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ARTICLE

You have to take my sludge!

INCINERATOR SHUTDOWNS TEST THE CAPACITY OF SOLIDS MANAGEMENT

by **Ned Beecher, Executive Director, North East Biosolids & Residuals Association**

This year has seen major strains in the markets for wastewater solids (sludge) management, especially in southern New England. From January through June, some managers of wastewater solids scrambled to find disposal and end use options. Trucks stood in lines for hours at some incinerators, waiting to dispose of solids. Others hauled solids to upstate New York and New Jersey. The routine flow of solids from some southern New England facilities into northern New England increased. Some municipalities were caught off guard and scrambled to find disposal options, incurring thousands of dollars in extra expense.

Sequence of Events

One factor in this market upset was the March 21, 2016 compliance deadline for new Environmental Protection Agency (EPA) air emissions regulations for sewage sludge incinerators (SSIs). The new regulation (Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Sewage Sludge Incineration Units, Subparts LLLL and MMMM of 40 CFR Part 60), finalized in 2011, requires all SSIs to meet prescribed ceiling limits on emissions of specific contaminants, including particulates, carbon monoxide (CO), nitrous oxides (NOx), and mercury (Hg). In addition, the new regulation requires site-specific emissions monitoring tests and plans, operator training, and record-keeping.

As the regulation's compliance deadline approached, some SSI operators took only limited steps to prepare, in part because of involvement in a major, multi-party legal challenge brought against EPA that may have changed or delayed the requirements. In contrast, other SSIs had prepared for several years, including installing new emissions control equipment. In response to the developing regulation, each SSI owner and operator had to analyze its needs and best options, and the local decisions and actions regarding each of the 14 SSIs in New England (as well as some in New York) had their impact on what became a crisis in the solids management market in 2016.

But the March 21 compliance deadline was not the only factor. There was the normal uptick in solids production that occurs each year in late winter and spring as wastewater flows increase from snowmelt and precipitation. And, over the past few years, there had been other solids management capacity reductions that played a role as well, such as:

- Rhode Island's 2010 floods wiped out the biosolids compost operation at West Warwick, Rhode Island, and eventually that operation was closed permanently, pushing about 6,000 wet tons (5,400 tonnes)/year (1,200 dry tons [1.100 tonnes]/year) onto the market.
- In recent years, several communities (e.g., most recently Dover, New Hampshire) abandoned on-site composting, and their solids have entered the market.
- In 2012, Fitchburg, Massachusetts, faced aging infrastructure upgrades in addition to the projected cost of meeting the new SSI air emissions regulations. The SSI, which had processed liquid solids from Fitchburg and many smaller communities, was closed. Communities that had relied on Fitchburg scrambled to find other options for their liquid solids disposal—a preview of what was to come in 2016.
- In 2013, the Moretown, Vermont Landfill closed; it had taken in mostly Vermont wastewater solids.
- For several years, the WeCare Environmental alkaline stabilization facility in Plymouth, Maine, has faced increasing local opposition due to its inability to control malodors. It has received numerous Notices of Violation (NOVs) from the Maine Department of Environmental Protection. In the past year, managers reduced the volumes of incoming solids, some of which had been hauled from as far away as Rhode Island. The facility, which has a permitted capacity of 60,000 wet tons (54,400 tonnes) per year, was receiving only about 10,000 (9,100 tonnes) in 2015. By June 2016, the facility was closing and all solids on site were being removed. (Facility management talks about developing a gasification system on the same site, but that is only in the early, exploratory stage, and because of technical and financial challenges no operating full-scale gasification system for wastewater solids in North America exists despite several attempts.)
- In 2015, the Barre, Massachusetts landfill closed and that town's solids went onto the market. The same thing may happen in the next year or two in Manchester, Connecticut.
- And, in April 2016, not far away, Montague, Massachusetts, stopped taking in outside solids from area towns as the plant's treatment system hit capacity, local politics arose, and its solids destruction system came under increased scrutiny.

In the last five years, the only new capacity offsetting these losses has been minor expansion at a few merchant facilities, filling of excess capacity here and there (e.g., Merrimack, New Hampshire, and Lewiston-Auburn, Maine, are now composting solids from a few other water resource recovery facilities [WRRFs]), and a new digestion facility opening this year in Brunswick, Maine plans to take in outside wastewater solids.

Incinerator capacity had expanded considerably in the 2000s (Table 1), creating a sense of plenty of capacity, and prices actually were stable for about 10 years and even fell, as merchant SSIs competed for solids to fill their increased space. Naugatuck, Connecticut, for example, was taking in solids from as far away as Long Island, to keep the SSI full and to help offset high fixed costs.

But by 2015, that sense of excess capacity was fading. Coming into 2016, the capacity for solids management in New England had been diminishing. So the new SSI air emissions regulation compliance deadline in March was the last straw—a point in time on which SSIs focused. Decisions at SSIs began to pile up, with facility shut-downs increasingly overlapping:

- The SSI at Glens Falls, New York, closed, unable to afford the upgrades needed for compliance, shutting off an outlet on which several Vermont facilities especially had relied.

