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Cost of Compliance for Three Potential Perchlorate MCLs

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Prepared for

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Section 1: Abstract

On March 11, 2004, the California Office of Environmental Health Hazard Assessment issued a Public Health Goal (PHG) of 6µg/L for perchlorate in drinking water. California Health and Safety Code §11635 (c) [Chapter 425, Statutes of 2002, SB 1822 (Sher)] defines the PHG as the estimate of the level of a contaminant in drinking water that is not anticipated to cause or contribute to adverse health effects. The PHG is the first step of a two step process to develop a state drinking water standard, or maximum contaminant level (MCL). Pursuant to Health and Safety Code §116293, the California Department of Health Services (CDHS) must adopt an MCL for perchlorate by 1 January 2004. Health and Safety Code §116365(a) requires CDHS, while placing primary emphasis on the protection of public health, to establish a contaminant's maximum contaminant level (MCL) at a level as close as is technically and economically feasible to its PHG.

Kahl/Pownall Advocates retained Kennedy/Jenks Consultants, a firm of independent engineers and scientists, to develop an estimate of costs for public water systems (PWSs) to comply with potential MCLs for perchlorate of 18 µg/L, 6 µg/L, and 4 µg/L. The major findings of this analysis are as follows:

- The cost to water utilities and their customers to comply with potential perchlorate MCLs of 4 µg/L to 18 µg/L will be substantial (see table below). These are planning level costs with an accuracy of +50 percent/-30 percent.

Potential MCL (µg/L)	Cost Component	Low ($1000)	Average ($1000)	High ($1000)
18	**Capital**	$30,000	$43,000	$64,000
	Total Annual Costs	$12,000	$17,000	$26,000
	20 year Project Costs	$240,000	$340,000	$520,000
6	**Capital**	$108,000	$155,000	$232,000
	Total Annual Costs	$35,000	$50,000	$75,000
	20 year Project Costs	$700,000	$1,000,000	$1,500,000
4	**Capital**	$176,400	$252,000	$378,000
	Total Annual Costs	$53,000	$75,000	$113,000
	20 year Project Costs	$1,060,000	$1,500,000	$2,260,000

- Assuming a project life of 20 years and using the average estimation point, the compliance cost is estimated to be 0.3 billion (18 µg/L); 1 billion (6 µg/L); and $1.5 billon (4 µg/L).

- 14, 42, and 64 utilities and 17, 115, and 179 sources, primarily groundwater, would be affected by adopting a perchlorate MCL of 18, 6, and 4 µg/L, respectively. This assessment is based on perchlorate testing as of July 2003 that only accounts for approximately 25 percent of the Public Water System (PWS) sources in California. The study projects that these numbers could double after all PWSs sources have been tested for perchlorate.

- The water production costs, expressed as dollars per acre-feet ($/AF) of water treated, would range from approximately $1,700/AF (150 gpm treatment facility) to $450/AF (5,000 gpm facility).

Section 2: Introduction

The Calderon-Sher Safe Drinking Water Act of 1996 requires the California Department of Health Services (CDHS) to adopt primary maximum contaminant level (MCL) drinking water standards for contaminants in drinking water that are to be set at levels as close as possible to the corresponding Public Health Goal (PHG). The Office of Environmental Health Hazard Assessment (OEHHA) is required to perform a risk assessment and, based upon that risk assessment, to adopt a PHG for contaminants in drinking water based exclusively on public health considerations.

Existing law defines a "public water system" (PWS) to mean a system that provides water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days of the year, except as specified.

The 2002 statute that amends the Calderon-Sher Safe Drinking Water Act of 1996 (SB 1822, Sher) requires OEHHA, on 1 January 2003, to perform a risk assessment and, based upon that risk assessment, to adopt a PHG based exclusively on public health considerations for perchlorate using specified criteria. In March 2004 OEHHA adopted a PHG of 6 µg/L for perchlorate. This statute also requires the CDHS, on or before 1 January 2004, to adopt a primary drinking water standard for perchlorate found in public water systems (California Health and Safety Code §116293). As of this writing (June 2004) CDHS has yet to adopt a primary MCL for perchlorate.

2.1 Objective of Study

Development of new drinking water regulations requires that the cost impacts to utilities, and their customers, be considered in context of the potential benefits derived from removing a contaminant from the public drinking water supply. This study does not address the cost impacts of these potential MCLs on other sources, such as agricultural wells, private wells, and the Colorado River, except where it is used for specific PWS sources. The objective of this study was to determine the likely incremental costs to water consumers and public utilities to remediate perchlorate present in a number of the state's drinking water systems to comply with three potential MCLs at 4, 6 and 18 µg/L. These values were selected to correspond with current or past CDHS Action Levels (ALs). This study would satisfy only the cost estimate component of the required analyses.

2.2 Project Authorization

On 21 July 2003, Kahl/Pownall Advocates retained Kennedy/Jenks Consultants, Inc., a firm of independent engineers and scientists, to develop an estimate of costs to comply with potential MCLs for perchlorate.

2.3 CDHS Procedure

It is expected that CDHS will evaluate a perchlorate MCL under its "Procedure for Reviewing Maximum Contaminant Levels (MCLs) for Possible Revision" (1 August 1999***)***. A copy of that protocol is included in Appendix A. Perchlorate is present in a number of the state's PWS water sources and the California Office of Environmental Health Hazard Assessment recently issued a PHG of 6 µg/L that will be considered in developing the perchlorate MCL.

In addition to the procedure set forth in Health and Safety Code Section 116365(a), (b), and (g), CDHS has indicated it will take the following actions in reviewing the MCL for perchlorate. CDHS will:

1. Obtain drinking water source and public water system data to use in developing costs.
2. Establish a number of potential perchlorate MCLs (review points) for the purpose of developing an adequate cost-benefit curve.
3. Develop a matrix of the contaminated drinking water sources, including highest contamination data point, the number of people served, and the estimated water flow; and ordering the contamination data points by potential perchlorate MCLs.
4. Determine costs incurred for removal, treatment and additional monitoring.
5. Estimate the populations served by the affected sources. CDHS uses the sum of these populations over all affected sources as an estimate of the number of exposures avoided in its benefits analysis for non-carcinogens such as perchlorate.

2.4 Cost of Compliance for this Study

This study was designed to develop statewide cost estimates for implementing three potential MCLs for perchlorate. Many of the study's costing methods were modeled after the American Water Works Association Research Foundation's (AwwaRF) cost of compliance protocol (Raucher et al 1995) summarized below. That protocol requires the reviewer to:

1. Determine the occurrence profile of the evaluated contaminant.
2. Determine the current configuration of the affected water system facilities.
3. Determine the treatment alternatives and costs necessary to achieve potential MCL compliance.
4. Determine the likely response the water systems will take to comply with the potential MCLs
5. Determine the total cost of compliance with the potential MCL requirements.

2.5 Current Perchlorate Regulatory Status

Currently there is no state or federal drinking water standard, here referred to as the MCL, for perchlorate. CDHS is in the process of developing a drinking water standard for Perchlorate.

Until an MCL is in place, CDHS is using a 6 µg/L advisory action level to protect consumers from adverse health effects resulting from perchlorate exposure. OEHHA's PHG is based on a precursor effect -- the inhibition of iodide uptake by the thyroid gland -- and the possibility of a resultant decrease in production of thyroid hormones, which are needed for prenatal and postnatal growth and development, as well as for normal body metabolism. The previous AL for perchlorate was lowered from18 µg/L to 4 µg/L in January 2002. The 4 µg/L concentration corresponds to the detection limit for reporting (DLR) for perchlorate. In March 2004 the AL was raised to 6 µg/L to be consistent with the recently adopted PHG.

Perchlorate is an Unregulated Chemical Requiring Monitoring (UCRM) by community water systems and non-transient, non-community water systems. Listing of chemicals that lack drinking water standards but nonetheless require analysis can be found in Title 22 of the California Code of Regulations §64450, effective 3 January, 2001.

In December 2002, OEHHA released a revised draft PHG of 2 to 6 µg/L. A final PHG of 6 µg/L was issued in March 2004 and CDHS must consider it in the setting of the primary drinking water standard.

In anticipation of proposing a drinking water standard for perchlorate, CDHS is in the process of determining the technical and economic feasibility of regulating perchlorate. This process includes selection of possible draft MCL concentrations for evaluation, evaluation of occurrence data, evaluation of available analytical methods, estimation of monitoring costs at various draft MCL concentrations, estimation of population exposures at various draft MCL concentrations, identification of best available technologies (BATs) for treatment, estimation of treatment costs at the possible draft MCL concentrations and review of the costs and associated health benefits (health risk reductions) that result from treatment at the possible draft MCL concentrations.

Once the drinking water standard for perchlorate has been proposed there is a 45-day public comment period. Any "post-hearing" changes made in response to comments are subject to a subsequent 15-day public comment period. After CDHS completes the regulatory process, it submits the regulation package, including responses to public comments, to the Office of Administrative Law (OAL).

OAL has 30 working days to review the regulation and approve or reject it. If approved by OAL, it is filed with the Secretary of State, becoming effective in 30 calendar days.

Table 1 summarizes regulatory information for perchlorate. Note that while there is no existing MCL for perchlorate, utilities must monitor for perchlorate as a UCRM. For this reason the reporting limit (DLR) is listed. The DLR is a determination by CDHS that represents the lowest concentration that a broad spectrum of laboratories (utility, private, and government) can reliably verify, and are the reporting levels required by CDHS to ensure uniform reporting. The reporting limit of 4 µg/L for perchlorate establishes the lowest values of perchlorate that (1) can be reliably used in assessing which sources have perchlorate present and, (2) the effectiveness of treatment for meeting potential MCLs.

Table 1: Current Regulatory Limits for Perchlorate

Level	**Perchlorate (µg/L)**
US EPA, MCL	None
California Title 22, MCL	None
Public Health Goal	6
Action Level	6
Reporting Limit	4

2.6 Selection of Potential Perchlorate MCLs for this Study

Table 2 summarizes the three potential MCLs, the affected source criteria, and treatment goals that were used in this study. The potential MCLs for Perchlorate of 4, 6 and 18 µg/L provide a reasonable range of potential MCLs and were selected based on historical perchlorate ALs described in the previous section of this report.

Table 2: Three Potential Perchlorate MCLs Selected for Evaluation

Element	Potential MCL (µg/L)		
	4	**6**	**18**
Affected Source Criterion (µg/L)	≥ 4.6	≥ 6.6	≥ 18.6
Treatment Goal (µg/L)	< 4	< 4	< 4

Table 2 lists an affected source criterion for each potential MCL. This criterion for each MCL is based on the use of significant figures for the MCL and the rounding off protocol used by CDHS for reported analytical results. For example, the CDHS procedure requires that a value between 5.4 and 4.6 µg/L be rounded to 5 µg/L for the present MCL (one significant figure and the number 5 rounded to the nearest even number). If the assigned perchlorate value for a given source met the affected source criterion, it was considered an affected source for the respective MCL.

A treatment goal, designated for each potential MCL, is also included in Table 2. For all the three potential MCLs, it was assumed that the perchlorate level in the treated water must be below DLR of 4 µg/L.

Section 3: Identification of Perchlorate Affected Sources

The first step in the cost of compliance is to determine the number of affected sources. This section describes the activities to assign a single perchlorate concentration to the PWS sources. The same databases and reduction steps were used to assign other water quality parameters such as nitrate and sulfate to these sources.

3.1 Data Sources

In the performance of this study, several databases were used and are identified in Table 3. This table also notes the type of information that was used from the identified sources.

Table 3: Summary of Sources of Data

Source	Name	Type of Data
Association of California Water Agencies (ACWA)	ACWA Radon and Arsenic Databases	Well Capacity
United States Geological Survey (USGS)	http://water.usgs.gov/public/watuse/spread95/caco95.txt	Per Capita Water Consumption by County
Department of Health Services (CDHS)	Water Quality Monitoring (WQM)	Water Quality, Utility Information, Population Served, Number of Connections
Department of Health Services (CDHS)	Permits, Inspection, Compliance, Monitoring, and Enforcement (PICME)	Utility Statistics, Well Capacity and System Configuration
Selected California Utilities	Not Applicable	Well Capacity, Construction and O & M Costs
Kennedy/Jenks	Not Applicable	Construction and O & M Costs
US EPA	Safe Drinking Water Information System (SDWIS)	Utility Information, Population Served

3.2 Identification of Potentially Affected Sources

The CDHS Water Quality Monitoring (WQM) database was used to estimate a representative perchlorate concentration for each active surface and groundwater sources. For public water supply groundwater sources, only untreated sources were selected from the database. For public water supply surface water sources, the data from the treated effluents were used.

Most sources in the CDHS database that had perchlorate compliance data had more than a single concentration that corresponded to different sampling dates for a particular source.

Before proceeding further, these data must be reduced to a single, assigned value for each source to be compared to the potential perchlorate MCL. This assigned value should correspond with the central tendency of the perchlorate results from repeated samples of a source.

As a first step in the data reduction procedure, all the non-detect (< Reporting Limit) values were assigned a concentration of 2 μg/L (one-half the reporting limit) to facilitate further electronic data processing. Subsequently, depending on the number of perchlorate data and the time period in which the samples were taken for each source, a number of procedures were used to assign a representative perchlorate concentration for each source. The following procedures were used in order of preference:

a. Six-month running average between 1 April 2002 and July 2003

b. Quarterly running average between 1 April 2002 and July 2003

c. Quarterly average post-2000

d. Monthly average post-2000

e. Monthly average pre-2000.

The post 2000 data were given a preference because the low level perchlorate methodology was only developed in 1998. Generally, it takes the water quality laboratory industry a number of years to develop reliable and consistent analyses on a state-wide basis for a parameter using new methods and instrumentation.

Appendix B describes the procedure used for data reduction in detail. If the assigned value of a source exceeds the affected source criterion for each MCL summarized in Table 2, it is identified as an impacted source. A listing of the affected sources by potential MCL is presented in Appendix B with the assigned perchlorate values.

