Sacramento County Water Agency

Groundwater Management Plan

SACRAMENTO COUNTY
WATER AGENCY

October 26, 2004

MWH

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EXECUTIVE SUMMARY

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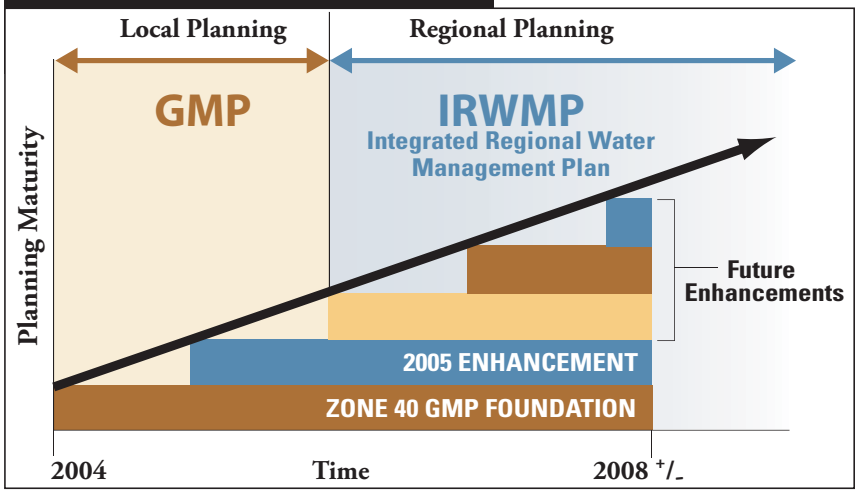
Zone 40 Groundwater Management Plan Satisfies Multiple Stakeholder Needs and Objectives

WHAT IS A GROUNDWATER MANAGEMENT PLAN?

A Groundwater Management Plan (GMP) is a planning tool that assists overlying water providers in maintaining a safe, sustainable and high quality groundwater resource within a given groundwater basin. GMPs are intended to be "living documents" that can be readily updated and refined over time to reflect progress made in achieving the GMP's objectives **(Figure 1)**. Because many agencies are new to groundwater planning, SB 1938 outlines a series of required, recommended, and voluntary actions that will promote ongoing growth in the GMP's depth and content.

Lastly, GMPs have become a required "baseline" document for agencies seeking grant funds available from the State of California. Like other planning documents required by the State, an approved GMP is a minimum requirement for agencies seeking competitively awarded grant funds.

Figure 1. Maturity and Planning

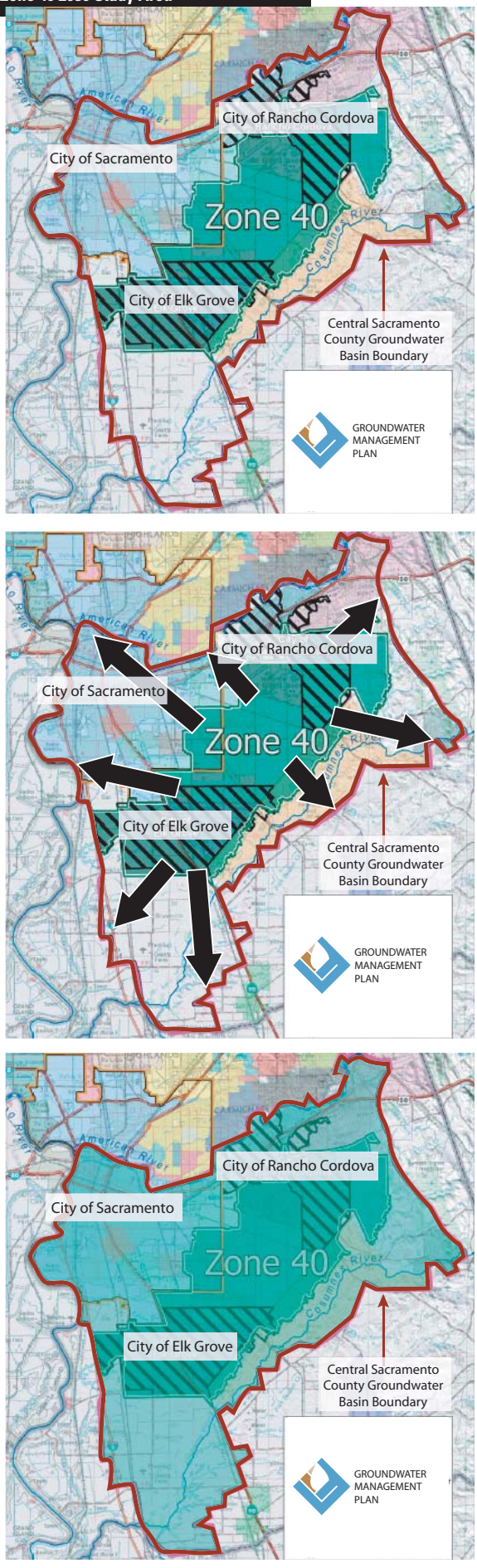


WHO BENEFITS FROM THE GMP?

The proposed GMP currently extends to the boundaries of Zone 40 **(Figure 2)** of the Sacramento County Water Agency (SCWA). Zone 40 is a significant geographic portion of the Central Sacramento County Groundwater Basin (Central Basin). The decision to limit the extent of this GMP to Zone 40 was intentional because deliberations and discussion are currently underway between interested stakeholders regarding future governance and management of a "groundwater authority" for the Central Basin. The Zone 40 GMP is intended to be a document that can grow into, and perhaps be superseded by, the GMP that will be needed for the entire Central Basin.

While this GMP is limited geographically to the boundaries of Zone 40, the work and analyses contained in this effort will benefit all stakeholders in the Central Basin.

Figure 2. Zone 40 2030 Study Area



WHAT IS REQUIRED IN A GMP?

Requirements in SB 1938 guide the preparation of GMPs and contain numerous technical requirements and provisions which are briefly summarized as follows:

- A GMP contains an inventory of water supplies and describes water uses within a given region.
- A GMP establishes groundwater Basin Management Objectives (BMOs) that are designed to protect and enhance the groundwater basin.
- A GMP identifies monitoring and management programs that ensure the BMOs are being met.
- The GMP outlines a stakeholder involvement and public information plan for the groundwater basin.

WHY WAS THE GMP PREPARED?

The Zone 40 GMP has been prepared by SCWA primarily to begin the groundwater planning process for Zone 40—positioning the agency for future activities. These activities are summarized as follows:

- A GMP is a prerequisite in applying for grant funding opportunities.
- The GMP develops a framework or baseline on which to build future planning efforts.
- Preparing a GMP is good planning procedure.

The Zone 40 GMP satisfies multiple stakeholder needs and objectives. Ultimately, this GMP will serve as the framework for a GMP that will encompass the entire Central Basin (see **Figure 2**). For the GMP to be expanded to include the entire Central Basin, Central Sacramento County Groundwater Forum (CSCGF) support would need to be secured and other interested parties' approval obtained.

Stakeholder Involvement

To address the needs of all affected stakeholders, SCWA has held several meetings and workshops and pursued several means of achieving broader involvement in the management of the Central Basin. Activities have included:

- SCWA supporting the Water Forum Successor Effort and the CSCGF financially.
- SCWA participating in monthly CSCGF stakeholder negotiation meetings.
- SCWA notifying and involving other local agencies and interests within and adjacent to the Zone 40 area.
- SCWA soliciting input from stakeholders in monthly CSCGF and cluster meetings during the development and public comment process for approving the GMP.
- SCWA developing and fostering relationships with state and federal regulatory agencies.
- SCWA pursuing a variety of partnerships to achieve local water supply sustainability.
- SCWA incorporating comments received from stakeholders into the GMP.

Future Action Items

The intended approval date of the Zone 40 GMP is November 2, 2004. Following approval, SCWA will begin refining the GMP, adding the next increment of detail beginning in early 2005 as additional recommendations and voluntary components of SB 1938 are developed. After the 2005 refinement of the GMP is completed, SCWA will consider the possible geographic expansion of the GMP to the Central Basin, subject to stakeholder input and direction.

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GROUNDWATER MANAGEMENT PLAN

Groundwater Management Plan

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ABBREVIATIONS AND ACRONYMS

AB	Assembly Bill
Aerojet	Aerojet-General Corporation
AF	Acre-feet
AF/year	Acre-feet per year
AFRPA	Air Force Real Property Agency
Agency Act	Sacramento County Water Agency Act
Ag/res	agricultural/residential
ARBCUP	American River Basin Regional Conjunctive Use Program
ARWRI	American River Water Resources Investigation
BAT	Best Available Technology
BMO	Basin Management Objective
BMP	Best Management Practice
Boeing	McDonnell-Douglas
Cal-Am	California-American Water Company
CALFED	CALFED Bay-Delta Program
CAS	California Aquifer Susceptibility
CCR	California Code of Regulations
Central Basin	Central Sacramento County Groundwater Basin
CEQA	California Environmental Quality Act
cfs	Cubic feet per second
CMP	Sacramento Coordinated Water Quality Monitoring Program
COC	Contaminants of concern
Cooperating Agencies	American River Basin Cooperating Agencies
CSCGF	Central Sacramento County Groundwater Forum

CSUS	California State University, Sacramento
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWC	California Water Code
DCA	1,2-dichloroethane
DCE	cis-1,2-dichloroethene
Delta	Sacramento/San Joaquin River Delta
DHS	California Department of Health Services
DMS	Data Management System
DTSC	Department of Toxic Substance Control
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection Program
EBMUD	East Bay Municipal Utility District
EDU	Equivalent Dwelling Unit
EIR	Environmental Impact Report
EMD	Sacramento County Environmental Management Department
EPA	United States Environmental Protection Agency
EWA	Environmental Water Account
Folsom	City of Folsom
FRCD/EGWS	Florin Resource Conservation District/Elk Grove Water Service
GAC	Granulated Activated Carbon
GMP	Groundwater Management Plan
GP	1993 Sacramento County General Plan
gpm	Gallons per minute
Groundwater Forum	Central Sacramento County Groundwater Forum

IGSM	Integrated Groundwater and Surface Water Model
InSAR	Interferometric Synthetic Aperture Radar
ISI	Integrated Storage Investigation
JPA	Joint Powers Authority
LSCE	Luhdorff & Scalmanini Consulting Engineers
LUFT	Leaking Underground Fuel Tank
LUST	Leaking Underground Storage Tank
M&I	Municipal and industrial
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MGD	Million Gallons per Day
mg/L	Milligrams per liter (also parts per million)
mmhos/cm	micromhos per centimeter
MMM	Multimedia Mitigation
MWH	MWH Americas, Inc.
MSL	Mean sea level
µ/L	Micrograms per liter (also parts per billion)
NAWQA	National Water Quality Assessment
NDMA	n-nitrosodimethylamine
NEPA	National Environmental Policy Act
NGS	National Geodetic Survey
O&M	Operations and Maintenance
PBE	Physical Barrier Effectiveness
PCAs	Potential Contaminating Activities
PCE	Perchloroethylene
pCi/l	pico curies per liter

PL	Public Law
POU	Place of Use
PSA	Purveyor Specific Agreement
Reclamation	U.S. Bureau of Reclamation
Roseville	City of Roseville
RWA	Regional Water Authority
RWMP	Regional Water Master Plan
RWQCB	Regional Water Quality Control Board
Sac Regional	Sacramento Regional Wastewater Treatment Plant
SACOG	Sacramento Area Council of Governments
Sacramento	City of Sacramento
SAFCA	Sacramento Area Flood Control Agency
SCWA	Sacramento County Water Agency
SCWC	Southern California Water Company
SDWA	Safe Drinking Water Act
SGA	Sacramento Groundwater Authority
SMUD	Sacramento Municipal Utility District
SMWA	Sacramento Metropolitan Water Authority
SOP	Standard Operating Procedure
SRCSD	Sacramento Regional County Sanitation District
SRWTP	Sacramento River Water Treatment Plant
SSCAWA	South Sacramento County Agricultural Water Authority
SWRCB	State Water Resources Control Board
SWTR	Surface Water Treatment Rule
TAF	Thousands of acre feet
TCE	Tetrachloroethylene

TDS	Total dissolved solids
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USBR	United States Bureau of Reclamation
USGS	U.S. Geological Survey
Water Forum	Sacramento Area Water Forum
WEP	Water Efficiency Program
WF DIER	Water Forum Draft Environmental Impact Report
WFA	Water Forum Agreement
WTP	Water treatment plant
WSMP	Zone 40 Water Supply Master Plan

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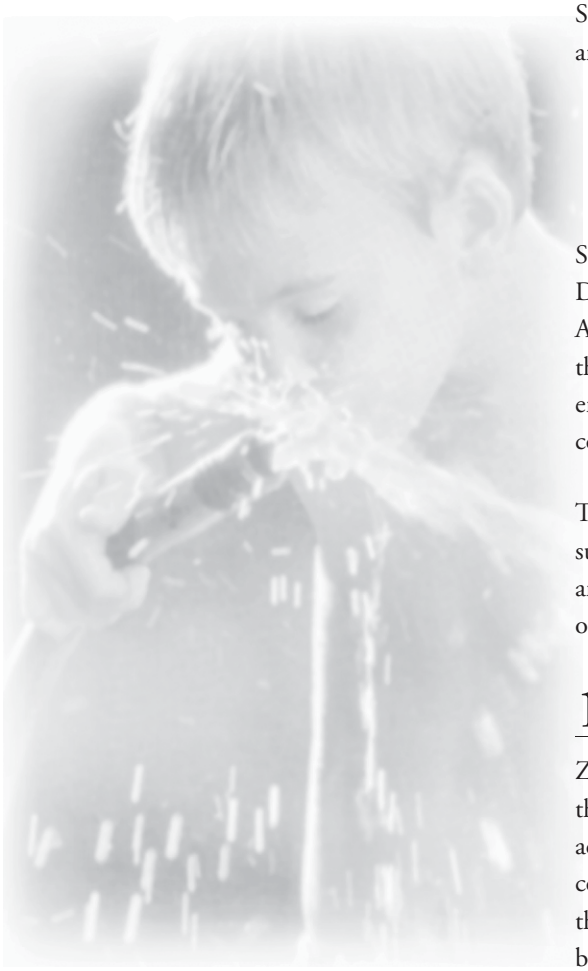
SECTION 1

INTRODUCTION

SECTION 1

This section describes the Sacramento County Water Agency (SCWA), its formation, and the formation and purpose of a special benefit zone within SCWA known as Zone 40. A summary of on-going master planning efforts has also been provided for context with various regional planning efforts taking place throughout Sacramento County.

INTRODUCTION



1.1 FORMATION OF SCWA

SCWA was formed in 1952 by a special legislative act of the State of California (the Sacramento County Water Agency Act [Agency Act]). SCWA's purposes include, but are not limited to, the following:

1 Making water available for any beneficial use of lands and inhabitants, and

2 Producing, storing, transmitting, and distributing groundwater in accordance with an approved Master Plan.

SCWA's boundaries include all of Sacramento County and is governed by a Board of Directors (ex officio, the Sacramento County Board of Supervisors). Under the Agency Act, the Board may contract with the federal government under reclamation laws with the same powers as irrigation districts, and with the State of California and federal government with respect to the purchase, sale, and acquisition of water. SCWA may also construct and operate any required capital facilities.

There are currently several benefit zones within SCWA that are related to both water supply (Zone 13, Zone 40, Zone 41, and Zone 50) and drainage (Zone 11, Zone 12 and Zone 13). Each has a unique purpose and generates revenue internally for carrying out that purpose.

1.2 CREATION OF ZONE 40

Zone 40 was created by SCWA Resolution No. 663 in May 1985, which describes the exact boundaries of the zone, and defines the projects to be undertaken as "... the acquisition, construction, maintenance and operation of facilities for the production, conservation, transmittal, distribution and sale of ground or surface water or both for the present and future beneficial use of the lands or inhabitants within the zone." The boundaries and scope of Zone 40's activities were expanded in April 1999 by Resolution WA-2331. Zone 40's scope now includes the use of recycled water in conjunction with surface water and groundwater.

Zone 40 is located in the central portion of Sacramento County (**Figure 1-1**). While much of Zone 40 consists of rural land uses, (i.e., agricultural, agricultural/residential (ag/res), and conservation reserve), urbanization has been occurring within the City of

Elk Grove, in the Vineyard and Mather/Sunrise areas of unincorporated Sacramento County, and more recently in the City of Rancho Cordova.

Historically, Zone 40 has relied on the underlying indigenous groundwater basin for agricultural, industrial, and residential water supplies. Over the past 10 years Zone 40 has supplemented the use of groundwater supplies with surface water, recycled water, and education and enforcement of water conservation. To address increasing demands for water in the region, SCWA is updating their Water Supply Master Plan (WSMP) for Zone 40. The WSMP is scheduled for approval in late 2004. SCWA is also signatory to, and has included in their WSMP, water supply policies in accordance with the Sacramento Area Water Forum Agreement. ***One of these policies provides for a sustainable average annual operational groundwater yield from the Central Sacramento County Groundwater Basin (Central Basin) of 273,000 Acre-Feet per year (AF/year).*** In 1990, when the Water Forum developed the sustainable yield, the Central Basin was yielding an estimated 250,000 AF/year. It is believed that the current extraction rate is the very close to the same amount. The extraction amount changes from year to year based on hydrologic conditions and consumer awareness of water conservation programs.

A primary role of Zone 40 is to meet growing urban water demands in a manner that maintains the integrity of the groundwater basin and existing groundwater users. Through the construction of groundwater wells that target portions of the underlying aquifer not used by private domestic wells, and through treatment of the groundwater before distribution to retail customers, Zone 40 has developed approximately 40 million gallons per day (MGD) of groundwater capacity. Through firm surface water contracts with the Bureau of Reclamation and wheeling agreements with the City of Sacramento, Zone 40 currently has the ability to deliver 7,000 AF/year of surface water and approximately 3 MGD (3,360 AF/year) of recycled water from the Sacramento Regional County Sanitation District's (SRCSD) Recycled Water Treatment Plant.

Zone 40 generates revenue to implement its capital program through development fees and from user fees collected bi-monthly from Zone 41 retail water service customers within Zone 40 and wholesale water service customers in the Elk Grove Water Service area.

1.3 OTHER REGIONAL MANAGEMENT EFFORTS

Over the past several decades, water supplies of the region have been effected by:

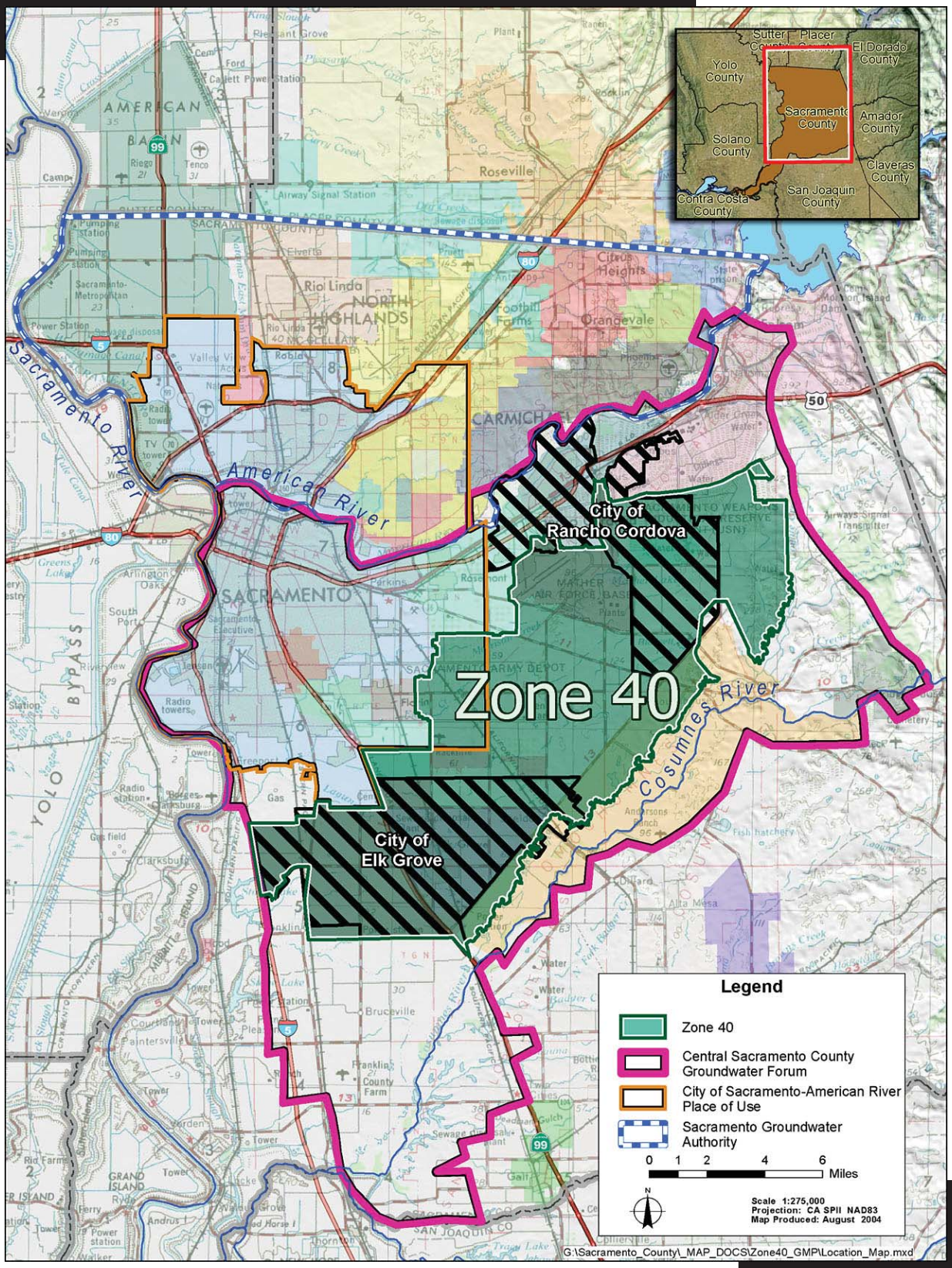
- Extended drought and wet periods.
- Increased push to dedicate surface water for environmental purposes.
- Groundwater contamination cleanup efforts ordered by the United States Environmental Protection Agency (EPA), the Central Valley Regional Water Quality Control Board (RWQCB), and the Department of Toxic Substance Control (DTSC).
- Declining groundwater levels.
- On-going and potential impacts to surface water quality and groundwater quality.

At the same time, demand for water in the region has continued to grow. To address these challenges, water purveyors in the region have invested substantial time and resources in a progression of regional planning efforts. In particular, the planning efforts most directly related to SCWA's efforts include:

- The Water Forum
- The Central Sacramento County Groundwater Forum (CSCGF)
- Completion of the Draft 2002 Zone 40 Water Supply Master Plan (WSMP) (SCWA, December 2002)
- Completion of the Draft Environmental Impact Report (EIR) for the Draft 2002 Zone 40 Water Supply Master Plan (EDAW, November 2003)
- The Regional Water Authority (RWA) and the Sacramento Groundwater Authority (SGA)
- The South Sacramento County Agricultural Water Authority (SSCAWA) and The Nature Conservancy (TNC).

Each of these regional planning efforts is discussed further below.

Figure 1-1. Boundary of SCWA Zone 40 and Area Covered by this Groundwater Management Plan



1.3.1 Water Forum

Begun in 1993, the Water Forum process brought together a diverse group of stakeholders that included business and agricultural leaders, citizens groups, environmentalists, water managers, and local governments to evaluate available water resources and the future water needs of the Sacramento Metropolitan Region. These stakeholders identified two co-equal objectives to guide the development of the Water Forum Agreement. These are:

- Provide reliable and safe water supply for the region's economic health and planned development through the year 2030; and
- Preserve the fishery, wildlife, recreational, and aesthetic values of the lower American River.

After a six-year consensus-based stakeholder process, the "Water Forum Agreement" (WFA) was completed. The WFA prescribes a regional conjunctive use program for the lower American River and the connected groundwater basin. The Water Forum also completed an "Environmental Impact Report (EIR) for the Water Forum Proposal" (State of California Clearinghouse Number 95082041). This document was certified by the two lead agencies (the City and County of Sacramento) in December 1999.

One of the seven elements of the WFA Plan is groundwater management. Implementation of this element includes adherence to an agreed upon long-term average annual pumping limit (sustainable yield) for each of the three geographic sub-areas of the groundwater basin within Sacramento County: 131,000 acre-feet ("AF") for the North Area (north of the American River); 273,000 AF for the Central Area (between the American and Cosumnes rivers); and 115,000 AF for the Galt or South Area (south of the Cosumnes River). Any proposed water supply project or groundwater management structure must satisfy the groundwater conditions specified in the WFA for the 2030 projected level of development.

The WFA includes Purveyor Specific Agreements (PSA), which define the benefits each water purveyor will receive as a stakeholder and actions each must take to receive these benefits. PSAs for the City of Sacramento and the Sacramento Municipal Utility District (SMUD) also describe commitments by the City of Sacramento, SMUD, and SCWA to address issues related to wheeling and wholesaling of surface water, CVP water transfers, and dry year water supply in Zone 40. A brief summary of SCWA's PSA follows:

- SCWA is responsible for providing wholesale water to an area that includes the Laguna, Vineyard, Elk Grove and Rancho Cordova communities commonly referred to as Zone 40. SCWA will divert firm and intermittent surface water from at or near the mouth of the American River or from the Sacramento River. SCWA will use groundwater and surface water conjunctively to meet water system demands.
- A portion of Zone 40 is situated within the Place of Use (POU) for the City of Sacramento's American River water entitlements (see **Figure 1-1**). It is assumed that these entitlements would be used to serve this area. Conditions for the use of this entitlement will be consistent with the conditions outlined in the City of Sacramento's PSA.
- All signatories to the WFA endorse SCWA's PSA, which provides for the construction of SCWA's water supply facilities. These include a diversion structure at or near the mouth of the American River or from the Sacramento River, treatment plants, pumping stations, wells, storage facilities, and transmission pipelines.
- Stakeholder support is contingent on project specific compliance with the California Environmental Quality Act (CEQA), and where applicable, the National Environmental Policy Act (NEPA), federal Endangered Species Act, and California Endangered Species Act.

Provisions in the WFA led to the establishment of the Sacramento North Area Groundwater Management Authority, now known as the SGA. Through a Joint Powers Agreement, the police powers of the Cities of Sacramento, Citrus Heights, and Folsom, the County of Sacramento, and SCWA are used by SGA for implementation of their adopted Groundwater Management Plan (GMP). SCWA is a member of SGA through their Zone 41 service area located north of the American River.

The WFA also calls for an interest-based negotiation process to provide all segments of the community an opportunity to participate in the development of a groundwater management structure for the Central Basin. This stipulation in the WFA led to the creation of the CSCGF under the aegis of the Water Forum Successor Effort.

1.3.2 Central Sacramento County Groundwater Forum

Acting on behalf of the Water Forum Successor Effort, the California Department of Water Resources (DWR) initiated the CSCGF by signing a Memorandum of Understanding with the Sacramento City-County Office of Metropolitan Water Planning (funded by SCWA and the City of Sacramento) to support discussions among stakeholders representing all segments of the community with an interest in developing a groundwater management structure and ultimately a GMP for the Central Basin. Stakeholders were selected through an area-wide assessment performed by the Water Forum Successor Effort to identify concerns and develop a structure for stakeholders to work together. Interviews were held with 94 stakeholders, resulting in the establishment of six interest groups: agriculture, agriculture/residential, business, environmental/community organizations, local governments/public agencies, and water purveyors. Each interest group is represented by five individuals who participate in the collaborative process known as CSCGF.

The CSCGF is currently in the negotiation phase of developing a governance structure for the Central Basin. Once this phase is completed, the governing body will develop and adopt their own GMP. That plan will supercede the Zone 40 GMP. In the interim, the CSCGF supports SCWA in developing and adopting the GMP in accordance with SB 1938 (Water Code Section § 10750 et seq.).

1.3.3 Zone 40 Water Supply Master Plan and Environmental Documentation

Zone 40 is located in the central portion of Sacramento County as shown in **Figure 1-2** and is entirely within the Central Basin. The WSMP has identified a study area ("2030 study area") within Zone 40 which consists of existing and developing industrial, commercial, office and residential land uses consistent with the City of Elk Grove and Rancho Cordova General Plans and the Sacramento County 1993 General Plan. The 2030 study area is approximately 46,620 acres and is shown as the purple shaded area in **Figure 1-2**.

Water demand is expected to be concentrated within the projected 2030 study areas shown in **Figure 1-2**. However, developments can be proposed and approved anywhere within Zone 40 where they are consistent with the framework and requirements provided in the various General Plans, Community Plans, Comprehensive Plans, Specific Plans, and zoning and subdivision ordinances.

Three retail water purveyors provide service within Zone 40: SCWA Zone 41 (formerly Sacramento County Water Maintenance District), Florin Resource Conservation District/Elk Grove Water Service Company ("FRCD/EGWS"), and the California-American Water Company ("Cal-Am" and formerly Citizens Utilities Company). Zone 40 currently provides wholesale water to a portion of the FRCD/EGWS service area under the terms of the First Amended and Restated Master Water Agreement. It has been assumed that Cal-Am will purchase wholesale water supplies from Zone 40 to serve its Security Park franchise area. The current service areas of these purveyors are shown on **Figure 1-2**.

1.3.4 Sacramento Groundwater Authority (SGA)

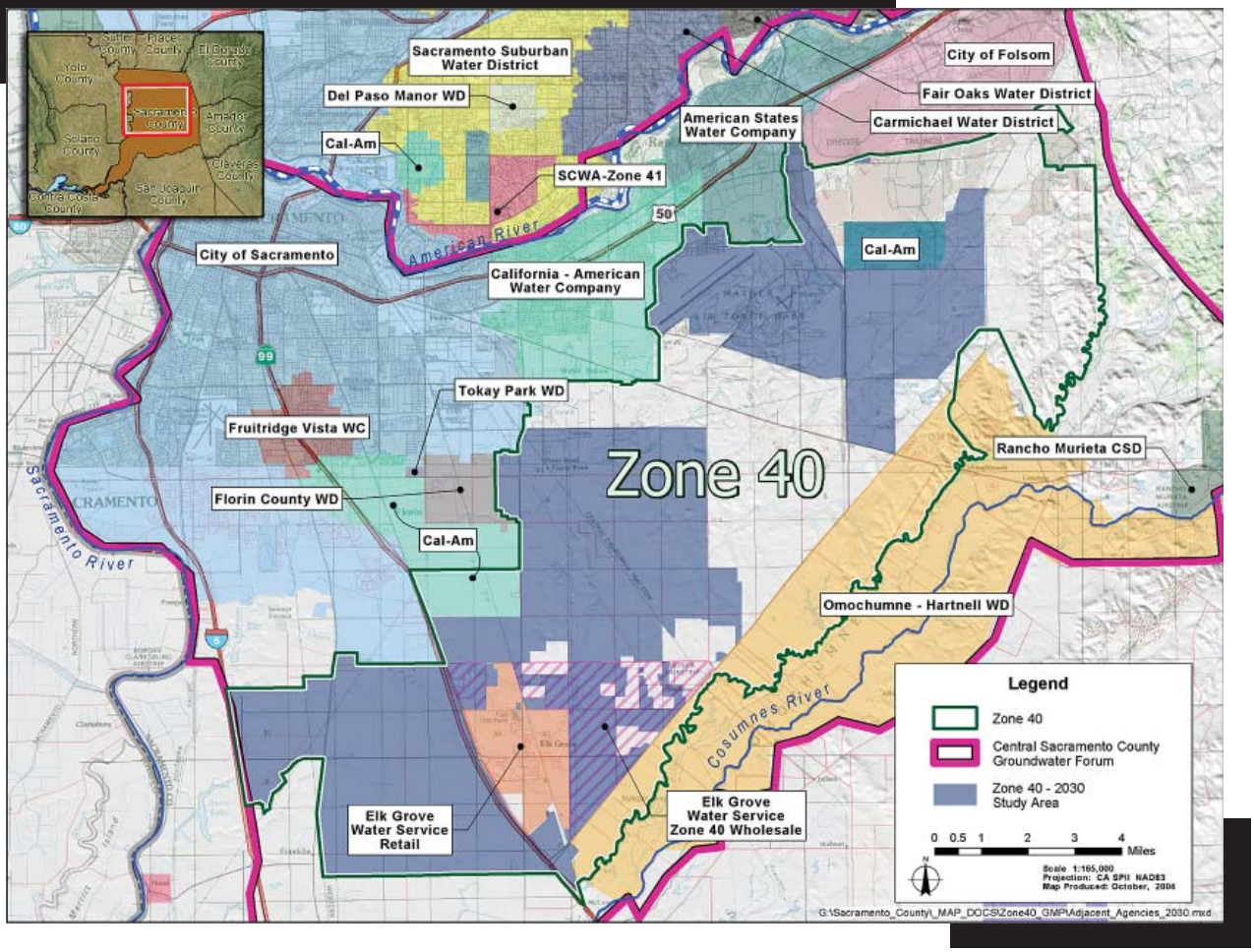
SGA is a joint powers authority (JPA) created to manage the North Basin. SGA's formation in 1998[1] was a result of a coordinated effort by the Sacramento Metropolitan Water Authority (SMWA) and the Water Forum to establish an appropriate management structure for the North Basin.

