MCL Evaluation for
1,2-dibromo-3-chloropropane (DBCP)

California Department of Health Services
Division of Drinking Water and Environmental Management

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INTRODUCTION

Pursuant to the Calderon/Sher Safe Drinking Water Act of 1996 (SB 1307), the California Department of Health Services (DHS) has reviewed the maximum contaminant level (MCL) for 1,2-dibromo-3-chloropropane (DBCP) for possible revision by conducting a cost benefit analysis.

Currently, the MCL for DBCP is 0.2 µg/L, the reporting limit is 0.01 µg/L, and the public health goal (PHG) is 0.0017 µg/L. Four DBCP levels below the current MCL (0.1, 0.05, 0.02 and 0.01 µg/L) were evaluated in terms of 1) health risks and 2) the costs of treatment and monitoring. DBCP concentrations below the 0.01 µg/L DHS reporting level were not evaluated.

BACKGROUND

The nematocide DBCP was first detected in California drinking waters in 1979. Subsequently, in 1983, a statewide drinking water source monitoring program was initiated and found DBCP to be the most commonly detected pesticide in ground water. Although its use was suspended in 1977, DBCP is still found in California drinking water sources, primarily in the central valley.

In the early 1980s, the California Department of Health Services (DHS) developed a DBCP action level (AL; non-enforceable health guidance concentration for a chemical in water). The AL of 1.0 µg/L was used as a criterion for evaluating the risk that might be posed by the levels of DBCP being found in drinking waters. Concerned by the chemical findings and in response to DHS recommendations, many utilities notified the public of the findings and, in some cases, installed treatment to meet the AL.

In 1989, DHS adopted an MCL of 0.2 µg/L with an associated risk of one excess cancer case in 10,000 people exposed over a lifetime of 70 years (10^{-4} risk level). A more stringent MCL was not economically feasible in California at that time due to the significant number of contaminated wells and the resulting economic burden. In 1991, the U.S. Environmental Protection Agency (USEPA) adopted an MCL at the same level.

In 1999, pursuant to Section 116365(c) of the Health and Safety Code (H&SC), the California Environmental Protection Agency (Cal/EPA) updated the DBCP risk assessment and adopted a cancer-derived PHG of 0.0017 µg/L. For carcinogens, PHGs are set at a risk level of one excess cancer case in a million people exposed over a lifetime of 70 years (10^{-6} risk level). The PHG for reproductive effects is 0.2 µg/L, which is the same as the current MCL and orders of magnitude higher than the cancer-derived PHG of 0.0017 µg/L. Derivation of the reproductive risk includes a 1,000-fold uncertainty factor and 6 liters daily water consumption (instead of the usual 2 liters per day). The current MCL of 0.2 µg/L is considered protective from a reproductive standpoint, even for children, and the focus of the possible MCL revision is therefore on cancer risk. The updated risk assessment confirms the fact that there has been no new scientific evidence to indicate that DBCP presents a materially different risk to public health than was previously determined in 1988.

At the time that DHS adopted the MCL, it designated both air stripping and GAC as the best available technology for removal; subsequent experience has demonstrated that GAC is the most cost-effective technology and it has been widely used for treating DBCP-contaminated sources.

Although neither of the criteria for possible revision stated in H&SC Section 116365(g) [change in risk assessment or treatment technology] is met by DBCP, DHS decided in March 1999 to list the DBCP MCL for review. This decision was predicated on the concerns expressed over the discrepancy between the MCL and the PHG; the MCL was set at the 10^{-4} risk level, which is two orders of magnitude higher than the PHG set at the 10^{-6} risk level. Subsequently, the State Budget Act of 1999-2000 established a requirement that DHS review the DBCP MCL and make a determination regarding revision. To provide a basis for such a determination, DHS has conducted a cost-benefit analysis. Using current DBCP monitoring data and estimated exposure, DHS has been able to approximate the incremental risk reductions and treatment costs for several MCLs.

DBCP MCL REVIEW PROCEDURE

A “Procedure for Reviewing Maximum Contaminant Levels (MCLs) for Possible Revision” (Procedure) was drafted in July, made available via our website and direct mailing to known interested stakeholders for comment, and finalized in August. This Procedure was used for reviewing the DBCP MCL (see attached).

