Association of
Metropolitan
Sewerage Agencies

October 27, 2003

Jerome K. Bowman
Assistant General Counsel
American Dental Association
211 E. Chicago Ave.
Chicago IL 60611

Dear Jerry:

The Association of Metropolitan Sewerage Agencies (AMSA) has reviewed the August 12, 2003 version of the American Dental Association's *Assessment of Mercury in the Form of Amalgam in Dental Wastewater in the United States* and would like to offer the attached comments for your consideration.

AMSA had the opportunity to provide peer review for an earlier draft of the assessment and was pleased to see that many of AMSA's comments were addressed in this most recent version. However, we do have some remaining concerns and comments regarding certain aspects of the report. Please feel free to contact me if you should have any questions regarding the attached comments.

Sincerely,

Chris Hornback
Director, Regulatory Affairs

1816 Jefferson Place, NW, Washington, DC 20036-2505 • 202.833.2672 • 202.833.4657 FAX
info@amsa-cleanwater.org • http://www.amsa-cleanwater.org

AMSA Comments on the ADA's *Assessment of Mercury in the Form of Amalgam in Dental Wastewater in the United States* *August 12, 2003* Version

General Comments:

1. As acknowledged in the *Introduction*, the report does not address the impacts of dental office mercury in biosolids that are not incinerated (i.e., beneficial reuse). AMSA believes this omission limits the accuracy of the report and its conclusions. If levels of mercury in biosolids exceed national standards, the biosolids cannot be beneficially reused and must be landfilled at considerable cost. For example, the Massachusetts Water Resource Authority, whose efforts to reduce dental discharges of amalgam have helped the Authority consistently meet the limits for beneficial reuse, has estimated that landfilling the 75 tons per day of biosolids that the Authority generates would cost over $8 million per year.[1]

   Public perception of the pollutants in biosolids and the risks associated with those pollutants, even if the biosolids comply with national mercury limits, can also impact the ability of a community to beneficially reuse the biosolids.

   The implications of mercury in biosolids also extend beyond a POTW's options for beneficial reuse. Some states (for example Wisconsin) are or have considered using the concentrations of pollutants, including mercury, in biosolids as the basis for prioritizing the need for additional regulatory controls, regardless of whether those pollutants are meeting their national limits.

   If the ADA wishes only to address dental office mercury contributions to the environment through POTW effluent and sewage sludge incinerators (SSI), then the report should clearly state, in the cost effectiveness discussion and the *Conclusions* section, that it does not account for any impacts related to mercury levels in biosolids that are not incinerated, including impacts on beneficial reuse.

2. One of the stated objectives of the report is to assess, "the amount of mercury from dental facilities entering surface water in the United States via publicly owned treatment works (POTW) effluent and sewage sludge incinerator (SSI) emissions." AMSA understands that the ADA has limited the scope of its report to the U.S., but believes that to adequately characterize dental office mercury impacts on the environment, the report should consider impacts outside the U.S. The aerial transport of mercury is global, with mercury emissions from various countries polluting surface waters worldwide.

3. The report assumes that 79% of mercury entering SSIs in biosolids is removed by wet scrubbing systems, with only 21% of the mercury exiting the SSI as air emissions. This figure was derived using EPA data on emission factors for SSIs, commonly referred to as AP-42 factors. The AP-42 factors for SSIs are highly uncertain and not meant to be used in a quantitative manner, but rather to provide order-of-magnitude estimates. The emission factors for SSIs were given the lowest quality rating possible by the EPA, an "E" rating. The description of an "E" quality rating is, "Poor. The emission factor was developed by "C" and "D" rated test data[2], and there is reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of

[1] Based on a cost of $300 per ton to landfill. This represents the cost in an existing contract and includes transportation costs. Other POTWs may be able to landfill for much lower costs, if they can eliminate transportation costs, but local siting of a facility for disposal of large volumes of biosolids is not always possible.