SGA draws its authority from a joint powers agreement signed by the cities of Citrus Heights, Folsom, and Sacramento, and the County of Sacramento and SCWA to exercise their common police powers to manage the underlying groundwater basin. With this authority, SGA manages the basin through representatives of the 14 local water purveyors and a representative from the agricultural and self-supplied pumpers, these representatives serve as the Board of Directors.[2]

[1] The SGA was originally formed in 1998 as the Sacramento North Area Groundwater Management Authority. In 2002, it was renamed the Sacramento Groundwater Authority.

[2] SGA Board members include representatives of California-American Water Company, Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Sacramento, Sacramento County Water Agency, Del Paso Manor Water District, Fair Oaks Water District, Natomas Central Mutual Water Company, Orange Vale Water Company, Rio Linda/Elverta Community Water District, Sacramento Suburban Water District, San Juan Water District, American States Water Company, and individual representatives from agriculture and self-supplied groundwater users (principally parks and recreation districts).

Figure 1-2. Zone 40 2030 Study Area



At the core of the SGA's management responsibility is a commitment to not exceed the average annual sustainable yield of the North Basin, which was estimated to be 131,000 acre-feet[3] in the WFA.[4] To accomplish this objective and to provide a safe, reliable water supply for a rapidly growing northern Sacramento County, SGA adopted their GMP in December 2003.

1.3.5 Regional Water Authority (RWA)

RWA represents a number of regional water supply interests and assists members in protecting and enhancing the reliability, availability, affordability, and quality of water resources. One of the principal missions of the RWA is facilitating implementation of the conjunctive use program prescribed by the WFA. The RWA currently has eighteen member agencies and three associate members, spanning Placer, Sacramento and El Dorado Counties. The County of Sacramento and SCWA are not members of RWA.

[3] This value was estimated based on water use and facilities in the basin at the time the WFA was adopted. This value was based on a number of assumptions, and was not intended to be a fixed value that could not be modified as conditions and assumptions changed in the basin. Examples of changed conditions include new or improved water conveyance, treatment, and storage facilities or changes in water supply contracts.

[4] The WFA is available online at www.waterforum.org or contact the Water Forum office at (916) 264-1999.

1.3.6 South Sacramento County Agricultural Water Authority (SSCAWA) and The Nature Conservancy (TNC)

The lower Cosumnes River watershed has been a major focus of conservation efforts in the Central Valley and is identified as a priority for ecosystem protection and restoration by both the California Bay-Delta Authority (formerly CALFED) and the USFWS Anadromous Fish Recovery Program, as well as in the Sacramento County General Plan. The Cosumnes channel and its associated floodplains are a major source of recharge for the Central Basin, and declining groundwater levels have adversely effected the river's salmon fishery and other environmental values. One of the goals of the WSMP environmental documentation has been to assess the extent of impairment of Cosumnes River flows and aquatic values that has resulted from historic and ongoing groundwater pumping (both M&I and agricultural) and to explore programmatic opportunities for restoring and maintaining these aquatic values through integrated water management. The Cosumnes River conservation partnership, which includes state, federal, local government, and non-profit land owners and managers, has been represented in the CSCGF process by TNC.

In addition to the natural values of the Cosumnes River corridor, the farmlands of the lower Cosumnes watershed are economically important and provide high value seasonal habitat for threatened and endangered wildlife species. The agricultural interests of the lower Cosumnes River watershed have participated in the CSCGF through the Sacramento County Farm Bureau and the SSCAWA, a joint powers agency comprised of three irrigation districts. SSCAWA and TNC, with the support of SCWA, are in turn actively investigating opportunities for flow restoration, conjunctive management, and enhanced recharge within the Cosumnes River corridor.

Because the ecological values of the Cosumnes River corridor have a statewide significance, and the River presents opportunities for integrated water management, goals of this GMP include the recognition, enhancement, and maintenance of the ecological values of the Cosumnes Rivers.

1.3.7 Other Ongoing Groundwater Management-Related Activities within Zone 40

There are a number of other on-going groundwater-related activities currently underway within Zone 40 and the Central Basin. Coordination between these efforts and SCWA will be discussed in more detail later in this GMP. The activities closely related to SCWA's groundwater management efforts include, but are not limited to, the following:

- Groundwater contamination investigation and remediation activities related to the former Mather Air Force Base now called Mather Field.
- Groundwater contamination investigation and remediation activities related to operations at the Aerojet-General Corporation (Aerojet) and the McDonnell-Douglas (Boeing) facilities.
- Groundwater contamination investigation and remediation activities related to operations at the Kiefer Landfill, and other abandoned landfills within Zone 40.
- Monitoring of groundwater levels and quality through participation in the California Department of Water Resources (DWR) Well Monitoring Program.
- Monitoring of groundwater levels and quality at California State University, Sacramento (CSUS).
- Monitoring of groundwater quality by the U.S. Geological Survey (USGS) as part of its National Water Quality Assessment Program.
- Monitoring of site investigations and remediation efforts at known leaking underground storage tanks (LUSTs) coordinated by the RWQCB.

1.4 PURPOSE OF THE SCWA ZONE 40 GMP

The purpose of this GMP is to maintain a sustainable, high-quality groundwater resource for the users of the groundwater basin underlying Zone 40. Ultimately, this GMP will serve as the framework for a GMP that will cover the entire Central Basin. Development of the Central Basin GMP will be through the governance structure currently under negotiations by the CSCGF (see **Section 1.3.2**).

1.5 AUTHORITY TO PREPARE & IMPLEMENT A GMP

The authority of SCWA to manage the Zone 40 Groundwater Basin is provided through the Water Agency Act. SCWA's Board of Directors elected to prepare this GMP as one of the tools necessary to effectively manage the groundwater basin underlying Zone 40. This GMP is consistent with the provisions of CWC § 10750 et seq. as amended January 1, 2003.

1.6 GMP COMPONENTS

The SCWA GMP includes both required and voluntary components.

Table 1-1 lists these components and indicates the section(s) in which each component is addressed.

Table 1-1. Location of GMP Components

Description		*Section(s)*
A.	**CWC § 10750 et seq., Required Components[5]**	
1.	Documentation of public involvement statement.	Section 3.4; Section 6.3
2.	Basin Management Objectives (BMOs).	Section 3.2
3.	Monitoring and management of groundwater elevations, groundwater quality, inelastic land surface subsidence, and changes in surface water flows and quality that directly affect groundwater levels or quality or are caused by pumping.	Section 3.5; Section 6.4
4.	Plan to involve other agencies located within groundwater basin.	Section 3.4
5.	Adoption of monitoring protocols by basin stakeholders.	Section 3.5
6.	Map of groundwater basin showing area of agency subject to GMP, other local agency boundaries, and groundwater basin boundary as defined in DWR Bulletin 118.	Figures 1-1; 1-2; 2-1
7.	For agencies not overlying groundwater basins, prepare GMP using appropriate geologic and hydrogeologic principles.	N/a
B.	**DWR's Recommended Components[6]**	
1.	Manage with guidance of advisory committee.	Section 3.4.3
2.	Describe area to be managed under GMP.	Section 1; Section 2
3.	Create link between BMOs and goals and actions of GMP.	Section 3.2
4.	Describe GMP monitoring program.	Section 3.5
5.	Describe integrated water management planning efforts.	Sections 1.3; 1.4; 3.8
6.	Report on implementation of GMP.	Section 4.1
7.	Evaluate GMP periodically.	Section 4.1; 4.2
C.	**CWC § 10750 et seq., Voluntary Components[7]**	
1.	Control of saline water intrusion.	Section 3.6.6
2.	Identification and management of wellhead protection areas and recharge areas.	Section 3.6.3; 3.6.4
3.	Regulation of the migration of contaminated groundwater.	Section 3.6.5
4.	Administration of well abandonment and well destruction program.	Section 3.6.2
5.	Mitigation of conditions of overdraft.	Section 3.7
6.	Replenishment of groundwater extracted by water producers.	Section 3.2
7.	Monitoring of groundwater levels and storage.	Section 3.5, 6.4
8.	Facilitating conjunctive use operations.	Section 3.4.2; 3.7; 3.8.1
9.	Identification of well construction policies.	Section 3.6.1
10.	Construction and operation by local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.	Section 2.6; 2.7; 2.9
11.	Development of relationships with state and federal regulatory agencies.	Section 3.4.4
12.	Review of land use plans and coordination with land use planning agencies to assess activities that create reasonable risk of groundwater contamination.	Section 3.8

[5] CWC § 10750 et seq. (seven required components). Recent amendments to the CWC § 10750 et seq. require GMPs to include several components to be eligible for the award of funds administered by DWR for the construction of groundwater projects or groundwater quality projects. These amendments to the CWC were included in Senate Bill 1938, effective January 1, 2003.

[6] DWR Bulletin 118 (2003) components (seven recommended components).

[7] CWC § 10750 et seq. (12 voluntary components). CWC § 10750 et seq. includes 12 specific technical issues that could be addressed in GMPs to manage the basin optimally and protect against adverse conditions.

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SECTION 2

WATER RESOURCES SETTING

SECTION 2

This section describes the current understanding of surface and subsurface features within the Central Basin underlying Zone 40. Locations and classifications of the different types of groundwater users within the Central Basin are shown in ***Figure 3-2****. Within Zone 40's boundaries, public retail water purveyors (i.e., Zone 41, FRCD/EGWS, and Cal-Am) currently rely exclusively on groundwater or a combination of surface water and groundwater. Groundwater and surface water supplies available to the basin are summarized below.*

Zone 40 currently utilizes groundwater, surface water, and recycled water. Zone 40 also implements the 16 Best Management Practices for water conservation as set forth in the SCWA's Urban Water Management Plan and in the Water Forum Agreement.

WATER RESOURCES SETTING

2.1 GROUNDWATER SUPPLIES

This section provides a regional description of the geologic and hydrogeologic conditions of the underlying groundwater basin. A map showing the area of the South American River Subbasin, as defined by DWR Bulletin 118 (2003), and the Zone 40 boundary within this basin is presented in **Figure 2-1**.

The South American Subbasin is defined as the area bounded on the west by the Sacramento River, on the north by the American River, on the south by the Cosumnes and Mokelumne Rivers, and on the east by the Sierra Nevada Range. Bulletin 118 provides additional information about the South American Subbasin on the agency's Web site[8] including:

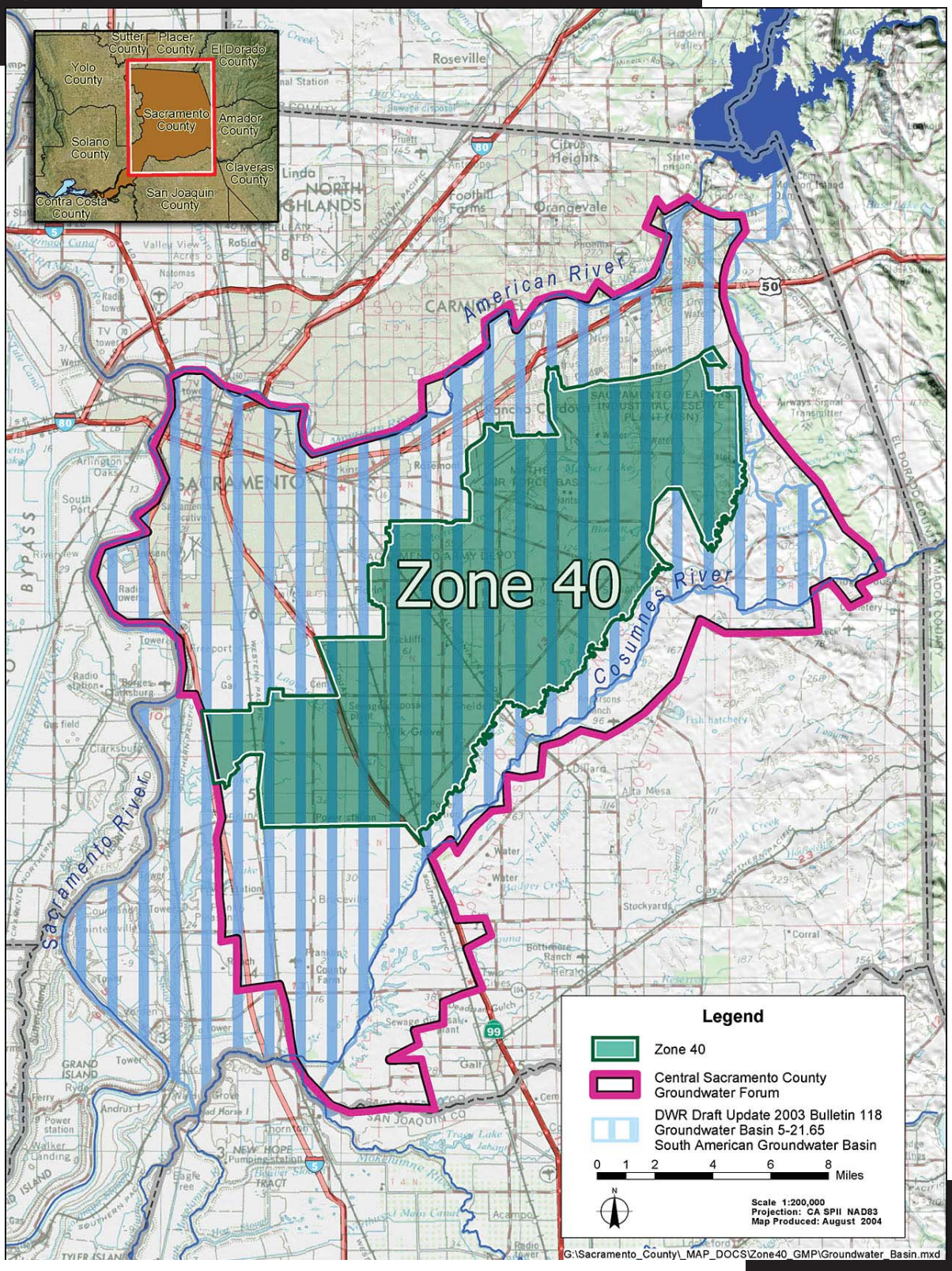
- Surface Area: 388 square miles.
- The perennial rivers that surround the subbasin generally create a groundwater divide in the shallow subsurface. It is clear that there is interaction between groundwater of adjacent subbasins at greater depths.
- Average annual precipitation in the basin ranges from about 14 inches along the western boundary to greater than 20 inches along the eastern boundary.
- The eastern basin boundary is defined by the uprising foothills of the Sierra Nevada and is a north-south line extending from Folsom Reservoir south to the small community of Rancho Murieta. This represents the approximate edge of the alluvial basin where little or no groundwater flows into or out of the groundwater basin from the Sierra Nevada foothills. The western portion of the subbasin consists of nearly flat flood plain deposits from the Sacramento, American, and Cosumnes rivers, and several small east side tributaries.

[8] At: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/5-21.64_North_American.pdf

2.1.1 Overview of Hydrogeologic Setting

The groundwater resources of Sacramento County have been extensively investigated and reported in the DWR Bulletin 118-3, Evaluation of Ground Water Resources: Sacramento County (July, 1974).

Figure 2-1. Location of South American Groundwater Subbasin



2.2 HYDROSTRATIGRAPHY OF ZONE 40 AREA

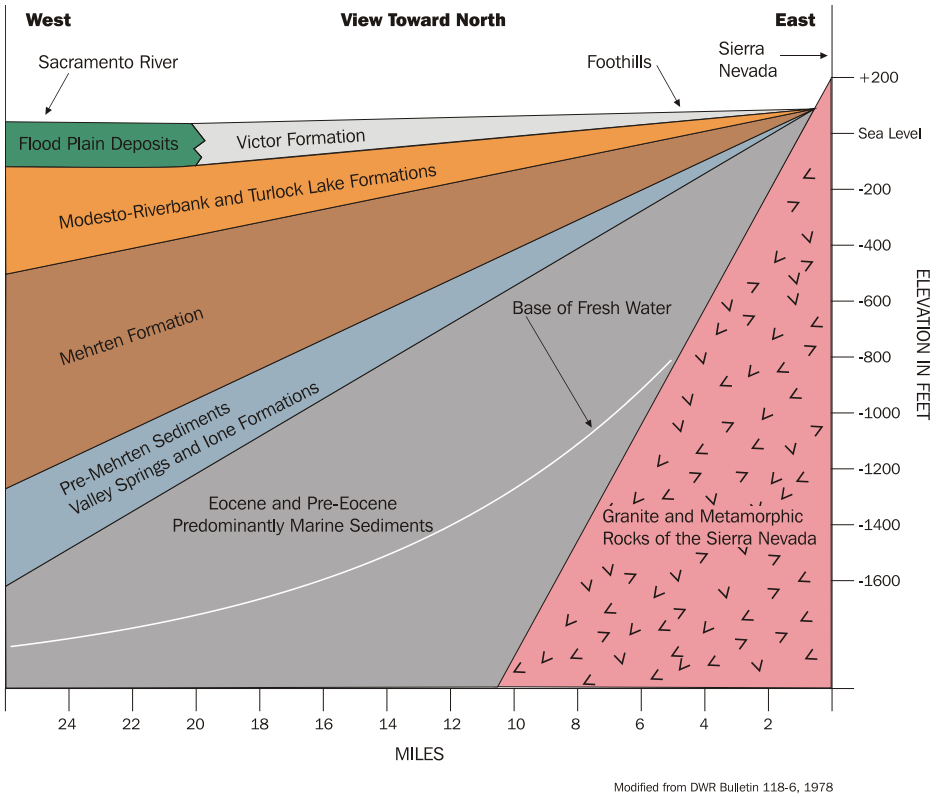
Bulletin 118-3 identifies and describes the various geologic formations that constitute the water-bearing deposits underlying Sacramento County. These formations include an upper, unconfined aquifer system consisting of the Victor, Fair Oaks, and Laguna Formations (now known as the Modesto Formation), and a lower, semi-confined aquifer system consisting primarily of the Mehrten Formation known for its fine black sands. These formations are shown on **Figure 2-2** and are typically composed of lenses of inter-bedded sand, silt, and clay, interlaced with coarse-grained stream channel deposits. **Figure 2-2** illustrates that these deposits form a wedge that generally thickens from east to west to a maximum thickness of about 2,500 feet under the Sacramento River. The Mehrten formation outcrops near the Sierra Foothills along the eastern Zone 40 boundary and is typically characterized as a black sandy lens.

Groundwater in the Central Basin is generally classified as occurring in a shallow aquifer zone (Laguna or Modesto Formation) or in an underlying deeper aquifer zone (Mehrten Formation). Within Zone 40 the shallow aquifer extends approximately 200 to 300 feet below the ground surface and, in general, the water quality in this zone is considered to be good except for the occurrence of arsenic in some locations. The shallow aquifer is typically targeted for private domestic wells requiring no treatment unless high arsenic values are encountered.

The deep aquifer is separated from the shallow aquifer by a discontinuous clay layer that serves as a semi-confining layer for the deep aquifer. The base of the potable water portion of the deep aquifer averages approximately 1,400 feet below the ground surface. Water in the deep aquifer typically has higher concentrations of total dissolved solids (TDS), iron, and manganese. Groundwater used in Zone 40 is supplied from both the shallow and deeper aquifer systems.

Older municipal wells and all domestic wells have been constructed in the shallow aquifer zone to avoid treatment. However, Zone 40 policies and practices has led to the construction of larger municipal wells that target the Mehrten Formation where higher production rates can be achieved and less impact to private domestic wells occur. This policy requires treatment of all municipal wells to

Figure 2-2. Regional Stratigraphic Column



Modified from DWR Bulletin 118-6, 1978

meet primary and secondary drinking water quality standards. This is discussed in more detail in the following section.

2.3 GROUNDWATER QUALITY

As mentioned previously, water quality in the upper aquifer system is regarded as superior to that of the lower aquifer system. The upper aquifer is preferred over the lower aquifer principally because the lower aquifer system (specifically the Mehrten formation) contains higher concentrations of iron and manganese. Water from the upper aquifer generally does not require treatment (other than disinfection). The lower aquifer system also has higher concentrations of total dissolved solids (TDS, a measure of salinity) than the upper aquifer, although it typically meets water quality standards as a potable water source. In general, groundwater at depths of approximately 1,400 feet or greater (actual depth varies throughout the basin), the TDS concentration exceeds 2,000 milligrams per liter (mg/L). At these concentrations, groundwater is considered to be non-potable unless reverse osmosis treatment is used to remove the dissolved solids.

Background Water Quality. Source groundwater quality meets all California Code of Regulations (CCR) Title 22 primary and secondary drinking water quality standards, with the exception of iron, manganese, and arsenic. A number of Zone 40's wells exceed secondary drinking water standards for iron and manganese. Secondary standards were established for aesthetic concerns (e.g., staining of laundry and porcelain fixtures), and at elevated levels do not pose a health hazard. Arsenic concentrations in six wells have been measured at levels that exceed recently implemented federal drinking water standards of 10 micrograms per liter (µ/L) (January 2001); these regulations require compliance by January 2006. Radon has also been measured in the groundwater in the greater Sacramento County area, although not at levels exceeding the current drinking water standards.

This description of background water quality is based on data used to populate the Data Management System (DMS). Available groundwater quality data from monitoring between 1999 and 2003 were used to populate the DMS for the Zone 40 groundwater basin. The DMS can be used to query data and develop statistics and graphics for the constituents included in this evaluation.

Total Dissolved Solids. TDS concentrations in most municipal wells are within the secondary drinking water standard; therefore, TDS does not limit the potable use of groundwater by Zone 40.

Iron and Manganese. Iron and manganese is found in the deeper Zone 40 wells and requires treatment through the addition of chlorine and pressurized sand filtration; therefore, iron and manganese does not limit the potable use of groundwater by Zone 40. Iron concentrations range from non-detect (less than 10 µg/L) to 16,000 mg/L, although most wells have average values less than 200 mg/L. Manganese concentrations range from non-detect (less than 2 mg/L), to 1,700 mg/L, although most wells have average values less than 50 mg/L.

Arsenic. Arsenic levels for individual wells and groundwater treated at a treatment plant are within the current primary drinking water standards; therefore, arsenic will not limit the potable use of groundwater. Prior to January 2006, wells that exceed the new arsenic standard and are not treated will be phased out and replaced through new construction or rehabilitation to deliver untreated water to an existing or future groundwater treatment plant.

Known "Principal" Contaminant Plumes. Principal groundwater contaminant plumes within or near the Zone 40 area are known to exist from source areas at Mather Field, Aerojet, and Boeing are shown on **Figure 2-3**. Contaminant plume data was collected from the following documents:

Montgomery Watson Harza (MWH). Mather Air Force Base Annual and Fourth Quarter 2002 Sitewide Groundwater Monitoring Report. March 2003.

Aerojet Environmental Remediation. Aerojet General Corp Superfund Site, Western Groundwater Cleanup 2004 Progress Report.

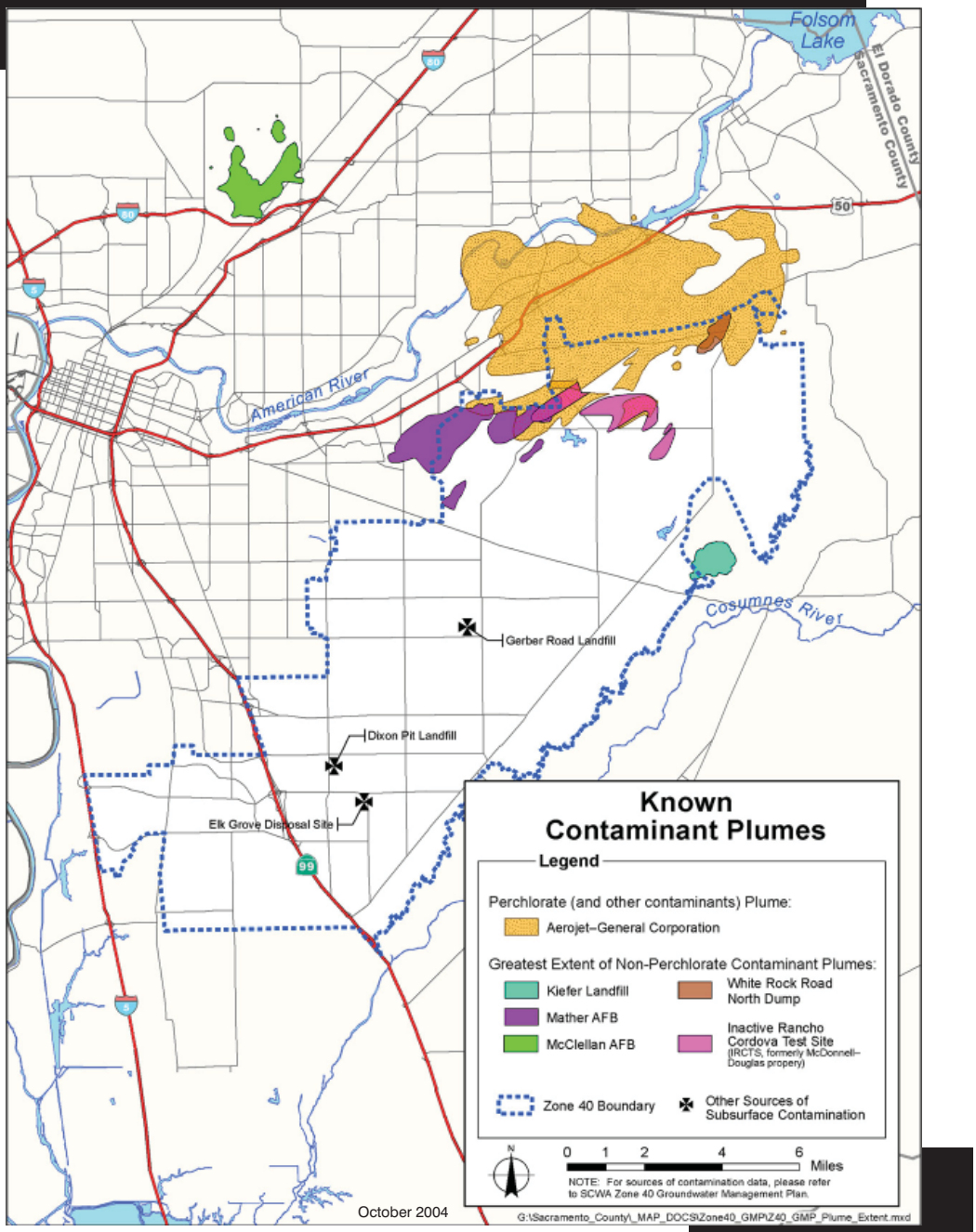
McDonnell Douglas/Boeing Environmental Remediation. McDonnell Douglas Sacramento Site, American River Study Area Groundwater Monitoring Results, April – June 2002. August 2002.

Disposal Sites. Integrated Waste Management Board.

Inactive Rancho Cordova Test Site. Figure 1 of ENSR 2001 Report showing well locations used in model development.

Although other localized plumes exist in and around Zone 40, the principal plumes shown in **Figure 2-3** are the largest and have the greatest current impact on existing groundwater

Figure 2-3. Principle Contaminant Plumes



use. For the Mather Field plumes, the primary Contaminants of Concern (COCs) are tetrachloroethylene (TCE), perchloroethylene (PCE), and carbon tetrachloride. The Mather Field plume edges represent a composite COC concentration of 0.5 mg/L, which is one-tenth of the maximum contaminant level (MCL) for these constituents.

For the Aerojet and Boeing plume, the primary COCs are TCE, n-nitrosodimethylamine (NDMA), and perchlorate.

There are currently 106 active leaking underground fuel tank (LUFT) sites within Zone 40 (source: http://geotracker.swrcb.ca.gov). While many sites can be fully remediated, the aggregate impact from undetected contamination on groundwater quality in the basin cannot be determined at this time and may ultimately be considerable.

2.4 Recharge and Extraction of Groundwater in Sacramento County

Evaluating changes in aquifer conditions requires an understanding of the dynamic processes and interactions that are taking place as extractions and recharge of the aquifer occur. Conceptual models of the aquifer that describe induced recharge, aquifer storage, and differences between localized and regional effects on the aquifer are discussed below. These conceptual models are meant to clarify concepts; not all aspects of groundwater hydraulics are described. These models only apply to the Central Basin and adjoining basins within Sacramento County.

Recharge. Groundwater in Central Sacramento County moves from sources of recharge to areas of discharge. Recharge to the local aquifer system occurs along active river and stream channels where extensive sand and gravel deposits exist, particularly along the American, Cosumnes, and Sacramento River channels. Additional recharge occurs along the eastern boundary of Sacramento County at the transition point from the consolidated rocks of the Sierra Nevada to the alluvial deposited basin sediments. This typically occurs through fractured granitic rock that makes up the Sierra Nevada foothills. Other sources of recharge within the area include deep percolation from applied surface water, precipitation, and small streams.

Changes in the groundwater surface elevation (or piezometric surface) result from changes in groundwater recharge, discharge, or extraction. In some instances, this change in groundwater elevation can induce natural recharge at locations where rivers or streams and the aquifer are hydraulically connected. To the extent that a hydraulic connection exists, as groundwater conditions change, the slope or gradient of the groundwater surface may change as well. A steeper gradient away from the stream would induce higher recharge from surface water into the aquifer.

