

Regional Mercury Reduction – A Case Study of the San Francisco Bay Area



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This project was funded by BACWA, a joint powers public agency that serves 9-county SF Bay Area

- BACWA conducts region-wide watershed programs to ensure long-term stewardship of the San Francisco Bay Estuary.
 - 5 principal members
 - 14 associate members
 - 36 affiliate members



Bay Area Clean Water Agencies

A Joint Powers Public Agency

Leading the Way to Protect our Bay



HIDDEN SLIDE: Objectives for Today

- Share our project to assist others with quantifying dental mercury efforts
 - Methodology
 - Lessons learned
- Provide initial results for Bay Area agencies



Outline for Today's Discussion

- Why we conducted this project
 - Regional Mercury Watershed Permit
- How we conducted this project
 - *Regional* approach to permit metrics
 - Methodology for quantifying results
- Conclusions
- Next Steps



California “Region 2” Municipal & Industrial Dischargers are Subject to a Single “Mercury Watershed Permit”

- The 5-year Order became effective March 1, 2008
- Includes a dental mercury source control program
 - Applies to **all municipal dischargers** that discharge to San Francisco Bay (Region 2)



Dental Metrics in Permit

- Regionally, Bay Area agencies are to be evaluated based on two metrics:
 - “target for this program is that **85% of dental offices** that generate mercury amalgam waste in the region will be participating in an amalgam program”
 - DEADLINE: March 1, 2013
 - “Dischargers... shall **estimate the dental amalgam collected** (with description of basis for estimate)... Dischargers may collaborate ... in a single report...”
 - DEADLINE: Provide this to Board by June 30, 2012



These are REGIONAL Goals

- Individual agencies are responsible for:
 - Initiating a “program” by *March 2010*
 - Providing program information to BACWA
- Individual agencies are NOT responsible for:
 - Reporting to the Board about these metrics
 - Quantifying dental amalgam collected in service area

