APPENDIX A

GROUNDWATER MANAGEMENT PLAN RESOLUTION OF INTENT

THE WITHIN INSTRUMENT IS A CORRECT COPY OF THE ORIGINAL ON FILE IN THIS OFFICE.

ATTEST: JAN 30 2007

ROBERT DEIS, Clerk of the Board of Directors of the SONOMA COUNTY WATER AGENCY
BY _____
DEPUTY CLERK

#24
Resolution No. 07-0081
County Administration Bldg.
Santa Rosa, CA

Date: January 30, 2007

RESOLUTION OF THE BOARD OF DIRECTORS OF THE SONOMA COUNTY WATER AGENCY OF INTENTION TO PREPARE A GROUNDWATER MANAGEMENT PLAN FOR THE SONOMA VALLEY BASIN OF SONOMA COUNTY.

WHEREAS, on June 20, 2006, the Sonoma County Water Agency's Board directed staff to initiate a non-regulatory groundwater management planning process in the Sonoma Valley Basin; and

WHEREAS, active public participation is critical to the success of development of any groundwater planning effort; and

WHEREAS, as part of initiating a groundwater management planning process in Sonoma Valley, a Basin Advisory Panel (BAP) was formed to act as the groundwater management plan stakeholder group for the Sonoma Valley Basin; and

WHEREAS, the BAP includes stakeholders from throughout the Sonoma Valley representing agricultural interests, local citizen groups, environmental groups, business interests, local well owners and government interests; and

WHEREAS, the BAP has been meeting since August 2006 to begin the groundwater management planning process in the Sonoma Valley; and

WHEREAS, development of a groundwater management plan would provide for the effective management of groundwater resources in the Sonoma Valley Basin; and

WHEREAS, the California Water Code requires that before a groundwater management plan can be prepared, a local public agency must provide notice and hold a hearing regarding the local public agency's intent to prepare a Groundwater Management Plan; and

WHEREAS, the Sonoma County Water Agency (Agency) was formed in 1949 by a special legislative act of the State of California ("Agency Act") and is a stakeholder of the Basin Advisory Panel; and

WHEREAS, under the Agency Act, the Agency may provide for the protection and preservation of groundwater resources in Sonoma County for current and future beneficial uses and may develop, adopt, and implement a plan to manage groundwater resources in the Sonoma Valley; and

WHEREAS, by completing a Groundwater Management Plan, existing and future State funding may be available for plan implementation; and

JB:FILESERVER/DATA/AGENDA/MISC/SV HEARING & RESOLUTION FOR SV GROUNDWATER MGMT PLAN.DOC

FILE: ~~WC/40-0-1~~ SONOMA VALLEY GROUNDWATER MANAGEMENT PLAN
WC/40-3-1

C Keene, Gasperac, Blakey, Rafile, mc

WHEREAS, a hearing has been duly noticed and held as required by law.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Sonoma County Water Agency hereby finds, determines, and declares as follows:

1. All of the above recitals are true and correct.
2. The Agency intends to prepare a Groundwater Management Plan for the Sonoma Valley Basin of Sonoma County.
3. The General Manager/Chief Engineer is authorized and directed to take such steps as are necessary to develop the Groundwater Management Plan for the Sonoma Valley Basin, for Board consideration, and to publish a copy of this Resolution as required by law.
4. Upon completion of a Groundwater Management Plan, the Board of Directors of the Sonoma County Water Agency will consider adopting and implementing the Groundwater Management Plan in accordance with the process required by law.
5. The General Manager/Chief Engineer shall take such steps as are necessary to ensure that the Groundwater Management Plan for the Sonoma Valley Basin contains at least the following components:

    a) Basin Management Objectives;

    b) Components relating to the monitoring and management of groundwater levels, groundwater banking, groundwater quality, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping;

    c) Monitoring protocols to track changes in conditions related to components in paragraph (b) and to generate information for the purpose of meeting Basin Management Objectives and establishing effective management of groundwater;

    d) A plan to involve other local agencies, water purveyors, and private well owners in the development of the Groundwater Management Plan;

    e) A map depicting the Sonoma Valley Basin, as defined by the California Department of Water Resources Bulletin No. 118 and the Basin Advisory Panel, other local agencies, and water purveyors in the Sonoma Valley; and

    f) Rules related to implementation of the Groundwater Management Plan.

6. The General Manager/Chief Engineer shall take such steps as are necessary to ensure active public participation in the groundwater management planning process and shall coordinate and staff the Basin Advisory Panel meetings which will serve to provide a forum for public involvement in the development of the Groundwater Management Plan. To support the groundwater management planning process, the Agency shall develop a plan for public involvement which shall include at least the following:

   a) The formulation of a Technical Review Committee to guide development of the Groundwater Management Plan;

   b) Preparation of a Public Outreach Plan;

   c) Provision of public review and comment periods, and public hearings pursuant to Water Code Section 10753 et seq.

DIRECTORS:

KERNS _____ SMITH _____ KELLEY _____ REILLY _____ BROWN _____

Ayes __5__ Noes _____ Absent _____ Abstain _____

SO ORDERED.

COUNTY OF SONOMA
AGENDA ITEM
SUMMARY REPORT

Clerk of the Board Use Only
Meeting Date ___/___/___ **Held Until** ___/___/___
Agenda Item No: _____ **Agenda Item No:** _____

Department: Sonoma County Water Agency			( ) 4/5 Vote Required
Contact: Bill Keene	**Phone:** 547-1922	**Board Date:** 01-30-07	**Deadline for Board Action:**

AGENDA SHORT TITLE:
Hearing and Resolution Regarding Sonoma Valley Groundwater Management Plan

REQUESTED BOARD ACTION(S):
Hold public hearing and consider adoption of Resolution of Intention to Prepare a Groundwater Management Plan for the Sonoma Valley Basin of Sonoma County.

CURRENT FISCAL YEAR FINANCIAL IMPACT

EXPENDITURES			ADD'L FUNDS REQUIRING BOARD APPROVAL		
Estimated Cost	$	-0-	**Contingencies (Fund Name:)**	$	
Amount Budgeted	$	-0-	**Unanticipated Revenue (Source:)**	$	
Other Avail Approp (Explain below)	$		**Other Transfer(s) (Source:)**	$	
Additional Requested:	$	-0-	**Add'l Funds Requested:**	$	

Explanation (if required):

Prior Board Action(s):

06/06 Board Workshop on Groundwater Management whereby Board directed staff to begin non-regulatory groundwater management planning process in Sonoma Valley.

11/04 Board Workshop on Water Supply and Reliability whereby Board directed staff to develop a work plan for a non-regulatory groundwater management plan in Sonoma Valley.

01/01 Board Action to initiate Sonoma County Water Agency/United States Geological Survey Cooperative Study of Groundwater Basins in Sonoma County

Alternatives - Results of Non-Approval:
Without hearing and adoption of the attached resolution, the Agency would not initiate a groundwater management planning process, and would not be eligible to receive existing state funding for groundwater projects in Sonoma Valley, nor be eligible for future State Bond or Grant monies for groundwater projects in the Sonoma Valley.

Background: Work Plan for Groundwater Management Plan for the Sonoma Valley, CA, and Sonoma Valley Groundwater Issues Assessment on file with the Clerk.

This agenda item provides a summary of groundwater management planning activities in Sonoma Valley to date, and presents the proposed Resolution of Intention to Develop a Groundwater Management Plan for the Sonoma Valley Basin, for Board consideration after conducting a hearing under the California Water Code (Section 10753.2).

Summary of Sonoma Valley Groundwater Management Planning Activities

In June 2006, the Sonoma County Water Agency's Board directed staff to begin a non-regulatory Groundwater Management Planning process in the Sonoma Valley. At that time, the Board approved a work plan under which staff would develop a groundwater management plan. A copy of the work plan is on file with the Clerk. The work plan involves the development of a non-regulatory groundwater management plan that emphasizes local control and is consistent with the requirements of the California Water Code (Section 10753 et seq.).

The required elements of a groundwater management plan include:

- Outreach to stakeholders,
- Development of basin management objectives,
- Involvement of local affected agencies,
- Performance of technical activities (e.g., water level measurements, water quality investigations),
- Monitoring protocols to ensure data quality and track changes to groundwater conditions,
- Development of a map of the management area, and
- Preparation of a plan using geologic and hydrologic principles

As a first step in implementing the work plan, in August 2006, Sonoma County Water Agency (Agency) staff convened a Basin Advisory Panel (BAP). BAP members were identified and selected through a stakeholder assessment process conducted on behalf of the Agency by the Center for Collaborative Policy (CCP). The report completed by the CCP outlined specific issues related to Groundwater Management in the Sonoma Valley, and formed the basis for selecting BAP members. A copy of the report is on file with the Clerk.

The BAP members represent a cross-section of stakeholders from throughout the Sonoma Valley, including agricultural interests, local citizen groups, environmental groups, business interests, local well owners, and governmental interests. Both the Agency and County of Sonoma (through the Permit and Resource Management Department) are represented on the BAP.

Continued...

Attachments: Resolution (R-1)

On File With Clerk: 1. Work Plan for Groundwater Management Plan for the Sonoma Valley, CA,
2. Sonoma Valley Groundwater Issues Assessment

CLERK OF THE BOARD USE ONLY

Board Action (If other than "Requested")	**Vote:**
_____	
_____	
_____	

Background (continued):

The first several meetings of the BAP have focused on public outreach and education, development of an organizational charter for the BAP, and development of draft Basin Management Goal and Objectives. Ongoing and future activities include additional public outreach and education regarding groundwater issues within the Sonoma Valley Basin, completion of groundwater management goal and basin management objectives, development of monitoring protocols and technical activities, and finalizing the groundwater management plan and implementation plan. Once the Board adopts a resolution of intention to prepare a groundwater management plan, the Agency must complete the plan within 2 years or the resolution of intention expires and a new hearing must be held and resolution approved before a plan may be approved.

Resolution of Intention to Prepare a Groundwater Management Plan in the Sonoma Valley Basin
The Agency must hold a public hearing regarding the matter before it may consider adopting the Resolution of Intention to Prepare a Groundwater Management Plan. Regarding the notice and hearing:

- The notice must be published once a week for two successive weeks in a newspaper.
- The notice must indicate that the Agency is considering adoption of a groundwater management plan pursuant to Water Code section 10750 et seq.
- At the conclusion of the hearing, the local agency may draft a resolution of intention to adopt a groundwater management plan for the purposes of implementing the plan and establishing a groundwater management program.
- If adopted, the local agency must publish the resolution of intention in the same manner as the notice of the hearing.

To date, the required newspaper notices for this hearing have been published in the Press Democrat and two local papers in the Valley, the Sonoma Index Tribune and Sonoma Sun. The hearing today serves as the noticed hearing for the adoption of a Resolution of Intention to prepare a groundwater management plan for the Sonoma Valley Basin.

To continue to support the Sonoma Valley BAP's efforts in preparing a groundwater management plan, and to meet the noticing requirements in the California Water Code (Section 10753), staff recommend that the Board hold a hearing, take any public comment and then adopt the attached Resolution of Intention to Prepare a Groundwater Management Plan for the Sonoma Valley Basin of Sonoma County.

REQUESTED BOARD ACTION(S):
Hold public hearing and consider adoption of Resolution of Intention to Prepare a Groundwater Management Plan for the Sonoma Valley Basin of Sonoma County.

R24
10:00 a.m.

AGENDA ITEM TRANSMITTAL REPORT

DEPARTMENT: Sonoma County Water Agency	**SUBMITTED BY:** Randy D. Poole
FOR BOARD ACTION ON: 01-30-07	**AS:** (X) **CONSENT** ( ) **REGULAR**

THIS ITEM REQUIRES: (Check appropriate boxes)

(X) **Hearing** 01/30/07 (date) 10:00 a.m. (time) ( ) **4/5 Vote**

( ) **Requests Gold Resolution** ( ) **Appropriation Transfer**

( ) **Public Appearance Anticipated** ( ) **Position Alloc List Change(s)**

(X) **County Counsel Approval Date** 1/18/07 **By:** [signature] jg

AGENDA SHORT TITLE:
Hearing and Resolution Regarding Sonoma Valley Groundwater Management Plan

REQUESTED BOARD ACTION(S):
Hold public hearing and consider adoption of Resolution of Intention to Prepare a Groundwater Management Plan for the Sonoma Valley Basin of Sonoma County.

[signature]
Signature of Department Head

Special Instructions to Clerk of the Board:

FOR AGENDA COMMITTEE USE

County Administrator's Office Recommendation:

( ) **Approval** ( ) **Submitted with Comment**
( ) **Not Recommended** ( ) **Policy Determination by Board**

Analyst Comment:

Signature of County Administrator

Agenda Committee Action:

( ) **Consent Calendar**
( ) **Regular Calendar**

Date Scheduled: ____/___/____
Time Scheduled: _____
(If required)

FEB 2 2 2007 WC/40-3-1 Sonoma Valley Groundwater Management Plan

PROOF OF PUBLICATION

(2015.5 C.C.P.)

STATE OF CALIFORNIA

County of Sonoma

I am a citizen of the United States and a resident of the county aforesaid: I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of the printer of The Press Democrat, a newspaper of general circulation, printed and published DAILY IN THE City of Santa Rosa, County of Sonoma; and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Sonoma, State of California, under the date of November 29, 1951, Case number 34831, that the notice, of which the annexed is a printed copy (set in type not smaller than nonpareil), has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates to wit:

February 9, 16

all in the year 2007
I certify (or declare) under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct.
Dated at Santa Rosa, California, this

16th day of February

2007

Roxanne Nessar

SIGNATURE

2/22/07 orig to Jane G.
cc: acctg, file, Jay G.

2002v1

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Proof of Publication of

Sonoma County Water Agency
Resolution No. 07-0081
Approved: January 30, 2007

RESOLUTION OF THE BOARD OF DIRECTORS OF THE SONOMA COUNTY WATER AGENCY OF INTENTION TO PREPARE A GROUNDWATER MANAGEMENT PLAN FOR THE SONOMA VALLEY BASIN OF SONOMA COUNTY.

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WHEREAS, the BAP includes stakeholders from throughout the Sonoma Valley representing agricultural interests, local citizen groups, environmental groups, business interests, local well owners and government interests; and

WHEREAS, the BAP has been meeting since August 2006 to begin the groundwater management planning process in the Sonoma Valley; and

WHEREAS, development of a groundwater management plan would provide for the effective management of groundwater resources in the Sonoma Valley Basin; and

WHEREAS, the California Water Code requires that before a groundwater management plan can be prepared, a local public agency must provide notice and hold a hearing regarding the local public agency's intent to prepare a Groundwater Management Plan; and

WHEREAS, the Sonoma County Water Agency (Agency) was formed in 1949 by a special legislative act of the State of California ("Agency Act") and is a stakeholder of the Basin Advisory Panel; and

WHEREAS, under the Agency Act, the Agency may provide for the protection and preservation of groundwater resources in Sonoma County for current and future beneficial uses and may develop, adopt, and implement a plan to manage groundwater resources in the Sonoma Valley; and

WHEREAS, by completing a Groundwater Management Plan, existing and future State funding may be available for plan implementation; and

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a) The formulation of a Technical Review Committee to guide development of the Groundwater Management Plan;

b) Preparation of a Public Outreach Plan;

c) Provision of public review and comment periods, and public hearings pursuant to Water Code Section 10753 et seq.

DIRECTORS:
KERNS SMITH KELLEY REILLY BROWN
Ayes 5 Noes Absent Abstain
SO ORDERED

2070566- Pub. Feb. 9, 16, 2007 2ti.

RECEIVED
FEB 2 2 2007
Sonoma County Water Agency

APPENDIX B

LIST OF SMALL WATER SUPPLY SYSTEMS IN THE SONOMA VALLEY

SMALL WATER SUPPLY SYSTEMS

Mutual Water Companies	Connections	Location
Mission Highlands MWC	68	Sonoma
Diamond A MWC	180	Sonoma
Bart's MWC	52	Sonoma
George Ranch MWC	27	Sonoma
Sobre Vista MWC	25	Sonoma
Rancho de Sonoma WC	99	Sonoma
De Anza Moon Valley WC	199	Sonoma
Lawndale MWC	79	Kenwood
Bennett Ridge MWC	115	Kenwood
Kinnybrook MWC		Kenwood
Kenwood Village WC		Kenwood
McFarren WC	22	Kenwood
Apartments and Mobile Home Parks		
Acacia Grove Mobile Home Park	65	Sonoma
Sonoma Mission Gardens	41	Sonoma
Medical and Health Care Facilities		
Sonoma Development Center		Eldridge
Wineries and Vineyards		
Sebastiani Vineyards		Sonoma
Roche Winery		Sonoma
Cohn Winery		Sonoma
Bartholomew Foundation		Sonoma
Gloria Ferrer Caves		Sonoma
Gunlach Bundschu Winery		Sonoma
Ravenswood Quarry Winery		Sonoma
Buena Vista Carneros Production		Sonoma
Jacuzzi Winery		Sonoma
Cline Cellars		Sonoma
Nicholson Ranch Winery		Sonoma
Schug Cellars		Sonoma
Viansa Winery		Sonoma
Imagery Estate Winery		Glen Ellen

Arrowood Vineyards & Winery	Glen Ellen
Deerfield Ranch Winery	Glen Ellen
Benziger Family Winery	Glen Ellen
Kenwood Vineyards and Winery	Kenwood
Blackstone Winery	Kenwood
Chateau St, Jean	Kenwood
Landmark Vineyards, Ltd.	Kenwood
St. Francis Winery	Kenwood
Wild Oaks Vineyard	Kenwood
Kunde Estate Winery	Kenwood

Hotels, Restaurants, and Tasting Rooms

Sonoma Lodge Hotel	Sonoma
Vineyards Inn	Sonoma
Vineburg Grocery & Deli	Sonoma
Babe's Burgers & Franks	Sonoma
Schellville Grill	Sonoma
Carneros Deli	Glen Ellen
Kenwood Restaurant & Bar	Kenwood
The Wine Room	Kenwood

Schools, Churches, Camps, & Fraternal Lodges

Presentation School	Sonoma
Sonoma 7th Day Adventist Church	Sonoma
Sonoma Valley Moose Lodge 2048	Sonoma
Camp Via	
Valley of the Moon Camp	
Sonoma Mountain Zen Center	

Parks and Recreational Facilities

Infineon Raceway	Hwy 37
Los Arroyos Golf Course	Sonoma
Sonoma National Golf Club	Sonoma
Jack London State Park	Glen Ellen
Fairfield Osborne Preserve	

Warehouses and Factories

Dowling Magnets	Sonoma

Carneros Warehousing	Sonoma
S&W Warehousing, LLC	Sonoma
Sonoma Warehousing	Sonoma
Groskopf Warehouse, Inc.	Sonoma

Other Businesses

Cornerstone Gardens	Sonoma
Westerbeke Ranch Conference Center	Sonoma

APPENDIX C

WATER MANAGEMENT OPTIONS ANALYSIS

GROUNDWATER MODELING SCENARIOS ANALYSIS

Sonoma Valley Groundwater Management Plan

Water Management Options Analysis

DRAFT

Prepared for:

Sonoma County Water Agency

October 2007

Prepared by:

Schlumberger Water Services
Sacramento, California

Version: 10/27/2007

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1 Introduction

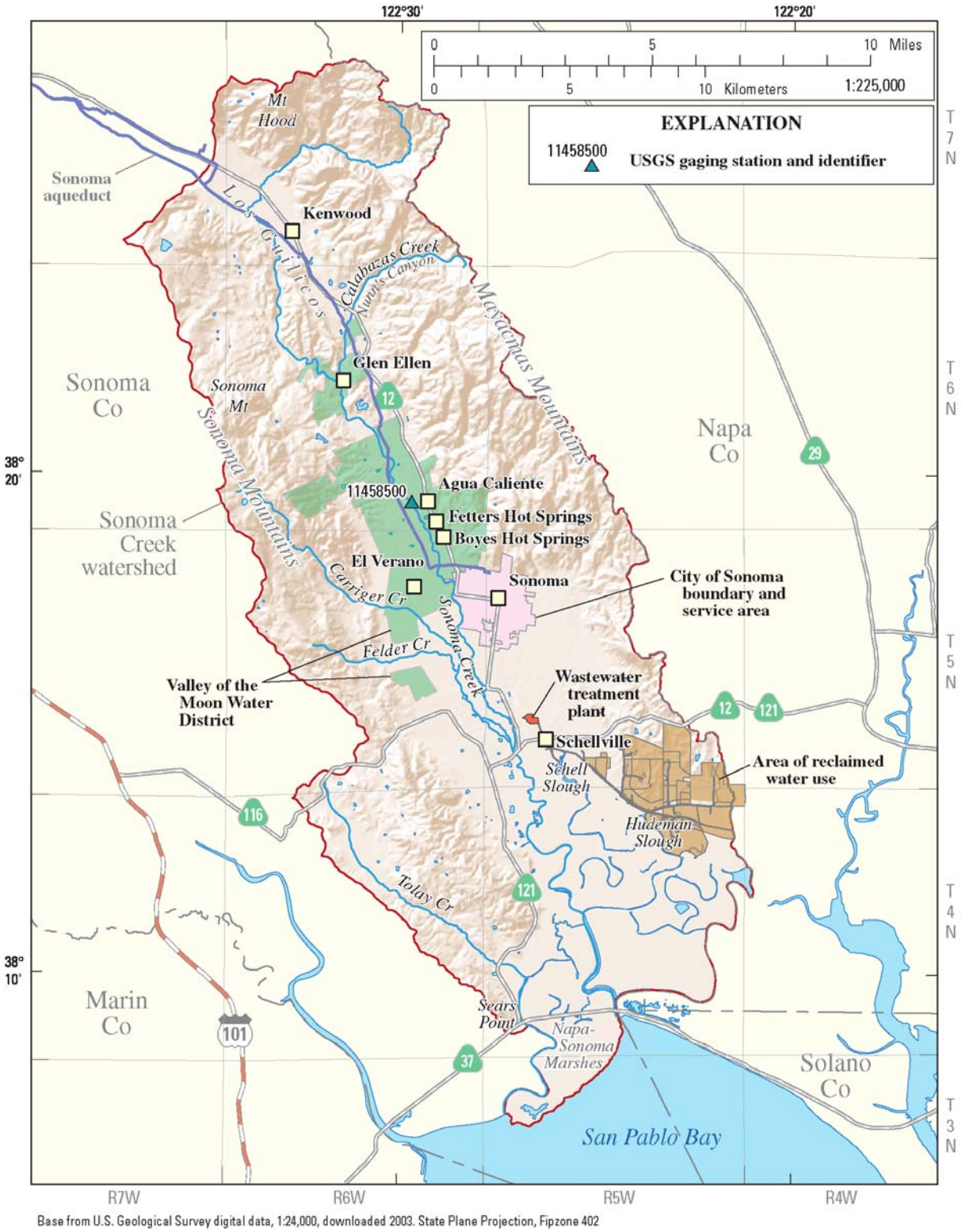
As part of its development of a Sonoma Valley Groundwater Management Plan for the Sonoma County Water Agency (Agency), Schlumberger Water Services (SWS) has performed a water management scenario analysis using a groundwater flow model developed by the United States Geological Survey (USGS) for the Sonoma Valley. The Sonoma Valley study area is shown in Figure 1-1. This report describes the work performed for this task along with the results of the analysis.

The objective of the scenario analysis was to assess the potential benefit of various water management projects under different water availability scenarios in the Sonoma Valley basin over a 30-year horizon. Additionally, the results of the analysis could help the Basin Advisory Panel (Panel) prioritize the Groundwater Management Plan recommendations. This task was accomplished using the existing Sonoma Valley basin groundwater flow model developed by the USGS (2006), along with technical input from the Agency and the Technical Work Group (TWG) of the Panel. The following sub-tasks were accomplished:

1. Meetings and discussions with the Agency and USGS throughout the course of the task to discuss the approach and results of the hydrologic and scenario analysis.
2. Review and import of USGS MODFLOW datasets into the visual pre-/post-processor Visual MODFLOW
3. Simulation of twelve water management scenarios
4. Assessment of the sensitivity of the model solution to key model parameters.

This report documents the modeling work performed, including a description of the alternative pumping demand, water supply and recharge scenarios considered; a qualitative comparison of the modeled scenarios; and a description of uncertainties and limitations of the simulations.

The remainder of this document is organized into five sections. Section 2 describes the existing USGS MODFLOW model and its import into the Visual MODFLOW pre-/post-processing software. The setup and input parameters of the existing model are presented here. Section 3 presents the components of the different model scenarios and their assumptions, as well as the implementation of these components into the model scenarios. The results of the scenario analysis are presented in Section 4. Section 5 describes the sensitivity analysis performed on this scenario analysis, as well as the overall sensitivity of the model to key parameters as identified by the USGS. Section 6 concludes the report by presenting recommendations for further data collection and improvements that could be made to the model to make the model an even better tool for the management of groundwater resources in the Sonoma Valley.



Base from U.S. Geological Survey digital data, 1:24,000, downloaded 2003. State Plane Projection, Fipzone 402

Figure 1-1 Study Area – Sonoma Creek Watershed, Sonoma Valley, Sonoma County, California. Map from USGS, 2006.

2 Description of Groundwater Flow Model

The numerical flow model of the Sonoma Valley study area that formed the basis for this scenario analysis was developed by the USGS as part of a groundwater study of the basin (USGS, 2006). The model was developed using the USGS MODFLOW-2000 simulation code (USGS, 2000), which uses a set of input files to calculate groundwater heads and fluxes. All inputs and output results are saved as ASCII or binary files with non user-friendly formats that are time consuming to handle and analyze.

The existing USGS MODFLOW model was imported into the Visual MODFLOW (Waterloo Hydrogeologic, Inc., 2006) in order to assist in data input and output visualization, and to facilitate participation from stakeholders represented by the TWG. Visual MODFLOW is a pre- and post-processing software for files required and generated by USGS MODFLOW and other numerical codes, allowing for more efficient data manipulation as well as visualization and graphic manipulation of both input parameters and output results for the simulations. This section describes the setup of the existing USGS model that formed the basis for the scenario runs.

2.1 Simulation Period

The USGS model was calibrated over a period from pre-1975 through 2000. The pre-1975 conditions were assumed to be near steady-state, and were simulated as such in the model. The period from 1975 through 2000 was simulated as a transient calibration period using the steady-state results as initial condition. The model thus consisted of a total of 1 steady-state and 26 transient annual stress periods, with six time steps approximately 60 days long in each stress period.

2.2 Model Domain and Boundary Conditions

The Sonoma Valley area model covers a 13 x 33-mile area encompassing the Sonoma Valley basin from Kenwood south to San Pablo Bay (see Figure 1-1). The Sonoma Valley basin refers to the valley area from Kenwood to San Pablo Bay, which is primarily drained by Sonoma Creek outflowing to San Pablo Bay. The Sonoma and Mayacamas Mountains form the groundwater no-flow boundaries to the east and west of the model. Model grid cells outside of the no-flow boundaries are inactive cells and do not contribute to flow during the simulations. The surface water that flows from the mountains into the valley via tributaries and seasonal creeks and percolates into the aquifer can be accounted for in the other boundary conditions of the model. The ground surface ranges from an altitude of 400 feet near Kenwood down to sea level at San Pablo Bay. The model extends vertically to the basement rocks, which can reach depths of nearly 10,000 feet below ground surface in some areas of the basin.

The model domain consists of a grid of 133 rows and 52 columns of cells oriented in the direction of groundwater flow, which is generally from northwest to southeast toward San Pablo Bay (Figure 2-1). The grid cells each cover an area of 1,320 feet by 1,320 feet (approximately 400 meters by 400 meters). The subsurface is represented by eight model layers. Model layers 1 through 7 have a mean thickness of approximately 125 feet, while layer 8 is approximately 4,000 feet thick on average.

A general head boundary covers layer 1 of the southern part of the model underlying San Pablo Bay (Figure 2-2), which allows water to enter and leave the model at a rate proportional to the hydraulic-head differences between the source and model cells. It is assigned a head elevation of 10.25 feet with varying values for hydraulic conductance.

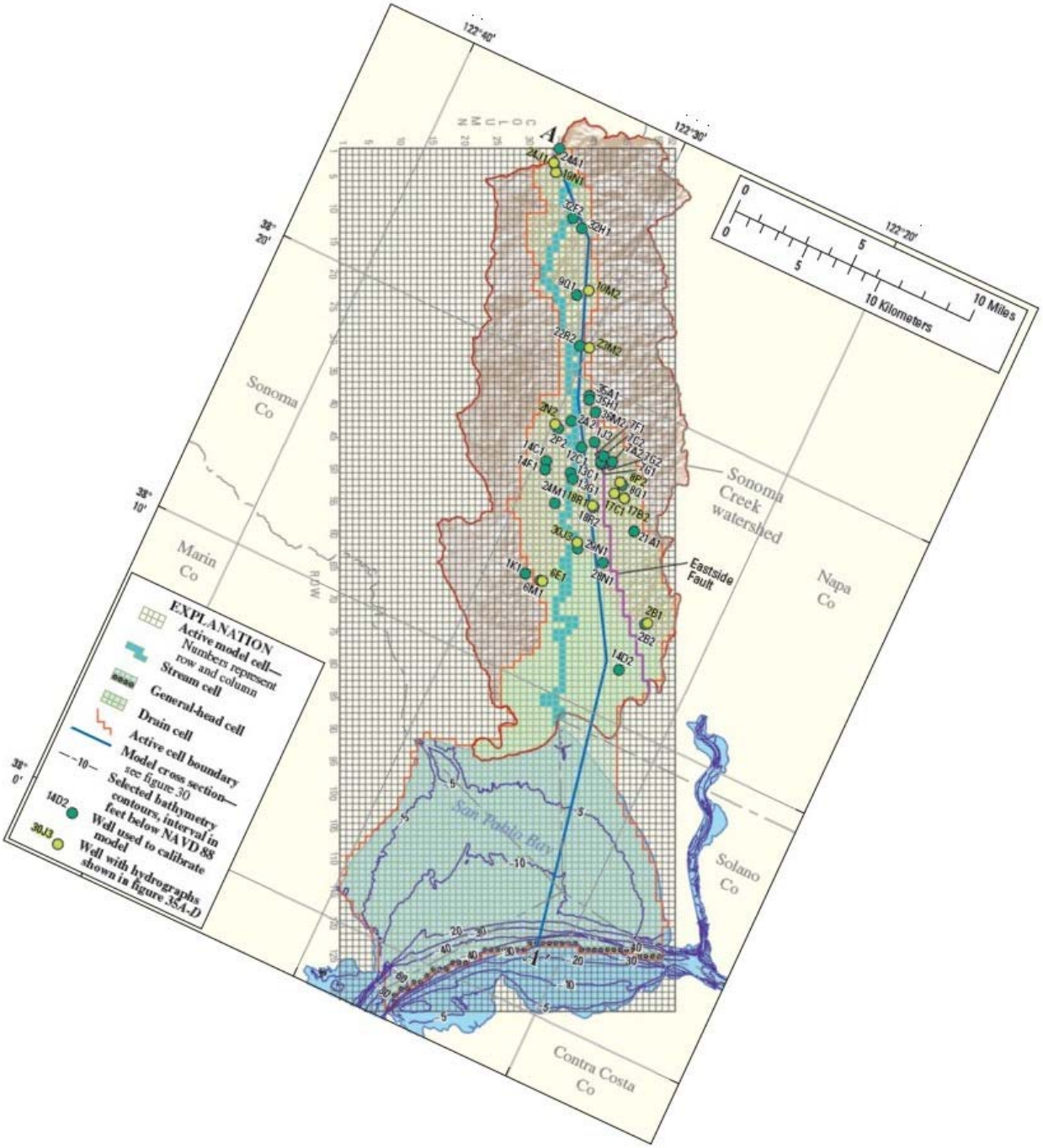
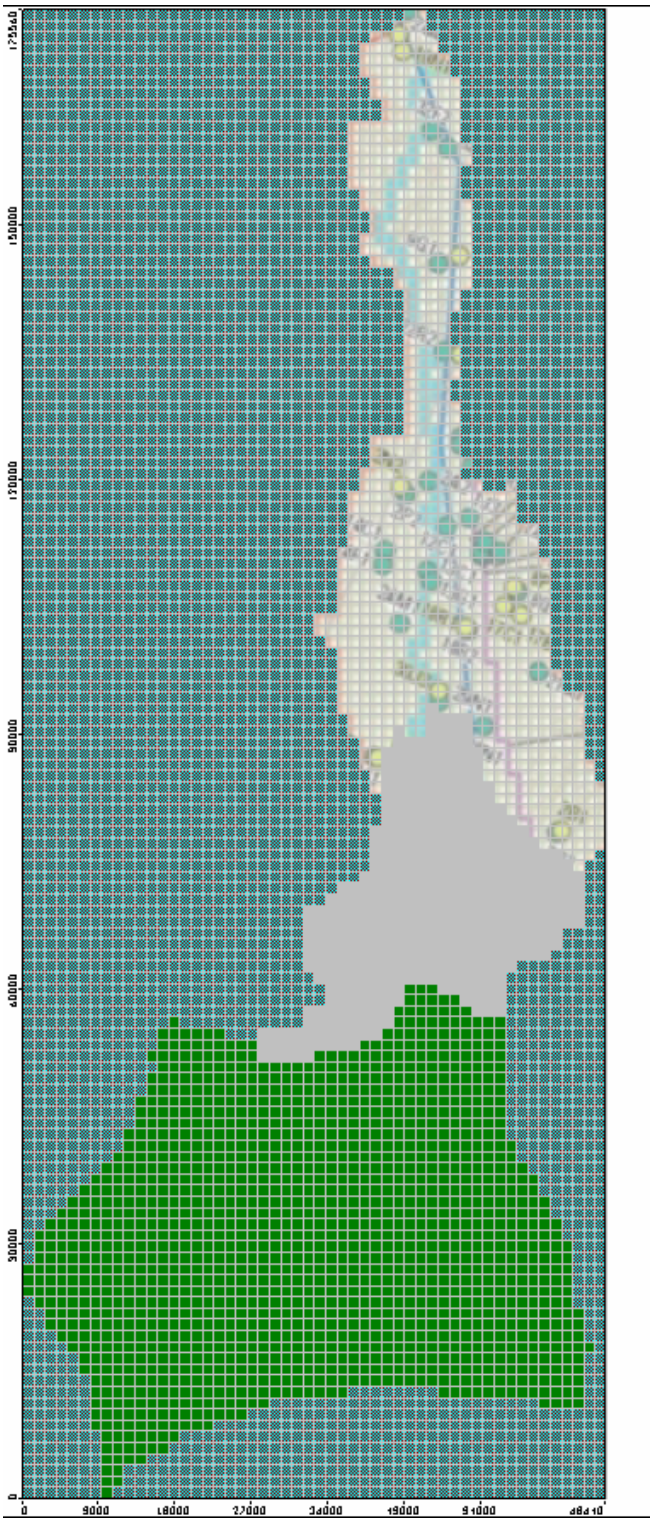


Figure 2-1 Model Grid Showing Boundary Conditions Used In the Ground-Water Flow Model. The figure has been rotated to show the alignment of the grid with the groundwater flow gradient (USGS, 2006)

Marsh-like conditions are represented by a drain boundary in layer 1 in the area of the Bay Mud deposits just north of San Pablo Bay. A drain boundary can remove water from the aquifer at a rate proportional to the difference between the head in the aquifer and some fixed head as long as the head in the aquifer is above that fixed head.

