

**GROUNDWATER MANAGEMENT PROGRAM FOR  
YUBA COUNTY WATER AGENCY:  
A CONJUNCTIVE USE PILOT PROJECT**

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**ABSTRACT**

The Yuba County Water Agency (YCWA), an independent, stand-alone government organization created in 1959, aims to develop and promote the beneficial use and regulation of the water resources of Yuba County. Over the last two decades, YCWA and its Member Units (currently eight Member Units) in cooperation with stakeholders; and local, state, and federal agencies have made significant planning efforts to improve both local and statewide water supply reliability. In 1984, YCWA started surface water deliveries to the North Yuba Subbasin and South Yuba Subbasin from the New Bullards Bar Reservoir. Following the surface water deliveries, groundwater elevations in the South Yuba Subbasin, which declined substantially (estimated 100 ft at some locations) between 1948 and 1981 due to groundwater overdraft, returned to near historical levels. In addition to supplying highly reliable water to its local Member Units, in 1987 YCWA began transferring surface water and groundwater to other parts of the State to increase statewide water reliability.

In 2001, the Conjunctive Use Pilot Project was designed to formalize the historically successful management of Yuba County's groundwater resources and to develop a framework for implementation of future activities. Funded by the California Department of Water Resources, this on-going project is a part of a comprehensive watershed and groundwater management effort in Yuba County.

YCWA has recently developed a collaborative agreement, known as the proposed Lower Yuba River Accord (Yuba Accord), working with a broad coalition of agricultural, environmental, and fisheries interests, including state and federal agencies. The Yuba Accord, proposed in early 2005 and anticipated to be implemented by late 2006, will improve river habitat conditions and provide YCWA with a source of revenue for activities, including an active surface and groundwater conjunctive use program. Through the past groundwater management and resource use activities, YCWA has proven its leadership role in progressively embracing the concept of sustainable groundwater management. Future resource management operations that will be implemented under the proposed Yuba Accord will further demonstrate YCWA's dedication to providing highly reliable local and statewide water supply.

**KEYWORDS**

Conjunctive Use, Groundwater Management, Groundwater Monitoring.

## INTRODUCTION

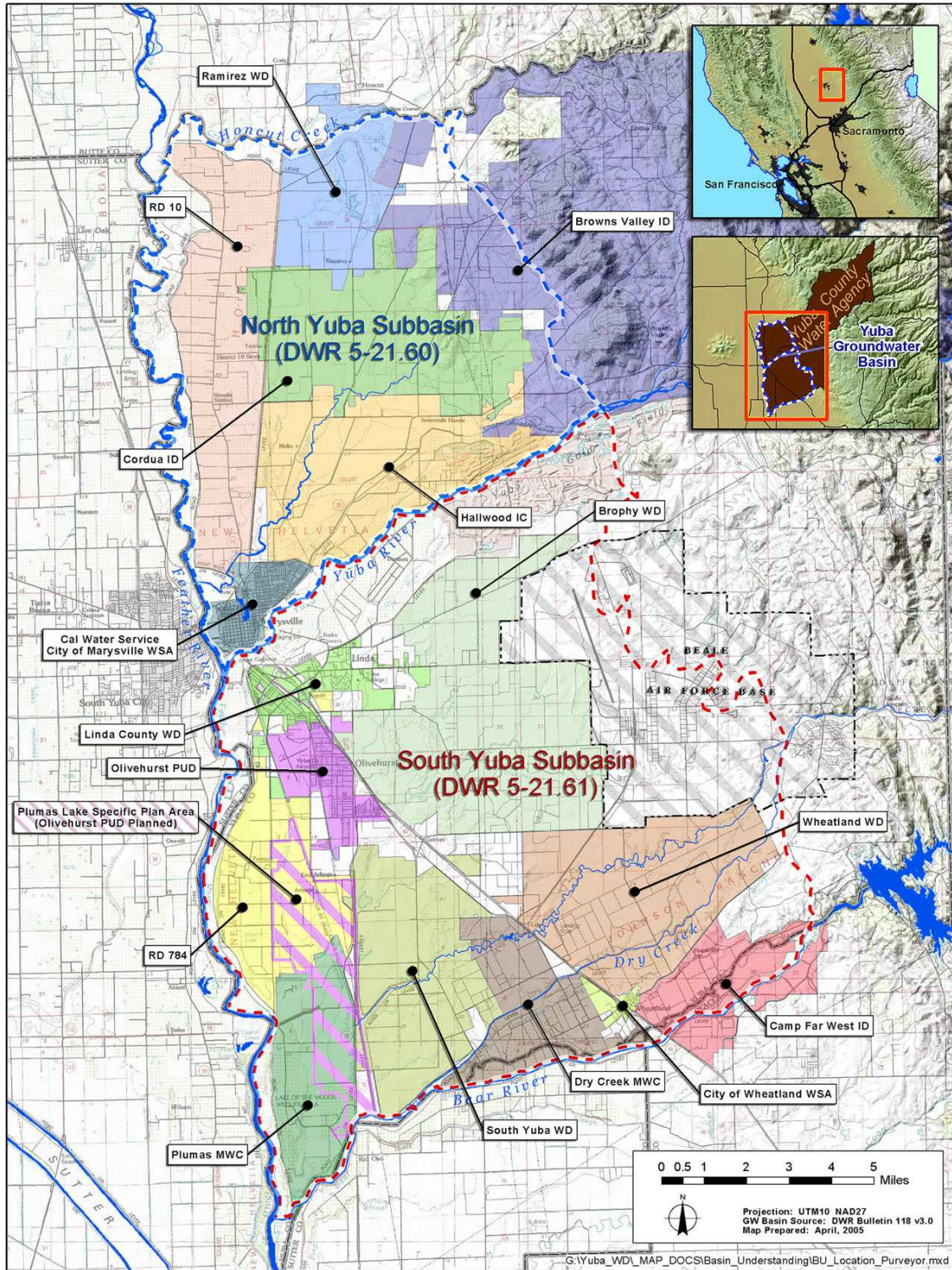
Yuba County Water Agency (YCWA) is an independent, stand-alone government organization created in 1959 by the Yuba County Water Agency Act. YCWA in cooperation with its Member Units, stakeholders, and local, state, and federal agencies has a long history of actively managing and regulating Yuba County's water resources for beneficial uses. Currently, eight districts are Member Units: Ramirez Water District (WD), Cordua Irrigation District (ID), Hallwood Irrigation Company (IC), Browns Valley ID, Brophy WD, Dry Creek Mutual Water Company (MWC), South Yuba WD, and Wheatland WD. In addition to the surface water delivered by YCWA, Member Units currently have existing capacity to pump groundwater to meet part of their demand. There are also five municipal purveyors located in Yuba County that rely exclusively on groundwater to meet their needs. The municipal purveyors are Linda County Water District (WD), Olivehurst Public Utilities District (PUD), California Water Services Company, City of Wheatland, and Beale Air Force Base (AFB). Member Units and municipalities within YCWA boundaries are shown in Figure 1.