[2] "C" data set quality ranking is assigned "when tests were based on an untested or new methodology or are lacking a significant amount of background data." "D" data set quality ranking assigned "when tests were based on a generally unacceptable method but the method may provide an order-of-magnitude value for the source."

variability within the source category population. Limitations on the use of these factors are always clearly noted." While the emission factors developed by the EPA may have been appropriate to determine the order-of-magnitude loading of atmospheric mercury emissions from SSIs relative to other sources,[3] they were not intended for the type of assessment being performed by the ADA.

The mercury capture efficiency of 79% was not calculated by EPA. This figure was not taken directly from the 1995 EPA document referenced in the report, but rather calculated assuming an average mercury concentration in biosolids of 5.2 mg per kilogram dry biosolids. The 5.2 mg per kilogram dry biosolids figure is also not found in the 1995 EPA document referenced in the report, but rather in a 1997 EPA document, *Locating and Estimating Air Emissions from Sources of Mercury and Mercury Compounds*, EPA-454/R-97-012. This document states, regarding the emission factors for SSIs developed by EPA, that they "should be used cautiously in that available data suggest that both mercury concentrations in sludge and control efficiencies vary widely."

When biosolids are incinerated most of the mercury is vaporized (metallic mercury has a boiling point of 357°C). While some of the mercury may be removed by wet scrubbers (in place to reduce conventional air pollutants), the wet scrubber effluent is generally sent back to the POTW headworks for treatment, simply transferring some of the mercury back into solids.

SSIs represent only 0.6% or less of the total mercury emissions from combustion point sources. Even if a worst-case assumption of 0% is made for SSI emission control mercury capture efficiency, the amount of mercury from dental industry amalgam that is annually emitted to the atmosphere from biosolids incineration in the U.S. remains dwarfed by the amounts emitted by other sources. Nevertheless, for the purposes of the report, AMSA suggests that the ADA evaluate the accuracy of the 79% mercury capture efficiency.

4. The report's cost effectiveness estimate is problematic. To develop the upper bound of its cost-effectiveness estimate, the report assumes that none of the dental-industry mercury passing through amalgam separators would be captured by downstream POTWs. In other words, the report assumes that the amount of mercury passing through amalgam separators after they are installed would be the same amount that is already estimated to pass through POTWs. The report presented no evidence to support this assumption, and concludes that since amalgam separators and POTWs have similar mercury removal efficiencies they must be removing the same mercury. As stated in the report, "the only benefit attained through the use of separators [in this scenario] would be the virtual elimination of the deposition to surface waters of an estimated 0.1 tons of mercury from the incineration of amalgam in SSIs in the United States." This assumption artificially increases the upper bound of the ADA's estimated costs to remove mercury (i.e., $1.24 billion per ton).

   AMSA is currently conducting a study to determine the degree of reduction of mercury concentrations in effluent and biosolids at POTWs with programs requiring the installation of amalgam separators at all upstream dental facilities. The full results of the study are not expected to be available for one to two years. However, some preliminary effluent data from one of the participating POTWs, the City of Wichita, Kansas, can be used to assess potential impacts.

   The City of Wichita required the implementation of best management practices at dental facilities in September 2000, which involved increased maintenance activities for the removal of particles at chair-side traps and cleaning the vacuum filter. Later, in October 2002, installation of amalgam separators was required. Effluent mercury data, using clean sampling methods and EPA Method 1631, were collected beginning in 1998. The data suggest that effluent mercury concentrations

[3] The purpose for development of the AP-42 factors.

significantly decreased throughout this period, including when installation of amalgam separators was required.