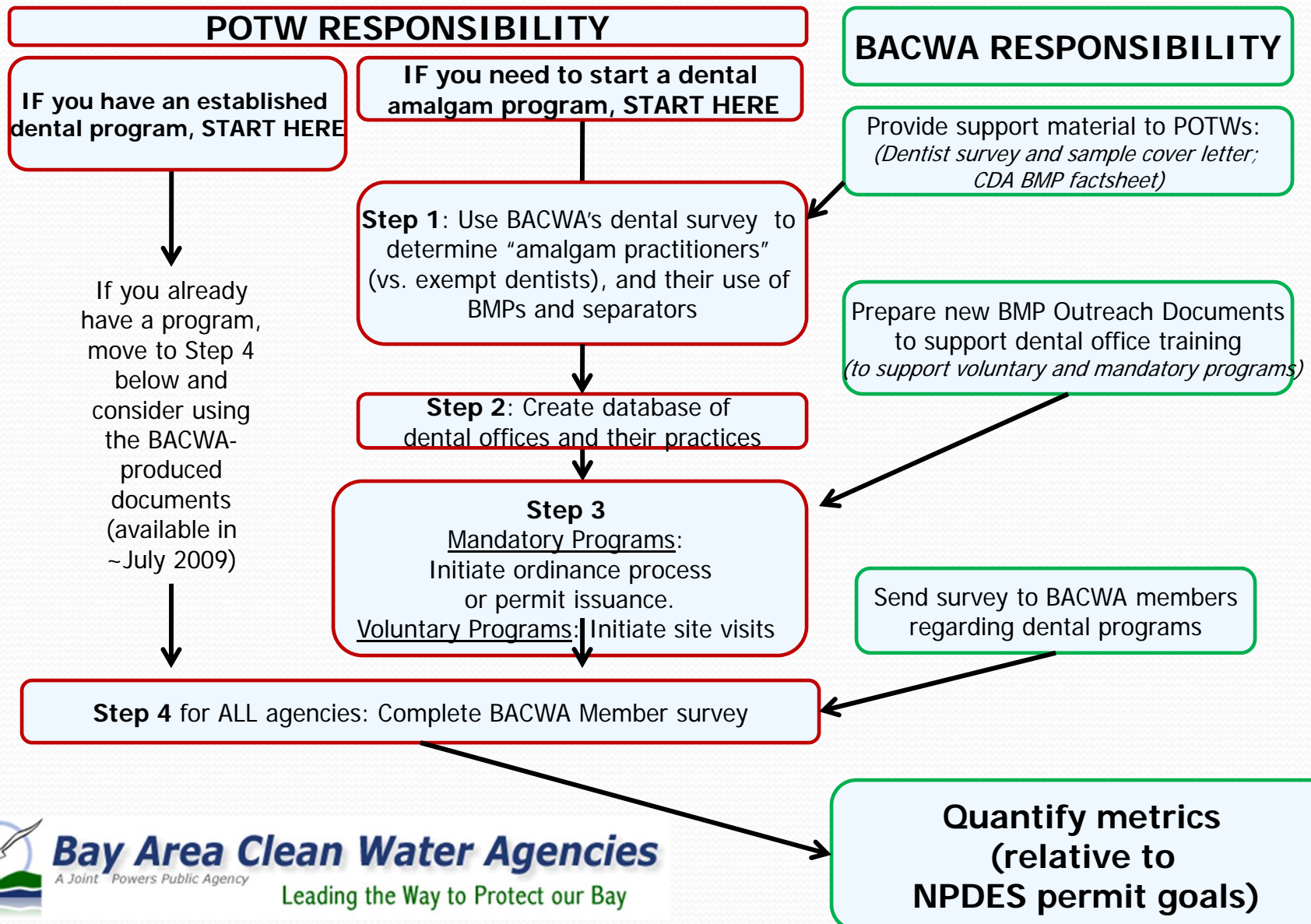


BACWA provided support to member agencies and affiliates

- Developed support materials for agencies to use
 - Sample survey (and cover letter)
 - BMP educational flyer
 - A web site with support materials
- Coordinated regional review of metrics
 - We developed a SINGLE result for each of these metrics as a result of this project

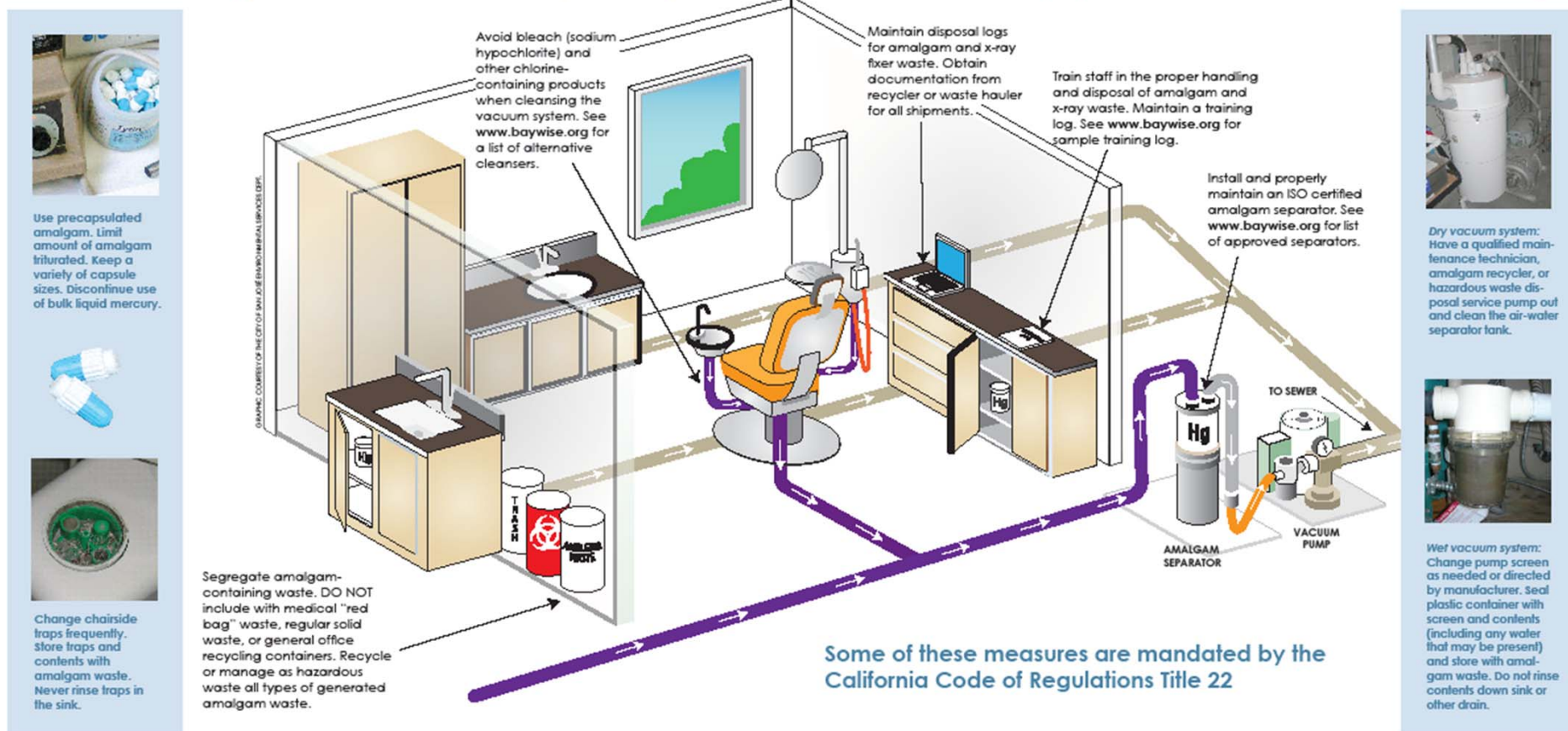


We identified a regional dental amalgam approach, including roles and responsibilities for POTWs and BACWA



See www.baywise.org for our dental training flyer

Best Management Practices (BMPs) in dental offices help protect San Francisco Bay



store amalgam waste in air-tight containers, following recycler's or waste hauler's instruction for separation of contact and non-contact amalgam. Do not add water or bleach.



