Orland-Artois Water District
Groundwater Management Plan

Prepared pursuant to the Groundwater Management Act (AB 3030)

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I. INTRODUCTION

A. Groundwater Management Act

Groundwater is used extensively to meet water supply requirements in many areas throughout California. For these reasons, the California State Legislature has declared groundwater a valuable natural resource, and has determined that groundwater should be managed to ensure both its safe production and its quality. The Groundwater Management Act (AB 3030) was passed by the State Legislature in 1992 and became law January 1, 1993. The act is codified as Sections 10750 *et seq*. of the California Water Code.

This groundwater management plan, prepared by Orland-Artois Water District (OAWD or the District), has been developed pursuant to the provisions of AB 3030. The District overlies the Sacramento Valley Groundwater Basin, as defined by the State Department of Water Resources in Bulletin 118-80, Groundwater Basins in California (DWR 1980).

B. Plan Components

According to California Water Code Section 10753.7, a groundwater management plan may include components relating to any or all of the following:

- Control of saline water intrusion
- Identification and management of wellhead protection areas and recharge areas
- Regulation of the migration of contaminated groundwater
- Administration of a well abandonment and well destruction program
- Mitigation of conditions of overdraft
- Replenishment of groundwater extracted by water producers
- Monitoring of groundwater levels and storage
- Facilitating conjunctive use operations
- Identification of well construction policies
- Construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling and extraction projects
- Development of relationships with state and federal regulatory agencies
- Review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination

OAWD has selected the following seven components for its groundwater management plan. They are to:

1. Monitor Groundwater Levels and Quality
2. Facilitate Conjunctive Use Operations
3. Implement Aquifer Storage and Recovery
4. Construct Groundwater Management Facilities
5. Support County Wellhead Protection Program
6. Promote Water Conservation
7. Comply with Glenn County's Basin Management Objectives Program

Each of these is described in Section V.

C. Agency Authorization

California Water Code Section 10753 (a) authorizes any local agency, whose service area includes a groundwater basin, or a portion of a groundwater basin, that is not already subject to groundwater management, to adopt and implement a groundwater management plan. Section 10752 (e) defines a groundwater management plan as "a document that describes the activities intended to be included in a groundwater management program." A groundwater management program is defined by Section 10752 (d) as "a coordinated and ongoing activity undertaken for the benefit of a groundwater basin, or a portion of a groundwater basin, pursuant to a groundwater management plan adopted pursuant to this part.

"Local agency" is defined as any local public agency that provides water service to all or a portion of its service area (Section 10752 (g)). The definition also includes a local public agency that provides flood control, groundwater management, or groundwater replenishment, or a local agency formed pursuant to the Water Code for the principal purpose of providing water service that has not yet provided that service (Section 10753 (b)). These local agencies may exercise the authority of this part, and are authorized by Section 10752 (g) to form Joint Powers Authorities in order to work cooperatively in establishing a groundwater management program.

According to Water Code Section 10754, for purposes of groundwater management, a local agency that adopts a groundwater management plan has the authority of a water replenishment district pursuant to Part 4 (commencing with Section 60220) of Division 18 and may fix and collect fees and assessments for groundwater management in accordance with Part 6 (commencing with Section 60300) of Division 18, subject to the approval of voters within the agency's boundaries.

D. Eligible Groundwater Basins

The act applies to all groundwater basins in the state of California, except those already subject to groundwater management by a local agency or watermaster pursuant to other provisions of law or a court order, judgment or decree, unless the local agency or watermaster agrees to the applications of the act. The Sacramento Valley Groundwater Basin is eligible for groundwater management under AB 3030.

E. Objective of Plan

OAWD values the importance of groundwater in the state of California as well as locally. It recognizes that proper management of groundwater basins is necessary to sustain the environmental, social and economic conditions that prevail in today's society. More importantly, the well being of future societies is dependent on the effectiveness of current groundwater resources planning, development and management. For these reasons, the District elected to prepare a Groundwater Management Plan to protect the groundwater in its area and the Sacramento Valley Groundwater Basin.

The objective of this groundwater management plan is to identify and implement a Program of effective groundwater management practices that will maintain the long-term availability of groundwater, protect groundwater quality and prevent land subsidence within the District.

F. Relationship to Glenn County

Glenn County has adopted an ordinance to govern the management of groundwater county-wide. The philosophy expressed in the draft ordinance is for the County "to work cooperatively with interested local agencies to further develop and implement joint groundwater management practices". The District regards itself as an interested local agency, and expresses its intent to work cooperatively with the County toward mutually agreeable groundwater management objectives. However, by development and adoption of this Plan, the District asserts that it holds sole legal authority for management of the District's groundwater resources.

II. Sacramento Valley Groundwater Basin

A. Boundaries

The Sacramento Valley Groundwater Basin encompasses approximately 4900 square miles including all of Sutter County, and parts of Yuba, Tehama, Glenn, Butte, Colusa, Yolo, Solano, Placer and Sacramento Counties. Its usable storage capacity has been estimated at approximately 40 million acre-feet (CALFED, 2000), making it one of California's largest groundwater basins.

The Sacramento Valley Groundwater Basin has been partitioned by the California Department of Water Resources into groundwater sub-basins based on natural hydrologic boundaries. The largest sub-basin in the Sacramento Valley Groundwater Basin is the Colusa Sub-Basin.

The Colusa Sub-Basin lies on the West Side of the Sacramento Valley Groundwater Basin (Figure 1). The northern boundary of the basin runs easterly from Black Butte Reservoir, along Stony Creek. The southern boundary runs along Cache Creek. The Coast Range in the West and the Sacramento River in the East bound the basin. The Orland-Artois Water District lies over the northern portion of the Sub-Basin, just south of Stony Creek.