3.3 Inactive and Standby Sources

Some of the perchlorate impacted groundwater sources were classified in the WQM and PICME databases as “inactive” or ”standby”. For estimating cost of compliance in this analysis, all of the wells with the classification of “standby” and 50% of the “inactive” sources were assumed to need corrective action to meet the potential perchlorate MCLs. A random number approach was used to identify the specific “inactive” sources that needed corrective action.

3.4 Extremely Impaired Water Sources

In November 1997, CDHS issued a policy guidance memorandum for direct domestic use of extremely impaired sources (CDHS 97-005). For chemicals considered as potential carcinogens or to have other chronic health effects, CDHS defined an extremely impaired source as a source that contains the chemical at concentrations that are 3 times higher than its corresponding MCL or action level (AL). For purposes of this study, all sources with assigned perchlorate level three times higher than each potential MCL were considered as extremely impaired water sources. Assignment of this permitting cost for this study was done at the PWS level.

3.5 Affected Sources and Utilities by County

Table 4 summarizes the number of affected utilities and sources by county. This table also summarizes the total and incremental number of utilities and wells affected by each potential MCL. A total of 17, 115 and 179 affected wells were identified at potential MCLs of 18, 6 and 4 μg/L, respectively. Los Angeles, San Bernardino, and Riverside counties had more than 83 percent of the affected sources at the lowest potential MCL.

Table 4: Summary of Affected Utilities and Wells by County for Three Potential Perchlorate MCLs

County	Potential MCL (μg/L)									
	18		6				4			
	Total Utilities	Total Sources	Incremental Utilities	Incremental Sources	Total Utilities	Total Sources	Incremental Utilities	Incremental Sources	Total Utilities	Total Sources
Imperial	0	0	0	0	0	0	1	1	1	1
Kern	0	0	0	0	0	0	1	1	1	1
Los Angeles	8	10	12	39	20	49	3	19	23	68
Monterey	0	0	0	0	0	0	1	1	1	1
Nevada	0	0	0	0	0	0	1	1	1	1
Orange	0	0	1	1	1	1	2	2	3	3
Riverside	1	1	3	27	4	28	3	13	7	41
Sacramento	1	1	1	1	2	2	1	1	3	3
San Bernardino	4	5	4	21	8	26	5	14	13	40
San Joaquin	0	0	1	1	1	1	1	4	2	5
Santa Clara	0	0	2	2	2	2	2	3	4	5
Sonoma	0	0	1	1	1	1	0	0	1	1
Tulare	0	0	2	4	2	4	1	4	3	8
Ventura	0	0	1	1	1	1	0	0	1	1
Total	14	17	28	98	42	115	22	64	64	179

3.6 Utilities by Population Served

The number of utilities by population served as a function of MCL is summarized in Table 5. The largest number of impacted PWS was those that serve a population over 33,000.

Table 5: Total Number of Affected PWS at Each Potential Perchlorate MCL

Population Served	Potential Perchlorate MCL (µg/L)		
	18	**6**	**4**
25-100	0	0	3
101-500	0	6	8
501-3300	0	3	6
3,301-10,000	3	6	8
10,001-33,000	0	2	4
33,001-100,000	6	13	18
>100,000	5	12	17
Total Affected Utilities	14	42	64

Section 4: Configuration and Treatment Alternatives of Affected Sources

The water systems considered in this study have one or more sources that are impacted by perchlorate. In the vast majority of cases (approximately 98 percent for the 4 µg/L case), the affected sources were wells. In general, the wells are configured so that treatment facilities must be installed at individual wellheads. The surface water supplies that were identified as affected sources were less than 1000 gallons per minute so the treatment systems were very similar to well head treatment facilities. Thus the key system configuration issues for development of treatment systems and estimation of treatment costs are the source capacities and the number of affected sources at each affected utility.

4.1 Estimating the Design Flow Rate of the Affected Sources

The size of an affected well is an essential element in determining the capital cost of treatment facilities and operational costs. The CDHS Permits, Inspection, Compliance, Monitoring and Enforcement (PICME) database quantifies the number and type of drinking water sources for each utility. However, it does not set forth the source capacity. Hence, source capacity data were obtained from an ACWA database and directly from select water utilities (Table 3). However, this data only covers approximately 6 percent of the PWS groundwater sources within California.

If the design flow rate of an affected source was available from the above databases, this information was used for estimating treatment cost. In a limited number of cases, where treatment for perchlorate is currently in the planning/construction stage, the design flow rates were obtained from vendors or owners and their representatives.

For the majority of cases, the design flow rates had to be assigned. Based on the size of the systems, two procedures were used for assigning the flow rates. Typically for smaller systems, where there were 1-3 sources, the population served by the PWS (these data were from the CDHS database) was multiplied by the county's per capita groundwater usage (USGS, 1995) multiplied by 365 days to determine the total annual production for the PWS. This volume was divided by the number of sources to determine the annual production for the source. A design capacity was assigned assuming that this annual production was achieved by operating the source for 40 percent of the time.

Some of the larger systems have a large number of wells that have a wide range in design flows. To assume that every well has the same capacity as in the above case, would tend to generate an unknown bias. Therefore, a modeling approach was taken for these systems. A PWS with known design flows in the Kennedy/Jenks Consultants database served as a model for the PWS without design flow data for their wells. The following steps were used:

1) A PWS with known flow rates that closely matched the population served, the number of sources, and location of the affected PWS was selected as the model PWS for well flow rate assignment;

2) The wells in the model PWS and the affected PWS were arranged side by side in an Microsoft® Excel spread sheet;

3) A random number (using the random number generation function in Microsoft® Excel) was assigned to each of the wells of the model PWS;

4) Then the wells in the model PWS were rearranged in ascending order of the assigned random number; and,

5) The design flow of a well in the model PWS was assigned to the well of the affected PWS that appeared in the same matching row of the spreadsheet.

4.2 Treatment Technology

CDHS has not designated best available technologies (BAT) for removing perchlorate from drinking water, as there is not yet a drinking water regulation for perchlorate. Based on conversations with CDHS staff in charge of developing the regulation, and professional judgment, ion-exchange and biological treatment appear to be the possible BATs. However, ion-exchange appears to be the treatment of choice for the agencies that have already installed treatment for perchlorate and those planning to install treatment in the near future.

Therefore ion-exchange was selected for estimation of treatment cost for the impacted sources. In addition, blending with uncontaminated water was also identified an option for some sources to meet a potential perchlorate MCL. The following procedure was used in the assignment of blending/ion-exchange treatment for the impacted sources:

- For some of the impacted sources, treatment for perchlorate is already under construction or in the planning/design phase. In all of these cases ion-exchange using a single pass mode or a regenerative carousel (ISEP) configuration is the treatment of choice. Capital and O&M costs for these sources were obtained from the vendors or owners.

- If a source exceeded the MCL by less than 25 percent (perchlorate concentration in the source $\leq$ 1.25 X MCL) blending with ”perchlorate-free” water was the corrective action.

- Single-pass ion-exchange was assigned as the treatment process for the sources that were not treated by blending,

Ion-exchange vessels in lead-lag configuration (single/multiple trains) were assumed as the process configuration, no additional ISEP configurations considered because of limited availability of brine disposal facilities (see Appendix C). The sources were considered to be off-line during resin replacement. Appendix C contains the unit cost estimate for blending and single pass ion-exchange, for design flow rates developed in the system configuration analysis, and for each appropriate potential perchlorate MCL. Cost assumptions used to develop this estimate are also described later in this report.

Section 5: Estimated Perchlorate Cost of Compliance

Generally, there are two cost components for complying with the potential perchlorate MCLs:

1. The costs of the initial assessment required by CDHS to determine whether a source needs corrective action, and

2. The treatment implementation costs (i.e., the capital and operations and maintenance (O&M) costs associated with treating water to comply with potential perchlorate MCLs.

5.1 Costs of Initial Assessment Required by CDHS

When an MCL is promulgated, CDHS will advise utilities that have potentially affected wells to conduct an initial assessment. For this report, it was assumed that if a source had an assigned value of 80 percent of the potential MCL, CDHS would be requesting an initial assessment. For rounding and analytical reasons, targeted sources were defined as sources with assigned values ≥14.4 µg/L, 4.8 µg/L and ≥2.4 µg/L for the 18 µg/L, 6 µg/L and 4 µg/L potential perchlorate MCLs, respectively. The assigned values ≥2.4 to 4 µg/L is an artificial result of the data reduction procedure that generated an average, single concentration for each source.

The CDHS procedure for the initial assessment is to first determine a six-month running average for each targeted source. If the six-month running average is above the potential MCL, the affected utility will have to submit a letter describing the proposed direction of the corrective action to CDHS for their review and approval. The letter would identify the general direction that the PWS would be taking for the affected source(s). Examples of potential solutions in the letter would be (1) take appropriate action to remove the source from service; (2) perform a corrective action study to recommend a solution, and (3) conduct a preliminary design study of a selected treatment alternative.

The estimated monitoring cost for developing the initial assessment is $600 per well for developing the six-month running average ($80 per analysis, $20 for shipment for a total of $100 per sample). The estimated cost for the letter is $5,000 for each affected utility, rather than each affected source, because the incremental cost for additional newly affected wells for an already affected utility was considered negligible. The estimated cost covers both the letter and review by CDHS. Table 7 summaries these costs for the affected wells and utilities for each potential MCL.

Table 6: Summary of Initial Assessment Costs

Potential Perchlorate MCL (µg/L)	Wells Needing Initial Assessments	Initial Monitoring Cost ($)	Affected Utilities	Planning Report Costs ($)	Total for MCL ($)
18	23	14,000	14	70,000	84,000
6	145	87,000	52	260,000	347,000
4	250	150,000	88	440,000	590,000

5.2 Total Project (Capital) Costs for Treatment Implementation

This subsection summarizes the total project costs to install blending or ion-exchange treatment facilities. The developed estimate for total project (capital) costs was developed using four major elements: (1) "Bid" costs for the corrective action, in this case either a blending station or a single-pass ion exchange treatment system; (2) Non-factored costs such as pipelines, additional land for the facilities and site improvements, (3) Factored indirect costs such as engineering, legal, permitting, regulatory review, interest during construction, and (4) Non-factored indirect costs for 97-005 permitting and public acceptance of the proposed project. The sections below describe all of the elements except the factored indirect costs. The procedure for developing capital costs from these elements and the factored indirect costs are described in Appendix C.

5.2.1 "Bid" Costs

Bid costs were developed for two corrective action solutions. One was blending and the other was single-pass ion exchange.

The bid cost for each solution was built up using non-factored and factored costs. For example, for the single-pass ion exchange system, vessels, pump modifications, and electrical and instrumentation were non-factored costs. For a non-factored cost, a unit price is obtained from previous projects, vendors, etc. An installation cost is then estimated from the unit costs. Contractor's overhead and profit, site work, and contingencies are examples of factored costs. Typically, the process equipment costs serves as the basis and separate multipliers are used for each of the factored cost elements. This approach and the specific factors are described in Appendix C to develop the bid cost for the various design cases described for each solution.

5.2.1.1 Blending

For sources using blending, two design cases were used. These design cases correspond to flow rates of 500-1,200 gpm and 1,300-5,000 gpm. Although the aggregated estimate assumes a single blending station for each source, if there are opportunities to address multiple sources with a single blending station, the estimated "bid" costs would be calculated by adding the individual costs of affected sources. The "bid" costs for this solution were based on similar projects implemented by Kennedy/Jenks, primarily for nitrate problems. Table 7 summarizes the capital cost for this technology for the two design cases. The cost details for the blending option are described in Appendix C.

5.2.1.2 Single Pass Ion Exchange

Average design flows were selected based on readily available vessels used in the proper increments for six design flow rates. Capital cost for ion-exchange systems were obtained from vendors, existing projects, and project bids. Table 7 summarizes the capital cost for this technology for the six design cases. The range of treated flows for each design case was based on design criteria such as empty bed contact times and surface loading rates.

Table 7: Capital Cost for Facilities for Corrective Actions

Blending Stations	
Design Flow Rate	**Facilities Costs ($1000) Per Source***
500-1200	$164
1300-5000	$186

Single-Pass Ion Exchange		
Design Flow Rate (gpm)	**Number of Vessels**	**Facilities Costs ($1000)***
150	2	$230
300	2	$350
600	2	$570
1000	2	$670
2000	4	$1,400
5000	10	$3,300

*Includes 25 percent for indirect construction costs

5.2.2 Non-factored Asset Project Costs

To install corrective action solutions to address the perchlorate contamination, additional improvements have had to be included in the project to get community and PWS acceptance. As a result a number of sites have been assigned costs to account for these requirements. In all cases a random number approach was used to make the assignments similar to the process described in Section 4.1.

5.2.2.1 Land Cost

Additional land for the treatment facilities was assigned to 25 percent of the sites. Sites where treatment is already in progress were excluded.

Since many well sites are located within a suburban community that occupies the equivalent of a home site, the median residential home price as of November 2003 was used to establish the cost for purchasing additional land. The median residential resale home price from Sacramento, Santa Clara Los Angeles, Riverside, and San Bernardino counties were used to develop the $241,000 assignment for the land costs.

5.2.2.2 Demolition Cost

If additional land had to be obtained for a treatment facility, 50 percent of the sites were assigned $120,500 to cover demolition.

Typically, 50 percent of the assessed value of a property is allocated to the building. The demolition cost was developed by making it equal to the appraised building cost from purchasing a residence for $241,000.

5.2.2.3 Building for Treatment System

Where aesthetics or security concerns exist, a building has been required for some projects. To address this requirement, 25 percent of the sites were assigned a building. Sites were excluded that had wall assignments or where treatment is already in progress.

The building foot print and estimated cost is present in Table 7 for each design case.

5.2.2.4 Wall

For some sites where aesthetics or security concerns exist, a five foot wall may meet this requirement. Twenty-five (25) percent of the sites were assigned an installation of a 5-foot high wall around the treatment facility. The cost and length of the walls is provided in Table 7 for each design case.

5.2.2.5 Pipeline to Off-site Treatment

In some case where additional land is required, an adjoining property next to the well site may not be available. In this case the water from an affected source needs to be piped to the acquired site. Costs were developed for a one-mile long pipeline for delivery of raw water from the well to the treatment location and the treated water to the distribution system to cover this scenario. A design criterion of 4 to 6 feet per second was used as the pipeline velocity to determine the appropriate diameter for each of the six design cases. The pipe diameter and cost for each design case is summarized in Table 7.