Properly dispose of x-ray fixer, using licensed waste hauler to recycle or dispose as hazardous waste. Due to the high silver content, never pour fixer down the sink.



Glutaraldehyde- or formaldehyde-based cold sterilization chemicals must be chemically neutralized or otherwise deactivated before discharging to the sink; otherwise, have them picked up as hazardous waste.



Approach to the Two Regional Metrics

Submitted Excel-Based Survey to All Bay
Area POTWs

We Used a Survey-Based Approach to Collect Needed Data

- Survey was Fall 2009
 - Therefore this is a **snapshot** in time
 - Results will improve as agency programs evolve
- Surveys sent out to all 39 Bay Area POTWs
 - 36 surveys returned
 - Conducted follow-up calls and emails to clarify some survey responses
- Surveys combined into a single master spreadsheet to evaluate regional results relative to the two metrics



BACWA Member Survey: Dental Amalgam Programs as of:

Fall 2009

This Excel survey for Bay Area municipal wastewater dischargers will be used to quantify results with respect to the two regional metrics included in the Regional Mercury Watershed Permit.

Instructions: 1. Cells of this shade REQUIRE a response.

2. Cells of this shade indicate to only answer if it is relevant to your program (usually with an "X").

3. Return survey to: steifehughes@yahoo.com

Due Date: Please return survey by **November 16, 2009**

Questions? Contact Stephanie Hughes at (408) 499-9271 or email at steifehughes@yahoo.com

PART I. AGENCY INFORMATION

Agency Name (Discharger Name)	
Person Completing Survey	
Your Title	
Your Phone Number	
Your Fax Number	
Your Email Address	
Number of residents in service area	
	residents
What year is this population estimate for?	
Average flowrate of discharge (mill gal / day)	
	MGD



Metric One

Quantifying Percent Participation

Metric One



- **GOAL of 85% dental office participation with an amalgam program by March 1, 2013**



How did we define “Dental Office”?

- Why is this important????
 - Different types of dental office structure
 - How we count this reflects back on that 85% metric and what that means
- What was decided
 - **EACH individual amalgam practitioner** in service area counted as a single “dental office” for purposes of quantifying participation



Regional Board Set Minimum Requirements for a “Dental Amalgam Program”

- Agency MUST at MINIMUM have a MEASUREABLE participation
 - For instance:
 - Survey
 - Permit
 - Site visit data
 - Other evaluation of BMP use in your service area

