the state; 1288 pounds of lead, 15 pounds of mercury and 38 pounds of cadmium composted and given away.</u>[6]

Because copper is phytotoxic and occurs at high levels in Vermont sludge relative to other metals, excess levels of copper would tend to limit land application before the other cumulative loading limits were reached.[7] Given a different ratio of metals, though, the amounts listed above could be applied to Vermont land with no violation of the regulations. This is a particular concern with regard to out-of-state sludge. Even more importantly, since composted sludge has no cumulative loading limits imposed on its use, no limiting factor like copper restrictions would keep thousands of pounds of toxics from being distributed for home and garden use.

[6] These figures are calculated using existing Vermont standards, except in the case of lead, where EPA's more stringent ceiling concentration of 840mg/kg would apply instead of Vermont's current 1000 mg/kg , and arsenic, where Vermont has no standard.

[7] Personal communication, Cathy Jamieson, DEC Residuals Management 1997; Mike Emond, Chief Operator, Springfield VT Sewage Treatment Plant, May 1999.

A system of regulation that aims at allowing increasing amounts of toxics in sludge is not protective of the environment or public health. In fact, the only logical rationale for such a system is to enable the importation into Vermont of far more toxic sludge than that generated in-state, or to allow for a marked increase in industrial discharges to our sewer systems with no decrease in land disposal of the resulting toxic materials. No regulation that could allow the legal dumping of thousands of pounds of lead and tens of pounds of cadmium and mercury per year into our environment can be considered adequately protective.

Organochlorines

Many persistent toxic pollutants belong to the family of organochlorines -- organic compounds that contain chlorine. These substances include infamous names such as dioxins, PCBs, DDT and Agent Orange, but also commonly used pesticides and solvents. Organochlorines are often formed as byproducts of the manufacture, use, and disposal of products that contain chlorine and will turn up in sewage sludge through industrial discharges, leachate inflows, sewer disposal of chlorinated pesticides and the combination of chlorine molecules with organic material in the sewage treatment process itself.

EPA's own literature states, "Most sludges contain organic compounds, primarily chlorinated hydrocarbons, which are relatively resistant to decomposition in soils and may be of concern from a human health standpoint" (US EPA, 1983). Information compiled from researchers at Cornell and the American Society of Civil Engineers showed the presence of many chlorinated pesticides in municipal sewage sludge (Lester, 1992).

Organochlorine compounds have long been associated with devastating health effects in wildlife – such as the near extinction of bald eagles through exposure to DDT in their prey species. They have also been strongly correlated with cancers in humans with high occupational or accidental exposures (John Snow Institute, 1994). Laboratory work has shown that organochlorine pesticides can promote the growth of breast cancer cells (Steingraber, 1997). Evidence further suggests that low-level environmental exposures to organochlorines may be capable of promoting cancer.

The organochlorine compounds of greatest concern may be dioxins, a class of related substances so potent that according to the EPA the acceptable daily dose is 0.006-picograms/ kilogram – the equivalent of one drop of dioxin in 600,000 railroad cars of water.

Citizens of Western industrialized countries are already exposed to dioxins and dioxinlike organochlorine compounds – dibenzofurans and PCBs--on a daily basis. The average body burden of dioxins and their counterparts in the US– the amount carried in the body's fatty tissues– is estimated at 58 parts per trillion (DeVito, et al, 1995). At a body burden of 58 parts per trillion (ng/kg), monkeys develop endometriosis, a painful reproductive disorder that effects some 5.5 million women in the United States and millions more around the globe (Gibbs, 1995; Colborn et al, 1997; Thompson, 1998). Humans with a body burden of 83 parts per trillion (ng/kg) show decreases in testosterone levels (Gibbs, 1995). Researchers note that levels of dioxin in the population will tend to vary greatly (DeVito et al, 1995), and that at least 5% of the population will have body burdens as much as twice as high as the average background level (Huisman, et al, 1995).

Dioxins

Dioxins are strongly associated with cancer promotion in exposed humans (JSI, 1994**).** They are also implicated in reproductive abnormalities, altered glucose tolerance, testicular atrophy, learning disabilities, spina bifida birth defects in children of exposed adults and other chronic effects in both animals and humans (Erickson, et al 1984; Sweeney, 1992; Roegner, 1991; Porterfield,1994). The cumulative evidence of thousands of studies reviewed by EPA indicates that dioxin is associated with so many different health effects because it interferes with the basic functions of the body's hormonal system, which regulates a dizzying array of physiological functions (US-EPA, 1994b).

The primary human route of exposure to dioxins is through eating dairy products and meat contaminated when farm animals graze on contaminated pastures or eat feed that contains dioxins (EPA 1994; Commoner and Richardson, 1998). Recent testing by Consumer Reports found an amount of dioxin in a single jar of baby food that exceeded the EPA recommended daily dose by 100 times (Consumer Reports, 1998). Breast fed babies can receive up to the total recommended lifetime dose of dioxinlike compounds in their first year of life through contamination of their mothers' breast milk (Colborn et al., 1997). More conservative estimates put the average total intake during breastfeeding at something closer to 10% of the lifetime dose (EPA 1994) – still a shocking intake level for the first year of life!

These early exposures are particularly troubling because dioxins, like other so-called endocrine disrupters, may have a particularly powerful effect on small children exposed at critical moments in their development. Studies of infants exposed to small amounts of dioxin in utero and through breast milk have found measurable changes in liver, thyroid, immune and neurological functions (Pluim, et al,1992). Several animal studies have shown major fertility decreases in rats and hamsters born to mothers exposed to a single, extremely tiny dose of dioxin during their gestation (Colborn et al, 1997).

"Background" exposures to dioxin in the US already meet or exceed the "safe" exposure level recommended by EPA and the Agency for Toxic Substances and Disease Registry – ATSDR. Though these agencies estimate the acceptable daily exposure levels differently (ATSDR's level is 1 picogram per kilogram) both estimate that, on average, US citizens experience a higher rate of exposure (EPA, 1994a).

EPA's draft dioxin reassessment estimates average intake of dioxins by humans at 3-6 picograms per kilogram of body weight per day, adding "This is more than 500-fold higher than EPA's 1985 risk-specific dose associated with a plausible... one in a million [cancer risk]" (EPA 1994b)**.** No level of such a substance can be considered safe – regulatory efforts should focus on eliminating any further release of dioxins and dioxinlike compounds, not promoting their dispersal into the environment.

EPA Regulation of Dioxins

In 1990, EPA's National Sewage Sludge Survey showed dioxins and furans (a closely related class of organochlorine compounds) in every sludge sample taken from large (over 100 million gallons a day) sewage treatment plants around the country. The mean concentration of dioxins was some 11micrograms per kilogram (parts per billion), with 35 percent of sludges tested showing the presence of 2,3,7,8 TCDD – the most toxic form of dioxin (EPA, 1990).

Land application of sludge released more dioxin to the US environment than cement kilns burning hazardous waste, aluminum smelters, industrial and residential wood burning, diesel engines and industrial coal combustion combined.

EPA's recently issued analysis of sources of dioxin in the US found that sewage sludge applied to land contained 12% of the total amount of dioxin released to the environment in 1995. That means that land application of sludge released more dioxin to the environment than cement kilns burning hazardous waste, aluminum smelters, industrial and residential wood burning, diesel engines and industrial coal combustion combined (US EPA, 1998c). And the 12% figure does not take into account sludge compost and other sludge-derived materials distributed directly to the public.

Yet there are currently no federal protocols or requirements for testing sludge for dioxins or furans or restricting its use based on dioxin/furan content. This stands in contrast to Germany, which has significantly restricted the reuse of municipal sludge based on concerns about dioxin contamination (Bleifuss, 1995). EPA says that it intends to regulate dioxins and furans in sewage sludge in the near future (Water Environment and Technology, 1998). The EPA has also promised to release the final draft of its Dioxin Reassessment for five years now but shows no sign of releasing it soon.

Vermont Regulation of Dioxins

Recent testing of sludge and sludge compost from 19 municipal sewage treatment facilities in Vermont, performed by the Department of Environmental Conservation, revealed some level of dioxin contamination in every one of the samples, and significant levels in some. The City of Rutland's sludge, which is currently landfilled, showed almost 60 parts per trillion of dioxin, while a compost sample from Springfield had levels close to 17 parts per trillion. (See Table 8)

There is some question whether or not the dioxin concentrations reported for the various samples are reliable. Discrepancies between the lab's reported "practical quantification limit" – that is, the level at which technicians can accurately assess the concentration of dioxin present in a given sample – its "estimated detection level" – the level at which they can estimate the concentrations but not accurately quantify them -- and the reported dioxin levels suggest that the results are inconclusive at best, and could be significantly in error (Robins, Dec.1998).[8]

Common sense would suggest that if Vermont wishes to retain an edge as a state that produces "pure" dairy products and other foods, we should not apply materials containing dioxins to land for used for fodder crops or pasture for dairy or meat animals. And given the potential public health impacts of increased dioxin exposure, regulators should attempt to restrict the public's contact with materials known to contain dioxin where such contact is unnecessary.

[8] (Full discussion of such technical detail is outside the scope of this paper. Because the issue of dioxin contamination is so crucial to assessing the risk posed by land application and distribution of sludge and septage, we will examine the dioxin research further in a follow-up study to this one.)

Table 9. Dioxin Levels in Vermont Sludge and Sludge Compost

Town	Dioxin Level	Fate of Sludge
Barre	5.08	land applied
Bennington		
Sludge	13.11	composted/distributed
Compost	3.18	
Brandon	27.40	incinerated (Glens Falls,NY)
Burlington - East	3.42	to Burlington Main
Burlington – Main	9.31	composted in Canada
Chelsea	10.54	land applied
Johnson	4.33	composted
Middlebury	9.72	land applied
Montpelier	7.63	landfilled
Pittsford	6.72	incinerated (Glens Falls,NY)
Randolph	4.82	landfilled
Richmond	1.54	land applied
Rutland	59.45	landfilled
St. Albans	7.97	land applied
St. Albans (duplicate)	6.30	land applied
South Burlington	2.18	landfilled
Springfield		
Sludge	9.12	composted/distributed
Compost #1	9.71	
Compost #2	16.83	

(Source: DEC Dioxin Test results, 1997)

But instead, sludge regulators argue that the levels found in Vermont's sludges are below concern, basing their contention on a Memorandum of Understanding between EPA and large paper companies in the state of Maine which allows land application of sludge containing dioxins up to 50 ppt.(US EPA ,1994c)[9]

Basing policy for Vermont on this agreement ignores several salient facts – 1) paper companies are the most significant industry in Maine, and one of the major sources of dioxin generation in the US, and 2) the agreement arose out of litigation and thus represents a compromise position, not a health based standard. Elsewhere, EPA's Region IX office has promulgated regulations governing Superfund cleanup standards that call for soil levels to be reduced to .45 femtograms per cubic meter (US-EPA Region IX, 1999**)--** a figure equal to less than one part per quadrillion, yet Vermont regulators have not embraced that standard as a model for their regulation of dioxins.

