Reclamation District 2035 Groundwater Management Plan Activities

RD 2035 adopted its groundwater management plan (GWMP) pursuant to §10753 of Division 6 of the California Water Code (Assembly Bill 3030) on April 25, 1995. See official RD 2035 Board meeting minutes adopting GWMP on Page-2 to Page-4 below. The purpose of the GWMP is to provide a framework for the protection and utilization of the aquifer system underlying RD 2035. The specific goals as identified in the GWMP are the following:

- To define criteria for groundwater pumping and aquifer protection that is based on scientific analysis of monitoring results and provides the flexibility to use groundwater as needed for agricultural production, recreation, wetland restoration, wildlife management, industrial and residential use, and/or water transfers or exchanges.

- To compile data based on work performed within the District service area which includes an existing groundwater and subsidence monitoring program and technical studies on groundwater resources.

- To establish the monitoring, recharge and evaluation programs necessary to actively manage conjunctive uses of groundwater and surface water supplies within the RD 2035 service area.

- To explore joint conjunctive use planning for Eastern Yolo County.

- To establish standards which will help protect the aquifers underlying RD 2035 from water quality degradation.

- To provide a document that can be used as a tool to provide public education about the groundwater basin underlying the service area of RD 2035 and the management of that basin.

RD 2035 coordinates its groundwater management and monitoring efforts through membership in the Water Resources Association of Yolo County. Regular reports are developed through RD 2035 and Yolo WRA to show changing groundwater elevations over time, groundwater quality, and subsidence.

RD 2035 proposes to implement a conjunctive use optimization program for eastern Yolo County and coordinate its implementation through a comprehensive update of its groundwater management plan consistent with current California Water Code requirements. The remaining portion of this documents provides a copy of RD 2035's existing GWMP.

RECLAMATION DISTRICT 2035

Board of Trustees

Special Meeting
April 25, 1995 at 4:00 pm
45332 County Road 25
Woodland, California

AGENDA

Item		Presented By:	Action Needed:	Attachment Number
Commence Meeting				
1.	Call to Order	Chairman	Information	
	Roll Call	General Mgr.	Information	
District Business				
2.	Minutes 2/22/95	General Mgr.	Trustee Motion	
3.	Public Hearing & Consideration of AB3030 Groundwater Management Plan	Gen Mgr.	Information/Trustee Motion	
4.	New Water Structure in Southwest Corner of Cache Creek Basin	General Mgr.	Information/Trustee Motion	
5.	Communications		Information	
Next Meeting				
5.	Set meeting date	Chairman	Information	
	Adjourn	Chairman	Information	

RECLAMATION DISTRICT NO. 2035
BOARD OF TRUSTEES
MINUTES OF SPECIAL MEETING
April 25, 1995

COMMENCE MEETING

1. Pursuant to a notice of special meeting, which was posted and served on the members of the Board of Trustees of Reclamation District No. 2035 more than one day prior to April 25, 1995, the Board of Trustees of Reclamation District No. 2035 met in a special meeting at 45332 County Road 25, Woodland, California. The meeting was convened at approximately 4:00 p.m. by President and Trustee Booth.

   Roll Call. President and Trustee Stuart Booth, Trustee Robert Frommer and Trustee Regina Cherovsky were present. President and Trustee Booth acted as Chairman of the meeting. Also present were District Manager, Mike Lear; District Accountant, James Staker; District Counsel, Cliff Schulz; Rob Beggs of West-Yost and Associates; and Carla Weir of Conaway Conservancy Group.

DISTRICT BUSINESS

Miscellaneous Business

2. **Minutes.** Jim Staker presented minutes of special meeting held February 22, 1995. A motion to approve the minutes was made by Trustee Frommer.

   Motion: Trustee Frommer, Second: Trustee Cherovsky, Vote: 3 Ayes, 0 Nays, 0 Abstentions.

3. **Public Hearing & Consideration of AB3030 Groundwater Management Plan.** The public hearing was opened by President and Trustee Stuart Booth. Present for the public hearing was Harrison Phipps, executive coordinator of the Water Resources Association of Yolo County. Cliff Schulz informed the board that all appropriate notices had been filed, that copies of the plan had been sent to all parties who might be interested in it and that the board had up to thirty five days after the public hearing to consider any written protest and to approve the plan. Rob Beggs then gave a brief review of the plan and its major components. Mr. Phipps commended the district for leading the way with the AB3030 plan. Staff commented that there had been no protests oral or written. Public hearing was then closed.

   After the public hearing was closed, Trustee Robert Frommer moved to adopt the plan as presented.

Motion: Trustee Frommer, Second: Trustee Cherovsky, Vote: 3 Ayes, 0 Nays, 0 Abstentions.

4. **New Water Structure in Southwest Corner of Cache Creek Basin.** Mike Lear presented letter from The Reclamation Board stating that maintenance of the irrigation structure shall be turned over to the district.

Trustee Robert Frommer moved to sign the letter subject to the receipts of written commitment by the Reclamation Board to complete all open construction and maintenance items on the structure.

Motion: Trustee Frommer, Second: Trustee Cherovsky, Vote: 3 Ayes, 0 Nays, 0 Abstentions.

5. **Communications.** No communications were received.

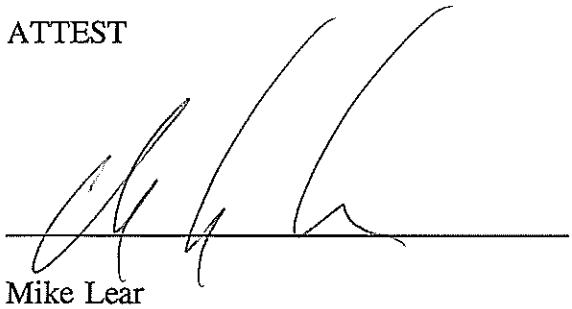
Next Meeting

6. No date was set for the next Trustee's meeting.

Adjourn. There being no further business to come before the Board of Trustees of Reclamation District 2035, Trustee Robert Frommer moved to adjourn the meeting.

Motion: Trustee Frommer, Second: Trustee Cherovsky, Vote: 3 Ayes, 0 Nays, 0 Abstentions.

ATTEST



Mike Lear
General Manager, Reclamation District 2035

GROUNDWATER MANAGEMENT PLAN

Prepared for

Reclamation District 2035

Adopted April 25, 1995

TABLE OF CONTENTS

RECLAMATION DISTRICT 2035
GROUNDWATER MANAGEMENT PLAN

INTRODUCTION

AUTHORITY

Section 10753 of Division 6 of the California Water Code (Assembly Bill 3030) authorizes local agencies which provide water to a service area overlying a groundwater basin to adopt and implement a groundwater management plan for that basin. On June 2, 1993, Reclamation District 2035 (RD 2035 or District) held a public hearing on the issue of whether or not to adopt a resolution of intention to draft a groundwater management plan. After that hearing, the Board of Trustees authorized the preparation of a groundwater management plan under the authority granted by AB3030.

RECLAMATION DISTRICT 2035

RD 2035 was formed in 1919 to provide flood protection, drainage, and irrigation water to Conaway Ranch and some adjoining lands in Eastern Yolo County. RD 2035 is governed by a board of three trustees elected by the landowners. The service area of RD 2035 is shown in Figure 1.

