GROUNDWATER STATUS AND MANAGEMENT PLAN

FOR

BUENA VISTA WATER STORAGE DISTRICT
Buttonwillow, California

September 9, 1997
Revised May 14, 2002

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GROUNDWATER STATUS AND MANAGEMENT PLAN
BUENA VISTA WATER STORAGE DISTRICT

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INTRODUCTION

Goal. It is the goal of Buena Vista Water Storage District to provide the landowners and water users of the District with a reliable, affordable, and usable surface and groundwater supply. In response to this goal, the District prepared a groundwater management plan as authorized by AB 255 in September 1997 to use as a guide in accomplishing this task. The District's Groundwater Status and Management Plan describes the District's plan to protect groundwater levels and quality in the present and over the long-term, keep groundwater use costs to a minimum, maintain groundwater control at the local level, document existing conditions, and initiate necessary programs and studies.

The years since the District's plan was completed have included two years of above normal hydrology (1997 and 1998) and three years of below normal hydrology (1999, 2000 and 2001). **The District, per Board Resolution No. 3832 (see Appendix H), has now prepared this update to the groundwater management plan to show current conditions and operations since the previous plan was completed. It is the District's goal to continue to facilitate programs that benefit and protect the groundwater basin.**

History. The Buena Vista Water Storage District lies in the trough of California's southern San Joaquin Valley as shown in Appendix A. The District lands are within a portion of the lower Kern River watershed, where historic runoff created the heavy clay soils from former swamp and overflow lands north of Buena Vista Lake. The area lies on the western side of the valley floor, about 16 miles west of the city of Bakersfield. It includes the former Buena Vista Lake Bed, now farmed by J.G. Boswell Company, and that portion of the swamp and overflow lands between the townsites of Tupman and Lost Hills. The unincorporated townsite of Buttonwillow (pop. 1500), being the hub of local farm activity, is situated in the geographical center of the project area. The District's water service area, which excludes the Buena Vista Lake lands, under jurisdiction of the Henry Miller Water District, contains 48,443 acres (49,057 assessed acres) of agricultural land. Approximately 45,000 acres of the District have been developed, and about 40,000 acres are annually farmed to field and row crops. The service area is physically divided into two distinct locations. The major portion situated north of Buena Vista Lake is known as the Buttonwillow service area. The much smaller area , east of Buena Vista Lake, is known as the Maples service area.

The area which the District now serves was originally developed by two former meat supply merchants from San Francisco, namely Henry Miller and Charles Lux. In the early 1870's, these two men joined forces and set out to build a cattle and sheep empire in the San Joaquin Valley. Extensive land holdings were acquired via the "Swamp and Overflow Act", the most productive Kern County portions of which are now within the Buena Vista Water Storage District. Miller and Lux's vast agricultural activities required farm help by way of tenant families many of whom immigrated from Italy. Surface water supplies diverted from the adjoining Kern River and from surface storage within Buena Vista Lake were used to develop lands north of and surrounding the lake, depending on its water levels.

Irrigation activities from the Kern River, in and around the Bakersfield area, were first undertaken during the late 1850's, when small private ditches diverted water for the irrigation of grains. As the upstream diversions increased, controversies over the water arose, which resulted in lengthy litigation between upper and lower river users. Much of today's California appropriative and riparian water rights law resulted from the Supreme Court's decision in the Lux vs. Haggin case. The ruling created what is now known as the "California Doctrine" which recognizes both riparian and appropriative water rights. Despite the court's decision, the dispute continued and was finally settled via the historic Miller-Haggin Agreement of July 28, 1888. This agreement, where both appropriative and riparian rights were recognized, continues to be the basis by which the flow of the Kern River is divided among "First and Second Point" interests. The "Second Point" interests, namely Miller and Lux, received about one-third of the river flows from March through August. A subsequent amendment also apportioned to Second Point some of the high runoff winter flows. The Second Point right equates to an average entitlement of about 158,000 acre-feet per year, delivered by First Point interests to Second Point of Measurement undiminished by delivery losses.

After the death of Henry Miller in 1916, Miller and Lux Land Company began selling much of their lands to the tenant farmers. Miller and Lux and the new landowners soon realized that a facilitator would be needed to represent the many vested interests of the water right. The Buena Vista Water Storage District was organized in July, 1924 and began operations following its 1927 Project Report. The Buena Vista project provided for the acquisition of the irrigation and drainage systems owned by Miller and Lux and for the distribution of the Second Point water rights that were tied to lands. The project also provided for added facilities to improve the distribution of the surface water supply. With completion of the District's 1927 project, the lands within the District were further developed for intensive agricultural use. Presently, the principal crops being produced are cotton, grain, sugar beets, and alfalfa. Cotton is by far the dominate crop, making up about 85% of the annual cropping pattern.

The main and lateral service canals provide surface deliveries from the higher east and west boundaries toward the center and to the north of the District. The District's topography naturally provided for drainage through the center of the District as the land surface falls to the north toward Tulare Lake via the historic low point slough which is now the Main Drain Canal, used to collect tailwater flows. Tail water flows are reclaimed by the District and its landowners with the remainder used north of the District for farming by separate agreement. Early in the area's agricultural development, Miller & Lux developed the Kern River Flood Channel to divert high flows destined for Tulare Lake and allow reclamation of what is now District lands. As land was developed for more intensive agricultural use, additional canals were incorporated into the distribution system to fulfill irrigation demands.

In 1973, the District contracted with the State Department of Water Resources (DWR) via the Kern County Water Agency (KCWA) for an additional surface water supply. The contract provided for an annual firm entitlement of 21,300 acre feet and surplus entitlement of 3,750 acre feet. The District currently has access to five turnouts from the California Aqueduct, that provide the system with about 850 cubic feet per second of added gravity inflow capacity directly into the District's distribution system. The District's geographic location, with respect to the California Aqueduct and other Kern County Water Agency member units, provides the opportunity for exchanges of the District's Kern River water for east side member unit's State water. The District has also been a historic user of surplus Friant-Kern Canal flows to serve irrigation demands and for groundwater recharge programs.

Even though District landowners are fortunate to possess valuable Kern River water rights and a State water contract, the average supply only provides for about two-thirds of their crop needs. The remaining demands are filled via landowner wells. Annual groundwater replenishment via District canal losses and intentional recharge serve to offset overall District pumping and thus maintain groundwater levels within the District. Over the 1962-2000 period, the District's operations have resulted in an annual positive groundwater balance of 44,500 acre-feet. Therefore, even though the southern San Joaquin Valley has been classified by the State Department of Water Resources as a critically overdrafted groundwater basin, this District has historically been able to achieve a positive groundwater balance. This District has also participated in groundwater banking programs, purchased other supplemental surface supplies, and developed irrigation tailwater recovery programs to insure its long term positive balance within the groundwater basin. The District also monitors both shallow and deep groundwater characteristics in an effort to better understand and manage this important groundwater resource. These efforts are described in the following sections.

Geology. The District, as is much of The San Joaquin Valley, has been filled with deposits of alluvial sediment from both the eastern Diablo coastal range and the western Sierra Nevada mountains. The Diablo range contributes marine sandstone and shale while the Sierra contributes granitic, sedimentary, and metamorphic rock. It is common for the top 0-10 feet of soil to be of the Lokern Series which is very clayish and poorly drained in nature. The formations below are coarse textured sediments in-laid with various thin clay layers. A predominant Corcoran Clay layer does not appear to divide the aquifer below, as in much of the San Joaquin Valley to the north. Thus the aquifer, below the District, reacts as a combination of an unconfined and semiconfined system.

MONITORING PROGRAMS

The landowners of the District have long realized the importance of their groundwater supply. District staff, as directed by the Board of Directors, began monitoring the groundwater as early as the 1940's. Today the District not only maintains explicit surface water delivery records, but comprehensive groundwater monitoring records as well. Both of these programs have progressed with new technologies as new concerns for our basin's protection materialize. The goal of groundwater monitoring is to identify the causes of and find solutions to increasing pumping depths, perched water tables, and groundwater quality degradation. Of course, pumping costs increase as the depth to groundwater increases. Crop yields suffer due to shallow, saline groundwater continually in the root zone. Crop yields also decrease as groundwater quality degrades. Table 1 shows water quality guidelines in relation to crop yield reductions. The cause and effect relationship of such groundwater and water quality parameters provides for better management decisions. Current District groundwater monitoring locations are shown in Appendix A.

Table 1. Guidelines for Water Quality

Water Quality Criteria	Degree of Problem		
	None	Increasing	Severe
Salinity			
EC (microS/cm)	< 750	750 - 3000	>3000
TDS (mg/L)	< 450	450 - 1800	> 1800
Permeability			
EC (microS/cm)	> 500	500 - 200	< 200
TDS (mg/L)	> 360	360 - 120	<120
Specific Toxicity			
Sodium (adj SAR)	< 3	3 - 9	> 9
Boron (mg/L)	< 0.75	0.75 - 2.0	> 2.0

From Ayers and Westcot, 1976

Production Well Surveys. The District currently measures the water levels in 57 of more than 200 grower and district production wells quarterly. Water quality samples are taken from these wells for irrigation constituent analysis when possible. These analyses indicate the levels of the constituents shown in Table 1 as well as many other vital indicators. All 200 of the wells within the District are monitored and classified every five years. Recorded data includes well location, state of use, depth to water, and any available pumping equipment physical characteristics.

Monitor Wells. Currently there are 19 designated monitoring wells throughout the District (locations shown on map in Appendix A). All of the monitor wells are measured for water levels quarterly and pumped to obtain samples for irrigation analysis semiannually.

Shallow Piezometers. The District, in conjunction with the Department of Water Resources (DWR), has also installed 104 shallow piezometers, designed to assist in monitoring the shallow groundwater table within the northern portion of the District (locations shown on map in Appendix A). These 20 foot deep completely perforated wells measure the groundwater found in the upper zone of the soil profile. They are measured for water levels quarterly and for salinity levels annually by means of a down-the-hole electroconductivity meter. This data provides the information needed to plot shallow groundwater level contours to denote annual fluctuations as well as changes over time for both water levels and groundwater quality.

Crop Surveys. Crop surveys provide data so that water demands can be better quantified. For that reason District staff annually produce crop survey maps. These maps are compiled in numerical spreadsheets so that total specific crop acreage can be calculated. Crop data are then graphically plotted. Figure 1 shows how cropping patterns have gradually changed over the past 40 years. A specific tabulation by type of crop is included as Table 2. Alfalfa acreage has remained fairly consistent over the period, while cotton acreage has increased by roughly 85% and grain acreage has decreased by about 60%.

In the last few years, there has been a decline in total cropped acreage as well as a slight increase in grain acreage and decrease in cotton acreage. Sugar beets were fairly consistent over the long term, but the acreage has dropped considerably over the last 5 years. However, cotton is still one of the most valued crops farmed in the District, accounting for about 31,000 of the 40,000 farmed acres, or 78% of total crop acreage, over the last 10 years.

TABLE 2

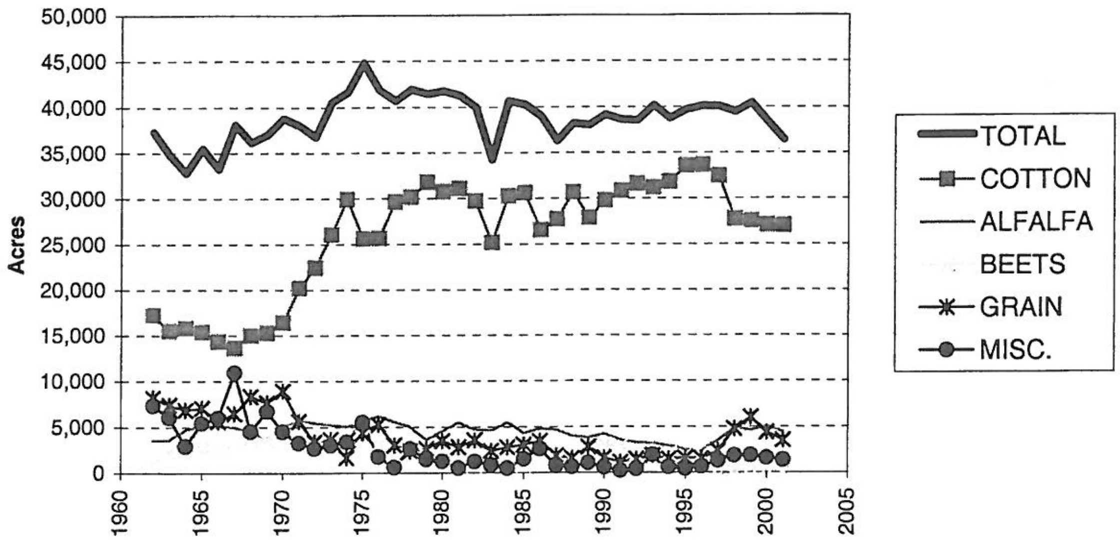
BUENA VISTA WATER STORAGE DISTRICT
HISTORIC CROP PATTERN AND
ESTIMATED CONSUMPTIVE USE OF WATER

YEAR	HISTORIC CROP PATTERN						ESTIMATED CROP CONSUMPTIVE USE	
	COTTON (ACRES)	ALFALFA (ACRES)	BEETS (ACRES)	GRAIN (ACRES)	MISC. (ACRES)	TOTAL (ACRES)	TOTAL (AF)	UNIT (1) (AF/AC.)
1962	17,251	3,555	983	8,173	7,337	37,299	92,000	2.47
1963	15,483	3,571	2,305	7,397	6,043	34,799	86,000	2.47
1964	15,797	4,699	2,512	6,867	2,931	32,806	84,000	2.56
1965	15,392	5,117	2,458	7,069	5,439	35,475	91,000	2.57
1966	14,324	5,087	2,240	5,628	6,006	33,285	87,000	2.61
1967	13,685	5,000	2,045	6,454	10,911	38,095	98,000	2.57
1968	14,995	4,528	3,760	8,323	4,548	36,154	90,000	2.49
1969	15,302	3,769	3,577	7,658	6,713	37,019	91,000	2.46
1970	16,404	5,026	3,932	8,922	4,498	38,782	97,000	2.50
1971	20,198	5,765	3,148	5,628	3,256	37,995	100,000	2.63
1972	22,408	5,466	2,842	3,373	2,679	36,768	99,000	2.69
1973	26,051	5,235	2,628	3,647	3,039	40,600	108,000	2.66
1974	29,908	5,061	1,664	1,634	3,383	41,650	114,000	2.74
1975	25,612	5,433	3,848	4,371	5,521	44,785	118,000	2.63
1976	25,643	6,172	3,020	5,258	1,757	41,850	111,000	2.65
1977	29,630	5,545	1,916	3,018	583	40,692	111,000	2.73
1978	30,165	5,030	1,700	2,383	2,646	41,924	114,000	2.72
1979	31,781	3,573	1,965	2,629	1,461	41,409	110,000	2.66
1980	30,760	4,574	1,700	3,462	1,261	41,757	111,000	2.66
1981	31,063	5,485	1,362	2,802	543	41,255	112,000	2.71
1982	29,728	4,706	803	3,533	1,220	39,990	107,000	2.68
1983	25,163	4,600	1,261	2,383	851	34,258	93,000	2.71
1984	30,288	5,476	1,599	2,788	504	40,655	111,000	2.73
1985	30,599	4,310	795	3,070	1,508	40,282	108,000	2.68
1986	26,530	4,818	1,609	3,435	2,611	39,003	104,000	2.67
1987	27,715	4,685	1,317	1,861	726	36,304	99,000	2.73
1988	30,649	4,023	1,307	1,593	625	38,197	104,000	2.72
1989	27,865	3,840	2,454	2,807	1,046	38,012	101,000	2.66
1990	29,766	4,216	2,974	1,610	572	39,138	106,000	2.71
1991	30,827	3,593	2,857	1,121	208	38,606	104,000	2.69
1992	31,602	3,259	1,884	1,433	377	38,555	104,000	2.70
1993	31,153	3,208	2,062	1,906	1,925	40,254	107,000	2.66
1994	31,799	2,908	2,037	1,491	526	38,761	103,000	2.66
1995	33,569	2,484	1,644	1,726	424	39,847	106,000	2.66
1996	33,784	2,306	1,891	1,899	1,078	40,958	108,000	2.64
1997	32,335	3,558	485	2,389	1,360	40,127	108,000	2.69
1998	27,462	5,097	301	4,731	3,157	40,748	109,000	2.67
1999	27,509	4,655	456	5,998	1,919	40,537	106,000	2.61
2000	26,765	5,069	389	4,591	1,579	38,393	103,000	2.68
2001	26,990	4,417	65	3,701	1,459	36,632	98,000	2.68
AVG:								
1962-2000	25,819	4,474	1,993	3,976	2,635	38,898	103,000	2.65
1991-2000	30,681	3,614	1,401	2,729	1,255	39,679	106,000	2.67

NOTE:

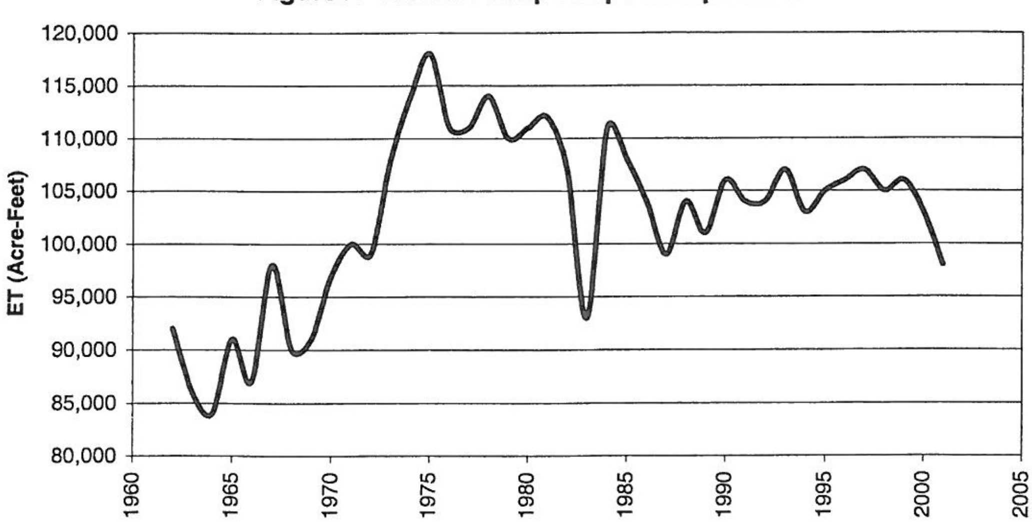
1. Average annual crop consumptive use of water estimated as follows: Cotton - 31.59 inches; Alfalfa - 48.54 inches; Beets - 26.01 inches; Grain - 17.88 inches; Misc. - 30.00 inches.

Figure 1 - BVWSD Cropping Patterns



This cropping data, when combined with local evapotranspiration (ET), is used to determine annual cropping consumptive use amounts. Evapotranspiration (ET) is simply defined as the amount of water that the plant uses for growth (transpiration) and the amount of evaporation from the plant and soil surfaces. The ET values used are average southern San Joaquin Valley values supplied by the Mobile Irrigation Lab and the State Department of Agriculture, Cooperative Extension Service. Total annual ET's for the District are shown in Figure 2. Total crop water demands peaked in the mid 1970's averaging

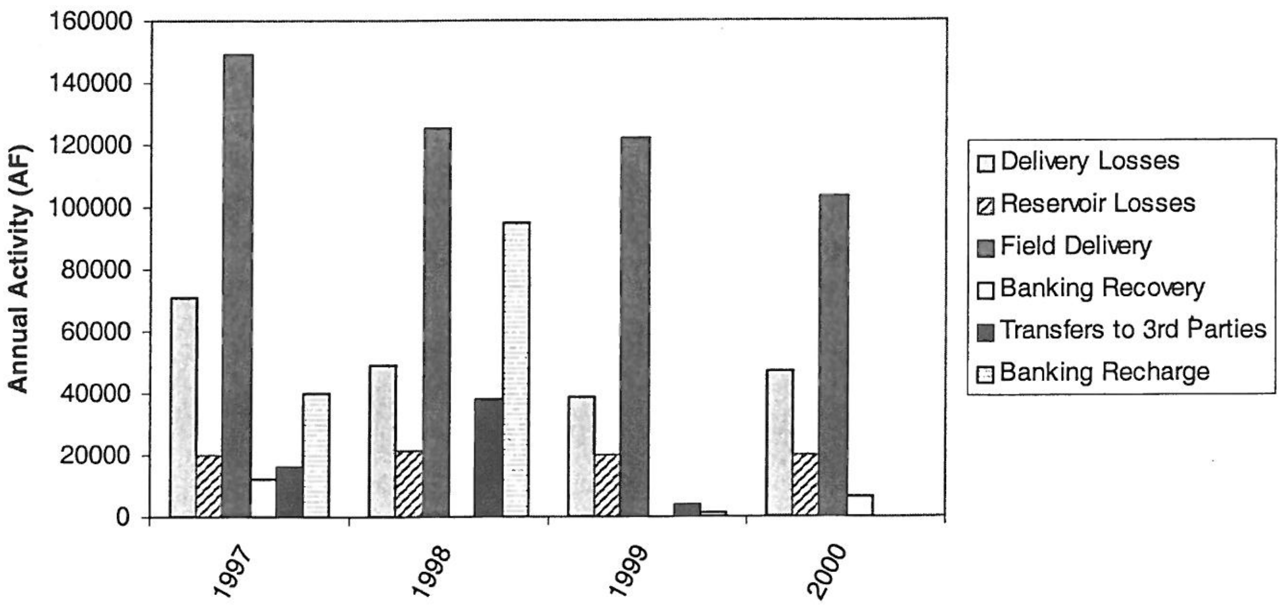
Figure 2 - BVWSD Crop Evapotranspiration



approximately 113,000 acre-feet. However, in the past ten years, total crop demand (ET) has declined to approximately 105,000 acre-feet per year. The ET for 2001 was less than 100,000 acre-feet due to decreased overall cropped acreage.

Surface Delivery Records. In part, surface delivery records are kept so that actual field delivery use can be known. With field delivery data and crop ET data, the estimated pumping, or net extraction from the basin, can be determined. The District's Hydrography Department maintains detailed surface delivery records that show how each acre-foot of District water is utilized. These uses include irrigation, canal losses, intentional recharge, reservoir losses, third party sales, and banking programs. Figure 3 shows an annual breakdown by use for the years 1997 through 2000. The table included in Appendix B shows the breakdown of total District deliveries and utilization.

Figure 3
BVWSD Operations (1997-2000)



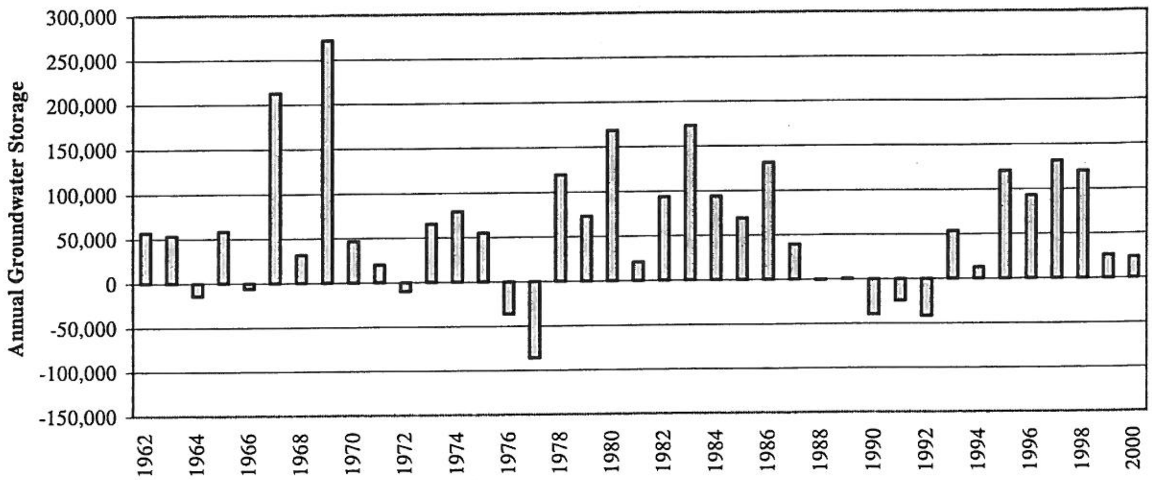
GROUNDWATER STUDIES

Since District groundwater supplies are vital in preserving the Landowner's agricultural interests, groundwater data review is integral to District water management practices. Groundwater balance studies (evaluating overdraft), groundwater depth and quality surveys, and consumptive use projections are a few of the tools used by District staff in making water management decisions.

Groundwater Balance Study. A groundwater balance, reflecting groundwater inflows and outflows (puts and takes) over time, was performed for the District's operations over the 1962-2000 period as shown in Table 3. The "SUPPLY" portion represents all flows such as irrigation deliveries, canal seepage, safe yield, reservoir losses, and intentional groundwater recharge. The District surface supplies and safe yield provide an average of 176,000 acre-feet annually. The "USAGE" portion represents the usage of the District's supplies including evapotranspiration, canal and spreading pond evaporation, spill to north of Highway 46, and water sent to third party groundwater accounts. Third party groundwater accounts include bank accounts for West Kern Water District, in which 95% of the West Kern deliveries to Buena Vista are accounted, and other exportable groundwater accounts, including preconsolidation water.

The difference between the "SUPPLY" and "USAGE" totals represents the annual groundwater balance. During the study period, a period of 112% of the long-term Kern River Index, the District's operations have resulted in an increase in storage of approximately 44,500 acre-feet per year in the groundwater basin. Looking at other periods of near normal hydrology, the resulting increase in storage ranged from about 25,000 to 32,000 acre-feet per year. It is also important to note that Buena Vista has maintained substantial groundwater bank account balances, in the 2800 Acres, Pioneer Project and ID#4, which are not accounted for in this groundwater balance tabulation. These bank accounts are used to fill water supply shortfalls and to provide added peaking capacity during dry years.

Figure 4 - Annual Groundwater Balance



The resultant annual groundwater basin "puts" and "takes" are shown in Figure 4. Using consumptive use calculations, from the crop mapping data and annual surface deliveries, an estimated average of 35,000 acre-feet of groundwater is extracted each year. To compensate for the leaching requirement and irrigation efficiency, the irrigation requirement is assumed to be 130% of the total evapotranspiration requirement.

Water Levels. The water level discussion is divided into 1) shallow zone (based on piezometer measurements), and 2) pumping zone (based on water supply wells and deep monitor wells). First, the shallow zone is discussed, followed by the pumping zone. In each part, the order of the discussion is as follows:

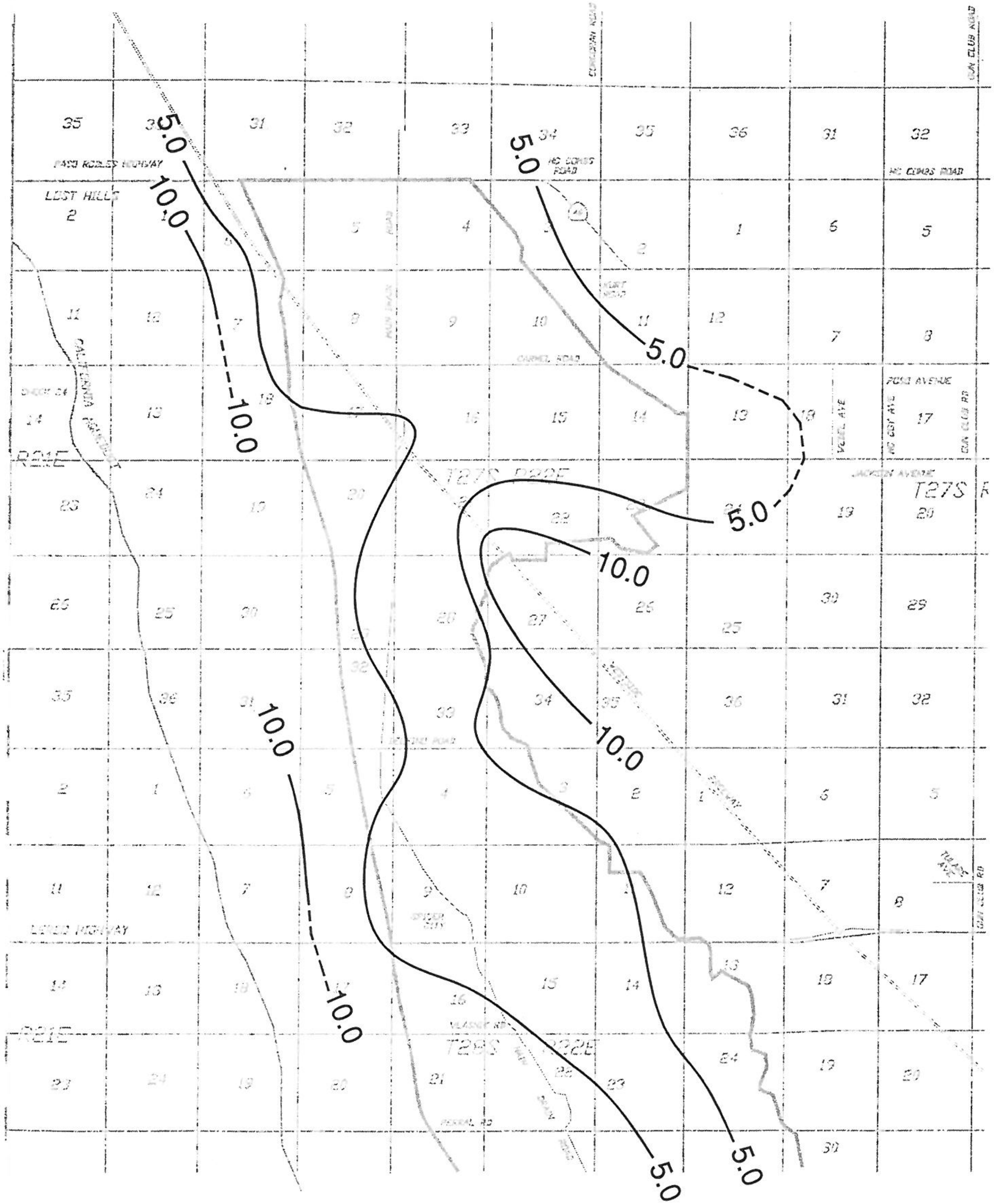
1. Depth to water.
2. Groundwater level elevations and the direction of groundwater flow.
3. Water level hydrographs.

Shallow Zone

Figure 5 is a depth to water map for the shallow zone in the north part of the District for March 2001. This map indicates that shallow groundwater was less than 10 feet deep beneath most of the District north of Perral Road. Depth to shallow

FIGURE 5

Depth to Groundwater
March 2001



groundwater was less than five feet beneath much of this area. Depth to the shallow groundwater generally increased to the west and east of the District.

Figure 6 shows water-level elevations and the direction of shallow groundwater flow in March 2001. Water-level elevations were generally highest (exceeding 240 feet) beneath the south part of this area, and were lowest (less than 230 feet) near the north boundary. The direction of shallow groundwater flow was generally to the north.

Appendix C contains water-level hydrographs for the shallow piezometers in this area. The period of record for most of these wells extends back to 1991. Water levels in the piezometers respond to irrigation, and generally rise during the irrigation season and fall after irrigation deliveries cease. Several patterns are evident. The following piezometers had relatively constant (i.e., not rising or falling) water levels during this period: No. 5, 8C, 10A, and Bel 3A. All of these are in the north part of the shallow groundwater area. The following piezometers had rising water levels during this period:

No. 17A, 27, 29, and Bel 15B. All of these are in the south half of the shallow groundwater area. The following piezometers had falling water levels during this period:

No. 2A, and GL No. 9. One of these wells (2A) was near the northwest corner of the District, and the other was east of the District in the Semitropic WSD.

The predominant water-level trend during the past decade for the shallow piezometers has been relatively stable levels beneath the north part of the shallow groundwater area, and rising water levels beneath the south part.

<u>Pumping Zone</u>

Figure 7 shows depth to water in wells tapping the pumping zone in March 2001. Depth to water generally was the least beneath the north part of the District, in the same area where shallow groundwater is present in the piezometers. Depth to water in deep wells was generally less than 20 feet deep in most of this area. South of Seventh Standard Road, depth to water increased to the southeast, from less than 30 to more than 100 feet. This increasing depth coincides with areas where more groundwater is pumped, which is largely where better quality groundwater is present.

Figure 8 shows groundwater level elevations and the direction of groundwater flow in the pumped zone in March 2001. A water-level high was indicated beneath part

FIGURE 6

Groundwater Elevations & Direction of Groundwater Flow March 2001

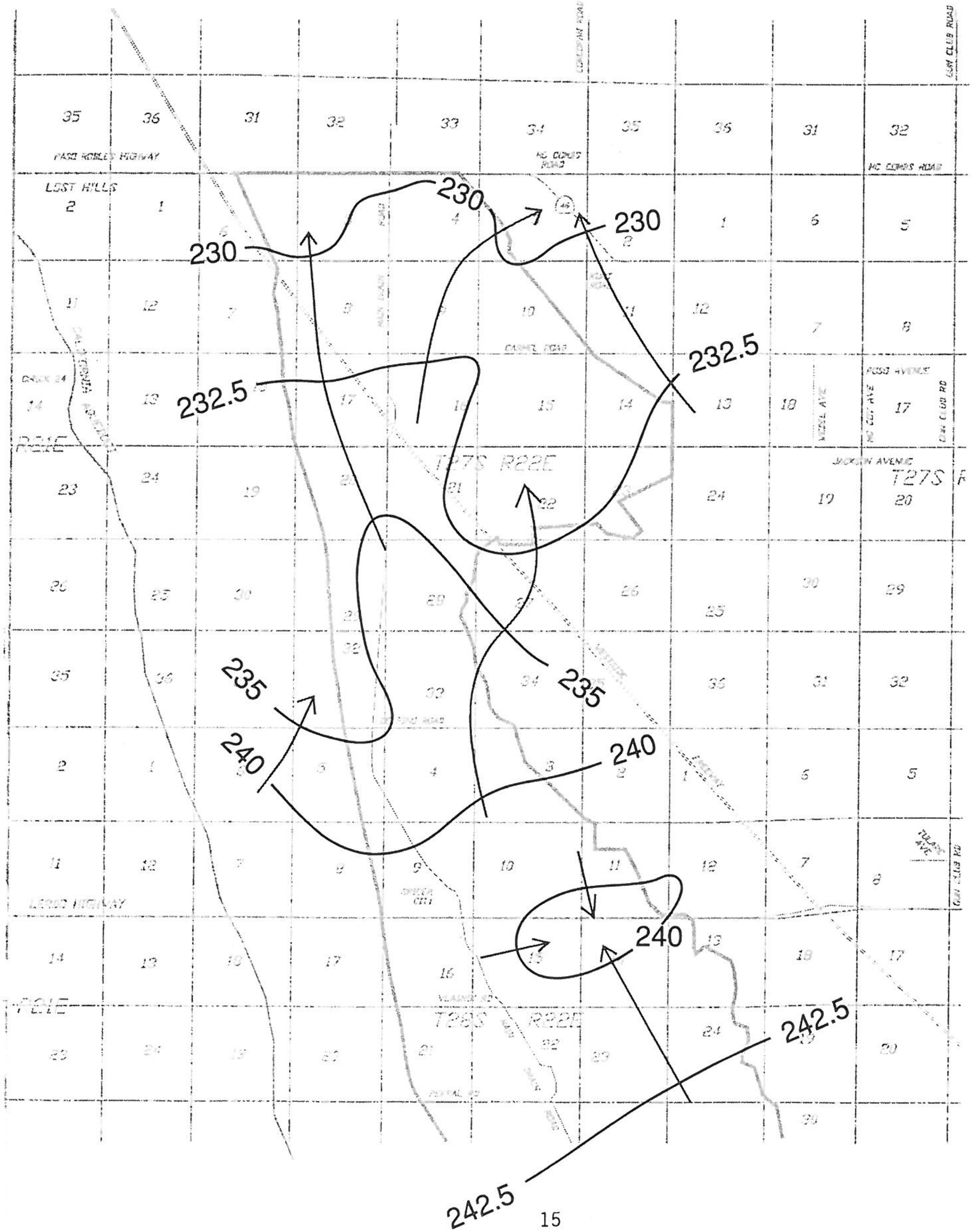


FIGURE 7

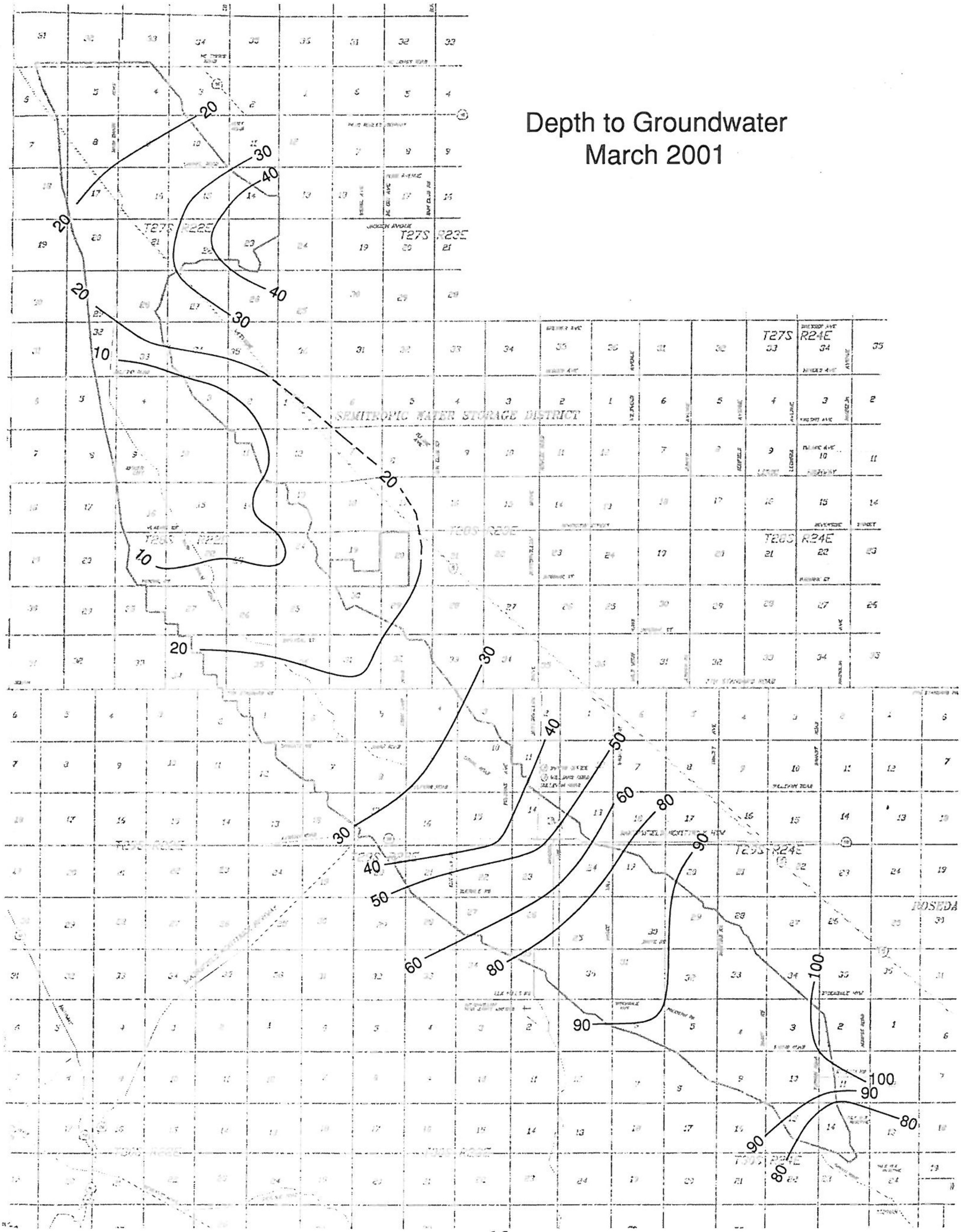
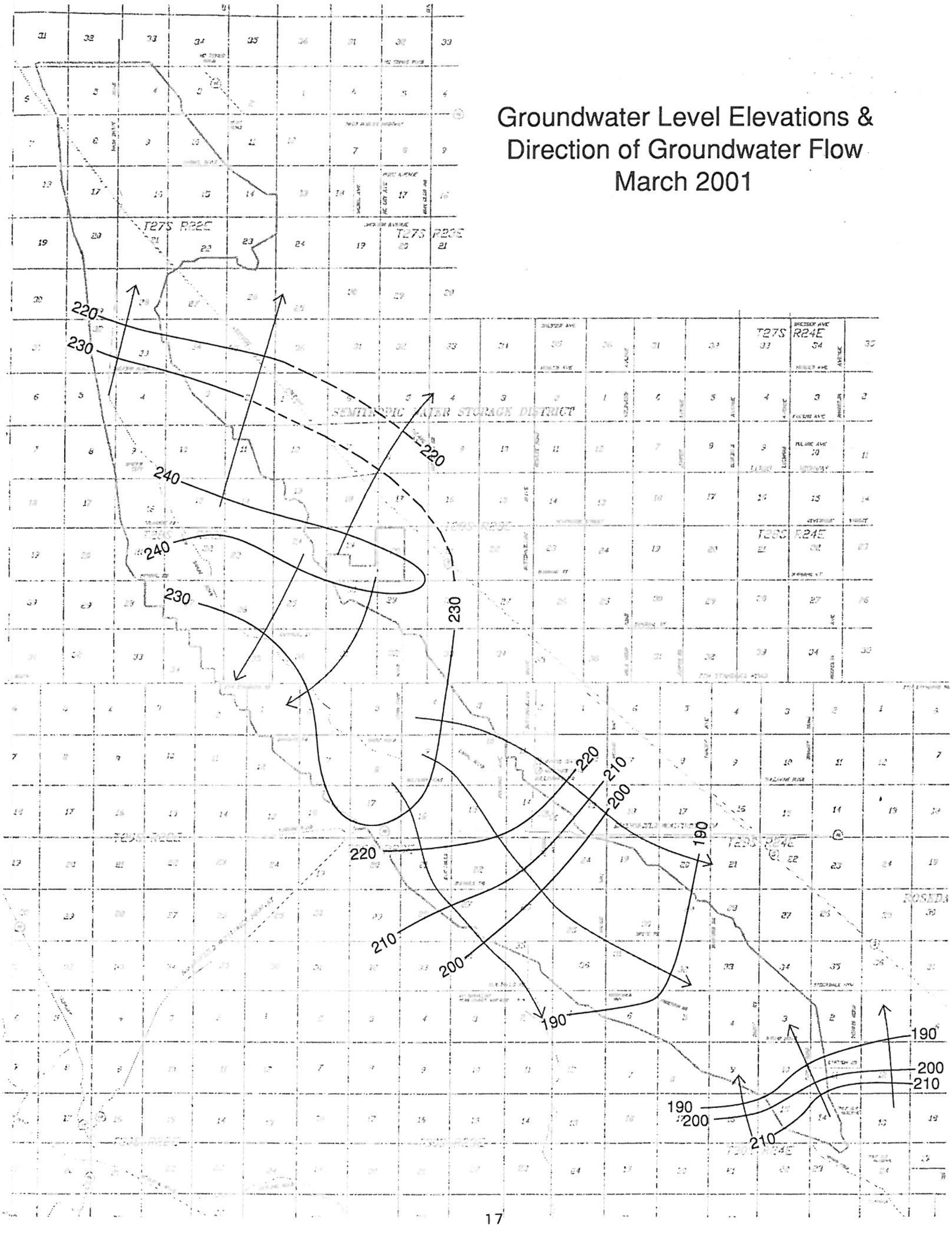

Depth to Groundwater
March 2001
T27S R22E
T27S R23E
T27S R24E
T28S R22E
T28S R23E
T28S R24E
T29S R24E
SEMITROPIC WATER STORAGE DISTRICT
POSEDA
20
30
40
10
50
60
80
90
100

FIGURE 8


Groundwater Level Elevations &
Direction of Groundwater Flow
March 2001
T27S R22E
T27S R23E
T27S R24E
T28S R24E
SEMITROPIC WATER STORAGE DISTRICT
220
230
240
240
230
220
230
220
210
200
190
190
220
210
200
190
200
210
210

of the shallow groundwater area, and groundwater moved mainly to the north-northeast and south-southwest from this high. Water-level elevations for deep wells exceeded 240 feet in this area. Groundwater was flowing out of the District to the northeast and the southwest from this high. In contrast, a water-level depression was present near and south of Stockdale Highway. Water-level elevations in deep wells in this area were less than 190 feet, and groundwater flowed toward this depression from the northwest and southeast. Groundwater was flowing into the District from the south in this area.

