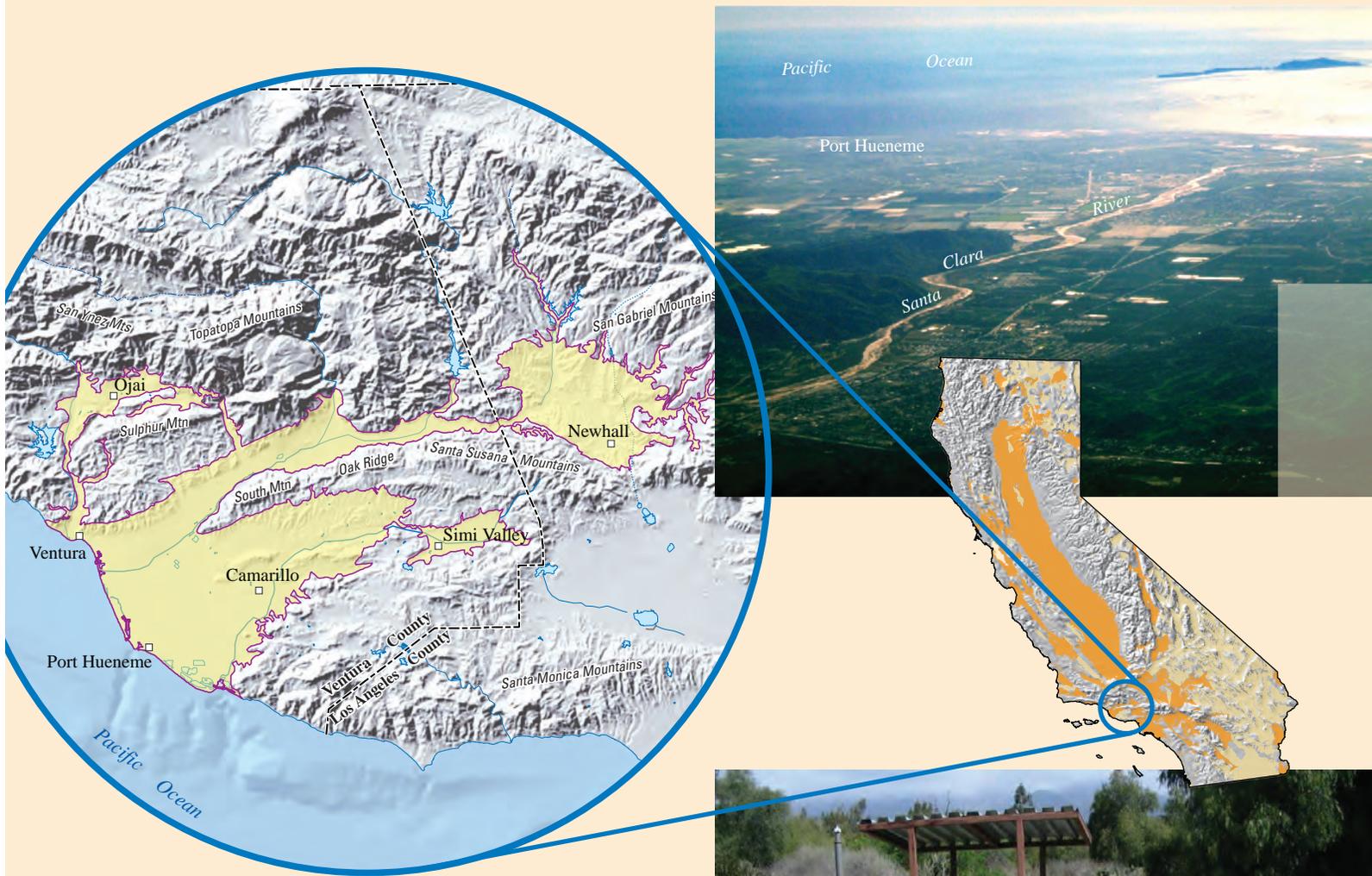


Prepared in cooperation with the California State Water Resources Control Board

Ground-Water Quality Data in the Santa Clara River Valley Study Unit, 2007: Results from the California GAMA Program



Data Series 408

U.S. Department of the Interior
U.S. Geological Survey



Cover: Top photograph: Looking west over Santa Clara River. Photograph taken by Jill Densmore, U.S. Geological Survey. Bottom: Pumping well used for sampling. Photograph taken by Cathy Munday, U.S. Geological Survey.

Ground-Water Quality Data in the Santa Clara River Valley Study Unit, 2007: Results from the California GAMA Program

By Joseph Montrella and Kenneth Belitz

Prepared in cooperation with the California State Water Resources Control Board

Data Series 408

**U.S. Department of the Interior
U.S. Geological Survey**

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2009

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Contents

Abstract	1
Introduction	2
Purpose and Scope	4
Hydrogeologic Setting	4
Methods	4
Study Design.....	4
Sample Collection and Analysis.....	8
Data Reporting.....	9
Quality Assurance.....	9
Water-Quality Results	9
Quality-Control Sample Results.....	9
Comparison Thresholds	10
Ground-Water-Quality Data	11
Field Parameters.....	11
Organic Constituents.....	11
Constituent of Special Interest.....	11
Inorganic Constituents.....	11
Inorganic Tracer Constituents	12
Radioactive Constituents.....	13
Microbial Indicators	13
Future Work	13
Summary	13
Acknowledgments	14
References Cited.....	14
Appendix	60

Figures

Figure 1. Map showing the hydrogeologic provinces of California and the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit	3
Figure 2. Map of the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the ground-water basins defined by the California Department of Water Resources and major hydrologic features	5
Figure 3. Map of the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of study area grid cells and the locations of sampled grid wells	6
Figure 4. Map of the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of study area grid cells and the locations of sampled grid wells and understanding wells	7

Tables

Table 1. Identification, sampling, and construction information for wells sampled for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	20
Table 2. Classes of chemical and microbial constituents and water-quality indicators collected for the slow, intermediate, fast, and depth-dependent well sampling schedules for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.....	22
Table 3A. Volatile organic compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2020	23
Table 3B. Gasoline oxygenates and degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 4024	25
Table 3C. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2003	26
Table 3D. Potential wastewater-indicator compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 4433	28
Table 3E. Pharmaceutical compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Code 9003	31
Table 3F. Polar pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the USGS National Water Quality Laboratory Schedule 2060	32
Table 3G. Nutrients and dissolved organic carbon, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2755, laboratory code 2612, and perchlorate (constituent of special interest) analyzed at the Montgomery Watson-Harza Laboratory	34

Tables—Continued

Table 3H. Major and minor ions and trace elements, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 1948	35
Table 3I. Arsenic, chromium, and iron species, comparative thresholds, and reporting information for the U.S. Geological Survey Trace Metal Laboratory, Boulder, Colorado	36
Table 3J. Isotopic and radioactive constituents, comparative thresholds, and reporting information for laboratories	37
Table 3K. Noble gases and tritium, comparison thresholds, and reporting information for the Lawrence Livermore National Laboratory	38
Table 3L. Microbial constituents, comparison thresholds, and reporting information for the U.S. Geological Survey Ohio Microbiology Laboratory parameter codes 90901, 90900, 99335, and 99332	38
Table 4. Water-quality indicators in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	39
Table 5. Volatile organic compounds (VOC), including gasoline oxygenates and degradates, detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	41
Table 6. Pesticides and pesticide degradates detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	43
Table 7. Potential wastewater-indicator compounds detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	44
Table 8. Constituent of special interest (perchlorate) detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	45
Table 9. Nutrients and dissolved organic carbon detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	46
Table 10. Major and minor ions and dissolved solids detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	47
Table 11. Trace elements detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	49
Table 12. Species of inorganic arsenic, iron, and chromium in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	53
Table 13. Results for analyses of stable isotope ratios and tritium and carbon-14 activities in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	54
Table 14. Results for analyses of noble gases in and helium isotope ratios derived for samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	56

Tables—Continued

Table 15. Radioactive constituents detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	58
Table 16. Microbial indicator results for samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	59

Appendix Tables

Table A1. Analytical methods used by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL) and additional contract laboratories to determine organic, inorganic, and microbial constituents	69
Table A2. Preferred analytical schedules for constituents appearing on multiple schedules for samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	71
Table A3. Quality-control summary for constituents detected in blank samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	72
Table A4A. Quality-control summary for replicate analyses of organic constituents detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	73
Table A4B. Quality-control summary for replicate analyses of major and minor ions, nutrients, and a constituent of special interest [perchlorate] detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	74
Table A4C. Quality-control summary for replicate analyses of trace elements detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	75
Table A4D. Quality-control summary of replicate analyses of radioactive constituents and stable isotopes detected in samples collected for the Santa Clara River Valley Ground-Water Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	76
Table A5A. Quality-control summary for matrix-spike recoveries of volatile organic compounds (NWQL schedule 2020) including gasoline oxygenates and degradates (NWQL schedule 4024) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	77
Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates (NWQL schedule 2003) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	79
Table A5C. Quality-control summary for matrix-spike recoveries of potential wastewater-indicator compounds in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	81

Appendix Tables—Continued

Table A5D. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates (NWQL schedule 2060) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	83
Table A6. Quality-control summary for surrogate recoveries of volatile organic compounds, including gasoline oxygenates and degradates, pesticides and pesticide degradates, potential wastewater-indicator compounds, and pharmaceutical compounds in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007	84

Abbreviations and Acronyms

AB	Assembly Bill (through the California State Assembly)
AL-US	action level (USEPA)
CAS	Chemical Abstracts Service (American Chemical Society)
CSU	combined standard uncertainty
E	estimated or having a higher degree of uncertainty
GAMA	Groundwater Ambient Monitoring and Assessment program
GPS	Global Positioning System
HAL-US	Lifetime Health Advisory Level (USEPA)
HPLC	high-performance liquid chromatography
LRL	laboratory reporting level
LSD	land-surface datum
LT-MDL	long-term method detection level
MCL-CA	maximum contaminant level (CDPH)
MCL-US	maximum contaminant level (USEPA)
MDL	method detection limit
MRL	minimum reporting level
MU	method uncertainty
N	Normal (1-gram-equivalent per liter of solution)
na	not available
nc	sample not collected
NL	notification level
NL-CA	California notification level (CDPH)
NWIS	National Water Information System (USGS)
PCFF	personal computer field forms program
QC	quality control
RPD	relative percent difference
RSD	relative standard deviation
RSD5	risk-specific dose at 10^{-5} (USEPA)
SCRV	Santa Clara River Valley study unit

Abbreviations and Acronyms—Continued

SMCL-CA	secondary maximum contaminant level (CDPH)
SSMDC	sample-specific minimum detectable concentration
TT-US	Treatment Technique (USEPA)
US	United States
V	value censored due to possible blank contamination and was not included in ground-water quality analyses
VPDB	Vienna Peedee Belemite
VSMOW	Vienna Standard Mean Ocean Water

Organizations

CDPH	California Department of Public Health
LLNL	Lawrence Livermore National Laboratory
MWH	Montgomery Watson Harza
NAWQA	National Water Quality Assessment (USGS)
NWQL	National Water Quality Laboratory (USGS)
SWRCB	State Water Resources Control Board (California)
TML	National Research Program Trace Metal Laboratory (USGS)
USEPA	U.S. Environmental Protection Agency
USGS	U. S. Geological Survey
UWCD	United Water Conservation District

Selected Chemical Names

CaCO ₃	calcium carbonate
CFC	chlorofluorocarbon
CO ₃ ⁻²	carbonate
Cr	chromium
DOC	dissolved organic carbon
Fe	iron
HCl	hydrochloric acid
HCO ₃ ⁻	bicarbonate
PCE	perchloroethene
TDS	total dissolved solids
THM	trihalomethane
VOC	volatile organic compound

Abbreviations and Acronyms—Continued

Units of Measurement

cm ³ STP/g	cubic centimeters at standard temperature and pressure (0 degrees Celsius and 1 atmosphere of pressure per gram of water)
cm	centimeter
°C	degrees Celsius
°F	degrees Fahrenheit
ft	foot (feet)
in.	inch
km ²	square kilometers
L	liter
mg	milligram
mg/L	milligrams per liter (parts per million)
mi	mile
mL	milliliter
µg/L	micrograms per liter (parts per billion)
µL	microliter
µm	micrometer
pCi/L	picocurie per liter
δ ⁱ E	delta notation, the ratio of a heavier isotope of an element (ⁱ E) to the more common lighter isotope of that element, relative to a standard reference, expressed as per mil (per thousand)

Notes

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is equivalent to parts per million (ppm) and micrograms per liter is equivalent to parts per billion (ppb).

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Ground-Water Quality Data in the Santa Clara River Valley Study Unit, 2007: Results from the California GAMA Program

By Joseph Montrella and Kenneth Belitz

Abstract

Ground-water quality in the approximately 460-square-mile Santa Clara River Valley study unit (SCRV) was investigated from April to June 2007 as part of the statewide Priority Basin project of the Ground-Water Ambient Monitoring and Assessment (GAMA) Program. The GAMA Priority Basin project was developed in response to the Groundwater Quality Monitoring Act of 2001 and is being conducted by the U.S. Geological Survey (USGS) in cooperation with the California State Water Resources Control Board (SWRCB).

The study was designed to provide a spatially unbiased assessment of the quality of raw ground water used for public water supplies within SCRIV, and to facilitate a statistically consistent basis for comparing water quality throughout California. Fifty-seven ground-water samples were collected from 53 wells in Ventura and Los Angeles Counties. Forty-two wells were selected using a randomized grid-based method to provide statistical representation of the study area (grid wells). Eleven wells (understanding wells) were selected to further evaluate water chemistry in particular parts of the study area, and four depth-dependent ground-water samples were collected from one of the eleven understanding wells to help understand the relation between water chemistry and depth.

The ground-water samples were analyzed for a large number of synthetic organic constituents (volatile organic compounds [VOC], pesticides and pesticide degradates, potential wastewater-indicator compounds, and pharmaceutical compounds), a constituent of special interest (perchlorate), naturally occurring inorganic constituents (nutrients, major and minor ions, and trace elements), radioactive constituents, and microbial constituents. Naturally occurring isotopes (tritium, carbon-13, carbon-14 [abundance], stable isotopes of hydrogen and oxygen in water, stable isotopes of nitrogen and oxygen in nitrate, chlorine-37, and bromine-81), and dissolved noble gases also were measured to help identify the source and age of the sampled ground water.

Quality-control samples (blanks or replicates, or samples for matrix spikes) were collected from approximately 26 percent of the wells, and the analyses of these samples were

used to evaluate the quality of the data for the ground-water samples. Assessment of the quality-control results showed that the quality of the environmental data was good, with low bias and low variability, and as a result, less than 0.1 percent of the analytes detected in ground-water samples were censored.

This study did not attempt to evaluate the quality of water delivered to consumers; after withdrawal from the ground, water typically is treated, disinfected, and (or) blended with other waters to maintain acceptable water quality. Regulatory thresholds apply to treated water that is delivered (or, supplied) to the consumer, not to raw ground water. However, to provide some context for the results, concentrations of constituents measured in the raw ground water were compared with regulatory and non-regulatory thresholds established by the U.S. Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH) and thresholds established for aesthetic concerns (secondary maximum contaminant levels, SMCL-CA) by CDPH.

Most constituents that were detected in ground-water samples were reported at concentrations below their established health-based thresholds. VOCs, pesticides and pesticide degradates, and potential wastewater-indicator compounds were detected in about 33 percent or less of the 42 SCRIV grid wells. Concentrations of all detected organic constituents were below established health-based thresholds. Perchlorate was detected in approximately 12 percent of the SCRIV grid wells; all concentrations reported were below the NL-CA threshold.

Additional constituents, including major ions, trace elements, and nutrients were collected at 26 wells (16 grid wells and 10 understanding wells) of the 53 wells sampled for the SCRIV study. The concentration of total dissolved solids (TDS) was reported above the upper SMCL-CA threshold in 18 of the 26 SCRIV wells sampled for TDS. The concentration of sulfate was reported above the upper SMCL-CA threshold in 10 of 26 SCRIV wells sampled for sulfate. Chloride was reported above the upper SMCL-CA threshold in 4 of 26 wells sampled for chloride; none of these 4 wells were used for public supply. The concentration of nitrite plus nitrate was reported above the health-based threshold in 5 of 26 SCRIV wells sampled for nitrite plus nitrate. Iron and manganese

2 Ground-Water Quality Data in the Santa Clara River Valley Study Unit, 2007: Results from the California GAMA Program

were above their respective SMCL-US thresholds in 7 and 14 SCRv wells, respectively. The gross alpha radioactivity (72-hour count) for one SCRv grid well was slightly above the established health-based threshold, and the gross alpha radioactivity (30-day count) in one SCRv understanding well was slightly above the established health-based threshold. Activities of radon-222 in samples from six wells were above the proposed MCL-US, 300 pCi/L, but below the alternative MCL-US, 4,000 pCi/L.

Introduction

Ground water comprises nearly half of the water used for public supply in California (Hutson and others, 2004). To assess the quality of ground water in aquifers used for drinking-water supply and to establish a program for monitoring trends in ground-water quality, the State Water Resources Control Board (SWRCB), in collaboration with the U.S. Geological Survey (USGS) and Lawrence Livermore National Laboratory (LLNL), implemented the Groundwater Ambient Monitoring and Assessment (GAMA) Program (<http://www.waterboards.ca.gov/gama>). The GAMA program consists of three projects: Priority Basin Assessment, conducted by the USGS (<http://ca.water.usgs.gov/gama/>); Voluntary Domestic Well Assessment, conducted by the SWRCB; and Special Studies, conducted by LLNL.

The SWRCB initiated the GAMA Priority Basin project in response to the Ground-Water Quality Monitoring Act of 2001 (Sections 10780-10782.3 of the California Water Code, Assembly Bill 599). AB 599 is a public mandate to assess and monitor the quality of ground water used as public supply for municipalities in California. The project is a comprehensive assessment of statewide ground-water quality designed to help better understand and identify risks to ground-water resources, and to increase the availability of information about ground-water quality to the public. As part of the AB 599 process, the USGS, in collaboration with the SWRCB, developed the monitoring plan for the project (Belitz and others, 2003; State Water Resources Control Board, 2003). Key aspects of the project are inter-agency collaboration, and cooperation with local water agencies and well owners. Local participation in the project is entirely voluntary.

The GAMA Priority Basin project is unique in California because the data collected during the study include analyses for an extensive number of chemical constituents at very low concentrations, analyses that are not normally available. A broader understanding of ground-water composition will be especially useful for providing an early indication of changes in water quality, and for identifying the natural and human factors affecting water quality. Additionally, the GAMA Priority Basin project will analyze a broader suite of

constituents than required by the California Department of Public Health (CDPH; formerly California Department of Health Services – replaced on July 1, 2007). An understanding of the occurrence and distribution of these constituents is important for the long-term management and protection of ground-water resources.

The range of hydrologic, geologic, and climatic conditions that exists in California must be considered in an assessment of ground-water quality. Belitz and others (2003) partitioned the state conceptually into 10 hydrogeologic provinces, each with distinctive hydrologic, geologic, and climatic characteristics (fig. 1), and representative regions in all 10 provinces were included in the project design. Eighty percent of California's approximately 16,000 public-supply wells are in ground-water basins within these hydrologic provinces. Most of these ground-water basins, defined by the California Department of Water Resources, consist of relatively permeable, unconsolidated deposits of alluvial or volcanic origin (California Department of Water Resources, 2003). Ground-water basins were prioritized for sampling on the basis of the number of public-supply wells in the basin, with secondary consideration given to municipal ground-water use, agricultural pumping, the number of leaking underground fuel tanks, and pesticide applications within the basins (Belitz, and others, 2003). In addition, some ground-water basins or groups of adjacent similar basins with relatively few public-supply wells were assigned high priority so that all hydrogeologic provinces would be represented in the subset of basins sampled. The 116 priority basins were grouped into 35 study units. Some areas not in the defined ground-water basins were included in several of the study units to represent the 20 percent of public-supply wells outside the ground-water basins. The SCRv was the seventeenth study unit in the GAMA program.

Three types of water-quality assessments are being conducted using the data collected in each study unit: (1) *Status*: assessment of the current quality of the ground-water resource, (2) *Trends*: detection of changes in ground-water quality and (3) *Understanding*: identification of the natural and human factors affecting ground-water quality (Kulongoski and Belitz, 2004). This report is one of a series of reports presenting the status of current water quality conditions in each study unit (Wright and others, 2005; Kulongoski and others, 2006; Bennett and others, 2006; Dawson and others, 2007; Fram and Belitz, 2007; Kulongoski and Belitz, 2007). Subsequent reports will address the trends and understanding aspects of the water-quality assessments.

The Santa Clara River Valley GAMA study unit, hereinafter referred to as SCRv, contains eight ground-water basins. The SCRv study unit was considered high priority for sampling to adequately represent the Transverse Ranges and Selected Peninsular Ranges hydrogeologic province (Belitz, and others, 2003).



Base from U.S. Geological Survey digital elevation data, 1999, Albers Equal Area Projection

Provinces from Belitz and others, 2003

Figure 1. The hydrogeologic provinces of California and the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit.

Purpose and Scope

The purposes of this report are: (1) to describe the study design and study methods; (2) to present the results of quality-control tests, and (3) to present the analytical results for ground-water samples collected in SCR. Ground-water samples were analyzed for organic, inorganic, microbial constituents, field parameters, and chemical tracers. The chemical and microbial data presented in this report were evaluated by comparing them to state and federal drinking water regulatory and non-regulatory standards that are applied to treated drinking water. Regulatory and non-regulatory thresholds considered for this report are those established by the United States Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH) (U.S. Environmental Protection Agency, 2006, 2007a,b; California Department of Public Health, 2007a,b). The data presented in this report are to characterize the quality of untreated ground-water resources within the study unit, not the treated drinking water delivered to consumers by water purveyors. Discussions of the factors that influence the distribution and occurrence of the constituents detected in ground-water samples will be the subject of subsequent publications.

Hydrogeologic Setting

Knowledge of the hydrogeologic setting is important in the design of a ground-water quality investigation. The Santa Clara River Valley (SCR) GAMA study unit covers approximately 460 square miles (1,191 km²) in Los Angeles and Ventura Counties, California ([fig. 2](#)). The study unit is located in the Transverse Ranges and Selected Peninsular Ranges hydrogeologic province ([fig. 1](#)) and includes eight ground-water basins ([fig. 2](#)); two of the basins, Santa Clara River Valley and Ventura River Valley ground-water basins, are divided into additional ground-water subbasins (California Department of Water Resources, 2003). The study unit is bounded on the south by the Santa Monica Mountains and on the north by the Topatopa and Santa Ynez Mountains. The San Gabriel Mountains form the eastern boundary, and the Pacific Ocean lies to the west of the study area.

The wells sampled in Ventura County, or western part of SCR study unit, are in or near the Ojai Valley, Upper Ojai Valley, Ventura River Valley, Santa Clara River Valley, Pleasant Valley, Arroyo Santa Rosa Valley, Las Posas Valley, and Simi Valley ground-water basins ([fig. 2](#)). The wells sampled in Los Angeles County are in the eastern part of the Santa Clara River Valley ground-water basin (California Department of Water Resources, 2004a–n).

The topographic relief of the SCR study unit rises from sea level to an elevation of 5,800 feet (1,768 meters) in the surrounding Topatopa Mountains of the Transverse

Ranges. The climate in the SCR study unit is characterized as Mediterranean, having cool, moist winters and dry, warm summers. The average annual precipitation range in SCR is 12 to 28 inches (30 to 71 centimeters) per year, with the majority of the rain falling in the winter months and at higher elevations (California Department of Water Resources 2004c, e, i, m). The average annual air temperature in SCR ranges from 44°F to 77°F (7°C to 25°C) (Oregon State University PRISM Group, 1971–2000).

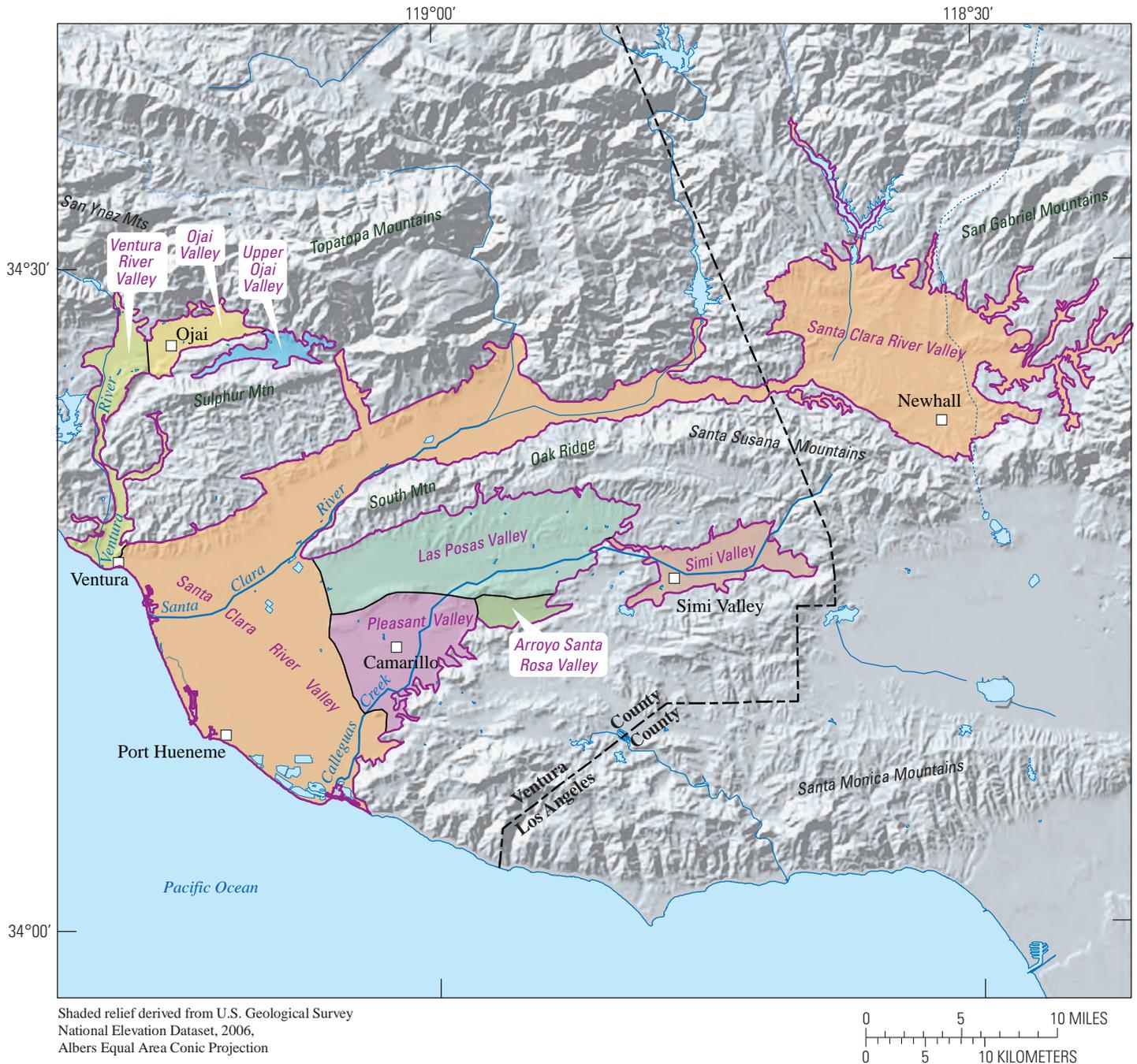
Natural and artificial ground-water recharge exists in the SCR (Hansen and others, 2003). Most natural recharge consists of streamflow and direct-precipitation infiltration. The Ventura River, Santa Clara River, and Calleguas Creek are three main river systems that drain the study area, eventually emptying into the Pacific Ocean ([fig. 2](#)). Sources of water for streams are natural precipitation, reservoir discharge, imported-northern California water, dewatering wells, and treated wastewater effluent. In the Oxnard subbasin, the United Water Conservation District's (UWCD) artificial recharge facilities located in the Oxnard forebay play an important role in recharging the aquifers underlying the Oxnard plain (United Water Conservation District, 2004). Percolation of irrigation return water also contributes to ground-water recharge, but varies across the study area.

Methods

Methods used for the GAMA program were selected to achieve the following objectives: (1) design a sampling plan suitable for statistical analysis, (2) collect samples in a consistent manner, (3) analyze samples using proven and reliable laboratory methods, (4) assure the quality of the ground-water data, and (5) maintain data securely and with relevant documentation. The [Appendix](#) to this report contains detailed descriptions of the sample collection protocols and analytical methods, and the quality-assurance methods.

Study Design

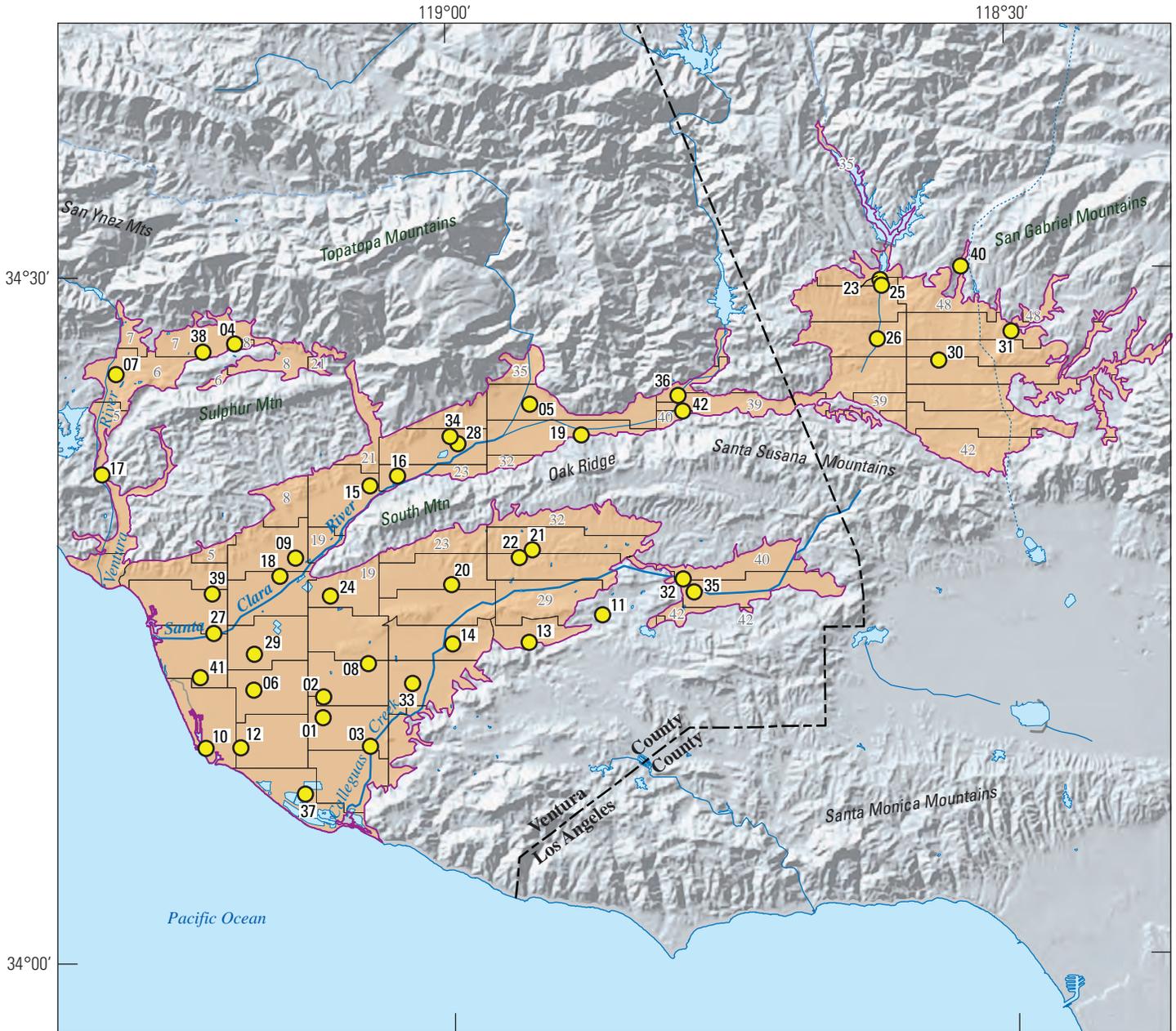
The wells selected for sampling in this study reflect the combination of two well selection strategies. Forty-two wells, referred to as grid wells ([fig. 3](#)), were selected to provide a statistically unbiased, spatially distributed assessment of the quality of ground-water resources used for public drinking-water supply, and 11 additional wells, referred to as understanding wells ([fig. 4](#)), were selected to provide greater sampling density in several areas to increase an understanding of specific ground-water quality issues in these areas. In addition to selecting 11 additional wells, four depth-dependent samples were collected from one of these eleven wells to address specific ground-water quality issues.