Reclamation District 2035 provides flood protection and/or water delivery services to 20,780 acres. For irrigation activities, water is diverted from the Sacramento River by a large pumping plant consisting of four 36-inch pumps located immediately upstream from the Vietnam Veterans Bridge on I-5. Additional surface water is also obtained from Cache Creek and Willow Slough. Irrigation is also supplemented by 24 wells operated by the District which pump water into the irrigation system.

In addition to the main pumps on the Sacramento River, the District also operates 10 pumping plants consisting of a total of 32 pumps which vary in size from 2.5 to 300 horsepower. These pumps are used as lift, booster, or drainage pumps. During the growing season the drainage pumps allow surface drainage from fields within RD 2035 to be captured and returned to the irrigation system for reuse. There are a number of pipes through the flood control levees as well as a large siphon under the Tule Canal and County Road 16 which are maintained and operated by the District for flood control and irrigation purposes.

DESCRIPTION OF GROUNDWATER BASIN

RD 2035 is part of the Sacramento Valley groundwater basin which extends from Red Bluff on the north down to the Delta. On a more local scale, the only major boundaries to groundwater flow are the Sacramento River and the Plainfield Ridge, which runs roughly north-south through the county approximately 4 miles west of Woodland. Effects of pumping

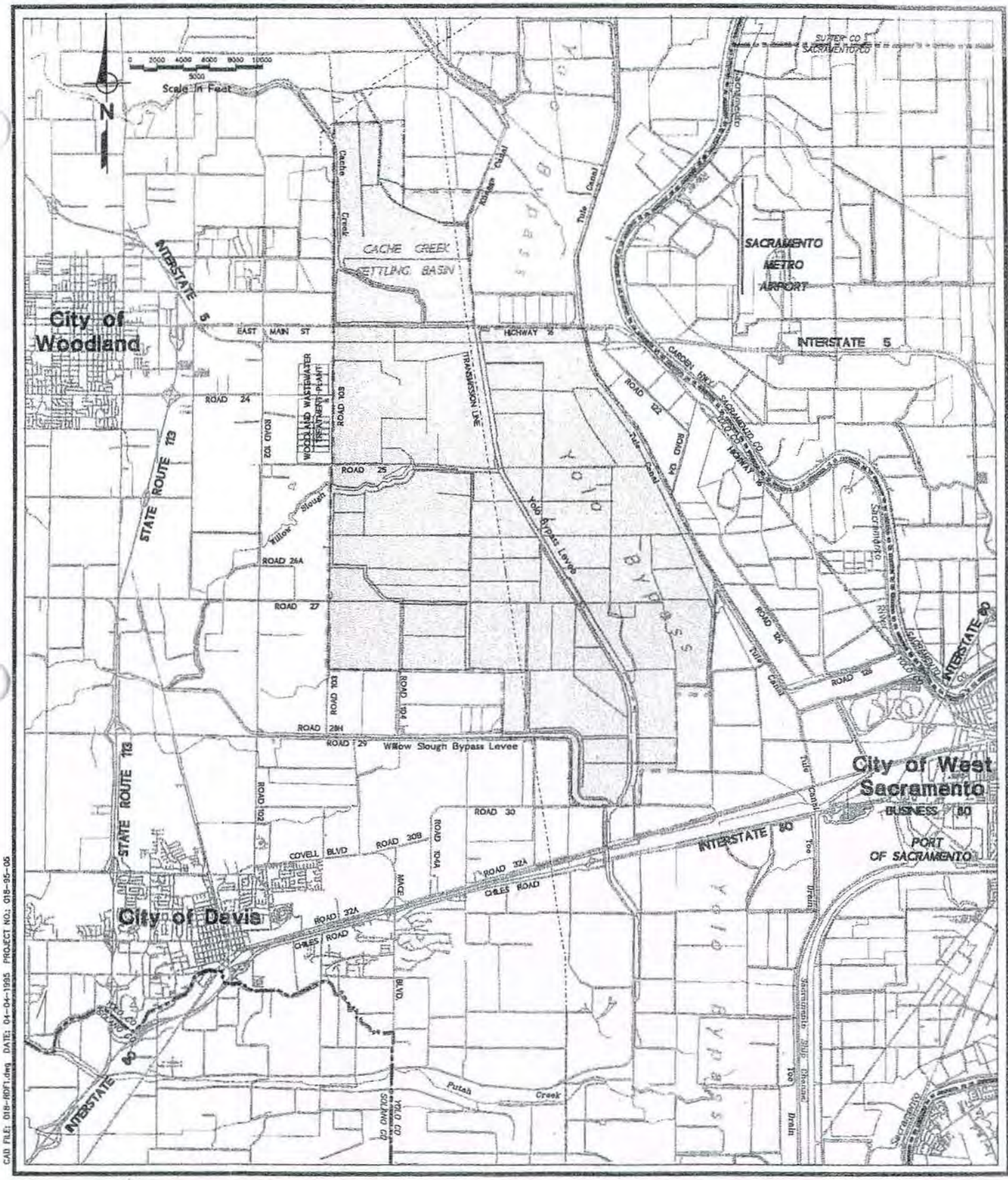


Figure 1

Legend:

RECLAMATION DISTRICT 2035

COUNTY BOUNDARY

WEST YOST & ASSOCIATES

Reclamation District 2035
Groundwater Management Plan

Location Map with
Sevice Area Boundary

in Yolo County in deeper aquifers can extend across the Sacramento River. For the purposes of this groundwater management plan, the groundwater basin is defined as the aquifer system underlying the service area of RD 2035. The continuity of groundwater with lands adjacent to RD 2035 is addressed in this plan where appropriate.

The sediments penetrated by water wells in the region were deposited in the past 12 million years and derived from three principal source areas — shed westward into the valley from the Sierra Nevada, shed eastward into the valley from the Coast Range, and transported southward from more distant sources by the ancient Sacramento and Feather Rivers. Throughout this depositional history, ancient streams in the valley changed their channels many times, and the channel of the Sacramento River was considerably west of its present location much of the time. In the vicinity of RD 2035, the depth of the continental formations is about 2,600 feet, and the base of fresh water is about 2,400 feet below the present land surface.

The hydrogeologic deposits to the west of RD 2035 are classified as alluvial fan deposits. Alluvial fan deposits consist of mixed sediments deposited by streams from the Coast Range and hills to the west. Deposits in the middle and western portions of RD 2035 are classified as flood basin deposits. Flood basin deposits consist of fine-grained materials which were deposited in the areas adjacent to major streams during periods of high runoff. Alluvium deposits are found in the area extending from the eastern portion of RD 2035 to the Sacramento River. These include stream channel and flood plain deposits which are composed of sand, gravel, silt and minor amounts of clay. The central and eastern portions of the district have significant deposits of coarse materials layered between the finer flood basin deposits. Most of the surface soils in RD 2035 are clay or silty clay.

As a result of geologic processes which deposited the sediments in the District, the distribution of sandy and clayey zones is highly variable, and deposits are discontinuous and of variable thickness. Most of the deeper aquifer zones penetrated by wells in and around RD 2035 behave as confined or semi-confined aquifers. Some of the shallow aquifers in the southeastern and far eastern portions of the District behave in a more unconfined fashion.

Seasonally, groundwater levels tend to be the highest in early spring and lowest in early fall. The groundwater gradient in the region is generally flat with some tilting towards the Sacramento River in the winter and away from the river in the summer.