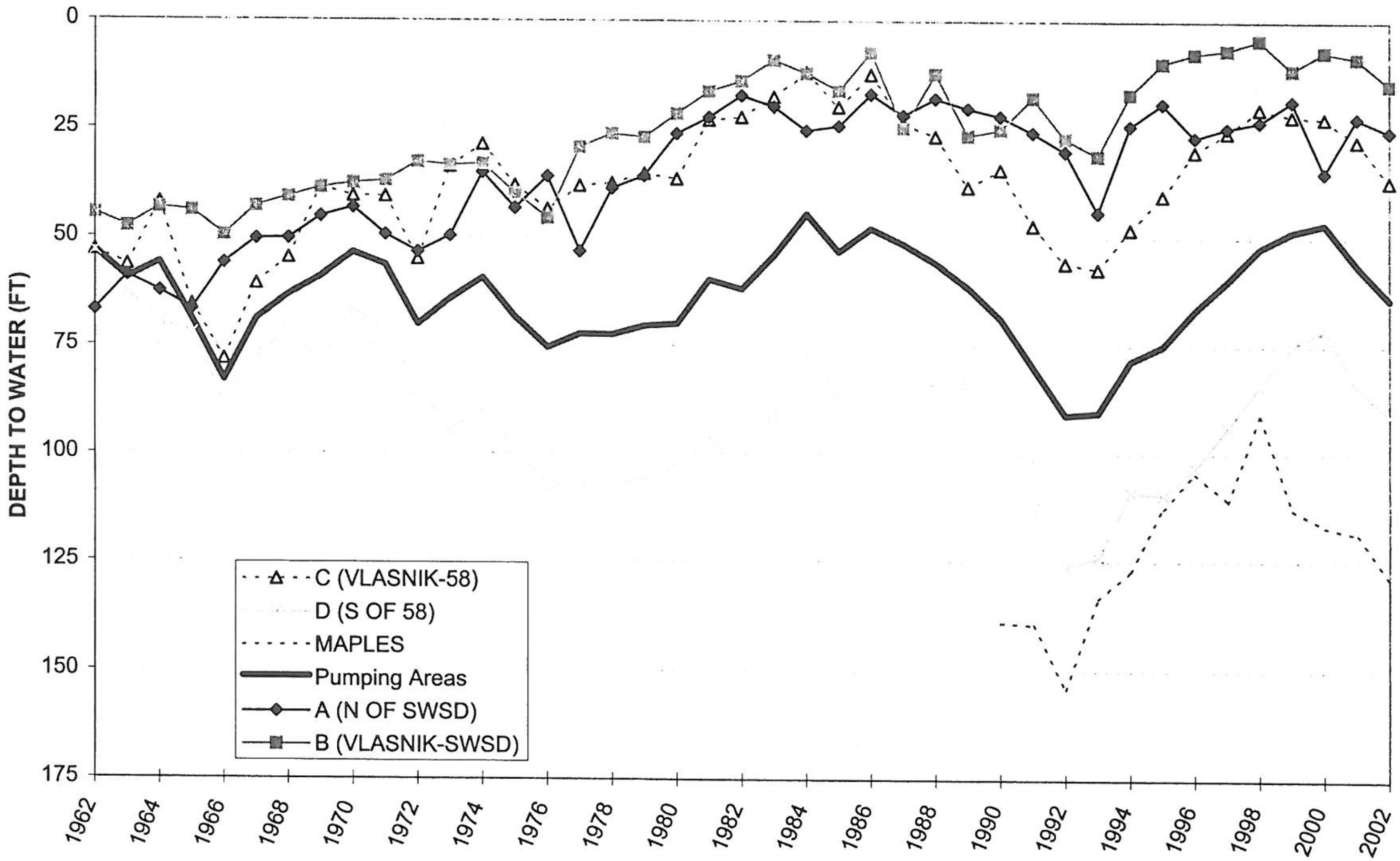
Appendix D contains water-level hydrographs for 24 wells tapping the pumped zone. Most of these extend back to the early 1990s. Figure 9 contains six water-level hydrographs representative of the last four decades. Two major different types are indicated. For Areas A, B, and C, which are in the north part of the District, water levels are shallower, and much less seasonal fluctuation is present. Deep wells in these areas had rising water levels between 1962 and about 1983. Water levels in those wells temporarily fell between 1986 and 1993, coincident with the last major drought. Water levels in these deep wells then recovered between 1993 and 1998, and have been relatively constant since 1998. Water levels in these wells have thus been somewhat influenced by pumping, much of which is either east or south of the northerly area.

Three of the hydrographs (Area D, Maples, and a composite of the pumping areas) generally show a greater depth to water and more fluctuations than the other areas. These hydrographs are representative of the south part of the District. Depth to water was about the same (between about 40 and 65 feet) in all of these areas in 1962, but diverged widely after the mid 1970s. The deepest water levels and greatest water-level declines have been in Area D and the Maples area, because there is more pumping in these areas. Overall, water levels in the south part of the District have been relatively stable since the early 1960s. They have risen during wet periods and fallen during dry periods. The water-level hydrographs do not indicate any groundwater overdraft in the District over the past several years.

Groundwater Quality. Shallow groundwater quality is first discussed, and this is followed by the quality of groundwater in the pumping zone. In each part, the area

FIGURE 9

WATER LEVEL HYDROGRAPH
In BVWSD Production Wells (Spring)



distribution of total dissolved solids (TDS) is discussed first. The changes in groundwater TDS with time are discussed.

Shallow Zone

Figure 10 shows TDS contours for July 2001, based on water samples bailed from the shallow piezometers. The lowest TDS concentrations (less than 1,000 mg/l) were present largely within the District. There were two areas within this larger area where TDS concentrations were less than 1,000 mg/l. TDS concentrations in the shallow groundwater increased to the west and east of the District, and to the south in the area south of Lerdo Highway. Much of the shallow groundwater to the west and the east of the District had TDS concentrations exceeding 4,000 mg/l. The highest TDS concentrations exceeded 10,000 mg/l, and were in shallow groundwater near the northeast corner of the District.

Appendix E contains ten TDS hydrographs for piezometers, generally extending from about 1991 through 2001. Two different trends are shown. The following piezometers had significant increases in TDS concentrations over the period of record: No. 2A, 5, and 17A. All of these piezometers are in the north part of the area. The remaining seven piezometers generally had a relatively constant trend, although No. 10A and 29 showed some increase in TDS concentrations. Many of the TDS values for the piezometers exhibit a very large range. This large variation makes determination of time trends difficult. This is likely due to the small size of the sample being measured. More representative trends could be obtained by pumping the piezometers with a hand pump until electrical conductivity values stabilize. Also, laboratory analyses should be used for TDS concentrations, as opposed to field meter readings, or EC values should be reported.

Pumped Zone

Figure 11 shows TDS concentrations in water from wells tapping the pumped zone. North of Seventh Standard Road, TDS concentrations were lowest (less than 1,000 mg/l), and highest (greater than 2,000 mg/l) to the northwest and far southwest corner (greater than 3,000 mg/l). South of Seventh Standard Road, TDS concentrations were highest to the northwest and lowest to the east.

FIGURE 10

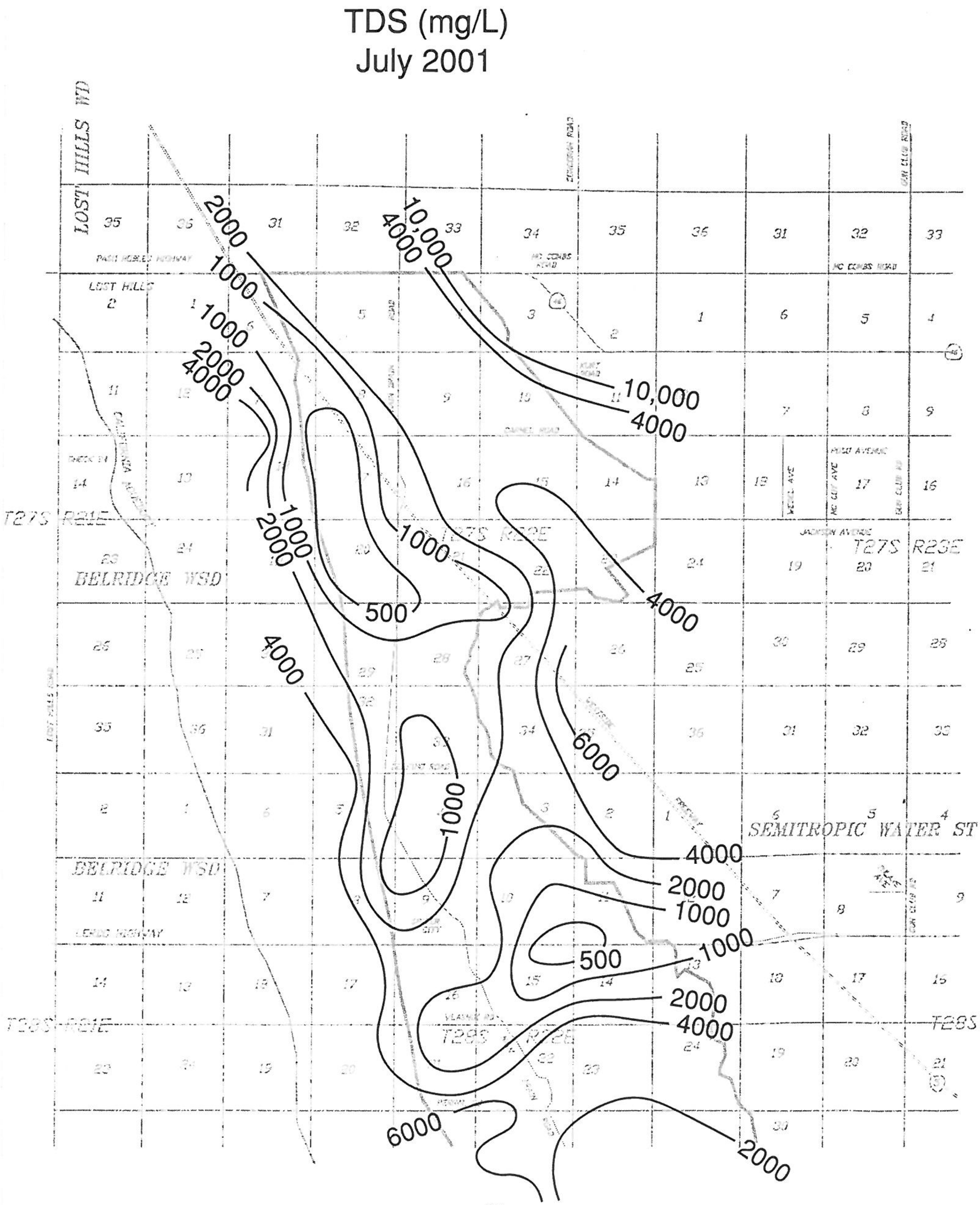

TDS (mg/L)
July 2001
LOST HILLS WD
BELRIDGE WSD
SEMITROPIC WATER ST
T27S R21E
T27S R22E
T27S R23E
T28S R21E
T28S R22E
T28S
10,000
4000
2000
1000
500
6000

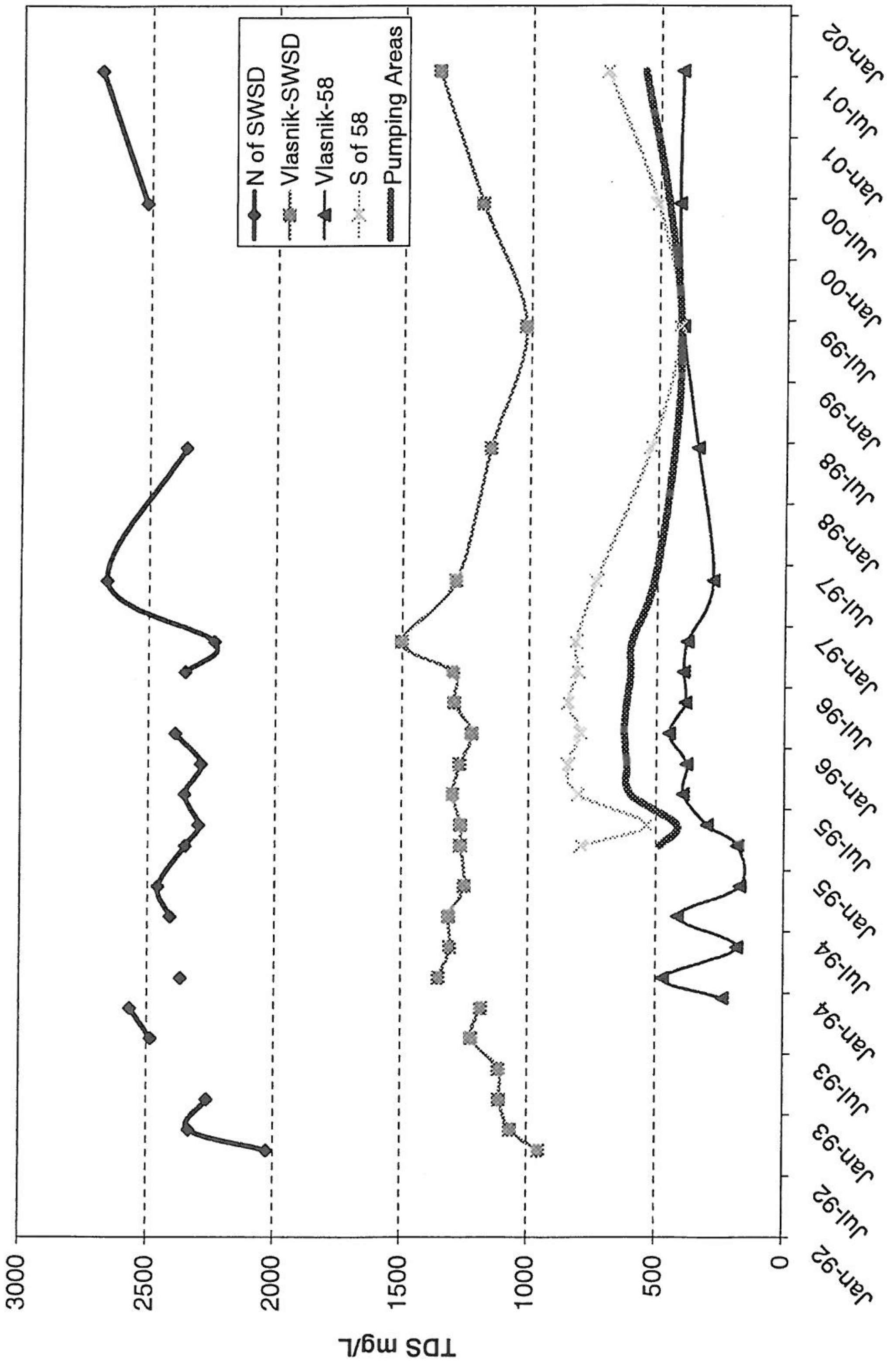
FIGURE 11


TDS (mg/L)
Summer 2001
2000
1000
3000
T27S R22E
T27S R23E
T27S R24E
SEMITROPIC WATER STORAGE DISTRICT
T28S R24E
T29S R24E

Figure 12 shows average TDS hydrographs for selected parts of the District. The wells monitored north of SWSD have had the highest average TDS concentrations and these gradually increased from 1993-2001. For the Vlasnik-SWSD area, moderate TDS concentrations were present on the average. Average concentrations increased from 1992-1994, were relatively constant from 1994-1997, decreased for 1997-1999, then rose from 1999-2001. Overall, the long-term TDS trend in this area is relatively constant. For the area south of Highway 58, TDS concentrations were relatively low and decreased from 1995-1999. This was followed by increasing values through 2001. The TDS decreases in this area appear to reflect recharge from water-banking projects and other sources. TDS increases appear to reflect less recharge of low TDS water in the area. The combined average hydrograph for the two pumping areas shows less variation and more of a constant long-term trend. More information on some specific wells is discussed in the next section.

Appendix F contains TDS hydrographs for 11 wells. In some cases, the initial or early results were not representative of later periods. For monitor wells, this may be associated with well trauma following installation. Disregarding such values (i.e. for DMW No. 2), TDS concentrations increased significantly in water from the following wells since the early 1990's: DMW No. 4, and 6. Both of these wells are located north of Seventh Standard Road. TDS concentrations apparently decreased significantly in water from the following wells since the early 1990's: DMW No. 3, 8, 10A, 11B, and 12A. Except for DMW No. 3, these wells are located south of Seventh Standard Road. One of the reasons causing these decreases in TDS concentrations south of Seventh Standard Road is likely water banking activities in the Kern Fan, which were expanded following 1993. The low TDS concentrations in the recharged water would tend to decrease TDS concentrations in the groundwater. TDS concentrations in water from the following wells were relatively constant during the period: DMW No. 1, No. 2, 5, 7, 10B, and 11A. TDS concentrations have fluctuated significantly in water for some wells. Examples include: DMW-1, 4, and 6. Part of this may be due to sampling techniques. The large variations make determination of time trends difficult.

Figure 12
BVWSD Monitor Well
Average TDS Hydrograph



Other Reports. The District is a member unit of the Kern County Water Agency and thus is included in various water supply reports performed by the Agency. The Agency's annual "Water Supply Report" accounts for the various water supplies which come into and are destined for use outside of the County, as well as the water quality aspects of these supplies. These supplies include State Water Project water, Central Valley Project water, Kern River water, Friant-Kern water and local groundwater. This report further calculates a water balance given the above information and estimates groundwater pumpage in excess of groundwater recharge. Groundwater recharge activities for banking and for overdraft correction are accounted for as well as pumped extractions from banking programs. This information also provides an overall picture of the County's activities with respect to the groundwater basin and allows the District to compare itself with the remainder of the County.

This District is currently participating in the monitoring committees of two groundwater banking programs, namely the Semitropic Banking Program Monitoring Committee and the Kern Water Bank Monitoring Committee. These Monitoring Committees were formed with the primary purpose of monitoring the recharge and extraction activities of the programs. The committees are tasked with identifying any resulting impacts to adjoining districts, projects or private landowners so that they can formulate recommendations for possible impact avoidance or mitigation. Reports are produced every 2-3 years by these monitoring committees and they include more regional groundwater data as shown in Appendix G.

MANAGEMENT PROGRAMS

This District is able to distribute a portion of it's wet year supplies into the groundwater basin to offset it's landowners dry year groundwater pumping needs and thus be in positive balance with the groundwater basin. Adjoining areas also benefit, as do District landowners, from reduced pumping lifts resulting from the District's recharge activities. The following is a summary of these programs and how they are integrated into the District's operations.

Exchange Programs. This District is geographically located adjacent to the California Aqueduct and low in elevation on the Kern River Fan. The District's Kern River entitlement is thus delivered by gravity from its origin in the Sierra-Nevada mountains north east of Lake Isabella. The District also has access to State Water Project (SWP) water from the California Aqueduct via its member unit contract with the Kern County Water Agency (KCWA). Other KCWA member units in the Bakersfield area also have contracted for SWP water but must pump their entitlements to their service areas upslope and to the east side of the valley via the Cross Valley Canal (CVC). These circumstances lend themselves to an exchange of Buena Vista's Kern River water for east side member units SWP water, thus avoiding or reducing energy use and resultant pumping costs across the valley. This process also frees up CVC canal capacity that would otherwise be necessary for transportation of east side member units SWP water. In order to allow maximum benefit from these exchanges, the District has increased it's SWP capacity by construction of a three pipe siphon Aqueduct Turnout (BV-7) having a capacity of 300 cfs. The District's Aqueduct capacity can now provide approximately 85-90% of peak system demand with a total flow capacity from the Aqueduct of approximately 800 cfs.

Although the exchange programs have provided benefits to the District, salt loading is an issue since SWP water supplies carry more salinity than Kern River water. This aspect is being analyzed and may influence the degree of exchange volume in particular years when salinity level differences are greater.

Banking Programs. This District has participated in several banking programs through the years and continues to do so because of the monetary and dry year water supply benefits. These programs can be done in the form of annual agreements with future payback provisions such as the Improvement District Number 4 (ID4)/BVWSD Advance Deliveries; long term direct recharge agreements with extraction capability such as the Olcese Water District/City of Bakersfield 2800 Acre Agreement; in-lieu programs to facilitate banked extractions by others such as the BVWSD/West Kern Water District (WKWD) SWP Banking Agreement; Kern County Water Agency (KCWA) member unit programs via participation agreements such as the Pioneer Project; or out-of-county banking/payback programs such as the BVWSD/Department of Water Resources (DWR) 1990 Kern Water Bank Local Element Demonstration Program and the CalFed sponsored 2001 Environmental Water Account Program through the DWR. All of these programs have the common element of placing water into the groundwater basin for later recovery and use. However, some programs only involve the exchange of surface water thus avoiding spreading and extraction costs.

The above noted District banking programs generally fall into two categories. The first category would be a program designed to return water to the District during a dry year when District supplies are restricted. The second category would be a program where the District is providing a banking and extraction service for monetary payment or similar benefits. The District wet year supplies have afforded it the ability to enter into both categories of banking programs which in turn allow the District to stretch its wet year supplies into dry year payback deliveries and thus help to even out required groundwater pumping. These programs also allow the District to make more efficient use of its Kern River water supplies over the long term which in turn minimizes the loss of water from the critically overdrafted groundwater basin.

Direct Groundwater Recharge Programs. This District's Kern River entitlement is dependent on the hydrologic cycles as they occur regardless of crop demands. During dry years, landowners must provide the difference between crop demands and District allocated surface deliveries via groundwater pumping from individually owned wells. During wet years, the District is able to satisfy maximum crop demands which eliminates the use of landowner wells. Excess wet year supplies are stored to maximize surface carryover use and followed by direct recharge, to the maximum extent possible, to replenish the groundwater supply. The efficiency of managing this difference between crop demands and available water supplies insures that the District, as a whole, is in positive balance with the groundwater basin.

This District's direct recharge capacity has been increased over the years to best accomplish both banking and overdraft correction on behalf of District landowners. The main recharge areas used by the District, below the Kern River Second Point of Measurement (Enos Lane), are the Kern River Bypass Area, the Kern River channel, the Main Canal, the Outlet Canal, the Tule Elk Reserve area near Tupman, and the upper reach of the Kern River Flood Channel. Recharge capacity has nearly doubled in the Kern River Bypass Area, due to improvements in the West Kern/Buena Vista banking program, and in the Tule Elk Reserve area via additional distribution facilities in sloughs and other low lying areas. The referenced 1962-2000 water supply study reveals that the District's direct diversions to groundwater accounts for an average of 14,500 acre feet per year (exclusive of seepage losses and banking programs) with wet years being as high as 69,000 acre feet and dry years as low as 0 acre feet. District canal and BV Lake seepage losses average approximately 49,000 acre feet per year which, when added to direct recharge, accounts for a total average annual recharge of approximately 63,500 acre feet per year.

It is noteworthy that the total recharge capacity of 250 cfs represents a high percolation rate per acre when compared to other projects. In addition, the District is a recharge participant in the Kern County Water Agency Pioneer Project and shares a first priority access to the total recharge capacity for overdraft correction.

Flood Channel	= 40 cfs
Tule Elk Reserve	= 60 cfs
Outlet Canal	= 25 cfs
Kern River Bypass Area	= 80 cfs
Main Canal	= 15 cfs
Kern River Channel	= 30 cfs
Total	**= 250 cfs = 500 acre feet/day**

The table included in Appendix A shows a breakdown of historic spreading deliveries by area.

Surface Water Storage Facilities. This District had historically stored its spring runoff flows within Buena Vista Lake until the lake bottom lands were freed from the storage right in exchange for conservation storage space in Lake Isabella. This storage space was purchased by the Kern River Interests upon construction of Isabella Dam by the U.S. Army Corps of Engineers. Buena Vista owns 31.6% of the conservation storage space within the reservoir with flood control being the only overriding purpose. This affords the District a maximum summer storage increment of 172,000 acre feet of regulation space with a maximum winter carryover capability of 68,800 acre feet. The District also retained storage rights within Cells 1 & 2 of Buena Vista Lake with a yield, after losses, of approximately 25,000 acre feet. Pursuant to the "Kern River Storage and Use of Water Agreement", the District is afforded use of this facility for wet year storage of excess Kern River entitlement. In addition, the District, via agreement with the County of Kern, maintains regulation storage use of 1,800 acre feet of space within the Buena Vista Aquatic Recreation Area Lakes. Therefore, the District has approximately 96,000 acre feet of surface storage space for regulation of its surface water supplies from one year to the next.

These surface storage rights are very important to the efficient management of the District's Kern River water rights since the April-July runoff period does not coincide with the District's crop irrigation requirements which occur in the January through March pre-irrigation and the June through September summer irrigation periods. The carryover capability within Isabella reservoir and the District's SWP entitlement allow the District to provide a surface water supply for the early pre-irrigation period even though the District's Kern River entitlement normally does not begin until the March-August entitlement period. The reservoir also provides peaking capability and facilitates other management practices such as the previously mentioned exchanges, banking, and recharge activities.

The Buena Vista Aquatic Recreational Area (BVARA) lakes provide the District with a very useful tool in daily operational storage for regulation of both Kern River and SWP flows to the District as well as some valuable surface storage. This facility receives the District's Kern River flows via the Alejandro Canal and SWP flows via turnout BV-3, while directing flows into the District's Outlet canal for use in the Buttonwillow service area. The lakes are also used to serve the Maples area and Henry Miller Water District. per agreement with the County and upon arrangement with Buena Vista.

Surface Water Sales. During wet years the District authorizes the sale of surplus water to reduce or avoid groundwater pumping and generate revenue to offset District operating costs. Generally, surplus water is offered to landowners within the District (for use above surface allocation), to landowners adjacent to the District who rely primarily on groundwater supplies, and to other non-adjacent parties. Such deliveries are beneficial since they correct overdraft, raise pumping levels, and generate revenue.

Water Delivery System. The District's surface water delivery system, some of which is more than a century old, is still quite effective with the improvements that have been made over the years. Most of the District's 125 miles of canals and tailwater drains are unlined. System delivery losses are approximately 30%-35% for the short pre-irrigation run and approximately 28% of total flow, for an average summer run. These loss estimates do not include Outlet Canal seepage. Seepage losses through the unlined canals recharge the primarily unconfined aquifer below. In areas experiencing lateral flow problems from canal seepage, affected landowners occasionally will install interceptor ditches or drain lines to minimize any localized crop damage. District interceptor drain lines are under consideration for alleviating this problem.

The District maintains inflow capability from the Kern River, the Friant Kern Canal, and the California Aqueduct. Kern River and Friant Kern flows are delivered via the Kern River channel, the City's Kern River Canal, and the District's Main, Outlet, and Alejandro Canals. California Aqueduct inflow points include, BV-1B, BV-2, BV-3, BV-6, and BV-7 which provide adequate capacity to operate at near peak demand. This flexibility allows the District access to large amounts of surplus water from various sources. The District is also able to make isolated deliveries to the northern portion of the service area via Aqueduct turnout BV-1B which allows for better water management within the perched water area.

Reclamation Programs. Certain programs have been instituted by the District to better utilize the tailwater supplies collected by the District's drain system. The District currently has six reclamation pumps that lift drain flows from the tailwater reclamation system into the delivery canals for re-use. These pumps are capable of recirculating up to 50 cubic feet per second or 100 acre-feet/day. These District pumps have reclaimed about 8700 acre-feet per year (average 1992-2000), which equates to about 0.2 acre-feet/acre of reclaimed supply that is delivered to the field.

In 1985 the District instituted a program allowing landowners to install similar reclamation pumps that can be used on their farms to increase their surface water allocation. The program is designed to provide two alternatives to the landowner. He may either pay a set rate to the District for the supply reclaimed or trade one acre foot of his surface allocation for each two acre feet of reclaimed supply. This program has been very successful as a means of increasing the efficiency of use of surface allocations in the District and providing additional surface deliveries in the northern portion of the District where groundwater supplies are of lesser quality. These grower reclamation pumps have recirculated about 4000 acre-feet per year (average 1992-2000). The District also encourages landowners to install their own reclamation system which allows them to reclaim their tailwater flows without having to pay a water cost provided the tailwater flows do not enter and flow through District maintained facilities.

Tailwater flows not reclaimed by the above programs pass north of Highway 46 via the Goose Lake Canal. By separate agreement, these flows are captured for farming operations in a portion of the Semitropic. The District receives compensation for use of such supply. Thus, tailwater flows not reclaimed within the District are used beneficially and not lost or wasted. The District also has investigated additional reclamation sites, some of which would involve major improvements that could become cost effective in future years. Efforts are being made to better educate landowners as to the negative impacts of high tailwater flows to encourage higher farm water efficiencies.

Drainage Control and Irrigation Conservation Programs. The northern portion of the District from just south of Lerdo highway to Highway 46 experiences the negative effects of perched groundwater in the root zone of crops. In the early 1980's, the District investigated the possibility of installing drainage improvements to alleviate the problem. However, since evaporation ponds are no longer a practical solution due to environmental concerns, other alternatives must be looked at. The District, in coordination with the Department of Water Resources, the State Water Resources Control Board, and the Soil Conservation Service, has installed a vast network of shallow piezometers to monitor this area. The District has also planted eucalyptus trees in areas to lower perched levels in adjacent farmed areas. A possible solution involves desalination of shallow groundwater for agricultural re-use in exchange for releasing good quality surface water to an urban participant interested in funding the program. The District is currently operating a pilot project that is evaluating larger scale feasibility.

The District has financed programs to encourage better irrigation efficiencies to reduce tailwater flows, reduce deep percolation, and to stretch the available surface water supplies. One example is District monetary support for the local Mobile Irrigation Lab which conducts on-farm irrigation evaluations in order to improve irrigation practices. The District also instituted a cost-share pilot program with Dellavalle Laboratory where a neutron probe is used to evaluate available soil moisture as an aide to irrigation scheduling. Recently the District has begun to sponsor local irrigation training seminars in conjunction with the Natural Resources Conservation Service and the Mobile Irrigation Lab. This will hopefully prove to be a forum for irrigation education for District farmers.

Cloud Seeding Program. In 1980 the Kern River Interests entered into a contract with Atmospherics Incorporated to perform weather modification via cloud seeding. The main purpose of the program is to increase the yield from individual storm events in order to increase seasonal Kern River runoff. According to research data, the cloud seeding efforts can potentially increase runoff yield by as much as 15%. However, an average increased yield over the long term is probably in the range of 3-5% in the southern Sierra Nevada mountains. An increase in seasonal runoff provides more surface water for irrigation purposes and thus decreases the amount of landowner pumping from the basin. Buena Vista will continue to make contributions towards the cloud seeding program to maximize our Kern River entitlement.

Groundwater Well Policies. All well construction and abandonment policies are set and enforced by the Kern County Environmental Health Department's groundwater well ordinance. These policies are stated in the Kern County Well Ordinance and included in the recently completed Kern County Environmental Health Department - Kern County Water Agency Memorandum of Understanding. This District has participated in the development of the above policies in order to insure that a reasonable and effective policy was instituted.

INSTITUTIONAL CONSIDERATIONS

California Water Code Sections 10750 et seq. provides the District with the necessary powers to adopt and operate a Groundwater Management Plan. The powers granted to the District, upon adoption of a Plan, include that of a water replenishment District (Part 4, Division 18, California Water Code).

The information and support data provided within this groundwater management plan shows that this District is in positive balance within a critically over-drafted groundwater basin. The problem areas described, such as the perched water area at the northern portion of the District, will require new and innovative solutions and corresponding management practices to enable the area to continue as a viable farming area over the long term. Groundwater quality differences have been closely monitored so that certain constituents that may be detrimental to crop production do not migrate into other areas unabated. Groundwater pumping adjacent to District lands have negatively impacted groundwater elevations within the District. Groundwater banking programs have resulted in lessening impacts from adjacent overdrafted areas. Regional monitoring committees, which this District participates in, are resulting in groundwater banking management techniques that insure that the groundwater basin is used in a manner which proves to be much less harmful by way of groundwater elevations and quality than has occurred in the past when such lands were farmed in overdraft.

This District will continue to monitor its activities as they relate to the groundwater basin and to search for new technologies or participate in pilot programs which are practical and can be made to be affordable. Cooperative programs involving such entities as the Department of Water Resources and possibly agriculture and urban joint programs may prove to provide the stepping stone necessary for long term solutions to some difficult problems.

The following areas are being considered by the District and will be evaluated as to their possibilities for successful implementation:

- Implement and continue necessary groundwater and surface water supply studies to initiate the most feasible programs for efficient water use, perched water reclamation, distribution, and total water supply management.

- Continue to work with local, State, and Federal agencies to investigate possible programs associated with agricultural water supplies (groundwater and surface waters) in search of solutions to ongoing problems.

- Continue to participate in regional groundwater monitoring committees (via MOU's) for the purpose of protecting the groundwater basin from impacts caused by recharge and extraction activities.

- Investigate common use areas where compatible facilities and joint operations can facilitate best use of available water supplies and possibly expand water supply opportunities.

- Investigate water management programs (i.e. water sales, direct recharge, and reclamation pumping), and their compatible fee structures to promote best management practices for maximum water use efficiency and groundwater basin protection.

- Continue to develop banking, extraction and groundwater recharge opportunities for maximum use of wet year water supplies for regulation to meet dry period demands with minimal basin impact.

- Evaluate most efficient use of available surface storage areas both at the District and State levels to provide maximum advantage from surface deliveries.

The above described areas will continue to be important to insure that the District uses its available water supplies in the most efficient and beneficial manner. The District's goal is to insure that the farming economy in this area, which depends on the efficient use of available water supplies, will continue to thrive as it has over the past one hundred plus years.