Table 1. Status and capacity of New England's sewage sludge incinerators (dry U. S. tons of solids per day)

Sewage Sludge Incinerator (operated by)	Capacity circa 2000	Capacity Today	Accepts Outside Solids?	Notes
Manchester, NH (Manchester)	—	36	No	Fluidized bed; has proactively worked toward compliance with new air emissions regulation.
Lynn, MA (Veolia)	—	~15	No	Fluidized bed. Has installed upgrades to comply with new air emissions regulation.
Fitchburg, MA	—	CLOSED (in 2012)	Yes, until closed	Fitchburg solids go to landfill now.
Brockton, MA (Veolia)	18	18	No	Multiple hearth; completed upgrades to meet new air emissions standards in January 2011.
Fall River, MA (Fall River)	—	CLOSED (in 2016)	No, now closed	Costs to meet new air emissions regulation too great; solids now going to merchant incineration facilities.
Upper Blackstone WPCF (Upper Blackstone)	91	144	Yes, but more selective than before	Multiple hearth. SSI permitted throughput is now limited by stack test.
Hartford WPCP (MDC)	60	120	Yes, but less than before	3 multiple hearth units (permit limits operations to 2 units at one time). Takes in less outside solids now. Has energy recovery system.
New Haven, CT (Synagro)	—	42	Yes, but less than before	Multiple hearth. Takes in less outside solids now. Has energy recovery system.
Mattabassett – Cromwell, CT (Mattabassett District)	—	36	Takes in liquid only, but less than before	Fluidized bed; has proactively worked toward compliance with new air emissions regulation.
Naugatuck, CT (Veolia)	54	84	Yes	Fluidized bed. Provides significant capacity; contract for operations expires in 2020.
Waterbury, CT (Synagro)	—	60	Yes	Fluidized bed. Currently seeking input on future options; current contract expires soon.
West Haven, CT (West Haven)	—	~10	No	Fluidized bed.
Cranston, RI (Veolia)	40	66	Yes	Multiple hearth. Takes liquid solids only; has been reliable outlet.
Woonsocket, RI (Synagro)	70	110	Yes	Fluidized bed; has completed significant upgrades to meet new air emissions regulation.

Note: Glens Falls and, occasionally, other incinerators in New York (e.g., Saratoga Springs) have taken New England wastewater solids in the past. Glens Falls and Saratoga Springs incinerators are now closed due to costs of aging infrastructure and upgrades to meet new air emissions regulation.

- Likewise, Fall River, Massachusetts, evaluated its options and found the prospect of upgrades too costly. It shut down its SSI permanently this year, sending its solids into the market.
- The Brockton, Massachusetts WRRF addressed the new air emissions requirements early, completing upgrades in 2011 that allow it to meet the new standards. But it only processes Brockton solids.
- The Upper Blackstone facility (serving the Worcester, Massachusetts area) has addressed the new SSI air emissions requirements and trucked in as much outside solids as it could during the SSI stack tests required by the new regulations. However, the solids throughput tested was lower than the rated capacity of the incinerators, and therefore the SSI throughput is currently limited by the stack test results
- The SSI at Lynn, Massachusetts, invested in new air emissions controls more recently. After running the new system several months, the carbon system fouled in May, and it shut down for six weeks. It is running again.
- In Connecticut, New Haven and the Mattabassett District evaluated their operations with compliance in mind. New Haven's multiple hearth incinerator (MHI) seemed able to meet the new standards applicable to that kind of SSI, but upgrades at the WRRF have meant it cannot take in as much outside solids (just as with the Metropolitan District Commission in Hartford). The fluidized bed incinerator at Mattabassett required investment of considerable time and money to meet the stricter limits for that kind of SSI. Both facilities had to reduce the amounts of outside solids taken in.
- Operators of West Haven, Connecticut's MHI, which was rebuilt in 2006, have been evaluating its compliance needs. In early April, a mechanical failure shut it down. Hartford Metropolitan District helped out (as did other SSIs), but the deliveries to Hartford were sporadic: a truckload one day, none for a few, and then suddenly five in a day. To ease its own operations, Hartford stopped taking it. Thus, a considerable portion of West Haven's solids have been hauled out of state. In August, the SSI shut down again.
- The larger privately run merchant facilities in Connecticut and Rhode Island mostly planned ahead and completed upgrades before this year. More than $6 million were spent on upgrades at the Woonsocket, Rhode Island SSI. The Cranston, Rhode Island MHI facility can meet the new air emissions standards. It has remained a reliable outlet for liquid solids. But that reliability has led to lines of trucks waiting at the gate, as other options for liquid solids have diminished.
- Waterbury, Connecticut, is facing challenges. Basic infrastructure repairs are needed, and upgrades needed to meet the new air emissions requirements add to the cost of continued operations. In the past 18 months, the city has issued three requests for proposals of interest seeking suggestions—upgrade the SSI or do something else with the solids. Three bidders presented ideas at a meeting in early July, and a decision was expected in late summer.
- And most significantly, in late January, the Naugatuck SSI, one of the large merchant facilities (84 dry tons [76 tonnes]/day), had mechanical issues and shut down. Repairs continued until close to the March 21 compliance deadline, and rather than operate out of compliance, the shut-down was extended. (A contract dispute with the town of Naugatuck was an added complication.) Negotiations with the enforcement staff at EPA Region 1 resulted in a plan to move forward, and the facility started up again on June 25. The facility operator absorbed the costs of the shut-down. But those six months without this large amount of capacity heightened the solids management crisis.

Suddenly, haulers had nowhere to take loads of solids—especially liquid solids. Companies holding contracts with municipalities tried not to have to default on the contracts, but some were renegotiated. "I had one customer in New York whom I advised to find a closer solution," said a CT-based SSI operator. "I gave them suggestions, but they were dissatisfied with the service they found there locally. So they came back to our facility and accepted a substantial rate increase to cover ever-increasing transportation and operational costs for serving a customer so far outside of the normal service radius, even though the new contract specifies that we will take their solids only on a space-available basis."