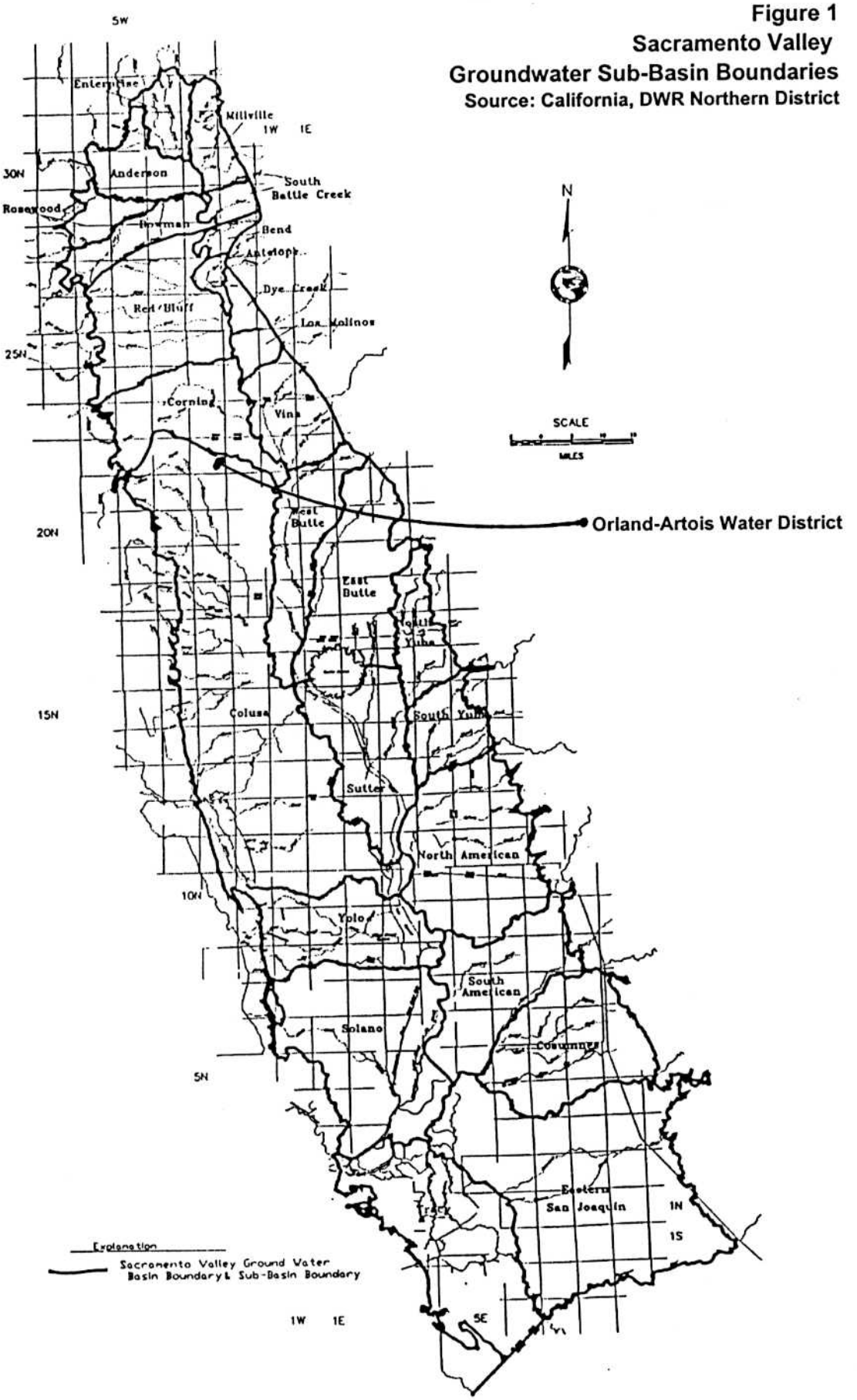
B. Agencies Within The Colusa Sub-Basin

In addition to the Orland-Artois Water District, there are five Irrigation Districts, 11 Water Districts, six other Districts, and five private pumper areas that lie completely or partially within the Colusa Sub-Basin (Table 1). Lands within the boundaries of these districts, as well as unorganized lands within the Sub-Basin, are excluded from this plan.

Table 1. Irrigation Districts, Water Districts, Other Districts and Private Pumper Areas Within the Colusa Sub-Basin

IRRIGATION DISTRICTS	WATER DISTRICTS	OTHER DISTRICTS	PRIVATE PUMPER AREAS
Glenn - Colusa	Orland-Artois	Orland Unit W.U.A.	East Corning Basin Private Pumpers
Provident	Glide	Willow Creek M.W.C.	West Corning Basin Private Pumpers
Princeton-Cordora-Glenn	Kanawha	Maxwell P.U.D.	BOS District 5 Private Pumpers
Maxwell	Holthouse	Colusa Drain W.U.A.	BOS District 3 Private Pumpers
La Grande	4-M	Myers Marsh M.W.C.	West Colusa Basin Private Pumpers
	Glenn Valley	Reclamation District 108	
	La Grande		
	Davis		
	Westside		
	Cortina		
	Colusa County		
	Dunnigan		

Figure 1
Sacramento Valley
Groundwater Sub-Basin Boundaries
Source: California, DWR Northern District



C. Subsurface Geology

The stratigraphy of the Colusa Sub-Basin area includes a non-water-bearing complex and various water bearing sediments on top of the basement complex. The basement complex consists of granitic and metamorphic rocks, which do not yield water freely to wells. The basement complex is overlain by continental deposits of late Tertiary and Quaternary age. Deposits from the Quaternary age include alluvial, flood basin and deposits from the Modesto, Riverbank and Red Bluff Formations. Deposits from the Tertiary age consist of the Tehama and Tuscan Formations.

The principle water-bearing complex of the Colusa Sub-Basin aquifer system is comprised of late tertiary age deposits from the Tehama Formation. The Tehama Formation consists of thick deposits of silt and clay interbedded with thin layers of lenticular sand and gravel. Permeability varies throughout the formation. In the northern part of the Sub Basin, there is a higher percentage of gravel that was deposited from the ancestral Stony Creek. This area can produce a significant quantity of water to wells. Outside the Stony Creek member of the Tehama formation, permeability is low to moderate due to a higher percentage of fine-grained sediments and the presence of hardpan layers.

The Tuscan Formation is a water-bearing complex located in the Northeast section of the Sub-Basin. It consists of interbedded volcanic lava flow, mudflow, conglomerate and tuff. Permeability is found to be higher in this formation than the Tehama Formation, although the Tuscan Formation is less utilized.

The older alluvium deposits overlie the low plain found in the western portion of the Colusa Sub-Basin. They are interspersed with deposits from the Tehama formation. The older alluvium consists of gravel, sand, silt and clay.

The younger alluvium consists of Basin deposits and alluvium. Basin deposits consist of fine-grained silt and clay and are found in the flood basin area adjacent to streams. Permeability is low through these deposits. Younger alluvium deposits are found along the Sacramento River. These deposits consist of unconsolidated, unweathered gravel, sand, silt and clay. Permeability is moderate to high due to a higher percentage of gravel and sand as opposed to Flood Basin deposits.