TABLE 3
BUENA VISTA WATER STORAGE DISTRICT
HISTORIC WATER BALANCE

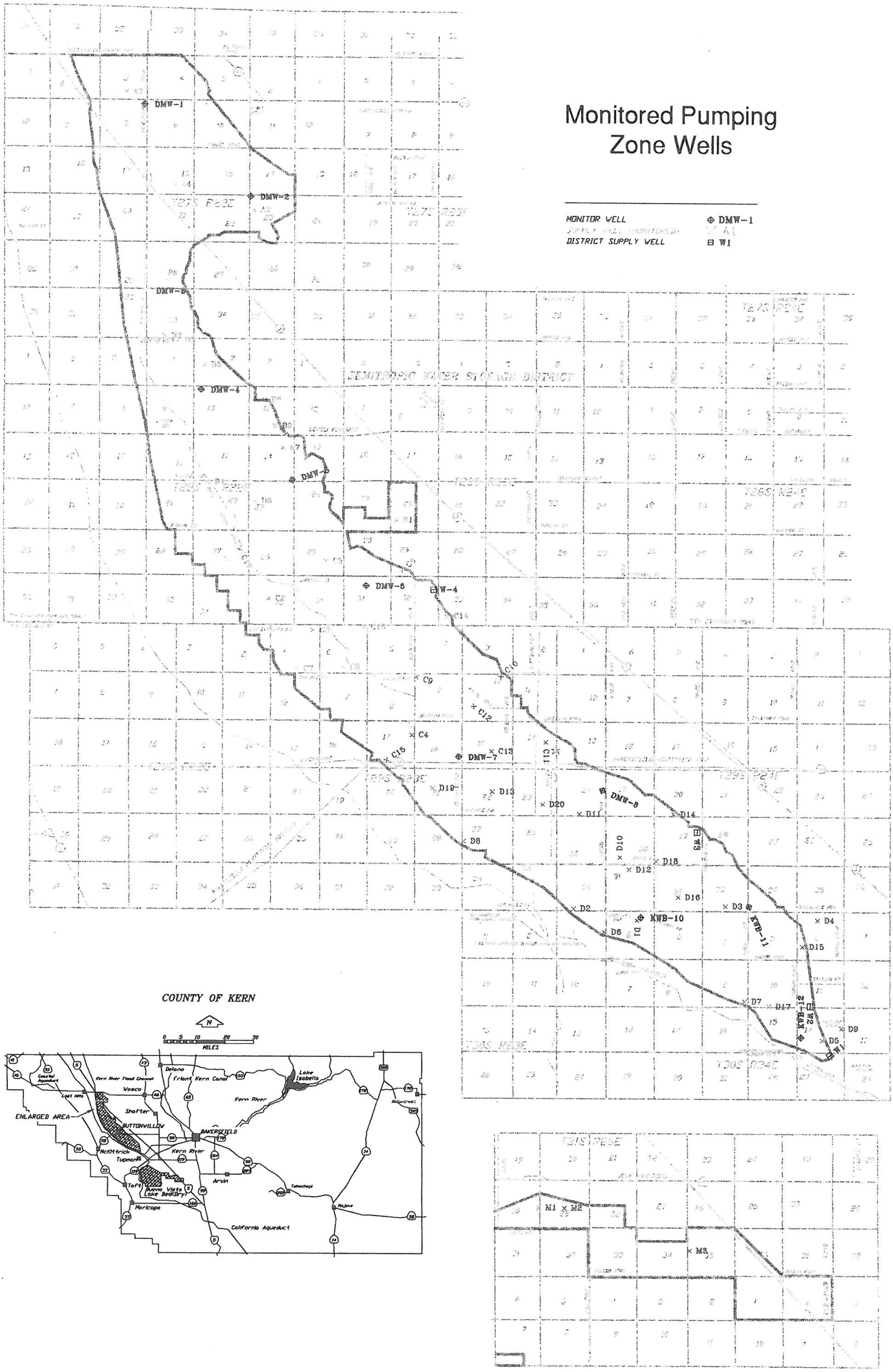
YEAR	[1] KERN RIVER APRIL-JULY RUNOFF % OF MEAN	[2] BV LAKE SEEPAGE LOSSES (AF)	[3] IN-DISTRICT SEEPAGE LOSSES (AF)	[4] FIELD DELIVERIES: SURFACE W/ 2800 AC WELLS (AF)	[5] FIELD DELIVERIES: RECLAIMED WATER (AF)	[6] FIELD DELIVERIES: TOTAL DELIVERIES	[7] DIRECT RECHARGE (AF)	[8] TRANS LOSS KR+OUTLET (AF)	[9] SURFACE WATER SUPPLY (AF)	[10] SURFACE WATER SUPPLY SOURCES: KR SUPPLY (AF)	[11] FK SUPPLY (AF)	[12] BV ST SUPPLY (AF)	[13] WK ST SUPPLY (AF)	[14] 2800 AC WELLS (AF)	[15] SAFE YIELD/ BENEFICIAL PRECIP. (AF)	[16] **TOTAL WATER SUPPLY (AF)**	[17] CROP WATER USE (AF)	[18] EVAP LOSSES AT 3% (AF)	[19] MAIN DRAIN SPILL TO N OF 46 (AF)	[20] TO 3rd PARTY GNDWTR ACCOUNTS (AF)	[21] **TOTAL WATER USE (AF)**	[22] **ANNUAL WATER BALANCE (AF)**	[23] ACCUM WATER BALANCE (AF)	[24] BVWSD GND WTR PUMPING (AF)
1962	109.6	5,034	25,329	74,985	5,529	80,514	0	30,225	135,573	121,748	13,825	0	0	0	15,000	150,573	92,000	1,700	2,925	0	96,625	53,948	53,948	34,000
1963	101.3	776	36,491	70,067	863	70,930	0	18,763	126,097	112,403	13,694	0	0	0	15,000	141,097	86,000	1,700	4,361	0	92,061	49,036	102,984	36,000
1964	38.9	0	18,976	27,894	2,160	30,054	0	8,639	55,509	55,509	0	0	0	0	15,000	70,509	84,000	800	4,115	0	88,915	-18,406	84,578	74,000
1965	97.1	0	40,301	59,972	2,874	62,846	9,891	26,609	136,773	109,468	27,305	0	0	0	15,000	151,773	91,000	2,300	4,542	0	97,842	53,931	138,509	50,000
1966	46.8	1,532	21,275	24,237	1,192	25,429	738	19,124	66,906	63,985	2,921	0	0	0	15,000	81,906	87,000	1,200	5,825	0	94,025	-12,119	126,390	83,000
1967	196.5	7,753	52,415	147,803	3,088	150,891	9,841	82,184	299,996	287,425	12,571	0	0	0	15,000	314,996	98,000	4,300	15,408	0	117,708	197,288	323,678	2,000
1968	52.8	1,181	20,596	67,586	3,421	71,007	0	18,458	107,821	107,821	0	0	0	0	15,000	122,821	90,000	1,200	4,054	0	95,254	27,567	351,245	41,000
1969	371.7	8,877	45,872	129,537	3,089	132,626	59,989	110,097	354,372	354,372	0	0	0	0	15,000	369,372	91,000	6,500	16,077	0	113,577	255,795	607,040	2,000
1970	67.9	732	19,333	87,812	4,982	92,794	0	22,312	130,189	117,431	7,310	5,448	0	0	15,000	145,189	97,000	1,200	9,086	0	107,286	37,903	644,943	28,000
1971	52.0	0	32,896	63,194	6,505	69,699	0	10,390	106,480	81,466	7,787	17,227	0	0	15,000	121,480	100,000	1,300	4,897	0	106,197	15,283	660,226	55,000
1972	27.2	0	25,468	43,937	7,689	51,626	0	5,484	74,889	32,853	0	42,036	0	0	15,000	89,889	99,000	900	740	0	100,640	-10,751	649,475	72,000
1973	153.9	0	29,784	99,258	6,537	105,795	18,740	12,712	160,494	149,082	746	10,666	0	0	15,000	175,494	108,000	1,800	12,137	0	121,937	53,557	703,032	30,000
1974	113.8	0	40,193	116,254	5,313	121,567	10,138	13,780	180,365	160,269	14,773	5,323	0	0	15,000	195,365	114,000	1,900	6,121	0	122,021	73,344	776,376	22,000
1975	82.1	0	35,272	107,049	4,815	111,864	8,255	9,099	159,675	138,781	0	20,894	0	0	15,000	174,675	118,000	1,600	7,384	0	126,984	47,691	824,067	37,000
1976	23.1	0	20,426	36,213	5,767	41,980	1,065	2,690	60,394	40,747	0	19,647	0	0	15,000	75,394	111,000	700	4,463	0	116,163	-40,769	783,298	97,000
1977	20.3	0	1,654	8,149	2,224	10,373	77	0	9,880	5,405	0	4,475	0	0	15,000	24,880	111,000	100	420	0	111,520	-86,640	696,658	129,000
1978	232.7	4,102	41,529	119,712	585	120,297	24,260	31,808	221,411	215,730	0	5,681	0	0	15,000	236,411	114,000	2,900	13,877	0	130,777	105,634	802,292	23,000
1979	89.3	1,060	48,304	112,051	3,415	115,466	11,495	11,665	184,575	128,312	0	41,463	14,800	0	15,000	199,575	110,000	2,100	12,807	14,800	139,707	59,868	862,161	23,000
1980	210.7	1,970	48,492	149,820	1,873	151,693	42,747	33,594	276,623	263,655	0	4,418	8,550	0	15,000	291,623	111,000	3,700	18,295	8,550	141,545	150,078	1,012,239	2,000
1981	53.7	533	47,290	94,584	4,326	98,910	6,389	8,154	156,950	62,319	0	77,631	17,000	0	15,000	171,950	112,000	1,900	12,351	57,000	183,251	-11,301	1,000,938	42,000
1982	169.4	2,394	49,583	129,510	1,470	130,980	33,413	16,107	231,007	168,266	18,741	21,852	22,148	0	15,000	246,007	107,000	3,000	15,904	22,148	148,052	97,955	1,098,893	3,000
1983	328.7	6,282	48,281	124,871	4,502	129,373	48,734	48,209	276,377	245,994	25,819	4,564	0	0	15,000	291,377	93,000	4,400	13,264	20,888	131,552	159,825	1,258,718	2,000
1984	90.0	531	49,638	142,134	4,364	146,498	18,322	10,741	221,366	152,793	2,289	44,748	21,536	0	15,000	236,366	111,000	2,400	16,478	61,536	191,414	44,952	1,303,670	2,000
1985	90.2	0	48,486	113,628	3,657	117,285	13,024	9,038	184,176	132,533	0	30,684	20,959	0	15,000	199,176	108,000	2,100	16,123	20,959	147,182	51,994	1,355,664	18,000
1986	188.5	2,328	42,424	141,390	1,060	142,450	33,349	25,315	244,806	211,616	10,279	2,113	20,798	0	15,000	259,806	104,000	3,000	24,589	22,839	154,428	105,378	1,461,042	2,000
1987	45.0	764	35,304	103,831	4,522	108,353	3,086	4,162	147,147	75,784	0	42,072	23,291	6,000	15,000	162,147	99,000	1,300	14,916	23,291	138,507	23,640	1,484,681	15,000
1988	34.5	0	30,733	76,753	6,764	83,517	216	4,986	112,688	50,627	0	32,350	24,711	5,000	15,000	127,688	104,000	1,100	16,309	24,711	146,120	-18,432	1,466,249	47,000
1989	49.8	0	39,993	65,717	12,950	78,667	3,532	6,280	115,522	59,023	0	24,402	28,959	3,138	15,000	130,522	101,000	1,500	5,080	28,959	136,539	-6,017	1,460,232	48,000
1990	24.1	0	23,787	52,948	7,978	60,926	0	3,961	80,696	21,126	0	26,899	30,429	2,242	15,000	95,696	106,000	800	4,165	30,429	141,394	-45,698	1,414,534	72,000
1991	58.8	0	23,205	43,344	10,171	53,515	0	5,288	71,837	58,600	0	2,127	6,700	4,410	15,000	86,837	104,000	900	4,558	6,700	116,158	-29,321	1,385,213	77,000
1992	38.1	0	27,600	29,366	11,301	40,667	799	2,148	59,913	42,584	0	911	12,414	4,004	15,000	74,913	104,000	900	3,927	12,414	121,241	-46,328	1,338,885	90,000
1993	124.3	0	39,064	102,108	11,175	113,283	30,713	5,064	176,949	90,593	2,848	53,103	30,405	0	15,000	191,949	107,000	2,200	8,641	30,405	148,246	43,703	1,382,588	21,000
1994	40.6	20	37,751	76,193	11,271	87,464	0	7,954	121,918	73,711	0	27,733	20,474	0	15,000	136,918	103,000	1,400	8,404	20,474	133,278	3,640	1,386,228	41,000
1995	197.6	1,342	57,436	130,175	11,018	141,193	50,919	12,457	252,329	185,950	4,479	21,521	40,379	0	15,000	267,329	105,000	3,600	28,394	40,379	177,373	89,956	1,476,184	2,000
1996	127.4	920	43,501	134,678	13,785	148,463	21,423	10,167	210,689	167,936	734	16,422	25,597	0	15,000	225,689	106,000	2,300	23,555	25,597	157,452	68,237	1,544,421	2,000
1997	121.5	199	53,403	137,303	11,461	148,764	36,154	16,677	243,736	211,150	12,407	2,259	17,920	0	15,000	258,736	107,000	3,200	28,118	17,920	156,238	102,498	1,646,919	2,000
1998	241.9	941	33,883	116,790	8,561	125,351	69,048	15,609	236,271	209,901	1,020	8,565	16,785	0	15,000	251,271	105,000	3,600	31,760	23,602	163,962	87,309	1,734,228	6,000
1999	53.7	551	33,706	106,049	15,617	121,666	536	5,839	146,681	54,068	8,942	53,913	29,758	0	15,000	161,681	106,000	1,200	23,067	29,758	160,025	1,656	1,735,884	11,000
2000	65.2	0	40,405	86,916	16,534	103,450	337	6,700	134,358	58,767	0	53,111	22,480	0	15,000	149,358	103,000	1,400	23,083	22,480	149,963	-605	1,735,279	25,000
AVG:																								
1980-00	112.1	894	40,665	102,767	8,303	111,070	19,654	12,307	176,288	123,666	4,169	26,257	21,014	1,181	15,000	191,288	105,048	2,186	16,237	26,240	149,710	41,577		25,238
1990-00	99.4	361	37,613	92,352	11,716	104,067	19,084	8,351	157,762	106,762	2,766	24,233	23,031	969	15,000	172,762	105,091	1,955	17,061	23,651	147,757	25,004		31,727
1986-98	99.4	501	37,545	93,123	9,386	102,509	19,172	9,236	159,577	112,200	2,444	20,037	22,989	1,907	15,000	174,577	104,231	1,985	15,570	23,671	145,457	29,120		32,692
1976-94	100.6	1,052	37,029	90,649	5,757	96,405	14,275	12,482	155,486	110,496	3,157	24,572	15,957	1,305	15,000	170,486	106,316	1,916	11,293	21,374	140,899	29,587		39,684
1972-94	99.5	869	36,272	90,818	5,814	96,633	13,407	12,097	153,463	112,191	3,282	23,730	13,181	1,078	15,000	168,463	106,913	1,852	10,476	17,657	136,898	31,565		39,783
1962-00	108.5	1,277	36,156	91,124	6,267	97,390	14,544	17,756	160,857	125,123	4,833	18,571	11,695	636	15,000	175,857	102,744	2,054	12,057	14,509	131,363	44,494		35,077

NOTES:

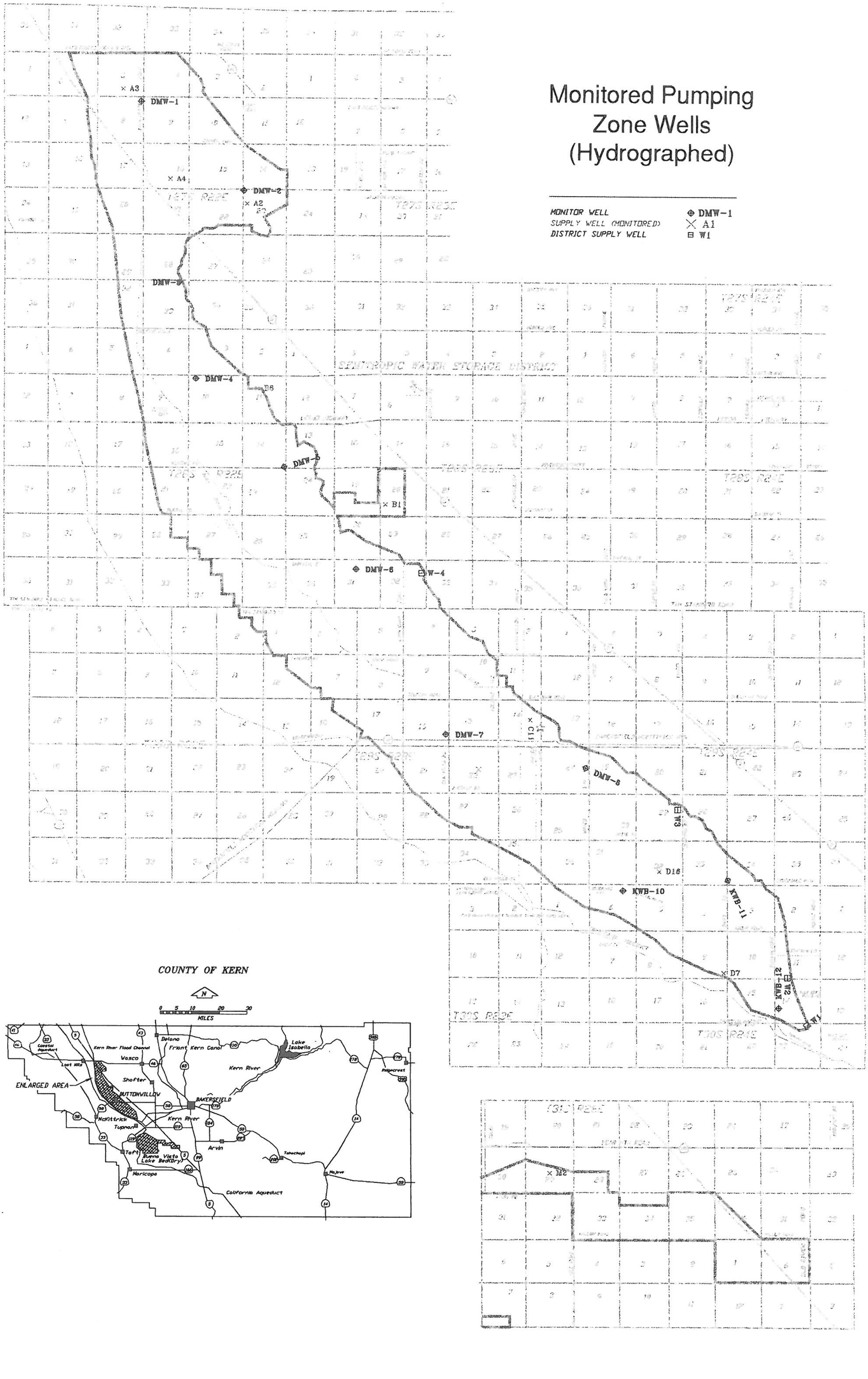
[1] April-July Runoff of the Kern River in % of normal
[2] Buena Vista Lake seepage losses estimated at 20% of total losses.
[3] Gross in-district seepage losses
[4] Net BV surface water deliveries including 2800 Acre well pumping.
[5] Field deliveries of reclaimed water.
[6] Total net field deliveries including 2800 acre well pumping.
[7] Direct spreading generally in the WK/BV program area (KR, Bypass, Main, Outlet, Elk Pen).
[8] Transportation seepage losses in Kern River and Outlet Canal.
[9] = [2]+[3]+[4]+[7]+[8].
[10] Total Kern River Supply (includes 20% of Lake losses).
[11] Total Friant-Kern Supply (includes 20% of Lake losses).
[12] Total BV State Supply (includes 20% of Lake losses).
[13] Total West Kern State Supply.
[14] Total 2800 Acre well pumping.
[15] Safe Yield estimated at 0.3 AF/year.
[16] = Sum of [10] through [15].
[17] Estimated crop water use (consumptive) from Table 2.
[18] Evap losses estimated at 3% of sum of losses above canal head, gross in-district losses, and direct recharge.
[19] Main Drain spill to north of Hwy 46.
[20] 3rd PARTY represents transfer of deliveries to other gw accounts primarliy WK SWP supplies.
[21] = [17]+[18]+[19]+[20].
[22] = [16]-[21].
[23] = [22] + Previous Year [23].
[24] BVWSD groundwater pumping estimated at 130% of crop water use less sum of surface water deliveries and beneficial precipitation (5,000 AF/year).
Minimum groundwater pumping estimated at 2,000 AF/year.

Monitored Pumping Zone Wells

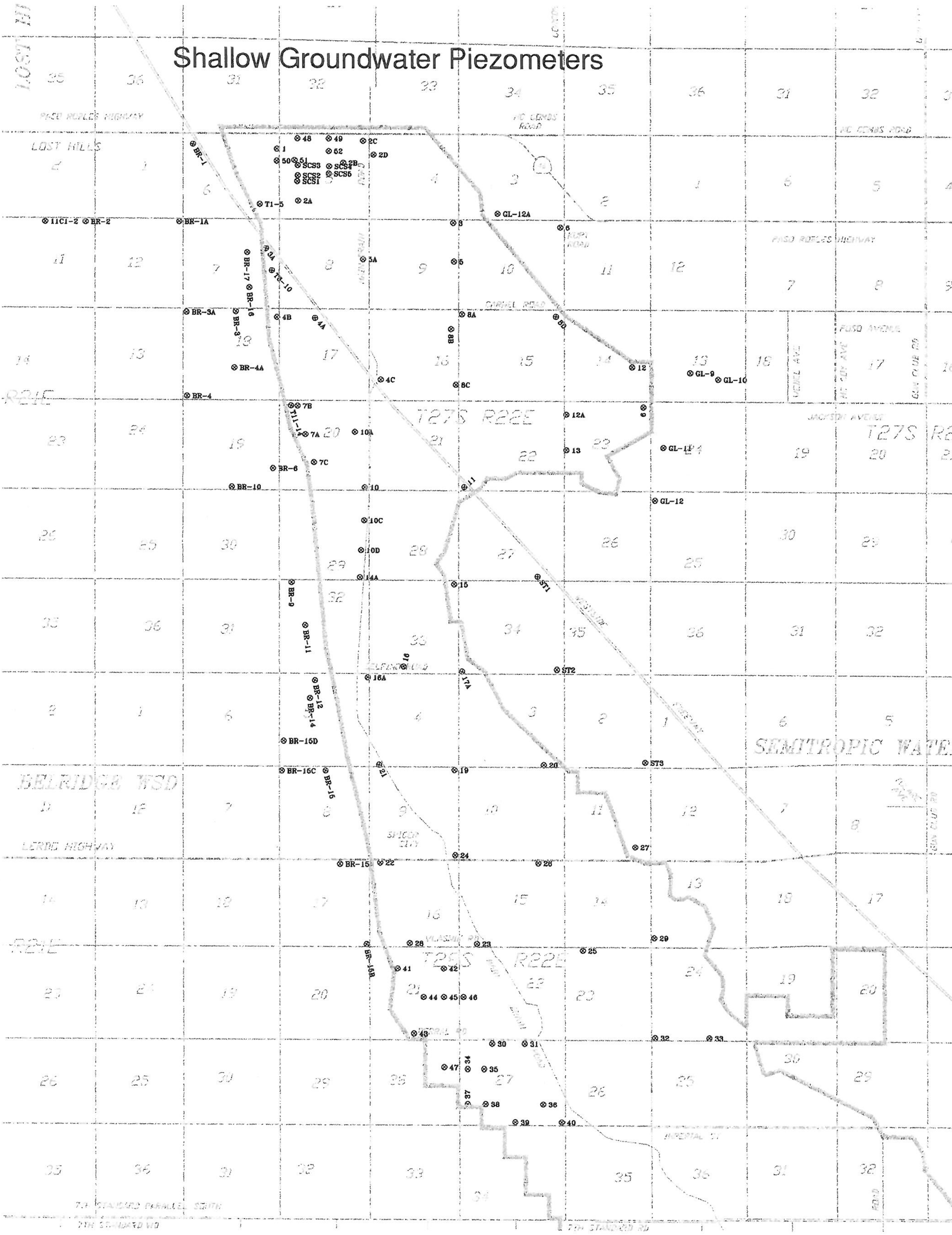
MONITOR WELL ⊕ DMW-1
SUPPLY WELL (MONITORED) × A1
DISTRICT SUPPLY WELL ⊟ W1



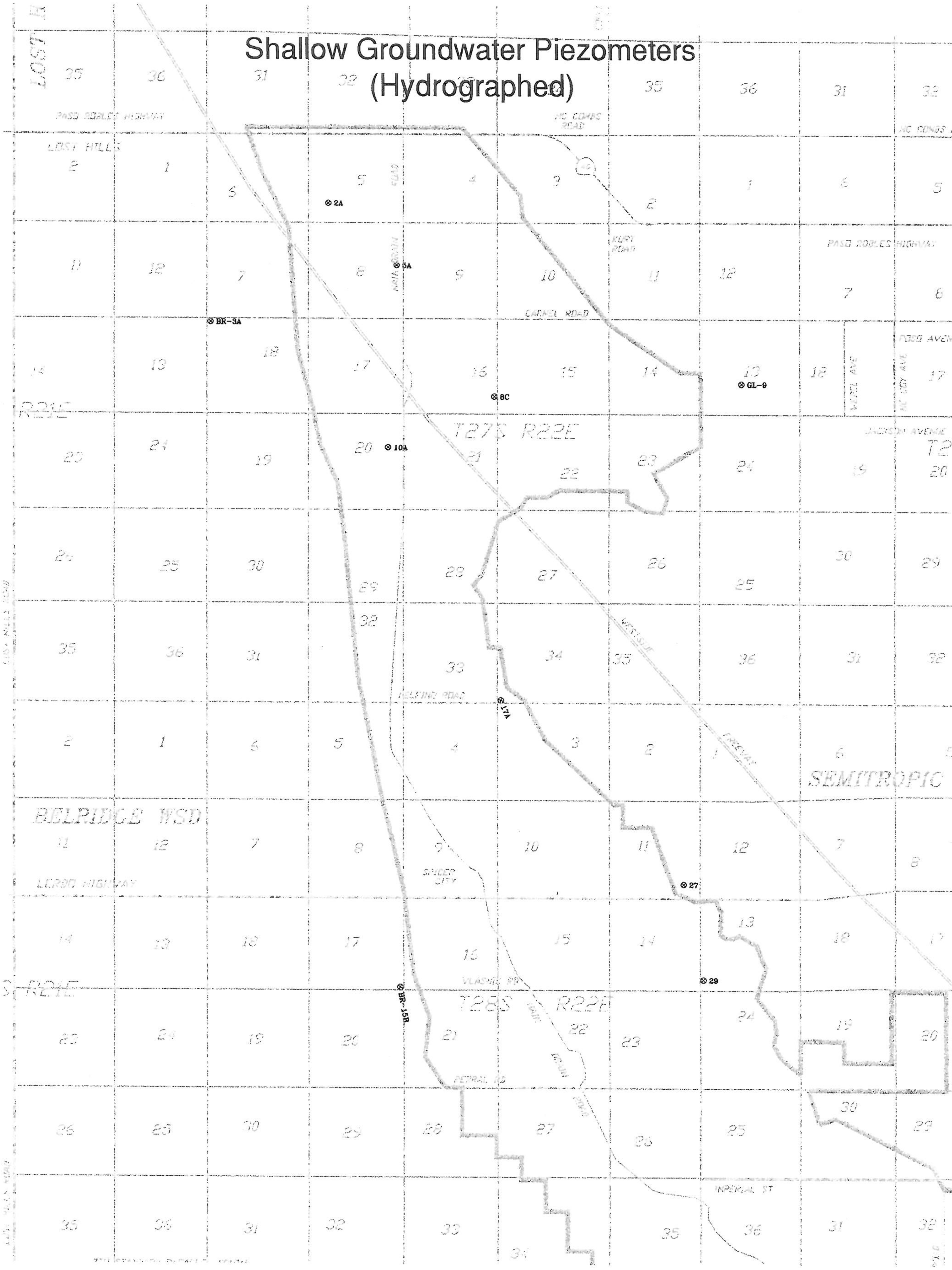
Monitored Pumping Zone Wells (Hydrographed)



Shallow Groundwater Piezometers



Shallow Groundwater Piezometers (Hydrographed)



BVWSD DELIVERY DATA

ACRE-FEET

YEAR	%AJ	CROP(AC)	TOTAL BW DELIVERIES	BW DIST WELLS	BW LAND OWN WELLS	BW RECL	TOTAL MAPLES DELIVERIES	MAPLES LAND OWN WELLS	MAPLES LAND OWN RECS	TOTAL SURFACE DELIVERY	TOTAL WELL DELIVERY	ALEJANDRO LOSS	TRANSP LOSSES	MAIN LOSSES	OUTLET LOSSES	BW LOSSES	MAPLES LOSSES	TOTAL IN-DIST T LOSSES	TOTAL TRANS LOSSES	BV LAKE & BVARA LOSS	SPREADING RIVER/BYPASS	SPREADING ELK/OUTLET	SPREADING FLOOD CH	SPREADING MAIN	TOTAL SPREADING	BW BV RECS	BW OTHER RECS	MAPLES OTHER RECS	SPILL @46
1962	108.8	37299	79053		309	2641	1770			80514	309		17685	9555	2986	25329		25329	55555	25495						2641			2925
1963	100.6	34799	68087			863	2843			70930			7362	10492	909	36491		36491	55254	3882						863			4361
1964	38.6	32806	29322			2160	732			30054		1263	3528	3848		18976		18976	27615							2160			4115
1965	96.4	35475	61404			2875	1442			62846		1841	10018	9890	4860	39582	720	40302	66911		9891				9891	2875			4542
1966	46.4	33285	24933			1192	496			25429		2211	11195	4831	887	20545	730	21275	40399	7658	738				738	1192			5825
1967	195.0	38095	142064			3088	8827			150891		6088	45981	6887	23230	51265	1150	52415	134601	38765		9841			9841	3088			15408
1968	52.4	36154	68877			3421	2130			71007		2143	6043	4522	5750	19881	715	20596	39054	5905						3421			4054
1969	368.8	37019	127598			3089	5028			132626		5563	81979	7192	15363	44301	1571	45872	155969	44385	59989				59989	3089			16077
1970	67.4	38782	90070			4982	2724			92794		4460	4258	9410	4184	18221	1113	19334	41646	3662						4982			9086
1971	51.6	37995	68101			6800	1721	123		69699	123	394	4172	5824		32260	931	33191	43581							6800			4897
1972	27.0	36768	50549			7689	1077			51626		79	1347	1062	2996	24694	774	25468	30952							7689			740
1973	152.7	40600	103055			6537	2740			105795			711		12001	29368	416	29784	42496		12346	6394			18740	6537			12137
1974	112.9	41650	110153			5313	11414			121567			2203		11577	38543	1650	40193	53973		10138				10138	5313			6121
1975	81.5	44785	106374			4815	5490			111864					9105	33750	1522	35272	44377		8255				8255	4815			7384
1976	22.9	41850	40659		355	5767	1749	73		41980	428		48		2642	20138	310	20448	23138		1065				1065	5767			4463
1977	20.2	40692	9363			2324	1010			10373						1754		1754	1754		77				77	2324			420
1978	230.9	41924	114842				5455			120297			17237		15110	43138	1171	44309	76656	20510	8876	11867		3517	24260				13877
1979	88.6	41409	110144			3701	5322			115466			25		11640	46396	1908	48304	59969	5302	8143	639		2713	11495	3701			12807
1980	209.1	41757	145667			1407	6028		117	151695			15366		18260	46538	2009	48547	82173	9852	17048	22453		3246	42747	1407		117	18295
1981	53.3	41255	91545			4259	7365			98910			17		8355	46264	1040	47304	55676	2667	446	4005		1938	6389	4259			12351
1982	168.1	39990	123835			1470	7143			130978			618		15489	47961	1622	49583	65690	11969	18383	11251		3833	33467	1470			15904
1983	326.2	34258	122634			3871	6739		125	129373			32819		15592	48450	1503	49953	98364	31409	12933	32382		3419	48734	3871		125	13264
1984	89.3	40655	138627			4364	7871			146498			627		10114	47754	1884	49638	60379	2654	5977	12345			18322	4364			16478
1985	89.5	40282	111630			3657	5655			117285			167		8871	46451	2035	48486	57524		2650	10199		175	13024	3657			16123
1986	187.1	39003	135733			1060	6717			142450			10913		14402	40267	2157	42424	67739	11653	12017	19882		1450	33349	1060			24589
1987	44.6	36304	96521		657	4491	6489			102353	657		33		4129	35400	763	36163	40325	3818	3086				3086	4491			14916
1988	34.2	38197	76184		2378	6871	4711			78517	2378				5163	30040	800	30840	36003		227				227	4933	1938		16309
1989	49.5	38012	76266		5800	13106	5697	634		75529	6434		60		6288	39043	1256	40299	46647		2393	865		274	3532	9473	3633		5080
1990	23.9	39138	58215		2615	8879	5371	2287		58684	4902				4257	24978	685	25663	29920	1000						5307	3572		4165
1991	58.4	38606	52359	448	5689	10659	4218	1335	379	49105	7472	22			5727	23595	622	24217	29966							6073	4586	379	4558
1992	37.8	38555	41602	2062	4067	12944	3952	2762	441	36663	8891		29		3202	29696	529	30225	33456		799				799	7563	5381	441	3927
1993	123.4	40254	108369		222	11624	5221	85	500	113283	307				5064	39167	698	39865	44929	1100	13390	13847	2618	859	30714	9674	1950	500	8641
1994	40.3	38761	83713		1728	10635	6102	623	754	87464	2351		2		7952	36135	1899	38034	45988	1170						5910	4725	754	8404
1995	196.1	39847	133309		73	9931	7957		758	141193	73		97		12404	55359	2262	57621	70122	6710	19301	12820	6763	12487	51371	7054	2877	758	28394
1996	126.5	40958	140248		175	13651	8390		310	148463	175				10167	42455	1465	43920	54087	4600	16670	668		4085	21423	10062	3589	310	23555
1997	120.6	40127	141268			11401	7496		60	148764					16677	51548	1855	53403	70080	996	16264	13838	3862	2190	36154	8914	2487	60	28118
1998	240.0	40748	117795			9833	7556		419	125351					16687	35697	1033	36730	53417	4706	29447	32222	7446		69115	8078	1755	419	31760
1999	53.3	40537	112538			14265	9128			121666					5839	31414	2305	33719	39558	3032	105	431			536	9497	4768		23067
2000	64.9	38393	96589		855	16578	7716			103450	855				6700	37239	3168	40407	47107			337			337	11541	5037		23083
TOTAL	4251.8	1553656	3609295	4980	24923	242213	199492	7922	3863	3773432	37825	24064	274540	73513	324579	1380083	46271		2123050	252900	290654	216286	20689	40186	567815	195915	46298	3863	470220
AVERAGE																													
1962-99	109	38911	92440	66	633	5938	5047	208	102	96578	908	633	8075	1935	8365	35338	1197		54630	6655	7649	5683	575	1058	14934	4852	1086	102	11767
1978-99	118	39572	106047	114	1064	7367	6390	351	176	110909	1529	1	3901		10063	40352	1432		55394	5598	8553	9078	1034	1827	20397	5492	1876	176	15663

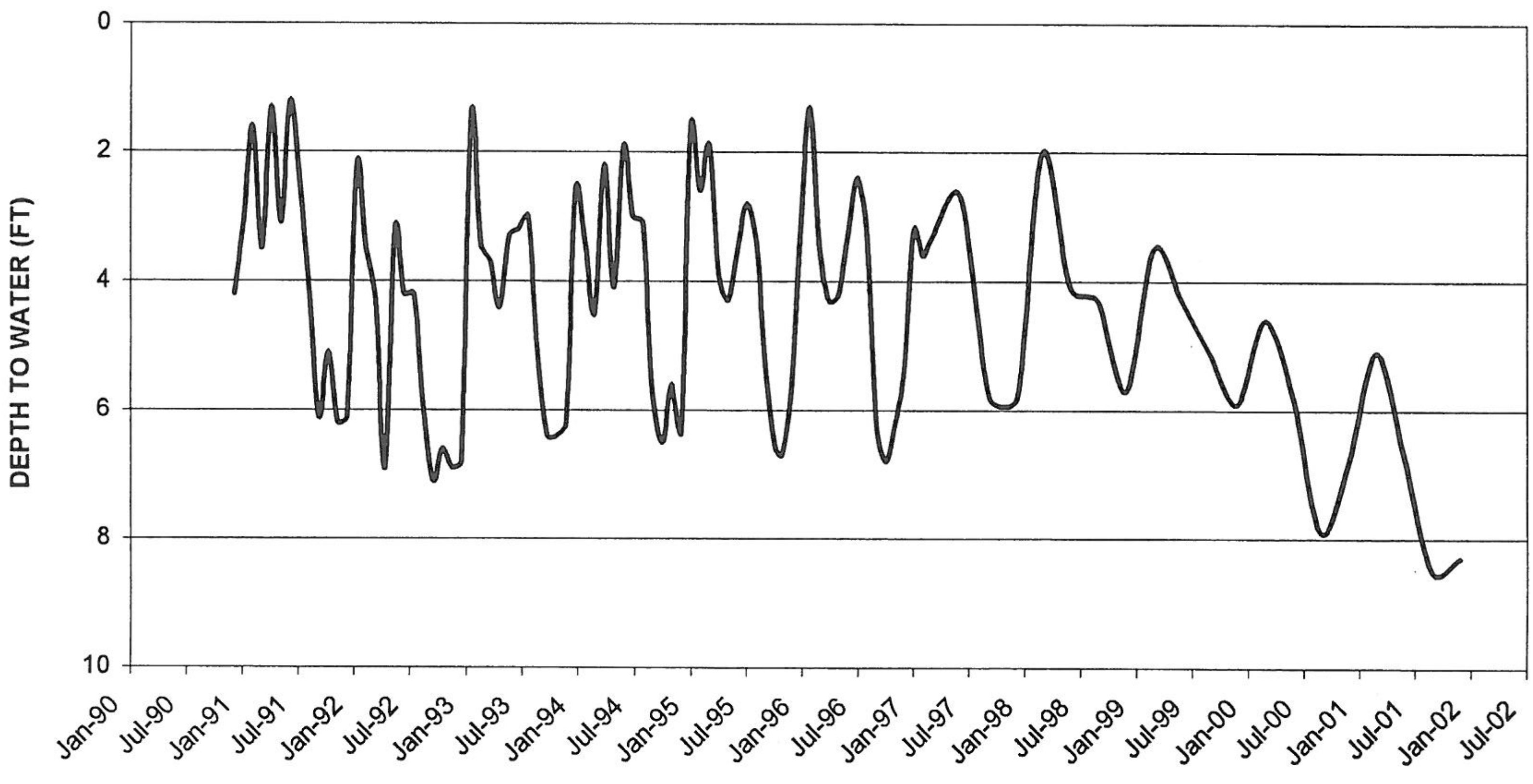
Note: In 1998 Spreading in Bypass / River & Main were combined.

%AJ = KR % OF APRIL-JULY RUNOFF
CROP = ACTUAL BV CROPPED ACREAGE
TOTAL BW DELIVERIES = ALL DELIVERIES MADE BY BV TO BV OR NON-DISTRICTED LANDS
DIST WELLS = DELIVERY OF DISTRICT WELL WATER FROM THE SYSTEM (LOSSES TAKEN OUT)

OTHER WELLS = GENERALLY FARMER WELLS DELIVERED INTO BV SYSTEM
TOTAL SURFACE DEL = TOTAL BW AND MAPLES LESS WELL (RECLAMATION INCLUDED)
TRANS LOSS = LOSS IN KERN RIVER, GENERALLY IN LARGE YEARS
BW & MAPLES RECL = RECLAMATION FIELD DELIVERIES (LOSSES TAKEN OUT)

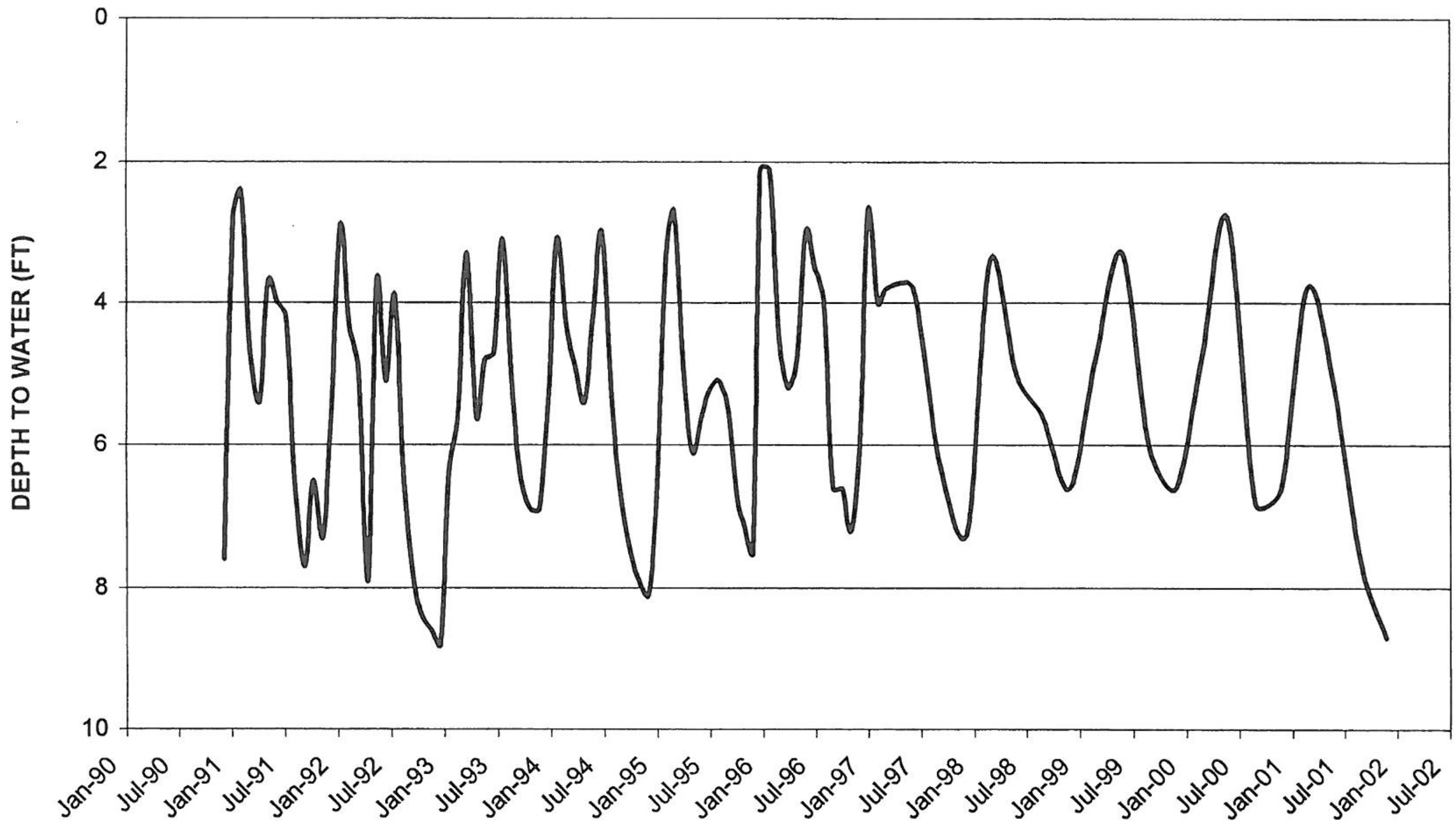
BW & MAPLES RECS = THESE RECLAMATION #S ARE RAW DELIVERIES (LOSSES NOT TAKEN OUT)