The rate of recharge from streams that are hydraulically disconnected from the groundwater surface is indifferent to changes in groundwater elevations or gradient. This is typically true with smaller streams where the groundwater surface is located far below the streambed. In such cases, surface water percolates through the unsaturated zone to the groundwater and its rate is a function of the aquifer materials underlying the streambed and the water level in the surface stream. The rate of infiltration under these conditions is not controlled by the change in elevation of the underlying groundwater. In the case of larger rivers, the American and Sacramento Rivers are considered to be hydraulically connected and the Cosumnes River is considered to be hydraulically disconnected in the lower reaches of the river that flow into the Central Basin. This GMP recognizes the importance of maintaining hydraulic connections with the larger river sources for sustainability of the groundwater supply and the environmental benefits of keeping water flowing in the riverbed.

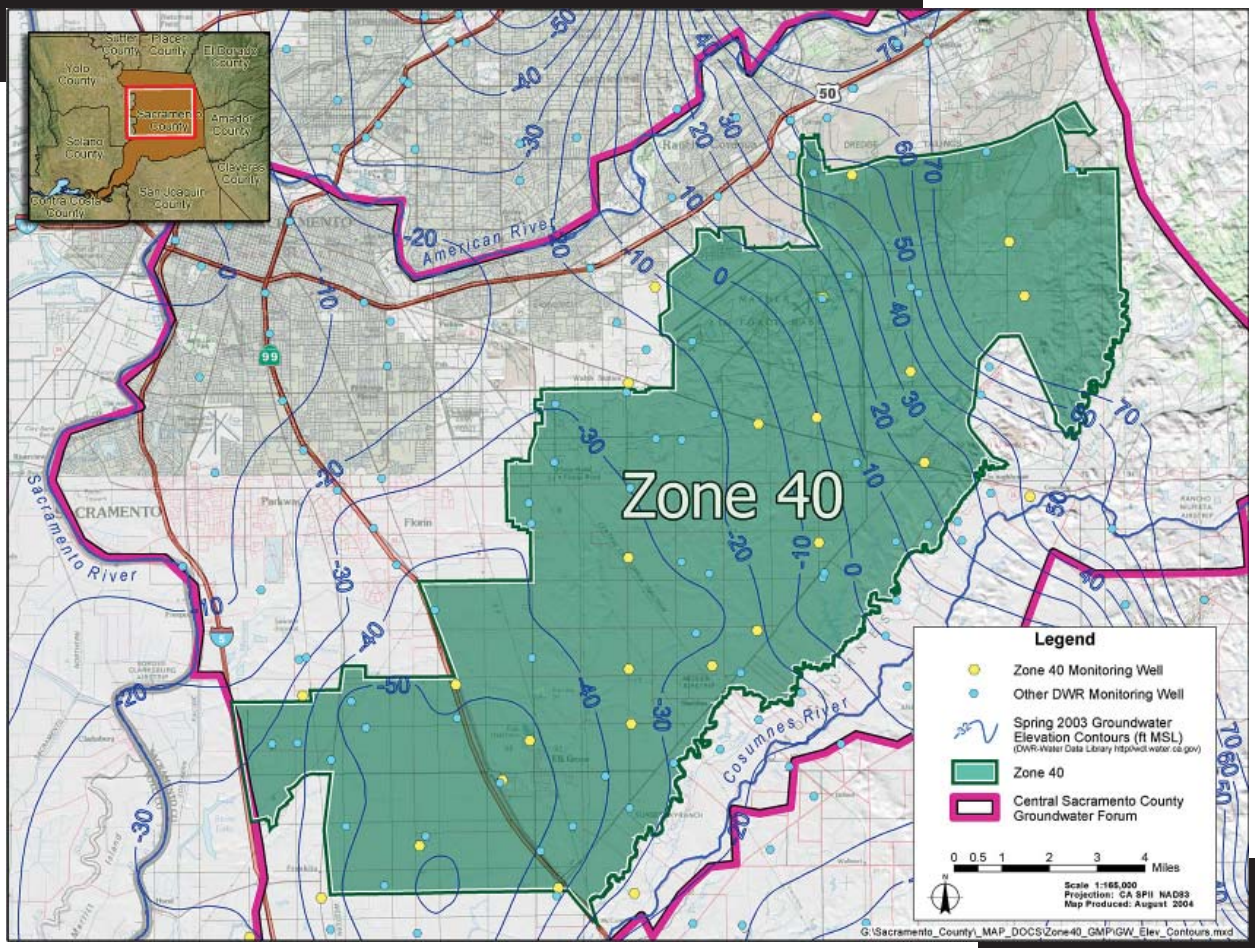
Localized Impacts of Groundwater Extraction. When extractions occur from a single well, a concentrated localized cone of depression is formed around the well. The shape and depth of the localized cone of depression depends on several factors including, but not limited to: (1) the rate of extraction, (2) the presence of nearby sources of recharge and/or extraction, (3) aquifer transmissivity, (4) natural impervious barriers or earthquake faults, and (5) the "confined" or "unconfined" state of the aquifer, (i.e., storage coefficient). Over time, extraction from an unconfined aquifer can de-water the aquifer around the well. However, when extraction ceases, the water level within the aquifer typically rebounds to its pre-extraction condition.

A confined or semi-confined aquifer behaves differently since the water is under pressure from a recharge source. Instead of de-watering the aquifer, a change in confining pressure occurs as a result of extractions; the aquifer remains saturated. In a confined aquifer, the pressure or piezometric surface elevation decline is more dramatic than in an unconfined aquifer; however, the recovery to pre-extraction conditions is typically much faster.

Regional Impacts of Groundwater Extraction. Large regional cones of depression can form in areas where multiple groundwater extraction wells are in operation. The location and shape of a regional cone of depression is influenced by the same factors as a single well. The regional cone of depression within Zone 40 is shown on **Figure 2-4**, as part of a water elevation contour map for spring of 2003. This map was prepared using water elevation data from DWR's water data library available on-line at: http://wdl.water.ca.gov. The map contours were determined using the Inverse Distance to a Power method.

Fluctuations in regional cones of depression are measured over years and result from: (1) changes in recharge, and (2) changes in extractions from increasing and decreasing

Figure 2-4. Spring 2003 Groundwater Elevation Contours



water demands. For example, a sequence of successive dry years can decrease the amount of natural recharge to the aquifer. If this is coupled with a coinciding increase in groundwater extraction, an imbalance is created between natural recharge and extractions. Consequently, groundwater elevations would decrease in response to this imbalance. Over time, the shape and location of the aquifer's regional cone of depression fluctuates.

The Inverse Distance to a Power gridding method was used to contour the water elevation data posted on **Figure 2-4**. This contouring method is a weighted average interpolator and is best used when there is a uniform distribution of data. With Inverse Distance to a Power, data are weighted during interpolation such that the influence of one point relative to another declines with distance from the grid node. Normally, Inverse Distance to a Power behaves as an exact interpolator. When calculating a grid node, the weights assigned to the data points are fractions, and the sum of all the weights are equal to 1.0.

Intensive use of the groundwater basin has resulted in a general lowering of groundwater elevations near the center of the basin away from the sources of recharge. As early as 1968, pumping depressions were evident in the Central Basin. These depressions have grown and coalesced into a single cone of depression centered in the southern portion of the Zone 40 area as shown in **Figure 2-4**.

Groundwater Level Trends. A review of 11 long-term hydrographs as shown in **Figure 2-5** shows a pattern of groundwater level trends through much of Zone 40. Groundwater elevations generally declined consistently from the 1950s-1960s to about 1980 on the order of 20-30 feet. From 1980 through 1983 water levels recovered by about 10 feet and remained stable until the beginning of the 1987 through 1992 drought. From 1987 until 1995, water levels declined by about 15 feet. From 1995 to 2003 most water levels recovered

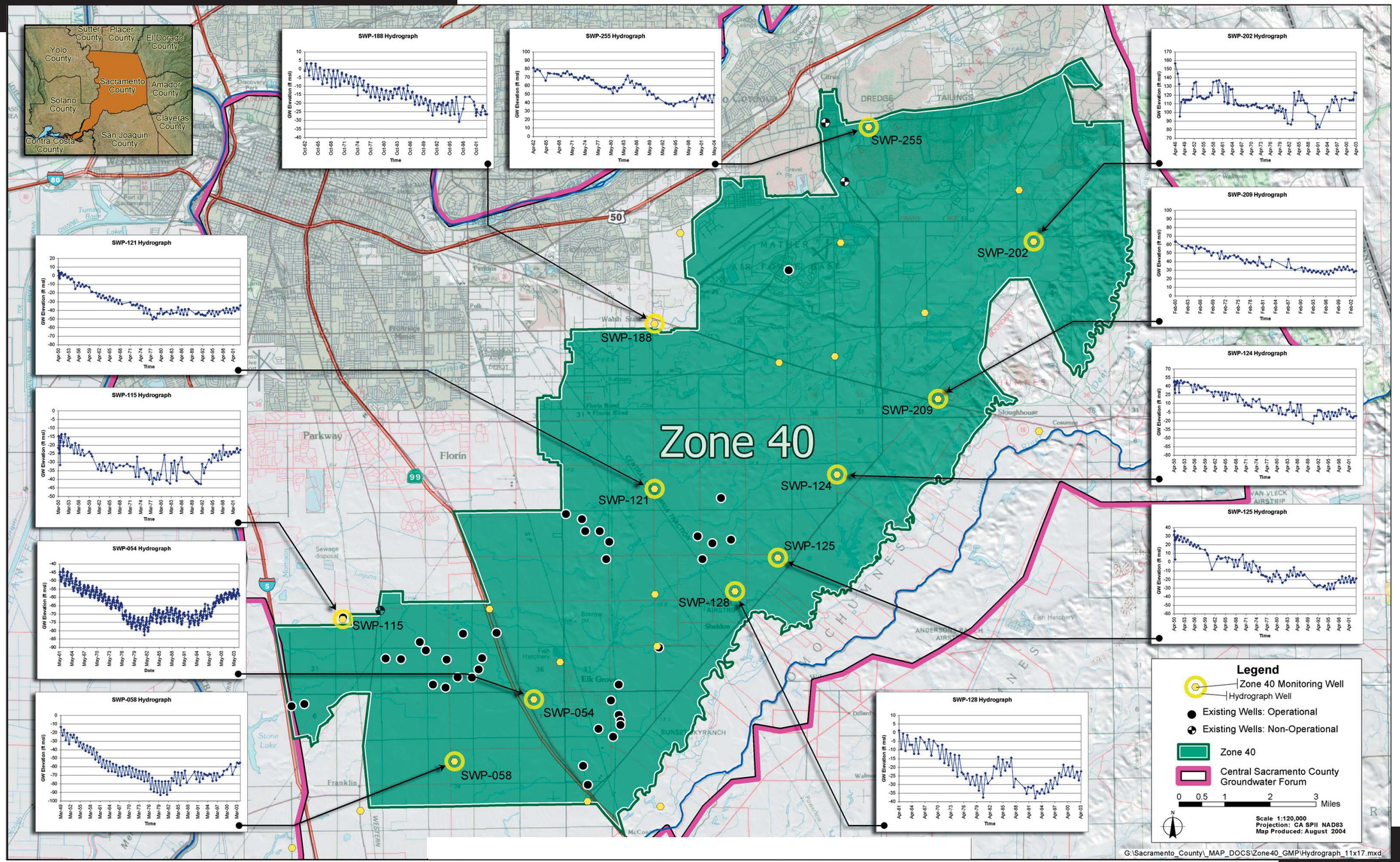
generally higher than levels prior to the 1987 through 1992 drought. Much of this recovery can be contributed to the higher use of surface water in Zone 40 and the fallowing of agricultural areas as they transitioned into new development areas in accordance with the General Plan.

Southern Area. The southern portion of Zone 40 extends from Interstate 5 to just east of Highway 99. Groundwater level trends in this area can be seen in hydrographs from wells SWP-115, SWP-058, and SWP-054 shown on **Figure 2-5**. The hydrographs for these wells show groundwater levels varying between 10 and 90 feet below mean sea level (MSL) between wells.

Central Area. The central portion of Zone 40 is the area between Highway 99 and Highway 16 (Jackson Highway). Groundwater level trends in this area can be seen in hydrographs from wells SWP-121, SWP-124, SWP-125, SWP-128, SWP-188 shown on **Figure 2-5**. The hydrographs for these wells show groundwater levels varying between 40 feet above to 40 feet below MSL between wells.

Northern Area. The northern portion of Zone 40 is the area north of Highway 16 (Jackson Highway). The general trend in this area is more stable than the other areas. Water level trends in this area can be seen in hydrographs from wells SWP-255, SWP-202, and SWP-209. The hydrographs for these wells show declines of about 40 feet since 1960.

FIGURE 2-5. Zone 40 Groundwater Elevation Hydrographs



2.5 SURFACE WATER SUPPLIES

Current water supply for Zone 40 is groundwater, recycled water, and surface water. To date, surface water has met less than 12% of Zone 40's water demands each year. SCWA's surface water contracts provide for two points of diversion, at or near the mouth of the American River or just north of the community of Freeport on the Sacramento River.

Approximately 4,500 AF/year of surface water (a portion of SCWA's 15,000 AF/year CVP contract water [P.L. 101-514]) is diverted at the City of Sacramento's Sacramento River Water Treatment Plant (SRWTP). This water is then wheeled through the City of Sacramento's conveyance facilities to a connection with Zone 40 facilities in Franklin Boulevard for use in the southern portion of Zone 40. In addition, there is approximately 2,066 AF/year of surface water used in the Sunrise Corridor service area which is purchased from American States Water Company as a short-term replacement for groundwater capacity lost as a result of contamination by Aerojet. Major surface water sources in the vicinity of Zone 40 include the American River to the north, Sacramento River to the west, and Cosumnes River to the southeast. Other surface water sources within or near Zone 40 include Deer Creek, which is tributary to, and parallels the Cosumnes River on the north, and the Morrison Creek Stream Group (Morrison, Elder, Gerber, Unionhouse, Florin, and Laguna creeks), which generally flow in a southwesterly direction across the Central Basin. This section describes the major surface water supplies available to Zone 40. **Table 2-1** is excerpted from the WSMP to indicate the existing and future surface water supplies being pursued at this time. The description for each of the supplies is provided in the table notes below.

Table 2-1. Detail of Surface Water Supply Components

Component		*Water Source(s)*	*Entitlement Amount (AF/year)*	*Estimated Long Term Average Use(AF/year)*	*Reliability*
Appropriative Water Supplies		American and Sacramento River	Undetermined	14,600	Low
CVP Supplies	SMUD 1 Assignment	American River	15,000	13,000	Moderate
	SMUD 2 Assignment	American River	15,000	13,000	Moderate
	"Fazio" Water (PL 101-514)	American River	15,000	13,600	Moderate
Other Water Supplies	Other Transfer Water Supplies	American and Sacramento River	Undetermined	6,400	Variable (Moderate to High)
	Purchase of Water From City for Use Within the American River POU	American River	9,300	9,300	High
	Total Surface Water		87,300	69,900	

Source: WSMP

Notes

1. Appropriative Water. SCWA has submitted an application to the State Water Resources Control Board (SWRQB) for the appropriation of water from the American and Sacramento Rivers (the Board authorized submittal of this application on May 30, 1995). This water is considered intermittent water that typically would be available during the winter months of normal or wet years. This water could be used for groundwater recharge.
2. SMUD 1 Surface Water Assignment. Under the terms of a three party agreement (SCWA, SMUD, and the City), and in accordance with SMUD's PSA, the City provides surface water to SMUD for use at two of SMUD's cogeneration facilities. SMUD, in turn, will assign 15,000 AF/year of its USBR CVP contract water to SCWA for M&I use. As the cogeneration facilities are located within the City's American River POU, authorization by State Water Resources Control Board (SWRCB) is not required. This CVP contract assignment is complete.
3. SMUD 2 Surface Water Assignment. SMUD's PSA directs SMUD to assign a second 15,000 AF/year to SCWA and for SCWA to construct groundwater facilities necessary to meet SMUD's dry year water shortages of up to 10,000 AF/year. This CVP contract assignment is complete.
4. CVP Water Public Law 101-514 ("Fazio" Water). In April 1999, SCWA obtained a CVP water service contract pursuant to PL 101-514 that provides a permanent water supply to Zone 40 of 15,000 AF/year.
5. Other Water Supplies. SCWA enters into purchase and transfer agreements with other entities that currently hold surface water rights in the north Sacramento River basin. This water could be used for groundwater recharge.
6. Purchase of Water from the City for use Within the American River POU. SCWA's PSA directs SCWA to enter into an agreement with the City whereby the City will sell surface water to SCWA for use in the portion of Zone 40 that lies within the City's American River POU.

2.5.1 Surface Water Conditions

2.5.1.1 Sacramento River

The Sacramento River drainage basin upstream of Zone 40 encompasses approximately 23,500 square miles and produces an average annual runoff of about 17,000,000 acre-feet (AF) as measured at the Freeport gaging station (below the confluence with the American River). Principal reservoirs controlling flows in the lower Sacramento River include Lake Shasta (4,552,100 AF) on the Sacramento River upstream of Redding, Trinity Lake (2,448,000 AF), which regulates deliveries made to the Sacramento River from the Trinity River basin, Lake Oroville (3,538,000 AF), and Folsom Reservoir (975,000 AF). Based on the 30-year record of data for the period 1968 through 1998, which spans a variety of water year types, individual monthly average flows have ranged from a low of 4,500 cubic feet per second (cfs) in October 1978 to a maximum of 87,000 cfs in January 1997. Overall, the average monthly flows of all 30 years range between 13,000 and 40,600 cfs, with the lowest flows occurring in October and peak flows in February. The 30-year average monthly flow during the wetter months of December through May is 32,200 cfs. During the typically drier months of June through November, the average monthly flow is 16,500 cfs.

2.5.1.2 American River

The American River drainage basin encompasses approximately 1,900 square miles. Folsom Reservoir is the principal reservoir in the basin with a capacity of 975,000 AF. Several smaller upstream reservoirs contribute another 820,000 AF of storage capacity. Nimbus Dam impounds Lake Natoma downstream of Folsom Dam and regulates releases from Folsom Reservoir to the lower American River. The entrance facilities to the Folsom South Canal are located along the south shore of Lake Natoma immediately upstream of Nimbus Dam. Mean annual flow in the lower American River is 3,300 cfs and the design capacity of the channel for flood flows is 115,000 cfs.

2.5.1.3 Cosumnes River

The Cosumnes River watershed extends from the headwaters, at an elevation of approximately 7,500 feet on the western slope of the Sierra Nevada, to the confluence with the Mokelumne River, approximately 10 miles south of the Zone 40 area. The Cosumnes River is the last major river on the western slope of the Sierra Nevada with no major dams. Minor dams on the river are used for recreational purposes. The hydrology of the Cosumnes River has changed substantially since development of the region and was likely the source of surface water diversions for agriculture since the 1800s. Until the 1940s, the Cosumnes River flowed year-round because it received baseflow from the extensive floodplain aquifer. Historical data suggest that flow volumes in the lower basin steadily decreased from 1942 to 1982, with more frequent periods of very low or no flow. During September and October, flows in the river are 27-30 cfs at Michigan Bar. Currently, surface flow ceases in a 5- to 10-mile section of the river (between Meiss Road and State Route 99) nearly every year at the end of California's dry season. Groundwater pumping is at least partly responsible for the decline in fall flows.

The ecological values of the Cosumnes River are of interest to many state, federal, and private institutions such as CALFED, AFRP, World Heritage Site, TNC, etc. The above mentioned low flows in the Cosumnes river attribute to a degradation of fishery, wildlife, recreational, and aesthetic resources of the lower Cosumnes River. Water temperature is also an issue associated with flow impairment and poses a threat to the salmon fishery.

2.5.2 Surface Water Quality

Based on the most current Watershed Sanitary Surveys for the American and Sacramento Rivers, both rivers are an excellent source of supply for drinking water in the Sacramento Metropolitan Area. These source waters can be treated to meet all Title 22 drinking water standards using both conventional and direct filtration processes, as well as membranes. There are no persistent constituents in the raw waters that require additional treatment processes. However, there are seasonal treatment requirements at times for rice herbicides on the Sacramento River. This treatment requirement is addressed through chemical oxidation processes. High turbidities during storm events are a treatment challenge which can be managed by optimizing operations including adjusting chemical types and dosing schemes and by reducing plant flow (Montgomery Watson and Archibald & Wallberg, 2000).

Primary drinking water standards are set for constituents that cause adverse impact to human health. Secondary drinking water standards are set for constituents that cause unpleasing aesthetic impact on the water quality; these are

not health-based standards. There were no violations of primary or secondary drinking water standards reported in any treated surface water supply.

2.5.2.1 American River

Surface water quality in the American River is a function of the mass balance of water quality from tributary streams, diversions, agricultural return flows, subsurface drainage flows, permitted discharges from municipal and industrial (M&I) sources, and urban runoff. In general, the quality of water in the American River is high from the river's headwaters to its confluence with the Sacramento River. It is low in alkalinity, low in disinfection by-product precursor materials, low in mineral content, and low in organic contamination. Limited data also indicate that the water is low in microbial contamination from Giardia and Cryptosporidium. Turbidity levels in the American River tend to be higher in the winter than summer because of higher flows associated with winter storms.

Lower American River at the City of Sacramento's E.A. Fairbairn Water Treatment Plant. The City of Sacramento diverts water on the lower American River just downstream of the Howe Avenue crossing at the E.A. Fairbairn WTP. This water may be used by other entities within the American River POU on a wholesale basis. Water diverted at the plant undergoes conventional treatment and disinfection. The treated water meets all current Title 22 drinking water quality standards (Archibald & Wallberg and MWH, 2003).

2.5.2.2 Sacramento River

Sacramento River water quality is largely influenced by a mass balance of water quality from upstream reservoir release operations, tributary flows (including the lower American River), agricultural runoff, subsurface drainage flows, and diversions, with other impacts from permitted discharges from M&I sources, urban runoff and spills. In general, the quality of the Sacramento River is high in the vicinity of Zone 40. There are moderate amounts of alkalinity and minerals and low levels of disinfection by-product precursors. Turbidity levels in the Sacramento River are higher during the winter and early spring months, usually associated with reservoir releases or runoff from storm events. There are very infrequent detects of organic chemicals, many of which are pesticides or herbicides from agricultural operations. Data collected to date indicate that there is a low prevalence of Giardia and Crytposporidium in the river, with protozoa only detected sporadically and at very low concentrations.

The characterization of the Sacramento River water quality in the vicinity of Zone 40 is based on reports from the SRWTP (Sacramento River Watershed Sanitary Survey; 1995 Report and 2000 Update, prepared by MWH and Archibald & Wallberg).

Sacramento River at the City of Sacramento's SRWTP. The City of Sacramento diverts water from the Sacramento River just downstream of the confluence with the American River. This water can be supplied to Sacramento and other entities within the place of use on a wholesale basis.

Sacramento treats water using conventional treatment processes (i.e., flocculation, sedimentation, and filtration) with chlorine disinfection. Treated water quality meets or exceeds all federal and state drinking water standards under current operations. Sacramento includes corrosion control in their treatment of the water.

2.5.2.3 Cosumnes River

Water quality in the Cosumnes River watershed is affected primarily by land-use and land cover. Monitoring data indicate that most of the river's nutrients and suspended sediments originate in the lower portion of the watershed below the Michigan Bar gauging station. Nutrient loading is strongly affected by a few point sources (e.g., wastewater treatment facilities in El Dorado County) and nonpoint sources related to urbanized areas and agricultural activity (Ahearn and Dahlgren 2000).

2.6 RECYCLED WATER SUPPLIES

A partnership between SCWA and the SRCSD has led to the implementation of a five million gallon per day (MGD) Water Recycling Program. This program provides recycled water for SRCSD on-site uses and for large irrigation customers in Zone 40. Recycled water is a desirable source of water for landscape irrigation and other non-potable uses because it conserves potable supplies, especially in times of drought. Recycled water also provides an alternative to discharging treated wastewater into the Sacramento River.

2.7 EXISTING FACILITIES

This section describes the capital facilities in Zone 40 that are owned and operated by SCWA for the treatment,

storage, and conveyance of groundwater and surface water supplies. As of late 2003, these facilities included a transmission and distribution system, approximately 46 MGD of groundwater production capacity, and 6 MGD (expandable to 11 MGD) of non-dedicated surface water treatment plant capacity from the City of Sacramento.

Water supply capital facility components have been grouped into the following categories: (1) groundwater, (2) surface water, and (3) recycled water. All facilities necessary to develop a particular supply source (i.e., wells and conveyance systems) have been grouped together under these categories. These facilities are shown in **Figure 2-6**.

2.7.1 Groundwater Facilities

Existing wells are shown in **Table 2-2**. These wells do not account for all wells within Zone 40's boundaries but only include those owned and operated by SCWA. Capital facilities necessary to provide groundwater production capacity include wells (including raw water piping to the treatment plant), treatment, conjunctive use facilities (storage and pumping), and conveyance to the distribution system. Treatment facilities have a maximum day input capacity ranging from approximately 2 MGD to 11 MGD per facility. Treatment plants provide iron, manganese, and possible arsenic removal.

2.7.2 Surface Water Facilities

Future capital facilities for surface water consist of a diversion structure on the Sacramento River near the community of Freeport, a raw water conveyance pipeline from the diversion structure to the central portion of Zone 40 (both constructed in partnership with the East Bay Municipal Utility District), an 85 MGD (ultimate capacity)

Figure 2-6. Existing SCWA Zone 40 Facilities

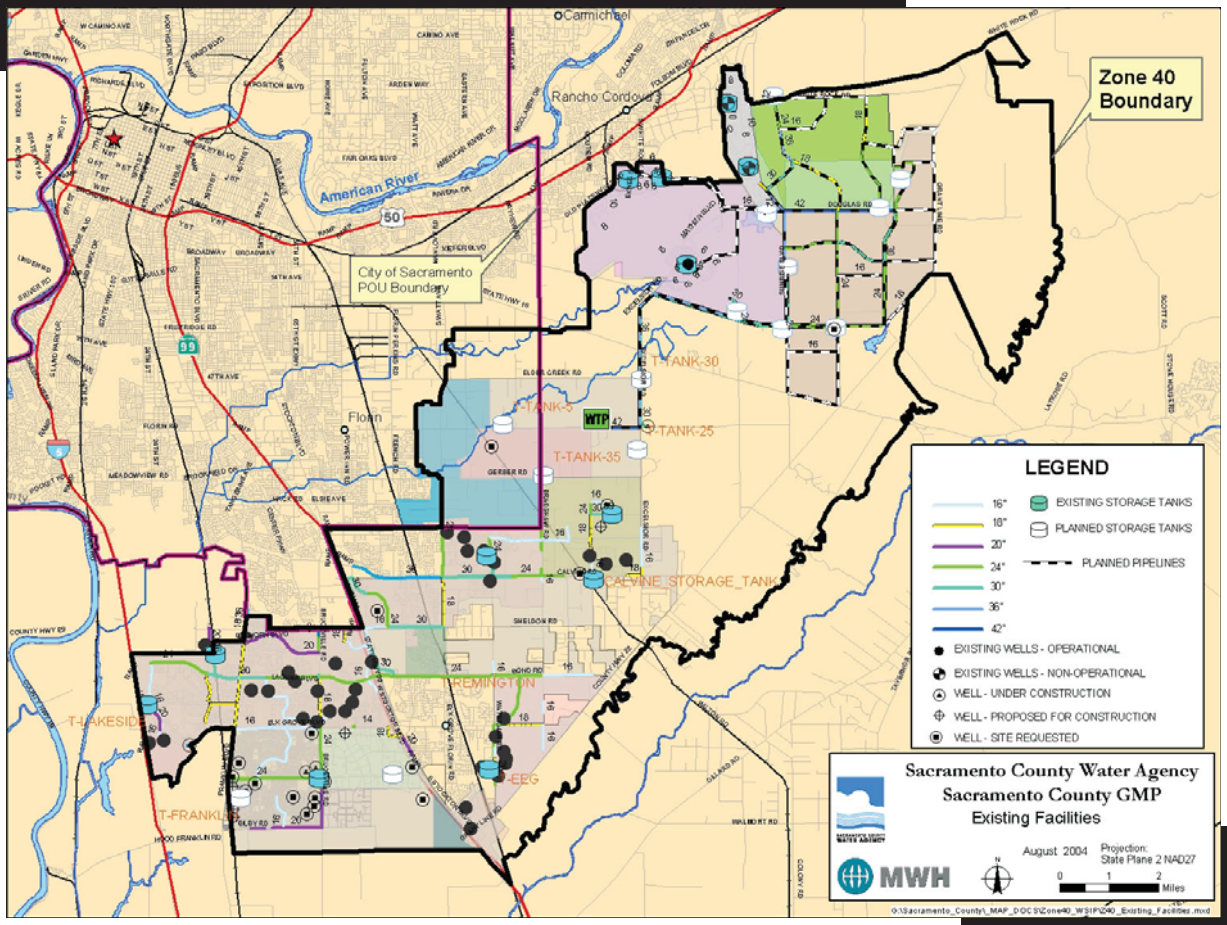


Table 2-2. Summary of SCWA Wells Owned and Operated by Zone 41

DMS Well ID	Well Name	State Well ID	Well Status	Installation Date	Pump Model	Motor Type	Motor Size (Hp)	Pump Capacity (gpm)	Well Depth (feet)	Boring Depth (feet)	Drilling Method	Well Diameter	Alternate Name	Nearest Cross Street	Community Area Served	Ground Elevation
184	VINTAGE PARK W-060	null	null	05/02/88	#N/A	#N/A	#N/A	#N/A	190	220	Reverse Rotary	14	Vintage Park	Vintage Park Dr.	Elk Grove	null
185	CAYMUS W-061	034/029-062	Active	06/01/88			0	1600	914	914	Reverse Rotary	16	Caymus	Vintage Park Dr.	Elk Grove	null
372	UNION INDUSTRIAL W-027	06N/06E-07Q02 M	Active	08/01/83	Turbine	Aurora 12 RH	125	1300	470	470	Cable Tool	16	null	Southeast side of Elkmont Way	Elk Grove	45
373	SURVEY RD W-028	06N/06E-18A01 M	Active	08/01/83	Turbine	Aurora 12 RH	125	1300	500	500	Cable Tool	16	null	9262 Survey Rd.	Elk Grove	45
374	STOCKTON BL W-029	06N/06E-18J02 M	Active	08/01/83	Turbine	Aurora 12 RH	125	1300	490	490	Cable Tool	16	null	Northeast side of E. Stockton Blvd.	Elk Grove	45
375	BRUCEVILLE W-040	06N/06E-18J02 M	Active	06/01/86	Peerless	Deepwell Turbine	100	1050	270	270	Reverse Rotary	16	Bruceville	West side of Bruceville Rd.	Elk Grove	27
376	SEASONS W-041	034/029-062	Active	07/01/86	Peerless	Deepwell Turbine	75	600	256	256	Reverse Rotary	16	Seasons	North side of Seasons Drive	Elk Grove	28
377	BANYON W-042	034/029-062	Active	07/01/75	Peerless	Deepwell Turbine	75	760	245	245	Reverse Rotary	14	Banyon	East side of Banyoh Dr.	Elk Grove	22
378	DUCK SLOUGH W-043	034/029-062	Active	11/04/86	Peerless	Submersible	100	1000	252	265	Reverse Rotary	16	null	5803 Laguna Park Dr.	Elk Grove	25
379	KILCONNELL W-044	034/029-062	Active	08/01/86	Peerless	Deepwell Turbine	75	750	302	302	Reverse Rotary	16	Kilconnell	South side of Kilconnel Dr.	Elk Grove	25
380	ACROPOLIS W-045	034/029-062	Active	10/23/86	Peerless	Deepwell Turbine	100	1000	242	295	Reverse Rotary	16	null	North side of Acropolis St.	Elk Grove	25
381	ASHURST W-046	034/029-062	Active	06/01/87	Peerless	Deepwell Turbine	100	1000	230	295	Reverse Rotary	16	Ashurst	East side of Franklin Blvd.	Elk Grove	20
382	FEATHER CREEK W-047	034/029-062	Active	11/01/86	Peerless	Submersible	100	800	238	238	Reverse Rotary	16	Feather Creek	South side of Feather Creek	Elk Grove	24
383	WADENA W-048	034/029-062	Active	07/01/75	Ingersoll-Rand	Deepwell Turbine	100	1050	286	290	Reverse Rotary	14	null	East side of Wadena Way	Elk Grove	35
384	SOARING OAKS W-049	034/029-062	Active	07/10/75	Ingersoll-Rand	Deepwell Turbine	100	1050	302	302	Reverse Rotary	14	null	West side of Soaring Oaks Dr.	Elk Grove	30
385	BIG HORN SOUTH W-050	034/029-062	Active	07/01/86	Ingersoll-Rand	Deepwell Turbine	125	1375	245	246	Reverse Rotary	16	Big Horn South	Big Horn	Elk Grove	
386	BIG HORN CENTER W-051	034/029-062	Active	10/01/86	Ingersoll-Rand	Deepwell Turbine	100	1000	249	265	Reverse Rotary	16	null	East side of Big Horn Blvd.	Elk Grove	32
387	BIG HORN NORTH W-052	034/029-062	Active	07/01/86	Ingersoll-Rand	Deepwell Turbine	100	940	240	240	Reverse Rotary	16	Big Horn North	Big Horn	Elk Grove	
388	WHITE ROCK W-017	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
389	RECYCLE W-018	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
390	W-62 ANDAL	034/029-062	Active	06/01/88			0	1100	296	296	Reverse Rotary	6	null	Southwest side of Andalusian Dr.	Elk Grove	70
391	EQUINE W-063	034/029-062	Active	null			0	1000	0	0	null	0	null	North side of Equine Dr.	Elk Grove	70
396	3RD STREET W-019	06N/04E-14N01 M	Active	06/01/55	Byron Jackson	Verticle Turbine	10	500	192	225	Cable Tool	12	null	West side of third Street	Sacramento	7
397	HOOD-FRANKLIN RD (replace 398)	null	Active	08/01/80	Gould	Deepwell Turbine	30	550	340	340	Cable Tool	12	null	South side of Hood-Franklin Rd	Hood	7
398	HOOD-FRANKLIN RD W-020	null	Active	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
399	SWALE	null	Active	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
447	OMEGA	null	Active	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
483	WESTRAY W-064	034/029-062	Active	06/01/88			0	1500	920	920	Reverse Rotary	2	Westray	Elk Grove-Florin	Elk Grove	
484	SHELDON NORTH W-065	034/029-062	Active	06/01/89			0	0	250	260	Reverse Rotary	16	null	North side of Sheldon Rd.	Elk Grove	30
499	WATERMAN RD W-067	034/029-062	Active	06/01/00			0	1500	970	1009	Reverse Rotary	15	null	8246 Waterman Rd.	Elk Grove	75
5172	null	null	null		#N/A	#N/A	#N/A	#N/A	999	999						0
5173	CALVINE MEADOWS W-066	null	null	09/04/93	#N/A	#N/A	#N/A	#N/A	684	695	Reverse Rotary	16	Calvine Meadows	Vineyard	Elk Grove	
5174	TILLOTSON W-068	null	null	04/02/97	#N/A	#N/A	#N/A	#N/A	921	950	Reverse Rotary	16	Tillotson Parkway	S/E Corner Meadow Brook IV Dev.	Sacramento	
5175	PERRY RANCH W-069	null	null	04/02/99	#N/A	#N/A	#N/A	#N/A	880	890	null	16	Perry Ranch	West of Waterman Rd.	Sacramento	
5176	DWIGHT RD RAW WATER WELL	null	null	06/27/99	#N/A	#N/A	#N/A	#N/A	740	880	Reverse Rotary	16	Dwight	S. of Dwight Rd	Sacramento	

Table 2-2. Summary of SCWA Wells Owned and Operated by Zone 41 cont.