Year	Annual Average Effluent Mercury (ng/L)
1998	11.8
1999	4.52
2000	3.39
2001	3.57
2002	2.17
2003 (through August)	2.77

For the years 2000 and 2001, prior to full installation of amalgam separators, the average mercury effluent concentration in Wichita was 3.48 ng/L. For the years 2002 and 2003, after installation of amalgam separators, the average mercury effluent concentration dropped to 2.47 ng/L, a 29% reduction. While it is clear that additional data are warranted before making a final assessment, and that other factors could be influencing these data (such as changes in solids removal at the treatment plant), these early trends suggest that mercury reductions may occur in POTW effluent when amalgam separators are installed. Therefore, the ADA should not use this assumption in the cost effectiveness estimate and develop a range of estimates that assumes some level of reduction from the installation of separators.

Specific Comments:

Section 1, Paragraph 1:

"The objectives of the assessment were to estimate…. (2) the amount of mercury from dental facilities entering surface waters in the United States via publicly owned treatment works (POTW) effluents and sewage sludge incinerator (SSI) emissions;"

See General Comment 2.

Additionally, the term "dental facilities" in this objective needs to be amended, as it implies that all dental facilities were considered. As written, the report only discusses private dental facilities. This limitation should be clearly spelled out in the introduction to the report.

Section 1, Paragraph 2

"It was recognized that additional indirect pathways may exist for the discharge of mercury to surface water, including:…. [see list]"

An additional pathway for the discharge of dental industry mercury to surface water is air emissions from dental facilities. The lack of consideration of this pathway should be clearly spelled out in the report. In the 1997 *Mercury Study Report to Congress*, air emissions from "dental preparations" were estimated to be 0.7 tons/year. This amount is not small in comparison to the primary pathways evaluated by the ADA, and lack of consideration of this source should be clearly identified.

The report also does not consider mercury entering surface water from the wear of amalgam fillings once they have been placed. In the report, it is assumed that 12% of the mercury placed in a filling wears off

before the filling is removed.[4] Applying this wear factor to the 24.0 tons of mercury placed in fillings each year[5] results in 2.9 tons per year of mercury released from placed amalgam fillings.[6] This amalgam is volatilized, excreted in human waste, or stored in the human body. What is not stored in the human body is released to the air or to POTWs. Unless the ADA has data indicating that the overwhelming majority of the mercury is stored in the human body, this source cannot be dismissed as "relatively small" in comparison with the primary pathways considered by ADA.

Section 2, Paragraph 1:
"ENVIRON conducted an assessment to quantify the use of mercury in the form of amalgam by the dental industry in the United States and to estimate the amount of mercury entering surface waters via POTW effluent and the amount of dental-related mercury entering surface waters through deposition from SSI emissions."

See General Comment No. 2. The term "dental-related" implies that all dental-related sources are being considered, such as mercury in human waste from the wear of amalgam fillings and air emissions from dental offices and placed amalgam fillings, which is not the case in this report.

Section 3.1, Paragraph 2:
"ENVIRON conservatively assumed that all of these specialists use amalgam in their practices."

The assumption that all of the specialists use amalgam in their practices is not conservative. Calculations for the amount of mercury released to internal dental facility wastestreams from specialists are based on the total amount of amalgams placed by these specialists, not based on a per-dentist placement rate. These calculations are independent of the number of specialists. The number of specialists using amalgam is used to calculate the total cost to the dental industry of using amalgam separators. In this case, assuming all pediatric dentists, prosthodontists, and endodontists use amalgam actually overstates the costs needed for the dental industry as a whole to install amalgam separators.

Section 3.4, Paragraph 2
"Although these data indicate a higher capture efficiency in POTWs for mercury in the form of amalgam than that for other forms of mercury, ENVIRON estimated an equivalent capture efficiency for all forms of mercury managed by POTWs."

This statement is not accurate. An equivalent capture efficiency was used to estimate how much mercury in dental industry wastewater was removed by POTWs when no amalgam separators are present. Later in the report, however, the capture efficiency was assumed to be lower for mercury in dental industry wastewater that had already passed through amalgam separators.