DHS was interested in reviewing possible MCLs ranging from the PHG (0.0017 µg/L) up through 0.1 µg/L. However, both the federal and state reporting levels for DBCP findings in water samples are 0.01 µg/L, which means that there are no data available below this level to provide an analytical basis. Also, the precision and accuracy achievable at levels below 0.01 µg/L are unknown, so the analytical feasibility of an MCL below 0.01 µg/L cannot be determined at this time. Hence, DHS based its analysis on the following levels: 0.01 µg/L, 0.02 µg/L, 0.05 µg/L and 0.1 µg/L. The past four years of DBCP data from the Division of Drinking Water and Environmental Management (DDWEM) compliance monitoring database and from local primacy agencies (LPAs) were used as the basis for the cost benefit analysis, pursuant to the Procedure referenced above.

IDENTIFICATION OF AFFECTED SOURCES

Occurrence Data

The Department of Health Services Water Quality Monitoring (WQM) database and the data collected individually from Local Primacy Agency (LPA) counties were used to calculate an average DBCP concentration for each well monitored from January 1995 through May 1999. Population and source data were taken from the DDWEM source water monitoring database PICME. Following data reduction, over 360 sources were analyzed.

Data Reduction

Sources were categorized for analysis based on the level of treatment required to comply with the proposed MCL levels. Active sources with an untreated designation (AU) in the WQM database and sources with no designation were grouped into an “untreated” database for analysis. Active sources with a treated (AT) designation were grouped into a “treated” database for analysis. Sources with “inactive” (IU, IR, and IT) “abandoned’ (AB), “destroyed” (DS), “standby” (SR, ST, and SU), “monitoring” (MW), or “agricultural” (AG) designations were eliminated from the analysis. For each source to be analyzed, an average DBCP concentration was calculated from the available monitoring data.

CALCULATIONS

1) Health risks

Estimates of excess cancer cases (EC) due to lifetime exposure to DBCP (70 years) were derived from the following equation:

EC = (DBCP concentration x 1000) x (exposed population) x (0.000000588234)

DBCP concentration =	avg. DBCP concentration, µg/L
exposed population =	avg. source population
=	system population/ # of sources (assume population of 222 per source if actual population unknown)
0.000588234 =	risk per µg/L of DBCP calculated from the1/1,000,000 risk per 0.0017 µg/L (=PHG)

Excess cancer cases per year were estimated by dividing the results of the above equation by 70.

2) Treatment costs

It was assumed that systems currently treating (“treated” database) were using granular activated carbon (GAC) treatment and GAC capital costs would only be incurred if additional units were placed in series to provide increased removals. A telephone survey of DHS Drinking Water Program field offices indicated that systems currently treating were employing GAC treatment. Alternatively, systems not currently treating (“untreated” database) would incur capital costs for new GAC installation. In addition to the capital costs associated with GAC installation, monitoring and O&M costs were also evaluated. Figure 1 outlines the process for assessing capital, monitoring, and O&M costs for each affected well.

An affected well is defined as one whose average DBCP concentration exceeds the compliance criterion for a specified potential MCL. Table 1 outlines the compliance criterion for each MCL, based on DHS' rounding policy.

Table 1
Compliance Criteria for Proposed MCLs

Potential MCL (µg/L)	0.1	0.05	0.02	0.01
Compliance Criterion	≥ 0.15	≥0.055	>0.025	≥0.015

Based on the compliance criteria, a well with an average DBCP concentration of 0.14 µg/L would be an affected source only at the 0.05, 0.02, and 0.01 µg/L MCLs. Cost estimates would vary depending on the current treatment status of the source as follows:

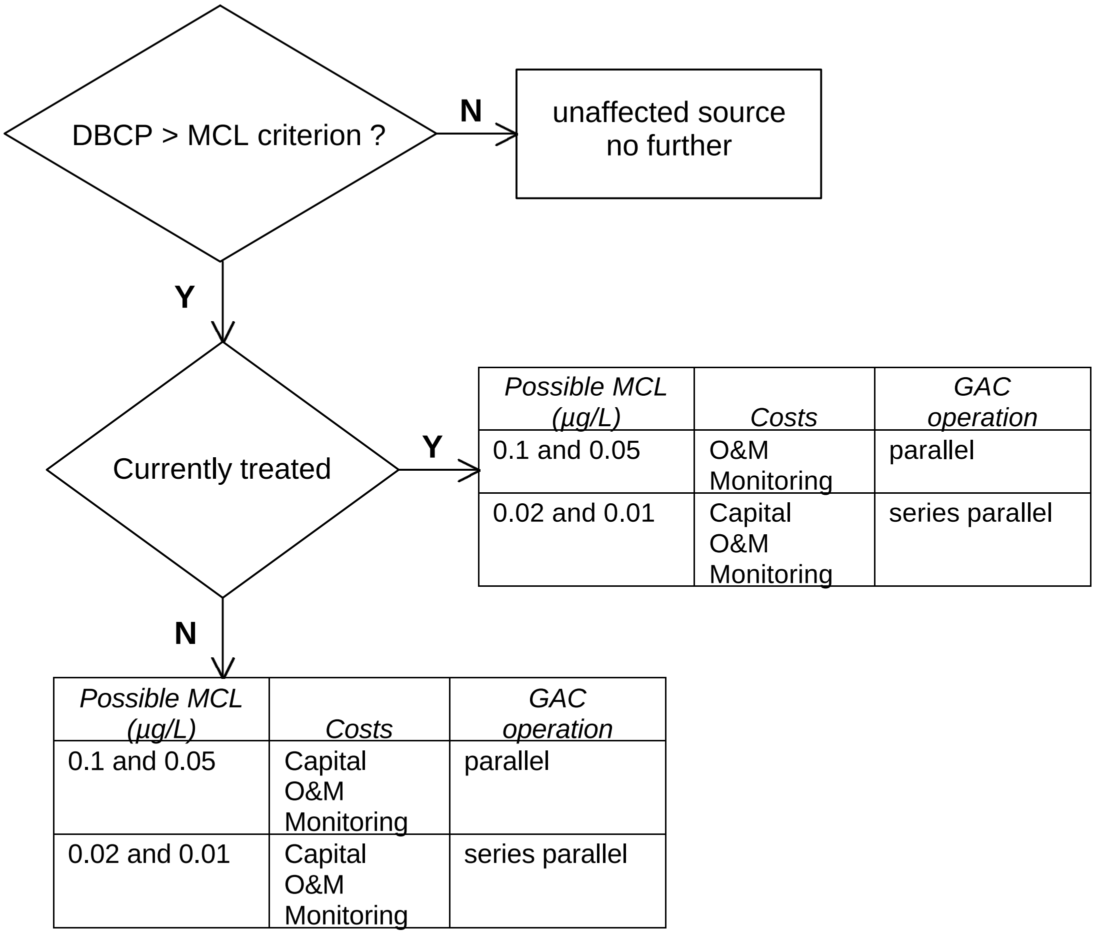
1. *Scenario 1: untreated source*
Capital, O&M, and monitoring costs are estimated. At the 0.05 µg/L MCL, capital costs are based on parallel operation (1 GAC unit per 750 gpm design flow increment). At the 0.02 and 0.01 µg/L MCLs, capital costs are based on series-parallel operation (2 GAC units per 750 gpm design flow increment). For systems with a single source, one standby GAC unit was added to the capital cost estimate.

2. *Scenario 2: treated source*
Capital, O&M, and monitoring costs are estimated. At the 0.05 µg/L MCL, capital costs are zero since treatment is assumed to be in place, and only monitoring and O&M costs are estimated. At the 0.02 and 0.01 µg/L MCLs, capital costs are based on series-parallel operation (2 GAC units per 750 gpm design flow increment). Since parallel treatment is assumed to be in place, costs are estimated for the one additional GAC unit per 750 pgm, as opposed to the 2 GAC used in the capital cost estimate for untreated sources. For systems with a single source, one standby GAC unit was added to the capital cost estimate.

GAC Capital Costs

System costs for GAC treatment were based on data from historical California wellhead treatment costs in Fresno and Clovis (Boyle Engineering, 1999). Appendix B details the cost estimating approach.

Figure 1
Treatment Assessment for Possible DBCP MCLs



Currently treated: Y

Possible MCL (µg/L)	*Costs*	*GAC operation*
0.1 and 0.05	O&M Monitoring	parallel
0.02 and 0.01	Capital O&M Monitoring	series parallel

Currently treated: N

Possible MCL (µg/L)	*Costs*	*GAC operation*
0.1 and 0.05	Capital O&M Monitoring	parallel
0.02 and 0.01	Capital O&M Monitoring	series parallel

Parallel operation: (1) GAC unit per 750 gpm design flow increment
Series-parallel operation: (2) GAC units per 750 gpm design flow increment
(1) Standby GAC unit added to systems with single source

Table 2
Capital costs for GAC treatment

Design Flow (gpm)	*GAC units required*	*Capital Cost($K)*[1]
≤750	1	557
>750 to ≤1500	2	777
>1500 to ≤2250	3	997
>2250 to ≤3000	4	1,218
>3000 to ≤3750	5	1,438
>3750 to ≤4500	6	1,658
>4500 to ≤5250	7	1,878
>5250 to ≤6000	8	2,098

1. Cost adjusted to include chlorination, enclosure and contingency costs, plus prorates for engineering (25%), escalation (3% per year), and market conditions (10%).