Twenty-five (25) percent of the additional land sites were assigned the appropriate design case costs. A random number approach similar to that as described in Section 4.1 was used to assign the appropriate costs from Table 7.

5.2.2.6 Access for Pipeline

In some cases where pipelines are needed to deliver raw water to an acquired site, a right-of-way access fee for pipeline installation becomes part of the project. To develop this cost, it was assumed that a 20 foot wide strip of land by 1 mile long was required. This is equivalent to approximately 2.4 acres per pipeline project. Seventy-five (75) percent of the median residential property was used as the cost per acre of land for the right-of-way access.

The need for the right-of-way access was assigned to 25 percent of the projects requiring off-site facilities and where the pipeline was larger than eight (8) inches in diameter. The 8-inch diameter and larger pipeline was for the 600, 1000, 2000, and 5000 gpm design cases.

Table 8: Contractor's Cost for Site Improvements and Piping Cost for Six Design Cases

Design Case (gpm)	Facility Building*($) and Dimensions (ft)	Wall Cost ($) and Length (ft)	Piping Cost ($) and Size (diameter)
150	$ 79,000 (17' X 22')	$ 17,000 for 216' (62' X 46')	$ 148,000 (4")
300	$ 97,000 (22' X 27')	$ 19,000 for 236' (62' X 56')	$ 222,000 (6")
600	$ 114,000 (26' X 31')	$ 20,000 for 252' (70' X 56')	$ 296,000 (8")
1000	$ 129,000 (30' X 31')	$ 21,000 for 264' (75' X 57')	$ 444,000 (12")
2000	183,000 (35' X 47')	$ 24,000 for 302' (80' X 71')	$ 665,000 (18")
5000	368,000 (83' X 47')	$ 32,000 for 396' (115' X 87')	$ 887,000 (24")

* Contractor's Bid Costs

5.2.3 Other Non-Factored Indirect Project Costs

As described in Appendix C, an amount equal to 25 percent of the estimated bid costs was used as the estimate of indirect construction costs such as engineering, construction management, interest during construction, contingencies, and permitting. However, due to some new project requirements, additional non-factored indirect project costs were added to develop more reasonable total project cost estimates.

5.2.3.1 97-005 Permitting

In November 1997, CDHS issued a policy guidance memorandum for direct domestic use of extremely impaired sources (CDHS 97-005). There are nine required steps before DHS will issue an amended water permit to a PWS allowing the delivery of treated water from a source captured by the "extremely impaired water source" definition.

This permitting process is relatively new to the water industry and early projects have incurred project costs of approximately $500,000 to obtain an amended water permit. Due to more experience by the drinking water community, a cost of $350,000 was assigned to a PWS if it had one or more sources with more than 3 times the potential MCL. This cost included the owner's cost as well as the CDHS review of the permit process using the CDHS hourly rate of $90/hr.

5.2.3.2 Community and PWS Acceptance

For non-97-005 affected utilities, public acceptance of the corrective action projects has been a major effort. As a result, the portion assigned to permitting using the factor approach is inadequate. A $50,000 adjustment for the public acceptance effort has been assigned to 25 percent of the non- 97-005 systems to more accurately estimate project costs.

5.2.4 Total Project Costs

Table 9 summarizes the roll up of these capital cost elements by potential MCL.

Table 9: Summary of Capital Costs Elements

Component	Potential MCL					
	18 µg/L		6 µg/L		4 µg/L	
	Sources	Cost ($1000)	Sources	Cost ($1000)	Sources	Cost ($1000)
IX Facilities/Blending Station	17	$36,000	115	$107,000	179	$182,000
Piping	3	$2,000	25	$21,000	39	$30,000
Pipe Access	2	$1,100	18	$10,000	26	$14,000
Land Purchase	4	$1,200	24	$7,000	38	$10,000
Demolition	2	$300	12	$2,000	19	$3,000
Security Building	3	$500	27	$5,000	38	$7,000
Wall	3	$100	25	$1,000	39	$1,000
97-005 Permitting*	3	$1,000	7	$2,400	15	$5,300
Public Acceptance*	2	$100	7	$400	10	$500
Total		$43,000		$155,000		$253,000

* PWSs

5.3 O&M Costs

The larger components of the O&M Costs are summarized below. Additional information is provided in Appendix C.

5.3.1 Blending

The largest O&M cost for blending was the cost of obtaining perchlorate free blending water. , The lower boundary costs for blending water is approximately $60/AF for pumping to a line pressure of 120 psig (assumes primarily electrical cost, i.e., no pump tax, etc.). This cost is assumed for PWSs that have an uncontaminated source that can be used for blending. The upper boundary for blending water is approximately $500/AF. For this cost estimate the cost for blending water was $250/AF.

5.3.2 Single-Pass Ion Exchange

The largest O&M cost is the resin replacement. Resin replacement is affected by the background nitrate and sulfate in the source. To make the appropriate adjustment on the impact of these water quality parameters, 16 cost estimation cases were developed. There were two nitrate levels, low (10 mg/L) and high (44 mg/L) and two sulfate levels, low (30 mg/L) and high (180 mg/L) for each of four perchlorate source water concentrations. Each source was assigned a resin replacement cost based on its average nitrate, sulfate, and perchlorate concentration. The range of resin replacement cost for these 16 cases are summarized in Table 10. The resin replacement costs were obtained from vendors and cost from various treatment plants and pilot studies.

Table 10: Summary of Resin Replacement Cases for O&M Costs

Perchlorate µg/L	Nitrate	Sulfate	Resin Replacement Cost ($/AF)
10	Low or High	Low or High	$145-$308
25	Low or High	Low or High	$197-$410
60	Low or High	Low or High	$216-$413
200	Low or High	Low or High	$249-$419

5.3.3 Sensitivity Analyses for Single-Pass Resin O&M Costs

Utility-specific conditions that are likely to affect annual O&M costs include electricity rates, labor costs, and analytical costs. Hence, sensitivity analyses were performed, by varying these components, to evaluate their impact on the water production cost estimates. The following analyses were performed:

- Electricity Cost: This cost estimate was developed using electricity cost of $0.12/KWh. A sensitivity analysis was performed using an electricity cost of $0.08/KWh.
- Labor Cost: A labor cost of $40/hr was used for this analysis. The impact of a 100% increase in labor cost was evaluated in the sensitivity analysis.
- Analytical Cost: A sensitivity analysis to evaluate the impact of a 100% increase in analytical cost was performed.

The results of the sensitivity analyses are summarized in Table 11. From this analysis the O&M costs are most influenced by labor and the analytical costs. Due to market forces, it is likely that analytical costs will remain the same or drop as this analysis becomes less of a specialized parameter.

Table 11: Impact (Percentage Change) of Electricity, Labor and Analytical Costs on Cost Estimate*

Flow Rate (gpm)	Electricity ($0.08/KWh)	Labor Cost (100% Increase)	Analytical Cost (100% Increase)
150	-2%	+30%	+25%
300	-1%	+20%	+16%
600	-2%	+13%	+10%
1000	-1%	+8%	+6%
2000	-2%	+4%	+4%
5000	-2%	+2%	+4%

* For 10 µg/L Perchlorate, 10 mg/L Nitrate and 180 mg/L Sulfate cases.

5.4 Water Production Costs

To estimate average water production costs in $/Acre-Foot (AF), the total annual cost has to be developed. Total annual cost is the sum of the O&M plus the amortization of capital (7 percent capital recovery rate over a 20-year period). This total is then divided by the total water produced to estimate the water production costs.

Table 12 summarizes the following average for each design case: capital costs, O&M, amortized capital, total annual. To develop these numbers, the capital costs for each design case category were totaled and divided by the number of cases assigned to the particular design case category that was to be used to meet the potential MCL. The same approach was used to develop the average O&M costs and average annual production costs. The amortized capital was calculated from the average capital cost assuming a 20 year project life.

Table 12: Average Unit Production Costs for Single-Pass Ion Exchange

Cost component	Design Case Flow Rate (gpm)					
	150	300	600	1,000	2,000	5,000
Average Capital Cost ($1000)	530	575	870	1,200	2,000	3,760
Average Annual O&M Cost ($1000/Yr)	42	81	138	237	430	665
Amortized Capital Cost ($1000/Yr)	50	54	82	113	189	355
Average Total Annual Cost ($1000/Yr)	92	136	220	351	619	1,019
Average Annual Production* (AF)	54	188	349	743	1,351	2,286
Average Unit Production Cost ($/AF)	1,717	722	631	472	458	446

*Average annual production for design case flow rate.

5.5 Aggregated Compliance Costs for Potential Perchlorate MCLs

The estimated costs for each potential MCL are summarized in Table 13. These costs were generated by aggregating the unit treatment costs, included in Appendix C, with the affected sources for each flow rate category and treatment technology mix for each potential perchlorate MCL. The costs are presented as a range due to uncertainties in the development of these planning level cost estimates.

The average estimate for the capital costs includes the cost estimated by the vendors, adjusted for California and indirect cost assumptions, and by experience for blending, as a base estimate. The high and low estimates were generated by increasing the average cost by 50 percent and decreasing the average cost by 30 percent, respectively, which is a typical spread for the planning level cost estimates used in this study.

The total annual costs consist of annual O&M costs plus amortized capital costs and range from $12 million to $26 million (18 µg/L); $35 million to $75 million (6 µg/L); and $53 to $113 million (4 µg/L).

Assuming a project life of 20 years and using the average estimation point, the compliance cost is estimated to be 0.3 billion (18 µg/L); 1 billion (6 µg/L); and $1.5 billon (4 µg/L).

Table 13: Estimated Aggregated Compliance Cost

Potential MCL (µg/L)	Cost Component	Low ($1000)	Average ($1000)	High ($1000)
18	**Capital**	$30,000	$43,000	$64,000
	Amortized Cost	$3,000	$4,000	$6,000
	O&M	$9,000	$12,600	$19,000
	Total Annual Costs	$12,000	$17,000	$26,000
	20 year Project Costs	$240,000	$340,000	$520,000
6	**Capital**	$108,000	$155,000	$232,000
	Amortized Cost	$11,000	$15,000	$23,000
	O&M	$24,800	$35,000	$53,000
	Total Annual Costs	$35,000	$50,000	$75,000
	20 year Project Costs	$700,000	$1,000,000	$1,500,000
4	**Capital**	$176,000	$252,000	$378,000
	Amortized Cost	$17,000	$24,000	$36,000
	O&M	$35,700	$51,400	$77,000
	Total Annual Costs	$53,000	$75,000	$113,000
	20 year Project Costs	$1,060,000	$1,500,000	$2,260,000

Section 6: Projection for Untested Wells

It is noted that approximately 25 percent of the all the PWS sources have been tested for perchlorate. The cost estimate presented in the previous sections was based on the data from tested sources. Since groundwater sources make up the majority of currently affected sources, an estimate of additional wells that may require corrective action was performed. The following steps were used to develop a state-wide estimate.

1. Generate zones with a 5-mile radius for all sources with assigned perchlorate concentrations above the potential MCL. Unlike the "known sources" estimate, which included only 50% of the inactive sources, all the inactive sources that had an assigned perchlorate value greater than the potential MCL were selected for this evaluation.

2. Develop a state-wide listing of all the public water supplies with at least one well in the 5-mile radius zone. From this listing, determine the total number of wells for the identified public water supplies. From this listing, determine the number of wells that have been tested and untested for perchlorate.

3. Determine the percentage of wells that have an assigned perchlorate value of the wells that have been tested for perchlorate.

4. Assign this same percentage to the untested number of wells.

Table 14 summarizes development of the projected number of wells. As can be seen in this table, the number of affected sources per potential perchlorate MCL is projected to double when all the sources have completed their perchlorate testing. Based on this information, it is estimated that the cost for perchlorate compliance as summarized in Table 9 will increase by a factor of two.

Table 14: State-wide Projected for Untested Wells

Potential MCL (µg/L)	No. of Systems	Tested Wells	Wells >Potential MCL	% Wells >Potential MCL	Untested Wells	Projected Untested Wells > Potential MCL
4	67	2393	210	8.8%	3331	292
6	46	2018	140	6.9%	2679	186
18	14	1020	28	2.7%	899	25

Table 15 summaries the expected increase in the cost to comply with the three potential MCLs when all the PWS wells have been tested. For the potential MCL of 6 µg/L the average, 20 year project cost is estimated to be $2 billion.

Table 15: Summary of Projected Compliance Costs When All PWS Sources are Tested

Potential MCL	Cost Component	Low ($1,000)	Average ($1,000)	High ($1,000)
18	**Capital**	$60,000	$86,000	$129,000
	Total Annual Costs	$24,000	$34,000	$52,000
	20 year Project Costs	$480,000	$680,000	$1,040,000
6	**Capital**	$217,000	$310,000	$465,000
	Total Annual Costs	$70,000	$100,000	$150,000
	20 year Project Costs	$1,400,000	$2,000,000	$3,000,000
4	**Capital**	$353,000	$504,000	$756,000
	Total Annual Costs	$106,000	$150,000	$226,000
	20 year Project Costs	$2,120,000	$3,000,000	$4,520,000

References

1. California Department of Health Services, 1999b. Procedure for Reviewing Maximum Contaminant Levels (MCLs) for Possible Revision. August 1.

2. Raucher, R.S., E.T. Castillo, A. Dixon, W. Breffle, D. Waldman, and J.A. Drago. 1995. *Estimating the Cost of Compliance with Drinking Water Standards: A User's Guide.* Denver, Colorado: AWWA Research Foundation and AWWA.

Appendix A

Department of Health Services

Procedure for Reviewing Maximum Contaminant Levels (MCLs) for Possible Revision

PROCEDURE FOR REVIEWING MAXIMUM CONTAMINANT LEVELS (MCLS) FOR POSSIBLE REVISION

July 20, 1999 **draft**

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.)
1. 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.
2. 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 ± 20%; do not eliminate those that are borderline.