PURPOSE OF GROUNDWATER MANAGEMENT PLAN

The purpose of this groundwater management plan is to provide a framework for the protection and utilization of the aquifer system underlying RD 2035. The specific goals are as follows:

1. To define criteria for groundwater pumping and aquifer protection that is based on scientific analysis of monitoring results and provides the flexibility to use groundwater as needed for agricultural production, recreation, wetland restoration, wildlife management, industrial and residential use, and/or water transfers or exchanges.

2. To compile data based on work performed within the District service area which includes an existing groundwater and subsidence monitoring program and technical studies on groundwater resources.

3. To establish the monitoring, recharge and evaluation programs necessary to actively manage conjunctive uses of groundwater and surface water supplies within the RD 2035 service area.

4. To explore joint conjunctive use planning for Eastern Yolo County.

5. To establish standards which will help protect the aquifers underlying RD 2035 from water quality degradation.

6. To provide a document which can be used as a tool to provide public education about the groundwater basin underlying the service area of RD 2035, and the management of that basin.

GOALS FOR THE BASIN

PROTECTION AND ENHANCEMENT OF GROUNDWATER RECHARGE

The groundwater basin is well suited for storage and extraction of groundwater for irrigation and other uses. A primary goal is to encourage activities which will maximize the recharge of the basin for beneficial use.

CONJUNCTIVE USE

Conjunctive use is the joint use of surface water and groundwater resources to maximize the amount and timely availability of water for beneficial use. This means using surface water when it is available to satisfy water needs, inducing direct groundwater recharge through surface flooding, and performing in-lieu recharge by reducing pumping demands on groundwater by substituting surface water when it is available. Groundwater can then be managed to provide supplemental water when needed and to provide storage for excess surface water which can be retrieved at a later date. The groundwater basin underlying RD 2035 could be actively managed to provide the opportunity for conjunctive use and to utilize the available storage to the greatest practical extent.

SUBSIDENCE PREVENTION

Areas to the west and northwest of RD 2035 have shown evidence of subsidence due to groundwater pumping by other parties. Based on sensitive ground elevation measurements since 1991, no permanent subsidence has been measured in RD 2035 as a result of groundwater pumping by the District. Because of the importance of maintaining the proper elevations of the flood control levees in RD 2035, the prevention of permanent subsidence is a primary goal of this groundwater management plan.

PROTECTION OF GROUNDWATER QUALITY

Groundwater is a vital component of the water supply for agricultural irrigation in RD 2035 and may be utilized as a municipal water source in the future. Therefore, the protection of groundwater quality from degradation which would adversely affect its current and potential future uses is a goal of this groundwater management plan.

CONDITION OF THE BASIN

MONITORING NETWORK

Monitoring by RD 2035

Within the boundaries of RD 2035 there are 26 irrigation wells (24 operated by the District), 3 domestic wells, and 7 wells that are abandoned irrigation or domestic wells now used solely as monitoring wells. All the production wells have been used for groundwater level monitoring when they are accessible and not pumping.

Twelve additional monitoring wells were constructed within the District in 1991 specifically to monitor groundwater. These wells consist of 12-inch bore holes drilled to a depth of between 250 and 400 feet. The wells were completed into separate shallow and deep zones by inserting two casings within each well, a 5½-inch diameter casing to a bottom depth of between 150 and 400 feet, and a 2-inch casing to a bottom depth generally less that 150 feet. Screened sections were installed in both casings opposite sand and gravel layers. Gravel pack was placed in the annular space between the casings and the bore hole. A grout plug was installed between the bottom of the 2-inch casing and the first screened section in the 5½-inch casing. Production wells and monitoring wells are shown on Figure 2.

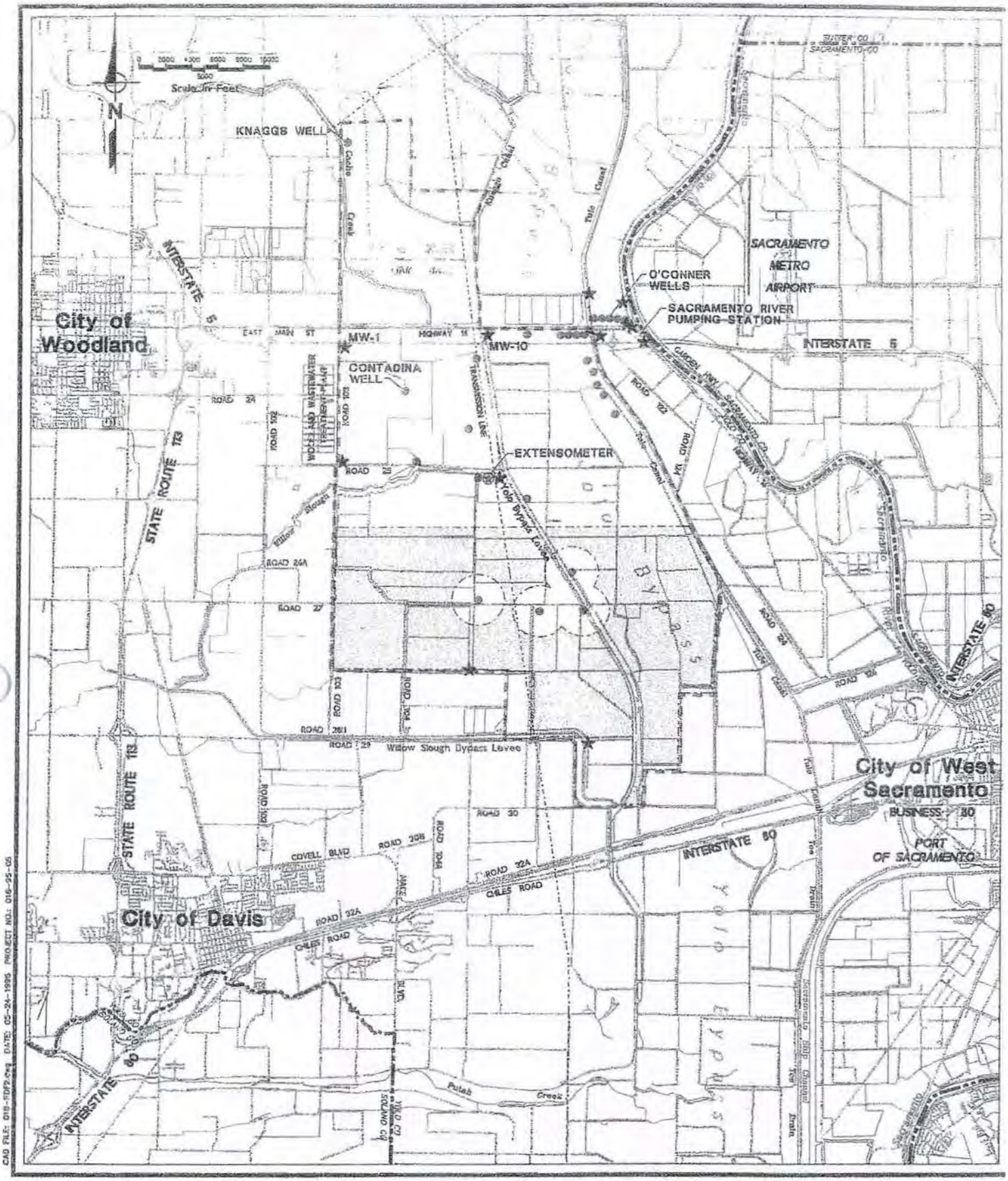
Two types of water level meters are used to monitor groundwater. Both are manufactured by Solinst Canada Ltd. Model 101 is a flat white tape level meter and reads to 1/100 of a foot. This probe is used on agricultural water wells and monitoring wells. Model 102 is a coaxial cable water lever meter marked in one foot increments and is used in applications where small diameter access holes won't allow the use of the larger flat white tape.