As discussed above, epidemiological and experimental evidence increasingly suggests that no level of dioxin exposure can be considered safe, and that we are all approaching "full" when it comes to the concentrations of dioxin in our bodies. Yet Vermont, like EPA, requires no testing for dioxins and furans before land application or composting of sludge and has not officially established any level of dioxins that would disqualify sludge from distribution. This failure to take proactive steps to protect public health from the potential impacts of this devastatingly toxic chemical reveals the shortsighted nature of the current system of sludge regulation.

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[9] personal communication, Cathy Jamieson, DEC Residuals Management, 1997.

PCBs

Extremely stable chlorinated compounds, polychlorinated biphenyls, better known as PCBs, were used as industrial lubricants, cutting oils, liquid seals and cooling fluid in electrical transformers for forty years. Over the years, they were also incorporated in consumer products – stucco, paints, inks, pesticides, and carbonless copy paper. By the time the US and other countries banned the manufacture and use of PCBs in the 1970's based on their ability to contaminate the environment, these persistent molecules had dispersed throughout the globe (Colborn, 1997).

Evidence from wildlife studies indicate that PCBs affect fertility, and human studies have associated PCB exposure with increased miscarriages and decreased sperm motility (Colborn, 1997). In addition, studies of children exposed to PCBs in utero have found striking signs of long-term neurological impairment, behavioral problems and learning deficits at levels of exposure only slightly above the exposure of the general population in the US (Jacobson,et al, 1984).

EPA Regulation of PCBs

PCBs are commonly found in municipal sewage sludge, and sludge application has been shown to increase concentrations of PCBs from 4 to 10 times over concentrations found in non-sludge-applied soils (Alcock et al., 1995; McLachlan et al., 1994). Because of this prevalence, PCBs were formerly regulated under federal rules that governed land application of sludge. The regulations required only that sludge containing greater than 10 parts per million (ppm) of PCBs be plowed under where animal feed crops are grown (US EPA, 1983), but they at least made some provision for reducing exposure.

This was hardly a stringent standard -- even if EPA had prohibited any "recycling" of sludge with 10ppm PCB concentrations, it would offer only minimal health protection, since EPA's standard for a 1 in 10,000 risk for cancer from exposure to PCBs is 4.6 ppm, or less than half the 10ppm figure (EPA, 1994). In the new 503 regulations put forth in 1993, PCBs are no longer regulated. There is no longer any requirement to test for them. The EPA says that it intends to begin (again) to regulate the most dioxin-like PCBs in sludge in the near future (Water Environment and Technology, 1998) but has taken no steps to address a real exposure issue now.

Vermont Regulation of PCBs

Vermont regulates PCBs in sludge and septage more strictly than EPA. Vermont's sludge rules forbid land application or distribution of sludge or septage that exceeds the 10mg/kg standard for PCBs. But correspondence between the Vermont Health Department and the Residuals Management section indicates that these test results need not pertain to the actual batches of sludge being land applied or distributed.

In 1996, during permitting of the Springfield sludge composting operation, the Health Department raised a concern with regard to PCBs, asking that operators be required to receive and review PCB test results for specific batches of compost before the material was distributed. The Residuals Management staffer writing the permit responded that the facility would have PCB test results "on hand" but distribution would not wait for the actual batch tests to be received – implying that sporadic test results on sludge from the plant would be assumed to represent all sludge composted. In other words, despite the fact that public health officials felt it was wise to do batch testing and review results before distribution, this concern was ignored (VT DEC, 1996). This is particularly striking choice because Springfield's sewage treatment plant receives leachate from a Superfund site contaminated with PCBs among other toxics, and because Springfield sludge tests positive for the presence of multiple congeners of PCBs on a regular basis.

PCB levels in Vermont sludge have consistently tested far lower than the 10 ppm standard. On the one hand, this is good news, yet it again raises the troubling question of why state regulators set acceptable limits for toxic contaminants in sludge so far above the actual concentrations found. Why not set a virtual elimination goal for this highly toxic and almost incredibly persistent chemical, and work to get there, instead of allowing for the possibility of sludge much more highly contaminated with PCBs finding its way onto Vermont land?

As with heavy metals levels, land applying or distributing sludge containing the "acceptable level" of PCBs would result in significant PCB contamination. If it contained PCBs at the ceiling limit specified in rule, land spreading the same amount of sludge that was land applied in Vermont in 1997 would result in the distribution of 30 pounds of PCBs across the state. Since exposure to mere molecules of PCB's is associated with detrimental health effects, establishing a system that could allow pounds of them over the land cannot be reasonably depicted as protective.

Persistent Toxics in Sludge: Conclusion

Because the health and environmental impacts of many persistent toxics are evident at such low levels of exposure, government agencies charged with protecting human health and the environment have undertaken huge efforts to reduce their release into the environment. The banning of DDT and PCBs and the phaseout of leaded gasoline are perhaps the most well-known of such efforts. In recent years federal and state regulators have also undertaken significant, and costly, efforts to reduce mercury exposures to the general population.

Persistent toxics are present in measurable amounts in all sewage sludges in the US, and it is inevitable that they will either build up over time to dangerous levels in the soil or leach out of soils and into waters where sludge is applied. Yet instead of eliminating or even seriously restricting the levels at which organochlorines, heavy metals and other persistent toxic substances can be spread upon land and distributed in the form of compost, EPA and the Vermont DEC actually promote their distribution in amounts that could significantly increase the contamination of agricultural and other soils in Vermont and unduly expose the public to their potential health impacts .

Endocrine Disrupters and Other Unknowns

Studies have found that of the 3000 chemicals produced or imported in the US at over a million pounds a year, less than a third have met the minimum accepted requirements for health hazard screening. We simply do not know whether or not these or others of the some 80000 chemicals in commercial use present a serious health risk or not, despite the fact that laws authorizing health screening of chemicals have been in effect in the US for over twenty years (Environmental Defense Fund, 1997).

Recently, grave concerns have surfaced over the strong possibility that many synthetic chemicals in everyday use can interfere with the actions of naturally occurring hormones. Because very small amounts of hormones control essential processes in all living things, environmental exposures to such "endocrine disrupting" chemicals (or EDCs) could have profound effects. Research from around the world is beginning to link hormone-influencing chemicals to some cancers, reproductive and immune system disorders and growth and developmental abnormalities in a wide range of organisms, including humans Scientists have hypothesized that apparent declines in human sperm counts worldwide may also be linked to exposure to these substances. (Colborn et al, 1997)

Some endocrine disrupters, such as DDT and dioxins, were already identified as toxic before the recent concern over chemical hormone disruption surfaced. But there is increasing evidence that elements formerly considered safe or only mildly toxic and contained in many everyday products can also profoundly affect hormonal processes.

Common chemicals, including such apparently benign substances as surfactants used in cleaning products (see box) and pthalate compounds used to increase plastic's flexibility are known to have endocrine disrupting effects on animals in the lab and in the wild (Colborn et al, 1997). In addition, estrogen-mimicking compounds regularly used in plastics have been shown to increase the growth of breast cancer cells in the test tube (Soto et al, 1991).

Household Product or Hormone Disrupter?

Alkylphenol ethoxylates (APEs) are compounds used as surfactants in many different household and industrial cleaning and cosmetic products – hard surface cleaners, detergents, pesticides, hair coloring, shampoo. They are not readily biodegradable and remain in sewage sludge in significant amounts following wastewater treatment. One study in Switzerland found concentrations of one of the alkylphenols as high as 2530 parts per million in samples of anaerobically stabilized sludge. A recent study of municipal sludge in the US showed levels of 160ppm. Exposure to these compounds and one of their common breakdown products, nonylphenols, has produced intersex effects in fish -- both in lab studies and in the wild, male fish develop yolk protein and reduced testicle size when exposed to APE's. Since some APEs are used intentionally as human contraceptives, it is a logical hypothesis that exposure to related compounds might disrupt the human body's reproductive system. Most European countries have banned or limited APEs in response to these findings and their implications. Yet in the US APEs are still widely used and there is no requirement to test sewage sludge or septage for them or their breakdown products prior to land application.

But the bulk of the chemicals currently in commercial use are as yet untested for endocrine disruption. We simply do not yet have the knowledge to adequately protect against the potentially devastating effects of the thousands of EDCs we may be exposed to daily. Yet the evidence suggests our exposure to these compounds is significant. Tests of newborn babies' umbilical cord blood found 12 to 16 pthalate compounds present**.** We do not adequately understand the effects of this lifelong exposure to hormone-mimicking synthetic chemicals within our own bodies and throughout our environment. The only prudent policy is to avoid unnecessary exposures to chemical compounds by preventing their release to the environment.

EPA and Vermont Regulation of Endocrine Disrupting Chemicals in Sludge

Land applying and distributing sewage sludge and septage, release the residues and breakdown products of thousands of chemicals in industrial or household use to the environment. Both practices are entirely inconsistent with preventing excessive exposure to endocrine disrupting and otherwise toxic chemicals. Yet EPA has failed to address the potential for widespread endocrine disruption through the application to the land of the many thousands of chemical compounds in sewage sludge and septage.

In response to concern about endocrine disrupters, EPA has established a study panel, which has recommended testing protocols to begin to determine chemicals' endocrine disrupting potential. However the preliminary screening process is likely to take years even to begin assessing the endocrine disrupting potential of all chemicals in commercial use. In the meantime, neither EPA nor Vermont offers any guidance on dealing with this issue as it regards exposure to sewage sludge.