1. 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).
2. 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.
1. 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

Occurrence Estimation Methodology And Listing of Affected Sources

APPENDIX B

OCCURRENCE ESTIMATION METHOLODOGY

The purpose of this appendix is to describe the data reduction procedures for developing a single perchlorate concentration to a source. The data reduction procedures are followed by tables summarizing the assigned perchlorate concentration of each source captured by each potential MCL.

WATER QUALITY DATA SOURCE

There was only one source of water quality data used in this study, the Department of Health Services (DHS) Water Quality Monitoring (WQM) database. A download of this database was performed in July 2003 and obtained from the DHS Drinking Water Program, Sacramento, CA. Since 1984, DHS has maintained an electronic record of all drinking water quality compliance monitoring required by Title 22, except for total coliform data. A preliminary evaluation of the database indicated some errors in the data entry. Hence, procedures were developed to handle the errors and make “corrected” data assignments. A description of each case and the subsequent handling is described in Table B-1. In WQM the “F” notation is used when the data are considered “unreliable”. The database does not indicate the underlying reason for the “unreliable” designation for the particular result that was assigned this designation.

Table B-1 Assignment of Various WQM Data Entries for “Mod” and “Finding”

Case	**WQM Field Names**		**Assignment**
	Mod	**Finding**	
	Entry In WQM Database		
1	<	Reporting Limit – typically this was equal to or less than 4	2 μg/L
2	<	Value*	2 μg/L or value – Case by case decision
3	<	0	2 μg/L
4	0	0	2 μg/L
5	0	Value	2 μg/L
6	F	0	Not included
7	F	Value	Not included
8		0	2 μg/L
9		Value	Value

* Value > 4

DATA REDUCTION PROCEDURES

Before determining the occurrence profiles of perchlorate for drinking water in California several data reduction steps were performed. This section describes these procedures. The first step was to develop a single, representative value of perchlorate for each source, because, in general, the WQM database contained perchlorate results from different sampling dates for each source.

The data reduction procedures used for this study gave more preference to recent (post-2000) perchlorate data for the sources. These procedures are described in detail below.

ASSIGNMENT OF PERCHLORATE CONCENTRATION FOR EACH SOURCE

In all cases the data were transformed using the rules described in Table B1. Next, the sources were divided into 3 cases. The following data reduction procedure was used for each case and sub-case as described below.

Case A: Source with <4 Findings

First, a monthly average was calculated. For example, there may be a total of 4 findings, two of which were taken at the same time (duplicate sample) or month. These two values would be averaged and then an overall average of these monthly averages would be used to generate the assigned perchlorate concentration for these sources.

Case B: Source with > 5 Findings from 1 April 2002 to 30 June 2003 (5 quarters)

1. Monthly average perchlorate concentrations were determined as in Case A, for the samples collected and analyzed after 1 April 2002. Subsequently, for sources that had > 9 monthly average values, a 6-month running average of the last six monthly averages was calculated and became the assigned perchlorate concentration.

2. For the sources with <9 monthly averages, quarterly average values were calculated. For sources with > 4 quarterly averages, the quarterly running average of the last four quarters was calculated and assigned as the perchlorate concentration.

3. For sources with < 3 quarterly averages, an average of all the quarters was calculated and assigned as the perchlorate concentration.

Case C: Sources with > 5 Findings, but not from 1 April 2002 to 30 June 2003 (5 quarters)

1. "Quarterly averages" were determined from the monthly average findings for these sources (in some cases, a single monthly finding became "monthly average" which became the "quarterly average"). For sources with > 4 quarterly averages since January 2000, the data from the last four quarters were averaged and assigned as the perchlorate concentration.

2. For sources with three quarterly averages since January 2000, the average of these three quarters was calculated and became the assigned value.

3. For the remaining sources, if >4 quarterly averages were available, the average of the last four quarterly averages was calculated and became the assigned perchlorate concentration.

4. For sources with <4 quarterly averages, all the quarterly averages were used to calculate the assigned perchlorate concentration.

Perchlorate Affected Sources for Three Potential MCLs

Based on the representative perchlorate values assigned to each source, the sources affected for each potential MCL were identified in the following manner.

18 MCL ===> Representative Value: >18.55 (i)
6 MCL ===> Representative Value: >6.55 (ii)
4 MCL ===> Representative Value: > 4.55 (iii)

LISTING OF AFFECTED SOURCES

Table B-2 to B-4 identified the affected sources, utility, assigned values, and current operational status for each potential MCL. All of the wells on standby status were classified as affected source that would need corrective action to meet the potential MCL. Fifty percent of the inactive wells as determined by a random number ranking were also classified as affected sources that would need corrective action to meet the potential MCL.

Inactive and standby wells were included as affected sources because many of the affected wells may have a private responsible party involved in providing the funds for the corrective action. Generally, for “naturally” occurring contaminants such as arsenic where there would be no private responsible party funds, PWSs do not attempt to bring back into service inactive and standby wells that are affected by a contaminant and require significant treatment.

Table B-2
Affected Sources for Potential MCL of 4 μg/L

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (μg/L)	CURRENT STATUS
Groundwater Sources						
1502545-001	WELL 01	1502545	SCHWEIKART WATER SYSTEM	Kern	5.0	Active
1909645-001	WELL 01	1909645	CITY OF LANCASTER, SOCCER COMPLEX	Los Angeles	7.0	Active
1910007-010	WELL 10 (AVWC8)	1910007	AZUSA LIGHT AND WATER	Los Angeles	9.9	Active
1910009-003	WELL 03 MORADA ST. - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	7.3	Inactive
1910009-007	WELL 07 LANTE STREET - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	77.0	Inactive
1910009-009	WELL 09 BIG DALTON - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	37.1	Inactive
1910017-017	SAUGUS WELL 01 - INACTIVE	1910017	SANTA CLARITA WATER CO.	Los Angeles	27.5	Inactive
1910017-018	SAUGUS WELL 02 - INACTIVE	1910017	SANTA CLARITA WATER CO.	Los Angeles	22.3	Inactive
1910024-005	CAMPBELL WELL 01 - INACTIVE	1910024	SCWC - CLAREMONT	Los Angeles	6.8	Inactive
1910029-005	WELL 03 - STANDBY	1910029	CITY OF INDUSTRY WATERWORKS SYSTEMS	Los Angeles	7.1	Standby
1910029-006	WELL 4 - STANDBY (12-27-01)	1910029	CITY OF INDUSTRY WATERWORKS SYSTEMS	Los Angeles	11.9	Standby
1910029-007	WELL 5 - STANDBY (12-27-01)	1910029	CITY OF INDUSTRY WATERWORKS SYSTEMS	Los Angeles	8.4	Standby
1910036-004	WELL 10-03	1910036	CALIFORNIA WATER SERVICE CO. - ELA	Los Angeles	7.6	Active
1910039-023	WELL B5B LACFCD 2994Q - INACTIVE	1910039	SAN GABRIEL VALLEY WATER CO.-EL MONTE	Los Angeles	6.3	Inactive
1910039-026	WELL B6C - INACTIVE	1910039	SAN GABRIEL VALLEY WATER CO.-EL MONTE	Los Angeles	72.5	Inactive
1910044-003	WELL 03G - INACTIVE	1910044	GLENDORA-CITY, WATER DEPT.	Los Angeles	13.0	Inactive
1910060-002	WELL 02 - STANDBY	1910060	LA PUENTE VALLEY CWD	Los Angeles	66.0	Standby
1910060-003	WELL 03	1910060	LA PUENTE VALLEY CWD	Los Angeles	48.0	Active
1910060-004	WELL 04 - STANDBY	1910060	LA PUENTE VALLEY CWD	Los Angeles	69.1	Standby
1910061-003	WELL 02	1910061	LAS FLORES WATER CO.	Los Angeles	6.2	Active
1910062-004	CARTWRIGHT	1910062	LA VERNE, CITY WD	Los Angeles	14.9	Active
1910062-009	LA VERNE HEIGHTS WELL 02	1910062	LA VERNE, CITY WD	Los Angeles	5.2	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
1910062-010	LA VERNE HEIGHTS WELL 03	1910062	LA VERNE, CITY WD	Los Angeles	12.5	Active
1910062-012	LINCOLN	1910062	LA VERNE, CITY WD	Los Angeles	13.6	Active
1910062-016	MILLS TRACT	1910062	LA VERNE, CITY WD	Los Angeles	16.3	Active
1910062-018	OLD BALDY	1910062	LA VERNE, CITY WD	Los Angeles	17.2	Active
1910062-032	AMHERST WELL	1910062	LA VERNE, CITY WD	Los Angeles	11.2	Active
1910067-188	TUJUNGA WELL 11	1910067	LOS ANGELES-CITY, DEPT. OF WATER & POWER	Los Angeles	11.8	Active
1910067-189	TUJUNGA WELL 12	1910067	LOS ANGELES-CITY, DEPT. OF WATER & POWER	Los Angeles	7.1	Active
1910092-013	WELL 12 - INACTIVE (PCE > 10X MCL)	1910092	MONTEREY PARK-CITY, WATER DEPT.	Los Angeles	9.3	Inactive
1910096-005	WELL 11 - INACTIVE	1910096	Newhall CWD-Newhall	Los Angeles	16.0	Inactive
1910124-001	ARROYO - INACTIVE	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	26.6	Inactive
1910124-006	COPELIN	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	11.0	Active
1910124-018	SUNSET	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	11.9	Active
1910124-019	VENTURA	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	5.9	Active
1910124-021	WELL 52	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	12.7	Active
1910124-022	WINDSOR	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	5.1	Active
1910126-003	WELL 03	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	6.0	Active
1910126-004	WELL 04	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	10.9	Active
1910126-006	WELL 06	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	11.6	Active
1910126-007	WELL 07 - INACTIVE	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	9.8	Inactive
1910126-010	WELL 10	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	6.5	Active
1910126-011	WELL 11	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	12.7	Active
1910126-012	WELL 12	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	13.3	Active
1910126-014	WELL 14	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	7.9	Active
1910126-015	WELL 15	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	8.6	Active
1910126-016	WELL 16	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	13.3	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
1910126-017	WELL 17	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	12.1	Active
1910126-018	WELL 18	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	11.6	Active
1910126-023	WELL 23	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	7.7	Active
1910126-026	WELL 26	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	6.0	Active
1910126-049	WELL 05B	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	5.4	Active
1910126-050	WELL 08B - INACTIVE	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	9.3	Inactive
1910126-051	WELL 09B	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	6.1	Active
1910126-052	WELL 34	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	14.1	Active
1910126-054	WELL 01B - INACTIVE	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	5.5	Inactive
1910127-003	GRAND AVE. WELL - INACTIVE	1910127	COVINA-CITY, WATER DEPT.	Los Angeles	21.5	Inactive
1910142-004	BASELINE WELL 03	1910142	SCWC-SAN DIMAS	Los Angeles	5.7	Active
1910142-005	BASELINE WELL 04	1910142	SCWC-SAN DIMAS	Los Angeles	16.5	Active
1910142-012	DURWARD	1910142	SCWC-SAN DIMAS	Los Angeles	16.5	Active
1910154-002	GRAVES WELL 02	1910154	SOUTH PASADENA-CITY, WATER DEPT.	Los Angeles	4.7	Active
1910163-002	WELL 02 LACFCD 3113	1910163	VALENCIA HEIGHTS WATER CO.	Los Angeles	5.1	Active
1910163-004	WELL 04 LACFCD 3102B - INACTIVE	1910163	VALENCIA HEIGHTS WATER CO.	Los Angeles	28.4	Inactive
1910163-010	WELL 06	1910163	VALENCIA HEIGHTS WATER CO.	Los Angeles	4.7	Active
1910167-012	WELL 18	1910167	VERNON-CITY, WATER DEPT.	Los Angeles	6.3	Active
1910199-014	WELL 14	1910199	CALIFORNIA DOMESTIC WATER COMPANY	Los Angeles	8.4	Active
1910205-025	139-W2	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	13.9	Active
1910205-027	139-W4	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	8.9	Active
1910205-028	139-W5	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	7.3	Active
1910205-030	140-W3	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	11.1	Active
1910205-031	140-W4	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	6.1	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
1910205-045	140-W5	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	6.3	Active
1910205-055	139-W6 - INACTIVE	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	31.2	Inactive
2710004-006	BERWICK WELL 08 - RAW	2710004	Cal-Am Water Company - Monterey	Monterey	5.8	Active
2910003-012	TRUCKEE AIRPORT WELL - RAW WATER	2910003	Truckee-Donner PUD, Main	Nevada	4.8	Active
3000585-001	WELL 01	3000585	Page Avenue Mutual Water Company	Orange	6.4	Active
3010022-022	LOWELL	3010022	Southern Calif WC - West Orange	Orange	5.1	Active
3010046-009	NEWPORT	3010046	CITY OF TUSTIN	Orange	8.3	Active
3301372-001	WELL 02 SOUTH - INACTIVE	3301372	LA QUINTA RIDGE MOBILE ESTATES	Riverside	12.0	Inactive
3301372-002	WELL #1(MAIN)	3301372	LA QUINTA RIDGE MOBILE ESTATES	Riverside	9.0	Active
3310001-139	WELL 6721 REDRILL - INACTIVE	3310001	Coachella VWD: Cove Community	Riverside	5.9	Inactive
3310005-013	WELL 09 - STANDBY	3310005	Desert Water Agency	Riverside	5.7	Standby
3310005-023	WELL 21	3310005	Desert Water Agency	Riverside	5.8	Active
3310009-042	WELL 44 - SUNNYMEAD 4	3310009	Eastern Municipal WD	Riverside	4.9	Active
3310031-002	ARMY WELL 01 - INACTIVE	3310031	Riverside, City of	Riverside	7.6	Inactive
3310031-003	ARMY WELL 03 - INACTIVE	3310031	Riverside, City of	Riverside	5.5	Inactive
3310031-016	ELEVENTH ST. WELL - INACTIVE	3310031	Riverside, City of	Riverside	15.5	Inactive
3310031-019	FILL WELL - INACTIVE	3310031	Riverside, City of	Riverside	13.0	Inactive
3310031-027	GAGE WELL 26-1	3310031	Riverside, City of	Riverside	8.4	Active
3310031-028	GAGE WELL 27-1	3310031	Riverside, City of	Riverside	6.1	Active
3310031-029	GAGE WELL 27-2	3310031	Riverside, City of	Riverside	10.7	Active
3310031-030	GAGE WELL 29-1	3310031	Riverside, City of	Riverside	9.4	Active
3310031-031	GAGE WELL 29-2	3310031	Riverside, City of	Riverside	12.4	Treated
3310031-032	GAGE WELL 29-3	3310031	Riverside, City of	Riverside	31.1	Treated
3310031-034	GAGE WELL 31-1	3310031	Riverside, City of	Riverside	7.8	Active
3310031-035	GAGE WELL 46-1	3310031	Riverside, City of	Riverside	15.5	Active
3310031-036	GAGE WELL 51-1	3310031	Riverside, City of	Riverside	48.1	Treated