One hauler reported his trucks were waiting in line for up to seven or eight hours. Where he used to make three round-trips in a day, he was down to one because of the length of the line or the length of the haul. His municipal customers were waiting longer for their solids to be removed, and worried about their solids holding capacity. "They weren't happy," he said. "The worst of it was May, June, and July, because Montague shut off in April. Naugatuck closing was bad too, but it just caused longer lines at Cranston."

One SSI operator remembers a phone call in March from a Connecticut facility that was hauling liquid solids to New Jersey at great cost. "But I am paying x dollars to Passaic Valley! You have to take my sludge!" To make matters even worse, in late August, news came that a fire at the Mattabassett District might keep its SSI closed for three to five months.

Market Adjusts and Enforcement is Gradual

The immediate crisis in the solids markets ended when Naugatuck came back online in late June. But, in the crisis, the market had responded—albeit at considerable cost to solids generators and haulers—and absorbed the extra solids. Much more than usual was hauled out of the region, to New Jersey and to upstate New York (sometimes with the additional cost of mobile dewatering). More went to landfills. And some biosolids management companies worked it into their operations in northern New England.

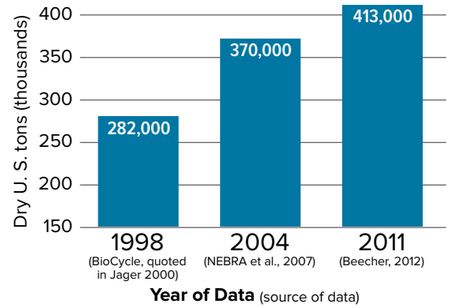

Figure 1. Historical estimates of New England wastewater solids production

The second relief valve to the capacity pressure came as SSI owners and operators realized that EPA enforcement of the new air emissions regulations was not going to be heavy-handed. Yes, NOVs are being issued (see sidebar), but SSIs are not having to shut down as they work toward compliance.

Those most directly involved in managing solids in southern New England are glad the crisis is past, but remain wary. One sees a silver lining: "It was a good test. If anything catastrophic happens to one of the incinerators, we know the system can handle it."

But not everyone considers the crisis over, and those most directly involved are watching capacity far more closely than before. One Massachusetts-based hauler said in late August: "I think that anybody who thinks the crisis is over is kidding themselves. On a day-to-day basis, everything is still full. There are even a couple of smaller facilities that are trying to figure out how to take in some outside sludge to gain some revenue."

Is This Just Part of a Market Cycle?

A look back shows that capacity is always in flux, driven by market demands. A *NEWEA Journal* article in 2000 lamented "disposal options are limited. New England's landfills are filling up, and the capacity of our incinerators is, for the most part, fixed. It is extremely difficult to site new disposal facilities, and the ones we have operating now are becoming increasingly expensive to keep due to their age and new regulatory requirements" (Jager, 2000). At the same time, the late 1990s had seen the height of public controversy over biosolids land application that led to restrictions in numerous towns in New Hampshire and a few in other states. "As a result, municipal officials responsible for establishing safe, environmentally, and economically sound programs are dealing with a mounting crisis," wrote Jager.

A few years later, another *NEWEA Journal* article counted 14 SSIs in New England, which, along with thermal drying facilities at Greater Lawrence Sanitary District (GLSD) and the Massachusetts Water Resources Authority (MWRA), served "some 8.5 million people" and managed "more than 75 percent of the municipal wastewater sewage solids generated in Connecticut, Massachusetts, and Rhode Island" (Donovan, 2004). The author touted the benefits of regional facilities, especially the cost benefits for smaller communities that could transport their solids—often in liquid form—to a moderately priced disposal facility. For example, he noted that Plymouth, Massachusetts, decided to abandon a plan to build a new dewatering system, "owing to a competitive solids service market in southern New England." By simply transporting liquid (not dewatered) solids to incineration, they saved $1 million in capital costs. In 2004, there was adequate capacity, and costs for solids disposal were reasonable.

Indeed, according to several solids management professionals, for much of the past decade there had been adequate or excess capacity in the solids management marketplace in New England—especially in the incineration market. As Donovan reported in 2004, several of the region's larger SSIs at that time were installing new fluidized bed burners or flue gas recirculation systems, significantly increasing the amount of solids they could process (Table 1).

So was this year's capacity crisis an anomaly? Perhaps somewhat. But the timing of the crisis could have been foreseen, with the March 21 compliance deadline for the new EPA air emissions regulation piling onto the fact that the region's incinerators—like other infrastructure—have been aging while municipal budgets and regulations have been tightening.

Was Over-Reliance a Factor?

The constraints of the new EPA air emissions regulation strained the New England markets for wastewater solids use and disposal in part because of southern New England's long-term heavy reliance on incineration. That region holds the greatest density of SSIs in North America (Table 1). Since the 1980s, Connecticut and Rhode Island especially have relied on incineration for disposal (Donovan, 2004), and a good amount of Massachusetts solids (both liquid and cake) is burned there as well. At the turn of the century, New England produced roughly 282,000 dry U. S. tons (256,000 tonnes) of solids annually, and 124 of New England's approximately 500 WRRFs—including many smaller ones— incinerated their sludge at facilities in Connecticut, Massachusetts, New York, and Rhode Island (Jager, 2000). In 2004, 94 percent of the 118,000 dry tons (107,000 tonnes) of solids produced in Connecticut and 89 percent of the 27,500 dry tons (25,000 tonnes) of solids produced in Rhode Island were incinerated, mostly at SSIs in those two states. Much of Massachusetts' wastewater solids have also been incinerated, mostly at several in-state SSIs, and one SSI has long served New Hampshire's largest city, Manchester. In 2004, 203 WRRFs (40 percent of New England's facilities) were sending solids to incineration, and total solids production throughout New England was about 370,000 dry U. S. tons (335,700 tonnes) (North East Biosolids & Residuals Association [NEBRA] et al., 2007). Today, more than 400,000 dry U. S. tons (363,000 tonnes) of wastewater solids are produced in New England (Figure 1).