EXPLANATION

- Study unit boundary
- Water bodies
- Ground-water basins within the study unit (from California Department of Water Resources)
- Stream or river
- - - Aqueduct

Figure 2 The Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the ground-water basins defined by the California Department of Water Resources and major hydrologic features.



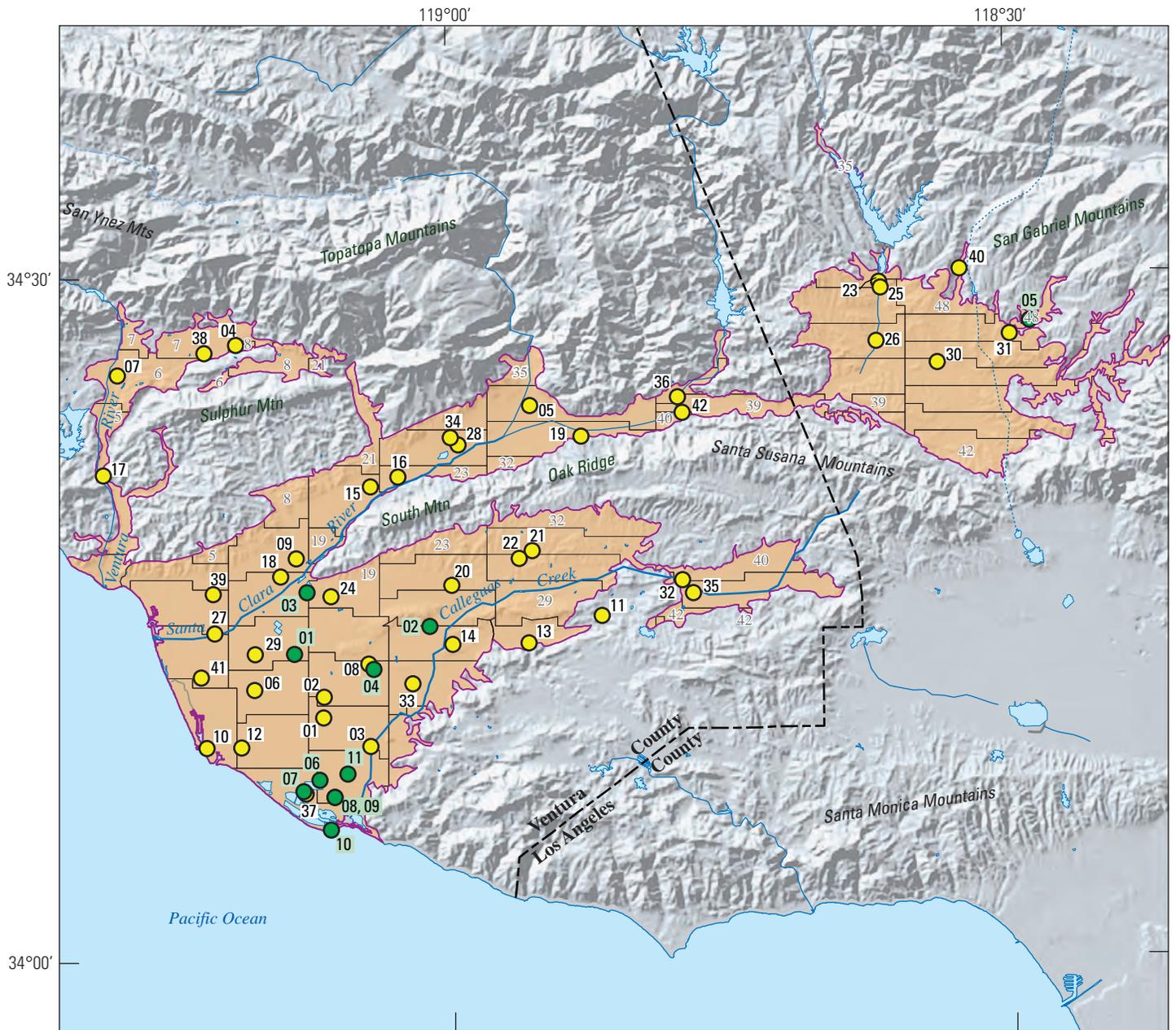
Shaded relief derived from U.S. Geological Survey National Elevation Dataset, 2006, Albers Equal Area Conic Projection



EXPLANATION

-  **Santa Clara study unit boundary**
-  **Randomized sampling grid cell**—Selected grid cell number indicates cell is continued across an area not included in the study unit
-  **Grid well and well number** (prefix “SCRV” is not shown) SCRV-11 was selected to represent grid cell number 29
-  **Water bodies**
-  **Stream or river**
-  **Aqueduct**

Figure 3. The Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of study area grid cells and the locations of sampled grid wells.



Shaded relief derived from U.S. Geological Survey National Elevation Dataset, 2006, Albers Equal Area Conic Projection



EXPLANATION

-  **Santa Clara study unit boundary**
-  **Randomized sampling grid cell**—Selected grid cell number indicates cell is continued across an area not included in the study unit
-  **Grid well and well number** (prefix “SCRV” is not shown) SCR-11 was selected to represent grid cell number 29
-  **Understanding well and well number** (prefix “SCRVU” is not shown)
-  **Water bodies**
-  **Stream or river**
-  **Aqueduct**

Figure 4. The Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of study area grid cells and the locations of sampled grid wells and understanding wells.

The spatially distributed wells were selected using a randomized grid-based method (Scott, 1990). The study area was subdivided into forty-eight grid cells each approximating 10 mi² (25 km²) (fig. 3). Locations of wells listed in statewide databases maintained by the CDPH and USGS were plotted. If a grid cell contained more than one public-supply well, each well was randomly assigned a rank. The lowest ranked well that met basic sampling criteria (for example, sample collection point before water treatment, capability to pump for several hours, and available well-construction information) and for which permission to sample could be obtained was then sampled. If a grid cell contained no accessible public-supply wells, domestic and irrigation wells were considered. An attempt was made to select domestic and irrigation wells having depths and screened intervals similar to those in public-supply wells in the area. In this fashion, a well was selected for a cell that had any wells to provide a spatially distributed, randomized monitoring network for each study area. Samples were collected from 42 of the 48 grid cells; the other 6 grid cells did not contain accessible wells. Grid wells in SCRIV were numbered in the order of sample collection, and the prefix “SCRIV” was appended to each number. One grid well (SCRIV-11) outside but near the randomized grid cell network was included in the study because the nearby grid cell had no accessible wells.

Many of the understanding wells sampled in the study unit were near the coastal area in the southwestern portion of the study area (fig. 4). Understanding wells were sampled to assess movement and source of salinity in ground-water in these areas. Understanding wells sampled as part of these studies for better understanding were not included in the statistical characterization of water quality in SCRIV because they were not selected using the randomized grid-based method. These additional wells were numbered in the order of sample collection, and the prefix “SCRIVU” (“U” indicating “understanding”) was appended to each number. Four depth-dependent ground-water samples were collected from one “understanding” well (SCRIVU-04). These samples were numbered in the order of sample collection and assigned the prefix “DD” (“DD” indicating depth-dependent sample).

Table 1 provides the GAMA-ID (alphanumeric identification number) for each well, along with the date sampled, sampling schedule, elevation, and well-construction information. Ground-water samples were collected from 28 public-supply wells, 15 irrigation wells, five monitoring wells, two dewatering wells, two standby wells, and one domestic well from April to June 2007.

Well locations and identifications were verified using Global Positioning System (GPS), 1:24,000 scale USGS topographic maps, comparison with existing well information in USGS and CDPH databases, and information provided by well owners. Driller’s logs for wells were obtained when available. Well information was recorded by hand on field sheets and electronically using specialized software on field laptop computers. All information was verified and then uploaded into the USGS National Water Information System (NWIS).

The wells in SCRIV were sampled using a tiered analytical approach. All wells were sampled for a standard set of constituents, including pH, dissolved oxygen, temperature, and specific conductance, VOCs, pesticides and pesticide degradates (NWQL Schedule 2003), potential wastewater-indicator compounds, perchlorate, stable isotopes of hydrogen and oxygen in water, dissolved noble gases, and tritium. The sampling schedule for a standard set of constituents was termed the “fast” schedule (table 2). Wells on the “intermediate” schedule were sampled for all the constituents on the fast schedule plus nutrients and dissolved organic carbon; major and minor ions and trace elements; stable isotopes of nitrogen and oxygen in nitrate; stable isotopes of chlorine and bromine; arsenic and iron abundance and speciation, and chromium abundance and speciation. Wells on the “slow” schedule were sampled for all the constituents on the intermediate schedule plus gasoline oxygenates and degradates, polar pesticides and pesticide degradates (NWQL Schedule 2060), pharmaceutical compounds, carbon isotopes, radioactive constituents, and microbial constituents. *Fast*, *intermediate*, and *slow* refer to the time required to sample the well for all the analytes on the schedule. Generally, one *slow*, or two *intermediate*, or three *fast* wells could be sampled in one day. The four depth-dependent samples were collected from one understanding well (SCRIVU-04) and were analyzed for major and minor ions and trace elements, and stable isotopes of hydrogen and oxygen in water. The deepest depth-dependent sample was also analyzed for stable isotopes of chlorine and bromine (table 2). In SCRIV, 27 of the 57 ground-water samples were collected on the fast schedule, 17 ground-water samples were collected on the intermediate schedule, 9 ground-water samples were collected on the slow schedule, and 4 depth-dependent samples were collected from SCRIVU-04 (table 1).

Sample Collection and Analysis

Samples were collected in accordance with the protocols established by the USGS National Water Quality Assessment (NAWQA) program (Koterba and others, 1995) and the USGS National Field Manual (U.S. Geological Survey, variously dated). These sampling protocols ensure that a representative sample of ground water is collected at each site and that the samples are collected and handled in a way that minimizes contamination. The methods used to collect samples are described in the Appendix section “[Sample Collection and Analysis](#)”.

Tables 3A–L list the compounds analyzed in each constituent class. Ground-water samples were analyzed for: 85 VOCs (table 3A), 8 gasoline oxygenates and degradates (table 3B); 63 pesticides and pesticide degradates (NWQL Schedule 2003) (table 3C); 69 potential wastewater-indicator compounds (table 3D); 14 pharmaceutical compounds (table 3E); and 59 polar pesticides and pesticide degradates (NWQL Schedule 2060) (table 3F); 1 constituent of special

interest (perchlorate) ([table 3G](#)); 5 nutrients and dissolved organic carbon ([table 3G](#)); 10 major and minor ions, and total dissolved solids, and 24 trace elements ([table 3H](#)); arsenic, iron, and chromium species ([table 3I](#)); stable isotopes of hydrogen and oxygen in water stable isotopes of nitrogen and oxygen in nitrate, stable isotopes of chlorine and bromine, 9 radioactive constituents, including tritium and carbon-14 ([table 3J](#)); 5 dissolved noble gases, helium stable isotope ratios ([table 3K](#)); and four microbial constituents ([table 3L](#)). The methods used for sample analysis are described in the Appendix section “[Sample Collection and Analysis](#)”.

Data Reporting

The methods and conventions used for reporting the data are described in the [Appendix](#). Twenty-two constituents analyzed in this study were measured by more than one method at the NWQL, but only the results from the preferred method are reported. Arsenic, iron, and chromium concentrations, and tritium activities, were measured by more than one laboratory, and both sets of results are reported.

Quality Assurance

The quality assurance methods used for this study follow the protocols used by USGS NAWQA program (Koterba and others, 1995) and are described in the USGS National Field Manual (U.S. Geological Survey, variously dated). The NWQL quality assurance plan followed by the NWQL, the primary laboratory used to analyze samples for this study, is described by Maloney (2005) and Pirkey and Glodt (1998). Quality-control (QC) samples collected in the SCRIV study include source-solution blanks, field blanks, an equipment blank, field replicates, matrix spikes, and surrogate spikes. QC samples were collected to evaluate contamination of the samples and bias and variability of the water chemistry data that may have resulted from collecting, processing, storing, transporting, and analyzing the samples in the laboratory. The quality assurance methods and quality-control sample results are described in the [Appendix](#).

Water-Quality Results

Results from analyses of raw (untreated) ground-water samples from SCRIV are given in [tables 4](#) through [16](#). Ground-water samples collected in SCRIV were analyzed for up to 350 constituents, and 240 of those constituents were not detected in any of the samples ([tables 3A–L](#)). The result tables ([tables 4–16](#)) give only the constituents that were detected, and list only wells in which at least one constituent was detected. For constituent classes that were analyzed for all of the grid wells, the tables include the number of wells at which each analyte was detected, the frequency at which it was

detected (in relation to the number of grid wells), and the total number of constituents detected at each well. Results from the understanding wells are given in the tables, but these results were excluded from the detection frequency calculations to avoid statistically over-representing the areas near the understanding wells.

[Table 4](#) includes water-quality indicators measured in the field and at the NWQL, while [tables 5](#) through [16](#) give the results of ground-water analyses organized by compound classes:

- Organic constituents
 - VOCs and gasoline oxygenates and degradates ([table 5](#))
 - Pesticides and pesticide degradates ([table 6](#))
 - Potential wastewater-indicator compounds ([table 7](#))
 - Constituent of special interest – perchlorate ([table 8](#))
- Inorganic constituents
 - Nutrients and dissolved organic carbon ([table 9](#))
 - Major and minor ions ([table 10](#))
 - Trace elements ([table 11](#))
 - Arsenic, iron, and chromium species ([table 12](#))
- Inorganic tracer constituents
 - Stable isotope ratios, and tritium and carbon-14 activities ([table 13](#))
 - Nitrogen and oxygen isotopes of nitrate ([table 13](#))
 - Noble gases and helium isotopes ([table 14](#))
 - Radioactive constituents ([table 15](#))
 - Microbial indicators ([table 16](#))

Results for pharmaceutical compounds are not presented in this report; they will be included in subsequent publications. The results of analyses of quality-control and ground-water samples are briefly described in the sections below. Health-based thresholds used to compare concentrations in ground-water samples also are described.

Quality-Control Sample Results

Results of quality-control analyses (blanks, replicates, matrix spikes, and surrogates) were used to evaluate the quality of the data for the ground-water samples (see [Appendix](#)). Assessing the blanks resulted in qualifying of less than 0.1 percent of the data for the ground-water samples. Matrix spike recoveries for a number of organic constituents were lower than the acceptable limits, which may indicate that these constituents might not have been detected in samples if they were present at very low concentrations. The quality-control results are described in the Appendix section “[Quality-Control Sample Results](#)”.

Comparison Thresholds

Concentrations of constituents in ground-water samples were compared with CDPH and USEPA drinking-water health-based thresholds and thresholds established for aesthetic purposes (U.S. Environmental Protection Agency, 2006, 2007a; California Department of Public Health, 2007a). CDPH replaced California Department of Health Services (CDHS) on July 1, 2007. The chemical and microbial data presented in this report characterize the quality of the untreated ground-water resources within SCRVA and are not intended to represent the treated drinking water delivered to consumers by water purveyors. The chemical and microbial composition of treated drinking water may differ from untreated ground water because treated drinking water may be disinfected, filtered, mixed with other waters, and exposed to the atmosphere before being delivered to consumers.

The following thresholds were used for comparisons:

- **MCL – Maximum Contaminant Level.** Legally enforceable standards that apply to public-water systems and are designed to protect public health by limiting the levels of contaminants in drinking water. MCLs established by the USEPA are the minimum standards with which states are required to comply, and individual states may choose to set more stringent standards. CDPH has established MCLs for constituents not regulated by the USEPA, as well as lowered the threshold concentration for a number of constituents with MCLs established by the USEPA. In this report, a threshold set by the USEPA and adopted by CDPH is labeled “MCL-US,” and one set by CDPH that is more stringent than the MCL-US is labeled “MCL-CA.” CDPH is notified when constituents are detected at concentrations exceeding MCL-US or MCL-CA thresholds in public supply well samples collected for the GAMA Statewide Basin Assessment project.
- **AL – Action Level.** Legally enforceable standards that apply to public water systems and are designed to protect public health by limiting the levels of copper and lead in drinking water. Concentrations of copper or lead above the action-level thresholds trigger requirements for mandatory water treatment to reduce the corrosiveness of water to water pipes. The action levels established by the USEPA and CDPH are the same, thus the thresholds are labeled “AL-US” in this report.
- **TT – Treatment Technique.** Legally enforceable standards that apply to public-water systems and are designed to protect public health by limiting the levels of microbial constituents in drinking water. Concentrations of microbial constituents above the treatment-technique thresholds trigger requirements

for additional mandatory disinfection during water treatment. The action levels established by the USEPA and CDPH are the same; thus the thresholds are labeled “TT-US” in this report.

- **SMCL – Secondary Maximum Contaminant Level.** Non-enforceable standards applied to constituents that affect the aesthetic qualities of drinking water, such as taste, odor, and color, or technical qualities of drinking water, such as scaling and staining. Both the USEPA and CDPH define SMCLs, but unlike MCLs, SMCLs established by CDPH are not required to be at least as stringent as those established by USEPA. SMCLs established by CDPH (SMCL-CA) are used in this report for all constituents that have SMCL-CA values. The SMCL-US is used for pH because no SMCL-CA for pH has been defined.
- **NL – Notification Level.** Health-based notification levels established by CDPH for some of the constituents in drinking water that lack MCLs (NL-CA). If a constituent is detected above its NL-CA, California state law requires timely notification of local governing bodies and recommends consumer notification.
- **HAL – Lifetime Health Advisory Level.** The maximum concentration of a constituent at which its presence in drinking water is not expected to cause any adverse carcinogenic effects for a lifetime of exposure. HALs are established by the USEPA (HAL-US) and are calculated assuming consumption of 2 liters of water per day over a 70-year lifetime by a 70-kilogram (154-pound) adult and that 20 percent of a person’s exposure comes from drinking water.
- **RSD5 – Risk-Specific Dose.** The concentration of a constituent in drinking water corresponding to an excess estimated lifetime cancer risk of 1 in 100,000. RSD5 is an acronym for risk-specific dose at 10^{-5} . RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by ten (RSD5-US).

For constituents having MCLs, concentrations in ground-water samples were compared to the MCL-US or MCL-CA. If a constituent had an SMCL, its concentration was compared to the SMCL-CA. For chloride, sulfate, specific conductance, and total dissolved solids, CDPH defines a “recommended” and an “upper” SMCL-CA; concentrations of these constituents in ground-water samples were compared with both levels. The SMCL-US for these constituents corresponds to the recommended SMCL-CA. Detected concentrations of constituents that lack an MCL or SMCL were compared to the NL-CA. For constituents that lack an MCL, SMCL, or NL-CA, detected concentrations were compared to the

HAL-US. For constituents that lack an MCL, SMCL, NL-CA, or HAL-US, detected concentrations were compared to the RSD5-US. Note that the result of using this hierarchy to select comparison thresholds for constituents that have multiple types of established thresholds may not be the threshold that has the lowest concentration. The comparison thresholds used in this report are listed in [tables 3A–L](#) for all constituents and in [tables 4-16](#) for constituents detected in ground-water samples from SCR. Not all constituents analyzed for this study have established thresholds available. Detections of constituents at concentrations greater than the selected comparison threshold are marked with asterisks in [tables 4-16](#).

Ground-Water-Quality Data

Field Parameters

Field and laboratory measurements of dissolved oxygen, pH, specific conductance, alkalinity, and associated parameters (turbidity and water temperature) are presented in [table 4](#). Dissolved oxygen and alkalinity are used as indicators of natural processes that control water chemistry. Specific conductance is the electrical conductivity unit for water and is proportional to amount of total dissolved solids (TDS) in the water. The pH value indicates the acidity or basicity of the water. Twenty-nine of 41 grid wells had specific conductance field values above the recommended SMCL-CA, and of these 29 grid wells, 8 were above the upper SMCL-CA. The specific conductance was not measured at one grid well because of a malfunctioning field meter. The specific conductance of samples was measured in the laboratory and in the field, but the field measurement is preferred. No wells had pH values outside of the SMCL-US range for pH.

Organic Constituents

Volatile organic compounds (VOC) are in paints, solvents, fuels, fuel additives, refrigerants, fumigants, and disinfected water, and are characterized by their tendency to evaporate. VOCs generally persist longer in ground water than in surface water because ground water is isolated from the atmosphere. Of the 85 VOCs analyzed, 18 were detected in ground-water samples; all concentrations were below health-based thresholds, and most were several orders of magnitude below the thresholds ([table 5](#)). One or more VOCs were detected in 13 of the 42 grid wells. The only VOC detected in more than 10 percent of grid wells was chloroform, a byproduct of disinfecting drinking-water.

Pesticides include herbicides, insecticides, and fungicides and are used to control weeds, insects, fungi, and other pests in agricultural, urban, and suburban settings. Of the 122 pesticide or pesticide degradates analyzed, 13 were detected. Five of the 13 pesticides detected had established health-based thresholds, and all detections were below their established health-based

thresholds ([table 6](#)). One or more pesticide compounds were detected in 13 of the 42 grid wells sampled. Three pesticides compounds were detected in more than 10 percent of samples from grid wells: the herbicides atrazine and simazine, and a degradate of atrazine. These three compounds are among the most commonly detected pesticide compounds in ground water nationally (Gilliom and others, 2006).

The potential wastewater-indicator compounds were collected at all 42 grid wells. Potential wastewater-indicator compounds include a wide variety of constituents. Compounds analyzed include cotinine (primary nicotine metabolite), *p*-cresol (wood preservative), and menthol (cigarettes, cough drops, liniment, mouthwash) ([table 3D](#)). Although these compounds may indicate the presence of wastewater, they have other sources also. Of the 69 potential wastewater-indicator compounds analyzed, 10 were detected. One or more potential wastewater-indicator compounds were detected in 10 of the 42 grid wells sampled ([table 7](#)). Of the ten compounds detected, phenol was the only compound having an established health-based threshold. Phenol was detected in one understanding well at a concentration four orders of magnitude below the health based-threshold. Each of the detected potential wastewater-indicator compounds was detected in less than 10 percent of the 42 grid wells ([table 7](#)).

Constituent of Special Interest

Perchlorate is a constituent of special interest in California because it may adversely affect water-quality and recently has been found in water supplies (California Department of Health Services, 2007b). Perchlorate was detected in 5 of the 42 grid wells sampled, and all concentrations measured in SCR wells were below the MCL-CA threshold of 6 µg/L ([table 8](#)). Perchlorate was not detected in any of the understanding wells.

Inorganic Constituents

Unlike the organic constituents, most of the inorganic constituents are naturally present in ground water, although their concentrations may be influenced by human activities. Samples to be analyzed for inorganic constituent were collected at all 17 intermediate and 9 slow wells, of which 16 were grid wells and 10 were understanding wells. Although dissolved organic carbon is an organic constituent it is included in this section. Depth-dependent samples are not included in the discussion of results.

Nutrients (nitrogen and phosphorus) and dissolved organic carbon in ground water can affect biological activity in aquifers and in surface-water bodies that receive ground-water discharge. Nitrogen may be present in the form of ammonia, nitrite, or nitrate, depending on the oxidation-reduction state of the ground water. High concentrations of nitrate can adversely affect human health, particularly the health of

infants. Nutrients, nitrogen and phosphorus, and the dissolved organic carbon were measured in 16 grid wells ([table 9](#)). The concentrations of nitrite plus nitrate were detected above the health-based threshold in five SCRIV grid wells. The concentration of ammonia measured in samples from SCRIV wells were below health-based thresholds.

The major-ion composition, total dissolved solids (TDS) content, and levels of certain trace elements in ground water affect the aesthetic properties of water, such as taste, color, and odor, and the technical properties, such as scaling and staining. Although there are no adverse health effects associated with these properties, they may reduce consumer satisfaction with the water or may have economic impacts. CDPH has established non-enforceable thresholds (SMCL-CAs) that are based on aesthetic or technical properties rather than health-based concerns for sulfate, chloride, TDS, and several trace elements.

Sulfate concentrations were measured in samples from 17 intermediate and 9 slow SCRIV wells, of which 16 were grid wells and 10 were understanding wells. Sulfate concentrations were measured above the recommended SMCL-CA threshold of 250 mg/L from samples in 19 wells; of these, 10 had sulfate concentrations above the upper SMCL-CA threshold of 500 mg/L ([table 10](#)). Chloride concentrations were measured in samples from 17 intermediate and 9 slow SCRIV wells, of which 16 were grid wells and 10 were understanding wells. Chloride concentrations were measured above the recommended SMCL-CA threshold of 250 mg/L from samples in 7 wells; of these, 4 wells had chloride concentrations above the upper SMCL-CA threshold of 500 mg/L. Samples collected from all 26 SCRIV wells had total dissolved solids (TDS) concentrations above the recommended SMCL-CA threshold of 500 mg/L; of these, 18 wells contained TDS concentrations above the upper SMCL-CA threshold of 1,000 mg/L.

Eighteen of the 24 trace elements analyzed in samples from SCRIV wells have health-based thresholds. Of the possible 24 trace elements, 22 were detected ([table 11](#)). Five trace elements were reported above their respective thresholds: barium, boron, iron, manganese, and strontium. Iron and manganese were reported above their respective SMCL-US thresholds in 7 and 14 SCRIV wells, respectively. Iron and manganese are trace elements whose concentrations are affected by the oxidation-reduction state of the ground water. Precipitation of minerals containing iron or manganese may stain surfaces orange, brown, or black.

Arsenic, iron, and chromium exist as different species, depending on the oxidation-reduction state of the ground water. The oxidized and reduced species have different solubility in ground water, and may have different effects on human health. The relative proportions of the oxidized and the reduced species of each element can be used to help interpret the oxidation-reduction state of the aquifer. Concentrations of total arsenic, iron, and chromium, and the concentrations of either the reduced or the oxidized species of each element

were analyzed at the USGS Trace Metal Laboratory (TML) and are given in [table 12](#). The concentration of the other species can be calculated by the difference from the total. The concentrations of arsenic, iron, and chromium given in [table 12](#) may be different than those given in [table 11](#) because different analytical methods were used (see Appendix, [table A1](#)). On the basis of the analytical method used, the concentrations of arsenic, iron, and chromium, reported on [table 11](#) are considered to be more accurate. In general, the iron in the SCRIV ground-water samples in which the iron concentrations were elevated ([table 12](#)) existed in the reduced (Fe-II) state ([table 13](#))

Inorganic Tracer Constituents

Stable-isotope ratios, tritium and carbon-14 activities, stable isotopes of nitrate, and noble gas concentrations can be used as tracers of natural processes affecting ground-water composition. Hydrogen and oxygen stable isotope ratios of water ([table 13](#)) can be used to help interpret ground-water recharge sources. The stable isotope ratios of water depend on the altitude, latitude, and temperature of precipitation and on the extent of evaporation of surface water or soil water. Stable-isotope ratios of nitrogen and oxygen of dissolved nitrate can be used to help interpret sources and processes affecting these solutes in aquifers. Noble-gas concentrations ([table 14](#)) can be used to help interpret ground-water recharge sources because the concentrations of the different noble gases depend on water temperature.

Tritium activities ([tables 13](#)), carbon-14 activities ([table 13](#)), and helium isotope ratios ([table 14](#)) can provide information about the age of the ground-water. Tritium is a radioactive isotope of hydrogen that is continuously produced, albeit at low levels (or background levels), by the interaction of cosmic radiation with the Earth's atmosphere where it becomes part of the water molecule. However, a large amount of tritium was produced by atmospheric testing of nuclear weapons between 1952 and 1963. Thus, concentrations of tritium in water above background levels generally indicate that the water was recharged since the early 1950s. Helium isotope ratios can be used with tritium concentrations to estimate ages for young ground water.

Carbon-14 is a radioactive isotope of carbon that is incorporated into dissolved carbonate species in water. Low levels of carbon-14 are continuously produced by interaction of cosmic radiation with the Earth's atmosphere, and incorporated into atmospheric carbon dioxide. The carbon dioxide dissolves in precipitation, surface water, and ground water exposed to the atmosphere, thereby entering the hydrologic cycle. Because carbon-14 decays with a half-life of approximately 5,700 years, low activities (or low percent modern [[table 13](#)]) of carbon-14 generally indicate presence of ground water that is at least several thousand years old.

A total of 17 samples were collected to be analyzed for the stable isotopes chlorine-37 and bromine-81 (table 13). Analyzing for these two isotopes in conjunction may improve the understanding of the origin and movement of saline ground-water.

Of the inorganic tracer constituents analyzed for this study, the only one that has a health-based threshold is tritium. All measured tritium activities in samples from SCR V wells were well below the established MCL-CA (table 13).

Radioactive Constituents

Radioactivity is the release of energy or energetic particles during changes in the structure of the nucleus of an atom. Most of the radioactivity in ground water comes from decay of naturally-occurring isotopes of uranium and thorium in minerals in the sediments or fractured rocks of the aquifer. Uranium and thorium decay in a series of steps, eventually forming stable isotopes of lead. Radium-226, radium-228, and radon-222 are radioactive isotopes formed during the uranium or thorium decay series. In each step in the decay series, one radioactive element turns into a different radioactive element by emitting an alpha particle (two protons and two neutrons) or a beta particle (electron or positron) from its nucleus. For example, radium-226 emits an alpha particle and therefore turns into radon-222. Radium-228 emits a beta particle to form actinium-228. The alpha and beta particles emitted during radioactive decay are hazardous to human health because these energetic particles may damage cells. Radiation damage to cell DNA increases the risk of getting cancer.

Activity is often used instead of concentration for reporting the presence of radioactive constituents. Activity of radioactive constituents in ground water is measured in units of picocuries per liter (pCi/L), and one picocurie equals approximately two atoms decaying per minute. The number of atoms decaying is equal to the number of alpha or beta particles emitted.

Groundwater samples from 9 slow wells (5 grid wells and 4 understanding wells) were analyzed for the radioactive constituents: radium-226, radium-228, radon-222, gross alpha radioactivity (72-hour and 30-day count), and gross beta radioactivity (72-hour and 30-day counts) (table 15). The SCR V wells that were analyzed for radioactive constituents had activities of radium-226, radium-228, and gross beta radioactivity less than established health-based standards. The gross alpha radioactivity (72-hour count) in one SCR V grid well was slightly above the established health-based threshold of 15 pCi/L; the gross alpha radioactivity (30-day count) in one SCR V understanding well was slightly above the established health-based threshold of 15 pCi/L. Activities of radon-222 in samples from six SCR V wells were above the proposed MCL-US of 300 pCi/L; however, no sample had an activity that was above the proposed alternative MCL-US of 4,000 pCi/L.

Microbial Indicators

Water is disinfected during drinking-water treatment to prevent diseases that may be spread by water-borne microbial constituents derived from human or animal wastes. Most of the specific viruses and bacteria responsible for diseases were not measured because routine analytical methods are not available. Measurements are made of microbial constituents that are more easily analyzed and serve as indicators of human or animal waste in water. Drinking water purveyors respond to detections of microbial indicators by applying additional disinfection techniques to the water.