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
3310031-038	GAGE WELL 66-1	3310031	Riverside, City of	Riverside	19.5	Active
3310031-043	GARNER WELL 02	3310031	Riverside, City of	Riverside	11.7	Active
3310031-051	HUNT WELL 06	3310031	Riverside, City of	Riverside	7.0	Active
3310031-052	HUNT WELL 10	3310031	Riverside, City of	Riverside	5.5	Active
3310031-053	HUNT WELL 11	3310031	Riverside, City of	Riverside	6.8	Active
3310031-056	ISELIN WELL 02 - INACTIVE	3310031	Riverside, City of	Riverside	8.8	Inactive
3310031-067	MOORE GRIFFITH - INACTIVE	3310031	Riverside, City of	Riverside	4.6	Inactive
3310031-074	PALMYRITA WELL 02	3310031	Riverside, City of	Riverside	7.0	Active
3310031-078	RAUB WELL 02	3310031	Riverside, City of	Riverside	10.3	Active
3310031-080	RAUB WELL 04	3310031	Riverside, City of	Riverside	10.5	Active
3310031-083	SCHEUER	3310031	Riverside, City of	Riverside	6.1	Active
3310031-085	STILES	3310031	Riverside, City of	Riverside	10.3	Active
3310031-093	TWIN SPRINGS - INACTIVE	3310031	Riverside, City of	Riverside	5.8	Inactive
3310031-100	WARREN WELL 01	3310031	Riverside, City of	Riverside	4.6	Active
3310031-111	GAGE WELL 92-1	3310031	Riverside, City of	Riverside	30.3	Treated
3310033-002	WELL 01A - INACTIVE	3310033	Santa Ana River Water Company	Riverside	5.8	Inactive
3310037-011	WELL 11	3310037	Corona, City of	Riverside	8.4	Active
3310037-013	WELL 13	3310037	Corona, City of	Riverside	12.0	Active
3310037-014	WELL 14	3310037	Corona, City of	Riverside	8.4	Active
3310037-015	WELL 15	3310037	Corona, City of	Riverside	5.5	Active
3310037-021	WELL 19	3310037	Corona, City of	Riverside	5.0	Active
3310037-029	WELL 12A	3310037	Corona, City of	Riverside	6.3	Active
3310037-030	WELL 07A	3310037	Corona, City of	Riverside	6.0	Active
3310037-031	WELL 08A	3310037	Corona, City of	Riverside	6.4	Active
3310044-002	WELL 02 - TROYER	3310044	Rubidoux Community SD	Riverside	8.0	Active
3310044-004	WELL 04 - OLD SKOTTY	3310044	Rubidoux Community SD	Riverside	9.5	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
3310044-006	WELL 06 - NEW SKOTTY	3310044	Rubidoux Community SD	Riverside	9.2	Active
3410015-003	WELL 01 - ALICANTE - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	6.0	Inactive
3410015-015	WELL 13 - CITRUS - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	322.5	Inactive
3410015-016	WELL 14 - WHISTLER - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	5.4	Inactive
3410015-017	WELL 15 - FOLSOM BLVD - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	197.5	Inactive
3410015-018	WELL 16 - PYRITES - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	215.0	Inactive
3410015-021	WELL 19 - KILGORE - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	11.9	Inactive
3410704-009	WELL 01 (WELL 88-MAIN BASE PLANT)-INACTV	3410704	SCWMD Mather-Sunrise	Sacramento	69.5	Inactive
3410704-010	WELL 02 (WELL 89 - NORDEN) - INACTIVE	3410704	SCWMD Mather-Sunrise	Sacramento	125.0	Inactive
3410706-003	WELL 03 (WELL 91 - FEMOYER)	3410706	Mather Field Water System	Sacramento	15.3	Active
3610004-028	WELL 37	3610004	WEST VALLEY WATER DISTRICT	San Bernardino	7.2	Active
3610004-031	WELL 41	3610004	WEST VALLEY WATER DISTRICT	San Bernardino	5.0	Active
3610012-004	WELL 05	3610012	CITY OF CHINO	San Bernardino	7.8	Active
3610012-008	WELL 09 - STANDBY	3610012	CITY OF CHINO	San Bernardino	12.8	Standby
3610012-009	WELL 10 - STANDBY	3610012	CITY OF CHINO	San Bernardino	19.0	Standby
3610012-011	WELL 12	3610012	CITY OF CHINO	San Bernardino	11.0	Active
3610012-013	WELL 14	3610012	CITY OF CHINO	San Bernardino	9.7	Active
3610013-006	MT. VIEW 02 - Inactive	3610013	CITY OF LOMA LINDA	San Bernardino	16.4	Inactive
3610013-009	RICHARDSON ST. WELL 01	3610013	CITY OF LOMA LINDA	San Bernardino	4.6	Active
3610014-021	WELL 24	3610014	CITY OF COLTON	San Bernardino	5.0	Active
3610018-002	WELL 01	3610018	CUCAMONGA CWD	San Bernardino	6.2	Active
3610018-027	WELL 17	3610018	CUCAMONGA CWD	San Bernardino	4.6	Active
3610018-030	WELL 20	3610018	CUCAMONGA CWD	San Bernardino	6.2	Active
3610034-003	WELL 04 - INACTIVE	3610034	ONTARIO, CITY OF	San Bernardino	7.4	Inactive
3610034-008	WELL 09	3610034	ONTARIO, CITY OF	San Bernardino	7.6	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
3610034-012	WELL 15	3610034	ONTARIO, CITY OF	San Bernardino	5.6	Active
3610034-015	WELL 18	3610034	ONTARIO, CITY OF	San Bernardino	6.5	Active
3610037-004	CHICKEN HILL WELL - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.8	Inactive
3610037-027	MISSION WELL - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	13.5	Inactive
3610037-028	NEW YORK STREET WELL	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	14.9	Active
3610037-037	WELL 10 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.9	Inactive
3610037-038	WELL 11 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.7	Inactive
3610037-039	WELL 13 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.1	Inactive
3610037-040	WELL 14 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	11.0	Inactive
3610037-041	WELL 16 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	4.7	Inactive
3610037-044	WELL 31A	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	66.8	Active
3610037-045	WELL 32	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	15.2	Active
3610037-046	WELL 34 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	10.7	Inactive
3610037-047	WELL 35 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	12.7	Inactive
3610037-051	WELL 41 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	9.8	Inactive
3610037-052	YUCAIPA BLVD WELL - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	9.2	Inactive
3610037-060	WELL 39	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	5.8	Active
3610037-102GACT	REES GAC TREATED - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	5.2	Inactive
3610038-010	ETIWANDA WELL (RIALTO 06)	3610038	RIALTO-CITY	San Bernardino	32.3	Active
3610038-014	HIGHLAND WELL (RIALTO 02) - INACTIVE	3610038	RIALTO-CITY	San Bernardino	44.7	Inactive
3610039-047	PERRIS HILL WELL 04	3610039	SAN BERNARDINO CITY	San Bernardino	6.0	Active
3610041-013	WELL F-03A (16) - INACTIVE	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	9.2	Inactive
3610041-029	WELL F-18A (34)	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	11.3	Active
3610041-033	WELL F-17B (39)	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	19.3	Active
3610041-036	WELL F-04A	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	11.2	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
3610041-039	WELL F-25A - INACTIVE	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	5.8	Inactive
3610041-042	WELL F-17C	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	7.0	Active
3610064-018	WELL 012A	3610064	EAST VALLEY WD	San Bernardino	13.1	Active
3610064-022	WELL 027 - INACTIVE	3610064	EAST VALLEY WD	San Bernardino	4.8	Inactive
3610064-026	WELL 041 - INACTIVE	3610064	EAST VALLEY WD	San Bernardino	8.5	Inactive
3610064-028	WELL 107	3610064	EAST VALLEY WD	San Bernardino	7.2	Active
3610111-001	WELL 01 - INACTIVE	3610111	VICTORIA FARMS MWC	San Bernardino	14.0	Inactive
3610111-003	WELL 03 - INACTIVE	3610111	VICTORIA FARMS MWC	San Bernardino	57.5	Inactive
3610852-003	WELL 10	3610852	PATTON STATE HOSPITAL	San Bernardino	9.6	Active
3910012-003	02 SSS	3910012	City of Stockton	San Joaquin	7.7	Active
3910012-004	04 SSS	3910012	City of Stockton	San Joaquin	4.7	Active
3910012-005	05 SSS	3910012	City of Stockton	San Joaquin	5.3	Active
3910012-033	WELL 13 - TIFFANY	3910012	City of Stockton	San Joaquin	5.5	Active
3910702-006	WELL 09	3910702	Admin. Support Ctr. West - Tracy Site	San Joaquin	6.5	Active
4300542-003	CAMPING WORLD WELL	4300542	San Martin County Water District	Santa Clara	4.7	Active
4300543-003	Well 02A (New Colony Well)	4300543	West San Martin Water Works, Inc.	Santa Clara	6.0	Active
4300543-004	Well 03 (County Building Well)	4300543	West San Martin Water Works, Inc.	Santa Clara	8.0	Active
4300939-001	WELL 01	4300939	Countryside Mushrooms, Inc.	Santa Clara	6.9	Active
4300976-001	WELL 01	4300976	Syngenta Seeds - Research	Santa Clara	4.7	Active
4900788-002	WELL 02	4900788	El Crystal Mobile Home Park	Sonoma	15.0	Active
5400935-001	WELL 300-01	5400935	CWS - Mullen Water Company	Tulare	4.9	Active
5410006-011	WELL 11 - RAW	5410006	Lindsay, City of	Tulare	8.0	Active
5410006-015	WELL 15 (CITY WELL) - RAW	5410006	Lindsay, City of	Tulare	4.7	Active
5410007-003	NORTH LINDSAY HEIGHTS WELL-STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	10.4	Standby
5410007-004	NORTH SECT 8 WELL - STANDBY (NO3, DBCP)	5410007	LSID - Tonyville	Tulare	7.6	Standby

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
5410007-005	SOUTH LINDSAY HEIGHTS WELL-STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	9.1	Standby
5410007-006	SOUTH SECT 8 WELL - STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	7.3	Standby
5410007-007	STARK SEC 8 WELL - STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	7.6	Standby
Surface Water Sources						
1310014-003	EAST HIGH LINE - AGRICULTURAL	1310014	Imperial Irrigation District	Imperial	4.7	Active
3310037-020	WTP INFLUENT - RAW	3310037	Corona, City of	Riverside	6.5	Active
3610017-001RAW	LAKE HAVASU - RAW	3610017	HAVASU WC	San Bernardino	5.4	Active
5610702-009	WINDMILL SPRINGS - SURFACE INFLUENCE	5610702	U.S.N., San Nicolas Island	Ventura	8.0	Active