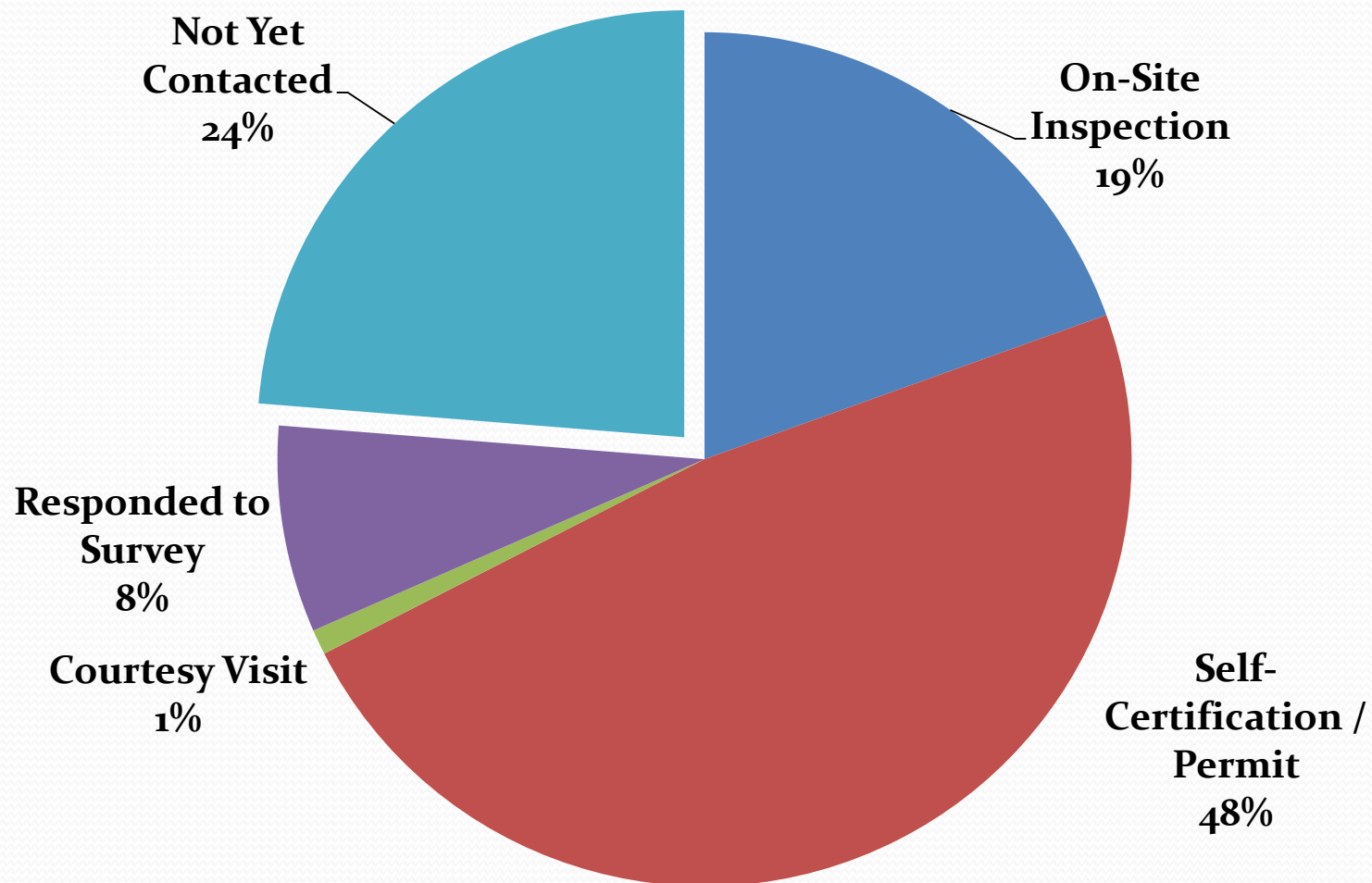


Participation levels have not yet reached the 85% permit metric

Participation Level	No. of Agencies	No. of Practitioners
100% of Practitioners	16	2,592
75% to 99%	2	164
50% to 74%	5	1,256
25% to 49%	3	26
1% to 25%	3	23
	29	4,061
Not Yet Contacted	10	1,264
Total	39	5,325

76%

Of estimated 5,325 dental amalgam practitioners, 76% have been contacted by their POTW at some level





Metric Two

Quantifying Reductions of Mercury
Discharges to Sewer

Metric Two



- Estimate the **dental amalgam collected** (with description of basis for the estimation)



How did we define “Amount of Amalgam Collected”?

- The goal is to estimate mercury
 - diverted from wastewater
 - vs. landfill diversions
 - and ONLY that attributable to implementation of POTW dental programs
 - because dental offices have been collecting Hg wastes previous to our programs

“amalgam *diverted* from collection system”



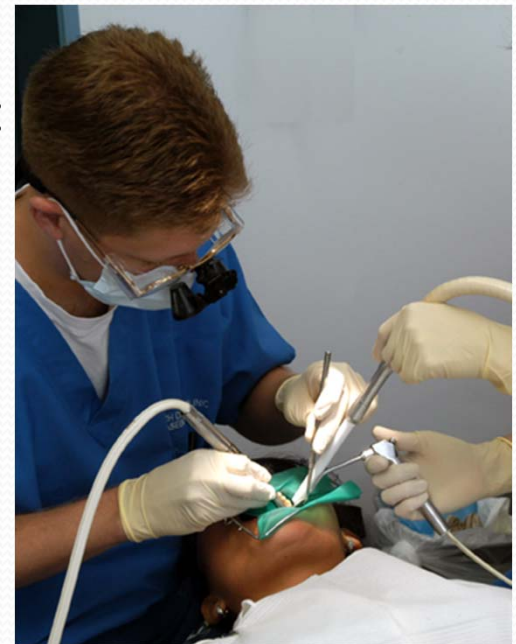
So how did we measure “Amount of Amalgam Diverted”?