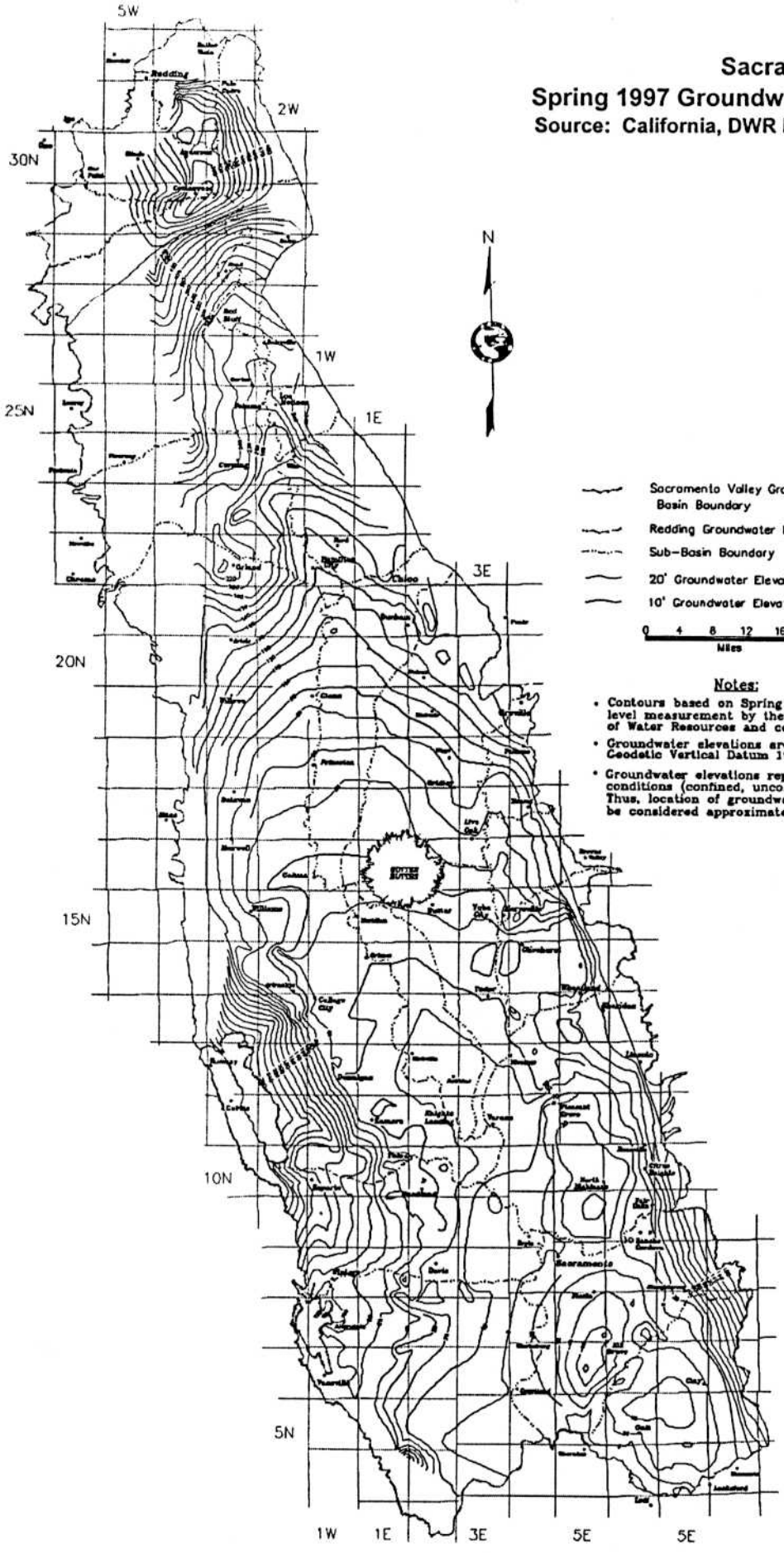
Natural groundwater recharge to the Colusa Sub-Basin is in the form of surface water recharge from Cache Creek, Stony Creek, and the Sacramento River, infiltration from precipitation, and groundwater baseflow from the western and eastern parts of the sub-basin. Most recharge to the area is in the form of deep percolation of applied irrigation water.

Groundwater Basin information was provided by the Northern District, California Department of Water Resources as part of the Sacramento River Basin-Wide Management Plan; Groundwater Hydrology Technical Memorandum.

D. Groundwater Conditions In The Orland-Artois Water District

Based on spring 1997 groundwater elevations (Figure 2), it appears that Stony Creek serves as a source of recharge to the Sub-basin and that groundwater flow is in the northwest to southeast direction. The United States Bureau of Reclamation (USBR, 1988) reported that groundwater recharge within the District is primarily from deep percolation of applied irrigation water. Other sources of groundwater recharge to the District included surface stream recharge and deep percolation of precipitation.

Figure 2
Sacramento Valley
Spring 1997 Groundwater Elevation
Source: California, DWR Northern District



Notes:

- Contours based on Spring 1997 groundwater level measurement by the Department of Water Resources and cooperators.
- Groundwater elevations are based on National Geodetic Vertical Datum 1988 (NGVD 88).
- Groundwater elevations represent mixed aquifer conditions (confined, unconfined, and composite). Thus, location of groundwater contours should be considered approximate.

III. EXISTING CONDITIONS IN THE DISTRICT

A. District History

The District is located generally between the towns of Orland and Artois, in the northwest portion of the Sacramento Valley (Figure 3). The District is comprised of 30,290 acres of land interspersed with non-district lands in a checkerboard-like pattern. The District's assessed (irrigable) area is 28,988 acres.

The District was formed in 1954 for the purpose of contracting with the Bureau of Reclamation for a supplemental surface water supply. Contract 14-06-200-8283A was entered into between the District and the Bureau in 1963, and water deliveries began in 1976, with completion of the District's distribution facilities. The contract had a 53,000 acre-foot annual contract amount. Since the expiration of that contract in 1995, the District has continued to receive Central Valley Project (CVP) water under a series of two-year interim contracts with Reclamation, each with the same contract amount as the original contract (53,000 acre-feet). Along with other historical CVP water contractors, the District is currently negotiating a new long-term water supply contract.

B. District Facilities

OAWD owns and operates a buried pipeline distribution system that conveys CVP water from the Tehama-Colusa Canal to District lands. There is a total of 100 miles of pipeline with diameters ranging from 8 to 96 inches. Water deliveries to farms are measured with totalizing flow meters. The combined delivery capacity through the 5 permanent and 3 temporary turnouts from the Tehama-Colusa Canal is 427 cubic feet per second. Deliveries to lands lying down gradient (generally east) of the Tehama-Colusa Canal are made by gravity while up-gradient deliveries are made by canal side pumping plants.