All other boundaries to the model are no-flow boundaries. Within the model, a horizontal flow barrier boundary, characterized by a thin, vertical low-permeability feature impeding the horizontal flow of groundwater, represents the Eastside Fault in layers 2 through 8 (see Figure 2-2). Sonoma Creek is represented by a stream boundary condition (see Section 2.4 - Inflows and Outflows).

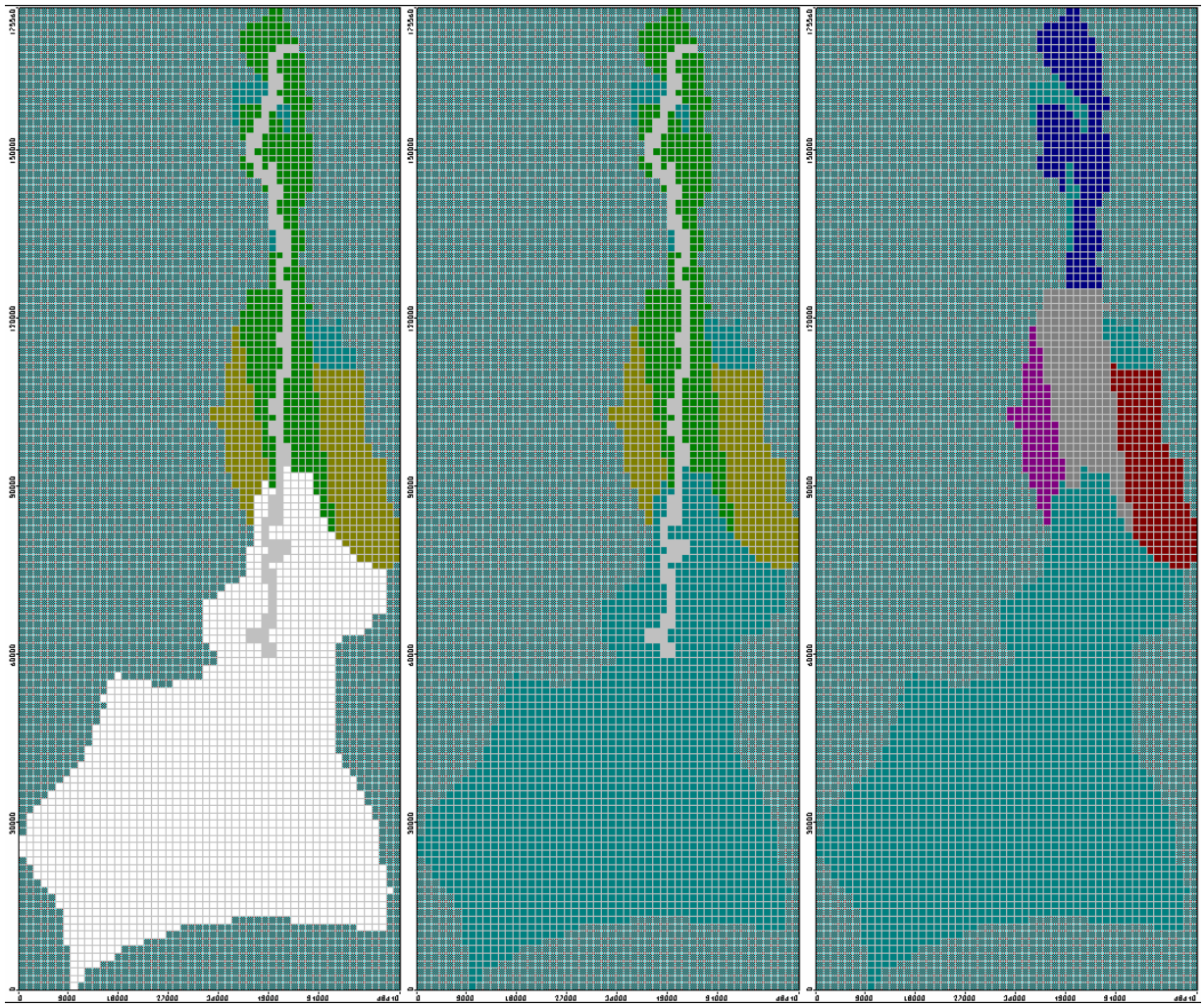


Boundary Conditions	
	General Head Boundary
	Drain Boundary
	Inactive Cells

Figure 2-2 Model Boundaries.

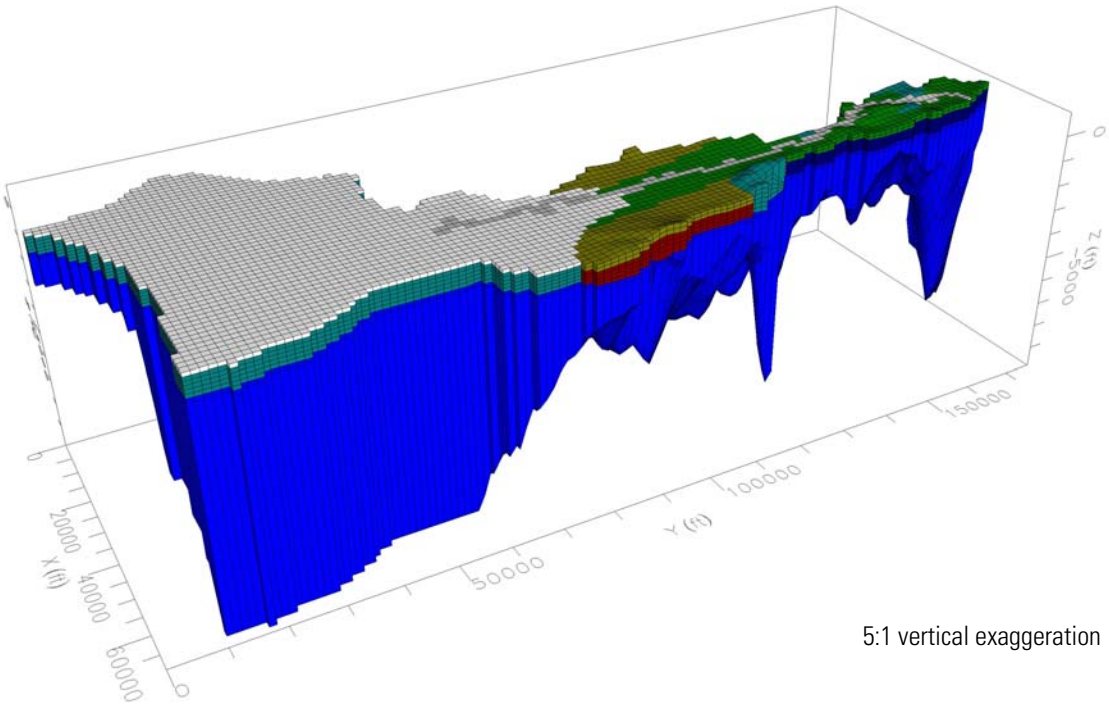
2.3 Subsurface Properties

The subsurface properties of the calibrated model – horizontal and vertical hydraulic conductivity, specific storage, and specific yield – were imported into Visual MODFLOW. The hydraulic conductivity values in the model are parameterized into homogeneous zones and horizontally-to-vertically anisotropic in model layers 1 through 6, as shown in Figure 2-3. The USGS had initially interpolated point-hydraulic conductivity values to generate a hydraulic conductivity value for each active model cell, but then parameterized the values into homogeneous zones to reduce the number of model parameters to a manageable number for the purposes of calibration and sensitivity analysis. Model layers 7 and 8 are homogeneous with a horizontal hydraulic conductivity of 0.8 feet per day and a horizontal to vertical anisotropy ratio of 10:1. These lower layers can be seen in the 3-dimensional view of the model in Figure 2-4.



Layer 1 Layer 2 Layers 3-6

Figure 2-3 Model Hydraulic Conductivity by Model Layer. See Figure 2-4 for legend.



5:1 vertical exaggeration

Hydraulic Conductivity (feet per day)		
	Horizontal	Vertical
	50	5
	25	0.1
	10	0.1
	7	0.07
	5	0.05
	5	0.02
	5	0.01
	3	0.03
	1	0.01
	0.8	0.08
	Inactive Cells	

Figure 2-4 3-Dimensional View of Model Hydraulic Conductivity.

Storage parameters are homogeneous for each layer. Figure 2-5 presents the values for specific storage by layer. The specific storage of a saturated aquifer is defined as the volume of water that a unit volume of aquifer releases from storage under a unit decline in hydraulic head due to compaction of the aquifer and the expansion of water (Freeze & Cherry, 1979). This definition as a volume per volume per unit decline in head (length) results in the unit 1/feet used in the model. Layer 1 is assigned a specific yield of 10%. This parameter is defined as the volume of water that an unconfined aquifer releases from storage per unit surface area of aquifer per unit decline in the water table.

2.4 Inflows and Outflows

Sources of basin inflows include recharge from precipitation, San Pablo Bay, and Sonoma Creek, while outflows include pumping wells, evapotranspiration, marsh conditions in the area of the Bay Mud deposits, as well as San Pablo Bay and Sonoma Creek. The model applies recharge from precipitation in the middle and northern parts of the model, shown in Figure 2-6, with recharge rates varying on an annual basis. A

stream boundary condition represents Sonoma Creek, with stream inflow also varying annually. The approximately 2000 wells in the Sonoma Valley basin are represented in the model in a simplified manner. In total, 908 agricultural, urban supply, and private domestic wells pumping at rates varying annually were assigned to the model. Because each model grid cell represents an area of 40 acres, each model well may represent several actual wells. Evapotranspiration was not modeled explicitly in the model, but was rather incorporated into the formulation of the stream and drain boundary conditions representing the areas where evapotranspiration was assumed to be occurring (USGS, 2006).

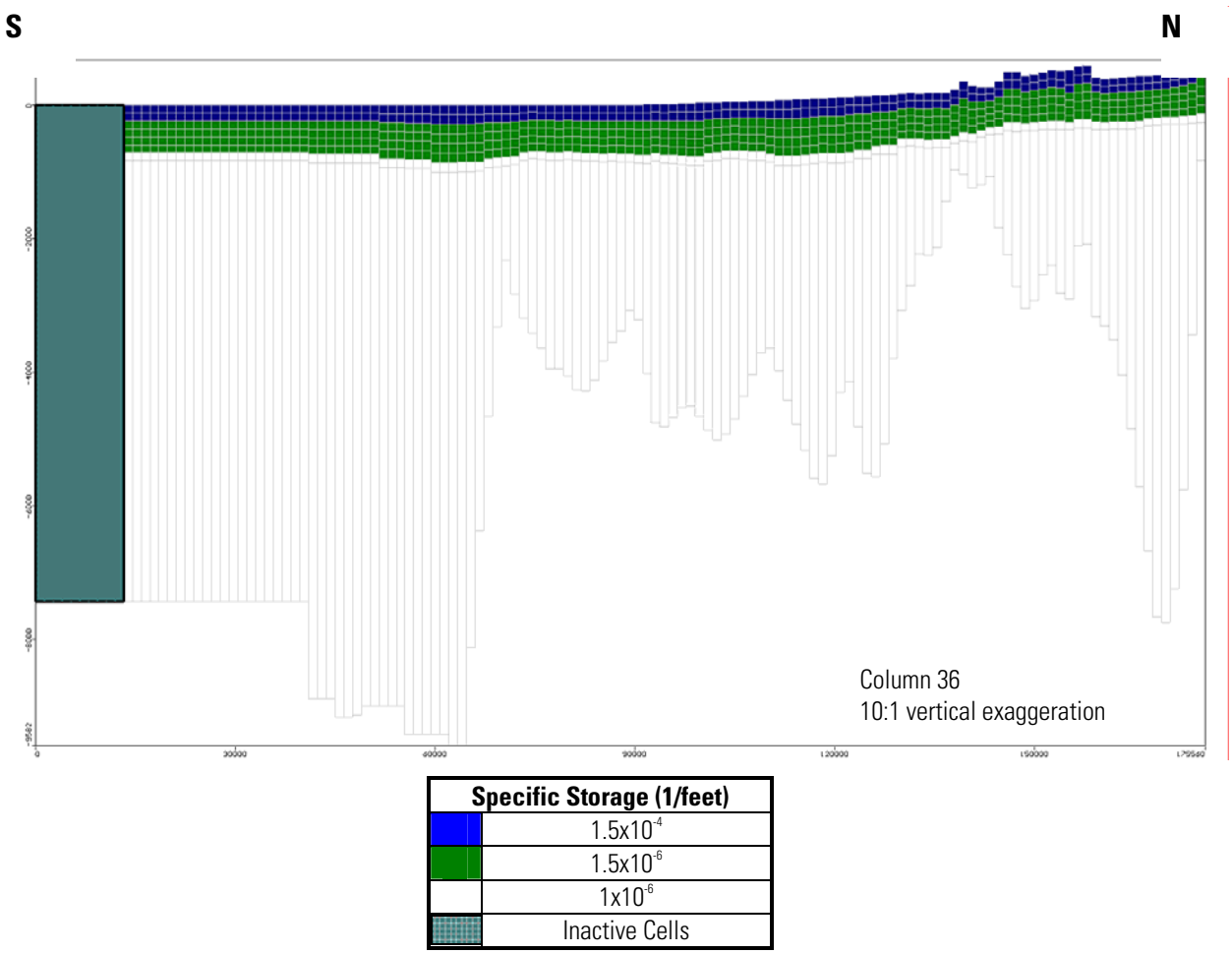
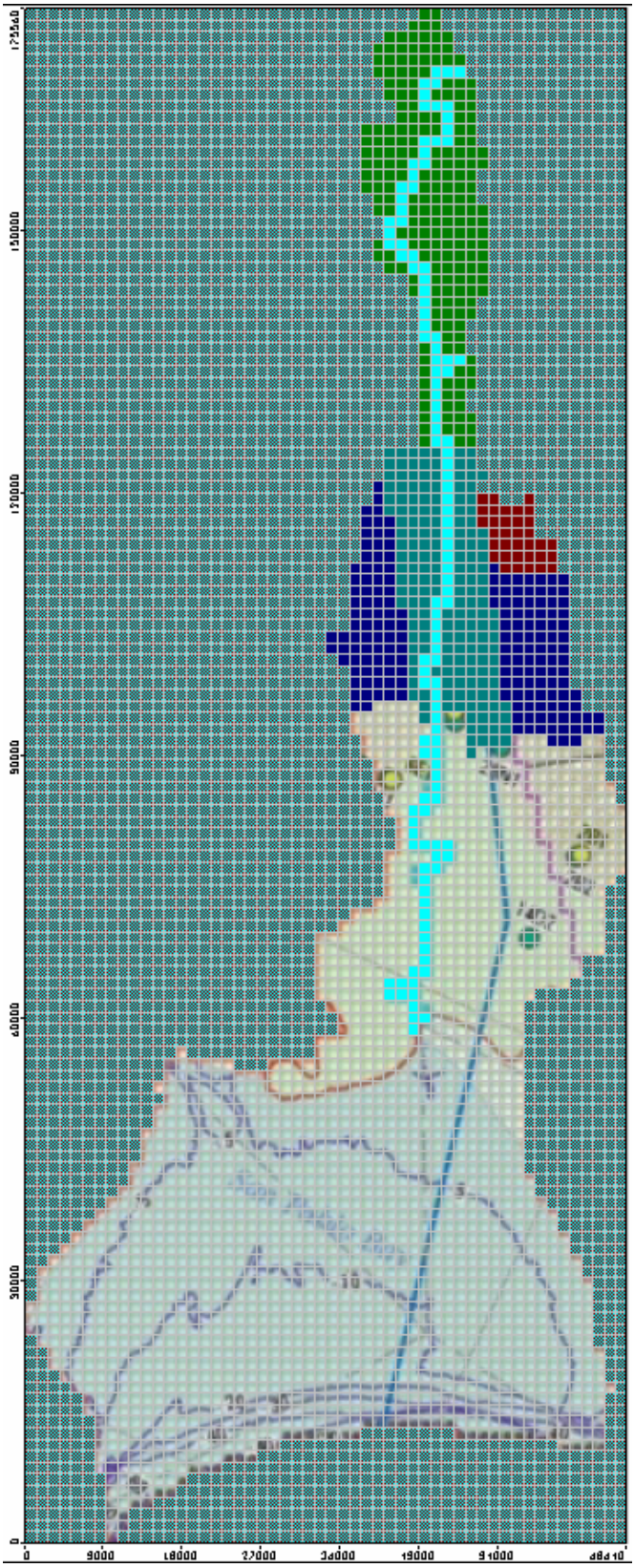


Figure 2-5 Cross-Sectional View of Model along Sonoma Creek Showing Specific Storage Values.

2.5 Limitations and Data Gaps

Review of the model and model report, along with subsequent conversations with the USGS, provided information on the limitations and data gaps of the model for the purposes of this task. Some of these limitations that may have affected the results presented in this document are listed below:

- Lack of reliable hydrostratigraphic data for building a representative conceptual hydrogeological model – As stated in the USGS report, the model layers were defined somewhat arbitrarily based on specific capacity values, and have little resemblance with geologic layers.



Stream boundary condition

Steady-State (1974) Recharge (inches per year)	
	39
	5.5
	2.2
	1.1
	Inactive Cells

Figure 2-6 Recharge Zones and Stream Boundary in Layer 1 of the Model Domain. Zones are shown over a map from USGS, 2006. No recharge is applied in the model to the southern half of the model domain.

- Coarse grid discretization – While the current model cell size of 1,320 feet by 1,320 feet (approximately 400 by 400 meters) is suitable for a regional evaluation and an overall mass balance, any local-scale evaluation would require more refined discretization. The current size of the grid blocks require that hydrogeologic properties be averaged over a large distance. Furthermore, the model hydrogeologic properties were estimated based on lithology data from drillers' logs, which do not directly provide information on hydrogeologic properties.
- Estimation of stream inflow and conductance based on data from a single stream gauge – The only stream gauge in the basin is located in the middle of the basin near Agua Caliente, which is insufficient for fully evaluating the stream-groundwater interaction.
- Simplified distribution and rates of recharge – Recharge distribution and rates in the model were estimated based on average annual rainfall instead of areas of recharge to the aquifer and actual recharge rates to the aquifer
- Estimated production rates for agricultural and domestic production maps – No actual production data (well locations, pumping rates) are available for applying agricultural and domestic production to the model and needed to be estimated based on land use maps and population, respectively. Because agricultural production represents over 70% of groundwater use in the basin in year 2000 of the calibrated model, uncertainty in this parameter can have a direct impact on model calibration and predictive accuracy.
- Coarse temporal discretization – The model simulates annual stress periods, which do not consider seasonal variations in recharge, stream flow, and pumping.
- Model layer types defined as confined for all layers except model layer 1 – A model layer with layer type "confined" has a transmissivity based on the layer thickness regardless of whether that layer becomes dewatered. The result may be an underestimation of the drawdown in the model. Additionally, actual drawdown at a well compared to its simulated drawdown may be significantly greater due to well losses and the grid discretization.
- Fully saturated groundwater flow model – The MODFLOW-2000 simulation code assumes that all groundwater flow is in fully saturated conditions; recharge applied to the model, including natural recharge and storm water recharge ponds, therefore reaches the aquifer immediately without considering travel through the unsaturated zone.
- Freshwater conditions – The MODFLOW-2000 simulation code does not consider brackish/saline conditions, and therefore does not model any density effects due to saltwater intrusion from San Pablo Bay.

Some additional data gathering efforts could be directed toward refining the temporal distribution and rates of natural recharge, the conductance of the Sonoma Creek riverbed, and the hydraulic properties of the upper layers of the model. Recommendations for data collection efforts for reducing the uncertainties and data gaps in the model are discussed later in Section 6.

3 Scenarios Components and Assumptions

There are a myriad of potential cases that could be evaluated for this scenario analysis. Two water availability scenarios were considered for additional imported water beyond existing water rights, each under 30-year normal and dry weather conditions. Under these water availability scenarios, different combinations of four proposed water management options (cases) were simulated. Twelve cases representing a range of conditions were simulated using the USGS MODFLOW model. These cases were evaluated to illustrate the best to worst case scenarios to explore the various combinations of water availability scenarios and implementation of water management options over a 30-year period. These scenarios were discussed and refined in conjunction with the TWG in the meetings of April 26 and July 5, 2007. This section describes the water availability scenarios, projected future demands, water management options, and model run configurations.

3.1 Water Availability Scenarios

Water availability scenarios consider two factors: (1) the amount of imported water; and (2) climatic conditions.

3.1.1 Imported Water

No Additional Imported Water beyond Existing Water Rights

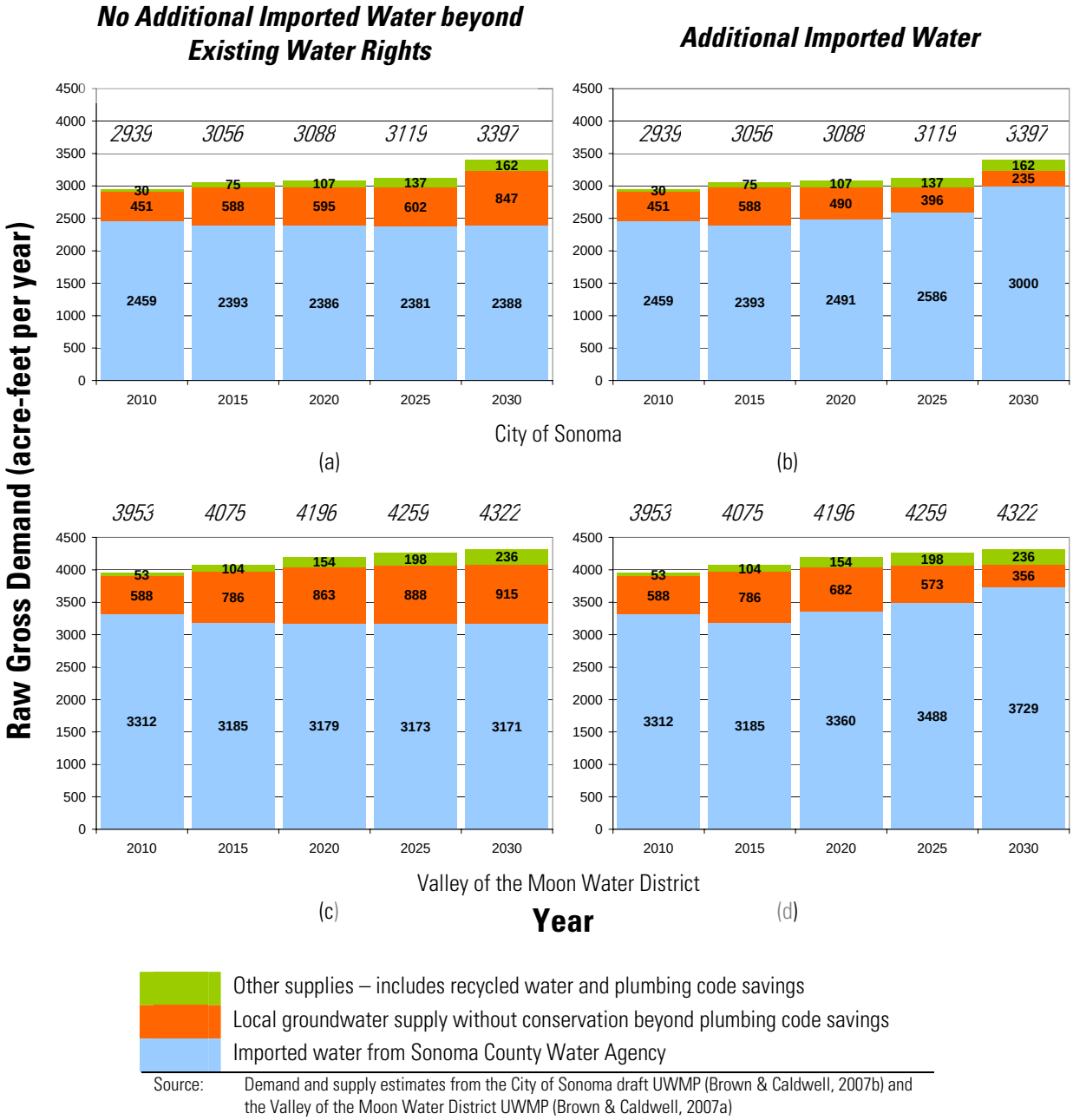
The scenario assuming no additional imported water beyond existing water rights assumes that future supplies to Sonoma Valley from imported surface water are limited due to infrastructure or water supply constraints, and that the Agency does not obtain water rights from the Russian River beyond its current water rights limits of 75,000 acre-feet per year. Diversions from the Russian River in 2006 were 61,382 acre-feet, not including deliveries from the three groundwater wells in the Santa Rosa Plain. This scenario assumes that these diversions will increase over time until the Agency's limit of 75,000 acre-feet per year is reached. Water demand in the Sonoma Valley continues to increase according to population growth and water demand projections in the 2005 Urban Water Management Plan (UWMP) Sonoma County Water Agency (Brown & Caldwell, 2006). The local groundwater withdrawal increases accordingly as the Russian River water supply projections are held constant from 2016 onward. Figure 3-1a and c plot the projected water demand through 2030 and the water supply components meeting that demand for the City of Sonoma (the City) and Valley of the Moon Water District (VOMWD), respectively, under this scenario. The imported water from the Agency shown in the plots consists of Agency groundwater (from outside of the basin) and imported surface water from the Russian River. While imported surface water supply is assumed to stay constant from 2016 onward, the projected Agency groundwater supply continues to vary as projected.

Additional Imported Surface Water

The scenario with additional imported surface water assumes that the Agency obtains additional water rights from the Russian River beginning in 2016, as described in the Agency 2005 UWMP (Brown & Caldwell, 2006). Imported water provided by the Agency is the primary source of water to meet demands by the City and VOMWD. Water demand in the Sonoma Valley continues to increase according to population growth and water demand projections in the VOMWD UWMP (Brown & Caldwell, 2007a) and in the City Draft UWMP (Brown & Caldwell, 2007b).

The VOMWD and City demands are met by the additional imported surface water beginning in year 2016. Between 2000 and 2016, the additional water demand would be tapped from local groundwater resources.

With the additional imported water coming in by 2016, the Agency projections of the local groundwater supply in both the City and VOMWD therefore begin to decrease in 2016 (Brown & Caldwell, 2007a & 2007b; see Figure 3-1). Figure 3-1b and d plot the projected water demand through 2030 and the water supply components meeting that demand for the City and VOMWD, respectively, under this scenario.



Source: Demand and supply estimates from the City of Sonoma draft UWMP (Brown & Caldwell, 2007b) and the Valley of the Moon Water District UWMP (Brown & Caldwell, 2007a)

Figure 3-1 Projected Urban Water Demand and Supply 2010-2030 for City of Sonoma and Valley of the Moon Water District With and Without Additional Imported Water Beyond Existing Water Rights.

3.1.2 Climatic Conditions

Climate conditions affect the rate and distribution of recharge and the flow rates of Sonoma Creek. Recharge and stream inflow rates were varied in the model to represent "normal" and "dry" weather

scenarios. These scenarios did not consider any changes in recharge area due to changes in land use associated with population growth.

30-Year Normal Weather Scenario

Rainfall, recharge and stream flow conditions for the normal weather scenario for the simulation period from 2001 through 2030 are assumed to be represented by historical data used in the USGS model for the simulation period of years 1974 through 2000. The USGS estimated the steady-state recharge for year 1974 to be the residual of subtracting total runoff and evapotranspiration from total precipitation and distributed the values to the five recharge zones (Figure 2-6) based on 23 contributing sub-basins within the Sonoma Valley study area. These steady-state recharge values were modified during calibration. Variable recharge for the transient calibration period was estimated by multiplying the annual average flux rate by the fraction of average annual precipitation normalized to 1974 conditions. For example, the total precipitation in 1975 was 101 percent of the precipitation in 1974. The average annual flux rate applied to the model was the 1974 flux rate multiplied by 1.01. During model calibration, the USGS applied an upper bound of 1.30 to the applied flux to prevent areas of the model from flooding. The resulting calibrated recharge values for the assumed normal year weather scenario for the northern recharge zone from the USGS model are plotted in Figure 3-2. This same schedule of variable recharge was used for the future scenarios.

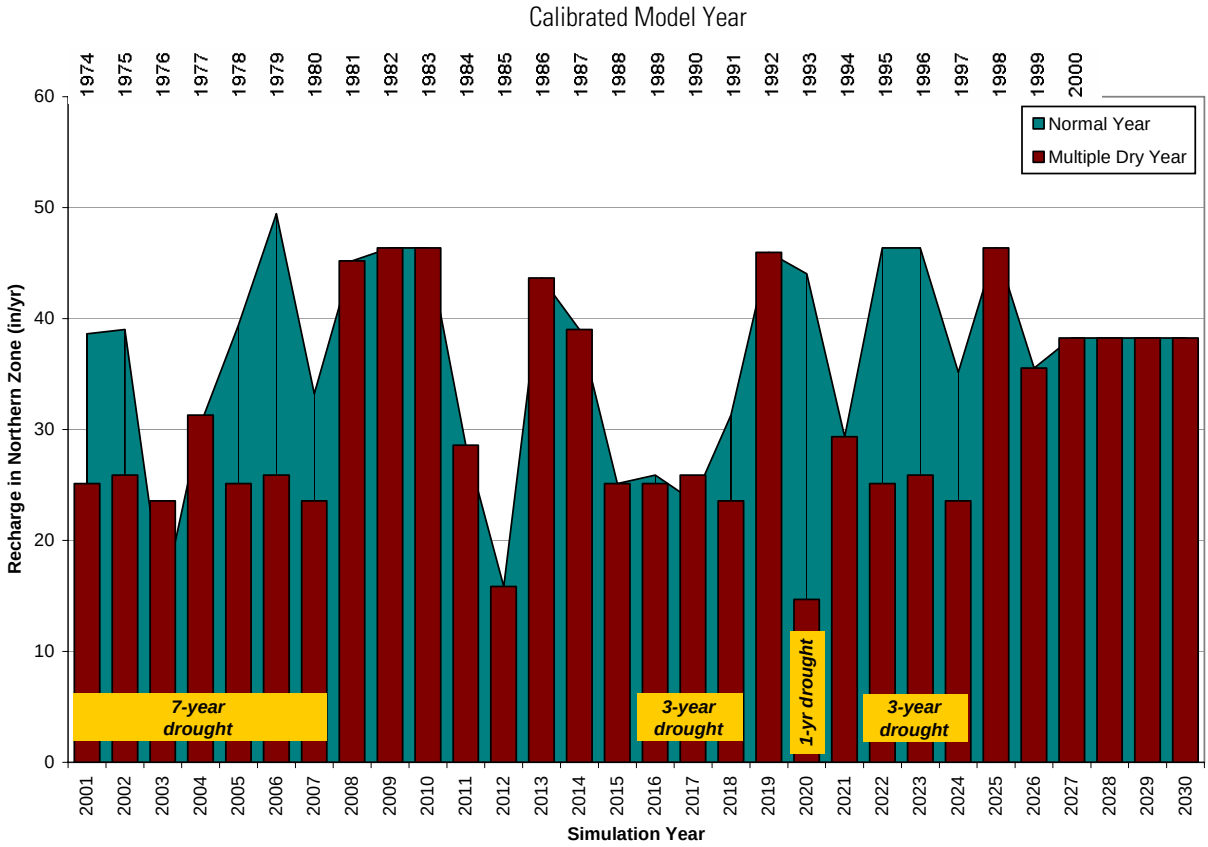


Figure 3-2 Recharge Applied To Northern Recharge Zone for the 30-Year Normal and Dry Weather Scenarios.

30-Year Dry Weather Scenario

For the dry weather scenario, data were gathered on the historically driest years experienced in California on record. To construct a realistic multiple dry-year schedule for the 30-year simulation period, the worst recorded multiple dry-year period was identified from the Southwestern States Flood and Drought Summaries – Major Floods and Droughts in California provided on the USGS website (2004b). According to this summary, the driest 30-year period in California occurred from 1928 through 1957, with 14 drought years occurring in the years 1928-34, 1943-45, 1947, and 1949-51. To simulate this 30-year period, the pattern and number of drought years from 1928 through 1957 were inserted into the 2001-2030 dry weather simulation schedule, as shown in Figure 3-2.

The flux rates during dry years from the transient USGS simulations were assumed to be representative for the dry years in the dry weather scenario. In the USGS simulations, the driest consecutive years occurred from 1988-1991, and the single driest year occurred in 1976. Therefore in developing the variable recharge schedule for this dry weather scenario, the calibrated 1988-1991 recharge and stream flow values were applied and repeated as necessary for the three multiple-dry year intervals. The calibrated 1976 values were applied to the single driest year. The resulting schedule for multiple dry year recharge in the northern recharge zone is plotted in Figure 3-2.