The design flow was based on an average daily demand of 150 gpd/capita multiplied by a factor of 2.5. The factor was based on an assumption that water usage would be higher than average in locations such as the central valley, where many of the contamination sites are located.

Design flow = (source population) x (maximum daily demand)

where: source population = system population/number of sources
maximum daily demand = 2.5 x (150 gpd/cap)

Capital costs were annualized based on a capital recovery factor of 0.0944 (7% interest over 20 years).

GAC O&M costs

GAC O&M costs were estimated from the costs for GAC adsorption in the "Technologies and Costs for Control of Disinfection Byproducts" (USEPA, October 1998). These costs may overestimate the actual O&M costs for DBCP removal since the regeneration frequencies are based on natural organic matter (NOM) removal. Regeneration or replacement frequencies may be lower for DBCP removal in groundwater. Table 3 summarizes the GAC O&M costs assuming a 10 min empty bed contact time (EBCT).

Using the USEPA estimates, the O&M costs in dollars per year were then estimated as follows:

O&M Cost ($/Yr) = (design flow, MGD) x ($/KGal) x 365 x 1000

The GAC regeneration or replacement frequencies and associated O&M costs would increase as the MCL was decreased, but this was not taken into account in the DBCP cost estimate. Disposal costs for spent GAC, potentially costing $0.65/lb GAC, were also not included in the O&M cost estimate.

Table 3
Estimated O&M costs for GAC
(USEPA, 1998)

Design flow (mgd)	O&M cost (¢/1000 gal)
0.024	295
0.087	155
0.27	113
0.65	103
1.8	84
4.8	66
11	46

Monitoring costs

Monitoring costs were based on the sampling requirements of a system with newly installed GAC treatment and reflect the post treatment monitoring required in addition to the baseline source water monitoring (California Code of Regulations, Title 22, Chapter 15, Article 5.5, Primary Standards – Organic Chemicals). Disinfection byproduct (DBP) monitoring, specifically for trihalomethanes (TTHMs) and haloacetic acids (HAA5), is included in the monitoring costs since it will be required of systems using chlorination as part of the Disinfectants/Disinfection Byproduct Rule (USEPA, 1998).

Table 4 summarizes the monitoring costs based on system size and average DBCP concentration. Based on these estimates, a system serving less than 10,000 persons, with a DBCP level greater than 0.1 µg/L, would incur a yearly monitoring cost of $1375 for exceeding the MCL.

SUMMARY OF ASSUMPTIONS

The following assumptions were used to facilitate the analysis:

1. "Affected well" is one that exceeds the MCL criterion based on average DBCP concentration.

2. Systems currently treating for DBCP removal are using granular activated carbon (GAC) treatment and GAC capital costs would only be incurred if additional units were placed in series to provide increased removals.

Table 4
Yearly Monitoring Costs
per source exceeding an MCL

	DBCP monitoring[1]		*DBP monitoring*	
	£0.1 µg/L	*>0.1 µg/L*	*<10,000 persons*	*>10,000 persons*
Additional samples required per year[2]	15	12	1 HAA5 1 TTHM	4 HAA5 4 TTHM
Cost per year($)[3]	1500	1200	175	700

Assumptions:

1. Systems with an average DBCP concentration ≤0.1 µg/L are assumed to currently be on a reduced baseline monitoring schedule of 1 sample/yr, while those with a DBCP concentration >0.1 µg/L are currently on a baseline monitoring schedule of 4 samples/yr.
2. Required in addition to baseline source (raw) water sampling
   15 samples/yr = 4 raw samples /yr + 12 treated samples/yr – 1 baseline raw sample/yr
   12 samples/yr = 4 raw samples /yr + 12 treated samples/yr – 4 baseline raw sample/yr
3. Cost per DBCP sample = $100
   Cost per HAA sample = $115
   Cost per TTHM sample = $60

3. Systems not currently treating, but requiring treatment to meet possibly lower MCLs, would opt to treat with GAC.

4. Water sources with no treatment information provided in the monitoring database are untreated. Most of the small water systems fell into this category.

5. Average daily demand = 150 gpd/capita

6. Peaking factor = 2.5 (average is 2)

7. Source population = 222 persons if unknown

8. GAC installation would include chlorination and thereby require DBP monitoring. (The DBP rule will not affect groundwater systems for another three years, but the monitoring costs were included under the assumption that by the time a new MCL went into effect and a system installed treatment, the DBP rule would be in effect.)

9. Baseline source water monitoring frequency is 1 sample per year if the average DBCP concentration is less than 0.1 µg/L and 4 samples per year if the average DBCP concentration is greater than 0.1 µg/L.