WATER LEVEL HYDROGRAPH
PIEZOMETER BV#2A
28-22 11Q GRND. ELEV=233.43 FT



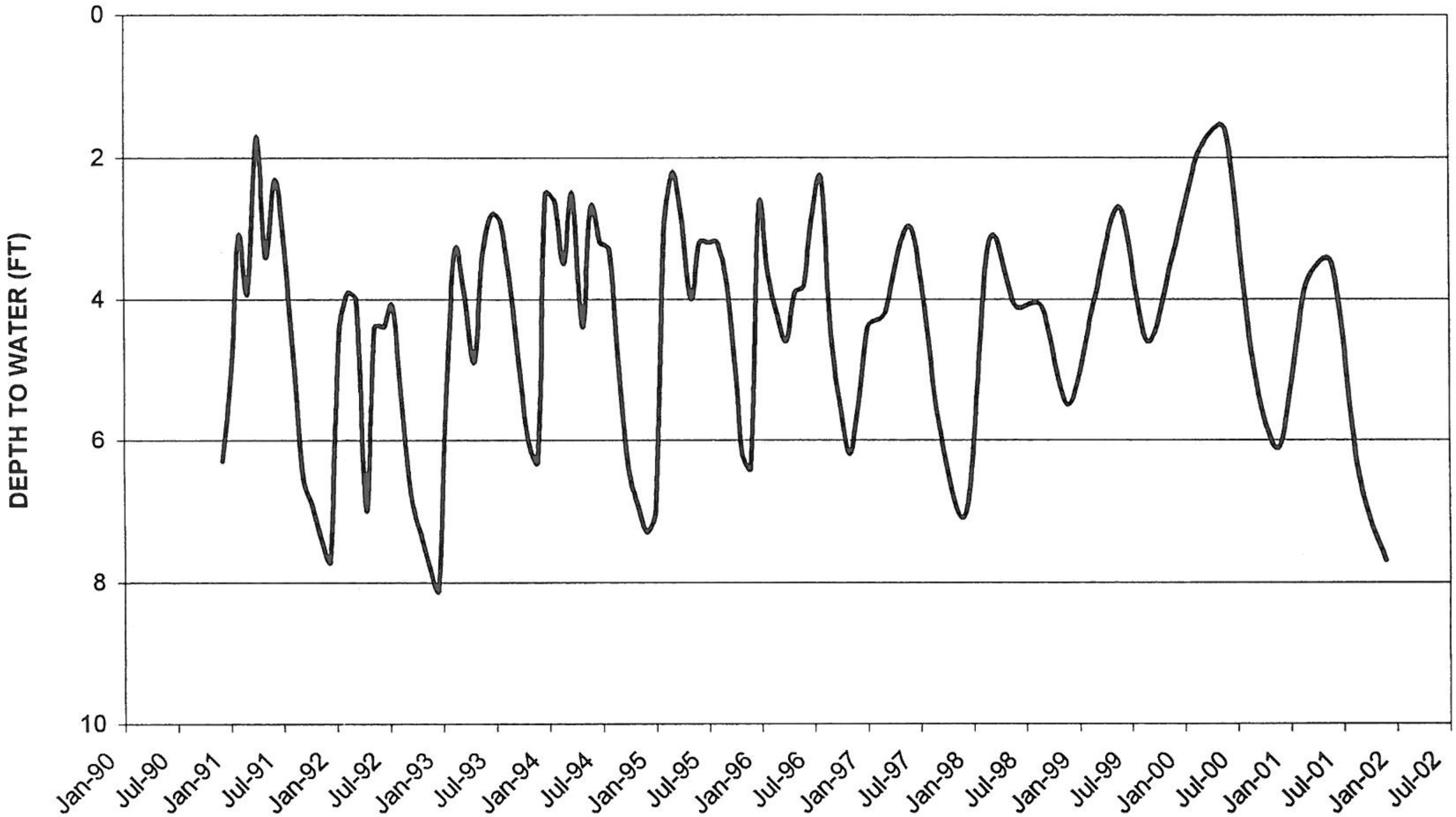
Buena Vista WSD

WATER LEVEL HYDROGRAPH
PIEZOMETER BV#5
27-22 9H GRND. ELEV=235.39 FT



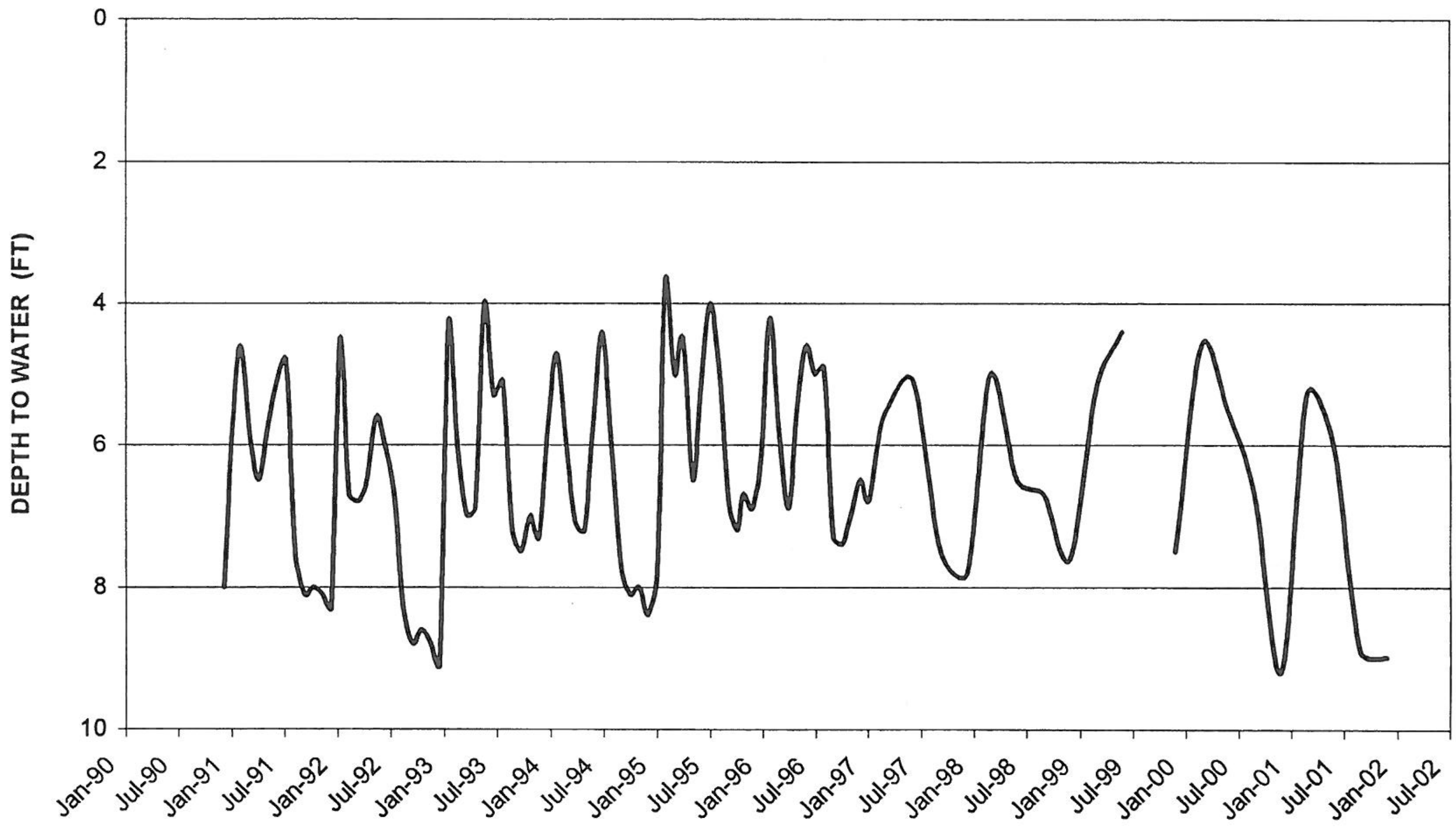
Buena Vista WSD

WATER LEVEL HYDROGRAPH
PIEZOMETER BV#8C
27-22 15N GRND. ELEV=236.06 FT



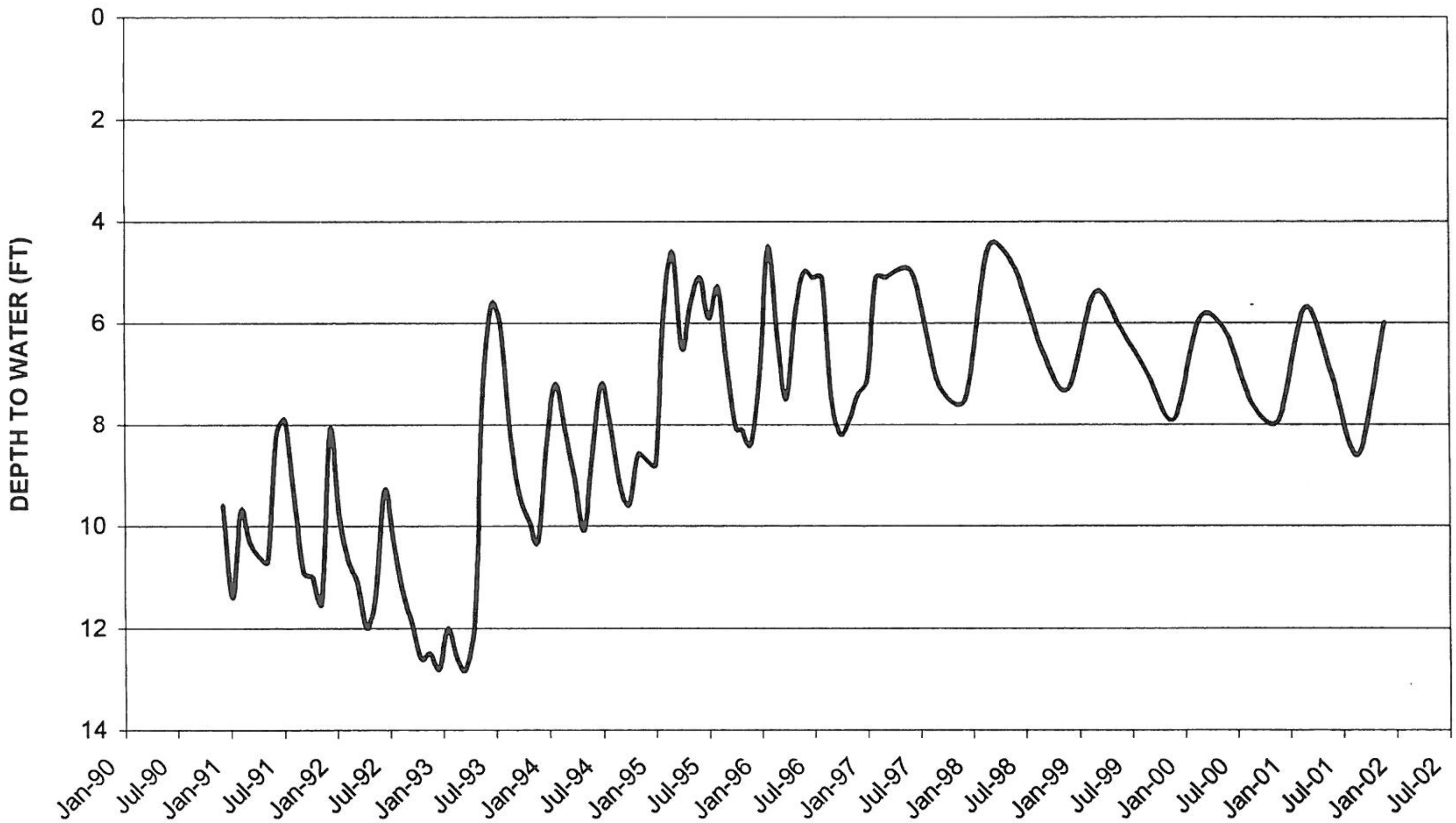
Buena Vista WSD

WATER LEVEL HYDROGRAPH
PIEZOMETER BV#10A
27-22 20H GRND. ELEV=239.63 FT

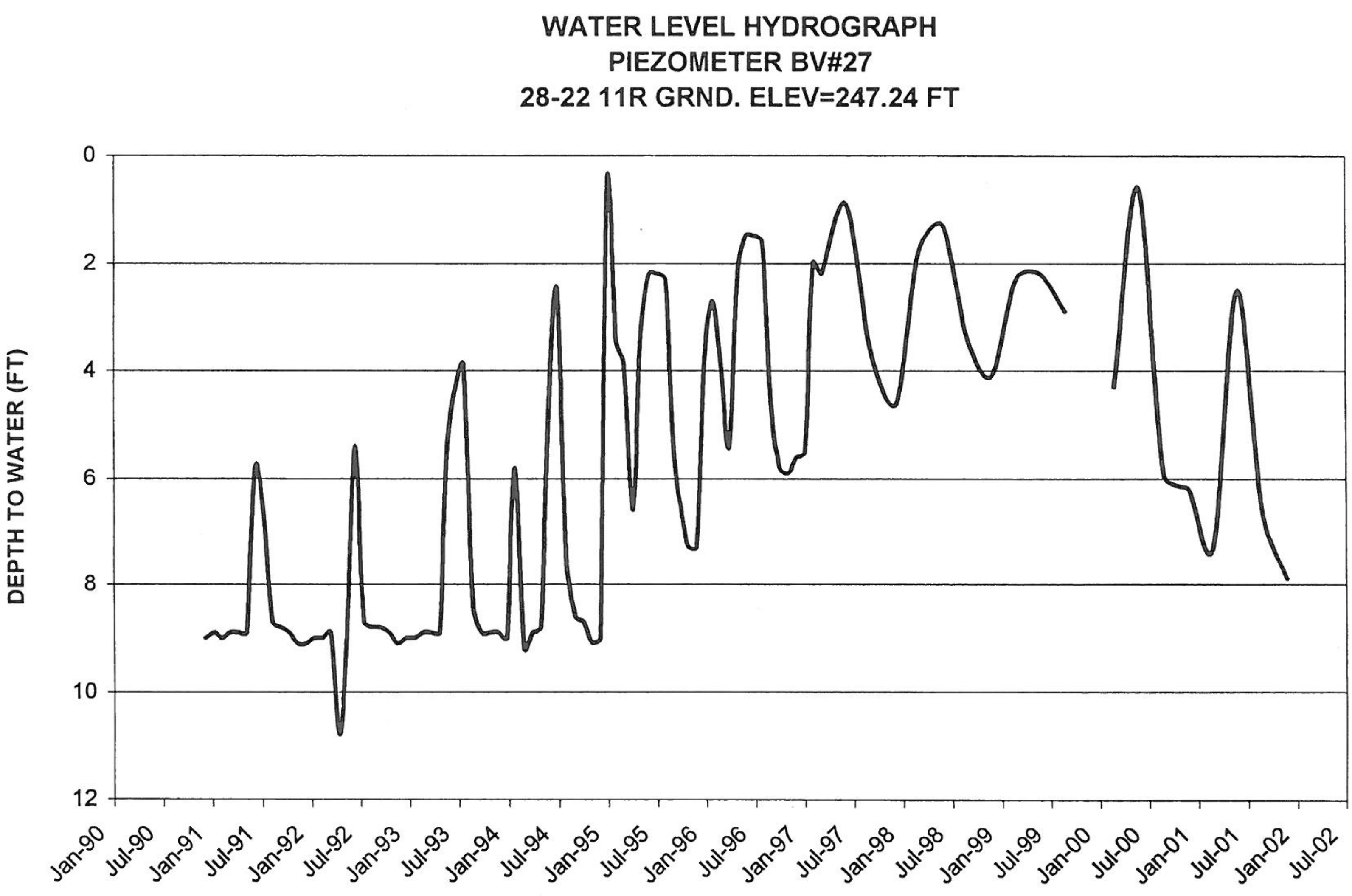


Buena Vista WSD

WATER LEVEL HYDROGRAPH
PIEZOMETER BV#17A
28-22 3D GRND. ELEV=244.28 FT

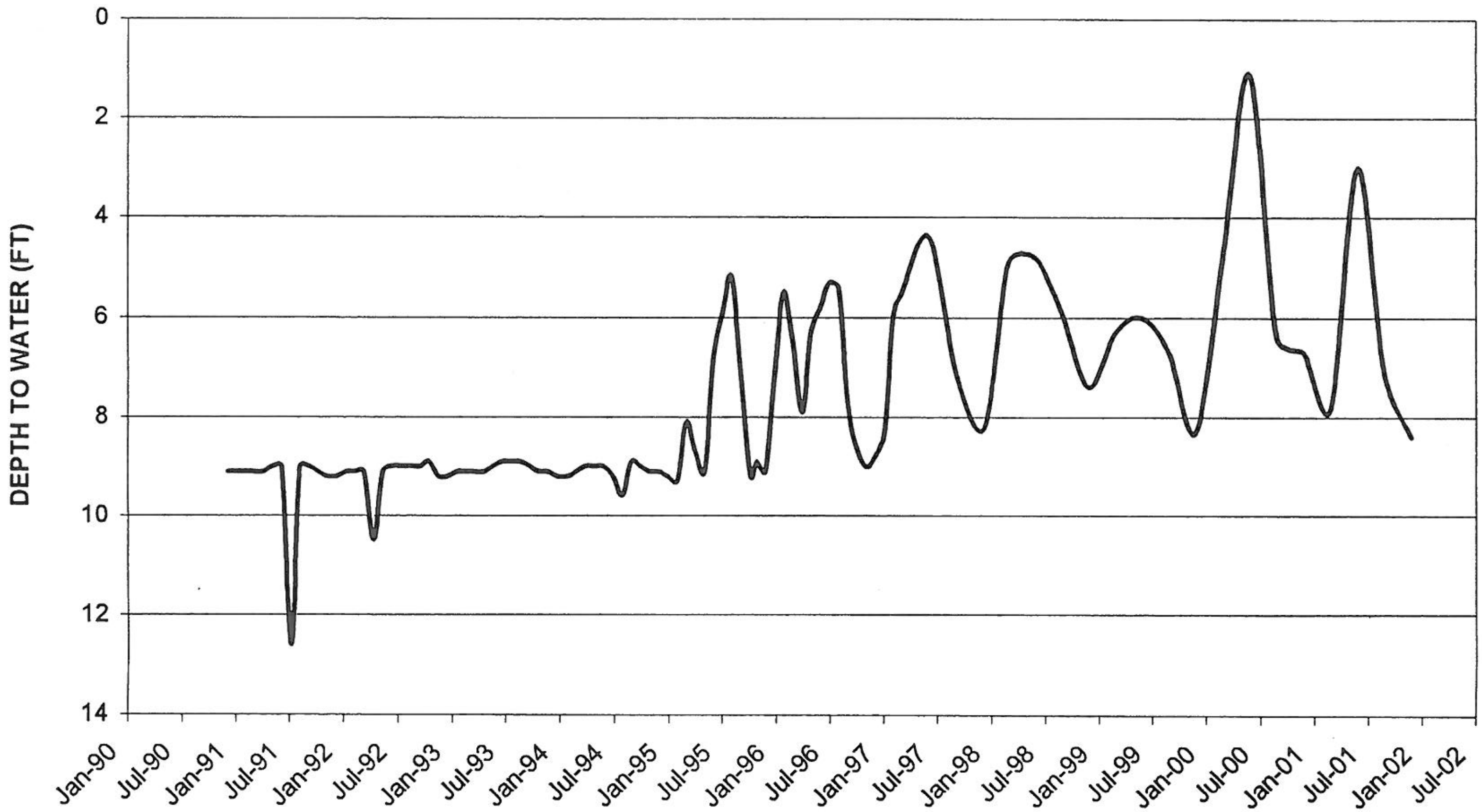


Buena Vista WSD



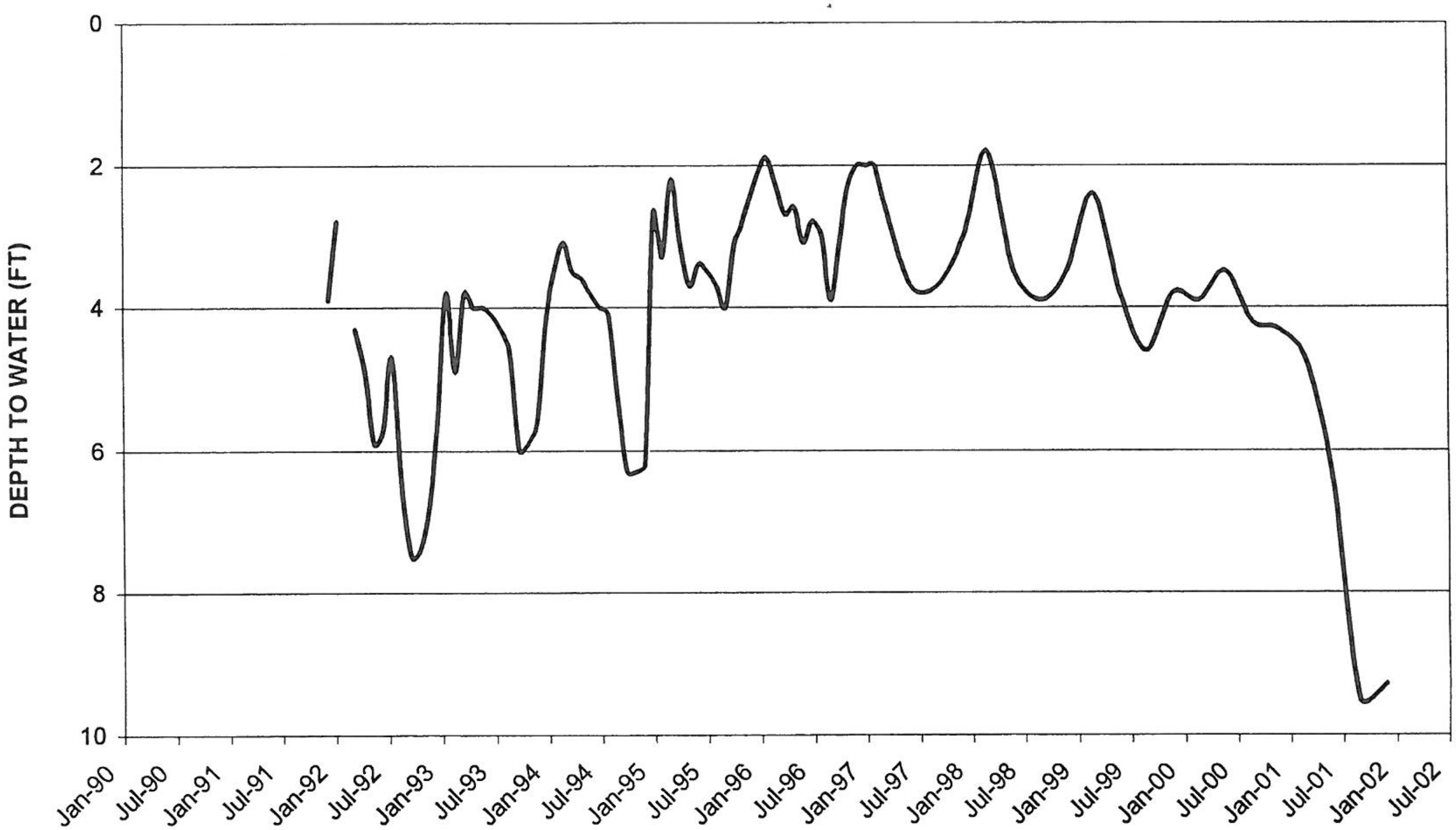
Buena Vista WSD

WATER LEVEL HYDROGRAPH
PIEZOMETER BV#29
28-22 13N GRND. ELEV=2251.31FT



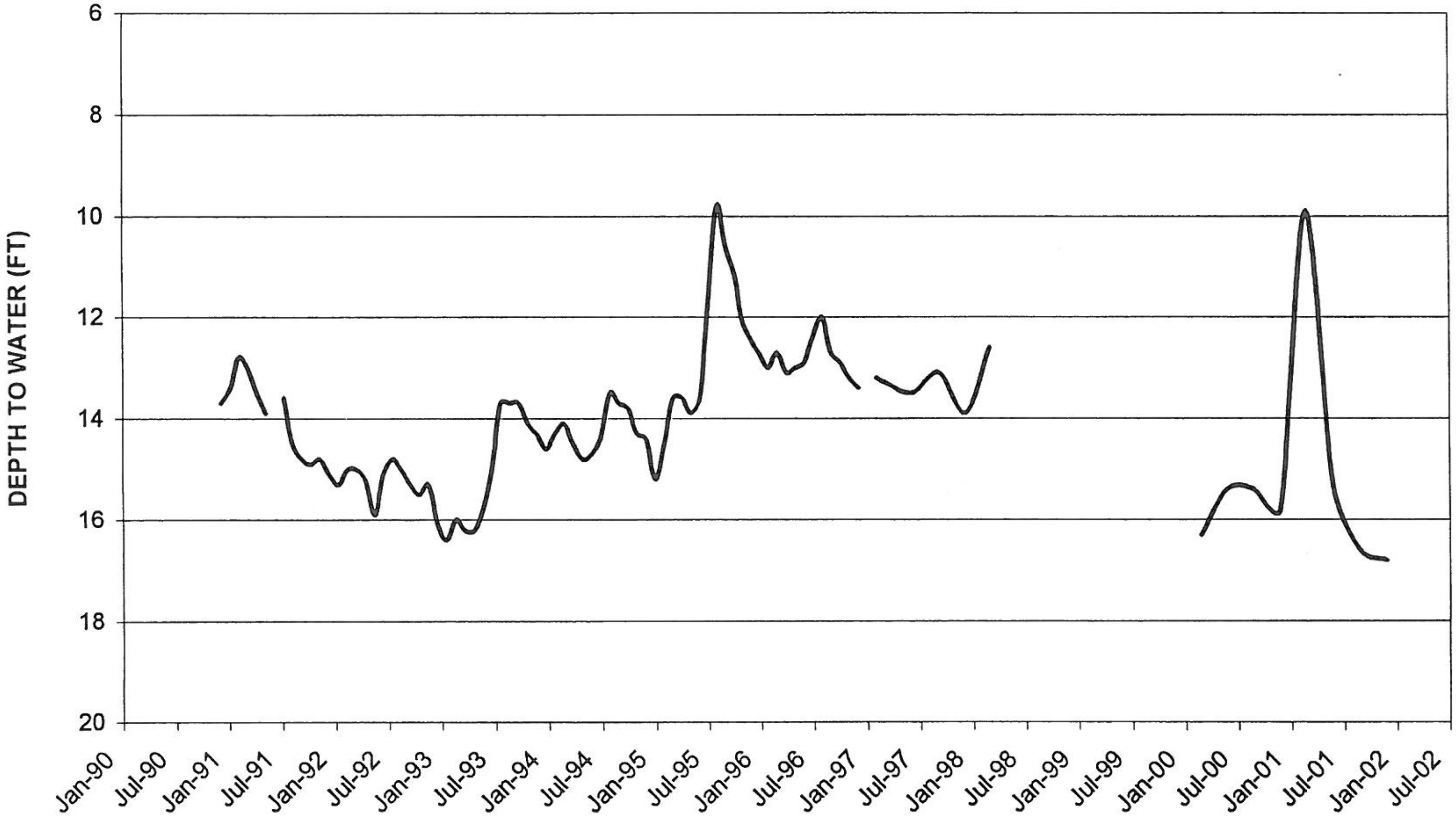
Buena Vista WSD

WATER LEVEL HYDROGRAPH
PIEZOMETER GL#9
27-22 13L GRND. ELEV=235.98 FT



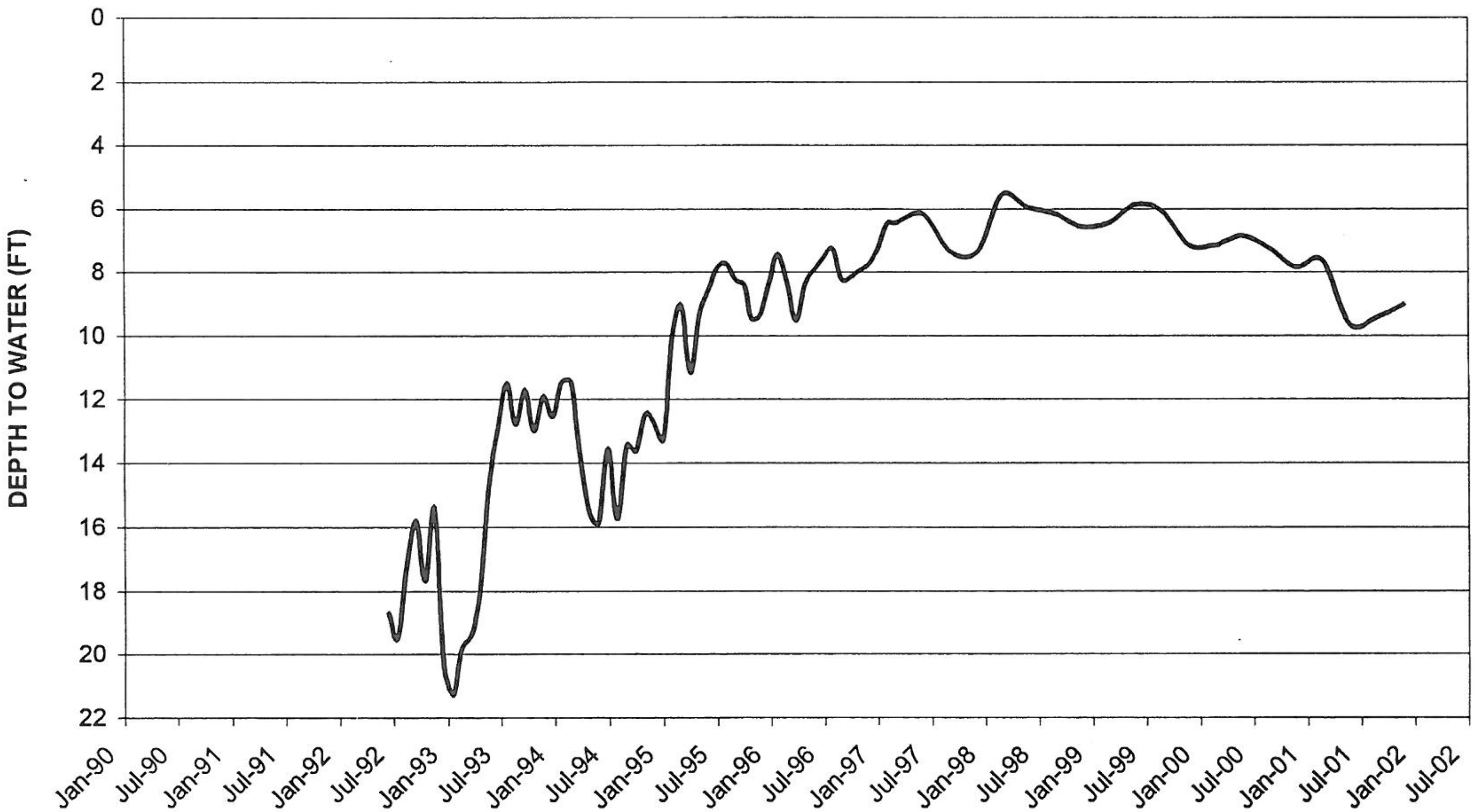
Buena Vista WSD

WATER LEVEL HYDROGRAPH
PIEZOMETER BEL#3A
27-22 7N GRND. ELEV=249.91FT



Buena Vista WSD

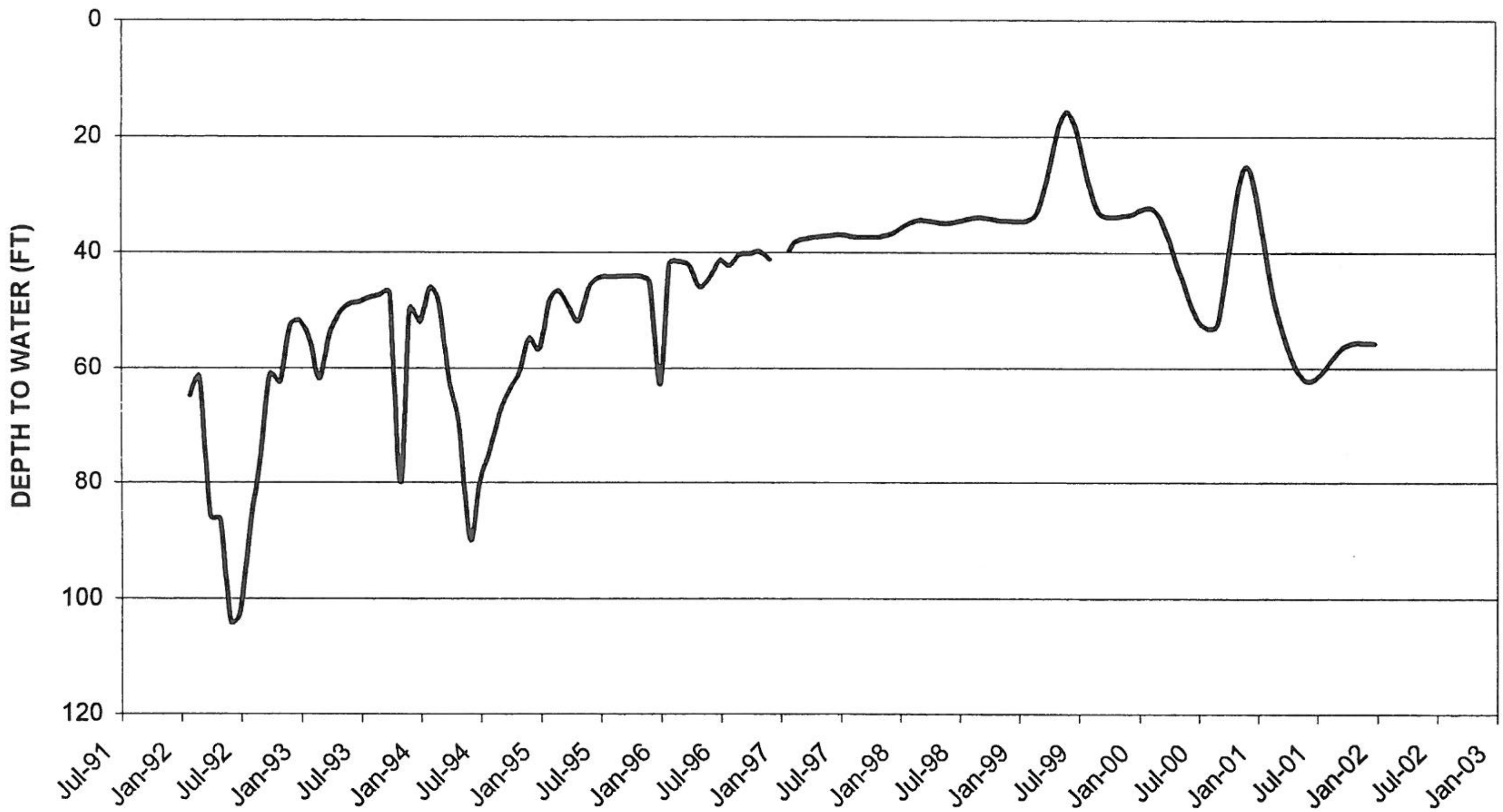
WATER LEVEL HYDROGRAPH
PIEZOMETER BEL#15B
28-22 16N GRND. ELEV=252.21FT



Buena Vista WSD

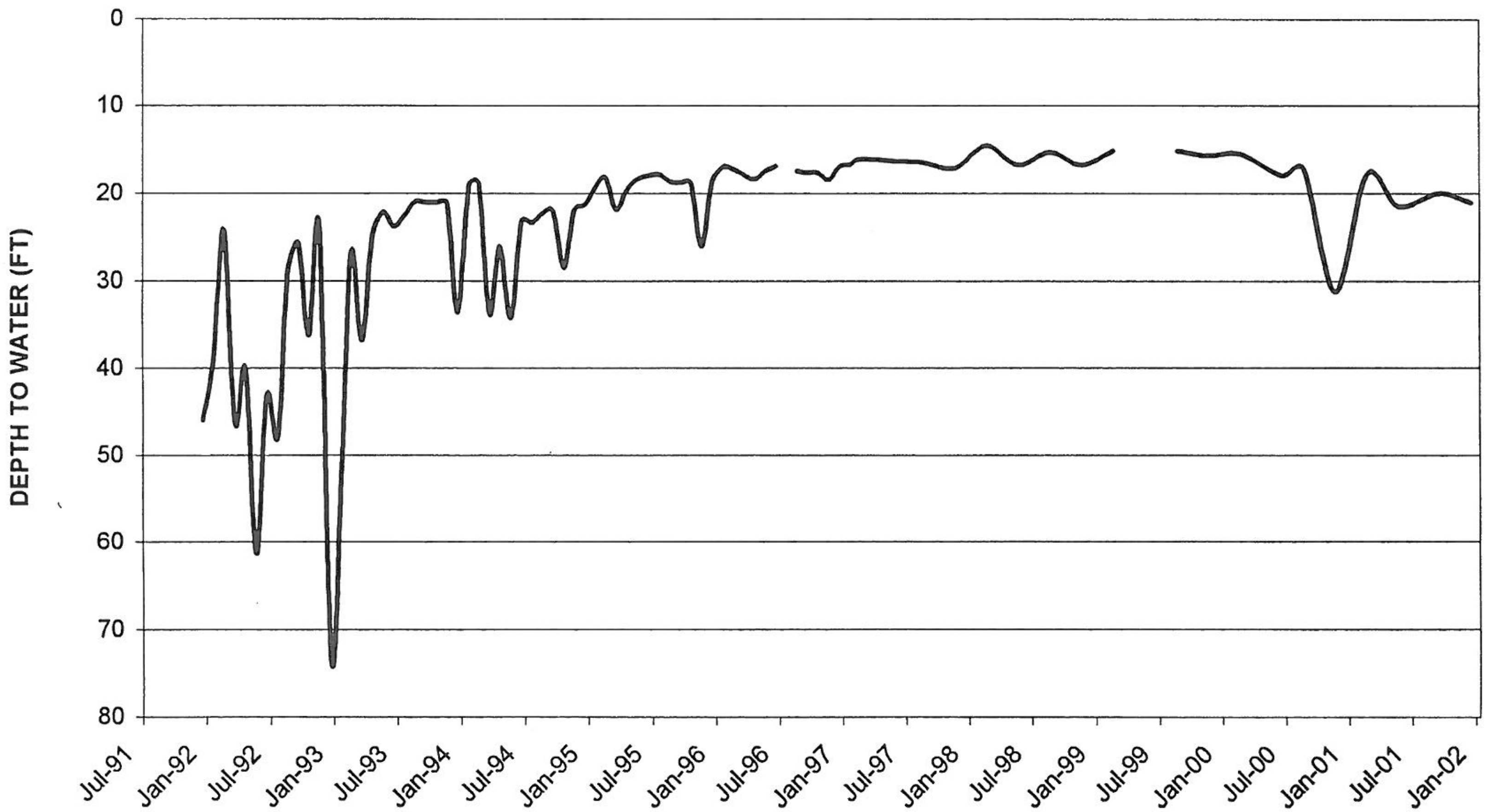
Appendix D

WATER LEVEL HYDROGRAPH
DMW #2
27-22 23D GRND. ELEV=234.5 FT



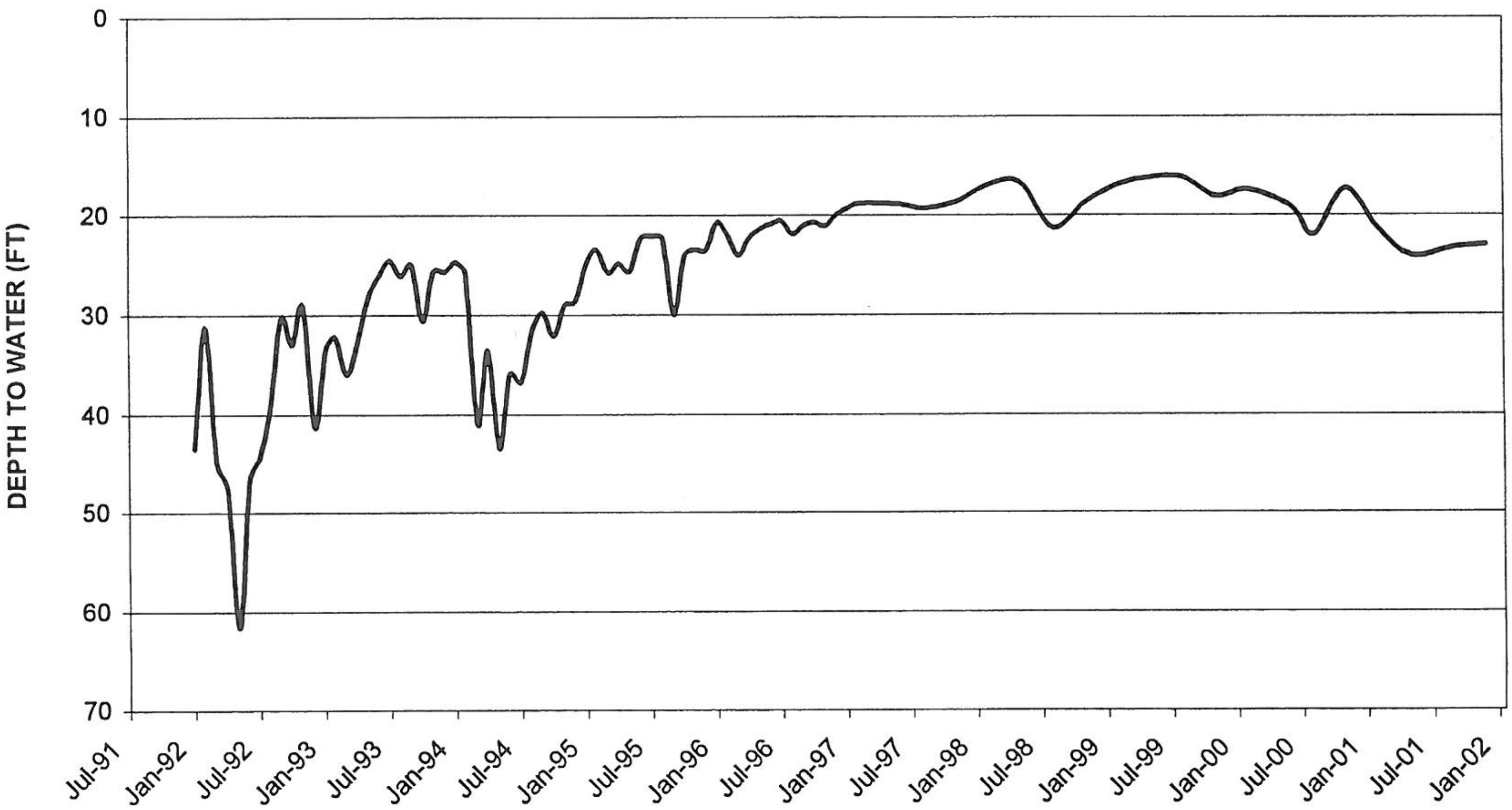
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #1
27-22 8A GRND. ELEV=235.7 FT



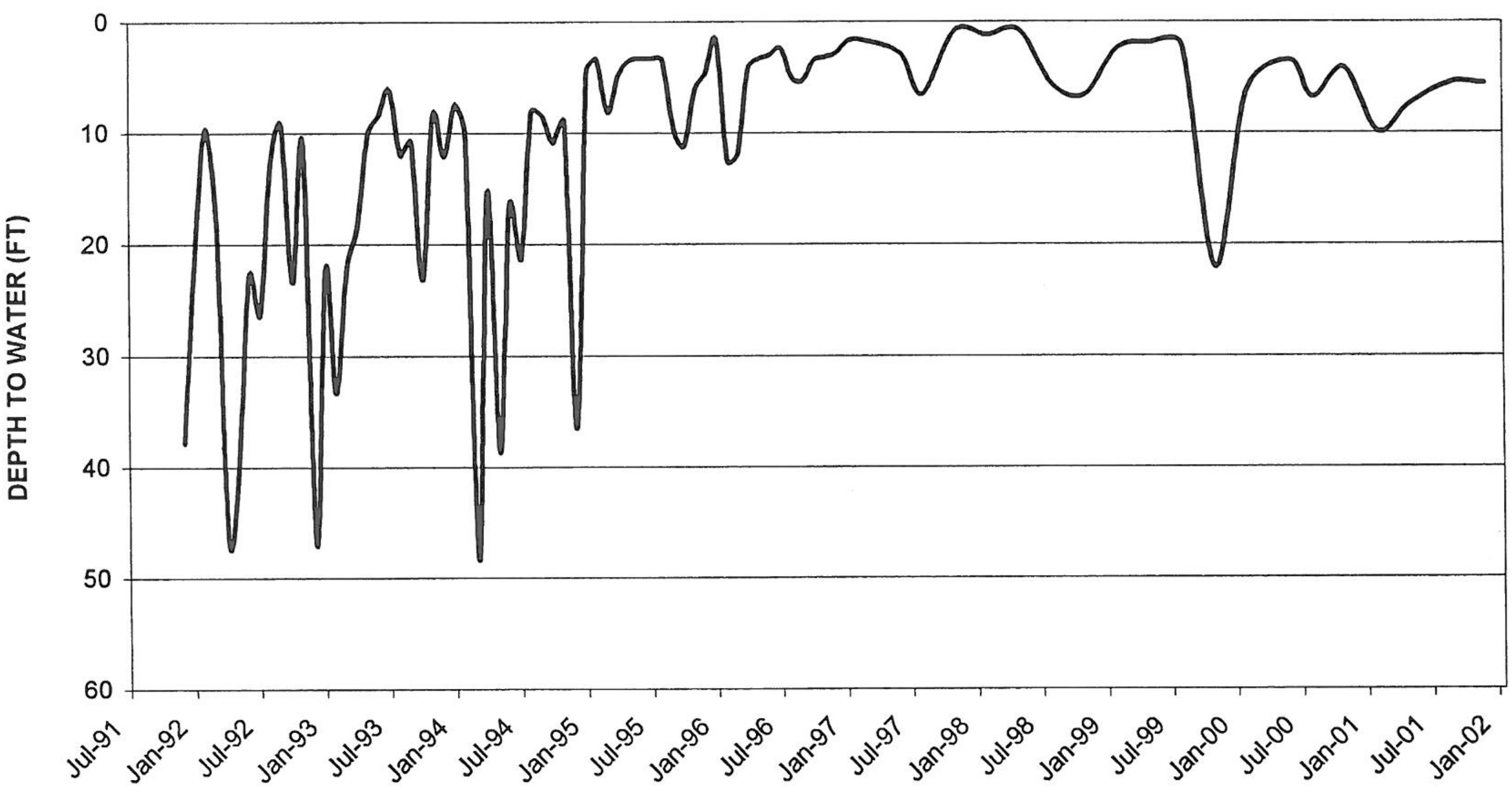
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #3
27-22 33A GRND. ELEV=240.5 FT