Over the past several decades, YCWA has faced a series of water resource management and legal challenges (see Figure 2), as will be explained later in the paper. To meet these challenges, YCWA and its Member Units have invested substantial time and resources in planning a proactive, coordinated conjunctive use program in Yuba County. The overall objective of this paper is to describe various elements of this conjunctive use program, including the hydrogeologic, operational, and institutional elements, with an emphasis on water resource management activities. Specific objectives are two-fold:

- To describe past and on-going resource management activities undertaken by YCWA and its Member Units, working in coordination with other state and federal agencies, in an attempt to enhance sustainable groundwater management in Yuba County and to improve local and statewide water supply reliability
- To describe future developments in conjunctive use of surface water and groundwater in Yuba County within the framework of the proposed Lower Yuba River Accord.

This paper presents a framework supported by a series of strategies and approaches that the YCWA has followed to deal with key water management issues. The framework will demonstrate other practitioners (water agencies and authorities) how to resolve similar issues encountered in their regions. Although water management issues vary from one region to another depending on geological, hydrological, institutional differences and, social and economical needs, this paper highlights one key element: local coordination and participation is the keystone for sustainable water management and water supply reliability at the local and regional scale.

**Figure 1- Member Units and Water Purveyors within Yuba County Water Agency Boundaries**



Note: Boundaries of North Yuba Subbasin and South Yuba Subbasin are defined by DWR (2003).

**Figure 2- Timeline of Various Events Affecting Yuba County Water Agency’s Water Resource Management Activities**



This paper is organized in three sections. The first section describes groundwater basin underlying Yuba County, including regional geologic setting, groundwater flow conditions and groundwater usage in Yuba County. The subsequent section talks about management and resource use activities undertaken by YCWA to improve local and regional water supply reliability. The final section describes future water resources management activities that will be implemented within the framework of the Lower Yuba River Accord. This section also defines the anticipated benefits of the Yuba Accord to local and regional entities and the role of groundwater management activities within the conjunctive use program.

## GROUNDWATER BASIN CHARACTERISTICS

Yuba County is located in the eastern central portion of the Sacramento Valley, and is bounded on the north by Honcut Creek, on the west by the Feather River, on the south by the Bear River, and to the east by the Sierra Nevada Foothills (Figure 1) (DWR, 2003). Below describes the basin geologic setting that controls the occurrence and movement of groundwater in the groundwater basin of Yuba County.

Groundwater aquifer underlying Yuba County is divided by the Yuba River into the North Yuba and South Yuba subbasins (see Figure 1). DWR defines these subbasins in Bulletin 118 as follows (DWR, 2003):

- **North Yuba Subbasin** (Basin Number 5-21.60) lies in the eastern central portion of the Sacramento Valley Groundwater Basin. It is bounded on the north by Honcut Creek, on the west by the Feather River, on the south by the Yuba River, and on the east by the Sierra Nevada Foothills.
- **South Yuba Subbasin** (Basin Number 5-21.61) lies in the southern portion of the Sacramento Groundwater Basin. It is bounded on the north by the Yuba River, on the west by the Feather River, on the south by the Bear River, and on the east by the Sierra Nevada Foothills.

North Yuba Subbasin and South Yuba Subbasin together encompass an area of approximately 216 square miles. For the purpose of this paper, these two subbasins are combined together and named as “Yuba Basin” to refer to the entire groundwater basin underlying Yuba County.

### **Regional Geologic Setting**

Yuba Basin is located within two distinct topological features: the Sacramento Valley and the foothills at the base of the Sierra Nevada Foothills as defined in DWR Bulletin 118 (2003). The principal water-bearing formations in the Yuba Basin include Surface Basin Deposits, Older Alluvium, Laguna Formation and Mehrten Formation, comprising over 95 percent of the Yuba Basin water storage volume.