Table B-3
Affected Sources for Potential MCL of 6 µg/L

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
Groundwater Sources						
1909645-001	WELL 01	1909645	CITY OF LANCASTER, SOCCER COMPLEX	Los Angeles	7.0	Active
1910007-010	WELL 10 (AVWC8)	1910007	AZUSA LIGHT AND WATER	Los Angeles	9.9	Active
1910009-003	WELL 03 MORADA ST. - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	7.3	Inactive
1910009-007	WELL 07 LANTE STREET - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	77.0	Inactive
1910009-009	WELL 09 BIG DALTON - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	37.1	Inactive
1910017-017	SAUGUS WELL 01 - INACTIVE	1910017	SANTA CLARITA WATER CO.	Los Angeles	27.5	Inactive
1910017-018	SAUGUS WELL 02 - INACTIVE	1910017	SANTA CLARITA WATER CO.	Los Angeles	22.3	Inactive
1910024-005	CAMPBELL WELL 01 - INACTIVE	1910024	SCWC - CLAREMONT	Los Angeles	6.8	Inactive
1910029-005	WELL 03 - STANDBY	1910029	CITY OF INDUSTRY WATERWORKS SYSTEMS	Los Angeles	7.1	Standby
1910029-006	WELL 4 - STANDBY (12-27-01)	1910029	CITY OF INDUSTRY WATERWORKS SYSTEMS	Los Angeles	11.9	Standby
1910029-007	WELL 5 - STANDBY (12-27-01)	1910029	CITY OF INDUSTRY WATERWORKS SYSTEMS	Los Angeles	8.4	Standby
1910036-004	WELL 10-03	1910036	CALIFORNIA WATER SERVICE CO. - ELA	Los Angeles	7.6	Active
1910039-026	WELL B6C - INACTIVE	1910039	SAN GABRIEL VALLEY WATER CO.-EL MONTE	Los Angeles	72.5	Inactive
1910044-003	WELL 03G - INACTIVE	1910044	GLENDORA-CITY, WATER DEPT.	Los Angeles	13.0	Inactive
1910060-002	WELL 02 - STANDBY	1910060	LA PUENTE VALLEY CWD	Los Angeles	66.0	Standby
1910060-003	WELL 03	1910060	LA PUENTE VALLEY CWD	Los Angeles	48.0	Active
1910060-004	WELL 04 - STANDBY	1910060	LA PUENTE VALLEY CWD	Los Angeles	69.1	Standby
1910062-004	CARTWRIGHT	1910062	LA VERNE, CITY WD	Los Angeles	14.9	Active
1910062-010	LA VERNE HEIGHTS WELL 03	1910062	LA VERNE, CITY WD	Los Angeles	12.5	Active
1910062-012	LINCOLN	1910062	LA VERNE, CITY WD	Los Angeles	13.6	Active
1910062-016	MILLS TRACT	1910062	LA VERNE, CITY WD	Los Angeles	16.3	Active
1910062-018	OLD BALDY	1910062	LA VERNE, CITY WD	Los Angeles	17.2	Active
1910062-032	AMHERST WELL	1910062	LA VERNE, CITY WD	Los Angeles	11.2	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
1910067-188	TUJUNGA WELL 11	1910067	LOS ANGELES-CITY, DEPT. OF WATER & POWER	Los Angeles	11.8	Active
1910067-189	TUJUNGA WELL 12	1910067	LOS ANGELES-CITY, DEPT. OF WATER & POWER	Los Angeles	7.1	Active
1910092-013	WELL 12 - INACTIVE (PCE > 10X MCL)	1910092	MONTEREY PARK-CITY, WATER DEPT.	Los Angeles	9.3	Inactive
1910096-005	WELL 11 - INACTIVE	1910096	Newhall CWD-Newhall	Los Angeles	16.0	Inactive
1910124-001	ARROYO - INACTIVE	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	26.6	Inactive
1910124-006	COPELIN	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	11.0	Active
1910124-018	SUNSET	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	11.9	Active
1910124-021	WELL 52	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	12.7	Active
1910126-004	WELL 04	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	10.9	Active
1910126-006	WELL 06	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	11.6	Active
1910126-007	WELL 07 - INACTIVE	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	9.8	Inactive
1910126-011	WELL 11	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	12.7	Active
1910126-012	WELL 12	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	13.3	Active
1910126-014	WELL 14	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	7.9	Active
1910126-015	WELL 15	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	8.6	Active
1910126-016	WELL 16	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	13.3	Active
1910126-017	WELL 17	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	12.1	Active
1910126-018	WELL 18	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	11.6	Active
1910126-023	WELL 23	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	7.7	Active
1910126-050	WELL 08B - INACTIVE	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	9.3	Inactive
1910126-052	WELL 34	1910126	POMONA- CITY, WATER DEPT.	Los Angeles	14.1	Active
1910127-003	GRAND AVE. WELL - INACTIVE	1910127	COVINA-CITY, WATER DEPT.	Los Angeles	21.5	Inactive
1910142-005	BASELINE WELL 04	1910142	SCWC-SAN DIMAS	Los Angeles	16.5	Active
1910142-012	DURWARD	1910142	SCWC-SAN DIMAS	Los Angeles	16.5	Active
1910163-004	WELL 04 LACFCD 3102B - INACTIVE	1910163	VALENCIA HEIGHTS WATER CO.	Los Angeles	28.4	Inactive

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
1910199-014	WELL 14	1910199	CALIFORNIA DOMESTIC WATER COMPANY	Los Angeles	8.4	Active
1910205-025	139-W2	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	13.9	Active
1910205-027	139-W4	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	8.9	Active
1910205-028	139-W5	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	7.3	Active
1910205-030	140-W3	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	11.1	Active
1910205-055	139-W6 - INACTIVE	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	31.2	Inactive
3010046-009	NEWPORT	3010046	CITY OF TUSTIN	Orange	8.3	Active
3301372-001	WELL 02 SOUTH - INACTIVE	3301372	LA QUINTA RIDGE MOBILE ESTATES	Riverside	12.0	Inactive
3301372-002	WELL #1(MAIN)	3301372	LA QUINTA RIDGE MOBILE ESTATES	Riverside	9.0	Active
3310031-002	ARMY WELL 01 - INACTIVE	3310031	Riverside, City of	Riverside	7.6	Inactive
3310031-016	ELEVENTH ST. WELL - INACTIVE	3310031	Riverside, City of	Riverside	15.5	Inactive
3310031-019	FILL WELL - INACTIVE	3310031	Riverside, City of	Riverside	13.0	Inactive
3310031-027	GAGE WELL 26-1	3310031	Riverside, City of	Riverside	8.4	Active
3310031-029	GAGE WELL 27-2	3310031	Riverside, City of	Riverside	10.7	Active
3310031-030	GAGE WELL 29-1	3310031	Riverside, City of	Riverside	9.4	Active
3310031-034	GAGE WELL 31-1	3310031	Riverside, City of	Riverside	7.8	Active
3310031-035	GAGE WELL 46-1	3310031	Riverside, City of	Riverside	15.5	Active
3310031-038	GAGE WELL 66-1	3310031	Riverside, City of	Riverside	19.5	Active
3310031-043	GARNER WELL 02	3310031	Riverside, City of	Riverside	11.7	Active
3310031-051	HUNT WELL 06	3310031	Riverside, City of	Riverside	7.0	Active
3310031-053	HUNT WELL 11	3310031	Riverside, City of	Riverside	6.8	Active
3310031-056	ISELIN WELL 02 - INACTIVE	3310031	Riverside, City of	Riverside	8.8	Inactive
3310031-074	PALMYRITA WELL 02	3310031	Riverside, City of	Riverside	7.0	Active
3310031-078	RAUB WELL 02	3310031	Riverside, City of	Riverside	10.3	Active
3310031-080	RAUB WELL 04	3310031	Riverside, City of	Riverside	10.5	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
3310031-085	STILES	3310031	Riverside, City of	Riverside	10.3	Active
3310037-011	WELL 11	3310037	Corona, City of	Riverside	8.4	Active
3310037-013	WELL 13	3310037	Corona, City of	Riverside	12.0	Active
3310037-014	WELL 14	3310037	Corona, City of	Riverside	8.4	Active
3310044-002	WELL 02 - TROYER	3310044	Rubidoux Community SD	Riverside	8.0	Active
3310044-004	WELL 04 - OLD SKOTTY	3310044	Rubidoux Community SD	Riverside	9.5	Active
3310044-006	WELL 06 - NEW SKOTTY	3310044	Rubidoux Community SD	Riverside	9.2	Active
3410015-015	WELL 13 - CITRUS - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	322.5	Inactive
3410015-017	WELL 15 - FOLSOM BLVD - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	197.5	Inactive
3410015-018	WELL 16 - PYRITES - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	215.0	Inactive
3410015-021	WELL 19 - KILGORE - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	11.9	Inactive
3410704-009	WELL 01 (WELL 88-MAIN BASE PLANT)-INACTV	3410704	SCWMD Mather-Sunrise	Sacramento	69.5	Inactive
3410704-010	WELL 02 (WELL 89 - NORDEN) - INACTIVE	3410704	SCWMD Mather-Sunrise	Sacramento	125.0	Inactive
3410706-003	WELL 03 (WELL 91 - FEMOYER)	3410706	Mather Field Water System	Sacramento	15.3	Active
3610004-028	WELL 37	3610004	WEST VALLEY WATER DISTRICT	San Bernardino	7.2	Active
3610012-004	WELL 05	3610012	CITY OF CHINO	San Bernardino	7.8	Active
3610012-008	WELL 09 - STANDBY	3610012	CITY OF CHINO	San Bernardino	12.8	Standby
3610012-009	WELL 10 - STANDBY	3610012	CITY OF CHINO	San Bernardino	19.0	Standby
3610012-011	WELL 12	3610012	CITY OF CHINO	San Bernardino	11.0	Active
3610012-013	WELL 14	3610012	CITY OF CHINO	San Bernardino	9.7	Active
3610013-006	MT. VIEW 02 - Inactive	3610013	CITY OF LOMA LINDA	San Bernardino	16.4	Inactive
3610034-003	WELL 04 - INACTIVE	3610034	ONTARIO, CITY OF	San Bernardino	7.4	Inactive
3610034-008	WELL 09	3610034	ONTARIO, CITY OF	San Bernardino	7.6	Active
3610037-004	CHICKEN HILL WELL - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.8	Inactive
3610037-027	MISSION WELL - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	13.5	Inactive

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
3610037-028	NEW YORK STREET WELL	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	14.9	Active
3610037-037	WELL 10 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.9	Inactive
3610037-038	WELL 11 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.7	Inactive
3610037-040	WELL 14 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	11.0	Inactive
3610037-044	WELL 31A	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	66.8	Active
3610037-045	WELL 32	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	15.2	Active
3610037-046	WELL 34 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	10.7	Inactive
3610037-047	WELL 35 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	12.7	Inactive
3610037-051	WELL 41 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	9.8	Inactive
3610037-052	YUCAIPA BLVD WELL - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	9.2	Inactive
3610038-010	ETIWANDA WELL (RIALTO 06)	3610038	RIALTO-CITY	San Bernardino	32.3	Active
3610038-014	HIGHLAND WELL (RIALTO 02) - INACTIVE	3610038	RIALTO-CITY	San Bernardino	44.7	Inactive
3610041-013	WELL F-03A (16) - INACTIVE	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	9.2	Inactive
3610041-029	WELL F-18A (34)	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	11.3	Active
3610041-033	WELL F-17B (39)	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	19.3	Active
3610041-036	WELL F-04A	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	11.2	Active
3610041-042	WELL F-17C	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	7.0	Active
3610064-018	WELL 012A	3610064	EAST VALLEY WD	San Bernardino	13.1	Active
3610064-026	WELL 041 - INACTIVE	3610064	EAST VALLEY WD	San Bernardino	8.5	Inactive
3610064-028	WELL 107	3610064	EAST VALLEY WD	San Bernardino	7.2	Active
3610111-001	WELL 01 - INACTIVE	3610111	VICTORIA FARMS MWC	San Bernardino	14.0	Inactive
3610111-003	WELL 03 - INACTIVE	3610111	VICTORIA FARMS MWC	San Bernardino	57.5	Inactive
3610852-003	WELL 10	3610852	PATTON STATE HOSPITAL	San Bernardino	9.6	Active
3910012-003	02 SSS	3910012	City of Stockton	San Joaquin	7.7	Active
4300543-004	Well 03 (County Building Well)	4300543	West San Martin Water Works, Inc.	Santa Clara	8.0	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
4300939-001	WELL 01	4300939	Countryside Mushrooms, Inc.	Santa Clara	6.9	Active
4900788-002	WELL 02	4900788	El Crystal Mobile Home Park	Sonoma	15.0	Active
5410006-011	WELL 11 - RAW	5410006	Lindsay, City of	Tulare	8.0	Active
5410007-003	NORTH LINDSAY HEIGHTS WELL-STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	10.4	Standby
5410007-004	NORTH SECT 8 WELL - STANDBY (NO3, DBCP)	5410007	LSID - Tonyville	Tulare	7.6	Standby
5410007-005	SOUTH LINDSAY HEIGHTS WELL-STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	9.1	Standby
5410007-006	SOUTH SECT 8 WELL - STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	7.3	Standby
5410007-007	STARK SEC 8 WELL - STANDBY (NO3)	5410007	LSID - Tonyville	Tulare	7.6	Standby
Surface Water Sources						
5610702-009	WINDMILL SPRINGS - SURFACE INFLUENCE	5610702	U.S.N., San Nicolas Island	Ventura	8.0	Active

Table B-4
Affected Sources for Potential MCL of 18 µg/L

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
Groundwater Sources						
1910009-007	WELL 07 LANTE STREET - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	77.0	Inactive
1910009-009	WELL 09 BIG DALTON - INACTIVE	1910009	VALLEY COUNTY WATER DIST.	Los Angeles	37.1	Inactive
1910017-017	SAUGUS WELL 01 - INACTIVE	1910017	SANTA CLARITA WATER CO.	Los Angeles	27.5	Inactive
1910017-018	SAUGUS WELL 02 - INACTIVE	1910017	SANTA CLARITA WATER CO.	Los Angeles	22.3	Inactive
1910039-026	WELL B6C - INACTIVE	1910039	SAN GABRIEL VALLEY WATER CO.-EL MONTE	Los Angeles	72.5	Inactive
1910060-002	WELL 02 - STANDBY	1910060	LA PUENTE VALLEY CWD	Los Angeles	66.0	Standby
1910060-003	WELL 03	1910060	LA PUENTE VALLEY CWD	Los Angeles	48.0	Active
1910060-004	WELL 04 - STANDBY	1910060	LA PUENTE VALLEY CWD	Los Angeles	69.1	Standby
1910124-001	ARROYO - INACTIVE	1910124	PASADENA-CITY, WATER DEPT.	Los Angeles	26.6	Inactive
1910127-003	GRAND AVE. WELL - INACTIVE	1910127	COVINA-CITY, WATER DEPT.	Los Angeles	21.5	Inactive
1910163-004	WELL 04 LACFCD 3102B - INACTIVE	1910163	VALENCIA HEIGHTS WATER CO.	Los Angeles	28.4	Inactive
1910205-055	139-W6 - INACTIVE	1910205	SUBURBAN WATER SYSTEMS-SAN JOSE	Los Angeles	31.2	Inactive
3310031-038	GAGE WELL 66-1	3310031	Riverside, City of	Riverside	19.5	Active
3410015-015	WELL 13 - CITRUS - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	322.5	Inactive
3410015-017	WELL 15 - FOLSOM BLVD - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	197.5	Inactive
3410015-018	WELL 16 - PYRITES - INACTIVE	3410015	Southern CA Water Co - Cordova Water Srv	Sacramento	215.0	Inactive
3410704-009	WELL 01 (WELL 88-MAIN BASE PLANT)-INACTV	3410704	SCWMD Mather-Sunrise	Sacramento	69.5	Inactive
3410704-010	WELL 02 (WELL 89 - NORDEN) - INACTIVE	3410704	SCWMD Mather-Sunrise	Sacramento	125.0	Inactive
3610012-009	WELL 10 - STANDBY	3610012	CITY OF CHINO	San Bernardino	19.0	Standby
3610037-038	WELL 11 - INACTIVE	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	6.7	Inactive
3610037-044	WELL 31A	3610037	REDLANDS CITY MUD-WATER DIV	San Bernardino	66.8	Active
3610038-010	ETIWANDA WELL (RIALTO 06)	3610038	RIALTO-CITY	San Bernardino	32.3	Active

WELL ID	SOURCE NAME	SYSTEM NO	SYSTEM NAME	COUNTY	PERCHLORATE (µg/L)	CURRENT STATUS
3610038-014	HIGHLAND WELL (RIALTO 02) - INACTIVE	3610038	RIALTO-CITY	San Bernardino	44.7	Inactive
3610041-033	WELL F-17B (39)	3610041	SAN GABRIEL VALLEY WC - FONTANA	San Bernardino	19.3	Active
3610111-003	WELL 03 - INACTIVE	3610111	VICTORIA FARMS MWC	San Bernardino	57.5	Inactive
Surface Water Sources						
No Surface Water Sources						

Appendix C

Backup Material for Cost Estimates And Listing of Affected Sources

Appendix C: BACKUP MATERIAL FOR COST ESTIMATES

C.1 Introduction

This appendix provides additional information on the cost estimates for the water quality improvements (blending stations and ion exchange treatment facilities) to meet the potential perchlorate MCLs presented in Section 5 of the report. The cost estimates used in this study are planning level costs that have an expected accuracy of +50 percent/-30 percent.