Ground-water samples from 9 slow wells were analyzed for microbial indicators (table 16). No samples from the 9 slow wells contained the viral indicators F-specific coliphage and somatic coliphage, or the bacterial indicator *Escherichia coli* (*E. coli*). Low levels of the bacterial indicator total coliforms were detected in two understanding wells. The threshold for total coliforms in public-supply wells is based on recurring detections; the wells in which they were detected were non-public-supply wells.

Future Work

Subsequent reports will be focused on assessment of the data shown presented in this report using a variety of statistical, qualitative, and quantitative approaches to evaluate the natural and human factors affecting ground-water quality. Water-quality data contained in the CDPH and USGS NWIS databases, and water-quality data available from other State and local water agencies will be compiled, evaluated, and used in combination with the data presented in this report; the results of these efforts will be presented in future publications.

Summary

Ground-water quality in the approximately 460-square-mile Santa Clara River Valley study unit (SCR V) was investigated from April to June 2007 as part of the Priority Basin project of Ground-Water Ambient Monitoring and Assessment (GAMA) Program. The California State Water Resources Control Board (SWRCB), in collaboration with the U.S. Geological Survey (USGS) and the Lawrence Livermore National Laboratory, is implementing the GAMA Program (<http://www.waterboards.ca.gov/gama/>). The Priority Basin project was designed by the SWRCB and the USGS in response to the Ground-Water Quality Monitoring Act of 2001 (Belitz and others, 2003; State Water Resources Control Board, 2003). The project is a comprehensive assessment of statewide ground-water quality designed to identify and characterize risks to ground-water resources, and to increase the availability of information about ground-water quality to the public. SCR V was the seventeenth study unit sampled as part of the project.

SCRV is located in the northwest part of the Transverse Ranges and Selected Peninsular Ranges hydrogeologic province and includes eight ground-water basins as defined by the California Department of Water Resources (California Department of Water Resources, 2003). Forty-two wells were selected using a randomized grid-based method to provide statistical representation of the study area (grid wells). Eleven wells (understanding wells) were selected to further evaluate water chemistry in particular parts of the study area, and four depth-dependent ground-water samples were collected from one of the eleven understanding wells to help understand the relation between water chemistry and depth.

Ground-water samples were analyzed for VOCs, pesticides and pesticide degradates, potential wastewater-indicator compounds, pharmaceutical compounds, nutrients, major and minor ions, trace elements, radioactivity, and microbial indicators. Naturally occurring isotopes (stable isotopes of hydrogen, oxygen, nitrogen, and carbon, chlorine, bromine, and activities of tritium and carbon-14) and dissolved gases also were measured to help interpret the source and age of the sampled ground water. This report describes the hydrogeologic setting of the SCRIV region, the sampling, analytical, and quality-assurance methods used in the study, and the results of the chemical and microbial analyses of the ground-water samples collected from April to June 2007.

Quality-control samples (blanks or replicates, or samples for matrix spikes) were collected at approximately 26 percent of the wells, and the results for these samples were used to evaluate the quality of the data for the ground-water samples. Assessment of the data derived from the blank samples resulted in censoring less than 0.1 percent of the ground-water quality data.

This study did not attempt to evaluate the quality of water delivered to consumers; after withdrawal from the ground, water typically is treated, disinfected, and blended with other waters to maintain acceptable water quality. Regulatory thresholds apply to treated water that is served to the consumer, not to raw ground water. However, to provide some context for the results, concentrations of constituents measured in the raw ground water were compared with regulatory and non-regulatory thresholds established by the U.S. Environmental Protection Agency (USEPA) and California Department of Public Health (CDPH).

VOCs, pesticides and pesticide degradates, and potential wastewater-indicator compounds were detected in about 33 percent or less of the 42 SCRIV grid wells. All concentrations of organic constituents were below established health-based thresholds. Perchlorate was detected in approximately 12 percent of the SCRIV grid wells; all concentrations were below the NL-CA threshold. The concentration of total dissolved solids (TDS) was above the upper SMCL-CA threshold in 18 of the 26 SCRIV wells sampled for TDS. The concentration of sulfate was above the upper SMCL-CA threshold in 10 of the 26 SCRIV wells

sampled for sulfate. The concentration of nitrite plus nitrate was above the health-based threshold in 5 of the 26 SCRIV wells sampled for nitrite plus nitrate. Chloride was above the upper SMCL-CA threshold in 5 of 26 wells sampled for chloride. Iron and manganese were above their respective SMCL-US thresholds in 7 and 14 SCRIV wells, respectively. The gross alpha radioactivity (72-hour count) for one SCRIV grid well was slightly above the established health-based threshold; the gross alpha radioactivity (30-day count) for one SCRIV understanding well was slightly above the established health-based threshold. Activities of radon-222 in samples from 6 wells were above the proposed MCL-US of 300 pCi/L, but below the alternative MCL-US of 4,000 pCi/L.

Subsequent reports will present analyses of the data in this report using a variety of statistical, qualitative, and quantitative approaches to assess the natural and human factors affecting ground-water quality.

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20 Ground-Water Quality Data in the Santa Clara River Valley Study Unit, 2007: Results from the California GAMA Program

Table 1. Identification, sampling, and construction information for wells sampled for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Sampling schedules are described in [table 2](#). **GAMA identification No.:** SCR.V, Santa Clara River Valley study unit grid well; SCR.VU, Santa Clara River Valley study unit understanding well; DD, depth-dependent sample. Land-surface datum (LSD) is a datum plane that is approximately at land surface at each well. The elevation of the LSD is described in feet above the North American Vertical Datum 1988 (NAVD 88). **Abbreviations:** ft, foot; na, data not available]

GAMA identification no.	Sampling information			Well type	Construction information		
	Date (mm/dd/yy)	Sampling schedule	Elevation of LSD (ft above NAVD 88)		Well depth (ft below LSD)	Top perforation (ft below LSD)	Bottom perforation (ft below LSD)
Grid wells							
SCR.V-01	4/2/07	Fast	35	Production	1,300	590	1,280
SCR.V-02	4/2/07	Fast	46	Production	1,310	750	1,290
SCR.V-03	4/2/07	Slow	24	Production	1,023	443	1,003
SCR.V-04	4/3/07	Intermediate	1,036	Production	na	na	na
SCR.V-05	4/3/07	Fast	447	Production	300	50	280
SCR.V-06	4/4/07	Intermediate	57	Production	220	120	220
SCR.V-07	4/4/07	Slow	590	Production	242	92	232
SCR.V-08	4/4/07	Fast	95	Production	910	700	890
SCR.V-09	4/5/07	Intermediate	191	Production	863	703	863
SCR.V-10	4/5/07	Slow	7	Production	766	610	738
SCR.V-11	4/9/07	Fast	587	Production	636	316	636
SCR.V-12	4/9/07	Slow	20	Production	1,200	720	1,180
SCR.V-13	4/9/07	Fast	233	Production	399	204	375
SCR.V-14	4/9/07	Fast	252	Production	830	512	740
SCR.V-15	4/10/07	Fast	254	Production	670	452	653
SCR.V-16	4/10/07	Intermediate	283	Production	700	260	700
SCR.V-17	4/11/07	Fast	253	Production	60	15	60
SCR.V-18	4/11/07	Fast	162	Production	420	300	400
SCR.V-19	4/11/07	Intermediate	473	Production	100	na	na
SCR.V-20	4/12/07	Fast	377	Production	1,440	800	1,440
SCR.V-21	4/12/07	Fast	613	Production	980	650	na
SCR.V-22	4/12/07	Fast	588	Production	980	670	980
SCR.V-23	4/16/07	Fast	1,142	Production	na	na	na
SCR.V-24	4/16/07	Fast	222	Production	1,042	642	1,042
SCR.V-25	4/16/07	Fast	1,135	Production	203	60	165
SCR.V-26	4/16/07	Fast	1,033	Production	142	na	na
SCR.V-27	4/16/07	Intermediate	61	Production	873	403	853
SCR.V-28	4/17/07	Intermediate	446	Production	334	105	240
SCR.V-29	4/17/07	Fast	81	Production	252	107	na
SCR.V-30	4/17/07	Fast	1,121	Production	208	na	na
SCR.V-31	4/18/07	Fast	1,353	Production	150	56	150
SCR.V-32	4/18/07	Fast	725	Production	300	50	230
SCR.V-33	4/18/07	Intermediate	122	Production	504	224	504
SCR.V-34	4/19/07	Fast	615	Production	920	500	920
SCR.V-35	4/19/07	Slow	767	Production	300	70	290
SCR.V-36	4/19/07	Fast	690	Production	300	na	na
SCR.V-37	5/8/07	Intermediate	9	Production	541	421	521
SCR.V-38	5/14/07	Fast	802	Production	644	281	644
SCR.V-39	5/14/07	Intermediate	247	Production	1,190	580	1,080
SCR.V-40	5/15/07	Fast	1,400	Production	na	na	na
SCR.V-41	5/16/07	Fast	35	Production	300	na	na
SCR.V-42	6/6/07	Intermediate	641	Production	275	110	275

Table 1. Identification, sampling, and construction information for wells sampled for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[Sampling schedules are described in [table 2](#). **GAMA identification No.:** SCRUV, Santa Clara River Valley study unit grid well; SCRUVU, Santa Clara River Valley study unit understanding well; DD, depth-dependent sample. Land-surface datum (LSD) is a datum plane that is approximately at land surface at each well. The elevation of the LSD is described in feet above the North American Vertical Datum 1988 (NAVD 88). **Abbreviations:** ft, foot; na, data not available]

GAMA identification no.	Sampling information			Well type	Construction information		
	Date (mm/dd/yy)	Sampling schedule	Elevation of LSD (ft above NAVD 88)		Well depth (ft below LSD)	Top perforation (ft below LSD)	Bottom perforation (ft below LSD)
Understanding wells							
SCRUVU-01	4/3/07	Slow	76	Production	820	400	820
SCRUVU-02	4/10/07	Slow	210	Production	759	459	759
SCRUVU-03	4/11/07	Slow	144	Production	330	100	320
SCRUVU-04	4/12/07	Slow	92	Production	1,483	403	1,463
DD-01	6/7/07	Depth-dependent	92	Production	¹ 790	na	na
DD-02	6/7/07	Depth-dependent	92	Production	¹ 830	na	na
DD-03	6/7/07	Depth-dependent	92	Production	¹ 970	na	na
DD-04	6/7/07	Depth-dependent	92	Production	¹ 1,130	na	na
SCRUVU-05	4/18/07	Fast	1,443	Production	na	na	na
SCRUVU-06	5/7/07	Intermediate	14	Monitoring	740	na	na
SCRUVU-07	5/8/07	Intermediate	13	Monitoring	720	680	720
SCRUVU-08	5/9/07	Intermediate	14	Monitoring	640	600	640
SCRUVU-09	5/9/07	Intermediate	14	Monitoring	970	930	970
SCRUVU-10	5/10/07	Intermediate	12	Monitoring	220	200	220
SCRUVU-11	5/16/07	Intermediate	14	Production	810	400	810

¹ Depth below land surface where depth-dependent sample was collected.

22 Ground-Water Quality Data in the Santa Clara River Valley Study Unit, 2007: Results from the California GAMA Program

Table 2. Classes of chemical and microbial constituents and water-quality indicators collected for the slow, intermediate, fast, and depth-dependent well sampling schedules for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Abbreviations: NWQL, National Water-Quality Laboratory]

Analyte classes	Sampling schedule				Table	
	Slow	Intermediate	Fast	Depth-dependent schedule	Analyte list	Results
Water-quality indicators						
pH, dissolved oxygen, temperature, specific conductance	X	X	X	X ¹		4
Alkalinity and turbidity	X					4
Organic constituents						
Volatile organic compounds	X	X	X		3A	5
Gasoline oxygenates and degradates	X				3B	5
Pesticides and pesticide degradates (NWQL schedule 2003)	X	X	X		3C	6
Potential wastewater-indicator compounds	X	X	X		3D	7
Polar pesticides and pesticide degradates (NWQL schedule 2060)	X				3F	6
Dissolved organic carbon	X	X			3G	9
Constituent of special interest						
Perchlorate	X	X	X		3G	8
Inorganic constituents						
Nutrients	X	X			3G	9
Major and minor ions	X	X		X	3H	10
Trace elements	X	X		X	3H	11
Chromium abundance and speciation	X	X			3I	12
Arsenic and iron abundances and speciation	X	X			3I	12
Stable isotopes						
Stable isotopes of hydrogen and oxygen in water	X	X	X	X	3J	13
Stable isotopes of nitrogen and oxygen in nitrate	X	X			3J	13
Stable isotopes of carbon and carbon-14 abundance	X				3J	13
Stable isotopes of chlorine and bromine	X	X ²		X ³	3J	13
Radioactivity and gases						
Tritium	X	X	X		3J	13
Tritium and noble gases	X	X	X		3K	14
Radium isotopes	X				3J	15
Radon-222	X				3J	15
Gross alpha and gross beta radiation	X				3J	15
Microbial constituents						
F-specific coliphage	X				3L	16
Somatic coliphage	X				3L	16
<i>Escherichia coli</i>	X				3L	16
Total coliform	X				3L	16
Additional analytes collected, but not included in this report						
Pharmaceutical compounds	X				3E	

¹ Dissolved oxygen not collected.

² Collected at 7 of the 15 intermediate wells.

³ Only collected for the deepest sample (DD-04).

Table 3A. Volatile organic compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2020.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. CAS number: This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CASRN through CAS Client ServicesSM. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10⁻⁵. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level. THM, trihalomethane; D, detected in ground-water sample (table 5); na, not available; µg/L, microgram per liter; -, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Acetone	Solvent	81552	67-64-1	6	na	na	-
Acrylonitrile	Organic synthesis	34215	107-13-1	0.4	RSD5-US	0.6	-
<i>tert</i> -Amyl methyl ether (TAME)	Gasoline oxygenate	50005	994-05-8	0.04	na	na	-
Benzene	Gasoline hydrocarbon	34030	71-43-2	0.016	MCL-CA	1	D
Bromobenzene	Solvent	81555	108-86-1	0.02	na	na	-
Bromochloromethane	Fire retardant	77297	74-97-5	0.06	HAL-US	90	D
Bromodichloromethane	Disinfection by-product (THM)	32101	75-27-4	0.04	MCL-US	180	D
Bromoform (Tribromomethane)	Disinfection by-product (THM)	32104	75-25-2	0.08	MCL-US	180	D
Bromomethane (Methyl bromide)	Fumigant	34413	74-83-9	0.4	HAL-US	10	-
<i>n</i> -Butylbenzene	Gasoline hydrocarbon	77342	104-51-8	0.14	NL-CA	260	-
<i>sec</i> -Butylbenzene	Gasoline hydrocarbon	77350	135-98-8	0.04	NL-CA	260	-
<i>tert</i> -Butylbenzene	Gasoline hydrocarbon	77353	98-06-6	0.08	NL-CA	260	-
Carbon disulfide	Organic synthesis	77041	75-15-0	0.06	NL-CA	160	D
Carbon tetrachloride (Tetrachloromethane)	Solvent	32102	56-23-5	0.08	MCL-CA	0.5	D
Chlorobenzene	Solvent	34301	108-90-7	0.02	MCL-CA	70	-
Chloroethane	Solvent	34311	75-00-3	0.1	na	na	-
Chloroform (Trichloromethane)	Disinfection by-product (THM)	32106	67-66-3	0.04	MCL-US	180	D
Chloromethane	Refrigerant/organic synthesis	34418	74-87-3	0.1	HAL-US	30	-
3-Chloropropene	Organic synthesis	78109	107-05-1	0.08	na	na	-
2-Chlorotoluene	Solvent	77275	95-49-8	0.04	NL-CA	140	-
4-Chlorotoluene	Solvent	77277	106-43-4	0.04	NL-CA	140	-
Dibromochloromethane	Disinfection by-product (THM)	32105	124-48-1	0.12	MCL-US	180	D
1,2-Dibromo-3-chloropropane (DBCP)	Fumigant	82625	96-12-8	0.5	MCL-US	0.2	-
1,2-Dibromoethane (EDB)	Fumigant	77651	106-93-4	0.04	MCL-US	0.05	-
Dibromomethane	Solvent	30217	74-95-3	0.04	na	na	D
1,2-Dichlorobenzene	Solvent	34536	95-50-1	0.04	MCL-CA	600	-
1,3-Dichlorobenzene	Solvent	34566	541-73-1	0.04	HAL-US	600	-
1,4-Dichlorobenzene	Fumigant	34571	106-46-7	0.04	MCL-CA	5	-
<i>trans</i> -1,4-Dichloro-2-butene	Organic synthesis	73547	110-57-6	0.6	na	na	-
Dichlorodifluoromethane (CFC-12)	Refrigerant	34668	75-71-8	0.14	NL-CA	1,000	-
1,1-Dichloroethane (1,1-DCA)	Solvent	34496	75-34-3	0.06	MCL-CA	5	-
1,2-Dichloroethane (1,2-DCA)	Solvent	32103	107-06-2	0.1	MCL-CA	0.5	-
1,1-Dichloroethene (1,1-DCE)	Organic synthesis	34501	75-35-4	0.02	MCL-CA	6	-
<i>cis</i> -1,2-Dichloroethene (<i>cis</i> -1,2-DCE)	Solvent	77093	156-59-2	0.02	MCL-CA	6	-
<i>trans</i> -1,2-Dichloroethene (<i>trans</i> -1,2-DCE)	Solvent	34546	156-60-5	0.018	MCL-CA	10	D
1,2-Dichloropropane	Fumigant	34541	78-87-5	0.02	MCL-US	5	-
1,3-Dichloropropane	Fumigant	77173	142-28-9	0.06	na	na	-
2,2-Dichloropropane	Fumigant	77170	594-20-7	0.06	na	na	-
1,1-Dichloropropene	Organic synthesis	77168	563-58-6	0.04	na	na	-
<i>cis</i> -1,3-Dichloropropene	Fumigant	34704	10061-01-5	0.06	RSD5-US	24	-
<i>trans</i> -1,3-Dichloropropene	Fumigant	34699	10061-02-6	0.1	RSD5-US	24	-
Diethyl ether	Solvent	81576	60-29-7	0.08	na	na	-
Diisopropyl ether (DIPE)	Gasoline oxygenate	81577	108-20-3	0.06	na	na	-

Table 3A. Volatile organic compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2020.—Continued

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. CAS number: This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CASRN through CAS Client ServicesSM. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10⁻⁵. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level. THM, trihalomethane; D, detected in ground-water sample (table 5); na, not available; µg/L, microgram per liter; –, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Ethylbenzene	Gasoline hydrocarbon	34371	100-41-4	0.02	MCL-CA	300	–
Ethyl <i>tert</i> -butyl ether (ETBE)	Gasoline oxygenate	50004	637-92-3	0.04	na	na	–
Ethyl methacrylate	Organic synthesis	73570	97-63-2	0.14	na	na	–
<i>o</i> -Ethyl toluene (1-Ethyl-2-methylbenzene)	Gasoline hydrocarbon	77220	611-14-3	0.04	na	na	–
Hexachlorobutadiene	Organic synthesis	39702	87-68-3	0.1	RSD5-US	9	–
Hexachloroethane	Solvent	34396	67-72-1	0.14	HAL-US	1	–
2-Hexanone (<i>n</i> -Butyl methyl ketone)	Solvent	77103	591-78-6	0.4	na	na	–
Iodomethane (Methyl iodide)	Organic synthesis	77424	74-88-4	0.4	na	na	–
Isopropylbenzene	Gasoline hydrocarbon	77223	98-82-8	0.04	NL-CA	770	–
4-Isopropyl-1-methylbenzene	Gasoline hydrocarbon	77356	99-87-6	0.08	na	na	–
Methyl acrylate	Organic synthesis	49991	96-33-3	0.4	na	na	–
Methyl acrylonitrile	Organic synthesis	81593	126-98-7	0.4	na	na	–
Methyl <i>tert</i> -butyl ether (MTBE)	Gasoline oxygenate	78032	1634-04-4	0.1	MCL-CA	13	–
Methyl isobutyl ketone (MIBK)	Solvent	78133	108-10-1	0.2	NL-CA	120	–
Methylene chloride (Dichloromethane)	Solvent	34423	75-09-2	0.04	MCL-US	5	–
Methyl ethyl ketone (2-Butanone, MEK)	Solvent	81595	78-93-3	1.6	HAL-US	4,000	–
Methyl methacrylate	Organic synthesis	81597	80-62-6	0.2	na	na	–
Naphthalene	Gasoline hydrocarbon	34696	91-20-3	0.4	NL-CA	17	–
Perchloroethene (Tetrachloroethene, PCE)	Solvent	34475	127-18-4	0.04	MCL-US	5	D
<i>n</i> -Propylbenzene	Solvent	77224	103-65-1	0.04	NL-CA	260	–
Styrene	Gasoline hydrocarbon	77128	100-42-5	0.04	MCL-US	100	–
1,1,1,2-Tetrachloroethane	Solvent	77562	630-20-6	0.04	HAL-US	70	–
1,1,2,2-Tetrachloroethane	Solvent	34516	79-34-5	0.1	MCL-CA	1	–
Tetrahydrofuran	Solvent	81607	109-99-9	1	na	na	D
1,2,3,4-Tetramethylbenzene	Gasoline hydrocarbon	49999	488-23-3	0.14	na	na	–
1,2,3,5-Tetramethylbenzene	Gasoline hydrocarbon	50000	527-53-7	0.12	na	na	–
Toluene	Gasoline hydrocarbon	34010	108-88-3	0.018	MCL-CA	150	D
1,2,3-Trichlorobenzene	Organic synthesis	77613	87-61-6	0.12	na	na	–
1,2,4-Trichlorobenzene	Solvent	34551	120-82-1	0.12	MCL-CA	5	–
1,1,1-Trichloroethane	Solvent	34506	71-55-6	0.04	MCL-CA	200	D
1,1,2-Trichloroethane	Solvent	34511	79-00-5	0.04	MCL-CA	5	–
Trichloroethene (TCE)	Solvent	39180	79-01-6	0.02	MCL-US	5	D
Trichlorofluoromethane (CFC-11)	Refrigerant	34488	75-69-4	0.08	MCL-CA	150	D
1,2,3-Trichloropropane (1,2,3-TCP)	Solvent/organic synthesis	77443	96-18-4	0.12	HAL-US	40	–
Trichlorotrifluoroethane (CFC-113)	Refrigerant	77652	76-13-1	0.04	MCL-CA	1,200	D
1,2,3-Trimethylbenzene	Gasoline hydrocarbon	77221	526-73-8	0.08	na	na	–
1,2,4-Trimethylbenzene	Gasoline hydrocarbon	77222	95-63-6	0.04	NL-CA	330	–
1,3,5-Trimethylbenzene	Organic synthesis	77226	108-67-8	0.04	NL-CA	330	–
Vinyl bromide (Bromoethene)	Fire retardant	50002	593-60-2	0.12	na	na	–
Vinyl chloride (Chloroethene)	Organic synthesis	39175	75-01-4	0.08	MCL-CA	0.5	–
<i>m</i> - and <i>p</i> -Xylene	Gasoline hydrocarbon	85795	108-38-3 / 106-42-3	0.08	MCL-CA	³ 1,750	–
<i>o</i> -Xylene	Gasoline hydrocarbon	77135	95-47-6	0.04	MCL-CA	³ 1,750	–

¹ The MCL-US, and MCL-CA thresholds for trihalomethanes are the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane.

² The RSD5 threshold for 1,3-dichloropropene is the sum of its isomers (*cis* and *trans*).

³ The MCL-CA thresholds for *m*- and *p*-Xylene and *o*-Xylene is the sum of all three xylene compounds.

Table 3B. Gasoline oxygenates and degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 4024.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; na, not available; µg/L, microgram per liter; –, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Acetone	Solvent	81552	67-64-1	1.2	na	na	–
<i>tert</i> -Amyl alcohol	Gasoline oxygenate	77073	75-85-4	0.6	na	na	–
<i>tert</i> -Amyl methyl ether (TAME)	Gasoline oxygenate	50005	994-05-8	0.04	na	na	–
<i>tert</i> -Butyl alcohol (TBA)	Oxygenate/degradate	77035	75-65-0	2	NL-CA	12	–
Diisopropyl ether (DIPE)	Gasoline oxygenate	81577	108-20-3	0.06	na	na	–
Ethyl <i>tert</i> -butyl ether (ETBE)	Gasoline oxygenate	50004	637-92-3	0.06	na	na	–
Methyl acetate	Solvent	77032	79-20-9	0.4	na	na	–
Methyl <i>tert</i> -butyl ether (MTBE)	Gasoline oxygenate	78032	1634-04-4	0.05	MCL-US	13	–

Table 3C. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2003.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} . **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample (table 6); na, not available; µg/L, microgram per liter; -, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Acetochlor	Herbicide	49260	34256-82-1	0.006	na	na	-
Alachlor	Herbicide	46342	15972-60-8	0.005	MCL-US	2	-
Atrazine	Herbicide	39632	1912-24-9	0.007	MCL-CA	1	D
Azinphos-methyl	Insecticide	82686	86-50-0	0.08	na	na	¹ -
Azinphos-methyl-oxon degradate	Insecticide	61635	961-22-8	0.042	na	na	-
Benfluralin	Herbicide	82673	1861-40-1	0.01	na	na	-
Carbaryl	Insecticide	82680	63-25-2	0.06	RSD5-US	400	-
2-Chloro-2,6-diethylacetanilide degradate	Herbicide	61618	6967-29-9	0.0065	na	na	-
4-Chloro-2-methylphenol degradate	Herbicide	61633	1570-64-5	0.005	na	na	¹ -
Chlorpyrifos	Insecticide	38933	2921-88-2	0.005	HAL-US	2	-
Chlorpyrifos, oxon degradate	Insecticide	61636	5598-15-2	0.0562	na	na	¹ -
Cyfluthrin	Insecticide	61585	68359-37-5	0.053	na	na	¹ -
Cypermethrin	Insecticide	61586	52315-07-8	0.046	na	na	¹ -
Dacthal (DCPA)	Herbicide	82682	1861-32-1	0.003	HAL-US	70	-
Deethylatrazine (2-Chloro-4- isopropylamino-6-amino- <i>s</i> - triazine) degradate	Herbicide	04040	6190-65-4	0.014	na	na	¹ D
Desulfinylfipronil degradate	Insecticide	62170	na	0.012	na	na	D
Desulfinylfipronil amide degradate	Insecticide	62169	na	0.029	na	na	-
Diazinon	Insecticide	39572	333-41-5	0.005	HAL-US	1	-
3,4-Dichloroaniline degradate	Herbicide	61625	95-76-1	0.0045	na	na	D
Dichlorvos	Insecticide	38775	62-73-7	0.013	na	na	¹ -
Dicrotophos	Insecticide	38454	141-66-2	0.0843	na	na	¹ -
Dieldrin	Insecticide	39381	60-57-1	0.009	RSD5-US	0.02	-
2,6-Diethylaniline degradate	Herbicide	82660	579-66-8	0.006	na	na	-
Dimethoate	Insecticide	82662	60-51-5	0.0061	na	na	¹ -
Ethion	Insecticide	82346	563-12-2	0.016	na	na	-
Ethion monoxon degradate	Insecticide	61644	17356-42-2	0.021	na	na	-
2-Ethyl-6-methylaniline degradate	Herbicide	61620	24549-06-2	0.01	na	na	-
Fenamiphos	Insecticide	61591	22224-92-6	0.029	HAL-US	0.7	-
Fenamiphos sulfone degradate	Insecticide	61645	31972-44-8	0.053	na	na	¹ -
Fenamiphos sulfoxide degradate	Insecticide	61646	31972-43-7	0.040	na	na	¹ -
Fipronil	Insecticide	62166	120068-37-3	0.016	na	na	D
Fipronil sulfide degradate	Insecticide	62167	120067-83-6	0.013	na	na	D

Table 3C. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2003.—Continued

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} . **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample (table 6); na, not available; $\mu\text{g/L}$, microgram per liter; -, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL ($\mu\text{g/L}$)	Threshold type	Threshold value ($\mu\text{g/L}$)	Detection
Fipronil sulfone	Insecticide degradate	62168	120068-36-2	0.024	na	na	D
Fonofos	Insecticide	04095	944-22-9	0.006	HAL-US	10	—
Hexazinone	Herbicide	04025	51235-04-2	0.026	HAL-US	400	D
Iprodione	Fungicide	61593	36734-19-7	0.026	na	na	—
Isofenphos	Insecticide	61594	25311-71-1	0.011	na	na	—
Malaoxon	Insecticide degradate	61652	1634-78-2	0.039	na	na	—
Malathion	Insecticide	39532	121-75-5	0.016	HAL-US	100	—
Metalaxyl	Fungicide	61596	57837-19-1	0.0069	na	na	D
Methidathion	Insecticide	61598	950-37-8	0.0087	na	na	—
Metolachlor	Herbicide	39415	51218-45-2	0.01	HAL-US	700	D
Metribuzin	Herbicide	82630	21087-64-9	0.012	HAL-US	70	—
Myclobutanil	Fungicide	61599	88671-89-0	0.033	na	na	—
1-Naphthol	Insecticide degradate	49295	90-15-3	0.0882	na	na	¹ —
Paraoxon-methyl	Insecticide degradate	61664	950-35-6	0.019	na	na	¹ —
Parathion-methyl	Insecticide	82667	298-00-0	0.008	HAL-US	1	—
Pendimethalin	Herbicide	82683	40487-42-1	0.02	na	na	—
<i>cis</i> -Permethrin	Insecticide	82687	54774-45-7	0.01	na	na	¹ —
Phorate	Insecticide	82664	298-02-2	0.02	na	na	—
Phorate oxon	Insecticide degradate	61666	2600-69-3	0.027	na	na	—
Phosmet	Insecticide	61601	732-11-6	0.0079	na	na	¹ —
Phosmet oxon	Insecticide degradate	61668	3735-33-9	0.0511	na	na	¹ —
Prometon	Herbicide	04037	1610-18-0	0.01	HAL-US	100	—
Prometryn	Herbicide	04036	7287-19-6	0.0059	na	na	D
Pronamide (Propyzamide)	Herbicide	82676	23950-58-5	0.004	RSD5-US	20	—
Simazine	Herbicide	04035	122-34-9	0.006	MCL-US	4	D
Tebuthiuron	Herbicide	82670	34014-18-1	0.016	HAL-US	500	D
Terbufos	Insecticide	82675	13071-79-9	0.012	HAL-US	0.4	—
Terbufos oxon sulfone	Insecticide degradate	61674	56070-15-6	0.045	na	na	—
Terbutylazine	Herbicide	04022	5915-41-3	0.0083	na	na	—
Tribufos	Herbicide	61610	78-48-8	0.035	na	na	—
Trifluralin	Herbicide	82661	1582-09-8	0.009	HAL-US	10	—

¹ The median matrix-spike recovery was less than 70 percent. Low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations.