C. Cropping Patterns and Irrigation Systems

Historically, the trend in irrigated agriculture within the District area (Figure 4) is that acreage in permanent crops (almonds, vineyards, and subtropical and deciduous orchards) has been increasing. Based on predictions of future cropping patterns made by the BOR in the Water Needs Assessment (2000), this trend will continue with an intensification of acreage cultivated with almonds. Reclamation also foresees that District irrigated acreage will increase by an additional 9000 acres in the year 2025 based on recent trends of double cropping. This is reflected by the dramatic increase in acreage that will be cultivated with winter wheat and field corn. Other prominent crops grown in the District are alfalfa, rice and irrigated pasture. Land planted with these crops will essentially remain at the current level.

Figure 3
Orland-Artois Water District

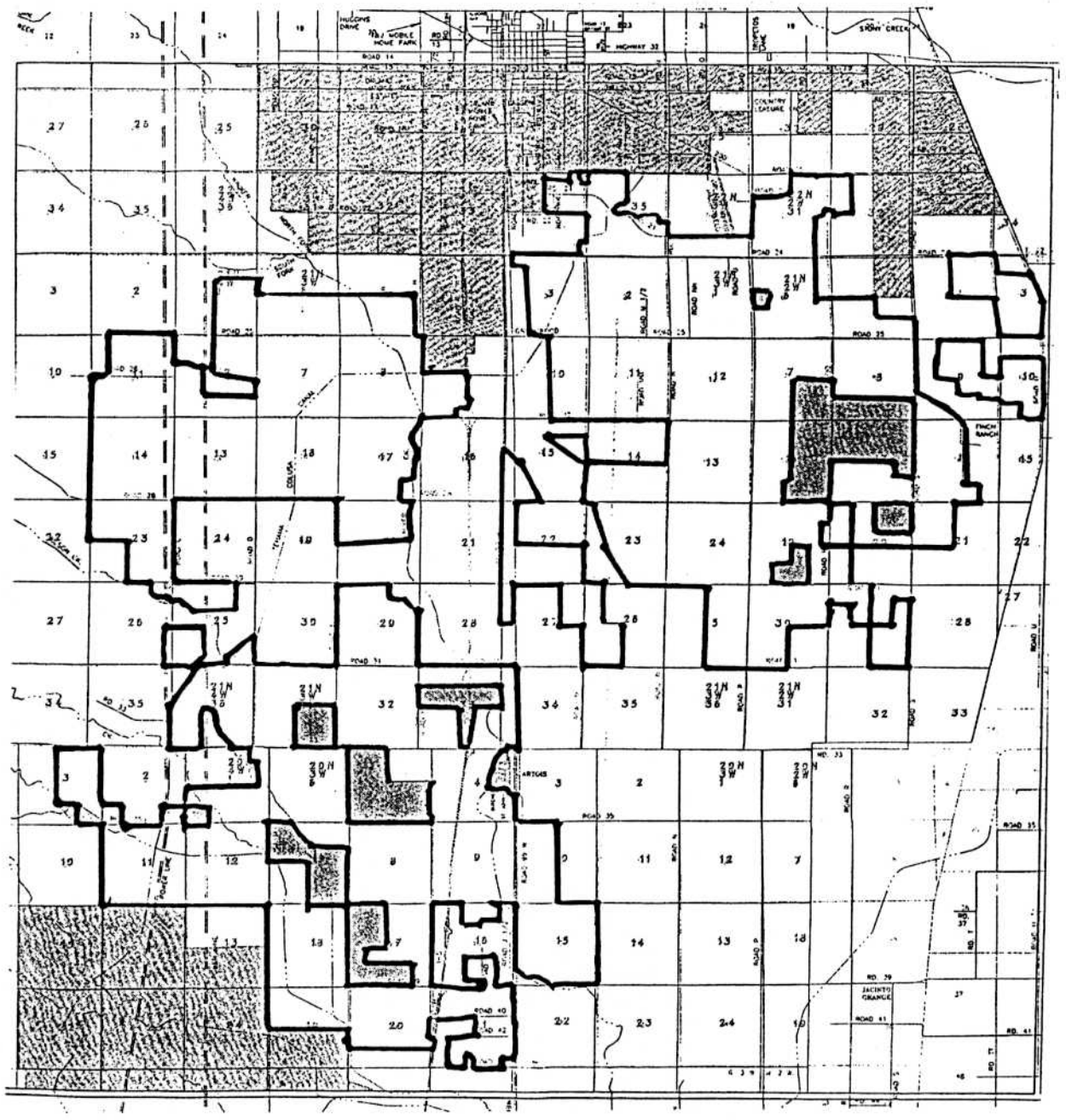
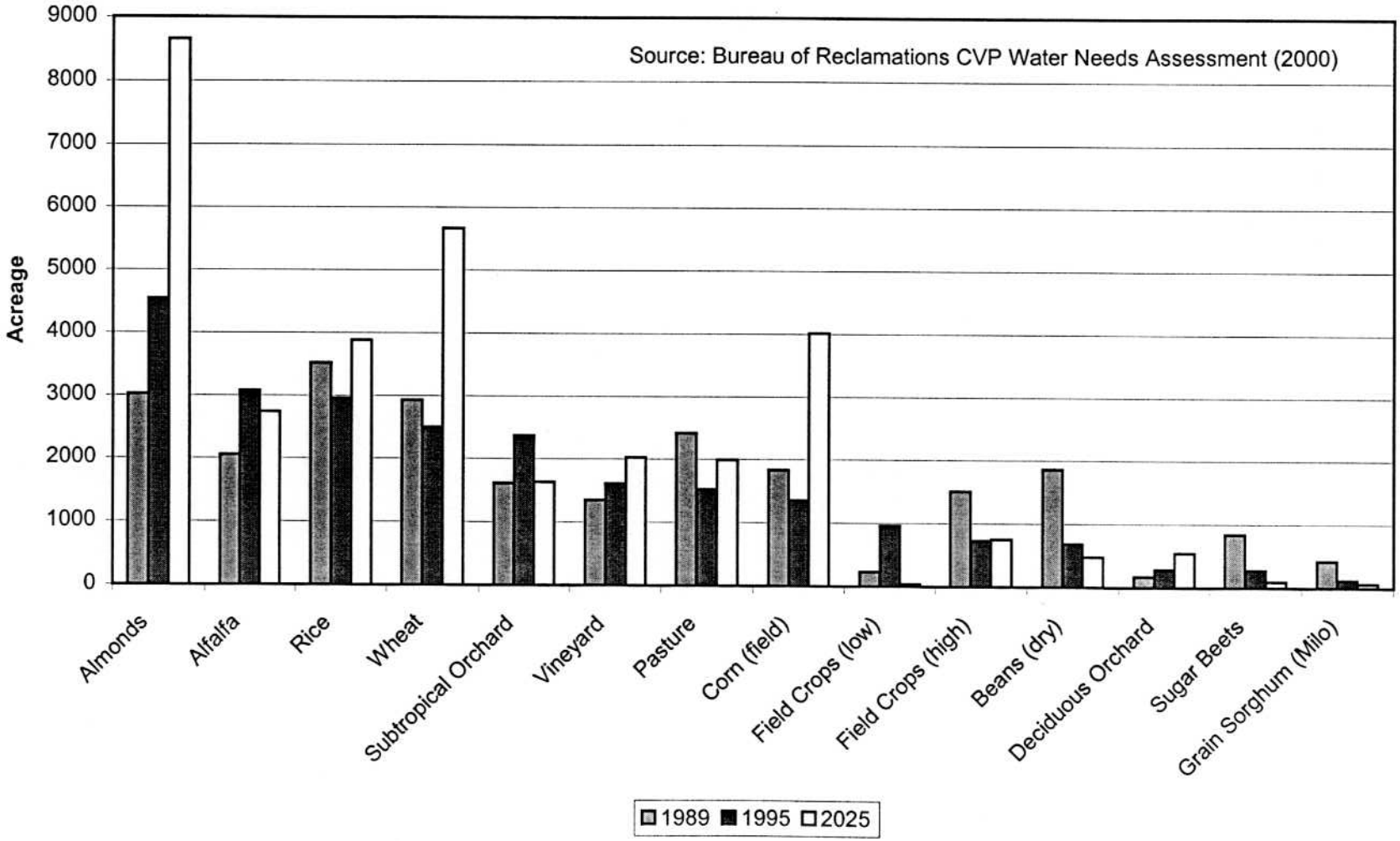