- Based on a methodology originally developed by Bill Johnson, Betsy Elzufon (LWA), and Tom Barron
- Excel-based tool to estimate the mass of amalgam diverted from influents
 - We used agencies with existing dental programs for model calibration
 - We incorporated **survey** information provided by Bay Area agencies



Metric 2 - Hg Reduction

- Two Step Process
 1. Obtained Data from BACWA Surveys:
 - Amalgam Procedures Done
 - Waste Hg Generated per Procedure
 - Best Management Practice Use
 2. Estimated Hg Discharge
 - For Each District
 - Total for Bay Area



Estimated amalgam procedures based on survey results

Estimated Number of:

- Active Dentists
5,325 in SF Bay Area
- Amalgam Placement Procedures
Average = 126 per dentist / yr
- Amalgam Removal Procedures
Average = 209 per dentist / yr

Trend: Amalgam Procedures Steadily Decreasing



Estimated amalgam waste generated from removals

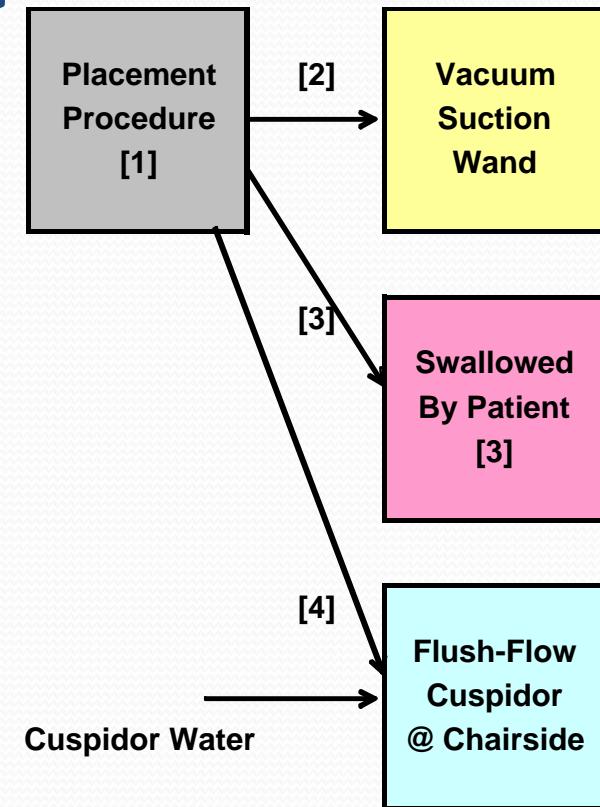
- Each procedure:
0.38 gram of Hg
- Hg from each dentist:
79.4 g/yr
- SF Bay Area:
423 Kg/yr



More waste than from placements ...

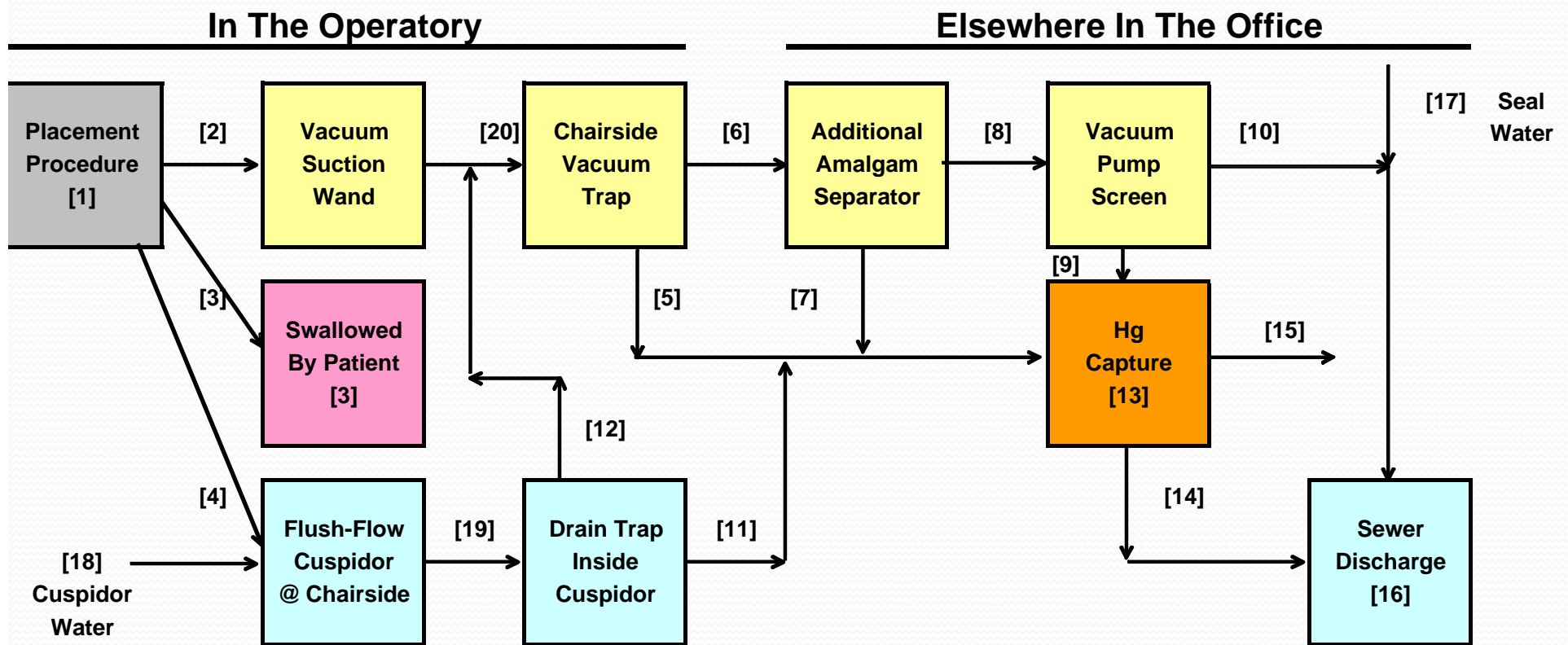
Estimated amalgam waste generated by placements