There are five subsidence survey monuments within the boundary of Reclamation District 2035. These monuments are 8-inch diameter by 10-feet deep reinforced concrete, or 3/4 inch diameter copper clad bars driven to a depth of 10 feet. All monuments are capped with a 4-inch diameter aluminum monument disc. These monuments were used in 1991 and 1992 to measure ground surface elevations using GPS satellite survey receivers.

Monitoring by Other Agencies

An extensometer was constructed in 1991 in a joint effort by the California Department of Water Resources (DWR) and RD 2035 to monitor compaction within the upper 716 feet of geologic formations at the site of monitoring well 7. The extensometer consists of a 2-inch diameter galvanized steel pipe cemented in the bottom of a 716 foot deep bore hole. A recorder at the surface measures any vertical movement of the top of the pipe with respect to the ground surface. The recorder is mounted within a steel building, on a steel reference table supported by two 4-inch steel posts cemented in 20 foot deep bore holes.

DWR also maintains a data base of historical groundwater levels for wells throughout Yolo County. This data base includes wells actively monitored by the Yolo County Flood Control



CAD FILE: 018-RDF2.dwg DATE: 05-24-1995 PROJECT NO.: 018-95-05

Legend:

- RECLAMATION DISTRICT 2035 BOUNDARY
- PREFERRED AREA FOR FUTURE GROUNDWATER EXPLORATION AND DEVELOPMENT
- GROUNDWATER SUPPLY WELL
- GROUNDWATER MONITORING WELL
- COUNTY BOUNDARY

Figure 2

WEST YOST & ASSOCIATES

Reclamation District 2035 Groundwater Management Plan

Existing Wells & Preferred Areas for Future Groundwater Development

and Water Conservation District (YCFCWCD), the U.S. Bureau of Reclamation (USBR), and DWR. The most recent summary report of this data[1] was produced in December, 1992.

There are two wells within the District's boundaries which are not operated by the District. One is north of the Cache Creek Settling Basin and is owned by Layton Knaggs Farms. Water levels in this well are monitored semi-annually by the Department of Water Resources. The other well is located on property owned by the City of Woodland and operated by Contadina. No monitoring records have been made available for this well.

ESTIMATED WATER AVAILABILITY

Groundwater Storage

There is a tremendous amount of groundwater storage beneath RD 2035, but only a portion is readily usable. The total amount of water in storage above 500 feet is estimated at 750,000 acre-feet (af) assuming a specific yield of 0.09[2] and an average water table depth of 25 feet. Usable storage is based on an assumed allowable drop in water levels and is much more difficult to quantify. Usable groundwater storage in RD 2035 under present economic conditions could exceed 100,000 af.

The amount of usable storage is a function of the underlying hydrogeology in terms of the amount of storage space available and the ability of the sediments to transmit water to wells. Because of this, coarse grained sediments provide most of the usable groundwater storage. There is a shallow aquifer system underlying much of the fine grained upper soils of the ranch to a depth of roughly 80 feet below ground surface. Below this, there are a number of deeper aquifers separated by fine grained aquitards down to a depth of at least 500 feet below ground surface. Assuming the shallow aquifer system averages 30 feet thick and has a specific yield of 0.1, it could store approximately 50,000 af. The shallow aquifer system is not currently tapped by most RD 2035 wells, so its storage could only be drained through seepage to deeper aquifers, unless wells constructed in the future are screened in the shallow aquifer.

Water Budget

Water Requirements. Irrigation water delivered by RD 2035 varies from year to year depending upon the crop mix and actual amount of land planted. The amount of water delivered during the period of 1981 through 1994 is estimated to have ranged from approximately 24,000 to 57,000 acre-feet per year (afa). Water use declined in the late 1980's because of more participation by growers in government set-aside programs. Water use in the 1990's has been affected by drought, participation in the State Emergency Drought Water Bank (Water Bank), and the increased acreage of rice in reaction to rising rice commodity values.

Surface Water Sources. RD 2035 diverts water from the Sacramento River under a contract with the US Bureau of Reclamation (USBR). The contract specifies a total allowable diversion of ~~50,862~~ af between April 1 and October 31, with a maximum total diversion of ~~13,452~~ af during the months of July through September. These entitlements can be reduced by the USBR by 25% in critically dry years, as determined by inflows to Shasta Reservoir.

Cache Creek is also a source of surface water for RD 2035. Diversions of water from Cache Creek are not metered, but estimated to have ranged from 0 to over 8,000 af per season, and averaged approximately 2,600 af during 1981 to 1994 based on RD 2035 water use calculations and Cache Creek flow measurements at the Yolo gage.

RD 2035 obtains an estimated average of 600 afa of surface water from rights originating on Willow Slough. Small amounts of drainage from the City of Woodland and from some adjacent farms to the west also enter the RD 2035 irrigation and drainage system.

Groundwater Pumping. RD 2035 has historically found it necessary to pump groundwater to meet irrigation needs during the July through September period to make up for restrictive surface water rights from the Sacramento River. Groundwater is also pumped to irrigate the 900 acre Contadina parcel and the Layton Knaggs Farms parcels which do not take water from the RD 2035 irrigation system. The total quantity of groundwater used by Contadina is not known, but it probably averages between 500 and 1,000 afa based on typical regional crop irrigation demands. The quantity of groundwater used by Layton Knaggs Farms is not known.

Pumping on lands surrounding RD 2035 may have an impact on water levels in RD 2035 wells. Most other land between the western boundary of RD 2035 and County Road 99 is irrigated with groundwater at an average rate of approximately 2.11 acre-feet per acre.[3] Lands to the north, south, and east of RD 2035 are irrigated by a combination of groundwater and surface water.

Groundwater Recharge. Spring groundwater levels within RD 2035 have stayed relatively high over the years. This is a good indication that recharge to the aquifer system underlying RD 2035 has been more than enough to offset groundwater pumping during the irrigation season. Recharge sources to the aquifer system underlying RD 2035 include:

- Irrigation Deep Percolation
- Rainfall Deep Percolation
- Rice Field Winter Flooding
- Cache Creek Settling Basin Flooding
- Yolo Bypass Flooding
- Sacramento River
- Other Lateral Inflow

Some information is available as to how much recharge is provided by these sources. For example, irrigation deep percolation and rainfall deep percolation are assumed to be equal to approximately 10% of applied water based on general recommendations for drainage design for clay loam soil.[4] Some information on the effects of winter season rice field flooding percolation has been developed through a test program within RD 2035 performed in fall of 1992 and winter of 1993.[5] Based on these and other general assumptions and future data collection, the amount of potential recharge to the aquifer system underlying RD 2035 will be developed. Potential recharge is substantially greater than the average historical groundwater pumping within RD 2035; however, the full recharge capacity of the basin will be determined through further investigation.

Perennial Yield. The perennial yield of the aquifer system underlying RD 2035 is a function of groundwater recharge within RD 2035 and lateral inflow or outflow. Because of the difficulty in estimating the maximum potential lateral inflow and recharge due to Yolo Bypass flooding, additional monitoring and evaluation would be necessary to determine the maximum perennial yield.