Figure 4
Orland-Artois Water District
Historical and Future Land Usage



Approximately 75% of the total irrigated acreage in 1999 was surface irrigated, 12% was sprinkler irrigated and 13% was drip irrigated. Growers in the district have gradually shifted to sprinkle and drip irrigation methods, dependant on the crop.

D. Climate and Precipitation

The District climate is characterized by hot dry summers and mild winters accompanied by moderate precipitation. Average annual precipitation at Orland, located immediately north of the District, is about 21 inches for the period 1948 to 2000 (Western Regional Climate Center, 2000). On average, 72 percent of the annual precipitation occurs in the 7-month period from October to April.

The dry climate is well suited for irrigated agriculture. The long, warm-to-hot dry summers allow ripening of crops without the threat of mildew. The summers are typically without precipitation, permitting the attainment of high irrigation efficiencies. Winter precipitation provides some water for winter crops and contributes to groundwater recharge and leaching of salts from the root zone.

IV. DISTRICT WATER DEMANDS AND SUPPLIES

A. Water Demand

The demand for irrigation water in the District is determined primarily by the crops grown on District lands, climatic factors, and on-farm irrigation systems and management. Reclamation has recently completed a water needs analysis for the District as part of the CVP long-term contract renewal process. The analysis shows that under recent historical conditions, the District has had an average farm delivery requirement of 3.31 acre-feet per acre, resulting in a total demand of about 79,000 acre-feet on the District's approximately 23,700 presently-irrigated acres (including double-cropped lands). This computation is based on an assumed aggregate district efficiency of 75 percent and reflects the contribution of precipitation toward meeting crop water requirements.

Based on recent trends toward increased double cropping in the District, Reclamation's water needs analysis assumes that District irrigated acreage will increase to nearly 32,600 acres by 2025. This will result in a total demand of nearly 101,000 acre-feet, and an average farm delivery requirement of 3.10 acre-feet per acre. This demand, based on an aggregate district efficiency of 80 percent, represents a 28 percent increase in irrigation water demand relative to existing conditions.