Pathogens in Sludge

In addition to toxics, sewage sludge inevitably contains a wide range of bacteria, viruses and parasitic organisms that can damage human and animal health. A person contaminated with an enteric virus, for example, can excrete millions of viruses per gram of feces, and can shed viruses into the sewage waste stream for up to 50 days (Melnick and Gerba, 1980).

Identifying all pathogens in a given sample of sludge is a daunting if not impossible task. As authors of one study put it, "Microorganisms are subject to mutation and evolution, allowing for adaptive changes in their environment. In addition many pathogens are viable but nonculturable by current techniques ... [so] concentrations in sludge are probably underestimated. Thus no assessment of the risks associated with the land application of sewage sludge can ever be considered to be complete when dealing with microorganisms"(Straub et al., 1994).

Serious Concerns about Pathogens

A brief review of the pathogenic organisms found in municipal sludges raises serious concerns:

- Listeria bacteria are found in high concentrations in sewage sludge, and have been shown to survive for more than 7 weeks in sludge applied soils (Watkins and Sleath, 1981). A study of coliform bacteria found significant survival and regrowth of such bacteria in sludge applied soils, particularly in cool and damp conditions (Pepper et al, 1991), similar to those in Vermont.
- Samples taken this year from land outside Kansas City where sludge was last applied in 1992 contained 650,000 salmonella and E. coli bacteria per hundred grams of soil – thousands of times higher than levels considered acceptable by public health officials (Lewis, 1999). House flies and birds have been shown to transport salmonella between sites in the wild; thus this highly infectious pathogen could travel beyond the limits of sludge applied fields (Beauchat &Ryu,1997).
- Viruses that can produce meningitis, congenital heart anomalies and serious gastroenteritis have been found to concentrate in sludge (Ward and Ashley, 1977; Wellings, 1976) and studies have shown high variability in secondary treatment's ability to reduce their presence (Soares, 1990). Sludge stabilization treatments reduce virus counts significantly, but studies show significant virus survival in sludge amended soils (Straub et al, 1994).
- Species of parasitic cysts such as Giardia and Cryptosporidium, which can cause serious gastroenteritis, are commonly found in sewage sludge in the US (Straub et al, 1993, Soares, 1990) Some evidence suggests that anaerobic digestion treatment can inactivate a portion of these cysts, but many studies indicate parasitic survival in cyst form is significant. Such organisms as cryptosporidium and giardia can survive for over a year in cyst form in surface water and can cause serious illness. There is no proof that they do not survive comparative time in land applied sludge that is only 20% solids. (Robins, 1997)
- Molds, especially a class of common fungus known as Aspergillus, are found in sewage and sludge throughout the treatment process (WHO, 1981). Aspergillus fumigatus can cause serious respiratory tract infections in humans and is found in significantly elevated levels at municipal sludge compost facilities. A 1984 EPA study found high rates of aspergillus antibodies in otherwise healthy sludge compost workers. For immunocompromised or

sensitive populations such as AIDs or chemotherapy patients, asthma sufferers, children or elderly people such infections can cause serious illness or even death (Kramer, 1992).

- Unknown quantities of pharmaceutical products also flow into sewage systems, ending up in effluent and perhaps in sludge (Buser and Muller, 1998; Raloff, 1998). Quoted in Science News, Stuart Levy, director of the Center for Adaptation Genetics and Drug Resistance at Tufts University, notes that antibiotics can affect e.coli and other bacteria at the parts per trillion level and their presence in wastewater together with those bacteria could "not only alter the ecology of the environment but also give rise to antibiotic resistance." (Raloff, 1998)

EPA Pathogen Regulation

EPA requires sludge or septage intended for land application to undergo PSRPs (Process to Significantly Reduce Pathogens). The processes involved – aerobic digestion, anaerobic digestion, air drying, composting and lime stabilization -- reduce but do not eliminate infectious material in the sludge or septage treated. Thus land-applied sludge will still contain viable pathogens and the potential for spreading infectious disease.

EPA contends that access and cropping restrictions on land application sites will prevent human contact with infectious agents. However fences and notices will not restrict animal or bird access to such sites. In addition, EPA regulations contain no siting restrictions for land application sites or composting facilities that prevent their being located close to schools, hospitals, residential neighborhoods, etc. Thus the distance wind, animals or birds must transport an infectious organism before it comes into contact with potential human hosts can be very short.

EPA regulations for "Class A" sludge and septage that can be distributed to the public require treatment by a Process to Further Reduce Pathogens, or PFRP. The options for PFRPs are high heat composting, heat drying, heat treatment, aerobic digestion, pasteurization or irradiation by exposure to cobalt. None of these treatments eliminate the possibility of infection through surviving organisms, yet the material is treated as noninfectious, with no federal requirements for tracking where it goes or who uses it (Harrison, et al 1999).

Vermont Pathogen Regulation

Vermont's rules on pathogen reduction follow the EPA model. All sludge disposed directly on a land application site must be shown to meet Class B pathogen reduction requirements. This can be demonstrated by testing of the material for fecal coliform OR salmonella levels, or treating it using one of the PSRP methods outlined in the federal regulations. The most common PSRP methods used in Vermont are anaerobic digestion and lime treatment, which have shown success in reducing bacterial and viral contamination but have little effect on parasitic cysts (Straub et al., 1993).

To qualify for distribution to the public, sludge has to undergo a PFRP as described above. Existing sludge composting facilities in Vermont use the high heat composting process, whereby compost piles are supposed to be maintained at 55° centigrade for at least three days, to satisfy the PFRP requirement.

But no conclusive evidence demonstrates that heat is evenly distributed throughout these compost piles. Thus pathogens could remain viable in lower-heat, exterior sections of a given pile and reinfect those sections effectively treated by the heat. In addition, piles of composted sludge or septage often sit for weeks or months following treatment, increasing the likelihood of reinfection. Surviving pathogens in compost could endanger worker health or contaminate the facility's surroundings if airborne dust escapes the treatment site. Verification of the even distribution of heat through the compost piles is left to the facility operators.

Like EPA, Vermont allows siting of composting facilities near homes, schools, businesses and health care facilities, increasing the risk that citizens could be exposed to pathogens and fungi. Because the same infectious agents that have little impact on a healthy adult can have a devastating impact on anyone -- people with AIDs, chemotherapy patients, elderly people -- whose immune system is weakened, proximity to sludge processing facilities can significantly increase health risks to these vulnerable populations (Kramer, 1992).

Pathogens: The Vermont Context

The latest data released by the Vermont Department of Health indicate that Vermont has experienced serious problems with infectious disease outbreaks over the past 15 years. In fact, during 1994 Vermont experienced the <u>highest incidence rate in the US</u> of salmonella enteriditis outbreaks. During 1995 an outbreak of disease caused by an enteric virus strain surfaced (Vermont Department of Health, 1998). And in 1997, a farm in Fairfax located only a few miles from a sludge application site experienced a terrifying outbreak of drug- resistant Salmonella DT104 (Spake, 1997). Investigators from the Centers for Disease Control have been unable to pinpoint a cause for that outbreak despite a full year of investigation. No investigation was made of the possible transfer of pathogens from sludge.[10]

Health Department officials have identified the issue of drug resistant infectious disease as a significant public health concern for the state (Vermont Department of Health, 1998), yet neither the Health Department nor the DEC has adequately addressed the possibility that sludge distribution might raise the risk of such diseases.

No definitive link can be established between outbreaks of infectious disease in Vermont and any single factor. In fact, one of the troubling aspects of the increased exposure to pathogens afforded by land applied sludge is that it would be extremely difficult to verify whether any link existed between an application site and an outbreak of disease (Wilcke, 1994). However, these events clearly suggest that state health and environmental officials should take a cautious approach to this issue and thoroughly analyze the potential for the spread of disease posed by the intentional release of viable pathogenic organisms to Vermont's environment in sewage sludge.

Radioactivity in Sewage

"The amount of radioactivity coming out of a hospital's sanitary sewage system because of patient excreta wouldn't be allowed if it were coming out of a nuclear power plant," health physicist David Allard, of Arthur D Little Consulting was quoted in an article in the Hudspeth County (TX) Herald in 1995).

In fact, hospitals, clinics and decontamination laundries discharge significant amounts of radioactive isotopes to sewage treatment facilities every day. A General Accounting Office (GAO) report undertaken after major radiation contamination was discovered at a sewage treatment plant in Cleveland indicated that not only were these discharges largely unsupervised by the Nuclear Regulatory Commission, which nominally oversees low-level waste disposal, but they apparently complied with applicable NRC regulations (1994).

Only a small portion of the sewage treatment operators interviewed by GAO staff were even aware that they could encounter radiation contamination problems from sewage inflows (GAO,

[10] Personal communication with farmer Cynthia Hawley, January 27, 1999.

1994). And radionucleides were found to concentrate in the plants' sludge rather than being flushed out in the plant's effluent (GAO, 1994). Many of the radionucleides discharged to sewage treatment plants carry a minimal radioactive charge and will decay fairly rapidly, but they nonetheless can pose exposure issues for those transporting and applying or composting sludge. Such radioactive material could also pose a threat if carried with dust from plowing land applied sites, since ingestion of radioactive particles, even those with a minimal charge, can allow those particles to lodge in the body and initiate cell mutations.[11]

EPA Regulation of Radioactivity in Sludge

As the GAO testimony summarized the situation: "The health implications of treatment plant workers and the public to contaminated sludge, ash and related by-products are unknown because neither NRC nor EPA knows (1) how much radioactive material may be in these products, and (2) how these products might affect people"(GAO, 1994). <u>EPA regulations on sewage sludge contain no limits or testing protocols for radioactivity, and no precautionary restrictions on the land application or composting of sludges derived from sewage systems into which low-level radioactive wastes can be expected to flow.</u>

Vermont Regulation of Radioactivity in Sludge

Vermont requires no testing of sludge or sludge products for the presence of radioisotopes. There are no restrictions on the application of materials to the land or their distribution to the public based on radioactivity. Yet hospitals in Vermont treating patients with radiation therapy must discharge these materials in sewage every day. Patients undergoing radiation treatment can also be expected to discharge irradiated matter into their septic tanks or town sewage systems.[12]

"The health implications of treatment plant workers and the public to contaminated sludge, ash and related by-products are unknown because neither NRC nor EPA knows (1) how much radioactive material may be in these products, and (2) how these products might affect people" (GAO, 1994).