DMS Well ID	*Well Name*	*State Well ID*	*Well Status*	*Installation Date*	*Pump Model*	*Motor Type*	*Motor Size (Hp)*	*Pump Capacity (gpm)*	*Well Depth (feet)*	*Boring Depth (feet)*	*Drilling Method*	*Well Diameter*	*Alternate Name*	*Nearest Cross Street*	*Community Area Served*	*Ground Elevation*
5177	East Park W-073	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5178	W. Stockton Blvd. W-074	null	null	09/14/99	#N/A	#N/A	#N/A	#N/A	206	225	null	18	Park Meadows	W. Stockton Blvd.	Sacramento	
5179	Legends W-076	null	null	12/20/99	#N/A	#N/A	#N/A	#N/A	702	720	Reverse Rotary	16	Legends	W. Savona Dr.	Elk Grove	
5180	LW-78 POPPY RIDG	null	null	06/03/02	#N/A	#N/A	#N/A	#N/A	1305	1320	Rotary	18	Poppy Ridge	7510 Poppy Ridge	Elk Grove	
5181	LW-105 AZINGER	null	null	09/14/01	#N/A	#N/A	#N/A	#N/A	629	720	Reverse Rotary	18	Azinger Way	E. of Vineyard	Elk Grove	
5182	LW-106 RODR CIR	null	null	09/21/01	#N/A	#N/A	#N/A	#N/A	620	745	Reverse Rotary	18	Rodriguez Circle	S. of Gerber	Sacramento	
5183	LW-109 TERRAZO	null	null	06/14/02	#N/A	#N/A	#N/A	#N/A	1334	1368	Reverse Rotary	18	Terrazo	Terrazzo	Elk Grove	
5184	LW-110 FERRAGAMO	null	null	07/09/02	#N/A	#N/A	#N/A	#N/A	1308	1350	Reverse Rotary	18	Ferragamo	Ferragam Wy	Elk Grove	
5185	LW-113 BISHOP	null	null	09/11/03	#N/A	#N/A	#N/A	#N/A	1084	1125	Reverse Rotary	18	Bishop Ranch	9609 Broad Stripes (Lot B)	Elk Grove	
5186	LW-114 WINDSOR D	null	null	08/06/03	#N/A	#N/A	#N/A	#N/A	1195	1195	Reverse Rotary	18	Windsor Downs	9615 Waterman Rd. (Lot B)	Elk Grove	
5245	W-055	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5246	W-056	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5247	W-070	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5248	W-075	null	null	09/10/99	#N/A	#N/A	#N/A	#N/A	258	270	null	16	Elliot Ranch	Elk Grove Blvd.	Elk Grove	
5249	W-077	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5250	W-007	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5251	W-016	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5252	W-020	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5253	W-032	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5254	W-081	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5256	W-089	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5257	W-099	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5258	W-108	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5259	W-B01	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5260	W-B02	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5261	W-B03	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5262	W-DA	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5263	W-M01	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5264	W-T01	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5265	W-T02	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5266	W-T03	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5267	W-T06	null	null	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

surface water treatment facility in the central portion of Zone 40, and appurtenant treated water conveyance pipelines. Currently, there is up to 11 MGD of non-dedicated capacity available at the City of Sacramento's SRWTP (the Wheeling Agreement with the City of Sacramento provides for conversion of non-dedicated capacity to dedicated capacity), and other Wheeling agreements that might be reached with the City of Sacramento.

Figure 2-7 shows the mix of surface water and groundwater supplies used by Zone 40 beginning in 1995 and ending in 2003.

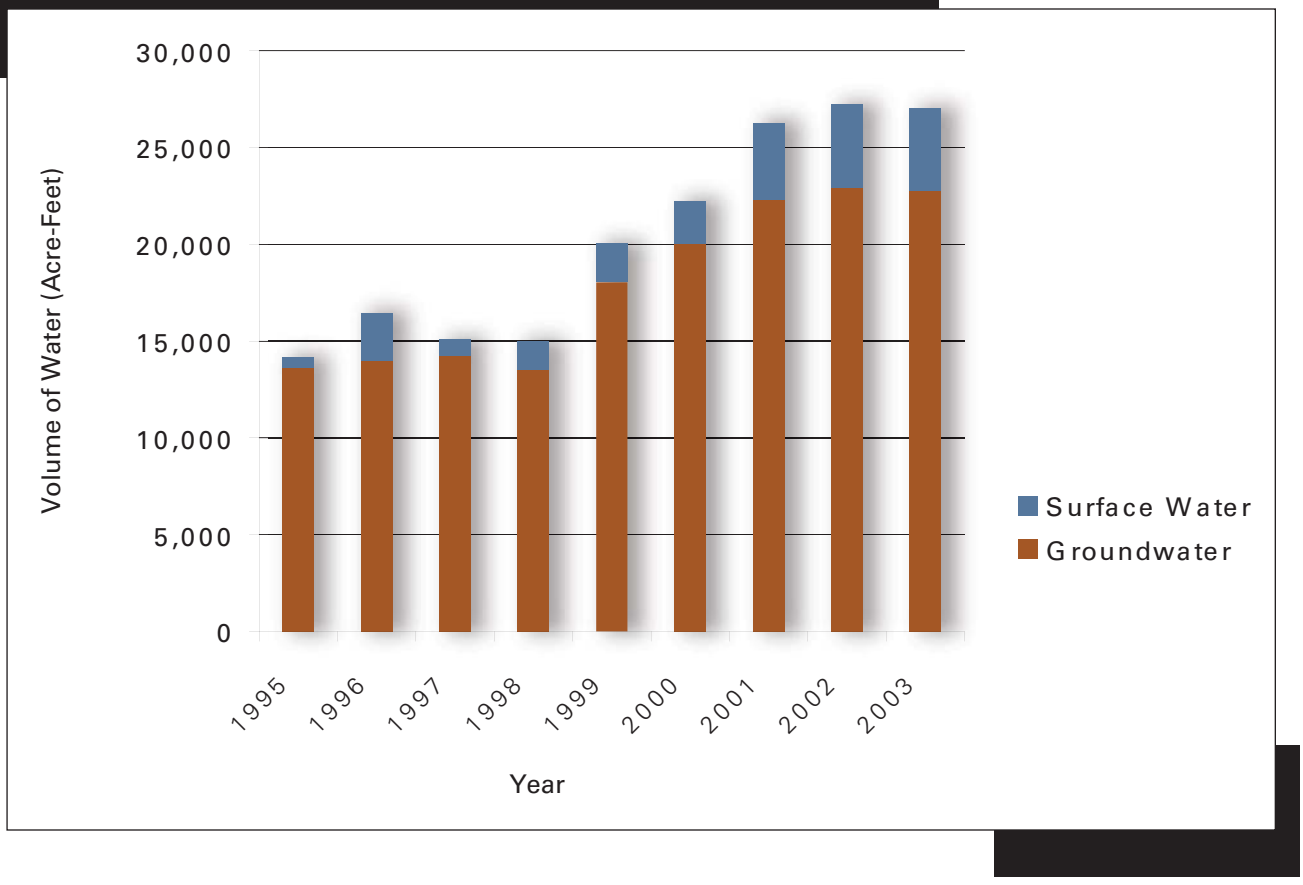
2.8 EFFECTS OF WFA IMPLEMENTATION

In general, the intent of the WFA is to implement a conjunctive use plan that will increase the use of groundwater in dry years and reduce surface water diversions. The decrease in available dry year diversions is a consequence of the WFA objective to provide instream flows in the lower American River for environmental purposes. In wet years, when more surface water is available, diversion will be increased and groundwater use will be reduced, thereby promoting recharge of the basin. According to the WFA, the long-term average annual yield from the Central Basin is 273,000 AF/year. For the Zone 40 portion of the basin, a long-term average annual yield of 40,900 AF/year of groundwater has been identified in the WSMP.

2.9 WATER YEAR TYPES

The WFA identifies three principal water year types. These year types are based on estimated March through November unimpaired inflow into Folsom Reservoir and are categorized as wet/average years, drier years, and driest years. These criteria are used in defining the availability of surface water supplies.

Figure 2-7. Surface Water and Groundwater Demands for Zone 40 (1995-2003)



2.10 FUTURE FACILITIES AND OPERATIONS

As water demands increase through new development, the need for additional supplies and facilities become imperative. Supplies to meet these demands will come from groundwater, surface water, and recycled water.

Groundwater extraction capacity is assumed to be 126 MGD. This capacity provides some redundancy during maximum day demands in the event that little or no surface water is available in dry and critical years.

The schedule of surface water diversions for SCWA was determined using a computer model of SCWA's water system. SCWA's diversion schedule of surface water and use of groundwater and recycled water were simulated based on 70-years of historical hydrology.

In the model, SCWA's potable water demand was assumed to be 108 TAF/yr in all years, reflecting build-out demand in Zone 40. Recycled non-potable demands are assumed to be 4.4 TAF/yr. Surface water delivery to Zone 40 was comprised of up to 11 MGD of the City of Sacramento's SRWTP's capacity and SCWA's 85 MGD Central WTP. It was further assumed that the Central WTP's capacity is reduced by 20 percent during wet months of wet years to accommodate for high turbidity and scheduled maintenance.

Sources of surface water include the following:

- three CVP water supply contracts: Fazio (15 TAF/year), SMUD 1 (15 TAF/year) and SMUD 2 (15 TAF/year);
- "Excess Water", defined as appropriated water in excess of the amount required to maintain the Sacramento – San Joaquin Delta in balance; and
- water right transfers, purchases from the City of Sacramento or additional appropriated water, referred to as "Other Water."

The timing and amount of surface water available from each source is based on estimates of their reliable yield, as determined by CALSIM II modeling. CALSIM II is a generalized water resources simulation model for evaluating operational alternatives of large, complex river basins. CVP sources are assumed to be subject to deficiencies based on hydrologic conditions evaluated under CALSIM. "Other Water" supplies are considered to be the most reliable of supplies, but for the purposes of the modeling, available CVP water and Excess Water are utilized first.

Underlying all operations scenarios is the assumption that SCWA will have access to a long-term average of 40,900 AF/year of groundwater. This value is based on calculations made during the Water Forum process and is consistent with the WFA. In years when sufficient surface water is available, groundwater can be "banked" as in-lieu storage for use during dry years. The sustainable yield objectives of the groundwater basin are met when the average long-term yield over the modeled 70-year hydrologic period does not exceed 40,900 AF/year. **Figure 2-8** illustrates how Zone 40 demands are met with the various water supply contracts and groundwater. This figure assumes build-out demands and available surface water supplies with shortages made up with groundwater. Recycled water is not shown on this figure since the demand already accounts for use of recycled water.

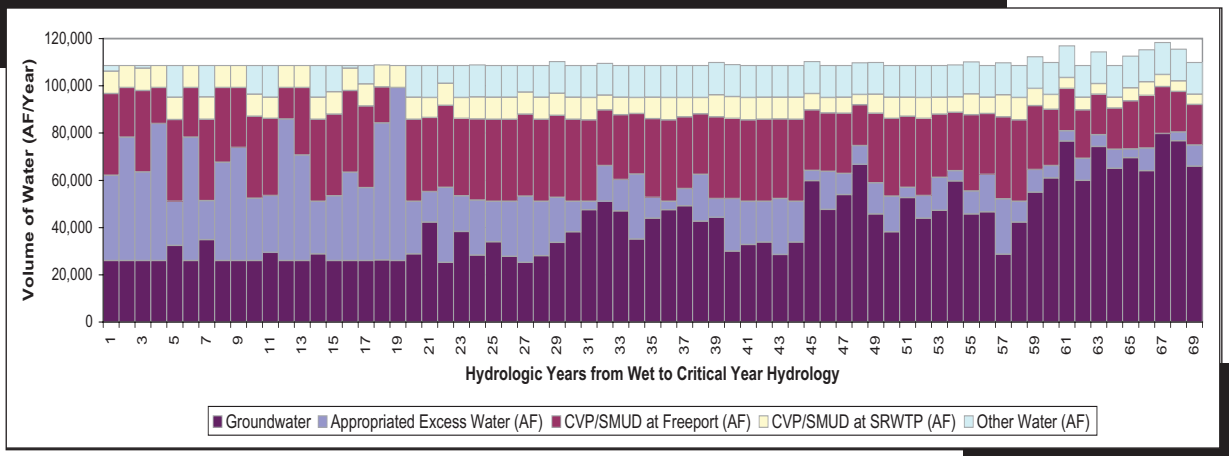
Groundwater recharge ("direct recharge") may be considered in the future as a way to enhance SCWA's conjunctive use program within the Central Basin. Direct recharge could consist of injection wells, spreading basins within the Cosumnes River floodplain, or direct discharge into the Cosumnes River to recharge the aquifers underlying the Central Basin. Water could potentially be obtained from either "Appropriative" or "Other" surface water sources, depending on availability. Treatment of surface water and approval by the RWQCB would be required prior to injection into the aquifer. The potential availability and use of recycled water within Zone 40 for landscape irrigation and other non-potable uses beyond existing agreements will be discussed by SCWA and SRCSD in the future.

2.11 WATER USE BY YEAR TYPE

Water Use in Wet/Average Years. In wet/average years, which occur in 64 percent of the years (i.e., the 70-year hydrologic period), surface water diversions will be maximized. In those years, surface water use by SCWA within Zone 40 will total approximately 78,000 AF/year to 84,000 AF/year.

Supplemental supplies including groundwater, additional recycled water, and water conservation will make up the

Figure 2-8. Changing Water Supplies from Wet to Critical years over the 70-Year Historical Hydrologic Conditions

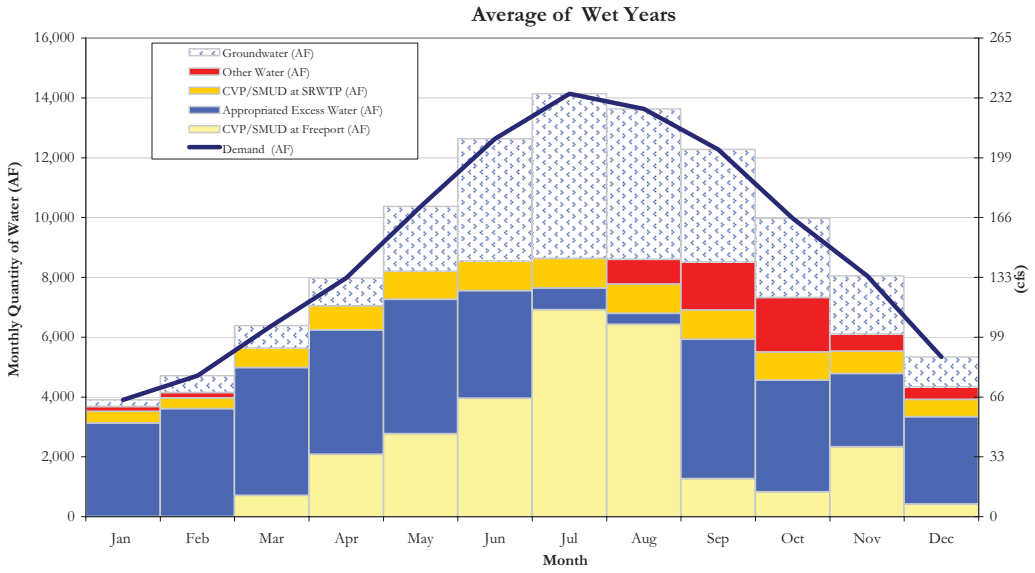


difference between demands and available surface water supplies. In wet/average years, the need for supplemental supplies is estimated to be approximately 30,000 AF/year and is generally assumed to be met with groundwater supplies. It should be noted that this is well below Zone 40's estimated long-term average use of 40,900 AF/year. **Figure 2-9** illustrates the utilization of Zone 40 supply sources in wet/average years.

Water Use in Drier Years. In drier years, which occur in 28 percent of the years, surface water diversions will be less than in wet/average years, ranging from 44,000 to 78,000 AF/year. Supplemental supplies will make up the difference between demands and available surface water supplies. The need for supplemental supplies is estimated to be up to 56,000 AF/year. It should be noted that in drier years, the groundwater extraction rate exceeds Zone 40's estimated long-term average use of 40,900 AF/year. Estimates for Zone 40's water use in drier years are shown in **Figure 2-10**.

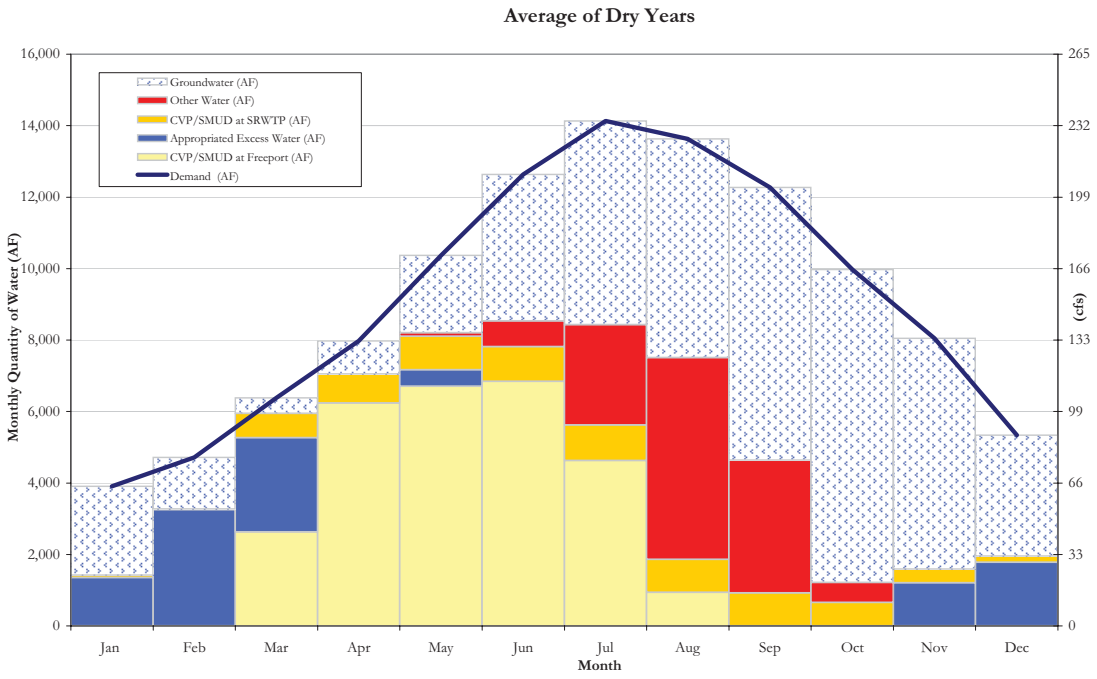
Water Use in Driest Years. In the driest years, which occur in only 8 percent of the years, surface water diversions will be minimized, totaling 27,000 AF/year as shown in **Figure 2-11**. In the driest years, the need for supplemental supplies will increase to 82,000 AF/year. The majority of these supplemental supplies will be derived from groundwater extraction, exceeding the 40,900 AF/year estimated long-term average use.

Figure 2-9. Wet/Average Year Water Utilization



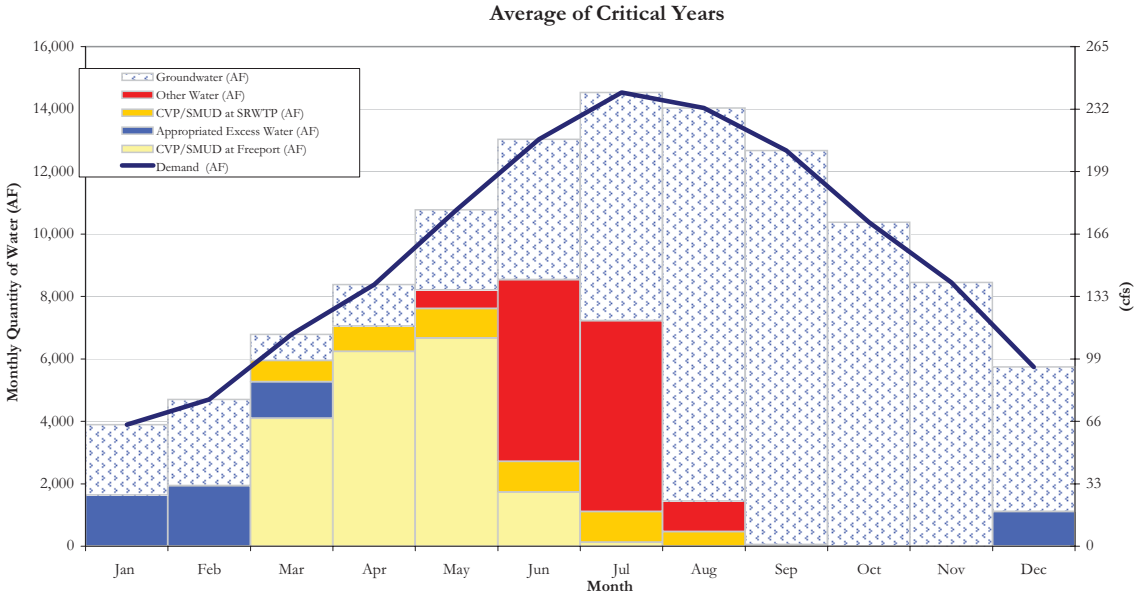
Wet Years	Priority	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Demand (AF)		3,910	4,716	6,385	7,976	10,369	12,633	14,134	13,629	12,271	9,972	8,051	5,340	109,384
Appropriated Excess Water (AF)	1	3,125	3,603	4,273	4,157	4,495	3,598	728	362	4,665	3,741	2,458	2,916	38,122
CVP/SMUD at Freeport (AF)	2	0	0	712	2,078	2,766	3,958	6,913	6,427	1,265	825	2,328	417	27,690
Other Water (AF)	3	155	187	0	0	0	0	0	823	1,606	1,831	569	417	5,587
Freeport Total (AF)		3,280	3,790	4,985	6,235	7,262	7,556	7,641	7,612	7,536	6,398	5,354	3,749	71,399
CVP/SMUD at SRWTP (AF)	1	395	359	645	807	940	978	989	985	975	928	746	583	9,331
SRWTP Total (AF)		395	359	645	807	940	978	989	985	975	928	746	583	9,331
Groundwater (AF)		235	566	754	934	2,168	4,099	5,504	5,032	3,760	2,645	1,951	1,008	28,655
Groundwater Storage (AF)		0	0	0	0	0	0	0	0	0	0	0	0	0
Net Groundwater Use (AF)		235	566	754	934	2,168	4,099	5,504	5,032	3,760	2,645	1,951	1,008	28,655
Total Surface Water (AF)		3,675	4,149	5,631	7,042	8,202	8,534	8,630	8,598	8,511	7,326	6,100	4,332	80,730
Total Water Supply (AF)		3,910	4,716	6,385	7,976	10,369	12,633	14,134	13,629	12,271	9,972	8,051	5,340	109,384
Max Month of Groundwater		285	4,547	754	934	2,168	4,099	5,504	5,032	3,760	7,864	7,241	4,901	

Figure 2-10. Drier Year Water Utilization



Dry Years	Priority	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Demand (MGD)		3,910	4,716	6,385	7,976	10,369	12,633	14,134	13,629	12,271	9,972	8,051	5,340	109,384
Appropriated Excess Water (AF)	1	1,354	3,252	2,632	0	454	0	0	0	0	0	1,208	1,783	10,683
CVP/SMUD at Freeport (AF)	2	0	0	2,632	6,235	6,709	6,839	4,630	937	0	0	0	0	27,983
Other Water (AF)	3	0	0	0	0	99	717	2,807	5,649	3,716	557	0	0	13,545
Freeport Total (AF)		1,354	3,252	5,265	6,235	7,262	7,556	7,437	6,586	3,716	557	1,208	1,783	52,212
CVP/SMUD at SRWTP (AF)	1	65	17	681	807	940	978	989	924	921	655	376	170	7,522
SRWTP Total (AF)		65	17	681	807	940	978	989	924	921	655	376	170	7,522
Groundwater (AF)		2,491	1,446	439	934	2,168	4,099	5,708	6,119	7,633	8,760	6,467	3,387	49,651
Groundwater Storage (AF)		0	0	0	0	0	0	0	0	0	0	0	0	0
Net Groundwater Use (AF)		2,491	1,446	439	934	2,168	4,099	5,708	6,119	7,633	8,760	6,467	3,387	49,651
Total Surface Water (AF)		1,419	3,269	5,946	7,042	8,202	8,534	8,426	7,510	4,637	1,212	1,584	1,953	59,734
Total Water Supply (AF)		3,910	4,716	6,385	7,976	10,369	12,633	14,134	13,629	12,271	9,972	8,051	5,340	109,384
Max Month of Groundwater		3,910	4,716	439	934	2,168	4,099	8,764	13,629	12,271	9,972	8,051	5,340	

Figure 2-11. Driest Year Water Utilization



Critical Years	Priority	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Demand (MGD)		3,890	4,696	6,785	8,376	10,770	13,034	14,534	14,030	12,671	10,372	8,452	5,740	113,350
Appropriated Excess Water (AF)	1	1,634	1,935	1,170	0	0	0	0	0	0	0	0	1,112	5,850
CVP/SMUD at Freeport (AF)	2	0	0	4,095	6,235	6,667	1,735	125	0	0	0	0	0	18,856
Other Water (AF)	3	0	0	0	0	595	5,822	6,104	978	0	0	0	0	13,498
Freeport Total (AF)		1,634	1,935	5,265	6,235	7,262	7,556	6,228	978	0	0	0	1,112	38,205
CVP/SMUD at SRWTP (AF)	1	0	0	681	807	940	978	989	466	52	0	0	0	4,912
SRWTP Total (AF)		0	0	681	807	940	978	989	466	52	0	0	0	4,912
Groundwater (AF)		2,256	2,761	839	1,335	2,568	4,499	7,317	12,586	12,620	10,372	8,452	4,629	70,234
Groundwater Storage (AF)		0	0	0	0	0	0	0	0	0	0	0	0	0
Net Groundwater Use (AF)		2,256	2,761	839	1,335	2,568	4,499	7,317	12,586	12,620	10,372	8,452	4,629	70,234
Total Surface Water (AF)		1,634	1,935	5,946	7,042	8,202	8,534	7,217	1,444	52	0	0	1,112	43,117
Total Water Supply (AF)		3,890	4,696	6,785	8,376	10,770	13,034	14,534	14,030	12,671	10,372	8,452	5,740	113,350
Max Month of Groundwater		3,890	4,696	839	1,335	2,568	4,499	9,165	14,030	12,671	10,372	8,452	5,740	

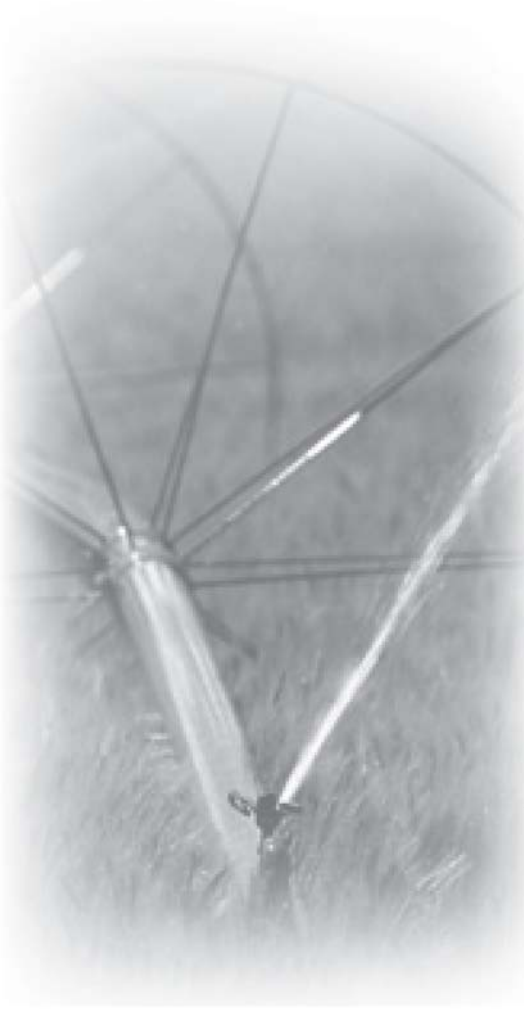
SECTION 3

MANAGEMENT PLAN ELEMENTS

SECTION 3

*The elements of this GMP include an overall goal, a set of management objectives, and a series of plan components that discuss and identify the actions necessary for meeting the goal and objectives (see **Figure 3-1**).*

MANAGEMENT PLAN ELEMENTS



3.1 GROUNDWATER MANAGEMENT GOAL

The goal of this GMP is to ensure a viable groundwater resource for beneficial uses including water for adjacent purveyors (see **Figure 3-2**), agricultural, agricultural-residential, industrial, and municipal supplies that support the WFA's co-equal objectives of providing a reliable and safe water supply and preserving the fishery, wildlife, recreational, and aesthetic values of the lower American River. In addition, this GMP partakes in the enhancement of maintaining ecological flows in the Cosumnes River.