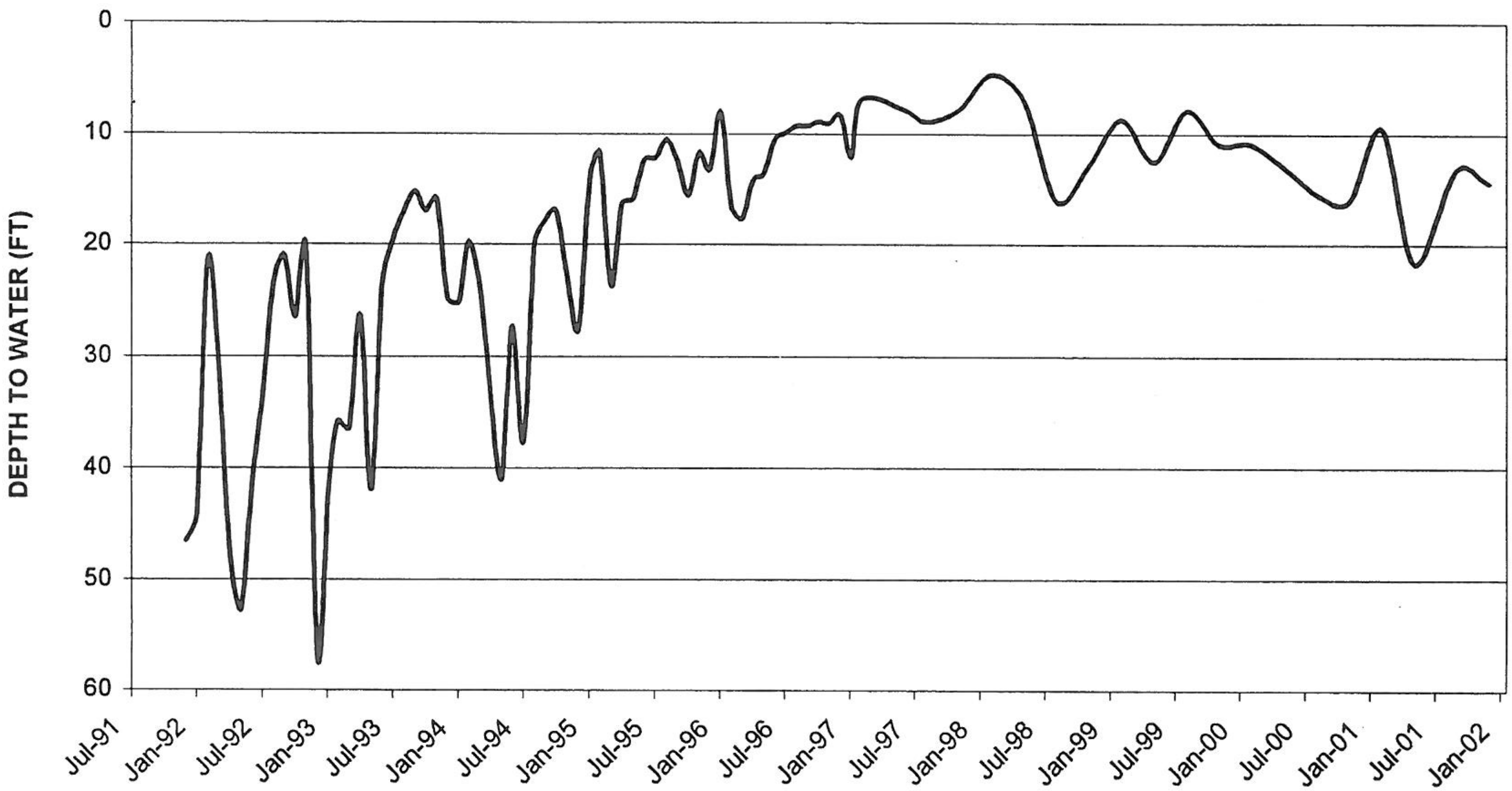
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #4
28-22 10D GRND. ELEV=242.8 FT



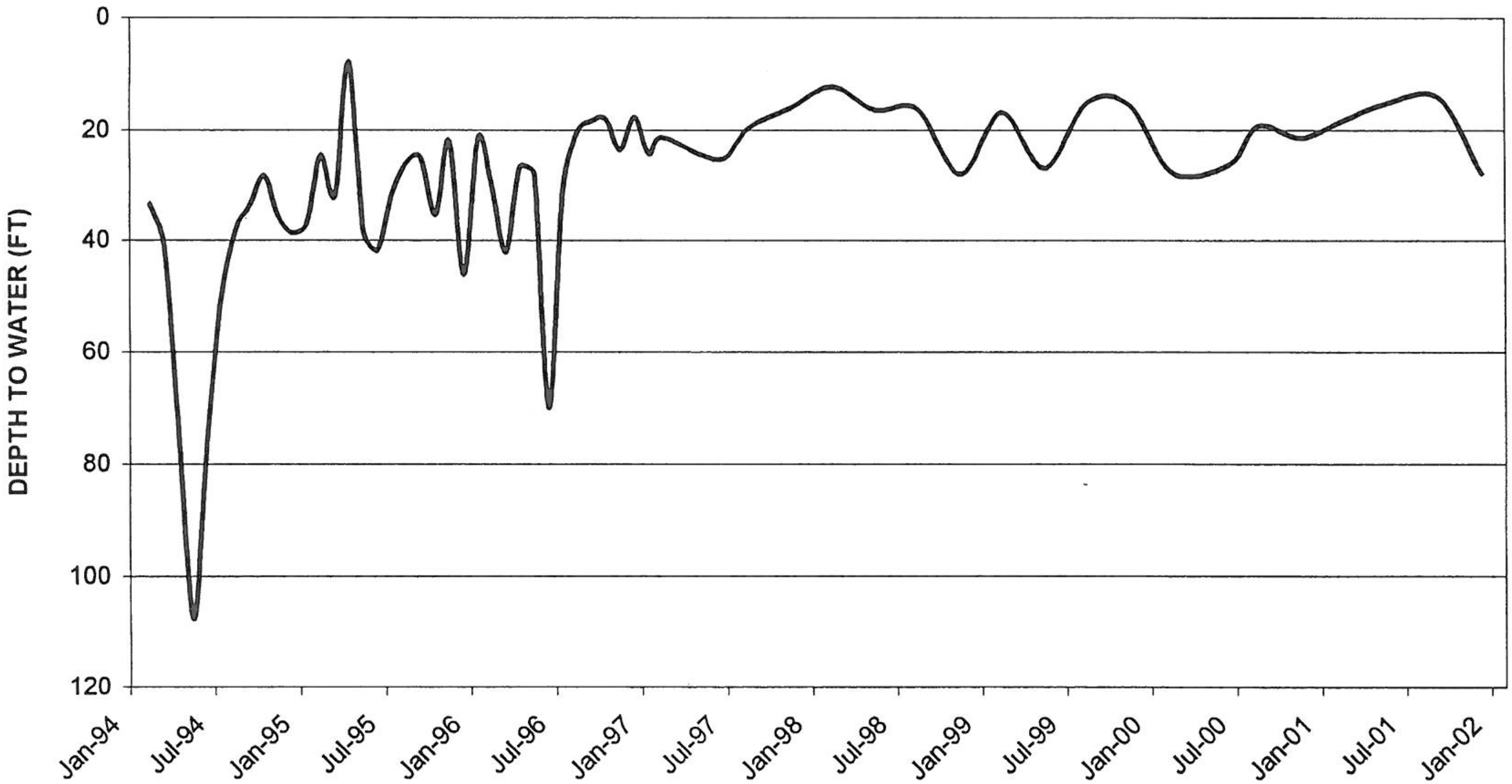
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #5
28-22 14R GRND. ELEV=250.9 FT



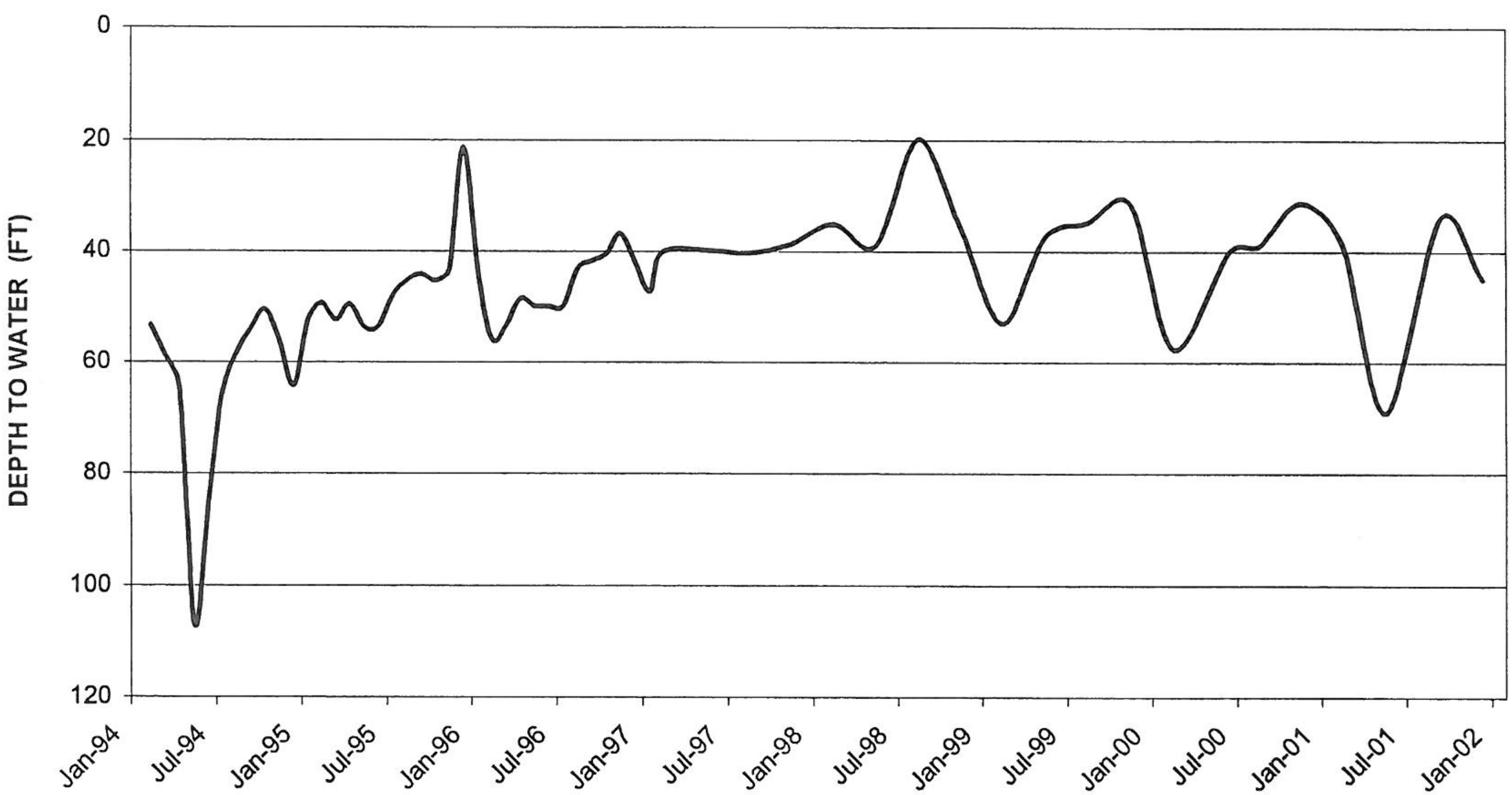
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #6
28-23 31B GRND. ELEV=257.0 FT



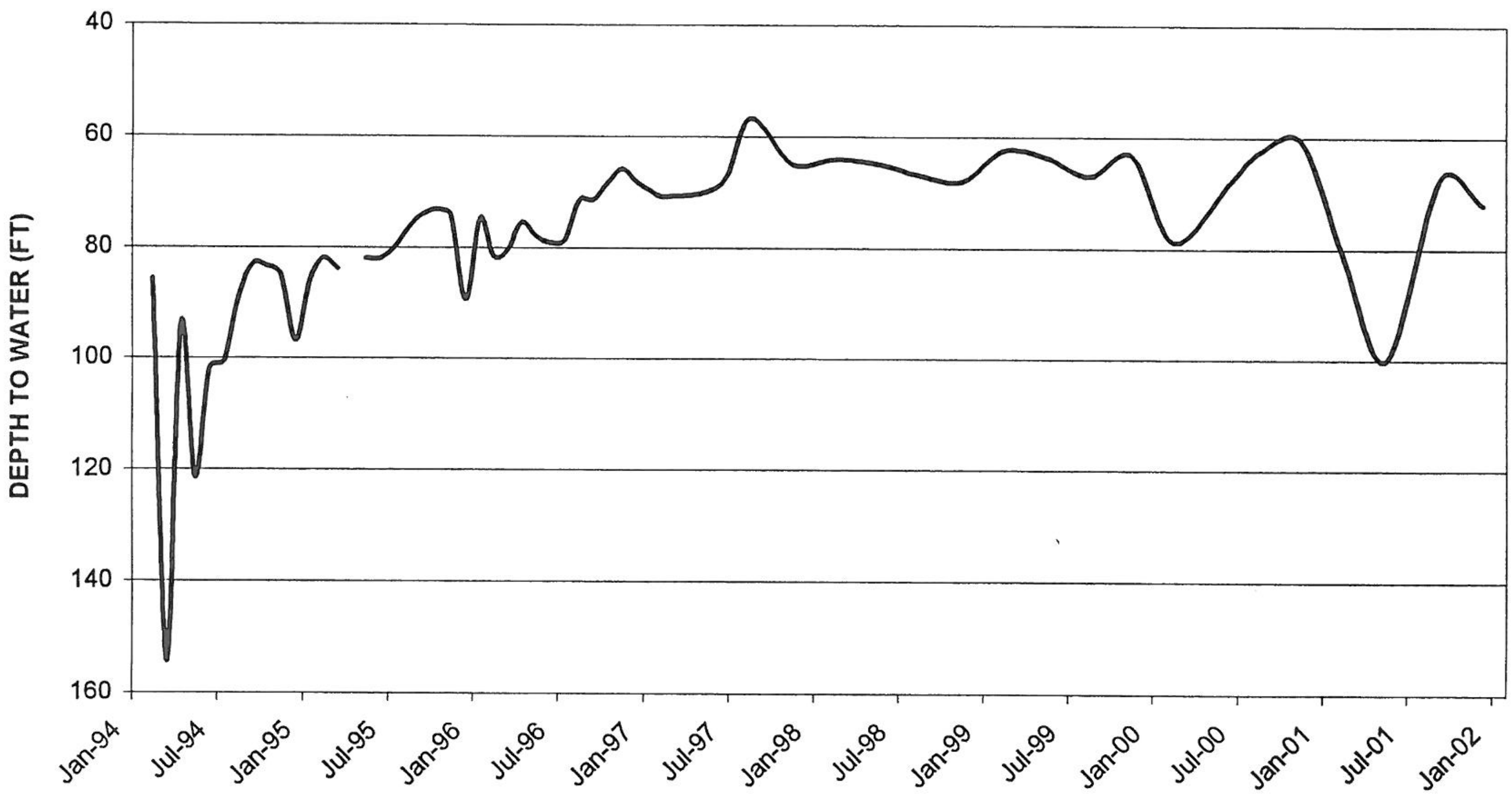
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #7
29-23 16R GRND. ELEV=262.0 FT

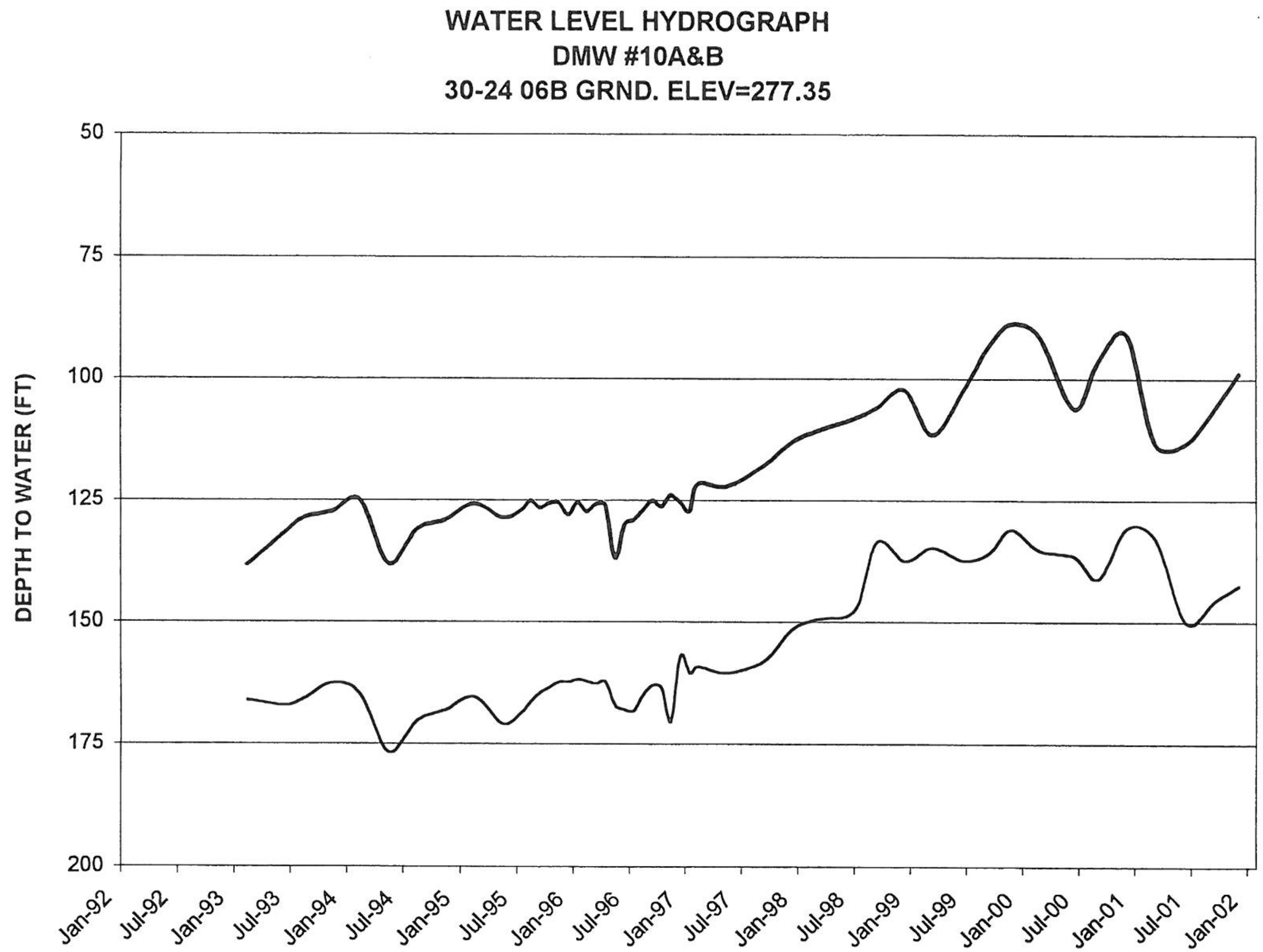


Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #8
29-23 24H GRND. ELEV=271.0 FT

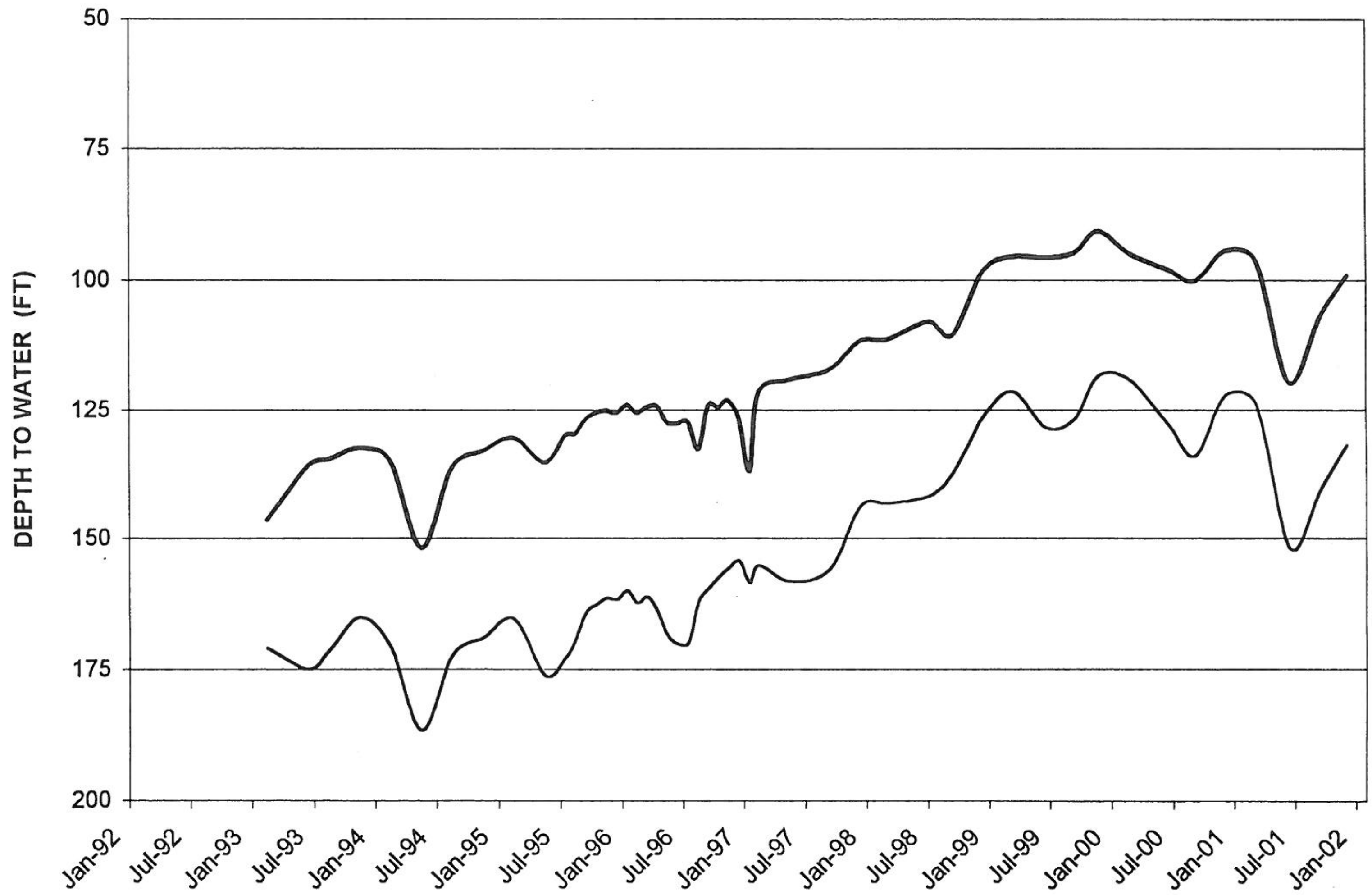


Buena Vista WSD



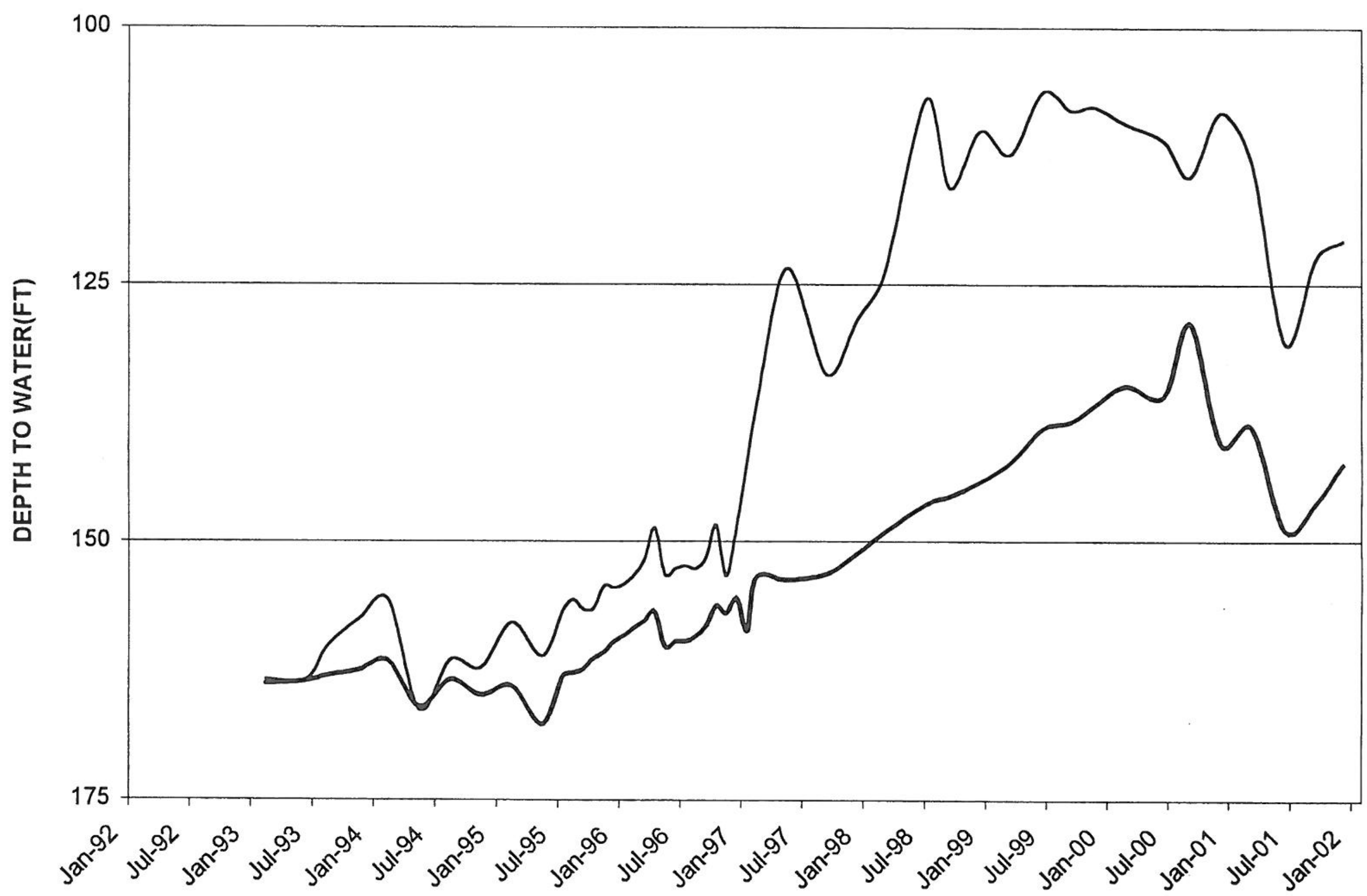
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #11A&B
30-24 34N GRND. ELEV=282.13



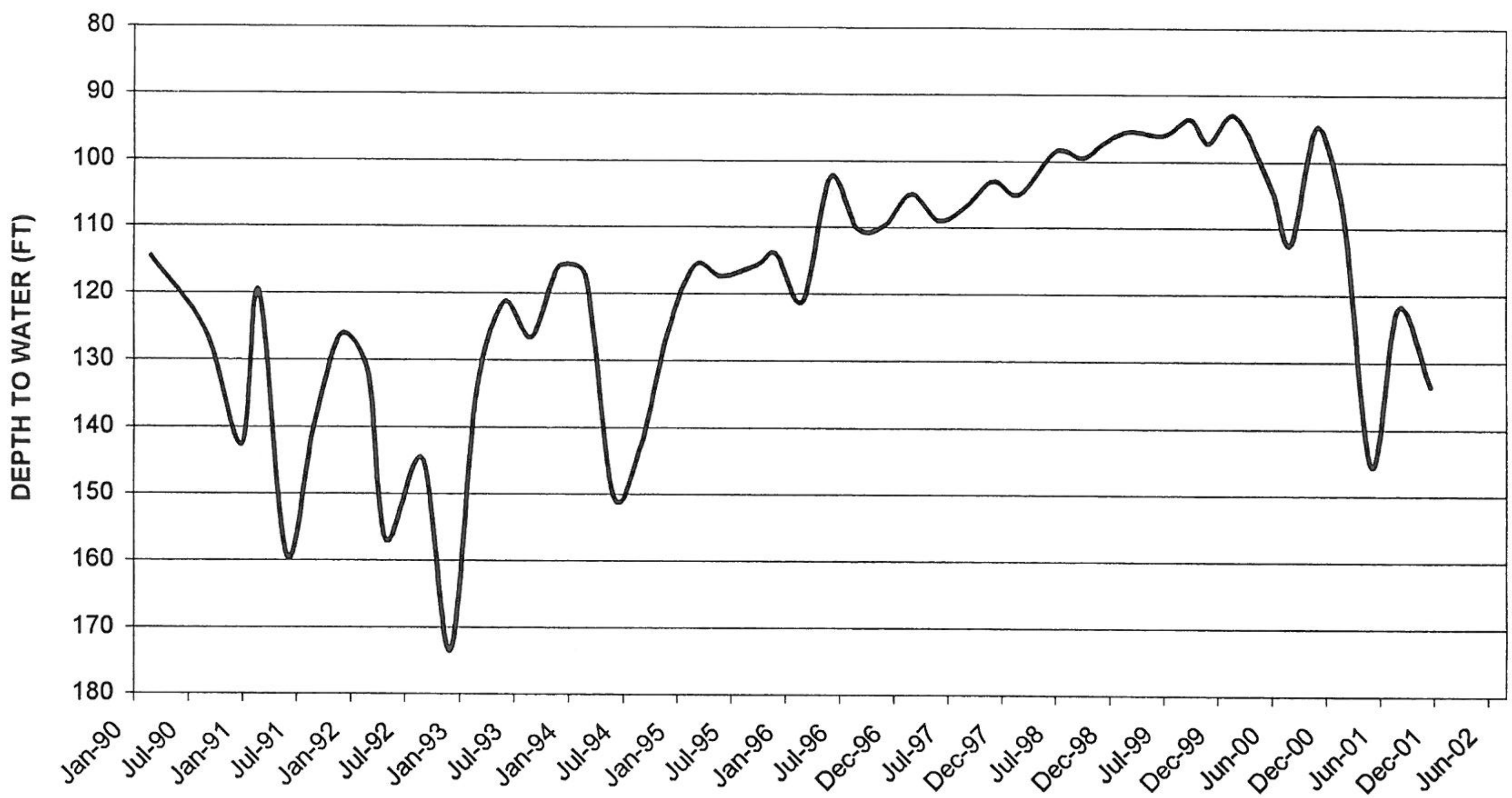
Buena Vista WSD

WATER LEVEL HYDROGRAPH
DMW #12A&B
30-24 14M GRND. ELEV=288.62



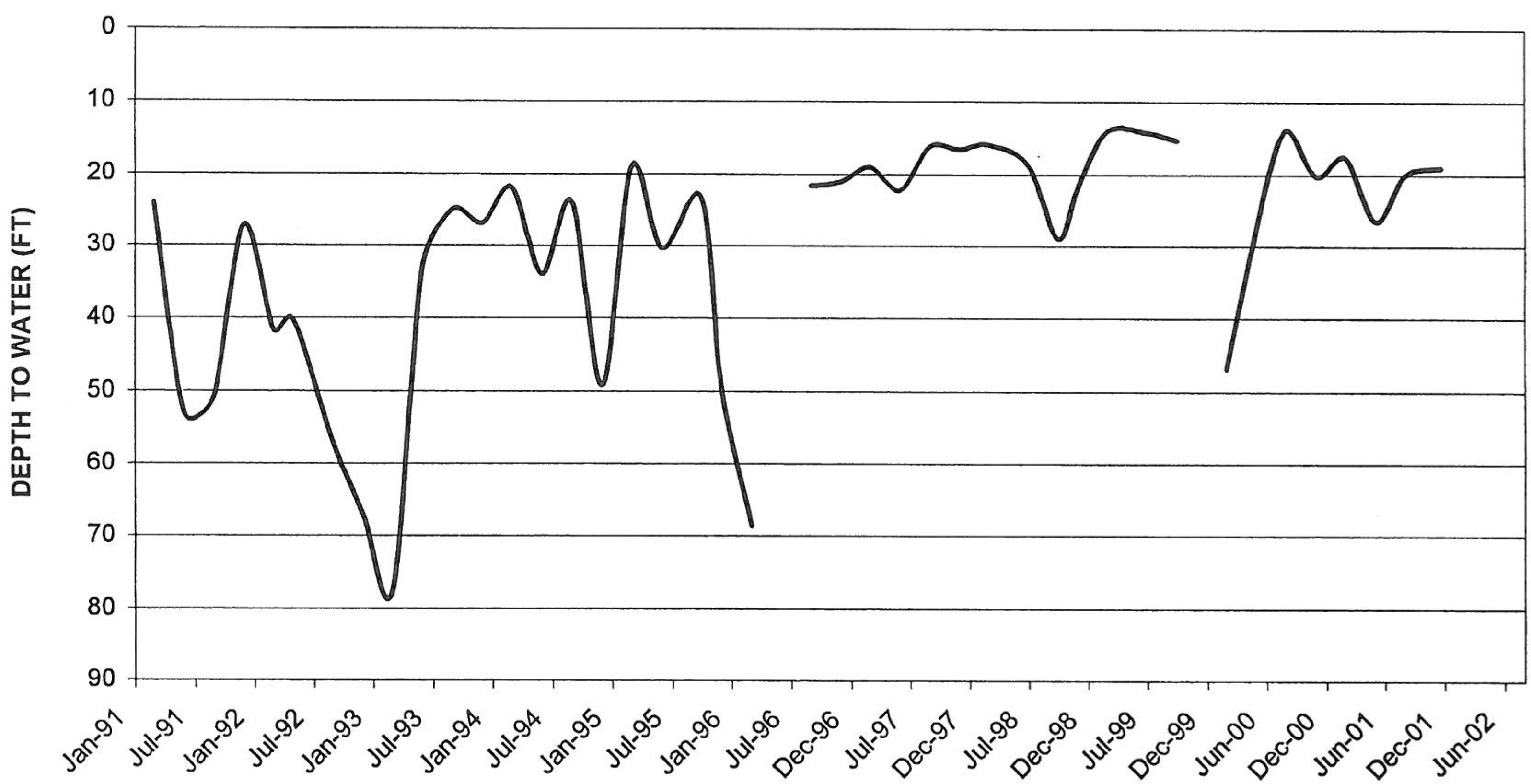
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL #A2
27-22 23D1 GRND. ELEV=238.0 FT



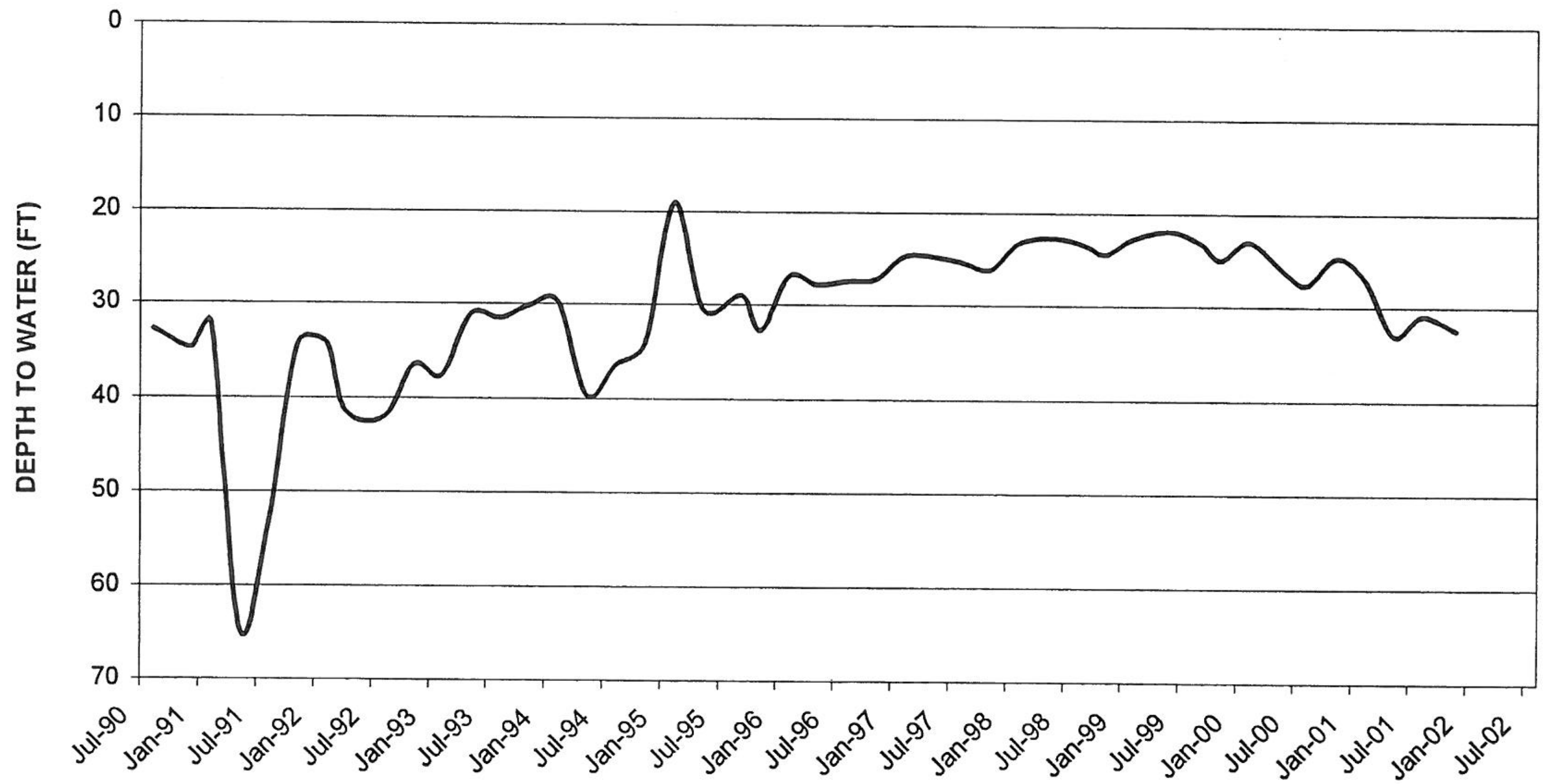
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL #A3
27-22 5P GRND. ELEV=236.0 FT



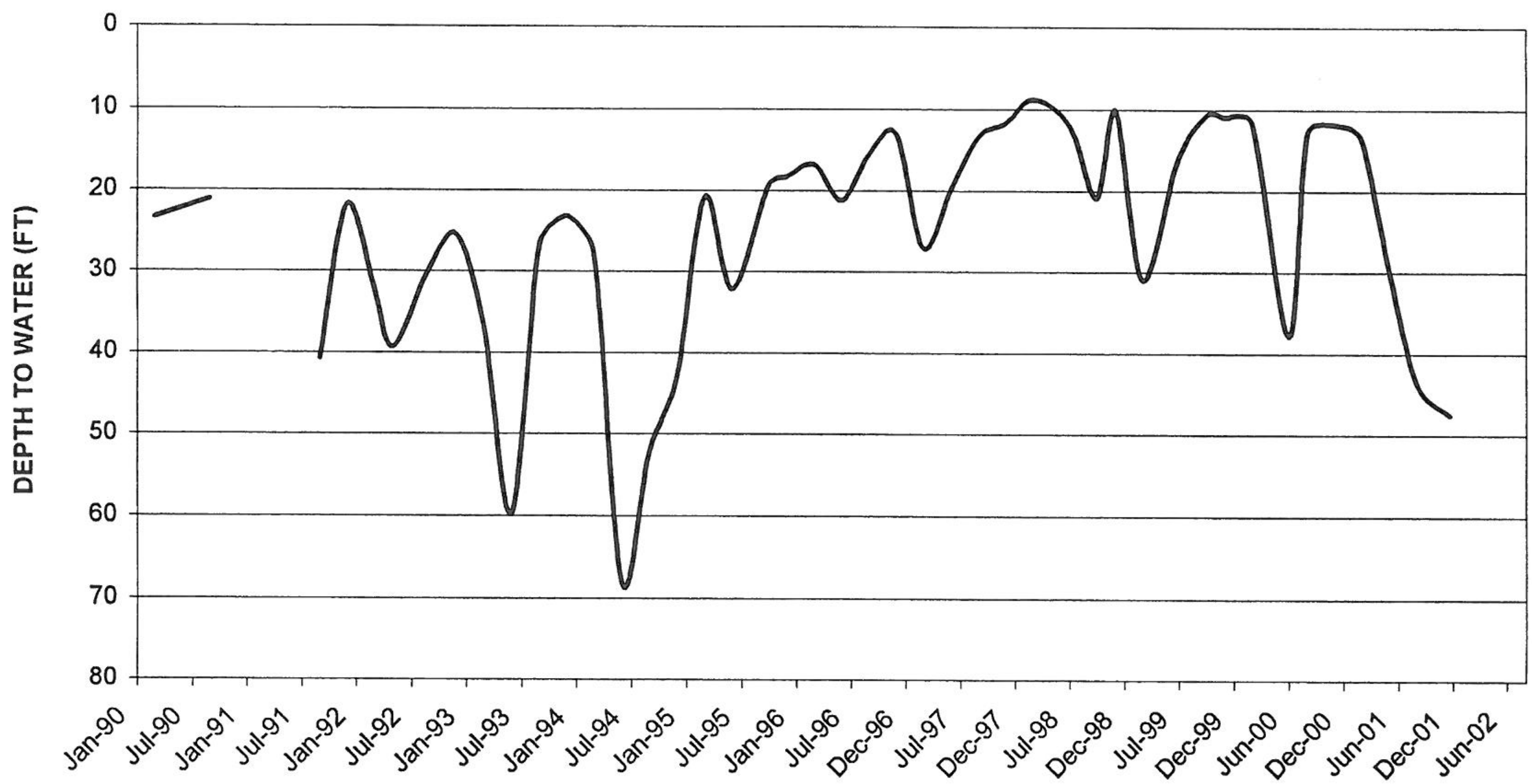
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL #A4
27-22 16Q GRND. ELEV=240.0 FT