WATER QUALITY

A comprehensive study of groundwater quality in Yolo County was published by the USGS in 1985.[6] A total of 188 domestic and agricultural wells within Yolo County were sampled to determine concentrations of general mineral and inorganic constituents. The study found that groundwater in the area is generally suitable for agricultural and domestic uses. However, many of the Yolo County wells sampled had boron concentrations which exceeded tolerance levels for many crops. Many of the wells also had moderately elevated levels of total dissolved solids.

Wells in RD 2035 were also sampled in December, 1991 as part of the Eastern Yolo County Groundwater Investigation studies.[7] These were performed for Conaway and Cowell Ranches to fulfill their monitoring commitments during the State Emergency Drought Water Bank. The conclusions of the groundwater quality investigation were that many Yolo County wells had moderately elevated (>500 mg/L) levels of total dissolved solids, some had elevated boron levels (>2 mg/L) and others had elevated levels of iron and manganese.

The source of the boron in the region is thought to be originally from geothermal springs in the Coast Range which discharge into Cache Creek. Wells with high boron levels were generally found in the vicinity of the Tule Canal. The sediments in this area were probably deposited from Cache Creek as it fanned out and entered the tule marsh conditions which used to be present in much of the present RD 2035 service area.

Wells with elevated salinity are scattered throughout RD 2035, with wells along the Tule Canal near Highway 16 producing water with the highest levels of salinity. Wells nearest the Sacramento River produce water with the lowest salinity, but higher levels of manganese.

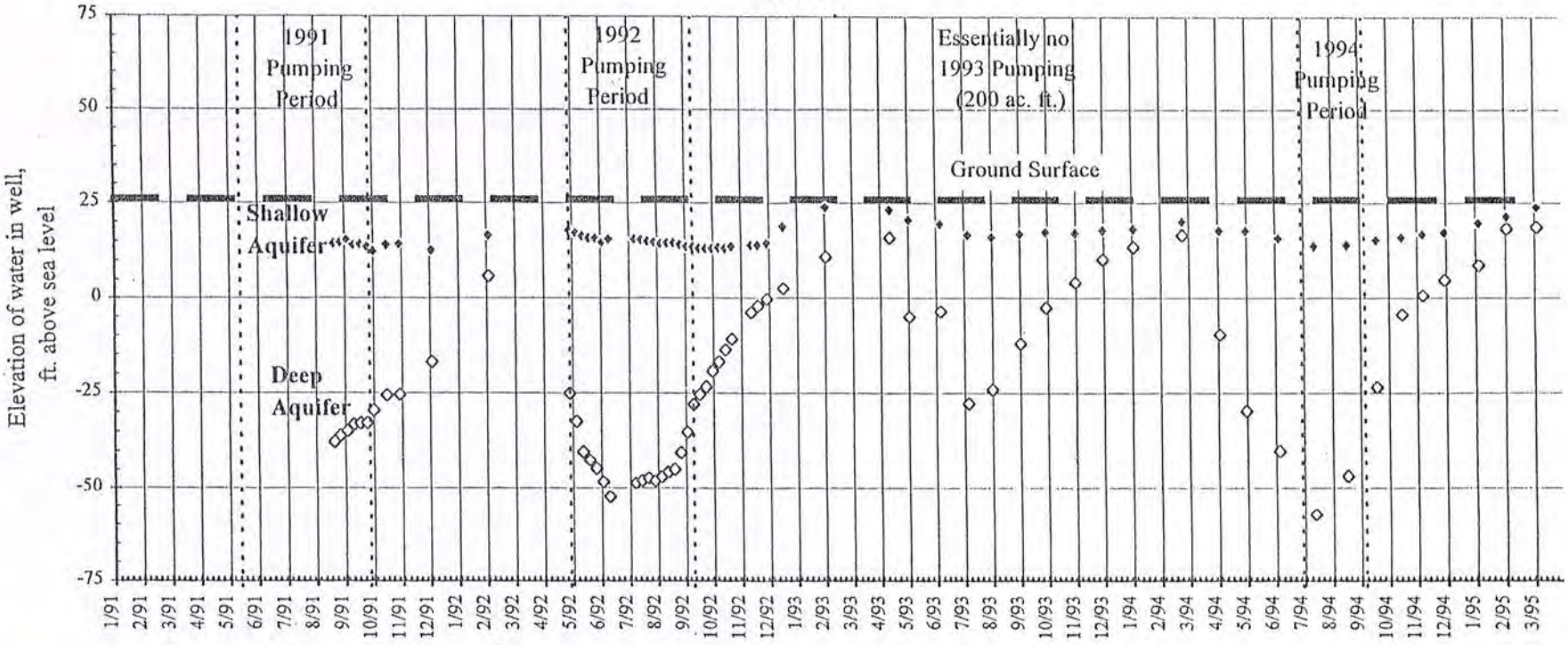
LAND USE

The productive lands within RD 2035 are being used extensively for agriculture. Some tracts of land in the District are also used for wastewater treatment ponds or other related facilities by the cities of Woodland and Davis. However, water is only supplied for agricultural irrigation at the present. The most common crops grown in the District are rice, corn, safflower, tomatoes, alfalfa, wheat, and sugar beets.

DATA EVALUATION

RD 2035 established a groundwater level monitoring program in 1991 which it has continued to carry out through the present. Data from the monitoring program has generally been evaluated every spring. Running hydrographs of the water levels in wells have been plotted to evaluate effects over time and among wells. An example of a hydrograph for monitoring well MW-1 at the western edge of the District is shown in Figure 3. The hydrographs are useful for evaluating

Figure 3
Water Level Hydrograph - Western Edge of District
MW - 1



the water level responses in shallow and deep aquifer systems to pumping by RD 2035 wells and wells on land surrounding RD 2035. For example, the 1993 and 1994 data show a high degree of influence from wells operated by others on lands outside the District. This is particularly evident for 1993 when only 200 af of groundwater was pumped by the District.

Spring water level trend graphs have also been plotted to evaluate long-term trends in groundwater levels. An example is shown in Figure 4. As can be seen, spring groundwater levels have remained relatively high over the last 10 years. This is an indication that the aquifer system is fully recharged every year. DWR also plots long-term trend graphs for water levels in wells throughout Yolo County which are measured in spring and fall.

In 1991, DWR and RD 2035 installed an extremely accurate extensometer for measuring ground surface subsidence near the east end of County Road 25 at the Yolo Bypass levee. Subsidence data at the extensometer have been plotted annually by DWR along with water levels in four different aquifer zones. Figure 5 shows the data through January, 1995 for ground surface elevation and water levels in two aquifer zones (second and third aquifers). Small groundwater elevation changes have been found to follow piezometric water level changes in the deeper aquifers closely. Only temporary, elastic ground surface changes have been evident in the measurements taken from late 1991 to the present.