In the early 1990s, a problem in Windham County confirmed that radioactive material could pose a risk from Vermont sludge. Inflows from Vermont Yankee (and perhaps local medical facilities) to the Brattleboro sewage treatment plant caused the plant's sludge to become irradiated to a significant degree. Yet because there were no testing protocols or safeguards in place, sludge had been spread on numerous fields around the Brattleboro area before the problem was discovered. Investigators from the Health Department found significant levels of radionucleides in the Brattleboro sewage sludge tested. Yet Health Department regulators have not set policies to address the possibility of low-level exposures arising from the widespread application of potentially irradiated sludge and septage materials to fields and gardens in the state.[13]

When state environmental regulators investigated radioactive contamination at the Safety Medical Systems medical waste plant in Colchester in 1998, they found several types of cobalt particles that have half-lives of up to a year (Burlington Free Press, 1998). This indicates that some medical facilities may generate waste irradiated with relatively stable isotopes with the potential to release radioactivity to the environment over a significant period of time. Yet

[11] personal communication, Dominique Casavant, professor of Physics, St Michael's college, 1998

[12] Personal communication, Ray McCandless, VT Health Department Occupational and Radiological Health Program May 1999

[13] Personal communication, Mike Jennings and Ray McCandless, VT Health Department May 1999

Vermont regulators have taken no formal steps to detect or divert such wastes from sewage treatment plants that land spread or compost their sludge.

A Broader Look at Regulatory Flaws

The above discussion reveals the alarming gaps in both EPA and Vermont's regulatory framework for sludge "recycling". In order to change the approach that generates those gaps and to move away from debating specific levels of risk, it is necessary to understand the fundamental flaws of analysis and intent that these rules are based on.

Analytical testing is inadequate

Sewage flows are so highly variable, sources of contamination are so varied and surges of unidentified toxic material coming through the pipe are so unpredictable that no testing program can adequately address the tens of thousands of potential contaminants in sludge. And even if all contaminants of the sewage waste-stream were identified, we simply do not have the data to adequately assess what risk most of them pose to human health or the environment. Sampling of small portions of the total sludge volume a plant produces could easily miss pockets of highly toxic materials. And sampling frequencies are woefully inadequate (See Table 10 for sampling frequencies in rules draft), allowing smaller plants to wait months between tests.

Table 10. Sludge Testing Frequency

Average Amount of Sludge Produced per day (tons)	Average Amount of Sludge Produced per year (tons)	Testing Frequency
0 to .85	0 to 320	Once per year
.85 to 4.5	320 to 1,650	Once per quarter (4 times per year)
4.5 to 45	1,650 to 16,500	Once per 60 days (6 times per year)
= or > 45	= or > 16,500	Once per month (12 times per year)

EPA's risk assessment for sludge is not protective

Though sludge proponents, including Vermont regulators, point to EPA's comprehensive risk assessment process as 'proof' that sludge is safe, several factors undermine this assertion.

1. EPA's "safety" figures are based on a one in ten thousand risk instead of the 1 in one million that is the standard for almost all other programs. This means levels of exposure are characterized as "acceptable" in this risk assessment if they will only cause one additional death per ten thousand people. Toxicologists argue that a one in one million risk is very close to no risk, which is why it is chosen as an adequately protective standard. No one can argue that one additional death in ten thousand people is no risk.
2. EPA assessed the risk posed by particular toxics in one medium at a time, with no assessment of total exposure scenarios. A person living near a sludge application site could be exposed to a particular substance through groundwater contamination, blowing dust, plant uptake or eating contaminated animal flesh, simultaneously or in turn. Yet EPA's risk assessment assumes that every exposure takes place separately and estimates 'safe' levels of exposure based on such single medium evaluation (Harrison et al., 1999).
3. EPA's risk assessment assumes that exposure to sewage sludge will be the only source of exposure to substances of concern. For such ubiquitous toxics as lead, dioxins, mercury and cadmium, and for many endocrine disrupting compounds in general use this is obviously a

false assumption. EPA's own literature asserts that levels of exposure to dioxin and mercury in the general population approach or exceed the dose considered "safe" already. Exposure to sewage sludge piles additional risk onto an already overloaded population.

4. <u>EPA considers no synergistic effects among the thousands of substances mixed together in sludge.</u> Scientific studies have repeatedly demonstrated that substances that have no or minimal effect alone can have major toxic impacts when combined with other compounds. This appears particularly true for hormone disruption effects, which can result in devastating impacts on development (Warren et al., 1999). Yet EPA's risk assessment made no attempt to evaluate synergistic reactions, even in a limited subset of chemicals found in sludge.

Chapter 2: On the Ground

Wherever possible, spokespersons and materials must have a down-home, community feel so that people will be comfortable with biosolids recycling and not view it as an imposition by outsiders.

from "Communications Plan on Biosolids" Powell Tate, 1993

There are 201 active land application sites[14] for sludge, septage and a small amount of food processing waste, located in 53 Vermont towns, varying in size from a few acres to 50 acres or more (see Table 1and map following Executive Summary**)** Active sludge application sites are found in every county of Vermont. Washington County has the highest number of active sites with 33, while Essex County has the fewest at 5. Many towns have multiple sites within their borders – notably Hinesburg with 11 sites, Barre with 10 and Woodstock with 8. In 1997, sludge, septage, and food waste were applied in 22 towns out of 53 (see Table 10). The Residuals Management Section does not have aggregate figures for how much total acreage is used for sludge and septage application in Vermont.

In !997 1535 tons of sludge were applied to land across the state. In addition to the sludge applied to in-state land, the City of Brattleboro sent some 305 tons of sludge across the river to be land applied in New Hampshire. Seven hundred sixty seven tons of Vermont sludge were composted in four locations and distributed to the public as a "soil amendment". With those 2302 tons of sludge, 510 pounds of lead, 28 pounds of cadmium, 12 pounds of mercury and almost 50 pounds of arsenic were also distributed across the state on farmland, playgrounds, parks and housing developments.[15]

Table 11. Towns in which Sludge or Septage was Land Applied in 1997

Town	Amount Land Applied in Dry Tons	Town	Amount Land Applied in Dry Tons	Town	Amount Land Applied in Dry Tons
Bethel	3.6	Middlebury	189.2	Richmond	97.3
Bradford	8.4	Newport City	145.6	Sheldon	1.1
Castleton	78.8	North Branch	8.4	St. Albans	212.9
Chelsea	7.1	North Troy	14.5	St. Johnsbury	185.9
Enosburg Falls	21.1	Northfield	43.1	Washington	230.4
Guildhall	8.1	Plainfield	5.2	Windsor	35
Hartford-WRJct	128.5	Randolph	29.1	Woodstock	37.4
Lyndon	43.9				

(Source: VT DEC 1997 Printout)

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[14] The "active" designation means sites currently permitted for land application of municipal sludge – not all active sites are currently applying sludge.

[15] Calculated from averages in DEC Solid Waste Plan Revisions Draft , January 1999. Actual amounts could be larger or smaller, as these figures are based on averages.

Because Vermonters have traditionally reused a wide range of waste materials such as manure and plant material to improve soils, the practice of reusing sewage sludge as a soil amendment seems benign to many Vermonters at first glance. Unfortunately, when we examine the materials currently flowing into our sewage systems, it becomes clear that the land application of sewage sludge and its distribution to the public as compost does not result in beneficial reuse of human waste materials alone. Instead it results in the distribution of persistent toxic materials across the state, the long-term contamination of some of our richest land, and a significant redistribution of responsibility for industrial wastes from their producers to the ordinary citizens whose health and well-being may be undermined by the impact of toxic sludge.

Yet in the most recent draft Solid Waste Plan revision, now under review, the Residuals Management section proposes to nearly double the percentage of sludge "recycled" through land application or composting from 45 to 80 percent (Solid Waste Division, 1999). Before any such expansion is undertaken, we believe the citizens of Vermont have the right to examine the current regulation of sludge, assess its impact on the ground and evaluate the options open to municipalities for sludge disposal.

Though state regulators insist that land application and composting are safe practices that have caused no harm in Vermont, the record is not so clear. Harm may well have been done to a farmer who lost cows to mysterious wasting disease after sludge was spread on his land. Harm has clearly been done to citizens who have spent months and years choking on overpowering odors from sludge operations in their neighborhoods. And more subtle damage may be occurring now as citizens are exposed without their knowledge or consent to toxics contained in sludge compost and spread on land application sites. The instances reviewed below, while only a sampling, make clear that the safety claims of sludge "recycling" proponents are far from ironclad.

Case Histories[16]

Dairy Herd Die-Off

In 1986**,** farmer Bob Ruane began accepting sludge from the Rutland wastewater treatment plant, applying it to his fields at a rate of 5.5 tons per acre and feeding his herd of 180 dairy cows corn silage grown on the fields between applications. Two years later, he began noticing strange health problems in the herd. They began to suffer from arthritic conditions and to lose weight. Cows aborted or bore calves with leg deformities. Milk production dropped significantly from 18,000 to 14,000 pounds per year. Finally the cows began to die.

Over the course of four years from 1988 to 1991, Mr. Ruane lost 101 of his cows. His average cull rate before this had been 2 cows per year. Alarmed by their strange ailments, he began to videotape the sick cows. His tapes show cows shaking uncontrollably, losing control of their legs and falling. His vet could not understand what factors could lead to this sort of illness in the herd, nor could Mr. Ruane, until he remembered the sludge.

Vermont Regulators Failed to Investigate Possible Sludge Connection

When Ruane questioned state and local officials about the possibility that his cows' illness was connected with the sludge application, he was told that the sludge had been applied at acceptable rates. Autopsies of some of the cows by veterinarians at Cornell showed signs of severe liver

[16] Information in this chapter is taken from the permit and compliance files of the individual sewage treatment plants and sludge operations discussed, from news coverage of those operations, and from conversations with affected parties where possible.

damage, but Ruane could obtain no conclusive proof connecting the deaths to the sludge application. In 1990, state sludge regulators refused to renew Rutland's land application permit, pointing to excess nitrate levels in two monitoring wells. (In our review of permits, we have seen multiple examples of excess nitrate levels in wells without site closure resulting.) Ruane's cows continued to die at unusually high rates, and in the same manner through 1991. Vermont sludge regulators maintained that the levels of metals in the sludge applied to Ruane's land were "acceptable" and could not have caused the damage he experienced.