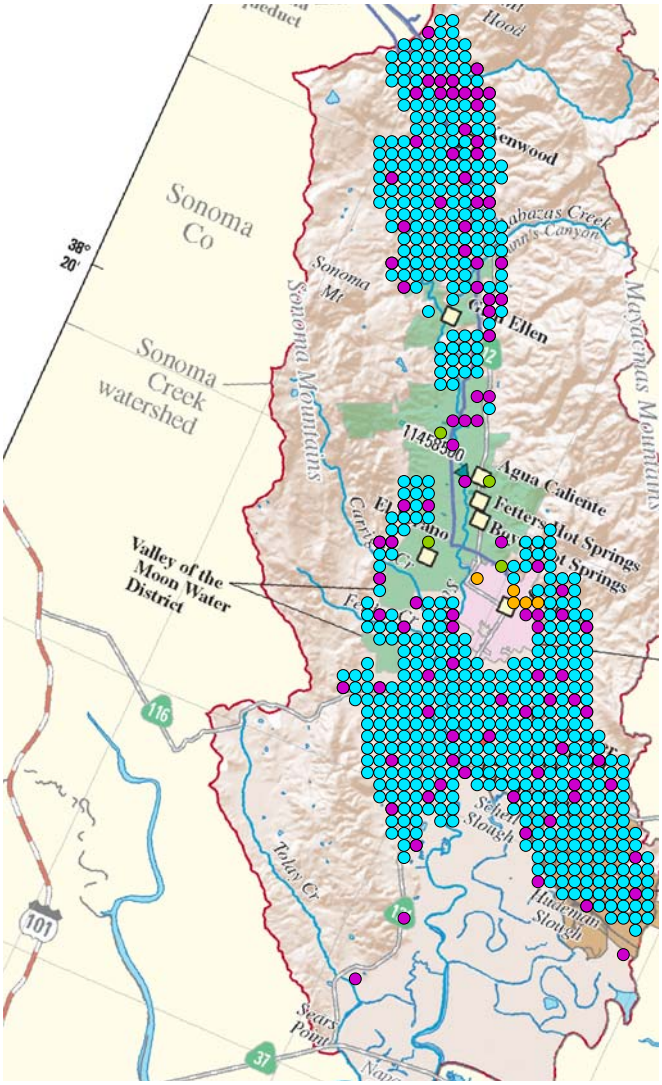
3.2 Simulation of Future Baseline Production

Annual groundwater production in the Sonoma Valley, as represented in the calibrated USGS groundwater model, grew from approximately 6,200 acre-feet in 1974 to 8,400 acre-feet per year in year 2000. For this analysis, the future groundwater production was projected from these year 2000 pumping rates. In year 2000, 753 out of the 908 wells in the model are pumping a combined total of approximately 8,435 acre-feet per year. This total groundwater production consists of three components:

1. Agricultural supply wells for irrigation
2. Private domestic wells
3. Urban supply wells

In year 2000, VOMWD urban supply wells were pumping while City urban supply wells were not pumping. To incorporate the City urban supply wells into the projected demand schedules, the six City urban supply wells and their pumping rates were taken from stress period 1999 and added to the schedule, making a total of 759 wells from which to project the 30-year demand. The locations of these wells are shown in Figure 3-3. The pumping rates in the wells were ramped by factors according to the category of the well: agricultural, private domestic, and urban supply.

Sonoma County Permit and Resource Management Department (PRMD) staff estimate agricultural production to increase by 1,500 acres of vineyards from years 2000 through 2020, replacing natural vegetation or non-irrigated agriculture (PRMD, 2007). A linear extrapolation from 2020 to 2030 predicts an increase in 2,250 acres of vineyards from 2000 through 2030. Assuming the applied water rate for vineyards of 0.6 feet per year (USGS, 2006), the increase in groundwater use would be 1,350 acre-feet per year from 2000 through 2030. The total production from agricultural wells of 6,117 acre-feet per year in year 2000 was interpolated to arrive at a final production of 7,467 acre-feet per year in 2030. However, no consideration was made for the offsetting factors of removing natural vegetation, which may actually remove more groundwater than vineyards due to higher evapotranspiration rates. Additionally, this projection does not consider any variations in groundwater production due to variations in rainfall from year to year.



- Model Agricultural Wells
- Model Private Domestic Wells
- Model Urban Supply Wells (City of Sonoma)
- Model Urban Supply Wells (Valley of the Moon Water District)

Note: Locations shown are approximate.
Model wells are shown at the center of the grid cell to which they are assigned. Some grid cells contain multiple wells

Reference: Map from USGS, 2006.

Figure 3-3 Location of Pumping Wells in Model.

Private domestic well production was estimated using a similar method as used by the USGS for their calibrated model. This method based private domestic production on projected population of the unincorporated county portion of the Sonoma Valley area, which excludes areas supplied by the City or VOMWD, the majority of which rely solely on groundwater for supply. The current draft Sonoma County General Plan (PRMD, 2005) estimates the population in the unincorporated areas outside of the Sonoma Urban Service Area from 2000 to 2020 to grow from 30,125 to 34,400. The projected population for the

VOMWD provided in 5-year increments from 2005 through 2030 in the UWMP (Brown & Caldwell, 2006) was subtracted from this total. The resulting population was multiplied by the factor of 0.19 acre-feet per year per person to arrive at a total production rate for private domestic wells (USGS, 2006). All population estimates were interpolated linearly to arrive at a schedule of annual estimates.

Production for the City and VOMWD urban supply wells are the estimates of the local groundwater supply projections for each service area provided by the Agency for 2010 through 2030 with no savings beyond plumbing code (Agency, 2007). All values were projected linearly through this time period. The resulting schedule of projected and historical demand broken down by agricultural, private domestic, and urban supply wells is presented in Figure 3-4. Further details on the future demand calculations are included in Attachment 1.

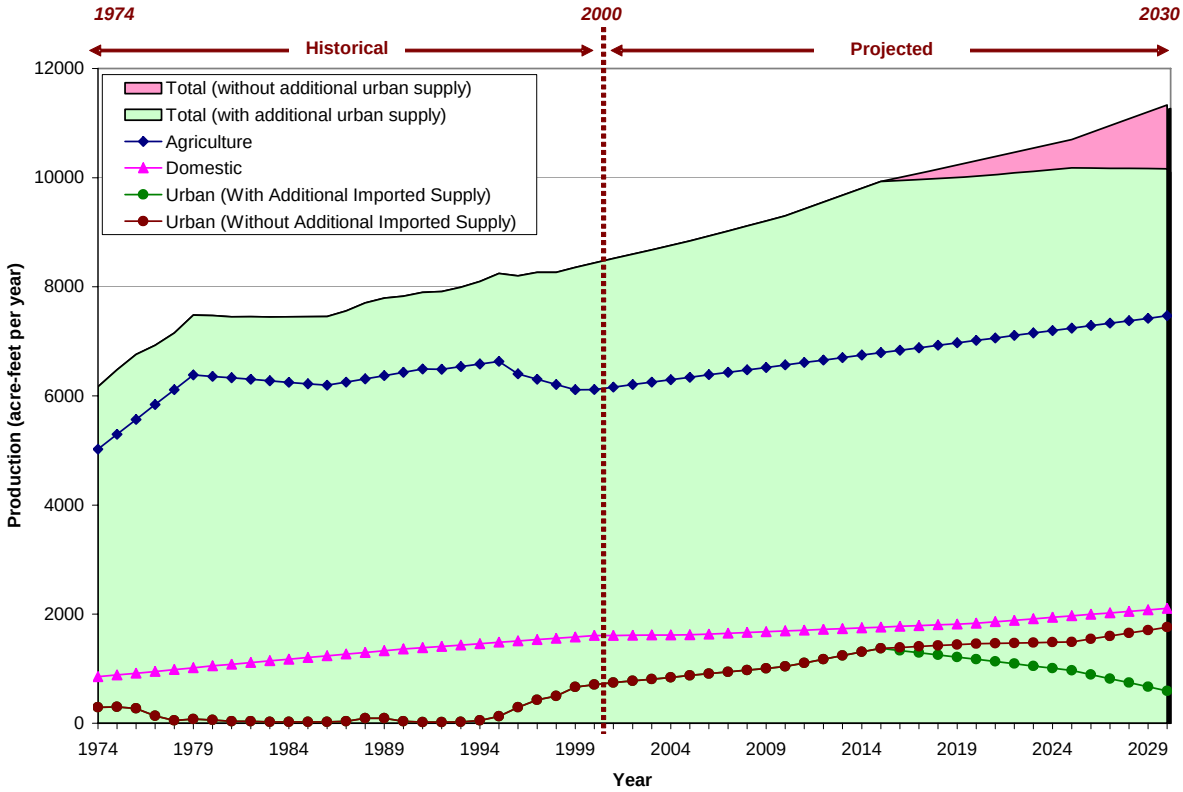


Figure 3-4 Historical and Projected Groundwater Production 1974-2030.

3.3 Water Management Options

Four proposed water management options were considered for this scenario analysis: Storm water recharge, groundwater banking, recycled water use, and conservation measures beyond the Plumbing Code. The following describes a preliminary conceptual project for each of these management options. It is anticipated that as more information becomes available, refined projects will be evaluated.

3.3.1 Option A – Stormwater Recharge

Option A is the implementation of storm water recharge in the Sonoma Valley, assuming that a fraction of the wet season flood waters runoff in Sonoma Valley is diverted to storm water recharge basins along Sonoma Creek. Approximately 101,000 acre-feet per year of runoff is captured in Sonoma Creek and

released to San Pablo Bay (USGS, 2006). This scenario assumes that 80 acres (2 model cells) near the largest groundwater depression near the City on the eastern banks of Sonoma Creek are converted to storm water recharge basins in year 2015 (see Figure 3-5). Assuming that there is a 0.1 feet per day loading for 120 days out of the year, a total loading of 960 acre-feet per year was applied to the model as a recharge boundary averaged over the year. This additional recharge was applied from 2015 through 2030, producing a total loading of 15,360 acre-feet of additional water during the simulation period.

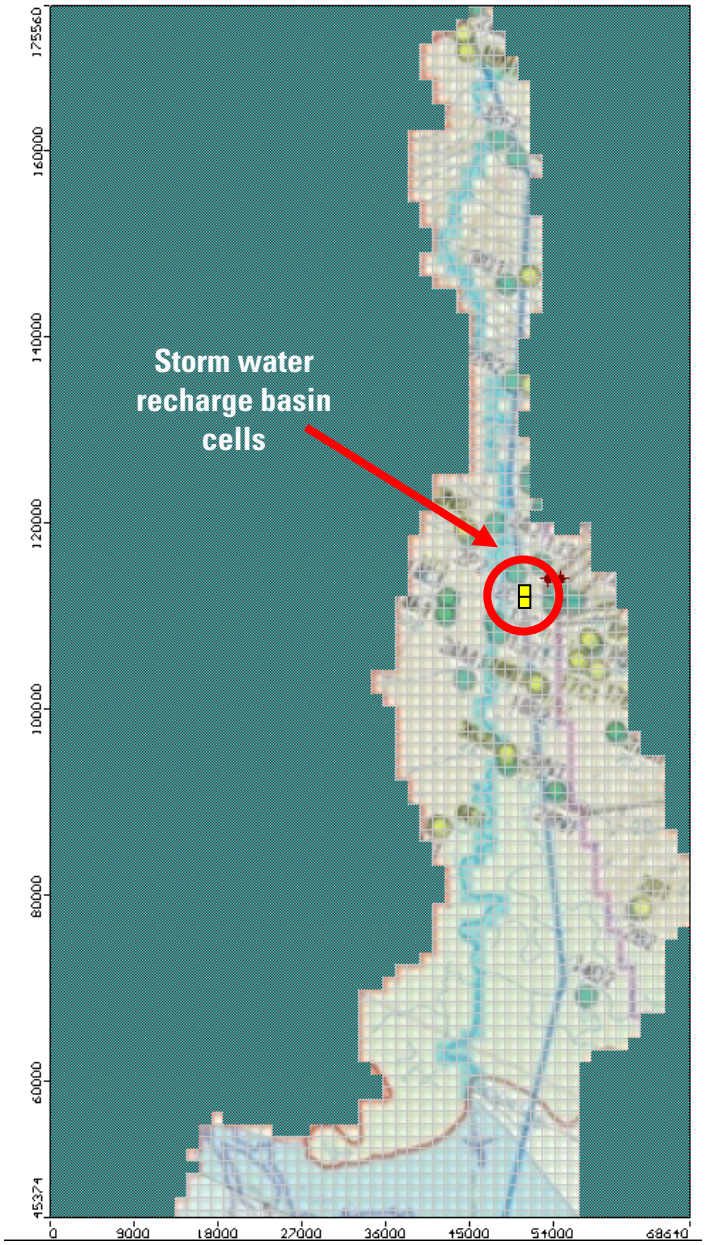


Figure 3-5 Location of Option A Stormwater Recharge Basins Represented In Model.

3.3.2 Option B – Groundwater Banking with Seasonally Available Imported Water

For option B, wet year and seasonally wet available water would be available for purchase and recharge into the ground. The wells are modeled as being located in the groundwater depression in Central Sonoma

Valley near the existing City urban supply wells. The groundwater banking project would recharge 1,500 acre-feet per year of water, which was assumed to later be extracted.

Figure 3-6 Location of Groundwater Banking Wells Represented In Model.

Option B was represented in the model by two wells each recharging approximately 1 cubic feet per second (465 gallons per minute) beginning in year 2015 and continuing through the end of the simulation period. The wells are located in two adjacent grid cells, 1,320 feet apart, and screened across model layer 4, which is the interval from 450 to 600 feet below ground surface (see Figure 3-6). Although the model runs on annual stress periods and therefore simulates these wells recharging at a constant rate throughout the year, actual wellfield design would consider that wet season water will only be available 3-6 months out of the year for wells. Actual well recharge rates would therefore be higher. Any variation in the recharge

rates due to variations in precipitation was not considered. The total water recharged to the aquifer from 2015 through 2030 is estimated to be 24,000 acre-feet.

3.3.3 Option C – Increased Recycled Water Use

Currently, approximately 1,000 to 1,200 acre-feet per year of recycled water is used for agricultural purposes in the Sonoma Valley. Option C considers increased recycled water use using the southwestern portion of Alignment 1 presented in the *Sonoma Valley Recycled Water Final Environmental Impact Report*, (ESA, 2006). It was assumed that Alignment 1 would be implemented in phases, and that this portion of the alignment would be operational beginning 2010 (see Figure 3-7). With average wastewater inflow estimated at 4,500 acre-feet per year increasing to 5,500 acre-feet per year at build-out, Option C consists of providing an additional 1,100 acre-feet per year of recycled water to agricultural users in the area served by this alignment. The net result of this additional water is a reduced demand in groundwater pumping, producing a total reduced demand of 23,100 acre-feet from 2010 through 2030. Other alignments evaluated in the draft feasibility study (Agency, December 2005) and the environmental impact report (ESA, 2006) could also be implemented. Recharge was assumed to be unchanged with the implementation of this option.

This option was applied to the model by reducing pumping from seven model agricultural wells in the area serviced by the southwestern portion of Alignment 1 beginning in year 2010 (see Figure 3-7). The combined total production from these wells in the final stress period (year 2000) of the calibrated model was 1,100 acre-feet. This amount was then subtracted from their projected pumping rates beginning in year 2010 in order to produce the net decrease in total agricultural production.

3.3.4 Option D –Conservation due to Best Management Practices

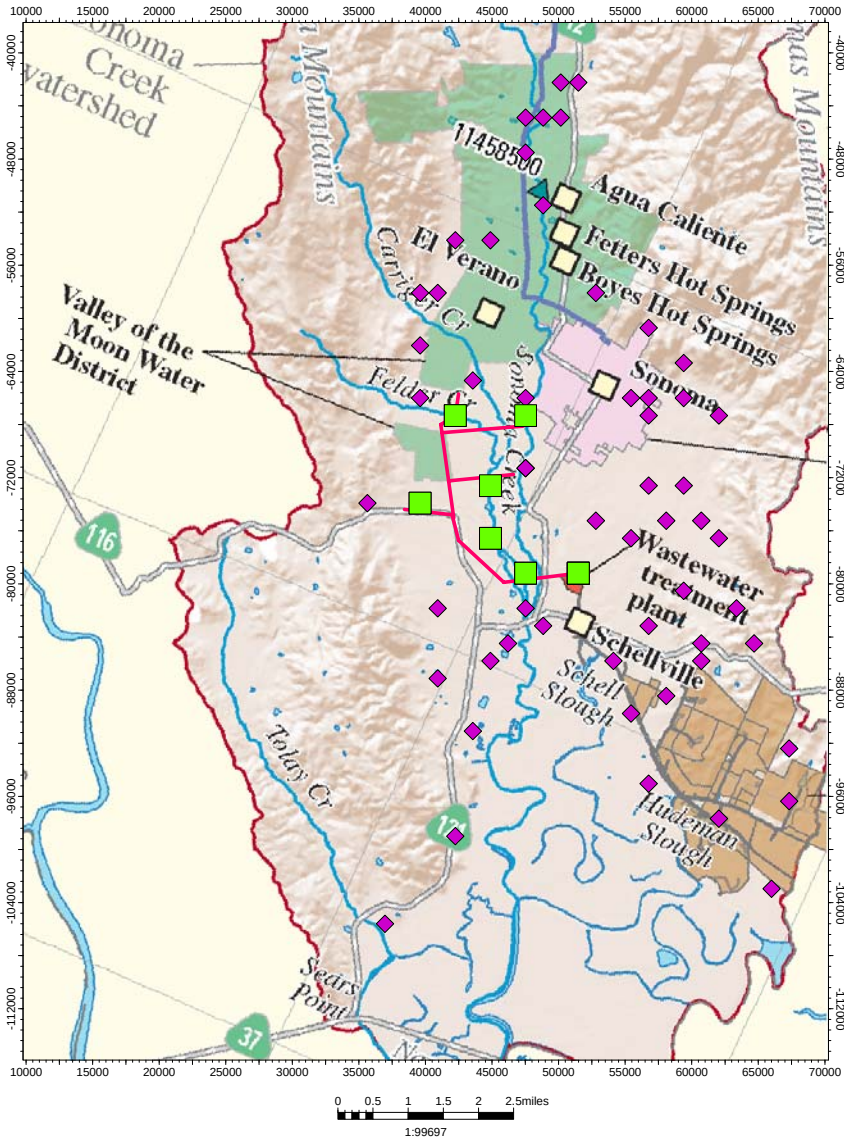
Option D considers the reduction in groundwater demand by the implementation of conservation measures beyond Plumbing Code with the use of Best Management Practices (BMPs). The following describes a preliminary conceptual project for each of these management options. It is anticipated that as more information becomes available, refined projects will be evaluated. These BMPs may include system water audits, leak detection and repair, public information programs, school education programs, graywater use, and pricing to encourage conservation. For this option, urban, agricultural, and domestic all practice conservation, which translates as a reduction in well pumping rates. The net result of this additional water is a reduced demand in groundwater pumping, producing a total reduced demand of 21,000 acre-feet.

Urban conservation rates were estimated in the City draft UWMP (Brown & Caldwell, 2007b) and the VOMWD UWMP (Brown & Caldwell, 2007a) for every five years from 2010 through 2030. Conservation in urban areas includes conservation from Tier 1 Future, 50% of Tier 2, New Housing Development, and Plumbing Code. Option D assumes that from 2001 through 2009, conservation in urban production includes Tier 1 to-date in addition to Tier 1 Future conservation. Beginning in 2010 through 2030, urban production is practicing all conservation measures mentioned above.

Conservation in agricultural production was assumed to produce 5% less due to conservation beginning in 2015 through 2030. The agricultural production reaches this rate after a linear ramp-up period from 2005 through 2014.

Domestic conservation was assumed to be similar to conservation practiced by urban supply. The average percent savings due to conservation over the raw gross demand for 2010 through 2030 for the City and VOMWD are 8.3 and 9.1 percent, respectively. Domestic conservation was assumed to be the lower of the

two values, 8.3 percent, beginning 2015 through 2030, with a linear ramp-up period from 2005 through 2014.



Southwestern Portion of Proposed Alignment 1
Model Agricultural Wells
Model Agricultural Wells Serviced By the Southwestern Portion of Proposed Alignment 1

Note: Locations shown are approximate.
Reference: Sonoma Valley Recycled Water Draft Feasibility Study (Agency, December 2005)
Map from USGS, 2006.

Figure 3-7 Location of Wells Serviced by the Southwestern Portion of Alignment 1 of the Proposed Recycled Water Project.

3.4 Summary of Simulation Cases and their Formulation

From the numerous combinations of water management options that could be evaluated against the four water availability scenarios (increased and limited imported water each under normal and dry year conditions), twelve of the more likely scenarios, ranging from the worst (least available water, no additional

action) to best cases (most available water, implementation of all water management options) were selected for simulation. Table 3-1 summarizes the formulation of the model simulations. These model runs are not intended to be an exhaustive analysis of all potential options, but rather to illustrate the range of outcomes that could result in the future. Table 3-2 summarizes key assumptions for each scenario component.

For the best case scenarios, all water management options were implemented against 30-year normal year climate conditions for both no additional imported water beyond existing water rights, and additional imported water scenarios (identified as Cases N-5 and N-6, respectively). Minimal water management option implementation was explored in the scenario of additional imported water supply in Cases N-1 and D-2. Worst case scenarios (no additional action above current activities and programs) under the limited imported water scenario were evaluated, where no water management options are implemented under both normal (N-0) and dry year weather conditions (D-0). The incremental benefit of each water management option for a scenario with no increase of additional imported water was evaluated in Cases N-4a through N-4d.

Table 3-1 List of Simulation Cases and Their Input Components.

Simulation Case		Water Management Option				Assumption
		A	B	C	D	
30-Year Normal Weather Scenario	30-Year Dry Weather Scenario	Stormwater Recharge	Groundwater Banking	Recycled Water	Conservation	Additional Imported Water
N-0	D-0					
N-1	---					X
---	D-2			X	X	X
N-3	---	X		X	X	X
N-4a		X				
N-4b			X			
N-4c				X		
N-4d					X	
N-5	---	X	X	X	X	
N-6	D-6	X	X	X	X	X

Table 3-2 Summary of The Assumptions For Each Scenario Component

	Component	Assumptions
	Additional Imported Water	• Imported surface water from the Agency increases under existing water rights through 2016 and then continues to increase beyond 2016 as additional water rights from the Russian River are obtained and transmission system projects are built. • Scenario translates to reduced groundwater pumping for urban supply.
	No Additional Imported Water Beyond Existing Water Rights	• Future supplies to Sonoma Valley from imported surface water are limited due to infrastructure or water supply constraints. • The Agency does not obtain water rights from the Russian River beyond its current water rights limits. Imported water increases in the short-term until the Agency's water rights limits are reached (estimated to be 2016) and then remains flat through the duration of the simulation. • Demand continues as projected without additional imported water.
	30-Year Normal Weather Scenario	• Recharge due to precipitation and stream flow continue at average rates provided from calibrated USGS model (1974-2000).
	30-Year Dry Weather Scenario	• Recharge and stream flow schedule match the period from 1928 to 1958, which includes the State's most severe extended drought on record; wet/dry years defined by calibrated values.
A	Stormwater Recharge	• Wet season flood waters are diverted into recharge ponds and/or wetlands along Sonoma Creek covering a total area of 80 acres • Schedule: 2015 through 2030 • Annual Loading: 960 acre-feet per year (0.1 feet per day for 120 days per year) • Total Loading 15,360 acre-feet over 16 years
B	Groundwater Banking	• Wet year/season surface supply is available for recharge through wells in the City. • Schedule: 2015 through 2030 • Annual Loading: 1,500 acre-feet per year • Total Loading: 24,000 acre-feet over 16 years
C	Recycled Water	• The southwestern portion of Alignment 1 from the Sonoma Valley Recycled Water Draft Feasibility Study (Agency, December 2005) would be implemented, translating to reduced groundwater pumping in agricultural areas. • Schedule: 2010 through 2030 • Annual Reduced Demand: 1,100 acre-feet per year • Total Reduced Demand: 23,100 acre-feet over 21 years
D	Conservation	• Conservation measures consist of system water audits, leak detection and repair, public information programs, school education programs, graywater use, outreach to areas outside the City and VOMWD services areas, and pricing to encourage conservation – option translates to reduction in groundwater pumping in all wells. • Urban: 2001 through 2009 – Only Tier 1 To-Date and Plumbing Code conservation 2010 through 2030 – All measures (Tier 1 future, 50% Tier 2, New Housing Development, and Plumbing Code) • Agriculture: 2005 through 2014 – ramp up 0.5% conservation per year 2015 through 2030 – 5% conservation • Domestic (estimated based on urban conservation rates) 2005 through 2014 – ramp up 0.83% per year 2015 through 2030 – 8.3% conservation
	Future Demand	• Urban demand increases per City draft UWMP (Brown & Caldwell, 2007b) and VOMWD UWMP (Brown & Caldwell, 2007a) projections • Agricultural demand increases by 2,250 acres of vineyards (0.6 feet per year) over 30 years. • Domestic demand increases according to population, multiplied by factor of 0.19 acre-feet per year per person.
	Initial Conditions	• Simulated heads from end of calibrated model run (end of year 2000).

4 Scenarios Results

The model results provide information on the heads, drawdowns, and basin groundwater budget for the 30-year simulation period. This section compares the different cases in terms of the simulated change in storage and simulated drawdown. The model results also provide information on the relative benefit of each water management option, discussed at the end of this section.

4.1 Change in Storage

The model predicts storage for the Sonoma Valley basin over the simulation period to decrease under all cases except for those where all four water management options are implemented. Despite the significant uncertainty (plus or minus a factor of 2) in the estimated change in storage for the cases, the results nevertheless indicate the necessity for active water management over the next decades (see Figure 4-1). In the most optimistic case (Case N-6) with a normal weather scenario and additional imported water beyond existing water rights, implementing all four water management options results in a net storage increase of 10,600 acre-feet over the 30 years. However, under a worst case scenario with multiple dry year conditions, no additional imported supply, and no implementation of any water management options (Case D-0), groundwater storage could decrease by 22,000 acre-feet. Even under the most optimistic water availability scenario, implementing no water management options (Case N-1) would still produce a decrease in storage of 16,000 acre-feet. The simulation results therefore suggest that all water management options should be implemented in order to improve water supply reliability for future generations. The simulation results are also summarized in Table 4-1.

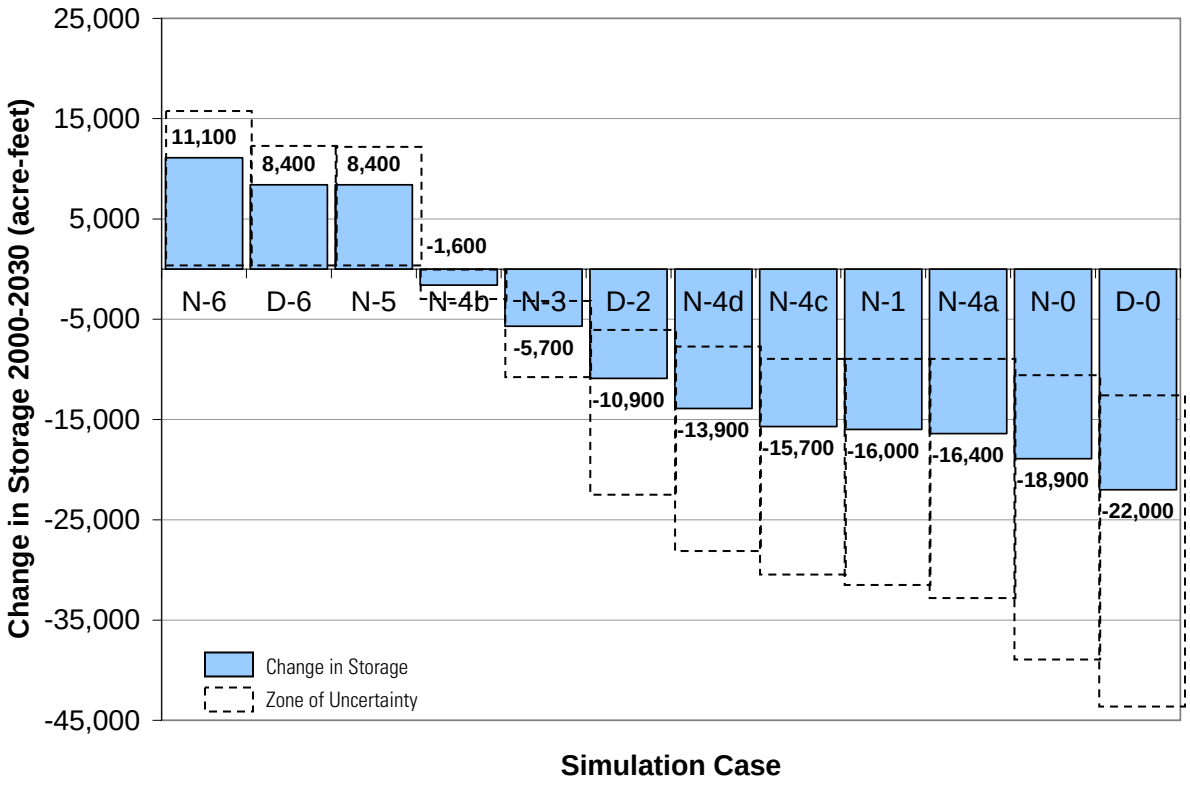


Figure 4-1 Simulated Change in Storage in the Sonoma Valley Basin for the Simulation Cases.

Table 4-1 Summary of the Simulated Change in Storage in the Sonoma Valley Basin for the Simulation Cases Listed with their Assumptions.

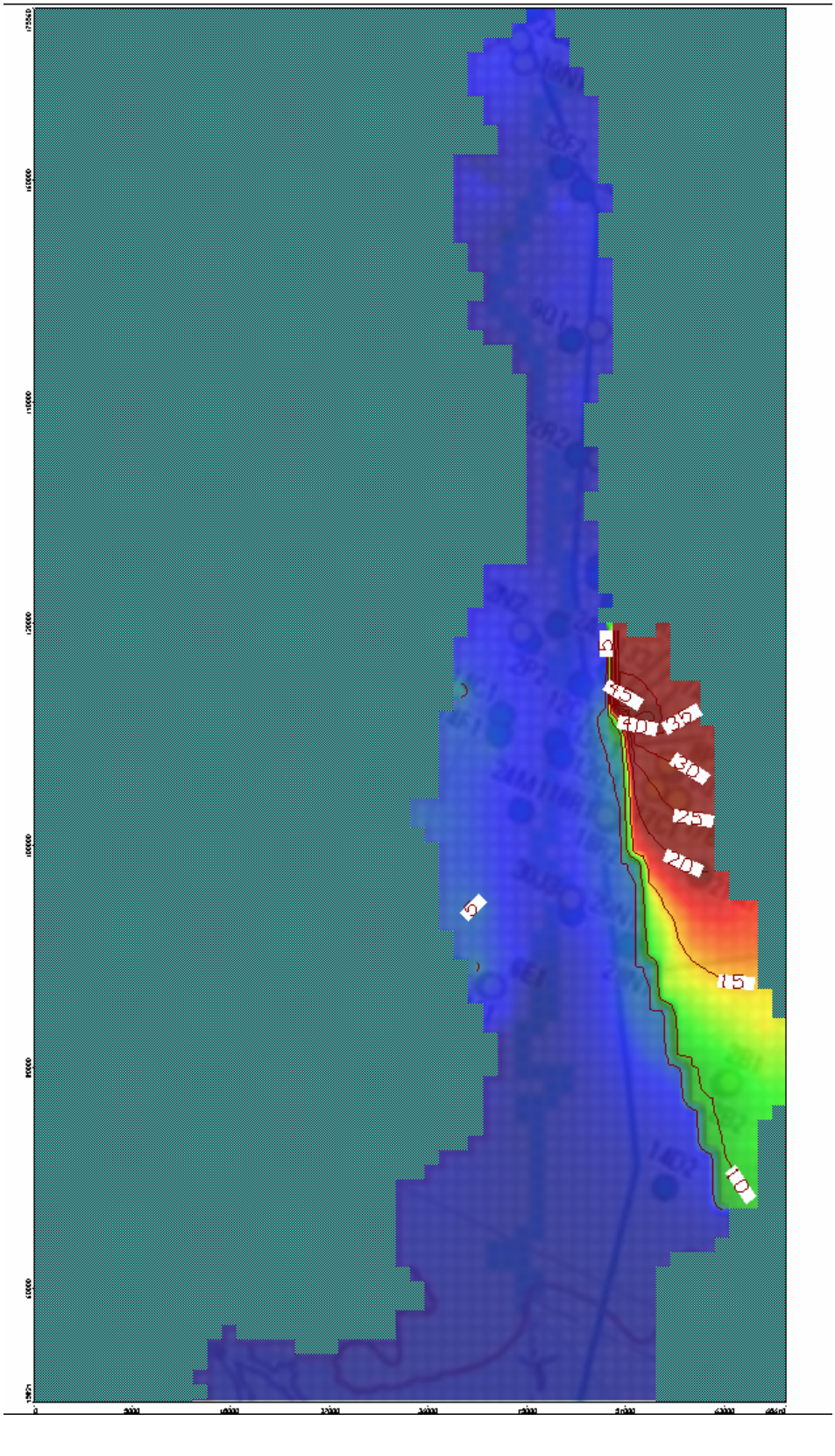
Simulation Case (Change in storage 2001 through 2030, acre-feet)		Water Management Option				Assumption
		A	B	C	D	
30-Year Normal Weather Scenario	30-Year Dry Weather Scenario	Stormwater Recharge	Groundwater Banking	Recycled Water	Conservation	Additional Imported Water
N-0 (-18,900)	D-0 (-22,000)					
N-1 (-16,000)	---					X
---	D-2 (-10,900)			X	X	X
N-3 (-5,700)	---	X		X	X	X
N-4a (-16,400)	---	X				
N-4b (-1,600)	---		X			
N-4c (-15,700)	---			X		
N-4d (-13,900)	---				X	
N-5 (+8,400)	---	X	X	X	X	
N-6 (+11,100)	D-6 (+8,400)	X	X	X	X	X

4.2 Drawdown

The largest drawdown over the simulation period is seen in the areas of the existing City urban supply wells, as can be seen in the worst case scenario that had the largest decrease in storage, Case D-0. This observation also correlates with recent 2003 water measurements (USGS, 2006).