Table 3D. Potential wastewater-indicator compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 4433.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} . **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample (table 7); na, not available; $\mu\text{g/L}$, microgram per liter; –, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL ($\mu\text{g/L}$)	Threshold type	Threshold value ($\mu\text{g/L}$)	Detection
Acetophenone	Fragrance, flavor additive	62811	98-86-2	0.2	na	na	–
Acetyl hexamethyl tetrahydro naphthalene (AHTN)	Musk fragrance	62812	21145-77-7	0.2	na	na	–
Anthracene	Wood preservative, combustion product	34220	120-12-7	0.2	na	na	–
9,10-Anthraquinone	Dye/textiles, seed treatment	62813	84-65-1	0.2	na	na	–
Atrazine	Herbicide	39630	1912-24-9	0.2	MCL-CA	1	–
Benzo[a]pyrene	Combustion product	34247	50-32-8	0.2	MCL-US	0.2	–
Benzophenone	Fixative for perfumes and soaps	62814	119-61-9	0.2	na	na	–
Bis(2-ethylhexyl)phthalate	Plasticizer, softener	39100	117-81-7	2	na	na	D
Bisphenol A	Polycarbonate resins, flame retardant	62816	80-05-7	0.4	na	na	D
Bromacil	Herbicide	30234	314-40-9	0.2	HAL-US	70	–
Bromoform (Tribromomethane)	Disinfection by-product	32104	75-25-2	0.08	MCL-US	80	D
3- <i>tert</i> -Butyl-4-hydroxy anisole (BHA)	Antioxidant, general preservative	61702	25013-16-5	0.2	na	na	–
Caffeine	Beverages	81436	58-08-2	0.2	na	na	–
Camphor	Flavor, odorant, ointments	62817	76-22-2	0.2	na	na	–
Carbaryl	Insecticide	39750	63-25-2	0.2	RSD5-US	400	–
Carbazole	Insecticide	77571	86-74-8	0.2	na	na	–
Chlorpyrifos	Insecticide	38932	2921-88-2	0.2	HAL-US	2	–
Cholesterol	Fecal indicator, plant sterol	62818	57-88-5	0.8	na	na	D
3- β -Coprostanol	Carnivore fecal indicator	62806	360-68-9	0.8	na	na	–
Cotinine	Primary nicotine metabolite	61945	486-56-6	0.8	na	na	–
<i>p</i> -Cresol	Wood preservative	77146	106-44-5	0.2	na	na	–
4-Cumylphenol	Nonionic detergent metabolite	62808	599-64-4	0.2	na	na	–
Diazinon	Insecticide	39570	333-41-5	0.2	HAL-US	1	–
Dichlorvos	Insecticide	30218	62-73-7	0.2	na	na	–
DEET (<i>N,N</i> -diethyl- <i>m</i> -toluamide)	Insecticide	61947	134-62-3	0.2	na	na	–
1,4-Dichlorobenzene	Moth repellant, fumigant, deodorant	34571	106-46-7	0.04	MCL-CA	5	–
3,4-Dichlorophenyl isocyanate	Intermediate for the synthesis of organic compounds	63145	102-36-3	2	na	na	–
Diethyl phthalate	Wood stains and varnishes, plasticizer, softener	34336	84-66-2	0.2	na	na	–
2,6-Dimethylnaphthalene	Diesel/kerosene	62085	581-42-0	0.2	na	na	–

Table 3D. Potential wastewater-indicator compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 4433.—Continued

[The five-digit U.S. Geological (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} . **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample (table 7); na, not available; $\mu\text{g/L}$, microgram per liter; –, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL ($\mu\text{g/L}$)	Threshold type	Threshold value ($\mu\text{g/L}$)	Detection
4-Nonylphenol monoethoxylates	Nonionic detergent metabolite	61704	na	2	na	na	–
4-Nonylphenol diethoxylates	Nonionic detergent metabolite	61703	na	3.2	na	na	–
4-Octylphenol diethoxylates	Nonionic detergent metabolite	61705	na	0.32	na	na	D
4-Octylphenol monoethoxylates	Nonionic detergent metabolite	61706	na	1	na	na	D
Fluoranthene	Component of coal tar and asphalt	34376	206-44-0	0.2	na	na	–
Hexahydrohexamethylcyclopenta- benzopyran (HHCB)	Musk fragrance	62823	1222-05-5	0.2	na	na	–
Indole	Pesticide ingredient	62824	120-72-9	0.2	na	na	–
Isoborneol	Fragrance in perfumery	62825	124-76-5	0.2	na	na	–
Isophorone	Solvent	34409	78-59-1	0.2	HAL-US	100	–
Isopropylbenzene	Fuels, paint thinner	77223	98-82-8	0.04	NL-CA	770	–
Isoquinoline	Flavors and fragrances	62826	119-65-3	0.2	na	na	–
<i>d</i> -Limonene	Fungicide	62819	5989-27-5	0.2	na	na	–
Menthol	Cigarettes, cough drops, liniment	62827	89-78-1	0.2	na	na	–
Metalaxyl	Herbicide, fungicide	04254	57837-19-1	0.2	na	na	–
3-Methyl-1H-indole (Skatole)	Fragrance, stench in feces	62807	83-34-1	0.2	na	na	–
5-Methyl-1H-benzotriazole	Antioxidant in antifreeze and deicers	61944	136-85-6	1.6	na	na	–
1-Methylnaphthalene	Gasoline, diesel fuel, or crude oil	81696	90-12-0	0.2	na	na	–
2-Methylnaphthalene	Gasoline, diesel fuel, or crude oil	30194	91-57-6	0.2	na	na	D
Methyl salicylate	Liniment, UV- absorbing lotion	62828	119-36-8	0.2	na	na	–
Metolachlor	Herbicide	82612	51218-45-2	0.2	HAL-US	700	–
Naphthalene	Fumigant, moth repellent, gasoline	34696	91-20-3	0.4	NL-CA	17	–
4-Nonylphenol (total)	Nonionic detergent metabolite	62829	84852-15-3	1.6	na	na	–
4- <i>n</i> -Octylphenol	Nonionic detergent metabolite	62809	1806-26-4	0.2	na	na	–
4- <i>tert</i> -Octylphenol	Nonionic detergent metabolite	62810	140-66-9	0.2	na	na	D
Pentachlorophenol	Herbicide, wood preservative	39032	87-86-5	0.8, 2	MCL-US	1	–
Perchloroethene (Tetrachloroethene, PCE)	Solvent, degreaser	34475	127-18-4	0.04	MCL-US	5	D

Table 3D. Potential wastewater-indicator compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 4433.—Continued

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} . **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample (table 7); na, not available; $\mu\text{g/L}$, microgram per liter; –, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL ($\mu\text{g/L}$)	Threshold type	Threshold value ($\mu\text{g/L}$)	Detection
Phenanthrene	Explosives, oil, combustion product	34461	85-01-8	0.2	na	na	–
Phenol	Disinfectant, organic synthesis	34694	108-95-2	0.2	HAL-US	2,000	D
Prometon	Herbicide	39056	1610-18-0	0.2	HAL-US	100	–
Pyrene	Component of coal tar and asphalt	34469	129-00-0	0.2	na	na	–
β -Sitosterol	Plant sterol	62815	83-46-5	0.8	na	na	–
β -Stigmastanol	Plant sterol	61948	19466-47-8	0.8	na	na	–
2,2',4,4'-Tetrabromodiphenyl ether	Brominated flame retardant	63147	5436-43-1	0.2	na	na	–
Tributyl phosphate	Antifoaming agent, flame retardant	62832	126-73-8	0.2	na	na	–
Triclosan	Disinfectant, antimicrobial	61708	3380-34-5	0.2	na	na	–
Triethyl citrate	Cosmetics, pharmaceuticals	62833	77-93-0	0.2	na	na	–
Triphenyl phosphate	Plasticizer, resin, flame retardant	62834	115-86-6	0.2	na	na	–
Tris(2-butoxyethyl) phosphate	Flame retardant	62830	78-51-3	0.2	na	na	–
Tris(2-chloroethyl) phosphate	Plasticizer, flame retardant	62831	115-96-8	0.2	na	na	–
Tris(dichloroisopropyl) phosphate	Flame retardant	61707	13674-87-8	0.2	na	na	–

Table 3E. Pharmaceutical compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Code 9003.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. The California Groundwater Ambient Monitoring and Assessment (GAMA) program uses more conservative reporting limits for the pharmaceutical compounds than recommended by the USGS National Water Quality Laboratory. For albuterol, carbamazepine, codeine, dehydronifedipine, diltiazem, sulfamethoxazole, thiabendazole, trimethoprim, and warfarin, the MDL corresponds to the long-term method detection limit determined by the USGS Branch of Quality Systems in October 2007 (BQS LT-MDL). For acetaminophen, caffeine, cotinine, diphenhydramine, and paraxanthine, the MDL corresponds to the effective method detection limit determined from assessment of quality-control data associated with GAMA samples collected from May 2004 through September 2007 (GAMA E-MDL). The GAMA E-MDL are higher than the BQS LT-MDL for those compounds. Detections reported by the USGS National Water Quality Laboratory with concentrations lower than the BQS LT-MDL or GAMA E-MDL are reported as non-detections by the GAMA program. **Abbreviations:** CAS, Chemical Abstract Service; na, not available; µg/L, microgram per liter]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	MDL (µg/L)	Threshold type	Threshold value (µg/L)
Acetaminophen	Analgesic	62000	103-90-2	0.04	na	na
Albuterol	Anti-inflammatory; bronchodilator	62020	18559-94-9	0.02	na	na
Caffeine	Stimulant	50305	58-08-2	0.03	na	na
Carbamazepine	Anticonvulsant; analgesic; mood stabilizer	62793	298-46-4	0.02	na	na
Codeine	Opioid narcotic	62003	76-57-3	0.02	na	na
Cotinine	Nicotine metabolite	62005	486-56-6	0.015	na	na
Dehydronifedipine	Antianginal metabolite	62004	67035-22-7	0.03	na	na
Diltiazem	Antianginal; antihypertensive	62008	42399-41-7	0.02	na	na
Diphenhydramine	Antihistamine	62796	58-73-1	0.025	na	na
Paraxanthine	Caffeine metabolite	62030	611-59-6	0.05	na	na
Sulfamethoxazole	Antibacterial, antiprotozoal	62021	723-46-6	0.05	na	na
Thiabendazole	Anthelmintic	62801	148-79-8	0.05	na	na
Trimethoprim	Antibacterial	62023	738-70-5	0.02	na	na
Warfarin	Anticoagulant	62024	81-81-2	0.03	na	na

Table 3F. Polar pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2060.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} . **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample (table 6); na, not available; $\mu\text{g/L}$, microgram per liter; –, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL ($\mu\text{g/L}$)	Threshold type	Threshold ($\mu\text{g/L}$)	Detection
Acifluorfen	Herbicide	49315	50594-66-6	0.028	na	na	–
Aldicarb ¹	Insecticide	49312	116-06-3	0.04	MCL-US	3	–
Aldicarb sulfone	Insecticide/degradate	49313	1646-88-4	0.018	MCL-US	3	² –
Aldicarb sulfoxide	Degradate	49314	1646-87-3	0.022	MCL-US	4	–
Atrazine	Herbicide	39632	1912-24-9	0.008	MCL-CA	1	D
Bendiocarb	Insecticide	50299	22781-23-3	0.020	na	na	–
Benomyl	Fungicide	50300	17804-35-2	0.022	na	na	–
Bensulfuron-methyl	Herbicide	61693	83055-99-6	0.018	na	na	–
Bentazon	Herbicide	38711	25057-89-0	0.012	MCL-CA	18	² –
Bromacil	Herbicide	04029	314-40-9	0.018	HAL-US	70	–
Bromoxynil	Herbicide	49311	1689-84-5	0.028	na	na	² –
Caffeine	Wastewater indicator	50305	58-08-2	0.018	na	na	–
Carbaryl	Herbicide	49310	63-25-2	0.018	RSD5-US	400	–
Carbofuran	Herbicide	49309	1563-66-2	0.016	MCL-CA	18	–
Chloramben, methyl ester	Herbicide	61188	7286-84-2	0.024	na	na	–
Chlorimuron-ethyl	Herbicide	50306	90982-32-4	0.032	na	na	² –
3-(4-Chlorophenyl)-1-methyl urea	Degradate	61692	5352-88-5	0.036	na	na	–
Clopyralid	Herbicide	49305	1702-17-6	0.024	na	na	² –
Cycloate	Herbicide	04031	1134-23-2	0.014	na	na	–
2,4-D plus 2,4-D methyl ester	Herbicides	66496	na	0.020	MCL-US	70	–
2,4-D methyl ester (2,4-Dichlorophenoxyacetic acid methyl ester)	Herbicide	50470	1928-38-7	0.016	na	na	–
2,4-DB (4-(2,4-Dichlorophenoxy) butyric acid)	Herbicide	38746	94-82-6	0.020	na	na	² –
DCPA (Dacthal) monoacid	Degradate	49304	887-54-7	0.028	na	na	–
Deethylatrazine (2-Chloro-4- isopropylamino-6-amino- <i>s</i> - triazine)	Degradate	04040	6190-65-4	0.028	na	na	² D
Deisopropyl atrazine (2-chloro-6- ethylamino-4-amino- <i>s</i> -triazine)	Degradate	04038	1007-28-9	0.08	na	na	–
Dicamba	Herbicide	38442	1918-00-9	0.036	HAL-US	4,000	² –
Dichlorprop	Herbicide	49302	120-36-5	0.028	na	na	–
Dinoseb (Dinitrobutyl phenol)	Herbicide	49301	88-85-7	0.038	MCL-CA	7	² –
Diphenamid	Herbicide	04033	957-51-7	0.010	HAL-US	200	–
Diuron	Herbicide	49300	330-54-1	0.015	HAL-US	10	–
Fenuron	Herbicide	49297	101-42-8	0.019	na	na	–
Flumetsulam	Herbicide	61694	98967-40-9	0.040	na	na	² –
Fluometuron	Herbicide	38811	2164-17-2	0.016	HAL-US	90	–
Hydroxyatrazine (2-Hydroxy-4- isopropylamino-6-ethylamino- <i>s</i> -triazine)	Degradate	50355	2163-68-0	0.032	na	na	–
3-Hydroxycarbofuran	Degradate	49308	16655-82-6	0.008	na	na	–
Imazaquin	Herbicide	50356	81335-37-7	0.036	na	na	–
Imazethapyr	Herbicide	50407	81335-77-5	0.038	na	na	–
Imidacloprid	Insecticide	61695	138261-41-3	0.020	na	na	² –
Linuron	Herbicide	38478	330-55-2	0.014	na	na	–

Table 3F. Polar pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2060.—Continued

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} . **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample ([table 6](#)); na, not available; $\mu\text{g/L}$, microgram per liter; –, not detected]

Constituent (common name)	Primary use or source	USGS parameter code	CAS number	LRL ($\mu\text{g/L}$)	Threshold type	Threshold ($\mu\text{g/L}$)	Detection
MCPA (2-Methyl-4-chlorophenoxyacetic acid)	Herbicide	38482	94-74-6	0.030	HAL-US	30	–
MCPB (4-(2-Methyl-4-chlorophenoxy) butyric acid)	Herbicide	38487	94-81-5	0.010	na	na	² –
Metalaxyl	Fungicide	50359	57837-19-1	0.012	na	na	D
Methiocarb	Insecticide	38501	2032-65-7	0.010	na	na	–
Methomyl	Insecticide	49296	16752-77-5	0.020	HAL-US	200	–
Metsulfuron methyl ¹	Herbicide	61697	74223-64-6	0.025	na	na	² –
Neburon	Herbicide	49294	555-37-3	0.012	na	na	–
Nicosulfuron	Herbicide	50364	111991-09-4	0.04	na	na	–
Norflurazon	Herbicide	49293	27314-13-2	0.020	na	na	–
Oryzalin	Herbicide	49292	19044-88-3	0.012	na	na	–
Oxamyl	Insecticide	38866	23135-22-0	0.030	MCL-CA	50	–
Picloram	Herbicide	49291	1918-02-01	0.032	MCL-US	500	² –
Propham	Herbicide	49236	122-42-9	0.030	HAL-US	100	–
Propiconazole	Fungicide	50471	60207-90-1	0.010	na	70	–
Propoxur	Insecticide	38538	114-26-1	0.008	na	na	–
Siduron	Herbicide	38548	1982-49-6	0.020	na	na	–
Sulfometuron-methyl	Herbicide	50337	74222-97-2	0.038	na	na	–
Tebuthiuron	Herbicide	82670	34014-18-1	0.026	HAL-US	500	D
Terbacil	Herbicide	04032	5902-51-2	0.016	HAL-US	90	–
Triclopyr	Herbicide	49235	55335-06-3	0.026	na	na	² –

¹Although listed as an LRL, these constituents are reported using method reporting levels (MRL).

²The median matrix-spike recovery was less than 70 percent. Low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations.

Table 3G. Nutrients and dissolved organic carbon, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2755, laboratory code 2612, and perchlorate (constituent of special interest) analyzed at the Montgomery Watson-Harza Laboratory.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample (table 9); na, not available; mg/L, milligram per liter; –, not detected]

Constituent (common name)	USGS parameter code	CAS number	LRL (mg/L)	Threshold type	Threshold value (mg/L)	Detection
Nutrients and dissolved organic carbon						
Ammonia	00608	7664-41-7	0.010	HAL-US	1 ²⁵	D
Nitrite (as nitrogen)	00613	14797-65-0	0.002	MCL-US	1	D
Nitrate plus nitrite (as nitrogen)	00631	na	0.060	MCL-US	10	D
Total nitrogen (ammonia, nitrite, nitrate, organic nitrogen)	62854	17778-88-0	0.06	na	na	D
Phosphorus, phosphate, orthophosphate (as phosphorus)	00671	14265-44-2	0.006	na	na	D
Dissolved organic carbon (DOC)	00681	na	0.33	na	na	D
Constituent of special interest						
Perchlorate	61209	14797-73-0	0.5	MCL-CA	6	D

¹ In earlier reports in this series, the HAL-US of 30 mg/L was used as the comparison threshold; however, ammonia “as NH₃” was used for that comparison.

Table 3H. Major and minor ions and trace elements, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 1948.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** SMCL-CA, California Department of Public Health secondary maximum contaminant level; Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; AL-US, U.S. Environmental Protection Agency action level. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in ground-water sample ([tables 10](#) and [11](#)); na, not available; mg/L, milligram per liter; µg/L, microgram per liter; -, not detected]

Constituent	USGS parameter code	CAS number	LRL	Threshold type	Threshold value	Detection
Major and minor ions (mg/L)						
Bromide	71870	24959-67-9	0.02	na	na	D
Calcium	00915	7440-70-2	0.02	na	na	D
Chloride	00940	16887-00-6	0.2	SMCL-CA	¹ 250 (500)	D
Fluoride	00950	16984-48-8	0.10	MCL-CA	2	D
Iodide	78165	7553-56-2	0.002	na	na	D
Magnesium	00925	7439-95-4	0.008	na	na	D
Potassium	00935	7440-09-7	0.16	na	na	D
Silica	00955	7631-86-9	0.04	na	na	D
Sodium	00930	7440-23-5	0.20	na	na	D
Sulfate	00945	14808-79-8	0.18	SMCL-CA	¹ 250 (500)	D
Residue on evaporation (total dissolved solids, TDS)	70300	na	10	SMCL-US	¹ 500 (1,000)	D
Trace elements (µg/L)						
Aluminum	01106	7429-90-5	1.6	MCL-CA	1,000	D
Antimony	01095	7440-36-0	0.2	MCL-US	6	D
Arsenic	01000	7440-38-2	0.12	MCL-US	10	D
Barium	01005	7440-39-3	0.2	MCL-CA	1,000	D
Beryllium	01010	7440-41-7	0.06	MCL-US	4	-
Boron	01020	7440-42-8	8	NL-CA	1,000	D
Cadmium	01025	7440-43-9	0.04	MCL-US	5	D
Chromium	01030	7440-47-3	0.04	MCL-CA	50	D
Cobalt	01035	7440-48-4	0.04	na	na	D
Copper	01040	7440-50-8	0.4	AL-US	1,300	D
Iron	01046	7439-89-6	6	SMCL-CA	300	D
Lead	01049	7439-92-1	0.08	AL-US	15	D
Lithium	01130	7439-93-2	0.6	na	na	D
Manganese	01056	7439-96-5	0.2	SMCL-CA	50	D
Molybdenum	01060	7439-98-7	0.4	HAL-US	40	D
Nickel	01065	7440-02-0	0.06	MCL-CA	100	D
Selenium	01145	7782-49-2	0.08	MCL-US	50	D
Silver	01075	7440-22-4	0.20	SMCL-CA	100	D
Strontium	01080	7440-24-6	0.4	HAL-US	4,000	D
Thallium	01057	7440-28-0	0.04	MCL-US	2	D
Tungsten	01155	7440-33-7	0.06	na	na	D
Uranium	22703	7440-61-1	0.04	MCL-US	30	D
Vanadium	01085	7440-62-2	0.10	NL-CA	50	D
Zinc	01090	7440-66-6	0.6	HAL-US	2,000	D

¹The recommended SMCL-CA thresholds for chloride, sulfate, and TDS are listed with the upper SMCL-CA thresholds in parentheses.

Table 31. Arsenic, chromium, and iron species, comparative thresholds, and reporting information for the U.S. Geological Survey Trace Metal Laboratory, Boulder, Colorado.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Abbreviations:** CAS, Chemical Abstract Service; MDL, Method detection limit; na, not available; µg/L, micrograms per liter; D, detected in ground-water sample ([table 12](#)); –, not detected]

Constituent	USGS parameter code	CAS number	MDL (µg/L)	Threshold type	Threshold level (µg/L)	Detection
Arsenic(III)	99034	22569-72-8	1	na	na	–
Arsenic (total)	01000	7440-38-2	0.5	MCL-US	10	D
Chromium(VI)	01032	18540-29-9	1	na	na	D
Chromium (total)	01030	7440-47-3	1	MCL-CA	50	D
Iron(II)	01047	7439-89-6	2	na	na	D
Iron (total)	01046	7439-89-6	2	SMCL-CA	300	D

Table 3J. Isotopic and radioactive constituents, comparative thresholds, and reporting information for laboratories.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** CAS, Chemical Abstract Service; MRL, minimum reporting level; MU, method uncertainty; CSU, combined standard uncertainty; CV, critical value; SD, standard deviation; na, not available; pCi/L, picocurie per liter; SSMDC, sample specific minimum detectable concentration; D, detected in ground-water sample (tables 13 and 15); na, not available]

Constituent	USGS parameter code	CAS number	Reporting level type	Reporting level or uncertainty	Threshold type ¹	Threshold value	Detection
Stable isotope ratios (per mil)							
$\delta^2\text{H}$ of water ¹	82082	na	MU	2	na	na	D
$\delta^{18}\text{O}$ of water ¹	82085	na	MU	0.20	na	na	D
$\delta^{15}\text{N}$ of nitrate ¹	82690	na	MU	0.30	na	na	D
$\delta^{18}\text{O}$ of nitrate ¹	63041	na	MU	0.50	na	na	D
$\delta^{13}\text{C}$ of dissolved carbonates ²	82081	na	1 sigma	0.05	na	na	D
$\delta^{37}\text{Cl}$ in water ²	na	na	MU	SD	na	na	D
$\delta^{81}\text{Br}$ in water ²	na	na	MU	SD	na	na	D
Radioactive constituents (percent modern)							
Carbon-14 ³	49933	14762-75-5	1 sigma	0.0015	na	na	D
Radioactive constituents (pCi/L)							
Radon-222 ⁴	82303	14859-67-7	SSMDC	CSU and CV	Proposed MCL-US	⁵ 300 (4,000)	D
Tritium ^{6,7}	07000	10028-17-8	MRL	1	MCL-CA	20,000	D
Gross-alpha radioactivity, 72 hr count ⁸	99920	12587-46-1	SSMDC	CSU and CV	MCL-US	15	D
Gross-alpha radioactivity, 30 day count ⁸	99921	12587-46-1	SSMDC	CSU and CV	MCL-US	15	D
Gross-beta radioactivity, 72 hour count ⁸	99922	12587-47-2	SSMDC	CSU and CV	MCL-CA	50	D
Gross-beta radioactivity, 30 day count ⁸	99923	12587-47-2	SSMDC	CSU and CV	MCL-CA	50	D
Radium-226 ⁸	99915	13982-63-3	SSMDC	CSU and CV	MCL-US	⁹ 5	D
Radium-228 ⁸	99916	15262-20-1	SSMDC	CSU and CV	MCL-US	⁹ 5	D

¹ USGS Stable Isotope Laboratory, Reston, Virginia.

² University of Waterloo (contract laboratory).

³ University of Arizona, Accelerator Mass Spectrometry Laboratory (contract laboratory).

⁴ USGS National Water Quality Laboratory.

⁵ Two MCLs have been proposed for radon-222. The proposed alternative MCL is given in parentheses.

⁶ USGS Stable Isotope and Tritium Laboratory, Menlo Park, California.

⁷ Lawrence Livermore National Laboratory.

⁸ Eberline Analytical Services (contract laboratory).

⁹ The MCL-US threshold for radium is the sum of radium-226 and radium-228 thresholds.

Table 3K. Noble gases and tritium, comparison thresholds, and reporting information for the Lawrence Livermore National Laboratory.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** CAS, Chemical Abstract Service; MU, method uncertainty; na, not available; cm³ STP/g, cubic centimeters of gas at standard temperature and pressure per gram of water; pCi/L, picocurie per liter; D, detected in ground-water sample (table 14)]

Constituent	USGS parameter code	CAS number	MU (percent)	Reporting units	Threshold type	Threshold value (pCi/L)	Detection
Helium-3 / Helium-4 ratio	61036	na / 7440-59-7	0.75	atom ratio	na	na	D
Argon	85563	7440-37-1	2	cm ³ STP/g	na	na	D
Helium-4	85561	7440-59-7	2	cm ³ STP/g	na	na	D
Krypton	85565	7439-90-9	2	cm ³ STP/g	na	na	D
Neon	61046	7440-01-09	2	cm ³ STP/g	na	na	D
Xenon	85567	7440-63-3	2	cm ³ STP/g	na	na	D
Tritium	07000	10028-17-8	1	pCi/L	MCL-CA	20,000	D

Table 3L. Microbial constituents, comparison thresholds, and reporting information for the U.S. Geological Survey Ohio Microbiology Laboratory parameter codes 90901, 90900, 99335, and 99332.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique - a required process intended to reduce the level of contamination in drinking water. **Abbreviations:** MDL, Method detection limit; mL, milliliter; D, detected in ground-water sample (table 16); na, not available; -, not detected]

Constituent	USGS parameter code	Primary source	MDL	Threshold		Detection
				Type	Value	
<i>Escherichia coli</i> ¹	90901	Sewage and animal waste indicator	1 colony/100 mL	TT-US	Zero	-
Total coliform - including fecal coliform and <i>E. coli</i> ¹	90900	Sewage and animal waste indicator	1 colony/100 mL	MCL-US	5 percent of samples positive per month	D
F-specific coliphage	99335	Sewage and animal waste indicator	na	TT-US	99.99 percent killed / inactivated	-
Somatic coliphage	99332	Sewage and animal waste indicator	na	TT-US	99.99 percent killed / inactivated	-

¹Analyzed in the field.

Table 4. Water-quality indicators in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique - a required process intended to reduce the level of contamination in drinking water. **GAMA identification No.:** SCR-V, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** °C, degree Celsius; mg/L, milligram per liter; nc, constituent not collected; na, not available; NTU, nephelometric turbidity unit; µS/cm, microsiemens per centimeter; CaCO₃, calcium carbonate; <, less than]

GAMA identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)	Alkalinity, lab (mg/L as CaCO ₃) (29801)	Alkalinity, dissolved, field (mg/L as CaCO ₃) (29802)
Threshold type	TT-US	na	na	SMCL-US	SMCL-US	SMCL-CA ¹	SMCL-CA ¹	na	na
Threshold level	1	na	na	6.5–8.5	6.5–8.5	900 (1,600)	900 (1,600)	na	na
Grid wells									
SCR-V-01	nc	< 0.2	22.0	nc	7.7	nc	*1,180	nc	nc
SCR-V-02	nc	< 0.2	23.5	nc	7.6	nc	834	nc	nc
SCR-V-03	0.1	0.4	23.5	7.8	7.7	*924	895	258	250
SCR-V-04	nc	5.0	18.5	7.2	7.0	*967	820	240	nc
SCR-V-05	nc	4.1	18.0	nc	7.0	nc	*1,010	nc	nc
SCR-V-06	nc	0.3	18.0	7.4	7.2	**1,890	**1,710	259	nc
SCR-V-07	0.1	5.9	17.5	7.4	6.8	856	835	196	186
SCR-V-08	nc	< 0.2	25.5	nc	7.5	nc	*1,030	nc	nc
SCR-V-09	nc	< 0.2	19.0	7.3	7.1	**2,090	**2,040	287	nc
SCR-V-10	0.1	< 0.2	20.0	7.7	7.6	*1,120	*1,130	202	197
SCR-V-11	nc	0.2	21.5	nc	7.5	nc	*919	nc	nc
SCR-V-12	0.2	0.3	21.0	7.8	7.6	*1,180	*1,180	203	197
SCR-V-13	nc	2.7	20.0	nc	7.4	nc	*1,540	nc	nc
SCR-V-14	nc	1.8	23.0	nc	7.4	nc	*1,150	nc	nc
SCR-V-15	nc	0.4	18.0	nc	7.3	nc	*1,370	nc	nc
SCR-V-16	nc	< 0.2	17.0	7.4	7.5	*1,370	*1,290	229	nc
SCR-V-17	nc	2.6	17.0	nc	7.1	nc	*1,010	nc	nc
SCR-V-18	nc	0.7	19.5	nc	7.2	nc	*1,430	nc	nc
SCR-V-19	nc	7.3	17.0	7.5	7.3	*1,260	*1,190	202	nc
SCR-V-20	nc	0.8	29.0	nc	7.8	nc	576	nc	nc
SCR-V-21	nc	0.5	24.5	nc	7.6	nc	607	nc	nc
SCR-V-22	nc	0.5	24.0	nc	7.5	nc	704	nc	nc
SCR-V-23	nc	< 0.2	16.0	nc	7.6	nc	684	nc	nc
SCR-V-24	nc	1.1	22.0	nc	7.4	nc	*1,530	nc	nc
SCR-V-25	nc	7.2	18.0	nc	7.7	nc	498	nc	nc
SCR-V-26	nc	2.2	20.0	nc	7.5	nc	*1,100	nc	nc
SCR-V-27	nc	0.3	20.0	7.5	7.4	**1,660	**1,620	239	nc
SCR-V-28	nc	3.2	20.0	7.3	7.1	*1,590	*1,540	263	nc
SCR-V-29	nc	E 3.4	17.5	nc	7.3	nc	*1,230	nc	nc
SCR-V-30	nc	3.0	18.0	nc	7.4	nc	890	nc	nc
SCR-V-31	nc	6.1	18.0	nc	7.4	nc	*996	nc	nc
SCR-V-32	nc	< 0.2	22.0	nc	7.0	nc	**2,020	nc	nc
SCR-V-33	nc	2.6	20.5	7.3	7.0	**2,930	**2,770	308	nc
SCR-V-34	nc	0.7	21.0	nc	7.3	nc	722	nc	nc
SCR-V-35	0.2	7.7	21.5	7.2	7.0	**2,500	**2,390	262	251
SCR-V-36	nc	3.0	19.0	nc	7.4	nc	*1,040	nc	nc
SCR-V-37	nc	< 0.2	22.0	7.6	7.5	**1,910	**1,880	278	nc
SCR-V-38	nc	0.2	23.0	nc	7.2	nc	866	nc	nc
SCR-V-39	nc	< 0.2	20.5	7.3	nc	**2,060	**2,040	307	nc
SCR-V-40	nc	nc	nc	nc	nc	nc	nc	nc	nc
SCR-V-41	nc	4.0	17.0	nc	nc	nc	*1,360	nc	nc
SCR-V-42	nc	4.6	16.5	nc	7.6	*1,160	*1,090	194	nc

Table 4. Water-quality indicators in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five digit number below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. **Threshold type:** SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique - a required process intended to reduce the level of contamination in drinking water. **GAMA identification No.:** SCR-V, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** °C, degree Celsius; mg/L, milligram per liter; nc, constituent not collected; na, not available; NTU, nephelometric turbidity unit; µS/cm, microsiemens per centimeter; CaCO₃, calcium carbonate; <, less than]

GAMA identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)	Alkalinity, lab (mg/L as CaCO ₃) (29801)	Alkalinity, dissolved, field (mg/L as CaCO ₃) (29802)
Threshold type	TT-US	na	na	SMCL-US	SMCL-US	SMCL-CA ¹	SMCL-CA ¹	na	na
Threshold level	1	na	na	6.5–8.5	6.5–8.5	900 (1,600)	900 (1,600)	na	na
Understanding wells									
SCR-VU-01	0.4	1.1	18.5	7.5	7.0	* 1,370	* 1,260	213	207
SCR-VU-02	0.6	< 0.2	23.0	7.3	7.2	** 1,920	** 1,870	237	222
SCR-VU-03	0.4	7.9	15.5	7.7	7.6	* 1,540	* 1,510	222	220
SCR-VU-04	0.2	< 0.2	24.5	7.7	7.6	** 1,780	** 1,760	316	315
DD-01	nc	nc	24.0	7.8	7.6	** 1,890	** 1,860	333	nc
DD-02	nc	nc	26.5	7.8	7.7	** 1,980	** 1,980	353	nc
DD-03	nc	nc	26.0	8.0	7.8	** 2,680	** 2,660	532	nc
DD-04	nc	nc	24.5	8.0	8.4	** 2,910	** 2,880	578	nc
SCR-VU-05	nc	5.1	17.5	nc	7.4	nc	888	nc	nc
SCR-VU-06	nc	< 0.2	23.0	7.7	7.4	* 1,150	* 1,120	238	nc
SCR-VU-07	nc	< 0.2	21.0	6.9	7.1	** 16,600	** 16,900	146	nc
SCR-VU-08	nc	< 0.2	23.0	7.1	6.9	** 14,200	** 14,300	199	nc
SCR-VU-09	nc	0.2	23.0	7.5	7.3	** 12,600	** 13,100	284	nc
SCR-VU-10	nc	0.4	19.0	7.0	7.2	** 44,000	** 44,800	165	nc
SCR-VU-11	nc	nc	26.0	7.3	nc	** 1,730	** 1,840	276	nc

¹ The SMCL-CA for specific conductance has recommended and upper threshold values. The upper value is shown in parentheses.