Dioxin testing of the Rutland plant's sludge in 1996 revealed that it contained the highest level of dioxins in the state, at over 59 ppt. Though dioxin may not have caused Ruane's cows' illness, it has been associated with damage to the central nervous system and enlargement of the liver (Gibbs, 1995). Whether or not cow's illness was related to the elevated dioxin levels, exposure for those humans plowing or harvesting on the sludge applied fields could have been at levels far exceeding the "safe" dosage.

Ruane is attempting to sue the state and the city of Rutland for damages connected with the sludge application operation on his farm, since he is unable to sell the farm due to sludge contamination. Despite this compelling story, state regulators continue to insist that the levels of metals and other toxics contained in sludge pose no threat to animals or humans, and to press for increased sludge application to farmland in Vermont.

Odor

Chittenden Pelletizing plant

In 1994 Burlington wastewater officials put a sludge "pelletizing plant" into operation in South Burlington. The plant was designed to treat sewage sludge at high heat to kill pathogens, then form it into pellets that could be sold to the general public for use as fertilizer. Though this scenario seemed positive, the project was plagued from the start by extremely strong and objectionable odors escaping the facility. Neighbors claimed that they were unable to work or carry on their daily activities because it was so powerfully obnoxious.

The problem appeared to arise from the very process of heating the sludge, which was required to make sure that it was free from infectious agents. Because it had not undergone biological digestion, the sludge gave off extremely strong odors (Robins, 1997b). When heated, the sludge also became an extremely fine powder that choked all air filters, thus ensuring that odors would escape the plant almost continuously[17].

After years of attempts to control the odor problems through various technical fixes, and despite receiving a settlement of 1.5 million dollars from the contractors who had sold the equipment to them, the Chittenden County Solid Waste District finally decided to close the facility in 1995. Solid Waste District Director Tom Moreau explained that even with the cash in hand, the district could not ensure that the plant would operate correctly or odor free, and so the decision to shut the facility was the best option available.

State regulators had made no demand that the facility be shut down, despite the fact that three years of discussions with the District had accomplished no resolution to the odor complaints.

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[17] Personal communication, Tom Moreau, Director of the Chittenden Solid waste Management District, March 1999.

Something Rotten in Randolph

Sludge and septage odor can disrupt neighborhood activities and impose a terrible burden on those neighbors subjected to it day after day. Though regulators point to odor control provisions included in every state permit as a guarantee against such suffering, experience on the ground suggests that such provisions are exceptionally hard to enforce.

In Randolph, neighbors have complained repeatedly about the overpowering odors emitted by Central Vermont Septic/Environmental Dewatering's land application site, without success. The company is owned by Robert Dimmick and all of its septage currently comes from Cassella Waste Management. Residents tell of numerous times when the smell was so bad they felt like prisoners in their own homes, as they could not go outside. Local business has suffered as well. According to one of the owners of a nearby horse farm, there have been days when their clients left because the odor from one of the land application sites was so overwhelming.

The citizens have found themselves in a dilemma. The state allows multiple materials to be applied to the same site, but in essence have told the citizens that if they want the state to crack down on the odor problem then the citizens must prove that it is the septage that is the problem. Residuals section staff visited the site in response to odor complaints but never officially cited Dimmick for the odors. Instead, they suggested that the odors might come from Mr.Dimmick's other operations of spreading manure and wastes from ice cream processing. No evidence was provided to back up these theories, nor were they tested. Yet they offered sufficient uncertainty that sludge regulators were not compelled to enforce the odor conditions in the septage permit and shut down Dimmick's operation until he could prevent odor from escaping the site.

Not only did regulators not take enforcement action in this case; in 1999, despite multiple unresolved odor complaints, they issued Dimmick a draft permit to operate a new sludge and septage composting facility in the same location. In the end, the proposed composting facility permit was withdrawn over a legal issue and not because it might disrupt a neighborhood or sicken citizens of the town. The withdrawal of the permit was only a partial victory for neighbors, who now await the summer months and the return of noxious septage odors with dread.

The Dimmick case points to the difficulty of enforcing odor provisions in any sludge or septage permit. It also elucidates the troubling fact that septage, manure and food wastes could all be legally spread on the same fields, without any coordinated management for the combined application efforts.This weakens regulators' claim that septage and sludge are only applied at the correct "agronomic rate" for a given crop. If multiple substances, all regulated by different programs or permits, can be placed on top of each other on a single site, what oversight ensures that the application of all three wastes remains within the limits of the various programs that govern their application?

Toxics

Toxic Inflows to Sewers in VT

Because of the high rate of small businesses in Vermont dealing with hazardous materials, and because of the cost and inconvenience of traveling long distances in rural areas to drop off household or workplace toxics for hazardous waste management, even small town sewer systems can receive significant toxic inflows. In some ways, Vermont's sewage flows may be less predictable and easily understood than the waste-stream elsewhere, precisely because we have so few regulated inflows and so many small, unregulated discharges.

Because of this lack of predictability, Vermont's regulation of the "recycling" of sewage sludge and septage should contain adequate precautionary measures to ensure that we do not contaminate our land either with known poisons or with substances of unknown character and toxicity. As discussed above, the rules governing these practices do not offer such a precautionary approach. Nor do regulatory management practices by Vermont's sludge regulators appear to protect against the specific potential for contamination arising from the circumstances of individual treatment plants.

Northfield: A Known Polluter Continues Discharging

In the village of Northfield, discharges from the Barry Chouinard clothing manufacturing plant account for approximately 25% of the inflows to Northfield's sewage system. When the village's sewage treatment plant failed its Whole Effluent Toxicity Test (WETT) procedure, plant operators logically looked to Chouinard for the source of toxicity. Testing of Chouinard's various process wastewaters revealed that several of them showed elevated levels of copper and significant toxicity to aquatic organisms. (WETT is a basic testing procedure, whereby concentrations of effluent are raised in a water sample until species of aquatic biota in the water begin to die.)

However, instead of halting Chouinard's discharge to the Northfield sewage treatment plant, the Agency of Natural Resources instead did a curious thing. In November of 1998, the Wastewater Management Division issued a wastewater discharge permit and an Assurance of Discontinuance simultaneously. That is to say, they issued permission for the facility to continue to contaminate the sewage waste-stream with unknown toxic elements and excess copper, while at the same time ordering them to cease doing so.

During the time that the discharges from the Chouinard facility were failing toxicity testing – that is to say, killing aquatic organisms – no restrictions were placed on the land application of the sludge from the Northfield sewage treatment plant because of the toxicity problems, though the land application site bordered the Dog River. No extra testing of sludge was required, no precautions were taken to prevent contamination of the land application site with whatever toxic element contaminated the Chouinard discharge.

Despite the fact that some element of unknown character in the discharge – hypotheses included formaldehyde, surfactants, dye --was obviously lethal to aquatic organisms, no official attempts were made to investigate or ensure that that element did not persist in the sludge, despite the fact that it was being land applied on a site 50 feet from the river.

Bennington: Eveready Raises Mercury Levels

The Eveready battery manufacturing plant in Bennington manufactures mercury-containing button batteries among other products. Judging by their discharge permit limit for mercury of 313.5 mg per day, they also discharge significant amounts of mercury to Bennington's wastewater treatment plant. The ceiling limit for mercury discharges in the facility's permit is 313.5mg/day, with a required monthly average of 127.23 mg per day. In three days at the ceiling limit, the plant could discharge almost a gram of mercury to the treatment plant. This may sound small, but mercury is a highly potent neurotoxin. A gram of mercury can contaminate a 20-acre lake to the point that fish are unsafe for pregnant women or children to eat.

In the month of December 1998 the plant exceeded even this generous limit and discharged 625.28 mg – more than half a gram -- of mercury in a single day to the Bennington treatment plant. Due in part to this extraordinary discharge, the plant also exceeded the monthly average limit in its permit during the month of December – the average discharge was 199.09 mg/day

(70 mg higher than permitted). That is, the plant discharged almost 6 grams of mercury in a month. Yet despite the plant's notification of the wastewater program that this extraordinary discharge had occurred, no restrictions were placed on the reuse of the sludge resulting from this discharge. A significant portion of those six grams of mercury, along with the rest of the mercury discharged at the permitted rate, will soon be distributed to the general public from the Bennington compost plant.

Compost in Vermont is not required to bear any label warning of possible health dangers, and the Bennington plant does not label its sludge compost with metals test levels as some plants voluntarily do. It is theoretically possible for a pregnant woman to take home compost containing mercury from Eveready's discharges and put it on her garden. Through breathing up dust particles bearing mercury or ingesting them from soil on her hands, she can expose her developing child across the placental barrier to levels of mercury that could create permanent impairments. There is no requirement in the rules to restrict her access to the material, or warn her of the potential consequences of exposure. And Eveready no longer bears any liability for the consequences of its discharge to the sewer of one of the most potent toxic materials known.

Springfield: Composting Superfund Leachate

Like Bennington, Springfield composts the sludge from its sewage treatment plants and gives it away to landscapers, developers and the general public. Springfield was one of the first sludge composting plants, starting in 1991. Town officials had expected to sell the compost and thus save money, but it has not worked out that way. For several years, they had to stockpile the sludge compost (an activity not allowed by their permit) for lack of buyers. They now give the compost away free and figure that the whole process only costs slightly more than paying to landfill the sludge ($90 per ton to compost versus $80 per ton to landfill.)[18]

Like Bennington, the Springfield treatment plant receives a significant amount of toxic inflows. The machine tool industry in Springfield discharges solvents and acids used for metal plating to the plant. More importantly, leachate from the Old Springfield Landfill and from BFI's Rockingham landfill --two sites on the Superfund National Priority List– has also been discharged to the treatment plant in significant amounts. These leachate flows can obviously be expected to contain concentrations of toxic compounds.