3.2 BASIN MANAGEMENT OBJECTIVES

To meet the goal stated above, the SCWA has adopted five specific basin management objectives (BMOs). These BMOs include the following:

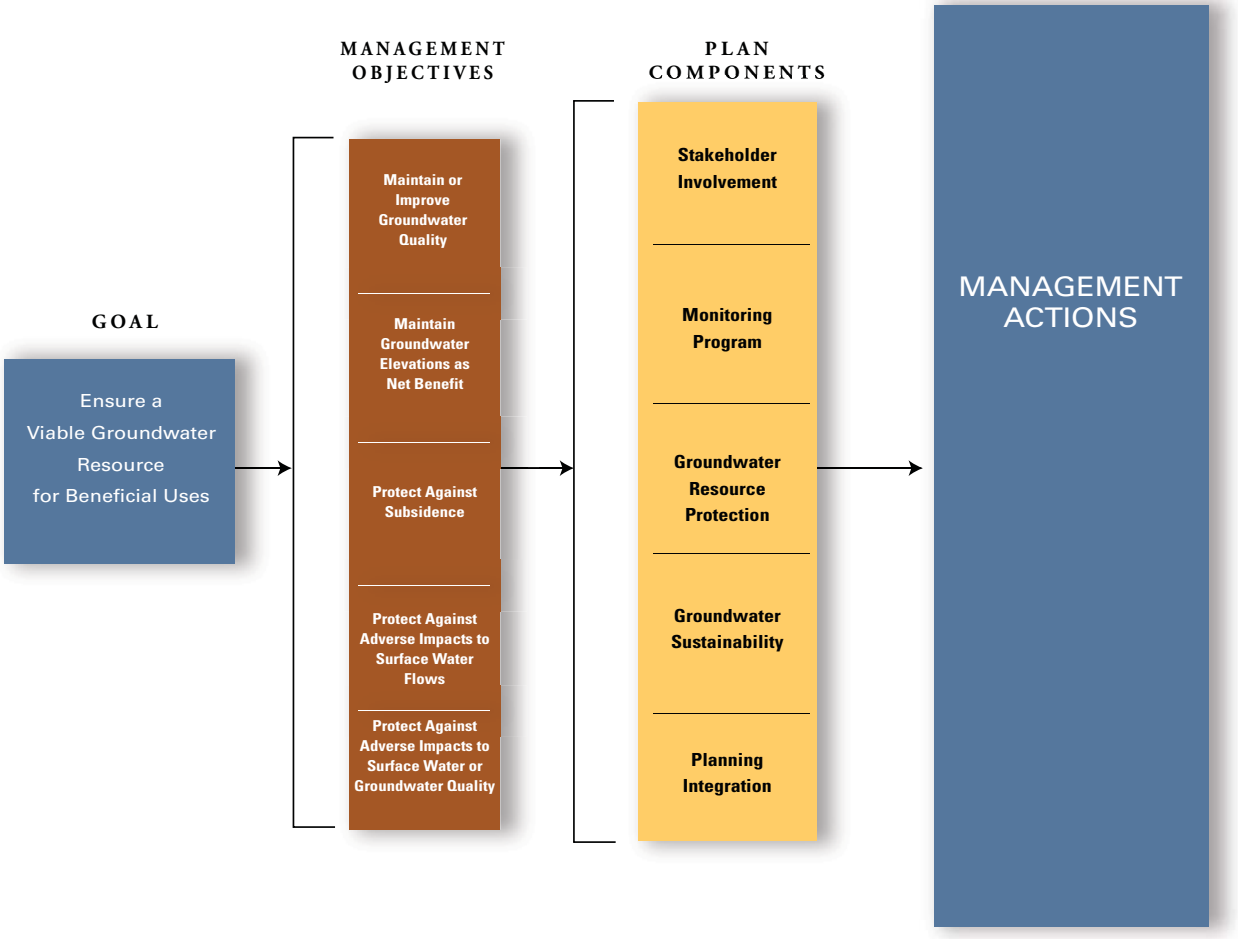
Maintain or improve groundwater quality in the Zone 40 area for the benefit of basin groundwater users. The groundwater supplied for potable use by Zone 40 meets all public health criteria.Within the basin, there are documented occurrences of large-scale groundwater contamination. Zone 40 will make use of groundwater within the basin that is not hindered by contamination, and that such use does not cause degradation of the quality of the resource either at the contamination sites or from naturally occurring contaminants present in the groundwater. Where groundwater contamination is currently documented or if it occurs in the future, Zone 40 will coordinate and cooperate with appropriate state and federal regulatory agencies and with other interested parties. Zone 40 will pursue all actions within its powers that result in the containment and eventual remediation of the contaminant.

Maintain groundwater elevations that result in a net benefit to basin groundwater users. Over the past several decades, extensive groundwater pumping by agriculture and more recently urban development has resulted in a persistent cone of depression in the southern Zone 40 area. Due to recent fallowing of agricultural lands and the importation of surface water into Zone 40, groundwater elevations at or near the cone of depression (**Figure 2-4**) have stabilized and in some areas recovered. SCWA understands

that lowering the aquifer can have adverse impacts on all groundwater users ranging from increased energy costs to the need to deepen existing private and public wells or even construct new wells. Full implementation of the conjunctive use program in the basin may result in short-term water levels being drawn down below previous historical lows, (this is a result of additional groundwater extraction during the drier and driest years). Zone 40 intends that the impacts during these times be quantified and then minimized so that overall groundwater levels in the basin do not degrade over time from their present condition.

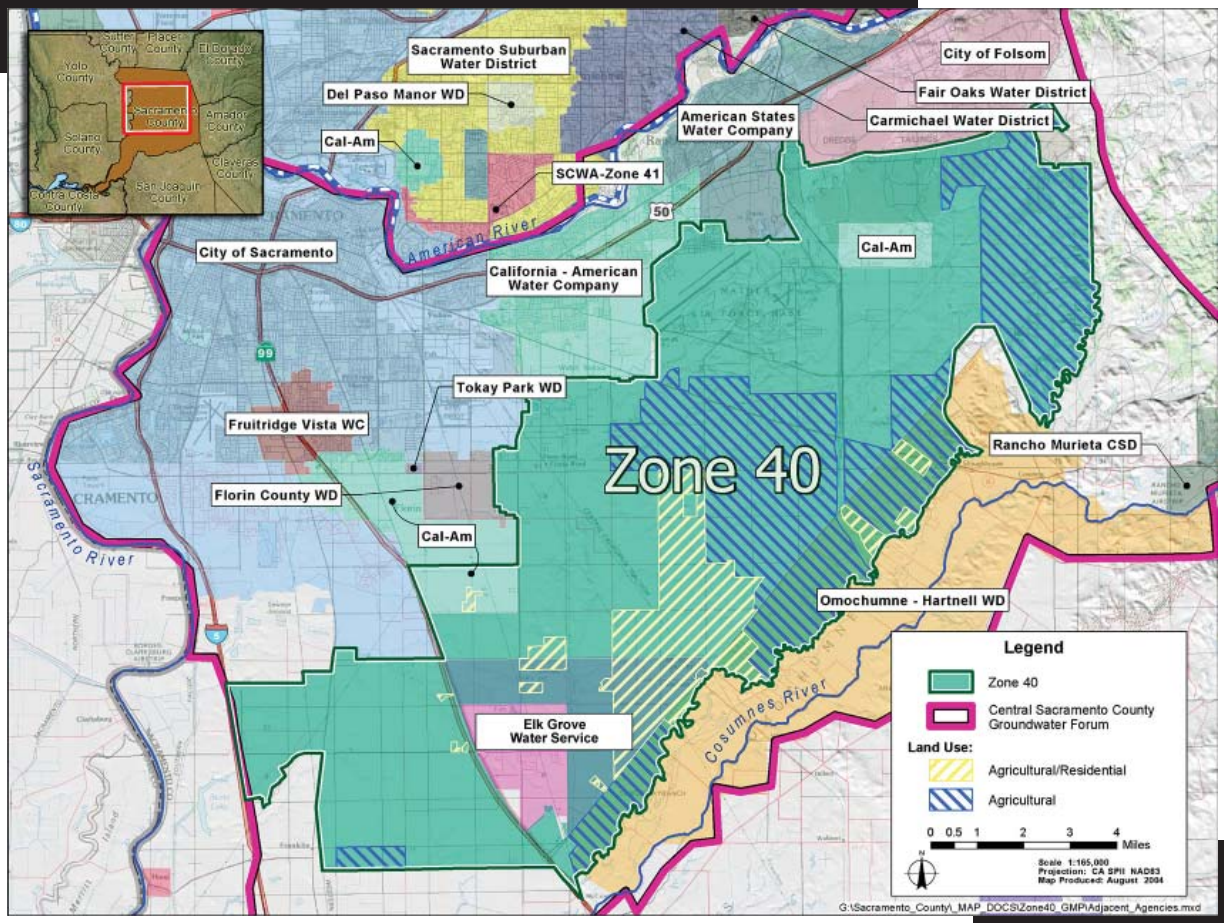
Protect against any potential inelastic land surface subsidence. Land subsidence can cause significant damage to essential infrastructure. Historic land surface subsidence within Zone 40 has been minimal, with no known significant impacts to existing infrastructure. Given the historical trends, the potential for land surface subsidence from groundwater extraction in the Central Basin appears remote. However, Zone 40 intends to cooperate with adjacent groundwater management agencies such as SGA to monitor for potential land surface subsidence. If inelastic subsidence is documented in conjunction with declining groundwater elevations, Zone 40 will investigate and take appropriate actions to avoid adverse impacts.

Figure 3-1. Organization of Management Plan Elements



Source: Graphic is taken from the Sacramento Groundwater Authority GMP

Figure 3-2. Groundwater Users within Zone 40 Boundaries



Protect against adverse impacts to surface water flows in the American, Cosumnes, and Sacramento rivers. Among other important uses, the American, Cosumnes, and Sacramento rivers provide habitat for a variety of fish and wildlife species. Zone 40 is committed to the objectives of the WFA, including the objective to protect and enhance the lower American River. Important elements of the WFA include commitments to reduce lower American River diversions during dry years and to not exceed agreed upon groundwater extractions of 273,000 AF/year on average. In addition, Zone 40 plans to monitor and evaluate in cooperation with SGA and others the relationship (if any) between groundwater pumping and adjacent river or stream flows.

In addition to the American Rivers this GMP includes the goals of restoring and preserving the fishery, wildlife, recreational, and aesthetic resources of the lower Cosumnes River and assuring a stable supply of water for agriculture in the lower Cosumnes River floodplain area.

Protect against adverse impacts to water quality resulting from interaction between groundwater in the basin and surface water flows in the American River and Sacramento River. In most natural settings, groundwater is higher in TDS and most other constituents than surface water. At the present time, the flow regime is such that groundwater is not discharging to the river systems (i.e., rivers in the region are termed as losing streams to the groundwater) in the Zone 40 area. It is possible that future actions could temporarily alter that condition. It is Zone 40's intent that controllable operations of the groundwater system do not negatively impact the water quality of the area's rivers and streams. Zone 40 will seek to gain a better understanding in cooperation with SGA and others of potential impacts of the discharge of local-area groundwater to surface water channels.

3.3 GMP COMPONENTS

The GMP includes a variety of components that are required by CWC § 10753.7, recommended by DWR Bulletin 118 (2003), optional under CWC § 10753.8, and other components that Zone 40 has already begun. These components can be grouped into five general categories: (1) stakeholder involvement, (2) monitoring program, (3) groundwater resource protection, (4) groundwater replenishment, and (5) planning integration. Each category and its components are presented in this section. Under each component is a discussion, proposed actions, and identification of the objectives toward which the component is directed.

3.4 COMPONENT CATEGORY 1: STAKEHOLDER INVOLVEMENT

The management actions taken by SCWA may have a wide range of impacts on a broad range of individuals and agencies that ultimately have a stake in its successful management of the basin. The local consumer may be most concerned about water rates or assurances that each time the tap is turned a steady, safe stream of water is available. To the industrial, agricultural, or agricultural-residential private well owner, they want to make sure their wells are safe from dewatering and degradation of water quality, and that energy costs do not increase significantly. To large state and federal water resource agencies, the degree to which Zone 40 can achieve local supply reliability and further banking and exchange programs provides opportunities for state and federal water programs to meet statewide needs, particularly in drier years. To address the needs of all these stakeholders, SCWA has pursued several means of achieving broader involvement in the management of the Central Basin. These include: (1) financially supporting the Water Forum Successor Effort and the CSCGF, 2) participation in the monthly CSCGF stakeholder negotiation meetings, (3) involving other local agencies within and adjacent to the Zone 40 area in the master planning efforts taking place in Zone 40, (4) using the monthly CSCGF stakeholder meetings and monthly CSCGF cluster meetings as advisory committees for development and implementation of the GMP, (5) developing relationships with state and federal water agencies, and (6) pursuing a variety of partnerships to achieve local supply sustainability. Each of these is discussed further below.

3.4.1 Involving the Public

Groundwater in California is a public resource, and SCWA is committed to involving the public in the development and implementation of Zone 40's GMP. The primary reason for Zone 40's creation was to undertake "... the acquisition, construction, maintenance and operation of facilities for the production, conservation, transmittal, distribution and sale of ground or surface water or both for the present and future beneficial use of the lands or inhabitants within the zone." At the time of its creation, groundwater elevations were steadily declining and development applications were moving forward with groundwater as the sole source of supply. The creation of Zone 40 also established a funding source to pay the cost of implementing a conjunctive use water program. The adoption of Ordinance No. 18 by SCWA's Board of Directors in 1986 empowered SCWA to establish fees, charges, credits, and regulations for the construction of capital facilities and the wholesale delivery of surface water and groundwater within Zone 40. The customers of Zone 40 are those connections that are within Zone 41, Cal-Am (Security Park), and the Elk Grove Water Service's "Tariff Area 2" (the older portions of Elk Grove are not within Zone 40 and rely solely on groundwater) retail service areas.

In preparing this GMP, SCWA has filed four separate notices in the Sacramento Bee (**Appendix A**). In accordance with CWC § 10753.2, a notice of intent to adopt a resolution to prepare a GMP was adopted on August 17, 2004. Upon adoption of the resolution, the text of the resolution was published in the Sacramento Bee on August 20 and 26, 2004. Additionally, a separate special meeting of the CSCGF was held on August 30, 2004 which was also open to the public. Finally, SCWA provided a public comment period on the draft GMP and noticed and held two meetings for the public to comment on the GMP, September 28 and October 5, 2004. The final GMP was adopted on November 2, 2004. Upon adoption, the text of the Resolution of Adoption was published in the Sacramento Bee on November 9 and 16, 2004.

SCWA has also demonstrated its commitment to outreach and education. In addition to all required public notification, SCWA has also accepted the GMP public outreach plan previously adopted by SGA and sponsored by DWR. The plan includes many strategies for communicating with both internal and external audiences for

various phases of the program and will be adapted to meet the needs of Zone 40 and its various stakeholders. SGA's Public Outreach Plan for Groundwater Management Program (Lucy & Company, 2003) and is included in this GMP as Appendix A.

SCWA has posted at its web site (http://www.msa.saccounty.net/waterresources/Home.asp) a copy of the WSMP, the GMP, and public notices. SCWA will continue to use its web site to distribute information on GMP implementation activities to the public.

Actions. SCWA will take the following actions:

Continue efforts to encourage public participation as opportunities arise.

Review and take actions as appropriate from the Public Outreach Plan during implementation of various aspects of the GMP.

Provide briefings to the Water Forum Successor Effort and the CSCGF on GMP implementation progress.

Work with stakeholders to maximize outreach on GMP activities including the use of the SCWA web site.

3.4.2 Involving Other Agencies Within and Adjacent to the Zone 40 Area

Zone 40's legal boundary is limited to that of the zone boundaries. **Figure 3-2** shows Zone 40 and adjacent purveyors within the Central basin and some of the key adjacent entities that Zone 40 has been coordinating with during development of this GMP including the agricultural and agricultural-residential groundwater users. One agency within the Zone 40 boundary that is not a water purveyor is the Air Force Real Property Agency (AFRPA), which oversees remediation efforts of contaminated soil and groundwater at Mather Field. SCWA has an ongoing dialog with both the County of Sacramento Department of Economic Development, SCWA and the AFRPA to discuss issues related to land use, wellhead protection, groundwater management and remediation efforts at Mather Field. SCWA will investigate integrating some of the monitoring wells at Mather Field into the Zone 40 monitoring network (see **Section 3.5**).

The Zone 40 boundary covers approximately one-half of the Central Basin as defined by the CSCGF (**Figure 1-1**). It is the intent of this GMP to act as a platform for developing a GMP that will cover the entire Central basin once the CSCGF negotiations have ended and a managing entity has assumed authority over the basin.

In December 2003, SGA adopted a GMP that covers the organized municipal water purveyors in North Sacramento County. The Zone 40 GMP recognizes SGA as a partner in managing the Sacramento County groundwater resources and has requested their review and assistance in the preparation of this GMP.

Other adjacent interested agencies and stakeholders are the SSCAWA and TNC who own and maintain wetlands and agricultural lands along the Cosumnes River corridor. Representatives from each of these agencies participate as stakeholders in the CSCGF negotiations. SSCAWA and TNC have assisted in the preparation of this GMP.

Actions. SCWA will take the following actions:

Continue a high level of involvement as demonstrated through the development of this GMP into implementation of the plan by continued participation with the various stakeholders groups described above.

Provide copies of the adopted GMP and subsequent annual reports to representatives from SGA, SSCAWA, TNC, CSCGF, San Joaquin county, and the Groundwater Forum Successor Effort.

Meet with representatives from SGA, SSCAWA, TNC, CSCGF and the Groundwater Forum Successor Effort as needed.

- *Coordinate meetings outside the CSCGF with agricultural and agricultural-residential self-supplied pumpers within the GMP area to inform them of SCWA's management responsibilities and activities relative to the GMP. Develop a list of their concerns and needs relative to the GMP.*
- *Coordinate meetings with other self-supplied pumpers within the GMP area to inform them of* SCWA's *management responsibilities and activities relative to this GMP. Develop a list of self-supplied groundwater pumpers concerns and needs.*

3.4.3 Utilizing Advisory Committees

SCWA has and will continue to use advisory committees in development and implementation of this GMP. Prior to beginning development of the GMP, the CSCGF was named as the Technical Review Committee to guide development of the GMP. The CSCGF and CSCGF "groundwater cluster" meetings met on approximately a monthly basis during the development of this GMP.

The primary groups represented on the Technical Review Committee include:

- American States Water Company
- Cal-Am Water Company
- City of Sacramento
- Agricultural-Residential
- The Nature Conservancy
- Water Forum
- SCWA
- City of Elk Grove
- Sacramento County Farm Bureau
- BIA
- Elk Grove Water Service
- Environmental Council of Sacramento
- DWR

Actions. SCWA will take the following action:

Upon adoption of the GMP, the Technical Review Committee will meet to discuss the continuation and composition of committees to guide implementation of the plan and provide these recommendations to the SCWA Board of Directors.

3.4.4 Developing Relationships with State and Federal Agencies

Working relationships between SCWA and local, state, and federal regulatory agencies are critical in developing and implementing the various groundwater management strategies and actions detailed in this GMP.

SCWA has developed on-going working relationships with local, state, and federal regulatory agencies (e.g., Sacramento County, Environmental Management Department (EMD), California Department of Health Services (DHS), EPA, etc.).

Actions. SCWA will take the following action:

Continue to develop working relationships with local, state, and federal regulatory agencies, as appropriate.

3.4.5 Pursuing Partnership Opportunities

Zone 40 is committed to facilitating partnership arrangements at the local, state, and federal levels. Over the past decade, the Sacramento-area water community and other local leaders have made great strides toward regional planning and collaboration on water issues. The historic WFA, which involved over 40 stakeholders and 7 years of facilitated discussions, resulted in a regional framework to balance the competing demands for increased use of surface and groundwater with the environmental needs of the lower American River through the year 2030. Several important partnerships have been formed to implement the WFA as well as provide a host of other benefits to water agencies and the customers that they serve.

While the facilities necessary to implement and expand Zone 40's conjunctive use program have been identified through the WSMP, the potential exists to expand these facilities on a basin wide level to achieve broader regional and statewide benefits. The needed facilities, however, would require substantial resources. To investigate any further opportunities would require resources provided through partnerships with potential beneficiaries.

For example, SCWA, TNC, and SSCAWA working cooperatively to enhance stream flows in the Cosumnes River.

Actions. SCWA will take the following actions:

Continue to promote partnerships that accomplish both local supply reliability and broader regional and statewide benefits.

Continue to track grant opportunities to fund groundwater management activities and local water infrastructure projects.

3.5 COMPONENT CATEGORY 2: MONITORING PROGRAM

At the heart of this GMP is a monitoring program capable of assessing the current status of the basin and predicting responses in the basin as a result of future management actions. The program includes monitoring groundwater elevations, monitoring groundwater quality, monitoring and assessing the potential for land surface subsidence resulting from groundwater extraction, and developing a better understanding of the relationship between surface water and groundwater along the American, Cosumnes

and Sacramento rivers. Also important is the establishing of monitoring protocols to ensure the accuracy and consistency of data collected. Finally, the monitoring program includes a tool, (DMS, a.k.a. SHEDTOOL) for assembling and assessing the groundwater-related data.

3.5.1 Groundwater Elevation Monitoring

SCWA has compiled a significant amount of historical groundwater level data measurements extending from prior to 1950 through 2003. Sources of this data for the Zone 40 area include:

- DWR/SCWA
- USGS
- SMUD

DWR and SCWA have a program that collects bi-annual (spring and fall) groundwater level data from more than 150 wells throughout Sacramento County. SCWA uses this data to generate bi-annual groundwater contour maps for the county. However, because wells have been added and dropped from the program over time it is difficult to compare a historic contour map with a recent one. For this reason, SGA and SCWA are establishing a standardized network of wells that combines those monitored by DWR, SCWA, SGA member water purveyors, and other sources. It is SCWA's intent that the wells comprising this program be maintained as a consistent long-term network that represents overall groundwater elevation conditions in the basin. **Figure 3-3** shows the wells currently proposed for this network.

The wells were selected to provide uniform geographic coverage throughout the approximately 133 square mile Zone 40 area, and in an area around the northern, western, and southern perimeter of Zone 40. The well network was developed by first establishing a network of sampling grids using the following method:

- Overlay a matrix of evenly spaced points over the entire Zone 40 area.
- Surround matrix of points with polygons.
- Conform the boundaries of the polygons to Zone 40's boundaries and regenerate area grids.

The resulting grid, shown on **Figure 3-3**, includes approximately 30 polygons of roughly equal area of about five square miles each. The proposed set of monitoring wells[9] was selected from the DMS to represent water levels for as many polygons as possible. Individual wells were selected by:

Giving preference to wells currently in DWR's and SCWA's monitoring program. These wells were selected because (a) they have long records of historic groundwater level data and are useful in assessing trends within the groundwater basins, (b) uniform protocols were used in measuring and recording the water level data, and (c) these are typically non-producing wells, so water level readings represent relatively static levels.

Identifying other municipal and private wells with well construction information, long records of groundwater level data and giving preference to those wells with the lowest recent extraction volumes.

Actions. Additional actions by SCWA will include:

Coordinate with DWR and others to identify an appropriate group of wells for monitoring for a spring 2005 set of groundwater elevation measurements.

Coordinate with DWR and others to ensure that the selected wells are maintained as part of a long-term monitoring network.

Coordinate with DWR to ensure that the timing of water level data collection by other agencies coincides within one month of DWR and SCWA data collection. Currently DWR and SCWA collect water level data in the spring and fall.

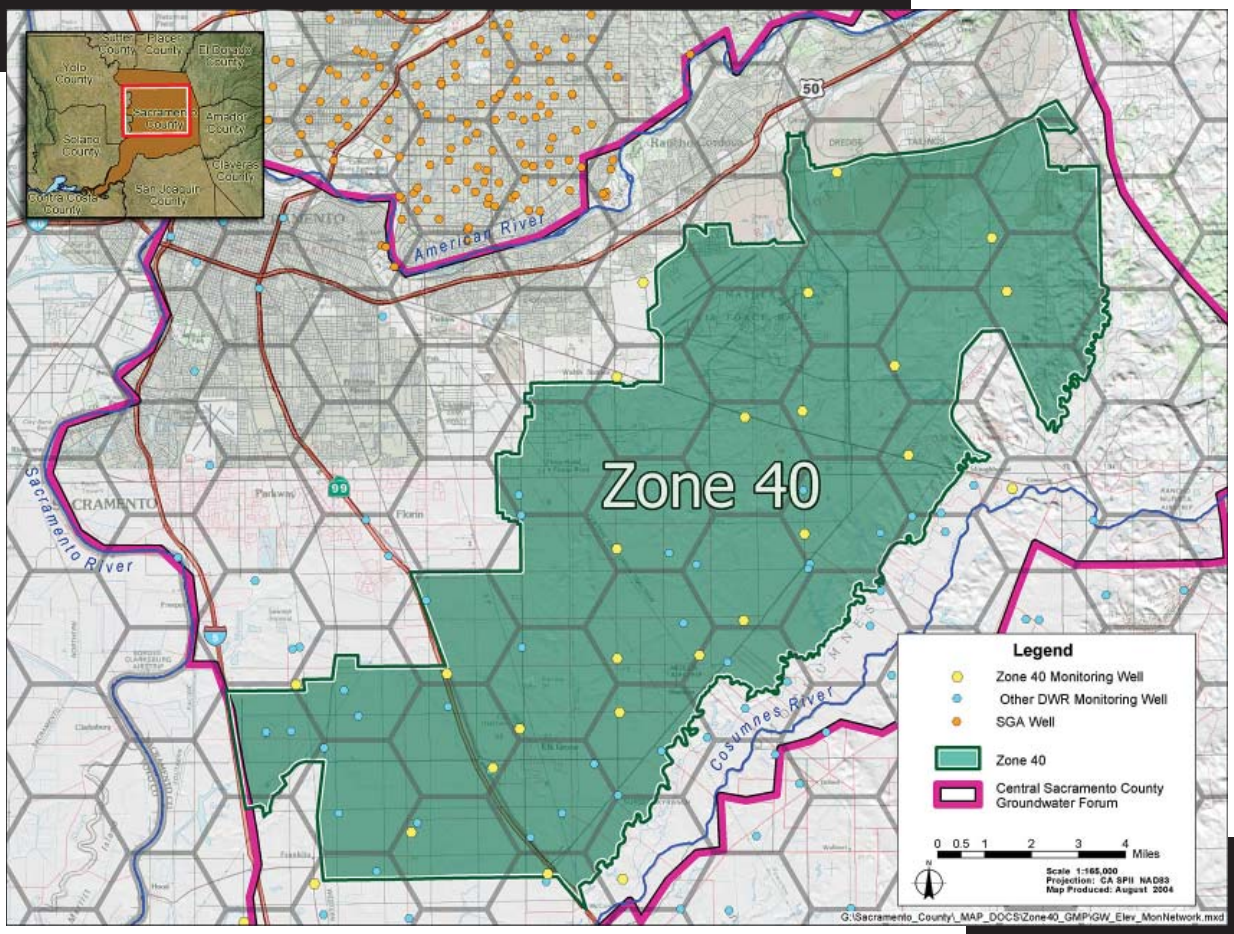
Coordinate with other agencies to ensure that needed water level elevations are collected and verify that uniform data collection protocols are used among the agencies.

Coordinate with the USGS to determine the potential for integrating USGS monitoring wells constructed for the NAWQA Program into the SCWA and SGA monitoring network.

Consider ways to fill gaps in the monitoring well network by identifying suitable existing wells or identifying opportunities for constructing new monitoring wells.

[9] No wells were selected east of the boundary because it is in consolidated rock outside of the groundwater basin.

Figure 3-3. Zone 40 Groundwater Elevation Monitoring Network



Assess groundwater elevation trends and conditions based on the monitoring well network annually.

Assess the adequacy of the groundwater elevation monitoring well network annually.

Identify a subset of monitoring wells that will be monitored more frequently than twice annually to improve SCWA's understanding of aquifer responses to pumping throughout the year.

3.5.2 Groundwater Quality Monitoring

Because most of the wells in the basin are used for public water supply, an extensive record of water quality data is available for most wells dating from about 1985 to present. SCWA has compiled available historic water quality data for constituents monitored as required by DHS under CCR Title 22. Sources of water quality data include:

- DWR
- SCWA Zone 41
- USGS

This level of monitoring is sufficient under existing regulatory guidelines to ensure that the public is provided with a safe and reliable drinking water supply. Ultimately, it may be advisable to have in place a network of shallow (less than 200 feet deep) sentry wells to serve as an early warning system for contaminants that could make their way to greater depths in the basin where Zone 40 primarily extracts groundwater. Zone 40 is working with AFRPA to identify a subset of the sentry wells located in and around the Mather Field for integration into the

Zone 40 monitoring effort. Zone 40 will also coordinate with EPA and the RWQCB, which oversees the remediation of Aerojet and Boeing's groundwater contamination and with LUSTs to identify existing dedicated monitoring wells in the basin.

Figure 3-4 shows existing Zone 40 production wells. CCR Title 22 water quality reporting is required by DHS for each of these public drinking water sources. Zone 40's water quality monitoring network includes these wells. The water quality monitoring well network may be expanded to include additional DWR, USGS, Mather Field, Aerojet, Boeing, RWQCB, and privately owned wells based on the outcome of coordination meetings with these agencies and various land owners.