- Each Procedure:
0.045 gram of Hg
- Hg from Each Dentist:
5.67 g/yr
- SF Bay Area Total:
30 Kg/yr



Location	Flow (l)	Hg Mass (mg)		%
[1] One Amalgam Placement	1.0	45.0		100%
[2] Suction Wand	0.9	31.5		70%
[3] Swallowed by Patient	0.1	4.5		10%
[4] Mouthwash into Cuspidor	0.5	9.0		20%

There are numerous paths for Hg waste in the office



How Much Hg Discharged?

Depends Upon:

- How Procedures Done
- BMP Use
- Amalgam Separator

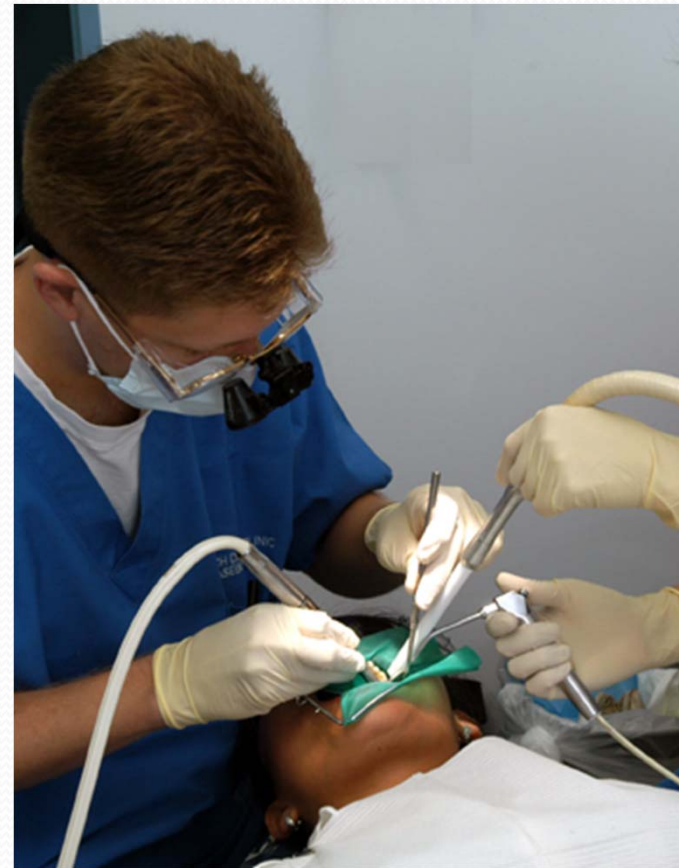


Photo: US Navy

Only some of the Best Management Practices (BMPs) impact sewer discharges

1. Use of Non-bleach Vacuum Line Cleaners
2. Collection of Chairside Trap Waste
3. Collection of Vacuum Pump Screen Waste
4. Proper Collection/Storage of All Amalgam Waste

Assumed that use of all four these key BMPs capture up to 80% of Hg Wastes



We also made an assumption regarding amalgam separators

- Our analysis assumed that they intercept up to **90%** of residual Hg that BMPs don't catch
 - Separators require maintenance to work well
 - Results in the field expected to be lower than in lab studies