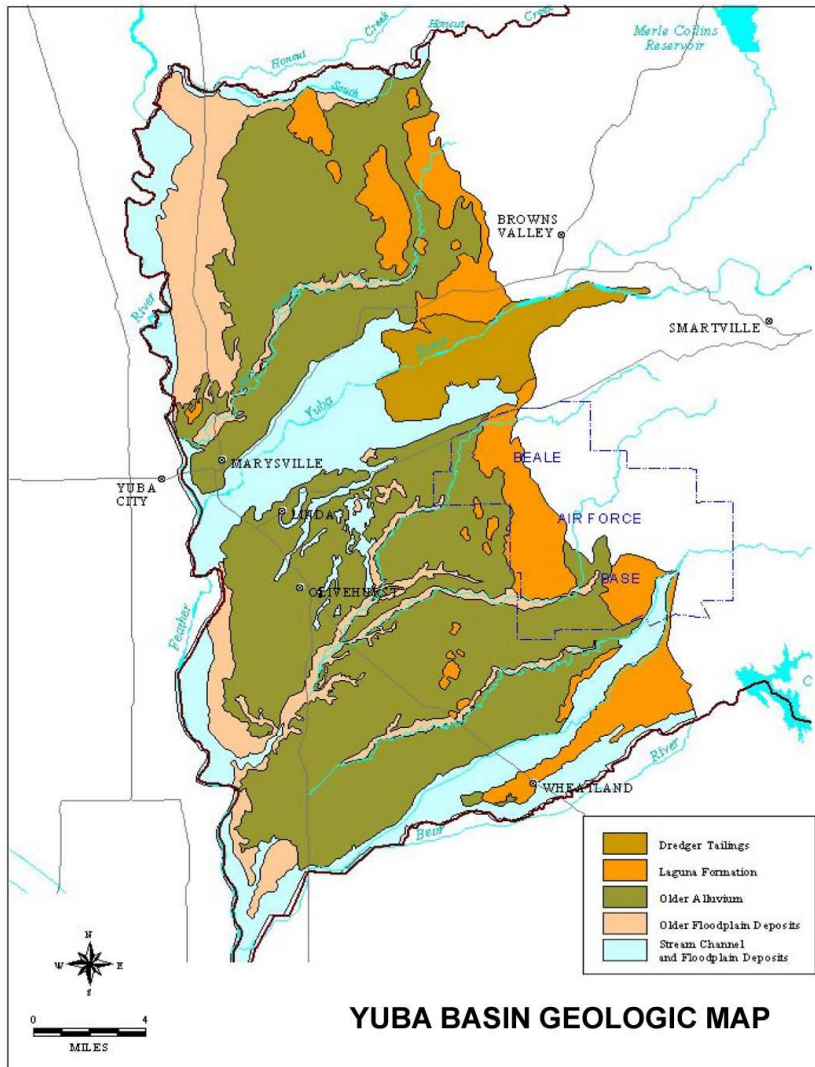
***Surface Basin Deposits*** – These deposits are composed of stream channel and floodplain deposits, and dredger tailings (Figure 3). Alluvial deposits are located along present day stream channels of the Yuba, Bear, and Feather Rivers and Honcut Creek. These deposits consist of highly permeable boulders, gravels, cobbles, and sands and can be up to 110 feet in thickness (Olmstead and Davis, 1961). All of the stratified alluvial deposits slope gently to the west, thickest along the Feather River and thinnest along the Sierra Nevada boundary. Extending downstream from the Sierras along the Yuba River for 15 miles are large piles of very coarse gravels and cobbles. These piles have been dredged for gold and range in thickness between 60 to 80 feet in the eastern area, and 100 to 125 feet in the west (DWR, 2003). The area of highest well yields is along the Yuba River. Wells with depths of 200 to 400 feet can yield 2,000 to 4,000 gallons per minute (gpm), with most of the yield derived from the upper 100 feet or more of sand and gravel.

***Older Alluvium*** – It is composed of older flood plain deposits and alluvial fan deposits. Estimates on unit thickness range from 100 feet in the south to 150 feet in the Yuba River vicinity. As seen in Figure 3, surface geology is mostly composed of the Older Alluvium. Several wells screened in the Older Alluvium yield 1,000 to 1,200 gpm. Much of the well yield is primarily derived from the Older Alluvium Formation. Several wells with depths of 150 feet below ground surface (bgs) or less within the Older Alluvium are reported to yield 1,000 to 1,200 gpm.

***Laguna Formation*** – It is exposed along the eastern study area boundary and found in deep wells to the west. It exists at thicknesses of 400 feet near the Yuba River, extending to 1,000 feet in the southwest portion of Yuba County. Wells screened in the Laguna are capable of producing up to 2,000 gpm.

***Mehrten Formation*** – Mehrten Formation is of great importance to the fresh ground-water basin in the Central Valley. In the Sacramento Valley, the formation consists of two general units: (1) an overlying unit composed of unconsolidated black sands interbedded with blue-to-brown clay and (2) an underlying unit of hard, very dense tuff breccia. The Mehrten ranges in thickness from 400 to 500 feet thick (Page, 1986). Surficial exposures of this unit are limited to a few square miles in the northeast corner of the Yuba Basin, dipping to the west and extending to great depths. Generally, the Mehrten Formation yields large quantities of water to wells.

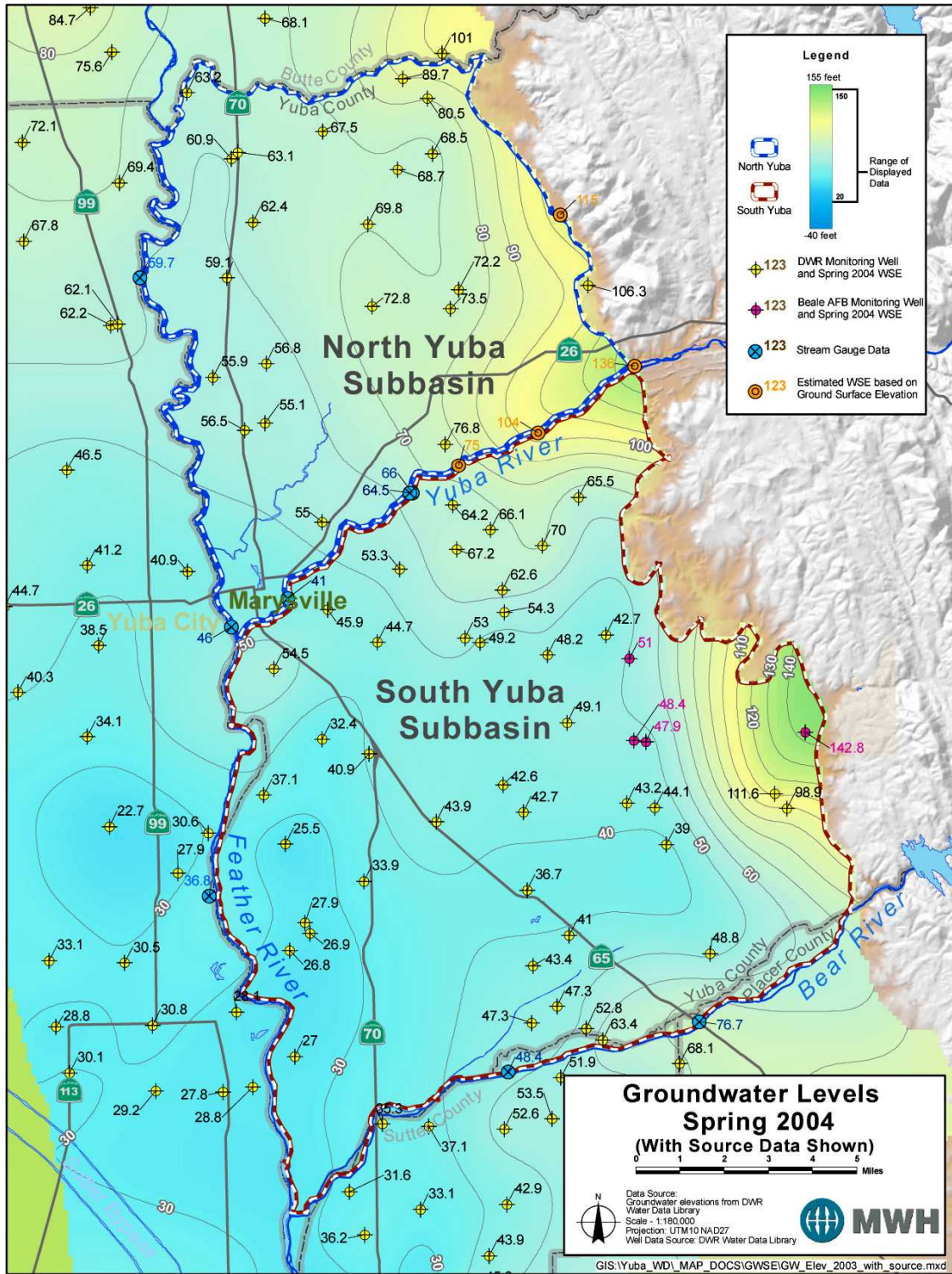
**Figure 3- Geologic Formations in the Yuba Basin**