Section 3.5, Paragraph 4:
"In 1997, the USEPA estimated that approximately one-third of the mercury emissions originating from the United States were deposited within the country (USEPA, 1997). ENVIRON applied this percentage

[4] (340 mg mercury placed – 300 mg mercury removed)/(340 mg mercury placed)
[5] 26.4 tons of mercury used in amalgam placements, less 9% that is discharged to the internal wastewater systems of dental facilities. Both figures are from the report.
[6] Although the 2.9 tons will be lost over the life of the amalgam, new amalgams are placed each year so the cumulative effect will be a 2.9 ton release each year.

to estimate that less than 0.1 ton of the mercury emitted from the incineration of amalgam with biosolids is annually deposited in the United States."

See General Comment No. 2.

Section 3.6, Paragraph 3:
This paragraph discusses contributions of mercury to septic systems from dental offices. While discharges of mercury from dental offices to septic systems may reduce POTW loadings, this is not always the case since septage is often brought to POTWs for disposal by waste hauler services from pumped septic systems, which contain concentrated levels of mercury. In AMSA's July 2000 report "Evaluation of Domestic Sources of Mercury," data were presented on mercury concentrations in septage. The Northeast Ohio Regional Sewer District collected and analyzed 34 samples from 12 different waste hauler services to determine concentrations of mercury in exclusively domestic septage. The results yielded mean and median mercury concentrations of 12,918 ng/L and 6,950 ng/L. Even in cases where septic tanks are not pumped, if not properly designed, septage systems have the potential to contaminate soils and groundwater. As written, the paragraph implies that there is an environmental benefit to the use of septic systems by dental facilities. The potential impacts of putting dental facility mercury into septic systems should be clearly identified.

Section 3.6, Paragraph 5
"At that time, the USEPA estimated the mercury concentration of biosolids as approximately 5.2 parts per million (ppm) (USEPA, 1995)."

The USEPA 1995 document does not include the 5.2 ppm figure. The 5.2 ppm figure can be found in the December 1997 EPA document, *Locating and Estimating Air Emission from Sources of Mercury and Mercury Compounds* (EPA-454/R-97-012). Per this document, the 5.2 ppm figure came from the National Sewage Sludge Survey[7]. Data from the National Sewage Sludge Survey was collected from August 1988 to September 1989. Therefore, the statement that the mercury concentration of biosolids in 1994 was 5.2 ppm is inaccurate. The 5.2 ppm figure was the national average biosolids mercury solids concentration for 1989. Note that this national average was dominated by data from small POTWs and had a high standard deviation. Average biosolids mercury concentrations were lower for larger POTWs.[8]

Section 3.6, Paragraph 5
"According to AMSA, the concentration of mercury in biosolids currently ranges from approximately 1 to 3 ppm (AMSA 2002)."

The AMSA 2002 document does not contain these figures.

Section 4.1, Paragraph 3
"As noted, ENVIRON conservatively assumed that 100%, or all 103,413 of these facilities, discharge to POTWs."

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[7] *Federal Register*, Volume 55, No. 218, November 9, 1990, 47210.
[8] Average concentrations were 2.36 mg/kg for those treating greater than one hundred million gallons per day of wastewater; 2.94 mg/kg for those treating between ten and one hundred million gallons per day; and 3.96 mg/kg for those treating between one and ten million gallons per day.

This assumption is not conservative when doing cost effectiveness calculations, but rather neutral. If fewer dentists were assumed to discharge to POTWs, there would be less mercury discharged and emitted from POTWs. However, fewer dentists would also be assumed to be discharging, so the total cost would be less. The net result would be that the cost per pound of mercury removed would not change.

Section 4.2, Paragraph 2
"The ADA recently conducted a bench study of the amalgam capture efficiency of 12 amalgam separators in accordance with ISO Standard 11143."

A reference should be provided for this study.