10. Prorates would be 25% for engineering, land, and city costs; 15% for chlorination, enclosure and contingencies; and 10% for market conditions.

11. The capital recovery factor would be 0.0944 (7% interest over 20 years).

12. USEPA GAC cost estimates for annual O&M costs provide a reasonable basis for this analysis.

13. GAC Treatment scenarios:
    - *Single well systems*: one backup GAC unit in addition to flow requirements
    - *0.01 and 0.02 MCLs*: series-parallel operation
      Minimum of 2 GAC contactors in series (i.e, if flow requirements necessitate 2 GAC contactors in parallel, then 4 contactors would be required). If a system is currently treating, (1) additional GAC contactor in series would be added for each existing contactor when treating to the 0.01 and 0.02 MCLs.
    - *0.05 and 0.1 MCLs:* parallel operation
      Number of contactors based on flow requirements

SUMMARY OF IMPACTS

Tables 5 through 9 summarize the cost-benefit analysis results for each of the MCL levels reviewed. Table 5 details the estimated costs that would be incurred for DBCP-contaminated wells that would require granular activated carbon treatment (untreated wells). Table 6 details the estimated costs for DBCP-contaminated sources that are currently treated. Table 7 summarizes the total estimated costs associated with each of the MCLs reviewed (i.e., a summation of Tables 5 and 6). Table 8 summarizes the per system and per capita costs for both large and small systems. Finally, Table 9 summarizes the cost-benefit analysis by providing the total number of affected wells, the estimated reduction in population exposed at the four MCLs, the estimated reduction in theoretical excess cancer cases, and the estimated cost per theoretical cancer-case-reduced.

At the 0.1 µg/L possible MCL, over 20 percent of the active DBCP-contaminated sources analyzed would be affected. For the 0.05 µg/L, 0.02 µg/L, and 0.01 µg/L MCLs, 50, 80, and 95 percent of the DBCP-contaminated sources would be affected, respectively.

CONCLUSIONS

Based on the estimated costs per theoretical cancer-case-reduced (Table 9), which range from $30.4 million to $178.5 million, it is recommended that the current MCL for DBCP remain unchanged. The burden that would be incurred at even the least costly level of 0.1 µg/L ($30.4 million for large water systems and $81.2 million for small water systems) does not justify any revision.

REFERENCES

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4. Fresno, City of. 1997 Annual Report, Operation of Granular Activated Carbon Treatment Sites, January, 1998.

5. USEPA. National Primary Drinking Water Regulations: Disinfectants and Disinfection Byproducts: Final Rule. *Fed. Reg*., 63:241:69390-69476, December 16, 1998.

6. Tulare, County of. DBCP Levels in Small Water Systems Regulated by Tulare County, Health and Human Services Agency, October, 1999.

7. California Department of Health Services. Water Quality Management (WQM) Database, Division of Drinking Water and Environmental Management, September, 1999.

8. California Department of Health Services. Permits, Inspection, Compliance, Monitoring and Enforcement (PICME) Database, Division of Drinking Water and Environmental Management, September, 1999.

Table 5
Estimated Costs for Wells with No Existing Treatment by Water System Size[1]

MCL (µg/L)	*No. of Affected Wells[2]*		*Capital Costs[3] ($M)*		*Annual O&M and Monitoring Costs[4] ($M)*		*Total Annual Costs[5] ($M)*		*Total Annual Costs per well[6] ($)*	
	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small
0.1	20	49	11.6	41.2	0.5	0.3	1.6	4.2	80,000	86,000
0.05	57	75	32.2	64.2	1.6	0.4	4.6	6.5	81,000	87,000
0.02	114	92	89.0	114.9	3.0	0.5	11.4	11.3	100,000	123,000
0.01	145	107	113.1	132.3	3.7	0.6	14.4	13.1	99,000	122,000

Notes:
1. Includes all Local Primacy Agency (LPA) sources and sources in the Water Quality Management (WQM) database that were coded "AU", active untreated. Large systems serve at least 200 service connections; small systems serve less than 200 service connections.
2. "Affected well" is one that exceeds the MCL criterion based on average DBCP concentration monitored from January 1995 through May 1999.
3. Capital Costs were based on the assumption that systems not currently treating would treat the contaminated well with GAC. GAC capital costs include prorates for chlorination, engineering, inspection, city costs, land, enclosure and contingencies.
4. Annual O&M costs were based on USEPA GAC cost estimates, which are a function of design flow. Design flow (MGD) = (150 gpd/capita) x (2.5 peaking factor) x (system population/number of sources). Assume population of 222 for wells with unknown systems population. Monitoring costs include DBCP and disinfection byproduct (DBP) monitoring costs.
5. Total annual costs = annual O&M costs + annual monitoring costs + annual capital costs, with capital recovery factor of 0.0944 at 7% interest over 20 years.
6. Total annual costs per well = Total annual costs/ No. of affected wells