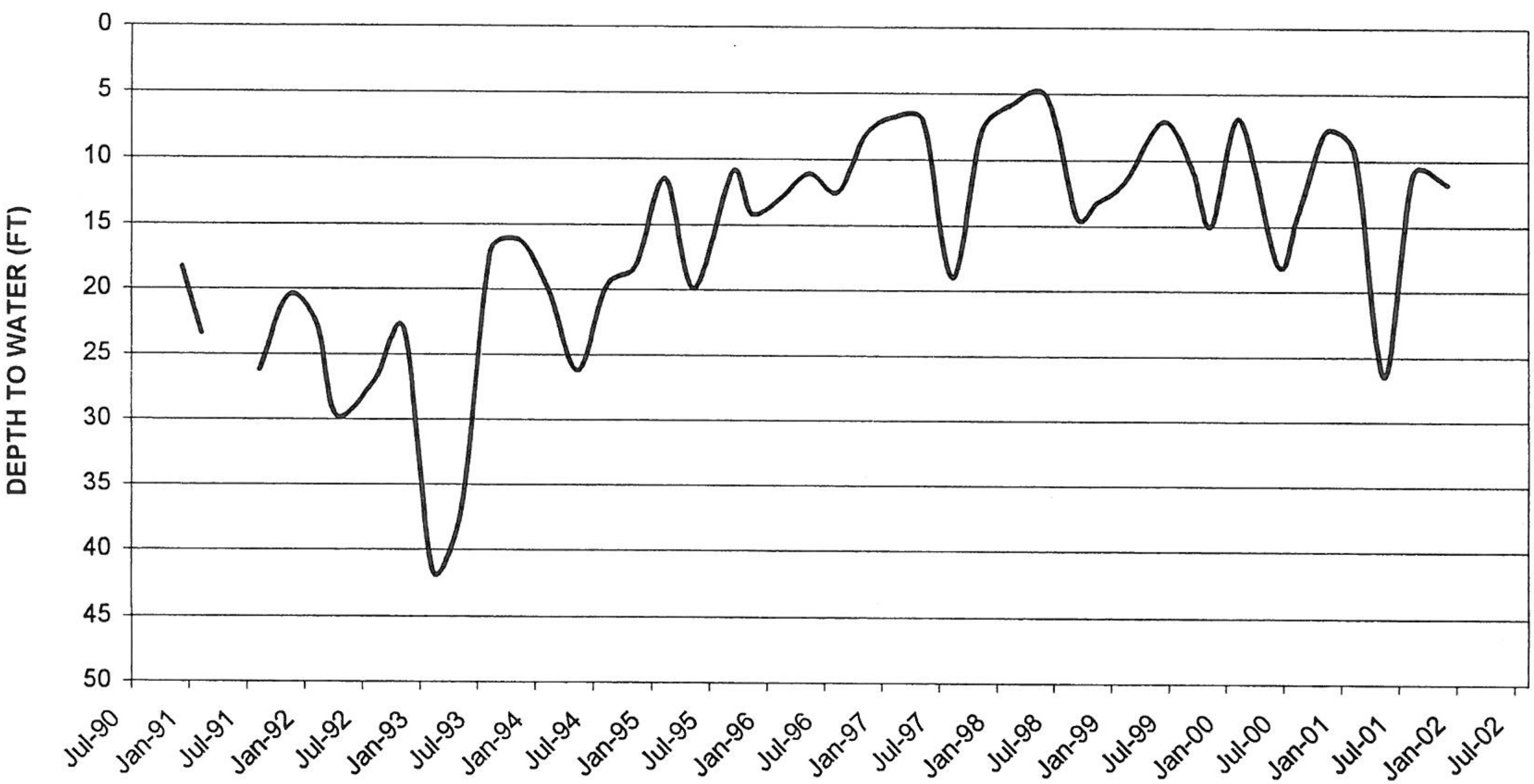
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL #B1
28-23 20N1 GRND. ELEV=256.0 FT



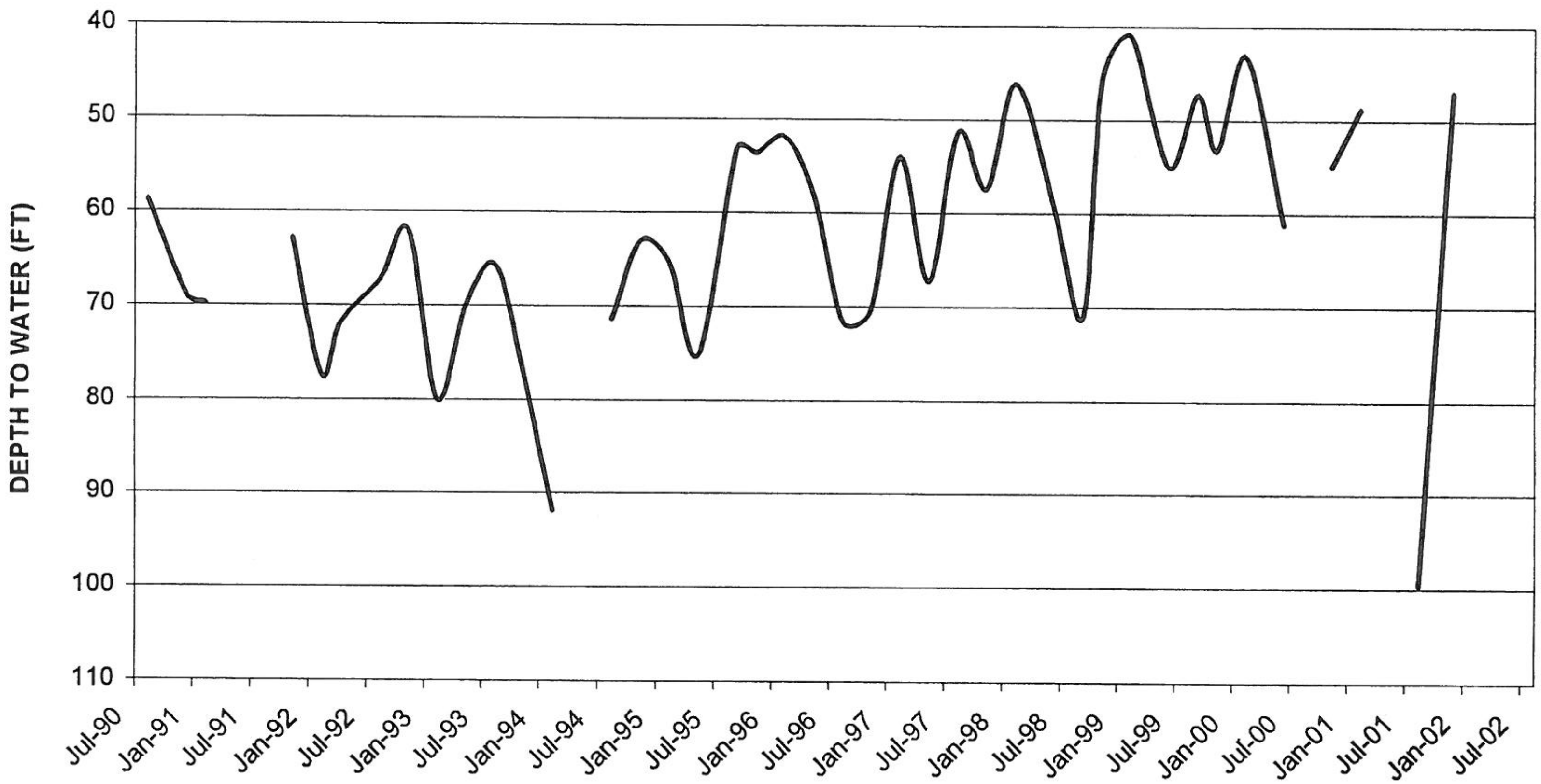
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL #B6
28-22 11Q GRND. ELEV=247.0 FT



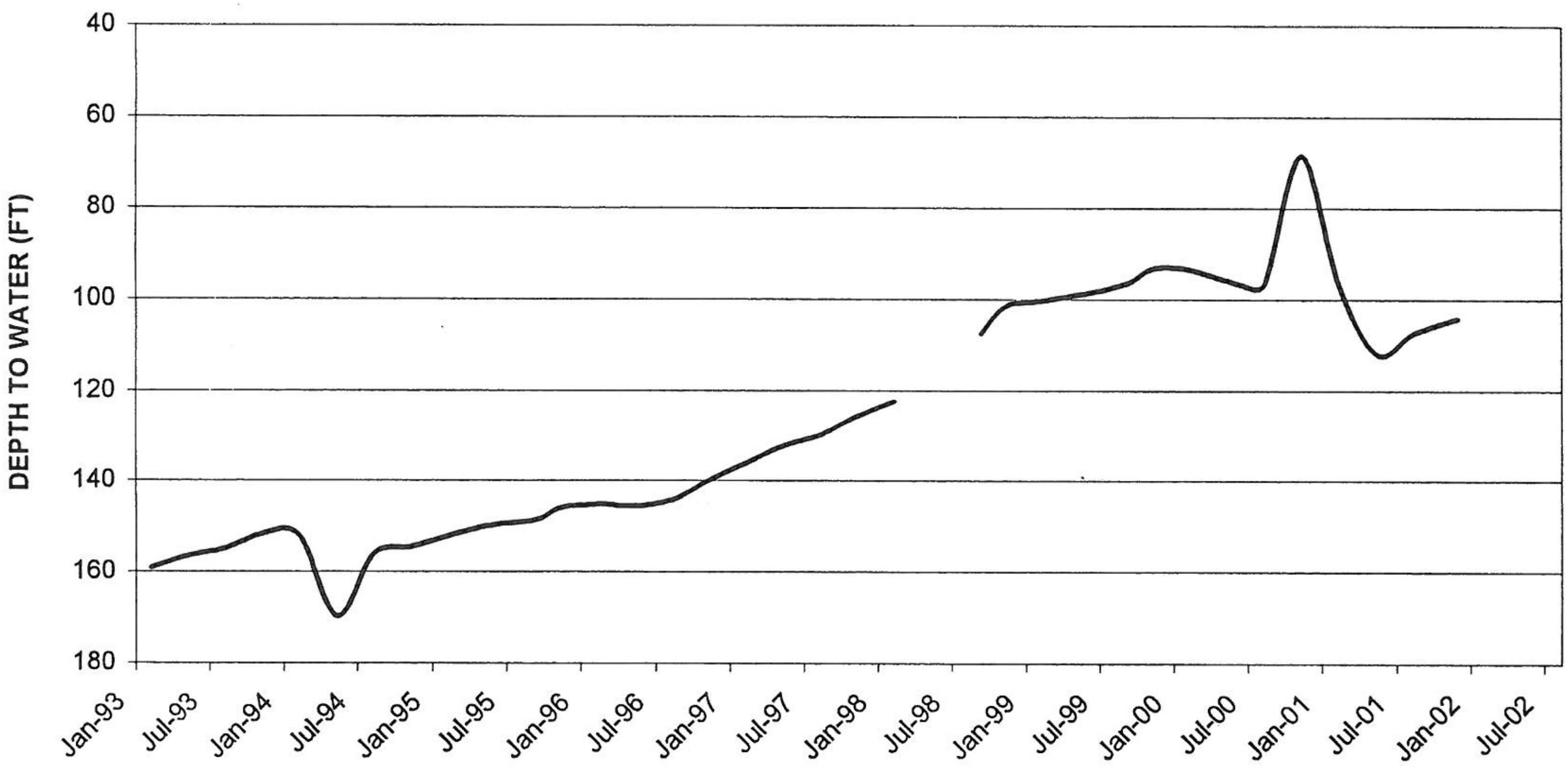
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL #C11
29-23 24P1 GRND. ELEV=269.0 FT



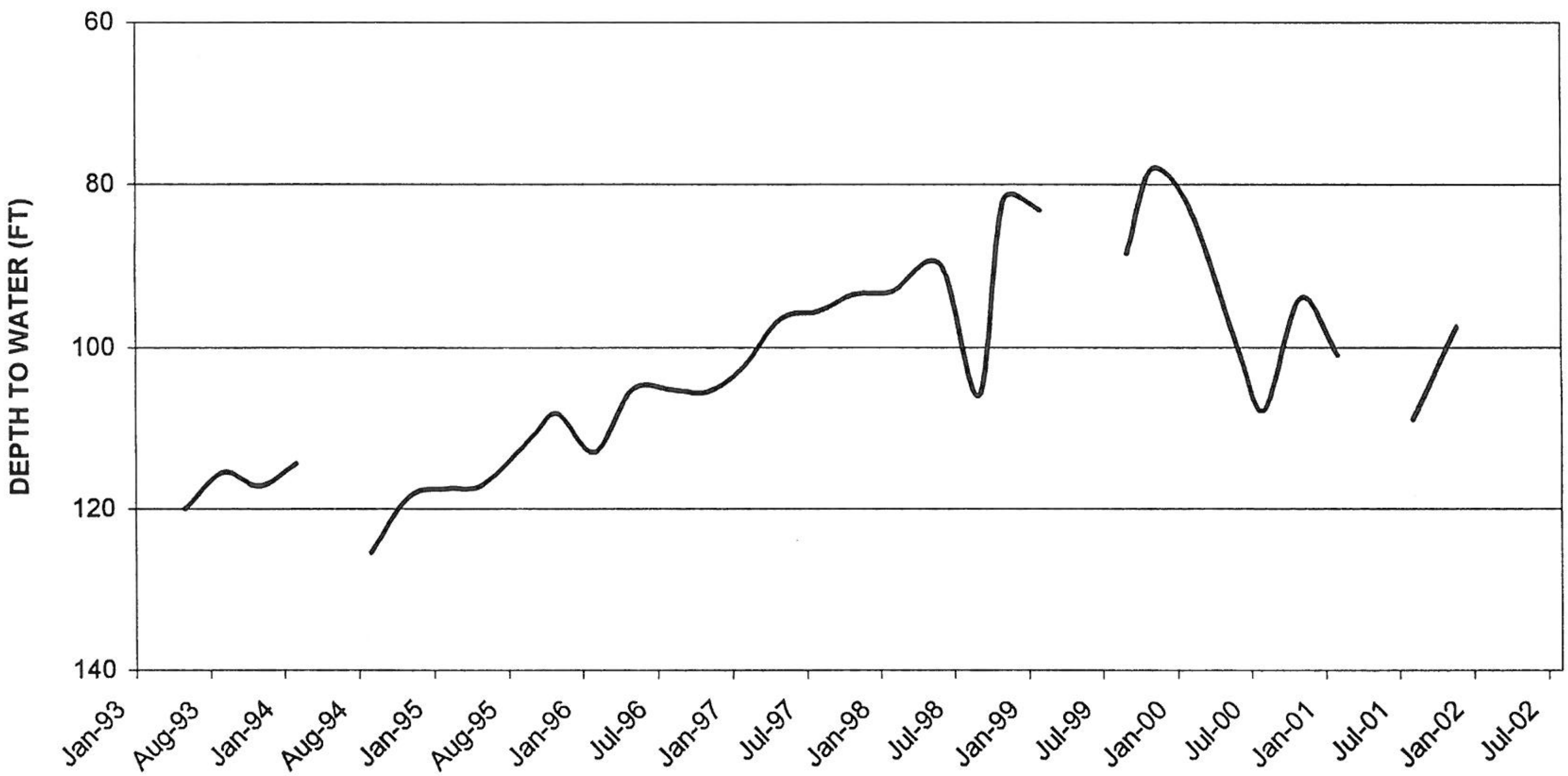
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL D7
30-24 15D GRND. ELEV=285.6 FT



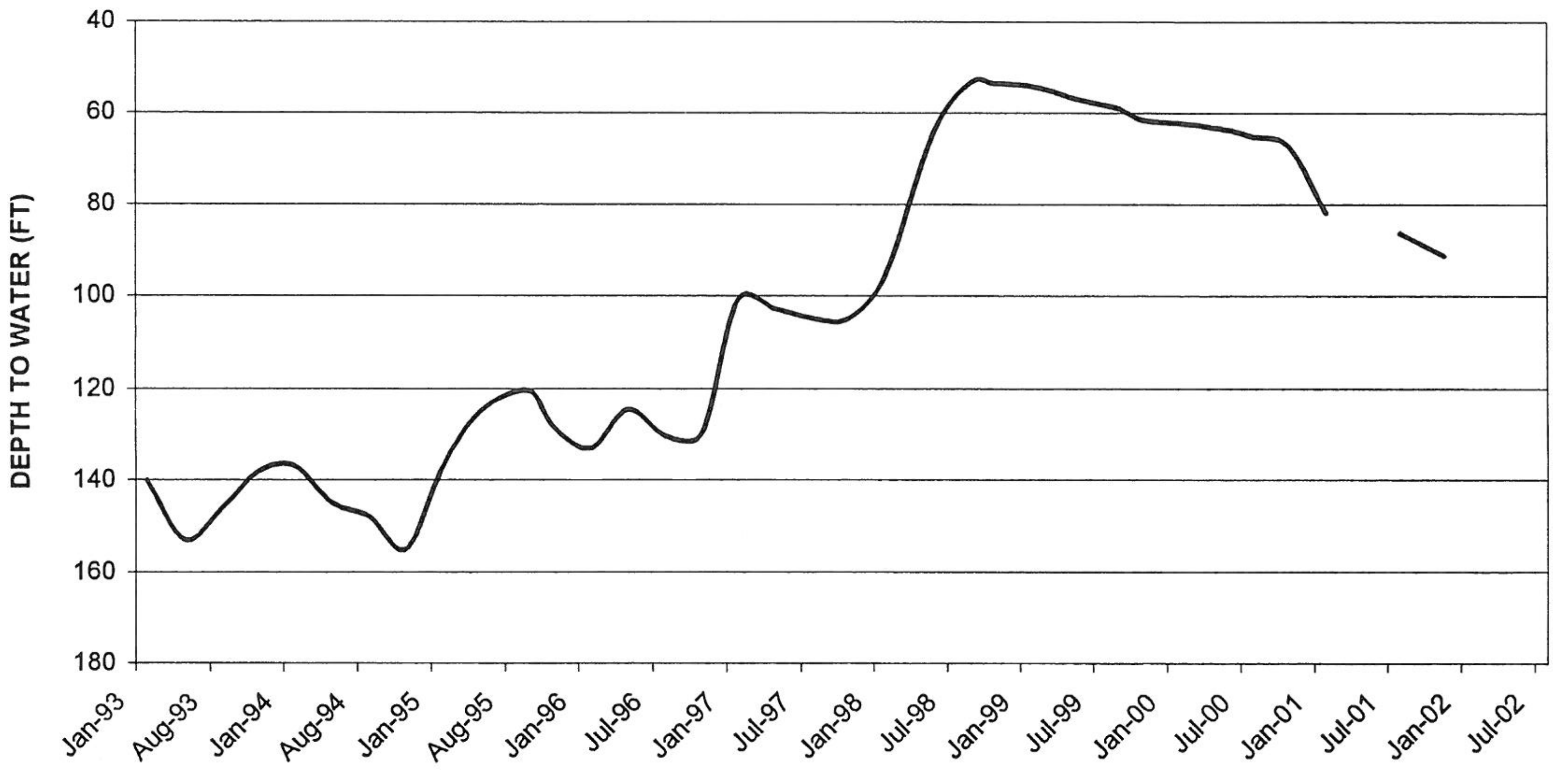
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL D16
29-24 32L GRND. ELEV=280.0 FT



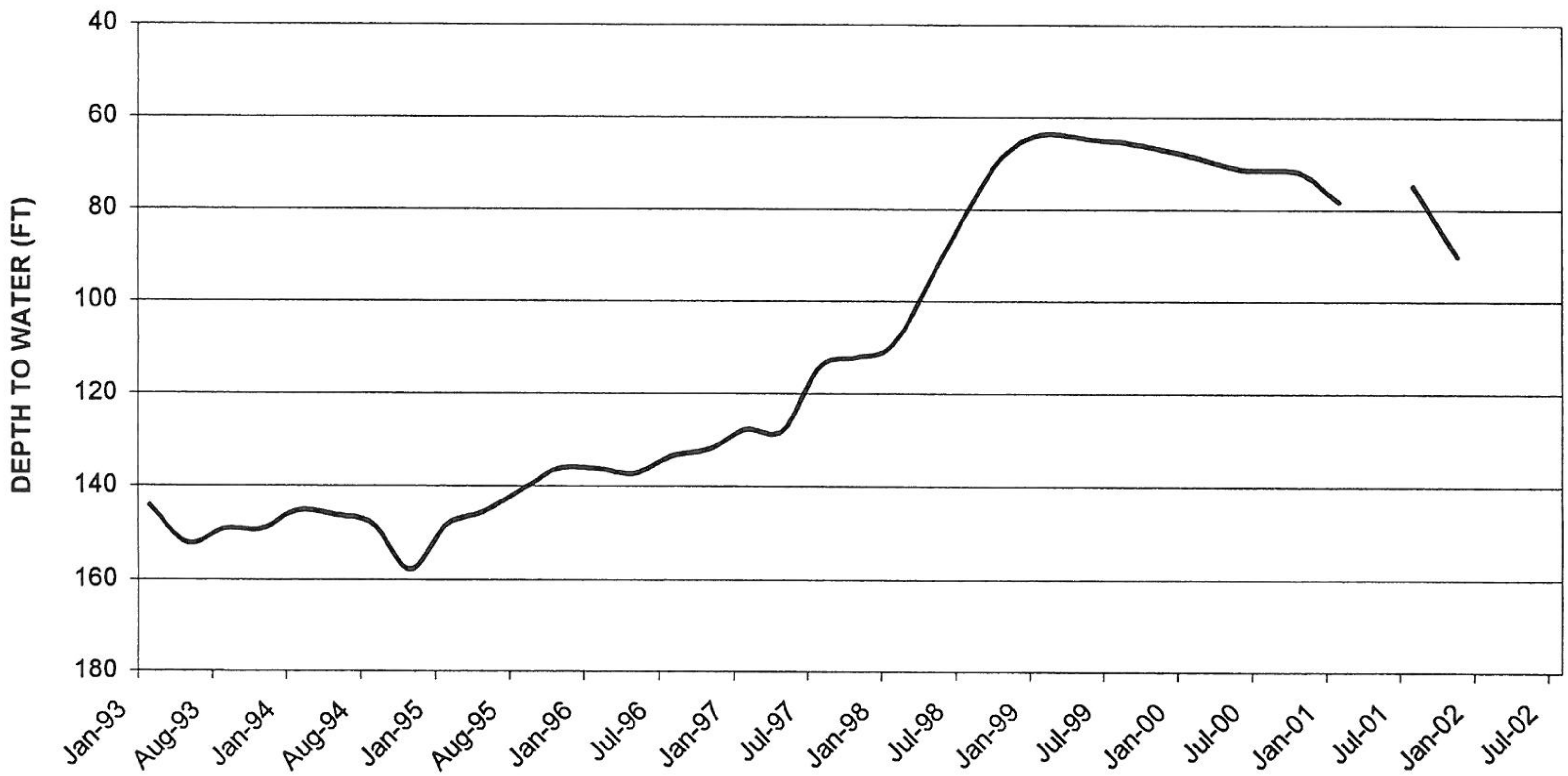
Buena Vista WSD

WATER LEVEL HYDROGRAPH
WELL W1
30-24 23B GRND. ELEV=293.18 FT

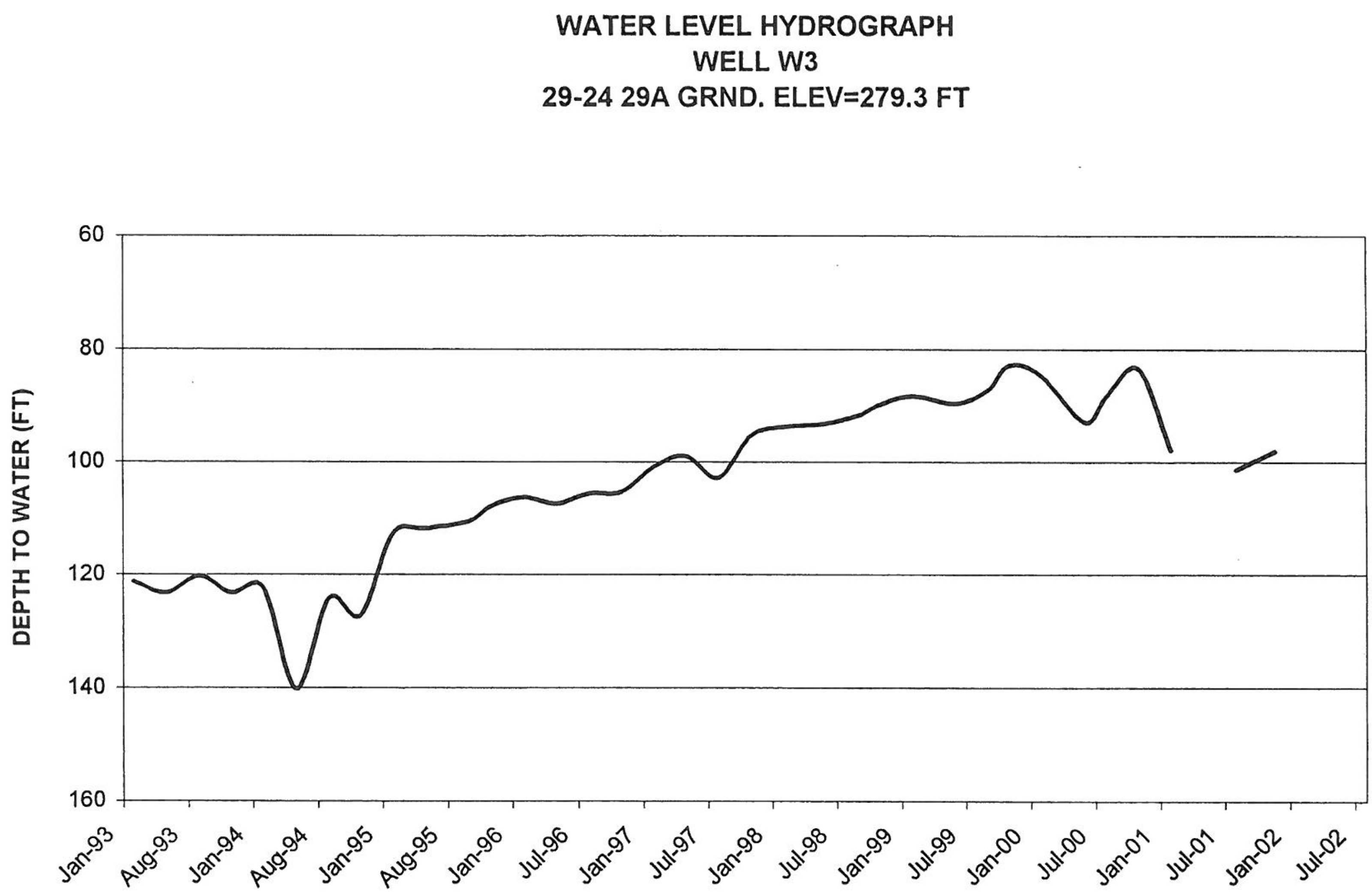


Buena Vista WSD

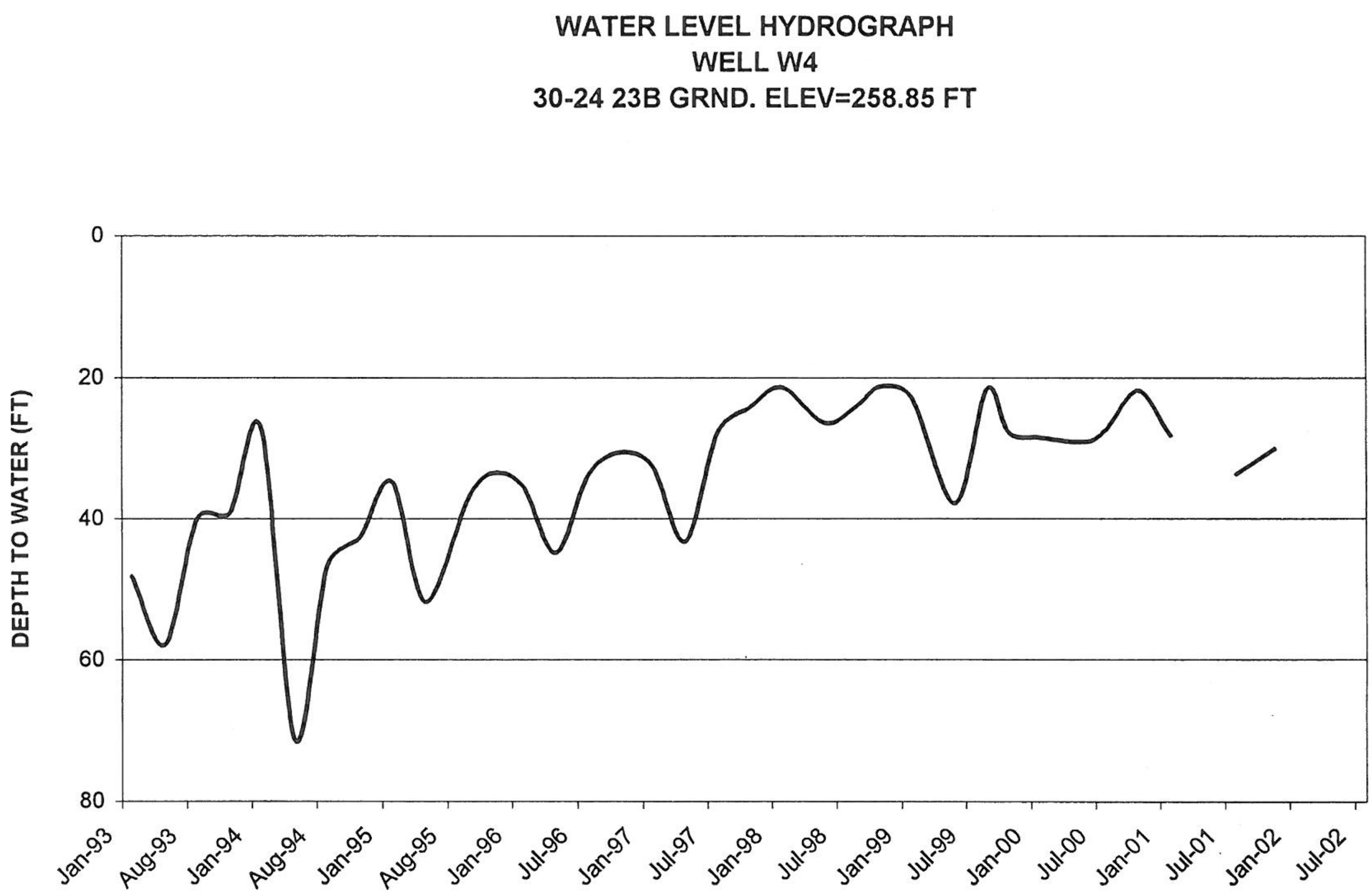
WATER LEVEL HYDROGRAPH
WELL W2
30-24 11P GRND. ELEV=291.84 FT



Buena Vista WSD

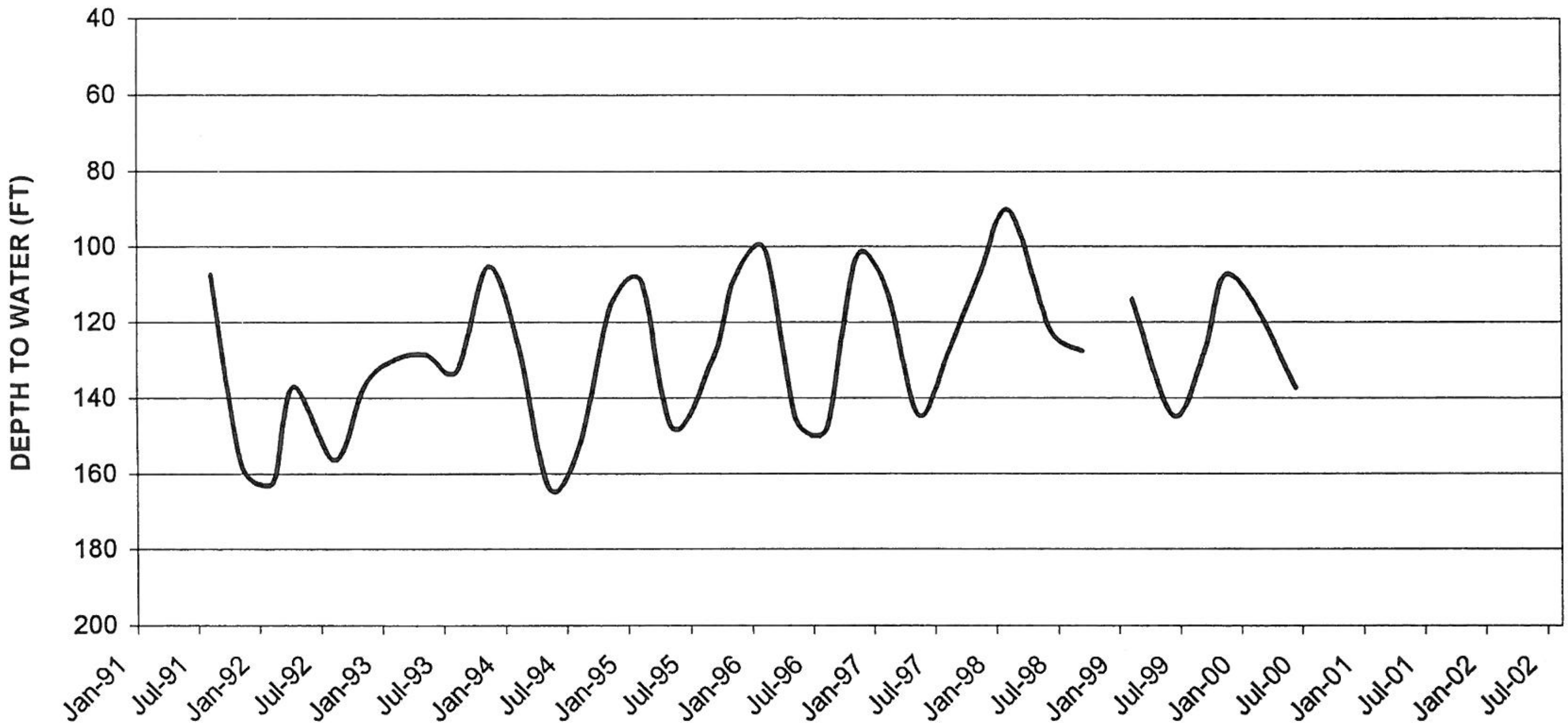


Buena Vista WSD



Buena Vista WSD

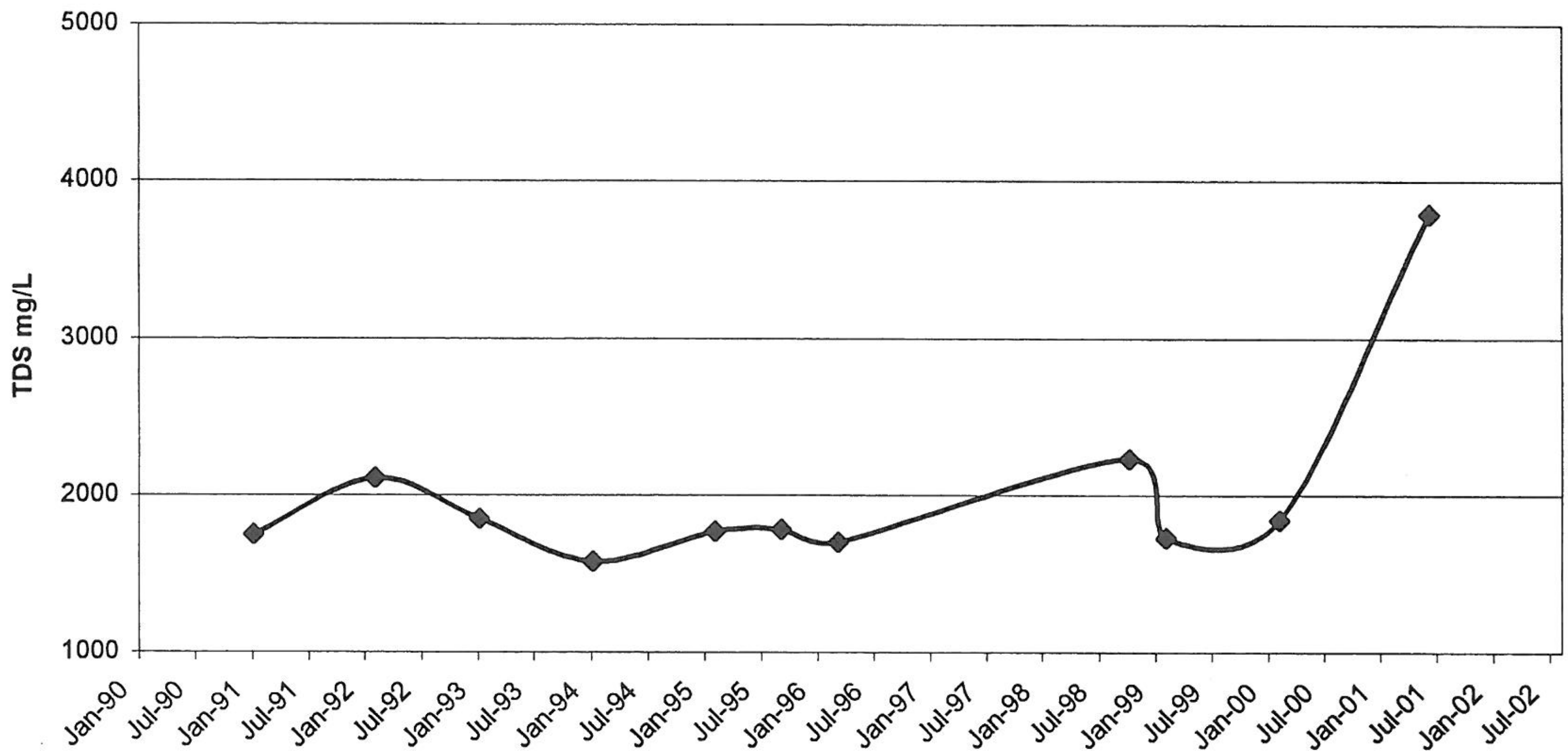
WATER LEVEL HYDROGRAPH
WELL M2
31-26 29L GRND. ELEV=291 FT



Buena Vista WSD

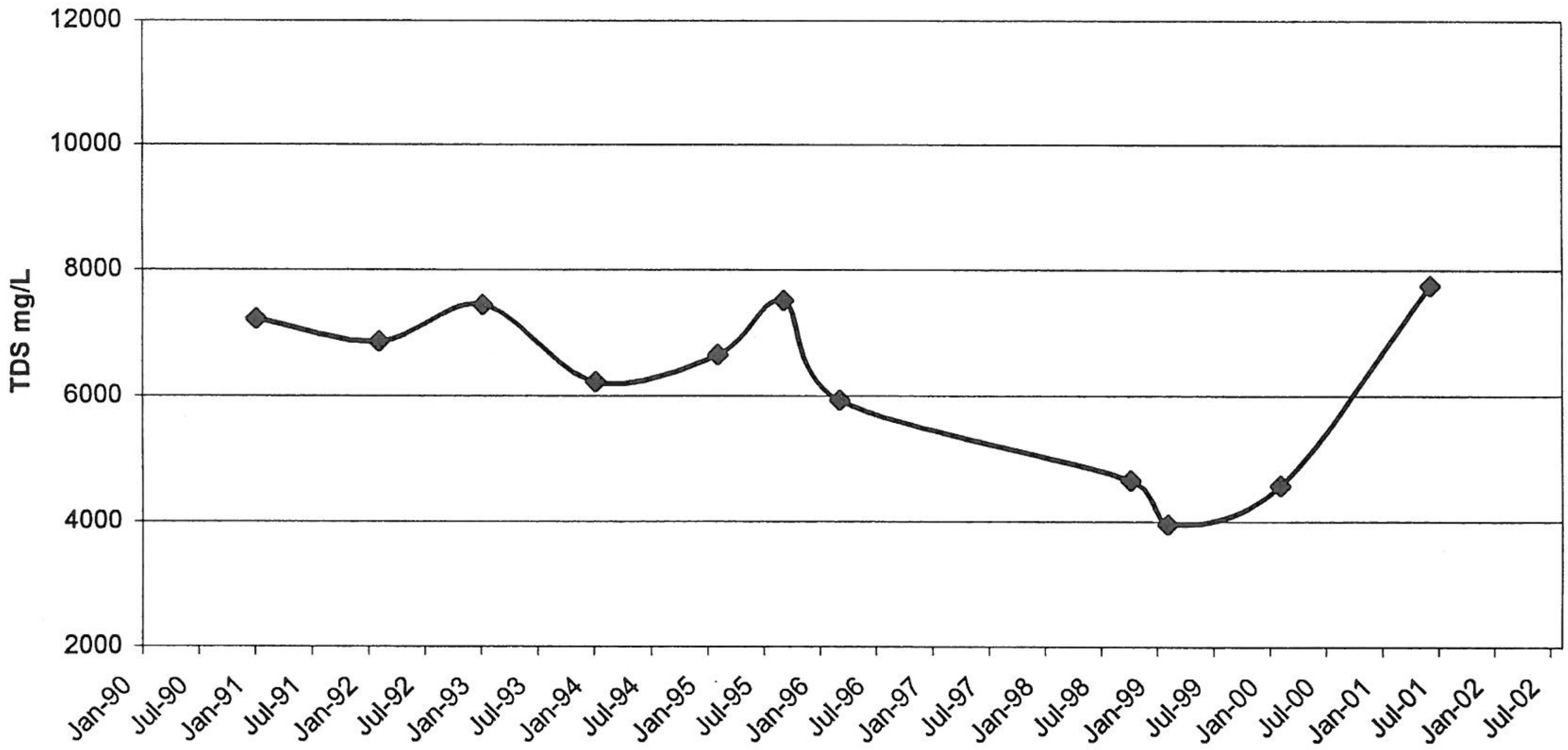
Appendix E

TDS HYDROGRAPH
PIEZOMETER BV#5
27-22 09H



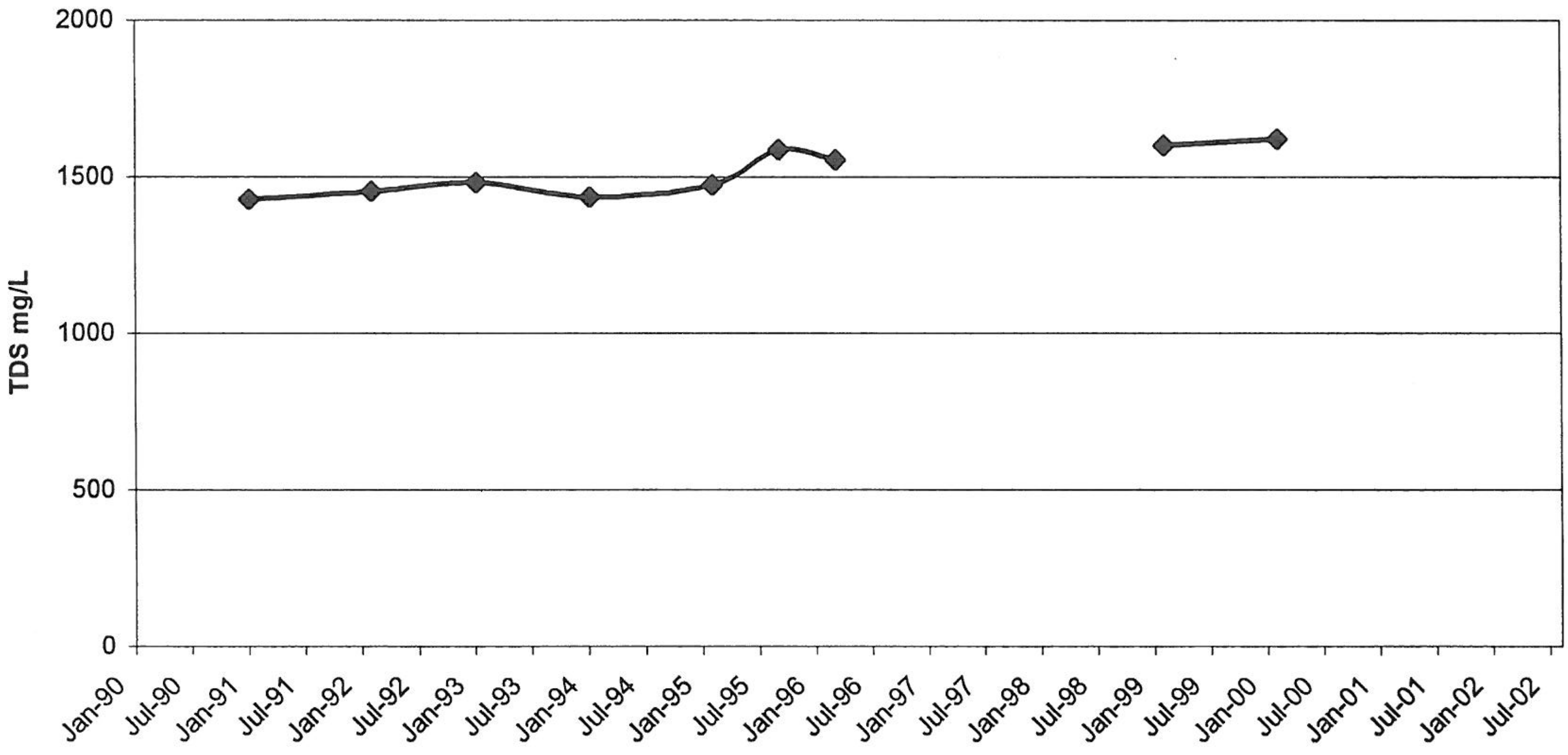
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER BV#8C
27-22 15N