*Value exceeds recommended threshold.

** Value exceeds upper threshold.

Table 5. Volatile organic compounds (VOC), including gasoline oxygenates and degradates, detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from all grid and understanding wells were analyzed, but only samples with detections are listed. Analytes are listed in order of decreasing detection frequency in the 14 grid wells. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **GAMA identification No.:** SCR-V, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well. **Abbreviations:** LRL, laboratory reporting level; E, estimated value; V, analyte detected in sample and an associated blank; thus, result is not considered a detection in ground-water quality assessment; µg/L, microgram per liter; –, not detected]

GAMA identification no.	Solvent		Gasoline oxygenate			Refrigerant		Organic synthesis		VOC detections per well
	Trichloro-ethene (TCE) (µg/L) (39180)	Tetrahydrofuran (µg/L) (81607)	Toluene (µg/L) (34010)	Benzene (µg/L) (34030)	<i>m</i> -Xylene plus <i>p</i> -xylene (µg/L) (85795)	Trichloro-fluoro-methane (CFC-11) (µg/L) (34488)	Trichloro-trifluoro-ethane (CFC-113) (µg/L) (77652)	Carbon disulfide (µg/L) (77041)	Bromo-chloro-methane (µg/L) (77297)	
LRL	[0.02]	[1]	[0.018]	[0.016]	[0.08]	[0.08]	[0.04]	[0.06]	[0.06]	
Threshold type ¹	MCL-US	na	MCL-CA	MCL-CA	MCL-CA	MCL-CA	MCL-CA	NL-CA	HAL-US	
Threshold level	5	na	150	1	1,750	150	1,200	160	90	
Grid wells										
SCR-V-03	–	–	–	–	–	–	–	0.31	–	1
SCR-V-06	–	–	–	–	–	–	–	–	–	1
SCR-V-10	–	–	1.02	E 0.02	–	–	–	0.15	–	4
SCR-V-12	–	–	–	–	–	–	–	–	–	3
SCR-V-13	0.99	–	–	–	–	12.9	31.3	–	–	7
SCR-V-15	–	–	–	–	–	–	–	–	–	1
SCR-V-17	–	–	–	–	–	–	–	–	–	2
SCR-V-19	–	–	–	–	–	–	E 0.05	–	–	1
SCR-V-20	–	–	–	E 0.02	–	–	–	–	–	1
SCR-V-25	–	–	–	–	E 0.03	–	–	–	0.18	7
SCR-V-33	–	–	–	–	–	–	–	–	–	1
SCR-V-35	–	–	–	–	–	–	–	–	–	1
SCR-V-37	–	–	V 0.03	–	–	–	–	–	–	0
SCR-V-42	–	–	–	–	–	–	–	–	–	1
Number of detections	1		1	2	1	1	2	2	1	
Detection frequency (percent) for grid wells	2.4		2.4	4.8	2.4	2.4	4.8	4.8	2.4	≈33
Understanding wells										
SCR-VU-05	–	–	–	–	–	–	–	–	–	
SCR-VU-06	–	–	V 0.02	–	–	–	–	–	–	
SCR-VU-07	–	2	V 0.02	–	–	–	–	–	–	
SCR-VU-08	–	–	V 0.02	–	–	–	–	–	–	
SCR-VU-09	–	–	V 0.02	–	–	–	–	–	–	
SCR-VU-10	–	–	V 0.03	–	–	–	–	–	–	

¹The MCL-US threshold for trihalomethanes is the sum of the chloroform, bromoform, bromodichloromethane, and dibromochloromethane thresholds.

²Frequency of detection of at least one VOC in the grid wells. Detections with V remark codes are not included.

Table 6. Pesticides and pesticide degradates detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from the 42 grid wells and 11 understanding wells were analyzed. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **GAMA identification No.:** SCR.V, Santa Clara River Valley study unit grid well; SCR.VU, Santa Clara River Valley study unit understanding well. **Abbreviations:** E, estimated value; mg/L, milligram per liter; na, not available; -, not detected]

GAMA identification no.	Simazine (µg/L) (04035)	Deethyl- latriazine (2-Chloro-4- isopropyl- lamino-6- amino- s-triazine) (µg/L) (04040)	Atrazine (µg/L) (39632)	Hexa- zine (µg/L) (04025)	3,4- Dichloro- aniiline (µg/L) (61625)	Desulfinyl- fipronil (µg/L) (62170)	Fipronil sulfide (µg/L) (62167)	Fipronil sulfone (µg/L) (62168)	Fipronil (µg/L) (62166)	Metola- chlor (µg/L) (39415)	Prometryn (µg/L) (04036)	Tebuthi- uron (µg/L) (82670)	Metalaxyl (µg/L) (61596)	Pesticide detections per well
	[0.006] MCL-US 4	[0.014] na na	[0.007] MCL-CA 1	[0.026] HAL-US 400	[0.0045] na na	[0.012] na na	[0.013] na na	[0.024] na na	[0.016] na na	[0.01] HAL-US 700	[0.0059] na na	[0.016] HAL-US 500	[0.0069] na na	
SCR.V-07	E 0.006	E 0.007	E 0.004	-	-	-	-	-	-	-	-	-	-	3
SCR.V-13	E 0.005	E 0.013	0.010	-	-	-	-	-	-	-	-	-	-	3
SCR.V-14	0.015	E 0.008	0.010	-	-	-	-	-	-	-	-	-	-	3
SCR.V-17	E 0.006	E 0.007	-	-	-	-	-	-	-	-	-	-	-	2
SCR.V-23	E 0.007	-	E 0.005	E 0.012	-	-	-	-	-	-	-	-	-	3
SCR.V-25	0.010	E 0.006	E 0.005	E 0.009	E 0.006	E 0.006	E 0.008	E 0.005	E 0.005	E 0.007	-	-	-	10
SCR.V-26	E 0.005	-	-	-	-	-	-	-	-	-	-	-	-	1
SCR.V-29	E 0.005	-	-	-	-	-	-	-	-	-	-	-	-	1
SCR.V-31	E 0.005	-	-	-	-	-	-	-	-	-	-	-	-	1
SCR.V-32	-	E 0.006	-	-	-	-	-	-	-	-	-	-	-	1
SCR.V-33	0.016	E 0.031	E 0.006	-	-	-	-	-	-	-	-	-	-	3
SCR.V-35	-	E 0.018	-	-	-	-	-	-	-	-	-	-	-	1
SCR.V-42	0.027	E 0.005	E 0.006	-	-	-	-	-	-	-	E 0.005	E 0.02	-	5
Number of detections	11	9	7	2	1	1	1	1	1	1	1	1	1	
Detection frequency (percent)	26	21	17	4.8	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	131
Understanding wells														
SCR.VU-02	E 0.005	-	-	-	-	-	-	-	-	-	-	-	-	0.010
SCR.VU-03	0.008	-	-	-	-	-	-	-	-	-	-	-	-	-

¹Frequency of detecting at least one pesticide or pesticide degradate in grid wells.

Table 7. Potential wastewater-indicator compounds detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from the 42 grid wells and 11 understanding wells were analyzed. **Threshold type:** HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory, **GAMA identification No.:** SCR.V, Santa Clara River Valley study unit grid well; SCR.VU, Santa Clara River Valley study unit understanding well. **Abbreviations:** E, estimated value; LRL, laboratory reporting level; µg/L, micrograms per liter; na, not available; -, not detected]

GAMA identification no.	Cholesterol (µg/L) (62818)	Bis(2-ethylhexyl) phthalate (µg/L) (39100)	4-Octylphenol diethoxylates (µg/L) (61705)	Bisphenol A (µg/L) (62816)	Indole (µg/L) (62824)	2-Methyl-naphthalene (µg/L) (30194)	4-tert-Octylphenol (µg/L) (62810)	4-Octylphenol monoethoxylates (µg/L) (61706)	Phenol (µg/L) (34694)	p-Cresol (µg/L) (77146)	Detections per well
LRL	[0.8]	[2]	[0.32]	[0.4]	[0.2]	[0.2]	[0.2]	[1]	[0.2]	[0.2]	
Threshold type	na	na	na	na	na	na	na	na	HAL-US	na	
Threshold level	na	na	na	na	na	na	na	na	2,000	na	
Grid wells											
SCR.V-02	-	3	-	-	-	-	-	-	-	-	1
SCR.V-10	-	-	-	1.5	E 0.02	-	-	-	-	-	2
SCR.V-12	-	-	E 2	-	-	-	E 0.3	E 0.5	-	-	3
SCR.V-16	-	E 0.8	-	-	-	-	-	-	-	-	1
SCR.V-22	E 0.7	-	-	-	-	-	-	-	-	-	1
SCR.V-23	E 0.7	-	-	-	-	-	-	-	-	-	1
SCR.V-26	E 0.8	-	-	E 0.2	-	-	-	-	-	-	2
SCR.V-33	-	E 1	-	-	-	-	-	-	-	-	1
SCR.V-34	-	-	E 0.2	-	-	-	-	-	-	-	1
SCR.V-36	-	-	-	-	-	E 0.03	-	-	-	-	1
Number of detections	3	3	2	2	1	1	1	1	1	1	1 ²⁴
Detection frequency (percent)	7.1	7.1	4.8	4.8	2.4	2.4	2.4	2.4	2.4	2.4	
Understanding wells											
SCR.VU-03	-	18	-	-	-	-	-	-	-	-	1
SCR.VU-07	-	-	-	E 0.08	-	-	-	-	E 0.2	-	3

¹Frequency of detecting at least one potential wastewater-indicator compound in grid wells.

Table 8. Constituent of special interest (perchlorate) detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples analyzed by the Montgomery Watson Harza laboratory (laboratory entity code CA-MWHL). Samples from all 53 wells were analyzed for perchlorate; only wells with a detection are listed. SCR-V, Santa Clara River Valley study unit grid well; MRL, method reporting level; MCL-CA, California Department of Public Health maximum contaminant level; µg/L, microgram per liter]

GAMA identification no.	Perchlorate (µg/L) (61209)
Threshold type	MCL-CA
Threshold level	6
MRL	0.5
Grid wells	
SCR-V-04	0.84
SCR-V-13	3.0
SCR-V-28	1.7
SCR-V-35	4.2
SCR-V-38	1.9
Number of wells with detections	5
Detection frequency (percent)	12

Table 9. Nutrients and dissolved organic carbon detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from 17 intermediate wells and nine slow wells were analyzed, of which 16 were grid wells and 10 were understanding wells. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **GAMA identification No.:** SCR-V, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well. **Abbreviation:** E, estimated value; V, analyte detected in sample and an associated blank; thus, result is not considered a detection in ground-water quality assessment; mg/L, milligram per liter; na, not available; –, not detected]

GAMA identification no.	Total nitrogen (ammonia + nitrite + nitrate + organic-nitrogen) as nitrogen (mg/L) (62854)	Phosphorus, phosphate, orthophosphate (as phosphorus) (mg/L) (00671)	Nitrite plus nitrate, as nitrogen (mg/L) (00631)	Ammonia, as nitrogen (mg/L) (00608)	Nitrite, as nitrogen (mg/L) (00613)	Dissolved organic carbon (DOC) (mg/L) (00681)
LRL	[0.06]	[0.006]	[0.06]	[0.02]	[0.002]	[0.4]
Threshold type	na	na	MCL-US	HAL-US	MCL-US	na
Threshold level	na	na	10	24.7	1	na
Grid wells						
SCR-V-03	0.25	0.047	–	0.214	–	0.7
SCR-V-04	11.8	0.013	* 11.2	–	–	V 0.4
SCR-V-06	13.5	0.048	* 12.9	–	0.006	1.2
SCR-V-07	0.98	0.010	0.94	–	–	V 0.3
SCR-V-09	0.12	0.046	–	0.070	–	1.5
SCR-V-10	0.24	0.031	–	0.186	–	0.6
SCR-V-12	0.69	0.034	E 0.04	0.610	–	0.8
SCR-V-16	1.93	0.102	1.86	–	0.007	V 0.5
SCR-V-19	2.80	0.052	2.71	–	–	1.1
SCR-V-27	3.13	0.035	3.09	E 0.012	0.074	1.0
SCR-V-28	22.3	0.023	* 22.2	–	–	V 0.5
SCR-V-33	15.9	0.044	* 15.2	–	–	1.2
SCR-V-35	12.7	0.027	* 12.4	–	–	1.5
SCR-V-37	1.55	0.040	–	1.33	E 0.001	1.5
SCR-V-39	0.62	0.067	0.38	0.188	0.002	1.2
SCR-V-42	2.24	0.071	2.10	–	–	1.1
Understanding wells						
SCR-VU-01	2.16	0.031	2.07	–	0.006	0.9
SCR-VU-02	0.40	0.037	–	0.308	–	1.6
SCR-VU-03	2.38	0.071	2.34	–	0.005	1.4
SCR-VU-04	1.14	0.040	–	1.01	–	1.4
SCR-VU-06	0.99	0.033	–	0.855	0.004	0.8
SCR-VU-07	6.21	0.058	–	5.88	0.003	4.8
SCR-VU-08	3.48	0.061	–	3.73	–	–
SCR-VU-09	3.89	0.198	–	3.80	–	–
SCR-VU-10	2.99	0.066	–	3.31	0.002	–
SCR-VU-11	1.16	0.027	–	0.991	–	1.5

¹The HAL-US is 30 mg/L “as ammonia.” To facilitate comparison to the analytical results, we have converted and reported this HAL-US as 24.7 mg/L “as nitrogen.”

*Indicates value above or equal to the threshold level.

Table 10. Major and minor ions and dissolved solids detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parenthesis below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from 17 intermediate wells and 9 slow wells were sampled, of which 16 were grid wells and 10 were understanding wells. The 4 depth dependent samples were analyzed. SMCL-CA, California Department of Public Health secondary maximum contaminant level; Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **GAMA identification No.:** SCR, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** LRL, laboratory reporting level; mg/L, milligram per liter; E, estimated value; na, not available; -, not detected. Bicarbonate and carbonate concentrations were calculated from the alkalinity and pH values (table 4) using the advanced speciation method (<http://or.water.usgs.gov/alk/methods.html>) with $pK^1 = 6.35$, $pK^2 = 10.33$, and $pK_w = 14$. pK_1 , equals $-\log_{10}(K_1)$, where K_1 is the first acid dissociation constant of carbonic acid; pK_2 , equals $-\log_{10}(K_2)$, where K_2 is the second acid dissociation constant of carbonic acid; pK_w , equals $-\log_{10}(K_w)$, where K_w is the acid dissociation constant of water]

GAMA identification no.	Calcium (mg/L) (00915)	Magnesium (mg/L) (00925)	Potassium (mg/L) (00935)	Sodium (mg/L) (00930)	Bicarbonate (mg/L)	Carbonate (mg/L)	Bromide (mg/L) (71870)	Chloride (mg/L) (00940)	Fluoride (mg/L) (00950)	Iodide (mg/L) (71865)	Siica (mg/L) (00955)	Sulfate (mg/L) (00945)	Total dissolved solids (TDS) (mg/L) (70300)
[LRL]	[0.02]	[0.014]	[0.04]	[0.2]	na	na	[0.02]	[0.12]	[0.1]	[0.002]	[0.018]	[0.18]	[10]
Threshold type ¹	na	na	na	na	na	na	na	SMCL-CA ¹	MCL-CA	na	na	SMCL-CA ¹	SMCL-CA ¹
Threshold level	na	na	na	na	1	1	na	250 (500)	2	na	na	250 (500)	500 (1000)
Grid wells													
SCR-V-03	56.9	29.1	2.85	101	304	1	0.33	61.2	0.25	0.114	44.2	137	* 604
SCR-V-04	136	31.4	1.13	31.8	292	-	0.06	13.9	0.35	-	22.9	225	* 681
SCR-V-06	210	72.3	5.53	115	316	-	2.67	65.3	0.67	0.013	30.4	** 673	** 1,490
SCR-V-07	108	26.6	1.94	39.7	227	-	0.07	23.7	0.57	-	15.8	227	* 596
SCR-V-09	292	71.4	4.53	105	350	-	1.02	84.4	0.46	0.187	36.4	** 811	** 1,700
SCR-V-10	118	33.6	4.61	81.8	239	-	0.25	37.2	0.67	0.04	34.8	* 343	* 818
SCR-V-12	128	31.3	4.72	87.2	240	-	0.27	42.2	0.32	0.041	33.2	* 367	* 871
SCR-V-16	138	45.1	4.14	96.4	279	-	0.2	39.3	0.69	0.027	30.6	* 448	** 1,030
SCR-V-19	128	44.4	4.48	81.6	247	-	0.23	50.1	0.85	0.003	25.8	* 387	* 924
SCR-V-27	164	52.6	4.96	136	291	-	0.52	64.4	0.61	0.029	31.6	** 572	** 1,280
SCR-V-28	206	55.7	1.95	67.8	321	-	0.28	51.2	0.6	0.002	22.4	* 483	** 1,190
SCR-V-33	261	85.8	5.25	271	375	-	1.15	240	0.31	0.018	39	** 905	** 2,250
SCR-V-35	271	81.9	4.27	170	306	-	0.9	152	0.55	0.01	42.9	** 893	** 2,010
SCR-V-37	118	40.8	8.17	205	339	-	2.61	* 433	0.31	0.715	39.6	39.5	** 1,080
SCR-V-39	198	64.8	6.03	187	373	-	0.94	88	0.6	0.125	33.7	** 719	** 1,580
SCR-V-42	91.1	35.2	4.57	98.4	236	-	0.25	85.8	0.61	0.007	19.4	* 268	* 774

Table 10. Major and minor ions and dissolved solids detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five digit number in parenthesis below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from 17 intermediate wells and 9 slow wells were sampled, of which 16 were grid wells and 10 were understanding wells. The 4 depth dependent samples were analyzed. SMCL-CA, California Department of Public Health secondary maximum contaminant level; Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **GAMA identification No.:** SCRUV, Santa Clara River Valley study unit grid well; SCRUVU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** LRL, laboratory reporting level; mg/L, milligram per liter; E, estimated value; na, not available; -, not detected. Bicarbonate and carbonate concentrations were calculated from the alkalinity and pH values (table 4) using the advanced speciation method (<http://or.water.usgs.gov/alk/methods.html>) with $pK_1 = 6.35$, $pK_2 = 10.33$, and $pK_w = 14$, pK_1 equals $-\log_10(K_1)$, where K_1 is the first acid dissociation constant of carbonic acid; pK_2 , equals $-\log_10(K_2)$, where K_2 is the second acid dissociation constant of carbonic acid; pK_w , equals $-\log_10(K_w)$, where K_w is the acid dissociation constant of water]

GAMA identification no.	Calcium (mg/L) (00915)	Magnesium (mg/L) (00925)	Potassium (mg/L) (00935)	Sodium (mg/L) (00930)	Bicarbonate (mg/L)	Carbonate (mg/L)	Bromide (mg/L) (71870)	Chloride (mg/L) (00940)	Fluoride (mg/L) (00950)	Iodide (mg/L) (71865)	Silica (mg/L) (00955)	Sulfate (mg/L) (00945)	Total dissolved solids (TDS) (mg/L) (70300)
[LRL]	[0.02]	[0.014]	[0.04]	[0.2]	na	na	[0.02]	[0.12]	[0.1]	[0.002]	[0.018]	[0.18]	[10]
Threshold type ¹	na	na	na	na	na	na	na	SMCL-CA ¹	MCL-CA	na	na	SMCL-CA ¹	SMCL-CA ¹
Threshold level	na	na	na	na	1	1	na	250 (500)	2	na	na	250 (500)	500 (1000)
Understanding wells													
SCRUVU-01	140	48.2	4.50	101	253	-	0.43	45.5	0.76	0.012	30.1	* 461	** 1,050
SCRUVU-02	214	52.1	5.33	139	270	-	0.7	148	0.22	0.05	33.8	** 586	** 1,400
SCRUVU-03	153	57.4	4.55	103	267	-	0.32	66.3	0.64	0.008	18.7	** 518	** 1,140
SCRUVU-04	92.5	32.3	6.80	246	383	1	1.12	188	0.42	0.235	42.2	* 316	** 1,150
DD-01	93.8	33.4	6.84	259	405	1	1.22	203	0.44	0.348	41.5	* 333	** 1,220
DD-02	93.2	34.4	7.32	284	429	1	1.35	223	0.43	0.360	41.6	* 336	** 1,270
DD-03	35.8	22.2	10.3	484	645	2	2.72	* 412	0.52	0.859	47.8	201	** 1,570
DD-04	28.2	22.4	13.0	571	689	8	3.03	* 463	0.5	0.857	51.6	184	** 1,700
SCRUVU-06	76.7	31.3	6.88	117	290	-	0.54	94.7	0.37	0.105	36.7	214	* 713
SCRUVU-07	1,700	707	28.8	539	179	-	43.7	** 6,130	0.12	12.6	41.4	< 4.50	** 11,200
SCRUVU-08	799	425	25.8	1,660	242	-	16.9	** 4,730	0.16	0.245	50.1	** 635	** 8,740
SCRUVU-09	321	215	38.2	2,110	345	-	15.1	** 4,060	0.43	0.647	23.4	* 330	** 7,640
SCRUVU-10	662	1,110	240	8,140	201	-	57.4	** 16,100	0.18	0.213	34.3	** 2,060	** 30,000
SCRUVU-11	70.7	40.0	7.98	220	337	-	1.32	232	0.34	0.335	51.2	247	** 1,080

* Indicates value is above or equal to recommended threshold level.

** Indicates value is above or equal to upper threshold level.

¹ The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses.

Table 11. Trace elements detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from 17 intermediate wells and 9 slow wells were analyzed, of which 16 were grid wells and 10 were understanding wells. **Threshold type:** SMCL-CA, California Department of Public Health secondary maximum contaminant level; Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; AL-US, U.S. Environmental Protection Agency action level. **GAMA identification No.:** SCR.V, Santa Clara River Valley study unit grid well; SCR.VU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** E, estimated value; LRL, laboratory reporting level; na, not available; µg/L, microgram per liter; -, not detected]

GAMA identification no.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)	Lithium (µg/L) (01130)
LRL	[1.6]	[0.06]	[0.12]	[0.08]	[8]	[0.04]	[0.12]	[0.04]	[0.4]	[6]	[0.12]	[0.6]
Threshold type	MCL-CA	MCL-US	MCL-US	MCL-CA	NL-CA	MCL-US	MCL-CA	na	AL-US	SMCL-CA	AL-US	na
Threshold level	1000	6	10	1,000	1,000	5	50	na	1,300	300	15	na
Grid wells												
SCR.V-03	-	-	0.69	46	327	0.04	-	-	-	76	E 0.09	22.4
SCR.V-04	-	-	E 0.07	54	29	E 0.02	0.12	-	0.93	9	1.13	18.7
SCR.V-06	1.6	0.14	0.87	52	759	0.29	0.15	E 0.03	3.1	14	0.64	57.0
SCR.V-07	-	E 0.04	E 0.10	23	398	-	0.14	-	1.1	-	0.28	40.4
SCR.V-09	-	E 0.03	1.5	30	469	-	-	0.06	-	* 1,420	0.4	57.6
SCR.V-10	2.6	-	-	26	570	E 0.03	-	-	-	* 906	-	33.0
SCR.V-12	E 1.2	-	0.53	42	556	0.04	-	E 0.03	-	* 319	E 0.11	40.5
SCR.V-16	E 0.9	0.06	0.55	21	616	0.31	-	0.18	0.53	E 3	0.35	35.5
SCR.V-19	-	0.14	0.72	21	511	0.19	0.29	-	E 1.1	E 3	E 0.1	28.9
SCR.V-27	-	-	0.71	21	478	0.20	-	0.08	2.3	44	1.28	48.8
SCR.V-28	-	E 0.03	E 0.10	45	159	0.04	0.17	0.04	0.75	30	E 0.11	39.1
SCR.V-33	E 3.1	0.16	1.6	20	867	0.14	2.6	E 0.06	2.3	-	3.24	76.4
SCR.V-35	-	0.11	0.79	16	978	0.09	2.3	E 0.03	2.1	-	0.52	64.6
SCR.V-37	-	E 0.03	0.18	131	690	-	-	E 0.03	E 0.26	* 330	-	57.0
SCR.V-39	E 0.9	0.09	3.0	26	659	0.05	-	0.06	0.42	* 934	0.43	109
SCR.V-42	-	0.10	0.66	25	506	0.05	0.25	0.26	1.6	8	-	29.0

Table 11. Trace elements detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from 17 intermediate wells and 9 slow wells were analyzed, of which 16 were grid wells and 10 were understanding wells. **Threshold type:** SMCL-CA, California Department of Public Health secondary maximum contaminant level; Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; AL-US, U.S. Environmental Protection Agency action level. **GAMA identification No.:** SCR, Santa Clara River Valley study unit grid well; SCR, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** E, estimated value; LRL, laboratory reporting level; na, not available; µg/L, microgram per liter; -, not detected]

GAMA identification no.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)	Lithium (µg/L) (01130)
LRL	[1.6]	[0.06]	[0.12]	[0.08]	[8]	[0.04]	[0.12]	[0.04]	[0.4]	[6]	[0.12]	[0.6]
Threshold type	MCL-CA	MCL-US	MCL-US	MCL-CA	NL-CA	MCL-US	MCL-CA	na	AL-US	SMCL-CA	AL-US	na
Threshold level	1000	6	10	1,000	1,000	5	50	na	1,300	300	15	na
Understanding wells												
SCR, VU-01	-	0.26	0.96	22	610	0.24	E 0.11	0.06	1.3	7	0.31	44.0
SCR, VU-02	E 0.9	E 0.03	0.92	63	459	0.04	-	0.04	-	137	E 0.06	45.1
SCR, VU-03	-	0.23	1.2	26	744	0.21	E 0.1	0.06	2.7	13	0.55	41.5
SCR, VU-04	3.1	-	E 0.11	36	757	E 0.02	E 0.07	-	-	128	-	48.3
DD-01	-	-	E 0.10	39	798	-	E 0.07	E 0.03	-	106	-	53.3
DD-02	E 1.2	-	E 0.07	40	859	-	E 0.09	E 0.02	-	75	-	56.2
DD-03	-	-	E 0.16	71	* 1,470	-	E 0.18	E 0.04	-	18	-	71.4
DD-04	-	-	0.24	102	* 1,620	-	E 0.22	E 0.04	-	E 14	-	82.7
SCR, VU-06	2.8	-	0.86	65	220	0.07	-	0.07	E 0.32	62	-	47.0
SCR, VU-07	-	-	1.2	* 2,730	565	E 0.2	-	E 0.19	-	* 7,960	-	208
SCR, VU-08	-	-	-	156	689	-	1.8	-	-	-	-	176
SCR, VU-09	-	-	-	145	* 2,330	-	-	-	-	-	-	150
SCR, VU-10	-	E 0.63	-	108	* 2,620	-	E 2.4	-	-	* 10,200	-	198
SCR, VU-11	E 1.2	-	-	81	655	-	-	-	-	17	-	59.0

Table 11. Trace elements detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from 17 intermediate wells and 9 slow wells were analyzed, of which 16 were grid wells and 10 were understanding wells. **Threshold type:** SMCL-CA, California Department of Public Health secondary maximum contaminant level; Maximum contaminant level thresholds are listed as MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; AL-US, U.S. Environmental Protection Agency action level. **GAMA identification No.:** SCR-V, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** E, estimated value; LRL, laboratory reporting level; na, not available; µg/L, microgram per liter; -, not detected]

GAMA identification no.	Manganese (µg/L) (01056)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Silver (µg/L) (01075)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Uranium (µg/L) (22703)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)
[LRL]	[0.2]	[0.12]	[0.06]	[0.08]	[0.1]	[0.4]	[0.04]	[0.06]	[0.04]	[0.04]	[0.6]
Threshold type	SMCL-CA	HAL-US	MCL-CA	MCL-US	SMCL-CA	HAL-US	MCL-US	na	MCL-US	NL-CA	SMCL-CA
Threshold level	50	40	100	50	100	4,000	2	na	30	50	5,000
Grid wells											
SCR-V-03	* 66.5	16.6	0.17	-	-	510	-	0.06	0.06	0.08	-
SCR-V-04	0.4	0.6	0.15	0.79	-	945	-	-	1.19	0.36	21.4
SCR-V-06	17.5	10.9	4.7	20.5	-	1,980	-	E 0.05	17.3	3.2	9.9
SCR-V-07	-	0.9	0.18	0.84	-	1,260	-	E 0.05	0.86	0.45	11.0
SCR-V-09	* 230	8.3	0.43	E 0.05	-	1,880	-	E 0.04	6.06	0.07	3.5
SCR-V-10	* 174	18.9	0.25	-	-	926	-	E 0.05	0.16	0.04	12.8
SCR-V-12	* 188	15.5	0.16	-	-	1,140	-	0.10	0.33	0.78	5.0
SCR-V-16	* 396	12.8	1.1	5.2	-	1,060	-	E 0.04	6.78	2.8	3.6
SCR-V-19	E 0.1	20.9	0.54	4.8	-	1,190	-	-	7.49	3.0	4.3
SCR-V-27	* 243	16.0	0.26	25.1	-	1,430	-	E 0.04	5.61	2.0	3.7
SCR-V-28	1.9	1.7	0.28	6.1	-	787	-	-	6.76	0.53	15.1
SCR-V-33	11.7	20.2	0.76	23.3	-	2,670	-	-	26.8	7.2	8.5
SCR-V-35	-	28.2	0.79	49.5	-	2,420	-	-	23	7.8	13.7
SCR-V-37	* 176	0.8	0.21	-	-	1,280	-	-	0.4	0.14	8.6
SCR-V-39	* 253	26.2	0.39	2.1	-	1,420	-	E 0.03	19.5	0.3	8.9
SCR-V-42	0.5	10.5	2.9	1.9	-	726	-	-	4.55	0.81	2.6

Table 11. Trace elements detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Samples from 17 intermediate wells and 9 slow wells were analyzed, of which 16 were grid wells and 10 were understanding wells. **Threshold type:** SMCL-CA, California Department of Public Health secondary maximum contaminant level; Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; AL-US, U.S. Environmental Protection Agency action level. **GAMA identification No.:** SCR, Santa Clara River Valley study unit grid well; SCR, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** E, estimated value; LRL, laboratory reporting level; na, not available; µg/L, microgram per liter; -, not detected]

GAMA identification no.	Manganese (µg/L) (01056)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Silver (µg/L) (01075)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Uranium (µg/L) (22703)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)
[LRL]	[0.2]	[0.12]	[0.06]	[0.08]	[0.1]	[0.4]	[0.04]	[0.06]	[0.04]	[0.04]	[0.6]
Threshold type	SMCL-CA	HAL-US	MCL-CA	MCL-US	SMCL-CA	HAL-US	MCL-US	na	MCL-US	NL-CA	SMCL-CA
Threshold level	50	40	100	50	100	4,000	2	na	30	50	5,000
Understanding wells											
SCR, VU-01	5.5	17.0	0.42	10.3	-	1,330	-	-	9.15	10	4.5
SCR, VU-02	* 149	15.0	3.4	E 0.05	-	1,460	-	-	3.99	0.25	2.2
SCR, VU-03	0.6	20.4	0.77	4.1	-	1,470	-	0.07	11.8	1.6	3.0
SCR, VU-04	27.6	8.4	0.07	-	-	829	-	0.09	0.97	0.19	-
DD-01	26.7	6.3	0.36	-	-	840	E 0.03	0.10	0.78	0.14	-
DD-02	23.9	5.6	0.4	-	-	832	-	0.11	0.64	0.13	0.83
DD-03	3.8	E 0.2	0.2	-	-	523	-	0.44	0.2	0.32	-
DD-04	2.8	-	E 0.1	-	-	516	-	0.4	E 0.06	0.52	-
SCR, VU-06	* 155	7.6	0.41	-	-	894	-	1.2	0.36	0.3	2.1
SCR, VU-07	* 2,370	0.8	1.1	-	1.4	* 22,000	-	E 0.35	-	0.51	6.4
SCR, VU-08	* 186	-	0.60	1.9	na	* 11,900	-	-	-	0.39	E 1.9
SCR, VU-09	* 221	-	0.44	2.3	na	* 5,490	-	E 0.29	-	0.35	-
SCR, VU-10	* 784	10.0	E 0.91	-	na	* 10,700	-	-	-	1.4	-
SCR, VU-11	8.9	0.2	-	E 0.05	-	1,110	-	0.06	0.04	0.05	-

*Indicates value is above or equal to threshold level.