Figure 4
Production and Monitoring Well Spring Water Levels, 1986 - 1995

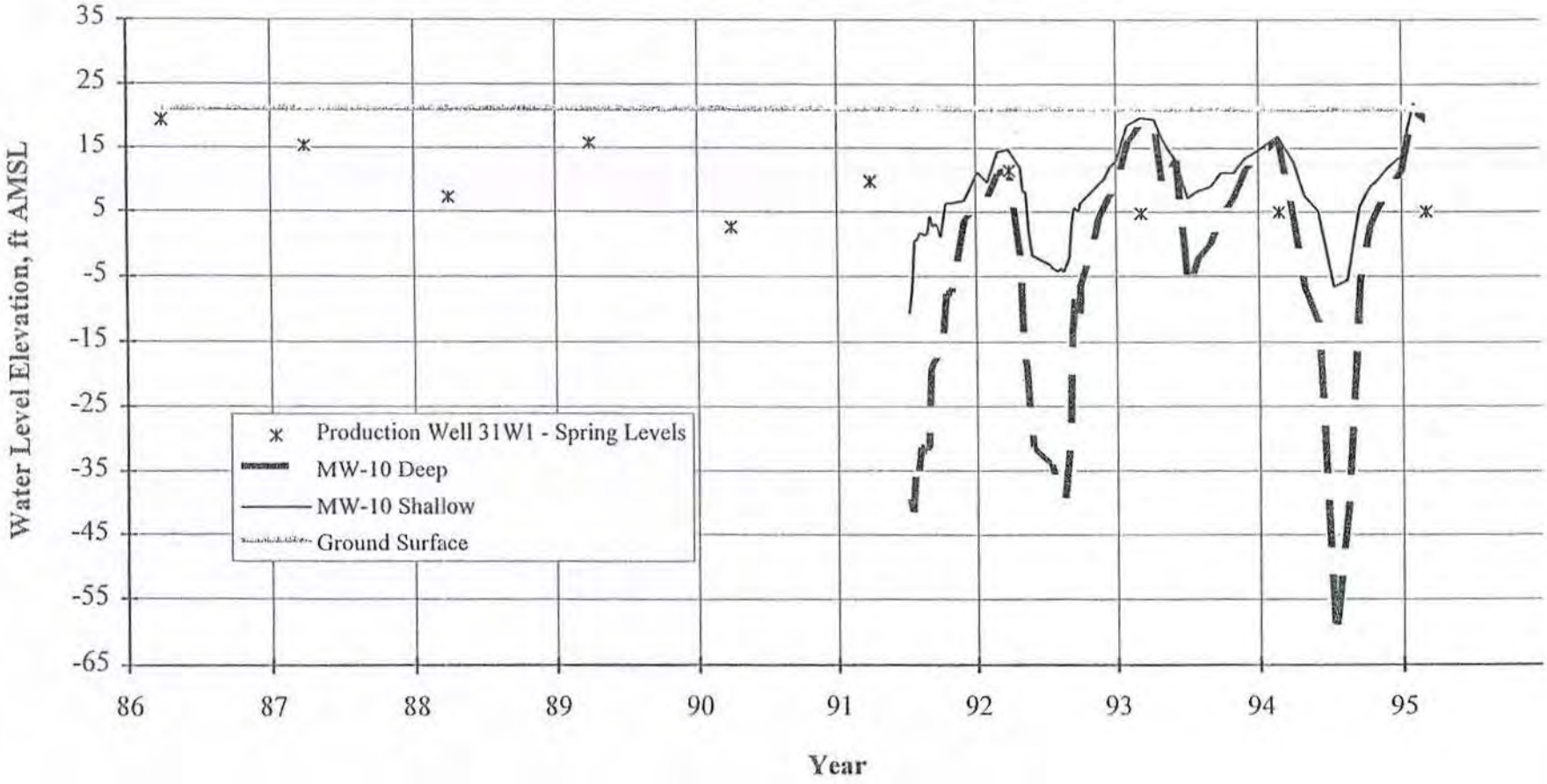
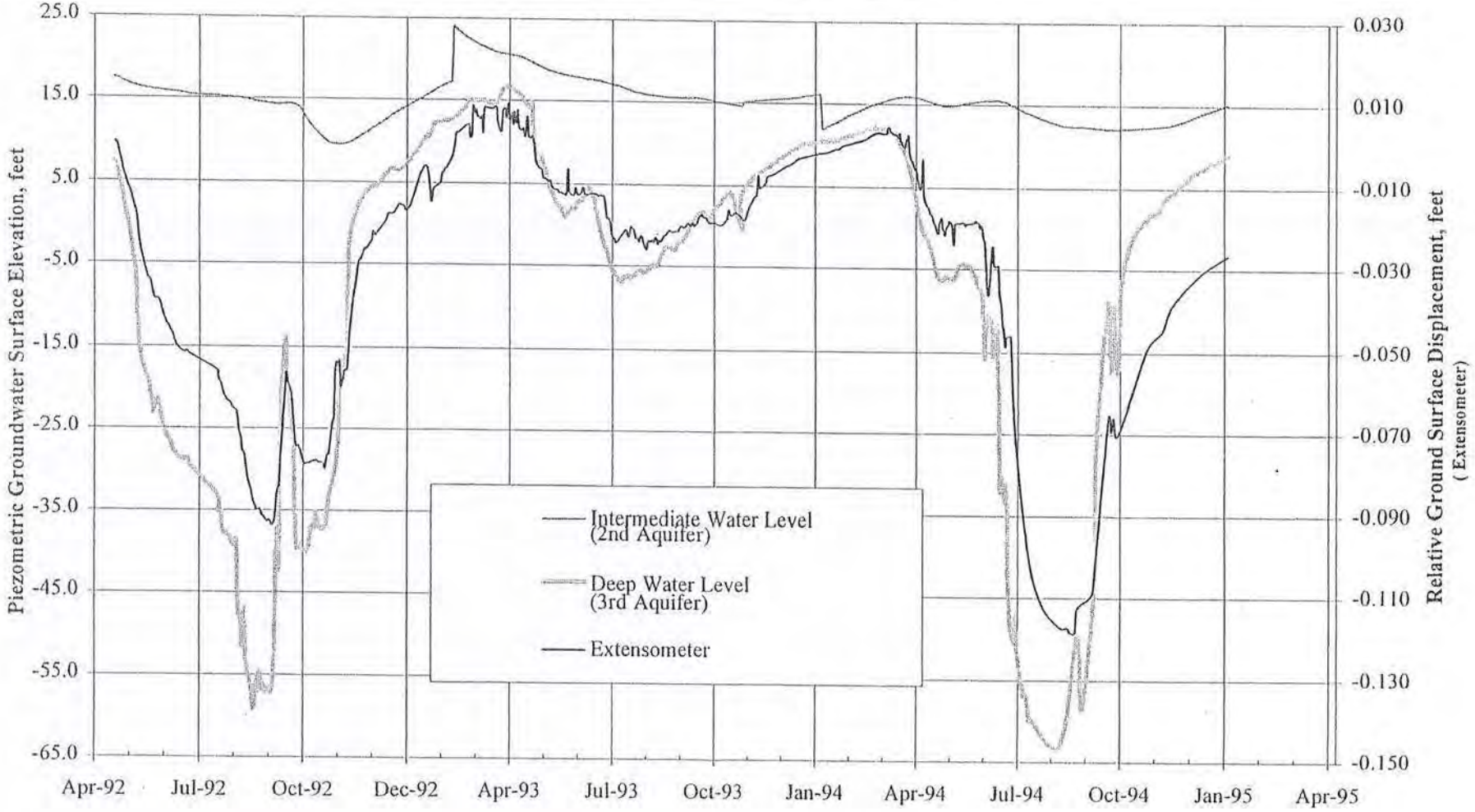


Figure 5
Water and Ground Surface Level Changes



FUTURE WATER DEMANDS

PROJECTED CHANGES IN WATER USE

Agricultural Use

Water use has fluctuated over time due to changes in cropping patterns. As world markets open up to crops grown in RD 2035, more land may be taken out of government set-aside programs and planted. This occurred for rice in 1993 and 1994. Although it is very difficult to predict, water demand for agricultural irrigation within RD 2035 will probably increase in the future.

