PANELIST PRESENTATION

Developing Techniques for Source Control

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I am speaking on behalf of the Association of Metropolitan Sewage Agencies (AMSA), which represents the major public treatment works and sewage dischargers throughout the country as well as most of the dischargers along the coast with which the National Research Council (NRC) report would be concerned. I will share some examples nationally and focus more specifically on Boston, where I work for the Massachusetts Water Resources Authority (MWRA), which supplies water and wastewater service to the metro area.

I will review what the NRC report says about source control and talk about point source trends, changes and associated effects, and chances for future reductions. The report makes many statements that are difficult to dispute. It talks about the strategies and potential for further source reduction, mentioning two strategies that the EPA is now attempting: watershed management and total maximum daily load (TMDL) assessment, and the EPA contaminated sediment strategy.

Regarding point-source trends, AMSA has surveyed its members over the years, and one survey covered about 75 dischargers from 1987 to 1995. The loads were normalized. For most metals (e.g., cadmium, chromium, copper) there was a significant reduction in the inputs of metals into the treatment plants during this time period. The loads are controlled through various source reduction activities and also reflect the changing nature of the U.S. industrial base; a lot of manufacturing no longer happens here. The EPA has written about various management practices that industries can use to reduce inputs.

The products of sewage treatment are effluent and sludge. Most of the contaminants end up in the sludge. A survey by AMSA of 200 plants, as well as data from EPA covering 30 plants, shows significant reductions in metals in sludges over time. We are getting to the point where we have most of the reductions that we will get. The remaining sources, for the most part, are household sources. For instance, a lot of copper, lead, and zinc is from the corrosion of piping in houses and the leaching of small amounts of metals as they get to the plant. We estimate that, for most of the contaminants coming to the plant, more than 90 percent come from household sources.

In Boston, we have seen the same trends. In 1984, we had about 3,000 lbs (1,362 kg) of metals per day coming to our plants; in 1993, we were down to about 600 lbs (272.4 kg) per day. In the last few years, we have dropped another 50 to 100 lbs (22.7 to 45.4 kg), but we have reached an asymptote of reducing or eliminating most of the sources that we can. The decline in sources can be seen in Boston Harbor, where the water column concentrations of zinc, cadmium, and copper have fallen. A regression of metals concentration in the harbor as a function of metals loadings yields a first-order approximation of the harbor flushing time if the contaminant behaves conservatively. Interestingly, this regression works reasonably well, yielding a harbor residence time of about 3.5 days.

The U.S. Geological Survey compared the concentration of metals in harbor sediments in 1993 to the records for 1977 and reported 30 percent to 50 or 60 percent reductions in concentrations of copper, zinc, chromium, lead, mercury, and silver. Similarly, we see declines in liver tumors in fish and in early blood measures of the health of fish (e.g., centrotubular hydropic vacuolation), which is related to declines in levels of organic contaminants, such as polychlorinated biphenyls (PCBs), chlorinated pesticides, and polyaromatic hydrocarbons (PAHs).

In sum, there has been a big improvement over the last 10 to 15 years in the inputs, the resulting concentrations in the water and sediments, and the health of animals living in the harbor. This trend is seen nationally too, with the mussel-watch data. The vast majority of trends for contaminants in mussels around the country are down rather than up.

The recovery of Boston Harbor actually has occurred much more quickly than anticipated. This is due to a lot of the nonlinear effects that Frank Bohlen talked about. Part of the reason for the improvement is the cessation of sludge discharge in 1991. Before that, a very small portion of the harbor could support benthic amphipods and ampelisca; by 1995, they had covered about 60 percent of the harbor, and this proportion increases each year. There is more mixing of oxygen into the sediments of the harbor, so that the redox discontinuity layer has increased from about 1 to 3 cm in the last couple of years.

The situation now is that, with primary treatment, the MWRA source issue is the relative input of the loads of pesticides, PCBs, and mercury. Our point-source discharge was a relatively large proportion of the total load. With secondary treatment, the input is declining quite a bit, so that we are looking at riverine sources, most of which are nonpoint. For mercury, atmospheric sources are starting to dominate, so the remaining point-source contribution to the load is quite small. As we have taken away the point sources, getting at the nonpoint source problem is not trivial. We have trouble getting at this problem to meet water quality standards, let alone some sort of sediment quality standards. It is hard to imagine how we will be successful with sediments in a way that we have not been for water.

It is important to remember that most of this problem is an historic problem. If you look at the annual loads of pesticides, PCBs, and mercury—not just in Boston Harbor but in the whole Massachusetts Bay system—the loads are small compared to the inventory in the water. In Massachusetts Bay, the residence time of water is about six months. To a large extent, what is driving the water-column concentrations at this point is probably release from the sediment load. For instance, of the total load of mercury of about 300 kg per year, MWRA's sewage discharge is responsible for about 30 kg, of which known industrial discharge is less than 3 kg.

We are going after small sources, such as dentist's offices, where the material in fillings is captured in a little screen as patients rinse. The dentists frequently clear that screen; we think that can capture a significant part of our existing mercury loads, but that is maybe a few hundred grams a year. When you look at how much money we will spend to get that extra few hundred grams, and you look at the inventory in surface sediments (i.e., the top few centimeters) of 40,000–80,000 kg, it is difficult to see how you will make a big dent in those materials.

I want to remind you that sewage treatment plants, in particular, face a number of other high capital costs as they look to the future. In an annual needs assessment by EPA, it has been estimated that wastewater facilities must take on $140 billion in remaining costs to rehabilitate sewers and further upgrade secondary treatment, perhaps to more advanced treatment for nutrient removal. There is already a fairly large set of expensive projects on our plate, without trying to increase the removal of sources of toxics.

That gets me to my conclusions. Point source inputs have declined dramatically. This story is not fully understood, but most of the contaminants of concern historically in contaminated sediment cleanup projects (i.e., metals, chlorinated pesticides, PCBs, PAHs), particularly in navigation projects as opposed to environmental remediation, have declined significantly. You can see the decline reflected in the status of the sediments around those discharge points.

It will be difficult to get further reductions because the sediment reservoir is so large that the remaining changes you can achieve through source control will be small. They also will be small compared to the ongoing sources, including nonpoint and particularly atmospheric sources. At this point, it is probably true that most of the PCBs coming into our system are from the transport of products sold outside the country.

If we are trying for a big benefit in the future, where are we likely to get it? It is clear from the changes in concentrations of chlorinated pesticides and PCBs that, at the national level, banning products is the way to make big changes. By the time we start to deal with that problem at individual treatment plants down the line, it does not make any sense. Are there other products out there that we will be worried about in the next 20 years in sediments? Should we be thinking about them now, and regulate them before they get into the waste stream? By the time it gets to the treatment plants—which exist not to treat toxic contaminants but rather to treat wastewater of human origin—it is too late.