Is having 40 percent of the region's WRRFs serviced by six large outlets a concern? Are there too many solids in the incineration basket? The testing of the market this spring suggests that the system is adequate but may benefit from diversification. In other parts of New England, regulations, experience, and knowledge for other solids management options are more developed. And that knowledge and capacity helped southern New England through the crunch. Clearly, however, few options exist for untreated liquid solids. And, most important, keeping all options open for solids management is critical and should be a focus for the region's regulatory agencies and policy makers, as well as for each WRRF.

Looking Ahead

As the fall arrives, solids management markets have settled down. But markets are not where they were a year or two ago. And most do not think they will be any time soon. Capacity remains constrained. Where else can it be found?

One possible source is anaerobic digestion (Table 2). It can provide capacity in two ways:

Table 2. Other current regional wastewater solids processing and disposal options in New England

Name	Location	Owner/Operator	Type	Capacity for WW Solids?
BENEFICIAL USE FACILITIES				
Grasslands Facility	Chateaugay, NY	Casella Organics	Advanced alkaline stabilization producing Class A biosolids lime & fertilizer product	**Some**
Residuals Management Facility	New Hampton, NH	Resource Management Inc.	Alkaline stabilization producing biosolids for land application	**Some**
Merrimack Compost	Merrimack, NH	Town of Merrimack, NH	Composting of local & some outside wastewater solids and leaf & yard waste	**Possibly some**
WeCare/Soil Preparation	Plymouth, ME	WeCare Environmental	CLOSED. Is removing all material from site (claims to be developing gasification system with ~60,000 wet ton capacity)	**Capacity lost, may not come back**
Hawk Ridge Compost Facility	Unity, ME	Casella Organics	New England's largest compost facility producing Class A biosolids composts and other composts and mulches	**Some**
Lewiston-Auburn WPCA	Lewiston, ME	Lewiston-Auburn Water Pollution Control Authority	Anaerobic digestion and composting of wastewater solids; piloting accepting other liquid high-strength organics into the AD system and some solids to composting	**Possibly some**
Village Green Digester	Brunswick, ME	Village Green Ventures	NEW 850,000 gal. anaerobic digestion of local wastewater solids, food scraps, and other organic residuals	**Some**
Ipswich Compost	Ipswich, MA	Agresource & Town of Ipswich	Composting of local wastewater solids, leaf & yard waste, food scraps	**Full**
LANDFILLS				
Waste USA Landfill	Coventry, VT	Casella	Accepts wastewater solids	**Yes**
Bethlehem Landfill	Bethlehem, NH	Casella	Accepts wastewater solids	**Yes**
Turnkey Landfill	Rochester, NH	Waste Management	Accepts wastewater solids, mostly from SE NH communities	**Yes**
Crossroads Landfill	Norridgewock, ME	Waste Management	Accepts wastewater solids	**Yes**
Juniper Ridge Landfill	Old Town, ME	Casella	Accepts wastewater solids, but only from Maine	**Yes**
Southbridge Landfill	Southbridge, MA	Casella	Does not accept wastewater solids	**No**
Central Landfill	Johnson, RI	RI Resource Recovery Corporation	Accepts wastewater solids, but only from Rhode Island; is seeing increasing amount of wastewater solids coming in.	**Yes**

Note: This list does not include larger water resource recovery facilities (WRRFs) that accept and process small amounts of outside solids

What's next for New England's SSIs?

March 21 was the deadline for sewage sludge incinerators (SSIs) to comply with new EPA air emissions regulations. The rule was originally instigated by a court order and first proposed in October 2010, with new emissions standards finalized on March 21, 2011 (Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Sewage Sludge Incineration Units, Subparts LLLL and MMMM of 40 CFR Part 60). Five years later, after some litigation, the rule and the original compliance deadline remained intact.

But what looks, in retrospect, like a clear march from new rule promulgation in 2011 to implementation in 2016 was anything but. The new air emissions regulations are complicated—far more than the air emissions requirements under 40 CFR Part 503 (EPA biosolids rule), applied to SSIs before. In addition, the SSI air emissions rule was linked to other developing rules (e.g., definition of sludge as a solid waste), creating more confusion. And as the court challenges against the rule progressed, led by the National Association of Clean Water Agencies (NACWA) and several municipalities (including, for example, Hartford Metropolitan District), it was not unreasonable for stakeholders to assume that the final rule would be changed or delayed.

So, when March 21 came around, almost all the 14 SSIs in the region were not ready, and some had not prepared for compliance, despite several EPA assurances that the rule was going to happen—and on time. Of course, EPA was also behind in, for example, developing the final implementation guidance for the new rule (under 40 CFR Part 62); that document was finally signed by EPA Administrator Gina McCarthy on February 22, 2016, only a month before the compliance deadline. And EPA Region 1 air program and enforcement staff, who started out with little experience with SSIs and their unique operations and complications (and their associated water resource recovery facilities), were burdened with applications and reports submitted by SSIs beginning to work toward compliance.

Thus, looking back, it is easy to see how these and other forces led to the most stressful testing of the region's solids management markets in decades (see main article).