Municipal Use

Conaway Ranch and the City of Woodland may develop the northeast portion of the District north of Willow Slough and south of the Cache Creek Settling Basin. Groundwater may be used to supply some of the water needs of development in this portion of the RD 2035 service area.

Conjunctive Use

Together with RD 2035, Conaway Ranch and other eastern Yolo County farmers, DWR has begun the evaluation of a potential conjunctive use project. This project would involve the storage of water in Eastern Yolo County groundwater during wet years and extraction of the stored groundwater during dry years. Groundwater would be recharged in large part by supplying farmers with surface water in lieu of their normal pumping of groundwater. Groundwater would be extracted primarily from wells in RD 2035, with some limited extraction on other ranches in Eastern Yolo County. RD 2035 is independently considering conjunctive use of surface water and groundwater resources within its own boundaries and possibly with some farmers on adjacent lands.

Pumping on Lands Near RD 2035

Many of the lands surrounding RD 2035 use groundwater as their major source of irrigation water. The average pumping rate for crops irrigated solely with groundwater was estimated at 2.11 afa by DWR.[3] This is about 2.5 times the average amount of pumping for crops within RD 2035. Average groundwater pumping on lands near RD 2035 will probably stay relatively constant in the future unless surface water is supplied to lands in a conjunctive use program to accomplish in-lieu groundwater recharge.

IMPACTS ON THE BASIN

DWR modeled groundwater reactions for several scenarios in the feasibility study for the Eastern Yolo County conjunctive use project.[3] The DWR model assumed pumping of approximately an extra 16,000 afa of groundwater from RD 2035 wells, and an extra 14,000 afa from wells on other ranches in Eastern Yolo County. Their model simulations indicate

that groundwater pumping for the conjunctive use project would have no significant adverse impacts on long-term groundwater level.

ELEMENTS OF THE GROUNDWATER MANAGEMENT PLAN

MONITORING OF GROUNDWATER LEVELS AND STORAGE

Monitoring

Section 10753.7 of Division 6 of the California Water Code lists monitoring of groundwater levels and storage as one of the possible elements of a groundwater management plan. Groundwater storage is typically calculated from groundwater level data and estimated aquifer properties. Ongoing monitoring of groundwater levels and storage will help RD 2035 evaluate trends and potential management options.

Since the end of the 1992 Water Bank, the monitoring program has consisted of monthly monitoring of all accessible wells in RD 2035, usually performed in the first week of each month. Groundwater pumping has also been measured for some of the wells using flowmeters with totalizers. As part of this groundwater management plan, RD 2035 will continue groundwater monitoring and data collection and recording procedures.

DWR has continued to monitor subsidence with the extensometer and water levels in MW-7 (adjacent to the extensometer). These measurements are recorded with automatic data loggers. RD 2035 will continue to provide access and logistical support to DWR for these measurements.

Water quality samples have not been taken since the end of the 1992 Water Bank. Henceforth, water quality sampling for TDS, nitrate, boron, iron and manganese will be performed for representative wells throughout RD 2035. The purpose of this monitoring will be to detect long-term groundwater quality trends.

Data Evaluation and Reporting

The data will be evaluated every spring, and an annual summary report will be prepared. This report will include water level hydrographs, subsidence graphs, a table of groundwater pumping and any other relevant monitoring data from the previous year. Data provided by DWR or YCFCWCD for wells from the area surrounding RD 2035 will also be included.

Evaluation of the data will include an estimate of groundwater in storage within the District, and discussion of any notable trends. Groundwater gradients in summer and spring will be plotted and discussed. Correlation of groundwater level changes in RD 2035 with groundwater levels and pumping outside of RD 2035 will also be evaluated. Correlation between groundwater pumping and subsidence will be evaluated, and any significant subsidence will be noted.

FACILITATING CONJUNCTIVE USE OPERATIONS

Conjunctive use can be described as the management of groundwater storage in a manner similar to the management of a surface water reservoir. Water is stored in the ground during

times of high surface water availability and withdrawn during times of low surface water availability.

The RD 2035 river diversion, conveyance system and wells could be operated to further facilitate conjunctive use. This may include planning and coordination of surface water resources, groundwater pumping, and enhancement of groundwater recharge.

Surface Water Resources

The use of Cache Creek water could be maximized when it is available, recognizing that Sacramento River water and groundwater are of greater cost and value. If conjunctive use is practiced for lands outside the RD 2035 service area, delivery of surface water to those lands should be maximized during the April through June period.

Development of Additional Groundwater Pumping Capacity

Additional wells may be necessary to provide pumping flexibility and peak month capacity for RD 2035. Geologically, the best area for new wells would be the southeast portion of the District. This area appears to have a low amount of confinement, potentially high well yields and good water quality. Unfortunately, this is also the lowest part of the water service area. Drainage return pumps would have to be used to get water from wells in this area back into the main irrigation system. Other areas south of Willow Slough are generally favorable for groundwater development, as long as new wells are not installed so close to existing wells as to cause excess interference. The preferred areas for new groundwater exploration and development were shown along with existing District facilities in Figure 2.

Winter Water Use

Sacramento River water has been diverted during the months of November through March under Conaway Ranch's riparian water rights to provide waterfowl habitat and decompose rice stubble. These activities incidentally enhance direct groundwater recharge. In recent years, approximately 4,000 to 6,000 acres of fields have been flooded for rice straw degradation and/or waterfowl. This amount will increase as rice stubble burning continues to be phased out and rice acreage is increased. The average acreage flooded could exceed 7,000 acres in the future.

Joint Conjunctive Use Operations with DWR

The proposed SWP Conjunctive Use project for Eastern Yolo County was based on the use of the diversion and conveyance facilities of RD 2035 to carry water to farms west and southwest of RD 2035. This would be accomplished by diverting extra State Water Project water from the Sacramento River when it is available and sending it back up Willow Slough. Farmers currently using groundwater for irrigation would pump water from Willow Slough instead, thereby leaving extra groundwater in place.

RD 2035 wells would also provide over half of the extraction capacity for the stored water. RD 2035 is ideally located to provide extraction of the stored groundwater since it is located in high

yield aquifers downhill (and generally downgradient) from where the in-lieu recharge would take place.

GROUNDWATER EXTRACTION CRITERIA

Groundwater pumping will be performed as is needed for crop irrigation to make up for any shortfall in normal surface water deliveries. However, since groundwater pumping should not cause permanent levee subsidence or permanent groundwater overdraft, the District will develop groundwater extraction criteria.

In 1992, groundwater pumping was voluntarily limited to that amount which would not cause a temporary seasonal ground surface decline of more than 0.2 feet. The 0.2 feet was assumed to be the maximum amount of elastic subsidence that could be experienced before permanent subsidence was initiated, based on monitoring at an extensometer in Zamora.