### **Groundwater Flow Conditions, Recharge and Discharge Areas**

Groundwater occurs generally within unconfined conditions throughout most of the Yuba Basin. Well drillers' reports for deeper wells reported changes on water levels with depth. This suggests that groundwater is maybe confined by overlying clay layers causing groundwater flow to occur within confined layers. This condition probably occurs at depths exceeding 300 to 400 feet, in particular within the Laguna Formation. The general flow of groundwater in the Yuba Basin is from east to the west, beginning in the mountain front recharge regions, descending into the east. The hydraulic gradient dips steeply in eastern Yuba County and gradually flattens out toward the west. The cone of depression that has been created as a result of agricultural pumping has induced groundwater to flow toward its center (shown in blue on the contour map in Figure 4).

Figure 4- Groundwater Elevation Contour Map in the Yuba Basin



Note: WSE: Water surface elevation; AFB: Air Force Base

Recharge and discharge areas in the Yuba Basin are identified primarily based on the interpreted potentiometric surface of groundwater conditions, shown in Figure 4, from field data collected by DWR and YCWA during spring 2004 (MWH, 2005a). Yuba Basin is recharged naturally along the eastern mountain front, primarily near the Bear and Yuba rivers and to a lesser extent in the north where highly permeable, stream channel and floodplain deposits are present (MWH, 2005a).

The contour map of spring 2004 groundwater levels suggests that the western boundary of the Yuba Basin along the Feather River is a natural discharge area where the majority of water is leaving the basin. The potential for artificial recharge in the basin is limited since areas of available storage space typically have overlying soils with very low infiltration rates that would restrict recharge potential (Bookman-Edmonston Engineering Inc., 1992).

### **Groundwater Storage Conditions**

Estimated to a depth of 200 feet bgs, total groundwater storage capacity in the study area is approximately 2.7 million acre-feet (MAF) (MWH, 2005a). A portion of this storage is currently exercised for local groundwater use and some portion is vacant. Total volume of freshwater within the Yuba Basin is estimated to be 7.5 million acre-feet (MAF), by evaluating the storage characteristics of aquifer material occurring above the base of freshwater and below the spring 2004 groundwater surface (MWH, 2005a). The base of fresh water contour map in the Yuba Basin has been recently revised based on geophysical logs from California Division of Oil, Gas, and Geothermal Resources and DWR. MWH in coordination with DWR analyzed the exploratory drilling information to establish additional data points to improve the characterization of the base of freshwater in the Yuba Basin. The base of freshwater dips from 200 feet below mean sea level (msl) along the east side of the basin, to over 800 feet below msl along the west side of the basin.