Example Hg Reduction for an Individual District

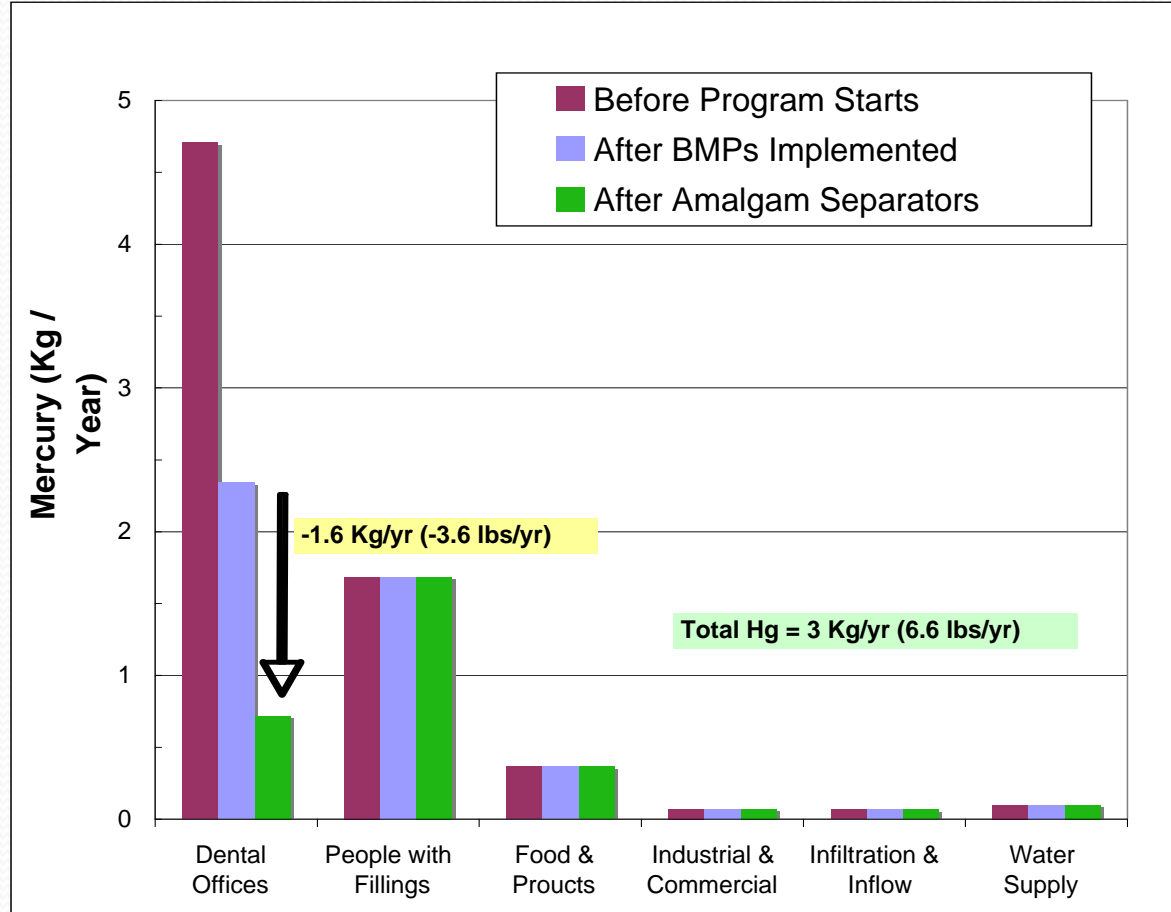
1. Dental Program Status

2. BMP Use Level

3. Separator Use

4. Inspection Results

5. Monitoring Data



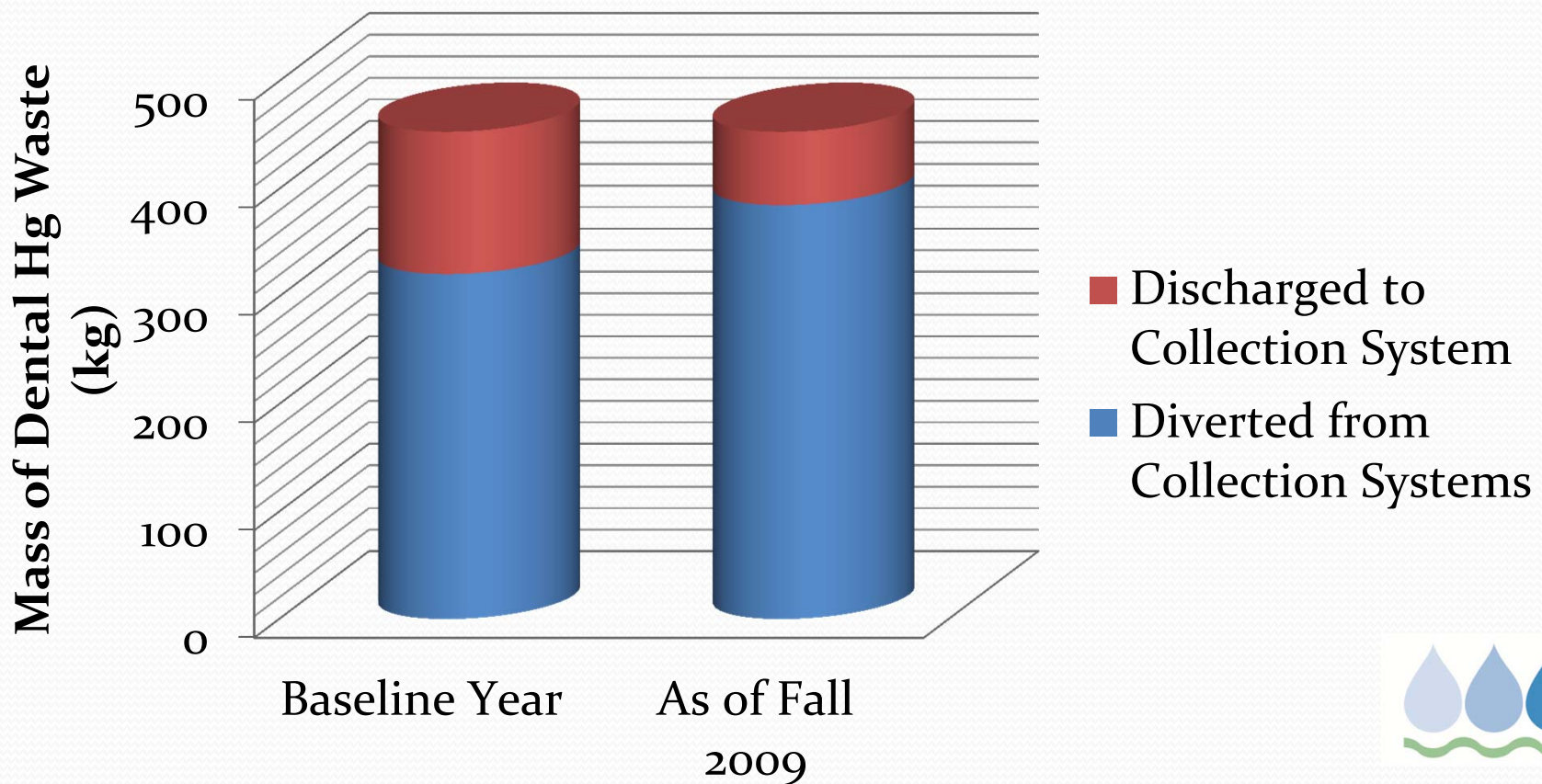


RESULTS: Estimated Dental Mercury Discharge Reduction

	Baseline (w/out BMPs)	Year 2009
Amalgam Practitioners	5,325	5,325
Hg Waste Generated (Kg/yr)	453	453
Percent Discharged	29%	15%
Hg Discharged (Kg/yr)	132	68

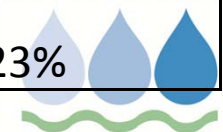
Estimate that mercury discharges have reduced from 29% of total generated waste to 15%

This represents an effective reduction to collection systems of 50%.



Conducted QC of our analysis by evaluating whether we were getting right “order of magnitude” regarding dental discharges (by comparing to POTW influent results)

POTW	Dental Hg Waste Generated (gm/year)	Estimated % Discharged	Dental Hg Mass Discharged (gm/year)	Influent mass estimate (gms/yr)	Calculated % of upstream mass that is dental
A	33,604	4%	1,401	4,991	28%
B	41,783	3%	1,253	9,100	27%
C	25,793	3%	774	5,447	14%
D	43,826	3%	1,315	17,885	7%
E	131,139	18%	23,212	25,150	92%
F	10,097	17%	1,696	7,400	23%



The Regional Board Reviewed and Approved our Methodology

- Next Steps
 - Update prior to June 2012 permit deadline
 - Provide final results to Regional Board relative to the two metrics
 - Hope to achieve/exceed the 85% target



Final (brief) topic