Table 12. Species of inorganic arsenic, iron, and chromium in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Analyses made by the U.S. Geological Survey Trace Metals Laboratory (laboratory entity code USGSTMCO). Samples from 26 intermediate and slow wells were analyzed for iron, arsenic, and chromium. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **GAMA identification No.:** SCR-V, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well. **Abbreviations:** MDL, method detection level; V, analyte detected in sample and an associated blank, thus data are not included in ground-water quality assessment; na, not available; µg/L, microgram per liter; <, less than]

GAMA identification no.	Iron (µg/L) (01046)	Iron(II) (µg/L) (01047)	Arsenic (µg/L) (99033)	Arsenic(III) (µg/L) (99034)	Chromium (µg/L) (01030)	Chromium(VI) (µg/L) (01032)
Threshold type ¹	SMCL-CA	na	MCL-US	na	MCL-CA	na
Threshold level [MDL]	300 [2]	na [2]	10 [0.5]	na [1]	50 [1]	na [1]
Grid wells						
SCR-V-03	74	74	<0.5	<1	<1	<1
SCR-V-04	8	3	<0.5	<1	<1	<1
SCR-V-06	17	5	<0.5	<1	<1	<1
SCR-V-07	5	<2	<0.5	<1	<1	<1
SCR-V-09	*1,590	1,270	<0.5	<1	<1	<1
SCR-V-10	* 855	659	<0.5	<1	<1	<1
SCR-V-12	* 321	321	<0.5	<1	<1	<1
SCR-V-16	V 4	3	<0.5	<1	<1	<1
SCR-V-19	V 2	2	<0.5	<1	<1	<1
SCR-V-27	42	4	<0.5	<1	<1	<1
SCR-V-28	31	22	0.61	<1	<1	<1
SCR-V-33	V 3	<2	<0.5	<1	1	1
SCR-V-35	V 2	2	<0.5	<1	2	2
SCR-V-37	* 320	322	<0.5	<1	<1	<1
SCR-V-39	* 914	836	1.3	<1	<1	<1
SCR-V-42	6	3	<0.5	<1	<1	<1
Understanding wells						
SCR-VU-01	7	4	<0.5	<1	<1	<1
SCR-VU-02	134	118	0.99	<1	<1	<1
SCR-VU-03	13	4	<0.5	<1	<1	<1
SCR-VU-04	140	140	<0.5	<1	<1	<1
SCR-VU-06	56	26	<0.5	<1	<1	<1
SCR-VU-07	* 8,160	7,590	0.75	<1	<1	<1
SCR-VU-08	3	3	6	<1	<1	<1
SCR-VU-09	14	14	5.5	<1	<1	<1
SCR-VU-10	* 9,630	9,500	<0.5	<1	2	<1
SCR-VU-11	17	17	3.6	<1	<1	<1

*Indicates value is above or equal to threshold level.

Table 13. Results for analyses of stable isotope ratios and tritium and carbon-14 activities in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Laboratory entity codes are listed in the footnotes. Samples from all 53 wells and four depth dependent were analyzed for stable isotopes of water and tritium; samples from fourteen of the intermediate and slow wells were analyzed for nitrogen (N) and oxygen (O) isotopic ratios of nitrate; samples from the nine slow wells were analyzed for carbon isotopes. Eleven samples from slow and intermediate wells and one depth-dependent sample were analyzed for stable isotopes of chloride (Cl) and bromide (Br). Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **GAMA identification No.:** SCR.V, Santa Clara River Valley study unit grid well; SCR.VU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** na, not available; nc, not collected; -, not detected; pCi/L, picocurie per liter; <, less than]

GAMA identification no.	$\delta^{18}\text{O}$ of H_2O (per mil) (82082) ¹	$\delta^{18}\text{O}$ of H_2O (per mil) (82085) ¹	Tritium (pCi/L) (07000) ²	$\delta^{15}\text{N}$ of Nitrate (per mil) (82690) ²	$\delta^{18}\text{O}$ of Nitrate (per mil) (63041) ²	$\delta^{13}\text{C}$ (per mil) (82081) ³	Carbon-14 (percent modern) (49933) ⁴	$\delta^{37}\text{Cl}$ (per mil) (82725) ³	$\delta^{81}\text{Br}$ (per mil) (82726) ³
Threshold type	na	na	MCL-CA	na	na	na	na	na	na
Threshold level	na	na	20,000	na	na	na	na	na	na
Grid wells									
SCR.V-01	-50.4	-7.45	-	nc	nc	nc	nc	nc	nc
SCR.V-02	-46.4	-6.95	0.6	nc	nc	nc	nc	nc	nc
SCR.V-03	-44.5	-6.71	-	-	-	-14.18	13.65	0.03	0.72
SCR.V-04	-41.0	-6.16	6.7	3.43	5.67	nc	nc	nc	nc
SCR.V-05	-51.6	-7.74	5.8	nc	nc	nc	nc	nc	nc
SCR.V-06	-48.2	-7.16	6.7	10.26	10.74	nc	nc	nc	nc
SCR.V-07	-46.1	-7.23	5.1	5.58	4.28	-11.41	88.92	0.45	1.16
SCR.V-08	-42.4	-6.46	-	nc	nc	nc	nc	nc	nc
SCR.V-09	-43.8	-6.78	0.3	-	-	nc	nc	nc	nc
SCR.V-10	-51.3	-7.65	0.3	-	-	-9.91	62.22	0.37	0.72
SCR.V-11	-38.7	-5.51	1.6	nc	nc	nc	nc	nc	nc
SCR.V-12	-49.6	-7.43	1.0	8.15	2.99	-10.84	39.32	-0.01	0.56
SCR.V-13	-39.1	-5.48	8.3	nc	nc	nc	nc	nc	nc
SCR.V-14	-36.8	-5.46	-	nc	nc	nc	nc	nc	nc
SCR.V-15	-47.1	-7.30	3.2	nc	nc	nc	nc	nc	nc
SCR.V-16	-52.1	-7.61	5.1	11.24	10.61	nc	nc	nc	nc
SCR.V-17	-45.1	-6.73	6.7	nc	nc	nc	nc	nc	nc
SCR.V-18	-45.8	-7.11	0.3	nc	nc	nc	nc	nc	nc
SCR.V-19	-54.0	-7.34	8.0	7.16	4.95	nc	nc	nc	nc
SCR.V-20	-41.6	-6.65	-	nc	nc	nc	nc	nc	nc
SCR.V-21	-46.0	-6.78	0.6	nc	nc	nc	nc	nc	nc
SCR.V-22	-42.9	-6.72	0.3	nc	nc	nc	nc	nc	nc
SCR.V-23	-62.0	-7.63	9.0	nc	nc	nc	nc	nc	nc
SCR.V-24	-49.7	-6.99	6.7	nc	nc	nc	nc	nc	nc
SCR.V-25	-68.0	-9.01	7.7	nc	nc	nc	nc	nc	nc
SCR.V-26	-56.4	-7.22	9.9	nc	nc	nc	nc	nc	nc
SCR.V-27	-50.1	-7.26	3.2	16.74	11.85	nc	nc	nc	nc
SCR.V-28	-43.6	-6.60	3.5	6.03	5.77	nc	nc	nc	nc
SCR.V-29	-51.6	-7.26	11.5	nc	nc	nc	nc	nc	nc
SCR.V-30	-60.7	-8.71	9.0	nc	nc	nc	nc	nc	nc
SCR.V-31	-69.7	-9.42	10.2	nc	nc	nc	nc	nc	nc
SCR.V-32	-44.1	-6.46	3.2	nc	nc	nc	nc	nc	nc
SCR.V-33	-38.8	-5.92	4.5	5.68	4.86	nc	nc	nc	nc
SCR.V-34	-46.9	-7.36	-	nc	nc	nc	nc	nc	nc
SCR.V-35	-45.0	-6.78	9.0	6.74	3.34	-11.58	66.04	0.09	0.56
SCR.V-36	-55.8	-7.69	8.3	nc	nc	nc	nc	nc	nc
SCR.V-37	-48.5	-7.27	0.6	-	-	nc	nc	-0.12	0.17
SCR.V-38	-46.5	-7.16	1.9	nc	nc	nc	nc	nc	nc

Table 13. Results for analyses of stable isotope ratios and tritium and carbon-14 activities in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Laboratory entity codes are listed in the footnotes. Samples from all 53 wells and four depth dependent were analyzed for stable isotopes of water and tritium; samples from fourteen of the intermediate and slow wells were analyzed for nitrogen (N) and oxygen (O) isotopic ratios of nitrate; samples from the nine slow wells were analyzed for carbon isotopes. Eleven samples from slow and intermediate wells and one depth-dependent sample were analyzed for stable isotopes of chloride (Cl) and bromide (Br). Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **GAMA identification No.:** SCR/V, Santa Clara River Valley study unit grid well; SCR/VU, Santa Clara River Valley study unit understanding well; DD, depth dependent sample. **Abbreviations:** na, not available; nc, not collected; –, not detected; pCi/L, picocurie per liter; <, less than]

GAMA identification no.	$\delta^{18}\text{O}$ of H_2O (per mil) (82082) ¹	$\delta^{18}\text{O}$ of H_2O (per mil) (82085) ¹	Tritium (pCi/L) (07000) ²	$\delta^{15}\text{N}$ of Nitrate (per mil) (82690) ²	$\delta^{18}\text{O}$ of Nitrate (per mil) (63041) ²	$\delta^{13}\text{C}$ (per mil) (82081) ³	Carbon-14 (percent modern) (49933) ⁴	$\delta^{37}\text{Cl}$ (per mil) (82725) ³	$\delta^{81}\text{Br}$ (per mil) (82726) ³
Threshold type	na	na	MCL-CA	na	na	na	na	na	na
Threshold level	na	na	20,000	na	na	na	na	na	na
Grid wells—Continued									
SCR/V-39	-44.4	-6.80	–	36.21	26.05	nc	nc	nc	nc
SCR/V-40	-66.4	-9.34	5.1	nc	nc	nc	nc	nc	nc
SCR/V-41	-50.5	-7.22	7.4	nc	nc	nc	nc	nc	nc
SCR/V-42	-56.1	-7.65	11.5	13.12	3.89	nc	nc	nc	nc
Understanding wells									
SCR/VU-01	-50.3	-7.41	6.4	9.36	6.36	-10.49	84.14	0.24	1.22
SCR/VU-02	-49.3	-6.69	8.6	–	–	-13.41	67.83	0.43	1.16
SCR/VU-03	-49.1	-6.96	6.3	13.44	5.49	-9.79	87.76	-0.06	0.97
SCR/VU-04	-44.1	-6.66	0.6	–	–	-16.18	25.22	0.21	0.91
DD-01	-43.0	-6.69	nc	nc	nc	nc	nc	nc	nc
DD-02	-43.0	-6.69	nc	nc	nc	nc	nc	nc	nc
DD-03	-44.6	-6.98	nc	nc	nc	nc	nc	nc	nc
DD-04	-46.4	-7.06	nc	nc	nc	nc	nc	-0.04	0.96
SCR/VU-05	-68.8	-9.37	9.6	nc	nc	nc	nc	nc	nc
SCR/VU-06	-42.2	-6.59	–	–	–	nc	nc	0.16	0.64
SCR/VU-07	-39.0	-6.06	–	–	–	nc	nc	0.11	0.13
SCR/VU-08	-36.1	-5.66	0.3	–	–	nc	nc	0.14	0.11
SCR/VU-09	-41.2	-6.18	–	–	–	nc	nc	0.33	0.23
SCR/VU-10	-9.2	-1.46	1.3	–	–	nc	nc	-0.11	-0.15
SCR/VU-11	-44.1	-6.76	–	–	–	nc	nc	-0.08	0.64

¹USGS Stable Isotope Laboratory, Reston, Virginia (USGSSIVA).²USGS Stable Isotope and Tritium Laboratory, Menlo Park, California (USGSH3CA).³University of Waterloo (contract laboratory) (CAN-UWIL).⁴University of Arizona, Accelerator Mass Spectrometry Laboratory (contract laboratory) (AZ-UAMSL).

Table 14. Results for analyses of noble gases in and helium isotope ratios derived for samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Analyses made by the Lawrence Livermore National Laboratory (laboratory entity code CA-LLNL). Samples from all 53 wells were analyzed. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **GAMA identification No.:** SCR-V, Santa Clara River Valley study unit grid well; SCR-VU, Santa Clara River Valley study unit understanding well. **Abbreviations:** cm³ STP/g⁻¹ H₂O, cubic centimeters at standard temperature and pressure per gram of water; na, not available; nc, sample not collected; pCi/L, picocurie per liter; nc, not collected]

GAMA identification no.	Helium-3/ Helium-4 (atom ratio) (61040)	Helium-4 (85561)	Neon (61046)	Argon (85563)	Krypton (85565)	Xenon (85567)
	(cm ³ STP/g ⁻¹ H ₂ O)					
Threshold type	na	na	na	na	na	na
Threshold level	na	na	na	na	na	na
Grid wells—Continued						
SCR-V-36	1.37E-06	1.01E-07	4.00E-07	3.95E-04	8.06E-08	9.96E-09
SCR-V-37	nc	nc	nc	nc	nc	nc
SCR-V-38	1.06E-06	1.99E-07	7.28E-07	4.78E-04	9.16E-08	1.09E-08
SCR-V-39	1.22E-06	7.32E-08	2.75E-07	3.64E-04	7.59E-08	1.02E-08
SCR-V-41	1.45E-06	1.17E-07	4.49E-07	4.81E-04	9.42E-08	1.13E-08
SCR-V-42	1.39E-06	1.18E-07	4.17E-07	4.12E-04	7.95E-08	1.04E-08
Understanding wells						
SCR-VU-01	1.48E-06	1.51E-07	5.71E-07	4.96E-04	9.17E-08	1.13E-08
SCR-VU-02	8.93E-07	6.79E-07	8.17E-07	7.10E-04	1.24E-07	1.37E-08
SCR-VU-03	1.38E-06	5.99E-08	2.50E-07	3.43E-04	7.35E-08	9.99E-09
SCR-VU-04	7.12E-07	4.33E-07	2.35E-07	3.82E-04	7.54E-08	1.02E-08
SCR-VU-05	1.12E-06	8.66E-08	2.80E-07	3.55E-04	7.27E-08	9.95E-09
SCR-VU-06	8.22E-07	2.41E-07	2.39E-07	3.36E-04	7.28E-08	1.00E-08
SCR-VU-07	nc	nc	nc	nc	nc	nc
SCR-VU-08	nc	nc	nc	nc	nc	nc
SCR-VU-09	nc	nc	nc	nc	nc	nc
SCR-VU-10	1.18E-06	1.78E-07	2.45E-07	3.16E-04	6.43E-08	8.59E-09
SCR-VU-11	9.00E-07	9.36E-07	2.34E-07	4.20E-04	7.42E-08	1.00E-08

Table 15. Radioactive constituents detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. Analyses made by Eberline Services (laboratory entity code CA-EBRL). A total of nine samples from slow wells were analyzed. Five of the wells sampled were grid wells and four wells were understanding wells. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; **GAMA identification No.:** SCR.V, Santa Clara River Valley study unit grid well; SCR.VU, Santa Clara River Valley study unit understanding well. **Abbreviations:** E, estimated value; pCi/L, picocurie per liter; <, less than]

GAMA identification no.	Radium-226 (pCi/L) (99915)	Radium-228 (pCi/L) (99916)	Radon-222 (pCi/L) (82303)	Gross alpha radioactivity, 72-hour count (pCi/L) (99920)	Gross alpha radioactivity, 30-day count (pCi/L) (99921)	Gross beta radioactivity, 72-hour count (pCi/L) (99922)	Gross beta radioactivity, 30-day count (pCi/L) (99923)
Threshold type	MCL-US	MCL-US	Proposed MCLs-US	MCL-US	MCL-US	MCL-US	MCL-US
Threshold value	¹ 5	¹ 5	² 300 (4,000)	15	15	50	50
Grid wells							
SCR.V-03	0.12	0.55	220	< 3.3	< 2.9	E 3.5	2.8
SCR.V-07	E 0.03	< 0.42	* 910	< 3.6	< 2.9	2.0	3.0
SCR.V-10	0.17	E 0.39	200	< 5.5	< 4.1	4.5	5.0
SCR.V-12	0.21	0.46	140	< 3.7	< 4.0	5.6	5.4
SCR.V-35	0.10	0.10	* 960	* E 15.4	< 11	E 5.2	9.9
Understanding wells							
SCR.VU-01	0.29	0.71	* 560	E 6.2	E 4.3	5.0	6.4
SCR.VU-02	0.27	0.71	* 570	E 8.9	* E 15.3	7.6	9.9
SCR.VU-03	0.15	< 0.44	* 600	E 5.1	E 5.5	E 4.4	6.8
SCR.VU-04	0.31	0.68	* 350	E 3.8	< 6.9	6.3	5.4

* Value exceeds lower threshold.

¹The MCL-US threshold for radium is the sum of the radium-226 and radium-228 thresholds.

²Two MCLs have been proposed for Radon-222. The proposed alternative MCL is in parentheses.

Table 16. Microbial indicator results for samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[The five digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 29, 2007. A total of nine samples from slow wells were analyzed. Five of the wells sampled were grid wells and four wells were understanding wells. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique - a required process intended to reduce the level of contamination in drinking water. **GAMA identification No.:** SCR.V, Santa Clara River Valley study unit grid well; SCR.VU, Santa Clara River Valley study unit understanding well. **Abbreviations:** mL, milliliter; E, estimated value]

GAMA identification no.	F-specific coliphage (units) (99335)	Somatic coliphage (99332)	<i>Escherichia coli</i> colonies/ 100mL (90901)	Total coliform colonies/ 100mL (90900)
Threshold type	TT-US	TT-US	TT-US	MCL-US
Threshold level	99.9% Killed/Inactive	99.9% Killed/Inactive	No fecal coliforms are allowed	5% of samples per month
Grid wells				
SCR.V-03	—	—	—	—
SCR.V-07	—	—	—	—
SCR.V-10	—	—	—	—
SCR.V-12	—	—	—	—
SCR.V-35	—	—	—	—
Understanding wells				
SCR.VU-01	—	—	—	—
SCR.VU-02	—	—	—	—
SCR.VU-03	—	—	—	¹ E 1
SCR.VU-04	—	—	—	² E 12

¹ Analyte detected in the sample and the associated procedure blank.

² Analyte detected in the environmental sample but not in the associated replicate sample.

Appendix

This appendix includes discussions of the methods used to collect and analyze ground-water samples and report the resulting water-quality data. These methods were selected to obtain representative samples of the ground water from each well and to minimize the potential for contamination of the samples or bias in the data. Procedures used to collect and assess quality-control data collected as part of SCRVS sampling also are discussed.

Sample Collection and Analysis

Sample Collection

Ground-water samples were collected using standard and modified USGS protocols (Koterba and others, 1995; U.S. Geological Survey, variously dated), and protocols described by Weiss (1968), Shelton and others (2001), and Ball and McClesky (2003). Before sampling, each well was pumped continuously in order to purge at least three casing-volumes of water from the well (Wilde and others, 2006). Samples were collected using Teflon tubing with brass and stainless-steel fittings attached to a collecting point on the well discharge pipe as close to the well as possible. The collecting point was always located upstream of any well-head treatment system or water storage tank. If a chlorinating system was attached to the well, the chlorinator was shut off before the well was purged and sampled in order to clear all chlorine out of the system. Samples of constituents on the fast (fewest constituents) and intermediate (more constituents) schedules were collected at the wellhead using a foot-long length of Teflon tubing. Samples of constituents on the slow schedule were collected inside an enclosed chamber located inside a mobile laboratory and connected to the wellhead by a 10- to 50-foot length of the Teflon tubing (Lane and others, 2003). All fittings and lengths of tubing were cleaned between samples (Wilde, 2004).

For the field measurements, ground water was pumped through a flow-through chamber fitted with a multi-probe meter that simultaneously measures the water-quality indicators: dissolved oxygen, temperature, pH, turbidity, and specific conductance. Field measurements were made in accordance with protocols in the USGS National Field Manual (Radtke and others, 2005; Wilde and Radtke, 2005; Lewis, 2006; Wilde, 2006; Wilde and others, 2006a). All sensors on the multi-probe meter were calibrated daily. Measured temperature, dissolved oxygen, pH, and specific conductance values were recorded at 5-minute intervals for at least 30 minutes. After these values remained stable for 20 minutes, samples to be analyzed in the laboratory were collected. Field measurements and instrument calibrations were recorded by hand on field record sheets and electronically in PCFF, a

software package designed by the USGS with support from the GAMA program. Analytical service requests and chain of custody documentation were also managed by PCFF. Information from PCFF was uploaded directly into NWIS at the end of each week during which samples were collected.

For analyses requiring filtered water, ground-water was diverted through a 0.45- μ m pore size vented capsule filter, a disk filter, or a baked glass-fiber filter, depending on the protocol for the analysis (Wilde and others, 2006b; Wilde and others, 2004). Before samples were collected, polyethylene sample bottles were pre-rinsed three times using deionized water and then once with sample water. Samples requiring acidification were acidified to a pH of 2 or less with the appropriate acids using ampoules of certified, traceable concentrated acids obtained from the USGS National Water Quality Laboratory (NWQL).

Samples were collected from monitoring wells using a portable, stainless-steel submersible pump attached to Teflon tubing with stainless-steel fittings. Once monitoring wells were sufficiently purged following USGS ground-water sampling protocols, samples were collected at the surface following the procedure described for the intermediate sampling schedule (Wilde and others, 2006b). For depth-dependent samples, ground-water was pumped to the surface using a gas-displacement, small-diameter pump to collect samples at discrete depths within the well bore (Izbicki, 2004). The sampling equipment consisted of two 1/8-inch diameter polyethylene tubes bundled together to form a single strand mounted on a motorized reel. Once lowered to the desired depth, compressed ultra-high purity (grade 5) nitrogen gas was used to displace water from one line into the other while one-way flow valves prevented the displaced water from flowing back toward the pump at the lower end of the hose. Repeated pressurizing and depressurizing the lines slowly brought the water at depth to the surface where it could be collected.

Temperature-sensitive samples (VOCs, pesticides, potential wastewater-indicator compounds, pharmaceuticals, perchlorate, DOC, major and minor ions and trace elements, and nutrients) were stored on ice before being shipped daily to the various laboratories. The non-temperature sensitive samples collected to be analyzed for tritium, noble gases, chromium speciation and stable isotopes of hydrogen and oxygen in water were shipped monthly, while the radium isotopes, gross alpha and beta radioactivity, and radon-222 samples were shipped daily from the field. Additional temperature-sensitive samples collected to be analyzed for stable isotopes of nitrogen and oxygen in nitrate, stable isotopes of carbon and carbon-14 abundance, arsenic and iron abundances and speciation were stored on ice before being shipped monthly to appropriate laboratories.

Detailed sampling protocols for individual analyses and groups of analytes are described by Koterba and others (1995) and in the USGS National Field Manual (Wilde and others,

1999; Wilde and others, 2004) and the references for analytical methods listed in [table 4](#); only brief descriptions are given here. Volatile organic compounds (VOC) including gasoline oxygenates and degradates in samples were collected in 40-mL sample vials that were purged with three vial volumes of sample water before bottom filling to eliminate atmospheric contamination. Six normal (6 N) hydrochloric acid (HCl) was added as a preservative to the VOC samples, but not to the gasoline oxygenate and degradate samples. The perchlorate sample was collected in a 125-mL polyethylene bottle. Tritium samples were collected by bottom filling two 1-L polyethylene bottles with unfiltered ground water after first overfilling the bottle with three volumes of water. Stable isotopes of water were collected in 60-mL clear glass bottles filled with unfiltered water, sealed with a conical cap, and secured with electrical tape to prevent leakage and evaporation.

Samples analyzed for pesticides and pesticide degradation products, potential wastewater-indicator constituents, and pharmaceutical compounds were collected in 1-L baked amber bottles. Pesticide and pharmaceutical samples were filtered through a glass fiber filter during collection.

Ground-water samples for major and minor ions, trace elements, alkalinity, and total dissolved solids analyses required filling one 250-mL polyethylene bottle with raw ground water, and one 500-mL and one 250-mL polyethylene bottle with filtered ground water (Wilde and others, 2004). The filter used was a Whatman capsule filter. The 250-mL filtered sample was then preserved with 7.5 N nitric acid. The arsenic and iron speciation samples were filtered into a 250-mL polyethylene bottle that was covered with tape to prevent light exposure and preserved with 6 N hydrochloric acid. The nutrient sample was filtered into a 125-mL brown polyethylene bottle. Samples for stable nitrogen and oxygen isotopes of nitrate were filtered into 125-mL brown polyethylene bottle. Samples to be analyzed for radium isotopes and gross alpha and gross beta radioactivity were filtered into 1-L polyethylene bottles and acidified with nitric acid. Carbon isotope samples were filtered and bottom filled into two 500-mL glass bottles that were first overfilled with three bottle volumes of ground water; these samples had no headspace and were sealed and with a septa cap to avoid atmospheric contamination. Field alkalinity titration samples were collected by filtering ground water into a 500-mL polyethylene bottle. Chlorine-37 and bromine-81 isotope analysis sample was collected by filtering ground-water into a 5-gallon polyethylene container, then securing the cap with electrical tape to prevent leakage and evaporation.

DOC, chromium speciation, radon-222, dissolved gases, and microbial constituents were collected from the hose bib at the wellhead, regardless of the sampling schedule (fast, intermediate or slow). DOC was collected after rinsing the sampling equipment with blank water (Wilde and others, 2004). The ground water sample was filtered through a 50-mL syringe and a 0.45- μ m disk filter into a 125-mL baked glass

bottle and preserved with 4.5 N sulfuric acid. Chromium speciation samples were collected using a 10-mL syringe with an attached 0.45- μ m disk filter. Before collecting the chromium speciation sample, the syringe was thoroughly rinsed and filled with ground water, then 4 mL of the ground water was forced through the disk filter; and the next 2 mL of the ground water was slowly filtered into a small centrifuge vial to be analyzed for total chromium. The hexavalent chromium (Cr-VI) sample was then collected by attaching a small exchange column to the syringe filter, and after conditioning the column with 2 mL of sample water, 2 mL was collected in a second centrifuge vial. Both vials were preserved with 10 μ L of 7.5 N nitric acid (Ball and McClesky, 2003a,b).

To collect radon-222, a stainless steel and Teflon valve assembly was attached to the sampling port at the well head (Wilde and others, 2004). The valve was partially closed to create back pressure, and a 10-mL sample was collected through a Teflon septum on the valve assembly using a glass syringe affixed with a stainless steel needle. The sample was then injected into a 25-mL vial partially filled with a scintillation mixture (mineral oil) and shaken. The vial was then placed in a cardboard tube in order to shield it from light during shipping.

Noble gas samples were collected in 3/8-inch copper tubes using reinforced nylon tubing connected to the hose bib at the wellhead. Ground water was flushed through the tubing to dislodge bubbles before flow was restricted with a back pressure valve. Clamps on either side of the copper tube were then tightened, trapping a sample of ground water (Weiss, 1968).

Microbial constituent samples were collected at the wellhead also (Bushon, 2003, Myers, 2004). Before the samples were collected, the sampling port was sterilized using isopropyl alcohol and flushed with ground water for at least three minutes to remove any traces of the sterilizing agent. Two sterilized 250-mL bottles were then filled with ground water to be analyzed for coliform (total and *Escherichia coliform* determinations), and one sterilized 3-liter carboy was filled with ground water to be analyzed for coliphage (F-specific coliphage and somatic coliphage determinations).

Sample Analysis

Ten laboratories analyzed chemical and microbial samples for this study ([table A1](#)), although most of the samples were analyzed at the NWQL or by labs contracted by the NWQL. The NWQL maintains a rigorous quality assurance program (Pirkey and Glodt, 1998; Maloney, 2005). Laboratory quality control samples, including method blanks, continuing-calibration verification standards, standard reference samples, reagent spikes, external certified reference materials, and external blind proficiency samples, are analyzed regularly.

Method detection limits are continuously tested and laboratory reporting levels updated accordingly. NWQL maintains the National Environmental Laboratory Accreditation Program (NELAP) and other certifications (http://nwql.usgs.gov/lab_cert.shtml). In addition, the Branch of Quality Systems within the USGS Office of Water Quality independently oversees quality assurance at the NWQL and laboratories contracted by the NWQL. The Branch of Quality Systems also runs a national field quality assurance program that annually tests the proficiency of all USGS field personnel who measure water-quality in the field (<http://bqs.usgs.gov/nfqqa/>). Results of analyses made at the NWQL or laboratories contracted by the NWQL are uploaded directly into NWIS by the NWQL.

Turbidity, alkalinity, and total coliforms and *Escherichia coliform* (*E. coli*) were measured in the mobile laboratory at the well site. Turbidity was measured in the field with a calibrated turbidity meter. Total coliforms and *Escherichia coli* (*E. coli*) plates were prepared using sterilized equipment and reagents (Myers, 2004). Plates were counted under an ultraviolet light, following a 22-24 hour incubation time. Alkalinity and the concentrations of bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) were measured on filtered samples by Gran's titration method (Gran, 1952; Stumm and Morgan, 1996; Rounds, 2006).

Concentrations of HCO_3^- and CO_3^{2-} were also calculated from the laboratory alkalinity and pH measurements. Calculations were made using the advanced speciation method (<http://or.water.usgs.gov/alk/methods.html>) with $\text{p}K_1 = 6.35$, $\text{p}K_2 = 10.33$, and $\text{p}K_w = 14$.

Data Reporting

The following section details the laboratory reporting conventions and the constituents that are determined by multiple methods or by multiple laboratories.