The cost estimates for similar cost of compliance studies are typically developed assuming that there are no extraordinary site preparation or “obstacles” to implementing treatment facilities. However, because many of the affected sites have been due to the activities of private responsible parties (PRPs), water utilities have looked to the PRPs for providing the funds and facilities to address the perchlorate contamination. In many cases, a PRP funded project is more complex and costly because some of the utility's procedures and assets are not available for the corrective action. Hence, consideration was given to these additional conditions that water utilities might encounter in implementing treatment facilities to address sources contaminated with perchlorate.

C.1.1 Overview of Cost Estimating Methodology

The development of this cost estimate for water quality improvement facilities considered the design of the treatment systems, estimating total capital costs, and estimating operations and maintenance (O & M) costs. These costs are then used to make statewide aggregate estimates of compliance costs for a potential perchlorate maximum contaminant level (MCL).

As described in Appendix B, the impacted systems include both groundwater sources and a small number of surface water sources. The sections below describe various steps used to develop capital and O&M cost estimates in detail for both groundwater and surface water sources.

The cost estimates for perchlorate compliance technologies were developed as follows:

- The applicable compliance technologies were identified and the process treatment goals were developed (Section C.1.2). In this study, blending and single-pass anion exchange treatment were the selected technologies.

- The capital cost elements for the selected compliance technologies were estimated (Section C.2). Capital costs include the construction “bid” costs associated with constructing the treatment or blending facilities, additional capital asset improvements, indirect construction costs, and special permitting costs.

- The annual operations and maintenance (O&M) costs are estimated for each compliance technology (Section C.3).

After these cost elements were estimated for individual design cases, statewide or aggregate cost estimates were developed for all affected sources implementing these technologies. Aggregate costs reflect the total estimated compliance cost for a potential MCL.

C.1.2 Applicable Compliance Technologies

CDHS has not yet designated any technology as best available technology (BAT) for removing perchlorate from drinking water at the most recent action level (AL) of 6 µg/L. However, it has approved specific anion exchange and biological treatment processes for perchlorate removal if specific requirements are met. In addition, reverse osmosis (RO) is capable of removing perchlorate. However, the RO reject stream would be at least 15 percent of the feed flow and disposing of these large wastes would be both wasteful of water resources and costly.

To date, water utilities in California have either implemented anion exchange for pechlorate removal from drinking water sources or have blended affected sources with other water sources to meet the AL or other operational goal. The anion exchange facilities installed have included both regenerable anion exchange beds (e.g., Calgon Carbon Corporation’s ISEP carousel system), where brine disposal systems have been available, and single-pass anion exchange systems, in which the resin is replaced after its perchlorate capacity is utilized. However, availability and use of brine disposal systems are limited and regenerable anion exchange systems were not considered further. For this study, blending and anion exchange (single pass) treatment systems were the only compliance technologies considered further in this cost analysis. These two technologies were evaluated for three potential perchlorate MCLs: 18 µg/L, 6 µg/L, and 4 µg/L, which are above or at the present reporting limit for perchlorate of 4 µg/L, and represent the present and previous perchlorate ALs.

C.1.2.1 Blending

Blending with essentially contaminant-free (< 50% MCL) water was considered as an option to comply with the potential MCLs. Some utilities pump to a blending and/or treatment facility and then send the blended water into the distribution system. The CDHS has approved similar projects in southern California for nitrate compliance. It was assumed that utilities would use this operational approach when perchlorate levels are not more than 25 percent above the potential MCL, unless the utility operates a single well or an essentially contaminant-free source for blending is not available. Thus, this option was applied for the 4 µg/L potential MCL to wells with perchlorate levels < 5.0 µg/L, for the 6 µg/L potential MCL to wells with levels > 6.5 µg/L to 7.5 µg/L, and for the 18 µg/L potential MCL to wells with levels > 18.5 µg/L to 22.5 µg/L.

C.1.2.2 Anion Exchange

Cost estimates were developed for single pass (or single resin use) anion exchange configuration, which is the wellhead treatment technology configuration that utilities will most likely implement in the future. The basic resin vessel configuration is a lead-lag arrangement in which water flows through two contactors in series. The train is operated until the first (lead) vessel is exhausted for perchlorate removal (effluent concentration equals influent concentration), at which time the lead vessel is taken off line for resin replacement and the second (lag) vessel becomes the lead vessel. After resin replacement, the first vessel is brought back on line as the lag vessel.

A key component of single pass anion exchange is the useful life of the resin, which governs the frequency of resin change out. Resin usage is primarily a function of the perchlorate, nitrate, and sulfate concentrations of the affected source. For a given perchlorate concentration, longer resin life is achieved when nitrate and sulfate concentrations are low. In this analysis, each source was categorized by concentrations of perchlorate (10, 25, 60, or 200 µg/L), nitrate (10 or 44 mg/L), and sulfate (30 or 180 mg/L) and vendors' estimates for resin replacement costs for the appropriate category were applied in the cost estimates. This resulted in 16 operations and maintenance (O&M) cases.

C.2 Capital Cost Estimates

Capital costs were developed to estimate total project costs to implement blending or ion exchange facilities. These cost estimates were divided into four categories:

- Construction "Bid" costs for the compliance action for the basic blending or ion exchange facilities
- Non-factored capital asset costs such as additional land for facilities, offsite pipelines, and site improvements
- Factored indirect construction costs such as engineering, legal, general permitting, and interest during construction of 25 percent of the "bid" costs
- Non-factored indirect costs for DHS 97-005 permitting and public acceptance of proposed projects.

These costs are planning level costs that have an expected accuracy of + 50 percent/-30 percent. The construction costs presented in this report are based on an Engineering News-Record (ENR) construction cost index of 7670, which represents an average of November 2003 construction costs in San Francisco and Los Angeles.

C.2.1 Construction "Bid" Costs

Construction "bid" costs are the costs an owner would expect to pay a contractor to build a basic blending station or ion exchange facility in response to a competitive bidding process. The construction "bid" costs include the following costs: process equipment; site preparation; building or structural work; mobilization; bonding; electrical equipment or instrumentation; and hiring a contractor to build the treatment system. For the single pass anion exchange systems, the process facilities costs represent installed costs for vendor supplied resin vessels with manifolds, modifications to existing well pumps, connecting piping, cartridge pre-filters, and electrical/instrumentation costs. Cost factors for contractor's overhead and profit (18 percent), site preparation (5 percent), and contingencies (15 percent) were then applied to the process costs to develop a "bid" cost, or costs directly attributable to construction. Bid costs for the blending station were based on Kennedy/Jenks experience with similar projects in southern California for nitrate compliance.

C.2.1.1 Blending Facilities

The blending systems assume that the affected source can be blended with water from the distribution system, with positive control of flow direction to ensure that the proper blending ratio is maintained, or that the affected source is shut down when the ratio is not achieved. The CDHS has approved similar facilities in southern California for complying with the nitrate MCL.

Table C-1 presents the estimates of capital costs for the basic blending facilities. For sources using blending, two design cases were used. These design cases correspond to flow rates of 500-1,200 gpm and 1,300-5,000 gpm. Based on Kennedy/Jenks experience with nitrate blending projects in southern California, the "bid" cost for the smaller blending stations would be about $131,000 and for the larger stations about $149,000 for single sources. If there are opportunities to address multiple sources with a single blending station, the estimated "bid" costs would be calculated by adding the individual costs of affected sources.

Table C-1
"Bid" and Indirect Construction Cost Estimates for Blending Facilities

Design Flow Rate (gpm)	**150**	**300**	**600**	**1,000**	**2,000**	**5,000**
Capital	***Costs in Thousands Of Dollars***					
Construction Bid *Cost*	131	131	131	131	149	149
Indirect Costs	33	33	33	33	37	37
Total Capital Costs	164	164	164	164	186	186

C.2.1.2 Anion Exchange Facilities

Table C-2 presents the design parameters for the anion exchange systems. Design capacities of 150 gpm, 300 gpm, 600 gpm, 1,000 gpm, 2,000 gpm, and 5,000 gpm were selected to cover the range of flows that California water utilities are likely to implement. Sizing was based on hydraulic loading design criteria for commercially available vessels. The hydraulic loading rate of each anion exchange train was checked to ensure it was between 6 gpm/ft^2 and 13 gpm/ft^2, and resin capacity would allow up to 12 minutes of empty bed contact time (EBCT) at the design capacity. For impacted groundwater sources steel pressure vessels were used for every system to utilize existing pumping equipment. A booster pump to compensate for the head loss in the treatment process was also included. For impacted surface water sources steel pressure vessels were used for treatment. A pump to compensate for the head loss of 50 psi in the pressure vessels was included to deliver the treated water for post-treatment operations.

The configuration of treatment train for groundwater and surface water sources included a single lead-lag train for up to 1,000 gpm, two lead-lag trains for the 2,000 gpm system, and five lead-lag trains for the 5,000 gpm system.

Table C-2
Design Parameters for Anion Exchange Systems for Perchlorate Removal

Design Flow Rate (gpm)	Number of Contactors	Contactor Diameter (ft)	Resin Capacity (cu.ft.)[1]	EBCT for Resin Capacity (min)

150	2	4	200	10
300	2	6	400	10
600	2	8	800	10
1,000	2	10	1,600	12
2,000	4	10	3,200	12
5,000	10	10	8,000	12

[1]Maximum quantity of resin that vessels may contain

For the single pass anion exchange systems, the process facilities costs represent installed costs for vendor supplied resin vessels with manifolds, modifications to existing well pumps, valves, connecting piping, cartridge pre-filters, and electrical/instrumentation costs. Cost factors for contractor's overhead and profit (18 percent), site preparation (5 percent), and contingencies (15 percent) were then applied to the process costs to develop a "bid" cost, or costs directly attributable to construction.

Table C-3 presents the estimates of construction "bid" costs for anion exchange systems for the various water quality conditions considered. The total capital costs are broken out into construction costs and indirect capital costs.

Table C-3
"Bid" and Indirect Construction Cost Estimates for Anion Exchange

Design Flow Rate (gpm)	**150**	**300**	**600**	**1,000**	**2,000**	**5,000**
Capital	***Costs in Thousands Of Dollars***					
Labor and Materials	131	202	330	390	780	1,980
Site Preparation	7	10	17	20	40	96
Contingency	20	30	49	59	117	288
Overhead and Profit	24	36	59	70	140	346
Subtotal	51	76	115	149	297	730
Construction Bid *Cost*	182	278	455	539	1,077	2,630
Indirect Costs	46	70	114	135	277	663
Total Capital Costs	230	350	570	670	1,400	3,300

C.2.2 Non-factored Asset Project Costs

To implement corrective solutions to address perchlorate contamination, additional improvements have had to be included in some projects to gain community and PWS acceptance. The following sections describe these additional improvements, the basis for their estimated costs, and the percentage of PWSs or sources to which they were applied in the aggregate analysis.

C.2.2.1 Land Costs

Some utilities may need to purchase land to implement treatment at some existing well sites. Additional land for treatment facilities was assigned to 25 percent of the sites. Sites where treatment implementation is already in progress were excluded.

Additional land for the treatment facilities is a fairly common requirement in PRP funded projects. Many of the sites are in urban or suburban areas where land costs are substantially higher. For purposes of this study, we have assumed that the base cost of the land will be the median of the median housing cost (November 2003) for the major counties impacted with perchlorate. Table C-4 shows the median housing costs for the counties with impacted perchlorate sources for the month of November 2003. The median housing cost of $241,000 corresponding to Sacramento County is the median of these costs. This was used as the cost for land acquisition in this study.

Table C-4
Median Housing Cost in Counties with Perchlorate Impacted Sources[1]

County	Median Housing Cost
San Bernardino	$164,000
Riverside	$220,000
Sacramento	$241,000
Los Angeles	$273,000
Santa Clara	$461,000

1 – November 2003 Data

C.2.2.2 Demolition Cost

In some cases where additional land is required, existing structures must be demolished before the treatment facilities can be installed. For this study, it was assumed that 50 percent of the purchased sites would require demolition of existing structures. Demolition costs were assumed to be equal to the value of the building on the acquired property, which is typically 50 percent of its assessed value. Thus, $120,500 was assigned to cover demolition costs when required.

C.2.2.3 Building for Treatment System

Where aesthetics or security concerns exist, a building has been required for some projects. To address this requirement, it was assumed that 25 percent of the sites would require construction of a building to house the treatment systems. Contractor's "bid" costs for buildings were developed. Table C-5 provides the building dimensions and contractor's bid costs for treatment systems from 150 gpm to 5,000 gpm design capacity.