Table 6
Estimated Costs for Wells with Existing Treatment[1]

MCL (µg/L)	*No. of Affected Wells[2]*		*Capital Costs[3] ($M)*		*Annual O&M and Monitoring Costs[4] ($M)*		*Total Annual Costs[5] ($M)*		*Total Annual Costs per well[6] ($)*	
	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small
0.1	8	2	-	-	0.5	0.01	0.5	0.01	63,000	4,000
0.05	49	3	-	-	1.6	0.01	1.6	0.01	33,000	3,333
0.02	81	4	47.8	1.1	2.4	0.03	6.9	0.13	85,000	33,000
0.01	93	4	54.9	1.1	2.8	0.03	8.0	0.13	86,000	33,000

Notes:
1. Includes sources in the WQM database that were coded "AT", active treated Large systems serve at least 200 service connections; small systems serve less than 200 service connections.
2. "Affected well" is one that exceeds the MCL criterion based on average DBCP concentration monitored from January 1995 through May 1999.
3. Capital Costs were based on the assumption that systems currently treating are treating the contaminated well with GAC. GAC capital costs include prorates for chlorination, engineering, inspection, city costs, land, enclosure and contingencies. Capital costs were only incurred at the 0.02 and 0.01 MCL levels for which a second GAC unit would be installed in series with the existing unit.
4. Annual O&M costs were based on USEPA GAC cost estimates, which are a function of design flow. Design flow (MGD) = (150 gpd/capita) x (2.5 peaking factor) x (system population/number of sources). Assume population of 222 for wells with unknown system population. Monitoring costs include DBCP and disinfection byproduct (DBP) monitoring costs.
5. Total annual costs = annual O&M costs + annual monitoring costs + annual capital costs, with capital recovery factor of 0.0944 at 7% interest over 20 years.
6. Total annual costs per well = Total annual costs/ No. of affected wells

Table 7
Total Estimated Costs by Water System Size[1]
(Existing Treatment + No Existing Treatment)

MCL (µg/L)	*No. of Affected Wells*		*Capital Costs ($M)*		*Annual O&M and Monitoring Costs ($M)*		*Total Annual Costs ($M)*	
	Large	Small	Large	Small	Large	Small	Large	Small
0.1	28	51	11.6	41.2	1.0	0.3	2.1	4.2
0.05	106	78	32.2	64.2	3.2	0.4	6.2	6.5
0.02	195	96	136.8	116.0	5.4	0.5	18.3	11.4
0.01	238	111	168.0	133.4	6.5	0.6	22.4	13.2

Notes:
1. Large systems serve at least 200 service connections; small systems serve less than 200 service connections.

Table 8
Summary of Estimated Costs

Large Systems

MCL (µg/L)	*No. of Affected Systems*	*Per System Annual Cost ($)*		*Per Capita Annual Cost ($)*	
		Avg[1]	*Range (min – max)*	*Avg*[2]	*Range (min – max)*
0.1	14	150,000	12,000 – 448,000	68	13 - 231
0.05	28	221,000	12,000 – 1,667,000	66	13 - 231
0.02	40	458,000	57,000 – 4,869,000	102	23 - 428
0.01	46	487,000	57,000 – 6,259,000	100	23 - 428

Small Systems

MCL (µg/L)	*No. of Affected Systems*	*Per System Annual Cost ($)*[1]		*Per Capita Annual Cost ($)*	
		Avg[1]	*Range (min – max)*	*Avg*[2]	*Range (min – max)*
0.1	37	122,000	3,000 – 104,000	410	28 - 3022
0.05	58	117,000	3,000 – 104,000	413	28 - 3022
0.02	73	169,000	55,000 – 146,000	541	67 - 4323
0.01	83	174,000	55,000 – 146,000	553	67 - 4323

Large and Small Systems

MCL (µg/L)	*No. of Affected Systems*	*Per System Annual Cost ($)*[1]	*Per Capita Annual Cost ($)*[2]
0.1	51	130,000	157
0.05	86	151,000	118
0.02	113	271,000	152
0.01	129	286,000	147

1. Per system annual cost = Total annual cost/ No. of systems
2. Per capita annual cost = Total annual cost/ Population exposed

Table 9
Summary of Estimated Costs vs Theoretical Risks by Water System Size[1]