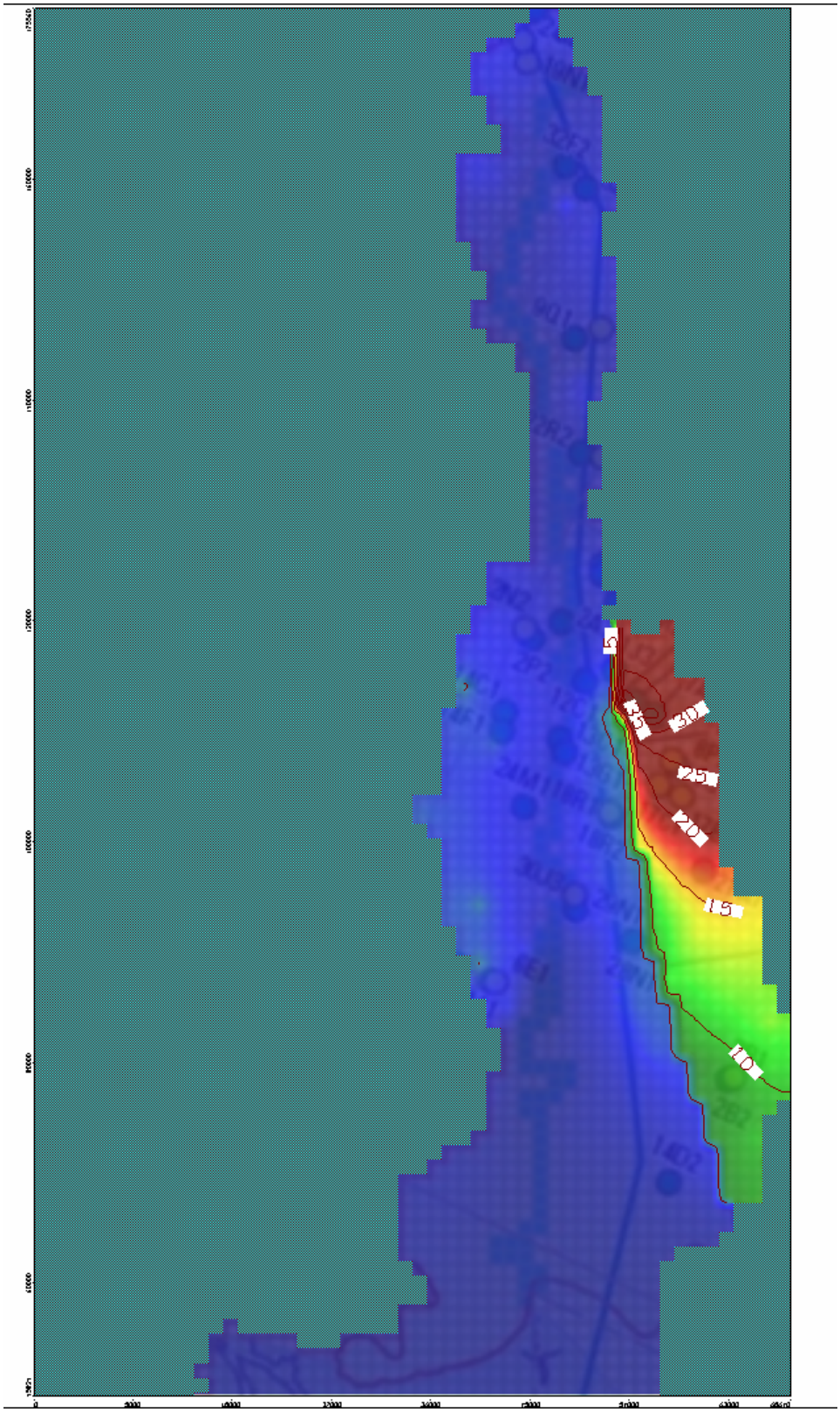
Figure 4-2 shows the drawdown for Case D-0 simulated from 2001 through 2030. This area is bounded to the west by a low-conductivity barrier, limiting flow from the creek and the remainder of the basin. This depression disappears with the implementation of water management options in that area, such as in Case N-5 (Figure 4-8) and Case N-6 (Figure 4-10). These maps show a negative drawdown (indicated by clear shading), meaning that water levels rose over the 30-year simulation period. Maps of drawdown at the end of the simulation period for the nine cases are included as Figures 4-2 through 4-10. Figure 4-11 shows the simulated heads over time at representative observation wells throughout the model domain.

The magnitude of the drawdown in this groundwater depression area is apparent in observation well 05N05W17C01, whose simulated head is plotted in Figure 4-11. The recharge of the aquifer is apparent beginning in year 2018 in the cases implementing Option B – groundwater banking, Cases N-4b, N-5, N-6, and D-6.



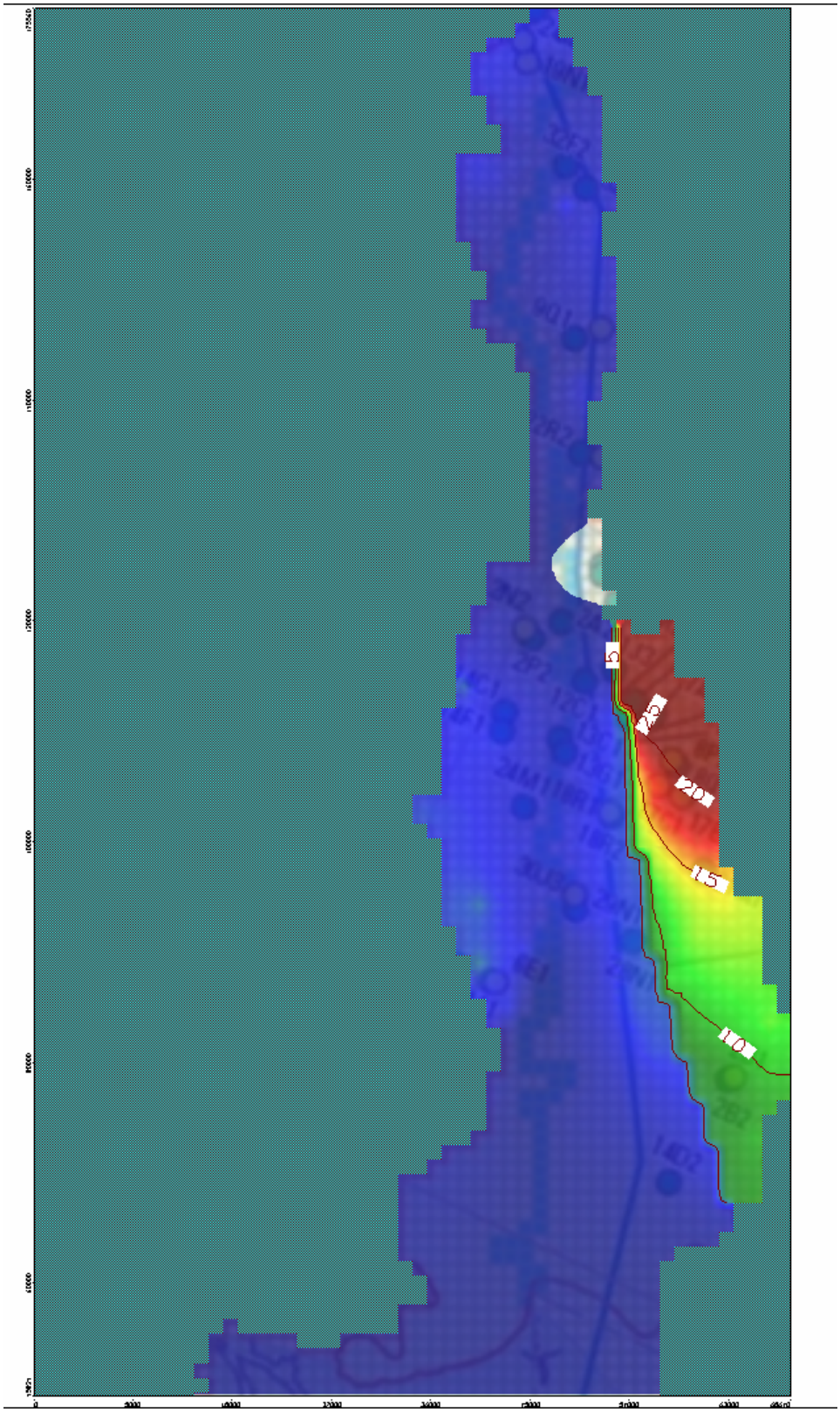
Drawdown (feet)	
	0
	3
	6
	9
	11
	14
	17
	Greater than 20

Figure 4-2 Simulated drawdown from 2001-2030 for Case D-0.



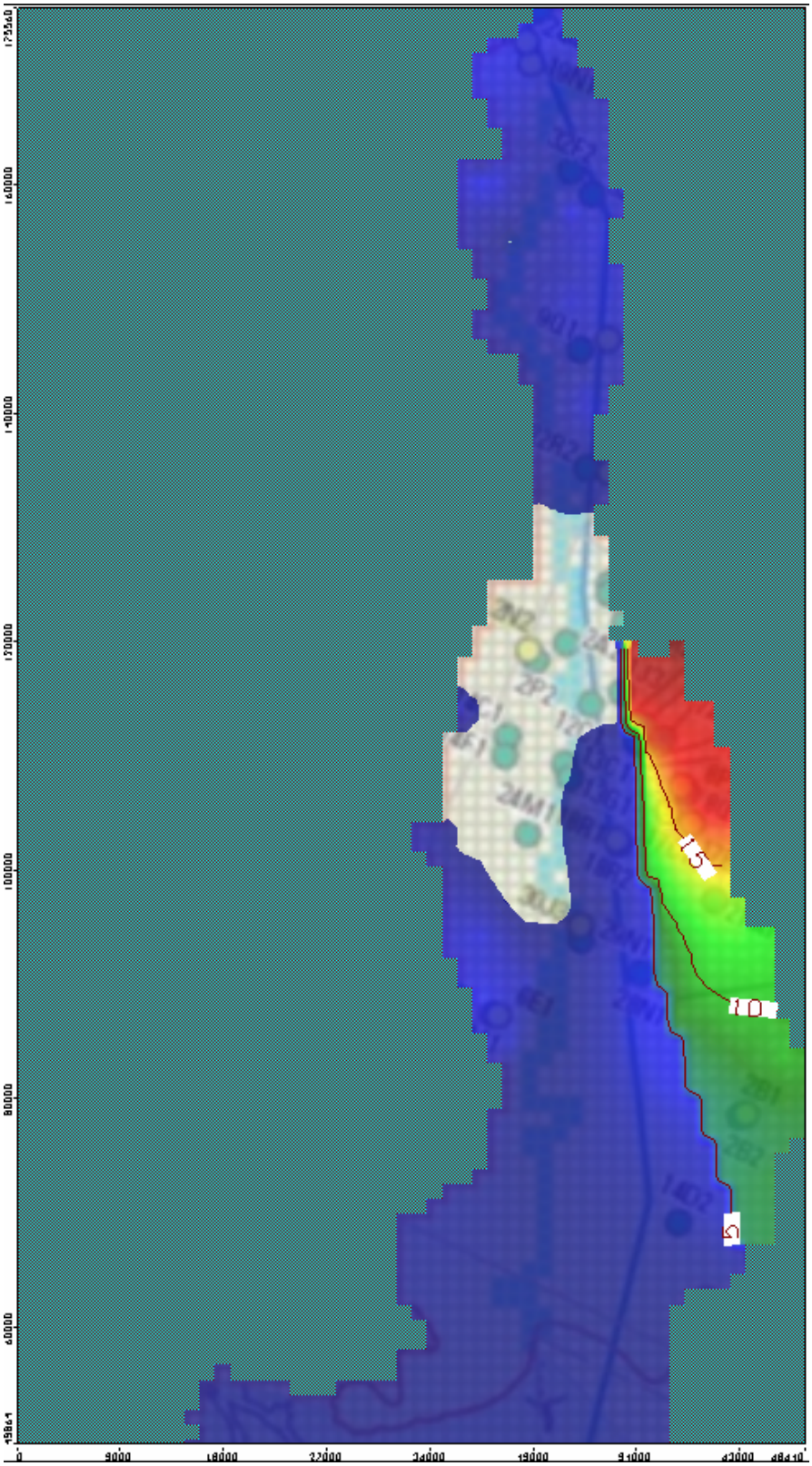
Drawdown (feet)	
	0
	3
	6
	9
	11
	14
	17
	Greater than 20

Figure 4-3 Simulated drawdown from 2001-2030 for Case N-0.



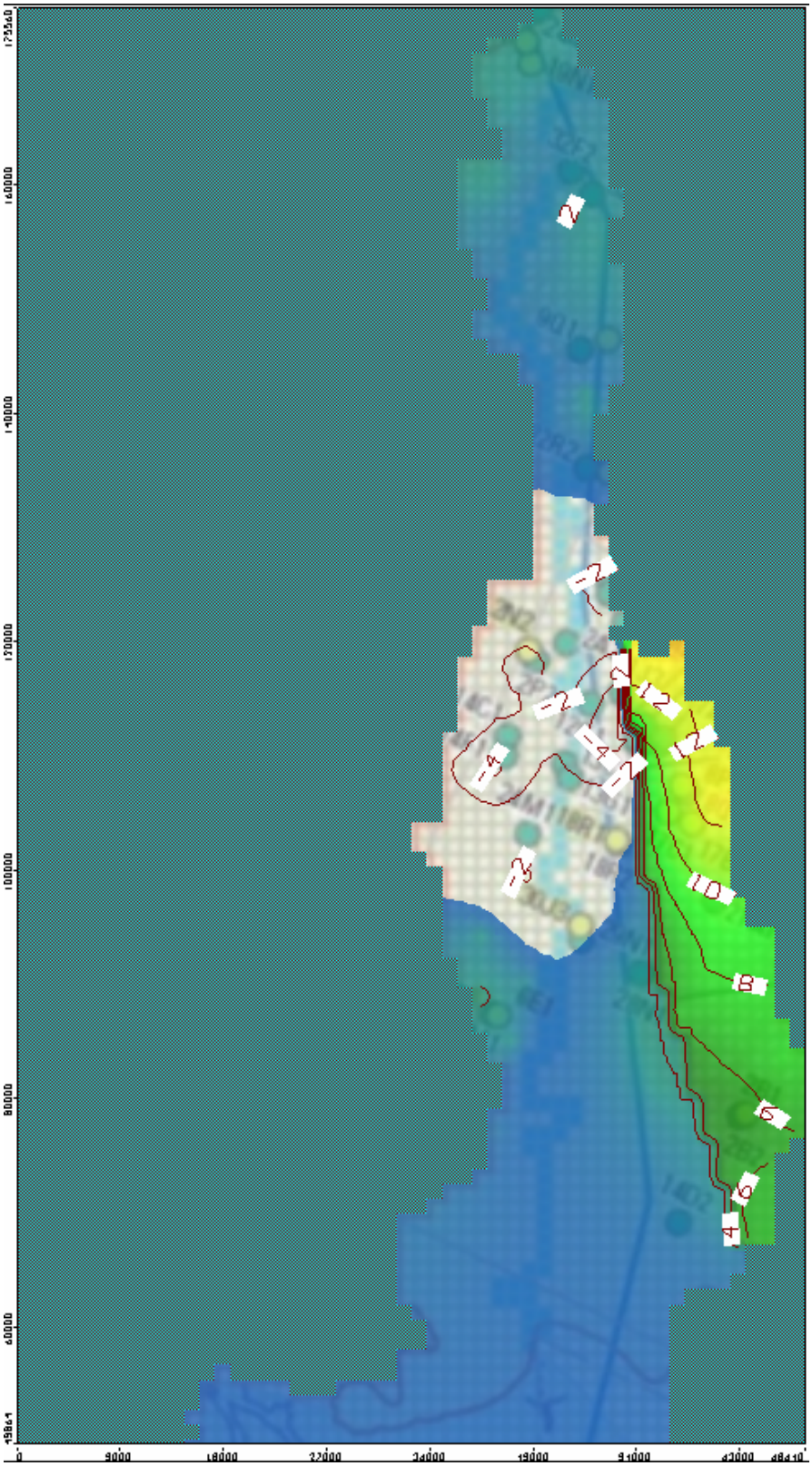
Drawdown (feet)
0
3
6
9
11
14
17
Greater than 20

Figure 4-4 Simulated drawdown from 2001-2030 for Case N-1.



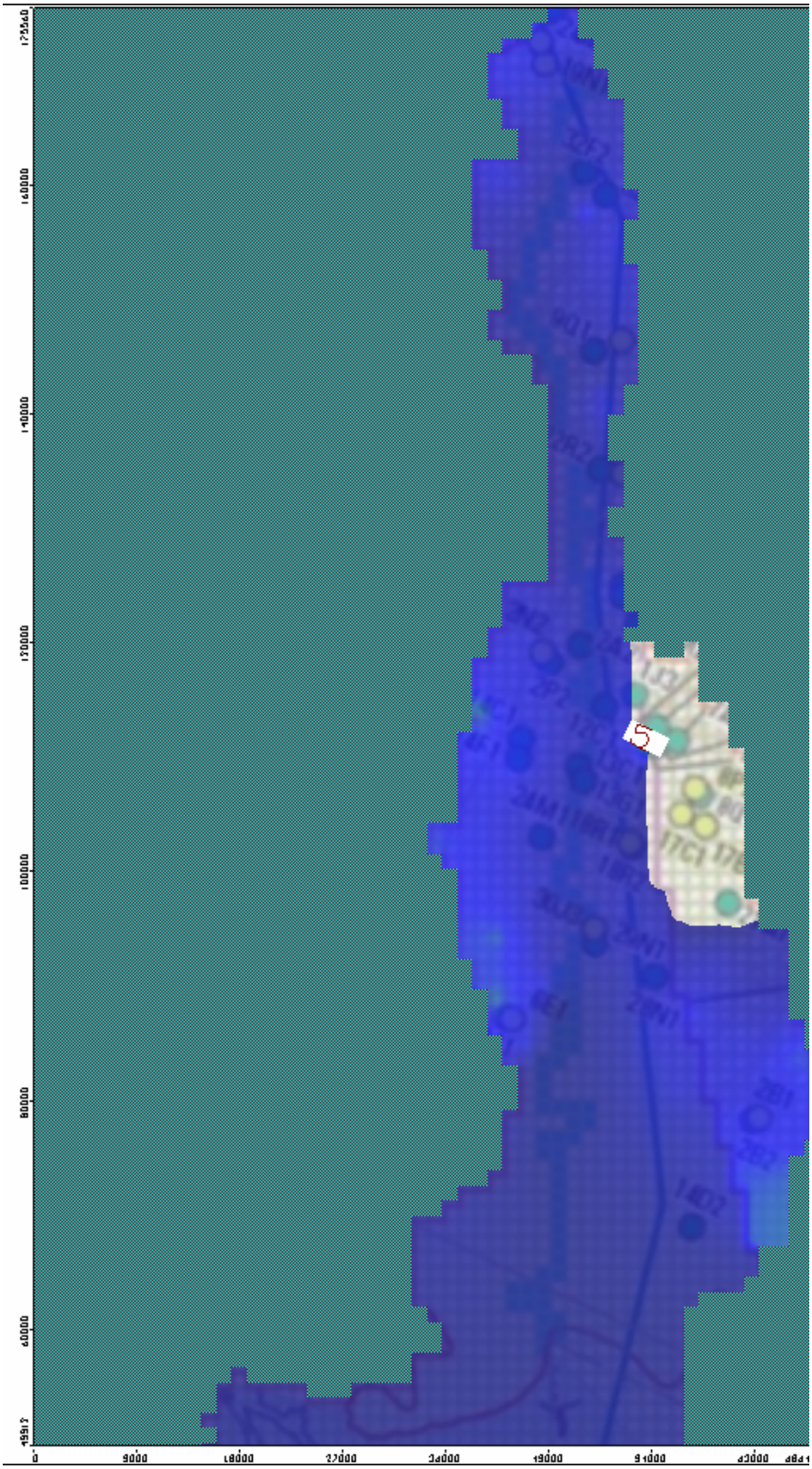
Drawdown (feet)
0
3
6
9
11
14
17
Greater than 20

Figure 4-5 Simulated drawdown from 2001-2030 for Case D-2.



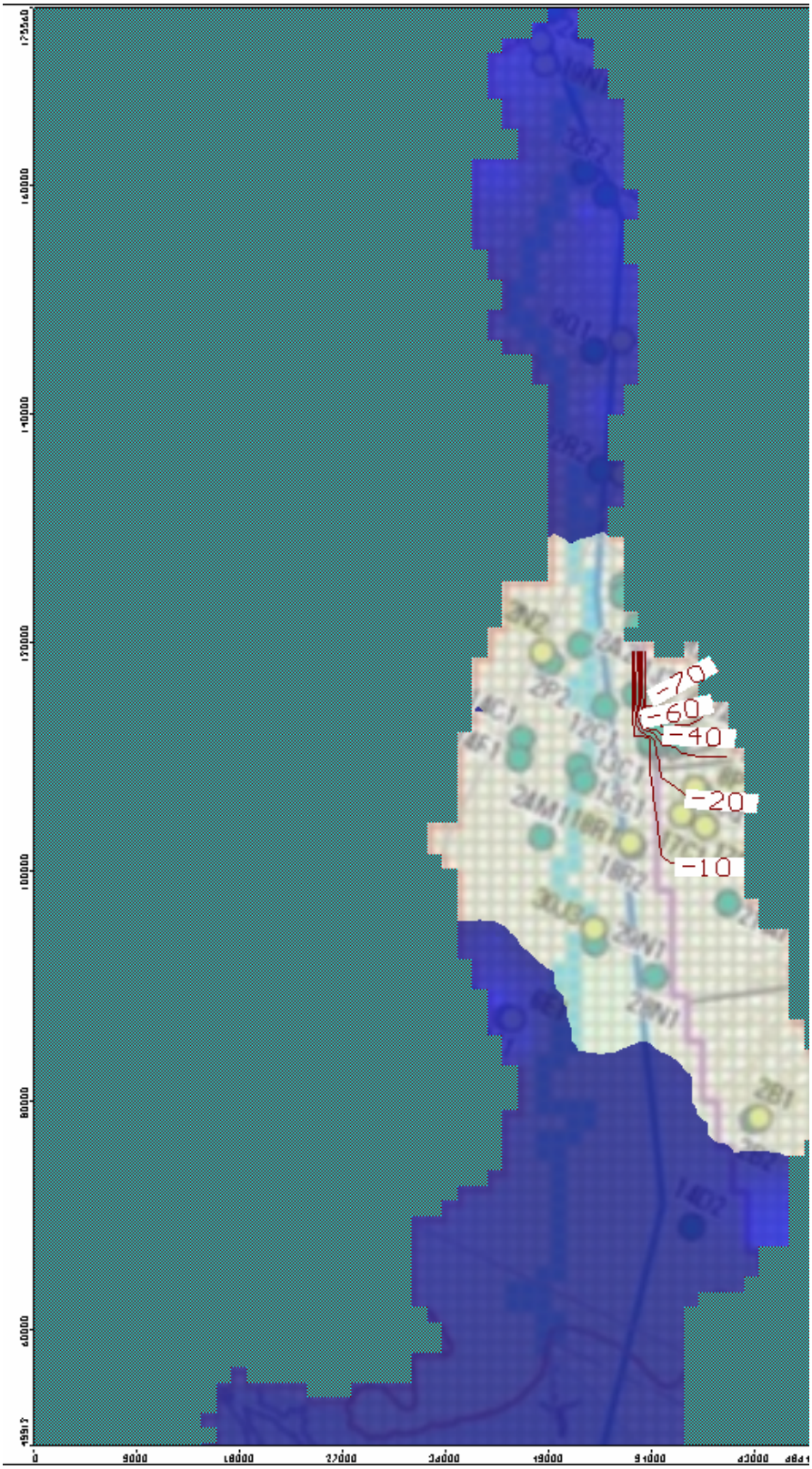
Drawdown (feet)	
	0
	3
	6
	9
	11
	14
	17
	Greater than 20

Figure 4-6 Simulated drawdown from 2001-2030 for Case N-3.



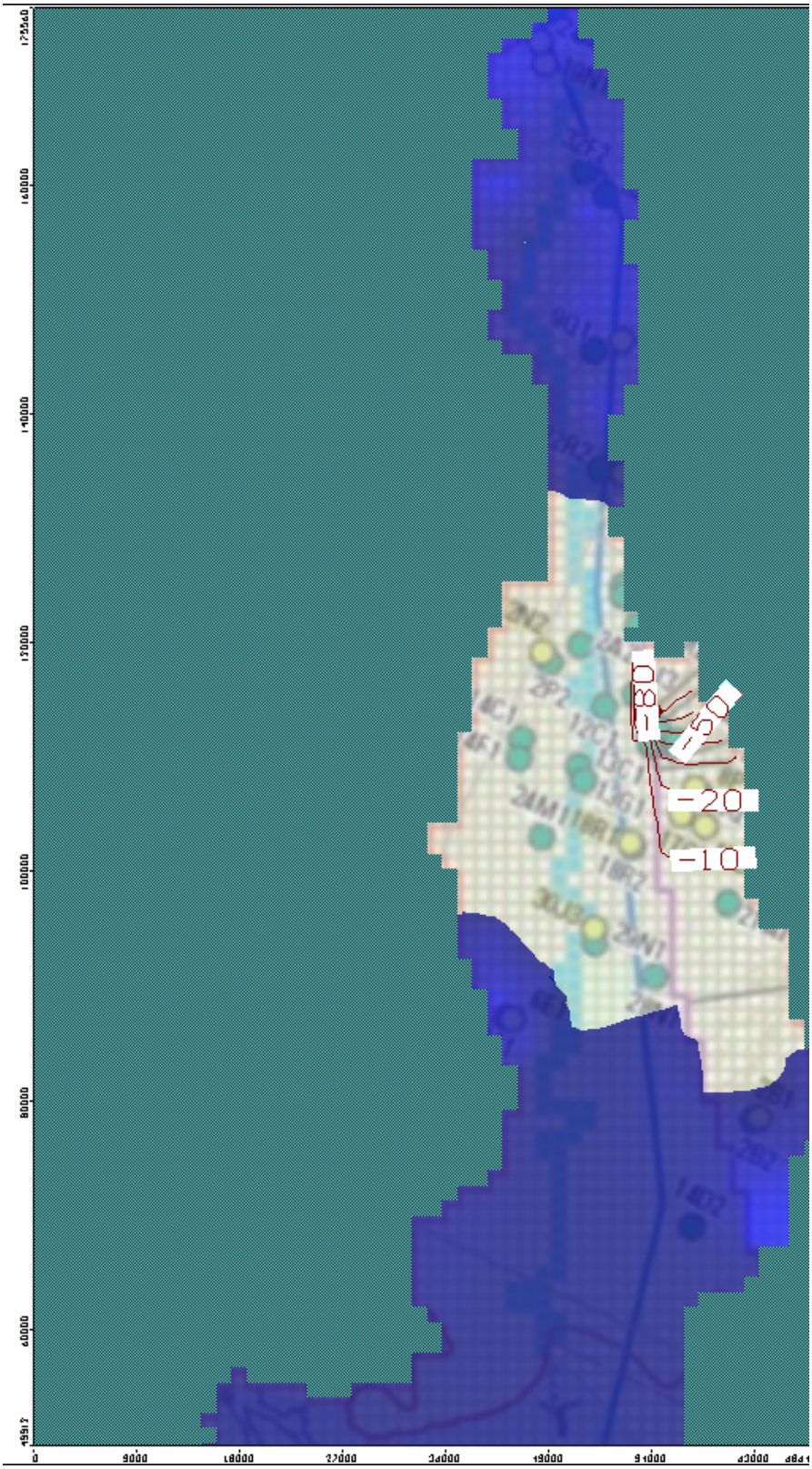
Drawdown (feet)	
	0
	3
	6
	9
	11
	14
	17
	Greater than 20

Figure 4-7 Simulated drawdown from 2001-2030 for Case N-4b.



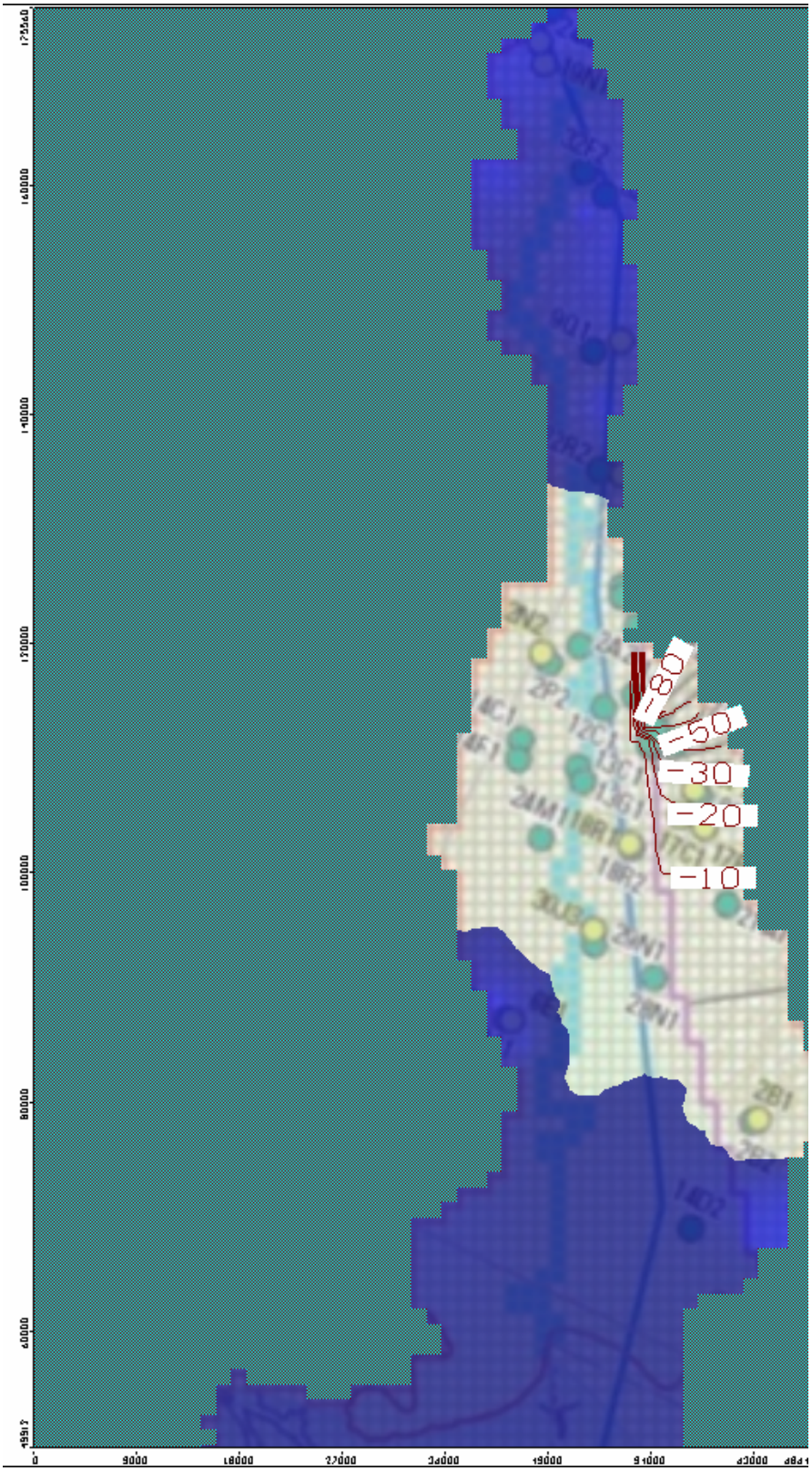
Drawdown (feet)	
	0
	3
	6
	9
	11
	14
	17
	Greater than 20

Figure 4-8 Simulated drawdown from 2001-2030 for Case N-5.



Drawdown (feet)	
	0
	3
	6
	9
	11
	14
	17
	Greater than 20

Figure 4-9 Simulated drawdown from 2001-2030 for Case D-6.



Drawdown (feet)	
	0
	3
	6
	9
	11
	14
	17
	Greater than 20

Figure 4-10 Simulated drawdown from 2001-2030 for Case N-6.

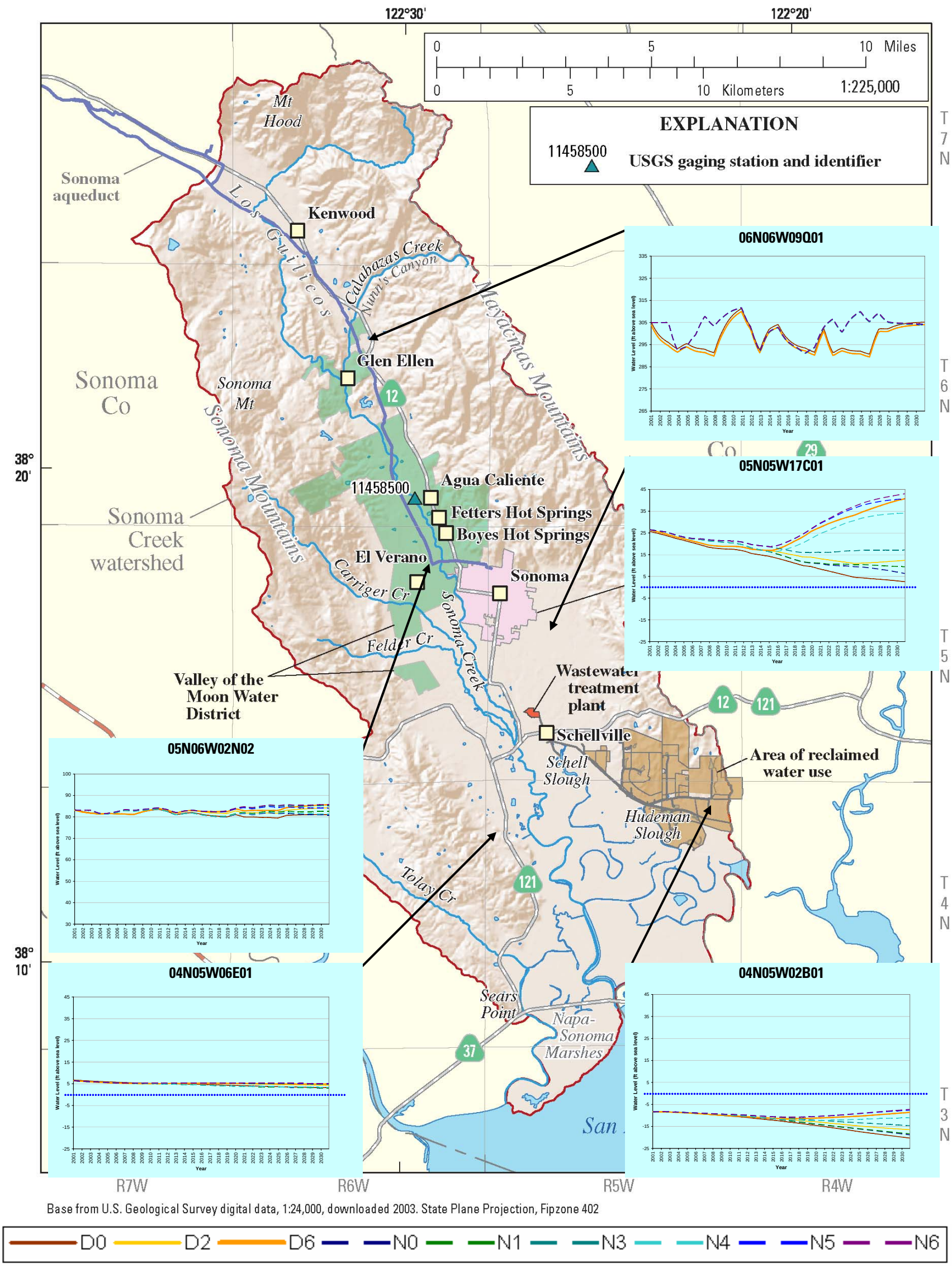


Figure 4-11 Simulated Water Levels in Selected Monitoring Wells for All Simulation Cases. (Base map from USGS, 2006; locations of indicated monitoring wells approximate)

4.3 Evaluation of Water Management Options

The model results show that all the water management options considered in this analysis contribute to and are necessary for the long-term sustainability of groundwater resources in the basin. Of the four water management options considered, the model indicates that Option B - groundwater banking results in the most benefit to the basin, providing over five times more storage over the 30 years than any other of the options considered. In Figure 4-11, the simulated heads at the observation 05N05W17C01 near the depression southeast of Sonoma demonstrates that the addition of groundwater banking in Cases N-4b, N-5, N-6, and D-6 provides a significant increase in the water levels in that area (Table 4-2). The scenario of additional imported water beyond existing water rights increases storage by 2,900 over the 30 years.