Actions. The following actions will be taken by SCWA to monitor and manage groundwater quality:

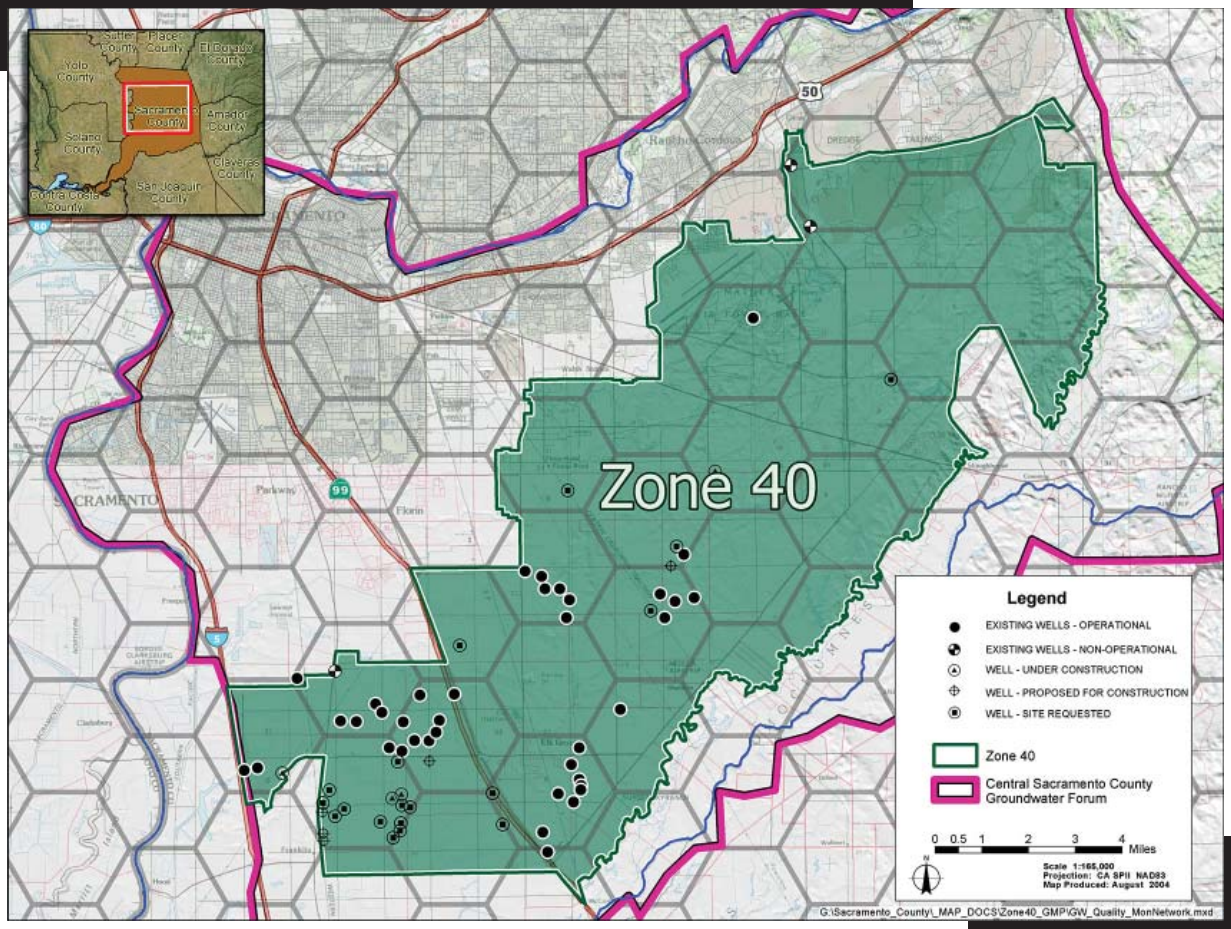
Coordinate with cooperating agencies to verify that uniform protocols are used when collecting water quality data.

Coordinate with USGS to obtain historic water quality data for NAWQA wells, determine timing and frequency of monitoring under USGS program and discuss the potential for integrating USGS monitoring resources with the Zone 40 network.

Coordinate with local, state, and federal agencies to identify where wells may exist in areas with sparse groundwater quality data. Identify opportunities for collecting and analyzing water quality samples from those wells.

Assess the adequacy of the groundwater quality monitoring well network annually.

Figure 3-4. Existing and Proposed Wells in Zone 40 Groundwater Quality Monitoring Network



3.5.3 Land Surface Elevation Monitoring

Subsidence of the land surface resulting from compaction of underlying formations affected by head (groundwater level) decline is a well-documented concern throughout much of the Central Valley. During a typical pumping season, changes in land surface elevation can be observed as a result of both elastic and inelastic subsidence in the underlying basin. Elastic subsidence results from the reduction of pore fluid pressures in the aquifer and typically rebounds when pumping ceases or when groundwater is otherwise recharged resulting in increased pore fluid pressure. Inelastic subsidence occurs when pore fluid pressures decline to the point that aquitard (a clay bed of an aquifer system) sediments collapse resulting in permanent compaction and reduced ability to store water in that portion of the aquifer.

While some land surface subsidence is known to have occurred as a result of groundwater extraction west of the Sacramento River[10], the extent of subsidence east of the Sacramento River has been minimal. DWR maintains three subsidence monitoring stations in the Sacramento Valley.

Historical benchmark elevation data for the period from 1912 through the late 1960s obtained from the National Geodetic Survey (NGS) were used to evaluate land subsidence in north Sacramento County. From 1947 to 1969 the magnitude of land subsidence measured at benchmarks north of the American River in Sacramento County ranged from 0.13 feet to 0.32 feet, with a general decrease in subsidence in a northeastward direction. This decrease is consistent with the geology of the area: formations along the eastern side of the Sacramento Valley are older than those on the western side and are subject to a greater degree of pre-consolidation making them less susceptible to subsidence. The maximum documented land subsidence of 0.32 feet was measured at both benchmark L846, located approximately two miles northeast of the former McClellan AFB, and benchmark G846, located approximately one mile northeast of the intersection of Greenback Lane and Elkhorn Boulevard.

Another land subsidence evaluation was performed in the Arden-Arcade area[11] of Sacramento County from 1981 to 1991. Elevations of nine wells in the Arden-Arcade area were surveyed in 1981, 1986, and 1991. The 1986 results were consistently higher than the 1981 results; this was attributed to extremely high rainfall totals in early 1986 that recharged the aquifer and caused a rise in actual land surface elevations. The 1991 results were consistently lower than the 1986 results; this was attributed to five years of drought immediately preceding the 1991 measurements which caused depletion of the aquifer and resulting land surface subsidence. Comparison of eight[12] of the locations indicates that seven benchmarks have lower elevations in 1991 than in 1981 and one benchmark has a higher elevation in 1991. Of the seven benchmarks with lower elevations in 1991, the maximum difference is 0.073 feet (less than one inch).

Whether this is inelastic subsidence is indeterminate from the data, but it is clear that the magnitude of the potential subsidence in the benchmarks during that period is negligible.

Actions. While available data and reports indicate that land surface subsidence is not a problem in the Sacramento County area, SCWA is interested in pursuing additional possible actions to continue to monitor for potential land surface subsidence. These may include:

Investigate the feasibility and costs of re-surveying the wells in the Arden-Arcade area that were last measured in 1991.

Coordinate with USGS to ascertain the suitability of the use of Interferometric Synthetic Aperture Radar (InSAR) images of Zone 40 and the surrounding area. If the technology appears suitable, identify the costs of determining ground surface elevations and identify potential cost-sharing partners.

Coordinate with other agencies, particularly the City and County of Sacramento and the NGS to determine if there are other suitable benchmark locations in the Zone 40 area to aid in the analysis of potential land surface subsidence.

[10] From 1988-1992 cumulative net sediment compaction of 0.78 feet was measured at the extensometer in Yolo County between June 15, 1988 and October 1, 1992 (USGS data from the Woodland land subsidence monitoring station, Yolo County, California, water years 1988-1992, USGS Open File Report 94-494)

[11] The boundaries of the Arden-Arcade area are (1) Sacramento's city limits on the west, (2) Sacramento's city limits and the American River on the south, (3) CWD on the east, and (4) Sacramento's city limits and Sac Suburban (Northridge Service Area) on the north.

[12] One of the nine wells could not be compared between 1981 and 1991 because the benchmark was destroyed and replaced between 1981 and 1986.

3.5.4 Surface Water Groundwater Interaction Monitoring

The interaction between groundwater and surface water has not been extensively evaluated within the Zone 40 area. SCWA is currently aware of the following:

A recent draft decision by the State Water Resources Control Board (SWRCB, 2003) regarding the American River concluded that from Nimbus Dam to about 6,000 feet below the dam, groundwater elevations and surface water elevations were similar enough to each other that groundwater could be tributary to the American River. Beyond 6,000 feet down river from the dam, groundwater elevations are sufficiently lower than the river channel to conclude that the American River is a losing stream down to its confluence with the Sacramento River.

Groundwater modeling (described in **Section 3.8.1**) has been used to estimate flow volumes between surface water and groundwater for various hydrologic conditions.

CSUS in cooperation with DWR has recently installed several monitoring wells in and adjacent to the American River to investigate groundwater interaction with the American River and how recent U.S. Army Corp of Engineers (USACE) levee reinforcement projects might have changed the surface water-groundwater flow relationships.

In 1991, SRCSD, Sacramento County, and the City of Sacramento established the Sacramento Coordinated Water Quality Monitoring Program (CMP). Since that time, the CMP has monitored surface water quality for a variety of constituents including trace elements at several locations on the American and Sacramento rivers. The CMP monitors the Sacramento River at the Freeport Bridge and the American River at Nimbus Dam.

SCWA has been working with TNC and SSCAWA to develop a Framework Agreement for the Management of Water Resouces in the Cosumnes River Corridor. This Agreement reflects a desire to work together to actively investigate opportunities for flow restoration, conjunctive use management and enhanced recharge within the Cosumnes River corridor.

Actions. SCWA will pursue actions to better understand the relationship between surface and groundwater in the Zone 40 area, including:

Work cooperatively with SGA and TNC to compile available stream gage data and information on tributary inflows and diversions from the American, Cosumnes and Sacramento rivers to quantify net groundwater recharge or discharge between gages in the Zone 40 area.

Coordinate with local, state, and federal agencies to identify available surface water quality data from the American, Cosumnes and Sacramento rivers proximate to the Zone 40 area.

Correlate groundwater level data from wells in the vicinity of river stage data to further establish whether the river and water table are in direct hydraulic connection, and if the surface water is gaining or losing at those points.

Continue to coordinate with local, state, and federal agencies and develop partnerships to investigate cost-effective methods that could be applied to better understand surface water-groundwater interaction along the American, Cosumnes and Sacramento rivers.

Coordinate with CSUS to analyze data obtained from recently constructed monitoring wells on the CSUS campus to better understand the relationship between the groundwater basin and surface water flows at that location.

3.5.5 Protocols for the Collection of Groundwater Data

Through the work completed as part of the SGA GMP, MWH has evaluated the accuracy and reliability of groundwater data collected by cooperating agencies within the Sacramento Region (MWH, 2002). The evaluation indicated a significant range of techniques, frequencies and documentation methods for the collection of groundwater level and groundwater quality data. Although the groundwater data collection protocol may be adequate to meet the needs of individual agencies, the lack of consistency yields an incomplete picture of basin-wide groundwater conditions. Other types of groundwater data collection protocols are included in **Sections 3.5.1** and **3.5.2** above.

Actions. To improve the comparability, reliability and accuracy of groundwater data, SCWA will take the following actions:

Use a Standard Operating Procedure (SOP) for collection of water level data by each of the cooperating agencies. ***Appendix B*** *includes an SOP for Manual Water Level*

Measurements. This SOP was prepared using guidance documents available through EPA and was included in a technical memorandum developed for SGA summarizing the accuracy and reliability of groundwater data (MWH, 2002).

Provide cooperating agencies with guidelines on the collection of water quality data developed by DHS for the collection, pretreatment, storage, and transportation of water samples (DHS, 1995).

Provide training on the implementation of these SOPs to cooperating agencies, if requested.

3.5.6 Data Management System

In order for SCWA to achieve its primary objective of sustaining the groundwater resource within the Zone 40 groundwater basin, it was essential to develop a data storage and analysis tool, or DMS. The DMS was developed by MWH under contract with the USACE. Other local sponsors included SGA and its member agencies, DWR, and SCWA.

The DMS is a public domain application developed in a Microsoft Visual Basic environment and is linked to a SQL database containing Zone 40 and other Central Basin purveyor data. The DMS provides the end-user with ready access to both enter and retrieve data in either tabular or graphical formats. Security features in the DMS allow for access restrictions based on a variety of user permission levels. Data in the DMS include:

- Well construction details.
- Known locations of groundwater contamination and potentially contaminating activities.
- Long-term monitoring data on:
  - Monthly extraction volumes.
  - Water elevations.
  - Water quality.
- Aquifer characteristics based on well completion reports.

The DMS allows for the viewing of regional trends in groundwater level and quality not previously available to SCWA (see **Figures 3-5a and 3-5b** for DMS screen captures). The DMS has the capability of quickly generating well hydrographs and groundwater elevation contour maps using historic groundwater level data. The DMS also has the ability to view water quality data for CCR Title 22 required constituents as a temporal concentration graph at a single well or any constituent can be plotted with respect to concentration throughout the Zone 40 area. Presentation of groundwater elevation and groundwater quality data in these ways will be useful for making groundwater basin management decisions.

SGA and SCWA are currently in the process of establishing data transfer protocols so that groundwater data in either area (by cooperating agencies, DWR, AFRPA, USGS, etc…) can be readily appended to the database and analyzed through the DMS. Annual summaries of groundwater monitoring data will be prepared using the analysis tools in the DMS and presented in the update to the State of the Basin report (see **Section 4**).

Once the DMS is fully populated and quality-control checked a summary of existing basin conditions will be prepared. From this initial summary analyses will be performed on at least an annual basis to assess the impacts of current and future SCWA management actions on the groundwater system.

Actions. To maintain and improve the usability of the DMS, SCWA will take the following actions:

Continue to update the DMS with current water purveyor data.

Make recommendations to the DMS developer on utilities to add to the DMS to increase its functionality.

3.6 COMPONENT CATEGORY 3: GROUNDWATER RESOURCE PROTECTION

SCWA considers groundwater protection to be one of the most critical components of ensuring a sustainable groundwater resource. In this GMP, resource protection includes both the prevention of contamination from entering the groundwater basin and the remediation of existing contamination plumes. Prevention measures include proper well construction and destruction practices, development of wellhead protection measures, and protection of recharge areas. Containment prevention also includes measures to prevent contamination from human activities as well as contamination from natural substances such as saline water bodies from entering the potable portion of the groundwater system.

3.6.1 Well Construction Policies

The Sacramento County Environmental Management Department (EMD) administers the well permitting program for Sacramento County. The standards for construction are identified in Sacramento County Code No. SCC-1217 as amended on April 9, 2002. In addition to general well construction standards, Sacramento County has a policy of special review by appropriate regulatory agencies for well permits within 2,000 feet of a known contaminant plume (referred to as Consultation Zones) and prohibits the drilling of new public supply wells at Mather Field or near the Aerojet or Boeing facilities. As part of the development of the DMS, the most recent extents of known contaminant plumes associated with Mather Field and the Aerojet/Boeing aerospace research centers were delineated for SCWA.

Actions. SCWA will take the following actions:

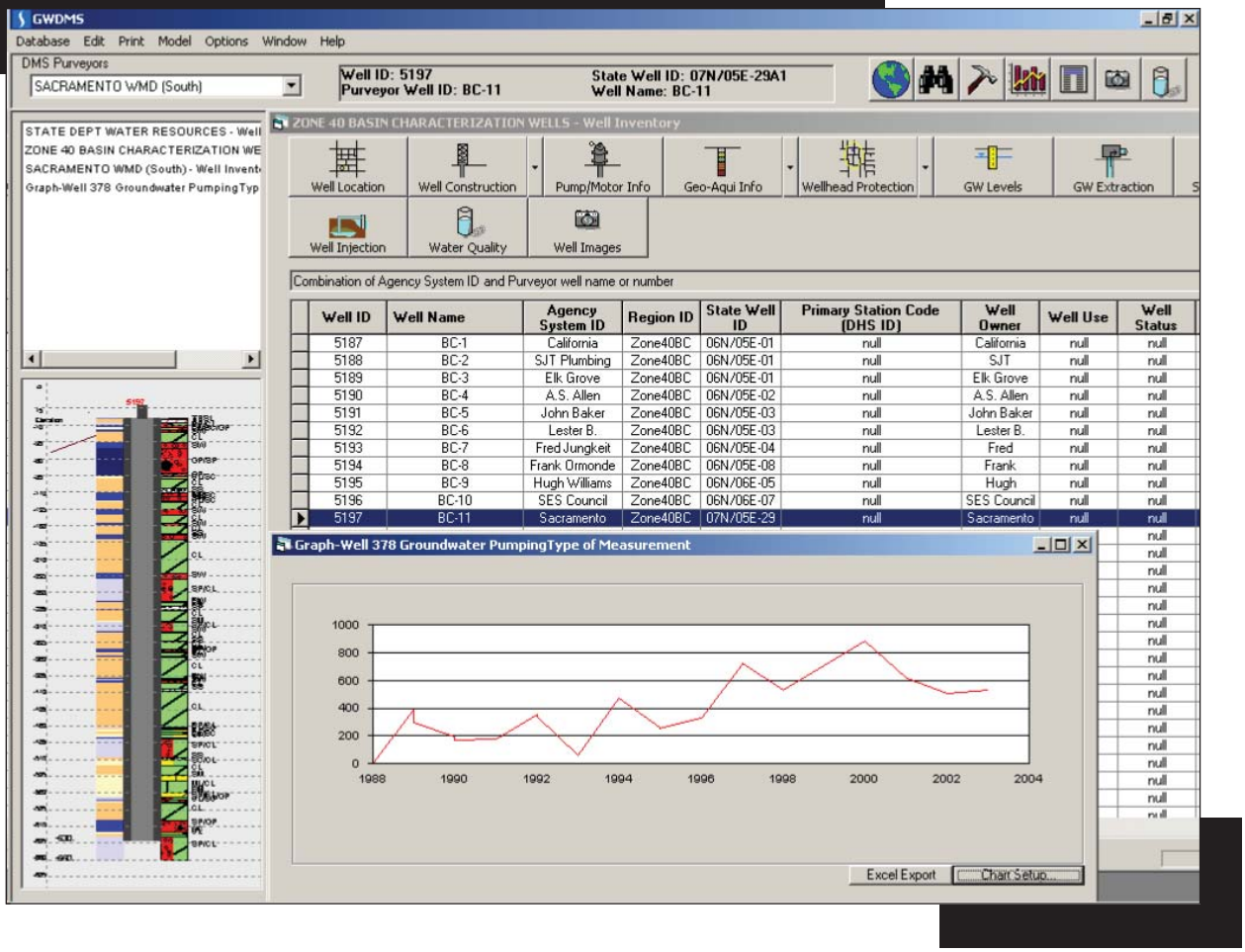
Ensure that appropriate staff are provided a copy of the county well ordinance and understand proper well construction procedures.

Adhere to Sacramento County's Consultation Zone and provide a copy of the boundary of the prohibition zones to appropriate agencies within the Central Basin.

Provide a copy at the most recently delineated plume extents Mather Field and Aerojet/Boeing to EMD and appropriate staff for their review and possible use.

Coordinate with other groundwater users in the Central Basin to provide guidance as appropriate on well construction. Where feasible and appropriate, this could include the use of subsurface geophysical tools prior to construction of the well to assist in well design.

Figure 3-5a. DMS Screen Capture



3.6.2 Well Abandonment and Well Destruction Policies

EMD administers the well destruction program for Sacramento County. The standards for well destruction are identified in Sacramento County Code No. SCC-1217 as amended on April 9, 2002. One concern expressed by SCWA and EMD is that many abandoned domestic wells have not been properly destroyed. As part of development of the DMS for SGA, DWR well records for all known wells in the basin were reviewed for reported abandonment and destruction. The wells were rated for the confidence of proper destruction based on the information provided on the report. This information was entered into the DMS. Examples of DMS screens are presented in **Figure 3-5a** and **Figure 3-5b**. The actions listed below will provide improved protection of groundwater quality within the Zone 40 area.

Actions. SCWA will take the following actions:

Complete a similar survey of abandoned wells in the Zone 40 basin and populate DMS with data.

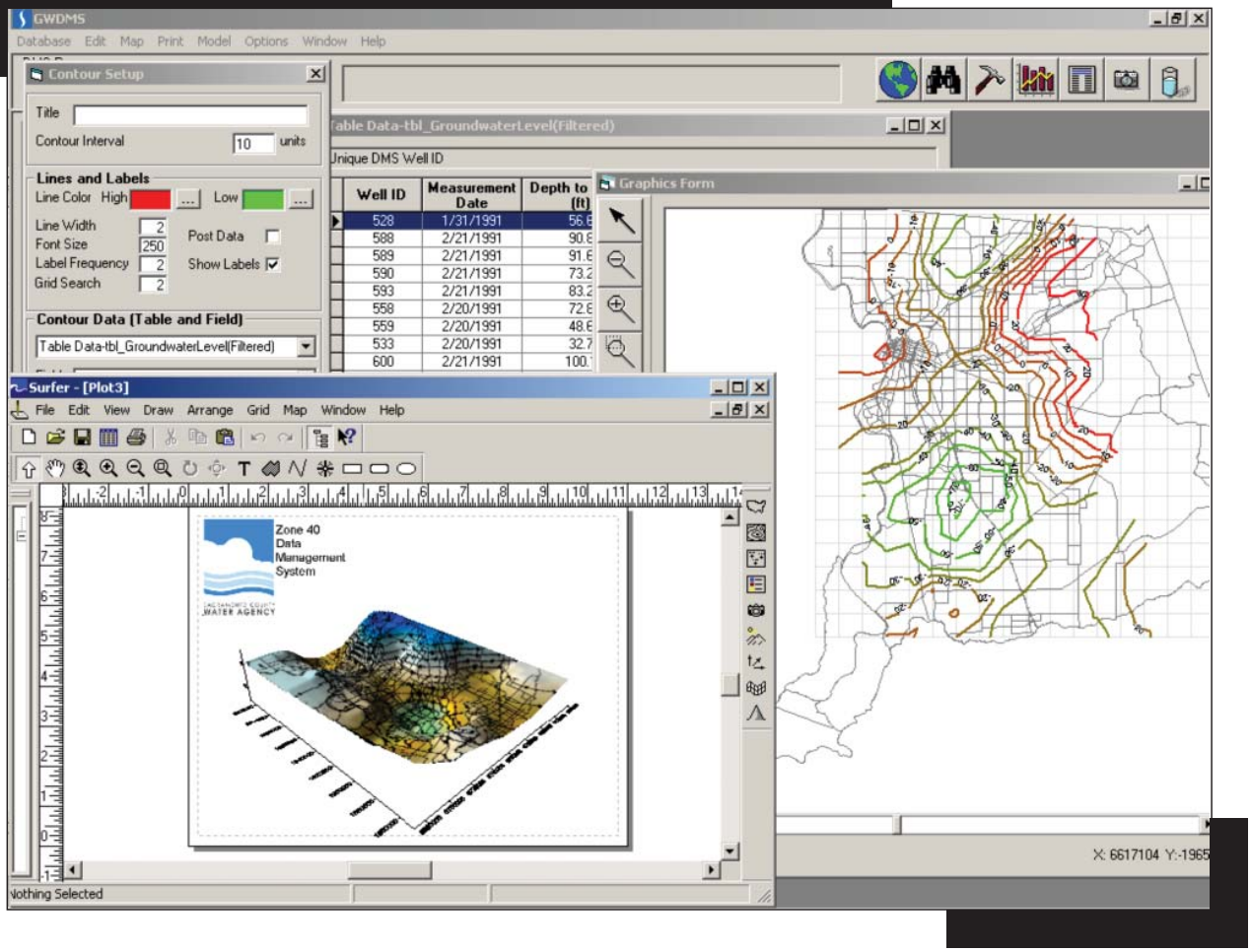
Ensure that all public and private agencies in Zone 40 are provided a copy of the code and understand the proper destruction procedures and support implementation of these procedures.

Follow up with cooperating agencies and EMD on the reported abandoned and destroyed wells to confirm the information collected from DWR.

Provide a copy of the information on abandoned and destroyed wells in the Central Basin to fill any gaps in their records.

Meet with EMD to discuss ways to ensure that wells in the Zone 40 area are properly abandoned or destroyed.

Figure 3-5b. DMS Screen Capture



Obtain "wildcat map from California Division of Oil and Gas to ascertain the extent of historic gas well drilling operations in the area as these wells could function as conduits of contamination if not properly destroyed.

3.6.3 Wellhead Protection Measures

Identification of wellhead protection areas is a component of the Drinking Water Source Assessment and Protection (DWSAP) Program administered by DHS. DHS set a goal for all water systems statewide to complete Drinking Water Source Assessments by mid-2003. Zone 40 has completed their required assessments by performing the three major components required by DHS:

- Delineation of capture zones around sources (wells).
- Inventory of Potential Contaminating Activities (PCAs) within protection areas.
- Vulnerability analysis to identify the PCAs to which the source is most vulnerable.

Delineation of capture zones includes using groundwater gradient and hydraulic conductivity data to calculate the surface area overlying the portion of the aquifer that contributes water to a well within specified time-of-travel periods. Typically, areas are delineated representing 2-, 5-, and 10-year time-of-travel periods. These protection areas need to be managed to protect the drinking water supply from viral, microbial, and direct chemical contamination.

Inventories of PCAs include identifying potential origins of contamination to the drinking water source and protection areas. PCAs may consist of commercial, industrial, agricultural, and residential sites, or infrastructure sources such as utilities and roads. Depending on the type of source, each PCA is assigned a risk ranking, ranging from "very high" for such sources as gas stations, dry cleaners, and landfills, to "low" for such sources as schools, lakes, and non-irrigated cropland.

Vulnerability analysis includes determining the most significant threats to the quality of the water supply by evaluating PCAs in terms of risk rankings, proximity to wells, and Physical Barrier Effectiveness (PBE). PBE takes into account factors that could limit infiltration of contaminants including type of aquifer, aquifer material (for unconfined aquifers), pathways of contamination, static water conditions, hydraulic head (for confined aquifers), well operation, and well construction. The vulnerability analysis scoring system assigns point values for PCA risk rankings, PCA locations within wellhead protection areas, and well area PBE; the PCAs to which drinking water wells are most vulnerable are apparent once vulnerability scoring is complete.

SCWA has already added PCA and capture zone information from the DWSAP into the DMS. The DMS includes a feature that will automatically calculate wellhead protection areas if no data are available or if new well locations are proposed.

Actions. SCWA will take the following actions:

Request that public water purveyor agencies within the Central Basin provide vulnerability summaries from the DWSAP to Zone 40 to be used for guiding management decisions in the basin.

Contact groundwater basin managers in other areas of the state for technical advice, effective management practices, and "lessons learned," regarding establishing wellhead protection areas.

3.6.4 Protection of Recharge Areas

SCWA has evaluated surface geology within and directly adjacent to Zone 40's boundary for the purpose of delineating areas of potentially high recharge rates. Much of the surface area considered to have the highest potential for recharge along the American River is developed. Abandoned aggregate mining pits north and south of Jackson Highway have been considered in previous studies to be a possible recharge location. These pits typically extend 20 to 30 feet below ground surface and are mined to the clay layer that separates the Laguna formation from the Mehrten formation. Water introduced to these pits could deep percolate vertically through the interbedded clay lens and horizontally through the pit walls into the Laguna formation. Flood waters and perhaps treated recycled water can be discharged into these pits for year round recharge. The RWQCB will need to provide regulatory approval prior to any use of these pits for recharge.

Other known recharge locations are along the Cosumnes River. The Cosumnes River overlies very transmissive soils evidenced by the lack of river flow during certain times of year. Enhancing this recharge is already being considered

through a pilot program (coordinated through the Water Forum, SCWA, TNC and SSCAWA) that would convey American River water through the Folsom South Canal and then discharge it to the Cosumnes River at the canal crossing. It is hoped that this program will demonstrate an improvement in the fishery and riparian habitat along the Cosumnes River.

Actions. SCWA will take the following action:

SCWA will continue to work with mining companies, TNC and SSCAWA to explore the possibilities for enhancing recharge into the Zone 40 groundwater basin.

3.6.5 Control of the Migration and Remediation of Contaminated Groundwater

Contaminated groundwater within Zone 40 is primarily from Mather Field, Aerojet, and Boeing. The groundwater contamination plumes from these sources are shown in **Figure 2-3**. Also of concern is localized contamination by industrial/commercial point sources such as dry cleaning facilities and numerous fuel stations throughout the basin.

While SCWA does not have authority or the responsibility for remediation of this contamination, it is committed to coordinating with responsible parties and regulatory agencies to stay informed on the status and disposition of known contamination in the basin. For example, SCWA has requested and entered into its DMS known LUSTs within the basin. This information is maintained by the SWRCB and RWQCB. Also, SCWA has been in communication with AFRPA, which is overseeing remediation efforts at Mather AFB (see **Section 3.4.2**).

Actions. SCWA will take the following actions:

Coordinate with known responsible parties to develop a network of monitoring wells to act as sentry wells for public supply wells.

If detections occur in these monitoring wells, meet with the responsible parties to develop strategies to minimize the further spread of contaminants. An example of a strategy would be to consider altering groundwater extraction patterns in the area to change the groundwater gradient.

Use the information on mapped contaminant plumes and LUST sites in developing groundwater extraction patterns and in the siting of future production or monitoring wells.

Meet with representatives of the RWQCB to establish a mutual understanding about SCWA's groundwater management responsibilities. Identify ways to have open and expedited communication with RWQCB regarding any new occurrences of LUSTs, particularly when contamination is believed to have reached the groundwater.

3.6.6 Control of Saline Water Intrusion

Saline water intrusion from the Sacramento/San Joaquin River Delta (Delta) is not currently a problem in the Central Basin, and is not expected to become a problem in the future. Higher groundwater elevations associated with recharge from the American and Sacramento rivers have maintained a historical positive gradient preventing significant migration of any saline water from the Delta into the Sacramento County region. These groundwater gradients will continue to serve to prevent any localized pumping depressions in the basin from inducing flow from the Delta into the Central Basin.

Actions. SCWA will take the following actions:

Track the progression, if any, of saline water bodies moving toward the east from the Delta. Because this is a highly unlikely scenario, this action will be limited to communicating with DWR's Central District Office on a biennial basis to check for significant changes in TDS concentrations in wells. DWR has a regular program of sampling water quality in select production wells throughout the adjacent Solano, San Joaquin, and Yolo counties. This will serve as an early warning system for the potential of saline water intrusion from the Delta.

Observe TDS concentrations in Zone 40's municipal wells that are routinely sampled under Title 22. This data will be readily available as part of the DMS and are already an on-going task for the annual review of basin conditions.

Inform all stakeholders of the presence of the salinity interface and the approximate depth to the interface for their reference when siting potential wells. SCWA will also ensure that EMD, which issues well permits, is aware of the interface. SCWA will provide a map indicating the contour of the elevation of the base of fresh water in Sacramento County to EMD for their reference when issuing well permits.