The old Springfield dump is contaminated with vinyl chloride, benzene and other volatile organic compounds, PCBs and other contaminants from the disposal of paint, solvents and other materials over the site's 20 years of operation (US-EPA, 1998b). Not surprisingly, Springfield's sludge frequently tests positive for all PCB congeners analyzed. Tests of the leachate inflows to the Springfield sewer system also show measurable levels of trichloroethane, methylene chloride and butadiene.

Though highly toxic, these substances are also volatile and will tend to at least partially evaporate during pretreatment. However, studies of municipal sludge have found that many similar volatile or semivolatile organics remain in sludges in significant amounts following sewage treatment (Switzenbaum, 1993). And these particular contaminants are cause for concern. Trichloroethane is a recognized carcinogen and mutagen (Sax and Lewis, 1989). Methylene chloride affects the central nervous system and increases the risk of liver and lung cancer in animals (EPA, 1998). Butadiene consistently reaches levels in Vermont's air that exceed safety standards for exposure. If these substances continue to volatilize during the composting process, workers in the plant or neighbors could be unduly exposed.

[18] Personal conversation, Mike Emond, Springfield Sewage Treatment Plant Chief Operator, May 1999

The Rockingham landfill was named to the Superfund priority list because of high levels of contamination by volatile organic compounds and heavy metals, particularly chromium, copper and lead. The Rockingham landfill also received metal- and dioxin-contaminated ash from Wheelabrator's Claremont, New Hampshire incinerator for a several years. The Springfield plant was permitted to receive up to 40,000 gallons of leachate per week from this dangerous site, and accepted the leachate for some three years.[19] No testing of leachate was required for dioxins.

Calculations performed by landfill operators to assess the impact of this discharge on Springfield's sludge show that the BFI/Rockingham inflow was expected to double the concentration of arsenic in the plant's sludge. Because the arsenic concentrations in the sludge remained beneath the regulatory concentration limit, this was not considered problematic. Despite the fact that arsenic has been used for thousands of years to poison people at very low doses, regulators did not prevent its being distributed to the public in compost. Springfield no longer accepts leachate from Rockingham.

In addition to the leachate from these two Superfund sites, Springfield, like Windsor (see below) also accepted leachate directly for several years from the New Hampshire/Vermont Project's ash dump in Newport, NH, where the Claremont trash incinerator dumps tons of ash daily. Over the six months from October of 1992 to April of 1993, while the sludge composting facility was operating, the Springfield plant accepted 2,750,000 gallons of this leachate flow, which has shown extremely high levels of lead and other metals and is likely to contain dioxins bound up with suspended particulate matter (New Hampshire/Vermont Project, 1992-3). Though the plant has not accepted this leachate for some years, the ash leachate's could well have contaminated compost processed during several years of operation.

Given the Springfield plant's history, it is not surprising that one test of Springfield's compost showed a dioxin level of close to 17 ppt -- one of the highest levels of any of the sludges and sludge products tested in the state.

"Toxics Laundering"

The process of depositing toxic material into the treatment plant and thereby diluting it, then distributing it to the general public as is done in Springfield and Bennington looks more like "toxics laundering" than appropriate treatment.

Through this process, those who are financially liable for the Superfund sites that discharge to the Springfield treatment plant are absolved of the cost and effort of disposing of the leachate in a restricted facility, despite the fact that sewage treatment will do little more than dilute and reconcentrate any persistent toxic materials in the various leachate streams. Similarly, the Eveready plant in Bennington is released from the financial and liability burden for disposal of the mercury that goes down its drains.

And finally, the Superfund responsible parties, the incinerator operators, the factory owners, the trash officials who run the toxic ash landfill, and state and federal officials are relieved of liability and responsibility as the toxics they have generated and regulated are gradually spread out through parks, housing developments, and home gardens in the Bennington and Springfield regions.

East Montpelier

A similar toxics laundering process is now proposed for Central Vermont. The city of Montpelier wants to build and operate a sludge composting plant in the neighboring town of

[19] Personal communication, Mike Emond, Springfield Sewage Treatment Plant Chief Operator, May 1999

East Montpelier. The proposed facility would accept sludge from sewage treatment plants in Montpelier, Barre, Bradford, Chelsea, Northfield, Plainfield and Randolph.

The Montpelier sewage plant is currently permitted to accept up to twelve thousand gallons per day of leachate from three different landfills. Last year the Montpelier plant accepted 1,976,000 gallons of leachate from those landfills, on 165 days of the year. (District 5 Environmental Commission, 1999) The town of Randolph, which is proposing to send sludge to the plant also, accepts leachate from its town landfill, at a permit rate of 5000 gallons per day. Preliminary analysis performed by the state of Vermont on landfill leachate around the state reveals that such leachate tends to contain high levels of volatile and semivolatile organics as well as metals.

The interesting feature of Montpelier and Randolph's current leachate treatment agreements is that they constitute almost closed loop economic systems. In exchange for the treatment of leachate from Casella Waste Management's landfills, Montpelier obtains a specified amount of sludge disposal space at those landfills at no cost. Randolph too had an agreement whereby the town landfill accepted sewage sludge in exchange for being allowed to dispose of leachate in the sewage treatment plant. (Since the landfill closed in 1997 this loop is no longer functioning.) If either leachate or sludge exceeds the agreed upon amount in such a system a nominal per gallon or per ton fee can be assessed.

Apart from intermittent problems with leachate flows into the plant that occasionally upset the treatment process, systems like those established in Montpelier and Randolph function to filter significant amounts of toxic materials from leachate and return them to the landfills, while costing neither the municipalities nor the landfill operators money. In fact, these systems constitute perhaps the most appropriate approach to handling landfill leachate that exists in the state. Such a system is not only environmentally but also economically sustainable, since it reduces or even cancels out the cost of sludge disposal from the municipalities' budgets.

The composting operation proposed for East Montpelier will instead set up an open-ended system whereby where landfill operators will have to pay for leachate disposal, municipal authorities will have to pay to finance the composting facility, and toxic materials filtered out of the landfill leachate will be distributed to the general public under the guise of fertilizer. Given the experience of the Town of Springfield, city officials may find they have problems getting rid of the composted materials and fail to reduce disposal costs. Yet City officials and state environmental regulators seem determined to support this change for the worse, even in the face of strong citizen opposition to the plant.

Compost Your Troubles Away...

This review of Bennington, Springfield and Montpelier points up a striking fact - three out of the five sewage plants in Vermont that compost their sludge or propose to do so (excluding only the Johnson and Wilmington facilities, which have no significant single sources of toxics) have highly toxic inflows to their sewage systems.

Three out of the five sewage plants in Vermont that compost their sludge or propose to do so have highly toxic inflows to their sewage systems.

Why would regulators choose to permit these facilities for composting, given the potential for citizen exposure to toxic materials through distribution of this sludge? Is this decision based on a precautionary approach to the question of sludge disposal or on an assumption that the benefit to a few parties of disposing of the material outweighs the potential risks to the public health and the environment?

Windsor: Dioxin Contamination

The lack of precautionary measures to limit exposures to toxics in sludge is evident in the sequence of events in Windsor during 1997 and 1998. The New Hampshire/ Vermont Project needed to renew their leachate disposal permit, which allowed the waste district to dispose of leachate from their metal- and dioxin-contaminated incinerator ash dump in the Windsor and Springfield sewage treatment plants. The leachate had repeatedly shown extremely high levels of lead and other metals, yet it was permitted to flow into a sewage treatment plant whose sludge was being land applied only a short distance form the center of Windsor, 50 feet from the bank of the Connecticut River, on fields used to grow fodder crops.

When Windsor's sludge tested at almost 12 parts per trillion, well above most other sludge in the state, Vermont regulators took no action to halt or even review the land application or composting program until local citizens became active on the issue. Questioned about this, state regulators replied that the dioxin levels found in Windsor's sludge were beneath concern for land application.

This contention is based on a portion of the memo of understanding signed between EPA and the major paper companies in Maine that was discussed in Chapter 1. This agreement represents a litigated compromise between extremely powerful industrial interests whose goal is to rid themselves of as much dioxin-contaminated sludge as possible and a regulatory agency trying to reduce dioxin contamination without offending a powerful political interest unduly. A standard set by such a process is not germane to Vermont's situation and that does not aim for the levels of protection that Vermont could actually achieve. Yet when the subject of dioxin comes up, the Residuals Management staff cite this document as justification for knowingly contaminating Vermont farmland with this extremely toxic substance.

Windsor has been struggling with severe dioxin contamination of the old state prison properties in town now used as school and residential property. Applying additional dioxins to the land is inappropriate anywhere in the state, but it is particularly inappropriate to do so in a town where many citizens may have already been exposed to dioxins at unsafe levels. But despite citizen pressure and expressions of concern from the town manager, the selectboard, and the farmer who was doing the sludge application on his land, the state took no steps to limit the landspreading, or to deny a permit renewal to the ash landfill operators. Instead, regulators told the citizens of Windsor that the levels being applied to land were safe and they shouldn't worry about them.

Instead, the citizens of Windsor took matters in their own hands last June, coming out in large numbers to a special meeting to convince their selectboard that it was senseless to knowingly add to the town's levels of dioxin contamination. The selectboard voted unanimously to begin to reduce toxic exposures in Windsor by rejecting the ash leachate inflows, and the money that came with them.

No Local Control

The events in Windsor can remind us that common sense may be better exercised locally than at the state or federal level. When the citizens of Windsor came out to dialogue with their leaders, with the farmer who was land applying, and with each other about what steps they could take, they were able to reach a consensus decision about refusing toxic imports into their town. Their action can serve as a model for Vermonters looking to limit their own and their neighbors' exposure to toxic contamination deemed "acceptable" by regulators.

St Albans: An ordinary operation

But perhaps the cases reviewed above are anomalies. In order to assess the functioning of a less extreme case, we looked at the records of an operation without any single outstanding problem -- the St. Albans wastewater treatment plant and its associated land application program.

High Levels of Lead

In looking at land application records alone, we found that levels of lead in St Albans' sludge were between 35 and over 100 mg/kg over the past 5 years. One 12-acre land application site in St Albans received between 1/3 pound and 1 pound per acre of lead over the five years from 1993 - 1997. Notes in the file indicated that the site could still receive another 346 pounds of lead per acre, (that's 346 x 12) before requiring closeout.