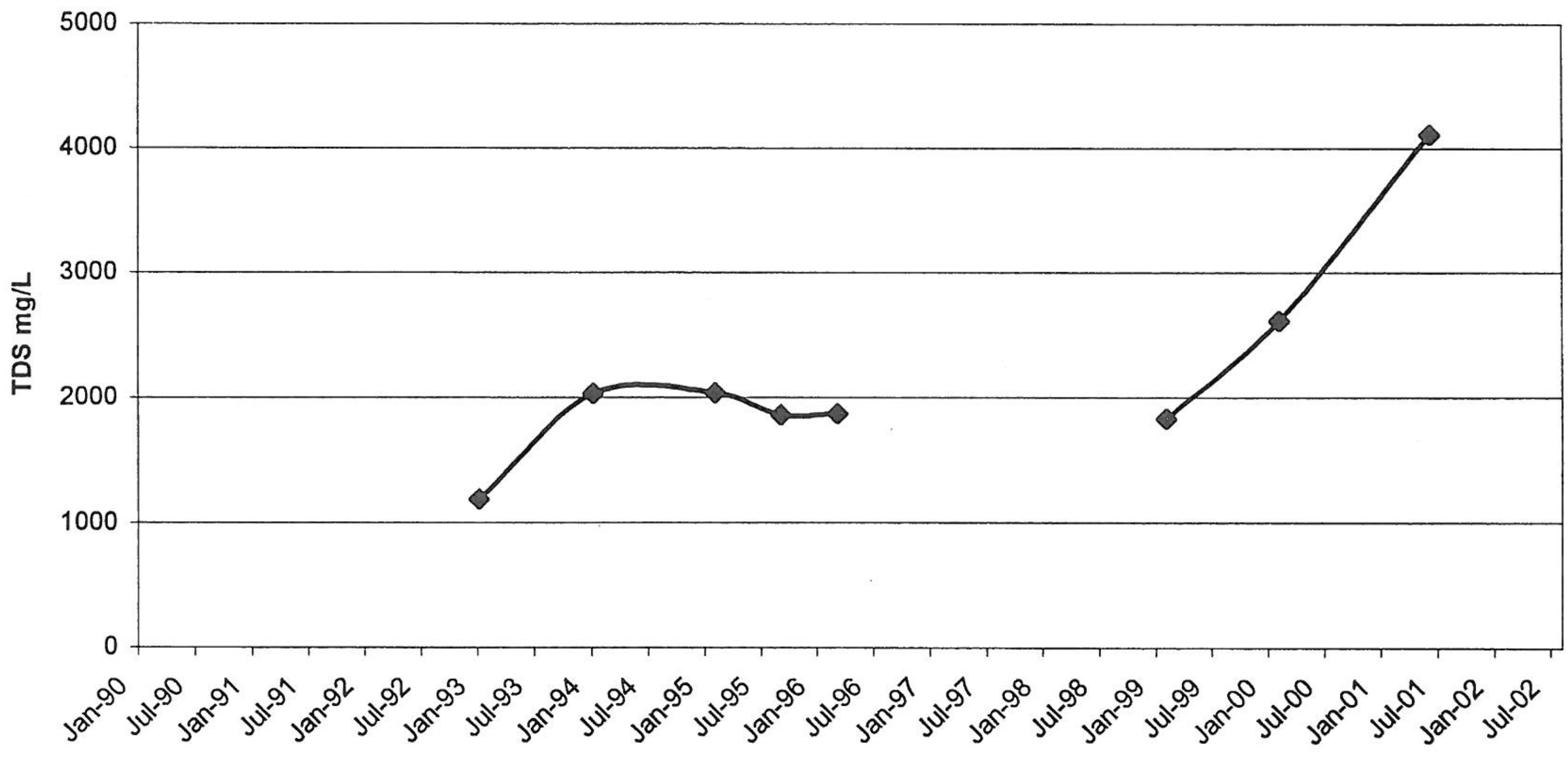
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER BV#10A
27-22 20H



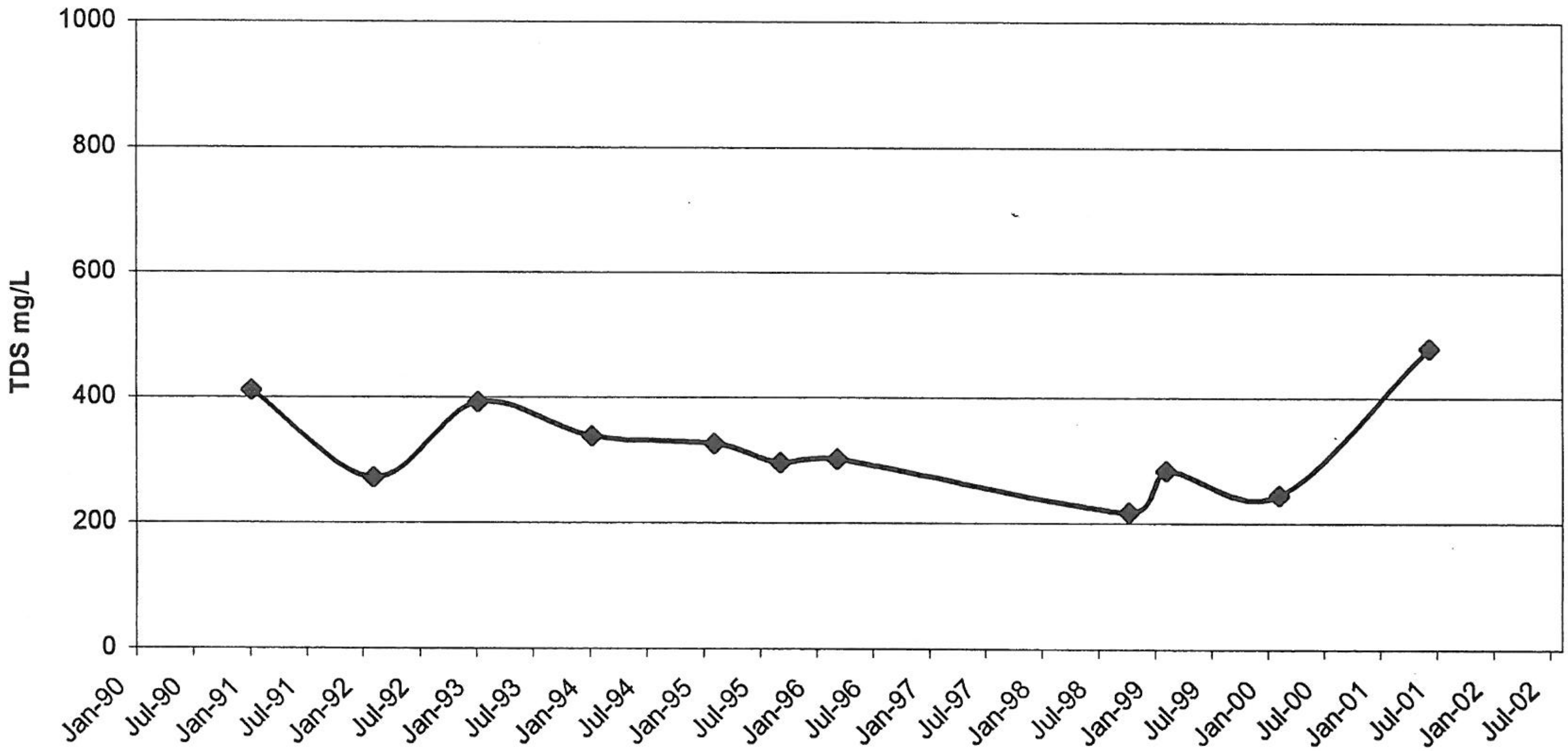
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER BV#17A
28-22 3D



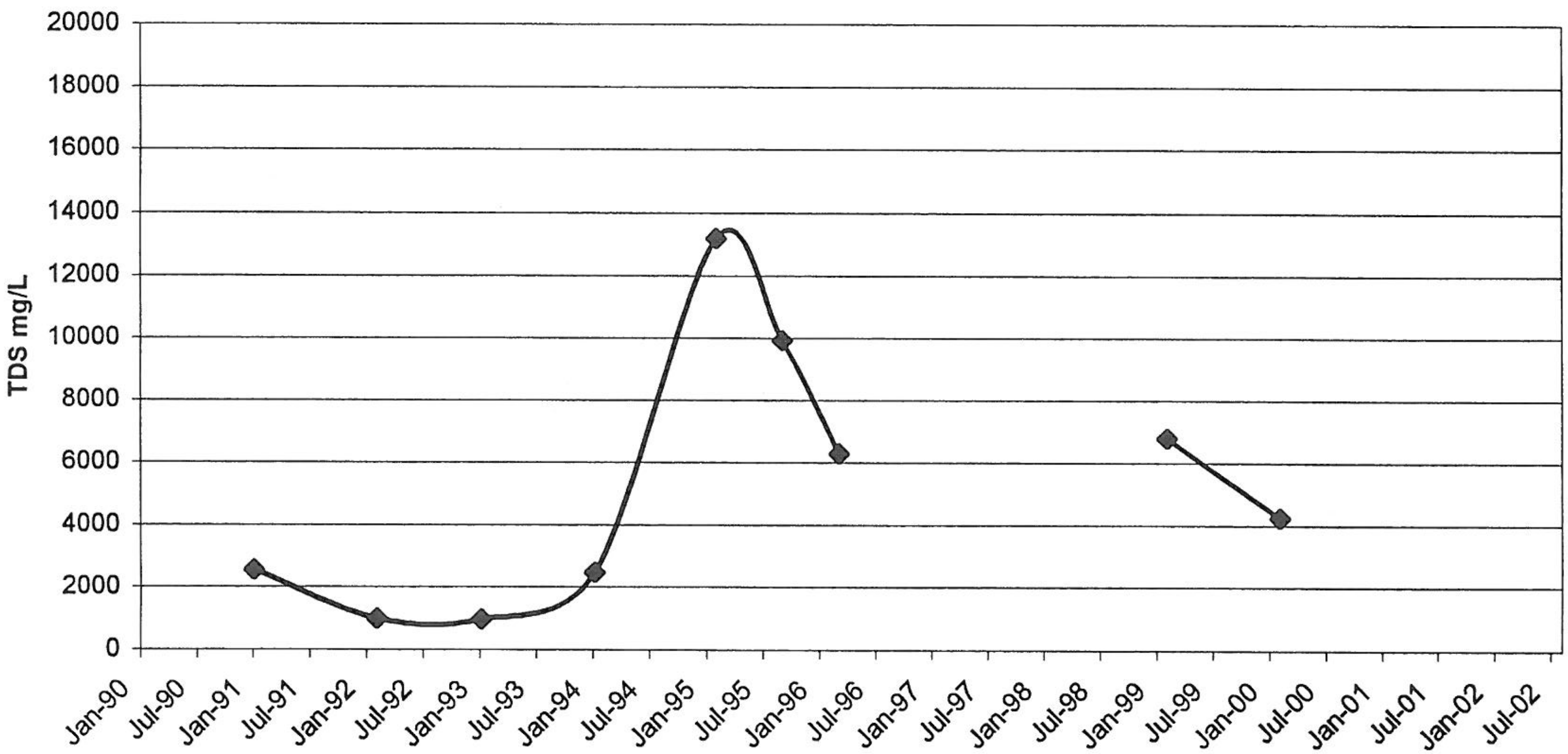
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER BV#27
28-22 11R



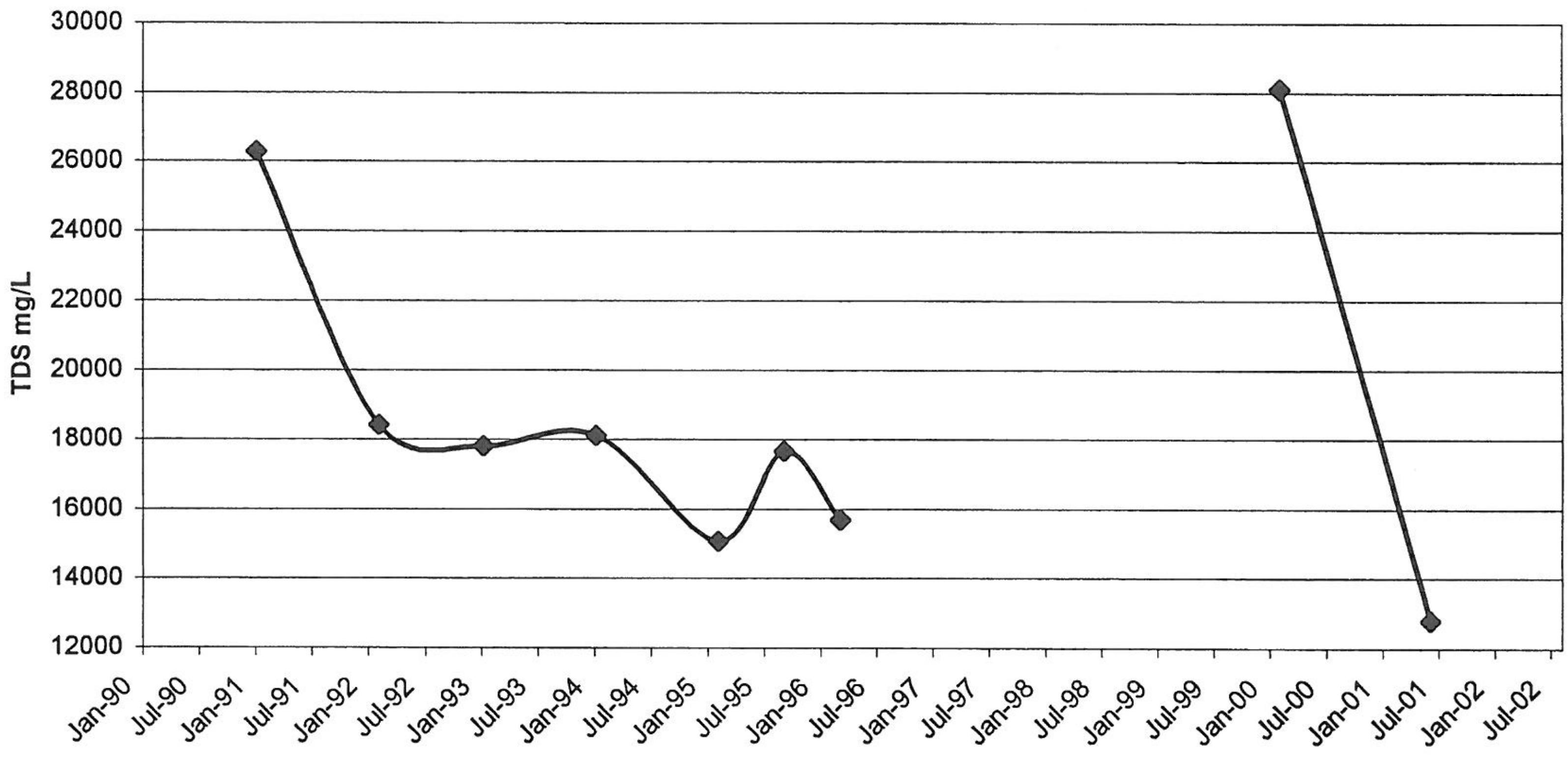
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER BV#29
28-22 13N



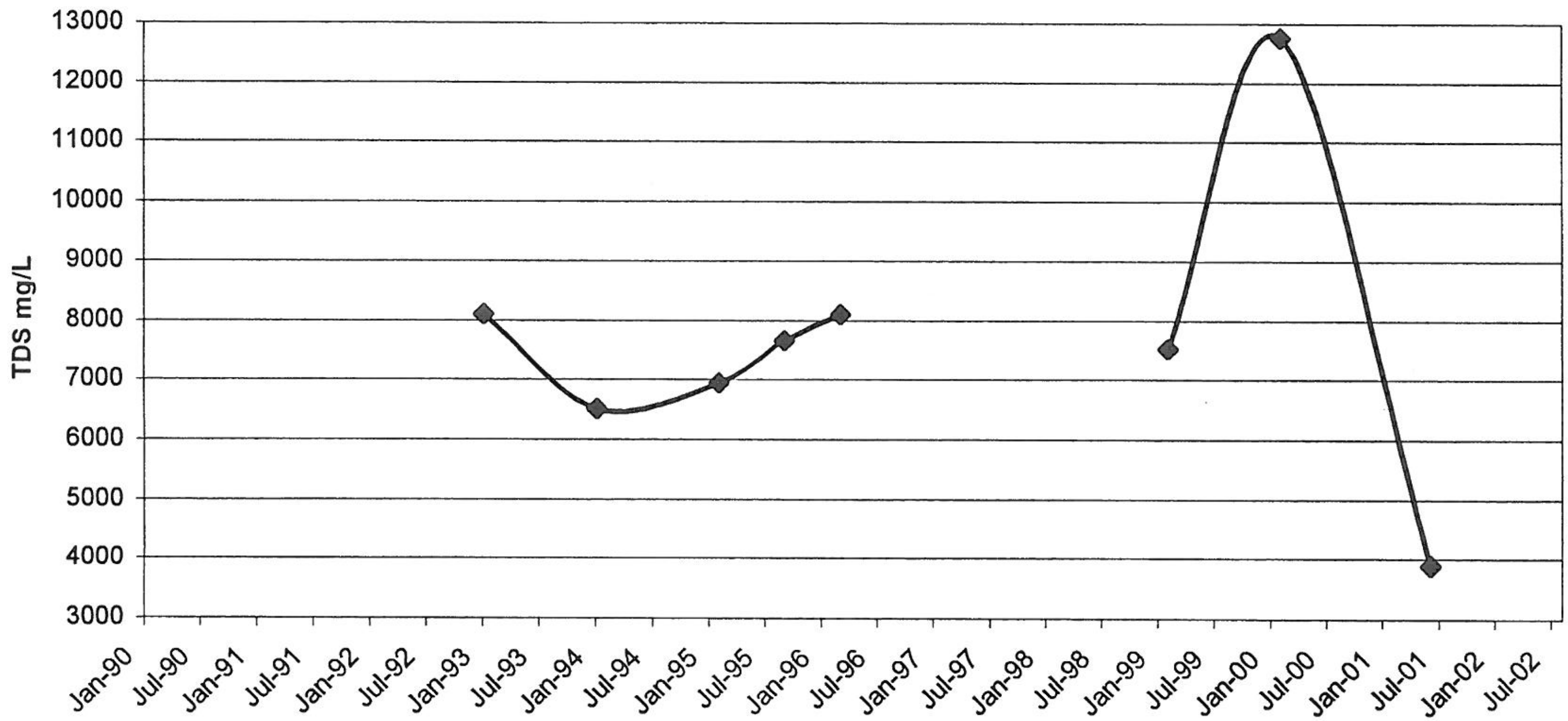
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER BEL#3A
27-22 7N



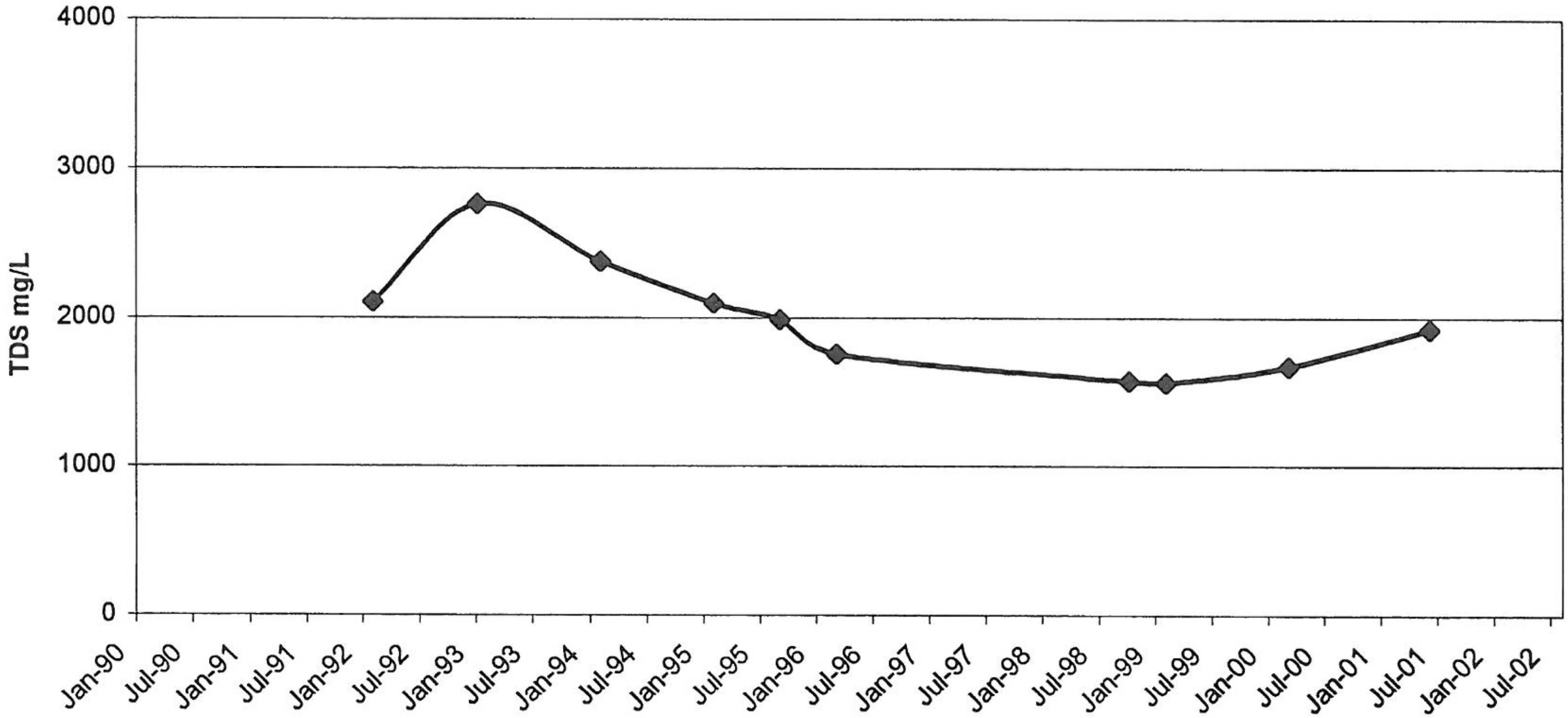
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER BEL#15B
28-22 16N



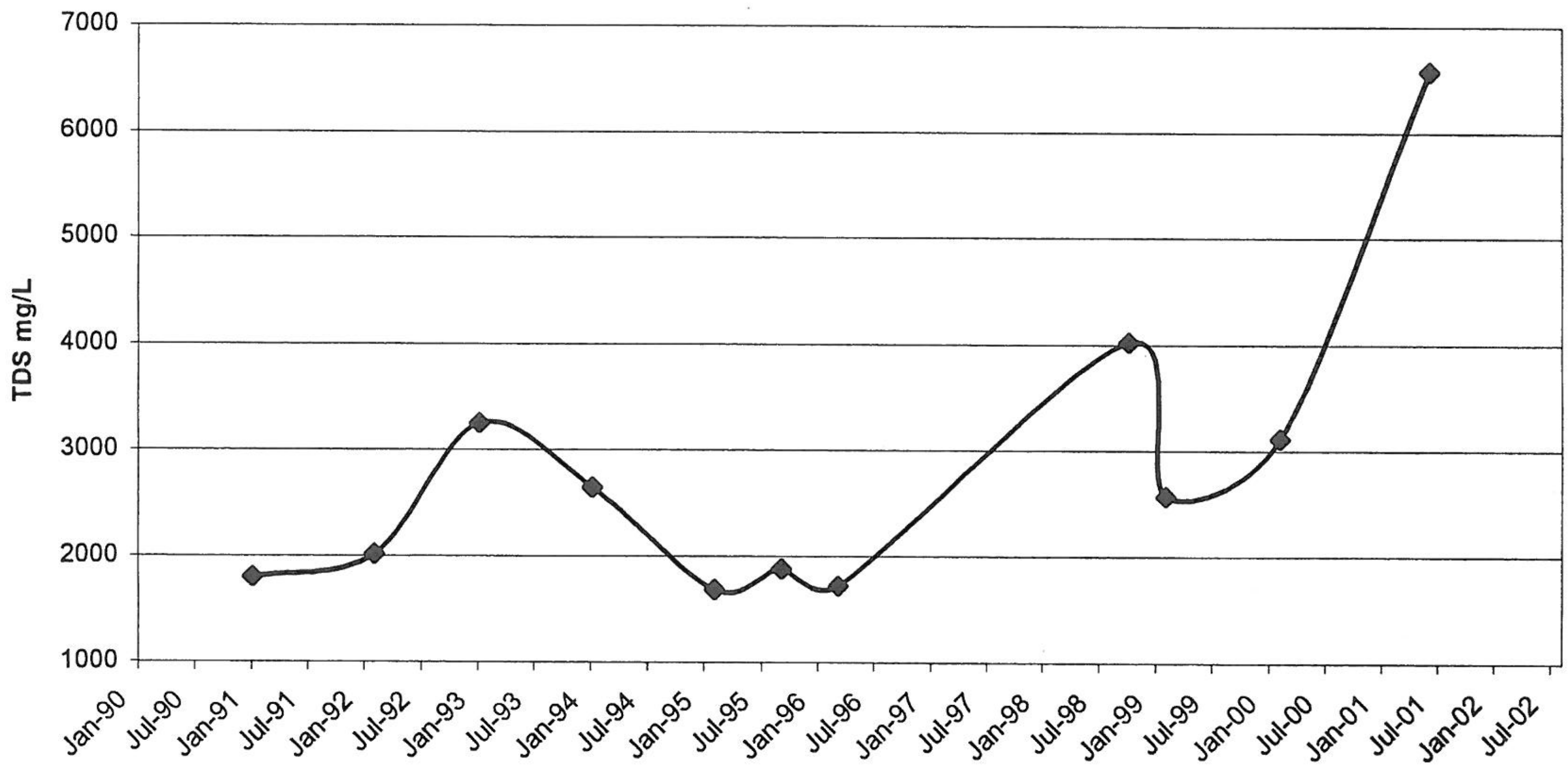
Buena Vista WSD

TDS HYDROGRAPH
PIEZOMETER GL#9
27-22 13L



Buena Vista WSD

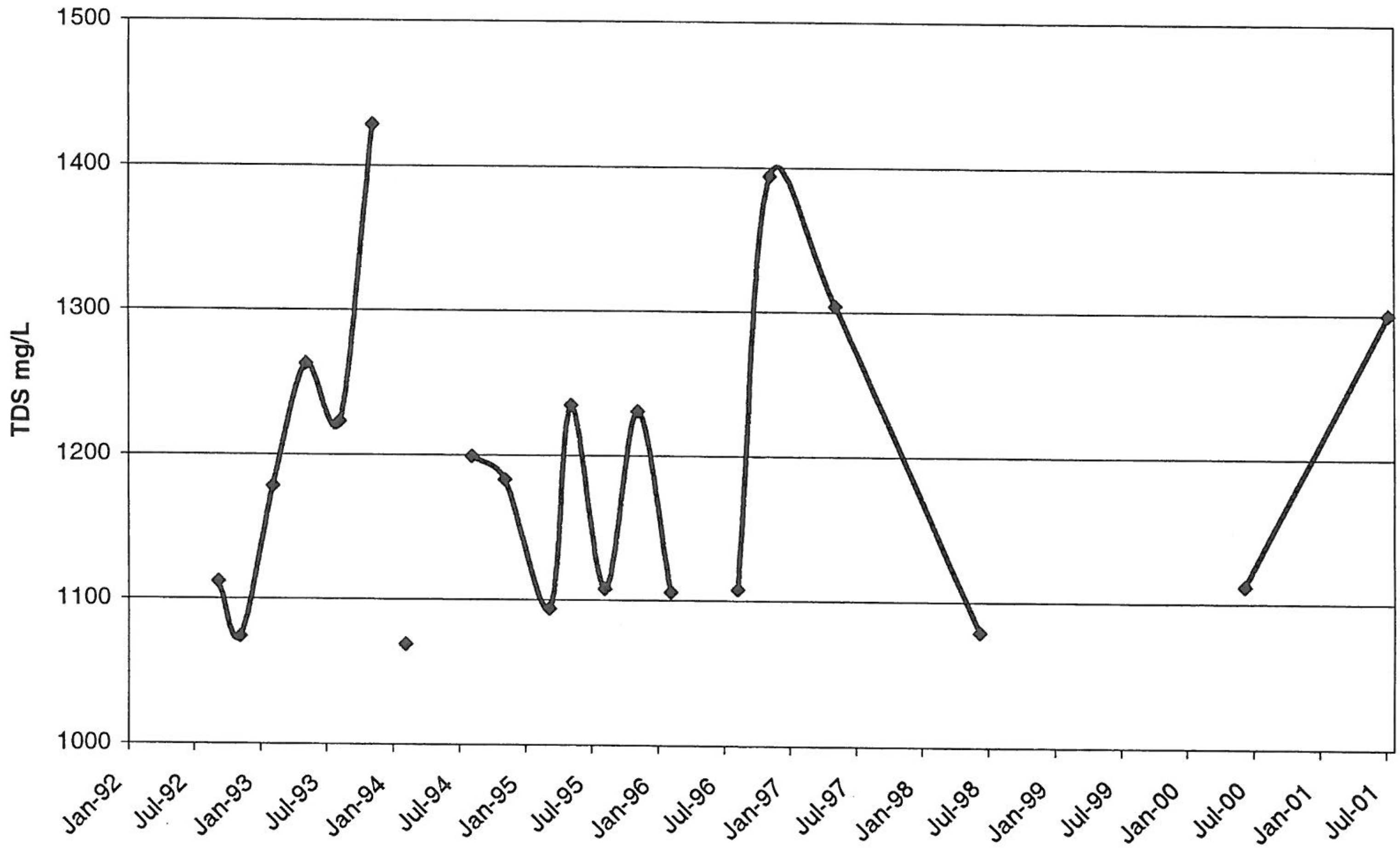
TDS HYDROGRAPH
PIEZOMETER BV#2A
27-22 11Q