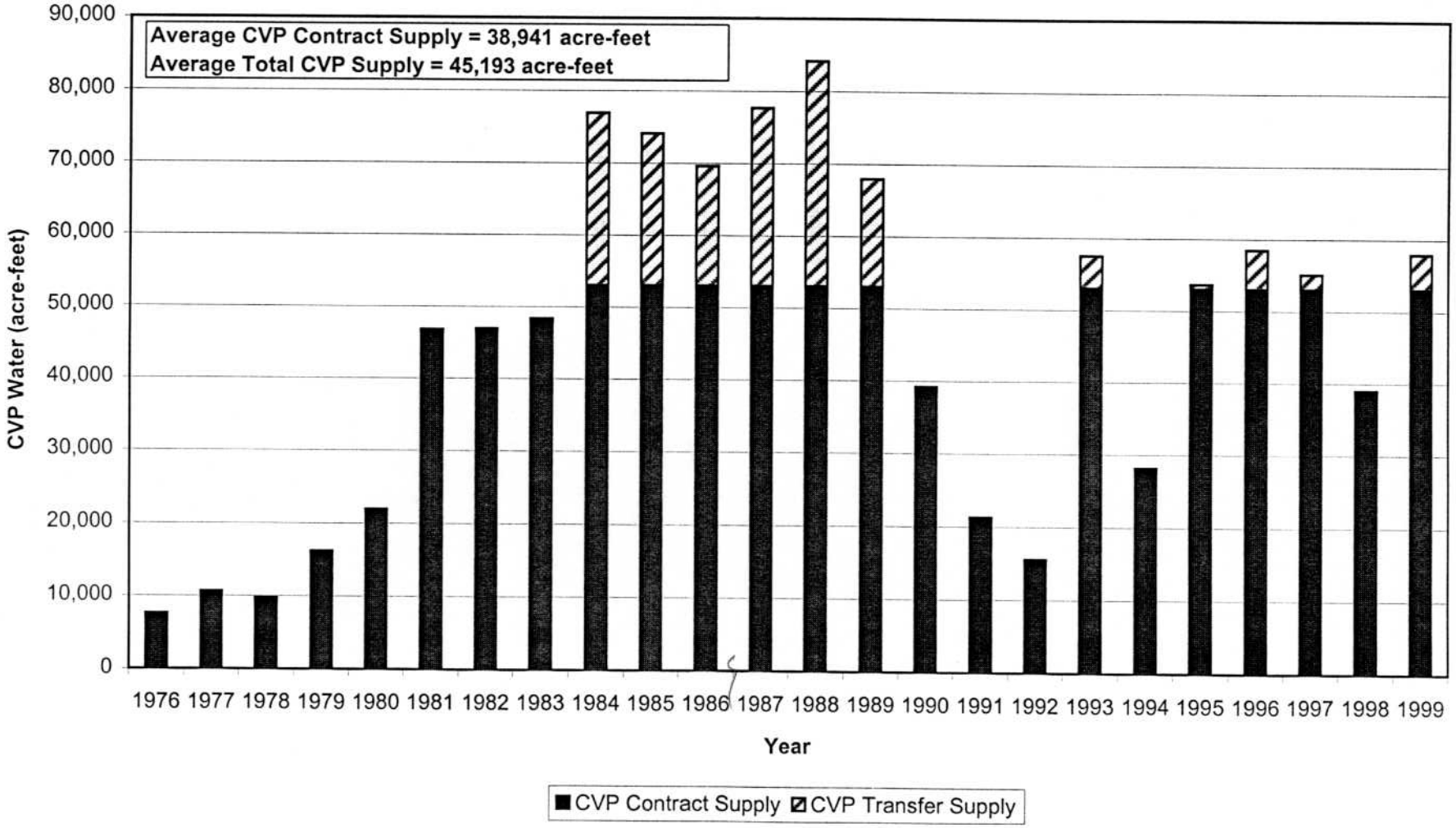
B. Water Supplies

The District has two principal sources of irrigation water, including groundwater and supplemental surface water from the CVP. Since the start of District operations in 1976, CVP contract deliveries have ranged from a low of 7,612 acre-feet in 1976, up to the contract maximum of 53,000 acre-feet in 11 of the years between 1976 and 1999 (Figure 5). The average CVP contract supply has been 38,941 acre-feet over the same period.

In addition to water received under its federal contract, the District has been able to acquire CVP water through water transfers from other CVP water contractors. Water transfers have occurred in 11 of the 25 years between 1976 and 1999 (Figure 5), yielding the most water during the period from 1984 through 1989. In recent years, transfers have yielded significantly less water, due substantially to the effects on Project operations of the Central Valley Project Improvement Act, which came into effect in 1992.

Apparent in the graph is the variability in surface water supplies from year to year. When water was abundant during the wet years of the mid-1980's, surface water supplies, from the annual contract and water transfers, were at a maximum level. During the drought years in the early 1990's water deliveries declined.

Figure 5
Orland-Artois Water District
Total Annual CVP Water Supply



The District does not own or operate groundwater production wells; however, some private landowners have constructed wells that they used in conjunction with District-provided CVP water to meet irrigation demands. The District does not maintain records of private well construction or groundwater production. However, each year since 1990, the District has prepared an estimate of private groundwater pumping based on estimates of average farm delivery requirements and records of District surface water sales. When viewed in conjunction with surface water sales, it is evident that private groundwater pumping is used to supplement available CVP surface water, with groundwater pumping rising in dry years and falling in wet years (Figure 6). Over the period 1990 through 1999, groundwater pumping has averaged 25,278 acre-feet and the combined surface water and groundwater supply has averaged 66,165 acre-feet.

Groundwater levels in wells[1] are monitored Statewide by the Department of Water Resources, including several wells in the OAWD. For purposes of developing this Plan, four wells with long-term records were chosen to represent groundwater levels within the District, each generally representing one quadrant of the District (Figure 7). Two of the wells (and possibly others), those in the southwest and northeast quadrants, have continuous records dating from the 1940s. It appears from those records that groundwater levels, while variable from year to year, were generally stable into the mid-1970s. Pronounced water level declines are evident in both wells in 1972 and in 1976.

Between the mid-1970s and mid-1980s, water levels in all four wells rose, most likely reflecting a response to high surface water use and relaxed groundwater pumping during that period. Since the mid-1980s, water levels in all wells have varied, but there are no apparent long-term upward or downward trends evident in any of the wells. This would suggest that current levels of groundwater production are sustainable. However, expected increases in future water demands, coupled with possible reduced reliability of CVP water supplies, may well lead to increased reliance on groundwater supplies and the possibility of declining water levels.

The four wells selected for development of this Plan (see preceding paragraphs) may or may not be used for future groundwater monitoring purposes.

C. Groundwater Quality

The District has not conducted water quality testing, but groundwater is considered to be good for irrigation purposes. District farmers report that cropping choices are not restricted with respect to water quality. However, two groundwater quality problems have been identified in the city of Orland just north of the District.

[1] DWR monitors levels in both production and monitoring wells; production wells may or may not be in active use.

Figure 6
Orland-Artois Water District
Surface Water and Groundwater Supplies
(From 1990 To 1999)