MCL (µg/L)	*No. of Affected Wells*		*Estimated Reduction in Population Exposed*		*Estimated Reduction in Theoretical Excess Cancer Cases per Year[2]*		*Estimated Cost per Theoretical Excess Cancer Case Reduced[3] ($M)*	
	Large	Small	Large	Small	Large	Small	Large	Small
0.1	28	51	31,000	11,000	0.07	0.052	30.4	81.2
0.05	106	78	93,700	16,500	0.12	0.059	51.0	110.1
0.02	195	96	179,200	22,800	0.15	0.074	122.9	155.3
0.01	238	111	224,900	26,100	0.16	0.074	142.5	178.5

Notes:
1. Large systems serve at least 200 service connections; small systems serve less than 200 service connections.
2. Reduction in excess cancer cases = (avg DBCP in µg/L) x (1000) x (source population) x (0.000000588234)/70; calculated based on California EPA Office of Environmental Health Hazard Assessment (OEHHA) Public Health Goal (PHG) of 1.7 ppt DBCP (risk of 1x10-6 excess cancer cases in a 70 year lifetime).
3. Cost per cancer case reduced = Total annual costs/ Reduction in excess cancer cases per year

APPENDIX A. PROCEDURE FOR REVIEWING MAXIMUM CONTAMINANT LEVELS (MCLS) FOR POSSIBLE REVISION

August 1, 1999

Objectives: Pursuant to Health and Safety Code Section 116365(g), DHS is to conduct a comprehensive review of all factors related to a possible revision of an MCL, including changes in technology or treatment techniques that permit a materially greater protection of public health or attainment of the public health goal (PHG), and any new scientific evidence that indicates that the substance may present a materially different risk to public health than was previously determined.

Criteria for selection of MCLs for comprehensive review:
Subsequent to the establishment of a PHG, the following criteria will be used to determine whether or not to select the MCL for comprehensive review.

1. Is the PHG lower than the state MCL?
2. Have there been any changes in the risk assessment since the existing MCL was promulgated, pursuant to criteria above?
3. Have there been any changes in technology making contaminant removal more feasible and/or less expensive, pursuant to criteria above?
4. If contaminant is a carcinogen, was existing MCL set at a level associated with greater than a *de minimis* (one excess case of cancer in a million people exposed for a 70-year lifetime) risk?
5. Are there any significant trends in contamination levels indicated by recent occurrence data?

Procedure for comprehensive review:
The comprehensive review includes a cost benefit analysis that, to the extent possible, reflects the incremental costs and benefits that would be accrued if the MCL were to be revised to a more stringent level between the existing MCL and down to and including the PHG. The review also includes an evaluation of the feasibility of quantification at any levels that fall below the current reporting level. The steps are as follows:

1. Obtain drinking water source and system data to use in developing benefits and costs:
   (a) All available detection data on occurrence in drinking water in California for past 4 years from WQM (Division of Drinking Water and Environmental Management [DDWEM] compliance monitoring database) and local primacy agencies (LPAs); data should be chronological by drinking water source, within system, within county, whenever possible.
   (b) For each drinking water source---type, volume of water supplied, and the population served for each of the last four years (if available); if not available, then for each system---type and number of sources, proportion of water supplied by groundwater vs surface water, total volume of water supplied for each of past four years, and population served. (If volume of water supplied is not available, estimate using population and 150 gallons/day/person.)

2. Establish a number of possible MCL levels (review points) ranging from the PHG up to the MCL, for purposes of developing an adequate cost-benefit curve.

3. Evaluate the feasibility of quantification at any review points that fall below the current reporting level (DLR).
   (a) Discuss available methods and method detection levels with Sanitation and Radiation Laboratory (SRL); contact members of Reporting Levels Workgroup (RLW) for input on feasibility of quantification at levels below DLR.
   (b) Eliminate from further consideration any review points that SRL and RLW agree are definitely not quantifiable within $\pm$ 20%; do not eliminate those that are borderline.

4. Develop a matrix of the contaminated drinking water sources, including highest contamination data point, the number of people served, and the estimated water flow in gallons per minute; order from lowest to highest contamination data point for easy division into ranges. A range consists of any level above the lower review point up through the next highest point; e.g., if the review points were 1, 2, and 3, then the ranges would be 1.1 up through 2.5, and 2.6 up through 3.4. (in conformance with Department policy on significant figures, which requires rounding to the nearest significant figure and that, the number 5 be rounded to the nearest even number).