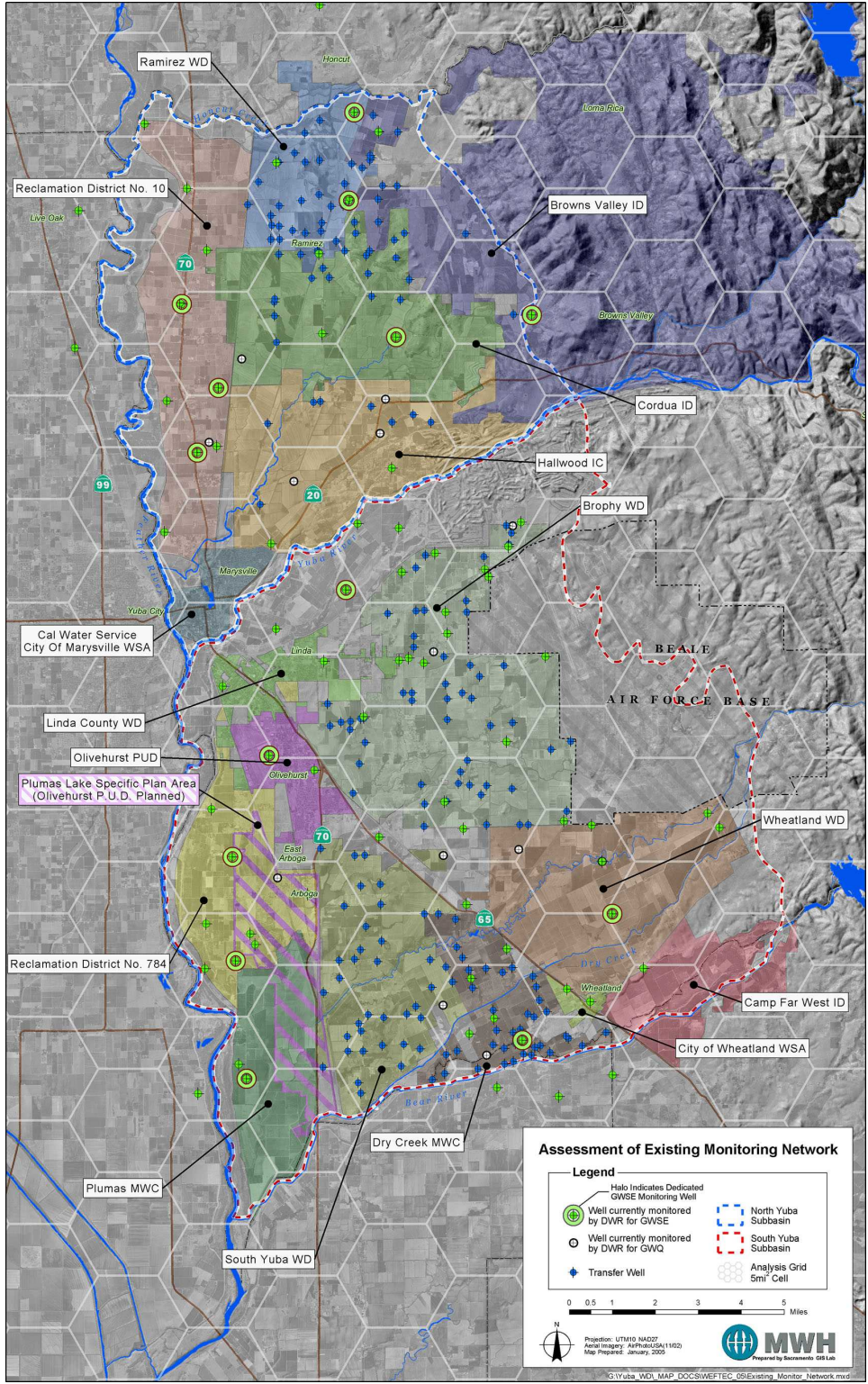
### **Groundwater Usage**

Historically, irrigation demands in the North Yuba Subbasin, except in Ramirez WD, have been sufficiently supplied with diversions from the Yuba River. Because of the historical surface water supply in the North Yuba Subbasin, this area has not been drawn down extensively. However, North Yuba Subbasin was historically significantly lower in storage than the pre-2001 transfer groundwater storage. After the late 1970's the storage of the basin increased, mainly due to the increased delivery of surface water in Ramirez WD and the wetter conditions that occurred at that time after a severe two-year drought from 1976 to 1977.

Conversely, in the South Yuba Subbasin, surface water supplies were limited and prior to surface water deliveries, agricultural and urban water uses in the South Yuba Subbasin relied heavily on groundwater supplies. This resulted in a well-developed cone of depression beneath the South Yuba Subbasin, most pronounced near the Wheatland WD service area. The delivery of surface water by YCWA to several of its Member Units, groundwater elevation has risen to above 1960-levels and is currently near the levels of the pre-development era. The exception is the Wheatland WD service area that continues to utilize groundwater for irrigation.



**Figure 5- DWR/YCWA Groundwater Monitoring Wells in the Yuba Basin**



Note: GWSE: Groundwater surface elevation; GWQ: Groundwater quality

## **Groundwater Wells and Well Yields**

Wells that are currently monitored by DWR and YCWA are shown in Figure 5. Currently active wells are utilized for the activities described below.

***YCWA Groundwater Transfer Program*** – There are approximately 200 production wells subscribed and operated by the Member Units. A subset of these wells is monitored by DWR and YCWA.

***DWR/YCWA Monitoring Program*** – Presently, there are approximately 75 production and dedicated monitoring wells included in this program. DWR, YCWA, and the Member Units monitor these wells. Of these, 17 wells are production wells that are monitored semi-annually by YCWA. The remaining 58 wells are monitored by DWR, either semi-annually or monthly (22 wells monitored semi-annually, 36 wells monthly) (see Figure 5).

***Domestic Pumping*** – A sub-set of domestic wells is monitored by the Member Units.

***Extraction and Monitoring by Municipalities*** – YCWA does not supply water for direct urban use. The five municipal purveyors Marysville, Olivehurst, Linda, Wheatland, and Beale AFB, all exclusively depend on groundwater for their municipal and industrial water supply. There are currently 33 production wells operated by the municipalities.

***Extraction and Monitoring by Beale Air Force Base (AFB)*** – There are both production and dedicated monitoring wells operated by Beale AFB. Detail on monitoring and measurement activities at the Beale AFB can be found elsewhere (CH2MHILL, 2004).

## **PAST AND CURRENT ACTIVITIES RELATED TO GROUNDWATER MANAGEMENT IN YUBA BASIN**

Knowledge on groundwater related activities taking place in the Yuba Basin are essential within the framework of active conjunctive use program. Below is an overview of past and current activities as they dictate YCWA's relationship to a variety of agencies with respect to groundwater management and monitoring plans.

### **Yuba River Development Project**

YCWA owns and operates the Yuba River Development Project, a multi-purpose project that provides hydroelectric generation, water supply, flood control, and instream flows for fisheries and recreation. The primary feature of this project is New Bullards Bar Dam and Reservoir on the Yuba River. This project is subject to numerous contracts, agreements, licenses, permits, and regulatory oversight from a wide range of organizations (e.g., Pacific Gas & Electric Company, the U.S. Army Corps of Engineers, the U.S. Forest Service, and DWR State Division of Safety of Dams, the Federal Energy Regulatory Commission, and the State Water Resources Control Board (SWRCB)). Among these, SWRCB Decision-1644 Interim Flow Schedule (adopted 3/2001) sets forth a schedule of minimum fish flows for the Project.

As part of county-wide conjunctive use operations, YCWA continues to utilize its water rights to regulate waters of the Yuba River in coordination with groundwater pumping activities. For diversion and use of waters within the Yuba River watershed, YCWA holds various water right permits and licenses for power, irrigation, domestic, and industrial uses in conjunction with the Project. YCWA's consumptive use water right permits total more than 1 MAF per year. The place of use for these rights is YCWA's service area, covering its Member Units' service areas and most of the agricultural land in Yuba County.

### **Yuba County Water Agency Transfer Program**

YCWA in cooperation with its Member Units participated in four groundwater transfers implemented in 1991, 1994, 2001, and 2002. In 1991 and 1994, YCWA transferred 82.3 and 26 thousand acre-feet (TAF) water, respectively, to the State to meet water demand during severe droughts. Figure 6 shows the total volume of groundwater pumped during these groundwater substitution years (the split of groundwater pumping during the 1994 transfer by the Member Units is unknown, thus not shown in Figure 6). Past groundwater transfers that YCWA has participated are listed in Table 1.