Table 4-2 Incremental Increase in Storage (2001-2030) For Each Water Management Option

Water Management Option	Incremental Increase in Storage (2001-2030) (acre-feet)
Option B – Groundwater Banking	17,300
Option D – Conservation	5,000
Option C – Recycled Water	3,200
Option A – Stormwater Recharge	2,500
Total increase in storage due to the implementation of all water management options	**27,300**[1]
Increase in storage due to additional imported water beyond existing water rights	**2,900**

[1]Based on comparison of Cases N-0 and N-5; total differs slightly from the sum of the contribution from each water management option.

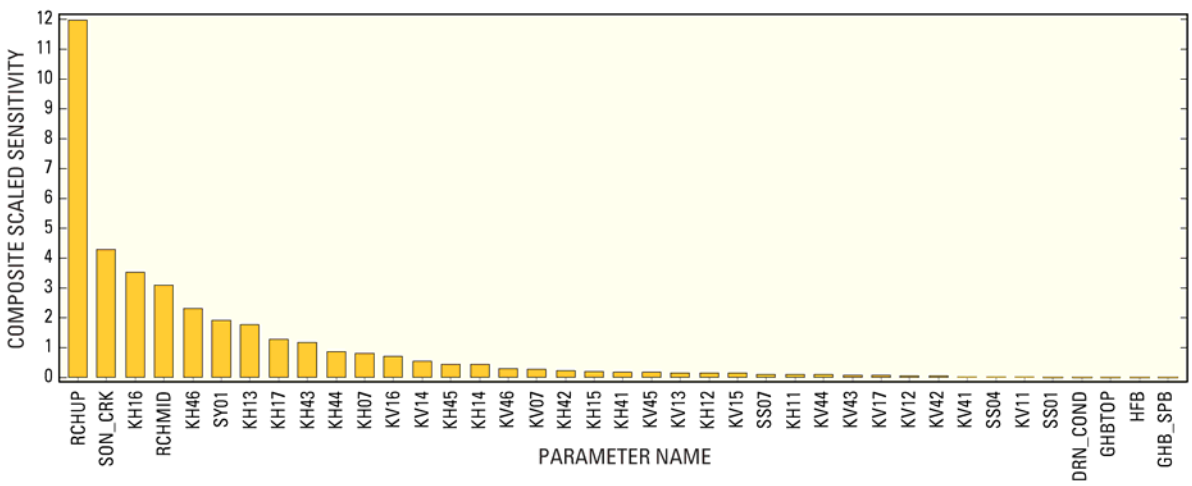
The large difference in the contribution to storage of Option B – groundwater banking and the other options is because the majority of the water recharged to the aquifer for those options discharges to the stream boundary condition. This effect is because there is a wall boundary condition representing the Eastside Fault located between the Option B recharge wells and the stream, effectively containing the recharged water. The loss of so much of the recharged water for the other three options to the stream boundary can be attributed to their proximity to the stream and to the low vertical to horizontal hydraulic conductivity ratio, which will cause the flow of groundwater be primarily horizontal. The extent to which these factors represent the actual conditions in the basin must be verified and explored through the implementation of pilot studies.

5 Sensitivity Analysis

A sensitivity analysis was performed in order to evaluate the uncertainty of the model results and the sensitivity of the model solution to key model parameters that might have affected the results of this scenario analysis. This work was built on the sensitivity analysis already performed by the USGS on the calibrated groundwater flow model (USGS, 2006).

5.1 Parameters Evaluated

The USGS analysis evaluated a total of 39 model parameters consisting of hydraulic conductivity varied by aquifer and zone, storage (specific storage and specific yield), drain conductance, general-head conductance, recharge, and streambed conductance. Composite-scaled sensitivities were calculated for each parameter (Figure 5-1). The analysis revealed that simulated hydraulic heads were most sensitive to recharge, the streambed conductance of Sonoma Creek, and horizontal hydraulic conductivity in the northern part of the basin.



Parameter name	Description
RCHUP	Upper recharge zone multiplier
SON_CRK	Streambed conductance
KH16	Horizontal hydraulic conductivity: layers 1–2, zone 6
RCHMID	Middle recharge zone multiplier
KH46	Horizontal hydraulic conductivity: layers 3–6, zone 6
SY01	Specific yield: layer 1
KH13	Horizontal hydraulic conductivity: layers 1–2, zone 3
KH17	Horizontal hydraulic conductivity: layers 1–2, zone 7
KH43	Horizontal hydraulic conductivity: layers 3–6, zone 3
KH44	Horizontal hydraulic conductivity: layers 3–6, zone 4
KH07	Horizontal hydraulic conductivity: layers 7–8
KV16	Vertical hydraulic conductivity: layers 1–2, zone 6
KV14	Vertical hydraulic conductivity: layers 1–2, zone 4
KH45	Horizontal hydraulic conductivity: layers 3–6, zone 5
KH14	Horizontal hydraulic conductivity: layers 1–2, zone 4
KV46	Vertical hydraulic conductivity: layers 3–6, zone 6
KV07	Vertical hydraulic conductivity: layers 7–8
KH42	Horizontal hydraulic conductivity: layers 3–6, zone 2
KH15	Horizontal hydraulic conductivity: layers 1–2, zone 5
KH41	Horizontal hydraulic conductivity: layers 3–6, zone 1

Parameter name	Description
KV45	Vertical hydraulic conductivity: layers 3–6, zone 5
KV13	Vertical hydraulic conductivity: layers 1–2, zone 3
KH12	Horizontal hydraulic conductivity: layers 1–2, zone 2
KV15	Vertical hydraulic conductivity: layers 1–2, zone 5
SS07	Specific storage: layers 7–8
KH11	Horizontal hydraulic conductivity: layers 1–2, zone 1
KV44	Vertical hydraulic conductivity: layers 3–6, zone 4
KV43	Vertical hydraulic conductivity: layers 3–6, zone 3
KV17	Vertical hydraulic conductivity: layers 1–2, zone 7
KV12	Vertical hydraulic conductivity: layers 1–2, zone 2
KV42	Vertical hydraulic conductivity: layers 3–6, zone 2
KV41	Vertical hydraulic conductivity: layers 3–6, zone 1
SS04	Specific storage: layers 3–6
KV11	Vertical hydraulic conductivity: layers 1–2, zone 1
SS01	Specific storage: layers 1–2
DRN_COND	Drain conductance
GHBTOP	Hydraulic conductance for horizontal face
HFB	Fault hydraulic characteristic multiplier
GHB_SPB	Hydraulic conductance for vertical face

Figure 5-1 Composite-Scaled Sensitivities for the Calibrated Groundwater Flow Model (USGS, 2006).

Sensitivity runs were performed on the worst case, Case D-0, for the most sensitive parameters previously identified by the USGS. Storage parameters were increased and decreased, as well as streambed conductance. No sensitivity runs were performed on the hydraulic conductivity because any adjustment would have necessitated a recalibration of the model to produce a new initial condition. The sensitivity of the model to recharge was considered to have been encompassed by the wet and dry year alternatives already modeled. The parameters that were adjusted for the sensitivity runs are summarized in Table 5-1.

Table 5-1 Summary of Sensitivity Analysis Parameters.

Parameter	Base Case	ID	Sensitivity Run
Aquifer Storage Properties	Sy = 0.1 Ss (Layers 1-2) = 1.5×10^{-4} Ss (Layers 3-6) = 1.5×10^{-6} Ss (Layers 7-8) = 1.0×10^{-6}	1a	*Decrease Sy by 2, decrease Ss by half an order of magnitude:* Sy = 0.05 Ss (Layers 3-6) = 3.0×10^{-5} Ss (Layers 3-6) = 3.0×10^{-7} Ss (Layers 1-2) = 2.0×10^{-7}
		1b	*Increase Sy by 2, increase Ss by half an order of magnitude:* Sy = 0.05 Ss (Layers 3-6) = 3.0×10^{-5} Ss (Layers 3-6) = 3.0×10^{-7} Ss (Layers 1-2) = 2.0×10^{-7}
Streambed Conductance	Values ranging from 0.0121527 to 4.455146 $feet^2$ per day	2a	*Decrease streambed conductance by half an order of magnitude*
		2b	*Increase streambed conductance by half an order of magnitude*

5.2 Analysis Results

Varying the storage parameters in the model has a linear effect on the simulated change in storage from years 2001 through 2030. The reduction in the storage parameters by 50 percent resulted in an increase in the simulated change in storage (a smaller decrease in storage) by 46 percent. Likewise, doubling the storage parameters resulted in a 97 percent decrease in simulated change in storage. These results are shown in Figure 5-2.

Varying the streambed conductance by half an order of magnitude caused the model to fail to converge.

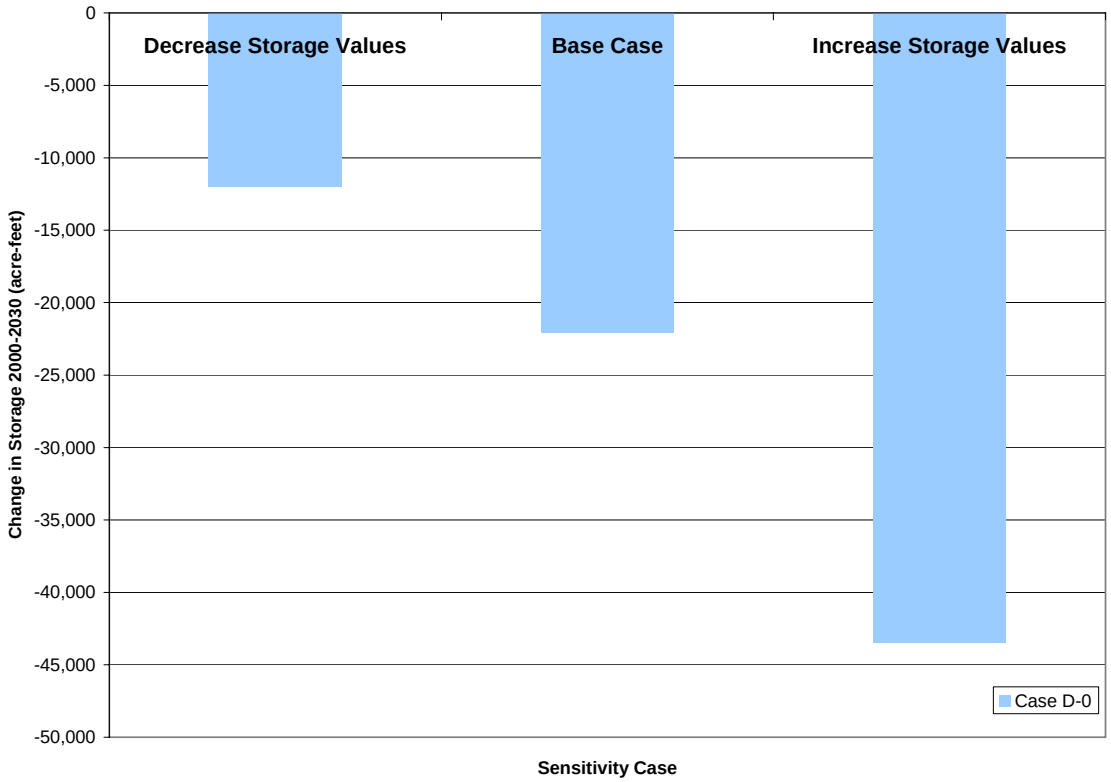


Figure 5-2 Sensitivity of Case D-0 to Storage Parameters.

6 Recommended Improvements to the Model and Further Action

The results shown in this document reflect the best available data at the time based on a preliminary groundwater budget-based model, which has limitations previously discussed and identified in the USGS report (2006) and in our own analysis (Section 2.5). As more data become available, the model and understanding of the Sonoma Valley study area can be refined and improved. Additionally, several inconsistencies were identified between the reported values and model files for the calibrated groundwater flow model, which have been partially addressed in communications with the USGS. A more detailed evaluation of the model is recommended before the model should be used for detailed assessments of future water management actions. Despite the model limitations, which have been addressed in Section 2.5, the model is the best available tool for predicting future groundwater conditions and has demonstrated the need for multiple water management options in order to yield groundwater sustainability in the Sonoma Valley.

The groundwater model should therefore be improved and refined as more information becomes available so that it can continue to be a useful groundwater basin management tool for the long-term. Improvements to the existing groundwater model can be made by collecting additional data in the basin and refining the grid and temporal discretization as needed to incorporate the additional data. The following data collection activities and analyses would help fill the data gaps that have been identified in the model:

- Collect additional groundwater level and quality monitoring data
- Collect additional groundwater production data (from public supply systems)
- Install additional stream gauges and collect additional stream flow data
- Better characterize the amount and spatial distribution of groundwater recharge
- Collect additional geologic, hydrogeologic, and borehole geophysical data and conduct additional analysis to provide a more detailed understanding of the hydrogeologic factors that control groundwater flow and storage
- Update the land use survey to the current time to better estimate the current groundwater production by agriculture
- Collect data on chloride distribution and sources to characterize the extent of seawater intrusion from San Pablo Bay.

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Attachment 1 – Calculation of Input Parameters for Scenarios

Urban Water Supply

Projected urban water demand was provided by the Agency (Agency, 2007):

	2010	2015	2020	2025	2030
City of Sonoma					
Raw Gross Demands	2939	3056	3088	3119	3397
Local Groundwater (with/without additional supply in 2016)	324	404	285/390	187/392	21/633
Imported Water (with/without additional supply in 2016)	2459	2393	2491/2386	2587/2381	3000/2388
Conservation Savings	156	239	282	306	326
Recycled Water	0	20	30	40	50
Valley of the Moon					
Raw Gross Demands	3953	4075	4196	4259	4322
Local Groundwater (with/without additional supply in 2016)	436	566	428/608	309/624	83/642
Imported Water (with/without additional supply in 2016)	3312	3185	3360/3179	3488/3173	3729/3171
Conservation Savings	205	324	409	462	504
Recycled Water	0	0	0	0	5

All values shown in acre-feet per year

A breakdown of the projected conservation savings was also provided by the Agency (Agency, 2007):

	2005	2010	2015	2020	2025	2030
City of Sonoma						
Tier 1 To-Date	89	78	73	70	67	65
Tier 1 Future	33	86	116	120	120	119
Tier 2	0	12	46	73	78	78
New Development	0	34	45	48	51	56
Plumbing Code Savings	5	30	55	77	97	112
Valley of the Moon						
Tier 1 To-Date	125	107	101	95	91	88
Tier 1 Future	45	130	161	166	165	164
Tier 2	0	19	52	69	70	69
New Development	0	13	33	54	64	75
Plumbing Code Savings	8	53	104	154	198	231

All values shown in acre-feet per year

The urban demand was then calculated as:

Urban demand = Local groundwater + Conservation Savings – Plumbing Code Savings

The resulting projected urban values are shown below:

	2010	2015	2020	2025	2030
City of Sonoma					
Urban Demand without conservation beyond plumbing code (with/without additional supply in 2016)	451	588	490/595	396/602	235/847
Valley of the Moon					
Urban Demand without conservation beyond plumbing code (with/without additional supply in 2016)	588	786	682/863	573/888	356/915

All values shown in acre-feet per year

The projected urban water demand was then interpolated from the USGS model year 2000 values to produce a schedule for 2001 through 2030:

Year	City of Sonoma		Valley of the Moon		Total Urban Supply	
	With Additional Supply	Without Additional Supply	With Additional Supply	Without Additional Supply	With Additional Supply	Without Additional Supply
2000[1]	**0**	**0**	**710**	**710**	**710**	**710**
2001	45	45	698	698	743	743
2002	90	90	686	686	776	776
2003	135	135	674	674	809	809
2004	180	180	661	661	842	842
2005	226	226	649	649	875	875
2006	271	271	637	637	908	908
2007	316	316	625	625	941	941
2008	361	361	613	613	974	974
2009	406	406	601	601	1007	1007
2010[2]	**451**	**451**	**588**	**588**	**1040**	**1040**
2011	479	479	628	628	1106	1106
2012	506	506	667	667	1173	1173
2013	533	533	707	707	1240	1240
2014	561	561	746	746	1307	1307
2015[2]	**588**	**588**	**786**	**786**	**1374**	**1374**
2016	569	590	765	801	1334	1391
2017	549	591	744	817	1293	1408
2018	529	592	724	832	1253	1424
2019	509	594	703	847	1212	1441
2020[2]	**490**	**595**	**682**	**863**	**1172**	**1458**

Year	City of Sonoma		Valley of the Moon		Total Urban Supply	
	With Additional Supply	Without Additional Supply	With Additional Supply	Without Additional Supply	With Additional Supply	Without Additional Supply
2021	471	596	661	868	1131	1464
2022	452	598	639	873	1091	1471
2023	434	599	617	878	1051	1477
2024	415	601	595	883	1010	1484
2025[2]	**396**	**602**	**573**	**888**	**970**	**1490**
2026	364	651	530	894	894	1544
2027	332	700	486	899	818	1599
2028	300	749	443	904	743	1653
2029	268	798	399	909	667	1707
2030[2]	**235**	**847**	**356**	**915**	**591**	**1761**

All values shown in acre-feet per year
Sources: [1]USGS, 2006
[2]Agency, 2007

Domestic Water Supply

The table below lists the population data that was used for estimating Domestic Water Supply.

Year	(a)	(b)	(c) = (a)-(b)	(d)	(e)	(f) = (c) interpolated	(g) = (f) – (d)	(h) = (g) * 0.19
	Sonoma Valley[1]	Sonoma Valley Urban Service Area (USA)[1]	Unincorporated Areas outside Sonoma USA	Valley of the Moon[2]	City of Sonoma	Unincorporated Areas outside Sonoma USA	Population on Domestic Water Supply	Domestic Water Supply
2000	39879	9754	30125	21660[4]	--	30125	8465	**1608[3]**
2005	---	---	---	22665	10733	31193.75	8529	**1620**
2010	---	---	---	23359	12348	32262.5	8904	**1692**
2015	---	---	---	24055	12642	33331.25	9276	**1762**
2020	48990	14590	34400	24753	12740	34400	9647	**1833**
2025	---	---	---	25109	12838	35468.75	10360	**1968**
2030	---	---	---	25466	12984	36537.5	11072	**2104**

All values shown in acre-feet per year
Sources: [1]PRMD, 2005.
[2]Brown & Caldwell, December 2006.
[3]USGS, 2006.
[4]VOMWD year 2000 population extrapolated in order to obtain year 2000 production using the production rate factor of 0.19 acre-ft per person per year provided in USGS (2006).

The projected private domestic water demand was then interpolated from year 2000 through 2030:

Year	Total Production for Domestic Water Supply
2000	**1608**
2001	1611
2002	1613
2003	1616
2004	1618
2005	**1620**
2006	1635
2007	1649
2008	1663
2009	1677
2010	**1692**
2011	1706
2012	1720
2013	1734
2014	1748
2015	**1762**
2016	1777
2017	1791
2018	1805
2019	1819
2020	**1833**
2021	1860
2022	1887
2023	1914
2024	1941
2025	**1968**
2026	1995
2027	2022
2028	2049
2029	2077
2030	**2104**

All values shown in acre-feet per year

Agricultural Water Supply

(a) Increase in Agricultural Land from 2000-2020: 1500 acres

(b) Increase in Agricultural Land from 2000-2030 calculated by extrapolating (a) 2250 acres

(c) Applied Water (USGS, 2006): 0.6 feet per year

(d) Additional groundwater production due to agriculture in 2030 = (b) * (c)

= 2250 acres * 0.6 feet per year = 1350 acre-feet per year

(e) Total year 2000 production for agricultural supply (USGS) 6117 acre-feet per year

The projected agricultural water demand was then interpolated from the USGS model year 2000 values (e) through 2030 (d):

Year	Total Production for Agricultural Supply (acre-feet per year)
2000	**6117**
2001	6162
2002	6207
2003	6252
2004	6297
2005	6342
2006	6387
2007	6432
2008	6477
2009	6522
2010	6567
2011	6612
2012	6657
2013	6702
2014	6747
2015	6792
2016	6837
2017	6882
2018	6927
2019	6972
2020	7017
2021	7062
2022	7107
2023	7152
2024	7197
2025	7242
2026	7287
2027	7332
2028	7377
2029	7422
2030	**7467**

All values shown in acre-feet per year

Option B – Groundwater Banking

Target Recharge Rate: 1500 acre-feet per year (178891 cubic feet per day)

Number of Wells: 2

Injection rate per well = Target Recharge Rate / Number of Wells

= (178891 cubic feet per day) / 2 = 89446 cubic feet per day

(1 cubic feet per second, 465 gallons per minute)

Screened Interval: Model Layer 4

Well spacing in model: 1320 feet (1 grid cell)

Start Year: 2015

Option C – Recycled Water Use

Amount of recycled water provided by the first implementation phase of Alignment 1, which is the southwestern portion (Agency, 2005): 1100 acre-feet per year

Start Year: 2010

The following wells in the model lie in the vicinity of this portion of Alignment 1, and were assumed to have their groundwater demand offset by recycled water. The pumping rate shown in the table below is the rate at which they are pumping in year 2000 in the calibrated model (USGS, 2006):

Model Well ID	Pumping Rate (cubic feet per day)
828	8304
894b	17871
902a	15572
902a	18956
782	6702
782	3288
782	7881
2220	984
2220	3410
2220	3410
2220	3410
2220	3410
2220	2341
1487	11682
1487	23399
883a	1034
883a	832
TOTAL	132486 cubic feet per day 1111 acre-feet per year

These year 2000 rates were subtracted from the projected production rate for these wells beginning in 2010 through 2030.

Option D – Increased Conservation

For the urban demand, the additional conservation savings were subtracted from the demand calculated for the future demand. The table below summarizes the adjusted demand schedule for urban supply wells due to increased conservation:

Year	City of Sonoma Demand with Increased Conservation		Valley of the Moon Demand with Increased Conservation		
	With Additional Supply	Without Additional Supply	With Additional Supply	Without Additional Supply	
2000	0	0	710	710	
2001	**39**	**39**	**688**	**688**	Begin Tier 1 to-date and plumbing code savings
2002	63	63	647	647	
2003	88	88	606	606	
2004	112	112	565	565	
2005	137	137	524	524	
2006	184	184	516	516	
2007	231	231	507	507	
2008	279	279	499	499	
2009	326	326	490	490	
2010	**324**	**324**	**436**	**436**	Begin implementation of all conservation measures
2011	340	340	462	462	
2012	356	356	488	488	
2013	372	372	514	514	
2014	388	388	540	540	
2015	404	404	566	566	
2016	380	401	538	574	
2017	356	399	510	583	
2018	332	396	483	591	
2019	309	393	455	600	
2020	285	390	428	608	
2021	265	391	404	611	
2022	245	391	380	615	
2023	226	391	357	618	
2024	206	392	333	621	
2025	187	392	309	624	
2026	154	440	264	628	
2027	120	488	219	631	
2028	87	536	174	635	

Year	City of Sonoma Demand with Increased Conservation		Valley of the Moon Demand with Increased Conservation	
	With Additional Supply	Without Additional Supply	With Additional Supply	Without Additional Supply
2029	54	584	128	638
2030	21	632	83	642

All values shown in acre-feet per year

Domestic demand was calculated by subtracting the percent conservation from the future domestic demand. The percent savings of 8.3 percent applied is the average projected conservation savings for the City of Sonoma. The table below lists the resulting domestic demand with increased conservation.

Year	Domestic Demand with Increased Conservation	Percent Conservation	
2000	1608	0	
2001	1611	0	
2002	1613	0	
2003	1616	0	
2004	1618	0	
2005	**1607**	**0.83**	Begin ramping up 0.83 percent conservation per year
2006	1607	1.67	
2007	1608	2.50	
2008	1608	3.34	
2009	1607	4.17	
2010	1607	5.00	
2011	1606	5.84	
2012	1605	6.67	
2013	1604	7.51	
2014	1603	8.34	
2015	**1615**	**8.34**	Maintain 8.3 percent conservation
2016	1628	8.34	
2017	1641	8.34	
2018	1654	8.34	
2019	1667	8.34	
2020	1680	8.34	
2021	1705	8.34	
2022	1730	8.34	
2023	1755	8.34	
2024	1779	8.34	

Year	Domestic Demand with Increased Conservation	Percent Conservation
2025	1804	8.34
2026	1829	8.34
2027	1854	8.34
2028	1879	8.34
2029	1903	8.34
2030	1928	8.34

All values shown in acre-feet per year

Agricultural demand with conservation was calculated by subtracting the percent conservation from the future demand. The table below lists the resulting agricultural demand with conservation.

Year	Agricultural Demand with Increased Conservation	Percent Conservation	
2000	6117	0	
2001	6162	0	
2002	6207	0	
2003	6252	0	
2004	6297	0	
2005	**6310**	**0.5**	Begin ramping up 0.5 percent conservation per year
2006	6323	1.0	
2007	6336	1.5	
2008	6347	2.0	
2009	6359	2.5	
2010	6370	3.0	
2011	6381	3.5	
2012	6391	4.0	
2013	6400	4.5	
2014	6410	5.0	
2015	**6452**	**5.0**	Maintain 5% conservation
2016	6495	5.0	
2017	6538	5.0	
2018	6581	5.0	
2019	6623	5.0	
2020	6666	5.0	
2021	6709	5.0	
2022	6752	5.0	

Year	Agricultural Demand with Increased Conservation	Percent Conservation
2023	6794	5.0
2024	6837	5.0
2025	6880	5.0
2026	6923	5.0
2027	6965	5.0
2028	7008	5.0
2029	7051	5.0
2030	7094	5.0

All values shown in acre-feet per year

APPENDIX D

STANDARD OPERATING PROCEDURE FOR THE COLLECTION OF WATER LEVEL AND QUALITY DATA

Working Draft
STANDARD OPERATING PROCEDURE
For
MANUAL WATER LEVEL MEASUREMENTS

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for the determination of the depth to water and separate phase chemical product (i.e., gasoline or oil) in a water supply well, monitoring well, or piezometer. These standard operating procedures may be varied or changed as required, dependent on site conditions , and equipment limitations. In all instances, the actual procedures employed will be documented and described on the field form. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Generally, water-level measurements taken in piezometers, or wells are used to construct water table or potentiometric surface maps and to determine flow direction as well as other aquifer characteristic. Therefore, all water level measurements in a given district should preferably be collected within a 24 hour period and SGA's area within one week. However, certain situations may produce rapidly changing groundwater levels that necessitate taking measurements as close in time as possible. Large changes in water levels among wells may be indicative of such a condition . Rapid groundwater level changes may occur due to:

- Atmospheric pressure changes
- Changes in river stage, impoundments levels, or flow in unlined ditches
- Pumping of nearby wells
- Precipitation
- Tidal influences

2.0 METHOD SUMMARY

A survey mark should be placed on the top of the riser pipe or casing as a reference point for groundwater level measurements. If the lip of the riser pipe is not flat, the reference point may be located on the grout apron or the top of the outer protective casing (if present). The measurement reference point should be documented on the groundwater level data form. All field personnel must be made aware of the measurement reference point being used in order to ensure the collection of comparable data. Before measurements are made, water levels in piezometers and monitor wells should be allowed to stabilize for a minimum of 24 hours after well construction and development. Measurements in water supply wells need to be noted as questionable if pumping has or is occurring. In low yield situations, recovery of water levels to equilibrium may take longer. All measurements should be made as accurately as possible, with a minimum accuracy of 0.1 feet. Future measurements may have to be more accurate (measurements to the nearest 0.01 foot may be needed for conjunctive use projects, ect.). Ideally, the minimum measurement accuracy is 0.1 feet and the recommended accuracy is 0.01 feet.

If there is reason to suspect groundwater contamination, water level measuring equipment must be decontaminated and, in general, measurements should proceed from the least to the most contaminated wells. This SOP assumes an absence of contamination and no need for air monitoring or decontamination.

Open the well and monitor the headspace with the appropriate air monitoring instrument if the presence of volatile organic compounds is suspected. For electrical sounders lower

the device into the well until the water surface is reached as indicated by a tone or meter deflection. Record the distance from the water surface to the reference point. Measurement with a chalked tape will necessitate lowering the tape below the water level and holding a convenient foot marker at the reference point. Record both the water level as indicated on the chalked tape section and the depth mark held at the reference point. The depth to water is the difference between the two readings. Remove measuring device, replace riser pipe cap, and decontaminate equipment as necessary. Note that if a separate phase is present, an oil/water indicator probe is required for measurement of product thickness and water level.

3.0 POTENTIAL PROBLEMS

1) Cascading water, particularly in open-hole or rock wells, may interfere with the measurement.
2) Some older types of electric sounders are only marked at five-foot intervals. A surveyor's tape is necessary to extrapolate between the 5-foot marks.
3) Oil or other product floating on the water column can insulate the contacts of the probe on an electric sounder and give false readings. For accurate level measurements in wells containing floating product, a special oil/water level indicator is required, and the corrected water level must be calculated.
4) Tapes (electrical or surveyor's) may have damaged or missing sections, or may be spliced inaccurately.
5) An airline may be the only available means to make measurements in sealed production wells but the method is generally accurate only to approximately 0.2 foot.
6) When using a steel tape, it is necessary to lower the tape below the water level in order to make a measurement. This assumes knowledge of the approximate groundwater level.

4.0 EQUIPMENT

The electric water level indicator and the chalked steel tape are the devices commonly used to measure water levels. Both have an accuracy of 0.01 feet. Other field equipment may include:

- Air monitoring instrumentation
- Well depth measurement device (sounder)
- Chalk
- Ruler
- Site logbook
- Paper towels and trash bags
- Decontamination supplies (assumed unnecessary)
- Groundwater level data forms

5.0 PROCEDURES

5.1 Preparation

1) Determine the number of measurements needed, the methods to be employed, and the equipment and supplies needed.
2) Decontaminate or pre-clean equipment, and ensure that it is in working order.

3) Coordinate schedule with staff and regulatory agency, if appropriate.
4) If this is an initial visit, perform a general site survey prior to site entry in accordance with a current approved site specific Health and Safety Plan (if applicable).
5) Identify measurement locations.

5.2 Procedures

Procedures for determining water levels are as follows:

1) If possible, and when applicable, start at those wells that are least contaminated and proceed to those wells that are most contaminated.
2) Rinse all the equipment entering the well.
3) Remove locking well cap, note well ID, time of day, and date on the groundwater level data form.
4) Remove well cap.
5) If required by site-specific condition, monitor headspace of well with a photoionization detector (PID) or flame ionization detector (FID) to determine presence of volatile organic compounds, and record results in logbook.
6) Lower water-level measuring device into the well. Electrical tapes are lowered to the water surface whereas chalked steel tapes are lowered generally a foot or more below the water surface. Steel tapes are generally chalked so that a 1-to 5-foot long section will fall below the expected water level.
7) For electrical tapes record the distance from the water surface, as determined by the audio signal or meter, to the reference measuring point and record. For chalked tapes, an even foot mark is held at the reference point, once the chalked section of the tape is below the water level. Both the water level on the tape and the foot mark held at the reference point is recorded. The depth to the water is then the difference between the two readings. In addition, note the reference point used (top of the outer casing, top of the riser pipe, ground surface, or some other reproducible position on the well head). Repeat the measurement.
8) Remove all downhole equipment, and replace well cap and locking steel caps.
9) Rinse all downhole equipment and store for transport to the next well.
10) Note any physical changes, such as erosion or cracks in protective concrete pad or variation in total depth of well on groundwater level data form.

6.0 CALCULATIONS

To determine groundwater elevation above mean sea level, use the following equation, where:

$$\mathbf{E_w = E - D}$$

$\mathbf{E_w}$ = Elevation of water above mean sea level (feet) or local datum
E = Elevation above sea level or local datum at point of measurement (feet)
D = Depth to water (feet)

7.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

1) All data must be documented on the groundwater level data forms.

2) All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified.
3) Each well should be tested at least twice in order to compare results. If results do not agree to within 0.02 feet, a third measurement should be taken and the readings averaged. Consistent failure of consecutive readings to agree suggests that levels are changing because of one or more conditions as indicated in Section 1, and should be noted on the field form.
4) Results should be compared to historical measurements while in the field and significant discrepancies noted and resolved if possible.
5) Wells for which no or questionable measurements are obtained need to have the codes entered on the field form as follows:

No Measurement		**Questionable Measurement**	
0	Discontinued	**0**	
1	Pumping	**1**	Pumping
2	Pumphouse locked	**2**	Nearby pump operating
3	Tape hung up	**3**	Casing leaking or wet
4	Can't get tape in casing	**4**	Pumped recently
5	Unable to locate well	**5**	Air or pressure gauge measurement
6	Well destroyed	**6**	Other
7	Special	**7**	Recharge operation at nearby well
8	Casing leaking or wet	**8**	Oil in casing
9	Temporarily inaccessible		
D	Dry well		
F	Flowing well		

6) The surveyor(s) must complete all fields on the field form and initial. Upon return from the field, appropriate corrective actions need to be communicated and completed prior to the next survey event.
7) All data entered into electronic spreadsheet or database should be double-keyed or hard copy printed and proofed by a second person.
8) Questionable wells or measurements noted during data compilation need to result in corrective actions if applicable.

8.0 HEALTH AND SAFETY

This SOP assumes that only uncontaminated wells are being measured. If not, a current approved site Health and Safety Plan should be consulted..

9.0 REFERENCES

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COLLECTION, PRETREATMENT, STORAGE AND TRANSPORTATION OF WATER AND WASTEWATER SAMPLES

STATE OF CALIFORNIA

DEPARTMENT OF HEALTH SERVICES

DIVISION OF DRINKING WATER AND ENVIRONMENTAL MANAGEMENT

SANITATION AND RADIATION LABORATORIES BRANCH

NORTHERN AND SOUTHERN CALIFORNIA SECTIONS

May 1, 1995

PETE WILSON, Governor

OF CALIFORNIA—HEALTH AND WELFARE AGENCY

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May 1, 1995

This is the fifth edition of the manual for the "Collection, Pretreatment, Storage and Transportation of Water and Wastewater Samples", prepared by the California Department of Health Services.