5. Benefit determination, i.e., <u>theoretical</u> adverse health effects avoided. Note that this determination assumes that adverse health effects occur immediately on exceeding an MCL; this would <u>never</u> actually be the case, because the MCLs are always set with a significant margin of safety to ensure against that; but for purposes of this type of analysis, the MCL is used as the cutoff for immediate risk of adverse effect.
   (a) For carcinogens, determine the number of excess theoretical cancer cases avoided as a function of theoretical cancer risk, contaminant concentration, and population exposed at concentrations just above the review point up through the current MCL.
   (b) For noncarcinogens, determine the number of people exposed to the contaminant at concentrations just above the review point up through the current MCL; this number is an estimate of the number of people that would no longer be exposed to the risk of the adverse health affect.

6. Cost determination for removal treatment and additional monitoring incurred
   (a) Determine BAT to use in review
      1) Determine whether any new technologies for removal are available that could qualify as Best Available Technology (BAT) for review points (pursuant to Section 116370, H&S Code, requires proof of effectiveness under full-scale field applications for removing the contaminant to below the MCL, i.e., the review points in this case).
      2) Determine technical feasibility of using existing BAT to remove the contaminant to the level of each of the review points.
      3) Determine most cost effective treatment for use in estimating treatment costs (existing BAT or newly qualified BAT; a combination might also be most cost effective, e.g., one more cost effective in the lower concentration range, the other in a higher range).

4) Develop/obtain cost curves to use in treatment cost estimate

(b) Calculate incremental treatment costs

1) For each source with contamination above a review point but not above the existing MCL, calculate treatment costs based on estimated source flow and contamination.
2) For each review point, sum the number of sources being treated and the treatment costs to determine total incremental costs for each point; also sum incremental costs for each system and the number of systems needing treatment.

(c) Calculate incremental monitoring costs

1) If a determination was made that quantification is feasible below the current DLR to accommodate a review point below that level, to the extent possible, estimate the number of sources that would be required to do follow-up quarterly monitoring if the reporting level were lowered, and determine the cost per source/year, as well as the number of systems involved and the costs per system/year. Sum costs for all sources/systems that would be impacted for each review point.
2) For a source with contamination above a review point but not above the existing MCL, calculate the cost of an MCL compliance determination (confirmation sample(s) + 5 additional samples within 6 months). Determine the number of sources/systems that would be required to do compliance determinations for each review point and sum the costs.

Evaluation of comprehensive review

Plot benefits versus costs for each review point. Consider the ratio of benefits to costs at each of the review points.

APPENDIX B. GAC CAPITAL COST ESTIMATING APPROACH

- Construction costs are based on a cost curve developed from historic construction costs for 16 sites in the Central Valley (Boyle Engineering, 1999). Historic costs are shown in Table B-1.

Table B-1
Historic baseline GAC treatment costs

Site	*No. of vessels*	*Cost (1997 $'s)*
Fresno 175	1	331,588
Reedley 6	2	408,693
Fresno 183	2	452,025
Clovis 22	2	484,640
Fresno 82	2	511,733
Clovis 21	2	578,635
Clovis 26	3	496,568
Fresno 137	3	599,625
Clovis 11	3	609,375
Clovis 12	3	609,375
Dinuba 14	4	625,650
Clovis 8A	4	656,580
Sanger 8	4	667,034
Fresno 297	4	750,671
Fresno 85	6	999,682
Fresno 89	6	1,010,759

- Average costs were found for a given flow rate and number of GAC vessels, then prorates were added to the base construction costs as follows:

Chlorination, enclosure and contingency	15%
Engineering, inspection, City costs, land, etc.	25%
Escalation – 3% per year for 2 yrs	6%
Market conditions	10%

Table B-2 shows projected 1999 capital costs for a given treatment capacity.

Table B-2
Projected GAC Treatment Costs

	Item	Prorate (%)	Number of GAC vessels 1	2	3	4	5	6
A	Base construction cost		$329,400	$459,500	$589,500	$ 719,600	$ 849,600	$ 979,700
B	Chlorination, enclosure, and contingency	15	65,900	91,900	117,900	143,900	169,900	195,900
C	***Subtotal - construction costs***		395,300	551,400	707,400	863,500	1,019,500	1,175,600
D	Engineering, inspection, City costs, etc.	25	98,800	137,800	176,900	215,900	254,900	293,900
E	Escalation – 3% per year for 2 yrs	6	23,700	33,100	42,400	51,800	61,200	70,500
F	Market conditions	10	39,500	55,100	70,700	86,300	102,000	117,600
G	***Projected cost (1999)***		$557,000	$777,000	$997,000	$1,218,000	$1,438,000	$1,658,000
	Maximum treatment capacity (gpm)		750	1500	2250	3000	3750	4500