Utilizing the Yuba River Development Project, YCWA provides full or supplemental water supplies to water entities through its water rights and facilities on the Yuba River. During the past 11 years, YCWA has managed regional groundwater substitution transfers in cooperation with its Member Units, providing water to other parts of the State and generating revenue to fund YCWA's programs (Table 1). In 2001 and 2002, YCWA and its Member Units entered into a contract with the CALFED Bay-Delta Program Environmental Water Account (EWA) to transfer 62.2 and 57.2 TAF water.

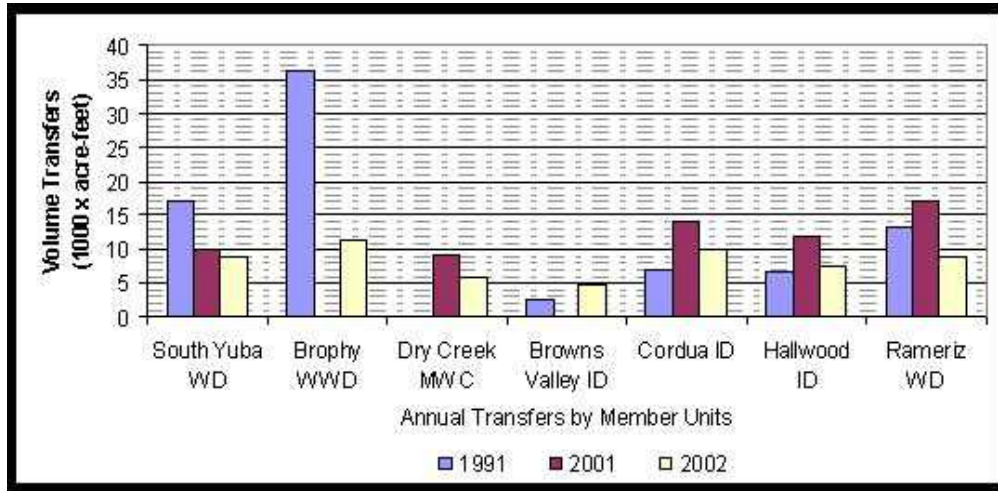
### **Conjunctive Use Pilot Project**

The objective of the Conjunctive Use Pilot Project (Pilot Project), as part of a comprehensive watershed and groundwater management in Yuba County, is to formalize a framework for a successful management of the County's water resources. More specifically, the Pilot Project will examine conjunctive use thoroughly to determine and define hydrologic, hydrogeologic, institutional, legal, managerial, and operational elements of coordinated conjunctive use program in Yuba County. With \$1.5 million in available funding under the Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act (Proposition 13), YCWA in cooperation with the funding agency DWR aims to formalize YCWA's water management operations and to regulate surface water resources in coordination with groundwater pumping activities. Under the Pilot Project, YCWA has undertaken three major activities that are of particular significance prior to the implementation of future groundwater activities: Groundwater Management Plan (GMP), Summary of Basin Conditions, and Measurement and Monitoring (M-M) Program. As described below, these activities are interrelated and have been on-going simultaneously.

***Groundwater Management Plan (GMP)*** – In recognition of the importance of groundwater management for the benefit of Yuba County and the State, YCWA has recently adopted its GMP (MWH, 2005b), in collaboration with a local water advisory committee, formed from representatives of local water purveyors (municipal and agricultural), the County Department of

Environmental Services, the County Agricultural Commissioner, Beale AFB and local interests.

**Figure 6- Volume of groundwater pumped by the Member Units in the Yuba Basin During 1991, 2001, and 2002**



**Table 1- Yuba County Water Agency Surface Water and Groundwater Transfers**

Year	Transferred to	Amount (acre-feet)		Total
		Surface Water	Groundwater Substitution	
1987	DWR	83,100	0	83,100
1988	DWR	135,000	0	135,000
1989	DWR for DFG	200,000	0	200,000
1989	East Bay Municipal Utility District (EBMUD)*	60,000	0	60,000
1989	City of Napa	7,000	0	7,000
1990	DWR	109,000	0	109,000
1990	City of Napa	6,700	0	6,700
1990	Tudor/Feather	2,951	0	2,951
1991	State Water Bank	99,200	84,840	184,040
1991	State Water Bank for DFG	28,000	0	28,000
1991	City of Napa	7,500	0	7,500
1992	State Water Bank	30,000	0	30,000
1994	DWR	0	26,033	26,033
1997	U.S. Bureau of Reclamation (refuge water)	20,000	0	20,000
1997	Sacramento Area Flood Control Agency	48,857	0	48,857
2001	Environmental Water Account (EWA)/ DWR	102,119	61,140	163,259
2002	EWA/DWR	101,792	55,258	157,050
2002	Contra Costa Water District	5,000	0	5,000
2003	EWA/DWR	65,000	0	65,000
2003	Contra Costa Water District	5,000	0	5,000

Source: Yuba County Water Agency

\* The contract with EBMUD was "take or pay." EBMUD did not take delivery of the water.

The purpose of the GMP is to formalize the historically successful management of Yuba County's groundwater resources and to develop a framework for implementation of future activities. GMP consists of a variety of components in achieving the GMP objective stated above. GPM fully complies with specific monitoring requirements documented in EWA Environmental Impact Statement/Environmental Impact Report (EIS/EIR) (Final report released in January 2005).

***Summary of Basin Conditions*** – This document summarizes the hydrogeologic conditions of the Yuba Basin, including groundwater levels (quantity), groundwater quality, and groundwater and surface water interactions (MWH, 2005a). The document reports the most recent available information on groundwater basin conditions such that individuals and agencies involved in managing groundwater for Yuba County are able to make informed decisions. Specific objectives in preparing the document include:

- To create a well construction and lithologic database
- To evaluate basin storage capacity and prepare graphical representations of the nature and distribution of groundwater producing zones and base of fresh water
- To evaluate historic groundwater elevations and groundwater substitution transfers
- To analyze and interpret historic and recent groundwater quality conditions across the Yuba basin

***Measurement and Monitoring (M-M) Program*** – The objective of this program is to report on current monitoring efforts throughout the basin and to determine if any enhancements are needed. To achieve these objectives, the monitoring program identifies four categories of measurement and monitoring activities that are required as outlined below:

- Groundwater storage and elevation
- Groundwater quality
- Inelastic subsidence
- Groundwater and surface water interaction

Through the implementation of the M-M Program, with respect to these four categories, YCWA will evaluate the adequacy of the existing monitoring well network and develop new wells where needed and appropriate. The objectives of the M-M Program are well integrated into the GMP such that data collection efforts through these four categories can be used as a guiding tool for planning and implementation of future groundwater activities to avoid potential adverse impacts on groundwater quantity and quality in the basin.