The four prior editions (Navone, 1953; Greenberg, 1958; and Tamplin, 1971 and 1985) no longer reflect present practices and should be discarded. The current edition was necessitated by recent additions and changes to the Safe Drinking Water Act and Title 22, California Code of Regulations, and endeavors to reflect sampling requirements up to and including Phases II and V of the Safe Drinking Water Act.

Although sampling, container, preservative and transportation requirements are universally applicable, this manual specifically outlines these steps for samples taken for submittal to the Sanitation and Radiation Laboratories of the California Department of Health Services.

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I. SAMPLING

Sampling or sample collection is the process of collecting a portion of the environmental medium (such as water) so that the amount collected is representative of the material being sampled. Not all aspects of sampling can be covered in their entirety here. However there are several documents available from standard setting agencies that deal with the subject in detail. Here we have excerpted some information that is central to this activity from *Standard Methods for the Examination of Water and Wastewater,* 18th edition, 1992.

A. Sampling Objective

"The objective of sampling is to collect a portion of material small enough in volume to be transported conveniently and handled in the laboratory while still accurately representing the material being sampled. This objective implies that the relative proportions or concentrations of all pertinent components will be the same in the samples as in the materials being sampled, and that the sample will be handled in such a way that no significant changes in composition occur before the tests are made.

"A sample may be presented to the laboratory for specific determinations with the collector taking responsibility for its validity. Often, in water and wastewater work, the laboratory conducts or prescribes the sampling program, which is determined in consultation with the user of the test results. Such consultation is essential to insure selecting samples and analytical methods that provide a true basis for answering the questions that prompted the sampling.

"The sampling program defines the portion of the whole to which the test results apply. Account must be taken of the variability of the whole with respect to time, area, depth, and in some cases, rate of flow.

B. General Precautions

"Obtain a sample that meets the requirements of the sampling program and handle it in such a way that it does not deteriorate or become contaminated before it reaches the laboratory. Before filling, rinse sample bottle out two or three times with the water being collected, unless the bottle contains a preservative or dechlorinating agent. Depending on determinations to be performed, fill container full (most organics determinations) or leave space for aeration, mixing, etc. (microbiological analyses). For samples that will be shipped, preferably leave an air space of about 1% of the container capacity to allow for thermal expansion.

"Sample carefully to insure that analytical results represent the actual sample composition. Important factors affecting results are the presence of suspended matter or turbidity, the method chosen for its removal, and the physical and chemical changes brought about by storage or aeration. Particular care is required when processing (grinding, blending, sieving, filtering) samples to be analyzed for trace constituents, especially metals and organic compounds. Some determinations, particularly of lead,

can be invalidated by contamination from such processing. Treat each sample individually with regard to the substances to be determined, the amount and nature of turbidity present, and other conditions that may influence the results.

"It is impractical to give directions covering all conditions, and the choice of technique for collecting a homogeneous sample must be left to the professional's judgment.

"Make a record of every sample collected and identify every bottle, preferably by attaching an appropriately inscribed tag or label. Record sufficient information to provide positive sample identification at a later date, including the name of the sample collector, the date, hour, and exact location, the water temperature, and any other data that may be needed for correlation, such as weather conditions, water level, stream flow, post-sampling handling, etc. Provide space on the label for the initials of those assuming sample custody and for the time and date of transfer. Fix sampling points by detailed description, by maps, or with the aid of stakes, buoys, or landmarks in a manner that will permit their identification by other persons without reliance on memory or personal guidance.

"Before collecting samples from distribution systems, flush lines sufficiently to insure that the sample is representative of the supply, taking into account the diameter and length of the pipe to be flushed and the velocity of flow.

"Collect samples from wells only after the well has been pumped sufficiently to insure that the sample represents the groundwater source. Sometimes it will be necessary to pump at a specified rate to achieve a characteristic drawdown, if this determines the zones from which the well is supplied. Record pumping rate and drawdown.

"When samples are collected from a river or stream, observed results may vary with depth, stream flow, and distance from shore and from one shore to the other. If equipment is available, take an "integrated" sample from top to bottom in the middle of the stream or from side to side at mid depth, in such a way that the sample is integrated according to flow. If only a grab or catch sample can be collected, take it in the middle of the stream and at mid-depth.

"Lakes and reservoirs are subject to considerable variations from normal causes such as seasonal stratification, rainfall, runoff, and wind. Choose location, depth, and frequency of sampling depending on local conditions and the purpose of the investigation. Avoid surface scum.

"Use only representative samples (or those conforming to a sampling program) for examination. The great variety of conditions under which collections must be made makes it impossible to prescribe a fixed procedure. In general, take into account tests or analyses to be made and the purpose for which the results are needed.

C. Types of Samples

Grab or catch samples:

"Strictly speaking, a sample collected at a particular time and place can represent only the composition of the source at that time and place. However, when a source is known to be fairly constant in composition over a considerable period of time or over substantial distances in all directions, then the sample may be said to represent a longer time period or a larger volume, or both, than the specified point at which it was collected. In such circumstances, some sources may be represented quite well by single grab samples.

"When a source is known to vary with time, grab samples collected at suitable intervals and analyzed separately can document the extent, frequency, and duration of these variations. Choose sampling intervals on the basis of the frequency with which changes may be expected, which may vary from as little as 5 minutes to as long as 1 hour or more.

"When the source composition varies in space rather than time, collect samples from appropriate locations.

"Use great care in sampling wastewater sludges, sludge banks, and muds. No definite procedure can be given, but take every possible precaution to obtain a representative sample or one conforming to a sampling program.

Composite samples:

"In most cases, the term "composite sample" refers to a mixture of grab samples collected at the same sampling point at different times. Sometimes the term "time-composite" is used to distinguish this type of sample from others. Time-composite samples are most useful for observing average calculations that will be used, for example, in calculating the loading or the efficiency of a wastewater treatment plant. As an alternative to the separate analysis of a large number of samples, followed by computation of average and total results, composite samples represent a substantial saving in laboratory effort and expense.

"To evaluate the effects of special, variable, or irregular discharges and operations, collect composite samples representing the period during which such discharges occur.

"For determining components or characteristics subject to significant and unavoidable changes on storage, do not use composite samples. Make such determinations on individual samples as soon as possible after collection and preferably at the sampling point. Use time-composite samples only for determining components that can be demonstrated to remain unchanged under the conditions of sample collection and preservation.

"If preservatives are used, add them to the sample bottle initially so that all portions of the composite are preserved as soon as collected. Analysis of individual samples sometimes may be necessary.

"It is desirable, and often essential, to combine individual samples in volumes proportional to flow. A final sample volume of 2 to 3 L is sufficient for sewage, effluents, and wastes.

"Automatic sampling devices are available; however, do not use them unless the sample is preserved as described below. Clean sampling devices, including bottles, daily to eliminate biological growths and other deposits.

Integrated samples:

"For certain purposes, the information needed is provided best by analyzing mixtures of grab samples collected from different points simultaneously, or as nearly so as possible. Such mixtures sometimes are called integrated samples. An example of the need for such sampling occurs in a river or stream that varies in composition across its width and depth. To evaluate average composition or total loading, use a mixture of samples representing various points in the cross-section, in proportion to their relative flows.

"Both natural and artificial lakes show variations of composition with both depth and horizontal location. However, under many conditions, neither total nor average results are especially significant, local variations are more important. In such cases, examine samples separately rather than integrate them.

"Preparation of integrated samples usually requires special equipment to collect a sample from a known depth without contaminating it with overlying water. Knowledge of the volume, movement, and composition of the various parts of the water being sampled usually is required. Therefore, collecting integrated samples is a complicated and specialized process that cannot be described in detail.

D. Methods of Sampling

Manual sampling:

"Manual sampling involves no equipment but may be unduly costly and time-consuming for routine or large-scale sampling programs.

Automatic sampling:

"Automatic samplers are being used increasingly. They are effective and reliable and can increase significantly the frequency of sampling. Various devices are available but no one sampler is universally ideal. Consult manufacturer's specifications to select the sampler best suited to the need.

E. Quantity

"Collect a 2-L sample for most physical and chemical analyses. For certain determinations, larger samples may be necessary. Do not use the same sample for chemical, (organic and inorganic) bacteriological, and microscopic examinations because methods of collecting and handling are different.

F. Preservation

"Complete and unequivocal preservation of samples, whether domestic wastewater, industrial wastes, or natural waters, is a practical impossibility. Regardless of the sample nature, complete stability for every constituent can never be achieved. At best, preservation techniques only retard chemical and biological changes that inevitably continue after sample collection.

Nature of Sample Changes:

"Some determinations are more likely than others to be affected by sample storage before analysis. Certain cations are subject to loss by adsorption on, or ion exchange with, the walls of glass containers.

"Temperature changes quickly; pH may change significantly, in a matter of minutes dissolved gases (oxygen, carbon dioxide) may be lost. Determine temperature, pH, and dissolved gases in the field.

"Iron and manganese are readily soluble in their lower oxidation states but relatively insoluble in their higher oxidation states; therefore, these cations may precipitate out or they may dissolve from a sediment, depending upon the redox potential of the sample. Microbiological activity may be responsible for changes in the nitrate-nitrite-ammonia content, for decreases in phenol concentration and BOD, or for reducing sulfate to sulfide. Residual chlorine is reduced to chloride. Sulfide, sulfite, ferrous iron, iodine, and cyanide may be lost through oxidation. Color, odor, and turbidity may increase, decrease, or change in quality. Sodium, silica, and boron may be leached from the glass container. Hexavalent chromium may be reduced to chromic ion.

"Biological changes taking place in a sample may change the oxidation state of some constituents. Soluble constituents may be converted to organically bound materials in cell structures, or cell lysis may result in release of cellular material into solution. The well-known nitrogen and phosphorus cycles are examples of biological influences on sample composition.

"The foregoing discussion is by no means exhaustive and comprehensive. Clearly, it is impossible to prescribe absolute rules for preventing all possible changes. Additional advice will be found in the discussions under individual determinations, but to a large degree the dependability of an analytical determination rests on the experience and good judgment of the person collecting the sample.

Time interval between collection and analysis:

"In general, the shorter the time that elapses between collection of a sample and its analysis, the more reliable will be the analytical results. Changes caused by growth of microorganisms are greatly retarded by keeping the sample in the dark and at a temperature. When the interval between sample collection and analysis is long enough to produce changes in either the concentration or the physical state of the constituent to be measured, follow the preservation practices given.

"Record time elapsed between sampling and analysis, and which preservative, if any, was added."

Preservation methods:

Sample preservation is difficult because almost all preservatives interfere with some of the tests. Immediate analysis is ideal. Storage at low temperature (4°C) is perhaps the best way to preserve most samples until the next day. Use chemical preservatives only when they are shown not to interfere with the analysis being made. When they are used, add them to the sample bottle initially so that all sample portions are preserved as soon as collected.

"Methods of preservation are relatively limited and are intended generally to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce volatility of constituents.

"Preservation methods are limited to pH control, chemical addition, the use of amber and opaque bottles, refrigeration, and freezing.

"Clearly it is impossible to prescribe absolute rules for the preventing of all possible changes. Additional advice will be found in the discussions under individual determinations, but to a large degree the dependability of analytical determination rests on the experience and good judgment of the person collecting the sample."

II. SAMPLE CONTAINERS AVAILABLE FROM THE LABORATORY

The proper sample container along with preservative (when applicable) should be chosen for each parameter. Table I provides the sample container types and volumes for most of the required tests.

Table II lists the containers for each parameter and the preservatives in each.

III. ANALYSIS REQUEST FORMS AVAILABLE FROM THE LABORATORIES

Each sample submitted to the laboratory must be accompanied with a Request for Sample Analysis. The table below identifies these forms:

Northern Section:	
LAB-808 (7/92)	Request for Sample Analysis (General and Inorganic)
LAB-809 (7/92)	Request for Sample Analysis (Organic)
LAB-803 (12/92)	Request for Sample Analysis (Radiological)
LAB-N-807 (8/93)	Microbiological Determinations
LAB-801 (6/91)	Shellfish Determinations
Southern Section:	
SRLform26 (9/22/94)	Analysis Request Form (All analyses)

The sample collector must complete all pertinent information in the above forms. If the information is not complete, sample analysis cannot begin and may warrant recollection of the samples. Laboratories have listed the tests they perform only to help the sample collectors recall what the testing parameters are. Request only those tests that are essential for the particular objective. Selecting all tests within a category will not automatically result in their analyses. When questions remain, the laboratories will call sample collectors to verify analytical requests prior to analysis.

If chain-of-custody is required, the sample collector must initiate the process in the field at the time of sample collection.

California State Department of Health Services
Division of Drinking Water and Environmental Management—SRLB

Legend: Full = Full bottle G1/G2 = G1 or G2

Constituent	Type of Bottle	Required Volume (mL)	Constituent	Type of Bottle	Required Volume (mL)
Ammonia-Nitrogen	N	200	PCBs	E	Full
BOD	G2	Full	Pesticides	E	Full
BOD (for seed) Collect before chlorination	G1	100	Petroleum HC (TPH)	H	Full
			pH	G1/G2	25
BNA	E	Full	Phenol	P	Full
Boron (B)	G1/G2	50	Phenols, chlorinated	E	Full
BTEX	V/VT	Two full vials	Phosphate, ortho	M	100
Calcium (Ca)	G1/G2	200	Phosphate, total	M	200
Chloride	G1/G2	200	Potassium (K)	G1/G2	50
COD	N	100	Radiochemical	2 × G2	Full
Color	G1	100	Residual chlorine	R	200
Cyanide	C	Full	Settleable matter	G2	1000
EDB/DBCP	V	Two full vials	Sodium (Na)	G1/G2	50
Fluoride	G1	25	Specific conductance	G1/G2	200
General Mineral	G2	Full	Sulfate	G1/G2	50
Hardness	G1/G2	200	Sulfide	S	50
Herbicides	E	Full	Suspended solids	G1/G2	200
Iron (Fe)	G1/G2	50	TDS	G1/G2	200
Kjeldahl-Nitrogen	N	200	Total alkalinity including: Bicarbonate Carbonate Hydroxide	G1/G2	200
Magnesium (Mg)	G1/G2	50			
Manganese (Mn)	G1/G2	50			
MBAS	M	200	Total nitrogen	N	Full
Nitrate, Nitrate-N	N	50	Trace elements	T,t	Full
Nitrite, Nitrite-N	N	50	Turbidity	G1/G2	50
Odor	D	Full	Volatiles (Non-chlorinated)	V	Two full vials
Oil & Grease	O	1000			
Organic Nitrogen	N	200	Volatiles (Chlorinated)	VT	Two full vials

For solid samples such as soils, sediments and sludges, collect the sample in one container (bottle type: W) for any type of analyses.

Table I

INFORMATION ON USING THE SAMPLE CONTAINERS

l samples must be kept cool after sampling except for Trace Elements. Do not rinse the sample bottles before use.

Bottle Type	To be used in sampling for:	Preservative added:
B	Microbiological tests	Sodium thiosulfate
C	Cyanide	Sodium hydroxide
D	Odor	None
E	Extractables such as: BNA, EDB/DBCP, Herbicides, PCBs, pesticides	None (solvent washed)
G 1 (pint) G 2 (½ gallon)	(For general use) BOD, Boron, Color, General Mineral, Hexavalent Chromium, Settleable Solids, Specific Conductance, Sulfite, Suspended Solids, Turbidity.	None
H	Petroleum Hydrocarbons	Sulfuric acid
M	MBAS and Phosphate	None (HCl acid washed)
N	Nitrogens: Ammonia & Kjeldahl Nitrogen, Nitrate, Nitrite, Organic Nitrogen, Total Nitrogen, COD	Sulfuric acid
O	Oil & Grease	Sulfuric acid
P	Phenol	Sulfuric acid
R	Residual Chlorine (put in 200 mL only)	PAO and acetate buffer
S	Sulfide (only)	Zinc acetate and sodium hydroxide
T,t	Trace Elements Take two, one big and one small.	Nitric acid (big) None (small)
V	VOC for non-chlorinated water. Two vials for each sample site.	None (heated)
VT	VOC for chlorinated water. Take two vials for each sample site.	(heated); Sodium thiosulfate
W	Solid wastes: soil, sediments, sludge	None

For other types of analyses, please contact the laboratory.

eneral Mineral includes:
Total Alkalinity (Bicarbonate, Carbonate, Hydroxide), Calcium, Chloride, Fluoride, Total Hardness, Iron, Magnesium, Manganese, Nitrate, pH, Potassium, Sodium, Sulfate, Specific Conductance and TDS.

Trace Elements include:
Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Selenium (Se), Silver (Ag), Zinc (Zn).

Heavy Metals include:

Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Lead (Pb), Mercury (Hg), Selenium (Se), Silver (Ag).

Please avoid submitting samples for:	Microbiological tests	on Thursday and Friday.
	Residual Chlorine	on Friday (after 12:00 noon).
Please submit samples for:	BOD	by appointment only.

otes: If you know in advance that the samples contain high level of toxic or dangerous compounds *e.g.*, cyanide, sulfide, etc., please note on Analysis Request Form under "Warning"

Table II

IV. BIOLOGICAL SAMPLES AND DETERMINATIONS

Before collecting large numbers of samples, or for more information, communicate with the laboratory. In northern California, call Ray Bryant at (510) 540-2077 or Dr. Daniel C. Mills at (510) 540-2172 in the Microbial Diseases Laboratory. The laboratory's general number is (510) 540-2242. In southern California, call Bill Steeber in the Sanitation and Radiation Laboratory (South) at (213) 580-5739 or (213) 580-5795.

A. Coliform Group

Sample Bottle

The laboratory can provide prenumbered sterile four (4) oz. wide-mouth containers containing enough sodium thiosulfate to give a concentration of 100 mg/L of sample.

Collection of Samples

Care must be used to protect the sample from contamination. Permit only the water sample to contact the inside of the bottle and the bottle cap.

DO NOT RINSE OUT BOTTLE PRIOR TO FILLING.

To collect a sample other than from a tap, hold jar near the bottom, remove bottle cap; plunge jar mouth downward, to an appropriate depth moving hand and jar in a wide arc away from the body. If the water being sampled is flowing, direct the mouth of the jar against the flow.

To collect a sample from a tap, select a tap in frequent use and run the water for 2-3 minutes or until temperature has stabilized before filling the bottle. Avoid leaky taps since water flowing over the external surface of the tap may contaminate the sample.

About 1/4 to 1/2 inch of air space should be left above the sample.

Sample Identity:

Identify samples by filling out the report forms (Form LAB-807 (8-93)). Request dilutions and tubes per dilution required. Use same sample request form for determination of total coliform, fecal coliform (EC), fecal enterococci, and standard plate count. If fecal streptococci is requested, check appropriate box on slip and write in fecal strep.

Sample Transportation and Storage

Examine samples as soon as possible after collection. Not more than 30 hours may elapse between sampling and analysis. Thirty hours is acceptable for samples mailed from treatment systems; otherwise, 6 hours are specified in EPA's *Microbiological Methods*.

Keep samples at 1-4°C during storage, but do not freeze. Use reusable freezing gels in portable insulated box for cooling and shipping. Avoid using ice or dry ice.

Schedule sample collection with delivery services to minimize delays. Do not send samples by U.S. Mail without refrigeration.

B. Standard (Heterotrophic) Plate Count

Collect samples using same procedure and containers as for the coliform determination.

Not more than 6 hours may elapse between sampling and analysis.

C. Sewage-Swab Samples (for Salmonella) by Prior Arrangement with EMBS-MDL

Sampling Materials

- Bagged sterile swab with attached string.
- Sterile 8 oz bottle for transportation of swab.

Collection of Samples

Take care to protect the swab and the samples from contamination. Prepare sampling site for the swab; carefully remove the swab from the bag touching only the free end of the string, insert the swab into the flowing sewage, and securely fasten the free end of the string. After an appropriate period of time (1-5 days), carefully remove the swab from the sewage and place it in the sterile bottle.

Sample Transportation

With minimum delay ship directly to the Environmental Microbial Diseases Section - Microbial Diseases Laboratory (EMDS-MDL) in Berkeley. Refrigerate the sample in transit. (See IV.A above: *Sample Transportation and Storage.*)

D. Giardia and Cryptosporidium Samples

Large volume (400-4000 liters) sampling of water sources is required to achieve acceptable sensitivity for the detection of these parasites. Water is filtered through the 1 micron pore size cartridge filter using motorized or hand-driven pump.

Sample Size

Consult the EMDS-MDL for guidance in determining the volume of water to filter.

Submit the entire filter cartridge and water remaining in the filter housing in a clean, sturdy plastic bag. Store samples refrigerated until examined, usually within 72 hours.

E. Shellfish Samples for Bacteriological Analysis

Samples of shell stock and shucked but unfrozen shellfish must be examined within 6 hours after collection. Store frozen samples at less than 10°C, but never exceed 24 hours.

Shell stock samples should be collected in clean, dry containers. Provide 10-12 shellfish or a minimum weight of about 200 g of meat and shell liquor.

Shucked shellfish are preferably collected in the final container for retail sale.

F. Samples for Marine Biotoxin Analysis

Examine shellfish as soon as possible after collection. Shell stock may be collected in clean, plastic bags providing at least 150 g of meat. Shucked shellfish may be collected in the final container for retail sale.

Samples which cannot be analyzed promptly should be shucked, drained for 5 minutes and frozen. At least 15 to 20 individuals (150 g of meat) should be collected per sample. Analyses are made only in the EMDS-MDL in Berkeley.

See attachment 1 for more information on sampling.

G. Iron Bacteria

Any wide mouth bottle is suitable. The bottle need not be sterile. In collecting the sample include a significant amount of iron-containing slime. Use no preservative. The sample should be held no longer than 2 days.

H. Plankton

Sampling for plankton requires proper equipment and training. This is activity routinely performed by the Shellfish Biotoxin Section of the Environmental Management Branch. If you need information or assistance for plankton sampling contact that section.

V. GENERAL AND INORGANIC CHEMICAL DETERMINATIONS

Prior to collecting large numbers of samples, or unusual samples, make arrangements with the laboratory. Submit sufficient sample using appropriate containers for the test. Table I on page 8 summarizes containers and sample volumes for many common analytes. To conserve space, the table and the section below list only the most common analytes. The laboratory can answer questions about others.

Do not rinse sample bottles containing preservative—simply fill them. Completely and correctly fill in the "Request for Sample Analysis" forms, specifying the analyses desired. For further information about the analyses please contact Ms. Tina Parangalan (SRLB-North) at (510) 540-2751 or 2201, or Mr. Bill Steeber (SRLB-South) at (213) 580-5739.

Acidity and Alkalinity

Completely fill a 500 mL plastic (G1) bottle. Have the analysis done as soon as possible, preferably within one day after sample collection. Refrigerate sample during storage.

Aluminum

Collect 500 mL in a plastic bottle and analyze within 1 day. If the analysis is to be for soluble aluminum, filter the sample in the field through a membrane filter (0.45 μm pore diameter) and submit the filtrate for analysis.

Biochemical Oxygen Demand 5 days (BOD_5)

Because of rapid changes in the BOD, arrange for analysis the day the sample is collected. Collect 1/2 gallon in a (G2) plastic bottle, keep refrigerated, and do not add any preservatives. Indicate the expected BOD range in completing the report form.

Boron

Collect sample in 500 mL plastic (G1) bottles.

Carbon, Organic and/or Inorganic

Collect sample in 4 oz organic free glass bottle. Keep cool and analyze as soon as possible.

Chemical Oxygen Demand (COD)

The analysis should be made within seven days of collection and preservation. Use an N bottle, which already contains sulfuric acid as a preservative. Alternatively, samples should be refrigerated or may be preserved by acidifying with H_2SO_4 to pH 2.

Chlorine, Residual

If the laboratory will analyze the sample, collect in an **R** bottle, ice it, and submit it as soon as possible. Alternatively, analyze residual chlorine in the field, using field kits provided by the laboratory.

Chlorophyll

Collect sample in 500 mL plastic bottle. Submit to lab as soon after sampling as possible.

Chromium

New 500 mL plastic bottles should preferably be used to collect samples. This will minimize adsorption of the chromium on the surface. If hexavalent chromium is to be determined, the sample must be refrigerated and analyzed within 24 hours after collection. For total chromium, collect sample in 500 mL plastic bottle containing 0.8 mL reagent grade or higher purity HNO_3.

Color

Collect samples in 500 mL glass bottles and refrigerate at 4°C. Determination must be made within one day.

Cyanide

Cyanides are very unstable and should be analyzed as soon after sample collection as possible. Fill one (1) liter or larger plastic sample bottle completely, and if immediate analysis is not possible, preserve the sample by adding NaOH to raise the pH to 12 or more. (Usually 10 mL or 50% NaOH per 500 ml sample). A **C** bottle is available, which already contains the preservative.

Fluorescein (or Other Dye Tracers)

Collect in solvent-washed 500 mL glass bottle. Refrigerate and analyze on the same day as collected. A sample of the dye used should be submitted along with a sample of untreated water.

General Mineral Analysis: total dissolved solids, hardness, alkalinity, calcium, magnesium, iron, manganese, sodium, potassium, chloride, sulfate, fluoride, nitrate, pH and specific conductivity (as part of QC)

Collect ½ gallon in a glass or plastic container (**G2** bottle). Refrigerate and deliver to the laboratory as soon as possible or within 3 days. To sample for individual analytes in the group which are not covered specially in this section, use a plastic bottle without preservative (**G1** or **G2**). Observe the volume requirements listed in Table 1 (page 8) to ensure there is sufficient sample for *all* analytes.

Manganese

Because manganese is adsorbed on glass, delays between sampling and analysis should be eliminated. Collect sample in 500 mL plastic bottle, and add Suprapur® HNO_3 to pH 2. Preferably, use the **T** bottles, and sample as for metals, described below.

MBAS (Methylene Blue Active Substances) - Detergents

Collect sample in an **M** bottle, which has no preservatives, but has been specially cleaned. It is necessary to use a glass container of at least 500 mL capacity. Cool to 4°C.

Metals

The laboratory is capable of analyzing for a wide spectrum of metals. If requesting only metal analysis, the general procedure is to submit *two* containers. The actual analysis for metals will be done on the liquid in the **T** bottle, which contains nitric acid preservative. The smaller **t** bottle contains no preservative, and enables the analyst to evaluate the water for quality control purposes.

Metals, Heavy (Cobalt, Molybdenum, Titanium, Vanadium)

Serious errors can be introduced during sampling and storage. Allow samples to contact only acid-washed plastic. Collect sample in two **T** bottles (one large and one small). The large bottle contains nitric acid preservative. It is permissible to take sample in 500 mL plastic bottle and add 0.8 mL Suprapur® HNO_3.

Metals, Trace (Arsenic, Antimony, Barium, Beryllium, Cadmium, Copper, Iron, Lead, Nickel, Thallium, Zinc)

Sample collection is the same as the prior paragraph.

Nitrogen: Ammonia, Nitrate, Nitrite, and Organic Nitrogen

The form in which nitrogen appears can be changed by biological activity. Collect in an **N** bottle, which contains sulfuric acid preservative. Transport or store as close to 0°C as possible. Alternatively collect in a 1/2 gallon plastic bottle and add 1 mL concentrated H_2SO_4/L.

Odor (and Taste)

Collect sample by completely filling a clean and odor free 1 liter glass bottle (**D** bottle). Refrigerate. Analyze on the day collected.

Oil & Grease

Collect in an **O** bottle, which contains sulfuric acid preservative. Refrigerate and submit as soon as possible to the laboratory. Sludge samples may be preserved with 1 mL concentrated H_2SO_4 per 80 g of sludge. Acidified samples may be stored for 3 weeks under refrigeration.

Oxygen, Dissolved

Collect sample with minimal aeration. Completely fill the BOD bottle. Analyze in the field using kit appropriately calibrated according to manufacturer instructions. If the laboratory will do the analysis, the sample should be submitted without delay.

pH

Bring a refrigerated sample back to laboratory as soon as possible after collection. If possible make pH measurements in the field using pH meters available from the laboratory.

Phenol

Collect in **P** bottle, which contains sulfuric acid as a preservative. Cool the sample to 4°C for transport to the laboratory. If a **P** bottle is not available, and sampling is imperative, use a clean glass container, cool to 4°C, and deliver immediately to the laboratory.

Phosphate

Collect sample in an **M** bottle, which has no preservative. If soluble phosphates are to be differentiated, field-filter the sample through a membrane filter (0.45 μm pore diameter) and preserve by adding 2 mL of conc. H_2SO_4.

Silica

Collect samples in 500 mL plastic bottles. May be kept 3 weeks under refrigeration.

Sludge and Bottom Sediments

Analyses should be made as soon as possible. If stored, preserve by adding 5 g sodium benzoate or 1 mL concentrated H_2SO_4 per 80 g sample. Check first with laboratory for possible interferences and to schedule sampling. Four-oz bottles (subsection 2.1.2) are convenient for samples of this kind.

Solids, Settlable

Collect one half gallon in a container without preservative (G2 bottle). Cool to 4°C and deliver to the laboratory on the same day.

Solids, Suspended

Collect one half gallon in a container without preservative (**G2** bottle).

Sulfides

Collect 500 mL with minimal aeration in a plastic bottle. For dissolved sulfides determine in the field within 3 minutes of collection with a field kit suitably calibrated according to manufacturer instructions. Total sulfide samples must be preserved, and the laboratory provides **S** bottles for this purpose.

Temperature

Contact laboratory for calibrated thermometers to be used at the time of sample collection. Determine on site.

Turbidity

If the laboratory will perform the test, take sample in a 500 mL or larger plastic bottle, without preservative (**G1** or **G2** bottle), hold in the dark, and submit to the laboratory on the same day. Turbidity may be analyzed in the field. Determine turbidity in the field using a portable turbidimeter which the laboratory has calibrated.

VI. RADIOLOGICAL DETERMINATIONS

The Radiochemistry Unit of the Sanitation and Radiation Laboratories Branch-North (SRLB-N/RCU) serves a number of different clients. These include, but are not limited to, the Division of Drinking Water and Environmental Management (DDWEM), the Radiologic Health Branch (RHB), and the Environmental Management Branch (EMB). Considering the large number of programs which the laboratory supports, it is important to coordinate sample collection to best utilize the laboratory resources. Before sampling, the collector should contact Carolyn Wong in the laboratory at (510) 540-2209 or 2513 (8-571-2513). The sample collection must be scheduled so samples arrive at a time when the laboratory may accomodate them. The call also serves to request delivery of necessary sample collection supplies and to obtain additional information.

The laboratory maintains supplies of appropriate containers for each type of analysis carried out in this laboratory. Any supplies the collector needs can be obtained from the laboratory. They are sample containers, packing materials, shipping chests, labels, and Request for Sample Analysis (Form 803) forms.

General Procedures

Preauthorization to submit samples to the laboratory is required. All sample collection activities must be prearranged with the laboratory, with the exception of the following routine programs:

- Environmental samples from four nuclear power plants
- Water samples from special projects - Division of Drinking Water and Environmental Management
- Special project environmental samples - Low Level Radioactive Waste, Office of Radon, U.S. Department of Energy
- Performance evaluation and interlaboratory comparison study samples - U.S. EPA
- Quality assurance samples - SRL (blind, internal)

Sample collectors will wear disposable gloves to avoid sample contamination.

All tools, including trowels, forceps, etc., for manipulating samples must be either single-use and therefore disposed of directly, or cleaned of contamination by or adequately rinsing with detergent and deionized water and drying, and the waste disposed of properly.

Submit a Request for Sample Analysis (Form 803) with each sample. The name, address and telephone number of the person requesting the analysis should be filled in legibly in the appropriate box on the Request for Sample Analysis. Complete in full all of the boxes on the form that ask for the sampling site, sample type, analyses requested, collection date and time.

If the samples were taken from a contaminated area as indicated by a survey meter, report the survey meter measurements on the Request for Sample Analysis.

Clearly state any known hazardous components in a sample in the comment section on the Request for Sample Analysis. Examples of the hazardous components are medical wastes, sewage, radioactive ore, reclaimed water, carcinogens, sharp objects, etc.

Note any preservatives added to the samples on the Request for Sample Analysis.

Do not insert the Request for Sample Analysis form in the same bag or container as the sample. Instead, place it in a small Ziplock® bag by itself. Zip the bag closed and place in it in the same shipping box with the sample, but not in the sample bag or container. Place the self adhesive label with the R number, accompanying the Request for Sample analysis, on the sample container.

If the sample contains water, put the sample in an air-tight plastic container with a screw cap. Then place the container in a plastic bag to avoid leakage.

Tie plastic bags with twist ties, not with paper tape. Paper tape does not adhere adequately to the plastic bags and can come apart during transit.

Package the samples securely in a shipping box to withstand the rigor of transportation.

Since all samples may potentially end up as evidentiary material in a court of law, documentation for chain-of-custody is important. Proper chain-of-custody must be maintained from the time of sampling until the generation of laboratory report(s) to adequately support chain-of-custody for litigation purposes. The U.S. Postal Service is adequate for samples that do not require stringent chain-of-custody. If stringent chain-of-custody is required the collector should deliver the samples directly to the laboratory.

Package samples to be transported to meet the U.S. Department of Transportation guidelines specified in the Code of Federal Regulations. Common carriers the samples collectors deal with routinely may be used for sample transportation.

Ship or deliver the samples to the following address:

California State Department of Health Services
Sanitation & Radiation Laboratories - Radiochemistry Unit
2151 Berkeley Way, Room 119
Berkeley, Ca 94704-1011

The collector should call the laboratory at 510-540-2513 upon shipping the samples so that the laboratory can track the arrival of the samples. If the samples are not received in due time, the laboratory personnel can call the collector to apprise him of the problem.

The following table summarizes the volume requirements, preservatives and recommended transit times for radiological analytes. The specified volumes are required for the analysis itself and for routine quality control. The recommended transit time is the maximum time that should elapse between sampling and submission to the laboratory. Samples that exceed these times might not be analyzed. The laboratory may have to reject an analytical request depending on the radionuclide sought, the decay of short half-life radionuclides and/or sample spoilage.