Table C-5
Contractor's Bid Costs for Facility Buildings

Design Capacity (gpm)	Facility Building Dimensions ft x ft (ft^2)	Contractor's Bid Cost ($)	Unit Cost ($/sf)
150	17 x 22 (374)	$79,000	$210
300	22 x 27 (594)	$97,000	$160

600	26 x 31 (806)	$114,000	$140
1,000	30 x 31 (930)	$129,000	$140
2,000	35 x 47 (1,640)	$183,000	$110
5,000	83 x 47 (3,900)	$368,000	$90

C.2.2.4 Aesthetic Walls

Some sources are located in sensitive areas where only an aesthetic wall shielding the treatment facility may be required to meet the project requirements. For this study, it was assumed 25 percent of the sites would require a wall around the site perimeter. Contractor's "bid" costs were developed for a 5-ft concrete split face block wall constructed around the treatment facility. The walls will be constructed such that a clear 20 foot truck space will be available on two sides and a total offset of 45 feet will be available for the other two sides. The direct construction cost of the wall was estimated to be $80 per linear foot. Table C-6 provides the wall length dimensions and contractor's bid costs for treatment systems from 150 gpm to 5,000 gpm design capacity.

Table C-6
Contractor's Bid Costs for Aesthetic Walls

Design Capacity (gpm)	Facility Wall Length (Dimensions) ft (ft x ft)	Contractor's Bid Cost ($)	Unit Cost ($/ft)
150	216 (62 x 46)	$23,000	$110
300	236 (62 x 56)	$26,000	$110
600	252 (70 x 56)	$28,000	$110
1,000	264 (75 x 57)	$30,000	$110
2,000	302 (80 x 71)	$33,000	$110
5,000	396 (115 x 87)	$44,000	$110

C.2.2.5 Pipelines to Offsite Treatment Facility

Some sources located on sites that are too small for additional treatment facilities will require pumping to an off-site treatment location. In addition, where more than one affected well is involved and they are close enough to each other, a single treatment site may be more appropriate than wellhead treatment. For this study, it was assumed that 25 percent of the sites would require a one-mile pipeline to take water from an affected site to the treatment site and deliver treated water to the distribution system. A design criterion of 4 to 6 feet per second was used as the pipeline velocity, which results in pipeline designs from 4-inch diameter for the 150 gpm flow to a 24-inch diameter for the 5,000 gpm flow. Cost of construction in a suburban area was used in the estimates. Table C-7 provides the pipeline diameters and contractor's bid costs for design capacities between 150 gpm and 5,000 gpm.

Table C-7
Contractor's Costs for PipelineCosts

Design Capacity (gpm)	Pipeline Diameter (inches)	Contractor's Bid Cost ($)

150	4	$200,000
300	6	$310,000
600	8	$410,000
1,000	12	$610,000
2,000	18	$920,000
5,000	24	$1,200,000

C.2.2.6 Right-of-Way Access for Pipelines

In some cases where pipelines are needed to deliver raw water to an off-site treatment system site, a right-of-way access fee for pipeline installation becomes part of the project. Typical pipeline right-of-ways are about 20-feet wide. For a one-mile pipeline, this is equivalent to 2.4 acres of land per mile. Access fees are typically seventy-five (75) percent of the property value of the land. For this study, we assumed access fees would apply for pipeline diameters larger than 8-inches (> 600 gpm design case). The land value per acre was set at $241,000/acre, equivalent to the median residential property resale value. Thus, right-of-way cost would be about $434,000 per affected site.

C.2.3 Factored Indirect Capital Costs

Utilities implementing treatment technologies also incur indirect capital costs that include engineering, construction management, interest during construction, legal, financial, and general permits. On the basis of experience with other cost of compliance studies, these indirect costs were equal to 25 percent of direct construction costs. Table C-1 and C-3 show how these indirect costs were applied to the basic blending station and anion exchange design cases, respectively.

C.2.4 Non-Factored Indirect Project Costs

The 25 percent factored indirect construction costs do not cover situations where special permitting or public acceptance is a key factor in obtaining project approval. In such cases, additional non-factored indirect project costs were added to develop more reasonable total project cost estimates.

C.2.4.1 CDHS Memorandum 97-005 Permitting Costs

In November 1997, CDHS issued a policy guidance memorandum for direct domestic use of extremely impaired sources (CDHS 97-005). There are nine required steps before CDHS will issue an amended water permit to a PWS allowing the delivery of treated water from a source captured by the “extremely impaired water source” definition. These permitting costs were assigned only to the utility with one or more affected sources rather than to each affected source.

This permitting process is relatively new to water utilities and early projects have incurred costs of approximately $500,000 to obtain an amended water permit. Due to more experience by the drinking water community, a cost of $350,000 was assigned to a PWS if it had one or more sources with three times the potential MCL. This cost includes the owner's costs as well as the CDHS review of the permit process using the CDHS hourly rate of $90/hr.

Table C-8 summarizes the number of systems and associated costs for extremely impaired source permitting for each potential MCL. These costs were aggregated separately.

Table C-8
Summary of 97-005 Permitting Costs

Potential Perchlorate MCL (µg/L)	PWS Needing Permit	Total Permit Costs
18	3	$1,050,000
6	7	$2,450,000
4	15	$5,350,000

C.2.4.2 Community and PWS Acceptance

For non-97-005 affected utilities, public acceptance of corrective action projects has been a major effort. As a result, the portion of indirect costs assigned to permitting using the factor approach is inadequate. A $50,000 addition for the public acceptance effort has been assigned to 25 percent of the non-97-005 PWSs to adjust the total project costs to cover this activity.

C.2.4.3 Total Capital Costs for MCL Compliance

Total capital costs are the sum of the direct construction costs and indirect costs. The total capital costs are used to determine bonding or other financial requirements to fund these construction projects.

Table C-9 summarized the estimated (average) aggregated capital cost estimates for the three potential perchlorate MCLs. These costs are shown as separate elements for anion exchange (IX) treatment facilities/blending stations, offsite piping systems, pipe access, land purchase, demolition, security buildings, aesthetic walls, and special permitting. The additional cost elements increase the basic treatment facilities/blending station total capital costs by 18 percent, 52 percent, and 39 percent for potential perchlorate MCLs of 18 µg/L, 6 µg/L, and 4 µg/L, respectively.

Table C-9
Summary of Aggregated Capital Costs Elements

	Potential MCL					
	18 µg/l		6 µg/l		4 µg/l	
Component	Sources	Cost ($1000)	Sources	Cost ($1000)	Sources	Cost ($1000)
IX Facilities/Blending Stations	15	$36,100	93	$102,700	165	$179,600
Blending Stations	2	400	22	$3,900	14	$2,400
Piping	3	$2,000	25	$21,000	39	$30,000

Pipe Access	2	$1,100	18	$10,000	26	$14,000
Land Purchase	4	$1,200	24	$7,000	38	$10,000
Demolition	2	$300	12	$2,000	19	$3,000
Security Building	3	$500	27	$5,000	38	$7,000
Wall	3	$100	25	$1,000	39	$1,000
97-005 Permitting*	3	$1,000	7	$2,400	15	$5,300
Public Acceptance*	2	$100	7	$400	10	$500
Total		$43,000		$155,000		$253,000

*PWSs

C.3 Annual Operations and Maintenance Costs

O&M costs include costs to operate and maintain the treatment system, control systems, and buildings. For this study, O&M costs were developed for electric power, labor, maintenance materials, resin replacement, and monitoring. On the basis of professional judgment and experience in similar studies, labor rates were estimated at an average of $40 per hour, electricity rates were estimated at 12¢/kWh, and an annual allowance for maintenance materials was estimated at 1 percent of total capital costs.

An average flow rate of 40 percent of annual design capacity was used to estimate power requirements arising from extra pumping to move water through the treatment facilities and mechanical equipment operation.

C.3.1.1 Blending Facilities

Annual O&M costs for blending stations consist primarily of the cost of the blending water and the costs of pumping the blended water into the distribution system. The lower boundary costs for blending water is approximately $60/AF for pumping to a line pressure of 120 psig (assumes primarily electrical cost, i.e., no pump tax, etc.). This cost was assumed for a PWS that has an uncontaminated source it can use for blending. The upper boundary for blending water is approximately $500/AF. For this cost estimate the cost for blending water was $250/AF.

Table C-10
Cost Estimates for Blending Facilities

Design Flow Rate (gpm)	**150**	**300**	**600**	**1,000**	**2,000**	**5,000**
Total Annual Costs	***Costs in Thousands of Dollars per Year***					
Total Annual O&M	24.7	49.4	98.7	164.5	329	822.6

C.3.1.2 Anion Exchange Systems

Annual O&M costs for anion exchange systems were developed for electric power, labor, water quality analytical costs, and maintenance materials using the cost factors described above. In addition, separate costs were developed for resin replacement, which was the major O&M cost.

As described in section C.1.2.2, resin replacement costs are a function of perchlorate, nitrate, and sulfate concentrations in the source water. In lieu of using on site regeneration, vendors offer resin replacement services on a cost per acre-ft of water treated basis, which includes removing spent resin, transporting and disposing of it, and providing new replacement resin.

The cost for the resins were provided by the vendors and modified as appropriate based on operational data and vendor bid packages that were available to Kennedy/Jenks Consultants. In addition, using the WQM database, assignments were developed for sulfate and nitrate concentrations for each affected well. The appropriate $/AF estimate from Table C-11 was selected and used to calculate the resin cost based on the annual production for each specific affected source.

It was assumed that a change out was required when the outlet concentration of the lead vessel was equal to the inlet concentration. This was based on the DHS drinking water permits for several single pass treatment systems treating perchlorate.

Table C-11
Resin Replacement Costs as Function of Water Quality

Resin Case Number	Concentration in Water (mg/L)			Resin Replacement Cost ($/acre-ft)
	Perchlorate	Nitrate	Sulfate	
10-10-30	10	10	30	145
10-10-180	10	10	180	225
10-44-30	10	44	30	245
10-44-180	10	44	180	308
25-10-30	25	10	30	197
25-10-180	25	10	180	309
25-44-30	25	44	30	324
25-44-180	25	44	180	410
60-10-30	60	10	30	261
60-10-180	60	10	180	342
60-44-30	60	44	30	316
60-44-180	60	44	180	413
200-10-30	200	10	30	249
200-10-180	200	10	180	419
200-44-30	200	44	30	286
200-44-180	200	44	180	419

Table C-12 presents the breakout for the annual O&M costs for electric power, labor, analytical, maintenance materials, and resin replacement (each of the 16 water quality cases for each design flow rate). As can be seen from Table C-11, the resin replacement costs generally are greater than the sum of the other annual O&M costs.

Table C-12
Annual Operations and Maintenance Cost Components

Design Flow Rate (gpm)	**150**	**300**	**600**	**1,000**	**2,000**	**5,000**
	Costs in Thousands Of Dollars per Year					
Electric Power	2	3	6	10	20	50
Labor	17	17	17	17	17	17
Analytical	14	14	14	14	18	30
Maintenance Materials	2	4	6	7	14	33
Subtotal	34	37	42	47	69	130
Resin Replacement						
10-10-30[1]	14	28	56	94	187	468
10-10-180	22	44	87	145	290	726
10-44-30	24	47	95	158	316	790
10-44-180	30	60	119	199	397	994
25-10-30	19	38	76	127	255	636
25-10-180	30	60	120	199	398	996
25-44-30	31	63	125	209	418	1,044
25-44-180	40	79	159	265	530	1,324
60-10-30	25	51	101	169	337	843
60-10-180	33	66	132	221	441	1,103
60-44-30	31	61	122	204	408	1,021
60-44-180	40	80	160	266	533	1,332
200-10-30	24	48	96	160	321	802
200-10-180	41	81	162	270	541	1,352
200-44-30	28	55	111	184	369	922
200-44-180	41	81	162	270	541	1,352

[1] Perchlorate (µg/L), nitrate (mg/L), and sulfate (mg/L) concentrations of affected source

C.4 Aggregated Compliance Costs

After the capital and annual O&M cost components are developed, these estimates must be aggregated for all sources and PWSs affected by a given potential perchlorate MCL. This includes determining the total capital costs and total annual costs for all blending stations and anion exchange treatment facilities, and the additional capital costs for additional facilities at certain sites and special permitting costs for certain PWSs. Because utilities generally fund construction projects by issuing bonds, the capital cost must be amortized over the life of the project and added to the annual O&M costs to determine the total annual costs. For this study, the total capital cost was amortized over 20 years at an interest rate of 7 percent. Using these factors, the annual amortized capital cost equals the total capital times a capital recovery factor of 0.09439. The annual costs are then summed over the 20-year project life to determine the overall compliance costs. Table C-13 summarizes the aggregated cost results for the three potential perchlorate MCLs.

Table C-13
Estimated Aggregated Compliance Cost

Potential MCL (µg/L)	Cost Component	Low ($1000)	Average ($1000)	High ($1000)
18	**Total Capital**	$30,000	$43,000	$64,000
	Amortized Capital	$3,000	$4,000	$6,000
	Annual O&M	$9,000	$12,600	$19,000
	Total Annual Costs	$12,000	$17,000	$26,000
	20 year Project Costs	$240,000	$340,000	$520,000
6	**Total Capital**	$108,000	$155,000	$232,000
	Amortized Capital	$11,000	$15,000	$23,000
	Annual O&M	$24,800	$35,000	$53,000
	Total Annual Costs	$35,000	$50,000	$75,000
	20 year Project Costs	$700,000	$1,000,000	$1,500,000
4	**Total Capital**	$176,000	$252,000	$378,000
	Amortized Capital	$17,000	$24,000	$36,000
	Annual O&M	$35,700	$51,400	$77,000
	Total Annual Costs	$53,000	$75,000	$113,000
	20 year Project Costs	$1,060,000	$1,500,000	$2,260,000

Compliance costs are estimated as planning level costs with an accuracy of +50 percent/-30 percent. Thus, it is important to show compliance cost estimates as ranges as well as central tendency (point) estimates. Table C-13 summarizes the estimated compliance costs for the three potential perchlorate MCLs, showing low (-30 percent), average, and high (+50 percent) estimates of total capital, amortized capital, annual O&M, total annual, and 20-year project costs. These estimates indicate that the average total 20-year compliance costs for potential perchlorate MCLs of 18 µg/L, 6 µg/L, and 4 µg/L would be $0.3 billion, $1.0 billion, and $1.5 billion, respectively.

C.8 REFERENCES

California Department of Health Services 1997. Policy Memo 97-005 Policy Guidance for Direct Domestic Use of Extremely Impaired Sources. November 5, 1997 memorandum.

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