Buena Vista WSD

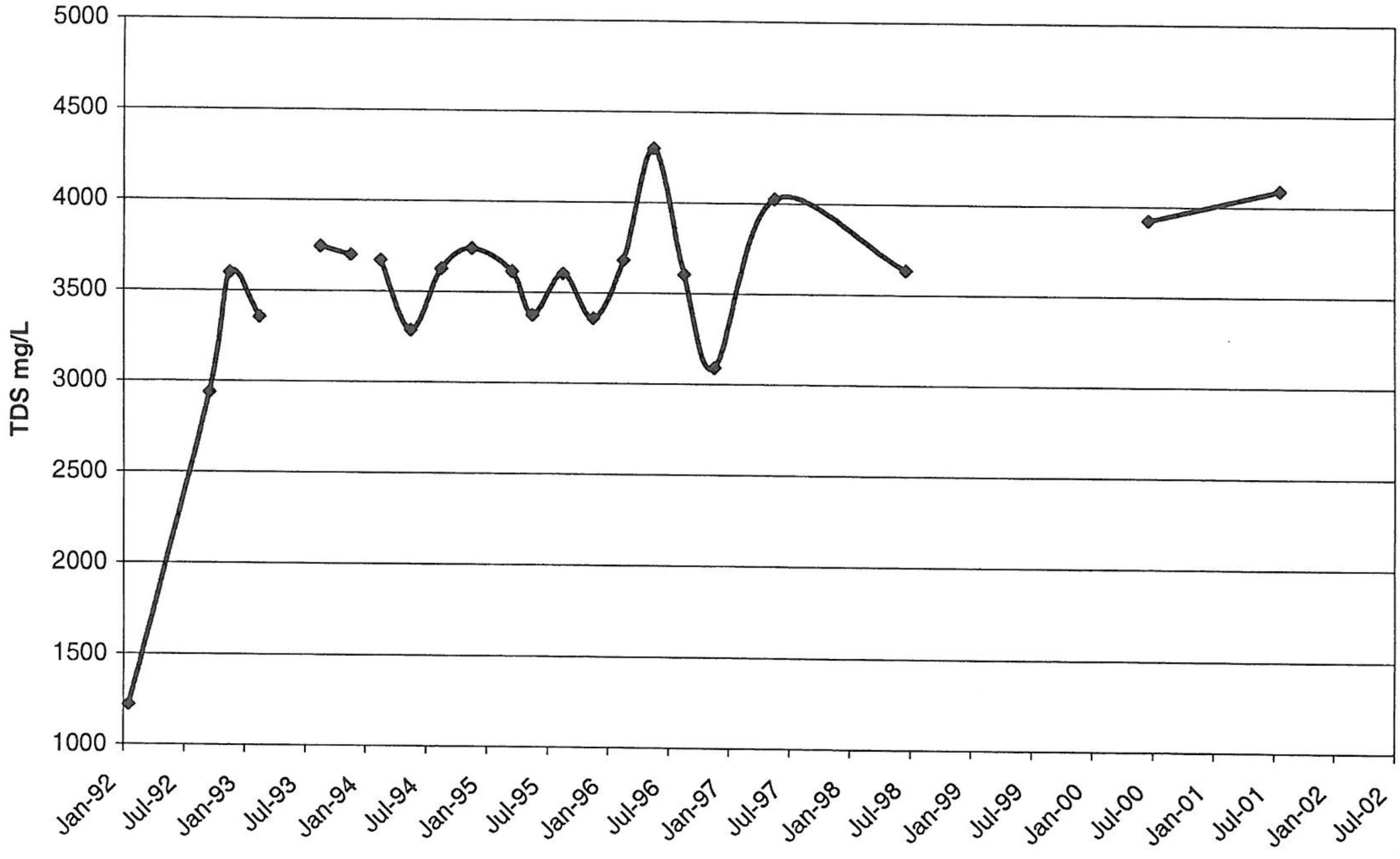
Appendix F

TDS HYDROGRAPH
DMW #1
27-22 8A



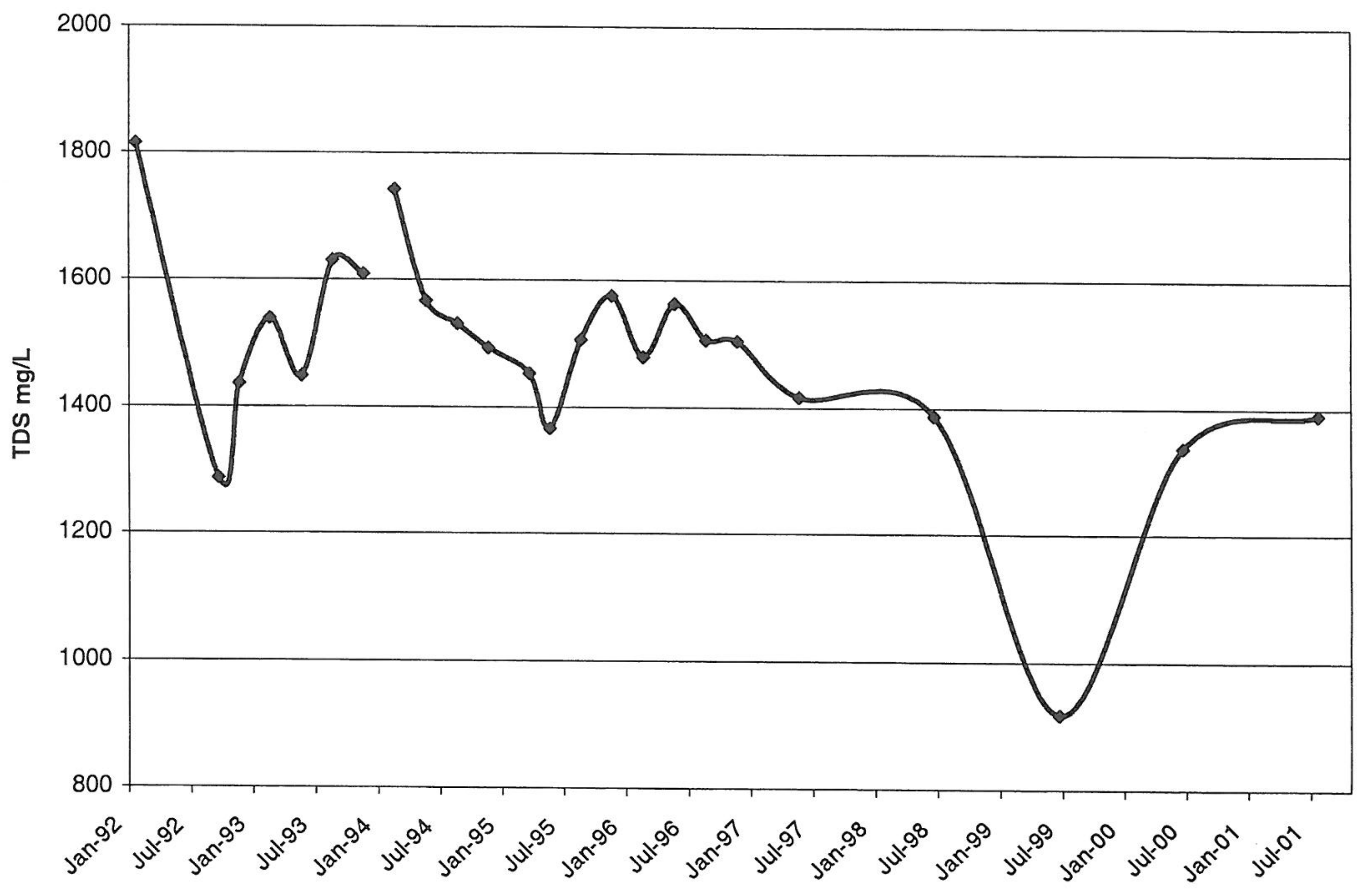
Buena Vista WSD

TDS HYDROGRAPH
DMW #2
27-22 23D



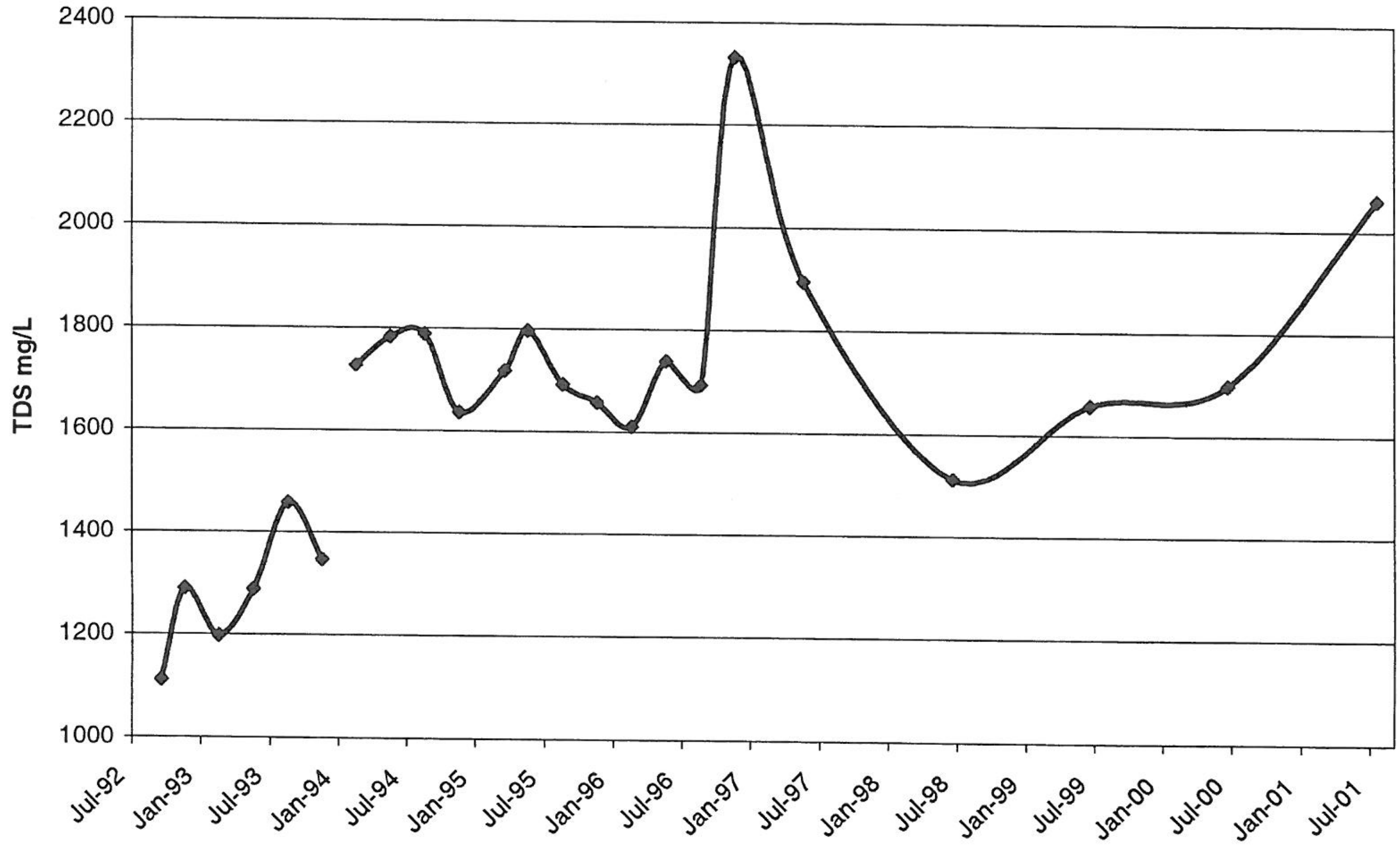
Buena Vista WSD

TDS HYDROGRAPH
DMW #3
27-22 33A



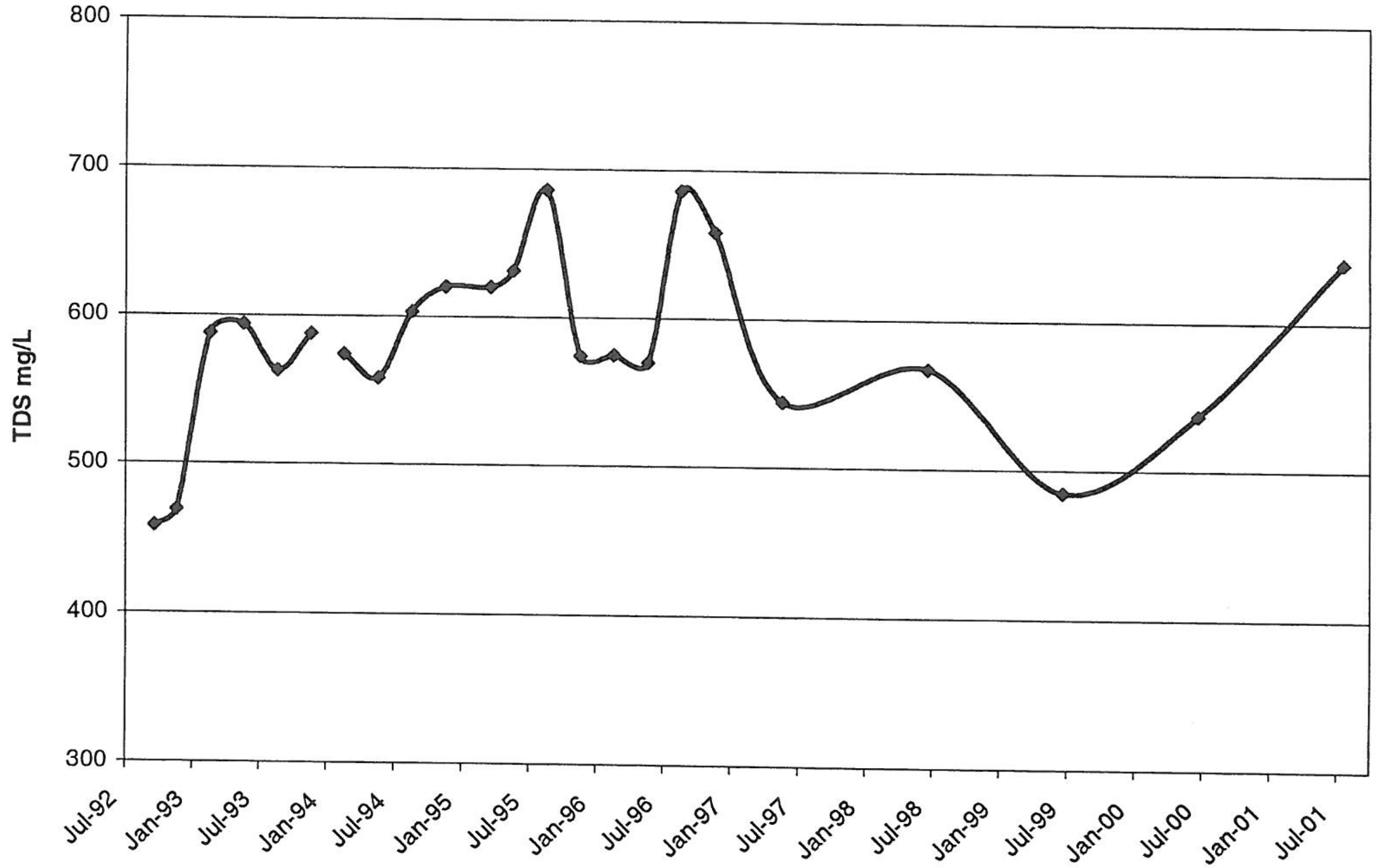
Buena Vista WSD

TDS HYDROGRAPH
DMW #4
28-22 10D



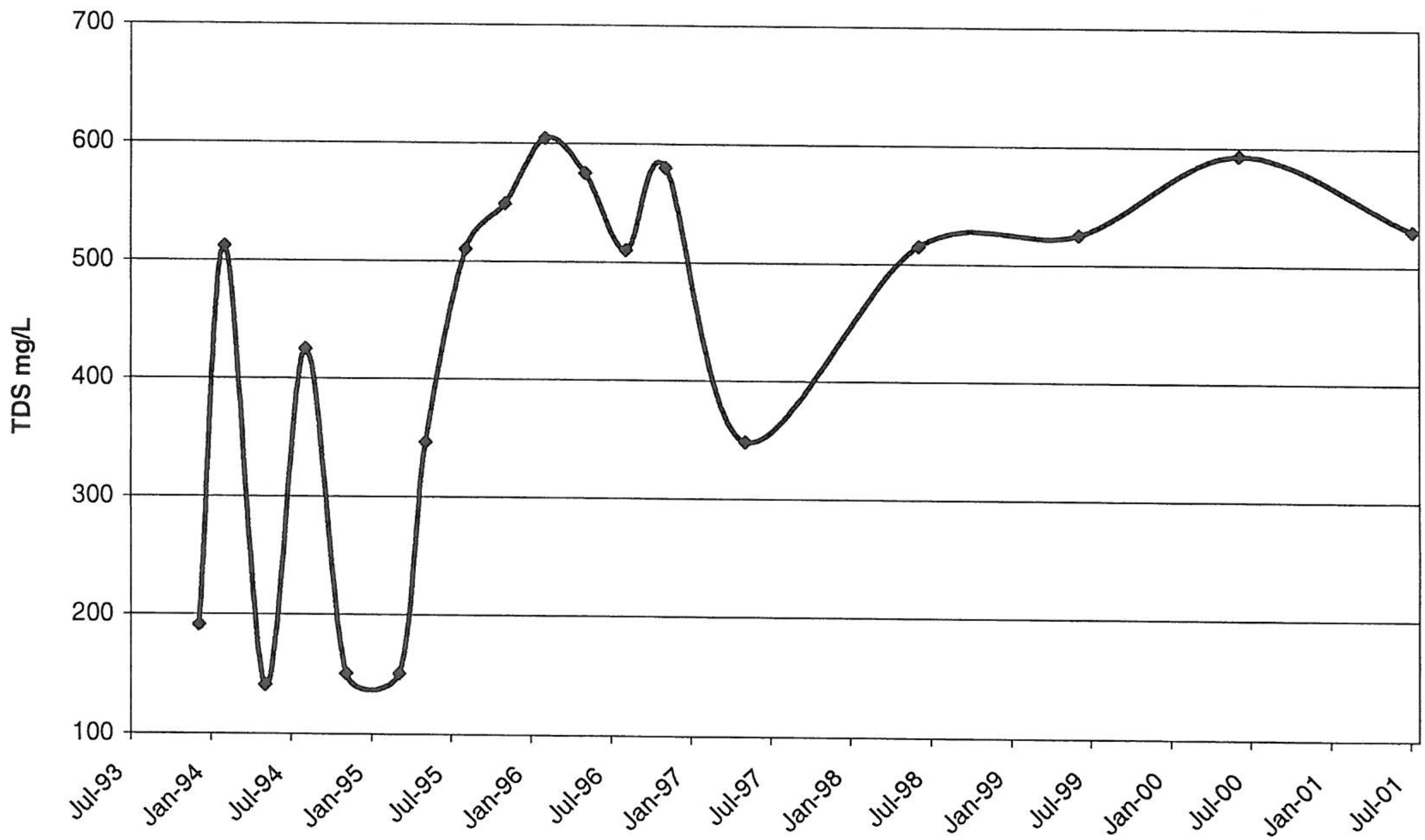
Buena Vista WSD

TDS HYDROGRAPH
DMW #5
28-22 14R



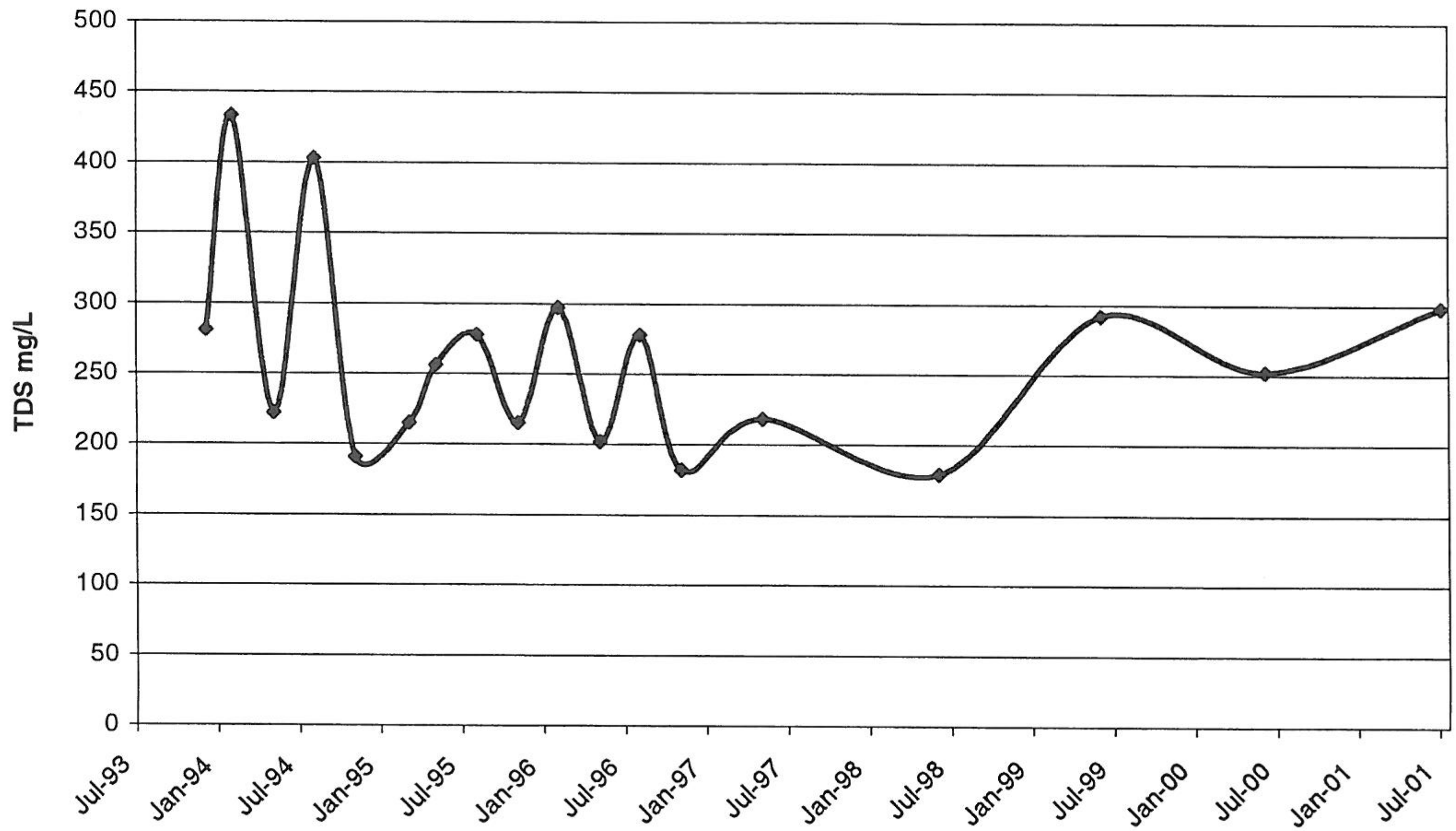
Buena Vista WSD

TDS HYDROGRAPH
DMW #6
28-22 31B



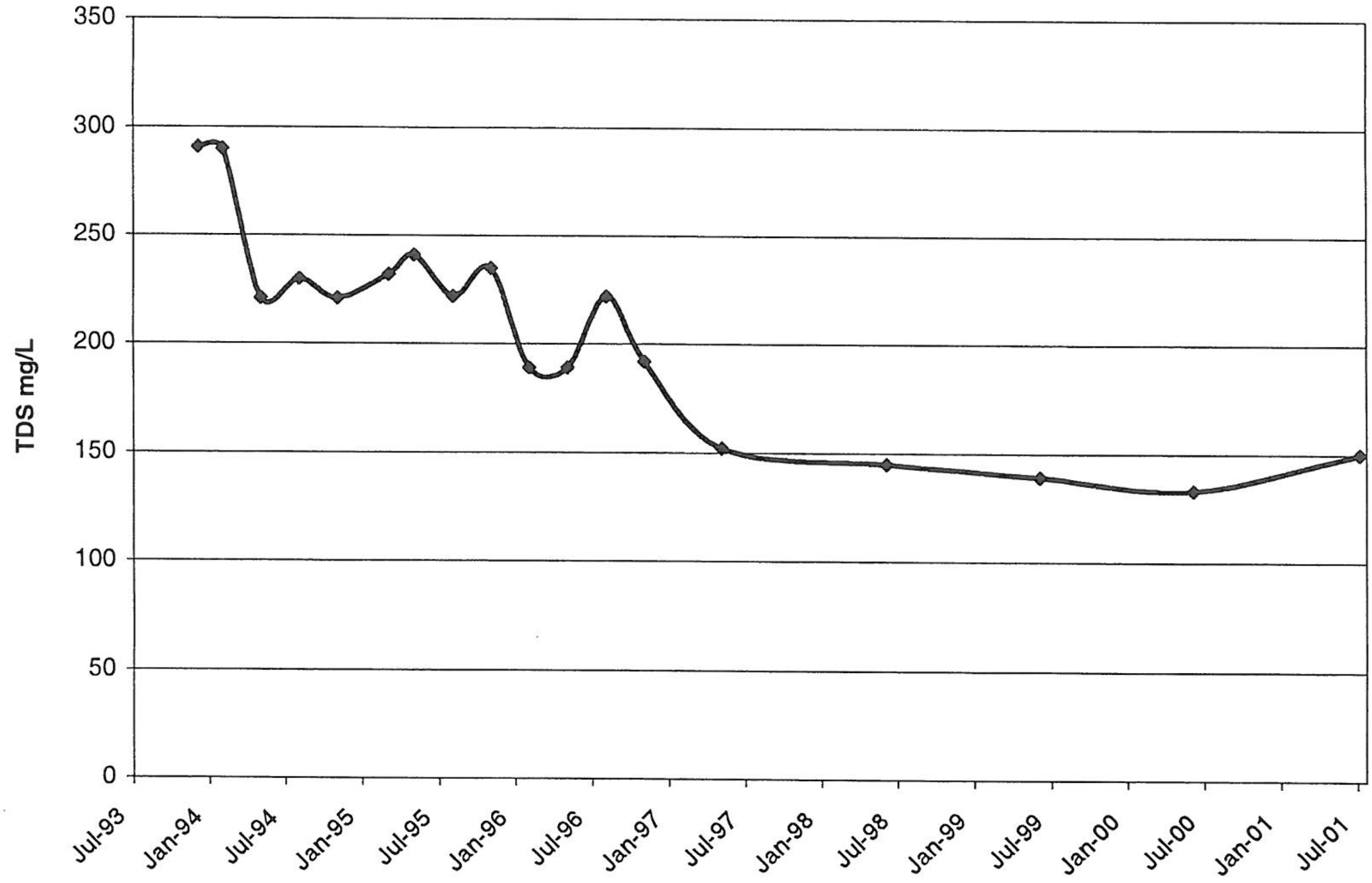
Buena Vista WSD

TDS HYDROGRAPH
DMW #7
29-23 16R



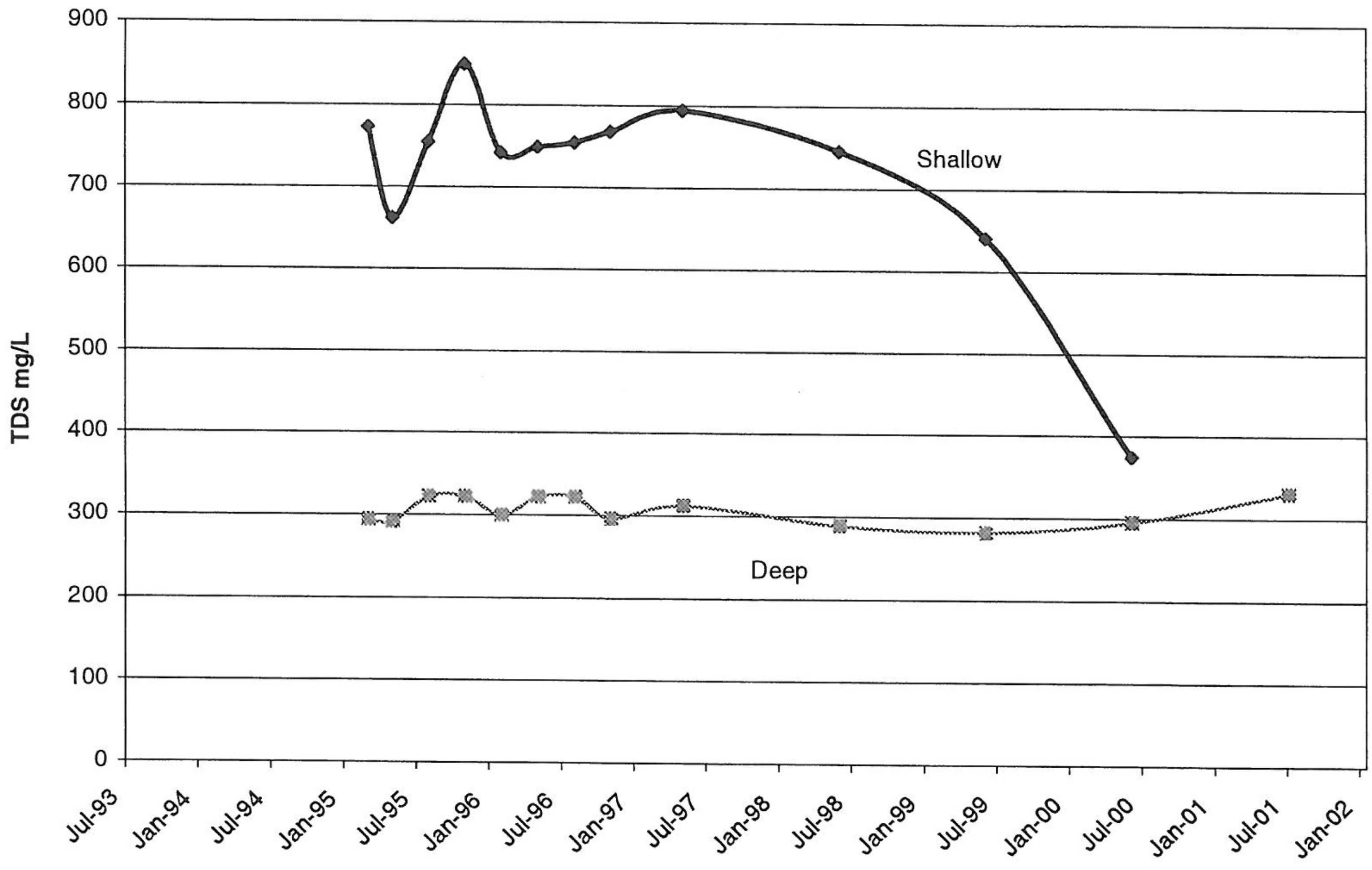
Buena Vista WSD

TDS HYDROGRAPH
DMW #8
29-23 24H



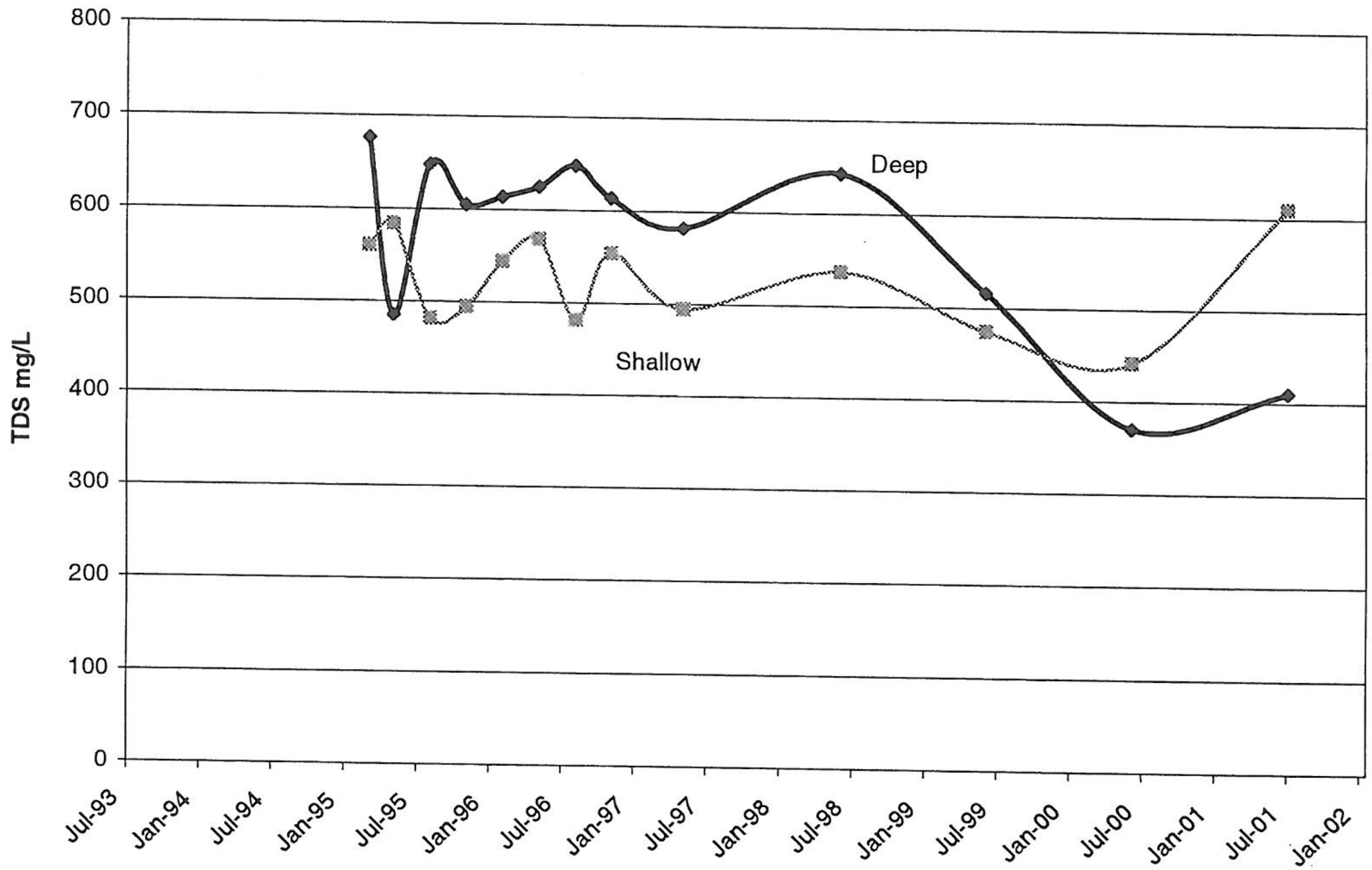
Buena Vista WSD

TDS HYDROGRAPH
DMW #10A&B
30-24 06B

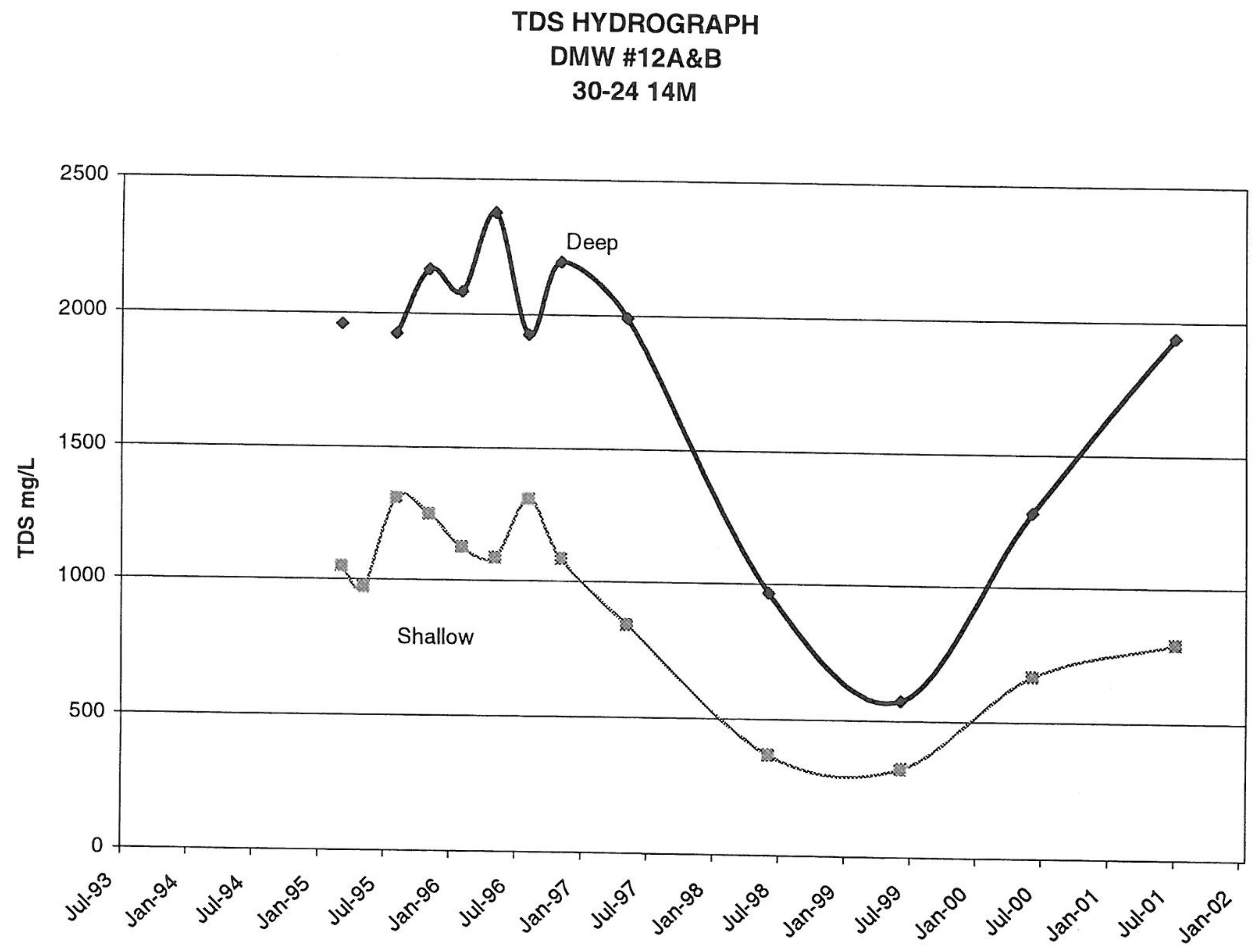


Buena Vista WSD

TDS HYDROGRAPH
DMW #11A&B
29-24 34N

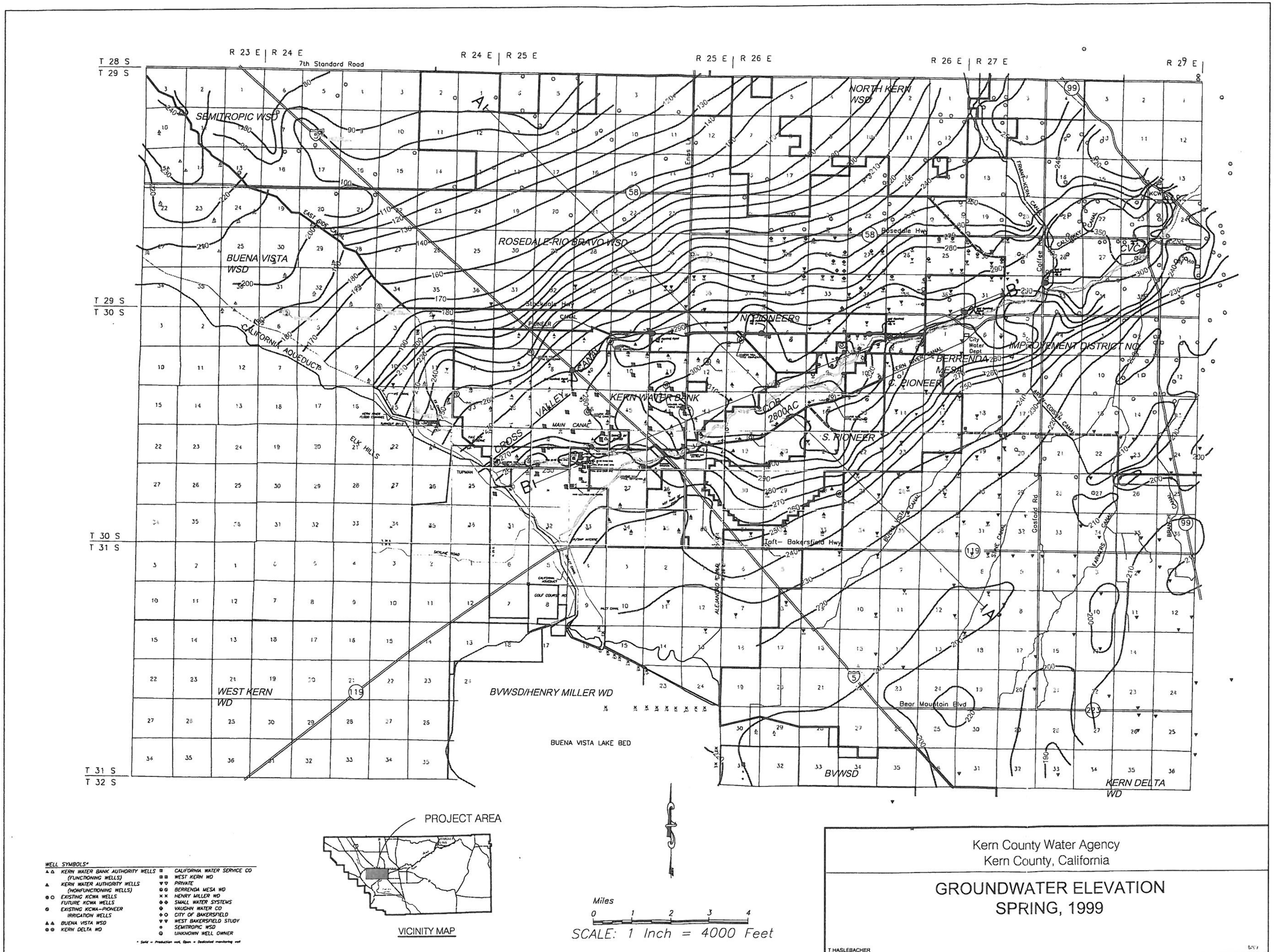


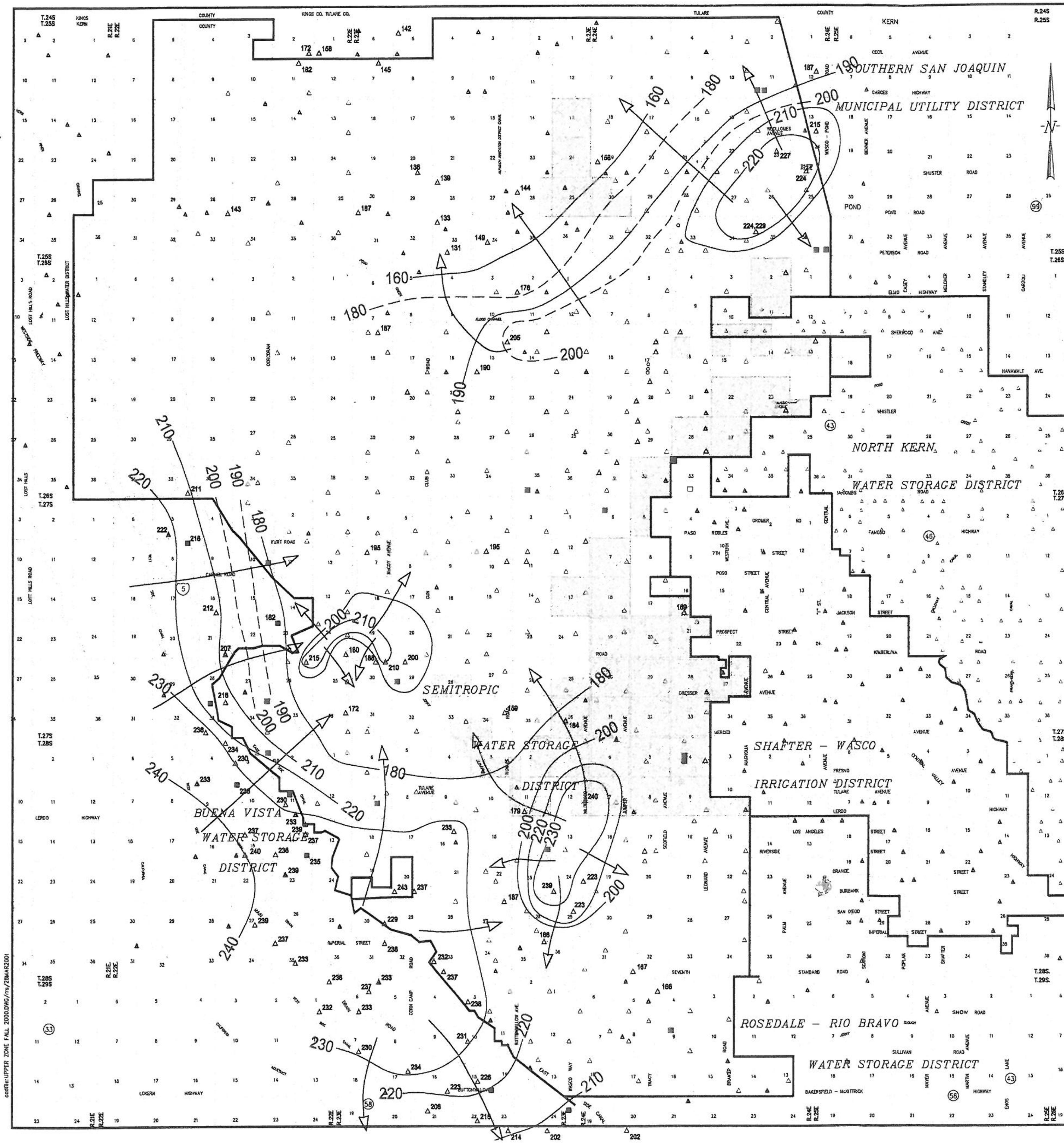
Buena Vista WSD



Buena Vista WSD

Appendix G


Kern County Water Agency
Kern County, California
GROUNDWATER ELEVATION
SPRING, 1999
T.HASLEBACHER
SEMITROPIC WSD
NORTH KERN WSD
BUENA VISTA WSD
ROSEDALE-RIO BRAVO WSD
KERN WATER BANK
N. PIONEER
C. PIONEER
S. PIONEER
BERRENDA MESA
IMPROVEMENT DISTRICT NO.
CITY Water Dept
WEST KERN WD
BVWSD/HENRY MILLER WD
BUENA VISTA LAKE BED
BVWSD
KERN DELTA WD
CALIFORNIA AQUEDUCT
CROSS VALLEY CANAL
MAIN CANAL
EAST SIDE CANAL
FRIANT-KERN CANAL
ELK HILLS
TUPMAN
7th Standard Road
Rosedale Hwy
Stockdale Hwy
Taft- Bakersfield Hwy
Bear Mountain Blvd
Gosford Rd
Enos Ln
Coffee
T 28 S
T 29 S
T 30 S
T 31 S
T 32 S
R 23 E
R 24 E
R 25 E
R 26 E
R 27 E
PROJECT AREA
VICINITY MAP
Miles
0 1 2 3 4
SCALE: 1 Inch = 4000 Feet
WELL SYMBOLS*
KERN WATER BANK AUTHORITY WELLS (FUNCTIONING WELLS)
KERN WATER AUTHORITY WELLS (NONFUNCTIONING WELLS)
EXISTING KCWA WELLS
FUTURE KCWA WELLS
EXISTING KCWA-PIONEER IRRIGATION WELLS
BUENA VISTA WSD
KERN DELTA WD
CALIFORNIA WATER SERVICE CO
WEST KERN WD
PRIVATE
BERRENDA MESA WD
HENRY MILLER WD
SMALL WATER SYSTEMS
VAUGHN WATER CO
CITY OF BAKERSFIELD
WEST BAKERSFIELD STUDY
SEMITROPIC WSD
UNKNOWN WELL OWNER



WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR THE UPPER ZONE FALL 2000

EXPLANATION

△22 Well and water level elevation

Direction of groundwater flow

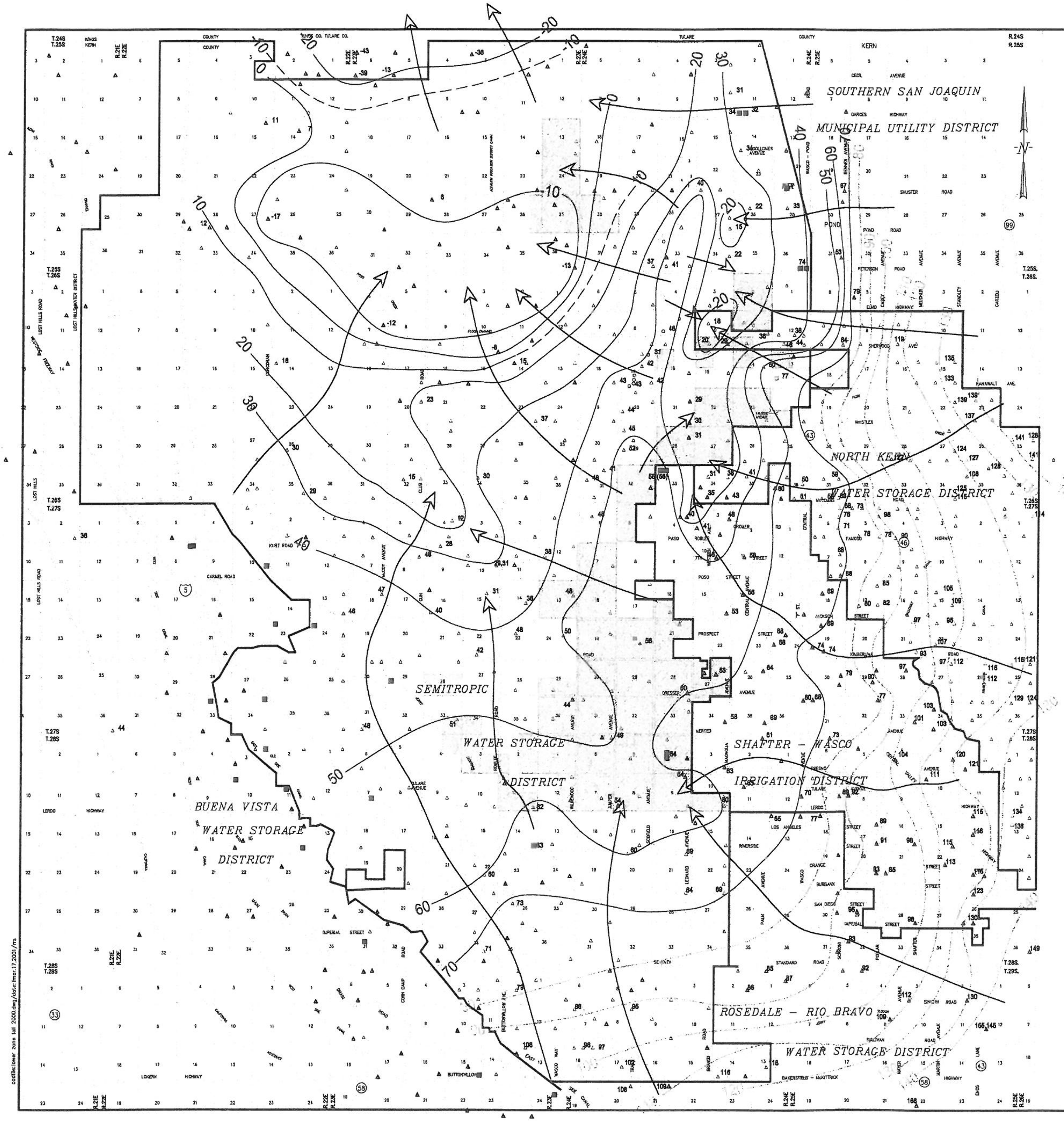
Water elevation contours for upper zone (Feet above MSL)

SEMITROPIC WATER STORAGE DISTRICT

SCALE OF MILES

1 0 1 2 3

cadfile: UPPER ZONE FALL 2000.DWG/rns/28MAR2001



WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW IN FOREBAY AREA AND LOWER ZONE FALL 2000

EXPLANATION

△22 Well and water level elevation

← Direction of groundwater flow

Water elevation contours (ft. above M.S.L.) in forebay area

30 ——— Water elevation contours (ft. above M.S.L.) in lower zone

SEMITROPIC WATER STORAGE DISTRICT

SCALE OF MILES

1 0 1 2 3

Appendix H

BUENA VISTA WATER STORAGE DISTRICT
P.O. BOX 756 525 N. MAIN STREET
BUTTONWILLOW, CALIFORNIA 93206
PHONE (661) 324-1101
(661) 764-5510
FAX (661) 764-5053

May 17, 2002

Re: Buena Vista Water Storage District 1997, AB255, Groundwater Management Plan Update – May 2002

To Whom It May Concern:

This District has updated the above referenced Plan to include data that was accumulated during the period 1997 through 2001. The information included and revised is found within existing tables, graphs and hydrographs. We have also added a more detailed analysis by a consulting groundwater hydro-geologist explaining the flow of groundwater and other aspects of the data.

The District has determined at it's regularly scheduled Board of Directors meeting on Tuesday, May 14, 2002 that this update merely includes data occurring after the original date of this report and it is prudent that the District include this new data in order to keep the existing Plan up-to-date.

The Plan update was approved via Board Resolution No. 3832 at our Board of Directors meeting on May 14, 2002 and a copy of this resolution can be obtained by requesting it from this office.

Yours very truly,

BUENA VISTA WATER STORAGE DISTRICT

Martin Milobar

Martin N. Milobar
Engineer Manager