This spring's crisis understandably heightened misunderstandings and apprehensions regarding the new EPA air emissions regulation and how it will be enforced. As the March compliance deadline moves into the past, some things are becoming clear:

- **EPA Region 1 is enforcing the rule**. So far, as of mid-August, it had sent Notices of Violation (NOVs) to eight SSIs (Brockton, Cranston, Manchester, Naugatuck, New Haven, Waterbury, West Haven, and Woonsocket), listing numerous compliance violations as of the rule's effective date of March 21. The rest have had or will soon have site visits from EPA. Most of the facilities seem able to meet all or most of the new air emissions limits. (Mercury is a challenge for some, and that has been the target of many of the most extensive emissions control upgrades in recent years.)

> **"We have not required facilities to shut down while they are working toward compliance."**
> – Steve Rapp, EPA Region 1

- **The regulation requires far more than SSIs have had to do before, and operators as well as EPA staff are continually learning**. For example, the new regulation requires strict control and monitoring protocols that will help ensure continuous compliance with the new emissions limits. Most of the violations being identified by EPA pertain to those control and monitoring systems, including the need for approved emissions testing for establishing specific operating parameters. A control plan is required for each of the nine regulated pollutants. This is challenging for mercury emissions if an SSI does not need to install new controls to meet the applicable standard. According to EPA, an option is to use theoretical calculation and mass balance of mercury in the wastewater and incineration system, and apply conservative assumptions to demonstrate the likelihood of an exceedance is very low. But, as one SSI operator noted, it is hard to complete mass balance calculations in the complexity of a sewer system, a WRRF, and an incinerator.
- **The NOV process is unlikely to shut down any facility**. As Steve Rapp, EPA Region 1, explained, "We have not required facilities to shut down while they are working toward compliance." He noted, for example, that in response to apprehensions at Naugatuck (and the defeat of a bond vote that would have funded the needed upgrades), EPA wrote the city a letter saying EPA would work with the borough to establish a compliance schedule for the design and installation of any necessary air emissions controls. "In cases like these, the agency wants to ensure that there are safeguards in place and they are not creating an immediate or imminent danger to public health. I don't think that most of the things that need to be done at these facilities is a significant endangerment of public health. However, we do require that they work toward minimizing emissions." He pointed to the operations at the Lynn SSI as an example of good practice: "As they have been working toward full compliance, operators have throttled back the solids feed rate as a hedge toward reducing emissions."

Rapp wanted to make clear that EPA does not have any say or preference in how a WRRF's solids are managed. "EPA, directed by Congress, sets air standards and regulations. We are in the mode of seeing that people are following those standards, setting a level playing field. We are not saying that this way of managing this material should be stopped. A decision to no longer operate is outside our decision-making; that is the municipality's decision. All we are concerned about is people being in compliance with the standards."

The NOV process now leads to meetings between each SSI and EPA, at which expectations, solutions, and timetables are agreed to. EPA understands that some upgrades will take a year or more to design and install. Rapp says EPA just needs to see plans and steady progress.

1. A stand-alone anaerobic digestion system can serve as a merchant facility, taking in liquid solids from various WRRFs (as noted above, outlets for liquid solids are particularly needed).
2. Anaerobic digestion reduces solids volume dramatically, creating less to be managed.

Anaerobic digestion has received much attention in recent years. Many projects have been proposed, but few have come to fruition, despite, for example, significant technical, regulatory, and grant support from the commonwealth of Massachusetts, including required diversion of food scraps from landfills. Many reasons account for the lack of progress on new anaerobic digestion capacity. One is that proponents of anaerobic digestion find it difficult to secure long-term, stable contracts for large-enough volumes of food scraps and other organic residuals to fill proposed new digesters. Too often overlooked is that taking in wastewater solids can make a project more financially viable. For example, the most promising Massachusetts project recently was planned for Bourne. It was to take in wastewater solids. But, early in 2016, the plan was scrapped due to funding shortfalls related to a failed power-purchase agreement.

Massachusetts does have two successful on-farm digesters treating manures and source-separated organics (SSO), but, like many of the recently proposed anaerobic digestion projects, they are not permitted for, nor do they accept, wastewater solids. Similarly, in Connecticut, which passed its large-scale food-waste ban legislation in 2011, only one of five proposed anaerobic digestion projects has moved ahead: The Quantum Biopower anaerobic digestion facility in Southington is under construction, but it will not take in wastewater solids.

This points to a significant issue in developing capacity for organics management through anaerobic digestion. In some circles, co-digestion is discouraged. This seems to be the position of the Connecticut Department of Energy and Environmental Protection (DEEP). In contrast, organics management professionals—and some regulatory agencies such as the Massachusetts Department of Environmental Protection (MassDEP)—recognize that wastewater solids are not that different from SSO, and, for anaerobic digestion projects to be economically and functionally viable and sustainable, co-digestion of all sorts of liquid organic residuals provides flexibility and a better chance of success.

This is the model that seems to be working for Village Green Ventures in Brunswick, Maine. This new 850,000-gallon (3,217,600-liter) anaerobic digestion system is beginning to co-process solids from the local WRRF, along with SSO, and will likely take in other WRRF solids.

While new capacity for wastewater solids treatment in stand-alone, merchant anaerobic digestion systems advances slowly, more immediate promise lies in expansions of existing capacity in anaerobic digestion systems at WRRFs. Such facilities already have expertise in managing liquid organic residuals, and some of them have experience with anaerobic digestion, biogas management, and combined heat and power (CHP). Last year, new digesters at the Fairhaven, Massachusetts WRRF settled into steady operation after several challenging years of startup; they are now taking in some outside fats, oils, and grease (FOG) but are unlikely to take in outside wastewater solids. This was the first new anaerobic digestion system at a New England WRRF since GLSD installed digesters in the early 2000s, although a few digestion systems have seen upgrades (e.g., Pittsfield, Massachusetts).