3.7 COMPONENT CATEGORY 4: GROUNDWATER SUSTAINABILITY

To ensure a long-term viable supply of groundwater, SCWA is seeking to maintain or increase the amount of groundwater stored in the basin over the long-term. The WFA's groundwater management element provides a framework by which the groundwater resource in the Sacramento County-wide basin can be protected and used in a sustainable manner. It recommends an average annual sustainable groundwater yield within the Central Basin of 273,000 AF/year. As discussed in **Section 2**, historic groundwater extractions have resulted in a net depletion of groundwater stored under the Zone 40 area. To ensure a sustainable resource, SCWA continues to move forward with its conjunctive use program in Zone 40 including pursuit of additional surface water supplies, increased use of recycled water, and implementation of the WFA water conservation element. Current conjunctive use activities include improvements to the City of Sacramento/SCWA Franklin Boulevard connection and continued development of the Freeport Regional Water Project that will bring additional surface water supplies into Zone 40.

Two primary activities will result in an improved ability to sustain the viability of the groundwater resource for the region. Conjunctive management is an activity that includes the planning and construction of facilities to increase the available water supply to the area as well as to create opportunities for the banking and exchange of water with local in-basin partners after local needs are met. These partnerships will result in increased surface water and perhaps revenue to pay for some of the necessary capital improvements to help sustain the resource in a cost-effective way (Conjunctive Management Activities).

SCWA is committed to expanded direct recharge activities and proposes to investigate a variety of ways of recharging water into the available storage space in the basin. Opportunities for direct recharge from overlying land in the basin exist through recharge basins (e.g., abandoned aggregate mining pits) or through aquifer storage and recovery (ASR). The City of Roseville is currently implementing ASR programs where treated surface water is being injected into the groundwater and recovered through wells in the summer months and dry years. Most of the potential recharge opportunities could occur by providing raw or treated surface water to municipal and agricultural users in-lieu of their extracting groundwater. During the early phases of Zone 40's conjunctinve use program, there is expected to be excess capacity in both the raw water pipeline from the Freeport diversion and the Central WTP that could be delivered through some means of conveyance to groundwater users.

Actions. SCWA will take the following actions:

Continue to investigate conjunctive use opportunities within the Zone 40 area. Zone 40 and other groundwater users within the Central groundwater basin will coordinate any recharge efforts.

Continue to investigate opportunities for the development of direct recharge facilities in addition to in-lieu recharge (e.g. injection wells or surface spreading facilities, through constructed recharge basins or in river or streambeds).

3.7.1 Demand Reduction

Another way to maintain the sustainable yield of the basin and continue to achieve in-lieu recharge is by reducing demand for potable water supplies by conservation and through the use of recycled water for landscape irrigation.

Water Conservation. While SCWA is not currently a member of the RWA, SCWA participates in RWA's efforts in developing and implementing a regional Water Efficiency Program (WEP). The WEP assists participants in meeting their water conservation agreements with the Water Forum, the California Urban Water Conservation Council, and if necessary, the Central Valley Project Improvement Act (CVPIA). The goal of the WFA is to achieve system-wide conservation of slightly more than 25 percent by the year 2030.

Water Recycling. SRCSD treats wastewater for the Sacramento region at its Elk Grove Wastewater Treatment Plant and is looking for ways to increase demand for tirtiary treated or recycled water. Currently, SRCSD is treating approximately 5 MGD of recycled water at its Elk Grove facility and delivering it to nearby landscape irrigation users within Zone 40. SRCSD expects the capacity of that facility to increase to 10 MGD over the next few years to serve the East Franklin and Laguna Ridge development areas within Zone 40.

Actions. SCWA will take the following actions:

Continue to participate in RWA's WEP to ensure that SCWA's conservation efforts are on track. For those who

receive wholesale water supplies from Zone 40, SCWA will ensure that they are informed of the benefits and regional importance of participating in the WEP.

Coordinate with SRCSD to investigate further opportunities for expanded use of recycled water throughout Zone 40 and the Central Basin.

3.8 COMPONENT CATEGORY 5: PLANNING INTEGRATION

With the large number of autonomous water purveyors serving the greater Sacramento area, the need to integrate water management planning on a regional scale is a high priority. Individual purveyors derive their supplies from the American River, the Sacramento River, the groundwater basin, or some mix of these sources. Individual purveyor infrastructure systems are mostly independent; where interconnections do exist between purveyors, they are typically for emergency purposes only.

The WFA provides a regional conjunctive use framework with commitments from individual purveyors concerning groundwater and surface water operations, including limitations on surface water diversions from the lower American River during dry years. SCWA and others planning efforts seek to better integrate the individual plans of various entities to implement various elements of the WFA in keeping with the 2030 regional framework. Such integration also promotes operational efficiency, cost savings, and in some cases generates larger statewide-system benefits. SCWA recognizes that some non-signatures to the WFA have an interest in water supply planning coordination.

3.8.1 Existing Integrated Planning Efforts

Zone 40 has already demonstrated implementation of integrated management in the region through its cooperation with the City of Sacramento in treating and wheeling surface water, through participation in the WEP, and through the SRCSD recycled water program. Some of the integrated planning efforts to date are listed below.

Water Efficiency Program.
Described in Section 3.7.1

City of Sacramento Wheeling Agreement.
Described in Section 2.5

SCWA/SRCSD Recycled Water Program.
Described in Section 3.7.1

Urban Water Management Planning. Zone 40 and its retail water purveyors are required to prepare Urban Water Management Plans. These plans, as defined by CWC § 10610 et seq., require public water suppliers with more than 3,000 customers or that deliver more than 3,000 AF of water annually to identify conservation and efficient water use practices to help ensure a long-term, reliable water supply. To date, all retail purveyors have submitted plans to DWR.

DWSAP Program. The DWSAP Program is administered by DHS. As a first step to a complete source protection program, DHS required water systems to conduct a preliminary assessment. The assessment includes the "delineation of the area around a drinking water source through which contaminants might move and reach that drinking water supply; an inventory of PCAs that might lead to the release of microbiological or chemical contaminants within the delineated area; and a determination of the PCAs to which the drinking water source is most vulnerable (http://www.dhs.ca.gov/ps/ddwem/dwsap/overview.htm)."

The assessments only apply to agencies that deliver groundwater for public drinking water supply. Data from the assessments have or will be incorporated into Zone 40's DMS.

Land Use Planning. Effective January 1, 2002, state law required (SB610 and SB221) that a water supplier take certain actions to confirm sufficency of water supply as a condition to approval of some new development projects. These actions involve the development of Water Supply Assessments and Writtern Verifications at the request of the land use authority. These documents provide an assurance that adequate water supplies are available before a project moves forward.

Integrated Surface Water and Groundwater Modeling. SCWA is interested in using and building upon existing groundwater models for the Sacramento area. In the late 1990s, a range of groundwater extraction and recharge scenarios were simulated using the North American River and Sacramento County Combined

Integrated Groundwater and Surface Water Model (IGSM[13]). This model was originally developed for the American River Water Resources Investigation (ARWRI) conducted by Reclamation and was later used for the Draft Water Forum Solution Model developed for the Water Forum. The purpose of the Water Forum's use of the model was development of a conjunctive use strategy for the groundwater basin underlying Sacramento County and southern Placer County. SGA recently updated the calibration model to run with the latest version of IGSM. Historical water budgets from 1969 to 1995 were developed and a comparison of model results with actual measured values for groundwater elevations and streamflows over the calibration period were provided. SCWA and SGA are pursuing having the calibration period extended from 1995 to 2000, and to extend the planning model hydrologic period that used for measuring effects of conjunctive use practices. Currently the hydrologic period extends from 1922 to 1995.

SCWA's interest in maintaining and updating the IGSM is because it forms the basis for the WFA, and the Zone 40 Master Plan Environmental analyses. SCWA is also interested in being custodian of the IGSM model because it is the model used for regional planning by Reclamation and DWR for projects such as the ARWRI, the CVPIA, and the CALFED process.

Actions. SCWA will take the following actions:

Prepare and adopt a formal integrated water management plan in accordance with CWC § 10540 et seq. The plan will include, but not be limited to, the elements listed above. Zone 40 will seek to form an ad hoc committee with the RWA, the SSCAGA, and the Nature Conservancy to determine which agency would be most appropriate to prepare that plan and to update and make use of the IGSM model.

Review the Water Forum Land Use procedures and make recommendations on what additional role, if any, the Zone 40 should take with respect to land use decisions within the Zone 40 area.

[13]The IGSM is a finite element, quasi three-dimensional, multi-layered model that integrates surface water and groundwater on a monthly time step. The IGSM was developed for use as a regional planning tool for large areas influenced by both surface water and groundwater. The tool is well-equipped to accommodate input and output of land use and water use data over large areas. Data input includes hydrogeologic parameters, land use, water demand, precipitation and other hydrologic parameters, boundary inflows, and historical water supply. For purposes of parameter definition and developing water budgets around physical and/or political boundaries, the IGSM divides Sacramento, Placer, Sutter, and San Joaquin counties into subregions. Each subregion is further divided into unique numbered elements varying from 200 to 800 acres in size. Overlying this grid is a coarse parametric grid utilized for specifying aquifer and other parameters.

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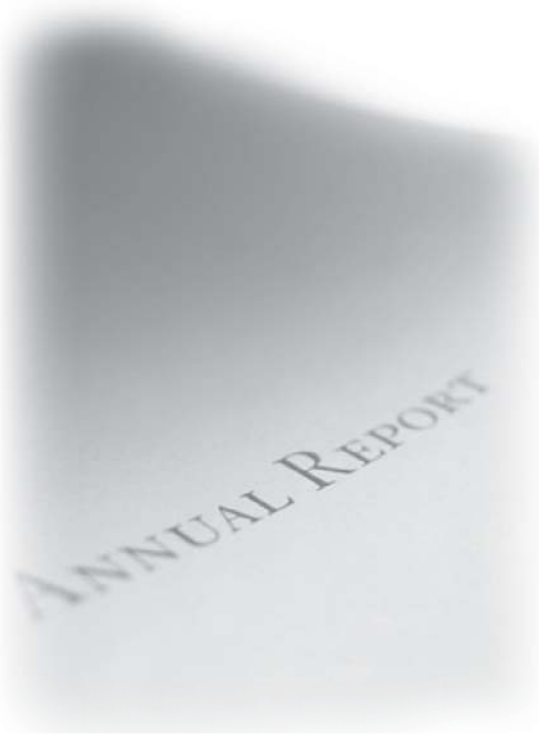
SECTION 4

PLAN IMPLEMENTATION

SECTION 4

Table 4-1 summarizes the action items presented in ***Section 3*** *and an implementation schedule. Many of these actions involve coordination by the SCWA with other local, state and federal agencies within 6 months of the adoption of this GMP. A few activities involve assessing trends in basin monitoring data for the purpose of determining the adequacy of the monitoring network. These assessments will be made as new monitoring data become available for review by SCWA and results will be documented in an annual State of the Basin report (see below).*

PLAN IMPLEMENTATION



4.1 ANNUAL GMP IMPLEMENTATION REPORT

SCWA will report on the progress made implementing the GMP in an annual State of the Basin report, which will summarize groundwater conditions in the Zone 40 area and document groundwater management activities from the previous year. Much of the data used in the annual State of the Basin report will come from the monitoring and successful implementation of the action items stated above and from data collected and entered into the DMS. **Appendix C** provides examples of the kinds of output that will be taken from the DMS and interpreted by a hydrogeologist in an annual report. **Figure 3-5** is an example of the cross-section utility of the DMS that can be used to indicate the heterogeneity of the basin and where water bearing deposits may lie in comparison with actual measured groundwater elevation and well screen data. This report will include:

- Summary of monitoring results, including a discussion of historical trends.
- Summary of management actions during the period covered by the report.
- Improved characterization of the groundwater basin through interpretation of the DMS cross section.
- Summary and interpretation of water quality and groundwater elevation data.
- A discussion, supported by monitoring results, of whether management actions are achieving progress in meeting BMOs.
- Summary of any plan component changes, including the addition or modification of BMOs during the period covered by the report.
- The State of the Basin report will be completed by April 1st each year and will report on conditions and activities completed through December 31st of the prior year.

Table 4-1. Summary of GMP Actions

Description of Action	Implementation Schedule (approximate time for commencing activity following adoption of GMP)
I. COMPONENT CATEGORY 1: STAKEHOLDER INVOLVEMENT	
INVOLVING THE PUBLIC	
1. Continue efforts to encourage public participation as opportunities arise.	on-going
2. Review and take actions from the Public Outreach Plan as necessary during implementation of various aspects of the GMP.	on-going
3. Provide briefings to the CSCGF on GMP implementation progress.	on-going
4. Work with basin stakeholders to maximize outreach on GMP activities including the use of the SCWA website.	12 months
INVOLVING OTHER AGENCIES WITHIN AND ADJACENT TO THE ZONE 40 AREA	
1. Continue high level of involvement with SGA, TNC, SSCAWA and others in implementing the GMP.	on-going
2. Provide copies of the adopted GMP and subsequent annual reports to representatives from CSCGF, SGA, TNC, SSCAWA and other interested parties.	6 months
3. Meet with representatives from CSCGF, SGA, TNC, SSCAWA and others, as needed.	6 months
UTILIZING ADVISORY COMMITTEES	
1. Upon adoption of the GMP, the acting Technical Review Committee will meet to discuss the continuation and composition of committees to guide implementation of the plan.	6 months
DEVELOPING RELATIONSHIPS WITH STATE AND FEDERAL AGENCIES	
1. Continue to develop working relationships with local, state, and federal regulatory agencies.	on-going
PURSUING PARTNERSHIP OPPORTUNITIES	
1. Continue to promote partnerships that achieve both local supply reliability and achieve broader regional and statewide benefits.	on-going
2. Continue to track grant opportunities to fund groundwater management activities and local water infrastructure projects.	on-going
II. COMPONENT CATEGORY 2: MONITORING PROGRAM	
GROUNDWATER ELEVATION MONITORING	
1. Coordinate with SGA, SSCAWA, TNC and others to identify an appropriate group of wells for monitoring for a spring 2005 set of groundwater elevation measurements.	6 months
2. Coordinate with DWR to ensure that the selected wells are maintained as part of a long-term monitoring network.	6 months
3. Coordinate with agencies involved in data collection to ensure that needed water level elevations are collected and verify that uniform data collection protocols are used among the agencies.	6 months
4. Coordinate with the USGS to determine the potential for integrating USGS monitoring wells constructed for the National Water Quality Assessment (NAWQA) Program into the Zone 40 monitoring network.	6 months
5. Consider ways to fill gaps in the monitoring well network by identifying additional suitable existing wells or identifying opportunities for constructing new monitoring wells.	6 months
6. Assess groundwater elevation trends and conditions based on the network annually.	Results and recommendations included in State of Basin report published in July of each year
7. Assess the adequacy of the groundwater elevation monitoring well network annually.	Results and recommendations included in State of Basin report published in July of each year
8. Identify a subset of monitoring wells that will be monitored more frequently than twice annually to improve SCWA's understanding of aquifer responses to pumping throughout the year.	12 months
GROUNDWATER MANAGEMENT SYSTEM	
1. Provide SCWA staff with training and use of the Zone 40 DMS.	6 months
2. Populate and update the DMS with available groundwater, water quality, well, and surface water data.	6 months
3. Develop list of recommended enhancements to the DMS.	6 months
4. Provide resources for maintaining and updating the DMS and the Sacramento County IGSM.	6 months
5. Develop State of the Basin Report.	6 months

Table 4-1. Summary of GMP Actions continued

III. COMPONENT CATEGORY 3: GROUNDWATER RESOURCE PROTECTION	
WELL CONSTRUCTION POLICIES	
1. Coordinate with the Sacramento County Environmental Management Department on the administration of the well construction and abandonment program.	on-going
2. Educate the Sacramento County Environmental Management Department on the Zone 40 GMP and SCWA's role in groundwater protection.	6 months
WELLHEAD PROTECTION	
1. Update list of PCA's and delineation of capture zone areas.	12 months
2. Coordinate with Sacramento County, City of Elk Grove, and City of Rancho Cordova Planning Staff on location of Zone 40 wells and their capture zones.	12 months
IV. COMPONENT CATEGORY 4: GROUNDWATER SUSTAINABILITY	
DEMAND REDUCTION	
1. Coordinate with SRCSD to investigate further opportunities for expanded use of recycled water.	on-going
V. COMPONENT CATEGORY 5: PLANNING INTEGRATION	
INTEGRATED WATER MANAGEMENT PLAN	
2. Prepare and adopt a formal integrated water management plan in accordance with CWC 10540.	on-going
2. SCWA will seek to form an ad hoc committee with the RWA, SGA, SSCAGA, and TNC to determine which agency(s) would be most appropriate to prepare an integrated water management plan and to update and make use of the IGSM model.	12 months

4.2 FUTURE REVIEW OF GMP

This GMP is intended to be a framework for the first regionally coordinated management efforts in the Zone 40 area. As such, many of the identified actions will likely evolve as Zone 40 actively manages and learns more about the basin and as the CSCGF negotiations determine a groundwater management entity for the entire Central groundwater basin. Many additional actions will also be identified in the annual summary report described above. The GMP is therefore intended to be a living document, and it will be important to evaluate all of the actions and objectives over time to determine how well they are meeting the overall goal of the plan. SCWA plans to evaluate this entire plan within five years of adoption.

4.3 FINANCING

It is envisioned that implementation of the GMP, as well as many other groundwater management-related activities will be funded from a variety of sources including the Zone 40 fee program; in-kind services by other agencies; state or federal grant programs; and local, state, and federal partnerships. Some of the items that would likely require additional resources include:

- Monitoring for groundwater quality or elevations in non-purveyor wells.
- Customization of the DMS interface.
- Preparation of GMP annual reports.
- Updates of the overall GMP.
- Update of data sets and recalibration/improvement of existing groundwater model.
- Collection of additional subsidence data.
- Construction of monitoring wells where critical data gaps exist.
- Stream-aquifer interaction studies.
- Implementation of the GMP including:
- Committee coordination.
- Project management.
- Implementation of regional conjunctive use program.
- During year one of plan implementation, an estimate of some of the likely costs associated with the above activities will be prepared.

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SECTION 5

REFERENCES

SECTION 5

REFERENCES

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SECTION 6

APPENDICES

Appendix A

Outreach and Education

Attachment A. Zone 40's Notices Published in the Sacramento Bee

Attachment B. "Summary of Public Outreach Plan for Groundwater Management" (Included as Separate Attachment)

NO427 PUBLIC NOTICE

NOTICE OF INTENT TO ADOPT A RESOLUTION TO PREPARE A GROUNDWATER MANAGEMENT PLAN

The Sacramento County Board of Supervisors intends to consider the adoption of a resolution to prepare a groundwater management plan at its August 17, 2004 Board meeting. The meeting, which the public is invited to attend, will begin at 9:30 am at the Sacramento County Board of Supervisors Chambers, County Administration Center, 700 H Street, Sacramento, California.

The Sacramento County Water Agency supplies water to unincorporated areas of Sacramento County south of the American River and north of the Cosumnes River. Any individual interested in the development of the groundwater management plan is encouraged to attend the meeting. For more information, please contact Bob Gardner at the Sacramento County Department of Water Resources at (916) 874-8433.

2Ti August 3 & 10, 2004

NO 529 PUBLIC NOTICE

RESOLUTION NO. WA-2561

RESOLUTION OF INTENT TO PREPARE A GROUNDWATER MANAGEMENT PLAN FOR ZONE 40 AND ADOPT A STATEMENT OF PUBLIC PARTICIPATION

WHEREAS, the Sacramento County Water Agency (hereinafter referred to as "Agency") was formed in 1952 by a special legislative act of the State of California (the Sacramento County Water Agency Act [hereinafter referred to as "Agency Act"]); and
WHEREAS, under the Agency Act the Agency is to provide for the protection, preservation, and enhancement, for current and future beneficial uses, the groundwater resources in Sacramento County; and
WHEREAS, the Agency, under a Joint Powers Authority, has participated in the Sacramento Groundwater Authority (hereinafter referred to as "SGA") for purposes of protecting groundwater resources in the North Sacramento County Groundwater Basin, north of the American River; and
WHEREAS, the Agency recognizes the adopted Groundwater Management Plan for the North Sacramento County Groundwater Basin completed by SGA; and
WHEREAS, under the Agency Act the Agency is empowered to develop, adopt and implement a plan for the management of groundwater resources.
NOW, THEREFORE, the Board of Directors of the Sacramento County Water Agency resolves and determines as follows:

Section 1. The foregoing recitals are true and correct and this Board so finds and determines.

Section 2. The Agency intends to develop, adopt, and implement a groundwater management plan for Zone 40. Among other components, the Zone 40 groundwater management plan shall include 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 the 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 SGA, other local agencies, water purveyors, and private well owners in the Central Sacramento County Groundwater Basin in the development of the groundwater management plan;
e. A map depicting the Central Sacramento County Groundwater Basin, as defined by California Department of Water Resources Bulletin No. 118 and the Central Sacramento County Groundwater Forum, the jurisdictional area of Zone 40, and the boundaries of SGA, other local agencies, and water purveyors in the Central Sacramento County Groundwater Basin; and,
f. Rules related to implementation of the groundwater management plan.

Section 3. The Agency will provide for public involvement in the development of the groundwater management plan. The Agency's plan for public involvement shall include the following:
a. The formation of a Technical Review Committee and Policy Committee to guide development of the groundwater management plan;
b. Coordination and participation from the Central Sacramento County Groundwater Forum;
c. Preparation of a Public Outreach Plan; and,
Public review and comment period and public hearings.

NO 603 PUBLIC NOTICE

A PUBLIC HEARING

to consider the

Adoption of the Zone 40 Groundwater Management Plan (GMP)

will be held on September 28, 2004 at 10:45 a.m. at the Sacramento County Board of Supervisors Chambers, County Administration Center, 700 H Street, Sacramento, California.

A copy of the proposed Groundwater Managed Plan can be accessed online at www.saccounty.net search for "Zone 40 GMP."

For more information, contact the Department of Water Resources at 874-6851.

2Ti September 14 & 21, 2004

NO249 PUBLIC NOTICE

The Sacramento County Water Agency Board of Directors will adopt a groundwater management plan for Zone 40 at their November 2, 2004 board meeting. The meeting, which the public is invited to attend, will be held on November 2, 2004 at 9:30a.m. at the Sacramento County Board of Supervisors Chambers, County Administration Center, 700 H Street, Sacramento, California.

The Sacramento county Water Agency supplies water to unincorporated areas of Sacramento County south of the American River and north of the Cosumnes River. Any individual interested in the development of the groundwater management plan is encouraged to attend the meeting. For more information, please contact Bob Gardner at the Sacramento County Department of Water Resources at (916) 874-8433.

2Ti October 19 & 26, 2004

Appendix B

Standard Operating Procedure for Manual Water Level Measurements

STANDARD OPERATING PROCEDURE

For

MANUAL WATER LEVEL MEASUREMENTS

TABLE OF CONTENTS

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 characteristics. Therefore, all water level measurements in a given district should preferably be collected within a 24-hour period and Zone 40'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, etc.). 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 (id 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, 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
11. 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:

$$E_w = E - D$$

where:

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**	Caved or deepened
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

Driscoll, F.G. 1986. Groundwater and Wells. Second Edition. Chapter 16. *Collection and Analysis of Pumping Test Data.* pp 534-579. Johnson Filtration Systems Inc. St. Paul, Minnesota.

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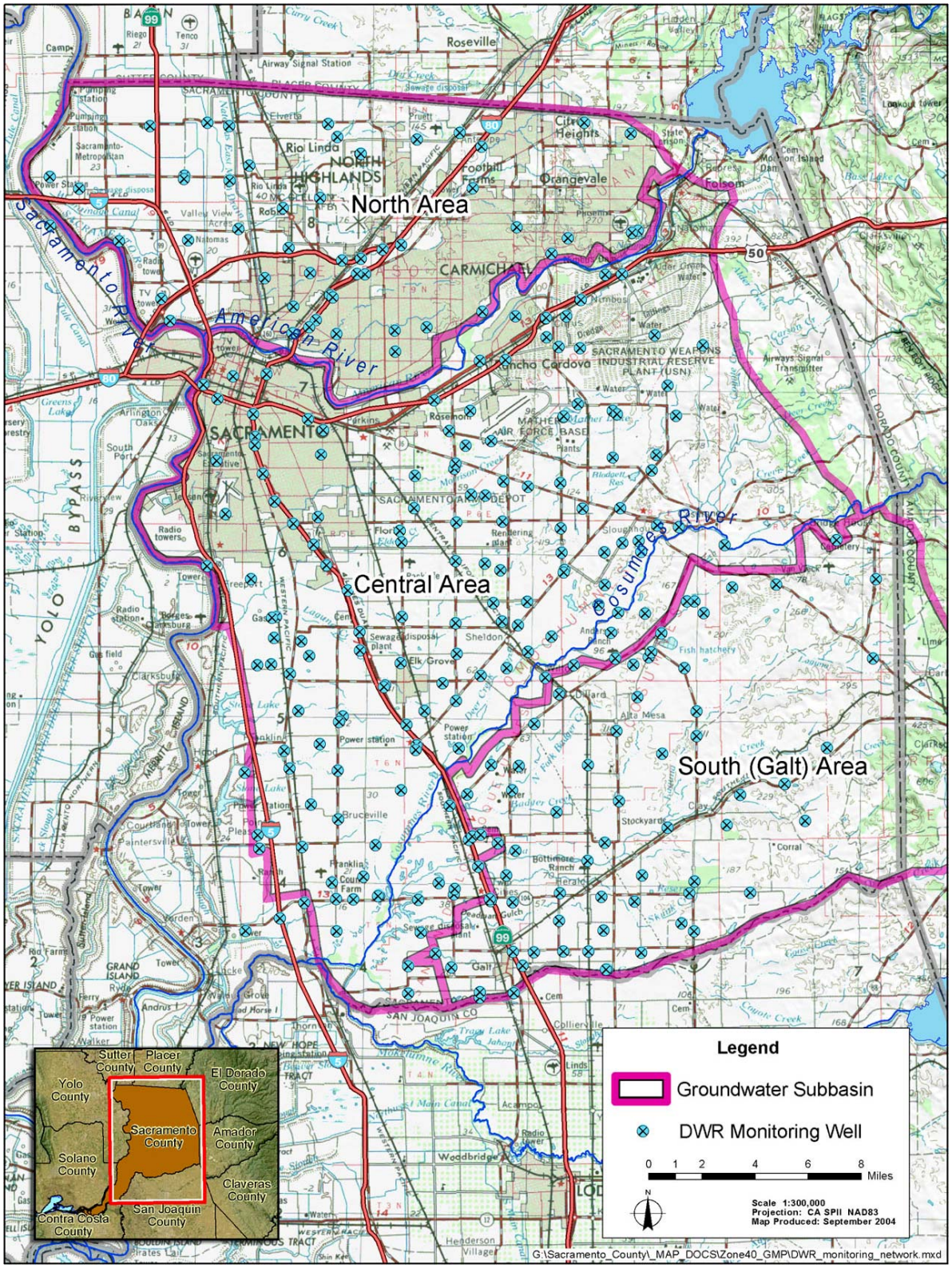
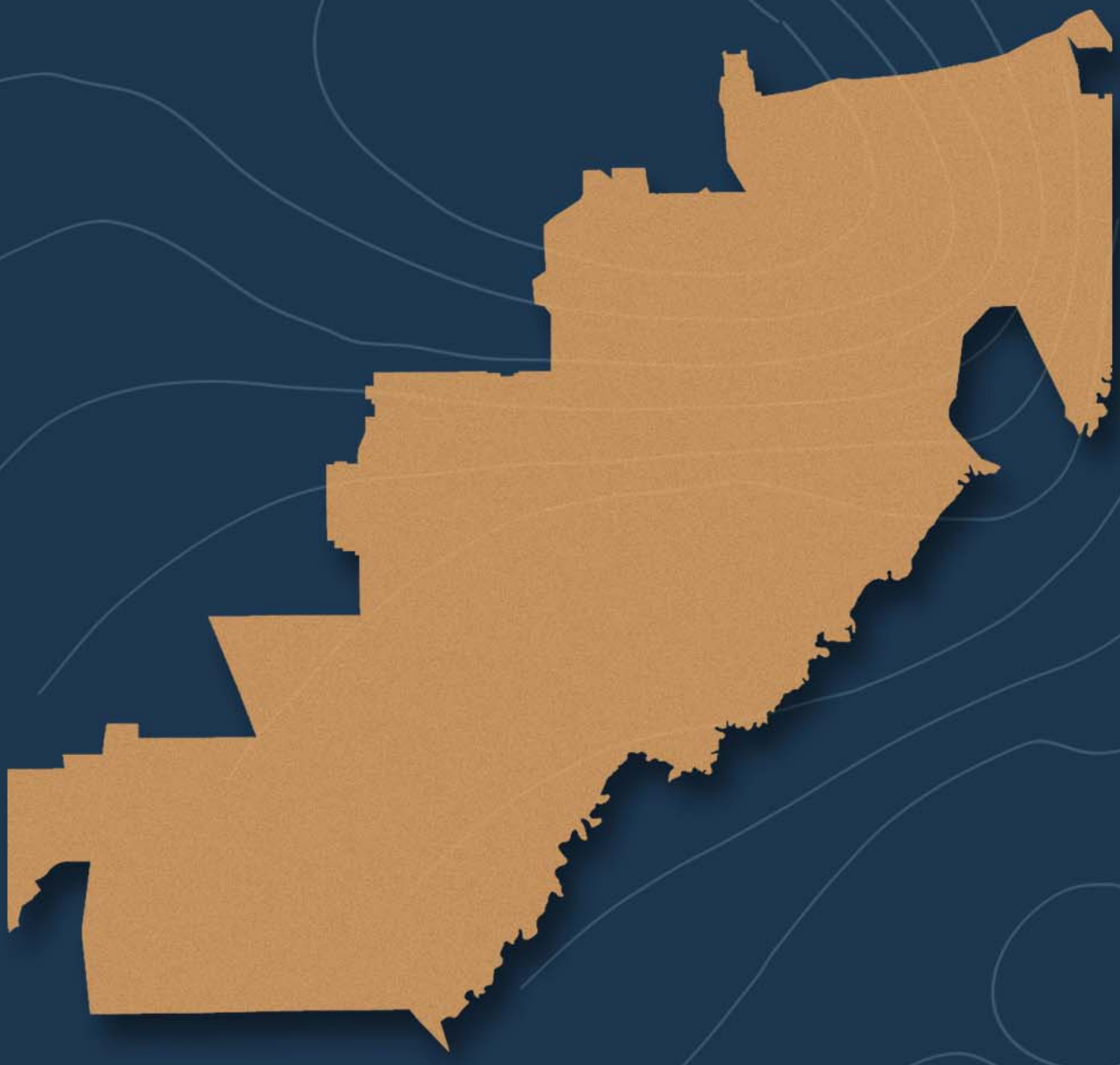


DWR Groundwater Level Monitoring Network in Sacramento County
(http://wdl.water.ca.gov)

Appendix C

Summary of the Data Management System



SACRAMENTO COUNTY WATER AGENCY ZONE 40

DATA MANAGEMENT SYSTEM

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
CHWD	Citrus Heights Water District
ARGET	American River Groundwater Extraction & Treatment
COC	Constituents of Concern
CWD	Carmichael Water District
DHS	Department of Heath Services
DMP	Data Management Plan
DMS	Data Management System
DPMWD	Del Paso Manor Water District
DPR	California Department of Pesticide Regulations
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection Program
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
FOWD	Fair Oaks Water District
GEIMS	Geographic Environmental Information Management Systems
IS	Internal Standards
LCS	Laboratory Spike Control
LLNL	Lawrence Livermore National Laboratories
MCL	Maximum Containment Levels
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MWH	Montgomery Watson Harza

OWC	Orangevale Water Company
PCE	Perchloroethylene
QA/QC	Quality Assurance / Quality Control
RLECWD	Rio Linda/Elverta Community Water District
RWMP	Regional Water Master Plan
RWQCB	Regional Water Quality Control Board
SAWWA	Sacramento Area Water Works Association
SCADA	Supervisory Control and Data Acquisition
SCWA	Sacramento County Water Agency
SCWC	Southern California Water Company
SMWA	Sacramento Metropolitan Water Authority
SGA	Sacramento Groundwater Authority
SOC	Synthetic Organic Compounds
SOP	Standard Operating Procedures
SOW	Scope of Work
TCE	Trichloroethylene
TDS	Total Dissolved Solids
USGS	U.S. Geological Survey
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

The overall objective of the DMS project is to develop a cost-effective groundwater data management tool. This DMS will be used to store and present the data required to monitor existing and future conditions of the groundwater basin underlying the boundaries of Zone 40.