Reporting Limits

The USGS NWQL uses the laboratory reporting level (LRL) as a threshold for reporting analytical results. The LRL is set to minimize false negatives (not detecting a compound when it is actually present in a sample) to less than 1 percent (Childress and others, 1999). The LRL is usually set at two-times the long-term method detection level (LT-MDL). The LT-MDL is derived from the standard deviation of at least 24 method detection limit (MDL) determinations made over an extended period of time. The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the concentration is greater than zero (at MDL, there is less than 1 percent chance of a false positive) (U.S. Environmental Protection Agency, 2002). The USGS NWQL monitors and updates LT-MDL and LRL values regularly, and the values listed in this report were

in effect during the period when ground-water samples from the SCRVA study were analyzed (April through June, 2007).

Concentrations between the LRL and the LT-MDL are reported as estimated concentrations. For information-rich methods, concentrations below the LRL have a high certainty of detection, but the precise concentration is uncertain. Information-rich methods are those that utilize gas chromatography or high-performance liquid chromatography (HPLC) with mass spectrometry to detect VOCs, gasoline oxygenates and degradates, pesticides, pharmaceuticals, potential wastewater indicators). Compounds are identified by characteristic fragmentation patterns in their mass spectra in addition to being quantified by measurements of peak areas at their associated chromatographic retention times. E-coded values also may result from concentrations outside the range of calibration standards, for concentrations that did not meet all laboratory quality-control criteria, and for samples that were diluted before analysis (Childress and others, 1999). The potential for sample contamination was assessed using results from field, source-solution, and laboratory blanks.

Some constituents in this study are reported using minimum reporting levels (MRL) or method uncertainties. The MRL is the smallest measurable concentration of a constituent that may be reliably reported using a given analytical method (Timme, 1995). The method uncertainty (MU) usually indicates the precision of a particular analytical measurement; it gives a range of values wherein the true value will be found.

The reporting levels for radiochemical constituents (gross-alpha radioactivity, gross-beta radioactivity, radium-226, and radium-228) are based on a sample-specific minimum detectable concentration (SSMDC), a sample-specific critical value, and the combined standard uncertainty (CSU) (U.S. Environmental Protection Agency, 2004; Bennett and others, 2006). A result above the critical value represents a greater-than-95-percent certainty that the result is greater than zero (significantly different from the instrument's background response to a blank sample), and a result above the SSMDC represents a greater-than-95-percent certainty that the result is greater than the critical value. Using these reporting level elements, three unique cases were possible when the raw analytical data was screened. If the analytical result is less than the critical value (case 1), the analyte is considered not detected and the concentration is reported as less than the SSMDC. If the analytical result is greater than the critical value, the ratio of the CSU to the analytical result is calculated as a percent (percent relative CSU). For those samples having percent relative CSU greater than 20 percent (case 2), concentrations are reported as estimated values. For those samples having percent relative CSU less than 20 percent (case 3), concentrations are reported as unqualified.

Stable isotopic compositions of oxygen, hydrogen, carbon, nitrogen, chlorine, and bromine are reported as relative isotope ratios in units of per mil using the standard delta notation (Coplen and others, 2002):

$$\delta^i E = \left[\frac{R_{\text{sample}}}{R_{\text{reference}}} - 1 \right] \cdot 1,000, \quad (1)$$

where

- i is the atomic mass of the heavier isotope of the element,
- E is the element (O for oxygen, C for carbon, or H for hydrogen, N for nitrogen, Cl for chlorine, or Br for bromine),
- R_{sample} is the ratio of the abundance of the heavier isotope of the element (^{18}O , ^{13}C , ^2H , ^{15}N , ^{37}Cl , or ^{81}Br) to the lighter isotope of the element (^{16}O , ^{12}C , ^1H , ^{14}N , ^{35}Cl , or ^{79}Br), in the sample and,
- $R_{\text{reference}}$ is the ratio of the abundance of the heavier isotope of the element to the lighter isotope of the element in the reference material hydrogen.

The reference material for oxygen and hydrogen is Vienna Standard Mean Ocean Water (VSMOW), which is assigned $\delta^{18}\text{O}$ and $\delta^2\text{H}$ values of 0 per mil (note that $\delta^2\text{H}$ is also written as δD because the common name of the heavier isotope of hydrogen, hydrogen-2, is deuterium). The reference material for carbon is Vienna Pee Dee Belemnite (VPDB), which is assigned a $\delta^{13}\text{C}$ value of 0 per mil. The reference material for nitrogen is atmospheric nitrogen gas, which is assigned a $\delta^{15}\text{N}$ value of 0 per mil. The reference material for chloride is Standard Mean Ocean Chloride (SMOC), which is assigned a $\delta^{37}\text{Cl}$ value of 0 per mil (Shouakar-Stash and others, 2005a). The reference material for bromide is Standard Mean Ocean Bromide (SMOB), and the isotopic composition is defined according to the standard definition (Shouakar-Stash and others, 2005b). Positive values indicate enrichment of the heavier isotope and negative values indicate depletion of the heavier isotope, relative to the ratios observed from the standard reference material.

Constituents on Multiple Analytical Schedules

Twenty-nine constituents targeted in this study are measured by more than one analytical schedule or more than one laboratory (table A2). The procedure recommended by the NWQL (http://www.nwql.cr.usgs.gov/USGS/Preferred_method_selection_procedure.html) was used to select the preferred methods for these constituents. Methods having full approval are preferred over those having provisional approval and approved methods are favored over research methods. The most accurate and precise method and lower LRL for the overlapping constituents is preferred. A method may be selected as the preferred method to provide consistency with historical data analyzed by the same method.

Twenty-two constituents appear on at least two of the following NWQL analytical schedules: VOCs (Schedule 2020), gasoline oxygenates and degradates (Schedule 4024), pesticides (Schedule 2003), polar pesticides (Schedule 2060), pharmaceutical compounds (lab code 9003), and potential wastewater-indicator compounds (Schedule 4433) (table A2). For constituents on Schedules 2020 and 4024, the preferred method was Schedule 2020 to provide consistency. For constituents on Schedules 2020 and 4433, the preferred method was Schedule 2020 because it is more accurate and precise, and the VOCs listed have lower LRLs. For constituents on Schedules 2003, 2060, and 4433, the preferred method was Schedule 2003 because it has greater accuracy and precision and lower LRLs for pesticide constituents. For constituents that appear on multiple NWQL analytical schedules, only the results from the preferred method are reported.

The water-quality indicators pH, specific conductance, and alkalinity were measured in the field and at the NWQL (table A2). The field measurements are the preferred method for all three constituents; however, laboratory alkalinity results are presented in this report when a field alkalinity sample was not collected.

For arsenic, chromium, and iron concentrations, standard methods used by the NWQL are preferred over the research methods used by the USGS Trace Metal Laboratory. The concentrations measured by the Trace Metal Laboratory are used only to calculated ratios of redox species for each element, $\frac{\text{As(V)}}{\text{As(III)}}$ for arsenic, $\frac{\text{Cr(VI)}}{\text{Cr(III)}}$ for chromium, and $\frac{\text{Fe(III)}}{\text{Fe(II)}}$ for iron. For example:

$$\frac{\text{Fe(III)}}{\text{Fe(II)}} = \frac{\text{Fe(T)} - \text{Fe(II)}}{\text{Fe(II)}}, \quad (2)$$

where

- Fe(T) is the total iron concentration (measured),
- Fe(II) is the concentration of ferrous iron (measured),
- and
- Fe(III) is the concentration of ferric iron (calculated).

Quality-Assurance

The purpose of quality-assurance is to identify which data best represent environmental conditions and which may have been affected by contamination or bias during sample collection, processing, storage, transportation, or laboratory analysis. Four types of quality-control (QC) tests were used in this study: (1) blank samples were collected to assess the potential for inadvertent sample contamination, (2) replicate samples were collected to assess variability, (3) matrix spike tests were done to assess the potential for matrix effects, and (4) surrogate compounds were added to samples analyzed

for organic constituents to identify general problems that may arise during sample analysis that could affect the results for all compounds in that sample. In this report, detections of analytes in ground-water that may have resulted from contamination were not included in water-quality assessments.

The quality-assurance used for this study followed the protocols used by the USGS NAWQA program (Koterba and others, 1995) and described in the USGS National Field Manual (U.S. Geological Survey, variously dated). The quality assurance plan followed by the NWQL, the primary laboratory used to analyze samples for this study, is described by Maloney (2005) and Pirkey and Glodt (1998).

Blanks

Blank samples (blanks) were collected using blank water certified by the NWQL to contain less than the LRL or MRL of the analytes investigated in the study. Nitrogen-purged, organic-free blank water was used for field blanks of organic constituents, and inorganic-free blank water was used for field blanks of other constituents. Three types of blanks were collected: source-solution, field, and equipment. Source-solution blanks were collected to verify that blank water used for the field blank samples was free of analytes of interest. Field blanks were collected to assess potential contamination of samples during collection, processing, transport, and analysis. The equipment blank was collected at the USGS San Diego Project office before the scheduled field sample was collected in order to assure the sampling equipment was free of analytes of interest. Source-solution and field blanks were collected at 9 percent of the wells sampled to determine if equipment or procedures used in the field or laboratory introduced contamination. Blank samples were analyzed for VOCs, gasoline oxygenates and degradates, pesticides and pesticide degradates, potential wastewater-indicator compounds, pharmaceuticals, perchlorate, nutrients, dissolved organic carbon, major and minor ions, trace elements, iron, arsenic, and chromium species, and radioactive constituents.

Source-solution blanks were collected at the field sampling site by pouring blank water directly into sample containers that were preserved, stored, shipped, and analyzed in the same manner as the environmental samples. Field blanks were collected after the source-solution blanks at the field sampling site. For field blank samples and the equipment blank sample, blank water was either pumped or poured through the sampling equipment (fittings and tubing) used to collect ground water, then processed and transported using the same protocols as those used for the environmental samples.

The equipment used to collect samples on the slow schedule was different than the equipment used to collect samples on the fast and intermediate schedules. Therefore, detections of constituents in field blanks collected at slow wells were compared with detections of constituents in ground

water samples from slow wells, and detections in field blanks collected at fast and intermediate wells were compared with detections in ground water samples from fast and intermediate wells. In addition, two different submersible pumps were used to collect ground-water samples from several monitoring wells. An equipment blank was collected using one of the submersible pumps (Keck™ pump), and a field blank was collected using the other submersible pump (Bennett Pump) used for sampling monitor wells. Detections of constituents in blank samples collected from the submersible pumps were compared with detections of constituents in ground water samples collected at the corresponding monitor wells.

Contamination in field blanks may originate from several different types of sources, including the source-solution water, carry-over from the previous sample, known sources specific to a field site, and (or) systematic or random contamination from field or laboratory equipment or processes. These different sources of contamination require different strategies for censoring (excluding) detections in ground-water samples on the basis of detections in field blanks.

Detections in source-solution blanks were used to evaluate potential contamination of the source-solution water. If a constituent was detected in a field blank, the associated source-solution blank results were examined for similar constituent detection. If the field blank and the source-solution blank contained a similar concentration of the same constituent, the source-solution water was interpreted as the origin of the contamination in the blanks, and the field blank detections collected using the same blank water were disregarded as indicating any contamination bias in the ground-water samples. If the ground-water sample collected just before the contaminated field blank had high concentration of the constituent in question, carry-over was considered to be the cause of the contamination.

If a constituent in a field blank could not be accounted for by contamination of the source-solution, carry-over, or another identifiable source of contamination, that field blank was used to censor detections in ground-water samples collected using the same equipment. The censoring level was defined as the concentration of the constituent in the field blank plus one-half the LRL for that constituent. Detections in ground-water samples below the censoring level were censored. Censored values are counted as non-detections for the summary statistics.

Replicates

Sequential replicate samples were collected to assess variability that may have resulted from the processing and analyses of inorganic and organic constituents. Relative standard deviation (RSD) of the measured values was used in determining the variability between replicate pairs for each compound. The RSD is defined as 100 times the standard

deviation divided by the mean concentration for each replicate pair of samples, multiplied by 100 percent. If a constituent was not detected in one replicate and its concentration was estimated to be below the LRL or MRL in the other replicate, the RSD was set to zero because the values are analytically identical. If one value for a sample pair was reported as a non-detection and the other value was greater than the LRL or MRL, then the non-detection value was set equal to one-quarter of the LRL and the RSD was calculated (Hamlin and others, 2002). Values of RSD less than 20 percent were considered acceptable in this study. An RSD value of 20 percent corresponds to a relative percent difference (RPD) value of 29 percent. High RSD values for a compound measured at low concentrations may indicate analytical uncertainty, particularly for concentrations within an order of magnitude of LT-MDL or MDL.

Matrix Spikes

Adding a known concentration of a constituent ('spike') to a replicate environmental sample enables the analyzing laboratory to determine the effect of the matrix, in this case groundwater, on the analytical technique used to measure the constituent. The known compounds added as matrix spikes are the same as those being analyzed using the method. Therefore, matrix interferences caused by each compound can be analyzed. Matrix spikes were added at the laboratory doing the analysis. Compounds with low recoveries are of concern if ground-water concentrations are close to the MCLs because a concentration below a MCL could be falsely indicated. Conversely, compounds with high recoveries are of concern if the ground-water concentration exceeds a MCL because a high recovery could falsely indicate a concentration above the MCL.

Acceptable ranges for matrix-spike recoveries are based on the acceptable ranges established for laboratory "set" spike recoveries. Laboratory set spikes are aliquots of laboratory blank water to which the same spike solution as that used for the matrix spikes has been added. One set spike is analyzed with each set of samples. Acceptable ranges for set spike recoveries are 70 to 130 percent for NWQL Schedules 2020, 4024, and 4433 (Connor and others, 1998; Rose and Sandstrom, 2003; Zaugg and others, 2006), 60 to 120 percent for NWQL Schedule 2003 (Sandstrom and others, 2001), and 60 to 130 percent for Schedule 2080 (Kolpin and others, 2002). On the basis of these ranges, 70 to 130 percent was defined as the acceptable range for matrix-spike recoveries for organic compounds in the SCRIV study unit.

Constituents used as matrix spikes in ground-water samples include VOCs, gasoline oxygenate and degradate compounds, pesticide compounds, and potential wastewater-indicator compounds because the analytical methods for these constituents are chromatographic methods which may be susceptible to matrix interferences. Replicate samples for

matrix spike additions were collected at 15 percent of the wells sampled, although not all analyte classes were tested at every well (tables A5A–D).

Surrogates

Surrogate compounds are added to environmental samples in the laboratory before analysis in order to compare the recovery of similar constituents. Surrogate compounds were added to all environmental and quality-control samples that were analyzed for VOCs, gasoline oxygenate and degradate compounds, pesticide compounds, pharmaceutical compounds, and potential wastewater-indicator compounds (table A6). Most of the surrogate compounds are deuterated analogs of compounds being analyzed. For example, the surrogate toluene-d8 added to the VOC analytical method has the same chemical structure as toluene, but the eight hydrogen-1 atoms on the molecule have been replaced by deuterium (hydrogen-2). Toluene-d8 and toluene behave very similarly during the analytical procedure, but the small mass difference between the two results in slightly different chromatographic retention times. The use of a toluene-d8 surrogate does not interfere with the analysis of toluene (Grob, 1995). Only 0.015 percent of hydrogen atoms are deuterium (Firestone and others, 1996). Thus deuterated compounds like toluene-d8 do not occur naturally and are not found in environmental samples. Surrogates are used to identify general problems that may arise during sample analysis that could affect the analysis results for all compounds in that sample. Potential problems include matrix interferences or incomplete laboratory recovery that produces a bias. A range of 70 to 130 percent recovery of surrogates was considered acceptable for the SCRIV study unit; values outside this range indicate possible problems with processing and analyzing the samples (Connor and others, 1998; Sandstrom and others, 2001).

Quality-Control Sample Results

Detections of Constituents in Field Blanks, Source-Solution Blanks, and an Equipment Blank

Field and source-solution blanks were collected at 5 of the 53 sites sampled in SCRIV. In addition, one equipment blank was collected from a submersible sampling pump used to collect ground-water samples from two monitoring wells during this study. One source-solution blank sample was not analyzed for organic constituents because no organic constituents were detected in the associated field blank sample. Table A3 gives a summary of detections of constituents in field blanks, source-solution blanks, and the equipment blank. Two VOCs detected in blank samples were methyl ethyl ketone (2-butanone, MEK) and toluene.

Methyl ethyl ketone was detected in 1 of 10 blank samples analyzed at a maximum concentration of E 0.9 µg/L. Methyl ethyl ketone was not detected in an environmental sample; therefore, no samples were censored. Toluene was detected in 3 of the 10 blank samples, ranging in concentration from an estimated (E) 0.02 µg/L to E0.06 µg/L. Toluene was detected in 7 environmental samples; concentrations in 6 of the 7 environmental samples ranged from E0.02 µg/L to E0.03 µg/L. Toluene was detected in the seventh environmental sample (SCRV-10) at a concentration of 1.02 µg/L. Toluene was detected in the 3 blank samples and the 6 environmental samples with the same sample collection equipment being used. In addition, the concentration of toluene in blank samples was equal to or greater than the maximum concentration detected in the six environmental samples (table A3). Therefore, toluene was censored in these six environmental samples. The concentration of toluene in the seventh environmental sample (SCRV-10) was not censored because this concentration was higher (or more elevated) than that detected in the blank samples and different sample collection equipment was used. Toluene was detected in source-solution and field blanks from earlier GAMA study units (Wright and others, 2005; Kulongoski and others, 2006; Bennett and others, 2007; Dawson and others, 2007; Kulongoski and Belitz, 2007).

One equipment blank and 3 (of 5) field blanks collected for SCRIV were analyzed for major ions, minor ions, and trace elements. Major ions, minor ions, and trace elements were not collected for source-solution blanks. Calcium was detected in 2 blank samples, 1 field blank and 1 equipment blank, at a concentration of 0.02 mg/L and 0.03 mg/L, respectively. The field blank was collected a submersible piston-pump, and the equipment blank was collected from a submersible rotary-pump, both of which were used to collect environmental samples from several monitoring wells. The lowest concentration of calcium detected in environmental samples was 35.6 mg/L; therefore, the calcium results were not censored. Silica was detected in the equipment blank at a concentration of 0.018 mg/L. The lowest concentration of silica detected in environmental samples was 15.8 mg/L; therefore, the silica results were not censored. Total nitrogen was detected in one field blank at a concentration of E0.03 mg/L. The lowest concentration of total nitrogen detected in environmental samples was reported at 0.12 mg/l; therefore, the total nitrogen data were not censored.

The concentration of chromium detected in the equipment blank was of 0.38 µg/L; it was collected from the submersible pump (Keck™ pump). The concentrations of chromium in the two environmental samples collected utilizing this submersible pump were 1.8 µg/L and E2.4 µg/L; thus no chromium data were censored on the basis of the detection in the equipment blank. Zinc was detected in 3 of 4 blank samples at concentrations ranging from E0.3 µg/L

to 1.6 µg/L. One field blank containing 1.6 µg/L of zinc was collected using the “slow” schedule sampling equipment; thus, data for other wells sampled using the “slow” schedule equipment were evaluated for contamination. No detections of zinc in environmental samples having concentrations less than 1.9 µg/L (1.6 µg/L plus one-half the LRL of 0.6 µg/L) were reported for “slow” schedule environmental samples; therefore, no data were censored (tables 12, A3). In addition, 1 field blank and 1 equipment blank containing zinc concentrations 0.86 µg/L and 0.34 µg/L, respectively, were collected from the two submersible pumps used to collect environmental samples. Both of the detected zinc concentrations in the environmental samples were greater than 1.16 µg/L (0.86 µg/L plus one-half the LRL of 0.6 µg/L); therefore, the environmental samples were not censored. Barium was detected in the equipment blank and two of the field blanks at a maximum concentration of E0.07 µg/L. The minimum concentration of barium detected in environmental samples was 16 µg/L; therefore, no environmental samples were censored. An estimated 0.2 µg/L of copper was detected in a field blank using the equipment for a “slow” sampling schedule. The minimum concentration detected in a “slow” environmental sample was 1.1 µg/L; therefore, no environmental samples were censored. Molybdenum was detected in the equipment blank at a concentration of E 0.1 µg/L and at a minimum concentration of 10.0 µg/L in environmental samples collected using the same equipment. The ground-water data for molybdenum was not censored. Nickel was detected in the equipment blank and a field blank (0.08 µg/L and E 0.04 µg/L, respectively) that were collected using the submersible sampling pumps. The minimum concentrations of nickel detected in the associated environmental samples (0.60 µg/L and 0.44 µg/L) utilizing the same equipment indicated that no ground-water samples should be censored.

Chromium species in 3 field blanks and arsenic and iron species in 2 field blanks were analyzed at the USGS Trace Metal Laboratory (TML). No source-solution blanks or equipment blanks were collected to be analyzed for arsenic, chromium, and iron species. Two field blanks contained 3 µg/L of iron. Because of iron detected in two field blanks, four detections of iron in ground-water analyzed by the TML at concentrations of 4 µg/L or less were censored (table 13). Note that iron was not detected in the field blanks collected at the same time to be analyzed by the NWQL (NWQL Schedule 1948). Arsenic and chromium were reported as not being detected in all field blanks analyzed by TML.

DOC was detected in 1 of the 3 field blanks at an estimated concentration of 0.3 mg/L, and low concentrations of DOC were detected in field blanks collected previously in other GAMA study units (Bennett and others, 2006; Kulongoski and Belitz, 2007). Also, the censoring level is defined as the concentration of the constituent in the field

blank plus one-half the LRL for that constituent; thus, the data for concentrations ranging from 0.3 mg/L to 0.5 mg/L in four environmental samples were censored ([table 10](#)).

Variability in Replicate Samples

[Tables A4A–D](#) summarizes the results of replicate analyses of constituents detected in ground-water samples collected in the SCRIV study unit. Replicate sample pairs were collected at 3 of the 53 sites sampled in SCRIV. All the constituents that were detected in ground-water samples are included in [tables A4A–D](#). Constituents that were not detected in replicate samples are not included in [tables A4A–D](#). Concentrations or activities in the environmental and their respective replicate samples are reported for all replicate analyses yielding RSD values greater than zero. Most replicate analyses yielded RSD values less than 5 percent and only one RSD value was greater than the acceptable limit of 20 percent. The replicate analyses of arsenic (total) analyzed at USGS TML yielded a RSD value of 110 percent ([table A4C](#)). The preferred analytical method for arsenic is the NWQL Schedule 1948 and not the USGS TML analytical method. For this particular replicate/environmental sample, arsenic was not detected in the replicate sample but was detected above the LRL in the environmental sample. In order to calculate the RSD value, the value of the LRL (0.5 µg/L) for the replicate sample was changed to one-fourth of the LRL. At these low concentrations, small deviations in measured values result in large RSDs. No data were flagged as a result of variability in replicate analyses.

Matrix-Spike Recoveries

[Tables A5A–E](#) summarizes matrix-spike recoveries for the SCRIV study. Adding a spike or known concentration of a constituent to an environmental sample enables the analyzing laboratory to determine the effect of the matrix, in this case ground water, on the analytical technique used to measure the constituent. Five environmental samples were spiked with VOCs to calculate matrix-spike recoveries ([table A5A](#)). Eighty of the 89 VOCs had spike recoveries within the acceptable range of 70 and 130 percent. Seven VOCs had at least 1 matrix-spike recovery greater than 130 percent, and 2 of these compounds (perchloroethene [PCE] and trichlorofluoromethane [CFC-11]) were detected in ground-water samples. The greatest matrix-spike recovery of PCE was 161 percent, and the greatest reported concentration in environmental samples was 0.15 µg/L. The greatest matrix-spike recovery of trichlorofluoromethane (CFC-11) was 131 percent, and the only detection of trichlorofluoromethane was reported at 12.9 µg/L. The median percent recoveries of

all 89 VOC compounds were within the acceptable range of 70 to 130 percent. Styrene and *trans*-1,4-dichloro-2-butene had minimum matrix-spike recoveries below 70 percent; however, these compounds were not detected in environmental samples ([table 5](#)). [NOTE – low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations].

Five ground-water samples were spiked with the pesticide and pesticide degradate compounds (NWQL Schedule 2003) in order to calculate matrix-spike recoveries ([table A5B](#)). Twenty-three of the 63 compounds had matrix-spike recoveries within the acceptable range of 70 and 130 percent for all five matrix-spike samples ([table A5B](#)). Six of the 11 compounds detected in ground-water samples had spike recoveries within the acceptable range. Two compounds (fipronil and fipronil sulfide) that were detected at low concentrations (E 0.005 µg/L and E 0.008 µg/L, respectively) in the same ground-water sample had at least one matrix-spike recovery greater than 130 percent. Three of the compounds (deethylatrazine, fipronil sulfone, and hexazinone) detected in ground-water samples had at least one matrix-spike recovery less than 70 percent. A total of 25 spike compounds had at least one matrix-spike recovery below 70 percent, and the median recovery was below 70 percent for 16 compounds. [NOTE – low matrix-spike recovery may indicate that the compound might not have been detected in some samples if it was present at very low concentrations].

Five ground-water samples were spiked with potential wastewater-indicator compounds (NWQL Schedule 4433). Sixty of the 69 compounds had recoveries less than 70 percent and 6 compounds had recoveries greater than 130 percent ([table A5C](#)). Three potential wastewater-indicator compounds (bisphenol A, cholesterol, and 4-octylphenol monoethoxylates) detected in environmental samples had at least one matrix-spike recovery below 70 percent. Two potential wastewater-indicator compounds (bis(2-ethylhexyl) phthalate and 4-octylphenol diethoxylates) detected in an environmental sample had one matrix-spike recovery greater than 130 percent. One of the compounds detected in environmental samples, perchloroethene (PCE), had a recovery of only 24 percent, but the potential wastewater-indicator analytical method (NWQL Schedule 4433) is not the preferred analytical method for perchloroethene ([table A2](#)).

One ground-water sample was spiked with pesticide and pesticide degradates (NWQL Schedule 2060). Forty-five of the 59 compounds had recoveries within the acceptable range of 70 to 130 percent; 15 of the compounds had recoveries less than 70 percent ([table A5D](#)). No compound had a matrix-spike recovery greater than 130 percent. Deethylatrazine (2-chloro-4-isopropylamino-6-amino-*s*-triazine) was the only compound detected in an environmental sample that had a matrix-spike recovery less than 70 percent on the NWQL Schedule 2060.

The NWQL Schedule 2060 was not the preferred analytical method for the three compounds (atrazine, deethylatrazine, and metalaxyl) detected in environmental samples ([table A2](#)). Results for pharmaceutical compounds are not presented in this report; they will be included in subsequent publications.

Surrogate Compound Recoveries

Surrogates are used to identify general problems that may arise during sample analysis that could affect the analysis results for all compounds in that sample. [Table A6](#) lists the surrogate, the analytical schedule on which it was applied, the number of analyses of blanks and ground-water samples, the number of surrogate recoveries below 70 percent, and the number of surrogate recoveries above 130 percent for the blank samples and ground-water samples. Blank and

ground-water samples were considered separately to assess whether the matrices in non-blank samples affect surrogate recoveries. No systematic differences between surrogate recoveries from blank and non-blank samples were measured. Seventy-nine percent of surrogate recoveries for VOC and gasoline oxygenate and degradate analyses were within the acceptable range of 70 to 130 percent. Pesticides and pesticide degradates (NWQL Schedule 2003) analyses had 95 percent of the surrogate recoveries within the acceptable range of 70 to 130 percent. Potential wastewater-indicator analyses had 68 percent of the surrogate recoveries within the acceptable range of 70 to 130 percent. Pesticide and pesticide degradates (NWQL Schedule 2060) analyses had 83 percent of the surrogate recoveries within the acceptable range of 70 to 130 percent.

Table A1. Analytical methods used by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL) and additional contract laboratories to determine organic, inorganic, and microbial constituents.