Soon after Fairhaven, the Lewiston-Auburn Water Pollution Control Authority (LAWPCA) in Maine installed new digesters and CHP, and that facility is now experimenting with taking in outside wastes to the digesters. In addition, by reducing the final biosolids volume exiting the LAWPCA WRRF, the new anaerobic digestion system has freed up capacity at LAWPCA's compost facility for other facilities' wastewater solids.

The greatest expansion of digester capacity in the region in the near term will likely be at GLSD, where upgrades will include a new 1.4-million-gallon (5.3-million-liter) digester, SSO storage capacity, biogas treatment systems, and two co-generation engines. But GLSD expects to fill this additional capacity only with SSO (e.g., food residuals and other high-strength wastes such as FOG), providing an outlet for a significant portion of the 350,000 wet tons (317,500 tonnes) of food waste that MassDEP hopes to see diverted under the 2014 commercial food waste disposal ban. MWRA is considering taking in SSO as well, but that potential is challenged by the need to convey SSO to the Deer Island Treatment Plant by barge.

Thus, expansion of New England's anaerobic digestion capacity is focused mostly on SSO—and almost none of the new capacity can be expected to provide an outlet for wastewater solids anytime soon.

What About Composting and Other Class A Processes?

In the late 1980s, the Hawk Ridge Compost Facility in Unity, Maine, started processing wastewater solids and other organics. It later expanded and now receives material from numerous large and small WRRFs in Maine, New Hampshire, and Massachusetts, and occasionally from further south. The facility has had its challenges, and it benefits from its rural location (but odor management is still critical). Overall, though, it has been successful in providing abundant capacity for wastewater solids and organic residuals processing, and producing valuable products.

Nevertheless, despite such demonstrated success, it is hard to imagine anyone siting another large regional biosolids composting facility anywhere else in the region, because current regulatory requirements and public perceptions seem overwhelming. Such facilities are being built in other states (e.g., California), and the markets for high-quality compost and other soil amendments remain strong.

Indeed, since the 1990s, just two new regional facilities have been built for processing New England wastewater solids for beneficial use. The first is the Residuals Management Facility in New Hampton, New Hampshire. It treats raw and minimally treated cake (dewatered) solids with alkaline stabilization, creating biosolids that are land-applied on farm fields and reclamation sites.

The second is actually not in New England. The Casella Grasslands facility in Chateaugay, New York, produces Class A advanced alkaline stabilized biosolids for use on farms, serving New England in a limited way: The primary source of the wastewater solids it processes come from Chittenden County (Burlington, Vermont area). While it shifted Chittenden County solids from landfills to beneficial use, the facility does not provide much for the rest of New England, because of its distant location in upstate New York.

What About Landfills?

Over the past 30 years, most local landfills have been closed, and standards for landfill construction and operations have tightened dramatically, leaving a relatively small number of larger regional landfills to service New England (Table 2). Some of these landfills accept wastewater solids. They require the solids to be dewatered and to meet paint filter tests and sometimes other requirements. Landfill operators and neighbors dislike odorous solids, and prices for disposal are greater as odor increases and solids content decreases. Before it closed in 2013, the Moretown, Vermont landfill had experienced odor issues and stopped taking in wastewater solids. The Southbridge, Massachusetts landfill does not accept wastewater solids; and the same is true of many other of the remaining smaller, local landfills.

What About Out-of-Region Capacity?

New York is our nearest neighbor, and it is facing the same solids management pressures. Two of that state's SSIs—Saratoga Springs and Glens Falls—which once served some New England communities, have shut down. Like Fitchburg and Fall River, Massachusetts, their equipment was aging and needed upgrades. Add to that the cost of meeting the new EPA air emissions standards, and the rational decision was to shut down. New York does provide landfill capacity, but, except for some western New England communities, the hauling distances make New York options costly. Still, out-of-state transport has always been popular as at least a back-up option.

Another Option: Make Your Own Marketable Product

The capacity to manage wastewater solids does not come solely from regional or other facilities taking in untreated or minimally treated solids from various WRRFs. That has been the most common model in Connecticut and Rhode Island, where merchant incinerators have serviced the market reliably for decades. Elsewhere in the region—and across North America—much of the capacity comes from WRRFs treating their own solids to a high standard for beneficial use. They make products that meet EPA Class A Exceptional Quality (EQ) and state standards for general distribution. Or they make Class B biosolids for managed and permitted use. In general, the more treated and aesthetically appealing the final product, the broader the options for its use. Thus, for example, for decades the Merrimack, New Hampshire WRRF has been producing highly valued biosolids compost that sells at retail for $30 and up per yard ($39.00 and up per cubic meter).

But making and marketing high-quality biosolids is not easy. It increases costs and complications at the WRRF. However, today an ever-increasing variety of technology and system options are available for all sizes of WRRFs. Heat-drying and thermal hydrolysis have been scaled down to work for moderate-sized facilities. Anaerobic digestion and CHP have proven viable for some small facilities (e.g., Essex Junction, Vermont). Dewatering (e.g., by screw presses) has improved dramatically. And composting remains an option—Sanford, Maine, is just starting up composting.

Being successful at making your own product requires marketing by people knowledgeable about the needs of farmers, landscapers, growers, and other product end users. That kind of knowledge and experience is available and used in New England through contracts between WRRF biosolids generators and biosolids management companies that provide marketing, permitting, and land application services. (In some parts of North America, e.g., Chicago, that expertise is found in public utilities, which have soil scientists and agronomists on staff.) One big challenge of selling a biosolids product is continually addressing questions and concerns from the public. But, today, there is much information and help available for that from NEBRA, NEWEA and its Residuals Management Committee, WEF, and others.