I was asked to survey POTWs around the country,
to quantify mercury reductions following
mandatory dental programs



Mercury Reductions are Dramatic for Agencies with Strong Dental Programs

Agency	Amalgam Program Fully Operational	% Mercury Reduction
Central Contra Costa Sanitary District	November 2007 (mandatory)	77% (biosolids)
King County, WA	End of 2004 (97% compliance)	55% (biosolids)
Madison Metropolitan Sewerage District , WI	December 2008 (mandatory)	45% (biosolids)
MWRA, Boston, MA	April 2006 (mandatory, statewide)	60% (biosolids)
MCES, Minneapolis / St. Paul, MN	January 2003 voluntary; later mandatory	51% (influent)
Regional Water Quality Control Plant, Palo Alto	March 31, 2005 (mandatory)	63% (biosolids)
San Francisco PUC	February 2004 (mandatory)	45% (biosolids)
Western Lake Superior Sanitary District, Duluth, MN	2005 (100% compliance)	62% (biosolids) 77% (effluent)

For more information

- See: <http://bacwa.org/>
 - Then look to left side “news and events”
 - “The first complete BACWA dental mercury assessment”
 - Technical memorandum describing analysis
 - Sample of the POTW survey for BACWA study
 - Detailed table of % Hg reductions at various USA agencies (with footnotes re sources)
- See www.baywise.org
 - Resources developed for dental offices



Thanks for your attention!

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Graphic courtesy of Jamie Hartshorn