Analysis	Volume	Container	Preservative	Recommended Transit Time
Gross α	0.5-3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
Gross ß	0.5-3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
Gross α/ß	0.5-3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
Gamma scan	3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
^{3}Hydrogen/^{14}Carbon	500 mL	Glass	None	3-5 days
^{89,90}Strontium	3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
^{131}Iodine	1-3.8 L	Plastic	None	3 days
^{226,228}Radium	3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
Natural Uranium-Radiometric	3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
Natural Uranium-Laser Phosphorimetry	100 mL	Plastic	Conc. HNO_3 to pH<2	3-5 days
Plutonium	1-3.8 L	Plastic	Conc. HNO_3 to pH<2	3-5 days
Radon	160 mL	French square bottles - glass	None	1 day

Table III

Procedures for Water

Gross Alpha and Gross Beta Analysis

Materials

- Request for Sample Analysis (Form 803)
- Plastic Bottle - 1 Liter (1 Quart) with cap or
- Cubitainer - 1 gallon polyethylene with cap
- Nitric Acid, 70% (conc.) - analytical grade

Sample Size - 1 Liter (1 Quart), 1 liter of sample is generally enough for gross alpha and gross beta analysis; however, if other analyses are required, a 1 gallon sample should be submitted.

Field Preservation - Add enough nitric acid (70%, conc.) to bring the sample to pH < 2 (2 ml nitric acid per liter is generally enough). Preserved samples may be held for 6 months. If nitric acid is not available in the field, ship the sample to the laboratory immediately.

Procedure - Collect a "representative" sample of the body of water under study. Preserve as above, and label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803).

Tritium and Carbon-14 Analysis

Materials

- Request for Sample analysis (Form 803)
- 250 mL Boston round glass bottle, with cap

Sample Size - 250 mL

Field Preservation - Do not add any preservatives to this sample. Ship the sample to the laboratory immediately.

Procedure - Collect a "representative" sample of the body of water under study. Label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803). A separate sample must be collected for tritium and carbon-14 analysis since adding nitric acid as a preservative would make it impossible to run these analyses.

Radon-222 Analysis

Materials

- Request for Sample Analysis (Form 803) and Labels - one for each duplicate sample set. A duplicate sample set consists of two (2) French square bottles (A,B) taken from the same sampling bucket.
- Small plastic bucket
- Tygon® tubing with sampling adapter(s)
- 6-oz. French Square bottle with rubber-lined cap.

Sample Size - Duplicate 6-oz samples taken from the same sampling bucket.

Field Preservation - Do not add any preservatives to this sample. Ship the sample to the laboratory immediately (The half-life of ^{222}Rn is 3.8 days).

Procedure

- Keep sample bottles cold, by making sure the ice pack is frozen and the box containing the bottles is stored away from the sun.
- Purge the system for 15 minutes to ensure collection of a water sample representative of the aquifer. This protocol is consistent with that for VOCs (AB 1803) and for the Division of Drinking Water and Environmental Management (DDWEM) proposed Monitoring Regulations.
- At sampling point attach a Tygon® tubing to port, faucet, tap, etc. using appropriate adapter as necessary. Direct delivery end to the bottom of the bucket and slowly run the water into the bucket for approximately 5 minutes. Discard the water in the bucket at least once and allow the water to overflow during the remainder of the sampling.
- Remove the bottle cap, and with the bottle in an upright position, carefully submerge the bottle and cap. Avoid agitating the water to minimize creation of bubbles. With the bottle underwater, insert the end of the tubing into the bottle and allow the water to exchange to assure a fresh sample. Remove the tubing and cap the bottle <u>tightly</u> while cap and bottle are both under water.
- After removing the capped bottle from the bucket, invert the bottle and check to see if any bubbles are present. If bubbles are present, empty the bottle and start this sample collection procedure over. <u>Collect at least two separate samples (duplicates) from the same sampling bucket.</u>
- Wipe bottles thoroughly, tape the cap with electrical tape in a clockwise direction (the same way the cap screws on), and attach an identification label to each dry bottle. Fill in the Request for Sample Analysis (Form 803) completely. Due to the short half-life of radon ($_{86}Rn^{222}$ $t_{1/2}$ = 3.8 d), it is essential that the <u>date and time</u> of collection be exact.
- Return the samples and any empty bottles with the frozen ice pack to the laboratory by overnight carrier.

Gamma Analysis (for water when gross β > 50 pCi/L)

Materials

- Request for Sample Analysis (Form 803)
- Plastic Bottle - 2 Liter (2 Quart) with cap or
- Cubitainer - 1 gallon polyethylene with cap
- Nitric Acid, 70% (conc.) - analytical grade

Sample Size - 2 Liters (2 Quarts), 2 liters of sample is generally enough for gamma analysis, however if other analyses are required, submit a 1 gallon sample.

Field Preservation - Add enough nitric acid (70%, conc.) to bring the sample to pH < 2 (2 ml nitric acid per liter is generally enough). Preserved samples may be held for 6 months. If nitric acid is not available in the field, ship the sample to the laboratory immediately.

Procedure - Collect a "representative" sample of the body of water under study. Preserve as above, and label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803).

Radiochemical Analysis (Uranium, Radium and Strontium)

Materials

- Request for Sample Analysis (Form 803)
- Cubitainer - 1 gallon polyethylene with cap
- Nitric Acid, 70% (conc.)- analytical grade

Sample Size - 3.8 Liters (1 Gallon)

Field Preservation - Add enough nitric acid (70%, conc.) to bring the sample to pH < 2 (2 ml nitric acid per liter is generally enough). Preserved samples may be held for 6 months. If nitric acid is not available in the field, ship the sample to the laboratory immediately.

Procedure - Collect a "representative" sample of the body of water under study. Preserve as above, and label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803).

Procedure for Sewage Effluent

Gross Alpha and Gross Beta Analysis

Materials

- Request for Sample Analysis (Form 803)
- Plastic Bottle - 500 ml (1 Pint) with cap or
- Cubitainer - 1 gallon polyethylene with cap

Sample Size - 500 ml (1 Pint), 500 ml of sample is generally enough for gross alpha and gross beta analysis; however, if other analyses are required, submit a 1 gallon sample.

Field Preservation - Do not add preservatives to these samples. If possible keep the samples refrigerated to prevent undue decomposition. Ship the samples to the laboratory immediately.

Procedure - Collect a "representative" sample of the body of water under study. Label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803).

Gamma Analysis

Materials

- Request for Sample Analysis (Form 803)
- Plastic Bottle - 2 Liter (2 Quart) with cap or
- Cubitainer - 1 gallon polyethylene with cap

Sample Size - 2 Liters (2 Quarts), 2 liters of sample is generally enough for gamma analysis; however, if other analyses are required, submit a 1 gallon sample.

Field Preservation - Do not add preservatives to these samples. If possible, keep the samples refrigerated to prevent undue decomposition. Ship the samples to the laboratory immediately.

Procedure - Collect a "representative" sample of the body of water under study. Label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803).

Radiochemical Analysis

Materials

- Request for Sample Analysis (Form 803)
- Cubitainer - 1 gallon polyethylene with cap

Sample Size - 3.8 Liters (1 Gallon)

Field Preservation - Do not add preservatives to these samples. If possible, keep the samples refrigerated to prevent undue decomposition. Ship the samples to the laboratory immediately.

Procedure - Collect a "representative" sample of the body of water under study. Label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803).

Procedure for Sewage Sludge

Gross Alpha and Gross Beta Analysis

Materials

- Request for Sample Analysis (Form 803)
- Plastic Specimen Container - 100 ml

Sample Size - 75 ml

Field Preservation - Do not add preservatives to these samples. If possible, keep the samples refrigerated to prevent undue decomposition. Ship the samples to the laboratory immediately.

Procedure - Fill the plastic specimen container 3/4 full with a "representative" sample. Label with the sample control number, location, date and time of collection. Complete the Request for Sample Analysis (Form 803).

Gamma Analysis

Gamma analyses are performed on the same sample as for gross alpha and beta.

Radiochemical Analysis

Not generally performed on these samples.

VII. SAMPLING FOR ORGANICS ANALYSIS

Prior to collecting large numbers of samples, or unusual samples, make arrangements with the laboratory. Use the containers indicated for the test. Completely and correctly fill in the "Request for Sample Analysis" forms, specifying the analyses desired. If you have any questions about the analyses please contact Dr. Bill Draper (510) 540-2201 or 3050 (SRLB-North) or Mr. Bill Steeber (213) 580-5739 (SRLB-South).

Various processes can change the organic chemicals in sampled water before the laboratory analyzes it. **Chemical processes** include hydrolysis and autoxidation and may be very rapid for some compounds. Examples include carbamate and phosphate hydrolysis, disulfoton and aldicarb oxidation. Halogenated compounds are subject to dehydrohalogenation. Oxidants used for disinfection not only sterilize the water, but may also react with dissolved organics to form other compounds. **Photochemical processes** break down compounds like metam-sodium, PAH or trifluralin when the sample is exposed to sunlight. **Microbiological metabolism** may decompose some organics, especially aromatics and unsaturated compounds. **Volatilization** is the loss of compounds from the water to the air, sometimes rapidly.

In devising a sampling protocol, the above issues must be taken into account. There are several ways to ensure that water samples change minimally before submission to the laboratory. These include keeping the sample cold (usually 4°C), getting the samples to the laboratory quickly, adjusting the pH, protecting the sample from sunlight (use brown bottles), removing oxidants by adding reducing agents like sodium thiosulfate, ascorbic acid or ammonium chloride.

General Sampling Procedure

In general, organic chemicals dissolved in water can be grouped into two classes. One group is the purgable compounds, substances which may be volatilized from the water. The non-purgables include base/neutral and acid extractables, organochlorine pesticides, other pesticides, like carbamates, and PCBs. In either case, sample should be taken from a tap at the well head prior to any treatment or storage. The well must be pumped for at least 15 minutes before sampling. Open the sampling tap and allow the water to run until the temperature is stable. Adjust the flow to about 500 mL/minute and collect samples as outlined below.

Sampling VOCs

Of utmost importance are proper collection of the sample, keeping the sample cool in an ice chest, and quick delivery to the laboratory.

To minimize change in the sample, a preservative may be added to the sample. There are two main types of preservative. To remove residual chlorine that may be present in treated samples, use a reducing agent like ascorbic acid or sodium thiosulfate. The reducing agent must be present in the sample container before sampling.

The other kind of preservative prevents biological degradation of the sample. For this purpose, the EPA specifies the use of hydrochloric acid as a biocide. Addition of HCl must be done after sampling, because otherwise it may react with the reducing agent. Use care adding the preservative. It is very corrosive to both person and property. There is also some potential for contamination through excessive handling of the sample.

To sample for VOCs, use the laboratory-provided VOC vials (there may be either clear or amber vials labeled **VC** and **VA**, respectively). Follow these steps while taking the sample:

- All samples are to be taken in duplicate.
- If samples are to be analyzed for THMs and/or are suspected to contain residual chlorine, make sure that a reducing agent is present in the laboratory-provided vial. Or add 25 mg of ascorbic acid or 3 mg of sodium sulfite per 40 mL of sample to all sample bottles before the samples are collected.
- Fill the bottles just to overflowing, being careful not to flush out the rapidly dissolving reducing agent.
- If the samples are to be analyzed for VOCs, they may preserved by adding one drop of 1:1 HCl per 20 mL of sample to the already full sample bottles.
- Seal the sample bottles, making sure the Teflon® side of the septum faces toward the sample. Shake the sample vigorously for one minute. Invert the sample and observe whether any air bubbles are trapped in it. If bubbles are apparent, the sample is invalid and a new one must be collected.
- Immediately cool the samples to 4°C. Samples must be stored at this temperature in an area free from any organic solvent vapors until analysis. Holding times vary by method.
- By the time the sample arrives at the lab, a small bubble may have developed. As long as this is no larger than a pea, the sample may be considered valid.

The methods used by the laboratory to examine the sample are extremely sensitive. The levels of organic compounds typically in the low parts per billion may easily be obscured by contaminants. To avoid artifacts (contamination) during and after sampling, bear in mind the following:

- Use appropriate containers and closures.
- Use properly cleaned, rinsed and dried containers.
- Store samples (especially VOAs) away from solvents, gasoline, etc.
- Store drinking water samples separate from waste samples.
- Avoid rubber and plastic tubing (i.e., Tygon®), plastic containers and inappropriate cap liners.
- Avoid unnecessary handling of samples with plastic gloves.

Sampling Other Organics

Non-purgeables (EPA Method 504)

Collect samples in 40 mL vials containing 3 mg sodium thiosulfate. Cap bottles with Teflon®-lined cap. Samples must be refrigerated at 4°C from the time of collection and analyzed within 28 days.

Organohalogen Pesticides and Aroclors (EPA Method 505)

Collect sample in 40 mL vials containing 3 mg sodium thiosulfate. Cap bottle with Teflon®-lined cap. Samples must be refrigerated at 4°C from the time of collection and analyzed within 14 days. See Method.

*Other Pesticides (EPA Methods 507, 508, *508A, 515.1, 531.1)*

The sampling, preservation, and storage conditions for agricultural chemicals and pesticides shall be: to collect samples in one (1) liter amber bottles; fill bottle so that the headspace is no greater than the threaded portion of the neck; cap bottle with Teflon®-lined cap and refrigerate at 4°C from time of collection. The EPA specifies an exception for carbamates like Aldicarb. Acceptable holding time maxima for extraction and analytical stages vary for analytes and methods.

Carbamates: The EPA considers this class of compound very labile, subject to rapid degradation. To protect the sample, they specify pH adjustment, buffering, and freezing the sample. Before sampling for carbamates, call the laboratory for specific instructions.

(GC/MS) Base/Neutrals, Acids and Pesticides (EPA Method 525)

Keep samples iced or refrigerated at 4°C from the time of collection until extraction. Protect sample from light. All samples must be extracted within seven days and completely analyzed within 30 days of extraction.

Organics - General (Grease, Petrochemicals, Petroleum, etc.)

For water where there is little or no visible pollution, collect two one liter samples in a solvent-washed amber glass bottle with a solvent washed, Teflon® lined cap. Plastic gloves, rubber or plastic materials, oils, waxes or other products can contaminate water samples and give misleading test results.

Samples taken for organic analysis should not contact anything but the clean sample bottle. Keep samples cool and deliver to the laboratory as soon as possible. When appropriate, collect small samples of reference materials in 1 or 2 oz solvent-washed jars to facilitate the analytical work but be very careful to avoid contaminating the sample.

The following table contains information excerpted from EPA documents, and details sampling guidelines for organics analysis.

Test Method		Sample Container	Volume Needed	Preservative/ Comment
502.2 524.2 503 624	Volatile organics Volatile organics Volatile aromatics Volatiles (Wastewater)	40 mL VOA	40 mL	a, b, c, n
504	EDB/DBCP	40 mL VOA	40 mL	a, b, c, n
505	Chlorinated Pesticides/PCBs	40 mL VOA	40 mL	a, b, d
551	Chlorinated DBP	40 mL VOA	40 mL	l, b
m-8015	TPH-Gasoline (& BTEX)	40 mL VOA	40 mL	
507 508	N- & P-Pesticides Chlorinated Pesticides	1 L glass	1 L	b, e, f, g, h
509	ETU	60 mL glass	50 mL	b, d
515.2	Chlorinated Acid	1 L glass	50 mL	b, e, h, i, j
525.1 625	Semivolatiles Semivolatiles (Wastewater)	1 L glass	1 L	b, e, i, j, h
531.1	Carbamate Pesticides	60 mL glass	1 L	b, j
547	Glyphosate	60 mL glass	60 mL	b, h, k
548.1	Endothall	1 L glass	1 L	b, e, h, i, j
549.1	Diquat/paraquat	1 L amber PVC or silanized glass	1 L	b, h ,i, k
552.1	Haloacetic acids	1 L glass	1 L	b, d, h, m
555	Chlorinated acids	1 L glass	1 L	b, h, i, j, p
418.1 or m-8015	TPH-Diesel & Motor oil	1 L glass	1 L	

Table IV

Keys to the preservatives and comments column in Table IV:

a Remove residual chlorine with sodium thiosulfate or ascorbic acid.
b Store and transport at 4°C.
c Adjust to pH<2 by adding 1 drop of 1:1 HCl.
d VOA vial should be dried in a 400°C oven.
e If residual chlorine is present, add 80 mg of sodium thiosulfate.
f 1.0 mL of 10 mg/mL HgCl has been added as a bactericide, but SRLB does not recommend use of this preservative. Some of the method analytes (507, 508) are unstable regardless of the preservation technique and therefore samples should be analyzed immediately.
g Prerinse bottle with sample.
h Avoid light during storage.
i Add 1:1 HCl at the time of sampling to obtain pH<2.
j Do not prerinse bottle with sample.
k Add 100 mg/L sodium thiosulfate (6 mg/60 mL).
l Method 551 analyzes for THMs, halogenated solvents, and additional organic DBP. Appropriate preservation varies depending on the analytes of interest: THMs follow generic sampling procedure except dechlorinate by adding 4 mg of sodium thiosulfate, sodium thiosulfite, or ammonium chloride, or 25 mg of ascorbic acid; to determine all DBP use ammonium chloride. Ammonium chloride preservation, however, requires sample acidification—before sampling you must determine the amount of 0.2N HCl required to adjust the sample pH to 4.5-5 by dropwise addition to 40 mL of the water (with the ammonium chloride) in a 100 mL beaker. If recoveries of chloral hydrate are low in the water studied, preserve with 100 mg/L sodium sulfite or 625 mg/L ascorbic acid.
m Add 100 mg/L ammonium chloride.
n Generic VOC sampling procedure and general precautions: Collect all samples in duplicate in 40 mL VOA vials, a travel blank is required for each sampling site, if the water contains residual chlorine destroy it by adding 25 mg of ascorbic acid or 3 mg of sodium thiosulfate before filling. Don't use thiosulfate where fixed gases are being determined as it can interfere. Fill the bottles slowly to just overflowing, but take care not to flush out the reducing agent. Adjust the pH to <2 by adding 1 drop of 1:1 HCl, seal the vial with PTFE side down, mix vigorously for 1 min. Store at 4°C prior to analysis. Alway store samples with their respective travel blank, never store near solvents, motor fuel or highly contaminated samples. The VOA vials (and septum caps) should be washed with detergent and rinsed with tap and distilled water, air dried and then place in an oven for 1 hr. Cool vial in an area free of organic solvents.
o Add 1.8 mL monochloroacetic acid buffer. To remove residual chlorine add 5 mg of sodium thiosulfate.
p To remove residual chlorine add 5 mg of sodium sulfite/100 mL.

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APPENDIX E

PROTECTION OF WATER RIGHTS WHEN RECYCLED WATER IS SUBSTITUTED FOR AN EXISTING WATER SUPPLY

Recycled Water and Water Rights Summary

Will My Water Rights Be Affected By Using Recycled Water?

Several sections of the California Water Code (Water Code) confirm that existing **water rights are not lost, reduced or affected by when the water-right holder uses recycled water instead of using the supply under his water right.** Below are summaries of these Water Code Sections:

Water Code Section 1010

The cessation of or reduction in the use of water under any existing water right as a result of the use recycled water is deemed equivalent to a reasonable beneficial use of the same amount of water under the existing water right. Accordingly, no existing water right will be reduced or lost to the extent that recycled water is used instead of water under the existing water right. Further, the use of recycled water in lieu of surface water is equivalent to maintaining that right and shall constitute beneficial use.

Water Code Section 13050

"Recycled water" means water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.

Water Code Section 13550

Certain conditions must be met before the State Water Resources Control Board (SWRCB) can require a right holder to accept recycled water. The recycled water must be of adequate quality for the purposes for which it will be used, be furnished at a reasonable cost to the water user, not be detrimental to public health, and not adversely affect downstream water rights or the environment. The SWRCB is responsible for making a determination on each of these conditions and may not require such use until after proper notice and opportunity for a hearing.

Water Code Section 13551

Potable water shall not be used for nonpotable uses if suitable recycled water is available. The use of recycled water constitutes beneficial use under any existing water right.

Reporting Use of Recycled Water

When the holder of an appropriative water-right permit or license uses recycled water in lieu of diverting and using water under his appropriative water right, he should report the amount of such recycled water use in the annual permittee progress reports or triennial license reports that he files with the SWRCB. Otherwise, he may not claim the benefits of the above statutes.

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8534-1

July 25, 2007

Mr. Randy D. Poole
General Manager/Chief Engineer
Sonoma County Water Agency
P.O. Box 11628
Santa Rosa, California 95406

Re: Protection of Water Rights When Recycled Water Is Substituted For An Existing Water Supply

Dear Randy:

Jay Jasperse recently asked me to prepare a letter to you discussing the legal protections for water users with existing water rights that decide to substitute recycled water for some or all of their existing water supplies. This letter responds to that request.

For the reasons discussed in this letter, the water rights of a water user that receives and uses recycled water in lieu of continuing to use water under his own water rights normally will be protected to the same extent that these rights would have been protected if the water user had continued to use water under his own water rights.

DISCUSSION

1. Water Code Section 1010

A copy of Water Code section 1010 is enclosed. Subdivision (a)(1) of this statute provides that, if the holder of any existing water right ceases to use his own water right, or reduces his use of his own water right, by instead using recycled water, then the use of recycled water will, for water-right purposes, be treated the same as if the water user had used the same amount of water under his own water right. Subdivision (a)(2) confirms that this rule applies to issues regarding lapse, reduction or loss of any existing water right. Subdivision (a)(3) confirms that this rule applies to issues regarding petitions under Water Code section 1398 for extensions of the deadlines in water-right permits to apply water to beneficial use. Subdivision (a)(4) confirms that this rule applies to the licensing of appropriative rights.

Subdivision (a) (5) states an important qualification to this rule. To obtain the protections of this statute, a water user that uses recycled water in lieu of using water under his own water right must file any statements required by the State Water Resources Control Board to describe the

amounts of recycled water that were used in lieu of water under the water user's own water rights. The SWRCB's forms for permittee progress reports, licensee reports and statements of water diversion and use (which are used for riparian and pre-1914 appropriative rights) all contain blanks for this information. To obtain the protections of Water Code section 1010, the water user must provide the appropriate information in these blanks, provide the other information requested in the forms, and file the forms with the SWRCB.

2. Water Code Section 13551

A copy of Water Code section 13551 is enclosed. The first part of this statute prohibits any person or public agency from using potable water for nonpotable uses, including irrigation uses, if suitable recycled water is available. The second part of this statute provides that such use of recycled water in lieu of using potable water shall be deemed to be a reasonable and beneficial use of the potable water that was not used, and that the use of recycled water in lieu of using potable water shall not cause any loss or diminution of any existing water right.

3. Water Code Sections 1005.1 and 1005.4

Water Code sections 1005.1 and 1005.4 contain additional protections for users of groundwater (including both percolating groundwater and groundwater flowing through known and definite channels) that cease or reduce their uses of groundwater because they instead are using water from an alternative supply like recycled water, so long as the recycled water is derived from water imported into the watershed. Copies of Water Code sections 1005.1 and 1005.4 are enclosed.

Water Code sections 1005.1, subdivision (a) provides that a water user that normally uses groundwater may instead use water from an "alternate supply of water from a nontributary source," and that such use of water then will, for water-right purposes, be treated as if the water user had continued to use the same amount of groundwater under his own right. This statute defines "nontributary source" to include "water imported from another watershed." This statute requires the water user to file annual reports with the SWRCB describing the amount of recycled water that was used instead of groundwater. Water Code section 1005.4 contains similar provisions, except that the reporting requirements are optional.

These statutes provide additional protections for groundwater users in areas like the Sonoma Valley that are not in the Russian River watershed. For these water users, recycled water derived from Russian River water would be "water from a nontributary source," so the cessation or reduction in groundwater pumping because of the use of such recycled water would be subject to the protections in sections 1005.1 and 1005.4.

A copy of the SWRCB's June 1991 publication, "Cessation or Reduction in Ground Water Extractions," which discusses these statutes and contains the reporting form for them, is enclosed.

CONCLUSION

For the reasons discussed in this letter, the rights of a water user that starts using recycled water in lieu of continuing to use water under his own water rights normally will be protected to the extent of the use of recycled water. However, additional details and issues may arise in connection with any specific substitution of recycled water for water from another supply. I would be glad to discuss specific situations with you and your staff as they arise.

Very truly yours,

ALAN B. LILLY

ABL:tmo
Encls.
cc w/encls.: Jill D. Golis, Deputy County Counsel
Jay Jasperse, Deputy Chief Engineer

§ 1010. Use of recycled, desalinated or polluted water as beneficial use; lapse, reduction or loss of rights; extension of permit; periodic reports; transfer of water or water rights

(a)(1) The cessation of, or reduction in, the use of water under any existing right regardless of the basis of right, as the result of the use of recycled water, desalinated water, or water polluted by waste to a degree which unreasonably affects the water for other beneficial uses, is deemed equivalent to, and for purposes of maintaining any right shall be construed to constitute, a reasonable beneficial use of water to the extent and in the amount that the recycled, desalinated, or polluted water is being used not exceeding, however, the amount of such reduction.

(2) No lapse, reduction, or loss of any existing right shall occur under a cessation of, or reduction in, the use of water pursuant to this subdivision, and, to the extent and in the amount that recycled, desalinated, or polluted water is used in lieu of water appropriated by a permittee pursuant to Chapter 6 (commencing with Section 1375) of Part 2, the board shall not reduce the appropriation authorized in the user's permit.

(3) The use of recycled, desalinated, or polluted water constitutes good cause under Section 1398 to extend the period specified in a permit for application of appropriated water to beneficial use to the extent and in the amount that recycled, desalinated, or polluted water is used. The extension by the board shall be granted upon the same terms as are set forth in the user's permit, and for a period sufficient to enable the permittee to perfect his appropriation, while continuing to use recycled, desalinated, or polluted water.

(4) The board, in issuing a license pursuant to Article 3 (commencing with Section 1610) of Chapter 9 of Part 2, shall not reduce the appropriation authorized by permit, to the extent and in the amount that reduction in a permittee's use, during the perfection period, including any extension as provided in this section, has resulted from the use of recycled, desalinated, or polluted water in lieu of the permittee's authorized appropriation.

(5) The board may require any user of water who seeks the benefit of this section to file periodic reports describing the extent and amount of the use of recycled, desalinated, or polluted water. To the maximum extent possible, the reports shall be made a part of other reports required by the board relating to the use of water.

(6) For purposes of this section, the term "recycled water" has the same meaning as in Division 7 (commencing with Section 13000).

(b) Water, or the right to the use of water, the use of which has ceased or been reduced as the result of the use of recycled, desalinated, or polluted water as described in subdivision (a), may be sold, leased, exchanged, or otherwise transferred pursuant to any provision of law relating to the transfer of water or water rights, including, but not limited to, provisions of law governing any change in point of diversion, place of use, and purpose of use due to the transfer. *(Added by Stats.1977, c. 1117, p. 3589, § 1, eff. Sept. 28, 1977. Amended by Stats.1978, c. 608, p. 2047, § 1; Stats.1982, c. 867, p. 3222, § 3; Stats.1991, c. 1161 (A.B.2207), § 1; Stats.1995, c. 28 (A.B.1247), § 12.)*

§ 13551. Nonpotable, industrial and irrigation uses of potable water prohibited; use of recycled water

A person or public agency, including a state agency, city, county, city and county, district, or any other political subdivision of the state, shall not use water from any source of quality suitable for potable domestic use for nonpotable uses, including cemeteries, golf courses, parks, highway landscaped areas, and industrial and irrigation uses if suitable recycled water is available as provided in Section 13550; however, any use of recycled water in lieu of water suitable for potable domestic use shall, to the extent of the recycled water so used, be deemed to constitute a reasonable beneficial use of that water and the use of recycled water shall not cause any loss or diminution of any existing water right. *(Added by Stats.1977, c. 1032, p. 3090, § 1, eff. Sept. 23, 1977. Amended by Stats.1978, c. 894, p. 2822, § 2, eff. Sept. 20, 1978; Stats.1991, c. 553 (A.B.174), § 2; Stats.1995, c. 28 (A.B.1247), § 40.)*

§ 1005.1. Ground water; cessation or reduction in extraction; alternate supply; reasonable beneficial use; statement of amount used; definitions

Cessation of or reduction in the extraction of ground water by the owner of a right to extract, as the result of the use of an alternate supply of water from a nontributary source, shall be and is deemed equivalent to, and for purposes of establishing and maintaining any right to extract the ground water shall be construed to constitute, a reasonable beneficial use of the ground water to the extent and in the amount that water from the alternate source is applied to reasonable beneficial use, not exceeding, however, the amount of such reduction. Any such user of water from an alternate nontributary source who seeks the benefit of this section , shall file with the board, on or before December 31st of each calendar year, a statement of the amount of water from such source so applied to reasonable beneficial use pursuant to the provisions of this section during the next preceding water year (November 1st to October 31st), and such user cannot claim the benefit of this section for any water year for which such statement is not so filed.

"Ground water," for the purpose of this section and of Sections 1005.2 and 1005.4, means water beneath the surface of the ground, whether or not flowing through known and definite channels.

The term "nontributary source," as used in this section, shall be deemed to include water imported from another watershed, or water conserved and saved in the watershed by a water conservation plan or works without which such water of the same watershed would have wasted, or would not have reached the underground source of supply of the owner relying upon this section. *(Added by Stats.1951, c. 1361, p. 3275, § 1, eff. July 9, 1951. Amended by Stats.1955, c. 1887, p. 3488, § 1; Stats.1957, c. 1932, p. 3375, § 39; Stats.1972, c. 274, p. 549, § 1; Stats.1976, c. 581, p. 1419, § 1.)*

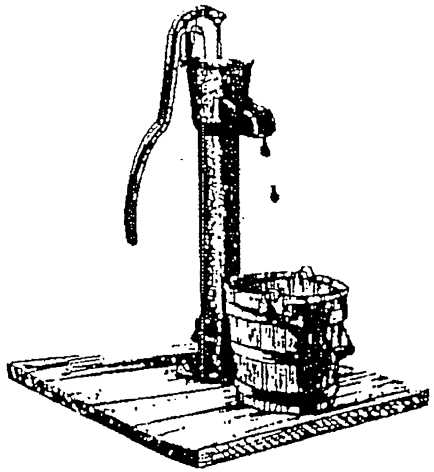
§ 1005.4. Ground water; cessation or reduction in extraction; alternate nontributary source; reasonable beneficial use; statement of reduction amount; applicability; definition

(a) Cessation of or reduction in the extraction of ground water, to permit the replenishment of such ground water by the use of water from an alternate nontributary source, is hereby declared to be a reasonable beneficial use of the ground water to the extent and in the amount that water from such alternate source is applied to beneficial use, not exceeding, however, the amount of such reduction. No lapse, reduction or loss of any right in ground water, shall occur under such conditions.

(b) Any such user of water from an alternative source may file with the board, on or before December 31st of each calendar year, a statement of the amount of reduction in the extraction of groundwater as a result of water from the alternative source having been so applied to reasonable beneficial use during the next preceding water year (October 1st to September 30th) to permit replenishment of such groundwater. However, failure to file such a statement shall in no way affect the right of a user to claim the benefit of this section.

(c) The provisions of this section apply only as to the cessation of, or reduction in, the extraction of ground water within that area in this state defined by the exterior boundaries of every county, except the Counties of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, San Diego, Imperial, Riverside, and San Bernardino.

(d) The term "nontributary source," as used in this section, shall be deemed to include water imported from another watershed or water conserved and saved in the watershed by a water conservation plan or works without which such water of the same watershed would have wasted, or would not have reached the underground source of supply of the owner relying upon this section. *(Added by Stats.1976, c. 581, p. 1418, § 2. Amended by Stats.1977, c. 12, p. 20, § 1, eff. March 21, 1977; Stats. 1981, c. 567, p. 2224, § 1, eff. Sept. 10, 1981.)*



Water Code Sections and Information Relating to

Cessation or Reduction in Ground Water Extractions

91-5 WR

June 1991

STATE OF CALIFORNIA
WATER RESOURCES CONTROL BOARD

BRC0013-2

STATE OF CALIFORNIA
Pete Wilson, Governor

STATE WATER RESOURCES CONTROL BOARD
P.O. Box 2000
Sacramento, CA 95812-2000
(916) 322-4503

W. Don Maughan, Chairman
Edwin H. Finster, Vice Chairman
Eliseo Samaniego, Member
John Caffrey, Member

Walt Pettit, Executive Director

Cover:
Drops indicate cessation or reduction that is being recorded.

Source:
Division of Water Rights

To reorder this publication refer to publication:
91-5 WR Cessation or Reduction in Ground Water Extractions

Cessation or Recordation in Ground Water Extractions

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General Information

State law provides a means for owners of rights to pump ground water to protect these rights when they substitute water from an alternate nontributary source for previously pumped ground water. Before the passage of the statutes, many ground water pumpers in overdrawn and depleted basins were reluctant to reduce pumping and substitute other water for fear of losing their rights to the ground water.

To qualify, a water user must have at one time pumped ground water under some claim of right and put it to beneficial use and subsequently to have reduced or ceased pumping such water and substituted water from a different source, such as imported water or water released from storage reservoirs.

Sections 1005.1 and 1005.2 of the California Water Code apply only to the counties of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, San Diego, Imperial, Riverside, and San Bernardino. Section 1005.3 applies to specific water basins, and Section 1005.4 applies to the remaining counties in California.

Chapter I Description of the Program

Ground Water users who wish to avail themselves of the water right protection, provided under California Water Code Sections 1000. through 1005.4, must file a first statement on prescribed form (Form 60-B) with the State Water Resources Control Board. Those groundwater users who maintain good groundwater extractions and use records should have no difficulty in filing the form. When groundwater is used for agricultural irrigation purposes, item 6 of the form (Form 60-B) may be helpful to estimate total extractions.

After the first statement is filed on Form 60-B, subsequent statements may be filed on the shorter annual statement form (Form 60-C). **These annual statements must be filed by December 31st of each year.**

Sections of the Water Code applicable to the cessation and reduction in ground water extractions are provided in this brochure for your information.

Chapter II
Water Code Sections

Division 2. Water, Part 1. General Provisions
Chapter 1. Definitions and Interpretation of Division

1000.
As used in this division, *"water"* includes the term "use of water".

1001.
Nothing in this division shall be construed as giving or confirming any right, title, or interest to or in the corpus of any water.

1002.
This division shall not be held to bestow upon any person, except as expressly provided in it, any right where no such right existed prior to the time this division takes effect.

1003.
As used in this division, *"Water Commission Act"* means Chapter 586, Statutes of 1913, as amended.

1003.5
As used in this division, *"board"* means the State Water Resources Control Board.

1004.
As used in this division, *"useful or beneficial purposes"* shall not be construed to mean the use in any one year of more than 2 1/2 acre-feet of water per acre in the irrigation of uncultivated areas of land not devoted to cultivated crops.