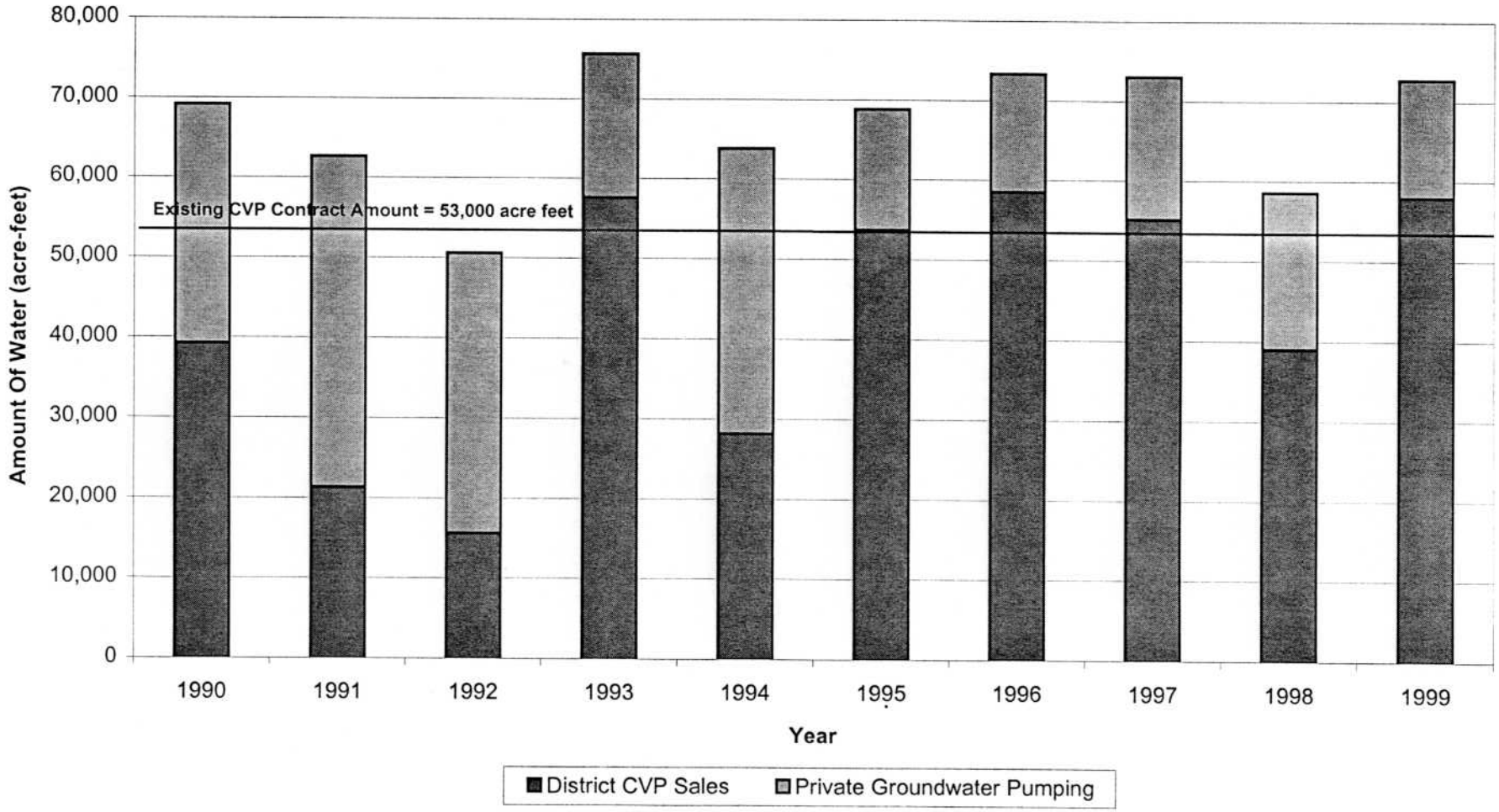
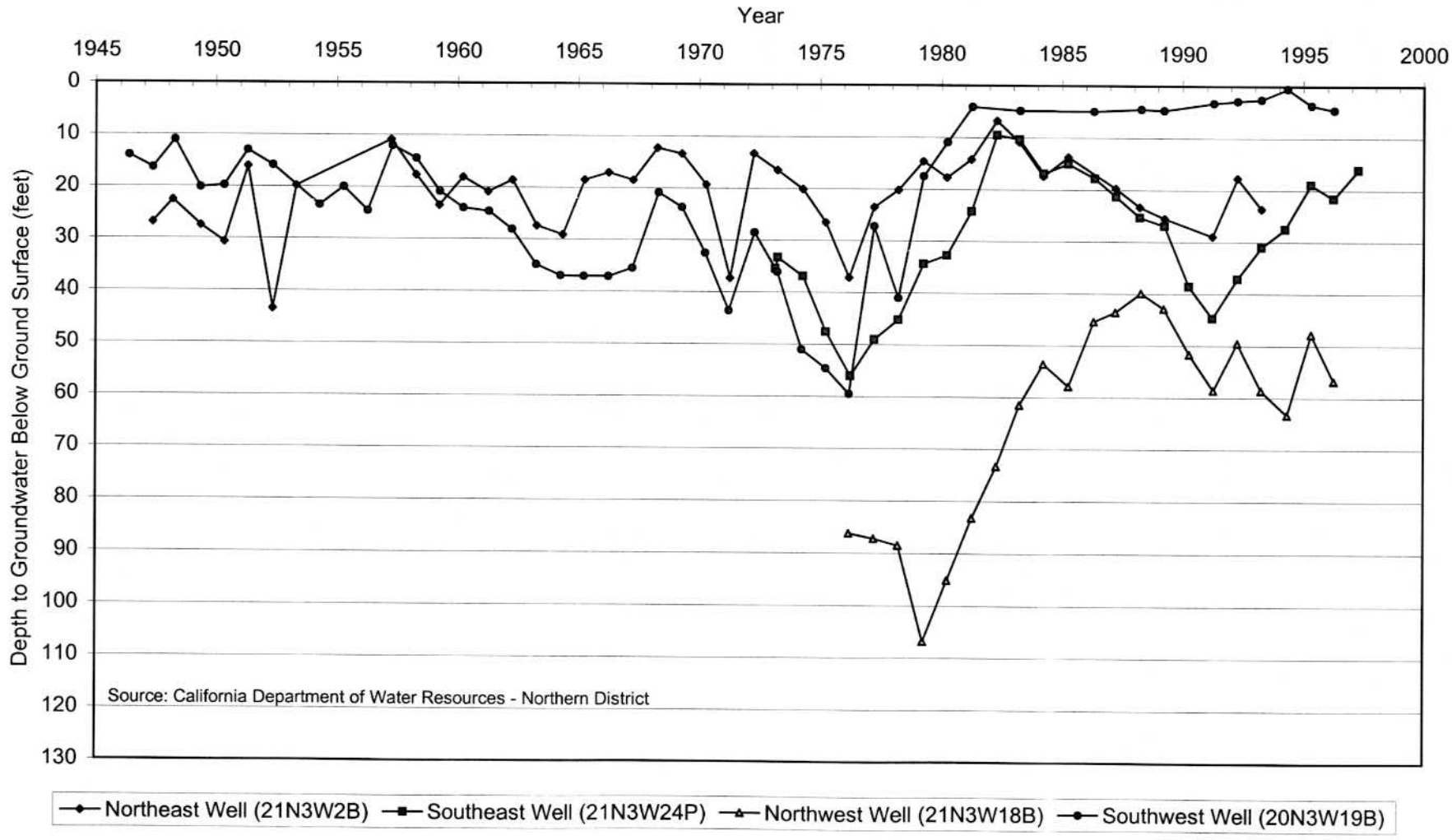


Figure 7
Orland-Artois Water District
Spring Depths to Groundwater in Selected Wells



V. GROUNDWATER MANAGEMENT PROGRAM

The elements comprising the District's Groundwater Management Program are described in the following sections.