Barium

In addition to significant lead loading, sites in St Albans have also had problems with elevated levels of arsenic and barium. In 1996, a groundwater monitoring well on one of St Albans land application sites showed elevated barium readings of .88 mg/liter -- well above the Preventative Action Level of .5 mg/ltr established by the Vermont Department of Health. This reading did not trigger immediate closure of the site or any further action on the part of the farmer, wastewater treatment plant operators or the state.

No monitoring of the flow of groundwater from the area of the monitoring well was required, no analysis was performed of the possible impact of this barium spike on local groundwater supplies. Instead the state simply required that the monitoring well results show lower levels for two years before the site could be officially closed. The site was closed in the end because of significant exceedences of nitrate levels in the monitoring wells. Barium levels in the affected well declined over time, as one would expect to happen as the metal leaches out into groundwater.

Arsenic

Elevated arsenic readings were also a problem for the St Albans sewage treatment plant. Several readings on the sludge levels indicated elevated concentrations of this carcinogenic metal. In one case, the test results showed a nondetect of arsenic at a detection level of 94 mg/kg -- indicating, if one did not analyze the results carefully, that arsenic was not present in the sludge. It was not until 2 years after the fact that a state regulator pointed out that this "detection limit" is higher than the standard of 75 mg/kg set for land applied sludge (Robins, 1997a). This type of incompatibility between testing protocols and protective standards reveals yet another flaw in a system that relies on analytical test data rather than preventive and protective practices to keep toxic materials off the land.

Nitrate Problems

In the end, a large portion of the St Albans land application sites was closed to further sludge application in 1997 due to elevated nitrate readings in monitoring wells on 11 different fields. The nitrate levels exceeded both Preventative Action Limits and enforcement standards on many of these sites, and continued to do so over many years between 1989 and 1997. These exceedances demonstrate that the notion of limiting nitrogen loading to agronomic rates is only partially protective of groundwater. Though nitrates are not acutely toxic to adults, their presence in well water can lead to significant increases in dangerous "blue baby" syndrome in newborns.

Poor Monitoring

The St. Albans sewage treatment plant's long-term reporting record provides further evidence of the inadequacy of testing and regulatory oversight to ensure compliance with environmental permits. The plant's compliance with its testing and reporting requirements for both its discharge and its sludge permit have been abysmal.

Discharge Permit. Wastewater Division records reveal that from April 1991 to December of 1998 not one set of monitoring and reporting data from the facility was complete. Effluent monitoring data were incomplete from September 1989 to November 1996, at times significantly so. However, none of these failures to monitor and report accurately and completely resulted individually or cumulatively in disciplinary action or legal proceedings of any kind.

Instead over many years, Department staff wrote letters to the sewage plant operators documenting their lack of compliance, and treatment plant staff wrote letters back explaining why they did not comply. So little did their failure to monitor and report on their operations affect the St Albans plant that they were twice issued permit renewals while in noncompliance. In 1997, permit renewal followed <u>six straight years of noncompliance</u> with permit requirements. Nowhere in the Department files on the plant is there any mention or analysis of the potential dangers posed by such incomplete monitoring and test data, despite the fact that environmental regulators routinely assert that monitoring will assure that particular operations are safe and do not unduly impact the environment.

Sludge Application Reporting. The same sewage plant staff who failed to report adequately on the operations of the treatment plant itself were also in charge of reporting compliance with the sludge application permit. In 1997, a state regulator wrote St. Albans to point out that their data reporting up to that time had been insufficient to allow regulators to determine whether or not they were in compliance with their permit.

"Until now," ran the letter, "much of the St Albans data ... has not been summarized by site or by monitoring well. Thus the data is difficult to review to determine if sampling is comprehensive... The current presentation of data does not satisfy Condition V [the reporting condition] of St Albans Full Certification." The letter then listed the parameters of reporting which would now have to be reported that had not been previously summarized or analyzed by plant operators. (Robins, 1997a)

These included sludge quality data; processes to reduce pathogens; groundwater quality data by well; soil summaries by field including soil quality test data, cumulative metals loading figures, actual biosolids applied, residual nitrogen and projected rates of application; application rates for sludge, including a check against metals loading limit restrictions, calculations for residual nitrogen and nitrogen application rates; annual phosphorus and potassium loading rates; and plant tissue composition quality data.

In other words, the Department was requesting that the St Albans operation actually begin to provide clear summary reporting on all the parameters required by its Certification, so that regulators could begin to analyze the operation's compliance with all prescribed limits. The sludge application operation had been running for almost ten years at this point. When regulators assure citizens that monitoring and oversight will assure that all the standards they impose on sludge application sites will be met, is this the level of oversight they mean?

Chapter Three: Why?

Benefits vs. Risks

To understand why regulators have failed to develop more protective standards for sludge application and distribution, it is important to remember that the existing regulations are based on the notion of risk/benefit equations. That is, because a process is deemed beneficial, policymakers can assert that the risks associated with it are balanced out by the benefits that accrue to society. A similar calculation of risk versus benefit is applied in the case of pesticides, where the benefits of increased crop yield or reduced infectious disease are weighed against the known toxicity of the chemicals used to achieve these ends. Sludge "recycling" is also portrayed in state and federal regulation and promotion as a beneficial process whose benefits outweigh its risks. But if we look closely at sludge "recycling" in Vermont, those benefits appear quite limited, and appear to accrue to a very few parties, not to society at large.

Do Farmers Get "Free Fertilizer"?

In fact, in the case of aerobically digested sludge very little nutrient value left at the end of the treatment process – most of the nitrogen is 'cooked off' in treatment so that levels are much lower than those in manure or commercial fertilizer. This is why sludge is prevented from being officially referred to as fertilizer and instead must be called "soil amendment". While this may be good in terms of runoff and nitrate concerns it is not a real benefit to the farmer. If it were, municipalities would not have to pay farmers to take sludge, as they currently do. Further, the relatively low nitrogen levels in some sludges could lead to overapplication by farmers in hopes of boosting the fertilizer value of the application. Such excess application could increase the toxic loading of a site more rapidly than expected.

Do Towns Get Cost Savings on Landfill Disposal ?

This latter benefit is minimal in practice -- after municipalities have paid for testing, drying, storing and hauling the sludge and liming the fields where it is applied, or footed the bill for the capital and labor costs associated with composting, their expenditures are not far under the cost to landfill. For example, Springfield's wastewater plant operator estimates that the total cost of composting their sludge is $90 per ton, while disposing of it in a landfill would cost around $80 per ton, including hauling fees.[20] Costs associated with land application sometimes include buying equipment for the farmer's use, and almost always include the cost of the lime needed to stabilize the site's pH. And in the larger view, municipalities will not actually profit if they exchange modest savings on landfill fees for the contamination of taxable land within their town.

Reduced Liability for Municipalities, Toxics Generators and Solid Waste Operators?

If businesses and municipalities were required to recapture and ship out the toxic substances they currently discharge to the sewer system, they would retain responsibility for those materials even after their disposal in a landfill or other disposal site. Once materials pass through sewage treatment, however, they are so mixed with all the other components of sewage that it is very difficult to trace them to specific sources. Thus specific liability for any damage done to the environment or human health due to some element of the sewage inflows is extremely hard to assign.

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[20] Personal communication, Mike Emond, Springfield Sewage Plant Chief Operator, May 1999

This is obviously a positive benefit for private interests involved in the generation, use and disposal of toxic materials. By land applying municipal sludge to farm fields, municipalities also divest themselves of liability for the potential harm caused by specific toxics in the material (unless those toxics have a direct impact on farm operations, and even then farmers like Bob Ruane have have had little success seeking redress in court). In fact, farmers are the only party in the process whose liability is not eliminated. Indeed, this fact is so striking that several farm insurance organizations have refused to sell policies to any farmer who applies sludge or sludge products to his or her land.

Other regulations that govern toxic materials, such as the federal Resource Control and Recovery Act (RCRA) specifically disallow this sort of tradeoff of private or municipal responsibility to an individual who did not generate the toxic material in question. Such laws are based on the assumption that maintaining liability for the generator of a hazardous waste throughout the disposal process will tend to prevent the illegal dumping of such wastes and reduce their generation.

Increased Landfill Capacity ?

Landfill space is at a premium in the state of Vermont. One of the most persuasive arguments regulators make in favor of sludge "recycling" is that it will prevent landfill space from being used up by a material that can be spread out over the land instead.

When we examine the state's own figures, however, this argument is less clear cut than regulators assert in public debate. According to the state's Draft Solid Waste Plan, the total amount of solid waste disposed of in Vermont's in-state landfills in 1997 was 246,669 tons. The amount of municipal sludge and septage land applied or composted in the state was 2,302 dry tons. This constitutes less than 1/100 of the amount of solid waste placed in landfills.

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The preservation of such a minute proportion of landfill capacity cannot be counted a significant benefit when balanced against the disposition of toxic materials across the state's arable land. Because sludge is currently landfilled in slurry form – at about 20% solids, technical issues arising from the increase in the liquid portion of landfill contents may arise from an increase in sludge disposal. This is the sort of meaningful technical challenge that arises out of a policy designed to prevent release of toxics to the environment, not a reason to reject such a policy choice.

The Real Risk/Benefit Equation

Overall, then, the benefits to most parties involved in sludge "recycling" seem minimal financially, environmentally or in social terms when compared with the positive environmental benefits of landfill disposal. Most of the benefits of "recycling" accrue to private interests, where the benefits of discrete disposal benefit the public at large. In a landfill, sludge and its potentially toxic, pathogenic and radioactive contents are segregated in a restricted access site where leachate is prevented from contaminating groundwater. Clean land is not contaminated, the public is only minimally exposed to potential health damage, and in many cases, the cost of disposal for municipalities is either less than or only slightly more than the costs for "recycling" operations.