### **Sacramento Valley Water Management Program Short-Term Settlement Agreement**

SWRCB engaged in proceedings in 1996 to determine which water users would be responsible to meet water quality standards in the Sacramento-San Joaquin Delta, set forth by the 1994 Bay-Delta Accord. The Sacramento Valley Water Management Program Short-Term Settlement Agreement (Agreement), signed by more than 100 organizations including YCWA in April 2001, is a regional collaborative water rights settlement to provide water as a mechanism to

avoid the SWRCB hearing that would determine the responsibility of water users to meet water quality standards. YCWA, as a signatory to the Agreement, is committed to providing water for Bay-Delta quality needs while it continues to manage its water resources for local supply reliability and beneficial use within Yuba County. As required by the Agreement, YCWA is committed to supply 15,000 acre-feet to SWRCB. The M-M Program should be sufficiently flexible to accommodate the Agreement and associated monitoring and measurement requirements.

## **FUTURE ACTIVITIES RELATED TO GROUNDWATER MANAGEMENT IN YUBA BASIN**

Future activities discussed below are closely related to groundwater management practices in the Yuba Basin.

### **Yuba River Accord**

Since 2003, representatives of YCWA, South Yuba River Citizens League, and other fishing, environmental, agricultural, state, and federal organizations and agencies, have been engaged in an interest-based initiative to develop a science-based, consensus-oriented proposal known as the proposed Lower Yuba River Accord (Yuba Accord). Yuba Accord discussions focus on resolving issues associated with operation of the Yuba Project in a way that enhances Lower Yuba River fisheries, protects local water-supply reliability, provides revenues for local flood control projects, provides water for protection and restoration of Delta fisheries, and increases state-wide water supplies. Implementation of the Yuba Accord requires three major elements:

***Fishery Agreement*** – Under this agreement, YCWA would revise the operations of the Yuba Project, providing higher flows in the Lower Yuba River to protect and enhance fisheries and to increase downstream water supplies.

***Conjunctive Use Agreement*** – This agreement is between YCWA and water districts within Yuba County for the implementation of a comprehensive program of conjunctive use and water use efficiency. It is anticipated that Conjunctive Use Agreement will require the M-M program to assimilate monitoring and measurement regulations documented in EWA EIS/EIR.

***Long-term Transfer Agreement*** – This agreement involves YCWA, U.S. Bureau of Reclamation, and DWR to put water released from the Yuba Project to beneficial use for transfer of the enhanced lower Yuba River flows resulting from this agreement.

### **Yuba County Water Agency Transfer Program**

It is anticipated that groundwater demand in the basin will increase in part due to urban development, as adopted by the Yuba County Planning Commission and Yuba County Board of Supervisors, within the Plumas Lake, Olivehurst, and East Linda areas (see [http://www.yubacomdev.org/planning/specific\\_plans/](http://www.yubacomdev.org/planning/specific_plans/)). For example, in the Plumas Lake plan, approximately 5,000 acres of land are currently under development. In addition to urban development, other anticipated future activities discussed above, e.g., Yuba County Water

Agency Transfer Program, Yuba Accord, and Agreement, the groundwater transfer program may be exercised with greater frequency and/or larger quantities.

In the case of groundwater substitution transfers, YCWA participated in close monitoring of the groundwater basin, with the monitoring plan detailed in transfer contracts between DWR and YCWA. As stated in the EWA Final EIS/EIR released in January 2004, future groundwater transfers to the EWA require an established measurement and monitoring program for groundwater levels and storage, groundwater quality, land subsidence, and groundwater and surface water interactions (EWA, 2004). The M-M Program will likely serve as the monitoring plan for future transfer program activities and it should be sufficiently flexible to accommodate a variety of transfer scenarios and partners.

### **Future Expansion of Measurement and Monitoring Program**

YCWA has recently applied for funding offered by DWR through the Local Groundwater Assistance Act of 2000 for Fiscal Year 2004-2005. This act, also known as “AB303” (Assembly Bill 303), prioritizes grant funding to local agencies that have adopted a groundwater management plan and demonstrated collaboration with other agencies in the management of groundwater basin. YCWA’s grant application has requested funding for the development of six dedicated monitoring wells to supplement the existing well network and collect data at key locations throughout the basin (YCWA, 2004). Data collected from these wells will improve the basin understanding for future development of the next *Summary of Basin Conditions* report.

Table 2 shows a summary of the existing and proposed monitoring infrastructure in the Yuba Basin, by primary purposes and funding sources. Working with DWR, YCWA has determined that the current, immediate monitoring need is for greater geographic distribution of wells used to monitor groundwater surface elevations. In large part, additional groundwater elevation monitoring is needed because of YCWA’s plan to use groundwater substitution to meet its 15,000 acre-feet commitment to the Agreement, scheduled to begin in 2005. The monitoring network represented in Figure 7 provides information to assist YCWA and DWR in prioritizing the first set of wells to install. The six proposed monitoring wells (PMWs), PMW-1 through PMW-6 are believed to have the highest priority by YCWA and DWR towards building a more comprehensive monitoring network.

In addition to the six dedicated monitoring wells proposed, Figure 7 shows locations of 21 other wells proposed for future consideration. These wells would expand the knowledge of the hydrogeology of the basin and can be considered in the next phase of the development of the monitoring network in the Yuba Basin. Overall, the expanded monitoring network will provide the following benefits:

- To better monitor the localized effects of groundwater pumping on groundwater surface elevations.
- To observe groundwater elevations in response to conjunctive use activities to better understand the effects of various management strategies on overall basin storage.