For purposes of this plan, the maximum allowable amount of temporary ground surface elevation decline would initially be defined as 0.2 feet within any single year. Spring ground surface elevations would continue to be compared year to year to determine if any significant amount (greater than 0.1 feet) of permanent subsidence has resulted. Based on future comparisons of spring ground surface elevations, the maximum allowable ground surface elevation decline during a season could be revised up or down in the future. If significant permanent subsidence has been caused during a pumping season, the lowest measured piezometric water levels and ground surface decline during that season should be noted. These lowest measured piezometric water levels and mid-season ground surface declines would then guide the determination of the allowable levels for any subsequent years. If significant permanent subsidence is measured at the extensometer, some additional subsidence measurements would also be warranted for areas in RD 2035 distant from the extensometer. Elevations at other points could be measured with a GPS survey system using the more advanced equipment and procedures that have been developed since the 1991 and 1992 surveys.

WELLHEAD AND AQUIFER PROTECTION

Contamination within areas which supply water to the wells in RD 2035 could create a threat to the quality of water from these wells. Setting up a wellhead protection plan consistent with the guidelines of Section 1428 of the Federal Clean Water Act would help maintain long-term assurance of water quality. One of the key elements of a wellhead protection plan is the delineation of wellhead protection areas. This requires an understanding of well construction, aquifer characteristics and groundwater pumping, and monitoring of groundwater quality.

One of the objectives of this groundwater management plan is to develop the necessary information to delineate wellhead protection areas and establish a wellhead protection program sometime in the future.

Wellhead Protection Plan Development

The U.S. Environmental Protection Agency has identified the following seven steps in a wellhead protection program:

1. Specify the roles and duties of State agencies, local governmental entities, and public water suppliers that will contribute to developing and implementing the wellhead protection program.

2. Delineate the wellhead protection area (WHPA) for each wellhead.

3. Identify potential sources of contaminants within each WHPA.

4. Develop management approaches to protect the water supply within WHPAs from contaminants.

5. Develop contingency plans for each public water supply system to respond to emergencies.

6. Site new wells properly to maximize yield and minimize potential contamination.

7. Ensure public participation.

Emphasis will initially be given to obtaining aquifer properties for the development of information which could be used in wellhead protection area delineation. This information will be derived from the evaluation of existing test data, the yearly monitoring data and future aquifer pumping tests.

Water quality trends will be evaluated as was specified in the monitoring section of this groundwater management plan. Adverse trends in water quality will be cause to accelerate the development of a wellhead protection plan and to begin sampling for additional constituents of potential concern.

New wells should be constructed to state guidelines and county standards, with seal depths as discussed in the next section.

WELL CONSTRUCTION AND ABANDONMENT POLICIES

Without proper planning and seal design, deep wells can inadvertently act as conduits to allow lower quality water from shallow aquifers to migrate to the deep aquifers. In conjunction with other agencies, RD 2035 will develop well construction guidelines to minimize the potential for the deterioration of water quality in deeper aquifers.

Well Construction/Abandonment Standards

New wells should be designed in accordance with state guidelines and county standards. The seal depths should extend to at least 50 feet. If it is desirable to tap the shallow aquifer (and the shallow aquifer quality is acceptable), a 50 foot seal depth would be appropriate. If there is not a good reason to tap the shallow aquifer, the seal should extend to at least 10 feet below the bottom of the shallow aquifer, or 100 feet below the ground surface, whichever is lesser. New wells may also need 100 foot seals if reclaimed water is delivered to the District from the Cities of Davis or Woodland.

Wells should also be abandoned according to state and county standards. This includes filling the wells with grout throughout their depth.

DEVELOPMENT OF RELATIONSHIPS WITH STATE, FEDERAL, AND OTHER AGENCIES

Federal Agencies

RD 2035 diverts water from the Sacramento River under a water rights settlement contract held by Conaway Ranch with the USBR. RD 2035 has worked with the USBR to develop estimates of the influence of wells on seepage from the Sacramento River. RD 2035 intends to continue to work with USBR to help resolve issues relating to water transfers, conjunctive use programs, and other issues related to diversions from the Sacramento River.

State Agencies

Through its participation in the 1991 and 1992 Water Banks and in a number of joint studies related to water resources in eastern Yolo County, RD 2035 has developed a cooperative working relationship with DWR. It is the intent of RD 2035 to continue working with DWR on the development of a joint Eastern Yolo County conjunctive use program. It is also the intent of RD 2035 to continue the sharing of monitoring data with DWR so that DWR can continue to develop and calibrate its groundwater model for Eastern Yolo County.

Other Agencies

The Water Resources Association of Yolo County was formed in 1993 to coordinate the collection and evaluation of information on surface and groundwater resources in Yolo County. The members of the Association are the Cities of Davis, Winters, Woodland and West Sacramento; Yolo County Board of Supervisors; Yolo County Flood Control and Water Conservation District; Dunnigan Water District; and U.C. Davis. The Water Resources Association is currently implementing a Water Resources Management Program as was outlined in a 1992 report by Borcalli and Associates.[8] This program includes gathering the information necessary to prepare a future potential joint groundwater management plan for all the areas served by the member agencies. The District is interested in coordinating groundwater management planning with the Water Resources Association of Yolo County.

IMPLEMENTATION

Implementation of this RD 2035 groundwater management plan will begin in June, 1995. Monitoring will continue as specified until the plan is modified. Additional monitoring may be performed from time to time as is necessary for other purposes.

RD 2035 will continue to coordinate the subsidence monitoring and conjunctive use planning with DWR. The District will also maintain communication with the Water Resources Association of Yolo County and its member agencies which adjoin RD 2035. This will allow an open dialog on groundwater management throughout Eastern Yolo County.

In accordance with California law, RD 2035 may adopt rules and regulations for the implementation and enforcement of this groundwater management plan and, where necessary, may modify the plan to assimilate additional information and to accommodate changing conditions. In adopting rules and regulations, RD 2035 will minimize, as required by California law, the impact of the rules and regulations on business and agricultural activities, consistent with the protection of the groundwater resources subject to the groundwater management plan. The District intends to protect and enhance the groundwater resources available to it consistent with the goals and objectives set forth in this plan. The elements of this groundwater management plan, including monitoring (groundwater use, groundwater levels, and ground surface elevation changes at the extensometer), the development of guidelines for well construction and abandonment, and the investigation of potential conjunctive use operations, will be implemented in an orderly and sequential process through the annual budgetary planning of the District.

ENDNOTES

1. Senter, E. and M. Collins under the direction of T. Dudley and H. Mann, *Historical Ground Water Levels in Yolo County*. California Department of Water Resources, Central District, December, 1992.

2. Lorens, P.J., under the direction of W. Gentry, *Evaluation of Ground Water Resources: Sacramento Valley*. California Department of Water Resources Bulletin 118-6, August, 1978.

3. J. Fielden, et. al., *SWP Conjunctive Use — Eastern Yolo County*. California Department of Water Resources, February, 1994.

4. *Design, Construction and Maintenance of Subsurface Drains in Arid and Semiarid Areas*. Engineering Practice EP463, American Society of Agricultural Engineers, St. Joseph, Michigan, 1988.

5. *Groundwater Recharge Program, Fall 1992 through Winter 1993*. Prepared by West Yost & Associates for Reclamation District 2035, April, 1993.

6. U.S.G.S., *Chemical Quality of Ground Water in Yolo and Solano Counties, California*. 1985.

7. *Eastern Yolo County Groundwater Investigation Summary Report*, West Yost & Associates, January, 1992.

8. *Yolo County Water Plan Update*, Borcalli and Associates, December, 1992.