Conflict of Interest

The practice of applying municipal sludge to the land entails many serious risks to environmental sustainability and public health. Citizens oppose it on a wide range of grounds, from issues of local control, to public health fears, to aesthetic concerns. And it is economically short-sighted, given its potential to contaminate the land, undermine Vermont foods' reputation for purity, and undercut the image of environmental purity that brings so many tourists into our state. Yet state regulators steadfastly maintain that the only problem with sludge "recycling" is the public's attitude toward it, and that there is no need to reexamine the current system of regulation or make it more stringent.

In order to understand this resolute resistance to discussion, it is essential to grasp the underlying conflict of interest that limits sludge regulators' willingness to contemplate increasing stringency or otherwise limiting sludge application to Vermont lands. Sludge regulators are charged by state law with identifying sludge and septage's "value as a soil amendment" and "actions which can be taken through existing state programs to facilitate beneficial use of septage and sludge"[21] -- i.e. promoting the reuse of sludge and septage as soil amendments or fertilizer. This promotional aspect of the Residuals Management section's work is fundamentally at odds with their regulatory functions.

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Is It Recycling?

It can be argued that this mandate is simply the parallel of the requirement that Solid Waste regulators must aim to increase recycling of solid waste; however looked at more closely these are not equivalent operations:

- Recycling involves keeping materials clean and separate so that they can be appropriately reused -- sewage sludge is an admixture of multiple unknown quantities that cannot be separated and therefore cannot be recycled.
- Recycling can bring economic benefits to the communities or companies practicing it -- acceptance of sludge application within a community contributes little to the local economy and through potential reduction in neighbors' land values can actually have a net negative impact.
- Recycling brings tangible environmental benefits in terms of disposal space, energy and other resources conserved -- the only benefits of sewage sludge "recycling" are marginally less pressure on landfill capacity and marginally less disposal cost for municipalities.

Thus comparison between recycling of reusable solid waste and land disposal of sewage sludge is not accurate -- and as a result, the tension between promotion and regulation within the sludge program is likely to be more acute than in other waste management programs.

Conflict in Action

A variety of occurrences over the past few years suggest that the Residuals Management section's fundamental conflict of interest has undermined staffers' execution of their regulatory oversight:

[21] Vermont Statutes Title 10 §6604 (d)

- While reviewing the draft certification for the East Montpelier sludge composting plant, a sludge regulator wrote a letter to the local newspaper extolling the virtues of sludge "recycling".
- Despite a history of odor complaints and lack of inclusion in the town plan, regulators issued a draft permit to the proposed Randolph sludge composting operation.
- When a former Residuals section staffer wrote detailed fact sheets to attach to specific sludge permits that discussed some of the potential issues associated with a site, he was forced to remove those sections before the permits were issued. (Robins, 1997)
- When the same staffer refused to affix his signature to a permit that he did not believe conformed to the regulations, he was threatened with dismissal (Robins, 1997).
- In the case where the employee was compelled to sign a certification against his will, residuals staff insisted that waste from Ben and Jerry's to be land applied under the permit would pose no odor problems (VT Labor Relations Board, 1997), yet in Randolph, residuals staff pointed to similar waste from Ben and Jerry's as the possible source of objectionable odors.
- Compost standards for sludge compost set less stringent levels for metals than do the Vermont standards for all other composted material regulated under the Solid Waste rules (see Table 12). If such standards are based on assessment of health risk, why are they not identical? If they are based on what is possible to attain with different materials, how can they be depicted as health based?

Table 12. Metal Standards for Vermont Compost

Metals	All Non-sludge Organic Waste Compost (ppm)	Current Sludge Rules (ppm)	Proposed Sludge Rules (ppm)
Mercury	10	10	10
Cadmium	10	25	21
Nickel	200	200	420
Lead	250	1000	300
Chromium	1000	1000	1200
Copper	1000	1000	1500
Zinc	2500	2500	2800
PCB	1	10	10

- Though regulators have had completed dioxin test results for Vermont sludge in hand for almost two years, they have yet to discuss those results voluntarily in public or engage in discussion of how to deal with the dioxin issue with regard to sludge application.
- While disregarding any of the issues raised in the past few years of sludge debate in the state, the section of the 1999 Draft Solid Waste Plan that deals with municipal sludge and septage proposes to almost double the percentage of these materials applied to Vermont land or composted and distributed, and to require municipalities to plan to "reuse" sludge and septage.

Over the past few years, groups of citizens have protested the permitting of sludge composting or land application facilities in towns across Vermont. Though those efforts have resulted in significant successes, and have reduced land application significantly, regulators have resisted making substantive changes to strengthen the policies governing sludge reuse in the state. The structural problems posed by sludge regulators' conflicting job responsibilities may underlie their apparent inability or unwillingness to respond to citizen concerns.

Conclusion

The most fundamental flaw in the approach to sludge regulation put forward by EPA and Vermont regulators is that it is designed to accommodate the status quo, not to set challenging goals that will protect human health, wildlife and the environment.

There are two possible questions one can ask about the release of a toxic substance to the environment. The first is the risk assessment question -- "How much of this substance is okay to put in the environment?" That is a question that, despite regulators' assertions, cannot be answered by scientific analysis, unless and until harm is done. Setting levels of exposure based on that question is performing uncontrolled experimentation with humans and the environment.

The regulatory system derived from the question "How much of this substance is okay to put in the environment?" is a system that carefully documents but does not stop environmental contamination – instead it issues permits to pollute.

The other possible question is "Knowing what we do about these toxic materials and the dangers they pose to human health and the environment, how can we prevent their release?" This question focuses on prevention and gives rise to useful discussion and debate that moves the issue forward. It can generate useful scientific and technical advances. But that is the question that EPA and state regulators fail to ask or answer.

In looking at EPA's regulation of sludge composting and land application in light of scientific evidence that suggests it is woefully inadequate, it becomes apparent that protection of environmental resources and public health has taken a back seat to the pressing need to dispose of contaminated materials generated in ever increasing amounts at the nation's sewage treatment plants.

Because we do not face such extreme pressure from industry, nor such toxic inflows as the rest of the country, Vermont has the opportunity to develop a system of sludge treatment and disposal that suits our needs. We are not compelled to adopt a system obviously designed around the need of those disposing of materials rather than those being exposed to the results of their disposal.

Chapter 4: Recommendations

Vermont's well being and economy rely on a healthy pure environment. It is our marketing edge, our heritage, and our most precious resource. Degrading it simply to solve a short-term problem that can be resolved in other ways is short sighted and inappropriate. We must do better.

What follows are some basic recommendations aimed at answering two questions – (1) how can we eliminate the application of persistent toxics, endocrine disrupters, pathogens and radioactive materials to our soils in sludge, and (2) how can we eliminate those contaminants from any human waste we wish to recycle so that it becomes a truly reusable commodity?

We hope these suggestions will provide a basis for in-depth discussion among all parties to the sludge issue, and all Vermonters, so that we can work cooperatively towards locally generated solutions to the issue of sludge disposal that protect our environment, our economy and our children. We provide these recommendations as a starting point for that discussion.

Primary Recommendation

<u>Establish a policy of banning the application of any and all persistent toxics or endocrine disrupters to the land, set a timetable and goals to achieve it in short order</u>. The contamination of the land with persistent and hormone affecting substances that will affect wildlife and human health for hundreds of years is simply the wrong choice. We must cease and desist from this shortsighted abdication of our stewardship of the land.

Transitional Recommendations

The transition from a system where we dispose of the toxics in sludge and septage on the land to one where we do not will not occur overnight. In the short run, we must implement a broad range of measures designed to protect the environment and public health while enabling towns and waste districts to develop alternative disposal systems for sludge and septage. To that end, we propose some interim measures to take effect immediately:

1. Immediately ban any industrial discharges or leachate inflows where land application or composting are operating or contemplated, and ban sludge reuse where there are industrial discharges or leachate inflows. Because any such inflows will contain unpredictable but potentially dangerous toxic contaminants, the best policy is simply to prohibit the land application of sludge derived from them.
2. Prohibit the siting of sludge or septage facilities (including land application sites) in towns that have not explicitly approved such a facility by a town-wide vote. Prohibit any such facility from being sited within two miles of schools, hospitals, nursing homes or town population centers.
3. Develop a system that economically and technically supports the use of sludge and septage materials as alternate daily cover in landfills and landfill all sludge and septage following January 1, 2000 until systematic changes are made to produce nontoxic materials for reuse. The amount of landfill space that would be taken up by sludge currently land applied or distributed is not excessive, and if offset by reductions in other daily cover materials can be minimized further. Restricted sites are preferred locations for disposal of toxic materials. Lower the cost of landfilling sludge by deducting the cost of daily cover materials it replaces from the tipping fee, and trade leachate treatment for sludge disposal wherever feasible.

4. Make municipalities clearly and continuously liable for land applied or processed sludge and septage. The current system shifts all liability to farmers, landscapers and others who apply toxic sludge to the land. Municipalities that generate the sludge should remain liable for any damages connected to its use even after it is land applied or distributed to the public.
5. Require maintenance of pH in perpetuity on all land application sites whether closed or active. Municipal generators of sludge will be responsible for the cost of lime or other amendments to maintain pH.
6. Require recording of any former or current large volume sludge application on all deeds, and require disclosure to potential buyers. Vermonters must disclose to buyers if they built a fence too close to their property line or didn t get a permit for their deck; surely they should let possible occupants know if they have applied potentially toxic materials to the land.
7. Stop encouraging sewering of communities through state laws and funding and begin subsidizing alternative systems. By encouraging alternatives to water-borne mixed waste systems, the state can continue to work towards eliminating direct sewage discharges and failed systems without simply creating additional mountains of contaminated sludge to be disposed of. Individual and neighborhood composting waste systems, constructed wetlands and other creative alternatives can resolve these problems and with proper safeguards against sprawl can be adapted to many different locations and needs.
8. Develop state-funded programs in all Solid Waste Districts to work aggressively and creatively with communities to detoxify their wastewater systems. By aggressive education of householders and small businesses on toxics, the Districts can motivate citizens and non-permitted business dischargers to detoxify their contributions to the sewage waste stream. Distribution of nontoxic products, door-to-door pickup for hazardous waste materials, contests for the cleanest town sewage and so on can aid in eliminating many of the toxic discharges now flowing into municipal sewers and individual septic tanks. Though this effort is unlikely to create sewage free from persistent toxics, it will reduce the toxicity of effluent and sludge significantly.

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