- To observe groundwater elevations in areas regarded as recharge areas of the basin to better understand the rate of recharge and changes in the gradient of groundwater surface elevation.

**Table 2- Summary of Monitoring Infrastructure, by Primary Purpose and Funding Source**

	Well No.	Groundwater / Surface Water Interaction	Groundwater Elevations & Storage	Water Quality	Subsidence	General Basin Understanding
<b>YCWA Self-funded in 1995</b>	1		●			
	15		●			
<b>DWR Funded</b>	16	●	○			
	17	●	○			
<b>Local Groundwater Assistance Program Fiscal Year 2004-2005</b>	PMW 1		●		○	
	PMW 2		○		○	●
	PMW 3	●	○		○	
	PMW 4		●	○	○	
	PMW 5		●	○	○	
	PMW 6		●	○	○	
<b>Future Funding (various sources)</b>	PMW 7					
	.					
	.					
	PMW .					

\* This well is being developed next to an existing monitoring well at a depth of approx. 200 ft. greater than the existing well, thereby creating a multi-level completion well at that location, to further the basin level understanding.

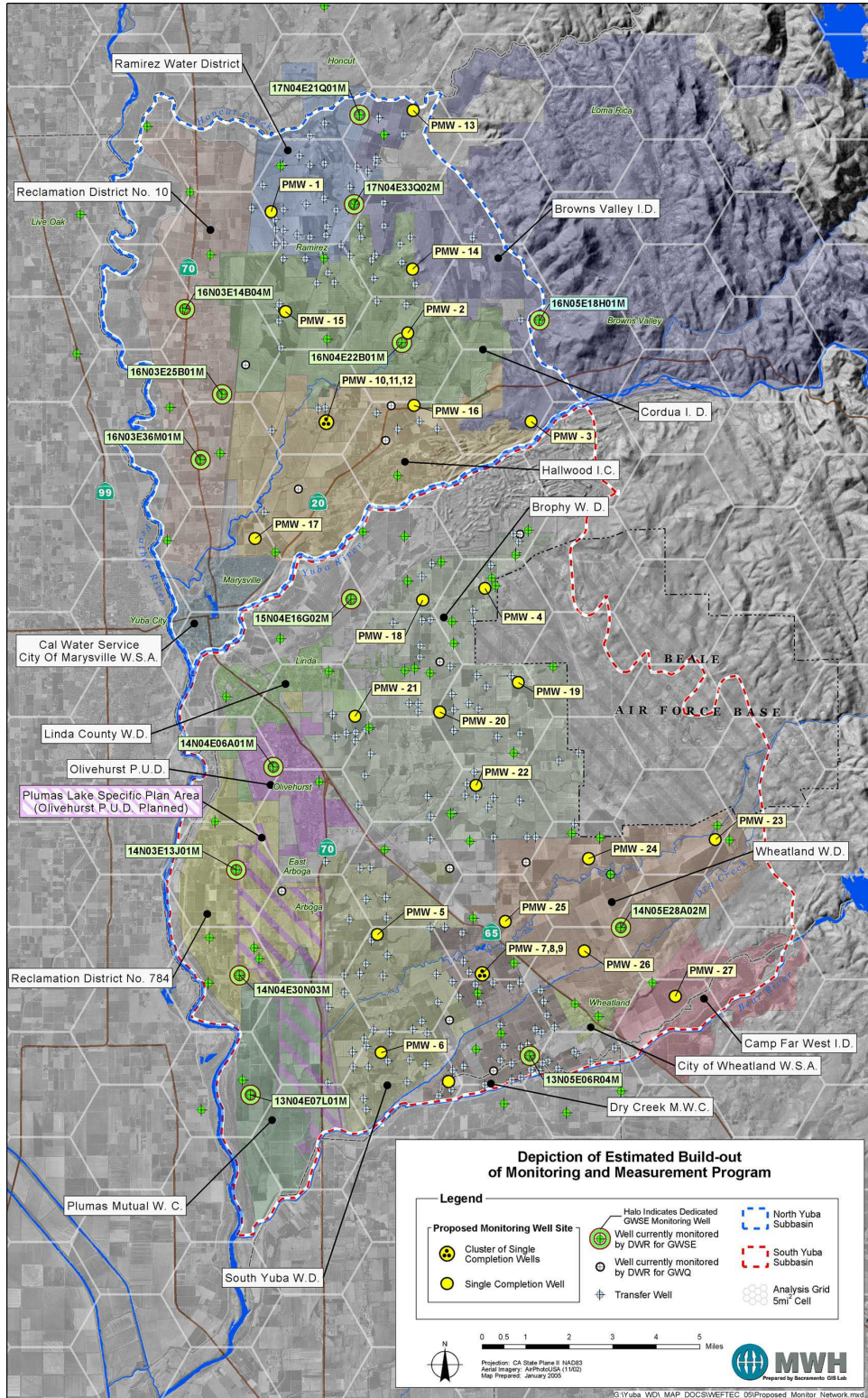
● Primary selection criteria for well location      PMW stands for Proposed Monitoring Well  
○ Other uses for well

- To better understand the relationship between the groundwater basin and the adjacent rivers
- To better understand the potential for land surface subsidence within the basin.
- To measure ambient water quality.

YCWA will implement an adaptive strategy for future development of the monitoring network: determining the future monitoring needs of the basin will depend in large part on information gathered from the proposed monitoring wells.



**Figure 7- Estimated Monitoring and Measurement Plan**



Note: GWSE: Groundwater surface elevation; GWQ: Groundwater quality

## CONCLUSION

Through the past groundwater management and resource use activities, YCWA has proven its leadership role in progressively embracing the concept of sustainable groundwater management. YCWA plans to seek opportunities to leverage state and federal resources to better characterize groundwater conditions in the Yuba Basin. Future resource management operations that will be implemented under the Yuba Accord will further demonstrate YCWA's dedication to providing a highly reliable local and statewide water supply. Management activities under GMP and M-M Program will be sufficient to accommodate the activities of the Yuba Accord. M-M Program, in particular, will provide valuable and necessary data to support management decisions as YCWA, its Member Units, and other water purveyors within the Yuba Basin work together toward building a comprehensive groundwater and surface water conjunctive use program.

## REFERENCES

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