Another angle to consider is solids minimization. Less solids to manage means lower costs. While a quality biosolids product can have high demand (and some producers run out every year and have farmers on waiting lists), every ton that needs to be managed still has net costs associated with it, even accounting for any revenues. Therefore, if you can produce less, you save money. For LAWPCA, that was the main economic driver behind its new anaerobic digestion system; most of the savings came from reduced solids end-use costs, not from producing electricity or charging tipping fees for outside wastes. Anaerobic digestion is a proven form of solids minimization. Over the years, a variety of technologies or processes have been advertised to minimize; many proved to be magic black boxes that did not perform. Still, the goal is worthy of consideration by any WRRF solids management planner.

Diversify Options

Diversification of options has long been a cornerstone of sound wastewater solids management planning and policy. Many of the continent's largest WRRFs use several different solids treatment processes as well as different contractors and market outlets.

A benefit of making a quality biosolids product is an increased diversity of end-use and disposal options. MWRA and GLSD are currently the two producers of heat-dried, Class A biosolids pellets in New England. About 20 percent of the MWRA product has been used as an alternative fuel in a Maryland cement kiln, where it replaces some coal (with greenhouse gas and air emissions benefits). And, if necessary, pellets can easily go into a landfill.

In southern New England, the reliance on incineration has been nearly universal for many utilities. For decades, the system has been reliable and at reasonable cost. This year's capacity crisis is a reminder that solids management planning should be ongoing, and back-up plans are crucial. A facility that produces liquid solids likely has the fewest options. That WRRF's solids treatment costs are minimal, but there is

really only one place to go for disposal—an incinerator. For a small facility, that is not a problem, because the incinerators still operating in this region today are likely to continue to do so, and many are large enough to absorb a few truckloads a week from a small plant. But a larger facility, or a lot of small facilities together, can begin to test the system's capacity. Should the system reach capacity, liquid sludge cannot go to composting or landfill without dewatering and quickly becomes expensive if it has to be hauled longer distances. A plant with a liquid-only program only can suddenly face large increases in disposal costs.

Cost Expectations

Providing a sense of the cost for solids management is challenging, because many factors affect tipping fees and the prices charged by contracted companies (Table 3). (And calculating in-house costs of solids treatment and management is an even greater challenge.) The simplest common indicators of market prices are tipping fees charged at a facility where solids are discharged and/or the contracted price for a biosolids management company or hauler to take solids from a WRRF.

Table 3. Costs for contracted wastewater solids management

	Apx. Cost (dry U. S. ton)
APPLICATION TO SOILS	
Raw cake solids – hauling, processing, & land application (NH, 2016)[a]	$360
Class B biosolids – hauling and land application (2016)[a]	$180 – $280
Class A EQ biosolids – hauling and land application (2016)[a]	$140
Hauling, processing to Class A EQ, and land application (VT, 2014)[b]	$360 predicted $300 actual *
Compost facility tip fee,[a] does not include hauling	$250
LANDFILL DISPOSAL	
Landfill disposal (average tipping fee in New England, U. S. EPA data mid-2000s)[b]	$308
Hauling and disposal (VT, 2014)[b]	$376
Hauling and disposal (MA, 2016)[a]	$344 ($86/wet ton)
Disposal (RI), does not include hauling	$360 ($90/wet ton)
INCINERATION	
Incineration, does not include hauling	$230 – $325

* Due to reduced fuel costs in 2015-16

Sources: [a] Personal communications with biosolids management companies

[b] Vermont Department of Environmental Conservation, 2016: *A Report to the Legislature on Wastewater Treatment Sludge & Septage Management in Vermont*

Prices will vary significantly based on such factors as hauling distances and solids quality (odor potential, percent solids). Conversions of data from the identified sources from wet tons to dry tons assumes 25 percent solids. (This solids percentage is assumed just for comparing approximate costs in dry tons; if a WRRF has a lower solids percentage going to application to soils or landfill, it will likely pay more per dry ton than the cost shown.).

Tipping fees are straightforward, but even they will change based on the nature of the particular wastewater solids. For example, some landfills charge more for lower solids (< 20 percent solids) material, because it requires more careful integration into landfilled waste. Similarly, at a compost facility, a lower-percent solids means more amendment is needed, so the tipping fee goes up. In New England, tipping fees are $340 to $380/dry ton ($375 - $418/tonne) at landfills and $230 to $325/dry ton ($253 - $358/tonne) at incinerators and compost facilities.

The prices in contracts for biosolids management companies to take raw solids or processed biosolids from a WRRF vary much more, because more factors influence the price calculation.

Factors affecting the price a contractor charges for taking solids from a WRRF include:

- Changing fuel costs (Some contracts adjust the per-ton price based on actual fuel costs.)
- Odor potential or other nuisance concerns (more odorous biosolids require additional contractor care.)
- Distance from the WRRF to the planned use or disposal site(s)
- Percent solids of the material
- Level of stabilization (Class A, Class B)
- Chemical quality (e.g., metals)

In general, use of biosolids on soils can be less expensive than for landfill disposal. But it depends on the level of treatment at the WRRF. For taking raw, dewatered solids and providing hauling, treatment, and land application, a biosolids management company may charge $300 to $360/dry ton ($331 - $397/tonne). However, if the WRRF treats its biosolids to Class A EQ standards, the biosolids management contractor provides mostly marketing and distribution, and the price is around $140/dry ton ($154/tonne). One contract for land application (or other use or disposal) of a low-odor, Class B biosolids produced in southern New Hampshire is priced at about $180/dry ton ($198/tonne).