Section 4.2, Paragraph 4
"Therefore, ENVIRON considered that none of the 0.3 tons of mercury in the form of amalgam particles bypassing the amalgam separators would subsequently be captured by the downstream POTWs (i.e., the 0.3 tons of mercury in the form of amalgam bypassing the separators would consist of the same 0.3 tons that is already estimated to bypass POTWs)."

ENVIRON has presented no evidence to support its contention that there would be no reduction in effluent mercury levels at POTWs when amalgam separators are installed. The only available evidence suggests that this contention may not be correct. See General Comment No. 4 for more discussion of this issue. Until conclusive evidence is available on this matter it is not appropriate to speculate that zero reduction will occur. AMSA recommends that this scenario be removed from the ADA analysis.

The term bypass should not be used to describe any mercury not captured by the POTW. The term bypass has specific connotations in wastewater treatment. Pass through is a more accurate description of what happens to mercury not captured by the POTW.

Section 4.2, Paragraph 5
"Therefore, ENVIRON applied the slight decrease identified by AMSA to the industry-wide mercury capture efficiency of 95% for POTWs in the United States to estimate that the capture of mercury in the form of amalgam that is bypassing amalgam separators would decrease to approximately 90% in the downstream POTWs. Under this scenario, the dental-related mercury discharges from POTWs to surface waters in the United States would be reduced slightly by less than 0.4 tons per year, at an annual cost of reduction of approximately $207 million to $310 million per ton."

This estimate of the cost of mercury reduction per ton is inflated. Prior to installation of separators, the amount of mercury entering surface water from the United States dental industry via POTWs is 1.3 tons per year.[9] When amalgam separators are installed, the amount of mercury entering POTWs drops from 6.46 tons per year to 0.32 tons per year.[10] Assuming that 90% of this is removed at the POTW, the amount directly entering surface waters would drop to 0.032 tons per year. The remaining 0.29 tons per year would enter grit or biosolids. Using ADA's assumption that 25% of the mercury in solids would

[9] This is based on 0.3 tons per year exiting POTWs as effluent and 0.96 tons per year emitted from SSIs. This figure does not ignore mercury that lands in other nations nor does it assume an incorrect figure of only 21% of mercury entering SSIs exiting as air emissions.
[10] (6.46 tons per year)(1 – 0.95) = 0.32 tons per year

enter grit, the amount in biosolids would then be 0.22 tons per year. Using ADA's assumption that 22% of biosolids are incinerated, the amount of mercury incinerated would then be 0.05 tons per year. If all of this mercury enters surface waters, then the total amount of mercury entering surface waters after amalgam separators are installed would be 0.082 tons per year. The net reduction in mercury entering surface waters is then 1.2 tons per year. This amounts to a cost of $69 million to $103 million per ton of mercury removed.[11]

Section 5, Paragraph 1
"ENVIRON conducted an assessment to quantify the use of mercury in amalgam by the dental industry in the United States and estimate the discharge of that mercury from dental facilities to surface waters via POTW effluents and SSI emissions."

See General Comment No. 2. Also note that the scope of the report does not include all "dental facilities" but rather only private dental facilities.

Section 5, Paragraph 3
"ENVIRON estimated that the annual cost to reduce the mercury discharges to surface waters in the United States through the use of amalgam separators would range from $207 million to $1.24 billion per ton."

These figures are inflated. More appropriate figures would be $69 million to $103 million per ton of mercury removed. *See* AMSA comments above on *Section 4.2, Paragraph 5*

Section 5, Paragraph 3
"This cost is significantly greater than the costs of mercury reduction initiatives relating to other industries that the USEPA has contemplated and chosen not to regulate." [Followed by an example of the proposed NESHAP for the portland cement manufacturing industry.]

A more appropriate cost comparison is to compare the cost for dentists to remove mercury to the cost for POTWs to remove the mercury. The POTW cost to remove mercury is approximately $21 million per pound, or $42 billion per ton.

[11] ($83 million per year to $124 million per year)/(1.2 tons per year) = $69 million per ton to $124 million per ton.