1005.
Nothing in this division shall be construed as depriving any city, city and county, municipal water district, irrigation district, or lighting district of the benefit of any law heretofore or hereafter passed for their benefit in regard to the appropriation or acquisition of water. Any right to the water of any stream which flows along a boundary of the State and which is the subject of an interstate compact to which the State is a party, to the extent such right relates to quantities of water which the United States has, under the authority of an act of Congress, contracted to deliver to any municipal corporation, political subdivision, or public district in the State, from storage constructed by the United States on any such stream, shall not be subject to any requirement or limitation provided by law relating to the time within which the construction of works for the use of such water shall be commenced, carried on, or completed, or within which such water shall be put to use, or relating to the continuity of use of such water; and water contracted to be delivered from such stream, shall be reserved to the contractor therefor without diminution by reason of the contractor's failure to apply such water to use during any period, and shall not be subject to appropriation by any other than such contractor.

Water Code
Continued

1005.1
Cessation of or reduction in the extraction of ground water by the owner of a right to extract, as the result of the use of an alternate supply of water from a **nontributary source**, shall be and is deemed equivalent to, and for purposes of establishing and maintaining any right to extract the ground water shall be construed to constitute, a reasonable beneficial use of the ground water to the extent and in the amount that water from the alternate source is applied to reasonable beneficial use, not exceeding, however, the amount of such reduction. Any such user of water from an alternate nontributary source who seeks the benefit of this section, shall file with the board, **on or before December 31st** of each calendar year, a statement of the amount of water from such source so applied to reasonable beneficial use pursuant to the provisions of this section during the next preceding water year (November 1st to October 31st), and **such user cannot claim the benefit of this section for any water year for which such statement is not so filed.**

"Ground water," for the purpose of this section and of Sections 1005.2 and 1005.4, means water beneath the surface of the ground, whether or not flowing through known and definite channels.

The term *"nontributary source,"* as used in this section, shall be deemed to include water imported from another watershed, or water conserved and saved in the watershed by a water conservation plan or works without which such water of the same watershed would have wasted, or would not have reached the underground source of supply of the owner relying upon this section.

1005.2
Cessation of or reduction in the extraction of ground water, to permit the replenishment of such ground water by the use of water from an alternate nontributary source, is hereby declared to be a reasonable beneficial use of the ground water to the extent and in the amount that water from such *alternate source* is applied to beneficial use, not exceeding, however, the amount of such reduction. No lapse, reduction or loss of any right in ground water, shall occur under such conditions. Any such user of water from an alternate source who seeks the benefit of this Section 1005.2 with respect to the use of such water occurring prior to the effective date of this section, shall file with the board, within ninety (90) days from said effective date, a statement of the amounts of reduction in the extraction of ground water as the result of water from said alternate source having been so applied to reasonable beneficial use prior to said effective date to permit the replenishment of such ground water and said amounts shall be segregated and shown for each water year (November 1st to October 31st) during which such use occurred prior to the effective date of this section. Any such user of water from an alternate source who seeks the benefit of this Section 1005.2 with respect to the use of such water occurring sub-

sequent to the effective date of this section, shall file with the board, **on or before December 31st** of each calendar year, a statement of the amount of reduction in the extraction of ground water as the result of water from said alternate source having been so applied to reasonable beneficial use during the next preceding water year (November 1st to October 31st) to permit the replenishment of such ground water. **Such user cannot claim the benefit of this section for any water year for which such statement is not so filed.**

The provisions of this section apply only as to the cessation of, or reduction in, the extraction of ground water within that area in this state defined by the exterior boundaries of the Counties of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, San Diego, Imperial, Riverside, and San Bernardino.

The term *"nontributary source"* as used in this section shall be deemed to include water imported from another watershed or water conserved and saved in the watershed by a water conservation plan or works without which such water of the same watershed would have wasted, or would not have reached the underground source of supply of the owner relying upon this section.

1005.3

During the pendency of an action to adjudicate substantially all water rights in a ground water basin situated in whole or in part within the **Tehachapi-Cummings County Water District in Kern County,** and until the date of judgment therein becomes final, which finality may be subject to any reserved jurisdiction of the court, the failure by any owner of water rights in and to such ground water basin to pump or extract therefrom the full quantity of water representing such water rights which he may be determined to have had as of the date of commencement of the action, shall not result in a loss of any such failure to pump or extract in any water year, calendar year, or other year ending after the effective date of this section, whether or not said action was commenced prior to that effective date.

This special provision is necessary because there are special and peculiar circumstances applicable to the ground water basins lying wholly or partially within the Tehachapi-Cummings County Water District. There are three such ground water basins, commonly referred to as the Tehachapi Basin, the Brite Basin and the Cummings Basin. The alluvial fill in each of said basins is very shallow when contrasted to most other ground water basins in this state. It is necessary to induce those pumpers who can possibly do so to reduce their pumping from the basins if sufficient ground water reserves are to be maintained for preservation of the existing economy until supplemental water is available from the State Water Facilities. Actions to adjudicate substantially all water rights have been filed as to each of those basins.

1005.4

(a) Cessation of or reduction in the extraction of ground water, to permit the replenishment of such ground water by the use of water from an alternate nontributary source, is hereby declared to be a reasonable beneficial use of the ground water to the extent and in the amount that water from such alternate source is applied to beneficial use, not exceeding, however, the amount of such reduction. No lapse, reduction or loss of any right in ground water, shall occur under such conditions.

(b) Any such user of water from an alternative source may file with the board, on or before December 31st of each calendar year, a statement of the amount of reduction in the extraction of groundwater as a result of water from the alternative source having been so applied to reasonable beneficial use during the next preceding water year (October 1st to September 30th) to permit replenishment of such groundwater. However, failure to file such a statement shall in no way affect the right of a user to claim the benefit of this section.

(c) The provisions of this section apply only as to the cessation of, or reduction in, the extraction of ground water within that area in this state **defined by the exterior boundaries of every county, except the Counties of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, San Diego, Imperial, Riverside, and San Bernardino.**

(d) The term *"nontributary source,"* as used in this section, shall be deemed to include water imported from another watershed or water conserved and saved in the watershed by a water conservation plan or works without which such water of the same watershed would have wasted, or would not have reached the underground source of supply of the owner relying upon this section.

For Information, Call:
the State of California, Division of Water Rights
at (916) 322-4503

Related Publications:

91-3 WR Recordation of Water Extractions and Diversions
91-10 WR Statements of Water Diversion and Use (1977)

CESSATION OR REDUCTION OF GROUND WATER EXTRACTIONS

WHAT IS THE CESSATION OR REDUCTION OF GROUND WATER PROGRAM?

- *The Cessation of Ground water Extractions Program is a program required by the Water Code Sections 1005.1 through 1013. It provides a means for owners of rights to pump ground water to protect these rights when they conserve water or substitute water from an alternate nontributary source source for water previously appropriated or for pumped ground water.*

- *Before the passage of the statute, many ground water pumpers in overdrawn and depleted basins were reluctant to reduce their water use or reduce pumping and substitute other water for fear of losing their appropriative rights or rights to the ground water. This permits the full amount of water beneficially used to be considered in the event of an adjudication.*

PURPOSE OF THE PROGRAM

- *The purpose of the Program is to encourage the water extractor to allow the replenishment of ground water by obtaining water from another water source or by putting into place a water conservation plan or works without which such water would have been wasted or would not have reached the underground source of supply of the owner. The Water Code (Section 1005.2) states, "No lapse, reduction or loss of any right in ground water, shall occur under such circumstances."*

WHO CAN FILE?

- *To qualify, a water user must have at one time pumped ground water under some claim of right, put it to beneficial use and, subsequently, to have reduced or ceased pumping such water and substituted water from a different source, such as imported water or water released from storage reservoirs.*

- *It applies to all counties in California.*

HOW DO THEY FILE?

- *To take advantage of this provision, extractors must file the initial statement (Form 60-B) which is sent to them upon request.*

- *Annual Statements (Form 60-C) are then sent in November to those who have filed an initial statement. These must be returned by December 31st of each year for the water obtained during the previous water year (November 1st to October 31st for the counties*

of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, San Diego, Imperial, Riverside, and San Bernardino; October 1st to September 30th for the remaining counties). It appears that the difference in the water years is simply a matter of oversight or error when the Water Code was written. A request was made in 1991 to correct this, but it apparently seemed too minor to warrant sending it to the Legislature.

WHAT DOES IT COST?

- *There is no cost to the extractor to file either the initial Statement or the Annual Statement.*

WHAT HAPPENS IF THEY DON'T FILE?

- *This Program is voluntary and few extractors take advantage of it. It is not advertised, therefore most may not even know about it. As of November 1993, there were only 54 extractors on the active list to receive the annual statement.*

- *If they do not file, or do not file on time, they do not receive the benefit of having the water they use from other sources being credited to them in the event of an adjudication.*

State of California
State Water Resources Control Board
DIVISION OF WATER RIGHTS
P.O. Box 2000, Sacramento, CA 95812-2000
Info: (916) 341-5300, FAX: (916) 341-5300, Web: http://www.waterrights.ca.gov

Cessation or Reduction Number _____

+=+=+ FIRST STATEMENT +=+=+
CESSATION OR REDUCTION IN GROUNDWATER EXTRACTIONS

_____ ( ) _____
Name of Owner Telephone

_____
Address City Zip Code

Name of groundwater basin _____

Located in _____ County, within _____

Source and name of the alternate non-tributary source of water (imported water from what watershed, reclaimed water, or polluted water, conserved water, etc.)

_____

How many wells were used before reduction or cessation of extraction? _____

How many wells have been used after reduction or cessation occurred? _____

Estimation of average annual groundwater extraction for agricultural irrigation purposes.

1	2	3	4	5	6
YEAR	TOWNSHIP RANGE, AND SECTION OF PLACE OF USE	CROP	RATE OF WATER APPLICATION (AC-FT/AC)	IRRIGATION ACREAGE	TOTAL WATER EXTRACTED

7. Please complete these tabulations for each of the five years before extractions were reduced or Ceased and for the years after extractions were reduced.

BEFORE EXTRACTIONS WERE REDUCED:

YEAR	AMOUNT OF EXTRACTION (IN ACRE-FEET)

AFTER EXTRACTIONS WERE REDUCED:

YEAR	AMOUNT OF EXTRACTION (IN ACRE-FEET)	REDUCTION	AMOUNT FROM NONTRIB. SOURCE—(IF RECLAIMED MARK "R", IF SOURCE POLLUTED, MARK "P")

8. Please submit a map showing the location of all wells used both before and after reduction or cessation occurred. Identify on the following map:

A. Those wells used only before extractions were reduced.
B. Those wells used only after extractions were reduced, and
C. Those wells used both before and after extractions were reduced.

Please show state well numbers.

9. State any other facts you think may clarify your statement.

_____

_____

_____

Date: _____ Signed: _____

Title: _____

APPENDIX F

SUMMARY OF GROUNDWATER MANAGEMENT PLAN ACTIONS AND PRIORITIES

PLANNED ACTIONS Green - Ready to go and funded Blue - Ready to go and unfunded Red - Not Ready to go	Cost – Order of Magnitude	Currently Funded	3-year Plan Schedule	Opportunity Available	Key Panel Priorities: **Demand Reduction**	**Increases Recharge**	**Protects Groundwater**	Improves basin Understanding	Enhances Integration	Geographic Issue
4.1 Stakeholder Involvement										
4.1.1 Involving the Public										
1) Circulate copies and publish the adopted Plan and subsequent annual reports on web site.	Staff Support	√	√	√						
2) Develop an insert to accompany City and VOMWD water bills, and even potentially with water bills that are sent out by some of the mutual water companies.		√	√	√						
3) **Develop and Execute Public Outreach Plan:** Develop and execute a Public Outreach Plan for Plan implementation to maximize outreach on implementation activities.		√	√	√						
4) Conduct public forums to encourage public participation.		√	√	√						
5) Maintain email and postal mail list to announce meetings and keep interested parties informed about Plan implementation.		√	√	√						
6) Invite interested parties to participate in PANEL meetings.		√	√	√						
7) Meet with representatives from interested organizations as appropriate.		√	√	√						
8) Coordinate meetings with stakeholders within the basin to inform them of the management responsibilities and activities relative to this Plan.		√	√	√						
4.1.2 Advisory Groups										
1) Following Plan adoption, the current PANEL will discuss and recommend the future composition of a new Panel and a potential ad-hoc Technical Advisory Committee to provide stakeholder input to Plan implementation.	Staff Support	√	√	√						
2) Structure Plan implementation according to the recommendations of the Panel and approval of the Sonoma County Water Agency Board of Directors.		√	√	√						
3) Maintain a high level of stakeholder involvement in Plan implementation by continuing to inform various stakeholder groups through briefings by Panel members.		√	√	√						
4) Hold quarterly meetings with the Panel to inform and seek guidance on implementation.		√	√	√						
4.1.3 Informing Public Agencies & Stakeholders										

PLANNED ACTIONS Green - Ready to go and funded Blue - Ready to go and unfunded Red - Not Ready to go	Cost – Order of Magnitude	Currently Funded	3-year Plan Schedule	Opportunity Available	Key Panel Priorities: **Demand Reduction**	**Increases Recharge**	**Protects Groundwater**	Improves basin Understanding	Enhances Integration	Geographic Issue
1) Continue to maintain and further develop relationships with local, state and federal agencies and organizations to benefit Plan implementation.	Staff Support	√	√	√						
2) Meet with representatives from agencies as appropriate.		√	√	√						
3) Conduct annual briefings with the elected officials who have adopted the Plan in conjunction with annual report.		√	√	√						
4.1.4 Partnerships										
1) Continue to promote partnerships that achieve both local supply reliability and broader regional and statewide benefits, including proactively addressing potential water conflicts, implementing total maximum daily loads (TMDLs), following through on California Floodplain Management Task Force recommendations.	Staff Support	√	√	√						
2) Coordinate implementation activities and work to the extent practicable with watershed groups, local stewardship groups, water interest groups, and state and federal regulatory agencies that have jurisdiction in areas related to Plan activities.		√	√	√						
3) Seek grant funding for Plan actions and coordinate grant funding efforts in the Plan area.		√	√	√	√	√	√			
4.2 Monitoring Program										
4.2.2 Groundwater Elevation Monitoring										
1) Assess groundwater elevations on annual basis including trends, conditions and adequacy of the groundwater level monitoring network.	Staff Support	√	√	√				√		
2) Develop an outreach program to obtain groundwater level data from private pumpers and private well owners in the Sonoma Valley.		√	√	√						
3) Coordinate with local, state and federal agencies to investigate opportunities to develop better information on groundwater level monitoring.		√	√	√				√		
4) **Project - Conduct Groundwater Elevation Monitoring:** Establish and fund a basin-wide, standardized, long-term well monitoring network. Select an appropriate group of wells (both public supply and volunteer private wells) to monitor through cooperative and volunteer efforts in spring 2008 for groundwater elevations.		√	√	√				√		

PLANNED ACTIONS Green - Ready to go and funded Blue - Ready to go and unfunded Red - Not Ready to go	Cost – Order of Magnitude	Currently Funded	3-year Plan Schedule	Opportunity Available	Key Panel Priorities: **Demand Reduction**	**Increases Recharge**	**Protects Groundwater**	Improves basin Understanding	Enhances Integration	Geographic Issue
5) **Project - Install New Multi-Depth Groundwater Monitoring Wells:** Obtain funding and install three new multi-depth monitoring wells in the central-southern Sonoma Valley area for long-term monitoring of groundwater levels and groundwater quality.	$$$		√	√			√	√		
4.2.3 Groundwater Quality Monitoring										
1) Assess water quality on annual basis including trends, conditions and adequacy of the groundwater quality monitoring network.	Staff Support	√	√	√				√		
2) Identify opportunities to capture and integrate existing water quality data, including Department of Public Health data, from small water distribution system operators (wineries, restaurants, schools and parks), mutual water companies (non-urban residential subdivisions), and other entities when current data is insufficient.		√	√	√				√		
3) **Project - Conduct Groundwater Quality Monitoring:** Select an appropriate group of wells (both public supply and volunteer private wells) to monitor in spring 2008 for groundwater quality and solicit agency in-kind support for sampling and analysis.		√	√	√				√		
4) **Study - Groundwater Ambient Monitoring and Assessment (GAMA) - Review Report and Conduct Additional Sampling Study**: Review the Groundwater Ambient Monitoring and Assessment (GAMA) interpretive report for the Sonoma Valley when it becomes available and evaluate whether additional water quality monitoring is needed. Collect and analyze additional surface and groundwater samples in the Sonoma Valley to improve GAMA assessment of ambient groundwater quality, including evaluating areas of recycled water application.	$$$			√			√	√		
4.2.4 Land Subsidence Monitoring (Related to Groundwater Extraction)										
1) **Study - Establish a long-term, periodic monitoring program for groundwater extraction related land subsidence in the Sonoma Valley:** Coordinate with VOMWD and City to determine if there are other suitable benchmark locations in the Sonoma Valley to aid in the analysis of potential land subsidence.	Staff Support	√	√	√			√	√		

PLANNED ACTIONS Green - Ready to go and funded Blue - Ready to go and unfunded Red - Not Ready to go	Cost – Order of Magnitude	Currently Funded	3-year Plan Schedule	Opportunity Available	Key Panel Priorities: **Demand Reduction**	Key Panel Priorities: **Increases Recharge**	Key Panel Priorities: **Protects Groundwater**	Improves basin Understanding	Enhances Integration	Geographic Issue
2) **Project - Interferometric Synthetic Aperture Radar (InSAR) for Subsidence Monitoring:** Continue to coordinate with USGS to ascertain the suitability of the use of Interferometric Synthetic Aperture Radar (InSAR) images of the Sonoma Valley for assessing potential changes in ground elevation over the last one to two decades. If the technology appears suitable, the cost will be estimated and potential cost-sharing partners will be identified to further consider this technology.	$$						√	√		
4.2.5 Surface Water-Ground Water Interaction Monitoring										
1) Continue to compile available stream gauge data and information on tributary flows and diversions from the Sonoma Creek area.	Staff Support	√	√	√				√	√	√
2) Collect and analyze stream gauge data to evaluate stormwater capture potential.		√	√	√						
3) **Study - Tracer Test and Modeling to Understand Surface Water-Groundwater Flow:** Perform a tracer test (possibly using Xenon gas isotopes) along Sonoma Creek (or another tributary) and use computer simulation with calibration to tracer, groundwater level, temperature, isotope, or water quality data to verify conceptual models of the surface-groundwater interaction.	$$$		√				√	√	√	
4) **Study - Stable Isotope Analysis to Understand Surface Water-Groundwater Flow:** Analyze surface water and groundwater samples for isotopes and other natural or anthropogenic tracers to evaluate surface water and groundwater interactions.	$$		√				√	√	√	
5) **Project - Install and Maintain New Stream Gauge on Sonoma Creek in Kenwood:** Install and maintain one additional stream gauge on Sonoma Creek in the Kenwood area of Sonoma Valley. Once the additional stream gauge is installed, quantify net surface water-groundwater exchange between gauges, and assess the long-term need for additional stream gauges in the Sonoma Valley.	$$	√	√	√				√	√	√
6) **Project - Conduct Seepage Runs And Install New Wells Along Sonoma Creek:** Conduct seepage runs and install new wells on Sonoma Creek to further assess surface water and groundwater interactions. Correlate groundwater level data from wells in the vicinity of stream gauges to further establish connectivity of the creek and groundwater.	$$$		√	√			√	√	√	√

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4.2.6 Monitoring Protocols										
1) Develop a schedule and coordinate the time of sampling and the sampling interval (time between samples) to ensure data collection frequency.	Staff Support	√	√	√				√		
2) Coordinate to ensure uniform, standard protocols are made available for water quality data collection.		√	√	√						
3) Use a Standard Operating Procedure (SOP) for the collection of water level data for wells (Appendix D).		√	√	√				√		
4) Provide guidelines on the collection of water quality data developed by the California Department of Public Health for the collection, pretreatment, storage, and transportation of water samples (Appendix D).		√	√	√				√		
5) Develop field and office quality assurance practices for the program. Review project specific quality assurance/quality control procedures for groundwater quality sample collection for individual studies to be conducted in the future in the Sonoma Valley.		√	√	√				√		
6) Provide training on water level sampling to volunteer well owners as needed.		√	√	√				√		
4.2.7 GIS Data Management System										
1) The Agency will be responsible for maintaining and updating the central GIS data management system including GIS layers and other data formats related to groundwater, hydrology, geology, land use, and relevant imagery.	Staff Support	√	√	√				√		
2) Maintain confidentiality of well data per requirement of California Water Code, Division 7, Chapter 10, Article 3, Section 13752.		√	√	√				√		
3) Obtain commitments from governmental agencies including DWR, VOMWD, the City, the Agency, Sonoma County Permit & Resource Management Department (PRMD), and any other non-governmental entity to provide data to update the database.		√	√	√				√	√	
4) Adopt standard data formats for collection, data transfer protocols, data reporting, and quality assurance-quality control checks to facilitate regularly scheduled data updates.		√	√	√				√	√	

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5) Use the GIS data management system to assist in the annual evaluation of data and to prepare the annual Plan report to summarize groundwater conditions within the basin and document groundwater management activities conducted in the previous year.		√	√	√				√	√	
6) **Study - GIS Mapping of Sonoma Valley Drainage Network:** Create a complete Sonoma Valley drainage network GIS layer that maps culverts and ditches.	$$		√	√				√	√	
7) **Study - Additional GIS Layers and Analysis:** Develop and coordinate related data including GIS layers and other data formats on topics including low flow conditions, recharge and discharge areas, impervious areas, land cover, drainage networks, historical hydrology and land cover, and wetlands distribution.	$$		√	√			√	√	√	
8) Pilot Project - WEBH2O web-based data management system: The Agency is currently working with the company H2O2U to implement a pilot WEBH2O web-based project to make data available to load and access on a website at the end of 2007 or beginning of 2008. If successful, this pilot project could become the Plan central data management system.	$$	√	√	√			√	√	√	
4.3 Groundwater Resources Protection										
4.3.1 Well Construction, Abandonment, and Destruction										
1) Develop improved well permit application requirements to improve hydrogeologic information through working with drillers, well owners, and other parties familiar with groundwater conditions in the Sonoma Valley.	Staff Support	√	√	√			√	√		
2) Improve well construction practices by ensuring that all licensed well drillers and well service providers operating in the Sonoma Valley area are provided a copy of the county well ordinance, understand the proper well construction procedures, are familiar with PRMD well-related policies and procedures, regulations, best practices, educational opportunities and value of obtaining detailed geologic data.		√	√	√			√	√		
3) Provide guidance as appropriate on well construction and destruction to well owners, operators, and licensed well drillers and service providers		√	√	√			√	√		

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4) Review the USGS report on the Sonoma Valley (USGS Scientific Investigations Report 2006-5092, 2006) and update Sonoma County information and maps on groundwater conditions.		√	√	√						
5) **Study - Obtain Better Information During Well Installations:** Develop approach to obtain better hydrogeologic information on well completions through a combination of voluntary-no-cost participation by well owner, and funding through soliciting in-kind services from agencies and/or applying for grants.			√	√			√	√		
6) **Study - Conduct Well/Abandoned Well Survey:** Conduct an inventory and survey of active and inactive wells in the Sonoma Valley area, to identify potential abandoned wells, and develop an approach for possible grant funding to provide incentives to properly destroy abandoned wells.	$$		√				√	√		
7) **Project - Develop Guide for Well Owners:** Prepare and distribute a "Guide for Well Owners" that includes consumer information about the Plan, the County's well construction, abandonment and destruction requirements, well head protection information, and tips for ensuring that wells are properly maintained, and monitoring.	$		√	√			√			
4.3.2 Wellhead Protection										
1) Incorporate available potentially contaminating activity (PCA) and capture zone information from Drinking Water Source Assessment and Protection (DWSAP) plans into the Sonoma Valley GIS data management system.	Staff Support	√	√	√			√	√		
2) Request VOMWD and the City to provide available vulnerability summaries from the DWSAP to be used for informational purposes and planning.		√	√	√			√	√		
3) Contact groundwater basin managers in other areas of the state for technical advice, effective management practices, and "lessons learned," regarding establishing wellhead protection areas.		√	√	√			√	√		
4.3.3 Controlling Migration and Remediation of Contaminated Groundwater										
1) Provide well owners with Sonoma County Department of Health Services guide, *What You Need to Know About Water Quality in Your Well.*	Staff Support	√	√	√			√			

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2) Incorporate information on any known high risk PCA in the Sonoma Valley GIS data management system		√	√	√			√			
3) Incorporate GIS layers on Leaking Underground Storage Tank (LUST) sites from the Regional Water Quality Control Board (RWQCB) and Sonoma County Environmental Health Department into the GIS data management system.		√	√	√			√			
4) Distribute information to Sonoma Valley licensed water system operators on mapped contaminant plumes and LUST sites and make available to all well owners.		√	√	√			√	√		
5) Contact the RWQCB and Sonoma County Environmental Health Department regarding any new occurrences of LUSTs, particularly when contamination is believed to be a threat to groundwater.		√	√	√			√			
4.3.4 Control of Saline Water Intrusion										
1) Track saline water movement from the San Pablo Bay. This will include additional monitoring per the groundwater monitoring program for chloride, total dissolved solids and water levels. See Component 2 (Section 4.2). Summarize in Annual Report. (see Section 5.3).	Staff Support	√	√	√			√	√		√
2) Examine total dissolved solids, chloride and sulfate concentrations in public supply wells of Sonoma Valley licensed water distribution systems that are routinely sampled under the DPH (formerly DHS) Title 22 Program to identify any trends. These data will be readily available in the Sonoma Valley GIS data management system and are already an on-going task for the annual review of basin conditions. Summarize in Annual Report		√	√	√			√	√		√
3) **Study - Salinity Sources and Distribution**: Evaluate the source and distribution of salinity with additional water quality sampling including chloride, bromide, iodide, barium, and boron in the mid- and southern-portion of the Sonoma Valley.	$$$		√	√			√	√		√
4) **Study – Seawater Intrusion:** Conduct feasibility study(s) to identify alternatives to mitigate seawater intrusion in South Sonoma Valley and saline thermal water along East Sonoma Valley.	$$$		√				√	√		√

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5) **Project – Seawater Intrusion:** Develop projects to mitigate seawater intrusion, including potential recharge projects using stormwater capture and possibly recycled water.	$$$$					√	√	√		√
4.4 Groundwater Sustainability										
4.4.1 Stormwater Recharge										
1) **Study - Groundwater Recharge Area Mapping and Analysis:** Develop and implement a study to further understand and map groundwater recharge areas, digitize current data on recharge areas, and map impervious areas and historic wetlands. Recommend protection alternatives for recharge areas in the Sonoma Valley.	$$		√	√		√	√	√	√	
2) **Study - Recharge Area Alternatives.** Recommend alternatives for preserving recharge areas in the Sonoma Valley. Analysis would include natural environment, economic, business, and groundwater sustainability issues, pros and cons. Alternatives could include posting areas for the public and providing maps for local planning agencies.	$$		√	√		√	√	√	√	
3) **Project - Public Outreach Program for Source Protection and Groundwater Recharge:** Develop information for public outreach on household hazardous materials and wastes and PPCPs, the importance of groundwater and surface water protection and proper methods for handling and disposing of these substances, and the importance of protecting and maintaining groundwater recharge areas.	$		√	√		√	√			
4) **Study - Recapture Unused Groundwater:** Assess potential to use groundwater extracted and currently disposed in the City of Sonoma surface culverts and ditches by evaluating quantity, timing and potential reuse for irrigation or other purposes.	$$		√		√			√		
5) **Study/Pilot - Feasibility Analysis and Pilot Stormwater Capture and Groundwater Recharge:** Conduct feasibility level analysis and pilot scale testing of stormwater capture and groundwater recharge to assess volumes, timing, best locations, estimate costs and potential benefits of implementation.	$$$		√			√	√	√		

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6) **Project - Stormwater Capture and Groundwater Recharge:** Develop and implement pilot-scale and subsequent large-scale projects to recharge groundwater with stormwater runoff capture and rainfall harvesting in the Sonoma Valley. Examples include: a) Off-stream spreading basins and percolation ponds b) Temporary wet season flooding of public lands such as parks or open space c) Rainfall harvesting and stormwater runoff recharge with dispersed, low impact development infiltration trenches and dry wells, with possible incentives for retaining water on-site d) Capturing and using stormwater runoff in the Sonoma Valley for irrigation; also using any remaining captured stormwater that does not infiltrate into the ground for irrigation	$$$$					√	√	√		
7) **Project - Stormwater Capture and Late-Year Release** - Make controlled releases of captured stormwater to streams during late summer and early fall when Sonoma Creek is typically dry in order to maximize the aquifer recharge, and improve fish habitat conditions.	$$$$					√	√	√		
4.4.2 Groundwater Banking										
1) **Study - Conduct Conjunctive Use Assessment:** Conduct a study of conjunctive use opportunities within the Sonoma Valley groundwater basin area. This will include assessing methods to optimize the use of surface water and groundwater, by using wet year and wet season water for irrigation and to recharge the aquifer with groundwater recharge wells and/or recharge basins, siting recharge facilities, and potentially shifting the timing of groundwater withdrawals.	$$$		√		√	√	√	√	√	
2) **Study/Pilot - Feasibility Analysis and Pilot Groundwater Banking:** Conduct feasibility level analysis and pilot scale testing of groundwater banking to assess volumes, timing, best locations, estimate costs and potential benefits of implementation.	$$$$		√		√	√	√	√	√	

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3) **Project: Develop Groundwater Storage Projects:** Develop and implement full-scale projects that use wet season and wet year water for groundwater banking.	$$$$$					√	√	√		
4.4.3 Recycled Water										
1) **Evaluate Graywater:** Evaluate graywater (any water that has been used in the home, except water from toilets) as a viable demand reduction alternative in the Sonoma Valley. If warranted, develop recommendations for model ordinance or code and guidance for greywater utilization for residential landscape irrigation.	Staff Support	√	√		√			√		
2) **Project - Recycled Water for Irrigation:** Increase recycled water use for irrigation through implementation of the Sonoma Valley County Sanitation District's Sonoma Valley Recycled Water Project.			√	√	√					
3) **Study - Evaluate Recycled Water Groundwater Recharge Feasibility:** Groundwater recharge through a spreading basin may be a suitable use of the SVCSD recycled water supply, as recycled water is used for groundwater recharge in many other areas of the state. This study would take information from the previous SVCSD studies and look at possible spreading basin opportunities considering other Sonoma Valley issues and challenges that need to be addressed.	$$$		√			√				
4.4.4 Conservation & Demand Reduction										
1) **Continue Implementing BMPs and Report Annually:** Continue implementing, maintaining and updating CUWCC BMPs, as appropriate, for urban areas. Annually report estimated savings for ongoing water conservation programs.	Staff Support	√	√	√	√					
2) **Water Conservation BMPs for Non-Viticulture Agriculture:** Encouragement of development of water conservation BMPs for voluntary non-viticulture agricultural and agricultural-residential water users.		√	√		√					

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3) **Encourage Additional Conservation and Best Practices to Address Soil Erosion and Surface Water Runoff for Viticulture:** Encourage viticulture agriculture water users to increase conservation by 5 percent and to use the Code of Sustainable Winegrowing Practices Workbook (Wine Institute and California Association of Winegrape Growers, 2002) and Vineyard Manual (Southern Sonoma County Resource Conservation District, 1999)) to address soil erosion and surface water runoff.		√	√		√					
4) **Project - Voluntary Water Conservation BMPs for Unincorporated Areas:** Develop program and seek grant funding for voluntary implementation of CUWCC water conservation BMPs in the unincorporated County areas not served by VOMWD or the City.			√		√					
5) **Project - Landscape Irrigation Efficiency:** Increase efficiency of water use and demand reduction by shifting landscape irrigation to evenings to reduce evapotranspiration. Include development of educational materials and public outreach component.	Staff Support		√		√					
6) **Project - Stormwater Capture and Reuse for Irrigation:** Develop and implement full-scale projects to capture and use stormwater runoff in the Sonoma Valley for irrigation.	$$$$		√		√					
4.4.5 Groundwater Modeling										
1) **Study - Update Land Cover and Water Use Estimates:** Develop land cover mapping for post-2000 land use changes for inclusion in the GIS data management system, and to update water use estimates for incorporation into the groundwater flow model.	$$		√	√				√	√	
2) **Study - Recharge and Infiltration Modeling:** Develop a preliminary screening watershed model based on existing data using the Preliminary Net Infiltration (INFIL) model, and perform some limited field mapping and compilation of existing recharge maps to gain a better understanding of recharge processes and for incorporation into the groundwater flow model.	$$		√	√			√	√	√	

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3) **Project - Improve Groundwater Flow Model:** Enhance and improve the groundwater flow model, addressing limitations in recharge, discharge, and conceptual hydrogeology, including identifying data collection and analysis activities, and developing plans and resources to obtain and analyze the additional data.	$$	√	√	√				√	√	
4.5 Planning Integration: Urban Water Management Planning (UWMP), Drinking Water Source Assessment and Protection (DWSAP), Land Use Planning, Groundwater Modeling, and Integrated Water Resources Management										
1) Monitor and track UWMPs, for consideration in Plan implementation.	Staff Support	√	√	√					√	
2) Incorporate pertinent data from DWSAPs into the GIS data management system, and periodically update and review DWSAP analysis and submittals.		√	√	√					√	
3) Make recommendations to the City and County regarding potential land use policies to protect the Sonoma Valley groundwater basin.		√	√	√			√		√	
4) **Project - Develop Multi-Beneficial Projects to Address Resources and Flood Hazards:** Develop multi-beneficial projects addressing stormwater runoff, flood management, habitat enhancement, water quality improvement, and groundwater recharge.	$$$$		√	√	√	√	√	√	√	√
IMPLEMENTATION PRIORITIZATION AND FINANCING										
Develop prioritization list and schedule for capital projects, studies monitoring, outreach, coordination, and partnerships.	Staff Support	√	√	√						
Identify resources needed, including local cooperative funding and state and federal grants.		√	√	√						
ANNUAL PLAN IMPLEMENTATION REPORT										
Report on groundwater management activities and progress made in implementing Plan.	Staff Support ($$)	√	√	√					√	
Summarize groundwater conditions, and monitoring results and trends of groundwater levels and quality.		√	√	√				√		
Provide information on improved characterization of basin through continued data collection and analysis.		√	√	√				√		

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Discuss whether management actions are meeting BMOs.		√	√	√						
Summarize any changes in plan components, or any BMO modifications.		√	√	√						
Outline future Sonoma Valley management actions.		√	√	√						
FUTURE REVIEW OF PLAN										
The Plan is a living document, updates will be identified in annual reports, and the Plan will be re-evaluated within three years and every five years thereafter.	Staff Support	√	√	√				√	√	