This year, however, prices are changing. Said one hauler of liquid solids: "Customers have had it good for a very long time.... As contracts expire, prices will go up." This sentiment was mirrored by all those interviewed for this article. Contract solids management prices for companies taking solids from a WRRF have increased from an average of $80 wet ton ($88/tonne) in 2015 to $90 ($99) or more in mid-2016. Some contracts now show more than $100/wet ton ($110/tonne), which, assuming 25 percent solids, is more than $400/dry ton ($441/tonne).

Conclusion

Since the spring of 2016, indications are that, for at least the next couple of years, New England will have little excess capacity in the solids management market. And when supply is short, prices go up. The companies that operate large merchant SSIs have had to become far more careful with their contracts, standards, and pricing. Some public SSIs are doing the same. One incinerator operator said: "We've started to increase our rates. And we're being more careful looking at what comes in. Septage rates are going to go up as well....

To set the price for a sludge, I look at how much capacity I have... I look at consistency: If you have large loads regularly for a long-term duration you get a better rate.... But if you're bringing just one truck a week that's digested you'll pay more. Also, we don't have the ability to store solids, so we've economically incentivized people to come at off-hours to equalize loading to the plant. We just started doing this in the past two years. We also prefer to provide service for Connecticut, so out-of-state sludge can only come in during off-hours and weekends. And we encourage dry-ton contracts, not wet tons or gallons. We test every new customer for metals, do testing ourselves as well as demand data from the recent past. We had one Massachusetts customer show some normally non-detect PCB congener, and we told the customer to clean it up before bringing in any more."

In addition, solids managers and haulers are having to work harder on tracking the market to locate capacity. They need to be ready for unexpected shutdowns that may force them to haul solids to New York or New Jersey or wait hours in line at a disposal outlet—adding significant costs to their operations. Said one incinerator manager: "While the capacity used to be great enough for all of us to help each other out in a pinch, this spring that became no longer possible all the time. Each incinerator is having to protect its own operations and interests more carefully now."

So the major message from this year's crisis is that WRRF managers need to pay close attention to solids management. Review your options and contracts. Expect price increases in the next year or two. Have contingency plans. Talk regularly with your contract hauler. And consider what you will do if and when you get the call: "We have nowhere to go with your solids today." Can you store onsite? Can you call on a back-up option? Do you have money to pay for the increased cost?

This year's events also remind the wastewater profession—operators, managers, engineers, and regulators—that solids management is a constant challenge. An increasing and intensifying number of factors impede every option:

- The growth of beneficial use on soils is stymied by excessive regulation driven by public perception.
- New England landfill space is limited and costly, and odor issues sometimes shut down this option.
- Incineration has just been shaken down, with several players dropping out and others becoming far more cautious as new regulatory requirements squeeze their operations.

The market is naturally responding. Prices are increasing and will, perhaps, stimulate new options and capacity. But for public utilities that have been hard-pressed financially for most of the past decade, these new costs will be competing with other vital local needs, including aging infrastructure and tighter regulatory requirements on the liquid and stormwater side.

Wastewater treatment is in a challenging time in this region and across the continent. There are opportunities, but ever-increasing requirements are driving costs beyond what some municipalities can manage. Solids management costs are a significant portion of any WRRF's budget, and all the current drivers—regulations and aging infrastructure—are only driving those higher.

As one of those interviewed for this article noted, "It makes sense for there to be a reassessment of all the different options for solids management. It's important that treatment plants think about this."

Another person said: "I hope DEEP is paying attention. I think it is hoping this will not become an issue. But for municipalities, it is big deal. Municipal budgets are still tight. When sludge management costs go up 10 to 20 percent, other things need to be cut to present the town with a not-too-big budget increase. For many years, sludges have been a transactional material, just something you pay someone to put on a truck and take away. That is no longer the case. This is a material that needs attention and expertise for use or disposal, and that costs something. A lot of facilities have ignored this fact."

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REFERENCES

- David, Beth. 2015. NEWEA Recognizes Fairhaven's Linda Schick. *Fairhaven Neighborhood News*: 10:3, January 22, 2015. (fairhavenneighborhoodnews.com/wp-content/uploads/2016/05/01-22-15-LindaShick.pdf)
- Donovan, John F. 2004. The Biosolids Management Method of Choice in Southern New England: Regional Thermal Processing. *NEWEA Journal*: 38: 2, 190-200. November
- Jager, Ronald A. 2000. Managing New England's 282,000 Dry Tons of Biosolids. *NEWEA Journal*, 34:2, 172-189. November, 2000.
- NEBRA (North East Biosolids & Residuals Association). 2007. A National Biosolids Regulation, Quality, End Use, and Disposal Survey. (nebiosolids.org/about-biosolids
- Sapienza, Frank; David Norton; and Louis Barry. 2012. Upgrade to Brockton's Multiple Hearth Sludge Incinerator to Meet Current Air Quality Standards. *NEWEA Journal*: 46:3, 32-40
- Vermont Department of Environmental Conservation (DEC). 2016: *A Report to the Legislature on Wastewater Treatment Sludge and Septage Management In Vermont*. (dec.vermont.gov/sites/dec/files/wmp/residual/Act%2064_Legislative%20Report%20on%20Sludge%20and%20Septage.pdf)
- Zaretsky, Mark. 2016. West Haven to pay out of state sludge disposal after incinerator breaks. New Haven Register: April 4, 2016. (nhregister.com/environment-and-nature/20160404/west-haven-to-pay-for-out-of-state-sludge-disposal-after-incinerator-breaks)