A. Monitor Groundwater Levels and Quality

The District will initiate groundwater level and water quality monitoring activities to provide data that, in combination with other available sources of information, is adequate to track temporal and spatial trends in groundwater behavior. The wells to be monitored and frequency of observation will be determined by the District, with the input of DWR, consultants or others whom the District may engage for technical support. Historical groundwater elevation records published by DWR will be reviewed to identify those wells that should be included in the monitoring program, to preserve and extend available historical records, where possible. Additional wells may be identified and included in the program.

The District will cooperate with DWR and possibly other agencies to identify and implement monitoring protocols and procedures that are consistent with current accepted practice. This cooperation will include providing training to District staff in the use of identified procedures.

Initially, the District will rely on access to existing groundwater wells for monitoring purposes, but may elect to install additional wells or other facilities deemed necessary for carrying out an effective monitoring program. Access to existing wells will be gained through cooperation with District and possibly non-District landowners.

With respect to water quality monitoring, the District intends to deploy District staff to collect water samples from selected wells. Samples will be submitted to reputable commercial laboratories for analysis, following prescribed sampling and handling procedures. Water quality analyses will concentrate on the suitability of water for agricultural uses, but may be expanded to address other concerns that could arise.

The District will implement a simple, computer-based data management program to store, analyze and report groundwater data. Initially, this will be accomplished through the use of spreadsheet or database software programs already in use by the District.

B. Facilitate Conjunctive Use Operations

The District realizes that the reliability and sustainability of the water supply available to District landowners depends on the managed conjunctive use of available surface water and groundwater resources. In view of the possibility of future water supply shortages, the District intends to develop means to expand and enhance its conjunctive use operations. Activities that the District may pursue in this regard include: acquisition of additional surface water supplies to be used directly (thereby relaxing groundwater pumping) or for artificial recharge; acquisition of land and construction of groundwater recharge facilities; strategic pricing of surface water supplies to induce desired groundwater pumping patterns; and construction of groundwater extraction facilities. The District's principal role is to take actions to assure sufficient, affordable supplemental surface water supplies are available to

District water users. In particular, the District will protect and maintain its CVP water supply contract with the United States.

C. Implement Aquifer Storage and Recovery

The District has participated in studies that indicate that CVP water, above the District's CVP contract supply, may be available under certain hydrologic conditions, when CVP releases are surplus to those needed to maintain Delta water quality objectives. Additionally, CVP contract supplies available to T-C contractors (including OAWD and others), are not fully utilized in all years. These intermittent water supplies could be converted to firm, usable supplies if they could be stored and produced on demand.

The District has purchased a 20-acre site located immediately south of Stony Creek and adjacent to the T-C Canal for the purpose of underground storage and recovery of intermittent surface water supplies like, but not necessarily limited to, those described above. As part of this Program, the District intends to determine the feasibility of developing the site for this purpose. This will involve completion of operations analyses to provide initial estimates of the yield of an aquifer storage (recharge) and recovery system on the 20-acre site, based on certain assumptions regarding infiltration and recovery rates, as well as availability of water and conveyance capacity in the T-C Canal. If the system appears feasible, then the District may elect to proceed with physical on-site testing to validate the assumptions.

Based on the outcome of these investigations, the District may elect to develop the site for aquifer storage and recovery. The District may consider other sites, both within and outside of the District boundaries, for implementation of aquifer storage and recovery facilities. The District may pursue these facilities alone or in cooperation with other entities.

D. Construct Groundwater Management Facilities

As outlined above, the District intends to ensure reliable water supplies to its users, primarily through conjunctive use operations. Facilities that may be constructed to enhance conjunctive use include groundwater recharge basins, extraction wells and expanded surface water distribution systems.

E. Support County Wellhead Protection Program

Serious groundwater problems can result if wellhead areas are contaminated or if groundwater wells are not properly constructed and abandoned. In these situations, wells can become conduits for contaminants, pollutants, and degraded waters to flow into otherwise usable groundwater aquifers.

The Glenn County Countywide Service Area under its Wellhead Protection Program currently administers all matters pertaining to well construction and abandonment, wellhead protection and contamination. The District acknowledges the County's jurisdiction in this regard and will cooperate with the County through provision of any relevant, available information to which the District may have access.

F. Promote Water Conservation

The District recognizes that good management of available surface and groundwater supplies begins with water conservation, defined here as seeking to minimize the amount of water extracted to accomplish the intended beneficial use. Toward this objective, the District will continue to promote voluntary adoption of on-farm water management practices that are appropriate and cost effective under District conditions.

G. Cooperate with Glenn County Groundwater Management Efforts

Glenn County has adopted an ordinance governing the management of groundwater county-wide. The thrust of the County's efforts will be to establish safe yield of the County aquifers by the Basin Management Objective (BMO) method and then conduct monitoring to assure that the specified water level, water quality and land subsidence criteria comprising the safe yield are observed. The County has formed a Water Advisory Committee and the District has one chair on the Committee. As previously explained, the ordinance expresses the County's intent to cooperate with interested local agencies.

The District has taken an active role in development of Glenn County's Groundwater Management Ordinance and intends to support the County's efforts to implement the ordinance as an element of its own Groundwater Management Program. In particular, the District intends to cooperate with the County in establishing the safe yield of the aquifers underlying the District and in monitoring of groundwater conditions.

VI. PLAN IMPLEMENTATION

A. Rules and Regulations

According to Water Code Section 10753.8 (a), a local agency shall adopt rules and regulations to implement and enforce an adopted groundwater management plan. The local agency is not authorized to make a binding determination of the water rights of any person or entity (Section 10753.8 (b)). The local agency is also not authorized to limit or suspend extractions unless the local agency has determined through study and investigation that groundwater replenishment programs or other alternative sources of water supply have proved insufficient or infeasible to lessen the demand for groundwater (Section 10753.8 (c)).

In adopting rules and regulations, the local agency shall consider the potential impact of those rules and regulations on business activities, including agricultural operations, and to the extent practicable and consistent with the protection of the groundwater resources, minimize any adverse impacts on those business activities (Section 10753.9).

B. Program Management

This Groundwater Management Program will be implemented and managed according to the policy and guidance of the Board of Directors of Orland-Artois Water District. At least annually at one of its regular meetings, the Board will review available information pertaining to groundwater conditions and consider taking appropriate actions consistent with the Program.

C. Plan Revisions and Updates

This Groundwater Management Plan may revised or updated from time to time, as deemed appropriate by the Board of Directors of the Orland-Artois Water District.

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