[Analytical method: MI agar, supplemented nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting, thus aiding in their detection and enumeration. Abbreviations: NWQL, National Water-Quality Laboratory; HPLC, high-performance liquid chromatography; UV, ultraviolet; VOC, volatile organic compound; USEPA, U.S. Environmental Protection Agency; VIS, visible; δ , stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
Water-quality indicators			
Field parameters	Calibrated field meters and test kits	USGS field measurement	U.S. Geological Survey, variously dated
Organic constituents			
VOCs	Purge and trap capillary gas chromatography/mass spectrometry	NWQL, schedule 2020	Connor and others, 1998
Gasoline oxygenates	Heated purge and trap/gas chromatography/mass spectrometry	NWQL, schedule 4024	Rose and Sandstrom, 2003
Pesticides and degradates	Solid-phase extraction and gas chromatography/mass spectrometry	NWQL, schedule 2003	Zaugg and others, 1995; Lindley and others, 1996; Madsen and others, 2003; Sandstrom and others, 2001
Polar pesticides and degradates	High-performance liquid chromatography/mass spectrometry	NWQL, schedule 2060	Furlong and others, 2001
Pharmaceuticals	Solid-phase extraction and HPLC/mass spectrometry	NWQL, laboratory code 9003	Kolpin and others, 2002
Potential wastewater-indicators	Solid-phase extraction and gas chromatography/mass spectrometry	NWQL, schedule 4433	Zaugg and others, 2006
Constituents of special interest			
Perchlorate	Chromatography and mass spectrometry	Montgomery Watson-Harza Laboratory	Hautman and others, 1999
Inorganic constituents			
Nutrients	Alkaline persulfate digestion, Kjeldahl digestion	NWQL, schedule 2755	Fishman, 1993; Patton and Kryskalla, 2003
Dissolved organic carbon	UV-promoted persulfate oxidation and infrared spectrometry	NWQL, schedule 2613	Brenton and Arnett, 1993
Major and minor ions, trace elements and nutrients	Atomic absorption spectrometry, colorimetry, ion-exchange chromatography, inductively-coupled plasma atomic emission spectrometry and mass spectrometry	NWQL, schedule 1948	Fishman and Friedman, 1989; Fishman, 1993; Faires, 1993; McLain, 1993; Garbarino, 1999; Garbarino and Damrau, 2001; American Public Health Association, 1998; Garbarino and others, 2006
Chromium, arsenic and iron speciation	Various techniques of ultraviolet visible (UV-VIS) spectrophotometry and atomic absorbance spectroscopy	USGS Trace Metal Laboratory, Boulder, Colorado	Stookey, 1970; Stumm and Morgan, 1996; To and others, 1998; Ball and McCleskey, 2003a and 2003b; McCleskey and others, 2003

Table A1. Analytical methods used by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL) and additional contract laboratories to determine organic, inorganic, and microbial constituents.—Continued

[Analytical method: MI agar, supplemented nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting, thus aiding in their detection and enumeration. Abbreviations: NWQL, National Water-Quality Laboratory; HPLC, high-performance liquid chromatography; UV, ultraviolet; VOC, volatile organic compounds; USEPA, U.S. Environmental Protection Agency; VIS, visible; δ , stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
Stable isotopes			
Stable isotopes of water: $\delta^2\text{H}$ and $\delta^{18}\text{O}$	Gaseous hydrogen and carbon dioxide-water equilibration and stable-isotope mass spectrometry	USGS Stable Isotope Laboratory, Reston, Virginia	Epstein and Mayeda, 1953; Coplen and others, 1991; Coplen, 1994
Nitrogen and oxygen isotopes of nitrate: $\delta^{15}\text{N-NO}_3$ and $\delta^{18}\text{O-NO}_3$	Denitrifier method and mass spectrometry	USGS Stable Isotope Laboratory, Reston, Virginia, lab code 2900	Casciotti and others, 2002
Carbon isotopes: $\delta^{13}\text{C}$ of dissolved inorganic carbon	Accelerator mass spectrometry	University of Waterloo, Environmental Isotope Lab; University of Arizona Accelerator Mass Spectrometry Lab	Donahue and others, 1990; Jull and others, 2004
Chlorine and bromine isotopes: $\delta^{37}\text{Cl}$ and $\delta^{81}\text{Br}$	Isotope ratio mass spectrometry	University of Waterloo, Environmental Isotope Lab	Shouakar-Stash and others, 2005a; Shouakar-Stash and others, 2005b
Radioactivity and gases			
Tritium	Electrolytic enrichment-liquid scintillation	USGS Stable Isotope and Tritium Laboratory, Menlo Park, California	Thatcher and others, 1977
Tritium and noble gases	Helium-3 in-growth and mass spectrometry	Lawrence Livermore National Laboratory	Moran and others, 2002; Eaton and others, 2004
Radon-222	Liquid scintillation counting	NWQL, schedule 1369	American Society for Testing and Materials, 1998
Radium -226/228	Alpha activity counting	Eberline Analytical Services, NWQL method 1262	U.S. Environmental Protection Agency, 1980 (USEPA methods 903 and 904)
Gross alpha and beta radioactivity	Alpha and beta activity counting	Eberline Analytical Services, NWQL method 1792	U.S. Environmental Protection Agency, 1980 (USEPA method 900.0)
Microbial constituents			
F-specific and somatic coliphage	Single-agar layer (SAL) and two-step enrichment methods	USGS Ohio Water Microbiology Laboratory	U.S. Environmental Protection Agency, 2001
Total and <i>Escherichia</i> coliform	Membrane filter technique with "MI agar"	USGS field measurement	U.S. Environmental Protection Agency, 2002

Table A2. Preferred analytical schedules for constituents appearing on multiple schedules for samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Laboratory: LLNL, Lawrence Livermore National Laboratory; MWH, Montgomery Watson Harza Laboratory; SITL, U.S. Geological Survey Stable Isotope and Tritium Laboratory; TML, U.S. Geological Survey Trace Metal Laboratory. **Abbreviation:** VOC, volatile organic compound]

Constituent	Primary constituent classification	Analytical schedules	Preferred analytical schedule
Results from preferred method reported			
Acetone	Solvent	2020, 4024	2020
Atrazine	Pesticide	2003, 2060, 4433	2003
Bromoform (Tribromomethane)	VOC	2020, 4433	2020
Caffeine	Wastewater indicator	4433, 2060, 2080	2060
Carbaryl	Pesticide	2003, 2060, 4433	2003
Chlorpyrifos	Pesticide	2003, 4433	2003
Cotinine	Wastewater indicator	2080, 4433	2080
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino-s-triazine)	Pesticide degradate	2003, 2060	2003
Diazinon	Pesticide	2003, 4433	2003
1,4-Dichlorobenzene	VOC, pesticide	2020, 4433	2020
Dichlorvos	Pesticide	2003, 4433	2003
Diisopropyl ether (DIPE)	VOC, gasoline oxygenate	2020, 4024	2020
Ethyl <i>tert</i> -Butyl ether (ETBE)	VOC, gasoline oxygenate	2020, 4024	2020
Isopropylbenzene	VOC	2020, 4433	2020
Metalaxyl	Pesticide	2003, 2060, 4433	2003
Methyl <i>tert</i> -butyl ether (MTBE)	VOC, gasoline oxygenate	2020, 4024	2020
Methyl <i>tert</i> -pentyl ether	VOC, gasoline oxygenate	2020, 4024	2020
Metolachlor	Pesticide	2003, 4433	2003
Naphthalene	VOC	2020, 4433	2020
Perchloroethene (PCE)	VOC	2020, 4433	2020
Prometon	Pesticide	2003, 4433	2003
Tebuthiuron	Herbicide	2003, 2060	2003
Results from both methods reported (different USGS parameter codes)			
Alkalinity	Water-quality indicator	field, 1948	field
Arsenic, total	Trace element	1948, TML	1948
Chromium, total	Trace element	1948, TML	1948
Iron, total	Trace element	1948, TML	1948
pH	Water-quality indicator	field, 1948	field
Specific conductance	Water-quality indicator	field, 1948	field
Tritium	Radioactive	LLNL, SITL	both

Table A3. Quality-control summary for constituents detected in blank samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Abbreviations: mg/L, milligram per liter; µg/L, microgram per liter; TML, U.S. Geological Survey Trace Metal Laboratory]

Constituent	Number of source solution blank detections/analyses	Number of field blank detections/analyses	Number of equipment blank detections/analyses	Number of ground-water samples censored
Organic constituents (µg/L)				
Methyl ethyl ketone (2-Butanone, MEK)	0/4	1/5	0/1	0
Toluene	1/4	1/5	1/1	6
Dissolved organic carbon	0/0	1/3	0/1	4
Inorganic constituents (mg/L)				
Calcium	0/0	1/3	1/1	0
Silica	0/0	0/3	1/1	0
Total nitrogen	0/0	1/3	0/1	0
Trace elements (µg/L)				
Barium	0/0	2/3	1/1	0
Chromium	0/0	0/3	1/1	0
Copper	0/0	1/3	0/1	0
Iron (TML) ¹	0/0	2/2	0/0	4
Molybdenum	0/0	0/3	1/1	0
Nickel	0/0	1/3	1/1	0
Zinc	0/0	2/3	1/1	0

¹Iron analyzed by U.S. Geological Survey Trace Metal Laboratory (TML). Note that NWQL Schedule 1948 is preferred method for iron. Iron was not detected in field blanks analyzed by NWQL Schedule 1948.

Table A4A. Quality-control summary for replicate analyses of organic constituents detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Abbreviations: RSD, relative standard deviation in percent; µg/L, microgram per liter; >, greater than]

Constituent	Number of RSDs greater than zero/number of replicates	RSD (percent)		Measured values for replicates with RSD greater than zero (environmental, replicate) (µg/L)
		Maximum	Median	
Volatile organic compounds and gasoline oxygenates (Schedules 2020 and 4024)				
Benzene	0/3	0	0	
Bromochloromethane	0/3	0	0	
Bromodichloromethane	0/3	0	0	
Bromoform (Tribromomethane)	0/3	0	0	
Carbon disulfide	0/3	0	0	
Carbon tetrachloride (Tetrachloromethane)	0/3	0	0	
Chloroform (Trichloromethane)	0/3	0	0	
Dibromochloromethane	0/3	0	0	
Dibromomethane	0/3	0	0	
<i>trans</i> -1,2-Dichloroethene	0/3	0	0	
<i>m</i> - and <i>p</i> -Xylene	0/3	0	0	
Perchloroethene (PCE)	0/3	0	0	
1,1,1-Trichloroethane (TCA)	0/3	0	0	
Trichlorotrifluoroethane (CFC-113)	0/3	0	0	
Tetrahydrofuran	0/3	0	0	
Toluene	0/3	0	0	
Trichloroethene (TCE)	0/3	0	0	
Trichlorofluoromethane (CFC-11)	0/3	0	0	
Pesticides and pesticide degradates (Schedule 2003)				
Atrazine	0/3	0	0	
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino- <i>s</i> -triazine)	0/3	0	0	
Desulfinyl fipronil	0/3	0	0	
3,4-Dichloroaniline	0/3	0	0	
Fipronil sulfide	0/3	0	0	
Fipronil sulfone	0/3	0	0	
Fipronil	0/3	0	0	
Hexazinone	0/3	0	0	
Metalaxyl	1/3	7	7	(0.010, 0.009)
Metolachlor	0/3	0	0	
Prometryn	0/3	0	0	
Simazine	0/3	0	0	
Tebuthiuron	0/3	0	0	
Potential wastewater-indicator compounds (Schedule 4433)				
Bis(2-ethylhexyl) phthalate	0/3	0	0	
Bisphenol A	0/3	0	0	
Cholesterol	0/3	0	0	
<i>p</i> -Cresol	0/3	0	0	
3,4-Dichlorophenyl isocyanate	0/3	0	0	
Indole	0/3	0	0	
2-Methylnaphthalene	0/3	0	0	
4-Octylphenol diethoxylates	0/3	0	0	
4-Octylphenol monoethoxylates	0/3	0	0	
4- <i>tert</i> -Octylphenol	0/3	0	0	
Phenol	0/3	0	0	
Pharmaceuticals (Schedule 2080)				
Sulfamethoxazole	0/1	0	0	
Diphenhydramine	0/1	0	0	
Carbamazepine	1/1	4	4	(0.017, 0.018)

Table A4B. Quality-control summary for replicate analyses of major and minor ions, nutrients, and a constituent of special interest (perchlorate) detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Abbreviations: RSD, relative standard deviation in percent; mg/L, milligram per liter]

Constituent	Number of RSDs greater than zero/number of replicates	RSD (percent)		Concentrations for replicates with RSD greater than zero (environmental/replicate) (mg/L)
		Maximum	Median	
Major and minor ions				
Calcium	2/3	1	0.7	(210, 212), (138, 140)
Magnesium	3/3	0.5	0.3	(72.3, 72.6), (45.1, 45.4), (52.1, 52.2)
Potassium	1/3	1	0.0	(4.14, 4.20)
Sodium	2/3	1	0.4	(115, 117), (96.4, 97.0)
Bromide	2/3	3	2	(2.68, 2.60), (0.20, 0.21)
Chloride	3/3	1	0.2	(65.3, 65.4), (39.3, 39.4), (148, 145)
Fluoride	2/3	2	1	(0.67, 0.68), (0.69, 0.67)
Iodide	3/3	5	3	(0.014, 0.013), (0.027, 0.026), (0.050, 0.048)
Sulfate	2/3	1	0.1	(673, 672), (586, 575)
Silica	3/3	0.9	0.7	(30.4, 30.1), (30.6, 30.2), (33.8, 33.5)
Total dissolved solids	2/3	0.5	0.2	(950, 953), (1,320, 1,310)
Residue on evaporation	1/3	1	0.0	(1,400, 1,380)
Nutrients and dissolved organic carbon				
Dissolved organic carbon	1/3	5	0.0	(1.6, 1.5)
Orthophosphate as phosphorous	3/3	13	5	(0.048, 0.049), (0.102, 0.085), (0.037, 0.040)
Total nitrogen	2/3	2	0.5	(13.5, 13.4), (0.40, 0.39)
Nitrate plus nitrite	1/3	0.5	0.0	(12.9, 13.0)
Ammonia	1/3	0.9	0.0	(0.308, 0.312)
Nitrite	1/3	9	0.0	(0.007, 0.008)
Constituent of special interest				
Perchlorate	0/3	0	0	

Table A4C. Quality-control summary for replicate analyses of trace elements detected in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Abbreviations: RSD, relative standard deviation in percent; nd, not detected; µg/L, microgram per liter; <, less than]

Constituent	Number of RSDs greater than zero/number of replicates	RSD (percent)		Concentrations for replicates with RSD greater than zero (environmental/replicate) (µg/L)
		Maximum	Median	
USGS National Water Quality Laboratory (Schedule 1948)				
Aluminum	1/3	8	0.0	(1.6, 1.8)
Antimony	1/3	11	0.0	(0.06, 0.07)
Arsenic	2/3	2	2	(0.87, 0.90), (0.92, 0.94)
Barium	1/3	3	0.0	(21, 22)
Boron	3/3	17	8	(759, 845), (616, 631), (459, 586)
Cadmium	2/3	20	5	(0.29, 0.27), (0.04, E 0.03)
Chromium	1/3	5	0.0	(0.15, 0.14)
Cobalt	0/3	0.0	0.0	
Copper	2/3	4	1	(3.1, 3.3), (0.53, 0.54)
Iron	2/3	5	2	(14, 13), (137, 140)
Lead	2/3	4	2	(0.64, 0.68), (0.35, 0.34)
Lithium	3/3	2	2	(57.0, 55.7), (35.5, 35.4), (45.1, 46.3)
Manganese	3/3	3	1	(17.5, 16.8), (396, 388), (149, 150)
Molybdenum	1/3	1	0.0	(12.8, 12.9)
Nickel	2/3	5	0.4	(4.72, 4.40), (3.40, 3.38)
Selenium	2/3	16	1	(20.5, 20.1), (E 0.05, E 0.04)
Silver	0/3	0.0	0.0	
Strontium	2/3	1	1	(1980, 1940), (1460, 1480)
Thallium	0/3	0.0	0.0	
Tungsten	0/3	0.0	0.0	
Uranium	3/3	0.7	0.5	(17.3, 17.4), (6.78, 6.85), (3.99, 4.02)
Vanadium	2/3	3	2	(3.2, 3.1), (0.25, 0.26)
Zinc	3/3	14	9	(9.9, 8.7), (3.6, 3.3), (2.2, 1.8)
USGS Trace Metals Laboratory				
Iron	2/3	16	3	(4, 5), (134, 140)
Iron(II)	2/3	20	4	(3, 4), (118, 125)
Arsenic	2/3	110	110	(<0.5, 1), (0.99, <0.5)
Arsenic(III)	0/3	0.0	0.0	
Chromium	0/3	0.0	0.0	
Chromium(VI)	0/3	0.0	0.0	

Table A4D. Quality-control summary of replicate analyses of radioactive constituents and stable isotopes detected in samples collected for the Santa Clara River Valley Ground-Water Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Abbreviations: RSD, relative standard deviation in percent; µg/L, microgram per liter; pCi/L, picocuries per liter]

Constituent	Number of RSDs greater than zero/number of replicates	RSD (percent)		Concentrations for replicates with RSD greater than zero (environmental/replicate) (µg/L)
		Maximum	Median	
Radioactive constituents (pCi/L)				
Radon-222	1/1	14	14	(573, 696)
Tritium	2/3	5	3	(6.7, 6.4) (8.6, 8.0)
Stable isotope ratios (per mil)				
Hydrogen-2/Hydrogen-1 in water	3/3	2	1	(-48.2, -47.8) (-52.1, -51.1) (-49.3, -47.9)
Oxygen-18/Oxygen-16 in water	2/3	2	0.2	(-7.16, -7.01) (-7.61, -7.59)
Nitrogen-15/Nitrogen-14 in nitrate	2/2	1	1	(10.26, 10.11) (11.24, 11.05)
Oxygen-18/Oxygen-16 in nitrate	2/2	0.6	0.4	(10.74, 10.71) (10.61, 10.52)
Chlorine-37/Chlorine-35 in water	1/1	65	65	(0.43, 0.16)
Bromine-81/Bromine-79 in water	1/1	14	14	(1.16, 0.95)

Table A5A. Quality-control summary for matrix-spike recoveries of volatile organic compounds (NWQL schedule 2020) including gasoline oxygenates and degradates (NWQL schedule 4024) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Acceptable recovery range is between 70 and 130 percent; values in bold fall outside this range. **Abbreviation:** THM, trihalomethane]

Constituent	Number of spike samples	Recovery (percent)		
		Minimum	Maximum	Median
Acetone ¹	5	91	114	112
Acrylonitrile	5	94	114	107
<i>tert</i> -Amyl methyl ether (TAME)	5	95	103	100
<i>tert</i> -Amyl alcohol	1	101	101	101
Benzene ²	5	105	107	107
Bromobenzene	5	101	107	103
Bromochloromethane ²	5	104	114	108
Bromodichloromethane (THM) ²	5	102	110	105
Bromoform (Tribromomethane, THM) ²	5	99	108	103
Bromomethane (Methyl bromide)	5	93	124	108
<i>tert</i> -Butyl alcohol (TBA)	1	97	97	97
<i>n</i> -Butylbenzene	5	84	113	93
<i>sec</i> -Butylbenzene	5	104	117	112
<i>tert</i> -Butylbenzene	5	105	119	118
Carbon disulfide ¹	5	84	102	85
Carbon tetrachloride (Tetrachloromethane) ²	5	98	122	108
Chlorobenzene	5	102	108	106
Chloroethane	5	72	227	112
Chloroform (Trichloromethane, THM) ²	5	102	116	114
Chloromethane	5	102	137	109
3-Chloro-1-propene	5	112	124	122
2-Chlorotoluene	5	104	113	112
4-Chlorotoluene	5	103	113	107
Dibromochloromethane (THM) ²	5	96	105	97
1,2-Dibromo-3-chloropropane (DBCP)	5	93	102	100
1,2-Dibromoethane (EDB)	5	101	109	103
Dibromomethane ¹	5	97	116	108
1,2-Dichlorobenzene	5	103	114	105
1,3-Dichlorobenzene	5	103	115	106
1,4-Dichlorobenzene	5	104	116	105
<i>trans</i> -1,4-Dichloro-2-butene	5	47	101	100
Dichlorodifluoromethane (CFC-12)	5	79	114	100
1,1-Dichloroethane (1,1-DCA)	5	110	102	111
1,2-Dichloroethane (1,2-DCA)	5	101	110	104
1,1-Dichloroethene (1,1-DCE)	5	103	115	108
<i>cis</i> -1,2-Dichloroethene (<i>cis</i> -1,2-DCE)	5	102	116	111
<i>trans</i> -1,2-Dichloroethene (<i>trans</i> -1,2-DCE) ²	5	112	122	114
1,1-Dichloropropene	5	100	111	105
1,2-Dichloropropane	5	95	105	101
1,3-Dichloropropane	5	103	115	106
2,2-Dichloropropane	5	81	94	91
1,1-Dichloropropene	5	100	111	105
<i>cis</i> -1,3-Dichloropropene	5	90	95	91
<i>trans</i> -1,3-Dichloropropene	5	87	99	97
Diethyl ether	5	96	109	107
Diisopropyl ether (DIPE) ¹	5	93	106	103
Ethylbenzene	5	108	115	109
Ethyl <i>tert</i> -butyl ether (ETBE) ¹	5	91	98	97
Ethyl methacrylate	5	86	100	93
<i>o</i> -Ethyl toluene (1-Ethyl-2-methylbenzene)	5	100	109	104
Hexachlorobutadiene	5	76	93	84
Hexachloroethane	5	79	108	104

Table A5A. Quality-control summary for matrix-spike recoveries of volatile organic compounds (NWQL schedule 2020) including gasoline oxygenates and degradates (NWQL schedule 4024) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued[Acceptable recovery range is between 70 and 130 percent; values in bold fall outside this range. **Abbreviation:** THM, trihalomethane]

Constituent	Number of spike samples	Recovery (percent)		
		Minimum	Maximum	Median
2-Hexanone (<i>n</i> -Butyl methyl ketone)	5	94	114	109
Iodomethane (Methyl iodide)	5	90	132	116
Isopropylbenzene	5	104	112	108
4-Isopropyl-1-methylbenzene	5	99	116	109
Methyl acetate	1	108	108	108
Methyl acrylate	5	94	108	103
Methyl acrylonitrile	5	104	133	113
Methyl <i>tert</i> -butyl ether (MTBE) ¹	5	92	101	98
Methyl methacrylate	5	86	94	91
Methyl isobutyl ketone (MIBK)	5	90	109	101
Methylene chloride (Dichloromethane) ²	5	98	113	111
Methyl ethyl ketone (2-Butanone, MEK)	5	90	108	103
Naphthalene	5	76	113	94
Perchloroethene (Tetrachloroethene, PCE) ²	5	104	161	115
<i>n</i> -Propylbenzene	5	102	115	109
Styrene	5	57	112	104
1,1,1,2-Tetrachloroethane	5	102	110	105
1,1,2,2-Tetrachloroethane	5	97	111	101
Tetrahydrofuran ¹	5	98	120	110
1,2,3,4-Tetramethylbenzene	5	80	113	91
1,2,3,5-Tetramethylbenzene	5	97	130	109
Toluene ¹	5	99	105	103
1,2,3-Trichlorobenzene	5	93	120	103
1,2,4-Trichlorobenzene	5	88	112	91
1,1,1-Trichloroethane (TCA) ²	5	105	115	110
1,1,2-Trichloroethane	5	102	113	102
Trichloroethene (TCE) ²	5	95	104	101
Trichlorofluoromethane (CFC-11) ²	5	111	131	113
1,2,3-Trichloropropane (1,2,3-TCP)	5	97	110	101
Trichlorotrifluoroethane (CFC-113) ²	5	85	106	97
1,2,3-Trimethylbenzene	5	104	119	111
1,2,4-Trimethylbenzene	5	107	122	113
1,3,5-Trimethylbenzene	5	104	114	109
Vinyl bromide (Bromoethene)	5	111	127	118
Vinyl chloride (Chloroethene)	5	112	135	119
<i>m</i> - and <i>p</i> -Xylene	5	109	122	116
<i>o</i> -Xylene	5	103	109	107

¹Constituents on schedules 2020 and 4024; only values from schedule 2020 are reported because it is the preferred analytical schedule.²Constituents detected in ground-water samples.

Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates (NWQL schedule 2003) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Acceptable recover range is between 70 and 130 percent; values in bold fall outside this range]

Constituent	Number of spike samples	Recovery (percent)		
		Minimum	Maximum	Median
Acetochlor	5	99	120	108
Alachlor	5	101	120	105
Atrazine ¹	5	95	116	100
Azinphos-methyl	5	80	149	92
Azinphos-methyl-oxon	5	26	109	42
Benfluralin	5	59	91	75
Carbaryl	5	106	131	121
2-Chloro-2,6-diethylacetanilide	5	93	113	100
4-Chloro-2-methylphenol	5	49	69	56
Chlorpyrifos	5	95	117	100
Chlorpyrifos, oxygen analog	5	14	78	28
Cyfluthrin	5	48	97	68
Cypermethrin	5	48	96	62
Dacthal (DCPA)	5	97	134	100
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino- <i>s</i> -triazine) ¹	5	40	54	44
Desulfinyl fipronil ¹	5	79	120	92
Desulfinyl fipronil amide	5	67	166	90
Diazinon	5	94	108	97
3,4-Dichloroaniline ¹	5	73	96	75
Dichlorvos	5	15	61	29
Dicrotophos	5	24	49	39
Dieldrin	5	87	128	103
2,6-Diethylaniline	5	90	115	94
Dimethoate	5	27	42	31
Ethion	5	71	134	95
Ethion monoxon	5	73	147	102
2-Ethyl-6-methylaniline	5	88	102	93
Fenamiphos	5	77	194	115
Fenamiphos sulfone	5	50	159	60
Fenamiphos sulfoxide	5	19	68	44
Fipronil I	5	86	182	99
Fipronil sulfide ¹	5	71	137	100
Fipronil sulfone ¹	5	53	121	76
Fonofos	5	85	104	92
Hexazinone ¹	5	64	98	71
Iprodione	5	63	109	75
Isfenphos	5	105	159	113
Malaoxon	5	82	122	109
Malathion	5	96	118	113
Metalaxy ¹	5	92	120	100
Methidathion	5	82	137	97
Metolachlor ¹	5	104	120	108
Metribuzin	5	75	100	85
Myclobutanil	5	80	146	98
1-Naphthol	5	28	83	40
Paraoxon-methyl	5	41	86	60
Parathion-methyl	5	77	119	87
Pendimethalin	5	89	168	100
<i>cis</i> -Permethrin	5	53	101	68
Phorate	5	53	98	84
Phorate oxon	5	78	163	119

Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates (NWQL schedule 2003) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.—Continued

[Acceptable recover range is between 70 and 130 percent; values in bold fall outside this range]

Constituent	Number of spike samples	Recovery (percent)		
		Minimum	Maximum	Median
Phosmet	5	11	30	16
Phosmet oxon	4	7	25	9
Prometon	5	89	114	99
Prometryn ¹	5	99	120	106
Pronamide (Propyzamide)	5	89	119	102
Simazine ¹	5	98	121	100
Tebuthiuron ¹	5	87	144	107
Terbufos	5	80	108	102
Terbufos oxon sulfone	5	63	115	91
Terbuthylazine	5	99	118	102
Tribufos	5	56	112	80
Trifluralin	5	66	100	83

¹Constituents detected in ground-water samples.

Table A5C. Quality-control summary for matrix-spike recoveries of potential wastewater-indicator compounds in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Acceptable recovery range is between 70 and 130 percent; values in bold fall outside this range]

Constituent	Number of spike samples	Recovery (percent)		
		Minimum	Maximum	Median
Acetophenone	4	71	112	96
Acetyl hexamethyl tetrahydronaphthalene (AHTN)	5	68	101	98
Anthracene	5	57	95	85
9,10-Anthraquinone	5	57	114	95
Atrazine	5	49	94	87
Benzo[a]pyrene	5	53	129	72
Benzophenone	5	70	107	97
Bisphenol A ¹	5	60	117	113
Bromacil	5	50	96	93
Bromoform (tribromomethane)	4	55	83	79
3- <i>tert</i> -Butyl-4-hydroxy anisole (BHA)	5	49	78	75
Caffeine	5	45	113	82
Camphor	5	57	91	88
Carbaryl	5	61	107	100
Carbazole	5	61	100	90
Chlorpyrifos	5	60	89	84
Cholesterol ¹	5	49	103	68
3- β -Coprostanol	5	48	115	70
Cotinine	5	25	67	54
<i>p</i> -Cresol	4	56	98	93
4-Cumylphenol	5	60	96	92
Diazinon	5	43	89	82
Dichlorvos	5	50	114	91
<i>N,N</i> -diethyl- <i>meta</i> -toluamide (DEET)	5	72	121	98
1,4-Dichlorobenzene	4	46	89	79
3,4-Dichlorophenyl isocyanate	5	0	83	56
Diethyl phthalate	5	72	117	101
2,6-Dimethylnaphthalene	5	58	96	83
bis(2-Ethylhexyl) phthalate ¹	5	96	607	259
Nonylphenol, monoethoxy- (total)	5	59	109	103
4-Nonylphenol diethoxylates	5	52	105	93
4-Octylphenol diethoxylates ¹	5	74	131	108
4-Octylphenol monoethoxylates ¹	5	68	114	99
Fluoranthene	5	64	207	93
Hexahydrohexamethylcyclopentabenzopyran (HHCB)	5	66	105	97
Indole	5	55	102	93
Isoborneol	5	60	111	88
Isophorone	5	54	104	85
Isopropylbenzene	4	34	78	65
Isoquinoline	5	44	115	93
<i>d</i> -Limonene	4	29	65	52
Menthol	5	60	113	83
Metalaxyl	5	63	97	92
3-Methyl-1(H)-indole (Skatole)	5	58	102	91
5-Methyl-1H-benzotriazole	5	72	110	93
1-Methylnaphthalene	5	60	95	84
2-Methylnaphthalene	5	59	93	83
Methyl salicylate	5	65	115	107
Metolachlor	5	59	92	88
Naphthalene	5	61	97	86
<i>para</i> -Nonylphenol (total)	5	67	112	94

Table A5C. Quality-control summary for matrix-spike recoveries of potential wastewater-indicator compounds in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.— Continued

[Acceptable recovery range is between 70 and 130 percent; values in bold fall outside this range]

Constituent	Number of spike samples	Recovery (percent)		
		Minimum	Maximum	Median
4- <i>n</i> -Octylphenol	5	60	98	88
4- <i>tert</i> -Octylphenol ¹	5	76	113	103
Pentachlorophenol	5	26	100	87
Phenanthrene	5	58	145	83
Phenol ¹	4	80	96	89
Prometon	5	58	145	83
Pyrene	5	61	167	88
β-Sitosterol	5	48	86	58
β-Stigmastanol	5	58	73	63
2,2',4,4'-Tetrabromodiphenyl ether	1	11	11	11
Perchloroethene (Tetrachloroethene, PCE)	4	24	59	44
Tributyl phosphate	5	68	115	102
Triclosan	5	57	117	102
Triethyl citrate (ethyl citrate)	5	57	107	93
Triphenyl phosphate	5	60	91	89
Tri(2-butoxyethyl)phosphate	5	44	102	91
Tri(2-chloroethyl)phosphate	5	57	93	84
Tri(dichlorisopropyl)phosphate	5	58	94	91

¹Constituents detected in ground-water samples.

Table A5D. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates (NWQL schedule 2060) in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Acceptable recover range is between 70 and 130 percent; values in bold fall outside this range]

Constituent	Number of spike samples	Recovery (percent)	Constituent	Number of spike samples	Recovery (percent)
Acifluorfen	1	70	Diuron	1	92
Aldicarb	1	123	Fenuron	1	81
Aldicarb sulfone	1	59	Flumetsulam	1	65
Aldicarb sulfoxide	1	101	Fluometuron	1	93
Atrazine ¹	1	88	Hydroxyatrazine (2-Hydroxy-4-isopropylamino-6-ethylamino- <i>s</i> -triazine)	1	88
Bendiocarb	1	82	3-Hydroxycarbofuran	1	79
Benomyl	1	81	Imazaquin	1	85
Bensulfuron-methyl	1	85	Imazethapyr	1	82
Bentazon	1	67	Imidacloprid	1	63
Bromacil	1	91	Linuron	1	92
Bromoxynil	1	49	MCPA (2-Methyl-4-chlorophenoxyacetic acid)	1	75
Caffeine	1	75	MCPB (4-(2-Methyl-4-chlorophenoxy)butyric acid)	1	63
Carbaryl	1	86	Metalaxyl ¹	1	92
Carbofuran	1	87	Methiocarb	1	87
Chloramben, methyl ester	1	85	Methomyl	1	120
Chlorimuron-ethyl	1	67	Metsulfuron methyl	1	69
3-(4-Chlorophenyl)-1-methyl urea	1	98	Neburon	1	92
Clopyralid	1	58	Nicosulfuron	1	121
Cycloate	1	80	Norflurazon	1	89
2,4-D (2,4-Dichlorophenoxyacetic acid)	1	80	Oryzalin	1	83
2,4-D methyl ester	1	85	Oxamyl	1	106
(2,4-Dichlorophenoxyacetic acid methyl ester)			Picloram	1	57
2,4-DB (4-(2,4-Dichlorophenoxy)butyric acid)	1	62	Propham	1	95
DCPA (Dacthal) monoacid	1	79	Propiconazole	1	89
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino- <i>s</i> -triazine) ¹	1	64	Propoxur	1	96
Deisopropyl atrazine (2-chloro-6-ethylamino-4-amino- <i>s</i> -triazine)	1	76	Siduron	1	94
Dicamba	1	58	Sulfometuron-methyl	1	82
Dichlorprop	1	77	Tebuthiuron	1	89
Dinoseb	1	62	Terbacil	1	88
Diphenamid	1	92	Triclopyr	1	69

¹Constituents detected in ground-water samples.

Table A6. Quality-control summary for surrogate recoveries of volatile organic compounds, including gasoline oxygenates and degradates, pesticides and pesticide degradates, potential wastewater-indicator compounds, and pharmaceutical compounds in samples collected for the Santa Clara River Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, April to June 2007.

[Acceptable recovery range is between 70 and 130 percent. **Abbreviations:** MWH, Montgomery Watson Harza Laboratory; VOC, volatile organic compound]

Surrogate	Analytical schedule	Constituent or constituent class analyzed	Number of blank analyses	Blank samples			Ground-water samples			
				Median recovery in blanks (percent)	Number of surrogate recoveries		Median recovery in ground-water samples (percent)	Number of surrogate recoveries		
					Below 70 percent in blanks	Above 130 percent in blanks		Below 70 percent in ground-water samples	Above 130 percent in ground-water samples	
1-Bromo-4-fluorobenzene	2020, 4024	VOC, gas oxygenate	10	71	5	0	53	72	24	0
1,2-Dichloroethane-d4	2020, 4024	VOC, gas oxygenate	10	122	0	0	53	122	0	12
Isobutyl alcohol-d6	4024	Gas oxygenate	1	104	0	0	9	106	0	0
Toluene-d8	2020, 4024	VOC, gas oxygenate	10	97	0	0	53	97	0	0
Diazinon-d10	2003	Pesticide	6	117	0	0	52	114	0	5
α-HCH-d6	2003	Pesticide	6	98	0	0	52	92	0	1
Barban	2060	Pesticide	1	93	0	0	9	88	0	0
Caffeine- ¹³ C	2060	Potential wastewater-indicator	1	107	0	0	9	73	3	0
2,4,5-T	2060	Pesticide	1	84	0	0	9	73	2	0
Caffeine- ¹³ C	4433	Potential wastewater-indicator	11	81	5	2	50	80	12	1
Decafluorobiphenyl	4433	Potential wastewater-indicator	11	74	5	0	50	71	23	0
Fluoranthene-d10	4433	Potential wastewater-indicator	11	92	1	2	50	94	3	1
Bisphenol A-d3	4433	Potential wastewater-indicator	11	62	7	0	48	70	24	0