The purpose of Task 7 is to document the software used in developing the DMS and provide a basic overview of the DMS features. The task also involves providing a general overview of how the primary functions of the DMS are performed.

This Task 7 summary memorandum is organized into the following sections:

Section 1: Introduction, including the purpose and scope of this document.

Section 2: User Requirements, including hardware, software, expertise, and training requirements necessary to operate the DMS to its full capacity.

Section 3: DMS Primary Functions, including a summary of the types of data that can be stored in the DMS, the types of ways the DMS can present the stored data, and a guide to the on-line help features.

Section 4: Summary and Recommendations

Bibliography

Attachments

2.0 USER REQUIREMENTS

MWH developed the DMS using Microsoft Visual Basic. The Visual Basic programming language allows for development of stand-alone applications that require no additional licensing or software purchases. The DMS stores and manages data using a SQL database that is compatible with Microsoft Access. The DMS is a software package that is installed on a computer similar to any stand-alone application. A CD will be provided for installation of the DMS and associated groundwater data. To use the DMS to its fullest capacity, the User should meet the following hardware, software, expertise, and training requirements.

2.1 Hardware

Required: Laptop or desktop computer (300 MHz or faster) running the Microsoft Windows operating system.

2.2 Software

Required: Microsoft Windows 98, 2000, or NT

Suggested support software that is automated by the DMS includes:

- **Seagate Crystal Reports,** for printing and developing custom reports;
- **Golden Software Surfer 7.0**, for printing of cross-section and contour data, and
- **Microsoft Excel**, for printing graphs

The DMS can run with or without these applications. The User is referred to the individual software documentation for the above programs as needed.

2.3 Expertise/Training

User familiarity with typical Microsoft Windows based programs and database functions is assumed. No programming skills are necessary.

The DMS is one of many tools used for management of the groundwater basin. To fully benefit from the DMS, it is preferable that the User posses familiarity with geology and groundwater terminology, and additional knowledge of the groundwater basin's characteristics (i.e., hydrogeology, water purveyors, conjunctive use programs, etc.), and the regulatory reporting requirements.

Although the DMS has been made as User-friendly as possible, some training will be required for efficient operation. It is anticipated that more comprehensive training as well as a more focused training manual will be provided to Zone 40 under a subsequent scope of work after the actual User has been identified.

3.0 DMS PRIMARY FUNCTIONS

Because the DMS is designed to support Zone 40's groundwater monitoring program, the main features of the program focus on storing and presenting data for groundwater levels and groundwater quality. Supplemental data, such as well construction, pump specifications, geologic descriptions, pumping amounts, and wellhead source protection are also included.

The primary tasks that the DMS can be used to perform are described in this section.

3.1 Storing Data

The database contains 26 tables and over 256 data fields. The following is a summary of the kinds of information stored for a selected well:

- **Water Purveyor,** including contact names, addresses, and phone numbers.
- **Well Inventory Information,** including purveyor, well names, locations, survey data, and accessibility.
- **Well Location Information,** including well names, addresses, communities served, and ground surface elevations.
- **Well Construction Information,** including installation date, depth, boring and construction details, screen intervals, and integrity.
- **Well Pump Information,** including pump models, sizes, capacities, and control.
- **Geological and Aquifer Information,** including subsurface stratigraphy, lithology, and aquifer physical parameters (transmissivity, hydraulic conductivity, porosity, pump test results, geophysical logs).
- **Wellhead Protection Information,** including well seal details, length of gravel pack, distance to sewer, enclosure type, and area surface drainage information.

- **Water Level Data,** including measurement dates, depths to water, measurement devices, and standing water elevations.

- **Groundwater Extraction Information,** including measurement frequency and production volumes.

- **Surface Water Use Data,** including annual and monthly surface water use for the DMS water providers.

- **Well Injection Information,** used for monitoring conjunctive use programs where treated surface water is injected through the selected well. These data include monthly and annual surface water volumes.

- **Well Water Quality Data,** including sample dates, constituents reported, analytical results, maximum contaminant limits, reported detection limits, and data flags.

The DMS includes additional features to provide consistent data entry and to secure data once it is saved. The User is asked to enter into a data edit mode before any changes or additions can be made, and upon completion the User is asked to commit changes before saving to the database. All data is portable through copy and paste commands to other program environments such as Microsoft Excel.

3.2 Presenting Data

The DMS can present stored information in the following ways:

- Comprehensive raw data tables (the database tables used by the DMS).

- Purveyor filtered data tables where the wells and associated information are based on the selected purveyor.

- Filtered data tables are presented according to parameters selected using the Query Building Tool.

- Visual formats including well cross section diagrams, street maps, contours, coloration based on well attributes, and graphs.

Additional presentation tools are provided through automation of Golden Software Surfer, Seagate Crystal Reports, and Microsoft Excel. These applications are used to supplement the DMS with a set of quality graphics for use in reporting on and documenting the basin's performance.

3.3 Using On-line Help

The DMS has an on-line help feature that will guide the User through the various features. Included as Appendix A are excerpts from the on-line Help for a brief orientation to the DMS. Additional on-line Help will be developed as needed under a subsequent scope of work.

4.0 SUMMARY AND CONCLUSIONS

The DMS has User requirements including hardware, software, expertise, and training for successful operation. Zone 40 will need to employ a person with several different discipline skills for successful operation of the DMS, including database and hydrogeology expertise. At that time, the DMS will be installed on Zone 40 computer hardware, more comprehensive training will be provided, and security measures will be developed under a separate scope of work.

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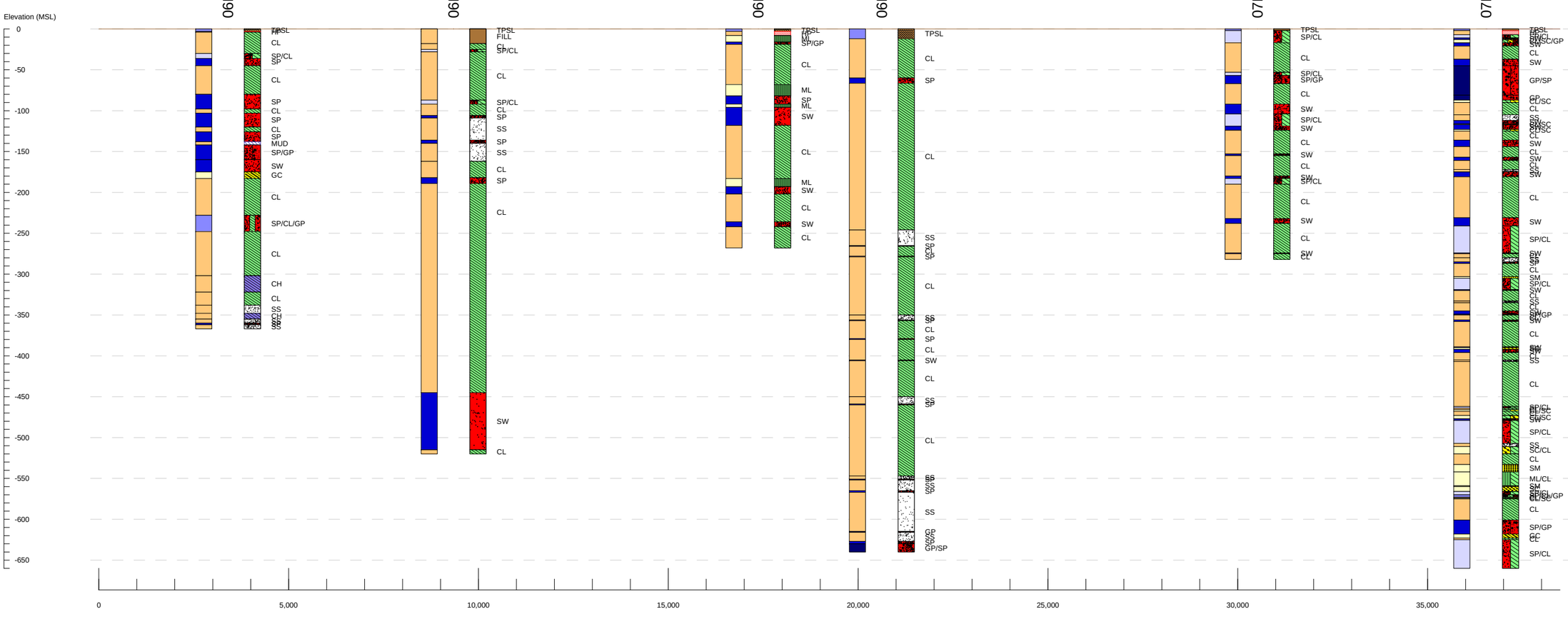
Zone 40 Data Management System

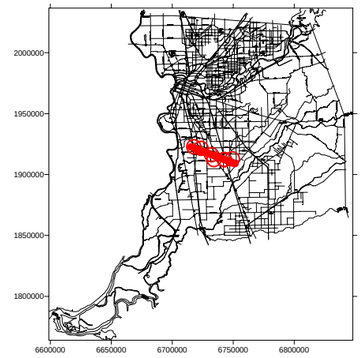
Cross Section Z40A-A



Lithology Hatching Patterns

Legend

- GP-Poorly graded gravel
- SP-Poorly-graded sand
- SW-Well-graded sand fine to coarse sand
- GC-Gravel with fines clayey gravel
- SM-Sand with fines silty sand
- SC-Sand with fines clayey sand
- ML-Inorganic silt
- CH-Inorganic clay of high plasticity fat clay
- CL-Inorganic clay
- SS-Sandstone
- HP-Hardpan
- FILL-Fill Material
- MUD-Mudstone



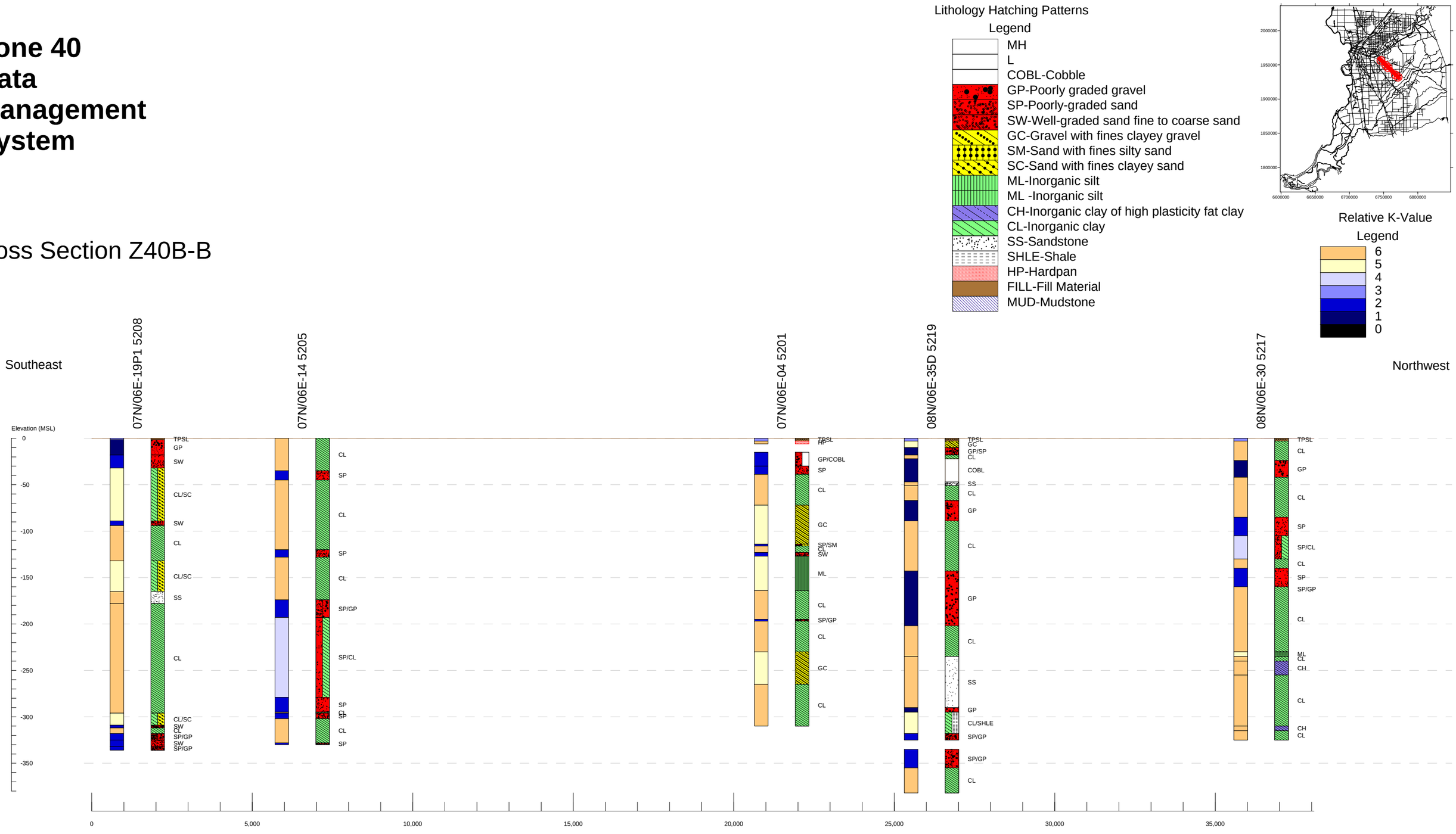
Relative K-Value

Legend

6
5
4
3
2
1
0

Zone 40 Data Management System

Cross Section Z40B-B



Lithology Hatching Patterns

Legend

- MH
- L
- COBL-Cobble
- GP-Poorly graded gravel
- SP-Poorly-graded sand
- SW-Well-graded sand fine to coarse sand
- GC-Gravel with fines clayey gravel
- SM-Sand with fines silty sand
- SC-Sand with fines clayey sand
- ML-Inorganic silt
- ML -Inorganic silt
- CH-Inorganic clay of high plasticity fat clay
- CL-Inorganic clay
- SS-Sandstone
- SHLE-Shale
- HP-Hardpan
- FILL-Fill Material
- MUD-Mudstone

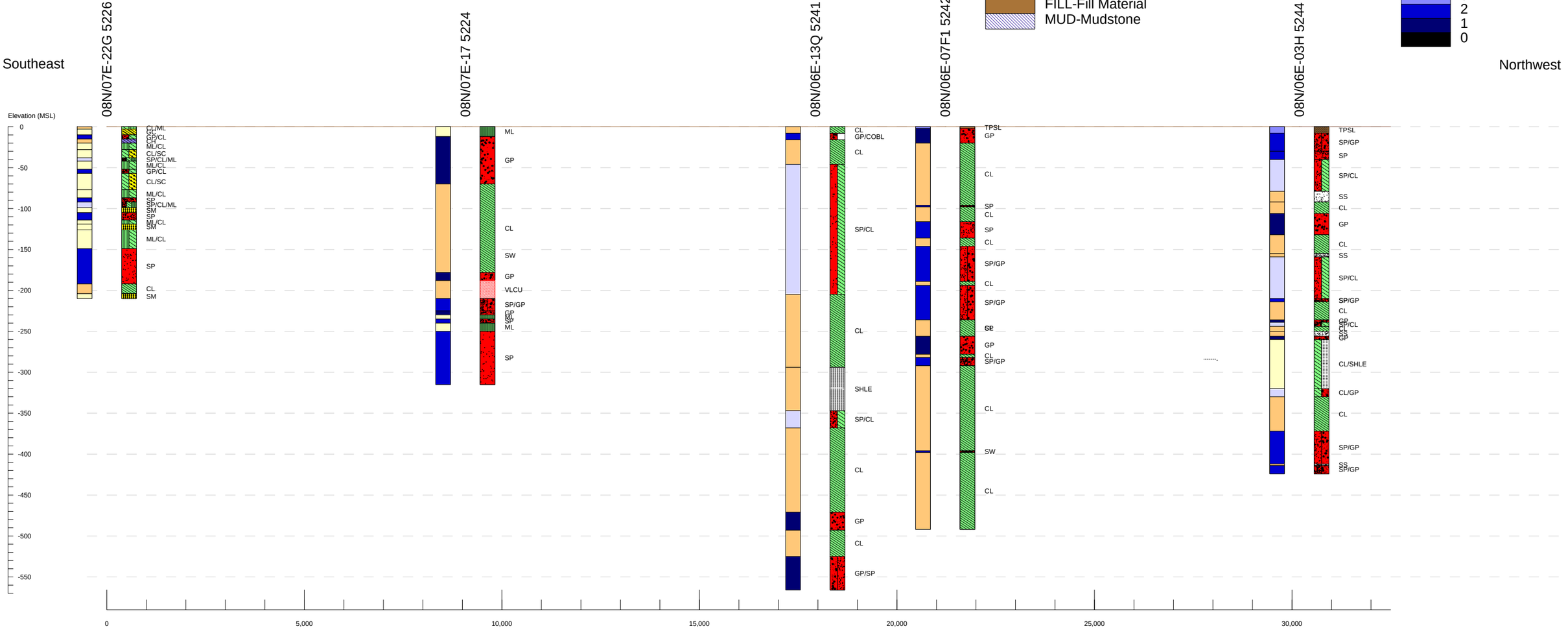
Relative K-Value

Legend

- 6
- 5
- 4
- 3
- 2
- 1
- 0

Zone 40 Data Management System

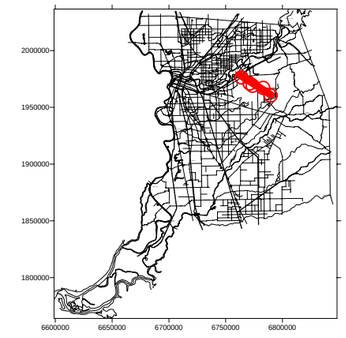
Cross Section Z40C-C



Lithology Hatching Patterns

Legend

- MH
- L
- COBL-Cobble
- GP-Poorly graded gravel
- SP-Poorly-graded sand
- SW-Well-graded sand fine to coarse sand
- GC-Gravel with fines clayey gravel
- SM-Sand with fines silty sand
- SC-Sand with fines clayey sand
- ML-Inorganic silt
- ML -Inorganic silt
- CH-Inorganic clay of high plasticity fat clay
- CL-Inorganic clay
- SS-Sandstone
- SHLE-Shale
- HP-Hardpan
- VLCU-Volcanic Rock
- FILL-Fill Material
- MUD-Mudstone



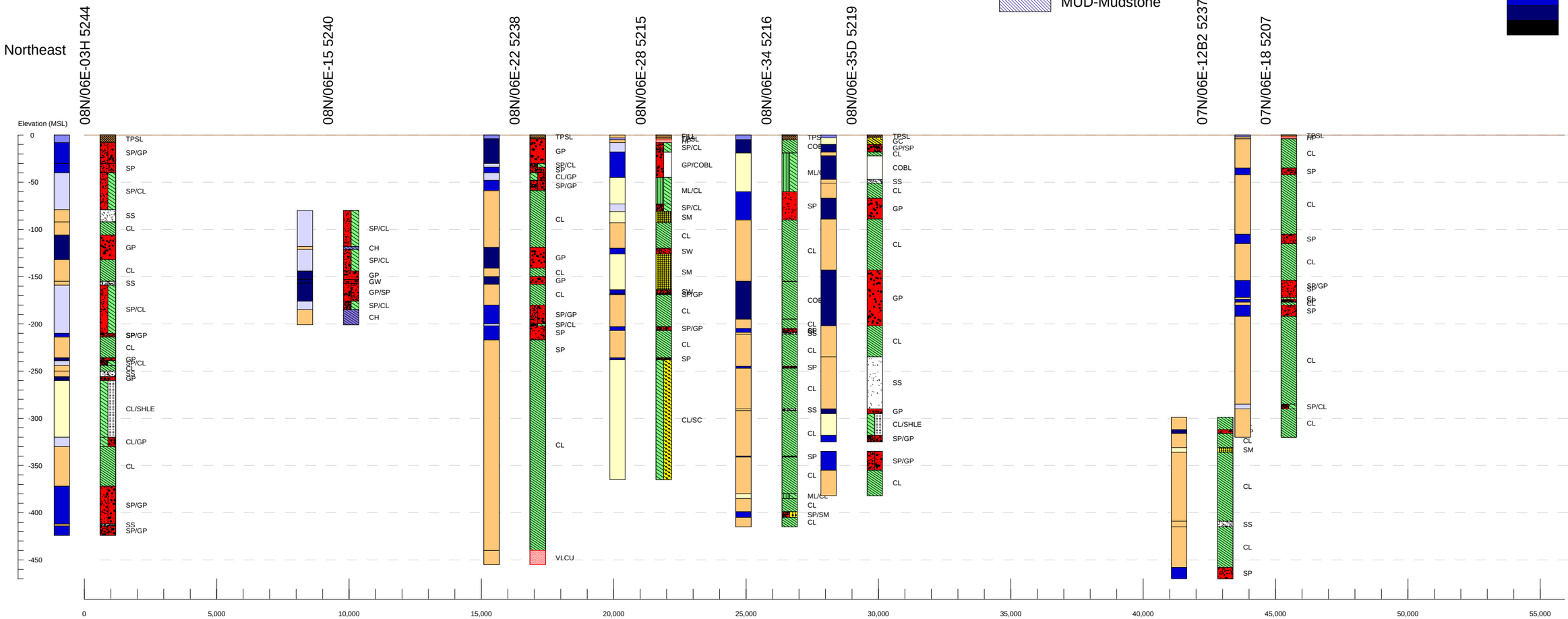
Relative K-Value

Legend

- 6
- 5
- 4
- 3
- 2
- 1
- 0

Zone 40 Data Management System

Cross Section Z40D-D



Lithology Hatching Patterns

Legend

- MH
- L
- COBL-Cobble
- GP-Poorly graded gravel
- GW-Well-graded fine to coarse gravel
- SP-Poorly-graded sand
- SW-Well-graded sand fine to coarse sand
- GC-Gravel with fines clayey gravel
- SM-Sand with fines silty sand
- SC-Sand with fines clayey sand
- ML-Inorganic silt
- ML -Inorganic silt
- CH-Inorganic clay of high plasticity fat clay
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- SS-Sandstone
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- VLCU-Volcanic Rock
- FILL-Fill Material
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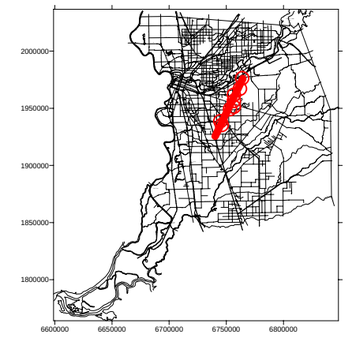


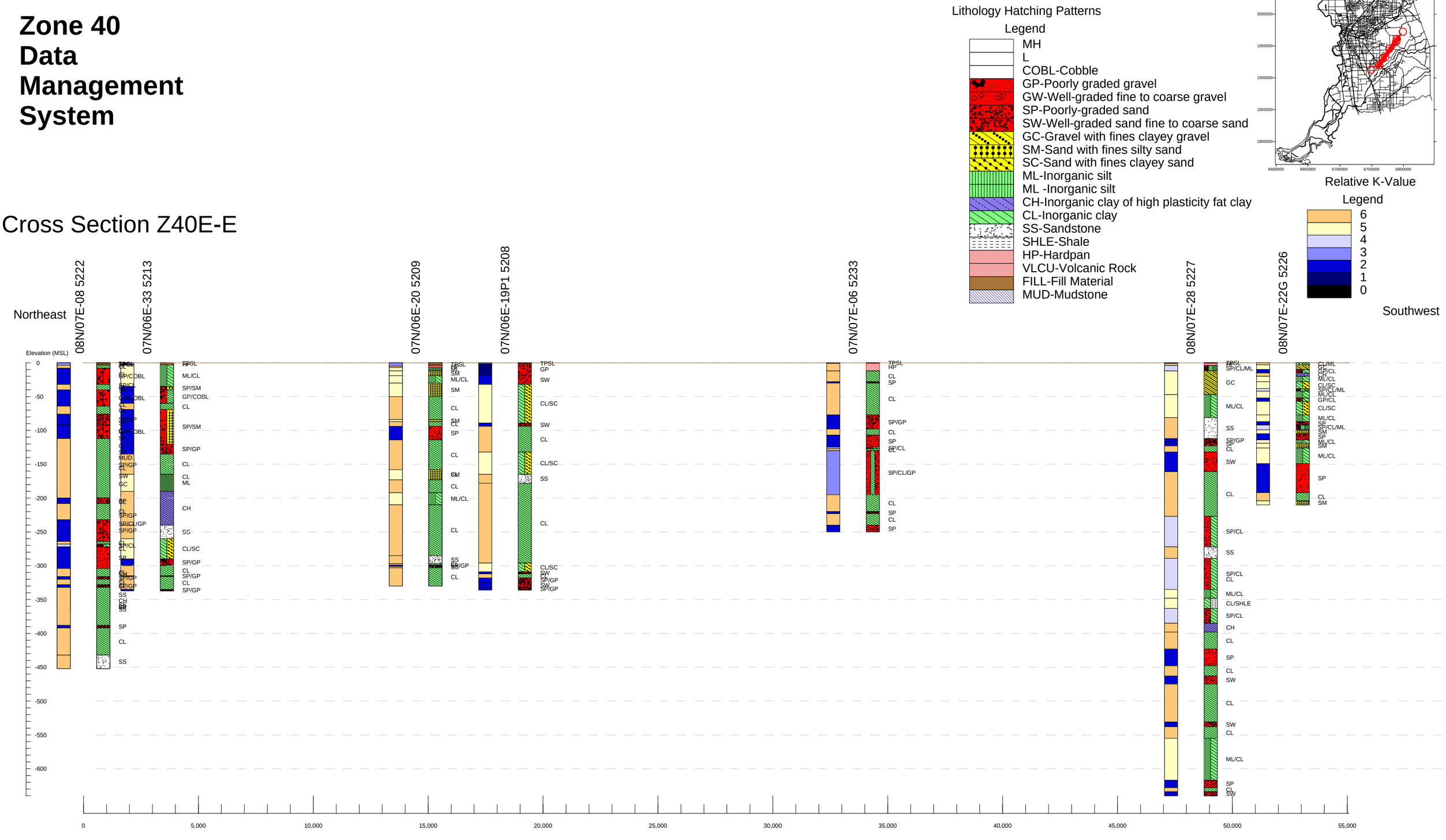
Relative K-Value

Legend

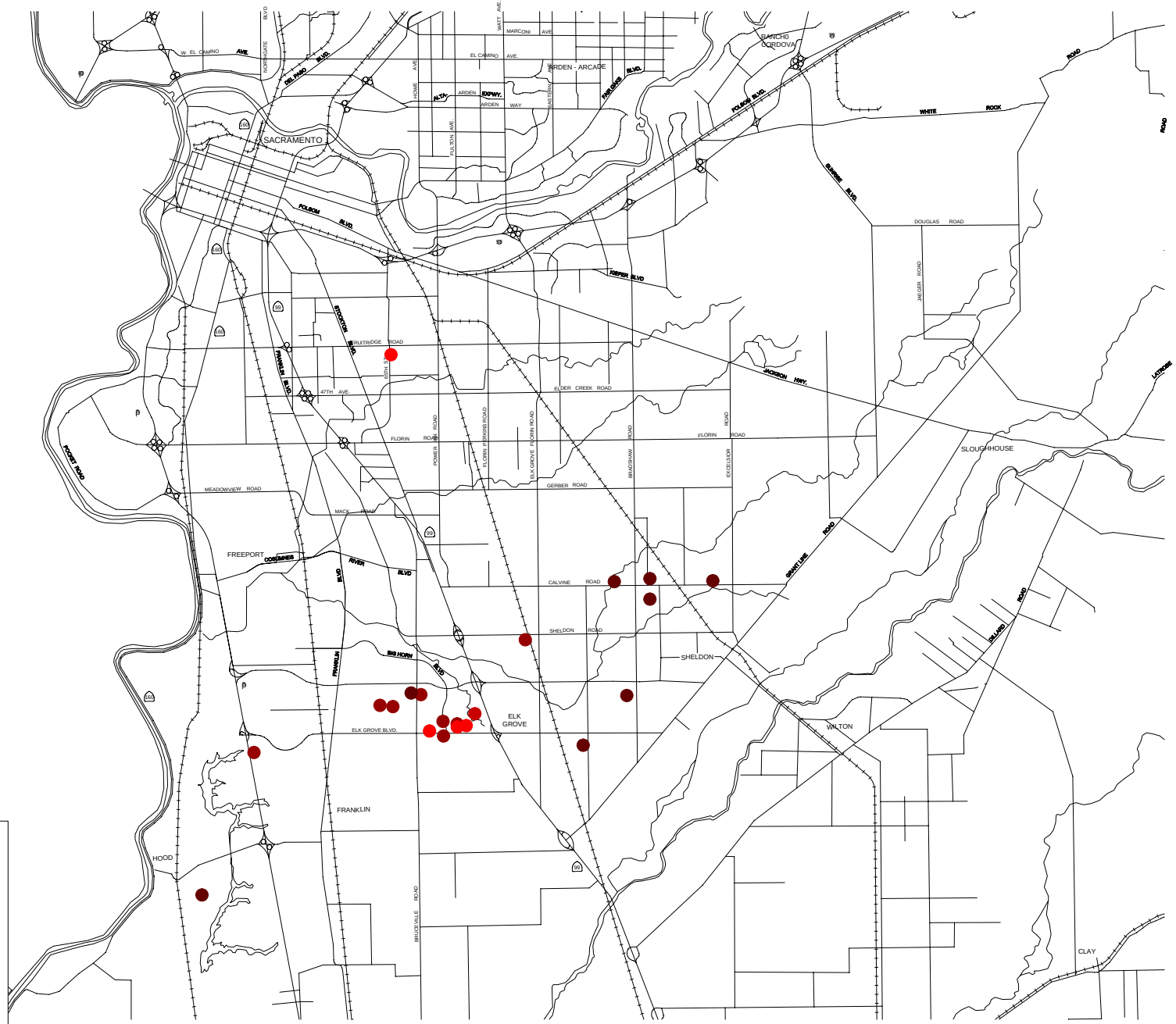
- 6
- 5
- 4
- 3
- 2
- 1
- 0

Zone 40 Data Management System

Cross Section Z40E-E



Zone 40 Data Management System



Detected Arsenic Levels
(micro grams per liter)

- 0 to 0
- 0 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25

0feet 80000feet 160000feet

P:\Sacramento_County\SCWA\Proposition 50-- GMP\GMP Development\GMP_Figures\Aresenic.srf

MWH

SACRAMENTO COUNTY
WATER AGENCY